VĚSTNÍK
ČESKOSLOVENSKÉ SPOLEČNOSTI
ZOOLOGICKÉ

XLVI
1982
1

ACADEMIA PRAHA
ISSN 0042—6595

VĚSTNÍK ČESKOSLOVENSKÉ SPOLEČNOSTI ZOOLOGICKÉ

Roč. Tom. 46 Čís. No. 1 Únor Februar 1982

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

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Věst. čs. Společ. zool., 46: 1—4, 1982

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OLFACTORY APPARATUS IN TWO INDIAN CLUPEID FISHES

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Received September 1, 1980

Abstract: The anatomy of the olfactory apparatus of two Indian clupeid fishes has been studied. The olfactory apparatus of both the fishes consists of anterior and posterior nares, the oval olfactory rosette and a pair of accessory nasal sacs. The olfactory rosette is composed of a large number of lamellae of different sizes.

INTRODUCTION

The study of the olfactory apparatus of teleostean fishes have been made by a number of zoologists (Bateson, 1889; Burne, 1909; Liermann, 1933; Allison, 1953; Teichmann, 1954; Johnson and Brown, 1962; Branson, 1963; Gooding, 1963; Pfeiffer, 1963; Kleerekoper, 1969). The olfactory apparatus of Indian fishes has been studied by Singh (1967), Ojha and Kapoor (1971, 1972, 1973a, b, c, 1974), Kapoor and Ojha (1972a, b, 1973a), b), Datta, Saha and Das (1976, Saha and Datta (1978), Datta and Das (1980, in press).

But it is explicit from the survey of relevant literature that the olfactory apparatus of many species of fishes has still remained to be studied. Therefore, an exhaustive study of the olfactory organ from functional, evolutionary and histochemical point of view is likely to bring forth some interesting results.

The present paper, however, records the observation made on two commercially important clupeid fishes of India.

MATERIAL AND METHODS

Hilsa ilisha (Ham.) and *Sardinella fimbriata* (Val.) belonging to the family Clupeidae, are the material of the present study. The specimens of above two species were procured from the local market and were preserved in 10% formalin. The olfactory organ was dissected under the stereoscopic dissecting binocular microscope. The structure of the olfactory apparatus and its relationships with the brain were meticulously studied. The skull was also prepared in order to determine the morphological disposition and relationships of olfactory apparatus with the surrounding bones. The structural elements comprising the olfactory apparatus have also been suitably illustrated.

OBSERVATIONS

The olfactory apparatus of *H. ilisha* (Ham.) and *S. fimbriata* (Val.) comprises anterior and posterior nares, olfactory rosette and a pair of accessory nasal sacs. The nature and disposition of the olfactory apparatus of both the fishes are very similar. The olfactory apparatus is placed on the dorsolateral aspect of the head in front of the eye and almost at the middle part of the snout.

Both the anterior and posterior nares are very closely placed and are separated by a very thick septum which may be termed internarial septum. The olfactory chamber is, however, incompletely separated into two by the internarial septum. The morphological nature of internarial septum is very peculiar. It is grooved ventrally so as to form a grutter which opens over the olfactory rosette. The gutter thus formed may be termed internal nasal tube (Fig. 1). The nasal flap is absent in both the species but the posterior nare is covered by an extension of the superficial part of the internarial septum. The anterior nare is a slit like aperture somewhat crescentic in shape and is shorter than the posterior one. The posterior nare is relatively elongated and roughly spindle shaped. The anterior nare leads into the olfactory chamber where olfactory rosette is located.

In both the species bony elements surrounding the olfactory chamber are more or less the same. The chamber is placed in a depression in the anterior ethmoidal region of the skull. It is dorsally bounded by moderately elongated nasal situated over the lateral ethmoid. The nasal is scalloped laterally to accomodate the narial opening. The concave anterior end is lined by lateral ethmoid, partly by pre-maxilla and lacrymal. Anterior part of the lacrymal lies at the antero-ventral margin of the concavity. Rod shaped palatine process is placed somewhat ventrally. Postero-ventral margin is bordered by the triangular cartilaginous antorbital. In *H. ilisha* dorso-posterior margin is bounded by a short ventro-lateral projection of frontal. Ventrally, elongated parasphenoid and anteriorly located prevomer jointly form the floor of the olfactory cavity.

The olfactory rosette is oval in shape (Figs. 2, 3) and is placed in the spacious olfactory chamber and are attached to the surrounding bones by fibrous connective tissue. The raphe is prominent and roughly club shaped. On all sides of the raphe, except its anterior end, there are compactly arranged large number of olfactory lamellae. The anterior and posterior lamellae are arranged obliquely on the axis of the raphe where as the middle ones are almost perpendicular to it.

Each lamella is roughly triangular in shape. In *S. fimbriata* (total length 16.9 cm) the number of olfactory lamellae is 46 but in *H. ilisha* (total length 23.9 cm) it is 48.

Two prominent accessory nasal sacs are present in both the species. The two sacs are unequal in shape and size. The outer sac is larger in size and somewhat elongated and bluntly conical. It runs ventrally along the outer anterior rim of the eye. The inner sac is remarkably smaller and more or less like a blind tube. Both the sacs are thin walled and transparent (Figs. 4, 5).

In both the species the fore brain is well developed. The paired olfactory tracts are much elongated. Each tract arises from the base of olfactory organ without having any olfactory bulb and passes backwardly through the anterior region of the skull where it joins with prominent olfactory lobe (Figs. 2, 3).

DISCUSSION

In the opinion of Hasler (1954) there is a vast degree of variation in the anatomy of olfactory apparatus of teleostean fishes. Virtually the study on olfactory apparatus of teleostean fishes is most incomprehensive and therefore, much more variations are to be found than expectation if an extensive survey of this structure is made on a large number of teleostean fishes. Usually the olfactory apparatus is represented by the rosette comprising the lamellae and raphe of which the former contains the potential olfactory receptor cells. But it is interesting to note that Datta and Das (Zool. Anz. in press) in their study on five species of gobioids found that such a rosette is altogether wanting.

Singh (1967) studied the olfactory apparatus of *H. ilisha* which is not only incomplete but also synoptic. It seems from the present study that Singh (op. cit.) either overlooked or ignored the presence of paired accessory nasal sacs (Figs. 4, 5) which are clearly demonstrable if the dissection is done meticulously. Unlike the gobids as studied by Datta and Das (op. cit.) and *Anabas testudineus* (Datta et al., 1976) the two nares in the fishes studied are very closely placed. Branson (1963) observed distinct nasal flap in *H. gelida* and *H. aestivalis*. Ojha and Kapoor (1973) also noted such flap in *Labeo rohita*. But in both the species of present study the nasal flap is absent.

The gutter like internarial septum i. e., the internal nasal tube perhaps fascilitates better water ventilation through the olfactory lamellae. According to Singh (1967) the lamellae are arranged in two transverse rows on both sides of raphe in *H. ilisha*. But the present observation does not corroborate the statement of Singh (op. cit.). Countrary to his views it has been observed that the lamellae are arranged, except at the anterior end, on all sides of the raphe. Furthermore, the shape of single lamella is not at all quadrangular as indicated by Singh (op. cit.), on the other hand, it is roughly triangular (Figs. 4, 5).

The eye and the olfactory apparatus of both *H. ilisha* and *S. fimbriata* are much developed and these may then be categorised along with Teichmann's (1954) eye-nose fishes. The oval olfactory rosette of these fishes conforms to Bateson's rosette type 3 and Burne's rosette column. I. It may be mentioned that both the species are anadromous and olfactory organ as a chemoreceptor plays a vital role in their migration. The ever increasing pollution of the river Ganga due to intensive industrialisation is perhaps one of the reasons of decreasing of *H. ilisha* in the said river system and the role of olfactory organ in the detection of such pollution can hardly be ignored.

SUMMARY

1. Morphological disposition of the anterior and posterior nares are similar in both *Hilsa ilisha* and *Sardinella fimbriata*. The two nares are closely placed on the dorsolateral aspect of the head.
2. Bony elements surrounding the olfactory apparatus are more or less same in both the cases.
3. Olfactory rosette is oval in shape and is placed in the olfactory chamber in both *H. ilisha* and *S. fimbriata* having prominent and roughly club shaped raphe.
4. Lamellae are arranged on all sides of the raphe except its anterior end. Each lamella is triangular in shape.
5. Two prominent accessory nasal sacs are present in either case. The two sacs are dissimilar in shape and size. The outer sac is comparatively large.

Acknowledgement

The authors are obligated to late Prof. D. N. Ganguly for encouragement and to Prof. D. N. Raychaudhuri, Head of the Department of Zoology, University of Calcutta, for providing laboratory facilities. Thanks are also due to Mr. S. Banerjee, M. Sc. of the Fishery and Ecology Research Unit, Department of Zoology, University of Calcutta, for his kind assistance. Authors are also thankful to Mr. B. Samanta for preparaing the illustrations.

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

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Věst. čs. Společ. zool., 46: 5—14, 1982

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STUDY OF THE PHENOLOGY OF SOME DROSOPHILA SPECIES (DIPTERA) IN SOUTHERN BOHEMIA

Jan MÁCA

Received August 1, 1980

A b s t r a c t· *Drosophila* species were captured through the mediation of beer traps in three different biotopes in Southern Bohemia. Traps were exposed repeatedly for periods of 14 days in average; a simple test has shown that uneveness of the lenghts of bait exposition does not substantially affect the results. Phenology of particular species, their sex-ratios and differences among localities are briefly compared.

During the year 1973, as large collections of Drosophilidae as possible were carried out by means of beer traps, primarily in order to ascertain which species occur in Southern Bohemia. In some localities, collections were continuous and quantitative, so that at least the results obtained by the study of more common species may be considered from the viewpoint of phenology.

The papers published on the phenology of European Drosophilidae were recently reviewed by L u m m e (1979); it seems, however, better to avoid detailed comparisons of hitherto published results, as, according to L u m m e (op. cit.), "the general impression arising from the seasonal occurence of different species is all but clear". One of the main reasons of discordances among the results may be the methodological one, as many different types of traps have been used; under such conditions, comparisons should be made mainly with the results of authors who bred *Drosophila* species from natural substrates (decaying fruits, fungi etc.).

BIOCLIMATIC CHARACTERISTICS OF THE STUDIED LOCALITIES

The localities investigated are situated in the Třeboň Basin, which is formed by the Lužnice with its tributary rivers (localities Borkovice and Val), and in the adjacent Vltavotýnská Highlands (locality Ševětín). Only these three localities are compared, as other localities were not studied for sufficiently long periods. Both of the first-

Tab. 1. Climatic data for 1973 recorded by the Hydrometeorologic Station, Borkovice

Month	Mean temperature (°C)	Precipitations (mm)	Relat. humidity (%)
IV.	4.5	30.0	78
V.	11.9	68.4	79
VI.	15.2	121.7	80
VII.	17.3	106.8	83
VIII.	16.4	14.6	77
IX.	12.5	29.4	78
X.	5.8	32.0	83

mentioned localities are approximately 420 m above sea level whereas locality Ševětín is somewhat elevated to about 470 m ab s l Great number of fish ponds in the region causes considerable accumulation of heat summer temperatures are therefore up to 1 °C higher than in the surrounding country without ponds in the evening and night at noon temperatures are accordingly lower In winter, a mass of cold air often clusters over the basin and lowers winter temperatures this probably

Tab 2 Collections at Veseli nad Luznici, 30 V — 27 VI 1974 Traps with bait changed at various intervals (see the Methods)

Traps	Species	30 V	6 VI	13 VI	20 VI	27 VI
A_{1-4}	*D phalerata*	70	52	35	20	12
	D transversa	8	7	5	9	15
	D kuntzei	8	8	5	6	4
	D obscura	3	1	4	6	7
	other spp — *D subobscura*, *D limbata*	4	3	5	3	6
B_{1-4}	*D phalerata*	72	62	46	19	16
	D transversa	6	10	10	8	19
	D kuntzei	7	7	6	4	4
	D obscura	—	5	7	3	10
	other spp — *D subobscura*, *D melanogaster*	3	3	3	1	3
C_{1-4}	*D phalerata*	68	60	30	27	20
	D transversa	10	12	5	14	41
	D kuntzei	10	9	5	6	6
	D obscura	2	4	3	6	10
	other spp — *D subobscura*, *D melanogaster*, *D histrio*	—	2	—	2	4
D_{1-4}	*D phalerata*	73	64	48	17	11
	D transversa	4	11	8	10	15
	D kuntzei	12	11	7	3	2
	D obscura	4	5	6	3	4
	other spp — *D histrio*, *D subsilvestris*	3	5	2	—	3

enables some remarkable cases of occurence of oligothermous animals in this region (climatologic considerations see N e k o v a r 1967, a list of oligothermous animals found in the Trebon Basin see H o f f e r 1967) Annual amount of precipitations is about 700 mm Microclimatic data within particular localities were not measured The standard methods of measuring them do not fit well for the study of species dwelling predominatly in tree canopies Therefore, data recorded by the Hydrometeorologic Station at Borkovice were taken over in order to show main macroclimatic characteristics (Tab 1) Such characteristics must be taken with caution and such factors as exposition shade geological situation etc must be also taken in account when studying particular localities (see e g K r o g e r u s 1960 H a c k m a n, 1970) The complex of factors characteristic for the individual locality seems to be well represented by the vegetation type of locality Therefore a short description of the studied localities is presented here

V a l Forest type of the locality is evidently *Querceto-Carpinetum*, although *Picea abies* (L) Karst and *Pinus silvestris* L are predominant trees at present (the forest type is determined according to B r e z i n a 1975 as well as in the following localities) The herb stratum has still relatively very natural constitution (*Hepatica nobilis* Mil, *Thalictrum aquilegiifolium* L, *Mercurialis perennis* L, *Melica nutans* L etc) Of the fungi mainly *Laetiporus sulphureus* (Bull ex Fr) Murrill, *Fistulina hepatica* (Schaeff) ex Fr and *Armillaria mellea* (Vahl ex Fr) Kumm growing on the trunks of several old oaks *(Quercus robur L.)*, serve evidently as feeding and breeding sites of many *Drosophila species*

S e v ě t i n Old beech wood of the vegetation type *Dentario-Fagetum*, with many characteristic plants *Phyteuma nigrum Schm* *Phegopteris dryopteris* (L.) Fee, *Dentaria bulbifera* L *Vicia silvatica* L *Oxalis acetosella* L *Pulmonaria officinalis* L *Symphytum tuberosum* L., *Prenanthes purpurea* L., etc Bracket fungi, especially *Fomes fomentarius* (L ex Fr) Kickx, are significant in connection with mycetophilous *Drosophila* species

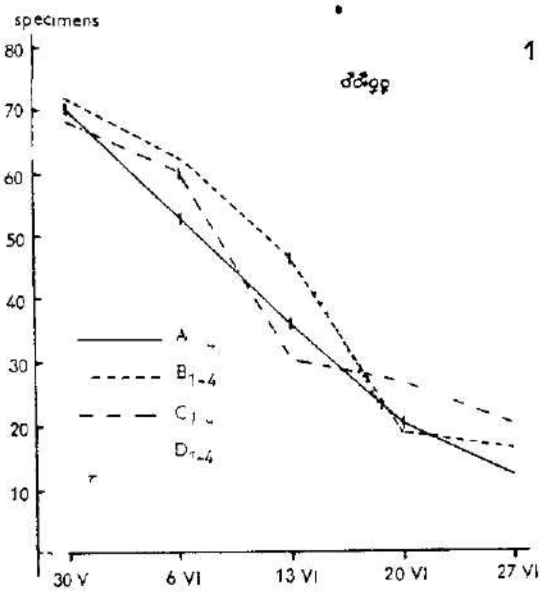


Fig 1 *Drosophila phalerata*, collections at Veseli nad Lužnici, 30 V–27 VI 1974 Traps with bait changed at various intervals — see text (Methods) and Tab 2 Perpendicular strokes in the graph indicate setting a fresh bait

B o r k o v i c e Large *Alnetum glutinosae*, surrounding a peat- bog The Drosophila species, as most groups of insects, occur here in greater abundance and diversity than in the central part of peat- bog, which is *Pino rotundatae- Sphagnetum ledeteosum* This phenomenon was discussed by N o v a k and S p i t z e r (1972) with regards to Lepidoptera except for the reasons for this uneven distribution of insects, given in the op cit, devastation of the central part of peat- bog by men (digging for turf) and the repellent effect of *Ledum palustre* L may play a role The studied locality is densely overgrown with hygrophilous trees (*Salix, Alnus, Populus* spp) with *Humulus lupulus* L twined over branches Many shrubs, especially *Spiraea salicifolia L*, grow mainly in the marginal parts so that the ground is strongly shaded and the herb stratum is therefore very poor

METHODS

For the collecting of Drosophilidae beer traps were employed (see M a c a 1973) Twenty traps were exposed over each locality (fifteen of them suspended in the tree canopies and five placed on the ground) at distances about 15 m Flies were withdrawn and bait set anew simultaneously at intervals of 14 days in average Periods of the exposition of traps were not absolutely equal, they however oscillated in the analogous manner throughout the whole season 1973, so that the longer periods e g months, are still comparable one another

D a t a o f c o l l e c t i o n s : Val: April 13, May 2, 11, 23, June 13, July 4, 12, 19, August 1, 15, September 6, 25, November 2. Ševětín: April 19, May 3, 14, 25, June 12, July 6, 13, 24, August 9, 22, September 13, October 4, 24. Borkovice. April 10, 23, May 5, 24, June 18, July 11, 26, August 14, 24, September 15, October 9, November 3. Flies were collected automatically through the periods preceding each date.

In order to ascertain how much the results are influenced by different time of the exposition of bait, an experiment was executed as follows: In a homogeneous vegetation (locality Veselí nad Lužnicí, *Fago-Quercetum)*, sixteen traps were arranged 23. V. 1974 in the groups of four ($A_1B_1C_1D_1 \ldots - A_4B_4C_4D_4$). Flies were taking withdrawn each seven days, up to 27. VI. 1975. In the traps "A", bait (beer) was exchanged simultaneously with the taking of flies, in the traps "B" it was exchanged only 13. VI., whereas in the traps "C" it was exchanged only 6. VI The traps "D" were left without exchanging of bait (Tab 2, Fig. 1). The results obtained seem to confirm that the differences of the length of bait exposition do not affect the results substantially.

Material of flies is preserved in the 75 % ethylalcohol, some specimens are mounted on pins in usual manner and placed in the collection of the Museum Tábor, Nat. Hist. Department, Soběslav.

When presenting the results, collections of all twenty traps used in the locality are summarized in order to reduce affects of micro-migration within the biotope. Graphs are constructed only for the species stated in sufficient number of specimens (axis x = time, axis y = number of specimens). Analyzing the graphs, it must be kept in mind that any variations of frequency seem to come somewhat later than in reality, as the peaks of graphs represent the results of preceding ca. 14 days of collecting.

COLLECTING RESULTS OF INDIVIDUAL SPECIES

Drosophila (Scaptodrosophila) deflexa Duda. Figs. 2 A—B

In the locality Val, this species is much more frequent in late summer than in other periods (only "autumnal" peak of frequency occurs, in August—September). In Ševětín, only several specimens were collected, from July to September. In Borkovice, only one specimen (a female) was captured; graph was therefore not constructed for this locality.

Drosophila (Sophophora) subsilvestris Hardy and Kaneshiro, Figs. 3 A—C

In Val and Ševětín, *D. subsilvestris* was practically or absolutely lacking in the first half of year. Autumnal peak of frequency is much conspicuous (end of September to the beginning of October). In Borkovice, the species seems to be more evently frequent throughout the season, but too little specimens were collected there for considering it significant.

Drosophila (Sophophora) obscura Fallén, Figs. 4 A—C

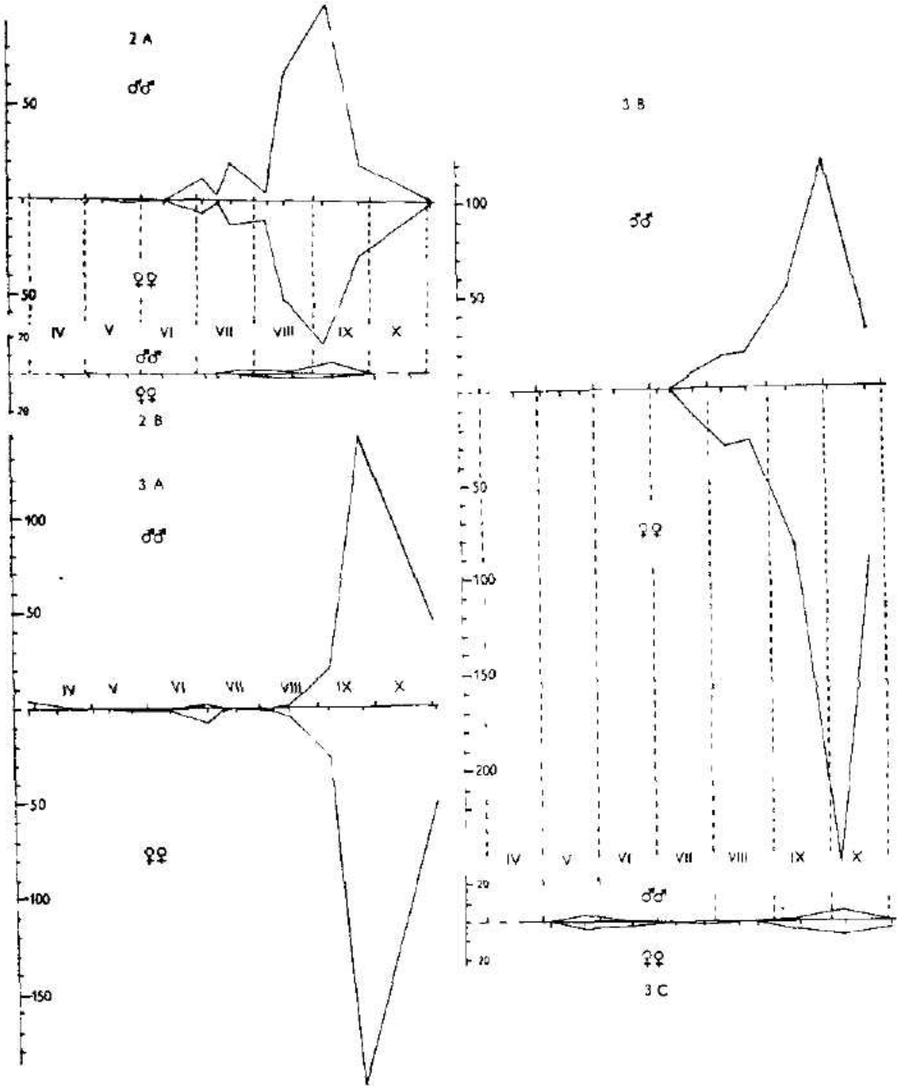
This species was collected throughout the vegetation season, but with different results in each of the three localities. In Val, the collections were more successful in the second half of year, with a peak in August—September. In Ševětin, pronounced vernal peak (April—May , and a second, equally pronounced peak in July and August, are present. Comparatively little specimens were collected in Borkovice, most of them in the first half of year.

Drosophila (Sophophora) subobscura Collin, Figs. 5 A—C

Most specimens were collected in Val, where the trees are not very densely accumulated and the ground is not shadowed (compare e. g. S h o r r o c k s, 1972). Vernal peak of frequency is not very steep (Val) or it is lacking; in the second half of year, frequency of this species culminates in August (Borkovice) or September (Val, Ševětín).

Drosophila (s. str.) *testacea* von Roser, Figs. 6A—C

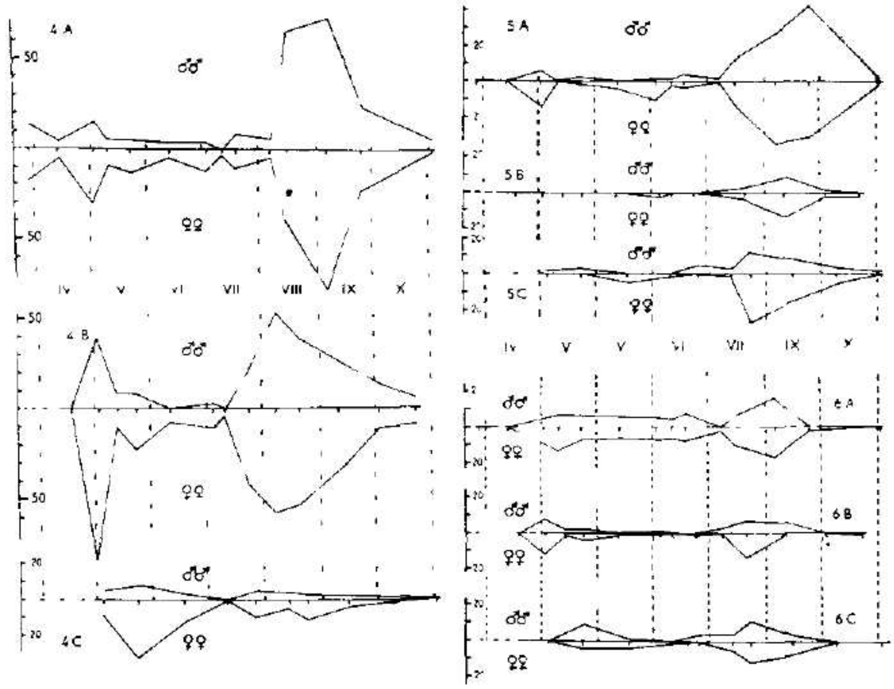
The species was collected throughout the vegetation season, with peaks of frequency in (April—) May and August (—September). Analogous results were obtained from all three localities. Yellow specimens were common in summer, whereas dark specimens prevailed in other seasons, in accordance with W a t a b e (1977).



Figs. 2—3. Total numbers of specimens collected from 20 traps for each locality. 2 A — *Drosophila deflexa*, Val. 2 B — *D. deflexa*, Ševětín. 3 A — *Drosophila subsilvestris*, Val. 3 B — *D. subsilvestris*, Ševětín. 3 C — *D. subsilvestris*, Borkovice.

Drosophila (s. str.) *phalerata* Meigen, Figs. 7 A—C·

The most abundant species in all three localities; it may be also captured by sweeping, although less commonly. In Val and Ševětín, there is a very pronounced vernal peak of frequency in May, with indications of another lower peak in June (—July): in the second half of year, a moderately high peak appears in August—September. On the other hand, gradual increase of frequency may be seen in Borkovice from May to August.



Figs. 4—6. Total numbers of specimens collected from 20 traps of each locality. 4 A — *Drosophila obscura*, Val. 4 B — *D. obscura*, Ševětín. 4 C — *D. obscura*, Borkovice. 5 A — *Drosophila subobscura*, Val. 5 B — *D. subobscura*, Ševětín. 5 C — *D. subobscura*, Borkovice. 6 A — *Drosophila testacea*. Val. 6 B — *D. testacea*. Ševětín. 6 C — *D. testacea*, Borkovice.

Drosophila (s. str.) *kuntzei* Duda, Figs. 8 A—C

D. kuntzei is not so abundant as *D. phalerata*, otherwise the graphs are very similar one another. as well in Val and Ševětín, as in Borkovice. Collections in Val were however much less numerous than in Ševětín in the case of *D. kuntzei*.

Drosophila (s. str.) *transversa* Fallén, Figs. 9 A—C

In Val and Ševětín, a high peak of frequency appears in May, a low one in (June—) July and another low peak in August— September. In Borkovice, two distinct peaks of frequency occur in June—July and in August.

Another thirteen species were stated only in a small number and they are listed below. The numbers in parentheses show the months, in which the particular species occured.

Drosophila (Dosilopha) busckii Coquillett (V. VII—XI).

