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Department of Parasitology, Charles University, Prague

A NEWLY DISCOVERED STRUCTURE OF TAXONOMIC VALUE IN PAUROPODA

JOSEF CHALUPSKÝ

Received November 27, 1970

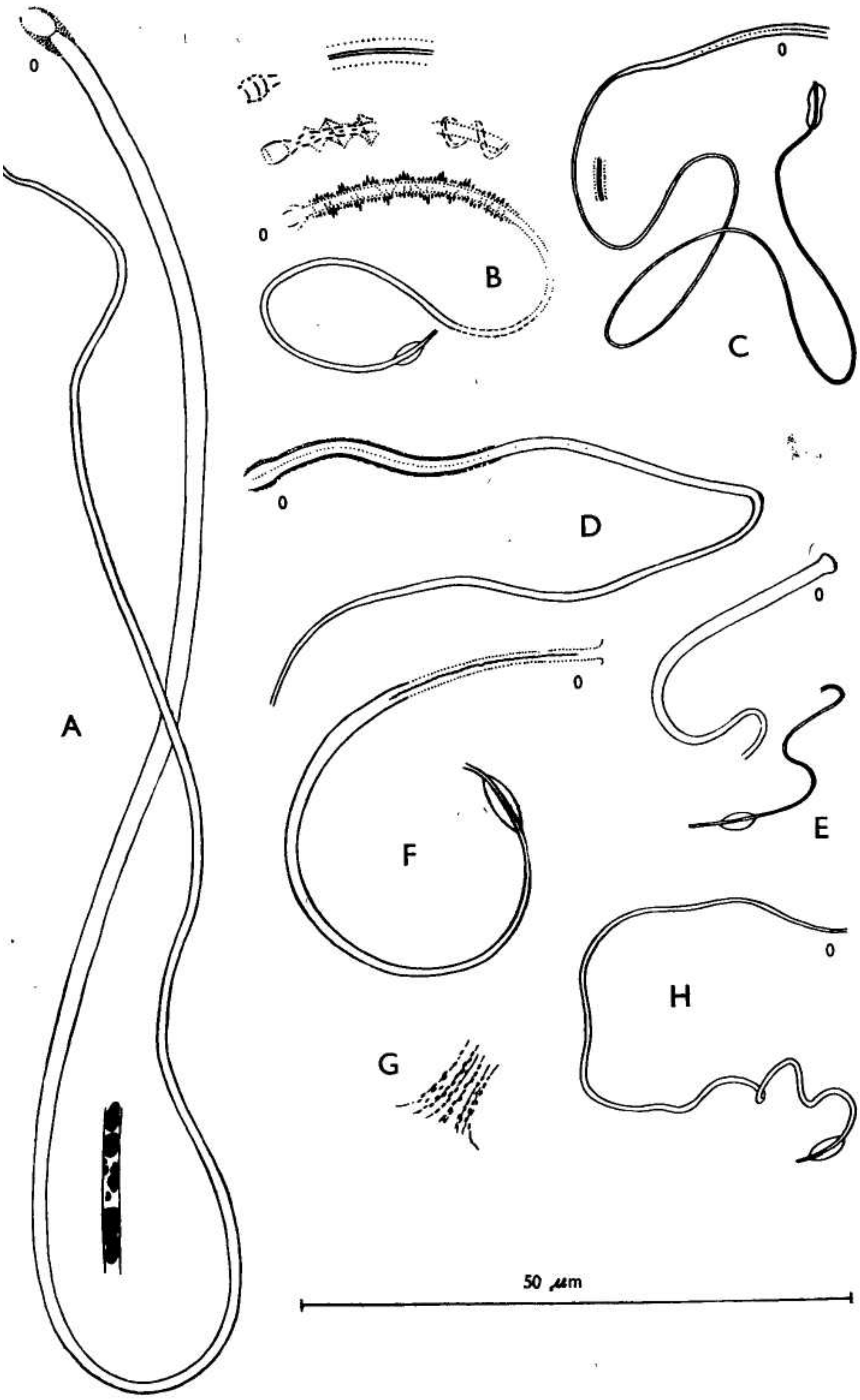
Abstract: The description of ductus receptaculi of various Pauropoda is presented and its possible taxonomic value is discussed.

The preparation of Pauropoda in Swan's clearing medium and their examination with the phase contrast microscope allowed us to notice a tube-like structure in females, connecting their receptaculum seminis with the outside. Older authors — Kenyon (1895) and Schmidt (1895) — who studied the anatomy of Pauropoda mentioned this connection. Kenyon says that "the duct is short, and shows no difference in structure from the sac" and presents it in Fig. 68 and 84 in *Eurypauropus spinosus*. Schmidt, who studied representatives of the so-called *Pauropoda agilia* is very precise about this structure, saying that "es stellt einen blinden und verhältnismässig engen, an seinem Ende etwas erweiterten U-förmigen Schlauch vor, der sich von der Geschlechtsöffnung aus nach hinten richtet, dann aber eine scharfe Biegung macht, neben seinem vorderen Theile verläuft und in dem Niveau der Geschlechtsöffnung endet". The accuracy of his observation is documented by Fig. 1 in the text and Fig. 18 in Tab. 26, where this part is indicated AR. Tiegs (1947), who has studied *Pauropus silvaticus*, interprets the connection of the receptaculum seminis with the outside as direct, or the receptaculum seminis leading into the genital atrium. The findings of Silvestri (1902), who also studied the anatomy of Pauropoda, cannot be given here. They will be discussed at the earliest opportunity. Considering the character of this tube, obviously it is a ductus receptaculi, and it will be so indicated in the following text (using the abbreviation d.r.).

As for the technique of my observations, Swan's medium modified by Kramář (1952) is the compound of chloral hydrate (60 g), gum arabic (15 g), glucose (3 g), glacial acetic acid (5 g) and distilled water (20 g) — essentially Berlese's compound without glycerol. Its advantage is in suppressing all non-solid inner structures of the prepared object, so that the d.r. can be very well examined with the phase contrast microscope. The clearing media which preserve soft parts of the anatomy are not suitable; the d.r. is quite invisible in them. For a detailed study of the d.r. oil immersion objectives must be used.

DESCRIPTION OF DUCTUS RECEPTACULI

In general we can say that the d.r. is a tube-like structure of varying length, connecting the receptaculum seminis of females with the outside or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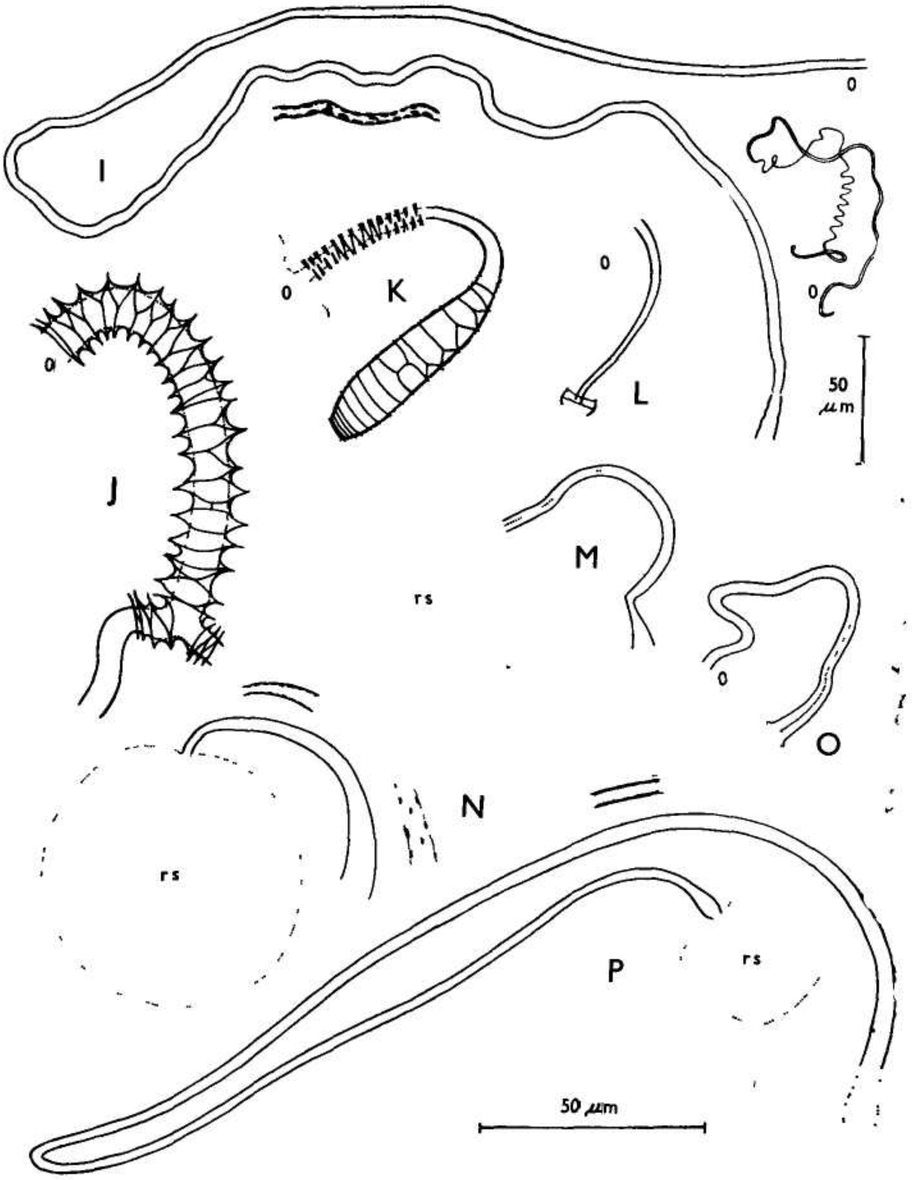

Fig. 1. Semidiagrammatic figures of the ducti receptaculi of the Pauropoda mentioned in the text (except for *Pauropus bagnalli*, which is figured elsewhere). A — *Allopauropus distinctus*, B — *A. gracilis* (with variations in the area of the orificium internum), C — *A. cuenoti*, D — *A. hessei*, E — *A. vulgaris* (a longer course of d.r. near the orificium externum is shown in the lower part), F — *A. tripartitus*, G — the entrance of the neighbouring duct from ovaries (only sometimes visible), H — *A. multiplex*, I — *A. helveticus* (specimen from Prague, on the right the course of another type from eastern Slovakia, on a different scale), J — *Pauropus huxleyi* (with the remnant of a bifurcation), K — *Scleropauropus grassei*, L — *Brachypauropus hamiger*, M — *Stylopauropus pedunculatus brevicornis*, N — *S. pedunculatus pedunculatus*, O — *S. beauchampi*, P — *Eurypauropus hamiger* (on a different scale). Explanations: O — orificium internum, rs — receptaculum seminis. The scale on the left applies to all ducti receptaculi except for those of one type *A. vulgaris* and *E. hastatus*, as has been mentioned. Details of structures are shown in shorter sections (see the text).

with the genital atrium, if there is any. Its course varies and in some species a **pars dilatata** can be distinguished; its ends are not always the same either, so that for better orientation we shall call them **orificium externum** and **orificium internum**. Along its entire length the d.r. is somewhere quite smooth, elsewhere partly or completely surrounded by a folding layer. The structure of walls and the content of the tube do not always look alike, differing perhaps according to the physiological state of the moment. The receptaculum seminis itself is most often not very well visible and is usually located rather by the sperm contained in it. Rarely can there be seen another structure near the orificium externum, which seems to belong to the neighbouring duct from ovaries.

The total arrangement is essentially different in individual genera (or groups of species); therefore brief characterizations of individual types with semi-diagrams are given below.

Only the species occuring in Czechoslovakia have been studied.

The genus *Allopauropus*

In most of the representatives studied the d.r. is an elongate, narrow, tube-like structure, usually widening towards the receptaculum seminis, sometimes with a distinct pars dilatata. In some species the pars dilatata is surrounded by a fine outer layer and in half of the species the orificium externum is equipped with a spindle-like tiny structure, found in this genus only. On the whole the ducti r. of some species are very similar, only a few well differentiated species possess a characteristically formed d.r. and can be identified by it.

A. gracilis (Hansen, 1902) — the d.r. is of medium length, thin, smooth along its entire length, but in pars dilatata is usually surrounded by a fine folding layer. It is not certain whether this ability of the layer is natural, but in the larger genera given below a folding layer is clearly visible. The d.r. is often variously sinous and with s-shaped curves. The orificium internum occurs in various shapes, sometimes simple, sometimes funnel- or barrel-shaped, or with ornaments. The orificium externum has a spindle-like part; the d.r. might freely run through it. *A. gracilis* is a very variable species, some of its varieties looking more like separate species, so that there are also numerous differences in the structure of the d.r. However, basically is the same in all the varieties studied.

A. hessei Remy, 1935 — its d.r. is very similar to that of *A. gracilis;* the same is true of *A. tripartitus* Krestewa, 1940, where the tube is widest somewhere before its end.

A. multiplex Remy, 1936 has also a very similar d.r., only not always widening towards the receptaculum seminis. On the whole the latter species do not have a d.r. well distinguishable from *A. gracilis* owing to its variability.

A. vulgaris (Hansen, 1902) has d.r. of a medium length, but its narrow tube usually markedly widens towards the receptaculum seminis. The narrow part varies from short to long (similarly as anal plates). The widened pars dilatata is sometimes very conspicuous, overshadowing the preceding part; sometimes it resembles an elephant tusk and appears like a single part.

A. cuenoti (Remy, 1931) has a long, very thin d.r., sometimes looking almost thread-like, curved and coiled, only slightly widening towards the receptaculum seminis. In some specimens there is a hardly perceptible outer layer, suggesting that the d.r. might be thicker than it appears, and the thin visible tube would then be the inner calibre.

A. helveticus (Hansen, 1902) has a very long d.r., often of a rough texture, bent to one side or running along the body, often meandering. In some specimens the tube is uniformly wide along its entire length, in others it is distinctly wider towards the receptaculum seminis. The thinner to very thin part towards the outside is usually densely meandering and forming loops. The d.r. is very conspicuous and well distinguishable from the other representatives of the genus.

A. distinctus Bagnall, 1936 possesses a very long d.r., in one part widther than in the previous species.

The genus *Stylopauropus*

The d.r. of *Stylopauropus* is relatively short (compared with the previous genus), smooth, without a spindle. The globular receptaculum seminis is usually very well visible.

S. pedunculatus pedunculatus (Hansen, 1902) possesses a d.r. in shape of rather short tube, tapering towards the receptaculum seminis, then in the opposite direction than in the genus *Allopauropus*. The pars dilatata is thus situated towards the outside. In *S. pedunculatus brevicornis* Remy, 1935 it is similar, but somewhat smaller.

The genus *Pauropus*

The d.r. of the representatives of this genus is shorter but wide, virtually always surrounded by a folding outer layer. The difference between the studied *P. huxleyi* Hansen, 1902 and *P. bagnalli* Remy 1935 is rather in the size of their ducti r. However, the d.r. of *P. bagnalli* is considerably variable; in some specimens the outer layer of the d.r. is not folded, even though it is visible, looking loose and inconspicuous. The d.r. is not always narrowed at the same end, so that it might change its shape.

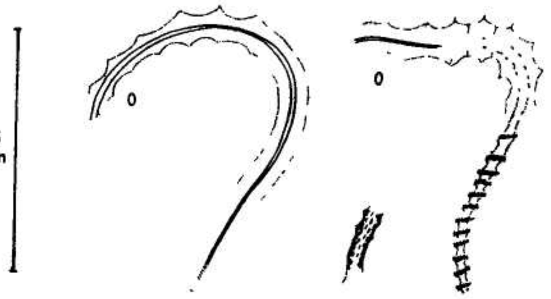

Fig. 2. Semidiagrammatic figures of the ducti receptaculi of *Pauropus bagnalli*. (For more see text).

The genus *Scleropauropus*

In several specimens of the only representative studied *S. grassei* Remy, 1936, the d.r. is a rather short tube widening towards the outside, adorned with external structures looking capable of folding, like in the previous genus. The pars dilatata is situated towards the outside.

In the only female specimen of the only representative *B. hamiger* Latzel, 1884 the d.r. is but partly visible as a smooth tube, reminding of the genus *Stylopauropus.*

The genus *Eurypauropus*

In the only female specimen of *E. hastatus* Attems, 1882 the d.r. is a long smooth tube, partly with a finely granular inner surface; owing to the robustness of the members of this genus it is substantially bigger than in the other genera. It somewhat resembles the d.r. of *Allopauropus.*

DISCUSSION AND COMMENTS

The main question of the taxonomic utility of the diverse morphology of the ducti r. is how great is their variability in the obviously fundamental characters, e.g. the length of the d.r., the narrowing and its direction, etc. There is a certain variability, but the basic pattern of the d.r. remains, being obvious on the generic level as well as in some highly differentiated species. The material studied, limited to Czechoslovakia, often comes from very distant western and eastern localities and its variability appears for the time being as less individual, but more local and geographical. An example of this experience is given by Pauropoda from Prague and its vicinity, studied most thouroughly. Their d.r. is very constant and highly differentiated species as *A. helveticus, A. distinctus,* etc. can be identified at first sight by their d.r. It will be interesting what the study of the d.r. of Pauropoda from larger regions will show. It should be added that the ducti r. may vary in appearence when especially their content, but their outer layers as well, look different, probably owing to the physiological state and fixation. The d.r. then appears dark or pale, finely or roughly granular, etc. Of course that does not consern the basic features mentioned above.

It seems from what has been said that the varying morphology of the d.r. offers a new tool for speculation on the relationship of genera or species and their classification into natural groups. Anal plates suggest much, serving as a basis for such speculations, but other characters, more valid than chaetotaxy, could support them. Exemplary in this respect is the group of *Allopauropus gracilis* with several described varieties or subspecies that can be grouped by the anal plates as well as the ducti r. On the contrary, some good species show their high differentiation on their d.r., too (e.g. *A. helveticus*). Genital structures are usually very important for the taxonomy of arthropods, so that a relationship that is or will be shown by them in some Pauropoda need not be just seeming.

As for the function of this genital part, certainly it is not different from similar structures in insects. For the most part is an apparently elastic structure, always long enough for the sperm to leave the receptaculum seminis slowly and not in mass. The above mentioned differences noticed in the inner structure obviously result from a varying physiological state, apparently owing to secretion.

The d.r. can be easily found by means of the method given above, if only we concentrate on the area between the 2nd pair of legs. Of course the d.r.

is not always perfectly visible, it may even seem to have completely disappeared in contracted specimens.

The illustrations to this paper have been drawn after well visible ducti r. of certain specimens, so that they are individual, not abstract types, although they are semi-diagrammatic. There where it could be helpful, other varieties as well as the inner structures, as they sometimes appear, are figured.

Photographs have been added for basic illustration only. Under the low pover objectives they allow obtain a reliable picture of only large ducti r., under large magnification the position of the d.r. does not allow us to see the whole arrangement.

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

Addendum

The earliest opportunity to discuss Silvestri's findings concerning the structure in question has offered itself now. Silvestri (1902) found it in *Allopauropus brevisetus* as a duct of the receptalucum seminis or, according to him, spermateca, and says that "il suo condotto cilindrico, lungo circa 190 μ e largo 8, è rivestito internamente da uno straterello di piccolissime cellule epiteliari ed all'esterno da uno strato di muscoli disposti circolarmente." The part of the duct is figured in fig. **46**.

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CONTRIBUTION TO THE GROWTH OF THYMALLUS ARCTICUS (PALLAS, 1776) FROM THE UPPER YENISEI RIVER OF MONGOLIA

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Received November 25, 1970

Abstract: Age and growth determinations were made from scales of 163 specimens of *Thymallus arcticus* from the upper Yenisei river of Mongolia. Computations of growth histories were made by the method of Lee, (1920). Growth is compared with the data of Svetovidov (1936). The conversion factors for standard, fork (Smith's standard length) and total lengths have been worked out.

INTRODUCTION

Thymallus arcticus (Pallas, 1776) a nominate species, is a common Salmonoid fish inhabiting the drainages of the river Kara, Ob, Yenisei and the river Kobdo in north-western Mongolia (Berg, 1948). Svetovidov (1936), Berg (1938) and Daši-Dorži (1955) appear to be the only literature available on Thymallus arcticus This paper is concerned with the growth of *Thymallus arcticus* from Šišchid river which is the Mongolian name of the upper Yenisei river.

MATERIALS AND METHODS

The specimens used in this study were collected by Dr. K. Hensel (Komensky University, Bratislava.) and Dr. K. Pivnička (Charles University, Prague) when they went to Mongolia on an expedition organised by the Mongolian State University and the Mongolian Academy of Sciences in July, 1969.

Thymallus arcticus was collected along with other species from 100 meters of Šišchid river at a locality 20 Km. from Dood-caagan nuur, (99°22′ EL, 51°30′ N Lat.) by a seine net with 7—8 mm mesh size. The river is 20—30 meters wide and has an average depth of 2 meters, in the region where collections were made (K. Pivnička, personal communication). All collections were made by towing the seine net once in the direction of the flow of water, in each of 30 to 35 meter lengths.

Scales and fork lengths (Smith's standard lengths) of 78 specimens and 88 preserved specimens were made available to the author. Standard, fork and total lengths were measured to the nearest mm. Weights were obtained to the nearest gram. Standard lengths were measured from the tip of the snout to the anterior end of the median caudal fin-rays; fork lengths from the tip of snout to the centre of fork of caudal fin and total lengths from the tip of the snout to the tip of the tail when the lobes are held parallel.

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* This paper is part of the post-graduate studies sponsored by the University of 17th November, Prague.

Table I. Growth of different age-classes of *Thymallus arcticus* from the river **Šišchid**.

Age-class	Year of hatching	Number	Average fork length in mm at the time of capture.		Back calculated fork length in mm. l_1	l_2	l_3	l_4	l_5	l_6	l_7
0	1969	11	(20— 29)	24.0	—						
I	1968	75	(59—134)	91.5	80						
II	1967	26	(130—184)	163.1	81	143					
III	1966	18	(205—245)	222.4	86	146	201				
IV	1965	23	(240—275)	256.5	82	130	190	241			
V	1964	7	(277—327)	293.0	78	141	191	245	283		
VI	1963	2	(296 ; 301)	298.5	86	128	186	218	269	299	
VII	1962	1		332.0	80	155	195	238	282	307	324
	Total	163	Average		82	141	193	236	278	303	324
			Annual increments			59	52	43	42	25	21
			Maximum		117	181	227	298	322	307	—
			Minimum		63	117	166	206	256	296	—

Table 2. Average body weights of *Thymallus articus* from the river Šišchid computed from the logarithmic graph 2.

Age-class	Number	Average fork length in mm at the time of capture	Average body weight in grams at the time of capture	Back calculated body weight in grams at the end of growth periods. w_1	w_2	w_3	w_4	w_5	w_6	w_7
0	11	24.0	0.3	—						
I	75	91.5	12.0	6.0						
II	26	163.1	36.8	6.2	40.0					
III	18	222.4	166.0	7.5	42.0	120.5				
IV	23	256.5	270.0	6.5	30.0	100.0	216.0			
V	7	293.0	400.0	5.5	38.5	104.0	230.0	360.0		
VI	2	298.5	422.0	7.5	28.0	93.0	156.0	300.0	422.0	
VII	1	322.0	580.0	6.0	52.5	110.0	208.0	360.0	460.0	552.0
Total	163		Average	6.5	38.5	105.5	202.5	360.5	441.0	552.0

Table 3. Tabulation of data employed in comparing the growth of *Thymallus arcticus*.

	Average fork length in mm at successive years of life.					
	l_1	l_2	l_3	l_4	l_5	l_6
Svetovidov, 1936 (a)	94	146	190	239	266	253
Author (b)	82	141	193	236	278	303
Average of (a) and (b)	88	143	191	237	272	278
% deviation of (a) from average*	+6.8	+2.1	—0.5	+0.8	—2.2	—9.0
% deviation of (b) from average*	—6.8	—1.4	+1.0	—0.4	+2.2	+8.9

* Refer graph 3.

Since lengths other than fork lengths are in usage in the study of Salmonoids, the conversion factors for standard and total lengths are calculated.

Standard length = Fork length × 0.9244
Total length = Fork length × 1.1078

The scale method was employed in assessing the age and growth. 3—5 scales were collected above the lateral line opposite the origin of the pelvic fin. All scales were examined in dry mounts using a microprojector (Carl Zeiss, Jena) with × 17.5 magnification. The ventral diagonal radius and the distance from the centre to the different annuli of one scale only were measured. The determination of age had been based on the counting of the number of annuli.

To determine the body — scale relationship, the lengths were grouped into 10 mm groups and the mean body lengths were plotted against the corresponding mean ventral diagonal radii. (See graph I.) Regression line was fitted by the standard statistical method. The relationship is expressed by the equation

$$L = 34.559 + 3.20668\,R,$$

where L = Fork length
and R = ventral diagonal radius ($\times 17.5$).

The constant 34.5 represents the theoretical fork length of a fish at which the scales start to develop. On the basis of the linear relationship the body lengths at the end of each growth period were back calculated using the method of R. Lee (1920) with a correction of 34.5 mm.

The average body weights at the end of each growth period were computed from the logarithmic graph (See graph 2.) according to the relationship expressed by the equation,

$$\log W = \log C + n \log L$$ (Lagler, 1950)

where W = weight of fish in grams
L = fork length in mm
C and n are constants.

RESULTS AND DISCUSSION

Thymallus arcticus from Šišchid river has a steady growth but additional yearly increments are less as the fish grow older. (See table I.) The condition of the fish appear to be improving annually. This is evident from the figures of K. (Table 4.)

To compare the growth of *Thymallus arcticus* from Šišchid with the data of Svetovidov (l.c.), the percentage deviation of the growth from the average of both data were represented in a graph. (See graph 3.) From the graph it appears that *Thymallus arcticus* from Šišchid has poor growth during the first two years of growth and good growth during the Vth and VIth years of life. The situation in the case of the *Thymallus arcticus* of Svetovidov (l.c.) is quite the opposite. It is interesting to note that there is no remarkable deviation in growth during the IIIrd and IVth years of

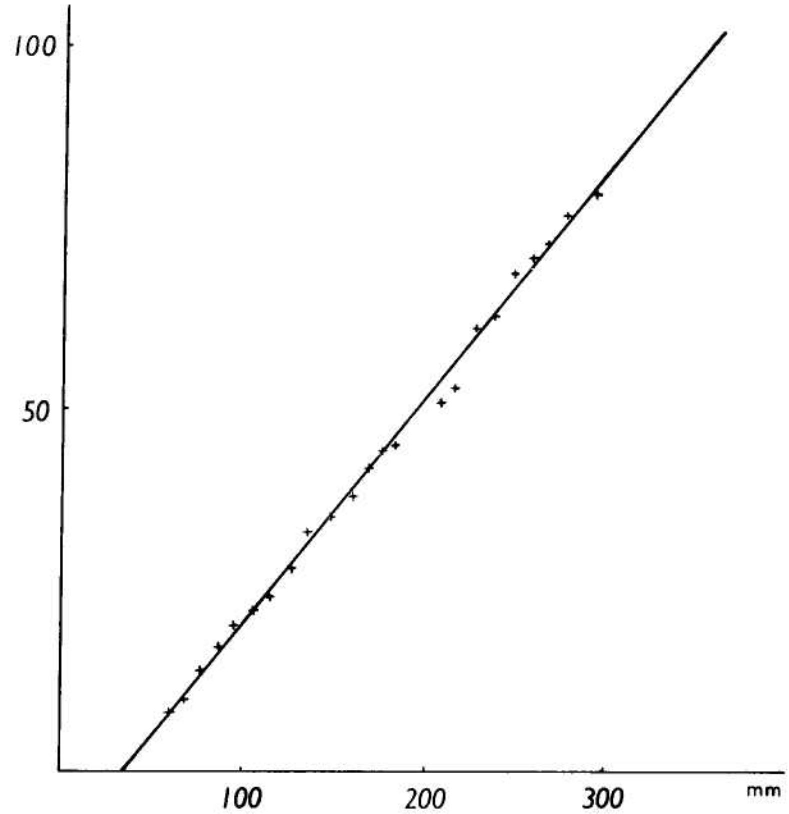
Table 4. Average growth of different age classes of *Thymallus arcticus* from the river Šišchid expressed in total, standard and fork lengths together with K.

