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SYNONYMY OF PRARASCARIS EQUORUM AND P. ZEBRAE (NEMATODA)

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Abstract: The outer morphology of the head posterior ends of nematodes recovered from *Equus caballus* and *E. quagga* was studied by scanning electron microscopy. It was found that the nematodes belonging to the genus *Parascaris* were morphologically identical. Consequently, the authors consider *P. zebrae* to be a synonym of *P. equorum*. A photographic documentation is attached.

INTRODUCTION

Yorke and Maplestone (1926) established a new genus, *Parascaris*, for ascarid nematodes parasitic in *Equus* L. (Equidae) as definitive hosts. The type species of this genus, *Parascaris equorum* (Goeze, 1782), was recovered from the small intestine of *Eauus caballus* L. and other equines. The same authors placed to this genus also another species, *Parascaris zebrae* (Skrjabin, 1916), originally described from *Equus quagga* Gmelin, 1788 from East Africa. Already at the time when the genus *Parascaris* was established, Yorke and Maplestone (1926) expressed some doubts (see p. 262) about the validity of *P. zebrae* which they supposed to be a young form of *P. equorum*. Mozgovoy (1963), on the contrary, agreed with the independence of the two species. Some differences in the shape of lips of *P. equorum* and *P. zebrae* were mentioned also in the generic diagnosis of *Parascaris* published by Hartwich (1975).

The synonymy of *P. equorum* and *P. zebrae* was studied by Ansel et al. (1974) by means of scanning electron microscopy (SEM). The authors observed in detail the morphology of the head end of nematodes recovered from horses and zebras and arrived at the conclusion that they were identical. The morphology of the head and tail ends of males and females of *P. equorum* was studied by SEM also by Kikuchi (1974), but the author did not make any taxonomical conclusions from his results.

The significance of SEM for the taxonomy and systematics of nematodes was mentioned in the synthetic study by Hirschmann (1983). The results of many studies performed by us or by other authors on various nematode species support his opinion. The present paper deals with the nematodes from horses and zebras with the aim to supplement some details of the morphology of their head and tail ends and eventually confirm the validity of taxonomic conclusions drawn by Ansel et al. (1974).

MATERIAL AND METHODS

Nematodes of the genus *Parascaris* recovered from two species of definitive hosts were used in our studies. The nematodes from *Equus quagga* Gmelin, 1788 were obtained after a preventive antihelminthic treatment of a specimen imported to Zoological Garden at Brno (Czechoslovakia) from Kenya (Africa). The nematodes from *E. caballus* L. were obtained in a similar manner from a young specimen at Albertov stud farm (Czechoslovakia). Of the rich material recovered from the two hosts, 5 males and 5 females from each of them, i.e. 20 specimens, were used for the SEM studies. It should be noted that the nematodes from the same hosts were studied also by stereomicroscope and optical microscope and no significant differences were observed.

The specimens used for SEM were fixed with 10 % formalin and anterior and posterior parts of bodies (7—10 mm) were separated. These parts were then dehydrated through an ethanol series and *subjected to the ultrasound for one minute while in absolute alcohol. The parts of* specimens were then critical point dried, mounted on a double-sided tape, coated with gold and examined in a Jeol JSM-S1 and Jeol JSM35 scanning electron microscope operating at at 15 kV. All described morphological details are documented in photomicrographs.

RESULTS

Since the nematodes from the two hosts were identical, the description concerns both of them. A special attention is given to the characters which some authors regarded as differential.

Anterior part of male and female bodies bears a globular head with 3 massive lips as main organs. One of them is dorsal and two lateroventral. The lips are separated from one another with a marked and deep incision termed interlabial channel. In lateral view, the lips are rounded, but they are further divided into a wide basal part (praelabium) and anterior narrower part (eulabium). These two basic parts of lips are separated by a conspicuous rounded incision termed labial sinus. From the outer side, the lips are covered with a smooth cuticle. The cuticle on cervical and other parts of body is disctinctly transversely striated.

The structure and shape of lips are identical in the nematodes from *Equus caballus* and in that from *E. quagga* (Plate I, Figs. 1—4), but the size of lips is very variable. Their total height (from the base to the top of eulabium) is 0.8—1.5 mm and maximum width 0.9—1.3 mm. The width of lips at level of their narrowing, i.e. at the bottom of labial sinus, is 0.45—0.70 mm. The labial sinus extends up to 0.05—0.10 mm in depth. The cervical part of body under the base of lips is 1.2 to 1.8 mm wide. In apical view, a buccal floor of triangular shape and measuring 0.3—0.5 mm in diameter is visible in the space between lips. An oesophageal aperture of a corresponding shape is situated in its centre. The upper part of eulabium is distinctly triangular. The medial wall of lips is lined with a smooth cuticle differing in its structure from that on the outer side of lips (Plate I, Figs. 3—4).

Triangular interlabia, measuring 0.20—0.35 mm in height, project into interlabial channel between the lip bases. In two thirds of its height the cuticle of interlabium is transversely striated. The cuticle of interlabial channel separating the lips proper from interlabia is evidently smooth (Plate II, Figs. 5—7). A dentigerous ridge runs on the margins of lips forming a border between their inner and outer walls. This ridge consists of a large number of denticles arranged in a continuous line. It is characteristical for these nematode species that the dentigerous ridge reaches almost the base of praelabium (Plate III, Figs. 8 and 9). There are no accessory morphological adaptations at the end of the ridge (Plate III, Figs. 8 and 9). Individual teeth are mostly conical and their tips are ground off to various degrees. In lateral view, the teeth are finger-shaped. Some of them are bifurcated at the tip. All teeth are of almost the same height, measuring 0.004—0.007 mm (Plate III, Figs. 10 and 11).

The posterior end of male is rounded and surrounded by narrow indistinct caudal alae measuring 1.2—1.8 mm in length. The cloaca is trapeazium-shaped, with margins markedly separated from the remaining parts of body cuticle. The lower lip of cloaca is situated at the distance of 0.72—0.94 mm from the tail end. Five pairs of caudal papillae, the first of them consisting of double papillae, are situated on ventral side in postcloacal region of body. One odd papilla lies medially on the margin of the upper lip of cloaca. A large number of simple papillae are irregularly distributed anteriorly on sides of cloaca. They are hemispherical, with a rounded process at the tip. Their width is 0.012—0.020 mm at base and height 0.007 to 0.009 mm (Plate IV, Figs. 12—14).

DISCUSSION

Our studies on the morphological identity of nematodes of the genus *Parascaris* Yorke et Maplestone, 1926 were performed on specimens originating from typical hosts, i.e., *P. equorum* from *Equus caballus* L. and *P. zebrae* from *Equus quagga* Gmelin, 1788 (from typical geographical region). In the opinion of Mozgovoy (1953), the differences between the two nematode species are manifested in the following characters: the length of the dentigerous ridge near lip margin, number and shape of postcloacal papillae, length of spicules and situation of vulva. According to Hartwich (1975), the first two characters and the shape of lips should be regarded as most important.

Nevertheless, the observations by Ansel et al. (1974) and Kikuchi (1974), as well as our results, show that the shape of lips is quite identical in both species. The lips are divided into praelabium and eulabium separated by incisions termed labial sinus. An important character would be the length of the dentigerous ridge on lip margin. In this relation Mozgovoy (1953) notes that the dentigerous ridge in *P. equorum* occurs only on the anterior half of lips (evidently only on eulabium), whereas in *P. zebrae*, it is also on the posterior half of lips (evidently praelabium). Ansel et al. (1974) observed the denticles not only along the eulabia but also all round the sinuses separating them from the praelabia. According to our observations, the dentigerous ridge runs along the margins of lips not only on eulabium and round the sinuses, but it continues up to the praelabium, where it terminates almost at the base of lips (Plate III, Figs. 8 and 9). These results support the conclusion by Amsel et al. (1974) that the morphology of the head end is identical in *P. equorum* and *P. zebrae*.

We have also studied the structure of the tail end of males. According to Mozgovoy (1953), characteristical for *P. equorum* is the number of postcloacal papillae (7), the first two pairs of them consisting of double papillae, whereas the tail end of *P. zebrae* males bears only 3 pairs of postcloacal papillae and all of them are simple. However, in our specimens of *P. zebrae* from *Equus quagga* we found 7 pairs postcloacal papillae. The first two pairs consisted of double papillae (4 + 4) and the remaining 3 pairs were simple (3 + 3). The same number and distribution of postcloacal papillae was reported by Kikuchi (1974) in males of *P. equorum* from *Equus caballus*. Consequently, this character cannot be used for the differentiation between the two species under study.

Mozgovoy (1953) reported also differences in the length of spicules: 2.4 to 3.00 mm in *P. equorum* and 4.8 mm in *P. zebrae*. In our opinion, while studying the significance of these differences it is necessary to consider also other measurements, particularly the body length of males which varies from 60 to 280 mm. We did not measure the length of spicules in our material, but according to Hartwich (1975) it is 2.4—4.0 mm in *P. equorum* males. Therefore even this character cannot be considered to be conclusive.

The last differentiating character reported in the literature is the situation of vulva. According to Mozgovoy (1953), it is situated at the beginning of the second fourth of body (evidently measured from head) in *P. equorum* and a small distance behind the middle of body length in *P. zebrae*. Hartwich (1975) states that the vulva of *P. equorum* females is situated in the region between the first and second third of body length, i.e., 17.5—90 mm from head. The comparison of these data shows a small difference, but if the general measurements and body length (60 to 380 mm) of females of these nematodes are considered, this difference cannot be decisive for the validity of *P. zebrae*. We have arrived at the conclusion that our results sufficiently document the morphological identity of the nematodes of the genus *Parascaris* originating from the hosts *Equus caballus* and *E. quagga*. Consequently, in agreement with Ansel et al. (1974) we consider *P. zebrae* to be a younger synonym of *P. equorum*.

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ON THE BAT FAUNA (CHIROPTERA) OF LIBYA

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Abstract: The present paper is based on total of 73 specimens of 9 bat species, collected in Libya during two short-term visits in 1979 and 1980. The sample is completed by a small collection of bats from various museums and by all literary data available from this area. The result of this study confirms the occurrence of 13 species of three families in the studied area. Five species (*R. mehelyi*, *M. blythi*, *P. pipistrellus*, *N. leisleri* and *M. schreibersi*) and one subspecies (*P. a. austriacus*) are reported for the first time from Libya, other findings are additional distributional records. The main external and cranial measurements, ecological comments and a preliminary taxonomical evaluation of the studied material are given. Provisionally zoogeographical analysis shows that the most of hitherto known Libyan bat fauna consist of species of Mediterranean and Palaearctic-arboreal origin.

This is the first publication devoted especially to the problems of taxonomy and distribution of Libyan bats. For this reason it is drafted in the way to give us a comprehensive picture of the present state of knowledge; both all existing literary data and those of the unpublished material are summarized. The bases of our study was a relatively small collection of bats obtained during two short-term field investigations carried out in April 1979 and in April/May 1980, and the material collected by the second author at the Department of Zoology, Al Fateh University in Tripoli during the last years, and last but not least occasional collections deposited at some of foreign museums.

Published reports on bats of Libya consist mainly of occasional observations made within the framework of larger scale investigations on mammals. The oldest records are the descriptions of *Vespertilio isabellinus* (Temminck, 1840) and *Pipistrellus deserti* (Thomas, 1902). The first more systematic work on the mammals of Libya (Klaptocz, 1909) differs only by providing us data on another species, *Pipistrellus kuhli*. Except the findings of *P. a. christiei* in the Giarabub (= Jaghbub) oasis (De Beaux, 1928), none of the field investigations carried out by Italian zoologists during the thirties and forties made a sound contribution to the enlargement of our knowledge of bats of Libya (De Beaux, 1932, 1938; Festa, 1921; Zavattari, 1934, 1936—37). It was not until the post-war review of new contributions to our knowledge concerning the mammals of Libya published by Toschi (1954) when the existing list of species was enlarged by *R. clivosus*, *A. tridens*, *O. hemprichi* and incorrectly, by that of *N. thebaica*. The more important papers originating in the post-war period either omit the bats completely (Ranck, 1968) or repeat some older data only (Hufnagl, 1972; Setzer, 1957). Results of investigations performed during last years have been published so far in one communication only, and namely in a report about the finding of *N. lasiopterus* in Cyrenaica (Spitzenberger, 1982).*) When all the published data were considered eight bat species documented from the Libyan territory could be identified. Some of them, however, are documented by only occasional findings ((*P. a. christiei*, *P. deserti*, *E. s. isabellinus*, *N. lasiopterus*), while the existence of the others is supported by rather inaccurate data at second hand (*A. tridens*, *R. clivosus*. *O. hemprichi*). *P. kuhli*, described from a large number of localities, is the only exception.

New informations resulting from the work presented are still far from giving us a total picture of the bat fauna from the area under investigation. For the first time, however, they evidenced the occurrence of five species and one subspecies that are new to the Libyan territory. For the above reasons it is necessary to take this study for the preliminary one giving an impetus to further research in this field in addition to both the review of all existing data and publishing another original data

In 1979 and 1980, the field investigations were carried out upon a cultural agreement between the Socialist Peoples Libyan Arab Jamahirya and the Czechoslovak Socialist Republic. Our investigations were organized by the Al Fateh University in Tripoli and the Garyounis University in Benghazi. In this place we would like to renew our thanks to the Deans of the Faculties of Science of the both Universities and to the staff of the Departments of Zoology of these Universities. Our thanks belong also to Dr Gianna Arbocco (Museo Civico di Storia Naturale, Genova), Dr Charles Handley and Helen Kafka (Smithsonian Institution, Washington) and Dr. Willy Issel (Augsburg) for the loan of additional material from Libya, as well as to Dr Karl Koopman (American Museum of Natural History, New York) for the loan of small collection of *P. a. christiei* from Egypt. Finally we wish to express our sincere gratitude to all persons who made valuable suggestions and provided hard to find literature, i.e. Doc Dr. J. Gaisler (Brno), Dr F. Spitzenberger and Dr K. Bauer (Wien), Dr. H. Felten and Dr D Kock (Frankfurt/Main). We are also indebted to the administration of the Kuf National Parc Project for the permission to do field work in this area and especially to Dr H. J. Herbert for help in the field work. The assistance of the members of the Czechoslovak Research Group — Doc Dr K. Hůrka, Dr. P. Štys and Doc. Dr. M. Kunst — during the course of the field work is also highly acknowledged.

MATERIALS AND METHODS

A relatively small collection made during our field investigations in 1979 and 1980 came from inside the daily hiding quarters of bats using common chiropterological techniques (hand collecting, hand netting, extracting bats from crevices with long forceps, mistnetting etc). This collection is deposited partly in the Department of Zoology, Al Fateh University in Tripoli, partly in the Institute of Systematic Zoology, Charles University in Prague The material lent from other institutions was measured by the senior author. Due to an absolute lack of data on the measurements of Libyan bats in literature, all the measurements obtainable from the Libyan material are being included in the present paper. Where data from other areas are given for comparison, our own measurements are always distinguished from the literary data.

Abbreviations used:

ISZP = Institute of Systematic Zoology, Charles University, Praha
DZUT = Department of Zoology, Al Fateh University, Tripoli
DZUB = Department of Zoology, Garyounis University, Benghazi
MSNG = Museo Civico di Storia Naturale, Genova
SIW = National US Museum, Smithsonian Institution, Washington
AMNH = American Museum of Natural History, New York

*) During the print of this paper two other reports dealing with bats of Libya have been published (Qumsiyeh, M. B., D. A. Schlitter, 1982: The bat fauna of Jabal al Akhdar, Northeast Libya. *Ann. Carnegie Mus.*, 51: 377—389; Qumsiyeh, M D., 1983: Occurence and zoogeographical implications of *Myotis blythi* (Tomes, 1857) in Libya *Mammalia*, 47: 429. There has been presented a number of faunistic data which could not be inserted into this communication. In addition to species we have recorded, there has been reported also occurrence of *Tadarida teniotis* (Rafinesque, 1814) in Libya.

BMNH = British Museum of Natural History, London
HB = length of head and body, measured from the tip of the snout to the distal margin of the annal swelling; T = length of tail, measured from the root to the tip of the tail ventrally; FA = length of forearm, measured from the extremity of the elbow to the extremity of the carpus with the wing folded; E = length of ear, measured from the lower border of the external auditory meatus to the tip of the pinna; TR = length of tragus, measured from the basal lobe to the tip; W = weight; GL = greatest length of skull (in Rhinolophus measured from the

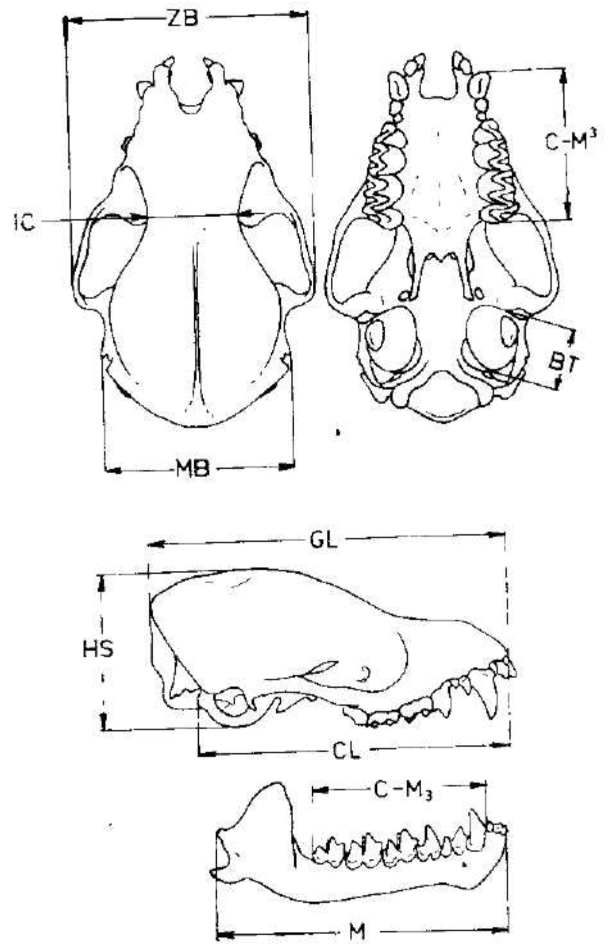

Fig. 1. Diagram showing how standard cranial measurement are taken in Vespertilionidae.

canine); CL = condylobasal length (in *Rhinolophus* measured as in GL); CCL = condylocanine length; ZB = zygomatic breadth; IC = interorbital construction; MB = mastoid breadth; HS = height of braincase; C-M^3 = maxillary toothrow; C-M_3 = mandibular toothrow; M = length of the mandible; BT = greatest diameter of bullae tympani.

RESULTS AND DISCUSSION

Account of species

Family *Nycteridae*
Nycteris thebaica E. Geoffroy, 1818

Based on the findings of a single specimen (leg. Kenneth Guichard, 21 April 1953) at Zouar, Tibesti Mts., the species was regarded as a member of the Libyan fauna. The record was first introduced to the literature by Toschi (1954) and was accepted by Setzer (1957) and Hufnagl (1972). Kock (1969) pointed out that Zouar (20°30′ N, 16°30′ E) is not Libyan locality, but place in Chad roughly 280 km South of the Libyan border. Therefore, this species cannot be allocated to the Libyan fauna until evidence is available of its presence in southern parts of Libya.

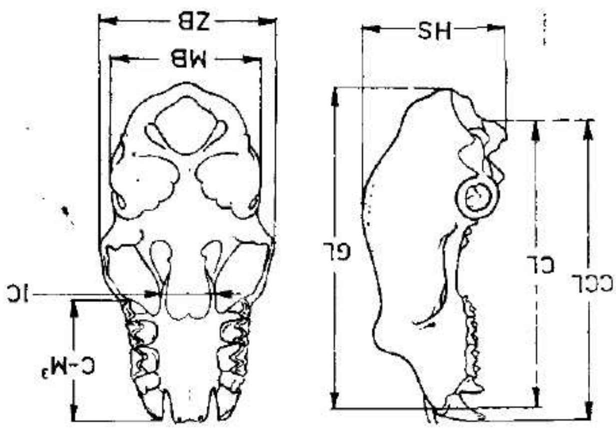

Fig. 2. Diagram showing how standard cranial measurements are taken in Rhinolophidae.

Family *Rhinolophidae*

Rhinolophus clivosus Cretzschmar, 1828

Published records: Fezzan (Toschi, 1954 — Chiesa in litt., without any particulars); subsequently quoted also by Setzer (1957) and Hufnagl (1972); the latter author records without particulars additional localities: Ghat, Murzuk, Traghen, Umm el-Araneb, Brak, Wadi Ajal.

Taxonomic remarks: Interspecific systematics of this species and related forms need to be clarified. In addition, the taxonomy of materials from Libya has not yet been studied in detail. Setzer (1957) assigned it to the subspecies. *R. c. schwarzi* Heim de Balsac, 1931 (t.t. Algerian Sahara) most likely for reasons of its geographical location.

Rhinolophus mehelyi Matchie, 1901

Material examined: Wadi al Kuf, unnamed cave, 18 ♂, 5 ♀, 23 April 1980 (ISZP).

Published records: "Cyrenaica" (Corbet, 1978 — based on specimens in British Museum).

Taxonomic remarks: The series from Wadi al Kuf has all the characters stated for this species in modern literature (e.g. De Blase, 1972). They include especially a typical abrupt taper of the lancet and short and slightly blunt process of the sella. From among cranial characteristics there are to be mentioned: position of P^1 in the teeth row and especially high values of ZB which expressively surpass values of MB (Tab. 1). Comparison of values of some other skull measurements (Tab. 2) reveals that the sample from Cyrenaica essentially corresponds to meaurements of series from Middle East (De Blase, 1972) or Morocco (Coll. Mus. Nat. Hist. Wien, own measurements). Significance of minute size differences between

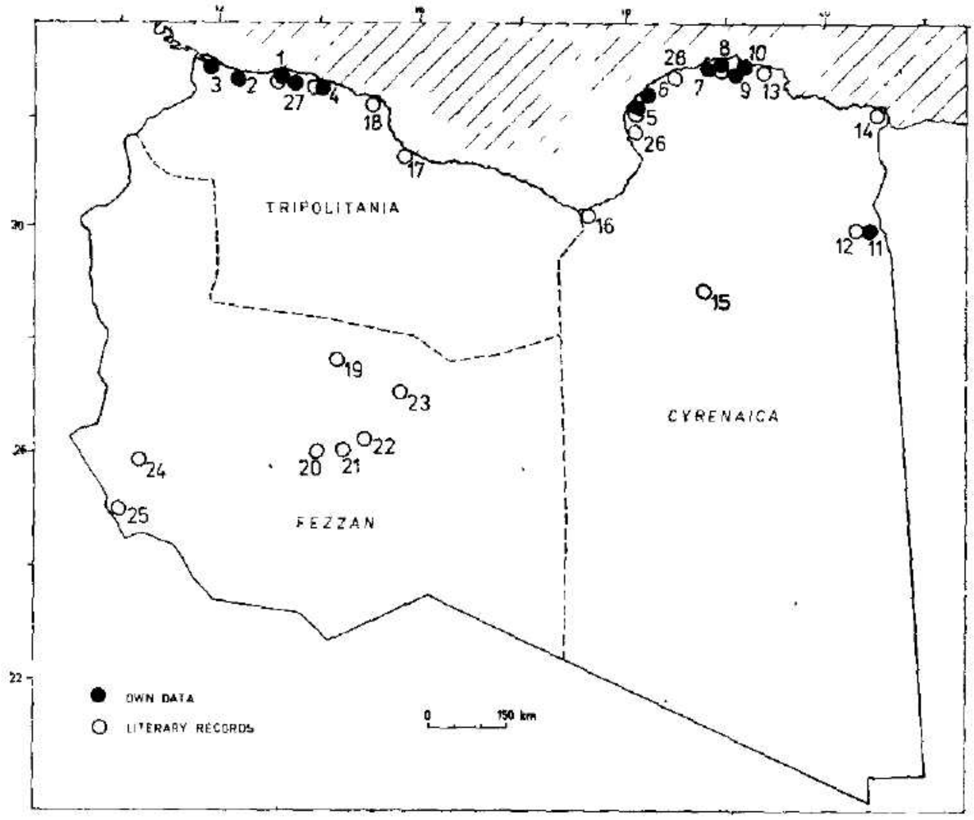

Fig. 3. Map of Libya illustrating all mentioned localities: 1, Tripoli (Zanzur, Sidi Mesri); 2, Sabratha; 3, Pisida; 4, Homs (Leptis Magna); 5, Benghazi (Fuehat); 6, Ain Zeyanah; 7, Wadi al Kuf; 8, Shahat (Cyréne); 9, Quariat al Fajoah; 10, Al Abraq; 11, Bahr el Tubat; 12, Giarabub; 13, Derna; 14, El Bardia; 15, Gialo; 16, El Agheila; 17, Buerat; 18, Misurata. 19, Brak; 20, Murzuk; 21, Traghen; 22, Umm el Araneb; 23, Wadi Ajal; 24, Serdelles; 25, Ghat; 26, Ghemines; 27, Mellaha; 28, Al Marj (= Barce).

particular samples can be evaluated only by means of a more detailed analysis of an extensive material from the whole area of distribution. Regarding complexity of all the problems one cannot advance one's views on subspecific status of the population from Cyrenaica. It is true that the data on distribution given by De Blase (1972) indicate that this population can be in a direct contact with the distribution area of this species in Egypt, but even subspecific position of that very population has not been cleared up yet.

So far, in Libya, the species has been stated to be found only in central parts of the Djebel al Akhdar Mts. and it cannot be excluded that it occurs in the whole coastal part of this region toward the Egyptian borders. The findings made in Tunissia (Kahmann, 1958, etc.) indicate that it could occur even in West Tripolitania, especially in the Djebel Nefousa Mts.

Family *Hipposideridae*
Asellia tridens (E. Geoffroy, 1813)

Material examined: Serdelles (= Sirir), W. Fezzan, 2 ♂ ad., 7 May 1955, leg. Jany, private coll. W. Issel, Augsburg (Germany).

Tab. 1. External and cranial measurements of *R. mehelyi* from Wadi al Kuf (Cyrenaica, Libya)

No.	Sex	W	HB	T	FA	E	GL	CL	ZB	IC	MB	C-M³	C-M₃	M
Li-51	♂	7.0	49.0	27.0	44.6	20.0	19.0	16.7	10.0	2.5	9.7	6.8	7.4	13.0
Li-52	♀	12.0	55.0	24.0	47.6	22.0	19.0	16.7	10.5	2.5	9.7	6.8	7.4	13.0
Li-53	♂	10.0	55.0	25.0	48.0	21.0	18.9	16.2	10.6	2.5	9.8	6.7	7.2	13.0
Li-54	♂	9.0	53.0	27.0	46.0	21.0	18.5	15.9	10.2	2.6	9.6	6.8	7.3	12.7
Li-55	♀	10.0	55.0	30.0	47.9	22.0								
Li-56	♂	9.0	53.0	26.0	46.0	21.0	18.2	16.5	10.0	2.6	9.5	6.6	7.0	12.1
Li-57	♂	9.5	55.0	25.0	47.3	21.0	18.8	16.4	10.3	2.5	9.6	6.8	7.0	12.5
Li-58	♂	9.5	53.0	25.0	47.0	21.0	18.5	16.4	10.3	2.4	9.5	6.8	7.2	12.6
Li-59	♀	9.0	54.0	25.0	47.0	20.0	18.5	16.2	10.0	2.5	9.5	6.6	7.0	12.2
Li-60	♂	10.0	53.0	27.0	47.8	21.0	18.6	16.4	10.4	2.6	9.7	6.7	7.1	12.5
Li-61	♂	11.0	53.0	28.0	48.2	21.0	18.8	16.4	10.4	2.6	9.7	6.8	7.4	12.9
Li-62	♀	14.0	57.0	27.0	48.0	22.0	18.6	16.4	10.3	2.5	9.5	6.7	7.2	12.6
Li-63	♂	8.0	54.0	23.0	47.3	22.0	18.3	16.1	10.3	2.5	9.7	6.7	7.1	12.2
Li-64	♂	10.0	57.0	28.0	47.2	23.0	19.0	16.5	10.5	2.5	9.5	6.8	7.4	12.8
Li-65	♂	10.0	54.0	27.0	47.6	22.0	18.8	16.4	10.2	2.4	9.6	6.7	7.0	12.6
Li-66	♂	10.0	55.0	25.0	48.0	21.0	19.3	16.9	10.4	2.5	9.8	6.8	7.3	13.0
Li-67	♂	9.0	55.0	23.0	46.0	22.5	18.6	16.2	10.4	2.6	9.6	6.6	7.0	12.6
Li-68	♀	8.0	52.0	23.0	46.0	21.0	18.3	16.2	10.2	2.6	9.5	6.5	7.0	12.5
Li-69	♂	11.0	56.0		47.6	22.0	18.8	16.7	10.2	2.6	9.6	6.6	7.0	12.7
Li-70	♂	7.5	54.0	24.0	46.7	21.0	18.5	16.0	10.0	2.5	9.5	6.6	7.1	12.0
Li-71	♂	10.0	56.0	23.0	47.4	23.0	18.7	16.2	10.2	2.5	9.6	6.6	7.0	12.4
Li-72	♂	10.0	57.0	26.0	47.2	23.0	19.0	16.7	10.2	2.4	9.6	6.6	7.3	13.0
Li-73	♂	10.0	56.0	26.0	48.0	21.0								
$\bar{X}$	♂	9.5	54.3	25.7	47.1	21.6	18.7	16.4	10.3	2.5	9.6	6.7	7.1	12.6
	♀	10.6	54.6	25.8	47.3	21.4	18.6	16.4	10.1	2.5	9.6	6.7	7.1	12.6

Published records: Fezzan (Toschi, 1954 — Chiesa in litt. 1952), subsequently quoted by Setzer (1957) and Hufnagl (1972); Murzuk, Fezzan (Kock, 1969 — 1 ex., coll. Senckenberg Museum, Frankfurt/Main, Germany, No. 11787); Serdelles, W. Fezzan (Jany 1960 — ex Kock, 1969). Incorrect record: Zouar in Tibesti Mts., Chad (Toschi, 1954).

