

**VĚSTNÍK
ČESKOSLOVENSKÉ
SPOLEČNOSTI ZOOLOGICKÉ**



Svazek XXXIX

Řídila redakční rada: doc. dr. Miroslav Kunst (vedoucí redaktor), doc. dr. Karel Hůrka (výkonný redaktor), členové redakční rady: prof. dr. S. Hrabě (Brno), doc. dr. J. Hrbáček (Praha), prof. dr. Jaroslav Kramář (Praha), dr. J. Lom (Praha), doc. dr. J. Mařan (Praha), člen korrespondent V. Novák (Praha), doc. dr. O. Oliva (Praha), prof. dr. F. Sládeček (Praha), doc. dr. Z. Veselovský (Praha)

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Geologisches Institut der Tschechoslowakischen Akademie der Wissenschaften, Praha

ZUR MIGRATION DER SÜSSWASSEROSTRACODEN

ADOLF ABSOLON

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Abstrakt. Es wird an zwei Beispielen die natürliche Entwicklung der Süßwasserostracodenfauna in der letzten geologischen Periode gezeigt. Die Fauna konnte Tausende von Jahren ununterbrochen einen Biotop besetzen und auf verschiedene Änderungen plastisch reagieren. Erst starke Eingriffe riefen plötzliche Faunenänderungen hervor. Heute werden ausgeprägte Faunenänderungen vor allem durch menschliche Eingriffe in die Natur verursacht. Bei systematischer Probenentnahme wurde festgestellt, dass die Störung des Ökosystems in einem Biotop die Störung des Ökosystems in der ganzen Umgebung bewirken kann.

PALAONTOLOGISCHE BEOBACHTUNGEN

Die paläontologischen Untersuchungen quartärer Ablagerungen ermöglichen es, die Entwicklung der Ostracodenfauna an einer einzigen Stelle Tausende von Jahren zu verfolgen. Es wurde nachgewiesen, dass sich die Süßwasserostracodenfauna in Übereinstimmung mit dem Klimawechsel von Glazialen und Interglazialen entwickelte. An günstigen Profilen kann beobachtet werden, wie anspruchslose glaziale Arten bei zunehmender Temperatur zurücktraten und neue wärmeliebende Arten erschienen. Dieser Prozess war allerdings sehr allmählich und dauerte Hunderte von Jahren.

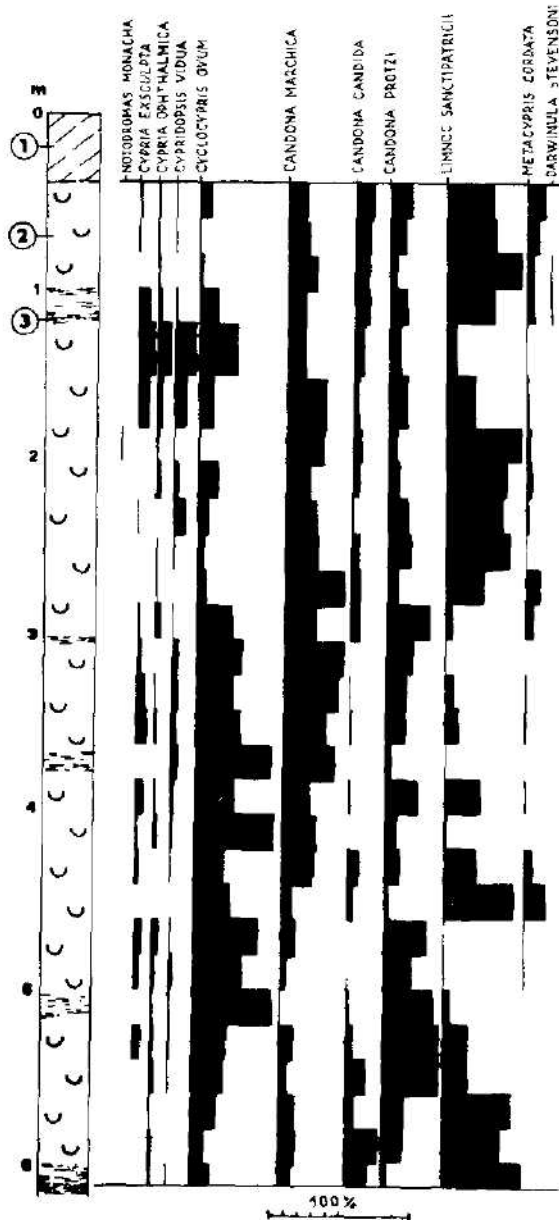
Innerhalb der kalten bzw. warmen Quartarperioden weist die Ostracodenfauna nur geringe Änderungen auf und es gibt Beweise dafür, dass in einem Biotop die Zusammensetzung der Ostracodengesellschaft Tausende von Jahren konstant sein konnte. Man spricht von der Besiedlung des Biotops, aber hier würde das Wort Besatzung passen, da es besser erfasst, dass die Gesellschaft keine neu immigrierten Elemente aufnimmt und in gleicher Zusammensetzung alle wenig günstigen Perioden übersteht. Als gutes Beispiel kann die fossile Fauna der Lokalität Weissensee in Bayern dienen. Es handelt sich um einen verlandeten See im Alpenvorland, der von der Seekreide und teilweise von Moor erfüllt ist. Nach der Pollenanalyse (Paul & Ruoff, 1932) bildete sich hier die Seekreide während des Mittelholozans, d. h. ca 2 500 Jahre lang. Wie man der Ostracodenanalyse entnehmen kann, war dieser Biotop die ganze Zeit nur von neun Arten besetzt (Abb. 1). Die prozentuale Artenvertretung schwankte zwar, aber keine Art verschwand und bei zwei immigrierten Arten, *Darwinula stevensoni* und *Notodromas monacha*, kam es nicht zu weiterer Fortpflanzung.

Bei den Quellbiotopen, in denen der klimatische Einfluss nicht so stark wirken konnte, dauerte die Besatzung einer geschlossener Gesellschaft oft

das ganze Holozän hindurch und dort, wo die Quelle noch heute vorhanden ist, kann man feststellen, dass die lebende Ostracodenfauna nicht von der fossilen abweicht.