D. (Hirtodrosophila) confusa Staeger (IV—X).

D. (Lordiphosa) fenestrarum Fallén (V).

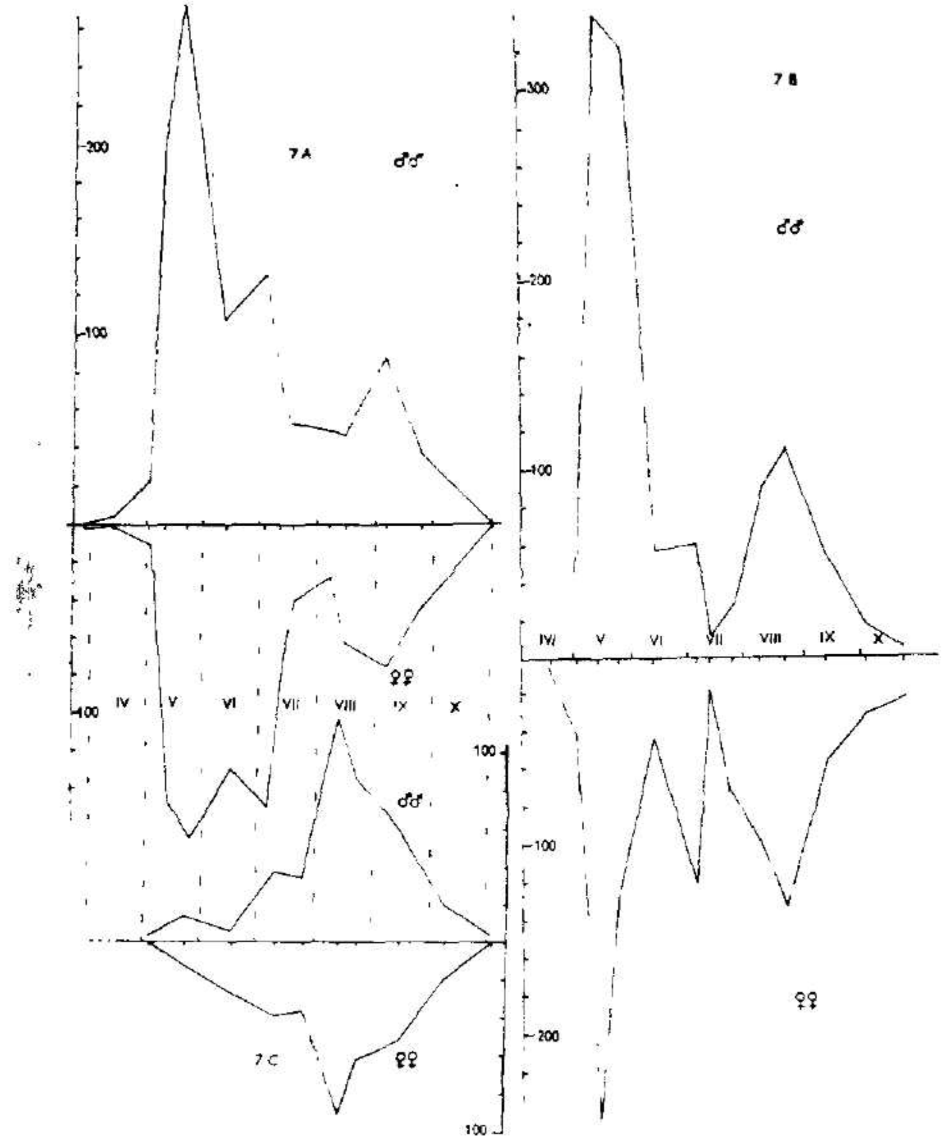
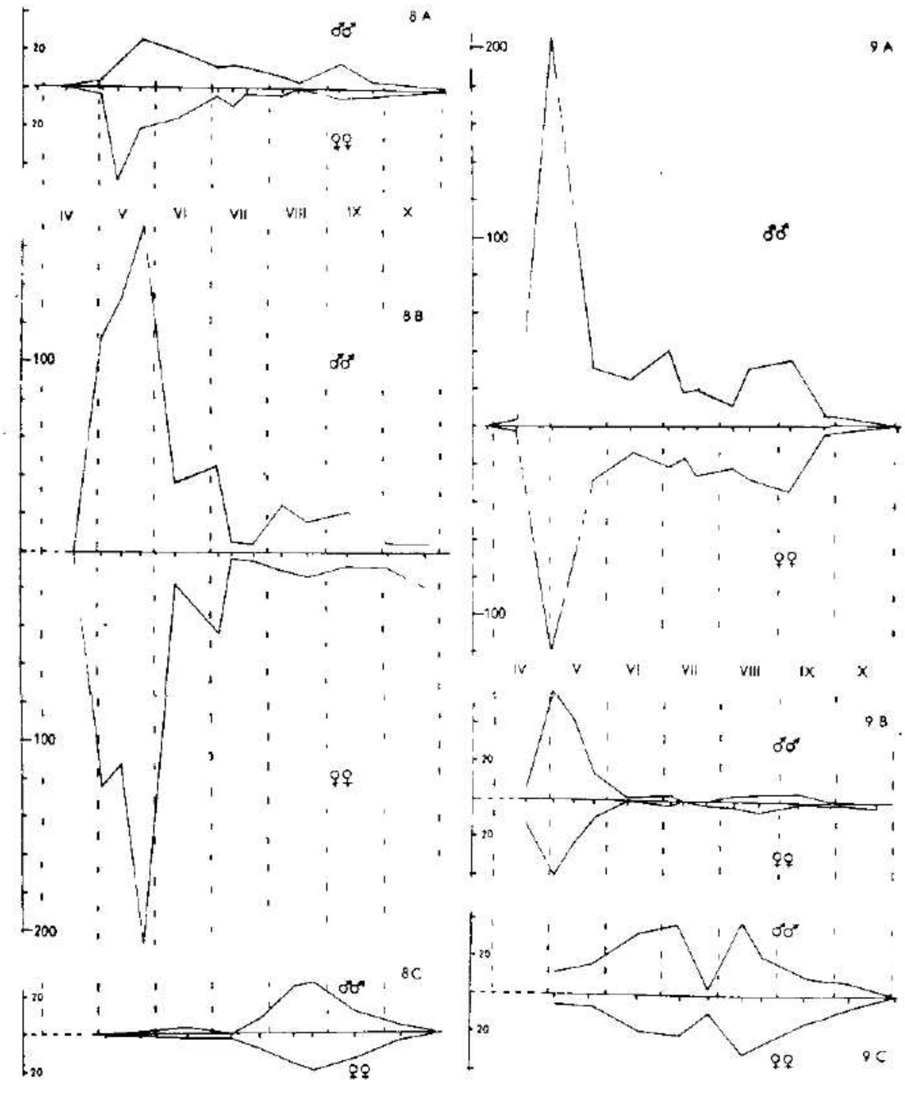


Fig. 7. Total numbers of specimens collected from 20 traps for each locality. *Drosophila phalerata*. 7 A — Val. 7 B — Ševětín. 7 C — Borkovice.

D. (Scaptodrosophila) rufifrons Loew (IX—X).
D. (Sophophora) melanogaster Meigen (V—X).
D. (S.) tristis Fallén (V, VII—XI).
D. (D.) hydei Sturtevant (VII—X).
D. (D.) littoralis Meigen (IX).
D. (D.) cameraria Haliday (VI).
D. (D.) funebris (Fabricius) (III, V, VII—VIII, X).



Figs. 8—9. Total numbers of specimens collected from 20 traps for each locality. 8 A — *Drosophila kuntzei*, Val. 8 B — *D. kuntzei*, Ševětín. 8 C — *D. kuntzei*, Borkovice. 9 A — *Drosophila transversa*, Val. 9 B — *D. transversa*, Ševětín. 9 C — *D. transversa*, Borkovice.

D. (D.) limbata von Roser (V—IX).
D. (D.) histrio Meigen (IV—V, VII—X).
D. (D.) immigrans Sturtevant (X).

Some of these species were found only on one or two of the studied localities.

SUMMARY AND DISCUSSION

a) Sex ratio. Ratio between the numbers of males and females collected is higher than one in *D. deflexa* and the species of *D. quinaria* group *(D. phalerata, D. kuntzei, D. transversa)* — see Figs. 2. 7–9. On the other hand, this ratio is lower than one in *D. testacea* and the species of *D. obscura* group *(D. obscura, D. subobscura, D. subsilvestris)* — see Figs. 3—6. This ratio should be affected by the type of bait and therefore should not be necessary identical with the sex ratio. The results obtained by breeding of various species of the *quinaria* group by Burla and Bächli (1968) however confirm that the sex ratio of these species is really higher than one. Sex differences in the reaction to bait are at least the cause of some temporal fluctuations: in some species, especially *D. phalerata*, males prevail initially, but later females tend to be more numerous (Graph 7). This may be caused by the fact that females look for fermenting substrates for oviposition, and possibly (as is usual in many groups of insects) by longer life span in females.

b) Comparison of localities. The studied localities are little affected by the activities of men and may be classified as eubiocoenoses. Synanthropic species *(D. busckii, D. melanogaster, D. hydei, D. funebris, D. immigrans)* are represented in the collections only in small number of specimens. Their occurence would not be over-estimated— see Laštovka and Zuska (1978).

Some *Drosophila* species seem to prefer rather strongly certain types of biocoenoses (e. g. *D. kuntzei* prefers beech woods), most species, however, seem to be rather eurytop at least in the imaginal stage. More localities should be compared to confirm it; the preferences may vary with the geographic position of localities etc.

In Borkovice, a retardation of the vernal "flush" was stated, in comparison to Val and Ševětín. In Borkovice the first specimens were captured on the 5th May; at that time, several hundred specimens had been already stated in both Val and Ševětín. This is evidently caused by special topoclimatic conditions of the peat-bog of Borkovice.

c) Seasonal changes. Two unequal peaks of frequency (in spring, and in autumn or late summer) may be usually stated within a year, when we consider the phenology of individual species. In the tree sap breeding species *(Drosophila obscura* group and *D. deflexa)* the autumnal peak is usually more pronounced, in the species breeding in fungi *(D. quinaria* group) vernal peak is more pronounced, as a rule. It must be kept in mind that in the period when lesser amount of natural feeding or breeding substrate is at disposal, higher concentration of specimens may be seen on the submitted bait. Data of Buxton (1961) and Burla & Bächli (1968) on the species bred from fungi however admit that the population density of those species may be in spring really higher than in autumn, although the amount of fungi growing in spring is comparatively small. This phenomenon may be explained by making use of mycelia by *Drosophila* larvae at spring (Buxton, 1961) and by competition with Mycetophilidae in autumn (Burla and Bächli, 1968). Other factors may also take part, e. g.

changes in the degree of parasitation; the host/parasite relations among Drosophilidae, parasitic wasps, nematods etc. are however little known at present.

Fluctuations of the numbers of collected specimens cannot be identified with the succesion of generations; examination of the ovarian development (K i m u r a et al., 1978) would however make possible to determine the number of generations per year.

Acknowledgements

I am much grateful to Mrs. Zdenka Zaňáková (Reserach Institute of Peat-bogs, Research Station Borkovice) for kindly providing me with meteorologic data of the Hydrometeorologic Station, Borkovice.

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Věst. čs. Společ. zool, 46: 15—24, 1982

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A CONTRIBUTION TO THE BIONOMICS OF CREPIDOSTOMUM METOECUS (TREMATODA: ALLOCREADIIDAE)

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Received September 17, 1980

Abstract: The bionomics of the trematode *Crepidostomum metoecus* (Braun, 1900) was studied in the Černovický Brook (the Elbe River basin) in Czechoslovakia in the years 1977—78. The first intermediate hosts appear to be herte the clams *Pisidium* spp., whereas mayfly nymphs (*Ephemera danica* Mull.) were found for the first time to serve as the second intermediate hosts (incidence 32 %, intensity of infection 1—31 cysts per mayfly). The definitive hosts are most often trout (*Salmo trutta* m. *fario* L.), less frequently bullhead (*Cottus gobio* (L.)). Larger trout acquire *C. metoecus* infection not only via the intermediate mayfly hosts, but also while feeding on small fishes (bullhead, small trout) as it was confirmed experimentally. The seasonal dynamics in the occurrence and maturation of *C. metoecus* was followed in trout; in contrast to some other localities, *C. metoecus* shows quite clearly an annual maturation cycle here, when all adult trematodes lay eggs up to May-June and then die. New infections in trout may occur throughout the year, but mostly in spring and autumn. Ecological factors, mainly the temperature regime in the locality and seasonal changes in the populations of intermediate mayfly hosts, determine whether *C. metoecus* falls one or two generations a year.

The trematode *Crepidostomum metoecus* (Braun, 1900) is known as a very abundant and widespread intestinal parasite of salmonid fish of the Holarctic. In Czechoslovakia, it belongs to the most frequent parasites of trout; in trout it often occurs along with the congeneric species *Crepidostomum farionis* (Müller, 1784) and was often mistaken for this species in the past (see Ślusarski, 1958a, Ergens 1963). Although the life-cycle of *C. farionis* has been studied by several authors (Braun, 1927; Hopkins, 1933; Crawford, 1939, 1943; Awachie, 1968), the development of *C. metoecus* was practically dealt with only by Awachie (1968) who followed as well the seasonal dynamics in the occurrence of this parasite in trout in Great Britain. Data on the seasonal dynomics of *C. metoecus* were also published by Thomas (1958), Ślusarski (1958b), Campbell (1972—73), Bwathondi (1976) and particularly by Alvarez Pellitero (1976).

In 1977—78, during studies on the life-cycle of the nematodes *Cucullanus truttae* (Fabricius, 1974) and *Cystidicoloides tenuissima* (Zeder, 1800) under conditions of the trout stream (Černovický Brook) in Czechoslovakia, some new data on the bionomics of *Crepidostomum metoecus* were also obtained on the basis of the material collected. The results of these observations are presented in this paper.

MATERIAL AND METHODS

The population dynamics of *C. metoecus* was followed in brown trout (*Salmo trutta* m. *fario* L.) from the upper reaches of the Černovický Brook near Tábor (the Elbe River basin) in South Bohemia, Czechoslovakia. Fish samples were taken at regular monthly intervals by means of an electric fishing machine from a locality near the village of Mlýny from September 1977 to October 1978 (Table 1); the characterization of this locality has been given in an author's earlier paper (M o r a v e c 1980). In addition to 270 specimens of brown trout, also 1 brook trout (*Salvelinus fontinalis* (Mitchill), 3 roach (*Rutilus rutilus* (L.)), 2 loach (*Noemacheilus barbatulus* (L.)), 1 eel (*Anguilla anguilla* (L.)) and 26 bullhead (*Cottus gobio* (L.)) were examined from this locality. Benthic invertebrates were sampled irregularly throughout the year; these were compressed and examined microscopically for the presence of helminth larvae. The following invertebrates were examined in this way: larvae of aquatic insects: Ephemeroptera 1080 specimens (among them *Ephemera danica* 681, *Baetis* 173, *Rhithrogena* 121, *Ecdyonurus* 59, *Paraleptophlebia* 39, *Habrophlebia* 13, *Ephemerella* 11, *Habroleptoides* 4, *Caenis* 1), Plecoptera 121, Trichoptera 71, Diptera 340, Megaloptera 5; Oligochaeta: 33 specimens; Mollusca (*Ancylus, Pisidium*) 28 specimens.

OBSERVATIONS

1. Definitive and postcyclic hosts of *C. metoecus* and their food:

The most frequent and most important host of adult *C. metoecus* is brown trout *Salmo trutta* m. *fario* in this locality. Additionally these trematodes were often found also in the intestine of bullhead *Cottus gobio*; a total of 16 of the 26 bullhead examined were infected (incidence 62 %), the intensity of infection being 1—148 (average 30) trematodes per fish. *C. metoecus* reaches maturity also in bullhead and attains the same size of body as in trout and most of the specimens recovered contained numerous eggs in the uterus; consequently, bullhed should be considered the definiteve host of *C. metoecus*. Of the fish occurring in this locality, also *Salvelinus fontinalis* and *Noemacheilus barbatulus* may be cosidered potential hosts of *C. metoecus*, but these trematodes were not found in them; the importance of these fishes as the definitive hosts of *C. metoecus* is however, negligible due to their rare occurrence.

Bullhead, which is a common definitive host of *C. metoecus*, often become a prey of larger trout and it seemed therefore probable that the trematodes can be thus transferred from bullhead to trout. In order to verify this presumption, two artificially reared specimens of rainbow trout, *S. gairdneri* (body length 10 cm) were fed with the intestines of bullhead naturally infected with *C. metoecus*. Trout were examined on days 4 and 6 after infection and their intestines contained 3 and 62 live adult specimens of *C. metoecus*, respectively. Numerous control fish were negative. The results of the experiment have confirmed that trout becomes not only the definitive host of *C. metoecus*, but while feeding on small fish (bullhead, small trout) it serves as well as the postcyclic host.

Examinations of stomach contents in trout revealed that in this locality, an important food component of these fish were benthic invertebrates (larvae of aquatic insects, oligochaetes and mollusks) during the whole year and particularly in winter months. In the period from August to October, however, terrestrial insects and imagoes of water insects prevailed. Occasionally also bullhead and small trout were found in the stomachs of larger trout. Mayfly larvae (including *Ephemera)* were found in trout diet throughout the year. The food of bullhead was composed altogether of minute larvae of aquatic insects (chironomids, mayflies, plecopterans, trichopterans, and beetles).

Table 1. Survey of *Salmo trutta* m. *fario* examined from the Černovický Brook and their infection with *Crepidostomum metoecus*

Year and month	No. of trout examined	No. of trout infected	Incidence (%)	Intensity of infection (mean, range)	Body length of trout in cm (mean, range)
1977					
September	12	10	83.3	18 (1–54)	23 (14–34)
October	18	16	88.9	47 (1–286)	24 (8–39)
November	22	22	100	48 (5–236)	21 (8–27)
December	27	27	100	40 (1–230)	20 (6–29)
1978					
January	22	21	95.5	32 (5–92)	18 (6–26)
February	10	10	100	36 (12–105)	22 (14–27)
March	20	20	100	25 (2–53)	17 (7–23)
April	18	18	100	52 (16–152)	21 (15–25)
May	18	18	100	26 (1–94)	19 (7–25)
June	27	21	77.8	10 (1–53)	19 (13–25)
July	29	27	93.1	20 (1–103)	19 (5–37)
August	17	12	70.6	10 (1–46)	21 (18–25)
September	17	13	76.5	12 (1–67)	20 (18–23)
October	13	12	92.3	13 (1–40)	21 (11–30)
Total	270	247	91.5	28 (1–286)	20 (5–39)

2. Occurrence of *Crepidostomum metoecus* in trout:

A total of 270 trout specimens were examined from this locality of which 247 (91.5 %) were infected with *C. metoecus* (a survey of trout examined and the degree of their infestation in individual months is given in Table 1). The incidence remained high throughout the year, a slight decrease occurred only in June and later in August and September (Fig. 1). The curve of mean intensity of infection showed two distinct peaks - after a sudden increase in October 1977 it gradually decreased from December to March of the next year; in April the mean intesity reached its maximum value and from May to October it dropped again deeply, with a minor increase only in July (Fig. 1).

The infections of *C. metoecus* in trout were distinctly in relation to the size of host body. The smallest trout bearing *C. metoecus* infection measured about 7 cm (O^+) only. As it is shown in Fig. 2, the incidence in trout smaller than 10 cm was only 64 %, but in the larger size groups of trout it increased rapidly and approximated or attained 100 %. The curve of mean intensity shows gradual increase of values reaching the maximum in the largest, 30—39 cm long fish (older than 3 years).

3. Seasonal changes in maturation of *C. metoecus*:

Fig. 3 shows the percentages of juvenile (without eggs) and adult (with eggs) trematodes in individual monthly samples from trout. It is obvivous from this histogram that even thougth the adult trematodes may be present in the locality during almost the whole year, their share in the samples increases gradually from September up to May-June when it reaches the maximum, whereas in July and August the number of adults suddenly drops. Moreover, the adult trematodes obtained in July-September were altogether young specimens with 1—4 eggs in and July—September.

These data show a distinct one-year cycle in maturation of *C. metoecus* Also the state of maturity in *C. metoecus* recovered from bullhead corresponds approximately to seasonal changes in maturation of this species in trout

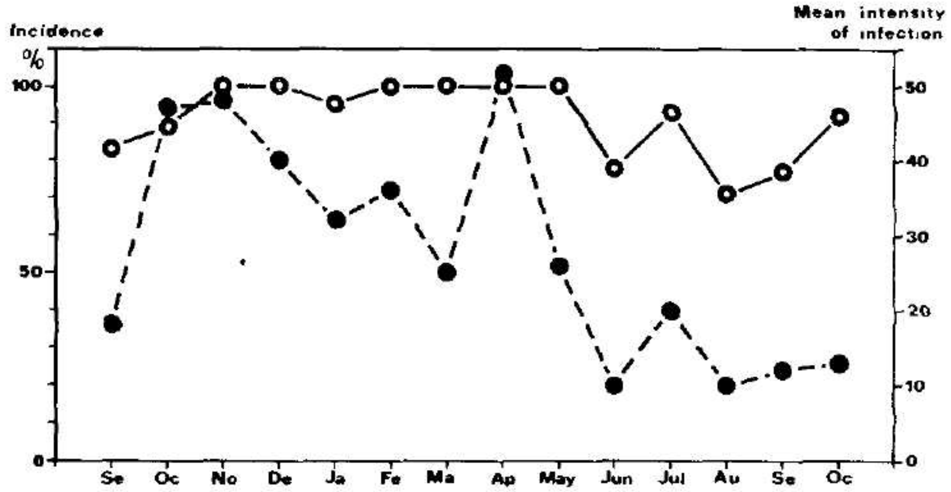

Fig 1. Variation of incidence (———) and mean intensity (– – – – –) of *C. metoecus* infection in brown trout of the Černovický Brook in the period from September 1977 till October 1978.

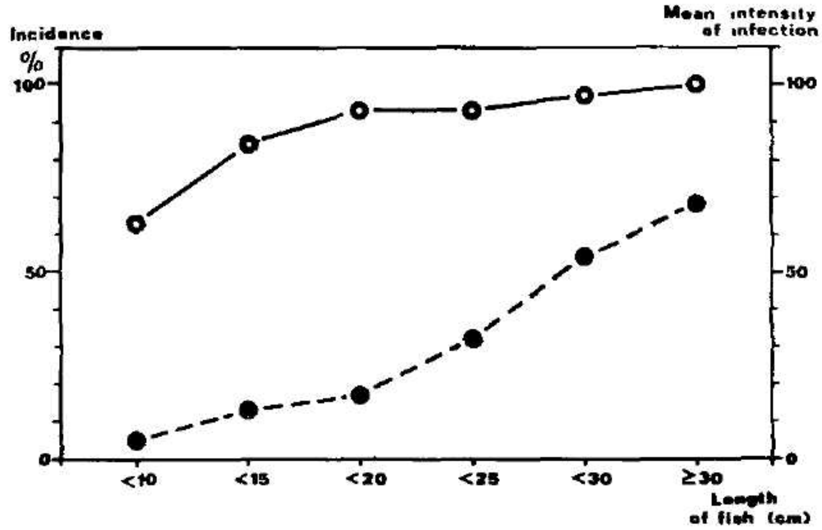

Fig. 2. Dependence of incidence (———) and mean intensity (– – – – –) of *C. metoecus* infection on the body lenght of brown trout.

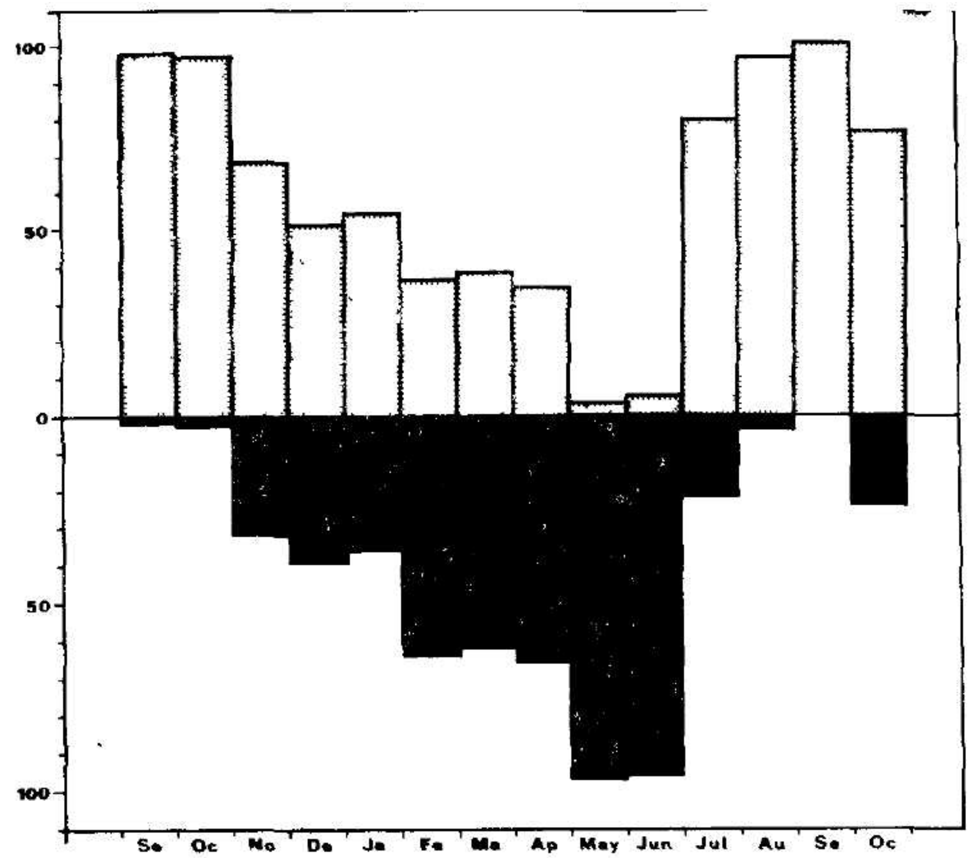

Fig. 3. Monthly changes in occurrence and state of maturity of *C. metoecus* in brown trout of the Černovický Brook in the period from September 1977 till October 1978. The data are expressed as percentages of the total number of *C. metoecus* specimens found per month: young specimens without eggs (stippled) and those containing eggs (blackened).

4. Presence of *Crepidostomum farionis* in fishes in the locality:

In addition to *Crepidostomum metoecus*, trematodes of the congeneric species *C. farionis* were found rarely in brown trout; they were not recorded from other fish species. Consistently with the data of Thomas (1958) and Awachie (1968), *C. farionis* were located always in the poterior part of host intestine, whereas *C. metoecus* were present mostly in pyloric caeca and anterior part of the intestine. Of the 270 trout examined only 9 specimens harboured *C. farionis* (incidence 3.7 %) with the intensity of one trematode per fish.

5. Intermediate hosts of *C. metoecus:*

The first intermediate hosts of *C. metoecus*, in which the development from miracidium to cercaria takes place, were not found in the studied locality. Of

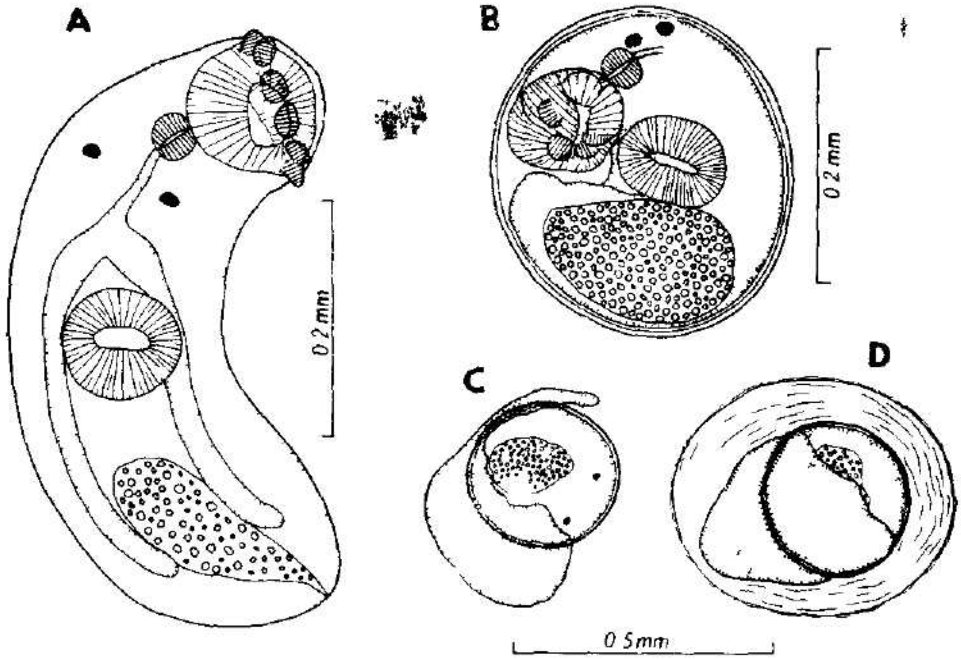

Fig 4 Metacercaria of *Crepidostomum metoecus* from naturally infected mayfly nymphs *Ephemera danica* A — metacercaria liberated from cyst, B — proper cyst of metacercaria partly enclosed in pigmented, brown-coloured cover, D — cyst of metacercaria with pigmented cover and enclosed in capsule produced by host s tissue

the freshwater mollusks there occur only the snail *Ancylus fluviatilis* Muller and clams *Pisidium casertanum* (Poli) and *P subtruncatum* Malm* which are very abundant here, some of them were examined (see p 16), but no infection was found It may be assumed, however, that the first intermediate hosts of *C. metoecus* are the members of *Pisidium* which are known as intermediate hosts for other species of *Crepidostomum* A w a c h i e (1968) mentioned *Lymnaea peregra* Muller to serve as the first intermediate host of *C. metoecus* in Britain, but this snail is not present in the locality under investigation.

The second intermediate hosts of *C metoecus* were found to be nymphs of the mayfly *Ephemera danica* Mull which are very abundant here. Of the 681 mayflies examined during October—July, 214 (incidence 31.5%) harboured encysted metacercariae of *C metoecus* with the intensity of infection 1—31 (most often only 1—4) cysts per mayfly The cysts are most frequently located in the muscles of the thorax less frequently of the abdomen of mayflies

The metacercariae (Fig 4) are enclosed in spherical, thin-walled, hyaline,colourless cysts measuring about 0 25 mm in diameter The proper cyst is usually surrounded by an irregular brown-coloured cover which is apparently a product of the host tissue The two released.non-stained metacercariae were 0 645—0 705 mm long and 0 219—0 255 mm wide The acetabulum measured 0 120 ×

* The species of the genus *Pisidium* were identified by Dr J Kuiper of the Institut Néerlandais, Paris, to whom our thanks are due

× 0 126 mm, ventral sucker 0 105 × 0 111 mm and pharynx 0 036 × 0 039—0 042 mm In order to verify whether the metacercariae belong to *C metoecus*, two artificially reared specimens of rainbow trout (*S gairdneri*) were fed with several cysts from mayflies. After 21 days these were examined and one juvenile specimen of *C metoecus* was found in the intestine of each of them It is probable that among the encysted *C metoecus* in *Ephemera danica* occur also metacercariae of *C farionis* in this locality, but with regard to the quantitative representation of both species in the fish hosts and to the number of cysts present in mayflies, the proportion of *C farionis* metacercariae must be negligible Besides *E danica*, also some other mayfly species (or larvae of other aquatic insects) may serve as the intermediate hosts of *C metoecus* in this locality, but no cysts of this parasite were found in them Awachie (1968) reported as the second intermediate host of *C metoecus* the shrimp *Gammarus pulex*, but no amphipods occur in the locality studied by us

Owing to unbalanced samples of *E danica* from individual months and their irregular collection it is impossible to determine precisely seasonal changes in the degree of infection in the intermediate mayfly hosts, the results suggest, however, that in the spring months (April—June) the infestation is higher than in the remaining part of the year

A direct dependence of the degree of *C metoecus* infection on the body size of mayfly nymphs was quite evident. This relationship is apparent, e g , in the sample of mayflies collected in November 1977 in this locality In the mayfly size groups with body lengths (without cerci) 21—25 16—20, 11—15 and 6—10 mm the incidence was 42 6 %, 22,6 %, 10 4 % and 0 % and mean intensity of infection 2 0, 1 6, 1 2 and 0 respectively This was the case also in some other months when a sufficiently large number of mayflies were collected The incidence and mean intensity of infection in individual size groups of mayfly nymphs from October 1977 to July 1978 were as follows

Mayfly size	Incidence	Mean intensity
21—25 mm	30—71 %	1 4—2 0
16—20 mm	20—68 %	1 2—3 7
11—15 mm	9—59 %	0—3 0
6—10 mm	0—18 %	0—2 0
up to 0 5 mm	0 %	0

DISCUSSION

The life-cycles of both species of the genus *Crepidostomum* (*C farionis* and *C metoecus*) parasitic in European salmonids have hitherto been only insufficiently known. Brown (1927) first described the development of *C farionis* under conditions of the trout streams in Great Britain, where he found lamellibranchs *Pisidium amnicum*, and rarely also *Sphaerium corneum*, serving as the first intermediate hosts The second intermediate hosts were the larvae of *Ephemera danica* Although the adult trematodes depicted by the author really represent the species *C farionis*, the larvae obtained only from naturally infected intermediate hosts might belong not only to *C. farionis*, but also to *C. metoecus* The same concerns the metacercariae found later by Baylis (1931) in *Gammarus pulex* and identified as *C farionis C. metoecus*, which was earlier often mistaken for *C farionis* (Ślusarski, 1958a, Ergens, 1963; Awachie, 1968), usually occurs together with *C. farionis* and in some localities in Great Britain it is much more abudant than *C. farionis* (Awachie, 1968; Bwathondi, 1976).