	Average length in mm at successive years of life.						
	l_1	l_2	l_3	l_4	l_5	l_6	l_7
Total length	91	156	214	261	308	336	359
Standard length	76	130	178	218	257	280	300
Fork length (Smith's standard length)	82	141	193	236	278	303	324
W (grams.)	6.5	38.5	105.5	202.5	360	441	552
K+	1.18	1.37	1.47	1.54	1.68	1.59	1.62

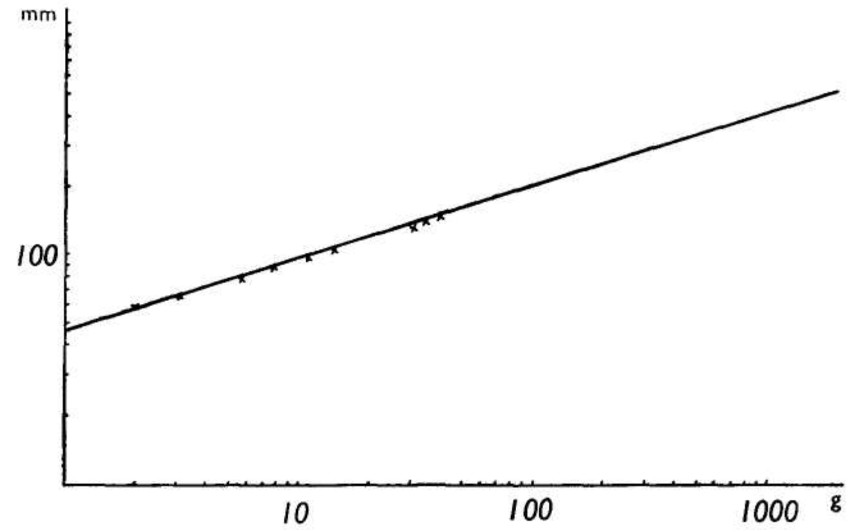
+ Fork length is used in the calculation of K

life in either samples and between them. The explanation for this will have to be found probably in the feeding habits of *Thymallus arctius*.

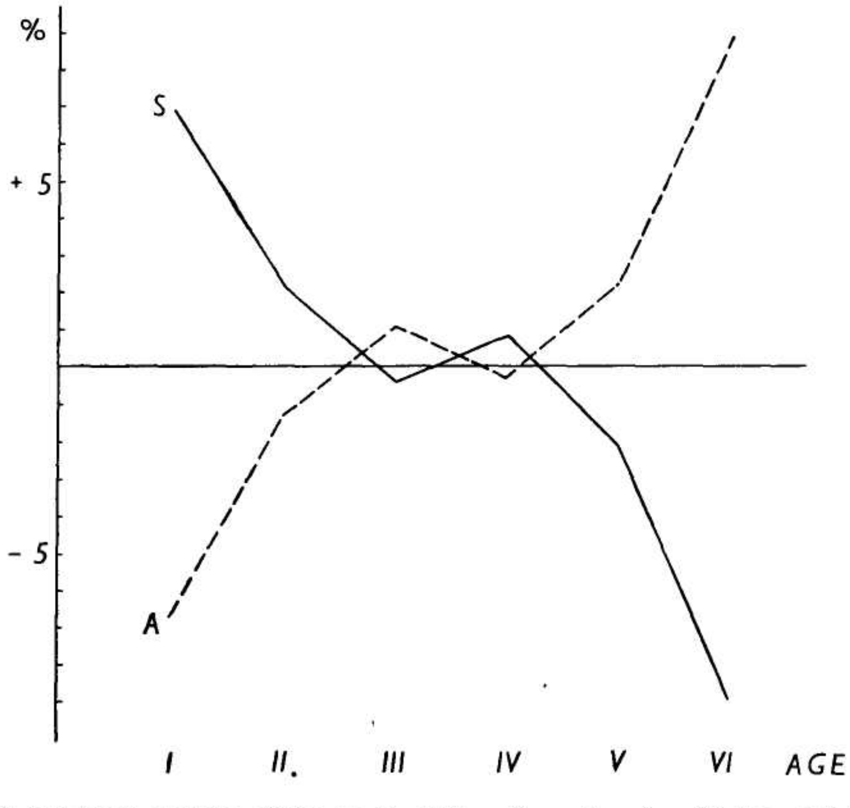
Comparing the present data with that of Balon (1961), concerning an allied species, *Thymallus thymallus*, it is evident that *Thymallus thymallus*



Graph 1 Relation between body length and ventral diagonal radius of *Thymallus arcticus* **Abscissa**, fork length, ordinate, scale radius × 17.5 in mm.



Graph 2. Logarithmic graph showing the relation of fork length (ordinate) to body weight (abscissa).



Graph 3. Percentage deviation of the growth of *Thymallus arcticus* from Šišchid and that of Svetovidov (1936) from the average of both. A = author (Šišchid) and S = Svetovidov.

grows better than *Thymallus arcticus*. Balon (l.c.) gives the following data for 59 specimens of *Thymallus thymallus* from the Riverine lake on Hnilec river, Czechoslovakia.

l_1	l_2	l_3	l_4	l_5
147	224	269	294	311

l=average standard length in mm

The collection was made during the early part of July. There was no difficulty in the interpretation of the annuli. (See photographs.) Of the 75 specimens in age class I, 11 had not formed their annuli. Judging from their length it is highly improbable that they belong to the 0 age class. These specimens which have not formed their annuli form 14.7% of the total 75 in age class I. However, their lengths were not included in the average for l_1. There were 11 specimens (20 – 29 mm) without any trace of scales. They are those included in age class 0.

There is a great range in length of fish in each age class. This is probably because spawning in *Thymallus arcticus* is spread over a longer period of the year. Berg's claim that *Thymallus arcticus baicalensis* Dybowski, 1876 spawns in the river Angara from the begining of May to middle of August confirms this.

Spawning marks were not present in any of the scales examined. The number of specimens in age classes V, VI and VII are relatively few. It would therefore be possible to conclude only that *Thymallus arcticus* spawns after the IVth year of life. This substantiates the observations of Svetovidov (1936), regarding the age of spawning.

The conversion factors for lengths have been calculated using the length data of specimens ranging from 59 mm to 147 mm. These were the only specimens available to the author. It is questionable whether the calculated conversion factors are applicable to fish beyond this range. However, it is felt that the error introduced here will be negligible.

Acknowledgements

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SUMMARY

1. The age and growth of 163 specimens of Thymallus arcticus from Šišchid river of Mongolia were studied.

2. There is a linear relationship between the length of fish and ventral diagonal radius of scale. The method of R. Lee (1920) has been used in the computations of growth histories.

3. Growth data has been compared with that of Svetovidov (1936). On the whole the growth of *Thymallus arcticus* from Šišchid is better than that investigated by Svetovidov (l.c.).

4. Growth of *Thymallus thymallus* from the Riverine lake on Hnilec river, Czechoslovakia (Balon, 1961) is better than that of *Thymallus arcticus.*

5. Spawning in *Thymallus arcticus* appears to take place after the IVth year of life.

6. It is believed that the great range in length of fish in each age class is due to the spawning spread over a longer duration of the year.

7. The conversion factors for standard, fork and total lengths have been calculated.

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The plate will be found at the end of their issue.

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MYOTIS BRANDTII (EVERSMANN, 1845) (VESPERTILIONIDAE, CHIROPTERA) IN DER TSCHECHOSLOWAKEI

VLADIMÍR HANÁK

Eingegangen am 14. Dezember 1970

Abstrakt: In der Arbeit sind alle bisher bekannten Funde der Form *Myotis brandtii* aus dem Gebiet der Tschechoslowakei zusammengefasst worden; es wird ein vorläufiges Gesamtbild ihrer Verbreitung in diesem Raum gegeben. Die Angaben über das sympatrische Auftreten beider Formen der Bartfledermäuse in der Tschechoslowakei bringen weitere Beweise für ihre artliche Differenzierung. Es werden auch die wichtigsten Unterscheidungsmerkmale der beiden verwandten Formen kurz diskutiert.

Vor einigen Jahren wurde über das Vorkommen zweier verschiedenen Formen der Bartfledermaus in der Tschechoslowakei berichtet, die vorläufig als zwei Subspezien der Art *Myotis mystacinus* (Kuhl, 1819) betrachtet worden sind (Hanák, 1965). Beide Formen kamen in einem gemeinsamen Winterquartier in der Eishöhle bei Dobšiná in der Ostslowakei vor. Damals wurde das gemeinsame Auftreten beider Formen an einer Lokalität durch die Migration osteuropäischer *brandtii*-Population im Areal der Nominatunterart liegenden Winterquartiere erklärt. Später hat es sich aber herausgestellt, dass beide Formen nicht nur in der Winterperiode, aber auch während des Sommers an einigen Stellen Mitteleuropas gemeinsam vorzufinden sind (Hanák, 1970; Gauckler und Kraus, 1970). Mit Rücksicht auf diesen Tatbestand sind beide Formen als selbständige Arten (sibling species) zu werten. In der vorliegenden Abhandlung werden die Kenntnise über das Vorkommen beider Formen auf dem Gebiet der Tschechoslowakei erneut zusammengefasst und dadurch ihre artliche Selbständigkeit deutlich belegt.

MATERIAL

Die Unterlage zu dieser Arbeit bildeten insgesamt 201 Bartfledermäuse aus dem Gebiet der Tschechoslowakei. 154 Stücke stammten aus den Sammlungen des Instituts für systematische Zoologie der Karlsuniversität, 27 Stücke aus den Sammlungen des Instituts für Wirbeltierforschung der ČSAV in Brno, 17 Exemplare aus den Sammlungen des Schlesischen Museums in Opava und 3 Stücke aus den Sammlungen des Westböhmischen Museums in Plzeň Für das Überlassen eines Teiles des Materials danke ich den Herren Dr. J. Gaisler (Brno), Dr. B. Beneš (Opava) und Dr. L. Hůrka (Plzeň), für die Mitteilung einiger Angaben auch den Herren J. Souček (Malá Morávka), Dipl. Biol. Z. Roček (Rychnov n. Kn.) und Dr. M. Nevrlý (Liberec). Dankbar erwähne ich auch die Hilfe weiterer Mitarbeiter, die für mich Material im Terrain gesammelt haben. Herrn Doz. Dr. W. Černý danke ich für die kritische Durchsicht des Manuscripts.

Das Material wurde vor allem nach den Schädelmerkmalen, den Zahnmerkmalen und bei Männchen namentlich auch nach Form und Grösse des Penis und Baculums gewertet. Die Kriterien, nach welchen beide Formen unterschieden wurden, sind im zweiten Teil dieser Abhandlung beschrieben.

Winterfunde von *Myotis brandtii*

Slowakei: Die Form *brandtii* wurde in der Tschechoslowakei zum erstenmal im Winterquartier in der Dobšinská Eishöhle (Bzk. Rožnava) im Winter 1963 festgestellt (Hanák, 1965) In diesem Massenquartier wurden am 3. 3. 1963 insgesamt 137 Bartfledermäuse angetroffen, worunter 127 ♂ und bloss 10 ♀ waren. Von der Gesamtzahl der Männchen, die nach der Grösse und Form des Penis gut unterschieden werden konnten, entfielen 94 Stücke auf die *brandtii*-Form und nur 33 auf die *mystacinus*-Form. Im Jahre 1964 wurden in demselben Quartier 76 Stücke der Bartfledermäuse (48 ♂ *brandtii*, 23 ♂ *mystacinus* und 5 näher nicht unterschiedene ♀) untersucht. Im Jahre 1968 waren es 269 Exemplare (126 ♂ *brandtii*, 81 ♂ *mystacinus* und 62 nicht identifizierte ♀). Im Jahre 1969 waren unter 122 Exemplaren 50 ♂ *brandtii*, 48 ♂ *mystacinus* und 24 ♀), im Jahre 1970 waren von 71 Stücken 32 ♂ *brandtii*, 25 ♂ *mystacinus* und 14 ♀. Alle diese Angaben betreffen regelmässig einmalige Kontrollen, die alljährlich im Februar gemacht wurden Die Ergebnisse zeigen, dass die Dobšinská Eishöhle ein ständiges und offenbar schon seit früher besuchtes Winterquartier beider Formen der Bartfledermäuse bildet Interessant ist das markante, einstweilen nicht leicht erklärliche Übergewicht der überwinternden Männchen. Unter den Männchen überwiegt wiederum ausdruckvoll die *brandtii*-Form, obwohl in den letztem Jahren das Verhältnis beider Formen ausgeglichen zu sein scheint.

Ein weiteres Exemplar aus der Slowakei, das mit seinen Massen und Zahnmerkmalen zur *brandtii*-Form gehört, wurde am 25. 2. 1964 in der Brestovská Höhle bei Zuberec (westlicher Teil der Hohen Tatra) gefunden (leg. J. Gaisler). Gleichzeitig wurde aus derselben Lokalität auch ein Stück der Form *mystacinus* gesammelt. Weitere Winterfunde der Bartfledermäuse aus dem Gebiet der Slowakei werden als *mystacinus* gewertet (s. Abb. 1).

Mähren: Aus dem mährischen Gebiet konnte nur Material aus 9 Winterquartieren (insgesamt 1—2 Exemplare) untersucht werden. Davon gehört zur *brandtii*-Form 1 ♂ aus der Pacltova-Höhle (Gebiet Králický Sněžník, Bzk. Šumperk, Nordmähren, 20. 1. 1966) und 1 ♀ vom 19. 10. 1966 aus der Höhle Býčí skála bei Adamov im Mährischen Karst (leg. J Gaisler) Die übrigen 10 Stücke aus Mähren zeigen Merkmale der *mystacinus*-Form. In letzter Zeit (4. 1 1971) fand J. Souček bei einer Kontrolle der verlassenen Grubeneinrichtungen in Malá Morávka (Jeseníky Gebirge, Bzk. Bruntál) 22 Bartfledermäuse, von denen er 3 ♂ als *brandtii* identifizierte Ein eigehender Bericht über diesen Funde befindet sich im Druck (Souček, 1971).

Böhmen· Aus Böhmen standen 35 Exemplare der Bartfledermäus aus 9 Winterquartieren zur Verfügung. Davon gehörten 14 Stücke zur *brandtii*-Form (aus 4 Winterquartieren), die übrigen 20 Stücke (aus 9 Winterquartieren) zur Form *mystacinus*. Das zahlreichste Material der *brandtii*-Form wurde in den Jahren 1957—1970 aus dem Stollen des Überstromkanals der Talsperre Bílá Desná im Isergebirge gewonnen. In diesem bekannten Winterquartier überwintert alljährlich eine grössere Anzahl Bartfledermäuse (Nevrlý, 1963), unser Material (10 *brandtii* und 3 *mystacinus*) wurde aber mit einer Auswahl gesammelt und stellt nicht das tatsächliche zahlenmässige Verhältnis beider Formen in diesem Winterquartier dar (der Anteil der *brandtii* form ist etwa 20 % der Gesamtpopulation der Bartfledermäuse — Nevrlý, in litt.).

Eine weitere Fundstätte der *brandtii*-Form in Böhmen sind die verlassenen Erzstollen in der Umgebung von Mikulov (Erzgebirge, Bzk. Teplice). In dieser Lokalität wurden in den Jahren 1958—1964 4 Bartfledermäuse gesammelt uns zwar 2 *brandtii* und 2 *mystacinus*. Auch die in letzter Zeit in einigen Stellen Ostböhmens von Z. Roček vorgenommene Durchforschung führte zu interessanten Funden. In den unterirdischen Gängen der Bunker „Bouda" bei Jablonné n. Orl. (Bzk. Ústí n. Orl) fand er am 9. 2. 1971 1 subad. ♂ *brandtii* uns 2 weitere Stücke *mystacinus*. In einigen Stollen bei Orlické Záhoří (Bzk. Ústi n. Orl) wurden nur 2 Stücke *mystacinus* ermittelt.

Nachtrag. Nach der Beendigung dieser Arbeit habe ich bei der Beringung in den Stollen bei Karlštejn (Bzk. Beroun) 2 Bartfledermäuse gefunden, von denen 1 subad ♀ nach den Schädel und Zahnnerkmalen zur *brandtii* gehörte (gefunden am 22. 2. 1971) Überdies übermittelte mir L. Hůrka Data seiner zwei *brandtii* Funde aus Westböhmen. Am 10 11. 1970 fand er 1 adult ♀ in einem Stollen bei Kašperske hory (Bzk. Klatovy, Südwestböhmen) und am 1. 8. 1970 eine weitere ♀ dieser Form in einer Höhle bei Výškovice (Bzk. Tachov, Nordwestböhmen). Alle diese neuen Angaben sind schon in der Abb 1. enthalten.

Sommerfunde von *Myotis brandtii*

Als Sommervorkommen betrachten wir die Funde aus den Wochenstuben, Funde von solitären Männchen während der Sommerzeit (Mai—Juli) und Funde beider Geschlechter in den Sommertypen der Quartiere zur Zeit der Migrationen (April—Mai, August—September)

Slowakei: Aus der Slowakei standen uns bloss die Funde von 1 ♂ und 1 ♀ (12. 8 1963) und 1 ♂ (25. 9. 1963) der Bartfledermäuse aus dem Forsthaus Zverovka bei Zuberec (Roháče,

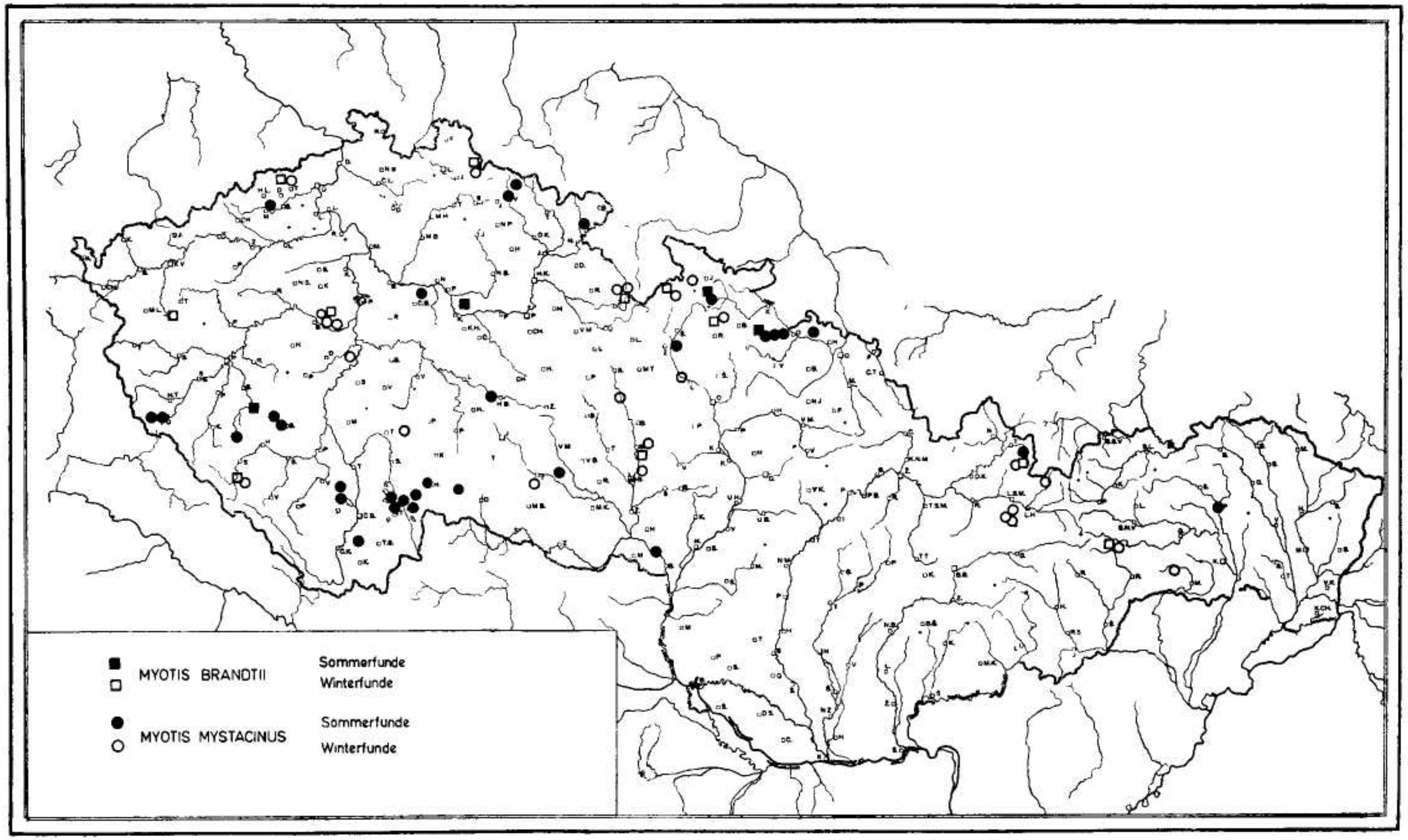

Abb. 1. Fundorte der beiden Bartfledermaus-Formen in der Tschechoslowakei.

Westl. Tatra, 1020 M. ü. M., leg. J. Gaisler) zur Verfügung. Alle diese Exemplare wurden in den Sommertypen der Unterschlüpfe gefunden und man kann sie als Angehörige der örtlichen Population betrachten. Nach den Schädelmassen sowie nach den Zahnmerkmalen fallen sie in die Variationsbreite der Form *mystacinus*. Zu dieser Form gehören offenbar auch weitere Sommerfunde aus der Hohen Tatra (Tichá und Koprová-Tal bei Podbansko, 1100 M. ü. M.), deren Schädelmasse in der Arbeit von Mošanský und Gaisler (1965) veröffentlicht worden sind. Merkmale dieser Form zeigt auch 1 ♂ aus der Umgebung von Prešov in der Ostslowakei (September 1961, Sammlungen des Schlesischen Museums in Opava). Die *brandtii*-Form wurde also einstweilen in der Slowakei nicht angetroffen.

Mähren: Auf dem Gebiet Mährens wurde das Material von 8 Sommerlokalitäten gewonnen, und zwar sämtlich aus den Wochenstuben. Die Analyse dieses Materials zeigte, das Exemplare von 6 Fundstellen zur *mystacinus*-Form gehören und dass nur 3 Exemplare aus 2 nordmährischen Orten als *brandtii* betrachtet werden können. Es handelt sich um 1 ♂ aus Hlavnice, Bzk. Opava (18. 8. 1968, leg. B. Beneš) und 2 ♂ aus Bělá pod Pradědem (Jeseníky Geb., 1. 8. 1969, leg. B. Beneš). Alle Stücke wurden in den Sommertypen der Quartiere angetroffen, wenngleich es sich mit Hinsicht auf das späte Abfangsdatum auch um Migranten aus anderen Gebieten (Polen?) handeln könnte. Dafür spricht ubrigens auch die Tatsache, dass gemeinsam in beiden Unterschlüpfen auch Angehörige der *mystacinus*-Form angetroffen wurden.

Böhmen: Aus dem Gebiet Böhmens konnte Material von 17 Sommerlokalitäten (darunter 14 Wochenstuben und 3 Funde von solitären Männchen) untersucht werden. Die Mehrzahl dieses Materials entsprach nach den körperlichen Merkmalen der *mystacinus*-Form, nur an 2 Stellen wurde die *brandtii*-Form gefunden. Es handelt sich um eine Wochenstube mit ungefähr 20 Weibchen mit Jungen am Dachboden einer Holzkammer beim Hegerhaus in Bychory bei Kolín (Mittelböhmen, 210 M. ü. M. — 19. 7. 1959) und um eine Wochenstube (cca 50 Weibchen mit Jungen) am Dachboden des Schlosses Žinkovy bei Klatovy (Südwestböhmen, 470 M. ü. M.) (Kontrollen am 10. 5. 1963, 2. 6. 1969, 28. 7. 1970 — leg. L. Hůrka). Beide Wochenstuben wurden während mehrerer Jahre kontrolliert, wobei es sich zeigte, dass sie ausschliesslich aus Einzelstücken der *brandtii*-Form bestanden. Die Merkmale dieser Form sind bei allen jungen und alten Exemplaren aus beiden Lokalitäten entwickelt. Während des Druckes dieser Arbeit wurden drei weitere Sommerfunde der Form *brandtii* in Böhmen festgestellt:

Wochenstube in Vyžlovka bei Jevany (Mittelböhmen), 30. 5. 1971 1 ♀ gesammelt; Teplice n. Metují (Nordostböhmen), 11. 5. 1971 1 ♀ erschossen; Prag, 15. 5. 1971 1 ♀ gefangen.

UNTERSCHEIDUNGSMERKMALE DER BRANDTII- UND MYSTACINUS FORMEN

Beide Formen der Bartfledermaus differieren nur in kleinen morphologischen Merkmalen und besonders im Terrain sind sie nach den üblichen Unterscheidungsmerkmalen (Färbung, Grösse, Form der Ohrmuschel) nicht unterscheidbar. Das einzige sichere Bestimmungsmerkmal im Terrain ist die Form und Grösse des Penis. Die übrigen Unterscheidungsmerkmale sind nur bei der Determination des präparierten Materials anwendbar. Einzelne Unterscheidungsmerkmale sind schon ziemlich eingehend in den Arbeiten von Topál (1958, 1963), Hanák (1965, 1970), Stubbe und Chotolchu (1968), Gauckler und Kraus (1970) und Vlček (1970) beschrieben worden. In der vorliegenden Abhandlung werden bloss konkrete Angaben über die Unterscheidungsmerkmale angeführt, wie sie sich am Material aus der Tschechoslowakei äussern.

Baculum: Die Abb. 2 zeigt Formen und Grössenunterschiede der Bacula beider Formen. Das Baculum der *brandtii*-Form ist auffalend grösser (Masse der 8 Stücke aus der Tschechoslowakei: Länge 0,81—0,97 mm, M = 0,87 mm; Breite 0,41—0,59 mm, M = 0,50 mm). Auch die sattelartige Form dieses Baculums erinnert eher an die Bacula einiger anderen Arten der Gattung (z B. *Myotis nattereri*) und unterscheidet sich deutlich von den einfachen Bacula der *mystacinus*-Form. Die Bacula der 11 Stücke von *mystacinus* aus der Tschechoslowakei messen 0,43—0,62 mm in der Länge (M = 0,49 mm) und 0,22—0,29 mm (M = 0,26 mm) in der Breite und haben die typische ovale Form ohne die Schenkel am proximalen Ende.

Die charakteristische Form des *brandtii*-Baculums wird offensichtlich sehr früh während der postnatalen Entwicklung entwickelt. Von den 4 Bacula der *brandtii*-Exemplare, die höchstens 6 Wochen alt waren (Wochenstube in Žinkovy bei Klatovy, 28. 7. 1970) sind 3 grösser als die Bacula der adulten Exemplare vor *mystacinus* (0,6 × 0,3 mm; 0,5 × 0,4 mm, 0,7 × 0,5 mm) und bei den grössten unter ihnen ist schon die charakteristische, sattelförmige Gestalt gut sichtbar. Die typische Form und Grösse der Bacula beider Formen bildet sich offensichtlich schon in den ersten Monaten des Lebens und ist besonders bei subadulten Exemplaren in der Zeit des ersten Überwinterung gut entwickelt.

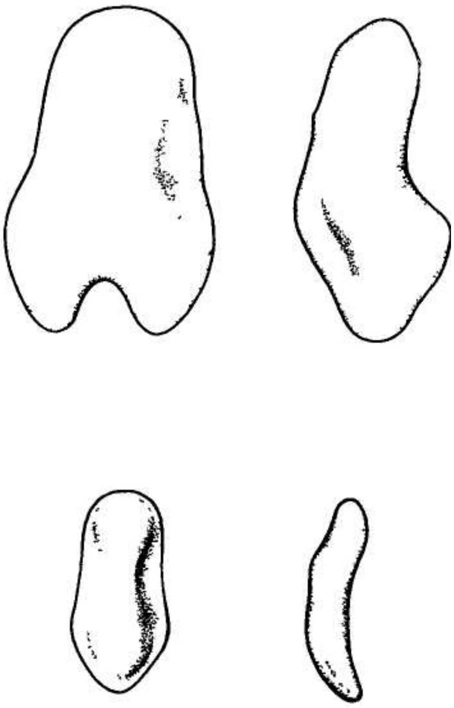

Abb. 2. Bacula von *M. brandtii* (obere Reihe) und *M. mystacinus* (untere Reihe). Links Dorsalansichten, rechts Lateralansichten. Etwa 100mal vergrossert.

Penis: Grösse und Form des Penis sind sehr bedeutsame Unterscheidungsmerkmale beider Formen, denn sie sind auch zur Determination im Terrain geeignet. Der Penis der *brandtii*-Form ist mächtiger und an der Spitze auffallend dicker (Abb. 3), während der Penis der *mystacinus*-Form kleiner und in der ganzen Länge gleichmässig schlang ist (Abb. 3). Die charakteristische Penisform von *brandtii* entwickelt sich übereinstimmend mit dem Baculum schon in der ersten Phase der Postnatalentwicklung (siehe Abb. 4 — Penis eines etwa 6 Wochen alten Jungtieres).