Tab. 2. Comparison of body and skull dimensions of *R. mehelyi* from various parts of Mediterranea

		Cyrenaica own data			Tunis Baker et al., 1974			Middle East De Blase, 1972		
FA	♂	18	(44.6–48.0)	47.1	12	(47.7–50.2)	49.2			
	♀	5	(46.0–48.0)	47.3	17	(48.3–59.8)	52.1			
CCL	♂	15	(16.4–17.0)	16.78	12	(16.8–17.7)	17.1	14	(16.1–17.0)	16.6
	♀	4	(16.2–17.0)	16.8	17	(16.7–17.4)	17.0			
ZB	♂	16	(10.0–10.6)	10.28				14	(10.0–10.6)	10.2
	♀	4	(10.0–10.3)	10.12						
IC	♂	16	(2.4– 2.6)	2.51	12	(2.5–2.9)	2.6	15	(2.3– 2.6)	2.5
	♀	4	(2.5– 2.6)	2.52	17	(2.5–2.8)	2.6			
MB	♂	16	(9.5– 9.8)	9.61	12	(9.7–10.2)	9.9	11	(9.5–9.9)	9.7
	♀	4	(9.5– 9.7)	9.55	17	(9.5–10.0)	9.8			
C-M³	♂	16	(6.6– 6.8)	6.7	12	(6.7–7.1)	6.9	15	(6.0– 6.9)	6.3
	♀	4	(6.5– 6.8)	6.65	17	(6.5– 6.9)	6.8			
C-M₃	♂	16	(7.0– 7.4)	7.15				15	(6.9– 7.5)	7.1
	♀	4	(7.0– 7.4)	7.15						
M	♂	16	(12.0–13.0)	12.6				14	(12.4–13.1)	12.6
	♀	4	(12.2–13.0)	12.7						

Taxonomic remarks: Sofar, the taxonomy of the Libyan material has not been studied in detail. Setzer (1957) decided, in view of its geographical location, to allocate it to the subspecies *A. tridens diluta* Andersen, 1918, described from Algeria. According to results of an analysis of numerous series from Africa, Kock (1969) suggested that populations from Tunisia, Algeria and Morocco should be assigned to *A. tridens murraiana* Anderson, 1881.

Distributory notes: The few incidental findings do not provide a clear-cut picture of the distribution and abundance of this Afro-eremic species in Libya. However, data on its distribution in Egypt and in Maghreb countries indicate that it may well be one of the more abundant species of the Libyan desert zone.

Family *Vespertilionidae*

Myotis blythi (Tomes, 1857)

Material examined: Sabratha, ruins of ancient Roman town, 1 ♂, 1 ♀, 2 April 1979, 2 ♂, 1 ♀, 7 April 1979. This is the first record of the species in Libya.

Taxonomic remarks: Problems of N. African populations of this species (more correctly the sibling species *M. blythi* and *M. myotis*) have recently been treated by Strelkov (1972), Felten (1977) and Bogan et al. (1978). Independently of each other, these authors came to the conclusion that the only representative of N-African "big Myotis" species is *M. blythi*. However, regarding size, the material from N. Africa differs rather distinctly from European populations of *M. blythi oxygnathus* (Monticelli, 1885) and in part also from *M. blythi omari* Thomas, 1906 from the Near East. Values for several cranial and external measurements of the N-African

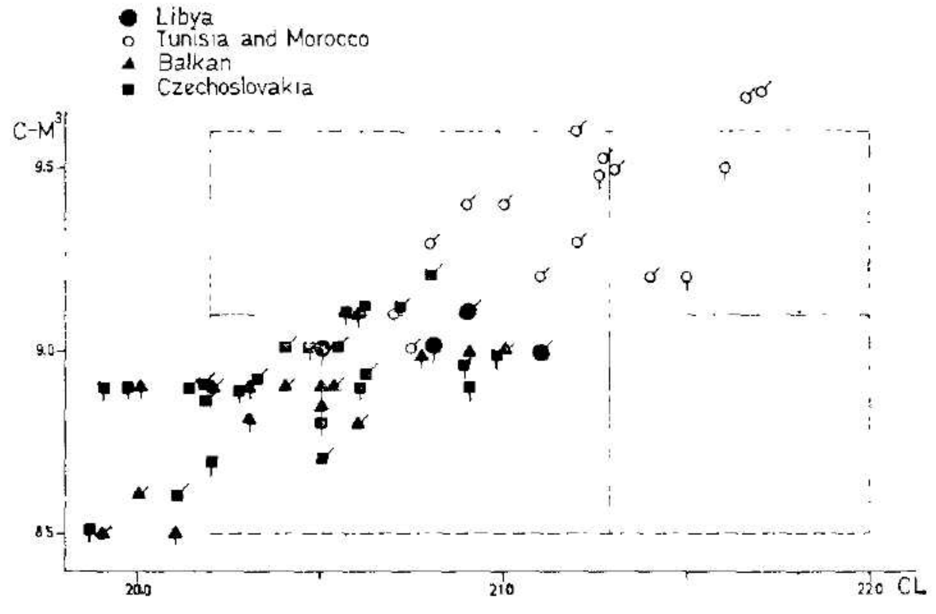

Fig. 4. Scatter diagram on which C-M³ is plotted against CL in different populations of *Myotis blythi*. The dotted line shows the variability and the solid line the average for *M. blythi punicus* (after Felten, 1977). Short lines pointing upwards = males; short lines pointing downwards = females.

Tab. 3. **External** measurements of some Libyan bats (weight in gr, other measurements in mm).

Loc.	No.	Coll.	Sex	Date	W	HB	T	FA	E	TR
				Myotis blythi						
Sabratha	Li–01	DZUT	♂	2. 4. 79	21.0	70.0	57.0	59.9	26.8	13.0
Sabratha	Li–02	DZUT	♀	2. 4. 79	29.0	71.0	58.0	61.3	26.2	14.0
Sabratha	Li–03	ISZP	♂	7. 4. 79	20.0	69.0	55.0	59.3	26.5	13.0
Sabratha	Li–04	DZUT	♂	7. 4. 49	20.0	70.0	59.0	60.0	25.4	14.0
Sabratha	Li–05	DZUT	♀	7. 4. 79	19.0	73.0	57.0	58.8	25.0	13.0
				Pipistrellus pipistrellus						
Al Abraq	325013	SIW	♀	8. 6. 62				31.5	11.0	5.0
Wadi al Kuf,	Li–74	ISZP	♀	29. 4. 80	5.0	42.0	32.0	32.0	9.5	5.0
5 km SW	Li–75	ISZP	♀	29. 4. 80	5.0	45.0	36.0	32.4	10.0	5.5
of Al Bayda	Li–79	ISZP	♀	1. 5. 80	5.3	43.0	34.0	32.0	9.5	5.0
				Nyctalus leisleri						
Wadi al Kuf, 5 km SW of Al Bayda	Li–80	ISZP	♂	1. 5. 80	13.0	63.0	42.0	41.1	14.0	7.5
				Otonycteris hemprichi						
Brak, Fezzan	Li–24	ISZP	♀	19. 6. 77		57.0	47.0	57.8	37.0	17.0
Bahr al Tubat,	325011	SIW	♂	29. 5. 62				55.0		
21 km ESE from Giarabub	325012	SIW	♀	29. 5. 62				61.0		
				Miniopterus schreibersi						
Tripoli, Sidi, Mesri	Li–25	DZUT	?	Nov. 79		44.0	57.0	45.0	10.3	
				Eptesicus serotinus						
Pisida	Li–29	MSNG	♀	29. 8. 37		68.8	54.0	52.0	17.5	8.0
Tripoli	Li–84	ISPZ	♀	6. 5. 80	22.0	77.0	58.0	50.5	16.5	8.8

material are still within the range of variability of *M. myotis*. This fact has been the cause of previous mistakes in its specific evaluation. This situation resulted in a differentiation of the N-African populations in the subspecies *M. blythi punicus* Felten, 1977. Our material has been evaluated with regard to these facts.

Our small series differs at first sight from *M. blythi oxygnathus* of central Europe, particularly in its evidently paler colour of the dorsal side and in relatively longer ear lobes. External and cranial measurements of our material are shown in Tab 3, 4 and more clearly in Fig. 4 which also gives values for the most important measurements of other material from Tunisia (ISZP), and data from a study by Felten (1977). The evidence indicates that our limited material is within the range of variability of these series and hence also in agreement with the above-mentioned subspecies *M. blythi punicus* Felten, 1977 (t.t. El Haouaria Cave, Cap Bon, Tunisia). The shape and size (length 1.0—1.1 mm, width 0.6—1.7 ,,) of the bacula of the two males from Libya (Fig. 5) are rather similar to the bacula of *M. blythi* as to *M. myotis* (cf. Topál, 1958).

Ecological remarks: We extracted all 5 of our specimens from crevices in vaulted stone ceilings of various underground — and aboveground ruins of an ancient Roman town. Two solitary hiding individuals (1 ♂, 1 ♀), were extracted from crevices in the ceiling of a short space in a cellar (height roughly 4 m, length 20 m) with a wide entrance hole opening into the sloping shore of the sea. Another male was hanging free from the ceiling of one of the galleries of an old Christian catacomb at about 1 km from the ruins of the town Sabratha. The last two specimens (1 ♂, 1 ♀) were recovered from crevices in the ceiling of an aboveground entry to a Roman theatre in the centre of this ruins. A point of interest worth emphasizing is the fact that all animals recovered were in a deeply torpid state, evidently associated with the unusually cool and windy weather (2—7 April). After transportation to Tripoli, one the females gave birth to a well-developed young weighing 5.5 gr, the other female, apparently subadult judging from the degree of tooth-wear, was not gravid The finding of a gravid female can be regarded as an indirect confirmation that the costal zone of western Libya belongs to the summer distribution area of this species.

Pipistrellus pipistrellus (Schreber, 1774)

Material examined: Al Abrag, 5 km SW, Cyrenaica, 1 ♂, 8 June 1962, leg. G. L. Ranck, SIW no. 325013; Wadi al Kuf, 5 km SW of Al Bayda, 2 ♀, 29 April 1980, netted, ISZP. These findings represent first records of this species in Libya.

Taxonomic remarks: The specimens from Cyrenaica are of a brownish red colour on the dorsal side, their ventral side is slightly paler. Wing membranes are dark brown, the posterior border of the wings lack any indication of paleness. In general these specimens were remarkably paler than those of a series of this species from the Balkans and Central Europe. Unfortunately, there was no comparative material available from Mediterranean islands or from NW-Africa.

Measurements of the Libyan material are slightly larger than the range of variability given for this species from various areas of Europe and W-Asia (Tab. 3, 4). There are no marked differences in the shape of the skull and dentition. Therefore having regard to certain inaccuracies in the evaluation of Mediterranean populations

Tab. 4. Cranial measurements of some Libyan bats (in mm).

No.	Sex	GL	CL	ZB	IC	HS	MB	C-M^3	C M_3	M
					Myotis blythi					
Li-01	♂	22.6	21.1		5.2	9.9	10.3	9.9	9.8	16.7
Li-02	♀	21.7	20.8		5.3	9.5	10.3	9.0	9.8	16.7
Li-04	♂	22.0	20.9	14.8	5.2		10.2	9.1	9.9	17.0
Li-05	♀	21.8	20.5		5.5	9.7	10.2	9.0	9.9	16.4
					Pipistrellus pipistrellus					
325013	♀	12.3	11.6	7.7	3.4	5.6	6.9	4.2	4.5	8.6
Li-74	♀	12.3	11.6	7.5	3.3	5.2	6.6	4.5	4.8	8.8
Li-75	♀	12.5	12.0	7.6	3.0	5.6	6.8	4.5	4.6	8.8
Li-79	♀	12.5	12.0	7.7	3.3	5.6	7.0	4.4	4.6	8.7
					Nyctalus leisleri					
Li-80	♂	15.3	15.3	9.9	4.4	7.2	9.1	5.8	6.2	11.6
					Otonycteris hemprichi					
325011	♂	22.4	21.3	14.2	4.1	9.2	11.2	8.2	9.2	16.4
325012	♀	21.4	20.0	13.0	4.1	9.2	10.6	8.0	9.0	15.4
					Miniopterus schreibersi					
Li-25	?	14.5	15.0		3.6	8.5	8.6	6.0	6.2	10.3
					Eptesicus serotinus					
Li-29	♀	20.1	19.6	14.0	4.6	8.3	11.2	7.8	8.5	15.0
Li-84	♀	20.3	19.9	14.4	4.2		11.0	7.8	8.3	15.2
Tunis	?	19.4	19.1	13.8	4.4	8.7	11.1	7.2	8.2	14.5
Tunis	♀	18.5	18.0	13.4	4.4	7.9	10.5	7.0	7.2	14.0

of this species, a subspecific allocation of the material under study might as yet be premature. In its paler colour, it resembles individuals from S-Europe and Mediterranean islands which sometimes have been considered as to beeing the independent subspecies *P. p. mediterraneus* Cabrera, 1904.

Distributory notes: The finding of this widely distributed Palaearctic species in NE-Libya is most surprising. So far, the only sites in Africa from which the species has been recorded are Morocco (Panouse, 1951, Brosset, 1955, 1960, Morales Agacino, 1933, 1943), Algeria (Loche, 1858, Dobson, 1880, Anciaux de Faveaux, Gaisler, 1983) and Tunisia (Aellen et Strinati, 1969, Vaughan, Cockrum et Vaughan, 1977). We can assume that the species is not common in NW-Africa and its distribution is strictly confined to the coastal or to mountaneous areas. The finding in Libya in a similar type of country (the Djebel al Akhdar Mts., 500—600 m above sea level and at 15 km from the shore) is in support of this hypothesis. It is remarkable mainly in that it is the only evidence of the occurrence of this species in N-Africa east of Tunisia. The closest more northern locality is Crete (Kahmann, 1959), and a more eastern locality is the North of Lebanon (Harrison, 1964). The findings at Al Abraq and Wadi al Kuf indicate a remarkably discontinuous distribution of the species in the climatically favourable plateau on the coastal area of Northern Cyrenaica. It suggests either that these isolated patches colonized by the species are remnants of an original abundance of the species in N-Africa, or may be the outcome of its much later penetration in these parts from Southern Europe by way of islands in the E-Mediterranean.

Pipistrellus kuhli (Kuhl, 1819)

Specimens examined: Tripoli Zanzur, town outskirts, 3 ♀, 2 ♂, May 1978 and spring 1979, DZUT; Benghazi, farm on the town outskirts, 1 specimen, winter 1978, DZUB; Ain Zeyanah, 15 km NE from Benghazi, abandoned house, 4 ♀ grav., 16 April 1979, 12 ♀, 5 ♂, 20 April 1980, 3 ♀, 3 May 1980, ISZP, Wadi al Kuf, 5 km SW from Al Bayda, 1 ♀, 1 ♂, 1 May 1980, netted, ISZP; Sabratha, ruins of ancient Roman town, 1 ♀ from nursing colony of 30 specimens, 7 May 1980, ISZP; Mellaha, 2 ♀, 30 September 1937, leg. Moltoni, MSNG; Pisida, 230 km W from Tripoli, 1 ♂, 28 August 1937, leg Moltoni, MSNG, Khoms (= Homs), 1 April 1979 observations of several foraging specimens.

Published records: Tripoli, 1 ♀, 29 July 1906. coll. Mus. Nat. Hist. Wien, no. 21961 (Klaptocz, 1909); Benghazi, Derna (= Darnah) — observations only (Klaptocz, 1909); Benghazi-Fuchat, 2 ♂. 16—25 May 1921 (Festa, 1921); Gheminez, 1 ♀. 13 May 1921 (Festa, 1921); Gialo (= Jalu), 2 ♀, 4 ♂, April 1931, 1 ♀, 1 ♂, 2 May 1931 (De Beaux, 1932); El Agheila, 1 ♂, August 1931 (De Beaux, 1932); Porto Bardia (= El Bardia), 1 ♂, March 1927, Leg. Krüger (De Beaux, 1928); Al Marj (= Barce), Benghazi (De Beaux, 1938); Tripoli, Gialo, Misurata Buerat — observations only (Hufnagl, 1972). Some of these records were subsequently quoted by Zavattari (1934, 1936—37), Toschi (1954), and Setzer (1957). Uncorrect records: Giarabub, Cufra (Wassif, 1959; Gaisler et al., 1972 — without resource data).

Taxonomic remarks: Although *P. kuhli* is abundant in the Mediterranean, there is still a considerable amount of confusion in the subspecific evaluation of its N-African populations. More complications are added by nomenclatorical problems and by the fact that there are marked differences in the colour of the individual populations, but minimal differences in values for external and cranial measurements. Our two series, from Tripolitania and N-Cyrenaica, differ slightly from each other in colour. Although both series belong to the so-called "pale-coloured" populations, the series from Tripolitania is distinctly paler (dorsal side a pale greyish

Tab. 5. Comparison of body and skull dimensions of *P. kuhli* from various parts of North Africa.

		Libya own data			Tunis own data			Egypt Gaisler 1972, own data		
GL	♂	10	(12.7–13.7)	13.24	6	(13.15–13.75)	13.46	8	(12.6–13.5)	13.18
	♀	24	(12.7–13.8)	13.24				4	(12.7–13.4)	13.02
CL	♂	10	(12.1–12.9)	12.8	6	(12.45–12.95)	12.81	8	(12.8–13.0)	12.74
	♀	24	(12.4–13.4)	12.81				4	(12.2–13.0)	12.52
ZB	♂	5	(8.5– 9.1)	8.78	5	(8.3 – 8.9)	8.66	4	(8.5– 8.8)	8.67
	♀	22	(8.4– 9.0)	8.73				3	(8.1– 8.3)	8.21
IC	♂	10	(3.1– 3.5)	3.34	6	(3.3 – 3.6)	3.38	8	(3.3– 3.5)	3.38
	♀	24	(3.2– 3.6)	3.42				4	(3.3– 3.4)	3.37
MB	♂	10	(7.0– 7.7)	7.52	6	(7.2 – 7.7)	7.46	8	(7.2– 7.9)	7.61
	♀	24	(7.3– 7.9)	7.91				4	(7.2– 7.7)	7.5
$C M^3$	♂	10	(4.8– 5.2)	4.9	6	(4.7 – 5.1)	4.88	8	(4.6– 5.0)	4.78
	♀	24	(4.6– 5.5)	4.96				4	(4.6–5.0)	4.77
$C M_3$	♂	10	(5.1– 5.4)	5.28	6	(5.0 – 5.3)	5.16	8	(5.0– 5.3)	5.15
	♀	24	(5.0– 5.5)	5.27				3	4.9– 5.3)	5.0
M	♂	10	(9.4–10.0)	9.69	6	(9.0– 9.5)	9.24	8	(9.3– 9.6)	9.44
	♀	24	(9.4-10.0)	9.77				3	(9.1– 9.9)	9.43
W	♂	6	(6.0– 6.8)	6.2	6	(4.9 – 6.0)	5.2			
	♀	22	(6.5– 9.0)	8.32						
HB	♂	11	(42.0–50.0)	46.0	6	(42.0 –49.0)	46.6	3	(44.5–47.5)	46.2
	♀	24	(43.0–52.0)	48.0						
T	♂	11	(36.0–40.0)	38.27	6	(37.0 –40.0)	37.3	3	(39.0–39.5)	39.33
	♀	24	(37.0–44.0)	41.04						
FA	♂	11	(32.0–34.4)	33.44	6	(31.8 –35.0)	32.85	7	(34.0–35.5)	33.9
	♀	24	(32.5–37.5)	34.20				4	(32.1–35.0)	33.4
E	♂	9	(10.0–12.0)	11.27	6	(11.8 –15.1)	13.1	3		12.0
	♀	24	(11.0–12.0)	11.55						
TR	♂	8	(6.0– 7.0)	6.81	6	(6.0 – 7.0)	6.1	3	(5.5–7.5)	6.6
	♀	24	(6.0– 6.7)	6.62						

brown with a creamy tinge and a wide whitish rim on the wing membranes), the series from Cyrenaica is darker (dorsal side brown with a narrow, pale rim on the wing membranes). Dark coloured individuals recorded by Gaisler et al. (1972) from Egypt, and by Deleuil et Labbé (1955a) from Tunisia, were absent from our material. Cranial measurements of our material compared with data from Tunisia (ISZP) and Egypt (Gaisler et al. 1972) show only little differences (Tab. 5).

The results of our analysis are not sufficiently consistent for an ultimate decision about the subspecific status of Libyan populations. Even if we decided to pay no attention to differences between the two Libyan sets and evaluated them merely as "pale coloured" we would still have to solve nomenclatorical problems. It is still an open question whether the name of the oldest described subspecies *P. k. aegyptius* Fischer, 1829 (vide Koopman, 1975) should be given to N-African populations, or that of *P. k. marginatus* Cretschmar, 1830 (vide Gaisler et al. 1972), or of *P. k. ikhwanius* Cheesman et Hinton, 1924 (vide Harrison, 1964, Kock, 1969). However, if evidence were to be obtained about the importance of differences in the colour of western and eastern populations of Libya, it would be necessary to reconsider the validity of some other descriptions, particularly that of *P. k. albolimbatus* Küster, 1835 (t.t. Cagliary, Sicily) and *P. k. pallidus* Heim de Balsac, 1936 (t.t. Algeria).

Distributory notes: *P. kuhli* is evidently the most abundant bat species of Libya in general, or at least of its coastal zone. According to older data in the literature, it has been found also in oasis (Gialo, i.e.) in the desert zone, but more frequently in human settlements in the coastal zone. It has been reported from large towns, villages, oases and isolated buildings. Its mass occurrences in the centre of the towns of Tripoli and Benghazi frequently reffered to in older literature (e.g. Klaptocz, 1909) are events of the past.

Ecological remarks: In 1979 a colony of 20 gravid females was found in the vicinity of Benghazi, in a narrow crevice between the ceiling and the wall of an abandoned house in a palm grove near a bay. All 4 females captured on April 16, were gravid, their well-developed embryos weighed from 1.0 to 1.5 g. In 1980, this colony was found to occur in the same house again. It was not concentrated, however, into a single space and groups of females and solitary males were sheltered in chinks of walls of the outer sides of the house. Most of the females were pregnant; from among 13 dissected females ten were with two and three with one embryos, respectively.

Pipistrellus deserti Thomas, 1902

Published records: Murzuk (= Murzuq), Fezzan, 1 ♂ ad. (Thomas, 1902). Holotype is deposited in BMNH, no. coll. 2.11.4.1. This record was subsequently quoted also by Klaptocz (1909), Zavattari (1934, 1936—37), Toschi (1954), Setzer (1957), Kock (1969), Hufnagl (1972), Gaisler et al. (1972) and Koopman (1975).

Remarks: *P. deserti* was described from a sigle specimen, an adult male from Murzuk, Fezzan. Libya. Later, it was reported from Algeria (Heim de Balsac, 1936, N-Sudan (Kock, 1969) and recently from Luxor, Egypt (Gaisler et al., 1972). As indicated by innumerable and geographically fairly distant findings, the species seems to be distributed over the whole of the Sahara area. Although the majority of authors tend to recognize the validity of the species, some have placed it within the range of subspecies of *P. kuhli* (e.g. Corbet, 1978).

Nyctalus leisleri (Kuhl, 1818)

Material examined: Wadi al Kuf, 5 km SW from Al Bayda, 1 ♂ ad., 1 May 1980, netted, ISZP. This is the first finding of the species in Africa; in 1982 was it proved to occur in Algeria (Hanák et Gaisler, 1983).

Taxonomic remarks: As far as the colouration, dentition characteristics, and measurements (Tab. 3, 4) are concerned the individual does not in any more substantial way differ from European specimens.

Distributory notes: Though only one finding of a single male in the spring season has been recorded so far, we may suppose that this is not a matter of a stray migrant from Europe but a member of a resident population. The locality of the respective finding, The Cyrenaican Plateau, 500 m a.s.l., corresponds well to its exigencies. This is a region with rests of forests (*Juniperus, Cupressus*), cannyon-like valleys and with rock crevices. This assumption has been corroborated also by findings of the following species with similar demands in the same region.

Nyctalus lasiopterus (Schreber, 1780)

Published records: Wadi al Kuf (32°42′ N, 31°34′ E), half-cave, 1 ♂, 9 August 1981, Col. Mus. Nat. Hist., Wien; Cyréne (43°47′ N, 21°49′ E), 2 ♂, 19 August 1981, netted, Coll. Mus. Nat. Hist., Wien (Spitzenberger, 1982).

Remarks: This is the first recorded occurrence of this species in Africa that has been a little later corroborated also by distinguishing of a further specimen of the species in an old material from Rabat in Morocco (Paris Nat. Hist. Mus.) (Palmeirim, 1982). The findings in Libya were made — similarily as in the previous species — in the best preserved part of Djebel al Akhdar Mts., where are still per-

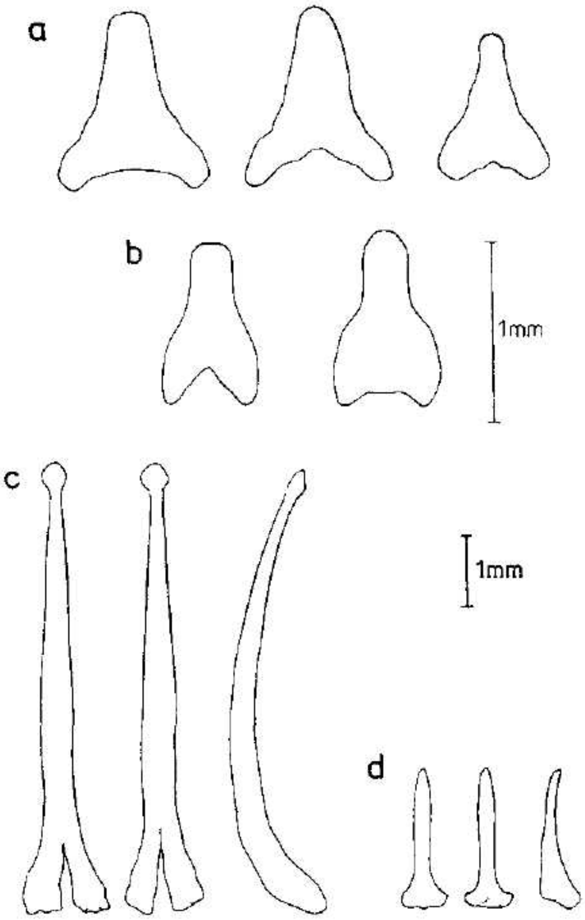

Fig. 5. The bacula of some Libyan bats: a. *Plecotus austriacus* (Li-6, Li-76, Li-86); b. *Myotis blythi punicus* (Li 1, Li-4); c. *Nyctalus leisleri* (Li-80), d. *Rhinolophus mehelyi* (Li 54).

sisting rests of original forests of *Juniperus* and *Cupressus*. Particulars of the findings indicate that the species takes here use of rather rock crevices than tree-hollows as its day shelters. This is most probably a resident population which penetrated there from South Europe.

Eptesicus serotinus (Schreber, 1774)

Material examined: Tripoli-Zanzur, town outskirts, 2 ♀, summer 1978, DZUT, Tripoli Sidi Mesri, Botanical garden of the University, 1 ♂, 6 May 1980, netted, ISZP; Pisida, 230 km W from Tripoli, 1 ♀, 30 August 1937, leg Moltoni, MSNG.

Published records: Environs of Tripoli (Temminck, 1840); subsequently quoted also by Klaptocz (1909), Zavattari (1934, 1936–37), Allen (1939), Toschi (1954), Deleuil et Labbé (1955b), Setzer (1957), Harrison (1963), Hufnagl (1972); Leptis Magna, 1 specimen, May 1969, leg. F. van Weerd (Hufnagl, (1972).

Taxonomic remarks: The above material from the vicinity of Tripoli (coll. by J. H. Clifford Cocq Breughel) was used by Temminck (1840) for the description of the new species *Vespertilio isabellinus*. Unfortunately, the original description did not include any cranial measurements and, as a results, precise affinities of this species have been uncertain until lately. The status of this form and its relationships to related species started to be clarified after the findings of other pale-coloured individuals of this genus from Morocco (Dorst et Panouse, 1957a, 1957b). At that time, there were three different opinions on the systematic position of this form. Various authors (Ellerman et Morrison-Scott, 1951; Deleuil et Labbé, 1955b; Toschi, 1954; Brosset, 1960) regarded it as a valid species in agreement with the original description, others (Klaptocz, 1909; Zavattari, 1934, 1936–37; Setzer, 1957; Hufnagl, 1972), as a subspecies *E. serotinus isabellinus*, while Hoogstraal (1962) placed it quite erroneously in the distinct species *E. bottae* (= *innesi*). Harrison (1963) studying the type material obtained conclusive evidence that the form *isabellinus* belongs to *E. serotinus* as a subspecies. We have accepted his opinion in the present study.

Our material from Libya consisted of four specimens of which two were juveniles and therefore useless for a taxonomic study. All four individuals were pale on the dorsal side justifying their allocation to *E. s. isabellinus*. As shown by a comparison of cranial measurements of the two adult Libyan specimens (Tab. 4) with a Tunisian one (ISZP, leg B. et W. Issel) and with data in the literature, a considerable variation in size is visible, though all data are within the range of the series of typical *E. serotinus* from Czechoslovakia. Unfortunately our material was too limited to allow for comments.

Distributory notes: *E. s. isabellinus* has for long been known only from the Libyan type series. Much later it was reported from Morocco (Heim de Balsac, 1936, 1947; Dorst et Panouse, 1957a, 1957b; Brosset, 1955, 1960; Hill, 1964), Tunisia (Deleuil et Labbé, 1955b) and Algeria (Dobson, 1880; Beaucournu et Clerc, 1968; Anciaux de Faveaux, 1976). As indicated by this findings, the N-African subspecies of this widespread Palaearctic species appears to be distributed throughout the coastal area of NW-Africa. Sofar, no direct proof has been given of its occurrence in the desert zone of this area, although this is to be expected. It has been found both in settlements and in the open country (rocky sites). Our new records from Tripolitania, together with the finding from Leptis Magna (Hufnagl, 1972), are the most eastern localities of this form in Africa. Although our findings confirm the contemporary presence of this form in the area from which it had been described originally, it is difficult to agree with Temminck's statement "wit engrand nombre dans les environs de Tripoli".

