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NOTES ON SMALL COLLECTION OF FISHES FROM AFGHANISTAN
WITH A DESCRIPTION OF GLYPTOTHORAX JALALENSIS, SP. N. :
(PISCES, Sisoridae)

EUGEN K. BALON and KÁROL HENSEL

Received August 18, 1969

Abstract: The work presents a description and diagnosis of four species of fish from the Afghanistan territory — *Salmo trutta oxianus* Kessler, 1874, *Schizothorax intermedius fedtschenkoi* Kessler, 1872, *Glyptothorax jalalensis* sp. n., and *Ophiocephalus gachua* Hamilton, 1822. The *Glyptothorax jalalensis* sp. n. is simultaneously the first proof of the occurrence of this genus in Afghanistan.

Through the courtesy of Prof. D. Povolný and Dr. J. Gaisler we have received a few specimens of fish collected in Afghanistan during an expedition of the Zoological Institute of the College of Agriculture, Brno, in 1967.

As the available studies on fish from Afghanistan (Day, 1880; Günther, 1889; McClelland, 1842; Annandale and Hora, 1920; Hora, 1934, 1935; Vijayalakshmanan, 1949) and from adjacent territories (Berg, 1949a, b; Turdakov, 1952; Sufi, 1957, 1963; Ahmad and Mirza, 1963, 1964) deal, for the most part, with individual specimens, and since more detailed diagnoses are often lacking, it is considered useful to present here a description of these fishes.

Two specimens of trout were caught on May 20, 1967 in the rapids of a mountain stream (2700 m above sea level) which joins the river Kunduz (a tributary of Amu-Darya) in the Bamian pass. Larger specimens are currently caught here, but only the smallest of them ended in formalin. The remaining fishes described here were caught in the lowland tributaries the Kabul river in the environs of Jalal-Abad (in the Indus watershed), in March and April of 1967.

The specimens are deposited in the collections of the Slovak National Museum in Bratislava.

Salmo trutta oxianus Kessler, 1874

Two specimens, 158 and 143 mm of standard length. The larger one is a female, the smaller one a male. Radu D III 10 and III 9, radu A III 8 in both, radu C VIII 17 VIII and IX 17 VIII, radii P I 11 and I 12, radu V I 8 in both. Lateral line scales 104 in both. Branchial spines 21/21 and 21/22 (external spines on the first branchial arch on left and right side of body) are thin, long and spiniform.

In % of standard length:
head length 29.1 and 29.4; preorbital length 7.6 and 7.7; internasal distance 5.4 and 4.9; diameter of eye 6.0 and 6.3; interorbital distance 8.9 and 8.4; postorbital distance 17.1 and 16.8; praedorsal distance 46.2 and 49.6; praeventral distance 57.6 and 55.2; praeanal distance 76.6 and 75.6; length of caudal peduncle 17.1 and 16.8; distance P-V 32.3 and 30.1; distance V-A 20.2 and 21.0; length of D 14.6 and 12.6; length of A 9.5 and 9.1; length of P 20.9 and 21.7; length of V 15.2 and 16.1.

Both specimens still show well defined juvenile dark spots on either side of their bodies. Both have an equally well developed annulus of the year 1966 on the scales, and a new annulus closely on their margin. Hence, they belong to the 2nd age class. Evidently there is question here of autochthonous trout found in and originally described from the Bamian river (McClelland, 1842), which were later found here and in the upper Amu-Daria river-basin by several authors (Kessler, 1874; Berg, 1905; Hora, 1933, 1935; Nikol'skij, 1938). The characters in our specimens agree with those already described. According to Balon's evolutionary hypothesis (1968) these trout are derived from the extinct Mediterranean species, whose "neotenic" populations penetrated through the continental river system thus far to the East and produced the *ezenami* and *oxianus* forms.

Schizothorax intermedius fedtschenkoi Kessler, 1872

The material from the tributary of the Kabul river contains two females of 178 and 121 mm standard length. Their counts and measurements are as follows: Radii D III 8 in both, radii A III 5 in both, lateral line scales 93 and 87 on the left, and 96 and 84 on the right, transversal rows of scales 19 and 18 on the left, and 16 and 14 on the right, number of branchial spines 14 and 12 on the left, and 17 and 17 on the right, lower pharyngeals 2.3.5 and 2.3.5, on the third hard dorsal ray the larger has 13 and the smaller one 15 little denticles.

In % of standard length:

head length 27.0 and 25.6; preorbital distance 11.2 and 9.1; 1-st barbel length 7.9 and 6.6; 2-nd barbel length 6.7 and 8.3; internasal distance 6.2 and 5.8; diameter of eye 3.9 and 4.5; interorbital distance 9.5 and 8.3; postorbital distance 12.9 and 12.4; depth of head 18.0 and 15.7; head length 17.4 and 14.9; praedorsal distance 53.9 and 53.7; praeventral distance 50.0 and 52.1; praeanal distance 74.7 and 76.8; depth of body 23.6 and 24.0; width of body 15.2 and 14.9; length of caudal peduncle 20.2 and 18.2; depth of caudal peduncle 12.9 and 12.4; width of caudal peduncle 8.4 and 7.4; last height of body 10.7 and 10.7; P-V distance 27.5 and 28.9; V-A distance 24.7 and 24.8; length of D 13.5 and 11.6; length of A 6.7 and 4.9; length of P 20.8 and 19.8; length of V 17.4 and 18.2; height of D 20.2 and 20.7; height of A 19.1 and 19.8.

The larger specimen belongs to the 4th age class (annuli 3+) the smaller one to the 3rd (annuli 2+). The smaller one shows dark irregular spots on its body, while the larger one is free of them, but the upper half of its body is darker (after imbedding in formalin). The larger specimen has strong fleshy lips, divided in the centre of the mandible and lobed at the sides. Fleshiness of lips in the smaller one is only weakly indicated, without lobes.

Glyptothorax jalalensis sp. n. (fig. 1)*

Holotype: Female 73.2 mm long (Fig. 1), caught in a tributary of the Kabul river near the town of Jalal-Abad, in March 1967. It is deposited in the Slovak National Museum under No. RY 2176.

Description: Radii D II 6, radii A III 10, radii P I 8, radii V I 5, radii C XII 17 XII.

In % of standard length:

head length 27.3; preorbital distance 15; diameter of eye 2.2; postorbital distance 12; depth of head 12.3; width of head 19.1; interorbital distance 6.3; internasal distance 4.0; length of nasal barbel 12.8; length of maxillary barbel 23.2; length of external mandibular barbel 16.5; length of internal mandibular barbel 10.4; praedorsal distance 39.6; praeventral distance 47.6; praeanal distance 65.6; depth of body 19.1; width of body 17.8; length of caudal peduncle 21.9; height of caudal peduncle 10.9; width of caudal peduncle 7.5; last height of body 9.3; P-V distance 27.3; V-A distance 16.4; length of D 11.6; length of A 12.0; length of P 20.5; length of V 16.4; height of D spine 11.5; height of A 20.0; length of adipose fin 19.1.

Derivation of the name: According to the town Jalal-Abad.

The head and body are covered with little soft tubercles. The head is longer than wide, but wider than high. The eyes are small and placed dorsally. The upper jaw is longer than the lower one. The mouth is inferior, and narrower than the length of the snout. The teeth are small and sharp, and on the prae-maxillaries they spread out in a narrow continuous crescent-like strip. On the dental, the strips of teeth are separated in the middle by a narrow gap. The lips are smooth, and the nostrils are situated near the tip of the snout. Nasal barbels reach beyond the eyes, the maxillary ones moderately overreach the

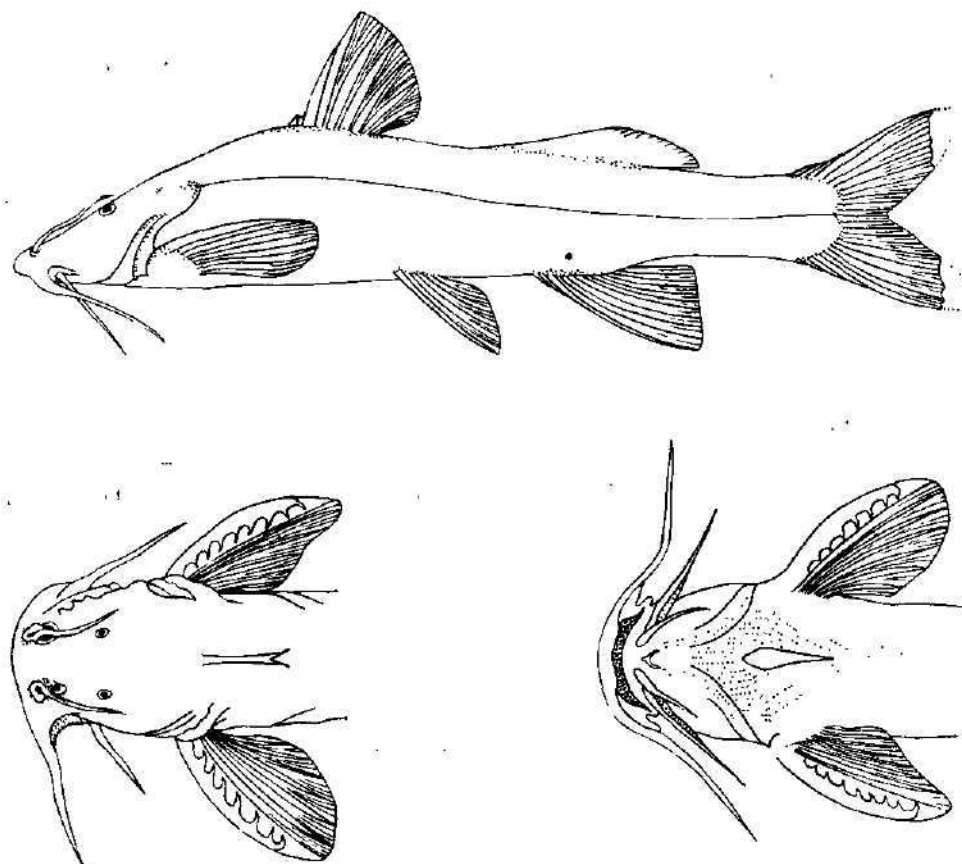


Fig. 1. The holotype of *Glyptothorax jialensis* sp. n. SNM No. RY 2176. Standard length 73.2 mm. Drawn by Mrs. Miriam Baradlai.

base of pectorals; the external mandibular barbels go as far as base of pectorals, while the internal ones are the shortest of all. The body is pressed in from the sides. The adhesive apparatus is developed only on the chest. It is longer than wide, with a slight depression in the middle. The insertion of the dorsal fin is more proximate to the adipose fin than to the end of the snout, and is lower than the height of the body. The dorsal spine is not serrated. The adipose fin is approx. 5 times longer than high, its base twice as long as its height. The gap between the posterior edge of dorsal base and the anterior edge of the

base of adipose fin is approximately equal to the length of the adipose fin. Five osseous platelets are hidden under the skin behind D, and three are behind the adipose fin. The pectoral spine is serrated and carries large teeth bent backwards, 7 on the left and 8 on the right. It is without any adhesive apparatus. The ventral fins reach beyond the anal orificium, but do not attain the anterior edge of anal basis. The anal orificium stands closer to anal base, and has a papilla. The anal fin lies under the adipose one.

The colouring of our specimen embedded in formalin is indistinct. It is darker on the upper part with hardly perceptible darker stains in the region of dorsal and adipose fin.

Discussion: Of the approximately 36 species of the genus *Glyptothorax* known so far, five occur in the Indus river-basis: *G. telchitta* (Hamilton, 1822), *G. cavia* (Hamilton, 1822), *G. platypogonoides* (Bleeker, 1855), *G. kashmiriensis* Hora, 1923 and *G. pectinopterus* (McClelland, 1842). *Glyptothorax stolickae* (Steindachner, 1867) from Simla probably originates from the Jamna river, in the Ganges watershed (Hora, 1923; Sufi, 1957, 1963; Ahmad and Mirza, 1963, 1964). Of these, only two specimens were found in the Kabul river basin, from which comes also our specimen: *G. platypogonoides* and *G. cavia*, both of them in the Swat river in West Pakistan (Sufi, 1957, 1963; Ahmad and Mirza, 1963, 1964). Our specimen is therefore the first proof of the occurrence of this genus on Afghanistan territory.

In our view, the systematics of the genus *Glyptothorax* does not seem to be clear enough. Hardly anything is known about the variability of individual taxonomic features. Likewise, very little is known about sexual dimorphism which is strikingly manifest e.g. in *G. kashmiriensis*. Since our specimen differs by its features from the forms mentioned above, we consider it as new, hitherto undescribed species.

Ophiocephalus gachua Hamilton, 1822

Belongs among the smallest species of the genus and is widely spread — from Afghanistan to Jawa. The features of our specimens agree with those reported by Smith (1945). They are given in the table.

No. of coll.	1	2	3	4	5	6	7	8
standard length in mm	83	73	96	91	90	88	99	87
sex	♂	♂	♀	♀	♀	♀	?	?
rays in D	36	34	36	35	35	34	35	35
rays in A	23	21	23	23	22	22	22	22
lateral line scales	44	44	44	44	43	44	45	44
transversal line scales	4/1/8	4/1/7	4/1/8	4/1/8	4/1/8	4/1/8	4/1/8	4/1/8
dropping row at l. l. scale	13	13	14	13	13	13	13	14
rows of scales on opercle	3	3	3	3	3	3	3	3
rows of scales between eye and angle of preopercle	5	5	5	5	5	5	5	5
in % of standard length:								
head length	31.3	32.3	32.3	31.9	33.3	31.1	31.1	33.3
præorbital distance	6.9	6.3	6.2	6.6	7.3	6.8	7.1	7.3
internasal distance	4.8	3.6	4.6	4.4	4.7	4.8	4.5	4.5
diameter of eye	4.8	5.2	5.1	4.8	4.9	4.5	4.5	5.0
interorbital distance	9.5	9.6	9.8	9.2	9.7	9.5	9.7	10.3
postorbital distance	20.2	20.5	21.2	20.9	21.3	20.7	20.8	21.3
head depth	15.6	16.4	17.4	16.5	17.8	16.8	17.3	16.5

head length	21.4	21.9	21.9	22.0	21.7	21.0	21.2	22.3
praedorsal distance	37.3	34.2	36.4	37.4	38.2	36.0	35.3	36.8
praeventral distance	38.5	39.7	39.6	39.6	38.9	38.9	37.4	41.4
praeanal distance	57.5	54.8	57.9	58.2	57.4	56.7	56.6	58.6
body depth	21.0	20.5	20.8	20.9	21.5	19.6	19.2	19.5
body width	19.3	17.8	18.7	18.5	19.8	18.2	18.2	18.4
caudal peduncle length	7.9	10.9	11.4	9.9	10.0	11.9	10.5	9.2
caudal peduncle depth	12.4	11.5	12.2	12.1	12.8	12.7	11.1	11.5
caudal peduncle width	5.8	5.5	6.1	4.7	5.5	5.4	4.8	5.7
last height of body	11.8	10.4	11.8	11.0	11.1	11.4	10.8	11.9
P-V distance	15.1	13.4	14.8	13.2	13.8	13.3	13.1	14.7
V-A distance	18.5	17.5	17.4	19.6	18.1	17.1	18.2	20.2
length of D	57.8	57.5	58.1	52.7	56.2	55.2	54.5	56.3
length of A	36.1	35.6	37.5	39.6	36.7	36.4	36.4	33.3
length of C	18.8	—	17.7	19.8	20.0	20.4	19.2	20.7
length of P	17.5	19.2	16.7	18.5	17.8	18.2	15.6	18.4
length of V	6.0	8.2	6.8	7.5	6.7	6.8	7.1	8.0

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* not seen in original

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**A CONTRIBUTION TO THE GROWTH OF YOUNG ROACH
(RUTILUS RUTILUS) WITH A DISCUSSION CONCERNING
THE RATE OF GROWTH**

STANISLAV FRANK

Received November 13, 1969

Abstract: The author describes the scalation and the rate of growth of young roaches (945 specimens) caught in the years 1962—1963 in the valley water reservoir of Klíčava (Middle Bohemia).

Roach is a common fish of European freshwaters, i.e. rivers, ponds, lakes, valley water reservoirs, but also of brackish waters, above all at the mouths of rivers emptying themselves into the Baltic Sea. Relatively well known is the rate of growth and the food biology of roach older than one year (Järnefelt, 1921; Schilde, 1935, 1936; Neuhaus, 1936; Stangenberg, 1953; Balon, 1955; Hruška, 1956; Frank, 1959a, b, 1962; Frank—Vostradovský, 1961; Holčík, 1961; Cabejšek, 1964; Cabejšek — Frank, 1968). The spawning, the postembryonic development and the scale foundation of roach was dealt with by Balon (1956a, b). As to the growth of roach during the first year of their life, only few statements can to be found.

MATERIAL AND METHOD

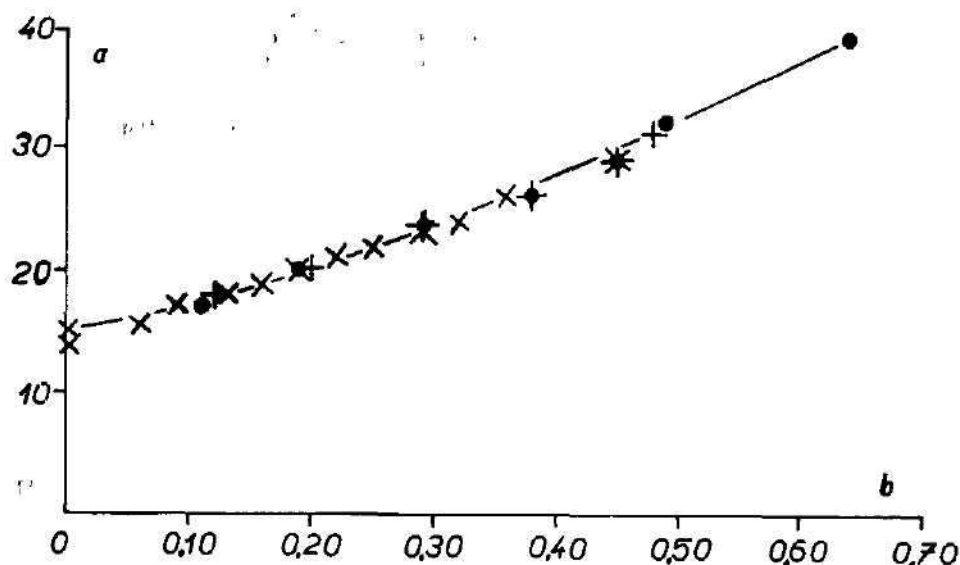
In the following study the growth of roach in the course of the first year of life in the valley water reservoir of Klíčava in the years 1962—1963 is treated and the results are discussed in comparison to literary statements concerning the growth of roach in general, as well as in relation to the quantitative development of fish populations in newly founded valley water reservoirs. On the whole 945 young roaches from the valley water reservoir of Klíčava were collected during the years 1962—1963 (the inundated area is 67 ha). After the capture these roaches were preserved by 4% formalin. The body-length stated in the graph and the tables was measured from the beginning of the upper jaw (snout) up to the end of the body scalation, or in the smallest specimens (16—17 mm of body-length) up to the beginning of the caudal fin (the end of hypural plates).

The scales were taken from the left body-side above the beginning of the insertion of the anal fin from the series below the lateral line, or in the smallest specimens (16—17 mm) from the tail side, approximately in the middle between the anal fin and the caudal fin. In each fish only the diagonal radius of one scale was measured.

RESULTS AND DISCUSSION

In young roaches from the valley water reservoir of Klíčava the first scales were found when their body-length (without the caudal fin) was 16 mm. The first scales were developing on the sides of the tail (between the anal and caudal fin) similarly as was found by Balon (1956a, b). The diagonal radius

of the basal plate (as yet without circuli) measured 0.06 mm (see table 1). The relationship between the growth of scales and the body-length is from the beginning of life typically parabolic and as regards the valley water reservoir of Klíčava the course of the curve was the same in the years 1962 and 1963 (Graph 1).



Graph 1. The body-scale relationship of roach (945 specimens) caught in the years 1962 and 1963.
 ● — a sample of roach (246 specimens) caught on 9th August, 1962, under the filter dam of the brook of Klíčava
 + — a sample of roach (141 specimens) caught on 9th August, 1962, under the filter dam of the brook of Lánský
 × — a sample of roach (558 specimens) caught on 16 June, 1963, under the filter dam of the brook of Lánský and on the bank near the island in the lower part of the valley water reservoir
 a — body-length in mm
 b — diagonal radius of scale in mm

It was with the other fish species forming the original ichthyofauna of the brooks of Klíčava and Lánský that roach came into the valley water reservoir of Klíčava. In the first years after the valley water reservoir had been filled up with water, the total number of roach was very low and the captures made in studying the quantitative development of fishes during the year contained only isolated specimens of roach (Oliva—Holčík, 1965). But after the year 1957 a rapid rise of this species took place, so that in the years 1963 to 1964 the roach is (after the perch, *Perca fluviatilis*) the second most numerous species living in the valley water reservoir of Klíčava (Holčík, 1965, 1967). The rate of growth of roaches in the valley water reservoir of Klíčava caught during the year 1957 (Frank, 1957a) was higher than that of roaches in the valley water reservoir of Slapy. Only roaches from the valley water reservoir of Pastviny grew yet more quickly, which fact was also confirmed by the results of Holčík (1965). Further results of Holčík (1965, 1967), obtained in studying the rate of growth of roach in the course of the years 1962—1964

in the valley water reservoir of Klíčava, in comparison to other places of capture, rivers, ponds or other valley water reservoirs, confirm a strikingly rapid growth of roach in the valley water reservoir of Klíčava. It is interesting, however, that young roach grow relatively slowly during the first year of life (see tables 1 and 2).

Tab 1. Average body-length and diagonal scale-radius of young roach in different size groups in valley reservoir of Klíčava

Size group in mm from—to	Average body-length in mm	Average diagonal radius of scale in mm	Number of specimens	Date and place of capture
16—18	17	0.11	44	9. VIII. 1962 ● *)
19—21	20	0.19	116	
22—24	23	0.29	58	
25—27	26	0.38	14	
28—30	29	0.45	8	
31—35	32	0.49	4	
36—40	39	0.64	2	9. VIII. 1962 + *)
Total			246	
16—18	18	0.12	17	
19—21	20	0.20	46	
22—24	23	0.29	61	
25—27	26	0.38	13	
28—30	29	0.45	3	16. VII. 1963 × *)
31—35	31	0.48	1	
Total			141	
14	14	—	16	
15	15	—	14	
16	16	0.06	33	
17	17	0.09	25	
18	18	0.13	44	16. VII. 1963 × *)
19	19	0.16	57	
20	20	0.19	63	
21	21	0.22	73	
22	22	0.25	83	
23	23	0.29	62	
24	24	0.32	44	
25—27	26	0.36	39	
28—30	29	0.45	6	
Total			558	

*) ●, +, × see graph 1

Moreover the valley water reservoir of Klíčava has a characteristic feature, i.e. the lack of benthic fauna (a watersupply reservoir with a stone base) and even the zooplankton is not developed very much (Řeháčková, 1959). A rapid growth of older groups of roach must consequently depend above all on plant food which, according to a number of authors, form an important food component (Järnefelt, 1921; Hartley, 1947; Hruška, 1956; Bogdanov, 1959; Bogatova, 1963 etc.).

But the fact that even roach with a slow rate of growth in any period of life are able to react immediately on the improved life conditions by a quicker rate of growth, had been investigated and proved in the experimental natural pond or pool Poltruba (the area of this natural pond being 1804 m², the greatest depth 6 m) in the river basin of the river Elbe. The slowly growing and considerably numerous fish population in the natural pond Poltruba (Oliva, 1960) was poisoned by Rotenon in September 1955. In the spring of 1956 during a flood of the river Elbe a wide neighbourhood was overflowed too and a small number of roach, which were also growing slowly, penetrated

Tab. 2. Average growth of roach in 1 st year of life

Place of capture	Author	Date of capture	Average body-length in mm	Number of fish
Pool of Poltruba (middle Bohemia)	Balon, 1955	25. VIII. 1952	43	9
		29. IX. 1952	49	23
Pool of Poltruba	Frank, 1959	7. IX. 1955	42	41
Valley Reservoir of Lipno	Frank-Vostradovský, 1961	1959	54	27
Valley Reservoir of Klíčava	writer	9. VIII. 1962	21	387
		16. VII. 1963	21	558

from the natural pond Procházková into the natural pond Poltruba. A new poisoning of fish in the natural pond Poltruba took place in August 1956. On the whole 693 roaches were obtained from the natural pond Poltruba in the years 1955 and 1956. It is the graph 3 (Frank, 1959b) which informs us best about the plasticity of growth during the life of roach in dependence on the volume of fish population and on the quantity of accessible food. This graph demonstrates the expressively improved last increments of roach in all age groups. It follows from this graph that a slow growth of roach has no genetic cause, but that it is influenced directly by the number of fishes in the basin and consequently also by the quantity and accessibility of food (Frank, 1959b, 1962).

In newly built valley water reservoirs we mostly meet with a rapid growth of cyprinid fishes, above all immediately after the valley reservoir had been filled up with water (Oliva and Frank, 1959a, b; Frank and Vostradovský, 1961, Balon, 1962 etc.). This fact can be easily explained on the basis of the rich development of plankton in newly flooded areas, which are very fertile (fields, meadows, cleared woods etc.). But in the following years, as a consequence of increasing numerically the populations of different fish species, the year increments are rapidly decreasing again because the food supplies are quickly getting used up. The acceleration of the growth of roach in the valley reservoir of Klíčava only at a later time seems then to be in a direct contradiction with the above-mentioned statements. However, here it is possible too to bring the rapid growth of roach during a few last years into a direct relationship with the slow overgrowing of the valley reservoir with submersed vegetation and with the increasing of the amount of phytoplankton, which both remarkably influenced the rate of growth of roach

and also shortened their period of sexual maturing as well as increased their fertility (Stehlík, 1965; Holčík, 1965, 1967).

CONCLUSION

The rate of growth of young roaches (945 specimens) had been watched for two years (1962—1963) in the walley water reservoir of Klíčava (Middle Bohemia). It was found out:

1) The first scales on the body of roach develop in a series on the side of the tail in the row between the anal and caudal fin. The diagonal radius of the basal scale plate (as yet without circuli) measured 0.06 mm, while the body-length of fish (without the caudal fin) amounted to 16 mm. The scalation of bigger specimens (17 mm) spread quickly above the anal fin too.

2) The relationship between the growth of scales and the body-length of roach is from the beginning of life typically parabolic.

3) No difference was found in the course of the curve (body-scale relationship) during two successive years 1962 and 1963.

4) It was proved again that the growth of roach depends first of all on the environment (mainly the quantity of food and the food composition) and can change owing to altered food conditions at any time during the life of roach. Then even in case of slowly growing populations often it is not the matter of the so-called dwarf form (within the scope of species), but only temporary unsuitable life (above all food) conditions, as well as very soon the dependence of the young fish on the overpopulation and inter- or intraspecific food competitions.

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INCIDENCE OF DIAPAUSE IN *AELIA ACUMINATA* (L.)
POPULATIONS FROM SOUTHWEST SLOVAKIA (HETEROPTERA)

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Abstract: In spite of conditions adverse to diapause (18 hr photophase in 24 hrs, 25—28°C const., supply of fresh food) a high percentage of bugs undergo diapause in F₁ generation: usually 85—95%. The percentage of the obligatory onset of diapause gradually decreases in successive generations of the continuous laboratory culture (in conditions stated). It is suggested that the decrease is achieved by negative selection of the diapause tendency. The tendency to obligatory onset of diapause is assumed to predominate in SW-Slovakian populations of *Aelia acuminata*.

INTRODUCTION

Aelia acuminata (L.) is a serious pest of grain in North Africa and in the Near East, together with other species of the genus *Aelia*, and especially with the Sunn Pest, *Eurygaster integriceps* Put. In some years it can endanger cereal crops in South-west and South-east Slovakia. Being a thermophil element, it is less common in colder parts of Czechoslovakia.

As early as in midsummer the imagoes fall into diapause which is a conspicuous feature of the life history of *Aelia acuminata*. The type of dormancy cannot be revealed if the life history is followed in natural conditions. Often the apparent obligatory monovoltinism (obligatory diapause) in the field may be caused by environmental conditions and thus, in fact, the latent potential polyvoltinism (facultative diapause) is involved which becomes evident under suitable laboratory conditions. Therefore the bugs of parent generation were transferred to the laboratory and successive generations reared there.

The aim of this study was to estimate the proportion between the effect of inner and environmental factors on the onset of diapause in our populations of *Aelia acuminata*. The authors are aware that a full genetic analysis was not carried out; to that end more numerous cultures of isolated lines and experimental cross-breeding would be needed. We think, however, that the presented results give a good idea about the incidence of short and long obligatory diapause in *Aelia acuminata*.

MATERIAL AND METHODS

Habitats of *Aelia*

According to our sampling in South-west Slovakia we presume two types of occurrence of *Aelia acuminata* there. In thin, light, mixed woods we may find bugs on grass steadily from spring

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till autumn. It may be assumed that the bugs develop and hibernate in this habitat. On the other hand, the occurrence of *A. acuminata* on grassy clearings of Malé Karpaty-hills alternates in time with the occurrence on grain fields in the lowland. Bugs are abundant on clearings on hills as early as mid-August, after grain in the lowland has been mown. They are almost entirely absent on clearings since late spring when they occur in large numbers on green fields of wheat, at first chiefly on green corn sown in autumn. Thus a spring migration from the hills to fields and the flight in the opposite direction in mid or late summer may be assumed.

Sampling and transfer

Bugs were collected throughout the whole year from the woods surrounding Plavecký Štvrtok, in spring on green wheat fields near Zohor and Lozorno, and in autumn on clearings in Malé Karpaty near Júr, Limbach, Jablonové. All the localities are in the vicinity of Bratislava. The average temperature of this area (measured in Bratislava-Vajnory) is 9,8° C.

The quantity of bugs collected from different habitats is not comparable: a certain number of sweepings in the wheat field provides more bugs than the same number of sweepings in a thin, irregular growth of wild grass in the forest. Collected bugs were transferred to the laboratory in plastic containers with grass; the lid was provided with a silon web and a moist cotton plug.

Breeding

After the failure of breeding in glass cylinders covered with silon, where food was soon depreciated by drying out or moulding, a method was introduced, decreasing the mortality to about 10%. The breeding procedure has been published only in Czech (Hodek, 1968) and is briefly described here. Bugs are kept in low plastic containers with a hole in the lid (taking up about a quarter of its diameter), covered with transparent silon. A bunch of green wheat is passed through a small hole in the bottom and around it some dry wheat corn is scattered. Series of vessels are placed on containers filled with water. Water transpiring from the leaves of wheat maintains the appropriate air humidity and the hole in the lid prevents vapour to condense on it. The nymphs of the 1st and 2nd instars are held in small flat boxes of 7—8 × 2—3,5 cm, 2—3 cm high. For the nymphs of the 3rd and 4th instars and for the imagoes larger containers are used, usually of a cubic shape (10 × 10 × 10 cm, or prismatic ones, equal in volume to 2 cubic boxes). Isolated couples are kept in smaller boxes of square base 4 × 4 cm, 6 cm high. Fresh food is exchanged every 5—6th day at 25° C, or every 4—5th day at 27—28° C. Grain is offered dry (care must be taken that it has not been treated with pesticides). Green corn attains a usable height after having been grown for a week in moist sawdust under 25° C.

The nymphs of the 1st instar are sensitive to touch, therefore eggs on a part of the wheat leaf are put into the little boxes. Usually batches of 12 eggs are laid.

The bugs were kept in air-conditioned boxes at temperatures of 25° and 27° C and photoperiods of 24 hours with 12 hr and 18 hr photophase. The P-generation was reared in mass cultures (Tab. 1—3), or as isolated couples (Tab. 4—11).

Non-diapausing females oviposited after 7—10 days. The bugs were reared for 3 weeks before they were dissected. The females with undeveloped ovarioles (no oocytes visible in the vitellarium) were considered as diapausing. The females with developing oocytes or mature eggs were considered as non-diapausing. Intermediate females produced abundantly in atypical conditions in experiments described elsewhere (Hodek, in prep.) were found here only exceptionally.

Some abbreviations are used: The symbol L 18, D 6 denotes a 24 hr photoperiod with a 18 hr photophase and a 6 hr scotophase, similarly L 12, D 12. The F₁ and F₂ generations of the strains of the same origin, cultured simultaneously, are denoted as B₁ and B₂, H₁ and H₂, O₁ and O₂ or b₁ and b₂, etc. For cultures of single pairs the abbreviation sp is used.

