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VĚSTNÍK ČESKOSLOVENSKÉ SPOLEČNOSTI ZOOLOGICKÉ
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Department of Parasitology, Charles University, Praha

MICROTUS ARVALIS, THE INTERMEDIATE HOST OF A COCCIDIAN FROM THE KESTREL (FALCO TINNUNCULUS)

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Received February 3, 1976

Abstract: We desctibe the development of previous unknown coccidian in a kestrel (*Falco tinnunculus*-final host) and the common European vole (*Microtus arvalis*-intermediate host). Thin-walled, sporulated oocysts are shed by the kestrel, which measure 19—20 × 13—14 μm. The oval sporocysts (13—14 × 10—11 μm) lack a Stieda body. Intensive asexual multiplication was observed in the liver of the vole on 6 day of infection with an oral dose of 600,000 sporocysts. Schizonts (17—18 × 14—15 μm) produce minute tachyzoites arranged in a rosette pattern. On day 51 after the inoculation of sporocysts, the skeletal muscles of *Microtus arvalis* harbour a large number of muscle cysts measuring from 30—900 μm in length and 30—80 μm in width. The number of bradyzoites (8—9 × 2—2,5 μm) is rather small in these cysts. Smaller cysts (approximately 30 μm in diameter) contain widely ovoid cells (6—4 μm) of the metrocyte type. This is a new coccidian of the genus *Sarcocystis*. Its life cycle occurs in *Falco tinnunculus* and *Microtus arvalis*. Asexual multiplication does not occur in *Mus musculus*.

This study was initiated by the repeated finding of unknown, isospora-like oocysts in the kestrel. The morphology of thin-walled oocysts sporulating already in the intestine of the kestrel shows a similarity to that of the "sarcocystis-like" type of oocysts reviewed by Frenkel (1974). In recent studies attention has been given mainly to similar oocysts shed by the cat, dog, weasel and man; there is increasing evidence that these belong to the life cycle of muscle parasites of the genus *Sarcocystis* parasitic in numerous vertebrates (Fayer, 1974; Frenkel, 1974; Rommel, Heydorn, Gruber, 1972; Tadros, Laarman, 1975).

In our opinion the coccidian recovered from the kestrel appears to be a heteroxenous species, and its asexual multiplication occurs in *Microtus arvalis* eaten by the kestrel. The results of our experiments are presented in this paper.

MATERIALS AND METHODS

The birds were obtained by courtesy of Dr Porkert. In 6 of 10 kestrels (*Falco tinnunculus*) from the Czech Socialist Republic examined we recovered "sarcocystis-like" oocysts.

Intestinal material was collected from two heavily infected birds and both oocysts and free sporocysts were separated from the intestinal detritus first by straining through 4 layers of gauze and then by repeated rinsing with water and centrifugation.

The oocysts and free sporocysts obtained were used for oral infection of four common European voles (*Microtus arvalis*) reared in the laboratory Ma_1—Ma_4 aged four weeks. Each vole received 600,000 sporocysts. A control group which had not received sporocysts consisted of 4 voles of similar age (MaK_1—MaK_4). We also inoculated 4 white laboratory mice (*Mus musculus*) aged 6 weeks (Mm_1—Mm_4) with the same dose of sporocysts. Control mice MmK_1—MmK_4 were not inoculated.

Impression films were made from the organs of the inoculated animals; they were fixed with methyl alcohol and stained with Giemsa-Romanowski solution; in addition all organs including

the muscles were sectioned and stained with Harris hematoxylin. Part of the skeletal muscles and part of the examined organs of the animals were triturated with saline in a mortar and the suspension obtained was examined immediately for the presence of free bradyzoites.

Antigen for the immunofluorescence test was prepared from bradyzoites released from muscle cysts in vole Ma_4. Antigens were prepared in those drops of muscle suspension containing a large number of bradyzoites (roughly 16 million in 1 ml of material); they were dried and stored without fixatin at — 20° C.

For a cross reactin with *Toxoplasma gondii* a human serum with a toxoplasma titre of 1 : 512 was used.

The fluorescein-labelled pig conjugate SWAH was used against human gamma globulin.

RESULTS

Description of oocysts from the *Falco tinnunculus*

The oocysts: They are covered with a very thin wall (approximately 0.5 μm) and measured 19—20 × 13—14 μm (30 oocysts measured). Sporulation occurs in the intestine of the infected bird (Figs. 1, 2).

The sporocysts: Oval, moderately attenuated at both poles, measuring 13—14 × 10—11 μm (50 sporocysts measured) without a Stieda body. They harbour 4 sporozoites. Visibility of the sporozoites is obscured by a large number of reserve granules inside the sporocyst (Fig. 1).

Life cycle in *Microtus arvalis*

Asexual multiplication in the organs. On day 6 of infection voles Ma_1 and Ma_2 died. Mature schizonts (17—18 × 14—15 μm) were observed in the liver of these animals with tachyzoites arranged in a rosette-like pattern (Fig. 3). Asexual multiplication was not observed in spleen, lung, heart, kidney and brain of the voles, and in the liver of a control vole killed on day 7 either. A third experimental vole was killed on day 14 after infection; no multiplicative protozoan stages were encountered in the liver and the other organs.

Formation of cysts in the muscles. On day 51 after inoculation we killed a fourth vole Ma_4. Sections disclosed the presence of a large number of cysts in the skeletal muscles of this animal. The cysts measured 30—900 μm in length and 30—80 μm in width (Figs. 4, 5, 6). The cysts harboured very small bradyzoites (8—9 × 2—2,5 μm). Free bradyzoites were obtained from the muscles by trituration (see Material and Methods) but not from other organs, sections of which did not disclose cysts.

The liberated bradyzoites were sickle-shaped and measured 8—9 × × 2—2,5 μm, their nucleus, which was situated excentrically, measured 2,5 × 2 μm and was stained brightly red violet with Giemsa. Near the margins of several cysts we found occasionally widely ovoid cells, measuring 6 × 4 μm and resembling metrocytes. In very young cysts measuring approximately 30 μm in diameter, these widely ovoid cells occupied the whole section through the cyst (Fig. 4).

In the uninoculated control voles killed after 55 days both organs and muscles were uninfected. The same negative results were obtained in 4 laboratory mice killed 68 days after inoculation with the same dose of sporocysts that was administered to the voles.

Results of serologic studies with anti-*Toxoplasma* serum in the indirect fluorescence test.

No cross reaction was obtained in the immunofluorescent test with sarcocysts antigen and an antiserum with antibodies against *T. gondii* with a titer of 1 : 512.

DISCUSSION AND CONCLUSION

In 1972, Rommel, Heydorn and Gruber suggested that oocysts with a very thin wall and with readily liberated sporocysts without a Stieda body, which had been assigned to the genus *Isospora* because of their bisporocystic character, may belong to the developmental cycle of *Sarcocystis* parasites on the muscles of various vertebrates. Oocysts recovered from our material from the kestrel corresponded fully to the "sarcosytis-like" type recorded from carnivores and man (Frenkel, 1974, Rommel et all., 1972, Tadros, Laarman, 1975).

On day 6 following artificial infection of the field vole (*Microtus arvalis*) with these "sarcocystis-like" oocysts from the kestrel, we observed numerous asexual stages in the liver of these small rodents. At this time, two of the infected voles died. There was no mortality in the control group. No protozoans were present in the liver of an uninfected vole from the control group. Although we did not use stages from the liver of the dead voles for a serological comparison with *Toxoplasma gondii* antibody we believe that the heavy intensity of infection in the liver of the infected animals is related to the high dose of sporocysts from the kestrel. This assumption is supported by the presence of a very large number of cysts in the skeletal muscles of a vole killed on 51 day after inoculation.

Also Tadros and Laarman (1975) observed that the common vole is the intermediate host of an unknown coccidian from the weasel (*Mustela nivalis*). The life cycle of this parasite from the weasel differed both in the morphology of the individual stages and in the course of infection from our coccidians from the kestrel. The *Sarcocystis* species from *M. nivalis* produced schizonts in the spleen and lymphatic nodes on day 14 after infection. The bradyzoites in muscle cysts of their voles were bigger ($14 \times 2{,}5$ μm) than those in muscle cysts in our experiments ($8-9 \times 2-2.5$ μm).

The new coccidian with a two-host cycle involving the kestrel (*Falco tinnunculus*) and the common vole (*Microtus arvalis*) has been assigned to the genus *Sarcocystis*. Although we found numerous cysts in the skeletal muscles of an infected vole, search for cysts in the brain was unproductive. When examined on day 51 after infection, when several muscle cysts measured up to 900 μm, we did not encounter even initial stages of multiplication of the parasites in the brain, as this has been reported for the M-organismus (*Frenkelia*) in an earlier paper (Jírovec, Černá, Ludvík, Šebek, 1961). In their recent study on the identity of oocysts of the coccidian "*Isospora buteonis*" from *Buteo buteo*, and of the genus *Frenkelia* from the brain of the bank vole (*Clethrionomys glareolus*) Rommel and Krampitz (1975) found that cysts in the brain tissue of the infected rodents measured around 50 μm 7 weeks after inoculation. Other findings supporting our identifying the new species as *Sarcocystis*, are the negative results of a cross reaction with *T. gondii*, and that sporulation of oocysts had already occurred in the intestine of the host.

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The plates (Figs. 1—6) are found at the end of this issue.

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VĚSTNÍK ČESKOSLOVENSKÉ SPOLEČNOSTI ZOOLOGICKÉ
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Zoologische Abteilung des Nationalmuseums Praha
und der Zoologische Garten Praha

BULGARISCHE CHILOPODEN IN DER SAMMLUNG VON NATIONALMUSEUM PRAHA

LUDĚK J. DOBRORUKA

Eingegangen am 9. Januar 1976

Abstract: A list of Bulgarian chilopods of the collection of the National Museum, Praha is presented. The species *Clinopodes escherichii* (Verhoeff, 1896), *Eupolybothrus grossipes* (C. L. Koch, 1847) and *Lithobius peggauensis* Verhorff, 1937 are new for the fauna of Bulgaria.

Chilopoda Bulgariens sind ziemlich gut bekannt und hauptsächlich in der letzten Zeit ausführlich durch Matic & Golemansky (1967), Negrea (1965, 1971) und Kaczmarek (1969, 1970, 1973) bearbeitet. Eine Übersicht der Literatur sowie auch die Liste der aus Bulgarien bekannten Chilopoden gibt Kaczmarek (1969).

Die Spezialisten des Nationalmuseums Prag führten in den Jahren 1933 bis 1935 mehrere Expeditionen auf die Balkan-Halbsinsel durch. Obwohl hauptsächlich das entomologische Material gesammelt wurde, brachten die Sammler auch einige Chilopoden mit. Dazu kommen noch einige Exemplare, die später durch weitere Zoologen gesammelt wurden. Insgesamt befinden sich in der Sammlung nur 59 Exemplare aus Bulgarien, doch sind einige Angaben interessant genug, um eine kleine Notiz darüber zu veröffentlichen.

GEOPHILOMORPHA

Bothriogaster signata graeca Verhoeff, 1901

Fundort: Melnik (2 Exemplare, 1. 7. 1935 Táborský lgt.).

Bisher nur in einem Stück von Ognianovski bani bekannt (Kaczmarek, 1970).

Clinopodes flavidus (Attems, 1895)

Fundorte: Melnik (1 Ex., 1. 7. 1935 Táborský lgt.),
Rhodopi, Kostenec (1 Ex., 7. 1935 Táborský lgt.).

Clinopodes escherichii (Verhoeff, 1896)

Fundorte: Strandža Planina (1 Ex., 7. 1934 Táborský lgt.),
Varna (2 Ex., 6. 1934 Táborský lgt.).

Die Art ist neu für die Fauna Bulgariens.

Strigamia acuminata (Leach, 1814)

Fundort: Velka Papija, Strandža Planina (1 Ex., 7. 1934 Táborský lgt.).

Zum erstenmal erst in 1969 durch Kaczmarek aus Bulgarien gemeldet.

SCOLOPENDROMORPHA

Scolopendra cingulata Latreille, 1789

Fundorte: Varna (1 Ex , 6. 1934 Táborský lgt.), Melnik (1 Ex., 1. 5. 1935 Táborský lgt.), Asparuchovo (3 Ex., 7. 9. 1966 Pfleger lgt).

Cryptops parisi Brolemann, 1920

Fundorte: Strandža Planina (1 Ex., 7. 1934 Táborský lgt.), Velka Papija, Strandža Planina (1 Ex., 7. 1934 Táborský lgt.).

Früher wahrscheinlich mit *C. hortensis* vermischt, erst durch Kaczmarek (1969) aus vielen Fundorten gemeldet.

LITHOBIOMORPHA

Eupolybothrus grossipes (C. L. Koch, 1847)

Fundort: Strandža Planina (2 Ex. 7. 1934 Táborský lgt.).

Wie Eason (1970) bewiesen hat, muss die Art *Egrossipes* als selbstständig, und nicht wie bisher als Synonym zu *E. fasciatus* (Newport, 1844) angesehen werden. Eine Revision der bulgarischen Arten der Gattung *Polybothrus* (= *Eupolybothrus*, cf. Jeekel, 1963, 1967) gab Kaczmarek (1973) an. Auch hier sind aber beide Arten zusammen behandelt. Die Art *E. grossipes* gilt als neu für die Fauna Bulgariens.

Eupolybothrus transsilvanicus (Latzel, 1882)

Fundorte: Bojana, Vitoša Planina (1 Ex., 7. 1935 Táborský lgt.) Kostenec, Rhodopi (1 Ex., 7. 1935 Táborský lgt.).

Lithobius forficatus (Linnaeus, 1758)

Fundorte: Rila, Čamkurija (7 Ex., 6. 1933 Táborský lgt.), Kostenec, Rhodopi (15 Ex. 7. 1935 Táborský lgt.), Varna (1 Ex., 6. 1934 Táborský lgt.).

Das Exemplar aus Varna, ein ♀, stimmt mit der Subspezies *L. f. brevicalcaratus* Folkmanová, 1946, überein.

Lithobius piceus L. Koch, 1862

Fundort: Ropotamo (1 Ex., 7. 9. 1966 Pfleger lgt.).

Lithobius peregrinus Latzel, 1880

Fundort: Ropotamo (1 Ex., 14. 9. 1966 Pfleger lgt.).

Die Art wurde bisher nur einmal in Bulgarien gesammelt und von Folkmanová (1936) gemeldet.

Lithobius erythrocephalus C. Koch, 1842

Fundorte: Kostenec, Rhodopi (9 Ex., 7. 1935 Táborský lgt.), Varna (1 Ex. 6. 1934 Táborský lgt.).

Lithobius peggauensis Verhoeff, 1937

Fundort: Rila, Čamkurija (4 ♂♂, 6. 1933 Mařan & Táborský lgt.).

Die Art *L. peggauensis* ist neu für die Fauna Bulgariens. Sie war aus Steiermark (Österreich) beschrieben und dann in Spišská Magura-Gebirge (Tschechoslovakei) gefunden (Dobroruka, 1971). Die Rila-Gebirge ist also der dritte, bisher südlichste Fundort dieser Art, die wahrscheinlich als ein Bergbewohner angesehen werden muss.

Monotarsobius beroni (Negrea, 1965)

Fundort: Velka Papija, Strandža Planina (1 Ex., 7. 1934 Táborský lgt.).

Über die Priorität der Name *beroni* Negrea, 1965 gegen *taschevi* Matic & Golemansky, 1965 siehe Matic & Golemansky (1967) und Negrea (1971).

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SIZE AND GONADOTROPIC ACTIVITY OF CORPUS ALLATUM AFTER DIFFERENT SURGICAL TREATMENTS IN PYRRHOCORIS APTERUS FEMALES (HETEROPTERA)

MAGDALENA HODKOVÁ

Received February 5, 1976

Abstract: The volume of the corpus allatum increases considerably during the first half of the reproduction cycle. Transection of the allatic nerves prevents this volumetric increase but the ovarian maturation proceeds normally. After the extirpation of the pars intercerebralis of the brain the c. allatum remains small and the oocytes do not develop regularly. It is concluded that the pars intercerebralis stimulates both the volumetric increase and the gonadotropic activity of the c. allatum. The gonadotropic activity is independent from the nervous connections of the c. allatum with the brain although the volumetric growth of the gland is clearly stimulated through nerves. There is no correlation between the c. allatum volume and its ability to stimulate ovarian maturation in Pyrrhocoris apterus.

INTRODUCTION

The process of ovarian maturation requires in many species of insects a stimulus by the gonadotropic hormone which is released from the corpora allata (Engelmann, 1970). This is usually associated with an increase in the corpora allata volume. For this reason the volume of corpora allata has been very often used as a criterion of the secretory activity of the gland (Highnam, 1964; Engelmann, 1970). It appears, however, that the physiological activity of the gland may not be always correlated with the volumetric changes (Johansson, 1958; Mordue 1965, 1967; Lea & Thomsen 1969; Gillot & Dogra. 1972; Johnsson & Hill, 1973; Tobe & Pratt, 1975). In the course of our investigation concerning the regulation of corpus allatum activity in *Pyrrhocoris apterus* (Hodková, in press) it appeared quite essential to know also the relationships between the size of the gland and its ability to stimulate maturation of the oocytes in adult females of this species. These relationships have been now investigated with respect to the effects of transection of the allatic nerves and extirpation of the pars intercerebralis of the brain.

MATERIAL AND METHODS

Pyrrhocoris apterus larvae and adults were fed on lime-tree seeds. They were reared at long day (18 hrs light) and 27° C. Experimental females were isolated within 24 hrs after ecdysis they were deprived of food for two days and operated

Operations were made under insect saline by the neck-membrane technique described by Sláma (1964). Allatic nerves were transected together with the aorta. Pars intercerebralis of the brain was removed through an incission in the neurilemma. In sham-operated females the same procedure was followed but the allatic nerves or the pars intercerebralis were left untouched. Four groups of control females were used: females with a simple incision in the neck membrane, females with transected aorta, females in which lateral regions of protocerebrum were injured and unoperated females.

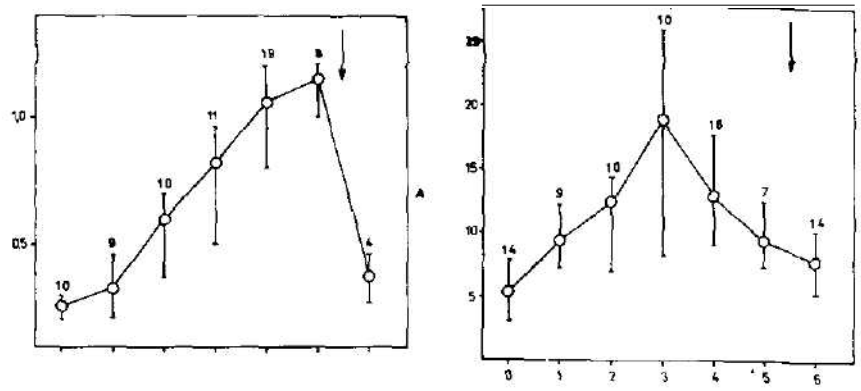

Fig. 1 A. Changes in the length of terminal oocytes during the first reproduction cycle in non-operated females. Horizontal axis: days after onset of feeding. Vertical axis: lenth of terminal oocytes (mm). Abscissae: range between min. and max. values. Figures above abscissae: number of ovaries measured. Arrow: oviposition.
Fig. 1 B. Changes of corpora allata volume during the first reproduction cycle in non-operated females. Vertical axis: volume of corpora allata (nannolitors). Other explanations see Fig. 1 A.

The length of terminal oocytes and the corpus allatum volume were measured in the light microscope. Bürker chamber of the depth of 0,01 mm was used for the measurement of the corpus allatum volume which was calculated according to the formula: π a b d (a and b = radii, d = = depth of Bürker chamber).

RESULTS

Volume of corpora allata and oocyte growth in normal females

The volume of corpus allatum undergoes a considerable increase during the first half of the reproduction cycle, as shown in Fig. 1 B. Maximum volume has been recorded on day 3 of the reproduction cycle which is terminated by oviposition between the days 5 to 6. Fig. 1 A shows that the oocytes grow successfully almost until the end of the cycle. Vitellogenesis is initiated when the oocytes reach the length of 0,4 mm and it is most intensive between the days 2 to 4. Maximum volume of the corpus allatum is reached when oocytes are about 0.8 mm in the middle of intensive vitellogenesis (Fig. 2). Growth of the corpus allatum is thus correlated with the growth of the oocytes.

Females with transected allatic nerves

Transection of the allatic nerves prevents the volumetric increase of the corpora allata (Fig. 3). Despite this, the growth of the oocytes has been delayed only for 1 day. The sham-operated females with the allatic nerves intact have reached the same size of the oocytes on day 4 as the operated ones (Fig. 4 A). This suggests that the mentioned delay in ovarian growth is not a direct result of the nerve transection. In comparison with the operated females, however, the corpus allatum of the sham-operated controls increased 2.5 times from the beginning until day 4 of the reproduction cycle (Fig. 4 B). These results indicate that the oocytes of these operated females do grow although the corpus allatum does not increase in size.

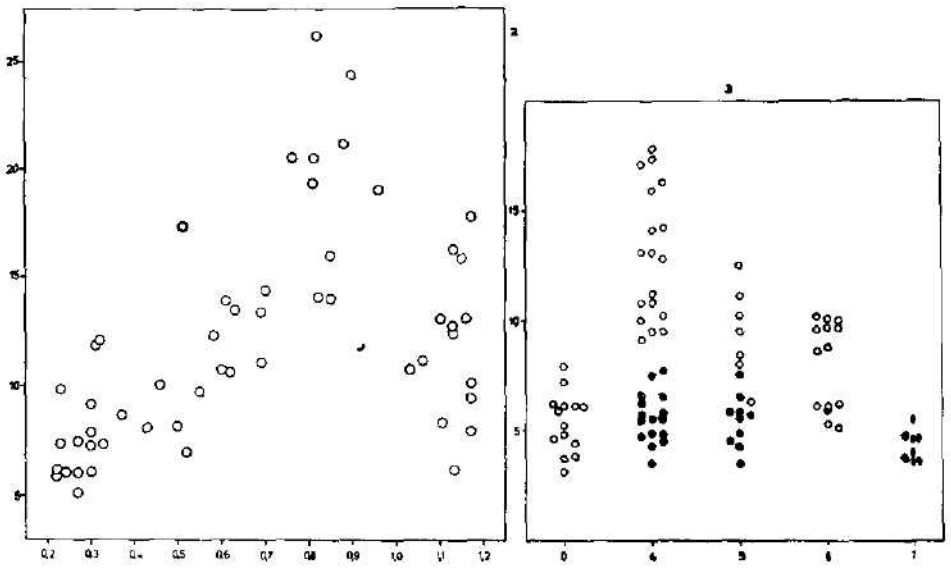

Fig. 2. Relation between the lenght of terminal oocytes and the corpora allata volume during the first reproduction cycle. Horizontal axis: length of terminal oocytes (mm). Vertical axis corpora allata volume (nannoliters).
Fig. 3. Changes of corpora allata volume during the first reproduction cycle in females with transected nervi allati. ○ non-operated controls; ● nervi allati and aorta transected. Horizontal axis. days after operation. Vertical axis: corpora allata volume (nannoliters). Non-operated controls oviposited between the 5th and 6th day. Females with transected nervi allati oviposited between the 6th and 7th day.

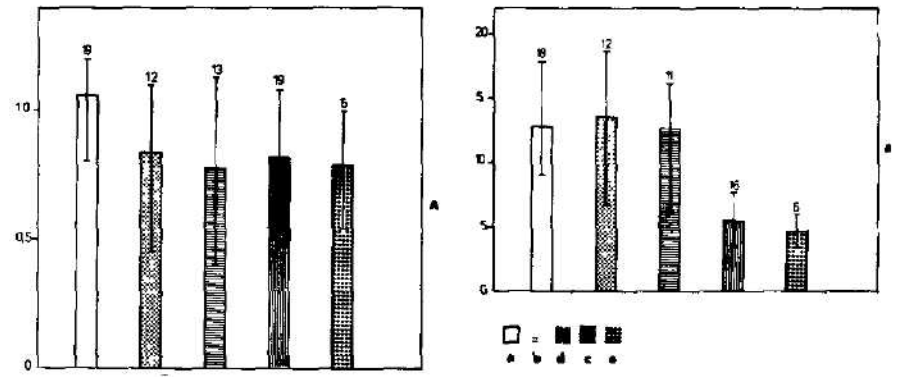

Fig. 4 A. Effect of transection of nervi allati on the length of terminal oocytes. a — non-operated controls; b — neck membrane incised; c — aorta transected; d — nervi allati transected, aorta transected completely; e — nervi allati transected, aorta transected partially. Vertical axis length of terminal oocytes (mm). Abscissae: range between min. and max values. Figures above abscissae: number of ovaries measured. Oocytes measured the 4th day after operation.
Fig. 4 B. Effect of transection of nervi allati on corpora allata volume. Vertical axis: corpora allata volume (nannoliters). Corpora allata measured the 4th day after operation. Other explanations see Fig. 4 A.

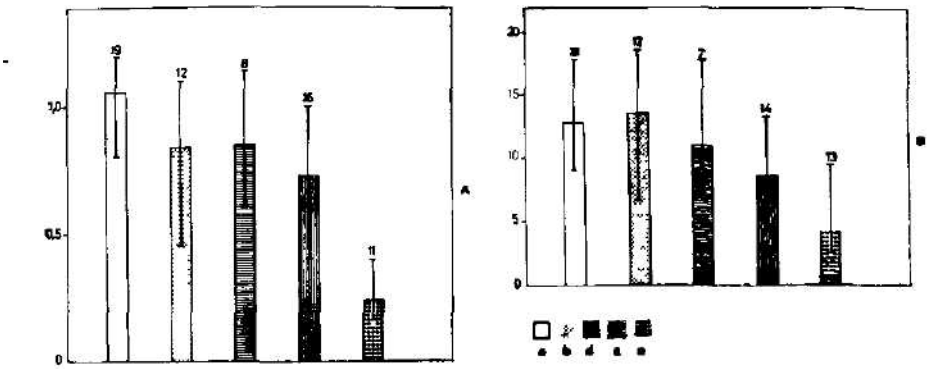

Fig. 5 A. Effect of extirpation of pars intercerebralis on the length of terminal oocytes. a — non-operated controls; b — neck membrane incised; c — lateral portions of protocerebrum injured; d — unilateral extirpation of pars intercerebralis; e — bilateral extirpation of pars intercerebralis. Vertical axis: length of terminal oocytes (mm) Abscissae: range between min. and max. value. Figures above abscissae: number of ovaries measured. Oocytes measured the 4th day after operation.

Fig. 5 B. Effect of extirpation of pars intercerebralis on corpora allata volume. Vertical axis: corpora allata volume (nannoliters). Corpora allata measured the 4th day after operation. Other explanations see Fig. 5 A.

Females with extirpated pars intercerebralis

After extirpation of the pars intercerebralis of the brain the corpora allata remained small and the oocytes did not develop regularly. This is documented by measurements performed on the females 4 days after operation (Fig. 5 A, B).

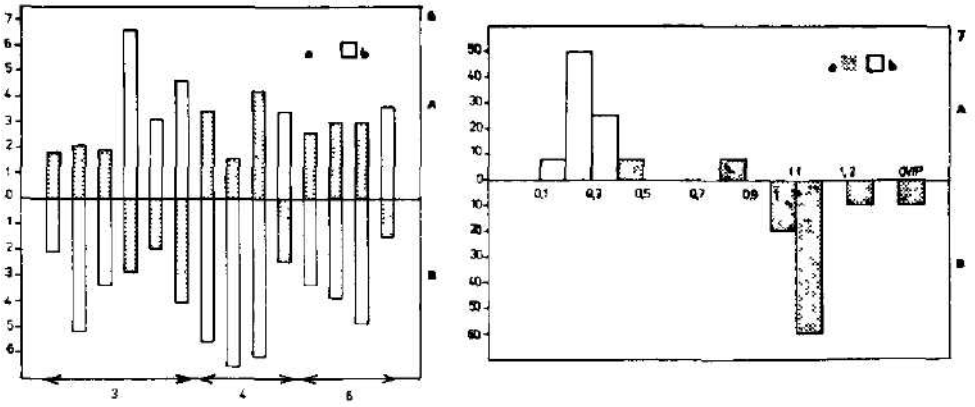

Fig. 6. Effect of unilateral extirpation of pars intercerebralis on corpora allata volume. Each bar represents volume of one corpus allatum. A — the half of corpus allatum on the extirpated side; B — the half of corpus allatum on the intact side; a — smaller hemisphere; b — greater hemisphere. Horizontal axis: days after operation. Vertical axis: corpora allata volume (nannoliters).

Fig. 7. Effect of juvenile hormone analogue on the growth of oocytes in females with extirpated pars intercerebralis (see also Tab. 1). A — extirpation of pars intercerebralis only; B — extirpation of pars intercerebralis and application of juvenile hormone analogue. Horizontal axis: length of terminal oocytes (mm). Vertical axis: incidence of females (%); a — oocytes with yolk; b — oocytes without yolk.