Otonycteris hemprichi Peters, 1859

Material examined: Brak, Fezzan, 1 ♀, 19 June 1977, leg. Roček, ISZP; Bahr el Tubat, 21 km ESE from Giarabub, 1 ♀, 1 ♂, 29 May 1962, leg Ranck and Shaw, SIW no. 325011, 325012.

Published records: Fezzan (Toschi, 1954 — Chiesa in litt., 1952), subsequently quoted by Setzer (1957), Hufnagl (1972) and Kock (1969).

Tab. 6. *Plecotus austriacus*, external and cranial measurements

Loc.	No.	Coll.	Sex	Date	FA	GL	CL	ZB	IC	HS	MB	C-M¹	C M₃	M	BT	SSP
								Libya								
Shahat	Li-06	ISZP	♂	14. 4. 79	38.1	16.8	15.8	9.0	3.6	7.9	9.3	5.7	6.0	10.9		AU
Quariat af Farogh	Li-76	ISZP	♂	30. 4. 80	39.8	17.0	16.0	9.0	3.5	7.8	9.2	5.7	6.2	11.2	4.6	AU
Giarabub	26220	MSNG	♂	1926—27	38.0				3.4			5.3	5.6	9.7		CH
Giarabub	26220	MSNG	♀	1926—27	39.5	16.6	15.4	8.7	3.2	7.6	9.2	5.5	5.7	10.5	4.4	CH?
								Egypt								
Thebes	E-197	IVZB	♂	30. 4. 69	39.5	16.1	15.0	8.5	3.4	7.6	8.7	5.2	5.7	10.0	4.4	CH
Siwa	297752	SIW	♀	21. 3. 52	37.8	16.1	15.0		3.2	7.6	8.8	5.4	5.7	10.3	4.3	CH
Siwa	297753	SIW	♀	21. 3. 52	37.3	16.1	15.2	8.4	3.2	7.8	8.8	5.3	5.7	10.4	4.4	CH
Siwa	297754	SIW	♀	21. 3. 52	38.8	16.6	15.4	8.5	3.2	7.4	8.9	5.4	5.8	10.6	4.3	CH
Siwa	297755	SIW	♀	21. 3. 52	37.5	16.0	15.0	8.3	3.2	7.1	8.6	5.2	5.6	10.0	4.3	CH

Remarks: In their measurements, the two specimens from Cyrenaica (Tab. 3, 4) approach the values of N-African and W-Asian samples of the species (cf. Gaisler et al., 1972; Harrison, 1964). Our table contains no measurements of the specimen from Brak because it was a juvenile female. We have no details of the sites where the specimens were found. The species appears to colonize the entire desert area of Libya, but is absent in the coastal zone.

Plecotus austriacus (Fischer, 1829)

Material examined: Shahat, ruins of the ancient Greek town Cyréne, 1 ♂, 14 April 1979, ISZP; Quariat al Faioah, 6 km S, cellar, 1 ♂, 30 April 1980, ISZP.

Published records: Giarabub (= Jaghbub) (De Beaux, 1928), subsequently quoted by Zavattari (1934, 1936–37); Toschi (1954); Setzer (1957); Kock (1969); Hufnagl (1972).

Taxonomic remarks: De Beaux and others identified the specimens collected at the Giarabub Oasis as *P. auritus* or *P. auritus christiei* Gray, 1838. To date, all pale-coloured populations of the genus *Plecotus* from N-Africa and W-Asia have been assigned to this form (as *P. austriacus christiei* = *P. a. aegyptius* Fischer, 1829?) This concept might be acceptable for population from Egypt and possibly for those from Near East (Harrison, 1964; Attalah, 1977; Gaisler et al., 1972), but not for populations from Morocco, Tunisia and Algeria for which this subspecific status is still doubtful (cf. Kock, 1969).

Our specimens from Cyrenaica are not in agreement with characteristics of the subspecies *christiei* either in coloration or in measurements. The colour of their dorsal side is dark grey, that of their ventral side markedly paler. Ear lobes, tips of tragi and wing membranes are darkly pigmented. In its colour, our specimens approache individuals from the Balkans or Central Europe except for a very pale strip of hair at the base of the ear lobes which is absent in individuals from Europe. These differences in colour appeared particularly salient in comparison with a specimen from Egypt (Thebes, IVZN, no. E 197, leg Gaisler). The dorsal side of this specimen was pale greyish white, the ventral side shading from completely greyish white to whitish. Also the wing membranes and ear lobes of this individual were pale. Another difference between the two sets was observed in the length of the fur — the dorsal hairs of the Libyan specimens measured about 8 mm, those of the specimen from Egypt 4–5 mm. On the other hand, an agreeing feature was their bicoloured fur. Each hair was dark in its basal half while the distal half was pale.

Marked differences in external and mainly cranial measurements between the individuals from Libya and the series of pale-coloured individuals from Egypt (AMNH, IVZB) are illustrated in Tab. 6. All important measurements (except FA) of the Libyan specimens are larger and therefore it falls rather in line with the range of variability of the nominate subspecies. An even better illustration of this fact is given in Fig. 6 which contains additional values for smaller series of the nominate subspecies from the Balkans (ISZP) and data on strange individuals from several islands of the Mediterranean (Dulić et Tvrtković, 1979; Kock, 1974; Felten et Storch, 1970). Based on these facts we have come to the conclusion that our specimens from N-Cyrenaica are not a member of the N-African desert subspecies *P. a. christiei*, but should be regarded as a very close relative of the nominate subspecies *P. a. austriacus*. Its systematic status will have to be established together with an analysis of small, dark-coloured samples from Mediterranean islands. If old collections from the Oasis Giarabub were to be found identical to the pale-coloured desert form *christiei* (which seems to be highly probable) then there ought to be exist two different subspecies of *P. austriacus* on the territory of E-Libya, one inhabiting extensive desert areas of Cyrenaica, the other, according to our present knowledge, confined to the climatically characteristic area of Djebel Akhdar Mts.

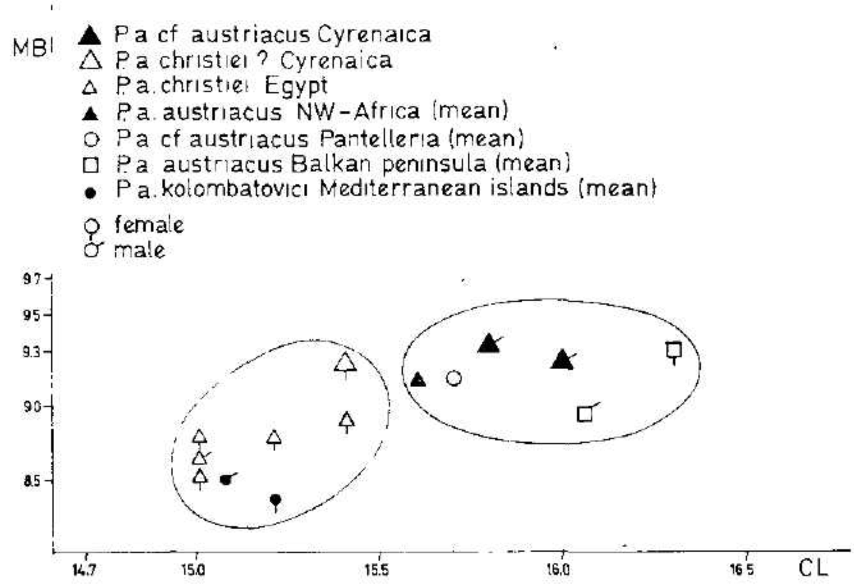

Fig. 6. Scatter diagram on which the MB is plotted against the CL in different populations of *Plecotus austriacus* (means only).

Koopman (1975) disagreed strongly with an allocation of N-African populations of the genus *Plecotus* to the species *P. austriacus*, arguing that their measurements were too small. However, Attallah (1977) confirmed in his study on bacula that populations from the Near East belonged to this species. In support of his statement are data on the shape and size of the bacula of our individuals (Fig. 5). A similar confirmation should be made available for desert populations of *P. austriacus christiei*.

Ecological remarks: We extracted our first individual (adult male) from a crevice in the ceiling of a large vaulted cellar, at a height of about 6 m. Owing to the cool and windy weather (14 April) the specimen was in a deeply torpid state. We did not determine the microclimatic conditions in the shelter. The individual was not sexually active (testes scrot. 4 × 2 mm). The second specimen was found in a similar situation — in a crevice on the ceiling of a small ancient cellar on a limestone plateau outside of human settlements. It was in a typical daily torpid state.

Miniopterus schreibersi Kuhl, 1819

Material examined: Tripoli, Sidi Mesri, town outskirts, 1 specimen — skull only, November 1979, DZUT.

Remarks: This is the first record of this species in Libya and also the most eastern locality of its occurrence in North Africa. Records from N-Africa include Morocco (Brosset, 1960), Algeria (Anciaux de Faveaux, 1976; Gaisler, 1983) and Tunisia Aellen et Strinati, 1969). It is known to occur in several islands of the Mediterranean, e.g., Sicily (Klemmer et Krampitz, 1954), Crete (Kahmann, 1959) and Cyprus (Spitzenberger, 1979). The subspecies status of N-African populations has not been confirmed. Aellen et Strinati (1969) listed populations from Tunisia as a nominate subspecies.

ZOOGEOGRAPHICAL COMMENTS

As evident from our review, the lack of mammalogical investigation of Libya has resulted sofar in a discovery of only 13 bat species. Considering the fact, that Libya is the second biggest of all N-African countries (1,759 000 km), knowledge of its bat fauna seems to be very scanty in comparison with that obtained in neighbouring countries of N-Africa. In Egypt which is only about half a big as Libya (not including the Sinai Peninsula), the number of ascertained species is 20 (Gaisler et al., 1972), in Tunisia, the western neighbour of Libya, it is 17 (Aellen et Strinati, 1969; Vaughan, Cockrum et Vaughan, 1977), in Algeria 26 (Anciaux de Faveaux, 1976; Gaisler, 1983, Hanák et Gaisler, 1983, Spitzenberger in litt.) and 25 in Morocco (Panouse, 1951, 1953, 1955, 1958; Laurent. 1937; Brosset, 1960; Hill, 1964; Corbet, 1978).

A mere comparison of the number of species in the individual territories does not, however, disclose important zoogeographical characteristics, but rather differences caused by a unlike size of these territories and differently intensive research. In spite of this, it may principially be possible to conclude from these data that the number of bat species to be expected from large and ecologically differentiated countries of northern Africa should be about 20—25. This assumption does not apply to Tunisia for its relatively small size, its geographical position and perhaps for the state of research work and neither does it hold for Libya, where the impeding factor is a scanty knowledge.

More interesting relationships might be disclosed by a comparison of the composition of species in these countries with an indication of their pertinent zoogeographical characteristics (Tab. 7). According to our results the wealth of the Moroccan bat fauna has to be ascribed mainly to a high representation of species of Mediterranean and Palaearctic-arboreal origin (about 80 %), and a relatively high participation of the Afro-eremic component (12 %). This composition is typical of a territory which is separated from Europe by a narrow sea channel, in which there are extensive mountain ranges with climatic and vegetational conditions approaching those of the European part of the Mediterranean, and simultaneously, with a large portion of the territory with Saharan environments. This is the situation in Algeria, although there the Palaearctic-arboreal component is possibly lacking two of its species (*M. mystacinus*, *B. barbastellus*), but has been enriched by species of Afro-eremic or Ethiopian origin (*T. nudiventris*, *P. deserti*, *P. rueppelli*, *T. aegyptiaca* and *O. hemprichi*). In Tunisia, other Mediterranean and Palaearctic-arboreal species are absent (*N. noctula*, *T. teniotis*) and, in a view of its geographical position, this impoverishment is made even more evident by the absence of Afro--eremic and Ethiopian elements. From these aspects, the most important fact established in studies on the Libyan bat fauna is a gradual reduction in the Mediterranean and Palaearctic-arboreal components proceeding in a West-East direction. This tendency appears in Libya despite of the fact that occurrence of additional species of arboreal origin, which were not expected but found during our investigation. In support of this trend is the situation in Egypt (except Sinai), where the bat fauna is composed mainly of species of Afro-eremic or Ethiopian origin, while

Tab. 7. The number of recorded bat species in various North African countries and their tentative classification into faunal elements (percentual values in parenthesis).

Country	Number of species	Faunal elements				
		Medi-terranean	Palaearctic arboreal	Afro eremic	Ethiopian	Others
Morocco	**25**	12 (48)	7 (28)	3 (12)	2 (8)	1 (4)
Algeria	**26**	11 (42.5)	5 (19.5)	6 (23)	2 (7.5)	2 (7.5)
Tunisia	**17**	10 (59)	3 (17 5)	3 (17.5)	0 (0)	1 (6)
Libya	**13**	4 (31)	4 (31)	4 (31)	0 (0)	1 (7)
Egypt except Sinai	20	3 (15)	1 (5)	9 (45)	5 (25)	2 (10)

Mediterranean elements are represented by three species only (*P. kuhli*, *R. mehelyi* and *T. teniotis*), of which *R. mehelyi* has clearly entered the country from the East

Using zoogeographical criteria, in an evaluation of today's composition of the Libyan bat fauna a most surprising feature is the high proportion of the Mediterranean and Palaearctic-arboreal species (about 60 %). This could be ascribed to the poor knowledge of the bat fauna in central parts of the country, because except for an occasional exploration of several oasis (Gialo, Giarabub, Murzuk, Serdelles), investigations have been made almost exclusively in coastal areas of Tripolitania and on the Plateau of Cyrenaica. These areas were the center of our studies in 1979 and 1980 and a logical consequence is the finding of species of arboreal origin. Having investigated Central Libya there will certainly be an increase in the number of Afro-eremic species and this will contribute to a fundamental change in the ratio of the two components. On the other hand, a more marked increase in the Ethiopian component similar to that in neighbouring Egypt can hardly be expected in Libya because these species have entered Egypt along the route of the Nile.

It is evident that even with the additional knowledge obtained in further investigations, the bat fauna of Libya will be less variable than that of other countries of northwestern Africa and of Egypt. This has also been suggested by Ranck (1968) with referrence to the Libyan rodent fauna.

One of the important results of the present paper is the finding that several bat species typical of the Mediterranean zone of northwest Africa have entered Libya. There, they are evidently confined to the western part of the country (coastal Tripolitania). Apparently the Syrta basin constitutes a barrier to their dispersal further eastward. So far, this distribution can be assumed for *M. blythi*, *M. schreibersi* and perhaps *E. serotinus*. Their area of distribution is roughly identical to that of several terrestrial mammals of NW-Africa, e.g. *Elephantulus rozeti*, *Ctenodactylus gundi* or *Gerbillus aureus* (cf. Ranck, 1968), though these have another origin. *P. kuhli* is the only species of Mediterranean origin, that is distributed through the entire N-African coast from Morocco to Egypt. However, the species has clearly entered more southern parts of western and eastern Africa, and moreover there is little evidence for its Mediaterranean origin. *R. mehelyi* also has a wide distribution along the African Mediterranean coast (Maghreb, Cyrenaica, Egypt), but it seems that the gap in its distribution is in the Syrta basin.

Another point worth emphasizing is the new and zoogeographically important knowledge obtained for the bat fauna of the Cyrenaican Plateau. In the zoological literature this area has always been regarded as a refuge for the Pleistocene fauna of Eurasian origin, as indicated by the isolated incidence of *Spalax ehrenbergi* and *Microtus mustersi* (Ranck, 1968). Of a similar interest are the findings of *Plecotus* *austriacus* cf. *austriacus*, *P. pipistrellus*, *R. mehelyi*, *N. leisleri* and *N. lasiopterus*, where these species have isolated islets of their distribution. The first species is represented in other parts of NE-Africa by the desert subspecies *christiei*, the others are completely absent elsewhere in this area, only *R. mehelyi* occurs in Egypt. As regards the origin of this patchy distribution, it might be explained as a remnant of a former continuous extension throughout the coastal part of N-Africa similar to that observed for some terrestrial mammals. However, in the case of flying forms, it might be caused by direct spreading from southern Europe and Mediterranean islands (Crete), and possibly of fairly recent date. Considering the close taxonomic relationship between the Cyrenaican samples of these species with the of southern Europe, the latter possibility appears to be more plausible.

TAXONOMIC CONCLUSIONS

In view of the scarcity of data on the bat fauna of North Africa, several species and mainly subspecies have so far been characterized only by fragmentary metrical data, which is in disagreement with the requirements of modern taxonomy. Even more recent and more numerous collections, particularly those from Tunisia and Morocco, have been disregarded as yet in taxonomic and systematic conclusions. A more detailed confirmation has been made of several species from Egypt (Gaisler et al., 1972). Other material from northern Africa has been evaluated in studies on bats from the Sudan by Kock (1969) and Koopman (1975). The most detailed taxonomic evaluation has been made of the N-African *Myotis blythi* samples recently studied by various authors (Strelkov, 1972; Felten, 1977; Bogan et al., 1978).

Our opinion on the subspecific status of Libyan populations of several Afro-eremic species (*A. tridens*, *O. hemprichi*, *R. clivosus*, *P. deserti*) is based only on literarye data. These conclusions have sometimes been simplified by the fact that populations of the whole N-African area are regarded as members of a single subspecies. The situation is more complicated for the species *R. clivosus* because problems concerning the relation and value of several forms described from Algeria (*schwarzi*), Egypt (*brachygnathus*) and Eritrea (*acrotis*) have not been clarified. Even more complicated is the subspecific allocation of Cyrenaican population of *R. mehelyi*; this problem needs a special reexamination of the material from the whole distributional area. Another check should be made of the little known desert species *P. deserti* described from Libya, the validity of which has been doubted by several authors (cf. Corbet, 1978).

Little known for the present are subspecific relations of species which have come to Africa from a more northern arboreal zone of Europe. The spreading of the individual species has evidently occurred in different intervals as evidenced by their systematic characteristics. Several of these species are apparently older migrants, and have therefore produced well-defined subspecies. This applies mainly to *P. austriacus christiei* and *E. serotinus isabellinus*. However, as shown in the example of *P. austriacus*, it is not possible to allocate automatically all N-African populations to this subspecies only. It is evidently a product of the oldest migration of *Plecotus* from the East; recent desert populations in Egypt, Libya and probably in more western Saharan areas are its descendents. Populations from the Mediterranean zone of Libya (and Maghreb countries) are more similar or perhaps identical to the European *P. a. austriacus* which confirms that they have been produced by a different migratory wave entering Africa from a more western site (via the Gibraltar straits) or from the eastern Mediaterranean. For *E. serotinus* we have found some differences in cranial measurements but they are identical in the pale colouration which is the main identifical character of the subspecies *E. s. isabellinus*. The problem of the taxonomic position of the so called "big *Myotis*" of N-Africa has apparently been solved by the description of the new form *M. blythi punicus* by Felten (1975). We accept this solution although we have found small differences both in measurements and colour in our Libyan material. The study of the bacula of the Libyan specimens support the widely held view that the only representative of the N-African "big *Myotis*" is *M. blythi*.

The remaining arboreal species which so far have been found in Libya are evidently in a subspecific agreement with European populations of the species. However, this assumption will have to be checked on at least these species: *P. pipistrellus*, *N. leisleri*, *N. lasiopterus* and *M. schreibersi*. Future studies, with additional specimens available for study will probably confirm this statement.

ECOLOGICAL REMARKS

Results of our field studies disclosed some knowledge of bionomics and the ecology of several of the species obtained. There appears to be a slight difference in seasonal relations of the sexual cycle between several species in the Mediterranean zone of Libya and those of Southern and Central Europe. This is evident in a case of one female of *M. blythi* from Tripolitania which gave birth to a well developed young on 9 April. Although parturition occurred in captivity and could have been influenced by stressing conditions, it might be assumed that even in the field offsprings are born early in the year. Moreover this is in agreement with a remark by Baker et al. (1974) who recovered an embryo from a female of this species from Tunisia early as the end of November. We found also well-developed embryos (weight 1.0–1.5 g) in all adult females of *P. kuhli* captured in a nursing colony near Benghazi on 16 April 1979 and 20 April 1980. This shows that parturition occurs in the second half of April or in the first days of May. In general it might be concluded that several bat species of the Mediterranean zone of Africa give birth to their offsprings four to five weeks earlier than those do in Central Europe. This statement has been contradicted by data from Egypt (Gaisler et al., 1972) in that were found embryos of different sizes in females of *A. tridens* and *R. hardwickei* in the first days of May. Basing on this evidence, the situation in the reproduction of N-African bats is in general not clear and is in need of a thorough investigation of a more numerous material from different climatic zones of N-Africa.

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THE BREAM, ABRAMIS BRAMA WITHOUT PELVIC FINS (PISCES: CYPRINIDAE)

Jindřich NOVÁK

Received September 2, 1983

Abstract: The bream, *Abramis brama* (Linnaeus, 1758) without pelvic fins is described.

RESULTS and DISCUSSION

During field operations on May 18, 1982, performed in the Klíčava valley reservoir (Central Bohemia, Czechoslovakia) the bream without pelvic fins was caught in the seine net. The great shoal of fish (*Abramis brama*, *Rutilus rutilus*, *Scardinius erythrophthalmus*) was observed just before seining. No fish with perceptible spoiled swimming was registered there.

Counts of meristic characters and body proportions of the specimen studied: D 2/10, A 2/26, P 1/15, 1.1.52 above 1.1.13, below 1.1.9 scales. The total length 430 mm, the standard length 369 mm. In % of the standard length: the head length 23, the body depth 37, the eye diameter 4, the snout length 7, the length of the postorbital part of the head 12, the interorbital width 9, the length of the pectoral fin 20, the length of the caudal peduncle 14, the depth of the caudal peduncle 12. Sex male, age 4+.

This specimen has a lower profile of the body with the remarkable deepening in the region of lacking ventral fins (Fig. 1 and 2). Also scales are not visible in this region, they are hidden under the skin. These scales seem to be not regenerated, their circuli are quite clearly observable. Only a few scales here have regenerated areas with the diameter of about 0.1—0.3 mm in the centre. No basipterygia of pelvic fins were found.

Similar cases in other fish species were formerly recorded. The roach, *Rutilus rutilus*, without pelvic fins was described by Dyk (1935), the chub, *Leuciscus cephalus*, with the same deformation by Oliva (1950), *Lutjanus argentriventris* by Alvarez-León (1980); finally the absence of the right pelvic fin in *Channa punctatus* was recorded by Tandon (1964).

The loss of fins in the bream described here, maybe the result of wounding in the postembryonal period which passed in the early period of life with regard to the regenerated parts of centres of some scales of the pelvic region. Or, this loss can be a developmental defect. The absence of pelvic fins does not probably hindered the spawning; the specimen described shows the spawning tubercles (Fig. 1 and 2).

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

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LA FAUNE DE PLUSIERS PUITS DE PRAGUE

Jaroslav ROSOL

Dedié à M. le Professeur S. Hrabě à l'occassion de son 85 anniversaire
Reçu le 22 octobre 1983

Abstract: Hydrobiological samplings have been carried out in 1970 of 7 Prague wells most of which had alredy been the object of research previously (Vejdovský 1879—1881, Řeháčková 1950—1951). The research aimed at a determination of possible changes in the composition of the regional autochthonous biocenosis.

It has been found that in comparison with the 30 species of higher pluricellular organisms found by Vejdovský and with the 13 species determined by Řeháčková, the recent biocenosis is represented by cca 11 species. That finding is discussed in the presented study. As new among them has been found the freshwater polychaet *Troglochaetus beranecki* Delachaux, this site is its westernmost occurrence in ČSSR so far. The absolute difference of the structure of biocenosis of Prague wells from Husmann's "Troglochaetusbiozonose" indicates an individual and isolated development of the so called regional biocenosis in historical times realized under the influence of factors of local validity.

INTRODUCTION

En novembre 1970, à l'initiative du monsieur prof. Dr. S. Hrabě, DrSc., et avec sa participation, a été réalisé une recherche hydrobiologique de plusiers puits pragois selectionnés.

Dés le temps de Vejdovský (1882), qui étudiait leur biocénose à la fin du siècle passé, ce n'était que Řeháčková qui a entrepsis une révision de plusiers puits dans les années 1950–1951 (Řeháčková 1953, 1956).

A l'origine nous avons compté avec la visite de 12 jusqu'à 14 objets; mais en conséquence de nombreuses reconstructions qui se poursuivent à Prague une partie de ces puits ont été entretemps supprimés (p. ex. celui de la rue Spálená) et nous n'avons pas trouvé d'autres puits parce qu'il y avait un changement de la numérotation de maisons (p. ex. le puits de la rue Sokolovská), de façon qu'enfin, dans la période de temps délimitée, nous avons pu prendre des échantillons de sept puits seulement. La plupart des objets se trouvaient dans un état excellent, ce qui était surprenant.

DESCRIPTION DES LOCALITÉS

Puits No. 1 — Karmelitská 528

Un vieux puits foncé à maçonnerie en briques à sec, můni d'une couverture en béton continue à passage non-étanche, ⌀ 1,50 m, profondeur 9,50 m, colonne d'eau 2,40 m, température de l'eau 10,0 °C, pH 5,4, au fond une couche épaisse de détritus avec des restes pourris de l'installation de pompage en bois originelle; inusité.

Puits No. 2 — Barvířská 1550

Un puits foncé renouvellé, blindé par des cintres bétonnés, můni d'une couverture en beton à passage etanche, ⌀ 1,50 m, profondeur 6,10 m, colone d'eau 1,60 m, température de l'eau

13,0 °C, pH 5,4, au fond une couche épaisse de détritus avec une grande quantité de racines vivantes poussant en dedans du puits d'un arbre se trouvant à côté; probablement usité de temps en temps.

Puits No. 3 — Jeruzalémská 8

Un puits foncé renouvellé, blindé par des cintres en béton, mûni d'un couvercle bétonné en deux parties à interstice nonétanché, ⌀ 1,50 m, profondeur 13,00 m, colonne d'eau 1,50 m, température de l'eau 11,0 °C, pH 5,1, au fond une couche mince de détritus mêlé avec du sable fin; probablement non-usité.

Puits No. 4 — Apolinářská 18

Un puits foncé renouvellé, maçonné de briques avec du liant de mortier, à enduit protecteur (latex?), mûni d'un couvercle continu en béton à passage étanche (il y a une cuve d'accès qui débouche dans un côté du puits), ⌀ 1,50 m, profondeur 8,40 m, colonne d'eau 3,10 m, température de l'eau 12,0 °C, pH 5,1, au fond une couche de sable à admixtion insignifiante de détritus et avec une grande quantité de restes de l'enduit protecteur écoulé; probablement usité de temps en temps.

Puits No. 5 — Lazarská 3

Un puits foncé renouvellé, blindé par des cintres bétonnés, mûni d'un couvercle bétonné en deux parties à interstice nonétanché, ⌀ 1,00 m, profondeur 12,50 m, colone d'eau 0,70 m, *température de l'eau 11,0 °C, pH 5,3, au fond une couche mince de détritus mêlé avec du sable* et avec de petites pierres; probablement non-usite.

Puits No. 6 — Všehrdova 435

Un puits foncé renouvellé, à maçonerie en briques à sec, mûni d'un couvercle en béton à passage étanche, ⌀ 1,50 m, profondeur 7,50 m, colonne d'eau 1,00 m, température de l'eau 11,0 °C, pH non-mesuré, au fond une couche de sable à de l'admixtion faible de détritus; non-usité.

Puits No. 7 — Loretánské náměsti 102

Un puits foncé renouvellé à maçonnerie en briques à sec, mûni d'un couvercle en béton à *passage étanche, ⌀ 2,00 m, profondeur 13,00 m, colonne d'eau 6,75 m, température de l'eau* 11,0 °C, pH non-mesuré, au fond une couche de sable mêlé avec du detritus; probablement usité de temps en temps.

Les localites No. 1—6 se trouvent sur la plaine mondée ou sur les terrasses de la rivière de Vltava, la localité No. 7 probablement dans le crystallinicum ou dans des sédiments métamorphiques.

De parmi ces stations Vejdovský avait prélevé des echántillons seulement dans celles de No. 1 et 4, Řeháčková aux numéros 1 jusqu' à 7.

MÉTHODES DE PRÉLÈVEMENT

Les prélèvements d'eau libre ont été réalisés en trainant le réseau à planeton (soie No. 13/XXX, ⌀ de la bouche 300 mm) à travers la colonne d'eau toujours du fond jusqu' à la surface. La *quantité approximative de l'eau filtrée a été calculée*, l'influence de la resistance de réseau trainé a été corrigée par le facteur empirique 0,7 (Tranter 1967; Tranter, Heron 1967).

Nous avons pris des échantillons de sédiments par l'excavateur de Birge-Ekman à une superficie de cca 100 cm².

Nous avons prélevé à chaque station par les deux méthodes pour la plupart deux échentillons à chacune, dont l'un a été fixé par formaline sur place, tandis que l'autre a eté transporté in vivo dans la thermos. Nous avons séparé quantitativement les organismes du filtrat du prélèvement sous une loupe binoculaire et après nous les avons déterminés, quant aux prelèvements des sédiments, nous les avons d'abord lévigés par la méthode de deux vases (Hrabě) et puis nous avons traité les organismes d'une façon analogue.

LES RÉSULTATS

Les résultats des prélèvements ont été ordonnés d'une manière synoptique dans les Tables 1 et 2.