RESULTS

1) Variability of diapause incidence and intensity in F₁-generations

a) Incidence of diapause in F₁-females

The proportion of diapausing females was variable. Rather important differences in diapause incidence were found between small groups of only 10—20 individuals. More reliable data could be achieved only as averages from more numerous breedings.

This fact is reflected e.g. by comparison of the culture of isolated pairs B₁ sp (Tab. 5) and the group culture B₁ (Tab. 4). Although all individuals of both cultures are progeny of one pair, the proportion of diapausing females does not coincide, amounting to 86% in the group culture B₁, whereas 5 females out of 10 diapause in the strain B₁-sp. A similar, evidently erratic proportion of diapausing females was achieved in another F₁ culture of single pairs (Tab. 11), where only 8 (out of 15) females were diapausing.

The variability in percentage of diapausing females was not very high among the group cultures of F₁-generation (Tab. 1), the lowest value achieved being 78% and the highest 97%.

Tab. 1. Incidence of diapause in the first four successive generations reared as group cultures at long-day conditions (L 18, D 6)

P-gen. bugs sampled on	gen.	Males		Females	
		number	diapausing (%)	number	diapausing (%)
11. 5. 1966 ²⁾	F ₁	—	—	115	78
13. 5. 1967 ¹⁾	F ₁	24	100	40	95
8. 6. 1967 ¹⁾	F ₁	39	90	51	88
	F ₂	34	88	67	91
31. 7. 1967 ¹⁾	F ₁	68	96	95	87
	F ₂	171	75	167	51
	F ₃	72	58	82	38
	F ₄	31	20	41	7
15. 9. 1967 ¹⁾	F ₁	40	88	37	97
	F ₂	61	90	73	78
	F ₃	49	71	55	53
	F ₄	52	77	55	53
13. 5. 1969 ¹⁾	F ₁	—	—	211	95
	F ₂	—	—	82	65
	F ₃	—	—	40	55
13. 5. 1969 ²⁾	F ₁	—	—	257	92
	F ₂	—	—	36	61
	F ₃	—	—	31	42

¹⁾ sampled on wild grass in the forest

²⁾ sampled on a wheat field

As the differences in diapause incidence were presumed to be inherited from parents with different diapause tendencies, isolated lines were bred in 1966 (Tab. 4), originating from single pairs of bugs. The percentage of diapause ranged, however, between 86 and 100%. This result does not differ from the conditions in the group cultures.

b) Different habitats

Aelia acuminata populations in South-west Slovakia have apparently two different types of occurrence (see Material and Methods). As the field and the forest differ in temperature and seasonal availability of the host-plant, the difference in diapause tendencies could have been expected between the bugs originating from these habitats.

The grouping of the results for diapause incidence in the F_1 -generation according to the origin of bugs does not reveal, however, any difference (Tab. 1 and 4).

Tab. 2. Incidence of diapause in later generations reared successively at long-day conditions (L 18, D 6)

Gen.	Males		Females	
	number	diapausing (%)	number	diapausing (%)
F_9	129	64	128	37
F_{11}	44	20	54	13
F_{12}	54	37	47	34
F_{13}	41	24	35	48
F_{14}	94	44	73	26
F_{15}	52	40	44	23
F_{16}	92	43	74	14
F_{17}	108	47	74	16

e) Parental effect

In order to check whether the hibernation of parents might affect the incidence of diapause in F_1 -generation we sampled the adults both after hibernation — in spring, and before hibernation — in autumn. The spring adults oviposited immediately or very soon, the bugs from the fall samples

Tab. 3. Percentage of diapausing bugs reared in successive generations at short-day conditions (L 12, D 12)

Gen.	Males		Females	
	number	diapausing (%)	number	diapausing (%)
F_1	127	100	133	100
F_3	29	83	19	85
F_9	99	88	123	89
F_{11}	50	82	43	77
F_{16}	76	89	53	79

after a prolonged pre-oviposition period (Hodek, Honěk, 1970). We can compare the diapause incidence in offspring of isolated couples of the P-generation in 1966 (Tab. 4). In the "spring cultures" the percentage of diapausing females ranged between 86 and 100% (aver. 93%) and in "fall cultures" the range was very similar: 89—92% (aver. 90%). Other results for comparison are from 1967, when the P-generation was reared in mass cultures. Here, too, the diapause incidence in F_1 -generation was the same both in the progeny of spring (May, 13) and fall (September, 15) samples, 95 and 97% resp. (Tab. 1.)

Considering the great variability of diapause incidence in *A. acuminata* populations, the above results are very stable and unambiguously exclude

the possibility of a parental effect, caused by a different environmental experience of the P-generation.

d) Intensity of diapause in F₁-females

The cultures of isolated couples reveal the variability in the duration of the pre-oviposition period at long-day conditions, i.e. in the diapause intensity.

Tab. 4. Incidence of diapause in isolated lines of single pairs, reared at long-day conditions (L 18, D 6)

P-gen. bugs sampled	Generation	Group culture	Number of females	Females with undeveloped ovaries (%)
11. 5. 1966 Zohor	F ₁	B ₁	44	86
		H ₁	38	97
		O ₁	21	100
		total	103	93
	F ₂	B ₂	89	65
		H ₂	59	89
		total	148	75
		B ₁ —B ₂		21
		H ₁ —H ₂		9
2. 9. 1966 Malé Karpáty hills near Júr	F ₁	b ₁	36	92
		h ₁	75	92
		o ₁	66	89
		total	177	90
	F ₂	b ₂	93	87
		b ₁ —b ₂		5

Bugs of the F₁ cultures are progeny of single couples belonging to the P-generation; bugs of the F₂ cultures B₂, H₂, b₂ resp. are progeny of single couples belonging to the cultures B₁, H₁, b₁ resp.

The intensity of diapause was lowest in B₁-sp (Tab. 5) (i.e. in the same series where also the lowest diapause incidence was found), where the pre-oviposition period of diapausing females averaged to 82 days (37—137), intermediate in H₁-sp (Tab. 6) with the average of 107 days (75—178) and very high in O₁-sp (Tab. 7). In this culture 7 females (of 9) oviposited later than after 120 days, the average pre-oviposition period of 8 diapausing females being 145 days (58—175).

A similar comparison can be made between the progeny of two P-generation couples (No 7 and 8) collected in spring 1964 in the same locality. Those two F₁ cultures of isolated couples differed much in the incidence of diapause: in culture 7 (Tab. 10) 7 females (of 15) were non-diapausing, whereas in culture 8 (Tab. 11) none of the 13 females oviposited without diapause. The difference of the same trend was found also in the intensity of diapause. The average length of the pre-oviposition period in 8 diapausing females amounted to 164 days (81—271) in culture 7 and in 10 females to 191 days (107—306) in culture 8. In both cases the higher diapause incidence was combined with more intense diapause.

Tab. 5. F₁-generation: culture B₁-sp
(single couples — offspring of the same P-generation couple as the group culture B₁ — see table 4)

Couple No.	Beginning of oviposition (after days)	laying of viable eggs (after days)	Longevity (days)	
			♀	♂
1	7—14	83	130*)	130*)
2	137	?	> 167	> 167
3	83	83	99	> 99
4 ⁺)	7—14	7—14	130*)	150
5 ⁺)	7—14	7—14	83	68
6	7—14	never	90	> 90
7	106	115	130*)	130*)
8	37	never	130*)	137*)
9	48	never	137*)	37
10	7—14	never	106	68

⁺) parents of F₂-generation group culture B₂ (Tab. 4)

*) the green corn in breeding boxes dried out and thus evidently caused premature dying

Females: 5 without diapause

3 with pre-oviposition 20—100 days : 37—83 days

2 with pre-oviposition longer than 100 days : 106 and 137 days

aver. pre-oviposition of 5 diapausing females : 82 days

Tab. 6. F₁-generation: culture H₁-sp
(single couples — offspring of the same P-generation couple as the group culture H₁ — see table 4)

Couple No.	Beginning of oviposition (after days)	laying of viable eggs (after days)	Longevity (days)	
			♀	♂
1	7—14	—	75	> 75
2	—	—	> 250	236
3	75	82	208	> 208
4	107	—	214	> 214
5 ⁺)	76	76	220	> 122
6	178	—	> 220	162
7 ⁺)	83	83	137	> 137
8	122	122	?	?

⁺) parents of F₂-generation group culture H₂ (see table 4)

Females: 1 without diapause

3 with pre-oviposition 20—100 days : 75—83 days

3 with pre-oviposition longer than 100 days : 107—178 days

aver. pre-oviposition of 6 diapausing females: 107 days; 1 not ovipositing at the age of 250 days (when the experiment was discontinued)

e) Incidence of diapause in F₁-males

In several group cultures the males were dissected and the specimens with small adenia and with enlarged fat body were considered as diapausing. The proportion of diapausing males did not differ much (not more than $\pm 10\%$) from the percentage of diapausing females of the same culture (Tab. 1).

In the rearings of isolated pairs it can be estimated approximately — according to viability of eggs laid — whether a male undergoes diapause. If only the males living with non-diapausing females are considered, two non-diapausing males were evidenced in each of the two cultures (Tab. 5 and 10).

In F_1 -cultures of individual couples, the diapause intensity might seem higher in 1964 than in 1966, the diapause incidence being similar. The limited extent of experiments does not allow, however, any assumptions at the influence of climatic conditions in both years.

Tab. 7. F_1 -generation: culture O_1 -sp
(single couples — offspring of the same P-generation couple as the group culture O_1 — see table 4)

Couple No.	Beginning of oviposition laying of viable eggs (after days)		longevity (days)	
			♀	♂
1	152	152	> 152	> 152
2	175	?	> 175	> 175
3	173	?	> 173	> 173
4	152	?	> 152	> 152
5	120	—	> 141	89
6	58	—	> 141	66
7	161	?	> 161	> 161
8	20	—	120	> 141
9	169	?	> 169	> 169

Females: 1 without diapause

1 with pre-oviposition 20—100 days : 58

7 with pre-oviposition longer than 100 days : 120—175 days

average pre-oviposition of 8 diapausing females : 145 days

f) Conclusions

The progeny of bugs collected in the open was reared under laboratory conditions adverse to diapause. In spite of it, in group cultures of the F_1 -generation a high percentage of diapausing females was always recorded ranging between 78 and 100%, most often between 86 and 95%. Thus the onset of diapause appears to be obligatory in the prevailing portion of the population studied.

The incidence of diapause in the F_1 -generation was affected neither by the habitat from which the bugs were sampled, nor by hibernation of parents in the open.

Intensity of diapause, measured by the length of the pre-oviposition period in long-day conditions, varied considerably, between 37 and 306 days, the extent of averages of individual series being 82—191 days.

2) Incidence of Diapause in Successive Laboratory Cultures

In course of laboratory breeding of successive generations the adopted method — i.e. the next generation was started only with those eggs of the

Tab. 8. F₂-generation
(single couples — F₁-generation was a group culture of the offspring of P-generation, collected on May 16, 1963 at Zohor)

Couple No.	Beginning of oviposition (after days)	laying of viable eggs (after days)	Longevity (days)	
			♀	♂
1	76	76	181	181
2	46	46	76	76
3	31	—	76	76
4	5—10	—	76	76
5	—	—	210	112
6	210	210	228	210
7	5—10	—	76	64
8	—	—	233	85
9 ⁺	34	34	76	76
10	5—10	—	76	76
11	34	34	76	76

⁺) progeny of pair 9 was reared in isolated couples (see tab. 9)

Females: 3 without diapause

5 with pre-oviposition 20—100 days : 31—76

1 with pre-oviposition longer than 100 days : 210

3 not ovipositing at the age of 210 and 233 days (when the experiment was discontinued)

average pre-oviposition of 6 diapausing females : 72 days

Tab. 9. F₃-generation
(single couples — offspring of the couple No. 9, F₂-generation, see table 8)

Couple No.	Beginning of oviposition (after days)	laying of viable eggs (after days)	Longevity (days)	
			♀	♂
2	—	—	123	123
3	33	40	108	108
4	40	—	54	54
5	40	54	123	123
6	67	67	123	123
7	152	—	168	54
8	116	—	123	123
9	—	—	123	123
10	—	—	123	123
11	—	—	123	123
12	—	—	123	123

Females: None without diapause

4 with pre-oviposition 20—100 : 33—67

1 with pre-oviposition longer than 100 days : 116

6 not ovipositing at the age of 123 days (when the experiment was discontinued, with the exception of No. 7, which oviposited after 152 days)

average pre-oviposition of 5 diapausing females : 59 days

previous generation which had been laid after a short pre-oviposition period — resulted in selection in the direction to “non-diapause”.

The selection is relatively slow and irregular because of the considerable variability of the populations studied (discussed in the previous chapter). In spite of that we can follow the flow of inherited trends. This is evident especially from the comparison of diapause incidence between the generations

Tab. 10. F₁-generation
(single couples — offspring of the couple No. 7 of the P-generation, collected in spring 1964)
(Zohor, April 27, 1964)

Couple No.	Beginning of oviposition (after days)	laying of viable eggs (after days)	Longevity (days)	
			♀	♂
1	7—14	7—14	49+)	49+)
2	7—14	—	49+)	130
3	7—14	—	49+)	58
4	81	81	109	256
5	271	—	320	118
6	249	—	365	58
7	158	—	263	58
8	109	—	235	109
9	7—14	7—14	34	195
10	7—14	—	49+)	58
11	233	—	249	144
12	95	—	?	95
13	7—14	—	58	228
14	118	—	172	151
15	7—14	118	151	118

+) the green corn in breeding boxes dried out and thus evidently caused premature dying

Females: 7 without diapause

2 with pre-oviposition 20—100 days : 81 and 95

6 with pre-oviposition longer than 100 days : 109—271

average pre-oviposition of the 8 diapausing females : 164 days

F₁ and F₂ in cultures derived from isolated couples (Tab. 4). In mass breedings B₁, H₁ and O₁ of generation F₁ the percentage of diapausing females was 86, 97 and 100%, respectively. The difference of the genetic equipment of P-gen. couples, indicated by the diapause incidence in their progeny, is revealed in the following F₂-generation, being affected to a great extent by the type of parental selection in F₁-generation. Group cultures B₂ derived from two couples of B₁-sp. (No 4 and 5, tab. 5) where both males and females were non-diapausing. Apparently that is why a rather great decrease of diapause incidence by 21% was achieved between generations F₁ and F₂ in line B. In couples H₁-sp. the sole non-diapausing female laid always unviable eggs, so that group cultures H₂ originated from eggs of the females with diapause of medium length, 76 and 83 days (No. 5 and 7, tab. 6). Perhaps due to this fact the difference in the percentage of diapause between both generations is much less important — 9%.

A hereditary tendency seems to be suggested by the experiments of the year 1963 (Tab. 8 and 9). In the generation F₂ (F₁ was not bred in isolated

Tab. 11. F₁-generation
(single couples — offspring of the couple No. 8 of the P-generation, collected in spring 1964)
(Zohor, April 27th)

Couple No.	Beginning of oviposition (after days)	laying of viable eggs	Longevity (days)	
			♀	♂
1	306	—	377	249
2	278	—	365	207
3	165	165	271	263
4	165	165	285	299
5	107	107	144	144
6	144	144	235	263
7	—	—	91	271
8	—	—	137	123
9	123	123	144	144
10	137	137	222	222
11	195	195	222	116
12	—	—	123	144
13	(130) 242 ⁺	—	327	107

⁺) the first number denotes the date of a small isolated egg batch, the second the onset of a normal oviposition period

Females: none without diapause

none with pre-oviposition 20—100 days

10 with pre-oviposition longer than 100 days : 107—306

3 no oviposition before death, at the age of 123, 144, 271 days

average pre-oviposition of the 10 diapausing females : 191 days

couples) 3 females were non-diapausing (but laid only unviable eggs), 4 females underwent a very long diapause (longer than 200 days), 1 female underwent a medium long diapause (76 days), 4 females diapaused for a comparatively short time (31—46 days). Progeny of the female with the pre-oviposition period of 34 days (No 9, tab. 8) formed the F₃-generation. In the breeding of 11 isolated couples (Tab. 9) all females were diapausing, 3 females diapaused for a short time, 1 female underwent a medium long diapause and 7 a longer one. Thus in the progeny of the "short-diapausing" females the "non-diapause" ones were missing.

The trend to decrease in diapause incidence in the laboratory culture of successive generations was exhibited also in continuous group cultures (Tab. 1). In the progeny of bugs collected on 31st July the gradual disappearance of diapausing individuals had a relatively rapid course; it was accomplished within 4 generations. In the progeny of samples taken on 15th September the decrease of percentage of diapausing females was substantially slower, and between F₃ and F₄ no change took place, so that in F₄ there were still 50% of diapausing females. As to the progeny of the early June sample, no decrease between generations F₁ and F₂ was recorded.

The great amplitude of the diapause genetic pool was shown in attempts at selection tending to "non-diapause" under "short-day" conditions: in F₁₁ a decrease of incidence to 77% was achieved (Tab. 3).

Conclusions

Attempts at selection tending to "non-diapause" were successful. In one line of mass breedings it was managed to decrease incidence of diapause between F_1 and F_4 generations by as much as 80% (gradually by 36, 13 and 31%). As far as the tendency to diapause is concerned, the extent of the genetic pool of *A. acuminata* populations from South-west Slovakia is considerably large and underlies the great plasticity of this material. It enables the selection of bugs that are reproductive even in short day. Both incidence and intensity of diapause seem to be determined by different strength of hereditary diapause tendency.

3. Preliminary Crossing Experiments

When studying the heredity of diapause, we made two crossings among the bugs collected in the field (Tab. 12) (their uncrossed progeny had a high diapause incidence — in the first experiment 97%, in the second one there were 95% of diapausing females) and the bugs held for 16 or 17 generations under selection, so that their uncrossed progeny had only a very low diapause incidence (14% and 16% of diapausing females, resp.).

Tab. 12. Crossing between the bugs from the open with high incidence of diapause and the selected material (16th and 17th gen.) with low diapause incidence

Generation	Sex	Incidence of diapause (%)			
P	♂♂	P ₀ (♀)	F ₁₆ (♂)		
	♀♀	88	43		
Offspring of		97	14		
		couple No. 1	couple No. 2		
	♂♂	N:	N:		
	♀♀	81 (36)	78 (37)		
(F ₁ —P ₀)	♂♂	48 (31)	78 (37)		
	♀♀	— 7	—10		
(F ₁ —F ₁₆)	♂♂	—49	—19		
	♀♀	+38	+35		
	♀♀	+34	+64		
P	♂♂	P ₀ (♀)	F ₁₇ (♂)	P ₀ (♂)	F ₁₇ (♀)
	♀♀	95	47	95	47
F ₁	♂♂	95	16	95	16
	♀♀	N:	N:	N:	N:
(F ₁ —P ₀)	♂♂	82 (113)	54 (87)	54 (87)	54 (87)
	♀♀	37 (119)	52 (94)	52 (94)	52 (94)
(F ₁ —F ₁₇)	♂♂	—13	—41	—41	—41
	♀♀	—58	—43	—43	—43
(F ₁ —F ₁₇)	♂♂	+35	+ 7	+ 7	+ 7
	♀♀	+21	+ 36	+ 36	+ 36

N — total number of individuals in the culture (in the brackets)

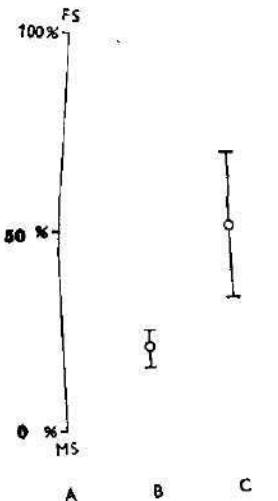
The females from the open were collected in autumn, when immaturity of young bugs of both sexes excludes fertilization before the experiment, and were activated separately from the males. In laboratory cultures bugs of both sexes were kept separately immediately after moult.

In the first experiment only two isolated couples were crossed. In both couples the females were taken from the open and the males were from laboratory selective breeding. In both cases the diapause incidence in the cross-bred females lay between the diapause incidence of both parents, naturally not exactly in the middle.

Fig. 1. — Indication of a sex-linked inheritance of diapause

- A — the relative difference in % of diapause between the paternal and maternal strain in the P-generation (= 100%). The value for the mother strain (MS) equals 0%, that for the father strain (FS) 100%.
- B — percentage of diapause in males of the F₁-generation (related to the P-generation, abscissa A)
- C — percentage of diapause in females of the F₁-generation (related to the P-generation, abscissa A)

Percentage of diapause in males and females of F₁-generation (average and standard deviation based on 4 experiments, Table 12) is given in percentage of the difference (diff. = 100%) between the two P-generation strains. The values for males or females resp. were calculated from the results gained on males and females, resp.



In the second experiment, cross-breeding of ten couples in group breedings was made, in order to obtain a higher number of cross-breeds. There were effected crosses of females from the open with males from the laboratory and reciprocal crosses of males from the open with laboratory females. Again, in both cases, the diapause incidence of cross-bred females was found to lie between the percentages of parental diapause incidence. In case of males brought from the open it occurred practically in the middle, in case of females from the open the resulting diapause incidence was closer to the value for laboratory parents (about one third) than to the value for the bugs from the open (about two thirds).

The difference between the diapause incidence in males and females (Tab. 12, Fig. 1) indicates the possibility of the sex-linked inheritance of the diapause tendency.

Numbers in table 12 are to be considered as preliminary indications. The results given in the previous chapters have shown the great individual variability in diapause tendency. The calculation is made here with the numbers indicating the average diapause incidence of other individuals from the group to which also the tested individuals belong.

Conclusion

The cross-breeds of bugs from the open with a high diapause incidence (about 95%) and bugs from selected laboratory cultures with a low diapause

incidence (about 15%) have a diapause incidence lying between the values of the parents. This indicates the heredity of the diapause tendency.

DISCUSSION

The gradual selection tending to the decrease of diapause incidence that we have achieved in *Aelia acuminata* corresponds to the results attained in the North-African populations of this species by Voegelé (1961). In his experiments 15—20% of females oviposited in the first generation, in the second generation 30—35%, and only up the third generation more than 50% bugs oviposited. Always, however, a certain percentage of diapausing females was maintained.

Results found in *Aelia acuminata* are not exceptional in literature on diapause. The same phenomenon of the decrease of non-diapause adults in course of a continuous breeding of successive generations in a laboratory was found in the coccinellid *Coccinella septempunctata* L. (Hodek, 1961) and confirmed for this species by Bonnemaison (1964). An apparently opposite finding is reported by Mangum, Earle, Newsom (1968) for the boll weevil *Anthonomus grandis* Boheman. The 1st-generation weevils from overwintering parents and the strain that had been maintained in the laboratory for about 25 generations responded by the same incidence of diapause (69%) to the rearing at 11 hr photoperiod. The authors, however, do not mention whether the beetles were selected during the continuous culture.

Norris (1964) calls attention to the possibility of the high percentage of diapause in F_1 -generation being caused by the previous influence of winter conditions on the P-generation. In our experiments females of *A. acuminata* collected before and after hibernation both in fall and in spring were therefore used as P-generation. Analogous results gained in both cases show that in *Aelia acuminata* no environmentally produced parental effect is involved. In contrast, Phillips and Newsom (1966) reported that only a small percentage of bollworms (*Heliothis* spp.) from overwintering parents were capable of entering diapause.

Bombyx mori L. is perhaps the most frequent subject for studying the genetics of diapause. Besides this species a successful selection of diapause tendencies was achieved in several Lepidoptera with larval or pupal diapause, such as *Ostrinia nubilalis* (Hübner) (Arbuthnot, 1944), *Choristoneura fumiferana* (Clem.) (Harvey, 1957, 1961), *Pectinophora gossypiella* (Saunders) (Barry & Adkisson, 1966). Multiple genes are assumed to control the diapause tendencies. The plasticity of these tendencies is demonstrated by *Ostrinia nubilalis* which was unintentionally introduced from Europe to North America in the twenties of this century and has adapted itself to new conditions of individual areas while spreading over North America. It forms geographic populations differing from one another by photoperiodic responses and other characteristics (Mutchmor & Beckel, 1959; Beck & Apple, 1961).

CONCLUSIONS

1) Two types of occurrence are assumed in SW-Slovakia: both development and hibernation in lowland forests or active life in fields and dormancy in clearings on hills.

2) A laboratory rearing method for continuous cultures is described, with only about 10% of larval mortality.

3) In spite of conditions adverse to diapause (18 hr photophase in 24 hrs, 25–28° C const., supply of fresh food) a high percentage of bugs undergo diapause in F₁-generation: 78–100%, but usually 85–95%. The diapause incidence in generation F₁ is affected neither by the habitat of origin nor by hibernation of P-generation. The diapause intensity is very variable.

4) The percentage of the obligatory onset of diapause gradually decreases in successive generations of the continuous laboratory culture (in conditions stated). Although another explanation might also be feasible, it is suggested that the decrease is achieved by negative selection of the diapause tendency.

5) The preliminary cross-breeding experiments indicate the inheritance of the tendency to diapause.

6) The tendency to an obligatory onset of diapause is assumed to predominate in SW-Slovakian populations of *Aelia acuminata*.

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STANDING CROP, ABUNDANCE, PRODUCTION AND SOME ECOLOGICAL ASPECTS OF FISH POPULATIONS IN SOME INLAND WATERS OF CUBA

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Abstract: The author presents the results of ichthyological investigations in 2 lakes and 1 backwater of the natural channel in Cuba. By poisoning the fish populations were removed. Abundance, ichthyomass, age, growth, mortality and survival rate, production, and F/C coefficient were studied as well as species composition of populations. Results are compared with those from other geographical zones and some problems are discussed.

INTRODUCTION

In the spring of 1966 the Hydrobiological expedition of the Czechoslovak Academy of Sciences worked in Cuba. The aim of their work, in cooperation with the Department of Hydrobiology of the Cuban Academy of Sciences, was the study of the limnology of Cuban inland lakes. In the frame of this work special attention was paid to the limnology of the laguna (= lake) Sabanilla and laguna La Luisa in the Habana province. These two lakes were studied both qualitatively and quantitatively in respect to phyto-, zooplankton, benthos and fish. Here we introduce the analysis of the fish populations of these lakes together with that of the backwater Zanja Blanco in surroundings of the Surjidero de Batabano, Habana province. For hydrobiological data concerning mentioned waters see Straškraba et alii, 1968.

DESCRIPTION OF LOCALITIES

Laguna Sabanilla can be found near the small town San José de Las Lajas in the area called Somorrostro, of about 30 km East from Habana. The area of this lake (at the time of mapping 26.—28. I. 1968) measured 2.5 ha, water content 25,000 m³, maximal depth 130 cm (Fig. 1). The littoral of lake is overgrown with dense vegetation of *Nuphar advena*, which covered 1/3 of the water area in that time (Fig. 2). Also small islet in the centre of the lake is composed by this plant. Among *Nuphar*, *Nymphoides grayanum* and *Eleocharis intersticta* is scattered. The bottom is covered with a thick layer of fine brown mud.

Laguna La Luisa is a small lake near the west suburbs of Habana in the area called Ariguanabo. The area measured (in 31. 3. 1966) 0.75 ha, water content 27,021 m³, maximal depth 310 cm (Fig. 3). The narrow band of shores is covered with a dense vegetation of *Eichhornia crassipes*, *Scirpus cubensis*, *Eichhornia azurea*, *Nuphar advena* and *Eleocharis intersticta*. Floating beds of *Eichhornia crassipes* and *E. azurea* covered a part of free surface near the margin. The bottom near the banks was covered by submersed *Cabomba piauhiensis* and *Characeae*. The character of mud was similar to that in the laguna Sabanilla.

The backwater of Zanja Blanco is a part of extensive marsh on the southern coast of Cuba of about 5 km eastern from Surjidero de Batabano, Habana provinces. This natural channel is situated about 200 m far from the sea coast. During the rain season this branch may be connected with sea and takes away all superfluous water from this area. The length of this branch (in 10. 2. 1966) measured 16 meters, the average width was 1.34 m, average depth 27 cm (10—37 cm) and area 21.6 m². The shore line is covered with a thick growth of grass. Bottom clear, muddy. Temperature of water at that time was 20.5° C, pH 7.4.

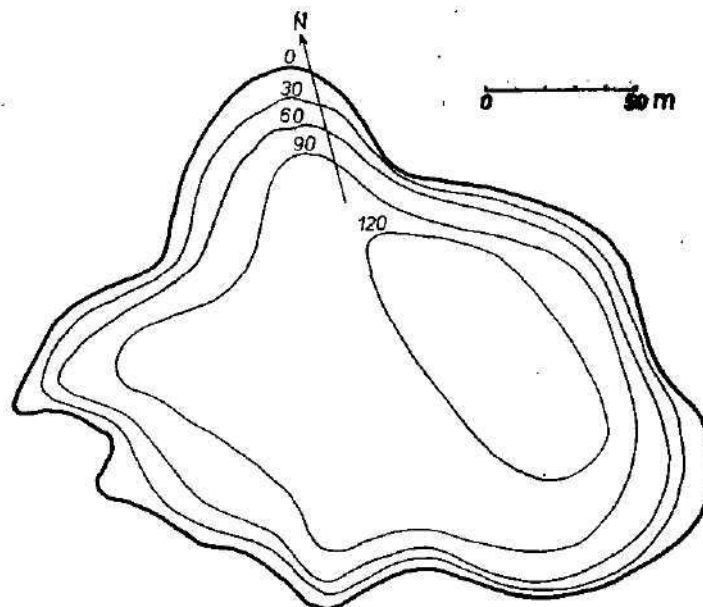


Fig. 1. Bathymetric map of the Sabanilla lagoon

METHOD

In all the mentioned water-bodies the whole fish stock was poisoned by the preparate Delicia Fribal-Emulsion (product from the German Democratic Republic) with 40% content of the active matter *Toxaphene* (C₁₀H₁₀Cl₈). We used a concentration 0.3 ppm in the Sabanilla, 0.4 ppm in La Luisa and 1.0 in the Zanja Blanco.

The lakes were sprayed by poison from boats so that the solution of water with poison was poured on behind the board motor. Inside the overgrown parts of the Sabanilla lake the channels were cut through vegetation by means of machete. The boat slowly moved through channels and the poison was poured on among vegetation and mixed by paddles. Laguna Sabanilla was sprayed by poison during 4 hours and 25 min., laguna La Luisa during 1 hour. Zanja Blanco and the littoral part of both lagoons were treated with poison from the banks.

The perishing of fish set in during 20 (Zanja Blanco) — 120 (Sabanilla) minutes after starting the first application of poison. The fish were collected both from boats and shores and fixed in formaline solution. By this way it was possible to conserve about half part of the whole fish stock. The second half had to be worked out immediately because of fast decomposition. The fish was determined, counted and measured then dropped into a hole on which gasoline was poured and set to fire. In the Sabanilla lagoon we collected all fishes larger than 10 cm. At the southern coast of lake the area measuring about 30 × 30 m (836 m²) was set up. This area turned down shore, littoral vegetation and free water (Fig. 2). Inside this area all fish was collected. Its number was counted over the whole area of lake so that the number of viviparous fish and other species which were smaller than 10 cm was counted over the area of the overgrown part of the lake whilst the number of fish which was larger than 10 cm was counted over the whole area of lake including vegetation. Namely, it was observed, that the open water was inhabited exclusively by fish

larger than 10 cm which included *Micropterus salmoides*, *Cichlasoma tetracanthus* and *Lepomis macrochirus*, whilst the young of these species together with populations of the other ones occupied exclusively overgrown parts mainly near the shore line (*Poeciliidae*). In the lake La Luisa and Zanja Blanco backwater all fish stock was removed.

Conserved fish (now deposited in the Slovak National Museum in Bratislava, Czechoslovakia) was further treated in laboratory. Each specimen was measured (standard length) and weighed. Using the Petersen curves the age and growth of three main species was estimated (Figs. 4—8).

The data concerning the age growth of *Cichlasoma tetracanthus* and *Lepomis macrochirus* can be regarded as reliable because of relatively sharp differences between the separate age groups. Data for *Micropterus salmoides* are influenced mainly by the less numerous material. Here the correct age was several times verified according to scales, mainly in fishes of older age groups. The data on the age composition of populations were used for calculation of the mortality rates using the formula of Jackson. Calculation of final net production (Holčík 1970) was made by the method of Burmakin and Žakov (1961), i.e. we used the data on growth increments of age groups and their number. Besides this we have studied also the mutual relation of predators and forage fishes using the F/C coefficient of Swingle (1950, 1956).

