

# VĚSTNÍK

ČESKOSLOVENSKÉ SPOLEČNOSTI

# ZOOLOGICKÉ

XXXV

1971

4

ACADEMIA PRAHA

VĚSTNÍK ČESKOSLOVENSKÉ SPOLEČNOSTI ZOOLOGICKÉ

Roč. 35 - Čís. 4 Listopad 1971  
Tom. 35 - No. 4 November

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Bibliografická zkratka názvu časopisu — *Věst. Čs. spol. zool.*  
Abbreuiatio huius periodici bibliografica

Vedoucí redaktor: Akademik Otto Jírovec. Členové redakční rady: doc. dr. K. Hůrka, doc. dr. M. Kunst (výkonní redaktoři), doc. dr. W. Černý (Praha), prof. dr. S. Hrabě (Brno), doc. dr. J. Hrbáček (Praha), prof. dr. J. Kramář (Praha), doc. dr. J. Maňan (Praha), dr. V. Novák (Praha), doc. dr. O. Oliva (Praha), dr. J. Lom (Praha), prof. dr. F. Sládeček (Praha)

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Laboratory of Ichthyology, Zoological Institute, Charles University, Prague

**SOME OBSERVATIONS ON THE GROWTH  
OF ALBURNUS ALBURNUS (LINNAEUS, 1758)**

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Received December 30, 1970

**Abstract:** Age and growth of *Alburnus alburnus* from the Labe river system were determined from 266 specimens using scales. The method of R. Lee (1920) was used in the computation of the growth histories. The largest growth increment was attained during the first year of life. Results are discussed and compared with growth data from Slapy and Lipno reservoirs of Czechoslovakia and with those from Finland, Germany, U.S.S.R., Romania and Great Britain.

INTRODUCTION

*Alburnus alburnus* (Linnaeus, 1758), commonly known as the bleak, is a small cyprinid fish, inhabiting regions from western Europe to the Caspian sea and is neither much esteemed as food nor is it a sporting fish (Jenkins, 1942). Based on this discrimination a class of fishes known as coarse fishes continue to exist. Some knowledge of these species may aid in understanding the production of more valuable fishes and also as fishing pressure increases, we may have to harvest more of these minor species to meet the demands for protein and for recreation (Carlander, 1968).

Relatively little is known about the growth of *Alburnus alburnus*. Berg (1933), Bauch (1955), Oliva-Frank (1959), Čihař (1961), Vostradovský (1963), Williams (1963) and Papadopol (1970) have dealt with the growth of *Alburnus alburnus*. Oliva-Frank (l.c.) and Čihař (l.c.) have reported the growth from Slapy reservoir while Vostradovský (l.c.) has compared his own data from Lipno reservoir with some of the already known data. The present paper is concerned with the growth of *Alburnus alburnus* from five localities of the Labe river system.

MATERIALS AND METHODS

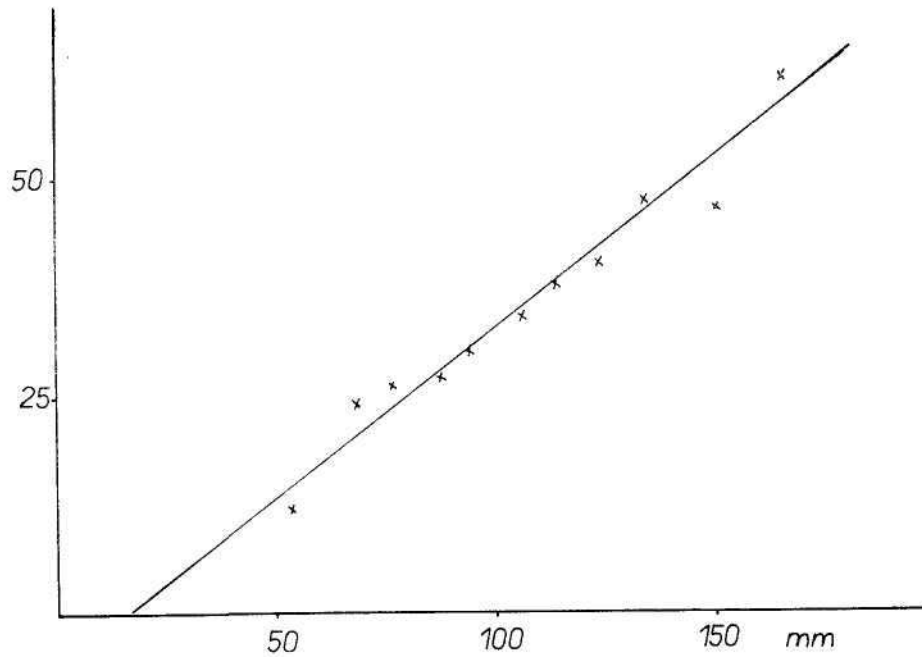
The study of age and growth of bleaks has been based on the determination of age and the computation of growth from scales of 266 specimens. Materials used in this study were collected from the river Vltava near Měchenice, the river Ohře near Karlovy-Vary, the rivulet Stropnice, the river Vltava near Podbaba and the river Labe near Dečín during the years 1948, 1951, 1953, 1954 and 1963 respectively and kept in the depository of the Laboratory of Ichthyology, Charles University, Prague.

Three to five scales collected on the left side, above the lateral line, opposite the origin of the pelvic fins were examined in wet mounts in a microprojector (Carl Zeiss, Jena) with 17.5 magnification. The distances from the focus to the different annuli and to the margin along the diagonal radius were measured, in one scale. The average standard lengths in each 10 mm intervals were plotted against the corresponding average diagonal radius. (See graph 1). The computed regression line for standard length on diagonal radius gave the following equation for linear relationship:

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

where  $L = 15.9663 + 2.59577 R$   
 $L$  = standard length and  
 $R$  = diagonal radius ( $\times 17.5$ ).

Back calculations of length at each annulus were made using the method of R. Lee (1920), with a correction of 16.0 mm. (15.9663 rounded to 16.0 mm). See graph 1.



Graph 1. Relation between standard length and diagonal radius of scale of *Alburnus alburnus*. Abscissa, standard length in mm; ordinate, scale radius  $\times 17.5$ , in mm.

Length-weight relation was calculated from fish grouped by 10 mm standard length intervals. Length-weight relation is expressed by the regression:

$$\log W = 3.32316 \log L - 5.54919$$

where  $W$  = weight in grams and  
 $L$  = standard length in mm.

The weights at different lengths were computed from the logarithmic graph. See graph 2.

The coefficient of condition,  $K$  was calculated using the conversion table of Carlander (1950). Growth characteristics were calculated using the formula  $C_{th} = \frac{\log I_n - \log I_{n-1}}{0.4343} I_{n-1}$  (Vasnečov's formula).

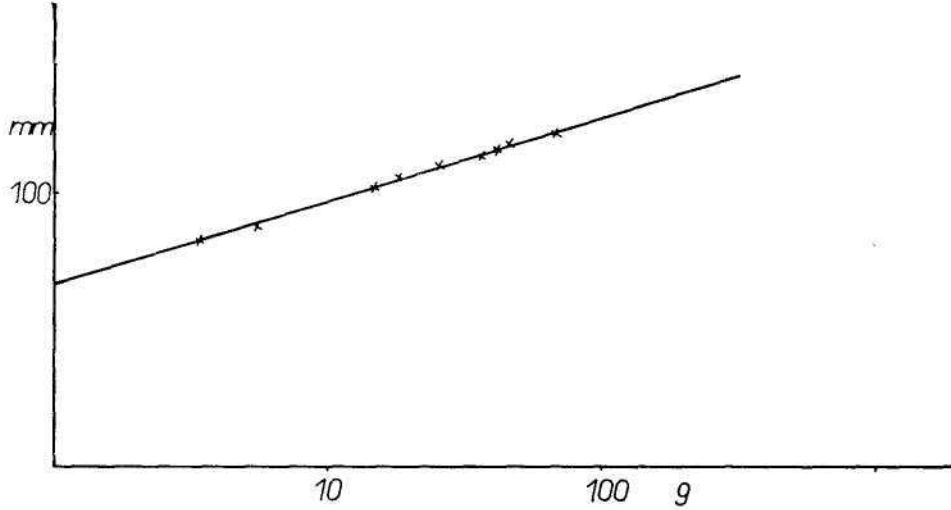
The age of fish was assigned by counting the number of annuli on their scales. Since each fish was considered to have passed into the next higher age class on January first a virtual annulus was accredited for those specimens caught between January first and the date of formation of the current year's annulus.

#### RESULTS AND DISCUSSION

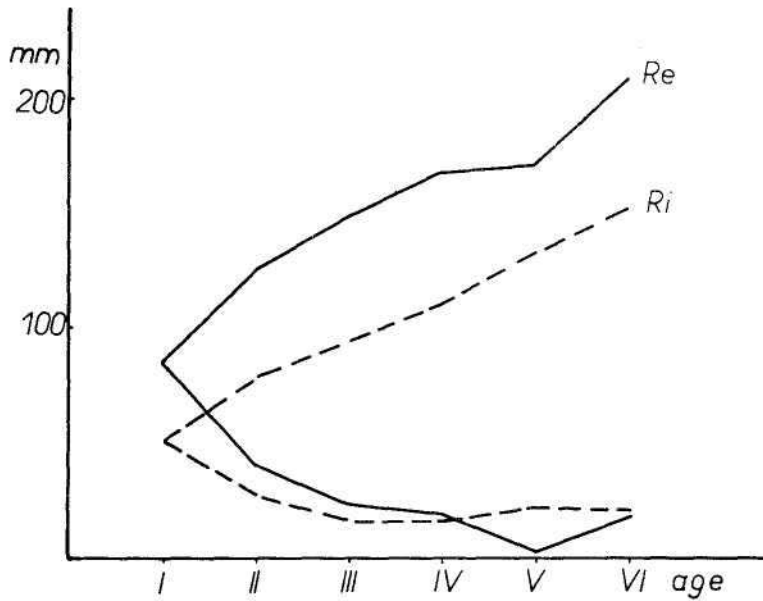
Growth of bleaks from Vltava—Podbaba, Vltava—Méchenice, Ohře—Karlovy-Vary, Stropnice and Labe—Děčín are shown in tables 1, 2 and 3. There is no significant difference in growth during the 1st and 2nd years



of life in the five localities under consideration. (See table 4.) However, bleaks from Vltava—Podbaba has the best growth and those from Stropnice the worst. During the 3rd year of life there is significant difference in growth between the bleaks in these two localities. As the material from Vltava—Podbaba and Stropnice are limited in number, strict conclusions cannot be



Graph 2. Logarithmic graph showing the relation of standard length (in mm, ordinate) to body weight (in grams, abscissa).



Graph 3. Average growth and yearly increments of *Alburnus alburnus* in the reservoirs (Slapy and Lipno) and in the river Labe system, in successive year of life. Reservoir — and river - - -.

Table 1. Growth of different age classes of *Alburnus alburnus* from the river Labe near Děčín.

Age-class	Year of hatching	Number	Average standard length in mm at the time of capture	Average body weight in grams at the time of capture	Back calculated standard length in mm (above) and weights in grams (below)							
					1	2	3	4	5	6	7	
II	1961	28	88.1	8.1	45	84						
III	1960	53	98.3	13.1	0.8	7.0						
					45	74	95					
IV	1959	15	120.0	24.2	0.8	4.6	10.5					
					48	76	98	117				
V	1958	8	127.3	28.6	1.1	5.0	12.0	21.0				
					46	71	93	113	123			
VI	1957	2	134.0	34.0	0.9	4.0	10.0	19.0	25.0			
					51	70	95	107	123	133		
VII	1956	2	158.0	57.5	1.3	3.9	10.5	16.0	25.0	33.8		
					50	77	101	121	139	151	151	
Total		108	Average	Average	48	75	96	115	128	142	151	
					1.0	4.9	11.2	20.0	29.3	41.9	50.0	
			K		0.90	1.16	1.27	1.32	1.39	1.46	1.45	

Table 2. Growth of different age classes of *Alburnus alburnus* from the river Vltava near Měchenice.

Age-class	Year of hatching	Number	Average standard length in mm at the time of capture	Average body weight in grams at the time of capture	Back calculated standard length in mm (above) and weights in grams (below)						
					1	2	3	4	5	6	
II	1946	8	107.3	13.4	58	97					
III	1945	65	111.9	15.8	2.1	11.5					
					54	80	105				
IV	1944	2	121.0	19.5	1.6	6.0	15.0				
					56	80	100	113			
V	1943	1	168.0	74.0	1.8	6.0	12.7	19.0			
					40	56	76	97	135	161	
VI	1942	1	168.0	74.0	0.6	1.8	5.0	11.5	35.0	63.0	
					52	78	94	105	135	161	
Total		76	Average	Average	52	78	94	105	135	161	
					1.5	6.3	10.9	15.3	35.0	63.0	
			K		1.07	1.33	1.31	1.32	1.42	1.51	

Table 3. Growth of different age-classes of *Alburnus alburnus* from (a) River Ohře near Karlovy-Vary, (b) River Vltava near Podbaba and (c) rivulet Stropnice.

(a) Locality	Age- class	Year of hatching	Number	Average standard length in mm at the time of capture	Average body weights in grms at the time of capture	Back calculated standard length in mm (above) and weights in grms. (below)			
						1	2	3	4
River Ohře near Karlovy-Vary	I	1950	40	78.4	6.1	46			
						0.9			
	II	1949	3	93.3	11.3	53	83		
						1.5	6.8		
	Total		43	Average		50	83		
				K		1.2	6.8		
						0.96	1.45		
(b) River Vltava - Podbaba.	III	1951	20	115.2	21.2	57	85		
						1.8	7.3		*
	IV	1950	1	138.0	40.0	51	88	110	*
						1.3	8.3	17.3	
	Total		21	Average		54	87	110	*
				K		1.6	7.8	17.3	
						1.02	1.19	1.29	
(c) Rivulet - Stropnice	I	1951	1	53.0	1.0	*			
	II	1950	3	79.0	4.7	57			
						1.8	*		
	III	1949	13	90.8	8.5	50	75		
						1.3	4.8	*	
	IV	1948	1	99.0	13.0	40	60	74	*
						0.6	2.3	4.6	*
Total		18	Average		49	68	74	*	
				K		1.2	3.6	4.6	*
						1.02	1.14	1.136	

\* Specimens were caught in January when the new year's annulus had not yet formed.



River Labe, near Děčín.	Author	108	48	75	96	115	128	142	151	1.99	1.91	1.74	1.66
Rivulet Stropnice, in Southern Bohemia.	Author	18	2.14	1.85	1.73	1.23	1.33	0.87					
River Vltava, near Podbaba.	Author	21	1.61	0.57						1.09			
River Vltava, near Měchenice.	Author	76	54	87	110					2.30			
River Ohře, near Karlovy - Vary.	Author	43	2.57	2.04									
Average for the Labe river system.			52	78	94	105	135	161		1.78	1.53	1.81	1.92
Average for Slapy and Lipno reservoirs.			50	83									
			51	78	94	110	132	152					
			2.17	1.45	1.48	2.01	1.86			1.81	1.70	1.78	1.79
			86	126	149	168	171	207		2.69	2.39	1.87	2.15
			3.28	2.11	1.79	0.29	3.27						

+ Total lengths given in original data have been converted into standard lengths using the conversion graph of Vostradovský, 1963.

\* Cited after Berg, 1933.

\*\* Cited after Bauch, 1955.

\*\*\* Cited after Vostradovský, 1963.

drawn from them. The bleaks from Ohře investigated for growth had attained only two years. Their growth figures agree well with those from other localities.

The largest numbers and older specimens investigated are from Vltava—Měchenice and Labe—Děčín. Although bleaks from Vltava—Měchenice have faster growth than those from Labe—Děčín, the difference in growth between them is also not significant.

Vltava—Podbaba, Vltava—Měchenice, Ohře—Karlovy-Vary, Stropnice and Labe—Děčín form the same river system of the river Labe and since there is no significant difference in growth during the corresponding growth periods, the average of growth in these five localities have been calculated to represent the growth of bleaks in the Labe river system. (See table 4). Compared with the growth of bleaks from Slapy (Oliva - Frank, 1959 and Čihař, 1961) and Lipno reservoirs (Vostradovský, 1963), it is clear that the growth in the reservoirs is faster than in the Labe river system. However, the annual increments during the 5th and 6th year are greater in the Labe river system. (See graph 3). The largest growth increment attained during the first year of life is a common feature of bleaks both in the reservoirs and in the Labe river system.

The superior growth of bleaks in the reservoirs is also reflected in the values of coefficient of condition. The coefficient of condition values for the bleaks from the Labe river system are as follows:

	1	2	3	4
K	0.99	1.25	1.25	1.32
	5	6	7	
K	1.41	1.49	1.45	

In the case of Lipno reservoir,  $K$  varies from 1.0 to 1.6 (Vostradovský, 1963) up to the third year of life. The value of  $K$  for the corresponding period in the Labe river system is 0.99 to 1.25.

The superior growth of *Alburnus alburnus* in the reservoirs appears to be due to the physical confinement of the fish in the reservoirs and to factors resulting from it subsequently. *Alburnus alburnus* in Lipno reservoir has come from Vltava (Vostradovský, 1963). It appears then that the populations of *Alburnus alburnus* in the reservoir and the Labe river system are genetically the same and the rapid growth therefore cannot be due to a hereditarily greater capacity for growth. Bleaks feed chiefly on plankton and larvae of fishes (Vostradovský, l.c.) and the reservoirs seem to provide this more than the river system.

Comparing the results of the present study with those of Vostradovský (l.c.), it appears that the reservoir environment is more suitable for the growth of *Alburnus alburnus* than the river water system. The higher growth rate of *Alburnus alburnus* from Endertal Valley water reservoir in Germany (Wunsch, cited after Bauch, 1955) and Učinskaja Valley water reservoir of U.S.S.R. (Svetovidova, 1960; cited after Vostradovský, 1963) in comparison with those from other water bodies in the respective countries confirms this. This is also in conformity with the findings of Balon (1962) regarding the growth of *Leuciscus cephalus* in Orava River and that of Frank (1970) regarding the growth of *Rutilus rutilus* from Klíčava reservoir.

The growth of bleaks from the Labe river system of Czechoslovakia compared with the growth of bleaks from rivers, lakes and reservoirs in foreign countries, appears to be better than those from Somova of the Danube Delta in Romania (Papadopol, 1970) and Teltow-canal in Germany (Bauch, 1955). If the average growth characteristic for the first five years of life are considered the growth in the Labe river system is also better than that in river Thames (Williams, 1963) and nearly the same or slower than those of others whose data are available. (See table 4). Averages of growth characteristic for younger age classes in some cases under consideration appear to give a different picture. This fluctuating values of growth characteristics obviously indicate a non-uniform trend in rates of growth in successive years of life.

*Alburnus alburnus* from Somova of the Danube Delta in Romania has the lowest growth ( $C_{th 1-4} = 1.14$ ) and those from Endertal Valley water reservoir of Germany the highest ( $C_{th 1-4} = 3.09$ ). However, the largest first year growth recorded is in the Slapy and Lipno reservoirs of Czechoslovakia.

#### Acknowledgement

I am greatly indebted to Doc. Dr. O. Oliva for suggesting the problem for study, for his valuable guidance, encouragement and critical reading of the manuscript. It is a pleasure to acknowledge the counsel and assistance of Dr. S. Frank, Dr. K. Pivníčka and Dr. K. Černý.

#### SUMMARY

1. Age and growth of *Alburnus alburnus* from the Labe river system has been studied using scales from 266 specimens.
2. The linear relationship between the length of fish and the diagonal radius of scale is expressed by the equation:

$$L = 15.9663 + 2.59577 R \quad \text{where}$$

L = standard length and

R = diagonal radius ( $\times 17.5$ )

3. Computations of growth histories were made by the method of R. Lee (1920), with a correction of 16.0 mm.

4. Length-weight relationship is expressed by the equation:

$$\log W = 3.32316 \log L - 5.54919 \quad \text{where}$$

W = weight in grams and

L = standard length in mm.

5. Averages of growth characteristic for 3, 4, 5 and 6 years of life have been calculated for the growth data of *Alburnus alburnus* so far reported and used for the comparison of growths.

6. There is no significant difference in growth of *Alburnus alburnus* from Vltava—Měchenice, Ohře—Karlovy-Vary, Stropnice, Vltava—Podbaba and Labe—Děčín.

7. Average growth of *Alburnus alburnus* from these localities is slower than those of Slapy and Lipno reservoirs of Czechoslovakia.

8. Reservoirs are claimed to be better environments for the growth of bleaks than the river system and this is believed to be due to the reservoirs providing more food than the rivers.

9. Average growth of bleaks from the Labe river system is better than those from Somova of the Danube Delta in Romania, Teltow-canal in Germany and River Thames.

10. The growth is nearly the same or slower than those of others so far reported from Germany, Finland and U.S.S.R.

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**GROWTH AND MORTALITY OF CRUCIAN CARP — *CARASSIUS CARASSIUS* (L.)  
MORPHA *HUMILIS* HECKEL 1840, IN THE NATURAL POND MANSFELDOVA  
IN THE CENTRAL ELBE BASIN**

KAREL ČERNÝ

Received May 28, 1971

**Abstract:** The study brings results of growth analyses of 533 specimens of crucian carps from the natural pond Mansfeldova in the central Elbe basin. The whole material has been gained by collection after the natural pond had been poisoned by means of DDT and HCH substance in October 1953. In these fishes the growth of length and weight during the past years of life was studied in backward direction. The found out rate of growth in this natural pond is low. Further the values of annual survival rates(s), of annual mortality rates(r) and of instantaneous mortality rates ( $\Delta$ ) have been determined in these fish specimens. The results are being discussed in comparison with statements of other authors concerning the growth of this species in other natural ponds of Elbe basin and other localities.

INTRODUCTION

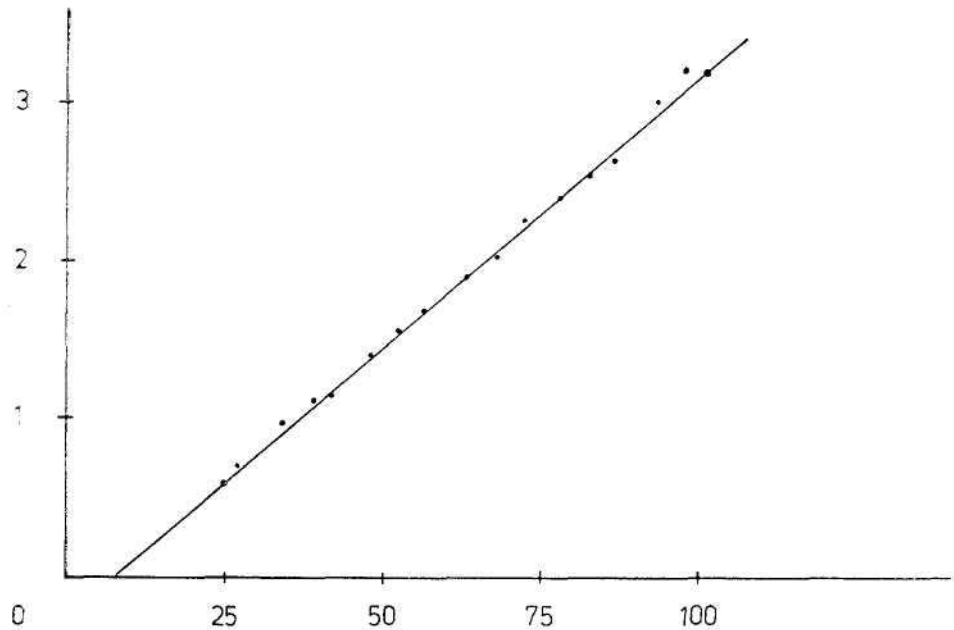
In the period after the second World War the natural ponds of central Elbe basin became an important experimental object of hydrobiologists and ichthyologists of the Prague Natural Sciences Faculty, Charles University and quite a number of new methods that had not been used till then in our biological research was practically checked up in them. Ichthyologists studied the growth, development, biometry and food of fishes from these natural ponds and in some of these ponds attempts were made to estimate the abundance of their fish population. The majority of the material gained during these years is deposited till now in the depository of the Zoological Institute of Charles University and waits for being worked up.

One of the fish species represented by a very fair collection in the depository is the dwarf form of crucian carp — *Carassius carassius* morpha *humilis*. According to Berg (1949) the dwarf form of crucian carp differs from the typical high-body form above all in the height of body which goes into the standard length 2.4—3 times, while in the high-body form the body-height goes into the standard length only 1.8—2 times. Crucian carps produce the dwarf form in unfavourable life conditions and this form is able to change into the normal, high-body form, in case of a marked improvement of food conditions. (Oliva, Hrabě, Lác, 1968).

A survey of authors, who dealt with the growth of crucian carp, is given by Čihař (1957) and Libosvářský (1963). In our waters the growth of this species was studied by Oliva and Hruška (1955), Čihař (l. c.) and Libosvářský (l. c.). However, of these authors it was only Čihař (l. c.)

who devoted himself to a more detailed study of growth of the dwarf form of crucian carp. The latter worked up 262 fish specimens from the natural pond Karasí in the central Elbe basin. Oliva and Hruška (l. c.) then only in an orienting way determined the growth of 16 crucian carps from another Elbe natural pond called Černá.

In view of the fact that till now we have relatively few data about the growth of this fish in our country, I decided to work on the material from



Graph 1. — The relationship of the diagonal scale radius (in mm, ordinate) to the standard length (in mm, abscissa) of crucian carps from the natural pond Mansfeldova.

the natural pond Mansfeldova which also belongs to the complex of the above-mentioned experimental ponds in the area of the central Elbe basin. The life conditions in the three Elbe natural ponds referred to above are similar enough and that is why it would be interesting to find out also if the growth of crucian carp in these natural ponds will have a similar character.

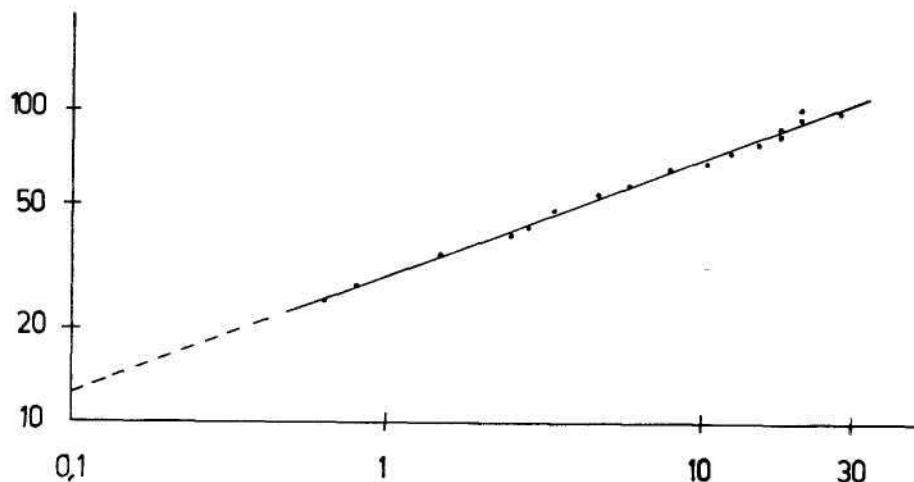
In addition to watching, the growth calculation has been carried out too of the annual mortality rate( $r$ ), of the annual survival rate( $s$ ), and of the instantaneous mortality rate( $\Delta$ ) of crucian carp in this natural pond.

#### MATERIAL AND METHOD

The whole of the worked up material has been gained by means of poisoning the natural pond Mansfeldova in the central Elbe basin in October 1953. For this poisoning of the natural pond have been used 200 g of DDT substance and three days later 200 g of HCH substance. On following days all the dead fishes have been collected carefully. Detailed data concerning methodics and the course of digestion itself are given by Oliva (1955a) who at the same time brings a description of the natural pond Mansfeldova as well. For that reason I am confining myself only to essential data: area of the natural pond — 209 m<sup>2</sup> (at the time of summer water level only 178 m<sup>2</sup>), maximum depth of this pond — 90 cm. After the poisoning of the natural

pond 675 crucian carps on the whole have been found of which 533 specimens are kept in the depository of the Zoological Institute of Charles University. These 533 fish specimens have been used for the purpose of growth analyses and mortality calculations. Of the total number 226 were males, 179 females and 128 juvenile fishes.

For the purpose of determining the age and the growth one used scales that were measured by means of a microprojector. Scales were taken from the first row below the lateral line between the insertion of ventral fins and the anal fin. The distance to separate annuli was measured at the diagonal scale radius. With regard to the linear character of the dependence between the standard length and the diagonal scale radius that is shown by the graph 1, the growth in the past years of life was back-calculated by the method of R. Lee (1920) by using the graphically obtained correction of 7 mm. The body-weights in the past years of life were read off from the



Graph 2. — The relationship of the standard length (in mm, ordinate) to the body weight (in grams, abscissa) of the crucian carps from the natural pond Mansfeldova.

graph 2 which is a logarithmic scale expression of the relationship between the body-weight and standard length of crucian carps at the time of capture. The annual survival rate ( $s$ ), the annual mortality rate ( $r$ ) and the instantaneous mortality rate ( $\Delta$ ) have been calculated according to Rounsefell and Everhart (1953) and for comparison's sake also in the way indicated by Ricker (1958).

## RESULTS AND DISCUSSION

### 1. Growth of crucian carp population in the natural pond Mansfeldova

The linear growth of the dwarf form of crucian carp is summarised in table 1, the weight growth in table 4. Results found out separately for both sexes are presented in tables 2 and 5. A comparison of the growth results themselves with statements of other authors concerning further localities has been made possible by table 3.

In comparison with data about the growth of the dwarf form of crucian carp in other localities one can say that its growth in the natural pond Mansfeldova has an average character. It is faster than the growth of this species in the natural pond called Karasí, ascertained by Čihař (1957), but distinctly slower than the growth in another Elbe natural pond Černá, determined by Oliva and Hruška (1955) or the growth in some Russian waters stated by Berg (1949). From the table 3 it follows further that the

Table 1. Growth of different age groups of crucian carp population.

Age group	Number of specimens	Average standard lengths in mm at the time of capture	Mean computed standard lengths in mm					
			l <sub>1</sub>	l <sub>2</sub>	l <sub>3</sub>	l <sub>4</sub>	l <sub>5</sub>	
0	19	27.2						
I	106	38.9	24					
II	212	56.8	26	44				
III	181	67.0	25	41	56			
IV	14	93.7	26	47	66	82		
V	1	95.0	22	34	48	70	87	
Total	533	Average	25	43	57	81	87	

Table 2. Growth of different age groups of crucian carp population separated for both sexes.

Age group	Number of specimens	Standard lengths in mm at the time of capture	Mean computed standard lengths in mm					Sex
			l <sub>1</sub>	l <sub>2</sub>	l <sub>3</sub>	l <sub>4</sub>	l <sub>5</sub>	
I	4	50.0	28					♂
II	128	57.7	26	45				
III	92	64.6	25	40	54			
IV	2	88.0	26	47	63	78		
Total	226		26	42	54	78		
I	2	50.5	29					♀
II	75	56.7	26	44				
III	89	69.5	25	42	58			
IV	12	93.8	26	47	67	82		
V	1	95.0	22	34	48	70	87	
Total	179		26	43	59	81	87	

typical high-body form of crucian carp mostly grows considerably quicker than the dwarf form from Elbe natural ponds. But only insignificant and not quite unequivocal differences have been found between the growth of the dwarf form in the natural pond Černá as well as in the Russian lakes Borovoje and Čajki and the growth of the typical form of some East-Slovakian and South-Moravian localities studied by Libosvářský (1963).

