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OBSAH — CONTENTS

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ZUR LYCOSIDENFAUNA JUGOSLAWIENS (ARANEAE : LYCOSIDAE)

JAN BUCHAR, ANTON POLENEC

Eingegangen am 18. Mai 1973

Abstrakt: Die vorliegende Arbeit enthält die Beschreibung des Männchens einer slowenischen Hochgebirgspopulation, deren ♀ schon früher als Typus der selbständigen Spinnenart *Acantholycosa strandi* (Kratochvíl, 1935) beschrieben worden ist; auf Grund eines Vergleichsstudiums der neu gesammelten Exemplare hat sich herausgestellt, daß es sich um eine nur in manchen Merkmalen eigentümliche Teilpopulation der alpeischen Art *Acantholycosa pedestris* (Simon) handelt. Außerdem werden Angaben über die jugoslawischen Populationen der Arten *Pardosa morosa* (L. Koch) und *Pirata knorri* (Scop.) diskutiert.

Diese Studie ist durch die Ergebnisse der langjährigen Mitarbeit beider Autoren veranlaßt worden. Namentlich wird unser Streben darauf gerichtet, die taxonomischen Beziehungen der sehr seltenen Hochgebirgsart *Acantholycosa strandi* (Kratochvíl, 1935) deren Typus-Exemplar sowie die Paratypen[1]) während des II. Weltkrieges verloren gegangen sind, zu untersuchen.

1. Verwandtschaftsbeziehungen der Art *Acantholycosa strandi* (Kratochvíl, 1935)

(Abb. A—E)

♂ — Beschreibung mit Bemerkungen zur Typusdiagnose: Grundfärbung des Carapax, der Extremitäten und des Sternums schwarzbraun. Opisthosoma schwarz ohne Zeichnung. Die dunklen Flecke des Carapax ganz undeutlich (auch die an der Abb. D abgebildeten dunklen Radiärflecke des ♀ — Carapax stellen vielmehr nur Radiärfurchen als wirkliche Flecke dar), keine Radiärfurchen. Die hellbraunen Flecke der Extremitäten viel ausgeprägter als die bei den Weibchen. Die Form und die Lage dieser Flecke ist bei den Vertretern beider Geschlechter identisch: Alle Fe und Ti auf der Oberseite ein Apikalpaar (der prolateralere Fleck immer länger). An den Fe I—IV noch ein retrolateraler länglicher und ein ventraler apikaler Fleck. An den Fe I—III verschmelzen diese Flecke miteinander. Clypeus und 3 längliche Flecke am Basalteil der Chelizeren von der gleichen Farbe

[1]) Die Angabe bei Kratochvíl, 1935 : 12 „Longuer" 8,5—9,0 mm bezeugt die Existenz wenigstens von einem Paratypus.

(hellbraun). Innenseite der Chelizeren gelbraun; Ventralseite der Coxen und Trochanteren mit gelbbraunen Flecken.

Opisthosoma ventral mit 2 Linien von kleinen weißlichen Punkten, die sich vom Außenrande der Lungen-Deckel fast bis zu den Spinnwarzen hinziehen.

Bestachelung der Beine: Fe I—IV stimmt mit den Angaben Kratochvíl's, 1935. Alle Patellen (bei beiden Geschlechtern) auf der Oberseite mit je 2 Stacheln; beim Männchen zusätzlich noch mit einem prolateralen und einem retrolateralen. Alle Ti mit 2 dorsalen Stacheln. Ti I und II (bei beiden Geschlechtern) pro-und retrolateral mit einer schrägen, immer fünfstacheligen Reihe; dazu oberhalb dieser Reihe noch mit einem pro- und retrolateralen Stachel (Abb. B) und ventral noch mit 2 apikalen Stacheln (beim Weibchen fehlt der retrolaterale). Ti III und IV beiderseits mit 3 Lateral- und 3 Ventral-Stacheln (hier einschließlich der apikalen). Met I und II mit je 2 retro- und 2 prolateralen, 4 ventralen und 5 apikalen Stacheln (basale pro- und retro-laterale Stacheln fehlen bei einem ♂-Exemplar). Met III und IV außerhalb der schon erwähnten noch mit einem Basalstachel auf der Oberseite.

♂ — Carapax-Länge: 3,95 mm.

Länge der ♂-Beinglieder (in mm):

	Fe	Pt	Ti	Mt	Ta	Ges.
I	3,55	1,64	3,50	3,84	1,90	14,43
II	3,55	1,60	3,32	3,84	1,90	14,21
III	3,45	1,60	3,00	4,28	1,72	14,05
IV	4,18	1,72	3,96	6,40	2,36	18,60

Bulbus genitalis — Abb. E.

Diskussion: Die Ansichten über die Selbständigkeit der im Alpenraum vorkommenden *Acantholycosa*-Arten waren bisher sehr unterschiedlich. Zum Beispiel hält Bonnet, 1955 : 131 die Art *Acantholycosa pedestris* sensu Dahl, 1908 für *Acantholycosa rupicola* (Duf.), aber *Acantholycosa pedestris* sensu Dahl & Dahl, 1927 für *A. strandi* (Kratochvíl).

Tatsächlich gibt es sehr kleine Unterschiede zwischen den Abbildungen bei Dahl, 1908 : 194 und bei Dahl & Dahl, 1927 : 12. Erst die Arbeit Lugetti & Tongiorgi, 1965 : 219 hat durch exakte Abbildungen der Art *Acantholycosa pedestris* (Sim.) zur Lösung des Problems teilweise beigetragen. Da die Angaben der beiden Autoren mit unseren Exemplaren nicht völlig übereinstimmten, waren wir vorerst der Ansicht, daß die Vertreter der jugoslawischen Population eine gut definierbare Unterart vorstellen.[2]) Jedoch die neuesten, aus den westlicheren Alpengebieten stammenden Exemplare,[3]) konnten keineswegs diese Annahme bestätigen (1♀ Innsbruck-Nordkette, Atzler Scharte ca 2000 m; 1♀ Pv. Brescia, Passo Croce Domini ca 2050 m).

Jedes von den beiden Weibchen weist gleichzeitig einige charakteristische Merkmale der italienischen (sensu Lugetti & Tongiorgi), sowie der jugoslawischen Populationen (sieh Tafel 1.) auf.

Fundorte und Material: Jugoslawien: Julische Alpen, Razor 2300 m (1♀; 12. X. 1968 Polenec leg.), Sovatna 2200 m (1♂; Polenec leg. 18. VII. 1969), Triglav — Hribarice 2300 m (1♀; Polenec leg 29. VII. 1969), Triglav — Planika Hütte 2400 m (1♂; Leben leg 27. VII. 1969).

Table 1. Die Variabilität der Merkmale von *Acantholycosa pedestris* (Sim.), nach den aus verschiedenen Alpengebieten stammenden Weibchen-Exemplaren

Lokalität	Die Quelle	Längenverhältnis zwischen dem Vorderteil und dem Mittelseptum der Epigyne (siehe Abb. C).		Zahl der Lateral-Stacheln an den Tibien I, II.	Grundfarbung des Carapax
Triglav, Jugoslawien	Kratochvíl, 1935	13 : 38	(0,34)	5—6	
Julische Alpen, Razor	Abb. A	31 : 82	(0,37)	5	röthlichbraun
Innsbruck, Nordkette	Collectio Thaler	31 : 81	(0,38)	5—6	rostigbraun
Bergamasker Alpen	Collectio Thaler	32 : 77	(0,41)	6—7	röthlichbraun
Triglav, Hribarice	Collectio Polenec	27 : 63	(0,43)	5	
Partenkirchen Bayerischen Alpen	Dahl, 1908 : 194	17 : 35	(0,48)	5—6	
Partenkirchen Bayerischen Alpen	Dahl & Dahl, 1927 : 13	15 : 26	(0,57)		
Friuli-Venecia Giulia, Carnia	Lugetti & Tongiorgi, 1965 : 222	19 : 36 19 : 35	(0,53) (0,54)	6—7	„bruno-rossiccio"

[2]) z.B. Ti I, II sämtlicher jugoslawischen Exemplare tragen nur 5 charakteristische Lateralstacheln, die italienischen 6—7; Länge des Vorderteils der Epigyne (Abb. C_a) stellt bei den Vertretern der jugoslawischen Populationen nur $\frac{1}{3}$ der Länge des epigynalen Längsseptums (Abb. C_b) dar, bei italienischen Weibchen $\frac{1}{2}$ derjenigen Länge; (sieh auch Tafel 1).

[3]) Es sei uns erlaubt, Herrn Dr. K. Thaler (Innsbruck), der uns freundlicherweise sein bisher unpubliziertes Material zugänglich machte, für diese wertvolle Unterstützung unseren besten Dank auszusprechen.

Nordtirol: Innsbruck-Nordkette, Arzler Scharte 2000 m (1♀; Thaler leg. 14. VII. 1972).

Norditalien: Bergamasker Alpen, Passo Croce Domini 2050 m (1♀; Thaler leg. 28. IX. 1971).

Biotop: Steingerolle.

2. *Pardosa morosa* (L. Koch)

(Abb. F—I)

Lycosa morosa L. Koch, 1870 : 8, 47; Bosenberg, 1903 : 380; Dahl, 1908 : 255 — *Lycosa furva* Bosenberg, 1903 : 387, Abb. XXXVI, 571 — *Lycosa Anneae* Strand, 1917 (n. nov. für *Lycosa furva* Bos. non Thorell) — *Acantholycosa nigripalpis* Giltay, 1932 : 12, Abb. 7 — *Lycosa furva* Kolosvary, 1938 : 16, Abb. 1; 1940 : 332 — *Pardosa anneae* Bonnet, 1958 : 3356 — *Pardosa morosa* Bonnet 1958 : 3393; Tongiorgi, 1966 : 311, Abb. 64—66 — *Pardosa nigripalpis* Buchar, 1968 (non *Pardosa pseudostrigillata* Tongiorgi) : 126, Abb. 5 I—K.

Beschreibung der Vertreter einer jugoslawischen Population: Carapax dunkel braunrötlich, Augenfeld, Radiärstreifung der Oberseite (Abb. G) und Sternum schwarz. Abdomen schwarzlich, Mittelstreifen wie Carapax gefärbt. Beine der Weibchen dunkler (dunkel braunrötlich) als

bei den Männchen (braungelb) und distalwärts sukzessiv heller; Ringelung undeutlich (Abb. H); Unterseite der Coxen schwarzgrau mit gelben Flecken am Sternumrande. Epigyne (Abb. F) und Bulbus von üblicher Form (sieh Tongiorgi, 1966 : 322).

Ökologie: Die supralitorale Zone der Meeresküste mit Steingeröll (Steine von 5 bis 10 cm Durchmesser), die von Zeit zu Zeit von Wellen bespritzt werden. Reife Männchen und Weibchen schon am 23. III., Männchen noch am 27. IV.; aber am 5. V. nur Weibchen mit Kokonen.

Diskussion: Die Identität der Arten *Pardosa furva* Bös. und *Acantholycosa nigripalpis* Giltay hat schon Kolosvary, 1938 und 1940 auf dem Material aus Albanien festgestellt. Die Vertreter der jugoslawischen Population unterscheiden sich nach Färbung und ihrem Biotop von allen bisher bekannten Populationen. Nichtsdestoweniger ermöglicht das dürftige Material und die ganz ungenügende Zahl der Lokalitäten im Rahmen der Balkanhalbinsel noch keine Festlegung der Unterarten (auch Kolosvari's Studien bieten keine Anhaltspunkte dafür). Zum Unterschiede von der fast einheitlichen dunklen Färbung der oben erwähnten jugoslawischen Exemplare weisen viele Autoren (z. B.: Bösenberg, 1903; Dahl & Dahl, 1927; Tongiorgi, 1966) auf den hellen Streifen auf der Oberseite des Carapax und die Ringelung der Beine hin. Die bisherige arachnologische Literatur enthält keine Angaben über derartige Standorte, die unsere Population bewohnt: Dahl, 1908 : 225 „zwischen und unter dem groben Geröll am Oberlauf der Flüsse, nicht an schmalen Bächen mit schmalem Geröllrand" (dasselbe gilt für die Populationen der ČSSR), Tongiorgi, 1966 : 311 „the edges of lakes, rivers and streams made up of pebbles, stones or, at least, rough sand. It is likely that *P. morosa* will be found in Italy in zones of middle altitude." Giltay, 1932 und Buchar, 1968 (sub *Pardosa nigripalpis*) — Bergland weit vom Flußufer: „Kniagevo versant N.-O. du mont Vitochka", „Golobardo — steinige Steppe, Kalksteinunterlage".

Fundort und Material: Jugoslawien: Rovinj, Meeresküste (1♀.1♂ Polenec leg. 23. III. 1970; 1♀ Polenec leg. 7. V. 1970).

3. *Pirata knorri* (Scopoli)

Gewisse Parallelen zu den soeben für die Lycosiden-Art *Pardosa morosa* geschliderten zoogeographisch-ökologischen Verhältnisse (die auffallenden Unterschiede im Charakter vom Biotop zwischen den mitteleuropäischen und jugoslawischen Populationen) finden wir auch bei der Art *Pirata knorri*. Die Beschaffenheit der meisten tschechoslowakischen Biotope dieser Art (etwa 150 Ex. aus Böhmen: Stěnava bei Broumov; Mähren: Moravice bei Nová Pláň, Starý Hrozenkov; Slowakei: Nová Sedlica), entspricht den treffenden Angaben des berühmtesten Kenners der mitteleuropäischen Wolfspinnen F. Dahl. Er schreibt (1908 : 123): „*Pirata knorri* kommt nur an schnellfließenden Gebirgsbächen vor, und auch nur dann, wenn am Rande dieser Bäche Geröllblöcke liegen." Doch gibt es bei uns einige Ausnahmen: Manche Populationen leben an Flüssen, deren Ränder mit Kiesel bedeckt sind (Jizera bei Bystrá, Hron bei Zámostie). Demgegenüber hat Polenec die jugoslawischen Exemplare dieser Art immer am Rande der Gebirgsseen oder einer Quelle gesammelt. Alle Vertreter der jugoslawischen Populationen stimmen, was die Morphologie und Färbungsmerkmale anbetrifft, vollkommen mit den Exemplaren aus der ČSSR.

Fundorte und Material: Jugoslawien: Ufer von 7. Triglav-See mit einem Steingeröll, 1340 m (3♀♀, 1♂ Polenec leg. 22. VI. 1969); Komaria-See, 1500 m (1♀ Polenec leg. 23. VII. 1968); bei Quelle am Fusse Storžic, 2132 m (2♀♀ Polenec leg. 22. VI. 1969).

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Für die Abbildungen siehe die Platte am Ende des Heftes.

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VĚSTNÍK ČESKOSLOVENSKÉ SPOLEČNOSTI ZOOLOGICKÉ
Svazek XXXVIII — Číslo 2 — 1974 — Str. 86—94

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EFFECT OF JUVENILE HORMONE ON THE CONTENT OF NUCLEIC ACIDS IN ORGANS OF ADULT PYRRHOCORIS APTERUS FEMALES (HETEROPTERA)

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Received January 11, 1973

Abstract: Changes in the total amount of nucleic acids in ovaries, fat body and midgut were analysed in daily intervals throughout the first reproduction cycle in females. In the ovaries there has been a considerable increase of both RNA and DNA content from the beginning until the end of the reproduction cycle. The increase was correlated with the presence of juvenile hormone (JH) and oocyte growth.

In the fat body the amount of RNA also increased during the feeding period in the first half of the reproduction cycle whereas it decreased in the second-half period of the cycle when vitelogenesis was still intensive. The increase of DNA content in the fat body was quite negligible in comparison with the RNA content. It has been concluded that changes in RNA content in the fat body are not directly dependent on JH. The decline in the fat body RNA content during the second-half of the cycle is most probably a result of a consumption of the fat body reserve by growing oocytes.

In contrast to ovaries and fat body, there have been no significant alterations in RNA or DNA content in the midgut. Thus, JH seems to have no effect on nucleic acids contents in this tissue during the reproduction cycle.

INTRODUCTION

The ovaries, fat body and midgut are organs which are responsible for considerable changes in the metabolic activity during the reproduction cycle of females. The ovaries are characterized by a rapid growth throughout the whole cycle with a sudden fall at oviposition. The fat body and midgut are characterized by a rapid growth in the initial feeding period with a progressive decrease in size towards the end of the cycle (Sláma, 1971).

It is well known that the growth of the folicular epithelium in ovaries and the intake of yolk precursors by oocytes are under the control of JH in many species (Telfer, 1965; Engelman, 1970). Proteins constitute a major part of yolk reserves and it has been shown that the synthesis of these proteins is controlled by JH in the ovaries as well as in the fat body (Minks, 1967; Lüscher, 1968; Broockes, 1969; Engelman, 1970; Wyss-Huber and Lüscher, 1972). In addition, metabolism of lipid and carbohydrate in the fat body may be controlled by JH (Orr, 1964; Minks, 1967; Stadler-Martin, 1969). It seems, therefore, that not only ovaries but also fat body is the target organ of JH. By contrast, activity of certain

digestive enzymes in the midgut seems to be under control of the brain hormone (Thomsen and Møller, 1963; Hrubešová and Sláma, 1967).

Remarkable changes in RNA metabolism have been found during the reproduction cycle in the fat body and midgut of *Periplaneta* (Mills et al., 1966) and in the ovaries and fat body of *Locusta* (Minks, 1967). Pemrick and Butz, 1970a,b, have shown interrelationship between synthesis of RNA and proteins in the fat body of *Tenebrio*. After allatectomy both the amount of RNA and the rate of protein synthesis were lowered in the fat body and ovaries of *Locusta* (Minks, 1967). Autoradiographic studies revealed that synthesis of RNA and proteins in ovaries, fat body and midgut were decreased in allatectomized *Rhodnius* (Vandenberg, 1963b).

The aim of this work has been to reveal the relationship between the growth of organs and the amount of nucleic acids and to ascertain the effect of JH on the content of nucleic acids.

MATERIAL AND METHODS

Virgin female adults of *Pyrrhocoris apterus* were used in all experiments. They were fed on lime-tree seeds and were kept at 27°C under long photophase (18 hours). In these conditions reproduction cycle lasts 5—6 days. When juvenile hormone analogue (JHA) has been applied on allatectomized females the induced reproduction cycle lasted 6—7 days.

Females were allatectomized by neck-membrane technique as described by Sláma, 1964 a. Ethyl ester of pivaloyl-L-alanyl-p-aminobenzoic acid which is highly effective on *Pyrrhocoris* (Poduška et al., 1971) was used as JHA. The dose of 10 μg of JHA dissolved in 1 μl of acetone was applied topically on each female.

The organs were dissected in insect Ringer solution, washed, frozen in the solid CO_2 and than stored at —20°C until used.

The content of nucleic acids was determined spectrophotometrically by measurements of absorbancy at 260 mμ after differential extraction of RNA and DNA according to Reddy and Wyatt, 1967. Analysis of each sample was duplicated by orcinol method for RNA according to Mejbaum (in: Keil, Šormová et al., 1959) and by diphenylamine method for DNA according to Burton, 1956. Absolute values obtained by these spectrocolorimetric reactions differed slightly from those obtained by the first mentioned UV-absorption readings, probably due to the interference of certain sugars. However, relative changes in the amount of nucleic acids were in a good accordance. The values presented in the Figures are those obtained by measurements of absorbancy at 260 mμ. Each value is an average of two measurements. The extract of five organs was used for each measurement.

RESULTS

Ovaries

The amount of nucleic acids in the growing ovaries has increased continuously from the beginning of oocyte development until the end of vitelogenesis. Maximum DNA content has been four times higher and that of RNA six times higher than the amount of DNA and RNA found at the beginning of the reproduction cycle. RNA rises more steeply than DNA and reaches maximum one day sooner (Fig. 1a, 2a).

In the absence of JH, such as in allatectomized females, the described increase of the ovarian nucleic acid content does not take place (Fig. 1a, 2a). After application of JHA on the allatectomized females oocytes are stimulated to develop and similar changes in the amount of nucleic acids as found in the ovaries of normal active females can be seen (Fig. 3a, 4a).

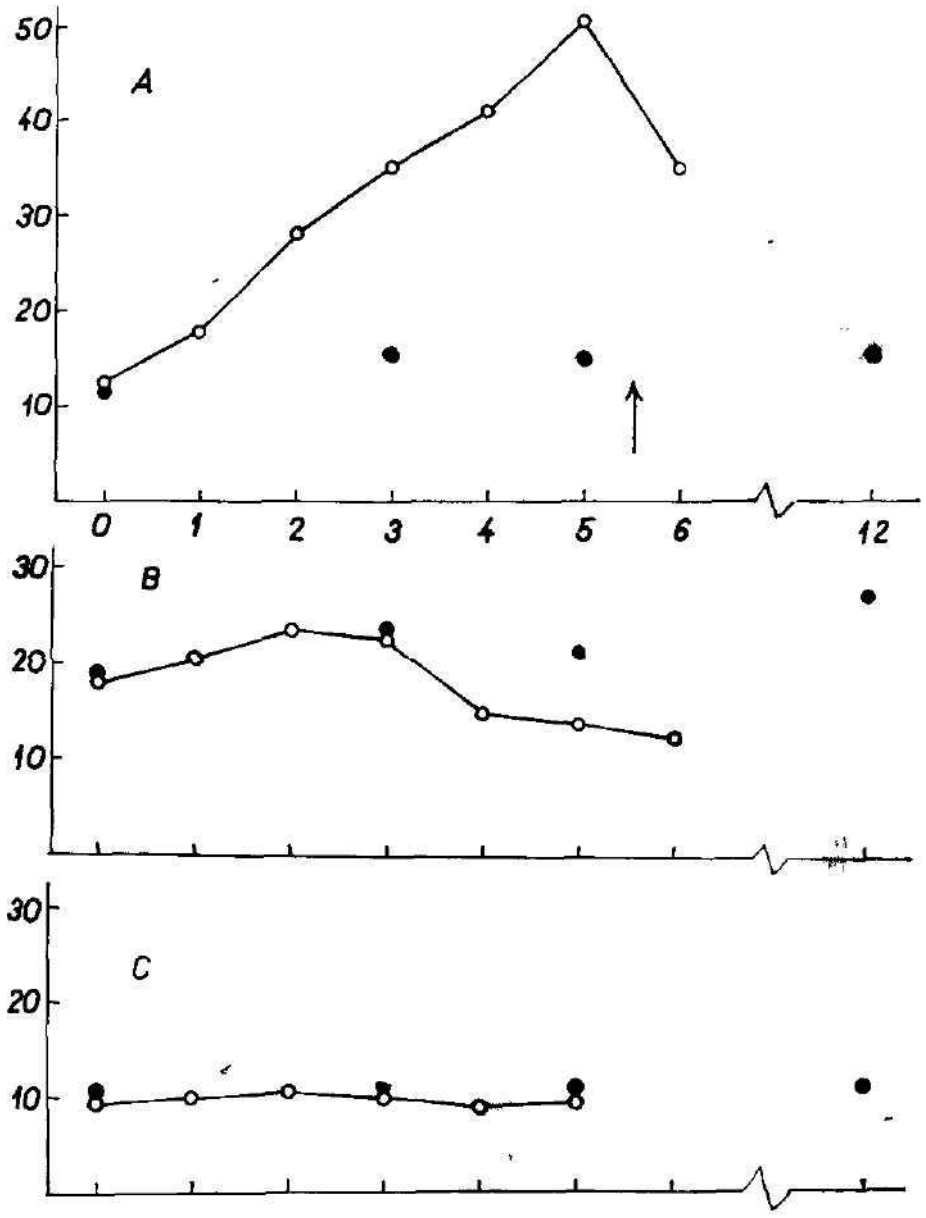

Fig 1 — Changes in the DNA content; A — ovaries, B — fat body, C — midgut
Ordinate: μMoles of DNA-nucleotides per organ
Abscissa: days after adult ecdysis
○ control females, ● allatectomized females
The arrow indicates the time of oviposition

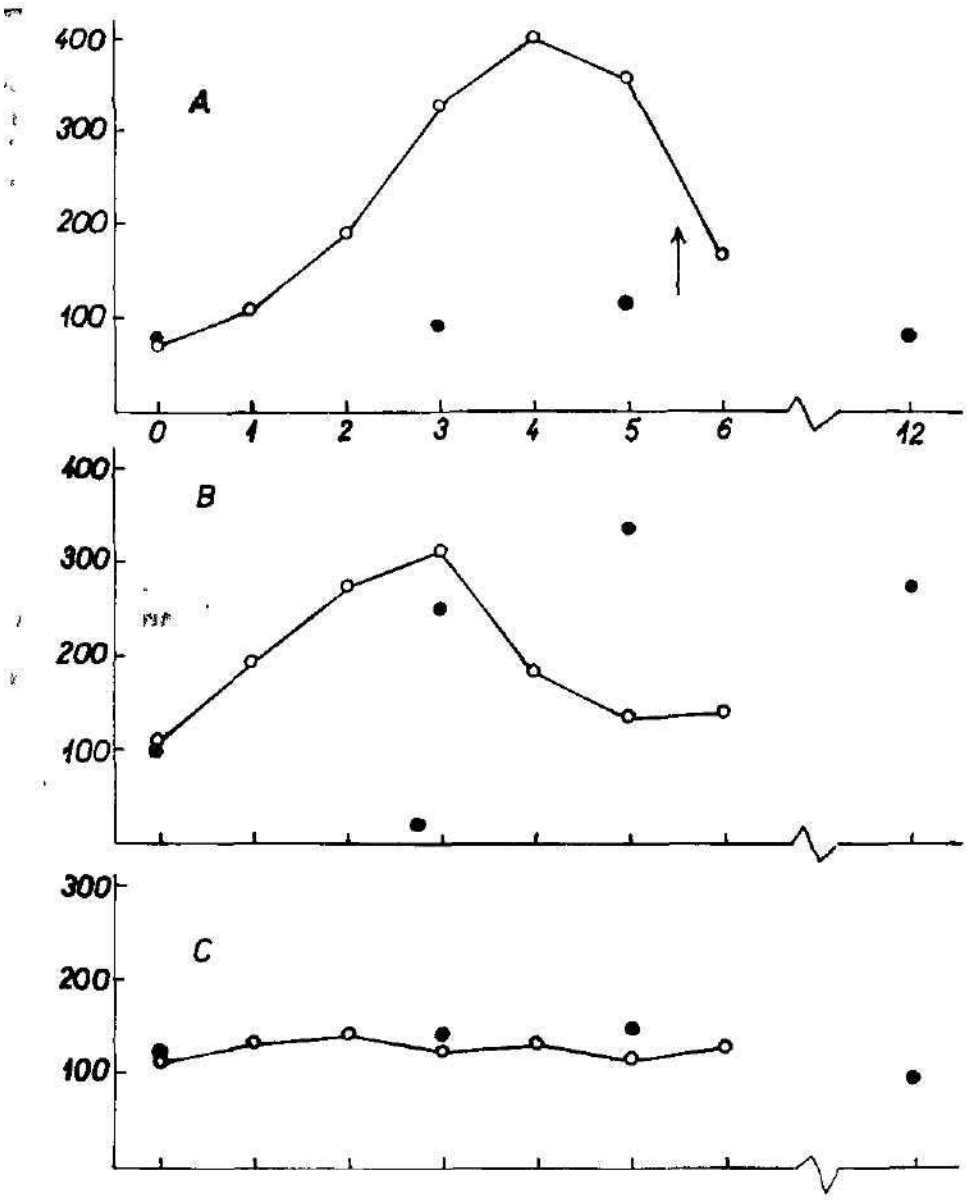

Fig 2 — Changes in the RNA content; for explanations see Fig 1

Fat body

In normal active females there occurs a considerable increase of RNA content in the fat body (three times) during the first half of the reproduction cycle. This is later followed by a decline in the nucleic acid content almost to the initial level during the late vitelogenesis (Fig. 2b).