Körper- und Schädelmasse: In beiden vorgehenden Arbeiten wurden die Unterschiede beider Formen bezüglich der Körper- und Schädelmasse kurz beschrieben (Hanák, 1965, 1970). In vorliegender Arbeit habe ich die Werte des ganzen zugänglichen Materials aus der Tschechoslowakei zusammengestellt (Tab. 1). Der Vergleich zeigt wiederum, dass sich bedeutende Unterschiede vor allem in der Längenmassen des Schädels, in den Längen der Zahnreihen und etwas weniger auch in der Länge des Antebrachiums äussern. Die Geschlechtsunterschiede im Rahmen der einzelnen Arten sind mit Ausnahme der Antebrachiumslänge nur geringfügig.

Zahnmerkmale: Diesbezüglich sind die Unterschiede zwischen *brandtii* und *mystacinus* eingehend in den Arbeiten von Gauckler und Kraus (1970) und Hanák (1970) beschrieben worden. Am Material aus der Tschechoslowakei hat sich als brauchbares Merkmal die Anwesenheit des sekundären Konus am Innerand von P^3 (Abb. 5) gezeigt. Unterschiede zwischen beiden Arten äussern sich im Grössenverhältnis der P_1 und P_2 und P^1 und P^2, wie es anschaulich die Abb. 6 und 7 zeigen. Diese Merkmale sind allerdings sehr variabel und man kann sie nur als Hilfskriterien benützen. Gauckler

Tab. 1. Korper-und Schadelmasse von *Myotis brandtii* und *Myotis mystacinus* aus der Tschechoslowakei

			Myotis brandtii			*Myotis mystacinus*	
		n		M	n		M
K + R	♀	11	42,0—50,0	46,2	69	36,0—48,0	41,9
	♂	31	39,0—49,0	44,9	68	35,0—45,0	40,8
Schw.	♀	11	36,0—41,0	38,5	64	31,5—43,0	38,1
	♂	30	32,0—44,0	39,3	67	30,0—43,0	36,8
Ant.	♀	11	33,4—36,0	35,2	86	31,5—37,0	34,6
	♂	36	33,2—37,7	35,4	73	31,0—36,5	33,9
Ohr	♀	11	13,5—16,0	15,2	67	12,0—19,0	14,9
	♂	30	12,5—17,0	14,0	66	12,0—16,5	14,1
Tragus	♀	11	5,5— 8,0	7,5	64	6,9— 9,0	8,0
	♂	30	7,0— 8,0	7,9	65	6,5—10,0	7,9
GSchl	♀	11	13,8—14,8	14,3	65	12,9—14,0	13,5
	♂	34	13,8—15,0	14,2	49	12,9—14,0	13,4
CbL	♀	11	13,0—14,1	13,6	67	12,0—13,4	12,8
	♂	36	13,0—14,2	13,6	48	12,0—13,5	12,7
ZBr	♀	8	8,2— 8,8	8,5	37	7,3— 9,0	8,1
	♂	29	8,0— 9,1	8,5	36	7,7— 8,5	8,2
IOBr	♀	12	3,5— 4,0	3,8	74	3,1— 4,0	3,5
	♂	37	3,4— 4,0	3,7	55	2,4— 4,0	3,5
MBr	♀	8	6,9— 7,8	7,4	42	5,1— 7,7	6,7
	♂	21	7,0— 7,9	7,4	27	6,5— 7,2	6,8
SchH	♀	8	5,7— 6,2	6,0	45	5,3— 6,5	5,9
	♂	21	6,0— 6,5	6,1	28	5,2— 6,2	5,8
MandL	♀	12	10,0—10,8	10,2	78	8,4—10,1	9,7
	♂	41	9,7—10,8	10,2	61	8,9—10,3	9,6
OZR	♀	12	5,1— 5,9	5,4	76	5,6— 5,5	5,1
	♂	40	4,6— 5,6	5,4	60	4,6— 5,4	5,0
UZR	♀	12	5,4— 6,0	5,7	73	5,0— 5,7	5,4
	♂	41	5,5— 6,0	5,7	62	5,0— 5,7	5,4

und Kraus (1970) und schon vordem Stubbe und Chotolchu (1968) erwähnen, dass die *brandtii*-Form durch Entwicklung des kleinen Protoconulus an den oberen Backenzähnen charakterisiert sei, was an die Situation in der Untergattung *Leuconoe* errinnert. Am tschechoslowakischen Material ist dieses Merkmal wenig auffalend und erscheint deutlich nur in etwa 30 % der untersuchten Serie.

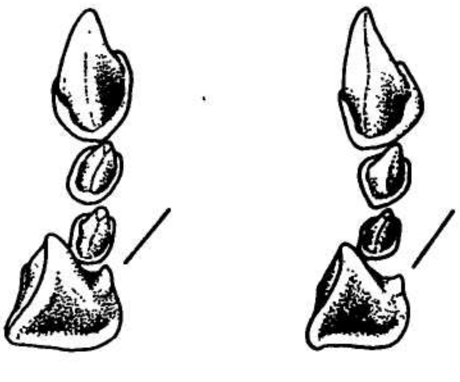

Abb. 5. Bildung des sekundaren Konus am inneren Rand von P^3 bei *M. brandtii* (links) und *M. mystacinus* (rechts).

Färbung· Mit der Beschreibung der Färbungsunterschiede haben sich eingehend Gauckler und Kraus (1970) befasst. Ihre Ergebnisse sind auch am tschechoslowakischen Material gut kenntlich. Die adulten *brandtii* sind durch die charakteristische gelbbraune Färbung des Felles mit einem goldenen Schimmer an der Oberseite gekennzeichnet. Demgegenüber sind adulte *mystacinus* durchgängig dunkler, bräunlich ohne gelbliche und goldene

Tone Diese im allgemeinen deutlichen Färbungsunterschiede sind aber durch die Anwesenheit junger und subadulter Stücke kompliziert, die bei bei den Formen viel dunkler, graubraun und gegenseitig schwer unterscheidbar sind. Nach Gauckler und Kraus kommt bei einigen offensichtlich nicht erwachsenen Einzelstücken noch ein Zwischenkleid vor, das der Färbung adulter *mystacinus* ähnlich ist. Es hat den Anschein, dass die Farbung der beiden Bartfledermäuse-Formen beträchtlich variabel ist und als Unterscheidungsmerkmal einstweilen nicht brauchbar ist.

Abb. 6 Unterschiede im Grossenverhaltnis des P^1 und P^2 *M brandtii* (oben), *M mystacinus* (unten)

Die ersten Beweise über das Vorkommen von zwei Formen der Bartfledermäuse im östlichen Teil Mitteleuropas (Ungarn, Tschechoslowakei) führten zum logischen Schluss, dass es sich nur um neue Belege der Verbreitung der osteuropäischen Form *brandtii* weiter westwärts handle (Hanák, 1965). Während der ersten Untersuchungsetappe ist die Form *brandtii* nur in einem einzigen Winterquartier in der Ostslowakei regelmässig gesammelt worden, wodurch diese Meinung gestützt war. Da die Sommerfunde aus dem gesamten Gebiet der Tschechoslowakei als *mystacinus* gewertet wurden, waren die Vorstellungen über ein Verfliegen der Form *brandtii* aus der nahen Westukraine und besonders aus Polen im grossen und ganzen begreiflich. In der weiteren Erforschungsphase interessierte uns die Feststellung der Westgrenze der Verbreitung der *brandtii*-Form in Europa. In diesem Zusammenhang wurde ein umfangreiches Museumsmaterial untersucht und die Ergebnisse dieses Studiums wurden in einer gesonderten Arbeit zusammengefasst (Hanák, 1970). Es hat sich erwiesen, dass die *brandtii*-Form in den Niederungen Mitteleuropas, in Polen und Deutschland verbreitet ist und dass sie nach Westen bis nach Holland und Nordwest-

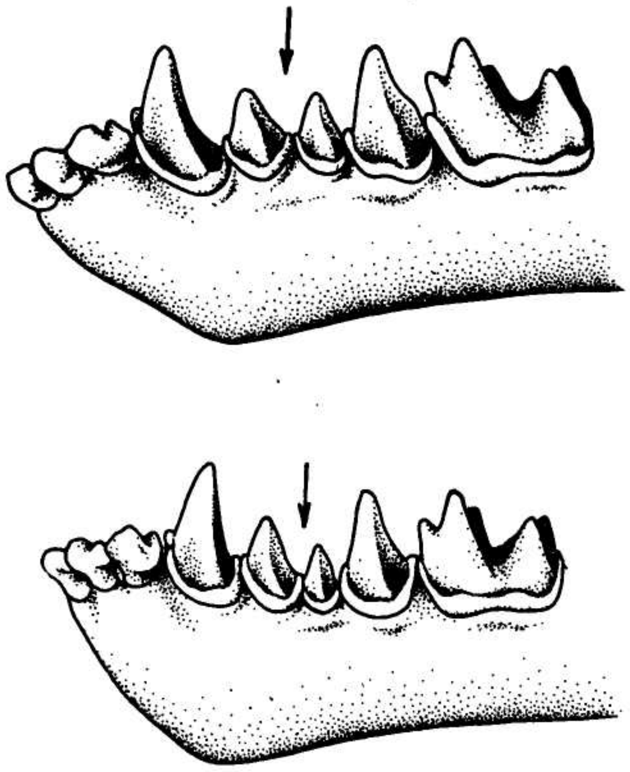

Abb. 7. Unterschiede im Grössenverhältnis des P_1 und P_2. *M. brandtii* (oben), *M. mystacinus* (unten).

frankreich reicht. Noch überraschender waren Beweise über das sympatrische Vorkommen beider Formen an einigen Stellen des mitteleuropäischen Hügellandes (Bayern, Hessen). Als weitere solche Nachweise müssen Funde von zwei Sommerkolonien von *brandtii* in Böhmen gewertet werden, die in der vorliegenden Arbeit angeführt sind. Diese Erkenntnisse sind nicht nur vom zoogeographischen Standpunkt aus bedeutungsvoll, sondern bringen auch weitere Beweise für die artliche Selbständigkeit beider Formen. Die Problematik der systematischen Wertung der Bartfledermäuse ist schon in einigen früheren Arbeiten behandelt worden (Gauckler und Kraus 1970, Hanák 1970).

Die Auswertung der bisherigen, spärlichen Funde beider Formen auf dem Gebiet der Tschechoslowakei führt auch zu weiteren Überlegungen. Wenn wir vorerst die Kenntnisse über die Winterfunde von Bartfledermäusen auf unserem Gebiet übersehen, die uns wenigstens ein annäherndes Bild über ihre Verbreitung geben könnten, so sehen wir, wie zahlreich das Vorkommen beider Formen in den einzelnen Gebieten der Tschechoslowakei ist. Während der Winterperiode ist fast im ganzen Gebiet die Form *mystacinus* die überwiegende, die Form *brandtii* kommt allgemein nur vereinzelt vor. Eine Ausnahme besteht nur im stetigen Überwiegen der *brandtii*-Form in der Eishöhle Dobšiná in der Ostslowakei und im regelmässig öfteren Vorkommen dieser Form in einigen nordböhmischen Winterquartieren (Erzgebirge, Isergebirge). Wenn wir auch die Funde von Einzelstücken der *brandtii*-Form in Nordmähren in Betracht ziehen (wahrscheinlich Zuwanderer), zeigt sich, dass *brandtii* regelmässig nur in Winterquartieren gefunden wird, im Bereich der von dieser Form überwiegend oder völlig (?) besiedelten Gebiete (die Niederungen Mitteldeutschlands und Polens) liegen. Ein Zuflug aus diesen Gebieten in unsere Winterquartiere muss als möglich betrachtet werden, wenngleich die bisherigen Beringungsergebnisse über diese Tatsache nichts aussagen (Roer, 1970). Leider fehlen jegliche konkrete Angaben über die Sommerverbreitung der Bartfledermäuse in den Niederungen von Mitteldeutschland und Polen, die unmittelbar an unser nördliches Grenzgebiet anknüpfen. Gauckler und Kraus (1970) teilen mit, dass *M. brandtii* in den Winterquartieren des deutschen Teiles des Bayerischen Waldes und im ganzen Fränkischen Jura fast die Hälfte aller Funde von Bartfledermäusen ausmachen. Wie unsere Karte (Abb. 1) zeigt, ist es im angrenzenden Gebiet der Tschechoslowakei (Süd- und Westböhmen) nicht der Fall.

Auch die Kenntnisse über die Sommerverbreitung der *brandtii*-Form in unserem Gebiet verdienen eine ausführliche Analyse. Wenn wir von einigen fraglichen Funden offensichtlich wandernder Einzelstücke (Nordmähren) absehen, bilden die Funde aus zwei Sommerkolonien in Mittel- und Südwestböhmen bisher die einzigen Belege über das sommerliche Vorkommen dieser Form in unserem Raum. Die Lage dieser Funde in Böhmen ist dadurch erklärlich, dass wir eben aus diesem Gebiet die meisten Funde aus der Sommerzeit haben, während Sommerangaben aus Mähren und der Slowakei wenig zahlreich sind. Die Sommerfunde aus der Slowakei stammen aus den Waldgebieten der höheren Lagen*, während die Funde aus Böhmen

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* Das Sommervorkommen von Bartfledermäusen in den höher gelegenen Waldgebieten, in Stellen ohne stehende Gewässer, kommt auch in den böhmischen und mährischen Gebirgen verhältnismässig häufig und wurde auch aus der Karpatenukraine verzeichnet (Abelencev, 1956). Diese Gebirgspopulationen gehören offensichtlich ausschliesslich zur *mystacinus*-Form

vorwiegend die Populationen aus wasserreichen Gebieten in den mittleren und niederen Lagen charakterisieren. Dem Biotop der *brandtii*-Form, wie wir ihn z. B. aus dem Gebiet der Sowjetunion kennen, entsprechen also mehr die böhmischen Lokalitäten. Anhand dieser Kenntnisse und Überlegungen scheint es, dass das Gebiet des sympatrischen Vorkommens beider Formen der Bartfledermäuse in Europa ein verhältnismässig enger ist, denn nach den bisjetzt belegten Funden umfasst er nur eine Zone im Raum der mitteleuropäischen Hügellandschaften. Einige Angaben über das Vorkommen der *brandtii*-Form in Italien (Lanza, 1959), auf der Balkanhalbinsel (Hanák, 1965) und in Schweden (Wallin, 1969) müssen in jedem Falle überprüft werden. Eine gründliche Untersuchung der Verbreitung beider Formen der Bartfledermäuse in den einzelnen Ländern Europas ist also auch weiterhin sehr aktuell.

ZUSAMMENFASSUNG

Die Arbeit fasst die bisherigen Kenntnisse über das Vorkommen von *M. mystacinus* und *M. brandtii* auf dem Gebiet der Tschechoslowakei zusammen und versucht ein vorläufiges Bild ihrer Verbreitung im untersuchten Raum aufzustellen. Als bedeutendste Ergebnisse erscheinen die Funde zweier Wochenstuben der *brandtii*-Form in Böhmen (Umgebung von Kolín in Mittelböhmen, Žinkovy bei Plzeň, Südwestböhmen), die das sympatrische Auftreten beider Formen im Gebiet von Böhmen nachweisen. Hierdurch wird ein weiterer Beleg für die Voraussetzung gebracht, dass beide Formen als eigene Arten zu betrachten sind. Die Übersicht der Winterfunde zeigte, dass *M. mystacinus* die überwiegende Form auf dem ganzen tschechoslowakischen Gebiet vorstellt. Ein regelmässiges öfteres Vorkommen von *M. brandtii* wurde nur in einigen Winterquartieren Nordböhmens und in einem Winterquartier in der Ostslowakei verzeichnet, was durchaus nicht die Möglichkeit ausschliesst, dass es sich um Migranten aus den nördlicheren Gebieten handelt (Mitteldeutschland, Polen). In der Arbeit sind auch die Unterscheidungsmerkmale beider Formen beschrieben, wie sie sich am Material aus der Tschechoslowakei äussern.

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

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SOME NOTES ON THE SYSTEMATIC STATUS OF CARASSIUS AURATUS GIBELIO (BLOCH, 1782) WITH FURTHER RECORD OF THIS FISH FROM THE DANUBE RIVER IN CZECHOSLOVAKIA

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Abstract: The relationship between *Carassius auratus auratus* (Linnaeus, 1758) and *Carassius auratus gibelio* (Bloch, 1782) is discussed. The author concluded that *Carassius auratus gibelio* is identical with *Carassius auratus auratus*.
A description is given of six female *Carassius auratus gibelio* (Bloch, 1782) from Radvaň on the Danube (about 18°22′ E; 47°44′18″ N). A tendency of the number of the gill rakers to increase, in comparison with the data reported by Mišík and Holčík (1962) and Balon (1962), was observed.

New material of *Carassius auratus gibelio* (Bloch, 1782) was obtained during an excursion of the Comenius University students on the Slovak part of the Danube between Bratislava and Štúrovo. Two specimens were collected by simultaneous hauling with seines normally used in commercial fisheries in this part of the Danube (the length of the seine was about 130 m, the meshes 35 × 35 mm) in June 1968. Additional specimens of *C. a. gibelio* were collected by Mr. V. Vincze from the State Fishery Staff in March 1968 (2 specimens) and by Mr. J. Vörös in August 1970 (2 specimens). All material was collected in the Danube near the village Radvaň nad Dunajom (about 18°22′ E; 47°44′18″ N) and deposited in 4% formaline solution. In the laboratory the measurements were made in the usual manner following the schemes used by Pravdin (1966). The first branchial arch was removed, the number of branchial spines counted and the structure of pharyngeal teeth was also studied.

RESULTS

For plastic measurements and meristic features see Table 1. The colouration is apparently different from that of typical *Carassius carassius*. The dorsal part above the lateral line in *Carassius auratus gibelio* from the Slovak part of the Danube is greyish to bluish, the first and second row of scales belov the lateral line are less pigmented, the basic color towards the belly is whitish and the pigmentation of scales not apparent. The colouration of the head is similar, the ventral part of the head being whitish, and the transitional zone runs parallel with the mouth cleft backwards. See also Pl. III. and IV.

Table 1. Counts and measurements of *Carassius auratus gibelio* from Czechoslovak waters

Locality and date	Danube (Radvaň n/D.)						Silesia	Danube
Features	VI. 1968	III. 1968	VIII. 1970	VIII. 1970	VI. 1968	III. 1968	Mišík-Holčík (1962)	Balon (1962)
No. coll.	2	4	5	6	1	3	1 ex.	4 ex.
Longitudo corporis	147	154,2	169	170	176,2	181	67,6	119—142
In % long. corporis:								
Longitudo capitis	29,2	28,7	28,6	29,4	28,6	27,9	26,3	30—32
Distantia praeorbitalis	9,7	10.0	9.0	9.8	9.4	9.3	6.9	10—12
Diameter oculi	5.3	5.0	4.8	4.7	5.2	4.5	8.1	4—6
Distantia postorbitalis	15.2	14.6	15.1	14.4	14.6	14.5	13.6	16—17
Altitudo capitis	23.7	22.6	26.9	26.2	22.7	21.2	23.0	24—27
Latitudo capitis	19.5	20.1	19.5	20.6	19.2	19.0	14.0	19—20
Distantia inter oculos	12.2	12.4	11.8	12.1	11.9	11.9	10.8	13—14
Distantia inter for. nasalia	6.6	6.4	7.1	7.5	7.4	6.2	5.0	8
Distantia praedorsalis	49.9	50.6	49.7	50.9	50.0	48.1	47.0	48—51
Distantia praeventralis	47.3	47.3	46.8	47.6	46.0	45.8	48.0	49—52
Distantia praenaalis	73.1	73.8	72.0	71.4	73.0	74.2	74.8	74—76
Altitudo corporis	36.7	39.9	36.7	36.8	32.9	37.1	29.3	39—42
Latitudo corporis	21.4	19.8	22.5	20.9	19.0	20.0	12.6	19—21
Longitudo pedunculi caudae	18.4	16.8	17.8	18.5	17.8	17.3	20.2	17—19
Altitudo pedunculi caudae	17.0	18.2	17.0	16.8	16.2	17.2	13.8	18—19
Minima altitudo corporis	15.1	15.6	15.2	14.9	14.7	15.2	12.6	15—16
Distantia P-V	19.8	20.0	20.6	20.2	19.3	19.4	23.6	19—22
Distantia V-A	28.6	28.6	27.2	26.3	28.0	29.9	26.2	26—27
Longitudo pinnae D	32.4	34.0	35.5	35.0	32.5	36.7	27.5	35—38
Longitudo pinnae A	10.5	11.1	10.4	10.1	10.8	11.2	10.4	11
Longitudo pinnae P	18.8	18.7	18.7	18.8	19.6	18.9	19.2	18—20
Longitudo pinnae V	20.4	21.0	20.3	20.6	21.0	19.9	21.0	19—23
Altitudo pinnae D	17.3	17.6	18.0	17.5	17.5	18.7	18.6	21—25
Altitudo pinnae A	15.2	15.0	14.6	15.0	14.4	16.0	15.4	18—20
Radii pinnae D	III 16	IV 17	III 18	III 17	III 17	IV 17	16	III 16—17
Radii pinnae A	III 5	III 5	III 5	III 5	III 5	III 5	6	III 5
Radii pinnae P	I 16	I 15	I 16	I 16	I 16	I 16	—	I 14—15
Radii pinnae V	II 8	II 8	II 8	II 8	II 8	II 8	—	II 7
Squamae in linea later.	30	31	30	30	30	30	28	30
Squamae transv.	$\frac{6+}{6+}$	$\frac{6+}{6+}$	$\frac{6}{6}$	$\frac{6+}{6+}$	$\frac{6+}{5+}$	$\frac{6+}{6+}$	$\frac{6}{5}$	$\frac{7-8}{7}$
Num. spin. branchialium	50	50	50	50	46	50	42	40—44

DISCUSSION

I. Linnaeus (1758) described two species of crucian carps — *Cyprinus carassius* ("Habitat in Europae stagnis. Facillime in piscinis educatur"), and *Cyprinus auratus* ("Habitat in Chinae, Japoniae fluviis. Piscis colitur in vasis murrhinis ob aurem fulgorem, tum multum pinnis varians"). A further species of crucian carp *Cyprinus gibelio* was described by Bloch in 1782("...wird in der Churmark, in Pommern, Schlesien, Preussen und naheren anderen Ländern aufgetroffen;"). In addition, Temminck and Schlegel (1942) gave a description of four species of crucian carps found in Japan: *Carassius langsdorfii*, *Carassius buergeri*, *Carassius cuvieri* and *Carassius grandoculis*.

C. gibelio was for a long time considered by several authors only as a form from *C. carassius*, and it was Berg (1932) who, on the strength of Drjagin's findings, drew attention to differences between the two species and declared *C. gibelio* to be a subspecies *Carassius auratus gibelio*.

II. The species generally known and commonly found in Czechoslovakia is *Carassius carassius*, while the domesticated *Carassius auratus auratus* has for many years been bred in park ponds, in a gold aberration (Oliva and Hruška, 1955). *Carassius auratus gibelio* was first found in free nature by Mišík and Holčík (1962). The only specimen they examined came from an abandoned water-logged mine near Horní Suchá in Silesia. Balon (1962), however, found four further specimens of *C. auratus gibelio* in the Danube. Moreover, on the basis of differences in the number of fin-rays and scales on the lateral line, he considers the specimen found by Mišík and Holčík to be closer to the typical form of *C. auratus* and writes: "Es ist deshalb möglich, dass die Karauschen in den Bodensenkungen der Steinkohlengruben nur Abkömmlinge des Goldfisches, welcher in Bassins und Aquarien wie Zierfisch vorkommen, sind". Balon (1964) subsequently qualified Holčík's and Mišík's classification as erroneous, but failed to adduce any reasons for his judgment.[1] On the other hand, he is of the opinion that the *C. auratus gibelio* found in the Danube represents an autochtonous subspecies. Bănărescu (1960, 1964) on the contrary, upholds the view that all the *C. auratus gibelio* have been brought to Europe from East Asia and have become wild here. A similar opinion is expressed by Gąsowska (1936) who adds: "...dass sie entweder — ähnlich wie die Goldkarausche — als Goldfisch direkt aus Asien eingeführt wurde oder in Europa durch Rückschlag zum Prototypus aus der Goldkarausche entstanden ist." Libosvárský (1962) also concluded that "Es gibt jedoch einige Umstände, die deutlich als Hinveis für das sekundäre Vorkommen der Silberkarausche sprechen" and he mentioned, among others: "Die Verbreitung der Silberkarausche in Europa ist sehr eigenartig — meist vereinzelt, mosaikartig... ein zusammenhängendes Areal fehlt".

It would not be an easy task now to determine the time when *C. auratus auratus* reached Europe. Dürigen (sec. Frey, 1959), mentions the year 1611, while others (e. g. Brehm, 1879 and Herald, 1961) think it to have been in 1691: in this year, *C. auratus auratus* is said to have reached Portugal and England. Oken (1836) writes that it was brought into England by Philip Worth in 1728. What is certain is that a gift of goldfishes was made to madame Pompadour (*1721, †1764) by the Franco-Indian Company, as recorded also by Brehm (1879). At first goldfishes extended slowly, and it became generally known only after its succesful breeding in Holland in the year 1782 (sec. Sterba, 1959).

Bloch described *C. auratus gibelio* from the then German territories in 1782. On the other hand, the diagnosis of one of three carps described by Gessner (1558) fits well also *C. a. gibelio*. Marsili (1726) mentions the species *Cyprinus* III from the Danube, with the diagnosis "...Germanis id generis (ait) vocantur Halb Karass, id est dimidii Carassii, ab aliis Karpkarass, quoniam è Carassio, et Carpa veluti compositi videntur... Similitudine inter Cyprinum et Carassium mediat, nam ex ovis Cyprini, quantùm

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[1] According to an oral communication by Dr. Holčík, Dr. Balon later found males in the same locality, and is reported to have stated that there could only be question of 'goldfish gone wild'. To make presence of males indicative of that of glodfish gone wild seems a rather far-fetched assumption (see further).

Piscatores afferunt, et semine, vel lacte Carassii, aut è contra progeneatur...". The accompanying illustration (see Pl. I, Fig. 2) shows a fish that is barbless, with 35 scales in the lateral line, a clearly furrowed operculum, and resembling in apperance *C. a. gibelio!*

Bănărescu (1960) doubts that Bloch described as *C. gibelio* really the wild form of *C. auratus* now living in Europe, or one elongated form of *C. carassius.* The coloured illustration (see Pl. I, Fig. 1) and the description in Bloch's works (1782, 1783), however, makes it quite clear that Bloch did not confuse the described fish with the common *Carassius carassius,* and Bănărescu (1960) is evidently in error on this point. Bloch (l.c.) sets down even the differences between *C. carassius* and *C. gibelio.* He mentions, among others, an elongated shape of the body, 27 vertebrae (evidently 28), 8 rays in the anal fin (evidently III 5), 19 rays in the dorsal fin (evidently III 16) a crescent-like tail, a higher fecundity (300,000 eggs) in *C. gibelio;* as against this, he speaks of a wider body, 30 vertebrae (evidently 31), 10 rays in the anal fin (evidently III 7), 21 rays in the dorsal fin (evidently III 18), a less arched tail and a smaller number of eggs (93,700) in *C. carassius.*

III. The difference between *C. carassius* and *C. auratus gibelio* are sufficiently known thanks particularly by to Berg (1932). However, Koževnikov (1954) found that although all the Yakutian crucian carps belong to the *C. auratus gibelio,* and therefore *C. carassius* does not live in this area[2]), yet resemble closely in external appearance and particularly in their colouration to *C. carassius* (he also found an unstable shape of the posterior chamber of the swimmbladder, which is commonly regarded as one of the distinguishing features between *C. carassius* and *C. auratus gibelio*). Gorjunova (1961) also drew attention to the unstable colouration of the peritoneum as being a taxonomic sign. Thus, for example, she found 74 specimens of *C. a. gibelio* living in the Žaksy Alkol' lake (Kazakhstan SSR) to have dark-black, black, grey-black to grey coloured peritoneum, while in 91 specimens the coloration was light-grey, light to very light. At the same time she observed in specimens with lighter peritoneum a greater number of identures on the last dorsal spine and a smaller number of gill rakers, hence it appears as if hybrid specimens with *C. carassius* were involved. However, she found a light coloured peritoneum also in *C. a. gibelio* from the Boščakol' lake (Kazakhstan SSR) were this lives in monoculture (grey-black to grey peritoneum in 126 specimens, light-grey to grey in 47 specimens). In the fastgrowing *C. a. gibelio* she failed to find specimens with a black peritoneum (approx. one third of the population), while it was dark-grey in 35, light-grey in 52 and very light with a golden tinge in 27 specimens. Finally, all the *C. a. gibelio* in the Kurkul'dak lake planted here from

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[2]) Drjagin (1933) affirms likewise that in Yakutia there lives only *C. a. gibelio.* Syč-Averinceva (1933) and Berg (1949,), however, state that it occurs here together with *C. carassius.* Kirillow (1955) (sec. Novikov, 1966) described a new subspecies from this area – *C. carassius yacuticus.* According to Novikov (1966) this species lives in the lakes of the middle and the lower course of the Kolyma river, in the basin of the Indigirka, the Lena and the Olenek rivers. Reportedly it differs from *C. carassius* primarily in the length of the intestine (4.7 × in T.L.), bilaterally idented last spiny rays on odd fins with large and multiple denticles, in the number of gill rakers (43–47) and in the number of vertebrae (28–29). Unfortunately, I have not seen *Kirillow*'s description. The subspecies he described may possibily be identical with *C. auratus.* It does not seem to be a subspecies of *C. carassius!*

the Boščakol' lake, had a golden-white peritoneum with a greyish tinge. On the other hand, Gorjunova failed to find a single specimen with a bright white peritoneum among the *C. carassius* in the Ul'kun Burli lake (Kazakhstan SSR): two specimens had even a totally black peritoneum.