Differences found by various authors between the growth rates of the dwarf form of crucian carp in three Elbe natural ponds Černá, Karasí and Mansfeldova can be explained by a different density of population of crucian carps in these natural ponds and by some differences in character of these

localities. In the years the worked up material comes from, there were strong fish overpopulations in all three natural ponds (Oliva, 1955b,c, Čihař, 1957) owing to absolute absence of predatory fish species. In the natural pond Černá, however, where the growth has been found to be the best, the abundance of crucian carps was markedly the lowest one according to statements of Oliva (1955b) only 500 sp/ha. In this natural pond the dominant species was represented by bitterling. On the contrary in the natural pond Mansfeldova the noticeably most abundant species was crucian carp whose abundance in that place amounted according to statements of Oliva (1955a) to 32 300 sp/ha. Here the slower growth was obviously influenced by a substantially higher number of crucian carps per unit of area and by a greater food competition between individuals of this species resulting from it. In the natural pond Karasí the abundance of crucian carps amounted according to results of Oliva's investigations stated by Čihař (l. c.) to 9600 sp/ha. Here the worst growth of crucian carps of all three natural ponds must have been caused in addition to fish overpopulation by abnormally unfavourable oxygen conditions described by Blažka (1957). According to this author it was only in the spring, after the ice had thawed that crucian carps found good oxygen conditions in this natural pond. In the beginning of summer the oxygen conditions in connection with a strong overgrowing of the pond with aquatic plants began to become worse and in the autumn period free oxygen was present only in the upper layers of water and that during the day only for several hours. From November to March the crucian carps inhabiting this natural pond

Table 3. Average standard length values of crucian carp in mm, ascertained by different authors in various localities.

Locality	Years of life									
	1	2	3	4	5	6	7	8	9	10
natural pond Mansfeldova										
natural pond Černá (Oliva, Hruška, 1955)	25	43	57	81	87					
natural pond Karasí (Čihař, 1957)	32	55	71	106						
Lake Čajki-river basin of Doňec (Berg, 1949)	29	38	47	59	69	78	91	108	117	128
lake Borovoje-river basin of Donce (Berg, 1949)	30	54	76	96	116	133				
	37	66	97	129	144					
Pavlovo-east Slovakia (Libosvářský, 1963)	29	44	55	75	83	98				
Leles-east Slovakia (Libosvářský, 1963)	36	55	68	100	119					
lake Zaječské-south Moravia (Libosvářský, 1963)	44	64	87	105	121					
Hlohovecký pond - south Moravia (Libosvářský, 1963)	46	76	99	127	140					
Jarohněvický pond - south Moravia (Libosvářský, 1963)	54	85	118	152	174	192	222			

Table 4. Growth in weight of different age groups of crucian carp population.

Age group	Number of specimens	Average body-weights in g at the time of capture	Mean computed body-weights in g					
			w <sub>1</sub>	w <sub>2</sub>	w <sub>3</sub>	w <sub>4</sub>	w <sub>5</sub>	
0	19	0.76						
I	106	2.1	0.58					
II	212	6.7	0.72	2.8				
III	181	11.9	0.64	2.5	5.6			
IV	14	22.3	0.72	3.5	8.8	16		
V	1	19.1	0.46	1.5	3.7	10.5	18	
Total	533	Average	0.66	2.7	5.8	15.6	18	

were not active and passed winter at the depth of 1.75 m and more where there were strictly anaerobic conditions during the most part of this period.

A comparison of average weights in separate years of life with weights in length groups stated by Čihař (1. c.) shows that even the weight growth of crucian carps was quicker in the natural pond Mansfeldova than in the natural pond Karasí.

In accordance with the results of Čihař (1. c.) from the natural pond Karasí it was in crucian carps from the natural pond Mansfeldova too that growth has been found to be slightly quicker in the case of females than in males, which can be seen in tables 2 and 5.

Table 5. Growth in weight of different age groups of crucian carp population separated for both sexes.

Age group	Number of specimens	Body-weights in g at the time of capture	Mean computed body-weights in g					Sex
			w <sub>1</sub>	w <sub>2</sub>	w <sub>3</sub>	w <sub>4</sub>	w <sub>5</sub>	
I	4	2.8	0.81					
II	128	6.6	0.72	3.1				♂
III	12	10.5	0.64	2.6	5.2			♂
IV	2	21.8	0.72	3.5	7.8	14		
Total	226		0.69	2.9	5.3	14		
I	2	3.4	0.96					
II	75	7.0	0.72	2.8				♀
III	89	13.2	0.64	2.6	6.2			
IV	12	22.4	0.72	3.5	9.2	16		
V	1	19.1	0.46	1.5	3.7	10.5	18	
Total	179		0.68	2.7	6.5	15.6	18	

## 2. Mortality of crucian carp population in the natural pond Mansfeldova

One is accustomed to calculate mortality mostly on the basis of results obtained in investigating the age composition of populations in certain localities. Here the best results can be obtained by using material gained by poisoning and collecting all the fish specimens in the locality; it was e.g. Holčík (1970) who had used this method for mortality calculation. While calculating mortality one starts from the assumption that the strength of year's groups going one after the other in continuous succession remains approximately the same all the time. In case it is not so, the calculations of mortality, survival and instantaneous mortality are greatly distorted. Using material gained from poisoned localities for calculations of mortality brings an advantage consisting in greater accuracy of values relating to fish numbers in separate age groups, even though here too these values can sometimes differ fairly from the real state in the locality owing to an incomplete collection of dead fish specimens. For these reasons the determined values of the annual mortality rate ( $r$ ), of the annual survival rate ( $s$ ) and of the instantaneous mortality rate ( $\Delta$ ) have only an orientative character attributed to these factors by Balon (1960) too.

The best way of ascertaining the mortality rate, the survival rate and the instantaneous mortality rate is based on the real value of mortality resulting from two estimations of abundance of a certain species in the locality in two periods of time. In our country it was Pivnička (1971) who called attention to this fact and determined in this way mortality of the most important fish species living in the valley water reservoir of Klíčava. But in case of a non-recurringly collected crucian carp population from the natural pond Mansfeldova it was not possible to use this method.

Annual mortality rate ( $r$ ) calculations, annual survival rate ( $s$ ) calculations and instantaneous mortality rate ( $\Delta$ ) of crucian carps from this natural pond are summarised in table 6. In addition to summary results for both sexes also the results obtained separately for males and females are given in this table.

For calculations of mortality and survival use has been made of methods described by Rounsefell and Everhart (1953) as well as by Ricker (1958). Calculations can be made according to this method only in case the abundance in age groups going one after the other shows a falling trend. It was for this reason that the mortality calculation concerning crucian carps from the natural pond Mansfeldova was carried out starting only with the age group II and in case of females even only with age group III.

Small number of individuals in age groups I and above all age group 0 testify to the fact that after the poisoning of the natural pond, particularly crucian carps of smallest dimensions escaped attention during the collection of material. After all that also follows from statements of Oliva (1955a) about the number of crucian carps found after the natural pond had been poisoned. This fact may partially have influenced also the value of the annual mortality rate, between the age groups II and III that is very low. Obviously a part of the smallest fish specimens belonging to the age group II has not been collected at all after the poisoning of the natural pond. Of course here the low value of the annual mortality rate can be influenced too by an eventual different abundance of these two year's groups of crucian carps



going one immediately after the other. Between the age groups III and IV, as well as IV and V a high annual mortality rate has been found. But on the whole it is in good agreement with statements of Oliva (l. c.) about the abundance of crucian carps in the natural pond Mansfeldova during the year 1953 that according to their standard lengths at the time of capture most probably belonged to these age groups.

Table 6. Age composition, survival(s) and mortality (r,  $\Delta$ ) rate of the population of crucian carp. Results in parenthesis calculated by the method of Jackson.

Age group	0	I	II	III	IV	V	Sum	Sex	
N	19	106	212	181	14	1	533	♀ + the sex not fixed	
%	3.6	19.9	39.8	33.9	2.6	0.2	100		
s	—	—	0.854	0.077	0.071	—	0.167 (0.482)		
$\Delta$	—	—	0.16	2.56	2.64	—	1.14 (0.73)		
r	—	—	0.146	0.923	0.929	—	0.833 (0.518)		
N	—	4	128	92	2	—	226		♂
%	—	1.8	56.6	40.7	0.9	—	100		
s	—	—	0.719	0.022	—	—	0.125 (0.427)		
$\Delta$	—	—	0.33	3.83	—	—	1.26 (0.85)		
r	—	—	0.281	0.978	—	—	0.875 (0.573)		
N	—	2	75	89	12	1	179	♀	
%	—	1.1	41.9	49.7	6.7	0.6	100		
s	—	—	—	0.135	0.083	—	0.106 (0.129)		
$\Delta$	—	—	—	2.00	2.48	—	2.24 (2.05)		
r	—	—	—	0.865	0.917	—	0.894 (0.871)		

The total annual survival rate was calculated by the method described by Rounsefell and Everhart (1953) that is based upon geometrical means of all older and corresponding younger age groups and for comparison's sake by Jackson's method too, presented by Ricker (1958) that starts from arithmetical means of the said relations. Considerable differences have been found between the results concerning the total annual survival rate that had been obtained by these two methods and consequently at the same time also between the values of total annual mortality rate and instantaneous mortality rate found out on the basis of the said total annual survival rate. Differences in calculations of the total annual survival rate when both above mentioned are used, are caused by a different character of the geometrical and arithmetical mean, as that had been pointed out by Pivnička (1971).



The later states it is more suitable to apply the method of Rounsefell and Everhart (l. c.) for these calculations, especially in case the annual survival rates between separate age groups fluctuate considerably, which can be observed even in the dwarf form of crucian carp from the natural pond Mansfeldova.

On the whole, one can say that the mortality of crucian carp in the natural pond Mansfeldova, while due regard to all possible defects of methods that had been used has been paid, is rather high. By Rounsefell's and Everhart's method the total annual mortality rate has been found to be 0.833, while calculated by Jackson's method it amounted to 0.518. In view of a considerable difference in these results and with respect to the fact that the number of fish specimens in the age group II, used for this purpose, had been evidently fairly influenced by an insufficient collection of fishes of the smallest body-sizes, the calculation of the total survival rate, of the mortality rate and of the instantaneous mortality rate has been carried out separately for fishes of age groups III—V as well and that by the method of Rounsefell and Everhart. The total annual mortality rate ascertained in this way was even higher — 0.926, the total annual survival rate reached up only to 0.074 and the instantaneous mortality to 2.6. It follows from these differences between the results that in practice, while correcting the estimates of abundance by mortality values, one must proceed with the greatest care and in evaluating the statements of different authors it is absolutely necessary to make a sensible differentiation as to the method by which the mortality values had been calculated.

#### SUMMARY

1. In material of 533 specimens of dwarf form crucian carps — *Carassius carassius* (L.) morpha *humilis* Heckel, 1840 from the natural pond Mansfeldova in central Elbe basin the length- and weight growth was watched and the values of annual mortality rate, of annual survival rate as well as of instantaneous mortality rate have been determined.

2. The growth rate of crucian carp in the natural pond Mansfeldova has been found to be low. In comparison with other localities of the central Elbe basin it is clearly slower than the growth rate of the same species in the natural pond Černá and slightly higher than in the natural pond Karasí. The growth of males is slightly slower than the growth of females.

3. The cause of the slow growth of crucian carp on the natural pond Mansfeldova is its strong overpopulating which is due to the fact that predatory fish species are entirely missing in this natural pond.

4. Mortality of crucian carp in the natural pond Mansfeldova is fairly high. The annual mortality rate has been found amounting to 0.833 by the method of Rounsefell and Everhart and to 0.518 by the method of Jackson.

5. Considerable differences have been found between the results concerning the total annual survival rate determined by methods of Rounsefell and Everhart as well as of Jackson. Similar differences have been found too between the values of the total annual mortality rate and instantaneous mortality rate determined on the basis of the value of the total annual survival rate.

6. In case of the crucian carps from the natural pond Mansfeldova the method of Rounsefell and Everhart is a more suitable way of determining the total annual survival rate.

#### Acknowledgement

Author is very much indebted to Assist. Professor Dr. O. Oliva CSc., and Dr. S. Frank CSc., for many valuable informations about problems of research work in the central Elbe basin in years 1950–1958. Thanks are also due to Dr. K. Pivnička for valuable suggestion with regard to calculations of mortality.

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## CHILOPODA VON BELANSKÉ TATRY UND SPIŠSKÁ MAGURA

LUDĚK J. DOBRORUKA

Eingegangen am 18. Mai 1971

Abstrakt: Es wird eine Übersicht der Chilopoden von Belanské Tatry und Spišská Magura (auf den älteren Karten Béler Kalkalpen und Szepes Magura), Slovakia borealis, gegeben. Zwei Arten sind als neu beschrieben: *Lithobius magurensis* n. sp. und *Monotarsobius homolaci* n. sp.; die Art *Lithobius peggauensis* Verhoeff, 1937 ist als neu für die Fauna ČSSR gemeldet.

Vorliegende Arbeit bringt die Ergebnisse der Bearbeitung eines umfangreichen Chilopoden-Materials (350 Exemplare, davon 307 bestimmbar), das ich von meinem Freund Ing. M. E. Homoláč erhielt. Das Material wurde während einer Exkursion vom 1. bis 19. September 1959 auf 11 Lokalitäten erbeutet. Ich sage meinem Freund Ing. Homoláč meinen herzlichsten Dank aus.

### I. BESCHREIBUNG NEUER FORMEN

#### *Lithobius magurensis* n. sp.

Derivatio nominis: Der Name ist nach dem Fundort — Spišská Magura — gewählt.

Locus typicus: Spišská Magura (Slovakia borealis), September 1959, Homoláč legit.

Holotypus: 1 ♂ (Abb. 1) in der Kollektion des National-Museums Prag

Paratypus: 1 ♀ in derselben Kollektion

Weiteres Material: 6 ♂♂ und 7 ♀♀.

Diagnosis: Tergite ohne Fortsätze, Endklaue einfach, 15. Beinpaar des ♂: Femur mit einer Furche, Tibia abgeplattet, manchmal mit Endgrübchen. 14. Beinpaar des ♂: Femur mit einer Furche, Tibia mit bewimpertem Hügel.

Descriptio: Länge 11—12 mm, Ozellen 11—12, Antennen mit 43 Gliedern, Kieferfüsse mit 2+2 Zähnen, Porodont lang. Ventropräfemuralstachel beginnt am 1. bis 3. Beinpaar. Koxen ohne Lateralstachel. Endklaue einfach. Alle Tergite ohne Fortsätze, Koxalporen 3343. 15. Beinpaar dorsal 10210, ventral 01331, beim ♂ mit einer Furche, Tibia abgeplattet, manchmal mit einem Endgrübchen. 14. Beinpaar dorsal 101-20-10, ventral 01332, beim ♂ Femur mit einer Furche, Tibia dorso-medial mit bewimpertem Hügel. Weibliche Gonopoden: 2+2 Spornen zweimal länger als breit, Gonopodenklaue lang, zweispitzig. Das 2. Gonopodenglied dorsal mit 4 langen Stachelborsten. Farbe dunkelbraun, bei einigen Exemplaren Tergite etwas heller.

Discussion: Diese Art erinnert etwas auf *Lithobius muticus* C. Koch, hauptsächlich durch das Vorkommen eines bewimperten Hügels auf der Tibia des 14. Beinpaares beim ♂. Sie unterscheidet sich aber deutlich durch die Zierden auf den Endbeinen, die bei *L. muticus* furchenlos und ohne sonstige Auszeichnung sind. Das ♀ unterscheidet sich hauptsächlich durch die Gonopodenklaue, die bei der neuen Art immer zweispitzig ist.

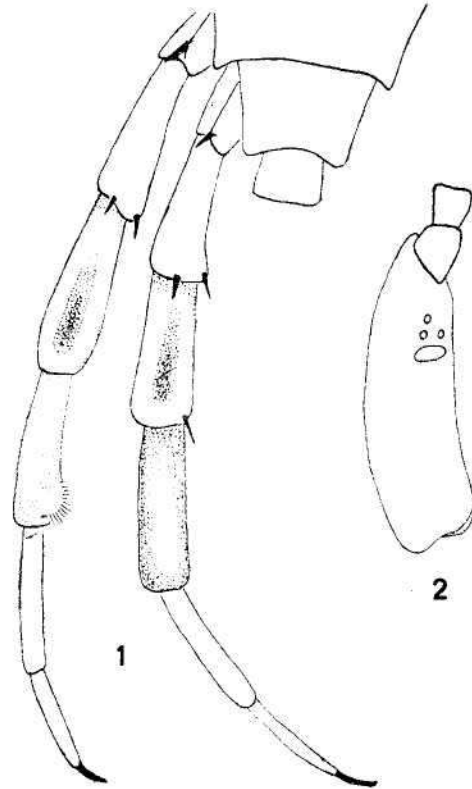


Abb. 1 — *Lithobius magurensis* n. sp. Beine des 14. und 15. Beinpaares beim ♂.  
Abb. 2 — *Monotarsobius homolaci* n. sp. Anordnung der Ozellen.

*Monotarsobius homolaci* n. sp.

Derivatio nominis: Die neue Art widme ich dem Sammler, Herrn Ing. M. E. Homoláč.

Locus typicus: Spišská Magura (Slovakia borealis), 1100—1200 Seehöhe, Gesiebe aus dem Buchenlaub, September 1959, Homoláč legit.

Holotypus: 1 ♂ (Abb. 2) in der Kollektion des National-Museums Prag.

Paratypus: 1 ♀ in derselben Kollektion.

Weiteres Material: 22 ♂♂ und 15 ♀♀.

Diagnosis: Ozellen 2—4, Antennen mit 28 bis 35 Glieder. Schleppfüsse ohne jede Struktur, Endbeinprä femur dorsal mit 2 Stacheln, ventral mit 2 Stacheln. Endklaue doppelt.

Descriptio: Länge. 7—10 mm, Antennen 28 bis 35 gliederig, Ozellen 2—4, sehr undeutlich. Koxosternum der Kieferfüsse mit 2+2 Zähnen, Porodont nicht verdickt. Das 1.

Beinpaar dorsal 000, ventral 000-1, 15. Beinpaar dorsal 00200, ventral 01210. Endklaue doppelt. Endbeine beim ♂ ohne jede Struktur. Gonopoden des ♀ mit 2+2 Spornen (ausnahmsweise beim 1 ♀ 3+3 Spornen), Gonopodenklaue kurz, stumpf dreizackig. Koxalporen 4444 oder 3333. Farbe rostbraun, Kieferfüsse, Distalend der Antennen und Beine gelb.

Discussio: Die neue Art ist dem *Monotarsobius gridellii* Manfredi, 1955 aus Italien am nächsten, wahrscheinlich auch dem *Monotarsobius heroni* (Negrea, 1965). Von beiden unterscheidet sie sich deutlich durch die Bestachelung des 1. und des 15. Beinpaares.

Anmerkung: 1 ♂ dieser Art wurde von mir am 18. 5. 1961 in Kleinkarpaten (Zochova chata) gesammelt, 1 ♀ erhielt ich vom Dr. Verner aus Bardejov (gesammelt am 10. 6. 1959), ein weiteres Paar vom demselben Sammler aus Ždiar (gesammelt am 22. 9. 1958). Die Art ist also wahrscheinlich in der Slowakei weiter verbreitet.

II. BESCHREIBUNG DER LOKALITÄTEN, NEBST VERZEICHNISS EINZELNER  
CHILOPODEN-FORMEN

Lokalität No. 1: Gebiet zwischen der Strasse von Ždiar nach Javorina und dem Tal des Baches Belá. 950—1050 m Seehöhe. Sammlungen aus den südlichen, mit Fichten bewalderten Abhängen, Durschiebe den Moosen, unter Steinen und unter abgestorbener Baumrinde.

No. 1a: Die Felsen gegen Riglaný-Bach. Mündung in den Belá - Bach. Steile Felsenmassive mit verkümmerten Buchen. Gesiebe.

Lok. No. 1: *Lithobius piceus piceus* Koch, 1862 — 1 ♂, 1 ♀ juv.; *Lithobius mutabilis* Koch, 1862 — 18 ♂♂, 11 ♀♀, 3 ♂♂ juv., 2 ♀♀ juv.; *Monotarsobius homolaci* n. sp. — 1 ♂; *Lithobius* sp. indet. — 4.

Lok. No. 1a: *Lithobius forficatus* Linnaeus, 1758 — 3 ♂♂, 1 ♀; *Lithobius mutabilis* Koch, 1862 — 2 ♂♂, 8 ♀♀; *Lithobius lucifugus lucifugus* L. Koch, 1862 — 1 ♂; *Lithobius magurensis* n. sp. — 2 ♀♀; *Lithobius tatricus tatricus* Dobroruka, 1958 — 1 ♀; *Monotarsobius homolaci* n. sp. — 2 ♂♂; *Lithobius* sp. indet. — 4; *Strigamia acuminata acuminata* Leach, 1814 — 2 ♂♂, 2 ♀♀; *Strigamia crassipes crassipes* C. Koch, 1835 — 1 ♂.

Lokalität No. 2: Tal des Belá-Baches und den Nebenbächen. 900—1000 m. Seehöhe. Gesiebe aus Moosen und unter Steinen.

*Lithobius mutabilis* L. Koch, 1862 — 4 ♂♂, 3 ♀♀; *Lithobius erythrocephalus silaesiacus* Folkmanová, 1954 — 2 ♂♂; *Lithobius* sp. indet. — 2; *Strigamia acuminata* Leach, 1814 — 1 ♂ (Übergangsform zwischen Subspezies *pachypus* und *acuminata*).

Lokalität No. 3: Talende des Riglaný-Baches, 1200—1300 m Seehöhe, westliche und nördliche Exposition. Gesiebe aus dem Ahorn-Laub, Moos, Knieholz und faulenden Farnen. Steiniger Boden. Obere Waldzone.

*Lithobius piceus* Koch, 1862 — 1 ♀; *Lithobius mutabilis* L. Koch, 1862 — 5 ♂♂, 4 ♀♀; *Monotarsobius homolaci* n. sp. — 3 ♂♂, 3 ♀♀; *Lithobius* sp. indet. — 5; *Strigamia acuminata acuminata* Leach, 1814 — 1 ♂, 1 adol.; *Strigamia pusilla perkeo* (Verhoeff, 1935) — 1 ♀.

Lokalität No. 4: Anfang des Tales zwischen Havran und Vidla, 1200—1300 m. Seehöhe. Weitere Angaben wie bei No. 3.

*Lithobius mutabilis* L. Koch, 1862 — 5 ♂♂, 1 ♀; *Lithobius magurensis* n. sp. — 1 ♂, 1 ♀; *Monotarsobius homolaci* n. sp. — 2 ♂♂; *Lithobius* sp. indet. — 5; *Strigamia acuminata acuminata* Leach, 1814 — 2 ♂♂, 1 ♀.

Lokalität No. 5: Spišská Magura, 1100—1200 m Seehöhe. Gesiebe des Buchenlaubes.

*Lithobius mutabilis* L. Koch, 1862 — 1 ♂, 1 ♀; *Monotarsobius homolaci* n. sp. — 1 ♂; *Lithobius* sp. indet. — 2.

Lokalität No. 6: Tal zu Široké pole, 1500—1600 m Seehöhe, Gesiebe des Ahorn-Laubes und unter Knieholz, Übergangszone des Waldes und des Knieholzes.

*Lithobius mutabilis* L. Koch, 1862 — 7 ♂♂, 5 ♀♀; *Lithobius lucifugus lucifugus* L. Koch, 1862 — 1 ♂; *Monotarsobius homolaci* n. sp. — 3 ♂♂, 5 ♀♀; *Monotarsobius microps microps* Meinert, 1868 — 1 ♂, 1 ♀; *Lithobiidae* indet. — 4; *Cryptops parisi intermedia* Folkmanová, 1954 — 1 ♂.

Lokalität No. 7: Talbecken zwischen Vidla und Havran auf dem östlichen Abhang. Gesiebe des Knieholz-Humuses, 1500—1600 m Seehöhe.

No. 7a: Gesiebe im Fichtenurwald, Moose, Ahorn-Laube. 1260 m Seehöhe.

Lok. No. 7: *Lithobius pelidnus* Haase, 1880 — 1 ♀ (Übergangsform zwischen Subspezies *pelidnus* und *insubricus*); *Lithobius mutabilis* L. Koch, 1862 — 2 ♀♀; *Monotarsobius homolaci* n. sp. — 2 ♂♂, 1 ♀, 1 ♀ juv.; *Lithobius* sp. indet. — 2.

Lok. No. 7a: *Lithobius mutabilis* L. Koch, 1862 — 1 ♀; *Monotarsobius homolaci* n. sp. — 2 ♂♂; *Lithobius* sp. indet. — 2.

Lokalität No. 8: Spišská Magura, Urwald mit Buchen, Fichten und Tannen (2-6-2), dicht mit *Oxalis acetosella* bewachsen, Anflug, östlicher Hang des Tales, feucht.

No. 8a: westlicher Hang des Tales, mehr trocken, Buchenbestand grösser (8-1-1).

Lok. No. 8: *Lithobius forficatus* Linnaeus, 1788 — 2 ♂♂; *Lithobius cyrtopus* Latzel, 1880 — 2 ♂♂, 1 ♀; *Lithobius pelidnus* Haase, 1880 — 1 ♀; *Lithobius mutabilis* L. Koch, 1862 — 16 ♂♂, 18 ♀♀ (ein ♀ mit 3+3 Gonopodenspornen); *Lithobius magurensis* n. sp. — 5 ♂♂, 3 ♀♀; *Lithobius erythrocephalus silesiacus* Folkmanová, 1954 — 1 ♂; *Lithobius lapidicola* cf. *stammeri* Verhoeff, 1939 — 1 ♂; *Monotarsobius homolaci* n. sp. — 6 ♂♂, 6 ♀♀; *Monotarsobius microps microps* Meinert, 1868 — 3 ♂♂, 1 ♀; *Strigamia acuminata acuminata* Leach, 1814 — 3 ♂♂, 1 ♀; *Strigamia pusilla perkeo* (Verhoeff, 1935) — 2 ♂♂, 2 ♀♀; *Geophilus insculptus rhenanus* Verhoeff, 1938 — 1 ♀.

Lok. No. 8a: *Lithobius forficatus* Linnaeus, 1788 — 1 ♂; *Lithobius mutabilis* L. Koch, 1862 — 5 ♂♂, 1 ♀; *Lithobius peggauensis* Verhoeff, 1937 — 2 ♂♂ (neu für das Gebiet der Tschechoslowakei, bisher zweiter und nördlichster Fundort); *Lithobius magurensis* n. sp. — 8 ♂♂, 2 ♀♀; *Lithobiidae* indet. — 6; *Cryptops parisi intermedia* Folkmanová, 1954 — 1 ♀; *Strigamia acuminata acuminata* Leach, 1814 — 1 ♂.

Lokalität No. 9: Mankova-Tal, 900–1100 m Seehöhe, Gesiebe des Moores beim Wege.

*Lithobius cyrtopus* Latzel, 1880 — 4 ♂♂, 3 ♀♀; *Lithobius mutabilis* L. Koch, 1862 — 6 ♂♂, 2 ♀♀; *Lithobius magurensis* n. sp. — 1 ♀; *Lithobius erythrocephalus silesiacus* Folkmanová, 1954 — 3 ♂♂, 1 ♀, 1 ♂ juv.; *Lithobiidae* indet. — 4; *Strigamia transsilvancia franconia* (Verhoeff, 1955) — 2 ♂♂, 2 ♀♀; *Strigamia acuminata acuminata* (Leach, 1814) — 1 ♂; *Strigamia pusilla perkeo* (Verhoeff, 1935) — 2 ♂♂; *Geophilus insculptus rhenanus* Verhoeff, 1938 — 1 ♀.

Lokalität No. 10: Tal des Riglany-Baches, Gesiebe aus den Moosen aus dem westlichen Abhang. 1000–1100 m Seehöhe.

*Lithobius forficatus* Linnaeus, 1788 — 1 ♀; *Lithobius piceus piceus* L. Koch, 1862 — 8 ♂♂, 1 ♀, 1 ♂ juv., 2 ♀♀ juv.; *Lithobius muticus* L. Koch, 1862 — 1 ♂; *Lithobius mutabilis*, L. Koch, 1862 — 13 ♂♂, 9 ♀♀; *Lithobius tatricus tatricus* Dobroruka, 1958 — 1 ♀; *Lithobius lucifugus lucifugus* L. Koch, 1862 — 3 ♂♂; *Lithobius erythrocephalus silesiacus* Folkmanová, 1954 — 1 ♀ juv.; *Lithobius magurensis* n. sp. — 1 ♂; *Lithobiidae* indet. — 5.

Lokalität No. 11: Südost-Abhang des Ždiarská Vidla — Berges, 1900–1950 m Seehöhe. Gesiebe des Humuses unter Knieholz, feucht.

*Lithobius mutabilis* L. Koch, 1862 — 2 ♀♀; *Monotarsobius homolaci* n. sp. — 1 ♂; *Monotarsobius duboscqui* Brolemann, 1898 — 1 ♀; *Strigamia pusilla perkeo* (Verhoeff, 1935) — 1 ♂, 1 ♀.





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**BEITRAG ZUR KLINISCHEN ANATOMIE DES MITTELOHRS  
VOM MEERSCHWEINCHEN, CAVIA APEREA F. PORCELLUS (LINNÉ, 1766)\***

Jiří DRASTÍK

Eingegangen am 27. Februar 1971

**Abstrakt:** Kurzgefasste Übersicht der Erfahrungen und Erkenntnisse über den anatomischen Bau des Meerschweinchen-Mittelohrs zum Zwecke der klinisch-experimentellen Praxis und mit Hinsicht auf den retroaurikulären Zutritt in die Bulla tympanica.

EINLEITUNG

Das Meerschweinchen ist zur Zeit aus vielen guten Gründen eins der meistbenützten Tiere für otolaryngologisches Experiment jeder Art. Trotzdem die Historie des Versuches am Meerschweinchen sehr reich ist, hat sich bisher niemand mit einer systematischen Studie der Anatomie des Meerschweinchenohres befasst. Auch in sonst umfangreichen Studien der komparativen Anatomie (Schmidt, 1902; Beyer, 1907—1909) finden wir diesbezüglich keine eindeutigen Informationen. Mit eng spezialisierten Fragen befassten sich später Haymann (1913, Bulla ossea), Hillenbrand (1934 Rtg-Diagnostik und Histologie), u.a. Auch im Lehrbuch der Anatomie der Labor-Tiere (Nejedlý, 1965) ist dem Mittelohr des Meerschweinchens keine besondere Stellung gewidmet worden.

Ausser den heute schon klassisch gewordenen otologischen Experimenten am Meerschweinchen (Blau, 1906, 1913; Haymann, 1914; Wittmaack, 1919; Steurer, 1925; Hillenbrand, 1934; Siirala, 1947; Friedmann, 1955) kann man auch bei uns moderne experimentale Schulen zitieren, die mit dem Meerschweinchen laufend arbeiten (ORL-Kliniken in Brno, Hradec Králové, Praha, HNO-Abteilung in České Budějovice) und bisher zahlreiche experimentelle Studien durchgeführt und publiziert haben, doch in keiner von diesen fanden wir Belehrung über die anatomischen Verhältnisse im Meerschweinchen-Mittelohr, die wir für eigene vorgehabte Versuchsarbeit benötigten. Dies war der Anlass, eigene anatomische Studie des Meerschweinchen-Mittelohrs vorzunehmen.