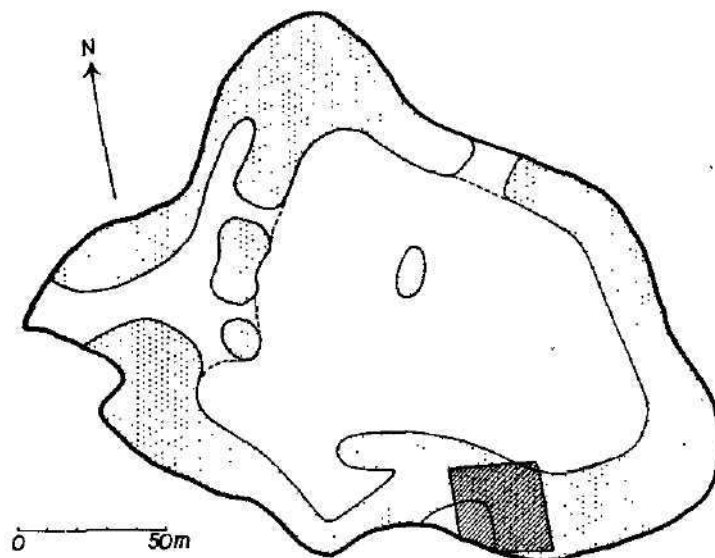


Fig. 2. Map of the Sabanilla lagoon showing the overgrown places along the shore line (dotted area) and the area from which all fish was removed (striped rectangle)

RESULTS

1) Laguna Sabanilla

The fishfauna of this lake was composed of 7 species: *Lepomis macrochirus* (bluegill), *Cichlasoma tetracanthus* (biajaca), *Micropterus salmoides* (largemouth bass), *Poecilia vittata*, *Gambusia puncticulata*, *Gambusia punctata*, *Dormitator maculatus*. After the poisoning it was found almost 250 thousand of fish weighed 632 kilograms in total, i.e. nearly 188 thousand of fish weighing 321 kg per hectare of area (Tab. 1). The most numerous species was bluegill — *Lepomis macrochirus* (87% of the total number and 61.8% of the total weight of all fish stock). Further two species — the largemouth bass and the *Cichlasoma* follow bluegill. Other species, comprehensively called as "guajacones"

by Cubans form only a negligible component of the fish stock in comparison with the first three species.

The weight relation of forage to carnivorous species expressed in F/C coefficient (Tab. 10) is 3.10 and shows a balanced fish stock in this lake. As carnivorous fish we have considered the largemouth bass and all *Cichlasoma* specimens larger than 20 cm of standard length (see below).

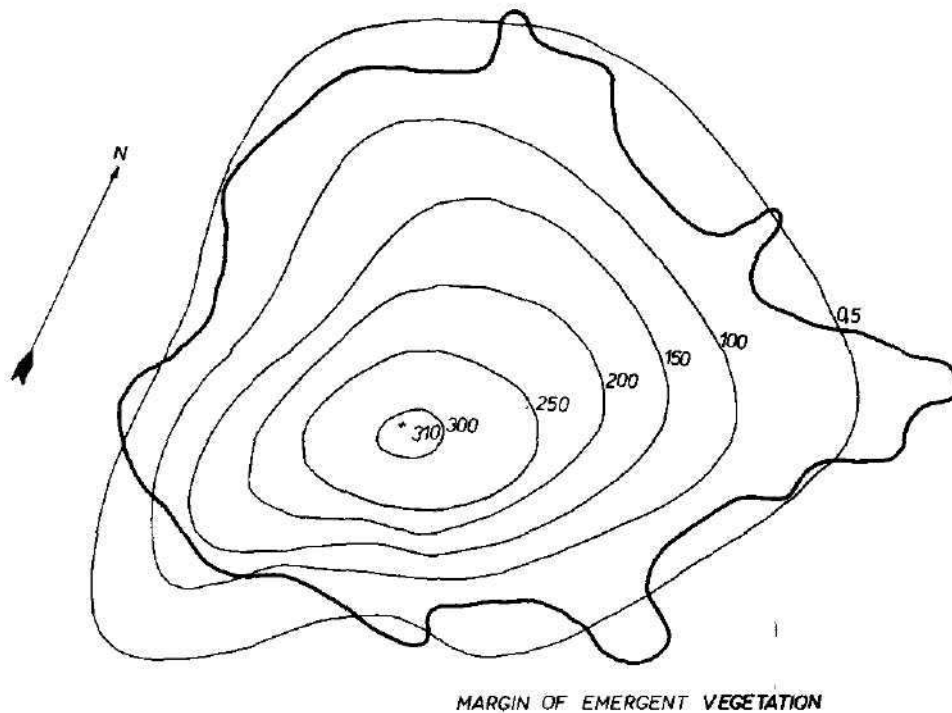


Fig. 3. Map of the La Luisa lagoon

Populations of the mentioned three main species consist of maximally 5 age groups including the age group 0. In bluegill the most numerous was young, other three age groups composed only 0.5% of population. In largemouth bass and in *Cichlasoma* the most numerous was age group I and II, and III. The annual mortality rate is unusually high: 99.4% in bluegill, 94.6 in *Cichlasoma* and 75.9% in bass. Remarkable is a relatively numerous age group IV in *Cichlasoma*, which several times surpasses the younger group. It is probably due to the extremely good survival conditions of young in the year of hatching of this age group.

The tables 7—9 show the growth of these species.

Final net production at the time of poisoning counted over the unit of area is 220.54 kg/ha (Tab. 13). The population of bluegill participates on this cipher by 61.6%, population of largemouth bass by 19.5% and that of *Cichlasoma* by 18.9%.

2) Laguna La Luisa

In this lake 5 fish species occurred: *Lepomis macrochirus*, *Micropterus salmoides*, *Cichlasoma tetracanthus*, *Gambusia puncticulata* and *Poecilia vittata* (Tab. 2). Also in this lake the most numerous fish was bluegill which formed 61.2% of the total number and 56.5% of the total weight of whole fish stock. The second place is occupied by the largemouth bass — 32.0% concerning its number and 39.5% of the total ichthyomass. Participation of *Cichlasoma tetracanthus* as well as other native species was negligible. These species numbered only 6.8% of the total fish stock and 4% of the whole ichthyomass. Altogether 6438 fish were collected weighing 244.39 kg which is 8584 specimens and 325.28 kg per hectare of area.

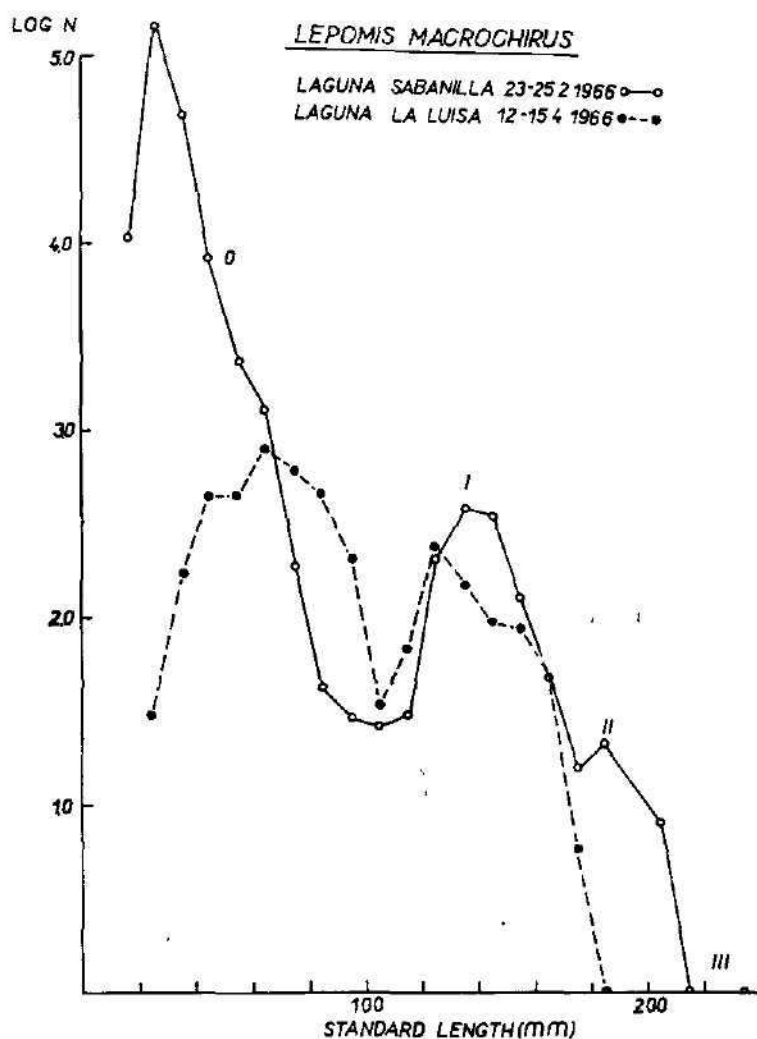


Fig. 4. Length-frequency curve of the bluegill population from the Sabanilla and La Luisa lagoons

Also in this case the age composition of populations of bluegill, largemouth bass and biajaca is similar to those in the lake Sabanilla (Tabs. 4, 5, 6). The most characteristic feature is a short age of populations and the great decrease of fish belonging to the oldest age groups. The population of largemouth bass shows a similar picture like that of biajaca in the Sabanilla lake, i.e. more fish in older age classes. Very interesting are data for the survival and mortality rate which are generally higher or lower than in the Sabanilla lake.

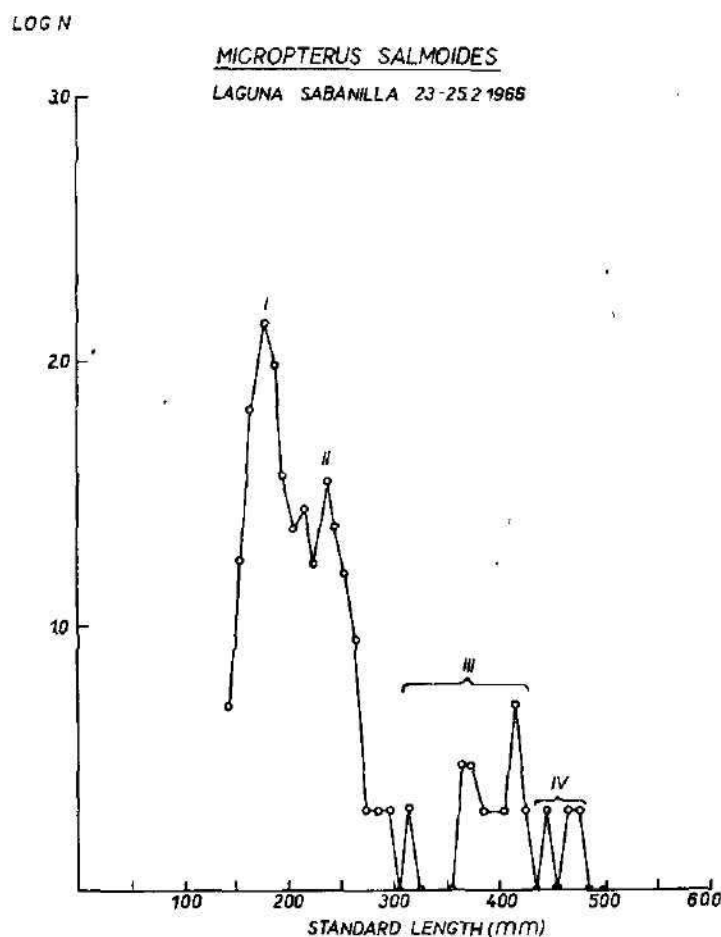


Fig. 5. Length-frequency curve of the largemouth-bass population from the Sabanilla lagoon

The growth rate of the main species (Tabs. 7, 8, 9) is generally less than that of populations living in the Sabanilla lagoon. Swingle's F/C coefficient is 1.48 showing the unbalanced population with prevailing predatory species. Final net production to the date of poisoning is 276.89 kg/ha. Participation of bluegill in this value is 65.5%, that of largemouth bass 31.5% and only 3.0% that of biajaca.

3) Zanja Blanco

Ichthyocenosis of this locality was composed of 6 species: *Gambusia punctata*, *Poecilia vittata*, *Cubanichthys cubensis*, *Rivulus cylindraceus*, *Girardinus metallicus* and *Cichlasoma tetracanthus*. One day before the treatment with toxaphene also *Cyprinodon variegatus riverendi* was found, but none specimen

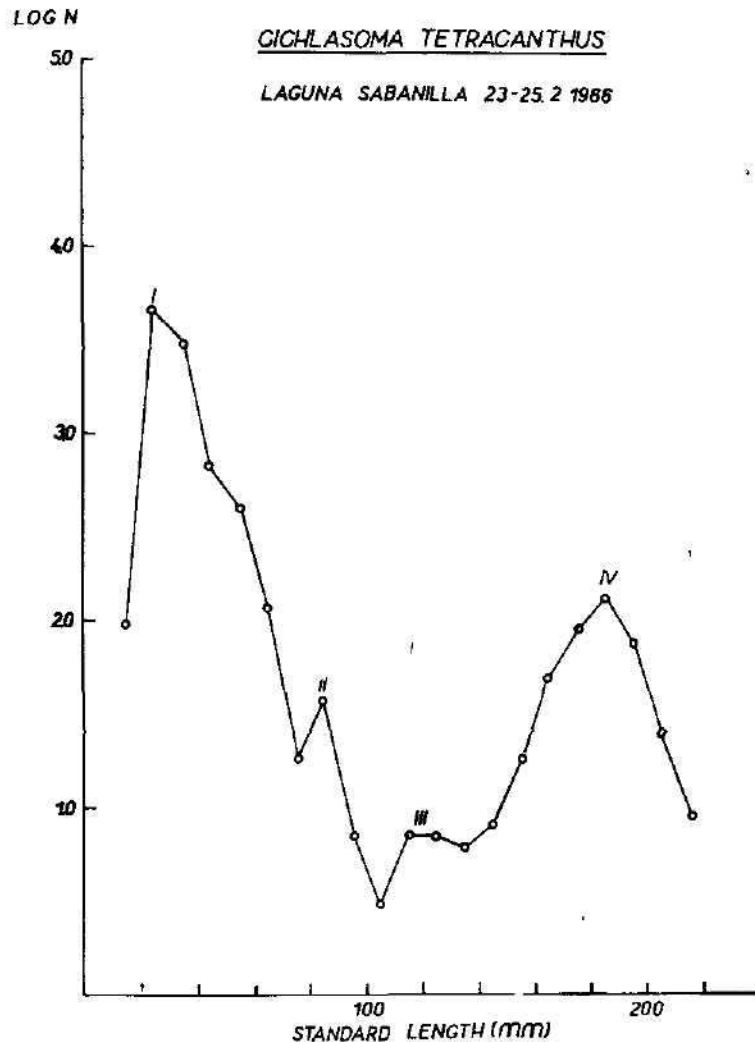


Fig. 6. Length-frequency curve of the bajaca population from the Sabanilla lagoon

of this species was collected during and after the poisoning. Altogether 321 fish weighing 123.3 grams were collected which is 57.09 kilograms and 148611 specimens per hectare of area (Tab. 3).

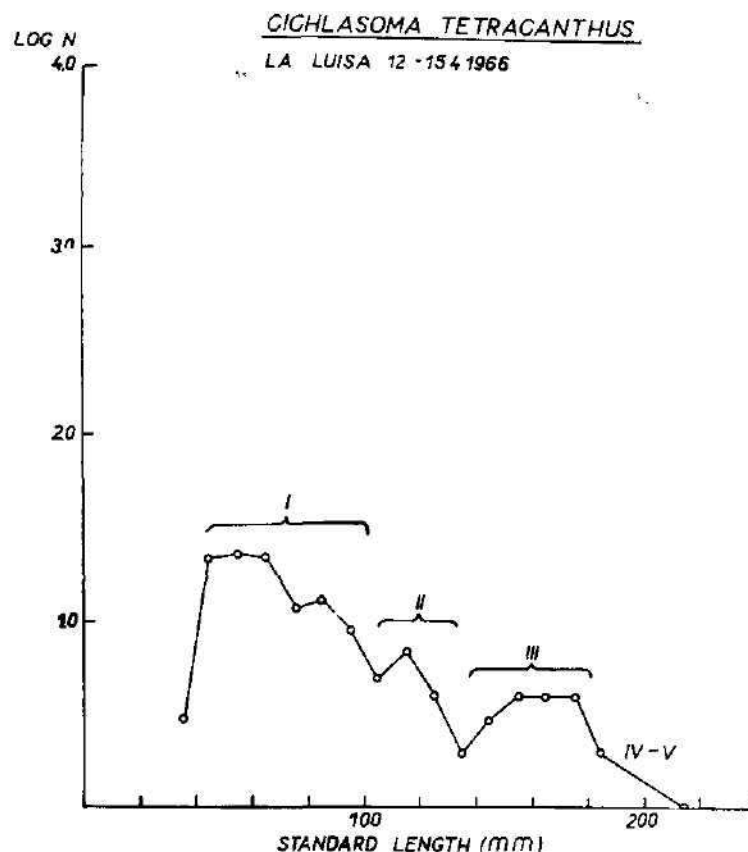


Fig. 7. Length-frequency curve of the biajaca population from the La Luisa lagoon

DISCUSSION

From the tables and results it follows that the prevailing mass of stock in lakes was composed of acclimatized North-American Centrarchids — *Micropterus salmoides* and *Lepomis macrochirus*. As mentioned elsewhere (Straškraba et alii, 1968) this type of Cuban populations is the so called *secondary* one which is prevailing in comparison with the *first-original type of populations*. It is interesting to note that both bluegill and largemouth bass were introduced to Cuba only in 1927 (Corral, 1936). In spite of a relative short time they spread quickly throughout the island and now they can be found practically in the all Cuban inland lakes and rivers. The mass distribution can be explained by the suitable reproduction and feeding conditions and by the absence of natural fish predators: the Cuban alligator gar — *Atractosteus tristoechus* is limited mainly to the peninsula of Zapata while the second potentially carnivorous fish, mainly in larger size—groups biajaca — *Cichlasoma tetracanthus* — could be considered as dangerous only for fry and early young of both centrarchids. On the contrary, the centrarchids caused a rapid

retreat of *biajaca* the occurrence of which although regular is not on a mass scale. The *biajaca* can be found mainly in running waters. It is due to the direct predation of both centrarchids as well as strong feeding competition by bluegill as can be considered according to the food composition of both mentioned species (Howell-Rivero and Rivas, 1940; Emig, 1966).

The high values of abundance and standing crop of both centrarchids were very surprising for us. The reports of Chinese authors (Wu and Ley, 1965) as well as our experts (Straškraba, personal communication) clearly stated the lack of larger fish species and overpopulated native fishes mainly guajacones (poecilids and cyprinodontids). The reason for this should be a lack of predators which would restrict guajacones. This information was due to

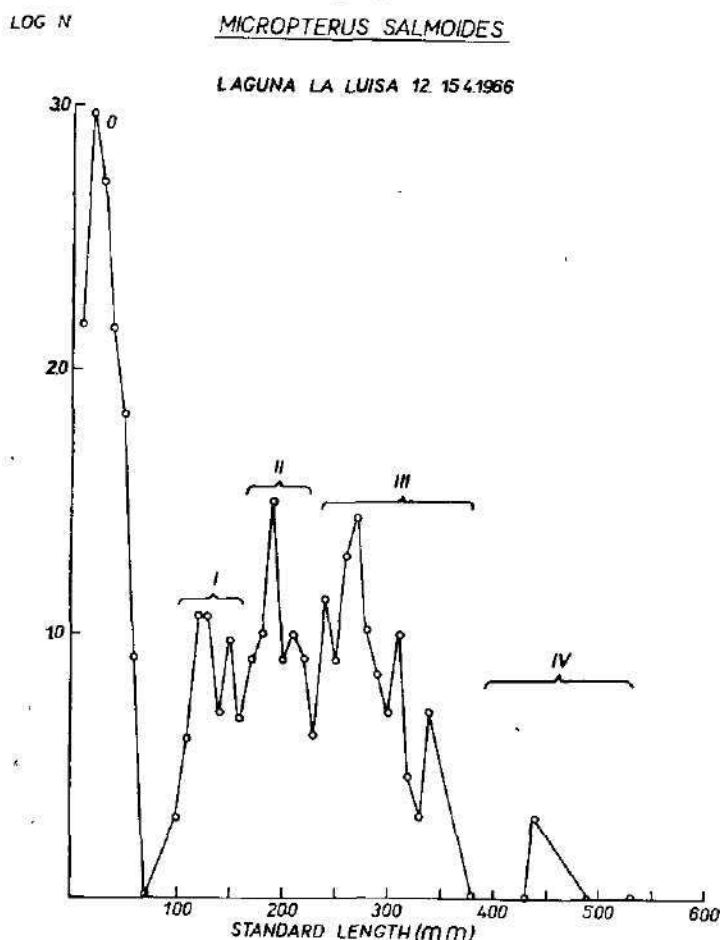


Fig. 8. Length-frequency curve of the largemouth-bass population from the La Luisa lagoon

unsuitable fishing gear used (small nets called "*jamo*" used by aquarists and entomologists) as well as the inability of inhabitants to catch the centrarchids by the haul seine or by the line. As can be seen from our data the acclimatized centrarchids form the most important component of the Cuban inland water

fish-fauna. The present inhabitation of water-bodies by centrarchids offers an instantaneous possibility to obtain a sufficient amount of valuable fish flesh.

The abundance of different species in both lakes was different in spite of seemingly the same conditions existing in them. Tables 1 and 2 show the relative higher number of bluegill and bairdi young as well as guajacónes in the Sabanilla lagoon while in the La Luisa lagoon the higher number of largemouth bass was found. This difference is caused by the fact that 1/3 of total area of the Sabanilla lagoon is overgrown by continual aquatic vegetation which offers an excellent shelter for the young centrarchids, bairdi and guajacónes as well. We have discussed the importance of plants for the littoral component of fish in a previous paper (Straškraba et alii, 1968). The direct influence between the density of fish and density of aquatic vegetation, especially for bluegill, was shown by Swingle and Smith, (1942).

Concerning the comparison of the density and ichthyomass of the Cuban inland waters it is necessary to say that there is only little information from tropics. As far as known to me the most exhaustive work is that of Holden (1963) from Africa. The author has investigated the inundation area of the Sokoto river (West Africa, basin of the Niger river) by means of marking-and-recapture method. He found the fluctuating standing crop of fish depending on the type of bottom: lakes possessing sandy bottom resulted 691 to 1007 kilograms of fish per hectare of area, those with muddy bottom had only 196–270 kg/ha and the last ones the bottom of which was of intermediate character showed 585–1440 kg/ha. It seems to me that the rules found by Holden have the general character as follows from ichthyomass found by us which is 321–326 kg/ha in both lakes with muddy bottom. It is of interest to compare the standing crop of fish in tropics with that found in the temperate zone. Carlander (1955) summarized the results from North America and found (on an average) 570 kg/ha of fish in river backwaters and oxbows, almost 453 kg/ha in midwestern reservoirs, 228–343 kg/ha in other reservoirs and ponds, 143–170 kg/ha in warm-water lakes and less than 57 kg/ha in trout lakes. A similar quantity of fish occurs in Europe: the ichthyomass of lakes, inundation waters and reservoirs ranged between 63.2–1006.4 kg/ha (Oliva 1955, 1960), Lác and Ertl, 1961, Burmakín, 1962; Balon, 1966a, b; Holčík, 1970). There exists a similar relation between the biomass of other organisms than fish in tropics and temperate zone. The production of tropical waters, however, is higher than that of a temperate zone. Final net production of the Sabanilla and La Luisa lagoon (Tab. 13) is 220.5 and 276.9 kg/ha respectively (Tab. 12). It means 70.8 and 85.0% of the existing standing crop in both lakes. As stated earlier (Burmakin and Žakov, 1961, Holčík, 1970) the production of fish in European waters is about 1/3 part of the ichthyomass only. The reason of this difference can be found in another age composition of populations. Life span of fish from the temperate zones is longer than those in the tropical ones. Clear example may be shown on both centrarchids found in Cuba. Bluegill is reported to live up to 9 years in its native country, 4–5 years on an average, while the largemouth bass as long as 16 years on the northern states of the USA and to 12 years in the southern ones. As can be seen from our tables 3, 4, 7, 8, the maximal age reached in the investigated lagoons is much shorter: 2–3 years in bluegill and 4–5 years in largemouth bass. The attainment of sexual maturity is also much shorter in Cuban centrarchids in comparison with that

of their ancestors in the USA. According to our observations, the bluegill spawns for the first time before the end of its first year, at the standard length of about 70–80 mm (in USA only when 2–3 years old). The age of sexual maturity in largemouth bass is also before the first year is reached, when the fish measures of about 140–250 mm of standard length (in ponds of Centro de Repoblacion fluvial near Habana it matures at the age of 8 months).

The growth of bluegill and largemouth bass is very fast and outruns that of fish from North America. Emig (1966) summarized data of growth from both species. The largemouth bass reaches 127–381 mm of total length in its native country at age 4, whilst in Cuba 447–468 mm of standard length at the same age (Tabs. 5, 8). Similarly bluegill in Cuba demonstrates very fast growth: it reaches 177–186 mm of standard length in the investigated lagoons (Tabs. 4, 7) at age 2, whilst in North America it is only 61 to 102 mm of total length. In comparison with these values the growth rate of endemic *Cichlasoma tetraodon* is retarded (Tabs. 6, 9). Also the sexual maturation of this species sets in later. According to our observations the first spawning occurs only at the age 2 when fish is 80–100 mm long. Also in these characters the bluegill is in disadvantage with both North-American centrarchids.

Obviously, the mortality rate of short living populations is much higher than those of longer life span. Calculated survival and mortality rates (Tabs. 4–9) shows a very low and high values respectively, mainly during the first two years of life. It concerns mainly bluegill which forms the principal food of largemouth bass. The mortality of later is lower. Fluctuating values in mortality and survival rates for bass in the La Luisa lagoon is evidently caused by the fact that in years subsequent to previous successful reproduction the population begins to suffer from the lack of food and heavy cannibalism occurs. The same phenomenon, called *cycle* composed of *phases*, in population of perch (*Perca fluviatilis*) in some European waters was observed by Rudenko (1962).

It is of interest to pay attention to Swingle's F/C coefficient expressing weight relationship between the forage and carnivorous fishes. In the Sabana lagoon the value of 3.10 was found while in the La Luisa lagoon 1.48 only. The first case means the balanced population, and the second the unbalanced one, with prevailing predators — a phenomenon very rare in nature. Both lagoons show very little utilization of fish populations by man. As known, (Oliva, 1955, 1960) the waters intensively fished by anglers contain unbalanced populations where forage fishes exceed the carnivorous ones and the F/C coefficient is of about 10 on an average.

Higher production biomass ratio in tropical waters observed also in other organisms than fish was discussed by Straškraba and others, 1968. The discrepancy between the higher gross primary production to equal or lower fish production in Cuba has been already discussed in the same work. Two possibilities were indicated.

- 1) the unfavourable species composition of the Cuban fish fauna,
- 2) the lower efficiency of the utilization of gross primary production throughout the trophic chain in tropical conditions. Although the first possibility cannot be excluded (the exact data from original native populations and their production are lacking), the second seems to be of the same importance. The loss of energy in metabolic processes is probably higher in fishes from tropics than in the temperate zones.

SUMMARY

1) Abundance, ichthyomass, age composition, growth, mortality and production of fish populations found in 2 lakes and 1 backwater in Cuba were investigated.

2) The fish populations of investigated water-bodies was composed of both aboriginal (*Cichlasoma tetracanthus*, *Poecilia vittata*, *Gambusia punctata*, *Gambusia puncticulata*, *Girardinus metallicus*, *Rivulus cylindraceus*, *Cubanichthys cubensis*, *Dormitator maculatus*) and acclimatized (*Lepomis macrochirus*, *Micropterus salmoides*) species. The later strongly predominated over the aborigenes concerning biomass.

3) The density of fish ranged between 8584 and 177822 specimens per hectare of area and the ichthyomass varied from 57.09 to 325.82 kg/ha. The lakes showed higher density-ichthyomass values than the backwater of natural channel, similarly as lakes overgrown by aquatic vegetation contained more fish and higher standing crop than those with little vegetation only.

4) The growth of bluegill and largemouth bass introduced at thirties of this century is faster, mortality rate higher, age of sexual maturation earlier and life span shorter in comparison with values of ancestor populations in USA.

5) Swingle's F/C coefficient shows the presence of balanced population in the Sabanilla lagoon (F/C — 3.10) and the unbalanced one in the La Luisa lagoon. The insufficient utilization of both lagoons concerning fishing is considered.

6) Final net production in both lakes ranges from 220.54 to 276.89 kg/ha, i.e. 70.8 and 85.0 per cent of total ichthyomass.

7) Standing crop of fish per unit of area was found to be the same like in similar waters both in Africa or in the temperate zone, whilst the production is higher which is due to the shortening of life span of populations, better growth, earlier sexual maturation.

8) It is supposed that the discrepancy between the much higher gross primary production to equal or lower fish production in Cuba is due also to the lower efficiency of the utilization of the gross primary production through the trophic chain, when the loss of energy during the metabolic processes is probably higher in fishes from tropics.