IV. Vovk (1935) noted that females outnumber males in the *C. a. gibelio* population in the siberian Tandovo lake (near the Čany lake in the Irtyš basin)[3]. Among 851 specimens brought in by the winter and summer catches he counted only 19 males. Mikulič (1939) found among *C. a. gibelio* from the Hanka lake (Amur river basin) that females prevail heavily over males in the summer catches, while males were somewhat more numerous in the winter catches[4]. According to Sysojeva (1956) females in the Amur river area represent, on an average, 67.5% of the *C. a. gibelio* population; the number of males fluctuates in the various areas between 7% and 57%. She caught the greatest number of males on breeding-grounds. A similar situation as regards female preponderance prevails in the Amur river basin Nikol'skij (1956), too.

These differences appear even more conspicuous in European waters: Berndt (1928) already pointed out that *gibelio* females outnumber the males. Lieder (1959) estimates the male ratio of *C. a. gibelio* in German waters at mere 15—20%. Savina (1958) found only two males in a population of 600 *C. a. gibelio* from the Červenoje lake (White Russia), Ivanova (1955) 6.2% of males in the Veselovsk dam waters (Don basin), Ščetinina (1956) did not find a single male among 500 specimens from the same area, similarly as Aniščenko (sec. Berg, 1949) in the fish ponds of northern Caucasus[5]. In such cases females are reproduced gynogenetically, a fact experimentally proved by Golovinskaja and Romašov (1948), Golovinskaja (1954) and Romašov and Golovinskaja (1960), who carried out their experiments in the fish ponds around Moscow, with *C. a. gibelio* females brought in from the Amur area. When crossbred these females with carp, crucian carp, "goldfish", tench and roach, these females had offsprings only of *C. a. gibelio* females. Kryžanovskij (1947) obtained matroklinic offsprings when crossbred *C. a. gibelio* females with the Amur fish *Hemibarbus labeo*. Nikol'skij's description (1949) of a hybrid of *C. carpio* × *C. a. gibelio* from the Sudočeje lake (in the Aral sea region) should be noted here, too. Berg (1949) also states that there exist strains among *C. a. gibelio* that produce offsprings when interbred with the carp.

According to Nikol'skij (1956) two groups of *C. a.* gibelio occur in the Amur river basin — the first is in the Ingoda, Onon and perhaps also the Šilka river basins, and grows much more slowly than individuals of the second group, living in the middle and lower Amur. These two groups differ also by certain counts and measurements (e.g. number of scales in the lateral line, number of rays in the dorsal fin, number of branchial spines, etc.). In addition, each of these two clearly distinguishable groups contains

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[3] Ioganzen (1945) described a high-bodied morpha *vovki* from this watershed (lakes in the Baraba steppes).

[4] Rozov (1934) reports that in the Hanka lake area there occurs an aberration of crucian carp of a golden coloration with a higher body, though smaller than *C. a. gibelio*.

[5] Cf. Libosvárský (1963) who sets the sex ratio for 1542 specimens of *C. carassius* at 737 : 805 in favor of females.

local shoals distinct by their own morphometric signs and rate of growth. Koževnikov (1954) studying *C. a. gibelio* in the Vil'uj river basin (a tributary of the Lena, Yakutia), found small-headed *C. a. gibelio* that inhabited lakes with abundant food (attaining up to 5 kg in weight in the T'ung river — a tributary of the Vil'uj), with females clearly predominating; as against this, he found large-headed *C. a. gibelio* living in the numerous shallow lakes with sparse food supply, the sex ratio here being about equal. Similarly, Leonenko (1960), studying *C. a. gibelio* in the Ošm'ansk region, came to the conclusion that there are two strains of *C. a. gibelio* living in Belorussia: a monosex line (with fast growth) and one approaching an equated sex ratio (of stunted growth). Gorjunova (1960) made a detailed study of *C. a. gibelio* in the Boščakol' lake (Kustanajsk region of Kazakhstan SSR) in which *C. a. gibelio* survived in monoculture after repeated decimations of the population by heavy frosts. After a time males and hermaphrodites began to appear in the lake. The number of males represented about 1% of the population, but at the spawning period it rose up to 10 to 15%. Hermaphrodites formed about 0.4% of the population. Another point of interest was that a part of the *C. a. gibelio* grew twice as fast as the rest. The males were smaller in size, the hermaphrodites of middle size. Not only males and females were present on spawning grounds, but also hermaphrodites in which the pearl organ was similarly developed as in the males. An artificial fertilization of normal females by sperms of hermaphrodites resulted in normally viable individuals. Detailed anatomical and histological study of hermaphrodites led Gorjunova to conclude that the appearance of males and hermaphrodites in female monoculture is related to their gradual masculinization. Golovinskaja, Romašov and Čerfas (1965) also report the occurrence in *C. a. gibelio* of two forms that cannot be morphologically differentiated. However, these differ essentially in the mode of reproduction: the first form is monosexual (with the exceptional incidence of defective males) and is reproduced gynogamically, while the second one is bisexual, giving rise to hybrids when crossbred with other species.

V. What is the difference between *C. auratus gibelio* and *C. auratus auratus?* From a comparison of descriptions of *C. a. auratus* living in its natural habitat in China and Japan (Abbot, 1901; Fowler, 1924; Everman and Shaw, 1927; Rendahl, 1928; Tchang, 1931; Lin, 1933; Mori, 1934; Nichols, 1943; Jordan and Fowler, 1903; Matsui, 1934; Tanaka, 1935; Okada, 1960; Nakamura, 1963) with those of *C. auratus gibelio* (Syč-Averinceva, 1930, 1933; Berg, 1931; Rendahl, 1933; Grib, 1935; Gąsowska, 1936; Taranec, 1937; Tichyj, 1938; Heuschmann, 1939; Nikol'skij, 1940; Nikoljukin, 1946; Bilyj, 1947; Serov, 1947; Berg, 1949; Nikol'skij, 1956; Bușnița and Christian, 1958; Savina, 1958; Ivanov, 1959; Mišík and Holčík, 1962; Balon, 1962; Bănărescu, 1964; Žukov, 1965, and our own data) it ensues that none of the counts and measurements can be considered as specific (Table 2). Likewise, no essential differences between these subspecies apparent from a comparison of descriptions and illustrations of their bones in the works by Koh (1931), Dimitrijeva (1957), Deng (1959) and Kurovskij (1968).

C. auratus auratus living in the wild state and known in China under the name of chi-yü and in Japan under that of funa, does not differ in coloration from *C. auratus gibelio*. Linnaeus (1758) described a domesticated

Table 2. Counts and measurements of *Carassius auratus gibelio* in comparison with *Carassius auratus auratus* and *Carassius carassius*

	C. a. auratus		*C. a. gibelio*		*C. carassius*[3]
	China	Japan	Asia	Europe	
Squamae lin. later.	26—29(33)	23—26	(27)30—34	(27)28—34	28—34
Squamae transv.	5/6—7/6	4/4—7/6	6/5—7/6+	5/5—8/7	6/6—8/7
Num. spin. branch.	45—49	(36)40—53[1]	39—51	(33)39—54	21—34[4]
Num. vertebrarum	29—32	——	30—32	28—32	31—34
Radii pinnae D	II—III	II—IV	III—IV	III—IV	III—IV
	(14)16—18	13—18(19)	15—19	(14)15—18	13—21
Radii pinnae A	II—III	II—III	III—IV	II—III	II—III
	5—6	5—7	5—6	5—7	5—9
Radii pinnae P	I 15—16	I 14—15	——	I 14—18	I 12—17
Radii pinnae V	I 8	I 7—8	——	I 7—8	I 7—9
In % long. capitis:					
Distantia praeorbitalis	25—35	25—31	28—32[2]	25—35	24—32
Diameter oculi	20—33	17—26	18—21[2]	16—25(32)	18—26
Distantia inter oculos	32—43	33—45	41—43[2]	39—47	34—52
In % long corporis:					
Longitudo capitis	27—32	26—33	24—31	23—31	23—33
Distantia praedorsalis	50—23	——	47—58	34—56	48—60
Altitudo corporis	32—47	31—44	38—53	(29)33—49	34—62
Longitudo ped. caudae	——	——	14—20	15—23	20—23
Altitudo ped. caudae	48—56	62	——	53—63	——
Minima altit. corp.	——	15—18	14—19	13—18	13—20
Distantia P-V	19—23	——	18—23	19—22	20—29
Longitudo pinnae D	——	37	34—44	28—39	29—49
Longitudo pinnae A	——	11	10—15	9—14	9—16
Longitudo pinnae P	20—26	17—21	16—22	17—23	15—22
Longitudo pinnae V	21—29	18—24	18—23	18—25	15—27
Altitudo pinnae D	——	15—22	15—22	14—25	13—27
Altitudo pinnae A	——	15—19	13—20	14—20	12—21

[1] 36—40 in "kinbuna" (*C. carassius* ssp.), 53—72 in "nigorobuna" (*C. carassius grandoculis*) and 106—120 in "gengorôbuna" (*C. carassius cuvieri*) (sec. Nakamura, 1963).

[2] Minimum and maximum diameters determined.

[3] According to the descriptions of Čigarž (1958), Žukov (1965) and Libosvarskij (1966).

[4] For young *C. carassius m. humilis* (10 to 60 mm in TL) reports Čigarž (1958) 9 to 28 gill rakers on the first branchial arch.

aberration ("C. pinna ani gemina, caudae transversa trifurca")[6] and assigned to it a rather wide 'terra typica' (Habitat in Chinae, Japoniae fluviis"). Hence, it may well be assumed that populations of individual river basins will differ considerably among themselves.

Particular attention should be devoted to Japanese crucian carps. Temminck and Schlegel (1842) described four species from Japan — *Carassius langsdorfi*, *C. buergeri*, *C. cuvieri* and *C. grandoculis*. Tanaka (1931, 1935), however, admits only a single species of crucian carp, viz. *Carassius carassius*. Okada (1960) is of the opinion that in Japan lives only *C. auratus* in three strains: gengorôbuna, hirabuna (= ginbuna) and marabuna (= hinbuna). Nakamura (1963) divides Japanese crucian carps into several

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[6] Pouchet (sec. Chen, 1956) recalls an illustration of *C. auratus* in Linnaeus's work 'Fauna Svecica' (1745): the specimen had a double tail-fin, and Linnaeus considered it to be normal!

subspecies of *C. carassius: C. carassius langsdorfi* (ginbuna), *C. carassius buergeri* (nagabuna), *C. carassius grandoculis* (nigorobuna), *C. carassius cuvieri* (gengorôbuna) and *C. carassius* ssp. (kinbuna). Of particular interest is the strain gengorôbuna *(C. cuvieri)* which differs from all the other crucian carps primarily by the number and shape of its gill rakers, of which it has over 100 on the first gill arch. Also nigorobuna *(C. grandoculis)* has an enlarged number of gill rakers (53 – 72) on the first gill arch.[7] According to Nakamura (l.c.), gengorôbuna originally lived in the Yodo river basin and the Biwa lake. Okada (1960) agrees with Matsubara's and Matsui's view (1934) that the goldfish was introduced into Japan, but this doubted by Hubbs (1962).

VI. What is the position as regards the sex ratio and reproduction in *C. auratus auratus?* Among 1353 specimens caught in the environs of Peking, Li (1959b) found 39.09% of males, while this proportion rose to 60.66% in the case of another batch of 1360 control specimens in an aquarium. Males exhibited a slower rate of growth than females. Li (1959a) further found a difference in mortality between the sexes after a prolonged period of starvation. He observed ovotestis in one male after protracted starvation! Sasaki (1926) sets the sex ratio also in the Japanese *C. auratus* always in favour of females – the mean proportion of males per 100 females amounting to 12.9 (3.8 in channels, 11.6 in small streams and 18.4 in fish ponds). In his view, this disparity may by due to the greater mortality rate in the males. Egashira (1935), testing the resistence of young *C. auratus* to enhanced NaCl content and oxygen deficiency, found the females to be somewhat more resistant to saltiness, while the males showed greater resistance to oxygen deficiency: he failed to observe any such differences in adult specimens. He sets the sex ratio for males from various localities at 16.5 to 36.86 per 100 females, and observes that females always predominate in older fishes, while males are totally absent among specimens over 15 cm length. He found eggs in the testes of some young males. Okada (1960) reports a predominance of females in hirabuna and marubuna strains which grow sloely (maximum length 20 cm), but an equal sex ratio in the gengorôbuna strain, which grow well (may attain 50 cm in length).

Suzuki (1953) obtained reciprocal hybrids from *C. auratus* × *Misgurnus anguillicaudatus* which survived up to 24 hours only. A similar short-term survival (of approx. 24 hours) for the hybrids of *C. auratus* × *Misgurnus anguillicaudatus* is also reported by Kobayasi (1963). However, some "hybrids" he examined attained the adult stage and resembled the maternal species! For the sake of completeness, the work by Tchou and Chen (1937) should be also mentioned: these authors found a spontaneous acti-

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[7] Tomoda (1960) made a study of the three strains of Japanese crucian carps living in the Biwa lake and reports the gengorôbuna ("Gengor-Funa") to have a large mouth and numerous gill rakers of a complicated pattern. Hiwara has thick lips, well-developed pharyngeal teeth, but a feeble mandible. The nigoro has fairly well-deweloped gill rakers, weak pharyngeal teeth, but a long mandible. Its air bladder and pneumatic bulb are equally developed as in the gengorôbuna. Yamagishi (1963) observed in experiments, that in streaming water the juvenile kinbuna tended to sink to the bottom, while that of the gengorôbuna rose towards the surface. Mention should also be made of Suzuki's experiments (1962) with reciprocal hybrids of *C. auratus* × *C. carpio*. While carps jumped out of the water and goldfish took refuge at the bottom during sudden changes, hybrids rushed towards the surface.

vation of mature eggs of *C. a. auratus* when put in contact with water (partenogenesis in which the vitality of ovae lasted 2 to 3 hours).

VII. Finally, the domesticated goldfish should be mentioned: Makino (1941) found the chromosomes in 14 varieties of goldfish to be identical with those in the wild species. Li et alii (1959) did not observe any essential differences between the developmental stages of the wild and the domesticated forms. Even the wild coloration was initially noticeable in the domesticated forms. Katoh (1932) reports an equal sex ratio for the domesticated form of the so-called "Iron Fish", and Sasaki (1926) for the "Wakin". In the case of the "Ryukin", he sets the ratio at 87 males per 100 females: the males are smaller.

CONCLUSION

Carassius carassius and *Carassius auratus* are two separate species and can be well differentiated. On the other hand, our existing knowledge on the variability of *Carassius auratus* does not permit differences between the typical form and the subspecies *gibelio* to be adequately defined. First, an exact 'terra typica' will have to be determined for *C. auratus*, and only then it will be possible to envisage a revision of the taxonomy and nomenclature for the described forms. It will likewise be necessary to elucidate the position of Japanese crucian carps.

SUMMARY

1. A description is given of six further specimens of *Carassius auratus gibelio* found in the Slovak part of the Danube. A tendency of the nuber of the gill rakers to increase, in comparison with the data reported by Mišík and Holčík (1962) and Balon (1962), was observed.
2. European autochtony of *Carassius auratus gibelio* is not proved. In this connection Marsili's data (1726) on *Cyprinus* III from the Danube are of interest.
3. Some morphological differences between *Carassius carassius* and *Carassius auratus gibelio* are not specific, particularly as regards coloration of the peritoneum and shape of the swimmbladder. Nevertheless, two separate species are involved.

   On the other hand, it is not possible at the present time to differentiate between *Carassius auratus auratus* and *Carassius auratus gibelio* on the basis of morphological signs.

   The Japanese nigorobuna *(C. grandoculis)* and especially the gengorôbuna *(C. cuvieri)* unequivocally differ from other crucian carps by the number of gill rakers.
4. *Carassius auratus gibelio* occurs in two morphologically undistinguishable forms: monosexual, reproducing gynogamically, with exceptional occurrence of defective males, and bisexual, giving rise to hybrids on crossbreeding with other species.

   A similar phenomenon is reported also for *Carassius auratus auratus*, whereby the differences in this respect between these two subspecies disappear.

   Carassius carassius and the Japanese gengorôbuna *(C. cuvieri)* have an equal ratio; gynogamic reproduction is unknown in them.

5. From the above it ensues that there exist two species of crucian carps: *Carassius carassius* and *Carassius auratus*. On the basis of existing knowledge, *Carassius auratus gibelio* is identical with *Carassius auratus auratus*. The existence of a third species of crucian carp in Japan is not out the question.

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SOME NOTES ON DENTITION IN MUSTELIDAE

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Received November 6, 1970

Abstract: The author describes variations of dentition in some species of Mustelidae. In the first part of the paper, cases of supernumerary and missing teeth in *Meles meles* and *Lutra lutra* are presented; a comparison of the degree of teeth abrasion in 27 species of Mustelidae is made in the second part of the paper.

Dentition of mammals is one of the most important characters used in their systematics and determination. However, the number, morphology and position of the teeth, even if very characteristic for each species or group of species, are not constant. Their variation is well known and its occurence is frequent enough in certain species. The absence of P1, for example, is very usual in the European Badger (*Meles meles* L.) being established in more than 50 per cent of specimens. However, also other variations, diseases or injuries of the teeth are known which may alter the general character of the dentition in the respective species.

In the present paper, I would like to deal with some of these variations. For some years past, I have had the opportunity to examine more than 800 specimens of Mustelidae. Although the aim of my work was quite different, I have made findings, too, which might be of some interest with regard to this problem.

OCCURRENCE OF SUPERNUMERARY AND MISSING TEETH IN SOME SPECIES OF MUSTELIDAE

Investigations of this kind were made in two species of Mustelidae, the European Badger (*Meles meles* L.) and the River Otter (*Lutra lutra* L.), the most numerous species of the material examined. Of other species, only the most interesting cases have been registered (see Heráň, 1970). In recent literature, only few papers of this kind have been published bearing on Mustelidae (Marshall, 1952; Reinwaldt, 1958; Van Gelder and McLanglin, 1961; Mazák, 1964). However, much valuable information on Mustelidae is found, too, in the more comprehensive publications by Colyer (1936) and Hall (1940).

European Badger (*Meles meles* L.)

Of 79 specimens of this species 51 (64.5 per cent) show deviations from normal dentition. One of them results from the presence of an extra pre-

Tab. 1

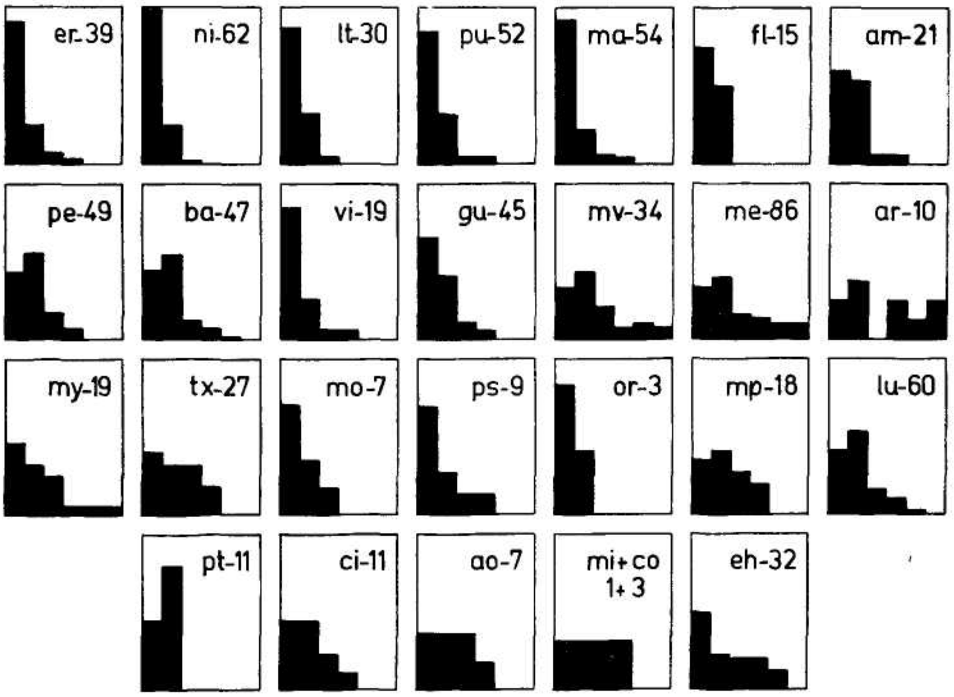
kind of variation	number of cases	percentage
all P1 missing	6	11.8
three P1 missing (2 upper, 1 lower)	6	11.8
two P1 missing	21 (17 upper, 3 lower, 1 upper + lower)	41.2 (33.3, 5.9, 1.9)
one P1 missing	15 (8 upper, 7 lower)	29.4 (15.7, 13.7)
three P1 (1 upper, 2 lower) and one lower P3 missing	1	1.9
one P1 (upper) and one P2 (upper) missing	1	1.9
two supernumerary premolars in upper jaws	1	1.9
total	51	100

molar in the position medially to the space between P2 and P3 in each upper jaw while all the other variations are the results of missing teeth The absence of P1 was the most frequent of them (63.2 per cent of the total number of specimens) while P2 and P3 were missing each in one case A detailed survey of these variations is given in the Tab. 1.

From these data the conclusion follows, too, that the absence of the upper premolars is more frequent than the absence of the lower. However, this fact is already known also from other papers bearing on this problem (Heptner and Naumov, 1967, etc.). More interesting are the cases of missing of teeth other than those in the position of P1, that is to say, the cases of missing left upper P2 (No. CM-012, National Museum, Praha) and the right lower P3 (No. 8086, Museum of Natural History, Basel). However, it is not quite clear whether the absence of these teeth is of developmental character or whether it is the result of injury or disease of the bone. In both cases referred to the bone shows a structure which might indicate that the tooth has been lost secondarilly at an early age. The X-ray frame of No. 8086 seems to allow this alternative.

Most interesting is the case of skull No. 14/60 922 (National Museum, Praha) where an extra premolar is present in each upper jaw as described before. Such a case is rather infrequent in Mustelidae being noted only in *Eira barbara* (one case of 61 specimens, Colyer, 1936), *Martes pennanti* (one case of 42 specimens, Heráň, 1970) and in the badgers: *Taxidea taxus* (one case of 110 individuals, Hall, 1940), *Melogale orientalis* (one case of 23 specimens, Colyer, 1936) and in *Meles meles* in which this anomaly is probably the most frequent of all the family (Colyer, 1936, has found among 89 specimens 15 cases in which an extra premolar was present in both maxillae, 6 cases in which it was present in the left maxilla and 3 cases with an extra premolar present in the right maxilla). No other species with supernumerary premolars are reported of Mustelidae although the occurence of other supernumerary teeth (incissors, molars) is well known in many species of this family.

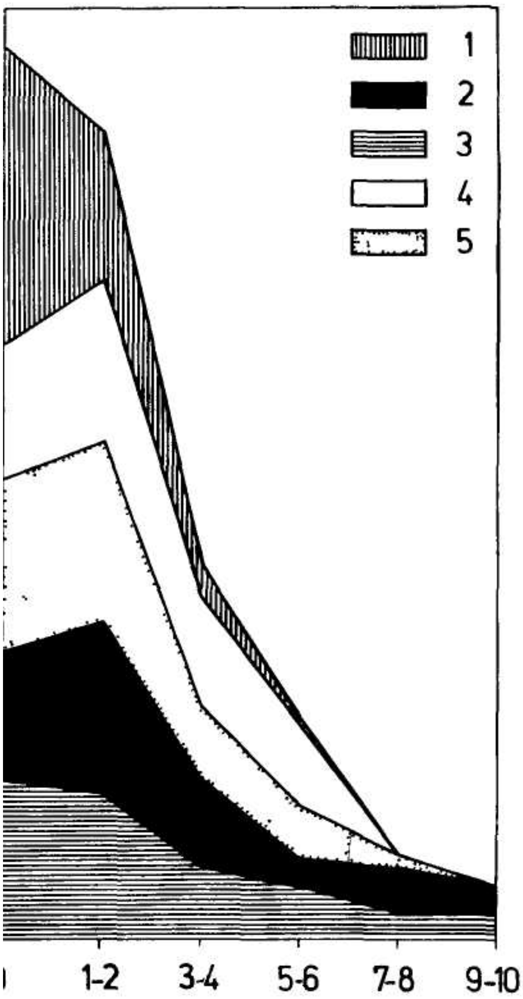
Note: In conclusion to his paper on teeth in Carnivora, Hall, (1940) says that "...Dental caries was found only in bears, although looked for in the 5657 other specimens of wild-taken mammals examined." In this connection, I would like to point out that in the anatomical collections of the National Museum in Prague a skull of *Meles meles* is deposited with a deep dental caries located very uncommonly in the foot of the right upper canine (see Heráň, 1965).



Graph 1. Teeth abrasion in Mustelidae. The degree of teeth abrasion is represented by columns showing, from left to right, types 0, 1–2, 3–4, 5–6, 7–8 and 9–10 in each species. The height of each column represents the number of individuals in per cent of the total sample. am – *Martes americana*, ao – *Aonyx capensis*, ar – *Arctonyx collaris*, ba – *Eira barbara*, ci – *Amblonyx cinerea*, co – *Paraonyx congica*, eh – *Enhydra lutris*, er – *Mustela erminea*, fl – *Martes flavigula*, gu – *Gulo gulo*, lt – *Lutreola lutreola*, lu – *Lutra lutra*, ma – *Martes martes*, me – *Meles meles*, mi – *Paraonyx microdon*, mo – *Melogale moschata*, mp – *Mephitis mephitis*, mv – *Mellivora capensis*, my – *Mydaus javanensis*, ni – *Mustela nivalis*, or – *Melogale orientalis*, pe – *Martes pennanti*, ps – *Melogale personata*, pt – *Pteronura brasiliensis*, pu – *Putorius putorius*, tx – *Taxidea taxus*, vi – *Grison vittatus*.
The figures show, in each graph, the numbers of specimen examined.

River Otter (*Lutra lutra* L)

Of 52 specimens only 2 (3 8 per cent) show deviations from normal dentition Both these variations are the result of one lower P3 missing in each specimen (one on the left side, the other on the right side of the mandible). On the contrary, no variations were found due to the absence of upper P1. Both the variations referred to were probably caused by disease of the mandible· in one specimen (No 14/60 1260, National Museum, Praha) the mandible is suppurated, in the other individual (No 14/60 276, National Museum. Praha) two little pits are visible in the bone which might be, in all probability, the incompletely obliterated alveoli of missing P3 A relatively small number of teeth variations found in the River Otters is well in line with the data published in literature



Graph 2. The occurrence of the types of teeth abrasion in the subfamilies of Mustelidae: (1) Mustelinae, (2) Mellivorinae, (3) Melinae, (4) Mephitinae, (5) Lutrinae Vertical lines — numbers of individuals in per cent of sample; horizontal scale — types of teeth abrasion

TEETH ABRASION IN MUSTELIDAE

Teeth abrasion is one of the factors which influence the patterns of teeth and which, in some mammals, may alter even their basic character (see Zejda, 1959). This is, it is true, not the case in carnivores, however, the abrasion of their dentition is nevertheless very conspicuous in some species This fact can be demonstrated, too, on the dentition of Mustelidae.