MATERIAL UND METHODEN

Wir führten grosse Anzahl von versuchsweisen Otoskopien auf lebendigen Tieren und nachher makroskopische Sektionen der Meerschweinchen-Mittelohren auf frischen und formalinierten Präparaten durch. Zuletzt präparierten wir die Meerschweinchen-Schläfenbeine unter Vergrösserung (Operationmikroskop Zeiss II.). Im Folgenden führen wir nur jene Ergebnisse

\* Vorgetragen in extenso an der Monatsversammlung der Tschechischen ORL-Gesellschaft in Prag am 4. 2. 1971.

an, deren Betonung wir für erfolgreiche Durchführung der Versuchsarbeit als wichtig betrachten, oder solche, die unseren Befunden nach von denen in der Literatur angegebenen unterschiedlich erscheinen.

#### ERGEBNISSE

Das äussere Ohr des Meerschweinchens besteht aus einer trichterförmigen Ohrmuschel und dem äusseren Gehörgang, der am Trommelfell endet. Der innere Teil der Ohrmuschel ist reich gegliedert, mit einer Anzahl von blind endenden Buchten. Der eigene Gehörgang ist sehr kurz. Die Base der Ohrmuschel (*Eminentia conchae*) scheint direkt in den knöchernen Gehörgang zu übergehen, sodass der knorpelige Gehörgang praktisch fehlt. Die Haut der Ohrmuschel-Innenseite ist reichlich pigmentiert und mit dichtem Haar versehen. Bei allen Tieren beobachteten wir ausdrucksvolle Produktion eines dunkelbraunen bis schwarzen Ohrschmalzes. Der Eingang in den knöchernen Gehörgang ist eng (Durchmesser 2–3 mm, dem Alter des Tieres gemäss).

Das nicht anästhesierte Tier reagiert sehr lebhaft auf die Einführung des Otoskops in die Ohrmuschel. Der Komplex der vorerwähnten Tatsachen macht das Aussuchen des Gehörganges in dem Gewirr der oft mit Cerumen ausgefüllten Falten und Krümmungen und somit auch die Otoskopie allein sehr umständlich. Ein Ohrtrichter für die Meerschweinchen-Otoskopie taugt lediglich bis zum äusseren Durchmesser von 2,5 mm. Ein Ohrspiegel mit grösserem Durchmesser ist unbrauchbar. Im Laufe des Versuches verwendeten wir zu den üblichen Kontrollen des klinischen Befundes ein Otoskop mit eigener elektrischer Beleuchtung vom inneren Spiegeldurchmesser 1,8 bis 2,2 mm. Zum Zwecke jedweder Manipulation im Gehörgang (Cerumen-Beseitigung, Gehörgangsdeseinfektion, Trommelfell-Punktion, Inokulation der Bakterienkultur) mussten die Tiere narkotisiert und die verwendeten Instrumente möglichst minimalisiert werden.

Der Gehörgang wird in seinem knöchernen Teil plötzlich sehr breit, im Abstand von 2 bis 3 mm vom Eingang erreicht er schon das Durchmesser von etwa 8 mm (Abb. 1). Hier inseriert der *Annulus tympanicus*, an den sich das Trommelfell heftet.

Das Trommelfell (Abb. 2) ist fast kreisförmig, mit einem tief eingreifenden zungenartigen Gebilde, dessen Basis am oberen Trommelfellrande das kreisförmige Relief des Trommelfells ergänzt. Dieses Zünglein reicht vom oberen Trommelfellrande bis in die Mitte des Trommelfells. Das Gebilde besteht aus einem feinen, transparenten knöchernen Plättchen, das am oberen Rand des *Annulus tympanicus* mit der oberen Gehörgangswand fest adheriert. Oberhalb dieses Gebildes befindet sich der *Recessus epitympanicus*, in dem die Gehörknöchelchen liegen. Der Hammer, bezw. kaudalwärts gerichteter Fortsatz, der dem *Manubrium* beim Menschen ähnelt, strahlt eine äusserst feine Knochenlamelle in das beschriebene zungenförmige Plättchen aus. Das Trommelfell ist in seiner ganzen Fläche gespannt. Die Existenz eines nicht gespannten Teiles des Trommelfells, der der Schrapnell'schen Membrane (*Pars flaccida tympani*) beim Menschen entspräche, gelang es uns beim Meerschweinchen nicht nachzuweisen.

Bei der Otoskopie sehen wir an der transparenten, perlmutterglänzenden Fläche des Trommelfells ein lichtetes Streifchen, das vom oberen Trommelfellrand bis etwa zu seinem Zentrum reicht. Dieses Streifchen, das auf ersten Blick (*per analogiam*) den Eindruck des *Manubriums* erweckt, wird eben von diesem bereits beschriebenen Knochenplättchen gebildet, das durch feine Knochenlamelle mit dem vertikalen Hammerfortsatz verbunden ist. Dicht unter dem Zentrum der sichtbaren Trommelfellpartie finden wir am gesunden Meerschweinchenohr einen ganz kleinen punktförmigen Reflex



(Abb. 2). Einen dreieckigen Reflex, der dem Reflex beim Menschen ähnlich gestaltet wäre, können wir nur bei sehr schräger, kaudalwärts gerichteter Beleuchtung des Trommelfells beobachten, was am Präparat gut möglich, bei der Otoskopie am lebendigen Tier aber schwer zu erzielen ist.

Die Trommelfelhöhle (in Übereinstimmung mit den Befunden von Friedmann) ist ein einheitlicher Raum, der aus der Haupthöhle und zwei Buchten (Recessus epitympanicus und Recessus posterior) besteht. Weder Scheidewände (Septa) — wie sie Beyer bei den Nagetieren beschreibt — noch deren Anzeichen haben wir beim Meerschweinchen beobachten können. Im Recessus epitympanicus liegt der Schalleitungsapparat, ein Konkretum des Hammers und des Ambosses, und dessen Artikulation mit dem Steigbügel. Der Recessus posterior entspricht dem Antrum mastoideum des Menschen (Haymann, Friedmann).

Die Mittelohrhöhle ist (nach Friedmann) mit flachem Epithel ausgekleidet; nur im vorderen unteren Teil, d.h. in der Umgebung der tympanalen Tuba-Mündung ist das Epithel höher. Die Austrittsstelle des Nervus facialis (Analogie des Foramen stylomastoideum) befindet sich nach Nejedlý (1965) im unteren Teil der lateralen Mittelohrhöhlenwand, dicht unter dem äusseren Gehörgangseingang (Abb. 3). Uns ist jedoch wiederholt nicht gelungen, in dem aus dieser Öffnung herausgeholt Gewebe die Anwesenheit irgendeines neuralen Gewebes histologisch nachzuweisen, immer wieder fanden wir lediglich das Bindegewebe. Demzufolge zweifeln wir daran, dass dies wirklich die Austrittsstelle des Nervus facialis sei.

Die mediale Mittelohrhöhlenwand birgt in ihrem mittleren oberen Teil beide Fenster (Fenestra vestibuli et F. cochleae); in ihrem unteren Teil wölbt sich in die Bulla das Promontorium in Form eines eingehängten Wespennestes vor, das den äusseren Teil der Schnecke (Cochlea) beinhaltet (Abb. 1 und Abb. 5).

Wollen wir — z.B. bei der transtympanalen Inokulation von Bakterien-Kulturen ins Mittelohr — eine Verletzung und direkte Infektion des Innenohrs vermeiden, dann müssen wir bei der Trommelfellpunktion die Nadel in den hinteren unteren Quadranten des sichtbaren Trommelfell-Teiles einführen. Die Nadel muss derart hergerichtet werden, dass sie die Spitze möglichst kurz hat. Mit Hinsicht auf die minimale Dicke aller Bulla-Wände muss die Punktion mit der äussersten Feinheit und ganz ohne Druck auf die Nadel geführt werden, alsbald die Spitze der Nadel das Trommelfell penetriert.

Der Rest der Schnecke und das Labyrinth befindet sich hinter dem mittleren oberen Teil der inneren Bulla-Wand. Die Lokalisation des Vestibulum zeigt die Lage beider Fenster an.

Die Gehörknöchelchen sind äusserst winzig (Abb. 4). Der miteinander verwachsene Hammer und Amboss hat die Form eines kleinen Kammes von 2 Zähnen. Die lange (horizontale) Partie des Konkretums hat eine Durchschnittslänge von 3 mm, beide kurzen Fortsätze messen etwa zu je 0,6 mm. Am Präparat vom jungen Tier lässt sich die Verwachsungslinie gut erkennen. Sie verläuft schräg und bogenförmig vom oberen Rand zwischen dem vorderen und mittleren Drittel kaudalwärts zwischen die beiden kurzen Fortsätze (Abb. 5). An den Präparaten von älteren Tieren weisen wir diese Teilungslinie auch im Operationsmikroskop nicht mehr nach.

Von den beiden vertikalen Fortsätzen ist die Funktion des hinteren unzweifelhaft. Er artikuliert mit dem Steigbügel und entspricht dem langen Ambossfortsatz beim Menschen. Der Vordere lässt durch seine Lage an das

Manubrium mallei beim Menschen denken, durch seine Funktion ähnelt er aber mehr dem langen Hammerfortsatz, zumal er an seiner Spitze mit einem Apparat fixiert ist, der dem Musculus tensor tympani analog scheint und mit dem Trommfell lediglich durch die schon erwähnte feine Knochenlamelle im Kontakt ist. Diese Knochenlamelle ist so fein, dass es uns sogar bei besonders vorsichtiger Präparation nie gelungen ist, ein komplettes isoliertes Präparat zu gewinnen.

Die horizontal gerichtete Hammerpartie entspricht ihrer Funktion nach dem langen Hammerfortsatz beim Menschen nicht. Man kann eher nur von einem prolongierten Hammer-Körper sprechen.

Der Steigbügel besitzt eine ovale Platte von längerem Durchmesser etwa 0,9 mm; das kürzere Durchmesser beträgt 0,4–0,5 mm. Beide Schenkel bilden ein Dreieck ca 0,8 mm hoch.

Die Bewegungen der Gehörknöchelchen können im Operationsmikroskop am Präparat gut beobachtet werden. Trotz winzigen Ausmassen ist jedoch das Herausnehmen der Gehörknöchelchen am frischen Präparat sehr umständlich und die Luxation des Steigbügels praktisch unmöglich. Das ovale Fenster ist nämlich in der Mitte der Zirkumferenz von oben und unten von Knochenfortsätzen (in Abb. 6 gut ersichtlich) eingeengt, die bis in den Raum zwischen die Stapes-Schenkel eingreifen und die Platte im ovalen Fenster zurechthalten. Selbst bei der Benützung feinsten Instrumente und einer recht vorsichtigen Manipulation gelingt es eher die Schenkel zu frakturieren, als den kompletten Steigbügel herauszuheben.

Die hintere Partie der Trommelfell-Höhle kann aus dem retroaurikulären Schnitt nach Abtragung der hinteren Bulla-Wand ohne weiteres überblickt werden. Aus auf diese Weise entstandener Trepanationshöhle kontrollieren wir ohne Schwierigkeiten den Schalleitungsapparat und die beiden Fenster, die für jede experimentelle Manipulation gut zugänglich sind. Die Schnecke liegt hinter der feinen und fragilen medialen Wand des Promontoriums, die in den Mittelohrraum prominert und so auch instrumentell leicht beschädigt werden kann.

Zur Ergänzung des Bildes des Meerschweinchen-Mittelohrs und zur klinischen Orientation über die Lage der einzelnen Mittelohrstrukturen trägt noch die Abb. 7 bei — die Sicht in die Bulla tympanica aus dem klassischen retroaurikulären Zutritt — die die Amboss-Steigbügel-Artikulation und die kochleäre Wulst darbietet.

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

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**ACANTHORHODEUS KRISTINAE SP. N., A NEW BITTERLING (PISCES,  
CYPRINIDAE, ACHEILOGNATHINAE) FROM CHINA**

JURAJ HOLČÍK

Received March 5, 1971

**Abstract:** The new species of bitterling *Acanthorhodeus kristinae* from Szechuan, China is described. It is supposed that this species is highly specialized and shows clear relationship between the genera *Acanthorhodeus* and *Rhodeus*.

Studying a collection of Acheilognathinae fishes from the National Museum of Natural History (USNM) in Washington, USA, I have found two specimens of *Acanthorhodeus*, originally labelled as *Rhodeus sericeus*, which now appear to be a new species.

*Acanthorhodeus kristinae* sp. n.

**Diagnosis:** A small bitterling with hard spines in dorsal and anal fins, minute but well distinguishable barbels and plicated pharyngeal teeth. The lateral line is not fully developed, consists of only 9–13 normally per-

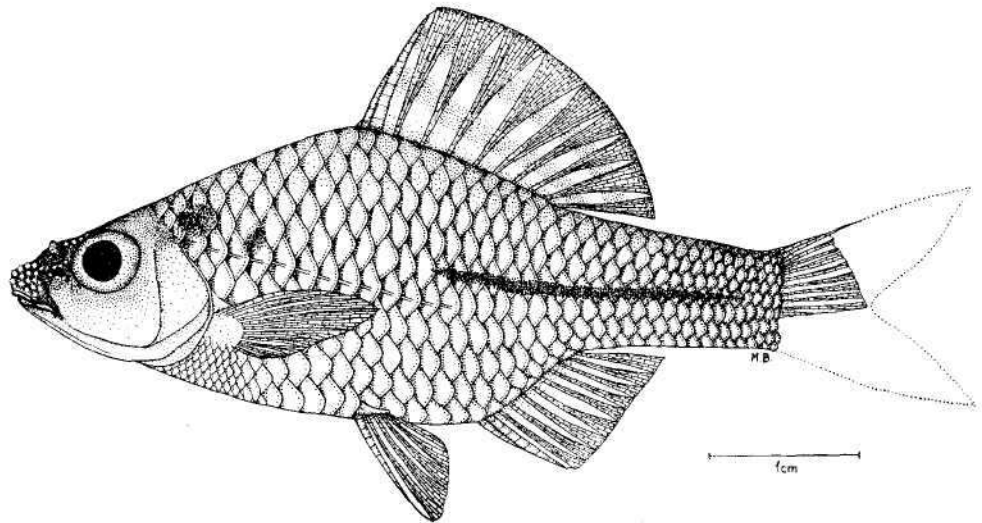


Fig. 1.: *Acanthorhodeus kristinae* sp. n. The holotype, USNM 87600. Note the nuptial tubercles on snout and near the eye as well as the minute barbel.

forated scales. Other scales bear only the traces of lateral line in the form of slightly visible concavity in the scale centre.

Holotype: USNM 87600, male, 47.8 mm in standard length, caught in Szechuan Province, China by D.C. Graham in 1925. Fig. 1, 3, 4.

D III 9, A II 9, lateral line 13 (perforated) + 22 (unperforated), 5 rows of scales above and 4 below the lateral line. Pharyngeal teeth uniserial, deeply plicated with good developed hooks on their tips, 5-5 in formula. The first branchial arch bears 8 short and stout gill rakers. Very little barbel at the angle of mouth, 0.4 % in standard length.

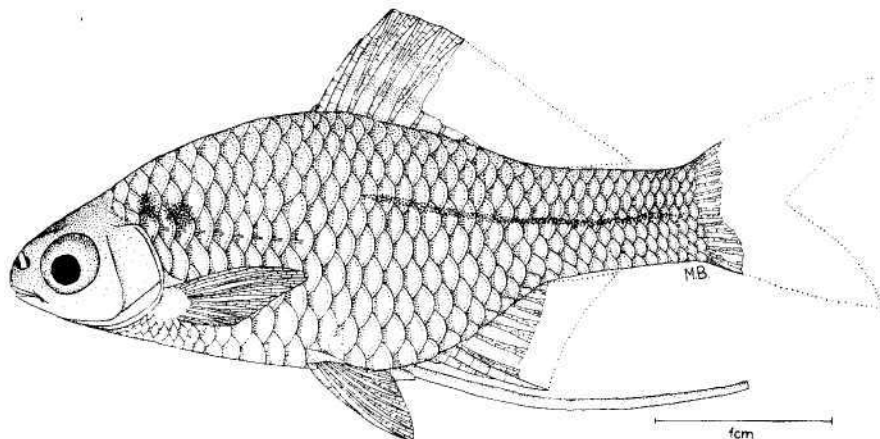


Fig. 2.: Paratype of *Acanthorhodeus kristinae* sp. n., USNM 206045. Female with developed ovipositor.

Scale oval with 23 radii (grooves) which are centripetal and irregularly waved. The relationship of caudal and centrolateral part of scales to the oral one is 2.48 and 2.87 respectively.

Body rhomboidal, prolonged and compressed, rather low. Head conical, with well developed nuptial tubercles on the upper tip of snout in front of eye and on the top of head between eyes.

Measurements (in percent of standard length): head length 25.3, snout length 6.9, barb length 0.4, internasal distance 5.4, diameter of eye 7.5, distance between eyes 8.8, postorbital distance 10.7, head depth 22.0, head width 12.1, predorsal distance 50.1, preventral distance 46.6, preanal distance 62.7, caudal peduncle length 24.7, caudal peduncle depth 17.6, minimal body depth 11.5, body depth 38.4, P-V distance 24.0, V-A distance 15.9, dorsal fin length 26.8, anal fin length 17.1, pectoral fin length 19.7, ventral fin length 17.8, depth of D 20.5, depth of A 14.3. Caudal fin damaged.

Coloration (in alcohol): cinnamon brown. In the centre of body begins the dark "rhodeine" stripe running over the middle of caudal peduncle and ending some 3-4 scales in front of caudal fin base. Behind the head and above the gill cover there are 2 poorly visible dark spots. Caudal, pectoral, pelvic and anal fins pale, dorsal fin bordered by the narrow dark belt. On the dorsal fin there are two wide nearly invisible dark stripes.

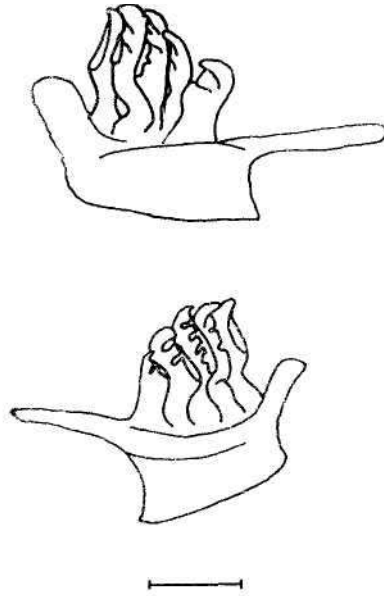


Fig. 3.: Pharyngeal teeth of *Acanthorhodeus kristinae*. Top: teeth of holotype, bottom: those of paratype. Scale = 1 mm.

Paratype: USNM 206045, female, 37.9 mm in standard length, with fully developed ovipositor. Same locality, collector and date of collection. Fig. 2, 3, 4.

D III 9, A III 8, lateral line 9 (perforated) + 25 (unperforated), 6 scales above and 4 below the lateral line. Teeth of the same structure like in holotype. First branchial arch possesses 9 gill rakers. Barbels present, 0.3% in standard length.

Scales of the same type as in holotype, with 22 grooves. Relations of the caudal and centrolateral part to the oral one are 2.50 and 2.60 respectively.

Measurements: head length 25.6, snout length 6.9, internasal distance 5.3, diameter of eye 9.2, distance between eyes

8.7, postorbital distance 10.8, head depth 21.4, head width 12.7, predorsal distance 53.0, preventral distance 48.5, preanal distance 65.2, caudal peduncle length 25.9, caudal peduncle depth 14.5, minimal body depth 12.7, body depth 38.0, P-V distance 24.0, V-A distance 18.5, length of D 23.5, length of A 16.1, length of P 201., length of V 16.9, depth of D 18.8, depth of A 12.7. Caudal, dorsal and anal fin damaged.

Coloration of the same type as in the holotype. The rhodine stripe is very narrow.

Derivation of the name: This new species is named after my wife Kristina in appreciation of her understanding, any help and support in my work.

Remarks: This new species is the only one member of the genus *Acanthorhodeus* which shows the short lateral line (*Acanthorhodeus atremius* from Japan with the short lateral line is now placed in the genus *Rhodeus* — Nakamura 1963, 1969). This character makes it possible to classify it as the highly specialized species in comparison with other members of the genus. This statement is also supported by the very short barbels as well as the short dorsal and anal fins with few rays only. Out of the 13 known species of the genus only *A. omeiensis* Shih et Tchang, 1934 seems to stand closely to *kristinae*, but its very long barbels draw the distinct border between them. The above mentioned characters to which, also the shape of scales and the number and character of scale radii can be added point to the narrow relations of the genus *Acanthorhodeus* with *Rhodeus*. On the other hand some species of the last mentioned genus bear features which show the relationship to the genus *Acanthorhodeus*. They are mainly the slightly serrated teeth of *Rhodeus sinensis* Günther, 1868, high number of dorsal and anal fin rays of *Rhodeus spinalis* Oshima, 1926 as well as the weak spines in dorsal and anal fin in the last species. Also two kinds of hybrids (the only natural hybrids known in this subfamily) originate from crossing of these two genera (*Acan-*

*thorhodeus macropterus* × *Rhodeus sericeus* Holčík, 1963, *A. macropterus tonkinensis* × *Rhodeus spinalis* Holčík, 1971) which also emphasizes the close phylogenetic connection between them. The course of lateral line

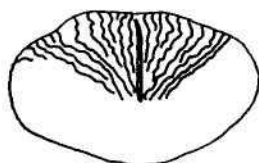
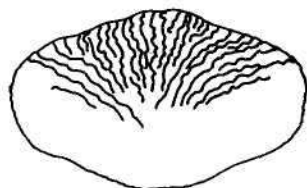
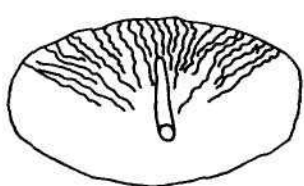


Fig. 4.: Scales of *Acanthorhodeus kristinae* holotype. Top: first scale of lateral line just behind opercle. Normally developed pore is visible. Centre: scale from the body centre above lateral line. Bottom: scale from the body centre behind the lateral line. Only a groove in scale centre is the remnant of lateral line. Scale = 1 mm.

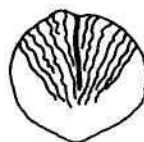
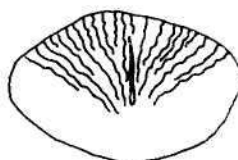
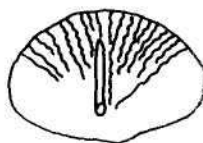


Fig. 5.: Scales of *Acanthorhodeus kristinae* paratype. Top: first scale of lateral line showing the normal pore. Centre and bottom: scales from the body centre and the end of tail respectively, showing the remnants of lateral line. Scale = 1 mm.

in *Acanthorhodeus kristinae* and the structure of poreless scales in posterior part of body obviously show the way of reduction of this organ in the genus *Rhodeus*. This feature and the presence of the very minute barbels and low number of fin rays in D and A — all in excellent agreement with the Dogiel's rule of oligomerisation — outline the possible evolution of this group of bitterling and clearly suggest the origin of the genus *Rhodeus*, the ancestor of which was doubtless the member of the genus *Acanthorhodeus*.

#### Acknowledgement

Mr. Robert H. Gibbs, Curator and Supervisor of Division of Fishes in US National Museum, Washington is greatly acknowledged for the kind loaning of museum's bitterling samples. Mrs. Miriam Baradlai kindly made the fine drawing of type specimens.



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- Holčík, J., 1971: Discovery of the natural hybrid between *Acanthorhodeus macropterus tonkinensis* Vaillant, 1892 and *Rhodeus spinalis* Oshima, 1926 (Pisces, Cyprinidae) from the Hainan Island, China. *American Museum Novitates*. In print.
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**COMPARATIVE STUDY OF HEAD PORES IN THE GENUS  
BOSMINA BAIRD (CRUSTACEA, CLADOCERA)**

VLADIMÍR KOŘÍNEK

Received April 2, 1971

**Abstract:** Within the genus *Bosmina* Baird three types of head pores were found: median, frontal and lateral ones. According to the lateral head pore pattern, three groups of species were classified. Comparing three types of lateral head pore arrangement with the subgeneric classification, the subgenera *Eubosmina* and *Neobosmina* cannot be distinguished. However, several species of the latter subgenus differ from the species of the former in the morphology of males. In the subgenus *Neobosmina*, the synonymy of *Bosmina chilensis* and *B. hagmanni* is not excluded. The validity of the species *Bosmina macrostyla* cannot be discussed because of insufficient material. In the subgenus *Sinobosmina*, the synonymy of *Bosmina fatalis* and *B. praeliariis* is probable. *Bosmina* cf. *japonica* was related to this subgenus. From the material examined, the taxonomic weight of male morphology seems to be apparent.

INTRODUCTION

The previously compact genus *Bosmina* Baird was recently divided by Lieder (1957, 1962) into four subgenera: *Bosmina*, *Eubosmina*, *Neobosmina*, and *Sinobosmina*. He based the subgeneric classification mostly on some differences in the male morphology and on several morphological characters of females. Frey (1959) and Goulden and Frey (1963) have drawn attention to the taxonomic value of head pores in the family Chydoridae and in the genus *Bosmina*. In the latter genus, they have found one pore occurring irregularly in the median line of the head shield and a lateral pore located in the proximity of the antennal articulation or above the mandibular articulation. The patterns of the lateral head pores (LHP) have enabled these authors to differentiate between the species *Bosmina longirostris* (O. F. Müller) and *Bosmina coregoni* Baird. The other species which they examined had the same LHP pattern as *Bosmina coregoni*. Therefore they doubted the validity of Lieder's subgeneric classification. Uéno (1967) described the LHP pattern of *Bosmina* cf. *hagmanni* Stingelin from lake Titicaca, South America, and recently the same author (Uéno, 1968) described the LHP pattern of *Bosmina fatalis* Burckhardt from Japan, different from those described previously.

As the same LHP pattern was found in various species occurring in different geographical regions and the material known till this time has been inadequate, the aim of the present study is to compare the head pore pattern on an ample material and to complete the description of species not well known. Species, the taxonomic position of which has not been clear yet, are

referred according to the name given by the original author. Lieder's subgenera are used as a subsidiary classification.

#### MATERIAL AND METHODS

All material used for this study (unless otherwise indicated) is deposited at Department of Hydrobiology, Charles University, Prague. The slides with the specimens examined are in author's collections. Fourteen species were examined: *Bosmina longirostris*, *B. coregoni*, *B. longispina*, *B. mixta*, *B. crassicornis*, *B. tubicen*, *B. chilensis*, *B. hagmanni*, *B. tenuirostris*, *B. macrostyla*, *B. meridionalis*, *B. fatalis*, *B. praeliaris*, and *B. cf. japonica*.

Preserved specimens were macerated in hot lactic acid or in 20 per cent potassium hydroxid solution. After washing in distilled water, the material was stained in a mixture of chlorazol black E and azophloxin (= lignin pink) in the manner personally recommended by Dr. Hrbáček and eventually mounted in Canada Balsam.

#### RESULTS

##### 1. Lateral head pore

###### *Bosmina (Bosmina) longirostris* (O. F. Müller, 1785)

In all the material studied, the location of the pore approximately agrees with the description given by Goulden and Frey (1963) (Fig. 1: A). However, in different populations the distance between the pore and the anterior margin of the head shield is very variable. The greatest distance was found in some populations from Congo, Zambia, U.S.A. and Mongolia (Fig. 1: B—D). The LHP pattern of the mongolian material resembles that of *Bosmina cf. japonica* Poppe et Richard. The reticulation of the head shield varies from population to population.

###### Material:

Czechoslovakia: Velké Morské Oko Lake, Sept. 1960. Vinné Jezero Pond, Sept. 1960. Pool at Laborec River, Sept. 1960. Slapy Reservoir, May, 1966. Vlasatka Pond, Aug. 1961. Temporary pool at Blatná, Oct. 1968. Kubov Pond, July, 1962. Dářsko Pond, July 1961. Pool at Želnava, Nov. 1964. Bezednice Pool, Apr. 1961. Poltruba Pool, Nov. 1953. Poroházkova Pool, May 1957. Author's collections. Prostřední Pond at Lednice, June, 1948, coll. J. Jírovec.

France: pond at Ecomoy, May, 1963. Pond in Gif sur Yvette, Dec. 1964. Coll. B. Dussart.

Germany: Erdfausse at Hopsten, May, 1964. Coll. W. Hollwedel.

Italy: lake d'Iseo, May, 1967. Lake Varese, May, 1964. Lake Trasimeno, June, 1930. Lake Segrino, Aug. 1967. Tank in Pallanza, July, 1966. Collections of Ist. Ital. d'Idrobiol. Pallanza.

Poland: Wdzydzkie Lake, Aug. 1960. Coll. K. Patalas.

Rumania: lake at Mamaia, July, 1958. Author's collection.

Sweden: N. Djupen, Sept. 1936. Collections of Limnol. Inst. Uppsala.

U.S.S.R.: Bolon lake, Oct. 1933. Collections of Zool. Inst. Acad. Sci., Leningrad.

Canada: Dragon Lake, Aug. 1952. Coll. K. Patalas. Pinehurst Lake, Sept. 1969. Columbia Lake, July, 1969. Laurel Creek Reservoir, Sept. 1969. Coll. Ang Kok Jee. Lake Ontario, June, 1968. Coll. H. C. Fernando. Lake Erie, Oct. 1969. Coll. C. C. Davis.

Cuba: swamps at Tesoro Lake, Feb. 1964. Coll. J. Komárek. Pond in El Dique, Apr. 1965. Coll. Nereida Martinez.

Surinam: Onwewacht swamp, March, 1967. Coll. J. van der Land.

U.S.A.: Bank Lake, June, 1967. Deep Lake, June, 1967. Washington Lake, June, 1967. Coll. M. Straškraba. Gull Lake, Oct. 1966. Coll. J. D. Hall. Auburn Pond, Apr. 1968. Coll. J. Hrbáček. Yellowwood Lake, Sept. 1967. Coll. Indiana University. Estes Lake, Sept. 1961. Coll. K. Patalas.

Congo: N. Ziloi I Lake (= Lualaba Reservoir), June, 1959. Coll. N. Magis. Lake Kampo-lombo, June, 1962. Lake Bangweulu, Dec. 1960. Mwadingusha Reservoir, May, 1966. Lake Shiwa Ngandu, July, 1966. Lake Kangwena, June, 1962. Luapula River, March, 1961. Coll. J. J. Symoens.

Ghana: Volta Lake, Nov. 1966. Coll. T. Petr.

Sudan: White Nil, Feb. 1969. Jebel Aulia Reservoir, Feb. 1969. Blue Nil, Feb. 1969. Coll. B. Fott.