Acknowledgement

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Tab. 1. Number and weight of fish in the Sabanilla lagoon*) found after poisoning (22. - 25.2. 1966)

	Number and weight after poisoning		Number and weight per hectare of area			
	N	W (kg)	N	%	W (kg)	%
<i>Lepomis macrochirus</i>	215 574	346.34	154 702	87.0	198.27	61.8
<i>Cichlasoma tetraanthus</i>	9 220	132.81	6 497	3.6	57.24	17.8
<i>Micropterus salmoides</i>	617	140.48	267	0.2	56.21	17.5
<i>Poecilia vittata</i>	16 756	11.1	12 055	6.8	7.99	2.5
<i>Gambusia puncticulata</i>	5 913	1.8	4 254	2.4	1.29	0.4
<i>Gambusia punctata</i>	48	0.06	35	0.01	0.04	0.01
<i>Dormitator maculatus</i>	16	0.03	12	0.01	0.02	0.01
Sum total	248 144	632.62	177 822	100.0	321.01	100.0

*) area at the time of poisoning 2.5 ha

Tab. 2. Number and weight of fish in the La Luisa lagoon*) found after poisoning (12.—14. 4. 1966)

	Number and weight after poisoning		Number and weight per hectare of area			
	N	W (kg)	N	%	W (kg)	%
<i>Lepomis macrochirus</i>	3938	137.97	5251	61.2	183.96	56.5
<i>Micropterus salmoides</i>	2058	96.91	2744	32.0	128.81	39.5
<i>Cichlasoma tetracanthus</i>	141	9.69	188	2.2	12.92	4.0
<i>Gambusia puncticulata</i>	286	0.09	381	4.4	0.12	—
<i>Poecilia vittata</i>	15	0.01	20	0.2	0.01	—
Sum total	6438	244.67	8584	100.0	325.82	100.0

*) area at the time of poisoning 0,75 ha

Tab. 3. Number and weight of fish in the Zanja Blanco backwater*) found after poisoning (10. 2. 1966)

	Number and weight after poisoning		Number and weight per hectare of area			
	N	W (kg)	N	%	W (kg)	%
<i>Gambusia puncticulata</i>	202	62.5	93 518	62.9	28.94	50.7
<i>Poecilia vittata</i>	92	45.0	42 593	28.7	20.83	36.4
<i>Cubanichthys cubensis</i>	18	3.0	8 333	5.6	1.39	2.4
<i>Rivulus cylindraceus</i>	5	1.7	2 315	1.6	0.79	1.4
<i>Girardinus metallicus</i>	3	0.4	1 389	0.9	0.19	0.3
<i>Cichlasoma tetracanthus</i>	1	10.7	463	0.3	4.95	8.7
Sum total	321	123.3	148 611	100.0	57.09	100.0

*) area at the time of poisoning 21.6 m²

Tab. 4. Age composition, survival (s) and mortality (i, a) rate of the population of *Lepomis macrochirus* in the lagoons Sabanilla and La Luisa

Locality		Sabanilla				La Luisa			
Age group	0	I.	II.	III.	Sum (ave.)	0	I.	II.	Sum (ave.)
N	214 374	1161	33	6	215 574	3223	708	7	3938
%	99.5	0.5	0.015	0.003	100.0	81.8	18.8	0.2	100.0
s	0.005	0.028	0.182		0.006	0.220	0.010		0.182
i	5.29	3.56	1.70		5.19	1.51	2.61		1.70
a	0.995	0.972	0.818		0.994	0.780	0.990		0.818

Tab. 5. Age composition, survival (s) and mortality (i, a) rate of the population of *Micropterus salmoides* in the lagoons Sabanilla and La Luisa

Locality		Sabanilla					La Luisa					
Age group	I.	II.	III.	IV.	Sum (ave.)	0	I.	II.	III.	IV.	Sum (ave.)	
N	422	100	22	9	553*)	1828	47	62	115	6	2058	
%	76.3	18.1	4.2	1.9	100.0	88.8	2.3	3.0	5.6	0.3	100.0	
s	0.236	0.220	0.409		0.241	0.026	—	—	0.052		0.112	
i	1.44	1.52	0.90		1.42	3.66	—	—	2.96		2.19	
a	0.764	0.780	0.591		0.759	0.974	—	—	0.948		0.888	

*) 64 specimens of age 0+ were excluded

Tab. 6. Age composition, survival (s) and mortality (i, a) rate of the population of *Cichlasoma tetraacanthus* in the lagoons Sabanilla and La Luisa

Locality		Sabanilla					La Luisa					
Age group	I.	II.	III.	IV.	Sum (ave.)	I.	II.	III.	IV.	V.	Sum (ave.)	
N	8744	53	18	405	9220	107	14	10	8	2	141	
%	94.7	0.6	0.2	4.4	100.0	95.9	9.9	7.1	5.7	1.4	100.0	
s	0.006	0.340	—	0.054		0.131	0.715	0.800	0.250		0.245	
i	5.03	1.08	—	2.91		2.03	0.34	0.22	1.39		1.41	
a	0.994	0.660	—	0.946		0.869	0.285	0.200	0.750		0.755	

Tab. 7. Growth of *Lepomis macrochirus* in the lagoons Sabanilla and La Luisa (empirical values found in January (Sabanilla) and April (La Luisa))

Age	Sabanilla		La Luisa	
	body length (mm)	body weight (g)	body length (mm)	body weight (g)
0+	25.9	0.87	65.6	1.47
1+	135.9	127.03	126.5	125.34
2+	185.6	271.97	176.9	278.00
3+	206.0	355.00	—	—

Tab. 8. Growth of *Micropterus salmoides* in the lagoons Sabanilla and La Luisa
(values of the same characteristics as in the Table 7)

Age	Sabanilla		La Luisa	
	body length (mm)	body weight (g)	body length (mm)	body weight (g)
0+	—	—	26.0	0.99
1+	175.9	139.76	135.6	65.38
2+	245.6	331.18	196.0	208.75
3+	373.6	1209.45	276.0	532.52
4+	467.7	2216.87	446.5	2923.33

Tab. 9. Growth of *Cichlasoma tetracanthus* in the lagoons Sabanilla and La Luisa
(values of the same characteristics as in the Table 7)

Age	Sabanilla		La Luisa	
	body length (mm)	body weight (g)	body length (mm)	body weight (g)
1+	26.2	1.32	65.5	1.80
2+	85.5	28.93	118.4	100.93
3+	116.2	95.69	152.5	226.60
4+	185.3	291.40	175.5	315.00
5+	—	—	225.5	830.00

Tab. 10. Weight of forage (F) and carnivorous (C) species (in kg) and the F/C coefficient
in the lagoons Sabanilla and La Luisa

	Sabanilla		La Luisa	
	F	C	F	C
<i>Micropterus salmoides</i>		140.48		96.91
<i>Cichlasoma tetracanthus</i>	118.97	13.84	8.03	1.66
<i>Lepomis macrochirus</i>	346.34		137.97	
<i>Poecilia vittata</i>	11.10		0.01	
<i>Gambusia puncticulata</i>	1.80		0.09	
<i>Gambusia punctata</i>	0.06			
<i>Dormitator maculatus</i>	0.03			
Sum total	478.30	154.32	146.10	98.57
F/C		3.10		1.48

Tab. 11. Calculation of production of *Lepomis macrochirus*, *Micropterus salmoides* and *Cichlasoma tetraodon* populations in the lagoons Sabanilla and La Luisa in 1966

Sabanilla						La Luisa					
Age group	N	Average length*) in mm	Average weight in g	Average increment in g	Total increment of age group in kg	N	Average length in mm	Average weight in g	Average increment in g	Total increment of age group in kg	
<i>Lepomis macrochirus</i>											
0	214 374	25.9	0.87	0.87	187.76	3 223	85.6	1.47	1.47	47.28	
I.	1 161	135.9	127.03	126.16	146.47	708	126.5	125.34	123.87	87.70	
II.	33	185.6	271.97	144.94	4.78	7	176.9	278.00	152.06	1.07	
III.	6	206.0	355.00	83.03	0.50	—	—	—	—	—	
Sum	215 574				339.51	3 938				136.06	
<i>Micropterus salmoides</i>											
0	—	—	—	—	—	1 828	26.0	0.99	0.99	1.81	
I.	422	175.9	139.76	139.76	68.98	67	135.6	65.38	64.29	3.02	
II.	100	245.6	331.18	191.42	19.14	62	196.0	208.75	143.37	8.89	
III.	22	376.3	1209.45	959.27	21.10	115	276.0	632.52	323.77	37.23	
IV.	9	467.7	2216.67	926.22	8.34	6	446.5	2923.33	2390.81	14.34	
Sum	553				107.56	2 058				65.29	
<i>Cichlasoma tetraodon</i>											
I.	8 744	26.2	1.32	1.32	11.55	107	65.5	1.80	1.80	1.93	
II.	53	85.5	28.93	27.81	1.46	14	118.4	100.93	99.13	1.39	
III.	18	116.2	95.69	66.76	12.02	10	152.5	226.80	125.67	1.26	
IV.	405	185.3	291.40	195.71	79.26	8	175.5	315.00	88.40	0.71	
V.	—	—	—	—	—	2	225.5	830.00	515.00	1.03	
Sum	9 220				104.29	141				6.32	

*) standard length

Tab. 12. Total production of fish populations in the lagoons Sabanilla and La Luisa

	Sabanilla		La Luisa	
	Production in kg per			
	whole area	1 ha	whole area	1 ha
<i>Lepomis macrochirus</i>	339.51	135.80	135.06	
<i>Micropterus salmoides</i>	107.56	43.02	65.29	181.41
<i>Cichlasoma tetraodon</i>	104.29	41.71	6.32	87.05
				8.43
sum total	551.35	220.54	207.67	276.89

Tab. 13. Production of fish populations in the lagoons Sabanilla and La Luisa and its percentage relation to the standing crop of fish (calculated per 1 ha of area)

	Sabanilla			La Luisa		
	Pro- duction in kg	Standing crop in kg	%	Pro- duction in kg	Standing crop in kg	%
<i>Lepomis macrochirus</i>	135.80	198.27	68.5	181.41	183.96	98.6
<i>Micropterus salmoides</i>	43.02	56.21	76.5	87.05	124.81	67.6
<i>Cichlasoma tetraodon</i>	41.71	57.24	72.8	8.43	12.92	65.2
Sum total	220.53	311.72	70.8	276.89	325.89	85.0

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POSTNATALE ENTWICKLUNG DES GROSSMAUSOHRS,
MYOTIS MYOTIS (BORKHAUSEN, 1797)

Jiří KRÁTKÝ

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Abstrakt: In dieser Arbeit wird die postnatale Entwicklung, das Wachstum und der Zahnwechsel an 98 Exemplaren der *M. myotis* bekannten Alters behandelt, die direkt aus der freien Natur gewonnen wurden. Besondere Aufmerksamkeit wird dem zeitlichen Wachstum der Körper-, Skelett- und Schädelmasse gewidmet.

EINLEITUNG

Die postnatale Entwicklung der Fledermäuse wird erst in letzter Zeit zum Mittelpunkt des Interesses. Mit dem Studium dieser Problematik hat sich Engländer (1952) in seiner Arbeit über die Ontogenese der Fledermäuse der Arten *Nyctalus noctula*, *Myotis myotis* und *Pipistrellus pipistrellus* eingehender befasst. Er ergänzte so teilweise die von Mohr (1932) publizierte Beschreibung des Wachstums der Jungen der Art *N. noctula*. Neuerdings hat sich Dittrich (1958) mit der Art *N. noctula* befasst und einige Daten über deren Ontogenese angeführt. Die postnatale Entwicklung und Dentition an der Art *M. nattereri* hat Balcells (1956) studiert. Einzelne Bemerkungen über das Gewicht und einige Ausmasse von Fledermausen verschiedenen Alters finden wir in den Arbeiten Eisentrauts (1937), Rybergs (1947), Kuzjakins (1950) und Sklenářs (1962). Ausser diesen Arbeiten existieren Studien betreffend die Dentition der Jungen (Leche, 1877; Spillmann, 1927; Friant, 1963 u. a.), sowie das Wachstum der Haare während der Ontogenese der Fledermäuse (Mazák, 1963; Klima und Gaisler, 1967). Zu diesen Arbeiten gesellt sich in letzter Zeit die Studie Gaislers (1962), die unter anderem die postnatale Entwicklung der Klemen Hufeisennase behandelte, und Sigmunds (1964) über das relative Wachstum des Grossmausohrs. Es besteht auch eine grössere Anzahl von Arbeiten, die sich mit der postnatalen Entwicklung aussereuropäischer Arten von Fledermäusen befassen (Barbu, 1961; Short, 1961; Kulzer, 1962; Jones, 1967; Davis, Barbour und Hassel, 1968 u. a.).

An dieser Stelle mochte ich gerne Herrn Dr. V. Hanák CSc. für die Einführung in die Problematik und das Interesse, mit dem er meine Arbeit verfolgte, danken.

MATERIAL UND METHODIK

Zum Studium der postnatalen Entwicklung des Grossmausohrs (*Myotis myotis*) wurden Junge verwendet, die aus der Sommerkolonie auf dem Boden der Schule in Beroun (Mittelböhmen) gewonnen wurden. Das Material wurde in den Jahren 1965 und 1966 gesammelt. Da Wert darauf gelegt wurde, dass die Entwicklung der Jungen ständig in natürlichen Bedingungen verlaufe, wurden möglichst viele junge Fledermäuse in dieser Kolonie gleich nach der Geburt mit farbigen Zeichen aus Kunststoff gekennzeichnet und im Verlaufe des Sommers bis zum Herbst wurden diese bezeichneten Individuen nach Bedarf weggenommen und in 4%igem Formalin (1965) und 60%igem Alkohol (1966) zur weiteren Behandlung fixiert. Auf diese Weise wurde Material von 98 juvenilen und subadulten Individuen (50 ♂♂, 48 ♀♀) bekannten Alters gewonnen, deren Entwicklung durch Übertragung in ein anderes Lebensmilieu nicht gestört wurde (Tab. Nr. 1).

Obwohl die Fledermäuse gleich am ersten Lebenstag beringt wurden, ist kein Weibchen bei der Geburt gefunden worden. Das Alter der Neugeborenen wurde nach dem Vorhandensein der Nabelschnur festgestellt, die 1—2 Tage nach der Geburt abfällt (Kolb, 1958; Gaisler, 1962; Sklenář, 1962).

An frisch getötetem Material wurden mittels eines verschiebbaren Massstabs einige Körpermasse mit einer Genauigkeit von 0,1 mm gemessen, die Patagiumfläche und ferner — mit einer Genauigkeit von 0,5 g — das Gesamtgewicht der einzelnen Fledermause festgestellt. Nach der Präparation wurden mittels des verschiebbaren Massstabs die Skelett- und Schädelmasse festgestellt.

DAS GESAMTBILD DER JUNGEN

Die aus der Sommerkolonie gewonnenen Neugeborenen haben einen Rest der Nebelschnur. Sie sind blind und ihr Körper ist mit feinem, schütterem wenig pigmentiertem Haar bedeckt, das mit blossen Auge kaum sichtbar ist

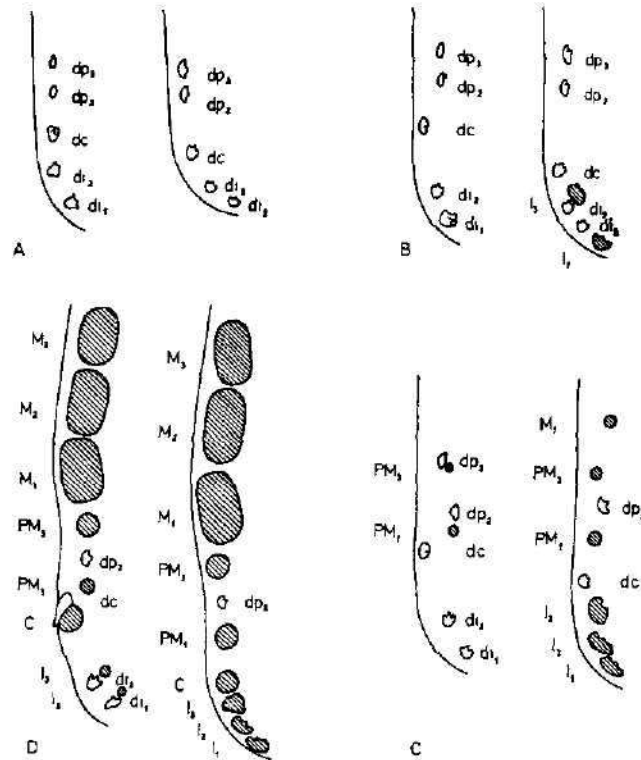


Abb. 1. — Vorgang des Durchbrechens des permanenten Gebisses. Junge im Alter von 1 (A), 11 (B), 14 (C) und 22 (D) Tagen. Links — die linke Hälfte des Unterkiefers, rechts — die rechte Hälfte des Oberkiefers. Permanente Zähne schraffiert. di — Milch-Schneidezähne; dc — Milch-Spitzzähne; dp — Milch-Prämolare; I — permanente Schneidezähne; C — permanente Spitzzähne; PM — permanente Prämolare; M — permanente Molare.

Dieses Haar bedeckt die ganze Oberfläche des Körpers und die anliegenden Teile des Patagiums. An der ventralen Seite des Körpers ist es kürzer, als an der dorsalen. Da die Farbe der nicht pigmentierten Haut durch diese Haare durchscheint, sind die Neugeborenen rosa gefärbt. Die eben geborenen Fledermäuse sind durch die grossen hinteren Gliedmassen und den sehr langen ersten Finger des Flügels auffallend.

Die Augen der Jungen beginnen sich am siebenten Tag nach der Geburt zu öffnen. Allmählich verlängern sich ihre juvenilen Haare und zwar zuerst

auf dem Fücken zwischen den Schulterblättern und im Nackengebiet des Schädels, wo sie bereits mit blossem Auge erkennbar sind, später auch an der ventralen Seite des Körpers. Die 22tägigen Jungen sind bereits völlig mit dichtem und langem Haar bedeckt, das sich vom Haar der adulten Exemplare einerseits durch die Farbe und andererseits dadurch unterscheidet, dass es dem Körper der Jungen dicht anliegt.

Die Grossmausohren beginnen zwischen dem 20. und 24. Tag ihres Lebens zu fliegen. Auf eine selbständige Jagd fliegen sie zum erstenmal etwa am 40. Lebenstag aus (zu dieser Zeit wurden bei seziierten Individuen zum erstenmal in ihren Mägen Insektenreste gefunden).

WACHSTUM UND ZAHNWECHSEL

Die Milchzähne der Mausohren durchschneiden das Zahnfleisch am Ende des (embryonalen Lebens. Eintägige Junge haben eine Formel des Milchgebisses $\frac{2\ 1\ 2}{2\ 1\ 2}$ (Bild 1A). Es fehlt ihnen noch der erste untere Inzisivus*). Zu

dieser Zeit existieren bereits in den Kiefern auch die Grundlagen der permanenten Zähne. Im Verlaufe weiterer dreier Tage erscheinen über dem Zahnfleisch auch die letzten Milchzähne, sodass viertägige Jungen schon endgültige

Anzahl der Milchzähne besitzen. Die Formel der Zähne ist $\frac{2\ 1\ 2}{3\ 1\ 2} = 22$.

Die permanenten Zähne durchschneiden das Zahnfleisch ungefähr am 10. Lebenstag der Jungen und zwar zuerst im Unterkiefer. Bei 11tägigen Jungen erscheinen in der Mandibel die Schneidezähne, von denen zuerst I_3 den Kiefer durchschneidet (Bild 1B). Das Wachstum der permanenten Schneidezähne verursacht die allmähliche Verdrängung und den Ausfall der Milchsneidezähne. Bei 14tägigen Fledermäusen erscheinen als erste obere Zähne des permanenten Gebisses in der Maxilla zwei Prämolaren — PM^1 und PM^3 , im Unterkiefer kommt zu den früher durchgebrochenen Inzisiven gleichfalls der 1. und 3. Prämolare hinzu. Die Formel des Milchgebisses

14tägiger Jungen ist $\frac{2\ 1\ 1\ (2)}{0\ 1\ 1\ (2)}$ (Bild 1C). Es fehlen bereits sowohl drei untere Schneidezähne, als auch in manchen Fällen die beiden dritten Prämolare, die von den entsprechenden bleibenden Zähnen verdrängt werden.

In der Zeit vom 14. bis 22. Lebenstag der Jungen erscheinen in ihren beiden Kiefern ausser den bereits durchgebrochenen unteren Schneidezähnen und den oberen und unteren PM^1 und PM^3 zuerst die Backenzähne (von diesen zuletzt M^3) und später die Spitzzähne. Die übrigen Zähne des Milchgebisses bleiben bisher erhalten. Die 22tägigen Jungen haben das bleibende Gebiss nahezu vollständig (es fehlt nur der obere und untere PM^2), da zu dieser Zeit als vorletzte Zähne die beiden oberen Schneidezähne wachsen. Vom Milchgebiss bleiben in der Maxilla die Schneidezähne (di^1 , di^2), ein Prämolare (dp^3) und bei manchen Individuen ein Schneidezahn. Im Unterkiefer bleibt bloss dp_2 erhalten (Bild 1D).

Als letzte Zähne des permanenten Gebisses schneiden sich etwa am 30. Lebenstag der Jungen die zweiten Prämolare durch, die gleichzeitig die beiden

*) In diesem ganzen Kapitel wird in der Beschreibung des Zahnwachstums stets nur die Hälfte des Ober- und Unterkiefers in Betracht gezogen.

Tab. 1. Durchschnittswerte der wichtigsten Körpermasse der Mausohren (in mm, Gewicht in G)

Alter (Tage)	n	Körper- gewicht	Körper- länge	Schwanz- länge	Länge d. Ante- brahiums	Länge des 3. Fingers	Länge des 5. Fingers	Kondylobas. Länge des Schädels	Zygomatische Schädelbreite
1	9	6,1	46,6	21,4	22,6	28,4	22,9	15,2	10,4
4	9	7,0	50,1	23,5	25,2	31,5	24,4	15,6	10,5
8	9	9,6	54,1	29,1	32,0	38,4	30,9	16,8	11,5
11	7	13,0	59,2	31,3	41,9	48,9	41,4	18,4	12,5
14	7	16,0	65,9	38,4	48,7	56,1	53,8	20,3	13,2
22	11	18,8	68,6	46,6	55,4	79,0	63,2	21,0	13,6
35	7	18,2	69,0	49,0	57,6	86,3	70,0	22,1	14,1
45	10	19,9	71,0	53,1	58,8	93,7	72,4	22,4	14,4
57	13	20,5	73,2	55,1	58,9	95,5	75,6	22,6	14,3
87	8	21,4	74,8	54,5	58,0	99,0	76,0	22,7	14,9
115	8	22,5	74,6	56,3	59,3	99,6	77,0	22,5	14,8

verbleibenden Milchzähne — den oberen und unteren dp^2 — verdrängen. Bei den 55 Tage alten Fledermäusen ist das bleibende Gebiss vollständig.

Seine Zahnformel ist $\frac{2\ 1\ 3\ 3}{3\ 1\ 3\ 3} = 38$. Ausser diesen Zähnen bleiben bei man-

chen Individuen Reste des Milchgebisses — der obere und untere dp^2 — erhalten. Zu dieser Zeit ist jedoch das Wachstum des permanenten Gebisses noch nicht beendet. Im weiteren Lebensverlauf der Fledermäuse ändert sich die Grösse der einzelnen Zähne und das Gebiss gewinnt sein typisches Aussehen, wie wir es bei subadulten Individuen kennen: mit weit hervorstehenden Spitzzähnen, scharfen spitzigen Molaren, mächtigen PM^3 und rudimentären PM^2 . Durch dieses Wachstum werden die Lücken zwischen den einzelnen Zähnen ausgefüllt, denn vom 35. Lebenstag der Fledermäuse bleibt die Länge der oberen und unteren Zahnreihe konstant und die Länge der Mandibeln wächst nur unwesentlich.

ZEITLICHES WACHSTUM

Das Wachstum der Mausohren wurde vom 1. bis zum 115. Tage ihres Lebens beobachtet. Die gewonnenen Daten über das zeitliche Wachstum sind in Tab. 1 zusammengefasst, die Wachstumskurven sind in den Abb. 2—9 veranschaulicht.

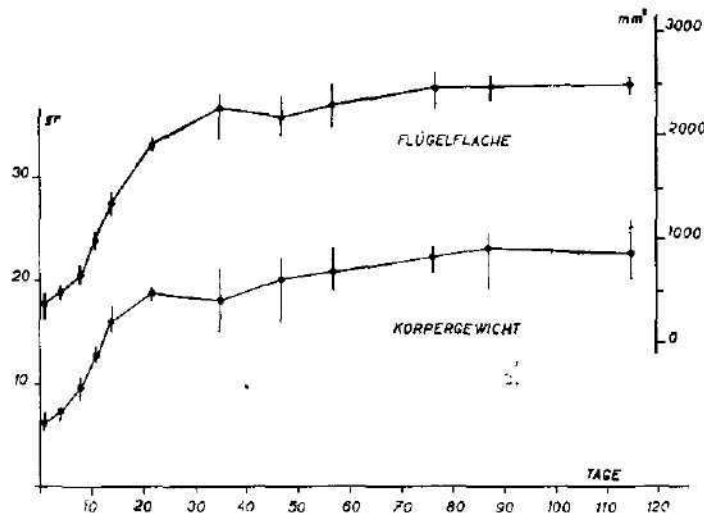


Abb. 2. — Zunehmen des Körpergewichtes und der Patagiumfläche

Das Körpergewicht wächst so wie der Grossteil der übrigen Ausmasse am schnellsten während der ersten Tage nach der Geburt (Abb. 2). Etwa am 20. Lebenstag der Fledermäuse verringern sich die Gewichtszunahmen, wenn auch das Körpergewicht während der ganzen Lebensdauer der Jungen in der Sommerkolonie sich vergrössert. Die Senkung der Kurve auf der graphischen Darstellung zwischen dem 20.—35. Lebenstag und in der Schlussphase der Entwicklung ist offensichtlich durch die grosse Variabilität dieses Ausmasses verursacht.

Ähnlich wie die Gewichtszunahme des Körpers verläuft auch das Längenwachstum des Körpers, des Schwanzes, der Ohrmuschel und des Tragus (Abb. 3). Der Zeitraum des intensiven Wachstums endet im Laufe der dritten Woche.

Die Patagiumfläche misst bei Neugeborenen durchschnittlich 376 mm². Im Verlaufe von 22 Tagen erreicht sie 1900 mm², d. i. 76,5 % der Oberfläche des Patagiums erwachsener Fledermäuse. Die Fläche des Patagiums ver-

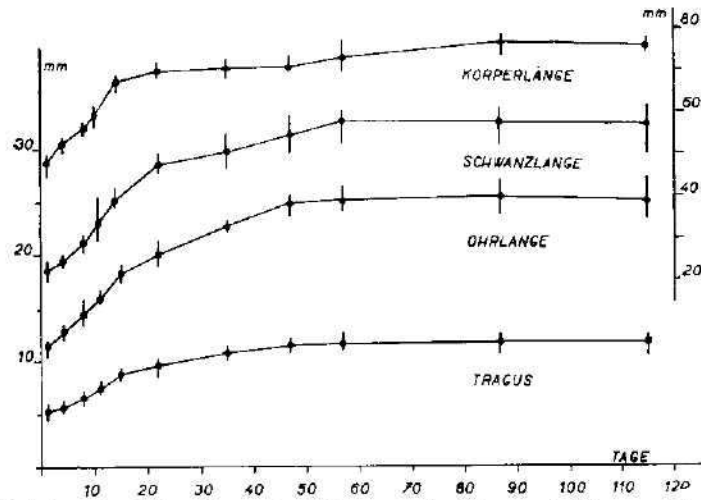


Abb. 3. — Wachstum der Körperlänge, des Schwanzes, der Ohrmuschellänge und der Traguslänge

grössert sich während der ganzen Zeit, in welcher die postnatale Entwicklung verfolgt wurde, d. i. bis zum Alter von 115 Tagen. Weiter wurden die Beobachtungen nicht durchgeführt (Abb. 2).

Der Humerus (Abb. 4) verlängert sich in der Anfangsphase des intensiven Wachstums um 31% seiner endgültigen Länge. Um den 15. Tag herum

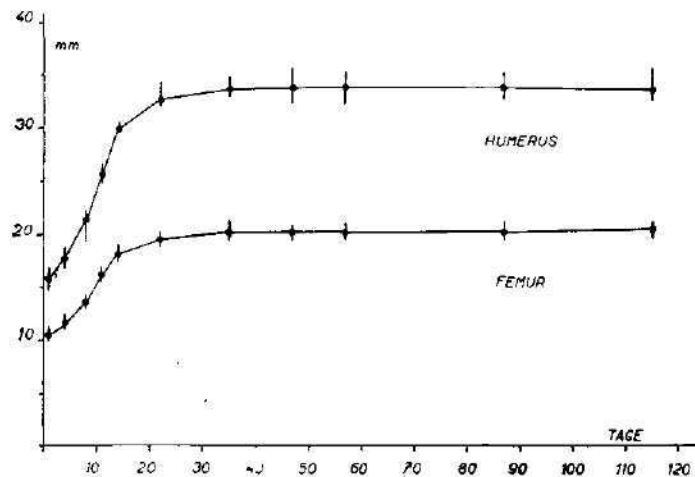


Abb. 4. — Wachstum der Länge des Humerus und Femurs

verringert sich die Zunahme seiner Länge und etwa am 50. Lebenstag der Jungen hört das Wachstum auf. Ähnlich wächst auch die Länge des Antebrachiums (Abb. 5), die jedoch in den ersten 14 Lebenstagen der Jungen rascher wächst und die endgültige Grösse später erreicht, als die Länge des Humerus.

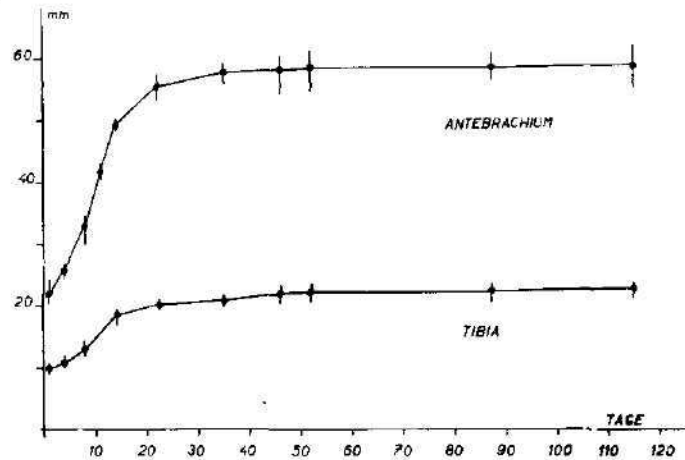


Abb. 5. — Wachstum der Länge des Antebrachiums und der Tibia

Die Wachstumskurven des 3. und 5. Metakarps und der Glieder des 3. und 5. Fingers unterscheiden sich einigermaßen von den Wachstumskurven der übrigen Skelettausmasse. Hier ist in grösserem Masse das langsame Wachstum dieser Knochen sichtbar, das sich allmählich beschleunigt und

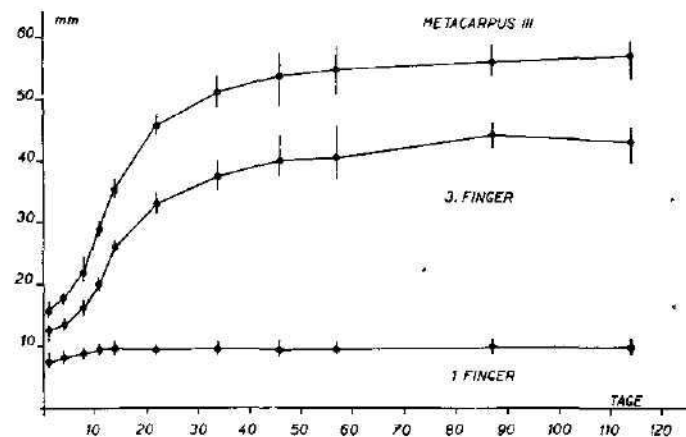


Abb. 6. — Wachstum der Länge des 3. Metakarpus und des 1. u. 3. Fingers

nach dem 14. Lebenstag der Jungen wieder abnimmt. Die endgültige Grösse erreichen die Glieder und Metakarpen der beiden Finger ungefähr am 80. Lebenstag der Fledermäuse (Abb. 6 und 7). Während die übrigen Knochen der

vorderen Extremität unmittelbar nach der Geburt klein sind (sie überschreiten nicht 50 % ihrer endgültigen Grösse), erreicht bei Neugeborenen der erste Finger 77 % seiner endgültigen Länge (Abb. 6). Innerhalb von 10 Tagen nach der Geburt wächst er vollständig aus, ebenso wie der Fuss, der bei Neugeborenen 82 % der endgültigen Grösse erreicht.

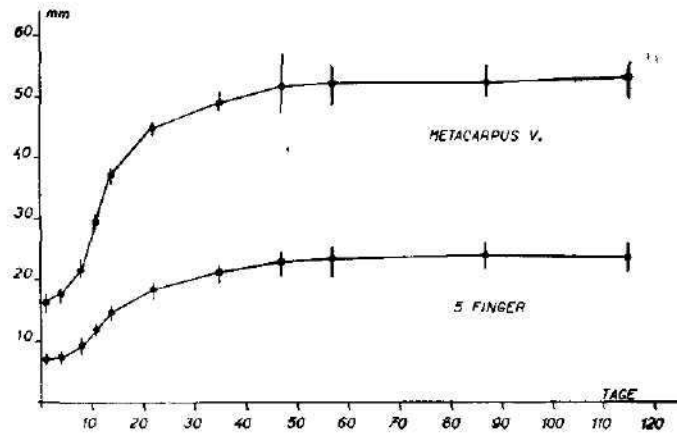


Abb. 7. — Wachstum der Länge des 5. Metakarpus und des 5. Fingers

Der Zeitraum des intensiven Wachstums des Femurs und der Tibia endet ungefähr am 15. Lebenstag der Jungen. Das Wachstum des Femurs hört etwa am 35. Tage auf, das der Tibia etwa am 50. Lebenstag der Jungen (Abb. 4 und 5). Die Wachstumsgeschwindigkeit der Brustbeinbreite beginnt etwa am 10. Tag zu sinken und nach dem 22. Tag hört sie auf, die Brustbeinlänge wächst erst nach der zweiten Lebenswoche der Jungen langsamer.

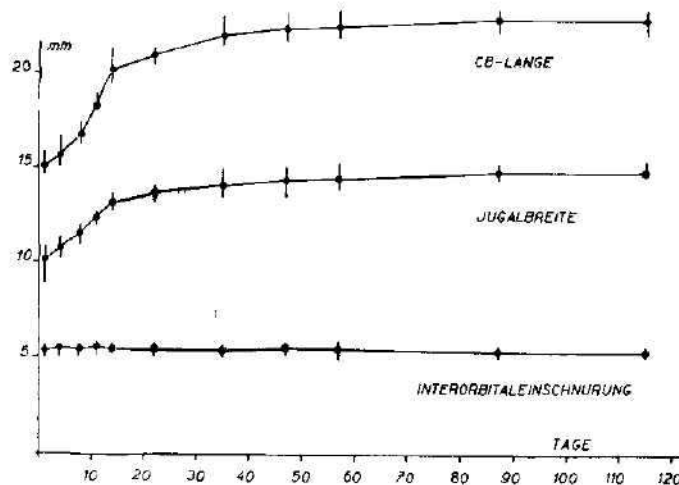


Abb. 8. — Zunehmen der kondylobasalen Länge, der zygomatischen und interorbitalen Schädelbreite

Die Condylbasallänge des Schädels wächst von der ursprünglichen Länge von 12,2 mm bei Neugeborenen innerhalb von 14 Tagen (d. i. im Zeitraum des raschen Wachstums) auf 20,3 mm. Ihr Wachstum endet etwa am 80. Lebenstag der Jungen, ebenso wie das Wachstum der zygomaticischen Breite. Die interorbitale Breite erreicht als einziges Skelettausmass bereits bei Neugeborenen die endgültige Grösse und wächst nicht während der postnatalen Entwicklung (Abb. 8). Die Hirnschädelbreite ist bei Neugeborenen ziemlich bedeutend (84,5 % der endgültigen Grösse). Etwa am 35. Tag beendet sie ihr Wachstum. Die Hirnschädelhöhe erreicht anfangs keine solche relative Grösse und wächst später nach (etwa am 50. Lebenstag der Jungen). Die Länge des Unterkiefers wächst am meisten bis zum 20. Lebenstag der Jungen, d. i. bis zu der Zeit, da das permanente Gebiss zum Grossteil bereits durchgebrochen ist (Abb. 9).