Das alles spricht dafür, dass vom ökologischen Gesichtspunkt aus sich die Ostracodengesellschaft als Ganzes plastisch verhält. Es gibt aber quartäre Profile, in denen auch plötzliche und ausgeprägte Änderungen in den fossilen Faunen festzustellen sind (Absolon, 1973). Dies sind für paläontologische Forschungen von grosser Bedeutung, da sie starke Eingriffe in den Biotop anzeigen. Als Beispiel führe ich die Lokalität Byšice-Lejkov an (Mittelböhmen). Hier entstand am Übergang zwischen Spät- und Postglazial eine mächtige Schicht vom Flachmoortorf, deren Sedimentation schon im Präboreal endete und in die Seekreide überging (Abb. 2). Beide Ablagerungen enthalten spezifische Ostracodenfaunen, die durch eine ungewöhnlich scharfe Grenze getrennt sind. Die faunistische Rejuvenation an der Lokalität Byšice-Lejkov wurde durch Klima- und gleichzeitigen Sedimentationswechsel bedingt.

Abb. 1. Mittelholozäne Ostracodengesellschaft an der Lokalität Weissensee in Bayern. 1 — Anmoor; 2 — Seekreide; 3 — Pflanzenreste



ZOOLOGISCHE BEOBACHTUNGEN

Während die paläontologischen Untersuchungen es ermöglichen, die natürliche Entwicklung der Ostracodenfauna an einer einzigen Stelle lange Zeit zu verfolgen, bringen die zoologischen Beobachtungen Daten über die heutige räumliche Verbreitung der Ostracodenarten. In der zoologischen Literatur treten sehr oft Angaben auf, dass manche Arten sehr verschiedene Biotope

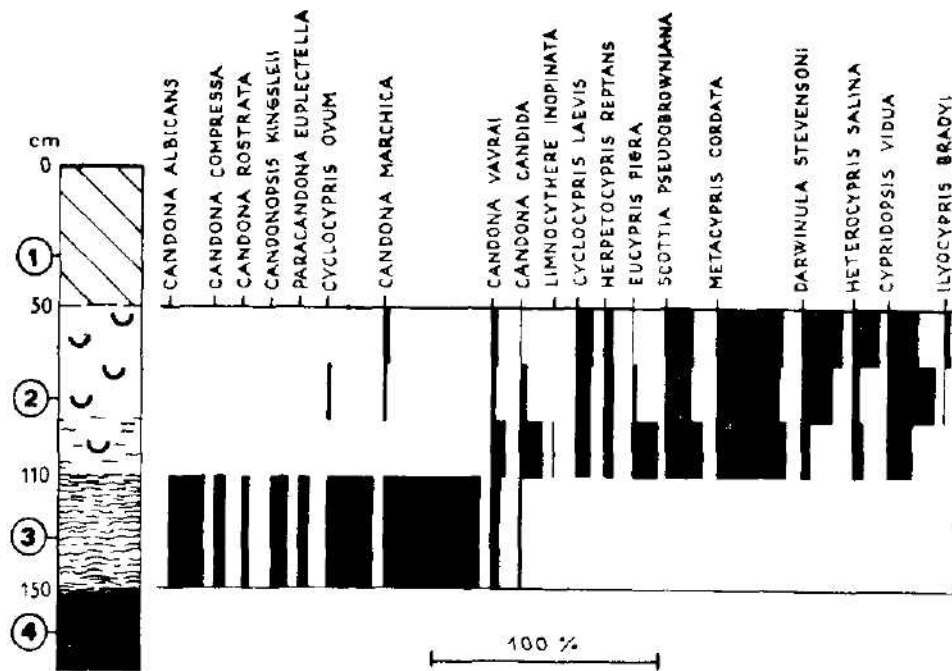


Abb. 2. Ausgeprägte Faunenänderung an der Lokalität Byšice-Lejkov in Böhmen. 1 — Ackerboden; 2 — altholozane Seekreide; 3 — kalkhaltiger Flachmoortorf; 4 — spätglazialer zersetzter Flachmoortorf

bewohnen, d. h. dass sie eine grosse Plastizität aufweisen. Diese Angaben beruhen vorwiegend auf isolierten Probenentnahmen in verschiedenen Gebieten Europas und entstellen die wirkliche ökologische Plastizität der Ostracodenarten. Ich möchte betonen, dass eine einzige Probe aus einem geologischen Profil und eine einzige Probe aus einem Landschaftsgebiet für die paläoökologische bzw. ökologische Untersuchung nur von informativer Bedeutung sind.

Ich versuchte, in einem geomorphologisch und geologisch einheitlichen Gebiet, das möglichst von der menschlichen Tätigkeit wenig berührt ist, Proben aus allen zur Verfügung stehenden Wasserbiotopen zu entnehmen. Diese Untersuchungen führte ich bisher in zwei Naturschutzgebieten in westslowakischen Gebirgen und in einem Quellgebiet und einem Seegebiet im mittelböhmischen Flachland durch. Diese zeitlich aufwendige Arbeit ergab interessante Erkenntnisse über die Lebensweise der Ostracoden in allen Zusammenhängen.

Es wurde festgestellt, dass jedes Gebiet faunistisch stabilisiert ist, d. h. dass es von einer geschlossenen Vergesellschaftung mit bestimmter Artenzahl bewohnt bzw. okkupiert ist. Wie die paläontologischen Beobachtungen zeigten, musste die Zusammensetzung der heutigen Ostracodenfauna in jedem Gebiet schon im Postglazial gegeben werden. Die Fauna besetzt alle Wasserbiotope und lässt keinen freien Lebensraum für immigrierte Arten. Auch neu entstandene Wasseransammlungen werden schnell von der lokalen Fauna besetzt, ähnlich werden Lücken in solchen Biotopen ausgefüllt, in denen sich für kurze Zeit die Bedingungen veränderten (z. B. durch Austrocknen). Diese