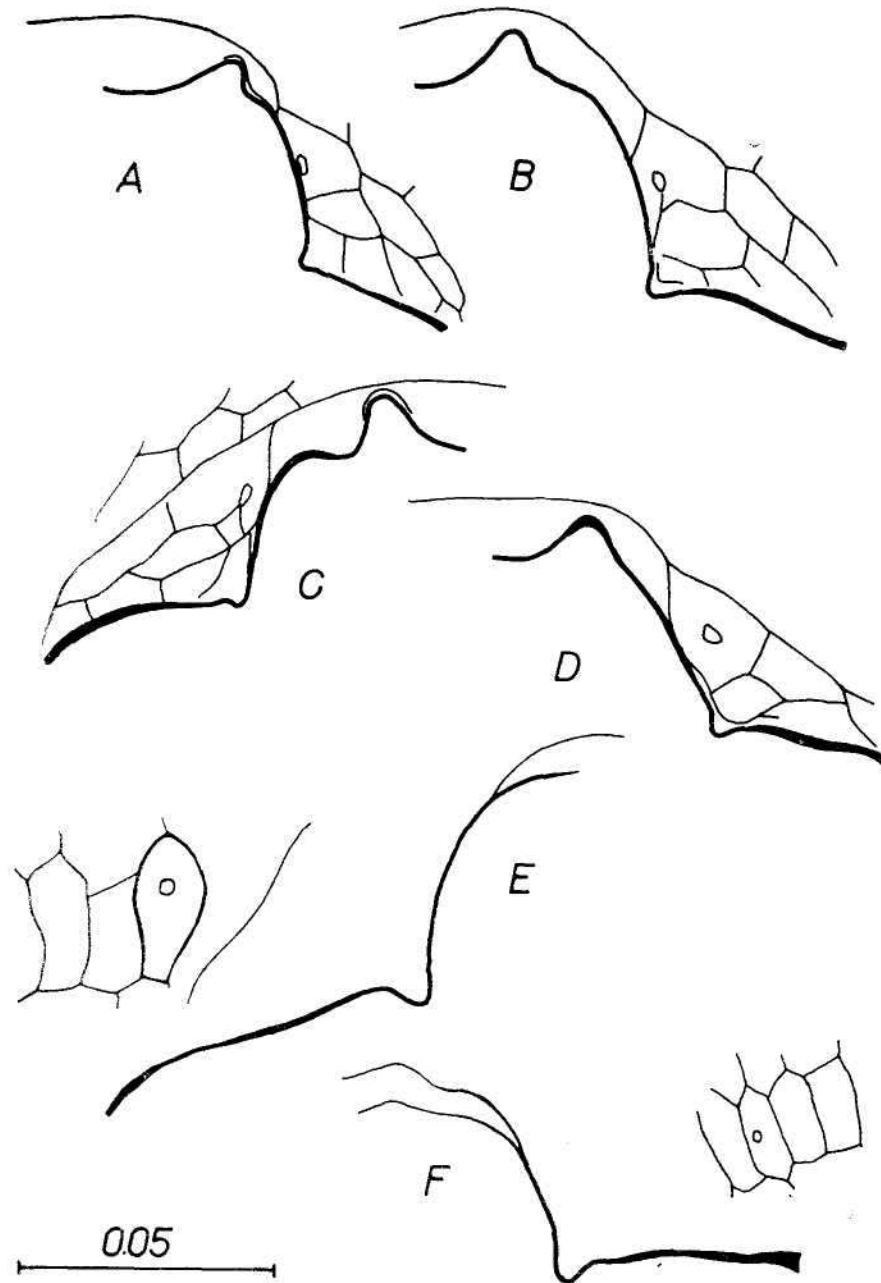


Fig. 1. Lateral head pores: *Bosmina longirostris*, asex. ♀: A — carp pond Kubov, July 1962, Czechoslovakia. B — Gull Lake, Oct. 1966, USA. C — Mwadingusha Reservoir, May 1966, Congo. D — Teliin tsagan, July 1967, Mongolia. *Bosmina coregoni*, asex. ♀: E — ssp. *gibbera*, Lake Marzecino, Aug. 1962, Poland. F — ssp. *coregoni*, Lipno Reservoir, June 1965, Czechoslovakia. (All measures in mm.)

Chad: Lake Chad, Nov. 1965. Coll. B. Dussart.  
Japan: Kyoto, Nr. F. 12746, Sars' coll. Oslo Museum.  
Mongolia: Boir Lake, July, 1965. Ich Nur Lake, Aug. 1967. Teliin Tsagan Lake, July, 1967. Tolbo Lake, Dec. 1967. Atehit Nur Lake, July, 1967. Erkhiiin Golyn Nur Lake, Aug. 1965. Sangiin Dalai Lake, June, 1966. Khar Us Nur Lake, July, 1967. Orog Lake, July, 1967. Khar Nur Lake, July, 1967. Baian Lake, June, 1966. Coll. Ajur Dulma.

*Bosmina (Eubosmina) coregoni* Baird, 1857

The LHP pattern in the material examined is identical with that in the original description (Fig. 1: E, F). No substantial differences were found in populations of various subspecies sensu Lieder (1957). The pear-shaped thickening surrounding the pore was observed, however it is not equally pronounced in all populations. Around the pore, the characteristic reticulation is evident.

Material:

Czechoslovakia: Slapy Reservoir, Aug. 1967. Coll. M. Dvořáková. Lipno Reservoir, June, 1965. Coll. Z. Brandl. Vltava River, Aug. 1956. Coll. V. Kaňkovská. Danube River, Oct. 1966. Coll. M. Vranovský.  
Finland: Simaa Kaukas, Aug. 1956. Saaserjärvi, Aug. 1956. Hormajärvi, Aug. 1956. Coll. J. Hrbáček.  
France: lake Léman, Sept. 1960. Coll. Station Thonon.  
Germany: Wunstorf Steinhuder Meer, Oct. 1968. Coll. W. Hollwedel.  
Poland: Skarlinkie Lake, without date. Krosino Lake, Aug. 1965. Dziakowo Lake, Aug. 1965. Osiek Lake, Sept. 1961. Lubiato Lake, Aug. 1966. Coll. K. Patalas. Gardynskie Lake, Sept. 1961. Coll. J. Lellák.  
Sweden: lake Ekoln, Aug. 1968. Hjälmar Lake, Sept. 1969. Coll. B. Grönberg. Lekrattret, Aug. 1913. Ygden, July, 1940. Nässjöbohussjön, Krist. Iän, July, 1936. Collections of Limnol. Inst., Uppsala.  
U.S.S.R.: Otradnoe Lake at Leningrad, June, 1960. Onega Lake, July, 1966. Coll. Zool. Inst. Acad. Sc., Leningrad. Peipsi Lake, July, 1962. Saadjärv Lake, July, 1969. Coll. A. Mäemets.  
Canada: lake Erie, Oct. 1969. Coll. C. C. Cavis. Lake Ontario, June, 1968. Coll. H. C. Fernando.

*Bosmina (Eubosmina) longispina* Leydig, 1860

The LHP is situated as in the preceding species (Fig. 2: A, B). The reticulation of the carapace around the pore is different in various populations. The northern often brown coloured populations have both the reticulations and the pore more distinct than those in south baltic and alpine regions. The pear-shaped thickening is pronounced only in some populations.

Material:

Austria: Wörther See, Dec. 1958. Lunzer Untersee, Aug. 1959. Ossiachersee, Dec. 1958. Klopenersee, Dec. 1958. Coll. Biol. Stat. Lunz.  
Czechoslovakia: Danube River, May 1967. Coll. M. Vranovský.  
Finland: Pitkäjärvi, Aug. 1956. Hormajärvi, Aug. 1956. Saaserjärvi, Ylä Salusjärvi, Aug. 1956. Coll. J. Hrbáček.  
Italy: lake Mergozzo, July, 1965. Lake Maggiore, June, 1947. Lake Trasimeno, June, 1930. Coll. Ist. Ital. d'Idrobiol., Pallanza.  
Norway: Blankvatn, Oslo, Dec. 1966. Sognsvatn, Oslo, Sept. 1968. Tjermlitjern, Oslo, Sept. 1969. Övre Heimdalsvann, Nov. 1968. Coll. P. Larsson. Korprana, Finnmark, July, 1966. Sperillen, July, 1962. Storetjen, Sept. 1966. Vestefjord, Sept. 1966. Tyrifjord, Sept. 1966. Kröderen, Aug. 1962. Hiltre Island 1966: Rodlivatn, June. Storvatn, July. Havna Langvatn, June. Staurfjellvatn, July. Hifjellvatn, June. Havik Kvornvatn, July. Morkdalsvatn, Aug. Lillevatn, July. Laksvatn, July. Indre Lebergatn, July. Saeter Langvatn, July. Balsnes Langvatn, July. Coll. K. Elgmork.

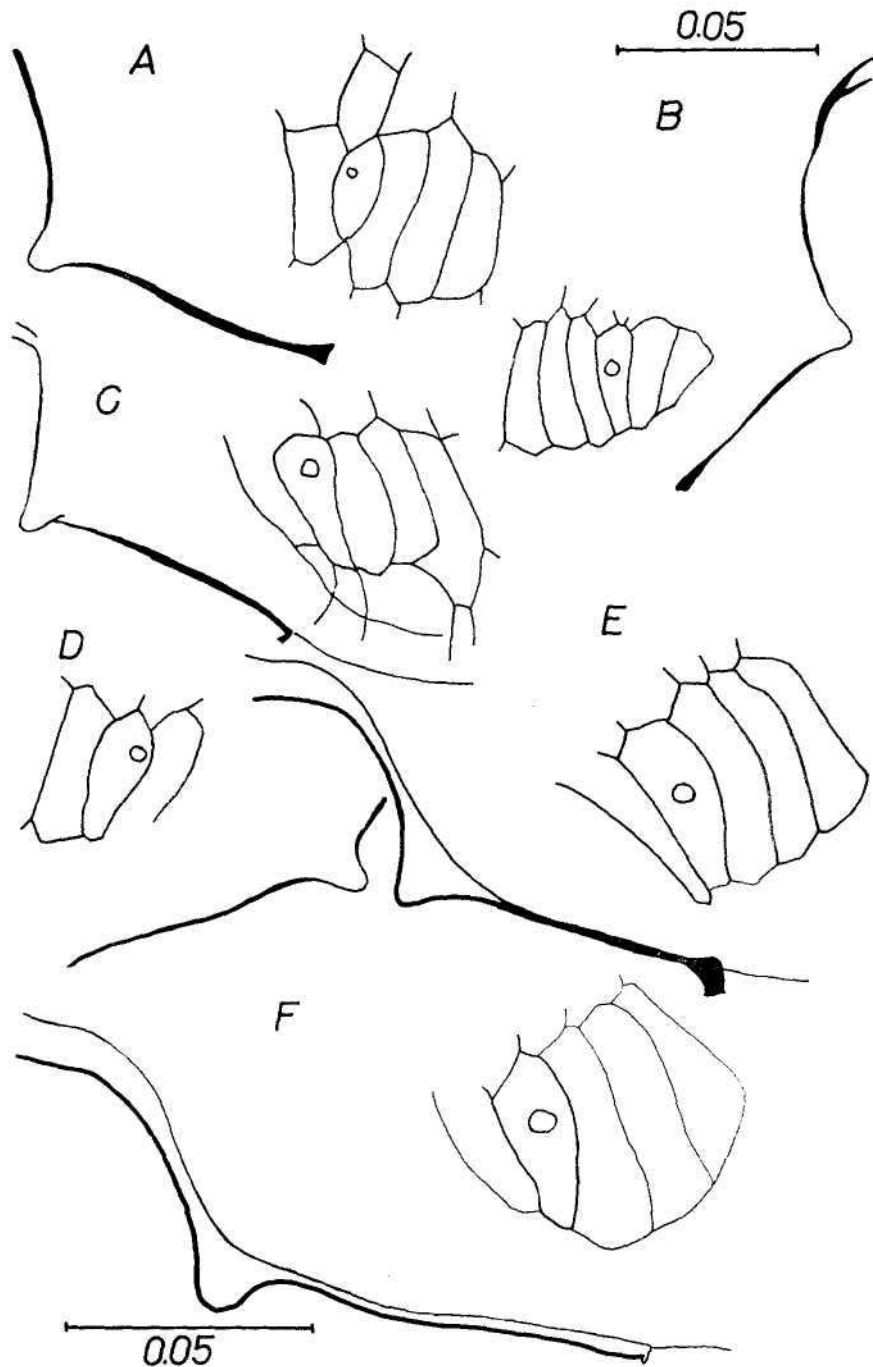


Fig. 2. Lateral head pores: A — *B. longispina*, asex. ♀, Haul Lake, July 1961, Canada. B — *B. longispina*, asex. ♀, Sedra Lulevatten, Aug. 1946, Sweden. C — *B. mixta kessleri*, asex. ♀, Häckstaviken i Rösta, Sept. 1933, Sweden. D — *B. mixta berlinensis*, asex. ♀, Lake Marzeczno, Aug. 1962, Poland. E — *B. mixta longicornis*, asex. ♀, Vedasjön, July 1942, Sweden. F — *B. mixta cederströmi*, asex. ♀, Torserydsjön, Sept. 1937, Sweden.

Sweden: Askö, Sept. 1963. Coll. H. Ackfors. Abiskojaure, Sept. 1963. N. Laksjön, Sept. 1963. Skelingen, Oct. 1965. Coll. S. Holmgrén. Lake Vänern, Sept. 1969. Coll. B. Grönberg. Sedra Lulevatten, Aug. 1946. Small lake at Ritsemjokk Viderag, Aug. 1946. Akkajaure, July, 1946. Kartjejaure, July, 1946. Coll. S. Ekman. Latnjavaggejaure, Lapland, Sept. 1967. Coll. J. Hrbáček. Yngen, Värmland, July, 1936. Askoker, Kronob län, July, 1939. Styrnsjön i Leksand, Aug. 1921. Gläcken, Aug. 1941. Hällsjön, Värmland, Sept. 1933. Tjärn Nr 35 at Abisko, Aug. 1948. Tjärn Nr 62, Abisko, Sept. 1948. Åtran Ålusb län, July, 1935. Nakerjaure, Aug. 1949. Skiringen vid Östano, Nora, July, 1942. Lersjön, Värmland, Aug. 1934. Hemsjön, Örebro län, Aug. 1934. Collections Limnol. Inst., Uppsala.

U.S.S.R.: Soozero, Oct. 1933. Otradnoe Lake, July, 1960. Bolon Lake, Amur region, Oct. 1933. Collections Zool. Institute Acad. Sc., Leningrad. Tänaularu, Estonia, June, 1969. Coll. A. Mäemets.

Canada: Haul Lake, Brit. Columbia, July, 1961. Coll. K. Patalas. Mobile Pond, Newfoundland, Sept. 1969. Coll. C. C. Davis.

Mongolia: Boir Lake, July, 1965. Coll. A. Dulma. Dod Tsagan Nur Lake, July, 1969. Coll. K. Pivnička.

### *Bosmina (Eubosmina) mixta* Lilljeborg, 1900

The LHP pattern is of the "coregoni" type. The reticulation of the head shield is more or less distinct in different subspecies (Fig. 2: C—F). The most remarkable pear-shaped thickening was found in the subspecies *berolinensis*, in which the pore is situated very near to the anterior margin of the thickening.

#### Material:

Italy: Lugano Lake, Dec. 1967. Collections of Instituto Italia no di Idrobiologia, Pallanza.

France: lake Léman, Sept. 1964. Coll. B. Dussart.

Poland: lake Insko, Aug. 1962. Serwinty Lake, Aug. 1961. Marzecino Lake, Aug. 1962. Coll. K. Patalas.

Sweden: Burtsäskrt, Lapland, Sept. 1943. Vedasjön, Nordingra Church, July, 1942. Trehörningen, July, 1942. Bysjön i Skärv, Aug. 1943. Coll. S. Ekman. Torserydsjön, Kronob län, Sept. 1937. Djurmosjön i Leksand, July, 1941. Orosjön, Kronob län, July, 1939. Spaden, Ålusb län, May, 1932. Romingen, Kronob län, Sept. 1937. Ygden, Värmland, July, 1936. Häckstaviken i Rösta, Helsingland, Sept. 1933. Collections of Limnological Inst., Uppsala.

U.S.S.R.: Pügandi Lake, June, 1953. Karijärv Lake, Aug. 1951. Konsu Lake, July, 1954. Peipsi Lake, July, 1962. Kurikumäe Lake, June, 1952. Bay of Petchora river, Barents Sea, without date. Coll. A. Mäemets.

### *Bosmina (Eubosmina) crassicornis* Lilljeborg, 1887

This species has also the coregoni pattern of LHP (Fig. 3: A). The distinct reticulation of the carapace is typical for the species. Consequently the sculpturation around the pore is well pronounced.

#### Material:

Poland: Charzykowo Lake, Aug. 1962. Skanda Lake, Sept. 1964. Insko Lake, Aug. 1962. Dobrowa Wek Lake, Aug. 1962. Mysdlborskie Lake, Aug. 1963. Miedwie Lake, July, 1965. Ustrych Lake, Aug. 1961. Coll. K. Patalas. Sniardwy Lake, Sept. 1961. Coll. J. Lellák.

U.S.S.R.: Vagula Lake, Sept. 1969. Coll. A. Mäemets.

The LHP pattern of males in all species of the subgenera *Bosmina* and *Eubosmina* with the exception of the species *Eubosmina crassicornis* was studied. The LHP is located on the same part of the head shield as in the females (Fig. 3: B, C). The reticulation of the adjoining part of the carapace does not differ from that of the female.

*Bosmina (Neobosmina) tubicen* Brehm, 1953

According to the original description, the antennules conspicuously curved forward are the main specific character. However, this character is very variable in the material examined. In the populations coming from Cuba island, females with short and straight or forward curved antennules occurred in April and May (Fig. 3: D). In the African material from Volta Lake, no such a periodicity was found (Fig. 3: E). The Australian material is unfortunately too limited to allow any definite conclusions to be drawn (Fig. 6: A, D).

Asexual females resemble in general shape of the body the palearctic species *Bosmina longispina* Leydig, namely populations described as *Bosmina obtusirostris* Sars, 1862. This resemblance is so apparent that, probably, many determinations of *Bosmina coregoni* sensu lato from South America may be erroneous. Some characters found in the males, from natural waters and fish ponds in Cuba and from Volta Lake in Ghana, separate the species from the subgenus *Eubosmina*. The male postabdomen is not tapering to its distal part (Fig. 4: B, C; 5: A—D).

The LHP pattern of both sexes is of the coregoni type, but the pore in the males is situated on the border line of two fields of the carapace reticulation (Fig. 4: E). This reticulation is more or less pronounced in various populations (Fig. 4: D, F). In some juvenile individuals, the dorsal serration of the mucro was observed (Fig. 4: F, G). The remains of the serration were observed in adults in some instances. The detailed description of sexual and asexual individuals will be included in future papers: Kořínek V., and Petr T., (in press), Kořínek V., and Hrbáček J., (in press).

Material:

Chile: Pichilafquén Lake, Nov. 1953. Coll. K. Thomasson.

Cuba: El Dique — fish ponds. Canals in Zapata. Lakes: Tesoro, Ariguanabo, Sabanilla, La Luisa, Santa Barbara, Alcatraz Grande, Algodonal. Reservoirs: Pontezuela, and Ochoita. Samples from various dates taken during years 1964 to 1966. Coll. members of Acad. of Sciences, Cuba and Hydrobiological Laboratory, Czechoslovak Acad. of Sc., Prague.

U.S.A.: Canal Zone: Gatun Lake, Sept. 1967. Coll. M. Zaret.

Ghana: Volta Lake, samples taken from various places during years 1964 to 1968. Coll. T. Petr.

Australia: Mardí Dam, N.S. Wales, Dec. 1968. Beo Hive Dam, Queensland, Aug. 1967. Coll. B. Timms. Woronora Dam, N.S. Wales, March, 1965. Coll. V. H. Jolly.

*Bosmina (Neobosmina) chilensis* Daday, 1902

It has not been possible to distinguish definitely this species from *Bosmina hagmanni* Stingelin. The dorsal serration which is the main specific character of the latter species, occurs in immature individuals also in the species *chilensis* as well as in species *Bosmina tubicen*, *B. meridionalis* and *B. macrostyla*. Daday (1902) mentioned another character of *Bosmina chilensis*: two rows of denticles, one on the cylindrical process of the postabdomen and the second on the postabdominal claws. The study of Daday's type material showed, that the individual used for drawing was in the premoult condition. Therefore, the new formed cuticula was observed in the postabdomen.

In our material, the dorsal serration of the mucro was found in some very young individuals (Fig. 6: B). The LHP pattern is of the coregoni type (Fig. 7: B). The reticulation of the adjoining part of the head shield is not



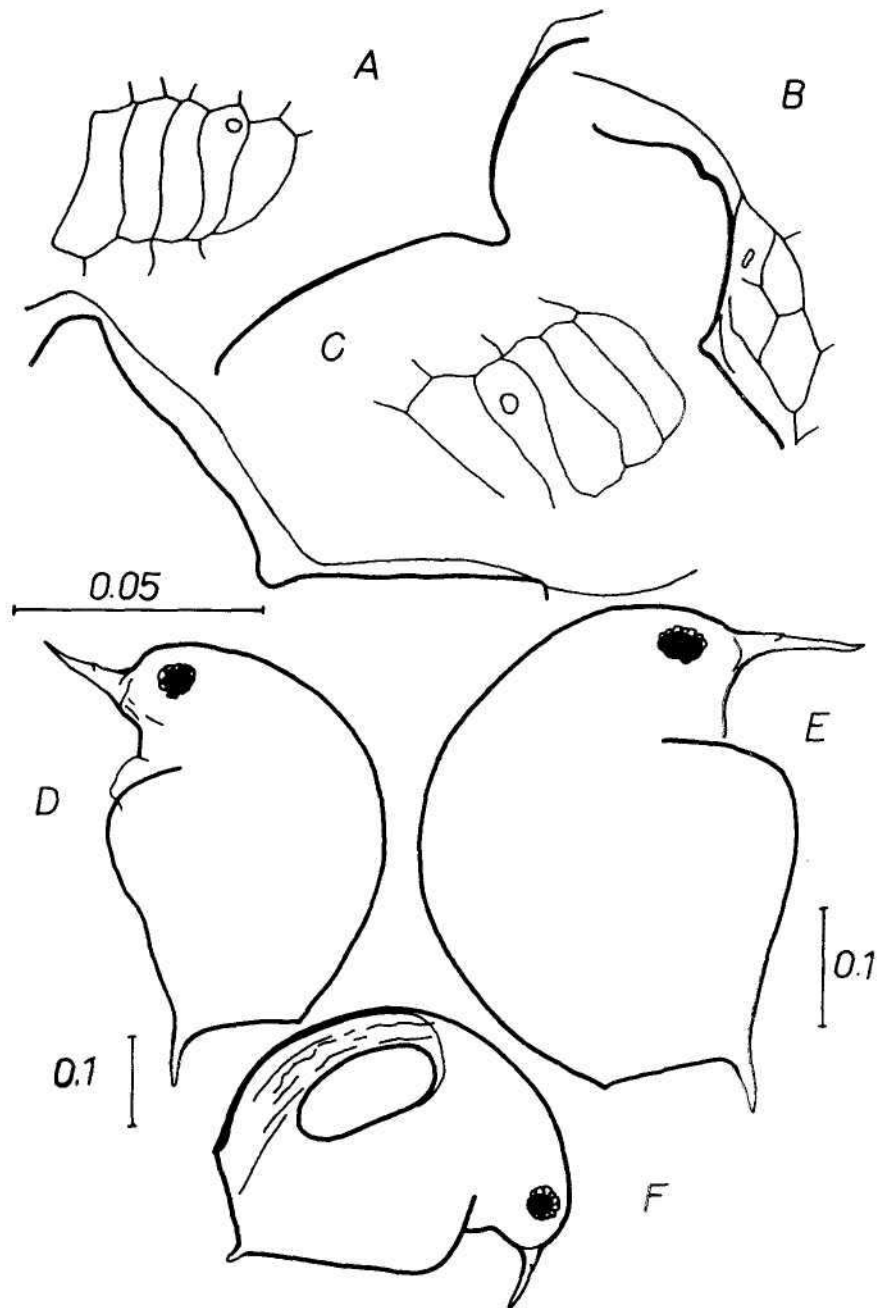


Fig. 3. Lateral head pores: A — *B. crassicornis*, asex. ♀, Dobrowa Wek, Aug. 1962, Poland. B — *B. longirostris* ♂, carp pond Kubov, July 1962, Czechoslovakia. C — *B. longispina* ♂, tjärn, Sept. 1951, Sweden. D — *B. tubicen*, asex. ♀, St. Barbara, Apr. 1966, Cuba. E — *B. tubicen*, asex. ♀, Volta Lake, Aug. 1968, Ghana. F — *B. tubicen*, sex. ♀, fish pond in El Dique, March 1966, Cuba.

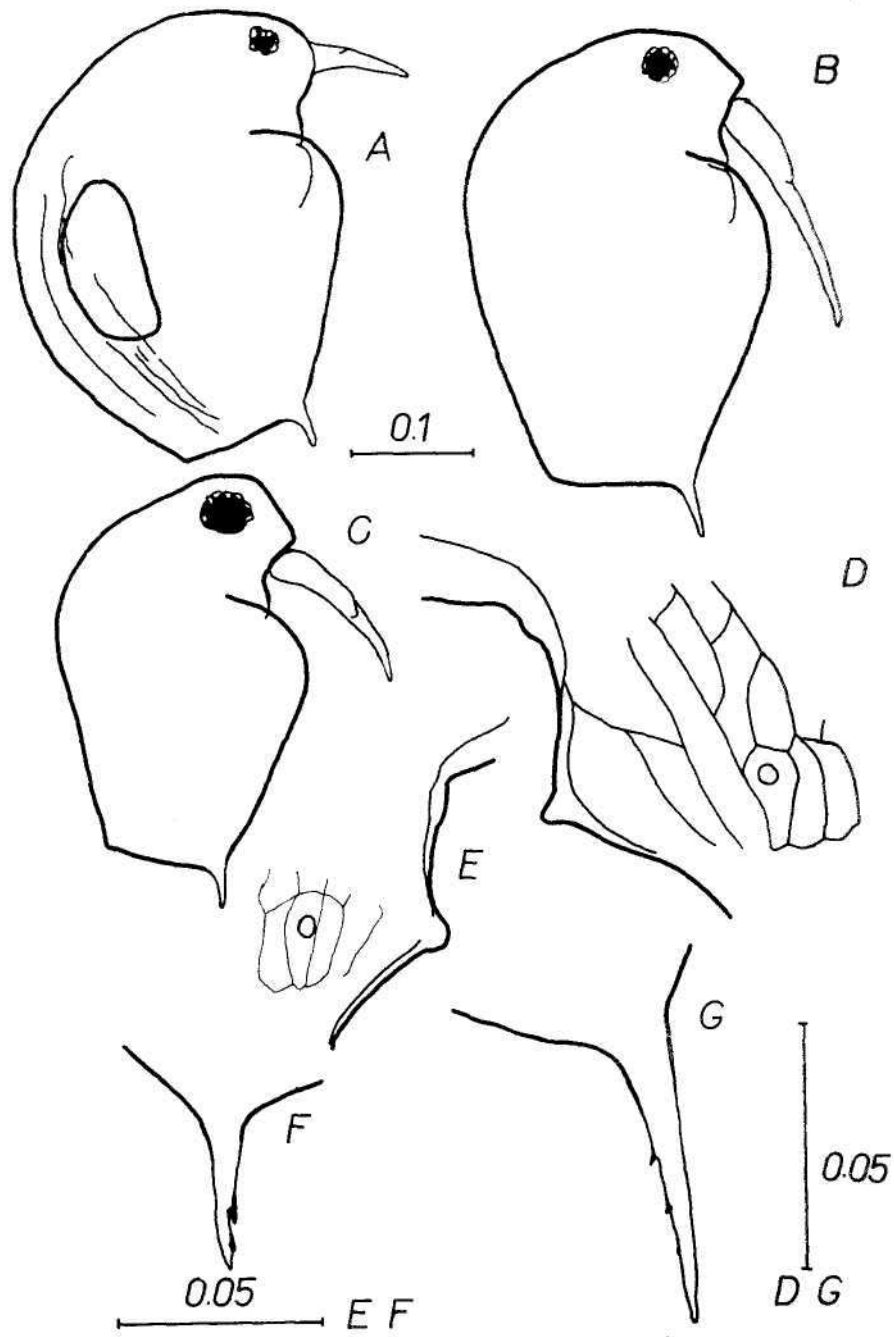


Fig. 4. *Bosmina tubicen*: A — sex. ♀, Volta Lake, July 1968, Ghana. B — ♂, Volta Lake, Nov. 1964, Ghana. C — ♂, Laguna del Tesoro, May 1966, Cuba. D — LHP ♀, Laguna St. Barbara, Apr. 1966, Cuba. E — LHP ♀, Volta Lake, Sept. 1964, Ghana. F — mucro of immature specimen, Volta Lake, July 1968, Ghana. G — mucro of immature specimen, Laguna Sabanilla, Oct. 1965, Cuba.

distinct. The eye is smaller than that of *Bosmina tubicen*. Males have not been described yet.

Material:

Chile: Lago di Villarica, March 31, 1899. Coll. F. Silvestri. Hungarian Natural History Museum, Budapest. Type material Nr. 1204/1901. Lago di Villarica, Dec. 2, 1953. Lake Calafquén, Dec. 6, 1953. Coll. K. Thomasson.

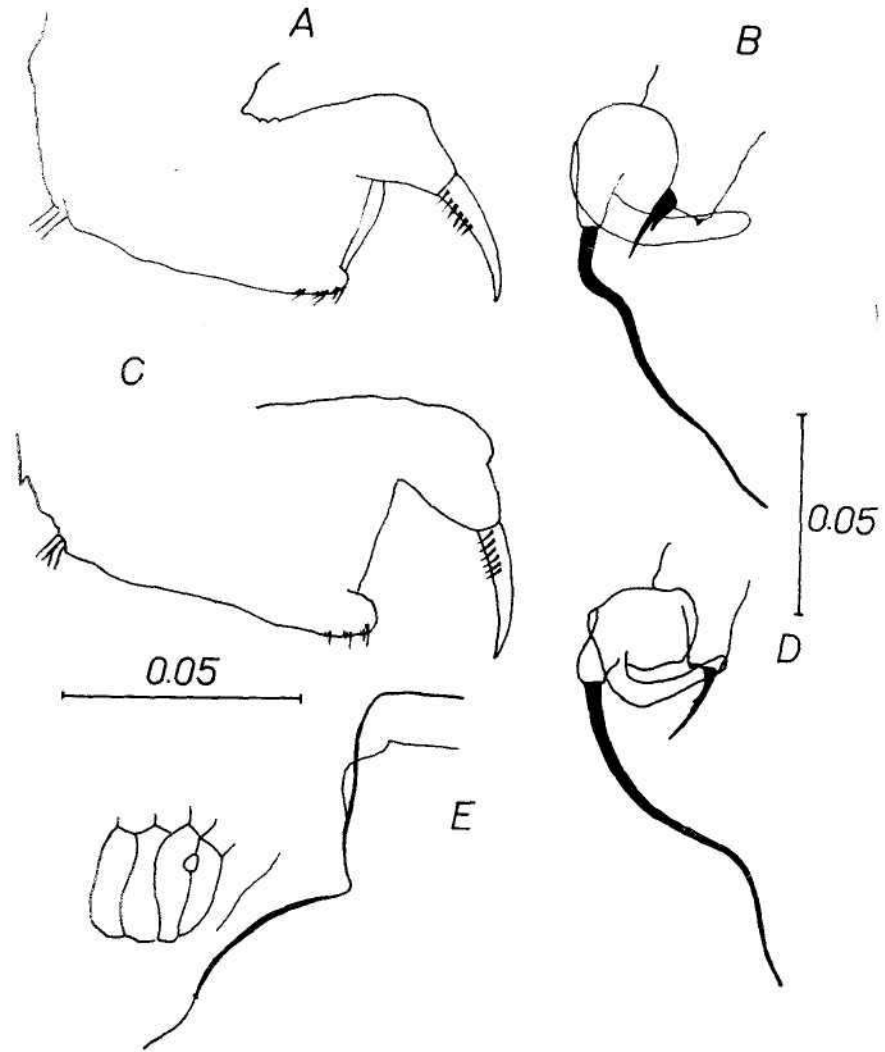


Fig. 5. *Bosmina tubicen*: A — postabdomen ♂, Volta Lake, Sept. 1961, Ghana. B — first leg of the same. C — postabdomen ♂, Laguna del Tesoro, May 1966, Cuba. D — first leg ♂, El Dique, March 1966, Cuba. E — LHP ♂, El Dique, Apr. 1965, Cuba.