Tab. 1. Effect of application of juvenile hormone analogue on the growth of oocytes in females with extirpated pars intercerebralis

Surgical intervention	n	Length of terminal oocytes (mm)[1]	Corpora allata volume (nanoliters)
Extirpated pars intercerebralis	12	0.33 (0.16—0.81)	3.7 (2.1—9.1)
Extirpated pars intercerebralis and application of JH analogue[3]	10	1.15[2] (1.05—1.32)	—

[1]) Females dissected 7 days after intervention.
[2]) Length of terminal oocytes measured in 9 females; one female oviposited between 6th and 7th day after surgery.
[3]) Females contaminated topically by 10 µg of the juvenile hormone analogue (methyl of 3,7,11-trimethyl-11-chloro-2-dodecenoate) in 1 µl of acetone on the day of intervention.

Pyrrhocoris apterus has only one fused corpus allatum but two corpora cardiaca, one for each of the hemispheres. Volumetric changes of the corpus allatum were sometimes assymetric after unilateral extirpation of the pars intercerebralis. However, measurements of the volume of each of the corpus allatum hemispheres separately revealed no specific influence of the operation on the contralateral or on the ipsilateral part of the gland (Fig. 6). The volume of the whole gland was slightly smaller in comparison with normal females but the oocytes developed regularly (Fig. 5 A, B).

The females with extirpated pars intercerebralis which have been treated with juvenile hormone analogue exhibited almost normal growth of the oocytes although the number of matured eggs was reduced (Fig. 7, Tab. 1). This demonstrates that the ovaries of the females deprived of the pars intercerebralis are able to undergo egg maturation provided that they receive exogenous juvenile hormone. Conversely, we can assume that the absence of ovarian growth in these females was due to the impaired secretory activity of the corpora allata.

DISCUSSION

Our results confirm that, as in many other insects (Engelmann, 1970), the corpus allatum volume undergoes cyclical changes in the course of the first reproduction cycle of *Pyrrhocoris apterus* females (Sláma et al., 1974). It has been found in other species that the corpus allatum fails to increase in size after the extirpation of the pars intercerebralis (Thomsen, 1952 – *Calliphora erythrocephala;* Johansson, 1958 — *Oncopeltus fasciatus;* Strong, 1965 a, b — *Schistocerca paranensis*). These relatively small glands have been assumed to be less active than the large ones of the normal specimens. Our results provide an indirect evidence that this assumption may be correct. The subnormal size of the corpus allatum in *P. apterus* females deprived of their pars intercerebralis appears to be well correlated with the lower secretory activity of the gland. This allows to conclude that the pars intercerebralis stimulates here both volumetric increase and the gonadotropic activity of the

corpus allatum. Half number of neurosecretory cells of the pars intercerebralis is sufficient for almost normal ovarian maturation although normal increase of corpus allatum volume proceeds only if pars intercerebralis is intact.

It has been observed that stimulation of corpus allatum growth is provided from the ipsilateral side of the pars intercerebralis in Schistocerca paranensis females (Strong, 1965 a, b). In contrast to this there are no direct correlations between the pars intercerebralis of each of the brain hemispheres and bilaterally assymetric growth of the corpus allatum in *P. apterus*.

Unlike in normal and pars intercerebralis-ectomized females there exist no correlations between the corpus allatum volume and gonadotropic activity in females with transected allatic nerves. The situation is similar to that reported for *Oncopeltus fasciatus* (Johansson, 1958), *Tenebrio molitor* (Mordue, 1965, 1967) or *Locusta migratoria* (Habai & Garcin, 1975). In *P. apterus*, *O. fasciatus* and *L. migratoria* the gonadotropic activity is independent from nervous connections of the corpus allatum with the brain, although the volumetric growth of the gland is clearly stimulated through the nerves. On the other hand, the denervated corpus allatum does not stimulate ovarian maturation in *T. molitor* in spite of its hypertrophic size. Finally, transection of allatic nerves has suppressed volumetric growth as well as gonadotropic activity of the corpora allata in *Schistocerca paranensis* (Strong, 1965 a, b) suggesting that both these functions are here dependent on nervous connections.

It is likely that the small, denervated corpus allatum of *P. apterus* females produces and secretes lower amounts of the hormone but the amount is still close to the physiologically effective concentrations. The final proof of this possibility will be investigated later using some other criteria than ovarian maturation. However, reports on other insects indicate that there may be no correlations between the glandular size and concentration of juvenile hormone in the haemolymph (Johnsson & Hill, 1973— *Locusta migratoria*) or synthesis of the hormone from the glands incubated in vitro (Tobe & Pratt, 1975 — *Schistocerca gregaria*). The results of this paper have demonstrated that there may be no correlations between the corpus allatum volume and its ability to stimulate ovarian maturation in *Pyrrhocoris apterus*.

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Westbohmisches Museum, naturwissenschaftliche Abteilung, Plzeň

CHIROPTEROZÖNOSEN EINIGER WINTERQUARTIERE IN WESTBÖHMEN

LUDĚK HŮRKA

Eingegangen am 10. Januar 1976

Abstract: An attempt is made to evaluate the coenoses of bats in various types of winter quarters by statistical-ecological methods.

EINLEITUNG

Im Jahre 1959 wurde die systematische Erforschung der Chiropterofauna in West- und Südwestböhmen eingeleitet und im Verlauf der folgenden 18 Jahre wurden unter anderem auch einige auserlesene Typen der ständigen Winterquartiere der Fledermäuse regelmassig verfolgt. Als Ziel stand hier die Erforschung der Änderungen in der Artenzahl, ihrer Bestandigkeit, der Dominanz und Affinitat einzelner Arten, der ökologischen Bedingungen im Verlauf der Überwinterung und schliesslich der Versuch um Bewertung der Chiropterozönosen in verschiedenen Typen der Winterquartiere vom Standpunkt der gegenseitigen Beziehungen der einzelnen Fledermausarten. Über die Ergebnisse der Forschung wird im vorgelegten Beitrag referiert.

MATERIAL UND METHODIK

In funf auserlesenen Winterquartieren wurden die Kontrollen mindestens einmal in der Winterperiode (November — April) auf gleiche Weise durchgefuhrt. Insgesamt sind in ihnen 1357 Exemplare der Fledermause angetroffen worden, die 12 Arten angehoren *Rhinolophus hipposideros, Myotis mystacinus, Myotis brandti, Myotis myotis, Myotis daubentoni, Myotis nattereri, Eptesicus nilsoni, Eptesicus serotinus, Pipistrellus pipistrellus, Barbastella barbastellus, Plecotus auritus* und *Plecotus austriacus*. Das Ergebnis jeder auf Feststellung der Zonose gezielten Kontrolle war die Bestandsaufnahme der Arten, gegebenfalls auch der Individuen derselben. Insgesamt wurden an verfolgten Lokalitaten 71 Kontrollen vorgenommen.

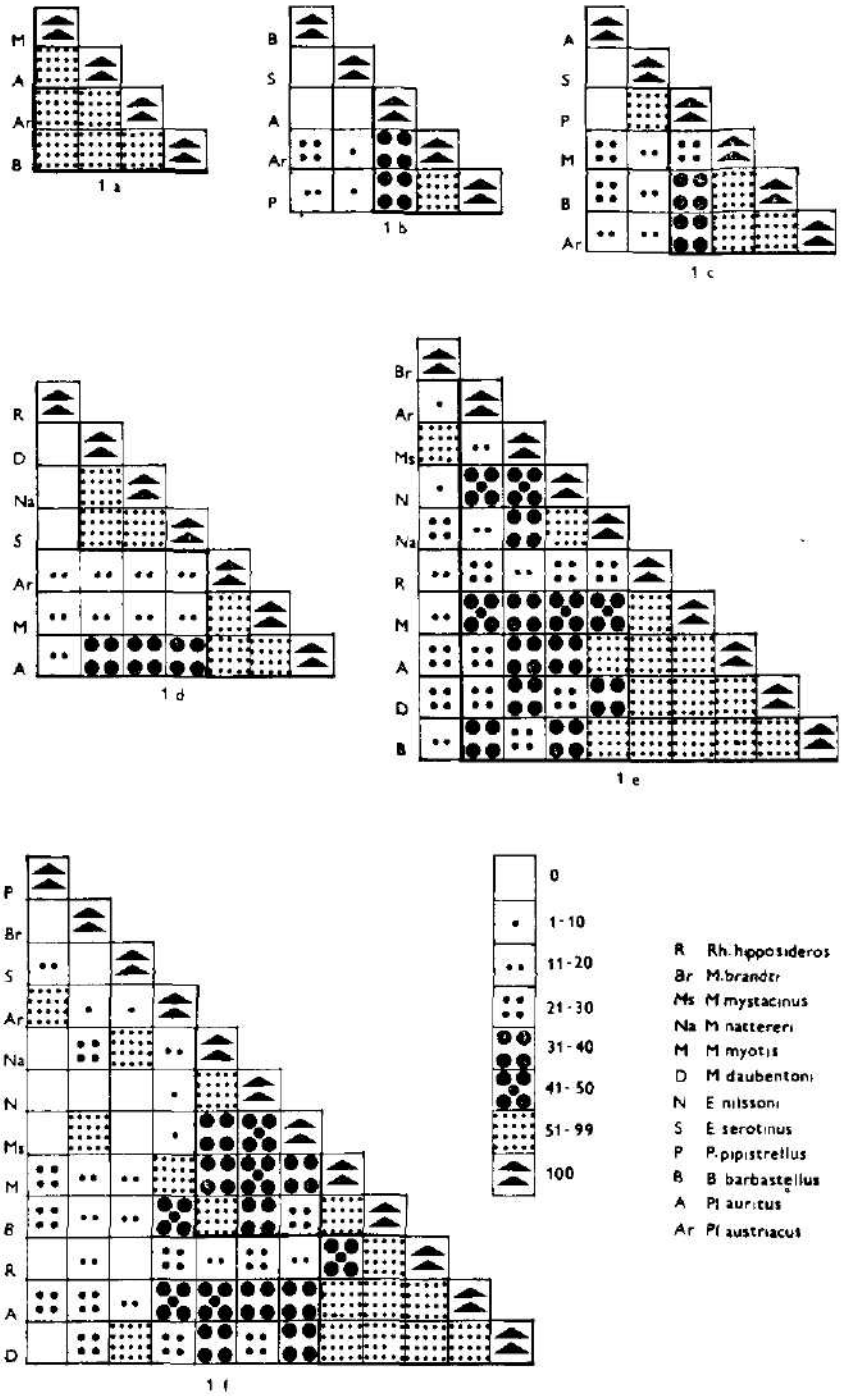
Die verfolgten Lokalitaten:

1 Kladruby bei Stříbro — ausgedehnte oberirdische Keller der ehemaligen Brauerei in 442 m u. M. Die Lokalitat besteht aus 4 Raumen, je $10 \times 30 \times 8$ m in Ausmass, die mit Gangen verbunden sind und weiters aus einigen kleineren Raumlichkeiten. Das ganze Objekt befindet sich am Rande der Gemeinde und ist von einem grossen Garten mit gemischten Baumbestand umgeben. Es wurden hier 12 Kontrollen durchgefuhrt

2. Horšovský Týn — unterirdische Keller des Schlosses in 337 m u. M. Zwei Raume $10 \times 10 \times 4$ m in Ausmass mit Zutrittsgangen, aus Stein erbaut Das Schloss steht ziemlich dicht an der Gemeindemitte und ist von einem grossen Garten der in Park mit einem Teich ubergeht umgeben. Die Lokalitat wurde insgesamt 19 mal kontrolliert.

3. Mirošov — unterirdische Keller des ehemaligen Speichers in 457 m u. M. Ausmass des durch ein Scheidewand aufgeteilten Raumes ist $19 \times 19 \times 3{,}5$ m; weiters ist hier eine 20 m lange Holztreppe und 50 m langer Gang, der nur 1,5 m hoch ist Der Speicher steht im Feld am Rande der Gemeinde und wurde 7 mal kontrolliert

4. Rabí — unterirdische Raume der Burgruine in 520 m u. M. Ein ausgedehntes Komplex der Keller in zwei Stockwerken ein Teil davon im Fels ausgehauen. Das Objekt steht am Rande der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R Rh. hipposideros
Br M. brandti
Ms M. mystacinus
Na M. nattereri
M M. myotis
D M. daubentoni
N E. nilssoni
S E. serotinus
P P. pipistrellus
B B. barbastellus
A Pl. auritus
Ar Pl. austriacus

Gemeinde und ist von Nadelwäldern, teilweise auch Laubwäldern umgeben. Es wurde 11 mal besucht.

5. Stollenkomplex im Amaliental (Goldbachtal) auf dem Kataster der Gemeinde Rejštejn, 650—710 m ü. M. Zehn Stollen sind hier im Gneis und Glimmerschiefer des mit Fichten und Kiefern bewachsenen Südhanges dessen Länge cca 3 km beträgt, ausgehauen. Es wurden hier 22 Kontrollen durchgeführt.

ERGEBNISSE UND DISKUSION

Zur Charakteristik der Grundzönose der Fledermäuse in einzelnen verfolgten Winterquartieren wurde von den statistischökologischen Methoden in der ersten Reihe das Sörensen'sche Affinitätskoeffizient angewandt, dann zur graphischen Veranschaulichung die Methode der Differenzialanalyse und schliesslich das Koeffizient χ^2, das zur Erfassung des Kohabitationsgrades zweier Fledermausarten dient (alles aus Dajoz, 1972).

Das Sörensen'sche Koeffizient ist wegen seiner im Vergleich mit Jaccard--Koeffizient höheren Werte erwählt worden, da diese sich zur graphischen Darstellung durch Differenzialanalyse besser eignen.

$$\text{Sörensen-Koeffizient: } q = \frac{2c}{a+b} \times 100 ,$$

wobei a die Probenzahl bedeutet, bei welchen die Fledermausart A vorgefunden worden ist, b die Probenzahl mit Fledermausart B, und schliesslich c die Proben angibt, in welchen beide Arten (A, B) gleichzeitig angetroffen wurden. Statt Proben kann man auch direkt die Stückzahl der vorgefundenen A und B — Arten einsetzen und das Ergebnis bleibt dasselbe.

Zur Berechnung der Werte $\chi^2 = \frac{N^3}{ab(N-a)(N-b)}) \times (c - P)^2$ wurden die gleichen Bezeichnungen wie oben angewandt: N bedeutet die Gesamtzahl der Proben und $P = \frac{ab}{N}$.

Nach der Festsetzung des Sörensen'schen Koeffizients wurden die einzelnen Werte in folgende Gruppen eingeteilt: 0, 1—10, 11—20, 21—30, 31—40, 41—50, 51—99, 100 % und mit Symbolen bezeichnet (siehe die Graphen). Die ermittelte und für einzelne Lokalitäten zusammengestellte Charakteristik der Zönosen entspricht dann den Graphen.

Aus diesen Graphen 1 a—f ergibt sich, dass die Chiropterozönosen in der Artenzahl der beteiligten Fledermäuse deutlich voneinander abweichen.

Nach der Differenzialanalyse, die auf Grund der Affinitätskoeffiziente durchgeführt wurde (wobei die Affinität hier, im Gegensatz zu den bisher in der Chiropterologie gebrauchten Bezeichnungen Treue, Beständigkeit, die mathematisch ermittelte Stufe der Kohabitation zweier Arten bedeutet), wird das Winterquartier Mirošov (Graph 1 a) von der nur aus Grundarten zusammengesetzten Chiropterozönose bewohnt (alle anwesenden Arten kohabitieren mit dem fast gleichen Werte des Sörensen-Koeffizients). Die ökologischen Bedingungen dieses Winterquartiers entsprechen also völlig nicht nur der Anwesenheit, sondern auch der Koexistenz aller vier hier vorgefundenen Arten (*M. myotis*, *Pl. auritus*, *Pl. austriacus* und *B. barbastellus*). Die

Graphen 1 a—f: Chiropterozönosen der verfolgten Winterquartiere; a — Mirošov, b — Horšovský Týn, c — Kladruby, d — Rabí, e — Amaliental, f — alle fünf Winterquartiere zusammen.

Grundsynusie der Fledermäuse an der Lokalität Horšovský Týn (Graph 1 b) wird nur von drei von den hier vorgefundenen fünf Arten gebildet. Trotz seines verhältnismässig grossen Umfangs gehört diese Lokalität nach der Zusammensetzung ihrer Chiropterozönose eher zu solchen Typen der Winterquartiere, die durch die Kellerräume in kleineren Wohnhäusern repräsentiert werden. Davon zeugt auch die Tatsache, dass hier in der Winterperiode *M. myotis* fehlt, dessen Wochenstube sich auf dem Dachboden der etwa 100 m entferten Kirche befindet. Eine weitere Ursache der abweichenden Zusammensetzung der Chiropterozönose dieses Winterquartiers dürfte die starke Konzentration von *P. pipistrellus* und das Charakter seiner Überwinterung sein (Hůrka, 1966). Die Fledermäuse dieser Art besetzen fast alle bewohnbaren Spalten und konkurieren durch diese Überwinterungsweise allen anderen Fledermausarten. Als Beweis, dass in einer kleineren Anzahl *P. pipistrellus* auch mit mehreren übrigen Arten koexistieren kann, dient die Lokalität Kladruby bei Stříbro (Graph 1 c). In der Grundzönose kommt hier aber *Pl. auritus* nicht vor, weil es in der Winterperiode den ökologisch mehr geeigneten Bergwerkstollen Vorzug gibt. In Kladruby ist ein kleinerer Stollen etwa 400 m von der Brauerei entfernt und bisher wurden hier nur Angehörige der *Pl. auritus* — Art angetroffen.

Am Graph 1 d, der die Chiropterozönese der Burgruine Rabí darstellt, sind zwei deutlich voneinander abweichenden Gesellschaften zu verzeichnen. Die eine wird von den hauptsächlich die Stollen bewohnenden Arten (*M. daubentoni, M. nattereri* und *E. serotinus*) gebildet, die zweite von den umfangreichere Kellerräume bewohnenden Fledermäusen (*M. myotis, Pl. auritus* und *Pl. austriacus*). Es zeigt sich, dass die ökologischen Bedingungen dieses Winterquartiers sehr verschiedenartig sind und dasselbe daher als Übergangstyp zwischen den Stollen und Gebäudekellern bezeichnet werden kann.

Graph 1 e darstellt die Fledermausgesellschaft aus den Stollen im Amaliental bei Rejštejn. Diese Zönose zeichnet sich durch eine hohe Artenzahl und hohe gegenseitige Artenaffinität aus und zeigt auf die idealsten ökologischen Bedingungen für die Überwinterung der Fledermäuse auf dem erforschten Gebiet.

Der letzte Teil des Graphes 1 f fasst die Ergebnisse zusammen, die auf Grund des Sörensen'schen Indexes für alle fünf öfter verfolgten Winterquartiere der Fledermäuse in Westböhmen gewonnen worden sind. Die Artenkoexistenz konnte man hier verlässlich nicht beurteilen, da das zur Verfügung stehende Material aus fünf Lokalitäten für diese Bewertung der Population nicht ausreicht. Man kann nur auf die breitere ökologische Valenz von *M. myotis* und *B. barbastellus* im Gegensatz zu anderen Fledermausarten hinweisen, die in zwei ökologisch abweichenden Gesellschaften aufgeteilt werden können. Die im Graph 1 f dargestellte Differenzialanalyse soll nur bestätigen, wie sich die Interartbeziehungen ändern und wie man sich bei den Schlüssen über die ökologischen Ansprüche einer bestimmten Fledermauspopulation ohne Anwendung der ökologischstatistischen Teste leicht irren kann.

Allgemein wäre also zu konstatieren, dass sich die Nachweislichkeit des angesammelten Materials mit Hilfe der statistischen Methoden gut testieren lässt, was dann die Bestätigung oder auch Richtigstellung der früheren theoretischen Schlüsse ermöglicht.

Zur Ergänzung und Präzisierung der obenerwähnten statistischen Methoden dienen bei der Bewertung der Zönose, der gegenseitigen Interartbezie-

hungen und bei der Ermittlung der Zufälligkeitsstufe der Eingliederung einzelner Arten in der Chiropterozönose (und Zoozönose überhaupt) die Werte, welche mit Hilfe des χ^2 — Testes errechnet wurden. Ich führe hier als Beispiel die mit dem χ^2 — Test erzielten Ergebnisse von den öfter kontrollierten Winterquartieren an: für sibling species *Pl. auritus* und *Pl. austriacus* beträgt der Wert an der Lokalität Mirošov 4,90; Kladruby 3,41; Rabí 1,10; Horšovský Týn 0,84 und Amaliental 0,01. Nach Dajoz, 1972 bedeutet das, dass die Koexistenz zweier Arten der Gattung *Plecotus* an Lokalitäten Mirošov und Kladruby höchstwahrscheinlich (92—97 %) und keineswegs zufällig ist. Wogegen an übrigen Stellen als sehr niedrig und zufällig bezeichnet werden kann. Diese theoretischen Schlüsse entsprechen vollauf den durch die Beobachtungen gewonnenen Erfahrungen über die ökologischen Ansprüche beider Arten auf dem erforschten Gebiet Westböhmens (Hůrka, 1971), bzw. auch dem quantitativen Vorkommen der einen oder anderen Art in bestimmter Gegend. Die obenerwähnten Werte können auch die Möglichkeiten der Winterquartierenauswahl im Gebiet andeuten.

Danksagung

Für wertvolle Ratschlage bei der Auswahl und Anwendungen der statistischen Methoden zur Bewertung der Fledermausgesellschaften in den verfolgten Winterquartieren und fur die Durchlesung des Manuskript bin ich dem Herrn Dozent Dr. J. Doskočil, CSc. von dem Lehrstuhl der systematischen Zoologie der Naturwissenschaftlichen Fak. der Karls-Universität in Prag sehr verpflichtet.

ZUSAMMENFASSUNG

1. Die Chiropterozönose eines Winterquartiers kann nur von den Grundarten gebildet werden und alle hier vorgefundenen Arten beteiligen sich annähernd im gleichen Masse an der Synusienbildung, oder sie kann aus den Grund- und Nebenarten zusammengesetzt sein, wobei die letzteren, die in die Grundzönose nicht gehören sich durch eine hochgradig verschiedenartige Affinität zu anderen an der Lokalität anwesenden Arten bemerkbar machen. Sie kommen auch nur unregelmässig, zufällig an der Lokalität vor.

2. Statistisch wurde die Verschiedenheit und Verschiedenartigkeit der relativ gleichen Winterquartiere in unterirdischen Räumen nachgewiesen, was in der Zahl der angetroffenen Arten und in der Stufe ihrer Koexistenz zum Ausdruck kommt.

3. Auf Grund des χ^2 — Testes wurden verschiedene Stufen der Kohabitation gleicher Fledermausarten in den relativ gleichen Typen der Winterquartiere festgestellt. Es erscheint daher notwendig auf Grund eines umfangreicheren Materials eine breitere Skala der Winterquartierstypen als bis jetzt (Gebäudekeller, Stollen, Grotten) in Anwendung zu bringen.

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BLUTPROTOZOEN DER FREILEBENDEN SINGVÖGEL IN DER TSCHECHOSLOWAKEI

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Abstract: 343 birds of the order Passeriformes (45 species) were examined for hematozoa. The parasites were found in 75 birds (19 species). The founded parasites belong to the genera *Trypanosoma*, *Plasmodium* (subgenera *Haemamoeba*, *Giovannolaia*, *Novyella*), *Haemoproteus*, *Leucocytozoon*, *Atoxoplasma* (a parasite of the leucocytes) and *Lankesterella* (a parasite of the erythrocytes). New host parasite associations were: *Trypanosoma*, *Plasmodium* and *Leucocytozoon* by *Anthus trivialis*, *Plasmodium* and *Lankesterella* by *Motacilla cinerea* and *Atoxoplasma* by *Sylvia curruca*, *Troglodytes troglodytes*, *Lanius collurio* and *Parus major*.

EINLEITUNG

Aus der Tschechoslowakei existieren bisher nur wenige Angaben über die Blutprotozoen der freilebenden Singvögel. Während in der Mehrheit der europäischen Länder eine verhältnissmässige Erforschung auf diesem Feld verläuft oder durchgeführt wurde (siehe z. B.: Wenyon (1926), Ramisz (1958, 1960), Dymowska u. Żukowski (1968), Geigy u. a. (1962), Lovrics (1967), Rogge (1965), Dylko (1966), Baker (1974), Corradetti (1974) u. a.), wurde diese Problematik in der Tschechoslowakei nur von Černý (1930, 1933) studiert.

In meiner Arbeit sind die Resultate der Erforschung des Vorkommens der Blutparasiten bei 45 Arten der freilebenden Singvögel angeführt und die Vergleichung des festgestellten Standes des Vorkommens dieser Parasiten mit dem Stand vor 40 Jahren durchgeführt, wie ihn Černý (1930, 1933) anführt, der bei den 202 untersuchten Singvögel (42 Arten) die Parasiten der Gattungen *Trypanosoma* (bei den 2 Singvögeln, d. h. 1 % der untersuchten), *Plasmodium* (10, d. h. 5 %), *Haemoproteus* (19, d. h. 9,5 %), *Leucocytozoon* (15,d. h. 7,4 %). und *Atoxoplasma* (8, d. h. 4 %) gefunden hat.

MATERIAL UND METHODIK

Die lebenden Vogel habe ich in Vogelnetze und Vogelfallen gefangen. Alle Vogel stammen aus 2 Bezirken der ČSSR: aus dem Mittelböhmischen Bezirk (hauptsächlich aus Prag und Umgebung) und aus dem Südböhmischen Bezirk (hauptsachlich aus der Umgebung der biologischen Station UK „Ruda" bei Veselí nad Lužnicí und aus der Umgebung der hydrobiologischen Station UK bei Blatná).

Die Sammlung der Materialien habe ich vom Dezember 1972 bis Dezember 1974 durchgeführt

Aus dem aus vena cutanea ulnaris abgenommenen Blut habe ich die getrockneten Blutausstriche verfertigt, die ich mit Methylalkohol fixiert und mit Giemsa gefarbt habe. Diese Präparate habe ich unter dem Immersionobjektiv untersucht (Vergrosserung 1000×). Insofern ich innerhalb von 30 Minuten keine Blutparasiten entdecken konnte, habe ich diese Blutausstriche als negativ betrachtet.

Tabelle 1. Übersicht der untersuchten Vogel mit den gefundenen Parasiten.

Wirtsvogel			Parasiten (Anzahl der inf. Vogel)						
Art (Familie)	Untersucht	Inf.	T	P	H	H?n.P?	Le	A	La
Muscicapidae:									
Muscicapa striata (Pall.)	1	1	—	—	1	—	—	—	—
Sylvidae:									
Sylvia borin (Bodd.)	4	1	—	—	1	—	—	—	—
S. atricapilla (L.)	11	6	—	—	6	—	—	—	—
S. curruca (L.)	8	2	—	—	1	—	—	1*	—
Turdidae:									
Turdus philomelos Brehm	12	3	—	—	3	—	—	—	—
T. merula L.	27	14	—	2	3	4	11	—	—
Troglodytidae:									
Troglodytes troglodytes (L.)	7	2	—	—	—	—	—	2*	—
Laniidae:									
Lanius collurio L.	9	6	1	1	3	—	—	4*	—
Paridae:									
Parus major L.	24	11	—	—	10	—	4	1*	—
P. caeruleus L.	14	5	—	—	4	—	1	—	—
Fringillidae:									
Chloris chloris (L.)	26	1	—	—	1	—	1	—	—
Pyrrhula pyrrhula (L.)	1	1	—	—	—	—	1	—	—
Fringilla coelebs L.	17	5	—	—	5	—	—	—	—
Emberizidae:									
Emberiza citrinella L.	8	3	—	—	2	—	1	—	—
Ploceidae:									
Passer domesticus (L.)	60	2	—	1	—	—	—	1	—
P. montanus (L.)	32	3	—	1	2	—	—	—	—
Motacillidae:									
Anthus trivialis (L.)	3	2	1*	1*	—	—	1*	—	—
Motacilla cinerea Tunst.	12	6	—	1*	—	—	—	—	5*
M. alba L.	1	1	—	—	1	—	—	—	—
Negative Vögel:									
26 Arten**	66	—	—	—	—	—	—	—	—
Insgesamt der Vögel	343	75	2	7	43	4	20	9	5
D. h. %	100	22	0,6	2	12,8	1	5,8	2,6	1,5
Anzahl der Arten	45	19	2	6	14	1	7	5	1

T: *Trypanosoma*, P: *Plasmodium*, H: *Haemoproteus*, H?n.P?: strittiger Fall zwischen den Gattungen *Plasmodium* u. *Haemoproteus*, Le: *Leucocytozoon*, A: *Atoxoplasma*, La: *Lankesterella*.
* Der erste Fund dieser Parasiten bei der gegebenen Wirtsart.
** Vogel, bei denen keine Infektionen gefunden werden: 1 *Ficedula parva* (Bechst.), 1 *Sylvia communis* Lath., 1 *Hippolais icterina* (Vieill.), 17 *Phylloscopus collybita* (Vieill.), 1 *P. trochilus* (l), 1 *Acrocephalus arundinaceus* (L), 2 *A. scirpaceus* (Herm.), 1 *Regulus regulus* (L.), 14 *Erithacus rubecula* (L), 1 *Phoenicurus phoenicurus* (L), 1 *P. ochruros* (Gm), 1 *Prunella modularis* (L), 1 *Cinclus cinclus* (L), 1 *Parus ater* L, 1 *P. cristatus* L, 6 *P. montanus* L, 1 *P. palustris* L., 2 *Aegithalos caudatus* (L.), 4 *Sitta europea* L., 1 *Certhia familiaris* L., 1 *C. brachydactyla* Brehm, 2 *Carduelis carduelis* (L.), 1 *Serinus serinus* (L.), 1 *Emberiza schoeniclus* (L.), 1 *Sturnus vulgaris* L., 1 *Garrulus glandarius* (L.).