Erscheinung, sowie die vollkommene Ausbreitung einzelner Arten über das geomorphologisch und geologisch einheitliche Gebiet ist durch die passive Migration zu erklären. Auf kurze Entfernung vollzieht sich die Migration sehr intensiv über direkte Wasserwege und durch die Tätigkeit von verschiedenen Organismen. Hier findet man auch die Erklärung für manche Unklarheiten, die bei isolierten Fängen entstehen. Ich führe zwei Beispiele an: 1. In zwei alten Teichen, deren Schlamm Boden heute nur von einer dünnen Schicht stehendes Wasser bedeckt ist, fand ich ein paar erwachsene Weibchen der seltenen Art *Prionocypris zenkeri* (Lok. Mělnická Vrutice — erster Fund in Böhmen). Es ist aber bekannt, dass diese Art stehendes Wasser meidet und langsam fließendes, also sauerstoffreiches Wasser mit Wasserpflanzen bevorzugt. Eine systematische Probenentnahme in der Umgebung zeigte, dass *Prionocypris zenkeri* in einer naheliegenden Forellenfarm massenhaft vorkommt und von dort aus verschleppt sein muss. Der alte Teich stellt also für *Prionocypris zenkeri* einen fremden Biotop dar. 2. Beim Kurort Bojnice in der Slowakei befinden sich manche Mineralquellen, in denen der Halobiont *Heterocypris salina* häufig vorkommt. Einzelne Exemplare dieser Art sind jedoch auch in umliegenden Biotopen mit Süßwasser, sogar in kurzlebigen Regentümpeln zu finden. Ich vermute, dass dieses Beispiel deutlich zeigt, wie ein isolierter Fund der verschleppten Art *H. salina* ins Regenwasser ihre ökologische Valenz entstellen könnte.

Sowohl paläontologische als auch zoologische Beobachtungen bringen Beweise dafür, dass nicht nur einzelne Ostracodenarten, sondern auch die Ostracodenfauna als Ganzes ökologische Plastizität aufweist. An einer Stelle oder in einem Gebiet übersteht die Fauna in fast gleicher Artenzusammensetzung verschiedene Änderungen der Lebensbedingungen. Falls aber der Eingriff in den Biotop, bzw. in das Gebiet, schon zu stark ist, kommt es plötzlich zu ausgeprägten Änderungen innerhalb der Ostracodenfauna. Diese Erscheinung wird als „Störung des Gleichgewichts im Ökosystem“ bezeichnet. Als Beispiel wurde schon die Fossilfundstelle Byšice—Lejkov angeführt, an der das Gleichgewicht im Ökosystem durch Klima- und Ablagerungswechsel gestört wurde. Heute werden die grossen qualitativen Änderungen in der Ostracodenfauna besonders durch menschliche Eingriffe in die Natur verursacht.

Im Jahre 1964 untersuchte ich Seen, Teiche und ihre Abflüsse in einem, von quartären Ablagerungen bedeckten Flachland bei Mnichovo Hradiště in Böhmen. Es wurden hier 27 Arten festgestellt. In der Zeit, als ich die Proben entnahm, wurde an einem kleinen Teich bei Žehrov eine Entenfarm angelegt. In diesem Teich fand ich damals folgende Ostracodengesellschaft:

<i>Cypridopsis vidua</i>	(41,0 %)	<i>Candona protzi</i>	(3,0 %)
<i>Notodromas monacha</i>	(33,0 %)	<i>Candona compressa</i>	(3,0 %)
<i>Cypria ophthalmica</i>	(8,0 %)	<i>Candona caudata</i>	(2,0 %)
<i>Limnocythere inopinata</i>	(5,0 %)	<i>Ilyocypris gibba</i>	(1,0 %)
<i>Cyclocypris ovum</i>	(4,0 %)		

Nach neun Jahren wiederholte ich in der Entenfarm die Probenentnahme und fand hier nur zwei Arten:

<i>Cypridopsis vidua</i>	(4,0 %)	<i>Physocypris kraepelini</i>	(96,0 %)
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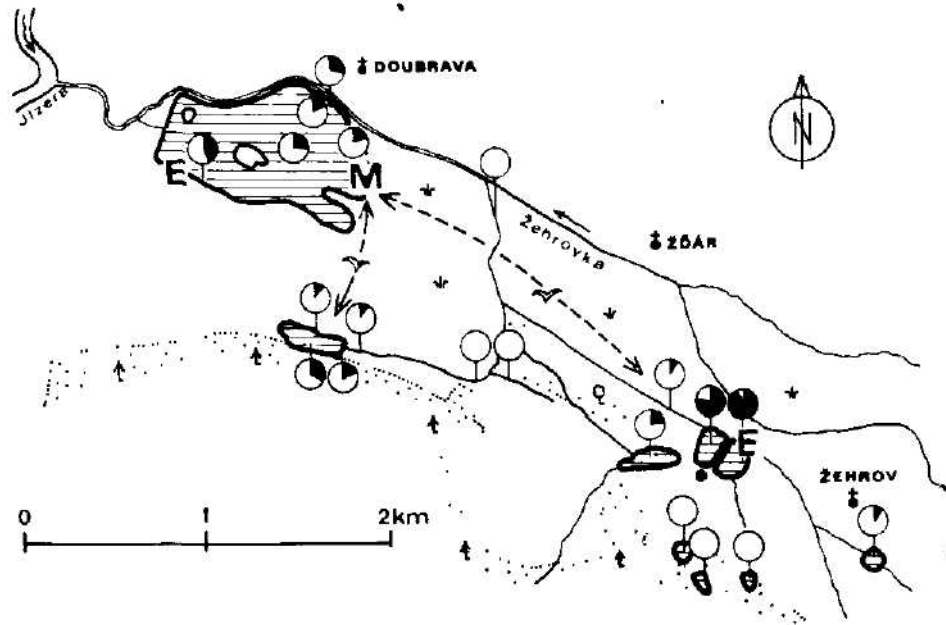


Abb. 3. Verbreitung der Art *Physocypria kraepelini* G. W. Müller im Seegebiet bei Mnichovo Hradiště in Böhmen. Schwarze Fläche im Kreis zeigt die prozentuale Vertretung der Art in der Ostracodenfauna. E — Entenfarm; M — Mowenistort

Überraschend war nicht nur die Artenarmut, sondern auch das massenhafte Vorkommen von *Physocypria kraepelini* G. W. Müller, die zu den seltensten Arten gehört und bisher nur in Deutschland (G. W. Müller, 1903; Klie, 1938), in den Niederlanden (Redeke und Dulk, 1940) und in Jugoslawien (Klie, 1941) nachgewiesen wurde. (Wenn *P. kraepelini* und *P. kliei* bzw. *fadeevi* ein Synonym darstellen, müsste man noch polnische und russische Funde in Betracht ziehen).