The author has examined 27 species of this family in order to make some interspecific and intraspecific comparisons of the morphology of their skulls. In connection with these studies an attempt has been made to use the degree of teeth abrasion for determining the relative age of the skulls examined. For this purpose, 11 types of abrasion were distinguished by the author ranging from intact teeth (type 0) up to the highest degree of abrasion (type 10) as shown in Fig. 8 Of course, such a method may be used, for this purpose, as an auxiliary means only, its exactness being dependend too much on the worker's peculiar criteria; in addition, the degree of abrasion itself is very much affected by the variety of the diet and the individual character of the specimen. On the other hand, however, even if original aim of the examination be left out of consideration, the data obtained are apt to give a certain idea of the modes of teeth abrasion in various species of Mustelidae (see graphs 1 and 2). They can be summarized as follows:

(a) The highest degree of teeth abrasion (types 9—10) was found in subfamilies Melinae and Mellivorinae. The crowns of molars can be ground away, in these species, practically down to the roots as shown in Fig. 8. The occurence of the several types of abrasion is on a slow decrease down the line from type 1—2 to 9—10. Type 0 is usually not so frequent as type 1—2. An exception is found only in *Taxidea taxus* where the highest degree of abrasion corresponds to type 5—6 and, mainly, in three species of genus *Melogale (M. moschata, M. personata, M. orientalis)* the graphs of which are very similar to those of the subfamily Mustelinae.

(b) Type 7—8 as maximal degree of abrasion occurs in *Lutra lutra* and in *Enhydra lutris*. The mode of teeth abrasion in the latter is very typical and differs from all other species examined (see Fig. 9). A conspicuously low degree of teeth abrasion was found, within the subfamily Lutrinae, in *Pteronura brasiliensis*.

(c) In the other subfamilies of Mustelidae (Mustelinae, Mephitinae) no degree of teeth abrasion higher than type 5—6 was found the maximum of individuals, in the greater part of species examined, being fallen under type 0. There are two exceptions to this general state of teeth abrasion of Mustelinae, those in *Martes pennanti* and *Eira barbara* respectively.

CONCLUSIONS

The characters of teeth variations in the species examined are, in general, in accord with the data found in literature. The occurence of supernumerary upper premolars in the European Badger seems to be the most interesting case of them. The highest degree of teeth abrasion was observed in omnivorous species (*Mellivora*, the greater part of Melinae) and in the strictly specialized Sea Otter *(Enhydra lutris)*. This fact results probably of the type of diet in the respective species.

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

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ON TRICHODRILUS PRAGENSIS VEJD. (OLIGOCHAETA, LUMBRICULIDAE)

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Received March 1, 1971

Abstract: The autor revises the description of *Trichodrilus pragensis* Vejd. on the basis of specimens from the wells in Prague in Bohemia and at Oslavany in Moravia.

Trichodrilus pragensis Vejd. belongs to the species of the family Lumbriculidae, described nearly 100 years ago. So far, nobody has revised its description published by Vejdovský (1875, 1876, 1884) because of the lack of suitable material.[1]

In the course of 1970, myself and J. Rosol succeded in collecting several specimens of *T. pragensis* during the investigation of the well fauna at Oslavany in Moravia and in Prague in Bohemia. Some of the collected individuals are mature.

These specimens, together with the individuals, showing initial stages of development of their genital apparatus from the collection of Mrs V. Řeháčková from some wells in Prague, enabled me to study the structure of *T. pragensis* and to complete or emend the description of this species published by Vejdovský.

The specimens studied by me are max. 22 mm long whereas Vejdovský states much longer length of the body (30—40 mm). The diameter of the body of my specimens is smaller (0.38 mm) than that of the individuals of Vejdovský (0.6—0.7 mm). The worms consist of 70—80 segments according to Vejdovský; my material contains one specimen consisting of 95 segments.

Prostomium nearly twice longer than wide.

Segment 3—7 divided in the anterior narrow and posterior wide portion as correctly figured in fig. 2, tab. XXXIX in the publication of Vejdovský (1876), only the numeration of segments is incorrect. The secondary annulation is recognisable in some individuals on the ventral side of their body as well as on all anteclitellial segments except the 1st and 2nd one (in the immature specimens, in the postclitellial segments, too).

Setae simple, not forked.

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[1] I have two specimens from the collection of prof. Dr. E. Piguet, determinated as *Trichodrilus pragensis* from the well in Bale in Switzerland (Dr. P. A. Chappuis leg.). In a series of sections made from these individuals mounted originally in Canada balsam, I ascertained that these specimens belonged to a new species *Dorydrilus mirabilis* Hr. (Hrabě, 1936).

Chloragogen cells cover the oesophagus from segment 7 on. They attain a great development in the middle segments. This prevented Vejdovský from studying the internal organs of living specimens.

Pharyngeal glands (septal glands according to Vejdovský), occur not only in segment 5—8 but in some individuals in segment 9. Vejdovský (1876) rightly points out that their secretion discharges to the digestive tube on the dorsal side of the pharynx.

1st pair of the nephridial funnels are suspended on 6/7, 2nd pair on the dissepiment 12/13, in accordance with the observation of Vejdovský (1884). The mentioned nephridia open in segment 7 and 13.

Vejdovský observed one pair of vessels connecting the dorsal vessel with the ventral one in anterior 5 segments (correct in segment 2—6) and in segment 10—12. I found these vessels in segment 7—9 as well.

The lateral vessels are missing in all the postclitellial segments of *T. pragensis*. I failed to find these vessels both in the total worms fixed in Zenker's solution mounted in Canada balsam and in transverse sections. Vejdovský observed the worms in vivo and in preparations of the young specimens in glycerol. In the 70's of the last century, the microscopical technique was just beginning to develop.

The vessels considered by Vejdovský as the transversal vessels homologous to the transversal vessels of *T. allobrogum* Clap. are in reality the vertical vessels of the perivisceral sinus. Their dichtomically divided ends are the horizontal vessels of the same sinus. The note of Vejdovský on dark red spots occurring on the lateral vessels conforms with my opinion. They occur in the places where the horizontal vessels run out from the vertical ones.

Two pairs of testes in segment 9 and 10. One pair of ovaries in segment 11. Vejdovský (1876) considered sperm-sacs to be testes and, in his monograph (1884), described a posterior pair of testes in segment 10 only.

Two pairs of male funnels on dissepiment 9/10 and 10/11. The posterior sperm-ducts rest in the vicinity of dissepiment 10/11 in segment 11. The spermducts open into the atrial ampulla on its opposite sides (Fig. 2,d).

One pair of atria in segment 10. They consist of an ampulla and a short duct, ending by short penis on top of a low conical porophore. Penial sacs are missing in all specimens with very differently developed sexual apparatus.

Atrial ampullae oblong oval to sphaerical. Atrial ampullae of the first form occur in specimens from Oslavany without ripe spermatozoa and in mature individuals from Prague with resorption vacuolae in spermathecal epithelium. Other specimens from Oslavany and Prague have sphaerical ampullae up to 140 μm in diameter. Ampullae of this form occur in the individuals with very reduced genital apparatus as well (Figs 1—3).

Only one pair of spermathecae in segment 11. Their ampullae are conspicuous by its considerable size. They occupy segment 11 and 12. The portion passing the dissepiment 11/12 is compressed by it. The compression is hardly visible in total preparations and this accounts for the first reference of Vejdovský (1875) about two pairs of spermathecae in *T. pragensis*. In the second paper, Vejdovský (1876) notes only one pair of spermathecae.

As regards the supplement to the description of *T. pragensis* published by Vejdovský in his monograph (1884), I suppose that Vejdovský in this case observed another species of *Trichodrilus* with two pairs of spermathecae.

I have a large number of individuals of *T pragensis* in first stages of development of genital apparatus from Prague and Oslavany but I could not observe any sign of a second pair of spermathecae (in segment 12) neither Vejdovský (1876) in his second paper about this species

One pair of femal funnels on dissepiment 11/12

Note *T pragensis* differs from *T tatrensis* Hr , *stammeri* Hr and *černo-*

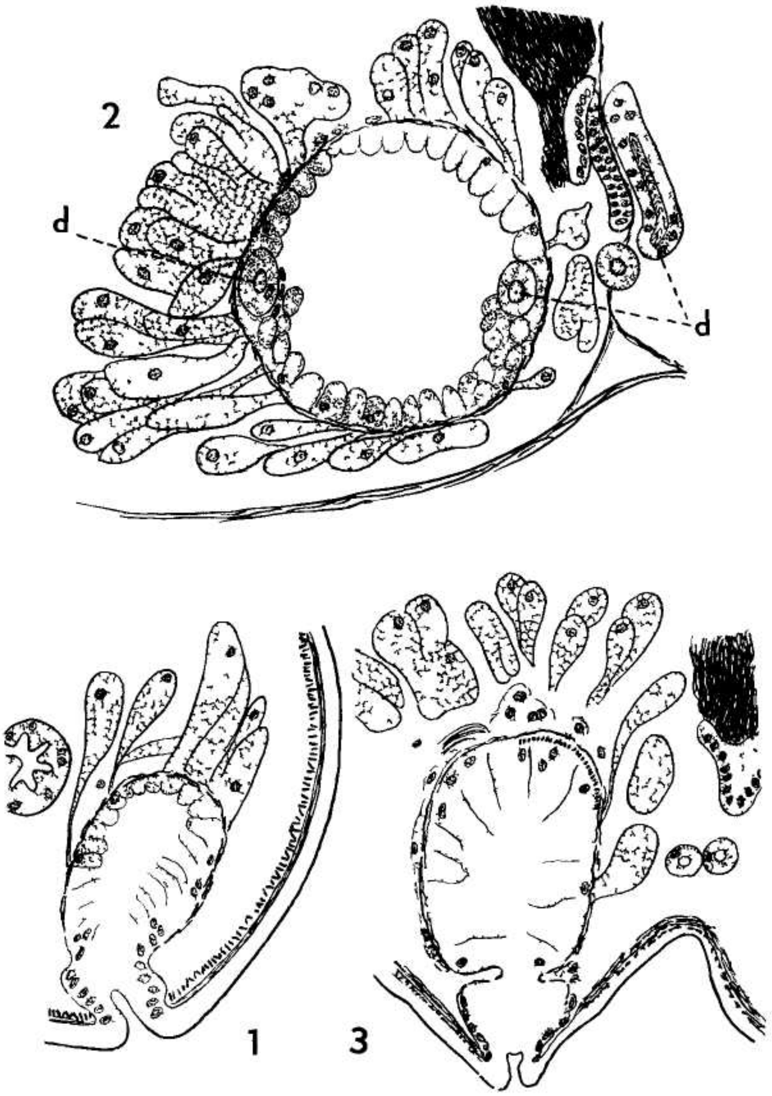

Fig 1 – 3 *Trichodrilus pragensis* Vejd

1 Atrium of one not fully mature specimen from Oslavany (without ripe eggs) – 2 Transversal section of atrial ampulla of a fully mature specimen from Oslavany (with ripe eggs in segment 15th and 16th) D spermducts in front of the opening into the ampulla cavity – 3 Atrium of one specimen from Prague (Karmelitska str) of similar maturity as the foregoing specimen

svitovi Hr. that have only one pair of spermathecae, in form of atrial ampullae. In *T. pragensis* they are oblong oval or even sphaerical while oblong pear-shaped in *T. tatrensis* and *stammeri* and very long, nearly cylindrical in *T. černosvitovi*.

T. ptujensis Hr. and *sketi* Hr. also possess one pair of spermathecae, *T. ptujensis* has pear-shaped atria with very thick muscular layer (26,5 μm). The atria of *T. sketi* are ovoid, similar to the atria of individuals from Prague. It is possible that this species is synonymous to *T. pragensis*, but the material from Slovenija was badly fixed, therefore I can not solve this problem in the present time.

Localities

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SAMPLING AND DISTRIBUTION OF ANIMALS IN SUBMERGED VEGETATION

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Abstract: In carp-pond submerged stands a 1-m^2 sampler was used for sampling the phytomacrofauna. The mean abundances and biomasses of animals were related to the unit bottom area, to unit plant weight, to the unit plant surface, and to the unit water volume. It is shown that a given aim of the sampling or given animal species asked an adequate expression of quantitative data. In animal populations various relations to the plant stand density were found. Distribution of animals was tested and the log-normal distribution was proved for the total biomasses of animals. Three predominant species have another distribution each, bein influenced by the behaviour of the species. An abundant material collected by the large sampler makes possible to treat quantitative data in terms of the normal distribution because of large means. The size of the sampler is also discussed according to the species overdispersion and the "edge effect" of samplers.

INTRODUCTION

There is no method accepted generally for quantitative sampling of the macrofauna in submerged vegetation. The reasons are: a great diversity of conditions in which submerged plants grow, various densities of plant stands, various relations of animals to plants, various aims of sampling etc. Quantitative samplers have been proposed for example by But (1938) (in Morduchaj-Boltovskoj, 1956), Andrews and Hasler (1943), Macan (1949), Gerking (1957), Barthelmes (1960), Garnett and Hunt (1965), or Gillespie and Brown (1966). However, they are considered inappropriate because of small numbers of individuals caught in one sample and because of a supposed "edge effect" resulting from their small working areas.

In shallow carp ponds near Blatná town, southwestern Bohemia, experience has been gathered with a new apparatus of 1-m^2 working area. The sampling was carried out in stands of *Elodea canadensis* Rich., *Potamogeton pectinatus* L., *Potamogeton lucens* L., and *Batrachium aquatile* (L.) Dum. Throughout the year 1965 series of samples were taken from an *Elodea* stand in order to study the population dynamics of the macrofauna. In the present paper, mainly these sample series were used for an evaluation of the sampling error, for demonstrating various relations of animals to plants, for testing distribution of animals, and for comparing results with those obtained using a frame method.

MATERIAL AND METHODS

I. Material

Sampling was carried out in an *Elodea* bed in the "Southern Bay" of the carp pond Radov (44 ha). The bay has an area of about 3 ha, an average depth of about 60 cm, and a maximum depth of 90 cm. Every thenth day samples were taken at four sites from May to September 1965. The sampling at short sampling intervals appeared to be necessary as both abundance and biomass of animals varies by large amounts from date to date. For some conclusions results from the sampling of *Potamogeton lucens* in 1965 and *Batrachium aquatile* in 1964 were used. These stands were sampled at the same intervals; *Potamogeton* in two sample series, *Batrachium* in four sample series.

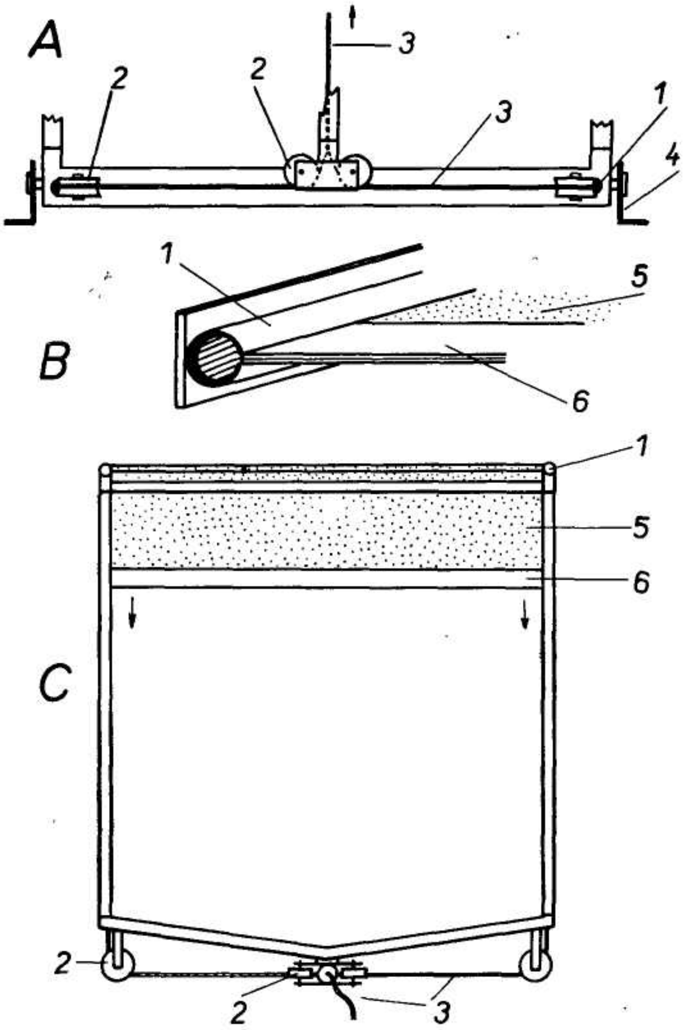

Fig. 1. Simple draft of the sampler bottom frame. (A) Side view; (B) rabbet with the sliding door; (C) top view. (1) Rabbet; (2) pulley wheel; (3) string; (4) skid; (5) oilcloth; (6) steel bar of the sliding door.

2. Sampler construction

The sampler consists of a tubular frame attached to a horizontal bottom frame of 1 × 1 m. Along four vertical 1.25 m long poles of the tubular frame an upper frame can be moved, making possible to sample at different depths. The bottom frame has two rabbets in which an oilcloth sliding door attached to a steel bar is drawn by a string (Fig. 1). Two skids on bottom frame sides keep the sampler on the bottom surface. The tubular frame is coated with synthetic 0.25 mm mesh cloth.

3. Sampling operation

The opened sampler is quickly lowered over a stand of vegetation and plants are carefully torn out by hand and left flowing on the water surface inside the sampler (Fig. 2). After this the sampler is left at rest for half an hour. This is the time which was found necessary for animals escaped or dropped to the bottom to swim up. Then the sampler is quickly shut and all plants are picked out by hand to polyethylene transport bags. It may be used in shallow littoral regions up to the depth of 1.25 m. Samples do not contain the bottom fauna. Two persons are needed for the sampling, one of them using a diving suit (at low temperatures).

Table I. Mean numbers of animals related to $1 m^2$ of the *Elodea* stand and to 100 g of the air-dried plant.

Date	ind./m^2	ind./100 g
25.5.	3,126	4,501
4.6.	4,800	5,872
11.6.	3,826	4,331
25.6.	6,720	3,653
6.7.	4,548	2,482
16.7.	6,072	2,586
27.7.	6,705	2,546
6.8.	6,655	2,829
17.8.	7.137	2,683
3.9.	8,672	3,622
22.9.	10,391	5,504
mean	6,240	3,690

On the pond bank animals attached to the sampler walls are rinsed with water. As the sliding door is waterproof animals, plant fragments, and a rest of water form a puddle on it. This is screened through a set of three graded sieves with meshes of 5 mm, 1 mm, and 0.6 mm (Fig. 3). Plants from the transport bags are placed into large containers and formalin is added as to achieve the resulting concentration of 0.5 – 1.0%. All animals attached to the plants get loose during 3 – 4 hours. Then the plants are washed and the water is filtered through the sieves.

4. Laboratory treatment

The plants deprived of animals are air dried and weighed. The sample of animals from two upper sieves is sorted as a whole. It represents 25 – 50% of the total number of animals and about 80% of their weight. The debris from the densest sieve contains, except animals, a large amount of fine detritus (about 150 cm^3, on the average). It is filled up with water to a given volume (250 cm^3 or greater), according to the amount of detritus, and then is stirred. Two to four 25-ml aliquots are taken by a large syringe. Zooplanktonic species were not counted.

Basic quantitative data obtained from samples were expressed in numbers of individuals or in grams per 1 m^2. As the relation to bottom is probably not the most important relation these values were converted to those coming to volume of 1 m^3, to 100 g of air-dried plant, and to 10 m^2 of plant surface.

RESULTS

1. Density and biomass of animals and relations to the density of plants

Tables I and II show mean wet weights of animals and plants and mean densities of animals per one sample (1 m^2). They ranged between 3,000 and 11,000 ind. per 1 m^2 and between 7 and 24 g per 1 m^2, annual mean being 6,240 ind. and 15.7 g respectively. These basic values show fluctuations regardless of plant quantities. They are useful for comparison with bottom fauna.

Table II. The sampling errors (a) on 0.05 level expressed in % of the arithmetic means ($\bar{x}$) of the total biomass of animals in grams per 1 m^2.

Date	*Elodea*		Animals	
	$\bar{x}$	a	$\bar{x}$	a
25.5.	70.4	40	11.13	49
4.6.	114.1	84	9.72	30
11.6.	133.0	76	6.76	34
25.6.	189.0	60	14.59	46
6.7.	184.2	12	16.86	20
16.7.	238.0	44	19.44	20
27.7.	268.8	33	15.22	53
6.8.	232.6	39	17.78	54
17.8.	272.8	38	17.32	51
3.9.	260.9	30	20.29	33
22.9.	199.8	36	23.03	39
mean	196.7	45	15.65	39

Table III. Mean population densities and mean biomasses of animals related to 10 m^2 surface area of *Elodea* and to the volume of 1 m^3.

Dates	Animals per 10 m^2		Animals per 1 m^3		water level
	ind	g	ind	g	
25. 5.	5,619	20.18	3,908	13.92	16
4. 6.	7,331	14.35	5,517	11.60	18
11. 6.	5,407	9.13	4,313	7.64	23
25. 6.	4,561	10.15	8,591	18.64	16
6. 7.	3,099	11.57	6,171	22.86	12
16. 7.	3,229	10.61	8,577	27.40	11
27. 7.	3,178	6.95	9,933	19.69	9
6. 8.	3,531	9.35	9,912	26.46	5
17. 8.	3,349	7.81	11,266	27.38	3
3. 9.	4,521	9.80	14,752	35.33	0
22. 9.	6,871	15.43	17,159	38.51	2
mean	4,609	11.34	9,100	22.67	

Table IV. The relative sampling errors (a) on 0.05 level and the confidence intervals (c.i.) of arithmetic ($\bar{x}$) and geometric (G) means of the total biomass of animals in grams per 100 g dry *Elodea*.

Date	$\bar{x}$	a	c.i.	G	c.i.
25. 5.	16.17	35	10.6—21.8	15.72	10.6—23.2
4. 6.	11.50	85	1.8—21.2	10.03	4.4—22.1
11. 6.	7.31	87	0.9—13.7	5.93	2.3—15.3
25. 6.	8.13	33	5.4—10.8	7.98	5.9—10.8
6. 7.	9.27	29	6.6—12.0	9.11	6.8—12.3
16. 7.	8.50	23	6.6—10.4	8.41	6.6—10.6
27. 7.	5.56	34	3.7— 7.4	5.44	3.9— 7.5
6. 8.	7.49	38	4.6—10.3	7.27	4.9—10.7
17. 8.	6.26	28	4.5— 8.0	6.16	4.7— 8.4
3. 9.	7.85	23	6.0— 9.7	7.77	6.2— 9.8
22. 9.	12.36	64	4.4—20.3	11.45	6.2—21.1

The population densities and biomasses of animals per 1 m^3 increased gradually during the season simultaneously with the water level decrease (Tab. III). The changes are similar to those in the per-bottom-area values. Comparable data on animals showing no apparent relations to plants can be obtained using this type of conversion.

The amounts of animals related to the unit of plant weight showed much smaller fluctuations from date to date then values related to bottom area or water volume. They ranged from 2,000 to 6,000 ind. per 100 g of dry *Elodea* with the annual mean of 3,690 ind., and from 6 to 16 g per 100 g of dry *Elodea* with the annual mean of 9.1 g (Tab. I and IV). This way of the result expression is used most commonly. Beside the comparison with other authors it also makes possible to investigate various relations of animals to plants and to the density of a plant bed. Some preliminary results are shown in Tab. V. The detailed study of the material according to the species composition and relations between animals and plants is published separately.

Quantities of collected animals related to the unit plant surface are shown in Tab. III. The relation that 1 g of dry *Elodea* equals to 808 cm^2 of plant

Table V. The annual means of *Elodea* biomass per 1 m^2 and corresponding mean abundances and biomasses of animals per 100 g dry *Elodea* at different sampling sites.

Sampling sites	$\bar{x} \pm \frac{s}{\sqrt{n}} \cdot t_{0.05}$			
	I	II	III	IV
Elodea g	139.3±30.4	185.2±53.6	215.8±50.2	246.4±60.4
Insecta ind.	3,561±961	2,319±684	1,828±526	1,661±305
g	8.45±2.79	5.94±1.88	4.56± 2.07	3.83±1.16
Mollusca ind.	564±392	1,026±493	917±265	819±302
g	1.61±0.86	3.36±1.62	3.50±1.13	3.06±1.15

surface, found by Jermář (1966), was used for calculations. The data can be compared with those obtained from different species of plants as an inaccuracy due to different ash content is excluded. Studying populations of animals associated with the plant surface the conversion of quantitative data to the unit of plant surface seems to be most appropriate.

2. Sampling variability and distribution of animals

The standard error of the estimate expressed in per cent of the arithmetic mean was calculated for total biomasses of animals per 1 m² of bottom and per 100 g of dry *Elodea* at all sampling dates (Tab. II and IV). The calculations were done supposing roughly normal distribution. The supposition was proved for plant weights. Testing the distribution of animal total biomasses, I found a high level of overdispersion. The log-normal appeared to be the adequate model for distribution of animal biomasses. The arithmetic and geometric means were compared and their confidence limits were calculated (Tab. IV). The confidence intervals of the geometric means are somewhat narrower than those of the arithmetic means but differences are negligible. Thus, the abundant material obtained using the large sampler can be treated in terms of the normal distribution as differences in distribution disappear in sets with relatively large means.

An evaluation of the sampling error according to the abundance of animals gave a more complicated pattern as the species composition cannot be neglected. We can assume that that the error of the estimate of the mean abundance of animals is influenced mainly by the distribution of the most abundant species. In 1965, chironomid larvae of *Ablabesmyia* gr. *monilis*, larvae of the mayfly *Caënis robusta* Eaton, and snails *Lymnaea peregra peregra* (Müller) were the most abundant of 75 species found, forming, on the average, 41% of the total abundance and 47% of the total biomass. Distribution models were investigated in these animal groups. According to Swedberg (1922), the ratio of variance and arithmetic mean was used for a rough estimate of departure from the nomal distribution It appeared all

Table VI. Coefficients of dispersion $\hat{e}$ calculated for abundances of predominant species (L — *Lymnaea*, A — *Ablabesmyia*, C — *Caënis*).

Dates	ind./100 g *Elodea*			ind./m² bottom		
	L	A	C	L	A	C
25. 5.		0.17	0.04		0.02	0.15
4. 6.	0.24	0.18	0.59	0.48	0.08	0.004
11. 6.	0.36	0.07	1.35	0.60	0.14	0.07
25. 6.	0.27	0.03	0.30	0.48	0.31	0.03
6. 7.	0.24	0.02	0.28	0.27	0.01	0.22
16. 7.	0.57	0.01	0.39	0.67	0.01	0.15
27. 7.	0.28	0.03	0.51	0.32	0.02	0.40
6. 8.	0.24	0.05	0.42	0.26	0.05	0.28
17. 8.	0.21	0.05	1.13	0.45	0.05	1.25
3. 9.	0.16	0.03	2.20	0.22	0.02	1.48
22. 9.	0.22	0.17	0.12	0.06	0.03	0.31

Table VII. The confidence intervals (c.i.) on 0.05 level for the *Caënis* mean densities per 100 g *Elodea* calculated for both arithmetic ($\bar{x}$) and geometric (G) means (% — percentual representation of *Caënis* in a whole sample).

Dates	%	x	c.i.	G	c.i.
25. 5.	40	1,791	1,207—2,375	1,755	1,282—2,404
4. 6.	29	1,674	(—246)—3,594	740	126—4,334
11. 6.	25	1,065	(—685)—2,815	679	166—2,768
25. 6.	17	610	99—1,121	538	246—1,177
6. 7.	15	376	69—683	327	140—762
16. 7.	10	253	11—495	207	74—584
27. 7.	5	136	(—11)—283	91	17—481
6. 8.	3	88	0—176	60	11—327
17. 8.	9	230	(—122)—582	122	18—826
3. 9.	16	586	(—585)—1,757	233	23—2,340
22. 9.	1	80	34—126	75	44—129

species are more or less overdispersed. As a measure of the relative level of overdispersion coefficients of dispersion ĉ were calculated (Tab. VI). The estimate of ĉ for a small number of samples was used (Cassie, 1962). Besides, the cumulative frequency distribution was plotted on probability paper.

The *Ablabesmyia* larvae population was only slightly overdispersed; almost random distribution could be expected. According to the cumulative frequency distribution also only a slight departure from the normal distribution was found. In *Caënis* larvae great differences were found in the values of ĉ throughout the year. The log-normal model fits to the distribution found. Confidence intervals of arithmetic and geometric means of the *Caënis*

Table VIII. Number of taxonomical groups recognized in the sampler and the frame collections.

animal group	number of groups recognized sampler	 frame
*Nematoda**	+	—
Oligochaeta	2	—
Hirudinea	6	4
Mollusca	8	3
*Hydracarina**	+	+
Heteroptera	15	3
Ephemeroptera	4	2
Odonata	5	1
Trichoptera	10	2
Lepidoptera	2	2
Coleoptera	7	—
Chironomidae	12	4
Diptera the other	2	—

*) groups in which no further taxons have been recognized till now.

Table IX. The **percentual** composition of the main groups of phytomacrofauna in samples collected using the frame (F) and the sampler (S).