Die Fachbenennung der Vögel und die Teilung in die Familien nach Kluz (1965).

ERGEBNISSE

a) Gesamtergebnisse

Insgesamt habe ich 343 Singvögel (45 Arten) untersucht. Blutparasiten habe ich bei 75 Vögel (19 Arten) gefunden. Die Übersicht der untersuchten

Singvögel mit den gefundenen Parasiten wird in der Tabelle 1 angeführt. Von der Gesamtzahl der 75 infizierten Singvögel war die Infektion doppelt und bei 2 Vögeln war die Infektion sogar dreifach.

b) Bemerkungen zu den einzelnen Gattungen der Parasiten

Trypanosoma Gruby, 1843

Die Vogeltrypanosomen sind sehr wenig wirtsspezifisch (Baker (1956), Bennet (1961) u. a.). Bei der Mehrzahl der Vögel wird heute nur eine Art *Trypanosoma avium* Danilewsky, 1885 anerkannt.

Das Vorkommen dieser Protozoen im peripherischen Blut der Vögel ist gewöhnlich sehr selten, sodass die Funde dieser Parasiten in den Blutausstrichen ziemlich zufällig sind und kein gutes Bild über den wirklichen Umfang der Infektion geben. Bei beiden Arten der infizierten Vögel habe ich in jedem Blutausstrich nur ein Exemplar des Parasiten gefunden.

Bei *Anthus trivialis* geht es um den ersten Fund der Trypanosomen überhaupt.

Die infizierten Vögel habe ich Ende Frühjahr (Mai, Juni) untersucht und bei beiden Arten handelte es sich um alte Individuen.

Plasmodium Marchiafava et Celli, 1885

Diese Arten der Parasiten (hauptsächlich bei der Untergattung *Haemamoeba*)sind heutzutage die besten durchstudierten Blutprotozoen der Vögel (s. z. b. Garnham (1966).

Corradetti, Garnham und Laird (1963) haben auf Grund der Morphologie Blutstadien das Aufteilen der Vögelplasmodien in 4 Untergattungen durchgeführt. Bei unseren Singvögeln habe ich Angehörige der 3 Untergattungen festgestellt: *Haemamoeba*, die ich bei *Turdus merula*, *Lanius collurio* und *Passer montanus* gefunden habe, *Giovannolaia* habe ich bei *Passer domesticus* und *Motacilla cinerea* gefunden und *Novyella* bei *Anthus trivialis*. Bei der Untergattung *Haemamoeba* geht es wahrscheinlich um *Plasmodium relictum* (Grassi und Feletti, 1891), bei der Untergattung *Giovannolaia* um *P. polare* Manwell, 1934 (der Parasit bei *Passer domesticus*) un *P circumflexum* Kikuth, 1931 (bei *Motacilla cinerea*) und bei der Untergattung *Novyella* geht es höchstwahrscheinlich um *P. rouxi* Sergent, Sergent und Catenei, 1928. Die genaue Diagnostik der Arten wäre jedoch erst auf Grund mehrmaliger Untersuchung der infizierten Vögel und nach der Durchführung der Experimentalinfektionen der Laboratoriumvögel möglich.

Bei zwei Arten der Singvögel (*Motacilla cinerea* und *Anthus trivialis*) geht es um die ersten Funde der Parasiten der *Plasmodium*-Gattung überhaupt.

Die Mehrzahl der infizierten Vögel habe ich in der Nestperiode (Mai bis Oktober) gefangen. Eine Ausnahme bildet ein Fund im Januar. Vier der infizierten Vögel waren alte Vögel (d. h. 3,5 % aller untersuchten alten Singvögel) und die restlichen 2 waren junge Vögel (d. h. 2,5 % aller untersuchten jungen Vögel).

Haemoproteus Kruse, 1890

Die Parasiten dieser Gattung kommen bei unseren Singvögeln am meisten vor.

Mit Rücksicht auf die kleinen Kentnisse über die Wirtsspezifizität und über die Lebenszyklen dieser Protozoen, ist heute die Problematik der Arten dieser Parasiten bei den Singvögeln nicht befriedigend gelöst.

Levine und Campbell (1971) sind der Meinung, dass es sich wahrschenlich um die wirtshöchstspezifischen Parasiten handelt. Sie gehen dabei von den Arbeiten Baker's (1966, 1968) aus, der festgestellt hat, dass zwei Arten der Parasiten der Gattung *Haemoproteus* bei 2 Arten der englischen Tauben *(Columba livia* und *C. palumbus)* vorkommen, die zwischen beiden Arten ihrer Wirtsvögel gegenseitig unübertragbar sind. Trotzdem dass bei allen Vögeln, bei denen ich die Infektion mit diesen Protozoen gefunden habe, die Parasiten schon früher von verschieden Autoren gefunden worden sind, sind bei ihnen nur 2 Arten beschrieben, u. zw.: *H. chloriis* Ortega und Berenguer, 1950 aus *Chloris chloris* und *H. fringillae* (Labbé, 1894) aus *Fringilla coelebs* (siehe Levine und Campbell 1971).

Demgegenüber sind Ramisz (1960) u. a. der Meinung, dass bei den Singvögeln nur zwei Arten vorkommen, die sich hauptsächlich von der Gametocytenform unterscheiden. Gametocyten der ersten als *H. danilewskii* (Kruse, 1890) bezeichneten Art verschieben gewöhnlich den Kern der Blutzelle nicht aus der Zentrallage und umkreisen diesen Kern in charakteristischer Weise, sodass es manchmal aussieht, als ob der Erythrocytenkern ganz von dem Parasiten umgeben wäre. Dementgegen die Gametocyten der anderen Art (*H. fringillae* (Labbé, 1894) haben nur kleine Tendenz zum Umgeben des Blutkernes, den sie am meisten aus der Zentrallage an den Rand verschieben. Der Status dieser beiden Arten ist jedoch ziemlich unklar, weil praktisch keine Angaben über ihre Entwicklung und mögliche Übertragungen unter den einzelnen Arten der Vögel bestehen. Darum bin ich der Meinung, dass es zutreffender wäre, die beiden abweichenden Parasitenformen vielmehr als Typen als Arten zu bezeichnen.

Das Vorkommen beider Typen bei unseren Singvögeln ist in der Tabelle 2 angeführt. Aus dieser Tabelle sieht man, dass immer nur ein Typus der Gametocyten in der überwiegenden Mehrheit bei einer Art des Wirtsvogels vorkommt. Eine Ausnahme bilden nur die bei *Turdus philomelos, T. merula*

Tabelle 2. Der Vorkommen der Parasiten des Typus „*Haemoproteus danilewskii*" und „*H. fringillae*" bei unseren Singvögeln.

Wirtsvögel	Typus des Parasiten (Anz. der inf. Vögel) „*H. danilewskii*"	vorübergehender	„*H. fringillae*"
Musicapa striata (Pall.)	–	–	1
Sylvia borin (Bodd)	1	–	–
S. atricapilla (L.)	6	–	–
S. curruca (L.)	1	–	–
Turdus philomelos Brehm	–	3	–
T. merula L.	–	3	–
Lanius collurio L.	3	–	–
Parus major L.	–	–	10
P. caeruleus L.	–	–	1
Chloris chloris (L.)	–	–	1
Fringilla coelebs L.	5	–	–
Emberiza citrinella L.	–	–	2
Passer montanus (L.)	–	2	–
Motacilla alba L.	–	–	1

und *Passer montanus* gefundenen Parasiten, bei denen die Gametocytenform auf dem Übergang zwischen beiden Typen ist.

Auf Grund der Entwicklung in den verschiedenen Arten der Insekten-Übertrager teilten Bennet, Garnham und Fallis (1965) die Gattung *Haemoproteus* in zwei Gattungen ein: *Haemoproteus*, die durch Fliegen aus der Familie Hippoboscidae übertragen wird, und eine neue Gattung *Parahaemoproteus* Bennet, Garnham und Fallis, 1965, die durch Insekten der Gattung *Culicoides* übertragen wird. In diese neue Gattung reihen sie auch die Parasiten der Singvögel *(Parahaemoproteus fringillae)* ein. Bei den Singvögelparasiten ist jedoch die Eingliederung in diese neue Gattung ziemlich problematisch, denn ein Grossteil davon gehört zu einer bisher unbekannten Art der Insekten-Übertrager. Ausserdem werden in der letzten Zeit diese neuen Taxone von verschiedenen Autoren eher als Untergattungen der Gattung *Haemoproteus* anstallt als selbständige Gattungen bezeichnet (siehe Levine, 1973).

Die Parasiten dieser Gattung sind im peripheren Blut unserer Singvögel nur in der Sommersaison (Mai—Oktober) mit einem maximalen Vorkommen im September und Oktober, wann ich 23 % infizierter Vögel festgestellt habe, vorgekommen. In den anderen Monaten hat sich das Prozent der infizierten Singvögel von 12 % bis 15 % bewegt. (Bemerkung: Die Prozente der Infektion wurden von der Anzahl der insgesamt untersuchten Vögel in dem diesbezüglichen Monat errechnet. Dasselbe gilt auch für die Gattung *Leucocytozoon*).

Alte und junge Vögel (Unnestlinge) wurden ungefähr in demselben Prozent (21 % der Alten von den insgesamt untersuchten alten Singvögeln und 18 % Jungen) infiziert, inzwischen wurde bei den Nestlingen die Infektion nur bei 10 % aller untersuchten Nestlinge festgestellt.

Leucocytozoon Berestnev, 1904

Die Problematik der Arten dieser Gattung wird bei den Parasiten unserer Singvögel auch bisher nicht gelöst. Die Situation ist hier noch schwieriger, als bei der Gattung *Haemoproteus*, weil die Gametocyten, die bei dieser Gattung in den weissen Blutzellen vorkommen, bei allen unseren Singvögeln morphologisch sehr ähnlich sind. Dem Verzeichniss der beschribenen Arten nach, die Hsu, Campbell und Levine (1973) anführten, gehören die Parasiten aus *Turdus merula* zur Art *Leucocytozoon mirandae* França, 1912, aus *Parus major* und *P. coeruleus* zur Art *L. majoris* (Laveran, 1902) Coatney, 1937, aus *Chloris chloris* zur Art. *L. seabrae* França, 1912 aus *Pyrrhula pyrrhula* zum *L. sakharoffi?* Sambon, 1908. Die Mehrheit dieser Arten wurde jedoch nur auf Grund der Funde der Gametocyten dieser Parasiten im peripheren Blut der gegebenen Wirtsvögel beschrieben und bisher bestehen keine Angaben über die Wirtsspezifität dieser Arten, welche wahrscheinlich nicht so hoch wie bei der Gattung *Haemoproteus* ist (siehe Hsu, Campbell und Levine, 1973).

Bei den Parasiten, die ich bei *Anthus trivialis* gefunden habe, geht es um den ersten Fund bei dieser Wirtsart. Das Vorkommen dieser Parasiten im peripheren Blut unserer Singvögel während des Jahres zeigt die gleiche Saisonbedingtheit wie bei der Gattung *Haemoproteus*. Die infizierten Vögel habe ich vom Mai bis Oktober gefangen, wobei die meisten infizierten Singvögel (15 %) im Herbst (September, Oktober) vorgekommen sind. In den anderen Monaten hat sich die Infektion um 4 % bewegt.

Tabelle 3. Das Vorkommen der 2 Typen der Blutstadien der Parasiten der Gattung *Atoxoplasma* und ihre Grösse bei den einzelnen Wirtsvögeln.

Wirtsvögel			Parasiten
Art	Anzahl	Typus	Grösse (µm)
Sylvia curruca (L.)	1	A	5,5—7 × 2—2,5
Troglodytes troglodytes (L.)	2	A	6,5—7 × 2—2,5
Lanius collurio (L.)	4	A	6—7 × 2—2,5
Parus major L.	1	A	7,5—8 × 2—2,5
Passer domesticus (L.)	1	B	3—5,5 × 3

Junge Vögel (auch Nestlinge) sind mehr empfindsammer zu Infektionen mit den Parasiten dieser Gattung als die alten Vögel. Während ich bei den alten Vögeln die Infektion bei 4 % aller untersuchten alten Singvögel festgestellt habe, wurden 14 % junger Vögel und 10 % Nestlinge infiziert.

Atoxoplasma Garnham, 1950

Weil die Gattungbenennung dieser Parasiten nur vorläufig ist (siehe Diskussion), werden diese Protozoen von verschiedenen Autoren unter verschiedenen Synonymen beschrieben, worunter *Lankesterella* heute am meisten erscheint (siehe Lainson, 1959). In der älteren Literatur sind die Benennungen wie *Haemogregarina, Toxoplasma,* „Vögeltoxoplasma", *Leucocytogregarina, Hepatozoon,* „Intra-leucocytic parasites = I. L. P." u. a. üblich.

Auch hier ist die Problematik der Arten bisher nicht geklärt. Bei den Vögeln, bei denen ich die Infektion mit diesen Protozoen gefunden habe, wurde nur eine Art *Atoxoplasma adiei* (Aragao, 1933), und zwar bei den Parasiten von *Passer domesticus,* beschrieben (siehe Levine, 1973).

Die Parasiten dieser Gattung habe ich im peripheren Blut insgesamt bei 9 Vögeln (5 Arten) gefunden. Bei 4 Arten *(Sylvia curruca, Troglodytes troglodytes, Lanius collurio* und *Parus major)* geht es um die ersten Funde dieser Parasiten.

Die infizierten Vögel sind im Sommer und Herbst (Juni—September) gefangen worden. Zwei von den infizierten Vögel waren alte Vögel (1,7 % aller untersuchten alten Vögel), 4 von ihnen waren junge Vögel (4 % aller untersuchten jungen Vögel) und 3 waren Nestlinge (d. h. 16 % aller untersuchten Nestlinge).

Im Blut kommen die Parasiten in Leukocyten (Monocyten) vor. Das sind wahrscheinlich Sporozoiten (Levine, 1973), bei denen ein zum grössten Teil entwickelter Kern und 1—2 grosse refraktille Körperchen gesehen werden. Das Pigment ist nicht entwickelt. Der Form nach habe ich Parasiten von 2 Typen gefunden:

Typ A (Abb. 1) zeichnet sich durch die gestreckte Form des Körpers aus. Der Typus scheint in der Wirtszelle neben ihres Kernes, der auch ungefähr genau so gross ist, zu liegen. Das Cytoplasma der Blutzelle beschränkt sich nur auf einen schmalen Streifen rund um den Parasiten. In der Mitte des Urtieres ist ein auffallender Gürtelkern, der aus einigen Reihen von gut sehbaren Chromatinkörperchen zusammengesetzt ist. Die Länge des Para-

siten Bildet ungefähr $^1/_3$ der Sprozoitenlänge. Auf beiden Parasitenenden werden oft zwei grosse, graublaue Refraktilkörperchen gesehen.

Typ B (Abb. 2, 3) zeichnet sich durch die ovalförmige bis rundliche Form des Körpers aus. Der Kern der angegriffenen Blutzelle ist gewöhnlich grösser als der Parasit, um den er sich grösstenteils stark dreht. Das helle Plasma der Leukocyte ist auch mehr entwickelt. Rundliche Formen sind den jungen Gametocyten der Leucocytozoon-Gattung ähnlich. Sie haben jedoch im hellblauen Plasma ausserdem aus roten Chromotinkörperchen zusammengesetzten Kern oft 1—2 grosse graublaue Refraktilkörperchen, die ähnlich wie bei dem Typus A sind.

Das Vorkommen dieser beiden Typen bei den infizierten Vögeln zeigt Tabelle 3. Aus dieser Tabelle sieht man, dass, soweit ich mehrere Vögel einer Art untersucht habe, fand ich bei ihnen nur einen Typus des Parasiten. Auch was die Grösse anbelangt, sind alle Parasiten des Typus A ähnlich, wogegen sich der Typus B von ihnen sehr unterscheidet.

Lankesterella Labbé, 1899

Die Parasiten, von denen ich vermute, dass sie zu dieser Gattung gehören könnten (siehe Diskussion), habe ich nur bei *Motacilla cinerea* gefunden. Es geht um den ersten Fund dieser Parasiten bei dieser Wirtsart und vielleicht auch bei den europäischen Singvögeln überhaupt. Die gleichen Protozoen hat nur Danilewski (?) (cit. Wasielewski, 1896) in den roten Blutkörperchen der Eulen, der Buntspechte und der Mandelkrähen in Südrussland gefunden. Auch die Parasiten der roten Blutzellen aus dem australienichen Singvögel *Climacteris picumnus*, die von Mackerras und Mackerras (1960) beschrieben werden, sind meinen Funden ähnlich und es ist möglich, dass es um die gleiche Parasiten-Gattung geht. Ähnliche Parasiten haben noch Baker, Lainson und Killick-Kendrick (1959) in den roten und weissen Blutzellen des *Corvus frugilegus* aus England gefunden. Morphologisch sind diese Parasiten jedoch abweichend von meinen Funden.

Über die Artangehörigkeit der gefundenen Parasiten kann ich bis heute nichts Konkretes sagen. Wasielewski (1896) beschreibt die Funde von Danilewski (?) als die Angehörigen der Art *Lankesterella* (syn. *Drepanidium*) *avium*. Es ist möglich, dass die Protozoen, die ich gefunden habe, auch zu dieser Art gehören.

Die Vögel, bei welchen ich die Infektion durch diese Protozoen gefunden habe, waren Nestlinge kürzlich vor dem Ausfliegen aus dem Nest, ungefähr 14 Tage alt. Im Nest waren insgesamt 5 Junge und bei allen habe ich starke Infektion im Blut gefunden.

Die Untersuchung habe ich Anfang Mai in Südböhmen (biol. Station „Ruda") durchgeführt.

Die Parasiten befallen nur rote Blutzellen, wobei sie ihre Form und Grösse nicht ändern, nur manchmal verschieben sie ihren Kern zum Zellenrande.

In den infizierten Erythrocyten habe ich 2 abweichende Typen dieser Parasiten gefunden: den wurmartigen Typus, von dem ich der Meinung bin, dass es um die Sporozoiten geht, und kleinere ovalförmige Gebilde.

Sporozoiten (Abb. 4, 5, 6) sind stark gedehnt bis wurmartig. Ihre durchschnittliche Länge beträgt 7 μm und ihre Breite 1 μm. Gewöhnlich liegen sie in der Blutzelle längs des Kernes, um den sie sich mässig drehen. Selten habe ich auch zwei Parasiten in einer Erythrocyte gefunden (Abb. 5). Manchmal

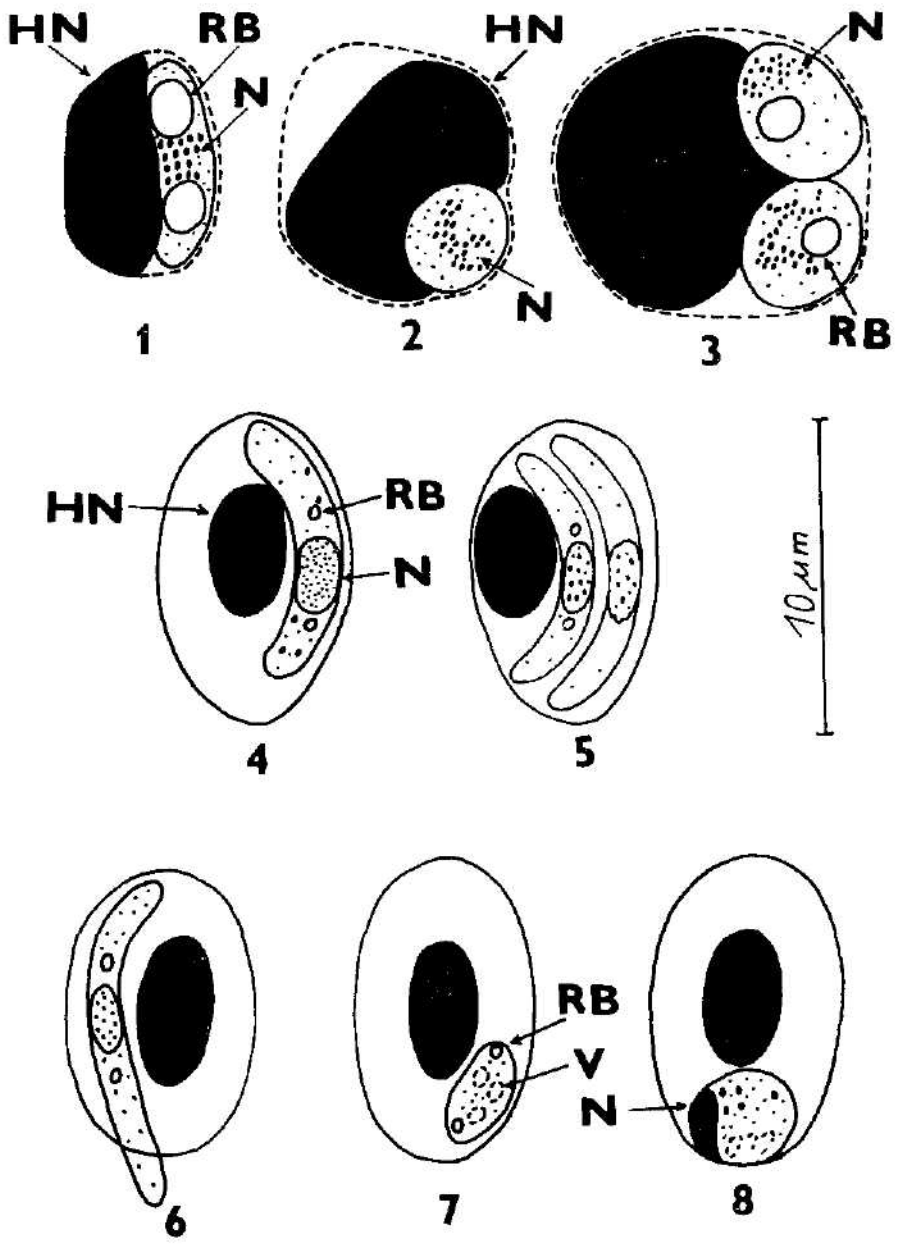

Abb. 1—8. 1 — *Atoxoplasma* sp (Typ A) aus *Sylvia curruca*. 2, 3 — *Atoxoplasma* sp. (Typ B) aus *Motacilla cinerea*. 4—8 — *Lankasterella* sp. aus *Motacilla cinerea*.
HN — der Kern der Wirtsblutzelle, RB — das Refraktilkörperchen, N — der Kern des Parasiten, V — die Vakuole.

überschreitet ihre Länge (bis 11 μm) die Blutzellenlänge, sodass es aussieht, als ob sie aus der Erythrocyte heraussteigen (Abb. 6). Oft kommen sie auch frei im Cytoplasma vor, aber immer liegt bei ihnen der vernichtete Kern der Blutzelle. Der Parasit hat nach der Giemsa-Farbung ein hellblaues bis violettes Plasma. In der Mitte liegt ein ziemlich deutlicher ovalförmiger und roter Kern von der Grösse durchschnittlich 2 × 1 μm. Auf beiden Polen des Kernes werden oft 2 kleine graublauige Refraktilkörperchen vom Durchschnitt etwa 0,3 μm gesehen.

Sehr selten kommen in den Blutzellen kleinere ovalförmige Gebilde vor (Abb. 7, 8). Sie sind 3 × 1,5—3 μm gross und haben ein helles rotviolettes Plasma, in dem gewöhnlich reiche Vakuolen sind. Ein dunkler gefärbter Kern ist gewöhnlich wenig deutlich. Öfter kommen in ihrem Cytoplasma einige kleinere violette Korner vor. Manchmal werden auf den Polen des Parasiten 2 kleinere graublaue Refraktilkörperchen (Abb. 7) gesehen. Wahrscheinlich geht es um wachsende Stadien.

DISKUSION

Bei unseren Singvögeln habe ich Blutparasiten der Gattungen *Trypanosoma*, *Plasmodium*, *Haemoproteus*, *Leucocytozoon*, *Atoxoplasma* und *Lankesterella* gefunden. Die Angehörigen der gleichen Gattungen (ausser der Gattung *Lankesterella*) hat bei unseren Vögeln auch Černý (1930, 1933) festgestellt (siehe Einleitung). Mit der Vergleichung meiner Ergebnisse mit den Ergebnissen von Černý (1930, 1933) ist es möglich zu dem Schluss zu gelangen, dass es in der Verbreitung der Blutparasiten bei unseren Singvögeln während der letzten 40 Jahre zu keinen wesentlichen Änderungen gekommen ist Der häufigste Parasit ist ständig *Haemoproteus*, ihm folgt der sehr häufig vorkommende *Leucocytozoon*, spärlicher kommen *Plasmodium* und *Atoxoplasma* vor und selten *Trypanosoma* und *Lankesterella*.

Auch die Prozente der durch einzelne Gattungen der Parasiten infizierten Vögel sind in beiden Arbeiten ungefähr die gleichen. Die Äusserung des Vorkommens der Parasiten in Prozenten kann jedoch nicht als absolut vergleichbare Zahl bei den verschiedenen Autoren genommen werden. Mit Rücksicht auf das Saisonvorkommen der Mehrheit der Blutparasiten ändert sich diese Zahl je nach dem Verhältnis der Vögel, die im Sommer gefangen wurden, zu denen, die im Winter gefangen wurden. Bessere Ergebnisse gibt darum die Äusserung in Prozenten nur der in der Sommersaison gefangenen Vögel. Da Černý (1930, 1933) in seiner Arbeit nicht anführt, ob er die Vögel nur in der Sommersaison oder während des ganzen Jahres untersucht hat, ist es nicht gut möglich zu sagen, ob das Vorkommen dieser Parasiten bei uns steigt oder sinkt.

Mit Rücksicht auf die Funde der Parasiten der Rotblutkörperchen, die ich provisorisch in die Gattung *Lankesterella* reihe, wollte ich zum Schluss noch die Problematik der Gattungen *Atoxoplasma* und *Lankesterella* erwähnen.

Unter dem Einfluss der Arbeit Lainson's (1959) bezeichnet nämlich die Mehrheit der zeitgenössischen Autoren die Parasiten der Weissblutkörperchen, die ich in die Gattung *Atoxoplasma* reihe, als Angehörige der Gattung *Lankesterella*. Lainson (1959) hat sehr sorgfältige Vergleichungen der Parasiten der weissen Blutkörperchen bei den Haussperlingen (G. *Atoxoplasma*) mit den Parasiten der Rotblutzellen bei Fröschen (G. *Lankesterella*) durch-

geführt und ist zum Schluss gekommen, dass keine genügend grosse Unterschiede für die Unterscheidung dieser beiden Gattungen bestehen, und dass darum diese beiden Typen der Parasiten in die einzelne Gattung eingereiht werden sollen, und zwar dem gesetz der Priorität nach in die Gattung *Lankesterella*.

Corradeti und Scanga (1963) haben dementgegen vorgeschlagen, die Parasiten dieses Typus, deren Sporozoiten nur die Blutzellen ohne Hämoglobin infizieren, in die Gattung *Atroxoplasma* und die Parasiten mit den Sporozoiten, die auch Rotblutkörperchen infizieren können, in die Gattung *Lankesterella* einzureihen. Die Fähigkeit, die Rotblutzellen zu infizieren, halten beide italienischen Autoren für ein wichtiges Evolutionszeichen, das die Aufteilung beider Typen der Parasiten auf dem Niveau der Gattungen ermöglicht

Der Meinung Lainson's (1959) entgegen sprechen auch die Arbeiten von Box (1970) und Černá (1972, 1973), die bewiesen haben, dass die Entwicklungsstadien der Parasiten der Gattung *Atoxoplasma*, wie sie Lainson (1958, 1959) bei den Sperlingen beschrieben hat, in Wirklichkeit in den Entwicklungszyklus der Kokcidie aus der Gruppe *Isospora lacazei* gehören. In diesen Zusammenhängen kommt hier die Frage auf, ob es nicht um eine Analogie mit dem Säugetier-Toxoplasma geht (siehe z. B. Galuzo, 1974).