Das Aussterben der ursprünglichen Ostracodenfauna mit Ausnahme der Art *Cypridopsis vidua* und die erstaunliche Vermehrung von *Physocypria kraepelini* wurde durch die Errichtung der Entenfarm verursacht. In letzten Jahren erreichte die Zahl der gefütterten Enten fast 5 000, dabei ist der Teich nur bis 1,5 m tief und seine Fläche nimmt ca 2,3 ha ein. Folgeerscheinungen sind heute nicht nur an der Fauna, sondern direkt im Teich zu sehen. Die gesamte Vegetation ging ein, nur an einer Stelle kümert noch *Carex*; der Seeboden ist kahl, tonig, da die Deckschicht aus organischem Detritus nicht mehr vorhanden ist.

Die Störung des Ökosystems im Teich bei Žehrov bewirkt die Störung des Ökosystems in der ganzen Umgebung. Die Entenfarm bei Žehrov stellt z. Z. den Herd dar, aus dem sich *Physocypria kraepelini* schnell ausbreitet (Abb. 3). In dem Teich, der in der Nachbarschaft der Entenfarm liegt und zu dem Enten auch Zugang haben, erreicht *P. kraepelini* in der Ostracodenfauna schon 76 %. In dem Abflussgraben der Entenfarm wurde *P. kraepelini* ebenfalls gefunden (9 % — 200 m unterhalb des Teiches). Häufiges Vorkommen von *P. kraepelini* (19 bis 49 %) wurde aber auch im See bei Dou-

brava festgestellt. Hier nisten jedes Jahr massenhaft Möwen, die ihr Futter in der Umgebung suchen und auch in die Farm bei Žehrov fliegen. Die Möwen müssen hier die passive Migration von *P. kraepelini* ermöglichen. Ihr grosser Nistort und eine kleine alte Entenfarm erhöhen gleichzeitig die Saprobität im See und bereiten so günstige Bedingungen für *P. kraepelini* vor. Aber das häufige Auftreten von *P. kraepelini* in anderen Seen, bzw. Teichen, die den Naturzustand aufweisen (am Waldrand südlich von Doubrava; westlich von der Entenfarm bei Žehrov) ist nur durch permanent intensive Migration zu erklären, die mit einer Infektion verglichen werden kann.

ZUSAMMENFASSUNG

Einzelne Ostracodenarten weisen eine verschieden grosse ökologische Plastizität auf. Auch die Ostracodenfauna als Ganzes reagiert auf Änderungen im Biotop plastisch, was man sowohl bei paläontologischen als auch bei zoologischen Untersuchungen feststellen kann. Erst starke Eingriffe in den Biotop oder in das ganze Gebiet rufen ausgeprägte Faunenänderungen hervor. Diese sind für das Studium der Entwicklung der Natur in der geologischen Vergangenheit von grosser Bedeutung.

Heute stehen Fragen des Naturschutzes im Vordergrund, für deren Lösung die Ostracodenforschung ein wertvolles Hilfsmittel ist. Die Ostracoden bilden nämlich einen der Indikatoren für verhältnismässig starke Eingriffe des Menschen in die Natur.

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Anschrift des Verfassers: Dr. A. Absolon, CSc., Geologický ústav ČSAV, Trojanova 13, 12 000 Praha 2, Tschechoslowakei.



Department of Systematic Zoology, Charles University, Prague

**A REVISION OF THE PALAEARCTIC TACHYDROMIINE
GENUS DYSALETRIA LOEW (DIPTERA: EMPIDIDAE)**

MILAN CHVÁLA

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Abstract: The genus *Dysaletria* Loew, 1864 (Diptera, Empididae, Tachydromiinae) includes 3 western Palaearctic species. Besides the European *D. atriceps* (Boheman, 1852), the type of the genus, described and illustrated as *D. nigripennis* sp. n. from Europe, and the Canarian *Tachydroma varicolor* Becker, 1908 (= *Platypalpus*) is also transferred to *Dysaletria*. The systematic position of the genus is discussed and the species are keyed.

The genus *Dysaletria* Loew, 1864 has been known until now as monotypic with a single species *D. atriceps* (Boheman, 1852) recorded from scattered localities of northern and central Europe. The species was poorly known for a long time and was fully redescribed with first description of the male sex only very recently (Chvála, 1975); also the detailed generic diagnosis was given. The second species of *Dysaletria*, described below, was discovered in 1974 in central Europe, in the south-east of Slovakia, Czechoslovakia. Finally, when revising, through the kindness of Dr. H. Schumann, the Becker's types of *Platypalpus* species deposited in the Zoologisches Museum, Berlin, I have found that *Platypalpus varicolor* (Becker, 1908) of the Canarian Isles represents a third species of the genus *Dysaletria*.

SYSTEMATIC POSITION OF THE GENUS

The genus *Dysaletria* Loew, 1864 is closely related to the genus *Platypalpus* Macquart, 1827, differing from it mainly by the contiguous eyes below antennae, by the very indistinctly developed or practically absent acrostichal bristles, by the thickened fore femora which are much deeper than mid femora, and by the somewhat narrow wings with less developed axillary lobe and very indistinct vein A. The large, very globular and conspicuously convex humeri in addition to the different armature of slender mid legs — mid femora with only fine small hairs in a double row beneath and mid tibia with not even a trace of apical spur — distinguish the *Dysaletria* species from all species of *Platypalpus* except for those of the somewhat intermediate *P. hackmani*-group sensu Chvála (1975). The latter, however, have always distinct even though linear face below antennae, dorsocentral and acrostichal bristles on mesonotum better developed, fore femora only slightly deeper than mid femora, etc. All the three known *Dysaletria* species

have also entirely dusted thoracic pleura including sternopleura, a feature which, however, is also present in several *Platypalpus* species.

The general appearance of *Dysaletria* species resembles more the species of the genus *Tachydromia* Meig. than those of *Platypalpus* Macq., particularly because of the slender habitus, and this is still more explicit by the dark clouded wings in the newly described *D. nigripennis*.