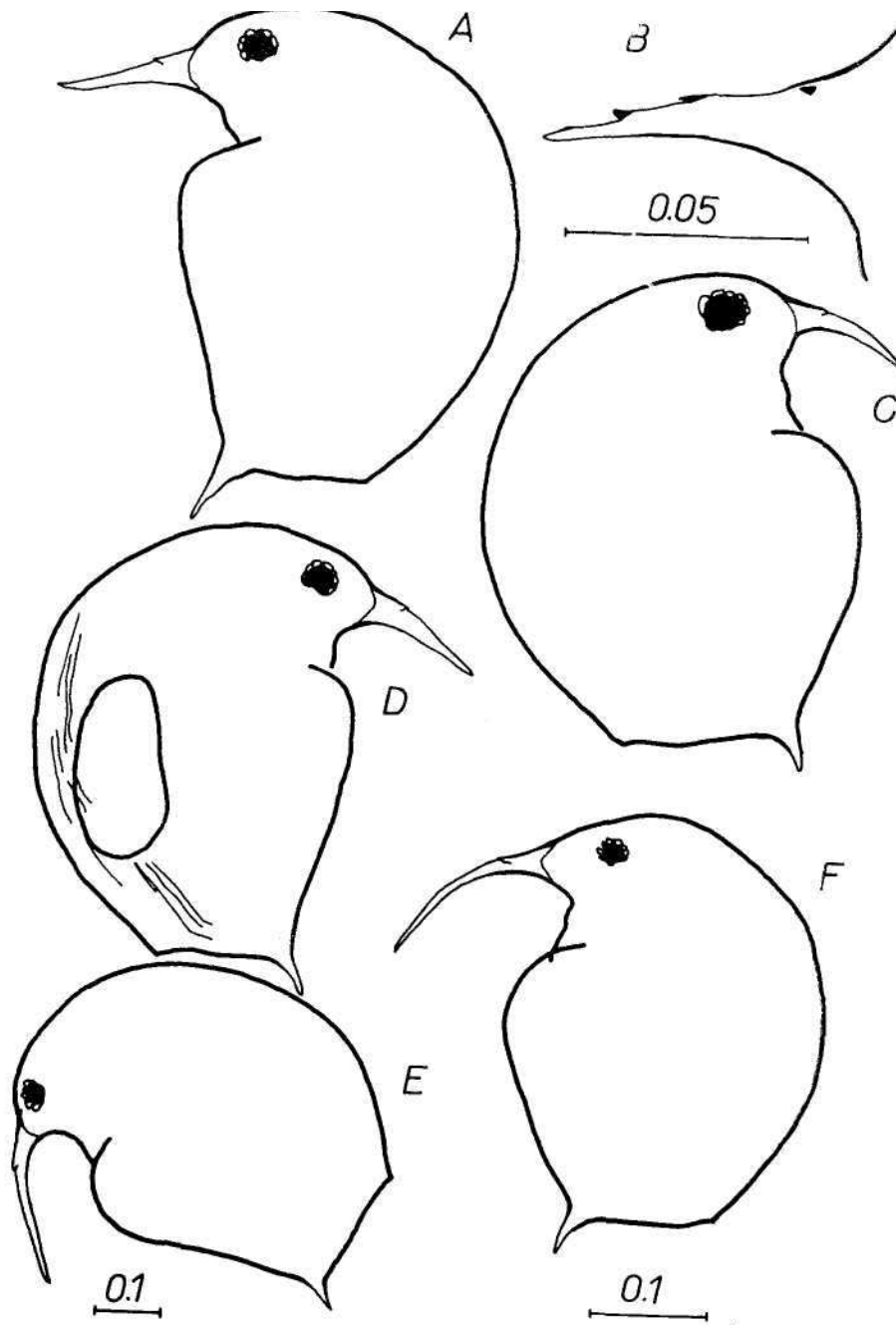


Fig. 6. *Bosmina tubicen*: A — asex. ♀, Mardi Dam, Dec. 1963, Australia. C — asex. ♀, Lake Pichilafquén, Nov. 1953, Chile. D — sex. ♀, Mardi Dam, Dec. 1968, Australia. *Bosmina chilensis*: B — mucro of immature specimen, Lake Calafquén, Dec. 1953, Chile. E — asex. ♀, Laguna Mucubají, June 1965, Venezuela. F — asex. ♀, Lake Calafquén, Dec. 1953, Chile.

*Bosmina (Neobosmina) hagmanni* Stingelin, 1904

Through kindness of Dr. C. E. Goulden, I had the opportunity to study a few specimens of this species. According to his unpublished data, the morphology of males differs this species from the others. The LHP pattern is of the coregoni type (Fig. 7: C). The reticulation of the surrounding part of the head shield is distinct only in some specimens. The males have not yet been described. Synonymy of the species with *Bosmina chilensis* is not excluded.

Material:

U.S.A.: West Belgrade Lake, Maine, Aug. 1963. Sebago Lake, Maine, Sept. 1963. Coll. C. E. Goulden.

*Bosmina (Neobosmina) macrostyla* Daday, 1905

(syn. *Bosmina tenuirostris* Daday, 1905).

Only the type material was examined. No differences between the species *B. macrostyla* and *B. tenuirostris* were found. The species is remarkable by the strong dorsal serration of the mucro. This character remains also in adults (Fig. 7: F). The LHP pattern is of the coregoni type (Fig. 7: E). The surface of the adjoining part of the carapace is only slightly reticulated. Because of the insufficient material, it is not possible to consider the validity of the species. Males are unknown. The name *Bosmina macrostyla* was chosen as it characterizes better the habitus of the species.

Material:

Paraguay: pool at Paraguay river, Corumba, Matto Grosso. 1901. Coll. J. D. Anisits. Hungarian Natural History Museum. Type material Nr. VIII/1-5, lectotype Nr. VIII-1/g.

*Bosmina (Neobosmina) meridionalis* Sars, 1903

Recently, the problem of the species has been complicated as the populations resembling the species *Bosmina tubicen* were sampled in Australia. However, several males found in Relf's Irrigation Dam distinguish the species from the populations found in Cuba. Regarding this poor material, the stability of differential characters cannot be proved. Males have not the distinct frontal depression of the head as in the American material (Fig. 8: B). The dorsal part of the carapace is so conspicuously vaulted that the body is more robust than in *Bosmina tubicen*. The first leg has a large hook on the hook-like segment (Fig. 8: D). The mucro is short and a little straightened forward, and the postabdomen is convex on the dorsal side (Fig. 8: F).

The asexual females have some characters similar to *Bosmina chilensis*: long antennules and thin mucro (Fig. 8: A). The LHP pattern of the material examined is of the coregoni type, the reticulation of the head shield being hardly visible (Fig. 8: C). The mucro of immature specimens is serrated on the dorsal margin (Fig. 8: E).

Material:

Australia: Lake Burragorang, N.S.W., Aug. 1965. Coll. V. H. Jolly. Malabogie Irrigation Dam, Aug. 1967. Relf's Irrigation Dam, N.S.W., Jan. 1968. Kentucky Creek Dam, N.S.W., Aug. 1967. Emmaville Tin Hole, N.S.W., Jan. 1968. Grahamstown Storage Reservoir, N.S.W.,

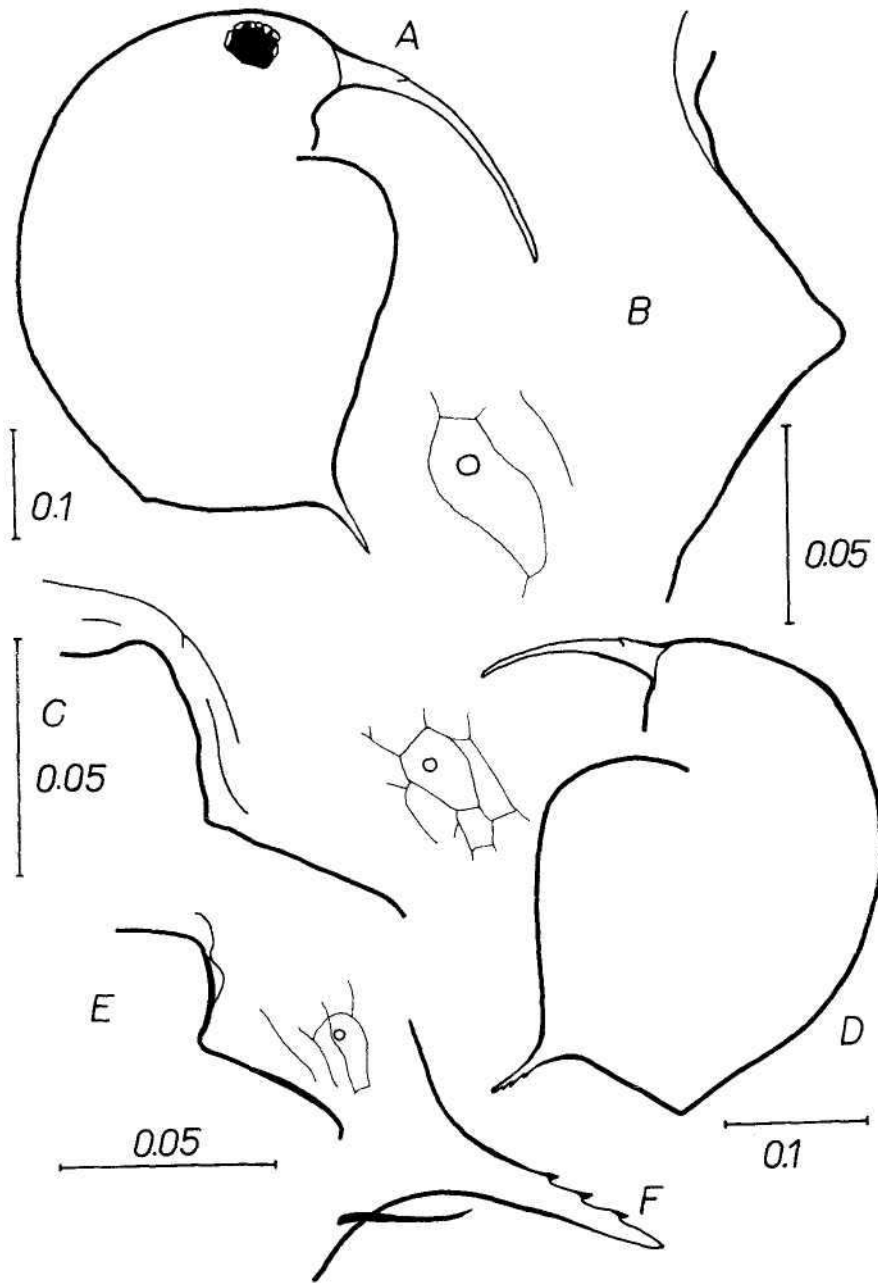


Fig. 7. *Bosmina chilensis*: A — asex. ♀, Laguna Negra, Sept. 1967, Venezuela. B — LHP ♀, Lake Calafquén, Dec. 1953, Chile. *Bosmina hagmanni*: C — LHP ♀, West Belgrade Lake, Aug. 1963, USA. *Bosmina macrostyla*: D — asex. ♀ exoskeleton, pool at Corumba, 1901, Paraguay. E—LHP ♀, the same locality. F — asex. ♀ mucro, the same locality.

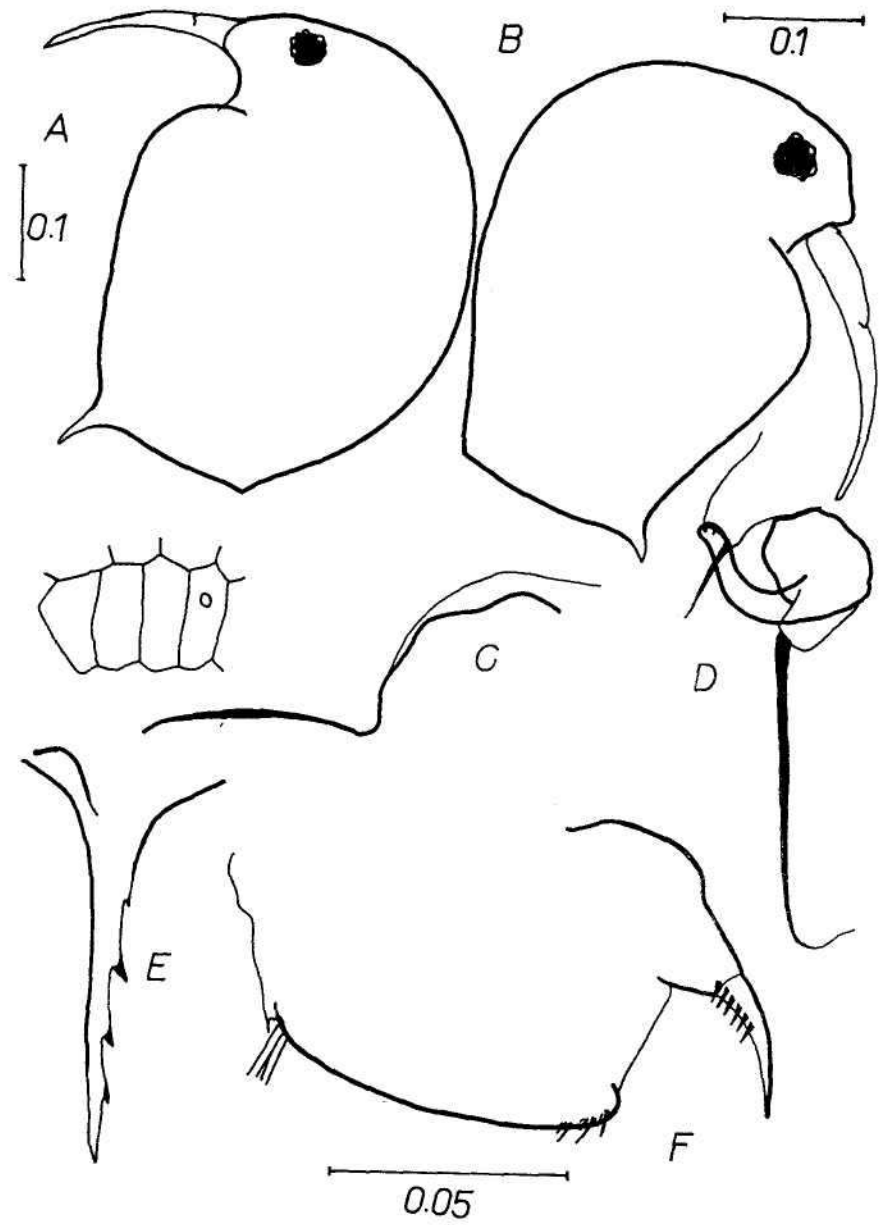


Fig. 8. *Bosmina meridionalis* from Australia: A — asex. ♀, Lake Burragorang, Dec. 1965, B — male, Relf's Irrigation Dam, Jan. 1968. C — LHP ♀, Lake Burragorang, Aug. 1965. D — male first leg, Relf's Irrigation Dam, Jan. 1968. E — immature specimen, micro, Lake Burragorang, Aug. 1965. F — male postabdomen, Relf's Irrigation Dam, Jan. 1968.



Aug. 1967. Coll. B. Timms. Lake Wendouru, Victoria, Sars' collection Nr. F. 12743, Zool. Museum, Oslo.

New Zealand: locality Nr. 55, Sars' collection Nr. 9784, Zool. Museum, Oslo. Lakes: Taupo, Wakatipu and Hayes, May, 1951. Coll. V. H. Jolly. Nr. 52 in collections of Brit. Museum Nat. History, London.

*Bosmina (Sinobosmina) fatalis* Burckhardt, 1924

The synonymy of the species is not clear to the present time. In the area of its probable distribution, following populations were sampled:

<i>Bosmina fatalis</i> Burckh., 1924	West China
<i>B. amemiyai</i> Brehm, 1925	Japan
<i>B. amemiyai</i> Brehm in Uéno (1926)	Japan
<i>B. coregoni</i> Baird in Uéno (1933) ssp. <i>yessoensis</i>	Japan
<i>B. fatalis</i> Burckh. in Aurich (1934) f. <i>phillipinensis</i>	Phillipines
<i>B. coregoni</i> Baird in Uéno (1938)	S. Kurile Islands
<i>B. fatalis</i> Burckh. in Uéno (1939) f. <i>chankensis</i>	N. E. China
<i>B. fatalis</i> Burckh. in Uéno (1944) f. <i>chianguensis</i>	E. China
<i>B. fatalis</i> Burckh. in Mashiko (1953)	Central China
<i>B. fatalis</i> Burckh. in Tsi-Chung and Clemente (1954)	Phillipines
<i>B. fatalis</i> Burckh. in Chiang Sieh-Chih (1955)	Central China
<i>B. praeliariis</i> Manuilova, 1964	E. U.S.S.R.
<i>B. fatalis</i> Burckh. in Uéno (1968)	Japan

The material examined originate from Khanka Lake and from Bolon Lake and several water-bodies in its vicinity. Individuals from Khanka Lake agree with Uéno's description (Uéno, 1939, p: 226—227, fig. 15—19). However, adult females from all samples are smaller than those found by Uéno: total length: 0.35—0.52 mm, max. height of valvae: 0.31—0.43 mm. The LHP pattern is the same as Uéno (1968) described. The pore is located between the posterior branches of the bifurcated fornix line. The shape of the pore is circular. The reticulation of the adjoining part of the carapace is hardly visible. There is no thickening around the pore (Fig. 9: D). No males were found in the material. Sexual females from late autumn samples do not differ in general shape of the body from asexual ones (Fig. 9: A—C). The total length of the former ranges between 0.41 and 0.57 mm, their max. height between 0.34 and 0.54 mm.

The populations from Bolon Lake and adjoining water bodies were described as the species of *Bosmina praeliariis* Manuilova, 1964 (collections of Zool. Inst. Acad. of Sciences U.S.S.R., Leningrad, paratypes Nr. 49997). The type material is characterized by the antennules curved forward and by the long and robust mucro (Fig. 9: E). These characters are the most distinct in summer population of asexual females. Females from autumnal samples have straighter antennules and shorter mucro than from summer ones (Fig. 9: F). Sexual females are very similar to those described in Burckhardt (1924) as *Bosmina fatalis* var. *cyanopotamia* (Fig. 9: G). Males were found in last summer and autumn samples. Their characters agree with the Burckhardt's description, except the first leg (Fig. 10: C—E). Burckhardt (1941) did not mention a small bulge on the basal part of the hooklike segment (Fig. 10: G). The LHP pattern is the same as in *Bosmina fatalis* from Khanka Lake and no difference was found

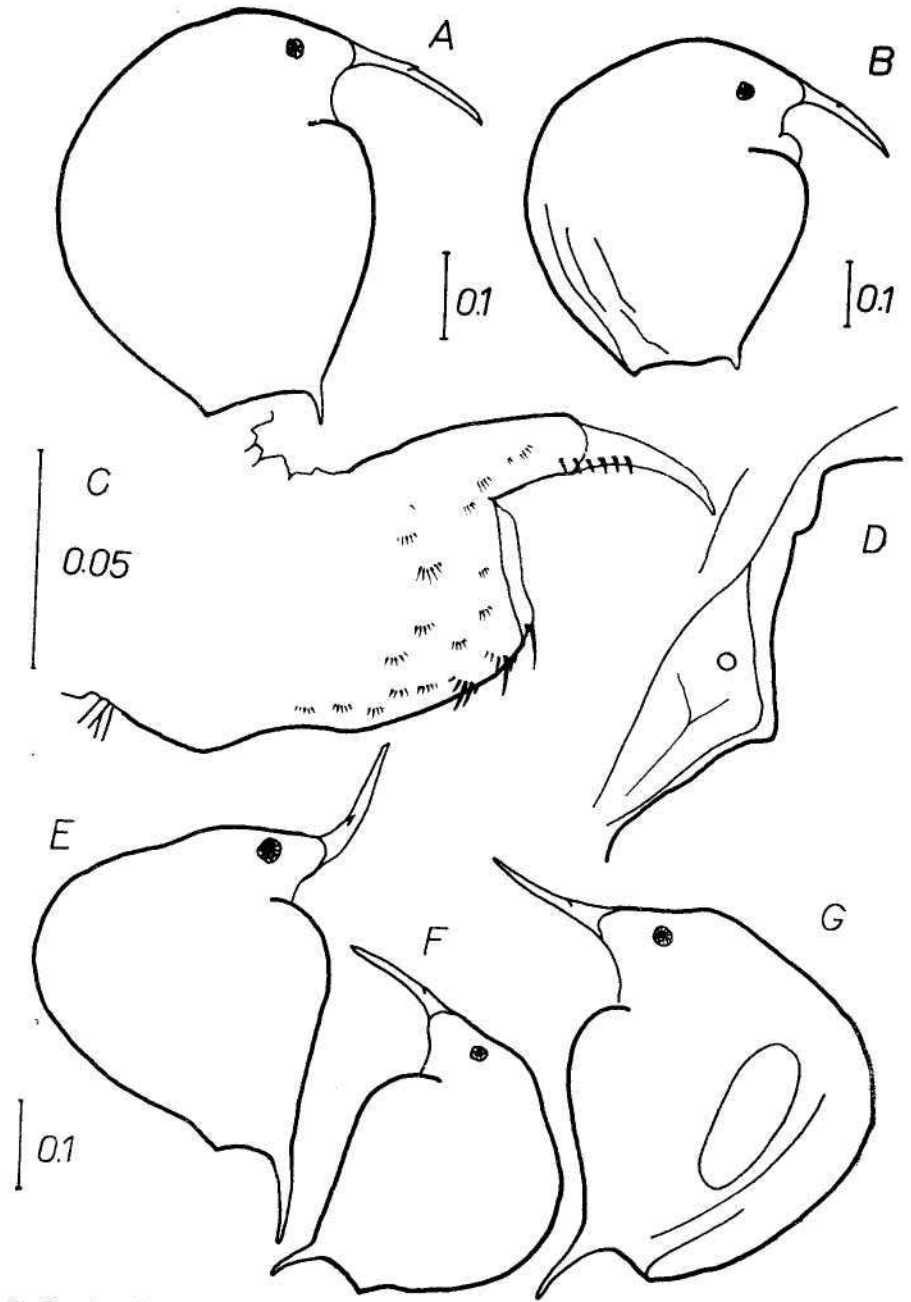


Fig. 9. *Bosmina fatalis* from Khanka Lake, U.S.S.R.: A - asex. ♀, June 1937. B - sex. ♀, Oct. 1936. C - postabdomen, asex. ♀, Sept. 1936. D - LHP ♀, Sept. 1936. *Bosmina fatalis praeliaris* from Bolon Lake, U.S.S.R.: E - asex. ♀, Oct. 1933. F - asex. ♀, Oct. 1933. G - sex. ♀, Oct. 1933.

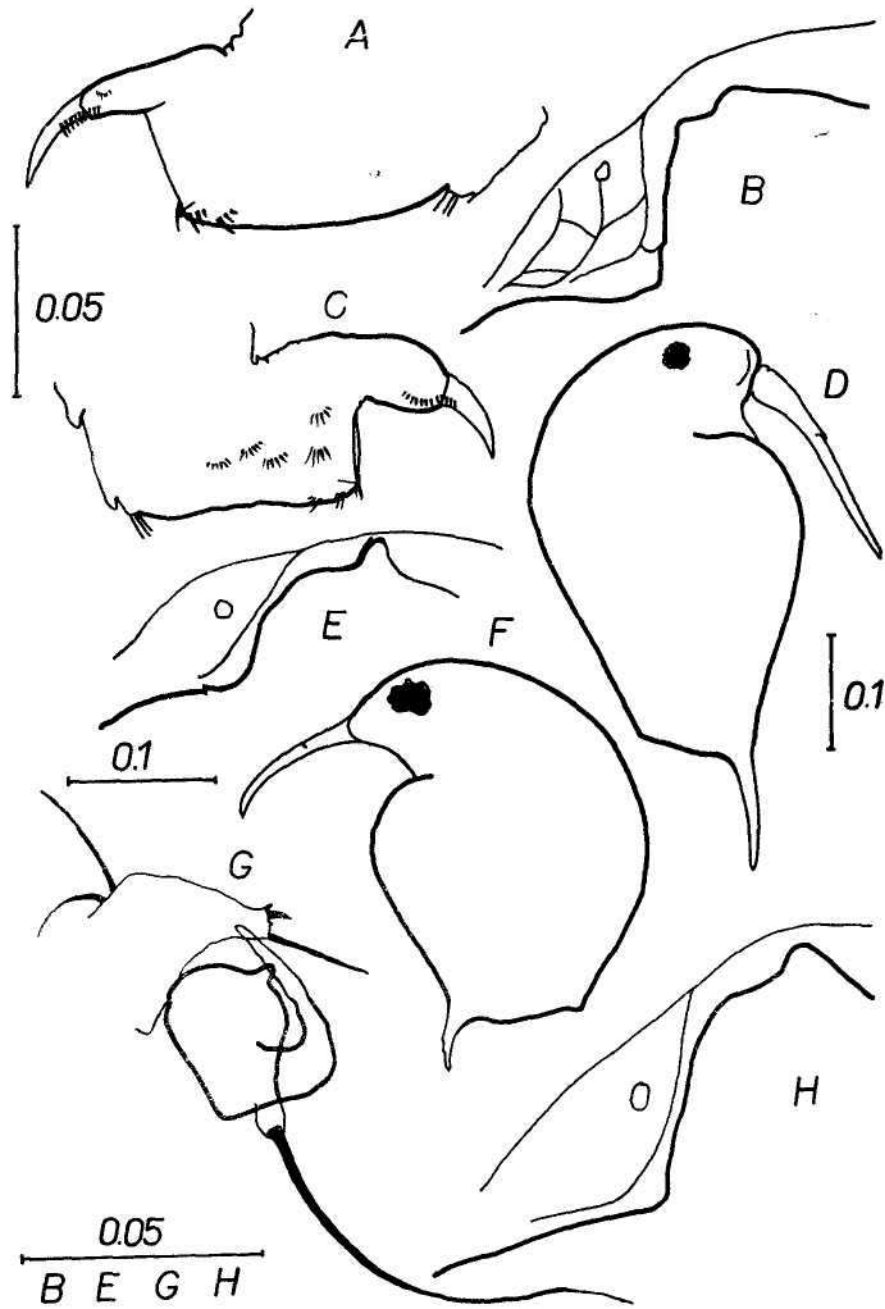


Fig. 10. *Bosmina fatalis praeliaris* from Bolon Lake, U.S.S.R.: A — asex. ♀, postabdomen, Aug. 1933. B — asex. ♀, LHP, Aug. 1933. C — postabdomen of male, Oct. 1933. D — male, Oct. 1933. E — LHP of male, Oct. 1933. G — first leg of male, Oct. 1933. *Bosmina cf. japonica* from Avalanchi Reservoir, Feb. 1970, India: F — asex. ♀, H — asex. ♀, LHP.

between the pore arrangement both in females and males from Lake Bolon (Fig. 10: B, E).

Actual measurements of formalin — preserved specimens from various samples are as follows (in mm):

	total length	height	length of mucro
Asexual ♀♀ (30)	0.32—0.48	0.25—0.43	0.09—0.20
Sexual ♀♀ (11)	0.35—0.40	0.32—0.34	0.07—0.08
Males (28)	0.34—0.40	0.22—0.24	0.08—0.12

Populations from the Bolon region are similar to some others species or subspecies previously described: *Bosmina fatalis* var. *cyanopotamia* (Burckhardt, 1924), *Bosmina amemiayi* (Brehm, 1925), and *B. fatalis* f. *chianguensis* (Uéno, 1944). Regarding the variability of the species *Bosmina fatalis*, *Bosmina praeliaria* is probably the subspecies of the former. The problem will be solved if comparison of the morphology of the first male leg of both the forms is done. Uéno (1968) distinguishes the species *Bosmina fatalis* from that of *coregoni* sensu lato on the basis of the knob on antenna, near its articulation. However, the small knob carrying the seta is present in all species of the genus *Bosmina*.

**Material:**

U.S.S.R.: Khanka Lake, samples from years 1936 and 1937. Collections of Zool. Inst. Acad. Sc., Leningrad, Nr. 329-1940 g: 217, 224, 270, 407, and 412.

Bolon Lake, samples from the year 1933, Nr.: 9, 30, 31, 34, 35, 49, 51, 69, and 119. Serebrannoe Lake, July 1933, Nr. 4. Udył' Lake, July, 1933, Nr. T-N2. Serebrannoe Lake, Sept. 1933, Nr. 67. Channel Sii, Sept. 1933, Nr. 71. All numbers of collections of Zool. Inst. Acad. Sc., Leningrad, Nr. 329-1940 g.

*Bosmina (Sinobosmina) cf. japonica* Poppe and Richard, 1890

A very limited material was examined from two reservoirs in India. Its classification as *Bosmina japonica* is questionable. The original description is not enough satisfactory and the type material was not available. Asexual females resemble those of *Bosmina longirostris* in general shape of the body (Fig. 10: F). The denticulation of the terminal claws of the postabdomen is not distinct (Fig. 11: A). The LHP pattern differs from that of *longirostris* type. The pore is circular and lies between the posterior branches of the bifurcated fornix line (Fig. 10: H). Some population of *Bosmina longirostris* are very similar from this point of view. However, the morphology of the male postabdomen and the first leg is quite different (Fig. 11: B—D).

**Material:**

India: Avalanchi Reservoir, Feb. 1970. Pillur Dam, Feb. 1970. Coll. A. Sreenivasan.