The development of *C. metoecus* was not dealt with in the literature, only Nöller (1928) supposed that the larval stage of this species is *Cercaria arhopalocerca* from *Pisidium sp.*, which encysts in the chironomid larvae. However, according to Awachie (1968) the first intermediate host of *C. metoecus* in Great Britain is the freshwater snail *Lymnaea peregra*, whereas as the intermediate host of *C. farionis* he recorded *Pisidium casertanum;* the metacercariae of both species were present in *Gammarus pulex* in the locality. Most probably the xiphidiocercariae from *Lymnaea peregra* were not *C. metoecus* but some other trematode species. This is evidenced also by our observations from the Černovický Brook, where lymnaeid snails are lacking, whereas *C. metoecus* is very abundant here; the life-cycle of *C. metoecus* undoubtedly involves clams of the genus *Pisidium (P. casertanum* and *P. subtruncatum).* Various species of *Pisidium* have been reported as intermediate hosts also in other members of *Crepidostomum* (Brown, 1927; Crawford, 1943; Awachie, 1968; Klein et al., 1969; Meier-Brook, 1970). As the second intermediate hosts of *C. metoecus* were reported shrimps *Gammarus pulex* and mayflies *Cloeon simile* and *Siphlonurus lacustris* (Awachie, 1968; Bwathondi, 1967) and according to our observations it is also *Ephemera danica*. The differentiation of the metacercariae of *C. metoecus* from those of *C. farionis* on the basis of their morphology, is, however, problematic for the time being and it will require detailed experimental studies of the development of both species. The range of the second intermediate hosts of *C. metoecus* and *C. farionis* seems to be similar and in addition to amphipods and mayfly nymphs it apparently may include also other aquatic insects.

The intermediate invertebrate hosts harbouring encysted metacercariae of this parasite have always been considered the only source of *C. metoecus* infection for trout. However, the findings of *C. metoecus* in bullhead *(Cottus gobio)* (Nybelin 1932; Awachie, 1968; own records) which are often ingested by trout show that larger trout can become infected also while feeding upon these small fish which was confirmed also in feeding experiments. A similar way of transmission through small forage fish (loach) was presumed also by Dyk et al. (1954) in *Crepidostomum farionis*. Owing to frequent cannibalism in salmonids, also young specimens of the same species can become a source of infection for large fish.

Awachie (1968), Campbell (1972—73) and Bwathondi (1976) found in the localities in Great Britain that *C. metoecus* infections in brown trout gradually increased with the size of the fish reaching the maximum in 20—28 cm long trout; in larger (older) fish the rate of infestation again declined. The authors explain this phenomenon by the changes in the diet of older trout, which pass from small invertebrates to larger animals (small fish). However, the data from the Černovický Brook show (Fig. 2) that both incidence and intensity of *C. metoecus* infection reach maximum values in the largest size group of trout (above 30 cm). This may be explained by the fact that the lower supply of *C. metoecus* metacercariae from invertebrates is here fully replaced by an increased number of juvenile and adult trematodes obtained from paratenic hosts — small fish (bullhead). Hence the relationship between the degree of infection and the size of host body is here determined by the ecological conditions in the locality.

Although C a m p b e l l (1972—73) did not find any seasonal periodicity in the incidence and intensity of *C. metoecus* infection in trout, T h o m a s (1958) and A w a c h i e (1968) observed distinctly defined seasonal cycles with the winter maximum and the summer minumum. This approximately corresponds to our observations from the Černovický Brook (Fig. 1) where the generally high incidence was decreased only in June and August–September, whereas the mean intesity dropped deeply in June—October and less also in December—March. The summer drop of *C. metoecus* infections is evidently related with the death of adult trematodes of the old generation and probably also with lower proportion of aquatic insects in the food of trout in summer months. A slight increase in the infection degree in July can be correlated with the emergence of adults of *Ephemera danica;* a slight decrease in the mean intensity in winter months (Fig. 1) is correlated apparently with lower feeding activity of trout in this season.

A l v a r e z P e l l i t e r o (1976) has reported that *C. metoecus* has two generations a year (a spring generation and an autumn one) in the rivers of north--eastern Spain. On the other hand, B w a t h o n d i (1976) observed in Great Britain that the seasonal changes in maturation of *C. metoecus* are exhibited rather quantitatively only, when most trematodes reach their maturity in April to July and least in August—September: all adults die by August. The results of our observations are very similar to those of B w a t h o n d i (1976) and show a distinct annual maturation cycle of *C. metoecus* in the Černovický Brook. The main period of trematode maturation is here May—June (Fig. 3), then follows a rapid release of adults from the host, so in July—September only young trematodes are present in trout: these seem to have been acquired during winter, spring and summer seasons. As it is suggested by own feeding experiments with *C. metoecus* (p. 21) or those of C r a w f o r d (1943) and K l e i n et al. 1969) with *C. farionis*, the development of these trematodes in the definitive host is very slow and the rate of the development seems to be influenced considerably by water temperature. This woud indicate that the metacercariae of *C. metoecus* obtained by trout during the winter, spring and summer seasons start to mature gradually only from summer, but mainly in autumn and survive in the host till the spring months of the next year: the trematodes obtained in autumn probably mature in early spring. All trematodes obtained in the previous year die by June which is exibited by a sudden decrease in the incidence and intensity of infection (Fig. 1) and porportion of adult trematodes in the samples (Fig. 3). New inefctions in trout may occur in all months of the year, since the main intermediate host, mayfly *E. danica* has a two-year life-cycle and its infected nymphs are present in the locality in all seasons. However, trout acquire new infections particularly in spring and autumn, which is due to the ecology and ethology of the definitive and intermediate hosts.

The present data indicate that the trematode *Crepidostomum metoecus*, like the trout nematode *Cystidicoloides tenuissima* (see M o r a v e c and D e 1982), can have one or two generations a year in various localities. The pattern of this seasonal periodicity is determined by ecological conditions in the locality, the main factors appearing to be the water temperature and seasonal changes in intermediate mayfly host populations. It follows from the papers by D y k et al. (1954), H a r e and B u r t (1975) and A l v a r e z P e l l i t e r o (1976) that also *Crepidostomum farionis* can fall one or two generations a year according to ecological conditions.

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COMPARISON OF TWO DIFFERENT METHODS OF GROWTH VALUES COMPUTATION ILLUSTRATED ON RUDD SCALES (PISCES: CYPRINIDAE)

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Received August 18, 1980

Abstract. Differences in growth values calculated by two different methods (the Rosa Lee method and the reading from empirical body/scale relationship) were studied using 880 scales of 475 specimens of the rudd — *Scardinius erythrophthalmus* (Linnaeus, 1758) of the Klíčava valley reservoir during years 1975–1979. Some significant differences were found using computation of 95 % confidence intervals. Selection of the method of growth values back calculation should be based on the construction of body scale relationships. The Rosa Lee method is not suitable for the body/scale relationship which does not form a straight line, as it was proved in the rudd from the Klíčava reservoir.

MATERIAL AND METHODS

Catching of samples of the rudd and scales sampling and measuring was described by Novák and Frank (1981). Growth values of the rudd of the Klíčava reservoir were calculated by the Rosa Lee method (15 mm correction factor) using the formula by Holčík and Hensel (1972) and by the direct reading from graphs representing the body length/vetrodiagonal radius of the scale relationship (Fig. 1). For each age group and year of life the average lenght, ranges and 95 % confidence interval as $\bar{x} \pm t \cdot s_{\bar{x}}$, where $\bar{x}$ ... average, t ... critical value ($\alpha = 0.05$), $s_{\bar{x}}$ ... standard error of the mean were computed. 1–9 scales of each specimen were measured. 95 % confidence intervals were computed with regard to the number of scales investigated in each age group. Following Dannevig and Høst (1931) back calculated growth values for one specimen depend on the location of the scale on the body. The growth cannot be studied by measuring of scales taken always from the same body part of collected specimens, because the number and position of scales is not quite constant in each individual and shows some differences. Sinse 1975 I have measured 1 scale of 1 specimen of age group II (only 2+), 11 sc. (5 sp.) of III (only 3+) and 20 sc. (16 sp.) of IV (only 4+); 1976 5 sc. of 1 sp. of II (only 2+), 2 sc of 1 sp. of III (only specimens with the first anulus from 1974, the second one from 1975, without the 1976 year's anulus, also only 3 and no 3+ age), 5 sc. of 3 sp. of IV (only age 4), 25 sc. of 9 sp. of V (only age 5); 1977 9 sc. of 1 sp. of I (only 1+), 167 sc of 81 sp. of III (33 sc. of 33 sp. of them of age 3+), 11 sc. of 6 sp. of IV (3 sc. of 2 sp of 4+), 3 sc. of 3 sp. of V (2 sc. of 2 sp. of 5+), 20 sc. of 10 sp. of VI (4 sc of 6+) and 2 sc. of 1 sp. of VII (only age 7); 1978 90 sc. of 30 sp. of age I (only 1+), 63 sc. of 23 sp. of II (only age 2+), 184 sc. of 104 sp. of IV (78 sc. of 42 sp. of them age 4+), 43 sc. of 22 sp. of V (only age 5), 37 sc of 21 sp of VI (16 sc of 8 sp. of them age 6+), 9 sc of 6 sp. of VII (4 sc. of 2 sp. of 7+) and 2 scales of 1 sp. of X (only age 9); 1979 70 sc. of 43 sp. of III (48 sc of 41 sp. of 3+), 29 sc. of 29 sp. of IV (28 sc. of 28 sp. of 4+), of V 62 sc. of 49 sp. (4 sc of 4 sp. of them age 5+), 4 sc. of 4 sp of VI (3 sc. of 3 sp. of them age 6+) and 6 sc. of 5 sp. of VII (1 sc. of 1 sp. of age 7+); althogether 880 scales of 475 specimens of the rudd.

RESULTS AND DISCUSSION

Results are summarized in Tables 1—5 and Figs. 1—3. Tables of the growth of the rudd in the Klíčava reservoir 1975—1978 obtained by direct reading from empirical body/scale relationship are also given by N o v á k and F r a n k (1981). Significant differences were found between back calculated body lengths obtained by the Rosa Lee method and by reading from body scale graph mostly in l_1—l_4 (Tables 1—5). In this region the empirical relationship differs considerably from straight lines computed by the R. Lee method (Fig. 1,2). Values l_1—l_4 computed by the R. Lee method are mostly lower than those obtained by

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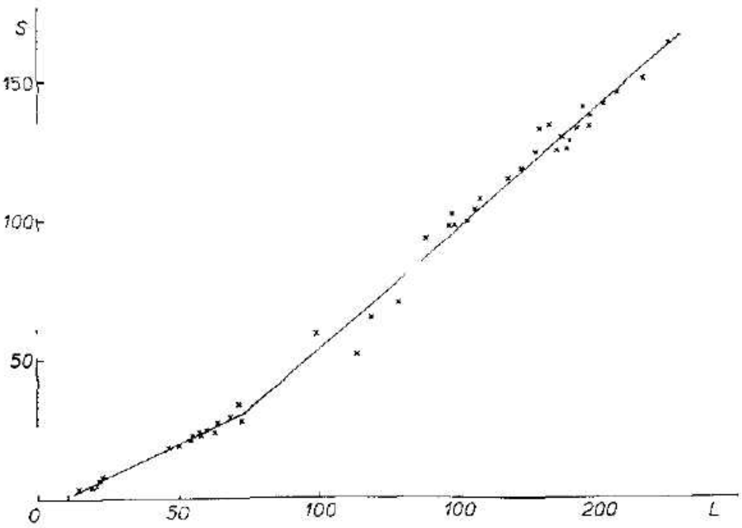

Fig. 1. Empirical relationship of the body length (L in mm) — ventrodiagonal radius of the scale (S in mm, magnified 17.5) of the rudd from the Klíčava reservoir during 1975—1979

reading from graph (Fig. 3). *Significance of differences* depends on the number of values measured, therefore some remarkable differences (Table 1: II — l_2, III — l_2: Table 2: III — l_2, IV — l_1, l_3, V — l_1, l_2; Table 3: IV — l_2, V — l_3 VII — l_1, l_2, l_3: Table 4: VII — l_3, l_4, l_5, l_6; Table 5: VI — l_1, l_2, l_3, l_4) do not show significance. The use of the t test ($\alpha = 0.05$) has given the same results considering the determination or significance of differences. But computation of 95 % confidence intervals allows the study of the growth differences in the years investigated, without performing new computations.

The reading from the empirical relationship averages individual specimens (scales). According to Fig. 2, all investigated specimens with anuli S_{1-2} obtain the same body length — L_x. But momentary (in one period of catching, or in one year) relationship is a mean criterion for selection of growth values back calculation, especially if the same relationships are found in each of the years investigated (the rudd population in the Klíčava reservoir in 1975—1979). The same body length ventrodiagonal radius of scale relationships as in the Klíčava reservoir were also found in the rudd of some Central European rivers and backwaters. Construction of empiric curves with correction tables was first recommended by S e g e r s t r å l e (1933), later, often with use of monograms by B r j u z g i n (1968). Č u g u n o v a (1968), H i l e (1968), P e ň á z (1968). Accor-

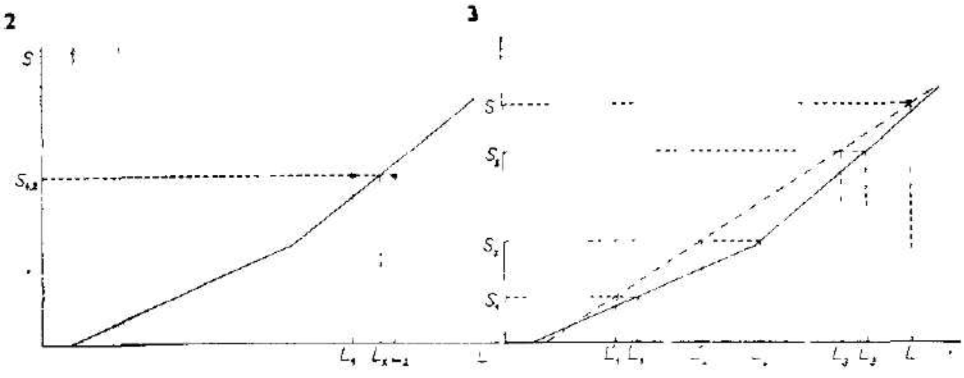

Fig. 2 Scheme of the reading of growth values from body scale relationship.
S... measurement of the scale
L. body length
L_1, L_2... body lengths of two caught specimens with the diameter of the scale of the same size ($S_{1,2}$) as is the distance of the centre of the scale—anulus of the investigated specimen
Lx... computed or read body length for each specimen with the distance of the anulus from the centre of the scale equals to $S_{1,2}$.

Fig 3 Graphical comparison of back calculated lengths obtained by the R. Lee method and by the reading from the empirical body scale graph
L. . body length
S... diameter of the scale
S_1, S_2, S_3... distances of the first, second and third anulus from the centre of the scale of the investigated specimen
L_1. L_2, L_3.. back calculated body lengths for the first second and third year of life of the investigated specimen obtained by the reading from empirical body,scale relationship
L'_1. L'_2, L'_3... back calculated body lengths for the first, second and third year of life of the investigated specimen obtained by the R Lee method (here read from graph — straight line, in practice usually the Lee's formula is used which represents the linear function, or Lea's desk).

ding to Carlander (1956). the R. Lee method can be used generally, except "special studies". But all growth studies (except the computation of production) can be consider as "special studies". From Figs. 1—3 and Tables 1—5 it can be seen, that the R. Lee method cannot be used in computation of growth values of the rudd in the Klíčava reservoir. Back calculated body length obtained by the Rosa Lee method do not correspond to average lengths of measured specimens which have the same diameters of scales as those of the centre of the scale — anuli of the investigated specimen — Fig. 3 If the body scale relationship is found to form a straight line and for each specimen (or scale) there is a single relationship described by the linear function, then the use of the R. Lee method appears as optimal. Each of these straight lines is determined by two points. One point is the same for all straight lines (specimens, scales) and it is determined by the correction factor from the Lee's formula. The second one has coordinates [body length; radius of scale]; both in time of catching. This method enables therefore back calculation for each specimen (scale) individually, without averageing. But in the sense of Segestråle (1933), Brjuzgin (1968) and other authors mentioned above, the R. Lee method cannot be re-

Table 1. Comparison of growth values of the rudd from the Kličava reservoir 1975

		Rosa Lee method with 15 mm correction		Graph reading			
age group	back calculated length	95% confidence interval in mm	ranges in mm	95% confidence interval in mm	ranges in mm	$\|\bar{x}_1 - \bar{x}_2\|$ in mm	significance of differences
II	l_1	40 ± —	—	38 ± —	—	2	—
	l_2	96 ± —	—	89 ± —	—	7	—
III	l_1	51 ± 5.70	34 – 66	57 ± 7.53	30 – 73	6	—
	l_2	99 ± 7.20	87 – 126	112 ± 9.58	89 – 116	13	—
	l_3	148 ± 7.24	128 – 172	153 ± 8.49	119 – 168	5	—
IV	l_1	38 ± 2.93	32 – 44	44 ± 2.62	30 – 47	6	+
	l_2	96 ± 1.88	87 – 107	106 ± 3.83	89 – 112	10	+
	l_3	142 ± 2.99	131 – 152	146 ± 5.84	117 – 157	4	—
	l_4	164 ± 2.37	144 – 178	164 ± 6.91	128 – 177	0	—

Table 2. Comparison of growth values of the rudd from the Kličava reservoir 1976

		Rosa Lee method with 15 mm correction		Graph reading			
age group	back calculated length	95% confidence interval in mm	ranges in mm	95% confidence interval in mm	ranges in mm	$\|\bar{x}_1 - \bar{x}_2\|$ in mm	significance of differences
II	l_1	33 ± 0.89	32 – 34	31 ± 2.33	28 – 33	2	—
	l_2	120 ± 0.61	119 – 120	110 ± 4.63	106 – 113	10	+
III	l_1	30 ± 9.02	29 – 30	32 ± 9.02	31 – 32	2	—
	l_2	90 ± 57.55	85 – 94	101 ± 9.02	100 – 101	11	—
IV	l_1	44 ± 5.61	36 – 47	39 ± 14.49	33 – 52	5	—
	l_2	96 ± 5.38	91 – 100	96 ± 5.74	84 – 102	0	—
	l_3	150 ± 12.88	132 – 156	135 ± 11.74	123 – 145	15	—
V	l_1	39 ± 1.32	30 – 46	47 ± 3.12	26 – 56	8	+
	l_2	96 ± 3.98	80 – 110	103 ± 3.83	87 – 117	7	+
	l_3	139 ± 4.60	126 – 161	142 ± 4.00	117 – 159	3	—
	l_4	160 ± 6.13	139 – 189	155 ± 6.15	134 – 173	5	—

Table 3. Comparison of growth values of the rudd from the Kličava reservoir 1977

		Ross Lee method with 15 mm correction		Graph reading			
age group	back calculated length	95% confidence interval in mm	ranges in mm	95% confidence interval in mm	ranges in mm	$\lvert\bar{x}_1 - \bar{x}_2\rvert$ in mm	significance of differences
I	l_1	32 ± 0.39	31 – 32	38 ± 1.54	35 – 40	6	+
III	l_1	33 ± 0.53	27 – 49	35 ± 0.74	28 – 64	2	+
	l_2	99 ± 1.49	78 – 125	108 ± 1.12	86 – 120	8	+
	l_3	155 ± 3.20	135 – 174	154 ± 2.14	139 – 163	1	–
IV	l_1	35 ± 1.92	30 – 44	36 ± 4.95	27 – 54	1	–
	l_2	86 ± 14.01	60 – 112	95 ± 14.15	68 – 120	9	–
	l_3	125 ± 15.42	95 – 156	129 ± 18.58	97 – 171	4	–
	l_4	163 ± 12.44	158 – 168	155 ± 34.81	141 – 168	8	–
V	l_1	36 ± 16.01	29 – 41	41 ± 23.71	30 – 47	5	–
	l_2	81 ± 51.25	57 – 96	91 ± 45.96	69 – 101	10	–
	l_3	128 ± 66.70	97 – 143	131 ± 64.50	101 – 151	3	–
	l_4	172 ± 45.00	150 – 183	170 ± 35.97	147 – 189	2	–
	l_5	186 ± 101.65	178 – 194	190 ± 178.39	174 – 203	4	–
VI	l_1	36 ± 1.61	29 – 44	40 ± 3.35	28 – 54	4	–
	l_2	84 ± 4.06	67 – 97	84 ± 5.27	79 – 112	0	–
	l_3	128 ± 5.13	95 – 147	133 ± 6.22	106 – 154	5	–
	l_4	157 ± 5.36	121 – 164	155 ± 6.57	128 – 176	2	–
	l_5	183 ± 5.99	146 – 207	181 ± 8.12	148 – 210	2	–
	l_6	189 ± 0.67	187 – 191	183 ± 24.50	168 – 197	6	–
VII	l_1	40 ± 9.01	39 – 41	49 ± 20.08	47 – 50	9	–
	l_2	74 ± –	–	85 ± 50.82	81 – 89	11	–
	l_3	102 ± –	–	112 ± 32.40	109 – 114	10	–
	l_4	150 ± 9.02	149 – 150	152 ± 63.53	147 – 157	2	–
	l_5	170 ± –	–	168 ± 70.14	162 – 173	2	–
	l_6	190 ± –	–	190 ± 101.65	182 – 198	0	–

Table 4. Comparison of growth values of the rudd from the Klíčava reservoir 1978

age group	back calculated length	Rosa Lee method with 15 mm correction: 95% confidence interval in mm	Rosa Lee method with 15 mm correction: ranges in mm	Graph reading: 95% confidence interval in mm	Graph reading: ranges in mm	$\|\bar{x}_1 - \bar{x}_2\|$ in mm	significance of differences
I	l_1	38 ± 0.79	33 – 44	34 ± 0.99	26 – 45	4	+
II	l_1	34 ± 0.76	30 – 37	35 ± 1.36	28 – 56	1	–
	l_2	99 ± 1.76	92 – 109	109 ± 3.68	79 – 122	10	+
IV	l_1	32 ± 0.55	26 – 46	35 ± 0.76	24 – 60	3	+
	l_2	91 ± 1.43	82 – 116	100 ± 1.20	82 – 129	9	+
	l_3	150 ± 1.23	131 – 173	150 ± 1.41	128 – 178	0	–
	l_4	179 ± 1.44	169 – 189	176 ± 3.32	157 – 200	3	–
V	l_1	33 ± 0.97	30 – 37	38 ± 1.60	28 – 52	5	+
	l_2	66 ± 3.48	52 – 91	78 ± 3.38	62 – 107	12	+
	l_3	100 ± 3.50	84 – 132	113 ± 4.18	93 – 158	13	+
	l_4	156 ± 3.17	141 – 187	162 ± 4.41	140 – 202	6	–
VI	l_1	35 ± 1.46	29 – 43	41 ± 2.42	28 – 58	6	+
	l_2	86 ± 3.76	50 – 98	102 ± 4.00	62 – 113	16	+
	l_3	135 ± 3.66	95 – 151	137 ± 3.56	103 – 154	2	–
	l_4	161 ± 2.99	141 – 178	157 ± 2.91	143 – 190	4	–
	l_5	182 ± 2.83	164 – 207	180 ± 4.18	156 – 210	2	–
	l_6	201 ± 4.37	191 – 214	193 ± 8.86	165 – 219	8	–
VII	l_1	38 ± 2.49	34 – 43	42 ± 3.92	36 – 47	4	–
	l_2	92 ± 7.75	82 – 114	94 ± 10.54	62 – 110	2	–
	l_3	149 ± 12.20	139 – 164	133 ± 18.79	89 – 150	16	–
	l_4	173 ± 5.93	160 – 183	154 ± 20.50	104 – 176	19	–
	l_5	200 ± 5.83	186 – 208	183 ± 16.95	143 – 200	17	–
	l_6	215 ± 7.33	198 – 230	198 ± 11.09	178 – 215	17	–
	l_7	227 ± 13.71	213 – 230	225 ± 26.70	197 – 230	2	–
X	l_1	37 ± –	–	44 ± 20.09	42 – 45	7	–
	l_2	98 ± –	–	108 ± 12.71	107 – 109	10	–
	l_3	128 ± –	–	133 ± 20.09	131 – 134	5	–
	l_4	143 ± –	–	146 ± 20.09	144 – 147	3	–
	l_5	155 ± –	–	157 ± 12.71	156 – 158	2	–
	l_6	179 ± –	–	179 ± 25.41	177 – 181	0	–
	l_7	188 ± –	–	190 ± 32.39	187 – 192	2	–
	l_8	209 ± –	–	213 ± 8.98	212 – 213	4	–
	l_9	219 ± –	–	227 ± 20.09	225 – 228	8	–

Table 5. Comparison of growth values of the rudd from the Kličava reservoir 1979

age group	back calculated length	Rosa Lee method with 15 mm correction: 95% confidence interval in mm	Rosa Lee method with 15 mm correction: ranges in mm	Graph reading: 95% confidence interval in mm	Graph reading: ranges in mm	$\|\bar{x}_1 - \bar{x}_2\|$ in mm	significance of differences
III	l_1	34 ± 0.74	27 – 38	34 ± 0.86	27 – 42	0	–
	l_2	93 ± 2.90	76 – 107	100 ± 2.08	78 – 116	7	+
	l_3	148 ± 3.15	118 – 161	147 ± 3.62	118 – 164	1	–
IV	l_1	33 ± 1.33	28 – 39	38 ± 1.68	31 – 45	5	+
	l_2	92 ± 4.75	71 – 125	104 ± 3.48	91 – 123	12	+
	l_3	147 ± 3.44	125 – 166	154 ± 2.40	145 – 168	7	+
	l_4	170 ± 4.08	159 – 203	185 ± 3.14	172 – 203	15	+
V	l_1	34 ± 0.66	29 – 40	37 ± 0.94	31 – 47	3	+
	l_2	89 ± 1.80	75 – 107	102 ± 1.98	85 – 122	13	+
	l_3	146 ± 1.62	129 – 164	146 ± 2.08	130 – 176	0	–
	l_4	176 ± 1.66	152 – 191	170 ± 2.98	159 – 203	6	+
	l_5	190 ± 6.68	184 – 194	189 ± 5.12	186 – 192	1	–
VI	l_1	33 ± 3.79	30 – 35	37 ± 4.77	33 – 38	4	–
	l_2	80 ± 19.28	63 – 89	104 ± 9.93	102 – 107	24	–
	l_3	131 ± 19.06	117 – 144	143 ± 26.28	135 – 164	12	–
	l_4	161 ± 22.69	151 – 181	172 ± 30.01	157 – 207	11	–
	l_5	183 ± 16.67	177 – 196	192 ± 23.67	174 – 212	9	–
	l_6	198 ± 26.42	189 – 209	208 ± 27.50	196 – 218	10	–
VII	l_1	35 ± 3.83	31 – 37	39 ± 4.34	31 – 40	4	–
	l_2	89 ± 8.33	81 – 99	103 ± 5.37	94 – 107	14	+
	l_3	137 ± 5.14	130 – 145	143 ± 13.91	126 – 159	6	–
	l_4	160 ± 9.46	153 – 169	164 ± 22.01	136 – 186	4	–
	l_5	181 ± 9.46	171 – 195	187 ± 27.20	150 – 216	6	–
	l_6	198 ± 7.30	190 – 209	203 ± 28.54	164 – 230	5	–
	l_7	205 ± –	–	219 ± –	–	14	–

commended for a nonlinear body/scale relationship of rudds from the Klíčava reservoir, especially due to significant differences obtained.

Acknowledgments

Thanks are due to Asst. Professor O. Oliva, PhD. for reading the rough script and valuable comments. K. Pivnička, PhD., Dr. M. Švatora and Mr. L. Hanel showed interest in my work and helped during field operations.

SUMMARY

Differences in back calculated growth values obtained by the R. Lee method and by reading from the empirical graph representing the body/scale relationship were studied using specimens of the rudd in the Klíčava reservoir in the Central Bohemia (Czechoslovakia). For each locality (eventually year) relationships between the body length and the measurement of the scale should be constructed. In the rudd of the Klíčava reservoir nonlinear body/scale relationship was found. Due to significant differences between back calculated body lengths obtained by the two mentioned methods .the R. Lee method cannot be used in growth values computation in the rudd from the Klíčava reservoir. Only if the body/scale relationship shows a straight line, the method of Rosa Lee can be used, which represents the optimal method for relationships described by the linear function. But it is no suitable for the body/scale relationship which does not show a straight line.