The genera *Symballophthalmus* Beck., *Platypalpus* Macq. and *Dysaletria* Loew form a well separated complex of genera within Tachydromiinae which all possess anal cell (cell Cu) on wing. In all other tachydromiine genera including tribe Drapetini the anal cell is absent, at most the lower branch of vein Cu, usually closing the anal cell, is present in most of the *Tachypeza* Meig. species, or a faint vein A in a form of a more or less distinct fold is present in *Chersodromia* Walk. and its allied genera. The three genera of the *Platypalpus*-complex with well developed anal cell on wing may be easily differentiated on the basis of the structure of (1) the head and (2) legs: (1) eyes are meeting above antennae in *Symballophthalmus* Beck., separated on both frons and face in *Platypalpus* Macq., and meeting below antennae in *Dysaletria* Loew. (2) anterior four femora are equally slender in *Symballophthalmus* Beck., subequal or mid femora usually stouter in *Platypalpus* Macq., and fore femora are stouter in *Dysaletria* Loew.

The genus *Symballophthalmus* Beck. is undoubtedly the most primitive tachydromiine genus, and *Dysaletria* Loew derived from *Platypalpus* Macq., forming a connecting link to other genera of the tribe Tachydromiini, particularly to genera *Tachydromia* Meig. and *Tachyempis* Mel.; this may also be well demonstrated on the gradual loss of anal vein on wing. The presence even though less distinct anal cell (Cu), the flattened palpi and the subequal basal cells (BR and BM) are characters common to both *Dysaletria* Loew and *Platypalpus* Macq. On the other hand the contiguous eyes below antennae, the reduced acrostichals and the thickened fore femora rank the genus *Dysaletria* Loew close to genera *Tachydromia* Meig. and *Tachyempis* Mel. There are several characters common to both *Dysaletria* and *Tachydromia* species, as for instance the rather parallel frons, presence of anterior ocellar bristles, and equally large facets on eyes. On the contrary the rather apically pointed antennal segment 3, short and almost rounded humeri, and the finely bristled venter of mid femur are common for *Dysaletria* Loew and *Tachyempis* Mel.

The generic diagnosis of *Dysaletria* Loew given by Chvala (1975) fits quite well to the further two species except for the statement that "yellow species" with "clear wings" are involved. The existence of further two *Dysaletria* species in addition to *D. atriceps* also confirms the justification of the generic status of *Dysaletria* Loew.

Dysaletria atriceps (Boheman, 1852)

Tachypeza atriceps Boheman, 1852 : 190 ♀

Dysaletria melanocephala Boheman; Loew, 1864 : 31 ♀ (unjustif. emend.)

Dysaletria atriceps Boheman; Engel, 1938 : 13 ♀; Chvala, 1975 : 210♂♀

♂♀. Entirely yellow species except for black coloured and greyish dusted head, antennae yellow. Legs yellow but last tarsal segment on all tarsi darkened.

Length: body ♂ 1.6–1.8 mm, ♀ 1.9–2.2 mm, wing 1.7–1.9 mm.

Distribution: Southern Sweden (Skåne, Öland, Östergötland, Södermanland), Lapland, NW of European part of the USSR (Leningrad region), Polish Silesia (Wrocław) and Bavaria (Haunstein).

Dates: June and July. In grass on dry biotopes (Boheman, 1852) and on bushes (Loew, 1864).

Holotype identification: Described by Boheman (1852) from a single ♀ taken on 10 July 1851 at Degeberga in Skåne, Sweden. There are altogether 5 ♂ and 9 ♀ of *Tachypeza atriceps* Boheman in coll. Boheman in Stockholm, 4 ♂ and 6 ♀ originating from Ögland (labelled O. G.), a pair from Södermanland (Hlm.), 1 ♀ from Öland (Oel.) and 1 ♀ from Skåne (Sc.); the last mentioned female was identified and labelled by the present author in 1972 as holotype of *Dysaletria atriceps* (Boheman, 1852). There are 2 ♀ in Loew's Collection in Berlin, both labelled "Lapland, Boheman". — 1 ♀ (No. 10799) was labelled by Loew as "TYPUS", the second ♀ as "PARA-TYPUS". However, these specimens cannot be types of *Dysaletria atriceps* (Boheman, 1852).

Dysaletria nigripennis sp. n.

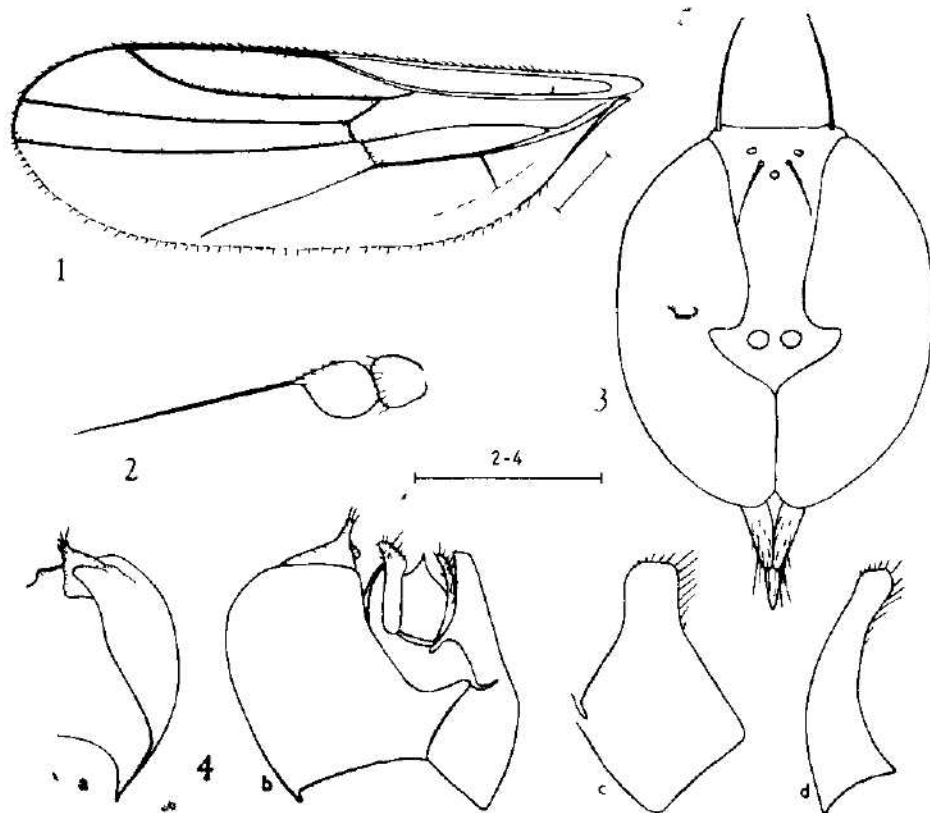
Diagnosis. A black species with head and thorax uniformly dark grey dusted, antennae and legs yellow. Large bristles on head and thorax blackish. Wings blackish-brown clouded leaving only base of wing somewhat milk-white.