After allatectomy the RNA content increases more slowly and there is no subsequent decrease. However, the application of JHA to allatectomized females is followed by a similar decrease of RNA as found in the second-half period of the normal reproduction cycle. Such a reduction of RNA content did not occur immediatelly after the application of JHA but it appeared later during vitelogenesis in analogy with the situation found in normal females (Fig. 4b).

The increase of DNA content in the fat body of normal females is much less pronounced than that of RNA. In the second-half period of the reproduction cycle the DNA content is also diminished but no similar decrease was observed when reproduction was induced by application of JHA on allatectomized females (Fig, 1b, 3b).

Midgut

The amount of nucleic acids (RNA and DNA) in the midgut did not change remarkably during the normal reproduction cycle or in experimentally induced reproduction (Fig. 1c, 2c, 3c, 4c).

DISCUSSION

The increased amounts of RNA and DNA in the ovaries are probably associated with mitosis and endopolyploidy and, eventually, with high proteosynthetic activity of ovarian tissues during maturation of the ovaries (Vandenberg, 1963a; Telfer, 1965). The decrease of nucleic acid level after oviposition can be explained partly by the degeneration of folicular epithelium, partly by a loss of nucleic acids deposited in the eggs. A slight decrease of RNA content one day before oviposition indicates that the folicular epithelium begins to degenerate just after chorion deposition This confirms the results of Vanderberg, 1963a on *Rhodnius* where an incorporation of tritiated uridine into RNA ceases soon after deposition of the chorion while synthesis of DNA in the folicular epithelium still continues.

Results that we have obtained with allatectomy and application of JHA on allatectomized females indicate that the increase of nucleic acids in ovaries is completely dependent on JH presence. In the telotrophic ovaries nucleic acids are generally synthetised both in the trophic tissue and the folicular epithelium (Engelman, 1970). It is thus likely that the effect of JH concerns both these ovarian tissues.

In the fat body changes in the amount of RNA are correlated with changes in size of this organ and probably with changes in proteosynthetic activity in the fat body. The value of RNA/DNA ratio (fig. 5b) indicates that variations in the RNA content are associated with changes in individual cells and not merely with changes related to the number of cells or endopolyploidy. Changes in DNA level are relatively small. This suggests that the function of the fat body is not associated with any high mitotic activity.

Unlike the ovaries, JH has nearly no effect on the increase of RNA in the fat body. This suggests an only slight effect of JH on the rate of synthesis of proteins in this organ. A very high amount of total nitrogen and haemolymph proteins in allatectomized females support this suggestion (Janda and Sláma, 1965; Sláma, 1964b). JH can still influence haemolymph proteins qualitatively (Sláma unpubl.). However, allatectomized females

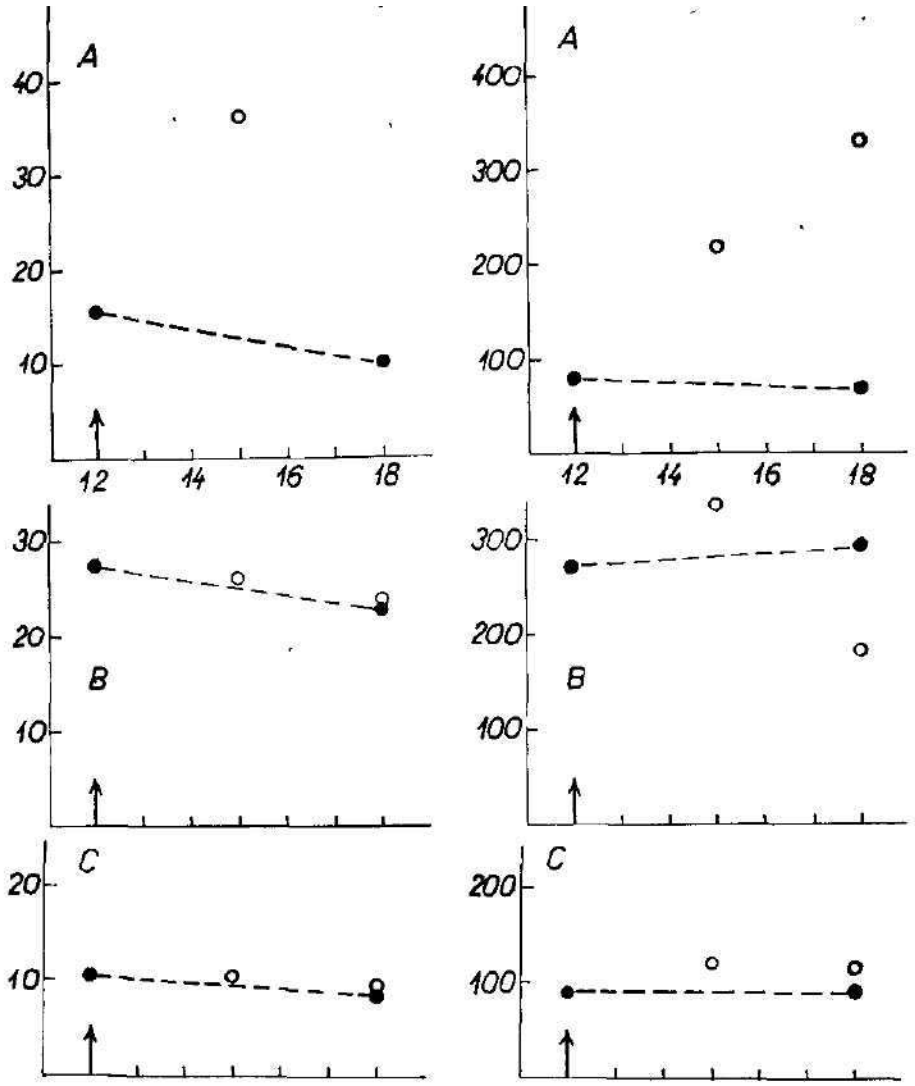

Fig. 3 — Effect of JHA on the DNA content; JHA was applied on 12 days old allatectomized females. A — ovaries, B — fat body, C — midgut
Ordinate: μMoles of DNA-nucleotides per organ
Abscissa: days after adult ecdysis
● allatectomized females, ○ allatectomized females + JHA
The arrow indicates the time of JHA application

Fig. 4 — Effect of JHA on the RNA content; for explanation see Fig. 3

of *Locusta* and *Rhodnius* have lowered content and/or synthesis of both RNA and proteins (Minks, 1967; Vandenberg, 1963). In contrast to the increase of RNA, JH is necessary for the subsequent decrease of RNA in the fat body. RNA does not decrease immediately after the application of

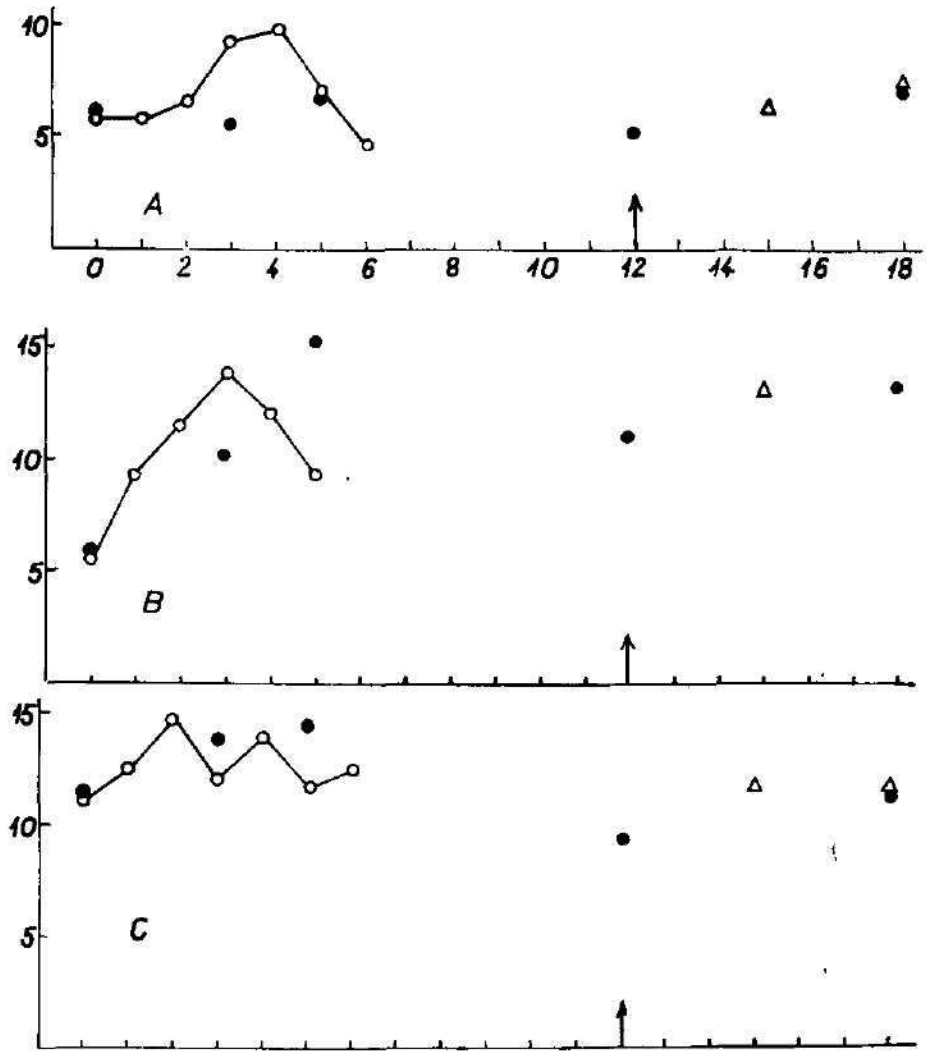

Fig. 5 — RNA/DNA ratio in ovaries (A), fat body (B) and midgut (C)
Ordinate: DNA/RNA ratio
Abscissa: days after adult ecdysis
○ control females, ● allatectomized females, △ allatectomized females + JHA
The arrow indicates the time of JHA application

JHA but only during vitellogenesis. This suggests that the fall of RNA is associated rather with an utilisation of the fat body reserves by developing oocytes than with a direct effect of JHA on the fat body. The high level of RNA in allatectomized females can be associated with a high proteosynthetic activity as the fat body of these females becomes gradually loaded with nutritional reserves (Sláma, 1971). A possibility of the transport of RNA from the fat body into the developing ovaries cannot be also excluded.

In the midgut, in contrast to ovaries and fat body, the amount of nucleic acids almost does not change during the reproduction cycle, although changes of dry weight and the activity of digestive enzymes are considerable (Hrubešová and Sláma, 1967; Němec et al., 1969). A high RNA/DNA ratio indicates a presence of highly developed endoplasmic reticulum in the midgut cells at any time of the reproduction cycle, including that of freshly moulted females (Fig. 5c). This can perhaps account for the fact that an increase of synthetic activity in the midgut is not essentially connected with an increase of RNA content. By contrast, Mills et al., 1966, observed considerable changes in RNA of the midgut in *Periplaneta* during the reproduction cycle.

We can conclude that there need not be any correlation between the amount of nucleic acids in an organ and its proteosynthetic activity. The presence or absence of such a correlation depends on the organ under consideration. The situation may be different in the same organ in different species.

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VĚSTNÍK ČESKOSLOVENSKÉ SPOLEČNOSTI ZOOLOGICKÉ
Svazek XXXVIII — Číslo 2 — 1974 — Str. 95—97

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NOTE ON THE OCCURENCE OF THE BROOK LAMPREY, LAMPETRA PLANERI (BLOCH, 1784) (CYCLOSTOMATA) IN ROUMANIA

JURAJ HOLČÍK and TEODOR NALBANT

Received June 22, 1973

Abstract: Specimen of brook lamprey, described by Prunescu-Arion and Bănărescu (1968) as *Lampetra planeri*, from the Moldova river, the right tributary of the Siret river: the Danube river basin in Eastern Roumania, is in fact *Eudontomyzon mariae*. On the other hand the collection of lampreys coming from the Vişeu river, left tributary of the Tisa river, North-West Roumania, appeared to be *Lampetra planeri*.

The fauna of cyclostomes in Roumanian waters consists of 4 species: *Eudontomyzon danfordi* Regan, 1911, inhabiting mainly the basin of the Tisa river, *E. mariae* (Berg, 1931) occurring in some direct tributaries of the Danube proper (e.g. the Arges river), then *E. vladykovi* Oliva and Zanandrea, 1959, in the upper course of the Olt river drainage near Sibiu (the Danube basin) and in the Bistra Marului — an indirect tributary of the Timis river (the Tisa river basin), and *Lampetra* planeri (Bloch, 1784) which was recorded in the Moldova river (right tributary of the Siret river, the Danube basin, Eastern Roumania) (Grossu et alii, 1962; Prunescu-Arion and Bănărescu, 1968; Bănărescu and Arion-Prunescu, 1968: Bănărescu, 1969). The presence of the last species so deep in the area of distribution of *E. mariae* was explained by Bănărescu and Arion-Prunescu (l. c.) as an immigration from the Vistula river basin.

The senior author had, during his visit in Roumania in September 1972, the opportunity to look through the collections of lampreys deposited in the Central Institute of Biology and in the Museum of Natural History "Grigore Antipa", both in Bucarest. Examination of the lamprey from the Moldova river (138 mm of the total length) classified as *Lampetra planeri* by Arion-Prunescu and Bănărescu (1968) has showed that this specimen is, undoubtedly *Eudontomyzon mariae*, as follows from its characteristics (Fig. 1): 1) there are villiform intermediate disc teeth between the circumorals and marginals (terminology after Hubbs and Potter, 1971), 2) five median anterior tooth rows on the anterior field, 3) three supraoral cusps (the median one small but well visible), 4) ten infraoral cusps, 5) distinctly pigmented

tail and dorsal fin borders. The number of myomeres in this specimen seems to be about 60. The only one character which does not agree with those of *E. mariae* is the teethless posterior field of the sucking disc bearing only marginals whose circumoral course is interrupted in the middle bottom of the posterior field. According to our oppinion, the specimen examined represents *E. mariae* with not fully developed sucking disc.

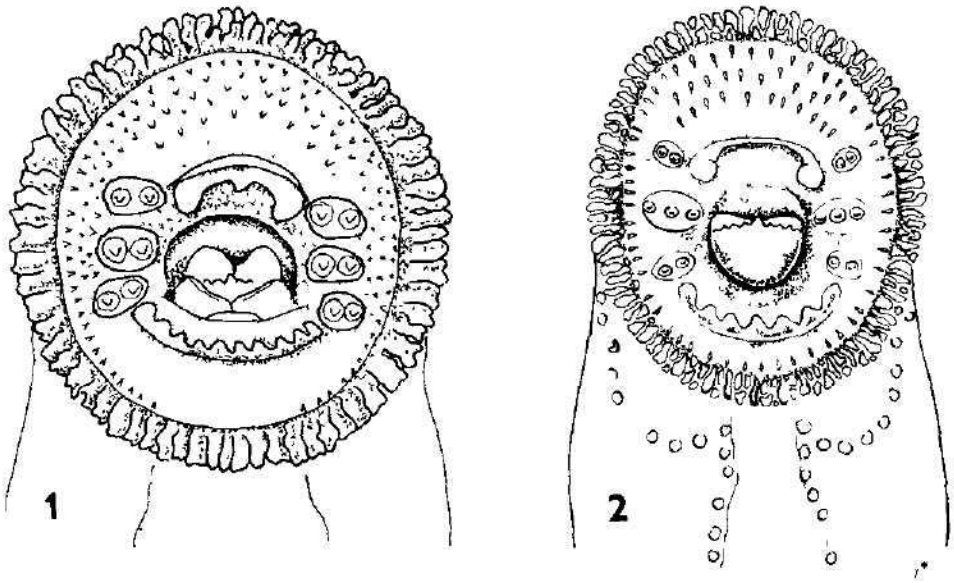

Fig. 1: Dentition of *Eudontomyzon mariae* from the Moldova river. Drawn by T. Nalbant.
Fig. 2: Dentition of *Lampetra planeri* from the Vişeu river. Drawn by T. Nalbant.

Despite this finding, the lamprey fauna of Roumania could not be diminished. The ichthyological collection of the "Grigore Antipa" Museum of Natural History contains the sample of 4 lampreys labelled as "*Lampetra fluviatilis*", collected by Dr. Vasile Homei in the Vişeu river (the left affluent of the Tisa river) in September 1945. Without any doubt this sample belongs to *Lampetra planeri*. All specimens (1 female with roe, 122.4 mm in TL, two metamorphing specimens of 132.8 and 178.2 mm in TL and one ammocoete measuring 99.3 mm of TL) display unpigmented caudal and dorsal fin border, 62 (ammocoete), 63 (adult specimen) and 64 (metamorphing animals) trunk myomeres, respectively. The dentition of the single adult is identical with that of *Lampetra planeri* (Fig. 2).

The discovery of *L. planeri* in the sources of the Tisa basin proves the foregoing finding of this species in the same river basin on the territory of eastern Slovakia (Holčík, 1970). After this, as well as after the Kux's (1969) discovery of *Lampetra planeri* in the Morava river basin in Czechoslovakia, our finding of this species is the third one in the drainage of the Danube river. The older data on the occurence of *L. planeri* in Bavaria and Austria have to be revised. According to the information of Dr. K. Lohnisky (personal communication (which we can confirm trough the investigation made by the senior author), the lampreys from the Inn near Wasser-

burg and the Paar brook near Aichach, Bavaria, deposited in the Zoological collection of the State Bavaria, Federal Republic Germany, all belong to *Eudontomyzon vladykovi*. Nevertheless, the very narrow proximity of the sources of the Danube and the Rhine and also the fact that during the years with low water level the sources of the Danube become the tributary of the Rhine (Balon, 1967) allow us to suppose, that even here the presence of *L. planeri* cannot be excluded, either. Anyway, the finding of *L. planeri* in the northern tributaries of the Danube river supports the opinion of Bănărescu and Arion-Prunescu (l. c.) on the southward penetration of this species.

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Svazek XXXVIII — Číslo 2 — 1974 — Str. 98—105

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THE SIZE OF PRIMIPARAE AND NEONATES OF DAPHNIA HYALINA LEYDIG (CRUSTACEA : CLADOCERA) UNDER NATURAL AND ENRICHED FOOD CONDITIONS

MARTA HRBÁČKOVÁ

Received June 1, 1973

Abstract: The postembryonic development of the offspring of *Daphnia hyalina* Leydig, released by the females shortly after collection from Slapy reservoir and reared under natural and under enriched food conditions, did not differ from the postembryonic development of the offspring of females of *Daphnia hyalina* from the same reservoir kept for some generations under favourable food conditions before the beginning of the experiments. The average body length of neonates of the first brood was nearly identical under both food conditions, but smaller at the successive stages. The primiparae reared under natural food conditions were smaller than those from enriched cultures, but the former produced relatively larger neonates. The number of eggs under enriched food conditions was greater by the factor of about 9.

INTRODUCTION

The influence of predation on the size of the related species of Cladocerans was the object of several studies (Hrbáček, 1962; Brooks, 1965). The influence of food concentration on the body size of related species was not studied systematically neverthelles the ecological theory supposes that related species are larger in less nutritious water (Odum, 1963). Findenegg (1948) reports that the size of individuals of *Daphnia cucullata* is greater in larger lakes as compared with smaller ones. It is, though, possible to assume that, in this comparison, the nutritious level is more important than the size of the lakes. Hrbáčková (1963) ascertained that the primiparae of well-fed individuals were larger than those of less-fed ones even though in both cases they were the offspring of well-fed females. The aim of the present paper is to compare, in the offspring of females from natural food conditions, the postembryonic development, the number of eggs production, and the size of comparable instars of individuals reared under natural and enriched food conditions.

MATERIAL AND METHOD

The object of my study was to examine the offspring of *Daphnia hyalina* Leydig released by females immediately after their collection from Slapy reservoir or of females cultivated from 1 to 2 generations under natural conditions. One part of individuals of one brood were reared separately in 100 ml vessels filled with Slapy water (natural food conditions); the other part of individuals of the same brood were kept separately in the same volume of Slapy water, en-

riched with algae of the genus *Scenedesmus* from an unsterile laboratory culture in a concentration of 8 cal/liter of water (enriched food conditions). The experimental vessels were kept in a box at 20°C under daylight conditions. The cultivation medium was changed daily. The water was pumped from a depth of 0.7 m from Slapy reservoir and filtered through silk bolting cloth No 13. The experiments were made in July, June and September. The concentration of the algae suspension was measured as optical density (O. D.) at 660 n m in 1 ccm cell. The optical density data were calibrated by the oxidometric procedure (dichromate catalyzed by Ag^{+}) to the caloric contents of algae. A mixture of human-serum albumen and glucose, in the same ratio

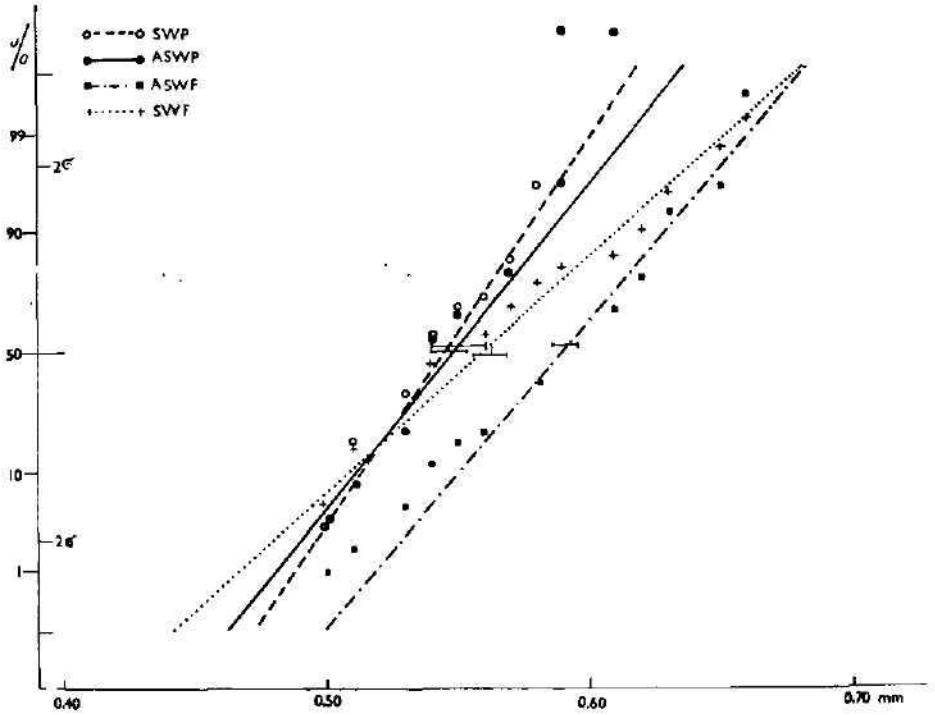

Fig. 1. Cumulative size distribution of the body length of neonates plotted on probability paper. SWP = neonates of primiparae cultivated in Slapy water, ASWP = neonates of primiparae cultivated in Slapy water enriched with algae; SWF = neonates of all broods of females cultivated in Slapy water, ASWF = neonates of all broods of females cultivated in Slapy water enriched with algae.

as proteins and carbohydrates + lipids in the cells, was used as the standard of the oxidometric procedure to allow for an uncomplete oxidation of protein by dichromate. The final ratio used in all calculations was: $A_{660} = 0.100 \rightarrow 0.18$ cal/ml. (Blažka, personal communication). The body length of individuals was measured after each molting from the stage of a neonate to a primipara and in many cases to further stages. From these values, the average body length of the successive stages was calculated and the growth curves were plotted. The confidence interval (c. i.) was calculated at 95% level in all cases. To check the normality of the size distribution the probability scale was used (Harding, 1949). The number of the eggs produced was expressed by a cumulative curve (Navaneethakrishnan, 1970).