Bezugnehmend auf diese Wirklichkeiten ist es meiner Meinung nach am passendsten, die Parasiten, deren ovalförmige Sporozoiten die Weissblutkörperchen der Vögel infizierten, einstweilig auch weiterhin in die von Garnham (1950) eingeführte Gattung *Atoxoplasma* zu reihen. Erst bis der Entwicklungszyklus dieser Parasiten einwandfrei erkannt sein wird, wird es möglich sein zu entscheiden, ob es um Angehörige der Gattung *Isospora* geht, wie das Box (1970) und Galuzo (1974) vorschlagen, oder ob es Parasiten aus der Familie Lankesterellidae sind. In dem letzten Fall wird es jedoch nötig zu erwähnen, ob es nicht passend wäre, diese Parasiten von der Gattung *Lankesterella* zu unterscheiden, wie das Corradetti und Scanga (1963) vorgeschlagen haben.

Die Anforderung, beide Gattungen voneinander zu unterscheiden, unterstützen auch meine Funde der Parasiten der Rotblutzellen bei *Motacilla cinerea*, von denen ich der Meinung bin, dass es allerdings um die Gattung *Lankesterella* gehen könnte. Diese Parasiten unterscheiden sich nämlich erheblich durch die Sporozoitenmorphologie oder durch den Typus der Wirtsblutkörperchen von den Parasiten der Gattung *Atoxoplasma*. Das Einreihen dieser Parasiten in die Gattung *Lankesterella* ist jedoch vorläufig, weil es sich nur auf die Morphologie der Blutstadien (Sporozoiten?) stützen kann. Diese Stadien sind jedoch morphologisch praktisch übereinstimmend mit den Parasiten der Rotblutzellen der Frösche und der Kriechtiere aus der Familie Lankesterellidae, sodass es sehr wahrscheinlich ist, dass es wirklich um Angehörige der Gattung *Lankesterella* geht.

Danksagung

Ich möchte der Frau Doz. RNDr. Ž. Černá, CSc. für die allseitige Hilfe bei meiner Arbeit und Herrn Doz. RNDr. W. Černý für die Hilfe bei der Sammlung des Materials für diese Arbeit danken.

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RELATIONS AMONG THE SUBMERGED MACROVEGETATION, THE QUANTITY OF NANNOSESTON AND THE POND-BOTTOM FAUNA

MILAN LAUPY

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Abstract: The author studied the changes in the quantity of nannoseston, the abundance of nannophytoplankton and the biomass of the bottom fauna from the development to the extinction of the submerged macrovegetation of *Potamogeton berchtoldii* Fieber*) and *Batrachium aquatile* (L.) Dum. The samples of nannoseston and nannophytoplankton were collected with a special device of low flow velocity through the filtering net which substantially reduced the destruction and the tearing-down of larger particles of seston and periphyton into the collected samples. In connection with the development of the submerged macrovegetation a decline of the quantity of nannoseston was noted in the center of the pond. The difference as compared with the quantity of nannoseston beyond the stand can be expressed by the quotient 0.41. An analogous decline expressed by the quotient 0.18 was recorded in the abundance of nannophytoplankton. The total biomass of the bottom fauna at the control station beyond the stand, furthermore, the marginal and the middle part of the submerged macrovegetation spread out in a relatively equal manner (quotients 1.00 : 1 29 : 1,20). The components of the bottom fauna showed a conspicuous decrease in the biomass of the pelophilous larvae of *Chironomus gr. plumosus* and of the phytophilous larvae of Chironomidae abunding in *Endochironomus gr. nymphoides*. An opposite distribution of the biomass with a maximum in the middle part of the macrovegetation was recorded in Oligochaeta.

INTRODUCTION

The relations among the submerged macrovegetation and the other components of the water biocoenoses were affected by a series of factors (Hrbáček, 1962; Bernatowitz, 1969; Hall, Cooper and Werner, 1970). In dependence on the quantity of the plant biomass, there occured changes in the light conditions and in the intensity of the water-flow in the stand (Hasler and Jones, 1949, Gessner, 1955; Barthelmes, 1959). Owing to the metabolism of the submerged macrovegetation, there also occurred changes in pH, the saturation of gases, quantity of nutrients, temperature stratification, specific conductivity and in further physical and chemical water properties in the stand (Hasler and Jones, 1949; Brandl, Brandlová and Poštolková, 1970). The submerged macrovegetation, moreover, formed a significant source of organic matter after decomposition.

The study presents the results of the complex influence of the mentioned factors in the quantity of nannoseston, the abundance of phytoplankton and the biomass of the bottom fauna. At the same time the changes were studied in the quantity, abundance and biomass of the mentioned components in the place beyond the submerged macrovegetation. Fig. 1, Table 1, illustrates the

*) Determined by Dr. Vl. Skalický CSc.

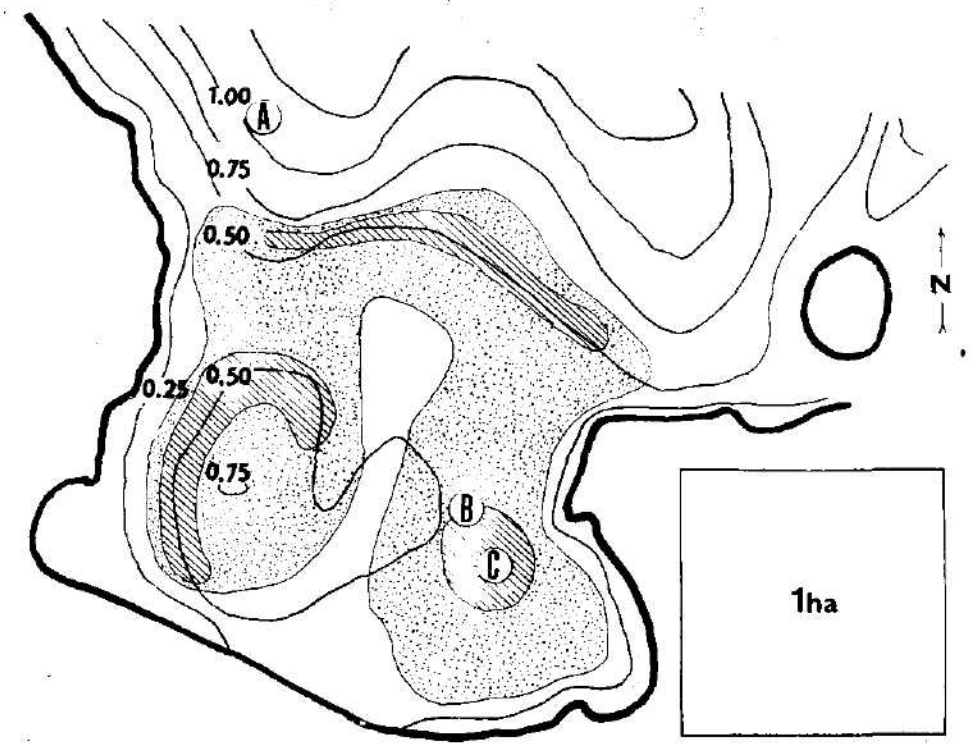


Fig. 1 South-eastern part of pond Radov (drawn from Hrbáček, 1966). A — station beyond the stand of submerged macrovegetation. B — station in the marginal part of the stand. C — station in the middle part of the stand.

shape of the investigated locality, the distribution of the submerged macrovegetation and gives in brief the location and characteristic of each of the sampling stations. The locality which was investigated from April to September 1972 is placed in a shallow southeastern part of the pond Radov (in the vicinity of Blatná in South Bohemia).

METHODS

The biomass of the pond vegetation was studied from the samples of the submerged macrovegetation, which had been torn out from a marked-off bottom area (0.5 m^2); its dry weight was determined at 105° C. To obtain samples of nannoseston and nannophytoplankton, a device was constructed. The sampling device consists of a perforated cylinder covered with a phosphor-bronze wire net of 40 μm mesh size. The cylinder is closed at both ends and is furnished with rubber packing rings to fasten the net. The cylinder is attached to a rod (4) placed amidst the stand. At the top of the vessel, there are two rubber pipes, one of which leads into a 5 l vessel, while the other serves as an air outlet. The filtered water containing the nannoseston is lead through the pipe into the vessel by the help of a suction pump. The filtering area of the cylinder is approximately 600 cm^2; if the 5 l vessel is to be filled in course of 1—2 min., the flow rate at the net is approximately 0.7—1.4 mm/sec. Part of the collected sample was treated by the method of sedimentation after fixation with Lugol's solution and the abundance of nannophytoplankton was determined (Vollenweider 1969; Hrbáček et al. 1972). The other part was used to state the amount of oxidable carbon present in particulare form as nannoseston. The determination

Table 1. The total characteristics of the stations A, B and C during the development of the stands of submerged macrovegetation (June 10 to July 9, 1972).

Station	A	B	C
Water column (m)	1.1—1.2	0.5—0.6	0.5—0.6
Bottom-surface composition	brownish black mud, clay	plant remnants,	sand,
Height of collected bottom sections (cm)	10—15	10—15	10—15
pH	8.6—9.0		8.7—9.6
Specific conductivity (25° C) μm S	390—430		360—400
Transparency (m)	0.5—0.7		Larger than 0.6, i.e. height of water column at the station
Temperature above the bottom (°C)	16.2—21		16.5—21.5
Oxygen saturation (%)	75—95		55—145

A — beyond stand; C — middle part of stand

was made by the modified method of Strickland and Parsons (1960). The samples of nannoseston were concentrated by underpressure filtration into a small fine-grained $MgCO_3$ layer deposited on the surface of a Synpor 3 ultra-filter. After the transfer of the collected nannoseston into the test tubes by means of 10% H_2SO_4 the samples were oxidized at high temperature with a mixture of potassium dichromate and sulphur acid. After completed oxidation the loss of the stain caused by dichromate ions was ascertained colorimetrically. As standards glucose solutions equivalent to 10—400 μg C/liter were used. Samples of the bottom fauna obtained by Lenz's zonation grab modified by Lellák (1957) were washed through a 0.67 mm mesh net. To determine the formaldehyde biomass (further on referred to as biomass only) the procedure of Borodičová (1960, 1961) and Laupy (1970) were used. For the evaluation of the values, the t-test for pair values was employed. As regards the small number of samplings which could be realized in the relatively short period of the developed submerged macrovegetation, as the test criterion the level of significance 0.10 was made use of.

Table 2. A survey of the average values of the abundance of nannophytoplankton, nannoseston quantity and the bottom-fauna biomass during the period before the developmpent of submerged macrovegetation (April 15 — May 28, 1972 = 4 samplings).

STATION		A
		$\bar{x} \pm s_{\bar{x}}$
submerged macrovegetation	(dry weight g/m²)	—
nannoseston	(mg C/l)	1.2 ± 0.1
nannophytoplankton	(10^3) cells/ml)	26.2 ± 15.0
Chironomus	(g/0.1 m²)	1.453 ± 0.255
Endochironomus	(g/0.1 m²)	0.001 ± 0.001
Oligochaeta	(g/0.1 m²)	0.766 ± 0.064
bottom fauna — total	(g/0.1 m²)	3.873 ± 0.447

Table 3. A survey of the average values of biomass of the submerged macrovegetation, abundance of nannophytoplankton, nannoseston quantity and the bottom-fauna biomass during the period of the development of submerged macrovegetation (June 10 to July 9, 1972 = 3 samplings).

STATION		A	B	C
submerged			$\bar{x} \pm s_{\bar{x}}$	
macrovegetation	(dry weight g/m²)	—	100 ± 15	150 ± 15
nannoseston	(mg C/l)	1.7 ± 0.4	1.0 ± 0.3	0.7 ± 0.1
nannophytoplankton	(.10³ cells/ml)	22.9 ± 5.4	11.7 ± 5.2	4.1 ± 0.6
Chironomus	(g/0.1 m²)	0.527 ± 0.125	0.092 ± 0.049	0.015 ± 0.015
Endochironomus	(g/0.1 m²)	0.011 ± 0.006	0.775 ± 0.418	0.058 ± 0.029
Oligochaeta	(g/0.1 m²)	0.878 ± 0.160	0.672 ± 0.042	1.536 ± 0.198
bottom fauna, total	(g/0.1 m²)	1.979 ± 0.100	2.547 ± 0.823	2.380 ± 0.229

RESULTS OF MEASUREMENTS

The period before the development of the submerged macrovegetation can be characterized by a gradual increase in the quantity of nannophytoplankton and nannoseston and consequently by a decrease in water transparency (Fig. 2). The biomass of the bottom fauna, however, had a decreasing tendency during that period (Fig. 3) owing to metamorphosis and the flight of the overwintering larvae of Chironomidae. The most conspicuous decrease in biomass was noted in *Chironomus* gr. *plumosus*, *Einfeldia* gr. *pectoralis*, and *E.* gr. *insolita*.

The decrease in the quantity of nannophytoplankton and nannoseston and, owing to that, the transient transparency of the pond water took place together with the development of the water bloom of *Aphanizomenon flos aquae* at the end of May, i.e. immediately before the development of the submerged macrovegetation. A survey of the values measured before the development of the submerged macrovegetation is given in Table 2.

The first continuous stands of the submerged macrovegetation was noted in the first half of June, 1972. Together with the increasing biomass of the gradually developing stands of *Potamogeton berchtoldii* Fieber and *Batrachium aquatile* (L.) Dum., a marked decrease in transparency was found in the

Table 4. A survey of the average values of biomass of the submerged macrovegetation, abundance of nannophytoplankton, quantity of nannoseston and biomass of the bottom fauna throughout the period after the extinction of submerged macrovegetation (July 30 to Sept. 3, 1972 = 3 samplings).

STATION		A	B	C
submerged			$\bar{x} \pm s_{\bar{x}}$	
macrovegetation	(dry weight g/m²)	—	—	—
nannoseston	(mg C/l)	2.9 ± 0.3	2.9 ± 0.3	2.8 ± 0.8)
nannophytoplankton	(.10³ cells/ml)	47.7 ± 10.7	40.3 ± 20.3	40.3 ± 14.3)
Chironomus	(g/0.1 m²)	1.204 ± 0.293	1.204 ± 0.672	1.415 ± 0.678
Endochironomus	(g/0.1 m²)	0.003 ± 0.003	0.015 ± 0.015	0.021 ± 0.021
Oligochaeta	(g/0.1 m²)	0.903 ± 0.052	0.547 ± 0.030	1.128 ± 0.183
bottom fauna — total	(g/0.1 m²)	2.551 ± 0.270	2.190 ± 0.568	3.284 ± 0.660

middle part of the stand (locality C). In accordance with that, there were also the value of nannophytonplankton abundance which were in the average lower by 82% than those beyond the stand. An analogous decline of the quantity of nannoseston was 59% (Table 3). Both differences are significant.

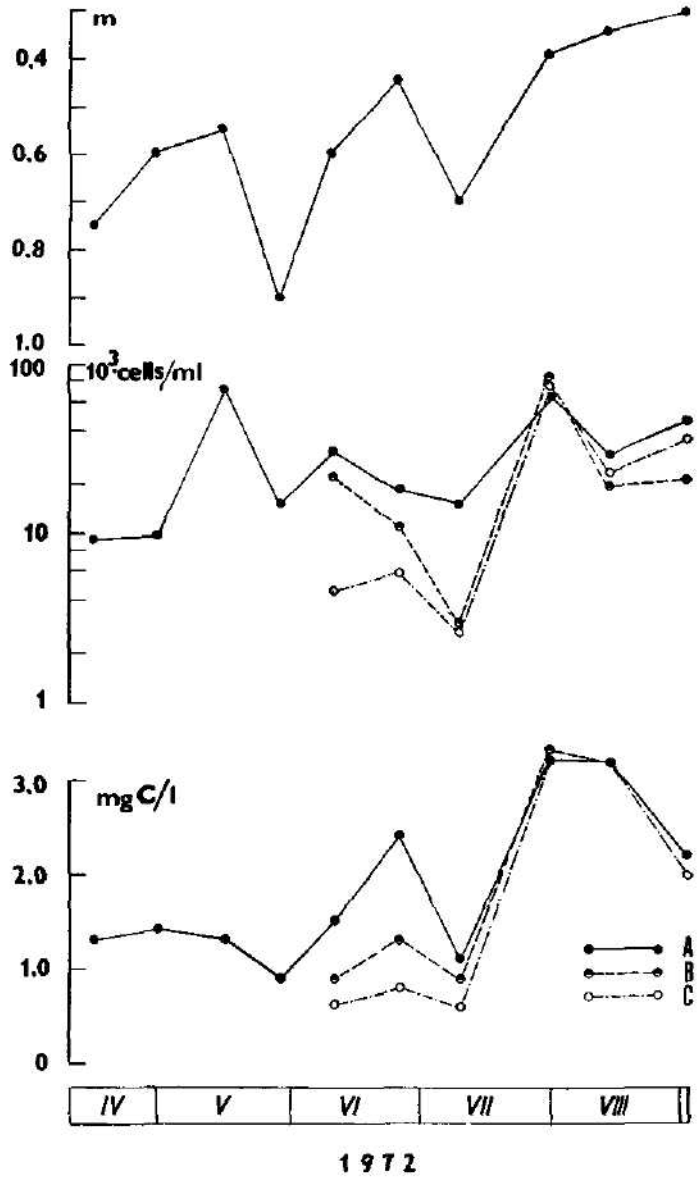
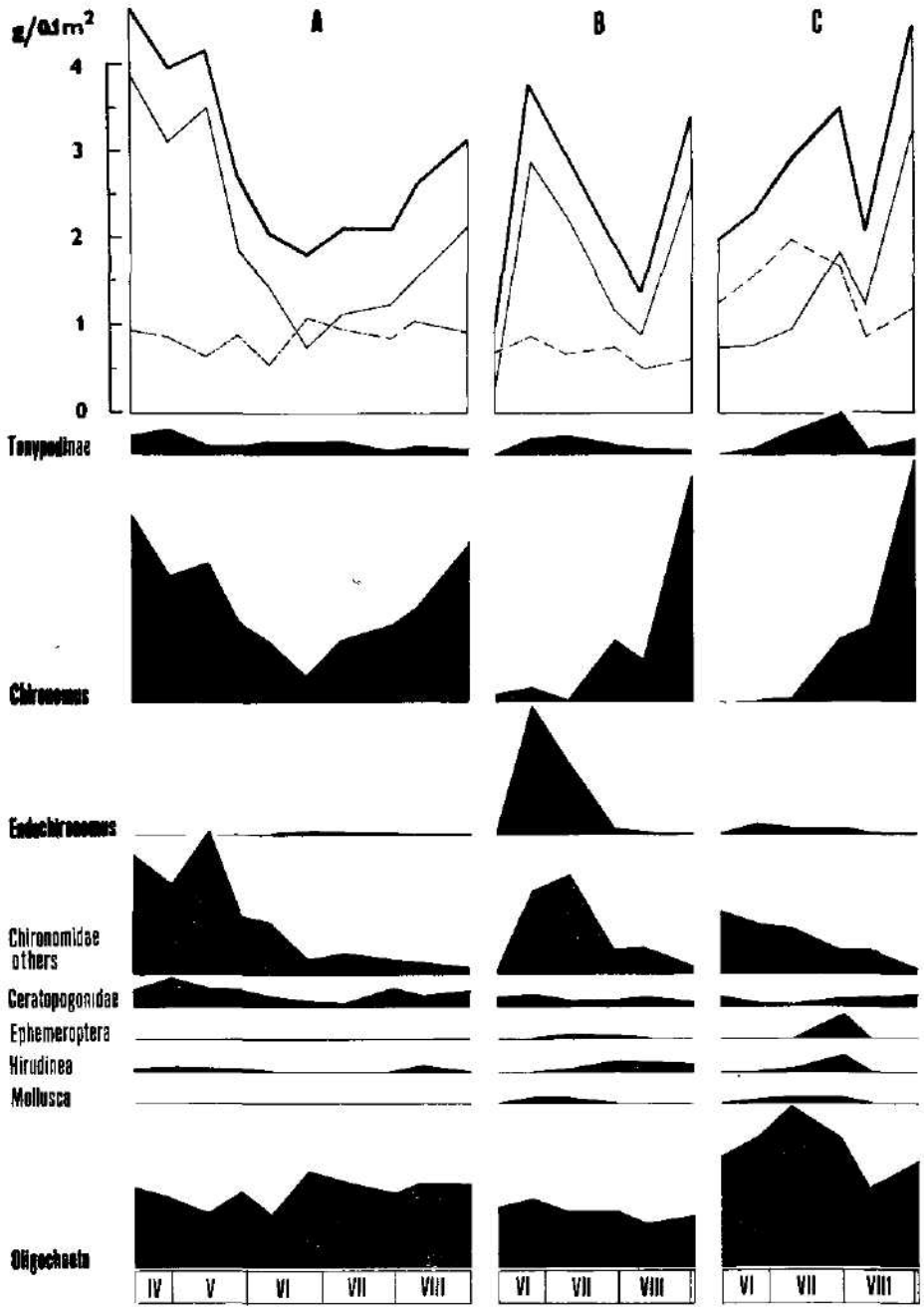


Fig. 2. Changes in transparency (in m), abundance of nannophytoplankton (in 10^3 cells/ml) and the quantity of nannoseston (in mg C/liter) at stations A, B and C in course of the vegetation season of 1972.


g/0.1m²
A
B
C
4
3
2
1
0
Tanypodinae
Chironomus
Endochironomus
Chironomidae others
Ceratopogonidae
Ephemeroptera
Hirudinea
Mollusca
Oligochaeta
IV
V
VI
VII
VIII
VI
VII
VIII
VI
VII
VIII

1972

The total biomass of the bottom fauna during the development of the submerged macrovegetation ranged approximately from 2.0—2.5 g/0.1 m²; but the differences of the total biomass of the bottom fauna at stations A to C (Fig. 1, Table 3) expressed as the quotient 1.00 : 1.20 showed no significance. Conspicuous differences in biomass at these stations were found in all the dominant components of the bottom fauna, which consisted throughout the development of the submerged macrovegetation of the pelophilous larvae of *Chironomus* gr. *plumosus* and of a group of the phytophilous larvae of Chironomidae and Oligochaeta. Beyond the stand, the larvae of *Chironomus* gr. *plumosus* were dominant. A lower biomass of these larvae in the marginal part of the stand (locality B) was compensated by an increase of the larvae of phytophilous Chironomidae together with the dominant genus *Endochironomus* gr. *nymphoides*. A marked decline of the biomass of both mentioned forms in the middle part of the stand (locality C) can be expressed by the quotient 0.3 (*Chironomus* gr. *plumosus* and 0.07 (*Endochironomus* gr. *nymphoides*). On the other hand, an increase of the biomass was found in the middle part of the stand in the group Oligochaeta (quotient 1.75), in comparison with the biomass beyond the stand. A survey of values measured throughout the development of the submerged macrovegetation is illustrated by Table 3.

The extinction of the submerged macrovegetation took place in August 1972. The abundance of nannophytoplankton and the amount of nannoseston reached maxima during that time and the values were, owing to the free flow of water, virtually alike (Table 4). A characteristic feature of the dynamics of the bottom fauna is the relatively quick compensation of the biomass of the dominant pelophilous larvae of *Chironomus* gr. *plumosus* at all the stations and the disappearance of the larvae of the phytophilous Chironomidae. A marked increase of biomass was also recorded in Oligochaeta. However, after the extinction of the submerged macrovegetation, there occurred no compensation of the biomass of this group among the stations. The survey of the values measured during that period is illustrated by Table 4.

DISCUSSION

Relation of the submerged macrovegetation to the abundance of nannophytoplankton and the quantity of nannoseston

Hasler and Jones (1949) have already pointed at the decrease in the abundance and the restriction of the development of phytoplankton in bodies of water with submerged macrovegetation. From the results of these authors, it is possible to express the ascertained decrease in the abundance of phytoplankton, in comparison with water bodies without any macrovegetation, as a quotient ranging from 0.10 to 0.17. Quite opposite results were obtained by Brandl, Brandlová and Poštolková (1970), who found the abundance of phytoplankton in the stand of submerged macrovegetation to be greater than beyond it. In addition to the effect of zooplankton as mentioned by these authors it may be the existence of the so-called horizontal curent of

Fig. 3. Changes in the biomass of the bottom fauna (in g/0.1 m²) in course of the vegetation season of 1972; strong full line — total biomass of the bottom fauna; thin full line — biomass of a temporal component; dotted line — biomass of a permanent component.

Barthelmes (1959) the measurements of which may explain this discrepancy. This current, causing the water exchange in the stands, may affect to a great extent the abundance of phytoplankton. In connection with this, one must remark that the investigation was performed so as to make the influence of the horizontal current as small as possible. The decrease in the abundance of nannophytoplankton in the middle part of the stand expressed by the quotient 0.18 is getting near to the values obtained by Hasler and Jones (1949).

Relation of the nannoseston to the total amount of seston

It was shown that the actual state of nutrients usable by the bottom fauna may differ to a great extent from the total amount of particulate organic matter present in water. These differences are most conspicuous during a mass development of water-bloom of the blue-green algae *Aphanizomenon flos aquae* and *Anabaena spiroides* towards the end of May afterwards throughout August 1972. The first case showed a difference of 1.5 mg C/liter between the quantity od seston and nannoseston (including particles smaller than 40 μm). In the other case, this difference increased up to 5.0 mg C/liter. Thus the transition of larger particles of seston to smaller fragments, e.g. by the decomposition of water-bloom, may cause a conspicuous fluctuation of the actual amount of wood without the occurrence of marked changes in the total organic matter in water. The resulting effect manifested itself in the quantity of the bottom fauna and that mainly in those components which showed a close dependence on the actual supply of food (Lelląk, 1965, 1966). The ability of the pelophilous larvae of *Chironomus* gr. *plumosus* to multiply their biomass in a short time, have also proved, in accordance with the results of the mentioned author, the data obtained during the extinction of the submerged macrovegetation. At sampling station C, there occurred in course of 6—7 weeks from the extinction of the submerged macrovegetation a 62-fold increase in the biomass of the pelophilous larvae.

Relation of the submerged macrovegetation to the bottom fauna

In addition to the restricted development of phytoplankton in the stand of the submerged macrovegetation (worse light conditions, decrease in the quantity of nutrients, etc.), changes in the intensity of sedimentation also contributed to the decline of the total amount of seston. If the submerged macrovegetation with a sufficiently high biomass was capable to withstand the horizontal current, the greatest decrease of its flow velocity was found in the marginal parts of the stand. Together with the decrease in the flow velocity, there occurred an increase in the intensity of sedimentation and consequently in the actual quantity of food. In accordance with that, Hantge (1960) and Kořínková (1967) ascertained an approximate 50 percentage increase in the biomass of the bottom fauna in the marginal parts of the stand as compared with the middle part of it (quotient 0.45—0.55). Observations disclosed that only a small decline of total biomass of the bottom fauna (quotient 0.93) was found in the middle part of the stand in comparison with the marginal parts. A relatively uniform distribution of total biomass of the bottom fauna in the marginal parts and in the middle part of the stand, and beyond it was the consequence of a weight compensation of, to a great

extent, ecologically clean-cut groups (pelophilous larvae of *Chironomus* gr. *plumosus*, a group of phytophilous larvae and Oligochaeta).

Together with the decrease in the abundance of nannophytoplankton and the quantity of nannoseston in the middle part of the stand, a decrease was noted in the biomass of the larvae of *Chironomus* gr. *plumosus* and of the phytophilous larvae with the dominant *Endochironomus* gr. *nymphoides*. A quite opposite distribution of biomass with a maximum in the middle part of the stand was recorded in Oligochaeta. Lellák (1965, 1966a) who studies the ecology of this group explains the biomass increase in Oligochaeta by a non-uniform distribution of the nutrient reserves at the bottom caused by the cyclic development of the submerged macrovegetation.

SUMMARY

In course of the vegetation season of 1972 the abundance of nannophytoplankton, the quantity of nannoseston and the biomass of the pond-bottom fauna were studied in the marginal and the middle part of the stand of submerged macrovegetation. For control reasons, that bottom area was also investigated, in which no submerged macrovegetation had developed.

The area of the studied stand of macrovegetation with the dominant *Potamogeton berchtoldii* Fieber and *Batrachium aquatile* (L.) Dum. measures approximately 200 m^2. The maximum biomass of the stand is in the range of 130—180 g/m^2 of dry matter.

In connection with the development of the stand of the submerged macrovegetation, significant differences were found in the abundance of nannophytoplankton, the quantity of nannoseston and the biomass of several components of the bottom fauna.

The decrease in the abundance of nannophytoplankton in the middle part of the stand may be expressed by quotient 0.18. The average abundance of nannophytoplankton in the middle part of the stand is $4.1 \pm 0.6 \cdot 10^3$/ml of cells.

The decrease in the quantity of nannoseston (particles smaller than 40 μm) in the middle part of the stand of submerged vegetation can be expressed by quotient 0.41. The average quantity of nannoseston in the middle part of the stand of macrovegetation is 0.7 ± 0.1 mg C/liter.

The decrease in the average biomass of the larvae of *Chironomus* gr. *plumosus* to 0.015 ± 0.015 g/0.1 m^2 found in the middle part of the stand can be expressed, in comparison with the control station beyond the stand, by quotient 0.03. An analogous decrease in the biomass was recorded in the group of the larvae of phytophilous Chironomidae with the dominant *Endochironomus* gr. *nymphoides*. The decrease in the average biomass of the mentioned larvae to 0.058 ± 0.029 g/0.1 m^2 found in the middle part of the stand can be expressed, in comparison with the marginal part, by quotient 0.07.