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MULTIVESICULA GEN. N. FROM THE SUBFAMILY TULLBERGIINAE (COLLEMBOLA: ONYCHIURIDAE)

Josef RUSEK

Received September 16, 1980

Abstract. One new genus and four new species of Tullbergiinae (Collembola, Onychiuridae) are described: *Multivesicula columbica* gen. n. sp. n. (British Columbia), *Multivesicula punctata* sp. n. (British Columbia), *Multivesicula dolomitica* sp. n. (Northwest Territories) and *Multivesicula giljarovi* sp. n. (Siberia). A key for the described species is given.

A new genus and four new species from the subfamily Tullbergiinae were discovered in soil samples taken for ecological studies. Three species are from Canada (British Columbia, Northwest Territories) and one from the USSR (Siberia). The new taxa are described in this paper and a key for determination of the new species is given.

Multivesicula gen. n.

Diagnosis: Body shape resembling *Mesaphorura* Börner, 1901. Length of body 425—550 μm. White. Antennal segment IV with four thickened sensory hairs a—d. Antennal organ III consists of two sensory clubs, two small sensory rods and one protecting integumental fold. Ventral side of antennal segment III with one large sensory club. Postantennal organ broad, sole-like, with about 60—110 small simple vesicles lying in four to seven irregular longitudinal rows. Meso- and metanotum without chaetae m_2, m_3 and p_2. Sensilla p_3 on abdominal tergite V slightly thickened. Pseudocelli with star-like centre. Abdominal tergite VI with two anterior crescentic ridges and two short anal spines on distinct papillae. Only females known.

Type-species: *Multivesicula columbica* sp. n.

Affinities: The new genus has very characteristic postantennal organ with great number of small, simple vesicles. Only *Scaphaphorura* Petersen, 1965 has such a postantennal organ, but other characters are quite diferent from the new genus. *Scaphaphorura* has f. e. only one sensory club in the antennal organ III and a peculiar shape of claws.

Derivatio nominis: The generic name is derived from the high number of vesicles in the postantennal organ.

Multivesicula columbica sp. n.

(Figs. 1—10)

Diagnosis: Body 550 μm long. White. Lateral sensilla s on meso— and metanotum thin. Sensilla p_3 on abdominal tergite V flame-like thickened. Chaeta m_4 missing on abdominal tergite I Anal lobes with chaeta l'_2 Postantennal organ with about 100 vesicles lying in four to six irregular rows Formula of pseudocelli 11 012 01011 Only females known

D e s c r i p t i o n Body elongated 550 μm long and 110 μm wide (Figs 1, 2) White Granulation on the whole body fine, on lateral parts and medial strip on notes and tergites slightly coarser Dorsum of the head and abdominal tergite V with very fine granulation granules about 0 5—1 μm in diameter here Most coarse granulation occurs on last abdominal tergite Chaetae well differentiated into micro— and macrochaetae (Figs 1, 2) Longest chaetae occur on last abdominal tergite (20 μm) Dorsal chaetotaxy as in following formula (Figs 1, 2)

	I	II	III	I	II	III	IV	V
p	—	10	10	10	10	10	8[3])	8[6])
a	8	6[1])	6	—	2	2	4[4])	—
m	—	8	8	10	10	10[2])	11[5])	8[7])
pl	2	3	3	2	3	3	6	1

Lateral sensilla s on meso— and metanotum thin, setaceous, 15 μm long (Fig 4) Sensory rod s' on meso— and metanotum 2 μm long, in a shallow pit (Fig 4) Anal lobes with chaeta l'_2

Pseudocelli circular, 8 μm in diameter, with star-like centre (Fig 5) Number and arrangement of pseudocelli (Figs 1, 2) 11/012/01011 Pseudocelli on mesonotum lateral, between chaetae m_7 and p_5.

Antennae shorter than head (65 75 μm) Lengths of antennal segments I II · III IV as 15 15 15 20 μm Antennal segment IV with four thickened sensillae a—d two small sensory rods f and g and one apical globular papilla (Fig. 3) Sensillae a—d with small basal heel Antennal organ III (Fig 3) consists of two small sensory rods concealed behind integumental fold and two thick sensory clubs bent toward each other Thick sensory club present on ventral side of antennal segment III (Fig 3)

Postantennal organ (Fig 5) 15 μm long and 8 μm wide It consists of about 100 simple vesicles lying in four to six irregular longitudinal rows.

Legs short, without clavate tibiotarsal hairs Claw without teeth, 8 μm long. Empodial appendage rudimentary, 1.5 μm long

Abdominal tergite IV without transversal groove Abdominal tergite V with thickened, flame-like sensilla p_3 (Fig 7) Abdominal tergite VI with two crescentic ridges anteriorly and two anal spines (Fig 2) Anal spines 5 μm long, on low papillae

Ventral tube with 6 + 6 chaetae Only females known Genital plate with two microchaetae on anterior lid

H o l o t y p e No 3 V 1975/C-235 in the Canadian National Collection, Ottawa, one paratype in V G Marshall's collection, Pacific Forest Research Centre, Victoria, B C Further paratypes in author's collection

L o c u s t y p i c u s Canada, British Columbia Vancouver Island, about 2 5 km SW of Bamberton 300 m on left from the highway Victoria — Nanaimo on the SW slope of Mt Jeffrey. about 400 m a s l (123° 33' W 48° 34' 50" N) Soil sample from a *Arbutus menziesii* stand with *Pseudotsuga menziesii*, *Pinus*

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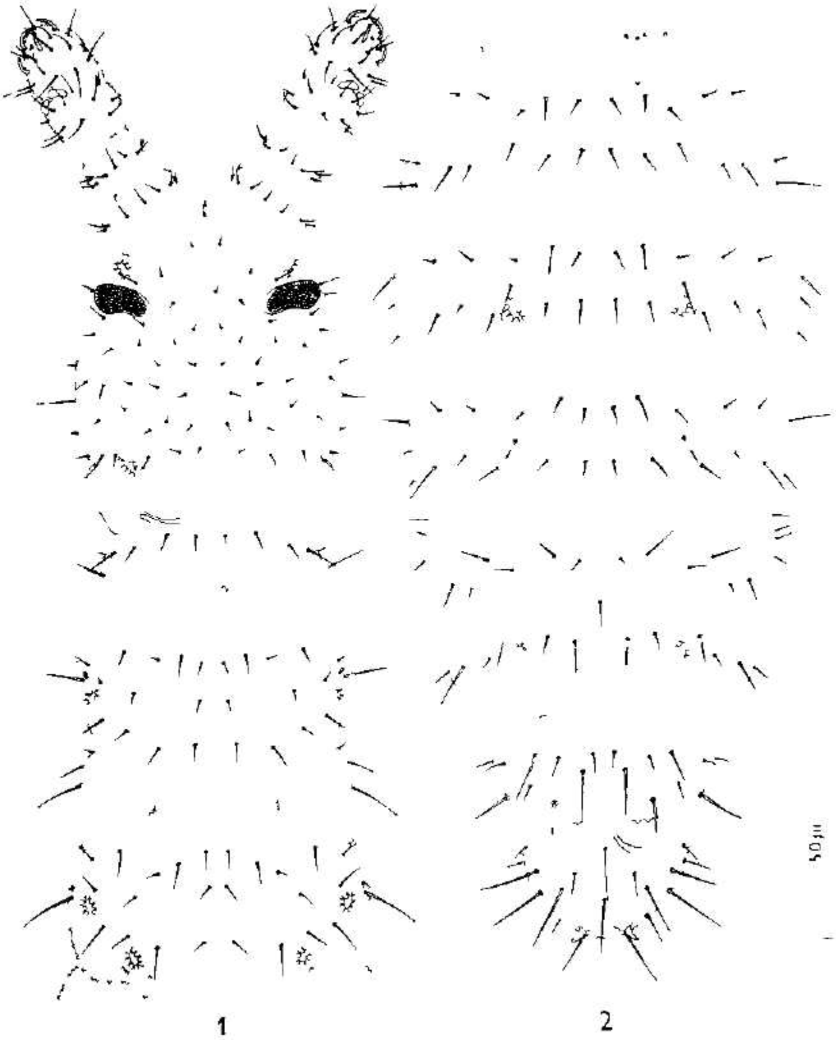
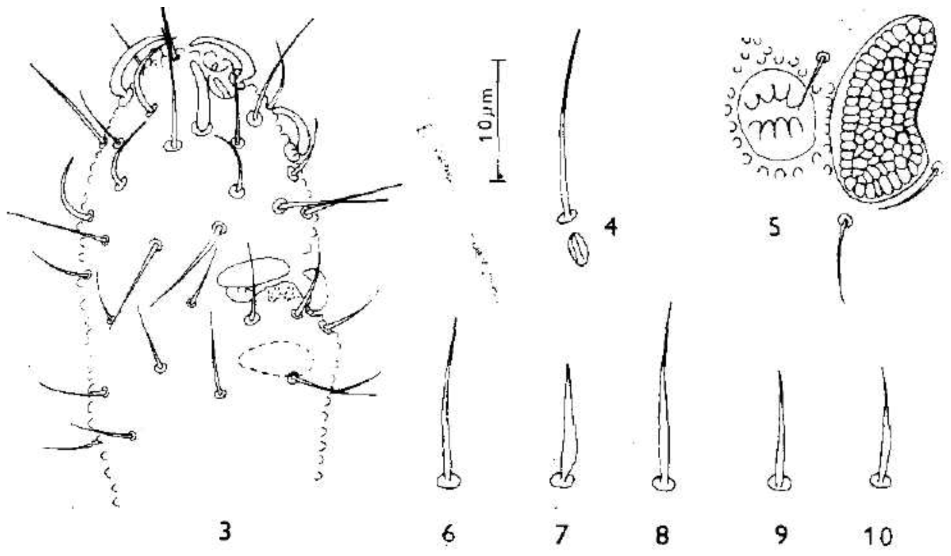
[1]) m_2 and m missing, [2]) p_1 slightly thickened (Fig 10) [3]) a missing [4]) m and m present, [5]) medial chaeta x present, [6]) a_2 missing, [7]) p_3 10 μm long flame-like sensilla (Fig 7)

contorta, Holodiscus discolor, Rosa gymnocarpa, Arctostaphylos columbiana Elymus glaucus, Dodecatheon hendersoni, Fragaria virginiana, Achilea milepholia Dark brown forest soil with moder. 3. V. 1975 8 specimens leg J. Rusek

D e r i v a t i o n o m i n i s: The name of the new species is derived from the terra typica British Columbia.



Figs 1–2 ***Multivesicula columbica*** gen n sp n 1 — dorsal chaetotaxy of head and thorax, 2 — dorsal chaetotaxy of abdominal segments I–VI Scale· Figs 1,2 50 µm



Figs. 3—10. *Multivesicula columbica* gen. n. sp. n.: 3 — dorsal chaetotaxy of antennal segments III and IV; 4 — lateral sensilla s and sensory rod s' from mesonotum; 5 — postantennal organ and pseudocellus; 6 — chaeta p_1 from abdominal tergite V; 7 — sensilla p_3 from abdominal tergite V; 8 — chaeta p_5 from abdominal tergite V; 9 — chaeta p_3 from abdominal tergite II; 10 — chaeta p_3 from abdominal tergite III. Scale: Figs. 3—10: 10 μm.

Multivesicula puctata sp. n.

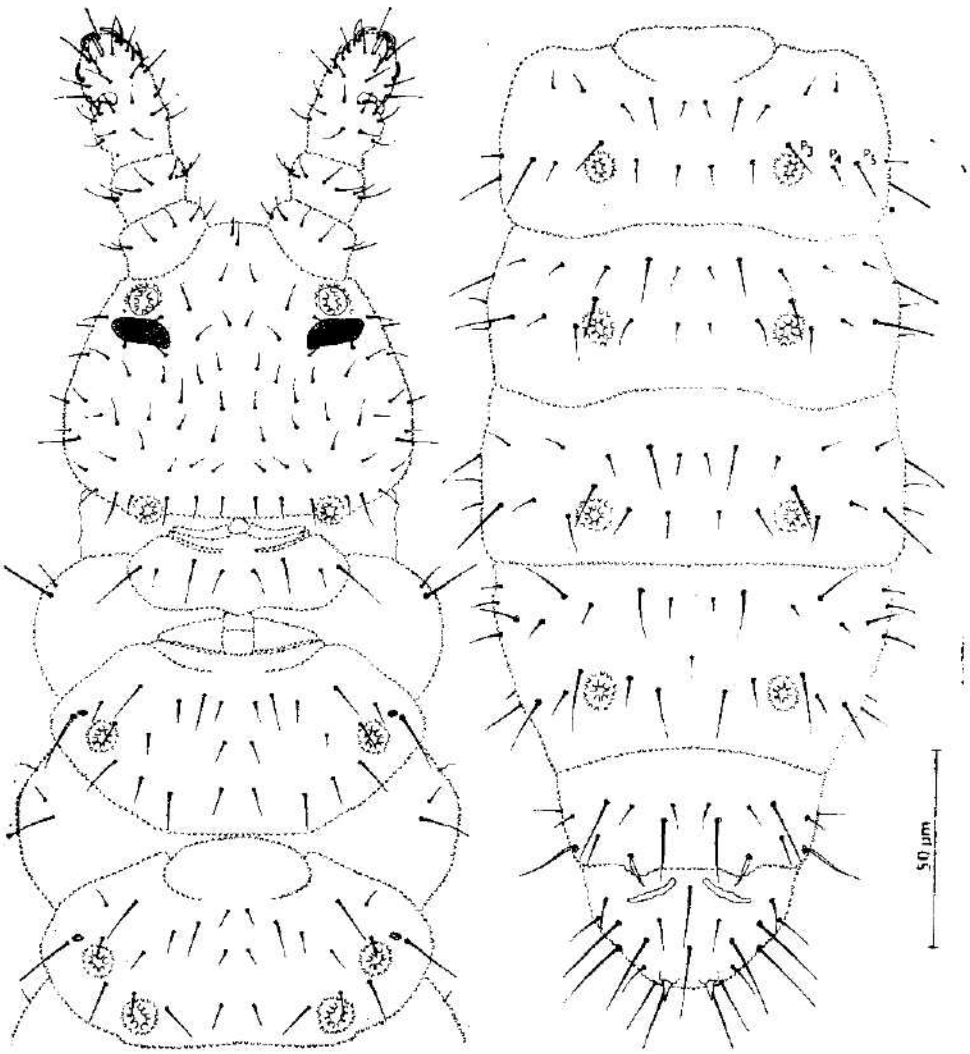
(Figs. 11—18)

Diagnosis: Body 425 μm long. White. Lateral sensilla s on meso— and metanotum thin. Sensilla p_3 on abdominal tergite V flame-like thickened. Chaeta m_4 missing on abdominal tergite I. Anal lobes with chaeta l'_2. Postantennal organ with about 110 vesicles lying in four to seven irregular rows. Formula of pseudocelli 11/012/11111. Only females known.

Description: Body elongated, 425 μm long and 110 μm wide (Figs. 11, 12). White . Granulation on whole body fine, on lateral parts and medial strip on notes and tergites slightly coarser. Dorsum of head and abdominal tergite V with very fine granulation, granules about 0.5—1 μm in diameter here. Most coarse granulation occurs on last abdominal tergite. Chaetae well differentiated into micro— and macrochaetae (Figs. 11, 12). Longest chaetae on last abdominal tergite (20 μm). Dorsal chaetotaxy as in following formula (Figs. 11, 12):

	I	II	III	I	II	III	IV	V
a	—	10	10	10	10	10	8[2])	8[5])
m	8	6[1])	6	—	2	2	4[3])	—
p	—	8	8	10	10	10	11[4])	8[6])
pl	2	3	3	2	3	3	6	1

[1]) m_2 and m_3 missing, [2]) a_5 missing, [3]) m_4 and m_5 present, **[4]) medial chaeta x present,**
[5]) a_2 missing, [6]) p_3 10 μm long flame-like sensilla (Fig. 17)



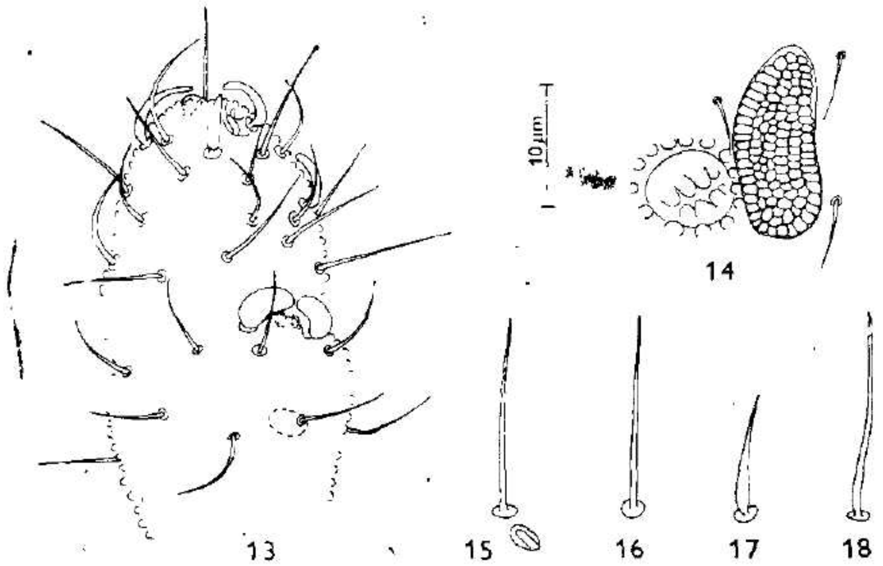
11 12

Figs. 11–12. ***Multivesicula punctata*** sp. n.: 11 – dorsal chaetotaxy of head and thorax; 12 – dorsal chaetotaxy of abdominal segments I–VI. Scale: Figs. 11, 12: 50 µm.

Lateral sensilla s on meso— and metanotum thin, setaceous, 15 µm long (Fig. 15). Sensory rod s' on meso– and metanotum 2 µm long, in a shallow pit (Fig. 15). Anal lobes with chaeta l'_2.

Pseudocelli circular, 8 µm in diameter, with star-like centre (Fig. 14). Number and arrangement of pseudocelli (Figs. 11, 12): 11/012/11111. Pseudocelli on mesonotum lateral between chaetae p_5 and m_5.

Antenae shorter than head (65 : 80 µm). Lengths of antennal segments I : II : : III : IV as 15 : 15 : 15 : 20 µm. Antennal segments IV with four thickened sensillae a—d, two small sensory rods f and g and one apical globular papilla (Fig. 13). Sensillae a—d with very small basal heel. Antennal organ III (Fig. 13). consists of two small sensory rods concealed behind ingumental fold and two thick sensory clubs bent toward each other. Thick sensory club present on ventral side of antennal segment III (Fig. 13).



Figs. 13—18. *Multivesicula punctata* sp. n.: 13 — dorsal chaetotaxy of antennal segments III and IV; 14 — postantennal organ and pseudocellus; 15 — lateral sensilla s and sensory rod s' from mesonotum; 16 — chaeta p_2 from abdominal tergite V; 17 — sensilla p_3 from abdominal terite V; 18 — chaeta p_5 from abdominal terite V. Scale: Figs. 13—18: 10 µm.

Postantennal organ (Fig. 14) 15 µm long and 7 µm wide. It consists of about 110 simple vesicles lying in four to seven irregular longitudinal rows. Peripheral vesicles longer than inner ones.

Legs short, without clavate tibiotarsal hairs. Claw without teeth, 10 µm long. Empodial appendage rudimentary, 2 µm long.

Abdominal tergite IV without transversal groove. Abdominal tergite V with thickened, flame-like sensilla p_3 (Fig. 17). Abdominal tergite VI with two crescentic ridges anteriorly and two anal spines (Fig. 12). Anal spines 5 µm long, on low papillae.

Ventral tube with 6 + 6 chaetae. Only females known. Genital plate with two microchaetae on anterior lid.

Affinities: The new species differs from *Multivesicula columbica* gen n. sp. n. clearly by the higher number of pseudocelli. In *M. punctata* are pseudocelli present also on abdominal tergites I and III, whereas in *M. columbica* there are absent on these tergites. Differences from other *Multivesicula*-species are given in the key on the end of this paper.

Holotype No. 3. V. 1975/C—235 in the Canadian National Collection, Ottawa, one paratype in V. G. Marshall's collection, Pacific Forest Research Centre. Victoria, B. C. Further paratypes in author's collection.

L o c u s   t y p i c u s: The same as for *Multivesicula columbica* gen. n. sp. n. 3. V. 1975 19 specimens leg. J. Rusek.

D e r i v a t i o   n o m i n i s: The name of this new species is derived from the high number of pseudocelli. It is the one representative of *Multivesicula*, which has pseudocelli present also on abdominal tergites I and III.

Multivesicula dolomitica sp. n.

(Figs. 19–25)

D i a g n o s i s: Body 540 μm long. White. Lateral sensilla s on meso— and metanotum thin. Sensilla p_3 on abdominal tergite V flame-like thickened. Chaeta m_4 missing on abdominal tergite I. Anal lobes with chaeta l'_2. Postantennal organ narrow, with about 60 vesicles lying in three, to four rows. Formula of pseudocelli 11 012/01011. Only females known.

D e s c r i p t i o n: Body elongated, 540 μm long and 110 μm wide (Figs. 19, 20). White. Granulation on whole body fine, on lateral parts and medial strip on notes and tergites slightly coarser. Dorsum of head and abdominal tergite V with very fine granulation, granules about 0.75—1 μm in diametr here. Most coarse granulation occurs on last abdominal tergite. Chaetae well differentiated into micro— and macrochaetae (Figs. 19. 20). Longest chaetae occur on last abdominal tergite (23 μm). Dorsal chaetotaxy as in following formula (Figs. 19, 20):

	I	II	III	I	II	III	IV	V
a	—	10	10	10	10	10	8[2])	8[5])
m	8	6[1])	6	—	2	2	4[3])	—
p	—	8	8	10	10	10	11[4])	8[6])
pl	2	3	3	2	3	3	6	1

Lateral sensilla s on meso— and metanotum thin. setaceous, 17 μm long (Fig. 23). Sensory rod s′ on meso— and metanotum 2 μm long, in a shallow pit (Fig. 23). Anal lobes with chaeta l'_2.

Pseudocelli circular, 8 μm in diameter, with star-like centre (Fig. 22). Number and arrangement of pseudocelli (Figs. 19, 20): 11/012/01011.

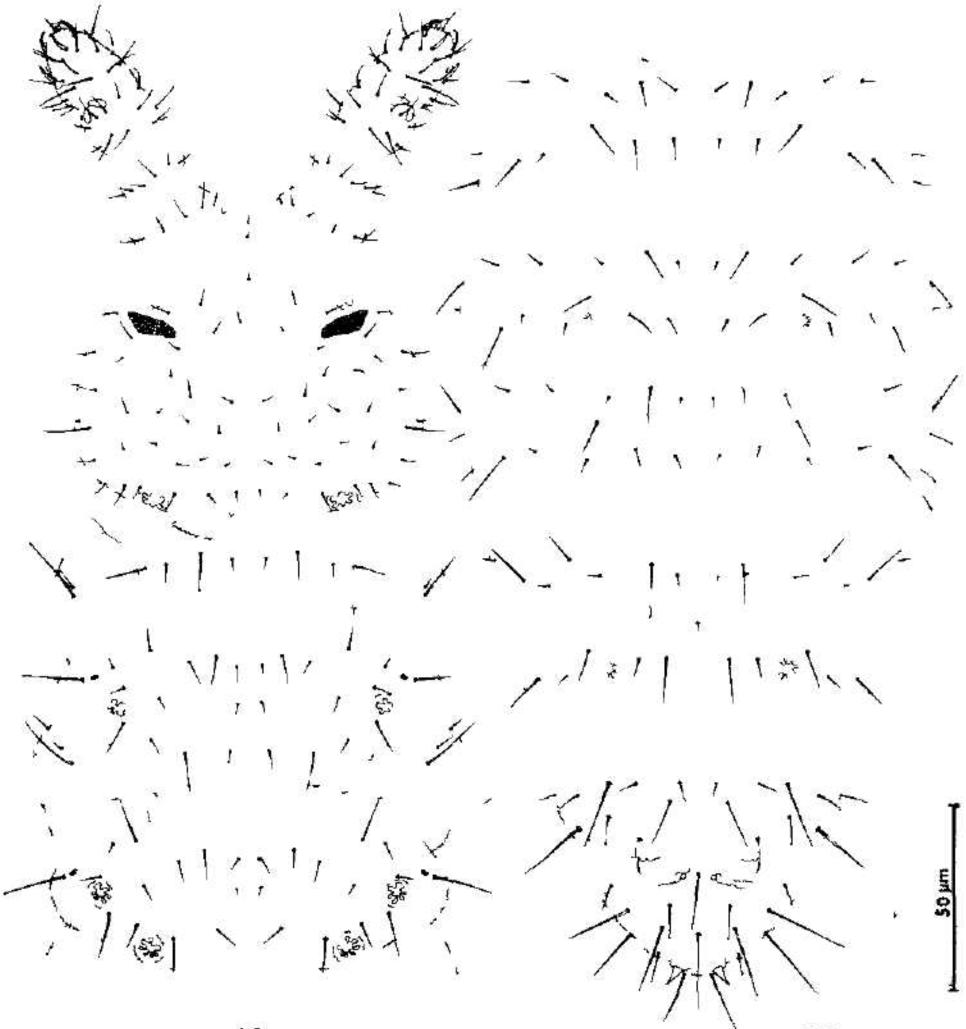
Antennae shorter than head (70 : 85 μm). Lengths of antennal segments I : : II : III : IV as 15 : 15 : 15 : 25 μm. Antennal segment IV with four thickened sensillae a—d, two small sensory rods f and g and one apical globular papilla (Fig. 21). Sensillae a—d with small basal heel. Antennal organ III (Fig. 21) consists of two small sensory rods concealed behind integumental fold and two thick sensory clubs bent toward each other. Thick sensory club present on ventral side of antennal segment III (Fig. 21).

Postantennal organ (Fig. 22) 15 μm long and 5 μm wide (measured in the wides part). It consists of about 60 simple vesicles lying in three parallel rows in the medial two thirds, and more or less irregulary lying vesicles in the widest lateral third. Peripheral vesicles larger than in the inner part of postantennal organ.

Legs short, without clavate tibiotarsal hairs. Claw without teeth, 12 μm long. Empodial appendage rudimentary, 1.5 μm long.

Abdominal tergite IV without transversal groove. Abdominal tergite V with thickened sensilla p_3 (Fig. 24). Abdominal tergite VI with two crescentic ridges

[1]) m_2 and m_3 missing, [2]) a_5 missing, [3]) m_4 and m_5 present, [4]) medial chaeta x present, [5]) a_2 missing, [6]) p_3 10 μm long flame-like sensilla (Fig. 24)



19 20

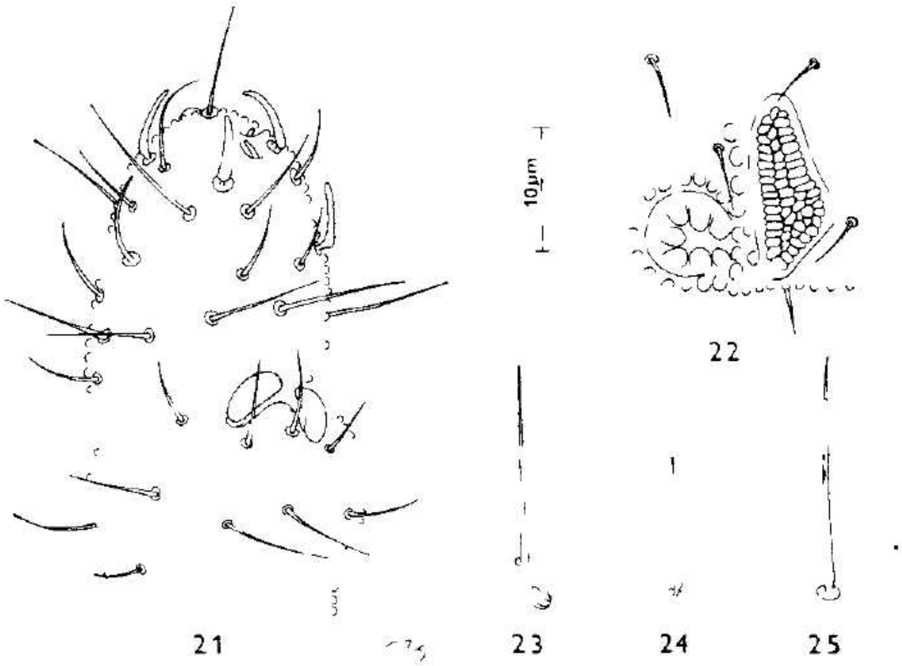
Figs 19—20 *Multivesicula dolomitica* sp n 19 — dorsal chaetotaxy of head and thorax, 20 — dorsal chaetotaxy of abdominal segments I—VI Scale Figs 19, 20 50 µm

anteriorly and two anal spines (Fig 20) Anal spines 5 µm long, on low papillae

Ventral tube with 6 + 6 chaetae Only females known Genital plate with two microchaetae on anterior lid

Affinities *Multivesicula dolomitica* sp n differs from all in this paper described species by the narrow postantennal organ with only about 60 vesicles All other northamerican *Multivesicula*-species have about 100 or more vesicles in postantennal organ *Multivesicula giljarovi* sp n, which has about 75 vesicles in postantennal organ, differs from *M. dolomitica* by the presence of chaeta m_4 on the abdominal tergite I.

Holotype No. 5. 7. 1975/C—382 in the Canadian National Collection, Ottawa, one paratype in V. G. Marshall's collection, Pacific Forest Research Centre, Victoria, B. C., further paratypes in author's collection.



Figs. 21—25. *Multivesicula dolomitica* sp. n.: 21 — dorsal chaetotaxy of antennal segments III—IV, 22 — postantennal organ and pseudocellus, 23 — lateral sensilla s and sensory rod s' from mesonotum, 24 — sensilla p_1 from abdominal tergite V, 25 — chaeta p_3 from abdominal tergite V. Scale: Figs. 21—25: 10 µm.