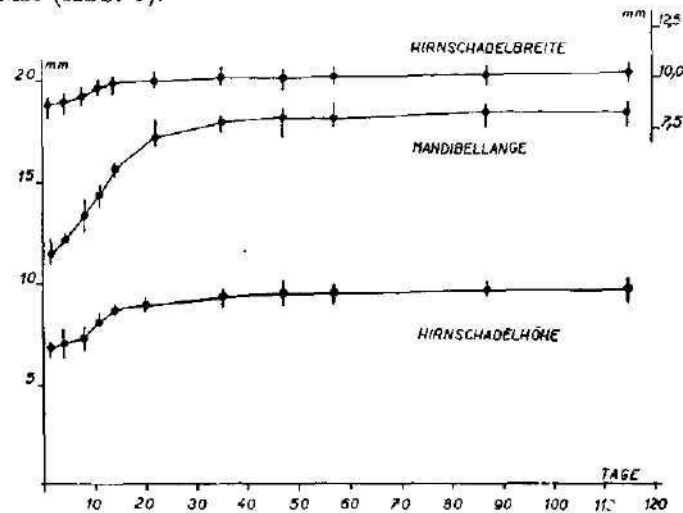


Abb. 9. — Wachstum der Mandibel, der Breite und Höhe des Hirnschädels

GESCHLECHTSUNTERSCHIEDE EINIGER LÄNGENMASSE

Aus der Literatur ist der Geschlechtsdimorphismus in der Länge des Schädels und einiger Knochen erwachsener Individuen des Mausohrs bekannt. Hanák (1960) gibt für die Population dieser Fledermäuse aus Mittelböhmen eine Länge des Antebrachiums bei Männchen von 60,1 mm, bei Weibchen von 62,5 mm an und für die Condilobasallänge des Schädels 22,4 mm (♂♂) und 22,5 mm (♀♀). Sigmund (1964) stellte fest, dass die Männchen des Mausohrs in der letzten Phase der postnatalen Entwicklung einen kürzeren dritten Metakarpus, einen längeren Femur, sowie eine längere Tibia haben, als gleich grosse Weibchen.

An dem mir zur Verfügung stehenden Material fand ich Geschlechtsunterschiede nur in der Länge des Antebrachiums, sowie des 3. und 5. Metakarpus (Abb. 10). Diese Unterschiede beginnen beim 3. und 5. Metakarpus nach dem 22. Lebenstag der Fledermäuse, beim Antebrachium etwa am 14. Lebenstag der Jungtiere markanter zu erscheinen. Am 22. Tag betragen die Unterschiede zwischen Männchen und Weibchen in der Länge des Antebrachiums

chiums 1,6 mm (♂♂ 54,6 mm, ♀♀ 56,2 mm), des dritten Metakarpus 0,5 mm (♂♂ 45,6 mm, ♀♀ 46,1 mm) und des 5. Metakarpus 0,2 mm (♂♂ 44,7 mm, ♀♀ 44,9 mm). Die 115 Tage alten Männchen haben die Antebrachiumlänge im Durchschnitt um 2,6 mm, die Länge des 3. Metakarpus um 2,3 mm und die Länge des 5. Metakarpus um 2,4 mm kürzer als gleich alte Weibchen.

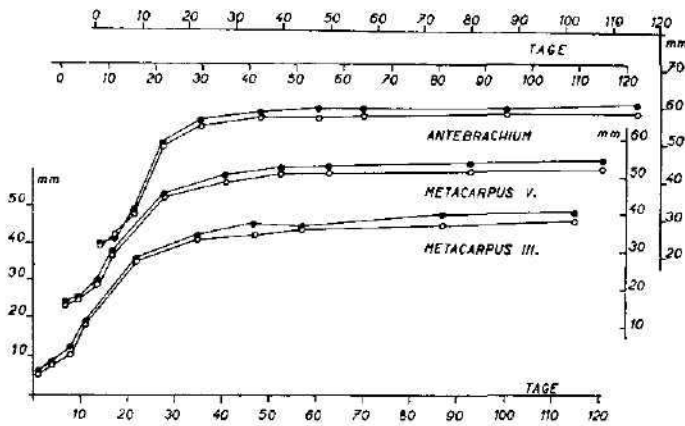


Abb. 10. — Wachstum des Antebrachiums, des 3. u. 5. Metakarps (○ ○ — ♂♂, ● ● — ♀♀).

RELATIVES WACHSTUM

Das relative Wachstum der Werte ist ebenso wie in der Arbeit Mohr's (1932) und Engländer's (1952) in Prozenten der gesamten Körperlänge der Jungtiere (Körper und Schwanz) der einzelnen Alterstufen ausgedrückt. Zum Vergleich der Geschwindigkeit des Wachstums zweier Ausmasse wird deren Wachstum im Hinblick auf die endgültige Länge dieser Organe angegeben.

Das Wachstum der vorderen Extremität wird durch den Längenzuwachs des Humerus, des Antebrachiums, des 1., 3. und 5. Fingers repräsentiert. Der Humerus wächst in der ersten Phase der postnatalen Entwicklung rascher als die gesamte Körperlänge, d. i. die Summe der Körper- und Schwanzlänge. Vom 11.—35. Lebenstag der Jungen ist die Zunahme des Wachstums der gesamten Körperlänge und der Länge des Humerus isometrisch, nach dem 35. Tag wächst der Humerus negativ allometrisch. Die Länge des Antebrachiums wächst bis zum 11. Tag rascher als die gesamte Körperlänge der Jungen. Nach dem 11. Tag nähern sich die Wachstumsgeschwindigkeiten beider Ausmasse, das Wachstum des Antebrachiums ist jedoch ständig etwas schneller. Etwa vom 35. Tage an wächst das Antebrachium im Hinblick auf die Gesamtlänge negativ allometrisch. Die Länge des 3. und 5. Fingers (der Metakarpien und Phalangen) wächst in den ersten Lebenstagen der Jungen nahezu isometrisch mit der Gesamtlänge des Körpers, später erhöht sich die Schnelligkeit ihres Wachstums und bis zum 35. Tag übersteigt es die Zunahme der gesamten Körperlänge. Nach dem 35. Lebenstag der Jungen wächst der Humerus negativ allometrisch. Die Länge des Femurs und der Tibia wächst bis zum 14. Lebenstag der Jungen rascher als die gesamte Körperlänge. Vom 14. Tag ist ihr Wachstum isometrisch bis negativ allometrisch. Der Fuss wächst ebenso wie der erste

Finger vom Anfang an in Hinblick auf die gesamte Körperlänge negativ allometrisch.

Die kondylobasale Länge und zygomatiche Breite des Schädels wachsen langsamer als die gesamte Körperlänge.

Um die Beziehung zwischen dem Wachstum des Körpergewichtes und der Wachstumszunahme der Patagiumfläche auszudrücken, werden in Tab. 2 die durchschnittlichen Gewichtswerte in g/cm² der Flügelfläche bei Jungen verschiedenen Alters verglichen. Wie zu sehen ist, verringert sich die

Tab. 2. Belastung der Patagiumfläche im Zusammenhang mit dem Alter der Fledermäuse

Alter (Tage)	1	4	8	11	14	22	35	47	57	87	115
Belastung der Patagiumfläche (g/cm ²)	1,63	1,51	1,45	1,28	1,18	0,98	0,79	0,87	0,85	1,10	0,80

Belastung der Flugfläche bis zum 35. Lebenstag der Fledermäuse — das Gewicht nimmt langsamer zu als die Fläche des Patagiums. Die geringste Belastung der Tragfläche haben 35–40tägige Junge, in der weiteren Entwicklung vergrößert sich das Gewicht auf jedes cm² der Oberfläche des Patagiums (das Wachstum des Patagiums verlangsamt sich und die Geschwindigkeit der Gewichtszunahme des Körpers beginnt vorzuherrschen). Die Belastung der Flugfläche erreicht jedoch nicht mehr so hohe Werte wie bei Jungen, die zu fliegen beginnen.

DISKUSSION

Das Gesamtaussehen der Jungen. Das Gesamtaussehen der jungen Fledermäuse wurde von einer Reihe von Autoren beschrieben. Mohr (1932) und Dittrich (1958) beschrieben das Aussehen und Wachstum von Fledermäusen der Art *Nyctalus noctula*, Gaisler (1962) befasste sich u. a. mit dem Aussehen der Jungen der Kleinen Hufeisennase. Allgemeine Angaben über die Art *Myotis myotis* sind in der Monographie Eisentrauts (1937) und in den Arbeiten Engländers (1952) und Sklenář's (1962) enthalten. Das Wachstum und der Haarwechsel des Mausohrs haben Mazák (1963, 1965), Klíma et Gaisler (1967) eingehend geprüft.

Die meisten Autoren führen an, dass die Jungen nackt geboren werden (Mohr, 1932; Eisentraut, 1937; Engländer, 1952; Dittrich, 1958; Sklenář, 1962). Wie aus neueren Arbeiten (Mazák, 1963; Klíma et Gaisler, 1967) ersichtlich ist, stimmt diese Angabe nicht ganz genau. Auch bei den geprüften, aus der Kolonie in Beroun stammenden Neugeborenen wurde eine schwache, schütterte Behaarung festgestellt, die den ganzen Körper und den anliegenden Teil des Patagiums der Jungtiere bedeckt.

Die Augen der Mausohren öffnen sich zwischen dem 7. und 11. Lebenstag. Ähnliche Daten geben auch Eisentraut (1937) und Sklenář (1962) an.

Die Mausohren beginnen am Ende der dritten und anfangs der vierten Lebenswoche zu fliegen, nicht also erst im Alter von 5 Wochen, wie Rollinat und Trouessart (ex Eisentraut, 1937) und Engländer (1952) anführen.

Ihre Beobachtungen sind allem Anschein nach durch die Zucht geprüfter Jungtiere in der Gefangenschaft beeinflusst, die auf die Zeit des Flügge-werdens der Jungen einwirkte. Diese Annahme unterstützt auch der Ver-gleich der Knochen der vorderen Extremität des in Gefangenschaft gehaltenen Jungtiers (nach Engländer, 1952) und der in freier Natur gewonnenen Individuen (siehe Diskussion zu den Körperausmassen der Fledermäuse).

Dentition. Die ersten, das Studium des Gebisses der Fledermäuse be-treffenden Arbeiten wurden bereits im vergangenen Jahrhundert geschrieben (Leche, 1877). Eine Studie Spillmanns (1927) befasst sich mit der Morpho-logie und dem Wechsel des Milchgebisses des Mausohrs. Matthews (1950) beschrieb das Milchgebiss eines Individuums der Art *Nyctalus leisleri*, Bal-cells (1956) der Art *Myotis nattereri*. Eine der letzten Arbeiten ist die Studie Friant's (1963), betreffend die Beschreibung des Milchgebisses und der Beziehungen zwischen dem zeitweiligen und dauernden Gebiss.

Die Milchzähne beginnen bei den Grossmausohren bereits während ihres embryonalen Lebens durchzubrechen. Engländer (1952) beschreibt drei Foeten, deren ältestem bis zur Beendigung des embryonalen Lebens etwa 28 Tage fehlten. Bei keinem dieser Embryonen waren noch die Milchzähne durchgebrochen, obwohl sie schon im Kiefer sichtbar waren. Aus diesen spärlichen Angaben kann geschlossen werden, dass die Milchzähne der Maus-ohren erst im letzten Stadium der embryonalen Entwicklung durchbrechen, was auch die Anzahl der Milchzähne der Neugeborenen bestätigt, denen noch der erste untere Incisivus (di_1) fehlt. Die Mausohren kommen also nicht mit einem vollständigen Milchgebiss zur Welt, wie Eisentraut (1937) anführt, wenn auch dieses Gebiss zum Grossteil entwickelt und innerhalb dreier Tage nach der Geburt komplett ist. Die Schlussformel des Milchgebisses $\frac{2 \ 1 \ 2}{3 \ 1 \ 2} = 22$ entspricht also auch der Anzahl der Milchzähne bei der Familie Vespertilio-nidae (Leche, 1877).

Das dauernde Gebiss bricht bei den Mausohren etwa am 10. Lebenstag der Jungen durch (Eisentraut, 1937 gibt das 2. Wochenende an). Der Vor-gang des Durchbruchs der permanenten Zähne ist im Ober- und Unterkiefer nicht gleich, wie Spillmann, 1927 anführt, sondern die Reihenfolge der durchgebrochenen Zähne unterscheidet sich einigermaßen. Der Unterschied zwischen der Maxilla und der Mandibel besteht darin, dass die permanenten Schneidezähne in der Mandibel als erste durchbrechen (am 10. Lebenstag der Jungen), hingegen in der Maxilla als vorletzte Zähne des permanenten Gebisses (20.—22. Lebenstag der Jungen). Damit hängt auch das Vorhanden-sein der Milchzähne im Oberkiefer noch in der Zeit des Flügge-werdens der Jungen zusammen, da diese Zähne erst von den wachsenden permanenten Schneidezähnen verdrängt werden. Noch länger erhalten sich der obere und untere dp^2 , weil die ihnen entsprechenden PM^2 im permanenten Gebiss als letzte erscheinen. Nach Spillmann (1927) verbleiben als letzte Zähne des Milchgebisses die oberen Schneidezähne. Das permanente Gebiss der Maus-ohren ist am 30.—35. Tag komplett, wie auch Rollinat und Trouessart (ex Eisentraut, 1937) konstatieren.

Leche (1877) und Spillmann (1927) geben an, dass in der Zeit, da das permanente Gebiss bereits durchgebrochen ist und die Milchzähne noch nicht verdrängt worden sind, die Gesamtzahl der Zähne in den Kiefern der Fleder-

mäuse 50 übersteigt. An dem geprüften Material wurden die meisten Zähne bei 22tägigen Individuen festgestellt, die in den Kiefern 44 Zähne hatten.

Spillmann (1927) bezeichnet das Milchgebiss der Fledermäuse als „Klammergebiss“ zum Unterschied vom „Fangergebiss“ der erwachsenen Individuen. Dieses Milchgebiss dient dem Jungtier zum Festhalten an der Brustwarze des Weibchens und zusammen mit dem Fuss, der mit starken Krallen versehen ist, bildet es ein Werkzeug, mit dessen Hilfe sich die Jungen an dem Körper ihrer Mütter festhalten. (Spillmann, 1927; Eisentraut, 1937; Friant, 1963). Darum verliert auch dieses Gebiss in der Zeit, da die Fledermäuse selbstständig zu fliegen beginnen, seine Bedeutung und verschwindet, wenn auch die Jungtiere offensichtlich die Nahrung noch nicht selbst besorgen und mit grösster Wahrscheinlichkeit von den Weibchen gesäugt werden, wie aus der Analyse ihres Magens hervorgeht.

Zeitliches und relatives Wachstum der Körpermasse. Die bisherigen Angaben in der Literatur betreffend die Problematik des zeitlichen Wachstums der Mausohren sind sehr spärlich. Sklenář (1962) führt ausser der Gewichtszunahme noch Wachstumswerte des Antebrachiums der Mausohren an, Engländer (1952) das Wachstum der gesamten Körperlänge und Wachstumskurven einiger Ausmasse der vorderen und Wachstumskurve einiger Ausmasse der vorderen und hinteren Extremität von Fledermäusen der Art *Myotis myotis*, *Pipistrellus pipistrellus* und *Nyctalus noctula*. Mit der postnatalen Entwicklung des Abendseglers haben sich auch Mohr (1932) und Dittrich (1958) befasst, einige Wachstumskurven dieser Art hat auch Ryberg (1947) bildlich dargestellt. Das Wachstum der Kleinen Hufeisennase hat Gaisler (1962), das relative Wachstum des Mausohrs Sigmund (1964) bearbeitet.

An den Wachstumskurven aller an Jungtieren der Mausohren festgestellten Gewichts- und Längenmasse kann die Anfangsphase der Entwicklung, in der die Wachstumsschnelligkeit am grössten ist, bestimmt werden. Die Zunahme an Länge und Gewicht verringert sich stetig im Laufe der weiteren Entwicklung und die Wachstumsschnelligkeit verlangsamt sich, bis das Wachstum endlich aufhört. Eine solche Art des Wachstums bezeichnet Bertalanffy (1957) als linear.

Bei einem Vergleich der Kurven der Gewichtszunahme bei den direkt aus der freien Natur gewonnen Mausohren (eigene Angaben und Angaben Sklenářs, 1962) mit der Gewichtskurve eines in der Gefangenschaft gehaltenen Jungtiers (Engländer, 1952) zeigen sich ziemlich bedeutende Unterschiede. Engländer stellte fest, dass ein 60tägiges Jungtier 30,0 g wog, d. i. ein um etwa 11,0 g höheres Gewicht hatte als das Gewicht gleichaltriger, direkt aus der Kolonie gewonnener Fledermäuse beträgt. Dieses extreme Gewicht ist offensichtlich eine Folge unterschiedlicher Nahrungs- und Bewegungsbedingungen des in der Gefangenschaft lebenden Tieres. Eine gleiche abnormale Gewichtszunahme bei Fledermäusen der Art *Nyctalus noctula*, die in der Gefangenschaft gehalten werden, stellte auch Dittrich (1958) fest.

Den grössten Längenzuwachs im ersten Lebensabschnitt weisen einige Knochen der Vorderextremität auf (hauptsächlich das Antebrachium und der 3. und 5. Finger). Damit hängt auch die rasche Entwicklung des Patagiums zusammen. Diese rasche Entwicklung des Flügels ist begreiflich, wenn wir die relativ kleine vordere Extremität der Neugeborenen beachten und in Betracht ziehen, dass die Jungen bereits etwa am 24. Lebenstag aktiv fliegen.

Hingegen erreichen der erste Finger des Flügels und der Fuss bei neugeborenen Fledermäusen nahezu jene Grösse, die diese Organe adulter Exemplare haben, was von den meisten Autoren als funktionelle Adaptation erklärt wird (Eisentraut, 1937; Engländer, 1952; Sklenář, 1962; Sigmund, 1964).

Die graphische Darstellung Nr. 11 vergleicht die Wachstumskurven der aus der Kolonie in Beroun gewonnenen Mausohren mit den Ergebnissen Engländers, betreffend das Wachstum eines in der Gefangenschaft gehaltenen Jungtieres dieser Art. Aus diesem Vergleich geht hervor, dass der Fledermaus

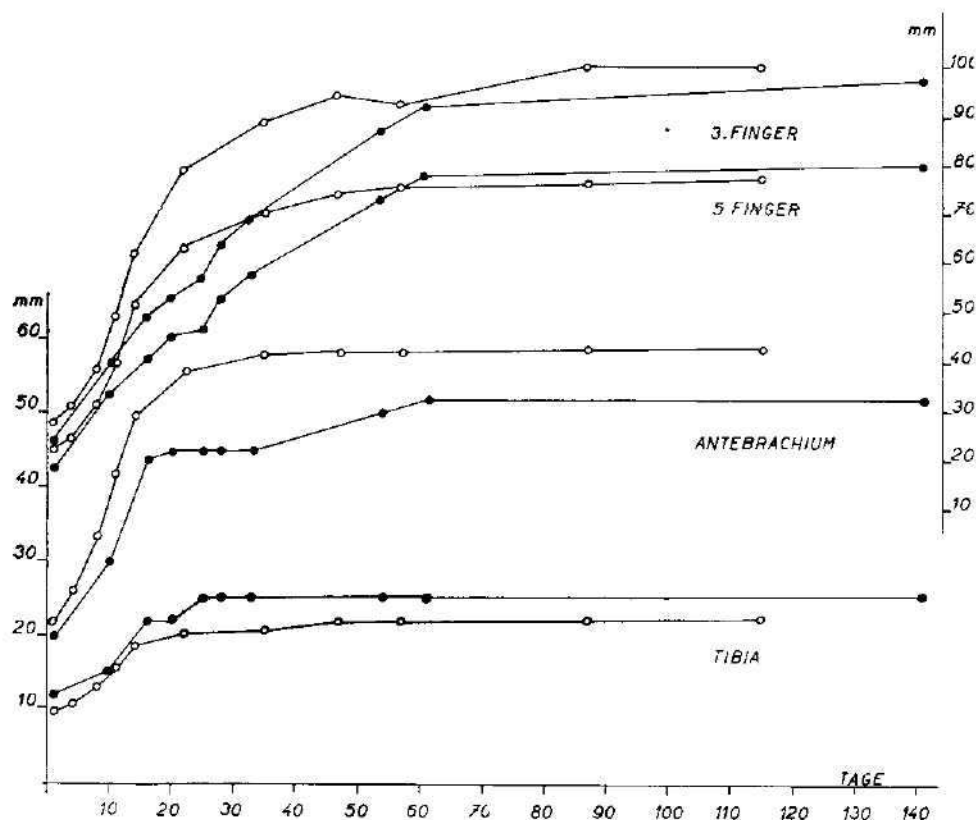


Abb. 11. — Vergleich der Wachstumskurven der Mausohren. ○ — eigene Angaben; ● — nach Engländer

in der Gefangenschaft die Knochen der vorderen Extremität langsamer wachsen und einige dieser Knochen am Ende der postnatalen Entwicklung nicht eine solche Länge erreichen, wie die Knochen von Jungtieren, die aus der freien Natur gewonnen werden (am Ende der postnatalen Entwicklung war die Vorderarmlänge eines in Gefangenschaft gehaltenen Jungtieres noch um 3,0 mm kürzer als die minimale Länge des Antebrachiums der Jungen aus Beroun). Das langsamere Wachstum der langen Knochen eines in Gefangenschaft gehaltenen Jungtieres erklärt vielleicht seine späte Flugfähigkeit. Engländer führt in seiner Arbeit an, dass diese Fledermaus erst am 37. Le-

benstag zu fliegen versuchte und erst am 45. Tag selbständig flog. Diese Feststellung steht im Widerspruch sowohl mit meinen Beobachtungen, als auch mit den Angaben Sklenářs (1962). Nach diesen Beobachtungen fliegen die Jungen der bereits am Anfang der 4. Woche (etwa am 24. Tag ihres Lebens).

Ähnlich wie die Mausohren wachsen auch die Kleinen Hufeisennasen (*Rhinolophus hipposideros*). Zum Vergleich der Wachstumskurven dieser beiden Arten wurden die Angaben Gaislers (1962) über die postnatale Entwicklung der Kleinen Hufeisennase verwendet. Der Verlauf der Wachstumskurven

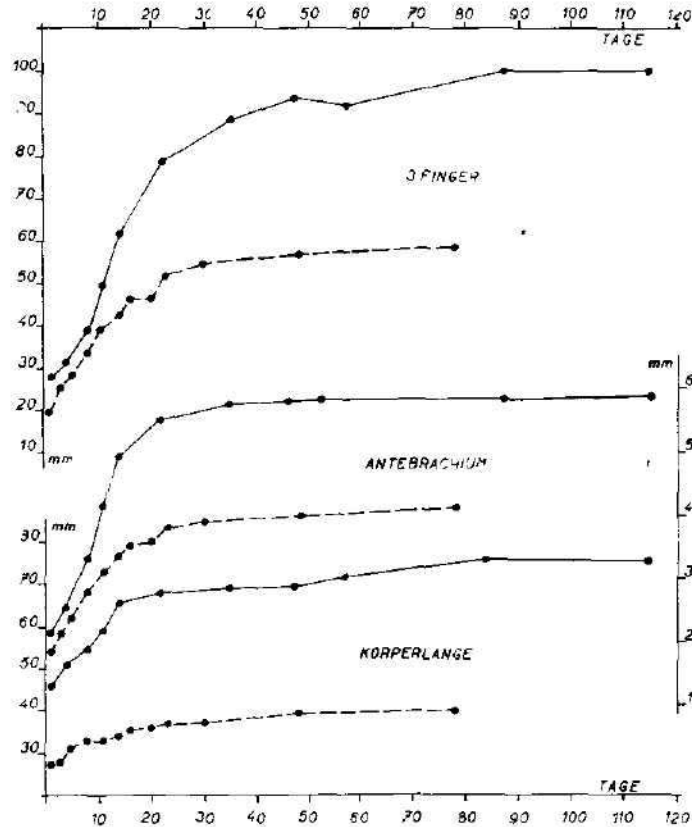


Abb. 12. — Vergleich des Wachstums einiger Körper- und Skelettmasse der Fledermäuse-Art *Myotis myotis* (ununterbrochene Linie) und *Rhinolophus hipposideros* (unterbrochene Linie).

der Länge des Körpers, des Schwanzes, des Antebrachiums, des 3. und 5. Fingers ist bei beiden Arten sehr ähnlich. Einigermassen unterscheiden sich die Wachstumskurven der Ohrmuschel, die bei den Mausohren langsamer wächst. Andere Masse wurden in Ermangelung von Angaben nicht verglichen.

Interessant ist der prozentuelle Vergleich der Körper- und Skelettmasse der Neugeborenen im Hinblick auf ihre endgültige Länge. Neugeborene Hufeisennasen haben eine relativ grössere Körperlänge (67,7 %) als gleichaltrige

Mausohren (63,1 %). Umgekehrt ist das Verhältnis bei den Schwanzlängen (*Myotis myotis* 39,9 %, *Rhinolophus hipposideros* 37,7 %). Der grösste Unterschied ist in der Länge der Ohrmuschel, die bei neugeborenen Hufeisennasen 60,3 % erreicht, bei den Mausohren hingegen nur 42,5 %. Durch diese Tatsache wird vielleicht die längere Wachstumsdauer der Ohrmuscheln bei den Mausohren erklärt. Die Länge des Antebrachiums, des 3. und 5. Fingers der vorderen Extremität ist bei den neugeborenen Hufeisennasen relativ grösser, als bei den eben geborenen Mausohren.

Was das relative Wachstum anbelangt, möchte ich nur auf die Unterschiede zwischen den Arten *Rhinolophus hipposideros* und *Myotis myotis* bei einem Vergleich der Wachstumsgeschwindigkeit der Knochen der vorderen und hinteren Extremität aufmerksam machen. Gaisler (1962) gibt an, dass bei der Kleinen Hufeisennase die hintere Extremität rascher wächst als die vordere Extremität und ihr Wachstum früher endet. Wie ich feststellte (und wie Sigmund, 1964 gleichfalls angibt) wachsen der Humerus und das Antebrachium in den ersten Lebenstagen bei den Mausohren rascher als der Femur und die Tibia. Ein Unterschied zwischen den Hufeisennasen und den Mausohren besteht auch in der Wachstumsgeschwindigkeit der Tibia im Hinblick auf die gesamte Körperlänge (Länge des Körpers + Schwanz). Bei der Hufeisennase wächst dieser Knochen rascher als die Gesamtlänge des Körpers und übersteigt sogar die Wachstumsgeschwindigkeit des Antebrachiums. Bei dem Mausohr jedoch wächst die Tibia (ebenso wie der Femur) im Hinblick auf die gesamte Körperlänge nahezu isometrisch. Diese Feststellung entspricht völlig den Ergebnissen Engländer (1952) und Sigmunds (1964).

ZUSAMMENFASSUNG

1. Die postnatale Entwicklung der Mausohren wurde auf Grund von Messungen an 98 Jungen (50 ♂♂, 48 ♀♀) studiert, die sukzessiv direkt aus der Sommerkolonie dieser Tiere in Beroun (Mittelböhmen) gewonnen wurden.

2. Die Jungen werden mit einer dünnen, schütterten Behaarung geboren, sind blind, haben einen auffallend grossen Fuss und den 1. Finger der vorderen Extremität. 22tägige Jungtiere sind bereits gut behaart, sind graubraun gefärbt und ihre Bauchseite ist hell. Die Augen beginnen sich im Laufe der zweiten Woche ihres Lebens zu öffnen (vom 7.—11. Tag). Die ersten Flugversuche wurden bei 20 Tage alten Individuen beobachtet, 24tägige Junge konnten schon gut fliegen.

3. Die Neugeborenen haben das Milchgebiss bereits zum Grossteil entwickelt. Die permanenten Zähne beginnen etwa am 10. Lebenstag der Jungen durchzubrechen. Zuerst durchdringen die unteren Scheidezähne den Kiefer, ferner die oberen und unteren Prämolaren (ausser PM³), die Molaren und Caninen. Die oberen Schneidezähne erscheinen über dem Kiefer erst bei 20—22 Tage alten Jungtieren. Als letzte wachsen in der Maxilla und Mandibel PM² am 30.—35. Lebenstag der Jungen.

4. In der postnatalen Entwicklung des Mausohrs kann man das anfänglich rasche Wachstum aller verfolgten Masse (mit Ausnahme der interorbitalen Schädelbreite, die im Verlaufe der postnatalen Entwicklung überhaupt nicht wächst) beobachten, das allmählich in ein langsames Wachstumsstadium übergeht. Zuerst erreichen der Fuss und der 1. Finger des Flügels ihre endgültige Länge. Das Wachstum des Antebrachiums, des 3. und 5. Fingers endet etwa am 80. Lebenstag der Jungen ebenso wie die Körper- und Schwanz-

länge. Der Humerus und die Knochen der hinteren Extremität wachsen etwas früher nach, ungefähr am 40. Lebenstag der Fledermäuse.

5. Die Geschlechtsunterschiede in der Länge des Antebrachiums, des 3. und 5. Metakarps machen sich im Laufe der postnatalen Entwicklung des Mausohrs am Ende der 2. und anfangs der 3. Lebenswoche der Jungen auffällender bemerkbar. Geschlechtliche Unterschiede anderer Längenmasse wurden an dem bearbeiteten Material nicht festgestellt.

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ON THE DRIFT OF A BROOK RUNNING THROUGH A POND

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Abstract: The number of organisms carried by water current varies with different sections of the stream. With some organisms this number evidently decreases down the stream, if there are no supplementary sources of drift. Besides other factors, the population density of net-spinning caddis-fly larvae plays an important role in the loss of drift during transport. These considerations are the subject of the present paper and further study.

INTRODUCTION

Studying the drift of some Czechoslovakian streams which run through ponds or river valley reservoirs (Kubíček, 1968b, c, 1969) I pointed out that the liquidation of drifting zooplankton depends on a number of factors, among others on the occurrence and population density of net-spinning caddis-fly larvae. This relationship has also been noticed by Chutter (1963).

In the course of research carried out in the Loučka creek (Kubíček, 1969; Sedlák, 1969) samples of drift were occasionally taken in a small right tributary running through a village pond. Apart from the drift, "live" (active) nets of larvae of the genera *Hydropsyche* and *Polycentropus* were twice sampled and organisms found in them were identified. The present results are preliminary and the study is continued in the field as well as in the laboratory.

METHOD AND STATIONS

The Mirošovský brook springs in the area of ponds in the Bohemian-Moravian Uplands above the village of Mirošov, and having passed through the eutrophic, shallow village pond in Mirošov it runs for 1525 m before reaching the Loučka creek near Blažkov (Fig. 1). At first the brook meanders through open meadows; its lower half is shaded by woods and therefore the temperature of water considerably changes. Owing to a rather steep slope there prevail series of runs and cascades, only in a few parts there are short pools. The steep gradient between the extreme points of the brook (see H_3 — H_4 in Fig. 1) is $I = 22.3$ per cent, between the sampling stations (H_1 and H_2) $I = 20.8$ per cent. The maximal width of the brook is 1.5 m, maximal depth 40 cm. The discharge greatly varies. A normal summer discharge amounts to about 10 litres/second. A higher flow was ascertained on 11. 6. 1965 and 7. 2. 1966. No fish was seen in the brook except for a few metres' section right at the confluence with the Loučka.

The drift was sampled at two places — near the village Mirošov, a few tens of metres below the pond, and near the confluence with the Loučka down in the valley (see H_1 and H_2 in Fig. 1). The drift was collected with a drift pipe and plankton net No 13 (more in Kubíček, 1968a) from 10 a. m. to 2 p. m. The average amount of water filtered was 190 litres.

"Live" nets of the caddis-fly larvae were scraped off stones into PVC bottles. Stones on the bottom of the brook were measured by Schroder's (1932) method and the population density of larvae was always ascertained from about 1000 cm² of the bottom. All samples were fixed with 4 per cent formaldehyd.

There were great differences in the summer temperature of water at the stations H_1 and H_2 . The water temperature at the lower locality H_2 was always somewhat lower than at the higher H_1 . The differences ranged between 1.8—6° C. They could not have been due to the lapse of time between measurements, but to the different exposure of the stations and the fact that warm surface water from the village pond flew to H_1 , whereas in the shaded section of the brook it cooled down again.