The increase in the average biomass of Oligochaeta to 1.536 ± 0.198 g/0.1 m^2 found in the middle part of the stand can be expressed, in comparison with the control station beyond the stand, by quotient 1.75.

Average values of total biomass of the bottom fauna reach at the control station beyond the stand (A) $1\,979 \pm 0.100$ g/0.1 m^2, in the marginal part of the stand (B) 2.547 ± 0.823 g/0.1 m^2 and in the middle part of the stand (C)

2.380 ± 0.229 g/0.1 m². The differences among the stations A, B and C, which can be expressed by quotients 1.00 : 1.29 : 1.20, are not significant

Acknowledgement

I wish to thank Doc. Dr. J. Lellák CSc and Dr. J. Fott at the Hydrobiological Department of the Faculty of Natural Sciences of Charles University for the outline of the problems and methodical guidance throught my work furthermore for the remarks and comments, which helped me to finish it.

I also thank Dr. M. Novák and Ing. M. Nováková at the Hydraulic Research Institute in Prague for their kind supply of the material treated herein.

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VĚSTNÍK ČESKOSLOVENSKÉ SPOLEČNOSTI ZOOLOGICKÉ
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Institute of Parasitology of the Czechoslovak Academy of Sciences, Praha

RHABDOSTYLA LIBERA SP. N. AND PYXIDIELLA LIMACIDARUM SP. N., TWO NEW SPECIES OF SOLITARY SESSILINE PERITRICHS

JIŘÍ LOM

Received January 30, 1976

Abstract: The paper presents description of two new species of sessiline peritrichs, free living *Rhabdostyla libera* sp. n., and an ectocommensal *Pyxidiella limacidarum* sp. n., along with discussion of the genus *Rhabdostyla*.

In the taxonomy of sessiline peritrich ciliates with acontractile stalks, one of the problems is posed by the genera *Rhabdostyla* Kent and *Pyxidiella* Corliss. They comprise species differing solely by being permanently solitary from members of the large genera *Epistylis* Ehr. and *Opercularia* Stein, respectively. Many of the species assigned to *Rhabdostyla* and *Pyxidiella* were later proved to be in fact colonial and thus their generic position had to be changed; most recent example was that of *Pyxidiella inclinans* (O. F. Müller) disclosed to be an *Opercularia* by Guhl (1972). This is why some authors expressed their doubts on the validity of these genera in general; e.g., in her monograph on Peritricha, Stiller (1971) quotes *Rhabdostyla* as a mere subgenus of *Epistylis*.

In the following text a description will be presented of two species, which according to our observations can be justly placed into the two above mentioned genera. The observations were made in the late fifties as a part of a greater, unfinished project; since it will hardly be probable to obtain some more material to complete the data already at hand, we are presenting the descriptions now.

Rhabdostyla libera sp.n.

Population of this free-living ciliate was found in a small body of stagnant water near Prague; the ciliates were also kept in agnotobiotic culture in the laboratory.

The body (Fig. 1 and 2) is very elongated, 81 (70—91) μm long, with the greatest width 18 (16—21) μm in its anterior third. The epistomial disc, encircled by slightly more than one turn of the adoral spiral, is conspicuously protruding above the exertile peristomial lip. This lip can be everted and is about 5 μm high. The arch-like macronucleus (25—30 × 4—7 μm) is situated transversally in the oral third of the body, around the infundibular funnel. A small micronucleus is located closely to the macronucleus. The contractile vacuole lies close to the mouth of infundibulum. The pellicle bears a very fine transverse striation; the insertion line of the wreath of telotroch locomotory cilia limits the attenuated aboral third of the body. In living ciliate,

the longitudinal subpellicular myonemes are well visible. Feeds on bacteria and algae.

The stalk is very short, 8—10μm, with a width of 3 μm, and is longitudinally striated. It is never branched, the ciliates are always solitary individuals, attached to non-living substrates.

In contraction, the body assumes a piriform shape, with considerably shortened aboral end. Telotroch formation was not observed, nor were any cysts detected.

This ciliate undoubtedly belongs to the genus *Rhabdostyla*, since no traces of coloniality could be detected. Under the conditions of our laboratory and field observations, no coloniality existed. This does not mean, of course, that

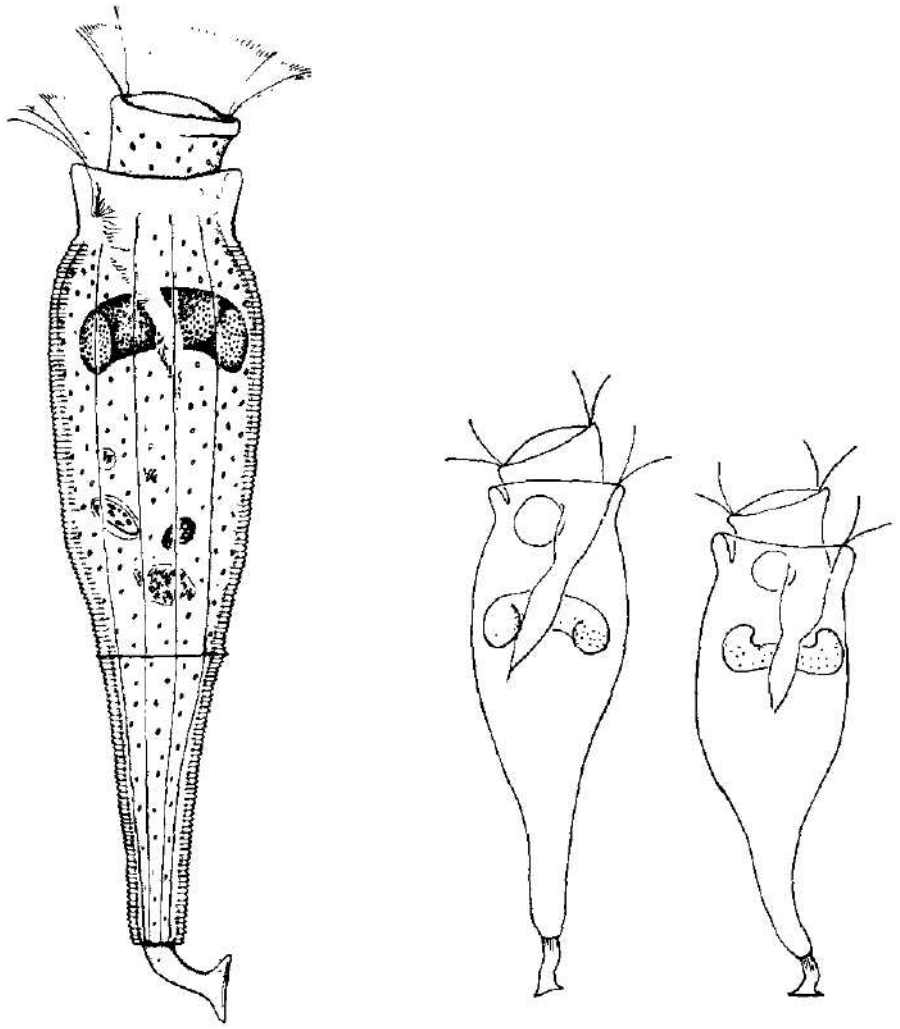

Fig. 1. *Rhabdostyla libera* sp. n.
Fig. 2. Two specimens of *R. libera* sp. n. to show the cell shape variation.

under different conditions a colonial state could not be expressed, as observed in most *Rhabdostyla* species; however, for the time being, our evidence allots this species a proper place in the genus *Rhabdostyla*.

The validity of the genus *Rhabdostyla* seems to be rather uncertain; the capacity of some species to form branched peduncles and colonies may have been just suppressed by some factors of the environment at the time of observation, while in other species it might be a constant, genetically fixed character. This applies to species constituting the genus in Kent's original conception. However, until the question is fully settled experimentally, we propose to retain the genus. Only one among the species included originally by Kent (1881) into this genus, *R. sphaeroides* (Frommentel), complies with the main generic characteristics, i.e., solitary state, separating it from the genus *Epistylis*, and we propose to consider it, by posterior designation in this paper, as the type species of this genus. *R. ovum* Kent and *R. brevipes* Clap. & Lachm. were described to form branched peduncles (Pénard, 1922; Stiller, 1931). *R. ringens* (Frommentel) is probably a *Vorticella;* the appurtenance to the genus *Rhabdostyla* of the remaining species listed originally by Kent (1881) i.e., *R. sertularium* Kent, *R. nebulifera* (Frommentel) and *R. longipes* Kent was put in doubt — and justly so — already by Bütschli (1889).

R. libera differs in its form and structure from all thus far described species

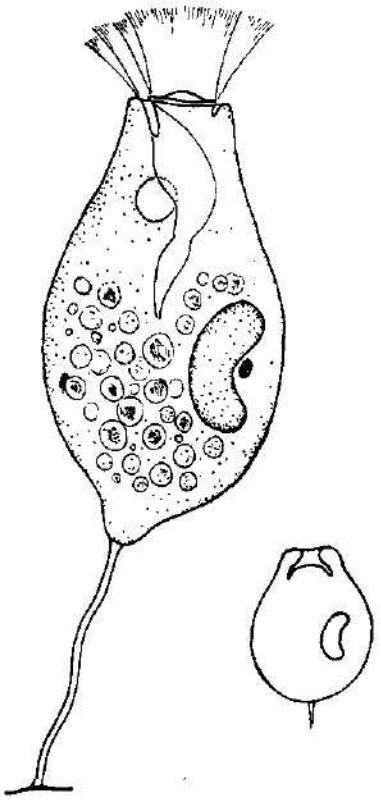

Fig. 3. Pyxidiella limacidarum sp. n.

of the genus *Rhabdostyla* and *Epistylis;* therefore we propose to designate it as a new species.

Pyxidiella limacidarum sp. n.

This ectocommensal species was found in the mucus beneath the anterior border of the mantle of *Bielzia coerulans* collected in forest of the West Tatra mountains (Czechoslovakia). It was found on all snails collected.

The body of an actively feeding individual is ovoid (Fig. 3) with average dimensions of 60 by 31 μm. Posteriorly, it tapers to a narrow scopula at the aboral end and anteriorly to a peristome of a diameter of about 15 μm. There is no evertible peristomial lip; the peristomial borders are thick and rigid. The epistomial disc of a very small diameter does not protrude beyond the border of the peristome, being set at about the same level. The disc is encircled by one turn of the adoral spiral; the infundibulum, a slender tapering funnel, reaches down to mid-body. A reniform macronucleus, 17 × 6 μm, is located at about the middle on the body length, the micronucleus, 2 × 1.5 μm, lies in its concavity. The pellicle is finely striated, about 12 striae to an interval of 5 μm. The acontractile peduncle, of a length inferior to that of the body, is exceptionally slender, only about up to 2 μm wide. In contracted state, the body becomes almost sphaerical, with pouting, contracted peristomial borders directed forward.

The rigidity of the peristomial borders and small diameter of the epistomial disc range this species to the genera *Opercularia* and *Pyxidiella;* since no colonies could be observed, its proper place is with the latter. It is at variance with all hitherto known *Pyxidiella* species by the combination of its unique features—by its terrestric mollusc host, non-protruding epistomal discs, and, before all, by the extremely thin peduncle. Although additional studies are required to elucidate the biology of this ciliate, to find out its mode of transmission and the possibility of cyst formation, the characters mentioned make it clear that we can consider it a new species of ectocommensal peritrichs, *P. limacidarum.*

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TO THE IDENTITY OF THE MICROSPORIDIAN PARASITES OF ODAGMIA ORNATA (MEIG.) (DIPTERA, SIMULIIDAE)

LUU THAM MUU

Received March 23, 1976

Abstract: The distribution of spore dimensions of the microsporidia described by Gassouma, compared with the same measurements on previously known microsporidia in blackfly larvae revealed the identity of *Thelohania minuta* and *T. avacuolata* with *T. bracteata*, *T. bertrami* and *T. canningi* with *T. varians* and *T. simulii* with *T. fibrata*. The two newly described Pleistophoras are *Pleistophora tillingbournei* identical with *P. simulii* and *P. leasei* identical with *P. debaisieuxi*.

INTRODUCTION

In a series of year-round investigations of the pathogens occurring in *Odagmia ornata* (Meigen) and other blaskfly larvae in a locality in Czechoslovakia (Kokořín valley) we identified six microsporidia infecting the larvae, their seasonal distribution and host relations. The species involved were *Thelohania bracteata*, *T. fibrata*, *T. varians*, *Pleistophora simulii*, *P. debaisieuxi* and *P. multispora*. The determination of the microsporidia was confirmed by Dr. J. Weiser, Laboratory of Insect Pathology, Institute of Entomology of the Academy of Sciences, and they were compared with the material of the late Prof. Jírovec which was the basis for his revision of the microsporidia in blackflies. After this revision (Jírovec, 1943) further descriptions of new pathogens brought evidence of material from more exotic regions such as the S. Alps (*Weiseria*), Northern Territories (Canada) and Alasca (*Caudospora*). In contrary to this, most studies of microsporidia in blackflies in the palearctic or nearctic regions as well as in the tropics brought evidence of an equal distribution of the above mentioned species over the whole area. Recently Gassouma (1972) published a series of 5 new Thelohanias and 2 Pleistophoras occurring in *Simulium ornatum* in southern England. It was very interesting from the point of view of zoogeography of insect diseases that such a large group of new organisms was distributed in a homogenous distribution area of *O. ornata* only in one perticular place and they were not recognized before by any former insect pathologist. Therefore we used our determinated material for a re-evaluation using the same methods as indicated by Gassouma (1972). The comparison of both evaluations is given in this paper. This paper itself is a part of a thesis for Ph. D. at the Inst. of Entomology, Academy of Sciences, Prague.

MATERIAL AND METHODS

Larvae of blackflies were collected on submerged plants in the Kokořín brook in the Kokořín valley and were transported in plastic bags to the laboratory where the infected ones were

selected according to white or brown cysts in their posterior segments. They were kept in shallow water in the refrigerator and dissected on slides under the dissecting microscope. The cysts were separated and smeared on microscopic slides or on cover slips, dried and stained with Giemsa stain. They were prepared in the same way as indicated by Gassouma (1972). Material was selected after the host larvae and divided in groups according to spore size and shape and number of spores in the pansporoblast. Stained smears were used for evaluation of the spores. 300 spores were measured using the filar ocular micrometer Zeiss 15× and objective HI 100×. The final

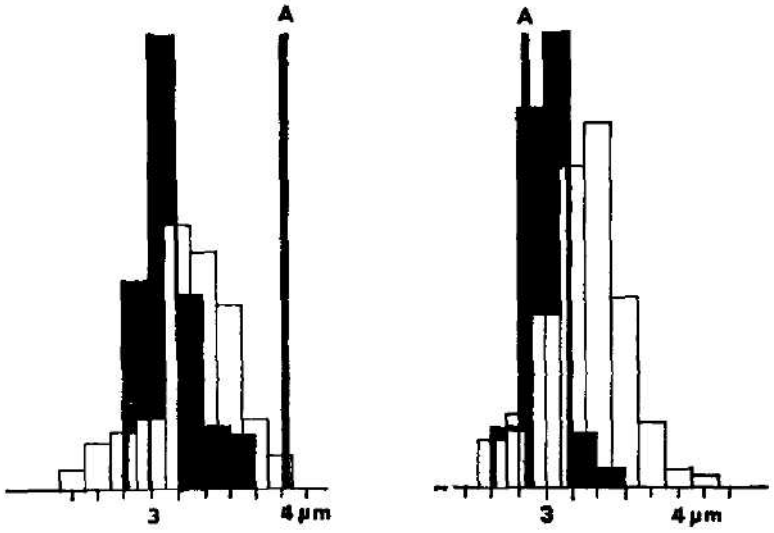

Fig. 1. Spore size (length left, breadth right) of *Thelohania bracteata* (black) and of *T. minuta* Gassouma. A-mean measures of *T. avacuolata*, Gassouma.

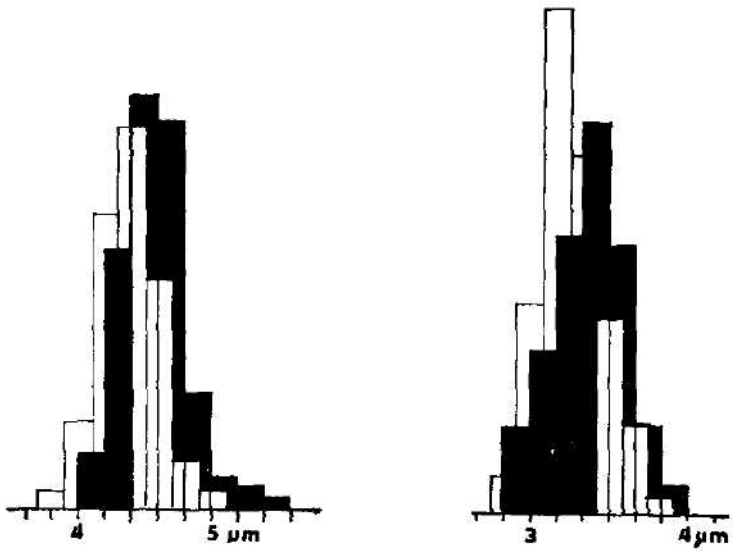

Fig. 2. Spore size (length left, breadth right) of *Thelohania varians* (black) and of *T. bertrami* Gassouma.

magnification of the system was 2,400×. Resulting indexes were expressed in µm with intervals of 0.2 µm. The measurements were presented in graphs in the way used by Gassouma, both in the same scale, and they are compared in Figs. 1—6.

RESULTS

The results are presented in four double graphs comparing our measurements with these of Gasouma (1972). Two graphs bring only our measure-

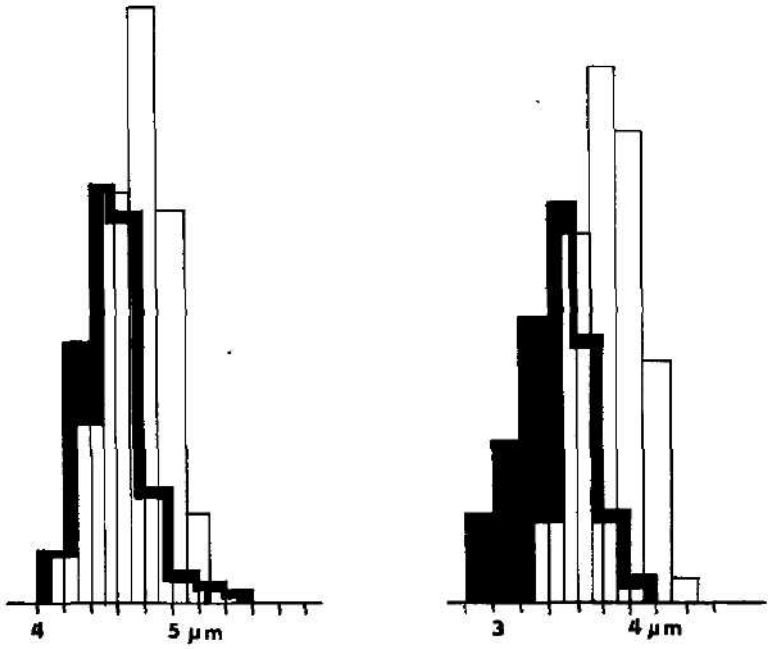

Fig. 3. Spore size (length left, breadth right) of *Thelohania varians* (black) and of *T. canningi* Gassouma.

ments as there are no corresponding data in Gassouma's paper. In our opinion all the new species of Gassouma are synonyms of old valid descriptions. They are connected as follows:

1. *Thelohania bracteata* (Strickland, 1913) (Fig. 1)

Synonyms: *Nosema simulii* γ Lutz et Splendore, 1904, *Glugea bracteata* Strickland, 1913, *Thelohania bracteata* Debaisieux et Gastaldi, 1919, *Thelohania minuta* Gassouma, 1972, *T. avacuolata* Gassouma, 1972.

The microsporidian is known as the "minor subspherical *Thelohania*" of blasckflies. Broad — oval spores with more or less flattened poles are 2.5 to 4 µm long and 2.3 to 3.6 µm broad. They have teratospores produced only to a limited extent. The prevailing length in our collections was 3 µm, on other localities only 2.8 µm. As shown in the figure, the coincidence of both measurements is very good. A supporting symptom is the known hypertrophy of the nuclei in the infected fat body. In late stages of the infections the hypertrophic nuclei have bursted and disappeared among the masses of spores. In

one part of the hosts the cyst inside the blackfly is brown. *Thelohania minuta* is identical with *T. bracteata*. *T. avacuolata* seems to be a case where young spores were measured which have not yet well formed the posterior vacuole.

2. *Thelohania varians* (Léger, 1897) (Fig. 2, 3).

Synonyms: *Glugea varians* Léger 1897, *Thelohania varians* Debaisieux, 1919, *Thelohania bertrami* Gassouma, 1972, *T. canningi* Gassouma, 1972.

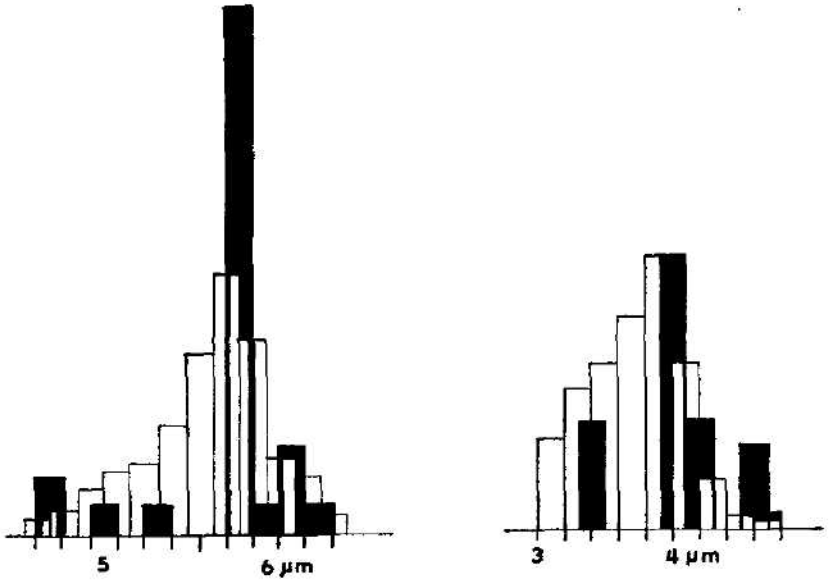

Fig. 4. Spore size (length left, breadth right) of *Thelohania fibrata* (black) and of *T. simulii* Gassouma.

This microsporidian is the "major subspherical *Thelohania*" of blackflies. The spores are again broad oval, poles flattened. The common strain has the dimensions of 5.5—6 by 3—4 µm. In some areas spores with the size of 5.5 to 8 by 5.0—5.5 µm were included in the same species. From the material presented by Gassouma *Thelohania bertrami* and *T. canningi* are identical with *T. varians*, as it is demonstrated in Figures 2 and 3.

3. *Thelohania fibrata* (Strickland, 1913) (Fig. 4).

Synonyms: *Nosema simulii* δ Lutz et Splendore, 1908, *Glugea fibrata* Strickland, 1913, *Thelohania fibrata* Debaisieux et Gastaldi, 1919, *T. simulii* Gassouma, 1972.

The spores of this microsporidian are rather big, connected in groups of eight. They are easily distinguished from the former two by their oval shape with regular rounded poles. The eight spores were in relatively persistent pansporoblasts. The spore size was 5—6 by 3—4 µm. The distribution of the dimensions was equal to that of *Thelohania simulii* Gassouma.

4. *Pleistophora simulii* (Lutz et Splendore, 104) (Fig. 5).

Synonyms: *Nosema simulii* β Lutz et Splendore, 1904 (pro parte), *Plistophora simulii* γ, δ, ε Debaisieux et Gastaldi, 1919, *Plistophora tillingbournei* Gassouma, 1972.

Plasmodia of this microsporidian may contain more than 100 nuclei but break during spore formation to irregular parts where the spores maturate in groups without persistent pansporoblast wall. In other cases the sporonts grow to stages with irregular numbers of nuclei in the range of 10 to 30. Roseta-like stages are common. The spores are oval, with the anterior end

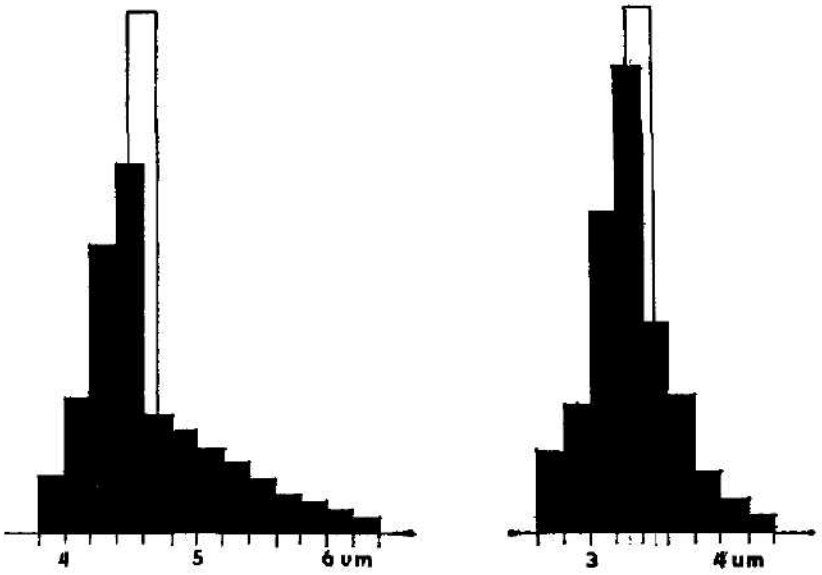

Fig. 5. Spore size (length left, breadth right) of *Pleistophora simulii* (black) and of *P. tillingbournei* Gassouma (mean dimensions).

more constricted. Their size is 4—4.5 μm by 2.5—3.5 μm. Gassouma gives no graphical analyses of the measurements in the case of his *Plistophora tillingbournei* and his mean spore dimensions 4.5 by 3.3 μm fit into the morphology of *P. simulii*.

5. *Pleistophora debaisieuxi* Jírovec, 1943 (Fig. 6).

Synonyms: *Plistophora simulii* γ, δ Debaisieux et Gastaldi, 1919, *Plistophora simulii* γ, δ Kudo, 1924, *Plistophora debaisieuxi* Jírovec, 1943 *P. leasei* Gassouma, 1972.

In the sporogony of this microsporidian groups of 16 to 30 sporoblasts and spores are formed. The well staining spores are elliptical, with both poles equal and rounded, 5—8 μm long and 3—4.5 μm broad. This range reported from the Kokořín locality fits well to the size indicated by Gassouma (5.6 by 4.0 μm as mean value).

Of the microsporidian-like infections listed by Gassouma from *Odagmia ornata*, that occurring in the gut wall is very close and most probably identical with *Octosporea simulii* Debaisieux, 1926, the only microsporidian occurring in the gut wall.

DISCUSSION

The descriptions of microsporidia are mainly based on the size and shape of the spores, on the number of spores in a pansporoblast, on their localization

in tissues, the host organisms and their reactions. The dimensions of the spores are a marker only in the range of microns. Differences in 0.1 μm or less are not significant for the differentiation of a new taxon if there are no other well distinct features in sporogony, localization in the host etc. The dimensions of fresh spores as refringent bodies very much depend in details of the medium where they are suspended. During drying or fixation they are deformed when spores flatten on the preparation gla s. Young spores with

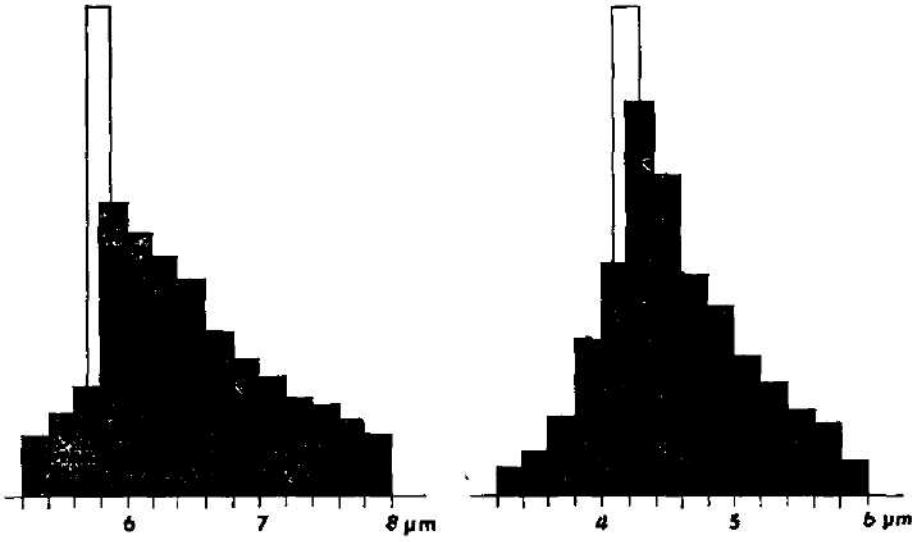

Fig. 6. Spore size (length left, breadth right) of ***Pleistophora debaisieuxi*** (black) and of *P. lassa* Gassouma (mean dimensions).

a more plastic wall are then larger than mature, hardened spores. The distribution of spore dimensions is of help if it is checked with the material which has to be compared. This is what we tried in this paper.