Date	F 14/5	S 25/5	F 23/6	S 25/6	F 5/7	S 6/7	F 15/7	S 16/7	F 24/7	S 27/7	F 8/8	S 6/8	F 22/8	S 17/8	F 15/9	S 22/9
Oligochaeta	—	21	—	5	—	6	—	2	—	2	—	1	—	1	—	1
Hirudinea	2	1	3	3	2	2	—	2	—	3	14	2	15	3	—	+
Mollusca	20	1	11	38	33	29	50	30	52	27	25	29	69	34	80	35
Heteroptera	11	4	4	3	4	9	7	7	6	9	4	12	6	14	4	5
Ephemeroptera	27	46	31	15	41	16	12	11	2	8	15	7	6	11	—	9
Odonata	2	+	—	+	3	2	—	9	—	14	—	10	1	10	5	5
Trichoptera	30	11	12	4	3	4	10	7	10	8	15	8	1	6	3	6
Lepidoptera	—	+	—	1	—	1	3	1	2	4	3	8	1	2	6	2
Chironomidae	7	12	36	29	11	27	18	29	26	24	20	22	1	19	1	35
Hydracariba	—	4	2	2	2	3	—	2	2	1	3	1	—	+	—	+
the other	1	+	1	+	1	1	—	+	—	+	1	+	—	+	1	2

larvae density were compared. They are apparently more realistic calculated from geometric means (Tab. VII). In *Lymnaea* ĉ varies most often at a range between 0.2 and 0.3. The negative binomial is the most adequate model for this species.

Thus, because of various distribution patterns of the species represented in samples it is not of a great importance to use the total abundance of animals for the sampling error estimation.

3. Comparison with a semiquantitative method

Simultaneously with the quantitative sampling, frame samples were taken from the same *Elodea* stand at comparable dates (Prchlíková, 1966). A wooden frame of 1 m^2 was laid on water surface and plants were collected from a boat by reaching into the water as deep as possible and tearing out all plants from the area bordered by the frame. The plants were placed into polyethylene bags and, in the laboratory, they were laid on dry paper. All animals were picked out from it gradually as they dropped off.

The mean number of 250 animals per 1 m^2 of *Elodea* stand was collected using the frame. In collections made by the sampler, 25 times as great number of animals was found. As regards the species composition only one third of the total number of taxonomical groups was collected using the frame (Tab. VIII). Moreover, in the frame samples not only the animals occurring scarcely did not appear but even those caught commonly by the sampler [e.g. *Cyrnus flavidus* McL., species of the family *Corixidae*, *Erythroma najas* Hans., *Armiger crista* (L.), *Naididae*]. These animals belong to the first fifteen of 75 species found in the sampler collections according to their abundance (above 100 ind. per sample) and weight biomass (above 0.2 g per sample).

The percentual composition of the macrofauna as obtained using two different methods differs substantially

(Tab. IX). Throughout the whole season, Prchlíková (1966) did not find *Oligochaeta* and, at certain sampling dates even *Lepidoptera, Hirudinea, Odonata,* and *Hydracarina* were not caught.

DISCUSSION

1. Size of the sampler

Most samplers used till now, except that of Andrews and Hasler (1943), have the working area of 0.1 m^2 or less (Tab. X). A great number of such small samples can give doubtless a better and more accurate description of a plant stand than a smaller number of larger samples if the quantity of plants is considered at the first place. However, if the sampling is aimed to an animal population small samples have several serious disadvantages: A) A relatively small number of animals is collected per one 0.1-m^2 sample. The number of 40 individuals of one species can be considered as a sufficient number to get a low sampling error at an adequate picture of animal size distribution for the study of population dynamics. If sampling area would be 0.1 m^2 three or four most common species only would be collected in sufficient numbers (Tab. XI). The total number of animals reported for one 0.1-m^2 sample of the phytomacrofauna is about 1,000 individuals distributed among about 60 species. B) It cannot be neglected that all species are more

Table X. Sizes of some phytomacrofauna samplers.

author	area in cm^2
Andrews and Hasler (1943)	5.000
Barthelmes (1960)	624
But (1938)	640
Garnett and Hunt (1965)	500
Gerking (1957)	750
Gillespie and Brown (1966)	1.000
Macan (1949)	1.000
sampler used here	10.000

Table XI. The mean frequencies of the taxonomical groups recognized per one sample.

ind./m^2	number of groups	g/m^2	number of groups
1	6	0.001	—
2—4	8	0.002—0.004	3
5—13	3	5—13	7
14—40	8	14—40	12
41—121	10	41—121	11
122—364	14	122—364	11
365—1,093	2	365—1.093	5
1,094—3.280	1	1.094—3.280	4
		3.281—9.841	1

or less overdispersed and that a level of the overdispersion depends not only on the species biology and on environmental conditions but even on the sample size (Wainstein, 1969). C) An influence of so called "edge effect" of small samplers. The expression "edge effect" means not only the phenomenon that plants are bent inside or outside the sampler during the sampling procedure (this compensates taking a great number of samples) but mainly the disturbing influence of the sampling itself upon animals. This increases with reducing sampler working area and multiplies with increasing number of samples. Unfortunately, there are no quantitative data in this field.

2. Conversion of numerical results

Amounts of invertebrates found in submerged vegetation are related to different units in literature: a) to units of the bottom area, b) to units of wet or dry weight of a plant, c) to units of the plant surface area, d) to volume units. As early as 1927 Segestråle pointed out that quantitative data on fauna of *Fucus* can be considered according to two standpoints· production and ecology. For production calculations quantity of animals per the unit bottom area is the suitable measure. As to obtain comparable data for an ecological study, quantity of plants per unit area must be used as the substrate measure. Krecker (1943) observed that ash content in submerged plants increased from spring to autumn as calcium carbonate accumulated on leaves and stems and thus, consequently, considerable errors can be done relating quantities of animals to the unit plant weight. In Bohemian carp ponds, such accumulation of calcium carbonate was not observed. Regardless these surface layers of carbonate, the percentage of ash in dry weight of given species changes by several per cent only throughout a year (Owens and Edwards, 1961). Because of the great sampling error the inaccuracy of this kind is negligible.

When comparing results from different species of submerged plants the role of ash percentage must be considered According to Straškraba (1968) ash content in submerged plants ranges from 9 to 25% of dry weight. Moreover, a wide range was found even in one species collected at different localities. The influence of these differences is excluded relating the density of an animal population to units of the plant surface. Edwards and Owens (1965) considered the ratio of dry weight to the plant surface area is often about 1 cm^2 per 1 mg dry weight, measured in *Berula*, *Callitriche*, *Sparganium*, and *Hippuris*. Jermář (1966) found this ratio to be somewhat smaller in different species. In *Elodea* 1 g of dry plant equals to 810 cm^2, in *Batrachium aquatile* 520 cm^2, and in *Potamogeton lucens* 840 cm^2. The surface area was estimated using the method of Harrod and Hall (1962) adapted for larger amounts of plants. Harrod and Hall showed there is positive relationship between computed or measured surface area of a plant and the weight of a covering film of a detergent solution on its surface. However, if the surface area is then related to the weight of a given species the relation cannot be used commonly. The surface estimation must be carried out always newly for every stand of this species.

From our results it can be shown the difference between the population density and biomass related to the unit of plant dry weight and to the surface area of three species of plants (Tab. XII). Studying a population of

Table XII The annual mean abundances and biomasses of animals from diffetent plants related to 100 g of dry plant and to 10 m² of its surface.

	Elodea	*Batrachium*	*Pot. lucens*
ind /100 g	3,691	7,791	7,689
% *Elodea*	100	211	209
g/100 g	9.13	10.58	14.84
% *Elodea*	100	116	163
ind /10 m²	4,609	14,897	9,187
% *Elodea*	100	324	199
g/10 m²	11.39	20.23	17.73
% *Elodea*	100	178	156

animals related closely to the plant surface it is necessary to use this type of conversion.

According to Morduchaj-Boltovskoj (1956) and Karassowska and Mikulski (1960), food storages for fish can be considered from quantities of the phytomacrofauna related to the given water volume (1 m³). These data may be also used when animals studied do not show apparent relations to plants.

Thus, for every study of the macrofauna of submerged plants appropriate substrate measure must be chosen according to the aim of the study and the composition of the fauna as well.

3. Distribution models

When the distribution of three predominant species was tested it appeared each of them is probably disposed by another distribution model. I suggest that it results mainly from the behaviour of animals as the sample size is relatively large. *Ablabesmyia* larvae, being predaceous, have their preying territories. Therefore relatively small differences were found among samples of one series, coefficients of dispersion being smaller than 0.1 (Tab. IV). As the number of individuals in one sample is great (about 400) the normal distribution appeared to be the most adequate model for *Ablabesmyia* larvae. Molluscs, feeding directly on plants, are supplied by large amount of food in the shortest time. This fact and their slow movements result in a high level of overdispersion and the negative binomial distribution. For *Caenis* larvae plants serve as substrate and shelter. Their food comes mainly from the water column. They probably crowd at the sites better supplied by food. The distribution due to this behavior is adequately described by the log-normal distribution.

The total population of the phytomacrofauna estimated according to its biomasses was found to be distributed by the log-normal model. Cassie (1962) suggested this model to be appropriate when the population is estimated indirectly

4. Quantitative samplers, plant hook, hand net, frame

The efficiency of the quantitative sampling and that of a plant hook were compared by Gerking (1957). In plant hook collections only 62% of the total number of invertebrates were found. A hand net worked with an efficiency of 21% if compared with a sampler (Gillespie and Brown, 1966). The wooden frame method as demonstrated in the present paper has the efficiency of about 4% only. In addition to high losses during the sampling many animals can be omitted during the separation from plants.

Generally speaking, collections taken using various nets, hooks, frames etc. cannot give data comparable since various species or groups of invertebrates are caught with various efficiency as it is shown in Tab. IX and in the above papers.

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SUMMARY

Experience has been gathered with a 1-m^2 sampler for the macrofauna of carp pond submerged plants. It can be used up to the depth of 1.25 m. The sampling method and the laboratory treatment of samples are described. The paper is based on 44 samples taken in four-sample series at ten-day intervals from an *Elodea* bed. To some conclusions results from *Batrachium aquatile* and *Potanogeton lucens* were used.

The mean densities of animals and their biomasses were related to bottom area, to dry weight of plants, to surface area of a plant, and to water volume. Annual means were 6,240 ind. and 15.7 g per 1 m^2 of bottom, 3,690 ind. and 9.1 g per 100 g of air-dried plant, 4,610 ind. and 11.4 g per 10 m^2 of plant surface, and 9,100 ind. and 22,7 g per 1 m^3. It is shown a given aim of the sampling or a given animal species asked an adequate substrate measure for amounts of the macrofauna. The standard error of the mean estimate for the total biomasses of animals related to bottom area ranged between 20 and 54% of the mean, and for those related to dry plants ranged between 33 and 87% of the mean. The log-normal distribution was proved for the total biomasses of animals. Each of three predominant species has probably another distribution, being influenced by different behavior of the species. The sampling efficiency of the method is compared with that of a semiquantitative method. Using a wooden frame, one third the number of taxonomical groups was collected only. The size of the sampler is discussed according to the number of animals collected, to overdispersion of species, and to the "edge effect" of samplers.

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

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THE IMPORTANCE OF SOME WILD DUCK SPECIES IN THE EPIZOOTOLOGY OF CESTODOSES OF DOMESTIC DUCKS

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Abstract: Both domestic and wild ducks from fishponds of southern Bohemia were infected with eleven cestode species. The exchange of parasites between wild and domestic ducks was faciliated by the mode of breeding domestic ducks. The wild duck species *Anas platyrhyncha*, *A. crecca*, *Aythya ferina* and *A. fuligula* were the main source of infection of the domestic duck species which, being bred on the fishponds, maintained together with the wild ducks the infection in the area under consideration throughout the year.

MATERIAL

Nineteen cestode species of the family Hymenolepididae Fuhrmann, 1907 and one species of the family Diploposthidae Poche, 1926 were recovered in post-mortem examination of a total of 1,289 domestic and wild ducks from fishponds near Třeboň, Lomnice n. Lužnicí, Písek, Vodňany and České Budějovice (Table 1).

The domestic ducks were parasitized by 11 cestode species: *Aploparaksis furcigera* (Rudolphi, 1819), *Cloacotaenia megalops* (Creplin, 1829), *Dicranotaenia coronula* (Dujardin, 1845), *Diorchis inflata* (Rudolphi, 1819), *D. nyrocae* Yamaguti, 1935, *Drepanidotaenia lanceolata* (Bloch, 1782), *Fimbriaria fasciolaris* (Pallas, 1781), *Microsomacanthus compressa* (Linton, 1782), *M. paracompressa* Czapliński, 1956, *Sobolevicanthus gracilis* (Zeder, 1803) and *Diploposthe laevis* Poche, 1926.

The wild ducks harboured, in addition to these 11 cestode species recovered from domestic ducks, another 8 cestode species: *Bisaccanthes bisaccata* (Fuhrmann, 1906), *Dubinolepis multistriata* (Rudolphi, 1810), *Diorchis ransomi* Schultz, 1940, *Hymenolepis teresoides* Fuhrmann, 1906, *Microsomacanthus paramicrosoma* (Gasowska, 1931), *Sobolevicanthus krabbeella* (Hughes, 1940), *S. octacantha* (Krabbe, 1869) and *Sphenacanthus macrocephala* (Fuhrmann, 1913) specific only of wild ducks. Some of these, however, were found also in domestic ducks. Ryšavý (1961, 1962) recorded the finding of *Diorchis ransomi* and *Sobolevicanthus octacantha* from domestic ducks in the vicinity of fishponds in southern Bohemia; Neradová (1966) found the species *Bisaccanthes bisaccata* in domestic ducks in fishponds near Benešov. Although no natural infection with the species *Sobolevicanthus krabbeella* has been recorded from domestic ducks, we succeeded in infecting a duckling of the species *Anas platyrhyncha* dom. with cysticercoids of this cestode (Neradová, 1967, 1969).

Three cestode species *(Diorchis inflata, D. longicirrosa* and *D. nyrocae)* were found in the coot. The species *D. inflanta* was found in domestic and wild ducks; the species *D. ransomi* in wild ducks only and the species *D. longicirrosa* in the coot only. This is consistent with the findings of *D. longicirrosa* recorded by Baruš and Lelek (1961) and Ryšavý (1962). A list of cestode species recovered from the different bird species in given in Table 2.

The cestode species found most frequently and in the highest numbers in both domestic and wild ducks were these: *Fimbriaria fasciolaris*, *Microsomacanthus paracompressa*, *M. compressa*, *Diorchis inflata* and *D. nyrocae* (Table 3). Also in the intermediate and reservoir hosts, the cysticercoids of these 5 cestode species were frequently found. Cysticercoids of *Fimbriaria fasciolaris* and *Microsomacanthus paracompressa* were available throughout the years in the fishponds and the first to be infected by them were the domestic ducks.

Table 1. List of cestodes found in domestic and wild ducks and in the coot.

Host	Number of birds examined	Number of positive findings	% of positive findings	Intensity of infection	*Aploparaksis furcigera*	*Bisaccanthes bisaccata*	*Cloacotaenia megalops*	*Dicranotaenia coronula*	*Diorchis inflata*	*Diorchis longicirrosa*	*Diorchis nyrocae*	*Diorchis ransomi*	*Diploposthe laevis*	*Drepanidotaenia lanceolata*	*Dubininolepis multistriata*	*Fimbriaria fasciolaris*	*Hymenolepis teresoides*	*Microsomacanthus compressa*	*Microsomacanthus paracompressa*	*Microsomacanthus paramicrosoma*	*Sobolevicanthus gracilis*	*Sobolevicanthus krabbeella*	*Sobolevicanthus octacantha*	*Sphenacanthus macrocephala*
Anas platyrhyncha dom.	1084	386	35.6	1—827	18	—	1	31	33	—	9	—	1	1	—	264	—	51	113	—	29	—	—	—
Anas platyrhyncha	92	89	96.7	1—2439	19	4	10	12	27	—	10	23	3	1	—	49	3	26	37	5	18	—	8	4
Anas crecca	17	17	100	1—105	—	—	—	—	6	—	4	—	—	—	—	5	—	—	—	—	2	3	—	—
Anas strepera	12	11	91.7	3—20	—	—	—	—	—	—	—	—	—	—	—	—	10	—	—	—	—	—	—	—
Aythya ferina	19	19	100	1—11	—	—	—	3	—	—	14	—	7	—	—	—	—	12	—	—	8	—	—	—
Aythya fuligula	14	14	100	1—220	—	—	—	11	—	—	12	—	1	—	—	3	—	—	—	—	—	—	—	—
Aythya nyroca	12	12	100	10—18	—	—	—	—	—	—	—	—	—	—	12	—	—	—	—	—	—	—	—	—
Fulica atra	19	18	94.7	9—184	—	—	—	—	16	9	—	11	—	—	—	—	—	—	—	—	—	—	—	—

DISCUSSION

A comparison of the cestode fauna of the waterbirds examined (Table 2) as regards the incidence of larval cestode stages revealed that the main source of infection of the domestic duck were the wild duck and the coot. According to our observations this applies mainly to the species *Anas platyrhyncha*, *A. crecca*, *Aythya ferina* and *A. fuligula*. Our results are consistent with those of Ryšavý (1961) as regards the degree of transmission of cestodes of the family Hymenolepididae from wild to domestic ducks. Zajíček (1961a, 1962) emphasized the importance of *Fulica atra*, *Anas platyrhyncha*, *Aythya ferina* and *A. fuligula*, in spreading helminthoses to domestic ducks.

Table 2. Comparison of the cestode fauna of wild and domestic waterfowl

Identified cestode species	Examined species of waterfowl							
	Anas platyrhyncha dom.	*Anas platyrhyncha*	*Anas crecca*	*Anas strepera*	*Aythya ferina*	*Aythya fuligula*	*Aythya nyroca*	*Fulica atra*
Aploparaksis furcigera	+	+						
Bisaccanthes bisaccata		+						
Cloacotaenia megalops	+	+						
Dicranotaenia coronula	+	+			+	+		
Diorchis inflata	+	+	+					+
D. longicirrosa								+
D. nyrocae	+	+	+		+	+		
D. ransomi		+						+
Diploposthe laevis	+	+			+	+		
Drepanidotaenia lanceolata	+	+						
Dubininolepis multistriata							+	
Fimbriaria fasciolaris	+	+	+			+		
Hymenolepis teresoides		+		+				
Microsomacanthus compressa	+	+			+			
M. paracompressa	+	+						
M. paramicrosoma		+						
Sobolevicanthus gracilis	+	+	+		+			
S. krabbeella			+					
S. octacantha		+						
Sphenacanthus macrocephala		+						

The transmission of infection from wild to domestic ducks depends on the mode of breeding domestic ducks. After hatching in artificial hatch boxes, the ducklings are kept in heated boxes and later transferred to sheds with adjacent runs; these are not in the immediate vicinity of the fishponds. Neither on these runs nor with water could the ducklings be infected with cysticercoids, because they were given only clean drinking water, which contained no intermediate hosts. Also the eggs of the cestodes dropped with the faeces of wild waterbirds occasionally visiting these runs, could not survive there, because their development is bound to aquatic conditions as well as to aquatic intermediate hosts. Although we examined approximately 200 ducklings from these sheds, we found no cestodes in them.

After 4 – 5 weeks, the ducklings are transferred to enclosures at the banks of the ponds and there, they acquire cestode infection. Since the ducklings are fed at these sites, masses of wild waterbirds are attracted by the abundance of food. Mature eggs dropped inside the enclosure with the faeces of wild duck and coot are ingested by copepods and ostracods, the intermediate hosts of these cestodes. The development of the eggs from the onchosphere to the cysticercoid occurs in the body cavity of these intermediate hosts; because the crustaceans are an important component of the food of domestic ducks, the infection is thus readily transmitted to them. However, these crustaceans are shortlived and, therefore, the infection is

Table 3. Survey of the representation of the three most frequent cestode species (incidence and intensity of infection) in the individual hosts

Host	The three most frequent cestode species Incidence	 Intensity of infection
Anas platyrhyncha dom.	*Fimbriaria fasciolaris* *Microsomacanthus paracompressa* *M. compressa*	*F. facsiolaris* *M. paracompressa* *M. compressa*
Anas platyrhyncha	*F. fasciolaris* *M. paracompressa* *Diorchis inflata*	*M. compressa* *M. paracompressa* *D. inflata*
Anas crecca	*D. nyrocae* *F. fasciolaris* *D. inflata*	*D. nyrocae* *D. inflata* *F. fasciolaris*
Anas strepera	*Hymenolepis teresoides*	
Aythya ferina	*Diploposthe laevis* *D. nyrocae* *M. compressa*	*D. nyrocae* *D. laevis* *M. compressa*
Aythya fuligula	*F. fasciolaris* *D. nyrocae* *M. compressa*	*D. nyrocae* *F. fasciolaris* *Dicranotaenia coronula*
Aythya nyroca	*Dubininolepis multistriata*	
Fulica atra	*D. inflata* *D. ransomi* *D. longicirrosa*	*D. ransomi* *D. inflata* *D. longicirrosa*

maintained so that watersnails of the same locality are utilized by cysticercoids of some cestode species as reservoir hosts. Also these snails constitute an important component of the domestic duck's food. The snails feeding on dead crustaceans accumulate inside their bodies individual cysticercoids which, according to our observations, survive for 3 – 7hrs in the dead crustaceans. In these snails, the cysticeroids survive for a long time without loss of infectivity.

The wall of the cysticercoids in reservoir hosts is strong, elastic and thick and protects them against damage while passing the digestive tube of the snail. These cysticercoids are deposited in the ultimate tubules of the hepatico-pancreas together with indigestible food remnants (grains of sand, diatom shells etc.). Cysticercoids of the cestode species *Dicranotaenia coronula, Microsomacanthus compressa, M. paracompressa* and *M. paramicrosoma* were found in *Lymnaea peregra ovata* (Draparnaud), *L. peregra peregra* (Müller), *L. auricularia* (Linné). In addition to these species, Ryšavý (1962) recovered from a total of 6 snail species cysticercoids of the cestode species *Microsomacanthus spiralibursata* (Czapliński, 1956) and *Echinocotyle rosetteri* Blanchard, 1891.

We found neither cysticercoids with a thin wall inside these snails (e.g. of the genera *Diorchis, Sobolevicanthus* or *Fimbriaria*) nor references of such findings in the literature except that of Zajíček (1961b) recording the finding of cysticercoids of the cestode *Diorchis nyrocae* in snails. However, our attempts to confirm this finding in experiments were unsuccessful; the cysticercoids did not survive in the snails, because their thin wall was damaged during the passage through the digestive tube of the snail. On the other hand, cysticercoids of cestodes of the genus *Microsomacanthus* survived as long as two years in the snail. Since their numbers were too small to perform feeding experiments with them, we were unable to prove that these cysticercoids were still capable of developing into mature cestodes after this length of time. For these experiments we employed snails collected in the spring in the mud of drained fishponds, because these snails had evidently eaten dead crustaceans harbouring cysticercoids in the autumn of the preceding year. In post-mortem examination of the ducks fed with these snails and then killed 4 weeks later, we found the pertinent cestode species.

The domestic ducks are kept on the fishpond for 4 – 6 weeks. This period is long enough for the ducks to acquire infection, for the cysticercoid to develop into an adult cestode and for this to mature sexually and to start egg-production. Within a year, 3 – 5 batches of ducks are introduced consecutively to one fishpond. When the second batch of ducks is brought to the fishpond, the eggs of the cestodes have almost completely developed into cysticercoids in the body cavity of the crustaceans. Thus, the infection is spread and chiefly maintained on these ponds not only by the wild duck and coot, but also by the domestic duck. At the time of the highest incidence of larval stages of the cestode species *Fimbriaria fasciolaris* and *Microsomacanthus paracompressa* (July 1966), post-mortem examination of ducks killed at the end of their first day on the fishpond revealed unattached cestode scolices in scrapings of the mucose membrane and in the contents of the small intestine; at the end of the second day we found already 2 – 8 segments, at the end of the 3rd day up to 15 segments, at the 4th day 18 to 25 segments and at the end of the 5th day up to 40 segments. Within a fortnight, we observed mature eggs in these cestodes.

The distribution of larval cestode stages depends also on weather conditions. If the weather is exceptionally windy, the crustaceans (possibly infected with larval cestode stages) are carried with the water from distant places to the duck enclosure, while strong winds blowing in the opposite direction, drive crustacean species which, until then, had been plentiful in the duck enclosure, to the other side of the pond and these species were no longer present in the plankton of the enclosure. Under normal, warm and windstill weather conditions we observed that certain species of ostracods and copepods (sometimes two species together), inhabited in colonies the same site, whereby their home range was restricted to 1 – 2 m. (This applies mainly to crustaceans of the littoral zone.) We determined the movement of a colony by "marking" the individual crustaceans: these were artificially infected with eggs of the cestode *Microsomacanthus paracompressa*, the cysticercoids of which measure about 0.3 mm and are macroscopically visible in the body cavity of these crustaceans.

The summer months of 1966 offered very suitable conditions for a long-lasting observation of the life cycle of cestodes on the fishpond Klec near Lomnice n. Lužnicí. In this pond we studied the development of cysticercoids of the cestodes parasitizing wild and domestic ducks in the intermediate hosts through the whole period, during which three successive batches of domestic ducks were bred on the fishpond. The first batch of ducks introduced to the fishpond was infected by the cestode species *Fimbriaria fasciolaris* and *Microsomacanthus paracompressa*. This infection must have been transmitted by wild ducks, because the domestic ducks introduced to this fishpond belonged to the first batch of that year. Copepods collected from the enclosure and inspected before the arrival of the first lot of domestic ducks, were infected with eggs of these cestode species. Fully developed cysticercoids were found in these crustaceans 14 days after the arrival of the domestic ducks. These were kept in the enclosure for another 4 weeks. This period is long enough for the cestodes to mature sexually in the digestive tract of their definitive hosts and to produce mature eggs, which infect other crustaceans. In the second batch of domestic ducks we found the species *Fimbriaria fasciolaris* and *Microsomacanthus paracompressa*, both well-established at this site; the two other cestode species – *Diorchis inflata* and *M. compressa*, found in these domestic ducks, had been introduced to this site by wild ducks. These four cestode species persisted and predominated in all domestic ducks introduced to this fishpond in the year under consideration.

Our results indicate that the rate of development of the individual cestode species in both the intermediate and definitive hosts can be established with an almost daily exactness by post-mortem examination of domestic and wild ducks, by regular inspection of the plankton and by coprological examinations. This is very important not only in the determination of the relationship between the cestode fauna of wild and domestic ducks, but also in investigations of their life cycle in the field.

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ÜBER DAS VORKOMMEN VON ALONA PROTZI HARTWIG (CLADOCERA) IN DER SÜDWESTLICHEN SLOWAKEI

MARIAN VRANOVSKÝ

Eingegangen am 11. August 1970

Abstrakt: Der Verfasser stellte im Jahre 1954 in der südwestlichen Slowakei das Vorkommen der Cladocerenart *Alona protzi* Hartwig fest, welche bisher nur aus einer geringen Anzahl von Lokalitäten in Europa und Asien bekannt war. Die gefundenen 5 ♀♀ werden beschrieben und die taxonomisch wichtigen Merkmale mit denen aus der Literatur verglichen. Zugleich wird der Charakter des Biotops in der Slowakei beschrieben. Die angeführte Art ist für die Tschechoslowakei neu.

Während der quantitativen and qualitativen Untersuchungen des Zooplanktons von Reisfeldern bei Okoč auf der Schüttinsel (südwestliche Slowakei) habe ich im Jahre 1954 in einem Entwässerungskanal ("Asódsky kanál"), aus welchem das für die Bewässerung der Reisfelder notwendige Wasser gepumpt wurde, mehrmals die Cladocere *A. protzi* Hartwig gefunden. Ich war bestrebt die taxonomischen Merkmale (u.a. die Kopfporen und die Oberlippe) näher zu studieren und habe versucht, an der ursprünglichen Lokalität weitere Exemplare von *A. protzi* zu fangen, da bei der Anfertigung von Dauerpräparaten die im Jahre 1954 gefundenen Exemplare vernichtet wurden. Dieses ist mir jedoch weder während weiterer intensiver Untersuchungen des Zooplanktons der Reisfelder und des Asóder Entwässerungskanals in den Jahren 1955 und 1956, noch bei sporadischen Untersuchungen in den nachfolgenden Jahren gelungen. Da es sich um eine seltene Art handelt, welche bisher nur auf einer geringen Anzahl von Lokalitäten festgestellt wurde, bringe ich im weiteren die Beschreibung der gefundenen Exemplare von *A. protzi* und des Biotops in der südwestlichen Slowakei.1)

HISTORISCHER ÜBERBLICK

A. protzi wurde von Hartwig (1900) nach 3 Exemplaren (2 ♀♀ und 1 ♂) beschrieben, welche im Hellsee in Brandenburg gefunden wurden. An weiteren 2 Stellen in Norddeutschland wurde sie später von Keilhack (1908, 1909a, 1909b, 1911) und im Fluss Ant in England von Gurney (1921) festgestellt. In den 20-er und 30-er Jahren wurde *A. protzi* von polnischen Autoren an einigen Stellen Polens, resp. der Sowjetunion festgestellt (Wolski, 1926 und 1927; Stark, 1930; Ramułt, 1931; Brzęk, 1935). Über das Vorkommen von *A. protzi* auf dem Gebiete von Grusinien hat unterdessen Schiklejew (1930 und 1933) berichtet und den Fund an zwei Stellen in Indien hat Sewell (1934) publiziert. (In Betracht des Mangels an Abbildungen und der Beschreibung von Sewells 2 Exemplaren kann leider deren Zugehörigkeit zur Art

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1) Für das Lesen und sprachliche Korrektur des Manuskriptes bin ich mit herzlichem Dank Herrn Dr. P. J. Donner (Katzelsdorf, Österreich) verpflichtet.