**2. Median head pore**

A more or less distinct pore was found in the median line of the head shield in all species examined. It is more distinct in the species with thick carapaces i.e. *Bosmina longispina* and some populations of *Bosmina tubicen*,

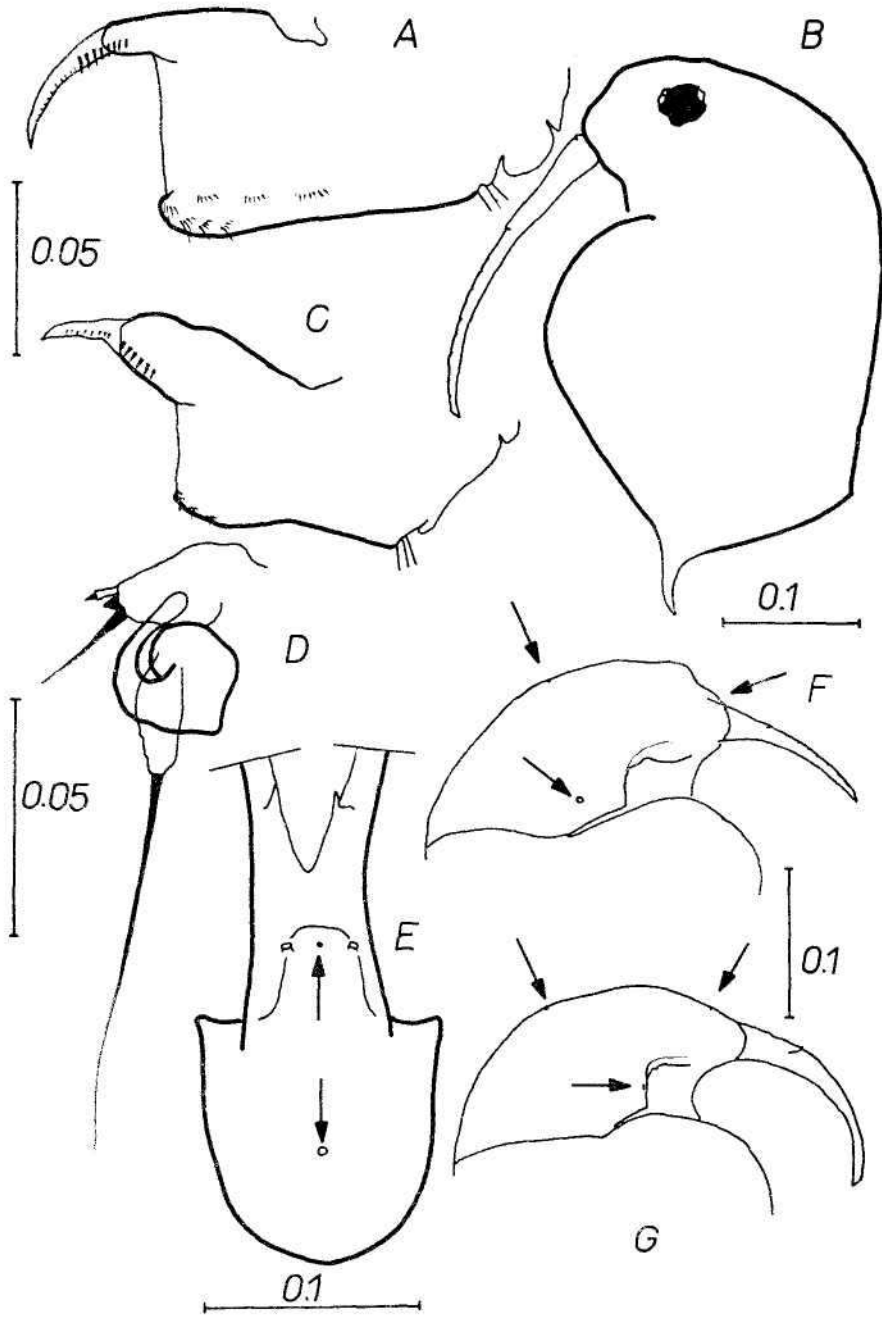


Fig. 11. *Bosmina cf. japonica*, Avalanchi Reservoir, Feb. 1970, India: A — postabdomen of asex. ♀. B — male. C — postabdomen of male. D — first leg of male. Median and frontal pores: *Bosmina longirostris*, asex. ♀, head shield, Kubov pond, July 1962, Czechoslovakia. E — dorsal view. G — lateral view. F — *Bosmina tubicen*, asex. ♀, lateral view of head shield, Laguna Sabanilla, June 1966, Cuba.

than in those with transparent carapaces. From lateral view, the pore is situated above the top of the intestinal arch (Fig. 11: F, G). From dorsal view, it is located between the antennal articulations (Fig. 11: E). In *Bosmina longirostris*, it lies between the posterior edges of the mandibular articulations. On stained specimens, the thin connection probably to the brain ganglion was observed (Fig. 12, 13).

### 3. Frontal head pore

A small pore, not described yet, was found between the frontal sensory setae, not far from the tip of the rostrum. Its location is variable in different species (Fig. 11: E—G). In *Bosmina longirostris*, *B. crassicornis*, *B. chilensis* and *B. fatalis*, it is situated between the frontal setae. It is shifted to the rostrum tip in *B. coregoni*, *B. longispina*, *B. mixta*, *B. tubicen* and *B. meridionalis*. In *B. mixta berlinensis* and some populations of *B. coregoni gibbera*, it was found closely by the rostrum tip or directly on it. As well as the median pore, the frontal one is connected with the brain ganglion (Fig. 12, 13).

### CONCLUSIONS

Material of fourteen species of the genus *Bosmina* was examined regarding the head pores. Within the genus three types of the head pores were found: median, frontal and lateral ones. The connection to the brain ganglion was observed on both the frontal and median pores. In the location of latter mentioned pores, no differences between the species were found. According to the lateral head pore pattern, three groups of species were classified. Comparing three types of lateral head pore arrangement with Lieder's classification of the genus, the subgenera *Eubosmina* and *Neobosmina* cannot be distinguished on this basis. However, *Neobosmina tubicen*, *N. meridionalis*, and *N. hagmanni* differ from the species of the subgenus *Eubosmina* in the morphology of males. In the other species of the subgenus *Neobosmina*, the males have not been described yet.

In australian and african materials, the populations with forward curved antennules were found, resembling the american species *Bosmina tubicen*. It cannot be excluded these populations belong to the latter species. In the subgenus *Neobosmina*, the synonymy of *Bosmina chilensis* and *B. hagmanni* is possible. The validity of the species *Bosmina macrostyla* cannot be decided because of insufficient material.

In the subgenus *Sinobosmina*, the synonymy of *Bosmina fatalis* and *B. praeliaria* is probable. On the basis of the lateral head pore pattern, the species determined as *Bosmina cf. japonica* was related to this subgenus.

From the material examined, the taxonomic weight of male morphology seems to be apparent.

### Acknowledgements

I am very indebted to Dr. Hrbáček for cladoceran materials from various parts of the world, and to him and Dr. Straškraba for helpful criticism of the manuscript.

I should like to thank following scientists of various museums and instituts for material and hospitality: Dr. N. A. Akatowa, Zool. Inst. Acad. Sc. U.S.S.R., Leningrad. Dr. K. Farkas, Natural History Hungarian Museum, Budapest, Dr. K. A. Mc Kenzie, Brit. Museum, Nat. History, London, and to Dr. N. Knaben, Zool. Museum, Oslo.

This study would have been impossible without the kind assistance of many people who contributed the material. Their names are listed against the material they supplied.

I also thank Dr. J. A. Spence for editing the English of the manuscript. The study was partly supported by the Czechoslovak Committee of the International Biological Program.

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

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**THE GROWTH OF THE BREAM (*ABRAMIS BRAHA* (L.)) IN SELECTED LOCALITIES OF CENTRAL AND EASTERN EUROPE (PISCES, CYPRINIDAE)**

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Received January 15, 1971

**Abstract:** In this report the author evaluates the growth of 1392 specimens of the Bream (*Abramis brama* (L.)) from two reservoirs situated in the territory of Czechoslovakia, from one situated in the U.S.S.R. and from the Danube river. Very good growth was ascertained of the fish coming from the Slapy reservoir, while less favourable growth was found to exist in the Lipno reservoir (the growth in these reservoirs is nearly that of the bream in the southern parts of its habitat); there was found good growth in the Rybinsk basin and bad growth in the Danube river.

INTRODUCTION

The Bream (*Abramis brama* (L.)) is in its economic and sporting aspects an important fish species in the waters of Central and Eastern Europe. Its significance and propagation is dealt with in the studies published by Bauch (1953), Berg (1949) and Dyk (1956).

The biological aspects and the significance of the Bream are aptly discussed in this country in a joint study by a team of the authors Havelka, Round and Vostradovský (1967).

The objective of the present paper consists in an ascertainment of the growth of the Bream in the Slapy, Lipno and Rybinsk basins, as well as in Danube; next to this there is given an evaluation of the growth development trends during the recent years; a comparison is established among the rates of growth in the different water habitats and the prospective rates of growth in the localities under review are outlined for the next few years.

The growth of the Bream was studied in this country by the following authors: the growth in the Slapy reservoir — see Čihař and Oliva (1959), Poupě (1964). The growth in the Lipno reservoir was investigated by Vostradovský (1964) and Poupě (1964). A review of the authors who investigated the growth of bream in the Danube river is given by Balon (1962a). In the Rybinsk basin the growth of the Bream is continually studied by research workers of the U.S.S.R. Academy of Sciences, see Ostroumow (1956).

In the present paper the author investigates the growth while taking into account such changes and events as might influence the growth, such as a change of the quality of water as a result of another basin that has been built, suffocation of the fish under ice, variations in the intensity of fishing, excessive propagation etc.

The author wishes to thank all those who co-operated in his investigation, particularly to Doc. RNDr O. Oliva CSc., to Ing. J. Vostradovský, to Doc. RNDr J. Hrbáček, to RNDr M. Novák and to the workers of the Laboratory of Fisheries in Bratislava.

#### MATERIALS AND METHODS

The material on hand of which the growth was being determined was drawn in 1963 from the Lipno and Slapy reservoirs, in 1967 from the Lipno reservoir, in 1959 from the Danube localities of Medvedovo and in 1966 from Vlčie Hrdlo (Wolf's Throat) and, finally, in 1964 from the Rybinsk Basin (U.S.S.R.).

##### A. Description of the Localities

The Lipno river basin forms the first step of a cascade of dams built along the course of the Vltava river. The altitude above sea level of the valley bottom adjacent to the dam is one of 705.5 m. Maximum height of backwater is 21 m, maximum length of backwater 48 kms, maximum flooded area 48.70 km<sup>2</sup>, maximum width of the reservoir 9 kms and maximum volume of the reservoir is  $306 \times 10^6$  m<sup>3</sup>. Average depth of the reservoir bottom is 6.28 m. For more details see Novák (1968).

The Slapy reservoir is the fourth important hydraulic project of the Vltava river cascade of dams. The altitude above sea level of the valley bottom adjacent to the dam is 214.5 m. Maximum effective head is 56.5 m, maximum length of backwater 44 kms and maximum flooded area 13.92 km<sup>2</sup>. The total volume amounts to  $270 \times 10^6$  m<sup>3</sup>. Average depth 19.40 m. For more details see Novák (1957). In the reservoir there was produced a change of hydrobiological conditions in 1960, when into the Slapy reservoir there began to flow cold and inadequately oxygenated water from the Orlik reservoir. On the influence of the Orlik reservoir see Hruška (1966).

The Rybinsk reservoir came into existence on the Volga and Sheksna rivers back in 1941. Maximum area of this reservoir is one of 4550 km<sup>2</sup>, the volume of impounded water is 25.4 km<sup>3</sup>, maximum head of 30 m, average depth 5.6 m. The productivity of this reservoir varies considerably from 5 kg to 87 kg of fish yield per hectare. For more details see Ostroumov (1956).

The Medvedovo locality is situated about 3 kms from the community of the same name. It is formed by one of the subsidiary branches of the Danube river. Average width of the watercourse is 7 m, average depth 1.20 m. The banks are steep and overgrown with vegetation, water is turbid, its flow being a very moderate one. The bottom is muddy.

Vlčie Hrdlo, also, is one of the subsidiary branches of the Danube river. Average width of the watercourse amounts to 5.5 m, average depth 90 cm. The banks are overgrown with vegetation, inclined to 30 deg. The bottom is muddy, water flows slowly and is turbid. Information about the above two localities were obtained by personal communication from the workers of the Bratislava Fisheries Laboratory.

##### B. Acquisition of Materials

The material obtained from the Lipno basin was caught in the course of the 1963 and 1967 years, the material from Slapy reservoir dates from 1963, that of Danube - Medvedovo dates from 1959, that of Danube - Vlčie Hrdlo dates from 1966 and that of the Rybinsk reservoir from 1964. Fish from the Lipno reservoir was caught in a drag-net and in a toil net of a  $3 \times 3$  cm mesh. All material for investigation is made up of the fish caught by the VÚRH (Fishery Research Institute) Vodňany, Lipno Reservoir Research Station. The breams that came from the Slapy reservoir were caught by the Nížbor State Fishery Establishment with a  $5 \times 5$  cm mesh drag-net. The breams from the Danube river were poisoned for the depository of the Bratislava Fishery Laboratory and preserved in formalin. The specimen from the Rybinsk reservoir was caught in toil nets and drag-nets of  $5 \times 5$  cm mesh.

##### C. Characteristics of the Material

Lipno 1963: The breams were caught at two time intervals, one early in June (spring specimen of 54 males and 14 females), the other on September 3 (autumn specimen of 198 individuals the sex of which was not identified). Neither the spring nor the autumn sample contained the youngest fish.

Lipno 1967: The specimen involves all breams which were caught by VÚRH Lipno in the course of the 1967 year. The spring portion of the whole yield (April-July) contained 179 individuals (112 males, 29 females and 38 specimens the sex of which was not identified). The

autumn proportion of the yield (September—October) was made up of 224 individuals the sex and weight of which were not identified.

Slapy 1963: The sample batch of fish contained 303 individual specimens (148 females and 155 males). The material was caught in June 1963 in the vicinity of Živohošť (the lower part of the reservoir) as well as in the vicinity of Bučily (the upper part of the reservoir). The sample that came from the upper part contained 57 specimens (27 females and 30 males), the sample from the lower part contained a total of 246 specimens (125 males and 121 females). The sex of all breams could be easily identified. The sample did not contain the 0 and 1 age categories.

Danube: The sample contains a total of 263 individuals: from the Medvedovo locality there are 12 and from the Vlčie Hrdlo locality 251 specimens. The fish from Medvedovo were poisoned on December 6, 1959 and those from Vlčie Hrdlo on September 29, 1966. In the sample there are represented individuals of the youngest age categories, including the 0 category. Rybinsk reservoir: The sample mailed contains 247 specimens that were probably caught in the course of the whole 1964 year and over the entire area of the reservoir. Sex was not identified. The sample suffered from serious shortcoming. In the envelopes were contained scales from various parts of the fish body, scales of fish of various age categories and even scales of other fish species.

#### D. Processing of the Material and Its Investigation

Once cleaned, the scales of the Lipno breams (1963) and of those coming from Slapy (1963) were subject to microscopic measurements. For more details see Poupě (1964). The author took measurements of the scales of the breams coming from the Danube river and from the Rybinsk and Lipno reservoirs (1967) on a Dokumator Lesegerät apparatus manufactured by VEB K Zeiss Jena (for a description see Peňáz—Libosvářský, 1961), under a magnification of 17.5 times. Measurements were taken of the ventro-lateral radius of a scale and of the spacing of individual annuli situated upon this radius. The measured values were read out in millimeter divisions with the help of a millimeter cross and recorded in transcript forms. Mean values of two scales were used in the procedure.

#### E. Classification into Age Categories

The fish were classified into age categories not only according to the number of annuli produced, but also with a view to the completion of annuli at the time a fish was caught. About the conception of the annuli see Holčík (1969). In the classification of the fish into age categories the author follows Balon (1962b).

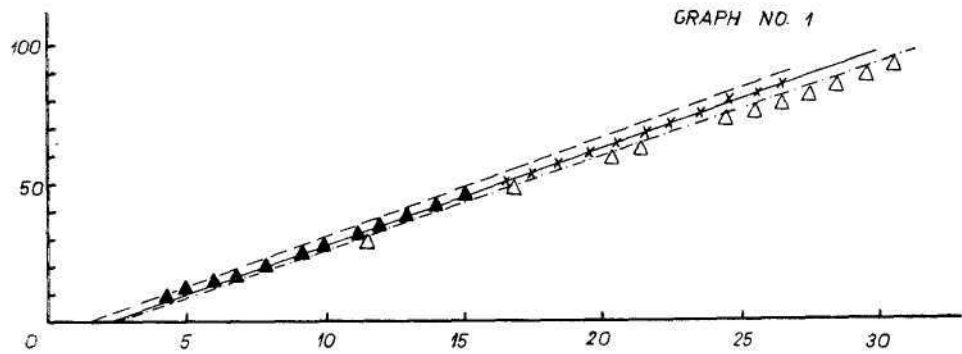
#### F. Methods of Growth Identification

A review of various methods of an analysis of growth and of back calculation of lengths is given by Balon (1955) and Holčík (1960).

### GROWTH OF THE BREAM

#### A. Relationship between the Growth of a Scale and That of the Body

A linear interdependence between the growth of a scale and that of the whole body is manifested by the ventrolateral radius of a scale. The growth evaluation was conducted according to the method devised by R. Lee. See R. Lee (1920). The length of the body at the time when scales came into existence was determined graphically and a check-up on the accuracy of the straight line development was conducted by a method of calculation of the coefficients of regression. See Novák (1963). The values established graphically are 14 mm (12 mm) for Danube, 21 mm (20 mm) for the Lipno reservoir and 22 mm (20 mm) for the Rybinsk reservoir. The figures in parentheses are the results arrived at by computation. A check-up of the results on the material was not conducted, as none of the specimens contained fish fry either without scales or with the first scales showing up.

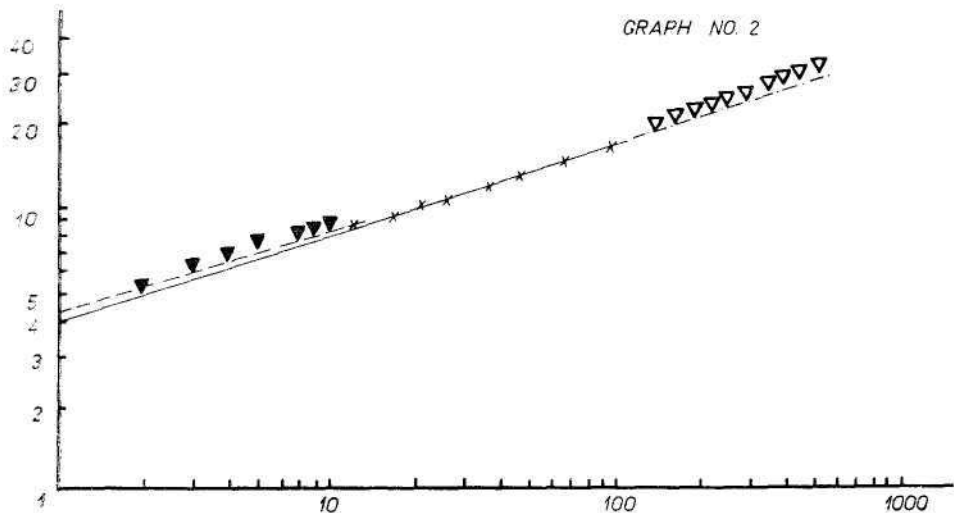


Graph No. 1 — Length of body at the time when scales start growing: — — — —  $\blacktriangle$  Danube; — — — —  $\times$  Lipno reservoir; — . . . —  $\triangle$  Rybinsk reservoir. Axis x — length of body in cm. Axis y — radius of scale in millimeter division (magnified 17.5 times).

### B. Relationship Existing between the Length of the Body and its Weight

On bilogarithmic paper there was graphically established the Bank start value (the body length for a weight of one gram). This value amounted to 48 mm for the Slapy and Lipno reservoirs (1963), to 40 mm for the Lipno reservoir (1967) and to 44 mm for Danube — Vlčie Hrdlo. For the interdependence of body length and weight see the graphic representation No. 2.

The computation of coefficient of condition was carried out by means of the Fulton formula. For the Slapy and Lipno reservoirs the author established the coefficient of condition at 1.22.



Graph No. 2 — — — —  $\blacktriangle$  Danube; — — — —  $\times$  Lipno reservoir; — . . . —  $\triangle$  Rybinsk reservoir. Axis x — weight in grams. Axis y — length of body in cm.

Table No. 1

Locality	age group	Annual group	Number of specimens	Average numerical values established for each annulus, with ranges indicated below																				
				1 <sub>1</sub>	1 <sub>2</sub>	1 <sub>3</sub>	1 <sub>4</sub>	1 <sub>5</sub>	1 <sub>6</sub>	1 <sub>7</sub>	1 <sub>8</sub>	1 <sub>9</sub>	1 <sub>10</sub>	1 <sub>11</sub>										
Slapy reservoir V. + VI, 1963	2	1960	7	99	156																			
				88-105	140-180																			
	3	1959	32	87	139	180																		
				74-97	119-158	150-214																		
	4	1958	159	88	133	188	230																	
				70-105	119-158	144-240	190-295																	
	5	1957	52	82	129	173	210	253																
				59-103	84-171	117-228	170-290	190-338																
	6	1956	27	84	134	185	220	245	291															
				69-108	108-175	137-240	174-279	204-317	230-357															
	7	1955	15	83	138	175	214	238	280	312														
			66-99	92-170	122-225	143-232	185-280	217-335	240-362															
8	1954	5	86	123	173	225	246	299	335	352														
			62-96	92-148	120-216	143-254	175-285	210-337	240-380	262-405														
9	1953	5	78	123	150	229	269	300	342	387	408													
			68-82	108-150	144-210	181-256	218-310	203-343	310-375	347-415	387-450													
11	1951	1	74	140	165	198	230	280	320	360	384	425	445											
			59-108	84-180	117-240	143-295	175-338	203-357	240-380	262-415	384-450													
Total			308	85	135	179	219	249	289	320	370	406	445											

Table No. 2

Locality	Age group	Annual group	Number of specimens	Average numerical values established for each annus, with ranges indicated below				
				l <sub>1</sub>	l <sub>2</sub>	l <sub>3</sub>	l <sub>4</sub>	l <sub>5</sub>
Lipno reservoir 6. VII. + 3. IX. 1963	1	1962	4	93 74-116				
	2	1961	86	86 67-105	136 95-165			
	3	1960	45	83 70-104	131 110-150	177 132-215		
	4	1959	31	83 69-103	132 95-168	170 130-225	217 166-250	
	5	1958	10	87 71-90	123 97-161	156 130-190	190 167-220	235 185-253
Total			176	85 67-116	133 95-168	174 130-225	210 166-250	235 185-253

Table No. 3

Locality	Age group	Annual group	Number of specimens	Average numerical values established for					
				l <sub>1</sub>	l <sub>2</sub>	l <sub>3</sub>	l <sub>4</sub>	l <sub>5</sub>	
Rybinsk reservoir 1964	2	1962	3	71 55-86	115 113-119				
	3	1961	5	84 79-92	118 115-126	149 142-159			
	4	1960	7	70 54-91	119 102-122	154 121-176	198 178-224		
	5	1959	31	86 55-114	124 89-187	163 131-219	197 159-240	227 184-274	
	6	1958	52	78 51-119	120 89-174	155 112-243	189 143-273	221 156-305	
	7	1957	38	75 52-104	118 88-160	154 108-210	192 131-241	222 166-273	
	8	1956	43	74 52-115	117 82-172	152 123-213	186 152-225	222 182-273	
	9	1955	28	69 48-107	113 87-157	155 103-198	191 130-248	218 148-274	
	10	1954	23	77 47-105	125 92-168	168 126-212	202 169-256	232 187-280	
	11	1953	10	70 51-111	119 96-168	162 134-217	195 156-259	226 174-298	
	12	1952	6	59 55-67	98 87-118	131 108-154	159 123-193	186 148-227	
	14	1950	1	52	103	137	172	209	
	Total			247	75 47-119	118 87-187	156 103-243	189 123-273	222 148-305



K Values for Lipno 1967

Age and sex	3 ♂♂	4 ♂♂	4 ♀♀	5 ♂♂	5 ♀♀	6 ♂♂	6 ♀♀	7 ♂♂	7 ♀♀
K	2.14	2.38	1.19	1.64	2.07	2.13	2.05	1.81	2.00
n	1	50	3	47	9	13	11	1	6

K Values for Danube — Vlčie Hrdlo

Age	0	1	2	3	4
K	1.89	1.81	1.78	2.38	1.93
n	58	62	99	29	3

For the different methods of establishment of an interrelation between the body length and weight see Kříženecká-Pulánková (1952).

C. Growth of the Large Bream according to Localities

In an evaluation of the growth of the Bream in the investigated localities the author obtained the following results: The poorest growth was recorded in the Vlčie Hrdlo locality and the best one in the Slapy reservoir. The order of the localities goes as follows: 1) The Slapy reservoir (1963), 2) the Lipno reservoir (1963), the Rybinsk reservoir (1964), 4) the Lipno reservoir (1967), 5) Danube — Medvedovo (1959), 6) Danube — Vlčie Hrdlo (1966). A review of the growth is given in the accompanying tables No. 1—5.

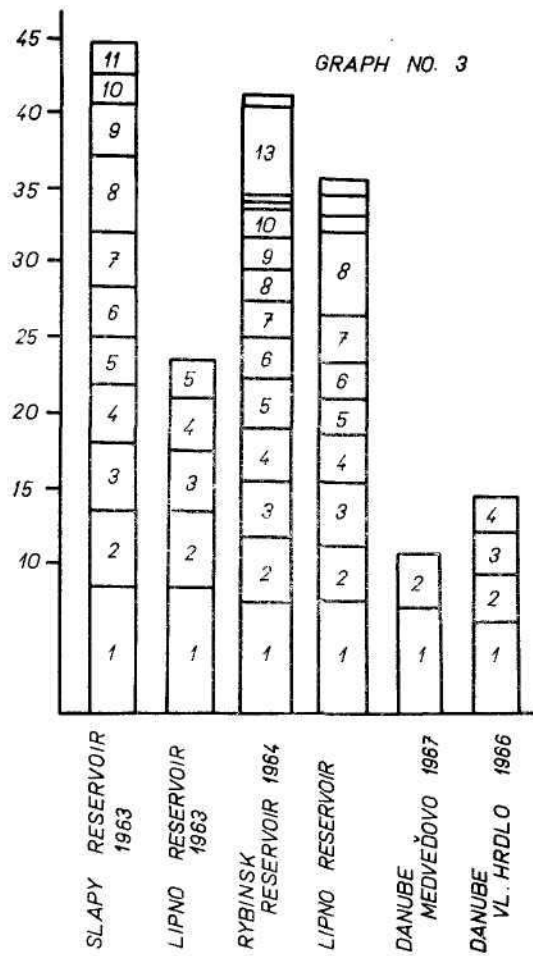
each annulus, with ranges indicated below

	l <sub>6</sub>	l <sub>7</sub>	l <sub>8</sub>	l <sub>9</sub>	l <sub>10</sub>	l <sub>11</sub>	l <sub>12</sub>	l <sub>13</sub>	l <sub>14</sub>
252									
186—320									
249		271							
190—297	213—324								
248	273	294							
195—305	218—337	234—349							
245	275	288	305						
168—289	188—307	210—325	222—342						
262	288	310	329	346					
203—310	231—340	245—362	264—382	279—400					
251	278	299	319	335	352				
198—318	237—335	263—344	288—356	299—376	309—385				
218	244	268	286	302	323	333			
182—261	205—294	224—316	233—339	243—355	252—367	262—380			
234	266	297	318	339	370	392	405	410	
250	274	295	315	335	340	344	405	410	
168—320	188—340	210—362	222—382	243—400	252—385	262—392			

In view of the reduced number of samples that came from the Danube river — Medvedovo (12) there are given only the final results

Body length at the time of capture		Weight at the time of capture		Average values numerically established for each annulus with ranges below		
Average	ranges	average	ranges	$l_0$	$l_1$	$l_2$
83,5	43–168 mm	16	2–35 g	54 43–77	72 65–82	105 99–112

For more particulars on the growth of the Bream see Poupě (1964, 1970).



DISCUSSION

The body length at the time of starting the development of scales in the Slapy reservoir was established (see Čihař — Oliva, 1959) at 21 mm. The value of 32 mm determined by the author (see Poupě, 1964) had been influenced by my own material and cannot be regarded as an entirely exact one. For the fish of the Lipno reservoir the body length at the time when scales started to develop was ascertained to amount to 32 mm (Vostradovský, 1964), to 30 mm (Poupě, 1964) and to 21 mm (Poupě, 1970). In no case there was made a check-up of the results on the material, while a verification by a method fore regressive equations was undertaken for the value of 21 mm and a resultant value of 20 mm was obtained. In the author's view the different results obtained in 1964 and 1970 respectively can be attributed to an increased number of breams in the reservoir, with an attendant growth decrease.

Graph No. 3 — Comparison of growth; Axis y — length of body in cm.

Table No. 4

Locality	Age group	Annual group	Number of specimens	Average numerical values established for each annulus, with ranges indicated below																				
				I <sub>1</sub>	I <sub>2</sub>	I <sub>3</sub>	I <sub>4</sub>	I <sub>5</sub>	I <sub>6</sub>	I <sub>7</sub>	I <sub>8</sub>	I <sub>9</sub>	I <sub>10</sub>	I <sub>11</sub>										
Lipno reservoir 1967	2	1965	11	80	130																			
				70-87	119-140																			
	3	1964	48	79	116	158																		
				57-112	92-168	112-209																		
	4	1963	155	80	119	159	192																	
				53-105	83-156	112-222	140-260																	
	5	1962	124	75	108	149	184	213																
				53-103	81-151	102-216	127-256	142-295																
	6	1961	52	69	100	139	178	207	230															
				55-84	83-129	113-188	141-248	166-261	191-290															
	7	1960	11	68	99	136	178	211	239	256														
			58-82	88-115	109-184	131-231	154-276	181-290	218-295															
8	1959	1	69	116	165	241	286	310	320	329														
			85	124	148	201	239	259	287	316	331	346	357											
11	1956	1																						
Total			403	76	112	152	186	210	233	264	322	331	346	357										
				53-112	81-168	102-222	131-260	154-295	181-310	218-320	316-329													

It results from what has been said that for a given species of fish it is impossible to establish one definite value of body length at a time when the scales start developing. The value tends to vary with the time and the locality. For analogous conclusions see Holčík (1960) and other authors.

Table No. 5

Locality	Age group	Annual group	Number of specimens	Average numerical values established for each annulus, with ranges indicated below				
				$l_0$	$l_1$	$l_2$	$l_3$	$l_4$
Danube Vlčie Hrdlo 29. IX. 1966	0	1966	58	57				
	1	1965	62	38-72	68			
	2	1964	99	—	40-86	62	95	
	3	1963	29	—	44-83	60	72-131	120
	4	1962	3	—	43-82	59	64-116	94-138
					56-61	82-99	110-128	145
Total			251	57	64	93	120	145
				38-72	40-86	64-131	94-138	140-152

In the Rybinsk reservoir the body length at the time when the scales started growing was found to be 22 mm, the value established by computation being that of 20 mm. The results are largely in line and the determination is of an adequate accuracy.

The localities of Medvedovo and Vlčie Hrdlo were dealt with simultaneously. The empirically ascertained value (14 mm) does not substantially differ from that which was established by computation. The data conform to the results published by Balon (1962a).