Locus typicus: Canada, Northwest Territories, about 35 km south of Inuvik, about 200 m on right from the higway on a dolomite outcrop about 370 m a. s. l. (68° 10′ N, 133° 28′ W), 20 soil samples à 10 cm^2 from a stony dark brown moist, 1—3 cm deep protorendzina with an open plant community. In the phytocenose dominanted lichens and mosses, from the higher plants grew *Saxifraga tricuspidata* and *Pulsatilla patens* in very low density here. 5. 7. 1975, 12 specimens leg. J. Rusek.

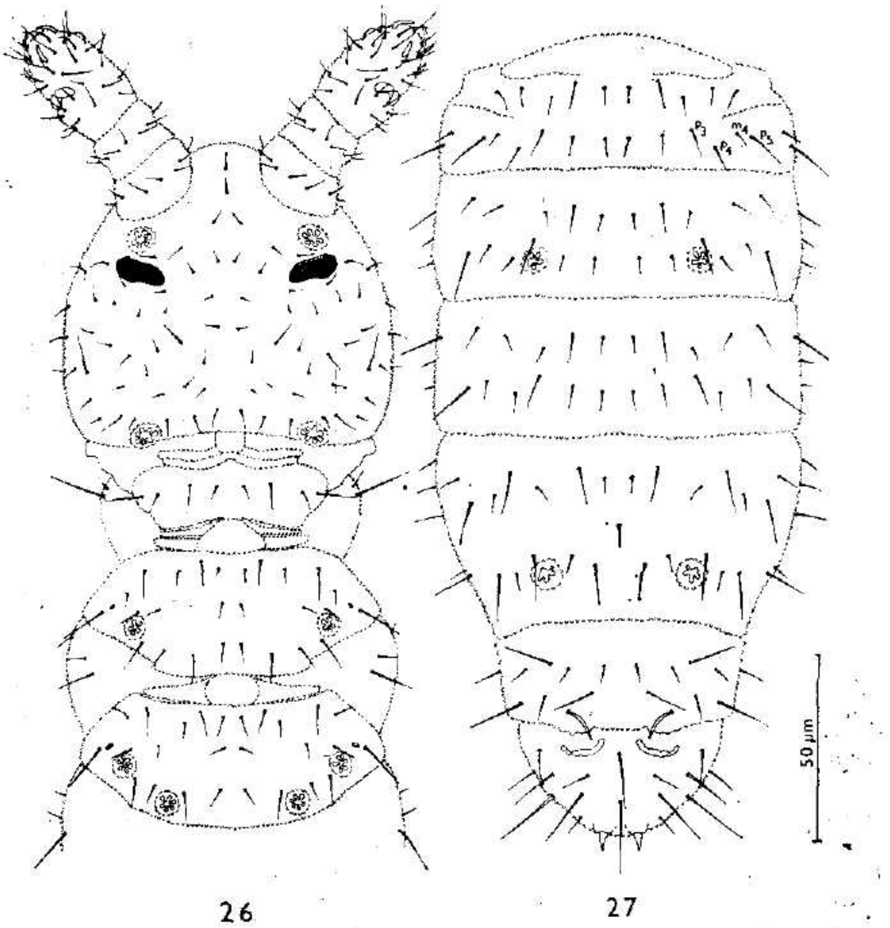
Derivatio nominis: The name of the new species is derived from the parental rock — dolomite of the locus typicus.

Multivesicula giljarovi sp. n.

(Figs. 26—32)

Diagnosis: Body 450 µm long. White. Lateral sensilla s on meso— and metanotum thin. Sensilla p_3 on abdominal tergite V slightly thickened. Chaeta m_4 present on abdominal tergite I. Anal lobes with chaeta l'_2. Postantennal organ with about 75 vesicles lying in four to six irregular rows. Formula of pseudocelli 11/012/01011. Only females known.

D e s c r i p t i o n: Body elongated, 450 μm long and 100 μm wide (Figs. 26, 27). White. Granulation on the whole body fine, on lateral parts and medial strip on notes and abdominal tergites slightly coarser. Dorsum of head and ab-

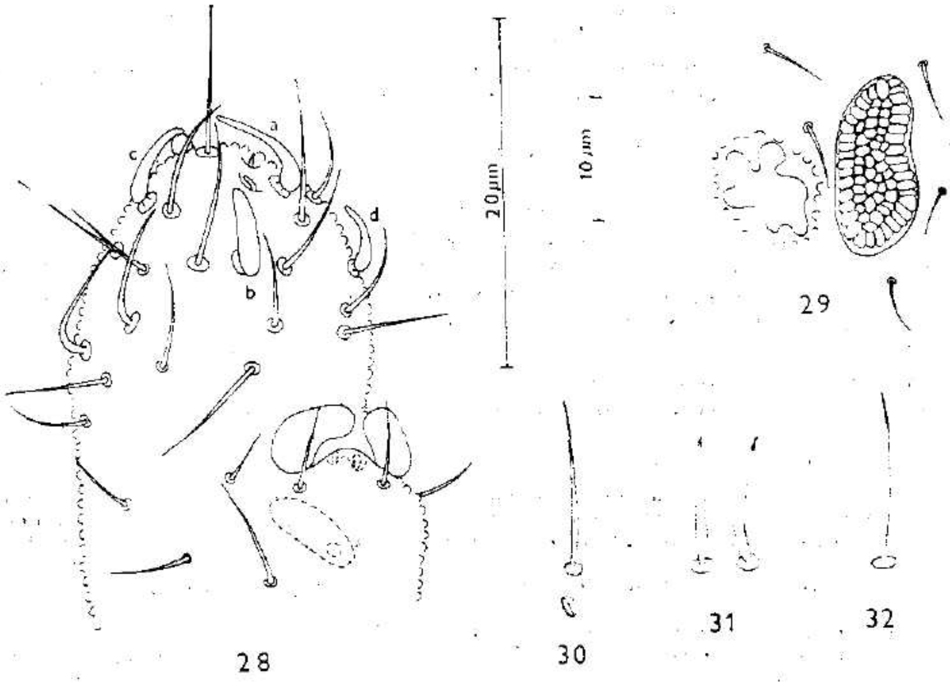


Figs. 26—27. *Multivesicula giljarovi* sp. n.: 26 — dorsal chaetotaxy of head and thorax; 27 — dorsal chaetotaxy of abdominal segments I—VI. Scale: Figs. 26, 27: 50 μm.

dominal tergite V with very fine granulation, granules about 0.5—0.75 μm in diameter here. Most coarse granulation occurs on last abdominal tergite. Chaetae well differentiated into micro— and macrochaetae (Figs. 26, 27). Longest chaetae occur on last abdominal tergite (18 μm). Dorsal chaetotaxy as in following formula (Figs. 26, 27):

	I	II	III	I	II	III	IV	V
a	—	10	10	10	10	10	10	8[4]
m	8	6	6	2[1]	2	2	4[2]	—
p	—	8	8	10	10	10	11[3]	8[5]
pl	2	3	3	2	3	3	5	1

Lateral sensilla s on meso- and metanotum thin, setaceous, 13 µm long (Fig. 30). Sensory rod s' on meso— and metanotum 2 µm long, in a shallow pit (Fig. 30). Anal lobes with chaeta l'_2.



Figs. 28—32. ***Multivesicula giljarovi*** sp. n.: 28 — dorsal chaetotaxy of antennal segments III—IV; 29 — postantennal organ and pseudocellus; 30 — lateral sensilla s and sensory rod s' from mesonotum; 31 — sensillae p_3 from abdominal tergite V; 32 — chaeta p_5 from abdominal tergite V. Scales: Fig. 28: 20 µm; Figs. 29—32: 10 µm.

Pseudocelli circular, 9 µm in diameter, with star-like centre (Fig. 29). Number and arrangement of pseudocelli (Figs. 26, 27): 11/012/01011. Pseudocelli on mesonotum lateral between chaetae m_5 and p_5.

Antennae shorter than head (65 : 85 µm). Lengths of antennal segments I : II : : III : IV as 15 : 15 : 15 : 20 µm. Antennal segment IV with four thickened sensillae a—d, two small sensory rods f and g and one globular apical papilla (Fig. 28). Sensillae a—d with small basal heel. Antennal organ III (Fig. 28) consists of two small sensory rods concealed behind integumental fold and two thick sensory clubs bent toward each other. Thick sensory club present on ventral side of antennal segment III (Fig. 28).

[1] m_4 present, [2] m_4 and m_5 present, [3] medial chaeta x present, [4] a_2 missing, [5] p_3 11 µm long, slightly thickened sensilla (Fig. 31)

Postantennal organ (Fig. 29) 14 μm long and 6 μm wide. It consists of about 75 simple vesicles lying in 4—6 irregular rows Peripheral vesicles larger than inner ones.

Legs short, without clavate tibiotarsal hairs. Claw without teeth, 11 μm long. Empodial appendage rudimentary, 1.5 μm long.

Abdominal tergite IV without transversal groove. Abdominal tergite V with slightly thickened sensilla p_3 (Fig. 31). Abdominal tergite VI with two crescentic ridges anteriorly (Fig. 27), and two anal spines. Anal spines 5 μm long, on low papillae.

Ventral tube with 6 + 6 chaetae. Only females known. Genital plate with two microchaetae on anterior lid.

Affinities: *Multivesicula giljarovi* sp. n. differs from all described *Multivesicula*-species by the presence of chaetae m_4 on abdominal tergite I. Further differences are given in the key to the described species.

Holotype No. 23. V. 1973 A-204 and one paratype in the author's collection.

Locus typicus: USSR, Siberia, near Lake Baikal, about 20 km before Bol'šaja Rečka on the road from Irkutsk to Listvjanka. Soil sample from a forest stand dominated by *Betula* sp. and *Pinus cembra* and with *Rhododendron dahuricum* in understory. Soil type: brown forest soil with thick layer of moder. moist. 23. 5. 1973 2 specimens leg. J. Rusek.

Derivatio nominis: The new species is dedicated to academician Prof. Dr. M. S. Giljarov, a well known soil zoologist and one of the founders of this branch of sience, on the occasion of his 70th birthday.

Key to the described *Multivesicula*-species

1. Pseudocelli present on all abdominal tergites; repartition of pseudocelli: 11 012/11111 (Figs. 11, 12). Abdominal tergite I without chaeta m_4 (Fig. 12). Postantennal organ wide, with about 110 simple vesicles (Fig 14) (British Columbia) *Multivesicula punctata sp. n.*

—. Abdominal tergites I and III without pseudocelli, repartition of pseudocelli 11 012 01011 2

2. Abdominal tergite I with chaeta m_4 (Fig 27). Postantennal organ with about 75 simple vesicles (Fig. 29). Sensilla b on antennal segment IV conspiciously thickened (Fig. 28) (Siberia) *Multivesicula giljarovi* sp n

—. Chaetae m_4 missing on abdominal tergite I. . . . . 3.

3. Postantennal organ narrow, with about 60 simple vesicles (Fig. 22). Northwest Territories) *Multivesicula dolomitica* sp. n.

—. Postantennal organ wide, with about 100 simple vesicles (Fig. 5). (British Columbia) *Multivesicula columbica* sp. n

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Věst. čs. Společ. zool., 46: 45—55, 1982

Bezirksmuseum Tachov

QUALITATIVE UND QUANTITATIVE ZUSAMMENSETZUNG DER WINTERLICHEN VÖGELSYNUSIEN IN BIOTOPEN EINER KLEINEN STADT

Pavel ŘEPA

Eingegangen am 22. März, 1980

Abstract: The author carried out during the winter-seasons since December 1974 untill February 1978 a counting of the birds on transects in the town Tachov in Southwest-Bohemia (14 000 inhabitans). In the following study he gives the data about density, diversity and equitability of winter bird-synusies in the town itself, its cotage quarters, new dwelling development, in the parks inside the town and in those of close surroundings He also brings the data about the presence of singular species in the synusies. It was found out that the density of birds in winter is in the little town distinctly minor than in bigger ones and the cities.

EINLEITUNG

Diese Arbeit knüpft an vorhergehende Analyse der Brutsynusien in einzelnen Biotopen der städtischen Umwelt in der kleinen Stadt Tachov in Südwestböhmen (Řepa 1981) an. In vorliegender Arbiet wird die Aufmerksamkeit der Zusammensetzung der Vögelsynusien in der Wintersaison gewidment. Wenn die Angaben uber die Vogelwelt der kleineren und kleinen Städte in der ornithologischen Literatur eine ziemliche Seltenheit darstellen, so fehlen sie aus der Winterperiode überhaupt. Auch die Studien über die winterlichen Vögelgesellschaften der grossen Städte sind sehr rar (Erz 1964, Haarman 1971, 1974, Hudec 1976).

BESCHRIEBUNG DES ERFORSCHTEN RAUMES

Die Stadt Tachov (14 000 Einwohner) liegt in Südwestböhmen, in Seehöhe von 490—540 m, am Fuss des östlichen Kammes des Gebirges Český les. Eine ausführlichere Beschreibung der Stadt findet man in der obenerwähnten vorhergehenden Arbeit (Řepa 1981). Zur Verfolgung wurden die gleichen Biotope wie in der Brutperiode ausgewählt:

Neue Siedlung: Fläche cca 32 ha. Sie liegt am Stadtrand und besteht aus 12 Wohnblöcken, unter diesen liegen Rasen und Fahrwege

Villenverbauung: Einstockige Gebaude, Einfamilienhäuser mit Obstbaumgarten Strassen mit einer schwachen Verkehrsfrequenz.

Villenverbauung am Stadtrand: Zwei am Stadtrand verlaufende Gassen Die Häuser und Kleingärten sind von demselben Character wie im vorhergehenden Biotop.

Stadtparke: 1. Horní-Park. Fläche cca 8 ha, in der Nachbarschaft befinden sich eine Villenverbauung und neue Siedlung. Durch den Park läuft eine Fahrbahn. Es gibt hier einen Omnibusbahnhof Die eigentlichen Parkflächen bestehen aus Rasen mit Asphaltwegen, die durch Reihen von mittelalten Baumen gesaumt sind Eine starke Frequenz sowohl des Kraftwagen- als auch des Passantenverkehrs 2 Vaclavský-Park Flache cca 3,5 ha, inmitten der Villen Bestehend aus Rasen mit einem zerstreuten Bestand von alten mächtigen Bäumen. Frequenz des Strassenvrkehrs in den anliegenden Strassen massig, die des Passantenverkehrs stark 3 Park Oddechu Flache 16 ha, von einer Villenverbauung umgeben Der Park besteht vor allem aus alten Baumen Frequenz des Kraftverkehrs in den anliegenden Strassen schwach, die des Passantenverkehrs im Park mittelmassig

Stadtanliegende Parke 1 Světecky-Park Flache etwa 100 ha Mit der Stadtverbauung, mit Wiesen und Feldern und auch mit einem Kiefernwald benachbart Den Park bilden alte Baume, die das Wegnetz saumen Unter ihnen befinden sich kleine feuchte Wiesen 2 Park an der Mineralquelle Flache cca 14 ha Er ist gebildet durch eine Allee alter Baume an dem durch ein Feld von der Stadt laufenden Weg In die Untersuchung schloss ich auch den Erlen — und Weidenbush entlang Seitenarmes des Flusses Mze ein, das parallel mit der Strasse lauft

METHODIK

Die Vogel wurden an Transekten (Šťastný 1974) gezahlt Drei von diesen Transekten wurden durch die Stadteile gefuhrt, welche auch fruher, in der Brutperiode, verfolgt wurden (Řepa 1981) Gesamtlange der Transekte betrug 7450 m, 950 m davon kamen auf neue Blockansiedlung, 1000 m auf Villen am Rande und 2800 m im Innern der Stadt, 800 m auf stadtische und 1900 m auf stadtanliegende Parke Die Beobachtungen und Zahlungen wurden immer in Dezember, Januar und Februar angestellt und zwar von 1974 bis 1978, also wahrend der vier Winterperioden Jeder Transekt wurde dreimal monatlich abgezahlt, insgesamt also neunmal in jeder Winterperiode Breite des Transekts betrug immer 50 m

Die angesammelten Angaben wurden fur alle vier Winter zusammen bewertet Es wurde Densitat (in Ex auf 10 ha), Dominanz und Frequenz des Vorkommens ermittelt (Palmgren 1930) Ferner wurde Index der Diversitat und Äquitabilitat festgestellt (Odum 1977) Zum Zweck des Vergleichs der qualitativen Zusammensetzung der Synusien wurden Sorensensche Indexe berechnet (Balogh 1956) in den Vergleich wurden dabei nur Arten mit der Dominanz uber 2% einbezogen (vglch Jablonski 1964) Zum Vergleich der quantitativen Zusammensetzung der Synusien wurde der Index von Renkonen (Balogh 1956) angewandt Nach der Dominanzstufe wurden die Arten in dominante (uber 5%), influente (2—5%), und accesorische (unter 2%) aufgeteilt

ERGEBNISSE

Die Angaben uber die Zusammensetzung der winterlichen Vogelsynusien findet man in den Tab 1—3 In den Parken beobachtete man, ebenso wie in der Brutperiode, bedeutende Unterschiede in der Zusammensetzung der Vogelsynusien die zweifellos von der Zusammensetzung und Struktur der Baumschicht und hauptsachlich von der Lage des Parks in der Stadt abhangig sind Ich fuhre deshalb die Ergebnisse fur jeden Park getrennt an Aus Platzmangel gebe ich zahlenmassige Werte der Densitat, Dominanz und Frequenz nur bei den Arten an derer Dominanz 1% ubersteigt, die übrigen Arten werden nur aufgenannt In der Tab 4 sind die Angaben uber Gesamtdensitat Gesamtzahl der festgestellten Arten, Diversitat und Aquitabilitat fur alle Biotope zusammengefasst

Die wenigsten Arten wurden in der neuen Blockansiedlung in kleineren innerstadtischen Parken (Horni und Vaclavsky) und im stadtanliegenden Park bei der Mineralquelle angetroffen Mehr Vogelarten gab es im Villenviertel am Rande der Stadt und im grossten Park (park Oddechu), noch mehr im Villenviertel innerhalb der Stadt und am meisten im stadtanliegenden Park Světecky Der Unterschied in der Artenzahl in beiden stadtanliegenden Parken ist ohne Zwiefel durch ihre sehr verschiedene Grosse gegeben (Světecky-Park 100 ha bei der Mineralquelle 14 ha) Diesen Unterschied in der Artenzahl konnte man bereits in der Brutperiode beobachten, aber im Winter wurde er noch deutlich grosser Der Park bei der Mineralquelle besteht aus einem

Tab 1 Zusammensetzung der Wintersynusien in den bebauten Stadtteilen Die Zahlangaben werden nur fur Arten mit Dominanz uber 1 % angefuhrt

Art	neue Seidlung			Biotop Villenverbauung am Stadtrand			Villenverbauung innerhalb der Stadt		
	De	Do	Fr	De	Do	Fr	De	Do	Fr
Perdix perdix	0,4	1,5	6	—	—	—	—	—	—
Streptopelia decaoto	0,2	1,1	28	2,0	2,1	21	7,0	10,2	93
Falco tinnunculus	0,4	2,3	34	—	—	—	—	—	—
Parus major	0,2	1,2	3	11,8	12,8	100	3,2	4,7	96
Parus caeruleus	—	—	—	5,4	5,5	84	1,2	1,8	80
Sitta europaea	—	—	—	1,0	1,1	25	—	—	—
Turdus merula	0 2	1,3	25	6 0	6,5	71	3,2	4,7	100
Turdus pilaris	—	—	—	1,0	1,1	6	—	—	—
Galerida cristata	1,0	10,0	37	—	—	—	—	—	—
Carduelis chloris	0,2	1,1	9	—	—	—	1,0	1,5	61
Cardeulis spinus	—	—	—	1,2	1,3	6	—	—	—
Pyrrhula pyrrhula	0,4	1 5	3	—	—	—	0,8	1,3	58
Passer domesticus	17,6	84,0	100	60,6	65,5	100	50,2	72,5	100

Arten mit Dominanz unter 1 %

Neue Siedlung *Corvus corone, Parus caeruleus, Carduelis carduelis, Fringilla coelebs Emberiza citrinella*

Villenverbauung am Stadtrand *Buteo buteo, Dendrocopos major Pica pica Sturnus vulgaris, Parus palustris, P montanus Aegithalos caudatus, Pyrrhula pyrrhula, Emberiza citrinella*

Villenberbauung innerhalb der Stadt *Falco tinnunculus, Picus viridis, Dendrocopos major, Corvus corone, Pica pica, Parus palustris, Aegithalos caudatus Sitta europaea Troglodytes troglodytes, Sturnus vulgaris Turdus pilaris, Erithacus rubecula, Galerida cristata, Carduelis carduelis, C cannabina, Fringilla coelebs, Emberiza citrinella Passer montanus*

Erklarungen De — Densitat (Ex pro 10 ha), Do — Dominanz, Fr — Frequenz

engen Streifen der Baumbestande, der von Feldern umgeben ist und daher allen ungunstigen Witterungseinflussen, dem Wind und Frost, mehr ausgesetzt Seine Besiedlung durch Vogel ist infolge aller dieser Umstande im Winter sehr arm Interessant ist dass im grossen stadtanliegenden Park Světecky mehr Arten festgestellt wurden als im Villenviertel innerhalb der Stadt Dast ist sicher darauf zuruckzufuhren, das bestimmte Vogelarten auch im Winter die Nahe des Menschen meiden und hochstens in stadtnahen Parken anzutreffen sind Weitere Arten dringen zwar in die Stadt hinein, halten sich aber nur in engen Raumen auf die vom Rande der Stadt nicht allzu entfernt sind Daher weist der grosste innerstadtische Park Oddechu, der dem Stadtrand am nachsten liegt, eine verhaltnismassig hohe Zahl der Arten in der Wintersynusie auf

Manche schreuere Vogel die in die Stadt eindringen, halten sich auch nur in grosseren Garten der Villenviertel auf und meiden die stark von Menschen frequentierten innerstadtischen Parke Horni und Vaclavsky Neue Blockansiedlung hat ebenso wie in der Brutperiode, die artenarmste Vogelsynusie Auch das relativ rauhe windige Mikroklima, das durch einseitige Orientierung der Hauserblocks und fast vollige Absenz der Baume verursacht ist durfte dazu beitragen

Gesamtdensitat der Vogelsynusie ist ziemlich hoch in Villenvierteln namentlich beim Stadtrand, und dann im Park Horni Bedeutend niedriger ist sie im Park-Oddechu und Světecky-Park, am niedrigsten im Park der Mineralquelle und wie schon erwahnt, in der neuen Siedlung

Hohe Densitat ist hauptsachlich dort zu verzeichnen, wo sich im grosseren Masse die haufigste Art, Haussperling, aufhalt An Orten, wo er seltener vor-

Tab. 2. Zusammensetzung der Wintersynusien der Vögel in Stadtparken. Die Zahlenangaben werden nur für die Arten mit Dominanz über 1 % angeführt

Art	Horní-Park			Václavský-Park			Park-Oddechu		
	De	Do	Fr	De	Do	Fr	De	Do	Fr
Streptopelia decaocto	2,4	2,4	36	1,8	6,8	88	0,4	1,0	25
Dendrocopos major	—	—	—	—	—	—	0,4	1,0	26
Parus major	8,2	10,4	88	6,2	24,1	51	16,0	37,2	100
Parus caeruleus	3,0	3,7	61	3,0	11,8	24	3,6	8,6	82
Aegithalos caudatus	—	—	—	0,4	1,2	3	—	—	—
Certhia sp.	—	—	—	0,4	1,2	5	1,4	3,3	64
Sitta europaea	—	—	—	—	—	—	1,6	3,7	57
Turdus merula	1,4	1,7	33	1,0	4,3	13	5,2	12,2	86
Carduelis chloris	0,8	1,0	6	—	—	—	0,4	1,0	9
Pyrrhula pyrrhula	10,1	12,9	54	4,4	17,2	24	5,0	11,8	57
Passer domesticus	52,6	65,0	100	7,0	27,2	19	4,1	9,6	45
Passer montanus	—	—	—	0,6	2,5	3	0,6	1,6	9

Arten mit Dominanz unter 1 %:
Horní Park: *Dendrocopos major, Aegithalos caudatus, Certhia* sp. *Carduelis spinus, Fringilla coelebs, Passer montanus, Falco tinnunculus*
Václavský-Park: *Sturnus vulgaris, Aegithalos caudatus, Fringilla coelebs*
Park-Oddechu: *Picus viridis, Parus palustris, Parus ater, Turdus pilaris, Aegithalos caudatus, Fringilla montifringilla*

Tab. 3. Zusammensetzung der Wintersynusien der Vögel in den stadtanliegenden Parken. Die Zahlenangaben werden nur für die Arten mit Dominanz über 1 % angeführt

	Světecký park			Park an der Mineralquelle		
	De	Do	Fr	De	Do	Fr
Streptopelia decaocto	0,4	1,0	28	—	—	—
Dendrocopos major	0,4	1,0	50	—	—	—
Corvus corone	—	—	—	0,6	2,9	10
Parus major	4,3	25,0	100	5,6	28,0	86
Parus caeruleus	3,4	10,0	87	1,8	9,5	50
Parus palustris	0,4	1,0	36	0,6	3,2	17
Aegithalos caudatus	0,6	2,0	25	—	—	—
Sitta europaea	3,6	10,6	98	1,2	6,1	37
Certhia sp.	2,0	5,9	98	2,0	9,7	53
Troglodytes troglodytes	0,2	1,3	47	—	—	—
Turdus merula	2,2	6,4	87	0,4	2,5	23
Carduelis spinus	4,4	13,0	47	—	—	—
Carduelis carduelis	—	—	—	1,0	5,4	7
Pyrrhula pyrrhula	2,0	5,9	52	3,6	18,8	40
Fringilla coelebs	0,8	2,3	44	—	—	—
Emberizia citrinella	—	—	—	1,4	6,8	7
Passer montanus	0,2	1,0	28	—	—	—
Passer domesticus	2,8	8,0	47	—	—	—

Arten mit Dominanz unter 1 %:
Světecký-Park: *Phasianus colchicus, Pica pica, Garrulus glandarius, Sturnus vulgaris, Parus montanus, P. ater, Buteo buteo, Cinclus cinclus, Erithacus rubecula, Prunella modularis, Turdus pilaris, Regulus regulus, Coccothraustes coccothraustes, Carduelis chloris, Loxia curvirostra*
Park an der Mineralquelle: *Phasianus colchicus, Dendrocopos major, Pica pica, Corvus corone, Falco tinnunculus, Aegithalos caudatus*

Tab. 4. Wichtigste Daten über die Wintersynusien der Vögel in den erforschten Biotopen

Biotop	Zahl der Arten	Gesamtdensität (Ex. pro 10 ha)	Diversität	Äquitabilität
neue Siedlung	13	21,0	0,78	0,30
Villenverbauung am Stadtrand	19	1,31	1,31	0,44
Villenverbauung innerhalb der Stadt	27	79,0	1,25	0,38
Städtische Parke:				
Horní-Park	15	80,8	1,42	0,52
Václavský-Park	11	25,6	1,99	0,83
Park-Oddechu	22	43,2	2,06	0,67
Světecký-Park	37	37,0	3,09	0,85
Park an der Mineralquelle	15	20,0	2,08	0,77

kommt (Park Oddechu und stadtanliegende Parke), ist auch die Gesamtdensität niedrig.

Vergleichung der Synusien in der Parken Oddechu und Světecký zeigt, dass in der Densität der innerstädtischen und stadnahen Parken keine allzu grossen Unterschiede bestehen. Ausserordentlich niedrige Densität im Park bei der Mineralquelle ist vielleicht durch ungünstiges Mesoklima bewirkt. Niedrige Densität im Park Václavský dürfte durch allzu kleine Fläche des Parks verursacht sein, oder ist es nur eine zufällige Erscheinung.

Diversität und Äquitabilität der Synusie ist in den Parken allgemein deutlich höher als in anderen Biotopen. Eine einzige Ausnahme bildet der vom Haussperling besuchte Park Horní. Daraus ergibt sich, dass die Diversität und Äquitabilität der Wintersynusien vor allen Dingen durch die Höhe des Anteils von *Passer domesticus* beeinflusst wird.

Derselbe ist, wie schon mehrmals erwähnt, die bedeutendste Vogelart der Stadt im Winter; er übersteigt überall 5 % der Gesamtzahl der Vögel und in den bebauten Biotopen und in Park Horní ist er die weitaus häufigste Art. Ein weiteres bedeutendes Mitglied der winterlichen Avifauna von Tachov ist *Parus major*. Diese Art dominiert in allen Biotopen ausser der neuen Siedlung; in allen Parken ausser dem Horní bildet sie mehr als 25 % der Synusie. *Parus caeruleus* ist bereits weniger zahlreich, übersteigt dennoch 5 % der Dominanz in allen Parken (ausser dem Horní) und in der Villenverbauung am Stadtrand. Sie ist in allen Biotopen, einschliesslich der neuen Siedlung angetroffen worden. In allen Parken ist auch *Pyrrhula pyrrhula* dominant, die in einer kleinen Zahl auch in anderen Biotopen vorkommt. In allen Biotopen ist im Winter *Turdus merula* und *Streptopelia decaocto* anzutreffen. Die erste Art ist im Park Světecký, Oddechu und in der Villenverbauung am Stadtrand dominant; *S. decaocto* ist am zahlreichsten in der Umgebung ihrer regelmässiger Nachtlager (Park Václavský und einige Abschnitte der Villenverbauung innerhalb der Stadt).

Einige Arten wurden öffter nur in einem der verfolgten Biotope angetroffen. *Galerida cristata* gehört zu Dominanten der neuen Siedlung, *Sitta europaea* und *Certhia* sp (im Winter kann man beide Arten von *Certhia* kaum voneinander unterscheiden) dominieren in stadtanliegenden Parken. *Carduelis spinus* im Park Světecký und *Emberiza citrinella* im Park bei der Mineralquelle Wenn wir zu den obengenannten Arten noch *Aegithalos caudatus*, *Falco* *tinnunculus, Dendrocopos major, Parus palustris, Turdus pilaris, Carduelis chloris, Fringilla coelebs* und *Passer montanus* hinzurechnen, erhalten wir Verzeichnis von 18 Arten, die den Kern der winterlichen Avifauna der Stadt bilden.