RESULTS

Size of neonates

Measurements were made of 25 neonates of primiparae from natural food conditions and 25 neonates of primiparae from enriched food conditions,

80 neonates of all broods of females from natural food conditions and 102 neonates of all broods of females from enriched conditions. The average body length of neonates of primiparae from natural food conditions was 0.54 mm (c.i. ± 0.010), of primiparae from enriched conditions 0.55 mm (c.i. ± 0.11). The average body length of neonates of the broods (including the first brood) of females from natural food conditions was 0.56 mm (c.i. ± ± 0.008), whereas of females from enriched conditions 0.59 mm (c.i. ± ± 0.006). The average body length of neonates of the broods (excluding the first brood) of females reared under natural food conditions was 0.57 mm (c.i. ± 0.011), of females from enriched conditions 0.60 mm (c.i. ± 0.011). From this and from the distribution of neonates presented in Fig. 1, it is evident that in both cases the neonates of primiparae were smaller than those of the later broods. The difference in the size of the neonates of primiparae from natural food conditions is not significantly different from that of primiparae from enriched food conditions. At further stages, the females from the enriched medium have definitely larger neonates.

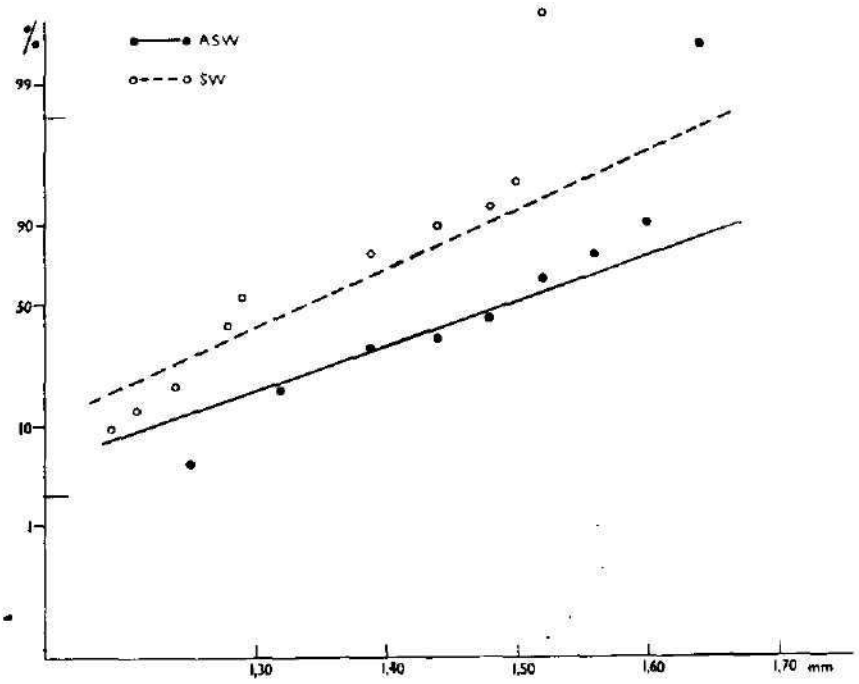

Fig. 2. Cumulative size distribution of the body length of primiparae plotted on probability paper. SW = individuals kept in Slapy water, ASW = individuals kept in Slapy water enriched with algae.

Size of primiparae

The average body length of primiparae from natural food conditions was 1.34 mm (c.i. ± 0.046), of primiparae from enriched food conditions 1.49 mm

Table 1

Number of the stages from N to P		Number of the days from N to P		Number of indiv. finished the postemb.. d.	
SW	ASW	SW	ASW	SW	ASW
5	5	6	5	9.1 %	15.4 %
6	6	8	6	18.2 %	61.5 %
7	7	9—10	7— 8	18.2 %	7.7 %
8	8	10—12	8—10	45.4 %	15.4 %
9	—	11—15	—	9.1 %	—

SW = individuals from natural food conditions
ASW = individuals from enriched food conditions

(c.i. $\pm$ 0.046). The size distribution is given in Fig. 2. The frequency of larger individuals is, in most cases, smaller than was expected by transformed Gaussian integral.

Postembryonic development

The postembryonic development was studied in 54 offsprings of females cultivated for two generations in the water from Slapy reservoir. Of these,

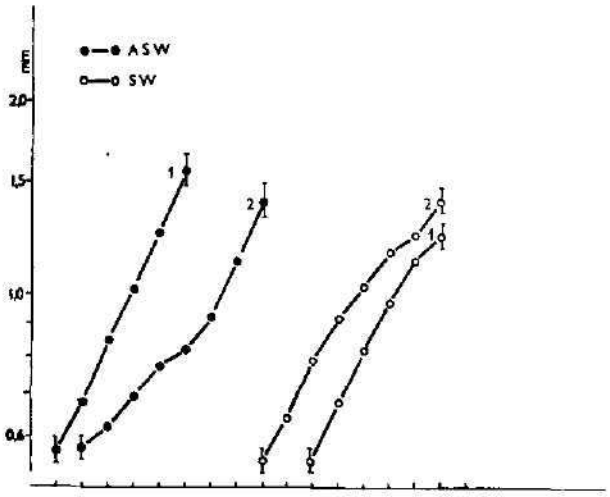

Fig. 3. Growth curves of *Daphnia hyalina* L. cultivated in Slapy water (SW) and in Slapy water enriched with algae (ASW). Groups maturing at 6th (1) and 8th (2) stage are selected. Ordinate: average body length; abscissa: successive stages. To avoid the accumulation of lines the beginning of the curves of individuals from different cultivation media is shifted by 1 or 2 stages to the right.

33 individuals were kept under natural, whereas 21 individuals under enriched food conditions. Of 33 individuals from natural food conditions, 24.20 % finished the postembryonic development; of 21 individuals from

the enriched medium, 81.40 %. Individuals kept under natural food conditions matured most frequently at 8th stage, whereas individuals kept under enriched food conditions at 6th stage. For further details see Table 1.

To compare the growth curves (Fig. 3), groups which matured at 6th and 8th stage were selected. The growth curves of the groups of individuals from an enriched medium and of those from natural food conditions which matured at 6th stage are closer to the logarithmic curve than the growth of the groups maturing at 8th stage.

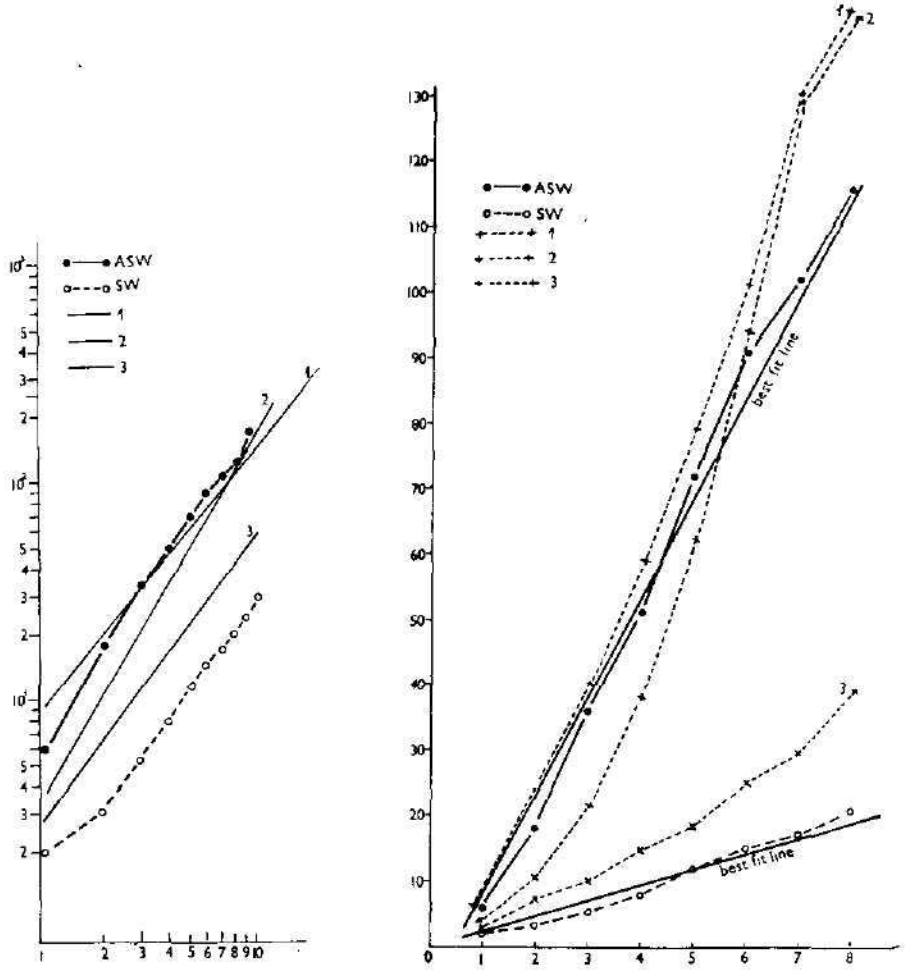

Fig. 4. Cumulative frequency of egg production in *Daphnia hyalina* L. Ordinate: frequency of the eggs; abscissa: successive stages. SW = Slapy water, ASW = Slapy water enriched with algae. Lines: 1 = temperate *D. pulex*, 2 = tropical *D. carinata*, 3. = tropical *C. cornuta* (data from Navaneethakrishnan's paper).

Fig. 5. Cumulative frequency of egg production in *Daphnia hyalina* L. The same data as in Fig. 4 on logarithmic scale. SW = Slapy water, ASW = Slapy water enriched with algae. Lines: 1 = = temperate *D. pulex*, 2 = tropical *D. carinata*, 3 = tropical *C. cornuta* (data from Navaneethakrishnan's paper).

During 30 days, females from natural food conditions produced, on the average, 21 eggs in 6 broods, whereas females from the enriched food conditions produced during the same period 189 eggs in 10 broods. Figs. 4 and 5 show that the increase in the number of eggs was approximately constant during the first stages irrespective of the food concentration. On some occasions, females from natural food conditions produced no eggs. This did not occur in the enriched medium.

Relation between the body size of neonates and primiparae

Fig. 1 shows that the size distribution of neonates is very little influenced by the feeding conditions of primiparae. From the growth curve (Fig. 3) it is evident that the primiparae grown in an enriched medium are larger than those reared under natural food conditions. The regressions between

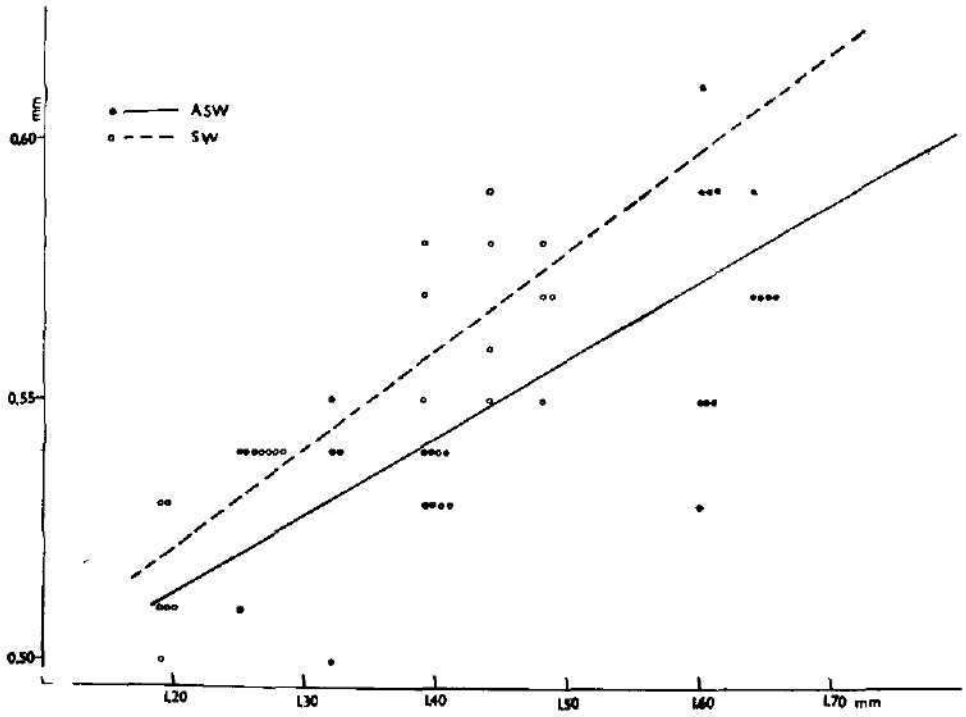

Fig. 6. Regression of the body size of primiparae and neonates. Abscissa: body length of primiparae; ordinate: body length of neonates. In cases in which one point meets with several points in the same place, the consecutive points are shifted to the right at equal distances. Bartlett's best fit lines stand for individuals kept in Slapy water (SW) and for individuals kept in Slapy water enriched with algae (ASW). For SW; x on y: a = 0.8105, B = 4.1289; y on x: a = 0.3739, b = 0.1216; r = 0.7087. For ASW; x on y: a = 0.1294, b = 2.6851; y on x: a = 0.3554, b = = 0.1434; r = 0.6207.

the size of primiparae and neonates are definitely different in the groups grown under natural food conditions and under enriched ones. From the different constant term in the regression it follows that the primiparae of

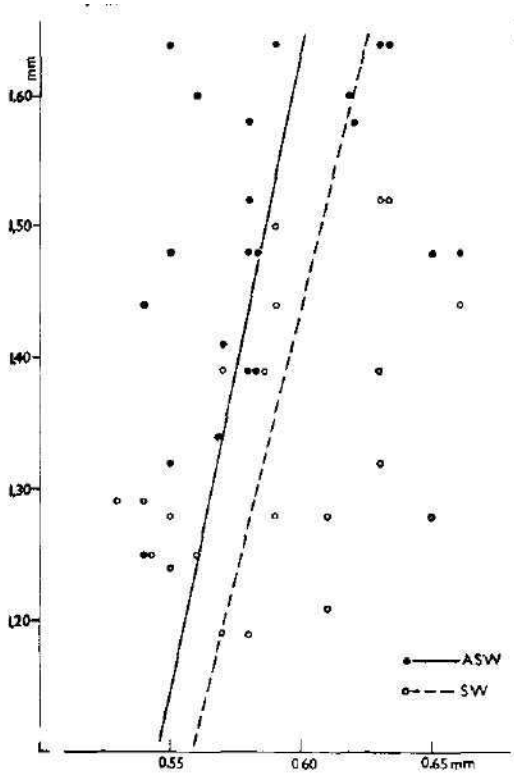

Fig. 7. Regression of the body size of neonates and primiparae. Abscissa: body length of neonates; ordinate: body length of primiparae. In cases in which one point meets with several points in the same place, the consecutive points are shifted to the right at equal distances. Bartlett's best fit lines stand for individuals kept in Slapy water (SW) and for individuals kept in Slapy water enriched with algae (ASW). For SW; x on y: a = 0.5749, b = 1.2817; for y on x a = 0.3649, b = 0 1689; r = 0.4652. For ASW; x on y : a = 0.6739, b = 1.3960; y on x: a = 0.3920, b = 0 1300; r = 0.4259.

a comparable body size in the enriched medium have smaller neonates. Fig. 6 shows Bartlett's best fit lines for both groups.

The regression between the body size of neonates and primiparae shows that the larger neonates grow into larger primiparae. The incline of Bartlett's best fit lines of the two groups (Fig. 7) shows that the neonates from natural food conditions grow into smaller primiparae as compared with neonates from enriched medium.

DISCUSSION

Again it was ascertained that the body size of primiparae depends on the food concentration during the postembryonic development; this was also found in descendants of the females grown at natural food level. In general, larger females produce larger neonates, but this relation is different for individuals under different food-level conditions. The primiparae reared under a low food concentration produced relatively larger neonates as compared with neonates reared under a higher food concentration. This fact agrees with the general ecological theory (Odum, 1963). Larger neonates produced larger primiparae under both food concentrations under study. The shift of the nearly parallel best fit lines (Fig. 8) for the regression of neonates

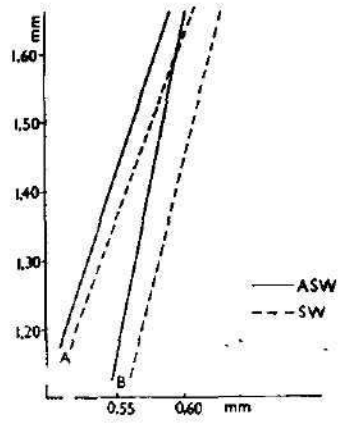

Fig. 8. Bartlett's best fit lines of the body size of primiparae and neonates (A), and neonates and primiparae (B). SW = Slapy water, ASW = Slapy water enriched with algae. The same data as in Figs 6 and 7.

to primiparae and for primiparae to neonates indicates that the relatively larger size of neonates does not affect the smaller size of primiparae reared under low food conditions. From this it follows that Findenegg's phenomenon cannot be explained by the physiological adaptation to low food conditions. In my previous papers (Hrbáčková, 1963 and 1971), I did not take into account the effect of the size of females on the size of neonates. The smaller size of *Daphnia hyalina* from lake Maggiore after the adaptation to good laboratory food conditions may be considered as the consequence of the predominant occurrence of primiparae in laboratory cultures, whereas larger neonates in the material collected from lake Maggiore may be regarded as the consequence of the predominant occurrence of older females.

The growth curves are closer to the logarithmic curves with the decreasing number of instars from a neonate to a primipara irrespective of their frequency. The finding that the number of eggs in the brood is influenced by the food concentration agrees well with the earlier observations of some authors (Anderson and Jenkins, 1942) on other species of the genus *Daphnia*. Navaneethakrishnan (1970) has used the logarithmic scale of the cumulative curve of the number of the eggs produced to characterize the difference between species from temperate and from tropical regions. Navaneethakrishnan hopes to give this difference in the higher position of curves as concerns the tropical species in his graph. If the logarithmic scale was used, the lines which passed through the x axis closely to the origin before transformation (Fig. 4) became parallel (Fig. 5). The almost identical slope of the most lines means that they all would pass origin without transformation. The different value at which they cross the y axis show the different relative increment of eggs per instar; this is definitely dependent on the food conditions irrespective of the climatic conditions. The different slope of *Daphnia carinata* is due to the more pronounced S form of the curve. Whether this is a species characteristic remains open to further investigation.

The postembryonic development of the offspring of females taken from Slapy reservoir did not differ from the postembryonic development of the offspring of females kept under good feeding conditions for several generations before the beginning of the experiments (Hrbáčková, 1963). This is different from the situation in the more oligotrophic lake Maggiore. Here the offspring of females caught in July have shown a much longer development even in an enriched medium (Kořínek, 1970; Hrbáčková, 1971) as compared with the offspring of females cultivated for several generations under good feeding conditions in the laboratory.

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AGE AND GROWTH OF THE EUROPEAN GRAYLING, THYMALLUS THYMALLUS (LINNAEUS, 1758) (OSTEICHTHYES: THYMALLIDAE) FROM UPPER VLTAVA RIVER OF CZECHOSLOVAKIA

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Abstract. Studies on age and growth were made from scales of 24 specimens of *Thymallus thymallus* from the Upper Vltava river, Czechoslovakia. Computations of growth histories were made by the method of Lee (1920) The growth of the Graylings from the Upper Vltava river was compared with the data published by different authors from various localities such as the USSR, Sweden, England, Poland and a few localities of Czechoslovakia The growth of the Grayling from the Upper Vltava is an average growth when compared with the values from various localities

INTRODUCTION

Thymallus thymallus (Linnaeus, 1758) is a widespread species in certain parts of European rivers. It is also one of common inhabitants of some regions of the Upper Vltava river, which is a drainage of Labe river

Table 1. Growth of different age classes of *Thymallus thymallus*

Age Class	Year of hatching	No of Specimens	Fork length at the time of capture in mm Ranges	Average	Back calculated fork length (Smitt's standard length) mm l_1	l_2	l_3	l_4
I	1964	2	(186—189)	187	123	—	—	—
II	1963	9	(183—242)	230	119	195	—	—
III	1962	6	(239—277)	251	120	154	215	—
IV	1961	7	(245—270)	257	116	158	200	239
	Total — 24		Average		120	169	208	239
			Annual increment			49	39	31
			Maximum		132	224	226	257
			Minimum		112	134	190	229

*) University of Bombay, India This paper is a part of the postgraduate studies sponsored by UNESCO.

Hutton (1923) seems to be the first person who studied the growth processes of the Grayling But the most precise work on growth studies of the Grayling using scale structure would be of Svetovidov (1936) which may be considered a fundamental work Svetovidov (l c) studied 194 specimens from the river Mesna Kanin Peninsula (the USSR) This locality is situated near the northern polar circle Balon (1953, 1961) has also done some extensive work on the growth of the Grayling from two different localities In 1953, he studied 30 specimens from the Revúca — a tributary of the Váh river and in 1961, he studied 62 specimens from riverine lake on the Hnilec river In addition to the two above mentioned authors there are also a few following workers who have also brought some contribution for the age and growth of the European Grayling Hochman (1964) studied 59 specimens from the river Divoká Orlice, Kirka (1962) studied 19 specimens from the brook of Vrica near Kláštor pod Znievom, Muller (1960) studied 967 specimens from the Lule Älv of North Sweden, Sedlár (1970) studied 252 specimens from the Nitra river-basin and Solewski (1960) studied 50 specimens from the Sola river in Poland Author has studied the growth of the Grayling from a locality situated on the Upper Vltava river — the drainage of the Labe which is described by Vostradovský (personal communication on 17. 1 1973) as — the river bed is about 15—20 m wide, the bottom is covered with gravel and sand banks like in the typical "Grayling Zone" of some middle European rivers The typical characters of this region disappeared around 1960 when the Lipno valley reservoir was established This part of the river is located above the maximum area of the lake level where carnivorous fish species, such as pike and perches (*Perca fluviatilis*) migrated from the riverine lake In recent years the Grayling are slowly returning to this place because of diminishing of the number of carnivorous fish in Lipno riverine lake. The banks are grassy, mostly covered by *Carex* bushes, the maximum depth reaches about 150 cm In this region the Upper Vltava river flows through a large peaty region and the colour of the water is more or less brownish

Dyk (1958) has also mentioned this locality as the Grayling Region. He writes about Stožec—Černý Kříž, 779 m above the sea level (the lower level is 770 m, the mouth of "Studená Vltava") (Cold Vltava) into the "Teplá Vltava" (Warm Vltava). The surrounding hills are about 1000 m above the sea level According to Dyk (1958) this locality was ascertained by him in 1936 and he also published a sketch figure of a grayling female from this locality (p 8)

MATERIAL AND METHODS

The specimens used in this study were collected by late Doc. Dr Rudolf Šrámek Hušek, the late Director of the Hydrobiological Laboratory of the Academy of Sciences in Třeboň during the angling trip (on 17—18. 9 1955) He did not study the material, that is why it was donated to the Zoological Institute of Charles University, Prague by Dr Václav Hruška from the same laboratory

The specimens are from the Upper Vltava river (near Volary in the direction of Stožec—Černý Kříž) which is a drainage of Labe. The upper portion of the river Vltava near its spring where the sample was collected is at the distance of 390—405 km from the mouth of the river Labe (13°50′ of the eastern length of Greenwich, and 48°50′ northern width).