In the Slapy reservoir the growth of breams was investigated since the time when the reservoir was impounded. During the first few years following the filling of the basin with water a marked growth improvement was recorded (see Čihař — Oliva, 1959) which was accounted for by a change of biological conditions in the basin and by a considerable increase of the biomass of benthos and plankton. See Novák (1957) and Hruška (1966). The specimen caught by the author in 1963 was growing up even better than the breams caught by Čihař and Oliva in 1957-1958. A substantial change of hydrobiological conditions took place in 1960, when cold water from the Orlik reservoir began to flow into the Slapy reservoir. Practically only the growth in the upper (upstream) part of the reservoir was influenced by the incoming cold water. The growth of specimens in the lower reaches of the reservoir did not show any marked variation. A temporary improvement of the growth evidently took place in the years of 1963 and 1964, when a large number of fish perished during the winter season. From 1965 onwards, that is, from the time when the Nížbor State Fishery Establishment no longer took charge of the basin's administration, there may also be presumed a gra-

Table No. 6. Comparative study of the growth of the Bream in various localities

Locality	Age													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Bonga — Segerstråle 1933	23	61	95	121	141	164	184	203	233	240	261	274	295	314
Havel (Sarkov) Bauch	38	61	99	130	155	172	195	200	227					
Danube — Komárno, Oliva 1938	46	88	131	166	217	266								
Volga — Kuybyshev, Berg, 1949	46	93	141	193	243	284	318	350	372	400				
Rybinsk basin, 1953, Ostroumov 1956	48	92	130	168	202	235	262	286	313	336	354	373	390	420
Labe near Sadičanky, Oliva, 1958	52	84	121	153	166	176	208							
Danube — Medvedovo, ♀ Balon, 1962	53	106	167	208	239	269	294	317	331	355	383	395		
Poltruba pool, Oliva, 1958	55	77	115	153	181	213	269	335						
Caspian Sea, Enzel (Lukas)	60	158	242	328	358									
Vltava — Praha, Oliva, 1958	62	103	146	165	217	250								
Rožmberk pond, Oliva, 1958	63	120	173	230	266	282	289							
Vl. Hrdlo, Poupě, 1970	64	93	120	145										
Large Plánsk lake, Bauch	70	110	170	250	270	350	400	410	440	500	550	570		
Danube — Medvedovo, Poupě, 1970	72	105												
Dyje — Břeclav, Poupě, 1964	73	117	145	186	217	242	283	300						
Caspian Sea — Teresehenko	73	162	253	295	332	360	393	405	421	431	437	457	462	
Lipno basin ♀♀, Poupě, 1970	75	108	149	192	222	247	265							
Rybinsk reservoir, Poupě, 1970	75	118	156	189	222	250	274	295	315	335	340	344	405	410
Lipno reservoir — Poupě, 1970	76	112	152	186	210	233	264	322	331	346	357			
Slapy reservoir — upper p. Poupě, 1964	78	131	170	210	247	296	329	376	405	425	445			
Slapy reservoir — Čihař — Oliva, 1959	81	126	165	196	216	242	303	340	383	412				
Lipno reservoir ♂♂, Poupě, 1970	81	118	159	195	214	231	261							
Dneperske Prahy, Ovehinik	81	161	238	293	340	375								
Slapy reservoir ♀♀, Poupě, 1964	84	138	178	218	250	294	324	350	392	425	445			
Aralian Sea — Morozova	84	145	202	246	281	314	340	370						
Lipno reservoir — Poupě, 1964	85	133	174	210	235									
Slapy reservoir — Poupě, 1964	85	135	179	219	249	284	230	370	406	425	445			
Slapy reservoir ♂♂, Poupě, 1964	86	133	180	220	248	284	316	390	418					
Slapy reservoir — lower part, Poupě, 1964	87	118	182	225	252	288	310	338						
Danube delta — Papadopol, 1960	112	184	247	297	342									

dual excess of population and thus, with this increased propagation, a deterioration of the growth of the Bream.

The Lipno reservoir underwent a great many changes since the time it had been filled with impounded water. For particulars see Novák (1968). These changes were also reflected in the composition of the fish colony that populated the reservoir. According to statistics of fish caught by the Czechoslovak Federation of Fishermen and by the State Fisheries, the species of fish prevailing in the Lipno reservoir shortly after it had been filled was the pike which up to 1956 accounted for more than one half of all fish caught. The bream made up 0.5% of the yield in 1958 and by 1959 its proportion dropped to less than one-tenth of %. It was not until 1963 that the bream again made up more than one per cent. In 1965 the bream came to nearly one-third of the whole yield of fish, the proportion having risen to as much as 40 per cent in 1966. In 1967 the figure was 50 per cent. The proportion of pikes caught dropped to 31700 of the whole yield in 1962 (which is less than one-third of the total of fish caught, while in 1963 the pike accounted for 27%, in 1964 for 16%, in 1965 for 12%, in 1966 for 8% and in 1967 for 6.6% (8.691 kg). (The above statistical data were taken over from the archives of the Czechoslovak Federation of Fishermen in Prague). These conditions were bound to be reflected in the growth of the Bream. The greatest setback (when compared to the growth of the specimens taken in 1963) is manifested during the first few years of the fish life. Older fish show a markedly better growth than the younger generation. One of the principal factors of an excessive propagation of the Bream is the reduced number of pikes which regulated not only the population of breams, but also that of other species of fish. A depletion of nourishment reserves is due to an excessive propagation of the pope-perch (*Acerina cernua*), the perch (*Perca fluviatilis*) the roach (*Rutilus rutilus*) and the bleak (*Alburnus alburnus*). (According to the information supplied by Ing. Vostradovský, superintendent of the Lipno branch establishment of the VÚRH Vodňany).

As results from the above Table 3, the growth of Bream in the Rybinsk reservoir is a regular one and the accessions show a continuing downward trend. Between the 11<sup>th</sup> and the 14<sup>th</sup> year the continuity of growth is somewhat disrupted. The reasons of this are the outnumbering individuals recruited from the slowly growing population in the category of breams aged 11 and 12 years, the same as the amount of growth of the only one bream aged fourteen years that formed part of the sample; this belongs to an evidently fast-growing population. Substantial differences in the rate of growth of different individuals are caused by the fact that the fish were caught over the entire area of the reservoir and the different parts of it show intense variations of the production capacity. The author's result coincide essentially with those obtained by Ostroumow (1956).

The growth of the Bream from the Danube river at Medvedovo conforms largely to the results recorded by Balon (1962a). At Vlčie Hrdlo the investigation has not been conducted so far. According to the author's findings breams there show the poorest growth among all localities of Danube. When the results obtained by all authors who engaged in the investigation of the growth of the Bream in the Danube river, are compared, it is found that in the blind and subsidiary arms of the river breams grow better than in the

main river stream. Good growth was found to exist in the lower reaches of the river and in the Danube delta.

For data on the influence of parasites and food on the growth of the Bream see Havelka, Round, Vostradovský (1967). Among the localities of its common occurrence the Bream shows the poorest growth in Karelia and in Norway, while it grows best in the warm southern seas (the Black, Caspian and Aralian Sea), the same as in the lower reaches of the rivers which empty into them. It grows better in stagnant and brackish waters than in running fresh water. (Berg, 1949; Bauch, 1953).

#### CONCLUSION

From the results obtained from a study of 1392 specimens of the Bream (*Abramis brama* (L.)) from a total of four localities situated in the territory of Czechoslovakia (the Slapy reservoir — 1963, — 303 specimens, the Lipno reservoir 1967 — 403 specimens, Danube—Medvedovo 1959 — 12 specimens, Danube—Vlčie Hrdlo 1966 — 251 specimens) and from one locality in the territory of the U.S.S.R. (the Rybinsk reservoir 1964 — 247 specimens) the author draws the following conclusions:

- 1) In the localities which have been investigated the fastest growth of bream was found in the Slapy reservoir. The other localities follow then in this order: the Lipno reservoir (1963) the Rybinsk reservoir, the Lipno reservoir (1967), Danube—Medvedovo and Danube—Vlčie Hrdlo.
- 2) In comparison with earlier data, the Lipno reservoir shows a setback in the growth, while no changes have been recorded in the Danube and in the Slapy and Rybinsk reservoirs. The cause of a slow-down of the growth in the Lipno reservoir is an increase of the population and an intensification of competitive consumption of food resulting from changes caused in the examined part of fish population in the course of the stage of stabilization.
- 3) The growth of the bream in the Danube river is a slower one, although it can be characterized as a good one when compared to the data supplied by other authors, particularly from northern localities.
- 4) The weight increase in the younger age categories keeps in line with the increase of body length. In the older age categories it lags slightly behind the growth of the body length. The coefficient of condition values vary considerably with respect to age, sex and time of capture of the different specimens.
- 5) There are more males in the population and they grow slightly worse than the females.
- 6) According to the data acquired from the administration of the Lipno reservoir it can be stated that due to a decrease of the number of predatory fish and to a gradually mounting propagation of the Bream that is going to be an excessive one, the growth of this species will become increasingly worse. Analogous conditions are envisaged for the Slapy reservoir.
- 7) The growth of the Bream in the Rybinsk reservoir is generally found satisfactory. Substantial differences found in the growth from one specimen to another are caused by varying production capacity of the different



parts of the reservoir and by infiltration of more slowly growing fish from the Volga and Sheksna rivers into the reservoir.

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**DIAGNOSTISCHE MERKMALE AN DEN SCHULTERBLÄTTERN  
EINIGER FLEDERMÄUSE DER FAMILIE RHINOLOPHIDAE  
BELL, 1836 UND VESPERTILIONIDAE GRAY, 1821\***

JIRÍ ŽALMAN

Eingegangen am 6. Oktober 1970

**Abstrakt:** In dieser Arbeit sind familien und gattungstypische Merkmale auf der Scapula der Fledermäuse beschrieben. Die festgestellten Merkmale sind in einem Bestimmungsschlüssel zusammengefasst. Die für diagnostische Zwecke dargelegten Proportionsunterschiede sind nur mit Vorsicht zu benützen.

**EINLEITUNG**

In der Diagnostik der Säugetiere werden ständig neue Methoden und Kriterien gesucht. In letzter Zeit wird die Aufmerksamkeit auch der Feststellung und Bewertung der Determinationsmerkmale am postkranialen Skelett gewidmet. Zur Feststellung dieser Merkmale eignen sich besonders Knochen, die morphologisch komplizierter sind und im Bewegungsapparat eine bedeutende Stellung einnehmen. An ihnen können die meisten Unterschiede gefunden werden und zwar deshalb, weil diese exponierten Knochen bei den einzelnen Arten Funktionsänderungen unterliegen. Die gegenseitige Abhängigkeit der Form und Funktion wurde z. B. von Vereščagin (1939), Bohman (1939) und bei uns von Dobroruka (1955) nachgewiesen. Aus den zitierten Arbeiten geht hervor, dass die sich im Knochenbau abspiegelnden Funktionsunterschiede auch innerhalb einer Verwandtschaftsgruppe vorkommen.

Der Bestimmungsmethode der Säuger nach Merkmalen am postkranialen Skelett ist vorderhand sehr wenig Aufmerksamkeit gewidmet worden. Zu den grundlegenden Arbeiten gehört die Studie von Gromova (1950), bei uns beschäftigt sich mit dieser Problematik in letzter Zeit Heráň (1962, 1967, 1968). Die vorliegende Arbeit befasst sich mit der Feststellung diagnostischer (vor allem morphologischer) Merkmale an der Scapula der Fledermäuse. Die Wahl der Scapula war nicht zufällig, da gute Kenntnisse ihrer Morphologie beim Bestimmen von subfossilen Resten der Fledermäuse in Höhlen entscheidend beitragen können.

**MATERIAL UND METHODIK**

Das Material stammt überwiegend aus der Sammlung des Instituts für systematische Zoologie der Karlsuniversität in Prag. Einige Exemplare wurden auch aus der Sammlung des Autors benutzt. Das gesamte Material, das ohne Rücksicht auf das Geschlecht bearbeitet wurde, ist in Tab. 1 zusammengestellt worden.

\* Teil der Diplomarbeit, die unter der Leitung von Dr. V. Hanák, CSc. durchgeführt wurde.

Tab. 1

Art	Zahl
<i>Rhin. ferrumequinum</i>	10
<i>Rhin. hipposideros</i>	8
<i>Rhin. euryale</i>	10
<i>Myotis myotis</i>	9
<i>Myotis blythi oxygnathus</i>	10
<i>Myotis mystacinus</i>	9
<i>Myotis emarginatus</i>	10
<i>Myotis nattereri</i>	10
<i>Myotis daubentoni</i>	10
<i>Myotis bechsteini</i>	2
<i>Eptesicus nilssonii</i>	5
<i>Eptesicus serotinus</i>	10
<i>Nyctalus noctula</i>	9
<i>Pipistrellus pipistrellus</i>	10
<i>Barbastella barbastellus</i>	9
<i>Vespertilio murinus</i>	5
<i>Plecotus austriacus</i>	10
<i>Plecotus auritus</i>	10
<i>Miniopterus schreibersi</i>	10

Alle Scapulae wurden so prepariert, dass sie restlos von Knorpelteilen gelöst wurden. Dabei wurde besonders auf die Entfernung von Cartilago scapulae geachtet, denn nur auf diese Weise präparierte Schulterblätter ähneln den Fragmenten von Schulterblättern, die in Höhlen zu finden sind.

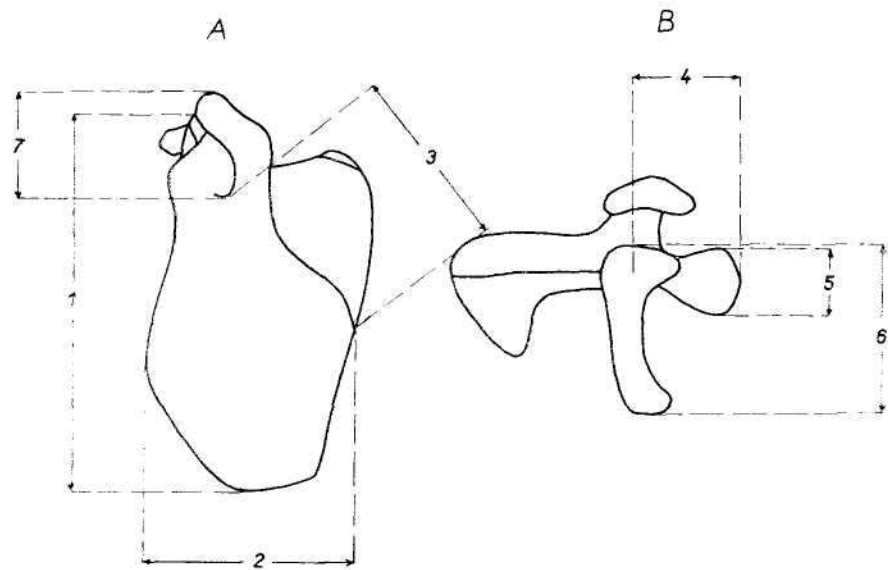


Abb. 1. Schematische Darstellung der Messstrecken am Schulterblatt der 19 untersuchten Fledermausarten. A – Facies lateralis, B – Norma cranialis. 1 – Länge der Scapula, 2 – Breite der Scapula, 3 – Länge der Spina scapulae, 4 – laterocostaler Durchmesser der Cavitas glenoidalis, 5 – craniocaudaler Durchmesser der Cavitas glenoidalis, 6 – Länge des Processus coracoideus, 7 – Länge des Acromions.

Tab. 2

Art	Die Massen an dem Schulterblatt							
		1*	2	3	4	5	6	7
<i>Rhin. ferrumequinum</i>	min	17,0	5,35	8,55	4,0	1,7	5,0	3,6
	max	18,4	6,9	9,8	4,2	1,85	5,2	4,0
	$\bar{x}$	17,62	6,17	8,9	4,04	1,78	5,12	3,82
<i>Rhin. euryale</i>	min	13,1	5,0	6,95	3,1	1,35	3,7	2,8
	max	14,8	5,8	7,6	3,4	1,45	4,4	3,2
	$\bar{x}$	13,78	5,38	7,25	3,26	1,39	4,08	3,02
<i>Rhin. hipposideros</i>	min	10,0	4,1	5,1	2,3	1,05	3,3	2,6
	max	11,4	4,9	5,5	2,5	1,2	3,7	2,9
	$\bar{x}$	10,75	4,59	5,24	2,49	1,15	3,53	2,67
<i>Myotis mystacinus</i>	min	9,2	4,2	4,3	2,3	1,0	2,6	1,95
	max	9,85	4,85	4,8	2,6	1,3	2,9	2,5
	$\bar{x}$	9,40	4,53	4,56	2,41	1,13	2,76	2,21
<i>Myotis myotis</i>	min	15,75	7,2	7,55	4,3	2,0	4,8	3,7
	max	17,3	7,9	8,85	4,9	2,3	5,6	4,25
	$\bar{x}$	16,47	7,51	8,21	4,56	2,11	5,23	3,99
<i>Myotis oxygnathus</i>	min	15,5	6,7	7,5	4,1	1,8	5,0	3,8
	max	16,6	7,05	7,9	4,4	2,05	5,5	4,3
	$\bar{x}$	16,03	6,92	7,70	4,27	1,94	5,17	4,05
<i>Myotis emarginatus</i>	min	10,5	4,75	5,1	2,5	1,3	3,1	2,2
	max	11,15	5,3	6,0	0,3	1,45	3,55	3,1
	$\bar{x}$	10,72	4,96	5,55	2,75	1,36	3,29	2,60
<i>Myotis nattereri</i>	min	10,5	4,65	5,0	2,8	1,1	3,2	2,55
	max	11,3	5,2	5,25	3,1	1,5	3,65	2,9
	$\bar{x}$	10,85	4,88	5,25	2,94	1,30	3,38	2,72
<i>Myotis daubentoni</i>	min	10,2	4,9	4,9	2,75	1,3	2,9	2,3
	max	11,1	5,2	5,45	3,0	1,4	3,3	2,7
	$\bar{x}$	10,67	5,0	5,1	2,89	1,37	3,10	2,52
<i>Eptesicus serotinus</i>	min	14,0	7,0	6,65	4,0	1,55	4,1	3,3
	max	15,95	7,0	7,75	4,8	2,0	4,8	4,0
	$\bar{x}$	15,02	6,49	7,14	4,30	1,87	4,32	3,72
<i>Nyctalus noctula</i>	min	17,0	7,25	6,65	4,65	1,9	6,0	4,2
	max	18,35	8,0	6,95	5,15	2,05	6,3	4,55
	$\bar{x}$	17,4	7,65	6,97	4,84	1,95	6,13	4,37
<i>Pipistr. pipistrellus</i>	min	9,4	4,3	3,8	2,4	1,0	3,3	2,1
	max	9,8	4,6	4,35	2,6	1,1	3,8	2,4
	$\bar{x}$	9,64	4,40	4,19	2,47	1,05	3,45	2,30
<i>Barb. barbastellus</i>	min	11,95	4,9	6,0	3,1	1,4	3,75	2,95
	max	12,75	5,5	6,45	3,45	1,5	4,2	3,55
	$\bar{x}$	12,3	5,26	6,21	3,26	1,41	3,98	3,31
<i>Plecotus auritus</i>	min	11,6	5,0	5,0	2,95	1,3	3,45	2,7
	max	12,5	5,5	5,85	3,3	1,45	3,85	3,0
	$\bar{x}$	11,93	5,31	5,44	3,12	1,38	3,67	2,88
<i>Plecotus austriacus</i>	min	10,55	4,7	5,0	2,6	1,0	3,0	2,4
	max	11,5	5,4	5,7	3,0	1,45	3,4	2,85
	$\bar{x}$	10,94	4,93	5,43	2,74	1,22	3,2	2,64
<i>Min. schreibersi</i>	min	14,0	6,35	5,65	3,8	1,6	4,9	3,5
	max	14,8	6,8	6,3	4,1	1,75	6,0	3,8
	$\bar{x}$	14,77	6,68	6,05	3,95	1,64	5,38	3,66
<i>Eptesicus nilssoni</i>	min	11,4	5,0	5,1	3,3	1,3	3,0	2,6
	max	12,1	5,4	5,3	3,45	1,5	3,9	3,0
	$\bar{x}$	11,79	5,21	5,2	3,37	1,43	3,52	2,80

\* Erklärung wie Abbildung 1.

Die ausgewählten Messstrecken sind der Abb. 1 zu entnehmen. Insgesamt wurden 166 Schulterblätter von 19 verschiedenen Fledermausarten gemessen. Diese Massen sind in Tab. 2 zu finden.

#### ERGEBNISSE

Um den Vergleich der Scapulae der verschiedenen Fledermausarten zu ermöglichen war es vorerst notwendig, ihre allgemeine Beschreibung durchzuführen, was bei Fledermäusen nicht ausführlich geschehen ist. Dabei wurde von den Arbeiten Kuzjakin (1950) und Vaughan (1959) ausgegangen. Die benützte Terminologie basiert auf Nomina Anatomica Veterinaria (1968).

Die Scapula der Fledermäuse (Abb. 2) ist ein verhältnismässig grösser, flacher Knochen, dorsal vom Brustkorb gelagert. Seine längere Achse verläuft diagonal zur Wirbelsäule. Es fehlt die knöcherne Verbindung mit dem

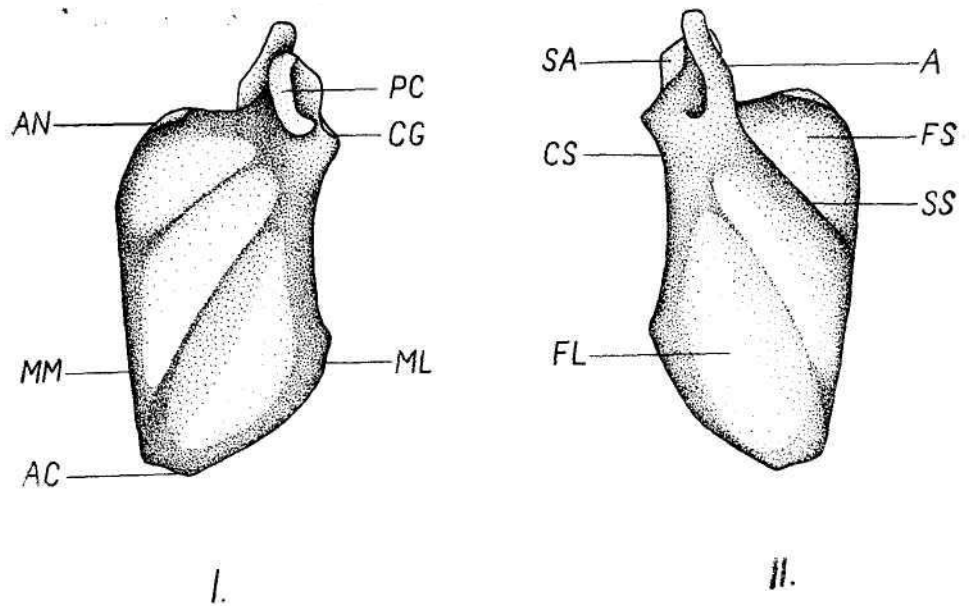


Abb. 2. Linkes Schulterblatt von *Myotis myotis* als Beispiel für das Schulterblatt der Fledermäuse. I – Facies costalis, II – Facies lateralis. A – Acromion, AC – Angulus caudalis, AN – Angulus cranialis, CG – Cavitas glenoidalis, CS – Collum scapulae, FL – Fossa infraspinata, FS – Fossa supraspinata, ML – Margo lateralis, MM – Margo medialis, PC – Processus coracoideus, SS – Spina scapulae, SA – Artikulationsfläche für Tuberculum majus humeri.

Sternum mittels des Coracoid, das bei den Fledermäusen, zum Unterschied von den Vögeln, rudimentär ist. Die Scapula hat die Form eines unregelmässigen Vier- oder Dreiecks. Ihr äusserer Rand, Margo lateralis ist einigermassen verstärkt. Der innere Rand, Margo medialis ist schwächer, der Wirbelsäule zugewandt. Der vordere Rand, Margo cranialis, geht an seinem lateralen Ende in einen hakenförmigen Ausläufer, Processus coracoideus, über. Den proximalen Teil dieses Ausläufers verbindet das Ligamentum coracoclaviculare mit dem Schlüsselbein. Der hintere Winkel der Scapula,

Angulus caudalis, geht in einen dreieckigen Knorpel, Cartilago scapulae über, der bei den Fledermäusen der Familie Rhinolophidae ganz verknöchert ist und so diesem Teil des Schulterblattes eine charakteristische dreieckige Form verleiht (Abb. 3). Mit dem Caput humeri ist das Schulterblatt

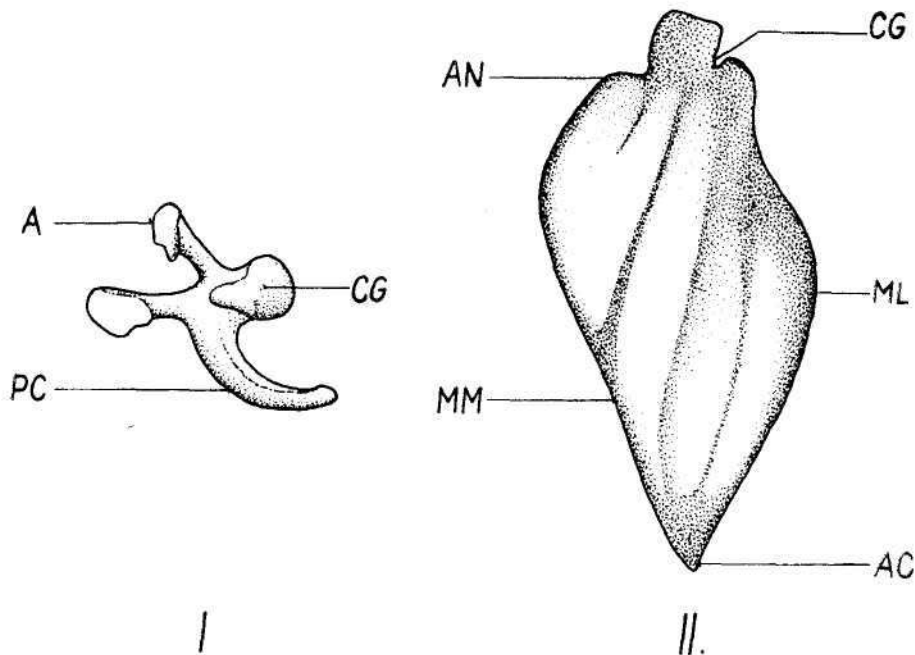


Abb. 3. Linkes Schulterblatt von *Rhinolophus ferrumequinum*. I — Norma externalis, II — Facies costalis. Beschreibung wie Abb. 2.

durch eine konkave Gelenksgrube, Cavitas glenoidalis verbunden. Über der Cavitas glenoidalis, sowie darunter, sind für den Anschluss der Muskeln Tuberculum supraglenoidale und Tuberculum infraglenoidale wahrnehmbar. Für die Verbindung mit dem Tuberculum majus humeri dient eine von der Fossa glenoidalis dorsocranial liegende Facies articularis. Die Cavitas glenoidalis ist vom Körper des Schulterblattes durch ein Collum scapulae getrennt. Den Rippen zugewandte Schulterblattfläche, Facies costalis ist seicht vertieft und trägt in der Mitte eine hervortretende Linea muscularis. Die obere Schulterblattfläche, Facies lateralis ist durch die Spina scapulae in eine kleinere, obere Grube, die Fossa supraspinata und in eine grössere, untere Grube, die Fossa infraspinata geteilt. Die Spina scapulae läuft in einen grossen Acromion aus, dessen distales Ende durch das Ligamentum claviculoacromiale mit dem Schlüsselbein verbunden ist.

#### Unterschiede in der Form des Schulterblattes

Nach der Gesamtform des Schulterblattes lassen sich leicht beide, bei uns vertretene, Fledermausfamilien unterscheiden. Bei der Familie Vespertilionidae hat das Schulterblatt an der Stelle des Angulus caudalis die Form

Tab. 3

Art	Indexe*			Art	Indexe*		
	A	B			A	B	
<i>Rhin. ferrumequinum</i>	min	48,8	28,0	<i>Pip. pipistrellus</i>	min	40,4	34,5
	max	53,2	30,1		max	45,7	38,5
	$\bar{x}$	50,4	29,0		$\bar{x}$	43,4	35,7
	$s_x$	1,40	0,60		$s_x$	1,23	1,11
	s	4,45	1,90		s	3,91	3,20
<i>Myotis myotis</i>	n	10	9	<i>Barb. barbastellus</i>	n	10	9
	min	46,5	29,4		min	48,9	30,6
	max	51,4	33,9		max	52,3	33,4
	$\bar{x}$	49,6	31,7		$\bar{x}$	50,2	32,0
	$s_x$	1,37	1,00		$s_x$	0,82	0,91
<i>Eptesicus serotinus</i>	s	3,89	3,20	s	2,47	2,51	
	n	8	10	n	9	8	
	min	43,7	26,9	<i>Plecotus auritus</i>	min	46,9	28,2
	max	49,6	30,2		max	52,3	30,6
	$\bar{x}$	46,9	28,6		$\bar{x}$	48,6	29,3
$s_x$	1,20	0,81	$s_x$		1,40	0,72	
s	3,83	2,41	s		4,45	1,91	
<i>Nyctalus noctula</i>	n	10	9	<i>Min. schreibersi</i>	n	10	8
	min	38,8	34,0		min	40,3	35,4
	max	42,0	36,2		max	43,1	40,5
	$\bar{x}$	40,0	35,1		$\bar{x}$	41,7	38,0
	$s_x$	0,70	0,42		$s_x$	0,56	1,63
s	2,23	1,43	s	1,91	4,52		
n	10	9	n	10	8		

\* A = Spina scapulae /Schulterblattlänge  $\times 100$ ; B = Länge von Processus coracoideus, /Schulterblattlänge  $\times 100$

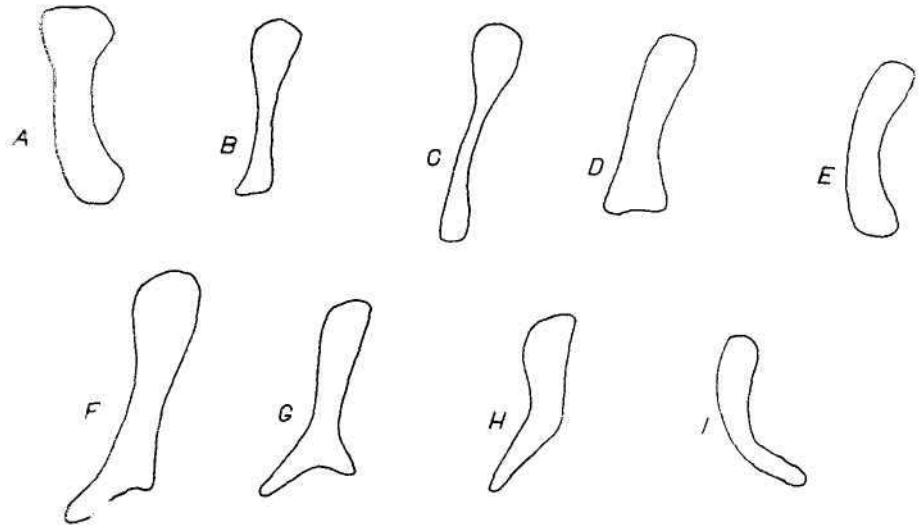
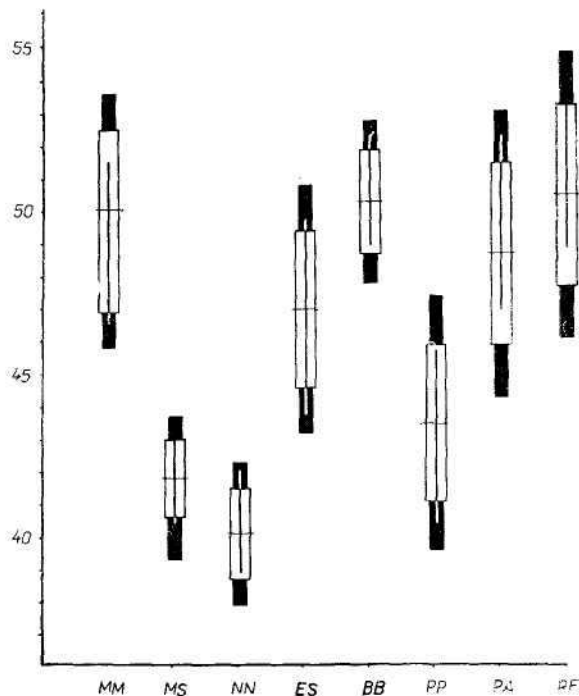


Abb. 4. Schematische Darstellung der Form des Processus coracoideus am linken Schulterblatt bei der Gattung *Myotis* (A), *Barbastella* (B), *Miniopterus* (C), *Eptesicus* (D), *Plecotus* (E), *Nyctalus* (F), *Vespertilio* (G), *Pipistrellus* (H) und *Rhinolophus* (I). Norma cranialis.