♂. Head black in ground colour, rather densely dark grey dusted, eyes contiguous below antennae. Frons rather deep, at least as deep above antennae as antennal segment 2, widening out above and almost twice as deep opposite hind ocelli. Occiput above with some short dark hairs becoming longer and pale below neck. A pair of vertical bristles long and widely separated, anterior pair of ocellar bristles almost as long, all dark; posterior ocellar bristles absent. Antennae yellow, basal segment invisible, segment 3 slightly larger than segment 2 and almost spherical; terminal arista about twice as long as rest of antenna, blackish. Palpi long ovate but small, pale yellow, covered with fine silvery pubescence, and usually with two long whitish hairs at tip. Proboscis yellow but black tipped, rather short but strong, scarcely half as long as head is high, somewhat pointed backwards.

Thorax black, rather densely grey dusted but somewhat subshining black on mesonotum when viewed from above, pleura uniformly dusted including sternopleura. Humeri large and almost globular, convex and very prominent, no distinct humeral bristle but there are three small hair-like bristles of equal length. Acrostichal bristles practically absent, uniserial dorsocentrals invisible except for a bristle-like last prescutellar pair which is dark and about as long as 2 notopleural bristles and a pair of apical scutellars; outer pair of scutellar marginal bristles small and hair-like, postalar bristle small, scarcely longer than humeral.

Legs uniformly yellow leaving only last tarsal segment on all pairs strikingly polished black. Fore femora distinctly thickened, ventrally on basal half with several long pale bristly hairs. Fore tibiae spindle-shaped dilated, dorsally with a row of minute but closely-set darker hairs, ventrally short pale haired. Mid femora rather slender, as deep as hind femora, ventrally with a double row of dark bristly hairs becoming longer towards base and ending in a single long pale bristly hair at base of femur; hind femora short

haired, anterodorsally with a row of minute dark hairs. Posterior four tibiae slender, mid tibiae ventrally with a row of small dark bristly hairs becoming denser towards tip, similar hairs also on mid metatarsus; no apical spur on mid tibia. Tarsi slender and only pale haired, all coxae with long pale bristly hairs anteriorly.



Figs. 1-4. *Dysaletria nigripennis* sp. n., paratype ♂: 1 - wing. 2 - antenna. 3 - head, frontal view. 4 - hypopygium; a - right lamella, lateral view; b - perianthrium with cerci; c - left lamella, dorsal view; d - the same, lateral view. Scales 0.2 mm.

Wings rather small and slender with slightly developed anal lobe, blackish-brown clouded except for pale, almost milky-white base of wing including whole of costal cell and the area of the reduced anal lobe. Vein R_1 , the corresponding section of vein C and other veins at extreme base pale, otherwise veins blackish. Veins R_{4+5} and M evenly bowed upwards and slightly diverging throughout, crossveins almost contiguous and consequently both basal cells nearly equal in length. The vein closing anal cell at right angles to vein Cu or slightly recurrent, vein A very indistinct. Squamae and halteres whitish-yellow.

Abdomen practically bare and almost subshining black, basal tergite and whole of the venter more greyish. Genitalia globular, about as deep as the

end of abdomen, more polished black in contrast to very finely dusted abdomen; both lamellae with minute pale marginal hairs, small slender cerci microscopically grey pilose.

Length: body 1.5–2.1 mm (holotype 1.7 mm), wing 1.6–1.9 mm (holotype 1.6 mm).

♀. Hind femora often slightly darkened towards tip, otherwise resembling male except for sexual differences. Abdomen very pointed apically, apical two segments and short ovate cerci scarcely denser greyish dusted.

Length: body 1.6–2.3 mm, wing 1.6–1.9 mm.

D. atriceps (Boh.) can be easily distinguished from *D. nigripennis* sp. n. by the yellow colour of thorax and abdomen, by the pale bristles on head and thorax and entirely clear wings.

Holotype ♂: Czechoslovakia, SE Slovakia, Plešany near Královský Chlmec, 27. V. 1974 leg. Chvála; deposited in author's collection.

Paratypes: The same locality, 25. V. 1974 4 ♂ 3 ♀, 27. V. 1974 7 ♂ 8 ♀ leg. Chvála; a pair in the British Museum (Nat. Hist.), London and in the collection of Dr. V. G. Kovalev; the rest of the paratype series in author's collection.

I collected specimens of this species by sweeping in the grasses growing in a well lit forest of the poplar tree (*Populus nigra*), the specimens were not uncommon in the grass. On 25 May I collected 4 ♂ and 3 ♀, which I took first for a new *Tachydromia* species, and 2 days later, when visiting again this locality, I took further 8 ♂ and 8 ♀. The species was not found in the neighbouring open places and meadows.

Dysaletria varicolor (Becker, 1908) comb. n.

Tachydromia varicolor Becker, 1908 : 39 ♀

♀. Head and thorax black in ground colour and densely greyish dusted, abdomen yellow. Antennae, palpi, proboscis and legs including last tarsal segments yellow. Contrary to the preceding two *Dysaletria* species, *D. varicolor* has mesonotum more bristled: humeri with a distinct pale bristle and 2 smaller fine hairs on the outside and, in addition to the pale thoracic bristles in usual position, there is a distinct posthumeral bristle and another pair of strong dorsocentral bristles in anterior third of mesonotum before the notopleural suture; otherwise the inconspicuous dorsocentrals and practically absent acrostichals as in other species.

Length: ♀ body 2.3 mm (2 mm according to Becker), wing 2.5 mm.