A. protzi nicht überprüft werden.) Von dieser Zeit an wurde *A. protzi* meines Wissens nur zweimal gefunden: Flössner (1962) hat 1 ♀ im Stechlinsee (Norddeutschland) und Negrea (1966) ebenso ein einziges Weibchen im Flachseenkomplex Crapina-Jijila im rumänischen Sektor des Donaudeltas festgestellt.[2])

BESCHREIBUNG DER GEFUNDENEN EXEMPLARE

Die Schale der im Asódkanal gefundenen Weibchen hat eine mehr oder weniger typische Form. Der ventrale Rand bildet knapp vor der Mitte seiner Länge eine meist schwache Wölbung, hinter dieser ist die Kontur flach konkav. Der ganze Ventralrand ist dicht mit kurzen Borsten besetzt. Der ventrokaudale Schalenwinkel ist mit einer Gruppe von Zähnen besetzt, die für die Art charakteristisch ist. Die meisten Autoren führen je 3 Zähne auf jeder Seite der Schale an (so z.B. Hartwig, 1900; Keilhack, 1909; Gurney, 1921), andere haben 2—3 (Keilhack, 1911), resp. 2—4 Zähne beobachtet (Wolski, 1926; Ramułt, 1931). Bei den 5 Exemplaren aus dem Asódkanal schwankte die Anzahl der Zähne am ventrokaudaudalen Schalenwinkel von 2—4, wobei im Falle einer ungleichen Anzahl die rechte Schalenhälfte mehr Zähne aufweisen konnte (Tab. 1). Die Schale war hyalin, gelblichbraun gefärbt, wobei im hinteren Teil eine schwach ausgeprägte Längsstreifung zu sehen war. Die maximale Höhe der Schale erreichte etwa 3/3 der Körperlänge.

Tab. 1. Anzahl der Zähne am hinteren unteren Schalenwinkel von 5 Weibchen *A. protzi* aus dem „Asódsky kanál."

	1.Ex.	2.Ex.	3.Ex.	4.Ex.	5.Ex.
Rechte Seite	4	3	3	4	3
Linke Seite	3	2	3	2	2

Gesamtlange	310—350 μm
Maximale Schalenhöhe	225—245 μm

Die 1. Antennen reichten beinahe bis zum Rostrumende, die Ästhetasken überragten es. Das Naupliusauge war kleiner als das Komplexauge. Das Postabdomen war kurz, distal schwach verjüngt. Der Basaldorn war lang und reichte bis zur Hälfte der Länge der Endkrallen. An der Basis des Basaldornes konnte man bei stärkerer Vergrösserung eine sehr feine Borste sehen (Gurney hat sogar 2—3, Ramułt 1—3 beobachtet). Die Distalhälfte des Dorsalrandes des Postabdomens war mit 10—11 kleinen Stacheln besetzt. (Gurney, 1921 gibt 8—10; Wolski, 1926 8—9 und Ramułt, 1931, der ein reichhaltigeres Material zur Verfügung hatte, gibt 8—12 Stacheln an, wobei meistens 10 Stacheln festgestellt wurden.) An den Seiten der Distalhälfte des Postabdomens hatten die Exemplare von der Schüttinsel 8 Gruppen von feinen Börstchen. Weder Hartwig (1900) in der Urbeschrei-

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[2]) Akatova (1958) fuhrte *A. protzi* im Verzeichnis des Zooplanktons einer Teichwirtschaft in Lettland an; später jedoch hat sie bei einer Revision festgestellt, dass es sich nicht um *A. protzi* gehandelt habe (Akatova, 1963).

bung noch Keilhack (1908, 1909b, 1911) führen die Seitenborsten an, doch haben mehrere Autoren, welche die Morphologie der taxonomischen Merkmale von *A. protzi* eingehend beschrieben haben, die Anwesenheit der Borstenbüschel vermerkt (Gurney, 1921; Wolski, 1926; Stark, 1930; Schiklejew, 1930 und 1933; Ramułt, 1931). Die Frage der Anwesenheit des angeführten Merkmals auf dem Postabdomen von *A. protzi* ist in der Literatur Gegenstand von Unklarheiten geworden. Da Hartwig (1900) die Seitenborsten nicht beschrieben hat, schlug Brehm (1933) für die mit Borsten versehene Form den Namen *A. protzi schiklejewi* vor, da er irrtümlicherweise annahm, dass Schiklejew (1930) dieses Merkmal als erster beobachtet habe (Gurney, 1921 hat es schon früher beschrieben). Obwohl es

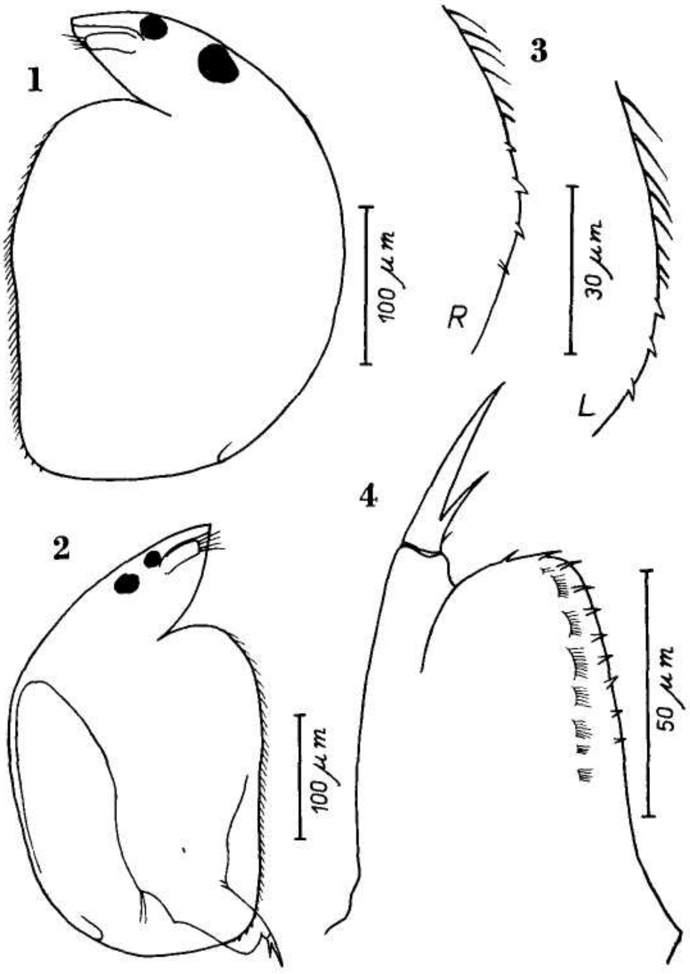

Abb. 1—4. *Alona protzi* Hartwig aus dem „Asódsky kanál". 1 — Ein Weibchen, 2 — Schale eines anderen Exemplars, 3 — Ventrokaudaler Schalenwinkel; rechte (R) und linke (L) Seite, 4 — Postabdomen.

interessant ist, dass weder Hartwig (1900), noch Keilhack (1908, 1909b, 1911) die Seitenborsten beobachtet haben, kann man in Betracht der Tatsache, dass dieses Merkmal erst bei stärkerer Vergrösserung zu sehen ist, voraussetzen, dass auch bei den Exemplaren von *A. protzi* aus Brandenburg die Seitenborsten am Postabdomen nicht gefehlt haben.

ÖKOLOGISCHE BEMERKUNGEN

Der Asódkanal, in welchem im Juli bis September 1954 zusammen dreimal das Vorkommen von *A. protzi* festgestellt wurde, ist einer der Kanäle des im Ostteil von Žitný ostrov (Schüttinsel) gebauten Entwässerungssystems. Der Kanal ist etwa 8 m breit und 3,5 m tief. Die geringe Strömungsgeschwindigkeit erlaubt es der emergenten Makrovegetation (hauptsächlich *Schoenoplectus*),tiefer der submersen *(Potamogeton crispus)* sowie auch natanten Makrovegetation *(Nuphar)* an beiden Seiten des Kanals zu wachsen. Vier Exemplare von *A. protzi* habe ich in qualitativen Proben des Litoralzooplanktons aus dem *Schoenoplectus*—Bestand festgestellt, 1 Exemplar in einer quantitativen Probe aus der Mitte des Kanals (0,1 Ind./l Wasser). Bisher wurde *A. protzi* beinahe ausschliesslich im von Makrophyten bewachsenen Litoral von Seen oder anderen stehenden Gewässern festgestellt. Nur Gurney (1921) hat sie in fliessendem Wasser, im Bewuchs von *Cordylophora lacustris* gefunden.

In den Zooplanktonproben aus dem Asódkanal habe ich insgesamt 30 Cladocerenarten festgestellt. Unter diesen dominierte *Chydorus sphaericus* O. F. Müller und verhältnismässig konstant kamen auch *Alona rectangula* G. O. Sars und *A. guttata* G. O. Sars vor (Vranovský, 1955).

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OBITUITARY

MVDr Vladimír Ondrej Buša CSc

It was a sad loss for helminthologists and all the zoological community in Slovakia when on 10 June 1970 MVDr. Vladimír Ondrej Buša CSc. left it forever by his own decision. He was a senior scientific worker and head of the Department of Systematics and Taxonomy of the Institute of Helminthology of the Slovak Academy of Sciences in Košice.

The death of Dr. Buša is so much more painful for us that it was unexpected. He left suddenly in the prime of his life and work. The Slovak science lost a very promising and versatile helminthologist and his co-workers lost a high-principled, conscientious and deeply humane colleague; he had their respect, affection and trust which he did not disappoint to his last moment.

Dr. V. O. Buša was born on 22 September 1923 in Leštiny on Orava. In 1949 he finished the grammar school and in the year 1954 he graduated from the Veterinary College in Košice as a Doctor of Veterinary Science. While still a student he had been interested in parasitology. No wonder that soon he worked as a volunteer in the Department of Parasitology, later as a demonstrator, and from 1952 as a lecturer. In June 1954 he joined the newly established Institute of Helminthology of the Slovak Academy of Sciences in Košice; there he worked until his tragic death.

Dr. Buša concentrated on the study of helminths of waterfowl with regard to the importance of these problems to the national economy. The results of his studies were presented in his PhD thesis in 1962.

Besides his scientific research Dr. Buša did much organizational work in the Institute of Helminthology in Košice as a head of department. He held that position from 1963 and devoted to it much of his time and energy. His department is one of the largest and most productive in the institute and Dr. Buša was most responsible and painstaking in organizing and managing it.

The results of Dr. Buša's scientific work appeared in more than forty papers in Czechoslovak and foreign journals. We can only regret that such a promising scientific progress could not be completed and was so drastically interrupted. Also his work of many years on the monograph of philophthalmosis remains unfinished. This eye disease of waterfowl interested him from the beginning of his connection with the Institute of Helminthology. He was the first to discover and describe its cause.

This brief sum of Dr. Buša's work would be incomplete without our remembering his years in Cuba. Also in that country, so distant and different from his native Orava, he won respect and appreciation by his perseverance, reliability and kind disposition. His work was important for the developing Cuban economy and — as it was done well — appreciated by the Cubans. It was probably best put by his Cuban co-workers: "Buša es Cubano".

If Dr. Buša could win such a degree of appreciation and popularity in a foreign, mentally and geographically so different country, it is not surprising that he was so well-liked in his native environment. His departure is painful for all of us and it will not be easy to become reconciled to something we cannot change... Long live his memory.

Doc. RNDr. I. Zmoray CSc

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To the memory of Dr. Jindřich Tauber (Henry Taabor)

Last year we lost the prominent Czech naturalist, traveller and painter, MUDr. and RNDr. Henry Taabor, by his original name Jindřich Tauber, surgeon by profession. He spent many years abroad and only returto his native country less than two years before his death. He deccaed after a long heart desease in the age of 76, in the year 1970. By his research work so as by many communications on his journeys and observations especially on the life of plants and animals in tropical countries and by his distinctive paintings he deserves a permanent memory among the outstanding personalities of this country.

Jindřich Tauber was born in Dlouhá Lhota in the district of Mladá Boleslav in 1894. Since his early youth he shew a deep interest in Nature and made a number of interesting observations, especially on the life of insects. Having finished the secondry school in Mladá Boleslav, he joined the Science Faculty of the Charles University in Prague. In his RNDr.-thesis he studied the metamorphosis in connection with the endocrine activity in the sphingid moth *Celerio euphorbiae*. His paper on this subject, published in Biologické listy (Folia Biologica) in 1926, arosed interes tamong the specialists abroad and was actually the second paper in the world literature (next to that by S. Kopeć) showing the endocrine activity in insects. In 1921, he reached the RNDr.-degree (PhD. equivalent) as one of the first doctors of the newly founded Science Faculty of the Prague University.

So as there was no chance for a man from countryside with no connections to work in research in that time, he continued in studiing medicine in the same University and having reached the MUDr. (M.D.) degree, he worked as a physician in his home region, in Libáň and Kopidlno. Later, after several years, and some practice in the Institute of Tropical Medicine in Hamburg, he undertook his first journey to a tropical region, to Ceylon, where he made a number of interesting observations on tropical plants and animals and learned to love the tropical Nature. Having come back to Czechoslovakia, he worked in plastic surgery under the guidance of the prominent specialist Professor Emil Burian and later as a privat surgeon in Prague.

In 1939. only a few weeks before the German occupation of the country, he succeded to leave for a second visite to Ceylon on the basis of an earlier invitation and thus to escape the tragic fate of our citizens of Jewish origin under the Nazi period. Having worked for a time in several hospitals in India, he left for California (U.S.A.) in 1941. After the outbreak of the war against Japan and Hitler's Germany, he joined the American Army. To avoid threatening the lives of his relatives in the occupied Czechoslovakia for the case of captivity, he changed his name to Henry Taabor. After the end of war, he became the citizen of U.S.A. and worked since that time as an appreciated plastic surgeon in San Francisco. All his free time, however. he spent by observation of life in the tropical Nature and by painting and photographing the animals, plants and landscape on his many journeys to the Middle and South America. Especially specific are his paintings of sphingid caterpillars in the above-life size. He had three expositions of his paintings in Prague. In Genova his exposition was rawarded by a silver medal and in San Francisco by a gold one. He often came back to his mother country during this period and he decided to stay here to the end of his life two years before the death.

Of his scientic papers first of all his mentioned paper on the insect hormones is of first rate importance. It has been re-printed in the Deutsche entomologische Zeitschrift (G. D. R.) in 1962. The list of his publications is to appear in the Acta entomologica Bohemoslovaca 1971. The most of his scientific heraditament and works of art have been deposited in the museums in Staré Hrady and Jičín.

Vladimír J. A. Novák

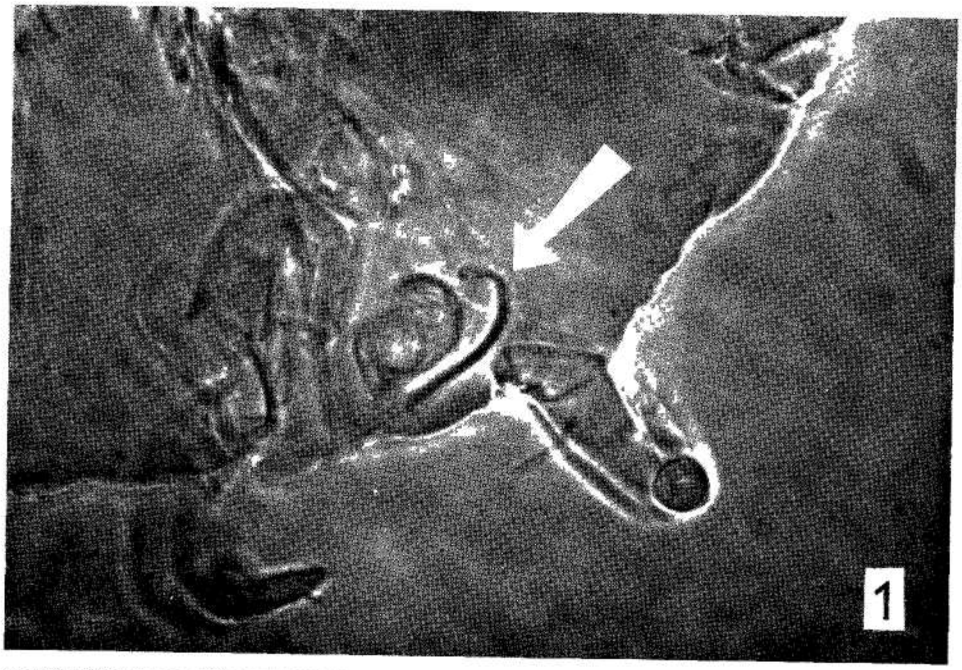
VĚSTNÍK ČESKOSLOVENSKÉ SPOLEČNOSTI ZOOLOGICKÉ
ročník XXXV

Vydává Čs. společnost zoologická v Academii, nakladatelství ČSAV, Vodičkova 40
Praha 1 - Nové Město, dod. pú. 1.

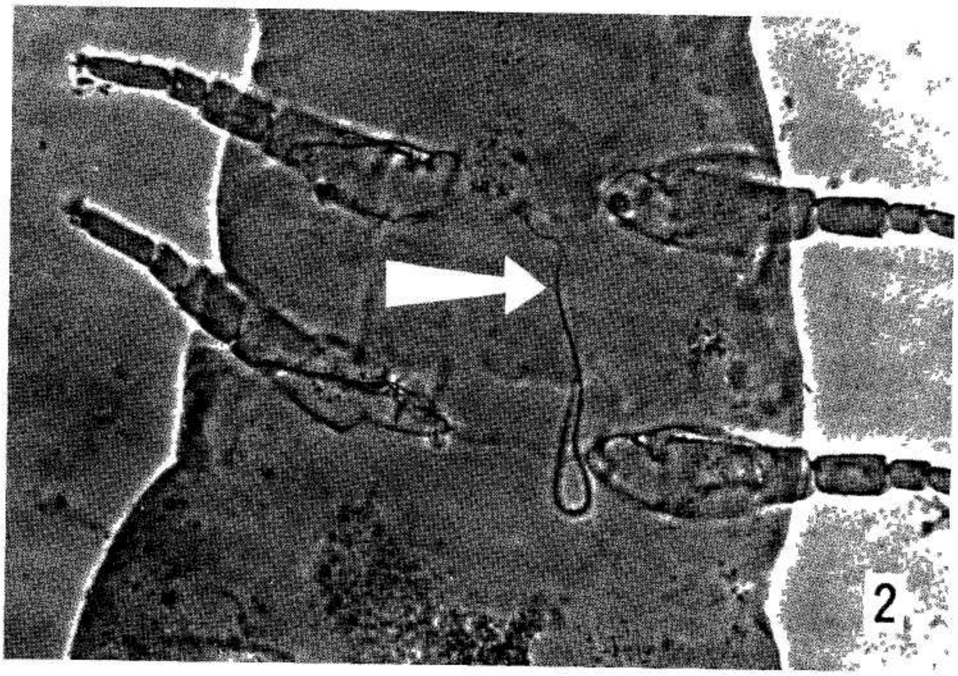
Tiskne Státní tiskárna, n. p., závod 4, Praha 10 - Vršovice, Sámova 12, dod. pú. 101.

Rozšiřuje Poštovní novinová služba. *Objednávky a předplatné PNS* — ústřední expedice tisku administrace odborného tisku Jindřišská 14, Praha 1. Lze také objednat u každé pošty nebo doručovatele.

Cena jednoho výtisku 10 Kčs, v předplacení (4 čísla ročně) 40 Kčs, $ 5,60, £ 2,34
Toto číslo vyšlo v srpnu 1971.

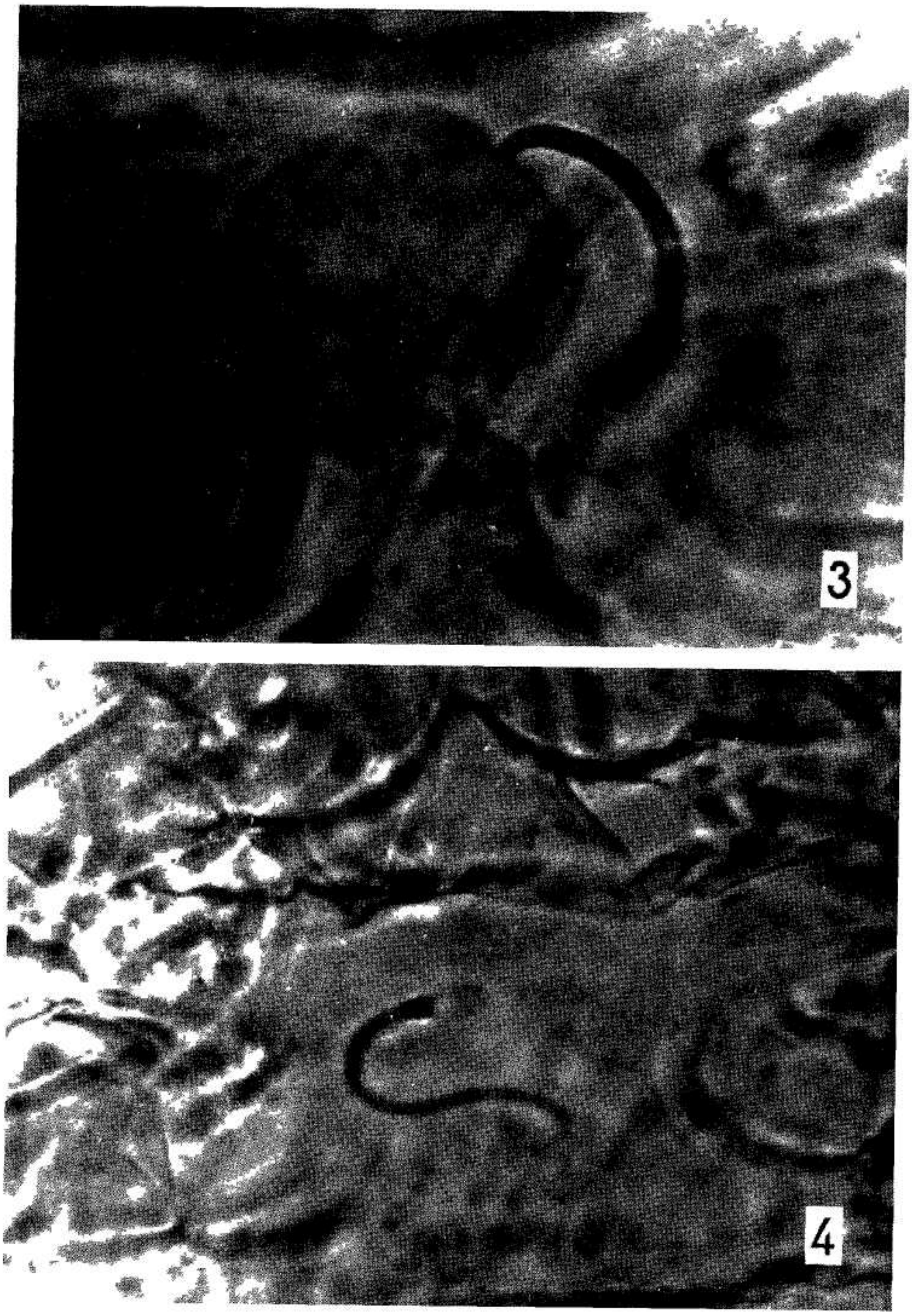


1

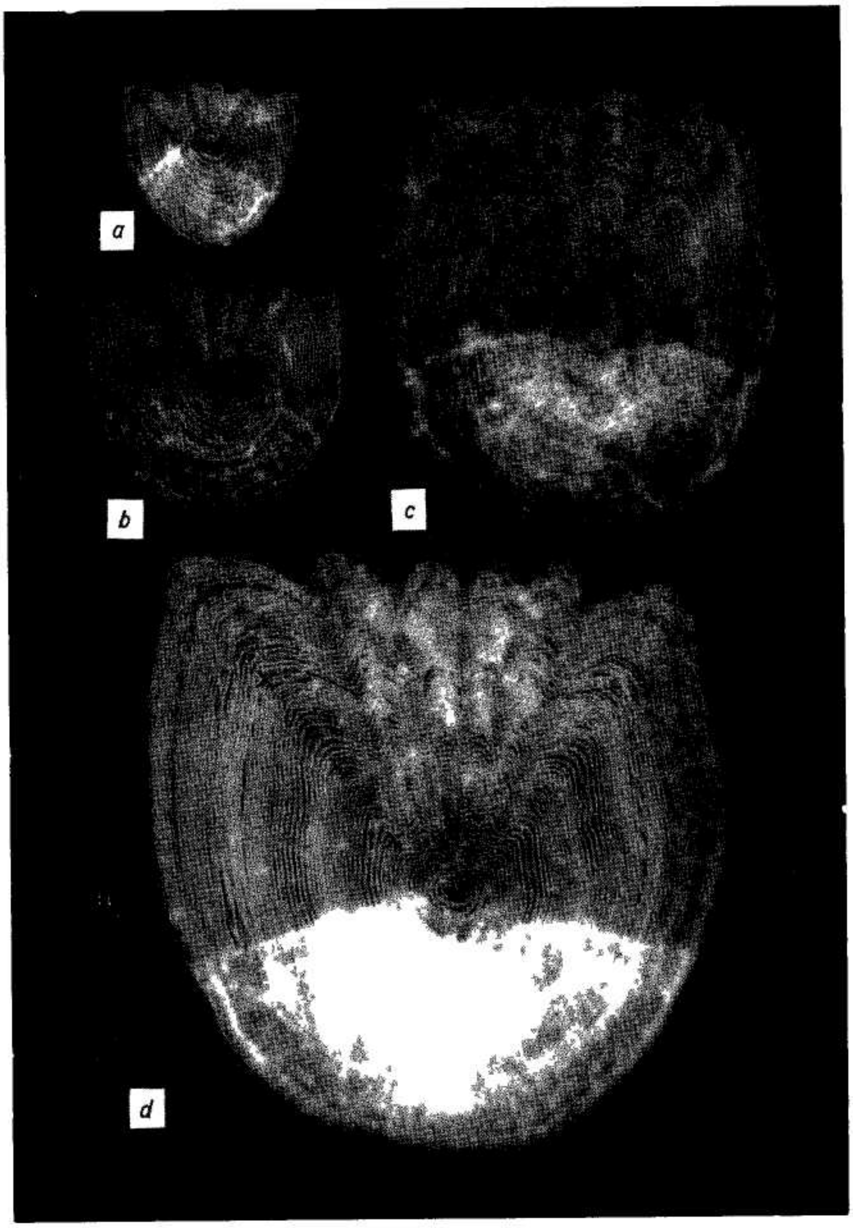


2

1 – *Allopauropus vulgaris*, 2 – *Allopauropus distinctus* (ductus receptaculi indicated by arrow),



3 — ductus receptaculi of *Stylopauropus pedunculatus pedunculatus*, 4 — ductus receptaculi of *Allopauropus gracilis*

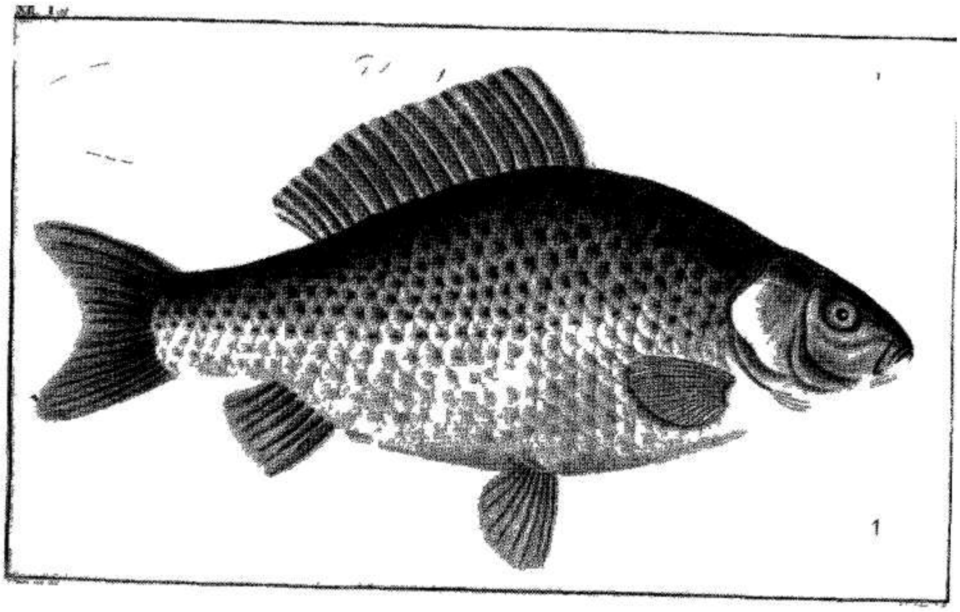


Photograph Scales of *Thymallus arcticus* (photographed with × 17.5 magnification) a Age class I, (1−) — fork length 72 mm b Age class II, (2) — fork length 130 mm c Age class III, (3+) — fork length 215 mm d Age class IV, (4+) — fork length 255 mm

Abb. 3 Unterschiede in der Grosse und Form der Penisse Unten *M brandtii*, oben *M mystacinus*. Lateralansichten

M

Abb. 4. Penis eines etwa 6 Wochen alten Exemplars von *M. brandtii*. Die Verdickung an der Spitze ist schon gut sichtbar.