Tab. 1 Quantité approximative de l'eau filtrée, nombre de prises d'essai de boue et le nombre total des organismes trouvés aux différentes localités

Localité	Volue d'eau en litres	Nombre de prises d'essai de boue	Nombre d'organismes
No. 1	1073,8	3	469
No. 2	505,5	3	142
No. 3	471,1	0	20
No. 4	941,5	3	22
No. 5	208,6	3	83
No. 6	396,9	0	7
No. 7	2042,6	0	381

Notes aux espèces individuelles

Troglochaetus beranecki Delachaux 1920 — cette polychète remarquable est connue sur le territoire tchécoslovaque déjà à plusieurs stations. L'ordre des découvertes: Kulhavý 1958 (Bratislava-Petržalka, la première découverte en Tchécoslovaquie); Štěrba 1961, 1962 (Potok nad Lomnicí dans les Tatras. Olše près de Třinec); Rosol, Kubíček 1969 (Bílovice nad Svitavou, Kanice u Brna); Rosol 1969 (Drnovice u Kunštátu); Hrabě, Rosol 1970 (Praha); Rosol 1974 (Kralický Sněžník); Rosol 1975 (Žitný ostrov dans la Slovaquie du Sud — Podunajské Biskupice); Kulhavý 1976 (Buková près de České Budějovice); et enfin Kulhavý 1977, 1981 (Nový Dvůr, Světlá nad Sázavou); les dernières découvertes indiquées (Kulhavý 1976, 1977. 1981) sont mentionnées ici selon une communication orale de l'auteur.

La découverte des stations de Prague, de même que d'autres découvertes plus récentes, confirme le fait que la distribution géographique de cet animal est beaucoup plus vaste que l'on ne croyait jusqu'ici; cependant à cause de la présence sporadique aux biotopes individuels, des dimensions insignifiantes, et de l'absence totale du pigment, cependant, cet animal a jusqu'ici pour la plupart échappé à l'attention des chercheurs. Sa découverte à Prague n'est pas surprenante, car elle associe d'une façon logique les découvertes effectuées dans l'Europe occidentale (Husmann et autres) à celles de la Moravie, Slovaquie et de la Hongrie septentrionale. La présence de ce relicte comprend probablement toutes les zones des mers neogènes d'autrefois.

Trichodrillus pragensis Vejdovský, 1875 — est une des vraies stygobiontes; son extension territoriale dans la ČSSR n'est pas connue pleinement jusqu'ici. Une revue des découvertes réalisées jusqu'à ces jours-ci se trouve dans la clé d'oligochètes aquatiques de Hrabě (Hrabě 1981). Il constitute probablement une partie permanente de la biocénose régionale des eaux souterraines de la plaine alluviale de Vltava.

Enchytraeidae g. sp. — nous avons trouvé ses représentants au total à deux stations, à l'une d'elles en nombre assez grand. Tous les individus étaient insexuels, ce qui est presque la règle dans cette tribu d'oligochètes; voilà pourquoi leur détermination plus proche n'était pas possible.

Acanthocyclops languidus Sars, 1863 — la plupart des auteurs les considèrent comme trogloxénes (Rylov 1948, Dussart 1969); ce n'est que sa variété *disjunctus* qui est considérée comme troglophile par quelques auteurs — elle se distingue par une fourque raccourcie avec la phalange distale plus courte de l'endopodite du 4ème paire des petons natatoires. La stabilité de ces caractères est cependant bien variable car à des stations individuelles (eaux souterraines alluviales de la rivière

Tab. 2. Une revue des organismes trouvés, leur quantité et representation en %

Organismus	1 N	1 %	2 N	2 %	3 N	3 %	4 N	4 %	5 N	5 %	6 N	6 %	7 N	7 %
Polychaeta:														
Troglochaetus beranecki	—	—	—	—	3	15.00	—	—	64	77.11	—	—	—	—
Oligochaeta:														
Trichodrillus pragensis	2	0.43	—	—	—	—	—	—	—	—	—	—	—	—
Enchytraeidae g. sp.	I	0.21	1	0.70	12	60.00	—	—	—	—	—	—	—	—
Cyclopoida:														
Acanthocyclops languidus	—	—	—	—	—	—	—	—	—	—	—	—	76♂ 42♂	30.97
Acanthocyclops languidoides	3♀	0.64	32♀ 70♂	71.83	—	—	6♀ 8♂	63.64	3♀ 8♂	12.05	5♀	71.43	—	—
Acanthocyclops bisetosus	45♀ 70♂	24.52	—	—	—	—	—	—	—	—	—	—	—	—
Paracyclops fimbriatus	23♀ 4♂	5.76	—	—	—	—	1♀	4.55	—	—	—	—	—	—
Ectocyclops phaleratus	—	—	—	—	1♀ 1♂	10.00	—	—	—	—	—	—	—	—
Copepodites	28	5.97	26	18.31	2	10.00	6	27.27	6	7.23	2	28.57	263	69.03
Nauplii	290	61.83	—	—	1	5.00	—	—	—	—	—	—	—	—
Syncarida:														
Bathynella natans	—	—	—	—	—	—	—	—	3	3.61	—	—	—	—
Amphipoda:														
Niphargus aquilex	—	—	3	02.11	—	—	1	4.55	—	—	—	—	—	—
Acarina:														
Hydracarina g. sp.	3	0.64	10	7.04	—	—	—	—	—	—	—	—	—	—
Σ	469		142		20		22		83		7		381	

Morava près d'Olomouc, de la rivière Dřevnice près de Gottwaldov, et ailleurs — leg. Rosol) j'ai souvent trouvé une ligne continue de formes de transition. Étant donné qu'il est largement présent dans les eaux souterraines, il s'agit plutôt d'un troglophile typique qui habite obligaroirement surtout les eaux souterraines des sédiments quaternaires dans la vicinité de rigoles. Il n'était pas présent dans les récoltes de Vejdovský et Řeháčková.

Acanthocyclops languidoides Lillj., 1901 — on a décrit une grande quantité de variétés de cette espèce qui est expressément troglophile (Rylov 1948, Dussart 1969); mais déjà Sládeček et Řeháčková (1951, 1952) se fondant sur l'analyse de plusieurs caractères morphométriques, sont parvenus à l'opinion qu'il s'agissait d'une seule espèce à variabilités extrêmement larges. Kiefer (1967) et d'autres l'indiquent déjà comme une seule espèce. Mes propres mesurages des groupes d'individus de populations de p. ex. Žitný ostrov dans la Slovaquie du Sud et d'autres stations sont tout à fait conformes avec les données des auteurs mentionnés ci-dessus. Sur le territoire de la Tchécoslovaquie cette espèce représente une des dominantes stygobiocénotiques les plus fréquentes, surtout dans les eaux souterraines alluviales peu profondes. Dans les puits de Prague également, situés dans la plaine alluviale et sur les terrasses de la rivière de Vltava, ils jouent un rôle bien dominant. Il n'était pas présent à la station No. 7 (Loretánské náměstí) où au contraire l'espèce dominante est *Ac. languidus*.

Acanthocyclops bisetosus Rehberg, 1880 — espèce à valence écologique très large, fréquente non seulement dans les eaux superficielles, mais présente régulièrement aussi dans les eaux souterraines modérément polluées des formations aquifères peu profondes.

Paracyclops fimbriatus Fischer, 1853 — espèce vivant dans une ambience froide, dans les eaux souterraines (surtout alluviales), où l'on la trouve très souvent; à la différence des eaux superficielles où elle se trouve surtout dispersée (d'habitude dans le littoral sous les pierres), sa présence surtout dans les puits fréquement bien forte jusqu'à massive. Ayant en vue son affinité aux eaux souterraines on peut la considérer comme une espèce troglophile. Les chercheurs ont décrit toute une série de formes (*imminuta, abnobensis*), mais les conclusions s'ensuivant du travail de Štěrba et Schmidt (1982) aboutiront, ce qui est évidemment inévitable, à une révision des taxones décrites.

Ectocyclops phaleratus Koch, 1838 — une espèce benthique qui est rare dans les eaux stagnantes et que je n'ai pas trouvée jusqu'ici dans les eaux souterraines de ce pays. Également dans les travaux de Husmann, Kiefer, et autres auteurs on ne la mentionne pas. La façon de laquelle cette expèce a été entraîneée dans le puits de la rue Jeruzalémská (ayant en vue la distance assez grande de Vltava) restera peut-être très difficile à éclairer.

Bathynella natans Vejdovský, 1882 — dès le temps de Vejdovský on n'a publié aucune découverte des stations pragoises. Cela ne signifie pas que la présence de ce crustacé est particulièrement rare; à plusieurs stations (Ivančice u Brna, Oslavany, et toute une série d'autres) il se trouve de temps en temps dans des quantités tout à fait extraordinaires (même plus de 50 individus dans 1 litre), de façon qu'il forme pratiquement une monoculture. Les stations où se trouve *Bathynella* sont connues aujourd'hui pratiquement sur tout le territoire tchécoslovaque. Les avis sur la différentiation taxonomique des espèces individuelles restent bien différents; p. ex. d'après Husmann (1964) les espèces de l'Europe centrale qu'on a décrit jusqu'ici ne sont que des races géographiques de *Bathynella natans*. Voilà pourquoi (et aussi en considération de la station) je range les individus trouvés parmi les formes nominales.

Niphargus aquilex Schiödte, 1855 — dans les eaux souterraines de ce pays une espèce stygobionte bien courante; elle se trouvait relativement sporadique aux stations que nous avons recherchées.

Hydracarina g. sp. — acariens aquatiques qui vivent dans les eaux souterraines tchécoslovaques et qui n'ont pas été systématiquement traités jusqu'ici. Leur présence dans les prélèvements d'eau puisée de même que dans celle des puits est cependant bien fréquente de façon qu'on puisse les considérer comme une partie plus ou moins stable des stygobiocénoses. Plusieurs groupes des hydrachnae for-ment une partie des communautés des sédiments aquifères (hyporhéal, sensu Schwoerbel 1967). Les matériaux des puits pragois n'ont pas été déterminés.

On peut constater (si c'est possible, cependant, se fondant sur un groupe de stations aussi peu nombreux) que la faune des puits de Prague, bien que la plupart d'eux se trouvent dans la plaine alluviale de Vltava, est relativement pauvre à présent en comparison avec d'autres stations de caractère similaire. Dans nos récoltes sont tout à fait absents p. ex. les *Harpacticoida* et *Ostracoda*. C'est encore dans les récoltes de Řeháčková que ces deux groupes ont été représentés par une espèce (*Viguirella coeca* — à quatre stations) ou deux espèces *Candona eremita* — à une station, *Heterocypris incongruens* — à deux stations). L'unique puits dans lequel Řeháčková a trouvé l'espèce *Candona eremita* (la station dans la rue Spálená No. 64) est maintenant déjà comblé. Vejdovský a trouvé cet ostracode dans plus de 50 puits.

Le spectre d'espèces aux stations de Prague individuelles ne correspondent pas à la «Troglochaetusbiozönose» de Husmann (Husmann 1962) comme elle est décrite par l'auteur dans les eaux souterraines des plaines alluviales de plusieurs grands fleuves allemands. Les seuls organismes conformes aux huit espèces typiques pour cette biocénose d'après Husmann sont justement le *Troglochaetus* et la *Bathynella*. On peut y voir une autre preuve que les biocénoses régionales des régions souterraines hydrobiologiques, qui sont bien éloignées l'une de l'autre, ou qui sont autrement isolées, se sont formées au cours du développement historique d'une façon individuelle sous l'influence des facteurs ayant une action locale.

Même si l'on considère le caractère différent des méthodes de prélèvement de Vejdovský, de Řeháčková, et de la nôtre il est évident de prime abord que pendant les presque cent ans passés dès le temps où Vejdovský avait étudié les puits a eu lieu un recul perceptible de toute une série d'espèces. Contrairement aux 30 espèces d'organismes pluricellulaires supérieurs dans les récoltes de Vejdovský (seule p. ex. l'Oligochaeta a été représentée par 13 espèces) nous trouvons 13 espèces dans le matériel de Řeháčková et 11 dans le nôtre. Je ne comprends pas dans le nombre total de taxones: les Rotatoria, les Gastrotricha et les Tardigrada que nous n'avons pas étudiés il s'agit en tout d'organismes qu'on trouve pratiquement dans de l'eau de toute sorte. Il est remarquable que Vejdovský a manqué la présence de *Troglochaetus beranecki*, qui était encore inconnu en son temps, bien que ce rechercheur ait procédé très solidement pendant les prélèvements des puits de Prague. Il faut chercher l'explication de toute evidence dans le caractère très différent des techniques de récolte; Vejdovský et Řeháčková puisaient de l'eau à laide des pompes à main montées et ils effectuaient les prélèvements du sédiment pa un dispocitif d'aspiration de Cori. Ayant en vue les volumes relativement petits des prélèvements réalisés on peut considérer que Vejdovský a réussi, fait bien connu à découvrir par raccroc la *Bathynella*.

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TWO NEW FOLSOMIA-SPECIES FROM CZECHOSLOVAKIA (COLLEMBOLA: ISOTOMIDAE)

Josef RUSEK

Dedicated to Prof. Dr. S. Hrabě, DSc. on occasion of his 85th birthday

Received November 29, 1983

Abstract: Two new species from the family Isotomidae are described: *Folsomia hrabei* sp. **n.** (South Moravia) and *Folsomia laurencei sp. n.* (central Bohemia).

Folsomia hrabei sp. n.

(Figs. 1—3)

Diagnosis: Length 400—500 µm, white. Without eyes. Fused abdominal segments with 3 + 3 basally thickened sensory hairs and 1 + 1 thickened sensory rods. Some sensillae on antennal segment IV and I conspicuously thickened. Retinaculum with 4 + 4 teeth and one chaeta. Ventral tube with 5 chaetae on posterior face. Manubrium with 1 + 1 chaeta ventrally and 10 + 10 chaetae dorsally. Dens with 8 chaetae on ventral and two on dorsal side. Only females known.

Description: Body 400—500 µm long and 100 µm wide. White, without trace of pigmentation. Without eyes. Chaetotaxy as in Figs. 1A, B, 3A. Microchaetae 5—10 µm long; shortest chaetae on head, longest on last abdominal tergites. Macrochaetae 13—20 µm long, outstanding (Figs. 1A, B).

Antennae shorter than head, as 80 : 100 µm. Antennal segment I : II : III : IV as 15 : 15 : 20 : 30 µm. Ventral side of antennal segment I with one thick, 6 µm long and one thin, 4 µm long sensory hair (Fig. 2B). Antennal organ III consists of two thickened, bent, 2 µm long sensory pegs, two 5 µm long sensory hairs and one small, thin sensory peg ventrolaterally (Fig. 2A). Antennal segment IV with some thickened, 6—7 µm long sensory hairs, two of them conspicuously thick (Fig. 2A). Near subapical sensory rod one thickened, bent sensilla present (Fig. 2A).

Labrum with chaetal arrangement 2—3/553. Ventral side of head with 4 + 4 chaetae along linea ventralis. Postantennal organ (Fig. 2C) elliptical, 17 µm long nad 5 µm wide.

Mesonotum with 3 + 3 sensillae laterally in front of lateral macrochaeta and further 2 + 2 sensillae posteriorly (Fig. 3D). Metanotum with 1 + 1 lateral sensilla in front of lateral macrochaeta and 1 + 1 sensilla anteriorly of posterior row of chaetae (Fig. 1A). Abdominal tergite I with 2 + 2 sensillae in posterior row of chaetae, abdominal segment II and III with 1 + 1 dorsal and 1 + 1 ventral sensillae (Fig. 1B). Fused abdominal segments IV—VI with 2 + 2 thin 8 µm long sensillae on the imaginary fourth segment and 3 + 3 basally conspicuously thickened, 11 µm, 11 µm and 17 µm long sensillae and 1 + 1 thickened 5 µm long sensory

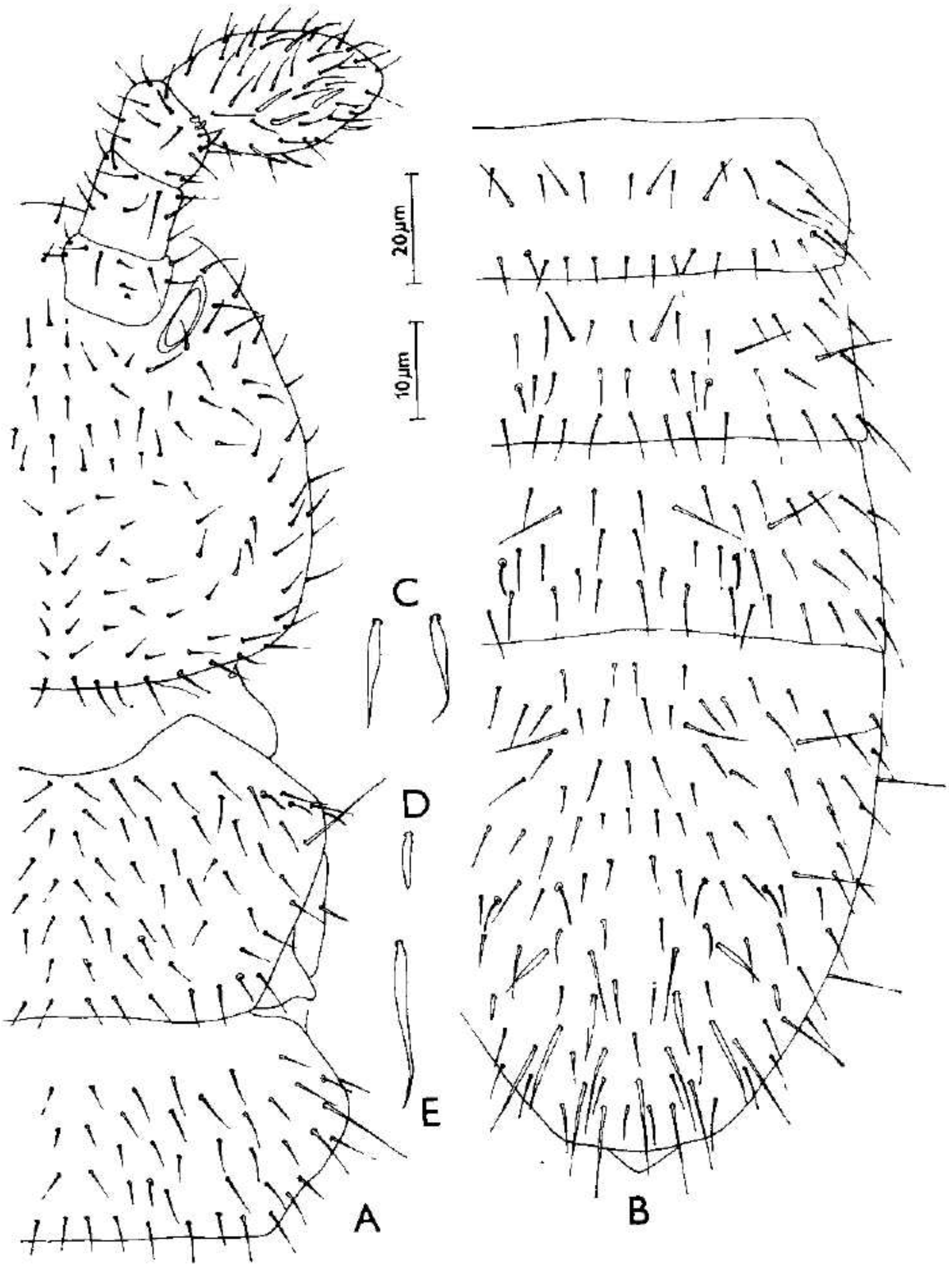

Fig. 1. *Folsomia hrabei* sp. n. A — dorsal chaetotaxy of head and thorax, right side; B — dorsal chaetotaxy of medial and right part of abdomen; C — thickened sensory hairs of abdominal tergites IV—VI; D — thickened sensory rod from abdominal tergites IV—VI; E — long thickened sensory hair from abdominal tergites IV—VI. Scales: C, D, E: 10 µm; A, B: 10 µm.

hair on the fifth one (Figs. 1B—E). Abdominal tergites I—III with 3 + 3 outstanding, 8—15 μm long macrochaetae. Repartition of macrochaetae on abdominal tergites IV—VI as in Fig. 1B.

Legs short, tibiotarsus without outstanding tenent hairs (Fig. 2D). Claws 11 μm long, without teeth (Fig. 2D). Empodial appendage 6 μm long. Thorax ventrally without chaetae.

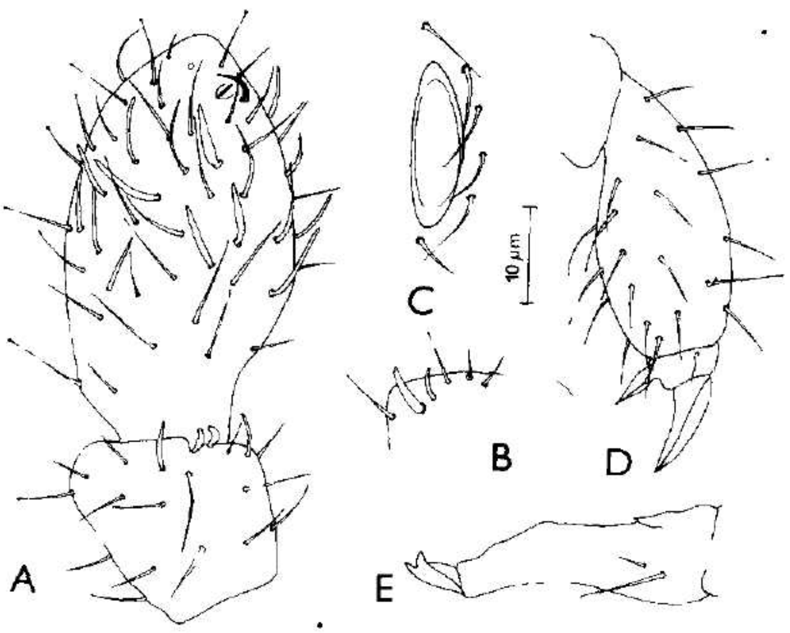

Fig. 2. *Folsomia hrabei* sp. n. A — dorsal side of antennal segments III and IV; B — ventral side of antennal segment I, C — postantennal organ; D — tibiotarsus and claw III, E — mucro and dorsal side of dens. Scale: A—E 10 μm.

Ventral tube with 6 + 1 + 6 chaetae (4 + 4 laterally and five on posterior face) (Fig. 3A). Ventral chaetotaxy of abdomen as in Fig. 3A. Retinaculum with 4 + 4 teeth on rami and one chaeta on corpus. Furca reaching to posterior part of abdominal sternite II (Fig. 3A). Manubrium: dens: mucro as 40 : 25 : 7 μm. Mucro with apical and anteapical teeth. Dens ventrally with 8 and dorsally with 2 chaetae (Fig. 3C). Manubrium on ventral side with 1 + 1 (Fig. 3C) and dorsal side with 10 + 10 chaetae (Fig. 3B). Female genital plate with 1 + 1 microchaetae on each lid (Fig. 3A). Males unknown.

Affinities: *Folsomia hrabei* sp. n. is related to *F. dovrensis* Fjellberg, 1976 described from Norway and known also from S-Bohemia (Rusek, 1980). They differ clearly in following morphological characters: the new species bears five chaetae on posterior face of ventral tube (four in *F. dovrensis*), 4 + 4 chaetae along linea ventralis on head (3 + 3 in *F. dovrensis*), 10 + 10 chaetae dorsally on manubrium (12 + 12 in *F. dovrensis*), some sensillae are thicker, especially on antennal segment IV and I and on fused abdominal tergites IV—VI, in the new species than in *F. dovrensis*.

Locus typicus: Czechoslovakia, Moravia meridionalis, Lanžhot, 156 m a.s.l., in soil samples from forest community *Ulmeto-Fraxineto carpineum*, type with *Lamium maculatum*, 16. V. 1978 2 specimens leg. J. Rusek.

Further locality: close to the Locus typicus, in black, sandy soil samples from forest community *Ulmeto-Fraxineto carpineum* with *Quercus robur*, 16. V. 1978 38 specimens leg. J. Rusek.

Ecological notes: Both localities represent the highest and driest sites in the inundated, large forest complex east of Lanžhot. The new species reached here a density up to 3 800 ex. m^{-2}.

Derivatio nominis: The new species is dedicated to my university teacher of zoology at the J. E. Purkyně University at Brno, emer. Prof. Dr. Sergěj Hra-

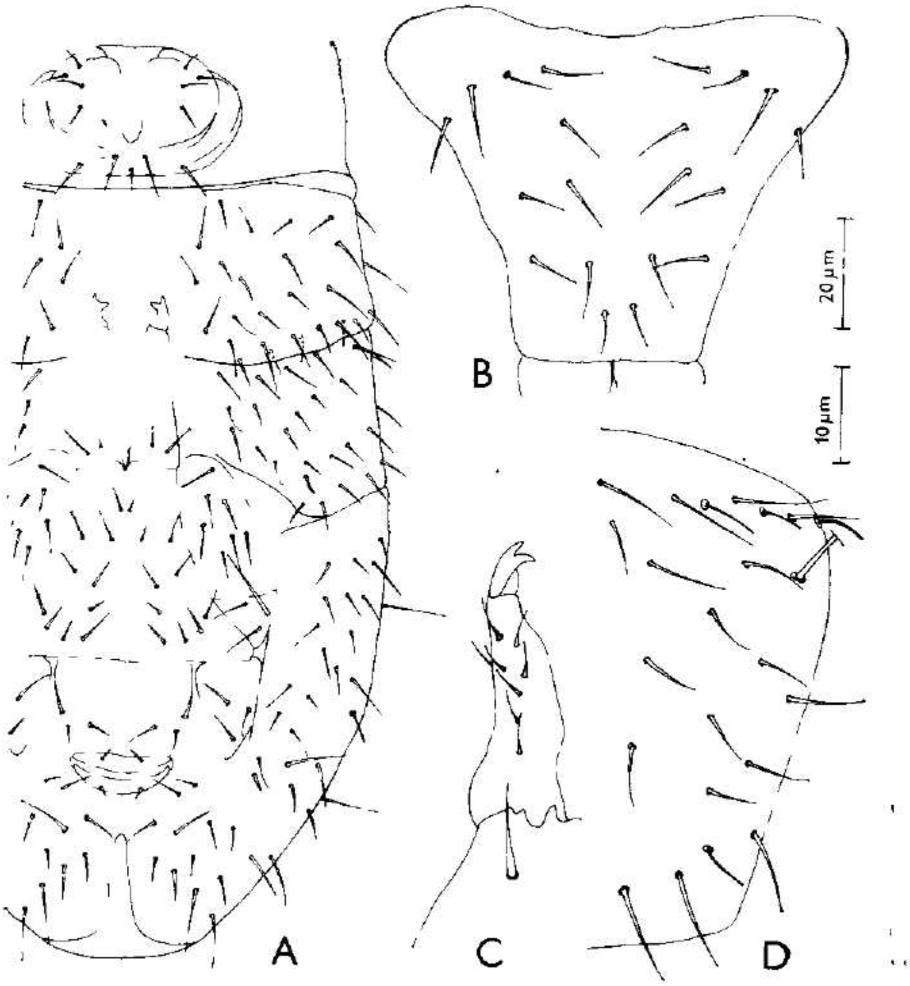

Fig. 3. *Folsomia hrabei* sp. n. A — ventral side of abdomen, B — dorsal side of manubrium, C — ventral side of left side of manubrium, dens and mucro; D — chaetotaxy of right side of mesonotum. Scales: A: 20 µm; B—D: 10 µm.

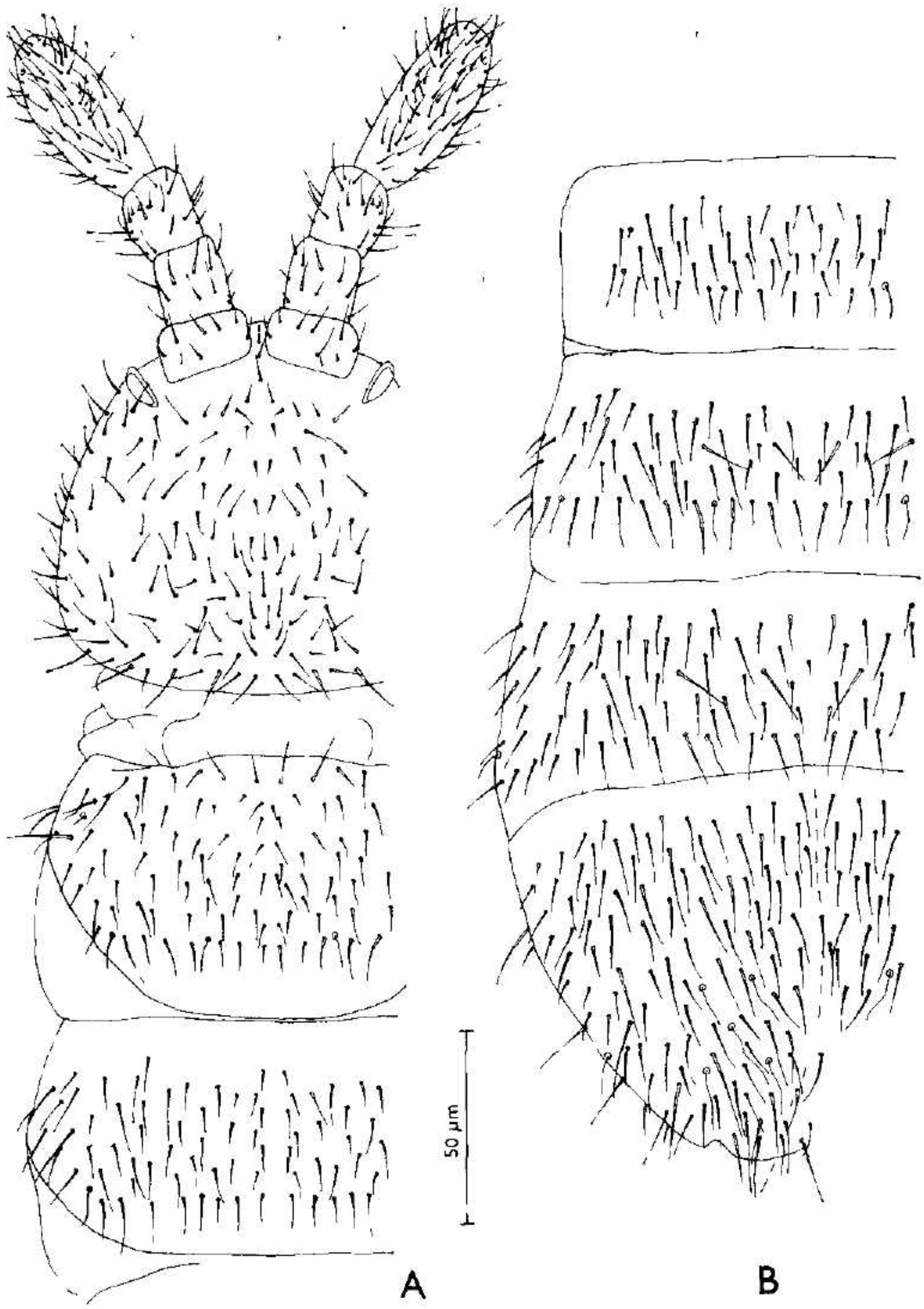

Fig. 4. *Folsomia lawrencei* sp. n. A — dorsal chaetotaxy of medial and left part of head and thorax; B — dorsal chaetotaxy of medial and left part of abdomen. Scale: A, B: 50 μm.

bě, D.Sc., well known zoologist and specialist in aquatic Oligochaeta on the occasion of his 85th birthday.