RESULTS

Drift

On the whole 86 taxa, 51 of them of zooplankton (including larvae of *Choborus crystallinus* De Geer) and the remaining 35 taxa mostly of rheobenthic organisms, were found in the drift of the Mirošovský brook. Down the stream the number of drifting taxa was decreasing. The following taxa were predominant among the 86 ones:

Testacea (most often *Arcella* and *Diffugia*)

Ciliata (most often Vorticellidae, *Stentor*, *Cyclidium*)

Rotatoria — *Keratella quadrata* (Müller), *Keratella cochlearis* (Gosse), *Polarthra dolichoptera* Idelson, *Asplanchna* and a group of unidentified Rot. g. sp.

Nematoda — Anguillulata

Oligochaeta — *Chaetogaster*, *Nais simplex* Piguët, *Nais communis* Piguët, *Tubifex*, *Limnodrilus* (fragments)

Copepoda — *Eudiaptomus vulgaris* (Schmeil), nauplii et copepodites

Cladocera — *Bosmina longirostris* (O. F. Müller), *Chydorus sphaericus* (O. F. Müller), *Daphnia longispina* O. F. Müller

Diptera, Chironomidae — *Tanytarsus* gr. *gregarius* Kieff., *Tanytarsus* sp., *Ablabesmyia* gr. *lentiginosa* Fries

Diptera, *Simulium verecundum* Stone et Jamnback.

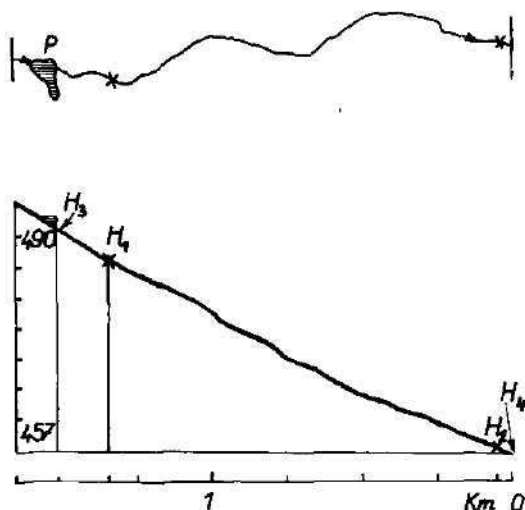


Fig. 1. — Situation of the Mirošovský brook, x = sampling stations, P = village pond

In the drift at the upper locality H_1 there were found 67 taxa (41 of zooplankton, 23 of zoobenthos), and 41 at the lower H_2 (27 of zooplankton, 14 of zoobenthos). The greatest differences between the two localities were found in the decrease of taxa with low population density and some littoral or indifferent types. E. g. at the lower locality near the confluence some rotifers (*Brachionus*, *Mytilina*, *Testudine-lla*), water-fleas (*Ceriodaphnia*, *Leydigia*, *Peracantha*, *Rhynchotalona*, *Macrothrix*) and copepods (*Mesocyclops leuckarti* Claus, *Thermocyclops oithonoides* (Sars), *Thermocyclops crassus* (Fischer)) were never found in the drift. Most

of the species forming frequently occurring or numerous groups in the pond zooplankton [e.g. *Eudiaptomus vulgaris* (Schmeil), *Cyclops strenuus* Fischer, *Cyclops vicinus* Uljanin, *Daphnia hyalina* Leydig, *Daphnia longispina* O. F. Müller, *Daphnia curvirostris* Eylman, *Bosmina longirostris* (O. F. Müller) and *Chydorus sphaericus* (O. F. Müller)] also appeared in the drift at the lower locality near the confluence with the Loučka (H_2).

Among the forms of drift other than plankton the most conspicuous specific differences between both localities were found in the family Chironomidae (8 taxa at the upper and 3 taxa at the lower locality).

There were conspicuous differences between the two localities in the quantitative composition of the drift (Table 1, Fig. 2). The number of specimens varied with individual samples, but always the values of drift ascertained at the lower locality H_2 were substantially lower than at the upper one, H_1 .

The total loss of drift (L) during transport was higher in the zooplankton (over 92 per cent) than in the zoobenthos (over 87 per cent). The loss of drift was calculated on the assumption that $nH_1 = 100$ per cent, $nH_1 - nH_2 = N$.

$$\text{The loss } L (\%) = \frac{nH_2 \cdot 100}{N} \quad (\text{see Tab. 2}).$$

Low values of the loss of drift (11. 6. and 7. 2. in Tab. 2) were probably connected with an increased discharge when the transport of drifting organisms was quicker. The lowest value of loss (40 per cent on 15. 9.) was due to a low number of drifting individuals and their increase at the locality H_2 (Tab. 1). At a normal discharge the loss of drift always exceeded 60 per cent.

Nets of the caddis-fly larvae of the genera *Hydropsyche* and *Polycentropus*

On 14. 6. and 7. 11. 1966 the nets of 42 caddis-fly larvae were collected at both localities during the day (10 a.m. to 4 p.m.)

The total of 3640 specimens of 26 taxa were found in the nets. Most of them were benthic organisms (2324), the others were representatives of zooplankton (1316). Most numerous and most frequently found in the nets were Oligochaeta (Naididae) and Diptera (Chironomidae), and among the zooplankton Rotatoria (*Asplanchna*, *Polyarthra*, *Keratella*, *Euchlanis*). Most of the organisms caught in the nets also occurred in the drift throughout the year.

The specific and quantitative composition of drift sampled at the same time did not correlate with the "catch" in the nets (Tab. 3). On the whole fewer individuals and more taxa were ascertained in the drift than in the nets of the caddis-fly larvae:

	drift (4 times 10 litres)	nets (42 larvae)
zooplankton	597	1316
zoobenthos	24	2324
Total n	621	3640
Taxon n	35	26

This disproportion is caused, above all, by a different composition and ecology of both basic zoocoenoses. According to findings by several authors (e.g. Müller, 1966) it is probable that at night the proportion of some drifting benthic organisms increases. Their being caught in nets depends on their size, behaviour during transport, and other factors. However, these questions are not the subject of the present report.

There are striking differences between the catch in nets at the upper and lower locality (Tab. 3). At the upper one 3519 individuals were found in the nets of 10 larvae, whereas in the nets of 32 larvae at the lower locality there

Tab. 1. Drift of the Mirošovský Brook

Station H₁ in the Mirošov village,

n/10 L	H ₁	1965						1966
		June 11	July '6	Sept. 15	Oct. 11	Nov. 1	Feb. 7	March 14
Zooplankton								
Ciliata planctonica		16	321	4	112			
Rotatoria		15	195		214	22	10	2
Copepoda (excl. Harpacticoidae)		11	377		6	14	4	3
Cladocera		1	681	1	9	5	1	1
Diptera (Chaoborinae)						1		
	S	43	1574	5	341	42	15	6
Benthos								
Testacea		4	22		2		1	
Hydroidea			1					
Nematoda		1			1	1		2
Oligochaeta		1	16		1			1
Bryozoa								
Tardigrada								1
Copepoda (Harpacticoidae)		1						
Ostracoda		1	1					
Hydracarina								
Ephemeroptera			6					
Plecoptera								
Trichoptera								
Diptera (Chironomidae)		1	56		112		1	2
Diptera (Simuliidae)			2		1			
	S	9	104		117	1	2	6
Total		52	1678	5	458	43	17	12

were only 121 specimens. The population density of the net-spinning caddis-fly larvae at the upper locality was several times higher than at the lower one (Tab. 3). The catch in the nets depends on a number of factors (size and age

Tab. 2. The loss of drift between stations H₁ and H₂

Date	1965						1966				
	11. 6.	6. 7.	15. 9.	11. 10.	- 1. 11.	7. 2.	14. 3.	12. 4.	14. 6.	7. 11.	
Drift L %											
Zooplankton	60.4	96.3	100	99.9	76.1	86.3	100	95.2	100	71.4	
Zoobenthos	55.5	91.3	0	97.4	0+(100)	0+(15)	83.3	70	85.7	66.6	
Total drift	59.6	96.7	40	99.1	72	58.2	91.6	93.5	99.6	71.1	

Note: Numbers in parentheses indicate increments at the station H₂

station H₂ at the confluence with the Loučka Creek

1966			H ₂	1965					1966				
Apr. 12	June 14	Nov. 7		June 11	July 6	Sept. 15	Oct. 11	Nov. 1	Feb. 7	March 14	Apr. 12	June 14	Nov. 7
155	1	3		10	54						1		
19	449	35		3	3		1	1	1		8		3
15	39	26		3				6	1		1		13
1		20		1				3					8
190	489	84		17	57		1	10	2		10		24
		1		1	6			2	1				1
	2			1	1								
2	2	1		1						1	2		
6	3	2		1	1	2	1		1		1	1	1
	1												
	1						1		1				
1						1							
	2												
1	1	1			1				1			1	
	1	1							1				
10	14	6		4	9	3	3	2	5	1	3	2	2
200	503	90		21	66	3	4	12	7	1	13	2	26

of the net, its location, density of population, type and behaviour of drifting organisms, turbulence, etc.) and the material studied is insufficient for their more detailed evaluation.

DISCUSSION

The daily drift of the Mirošovský brook consisted for the most part of zooplankton. The amount and specific composition of the drifting zooplankton depends mainly on the state of its development in the pond and on hydrological situation. On 11. 6. 1965 and 7. 2. 1966 there was higher flow in the brook and yet the amount of drifting zooplankton was relatively small (Fig. 2). The largest amount of the drifting zooplankton was ascertained at the time of maximal development of some of its components in the village pond, or in the autumn when other ponds connected with the stream were being emptied (November).

The amount and specific composition of rheobenthic organisms in the drift depended on the composition and state of development of the benthos

Tab. 3. Aquatic animals taken in the drift samples and in the catch of net-spinning nymphs
(* more abundant Naididae, *Nais simplex* Piquet and *Nais communis* Piquet)

	St. H ₁				St. H ₂			
	14 Jun. 1966		7 Nov. 1966		14 Jun. 1966		7 Nov. 1966	
	Drift n/10 l	Catch nets 5 nymphs	Drift n/10 l	Catch nets 5 nymphs	Drift n/10 l	Catch nets 6 nymphs	Drift n/10 l	Catch nets 11 nymphs
Zooplankton								
Ciliata (planctonics)	1	990	3	0	0	0	0	0
Rotatoria	449	226	35	81	0	0	3	10
Copepoda	39	2	26	1	0	4	13	0
Cladocera	0	0	20	2	0	0	8	0
Benthos								
Testacea	0	0	1	0	0	0	1	0
Hydroides	2							
Nematoda	2	500	1	13	0	23	0	2
Oligochaeta	3	1620*	2	25	1	26	1	18
Bryozoa	1	0	0	0	0	0	0	0
Ostracoda	1	0	0	0	0	0	0	0
Amphipoda	0	0	0	0	0	1	0	0
Hydracarina	1	0	0	0	0	0	0	0
Ephemeroptera	0	0	0	0	0	1	0	0
Trichoptera	2	0	0	0	0	0	0	0
Diptera, Chironomidae	1	80	1	29	1	16	0	20
Diptera, Simuliidae	1	0	1	0	0	0	0	0
S	489	1218	84	84	0	4	24	10
Total	503	3368	90	151	2	71	26	50

Density of nymphs (*Hydropsyche*
and *Polycentropus*) in the bottom
samples (1000 cm³)

50 79 10 12

in the brook. E.g. in both maxima of the drift (Fig. 2, 6. 7. and 11. 10. 1965) midge larvae predominated. Their occurrence in the drift is not incidental, being connected with the development of this group in the rheobenthos throughout the year (e.g. Kubiček, 1968d; Besch et al., 1967). Dominant species in the benthos of the Mirošovský brook were represented mainly by larvae of some chironomids, black-flies and caddis-flies.

The differences in the amount of drift between the two stations in the brook are caused by heavy losses (Tab. 2) manifested within a relatively short distance (1325 m) by a conspicuous decrease in the number of organisms (Tab. 1, Fig. 2). This great decrease may be due to several factors (Kubiček, 1968b, c), two of which appear to be most significant in the Mirošovský brook: the slope of the markedly turbulent stream, and the population density of the net-spinning caddis-fly larvae.

In contrast to bigger streams where a striking loss of the drifting zooplankton occurs only several kilometres below a reservoir (Chutter, 1963 — 8 km, Kubiček, 1968b, c — 10—28 km), in the Mirošovský brook the drifting organisms liquidated within a few hundred metres from the place where the stream leaves the pond. The turbulence of the brook (the series of runs and cascades) is due to its steep gradient amounting to $I = 22.3$ per cent from the village pond to the confluence with the Loučka and to $I = 20.8$ per cent between the two sampling stations, H_1 and H_2 , whereas in the rivers Svatka and Orava (Kubiček, 1968c) the slope was less steep ($I = 2.8—3.1$ per cent).

The population density of the net-spinning larvae of Trichoptera is higher in the upper section of the brook than down near the confluence, and it is correlated with the decrease in the number of drifting organisms (Tab. 3). The part taken by the slope or number of nets in this change is the subject of further study.

The occurrence of large numbers of the net-spinning larvae of Trichoptera depends mainly on temperature and abundance of food. The lower population

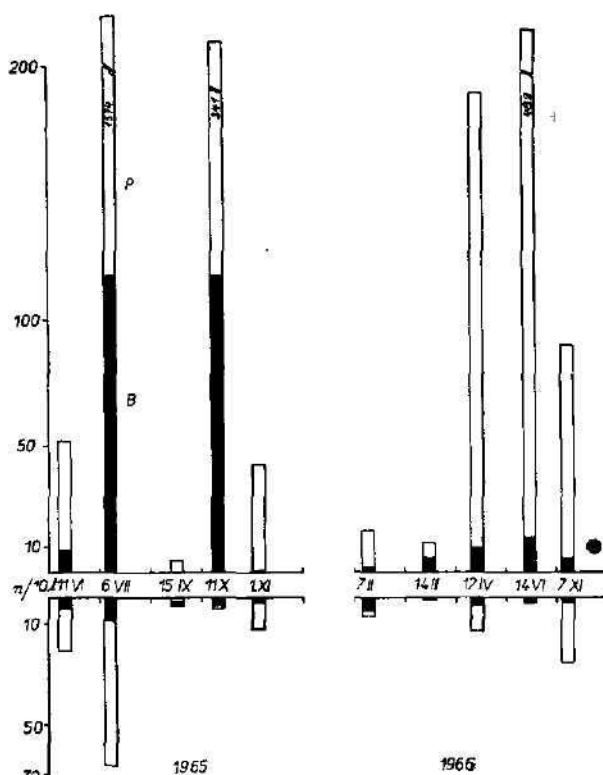


Fig. 2. — The main components of drift at both sampling stations in the Mirošovský brook, P = zooplankton B = zoobenthos

density of the *Hydropsyche* and *Polycentropus* larvae at the lower locality H₂ is limited, besides other factors, by a lower temperature of water.

In the Mirošovský brook the water temperature drops down the stream along with the population density (the shaded section of the brook), whereas in rivers below dams the values of both coefficients are increasing down the stream (Kubiček, 1968b, c). In cases where warm surface water flows away from the reservoir, many net-spinning caddis-fly larvae are present near the dam (Chutter, 1963).

SUMMARY

The daily drift was observed at two places in a small brook with runs and cascades, running through a village pond. In spite of a short distance between the two sampling stations there is a pronounced difference in their altitude and therefore the stream is rather turbulent. Zooplankton predominated among the drifting organisms; Oligochaeta, Nematoda, Testacea and the larvae of Trichoptera also frequently occurred. The amount of drift depended mainly on the state of development of the zooplankton in the pond and on the composition of benthos in the brook. There were great differences in the amount of drift in the upper and lower sections of the brook owing to mechanical effects of the current and a different population density of the net-spinning caddis-fly larvae of the genera *Hydropsyche* and *Polycentropus*. The amount of drift decreased down the stream. Despite a relatively large amount of the drifting zooplankton only a small number of individuals were carried into the Loučka creek (about 1.5 km from the pond).

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COMMENTS ON THE DISTRIBUTION OF THE LYNX,
LYNX LYNX LYNX (LINNAEUS, 1735) IN SCANDINAVIA

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Abstract: The author comments Curry-Lindahl's paper on the Lynx in Scandinavia as well as his own paper on the same subject published elsewhere (Mazák, 1968) and brings forward some new aspects of the problem.

In July and August 1967 an expedition to Scandinavia was organized by the "Centre National de la Recherche Scientifique, Paris". During this expedition some new data on the distribution and taxonomy of the Lynx were collected, and published elsewhere (Mazák, 1968).*)

Recently, Curry-Lindahl (1969) criticized my 1968-paper. In any field of science there certainly is no progress where there is no disagreement. I feel, and have always felt, that this is true and I have always admitted any justified criticism. As Curry-Lindahl's remarks on my paper seem to be based on a misunderstanding I have requested the Editors of this journal to be kind enough to publish this explanatory article. I do not want to start a polemic and I tried to explain everything that should be, in my opinion, explained in this article. In order to avoid any further misunderstanding I asked the Editors to publish this paper in English and not in French though the latter was the language of my 1968-paper.

In the first part of his paper Curry-Lindahl (1969, pp 140—41) states that I misinterpreted the text of Johnsen when quoting that in the 19th century Lynxes were found in counties of the Troms and the Finnmark. Curry-Lindahl (l.c.) says: "As regards the former situation in Norway, Mazák gives some records from the provinces Troms and Finnmark of Northernmost Norway during the 19th century. However, these records do not at all reflect a resident population. According to Collett (1912), Olstad (1945) and Johnsen (1947) these provinces do not seem to have ever been populated by the Lynx. Only stragglers appeared there very rarely. Mazák has apparently misinterpreted Johnsen's text."

I think that this statement of Curry-Lindahl does not reflect my actual words. In my 1968-paper I wrote (p. 327). "Par exemple, Johnsen (1957, p. 416) écrit que ce félin a hanté au cours du siècle dernier les forêts des

*) For certain reasons this paper could not be published in "Mammalia" where my 1968-paper appeared.

comtés de Troms et de Finnmark." As one can see I did not at all mention the term "resident population". In addition, I used the French verb „hanter" corresponding to the English verb "to visit" which, further on, corresponds perfectly to the text of Johnsen. I would also like to emphasize that I quoted "Johnsen (1957)" whilst Curry-Lindahl is referring to "Johnsen (1947)". According to the references given by Curry-Lindahl (1969, p. 144) it seems that Curry-Lindahl and myself are referring to the same text but that each of us has seen a different edition of Johnsen's work.

Curry-Lindahl states further (p. 141): "Mazák seems to attribute great importance to an information concerning Sweden, that he has quoted from a publication (Andrén, 1961), where it is stated that the lynx 'was common in all Sweden'."

I would like to add that I only said (Mazák, 1968, p. 327): "Andrén (1961, p. 48), par exemple, écrit que 'Formerly, it (le Lynx) was common in all Sweden'." It seems to me that this quotation does not show that I have attributed any greater importance to the publication in question than to any of other publications quoted in my paper, nor does it show that I have based any of my conclusions upon the publication of Andrén. Besides, Curry-Lindahl himself (1969, p. 141) claims that "Dr. Andrén... has based his text about animals on Fries and Curry-Lindahl (1961)...".

Curry-Lindahl tries to show further that I have misinterpreted his own data as well as my findings and that I claimed that the Lynx had regularly inhabited the whole Scandinavian Peninsula. I can only say that this seems to be a very unhappy misunderstanding. I have never tried to make a reconstruction of the distribution of Lynx in Scandinavia in the past. I only wished to bring forward some new data on the Lynx that I succeeded in collecting during my 1967-journey to Scandinavia. In my 1968-paper (pp. 327 and 327-328) I did not state anything more than that "On ne peut... exclure complètement la possibilité de la présence du Lynx, vers le milieu du XIX^e siècle, en Suède du Nord... il existe une probabilité que le Lynx ait habité au cours du siècle dernier les régions situées plus au Nord que celles indiquées par Curry-Lindahl." The literature data, my personal data, and the material of the Naturhistoriska Riksmuseet of Stockholm seem to indicate that my statement given above was justified.

Skulls of the Lynx deposited in the Naturhistoriska Riksmuseet in Stockholm, that Curry-Lindahl has perhaps seen but never mentioned in any of his articles (as far as I know, at least), show quite clearly that Lynxes formerly visited more northerly regions than those indicated by Curry-Lindahl in his papers (1951, 1960, 1965a, 1965b, 1966, 1968). Curry-Lindahl (1969: 141) writes: "Mazák (1968) mentions one record from the province Västerbotten in 1832, located about 130 kms north of where Curry-Lindahl (1960) on a map (based on Lönnberg 1930) has drawn the northern limit of the distribution range of the Lynx in 1850. Again Mazák is referring to a record of a straggler, while I am dealing with a resident population." To this quotation I can only say once again that in my 1968-paper I never mentioned anything about a resident population. On the contrary, in my paper the following words can be read: "Le matériel n'est, bien entendu, pas très abondant et il est difficile de savoir si les spécimens du Musée de Stockholm reflètent la présence régulière ou seulement occasionnelle du Lynx." (Mazák, 1968 : 329).

In a further part of his 1969-paper (pp. 141—42) Curry-Lindahl tries to demonstrate that I have misinterpreted his data on the recent distribution of the Lynx in Sweden. He says that he has never seen a paper of his which I quoted (Curry-Lindahl, 1966) and which was published in a French journal. He also says that the paper in question was evidently "based on a paper published in Great Britain (Curry-Lindahl, 1965b)." Apparently the Editors of the French journal concerned did not inform him of the publication of the above-mentioned paper but I do not agree that the paper was "either . . . very badly translated or edited" as Curry-Lindahl (1969 : 142) suggests. When comparing the French text with the English original as quoted by Curry-Lindahl himself (l.c.), one cannot find any important difference. Curry-Lindahl (l.c.) criticizes a sentence concerning „nomadic lynxes" that I quoted from his 1966-paper. As far as my knowledge of both French and English languages reaches I think that the French version of the sentence in question is more or less an exact translation of the English one. Let the reader check it himself:

English (Curry-Lindahl 1969 : 142, quoted from his 1965-b-paper):

"In recent years nomadic lynxes have appeared from time to time in all the provinces of the Swedish mainland, except Scania the southernmost."

French (Curry-Lindahl 1966 : 144):

"Au cours des dernières années, des Lynx nomades ont été observés dans toutes les provinces de la Suède, à l'exception de la plus méridionale, la Scanie."

Curry-Lindahl (l.c.) further writes that Lynxes „in Mazak's interpretation of my text should travel widely around also in southern Sweden." I want to emphasize that I have not written anything that could be called a misinterpretation of Curry-Lindahl's statements as the reader can check if comparing the text of my 1968-paper with that of Curry-Lindahl's 1969-paper.

In my 1968-paper (p. 328) I wrote that according to Curry-Lindahl's data the present distribution area of the Lynx in Sweden lies between the 62nd and 67th parallels. Contrary to this, Curry-Lindahl (1969 : 142), quoting from his 1965-b-paper, says that the distribution area of resident lynx populations lies between the 63rd and 68th parallels. I based my above quoted statement on the maps published by Curry-Lindahl in his papers and partly on the text of his "incriminated" 1966-paper. Now, I have once more compared the maps published by Curry-Lindahl (1960 : fig. 4, 1965a : 186) with detailed geographical maps of Scandinavia where the parallels and meridians are drawn and have found again that Curry-Lindahl's maps show the distribution area of the Lynx in Sweden exactly as I have stated in my 1968-paper, i.e. it lies between the 62nd and 67th parallels. The same situation is shown even on a map published in another paper of Curry-Lindahl (1968) that was in press at the time when I wrote and published my 1968-paper. Thus I really do not know why Curry-Lindahl calls my quotations of his data as being "highly misleading" . . .

In another part of his 1969-paper (pp. 142—43) Curry-Lindahl says "Mazak criticizes [*sic*] my statement (in Curry-Lindahl 1960) that 'En 1925

l'aire de répartition permanente atteint son minimum et se limita presque complètement au Jämtland.' This statement of mine refers to Lönnberg (1930), but Mazák thinks that it is erroneous . . .". I would like to say that in my 1968-paper I did not put any criticism upon the statement quoted above nor did I express any indication that it was erroneous. I have only stated that "Cette constatation [of Curry-Lindahl] n'est pas cependent complètement en accord avec les données que l'on peut trouver chez Lavau-den (1930, pp. 61—62) . . ." (Mazák, 1968 : 328—29) and I have further quoted some examples that supported this statement of mine in order to show that it was justified. I think it is not necessary to discuss this question in more detail since all the data can be found in my 1968-paper.

Curry-Lindahl (1969 : 143) also states that when describing the situation in Norway I once again confused stragglers with resident, settled lynx populations. Curry-Lindahl (l.c.) criticizes my statement that in Norway the Lynx may be found in almost the whole of that country (which has been shown again by Myrberget, 1968, figs 5 & 6) but he has evidently overlooked another statement of mine that particularises the matter and that runs as follows: ". . . on peut constater que, de nos jours, l'aire principale de répartition régulière du Lynx en Norvège s'étend entre les parallèles 61° et 68° . . .". (Mazák, 1968 : 331). This is in full accordance with the data published by Myrberget (l.c.).

Finally, Curry-Lindahl (1969 : 143) says that „the statement by Mazák that the Lynx is protected in Sweden since 1928 is not entirely correct. It was protected between 1928 and 1943, but since then it may again be hunted from one to four months a year in various provinces." The context of the paragraph in question of my paper (Mazák, 1968 : 333) shows quite clearly that I did not intend to discuss in detail the problem of protection of the Lynx in Sweden. If I wanted to do so then I could certainly quote the precise details from Curry-Lindahl's 1960-paper (pp. 187—88). I only wanted to show that "grâce à cette protection, le recensement des populations atteint au cours des dernières décades, un niveau assez satisfaisant." Besides, in my paper I said: "Depuis 1928, le Lynx est officiellement protégé en Suède", and not "complètement protégé". I think that one should agree that if an animal may be hunted just one or four months a year then this is certainly a kind of protection.

Curry-Lindahl (1969 : 143) suggests that some of the misunderstanding could be explained by a different approach to the interpretation of the individual records of the occurrence of the Lynx. I agree entirely. I would, for instance, prefer the term "area of regular occurrence of lynx" to the term "resident population". We know that the Lynx is certainly not a true nomadic species but we also know and must agree that this member of the cat family is able to cover relatively large distances (cf. Haglund, 1966). I would say that it is rather difficult to determine whether or not the Lynx forms "the resident population" in a certain area. One has to consider a complex of different factors: trophic relations, the season of year, population density of those species that belong to the prey of Lynx, etc. I have discussed this question with people who have for years been studying the Lynx in Slovakia and I have been told that there are regions where the Lynx regularly appears five or six times a year, staying just a few days. These regions are thus on the regular "beat" of an individual animal. Should such

regions be considered as regions of regular occurrence or as those of occasional occurrence of the Lynx? In my opinion the former alternative reflects better the situation as regions in question are regularly visited by the same animal, forming a part of its natural home range. I do not doubt that the individual home range of a Lynx is somewhat bigger in Scandinavia than that in Slovakia. Hence, the intervals between the two visits of a certain region by a certain animal may be even longer than those in Slovakia. Such regular visits of a place situated on the regular "beat" of a certain animal are known from Sweden, too. The question is still the same: shall we consider these places as parts of the area of regular occurrence of Lynx or shall we consider these regular visits as occasional occurrence of Lynx? As I have already said I prefer the former alternative.

As to the northern parts of Scandinavia one also has to respect the fact that these regions are less populated by Man, which means that the presence of Lynx is much more difficult to register and/or be made known to professional zoologists. Thus we have just a few data on the occurrence of the Lynx in the northernmost parts of Scandinavia and this might represent one of the reasons why we incline to believe that the Lynx visits northern parts of the Scandinavian Peninsula just occasionally.

All these facts lead me to that position that one has to be very careful as far as the problem of the "regular distribution area of the Lynx" is concerned.

Coming back to my 1968-paper I would like to state that I regard as very probable that the Lynx has regularly inhabited and still inhabits more northerly regions of northern Scandinavia than those shown by Curry-Lindahl in his papers (1951, 1960, 1965a, 1965b, 1966, 1968, 1969). This has again been demonstrated in a series of papers recently published by various authors. For example, Haglund (1966, cf. pp. 100—104 and 249—50) has found that the Lynx occurred in all the ten areas of Sweden studied by him, one of them being located in the very northernmost part of Sweden. Myrberger (1968 : 17) states that in Norway "there are established populations north of the 69th parallel and strays have been recorded as far as the 70th one." Similarly, the maps published by Pulliainen (1968, cf. figs 9, 10, 16 and 17) show that the Lynx in the past inhabited and at present inhabits again those regions of Finland that lie as far north as the 69th parallel. In addition, Pulliainen (l.c., p. 30) states: "It is clearly seen that the lynxes repopulating Finland have settled in areas where the species was common in the 1800's as well." The distribution map of the Lynx given by Siivonen (1968, map No. 62) also shows that this cat can be regularly met with in more northerly regions of Scandinavia than was previously believed.

The occurrence of the Lynx in the northernmost Sweden, or in the Sweden-Norway boundary region, has once again been documented by a skull of a young lynx that I received from Ing. M. Hrnčíř who is staying in Sweden temporarily. The specimen was found dead in a forest near Råstojaure (south of Kilpisjärvi; ca. 21°E, 69°N) in July, 1969. The specimen must have been dead for a long time and its remains were incomplete. The skull sent to me lacks the mandible and belongs to a young animal in the last phase of the tooth-change (still having milk Pm³, i.e. the milk carnassials, but also having all the permanent teeth cut through the bone). In my opinion the specimen

can be considered as a female. The principal skull measurements are as follows:

Greatest length	116.5 mm
Condylobasal length	106.0 mm
Rostral breadth	30.9 mm
Interorbital breadth	21.5 mm
Bizygomatic breadth	77.5 mm
Mastoidal breadth	53.6 mm
Pm ⁴ length	15.7 mm

The skull in question bears No. S-2 of my private collection that is designated to become the property of the National Museum in Prague.

To make these comments on the Scandinavian Lynx complete I would like to mention here some basic data concerning a lynx from Sweden that have kindly been reported to me by Dr. P. J. H. van Bree of the Zoölogisch Museum, Amsterdam. The Lynx in question is a fullgrown female killed on April 1, 1967 in Fiskåfjället, Jämtland (ca. 15°E, 64°30'N). The external measurements were as follows: total length 1031 mm, tail 174 mm, hind foot 231 mm, weight 11945 g. Mounted skin, skull and postcranial skeleton are deposited in the Zoölogisch Museum, Amsterdam, No. ZMA 12.264 (P. J. H. van Bree, in litt. August 7, 1969).

Finishing this article I would like to say that I think (and have always thought) that the task of all scientists is to discuss new data, new opinions, and new ideas among themselves. This has been the purpose of the present paper as well as of my 1968-one. I dare not say whether or not my papers have always fulfilled this task but I know that I did not try to misinterpret any data of any author I quoted in my papers, nor did I try to criticize any of these authors. I have only tried to compare various data and to summarize the result of such a comparison.

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

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THE EYE MUSCLES IN ARGYROPELECUS OLFERSI (CUVIER, 1829)
AND BOLEOPHTHALMUS VAL., 1837

OTA OLIVA & VLASTISLAV SKOŘEPA

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Abstract: The topography of eye muscles with regard to the myodome problem was studied in two species of different mode of life and different systematic relationship. In the pelagic deep sea fish species *Argyropelecus* lacks the anterior myodome and the posterior one is only poorly developed, with short and narrow rectus externus muscle. In *Boleophthalmus*, known as a fish representative with semiamphibious mode of life, there is a well developed posterior myodome, which may be connected even with its life habitats.

METHODS

Two heads of *Boleophthalmus* and *Argyropelecus* were employed for dissections by use of the same technique as described in previous publications (see Oliva & Skořepa, 1968). For determinations keys in the works of Brauer, 1906 and Schultz, 1964 were applied.

Explanations to Abbreviations

AMY — anterior myodome	PA — parietal
ASPH — alisphenoid	PRO — prootic
BO — basioccipital	PS — parasphenoid
EL — lateral ethmoid	PTM — posttemporal
cart. eth. — ethmoidal cartilage	rm — rectus medialis muscle
EXO — exoccipital	re — rectus externus muscle
EPO — epiotic	ri — rectus inferior muscle
FR — frontal	rs — rectus superior muscle
MY — posterior myodome	SO — supraoccipital
no — optic nerve	SPH — sphenotic
oi — obliquus inferior muscle	SPT — supratemporal
os — obliquus superior muscle	VO — vomer

RESULTS

There is no anterior myodome in *Argyropelecus olfersi*, the obliquus superior originates from frontal bone, the obliquus inferior from lateral ethmoid bone, there is no common point of origin. The corresponding muscles of both sides communicate. The obliquus inferior is wide near the attachment to the medio-ventral surface of the eye bulb, covers the insertion of the rectus inferior. The obliquus superior is attached to the dorsocaudal (aboral) face of the eye bulb, the attachment is long, the resting muscle body short and dorsoventrally flattened. The posterior myodome is short, formed by the parasphenoid, prootic, basisphenoid and alisphenoid. The rectus externus is relatively

short and very narrow, attached on the aboral surface of the eye bulb. The rectus superior originates from the parasphenoid, it is rounded in shape, the attachment on the eye bulb is wide. The rectus inferior originates from the parasphenoid, attached to the medioventral face of the eye bulb.