Out of the 24 specimens studied 3 were juveniles, 8 were males and 13 were females Scales were taken from the left side just below the lateral line in the line of anterior part of the dorsal fin Lengths such as standard length, fork length (in means of Smitt's 1886, 1887 standard length) and total lengths were measured to the nearest mm. Standard or body length was measured from tip of the snout to the anterior end of the median caudal fin rays, fork or Smitt's standard length from tip of the snout to the centre of the fork of caudal fin i e., posterior margin of central caudal rays, and the total length from the tip of the snout to the tip of the caudal fin when the lobes are held parallel to receive maximum length

Since the lengths other than fork length are also in usage in the study of *Thymallidae*, the conversion factors for standard and total lengths are calculated

Standard Length = Fork Length × 0 9217
Total Length = Fork Length × 1 0711

The scale method was used in assessing the age and growth of the specimens 3—5 scales were selected from every specimen for the purpose of studies All scales were examined in dry mount ings using a microprojector (Carl Zeiss, Jena) with × 17 5 magnification The ventral diagonal radius and the distance from the centre to the different annuli of the scale were measured The number of annuli on the scale were used to determine the age of the fish

To determine the body scale relationship, the lengths were grouped into 10 mm groups and the mean fork length from the groups were plotted against the corresponding mean ventral diagonal radii The intercept that is the probable fork length attained at the time of scale develop *ment was found to be 35 mm. The growth curve was found to be linear (Fig 1)*

Table 2. Tabulation data employed in comparing the average growth in *Thymallus thymallus*

Author	Locality	No. of sp.	Average fork length (Smitt's standard length) in mm									
			l_1	l_2	l_3	l_4	l_5	l_6	l_7	l_8	l_9	l_{10}
Svetovidov (1936)	Mesna river - Kanin Peninsula, USSR	194	75	127	181	224	251	—	—	—	—	—
Balon (1953)	Revúca - tributary of Váh river, Danube drainage	30	79	180	260	310	342	—	—	—	—	—
Solewski (1960)	Sola river - tributary of river Vistula in southern Poland, drainage of Vistula	50	88	171	207	237	—	—	—	—	—	—
Kirka, A. (1926)	Brook of Vríca near Kláštor pod Znievom - tributary of river Turiec, drainage of river Váh, Danube basin	19	95	174	209	237	245	—	—	—	—	—
Sedlár (1970)	Nitra river basin, Danube drainage	252	102	176	227	276	325	—	—	—	—	—
Author	Upper Vltava river, drainage of Labe	24	120	169	208	239	—	—	—	—	—	—
Hochman (1964)	Drainage of upper part of river Divoká Orlice, left affluent of upper part of Labe river, Labe drainage	59	138	218	276	314	370	—	—	—	—	—
Balon (1961)	Riverine lake on Hnilec river - Danube drainage	62	147	224	269	294	311	—	—	—	—	—
Müller (1960)	Lule Älv of North Sweden	967	151	195	237	277	324	335	376	—	—	485

Table 3. Tabulation data emploed in comparing the growth ranges in *Thymallus thymallus*

Author	Locality	No. of sp.	Ranges of fork length (Smitt's standard length) in mm									
			l_1	l_2	l_3	l_4	l_5	l_6	l_7	l_8	l_9	l_{10}
Solewski (1960)	Sola river tributary of river Vistula in southern Poland, drainage of Vistula	50	76–106	131–187	173–233	205–266	–	–	–	–	–	–
Hochman (1964)	Drainage of upper part of river Divoká Orlice - left affluent of upper part of Labe river - Labe drainage	59	104–180	184–258	243–312	274–349	360–380	–	–	–	–	–
Muller (1960)	Lule Älv of North Sweden	967	114–181	119–243	204–278	246–297	294–357	350–401	–	–	–	485
Author	Upper Vltava river, drainage of Labe	24	112–132	134–224	190–226	229–257	–	–	–	–	–	–

Table 4. Tabulation data to show annual increments in *Thymallus thymallus*

Author	No. of sp.	Annual increments in fork length (Smitt's standard length) I	II	III	IV	V	VI	VII	VIII	IX	X
Svetovidov (1936)	194	—	52	54	43	27	—	—	—	—	—
Balon (1953)	30	—	101	80	50	32	—	—	—	—	—
Solewski (1960)	50	—	83	36	30	—	—	—	—	—	—
Kirka (1962)	19	—	79	35	28	8	—	—	—	—	—
Sedlár (1970)	252	—	74	51	49	49	—	—	—	—	—
Hochman (1964)	59	—	80	58	38	36	—	—	—	—	—
Balon (1961)	62	—	77	45	25	17	—	—	—	—	—
Müller (1960)	967	—	44	42	40	47	11	—	—	—	—
Zinovev (1962)	365	54	44	55	43	72	31	22	65	6	37
Hutton (1923)	—	—	127	70	31	10	35	—	—	—	—
Author	24	—	49	39	31	—	—	—	—	—	—

RESULTS AND DISCUSSION

It is somewhat difficult from the methodical point of view to compare the obtained values of the studied specimens with the data published by various authors using different lengths. In Salmonids, the Smitt's (1886, 1887) length of body, which is referred to as the fork length (Carlander, 1950). is in usage. Svetovidov (1936), Balon (1953), Balon (1961) and Sedlár (1970) have used regular Smitt's length of the body in their calculations. Müller (1960) and Solewski (1960) have used total lengths which are converted into fork lengths by the author using the calculated conversion factor. But Hochman (1964) and Kirka (1962) used body length and not Smitt's

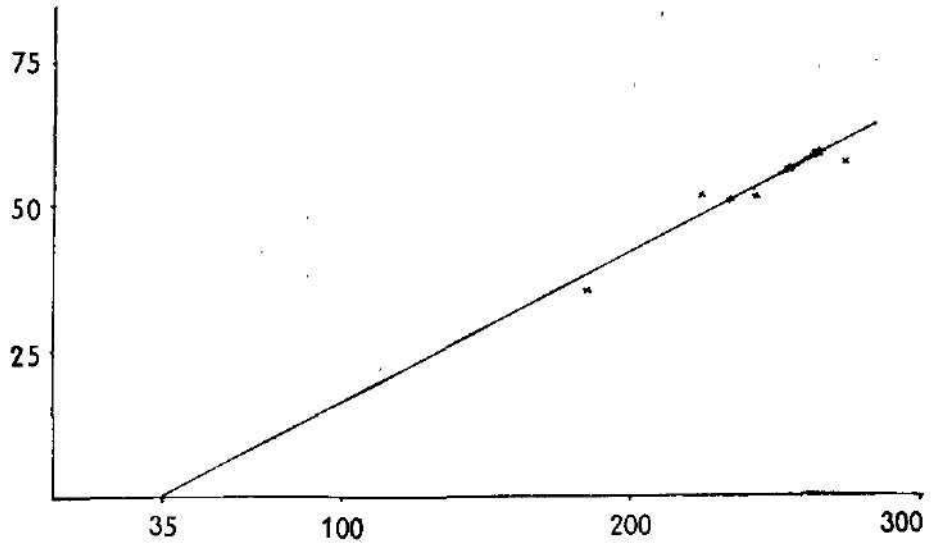

Fig. 1. Relation between body length and ventral diagonal radius of *Thymallus thymallus*. Abscissa, fork length; ordinate, scale radius × 17.5 in mm.

length of the body, but the length without caudal fin as in Cyprinidae (see Berg, 1948). These values were also converted into fork lengths by the author using conversion factor. Hochman (1964) erroneously tabulated the values of Balon (1961) in the table for the body or the standard length apparenty understood by him as body length without caudal as in Cyprinidae and not in the means of Smitt (1887).

During the first year the specimens from the Upper Vltava river reached an average growth level (120 mm). The specimen from Hnilec riverine lake have the maximum length (147 mm) while the specimens from the Mesna river — Kanin Peninsula have the minimum length. During the second and the third year the specimens from Upper Vltava river have slower growth. Their length was reached less than the average length in most reviewed localities. But by the fourth year the specimens reach about the same average length as in other localities. Since the studied material is limited, it is difficult to compare the growth of the Grayling on the whole area of its habit.

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SUMMARY

1. Age and growth of 24 specimens of *Thymallus thymallus* from Upper Vltava river — drainage of Labe river of Czechoslovakia were studied by using the scales.

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

3. The growth data was compared with the data published from other localities as — USSR, Sweden, England, Poland and a few localities of Czechoslovakia.

4. The growth of *Thymallus thymallus* from the Upper Vltava river has found to be normal when compared with the data published from various other localities.

5. Conversion factors for standard, fork and total lengths have been calculated.

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VĚSTNÍK ČESKOSLOVENSKÉ SPOLEČNOSTI ZOOLOGICKÉ
Svazek XXXVIII — Číslo 2 — 1974 — Str. 113—116

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NOTE ON GROWTH OF THE BREAM, ABRAMIS BRAMA (LINNAEUS, 1758) IN THE ORLÍK VALLEY WATER RESERVOIR

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Received February 24, 1973

Abstract: Age and growth was studied by using scales of 121 specimens of *Abramis brama* from the Orlík valley water reservoir of Czechoslovakia. Computation of growth history was made by using Lee's (1920) method. The growth of bream from the Orlík valley water reservoir compared with some selected data published from various localities of Czechoslovakia, show a relatively slow rate of growth compared with the growth in other valley water reservoirs. In comparison with the data summarised by Oliva (1958) and Poupě (1971) the rate of growth is an average one.

INTRODUCTION

The bream — *Abramis brama* (Linnaeus, 1758) (Cyprinidae, Osteichthyes) is one of the most common fish species found in Bohemia, especially in lowland parts of the rivers and valley water reservoirs (riverine lakes) in Czechoslovakia. But still there is lack of information concerning many details of its biology (see Oliva, 1958; Čihař and Oliva, 1960, Skořepa, 1966; Poupě, 1971). Except the data published on growth of the bream from the Slapy and the Lipno valley water reservoirs (see Poupě, 1971) there has appeared no other information about the growth of bream in the Orlík valley water reservoir, which was established in 1964. The maximum area of this reservoir is about 2600 ha (= 10.388 square miles = 6522 acres). It is about 66 km in length and the maximum depth is about 70 m.

A sample of fish consisting of 52 roaches *Rutilus rutilus* (Linnaeus, 1758), several perch *Perca fluviatilis* (Linnaeus, 1758), 6 specimens of pike-perch *Sander lucioperca* (Linnaeus, 1758) and 121 specimens of bream were collected in June 1972 by means of seine net during the commercial fishing organised by „Český svaz rybářů" (Czech Angler's Union) near the castle Zvíkov at the mouth of river Otava into Vltava. The depth of water here was said to be about 20 m. The sample was influenced by the selection of the gear and apparently very small specimens escaped from the net as the size of the meshes was about 25—30 mm., but why the larger ones were lacking is without any explanation to us.

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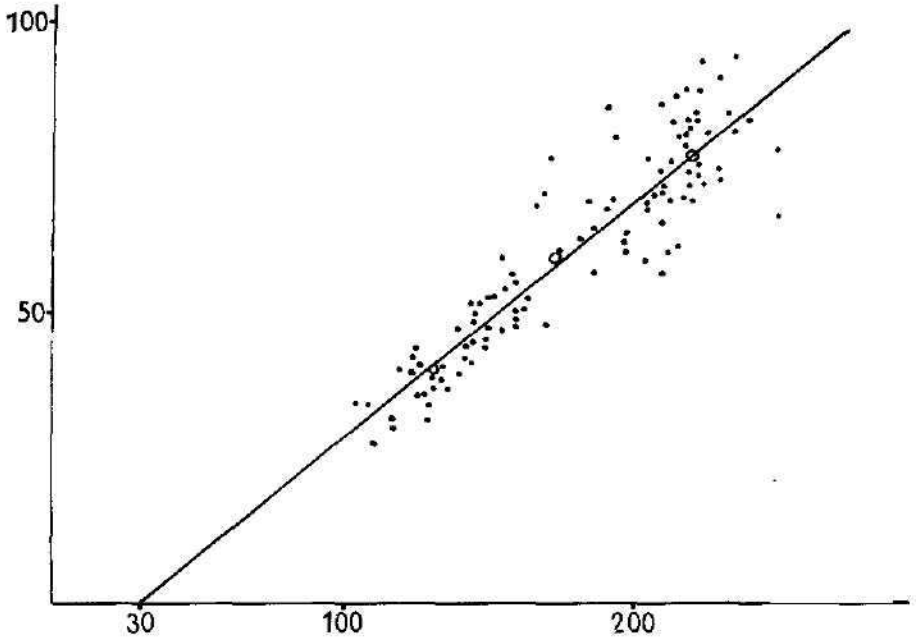
METHODS

The age in breams was determined by the common method using "representative scales" (5—7 scales) extirpated below the lateral line scales, from the first row, obliquely above the insertion of ventral fin. For more details I refer to the paper published by Oliva (1958). All the scales were examined in dry mountings using a microprojector (Carl Zeiss, Jena) with ×17.5 magnification. The ventral diagonal radius and the distance from centre to the different annuli of the scale were measured. The number of annuli on the scale were used to determine the age of the fish. In most cases the annuli were very well visible and the author did not find any special difficulty in detecting them. The body length at the time of scale formation was determined graphically and the intercept was found to be 30 mm. (Graph 1). With the use of this intercept all the back calculations were performed.



Graph 1. Body length and ventral diagonal radius relationship. X — body length in mm, Y — ventral diagonal radius in mm (magnified 17.5 times).

RESULTS

The results are given in Table 1. It shows that the annual increments are greater during the first three years than the remaining last two years, but in general the increments are more or less similar.

DISCUSSION

Discussion could be made concerning the suitability of the correction value (intercept) of 30 mm which I have used for back calculation of body lengths. Segerstrale (1932) ascertained the formation of scales when the body length reached 16—18 mm and total length 20—22 mm. Oliva (1958) found an intercept 21 mm for the bream population from back-water "Poltruba" which he believed to coincide with the begin of scale formation, but when he mixed various Czech populations of bream (Oliva, 1958,

Table 1. Growth of different age classes of *Abramis brama*

Age class	Year of hatching	No. of specimens	Body length at the time of capture in mm. ranges	averages	Back calculated body length in mm. l_1	l_2	l_3	l_4	l_5	l_6
III	1972	54	105–164	138	56	91	126	—	—	—
IV	1971	5	167–175	171	55	94	130	168	—	—
V	1970	11	182–198	193	58	93	124	156	182	—
VI	1969	51	205–250	220	60	95	127	160	192	212
Total No. of specimens — 121.			Average		57 (50)	93 (88)	127 (123)	161 (156)	187 (183)	212 (208)
			Annual increments		36 (38)	34 (35)	34 (33)	26 (27)	25 (25)	
			Maximum		60 (52)	95 (89)	130 (129)	168 (162)	192 (184)	—
			Minimum		55 (48)	91 (87)	124 (119)	156 (153)	182 (181)	

The values in brackets represent the back calculated lengths using 21 mm of intercept.

fig. 2, 173) he found one more value of intercept, i.e. 12 mm. He showed that there are no too big differences when used different intercepts obtained by him for back calculation (Oliva, 1958; tables 14 and 15). Čihař and Oliva (1960) worked with the intercept 21 mm, which seems to be closer to Segerstrale's (1932) value. However, Skořepa (1966) used the correction value (intercept) 39 mm for the population of the bream of the backwater "Poltruba", where Oliva (1958) used the correction value of 21 mm. Skořepa (l. c.) supposed that the relatively high value was caused by the lack of specimens smaller than 70 mm of body length in his sample. In another case Skořepa has also used the smaller value of 21 mm, following the value given by Čihař and Oliva (1960). To avoid any misunderstanding I have used both the value i.e. 30 mm and 21 mm to show the differences. The growth

Table 2. Comparative study of growth of *Abramis brama* in different localities.

Author	Locality	No. of specimens	l_1	l_2	l_3	l_4	l_5	l_6	l_7	l_8	l_9	l_{10}	l_{11}
Author	Orlík valley water reserv.	121	57	93	127	161	187	212	—	—	—	—	—
Oliva (1958)	Poltruba pool	352	55	77	115	153	181	213	269	335	—	—	—
Oliva (1958)	Vltava river, Praha	32	62	102	146	165	217	250	—	—	—	—	—
Poupě (1964)	Lipno reservoir	176	85	133	174	210	235	—	—	—	—	—	—
Poupě (1964)	Slapy reservoir	303	85	135	179	219	249	284	320	370	406	425	445
Poupě (1964)	Slapy res. lower part	246	87	118	182	225	252	288	310	338	—	—	—
Poupě (1970)	Lipno reservoir	403	76	112	152	186	210	233	264	322	331	346	357

of bream from the Orlík valley water reservoir is relatively slower when compared with the growth from other valley water reservoirs of Czechoslovakia, but when compared with the data summarised by Oliva (1958) and Poupě (1971) the rate of growth is an average one.

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SUMMARY

1. Age and growth of 121 specimens of *Abramis brama* from Orlík valley water reservoir of Czechoslovakia were studied using scales.
2. The relationship between body length of fish and ventral diagonal radius was found to be linear. The intercept found was 30 mm. For comparison, the smaller intercept, 21 mm, which seems to be more closer to the actual length at the time of scale formation was also used and the results obtained by using both the intercepts were compared (Table 1).
3. The growth rate of *Abramis brama* from Orlík valley water reservoir was found to be slower one when compared with the data published from various valley water reservoirs of Czechoslovakia, but an average one when compared with other European localities.

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NOTE ON SYSTEMATICS OF THE STONE-LOACH, NOEMACHEILUS BARBATULUS (LINNAEUS, 1758) (OSTEICHTHYES : COBITIDAE)

Dedicated to the 75th birthday of Hermann Meinken

Ota OLIVA and Karthigesu CHITRAVADIVELU

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Abstract: The morphometric description of 52 specimens of the stone-loach, *Noemacheilus barbatulus* (Linnaeus, 1758), from Poland, drainage of the upper Vistula, is given. Authors have also revised the characters of sexual dimorphism and summarised the data of systematic position of the stone-loach, supporting the concept of systematics given by Berg (1949).

INTRODUCTION

In the contradiction to the fact that the stone loach, *Noemacheilus barbatulus* (Linnaeus, 1758), is a very frequently occuring species on the broad territory ranging from England (excluding northern Scotland) up to the river Kolyma in Siberia and northern China (here there are distinct subspecies) (Berg, 1949), we have no precise knowledge concerning the systematic position of European populations. The important papers of Smyly (1955) and Libosvárský (1957) are devoted mainly to the biology of stone-loach. For the purpose of our study we have chosen a sample of stone-loaches from the river Raba (in the town Dobczyce) in southern Poland. The river Raba is the affluent of the Vistula drainage (the Baltic Sea drainage). We have compared our data with the previous data published by Berg (1949), Vladykov (1931), Dorko (1952), Balon and Frank (1953) and Libosvárský (1957). We have also taken into account the previous papers of Vladykov (1928, 1931), Štědronský (1939), Oliva (1952) and Radaš (1964) regarding the sex dimorphism and the papers of Berg (1949), Dybowski (1869), Vladykov (1928) and Nichols (1925, 1943) regarding the systematic position of the typical stone-loach and its subspecies.

MATERIAL AND METHOD

The fish were measured using a divider with ± 0.5 mm accuracy by the common method used on taxonomy of fishes (see Vladykov, 1931; Berg, 1948, 1949). All the specimens (52 in number) were collected by the senior author (Oliva) during August, 1969, in the mill race originating from the river Raba in the town Dobczyce, about 15 km southeast (by direct line) from Kraków in southern Poland. The river Raba is the right side tributary of the upper part

Table 1. Morphometric characters of *Noemacheilus barbatulus*

Authority	Authors					
Sex	Males		Females		Males & Females	
Number of specimens	26		26		52	
	Ranges	Ave.	Ranges	Ave.	Ranges	Ave.
Total length in mm.	64.0—80.0	73.0	43.0—101.0	71.0	43.0—101	71.5
Standard length in mm.	54.0—66.0	60.7	36.0—85.0	59.0	36.0—85.0	59.4
In % of total length:						
head length	17.3—18.9	18.3	17.7—20.0	18.8	17.3—20.0	18.7
body depth	10.2—13.4	11.8	10.3—14.0	11.6	10.2—14.0	11.7
caudal peduncle length	13.9—17.6	15.5	13.3—16.7	15.4	13.3—17.6	15.4
length of P	13.0—15.7	14.4	12.7—16.0	14.2	12.0—16.0	14.3
In % of standard length						
head length	21.0—22.9	22.0	21.2—23.8	22.6	21.0—23.8	22.5
body depth	12.0—16.1	14.2	12.7—16.5	13.9	12.0—16.5	14.0
caudal peduncle length	16.7—21.0	18.5	16.5—20.2	18.6	16.5—21.0	18.8
length of P	15.6—19.0	17.2	15.2—18.9	17.2	15.2—19.0	17.2
lengt of V	12.0—15.3	14.3	12.9—15.7	14.1	12.0—15.7	14.2
In % head length:						
head depth	46.5—54.0	51.8	46.0—60.0	52.2	46.0—60.0	52.0
preorbital length	42.3—50.0	45.4	38.4—46.5	43.2	38.4—50.0	43.7
eye diameter	16.7—20.0	18.5	15.0—20.8	18.1	15.0—20.8	18.2
maxillary length	25.0—30.8	29.0	24.0—33.3	28.9	24.0—33.3	28.9
interorbital width	28.6—34.6	31.2	25.6—37.5	31.0	25.6—37.5	31.1
In % of P—V distance						
length of P	47.5—61.2	53.9	43.3—60.5	53.3	43.3—61.2	53.4
In % of V—A distance						
length of V	50.0—76.0	62.8	55.0—72.6	61.3	50.0—76.0	61.6
In % of caudal peduncle length:						
depth of caudal peduncle	46.1—62.2	53.7	43.5—62.2	53.1	43.5—64.2	53.2

of the river Vistula, which belongs to the Baltic Sea drainage. The river is about 129 km long and its whole drainage covers area of 1527 sq km. The spring of the river Raba is about 780 m above the sea level on the west side of the hill Obidowa (Górce). The ranges of the water level are high up to 9 m, and overflow is very frequently observed, especially in the summer. All collected material was deposited in the Laboratory of Ichthyology, Department of Systematic Zoology, Charles University in Prague.

RESULTS

From our investigations it is clear that the males as well as females in the sample have almost the same average length. The females have slightly bigger head, but smaller preorbital distance, smaller length of ventral fin calculated in % of V—A distance. It is interesting that the length of P in % of standard length is absolutely the same in both the sexes (see Table 1) and almost the same concerns the length of V.

Concerning the meristic characters, they are also stable. In the males the rays of D are III (IV) 7, in females D III (IV) 7. Only 8.3 % of males had 4 hard rays, the same had 12.5 % of females in the investigated sample. In males the anal fin is composed of III (IV) hard and 5 soft (ramified) rays; 8.3 % males had 4 hard rays, but an almost twice larger number (15.6 %) of females showed the same characters, 4 hard rays in A.

Vladykov (1931) M & F 202 Ranges	Oliva (1952) Males 20 Ranges	Ave.	Females 20 Ranges	Ave.	Balon-Frank (1952) Males & Females 18 Ranges	Ave.
	67.0—109	87.1	81.0—121	98.7	62.0—120	87.3
81.0—104	—	—	—	—	52.0—104	74.8
21.0—23.0	17.0—21	19.3	18.0—21.0	19.5	—	—
11.0—15.0	12.0—14	12.7	12.0—15.0	13.5	—	—
11.0—18.0	14.0—18.0	17.5	14.0—17.0	15.3	—	—
—	15.0—20.0	16.6	12.0—15.0	13.3	—	—
23.0—25.0	—	—	—	—	22.0—25.0	22.9
13.0—19.0	—	—	—	—	11.0—15.0	13.2
14.0—22.0	—	—	—	—	13.0—24.0	17.8
—	—	—	—	—	—	—
—	—	—	—	—	—	—
—	46.0—55.0	53.3	48.0—58.0	54.3	—	—
46.0—56.0	41.0—50.0	44.9	44.0—51.0	46.6	42.0—57.0	46.2
—	9.0—15.0	11.3	7.0—12.0	10.4	7.0—11.0	8.9
—	—	—	—	—	—	—
—	22.0—23.0	22.5	24.0—29.0	25.4	21.0—30.0	23.4
—	56.0—67.0	59.9	53.0—54.0	48.4	51.0—64.0	53.0
—	59.0—71.0	66.1	56.0—65.0	61.9	50.0—79.0	63.5
—	50.0—65.0	58.6	53.0—64.0	60.5	—	—

SEXUAL DIMORPHISM

Sex differences in stone-loach were sufficiently studied by many authors (Bacescu-Mester, 1967; Dorko, 1964; Libosvárský, 1957; Oliva, 1952; Radaš, 1964; Smyly, 1955; Štědronský, 1939 and Vladykov, 1928, 1931, 1935) and therefore any additional remarks are unnecessary. It should be only noted that the sexual dimorphism as shown in proportions of paired fins in our Polish material was not so evident as in the data of other authors (Tables 1 and 2).

DISCUSSION

The average size of males is larger in our Raba sample, and Ondava sample of Dorko (1964), but in the sample studied by Oliva (1952) and Radaš (1964) the females are larger in average. Concerning the size of stone-loach, Heinrich (1856) reports 120—150 mm, Frič (1859) only 77—102 mm, maximally 128 mm. Vladykov (1926) gave the ranges of 100—150 mm, Dyk (1925) found specimens up to 147 mm of length and 24 g in weight in the river Moravice. Berg (1949) gave the same range as Vladykov (1926), near Moscow specimens more than 150 mm long were occassionally found, in Finland up to 180 mm. In our material the largest specimens (121 mm, 120 mm resp.) of total length were found by Oliva (1952) and Balon-Frank (1952). The largest specimen recently found (dead) in Fin-

Table 2. Morphometric characters of *Noemacheilus barbatulus*

Authority	Radaš (1964)				Banarescu (1964)
Locality	Pond Nový				Romania
Sex	Males		Females		Males & Females
Number of Specimens	100		100		25
	Ranges	Ave.	Ranges	Ave.	Ranges
Total length in mm.	—	—	—	—	50.5—95.0
Standard length in mm.	50—101	72.7	50—101	74.8	43—80
In % of total length					
head length	—	—	—	—	—
body depth	—	—	—	—	—
length of P	—	—	—	—	—
In % of standard length:					
head length	21—28	22.9	20—27	23.1	21.0—25.3
body depth	11—18	15.0	14—18	16.0	12.2—17.3
caudal peduncle length	14—19	17.2	14—19	17.0	17.5—22.5
length of P	16—21	18.4	13—18	14.9	18.3—20.8
length of V	11—17	13.7	11—15	13.2	12.8—16.5
In % of head length:					
head depth	—	—	—	—	—
preorbital distance	41—52	46.7	37—52	46.6	—
eye diameter	8—13	10.4	8—14	10.3	12.1—17.0
interorbital width	24—33	29.6	26—36	29.4	—
In % of caudal peduncle:					
depth of caudal peduncle	53—71	62.8	55—81	63.6	—
In % of P—V distance:					
length of P	52—71	61.5	36—59	49.47	—
In % of V—A distance:					
length of V	53—68	58.9	55—66	58.7	—

land was measured by Sauvonsaari (1971) and collected on the shore of Hietamankoski rapid in Äänekoski on October 28, 1964. Its total length was 166 mm and its age was determined to be 6 years. Largest head length was found in French specimens from the river Le Lez (Babescu-Mester, 1967), smallest in Polish specimens examined by the present authors.