Folsomia lawrencei sp. n.

(Figs. 4—6)

Diagnosis: Length 570 μm, white. Without eyes. Fused abdominal segments IV—VI without thickened sensory hairs. Antennal segment IV with slightly thickened sensillae only. Retinaculum with 4 + 4 teeth and one chaeta. Ventral tube with four chaetae on posterior face. Manubrium with 3 + 3 chaetae ventrally and 15 + 15 chaetae dorsally. Dens with four chaetae dorsally and 17 chaetae ventrally. Both sexes known.

Description: Body 570 μm long and 110 μm wide. White, without trace of pigmentation. Without eyes. Chaetotaxy as in Figs. 4A, B. Microchaetae 8—15 μm long; shortest chaetae on head, longest on last abdominal tergites. Macrochaetae

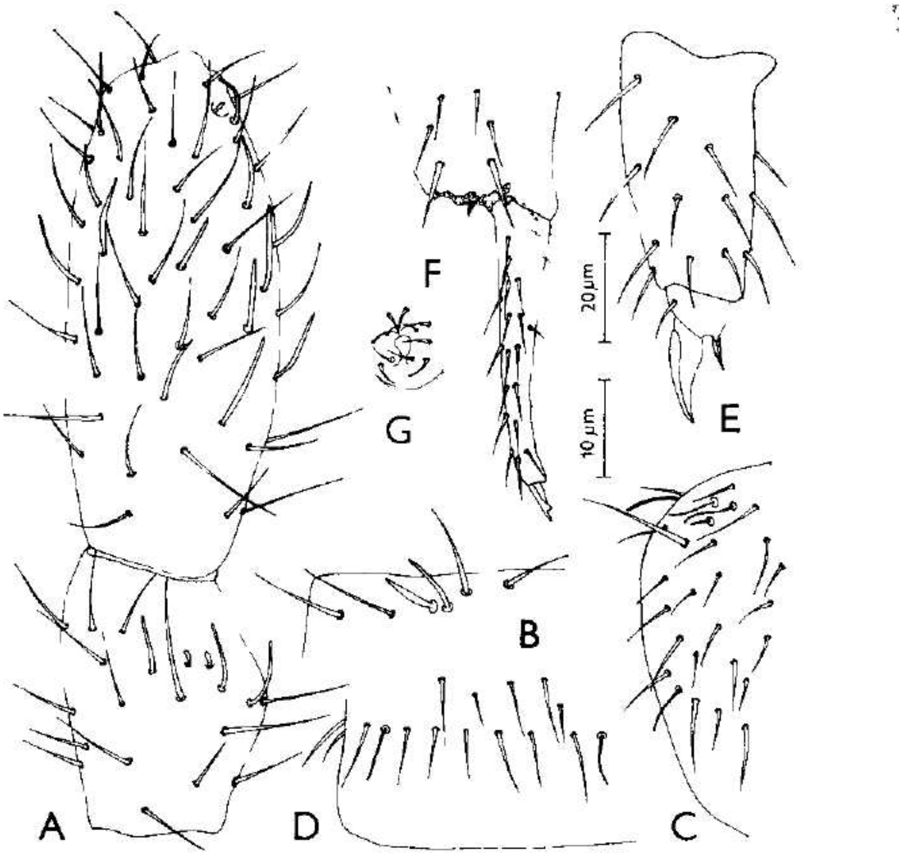

Fig. 5. *Folsomia lawrencei* sp. n. A — dorsal side of antennal segments III and IV, B — ventral side of antennal segment I, C — left part of mesonotum, D — left side of posterior part of abdominal tergite II; E — tibiotarsus and claw II; F — ventral chaetotaxy of manubrium and dens with mucro, G — male genital plate. Scales: A, B, E: 10 μm, C, D, G, F 20 μm

15—25 μm long, outstanding (Figs. 4A, B). Antennae 110 μm long, as long as head. Antennal segments I : II : III : IV as 15 : 25 : 25 : 55 μm. Ventral side of antenal segment I with two thin, 6 μm long sensillae (Fig. 5B). Antennal organ III consists of two slightly thickened, bent, 2 μm long sensory pegs and three thin sensory hairs (Fig. 5A). Antennal segment IV with some slightly thickened, 7 to

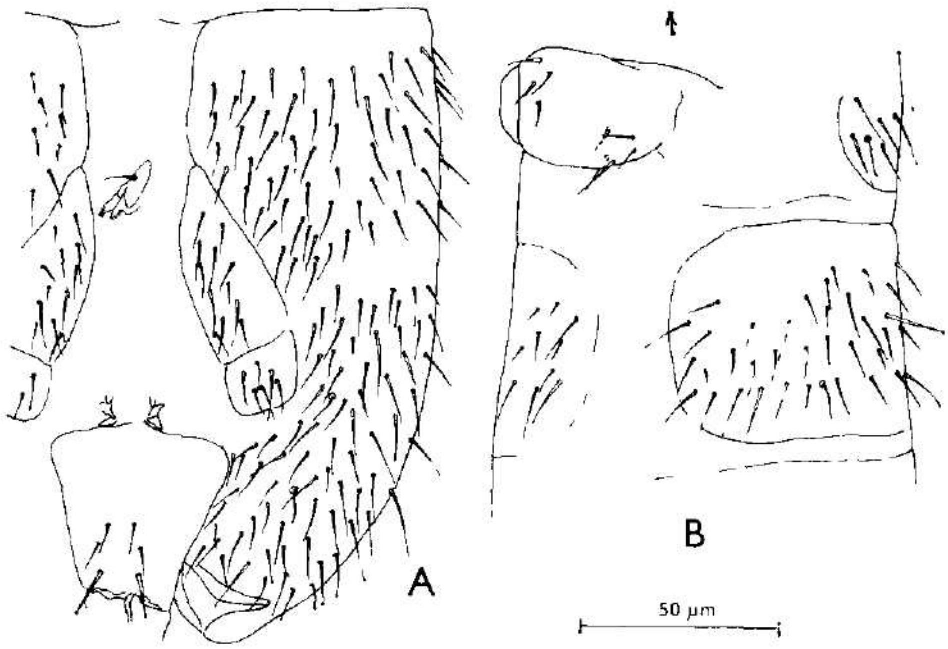

Fig. 6. *Folsomia lawrencei* sp. n. A — ventral chaetotaxy of abdominal segments III—VI; B — ventral chaetotaxy of abdominal segments I and II and ventral tube. Scale: A, B: 50 μm.

10 μm long sensory hairs (Fig. 5A). Near subapical sensory rod one slightly thickened, bent sensory hair present (Fig. 5A). Labrum with chaetal arrangement 2/554. Ventral side of head with 4 + 4 chaetae along linea ventralis. Postantennal organ (Fig. 4A) elliptical, 15 μm long and 5 μm wide. Mesonotum with three thin, 15 μm long lateral sensillae and one 5 μm long sensory peg on each side and 2 + 2 thin, 10 μm long sensillae in posterior row of chaetae (Fig. 4A). Metanotum with 1 + 1 lateral sensillae and 2 + 2 thin sensillae in posterior row of chaetae (Fig. 4A). Abdominal tergite I with 2 + 2 thin, 10 μm long sensillae in posterior row of chaetae and 1 + 1 short sensory pegs anterolaterally (Fig. 4B). Abdominal segment II and III with 2 + 2 thin, 13 μm long sensillae in posterior row of chaetae. Fused abdominal segments IV—VI with 3 + 3 thin, 15 μm long sensillae on the imaginary fourth segment and 3 + 3 ones on the segment fifth (Fig. 4B). Repartition of outstanding macrochaetae as in Figs. 4A, B. Legs short, tibiotarsus without outstanding tenent hairs (Fig. 5E). Claw 12 μm long, without teeth (Fig. 5E). Empodial appendage 5 μm long. Thorax ventrally with 2 + 2 chaetae on metasternum. Ventral tube with 3 + 3 chaetae laterally and further four on posterior face (Fig. 6B). Ventral chaetotaxy of abdomen as in Figs. 6A, B. Retinaculum with 4 + 4 teeth on rami and one chaeta on corpus. Furca reaching to posterior part of abdominal

sternite II. Manumbrium: dens: mucro as 50 : 55 : 7 μm. Mucro with apical and anteapical teeth (Fig. 5F). Manubrium ventrally with 3 + 3 chaetae in longitudinal rows (Fig. 5F). Dorsal side of manubrium with 15 + 15 chaetae. Dens dorsally with four and ventrally with 17 chaetae (Fig. 5F). Female genital plate with 1 + 1 microchaeta on each lid. Male genital plate with four minute and further normal chaetae (Fig. 5G).

Affinities: This species agrees well in some characters with the short diagnosis given by Gisin (1960) for *Folsomia litsteri* Bagnall, 1939. Lawrence (1973) revised the type material of this species and concluded that *F. litsteri* were juvenile specimens of *F. candida* Willem, 1902. I draw the same conclusion on the material of *Folsomia candida* from the caves in Moravian karst. The juvenile, 0.6—0.8 mm long specimens corresponded with *F. litsteri* Bagnall, 1939 having 3 + 3 chaetae on ventral side of manubrium, whereas the adult specimens had the ventral side of manubrium covered with many chaetae, which is one of the diagnostic characters of *F. candida* Willem, 1902. The above described *F. lawrencei* sp. n. has well developed female and male genital plate and 3 + 3 chaetae on ventral side of manubrium. It is not identical with the juvenile holotype of *F. litsteri* and represents a new species. It belongs to the group of *Folsomia* — species without eyes and with only a few chaetae on ventral side of manubrium. It is near to *F. fimetaria* (L., 1758) and *F. kerni* Gisin, 1948, both with 4 + 4 chaetae on ventral side of manubrium. *F. lawrencei* sp. n. differs from them clearly by the 3 + 3 chaetae on ventral side of manubrium, by the small size of adult specimens (0.6 mm in sp. n. and 0.8—1.4 mm in the related two species). The new species has manubrium almost as long as dens, in *F. fimetaria* and *F. kerni* the dentes are distinctly longer than manubrium.

Folsomia lawrencei had been probably in some cases missinterpreted and recorded as *F. litsteri* before the revision of Lawrence (1973) appeared.

Locus typicus: Czechoslovakia, Bohemia centralis, Jevany, forest area "Bohumile", 440 m a.s.l., in soil samples from the forest community *Luzuleto pilosae — Abietum* with *Picea excelsa*. Soil type: brown forest soil with moder, 15. V. 1980 28 specimens, 3. VII. 1979 8 specimens leg. J. Rusek.

Ecological notes. The new species occurred in low density on experimental plots sprayed with herbicides. During three years of investigation it reached a density up to 2 500 ex. m^{-2}.

Derivatio nominis: The new species is dedicated to my friend, Mr. P. N. Lawrence (British Museum), a well-known collembologist contributing extensively to the knowledge of Collembola of different parts of the world. His revisional work enabled the author to discover this new species.

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District Museum in Tachov

THE BREEDING SYNUSIA OF BIRDS IN A FOREST PEATBOG IN THE ČESKÝ LES MTS. (SOUTHWESTERN BOHEMIA)

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Abstract: In the years 1979—1981 the composition of bird synusia in the State Nature Reserve Podkovák (district Tachov) in the Český les Mts. was ascertained by means of mapping the breeding territories. The reserve under study is represented by a rather small forest peatbog with a stand of the Swiss mountain pine (*Pinus mugo* ssp. *uncinata*). The proper stand of the Swiss mountain pine as well as the stand of Swiss mountain pine with an admixture of spruce and the old spruce and pine yield forests surroundings the reserve were investigated. In total 27 species of breeding birds were found here, for each biotope the total density of breeding birds, the number of species and the diversity and equitability of the respective community were assesed. All these characteristics are higher in the Swiss mountain pine stands than in surrounding forests. In addition, the density and dominance values for individual species of breeding birds in the biotopes under study were ascertained.

The stands with the Swiss mountain pine in the mountain peatbogs belong to the typical original stands of moist habitats in many mountain regions of Czechoslovakia. Recently it has been found that they survive the infavourable influence of industrial exhalations better than other forest types, so that they seem to be perspective stand type for the strongly affected regions (Havelka 1983). Therefore I tried to describe also the bird communities breeding in these stands. I examined the larger peatbog in the State Nature Reserve (SNR) Farské bažiny where I used the line method. Here the results from the SNR Podkovák are presented, where the configuration of territory and the nature of stands enabled well to apply the method of mapping the breeding territories recommended as the international standard method (IBCC 1969).

DESCRIPTION OF THE RESERVE UNDER STUDY

The SNR Podkovák covers an area of 5.6 hectares near the village Lesná (district Tachov) in the part Havranská of the Přimdský les Mts., which is a part of the orographic complex called the Český les Mts. A detailed description of the natural conditions of the Český les Mts. is to be found in the paper by Skalický (1975). The reserve lies at an altitude of 720 m, in a wooded landscape, a detailed description of the surrounding landscape is contained in the preceding paper of the present autor (Řepa 1983). It is formed by a saucer-shaped depression, in which a rather small peatbog arose. It is covered with an adult stand of Swiss mountain pines with an undergrowth of typical peatbog herbs. On the borders the spruce (*Picea excelsa*) has penetrated into the reserve, so that some parts of the stands consist of a mixture of Swiss mountain pines and of spruces. The reserve is surrounded by an extensive, continuous forest; the stands adjacent to the northern side of the reserve consist of pines, those on southern side consist of spruces. A sketch of the reserve and of its close surroundings is given in Fig. 1. A detailed description of the SNR Podkovák is included in the paper by Řepa (1981).

For the mapping of breeding territories an area of 21.19 hectares was chosen; it includes the whole reserve and its closest surroundings. The area was divided into seven subareas belonging to five basic biotopes (Fig. 1).

Biotope 1: stand of the Swiss mountain pine (subareas B 1, B 2).
(B 1) 2.0 hectares. In the tree layer only the Swiss mountain pine, height up to 12 m, stem diameter up to 20 cm, coverage 60—70 %. In the shrub layer young Swiss mountain pines, height up to 3 m, coverage 40 %. The herb layer consists of a dense stand of typical peatbog plants (mainly *Eriophorum angustifolium* and *E. vaginatum*, *Vaccinium uliginosum* and *V. myrtillus*). Soil very moist to wet.

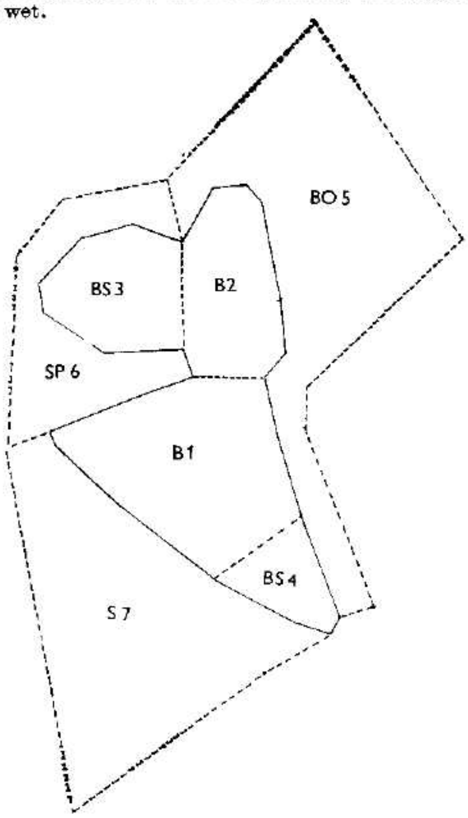

Fig. 1. Schematic map of the State Nature Reserve Podkovák with the situation of subareas studied.
Heavy dash line — boundary of the reserve; interrupted line — boundaries of subareas; B 1 and B 2 — stand of Swiss mountain pine; BS 3 and BS 4 — stand of Swiss mountain pine with admixture of spruce; BO 5 — high pine forest; SM 6 — swamped spruce forest; S 7 — dry spruce forest.

(B 2) 1.76 hectares; in the tree layer Swiss mountain pine with an admixture of spruce, height 8—10 m, stem diameter up to 20 cm, coverage 50 %, here and there bare sites. In the shrub layer young Swiss mountain pines and spruces, height up to 3 m, coverage 20 %. Herb layer the same as in B 1. Soil wet.
Biotope 2: stand of the Swiss mountain pine with an admixture of spruce (areas BS 3, BS 5).
(BS 3) 1.0 hectare; in the tree layer Swiss mountain pine (60 %) and spruce (40 %), height 10—15 m, stem diameter up to 20 cm, coverage 70 %. Here and there dead trees. Below the trees an undergrowth of bilberries (*Vaccinium myrtillus*) and mosses, in the open sites a stand identical with that in B 1. Soil moist.
(BS 4) 0.87 hectare; in the tree layer spruce (60 %) and Swiss mountain pine (40 %), height up to 15 m, stem diameter up to 20 cm, coverage 80 %. In the shrub layer young spruces (80 %) and Swiss mountain pines (20 %). In the herb layer mainly bilberries, locally grasses and mosses; coverage about 50 %. Soil moist to swamped.
Biotope 3: high pine forest (subarea BO 5)
(BO 5) 6.97 hectares. In the tree layer the Scots pine (*Pinus silvestris*), height up to 20 m, stem

diameter up to 30 cm, coverage 70 %. The shrub layer is lacking, in the herb layer bilberry and whortleberry (*Vaccinium vitis-idaea*), locally grasses occur; coverage 60 %. Soil dry.

Biotope 4: swamped spruce forest (subarea SP 6).

(SP 2) 2.55 hectares; in the tree layer the common spruce, height up to 20 m, stem diameter up to 25 cm, coverage almost 100 %. The shrub layer is lacking, in the herb layer only mosses (*Polytrichum* sp.) occur; coverage about 20 %. Soil moist, locally strongly swamped. A trickle passes across the area.

Biotope 5: high spruce forest (subarea S 7).

(S 7) 6.14 hectares; in the tree layer the common spruce, height up to 25 m, stem diameter up to 30 cm, coverage 90 %. Shrub layer consisting of young spruces, height up to 4 m, coverage 10 %. The herb layer is lacking, litter is spread on the ground. Soil dry. Here and there heaps of twigs after the forest thinning.

METHODS

In the section under study samples were taken for mapping the breeding territories (IBCC 1969) during the years 1979—1981 between 20 April and 15 June respectively. In each year 10—12 samples were taken. A special attention was paid to the contemporary contacts (Tomialojc 1979). In the evaluation, the number of territories in the whole area under study was ascertained in the usual way. This area, however, consisted of mosaic of smaller subareas of various biotopes; the mapped territories were therefore divided among the subareas. This was made in the way that in the case of territories penetrating into more areas, only a part of territory was added to each area. Its was determined on the basis of the ratio represented by the number of contacts in the respective subarea to the total number of contacts on whose basis the territory was mapped (Puchstein 1966).

Both for the whole area and for individual biotopes the density (in territories per 10 hectares) and the dominance (Palmgren 1933) were calculated. For the whole bird synusia the number of species, total density, diversity of the synusia according to Shannon, Weawer (1949) and equitability of the synusia according to Pielou (1966) were ascertained. On the basis their significance in the synusia the species were divided into dominant (above 5 % of dominance), influent (2—5 %), and accessorial (below 2 %) ones (Palmgren 1933).

RESULTS

In Tables 1—2 the values of density and dominance of all species found as well as the values of numbers of species, of total density, diversity and equitability of the synusia in all biotopes under study are given. In Table 3 the data for the whole area under study are arranged. In all cases the mean values of all three years of investigation were calculated.

In total, 27 bird species were found. Most varied was the synusia in the Swiss mountain pine stand without admixture of spruce (24 species); in the Swiss mountain pine stand with admixture of spruce and in the dry spruce forest the number of species was lower, and the poorest in bird species were the pine forest and especially the swamped spruce forest.

The total density of breedings birds in the whole area amounted to about 34 territories per 10 hectares. The highest density was found in the Swiss mountain pine stands, first of all there where the spruce was admixed. A high density showed also the swamped spruce forest, whereas in the dry spruce forest and in pine forest the densities were low. The highest diversity of synusia was found also in the Swiss Mountain pine stands; it was lower in the pine and dry spruce forest, very low it was in the swamped spruce forest. The equitability of the synusia was about the same in the both Swiss mountain pine stands and in the high pine forest, in the dry spruce forest it was already a little lower, and it was very low in the swamped spruce forest.

The Swiss mountain pine stand with or without the admixture of spruce shows the same diversity, because its equitability is not different, and the number of species differs only slightly here. The insignificantly higher number of species in

Table 1. Composition of the breeding synusiae of birds in the Swiss mountain pine stands in the State Nature Reserve Podkovák in the course of years 1979—1981.

	"pure" stand of Swiss mountain pine without admixture of spruce		stand of Swiss mountain pine with admixture of spruce	
	density	dominance	density	dominance
Prunella modularis	4.70	10.4	8.37	14.2
Parus ater	4.78	10.6	6 06	10.4
Fringilla coelebs	4.61	10.2	5.88	10.0
Regulus regulus	3.46	7.8	2.49	4.2
Anthus trivialis	3.37	7 5	—	—
Phylloscopus collybita	3.19	07.1	1.96	03.3
Erithacus rubecula	2.75	06.2	7.48	12.8
Phylloscopus trochilus	2.39	05.3	1.78	03.0
Carduelis spinus	2.30	5.1	1.60	02.7
Pyrrhula pyrrhula	1.95	04.4	1.42	02.4
Parus caeruleus	1.68	3.8	0.71	01 2
Certhia familiaris	1.25	03.6	1.25	02.2
Streptopelia turtur	1.59	3.5	—	—
Turdus philomelos	1.15	02.6	10.10	17.2
Turdus merula	0.88	02.0	1.07	01.8
Parus major	0.88	02.0	0.53	00.9
Aegithalos caudatus	0.88	02.0	—	—
Parus cristatus	0.71	01.6	1.78	03.0
Phylloscopus sibilatrix	0.62	1.4	—	—
Parus palustris	0.62	1.4	—	—
Troglodytes troglodytes	0.53	01.2	0.18	00.3
Sitta europaea	0.44	1.0	—	—
Dendrocopos major	0.26	00.6	0.35	00.6
Regulus ignicapillus	0.18	00.4	4.45	07.6
number of species	24		19	
total density	44.72		58.35	
diversity	2.725		2.508	
equitability	0.857		0.851	

Density — in territories per 10 hectares

the "pure" stand of Swiss mountain pine is compensated by a slight increase of the total density in the Swiss mountain pine with the admixture of spruce. The decrease of the diversity index in the pine forest is caused mainly by the lower number of species in the synusia, the equitability being the same as in the Swiss mountain pine stands. In the dry spruce forest the lower diversity of the community in comparison with the stands of the Swiss mountain pine is probably caused by the lower equitability; the number of species is not too different here. The swamped spruce forest harbours a bird synusia both with a low species number and with a low equitability, its diversity is therefore substantially lower.

The differences in the representation of various species in the synusiae of individual biotopes indicate the shares represented in the synusiae by the individuals belonging to various ecological groups according to the ways of breeding. The hollow-dwelling species show the lowest representation in the stands of the Swiss mountain pine. This tree species, even in adult stage, possesses a thinner stem than the spruce or pine, so that the stand of the Swiss pine answers from this viewpoint rather to the young stands of these species. Apparently, a part is also played here by the swamped ground, which prevents the breeding of some hollow-dwelling species in the ground hollows (e.g. *Parus ater*).

Table 2. Composition of the breeding synusiae of birds in the stands of yield forest surrounding the SNR Podkoväk in the course of years 1979—1981.

	high dry spruce forest		high swamper spruce forest		high pine forest	
	density	dominance	density	dominance	density	dominance
Fringilla coelebs	9.77	33.2	13.07	31.9	6.45	26.5
Regulus regulus	3.74	13.0	10.45	25.2	3.91	11.4
Parus ater	3.09	10.5	4.31	10.3	2.90	12.1
Dryocopos martius	1.63	5.5	—	—	—	—
Parus cristatus	1.57	5.4	1.96	4.7	1.34	5.5
Certhia familiaris	1.57	5.4	1.44	3.5	1.15	4.7
Erithacus rubecula	1.46	5.0	0.78	1.9	1.63	6.6
Regulus ignicapillus	1.25	4.3	1.04	2.5	1.53	6.2
Troglodytes troglodytes	1.08	3.7	4.31	10.3	—	—
Turdus merula	0.76	2.6	0.42	1.3	0.28	1.2
Columba palumbus	0.76	2.6	—	0—	0.28	1.2
Turdus philomelos	0.70	2.4	2.09	5.0	1.96	7.9
Nucifraga caryocatactes	0.54	1.8	—	—	—	—
Parus caeruleus	0.49	1.7	—	—	0.38	1.6
Sitta europaea	0.27	0.9	—	—	0—	—
Carduelis spinus	0.16	0.5	0.26	0.6	—	—
Phylloscopus trochilus	0.16	0.5	—	—	0.95	3.9
Parus palustris	0.16	0.5	—	—	—	—
Anthus trivialis	0.11	0.4	—	—	1.91	7.8
Phylloscopus collybita	—	—	—	—	0.62	02.5
Parus major	—	—	0.91	2.2	—	—
Streptopelia turtur	—	—	0.26	0.6	0.24	1.0
Dendrocopus major	—	—	—	—	0.24	1.0
Phylloscopus sibilatrix	—	—	—	—	0.14	0.6
number of species	19		13		17	
total density	29.27		41.40		24.35	
diversity	2.368		1.746		2.420	
equitability	0.804		0.659		0.853	

density — in territories per 10 hecares

On the contrary, the shrub-breeding and ground breeding species are most abundantly represented in the stands of the Swiss mountain pine. The adult stand is substantially sparser and lighter than spruce forest of the same age. That's shrub and herb layer are developed more luxuriantly and the conditions for the occurrence of species belonging to the groups mentioned are favourable here.

Only few species may be designated as specific for a certain biotope. Only as regards the species *Prunella modularis* and *Pyrrhula pyrrhula*, the territories mapped were situated exclusively in the Swiss mountain pine stands. Also in the case of *Phylloscopus collybita* the decisive majority of contacts, on the base of which the territories were mapped, were found in this biotope, only single contacts were found in the spruce forest. All these species prefer generally the biotopes with shrubs, therefore they occured in the area under study in the sparsest tree stand.

Columba palumbus and *Dryocopus martius* had their territories in the high spruce forest only; however, in the area under study only one territory for each species was mapped respectively.

Furthermore, several species which were mostly registered in one biotop only are to be pointed out. Thus, *Carduelis spinus* was bound to stands with the Swiss mountain pine, *Troglodytes troglodytes* to the spruce stands. The preference of the

Table 3. Composition of the breeding synusia of birds ih the whole section under study in the SNR Podkovák and in immediate surroundings of its in the course of years 1979—1981.

	density	dominance
Fringilla coelebs	7.81	22.8
Regulus regulus	3.91	11.4
Parus ater	3.75	10.6
Turdus philomellos	2.19	6.3
Erithacus rubecula	2.19	6.3
Prunella modularis	2.19	6.3
Parus cristatus	1.40	4.1
Regulus ignicapillus	1.40	4.1
Certhia familiaris	1.35	3.6
Anthus trivialis	1.35	3.6
Phylloscopus collybita	0.94	2.7
Phylloscopus trochilus	0.94	2.7
Troglodytes troglodytes	0.94	2.7
Turdus merula	0.63	1.8
Parus caeruleus	0.63	1.8
Carduelis spinus	0.63	1.8
Pyrrhula pyrrhula	0.63	1.8
Streptopelia turtur	0.47	1.4
Dryocopos martius	0.47	1.4
Parus major	0.31	0.9
Columba palumbus	0.31	0.9
Sitta europaea	0.15	0.5
Aegithalos caudatus	0.15	0.5
Phylloscopus sibilatrix	0.15	0.5
Dendrocopus major	0.15	0.5
Nucifraga caryocatactes	0.15	0.5
Parus palustris	0.15	0.5
number of species	27	
total density	34.36	
diversity	2.767	
equitability	0.830	

density — in territories per 10 hectares

high spruce forest by *T. troglodytes* was also ascertained during our investigation of the near Farské bažiny (Řepa 1984). *C. spinus*, however, was found during the investigation of the SNR Farské bažiny equal numbers both in the Swiss mountains pine stands and in the spruce forest. That corresponds with the general conception of this species as dweller of all types of spruce forests (Ferianc 1965). In the SNR Podkovák each year only 1—2 territories were mapped, so that the preference of Swiss mountain pine stands by the siskin in this reserve may be regarded as a casual phenomenon only.

The composition of communities of individual biotopes was also compared by means of the Cody's indices (Tab. 5), where the differences in the diversity of synusiae are compared. The highest similarity was found between the both types of the Swiss mountain pine stands. High also was the similarity of bird synusiae in the dry spruce and pine forests and between the synusiae in the stand of the Swiss mountain pine with an admixture of spruce and in the pine forest as well. The most different from others is the synusia of the swamped spruce forest; it is essentially poorer in the species number, and its equitability is low, too.

Table 4. Representation of ecological groups on the basis of way of breeding in the breeding synusia of individual biotopes in the SNR Podkovák in the course of years 1979—1981.