The rectus medialis originates from the parasphenoid, medially from the origin of the rectus inferior and rectus superior, the muscle is short and wide, lateromedially flattened near the attachment, its attachment being situated on the aboral part of the eye bulb (on its medial surface).

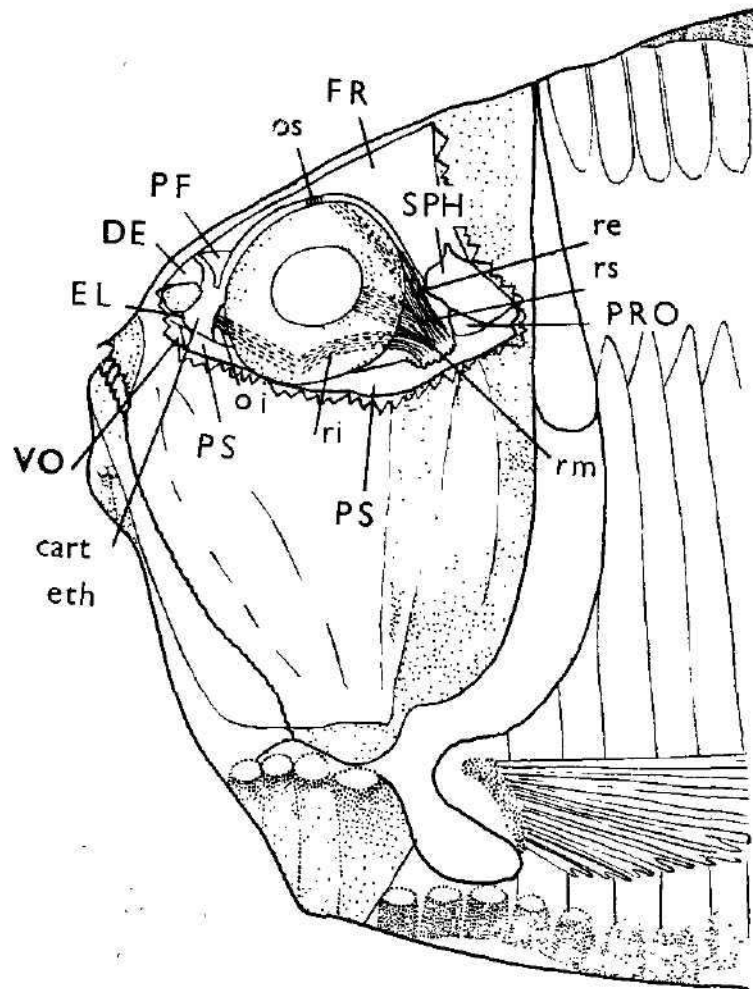


Fig. 1. — *Argyropelecus olfersi*. Head from the lateral view.

In *Boleophthalmus* the anterior myodome exists and is formed by lateral ethmoid, parasphenoid, vomer, mesethmoid and prefrontal bones. The anterior myodome is shallow and both obliqui muscles penetrate into it.

The obliquus inferior muscle which is flat and narrow crosses the insertion

of the rectus inferior muscle to the eye bulb. The obliquus superior is also flat and narrow and does not cover the attachment of the rectus superior on the eye bulb. The relatively long posterior myodome is formed by the parasphenoid, alisphenoid, prootic and frontal bones.

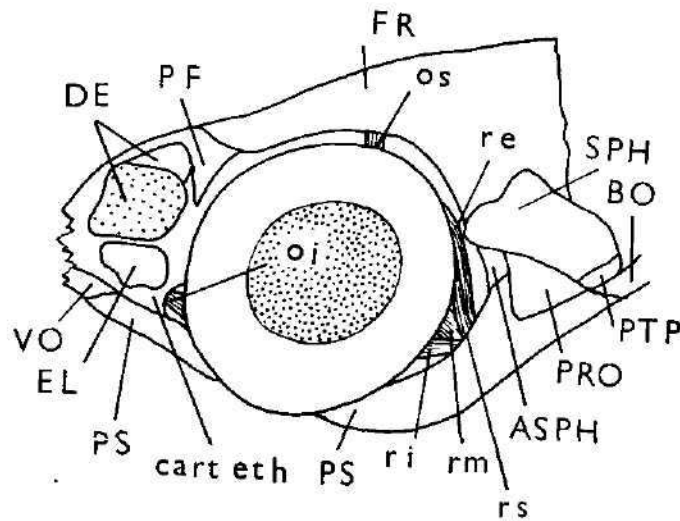


Fig. 2. — The detail lateral view of eye muscle's topography in *Argyropelecus olfersi*.

The rectus externus muscle is lateromedially flattened, it penetrates alone into the posterior myodome through its entire length. It originates from the parasphenoid. The rectus inferior is bifurcated in about one half of its course and possesses two insertions. The rectus superior does not cover the insertion

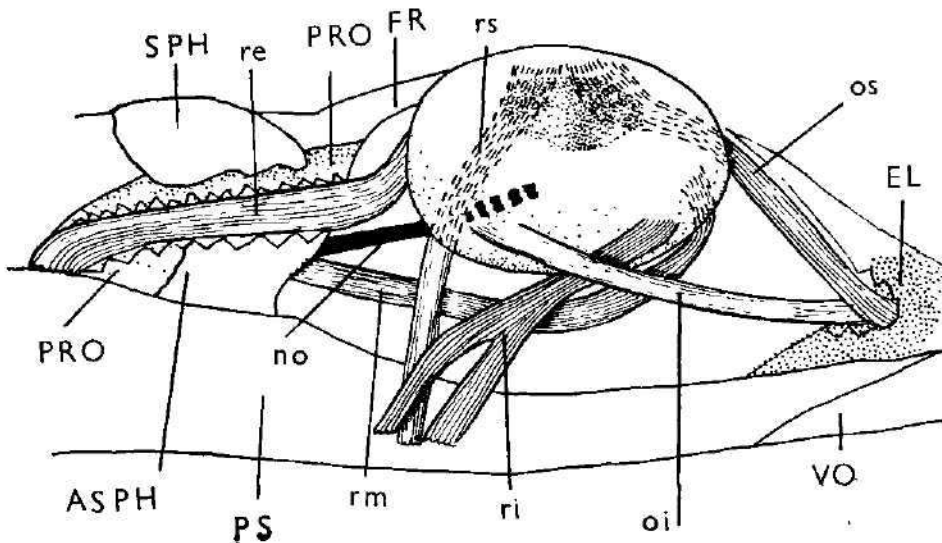


Fig. 3. — *Boleophthalmus* sp. The detail lateral view on eye muscles topography.

of the obliquus superior to the eye bulb, this muscle originates from the parasphenoid between the bifurcated rectus inferior muscle. The rectus medialis originates between attachments of the obliquus superior and obliquus inferior, this muscle is wide and lateromedially flattened, it originates from the alisphenoid.

DISCUSSION

For elucidation of the structure of eye muscle apparatus it is useful to survey some data on biology of both studied species. The genus *Argyrolepecus* (Cocco, 1829) family Sternoptychidae) belongs to the family of deep sea fishes with groups of characteristically arranged photophores for each genus (the remaining genera are *Sternoptyx* Hermann, 1781 and *Polyipnus* Günther, 1887). They are caught in the open sea in plankton nets and trawls in all temperate and tropical seas from the surface to considerable depths. In the Pacific, records indicate 16,200 feet, and in the Atlantic, 12,700 feet. However, captures at such depths are most inadequately documented because closing nets were seldom used in oceanographic exploration. The fish could have been caught somewhere between the surface and the deepest point reached by the equipment (Schultz, 1964).

Opposite opinion to the bathypelagial mode of life of the genus *Argyrolepecus* was expressed very long ago by Günther (1886), who supposes, the specimens entered the dredge its passage through the surface strata. The great development of the luminous organs, combined with the large eyes, indicates the nocturnal habits of the fish, which would induce it to decent to a greater depth during the day time. Also the firm structure of the bones disproves the bathypelagial habits of *Argyrolepecus* (p. 127). The captures from the depth of 200 and 4500 metres fathoms seemed to him to be dubious. *Argyrolepecus olfersi* (Cuvier) is according to Goode et Bean (1896) considered to be a pelagic surface form, but it was taken by the French expedition off Portugal in 950 and 1615 meters. The Challenger dredges a specimen 21 $\frac{1}{4}$ inches long, at a depth of 1125 fathoms, off Cape Finistere. A relative species, *Argyrolepecus hemigymnus* is according to Günther (1886) frequently caught at night in surface net. Günther (l.c.) concludes that this fish is of nocturnal habits, living during the day at a depth the surface which varies according to circumstances. The French expeditions obtained it in the Gulf of Marseilles in 1060 meters, in the Gulf of Gascony in 741—1534 meters, off the Canaries in 1200 meters, off the coast of Portugal in 950—1100 meters, and off the coast of Morocco in 1123 meters.

According to data of Schultz, 1964 *Argyrolepecus olfersi* occurs at depths of 1800 meters and as far north in the Atlantic as Lat. 52°20', it inhabits also Pacific and Indian Oceans.

On contrary, the life habits of *Boleophthalmus* seems to be similar as in *Periophthalmus* (Oliva, Skořepa, 1970).

The existence of myodome in *Argyrolepecus* is cited also by Allis (1919), but Brauer (1908) erroneously supposed *Argyrolepecus* possesses only four extrinsic eye muscles (similarly as *Opisthoproctus*, *Dolichopteryx* and *Winteria*). This erroneous statement was corrected by Handrick (1901), cited after Munk 1966) and by us.

Similarly, as in *Periophthalmus* and *Chauliodus*, comparing *Boleophthalmus* and *Argyrolepecus* the ecological factors plays role in forming of eye muscle

apparatus and presence or absence of myodomes, the less prominent development of the posterior myodome without specific peculiarities described previously in *Periophthalmus* may be connected with less progressive adaptability to terrestrial life of *Boleophthalmus* (Sterba, 1959).*)

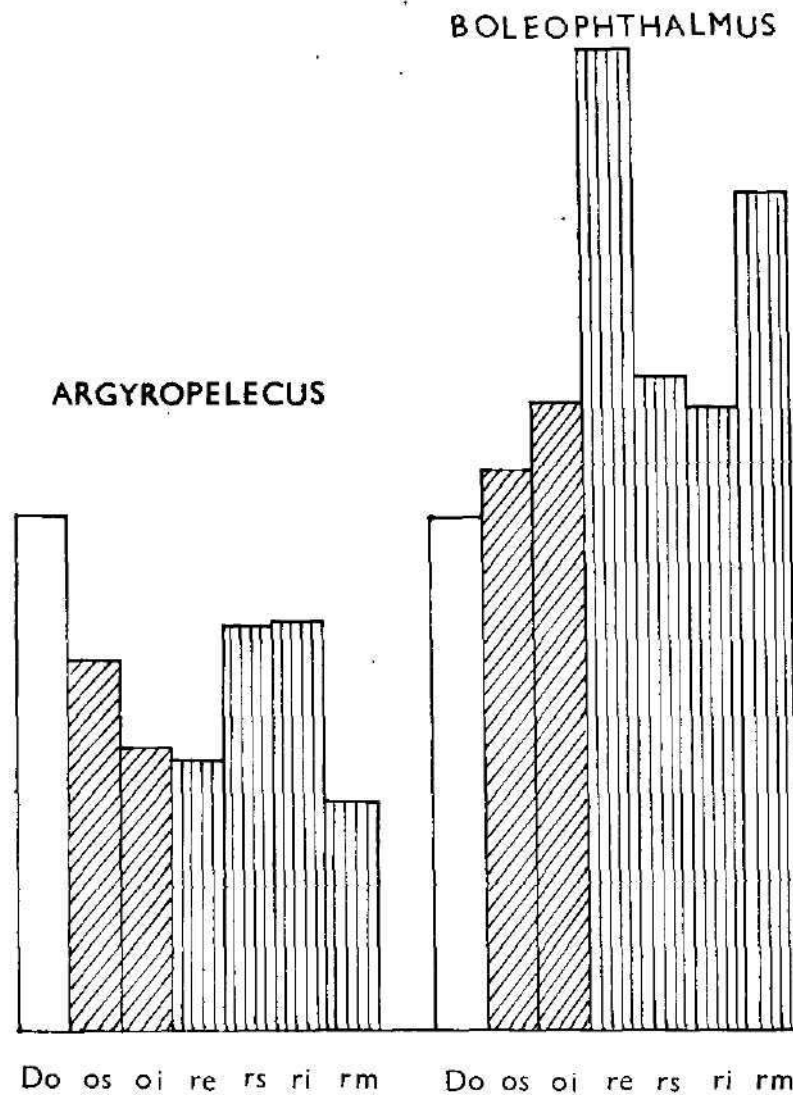


Fig. 4. — Relative length of eye muscles in *Argyropelecus* and *Boleophthalmus*. Do — diameter oculi, considered as being 100 p.c., the individual length of each muscle being given in % of eye bulb diameter and illustrated graphically to make possible the comparison.

*) The mobility of eye in *Boleophthalmus* is expressed again in the generic name given by A. Valenciennes (1837). Hist. nat. des poissons, 12, 198 — "with a quick eye" — Stoye (1935).

SUMMARY

In the pelagic deep sea fish *Argyropelecus* lacks the anterior myodome the posterior one is only poorly developed. All eye muscles are short, but six in number (and not four, as supposed erroneously by Brauer, 1908). In *Boleophthalmus* both myodomes are well developed, this fact can be certainly connected with the semiamphibious mode of life.

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ECOLOGICAL CHARACTERISTICS OF THE MAIN SPECIES OF MINNOWS
(PISCES, CYPRINIDAE) FROM THE DANUBE DELTA

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Abstract. The paper represents a short synthesis of the studies pursued by the author during the period 1956—1968 on the reproduction biology and on the rate of growth of the main species of minnows living in the Danube Delta

Based on his studies on biometry, sexual maturity, fecundity and age determination of a large number of specimens of different ages and sizes, belonging to 11 species of Cyprinidae, the author succeeded in establishing the principal reproductive indexes (sexual maturity, fecundity, type of egg-laying) and rate of growth (in length and in weight) of these species and ascribed them to several ecological groups

INTRODUCTION

The reproduction is one of the most important events in the life cycle of the species, providing their survival. Each species has its own reproductive peculiarities which are adaptative. The number and quality of descendants depend on the quality of the reproductive stock, on the reproductive potentiality of the parents (fecundity, age of maturation, etc.), on the type of egg-laying, on the egg-development and on the survival of the fry. The growth of fish too reflects their adaptation to habitat conditions, contributing to their survival.

Within the range of each species, the biological characters vary as strongly or even more strongly than the morphological ones; one must therefore study these characters in each region where a species occurs.

Some authors have already published a few contributions to the knowledge of the biology of Cyprinidae from the lower Danube: Russov (1932), R. Leonte and V. Leonte (1958), V. Leonte (1959), Niculescu Duvăz (1944—1947), L. Popescu (1958, 1961), E. Popescu a. o. (1960), E. & A. Cristea (1969). I too published several papers on the fecundity, sexual maturity and rate of growth of several species of Cyprinidae living in the Danube Delta (Papadopol, 1957, 1958, 1960, 1961a, 1961b, 1962a, 1962b, 1963a, 1963b, 1965a, 1965b, 1965c, 1965d, 1966, 1967, 1969; Papadopol & Maftai, 1963).

I considered it would be useful to publish a comprehensive synthetical paper including the general conclusions of the investigations I carried on during 12 years in this field; these conclusions are based both on the results of the papers mentioned above, and on some more recent, still unpublished investigations on the same subject and even on those of other authors.

MATERIAL AND METHOD

The data summarized in this paper result from the study of 2024 fish specimens, belonging to 11 species and subspecies of minnows: carp (*Cyprinus carpio* L.), bream (*Abramis brama danubii* Pavlov), ide (*Leuciscus idus* (L.)), tench (*Tinca tinca* (L.)), roach (*Rutilus rutilus carpathorossicus* Vladykov), rudd (*Scardinius erythrophthalmus* (L.)), crucian-carp (*Carassius carassius* (L.)), white bream (*Blicca bjoerkna* (L.)) and bitterling (*Rhodeus sericeus amarus* (Bloch)). For 10 of this species I calculated all main biological indexes related to reproduction and growth; in *V. vimba carinata* only some of them. All fishes, except the valueless bitterling were obtained from professional fishermen fishing with normal seines in different lakes of the Danube Delta in 1956—1968. Most fishes were captured before their spawning (in April-May).

In studying the degree of development of the gonads, the age and size when the sexual maturity occurs, the fecundity, type of gametogenesis, of egg-laying, the rate of growth, etc. have been established based on the use of the existing material with well-known methods, usually used in such studies, I will therefore mention only the most important ones. The degree of maturation of the gonades was appreciated after the 7-stages scale of Kulaev and Meien (mentioned by Căărănușu, 1952) for Cyprinidae and Percidae. The absolute fecundity was established by weighing; the relative fecundity was calculated for 1 g of the fish-body. The type of ovogenesis and of egg-laying were established both statistically and by a histological examination of mature ovaries, the rate of growth in length by the method of retrospective determination after the scales (linear), the rate of growth in weight by the method of correlation between length and weight of the fishes (ponderal).

RESULTS

The data obtained are presented in tables 1-4. These data enable us to classify the 10 species of Cyprinidae, from a biological point of view, as follows:

According to the age when attaining the sexual maturity (see Table I), one can distinguish two groups.

Table I — Age and length of the principal species of Cyprinidae from the Danube Delta when reaching sexual maturity.

The species and the year of investigations	Sex	Age of sexually maturation		Body length (without C) cm		Number (n)
				medium	variation	
<i>Cyprinus carpio</i> , 1956, 1959, 1961	♂♂ ♀♀	(2)*	3 4	26 30	22—28 26—32	615
<i>Leuciscus idus</i> 1959, 1961	♂♂ ♀♀	(2) (3)	3 4	26 28	23—27 24—30	66
<i>Tinca tinca</i> 1967, 1968	♂♂ ♀♀	(2) (3)	3 4	22 25	18—21 19—22	124
<i>Abramis brama danubii</i> 1959, 1961	♂♂ ♀♀		2 (2)	18 20	14—20 16—22	521
<i>Scardinius erythrophthalmus</i> 1959	♂♂ ♀♀		2 2	12 13	11—14 11—16	101
<i>Carassius carassius</i> , 1961	♂♂ ♀♀		2 2	10 11	9—11 10—13	139
<i>Blicca bjoerkna</i> , 1965	♂♂ ♀♀		2 2	9 10	8—12 8—14	114
<i>Rutilus r. carpathorossicus</i> , 1961	♂♂ ♀♀		2 2	8 9	7—9 7—10	180
<i>Alburnus alburnus</i> , 1959	♂♂ ♀♀	(1) (1)	2 2	7 8	5.5—8.5 6.0—9.5	134
<i>Rhodeus sericeus amarus</i> , 1958	♂♂ ♀♀	(1)	2 2	3.8 3.7	3.6—4.0 3.5—4.0	31

* Between parentheses the age of the maturation the first individuals

1. Precocius (early maturing) species. rud, crucian carp, white bream, roach, bleak and bitterling.

2. Later maturing species: carp, *Leuciscus idus*, tench, bream and probably *Vimba vimba* too. As we have observed in the present research.

Table IIA. Indexes of the growth in length of the principal species of Cyprinidae from the Danube Delta.

The species, place and the year of investigation	Number	The body length (without C) cm/years								The rate of growth, cm/years							
		I	II	III	IV	V	VI	VII	VIII	I	II	III	IV	V	VI	VII	VIII
<i>Cyprinus carpio</i> , Crişan, 1956	260	11.5	21.2	30.1	36.2	41.0	—	—	—	11.5	9.7	8.9	8.9	4.8	—	—	—
<i>Abramis brama danubii</i> , Crişan, 1959	154	8.6	16.6	24.3	29.9	35.8	40.6	44.3	47.6	8.6	8.0	7.7	5.6	5.9	4.8	3.7	3.3
<i>Leuciscus idus</i> , Roşuleţ, 1961	44	7.9	15.4	23.7	30.2	34.2	—	—	—	7.9	7.5	8.3	6.4	4.0	—	—	—
<i>Tinca tinca</i> , Roşu, 1967	64	7.1	13.2	19.5	24.4	27.8	31.4	35.1	—	7.1	6.1	6.3	4.9	3.4	3.6	3.7	—
<i>Rutilus r. carpatho-</i> <i>rossicus</i> , Roşu, 1961	180	6.1	11.2	14.4	17.5	—	—	—	—	6.1	5.1	3.2	3.1	—	—	—	—
<i>Vimba v. carinata</i> , Sf. Gheorghe, 1961	163	9.2	16.2	20.8	—	—	—	—	—	9.2	7.0	4.6	—	—	—	—	—
<i>Scardinius erythro-</i> <i>phthalmus</i> , Roşuleţ, 1961	101	6.0	11.2	15.0	19.3	22.6	25.1	—	—	6.0	5.2	3.8	4.3	3.3	2.5	—	—
<i>Carassius carassius</i> , Roşu, 1961	74	6.6	11.4	16.4	18.4	—	—	—	—	6.5	4.9	4.0	3.0	—	—	—	—
<i>Blicca bjoerkna</i> , Ivancea, 1965	25	—	12.3	13.2	15.0	—	—	—	—	—	—	0.9	1.8	—	—	—	—
<i>Alburnus alburnus</i> , Somova, 1959	134	6.8	7.8	9.1	10.5	—	—	—	—	6.8	1.0	1.3	1.4	—	—	—	—

Table IIB. Indexes of the growth in weight of the principal species of Cyprinidae from the Danube Delta.

The species, place and the year of investigation	Number	Average weight of the fishes, g/years							The rate of growth, g/years								
		I	II	III	IV	V	VI	VII	VIII	I	II	III	IV	V	VI	VII	VIII
<i>Cyprinus carpio</i> , Grisan, 1956	250	37	227	618	1053	1530	—	—	—	37	190	391	435	487	—	—	—
<i>Abramis brama danubii</i> , Grisan, 1959	154	12	97	318	612	1081	1609	2110	2520	12	85	221	294	469	528	501	410
<i>Leuciscus idus</i> , Roşuleţ, 1961	44	15	99	335	686	955	—	—	—	15	84	236	331	289	—	—	—
<i>Tinca tinca</i> , Roşu, 1967	84	25	106	280	436	550	782	1012	—	25	81	154	176	154	192	230	—
<i>Rutilus r. carpaho-</i> <i>roasticus</i> , Roşu, 1961	180	7	39	81	140	—	—	—	—	7	32	42	59	—	—	—	—
<i>Vimba v. carinata</i> , Sf. Gheorghe, 1961	163	18	86	170	—	—	—	—	—	18	68	84	—	—	—	—	—
<i>Scardinius erythro-</i> <i>phthalmus</i> , Roşuleţ, 1961	—	6	41	101	218	359	487	—	—	6	35	60	117	141	128	—	—
<i>Carassius carassius</i> , Roşu, 1961	74	15	70	174	298	—	—	—	—	15	55	104	124	—	—	—	—
<i>Blicca bjoerkna</i> , Ivancea, 1965	27	—	43	54	90	—	—	—	—	—	—	11	36	—	—	—	—
<i>Alburnus alburnus</i> , Somova, 1959	134	3.1	6.2	8.7	13.5	—	—	—	—	3.1	3.1	2.5	4.8	—	—	—	—

Table III. — Age and size structure and state of maturation of the gonades in mature specimens

Age (years)	Number	Length (without C) (cm)		Weight of fishes (g)		State of maturation of the gonades
		medium	variation	medium	variation	
<i>Cyprinus carpio</i> female						
3	28	31.5	28.3—34.9	722	520—1080	IV
4	33	37.0	32.5—43.7	1170	740—2000	IV
5	2	39.5	36.2—42.9	1530	1220—1840	IV
male						
3	26	31.2	28.0—37.0	690	480—1080	IV
4	8	35.4	33.1—40.2	1002	730—1290	IV
<i>Abramis brama danubii</i> female						
3	32	26.8	22.4—30.1	432	310— 650	IV
4	50	30.5	27.7—35.2	649	500—1080	IV
5	14	36.1	34.0—38.3	1078	820—1380	IV
6	2	40.1	38.4—41.7	1548	1440—1660	IV
male						
3	26	25.7	23.5—29.0	370	260— 550	IV
4	26	29.4	26.5—33.9	575	430— 880	IV
5	3	34.3	33.5—35.0	954	910— 980	IV
<i>Blicca bjoerkna</i> female						
2	5	12.3	11.5—12.9	43	35— 55	IV
3	12	13.3	12.1—14.5	56	24— 76	III—IV
4	4	15.1	14.6—16.1	92	92— 105	IV
male						
3	5	13.1	12.8—13.7	47	42— 56	IV
4	1	14.6	—	76	—	IV
<i>Leuciscus idus</i> female						
3	7	25.8	23.5—29.4	450	281— 540	II—IV
4	8	31.5	30.5—33.3	795	595— 855	IV
5	7	33.9	32.9—35.2	969	840—1170	IV
male						
3	4	23.9	22.8—25.5	350	236— 380	IV
4	8	31.8	29.6—33.0	788	525— 775	IV—V
5	10	34.5	33.2—35.9	931	780— 975	IV—V
<i>Rutilus r. carpathorossicus</i> female						
2	65	10.4	7.0—13.6	23	8— 75	IV
3	56	13.0	11.6—15.5	65	35— 125	IV
male						
1	1	6.5	—	6	—	II
2	35	9.5	7.1—12.4	17	7.3— 32	IV
3	24	12.8	11.7—14.5	43	30— 90	IV—V

of the principal species of Danube Delta Cyprinidae dissected priorly to the spawning period.

Age (years)	Number	Length (without C) (cm)		Weight of fishes (g)		State of maturation of the gonades
		medium	variation	medium	variation	
<i>Tinca tinca</i> female						
3	9	22.9	21.5—25.6	360	225—475	IV—V
4	17	26.5	23.7—30.1	520	415—745	IV—V
5	8	29.6	28.5—31.0	720	655—845	IV—V
6	10	31.8	30.7—34.1	866	740—970	IV—V
7	3	35.1	34.5—35.9	1030	955—1070	V IV—V
male						
3	8	21.6	20.1—23.4	335	245—405	III—IV
4	5	24.1	23.3—25.7	392	380—435	IV—V
5	2	29.4	28.7—30.2	698	670—725	IV—V
6	2	30.5	30.4—30.6	755	750—760	IV—V
<i>Scardinius erythrophthalmus</i> female						
2	28	13.3	11.3—15.8	71	35—115	III—IV
3	37	15.4	13.5—17.8	103	80—180	III—IV
4	10	19.4	17.3—22.3	230	140—330	IV
5	2	25.1	25.1—25.2	475	460—490	IV
male						
2	11	12.9	11.1—14.6	64	35—85	IV
3	13	14.7	13.6—16.6	90	75—115	IV
<i>Carassius carassius</i> female						
2	22	13.0	8.9—15.4	100	40—160	III—IV
3	22	16.1	14.0—18.8	246	130—330	III—IV
4	5	18.4	17.8—19.3	299	260—330	IV
male						
2	16	11.8	9.9—14.2	85	40—140	III—IV
3	9	14.8	13.0—18.1	157	100—270	IV
<i>Alburnus alburnus</i> female						
1	26	7.1	6.1—8.1	4.1	2.1—6.7	III—IV
2	36	8.3	7.5—9.3	6.5	4.9—9.9	III—IV
3	12	9.4	8.8—10.0	9.4	7.8—11.0	IV
4	7	10.5	9.5—11.3	14.1	10.2—15.5	IV
male						
1	15	6.4	5.4—7.2	2.9	1.2—3.4	III—IV
2	28	7.4	7.0—8.4	6.0	3.2—6.6	IV
3	10	8.7	8.0—9.4	7.2	6.1—9.5	IV

In the species belonging to the first group, the great bulk of specimens, males as well as females, become mature at the age of two years; in some species (bleak, bitterling), a some males especially among some of them become mature sexually, in favorable trophic conditions, already at one year with variable percentage.

A characteristic common to the species included in the group of Precocious minnows, is shown by a relatively slow rate of growth linear and ponderal of the specimens. Consequently, the specimens are rather small when reaching sexual maturity (Table I, IIA, IIB, III). In all these species, except the Bitterling, the males grow more slowly than the females, being thus smaller than the females of the same age, quite exceptionally among the Cyprinidae from Roumania, in the Bitterling the males are larger and have a higher body than the females of the same age.

The difference in the rate of growth in length and especially in weight growth between young, immature, and sexually mature specimens is determined by the fact that a great amount of the food is used in the last named in the process of maturation of the sexual elements, this fact implying the modification of the relations between energetic and plasting elements in favour of the first named.

In the species belonging to the second biological group with middling precocity the sexual maturation of specimens of different sexes does not take usually place in the same time for the males usually mature takes place one year earlier than for females. In the carp, *Leuciscus idus*, tench and, according to our preliminary observations of former years, in *Aspius aspius* too, the males mature at the age of 3 years, the females at 4 years, while in the bream and in *Vimba vimba* the males mature at 2 years, the females at 3 years (Table I and III). Both last named species can thus be considered as intermediate between both biological groups. Because in the species of the second biological group (including the bream and *Vimba*) the process of sexual maturation is long, including usually two annual classes, the body lengths at which the sexual maturity is attained in males at females vary between wider boundaries comparatively to the species belonging to the first group (Tables I and III).

The rate on growth, both in length and in weight, is accentuated in the Cyprinidae belonging to the second biological group, especially in carp and in *Leuciscus idus*, somewhat slower in bream, tench and in *Vimba vimba* (Tables IIA and IIB); consequently, the specimens have a much larger size when reaching sexual maturity than those belonging to the first group (Tables I and III). In the species belonging to the second group, the growth, especially in weight, is slower in males than in females (Table III).

The slowly growing and small-sized species can live, and even be abundant also in water bodies with poor trophic resources. On the contrary, the species having an intensive rate of growth, especially before reaching sexual maturity, are medium- or large-sized, can live only in water-bodies with sufficient food-supply, allowing the survival of large populations, consisting in individual of different sizes. The rapidly growing species have the advantage to be less accessible to predators than the small-sized slowly growing ones; yet these species have, as we shall see, a higher reproductive potentiality or other biological peculiarities which allow the maintaining of the population density.

According to the spawning period and to the ecological conditions of

reproduction, which induce the type of gametogenesis and of egg-laying and other peculiarities of their reproductive biology, the 11 species studied can be ascribed to three biological types or groups:

a) Polycyclic species, with synchronous gametogenesis and egg-laying: the roach and *Leuciscus idus* — in which the spawning period is short and the eggs are laid at once, in a single portion. Both species spawn early, in March or April, at the beginning or during the period of high waters, when the water is still cold (8—10° C). The eggs are relatively large (Plate I, II) the reproductive potentiality (absolute and relative fecundity) is rather low comparatively to the species belonging to the two following groups (Tables III and IV). The ovary of these species contains at the beginning of the spawning season and even before, only almost exclusively ripe or rapidly ripening eggs and only a quite small number of minute ovocytes, which represent the generation of the following year (Plate I, II). The egg-laying lasts a very short period (some hours), yet the specimen who doesn't spawn at once: at first spawn the older and larger specimens, while the younger specimens (which spawn for the first time in their life) lay the eggs at the end of the spawning period.

b) Polycyclic species with partially asynchronous gametogenesis and egg laying: carp, bream and, according to our recent observations, white-bream (*Blicca bjoerkna*) too. The spawning period of these species is longer and the specimens lay the eggs in two, rarely in three portions. The spawning season lasts usually from April or the first days of May till June and coincides with the end of the period of high-water. The spawning occurs usually at a water temperature of 14—20° C, occasionally at an even higher one. The eggs are slightly smaller than those of the species belonging to the precedent group (Plate I, II) and the reproductive potentiality, respectively the absolute and relative fecundity is higher (Tables III and IV). On finds in the ovaries of these species, at the beginning of the spawning period and slightly before it, ripe and almost ripe eggs, representing the first portion and the most important one (it represents 70—83% of the total number of eggs, respectively of the absolute fecundity), then ovocytes in different stages of development (Plate I, II), representing the second or third portion. The laying of the second portion occurs about a month after that of the first portion; during this period, the ovocytes, remained after the elimination of first portion (it represents 17—30% from absolute fecundity) become ripe eggs.

In the species belonging to this biological group, like in those of the first group, the spawning of the larger (and older) specimens occurs before that of the medium-sized (and middle-aged), while the younger specimens spawn the last.