Our results show that the new species proposed from blackflies of South England fall into old, known species. It is only logical to expect that in an distribution area which is not divided by some inpermeable barriers the diseases of the insects would be quite uniform or may present only one or two new elements which escaped observation.

In a recent publication Hazard and Oldacre (1975) proposed to include *Thelohania bracteata* into the newly formed genus *Amblyospora*. This genus is characterized by octosporous pansporoblasts and spores with a thick membrane which is thin at both poles. The polar filament has a thickened and thin part and the development in the host has two distinct types, in larvae and in adults. Of all these symptoms only the morphology of the spore wall could be confirmed. Therefore we still used the old designation.

I wish to thank Dr Jaroslav Weiser, Department of Insect Pathology, Inst. of Entomology, Academy of Sciences, Prague for his assistance in this work and for the discussion of this paper during its preparation.

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SOME DIGENETIC TREMATODES FROM EGYPTIAN FRESHWATER FISHES

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Abstract: The present paper comprises a systematic survey of digenetic trematodes collected from 162 specimens of freshwater fishes in Egypt. In addition to 9 species of adult digeneans (*Allocreadium sudanensis, Orientocreadium batrachoides, Haplorchoides cahirinus, Astiotrema reniferum, Acanthostomum spiniceps, A. absconditum, Sandonia sudanensis, Basidiodiscus ectorchis, Deropristis inflata*) this material also included 8 species of larval forms (Diplostomatidae gen. sp., Prohemistomatidae gen. sp., *Centrocestus cuspidatus, Heterophyes* sp., *Metacercaria* type 1, *Metacercaria* type 2, *Metacercaria* type 3, Didymozooidea gen. sp.) the adults of which being often potentional parasites of man. Redescriptions of 7 species of adult trematodes, extending the present knowledge of their morphological and metrical variability, have been supplemented by descriptions of all the recorded metacercariae. *Allocreadium sudanensis* as well as some larval forms have been found in Egypt for the first time. *Bagrus bayad* is a new host record for *Sandonia sudanensis*. Some problems concerning the taxonomy and geographical distribution of these helminths have been also discussed.

Despite the fact that little knowledge is available on the parasite fauna of African freshwater fishes, some data on helminths from fishes of Egypt date back to the second half of the last century. Looss (1896, 1899, 1900, 1901) was the first to describe and illustrate several common digenetic trematodes from Egyptian fishes. His work was followed only recently by Fischthal and Kuntz (1959, 1963 b, c, d, e, f) who confirmed occurrence of some species previously described by Looss and added several others. Records of metacercariae in Egyptian fishes have been mentioned in several papers by other authors. Lately two theses have been worked out in Egypt on the helminth parasites of freshwater fishes; however, as far as the author knows, the results have not been published.

Until now, there have not been carried out any detailed and systematic investigations in Egypt in this respect and many fish species have not yet been examined helminthologically. Therefore, the present list of the helminth parasites of fishes in this country may be supposed to be considerably incomplete. However, studies on the fish parasites are of special significance in Egypt, because in this area fishes may be a source of different serious helminthoses of domestic animals or man.

From October 1971 until March 1972, during the author's stay in Egypt, a certain number of freshwater fishes was helminthologically examined. The nematodes of this material have been dealt with in an earlier paper (Moravec, 1974), while the results of the systematic evaluation of digeneans are presented in this study.

MATERIAL

Data in this paper are based on materials obtained by examining 152 specimens of fishes, representing 23 species of 12 families: Mormyridae: — *Mormyrus cashive* (1), *M. kannume* (2), *Marcusenius isidori* (5); Characidae: — *Alestes nurse* (18), *Hydrocyon forskali* (1); Cyprinidae: — *Barbus bynni* (8), *B. perincae* (5), *B. werneri* (1), *Labeo forskali* (1), *L. horie* (4); Bagridae: — *Bagrus bayad* (12), *B. docmac* (1), *Chrysichthys rueppeli* (9); Mochocidae: — *Synodontis schall* (4); Claridae: — *Clarias lazera* (16), *C. anguillaris* (1); Malapteruridae: — *Malapterurus electricus* (1); Schilbeidae: — *Schilbe mystus* (4), *Eutropius niloticus* (1); Poecilidae: — *Gambusia affinis* (25); Anguillidae: — *Anguilla anguilla* (8); Centropomidae: — *Lates niloticus* (7); Cichlidae: — *Tilapia zilli* (17).*) Most fishes were bought in the fish market in Cairo (Giza), only a small number of them was caught in the River Nile or in the adjacent irrigation canals or drains. The trematode material was largely examined as stained total mounts, some metacercariae were also studied alive.

SURVEY OF SPECIES

I. Adults:

Fam. Allocreadiidae Stossich, 1903

1. *Allocreadium sudanensis* Saoud, Abdel-Hamid et Ibrahim, 1974 (Fig. 1A)

Host: *Barbus bynni* (Forsk.).
Location: intestine.
Incidence: in 1 out of 8 fishes examined; intensity of infection: 14 specimens.

Description: Body elongate-oval, with smooth cuticle. Length of body 4.38—7.19 mm, maximum width 1.59—1.77 mm. Subterminal oral sucker almost round, size 0.449—0.517 × 0.490—0.544 mm; its inner margin provided with circle of several small papillae. Acetabulum (0.449 — 0.530 × × 0.476—0.558 mm) equal in size with oral sucker, being situated in the first third of body length. Size of oval pharynx 0.218—0.231 × 0.204—0.272 mm; oesophagus 0.435 mm long. Intestinal bifurcation at acetabulum level, caeca extending posteriorly to near body end. Smooth ovary oval-shaped, located below acetabulum level, size 0.313 — 0.408 × 0.354—0.367 mm. Postovarian seminal receptacle rather large. Testes smooth, oval-shaped, almost equal (anterior testis measuring 0.476—0.666 × 0.422—0.571 mm, posterior testis 0.544—0.666 × 0.544—0.734 mm), tandem or diagonal. Genital pore slightly below pharynx level. Cirrus sac (length 0.571—0.816 mm, width 0.367 mm) containing seminal vesicle, prostatic part and ductus ejaculatorius. Uterus reaching posteriorly to level of anterior margin of posterior testis. Eggs measuring 0.102—0.105 × 0.060—0.066 mm. Follicular vitellaria filling up whole space of body posterior to testes; anteriorly they form two lateral bands reaching mostly to level of posterior end of ovary, sometimes extending up to posterior margin of acetabulum.

This species has recently been described (Saoud, Abdel-Hamid, Ibrahim, 1974) from *Barbus bynni* from the White Nile in the Sudan. Contrary to the original description, our specimens are considerably larger and the topography of their internal organs is somewhat different (e.g. situation of testes and ovary, extention of uterus, etc.). These differences can be, however, explained so that *A. sudanensis* was described on very young worms, as suggested by the illustrated specimen containing only several eggs in the uterus. Our specimens are roughly identical with *A. sudanensis* in many

*) For identification of the fish hosts my thanks are due to Dr. S. Frank, CSc of the Faculty of Sciences, Charles University, Prague.

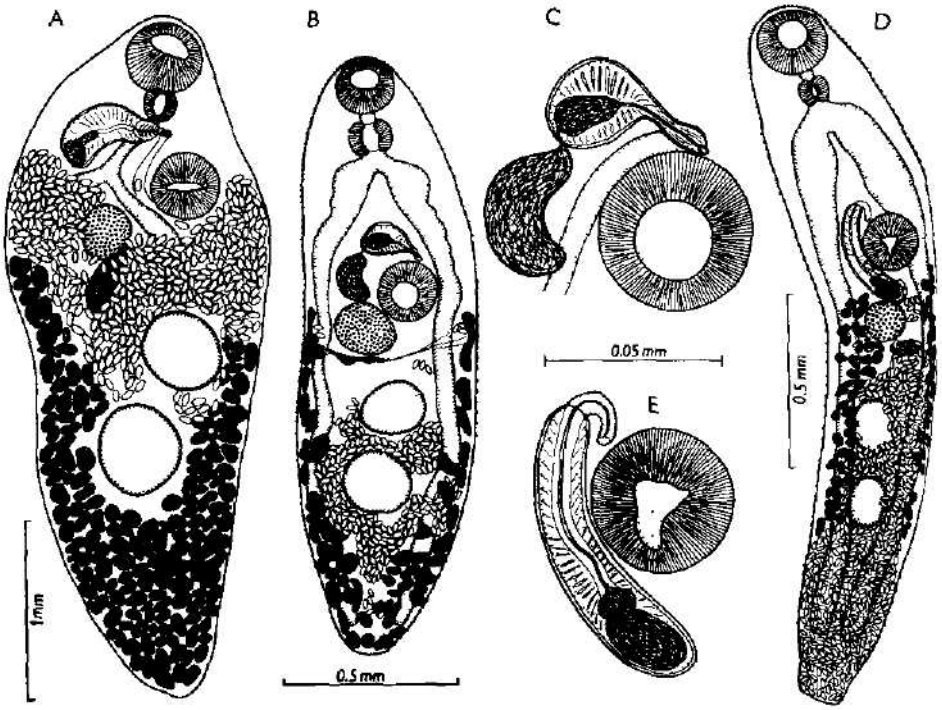

Fig. 1. A — *Allocreadium sudanensis* Saoud, Abdel-Hamid et Ibrahim, 1974; B — *Orientocreadium batrachoides* Tubangui, 1931; C — cirrus sac of *O. batrachoides;* D — *Astiotrema reniferum* (Looss, 1898); E — cirrus sac of *A. reniferum.*

important characters, they originated from the same host from the same water drainage system and are, therefore, considered to belong to this species. It is possible that further studies may prove *A. sudanensis* to be identical with *A. indistinctum* Baer, 1959, described from *Barbus* sp. from Zaire, and with *A. mazoensis* Beverley-Burton, 1962 from *Clarias mossambicus* from Rhodesia (in the latter species the uterus also reaches up to the space between testes)

2. *Orientocreadium batrachoides* Tubangui, 1931 (Fig. 1 B, C)

Host: *Clarias lazera* C. & V.
Location: intestine.
Incidence: in 11 out of 16 fishes examined; intensity of infection: 2 to 110 specimens.

Description: Body length of adult specimens 1.40—2.45 mm, maximum width 0.558—0.666 mm. Cuticle covered with very fine spines which are dense on anterior end of body and gradually diminish in number posteriorly. Oral sucker measuring 0.165—0.213 × 0.180—0.243 mm; acetabulum slightly smaller, size 0.165—0.240 × 0.186—0.228 mm. Prepharynx maximally 0.057 mm long, sometimes indistinct. Pharynx strongly muscular, measuring 0.102—0.147 × 0.099—0.183 mm. Oesophagus at most 0.015 mm long, sometimes indistinct. Intestinal caeca extending to near posterior extremity. Ovary oval, 0.126—0.180 × 0.168—0.210 mm, submedian, postacetabular. Oval testes tandem, postovarian. Cirrus sac short (length 0.135 — 0.180 mm),

containing short anterior part of seminal vesicle; external part of seminal vesicle 0.180—0.270 mm long. Genital pore situated at anterior margin of acetabulum. Uterus reaching to almost posterior end of body. Mature eggs yellow, measuring 0.033—0.036 × 0.018—0.021 mm. Vitellaria follicular, some follicles very elongated; vitellaria start approximately at level of posterior margin of acetabulum, extend along sides of body to join near posterior extremity. Small vitelline reservoir present below ovary.

This species was originally described from *Clarias batrachus* from the Philippines (Tubangui, 1931); Beverley-Burton (1962) synonymized with this species several other members of the genus which had been described from siluroid fishes of India. In African Continent *O. batrachoides* was recorded only in members of the genus *Clarias* — in *C. lazera* from the Sudan (Khalil, 1961, 1969) and Egypt (Fischthal and Kuntz, 1963 f), and in *C. mellandi* and *C. mossambicus* from Rhodesia and Zambia (Beverley-Burton, 1962). Paperna (1964) reported it from *C. lazera* from Israel. In Egypt this parasite belongs to the most frequent parasites of *C. lazera*.

Fam. Cryptogonimidae (Ward, 1917) Ciurea, 1933

3. *Haplorchoides cahirinus* (Looss, 1896) (Fig. 2 A)

Hosts: *Bagrus bayad* (Forsk.) and *B. docmac* (Forsk.).
Location: intestine.
Incidence: in 6 out of 12 *B. bayad* (intensity of infection 1 to about 15 000 specimens) and in single *B. docmac* examined (200 specimens).

Description: Small trematodes with spinose cuticle. Body length of specimens containing eggs 0.73—1.51 mm, maximum width 0.245—0.340 mm. Oral sucker oval-shaped, size 0.045—0.054 × 0.054—0.069 mm. Prepharynx long (0.120—0.180 mm); pharynx muscular, measuring 0.039—0.051 × × 0.036—0.042 mm. Oesophagus 0.069—0.105 mm long. Narrow intestinal caeca ending at small distance below testis. Almost spherical, single testis (size 0.120—0.204 × 0.150—0.213 mm) slightly postequatorial. Thin-walled seminal vesicle bipartite, intracaecal, situated in front of ovary; its anterior part is larger than posterior one. Ventrogenital sac almost spherical (0.045 to 0.051 mm in diameter), located below intestinal bifurcation; it contains genital opening and ventral sucker with modified margin forming two lobes equipped with minute spines arranged in rows. Nearly spherical ovary (size 0.072—0.114 × 0.081—0.114 mm) approximately equatorial. Large, round seminal receptacle present, situated obliquely below ovary. Uterus extending from ventral sac up to posterior extremity. Eggs measuring 0.036—0.039 × × 0.015—0.018 mm. Vitelline follicles rather large, forming main lateral groups, two pretesticular and two posttesticular; some follicles are found even in median line. In young specimens vitellaria reach nearly to posterior extremity, in older specimens they are shifted and posterior end of body is filled only with uterus containing numerous eggs.

Hitherto this species is known only from Egypt (Looss, 1896, 1899; Fischthal and Kuntz, 1963) and Uganda (Khalil and Thurston, 1973) from *Bagrus bayad* and *B. docmac*. Our specimens exhibit higher degree of metrical variability than found by Khalil and Thurston (1973).

Fam. Plagiorchiidae Lühe, 1901

4. *Astiotrema reniferum* (Looss, 1898) (Fig. 1 D)

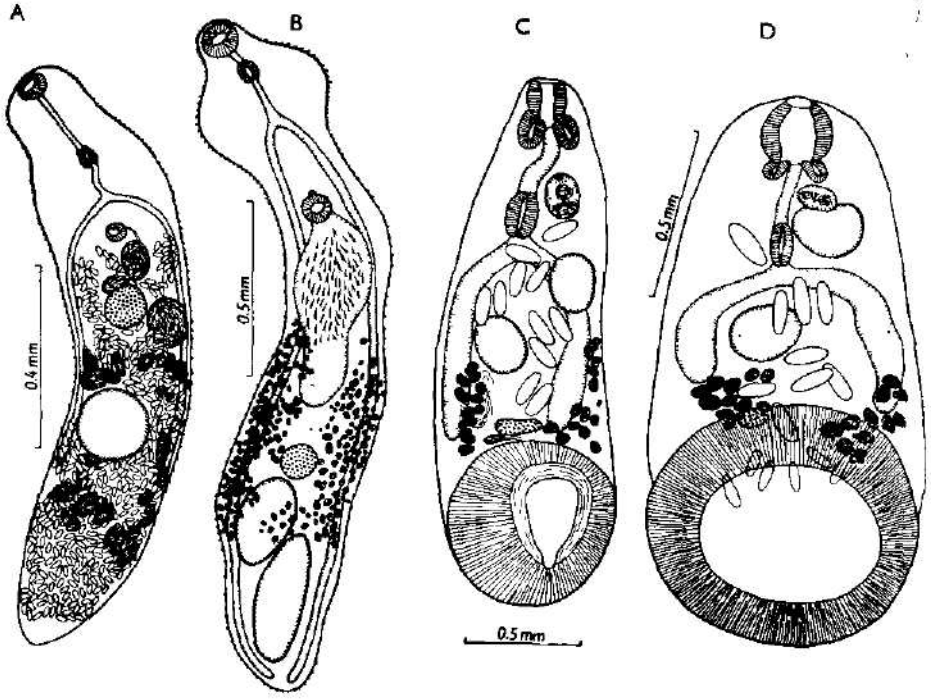

Fig. 2. A — *Haplorchoides cahirinus* (Looss, 1896); B — *Deropristis inflata* (Molin, 1859); C — *Sandonia sudanensis* McClelland, 1957; D — *Basidiodiscus ectorchis* Fischthal et Kuntz, 1959.

Host: *Clarias lazera* C. & V.
Location: intestine.
Incidence: in 3 out of 16 fishes examined; intensity of infection: 2—6 specimens.

Description: Elongate-oval trematodes with trucated posterior end. Body length of specimens containing eggs 1.47—2.31 mm. Cuticle covered with tiny spines, which are dense on anterior end of body and gradually diminish in number posteriorly. Oral sucker slightly oval or spherical, size 0.186 to 0.246 × 0.210—0.279 mm. Almost spherical acetabulum slightly smaller than oral sucker, measuring 0.183—0.261 × 0.168—0.270 mm. Prepharynx very short (maximally 0.015 mm long) or indistinct. Oesophagus at most 0.060 mm long, sometimes indistinct. Intestinal caeca wide, extending posteriorly to end at distance of 0.180—0.225 mm from posterior extremity. Seminal receptacle oval-shaped, located below ovary. Testes tandem, oval-shaped, smooth; anterior testis measuring 0.159—0.225 × 0.159—0.240 mm, posterior testis 0.186—0.204 × 0.156—0.240 mm. Cirrus sac large, elongate, length 0.276—0.390 mm, lying at side of acetabulum; it contains bipartite seminal vesicle and prostatic part. Genital pore situated near anterior margin of acetabulum. Uterus forming upward and downward loops reaches to posterior end of body, where it fills in almost whole posttesticular space. Yellow eggs measure 0.036—0.039 × 0.018—0.021 mm. Follicular vitellaria extend laterally mostly from level of posterior edge of acetabulum to posterior margin

of second testis; sometimes they reach anteriorly up to half of acetabulum and posteriorly to half of second testis only.

In 1972 Khalil described from *Clarias lazera* of the Sudan trematodes which he considered as members of the family Allocreadiidae (subfamily Wallininae); he established for them a new species and genus *Afromacroderoides lazerae*. The morphology and dimensions of this species are almost identical with *Astiotrema reniferum*, slight differences being only in the length of the oesophagus and in the size of eggs; the cirrus of *A. lazerae* has been described as spinose while that of *A. reniferum* is smooth, without any spines. Since the description of *A. lazerae* was based on the only available specimen the cirrus of which was not protruded out (as obvious from the drawing), the transverse folds present on the withdrawn cirrus in *A. reniferum* might easily be mistaken for spines. It is probable, therefore, that *A. reniferum* and *A. lazerae* are congeneric and, perhaps, even conspecific. The only substantial difference between *Astiotrema* and *Afromacroderoides* should be the shape of the excretory vesicle (Y-shaped in *Astiotrema* and tubular in *Afromacroderoides*); this has not been, however, observed in *A. lazerae*. Until the question about the generic appurtenance of these trematodes is solved satisfactorily, our specimens, in which the excretory vesicle was not studied (only mounted specimens were available), are considered to be members of the genus *Astiotrema*.

A. reniferum was originally described by Looss (1896, 1898) from the freshwater turtle *Trionix nilotica* from Egypt and occurs frequently also in *T. triunguis* in Egypt and the Sudan (Odhner, 1911; Khalil, 1959). It was also found in siluroid fishes — in *Clarias batrachus* from Burma and India, in *C. lazera* from the Sudan (Khalil, 1959, 1969), in *C. mossambicus* from Rhodesia and Zambia (Beverley-Burton, 1962), and in *Bagrus docmac* from Uganda (Khalil, Thurston, 1973). This is the first record of this species from a piscine host in Egypt.

Fam. Acanthostomatidae Poche, 1926

5. *Acanthostomum absconditum* (Looss, 1901)

Host: *Bagrus bayad* (Forsk.).
Location: intestine.
Incidence: in all 12 *B. bayad* examined; intensity of infection: 2 to 50 specimens.

This species has been dealt with in a previous paper (Moravec, 1976).

6. *Acanthostomum spiniceps* (Looss, 1896)

Hosts: *Bagrus docmac* (Forsk.) and *B. bayad* (Forsk.).
Location: intestine.
Incidence: in single *B. docmac* examined (28 specimens) and in 2 out of 12 *B. bayad* (2 to 16 specimens per fish).

The species *A. spiniceps* has been treated in the author's earlier paper (Moravec, 1976).

Fam. Deropristiidae (Skrjabin, 1958) Peters, 1961

7. *Deropristis inflata* (Molin, 1859) (Fig. 2 B)

Host: *Anguilla anguilla* (L.).
Location: intestine.
Incidence: in 1 out of 8 eels examined; intensity of infection: 3 specimens.

Description: Small-sized trematodes, still without eggs. Length of body 2.38—2.61 mm, maximum width 0.449 mm. Whole body surface covered with small spines which are dense on anterior end of body and gradually diminish in number posteriorly. Oral sucker almost round, 0.105—0.114 × ×0.078—0.104 mm. Oval acetabulum situated approximately at border of first and second third of body length, size 0.072—0.114 by 0.075—0.120 mm. Short prepharynx (length 0.066 mm), oval-shaped pharynx (0.060 × 0.045 mm) and fairly long oesophagus (0.171 mm) present. Narrow intestinal caeca extend posteriorly up to end of body. Cirrus sac large (length 0.680 to 0.748mm), densely spinose inside. Genital pore lying near anterior edge of acetabulum. Ovary oval-shaped (0.129 × 0.111 mm), median, at small distance bellow posterior end of cirrus sac. Testes elongate-oval, smooth, located obliquely in postovarian space. Size of anterior testis 0.102—0.309 × 0.075 to 0.189 mm, of posterior testis 0.141—0.450 × 0.090—0.174 mm. Follicular vitellaria in form of wide lateral bands starting at level of last third of cirrus sac and extending posteriorly approximately to anterior edge of second testis.

This species is a long ago known parasite of *Anguilla anguilla*. From Egypt it has been reported from the same host by Fischthal and Kuntz (1963).

Fam. Paramphistomatidae Fischoeder, 1901

8. *Sandonia sudanensis* McClelland, 1957 (Fig. 2 C)

Hosts: *Synodontis schall* Bl. Schn., *Bagrus docmac* (Forsk.).
Location: posterior end of intestine.
Incidence: in 1 out of 4 *S. schall* (88 specimens) and in single *B. docmac* examined (1 specimen).

Description: Shape of body elongate-oval; length of specimens containing eggs 1.58—2.82 mm, maximum width 0.571—1.061 mm. Large ventroterminal acetabulum measuring 0.476—0.816 × 0.558—0.911 mm, provided with oval-shaped apperture. This apperture is marginated with lamella-like thickening, with usually short interruption on dorsal side. Oral sucker terminal (length 0.180—0.272 mm, width 0.165—0.264 mm), with distinct diverticula 0.099—0.136 mm long. Rather long oesophagus (length 0.255 to 0.520 mm) opening into oesophageal bulb (size 0.105—0.189 × 0.051 to 0.135 mm). Intestinal caeca ending posteriorly at ovary level. Testes diagonal; anterior testis (0.195—0.408 × 0.135—0.408 mm) mostly intracaecal, sometimes partly or completely extracaecal; posterior testis (0.156—0.435 × ×0.144—0.394 mm) intracaecal. Genital pore submedian, located in front of oesophageal bulb; cirrus sac oval-shaped, size 0.180—0.219 × 0.090—0.126 mm. Ovary of irregular shape (size 0.108—0.159 × 0.090—0.105 mm), situated in front of acetabulum between ends of intestinal caeca. Uterus occupying intracaecal space. Eggs considerably large, size 0.180—0.210 × ×0.078—0.090 mm). Vitellaria formed as two lateral groups of follicles distributed near intestinal ends, reaching anteriorly to level of posterior testis.

The morphology of our specimens corresponds on the whole to the description of *S. sudanensis;* however, the range of their dimensions is not as wide as given in the original description and the eggs are somewhat bigger. So far this species has been found in *Synodontis schall*, *S. batensoda*, *S. clarias*, *S. membranaceus* and *Distichodus niloticus* in the Sudan (McClelland, 1957; Khalil, 1969) and in *S. schall* in Egypt (Fischthal, Kuntz, 1959).

Bagrus docmac, in which a mature specimen of *S. sudanensis* (containing eggs in the uterus) was found, is a new host record for this species.

9. *Basidiodiscus ectorchis* Fischthal et Kuntz, 1959 (Fig. 2 D)

Host: *Synodontis schall*. Bl. Schn.
Location: posterior end of intestine.
Incidence: in 1 out of 4 fishes examined; intensity of infection: 45 specimens.

Description: Small trematodes of conical shape. Length of body of specimens containing eggs 0.83—1.80 mm, maximum width 0.584—0.938 mm. Acetabulum large, ventroterminal, size 0.408—0.816 × 0.476—0.898 mm. Oral sucker terminal, with saccular diverticula; length of oral sucker 0.150 to 0.216 mm, width 0.150—0.246 mm, length of diverticula 0.060—0.075 mm. Oesophagus rather long (0.060—0.270 mm), opening into elongate-oval oesophageal bulb (size 0.060—0.120 × 0.036—0.072 mm). Simple intestinal caeca ending at small distance from body end. Testes oval, diagonal; anterior testis (size 0.066—0.159 × 0.090—0.255 mm) mostly extracaecal, in anterior third of body; posterior testis (size 0.060—0.180 × 0.105—0.225 mm) intracaecal, in about middle of body. Genital pore submedian, in front of oesaphageal bulb; oval-shaped cirrus sac present. Ovary small (0.060—0.075 × × 0.060—0.165 mm), irregularly oval, median or submedian, situated below ends of intestinal caeca. Uterus intra- and extracaecal, pre- and postcaecal. Eggs measuring 0.168—0.180 × 0.057—0.090 mm, mature eggs embryonated. Follicular vitellaria lateral, posttesticular, distributed near posterior ends of intestinal caeca.

Our specimens, which were studied as whole mounts only, exhibited slight differences from the original description: the acetabulum was not wider than the body width and no papilla-like projections were observed at the bottom of the acetabulum. However, in the shape of the body, arrangement of the internal organs and in measurements the specimens in our material correspond to the species *B. ectorchis*, which has been known from *Synodontis schall*, *S. batensoda*, *S. clarias* and *Mormyrus kannume* from the Sudan and Egypt only (Fischthal, Kuntz, 1959; Khalil, 1969).

II. Larval forms:

Fam. Diplostomatidae Poirer, 1886

10. Diplostomatidae gen. sp. — metacercaria (Fig. 3 A)

Host: *Clarias lazera* C. & V.
Location: muscles.
Incidence: in 1 out of 16 fishes examined; intensity of infection: 30 specimens.

Description: In fairly big, whitish spherical cysts composed of several covers, without pigmentation. Outline of outer, apparently connective cyst wall (about 0.2 mm thick) 1.7—2.0 mm in diameter. Inner, proper cyst oval-shaped, thin-walled, size 0.762 × 0.489—0.517 mm (0.009 mm thick); it occupies only little space of connective cyst. Metacarcarial body filling entire space of inner cyst. Body of released metacercaria foliaceous, approximately oval in outline. Body length of mounted specimens 0.898—1.129 mm, maximum width 0.503—0.585 mm. Cuticle on anterior two thirds of body covered with small spines and practically smooth on last one. Oral sucker subterminal, size 0.060—0.069 × 0.072—0.087 mm. Two distinct lateral

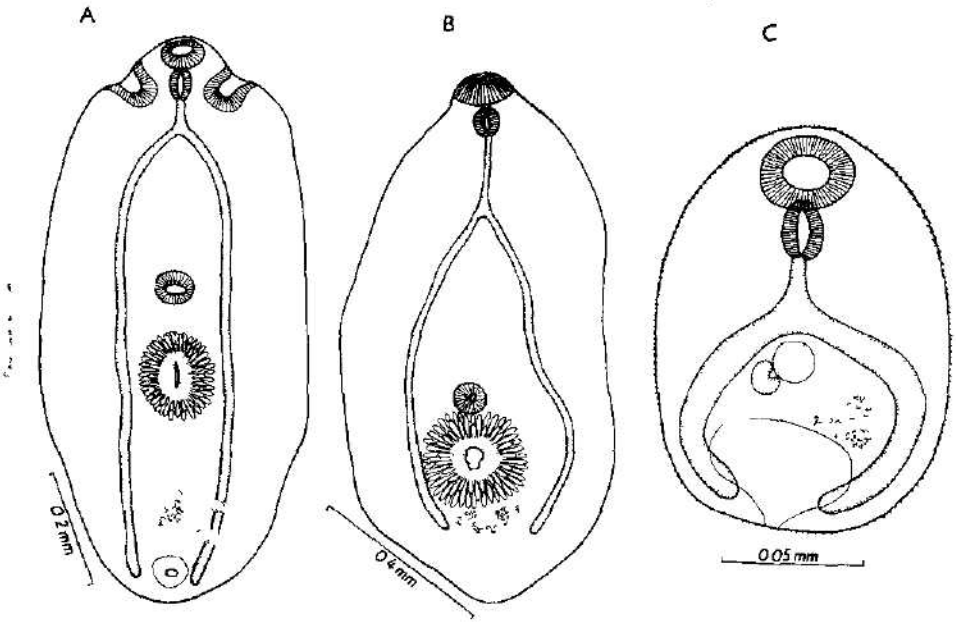

Fig. 3. A — Diplostomatidae gen. sp. — metacercaria from *C. lazera*, B — Prohemistomatidae gen. sp. — metacercaria from *T. zilli*; C — *Heterophyes* sp. — metacercaria from *B. bayad.*

pseudosuckers present at level of pharynx. Transverse-oval acetabulum slightly preequatorial, measuring 0.057—0.066 × 0.072—0.075 mm. Strongly muscular pharynx oval-shaped, size 0.048—0.051 × 0.039—0.045 mm. Short oesophagus present (length 0.039—0.045 mm). Intestinal caeca extending almost to end of body. Just postequatorial, oval-shaped holdfast (0.135—0.150 × 0.129—0.144 mm) with split-like apperture located at short distance below acetabulum. Developing sexual glands present near posterior extremity. Spherical, fairly big excretory pore situated at level of ends of caeca.