These specimens were described as the subspecies *Noemacheilus barbatulus quignardi* (Bacescu-Mester, 1967). The smallest body depth was found in Silesian specimens examined by Balon and Frank (1952), the largest in specimens from North England and southern France (Bacescu-Mester, 1957). The shortest caudal peduncle appeared in *N. barbatulus quignardi*, while the longest in the Polish specimens studied by us. The longest pectoral was found in specimens from Southern England and Spain, the shortest in the females from Radaš material (1964, pond Nový, Bohemia). The longest ventral can be found in the specimens from Spain and Southern England. The largest head depth had the specimens from Le Lez river and from Southern England, the smallest the males from our Polish material. The longest snout (preorbital distance) was measured in loaches from Spain and northern England, the smallest in females of Polish population examined by us. The smallest eyes were found in the specimens from Morávka, the apparently largest ones in the specimens from Poland. The interorbital width was the largest in the Polish material studied by us, than in the specimens from Southern England, the smallest was found in males examined by Oliva (1952). The specimens of Radaš (1964) have the deepest caudal pe-

Dorko (1964)					Bacescu-Mester (1967)							Dybowski (1869)
	Ondava		Žukov (1966) White Russia Males & Females		Le Lez France Males & Females	Saint Andre Males & Females	Spain Males & Females	Jugoslavia Males & Females	North England Males & Females	South England Males & Females	Romania Males & Females	Buldurga Males & Females
Males	Females & males	Females	25		17	15	11	13	10	10	7	2
140 Ave.	140 Ave.	280 Ave.	Ranges	Ave.	Ave.	Ave.	Ave.	Ave.	Ave.	Ave.	Ave.	Ranges
—	—	—	—	—	—	—	—	—	—	—	—	203—210
74.12	71.82	72.9	38—75	58.5	—	—	—	—	—	—	—	175—184
—	—	—	—	—	—	—	—	—	—	—	—	18.1—17.5
—	—	—	—	—	—	—	—	—	—	—	—	12.4—14.7
—	—	—	—	—	—	—	—	—	—	—	—	14.8—13.3
22.5	28.0	22.7	23—27	24.5	24.9	23.9	22.4	23.7	23.4	24.6	21.9	21—20
15.1	15.3	15.2	13—17	15.4	18.1	16.0	16.6	14.4	18.6	17.7	13.4	14.3—15.7
16.7	18.5	17.6	14—21	17.1	13.2	15.2	15.8	15.6	14.2	15.1	17.4	—
17.9	17.2	17.6	15—20	17.5	20.5	18.9	20.9	19.1	19.6	21.0	17.9	18.1—15.2
14.4	14.3	14.4	14—17	14.8	15.5	14.9	15.4	15.3	15.2	15.6	15.1	13.1—12.5
54.0	54.0	54.0	—	—	56.9	56.0	54.5	52.1	54.5	56.7	51.1	46.9—48.5
44.9	49.7	47.3	36—54	44.7	47.0	46.2	49.1	43.2	48.4	48.1	46.4	47.5—44.5
17.0	16.7	16.9	7.7—20	14.0	19.3	16.2	20.4	17.3	18.7	20.6	18.9	12.1—13.5
28.4	25.3	29.8	—	—	30.0	30.7	29.9	29.7	25.9	30.8	28.8	—
59.5	52.9	56.0	—	—	—	—	—	—	—	—	—	—
60.0	56.6	58.3	—	—	—	—	—	—	—	—	—	—
63.7	62.4	63.4	—	—	—	—	—	—	—	—	—	—

duncle, while the smallest one the males of the Ondava river (Dorko, 1964). The chief difference between *Noemacheilus barbatulus* typ. and subspecies *toni* (Dybowski) is, according to Berg (1943), is the depth of body (in nominate subspecies the depth of the body in its length without caudal fin = = 12.5—20.0 %, in subspecies *toni* = 11.5—15.4 %). In subspecies *toni* the anterior part of the body is nude or the scallation here is not fully developed. Length of P in P—V distance should be 40—50 % in typical form, but 41.5—55.5 % in subspecies *toni* (Berg, 1949). According to Berg (1. c.), on the western slope of the Oural mountains specimens of stoneloach can be found which can be classified as subspecies *toni*. In 84 specimens from the river Kama near Perm (Molotov) the maximum body depth in body length (without C) was found to be 11.5—20.5 %; the minimum body depth in caudal peduncle length was 40.0—59.0 %. Berg (1949) also points out that subspecies *toni* shows many varieties which can be hardly confined to certain geographical areas in recent time. The description of Dybowski (1869, p. 957) is unsufficient. Here the only interesting note is that in males pectorals are 16.7 % of total length (table of plastic and meristic characters

Table 3. Ranges and averages of meristic characters of *Noemacheilus barbatulus*, and allied forms (in brackets average values).

Authority	Locality	No. of specimens	branched dorsal rays	No. of specimens	branched anal rays	No. of specimens	branched pectoral rays	No. of specimens	branched ventral rays	No. of specimens	caudal rays
Authors	Vistula drainage	52	7—8 (7.0)	52	5 (5)	—	—	—	—	—	—
Vladykov (1931)	Tisza drainage	8	7 (7)	5	5 (5)	—	10—12	—	6—7	8	16—18 (17.5)
Libosvárský (1957)	Labe drainage	31	7 (7)	31	5 (5)	31	10—12 (11.2)	31	6—7 (6.0)	31	17—19 (18)
dtto	Danube drainage	31	7 (7)	31	—	31	9—12 (10.9)	31	5.7 (6.1)	31	14—19 (17.3)
Russov (1921)	Dniestr drainage	19	7 (7)	19	5—6 (5.0)	19	10—12 (10.3)	19	6—7	19	17—18
Oliva (1952)	Labe + Odra drainage	40	7 (7)	40	4—6 (5.0)	30	10—13 (11.1)	30	5—7 (5.7)	—	—
Bacescu-Mester (1967)	Danube drainage	42	7—8	42	5—6	42	10—11	42	5—6	42	14—16
	Mediterranean	17	7—8	17	5—6	17	10—12	17	5—6	17	15—16
dtto	Saint Andre	15	8	15	6	15	9—11	15	6—7	15	16
dtto	Spain	11	8—9	11	6	11	10	11	5—6	11	15—16
dtto	Northern England	10	8—10	10	6	10	10—11	10	6—7	10	14—17
dtto	Southern England	10	8	10	6	10	9—12	10	5—6	10	14—16
dtto	Yugoslavia	13	8	13	6	13	9—10	13	6	13	16—17
Balon-Frank (1962)	Siberia, Odra	18	7	18	4—5	18	10—12	18	6—7	—	—
Oliva-Frank (1953)	Siberia, Odra	80	7	80	5—6 (5)	—	—	—	—	—	—
Radaš (1964)	Bohemia	200	6—7 (6.7)	200	4—6 (5.5)	200	9—13 (10.7)	200	5—7 (6.4)	—	18+19
Dorko (1964)	Tisza drainage	100	7	100	5	—	—	—	—	—	—
Dybowski (1869)	Buldurga	2	7	2	5	2	6	2	10	2	16

of 2 specimens is added). Terra typica are the rivers Onon and Ingoda in the Transbaikal region of Siberia. As it can be seen from our tables, the body depth in all material examined by us and by the other authors does not reach 20 % of body length without C, the length of P in the distance of P—V exceeds the values for both subspecies given by Berg (1949). The lengths of pectorals and ventrals cannot be used as good distinctive characters for recognition of subspecies, because they represent one of the characters of sex dimorphism. In the males, paired fins are considerably longer than in the females and therefore the ratio of both the sexes in the sample has the influence upon the ranges the average values of P and V respectively. This was known to Vladykov (1928), who rightly criticised Berg (1923). The specimens measured by Dybowski (1869) from the Buldruga in Siberia can be considered as types which have no apparently prolonged body as could be supposed from Berg's (1949) diagnosis. There are only few more remarkable differences in comparison with the specimens from Le Lez (France) and northern England (Bacescu-Mester, 1967). The distribution of scales on the anterior part of the body was not studied by us. Bacescu-Mester (1967) studied of scales the shape (Fig. 4, p. 367 l. c.) and the density of scales on 1 sq. cm. There are considerable differences here, from 545—1200 scales per 1 sq. cm. in Southern England specimens up to 1322—1527 per 1 sq. cm. in the Le Lez river specimens. Unfortunately no data concerning the place of body at which scales were counted are given. The shape of the scales, number of the circuli (striae) and radial canals depend on the size and age of the fish revised, and according to us they are not usable, as it is very well known to anybody who deals with the age determination in fish.

As it is evident from Table 3, meristic characters were studied in all the 597 specimens; 390 specimens of these were examined by the senior author and his collaborators. It is evident, with the exception of the French, Spanish, English and Yugoslav material of stone-loach, that the predominating number of soft (ramified) dorsal rays is 7. It seems to us that high number of dorsal rays, 8—9, up to 10, in this material, examined by Bacescu-Mester (1967), is an error due to counting the last ramified ray in dorsal fin as two rays. The higher number of anal rays (6 instead of 5 predominating in all authors) could be explained in the same way. For the same evident and obvious error Oliva—Chitravadivelu (1972) criticised Starmach and Rosól (1961). Berg (1949) also reports only 7 ramified rays in caudal fin, as well as Dybowski (1869) in his original description of subspecies *toni*. Recently, on a very rich material of stone-loach from the rivulet Ondava and tributaries in eastern Slovakia, Dorko (1964) confirmed the absolute stability of number of soft rays in dorsal (always 7) and anal (always 5) fin. According to Berg's (1949) concept of interspecific classification within the species *barbatulus*, four subspecies (*toni* Dybowski, *caucasicus* Berg, *vardarensis* Karaman, *sturanyi* Steindachner) are recognised. Newly, Vuković and Ivanović (1971) repeated without any remark unsufficient Karaman's descriptions (1924, 1929), although Tortonese (1970) made a right remark on obscurities in the systematics of European stone-loach. A critical review of the classification of Chinese forms of "*Barbatula toni*" sensu Nichols (1925, 1943) is uneasy because Nichols (l. c.] had at his disposal very little material from every form and his description is generally based on a single specimen only. The difference between subspecies *toni*

and nominate form of stone-loach permit to recognise maximally the subspecific rank, which was made already by Berg (1916) and repeated again by the same author (1923, 1932—33, 1949). Therefore there is no reason to separate subspecies *toni* into distinct species. A valid subspecies could be "*sturanyi* Steindachner" from Lake Ohrid, regarding the previous geological history of the origin of this lake (see e.g. Komárek, 1940, 1953). But here also the description is based on 1 specimen which had Steindachner (1892) and two other specimens collected by Karaman (1924). It is interesting that the difference between the "typical" (sensu Karaman, 1924) stone loach from the river Vardar drainage and this lake form is in more blunt and elevated snout (Karaman, 1924), this phenomenon occurs in the same way in lake Ohrid gudgeon, *Gobio gobio ohridanus* Karaman, 1924. This subspecies of gudgeon is accepted as a valid one (see Berg, 1933; Oliva, 1950). The description of subspecies *vardarensis* in Karaman (1929) seems to be unsufficient for establishing a separate subspecies. As regards the form described by Bacescu-Mester (1967), it is difficult to say if the differences are of geographical or ecological rank; subspecies *quignardi* could be also represented as the so called "starvation morpha" well known e.g. in the Crucian Carp, *Carassius carassius* (Linnaeus, 1758), occuring in certain type of water as "morpha *humilis*" (see Berg, 1948, 1949). Žukov (1965) reported differences between the "typical" *N. barbatulus* (sensu Berg, 1949) and the population from the river Zapadnaya Dvina (Western Dvina) emptying into the gulf of Riga (the Baltic Sea): the number of vertebrae in Dvina stone-loaches is lower (36—38); according to Berg, typical form has 39—40 vertebrae. Dvina loaches as described by Žukov (l. c.) are more slender with more prolonged pectorals and "with some other marks" differing from the nominal form. It can be summarised that the European stone-loach, *Noemacheilus barbatulus* (Linnaeus, 1758), shows certain variability on its areal of distribution until recently, this variability has been studied with simultaneous regard to both ecological and geological conditions, sometimes on a very limited material (Karaman, 1924; Bacescu-Mester, 1967) and without regard to sexual dimorphism (Berg, 1916, 1923, 1932—33, 1949). Therefore it is very difficult to formulate a definitive conclusion as regards the validity of subspecies described from the whole areal of its distribution, with the possible exception of subspecies *sturanyi* Steindachner from the Lake Ohrid and Transbaikalian population of subpecies *toni* Dybowski.

NOMENCLATURE

Smith (1945) stressed the necessity to use *Noemacheilus* Van Hasselt 1823, p. 133 instead of *Nemachilus* of many authors, which is "corrected" writing of the original generic name. Smith (1945) pointed out that "most authors working with this group of fishes have spelled the name of the genus *Nemachilus* after Günther's (1868, p. 11, 347) amemded spelling, but original spelling by van Hasselt is *Noemacheilus*". Berg (1949, p. 849) remarked that the spelling *Nemachilus* was corrected from *Noemacheilus* by Günther (1868) because the latter was in his concept an "evident error" of Van Hasselt. Generic type is *N. fasciatus* from Sumatra, Java and Borneo. The generic name *Barbatula* Linck (1790, VI, 3, p. 38), with the citation "hierher gehören *Cobitis Barbatula Taenia*" is according to Berg (1933, p. 547) "nomen de-

lendum", Berg (1949, p. 849) gave the author's name of Linck into brackets and according to him the author of the generic name is Jordan, (1917, p. 49) (type *Cobitis barbatula* L.). Nichols (1925, 1943) keeps genus *Barbatula* as a valid one (type species *Cobitis barbatula* Linnaeus, 1758), and "*Cobitis toni* Dybowski" is considered by him as a valid species, *Barbatula toni* (Dybowski). With this concept we do not agree, being of the opinion that the nomenclature and classification as proposed by Berg (1949) is better.

CONCLUSIONS

1. 52 specimens of stone loach, *Noemacheilus barbatulus* (Linnaeus, 1758), from the river Raba, rightside of southern tributary of the upper Vistula in Poland, were morphometrically studied.
2. From the random sample it is clear that both the sexes have almost the same length. There are no differences in the relative length of pectorals and almost no differences in the length of ventrals. This is contrary to most observations concerning the sex dimorphism in stone-loach and can be explained only by the relatively small size of specimens examined.
3. Meristic characters concerning both hard and soft dorsal and anal fin rays show constant stability. This is in coincidence with all known facts, with the exception of some data of Bacescu-Mester (1967). This case is probably a serious error caused by a false concept of counting the rays.
4. There is a certain variability of stone-loach within the areal of its distribution. Authors have observed here mainly the concept of its systematics pusblihed by Berg (1949), as up to the present no regard to the relationship between ecological and geographical conditions is taken in describing various forms.

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TESTACEA (PROTOZOA: RHIZOPODA) OF THE RIVER BOBRAVA IN MORAVIA

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Abstract: In the submitted paper was investigated the fauna of Testacea in the river Bobrava and its tributaries. Differences among the populations of Testacea were investigated in different parts of the transversal section of the stream, i.e. near the bank, in the current, and in the periphyta. It was found out that the main factor influencing the composition of the fauna of Testacea is the character of the bottom substrate. The speed of the current does not affect the species composition of the fauna of Testacea in a direct way. The current is a secondary factor which influences the quality and quantity of depositing material as a suitable environment for the development of the fauna of Testacea.

INTRODUCTION

In recent years more and more attention has been paid to the fauna of streaming waters which, in the hydrobiological practice, serves as an indicator of the cleanness of water and which is an important component in the production conditions, food relations etc.

This is why I have concentrated on the fauna of Testacea living in streaming waters. In the submitted paper I have tried to find out the basic composition of the Testacea fauna of a small type of stream in relation to the substrate. Further ecologic factors were not followed. The influence of pollution has not been included in this paper either, as it did not manifest itself conspicuously; it will require further analysis.

The earliest work on Rhizopoda from the territory of the ČSSR concerns mostly standing waters. A detailed list of our literature, starting from the earliest sources, as well as of the most important literature from abroad, is included in the work by Bartoš (1954).

The first notes on Rhizopoda from the streaming waters on our territory can be found in the work by Frič, Vávra (1903), devoted to the study of the Elbe and its old branches. Some species are given in the work by Kalmus (1928) on the benthos of the Vltava and in Kostomarov et al. (1937) on the pollution of the Upper Vltava. In recent years Štěpánek (1953, 1954) described Rhizopoda from minor streams. In Slovakia Ertl (1954, 1966) studied Rhizopoda of the Danube. Within the framework of hydrobiological and protozoological investigations Rhizopoda were followed in the rivers Hnilec and Hornád (Bílý, Hanuška, Winkler, 1952) and in the river Nitra (Hanuška, 1962, 1971).

Table 1. Physical and chemical data in the stations under investigation of the river Bobrava

Sample No.	Date of taking	Air temperature °C	Water temperature °C	Speed of current m/sec	pH	O_2 mg/l
1	26 Nov. 1970	2.5	7.0	0.2–0.5	6.4	79
2	26 Nov. 1970	3.0	5.5	0.3–0.4	7.0	77
3a	25 Aug. 1970	17.0	13.0	0.5–1.0	7.3	89
3b	25 Aug. 1970	17.0	13.0	0.5–1.0	7.3	89
4a	14 Jul. 1970	29.5	17.5	–	7.3	88
4b	14 Jul. 1970	29.5	17.5	–	7.3	88
5	1 Jun. 1970	13.5	12.5	0.8–1.0	7.5	83
6	14 Jul. 1970	27.0	17.5	–	7.3	91
7	9 Jun. 1969	16.0	12.0	–	7.3	–
8a	18 May 1970	18.0	12.5	0.5–1.0	8.5	99
8b	4 Jul. 1970	15.5	14.0	–	8.0	109
9	9 Jun. 1969	17.5	15.0	–	6.9	–
10	29 Oct. 1970	9.5	7.5	0.5–1.0	8.0	84
11	29 Oct. 1970	12.0	7.5	0.2–0.3	7.5	85
12	30 Jul. 1969	24.5	15.5	–	–	–
13	30 Jul. 1969	23.5	14.5	–	–	–
14a	17 Apr. 1970	16.0	8.5	1.0–1.5	7.3	93
14b	1 Jun. 1970	14.5	10.5	1.0–1.5	6.4	–
15a	17 Apr. 1970	14.5	7.0	1.0–1.5	7.3	89
15b	1 Jun. 1970	16.5	10.0	0.5–0.8	8.5	89
16a	9 Jun. 1969	17.5	15.0	–	7.8	–
16b	18 May 1970	20.0	11.5	0.5–0.8	8.5	104
16c	18 May 1970	16.5	11.5	0.5–0.8	8.5	103
17	9 Jun. 1969	23.0	9.0	–	7.0	–

Most of the foreign authors studying Testacea in water in detail concentrated on various types of standing waters, in which they also dealt with the ecology of this group.

Out of recent papers Golemanski (1968, 1970), Laminger (1971) Moraczewski (1961, 1962, 1966, 1967), Schönborn (1962, 1964, 1965, 1966, 1967), Schönborn, Flössner, Proft (1965) can be mentioned. The conclusions of the investigation in standing waters cannot be applied to the systems of streaming waters.

An interesting work have been published by Chardez (1958). This paper deals with Testacea in semi-standing boggy water.

Out of European authors studying Testacea in streaming waters one can quote the paper by Moraczewski (1964), which follows the seston of the Wkra and the Narew and the paper by Gurvič (1971) on the benthos of the Dniepr.

In 1969–1970 I collected Rhizopoda, and out of these mostly Testacea in the small river Bobrava and in its tributaries, situated in the surroundings of Brno. Altogether I took 92 samples at 17 stations. I found out 85 taxa and saw 12,362 specimens.

In this place I should like to thank Dr. M. Štěpánek, CSc., from the Institute of Hygiene in Prague for checking the determination of the taxa found out and Dr. J. Unar from the Department of Biology of Plants of the Faculty of Science in Brno for the determination of mosses

Table 2. The occurrence of Rhizopoda in the stations under investigation in dependence on the character of the stream

Sample No.	Depth m	Width m	Bottom substrate	Testacea taxa	Testacea indiv.	Amoebina	Heliozoa
1	0.05	0.2	mud	37	410	–	–
2	0.1 – 0.05	0.5	sand	22	58	–	+
3a	0.1 – 0.2	1.5	stones sand	32	148	–	–
3b	0.1 – 0.2	2.0	stones sand	28	124	–	–
4a	0.3	3.0	stones	22	36	+	–
4b	0.25 – 0.3	3.0	stones mud	17	71	+	–
5	0.4 – 0.6	3.0	stones mud	24	485	+	–
6	0.2 – 0.4	3.0	stones	19	85	+	–
7	0.5	5.5	stones	21	91	–	–
8a	0.5 – 1.0	6.0	mud	21	770	+	+
8b	1.0 – 1.5	6.0	stones mud	25	138	+	–
9	0.25 – 0.5	4.0	stones mud	25	225	+	–
10	0.3 – 0.5	4.0	stones sand	28	144	+	–
11	1.0 – 1.5	10.0	mud	33	158	+	–
12	0.1 – 0.2	0.5	stones	28	157	–	+
13	0.1 – 0.2	0.5	mud	33	236	–	–
14a	0.3 – 0.5	3.0	stones	32	286	–	+
14b	0.3 – 0.5	1.5	mud	17	203	+	+
15a	0.3 – 0.4	2.5	stones	25	169	+	+
15b	0.1 – 0.2	1.5	stones	29	351	+	+
16a	0.15	2.5	stones	23	1335	+	–
16b	0.2 – 0.4	2.0	mud	24	4699	+	+
16c	0.3 – 0.4	2.0	mud	20	1679	+	+
17	0.05	0.2	stones	31	304	+	+

METHODS

The mud itself or with periphyta was scraped off by means of a scalpel from the surface of stones. From the other substrates samples were taken with the Rawson sucker (cf. e.g. Hrbáček et al. 1962) or within a special pipette. A part of the samples were fixed on the spot by 4 % formalin, the other part was brought fresh to the laboratory where it was kept in a refrigerator (t 8 °C) before it could be processed. The individuals were counted in the Sadwick-Rafter cell (volume 1 ml) twice: for the first time alive and for the second time after fixing by 4 % formalin. In some of the first samples (6) the quantitative analysis of the living material was carried out according to Štěpánek (1956) on the area of 10 cover glasses. Quantitative data compared in the paper were always obtained by the same method.

When taking the samples some other data were found out, such as pH, O_2, water temperature, air temperature, the width of the stream, and the speed of the current (by means of a float). These data are summarised in Tab. 1, 2. The chemism of water was not followed in detail. Further the charakter of the bottom was noted and the plant cover on the banks and in the immediate proximity of the stream.

I stated the values of dominance by the Schönborn (1962) method using the following formula:

$$D = \frac{\text{abundance of a certain species}}{\text{abundance of all species}} \times 100$$

Dominance of taxa with the abundance lower than 15 specimens in all samples was not stated.

DESCRIPTION OF THE INVESTIGATED TERRITORY AND THE CHOICE OF STATIONS

The river Bobrava has its spring in the woods of Domášov near the village Rudka at the height of 470 m above sea level. It flows through a hilly terrain and near the village Popovice it merges as a right bank tributary into the

river Svratka at the height of 188 m above sea level. The length of the stream is 36 km. It takes altogether 8 major and several minor tributaries. The right bank tributaries of the Bobrava are the brooks Bílá Voda, Habřinka, Tetčický and Brahovický potok and near Želešice the brook Hajanský potok. The left bank tributaries are the Ostrovačický, Omický, and Troubský potok. The catchment area is about 187 sqkm. One quarter to one third of the catchment area is covered with woods (Brücknerová, 1967; Sukop, 1970).

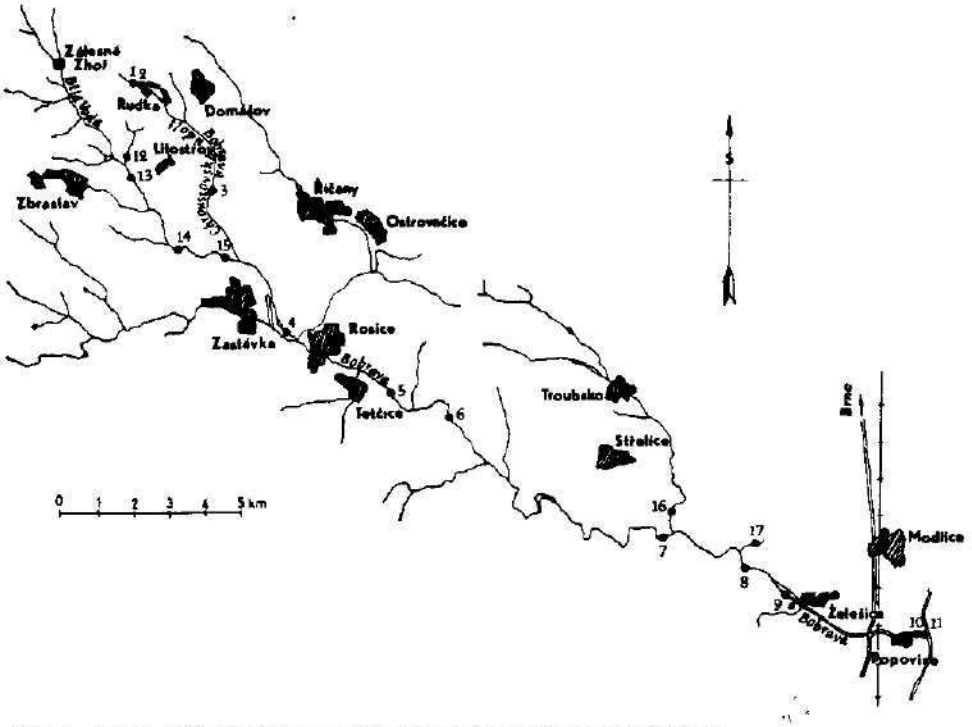

Fig. 1. A map of the Bobrava and its tributaries with marked stations.

The Bobrava flows through the following towns and villages: Rosice, Tetčice, Želešice (Fig. 1).

A — The Bobrava

Station No. 1

It is a spring brooklet of the Bobrava above the village Rudka. The right bank of the brooklet is lined with alders and spruce wood reaches up to the left bank. The banks themselves are covered reaches up to the left bank. The banks themselves are covered with moss and fern. In the place of the sample taking the width of the brooklet was 0.2 m, the bottom was muddy, covered with fallen leaves. The samples were taken on Nov. 26, 1970.

Station No. 2

This station lies at the distance of about 10 m from station No. 1 above a small pond at the beginning of the village Rudka. On the right bank there is only a solitary elm-tree, the left bank is covered by a spruce wood. The width of the stream was 0.4 to 0.5 m, the bottom was sandy. Samples were taken on Nov. 26, 1970.