Abb. 5. Die zwischenartliche Variabilität der Spina scapulae als Funktion der Schulterblattlänge  $\times 100$ . Index A in Tab. 3. MM — *Myotis myotis*, MS — *Miniopterus schreibersi*, NN — *Nyctalus noctula*, ES — *Eptesicus serotinus*, BB — *Barbastella barbastellus*, PP — *Pipistrellus pipistrellus*, PA — *Plecotus austriacus*, RF — *Rhinolophus ferrumequinum*. Vertikale — Variationsbreite, Horizontale — arithmetisches Mittel, schwarz voll — 1 Standardabweichung beiderseits vom Mittelwert, leeres Rechteck — 2 mittlere Abweichungen beiderseits vom Mittelwert.



eines Vierecks, bei der Familie Rhinolophidae die Form eines scharfwinkligen Dreiecks (Abb. 3). Von den übrigen Familienunterschieden kann zu diagnostischen Zwecken nur der Unterschied in der Form des Processus coracoideus verlässlich verwendet werden.

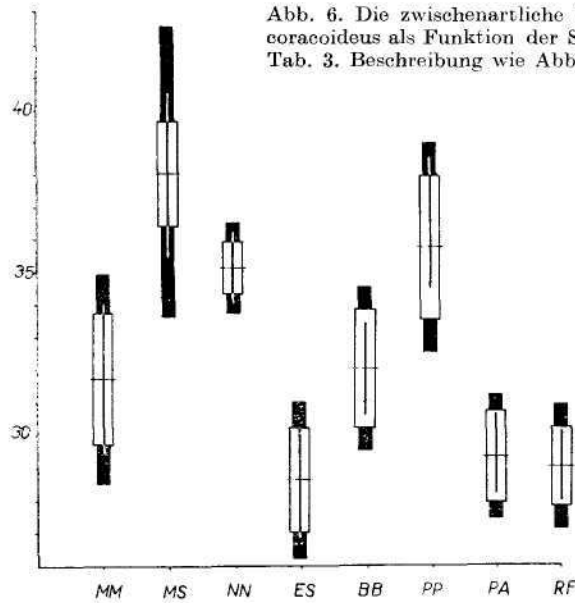
Bei den Hufeisennasen (Abb. 3 und 4I) ist er schlank und lateral so gebogen, dass sein distales Ende das Niveau des lateralen Randes der Cavitas glenoidalis überragt.

Auch die Schulterblätter der Fledermäuse aus der Gattung *Myotis* und *Plecotus* haben einen bogenartigen, lateral gekrümmten Processus coracoideus (Abb. 4A, E), aber sein distales Ende überragt nicht das erwähnte Niveau der Cavitas glenoidalis (Abb. 1B).

Bei der Gattung *Eptesicus* finden wir einen beinahe geraden Processus coracoideus, dessen distales Ende sichtlich erweitert ist (Abb. 4D). Bei der Gattung *Pipistrellus* ist er schlank, ungefähr in der Hälfte seiner Länge medial geknickt (Abb. 4H). Die Gattung *Barbastella* hat ebenfalls einen schlanken, geraden, auf dem distalen Ende häckenartig geknickten Processus coracoideus (Abb. 4B). Bei der Gattung *Nyctalus* und *Vespertilio* finden wir einen gespaltenen Ausläufer (Abb. 4F, G). Bei der Gattung *Miniopterus* beobachten wir einen Processus coracoideus, der gerade, auffallend lang, in der Richtung zum distalen Ende verengend und an der Spitze leicht erweitert ist (Abb. 4C).

An den Schulterblättern der einzelnen Fledermausarten sind auch Proportionsunterschiede zu erkennen. Sie drücken sich vor allem in der Länge des Processus coracoideus und in der Länge der Spina scapulae aus. In Tab. 3 und in Abb. 5 und 6 sind diese Verhältnisse durch die Werte der Indexe A und B ausgedrückt. Bei Anwendung dieser Indexe als Determinationsmerk-

Abb. 6. Die zwischenartliche Variabilität der Länge von Processus coracoideus als Funktion der Schulterblattlänge  $\times 100$ . Index B in Tab. 3. Beschreibung wie Abb. 5.



male muss aber sehr vorsichtig vorgegangen werden, da die Indexwerte eine bedeutende Variabilität ausweisen.

Alle festgestellten und für diagnostische Zwecke geeigneten Merkmale, sind am Ende dieser Arbeit in einem Bestimmungsschlüssel zusammengefasst. Darin sind vorwiegend morphologische Merkmale, nur in einigen Fällen absolute Massen, angegeben, die für die Schulterblätter aller geprüften Arten übersichtlich in Tab. 2 verzeichnet sind.

#### Bestimmungsschlüssel der Familien

- 1/2 Das Schulterblatt und besonders der Teil des Angulus caudalis hat die Form eines scharfwinkligen Dreiecks, der Processus coracoideus ist lateral gebogen und sein distales Ende überragt das Niveau des lateralen Randes der Cavitas glenoidalis . . . . . *Rhinolophidae*
- 2/1 Das Schulterblatt und besonders der Teil des Angulus caudalis hat die Form eines unregelmässigen Vierecks. Falls Processus coracoideus lateral gebogen, überragt sein distales Ende nicht das Niveau des lateralen Randes der Cavitas glenoidalis. . . . . *Vespertilionidae*

#### Bestimmungsschlüssel von Arten der Familie Rhinolophidae

- 1/4 Die Schulterblattlänge kürzer als 17 mm . . . . . 2
- 2/3 Die Länge des Schulterblattes 10,0–11,5 mm . . . . . *Rhinolophus hipposideros*
- 3/2 Die Länge des Schulterblattes 13,0–15,0 mm . . . . . *Rhinolophus euryale*
- 4/1 Das Schulterblatt ist länger als 17 mm . . . . . *Rhinolophus ferrumequinum*

#### Bestimmungsschlüssel von Gattungen der Familie Vespertilionidae

- 1/4 Der Processus coracoideus ist auf dem distalen Ende gespalten . . . . . 2
- 2/3 Die Spaltung des Processus coracoideus ist sehr auffallend, der laterale Zweig ist nur unmerklich kürzer als der mediale (Abb. 4G), die Knochenlänge übersteigt nicht 13 mm . . . . . *Vespertilio*
- 3/2 Der laterale Zweig des gespaltenen Processus coracoideus hat das Aussehen eines lateral herausragenden Höckers, (Abb. 4F), die Knochenlänge stets grösser als 13 mm . . . . . *Nyctalus*
- 4/1 Der Processus coracoideus ist nicht gespalten . . . . . 5



5/8	Der Processus coracoideus ist lateral entweder gebogen oder beinahe gerade, aber in diesem Falle merklich erweitert . . . . .	6
6/7	Der Processus coracoideus ist bogenförmig, lateral gekrümmt (Abb. 4A, E) . . . . .	<i>Myotis, Plecotus</i>
7/6	Der Processus coracoideus ist flach, beinahe gerade und in der Richtung zum distalen Ende erweitert (Abb. 4D) . . . . .	<i>Eptesicus</i>
8/5	Der Processus coracoideus ist lateral nicht gebogen und nicht erweitert . . . . .	9
9/12	Der Processus coracoideus ist gerade und medioventral direkt auslaufend . . . . .	10
10/11	Der Processus coracoideus ist schlank und dem distalen Ende zu verengt. Die Spitze ist häckenförmig gebogen (Abb. 4B). Die Knochenlänge übersteigt nicht 14 mm . . . . .	<i>Barbastella</i>
11/10	Der Processus coracoideus ist schlank, gerade und auffallend lang (Abb. 4C). Die Knochenlänge stets grösser als 14 mm . . . . .	<i>Miniopterus</i>
12/9	Der Processus coracoideus ist schlank, in der Richtung zum distalen Ende verengt und ungefähr in der Hälfte seiner Länge medial geknickt (Abb. 4H), die Knochenlänge übersteigt nicht 10 mm . . . . .	<i>Pipistrellus</i>

Die Gattung *Myotis* ist von der Gattung *Plecotus* nach Merkmalen des Schulterblattes nicht verlässlich unterscheidbar.

#### ZUSAMMENFASSUNG

Auf dem Schulterblatt der Untersuchten Fledermausarten wurden familien und gattungstypische Merkmale beschrieben. Zu den Familien-Merkmalen sind die Form des Schulterblattes im Teile des Angulus caudalis und die gegenseitige Lage des Processus coracoideus und Cavitas glenoidalis zu rechnen. Die gattungstypischen Merkmale sind nur in der Form des Processus coracoideus zu suchen. Die festgestellten Proportionsunterschiede in der Länge des Processus coracoideus sowie der Spina scapulae sind dagegen mit Vorsicht anzuwenden, da sie eine gattungstypische Variabilität meistens nicht aufweisen. Auch die Unterscheidung der Gattung *Myotis* von der Gattung *Plecotus* ist nach Merkmalen am Schulterblatt nicht verlässlich.

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*Anschrift des Verfassers:* Jiří Žalman, Okresní muzeum Praha-východ, Brandýs nad Labem-Stará Boleslav.

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RECENSE — REVIEWS

**Runham N. W. & P. J. Hunter (1970): Terrestrial Slugs.** 184 pp., 57 figs., 14 tpls. Hutchinson University Library, Hutchinson & Co Ltd, London. Price 16s (80 p).

Slugs are terrestrial pulmonate gastropods with a strongly reduced or absent shell and the visceral mass incorporated into the head-foot. It is a group of unrelated species belonging to 2 suborders and 7 families sharing the general appearance and many structural and ecological features. Slugs are serious agricultural pests, particularly of potatoes, winter wheat, sugar beet and horticultural crops, though the damage caused by them varies from country to country, being habitually underestimated.

The authors of the present book, the first one a specialist in the anatomy and development of gastropods, the second in the population ecology and control of slugs, have written a comprehensive and well balanced account of the anatomy, physiology and ecology of slugs in relation to their status as pests and promotion of their use for research and teaching. After the introductory chapter there follows a review of the classification of slugs with special attention given to British species. All aspects of the anatomy, physiology, reproduction and development of slugs are covered next; these parts are commendable for an extremely good integration of structural, functional, behavioural and general bionomical data. The little known ecology of slugs is considered, and the results of Hunter's studies on their population ecology and the relevant methods are discussed in detail. The role of slugs as pests is reviewed and control measures are considered. The book is complemented by an extensive list of references.

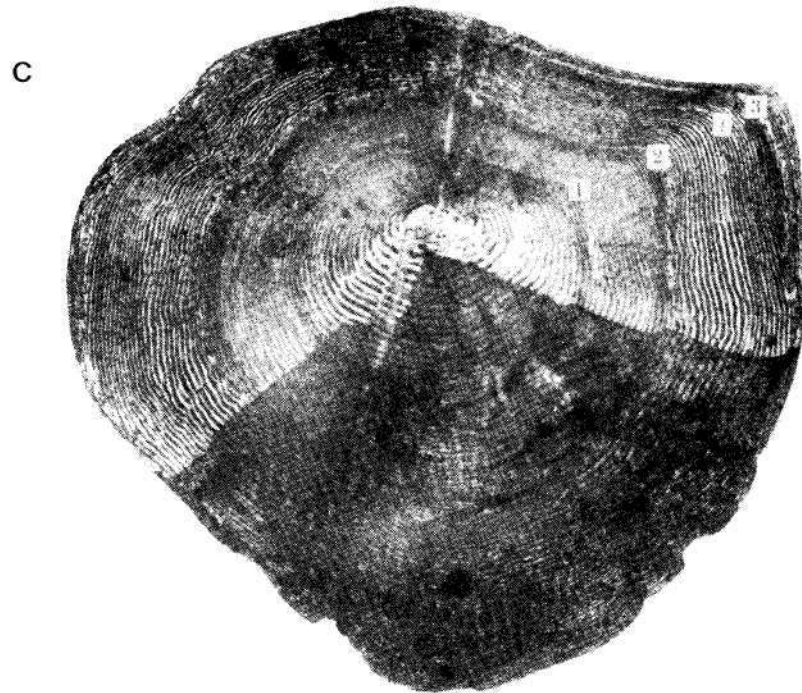
Runham's and Hunter's book represents a very good and the only available account of slugs, and is to be recommended particularly to all zoologists concerned with the basic and applied research of molluscs or with the control of agricultural and horticultural pests. It provides important information for teachers of zoology and students of general ecology as well as in vertebrate anatomy and physiology.

*P. Štys*



Scales of *Alburnus alburnus*.

A and B: Age class II, (2+); standard length 86.0 mm and weight 7.0 grams. A is from the lateral line and in this the annuli are clearly seen.



C: Age class III, (3+); standard length 118.0 mm and weight 19.0 grams. The question mark indicates a false annulus.  
D: Age class III, (3+); standard Length 108.0 mm and weight 16.0 grams.

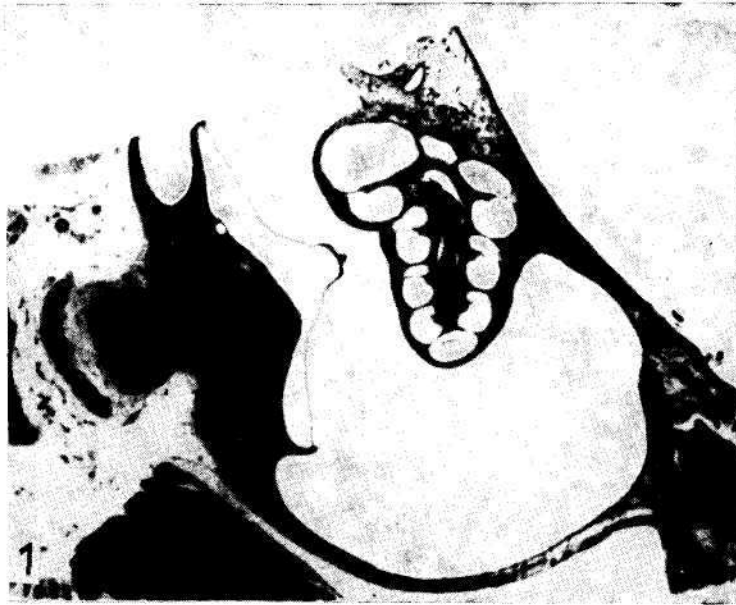


Abb. 1 - Frontalschnitt durch das Meerschweinchen-Mittelohr, 10× vergr. (Nach Friedmann);  
Abb. 2 - Otoskopisches Bild des Meerschweinchen-Trommelfells (10× vergr.).

*Drastik J.: Beitrag zur klinischen Anatomie des Mittelohrs vom Meerschweinchen.*

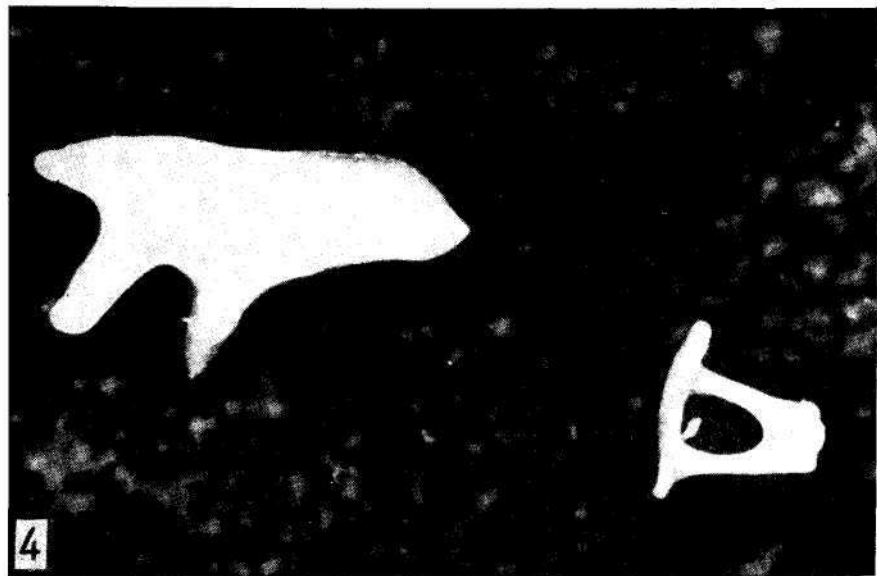


Abb. 3 — Schläfenbein des Meerschweinchens (6× vergr.), a — äusserer Gehörorgan, b — Foramen mastoideum;

Abb. 4 — Gehörknöchelchen vom Meerschweinchen (25× vergr.).



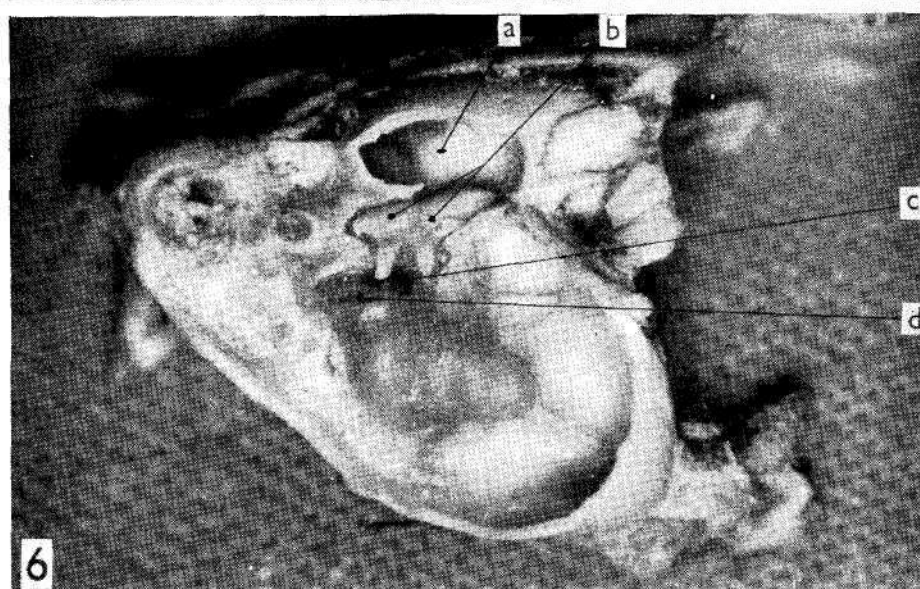
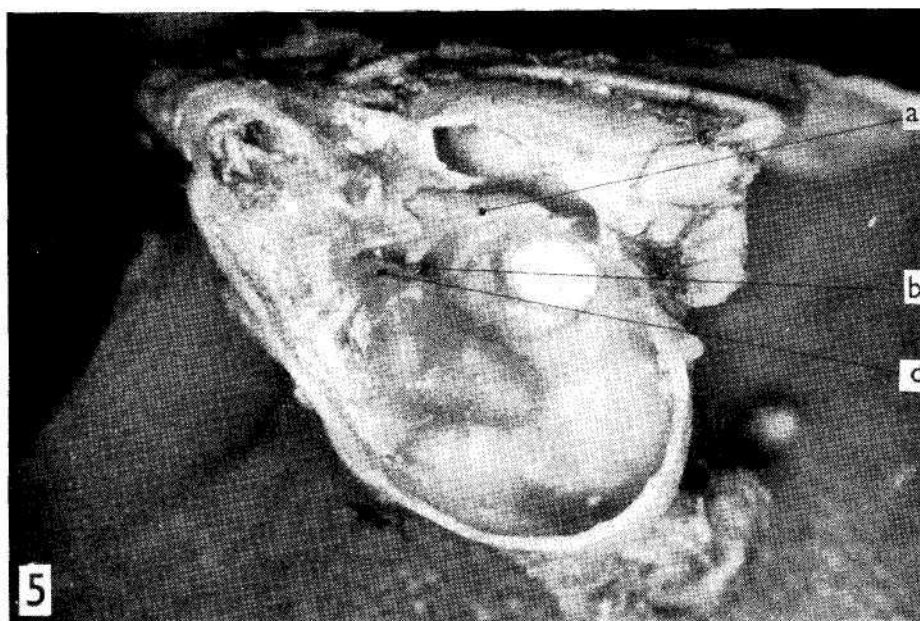


Abb. 5 — Mittelohr des Meerschweinchens nach Abtragung der lateralen Bulla-Wand, a — Hammer-Ambos-Konkretum (Verwachsungs-Linie gut ersichtlich), b — ovales Fenster, c — Nische zum runden Fenster;  
Abb. 6 — Dasselbe nach kompletter Freilegung der Gehörknöchelchen, a — Recessus epitympanicus, b — Hammer und Ambos, c — ovales Fenster mit hineingesunkenem Steigbügel, d — Nische zum runden Fenster.

*Drastik J.: Beitrag zur klinischen Anatomie des Mittelohrs vom Meerschweinchen.*

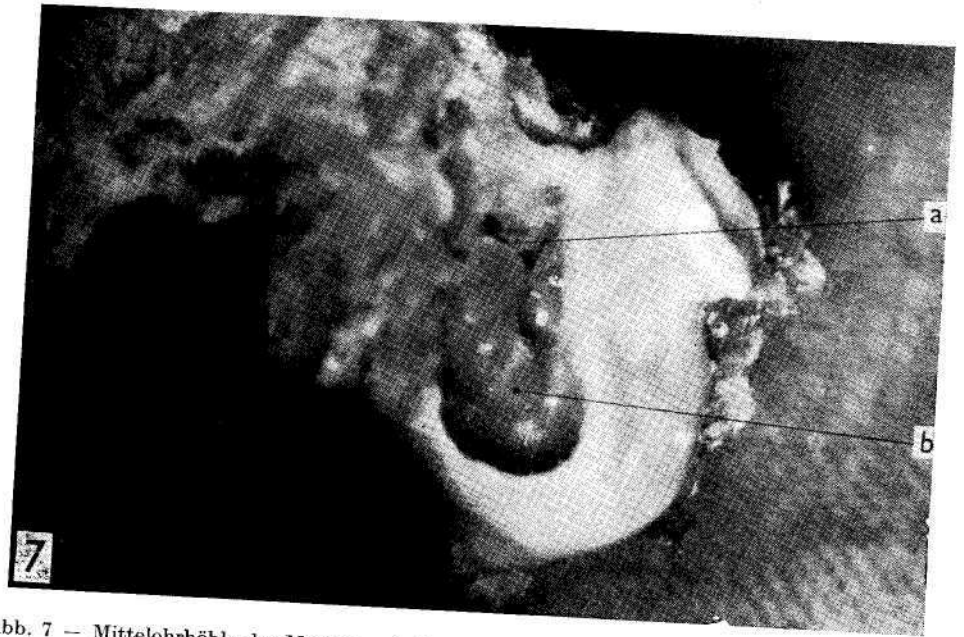


Abb. 7 – Mittelohrhöhle des Meerschweinchens, aus dem retroaurikulären Trepanationszugang gesehen, a – incudo-stapediale Artikulation, b – prominierende Schnecke.



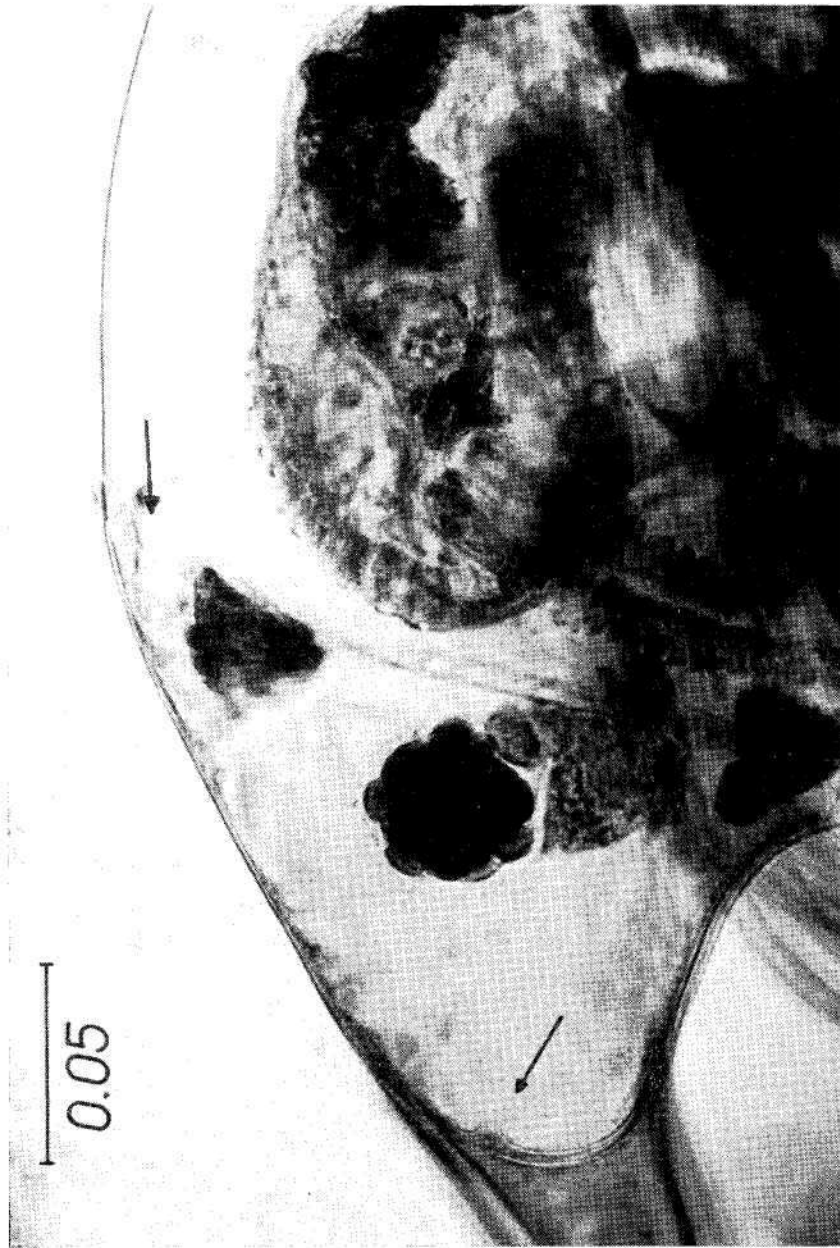


Fig. 12. *Bosmina coregoni gibbera*, connection of both the frontal and median head pores with the brain ganglion. Lake Marzecino, Aug. 1962, Poland. Stained with brilliant cresyl blue and cresyl fast violet.

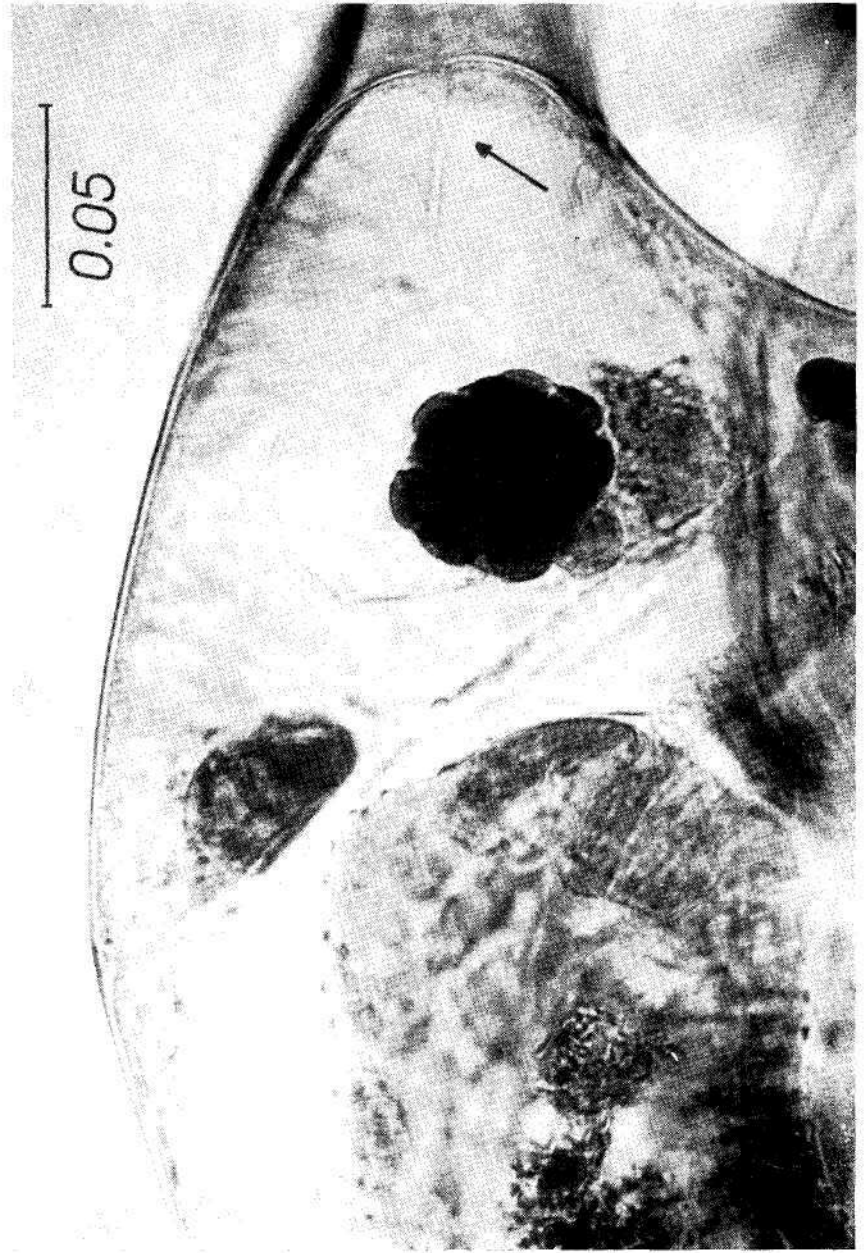


Fig. 13. *Bosmina coregoni berolinensis*. Frontal head pore and its connection with the brain ganglion. The same locality and staining.

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ČESKOSLOVENSKÉ  
SPOLEČNOSTI ZOOLOGICKÉ**

**Svazek XXXV**

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Datum vyjití jednotlivých sešitů

1. — 15. 2. 1971      2. — 19. 5. 1971

Date of offearance of the numbers

3. — 10. 8. 1971      4. — 11. 11. 1971