	"pure" stand of Swiss mountain pine	stand of Swiss mountain pine with the admixture of spruce	high pine forest	high dry spruce forest	high swamped spruce forest
hollow-dwelling species	12.2 %	18.2 %	29.8 %	20.7 %	23.9 %
species nesting freely on trees	39.6 %	26.0 %	44.4 %	60.8 %	43.4 %
shrub-nesting species	39.2 %	55.7 %	22.1 %	14.2 %	28.4 %
ground-nesting species	8.9 %	—	8.4 %	—	4.1 %

DISCUSSION

There exist remarkable differences between the ornithocenoses of the Swiss mountain pine stand in the SNR Podkovák and of the surrounding yield forest stands. Some species either do not breed in the surrounding stands at all (*P. modularis*, *A. trivialis*) or breed only very rarely in them (*Ph. collybita*, *Ph. trochilus*, *R. ignicapillus*). However, they are not specific for this Swiss mountain pine stand. The species showing the highest density of all biotopes under study in the Swiss mountain pine stands without spruce belong to species preferring more open biotopes. The species showing the highest density of all the biotopes under study in the stand of the Swiss mountain pine with admixture of spruce belong to species liking very dense bushes. The stands surrounding the SNR Podkovák, which were used for comparison, are lacking in the shrub undergrowth, and the canopy of their tree layer is mostly very dense. The species mentioned therefore do not find a suitable environment here. The analysis of the avifauna in the wider surroundings of the SNR Podkovák, as made at the occasion of the investigation of the near SNR Farské bažiny (Řepa 1984), has demonstrated that these species are common in the coniferous yield forests, however, in the younger stands of them. Thus, no specific species occurs in the breeding synusia of the SNR Podkovák which would not breed commonly in other surrounding biotopes, too. We made a similar finding in the other peatbog reserve in the Český les Mts., Farské bažiny (Řepa 1984).

Table 5. Cody's indices for comparison of breeding synusiae of birds of individual biotopes investigated in the SNR Podkovák in the course of years 1979—1981.

	"pure" stand of Swiss mountain pine	stand of Swiss mountain pine with admixture of spruce	high pine forest	high dry spruce forest	high swamped spruce forest
"pure" stand of Swiss mountain pine	× × ×	0.037	0.291	0.322	0.196
stand of Swiss mountain pine with admixture of spruce		× × ×	0.111	0.339	0.243
high pine forest			× × ×	0.074	0.191
high dry spruce forest				× × ×	0.338
high swamped spruce forest					× × ×

On the other hand, differences were found in some general characteristics of the bird synusia. First of all, a higher total density of breeding birds in the stands of the Swiss mountain pine was found than in the yield forest in the surroundings. In the SNR Farské bažiny (Řepa 1983) a quite opposite situation was found. A direct comparison of the density found in both reserves is not possible, because different methods for the census of birds were used. The phenomenon mentioned above may be explained on the basis of Peitzmeier's rule (1950) of the dependence of the density of avifauna on the size of area. This rule was originally formulated for small field groves in the open landscape; however, it can be applied to any islets of a biotope surrounded with a different environment, i.e., also to the islets of the Swiss mountain pine stands on the peatbogs surrounded with the coniferous yield forest. Peitzmeier's rule says that the larger is the area of the islet the lower is the density. Thus in the about three times smaller Swiss mountain pine stand in the SNR Podkovák a higher density of avifauna is to be expected than in the SNR Farské bažiny. This is in accordance with the fact that the density in the Swiss mountain pine stand in the SNR Podkovák is higher than the density of birds in the surrounding forests, whereas in the Swiss mountain pine stand in the SNR Farské bažiny, on the contrary, the density of birds is lower than in the surrounding forests.

The species number in the Swiss mountain pine stand in the SNR Podkovák is analogously with the same biotope in the SNR Farské bažiny higher than in the surrounding forests. The Swiss mountain pine stand is structurally richer, which is due first of all to the well-developed shrub and herb layers. It is known generally that in the stands with a higher diversity of their structure also the specific variability of avifauna is higher (Mac Arthur, Recher, Cody 1966).

Also the equitability in the SNR Podkovák, analogously again with the SNR Farské bažiny (Řepa 1983), is higher than in the surrounding forests. The higher number of species and equitability ensure also the higher value of diversity of the bird synusia. Thus, the higher diversity of bird breeding synusiae of the Swiss mountain pine stands on the peatbogs of the Český les Mts in comparison with the yield forests seems to be a rule. It confirms generally widespread opinion that the natural stands (to which the Swiss mountain pine stands belong) harbour more diverse communities than the forest stands strongly influenced by man. Our results obtained from the Swiss mountain pine stands confirm the opinion that the more diverse is bird community the healthier and better balanced is the landscape inhabited by the respective avifauna. On this opinion the processes are based which within framework of landscape planning the worthy sections of landscape are sought out according to the high diversity a specific variability of bird communities (Bezzel 1974, Mayer 1977, Blana 1979).

Only in the SNR Podkovák the Swiss mountain pine stand was without any admixture. The other part of the stand in the SNR Podkovák and the whole in the SNR Farské bažiny posses more or less an admixture of spruce which has penetrated into the reserves from the surrounding stands. At present an artificial removal of spruce from the reserves is in preparation in order to secure a successful development of the Swiss mountain pine stands in the future (Čížek 1979). A comparison of the bird communities in stands without and with admixture of spruce can demonstrate what changes in the composition of breeding avifauna are to be expected as results of these actions. From the comparison it is evident that in the Swiss mountain pine stands without admixture two species breed (*A. trivialis* and *A. caudatus*), which did not breed in the stands with admixture of spruce. On the contrary no species occured in the SNR Podkovák which would not breed at the same time in the "pure" stand of the Swiss mountain pine. In the SNR Farské bažiny (Řepa 1984) several species were found in the Swiss mountain pine stand with admixture of spruce (*G. glandarius*, *C. palumbus*, *L. curvirostra*, *N. caryocatactes*), which did not occur in any type of the Swiss mountain pine stands in the SNR Podkovák.

Certain differences between the Swiss mountain pine stands with and without admixture of spruce in the SNR Podkovák were also found as regards the quantitative representation of some species. For example, *F. coelebs* and *T. philomelos* achieved a higher density in the stand with admixture of spruce. *Ph collybita* and *Ph. trochilus*, on the contrary, in the "pure" stand. These differences are caused by the diversities in the structure of the stand. The total number of species was a little lower in the stand with admixture of spruce, the equitability of the synusia was not very different, the density of the breeding synusia was higher.

Thus, it may be supposed that the removal of spruce from the Swiss mountain pine stands will cause only unimportant changes in representation of individual bird species in the breeding synusia; the general level of abundance, specific variability and diversity of the synusia will experience no essential changes.

Between the composition of the breeding synusia of birds in the SNR Podkovák and the composition of the avifauna in the analogous biotope in the SNR Farské bažiny only isignificant differences were found. The results of comparison with the data of various European authors, as made in the evaluation of the SNR Farské bažiny (Řepa 1984), holds good for the SNR Podkovák, too. In general, the breeding synusia of this reserve does not differ from the European medium for the analogous peatbog biotop

SUMMARY

In the course of 1979 till 1981 the investigation of the breeding avifauna by means of the method of breeding territory mapping in the forest peatbog in the State Nature Reserve Podkovák near Lesná in the Český les Mts. (district Tachov, N. W. Bohemia) was made. The investigation was carried out in an area of 21.29 hectares, where the following forest grew: the Swiss mountain pine stand on the peatbog, the Swiss mountain pine stand with the admixture of spruce, the high dry spruce forest, the high swamped spruce forest, the pine forest.

In the stand of the Swiss mountain pine on the peatbog 24 species of breeding birds were found, the total density of the breeding synusia amounted to 44.7 territories per 10 hectares of area, the diversity of the synusia amounted to 2.725, its equitability to 0.857. The dominant species were *Prunella modularis*, *Parus ater*, *Fringilla coelebs*, *Anthus trivialis*, *Phylloscopus collybita*, *Erithacus rubecula*, *Ph. trochilus* and *Regulus ignicapillus*.

In the stand of the Swiss mountain pine with an admixture of spruce 19 species were found; total density 58.3 territories per 10 hectares, diversity of synusia 2.508, equitability 0.851. Dominant species: *Turdus philomelos*, *P. modularis*, *E. rubecula*, *P. ater*, *F. coelebs*, *R. ignicapillus*.

In the high dry spruce forest 19 species were found; total density 29.3 territories per 10 hectares, diversity 2.368, equitability 0.854. Dominant species: *F. coelebs*, *Regulus regulus*, *P. ater*, *Dryocopus martius*, *Parus cristatus*, *Certhia familiaris*, *E. rubecula*.

In the swamped high spruce forest only 13 species were found; total density 41.4 territories per 10 hectares, diversity 1.746, equitability 0.659. Dominant species: *F. coelebs*, *R. regulus*, *P. ater*, *T. troglodytes*, *T. philomelos*.

In the high pine forest 17 species were found; total density 24.3 territories per 10 hectares, diversity 2.420, equitability 0.853. Dominant species: *F. coelebs, P. ater, R. regulus, T. philomelos, A trivialis, E. rubecula, R. ignicapillus, P. cristatus.*

If the area under study is evaluated as a whole, 27 breeding species were found in the SNR Podkovák amd in its close surroundings; the total density of the breeding synusia amounted to 34.4 territories per 10 hectares, the diversity of the synusia to 2.767, its equitability to 0.830. Dominant species: *F. coelebs, R. regulus, P. ater, T. philomelos, E. rubecula, P. modularis.*

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FURTHER CONTRIBUTION TO THE GROWTH OF THE RUFFE, ACERINA CERNUA (PISCES : PERCIFORMES)

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Abstract: Growth rate of the ruffe, *Acerina cernua* (Linnaeus, 1758) collected from 1946 to 1982 in 9 localities, has been studied using scale structure of 356 specimens. Specimens of eigth age classes were recorded. Pond specimens were growing faster in comparison with those from the riverine lake Klíčava. In general the growth is slow and the fish does not reach a considerable age.

INTRODUCTION

Literature about growth of the ruffe was summarized by Johal (1980). Only few additions were made in the recent study. The growth of the ruffe was studied by Berg (1949), Redeke (1941), Staff (1950), Bauch (1954), Podlesnyj (1958), Leeming (1963), Banarescu (1964), Pisanko (1966), Sabanejev (1980). The frequency of the ruffe was studied by Mišík (1957),

MATERIAL AND METHODS

356 specimens of the ruffe were collected from following localities:

	No. of species	Date of collection	Coll. by
Ponds			
1. Záblatský at Třeboň	152	2. X. 1982	J. Kubečka
2. Ženich at Třeboň	49	V., X. 1954	O. Oliva
Rivers			
3. The Vltava, Prague	10	IV., VI., IX. 1982	J. Kubečka
4. The Berounka at Dolní Mokropsy	1	1981	J. Kubečka
5. The Labe at Velké Žernoseky	2	30. VII. 1981	J. Kubečka
6. Kudomozero, USSR	1	16. VII. 1981	J. Kubečka
Bay			
7. Bay of the river Vistula, Poland	26	6. VIII. 1958	O. Oliva
Valley water reservoirs			
8. Rożnów, river Dunajec Poland	1	17. VI. 1946	W. Juszczyk
9. Klíčava	114	1982	J. Kubečka

The whole material is deposited in the ichthyological collections of the Department of Systematic Zoology, Faculty of Sciences, Charles University, Prague. The same method during scale study was used as described by Johal (1980).

Ioganzen and Krivoščekov (1972), Holčík and Bastl (1973), Vostradovský, Leontovyč and Vostradovská (1974). The frequency and growth of the ruffe was studied by Bade (1901), Gasowska (1962), Pisanko (1964), Rudnicki, Waluga and Waluś (1973) and Szczerbowski (1981).

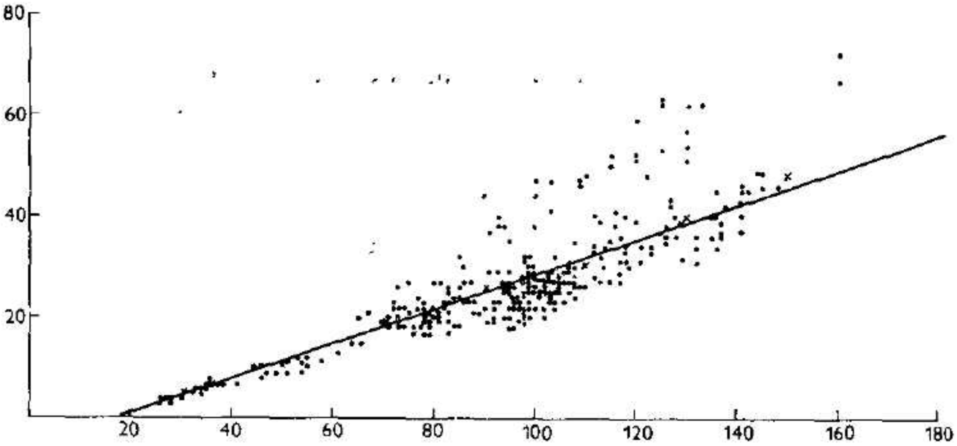

Fig. 1. Relationship between the body length (along abscissa) and the scale radius (along ordinate) in the ruffe. Dots = original measurements, crosses = average values at 10 mm interval.

RESULTS AND DISCUSSION

The body length/diagonal scale radius relationship (Fig. 1) shows linear relationship, and the scale formation as ascertained graphically seems to appear at 19 mm of body length, as demonstrated also by Johal (1980).

Tab. 1. Pond Záblatský at Třeboň, 20. X. 1982

Age Class	No of Specimens	Body Length	Average Back-Calculated Lengths in mm (in brackets ranges) l_1	l_2	l_3	l_4	l_5
1+	66	99.73 (86–104)	56.95 (46–68)				
2+	77	100.29 (95–114)	54.74 (42–64)	85 (74–95)			
3+	4	119.5 (116–123)	47.5 (44–52)	75.5 (59–87)	97.5 (90–105)		
4+	1	128	62	76	91	114	123.75
5+	4	145.5 (144–148)	46 (43–50)	67 (64–71)	84.25 (78–87)	105.5 (94–112)	123.8 (111–132)
Total	152		53.6 (46–62)	76 (67–85)	91 (94–98)	110 (106–114)	124
Annual increment in mm.				24	15	9	14
Specific Rate of Linear Growth (CL)				44.44	19.73	9.89	12.72

Tab. 2. Pond Ženich at Třeboň, V. and X., 1954

Age Class	No of Specimens	Body Length	Average Back-Calculated Lengths in mm (in brackets ranges) l_1	l_2	l_3	l_4	l_5
0+	1	66					
1+	3	85 (79− 91)	64 (59−71)				
2+	13	113 (103−119)	54 (48−65)	83 (79−100)			
3+	19	113 (117−141)	55 (47−65)	82 (70−103)	114 (100−124)		
4+	9	135 (127−138)	51 (43−59)	73 (63− 85)	111 (91−107)	121 (114−130)	
5+	3	141	52 (46−58)	71 (66− 80)	86 (82− 94)	106 (103−110)	128 (124−131)
Total	49		55 (43−71)	77 (63−103)	104 (82−124)	113 (106−121)	128 (124−131)
Annual Increment in mm.				22	27	9	15
Specific Rate of Linear Growth (CL)				40	35.06	8.65	13.27

Using this correction factor for back calculations of succesive body length it was found that the first annulus was formed after attaining the average size of 42 mm in the specimens from the Baltic Sea, 48 mm in the specimens from the river Vltava, 45and 54 mm in the Klíčava valley water reservoir and in the Záblatský pond specimens, and 55 mm in the specimens from the pond Ženich. Maximum age classes 8 + were recorded from the Bay of the Vistula (Poland). When these data are compared with those of J o h a l (1980), somewhat smaller walues were found in the back — calculated body lengths. The observa-

Tab. 3. The River Vltava, Prague, 1982

Age Class	No of Specimens	Body Length	Average Back-Calculated Lengths in mm l_1	l_2	l_3	l_4	l_5
3+	6	106 (93−117)	47 (38−57)	56 (51−74)	90 (91−101)		
4+	3	119 (128−113)	50 (43−60)	72 (66−83)	92 (82−108)	107 (102−118)	
5+	1	123	47	60	68	90	119
Total	10		48 (47−50)	62 (56−72)	83 (68− 92)	98 (90−107)	119
Annual Increment in mm.				14	21	15	21
Specific Rate of Linear Growth (CL)				29.16	33.87	18.07	21.12

Tab. 4. Valley Water Reservoir Kličava, 1982

Age Class	No of Specimens	Body Length	Average Back-Calculated Lengths in mm l_1	l_2	l_3	l_4	l_5
0+	37	40					
1+	42	78 (64–91)	49 (41–63)				
2+	27	83 (73–94)	46 (30–62)	64 (52–98)			
3+	5	99 (94–104)	40 (39–46)	59 (57–63)	60 (76–86)		
4+	2	112 (107–118)	43 (42–45)	64 (61–68)	84 (74–95)	90 (93–105)	
5+	1	122	47	60	68	90	119
Total	114		45 (40–49)	61 (59–64)	70 (60–84)	90	119
Annual increment in mm.				16	9	20	29
Specific Rate of Linear Growth (CL)				27.6	14	28.5	30.5

tions from the different ponds are presented in Table 1 from **Záblatský pond** at Třeboň, and in Table 2 from the pond Ženich.

The growth of specimens from the river Vltava is presented in Table 3. Unfortunately from river Berounka at Dolní Mokropsy only one specimen was caught having the body lenght of 142 mm. It completed 6 years of age: l_1—65, l_2—92, l_3—106, l_4—114, l_5—120 and l_6—128 mm.

From the Lake Kudomozero (USSR) only one specimen was caught with the body length of 72 mm that completed 2 years of age, with l_1—48, l_2—65 mm.

The growth of the ruffe from the Bay of the river Vistula is presented in Table 4.

From the riverine lake Rožnów on the river Dunajec (Poland) only one specimen was caught with the body length of 141 mm that completed 5 years of age: l_1—58, l_2—78, l_3—108, l_4—121 and l_5—133 mm.

From the river Labe at Velké Žernoseky 2 specimens were caught belonging to two year classes. In the age class III, 1 specimen with the body length 95 mm (l_1—46, l_2—73, l_3—83 mm). In the age class IV, 1 specimen with the body length of 127 mm (l_1—50, l_2—75, l_3—89, l_4—110 mm).

The growth of the ruffe or stone-perch from the different ponds indicated that the maximum rate of growth was observed from all age classes in the pond Ženich at Třeboň (see Table 2). From the comparison with the findings of J o h a l (1980), I can conclude that the ruffe from the ponds studied by me showed slightly faster growth.

Among rivers, one specimen from the river Berounka (Bohemia) showed a maximum rate of growth in all age classes, but due to a small number of specimens, it is not advisable to include this population in the present discussion. For the same reason, either the sample from the river Labe at Velké Žernoseky is not included. In the age classes I—V the maximum rate of growth was found in the river Vltava (Table 3).

Tab. 5. Bay of the River Vistula, Poland, 1958

Age Class	No of Specimens	Body Length	Average Back-Calculated Lengths in mm l_1	l_2	l_3	l_4	l_5	l_6	l_7	l_8
2+	5	96 (85–103)	44 (38–51)	77 (70–84)						
3+	3	97 (90–103)	40 (35–47)	65 (54–75)	83 (76– 88)					
4+	6	114 (109–130)	47 (41–49)	64 (56–49)	90 (70–104)	101 (88–104)				
5+	8	124 (120–133)	38 (40–49)	47 (50–62)	67 (65– 89)	115 (86–107)	110 (101–120)			
6+	2	130	44 (39–49)	62 (55–70)	77 (69– 86)	89 (82– 97)	102 (96–109)	120 (120–121)		
8+	2	160	42.5 (43–43)	56.5 (57–58)	73 73	81 (79– 83)	96 (95– 97)	113.5 (113–114)	127.5 (127–128)	141 (140–142)
Total	26		42 (38–47)	61 (47–77)	78 (67– 92)	81 (81–115)	99 (96–110)	116 (113–120)	127.5 (127–128)	141 (140–142)
Annual Increment in mm.				19	17	18	3	17	11	14
Specific Rate of Linear Growth CL				45.23	27.86	23.07	3.12	17.17	9.48	11.02

Tab. 6. The growth of Acerina cernua from different localities

Locality	No of Specimens	Years of Life, Calculated Total/Body Lengths 1	2	3	4	5	6	7	8
Ponds:									
Záblatský at Třeboň	152	65/54	92/76	110/91	133/110	150/124			
Ženich at Třeboň	49	67/55	83/77	126/104	137/113	155/128			
Rivers:									
Vltava, Prague	10	58/48	76/63	100/83	113/98	144/119			
Berounka	1	79/65	111/92	128/136	138/114	145/120	**155/128**		
Labe at Velké Žernoseky	2	58/48	90/70	104/86	133/99				
Lake:									
Kdomozero, URSS	1	58/48	79/65						
Bay:									
Bay of Vistula, Poland	26	51/42	74/61	94/78	116/96	120/99	**140/116**	**154/127**	**171/141**
Valley water reservoirs:									
Rożnów, river Dunajec	1	70/58	94/78	131/108	146/121	161/133			
Klíčava	114	54/45	74/61	85/70	109/90	144/119			
Total	356								

Tab. 7. The growth of Acerina cernu from different type of water bodies. Total length/body length

Type of Water Body	No of Specimens	Year of Life, Calculated Total/Body Lengths 1	2	3	4	5	6	7	8
Ponds	201	66/54.5	87.5/76.5	118/97.5	134/111	152/126	—	—	—
Rivers	13	65/54	93/75	111/92	128/104	144.5/119.5	155/128	—	—
Valley Water Reservoir	114	54/45	74/61	85/70	109/90	144/119	—	—	—
Bay	26	51/42	74/61	94/78	116/96	120/99	140/116	154/127	171/141

Total length and body length in mm.
Total length calculated by the conversion factor: Total length = 1.21 of body length.

Podlesnyj (1958) studied the growth of the stone-perch from the river Jenisej (West Siberia), and his average growth values are as follows: l_1—84, l_2—109, l_3—131 mm.

Specimens examined by me grew more slowly. In general it can be concluded that the ruffe from Czechoslovakia grows more slowly than that in the rivers of the USSR.

Concerning the valley water reservoirs the maximum rate of growth for all age classes was observed in the riverine Lake Rożnów, but only in 1 specimen; therefore, no comparison is possible with the specimens from the valley water reservoir Klíčava (Table 4). Johal (1980) studied the growth of the ruffe from 5 valley water reservoirs in Czechoslovakia. In comparison with my results, it can be observed that in the age classes I to IV my specimens show a slower rate of growth, whereas in the age class V showed a higher rate. It can be concluded that the ruffe from the valley water reservoirs studied by me showed a slower growth than the specimens of Johal (1980). Berg (1949) quoted observations of Radčenko and Sviderskaja on the growth of the ruffe in Lake Ubinskoje (USSR) which is faster when compared with our results.

Specimens examined from the Bay of Vistula (Table 5) show a slower growth but reach a considerable age of 8 +. On the contrary, Bauch's (1954) specimens from the estuaries of The Baltic Sea were growing faster.

Concerning the final maximum length of the ruffe some data are available in literature: Redeke (1941), Berg (1949), Staff (1950), Banarescu (1964), Gasowska (1962), Rudnicki (1971), Sabanejev (1980), Szczerbowski (1981), Bade (1901), Pisanko (1964), Otterström (1932). The maximum size in Siberia according to Berg (1949) is 500 mm, sometimes 250—300 mm, generally 100—150 mm. But there were no specimens above 150 mm present in the material of Podlesnyj (1958). All authors pointed out the growth of the ruffe and its maximum size was stated to be about 150 mm.

Concerning the frequency of the ruffe in Siberia, the fish is used commercionally, up to 13 metric tons during 1946—1955 (Podlesnyj, 1958), 2500 tons during 1962 (Pisanko, 1964), and 3000 tons (Ioganzen and Krivoščenkov, 1972) were fished out yearly. In the Baltic Sea it was once 780 tons fished out (Bade 1901), in Poland 500—600 tons annualy are fished out (Gasowska 1962).

In Czechoslovakia, the frequency of the ruffe in one locality was only 0.3 % of the total of seined fishes (Mišík 1957), in another locality 0.1 % in 1974 in some localities 3.85 % (Vostradovský, Leontovyč and Vostradovská, 1974). The frequency in Czechoslovakia seems to be very low in comparison with Siberia.

While comparing the growth of the ruffe from different types of water bodies (Table 7 and Fig. 2) it was observed that in the age clases I and II, the specimens from ponds and rivers grow at a higher rate, whereas those from valley water reservoirs and bays at a slower rate. These results are the same as in the age classes III and IV. In the age class V, the specimens from ponds grow at a higher rate, the specimens from rivers and valley water reservoirs at a medium rate, and the specimens from the bay at a slow rate. In the age class VI the specimens from rivers grow at a higher rate whereas those from the bay grow at a slow rate. In the age class VII and VIII, the specimens from the bay grow at a higher rate. The specimens from the ponds and rivers showed a similar rate of growth in the age classes I to III.

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SUMMARY

The growth of 356 specimens of the ruffe from 9 water bodies was studied using scale method. It was confirmed again that in general the growth is slow, and specimens observed did not exceed the age of 8 + years.

The best growth was found in ponds in the age classes from I to the IIIrd, and in the valley water reservoirs in the age classes III—V. The worst growth in the Bay of Vistula in the age classes IV and V. The maximum size of the ruffe is about 150 mm.

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THE INFLUENCE OF THE WATER WORKS AT DALEŠICE ON MACROZOOBENTHOS OF THE JIHLAVA RIVER

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A b s t r a c t: *During 1976—1980 the influence of the water works at Dalešice on aquatic invertebrates of the Jihlava River was studied. The research was started even before the filling of the reservoirs of the water works. The samples of macrozoobenthos were taken about 1 km below the auxiliary reservoir. 82 species were found altogether, at the end of the period under investigation the number of species was smaller by approximately 30 % than in 1976. The abundance per 1 m² of bottom was enhanced by about 300 %, above all due to the mass development of chironomid larvae. The biomass decreased with the decrease in the larvae of caddis flies, in 1980 being by about 40 % smaller than in 1976.*

The stream section under study was classified as trophically poor, beta-mesosaprobic. The aim of the present paper is to provide a basis for considering future influences of the power at Dukovany on the stream of the Jihlava River.

INTRODUCTION

In 1982 ten years had passed since the construction of the water works at Dalešice was started on the Jihlava River. This water works are intended as a water supply for the nuclear power plant at Dukovany which is under construction. The filling of the reservoir started in 1976, so that the system of the main and auxiliary reservoirs of the water works at Dalešice has been in operation on the Jihlava River for 6 years affecting the water stream considerably. Evidence was given for the predictions of the changes in water discharge, water temperature regime, water chemism, hydrobiological and ichthyological conditions in the stream as reported by Z e l i n k a (1966), K ř í ž (1975, 1976), etc.

During 1976—1980 a detailed attention was paid to the composition of macrozoobenthos below the auxiliary reservoir to determine the influence of the changes which occurred due to the construction, filling, test operations and permanent operation of the water works on the conditions in the stream of the Jihlava River as a starting base for the estimation of a possible future influence of the nuclear power plant at Dukovany.

It is my pleasant duty to extend my thanks to all persons who helped or advised me during my study, particularly to RNDr. E. Wohlgemuth CSc., for his assistance in taking samples, RNDr. B. Losos CSc. for the determination of the family Chironomidae and to Ing. M. Peňáz CSc. for his valuable advice in the evaluation of samplings.

MATERIAL AND METHODS

Samples of macrozoobenthos were taken regularly at monthly intervals from 1976 to 1980 as far as the water level in the stream allowed. The samples were taken near the Mohelno Mill, about1 km below the auxiliary reservoir of the water works at Dalešice. Before starting the construction the river was a barbel zone in this section, the maximum depth being 0.5 m and stream velocity around 0.1 m/s, the bottom was grevelly sandy with large rocks. The water temperature varied considerably in the course of a year. In summer it exceeded 20 °C, in winter the river got frozen.

During the construction and test operations of individual turbines the depth, discharge and transparency of water showed considerable variations (P e ň á z & al. 1979, T r n k o v á 1980). Remarkable changes appeared particularly in the temperature regime of the river. In connection with the discharging of water from the depth of the auxiliary reservoir the water stream below the dams is permanently cold. The difference in water temperature in the course of a year decreased considerably (cf. Tab. 1).

At the end of the period under study the Jihlava River in the locality at Mohelno exhibited signs characteristic for the streams below valley reservoirs. The depth reached 50 to 80 cm, the stream velocity was nearly 1 m/s. These values show considerable variations from time to time, which is associated with the operation of the water works.

In accordance with the changes of abiotic factors, changes in fish composition pattern appeared from typical representatives of the barbel zone to oligostenothermic and/or eurythermic representatives of the trout and grayling zones (P e ň á z & al. 1979).

The samples of macrozoobenthos were taken with the Surber collector the lower frame of which involved an area of 0.1 m^2. In each field work 10 samples were taken across the stream, i. e. from the total area of 1 m^2.

The samples of aquatic invertebrates were fixed in 4 per cent formaldehyde and determined in a species, if it was possible. Their abundance (number of individuals per 1 m^2), dominance (relative representation of a species in the total number of specimens), species diversity (S h a n n o n & W e a v e r 1949) and equitability (S c h e l d o n 1969), biomass (weight of individuals per 1 m^2), saprobity after S l á d e č e k & al. (1981) and productivity after A l b r e c h t (1959) were evaluated.

RESULTS

Water temperature

From abiotic factors the temperature conditions were affected most remarkably by the construction of the water works at Dalešice within the whole stream section of the Jihlava River below the reservoir. The annual temperature amplitude was narrowed significantly, the river does not freeze in winter while in summer the water temperature does not exceed 16 °C. The water temperature ranges in the Mohelno locality at samplings during 1976—1980 and their average values are summarized in Tab. 1.