In the muscles of *Clarias lazera* of Egypt, unidentified, encysted strigeid metacercariae, probably identical with metacercariae of our material, have been found by El-Mossalami and Sherif (1964). According to the morphology these larvae can be assigned to the family Diplostomatidae; however, their more axact indentification will be possible only after feeding experiments with definitive hosts, these being apparently some waterbirds. In the morphology (e.g. the presence of pseudosuckers), type of the cysts and location in the host they resemble metacercariae of the genus *Hysteromorpha*, differing from them principally by the situation of the holdfast. Although these metacercariae had occurred in only one specimen of *C. lazera* of the present material, the same larvae were found later (spring 1973) in all 27 examined *C. lazera* bought at the fish market in Cairo (intensity of infection being mostly several hundred cysts per fish).

Fam. Prohemistomatidae Sudarikov, 1961

11. Prohemistomatidae gen. sp. — metacercaria (Fig. 3 B)

Host: *Tilapia zilli* (Gerv.).
Location: abdominal cavity, surface of liver.
Incidence: in 5 out of 17 fishes examined; intensity of infection: 1 to 3 specimens.

Description: In spherical cysts 0.31 mm in diameter. Body of released and mounted metacercaria 0.675 mm long and 0.351 mm wide. Cuticle smooth. Anterior end of body somewhat tapering. Oral sucker terminal, 0.045 × 0.075 mm. Acetabulum slightly postequatorial, weakly muscular, measuring 0.036 × 0.045 mm. Pharynx spherical, strongly muscular, 0.036 mm in diameter. Length of oesophagus 0.087 mm. Caeca narrow, exceeding slightly posterior margin of holdfast. Holdfast almost spherical, 0.114 × 0.120 mm, just postacetabular; developing sexual glands slightly outlined at short distance below holdfast. Excretory system represented by dense network of excretory canals containing granules.

Morphologically these larvae may belong to the *Prohemistomum*, *Mesostephanus* or *Paracoenogonimus* of which only members of the first two genera have so far been recorded from Egypt; the adult forms of them are mostly parasites of carnivores, less frequently of birds. Azim (1933) found in experiments that the metacercariae of *Prohemistomum vivax*, a frequent parasite of dogs and cats in Egypt, were located in round cysts 0.3 mm in diameter in the muscles and peritoneum of *Tilapia nilotica* and *Gambusia affinis*. The same species was obtained in Egypt by Fahmy and Selim (1959) from dogs fed on fishes *Tilapia nilotica* and *Mugil capito*. Adult *P. vivax* were also recorded from man (Nasr, 1941) in whom it can cause the illness similar to disenteric diseases. It will have to be proved experimentally whether the larvae of the present material belong to *P. vivax* or to some other species or genus.

Fam. Heterophyidae Odhner, 1914

12. *Heterophyes* sp. — metacercaria (Fig. 3 C)

Host: *Bagrus bayad* (Forsk.).
Location: abdominal cavity.
Incidence: in 3 out of 12 fishes examined; intensity of infection: 1 to 14 specimens.

Description: Metacercariae encysted in thin-walled, hyaline spherical cysts about 0.30 mm in diameter. Released, mounted metacercaria is 0.204 to 0.210 mm long and 0.150—0.153 mm wide. Cuticle covered densely with small spines which are somewhat smaller on last third of body length. Subterminal oral sucker measuring 0.036 × 0.051 mm. Prepharynx absent. Strongly muscular, oval—shaped pharynx measuring 0.033 × 0.024 mm. Oesophagus 0.027 mm long. Intestinal bifurcation approximately at midbody and ceaca reaching up to posterior end of body. Round acetabulum (0.021 mm in diameter) little distinct; gonotyl submedian, postacetabular. Indistinct, developing sexual glands located in space between right caecum and excretory vesicle. Latter oval-shaped, situated between ends of caeca; anteriorly it reaches approximately halfway between posterior end of body and acetabulum.

Adult trematodes of this genus are intestinal parasites of carnivores, mainly of dogs and cats, and also of man. Encysted metacercariae are found

in the muscles and abdominal cavity of fishes, which act as the second intermediate hosts of these parasites. Metacercariae of the genus *Heterophyes* are known from Egypt from *Tilapia nilotica* and *Mugil capito* (Khalil, 1933; Fahmy, Selim, 1959). Hitherto they have not been recorded from *B. bayad*.

13. *Centrocestus cuspidatus* (Looss, 1896) — metacercaria (Fig. 4 A, B)

Host: *Gambusia affinis* (Baird & Girard).
Location: gills.
Incidence: in 1 out of 25 fishes examined; intensity of infection: 2 specimens.

Description: Metacercariae in small round cysts. Body of released, somewhat damaged mounted metacercaria 0.306 mm long and 0.135 mm wide,

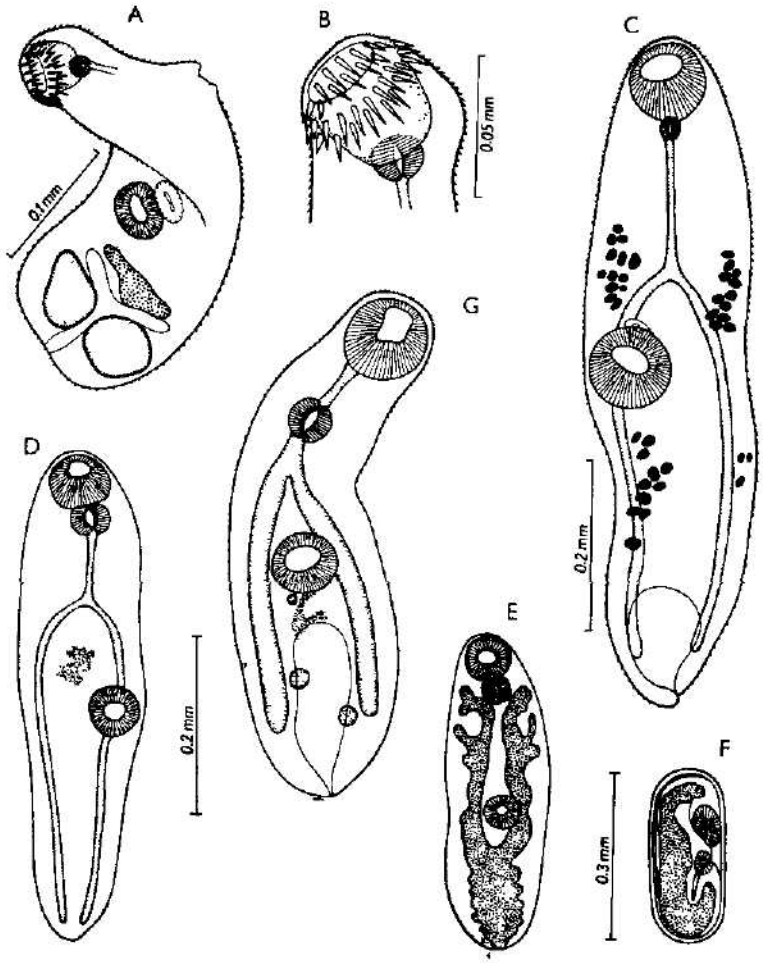

Fig. 4. A — *Centrocestus cuspidatus* (Looss, 1896) — metacercaria from *G. affinis;* B — anterior extremity of *C. cuspidatus* metacercaria; C — *Metacercaria* type 1 from *T. zilli;* D—F — *Metacercaria* type 2 from *T. zilli* (D — stained specimen; E — living metacercaria with distinct excretory vesicle; F — cyst); G — *Metacercaria* type 3 from *T. zilli.*

tapering somewhat to anterior end. Body surface covered densely with small spines. Oral sucker terminal, size 0.045 × 0.045 mm, provided with two rows of big peribuccal spines (length 0.012—0.015 mm), 32 in number. Prepharynx absent. Oval-shaped, muscular pharynx measuring 0.015 × 0.018 mm. Oesophagus present; following parts of digestive tract could not be observed due to damage of specimen. Acetabulum approximately equatorial, oval-shaped, size 0.033 × 0.045 mm. Oval-shaped gonotyl submedian, just preacetabular. Two equal testes (0.039 × 0.048 mm) situated sublaterally near posterior end of body. Developing ovary short distance in front of testes. Excretory vesicle Y-shaped, its branches lying between ovary and testes.

This trematode species was originally described from Egypt. Adults are parasitic in *Milvus parasiticus*, dogs, and also in man; they were obtained experimentally as well from chickens and rats. Paperna (1964) mentions that metacercariae of the genus *Centrocestus* cause a serious damage to the gills of highly infected young fishes of various species.

14. *Metacercaria* type 1 (Fig. 4 C)

Host: *Tilapia zilli* (Gerv.).
Location: liver.
Incidence: in 1 out of 17 fishes examined; intensity of infection: 1 specimen.

Description: Metacercaria encysted in round transparent cyst. Body of released and mounted metacercaria 0.831 mm long and 0.207 mm wide. Whole surface of body covered with small spines. Both suckers muscular, almost round. Oral sucker subterminal, 0.096 mm in diameter; acetabulum (0.093 × 0.111 mm) located approximately in middle of body. Prepharynx absent. Pharynx rather small, size 0.024 × 0.021 mm, length of oesophagus 0.150 mm. Intestinal bifurcation at small distance in front of acetabulum. Ends of caeca little distinct, caeca extending approximately to posterior extremity. Small, oval-shaped formation (probably gonotyl) present in front of acetabulum. Two lateral groups of formations resembling vitelline follicles present in space anterior to intestinal bifurcation; similar, less distinct formations located laterally below acetabulum. Excretory vesicle seems to be oval-shaped, relatively short.

The morphology of the found metacercaria resembles that of larvae of the subfamily Apophallinae (fam. Heterophyidae).

15. *Metacercaria* type 2 (Fig. 4 D—F)

Host: *Tilapia zilli* (Gerv.).
Location: abdominal cavity.
Incidence: in 1 out of 17 fishes examined; intensity of infection: 2 specimens.

Description: In thin-walled, oval-shaped cysts 0.315 × 0.140 mm in diameter. Body of released metacercaria oval in shape, cuticle seems to be smooth. Mounted metacercaria 0.615 mm long and 0.165 mm wide. Subterminal oral sucker measuring 0.069 × 0.075 mm. Acetabulum strongly muscular, size 0.060 × 0.063 mm. Prepharynx absent; oval, strongly muscular pharynx measuring 0.036 × 0.054 mm. Oesophagus rather long (0.090 mm); intestinal bifurcation situated approximately in midway between pharynx and acetabulum. Caeca extending to posterior end of body. Developing sexual glands located slightly in front of acetabulum. Excretory vesicle Y-shaped, its bifurcation being at short distance below acetabulum; anterior branches of

excretory vesicle extending up to pharynx. Excretory vesicle filled with numerous granules.

In the shape of body, structure of the digestive tract and in the size of suckers these larvae resemble the metacercariae of the foregoing type; however, they differ from them in possessing the conspicuously large, strongly muscular pharynx, the Y-shaped excretory vesicle and the more elongated shape of the cysts. Similar larvae have been reported by Paperna (1964) from *Tilapia nilotica*, *T. zilli* and several other fines from Israel.

16. *Metacercaria* type 3 (Fig. 4 G)

Host: *Tilapia zilli* (Gerv.).
Location: abdominal cavity.
Incidence: in 3 out of 17 fishes examined; intensity of infection: 1 to 5 specimens.

Description: In thin-walled hyaline cysts of oval shape, size 0.28—0.32 by 0.23—0.24 mm. Length of released, mounted metacercaria 0.564 mm, maximum wide 0.196 mm. Body surface covered with very fine spines. Both suckers strongly muscular, almost spherical. Oral sucker subterminal, measuring 0.096 × 0.099 mm. Acetabulum somewhat smaller 0.069 × 0.075 mm), lying approximately in midbody. Prepharynx rather long (0.048 mm). Almost round, strongly muscular pharynx measuring 0.045 mm in diameter. Oesophagus short (0.021 mm). Caeca rather wide, ending 0.084 mm from posterior extremity. Developing testes (0.024—0.029 mm in diameter) diagonal, situated between ends of caeca. Small developing ovary and formation resembling cirrus sac present below acetabulum. Excretory vesicle sac-shaped, ending anteriorly at short distance below acetabulum.

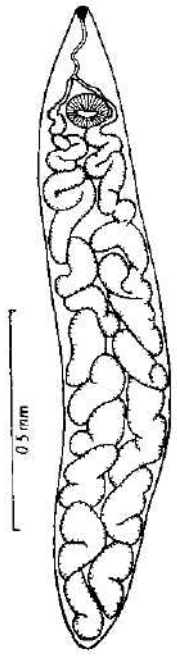

Fig. 5. Didymozooidea gen. sp. juv. (*Torticaecum* group) from the stomach of *Hydrocyon forskali*.

17. Didymozooidea gen. sp. juv. — *Torticaecum* group (Fig. 5)

Host: *Hydrocyon forskali* Cuv.
Location: stomach.
Incidence: 1 specimen found in a single *H. forskali* examined.

Description: Small spindle-shaped trematode with smooth cuticle. Length of body 1.63 mm, maximum width 0.272 mm. Digestive tract starting with oval-shaped pharynx (0.045 × 0.030 mm), followed by narrow oesophagus 0.111 mm long. In front of acetabulum oesophagus bifurcates into two caeca extending up to posterior extremity. These are wide, with many folds, filling up whole space of body posterior to acetabulum. Sexual glands absent. Acetabulum well developed, oval in shape, size 0.090 × 0.108 mm.

Adult didymozoids are parasitic in various tissues or organs of marine and, less frequently, of freshwater fishes. Various fishes may acquire immature didymozoids by eating infected crustaceans and thereby serve as paratenic hosts. The specimen found in *H. forskali* belongs evidently to *Torticaecum* Yamaguti, 1942, which is now regarded as a collective larval group name (Yamaguti, 1971). A similar larva was found in the intestine of *Bagrus bayad*, but it has been lost.

Although only helminths obtained from a small number of fishes are included in the present survey, the results confirm the richness and diversity of the digenean fauna parasitizing Egyptian freshwater fishes. The adult trematodes from fishes, as well as their hosts, largely belong to the Ethiopian fauna, showing affinities with members of the Neotropical and, mainly of the Oriental Regions (Khalil, 1973). Two of the recorded species (*O. batrachoides* and *A. reniferum*) occur in congeneric hosts also in tropical Asia; also the species *A. sudanensis* is both morphologically and metrically very close to several Indian species of the genus *Allocreadium* described from *Barbus* spp. and a future revision of the materials may prove their conspecificity. On the other hand, the larval trematodes from fishes are not usually typical members of the Ethiopian fauna. They are mostly Palaearctic elements or species with a cosmopolitan distribution, this being associated with the distribution of their definitive hosts. The wealth of bird species in Egypt, both local and migratory, and their occurrence in large numbers, as well as the presence of other suitable hosts provide optimal living conditions for those trematodes the metacercariae of which are found in fishes; this has also been confirmed by the present findings. Adults of some species of these trematodes are known as the parasites of domestic animals or man, being often the cause of serious diseases. According to our results, a high degree of infestation with the larvae of pathogenic trematode species is found namely in those fishes which are quite common in Egypt and are consumed most frequently by local people (e.g. *Tilapia*, *Bagrus*). In future it will be therefore necessary to pay attention to studies of the fish parasites in Egypt, mainly in the connection with construction of new water reservoirs and developing fish culture.

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THE INFLUENCE OF TEMPERATURE ON THE SUSCEPTIBILITY TO INSECTICIDES IN THE HOUSE FLY (*MUSCA DOMESTICA* L.)

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Abstract: The susceptibility to DDT, dieldrin, malathion, fenitrothion and bromophos-ethyl was found to be more reduced in females of the resistant house fly strain H whose life cycle developed at 17° C than in females of the same strain developing parallel at the temperature of 25° C. The reduced susceptibility was detectable also in the next house fly generation kept at the temperature of 25° C. The effect of temperature on the degree of susceptibility is most probably one of the factors influencing susceptibility changes recorded during 1971 and 1972 vegetation seasons in F_1 house fly generations from five different localities. The highest susceptibility was observed during the maximum summer temperatures (June—July), the highest resistance was recorded in August—November.

Season-dependent changes in the house fly resistance to DDT were observed in Florida, USA, already in 1950 and 1951 (Gilbert, Couch and McDuffie, 1953). Similar changes were also reported in the resistance to HCH (Linquist, 1953) and to organophosphates (Georghiou and Bowen, 1966). Busvine (1971), analysing the effect of temperature on the course of insecticide poisoning in insects, came to the conclusion that the effect of temperature resulted from numerous interactions occurring in the process of intoxication. In our paper presented here we focus our attention on the seasonal susceptibility changes in the house fly at large and on the effect of life cycle temperature on the susceptibility development.

MATERIAL AND METHODS

House fly imagos (*Musca domestica* L.) were captured in 1971 and 1972, approximately in monthly intervals from May to November, in piggeries and calf houses located in localities near Prague. Each time about 300 imagos were caught, the susceptibility to insecticides was tested in F_1 generation.

For laboratory experiments we used a DDT-resistant strain H kept in our laboratory for more than 10 years without insecticide selection. The data on its resistance are presented in our previous report (Rupeš and Pinterová, 1975). The eggs from females of parent generation kept at 25° C were transferred to the environment with the temperature of 17° C. A part of F_1 females originated here was tested on the susceptibility to insecticides, another part was left to produce next generation at this temperature, and a part was replaced again to 25° C environment. The susceptibility to insecticides was regularly tested also in the parent generation.

Generally, the gauze soaked with a water suspension of dried milk was used as a larval medium. Only in flies captured in 1972 we used a medium composed of dried yeasts, dried milk and agar.

The susceptibility was tested by using topical application of insecticides as recommended by WHO. Insecticides were dissolved in methyl-ethyl-ketone and then applied, by means of a self-filling micropipette, on the dorsum of imagos in a dose of 0.36 µl solution. Both males and females, aged 4—10 days and fed with glucose and water, were used in the experiment. CO_2 was

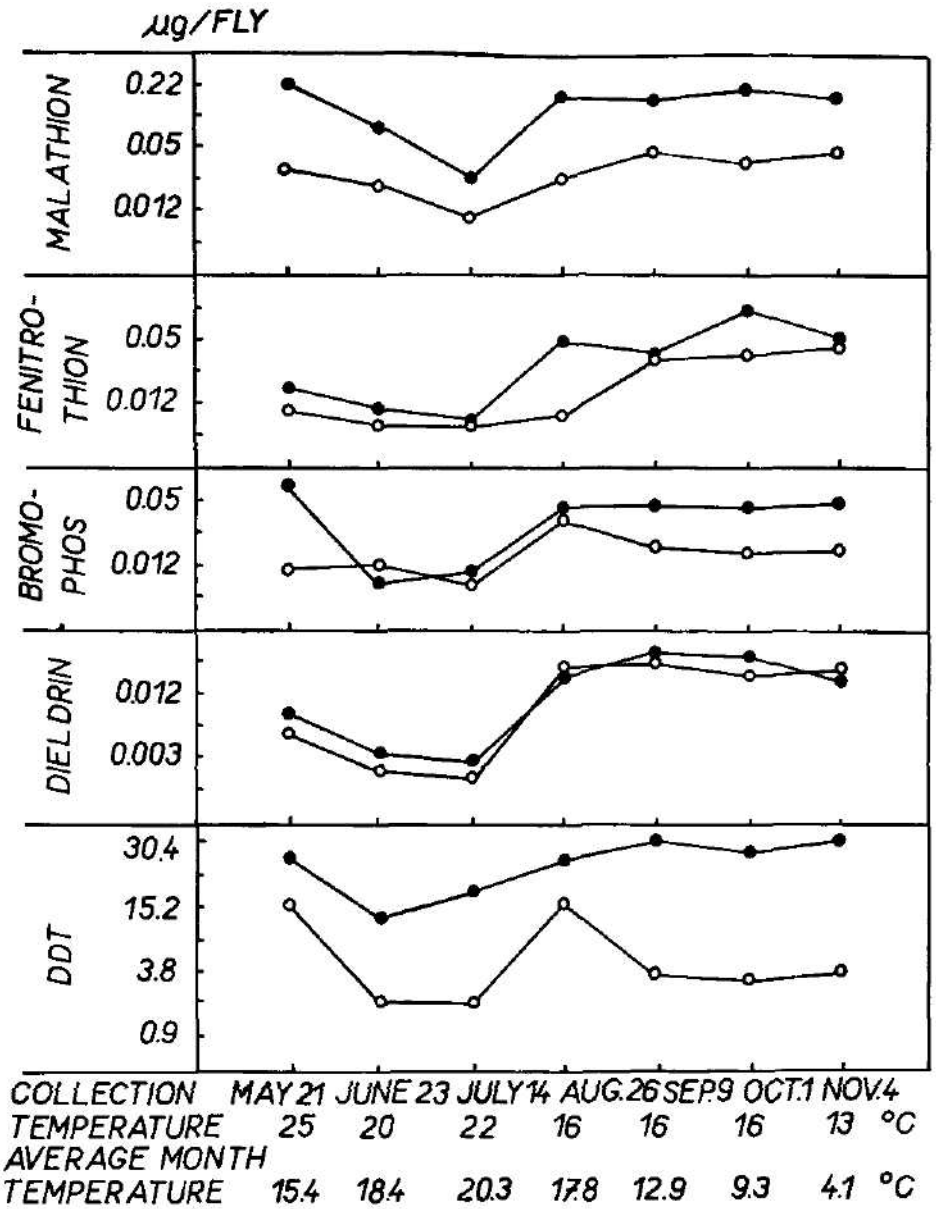

Fig. 1. The values of LD_{50} for male (black points) and female (white points) F_1 generation house flies captured in the locality Kuří in 1971.

used to produce narcosis. The mortality was scored after 24 hours, during this period ad libitum water was available to the flies. The temperature during the test ranged between 20—22° C. 4—5 geometrically increasing doses of insecticides were used to determine the LD_{50} values, each dose was given to about 30—40 house flies.

Tab. 1. Percentage mortality of females/males after treatment with DDT in F_1 generation of the house fly *(Musca domestica)* catched in 1972

Locality	DDT in µg/fly	Date of catching May 5	June 6	July 7	Aug 4	Sep. 9	Nov 10
Kuří	7.6	27/40	40/45	30/100	30/40	11/10	20/40
	19	30/60	45/60	35/100	30/60	20/40	22/60
Nupaky	7 6	17/27	45/70	20/20	20/33	0/10	—
	19	23/30	50/90	50/50	20/23	0/40	—
Tismice	7.6	—	10/44	10/30	10/30	0/0	—
	19	—	23/57	20/40	10/30	0/0	—

The LD_{50} values in Fig. 1 and 2 were estimated by using graph probit method after Liechtfield and Wilcoxon (from Roth et al , 1962) The estimation of LD_{50} indicated in Table 2 was based on the numeric probit method.

The following insecticides were used in the experiment: pp'-DDT (further DDT only) produced by Spolana, Neratovice; gamma-HCH (Merck, BRD), dieldrin (producer unknown); malathion (Cyanamid, USA), fenitrothion (J. Dimitrov Chemical Works, Bratislava); and bromophos-ethyl (Cella, BRD) All the used insecticides were in the state of technical purity.

The mean monthly temperatures recorded in Prague-Karlov site were obtained from the Institute of Hydrometeorology in Prague. In the course of fly capture the temperature was measured inside individual piggeries and calf houses, in our results, however, there is presented the round-off mean of recorded temperature values. Mortality changes in house flies caught in 1972 were studied only at the application of 2 doses of DDT

RESULTS

Susceptibility changes recorded in F_1 house fly generation in 1971 vegetation season are demonstrated in Fig. 1. In both sexes and in all the insecticides used there is quite a similar course of susceptibility changes, with the maximu used there is quite a similar course of susceptibility changes, with the maximum susceptibility in June-July and with the minimum susceptibility in Septemner—November. The female susceptibility to DDT in the last case represents the only exception.

In 1972, the susceptibility changes were studied in 3 different localities (Fig. 2 and 3; Table 1) and also in this case their similar course pattern was

Tab. 2 Values of LD_{50}/LD_{90} in µg/fly for females of DDT resistent strain H, that developed in different temperature

Insecticide	25° C permanently	Development in temperature F_1 in 17° C	F_2 in 17° C	F_2 in 25° C
melathion	0 038/0 081	0.24/0.59	0 34/1 41	0.15/0.28
fenitrothion	0.09[a]/0.84	0.15[a]/0.44[a]	0.26/0.99[a]	0.19[a]/0.51[a]
bromophos-ethyl	0.04/0.21	0.20/0.57	0.22/0.69	0.11/0.27
dieldrin	0.0015/0.004	1.32/—	1.26/1.58	0.020/0.054
DDT	3.71/8.24	4.82[a]/25.3[a]	5.32[a]/16.1[a]	4.35/10.1[a]

[a] the difference from the susceptibility of flies under standard condition is not significant (at $P \geq 0.05$).

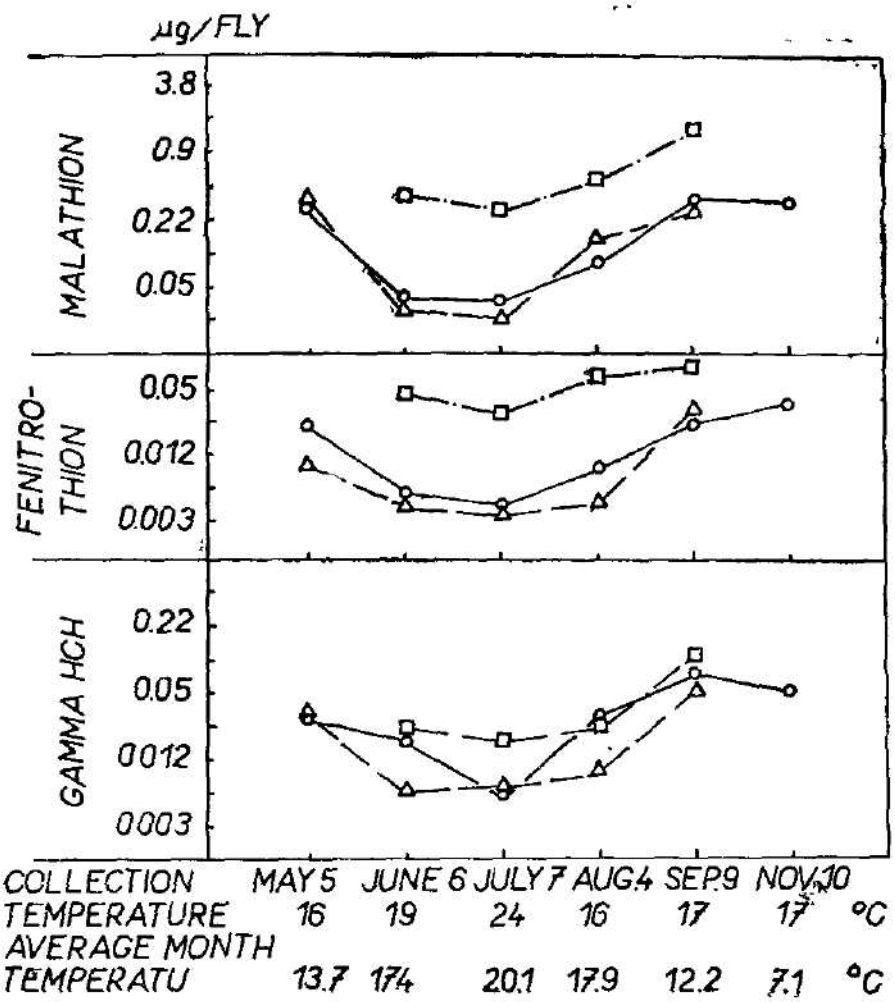

Fig. 2 The values of LD_{50} for female F_1 generation house flies captured in the localities Kuří (full line), Nupaky (dash line) and Tismice (point-dash line) in 1972.

observed in all three localities and in all the insecticides used. At the same time it is, however, evident that the degree of resistance, particularly to malathion and fenitrothion, is higher in Tismice than in the remaining two localities.