Auf der Abb. 1 und 2 sind die Werte der Sörensenschen und Renkonenschen Indexe graphisch dargestellt, die zur Vergleichung der qualitativen und quantitativen Ähnlichkeit der winterlichen Vögelsynusien in der Stadt Tachov dienen können.

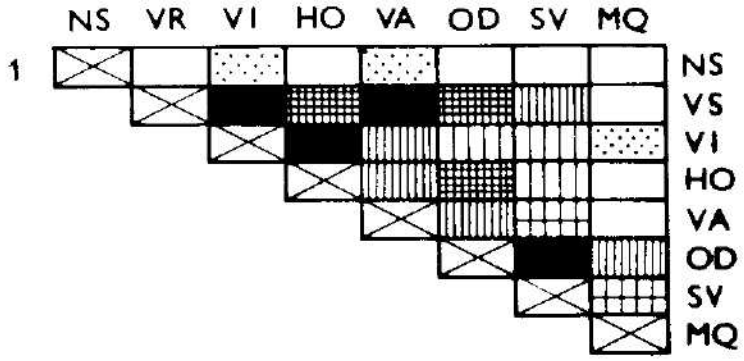

Abb. 1: Sorensensche Index, durch welche die qualitativen Zusammensetzung der Wintersynusien der Vögel zwischen den untersuchten Stadtbiotopen von Tachov verglichen werden.
Erklärungen: NS — neue Siedlung, VR — Villenverbauung am Standrand, VV — Villenverbauung innerhalb der Stadt, HO Horní - Park, VÁ — Václavský - Park, OD — Park - Oddechu, SV — Světecký - Park, MQ — Park an der Mineralquelle.
Deutung der Werte von Sørensenschen Indexen: volle Rechtecke — 81—90%, dicht karierte Rechtecke — 71—80%, dicht schrafierte Rechtecke — 61—70%, dünn karierte Rechtecke — 51—60%, dünn schrafierte Rechtecke — 41—50%, punktierte Rechtecke — 31—40%, leere Rechtecke — 0—30%.

Durch qualitative Synusienzusammensetzung unterscheidet sich von anderen Biotopen einerseits die neue Siedlung, anderseits der stadtanliegende Park bei der Mineralquelle. Es handelt sich um Biotope mit rauhesten klimatischen Be-

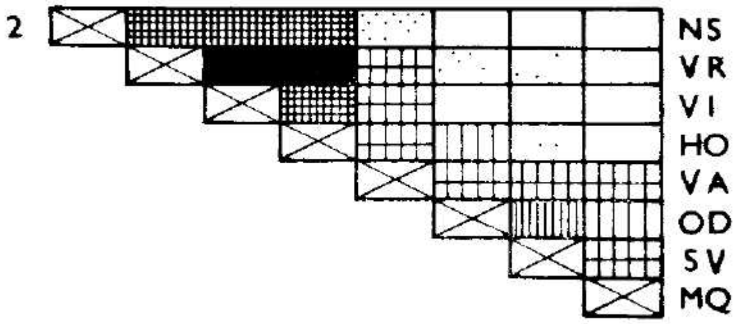

Abb. 2: Renkonensche Indexe zum Vergleich der quantitativen Zusammensetzung der Wintersynusien der Vögel unter einzelen Biotopen in Tachov.
Erklärungen siehe bei Abb. 1.

Tab. 5. Vertretung einzelner Arten in der Wintersynusien der vier städtischen Grundbiotope

Art	Biotop NS	VV	SP	SaP
Perdix perdix	+	–	–	–
Carduelis cannabina	–	+	–	–
Galerida cristata	+	+	–	–
Corvus corone	+	–	–	–
Carduelis carduelis, Emberiza citrinella	+	+	–	+
Streptopelia decaocto, Falco tinnunculus, Parus major, P. caeruleus, Turdus merula, Carduelis chloris, Pyrrhula pyrrhula, Fringilla coelebs, Passer domesticus	+	+	+	+
Dendrocopos major, Sturnus vulgaris, Parus palustris, Aegithalos caudatus, Sitta europaea, Turdus pilaris, Carduelis spinus, Passer montanus	–	+	+	+
Troglodytes troglodytes Erithacus rubecula, Buteo buteo	–	+	–	+
Picus viridis, Parus ater, Certhia sp.	–	–	+	+
Fringilla montifringilla	–	–	+	–
Phasianus colchicus, Pica pica, Garrulus glandarius, Cinclus cinclus, Prunella modullaris,Regulus regulus, Coccothraustes coccothraustes, Loxia curvirostra	–	–	–	+

Erklärungen: NS – neue Siedlung, VV – Villenverbauung, SP – Stadtparke, SaP – stadtanliegende Parke

dingungen. Die übrigen Biotope kann man auf zwei Gruppen aufteilen. Erstens sind es Park Oddechu und Park Světecký, dann übrige städtische Parke und Villenverbauungen. Unterschiede zwischen beiden Gruppen werden von Arten der ersten Gruppe verursacht, die weniger auf die Nähe des Menschen angepasst sind.

Die Ähnlichkeit der quantitativen Zusammensetzung der winterlichen Vögelsynusie ist bei den Biotopen am grössten, wo *Passer domesticus* Mehrheit der Population bildet. Es sind die Biotope mit Wohnhäusern und der Park Horní. Der Park Václavský bildet bereits einen Übergang zum Park Oddechu und dem von Světce. Der Park bei der Mineralquelle unterscheidet sich wiederum stark von allen anderen Biotopen.

Die höchsten Wert der Sörensenschen und Renkonenschen Indexe hat man zwischen dem Park Světecký und Park Oddechu festgestellt, die voneinander kaum 100 m entfernt sind. Beim Vergleich mit analogischen Daten aus der Brutperiode (Ř e p a 1981) scheint es, dass die Ähnlichkeit im Winter nicht nur von der Struktur der Baumbestände, sondern auch von ihrer gegenseitigen Lage abhängig sei.

Die Tab. 5 fasst das Vorkommen aller Arten in vier verfolgten Hauptbiotopen (neue Siedlungen, Villenverbauung, städtische und stadtanliegende Parke) zusammen. Sie bietet Möglichkeit die Stufe der Anpassung einzelner Arten auf die Nähe des Menschen im Winter festzustellen.

Wenn wir von einigen vereinzelt vorkommenden Arten absehen (*Buteo buteo, Perdix perdix, Corvus corone, Erithacus rubecula, Troglodytes troglodytes, Fringilla montifringilla, Carduelis cannabina*), dann können wir die Vögel der Wintersynusien auf fünf Gruppen aufteilen.

Die erste Gruppe bildet eine enzige Art — *Galerida cristata die* nur in verbauten Biotopen vorkommt. Die in die zweite Gruppe angehörenden Arten kommen in allen Biotopen vor. Einige von ihnen sind aber zahlreicher in Biotopen mit Gebauden *(F. tinnunculus, S. decaoto, C. chloris, C. carduelis, E. citrinella* und *P. domesticus)*, andere wiederum in Parken *(P major, P. caeruleus, P. pyrrhula)*. *T. merula* und *F. coelebs* finden sich ziemlich gleichmässig in allen Biotopen. Beim Vergleich mit den Daten aus der Brutperiode (Řepa 1981) können wir feststellen, dass alle konstanten Arten dieser Gruppe auch im Winter in dieselbe angehören. Dazu kommen noch jene Arten, die in der Brutperiode in der neuen Siedlung nicht festgestellt wurden *(P. major, P. caeruleus, C. carduelis, F. coelebs* und *E. citrinella)*.

Die Gruppe der Arten, die in allen städtischen Biotopen ausser der neuen Siedlung angetroffen wurden, bildet *D. major, Sturnus vulgaris, Parus palustris, A. caudatus, S. europaea* und *C. spinus*. Zum Unterschied von der Brutperiode beobachtet man in Winter begreiflicherweise Abwesenheit der Zugarten und ferner derer, die in die vorhergenannte Gruppe übergangen sind, und auch von *Picus viridis* und *Pica pica,* die im Winter nur in Parken vorkommen. Dagegen ist Zunahme von *Parus palustris* und *S. europaea* zu verzeichnen, die man in der Brutperiode nur in beiden Typen der Parke beobachtete, und von *A. caudatus* und *Turdus pilaris,* die nur in den stadtanliegenden Parken bruteten.

Die Gruppe der Arten, die im Winter Parktypen vorkommen, enthält *P. viridis, Parus ater* und *Certhia sp.* Der Grünspecht brütete auch in der Villenverbauung, dagegen Tannenmeise ist in der Brutperiode im Stadtbereich überhaupt nich angetroffen worden.

Die letzte Gruppe wird von Arten gebildet, die im Winter nur in den stadtnahen Parken auftreten. Es gehört hierher *Cinclus cinclus* und *Prunella modularis,* die in diesem Biotop auch in der Brutperiode angetroffen wurden, und ferner *Phasianus colchicus, Garrulus glandarius, Regulus regulus, Coccothraustes coccothraustes* und *Loxia curvirostra*, die während der Brutzeit in der Stadt überhaupt nicht vorgekommen sind.

Man kann also sagen, dass im Winter die stadtischen Vögelsynusien auch um einige Arten bereichert werden, die sich in die Nähe der menschlichen Behausungen verschieben.

DISKUSSION

Angaben über Winteravifauna der Städte, die mit ihrer Grösse etwa der Stadt Tachov entsprechen würden, habe ich in der zugänglichen Literatur nich gefunden. Ich vergleiche daher Ergebnisse meiner diesbezüglichen Forschungen mit den Angaben aus vergleichbaren Biotopen der grösseren und grossen Städte.

Die Artenzahl, die in Olsztyn (Okulewicz 1971) und Brno (Hudec 1976) festgestellt wurde, stimmt im ganzen mit unseren Daten aus Tachov gut überein. In den Villenvierteln von Olsztyn (Polen) hat man im Winter mehr Arten angetroffen als in Tachov; dagegen gibt Erz (1964) aus Kiel die gleiche Zahl an. In den städtischen Parken haben einige Autoren (Truszkowski 1963 in Pruskow, Schnebel 1969 in Uelzen, Wiehe 1976 in Braunschweig) höhere Artenzahlen als die von Tachov angegeben. Dagegen fand Hudec (1976) im städtischen Park von Brno eine analogische Artenzahl. Summe der Arten, die er in einem stadtanliegenden kleinem Wald festgestellt hat (Hudec 1976), liegt zwischen den in beiden Parktypen von Tachov ermittelten Werten.

Die Angaben über die Densität der Wintersynusien der Vögel gibt Hudec (1976) für alle von mir verfolgten Type der Biotope; Erz (1964) nur für Villenverbauung und Schnebel (1969) aus Uelzen, sowie Wiehe (1976) aus Braunschweig für städtische Parke. In allen Fällen waren vergleichbare Werte deutlich höher als die von Tachov.

Angaben über Diversität und Äquitabilität bringt nur Hudec (1976). In der neuen Blockhäusersiedlung und in der Villenverbauung waren diesbezügliche Werte in Brno bedeutend höher als in Tachov; dagegen bei den Parken ist kein wesentlicher Unterschied festgestellt worden.

Die Vertretung einzelner Arten in unseren neuen Siedlungen kann man auch sonst mit den Angaben von Hudec (1976) und auch von Okulewicz (1971) vergleichen. In Brno, Olsztyn und Tachov wurden vor allem die wichtigsten Winterarten der städtischen Synusien (*P. domesticus, P. major, P. caerulus* und *P. pyrrhula)* in ziemlich gleichem Ausmass angetroffen. Bei übrigen Arten können wir grössere Ähnlichkeit von Tachov mit Brno (Hudec 1976) als mit Olsztyn (Okulewicz 1971) beobachten.

Die winterlichen Vögelsynusien in Villenvierteln von Kiel (Erz 1964), Olsztyn (Okulewicz 1971) und Brno (Hudec 1976) hatten folgende gemeinsame Arten *P domesticus, S. decaocto, P. major, P. caerules, C. chloris, D. major, S. vulgaris, P. palustris, F. coelebs* und *Coloeus monedula*. Mit Ausnahme der letzgenannten Art, die in Tachov auch in der Brutperiode fehlt, wurden alle vorhergehenden auch in der Villenverbauung von Tachov festgestellt.

In städtischen Parken in Pruszkow (Truszkowski 1963), Uelzen (Schnebel 1969), Braunschweig (Wiehe 1976) und in Brno (Hudec 1976) wurden gemeinsame 10 Arten festgestellt *(S. vulgaris, P. major, P. caeruleus, P. palustris, S europaea, T. merula, C. chloris, C. spinus, P. pyrrhula* und *P. domesticus)*. Alle diesen Arten sind auch in städtischen Parken in Tachov angetroffen worden; auch alle dominanten Arten befinden sich unter ihnen.

Von den Arten, welche in verglichenen Parken dominant waren, wurden in städtischen Parken von Tachov *P. major, T. merula, C. chloris, P. domesticus* und *C. spinus* festgestellt. Bloss *Anas platyrhynchos*, die an kleinem See in Braunschweig überwinterte (Wiehe 1976), und zwar in einer solchen Menge, dass sie hier die häufigste Art darstellte, musste in Tachov wegen Mangel an geeignetem Biotop und vielleicht auch aus anderen Gründen fehlen.

Winterliche Aviafauna der stadtanliegenden Parke von Tachov lässt sich nur mit den Vögeln des stadtnahen Wäldchens bei Brno (Hudec 1976) vergleichen. Von 23 hier festgestellten Arten wurde Mehrzahl auch in den Parken von Tachov angetroffen.

Im ganzen kann man also eine gute Übereinstimmung der qualitativen Zusammensetzung der winterlichen Vögelsynusien in verfolgten Biotopen von Tachov mit diesbezüglichen Angaben aus anderen mitteleuropäischen Städten feststellen.

Wir sehen, dass der einzige grössere Unterschied zwischen einer kleine Stadt wie Tachov mit den verglichenen grösseren Städten in der Densität der winterlichen Vöglesynusien besteht. Das dürfte dadurch verursacht werden, dass bei kleinen Städten kein deutlicher Zufluss der Vögel aus der Umgebung ins Stadtinnere eintritt, wie es bei den grösseren Städten der Fall ist (vgl. Erz 1964, Schnebel 1966). Wahrscheinlich tritt auch im Mesoklima der kleineren Stadt im Winter keine so grosse Milderung ein, wie sie in grossen Städten zu beobachten ist. Ferner ist möglich, dass hier auch grössere Seehöhe von Tachov zum Ausdruck kommt.

ZUSAMMENFASSUNG

1. In Winterperiode (Dezember - Januar - Februar) wurde seit Dezember 1974 bis Februar 1978 durch Zählungen an festen Transekten die Zusammensetzung der Vögelsynusie an vier Hauptbiotopen (in neuer Siedlung, in Villenverbauung, städtischen und stadtanliegenden Parken) der kleinen Stadt Tachov (14 000 Einwohner) in Südwestböhmen festgestellt. Gesamtlänge der Transekte betrug 7450 m und jeder Abschnitt wurde dreimal monatlich abgezählt.
2. In der neuen Blockansiedlung sind 13 Arten angetroffen; durchschnittliche Densität der Synusie von 21 Ex auf 10 ha, Diversität 0,78; dominante Arten waren *Passer domesticus* und *Galerida cristata.*
3. In der Villenverbauung an Rändern der Stadt wurden 19 Arten, im Stadtinneren 27 Arten angetroffen, die Densität der Synusien war 93,4 Ex bzw. 90 Ex. auf 10 ha und Diversitat 1,31 bzw. 1,25. Dominante Arten waren hier *P. domesticus, P. major, P. caeruleus* und *T. merula.*
4. In drei städtischen Parken wurden 15, 11 und 22 Arten festgestellt. Die Densität schwankte von 25,6 bis 80,8 Ex. auf 10 ha, Diversität zwischen 1,42 und 2,06. Dominant waren hier *P. major, P. pyrrhula, P. domesticus, S. decaocto, P. caeruleus* und *T. merula.*
5. In zwei standanliegenden Parken sind 37 und 15 Arten angetroffen. Die Densität war 37 und 20 Ex. auf 10 ha, Diversität 3,09 und 2,08. Dominante Arten. *P. major, P. caeruleus, S. europaea, C. spinus, P. pyrrhula, P. domesticus, Certhia sp.* und *E. citrinella.*
6. Es wurde festgestellt dass-abwiechend von der Brutperiode — im Winter viele weitere Vogelarten in die Stadt eindringen und manche Arten, die in der Brutzeit nur in Parken leben, im Winter auch in die verbauten Teile der Stadt vordringen.
7. Durch Vergleich mit den Angaben weiterer Autoren (Truszkowski 1963, Schnebel 1969, Erz 1964, Wiehe 1971, Hudec 1976, Okulewicz 1976) konnte man festellen, dass in der Artenzahl und qualitativen Zusammensetzung die winterliche Synusien einer kleinen Stadt keine wesentlichen Unterschiede von den Synusien der vergleichbaren Biotopen der grossen Städte aufweisen. Die Gesamtdensität der Synusie war dagegen in Tachov niedriger als in den grösseren Städten.

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Anschrift des Verfassers: RNDr. Pavel Řepa, Zoologische Abteilung, Bezirksmuseum, tř. Míru 447, 347 01 Tachov Tschechoslowakei.

Věst. čs. Společ. zool., 46: 56—69, 1982

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ON THE FISH AND FISHERIES OF JAISMUND LAKE, RAJASTHAN, INDIA

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Received July 15, 1980

Abstract: Fish and fisheries of Jaismund Lake (24° 14′ E and 73° 57′ N; area 7304 ha), Rajasthan, India have been described based on the fish landings during the years 1962—1979 (except 1966—69 and 1976—1977). Percentage of major carp landings had shown declining trend except in the years 1963—65, whereas the percentage of predatory fishes was increasing. Monthwise catch data during the year 1969—70 indicated the maximum intensity of catch in the months of March—June 1970, reducing the population of brooders.

Faunal survey had revealed the presence of 41 species of fishes belonging to 3 *superorders*, 7 *orders*, 11 *families* and 25 genera including two hybrids. Order Cypriniformes constituted 68.27 % of the total species. Maximum size, breeding seasons and commercial importance has also been given wherever available.

Based on the investigations of 13 years, suggestions have been given to increase the fishery potentials. Furthermore, based on the physical features of the lake, it is pointed out that Jaismund Lake should be *called as Jaismund Sagar (Jaismund* Reservoir).

The average annual production during the years 1962—79 was 59.78 kg. ha. with 243.92 fishing days in a year. The major carp catches constituted 34.86 % of the total catch. Is is observed that the production of this reservoir is higher than of any other reservoir of India.

INTRODUCTION

The world — known Thar Desert is a part of Rajasthan State, but still the riverine, lacustrine and reservoir fisheries in the State is not a surprise. The north-west part of the State is the well known granary and north-south has large number of lakes and reservoirs contributing maximum to the fishery resources. The north-west part is not only producing agricultural products but the fishery resources are also present because this area is richly netted with canals and the beds of the river Ghagger. During the last decade, State Fisheries Department has tried their level best to increase the fish productions. Due to the high price of the fish major part of the productions is exported to other States inspite of that the State has very poor transport facilities. Several workers have published the papers dealing with different aspects of fishery science of Rajasthan State viz., Mathur (1952), Hora and Mathur (1953), Moona (1963), Dhawan (1969), Datta and Majumdar (1970). Johal (1975), Johal and Dhillon (1975), Durve (1976), Chaudhary (1978), Johal and Sharma (1979) and Sharma and Johal (1980).

The present communication deals with the fish fauna and fish and fisheries of Jaismund Lake based on the observations for the last 13 years. In addition some suggestions have also been given to increase the fish production.

Rajasthan State has large number of reservoirs and lakes covering the total area of about 43.920.430 ha. *Jaismund Lake* is one of the artificial, softwater and man made lake in Rajasthan State and may be one of the oldest lakes in India. It has a longitude of 24° 14′ E and latitude of 73° 57′ N and is about 52 km. from Udaipur. Several efforts have been made in the past by FAO (B o t k e, 1954; Z n a m e n s k y, 1967; G e r h a r d e n, 1969 and J a k o b s o n, 1971) and Government of India (J h i n g r a n and T r i p a t h i, 1960) to de-

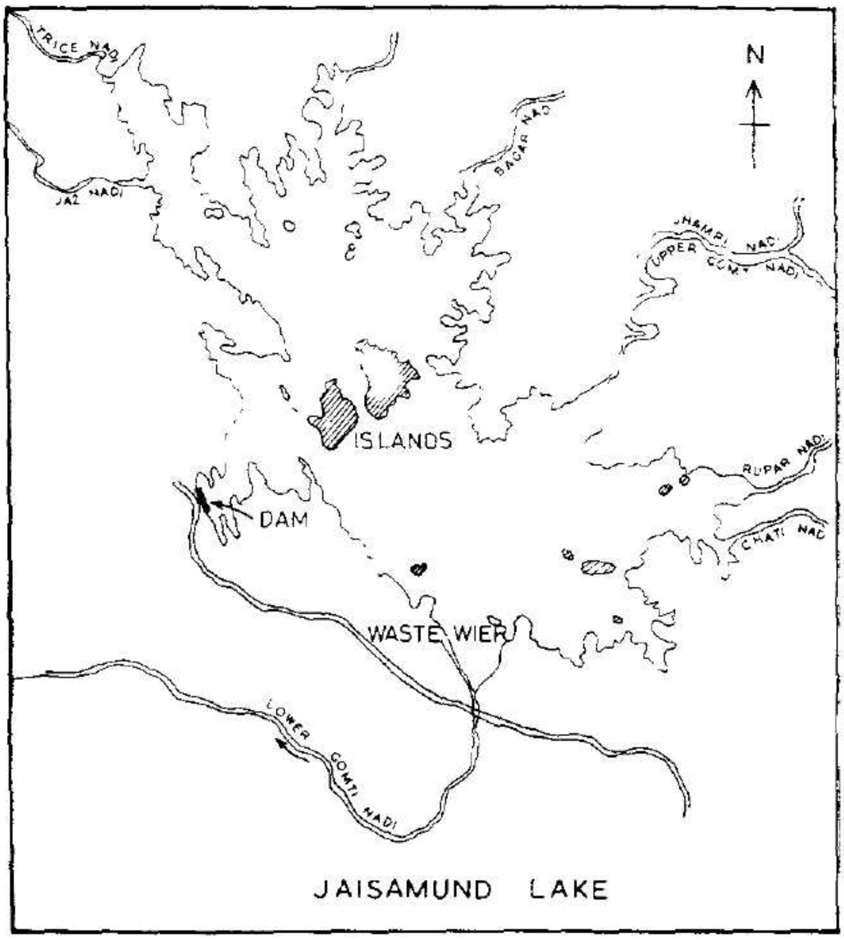

Fig. 1. Map of Jaismund Lake showing different tributaries.

velop different reservoirs in India. but the State of Rajasthan had been completely ignored inspite of its rich fauna and fishery potentials.

Considering the fishery potentials of this area, an *preliminary attempt* has been made to study the fish fauna and fishery aspects based on the observations during the years 1962—79 (except 1966—69 and 1976—77) with the help of State Fisheries Department. The fish fauna of Jaismund Lake has been described for the first time. Along with species name, maximum size available, breeding habits and the commercial importance has also been given.

MATERIAL AND METHODS

For the purpose of faunal survey and the estimate of fish yields, the fishing was done throughout the year in the lake during the years 1962—1979 (except 1966—69 and 1976—77) leaving the dam area (being prohibited) The fishing nets used were of diverse type viz, gill nets, drag nets with and without bags, cast nets, baited hooks and pot method The daily catches were brought to the landing centres made at the waste wier about six kilometers away from the dam site were examined At the landing centres the catches were sorted out, segregated and categorised into four major groups, major carps with and above 2kg, major carps below 2kg, cat fishes with and above 2kg and cat fishes and miscellaneous fishes below 2kg The procedure was adopted for the purposee of marketing by the fishing contractor

Monthly water samples were taken in 1969—70 for water analysis and were analysed in the local hospital with the help of Public Analysit

For the study of fish fauna few specimens of varying size were collected of each species, indentified, classified and preserved in 5% formaldehyde solution and deposited in the ichthyological collections of Department of Zoology, University of Rajasthan, Jaipur

HISTORY OF THE LAKE AND PHYSICAL FEATURE

The construction of this lake was started by erstwhile ruler of Udaipur State Maharana Udai Singh in 1711 by building a dam on Gomati river and was completed in 1730 It receives the water from large number of tributaries viz Gomati nadi, Jamri nadi, Hukli nadi, Burli nadi, Sirohi nadi, Sadarni nadi, Gargal nadi Tiice nadi and Makri nadi (Fig 1) These are seasonal streams bringing water from catchment area of 1,127 kilometers The lake has water spread of 7 304 ha at Full Reservoir Level the maximum height of the dam is 36 meters The maximum depth of water was about 24 meters in 1969—70 at the dam where thermal stratification actually takes place Within the lake there are 11 islands and are made use by the fishermen both for habitation and cultivation The average annual rain fall was about 700mm and the temperature varied between 15 °C—34 °C in 1969—70

The southern side of the lake is mainly consist of clay mixed with gravel, eastern side is muddy, whereas the northern and western sides are rocky Surrounding the environment of this lake there is thick vegetation of *Mangifera indica*, *Acacia nilotica* *Acacia jacquemontic*, *Acacia modesta*, *Prospis cineria* (= *P spicigera*), *Bombax malabaricum*, *Melia indica*, *Melia azedarach*, and *Eucalyptus* spp Submerged vegetation consist of *Vallisneria* (Tape grass) *Potamogeton*, *Ceratophyllum* (Hornwort) *Chara* (Stone wort) *Eichhornia*, (Water Hyacinth), *Pistia*, and *Typha* Wild animals reported from this area are Tigers, Panthers, Wild Pigs Monkeys, Beer, Jackal and Wild fox

CHEMICAL FEATURES

Soil is rich in nutrients e g, nitrates silicates and iron The average pH of water during 1972 was 7 5—8 7 (8 2), chlorides 24 0—56 8 (37 0) ppm, nitrates 19—61 (51 00) ppm silicates 12—26 (22 4) ppm and iron 0 05—14 (6 04) ppm The occurrence of phosphate was also noticed The average total alkalinity was 435 ppm and dissolved oxygen in water varied from 5 00—18 0 ppm

HISTORY OF FISHING IN THE LAKE UPTO 1979

The erstwhile Maharajas of Udaipur, who were responsible for the construction of this lake in 1711—1730 did not seem to have realized the importance of this creation of theirs from the fishery point of view Water was stored for irrigation and emergency purposes Upto 1960 there are no official record concerning fishery revenue and fishery potentials of this lake Just before the integration of the State of Udaipur into Rajasthan State, whole of the lake was leased to a fishing contractor for a nominal sum for 20 years There were no restrictions as to the amount, kind or timings of the fishing ignoring the importance of conservations and fishery management In fact the Rajasthan Fisheries Act and Rules were not applicable till the year 1953 The fishing contractor was naturally indiscriminate and did not even spare the brooders in the breeding season This was particularly so in the later part of the contract when he appears to have thought of making the maximum of the laissez faire while it lasted

In 1962, State Fisheries Department posted Fisheries Project Officer to look after the affairs of the lake The record of the daily catches were maintained The year-wise data from 1962—1979 (except 1967—1968 and 1976—77) are tabulated in Table II The monthwise data of fish landing during the year 1969—70 are given in Table III giving clear picture of the species wise catch

From Table III, it is evident that the maximum fish landings were during the years 1962—63, 1963—64, 1964—65, 1965—66 and 1978—79 moderate during the years 1969—70, 1970—71 1972—73 1974—75 and 1975—76 poor during the years 1971—72, 1973—74 and 1977—78 In 1976—77 there was no fishing Further, is is observed that during the period of investigations the major carps were dominant in the catches The maximum production was 90 53 kg ha year in 1965—66 and minimum 25 08 kg/ha year in 193—74

It is significant to note that from March to June 1970 (Table III) the fishing intensity was maximum and the major carps above and below 2kg were fished out in greater number in June, 1970 Thus potential brooders were ruthlessely eliminated not only for the year 1969—70 but also for the other years

FISH FAUNA

Very little is known as far as fish fauna of Rajasthan State is concerned despite its rich resources Even Day (1878) in his classic work "Fishes of India" described very few fish species occuring only in riverine system and completely ignored the fish fauna of major lakes and reservoirs After partition of India and Pakistan in 1947, several workers from time to time published full length or short faunal reports indicating the presence of varied type of fish fauna in Rajasthan State viz , Mathur (1957) Datta Gupta et al (1961), Moona (1963), Dhawan (1969), Mathur and Yazdani (1969, 1971 1973) Roonwal (1969) Datta and Majumdar (1970), Johal (1975), Johal and Dhillon (1975), Johal and Sharma (1979) and Sharma and Johal (1980) The above mentioned papers give the outlines and general idea of fish fauna of Rajasthan State, but too much is yet to be reported such as seasonal availability, habits habitat maximum size and migration etc

Table I describes the fishes collected during the year 1962—79 (except 1966—69 and 1976—77) describing availability during different parts of the year, breeding habits, their commercial value and maximum size recorded (wherever available) The classification ascertained in Table I is given after Greenwood et al. (1966) upto family level For species identificaion mainly Day (1878), Misra (1959), Srivastva (1968), Munro (1955) and Johal and Tandon (1972) were consulted Synonyms are also given wherever applicable

The present collection includes 41 species (including two hybrids) belonging to 3 superorders, 7 orders, 11 families 25 genera of the class Osteichthyes and subclass Actinopterygii

DISCUSSION

Jaismund lake is a reservoir, not a Lake' because it has a definite outlet for irrigation purpose Definitions of the lake are given by different workers viz Muttouski (1918) refer to lake as those bodies of standing water which are of considerable expense and deep enough to stratify thermally He further

12.	*L. gonius* (Ham.)	Sarsi 540	Breeds after first monson shower; not very tasty fish.
13.	*L. bata* (Ham.)	Bata 500	Breeds in July; not liked due to scanty flesh.
14.	*L. boggut* (Ham.)	Boggut 324	Good table fish; constitute very small percentage of the total catch.
15.	*Cirrhina mrigala* (Ham.)	Mrigal or Narain	Breeds just little ahead of *L. rohita*; as good as *L. rohita* in taste.
16.	*C. reba* (Ham.)	Bhangan 109	Neither tasty nor common.
17.	*Catla catla* (Ham.)	Katla 970	Breeds just after *C. mrigala* and *L. rohita*; good tasty fish.
18.	*Tor khudree* (Sykes)	Mahseer 1120	Good table fish; rich in oil contents; breeding habits not very well known.
19.	Hybrid 1. *Labeo rohita* × *Catla catla*	Dogla 840	Rare; only 32 specimens were collected in 1969–70.
20.	Hybrid 2. *Cirrhina mrigala* × *Labeo rohita*	Dogla 355	Very rare; only one specimen was caught in 1969–70
21.	*Puntius sophore* (Ham.)	Khursa 75	Not tasty fish; aquarium fish; breeds during monsoon.
22.	*P. sarana* (Ham.)	Puthi 240	Good table fish; breeds in July.
23.	*P. ticto* (Ham.)	Chidhu 80	Not very common; aquarium fish.
24.	*P. chagunio* (Ham.)	Chidhu 80	Not very common; aquarium fish.
25.	*Garra gotyla gotyla* (Ham.) (Syn. *Discognathus lamta*)	Pathar Chat 140	Rare; found in crevices at bottom.
		Family: Cobitidae	
26.	*Noemacheilus botia* (Ham.)	Bamna 80	Bottom dwelling fish; rarely netted; good aquarium fish.
27.	*Botia lohachata* Chaudri	Bamna 50	Bottom dwelling fish; rarely netted; aquarium fish.
28.	*Lepidocephalichthys guntea* (Ham.)	Pahari Machli 120	Bottom dwelling; not very common; good aquarium fish.
		Order: Siluriformes	
		Family: Bagridae	
29.	*Mystus seenghala* (Sykes)	Singhara 1190	Market status very good; very good table fish; carnivore.