In about 7% of the females of the Danube Delta bream I found that the development and maturation of the ovocytes — and consequently the egg laying too — occurs synchronically, as in the Central- and North-East European nominal subspecies, *Abramis brama brama*. This fact suggests that the asynchronous gametogenesis and egg-laying of the Lower Danube-subspecies, *A. brama danubii* Pavlov, 1956 are recent and not yet perfected adaptation. The same phenomenon occurs in the subspecies *A. brama orientalis* Berg which lives in the south-eastern part of the species range.

c) Polycyclic species with typically asynchronous gametogenesis and egg-laying. The development, maturation and laying of the eggs occur

Table IV. — Absolute and relative fecundity and type of egg-laying in the principal species of Cyprinidae from the Danube Delta studied in the period 1958—1968.

Length (without C) (cm)	Number	Absolute number of eggs in the gonades		Relative number of eggs for 1 g of body		Type of eggs laying
		medium	variation	medium	variation	
<i>Cyprinus carpio</i>						
28.1—31	12	111 200	74 900—148 400	178	137—200	2—3 portions
31.1—34	17	126 600	75 400—154 000	163	102—207	
34.1—37	18	144 600	72 800—183 300	148	86—232	
37.1—40	4	187 000	107 100—229 000	140	74—184	
40.1—43	10	194 500	120 000—229 200	123	81—175	
<i>Abamis brama danubii</i>						
24.1—27	12	72 300	41 500—132 000	200	131—300	2—3 portions
27.1—30	27	145 800	74 000—314 600	277	172—572	
30.1—33	15	193 400	115 200—273 000	287	202—470	
33.1—36	9	306 900	140 400—436 000	296	170—496	
36.1—39	9	316 600	269 600—378 000	260	224—305	
<i>Blicca bjoerkna</i>						
11.5—12.5	2	23 900	23 500—24 400	655	615—695	2—3 portions
12.6—13.5	8	35 700	15 700—49 500	636	347—860	
13.6—14.5	6	42 500	30 300—54 100	629	404—870	
14.6—15.5	3	67 100	51 700—82 500	714	530—900	
<i>Leuciscus idus</i>						
23.5—26.5	4	36 900	24 700—45 400	103	88—114	1 portion
26.6—29.5	2	62 000	61 700—62 300	115	114—117	
29.6—32.5	7	78 100	60 700—90 700	105	81—138	
32.6—35.5	8	99 400	74 400—127 900	104	80—127	
<i>Rutilus r. carpathorossicus</i>						
7.1—8.5	6	2 830	1 400—2 766	271	198—324	idem
8.6—10.0	7	4 566	4 116—5 392	266	212—297	
10.1—11.5	30	7 381	5 124—10 592	284	168—423	
11.6—13.0	24	9 600	4 698—13 970	234	104—352	
13.1—14.5	20	12 645	6 753—17 871	165	90—222	
14.6—15.5	4	23 580	17 584—26 913	208	140—253	
<i>Tinca tinca</i>						
22.3—25.0	6	237—498	144 400—311 100	638	382—1 006	3—4 portions
25.1—28.0	10	274 510	180 000—388 000	538	384—808	
28.1—31.0	12	467 805	307 500—662 200	717	484—1 113	
31.1—34.0	4	506 700	259 200—723 300	685	346—975	
34.1—35.9	4	673 442	517 400—836 500	782	652—952	
<i>Scardinius erythrophthalmus</i>						
11.5—13.5	10	19 700	12 700—22 900	377	310—469	3—4 portions
13.6—15.5	18	38 900	24 100—52 700	456	300—653	
15.6—17.5	18	49 800	31 600—88 200	407	312—588	
17.6—19.5	10	100 100	47 400—130 000	523	340—650	
19.6—21.5	2	143 800	120 000—167 600	532	462—607	
21.6—23.5	2	180 000	162 200—198 000	554	490—618	
23.6—25.5	2	361 100	347 200—375 000	748	680—815	
<i>Carassius carassius</i>						
9.5—11.5	4	11 400	5 600—21 00	156	103—221	4—5 portions
11.6—13.5	5	17 500	15 600—21 900	203	142—258	
13.6—15.5	23	29 700	18 200—52 200	201	123—348	
15.6—17.5	8	39 800	33 100—51 200	190	164—220	
17.6—19.5	7	70 900	60 400—84 700	239	183—293	

Length (without C) (cm)	Number	Absolute number of eggs in the gonade		Relative number of egg for 1 g of body		Type of eggs laying
		medium	variation	medium	variation	
<i>Alburnus alburnus</i>						
6.5— 7.5	14	2 406	1 480— 3 220	636	540—738	3—4 portions
7.6— 8.5	12	3 670	2 700— 4 770	651	567—738	
8.6— 9.5	16	4 850	2 980— 6 830	608	430—775	
9.6—10.5	4	5 570	4 730— 6 820	507	437—578	
10.6—11.5	5	9 120	7 870— 11 510	611	540—748	
<i>Rhodeus sericeus amarus</i>						
3.6— 4.0	11	119	86— 163	95	64—124	6—8 portions
4.1— 4.5	8	152	112— 180	89	58—116	
4.6— 5.0	2	201	181— 221	70	61— 80	
5.1— 5.5	1	228		75		

in 3—4 successive portions in the rudd, tench and bleak, in 4—5 portions in the crucian carp, in 6—8 or even more portions in the bitterling. The spawning period is long, lasts some 2 months, occurring in June—July or even in August, after the period of highwaters, when the water temperatures are as the highest (more than 20—22° C) and the water level is low.

The eggs of the species belonging to this group are small, comparatively to the body size (with the exception of *Rhodeus* in which the ripe eggs are very large: 2—3/1—1.5 mm) and the absolute and relative fecundity or reproductive potentiality are high, with the exception again of *Rhodeus* which differs from all other European species of minnows by laying the eggs in the gill cavity of living freshwater-mussels. One finds in the ovaries of the species belonging to this group at the beginning of the spawning season (second half of May or beginning of June), beside large ripe eggs which represent their first portion and whose proportion varies between 20 and 40—45% of the absolute fecundity, a much higher percentage (55—80%) of ovocytes in different development stages. These ovocytes mature later on and are laid in the 2—8 following portions. The interval of time between the laying of the successive portions of eggs ranges between 7—8 days (*Rhodeus*) and 10 to 15 days.

All the Cyprinidae here dealt with, as well as the great majority of the freshwater fishes of Roumania, are polycyclic species, spawning several times after having reached the sexual maturity, usually during a determined spawning period in each year. This spawning period can be short or long; during this period a specimen lays the eggs either in a single portion or in several portions, as already mentioned (Table IV). The length of the spawning period is directly proportional with the number of portions, while the interval of time between the laying of two successive portions is inversely related to the number of portions.

The gametogenesis and the type of egg laying in the freshwater fishes inhabiting the temperate zone are determined by the abiotic and biotic reproductive conditions. When the conditions are relatively favorable for the embryonal and postembryonal development but the trophic basis is not rich and there is no food competition between the young fishes, the synchronous

gametogenesis and egg laying was favoured. This situation occurs in the early spawning fishes, whose reproduction happens at the beginning and in the middle of the period of high water: *Leuciscus idus*, *Rutilus rutilus*, *Aspius aspius* a.o. The conditions of temperature and of water level are somewhat worse at the end of the high water period and later, during the warm summer months, when the mortality of the eggs and of the early developmental stages of fishes is stronger and in the same time there is a rather intense competition for food between the young of the many species spawning during this period; but the trophic base is much richer than in the early months. All these facts have favoured the asynchronous type of egg laying in the fish species spawning at the beginning of summer (carp, bream, white bream) or in middle summer (rudd, tench, crucian carp, bleak, bitterling, etc.).

CONCLUSIONS

1) According to the age or rate of sexual maturation, the 11 species of Danube Delta studied Cyprinidae can be ascribed to two biological groups: 1) Early maturing and slowly growing species — rudd, crucian carp, roach, white bream, bleak, bitterling; 2) Later maturing and more quickly growing species — bream, *Vimba vimba*, tench and especially carp and *Leuciscus idus*.

2) According to the biological peculiarities of their reproduction, (gametogenesis, spawning period, fecundity etc.), the same species can be ascribed to three other groups: a) Species with synchronous gametogenesis and egg laying, who spawn early in the spring (usually in April or May) and whose fecundity is rather low: roach (*Rutilus rutilus*) and *Leuciscus idus*; b) Species with partially asynchronous gametogenesis and egg laying (the eggs being laid in two or three portions), whose fecundity is somewhat higher and spawning period longer and occurring later (usually in May or June): carp, bream, white bream; c) species with typically asynchronous gametogenesis and egg laying (in more than 3 portions), rather high fecundity, still longer and later occurring spawning period; rudd, tench, crucian carp, bleak and bitterling (Tables 3 and 4).

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

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Dr. Karel Michal

8 March 1905 — 28 July 1969

Dr. Karel Michal was born in Stará Huť near Kutná Hora, where his father was a forester. He attended a real-gymnasium in Prague; in the years 1924—1929 he studied at the Faculty of Natural History of the Charles University in Prague, working at the Zoological Institute under Professor Komárek and at the same time in the State Institutes for Agricultural Research in Dejvice. On 21 June 1929 he graduated as Doctor of Natural History, having defended his doctoral



thesis on the biology of *Tenebrio molitor*. Between 1933 and 1937 he occasionally taught at secondary schools in Prague, and from 1937 to 1945 he was a grammar-school professor. In the years 1945—1951 he was Head of the Section of Agrobiology in the Association for Chemical and Metallurgical Production. After various reorganizations he took a post at the Research Institute of Pharmacy and Biochemistry in Prague and, finally, in the state corporation Medicinal Plants at Zbraslav.

Dr. Michal became one of the first pioneers of applied zoology in Czechoslovakia. As early as at the time of his university studies he had in mind the practical application of zoology to production. He studied the development of *Tenebrio molitor* in minute detail, particularly optimal conditions (temperature, humidity, and other factors), intending to use this species as food for poultry. He succeeded in reducing the time of development to 60 days and enhancing egg production as well as limiting the mortality of chickens by giving the birds live larvae as additional food. He tried to use the dung from mass cultures of *Tenebrio* as manure in greenhouses, gardens and fish-ponds as well as for the rearing of housefly larvae, another poultry food. He recommended sugar waste (patent No 67.647 of 25. 5. 1940) and mycelial waste coming from the production of citric acid at Kaznějov (patent No 735.247 of 11. 5. 1940) for the manuring of fish-ponds. After the war he was mainly interested in medicinal plants. By the interspecific crossing of digitalis he obtained hybrids with a higher content of digitoxin. He organized the growing of digitalis and primula on a large scale; in his last years he was concerned with the artificial growing of ergot and developed methods of inoculation and harvesting which greatly contributed to the mechanization of production.

Dr. Michal was an extremely industrious and assiduous worker, knowing neither rest nor leisure. He asserted his ideas and suggestions with boundless energy and was very popular among his colleagues for his devotion to his work and personal disinterestedness.

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Akad. Jírovec

RECEPSE — REVIEWS

Watt, Kenneth E. F. (1968): *Ecology and Resources Management, A Quantitative Approach*, McGraw-Hill Book Company, New York, 450 pp., 14,50 \$.

Pojmy ekologie a ochrany přírody, jak je autor používá v této knize, mají málo společného s tradiční náplní těchto slov u nás. Je těžké vyhnout se používání termínu ekologie, v dalším však

budu používat u nás zatím neobvyklého termínu hospodaření zdroji (biologickými, tedy obnovitelnými), místo obvyklého ochrany přírody.

Pokud jde o cíle, které autor v knize sleduje, jsou dva: 1. vytvoření obecné teorie hospodaření zdroji, 2. aplikace systémové analýzy pro rozhodnutí teorie o způsobech nejúčinnějšího hospodaření přírodními zdroji. V obou těchto cílech nemá kniha předehůdce, i když možnosti aplikace systémové analýzy byly předmětem jiné knihy, redigované rovněž K. E. F. Wattem (*Systems analysis in ecology*, Academic Press, New York and London, 276 pp.).

Při řešení starých problémů netradičními způsoby dostává se autor do problému určení knihy. Může jít buď o monografii, určenou úzkému okruhu specialistů, nebo široké obci studentů ekologie. Autor se snaží zřejmě splnit požadavky obou okruhů možných čtenářů, přičemž však zůstává mnoho dlužen pokud jde o možnost sledovat jeho knihu bez důkladné znalosti matematické analýzy, numerické matematiky a statistiky a programování počítačích strojů. Autor v úvodu výslovně uvádí, že předpokládá jen základní znalosti statistiky, derivování a integrování. Ačkoli tuto podmínku splňuji, nebyl jsem sto sledovat přes několiknásobné pokusy nejen některé odstavce, ale i stránky v poslední sekci knihy, pojednávající o metodách hospodaření zdroji.

Přes tento nedostatek jako učebnice je nespornou zásluhou knihy, že ukazuje na možnosti jak aplikovat principy analýzy systémů na komplexní ekologické situace a že formuluje společné základy pro hospodaření zdroji i za tak odlišných podmínek jako představují podmínky mořského rybářství a kontroly lesních a zahradních škůdců (hlodavců i hmyzu). Je pochopitelné, že v knize nemohou být aplikace obecných principů probírány do detailů, nýbrž jsou uváděny jako příklady. Pro zájemce o podrobnosti je k dispozici bohatá bibliografie.

Základem autorových úvah o principech ekologie je lineární vztah mezi výtěžkem biomasy a součinem biomasy a rychlostí využití. Je to vzdálená analogie Ohmova zákona. Vzdálená proto, že číselné hodnoty jsou různé nejen u různých druhů, ale i u téhož druhu při různém věkovém složení biomasy. Mimořádnost člověka jako ekologického činitele hodnotí tím, že jej označuje jako destruktivního dravce, protože růst lidské populace není omezen vyhubením živočicha, na jehož produkci masa byl až do podstatné redukce jeho biomasy závislý. Ukazuje to mj. na nesmyslném decimování velkých stád bisona v Severní Americe.

Důležitou roli v autorově koncepci hraje otázka, do jaké míry rozvoj různých druhů závisí na faktorech, které jsou závislé či nezávislé na hustotě jejich populace (závislé např. konkurence, predace, parazitace, nezávislé např. meteorologické vlivy). Ukazuje, že neobvyklé parametry faktorů nezávislých na hustotě mohou podstatně změnit velikost populací a tím podstatnou měrou nejen ovlivnit vzájemný vztah faktorů, závislých na hustotě, ale i velikost a složení populací.

Vzhledem k tomu, že produktivita se mění sukcesí a je různá na různých místech, má autor za to, že přirozeně vytvořený ekosystém maximalizuje tok energie za daného typu půdy a klimatu, přičemž je si vědom metodických potíží s ověřením nebo vyvracením tohoto předpokladu. Současně ukazuje, že z hlediska hospodaření zdroji je základní otázkou, k čemu vztahovat tuto maximalizaci. Má být zaměřena k vytvoření maximální biomasy využívaného zdroje, nebo k potlačení ztrát v důsledku přirozené mortality? Jestliže chceme maximalizovat produkci, pak musíme těžbu zaměřit na dospělé jedince tak, aby mladí jedinci nebyli omezováni v růstu konkurencí se staršími. Chceme-li minimalizovat ztráty, je účelné těžit mladé jedince, abychom zabránili ztrátám při jejich dalším růstu. Jako jednu z praktických aplikací těchto principů, ukazuje autor, že produkci masa v Africe na jih od Sahary lze lépe organizovat racionálním lovem vhodných místních zvířat v jenom mírně změněném prostředí, než přeměněním celého ekosystému na evropský typ zemědělství.

V recenzi knihy tak bohaté myšlenkami je nutno se omezit jen na několik příkladů. Nabil-li, čtenář z nich dojem, že jde o knihu nejen stimulující novými myšlenkami, ale přispívající i mimořádně velkou hřívnou k formulování ekologie jako obecného základu hospodaření přírodními biologickými (obnovitelnými) zdroji, mám za to, že jde o názor oprávněný. Přičina proč jsem se podrobněji zabýval jejími nedostatky jako učebnice je v tom, že se jeví velmi nutným obohatit i českou literaturu o knihu tohoto typu i formou překladu, když v dohledné době nelze čekat produkci domácí. Z důvodů, které jsem uvedl dříve však nelze předpokládat, že by její český překlad našel široký ohlas.

J. Hrbáček

Ramon Margaleff (1968): Perspectives in Ecological Theory. The University of Chicago Press 111 pp.

Charakter knihy je dán tím, že vznikla na základě čtyř přednášek. Najde tedy o konfrontaci různých konceptů teoretických základů ekologie, ale o řešení základních konceptů ekologie na základě principů kybernetiky, tj. zpětné vazby, prahu a obsahu informace v jednotlivých složkách společenstva. Jde tedy o nové uspořádání faktů nikoli o nová fakta.

Autor vychází z charakterově odlišných nároků jednotlivých druhů na prostředí soustavou diferenciálních rovnic. Tím se vyhýbá problémům se stanovením hodnoty jednotlivých parametrů pro mnohorozevřený model bezprostředního prostředí (niche) jednotlivých druhů.

Pomocí koncepce ekosystému jako otevřeného kybernetického systému se vyhýbá jinému problému, jemuž formální ekologové věnovali spoustu úsilí bez uspokojivých výsledků, totiž problému ohraničení a klasifikace jednotlivých společenstev, resp. jejich částí. Autorova koncepce dovoluje libovolné ohraničení studovaného prostoru tím, že studuje kvalitativní i kvantitativní stránku interakcí na jeho hranicích. Vztahy na těchto hranicích mohou být značně asymetrické — autor uvádí jako příklad vztah planktonu a benthosu. Je zřejmé, že tento koncept může podstatnou měrou přispět k objektivizaci kritérií pro formální členění ekosystémů tím, že se budou hledat hranice s minimální interakcí.

Asymetrie vztahů v tomto konceptu není nic neobvyklého, neboť vztah kořisti a dravce je rovněž asymetrický. Sežrání jednoho jedince druhým představuje práh přestupu energie. Protože kořist si nemůže udržet informaci o svém životě včetně toho, jak došlo k sežrání poté, co přispěla k výživě dravce, dochází při přestupu energie přes práh k ztrátám informací. Jak autor dodává, lze doufat, že jde o redundantní informaci.

Pro kvalitativní popis složení společenstev rozvádí koncept diversity odvozený z teorie informace. Na rozdíl od počtu zjištěných druhů není jeho hodnota podstatně ovlivněna řádovými rozdíly v počtu identifikovaných jedinců při různých studiích.

Kybernetický koncept je aplikován i na otázky úspěchu vývoje organizace ekosystémů a využití resp. ovlivnění ekosystémů člověkem. Základem pro další úvahy je tu rozlišování stupňů zralosti společenstev. Kritériem je zde intenzita metabolismu vzhledem k biomase. Přírodní sukcese vede k zvyšování zralosti, člověk naopak nahrazuje zralá společenstva mladými.

Jedna z kapitol je věnována výsledkům autorovy aplikace těchto teoretických konceptů na popis pelagického společenstva moří na základě podkladů získaných autorem a jeho spolupracovníky.

Pro všechny zájemce o nové pohledy na základní koncepty ekologie lze vřele doporučit jako inspirující četbu. O tom jak dokonalých funkcí bude schopné tělo vybudované na kostře, navržené autorem, rozhodnou další práce. V každém případě je autorův koncept další možností jak stanovit společné principy pro velmi odlišná společenstva (společenstva moří a pouště jako extrémní případ) a i pro různé skupiny organismů. Je to velmi důležitý příspěvek k hledání společných principů biologických věd.

J. Hrbáček

Hauerschild C., A. Fischer: Platynereis dumerilii. Grosses zoologisches Praktikum, Heft 10b. 55 stran, 37 obr. 1969. Gustav Fischer Verlag. Stuttgart, cena brož. DM 26,—.

Známé Fischerovo nakladatelství pokračuje tímto sešitem ve vydávání monografických přehledů anatomie, vývoje a biologie vybraných, v laboratorních používaných druhů živočichů. Tento svazek je věnován mnohoštětinatcům, jejichž studium má základní význam pro poznání vlastností článkovaných bezobratlých. Na rozdíl od praktických cvičení, která byla dosud k dispozici a používala pro studium volně získaných forem (srv. např. Bolšoj praktikum po zoologii bezpovonočných 1. díl: 423 — *Nereis pelagica*), volili autoři druh *P. dumerilii*. Při synchronizovaném chovu podle jejich návodů, které jsou důkladně podány v první části práce, je zajištěno v laboratorních podmínkách stále dostatečné množství červů ve všech vývojových stádiích, počínaje oplozenými vajíčky přes atokní fázi po epitokní formu množící se pohlavně. V dalších kapitolách tohoto původního díla je probrán embryonální a larvální vývoj, způsob života atokní fáze a regenerace, dále mikroskopická anatomie, rozdělení těla, stavba parapodií a štětín, pokožka, svalovina, trávicí trubice, coelom a nefridie a nervový systém se smyslovými orgány. V závěrečné části popisují autoři proměnu v heteronereidní plovoucí formu, vývoj pohlavních buněk, vznik epitokie a pohlavní rozmnožování. Pro další studium připojují i seznam speciální literatury.

Poněvadž dosavadní údaje literární se týkají většinou jiných, často odlišných forem mnohoštětinatců, byly autoři nuceni prověřit všechna data vlastním studiem. Vzniklo tak původní dílo — malá monografie modelového laboratorního objektu na němž mohou být prováděny studie embryologické, fyziologické i histologické. Původní obrázky mají vysokou úroveň, některé jsou dvoubarevné. Vybavení a úprava odpovídají vysokému standardu knih nakladatelství Fischerova.

Vydání sešit je cennou součástí široce založeného díla, které by mělo patřit k vybavení všech pracovišť zoologických nebo biologických. Má ovšem význam nejen jako návod pro studium objektu ale i jako velmi cenný přehled o stavbě a biologii nespecializované formy základní skupiny článkovaných živočichů, nutný pro pochopení dalšího vývoje ve skupinách hmyzu, korýšů a pavoukovec. S jeho obsahem by se měl proto seznámit každý zoolog.

M. Kunst

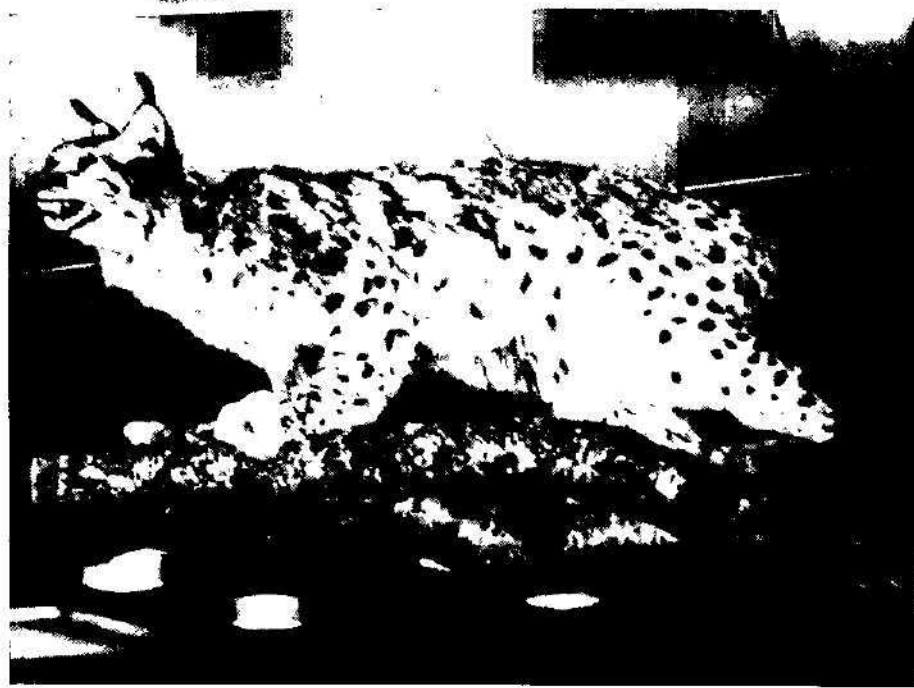


Fig. 1. Mounted skin of an adult Lynx that was killed in January, 1967 in the far north of Scandinavia (male; loc.: Dividalselva, Tromsø region -- ca. 68°55' N, 19°30' E; private property Tromsø) (cf. Mazák 1968, p. 331).

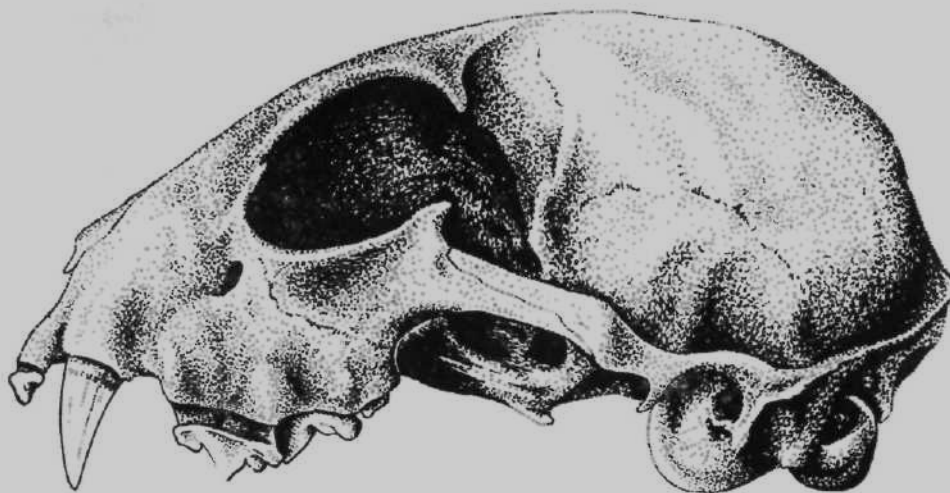


Fig. 2. Skull of a young (?female) Lynx from Rästöjaure (ca. 69° N, 21° E) found dead in July, 1969. *Del.* Mazák.

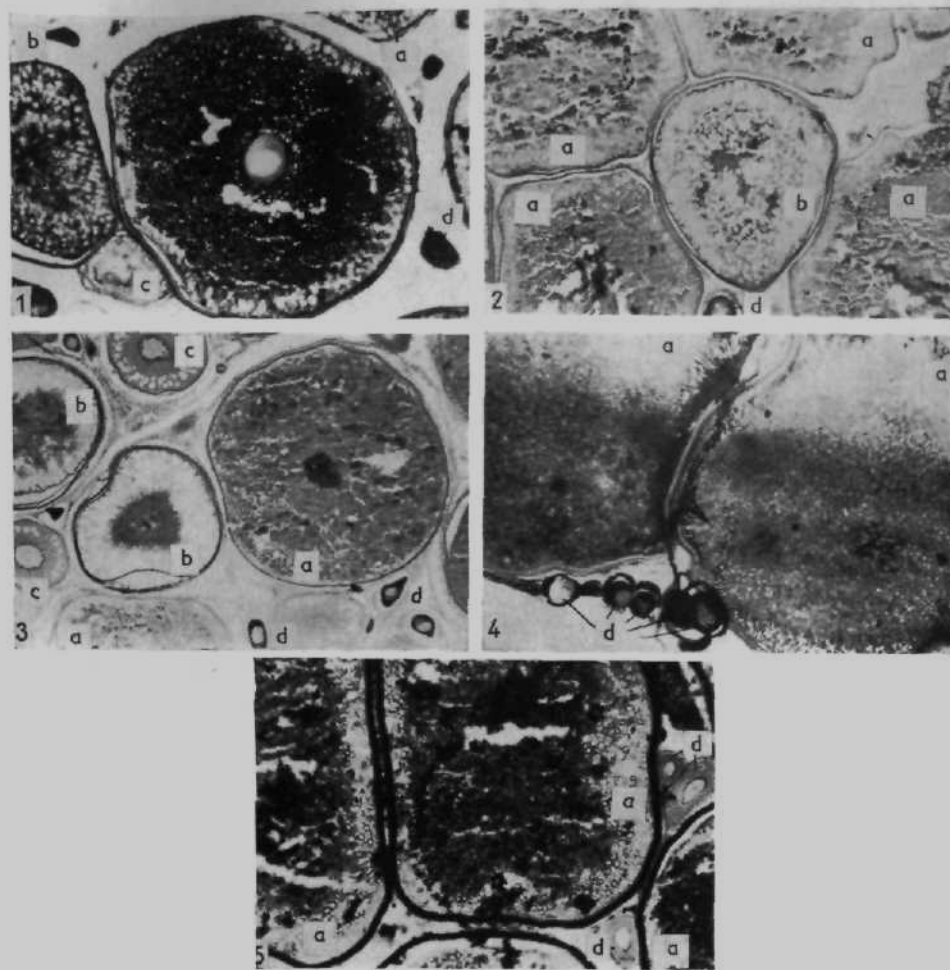


Plate I. — Histological section through ovaries of sexually mature females fished in different sites in Danube Delta, before the reproduction (April-June), showing the III—IVst — especially IVst stages of the maturation:

1 — *Cyprinus carpio*; 2 — *Abramis brama danubii*; 3 — *Blicca bjoerkna*; 4 — *Aspius aspius*; 5 — *Leuciscus idus*; a) mature or maturing ova; b), c), d) — oocytes in more or less early stages of development (Ob. 6 $\times$, oc. 6 $\times$, microphoto M. Papadopol).

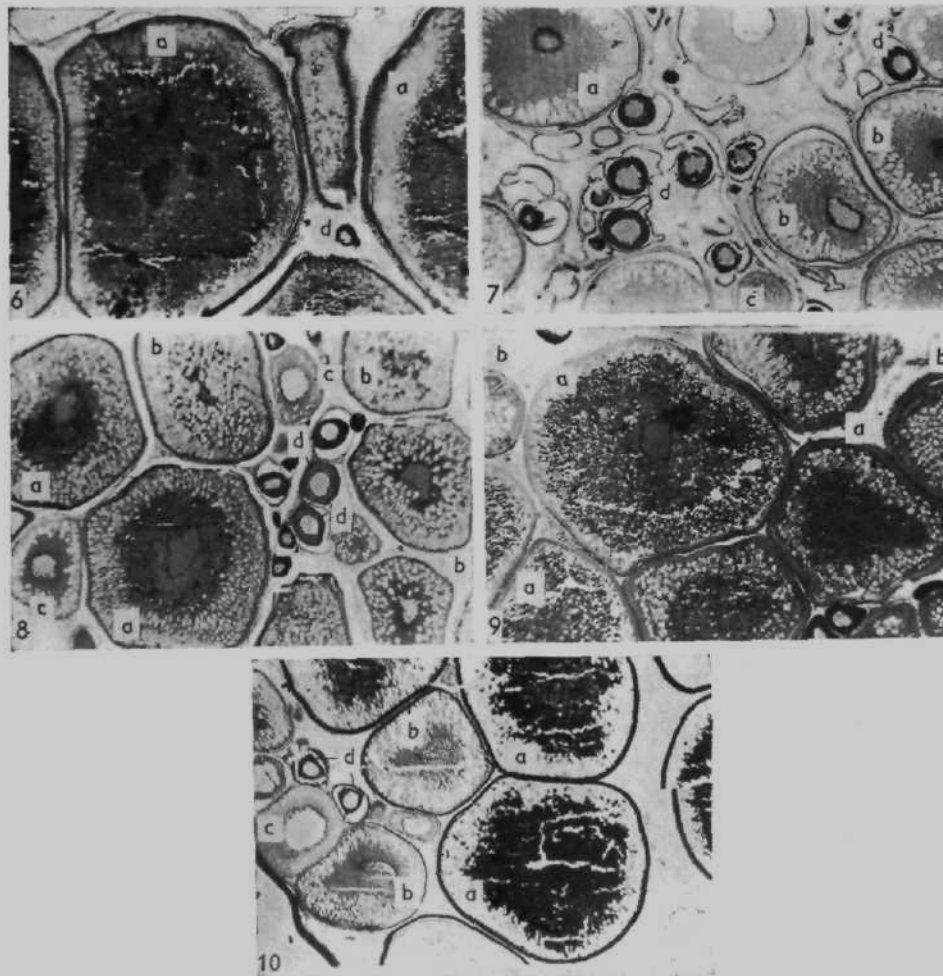


Plate II. — Histological section through ovaries of sexually mature females fished in different sites in Danube Delta, before the reproduction (April-June), showing the III—IVst — especially IVst stages of the maturation:

6 — *Rutilus r. carpathorossicus*; 7 — *Tinca tinca*; 8 — *Scardinius erythrophthalmus*; 9 — *Carassius carassius*; 10 — *Alburnus alburnus*; a) mature or maturing ova; b), c), d) — oocytes in more or less early stages of developement (ob. 6 $\times$, oc. 6 $\times$, microphoto M. Papadopol).

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