Station No. 3 (3a, 3b)

Lies approximately in the middle of the valley called Chroustovské údolí. Round the stream there is a mixed wood with a rich herb undergrowth. The width of the stream was 1.2 to 2 m, the bottom stony. Samples were taken in 2 places, lying about 800 m from each other, on August 25, 1970.

Station No. 4 (4a, 4b)

is situated near the bridge near the town of Rosice. In a small distance from there upstream are the first houses of the village Zastávka. The banks are covered with shrubs and herbs. The width of the stream was 2.0 to 3.0 m, the bottom was stony. Samples were taken in 2 places: several metres above the bridge and then below the bridge on Jul. 14, 1970.

Station No. 5

lies on the Bobrava below Tetčice near the road to Střelice. The banks are covered with shrubs. The width of the stream is 2 to 3 m, the bottom stony and muddy. Samples were taken on Jun. 1, 1970.

Station No. 6

is situated on the stream in the sector between the railway station Omice and the road to Omice. The Bobrava flows through meadows in that part, the banks are covered with bushes. The width of the stream is 2.5 to 3 m, the bottom is stony. Samples were taken on Jul. 14, 1970.

Station No. 7

lies several metres before the crossroads in the direction of Ořechov-Moravany. The banks are covered with alders. The width of the stream is 5.5 m, the bottom is stony. Samples were taken on Jun. 9, 1969.

Station No. 8 (8a, 8b)

It is situated near the quarry of Želešice. In that part the Bobrava flows through a mixed wood. The width of the stream is 5 to 6 m, the bottom is rocky and muddy. Samples were taken on May 18 and on Jul. 4, 1970.

Station No. 9

Situated at the edge of the village Želešice. The banks are covered with grass and bushes. Samples were taken on Jun. 9, 1969.

Station No. 10

Situated about 200 m away from the mouth of the Bobrava into the Svratka. In that place the Bobrava has a deep river bed with high banks, covered with alders and willows. It flows through fields. The width of the stream is 3 to 4 m, the bottom is covered with fine sand. Samples were taken on Oct. 29, 1970.

Station No. 11

Situated in the mouth of the Bobrava into the Svratka. The banks are steep and muddy, covered with bushes. The bottom is muddy, covered with leaves and twig fragments. The width of the stream is 8 to 10 m. Samples were taken on Oct. 29, 1970.

B — The tributaries of the Bobrava

The Bílá Voda

Station No. 12

It is a meadow muddy brooklet with banks covered with alders, a left tributary of the Bobrava. It flows through meadows situated to the West of the village Litostrov. The width of the stream is 0.3 m. Samples were taken on Jul. 30, 1969.

Station No. 13

Situated about 20 m below the confluence with a small left bank tributary (station No. 12). The right bank rises steeply to the wood, on the left bank there is a meadow. Banks covered with alders. The width of the stream is 0.5 m, the bottom is stony. Samples taken on Jul. 30, 1969

Station No. 14 (14a, 14b)

Situated at the beginning of the Mariánské údolí valley near a gamekeeper's lodge. In that part the brook flows through a meadow. The banks are covered with alders, poplars, and willows. The width of the stream is 1.5 to 2.5 m, the bottom is stony. Samples taken on Apr. 17 and Jun. 1, 1970.

Station No. 15 (15a, 15b)
It is about 600 m away from the influence of the Bílá Voda with the Bobrava. The brook flows through a meadow, the banks are covered with shrubs. The width of the stream is 2 to 3 m, the bottom is stony. Samples were taken on Apr. 17 and on Jun. 1, 1970.

The Troubský potok

Station No. 16 (16a, 16b, 16c)

It is a meandering brook with a stony and clayey bottom, whose right bank is covered with a mixed wood. The width of the stream is 1.5 to 2 m. Three samples were taken at this station: 16a — on Jun. 9, 1969, and another two — 16b and 16c — on May 18, 1970.
The places where samples 16b and 16c were taken are situated several metres from each other.

The brooklet under the Kozí hora

Station No. 17

It is a small wood brooklet, emptying into the Bobrava from the left. The width of the stream is 0.2 m. The bottom is stony with moss covers. Samples taken on Jun. 9, 1969.

QUALITATIVE COMPOSITION OF THE MATERIAL

In the following list on the taxa found out I used the systematic division as given by Saedeleer (1934).

The abbreviations used denote: L = length of the test, L min.—max., $L\bar{x}$. D = diameter of the test, D min.—max., $D\bar{x}$. A = aperture (pseudostom). B = breadth of the test. N = total number of individuals, found out in all samples. + new taxa for the ČSSR. The dimensions of tests are expressed in μm.

Fam. Cochliopodiidae De Saedeleer, 1934
Cochliopodium bilimbosum Auerbach, 1856
D: 34—69, 46. N: 76.

Fam. Microcoryciidae De Saedeleer, 1934
Microchlamys patella Claparède et Lachmann, 1859
D: 41—62, 54. N: 58.

Fam. Arcellidae Ehrenberg, 1830
Arcella arenaria Greeff, 1866
D: 103. N: 1.
Arcella discoides var. *scutelliformis* Playfair, 1918
D: 62—83, 70. N: 27.
Arcella hemisphaerica Perty, 1852
D: 62. N: 1.
Arcella rotundata var. *aplanata* Deflandre, 1928
D: 48—57, 55. N: 5.
Pyxidicula operculata Agardh, 1827.
D: 34. N: 1

Fam. Centropyxidae Deflandre, 1953
Centropyxis aculeata var. *aculeata* Stein, 1857
D: 83—159, 96. N: 162.
Centropyxis aculeata var. *grandis* Deflandre, 1929
D: 163, 172. N: 2.
Centropyxis aculeata var. *oblonga* Deflandre, 1929
L: 83—145, 103. N: 152.
Centropyxis aerophila var. *sphagnicola* Deflandre, 1929
D: 48—76, 64. N: 384.
Centropyxis cassis Wallich, 1864
L: 55—90, 68. N: 92.
Centropyxis constricta Ehrenberg, 1838
L: 110—193, 133. N: 18.
Centropyxis delicatula Pénard, 1902
D: 76. N: 1.
Centropyxis discoides Pénard, 1902
D: 124. N: 1.

Centropyxis ecornis Ehrenberg, 1838
D: 131, 207. N: 2.
Centropyxis gibba var. *inermis* Bartoš, 1940
D: 69, 83. N: 2.
Centropyxis laevigata Pénard, 1902
D: 83, 90. N: 2.
Centropyxis minuta Deflandre, 1929
D: 48–79, 64. N: 43.
Centropyxis orbicularis Deflandre, 1929
D: 83–138, 87. N: 24.
Centropyxis patula Štěpánek, 1967
L: 55. N: 1.
Centropyxis platystoma Pénard, 1902
L: 48–110, 69. N: 127.
Centropyxis spinosa Cash, 1909
L: 124–145. N: 4.
Centropyxis sylvatica (Deflandre) Thomas, 1955
L: 55–83, 62. N: 163.
Cyclopyxis arcelloides Pénard, 1902
D: 110. N: 3.
Cyclopyxis kahli Deflandre, 1929
D: 69–103, 97. N: 83.
Cyclopyxis sp.$_1$
D: 34–48, 39. A: 21. N: 33.
Cyclopyxis sp.$_2$
L: 55. B: 48. A: 21. N: 2.
\+ *Plagiopyxis declivis* var. *oblonga* Bonnet et Thomas, 1955
L: 90–97. N: 5.
Plagiopyxis labiata Pénard, 1910
D: 83–103, 90. N: 5.
\+ *Plagiopyxis minuta* Bonnet, 1959
D: 48–62, 54. N: 4.
\+ *Plagiopyxis penardi* var. *oblonga* Bonnet, 1959
L: 69–83, 77. N: 11.

Fam. Difflugiidae Awerintzew, 1906
Difflugia avellana Pénard, 1885
L: 90–145 (255), 108. N: 7.
Difflugia brychtai Štěpánek, 1967
L: 117, B: 69, A: 34. N: 1.
Difflugia capreolata Pénard, 1902
L: 86–93, 88. N: 4.
\+ *Difflugia compressa* (Leidy) Gauthier-Lièvre et Thomas, 1958
L: 76, 90. N: 3.
\+ *Difflugia curvicaulis* var. *inflata* Decloitre, 1951
L: 145, B: 90, A: 34. N: 1.
Difflugia difficilis Thomas, 1954
L: 83–110, 99. N: 73.
Difflugia fallax Pénard, 1890
L: 48–83, 64. N: 207.
Difflugia glans Pénard, 1902
L: 83–103, 92. N: 6.
Difflugia globularis (Wallich) Leidy, 1877
L: 97–145 (207), 114. N: 10.
Difflugia gramen Pénard, 1902
L: 62–90, 70. N: 197.
\+ *Difflugia lanceolata* Pénard, 1890
L: 117–159, 126. N: 8.
Difflugia lithophila (Pénard) Gauthier-Lièvre et Thomas, 1958
L: 76–110, 91. N: 138.
Difflugia lucida Pénard, 1890
L: 48–83, 66. N: 4.
Difflugia mammilaris Pénard, 1893
L:138. N: 2.

Difflugia mammilaris Pénard, 1893 f.
L: 124—145, 138. N: 6.
\+ *Difflugia minuta* var. *grandis* Gauthier-Lièvre et **Thomas, 1958**
L: 90. N: 1.
Difflugia oblonga var. *oblonga* Ehrenberg, 1838
L: 97—241, 149. N: 88.
Difflugia oblonga var. *acuminata* Ehrenberg, 1838
L:131. N: 1.
Difflugia oblonga var. *brevicolla* Cash, 1909
L: 110, 179. N: 3.
Difflugia oblonga var. *bryophila* Pénard, 1902
L: 69—90, 83. N: 62.
\+ *Difflugia oblonga* var. *elongata* Oye, 1953
L: 186, B: 62, A: 34. N: 1.
Difflugia penardi Hopkinson, 1909
L: 48—76, 60. N: 111.
Difflugia sp.1
L: 90, B: 48, A: 28, N: 1.
Difflugia sp.2
L: 110, B: 55. A: 28, N: 1.
Difflugia sp.3
L: 69, B. 44, A: 28.N: 1.
*Difflugia sp.*4
L: 55, B: 34, A: 28. N: 1.
Difflugia sp.5
L: 90, B· 41, A: 21 N: 1.

Fam. Nebelidae Taránek, 1882
Heleopera petricola Leidy, 1879
L: 76—131, 95. N: 8.
Heleopera petricola var. *amethystea* **Pénard, 1902**
L: 103, 110. N: 2.
Heleopera rosea Pénard, 1890
L: 124. N: 1.
\+ *Hyalosphaenia punctata* Pénard, **1891**
L: 69—93, 76. N: 8.
Nebela collaris Leidy, 1879
L: 117. N: 1.
Nebela dentistoma Pénard, 1890
L: 124. N: 1.
Quadrulella symmetrica (Wallich) Schulze, 1875
L: 83—90. N: 3.

Fam. Phryganellidae Jung, 1942
Phryganella haemisphaerica Pénard, 1902
D: 37—69, 45. N: 23.

Fam. Cryptodifflugidae Rhumbler, 1923
\+ *Cryptodifflugia compressa* Pénard, 1902
L: 34. N: 26.
Difflugiella oviformis (Pénard) Bonnet et **Thomas, 1955**
L: 31. N: 4

Fam. Gromidae Claparède et Lachmann, 1861
Chlamydophrys stercorea Cienkowski, 1876
D: 34—62, 39. N: 711.
Pseudodifflugia globulosa var. *oblonga* var. n.
L: 55—62, 59. N: 79.
Pseudodifflugia gracilis Schlumberger, 1845
L: 28—55, 34. N: 8, 541.
\+ *Pseudodifflugia gracilis* var. *terricola* Bonnet et **Thomas, 1960**
L: 41—55, 46. N: 110.
Pseudodifflugia orchas Štěpánek, 1967
L: 34—41, 35. N: 8.

Fam. Euglyphidae Wailes, 1919
Assulina muscorum Greeff, 1888
L: 34—48, 45. N: 5

Euglypha acanthophora Ehrenberg, 1843
L: 62—90, 77. N: 25.
Euglypha ciliata Ehrenberg, 1843
L: 76. N: 1.
Euglypha laevis Ehrenberg, 1832
L: 34—62, 54. N: 40.
Sphenoderia lenta Schlumberger, 1845
L: 55. N: 1.
Tracheleuglypha dentata (Vejdovský) Deflandre, 1928
L: 34—62, 49. N: 27.
Trinema complanatum Pénard, 1890
L: 52. N: 1.
Trinema enchelys Ehrenberg, 1838
L: 48—90, 59. N: 22.
Trinema lineare Pénard, 1890
L: 34—52,37. N: 58.

Fam. Cyphoderiidae Deflandre, 1953
Cyphoderia ampulla Ehrenberg, 1840
L: 69—186, 118. N: 221.
Campascus minutus Pénard, 1899
L: 48. N: 1.

SYSTEMATIC NOTES ON SOME TAXA FOUND OUT

Difflugia brychtai Štěpánek
The species was described by Štěpánek (1967) from the reservoir of Vranov and now it was found out in the Bobrava. This is the second find of this species.
Difflugia mammilaris Pénard f.
The individuals found by me differ from the typical examples by a more slender test and more pointed bottom of the test. That is why I marked them as a form of the above species.
Difflugia sp.1
The test is cylindrical, chitinous, of yellow colour, sparsely covered with flat xenosomata. Round the circular aperture there is a very short neck.
Difflugia sp.2
The test is elongated, not compressed. The bottom of the test is pointed. The aperture is circular. The cover is formed by large flat xenosomata.
Difflugia sp.3
The test is ovoid, densely covered with xenosomata. The aperture is circular.
Difflugia sp.4
The test is pear-shaped and is densely covered with xenosomata. The aperture is circular.
Difflugia sp.5
The test is elongated, cylindrical, densely covered with xenosomata. The aperture is circular. By its shape it somewhat resembles the species *D. lemani* Blanc, 1892.
Cyclopyxis sp.1
The test is hemispherical, chitinous with isolated xenosomata. The aperture is circular, its periphery is slightly bent into the test.
Cyclopyxis sp.2;
The test is spherical, hyaline sparsely sprinkled with flat xenosomata. The aperture is small, circular.
Centropyxis patula Štěpánek
This species was described by Štěpánek from the Vranov reservoir. Its occurence in my material is its second find.

Pseudodifflugia globulosa var. *oblonga* m. n. v. (Fig. 2)
From typical examples of *P. globulosa* the individuals in my material differed by an elongated test and by bigger dimensions. In the original description Štěpánek (1967) said that the species *P. globulosa* had a test of 28 μm, whereas my specimens were 55 to 62 μm long.

Pseudodifflugia orchas Štěpánek
The species was described first by Štěpánek (1967) from the Vranov reservoir. In my material it was found out for the second time.

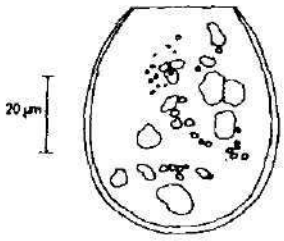

Fig. 2. *Pseudodifflugia globulosa* var. *oblonga* var. n.

ECOLOGICAL NOTES

In this paper I have processed Testacea of a small stream with a comparatively swift current. I have tried to find out whether there are differences resulting from the nature of the substrates (muddy sediment, sandy sediment, among fallen leaves) and differences resulting from the current conditions in the individual biotopes (i.e. whether they lie in the fluviatile or in the torrentile zone).

Schönborn (1969) investigated various tests of Testacea — the structure, the size of the aperture, the shape of the test — as a result of the adaptation to the conditions in individuals biotopes. For marking the structure of the test used the following indices: X-test covered with xenosomata, I-test covered with idiosomata, M-membranous test. This marking is also used in my paper.

As, however, the species *Pseudodifflugia gracilis* occurred in my material in great number and as this species greatly influenced the quantitative composition of the fauna of Testacea, I have introduced another index —Ps.

Thus index X comprises the following genera: *Plagiopyxis, Difflugia, Centropyxis, Cyclopyxis, Heleopera, Phryganella.*

Index I includes the following genera: *Nebela, Quadrulella, Assulina, Euglypha, Tracheleuglypha, Trinema, Campascus.*

Index M includes the genera: *Cochliopodium, Microchlamys, Arcella, Pyxidicula, Hyalosphaenia, Cryptodifflugia, Difflugiella, Cyphoderia.*

By index Ps I understand all species of the genus *Pseudodifflugia.*

At each station I took several samples from various places of the stream, marked as microbiotopes which were divided into three groups according to whether they were situated in the fluviatile or in the torrentile zone or whether there were covers of algae and mosses there.

I. The fluviale zone (bank)

Ia — muddy sediment
Ib — muddy sediment on stones
Ic — muddy sediment on roots, among fragments of branches
Id — muddy sediment among fallen leaves
Ie — fine sand
If — rough sand

II. The torrentile zone (current)

IIa – muddy sediment
IIb – sandy sediment
IIc – sediment on stones
IId – sediment on fallen leaves
IIe – nets of caddies flies

III. Covers

IIIa – *periphyta of the alga Cladophora glomerata*
IIIb – mosses in the torrentile zone
IIIc – mosses in the fluviatile zone

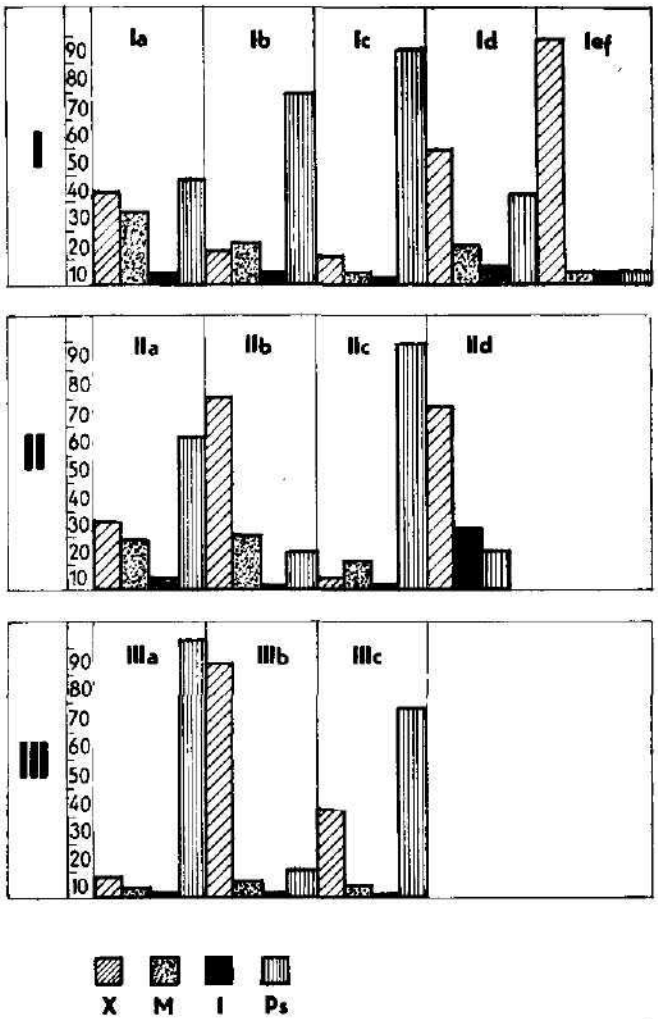

Fig. 3. The total representation of the groups of Testacea according to the building of the tests (percentual) in individual microbiotopes. I. Microbiotopes near the bank: Ia – muddy sediment, Ib – muddy sediment on stones, Ic – muddy sediment on roots, among fragments of twigs, Id – muddy sediment among fallen leaves, Ief – fine and rough sand. II. Microbiotopes in the current: IIa – muddy sediment, IIb – sandy sediment. IIc – sediment on stones, IId – sediment among fallen leaves. III. Periphyta: IIIa – periphyta of *Cladophora glomerata*, IIIb – mosses in the current, IIIc – mosses near the bank.

Notes on the individual microbiotopes

The list of kinds is ranked according to the values of dominance (see methods) from the highest to the lowest. In Fig. 3 I give a survey of the representation of Testacea groups (X, I, M, Ps) in the individual microbiotopes.

Microbiotope Ia — muddy sediment

In this sediment were mostly the species of the genus *Pseudodifflugia*, but species with xenosomata were also represented in considerable numbers However, in evaluating the individual samples I have found out that in 12 samples prevailed tests with xenosomata, in 3 samples species of the genus *Pseudodifflugia* and in 2 remaining samples membranous tests.

According to the values of dominance the first place was taken up by the species *Pseudodifflugia gracilis*, then followed *Chlamydophrys stercorea*, *Difflugia gramen*, *D. lithophila*, *Centropyxis aerophila* v. *sphagnicola*, *Cyphoderia ampulla*, *Difflugia difficilis*, *D. fallax*, *D. oblonga* v. *oblonga*, *D. oblonga* v. *bryophila*, *D. penardi*, *Cyclopyxis kahli*, *Centropyxis aculeata* v. *aculeata* *C. aculeata* v. *oblonga*, *C. cassis*, *C. platystoma*, *Pseudodifflugia globulosa* v *oblonga*, *P. gracilis* v. *terricola*.

Microbiotope Ib — muddy sediment on stones

In most of the samples prevailed species of the genus *Pseudodifflugia*. They were those samples in which a great number of diatoms or individual threads of *Cladophora glomerata* were found out. In 2 samples prevailed xenosomatic tests.

In the species composition the first place was taken up by the species *Pseudodifflugia gracilis*, frequent was also the species *Chlamydophrys stercorea*. The following species were also frequently represented: *Microchlamys patella*, *Cochliopodium bilimbosum*, *Difflugia lithophila*, *D. penardi*, *Centropyxis aerophila* v. *sphagnicola*, *C. aculeata* v. *aculeata*, *C. aculeata* v. *oblonga*.

Microbiotope Ic — muddy sediment on roots, among fragments of branches

In this sediment the genus *Pseudodifflugia* prevailed strikingly in 3 samples. Again they were samples in which great numbers of diatoms were found. In the remaining 4 samples were mostly xenosomatic tests and in 1 sample prevailed membranous tests.

In the species composition the highest number belonged to the species *Pseudodifflugia gracilis* Other frequent species were *Chlamydophrys stercorea*, *Cyphoderia ampulla*, and *Centropyxis aerophila* v. *sphagnicola*.

Microbiotope Id — muddy sediment among fallen leaves

Xenosomatic tests prevailed in almost all samples but one, in which the genus *Pseudodifflugia dominated*.

In spite of that the highest number of individuals was that of the species *Pseudodifflugia gracilis*. Then followed the species *Centropyxis platystoma*, *Cyphoderia ampulla*, *Pseudodifflugia gracilis* v. *terricola*, *Difflugia fallax*, *Centropyxis sylvatica*, *Trinema lineare*, *Centropyxis aerophila* v. *sphagnicola*, *C. cassis*, *Chlamydophrys stercorea*, *Cyclopyxis kahli*, *Difflugia oblonga* v. *oblonga*, *D. gramen*, *Cochliopodium bilimbosum*, *Difflugia lithophila*, *D. oblonga* v. *bryophila*, *D. penardi*, *Centropyxis aculeata* v. *aculeata*, *C. aculeata* v. *oblonga*, *Pseudodifflugia globulosa* v. *oblonga*.

Microbiotope Ie — fine sand

In all samples prevailed xenosomatic tests.

The highest number was reached by the species *Centropyxis aerophila* v. *sphagnicola*, and the following species were also frequent: *Cyclopyxis kahli*, *Centropyxis aculeata* v. *oblonga*, *Cyphoderia ampulla*, *Centropyxis sylvatica*, *C. aculeata* v. *aculeata*, *C. orbicularis*, *Difflugia gramen*, *D. oblonga* v. *oblonga*, *D. oblonga* v. *bryophila*, *D. fallax*, *Centropyxis cassis*, *C. minuta*, *Difflugia penardi*, *Centropyxis constricta*, *Euglypha laevis*, *Phryganella haemisphaerica*, *Pseudodifflugia globulosa* v. *oblonga*.

Microbiotope If — rough sand

In all samples prevailed xenosomatic tests.

The highest number of individuals belonged to the species *Centropyxis aerophila* v. *sphagnicola*; frequent species were *Cyclopyxis kahli*, *Difflugia oblonga* v. *oblonga*, *Pseudodifflugia gracilis*, *Centropyxis aculeata* v. *aculeata*, *C. minuta*, *C. sylvatica*, *C aculeata* v. *oblonga*, *C. constricta*, *Cyphoderia ampulla*.

Microbiotope IIa — muddy sediment

In this sediment xenosomatic tests prevailed in 6 samples, the genus *Pseudodifflugia* in 6 samples and membranous tests in 2 samples.

Most frequently represented, as far as the number of individuals is concured, was the species *Pseudodifflugia gracilis*, somewhat less frequent was the species *Chlamydophrys stercorea*, followed by the species *Difflugia fallax*, *Cyphoderia ampulla*, *Difflugia lithophila*, *Centropyxis aerophila* v. *sphagnicola*, *Pseudodifflugia gracilis* v. *terricola*, *Difflugia gramen*, *D. oblonga* v. *oblonga*, *D. penardi*, *Centropyxis aculeata* v. *aculeata*, *C. aculeata* v. *oblonga*, *C. cassis*, *C. platystoma*, and *C. sylvatica*.

Microbiotope IIb — sandy sediment

In 4 samples prevailed xenosomatic tests, in 1 sample prevailed membranous tests.

Most frequently represented were *Difflugia oblonga* v. *oblonga* and *Cyphoderia ampulla*, followed by further species *Pseudodifflugia gracilis*, *Cyclopyxis kahli*, *Centropyxis aculeata* v. *aculeata*, *C. platystoma*, *Microchlamys patella*, *Difflugia gramen*, *Centropyxis aerophila* v. *sphagnicola*, *Difflugia lithophila*, *D. penardi*, *D. difficilis*, *D. fallax*, *D. oblonga* v. *bryophila*, *Centropyxis aculeata* v. *oblonga*, *C. constricta*, *C. minuta*, *C. sylvatica*, *Trinema lineare*, *Pseudodifflugia gracilis* v. *terricola*, and *Chlamydophrys stercorea*.