Distribution: Canary Islands.

Dates: December.

Holotype identification: Becker (1908) described it from a single ♀ taken in December "aus dem Lorbeerwalde von Agua garzia 6–700 m hoch" in Tenerife, Canary Is. There is a single ♀ in coll. Becker in Berlin labelled "Teneriffe No. 46671, 14. XII." and "varicolor Beck." in Becker's handwriting. This specimen is undoubtedly the holotype of *Tachydromia varicolor* Becker, and was accordingly labelled by the author.

Note. No other material of this species is available and Engel (1939 : 103) when elaborating the genus *Platypalpus* Macq. (as *Coryneta* Meig.) in Lindner, Die Fliegen der Palaearktischen Region, only retyped the rather accurate Becker's original description. Through the kindness of Dr. M. Baez from

Tenerife I have seen a very interesting female of an undescribed *Platypalpus* species from Tenerife (Mte de Icod, 19. I. 1947, leg. M. Baez), which superficially resembles in some characters (large round humeri, thickened fore femora) *D. varicolor*. However, it is a species of the *Platypalpus hackmani*-group with face very linear below antennae, but eyes not contiguous there, with a very broad frons, antennal segment 3 and arista blackish-brown, abdomen black in ground colour with greyish tomentum, and with all thoracic bristles extensively darkened including distinct and equally long black uniserial dorsocentrals and narrowly biserial acrostichals.

KEY TO DYSALETRIA SPECIES

- 1 A posthumeral bristle present and a pair of strong dorsocentrals in anterior third of mesonotum before the notopleural suture. Head and thorax black, abdomen yellow (Canary Islands) *varicolor* (Beck.)
 — Posthumeral bristle absent and only 1 pair of strong dorsocentral bristles in front of scutellum 2
- 2 (1) Body yellow except for blackish-grey head, wings clear (N. and C. Europe)
 *atriceps* (Boh.)
 — Body entirely black, wings dark clouded (C. Europe) *nigripennis* sp. n.

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Author's address: Dr. Milan Chvála, Přírodovědecká fak. University Karlovy, katedra systematické zoologie, Viničná 7, 128 44 Praha 2, Czechoslovakia.

Der Zoologische Garten Dvůr Králové n. L.

HAARWECHSEL DER ZEBRAS

LUDĚK J. DOBRORUKA

Eingegangen am 16. Oktober 1974

Abstrakt: Es ist die topographische Sukzession des Haarwechsels bei erwachsenen Individuen der drei heute lebenden Zebra-Arten, *Equus zebra*, *Equus burchelli* und *Equus grevyi* beschrieben und mit dem Haarwechsel anderer Arten der Gattung *Equus* verglichen.

EINLEITUNG

Die topographische Sukzession des Haarwechsels bei einigen Arten der Gattung *Equus*, i. e. *E. przewalskii*, *E. hemionus* und *E. kiang* wurde schon früher studiert und ausführlich diskutiert (Mazák, 1961, 1962a, 1962b). Über den Haarwechsel bei Zebras haben wir keine Informationen. Nur bei Antonius (1951) finden wir eine kurze Notiz: „Nur die aussertropischen Formen zeigen einen den Jahreszeiten angepassten Haarwechsel zwischen einem kurzen glatten Sommerhaar und einer längeren, mehr wirren und wolligen Winterbehaarung. An einem frisch eingeführten Bergzebra, das im Südafrikanischen Winter- also unserem Sommer- mit sehr deutlichem Winterkleid angekommen war, beobachtete ich, dass etwa 1½ Jahre nötig sind, um eine völlige Umstellung auf unsere Jahreszeiten durchzuführen. Bei den tropischen Ortsrassen bildet sich, wenn man die Tiere in unserem Winter oft ins Freie lässt, übrigens innerhalb einigen Jahren gleichfalls eine Art Winterhaar aus, das besonders an den dunklen Streifen durch seine deutliche Braunstichigkeit auffällt.“

Wir haben festgestellt, dass — wie auch bei anderen Equiden- nur ein einziger Haarwechsel im Jahre stattfindet, u. zw. in der Zeitspanne vom etwa Februar bis Juni. Im Herbst dagegen verlängert sich nur das Sommerhaar, an einigen Stellen jedoch durch Aufwachsen neuer Haare verdichtet.

Die überwiegende Mehrzahl der beobachteten Exemplare kam als Wildfänge in den Monaten August bis September an. Der Haarwechsel trat bei einigen Individuen schon in dem nächsten Jahre an, bei manchen aber erst nach der zweiten Überwinterung. Im diesen letztgenannten Falle handelte es sich um die Unterarten, die aus dem tropischen Teile Afrikas kamen und die in ihrer Heimat keinen deutlichen Haarwechsel zeigen. Das bestätigt also völlig die Angaben von Antonius.

MATERIAL

Es wurden die Zebras in den Zoologischen Garten Prag und Dvůr Králové im Laufe der Jahre 1970 bis 1974 untersucht. Folgendes Material war vorhanden:

- Equus burchelli antiquorum* (H. Smith, 1841) — 20 Exemplare
(4 aus der Etoscha-Becken im Zoo Prag, 16 aus der Etoscha-Becken im Zoo Dvůr Králové)
- Equus burchelli chapmani* Layard, 1865 — 12 Exemplare
(aus Transvaal im Zoo Dvůr Králové)
- Equus burchelli* ssp. — 25 Exemplare
(Mähnenlose Zebras aus Karamoja im Zoo Dvůr Králové)
- Equus burchelli bohemi* Matschie, 1892 — 3 Exemplare
(ohne Fangort, im Zoo Prag)
- Equus zebra hartmannae* Matschie, 1898 — 10 Exemplare
(1 im Zoo Berlin geboren und 2 aus Südwest-Afrika im Zoo Prag, 7 aus Südwest-Afrika im Zoo Dvůr Králové)
- Equus grevyi* Oustalet, 1882 — 18 Exemplare
(aus Lorian Swamp, Nordkenya, im Zoo Dvůr Králové)

Bemerkung: Im Gegensatz zu einigen Autoren, die die Steppenzebras für Subspezies der Art *Equus quagga* halten, sind hier die Steppenzebras als Unterarten der Art *Equus burchelli* anerkannt. Wie viele Autoren bestätigten (Harris, 1840; Cabrera, 1936; Allen in Harper, 1945; Roberts, 1951; Ellerman, Morrison-Scot und Hayman, 1953; Groves, 1974 u. a. m.) lebten *E. quagga* und *E. burchelli* sympatrisch in dem Gebiet zwischen Vaal und Oranje-Fluss, ohne Bastardierung und darüberhinaus unter verschiedenen synökologischen Bedingungen. Wenn aber diese beiden Formen sympatrisch lebten, können nicht konspezifisch sein (Mayr, 1967).