Table I

S. No.	Scientific name	Local name. Maximum size recorded in mm.	Remarks (Availability, food value and breeding habits etc.)
		Class: Ostoichthyes Subclass: Actinopterygii Superorder: Osteoglossomorpha Order: Osteoglossiformes Suborder: Notopteroidei Family: Notopteridae	
1.	*Notopterus notopterus* (Pallas)	380	Available throughout the year, particularly considered good for fish soup.
		Superorder: Ostariophysi Order: Cypriniformes Suborder: Cyprinoidei Family: Cyprinidae Subfamily: Abraminae	
2.	*Chela clupeoides* (Bloch)	Silver Chal 160	Available throughout the year.
3.	*C. bacaila* (Ham.)	Chal 150	Not very common.
		Subfamily: Rasborinae	
4.	*Danio devario* (Ham.)	Chanlore 80	Rarely available.
5.	*Barilius bendelisis* (Ham.)	— 140	Very fast swimmer, keeping eyes above the surface of water, insectivore.
6.	*B. barna* (Ham.)	Gala 70	Not ver common.
7.	*Rasbora daniconius* (Ham.)	Zebra 75	Frequentily available.
8.	*Amblypharyngodon mola* (Ham.)	Mehra 70	Raro.
		Subfamily: Cyprininae	
9.	*Labeo rohita* (Ham.)	Rohu 1040	Breeds after first monsoo n shower but little later than *C. mrigala*; good table fish.
10.	*L. calbasu* (Ham.)	Kalbans 700	As compared to *L. rohita* its demand is less; breeds after first monsoon.
11.	*L. fimbriatus* (Ham.)	Mamola	Breeds during August; good table fish.

30.	*M. aor* (Ham.)	Katarana 640	Market status good; good table fish.
31.	*M. cavasius* (Sykes)	Katva 220	Market status poor; available throughout the year.
		Family: Siluridae	
32.	*Wallago attu* (Bl & Schn.)	Lanchi or Mulee 1170	Not frequently available; breeds during south west monsoon; good table fish market status good; piscivore.
33.	*Ompok bimaculatus* (Bloch)	Palwa 300	Very good market status in the market of Calcutta; rich in oil content.
		Family: Heteropneustidae (Syn. Saccobranchidae)	
34.	*Heteropneustes fossilis* (Bl.) (Syn. *Saccobranchus fossilis*)	Singhi 190	Available throughout the year; breeds in June.
		Order: Perciformes Suborder: Percoidei Family: Centropomidae	
35.	*Ambassis nana* (Ham.)	Sisha 70	Available throughout the year; inhibits clear standing water; good aquarium fish.
		Suborder: Gobiodei Family: Gobiidae	
36.	*Glossogobius gutum* (Ham.) (Syn. *G. giuris*)	Gobi 200	Commonly available; without any commercial value.
		Superorder: Atherinomorpha Order: Atheriniformes Suborder: Exocootoidei Family: Belonidae	
37.	*Xenentodon cancila* (Ham.) (Syn. *Belona cancila*)	Suya 280	Very rare.

		Order: Channiformes Family: Channidae	
38.	*Channa marulius* (Ham.)	Saval 800	Very good table fish; hatchlings were collected during July—August; according to local belief the otoliths of this fish are a remedy for patients suffering from kidney stone.
39.	*C. punctatus* (Bloch)	Kabra 600	Frequently available; good table fish.
40.	*C. striatus* (Bloch)	Girai 500	Frequently available; without any commercial value.
		Order: Girai 500	Frequently available; without any commercial value.
		Order: Mastacembeliformes Family: Mastacembelidae	
41.	*Mastacembelus armatus* (Lacépede)	Bam 600	Rich in fat content; available throughout the year; caught by rod and line or drag net only.

defined lake as a body of standing water completely isolated from the sea and having an area of open relatively deep water sufficiently large to produce somewhere on its periphery a barren wave-swept shore. W e l c h (1952) includes all water bodies with standing water as lakes excluding ponds. W e l c h (1952) defined reservoir as a large expense of impounded ater artifically created by putting accross a stream. an earthen, stone masonary or concrete bundh or dam. Reservoirs are formed mainly for irrigation, generation of power. flood control, recreation and fishery development etc. From the above definitions and considering the hisstory, is is more appropriate to call it as a 'reservoir' than 'lake' due to the following reasons:

i. thermal stratification is very poor and only takes place near the dam,
ii. having an definite outlet,
iii. stored water is used for irrigation purpose.

It is interesting to note that the lake is inhabited by more than 50 % of total fish species known to be present in Rajasthan State (D a t t a and M a-j u m d a r, 1970; D h a w a n, 1969). further as noted above, certain species such as *Catla catla, Labeo fimbriatus, Mystus aor., Glossogobius gutum* and *Channa striatus* are conspicuous by their absence in lakes around Udapur situated only about 50 km away.

Changes in species composition and size

During the year 1969—70, the major carp landings had been reduced to 17.63 % of the total yield, whereas in 1962—63. 1963—64 and 1964—65 their production was maximum. *Catla catla* in particular had declined tremendously because only 18 specimens were caught in 1969—70. Except during the years 1962—65, it is obvious that the pressure of fishing had gone much beyond the point of optimum fishing.

Table II. Yearwise catches and production

Years	Total catch in kg.	Production kg./ha.	Fishing days	Major Carp catches	Percentage of major carps.
1962-63	636, 672	88.8	298	381, 577	59.99
1963-64	634, 330	88.47	283	394, 173	62.14
1964-65	599, 320	83.60	258	368, 102	61.42
1965-66	648, 983	90.53	243	220, 819	34.03
1969-70	338, 420	47.20	220	59, 651	17.63
1970-71	350, 492	48.88	230	103, 975	30.90
1971-72	270, 765	37.74	232	107, 691	39.70
1972-73	311, 218	43.43	240	62, 675	20.15
1973-74	179, 888	25.08	228	46, 058	25.60
1974-75	330, 085	46.03	237	78, 117	23.00
1975-76	401, 459	59.99	222	82, 913	20.60
1976-77	No fishing during this year				
1977-78	264, 940	36.95	250	146, 33	23.24
*1978-79	555, 866	77.52	230	—	—

* In 1978-79 species wise data could not be sorted out.

During the last 13 years Jaismund Lake has shown the production of 59.78 kg/ha/year with 243.92 fishing days in a year. Major carp*catch constituted 34.86 %

Table III. Showing the group and monthwise landings during 1969—70. Total number of fishing days and daily average catch per day per man in kilograms

Month	No. of fishing days	Catch per unit of efforts of different categories of fishes (days' basis)				Average catch per day in kg.	Total catch in kg.	Average No. of fishermen engaged	Catch in kg./man/day
		Major carp above 2 kg. kg	Major carp below 2 kg. kg	Catfishes above 2 kg. kg	Catfishes & miscellaneous fishes below 2 kg.				
November	10	60.6	192.8	28.1	492.1	773.6	7736	250	3.09
December	31	27.4	78.2	47.8	606.5	759.6	23548	250	3.04
January	31	32.1	31.4	95.8	1348.9	1508.2	46760	250	6.03
February	28	48.8	71.2	107.1	1517.8	1745.0	48860	250	6.98
March	31	78.9	154.8	68.0	1321.0	1622.7	50304	250	6.49
April	29	73.0	285.9	66.2	1619.4	2044.5	59295	250	8.18
May	30	87.4	233.3	46.3	1271.0	1638.0	49140	250	6.55
June	30	297.9	272.1	87.4	1089.5	1746.9	52407	250	6.99

... yield. Considering the annual yield, it is better than all most all the lakes and reservoirs in India except Ooty Lake and Mettur (Stanley) reservoir where the recorded annual yields are 75 and 250 kg/ha/year respectively. Jhingran and Tripathi (1969) described the average yield 6—7 kg/ha/year from the Indian reservoirs.

Faunistic survey along with breeding habits, maximum size available and market value has been conducted for the first time of this reservoir. From the variety of the fish species available, it can be concluded that this reservoir has the balanced fish faun representing 3 superorders, 7 orders, 11 families, 25 geners and 41 species including 2 hybrids. Out of 41 species, 28 belongs to order Cypriniformes (68.29 %), but major carp production was only 34.86 % during the last 13 years. Since 1964—65, the major carp catches had shown declining trend and the cat fishes were predominant. Not only this the total yield had also gone down, which has forced us to take necessary steps to increase the yield. Authors suggest the following steps to increase the production.

1. Clearence of submerged obstruction: Some areas of the reservoir are infested with heavy vegetation (Type of plants are described in history of the lake and physical features). Presence of aquatic vegetation not only hampers fishing, but also supresses growth of benthic fauna as it occupies the productive zone. It also obstructs the light penetration decreasing the productivity.

2. Establishment of Fish Farms at Dam sites: At present there is no Fish Farm attached to the reservoir. Natural breeding takes place during every monsoon, but more than 60 % of the population consists of predatory fishes, therefore, the survival rate of major carps is very low. With the construction of Fish Farms, there can be more stocking of major carp seed, possibly the survival rate will also come up.

3. Eradication of predatory fishes: Steps should be taken to eradicate the predatory fishes by building up a population of commercially important fishes feeding on the lower food chains. This can be done by introducing *Ctenopharyngodon idella*, *Hypophthalmichthys molitrix* and varieties of *Cyprinus carpio*. At present these quick growing fishes are conspicuous by their absence.

4. Breeding Grounds: It has been observed that during breeding season. fishes move to the specific areas called 'Breeding grounds'. These breeding grounds should be declared as 'Sanctuaries' for better propagation and stocking.

5. Nets: Selected fishing nets should be used for example *Catla catla* require high mesh size (152 mm.) as compared to all the species of *Labeo* (38—100 mm.). To improve the catching efficiency Gulbadamov (1961) recommended immediate reconstruction of indigenous nets on the following lines;

i. Application of hanging coefficient of 0.5 while rigging the nets.

ii. Compete framing of the nets by attaching breastlines and a lead line.

iii. Better distribution of the buoyancy along the float line and similarly equal distribution of sinkers along the lead line.

7. Enforcement of close season: Till now, there is no limit on size of the fish to be caught and complete prohibition during the breeding

* Major carps include ***Labeo rohita*, *Labeo calbasu*, *Cirrhina mrigala*** and ***Catla catla***.

season. Growth studies of all the commercial fishes should be undertaken to enforce the legal size of the fish. Further, after every three years, there should be no fishing for complete one year for proper stocking. Chaudhary (1978) was also of the opinion that in Rana Partap Sagar close season should be observed from 15th June to 30th August of every year; urgent need to evolve suitable gears; removal of aquatic weeds and introduction of grass carp to control the weed growth.

Socio-economic conditions of the fishermen:

There vere about 250 active fishermen deployed for the exploitation of the lake. The average catch for 243.92 days in a year is 5.96 kg/man/day and they were paid Rs. 2.40* at the rate of Rs. 0.40 kg by the contractor in king only. The fishermen ,who have taken the loan from the contractor, bring their own crafts and tackles. The fishermen are thus, fully exploited by the contractor. Therefore. the authors suggest the formation of Fisheries Cooperative Society under the patronship of State Fisheries Department to safe guard the interests the fishermen.

Riggs (1959) described fish production upto 33.6 kg/ha/year as a normal production in different reservoirs of U.S.A. Pearson (1958) suggested that the fish production in storage reservoir would be about 15.68 kg/ha/year. The production from the Jaismund reservoir for the fishing years 1962—1978 has been recorded 59.78 kg/ha/year despite 20 years of indiscriminate fishing and without putting much efforts. It may, therefore, be concluded that Jaismund reservoir is one of the most productie reservoirs of India.

SUMMARY

Fishery potentials and fish fauna of Jaismund reservoir have been described based on the data of 17 years (1962—1979). Jaismund Reservoir was built in 1730 by erstwhile rulers of Udaipur State. The reservoir has an area of 73.04 ha and the depth varies from 24 m. to 36 m.

The reservoir is richly inhabited by aquatic vegetation and the water analysis had indicated that the water is rich in nutrients.

Before 1962, there were no official records of fishing. Since 1962 onwards the average annual fish landings have been 424 803 kg, annual production 59.78 kg/ha with 243.92 fishing days in a year. The maximum percentage of major carps in the catches were recorded in the year 1963—64 (62.14 %) and 1964—65 (61.42 %). In other years the percentage of major carps showed a declining trend and the percentage of predatory fishes increased considerably. A drastic fall in the catchces of *Catla catla* has been recorded, which is very alarming.

Monthwise data for the year 1969—70 showed the maximum fishing intensity during the months March—June 1970, eradicating the brooder's population of major carps.

Faunal survey has revealed the presence of 41 species belonging to 3 superorders, 7 orders, 11 families and 25 genera of the class Osteichthyes and subclass Actinopterygii. Order Cypriniformes constituted 68.29 % of the total species reported.

* U.S. $ = Indian Rs. 8.25.

To increase the fishery potentials a few suggestions have been given viz..

i. Clearence of submerged weeds.

ii. Establishment of Fish Farms at Dam site.

iii. Eradication of predatory fishes.

iv. Observing close seasons and no fishing after every three years.

v. Reconstruction of indigineous nets.

vi. Declaration of breeding grounds as sanctuaries.

viii. Formation of Co-operative Societies

Acknowledgements

Authors are greatly thankful to Dr. K. K. Tandon, Department of Zoology, Panjab University, Chandigarh for critically going through the manuscript, to Dr P. N. Srivastva, Professor and Head, Department of Zoology, University of Rajasthan, Jaipur and to The Fisheries Development Officer, Jaismund for providing the necessary facilities during the period of investigations.

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Věst. čs. Společ zool., 46: 70—75, 1982

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EXPERIMENTELLE AUSWERTUNG EINIGER MORPHOLOGISCHEN MERKMALE DER CYCLOPIDEN (COPEPODA, CYCLOPOIDA)

Otakar ŠTĚRBA und Ludvík SCHMIDT

Eingegangen am 4. April 1980

Abstract: It has been proved experimentally that the swimming organs of *Paracyclops fimbriatus* (Fischer) (Crustacea, Copepoda) become considerably shorter in the medium of interstitial waters. This finding is important for the evaluation of properties of species described on the basis of relative dimensions of their swimming organs

Unter die elementaren morphologischen Merkmale in der Taxonomie der Copepoden gehört die Dimension und das Länge-Breiteverhältniss (Index) der Furka und des 3. Gliedes des Endopoditen der Beine des 4 Paares Einige Autoren machen allerdings darauf aufmerksam, dass diese Merkmale bei vielen Arten ziemlich variabel sind. Als Allgemeinerscheinung können wir die Tatsache betrachten, dass es bei dem Übergang in die unterirdischen Gewässer zu einer Verkürzung der Schwimmorgane kommt, vor allem dann, wenn die Oberflächenpopulation in die interstitialen Gewässer der Sandkiessablagerungen übergeht, wo die Raumverhältnisse beträchtlich eingeschränkt sind (Štěrba 1965, Rosol-Štěrba im Druck). Ähnlich ist es im Falle dicht verwachsener Oberflachengewässer, vor allem in Moortümpeln (Pór 1957)

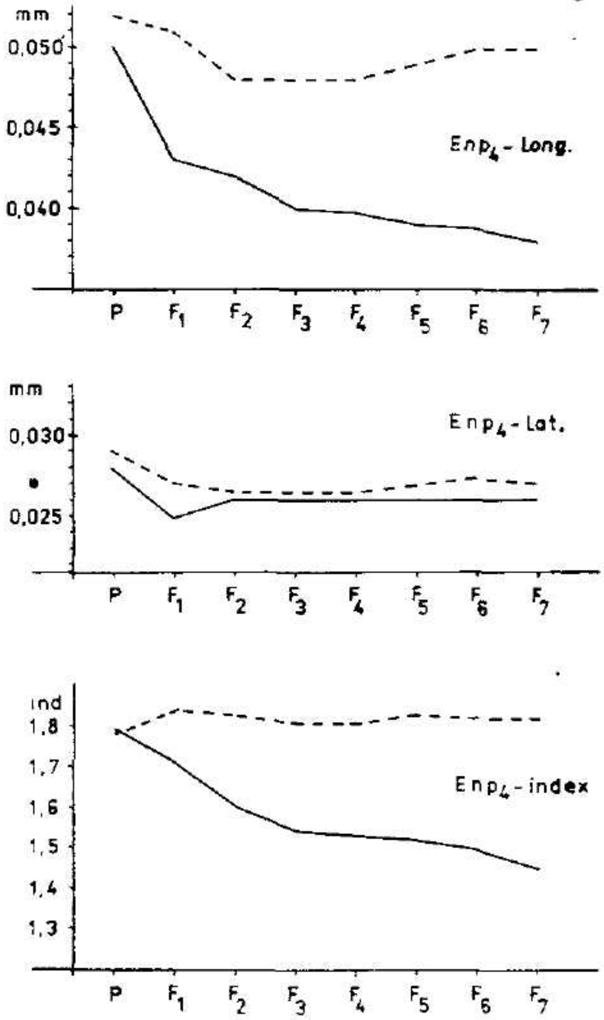
Im Rahmen einiger Diplomarbeiten unserer Fakultät bemühten wir uns diese „Verkürzungen" einiger Organe experimentell auszuwerten. Fur die Experimente wählten wir die Art *Paracyclops fimbriatus* (Fischer), bei der einige Unterartentaxone beschrieben sind (var. *imminutus* Kiefer, var. *abnobensis* Kiefer, var. *finitimus* Kiefer). Wir nehmen an, dass die Ergebnisse von einer allgemeineren Gültigkeit sein könnten.

METHODIK

Das Prinzip des Experimentes war einfach. Befruchtete Weibchen, die in dem Flusschen Bystřička in der Vorstadt von Olomouc gefangen wurden, liessen wir die Eiersacke im künstlichen Milieu, das die Raumverhaltnisse der Sandkiessablagerungen immitiert, ablegen. In diesem Milieu wurden dann weitere Generationen gehalten (im Ganzen 7 Filialgenerationen, F_1—F_7) und ihre gewahlten Merkmale wurden mit der Kontrollreihe der Weibchen verglichen, die in gleichen Eprouvetten nur im Wasser ohne Sand gehalten waren Als imitiertes Milieu der Interstitialgewässer haben wir Eprouvetten vom Ausmass 2 × 6 cm, zu 2 3 mit sterilisiertem Sand von Korngrösse 1 mm vorbereitet Über der Sandschicht war nur 1 cm von Wasser, das sich im Laufe von wenigen Tagen bis zum Niveau des Sandes gesenkt hat.

Die Versuchstiere gingen fast immer aktiv in die wasserige Sandschicht über, gewohnlich sofort oder im Laufe einiger Stunden, und lebten dann ständig in diesem Raume Die Weibchen legten ihre Eiersacke nach 7—10 Tagen ab. In den folgenden Tagen wurden die 1. Nauplienlarven ausgebrütet, die in etwa 4 Wochen heranreiften.

In dieser Zeit war es nötig die Tiere aus den Eprouvetten samt Sand in grössere Petrischalen auszukippen und erwachsene Männchen und Weibchen auszunehmen. Zwei Weibchen aus jeder Zweiglinie und mehrere Männchen liess man lebendig zur weiteren Zucht, die anderen Weibchen wurden durch Formaldehyd fixiert und durchmessen. Bei dem Kreuzen mussten die genetischen Grundregeln beachtet wer-



Graph. 1. Der Verlauf der Länge (Enp_4–Long.), Breite (Enp_4–Lat.) und des Indexes (Enp_4–Index) des 3. Gliedes Enp_4 im Experiment. Volle Linie = Eprouvetten mit dem Sand, unterbrochene Linie = Kontrollserie.

den. Der gleiche Prozes war in der Kontrollreihe der Eprouvetten ohne Sand eingehalten. Die Versuchsindividuen wurden mit einem Brei aus Würmern *Tubifex tubifex* und *Limnodrilus hofmeisterii* genährt.

In jeder Filialgeneration waren 20 Eprouvetten mit Sand verfolgt, aus welchen die 20 × 7 vermessenen Weibchen stammen. Zu diesen sind 20 Parentalweibchen aus dem Fluss Bystřička (P) vorgereiht, in der Kontrollreihe waren 4 Reihen verfolgt.

Statistisch wurden also insgesamt 192 Weibchen ausgewertet, bei denen die folgenden Merkmale verfolgt wurden: Länge und Breite des 3. Gliedes Enp_4, die Länge und Breite der Furka (bei beiden Merkmalen wurde dann ihr Index berechnet) und weiter die Länge des Antenulla (A_1)

Die Methodik dieses Experiments war in den Diplomarbeiten von Drbal (1966) und Filip (1966) ausgearbeitet. Auf ihre Ergebnisse knüpfte Schmidt (1967) an, aus dessen Arbeit die in diesem Beitrag verarbeiteten Resultate stammen.

Tab. 1. Durchschnittswerte der verfolgten Merkmale *Paracyclops fimbriatus* bei den Generationen im Sand

Gen	Segm. 3 Enp_4			Furka			A_1
	Long.	Lat.	Ind.	Long.	Lat.	Ind.	Long.
P	0,050	0,028	1,79	0,140	0,024	5,69	0,232
F_1	0,043	0,025	1,71	0,124	0,025	4,96	0,218
F_1	0,042	0,026	1,60	0,121	0,023	4,88	0,213
F_2	0,040	0,026	1,54	0,119	0,026	4,62	0,210
F_3	0,040	0,026	1,53	0,118	0,026	4,55	0,210
F_4	0,040	0,026	1,53	0,118	0,026	4,55	0,210
F_5	0,039	0,026	1,52	0,117	0,026	4,53	0,207
F_6	0,039	0,026	1,50	0,118	0,026	4,49	0,207
F_7	0,038	0,026	1,45	0,116	0,026	4,39	0,204

ERGEBNISSE

Die Ergebnisse sind übersichtlich in den Tafeln Nr. 1 und 2 verarbeitet, sowie in den Graphen Nr. 1—3, die die verdurchschnittlichten Werte der verfolgten Merkmale aller vermessenen Individuen aus den ensprechenden Generationen angeben. Aus diesen Unterlagen lassen sich die folgenden Schlussfolgerungen ableiten:

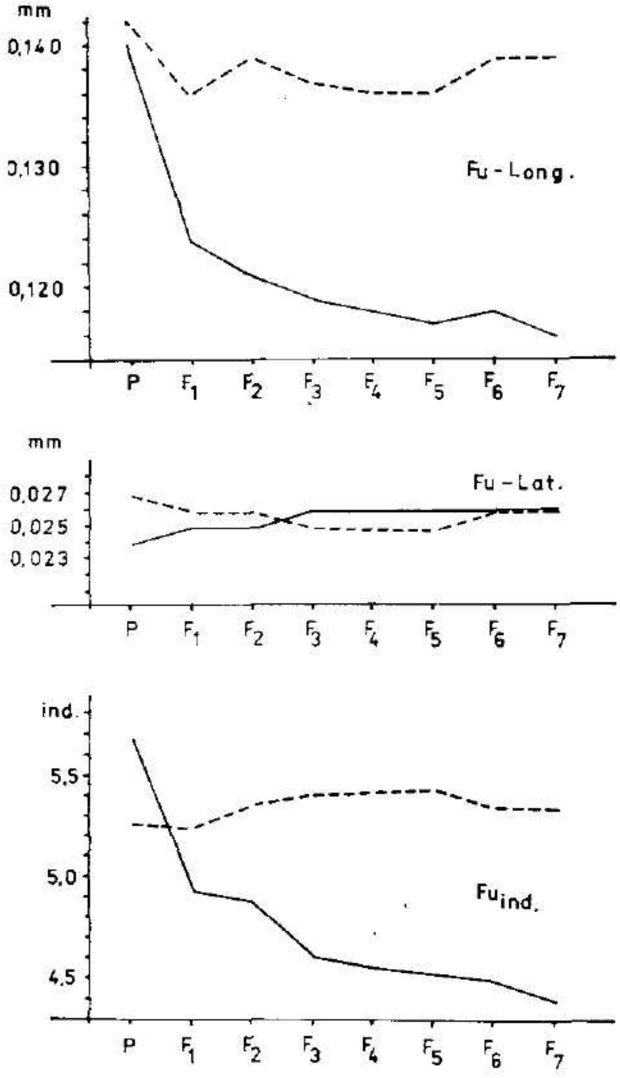
1) Das 3. Glied Enp_4 verkürzt sich während des Überganges in die interstitialen Gewässer bereits in der 1. Filialgeneration, die Verkürzung in den weiteren Generationen ist langsamer und mehr oder weniger kontinuierlich, bis

Tab. 2. Durchschnittswerte der verfolgten Merkmale *Paracyclops fimbriatus* bei den Generationen in den Kontrollserien (Eprouvetten ohne Sand)

Gen	Segm. 3 Enp_4			Furka			A_1
	Long.	Lat.	Ind.	Long.	Lat.	Ind.	Long.
P	0,052	0,029	1,78	0,142	0,027	5,26	0,237
F_1	0,051	0,027	1,84	0,136	0.026	5,23	0,231
F_2	0,048	0,026	1,83	0,139	0,026	5,35	0,228
F_3	0,048	0,026	1,81	0,137	0,025	5,39	0,227
F_4	0,048	0,026	1,81	0,136	0,025	5,42	0,226
F_5	0,049	0,027	1,83	0,136	0,025	5,44	0,227
F_6	0,050	0,027	1,82	0,139	0,026	5,35	0,229
F_7	0,050	0,027	1,82	1,82	0,026	5,35	0,227

zum Endwert der Verkürzung 1,9×. Bei den Kontrollzüchten kam es vorerst zu einer mässigen Verkürzung, dann schrittweise wieder zu einer Verlängerung des Gliedes, und am Ende des Versuches waren die Glieder verhältnissmässig gleich lang wie bei der Parentalgeneration. Die Breite des Gliedes war bei allen Generationen ungefähr gleich. Der Index Enp_4 verringert sich bei den Generationen im Sand von dem Ausgangswert 1,79 (P) bis auf den Endwert 1,45 (F_7).

2) Prinzipiell gleiche Veränderungen treten bei der Furka ein. Ihre Länge bei der 1. Filialgeneration im Sand verringerte sich heftig, die Breite veränderte sich praktisch nicht. Der Furkalindex bei F_1 im Sand sank vom Wert

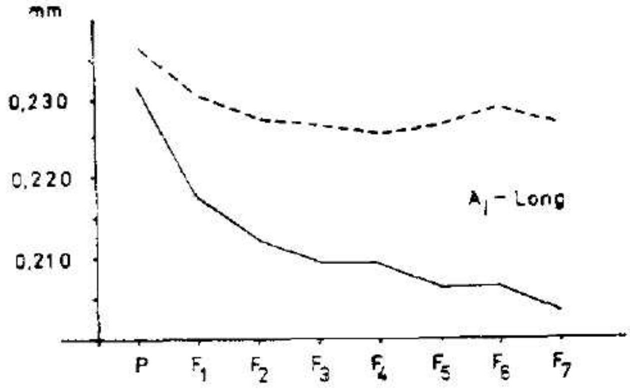


Graph 2. Der Verlauf der Länge und der Breite der Furka und des Furkalindexes.

5,69 auf 4,96, in den weiteren Generationen verlief die Verringerung des Indexes bereits langsamer bis auf den Wert 4,39 bei F_7. In den Kontrolleprouvetten ohne Sand hat sich die Furka gegen den Ausgangszüchten eher verlängert.

3) Die Antennula (A_I) verkürzte sich bei den Generationen aus dem Sand bis auf 1,14× bei F_7 (von 0,232 mm bis 0,204 mm), wobei auch hier der grösste Sprung bei F_I war.

4) Wir sehen also, dass es bei dem Übergang in das Milieu der Interstitialgewässer zu einer auffälligen Verkürzung aller drei verfolgten Schwimmorgane kommt, von welchen die Furka und das 3. Glied Enp_4 zu den taxonomischen Grundmerkmalen gehören.