Microbiotope IIc — sediment on stones

In this sediment the genus *Pseudodifflugia* prevailed on the whole. In 4 samples the genus *Pseudodifflugia* reached the maximum number of individuals. In one sample xenosomatic tests and tests of the genus *Pseudodiflugia* had the same percentual representation, in 1 sample there prevailed xenosomatic tests and in 1 sample membranous tests.

The most frequent was the species *Pseudodifflugia gracilis*, then *Chlamydophrys stercorea*. The other species did not even amount to 1 per cent.

Microbiotope IId — sediment on fallen leaves

In this sediment prevailed only xenosomatic tests.

Most frequently represented was *Centropyxis aerophila* v *sphagnicola*, followed by the species *Phryganella haemispherica*, *Pseudodifflugia gracilis*, *Centropyxis cassis*, *Euglypha laevis*, *Trinema lineare*, *Cyclopyxis kahli*, *Cyclopyxis* sp.1, *Difflugia gramen*, *Centropyxis aculeata* v. *aculeata*, *C. minuta*, *C. platystoma*, *Trachelcuglypha dentata*, and *Pseudodifflugia gracilis* v. *terricola*.

Table 3. Comparison of the population of the microbiotopes from the bank zone, in the current and in the periphyta

		Muddy sediment		Sediment on stones		Sandy sediment		Fallen leaves		Periphyta algae	mosses
		Ia	IIa	Ib	IIc	Ief	IIb	Id	IId	IIIa	IIIbc
No. of samples		17	14	6	8	6	6	7	2	7	9
No. of taxa		50	53	30	37	40	25	36	15	25	39
X	No. of taxa	36	30	16	26	31	19	20	9	14	23
	% of indiv.	35	25	12	4	87	68	48	65	6	41
I	No. of taxa	6	8	5	3	4	1	5	3	4	7
	% of indiv.	2	2	1	—	4	1	6	22	—	3
M	No. of taxa	5	11	6	4	2	3	8	—	4	5
	% of indiv.	25	18	12	8	4	18	13	—	3	4
Ps	No. of taxa	3	4	3	4	3	2	3	3	3	4
	% of indiv.	38	54	76	88	4	12	33	14	90	52
	Σ of indiv.	1071	1552	890	2026	160	65	377	37	2169	1073

I. — the bank zone; II. — the current; III. — periphyta

Microbiotope IIe — nets of caddies flies

Only one sample was taken, in which two species were found: *Pseudodifflugia gracilis* and *Trinema lineare*. This microbiotope is not given in the tables.

Microbiotope IIIa — periphyta of alga *Cladophora glomerata*

In this microbiotope the genus *Pseudodifflugia* prevailed on the whole. But in the individual samples of the whole (5) the genus *Pseudodifflugia* prevailed in 3 samples only, while in the other two samples occurred xenosomatic tests.

As for the species composition, the species *Pseudodifflugia gracilis* constituted 90 % of the whole number of individuals. From other species only the species *Chlamydophrys stercorea* was quite frequent.

Microbiotope IIIb — mosses in the torrentile zone

Xenosomatic tests prevailed, the genus *Centropyxis* prevailing mostly in the percentual composition over the genus *Difflugia*.

In the samples the following mosses were determined: *Calliergonella cuspidata* (Hedw.) Loeske, *Amblystegium serpens* (Hedw.) Br. eur.; *Platyhypnidium riparioides* (Hedw.) Podp., *Cratoneuron filicium* (Hedw.) Roth.

The most frequent taxa were *Centropyxis aerophila* v. *sphagnicola*, *C. sylvatica*, *Difflugia penardi*, *Centropyxis minuta*, *Pseudodifflugia gracilis*, *Cryptodifflugia compressa*, *Cyclopyxis* sp.1, *Centropyxis aculeata* v. *aculeata*, *Cyclopyxis kahli*, *Centropyxis aculeata* v. *oblonga*, *C. cassis*, *Euglypha laevis*, *Trinema lineare*, *Cyphoderia ampulla*.

Microbiotope IIIc — mosses in the fluviatile zone

In these moss samples, taken as a whole (together 5 samples) the genus *Pseudodifflugia* prevailed. Individually, however, xenosomatic tests domi-

nated in 3 samples and *Pseudodifflugia* in 2 samples. The genus *Centropyxis* prevailed again over the genus *Difflugia* in the percentual representation.

In the samples the following species of mosses were determined: *Brachythecium rutabulum* (Hedw.) Br. eur., *Amblystegium serpens* (Hedw.) Br. eur.; *Hypnum* sp.; *Cratoneuron filicinum* (Hedw.) *Platyhypnidium riparioides* (Hedw.) Podp.

The species *Pseudodifflugia gracilis* was most frequently represented, followed by further taxa: *Centropyxis aerophila* v. *sphagnicola*, *C. aculeata* v. *oblonga*, *C. aculeata* v. *aculeata*, *Pseudodifflugia globulosa* v. *oblonga*, *Microchlamys patella*, *Difflugia fallax*, and *D. penardi*.

Table 4. Comparison of the population of microbiotopes with plant material

		Decomposing plant material	Living plant material
No. of samples		17	16
No. of taxa		55	44
X	No. of taxa	34	26
	% of indiv.	15	18
I	No. of taxa	8	7
	% of indiv.	2	1
M	No. of taxa	9	7
	% of indiv.	7	3
Ps	No. of taxa	4	4
	% of indiv.	76	78
	Σ of indiv.	3231	3242

The comparison of the microbiotope populations

If we compare the population of muddy sediment from the current and from near the bank (Tab. 3) we can see that there is no conspicuous difference between the Testacea fauna in those two zones of the stream, neither in the

Table 5. Comparison of mineral substrate and plant material

		Mineral substrate	Plant material
No. of samples		57	34
No. of taxa		73	61
X	No. of taxa	46	39
	% of indiv.	20	16
I	No. of taxa	11	9
	% of indiv.	1	2
M	No. of taxa	12	9
	% of indiv.	13	5
Ps	No. of taxa	4	4
	% of indiv.	65	77
	Σ of indiv.	5889	6473

Table 6. Comparison of the taxa composition of Testacea (percentual) in the main stream and the tributaries of the river Bobrava

Taxon	Bobrava	
	main stream	tributaries
Pseudodifflugia gracilis	44.1	84.2
Chlamydophrys stercorea	7.4	5.2
Difflugia gramen	3.9	0.8
Centropyxis aerophila v. *sph.*	3.6	2.9
Cyphoderia ampulla	3.6	1.2
Centropyxis platystoma	3.0	0.3
Difflugia lithophila	2.7	0.6
Cochliopodium bilimbosum	2.3	—
Difflugia penardi	2.2	0.5
Difflugia oblonga v. *oblonga*	2.1	0.2
Centropyxis sylvatica	2.0	1.0
Centropyxis aculeata v. *ac.*	1.9	1.1
Difflugia fallax	1.6	1.6
Centropyxis aculeata v. *obl.*	1.6	1.0
Microchlamys patella	1.5	—
Difflugia difficilis	1.4	0.3
Cyclopyxis kahli	1.4	0.4
Centropyxis cassis	1.3	0.5
Difflugia oblonga v. bryoph.	1.2	0.3
Pseudodifflugia globulosa v. *obl.*	1.1	0.4
Trinema lineare	0.9	0.3
Pseudodifflugia gracilis v. *terr.*	0.7	0.9
Centropyxis minuta	0.6	0.2
Euglypha acanthophora	0.6	—
Euglypha laevis	0.5	0.2
Arcella discoides v. *scutell.*	—	0.2
Cyclopyxis sp.$_1$	—	0.2
Centropyxis orbicularis	—	0.1
Tracheleuglypha dentata	—	0.2
Trinema enchelys	—	0.2
Phryganella haemisphaerica	—	0.1
Cryptodifflugia compressa	—	0.1

Only taxa with abundance 0.1% and higher are given in the table.

number of taxa nor in the number of individuals. The current zone shows even a higher number of individuals than the bank zone. This difference on the number of individuals in the sectors of the stream under investigation is mainly due to the greater number of individuals of *Pseudodifflugia gracilis*.

Further, when one compares the sediment from the surface of stones in the current and from near the bank (Tab. 3) one realizes that in the sediment in the current a higher number of individuals as well as higher number of taxa was found out. This difference was also due to a rich population by the species *Pseudodifflugia gracilis* of some samples.

When comparing the sandy sediment from both zones mentioned above (Tab. 3) a conspicuous difference can be seen between the sand near the bank and the sand in the current. The sandy sediment in the current is much poorer than the sand near the bank. And further, if we compare the sandy sediment with the muddy one on the whole, it becomes evident that the

muddy sediment shows qualitatively and quantitatively richer microfauna. This means that the share of detritus is an outstanding factor for the presence of Testacea to the biotope in question. It is also in connection with the influence of the current which, on the one hand, does nor allow an accumulation of fine detritus and, on the other hand, keeps the sandy bottom moving.

If we compare fallen leaves near the bank and in the current we can see that the samples of leaves in the current are considerably poorer than those near the bank (Tab. 3).

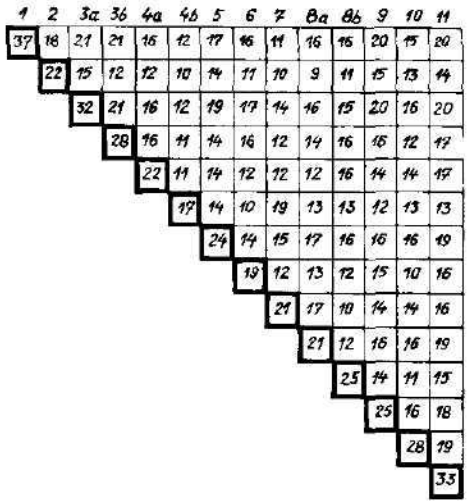

Fig. 4. Species identity of Testacea in the stations under investigation from the main stream of the Bobrava. Nos. 1—11 mark the individual samples. Other numbers give the number of common taxa occuring simultaneously in two samples under investigation. Number in the thickly lined squares give the total number of taxa in individual samples.

And, last but not least, if we compare the population of the periphyta of algae with those of mosses, there is a significant difference both in the number of taxa and in the number of individuals (Tab. 3). The periphyta of algae are poorer in taxa, but richer, as far as the number of individuals of the species *Pseudodifflugia gracilis* are concerned. Mosses, on the other hand, show fauna richer in taxa, but with a lower number of individuals.

In tab. 4 I compare the population of the microbiotopes of fallen leaves, fragments of twigs and roots with the periphyta of algae and mosses, i.e. living material. There does not seem a major difference between these two groups, but for a higher number of taxa xenosomatic tests in decomposing plant material.

If we compare totally the microbiotopes of sediments with those of plant material (Tab. 5) we can see that in plant material the genus *Pseudodifflugia* has a higher percentual representation, whereas in the sample from mineral substrate it is the xenosomatic tests that have a higher percentual representation.

When comparing the microfauna of the main stream with that of the tributaries we can say that there is no major difference (Tab. 6). In the main stream 14 samples were taken at 11 stations with an average of 25 taxa and 210 individuals. In the tributaries there were 10 samples at 6 stations. The average was 26 taxa and 941 individuals. The number of taxa is almost the same, only the (average) number of individuals is higher owing to a rich occurence of *Pseudodifflugia gracilis* in some samples.

The distribution of the fauna of Testacea along the whole length of the stream from the spring down to the mouth is pictured in Fig. 4, compiled on the basis of comparison of the common taxa for the individual pairs of samples. Instead of the species identity, given percentually, I expressed

Table 7. Composition of common taxa (percentual) from the Moravice and from the Bobrava

Taxon	Moravice Štěpánek, 1953 main strm.	trib.	Bobrava main strm. + trib
Pseudodifflugia gracilis	+	0.5	69.0
Chlamydophrys stercorea	+	—	5.7
Centropyxis aeroph. v. sph.	1 0	1.0	3.1
Cyphoderia ampulla	1.5	2.5	1.7
Difflugia fallax	0.5	1.0	1.6
Difflugia gramen	+	+	1.5
Centropyxis aculeata v. ac.	2.5	3.5	1.3
Centropyxis sylvatica	0.5	2.0	1.3
Centropyxis aculeata v. ob.	1.0	1.0	1 2
Difflugia lithophila	+	—	1.1
Centropyxis platystoma	1.0	4.0	1.0
Trinema enchelys	39.0	20.0	0 1
Euglypha acanthophora	10.0	+	0.1
Centropyxis aerophila v. aer.	+	7.0	—
Euglypha laevis	+	6.0	0.3
Centropyxis orbicularis	5.0	5.0	0.1

the species identity of Testaeca on the pairs of stations compared by the number of common taxa.

From Fig. 4 it follows that the highest number of taxa apperead in spring part of the stream and near its mouth into the Svratka. In the middle sector, however, a drop in the number of taxa appeared in most stations. This can be explained by the fact that both in the spring sector and in the mouth the bottom was muddy, covered with a considerable quantity of fallen leaves, fragment of twigs and roots etc., which is a suitable environment for the occurence of Testacea. In the middle sector of the stream, on the other hand, the bottom was mostly stony with little detritus, which had a negative influence on the development of microfauna. This is also in connection with a drop in the number of common taxa.

DISCUSSION

According to the literature I had at my disposal, the results of my investigation can in detail be compared with the papers by Štěpánek (1953, 1954), concerning a minor stream, the Moravice (maximum width 6 m) and brooks in the environs of Jánské Lázně (Tab. 7).

The samples from the Moravice often contained, apart from sediments of various character, leaves, moss. needle-leaves, and algae, or they were taken in places covered with growing reeds, grass etc. In the samples from brooks in the environs of Jánské Lázně there was often moss and grass. When comparing the fauna of Testacea of the Bobrava with that of the Moravice and tributaries we can see that in the Bobrava the species *Pseudodifflugia gracilis* was the most abundant, whereas in the Moravice it was the species Trinema enchelys. Another difference concerns the representation of the species *Euglypha acanthophora*, which, in the Moravice (not taking tributaries into account) reached 10% of the total number, whereas in the Bobrava its occurence was as low as 0,1%. When comparing the percentual representation (Tab. 8) of the most frequent genera in the streams mentioned above we find the following facts: the genus *Arcella* has a much higher representation

Table 8. Representation of the most current genera of Testacea (percentual) in several stations of streaming waters

Station / Genus	Dunaj Ertl, 1954	Wkra, Nar. Moracz., 1964	Dniepr Gurvič, 1971	Moravice Štěpánek, 1953	Jánské L. Štěpánek, 1954	Bobrava
Arcella	14	33	10	20	12	5
Centropyxis	19	10	16	18	20	20
Difflugia	19	30	58	23	16	32
Euglypha	4	—	—	6	4	3
Nebela	—	3	—	1	9	2
No. of taxa	21	30	31	96	111	85

in the Moravice and the brooks round Jánské Lázne than in the Bobrava, the genus *Centropyxis* is represented very similarly in both streams, the genus *Difflugia*, on the other hand, is more frequent in the Bobrava; the genus *Euglypha* does not show great differences, but the genus *Nebela* shows considerable numbers only in the brooks in the environs of Jánské Lázně.

Schönborn (1967) says that the genus *Nebela* is mainly widespread in moss and soil, whereas the species of the genus *Difflugia* are the most typical inhabitants of the bottoms of water reservoirs. The species *Euglypha acanthophora* with some other species lives predominantly in the litoral. The species *Trinema lineare* and *T. enchelys* occur predominantly in the litoral too, but they can also occur in terrestrical microbiotopes. The species *Pseudodifflugia gracilis* is considered by Schönborn (1962) to be a litoral population, and Moraczewski (1965) says that it occurs in the periphyton.

Starting from the above mentioned data I think that the differences in the populations of the Moravice, the brooks from the environs of Jánské Lázně, and the Bobrava consist in a different composition of samples with different plant material and various degree of its decomposition.

From the comparison of the Testacea fauna of minor streams and big rivers (the Danube, the Wkra and the Narew, the Dniepr) it follows (Tab. 8) that in big streams a lower number of taxa were found out and the genera *Euglypha* and *Nebela* were missing completely. In the material by Gurvič (1971) from the Dniepr, where the base of the stream is constituted by mineral substrate (sand or muddy sand) without the presence of plant material, these genera were not represented at all. The dominant genus was *Difflugia*.

The size of the stream apparently influences the Testacea fauna in that way that in big streams there is a greater accumulation of sediment and in the bank zones with growing vegetation there is an accumulation of plant material, which influences the microfauna. The main factor, however, is again the character of the substrate of the bottom, which was verified by the paper by Gurvič (1971). When comparing the population of sandy sediment and sediment containing sand and mud it followed clearly that the population of sandy sediment was much poorer both in the species and in the quantity than in the other type. The average number in thousands of specimens per m^2 was 2.1 in sand and 55.7 in sand with mud.

As for the influence of the current it is possible to say that it does not influence the fauna of Testacea primarily, but affects the quantity of depositing sediment and detritus, which in turn affects the qualitative and

the quantitative compositions of the fauna. Gurvič (1971) found out for the Dniepr that the speed of the current higher than 0.2 m/sec. affects negatively the development of fauna, whereas a lower speed supports its development.

Chemical factors (Tab. 1) — pH, O_2 — in my material, as they were measured, did not show any conspicuous differences in the values found out, and did not influence the composition of the fauna of Testacea either.

CONCLUSIONS

In the river Bobrava and its tributaries 12,362 individuals were inspected and 85 taxa found out, 10 of which being new to Czechoslovakia.

Differences among the population of the Testacea were investigated in different parts of the transverse section of the stream, i.e. near the bank in the current, and in the periphyta.

It was found out that the population of muddy sediment in the current and near the bank did not differ, whereas sandy sediment in the current was much poorer than near the bank. Also leaves in the current were less populated than those near the bank.

Mosses had fauna richer in taxa with a lower number of individuals when compared with the periphyta of algae, where the number of taxa was lower, but the number of individuals was high, particularly in the species *Pseudodifflugia gracilis*.

No difference was found in the population of living plant material and that in the decomposing plant remnants.

On mineral substrate, xenosomatic tests had a higher percentual representation of individual as, in the plant material as whole the genus *Pseudodifflugia* dominated.

No differences were found in the species composition of the main stream and the tributaries. Only the abundance of Testacea in the tributaries was higher than in the main stream.

The observed physical and chemical factors within those limits as they were found out did not influence the composition of the Testacea (Tab. 1)

The speed of the current (Tab. 1) does not affect the species composition of the fauna of Testacea direct. The current is secondary factor which influences the quantity and quality of the depositing material as a suitable environment for the development of the fauna of Testacea.

The population of the stream does not, to a certain extent, depend on the length of the stream. The distribution of fauna along the length of the stream, from its spring down to its mouth, is given in Fig. 4.

The results of my investigation verify the conclusions made by Gurvič (1971), that main factors influencing the fauna of Testacea are the character of the bottom substrate and the speed of the current, which accounts for the accumulation and composition of the sediment both on the bottom and on the stones as well as among plant material.

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A NOTE ON SUBSTITUTES OF PLANT POLLEN IN THE ADULT DIET OF METASYRPHUS COROLLAE (FABR.) (DIPTERA)

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Abstract: The adults of *Metasyrphus corollae* (Fabricius) were reared in the laboratory on three diets where the plant pollen was replaced by other substances. The females laid fertile eggs when reared exclusively on fructose solution and any of the three powdered substitutes of pollen. These substitutes were commercial products Tebi, Sojapyl and the mixture of torula dried yeast, casein and fructose. The fecundity was highest on the mixture of torula dried yeast, casein and fructose. The vitality of *M. corollae* decreased in the subsequent generations reared on this diet. The culture died out in F_3 generation.

Natural food of adults is basically the same in various aphidophagous species of the family Syrphidae. Main food resources are the plant nectar, pollen and honeydew. Egg maturation depends on the consumption of a suitable kind of pollen.

In the laboratory cultures of *M. corollae* and the other aphidophagous species the plant nectar and the honeydew have been replaced by the water solution of sucrose (Schneider, 1948), glucose and fructose (Stürken 1964) or honey (Barlow, 1961). The life span prolongated with an increasing concentration of sugars. Pollen was often provided in form of freshly cut flowers, but more frequently pollen of *Corylus avellana* L. collected in early spring has been offered. Up to the present time a substitute of pollen in the food of the adults has not been found (Schneider, 1969). This paper tries, therefore, to contribute to the solution of this problem.

MATERIAL AND METHODS

Three types of substitute of pollen were tested. A criterium of their suitability was the control culture where the adults were kept on pollen of *Corylus avellana*. The pollen was collected the same year and stored at a temperature of —6°C. The tested substances were the commercial products Sojapyl, Tebi and a mixture of torula dried yeast, casein and fructose in the proportion 1 : 5 : 5. Adults accepted any of these substances in form of a fine powder instead of the pollen in previous orientation tests.

Sojapyl is a pollen substitute used as additional food for honey bees in early spring. It is based on powdered soja enriched by a mixture of vitamins. Tebi is a kind of dry brewer's yeast recommended for the same purpose normally used as enrichment of the human diet. The third substitute with choline chloride, ascorbic acid and water provided an aedequate artificial food for the adults of *Chrysopa carnea* Steph. for many generations (own unpublished results). A simple diet containing non-hydrolysated yeast and sucrose was satisfactory for oviposition of *Ch. carnea* as well, although it did not show as good results as the diet with yeast hydrolysate (Hagen and Tassan, 1966).

Table 1. Oviposition of *M. corollae* females reared on four diets

The powdered component of diet	Pollen of *C. avellana*		Torula dried yeast, casein and fructose		Tebi		Sojapyl	
No. of eggs	Hatched	Total	Hatched	Total	Hatched	Total	Hatched	Total
Oviposition I.	285	328	261	298	74	145	44	51
II.	275	369	242	324	117	153	38	57
III.	236	399	197	356	145	194	35	72
Total	796	1096	600	978	336	492	117	180
Fecundity (%)		100		89.2		44.9		16.4
Viability of eggs (%)	72.6		61.3		68.3		65.0	

Freshly hatched adults of *Metasyrphus corollae* (Fabr.) from a laboratory culture were used for the experiment. The adults of the previous five generations were reared on fructose solution and *C. avellana* pollen, their larvae were fed by *Acyrthosiphon pisum* Harr. This culture as well as the experiment rearing was kept at a constant temperature of 20°C, 16 hours photoperiod and 55—70 % RH.

Half litre jars served as rearing units. Fluon paint on the inside margin prevented adults with amputated wings (Schneider, 1948) from escaping. Water, 20 % fructose solution and the pollen or its substitutes were exchanged daily. Five females and five males were kept together on each type of diet. Oviposition was stimulated by *Acyrthosiphon pisum* in small nylon bags for the first time after eight days. The second and the third oviposition followed in four day intervals. The females were induced to oviposit for four hours on each occasion.

The larvae were reared on the green form of *A. pisum* in 150 ccm plastic boxes with moist cotton wool on the bottom. Up to ten larvae were kept in one box. The aphids were exchanged daily and provided in a higher number than the larvae were able to consume.

RESULTS AND DISCUSSION

The first two substitutes affected the frequency of copulations in a negative way. The adults copulated about five times less frequently on Sojapyl than on the pollen diet. The number of copulations recorded on Tebi was only a little higher than that on Sojapyl. On the contrary, the mating behaviour on the mixture of torula dried yeast, casein and fructose was practically the same as on the pollen diet.

The oviposition was the highest on the diet where the pollen was replaced by the mixture of torula dried yeast, casein and fructose. The total amount of the eggs laid here decreased only by 10.8 %. On the contrary, the substitutes Tebi and Sojapyl were much less suitable. On Sojapyl the fecundity was even less than 1/5 of that which was found on pollen of *C. avellana*.

Table 2. Comparison of development of *M. corollae* on two diets for the adults. Larvae fed on *A. pisum*. Numbers of individuals are in the square brackets.

The powdered component of diet		Pollen of *C. avellana*		Torula dried yeast, casein and fructose	
Generation		F_1	F_2	F_1	F_2
Larva	Days	8.1 [27]	8.2 [17]	8.3 [20]	8.9 [22]
Puparium	Days	7.6 [23]	7.6 [15]	7.7 [14]	8.0 [21]
	Weight	29.9 ± 4.4	30.5 ± 2.8	29.4 ± 2.4	26.9 ± 2.2

One female reared on Sojapyl did not oviposit at all. Another female on this diet laid exclusively sterile eggs, as well as one female on the pollen diet All the other females laid eggs which hatched. Although the egg production was the highest on the diet containing the mixture of torula dried yeast, casein and fructose, the viability of the eggs was the lowest (61.3 %) compared with pollen (72.6 %), Tebi (68.3 %) and Sojapyl (65.0 %). Oviposition on the diets is summarized in Table 1. No female died during the experiment.

The culture of the adults fed by the most suitable substitute, the mixture of torula dried yeast, casein and fructose, was maintained for further rearing. The larval development was prolongated and the weight of the puparia gradually decreased in F_1 and F_2 generations. The mean time of larval development and the mean weight of the puparia from which the adults hatched with its standard deviation in F_1 and F_2 generation are given in Table 2 The larval mortality was not recorded. This was accompanied by the reduction of the fecundity and the decrease of the egg size. The eggs of F_3 generation did not hatch.

A similar decrease of egg production was found when coccinelids (Hodek, 1973) and chrysopids (Hagen, 1950) were reared on some artificial diets. The artificial diet for a species has to comprise the precursors of the amino-acids which the species is unable to synthetize (Atallah and Killebrew, 1967). A simple diet based on brewer's yeast and sucrose was inadequate for oviposition of *Coleomegilla maculata lengi* Timb. The adults laid eggs when yeast was replaced by extract from the liver (Smith, 1965a). Banana diet proved successful for this species as well as for *Adalia bipunctata* (L.). However, this diet was not suitable for all the tested coccinellid species (Smith, 1965b). *C. maculata* was maintained for eight subsequent generations on a diet containing liver extract and a mixture of carotenoids and sterols from cotton leaves (Atallah and Newson, 1966). Good results were achieved on artificial diets mixed with a small amount of dried natural food (Smirnoff, 1958; Chumakova, 1962).