Tab. 1. Water temperature at samplings of macrozoobenthos

Year	Temperature range °C	Average value °C
1976	0—22.5	12.0
1977	0—15.0	8.4
1978	3.0—16.0	10.2
1979	2.5—16.0	10.7
1980	2.5—16.0	10.1

During the winter months the water temperature at samplings after filling the water works was up to 8 °C higher than air temperature, in summer, on the contrary, up to 10 °C lower.

Tab. 2. Composition of macrozoobenthos in 1976 (number of individuals per 1 m^2)

Taxon — Species	Month						Total	Average value	%
	J	J	A	S	O	N			
Oligochaeta									
Eiseniella tetraedra	—	—	—	3	1	2	6	1.0	0.6
Limnodrilus	1	—	—	8	12	2	23	3.8	2.3
Tubifex tubifex	3	1	—	6	2	—	12	2.0	1.2
Hirudinea									
Glossiphonia complanata	—	1	2	—	—	1	4	0.7	0.4
Hemiclepsis marginata	—	1	—	—	—	—	1	0.2	0.1
Herpobdella octoculata	9	16	10	17	13	12	77	12.8	7.7
Piscicola geometra	—	—	1	—	—	1	2	0.3	0.2
Gastropoda									
Ancylus fluviatilis	1	7	14	35	27	15	99	16.5	9.8
Bivalvia									
Pisidium sp.	1	—	20	6	2	7	36	6.0	3.6
Isopoda									
Asellus aquaticus	1	—	1	—	—	—	2	0.3	0.2
Ephemeroptera									
Baëtis rhodani	—	20	14	1	6	—	41	6.7	4.1
Heptagenia sulphurea	4	—	—	—	—	—	4	0.7	0.4
Potamanthus luteus	28	58	2	3	—	4	95	15.8	9.5
Odonata									
Calopteryx splendens	—	—	—	46	3	1	8	1.3	0.8
Trichoptera									
Hydropsyche angustipennis	10	62	178	40	46	59	395	65.8	39.3
Limnephilus nigriceps	—	—	—	—	—	1	1	0.2	0.1
Rhyacophila pubescens	1	1	5	5	—	11	23	3.8	2.3
Rhyacophila nubila	33	12	7	—	—	3	55	9.2	5.5

Heteroptera									
Ilyocoris cimicoides	1	—	2	2	2	2	9	1.5	0.9
Diptera									
Brillia longifurca	2	—	—	2	1	2		1.0	0.
Orthocladius sp.	15	3	1	2	—	—	21	3.3	2.1
Orthocladini g. sp. div.	2	—	—	—	—	—	2	0.3	0.2
Limnochironomus nervosus	1	13	3	11	20	1	49	8.3	4.9
Microtendipes gr. *chloris*	—	—	—	—	—	3	3	0.5	0.3
Phytotendipes gr. *gripekoveni*	4	—	3	4	8	—	19	3.2	1.9
Rheotanytarsus gr. *exiquus*	—	—	—	—	1	—	1	0.2	0.1
Atherix marginata	1	2	1	—	—	1	5	0.8	0.5
Simuliidae g. sp. div.	4	1	—	—	—	—	5	0.8	0.5
Antocha vitripennis	1	—	—	—	—	—	1	0.2	0.1
Total, individuals	123	198	264	149	144	127	1005	167.5	100.0
Total, species	20	14	16	16	14	18	29	16.3	—
Species diversity	3.23	2.71	1.98	3.00	2.83	2.78	2.28	—	—
Equitability	0.75	0.71	0.50	0.75	0.74	0.67	0.47	—	—

Undeterminated taxon was considerd as one species in the total

Tab. 3. Composition of macrozoobenthos in 1977 (number of individuals per 1 m²)

Taxon — Species	M	A	M	J	J	A	S	O	N	D	Total	Average value	%
Oligochaeta													
Eisniella tetraedra	—	—	—	—	—	—	—	1	—	—	1	0.1	0.1
Limnodrilus sp.	5	1	1	9	13	2	2	—	—	10	43	4.3	2.8
Tubifex tubifex	1	—	—	13	3	—	2	—	—	—	19	1.9	1.3
Hirudinea													
Glossiphonia complanata	—	1	—	—	—	1	—	2	—	—	4	0.4	0.3
Herpobdella octoculata	13	4	10	54	57	19	15	8	4	2	186	18.6	12.3
Gastropoda													
Ancylus fluviatilis	28	4	26	61	8	3	12	40	40	32	214	21.4	14.2
Bivalvia													
Anodonta cygnea piscinalis	—	—	—	—	—	—	—	1	—	—	1	0.1	0.1
Pisidium sp.	—	—	1	1	—	1	—	—	—	—	3	0.3	0.2
Isopoda													
Asellus aquaticus	—	—	1	4	2	8	12	56	—	6	89	8.9	5.9
Ephemeroptera													
Baëtis rhodani	—	—	—	—	1	3	—	2	6	8	20	2.0	1.3
Baëtis vernus	1	—	—	2	5	—	—	—	—	—	8	0.8	0.5
Caenis moesta	—	—	—	1	6	4	2	4	—	2	19	1.9	1.3
Ephemerella ignita	—	—	—	—	1	—	1	—	—	—	2	0.2	0.1
Potamanthus luteus	—	—	—	5	1	4	4	2	2	2	20	2.0	1.3
Odonata													
Calopteryx splendens	1	—	—	—	—	—	—	—	—	—	1	0.1	0.1
Trichoptera													
Hydropsyche contubernalis	10	2	1	16	—	—	—	—	—	—	31	3.1	2.1
Hydropsyche pellucidula	7	1	8	10	4	—	3	—	2	—	35	3.5	2.3
Polycentropus flavomaculatus	—	4	3	18	4	—	—	6	4	10	49	4.9	3.2
Rhyacophila nubila	—	—	—	—	21	—	4	—	—	—	25	2.5	1.6
Sericostoma sp.	—	—	—	—	—	—	1	—	—	—	1	0.1	0.1
G. sp. div. (puppa)	—	—	—	—	11	2	—	—	—	—	13	1.3	0.9

Heteroptera													
Ilyocoris cimicoides	1	—	—	1	—	2	1	—	—	—	5	0.5	0.3
Coleoptera													
Helochares lividus	—	—	—	2	—	—	—	—	—	—	2	0.2	0.1
Dytiscidae g. sp. div. (larva)	—	—	—	1	—	—	—	2	—	—	3	0.3	0.2
Megaloptera													
Sialis fuliginosa	—	—	—	—	—	2	—	—	—	—	2	0.2	0.1
Diptera													
Micropsectra gr. *praecox*	—	—	—	—	8	17	8	20	—	—	53	5.3	3.5
Thienemannimyia sp.	—	—	—	—	—	—	4	8	—	—	12	1.2	0.8
Macropelopia nebulosa	—	—	—	—	—	1	—	2	—	—	3	0.3	0.2
Trissopelopia sp.	—	—	—	—	—	—	—	2	—	—	2	0.2	0.1
Pottasthia longimana	—	—	—	—	—	—	—	—	—	12	12	1.2	0.8
Diamesa thienemanni	1	5	—	117	81	—	—	—	—	—	204	20.4	13.5
Prodiamesa olivacea	—	—	—	—	10	8	3	1	6	8	35	3.5	2.3
Cricotopus inaequalis	—	—	—	27	5	—	—	—	—	—	32	3.2	2.1
Metriocnemus cavicola	—	—	1	1	—	—	—	—	—	—	2	0.2	0.1
Brillia modesta	—	—	—	—	—	—	—	4	—	—	4	0.4	0.3
Orthocladius thienemanni	—	—	1	—	—	—	—	—	—	—	1	0.1	0.1
Orthocladius sp.	4	4	13	121	56	47	19	24	16	20	324	32.4	21.4
Orthocladius saxicola	1	—	1	1	1	—	—	—	—	—	4	0.4	0.3
Rheorthocladius gr. *exiquus*	—	—	1	—	—	1	—	—	—	—	2	0.2	0.1
Orthocladiinae g. sp. div.	—	—	—	1	—	—	—	—	—	—	1	0.1	0.1
Chironomariae g. sp. div.	—	—	—	—	—	1	—	—	—	—	1	0.1	0.1
Limnochironomus gr. *nervosus*	—	—	1	4	—	—	—	—	—	—	5	0.5	0.3
Microtendipes gr. *chloris*	1	—	—	—	—	—	—	—	—	—	1	0.1	0.1
Polypedilum breviantennatum	—	—	—	—	1	—	—	—	—	—	1	0.1	0.1
Simuliidae g. sp. div.	1	—	—	—	—	—	—	—	—	—	1	0.1	0.1
Ceratopogonidae g. sp. div.	1	—	—	—	—	—	1	—	—	—	2	0.2	0.1
Atherix marginata	1	—	—	—	—	—	1	2	—	2	6	0.6	0.4
Limnophora riparia	—	—	—	—	—	—	—	4	—	—	4	0.4	0.3
Tipula lateralis	—	—	—	—	—	1	—	—	—	2	3	0.3	0.2
Total, individuals	77	26	71	470	299	128	94	148	82	116	1511	151.1	100.0
Total, species	16	9	14	22	21	20	17	17	9	13	48	15.8	—
Species diversity	2.81	2.96	2.66	3.08	3.27	3.27	3.46	2.92	2.03	3.20	3.84	—	—
Equitability	0.70	0.45	0.69	0.69	0.74	0.75	0.84	0.71	0.31	0.86	0.68	—	—

Undertorminated taxon was considerd as one species in the total

Macrozoobenthos

The changes in the composition of macrozoobenthos association are indicated in Tabs. 2 to 10.

In 1976, 168 benthic invertebrates were ascertained on the average per 1 m^2 of bottom, their maximum number being found in August (264), minimum number in June (123). Totally, 29 species were ascertained, the average incidence per 1 m^2 being 16 species, their highest number was observed in June (20), the lowest in July and October (14). The diversity index was the highest in June (3.23), the lowest in August (1.98), the equitability index was the highest in October (0.75), the lowest in August (0.50). The representatives of the order Trichoptera formed 47.0 % of all individuals.

The average value of benthic invertebrates biomas per 1 m^2 was 3.097 g, the highest value being ascertained in October (4.769 g), the lowest in July (1.006 g). Trichoptera participated in the biomass with 74.8 %.

In 1977 the average abundance of macrozoobenthos per 1 m^2 was 151 individuals, with the maximum number of 299 individuals in July and the minimum number of 26 individuals in April. The total number of ascertained species was 48, the average value was 16 species, the maximum number of 22 species was ascertained in June, the minimum number of 9 species was ascertained in April and November. The greatest species diversity was determined in September (3.46), the least in November (2.03). Equitability was the highest in December (0.86), the lowest in November (0.31). The most abundant taxonomic group was formed by Diptera making up 47.7 % of all individuals.

The average value of biomass amounted to 2.222 g with the maximum of 6.144 g in July and the minimum of 1.108 g in November. The highest weight was reached by Hirudinea, which formed 53.6 % of biomass.

In 1978 the average abundance per 1 m^2 increased up to 306 individuals, limit values were ascertained in April and July (947 and 32 individuals, resp.), the total number of ascertained species was 50, the average value was 18 species, the maximum was 29 species (April), the minimum value was 7 species (July). The greatest species diversity was observed in December ($H' = 3.40$), the least in May ($H' = 1.77$). As far as the number of individuals is concerned, the highest equitability was found in July sampling ($J' = 0.88$), the lowest in the sampling of May ($J' = 0.43$). The representatives of the order Diptera accounted for 85.3 % of all individuals in that year.

The average value of biomass decreased to 1.045 g, the highest weight was found in the sampling in April (1.987 g), the lowest in January (0.357 g). Trichoptera accounted for 38.7 % and Diptera for 42.5 % of all individuals.

In 1979 the abundance reached up to the average value of 773 individuals per 1 m^2 of bottom, the highest number of animals being ascertained on this area in June (2383), the lowest in August (146). The total number of species amounted to 31, the average value was 17 species, the maximum number of 21 species was ascertained in November and the minimum of 14 in July. The diversity indices ranged within 1.72 (June) and 3.00 (July), the equitability indices ranged within 0.41 (June) and 0.78 (November). 88.3 % of all individuals were formed by Diptera.

In the above mentioned year the average value of biomass per 1 m^2 was 2.180 g, the highest one in June (5.079 g), the lowest in August (0.646 g). In 1979 Diptera accounted for the predominating part of the annual biomass as well, with their 53.0 % of the total weight.

Tab. 4. Composition of macrozoobenthos in 1978 (number of individuals per 1 m²)

Taxon — Species	Month									Total	Aver-age value	%
	J	A	M	J	A	S	O	N	D			
Oligochaeta												
Limnodrilus sp.	—	1	—	—	—	—	1	2	—	4	0.4	0.1
Tubifex tubifex	—	5	1	—	3	3	1	4	—	17	1.9	0.6
Eiseniella tetraedra	—	—	—	—	—	—	—	—	2	2	0.2	0.1
Lumbriculus variegatus	—	—	—	—	—	1	—	—	—	1	0.1	0 0
Hirudinea												
Glossiphonia complanata	—	1	—	—	1	1	2	1	—	6	0.6	0.2
Herpobdella octoculata	4	6	1	—	1	—	2	3	—	17	1.9	0.6
Gastropoda												
Ancylus fluviatilis	—	5	8	—	—	—	1	—	—	14	1.5	0.5
Bivalvia												
Anodonta cygnea piscinalis	—	1	—	—	—	—	—	—	—	1	0.1	0.0
Pisidium sp.	—	2	—	—	—	1	2	1	2	8	0.9	0.3
Isopoda												
Asellus aquaticus	16	6	1	—	7	2	14	32	8	86	9.5	3.1
Ephemeroptera												
Baëtis rhodani	8	23	1	2	1	1	—	—	19	54	6.0	1.9
Baëtis vernus	2	—	—	—	—	—	—	—	—	2	0.2	0.1
Caenis moesta	4	2	1	2	—	—	—	—	4	13	1.4	0.4
Potamanthus luteus	—	2	1	—	1	—	1	2	—	7	0.8	0.2
Trichoptera												
Rhyacophila nubila	2	15	26	8	5	1	—	1	2	60	6.6	2.2
Polycentropus flavomaculatus	6	7	21	8	1	3	18	24	10	98	10.9	3.5
Notidobia ciliaris	—	—	—	2	—	—	—	—	—	2	0.2	0.1
G. sp. div. (puppa)	—	—	—	—	—	—	—	3	—	3	0.3	0.1
Coleoptera												
G. sp. div. (larva)	—	—	—	—	—	—	3	1	—	4	0.4	0.1

Diptera												
Diamesa insignipes	—	5	6	—	—	—	—	—	—	11	1.2	0.4
Diamesa thienemanni	—	6	69	8	60	2	1	—	6	152	16.9	5.5
Eukiefferiella alpestris	—	225	11	—	—	—	—	—	—	236	25.2	8.5
Eukiefferiella bavarica	12	17	—	—	—	48	—	—	14	91	10.1	3.3
Potthastia longimana	14	12	—	—	—	1	—	—	—	27	3.0	0.9
Prodiamesa olivacea	—	—	—	—	10	—	—	—	—	10	1.1	0.3
Cricotopus algarum	—	—	—	—	—	—	11	—	—	11	1.2	0.4
Cricotopus sp.	—	6	—	—	—	—	—	—	—	6	0.7	0.2
Cricotopus sylvestris	—	2	—	—	—	—	—	—	—	2	0.2	0.1
Synorthocladius semivirens	—	12	1	—	—	—	—	—	—	13	1.4	0.4
Micropsectra gr. *praecox*	—	17	—	—	—	—	—	—	—	17	1.9	0.6
Rheotanytarsus gr. *exiquus*	40	—	—	—	13	30	5	31	2	121	13.4	4.3
Tanytarsus gr. *gregarius*	26	—	—	—	45	15	9	80	10	185	20.5	6.7
Tanytarsiinae g. sp. div.	—	—	—	—	—	4	—	—	—	4	0.4	0.2
Macropelopia nebulosa	—	1	—	—	9	1	—	1	—	12	1.3	0.4
Tanypodiinae g. sp. div.	—	—	—	—	4	—	—	—	—	4	0.4	0.2
Thienemannimyia sp.	16	14	—	—	28	19	38	58	28	201	22.3	7.3
Harnischia fuscimana	—	—	—	—	6	5	—	—	—	11	1.2	0.4
Limnochironomus gr. *nervosus*	—	—	—	—	—	1	—	—	—	1	0.1	0.0
Microtendipes g.. *chloris*	—	—	—	—	—	—	—	4	—	4	0.4	0.2
Phytotendipes gripekoveni	—	—	—	—	—	—	2	—	—	2	0.2	0.1
Pentapedium exsectum	—	—	—	—	—	—	—	1	—	1	0.1	0.0
Polypedilum gr. *pedestre*	—	—	—	—	3	—	—	—	—	3	0.3	0.1
Ceratopogonidae g. sp. div.	—	4	3	—	—	—	—	—	—	7	0.8	0.2
Antocha vitripennis	—	1	5	2	—	—	—	—	—	8	0.9	0.3
Limnophora riparia	—	—	—	—	—	—	—	1	—	1	0.1	0.0
Dicranota sp.	—	—	—	—	—	2	3	—	6	11	1.2	0.4
Wiedemannia sp.	—	4	7	—	1	2	—	—	2	16	1.8	0.6
Tipula lateralis	—	2	—	—	—	3	1	6	2	14	1.5	0.5
Total, individuals	150	947	507	32	439	186	115	284	114	2754	306.0	100.0
Total, species	12	29	17	7	19	22	18	21	15	50	17.8	—
Species diversity	2.79	2.15	1.77	2.47	2.34	3.21	3.25	3.08	3.40	3.34	—	—
Equitability	0.78	0.44	0.43	0.88	0.55	0.72	0.78	0.70	0.87	0.59	—	—

Undeterminated taxon was considers as one species in the total

Tab. 5. Composition of macrozoobenthos in 1979 and 1980 (number of individuals per 1 m²)

Taxon — Species	1979 Month J	J	A	N	Total	Average value	%	1980 Month J	S	D	Total	Average value	%
Nematomorpha													
G. sp. div.	3	—	—	2	5	1.3	0.1	—	—	—	—	—	—
Oligochaeta													
Limnodrilus sp.	4	—	—	—	4	1.0	0.1	2	—	—	2	0.7	0.1
Tubifex tubifex	13	1	—	—	14	3.5	0.4	—	—	—	—	—	—
Hirudinea													
Herpobdella octoculata	9	4	—	2	15	3.8	0.5	4	3	4	11	3.6	0.6
Gastropoda													
Ancylus fluviatilis	3	1	2	—	6	1.5	0.2	4	—	—	4	1.3	0.2
Bivalvia													
Pisidium sp.	—	—	—	—	—	—	—	1	—	—	1	0 3	0.0
Isopoda													
Asellus aquaticus	1	1	7	30	39	9.8	1.2	—	—	—	—	—	—
Ephemeroptera													
Baëtis rhodani	9	13	12	54	88	22.0	2.8	—	1	3	4	1.3	0.2
Ephemerella ignita	—	104	20	—	124	31.0	4.0	—	1	—	1	0.3	0.0
Caenis moesta	—	—	4	—	4	1.0	0.1	2	5	—	7	2.3	0.4
Potamanthus luteus	1	—	—	—	1	0.3	0.0	2	1	8	11	3.7	0.6
Plecoptera													
Leuctra sp.	—	3	3	—	6	1.5	0.2	—	—	—	—	—	—
Trichoptera													
Hydropsyche angustipennis	—	—	—	2	2	0.5	0.1	3	24	—	27	9.0	1.4
Rhyacophila nubila	6	10	5	2	22	5.7	0.7	2	10	—	12	4.0	0.6
Polycentropus flavomaculatus	9	5	1	12	27	6.8	0.8	8	14	—	22	7.3	1.1
Hydroptila sparsa	—	—	—	—	—	—	—	16	—	—	16	5 3	0.8

Coleoptera													
Ditiscidae G. sp. div.	—	—	—	4	4	1.0	0.1	—	—	—	—	—	—
Diptera													
Diamesa thienemanni	297	70	49	—	416	104.2	13.5	372	58	1	431	143.7	22.1
Prodiamesa olivacea	—	2	—	—	2	0.5	0.1	—	—	—	—	—	—
Eukiefferiella alpestris	156	4	—	—	160	40.0	5.2	—	—	—	—	—	—
Eukiefferiella bavarica	6	—	1	—	7	2.2	0.3	3	—	—	3	1.0	0.1
Potthastia longimana	1	3	—	—	4	1.0	0.1	—	—	—	—	—	—
Cricotopus vitripennis	—	2	—	—	2	0.5	0.1	—	—	—	—	—	—
Microcricotopus bicolor	—	—	—	—	—	—	—	4	—	1	5	1.6	0.3
Orthocladius sp.	1665	81	28	—	1774	443.8	57.5	1362	—	9	1371	456.6	10.2
Micropsectra gr. *praecox*	—	—	—	—	—	—	—	8	—	—	8	2.7	0.4
Tanytarsus gr. *gregarius*	—	1	—	42	43	10.8	1.4	—	—	—	—	—	—
Tanytarsus lobatifrons	—	—	3	16	19	4.7	0.6	—	—	—	—	—	—
Rheotanytarsus gr. *exiquus*	—	8	—	—	8	2.0	0.2	—	—	—	—	—	—
Thienemannimyi sp.	180	7	9	58	254	63.5	8.2	17	—	—	17	5.7	0.9
Microtendipes gr. *chloris*	—	—	—	10	10	2.5	0.3	—	—	—	—	—	—
Antocha vitripennis	14	1	1	—	16	4.0	1.5	—	1	—	1	0.3	0.0
Limnophora riparia	5	—	—	4	9	2.2	0.3	—	—	—	—	—	—
Tipula lateralis	—	—	—	10	10	2.5	0.3	—	—	—	—	—	—
Total, individuals	2383	323	146	240	3092	773.0	100.0	1809	118	26	1953	651.0	100.0
Total, species	19	21	15	14	31	17.3	—	16	10	6	19	10.7	—
Species diversity	1.72	3.00	2.97	2.98	2.32	—	—	1.14	2.19	2.20	0.40	—	—
Equitability	0.41	0.68	0.76	0.78	0.47	—	—	0.79	0.66	0.85	0.09	—	—

Underterminated taxon was considerd as one species in the total

Tab. 6 Biomass of macrozoobenthos per 1 m² in 1976 (g)

Taxon	Month						Total	Average value	%
	J	J	A	S	O	N			
Oligochaeta	0.005	0.000	—	0.020	0.005	0.001	0.031	0.005	0.2
Hirudinea	0.211	0.045	0.017	0.861	0.183	0.134	1.451	0.242	7.8
Gastropoda	0.002	0.011	0.012	1.012	0.171	0.031	1.239	0.206	6.7
Bivalvia	0.021	—	0.056	0.047	0.012	0.022	0.158	0.026	0.8
Isopoda	0.002	—	0.001	—	—	—	0.003	0.001	0.0
Ephemeroptera	0.312	0.304	0.006	0.027	0.019	0.014	0.682	0.114	3.7
Odonata	—	—	—	0.392	0.238	0.012	0.642	0.107	3.4
Trichoptera	2.301	0.625	3.655	1.253	4.102	2.166	14.102	2.350	75.9
Heteroptera	0.019	—	0.073	0.003	0.030	0.004	0.129	0.021	0.7
Diptera	0.077	0.021	0.004	0.021	0.009	0.014	0.146	0.024	0.8
Total	2.950	1.006	3.824	3.636	4.769	2.398	18.583	3.097	100.0

In 1980, 651 benthic invertebrates were found per 1 m² of bottom, the highest number was ascertained in June (1809), the lowest in December (26). Benthos was formed only by 19 species, the average value being 11 species, the maximum number of 16 species was ascertained in July, the minimum number of 6 species in December. The greatest species diversity in the association was observed in December (H′ = 2.20), the least in June (H′ = 1.14), the equitability of the number of individuals was the highest in December (J′ = 0.89), the lowest in September (J′ = 0.66). The share of Diptera in the abundance reached 94.0 %.

The average value of biomass was 1.785 g, the highest weight was ascertained in the sample in June (3.758 g), the least in December (0.256 g). The greatest share in biomas was determined in representatives of the orders Diptera and Trichoptera (53.9 % and 34.4 %, resp.).

Tabs. 2 to 10 indicate that 82 species of benthic invertebrates were recorded altogether, the highest mean abundance per 1 m² of bottom was ascertained in 1979, the lowest in 1977. The highest number of species was recorded in 1978, the lowest in 1980. The diversity index was the highest in 1977, the lowest in 1980, the equitability index was the highest in 1977, the lowest also in 1980. The greatest biomass was ascertained in 1976, the least in 1978.

The development of macrozoobenthos association in the period under study is show in Graph 1. A significant increase in abundance per 1 m² of bottom is manifested in the order Diptera, which is associated with a strong enhancing of individuals of the family Chironomidae. Simultaneously, the decrease in abundance is observed in the orders Trichoptera and Ephemeroptera. The biomass of Diptera increased during the whole period under study. From the point fo view of biomass formation, Hirudinea was a significant group. Their share was strongly enhanced in 1977, while during the following years it was lowered to the initial values of 1976. In 1977 the biomass of Trichoptera decreased considerably, while during the next years the differences were not so remarkable.

The incidence of benthic invertebrates did not correspond with natural changes in the stream during that year but it varied in dependence on the changes in physical conditions in the stream below the water works at Dalešice. It was apparent predominantly in the period of 1976 to 1978.

The development of benthic association is summarized in Tab. 10 where the values of abundance, number of species and biomass are given in such

Tab. 7. **Biomass** of macrozoobenthos per 1 m^2 in 1977 (g)

Taxon	Month										Total	Average value	%
	M	A	M	J	J	A	S	O	N	D			
Oligochaeta	0.011	0.001	0.000	0.043	0.013	0.001	0.009	0.167	—	0.007	0.252	0.025	1.1
Hirudinea	0.360	0.246	0.257	3.438	4.788	1.408	0.651	0.560	0.012	0.168	11.888	1.189	53.5
Gastropoda	0.277	0.019	0.362	0.757	0.127	0.003	0.095	—	0.047	0.115	1.802	0.180	8.1
Bivalvia	—	—	0.014	—	0.019	0.010	2.640	—	—	—	2.683	0.268	12.1
Isopoda	—	—	0.009	0.040	0.041	0.031	0.094	0.473	—	0.034	0.722	0.072	3.2
Ephemeroptera	0.005	—	—	0.036	0.042	0.097	0.072	0.093	0.009	0.022	0.376	0.038	1.7
Odonata	0.044	—	—	—	—	—	—	—	—	—	0.044	0.004	0.2
Trichoptera	0.677	0.058	0.363	0.809	0.896	0.289	0.118	0.031	0.032	0.029	3.302	0.330	14.9
Heteroptera	0.008	—	—	0.005	—	0.014	0.016	—	—	—	0.043	0.004	0.2
Coleoptera	—	—	—	0.007	—	—	—	0.009	—	—	0.016	0.002	0.1
Megaloptera	—	—	—	—	—	0.028	—	—	—	—	0.028	0.003	0.1
Diptera	0.124	0.017	0.817	0.033	0.218	0.163	0.031	0.175	0.008	0.285	1.071	0.107	4.8
Total	1.506	0.341	1.022	5.168	6.144	2.044	3.726	1.508	0.108	0.660	22.227	2.222	100.0

Tab. 8. Biomass of macrozoobenthos per 1 m² in 1978 (g)

Taxon	Month									Total	Average value	%
	J	A	M	J	A	S	O	N	D			
Oligochaeta	—	0.007	0.001	—	0.000	0.084	0.002	0.004	0.083	0.181	0.020	1.9
Hirudinea	0.076	0.167	0.060	—	0.124	0.010	0.079	0.089	—	0.605	0.067	6.4
Gastropoda	—	0.012	0.038	—	—	—	0.010	—	—	0.060	0.007	0.6
Bivalvia	—	0.014 +40.700	—	—	—	0.008	0.012	0.003	0.010	0.047	0.005	0.5
Isopoda	0.106	0.014	0.003	—	0.028	0.008	0.068	0.200	0.031	0.458	0.051	4.9
Ephemeroptera	0.021	0.146	0.005	0.008	0.003	0.005	0.032	0.009	0.045	0.274	0.030	2.9
Trichoptera	0.120	0.305	1.107	0.829	0.686	0.018	0.338	0.234	0.048	3.685	0.409	39.2
Coleoptera	—	—	—	—	—	—	0.037	0.011	—	0.048	0.005	0.5
Diptera	0.034	1.322	0.685	0.126	0.387	0.301	0.110	0.899	0.189	4.053	0.451	43.1
Total	0.357	1.987	1.899	0.963	1.228	0.434	0.688	1.449	0.406	9.411	1.045	100.0

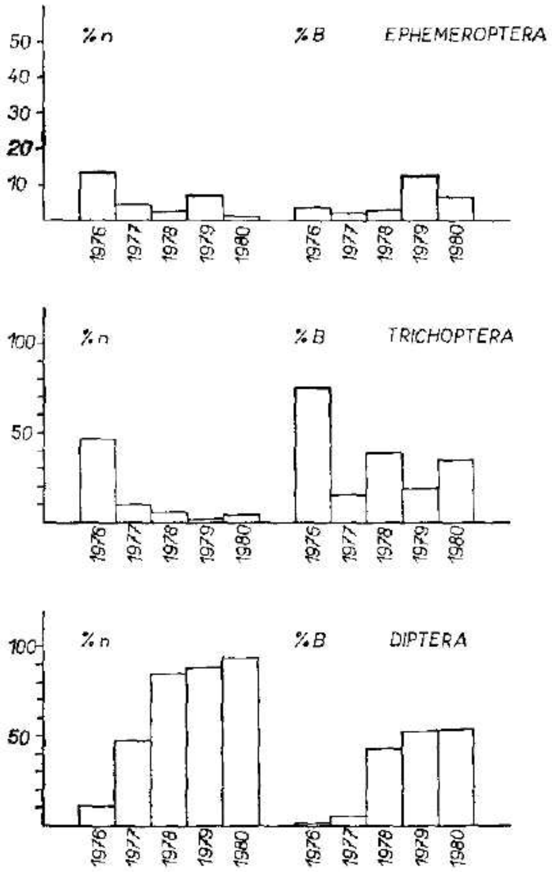
+ mass of *A. cygnea* (Bivalvia) not included in biomass

Tab. 9. Biomass of macrozoobenthos per 1 m^2 in 1979 and 1980 (g)

Taxon	1979							1980					
	Month				Total	Average value	%	Month			Total	Average value	%
	J	J	A	N				J	S	D			
Nematomorpha	0.010	—	—	0.004	0.014	0.004	0.1	—	—	—	—	—	—
Oligochaeta	0.037	0.002	—	—	0.039	0.010	0.4	0.009	—	—	0.009	0.003	0.2
Hirudinea	0.457	0.196	0.036	0.006	0.695	0.174	8.0	0.009	0.135	0.104	0.248	0.083	4.6
Gastropoda	0.060	0.018	0.004	—	0.082	0.021	0.9	0.015	—	—	0.015	0.005	0.3
Bivalvia	—	—	—	—	—	—	—	0.001	—	—	0.001	0.000	0.0
Isopoda	0.005	0.002	0.019	0.440	0.466	0.116	5.3	—	—	—	—	—	—
Ephemeroptera	0.108	0.669	0.115	0.215	1.107	0.277	12.7	0.116	0.130	0.110	0.356	0.119	6.6
Plecoptera	—	0.009	0.007	—	0.016	0.004	0.2	—	—	—	—	—	—
Trichoptera	0.609	0.605	0.181	0.238	1.633	0.408	18.7	1.157	0.683	—	0.840	0.613	34.4
Coleoptera	—	—	—	0.046	0.046	0.011	0.5	—	—	—	—	—	—
Diptera	3.793	0.439	0.284	0.104	4.620	1.159	53.0	2.450	0.393	0.042	2.885	0.962	53.9
Total	5.079	1.940	0.646	1.053	8.718	2.180	100.0	3.757	1.341	0.256	5.354	1.785	100.0

a way that the starting year of 1976 is considered 100 % and the values of the parameters during the next years are related to those of that year.