Graph 3. Der Verlauf der Länge A_I.

ZUSAMMENFASSUNG

Populationen der Art *Paracyclops fimbriatus* (Fischer) aus Oberflächengewässern waren in immitierten Milieu der Interstitialgewässer gezüchtet, und zwar die Dauer der Entwicklung von 7 Filialgenerationen. Bereits bei der 1. Filialgeneration kommt es zu einer nachweislichen Verkürzung aller drei verfolgten Merkmale (Furka, 3. Glied Enp_4, A_I), die einigermassen langsamer in der Richtung der Endversuche fortgeschritten hat. Experimentell wurde so die Erscheinung, zu der es zweifellos bei vielen Arten Copepoda auch in der Natur kommt, nachgewiesen. Den genetischen Mechanismus dieser Erscheinung erklärt unser Versuch nicht. Es zieht die Aufmerkamkeit an sich, dass es sich um Schwimmorgane handelt, die in Interstitialgewässern mit beschränkten Raumverhältnissen nur kleine Anwendungsmöglichkeiten finden. Die Ergebnisse des Experimentes deuten gleichzeitig an, dass der Wert vieler Unterartentaxone, wie er an Grund der Länge-Breiteverhältnisse der Furka und des 3. Gliedes Enp_4 beschrieben wurde, fragwürdig ist und das man diese Taxone nur als ökologische Formen betrachten kann. Es betrifft z. B. den Bereich der Taxone *Paracyclops fimbriatus*, *Acanthocyclops languidus*, *A. languidoides*, *Eucyclops serrulatus* und andere plastische Arten, vor allem jene, die so in Oberflächen — wie in Unterirdischen Gewässern leben, oder in anderen Biotopen, wo es zur Raumbeschränkung des Lebensraumes kommt.

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Soldan T *Comparative anatomy of the internal reproductive organs of mayflies (Ephemeroptera)* 120 pp 261 Abb, Studie ČSAV, Academia, Praha 1981 Preis 38 00 Kčs

In der Arbeit werden die Ergebnisse der Untersuchung der inneren Geschlechtsorgane von 17 Familien der Ordnung Ephemeroptera beschrieben (94 Gattungen, 164 Arten) Das sehr umfangreiche Material enthalt ausser der australischen Familie Siphlaenigmatidae praktisch alle bekannten Familien der Ordnung, von allen zoogeographischen Regionen Der Schwerpunkt der Publikation bilden die systematisch geordneten Beschreibungen sowohl der mannlichen als auch der weiblichen Gonaden Den Text begleiten zahlreiche Zeichnungen An den systematischen Teil knupft eine ausfuhrliche Diskussion an Die Resultate des Autors werden mit den Literaturangaben verglichen Es werden die Beziehungen der Eintagsfliegengonaden zu denen der Insektengruppen mit dem panoistischen Typ der Ovariolen diskutiert Auf Grund des Studiums der Anagenie der inneren Geschlechtsorgane unterscheidet der Autor 4 Hauptlinien der Entwicklung dieser Organe im Rahmen der Ordnung

Im System der Insekten gehoren die Eintagsfliegen zu den Ordnungen fur welche relativ viele Angaben uber verschiedene Organsysteme vom Sichtpunkt der vergleichenden Anatomie zur Verfugung stehen Der Vermehrungsapparat bildete bisher eine Ausnahme da er auf diese Weise und in diesem Umfang bei den Eintagsfliegen noch nicht verarbeitet wurde Durch das Erscheinen dieser Publikation wird diese Lucke in der Literatur entfernt

Der Text ist ubersichtlich in einzelne Kapitel gegliedert und mit der Zusammenfassung in der deutschen englischen und tschechischen Sprache versehen Das Literaturverzeichnis enthalt 122 Quellen Die Federzeichnungen wurden in guter Qualitat gedruckt Schade dass so eine Publikation in der so viele Insektennamen erwahnt werden ein Register entbehrt welches dem Leser die Orientierung im Text wesentlich erleichtern wurde Bis auf kleine Ausnahmen (z B auf der Seite 9 stimmen bei manchen Zitationen die Jahreszahlen mit dem Literaturverzeichnis nicht uberein) ist der Text fehlerlos geschrieben

Neben vielen originellen Angaben uber die Anatomie der inneren Geschlechtsorgane der Eintagsfliegen bringt die Arbeit auch viele theoretische Schlussfolgerungen eines erfahrenen Autors, die sicher fur jederman der sich mit der vergleichenden Anatomie der Insekten beschaftigt vom Nutzen sein werden Ausserdem sind die Kentnisse uber die Vermehrung der Wasserinsekten auch fur die Praxis sehr wichtig weil die Eintagsfliegen zu den wichtigsten Indikatoren der Wasserqualitat gehoren Auf den Markt kommt also eine Publikation welche bei den Spezialisten sicher Interesse erwecken wird

M Tonner

Barlow N D & Dixon A F G *Simulation of lime aphid population dynamics* 165 pp, 72 figs Centre for Agricultural Publishing and Documentation, Wageningen 1980 Price Dfl 35 00 ISBN 90-220-0706-5

This volume, further contribution to the Population Monographs series, represents particularly stimulating attempt of systems approach to the study of population dynamics of the lime aphid, *Eucallipterus tiliae*. The system modelled comprises the aphid, a tree as a host plant and other insects living on this plant which affect the aphid, two preddators, a capsid of the genus *Blepharidopterus*, a coccinellid of the genus *Adalia* and their alternative prey leafhopper *Alnetoidea alneti*

The model elaborated is compared with the results obtained during 8 year study in the field and in the laboratory Various kinds of mathematic population models are discussed The model presented here is described in detail Numerous explaining schemes and graphs accompany the text List of references summarises 67 works on this topic The book is provided with the appendices Glossary of Fortran Symbols and detailed Program listing

The discussion of problems of future field and laboratory research problems is very valuable Despite of limited application which is awared by authors, this publication represents the most perfect mathematical model of aphid population dynamics in the world at present

This book represents the combination of elaborating long-term field and laboratory studies and mathematical modelling approach It is very useful especially for biologists dealing with ecology of populations

M Tonner

B a r t h e l m e s, D, 1981 *Hydrobiologische Grundlagen der Binnenfischerei* VEB Gustav Fischer Verlag, Jena 1st edition 252 pp, 100 figs 30 tabs 35 – M

Freshwater fisheries are becoming an important part of agricultural production in many countries They have been rapidly industrialized and intensified during the last few decades Production has especially increased in the traditional fish-pond fishery carried out in relatively small man-made water bodies that can be emptied and refilled as required, meliorated, their bottom sediments and unsuitable vegetation can easily be removed, the composition of species age structure and abundance of the fish stock can be regulated, nutrients necessary for an increase in primary production can be supplied as well as artificial fish food etc Experience gathered from pond fishery is frequently applied to utilization of natural lakes, old river branches and valley reservoirs which can be used for production of fish However, production processes in natural waters, especially streams, are difficult to control, so that various hazards are involved in their utilization for fisheries Excessive fertilization together with the supply of nutrients from tributaries as well as from fertilizers applied to fields and meadows along the streams and in the vicinity of reservoirs may bring about undesirable biological and biochemical processes and impair the quality of the water This concerns in particular the reservoirs also used for recreation and as sources of utility and drinking water

The author of the book is a widely experienced specialist and teacher, and has published many original papers on fisheries, fish-pond fishery, and biological productivity of the water ecosystems When writing the textbook intended mainly for students, specialists and practitioners in fisheries he was aware of the necessity of impressing upon the reader the ecological point of view as well as the need of evaluation of production processes in practical utilization of biological sources of water ecosystems

In fifteen mostly detailed chapters the author discusses the species composition of the ichthyofauna of different types of water bodies regularities affecting the growth and production of economically important species of fish their food bionomy and competition, the role of fish stock as a biotic factor markedly modifying individual links of the production chain and, consequently, the flow of materials and production processes in water ecosystems, indirectly affecting the very physical and chemical properties of water in reservoirs The analyses of the structure and function of ecosystems of lakes, carp ponds, and floating waters are objective There are also thought-stimulating analyses of interaction between the fish stock as a whole as well as individual dominant species, and physical and chemical factors in environment The immediate problems of eutrofikaction of water bodies and effects of eutrofikation on fisheries in freshwater ecosystems are dealt with in a separate chapter The author has drawn on his rich experience in a chapter on the problems involved in increasing the yield of fish in lakes and carp ponds The possibilities of applying modern methods and experience gathered from carp-pond fishery to the utilization of lakes are examined In one of the chapters are treated problems connected with the quality of water, concerning both hygiene and water management The quality of water in reservoirs can be substantially affected by a well-chosen fish stock, by the number of fish as well as of their species composition Undesirable trash fish can be controlled by suitable predatory species Phytophagous fish can be used to limit the growth of water plants, and besides the economical effect of chemical control, with all its negative consequences, can thus be avoided

The book by D Barthelmes, with its ecological approach, evaluation of data in literature and their objective treatment, is a valuable modern textbook on an important field of applied hydrobiology and water ecology Data are presented in tables only when it is necessary, graphs and diagrams being preferred by the author The scope of the problems is evident in over 20 pages of carefully selected references

J Lellak

I Ch Šarova, 1981 *Žiznennye formy zuzelic* (Life forms of arabids) (Coleoptera Carabidae) Nauka Moskva 360 pp 61 Figs, 3 Rbl 40 kop

Autorka, profesorka zoologie na pedagogicke fakultě v Moskve ktera vysla ze školy akademika Giljarova, podava ve sve knize prehled o klasifikaci zivotnich forem jedne z nejpocetnějších celedi řadu Coleoptera, celedi Carabidae, a to na zakladě morfo-ekologickych principů Nejvyšši taxony tridy, jsou rozlišeny podle habitu a struktury ustniho ustroji a představuji troficke typy U imag jsou to zoofagove, myxofytofagove a symfilove, u larev zoofagove, myxofytofagove, symfilove, mycetofagove a ektoparasiti Dalsi členěni je podřizeno způsobu adaptace k pohybu a životu v různych vertikalnich vrstvach biocenos V ramci imag je rozlišeno 29 typů životnich forem, larvy jsou rozděleny do 23 typu U imag jsou kriteriem typ nohou, uroveň vyvoje oči a tykadel, rozměry tela a zbarveni a sklerotizace povrchu tela Skupiny zivotnich forem larev jsou charakterizovany morfologickymi adaptacemi spojenymi s životem v ruznych vrstvach biogeocenos

Porovnani životnich forem imag vzhledem k jejich specializaci ukazalo, že evoluce se ubirala od zootagie k myxofytofagii a myrmecofilii V průběhu evoluce zoofagove opustili povrch pudy a pronikli do hrabanky, do půdy, do chodeb a nor hlodavců, do jeskyň, dale do dutin a pod kuru stromů a na traviny V ramci myxofytofagů se zretelne projevuje trend k bylozravosti a k ryti v pudě Srovnavaci morfologicke studie larvalnich zivotnich forem ukazuji, že ekologicka radiace larev prochazela od zoofagů k myxofytofagum, symfilum, mycetofagum a ektoparasitum Zoofagove a mycetofagove vykazuji v evoluci tendenci přechodu od zivota v hrabance k zivotu na povrchu půdy nebo v pudnich dutinach, chodbach nebo v jeskynich Přechod k životu v pevne půdě je provazen zvyšenim aktivity ryti

Autorka sledovala zivotni formy strevlikovitych i ve vztahu k vegetačnim zonam v ramci evropske časti SSSR (krome hor) a zjistila, ze smerem k jihu narůsta jejich variabilita Jiznim smerem narůsta take pocet zivotnich forem adaptovanych k zivotu v půde a k ryti Pomer zoofagů a myxofytofagů je ruzny v ruznych zonach Myxofytofagove jsou percentualně nejpocetnějši ve stepni a polopouštni zone (50 %) Jejich abundance klesa severnim a jiznim smerem Naopak abundance zoofagů stoupa od stepni zony severě i jizne Spektrum zivotnich forem může dobre sloužit jako krajinny indikator, nektere stenobiontni ,životni formy jsou indikatory určitych pudně-vegetačnich podminek

Knizku doplnuji kliče pro imaginalni i larvalni životni formy, 26 typu imag je vyobrazeno (habitualni fotografie), stejne jako 16 typů larev (perovky habitu) Knizka je dobre dokumentovana i tabelarně a to jak morfometrickymi charakteristikami trid a podtřid, tak i srovnavacimi tabulkami vyssi klasifikace celedi s klasifikaci životnich forem imag i larev Hlavni diferencialni morfologicke znaky třid a podtřid larev i imag jsou vyobrazeny, stejne jako schemata adaptivni radiace těchto znaků

Prace je ve světove literature ojediněla svym ekologickym pohledem na evoluci a klasifikaci jedne z nejvyznamnejšich čeledi radu Coleoptera, ktera slouzi velice často jako modelova skupina pro nejrůznějši ekologicka studia Je využitelna jak pro kausalni prace biocenologicke, tak pro studie spojene s ochranou a tvorbou krajiny, především pro svou vysokou bioindikacni hodnotu v ramci evropskych vegetacnich zon V neposlední řadě poslouzí jistě jako zaklad pro obdobne studie duležitych zivocišnych skupin, a to nejen z kmene členovců Je napsana rusky s anglickym souhrnem

K Hůrka

B o c q u e t C, J G e n e r m o n t et M L a m o t t e (eds) *Les problemes de l'espece dans la regne animal* Vols 1,2 Memoires Societé Zoologique de France, 38 1—407, 1976 a 39 1—381, 1977 Cena 90 Fr

Francouzska zoologicka spolecnost vydala trojdilnou mnohoautorskou publikaci věnovanou slozite a nevycerpatelne problematice zivocišneho druhu — publikaci fascinujici, potrebnou a kupodivu znamou Jejim specifickym rysem je jednak to, ze je psana pouze frankofonnimi zoology, jejichž prinos k evolucně taxonomickym otazkam byva opomijen diky zaplavě praci z anglicke jazykove oblasti, jednak i jeji skupinově orientovany pristup k problematice prve dva svazky obsahuji 17 kapitol, z nichz vsechny krome uvodni editorske eseje o vyvoji koncepce biologickeho druhu jsou věnovany všestrannemu rozboru problematiky z hlediska vybranych zivocisnych skupin (Teprve treti, zde nerecenzovany svazek obsahuje pouze obecně orientovane prispevky)

První díl obsahuje kapitoly o druhu v ornitologii (F *Vuilleumier*), u kostnatych ryb (J D a g e t a M-L B a u c h o t), motylů (H D e s c i m o n a M G u i l l a u m i n), Drosophilidae (L T s a c a s a C B o c q u e t), komarů (A G r j e b i n e, J C o z, J-M. E l u a i d, J M o u c h e t a J R e g e a u), modelovych skupin koryšů (C B o c q u e t), morskych mlžů (P L u b e t) a prvoků (J G e n e r m o n t), druhy dil o druhu u pavouků (P B l a n d i n), chvostoskoku (P C a s s a g n a u), rovnokridleho hmyzu (P D r e u x, plzu (A F r a n c), zab (A D u b o i s — snad nejvšestranněji a nejhloubeji pojata kapitola!), mloku (F G a s s e r), africkych gekonu z rodu *Lygodactylus* (G P a s t e u r) a hlodavců (J C h a l i n e a L T h a l e r) Tento taxonomicky pristup umožnuje mimo jine seznamit se zasvedceně s problematikou a soucasnou interpretaci teoreticky vyznamnych a modelove studovanych druhovych komplexu, jejichz hodnoceni se notoricky vymyka tradičnimu pojeti diky přitomnosti semispecies kryptickych, uniparentalnich a hybridogennich druhů, atp, podrobne je kupr rozebrana situace u druhovych skupin *Paramecium aurelia, Jaera albifrons* (Asellota Janiridae) *Erebia tyndarus* (Satyridae), *Anopheles maculipennis, A gambiae, Culex pipiens, Rana pipiens a Rana "esculenta"*

Jednotlive přispěvky jsou orientovany predevšim na zhodnoceni situace u jednotlivych živocisnych skupin dane jejich specifickymi biologickymi vlastnostmi ale i urovni a historickym vyvojem jejich studia mirou znalosti neortodoxnich situaci a mirou pouziti netradicnich taxonomickych metod po probrani a metodickem a interpretačnim zhodnoceni souborů pouzivanych znaků jsou vetsinou analyzovany modelové situace, ktere jsou dale diskutovany v kontextu s obecnou teorii druhu a speciace Vsichni autori zastavaji koncepci biologickeho druhu a zduraznuji jednotu kriterii a pouziti metod strukturalnich, biometrickych, cytotaxonomickych, biochemickych, ekologickych, ethologickych, biogeografickych i mixiologickych Většina autoru vychází z tradični Mayrovske představy allopatricke speciace mnohokrate je však zdůrazněna i existence speciace allochronicke, stasipatricke a hybridogenni, napadne casto se objevuje potreba revidovat statut populaci parapatrickych tradičně povazovanych za poddruhy Z obecne problematiky je dale mnohokrat diskutovana koncepce superspecies a nejrůznejšich typu semispecies (druhů in nascendi), objevuji se otazky tykajici se druhu v case, statutu hybridogennich a gynogenetickych populaci, ethospecies, kryptickych druhů, pojeti druhu u organismu bez sexuality, atd. Z metodickeho i interpretacniho hlediska jsou rozebirana kriteria mixologicka, udaje o polymorfismu populaci a diskordantni geograficke variabilite Často se objevuji historicko-statisticke přehledy o trendech taxonomickeho vyzkumu jednotlivych skupin a jejich korelacích; zvláště poutavá, všestranná a vyčerpávající analýza je podána u obojživelníků A. Duboisem.

Dílo francouzských zoologů je skutečně nevyčerpatelným zdrojem věcných i bibliografických informací a podnětných myšlenek; ideálně spojuje rozbor konkrétních situací s jejich teoretickým zobecněním, dokumentuje invazi nových metod a kritérií do gama-taxonomie a potvrzuje, že dynamický charakter biologického druhu se vzpěčuje jednoduché tradiční klasifikaci prakticky u všech živočišných skupin. Jde o stěžejní publikaci pro každého evolučního biologa a obecněji zaměřeného taxonoma.

P. Štys

Cloudsley-Thompson, J. L., *Evolutionary Trends in the Mating of Arthropoda.* Patterns of Progress, Series Zoology 5, Shildon, 1976, 85 str., 32 obr., $ 7.

Známý anglický vysokoškolský učitel a zoolog, který působil řadu let v Africe a autor mnoha knih a monografií věnovaných terestrickým bezobratlým živočichům, jejich adaptacím k životu na zemi, v poušti apod., sleduje v tomto svazku série drobných monografií vydávaných nakladatelstvím Meadowfield velmi zajímavou oblast epigamních projevů a oplozování členovců.

Po krátkém obecném úvodu, v němž podává přehled základních vývojových trendů ve způsobu oplozování a diskutuje i otázku tvorby spermatoforů a jejich homologie u různých skupin členovců, podává krátký výklad fylogeneze skupiny. Třetí kapitolou začíná probírání vlastního tématu počínaje vnějším oplozením, které se u členovců vyskytuje ještě u některých vodních forem. Pokračuje dále vývojem způsobu oplozování u terestrických skupin, a to nejprve kladením spermatoforů volně v prostředí, později za přítomnosti samic nebo po složitých zásnubních hrách přes přímé předávání spermatoforů až po vnitřní oplození, které představuje jedině ekonomický způsob, zabraňující ztrátě bílkovin. Autor upozorňuje na to, že tato zajímavá stránka života živočichů, související úzce s reprodukčními izolačními mechanismy a tím i s existencí druhů, poskytuje samozřejmě i řadu důležitých aspektů pro posuzování fylogenetických vztahů mezi skupinami sledovaného živočišného kmene. Také tato fakta podporují závěry o polyfyletickém původu členovců.

Brožura je zakončena přehledem klasifikace tříd a řádů členovců uváděných v předcházejícím textu. Je zde na jedné straně použito moderního označení větve vzdušnicovců (ovšem bez drapkonošů) jako Uniramia s chvostoskoky jako samostatnou třídou, na druhé straně řadí ještě hmyzenky a vidličnatky jako řády mezi bezkřídlý hmyz. U korýšů používá již zastaralého třídění na třídy Entomostraca a Malacostraca.

V seznamu literatury uvádí výběr nejdůležitějších prací o tématu, především anglosaské produkce. Chybí zde proto pro naše čtenáře důležitá kniha akad. Giljarova, Zakonomernosti prisposoblenij členistonogich k žizni na suše, Moskva 1970, která obsahuje i obdobně pojatou kapitolu o epigamních projevech.

Recenzovaná knížka je napsána stručně, s pedagogickým taktem, utříděně, a je provázena i řadou převzatých instruktivních obrázků. Přes malý rozsah se autorovi podařilo shromáždit mnoho údajů podávaných i v evolučních souvislostech a to tak, že nutí čtenáře k zamyšlení. Domnívám se, že ji bude s potěšením číst nejen každý zoolog, ale i biolog. Přispěje nejen k podstatnému rozšíření jeho představ o vývoji největšího živočišného kmene, ale i k zamyšlení nad evolucí vůbec.

M. Kunst

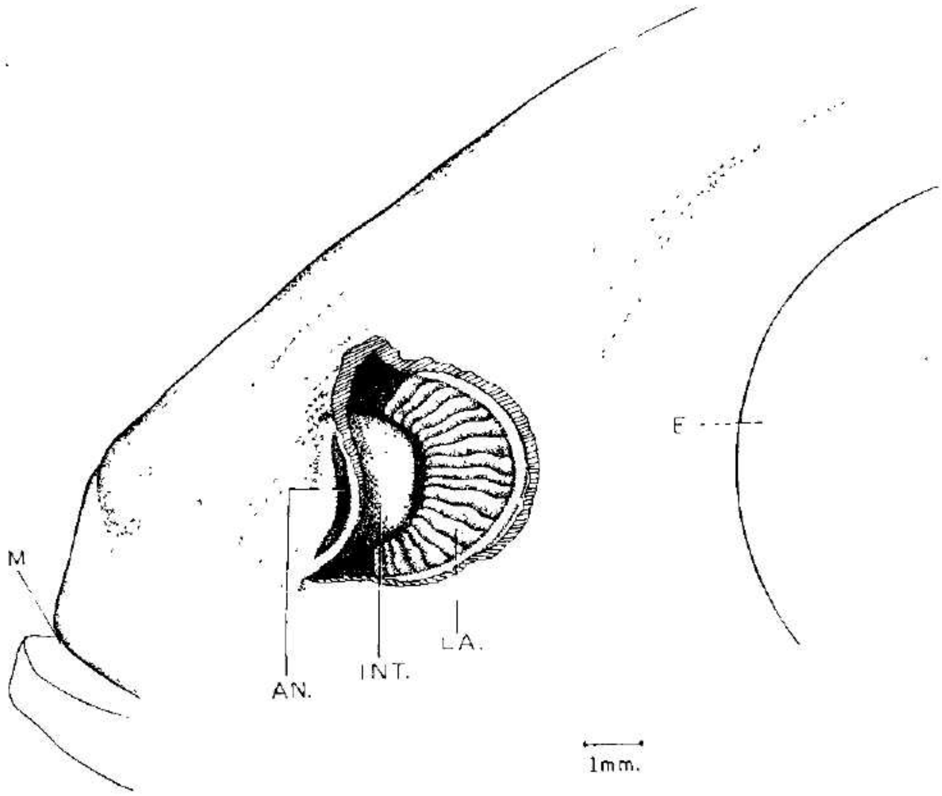

Fig. 1 Lateral view of the head of *H. ilisha* to show the position of anterior nare, internal nasal tube and lamellae (posterior nare removed).
Explanation of abbreviations used in figures:
A.N. = Anterior nare; CB = Cerebellum; C.H. = Cerebral hemisphere; E. = Eye; I.N.S. = Inner accessory nasal sac; I.N.T. = Internal nasal tube; LA. = Lamella; M. = Mouth; M.O. = Medulla oblongata; O.L. =Olfactory lobe; O.N.S. = Outer accessory nasal sac; O.P. =,Opening of accessory nasal sac; OP.L. = Optic lobe; O.T. = = Olfactory tract; RA. = Raphe; RO. = Rosette.

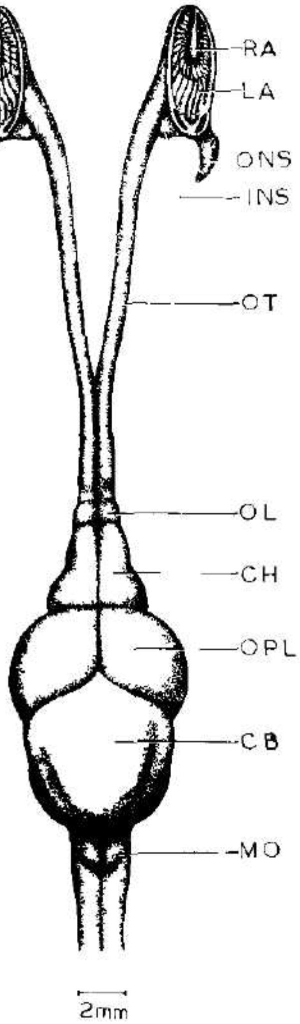

Fig 2 Dorsal view of the brain of *H ilisha* along with olfactory tracts and olfactory apparatus

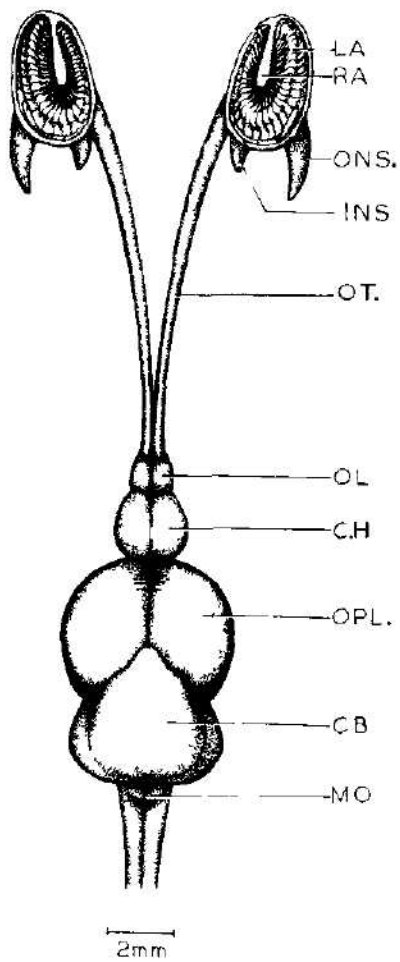

Fig 3 Dorsal view of *S. fimbriata* along with olfactory tracts and olfactory apparatus

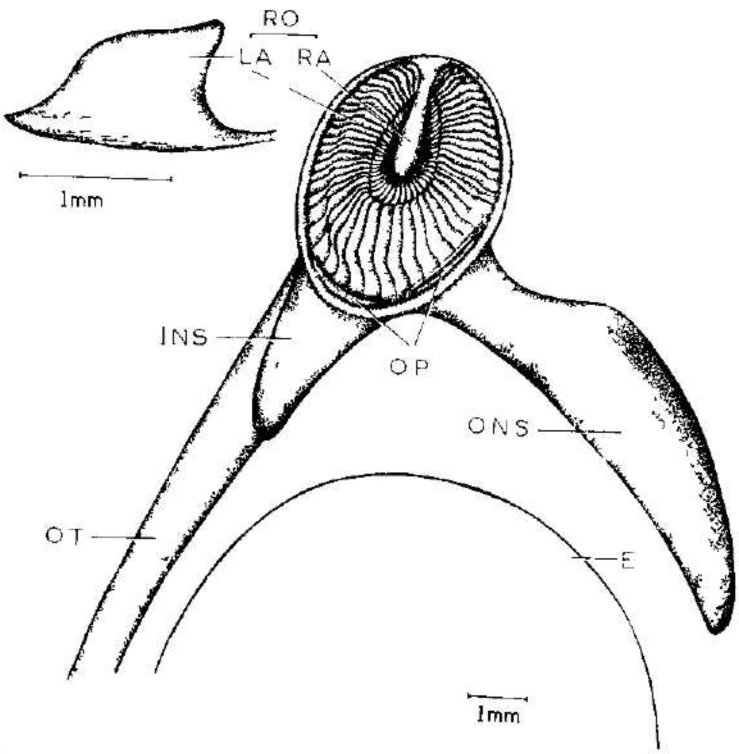

Fig. 4 Enlarged view of the olfactory apparatus showing the raphe, accessary nasal sacs and lamellae of *H. ilisha*. A single lamella has been shown.

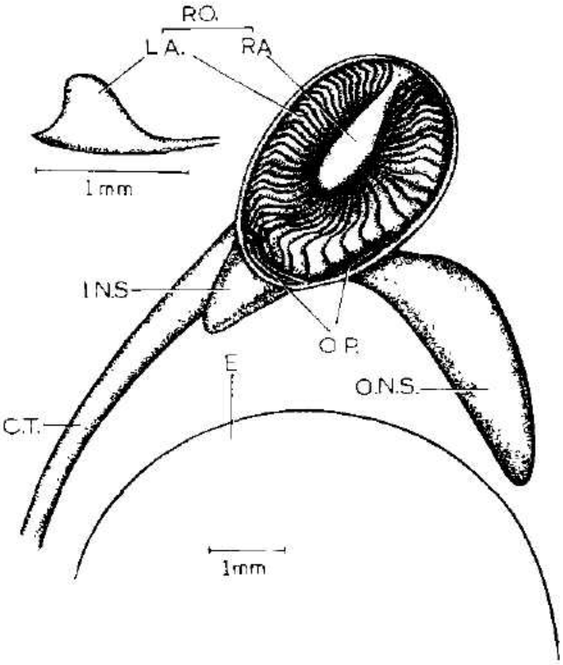

Fig. 5. Enlarged view of the olfactory apparatus showing the raphe, accessory nasal sacs and lamellae of *S. fimbriata*. A single lamella has been shown.

POKYNY PRO AUTORY

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

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

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

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

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

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

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Toto číslo vyšlo v únoru 1982