The susceptibility of females kept under a lower temperature was always lower than the susceptibility of parent generation females, in the majority of cases the differences were statistically significant (Table 2). If the life cycle of the next generation developed also at the lower temperature the susceptibility of females to malathion, fenitrothion and DDT was further reduced while the susceptibility to bromophos-ethyl and dieldrin remained on the same level. If the F_2 generation developed at 25° C the susceptibility of

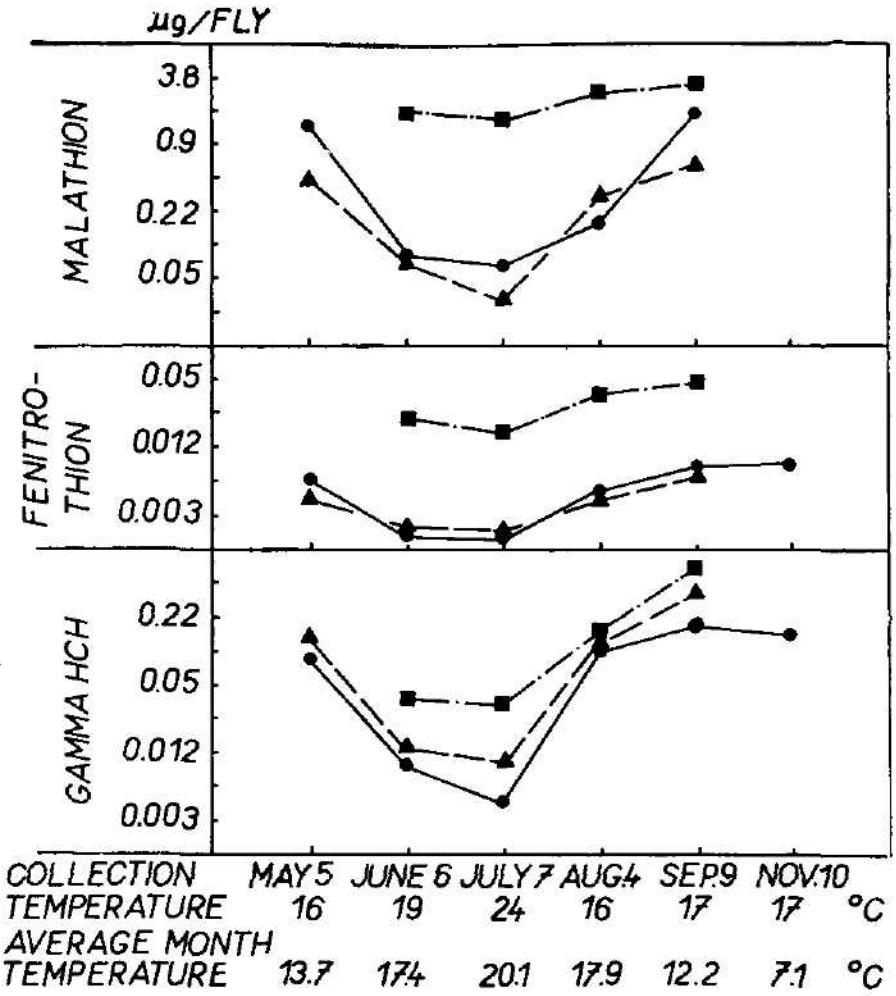

Fig. 3. The values of LD_{50} for male F_1 generation house flies captured in the localities Kuří (full line), Nupaky (dash line) and Tismice (point-dash line) in 1972.

females was increased, however, it never reached the susceptibility level of the parent generation.

DISCUSSION

In the localities studied an attempt was made — at irregular intervals – to exterminate house flies by using organophosphates (trichlorfon and fenitrothion), quite exceptionally by DDT and HCH. It may be therefore assumed that a certain degree of selctivity and an increased resistance developed during the season. The type of calf houses and piggeries was rather obsolete, they were unheated and the inside temperature was heavily dependent on the outside environment. In all the localities there were only outdoor, uncovered manure-hills. House fly larvae developed partly inside and partly outside,

but in both cases in the dependence on season temperature. We are therefore inclined to believe that one of the factors influencing the susceptibility changes in the F_1 generation was the life cycle temperature of pre-imago stages of the parent generations. The changes of the F_1 generation susceptibility corresponded with the inside temperature recorded during the capture as well as with the mean monthly temperature. A certain discrepancy occurs in August between a relatively high mean month temperature and a relatively low tmeperature recorded in both years during fly capture which corresponds with the reduced susceptibility of the house fly. This month is usually characterized by chilly nights and by a relatively high temperature during the day. It is possible that the reduced susceptibility is induced by a certain threshold temperature.

We believe that our conclusions are in accord with our experimental results. Laboratory experiments have quite clearly confirmed that the susceptibility of females is considerably dependent on the temperature occurring during the larval and pupal stage of development and that the susceptibility reduction due to by 7° C lower temperature is still detectable in the next generation. Comparably to field study results the most pronounced temperature effect was observed in the susceptibility to malathion and dieldrin.

The problems of the house fly resistance to insecticides in Czechoslovaki will be discussed later.

Aoknowledgement

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AGE AND GROWTH OF PUMPKIN SEED, LEPOMIS GIBBOSUS (PERCIFORMES, CENTRARCHIDAE) FROM HUNGARIA

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Dedicated to 50th birthday of Assist. Prof. RNDr. Ota Oliva

Abstract: Age and rate of growth of a random sample of 46 specimens of *Lepomis gibbosus* (Linnaeus, 1758) from the Hungarian village pond have been studied and compared with the observations of other authors, especially from the United States. The growth has been observed to be slow.

INTRODUCTION

The history of the introduction of the Pumpkin Seed in some European waters has already been described by Tandon (1976). As early as 1926, Creaser gave a detailed account of the age and growth of Pumpkin Seed from Houghton and Douglas Lakes, U.S.A. He also gave an elaborate review of the scale method and its utility in the determination of age and growth of fishes. The method of computing growth histories from hard parts, especially scales, has been widely used and is acclaimed as the most reliable. Van Oosten (1953), Whitney and Carlander (1956), Balon (1968), Čugunova (1968), Hile (1968) and Tesch (1968), to quote a few, have either given excellent reviews or methods or both of determining age and growth histories of fishes by using scales. The literature on the scales is so varied that it is not possible to cite all references here.

Sunfishes have been widely studied in U.S.A. from time to time (for details see Carlander, 1950 and 1953). Sprugel (1954) studied the growth of Bluegill, *Lepomis macrochirus*, from New Lake. Di Costanzo (1957) described the growth of Bluegill and Pumpkin Seed, *Lepomis gibbosus*, from Clear Lake, Iowa. Shireman (1968) gave an account of the growth of Bluegill from Central Iowa farm ponds. Balon (1959) described the breeding behaviour and postnatal development of *L. gibbosus* from southern Slovakian waters. Papadopol and Ignat (1967) studied the reproduction and growth of *L. gibbosus* from Lower Danube. Unfortunately, so far as I know, there is no report on the age and growth of the introduced Pumpkin Seed from the Hungarian and neighbouring Czechoslovak waters.

MATERIAL AND METHODS

Details about the material have already been given (Tandon, 1976). The scales were selected from the row below the lateral line where the pectoral fin rays distally ended. It is interesting to

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point out that in most of the specimens a large number of scales had to be rejected because they were regenerated. Three good scales were selected from each fish for reading the growth histories. Scales were examined in dry mount. The dorsal diagonal radius of each scale was measured in mm. from the focus by using a microprojector (Carl Zeiss, Jena) with 17.5 magnification. The average value of scale radius from each specimen was computed and plotted against the standard length (measured from the tip of snout to the base of the median caudal rays. Considerable difficulty was experienced in the beginning to read correctly the annuli, the readings were then repeated and

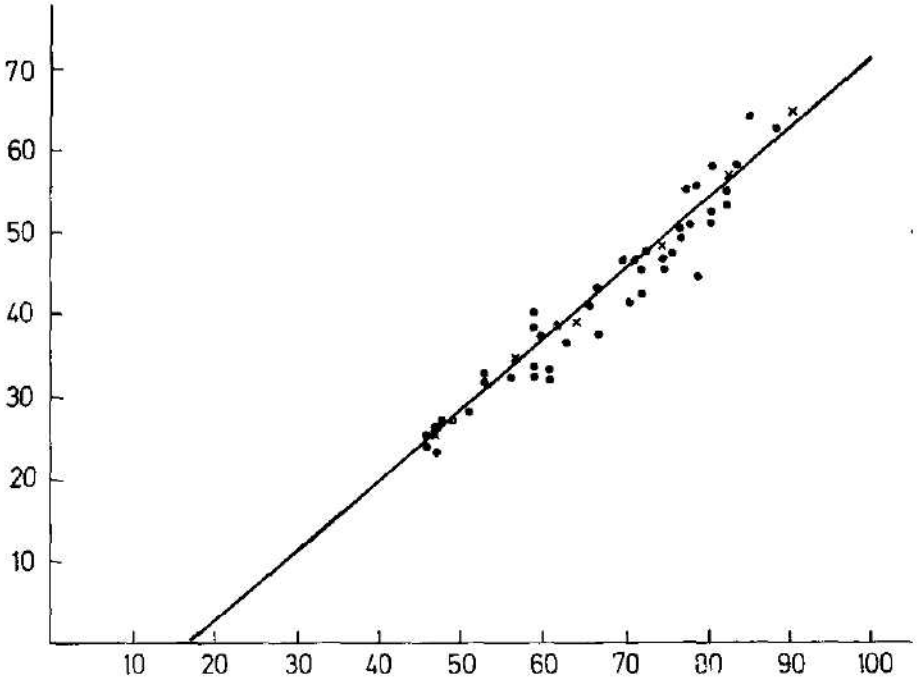

Fig. 1. Relationship between body length and scale length in *L. gibbosus*. Body length (in mm.) is along abscissa, and dorsal diagonal scale radius (in mm.) is along ordinate.

in most cases were found to coincide with the earlier ones. The fish lengths were, then, grouped at 10 mm. interval and the corresponding scale radii noted. The average scale radius was plotted against the average standard length of the group interval. The relationship was seen to be almost linear. The line of best fit was drawn passing through the grouped data and cutting the abscissa. This gave the correction factor, designated often as the time of scale formation, which was used for the computation of growth histories using Rosa Lee's nomogram for the back calculation of body lengths. Back calculated lengths were grouped according to age groups and the average lengths at the formation of annuli calculated.

The conversion factor for the total and standard lengths was found to be: total length = 1.275 standard length. In all forty six specimens were examined, out of which twenty six were males, nineteen females and in one case the sex could not be determined.

Specific rate of linear growth (C_1) and index of species average size (φh) were calculated as follows (Balon, 1971):

$$C_1 = \frac{l_n - l_{n-1}}{l_{n-1}} \cdot 100 \text{ and } \varphi h = \frac{\sum_{h=1}^{n_{j+a}}}{n_{j+a}}$$

where l_n and l_{n-1} are mean computed standard lengths in mm. at successive years of life, h is the absolute length increment in mm., n is age class, j and a indicate juveniles and adults respectively.

RESULTS

The age and growth of *L. gibbosus* as assessed from the study of forty six specimens, ranging in standard length from 46 to 91 mm., from the Hungarian waters are presented in Table 1. It can be seen that all the fish were in 2+ years and above. This is apparently due to the sampling method. The body length-scale length relationship indicates that the scale formation perhaps starts when the fish is about 17 mm. in standard length (Fig. 1). The back calculated lengths indicate that the first annulus was formed when the fish had attained an average lenght of 32 mm., the second at 50 mm, the third at 66 mm, the fourth at 76 mm and the fifth at 80 mm. The annual increment has been observed to be maximum between l_2 and l_1 and goes on decreasing as the fish advances in age. It may be pointed out here that fish measuring 46 mm had testes in an advanced state of maturity. Similarly females measuring 59 mm were seen to have ovaries in an advanced stage.

Since the specific rate of linear growth and the index of species average size are used to compare the growth rates and classify the fish as regards commercial importance respectively from different localities, as such it was found that the maximum specific rate of linear growth was 56.2 between l_2 and l_1 and minimum 5.3 between l_5 and l_4. The index of species average size was calculated to be 16 mm.

DISCUSSION

Creaser (1926) and Di Costanzo (1957) observed a slightly non-linear relationship between the body length and scale length of *L. gibbosus*. The latter author, however, used the linear relationship with the correction factor, by fitting straight line to his modified data, for back calculations. Sprugel (1954) described the body-scale relationship in Bluegill by third degree equation but calculated lengths based upon a straight line relationship. In the present studies, though the relationship is slightly non-linear, the calculations are based upon the straight line relationship that could be best fitted to the data. An inspection of the data of Creaser (1926) shows that the formation of the scales starts at about 15 mm standard length and this is quite in agreement with the present observations, He gave an elaborate account of the scales of *L. gibbosus* and studied the growth in relation to anterior and posterior fields. He concluded that the use of total length and posterior field is not practicable. He also showed that the relation of the anterior length of scale to the length of fish is a changing one. He further remarked that no simple formula can be derived to calculate accurately the length of fishes at past scale margins or annuli. Hence in the present studies the dorsal diagonal radius was choosen.

The data of earlier authors as summarized by Carlander (1950 and 1953) are presented in Table 2 along with the author's observations. The wide variation in the results of different workers can be attributed to the ecological conditions of the specimens from where they were procured. It may be seen from Table 3 that the specific rate of linear growth and index of species average size also show wide variations. The minimum index of species average size has been noted in the Hungarian specimens. It may be stated that the present specimens were collected from a village pond which was probably overpopulated. This line of argument can safely be advanced when we see that a male of 46 mm and a female of 59 mm had gonads in an advanced state of maturity. That the temperature plays a dominant role in the determi-

Table 1. Growth of Pumpkin Seed, *Lepomis gibbosus*, from a Hungarian village pond, July 1974

No of specimens	Age group	Year of hatching	Average standard length (in mm) at time of capture, ranges in in brackets	Average back calculated lengths with ranges in brackets				
				l_1	l_2	l_3	l_4	l_5
8	II	1972	49.4 (46—61)	32.0 (29—34)	47.4 (45—54)			
18	III	1971	64.0 (53—76)	28.7 (25—32)	51.8 (46—61)	61.9 (52—73)		
18	IV	1970	79.6 (71—91)	31.6 (24—37)	48.9 (40—60)	69.2 (59—82)	77.2 (66—90)	
2	V	1969	80.5 (77—84)	34.0 (34)	52.5 (48—57)	67.5 (66—69)	75.0 (73—77)	79.5 (76—83)
			Average	32	50	66	76	80
			Anual increment	18	16	10	4	
			Absolute increment (h)	32	18	16	10	4
			Specific rate of linear growth (C_1)	56.2	32.0	15.2	5.3	
			Index of species average size (φh)			16		

Table 3. Comparison of specific rate of linear growth and index of species average size of Pumpkin Seed, *Lepomis gibbosus*, from different localities.+

Locality	Author & year	Specific rate of linear growth							Index of species average size
		l_1	l_2	l_3	l_4	l_5	l_6	l_7	
Mich. Crystal L.	Hubbs & Hubbs, 1933	72.0							
Mich. Wiards P.	Hubbs & Hubbs, 1931	91.3							
Mich. Houghton L.	Creaser, 1926	100.0	58.3	40.0	18.8	8.9	4.7		25.7
Hungary	Author, 1976	56.2	32.0	15.2	5.3				16.0
Minn.	Eddy & Carlander, 1942	128.9	25.3	25.6	17.4	25.9			34.0
Ohio	Roach, 1950	100.0	47.4	25.0	12.1				31.4
Iowa, Clear L.	Di Costanzo, 1957	87.7	28.5						37.0

+ Calculated by the author from the data summarized by Carlander (1950 & 1953)

Table 2. Comparison of growth data of Pumpkin Seed, *Lepomis gibbosus*, from different localities

Locality	Author & year	Standard length in mm						
		l_1	l_2	l_3	l_4	l_5	l_6	l_7
*Mich. Crystal L. (U.S.A.)	Hubbs, C. L. & Laura C. Hubbs., 1933	25	43					
*Mich. Wards P. (U.S.A.)	Hubbs, C. L. & Laura C. Hubbs., 1931	23	44					
*Mich. Houghton L. (U.S.A.)	Creaser, 1926	30	60	95	133	158	172	180
Hungary (Europe)	Author, 1976	32	50	66	76	80		
*Minn. (U.S.A.)	Eddy & Carlander, 1942	38	87	109	138	162	204	
*Ohio (U.S.A.)	Roach, 1950	38	76	112	140	157		
Iowa, Clear L. U.S.A.)	Di Costanzo, 1957	46	86	111				

*After Carlander (1950 & 1953).

nation of growth has been shown by Beckman (1943) in Bluegill and by Cable (1966) in Yellowperch. Breder and Redmond (1929) described that Bluespotted sunfish attains a size of 15 mm in the summer of hatching when they winter over for the first time. In the third winter the males attain a size of 40 to 50 mm. Schäferna (1932) examined a single specimen measuring 150 mm in body length from the backwaters of the river Labe (Elbe) near the town of Kolín in Bohemia and ascertained its age to be 3 years from the scale structure. Balon (1959), from a large number of specimens, selected a male of 102 mm and a female of 107 mm standard length for artificial fertilization from the inundation area of the Danube (southern Slovakia) and concluded that such specimens were in 3+ years. In 1966 he stated that this fish gets sexually matured in the fourth, exceptionally in the third year of life. Papadopol and Ignat (1967) stated that the males of *L. gibbosus* sexually mature the third summer i.e. at an age of 2 years (56 to 60 mm) and females mature at 2 to 4 years (73 to 131 mm). The linear growth, according to them, is slow in *L. gibbosus* becoming more accelerated in the year preceeding the sexually maturity. The present observations are in agreement with theirs so far the age of males or females at sexual maturity is concerned but the length attained by them is quite different. As stated already this can be attributed to the different ecological conditions from where the specimens were collected.

Acknowledgement

I am greatly indebted to Dr. O. Oliva, Ph. D., Lecturer of Vertebrate Zoology, for suggesting the problem, his continued interest during the course of this work, going through the manuscript, criticism, suggestions and for providing necessary library facilities. To Mr. Václav Lanka, my thanks are due to putting the material of *L. gibbosus* at the disposal of Dr. O. Oliva. Thanks are also due to Professor G. P. Sharma, Head of the Department of Zoology, Panjab University, Chandigarh (India), and to UNESCO for sponsoring my studies in Ichthyology in Prague (Czechoslovakia).

SUMMARY

In all, forty six specimens were examined, out of which twenty six were males and nineteen females. One specimen could not be sexed.

The standard length varied from 46 to 91 mm.

The age as ascertained from the scales showed that specimens were 2 to 5 years old.

The present observations were compared with six authors and it was found that there is a wide variation in the specific rate of linear growth and index of species average size from different localities in the U.S.A. and author's observations. The rate of growth was observed to be slow in Central Europe.

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Werner, Fritz Cl.: **Die Kopf- und Körperhaltung und das Gleichgewichtsorgan der Wirbeltiere.** VEB Gustav Fischer Verlag Jena, 1975. 86 S., 56 schwarzweisse Abb.

Das Gleichgewichtsorgan hat im Leben der Wirbeltiere eine wichtige Aufgabe. Mittels dieses phylogenetisch relativ alten „Gravitationsorgans" nehmen die Tiere die optimale Stellung im Raum ein, was zu den lebenswichtigsten Funktionen gehört. Das soeben erschienene Büchlein enthält eine morphologisch-funktionelle Übersicht der wichtigsten Ergebnisse über dieses interessante Organ der Wirbeltiere.

Im 1. Kapitel „Die Stellung der Organe und das Gleichgewicht" (7 Seiten) werden die Hauptfunktionen des Gleichgewichtsorgans geschildert (Gleichgewicht und räumliche Orientierung, Körper- und Kopfhaltung in der Ruhe und Bewegung, die Stellung der Augen im Kopf und im Raum) und das Zusammenspielen des Vestibularisapparates mit den anderen Organsystemen (Muskelsystem, Kopf- und Halshaltung, Augen) besprochen.

Im 2. Kapitel „Die Morphologie des Labyrinthes" (9 Seiten) wird vom Verfasser kurz die ontogenetische Entstehung des Gleichgewichtsorgans besprochen und ein allgemeiner morphologischer Überblick bis auf die elektronenmikroskopische Ebene gegeben.

Es folgt das 3. und umfangreichste Kapitel „Die Klassen der Wirbeltiere und ihr Gleichgewichtsorgan" (34 Seiten), in dem die Morphologie des Vestibularisapparates der Säuger, Lurchen, Kriechtiere, Vögel, der Knochenfische, Knorpelfische (Elasmobranchia und Chondrichthyes) und der Rundmäuler (Cyclostomata) kurz geschildert wird. Dabei wird die grösste Aufmerksamkeit dem Utriculusorgan gewidmet, da in ihm der Verfasser den wichtigsten Teil des Gleichgewichtsorgans für die Kopf- und Körperhaltung sieht.

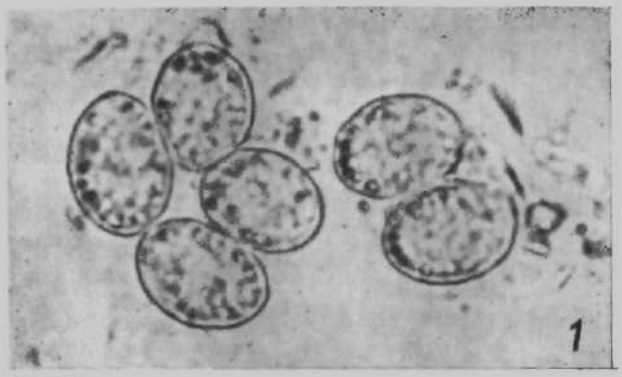
Das 4. Kapitel „Verallgemeinerungen und Folgerungen" (11 Seiten) vergleicht und verallgemeinert die Resultate des vorstehenden Teiles und versucht die morphologischen Resultate funktionell zu interpretieren.

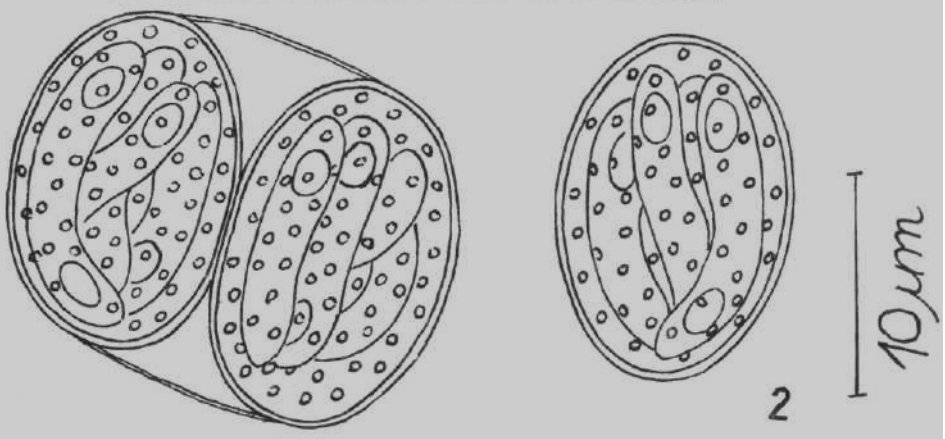
Im letzten, 5. Kapitel „Die räumliche Ordnung der Kopforgane im dreidimensionalen Raum" (8 Seiten) wird die Bedeutung der Bogengänge (besonders des „horizontalen" Bogenganges), sowie der Augenreflexe für die Kopfhaltung und das Gleichgewicht diskutiert.

Das Literaturverzeichniss, das nur die wichtigsten Quellenangaben enthält, ist der Problemstellung nach und systematisch gegliedert.

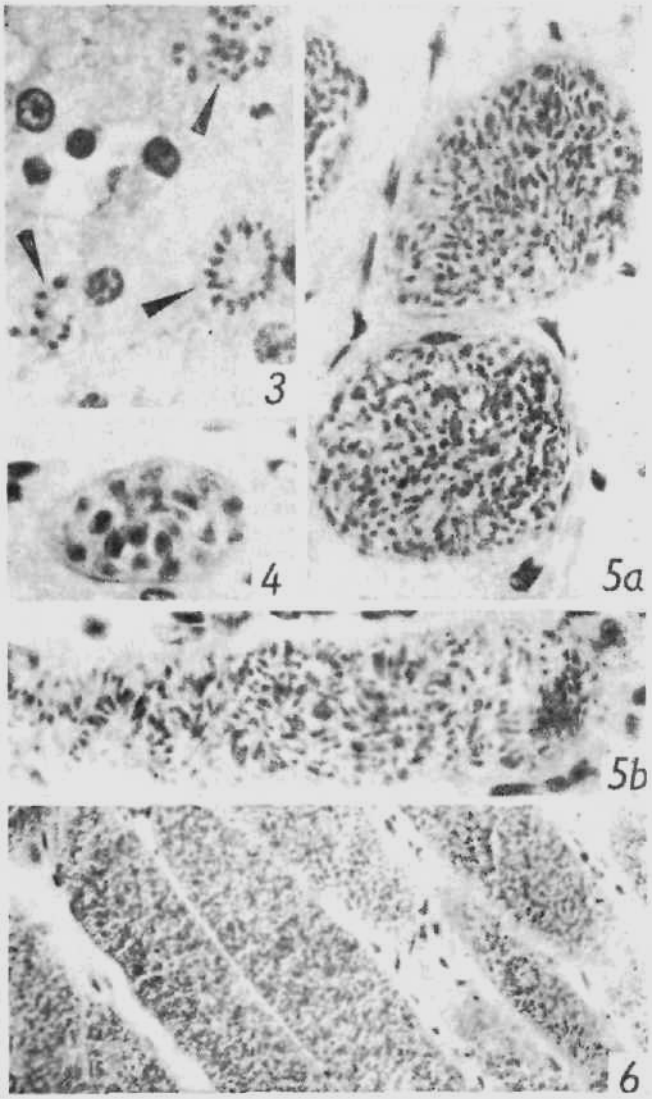
Insgesammt gesehen, handelt es sich bei diesem vorliegenden Büchlein um einen komplexen Blick auf den Vestibularisapparat der Wirbeltiere, der die wichtigsten Ergebnisse dieses interessanten Vorschungzweiges seit Retzius-Zeiten bis in die Gegenwart berücksichtigt. Für die Zoologen ist nur zu bedauern, dass die Gliederung des Stoffes sowie die Schlussfolgerungen nicht immer konsequent mit der Phylogenie der Wirbeltiere im Einklang sind. Das Büchlein ist empfehlenswert für Zoologen, vergleichende Anatomen und Physiologen, die sich für die Sinnesorgane der Wirbeltiere interessieren.

L. Sigmond





1 — Oocysts concentrated from *F. tinnunculus* (× 1000).
2 — Schematic illustration of oocyst and sporocyst from *Falco tinnunculus*.



3 — Asexual multiplication in the liver of *Microtus arvalis* (day 6) (× 700). 4 — Young muscle cyst with ovoid cells (day 51) (× 300). 5 a, b — Muscle cysts with small bradyzoites (day 51) (× 400). 6 — Massive infection in skeletal muscle of *M. arvalis* (day 51) (× 200)

POKYNY PRO AUTORY

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

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

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

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Přepis cyrilice proveďte podle mezinárodních pravidel vědecké transliterace (nikoliv fonetické transkripce) — viz ISO Recommendation R 9. International System for the transliteration of cyrillic characters 1. Ed. October 1955 nebo Zekalle R., 1964: *Pedobiologia*, 4 : 88—91, Jena.

Obrázky a grafy kreslete černou tuší na kladívkový nebo pausovací papír v poměru 1 : 1 až maximálně 1 : 3, u taxonomických prací musí mít obrázky měřítko. Obrázky kreslete pokud možno tak, aby mohly být všechny stejným způsobem zmenšeny. Fotografie musí být ostré, kontrastní, na lesklém papíře. Obrázky sestavte do tabulí, které by bylo možno reprodukovat na šíři strany (126 mm), nebo s textem na celé zrcadlo (126 × 188 mm). Obrázky nebo obrazové tabule průběžně očíslujte a v rukopise vyznačte místo, kam mají být zalomeny.

Tabulky jsou tištěny jako otevřené, tj. bez svislých linek. V tabulkách oddělte vodorovnými linkami jen záhlaví tabulky a dolní okraj. Tabulky protokolárního charakteru nebo opakující údaje z textu, případně tak velké, že by je nebylo možné vytisknout na dvě protilehlé strany, nebudou přijímány.

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

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

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