Better results with *M. corollae* could possibly be obtained on a mixture of torula dried yeast, casein and fructose with the commercial Tebi on which the viability of eggs was found to be slightly higher. Addition of a small amount of the pollen to the mixture of torula dried yeast, casein and fructose might give satisfactory results as well as a preliminary short time feeding on *C. avellana* pollen before the artificial diet is offered.

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THE EFFECTS OF TWO TIME-DIFFERENT FEEDING REGIMENS ON FOOD INTAKE, GROWTH RATE AND LIPID METABOLISM IN GOLDEN HAMSTER (RODENTIA)

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Abstract: The effects of intermittent fasting (rhythm of feeding every second day) or one hour a day food allowance system on the development od periodical hyperphagia, growth rate and lipid metabolism in male and female hamsters (*Mesocricetus auratus*) during 15 weeks were investigated.

It has been shown that periodical hyperphagia develops up to 5 weeks of adaptation only. Afterwards the amount of food consumed reaches about the same level. Both systems of infrequent feeding decrease the lipid content and proportion of body fat with the greater effect of hour feeding. One hour a day feeding decreases also serum cholesterol content.

INTRODUCTION

In a number of works, especially during the last 30 years, the significance of time distribution of food intake, besides the aspects of its quantity and quality, has been demonstrated (review see Fábry, 1969).

With the progress of the research in this field the response to time-different food intake appeared to depend not only on different species, but also on their varieties, races and strains. The studies of the influence of all systems of infrequent feeding were caried out mainly with the white rat. Attention of many workers was paid, therefore, to other species of laboratory animals, as white mouse (Fábry et al., 1966; Kekwick and Pawan, 1966; Pawan, 1966) and golden hamster (Šimek, 1968, 1969).

Experimental works dealing with the effect of intermittent fasting in golden hamster (Šimek, 1968, 1969) demonstrated that this kind is able to compensate for this feeding regimen, although the answer was less expressive in comparison with the laboratory rat. We were interested to know what where the changes in some parameters of lipid metabolism in golden hamster, because it is metabolism that is the most influenced in rats adapted to infrequent supply of food. Intermittently fasting animals were compared with the group of control hamsters and the group of animals fed only one hour per day.

MATERIAL AND METHODS

The experiments were performed with both sexes of golden hamsters about 6 weeks old, kept at the temperature 22 ± 1°C. Regular twelve-hour alternation of light and darkness was ensured. The total experimental period covered 15 weeks. Animals of identical sexes were divided

in three groups — the first group was fed ad libitum daily, the second was fasting intermittently (days of free access to food alternated with days of starvation) and the third fed one hour per day. All animals received the standard laboratory diet (composition see Fábry, 1959). The food intake was investigated by weighing daily all food remnants and the growth by recording the weekly weight increments of the animals.

In the end of experimental feeding the experimental conditions were adjusted to enable the killing of animals within the comparable nutrition regimen. After 20 hours of fasting they received an estimated amount of food (5g/100g body weight) and after another 20 hours they were killed by decapitation. Lipids in the liver and perirenal adipose tissue were extracted by the

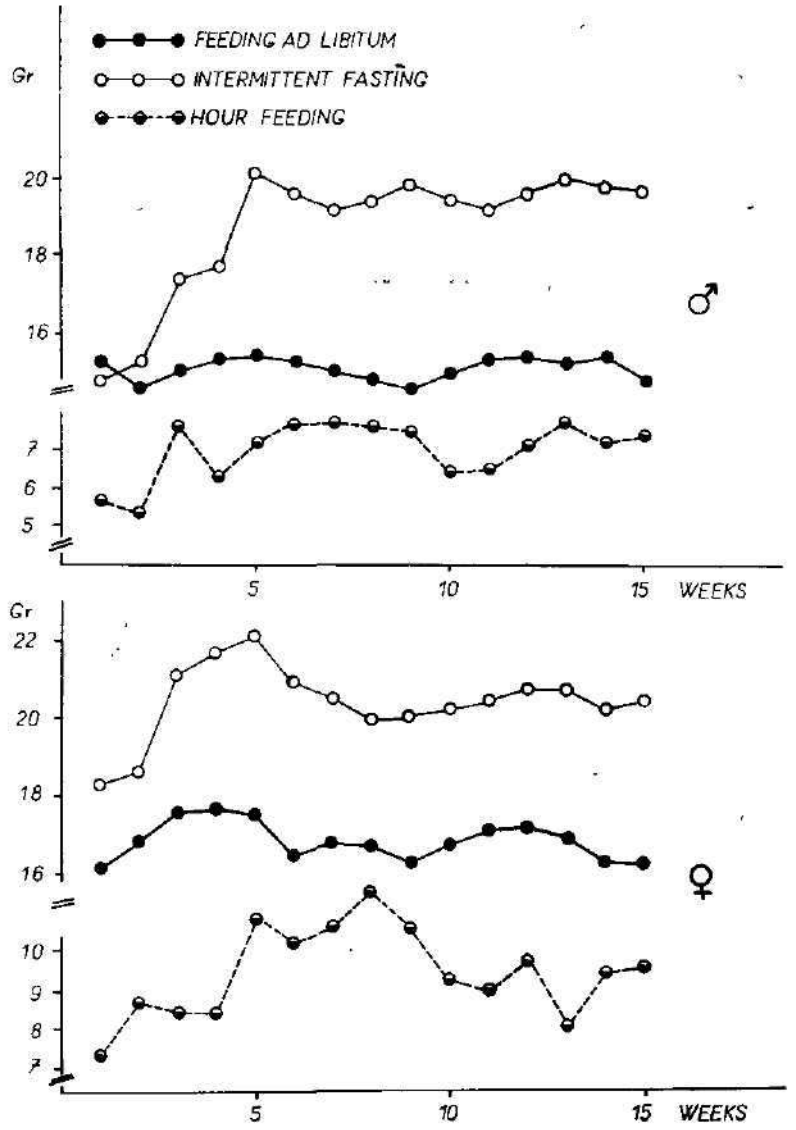

Fig. 1. Amount of food ingested by controls, intermittently fasting and one hour daily feeding males (above) and females (below) of golden hamster during one feeding period. Expressed in g/animal/ration.

procedure of Folch et al (1957) and their content was determined by weighing method. Total body fat was estimated by the modified method according to Mickelsen and Anderson (1959). Serum cholesterol was estimated by the method of Novák (1961).

T-test was used to test the difference between relevant means.

RESULTS

Intermittently starved hamsters consumed about 25—30 per cent more food already in the first 5 weeks than ad libitum fed animals. Afterwards the level of food intake is nearly constant. In the group fed one hour a day the amount of food intake is by 50 per cent lower in comparison with intermittently fasting animals (see figure No 1). Total amount of food consumed

Table 1. Total amount of food ingested of controls, intermittent fasting and one hour per day feeding females and males of hamster during 15 weeks of experimental period

Feeding pattern	Total consumption of food (g)		Total consumption of food (expressed in 100g body weight)	
	females	males	females	males
Feeding ad libitum	1.809	1,496	818	947
Intermittent fasting	1,073	977	879	905
Feeding 1 hour per day	971	731	866	925

over 15 weeks of adaptation to time-changed feeding regimen (see Table 1) is in both experimental groups by nearly 50 per cent lower in comparison with the controls, food intake in females being higher. The opposite is true in respect to sex when we adjust the food consumption to 100 g body weight.

The decline in food intake results necessarily in the decrease of body weights of the experimental animals (see Figure 2). Starting with the 6th week of experimental feeding the body weight gradually increased. Exception in this fact is the group of males fed one hour a day. Their decrease of body weight continued during the total experimental period.

Liver lipid contents in female hamsters are not substantially influenced by any model of infrequent feeding, although some tendency for decrease could be observed in the group intermittently starved. The same tendency, but more marked and statistically significant, was found in intermittently starving males (Table 2, first left column). In the perirenal adipose tissue of both sexes a decrease was found with the group fed one hour a day. whereas the values in groups of hamsters intermittently starved were practically identical with controls fed daily ad libitum (Table 2, second column). In both groups of animals fed infrequently, reduced amounts of body fat were found, the reduction being greater in males than in females. In addition, a difference was also observed between the intermittent starving and one hour a day feeding types of restricted feeding. The latter model resulted in both sexes in a more marked body fat decrease than intermittent starvation (see table 2, third column).

A different effect of the models of infrequent feeding was found also with respect to serum cholesterol. Whereas intermittent starvation adds to slight,

but statistically insignificant, cholesterolomy, the one hour a day feeding system causes a reduction of serum cholesterol in both sexes (see Table 2, last column).

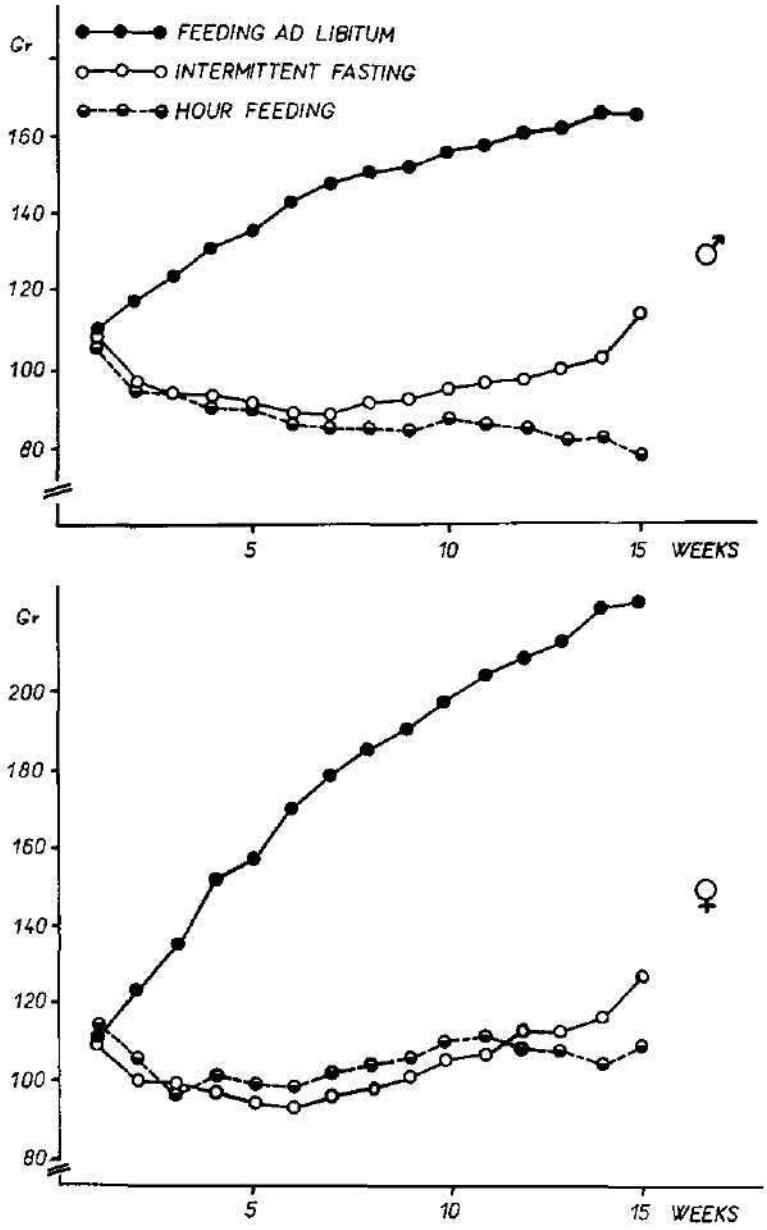

Fig. 2. Weight changes in controls, intermittently fasting and one hour per day feeding males (above) and females (below) of golden hamster.

Table 2. Influence of feeding pattern on amount of lipids in liver and perirenal adipose tissue, on the proportion of body fat and amount of cholesterol in serum in females and males of hamster.

Feeding pattern	Lipids in liver (g%)	Lipids in perirenal adipose tissue (g%)	Body fat (%)	Cholesterol in serum (mg%)
FEMALES				
Feeding ad libitum	6.05 ± 0.50	84.93 ± 1.68	29.40 ± 2.56	190.16 ± 16.02
Intermittent fasting	5.77 ± 0.67	82.83 ± 1.41	19.56 ± 2.10[3]	228.50 ± 21.96
Feeding 1 hour a day	6.08 ± 0.58	69.17 ± 5.44[3]	10.61 ± 1.94[1]	137.33 ± 3.05[2]
MALES				
Feeding ad libitum	5.82 ± 0.24	83.48 ± 1.38	24.26 ± 1.69	149.66 ± 4.37
Intermittent fasting	4.83 ± 0.34[4]	76.02 ± 3.54	12.39 ± 1.55[1]	160.33 ± 9.99
Feeding 1 hour a day	6.45 ± 0.55	69.26 ± 2.52[1]	4.08 ± 0.70[1]	122.75 ± 9.29[4]

Values are given in group averages ±S.E.
1) Difference from value for the corresponding ad libitum fed group is significant for $P < 0.001$, 2) for $P < 0.01$, 3) for $P < 0.02$, 4) for $P < 0.05$.
In all groups six animals were used.

DISCUSSION

Our results have repeatedly shown that golden hamster is capable to adapt to time distribution of food intake, although the rate and degree of this adaptation slightly differ from those in the laboratory rat. Even when total food intake in animals fed intermittently and those with access to food only one hour per day over 15 weeks of experimental period was lower in comparison with the controls fed ad libitum, golden hamster possessed, too, the ability to compensate for the hold-back food on days of free access to it. This is evident from changes proved in the morphological structure of the digestive tract (Šimek, 1969), from the increased activity of total dehydrogenases and succinic dehydrogenase in the liver of intermittently fasting hamsters (Šimek, 1968), and from the higher values of basal and resting metabolism (Šimek, in press).

Although some differences appear between the individual systems of feeding in the study of the effect of time-different feeding on the organism (food supply by means of the stomach tube, time-limited and intermittent fasting systems of feeding), there exists one basic response to the total caloric intake, and that is an increased deposition of fat which is convenient and vital to the animals.

As indicated by data in several works, periodical hyperphagia results in an increased ability of animals to synthetize fatty acids independent from the level of calories received. An increased lipogenese in liver slices of rats fed one hour a day is reported by Tepperman & Tepperman (1958). Hollifield & Parson (1962) and Stevenson et al., (1964) in rats fed the

same way found an increased incorporation of labelled acetate in the fatty acids of the adipose tissue. An increased incorporation of 1-^{14}C-acetate in liver slices of rats adapted to intermittent fasting was observed by Fábry et al. (1962). The higher rate of incorporation was found not only in the resorption phase; even after 48 hours of food abstention the lipogenesis in intermittently fasting animals was higher than in the controls. Similarly, also in the adipose tissue of intermittently fasting rats an increased lipogenetic activity was found (Petrásek, 1965). Elevated lipogenesis values also in the epididymal adipose tissue of rats fed 1—2 hours daily were found by Cohn (1967) in comparison with animals whose total daily ration was divided into several portions.

To the increased lipogenesis in animals adapted to periodical hyperphagia answers, in a number of experiments, also an increased portion of body fat. This was confirmed by the experiments of Cohn (1963) and Cohn et al., (1965), who compared rats force-fed by means of a stomach tube with animals fed ad libitum. It must be underlined that both the experimental and control groups received the same level of calories and main nutrients. Similar results were obtained also by Fábry et al. (1964) in their work with intermittently fasting rats. The increase of the fat content in the experimental group was, however, by far not so marked as in the experiments of Cohn, even when in Fábry's experiments a high lipogenetic activity was observed. In rats fed two hours a day Stevenson et al. (1964) confirmed increased lipogenesis in the adipose tissue, but at the same time they found a decreased portion of body fat in adapted rats.

Besides the ability to form fatty acids also their higher rate of oxidation was found in animals with the time distribution of food intake. Petrásek et al. (1964) reported increased oxidation of palmitate-1-^{14}C through liver slices of intermittently fasting rats in comparison with the controls fed ad libitum and rats simply underfed. The questions of mobilization and utilization of fat reserves in infrequently feeding rats was studied by Braun et al. (1964). They found that for the stage of realimentation in intermittently fasting rats low values of NEFA from the adipose tissue and their low level in the serum are characteristic. Surprising were contradictory results with animals fed two hours per day.

Animals with the time distribution of food intake can, besides the increased lipogenetic activity, also utilize their body fat in a higher degree. The portion of body fat is governed by the predominance of one of these antagonistic processes (Petrásek et al., 1969).

In our experiments with golden hamster we observed a considerable decrease of total body fat values in two groups fed infrequently, more marked in the group fed one hour per day. The cause of this decrease was obviously the much reduced food intake in both groups fed infrequently, resulting thus in a marked decrease of body weight and fat reserves. It is, however, interesting to note that with nearly the same food intake there exists such a great difference in the body fat content between animals intermittently starving and those fed one hour per day, namely twice as low in females and even three times as low in males intermittently starved. It seems from this difference that within the type of intermittent starvation there exists a weaker antagonism between formation and release with subsequent utilization of fat depots than in animals fed one hour per day. This seems to be

caused also by the declined values of liver fat in intermittently starved animals, especially in males, and, in the contrary, by the decreased content of fat in the adipose tissue of animals receiving food one hour per day.

Contrary to rats, intermittent starvation in hamster leads to a decrease in total body fat due to the overall decreased caloric intake during the period of feeding (smaller hyperphagia). Nevertheless, intermittent starvation represents substantially a lipogenic factor, which is demonstrated by comparison with animals fed one hour per day. Reduction of fat reserves is probably caused by fat utilization in the period of starvation.

In addition, our results indicate that besides the influence of feeding regimen it is also the sex which influences the rate of lipogenetic processes and body fat contents. The same is true also with the serum cholesterol content in hamsters fed one hour per day in which the statistically significant decrease of cholesterol is especially striking. In a study of the serum cholesterol level in rats fed one hour daily Okey et al. (1960) found a higher level in females, but only in the group receiving one per cent dietary cholesterol. No substantial difference appeared between the two groups (food intake one hour per day and controls fed ad libitum) with diets free of cholesterol. From those data, as well as from the results obtained in a number of other experiments carried out by Fábry (unpublished data), Wells et al. (1962), Gopalan et al. (1962), it thus appears that the serum cholesterol level in rats is affected by the frequency of feed intake significantly only when atherogenic diets are given.

SUMMARY

The development of periodical hyperphagia, body weight and lipid metabolism changes in the group of golden hamster (*Mesocricetus auratus*) fed one hour daily and in the group intermittently fasting in comparison with the controls fed ad libitum were investigated during a 15-weeks' period of adaptation. It was found that in intermittently fasting hamsters periodical hyperphagia increased until the 5th week of adaptation. In the following weeks the food intake reached about the same level.

The system of intermittent starvation results in a decrease of the liver lipid contents in male and female hamsters and their body fat by about 50 per cent of the relative values of the controls. The system of feeding one hour per day resulted in the decrease of the fat content in the perirenal adipose tissue and a marked decrease of total body fat, especially in males. The serum cholesterol content is significantly affected by both systems of the time distribution of food intake, especially in females. The system of intermittent fasting has a tendency to non-significant increase while the system of feeding one hour per day substantially decreases the cholesterol level.

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Balthasar V., 1973: Grabwespen Sphecoidea, Fauna ČSSR sv 20, 471 pp , 165 obr , 9 fot tab Academia Praha, cena váz výt 110 Kčs

Jubilejni dvacáty svazek edice Fauna ČSSR je po ctyřlete prestávce opět věnovan hum zu a to v pořadi již druhe nadceledi blanokřidlych, kutilkám

Má obdobnou upravu i obsah jako ostatni díly Fauny Po systematickem přehledu 418 druhu ve 46 rodech a 2 podčeledich následuje velice stručna všeobecná část, zahrnujici morfologicko taxonomickou charakteristiku skupiny, morfologicky popis nadčeledi, druhovou variabilitu kapitolku o vyvojovych stadiich a bionomii kutilek, několik slov o jejich hospodářskem významu stručny zoogeograficky rozbor fauny kutilek Československa a konečně poznamky k lovu usmrcování a preparaci těchto blanokřidlych 90 % textu je věnováno systematicke části kde po uvodnim slově ke klasifikaci nadčeledi nasledujé klic rodu a potom výčet jednotlivych rodu se systematicko bionomickou charakteristikou, klíčem a strucnym popisem jednotlivych druhu Dilo je doplněno 165 perovkami diakritickych znaku a 9 tabulemi habituelnich fotografii významnějších rodů

Na rozdil od ostatnich svazku edice je uvaděny díl psan cizojazycně (německy) a zahrnuje kromě všech u nas dosud zjistěnych druhu kutilek i druhy pravděpodobne, ktere je možno s zoograficky ch důvodů u nás očekavat Tak se stava Balthasarovo dilo použitelne pro oblast celé střední Evropy a navic i pro severni část Balkanu a vychodni cast zapadni Evropy Dik německemu textu bude jistě sloužit jako pomucka pro určovani kutilek ve vsech sousednich zemích

K. Hrubý

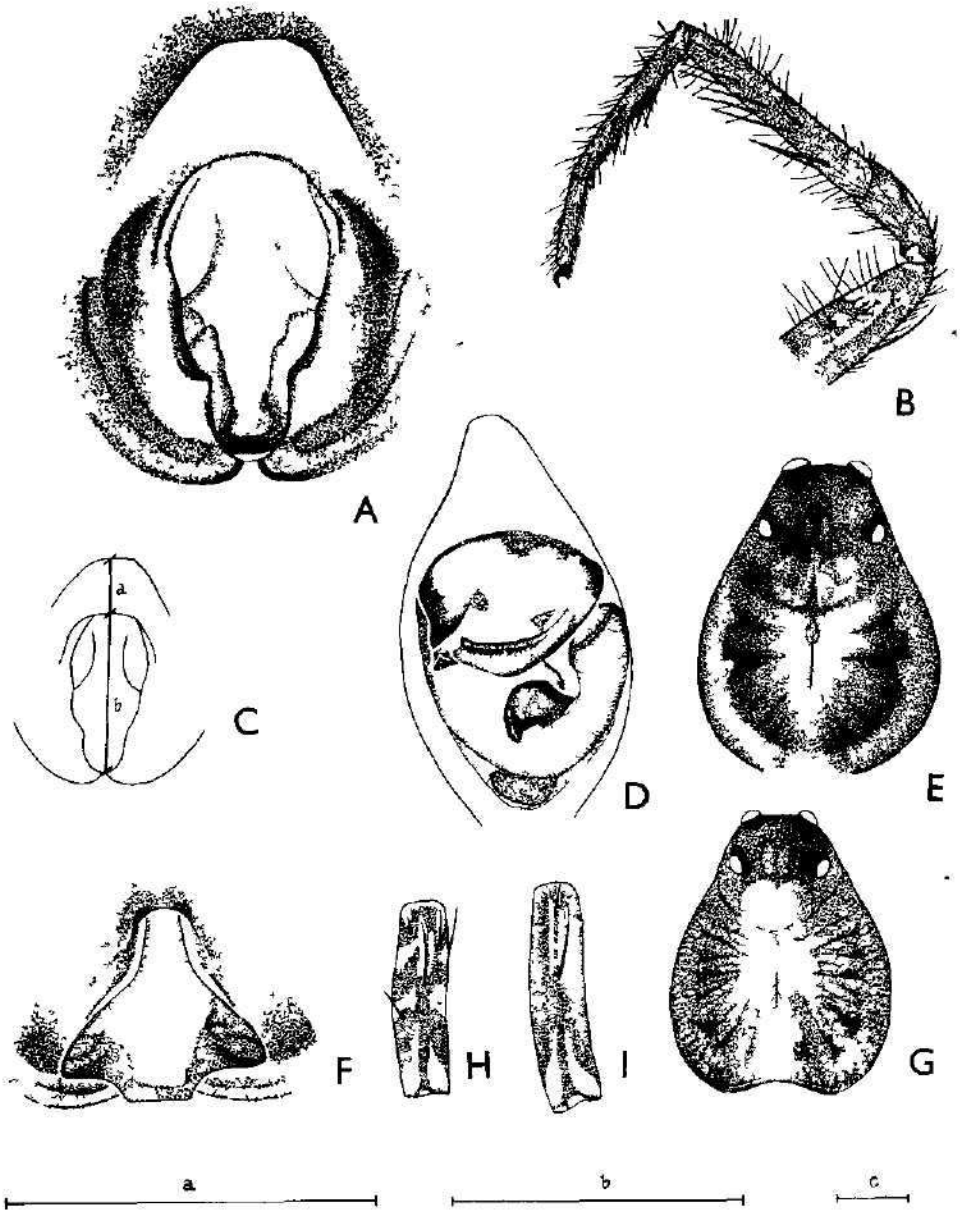

Abb A—E *Acantholycosa pedestris* (Simon) A — Epigyne, B — das erste ♀ Bein von hinten, C — Messung der Langen des Vorderteiles (a) und Mittelseptum (b) der Epigyne D — Dorsalseite von ♀ Prosoma E — rechter ♂ Bulbus von unten
F—I *Pardosa morosa* (L Koch) F — Epigyne, G — Dorsalseite von ♀ Prosoma H — Femur I, Zeichnungsmuster von Dorsalseite (Jugoslawien, Rovinj) I — dasselbe nach dem Vertreter der mitteleuropaischen Population (ČSSR, Nová Sedlica)
Maßstab a = 0,5 mm (fur Abb A + F), b (fur Abb E) und c (fur alle ubrigen Abbildungen) = = 1 mm (Gezeichnet von E Laštovkova)