After initial decrease the number of individuals was enhanced considerably due to the development of chironomids. The decrease in the number of benthic animals with higher weight, esp. in the larvae of caddis flies at the beginning,



Graph 1: Percentual representation of some insect orders in the total number of individuals (n) and in the total biomass (B) during the period under study.

and in leeches at the end of the period under study, was responsible for an essential lowering of biomass values. In 1980 the number of species decreased by about 30 % but, predominantly, the species were modified. Only 9 species were found both in 1976 and in 1980, 20 species ascertained in 1976 were not present in 1980, 10 species found in 1980 were not ascertained in 1976.

From the point of view of fish nutrition the stream section below the water works at Dalešice could be classified as trophically poor for the whole period under study, with the average value of biomass per 1 m^2 of bottom lower than 6 g, from the point of view of water purity the locality was evaluated as beta-mesosaprobic section.

Tab. 10. Average values of basic parameters of macrozoobenthos in the period under study (%)

	1976	1977	1978	1979	1980
Abundance	100.0	89.9	182.1	460.1	387.5
Number of species	00.0	100.0	112.5	106.2	68.8
Biomass	100.0	70.7	33.8	69.4	57.0

DISCUSSION

The contruction of the water works at Dalešice on the Jihlava River was responsible for changes in abiotic and biotic factors below the reservoir and thus for changes in the association of benthic invertebrates. The influence of permanently low water temperature in the stream below the auxiliary reservoir could have resulted in the formation of oligostenothermic association of the trout zone, which was found e. g. in the reservoir on the River Dyje below the Vranov valley reservoir (Zelinka 1979), below the Vír valley reservoir (Peňáz 1966, Peňáz & al. 1968), or below the valley reservoir on the Orava River (Obr 1963, 1972). The fact that this situation has not been observed up to now is caused by other factors, first of all by permanent irregular flow fluctuation. The decrease in abundance of zoobenthos due to the flow fluctuations is reported by Albrecht (1952, 1959), the negative influence of strong flows by Müller (1953), Peňáz & al. (1968), Obr (1963, 1972) and others. The same unfavourable influence was exerted on the Jihlava River even by the lowest flows, especially when filling the reservoirs of the water works at Dalešice.

The above mentioned data indicate that 5 years is a relatively short time to adapt the ecosystem of the river below the valley reservoir to new conditions. Obr (1972) reported the adaptation time to be about 10 years. In the Jihlava River below the water works at Dalešice a significant decrease in the biomass of macrozoobenthos was ascertained, above all due to the decrease in Trichoptera larvae. Some species disappeared while the other ones were well-developed as e. g. those of the family Chironomidae, which is in harmony with the findings from other rivers, as e. g. the River Orava (Obr 1963, 1972), Svratka (Peňáz 1966, Peňáz & al. 1968) or from the Jihlava River in the locality of Hrubšice during the first years of the operation of the water works at Dalešice (Kubíček & al. 1978). The incidence of zooplankton below the water works is also concordant.Contrary to the observation on the Orava River and in the locality of Hrubšice on the Jihlava River, the abundance per 1 m^2 of bottom was enhanced 3 to 4 times at the end of the period under study also thanks to the family Chironomidae.

SUMMARY

During 1976—1980 the influence of the water works at Dalešice on macrozoobenthos of the Jihlava River below the auxiliary reservoir was studied. The sample locality was situated in the territory near the Mohelno Mill, about 1 km below the bottom dam of the auxiliary reservoir. The samples were taken to investigate the number of species, abundance and biomass per 1 m^2 of bottom, the indices of diversity and equitability were calculated. The data are summarized in the Tables.

In the period under study the total number of species in macrozoobenthos was 82, in 1976 it amounted to 29, during the next years 48, 50, 33 and 19,

respectively. In 1980 only 9 species were found identical with those in 1976, 20 species were absent and 10 species were newly ascertained when comparing with 1976. The total number of species decreased by about 30 %. The abundance per 1 m^2 of bottom increased continuously, above all due to the mass development of chironomid larvae, at the end of the period under study being roughly higher by 300 % than at the beginning. On the contrary, the biomass decreased on the same area as a response to the permanent decrease in the larvae of caddis flies. In 1980 it was lower by about 40 % than in 1976.

From the point of view of fish nutrition, the section of the stream was evaluated as trophically poor during the whole period under study, from the point of view of water purity as beta-mesosaprobic.

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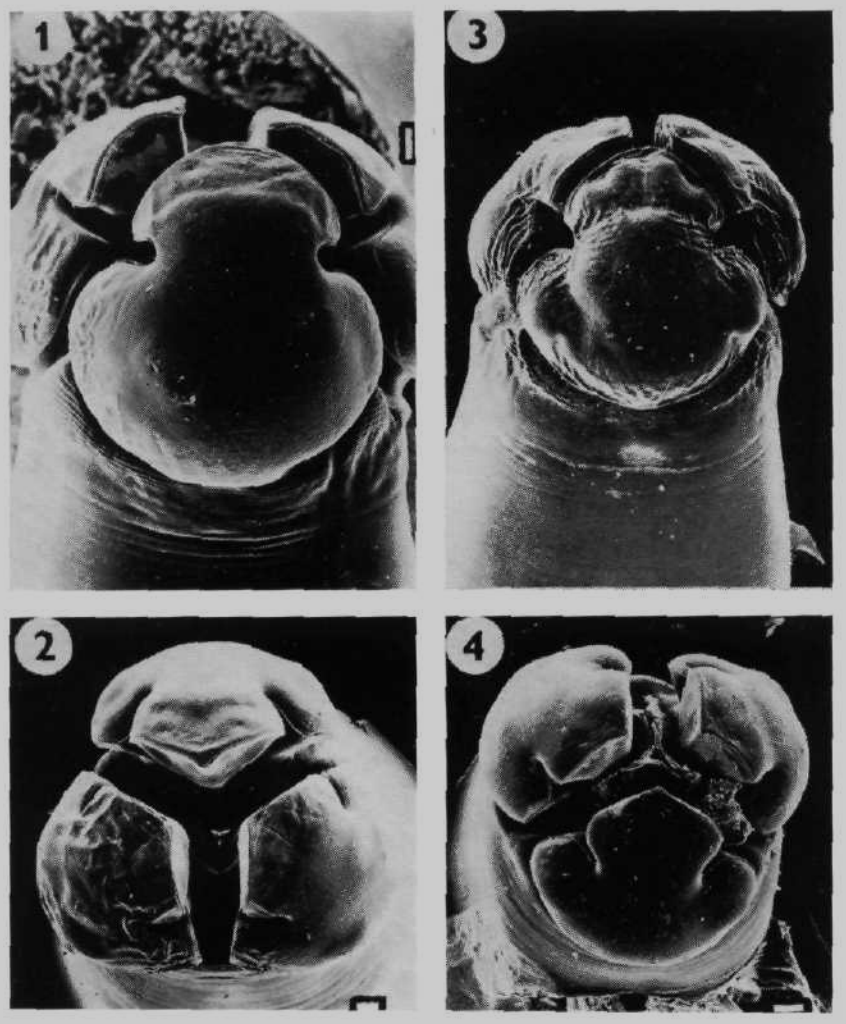


Plate I
Figs. 1—4. Scanning electron micrographs of *Parascaris equorum* from the hosts *Equus caballus* L. (Figs. 1—2) and *E. quagga* Gmelin, 1788 (Figs. 3—4). Fig. 1. Head end of female body — general dorsal view (white scale = 0.1 mm; ×60); Fig. 2. Head end of female body — apical view (white scale = 0.1 mm; ×40); Fig. 3. Head end of female body — dorsal view (white scale = 0.1 mm; ×60); Fig. 4. Head end of female body — apical view (white scale = 0.1 mm; ×40).

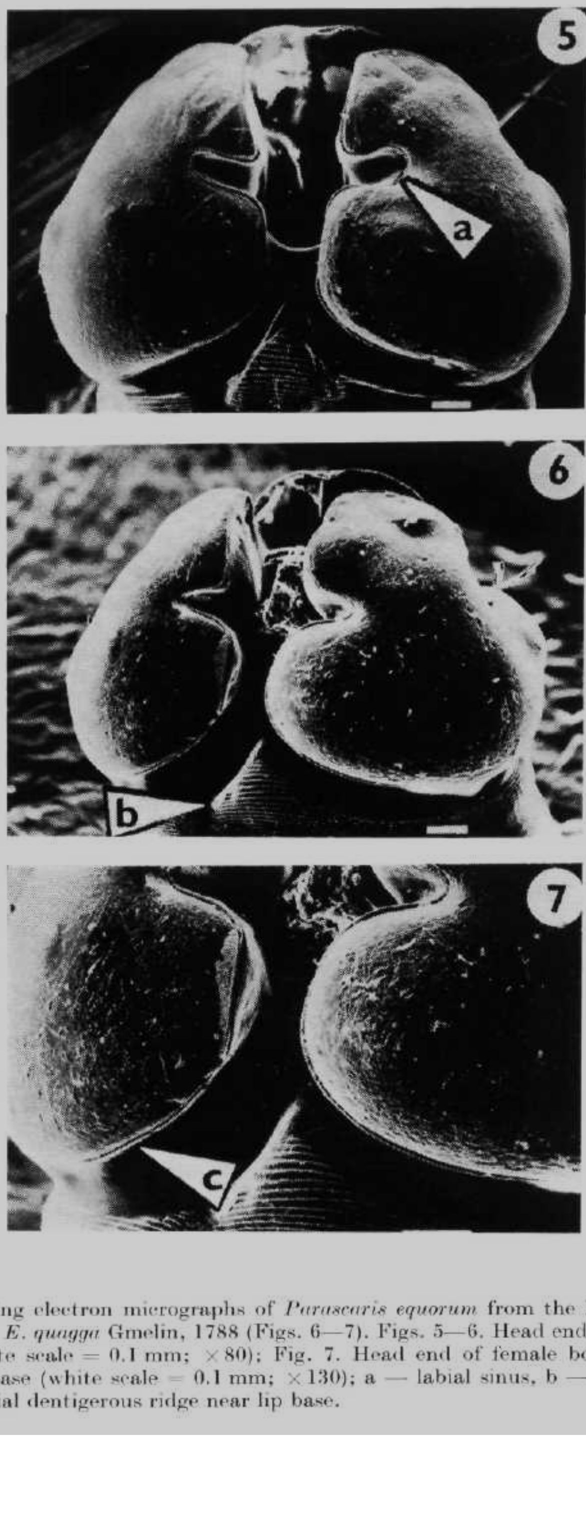


Plate II

Figs. 5—7. Scanning electron micrographs of *Parascaris equorum* from the hosts *Equus caballus* L. (Fig. 5) and *E. quagga* Gmelin, 1788 (Figs. 6—7). Figs. 5—6. Head end of female body — ventral view (white scale = 0.1 mm; ×80); Fig. 7. Head end of female body (ventral view) and detail of lip base (white scale = 0.1 mm; ×130); a — labial sinus, b — interlabium, c — termination of labial dentigerous ridge near lip base.

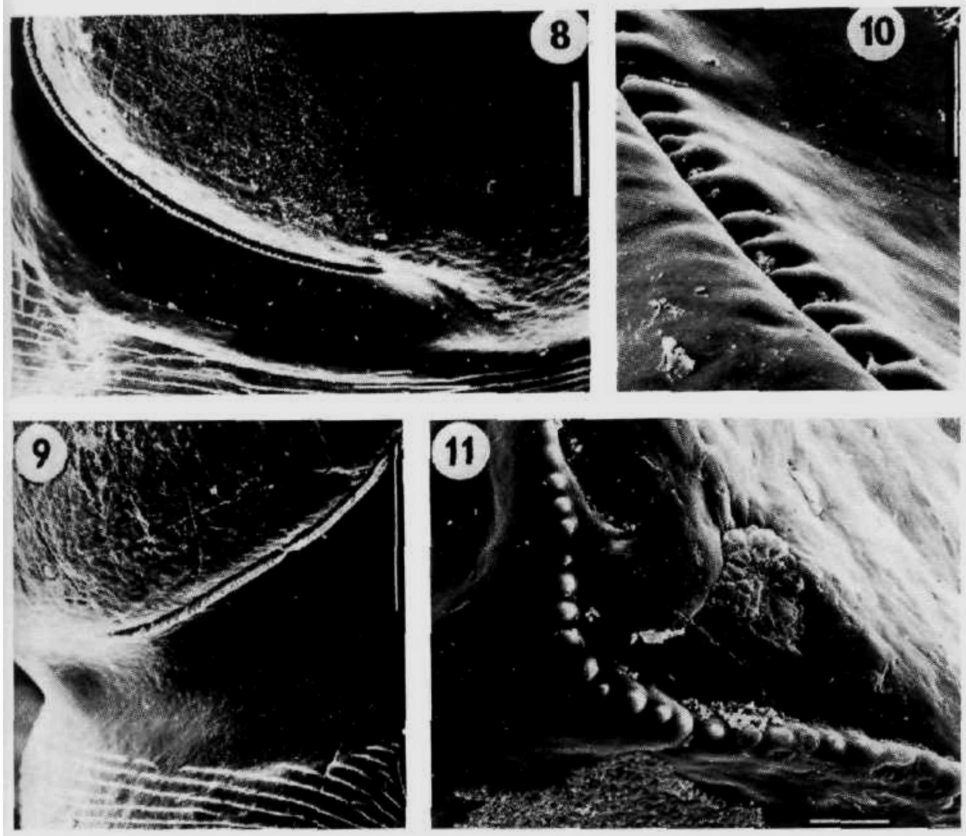


Plate III
Figs. 8—11. Scanning electron micrographs of *Parascaris equorum* from the hosts *Equus caballus* L. (Figs. 8 and 10) and *E. quagga* Gmelin, 1788 (Figs. 9 and 11). Figs. 8—9. Detail of termination of dentigerous ridge reaching up to the lip base behind eulabium in nematodes from both host species (white scale = 0.1 mm; ×220 and ×320); Fig. 10. A part of dentigerous ridge at the edge of eulabium — ventral view (white scale = 0.01 mm; ×7000); Fig. 11. Terminal part of lateroventral lip of female with a part of dentigerous ridge — apical view (white scale = 0.01 mm; ×4400).

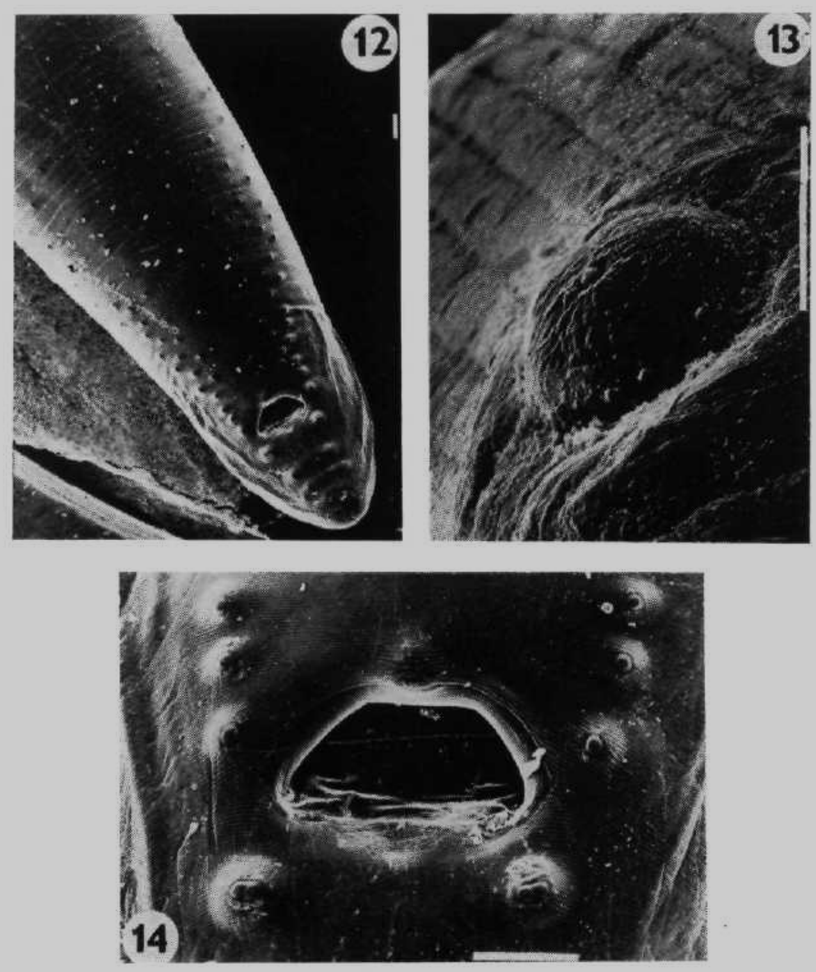
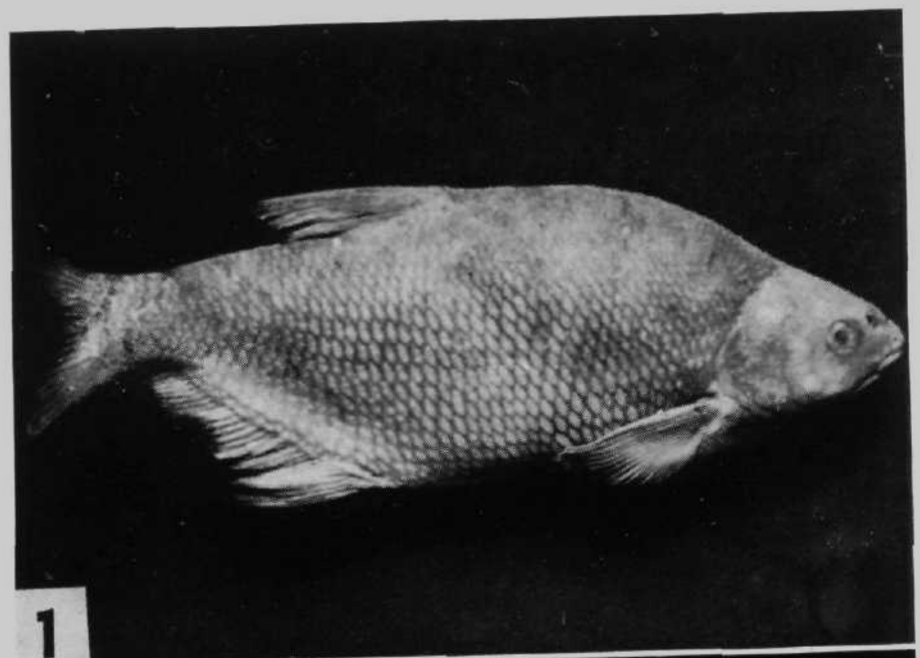


Plate IV

Figs. 12—14. *Parascaris equorum* from the host *Equus quagga* Gmelin, 1788. Fig. 12. Posterior end of male body: situation of cloaca and topography of praecloacal and postcloacal papillae — general ventral view (white scale = 0.1 mm; ×50): Fig. 13. Third praecloacal papilla from upper margin of cloaca — detail (white scale = 0.01 mm; ×3600); Fig. 14. Cloacal aperture with three pairs of simple papillae, one odd praecloacal papilla and a pair of double postcloacal papillae — detail (white scale = 0.01 mm; ×200).



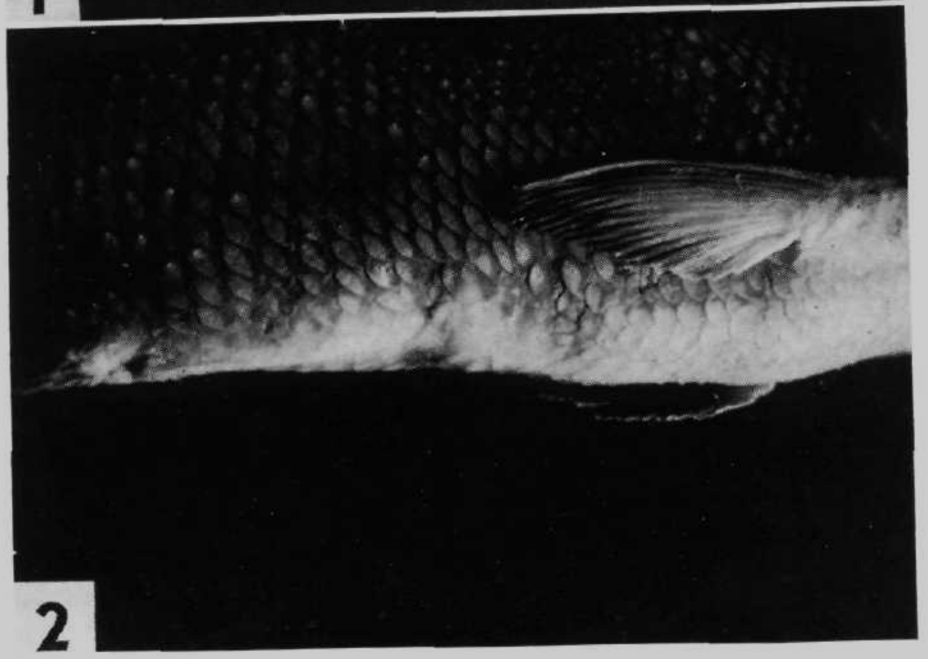


Fig. 1. The male of the bream (*Abramis brama*) without pelvic fins.
Fig. 2. View on the abdominal part of the bream without pelvic fins.

Hiepe, T., Jungmann, R. *Lehrbuch der Parasitologie*, Bd. 2, *Veterinärmedizinische Protozoologie*. VEB Gustav Fischer Verlag Jena, 1983, 231 pp., 49 Figs., DDR 32.00 M

The second volume of this very welcome compendium is on veterinary parasitology. (The first volume on general parasitology and the fourth one on arachnoentomology appeared in 1981 and 1982 respectively; the third one on helminthology should appear in 1984.) The authors followed their economic style of the preceding volumes and the book affords every reader concise and quickly comprehensible information again about parasitic protozoa. The text is written mostly on a quite modern level as to content and terminology and is completed, especially in coccidia, by tables and photographic synopsis. The literature follows each chapter.

After the wealth of illustrations that appeared in the preceding volume on arachnoentomology, this volume under review shows a lesser abundance. Some important genera of protozoa are depicted only in the general chapter and at different microscopic levels. Various minute errors were increased. In such a large compendium it is probably inevitable.

The notes mentioned above do not reduce the basic informative quality of the book. It is a useful volume not only for parasitologists, but for zoologists, too, and it will give good service on their shelves.

J. Chalupský

Gude, W. D., Cosgrove, G. E., Hirsch, G. P. *Histological Atlas of the Laboratory Mouse*. Plenum Press, New York and London, 1982, 151 pp., $ 30

The idea of replacing animals in the laboratory by the development of "alternatives" will not be easily realized. So the laboratory animals, especially laboratory rodents, will remain as the experimental objects for the meantime.

Every experimentater who uses laboratory mice and who is not a specialist in histology must from time to time reach for a manual that will quickly inform him about the microscopical anatomy of his animals. But such books are not available. Perhaps the only one approaching this field is the histology of laboratory rats with black and white photographs (Smith and Calhoun 1968).

The reviewed book is what he needs. It contains 168 colored, well selected micrographs of histological sections of all anatomical parts of the mouse body. The dimensions of photographs are approximately 10×8 cm, there are 3–4 pictures on one page, with explanations on the opposite page and with details numbered. The first 32 pages of the book are devoted to verbal descriptions of structures, the last 14 to fixatives and staining methods.

The book is printed on coated paper of first quality, well done by the printer. Only the original photographs do not have the same background. But this is the problem of publications of this type.

The format of the book, 27.5 cm wide by 18.5 cm high is comfortable, especially with its spiral binding. It is a useful book not only for investigators, but also for teachers and students of zoology. Considering the printing quality of the book and comparing the prices of books on the world market, its price is not exorbitant.

J. Chalupský

Rozkošný B., Vaňhara J. (eds): *Dipterologica Bohemoslovaca III*. Folia Fac. Sc. Nat. Univ. Purk. Brun. 23, 7, 145 pp., 1982. Price 15 Kčs

The volume contains one biography and 26 papers read at the 6th Meeting of Czechoslovak Dipterologists, held on 22–24 October 1980 at Cikháje near Žďár n. S. and organized by the Department of Biology of Animals and Man, Faculty of Science, J. E. Purkyně University, Brno. The individual contributions are devoted to methodological problems, taxonomy, faunistic, ecology and ethology of various dipteran taxa, control of mosquitoes and insecticide resistance in house flies. The investigation covered mostly the territory of Czechoslovakia but several papers deal with the material from Latvia, Lithuania, Mongolia and Afghanistan. Six papers discuss various parasitic Diptera, three papers treat the family Tephritidae. The papers include a description of a new species of Stratiomyidae from Afghanistan, many new faunistic records for Czechoslovakia, in some instances also for Europe or Palaeartic region. Many figures, mostly of good quality, and tables accompany the text. As a whole, the publication gives a very good account of the range of investigations, activities and results achieved by Czechoslovak dipterologists.

V. Černý

Insect Flight 1–II. *Insektenflug* 1–II. BIONA report 1–2. W. Nachtigal Ed., Akad. Wiss. Mainz, G. Fischer, Stuttgart, New York, 1982. Price DM 76.–.

23 lectures from a specialized symposium held in Saarbrucken are devoted to various aspects of insect flight including morphology, aerodynamics, metabolism and mostly (the whole vol. 2) to its nervous regulation. In a sense this symposium was a continuation of the Mainz symposium Physiology of Movement – Biomechanics (1976) by the same editor. On the other hand, further BIONA reports are planned on related subjects, e. g. on bird flight. The present two volumes give an excellent survey of the up-to-date state of the research in the field. There are several methodical contributions showing that the technique for the study of various aspects of the insect flight is being continuously refined and improved; several new and complicated devices are described. As far as physiology of metabolism is concerned, there are two papers of broader interest: One by Casey and May on the metabolism of euglossine bees during hovering flight, an attempt to assess how the total energy output is divided to supply various mechanical functions, assuming mechanical efficiency of the flight muscle to be about 0.2 they conclude that only about 4 % of the total energy output is used for aerodynamic work, the ramaining mechanical energy being necessary to overcome the inertia of the wings (this is a polemics with the Wois-Fogh's assumption that wing inertia is overcome by stored elastical energy). Another almost heretic view is expressed in a contribution by Kestler who opposes the long accepted Krogh's assumption that small insects do not actively ventilate their tracheal system even in conditions of maximal energy consumption; he calculates that they even have to avoid gas exchange by pure diffusion since this would be accompanied by higher water loss than exchange by ventilation.

On insect flight aerodynamics there is an important contribution by Nachtigall on the ascending flight in *Tipula*, describing in quantitative details the rotation of the wing and changes in the geometric and aerodynamic angels of attack during the flight cycle. The extensive paper by Zarnack concernes the flight of the locust and gives a very detailed description of wing movemnts including the changes of wing profiles, the importance of wing rotation for the generation of aerodynamic forces during flight is discussed. It is impossible to discuss here even the most important papers on the nervous regulation of insect flight. The present state of the problem is excellently revised in the closing paper by Jennifer Altman. This concernes the development since the time of the description by Wilson (1961) of the central pattern generator supplying rhytmical impulses for coordinated movements of the flight muscles; its activity was at that time believed to depend mainly on the tonic input from the head. Now it appears that attention concentrates mainly on the importance of the phasic input. This may originate in the segmental sensory organs – the wing stetch receptor and chordotonal organ (paper by Pfau), but even the head hairs, stimulated by air flow and believed to be a typical source of tonic stimulation were now shown to be affected by changes in air flow generated by (and being in phase with) the wing strokes and to contribute to the phasic component of the suprasegmental sensory input; this may apply to the antennae nad cerci as well (paper by Heinzel). Generally it seems to be accepted that whereas the centrl pattern generator may produce rhytmic impulses for coordinated movements of the wings, the real flight, requiring continuous corrections of disturbances from outside, would be impossible without operation of numerous feedback loops supplying phasic stimulation to the thoracic ganglia.

V. Kubišta