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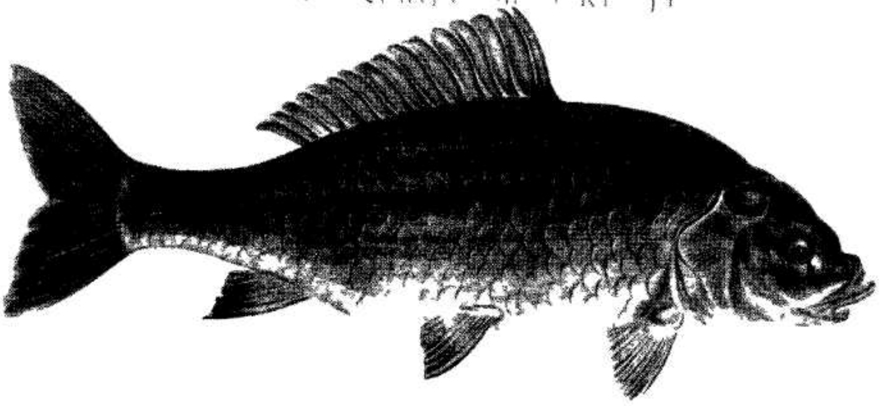
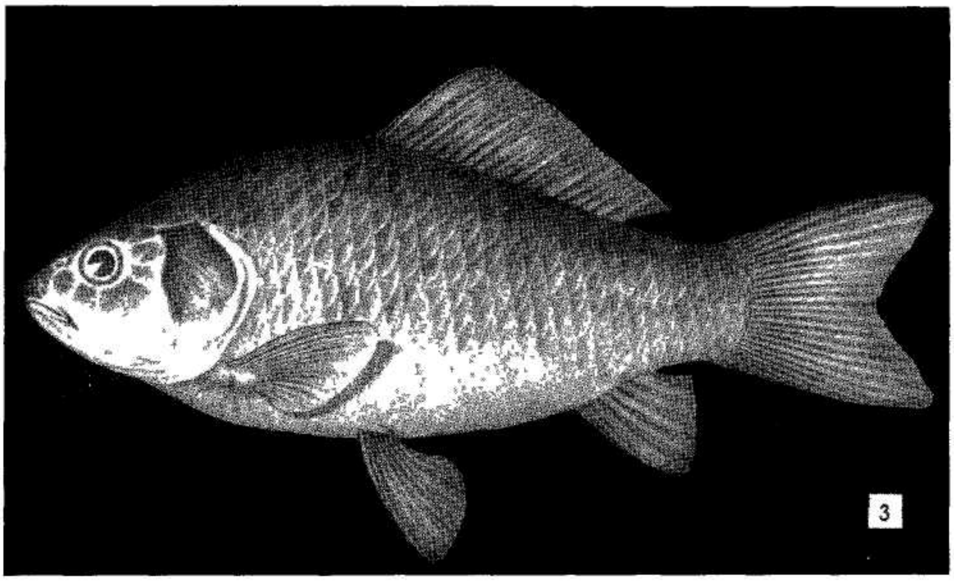


2

Plate I
Fig 1 *Cyprinus gibelio* Illustration in Bloch's work, 1782
Fig. 2 *Cyprinus III* Illustration in Marsili's work, 1726



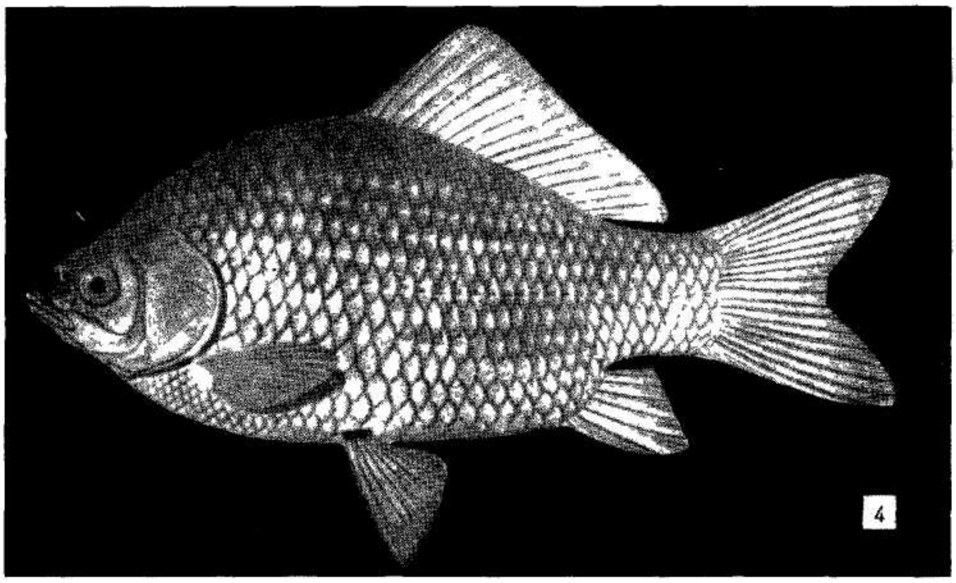


Plate II.

Fig. 3. *Carassius auratus* (Linnaeus, 1758). Specimen from the Summer Palace of Jehol (after Mori, 1934).

Fig. 4. *Carassius auratus gibelio* (Bloch, 1782). Specimen from the lake in the river Amur basin (after Berg, 1949).

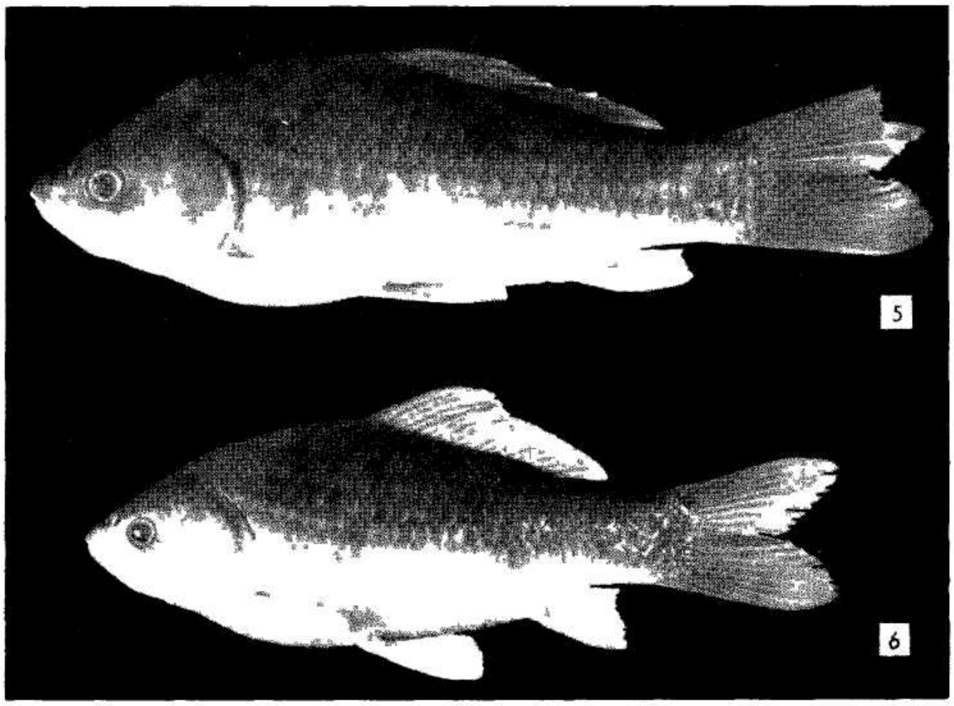
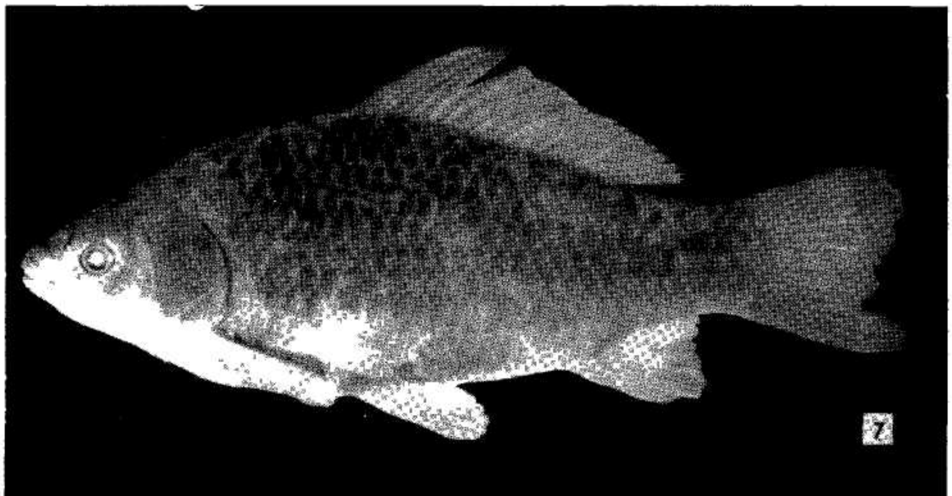


Plate III

Fig 5 and 6 New recorded specimens of *Carassius auratus gibelio* from river Danube in Czechoslovakia (June 1968)

Hensel K.: Some notes on the systematic status of Carassius auratus gibelio (Bloch, 1782). with further record of this fish from the Danube river in Czechoslovakia.



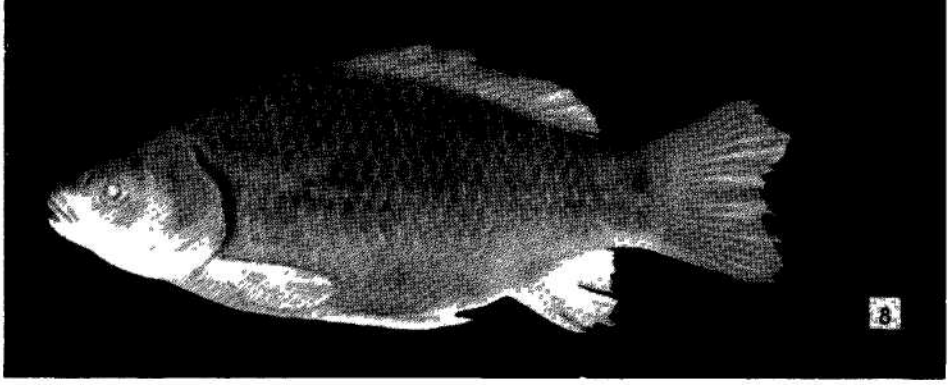


Plate IV.

Fig. 7 and 8. New recorded specimens of *Carassius auratus gibelio* from the river Danube in Czechoslovakia (March 1968).

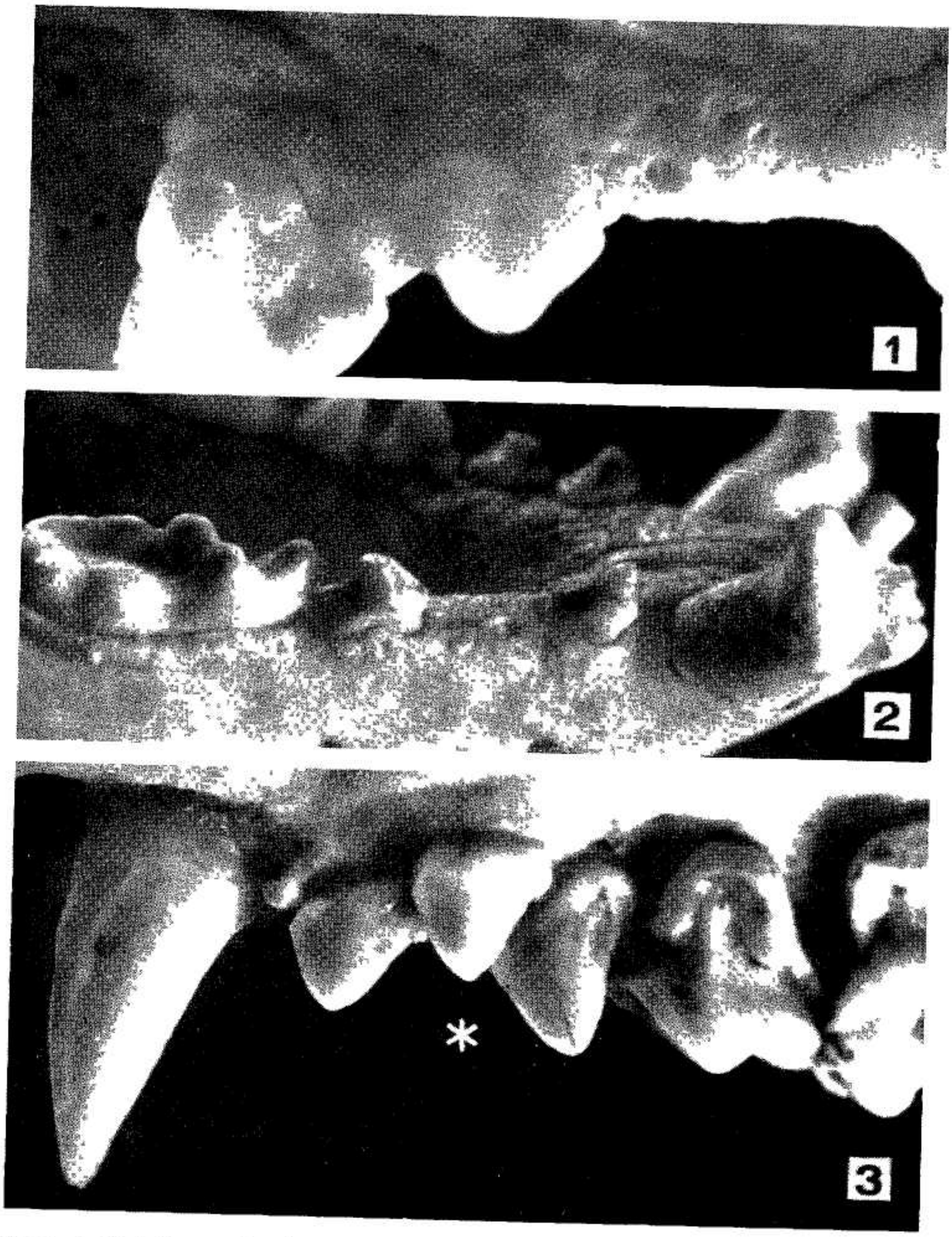


Fig. 1—3: Variations in the dentition in *Meles meles*. (1) Left upper jaw, P1 and P2 missing. Skull No. CM-012. (2) Right lower jaw, P1 and P3 missing (in the left lower jaw P1 missing). Skull No. 8086. (3) Right upper jaw, an extra premolar (*) in position between P2 and P3. Skull No. 14/60 922.

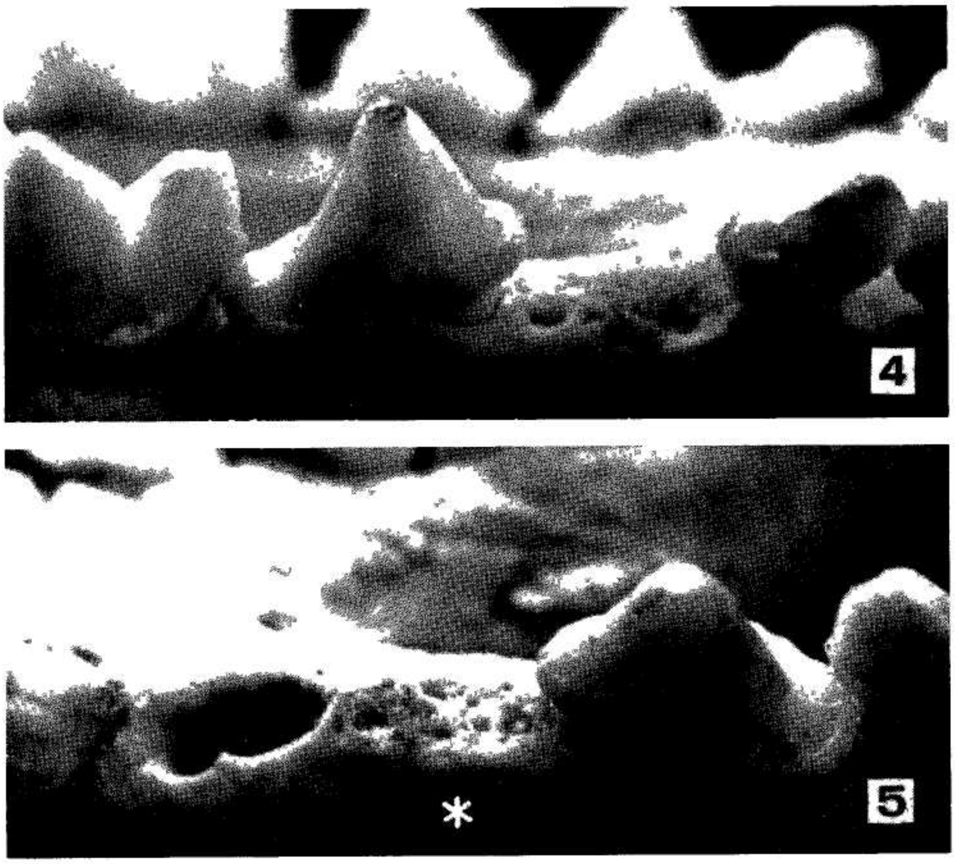


Fig 4 5 Variations in the dentition in *Lutra lutra* (4) Right lower jaw, P3 missing Skull No 14/60 276 (5) Left lower jaw, P3 missing (*) Skull No 14/60 1260

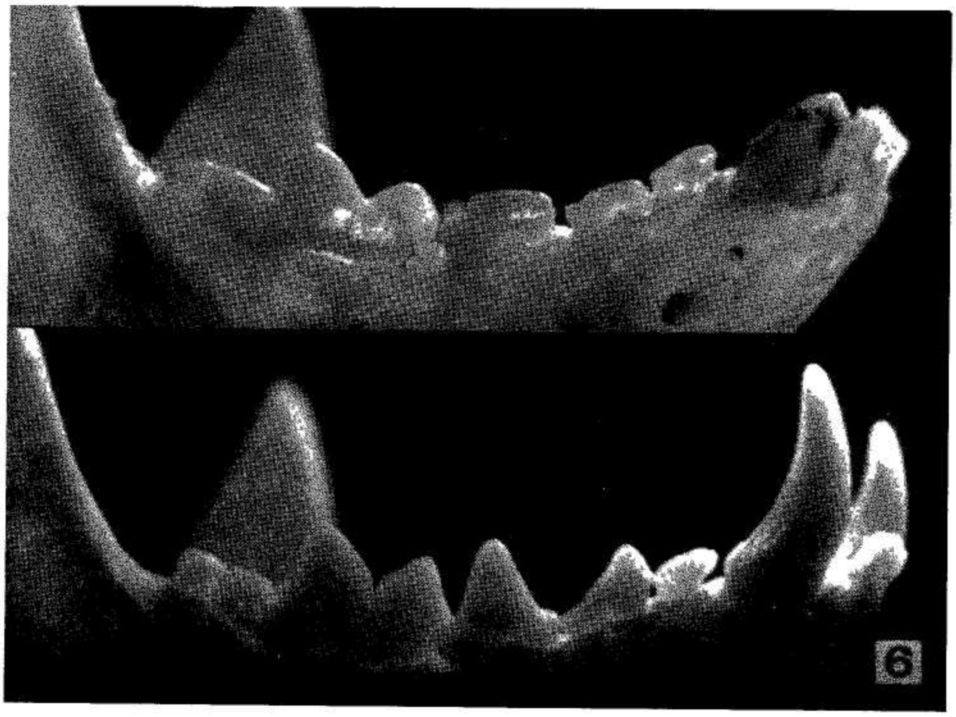


Fig. 6 *Mustela nivalis*, right mandible, lateral view. Teeth with the highest degree of abrasion found (type 4, above) compared with intact teeth (type 0, below).

Fig 7 *Martes martes*, right mandible, lateral view. Teeth with the highest degree of abrasion found (type 6, above) compared with intact teeth (type 0, below).

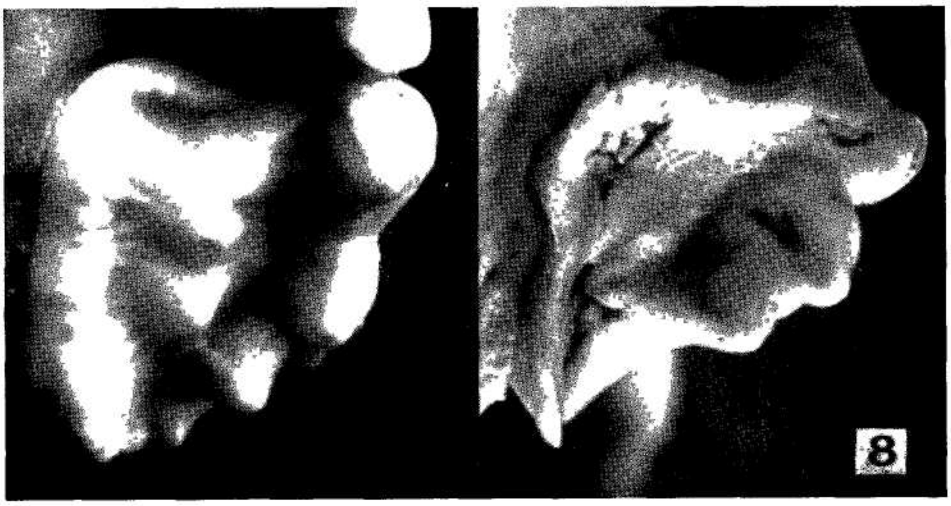


Fig. 8. *Meles meles*, left upper molar, view to the occlusal area. Tooth with the highest degree of abrasion found (type 10, right) compared with intact tooth (type 0, left).

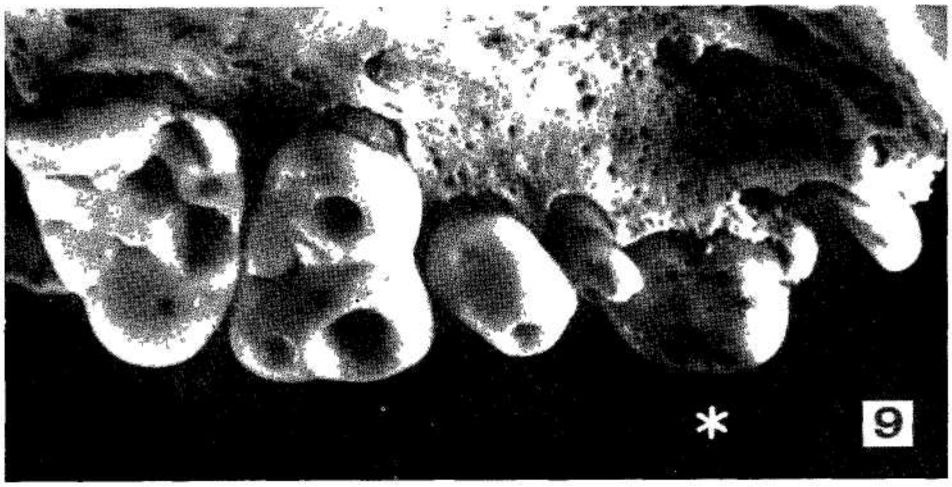


Fig. 9. *Enhydra lutris*, left upper jaw, ventromedial view. Characteristic mode of teeth abrasion. * = canine.

(Photographs by I. Heráň)

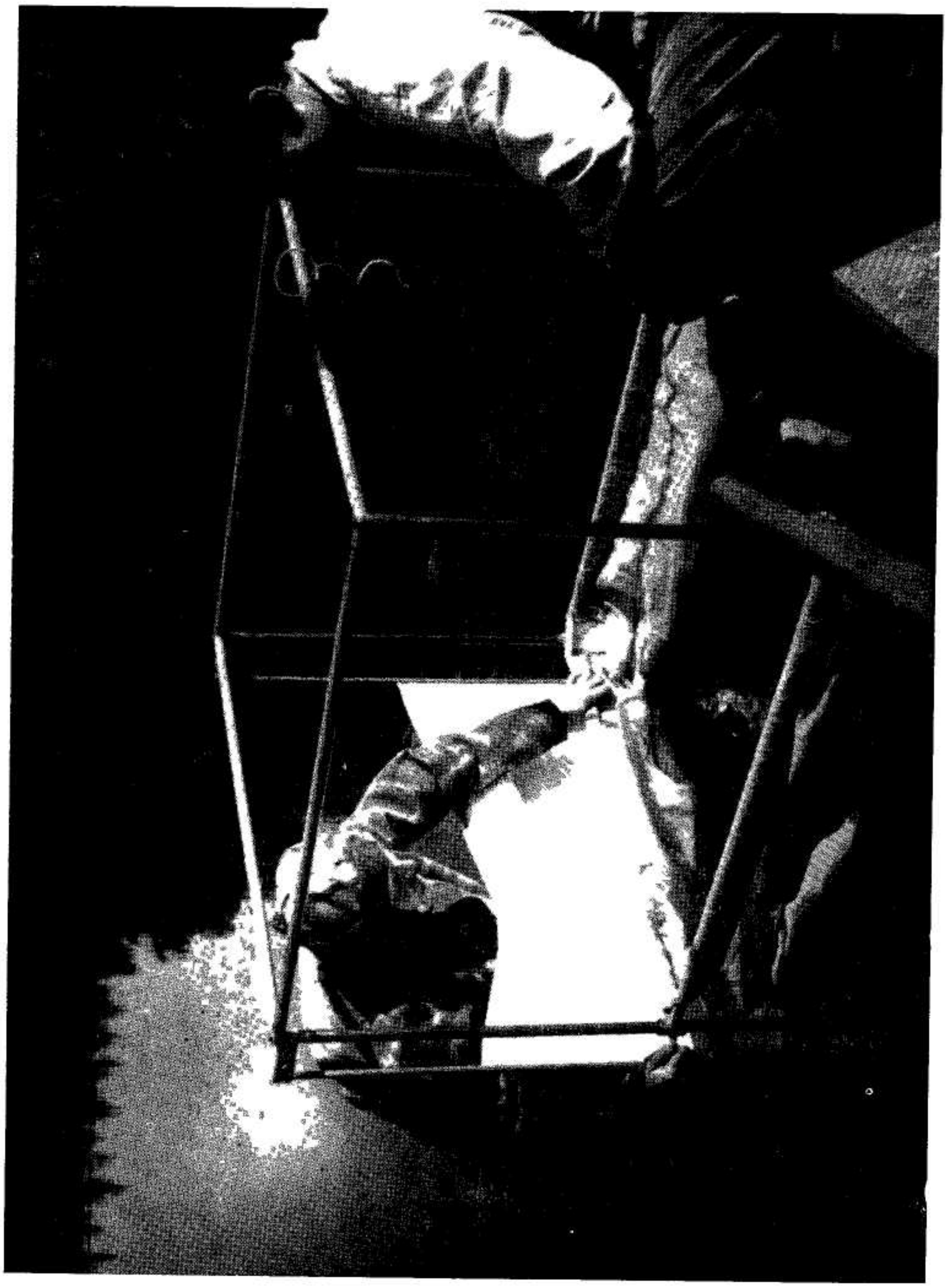


Fig 2 Sampler lowered over a stand of *Elodea*

Fig 3 Sample concentrated on the sampler sliding door ("puddle")