ERGEBNISSE

Der Anfang des Haarwechsels beginnt manchmal schon Anfangs Februar, meistens aber im März. Bei dem Grevy-Zebra geht er schneller vor sich und ist in etwa zwei Monaten beendet, bei Steppen- und Hartmann-Zebras dauert er um etwa einen Monat länger.

Die Länge des Sommer- bzw. Winterhaares haben wir lediglich an den Haaren der *Regio thoracis lateralis* bzw. *R. costalis* gemessen, da solche Haare bei allen Tieren erreichbar waren. Bei solchen Tieren, die entweder scheu oder böse waren und die man nicht berühren konnte, sammelten wir diese Haare von den Scheuersäulen.

Bei den Arten *E. grevyi* und *E. zebra* fanden wir keinen Unterschied in der Haarlänge beider Geschlechter. Bei der Art *E. burchelli* dagegen haben wir einen geringeren Unterschied festgestellt, wobei die Haare der Männchen kürzer sind, was hauptsächlich im Winterfell auffällt.

Das Grevyzebra hat einen dicht, lang behaarten Aalstrich, an welchem die Haare in der Lendengegend am längsten sind. Im Sommerhaar erreichen sie 45 mm, im Winterhaar 50 mm. Bei den nördlichen Unterarten des Steppenzebras sind die Haare der Lendengegend auf etwa 20 mm verlängert, bei den südlicheren Unterarten verlängert sich das Haar in dieser Gegend nicht.

Die gemessene Haarlänge der Seitenhaare einzelner Arten bzw. Unterarten sind in der Tab. I. angeführt:

Tab. I.

	Sommerhaar mm	Winterhaar mm
<i>Equus grevyi</i>	4 — 5	15 — 16
<i>Equus burchelli</i> ssp. (mähenloses Zebra)	♂ 7 — 10 ♀ 8 — 12	10 — 13 15 — 17
<i>Equus burchelli chapmani</i>	♂ 7 — 10 ♀ 9 — 10	15 — 17 20 — 23
<i>Equus burchelli antiquorum</i>	♂ 7 — 10 ♀ 10 — 15	12 — 15 20 — 25
<i>Equus zebra hartmannae</i>	9 — 12	13 — 18

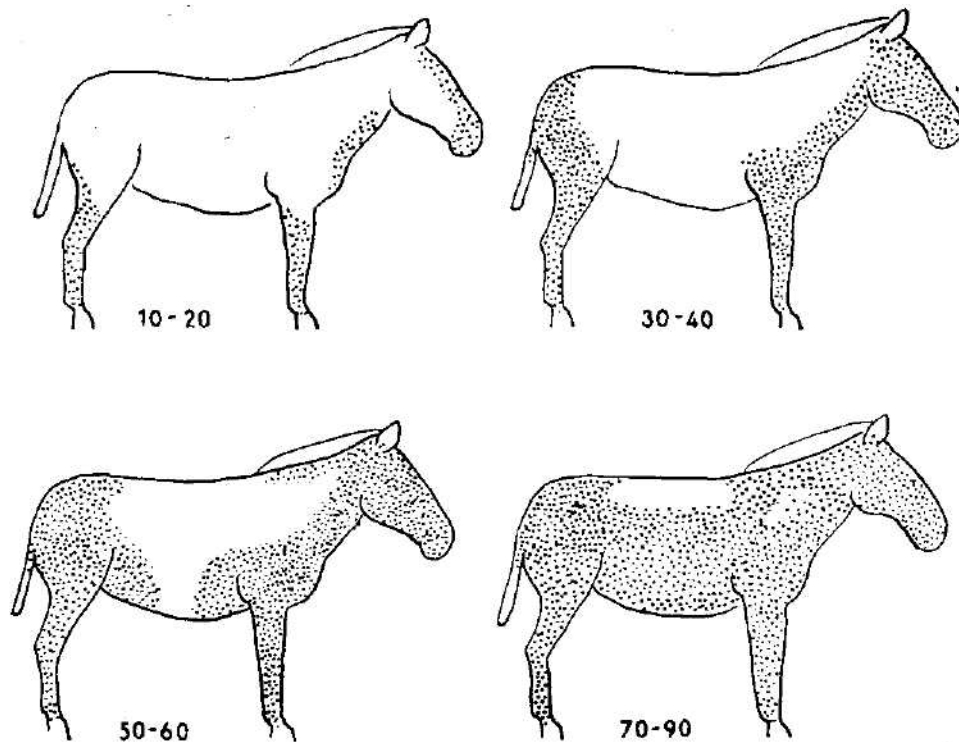


Abb. 1. Sukzession des Haarwechsels bei *Equus burchelli* und *Equus zebra*. Die Nummer geben die Tagesanzahl nach dem Haarwechselbeginn an.

Das Sommerhaar wurde im Juli–August gemessen. Das Winterhaar scheint im Oktober völlig entwickelt zu sein. In der zweiten Hälfte Oktobers werden die Zebras aus dem Freigehege in die geheizte Winterubikationen umgesiedelt, was möglicherweise die Weiterentwicklung des Winterhaares negativ beeinflusst, obwohl die Zebras täglich für mehrere Stunden ins freie Gehege ausgelassen werden.

Die Sukzession des Haarwechsels zeigen die Abb. 1 und 2. Die Arten *E. burchelli* und *E. zebra* haaren in einem übereinstimmenden Schema um. Der Haarwechsel beginnt auf der Dorsalseite des Kopfes, auf der Ventralseite des Halses und auf den Extremitäten, dann erstreckt sich auf die Keulen und auf den Bauch. Am letzten haart der Rücken um.

Die Art *E. grevyi* hat eine unterschiedliche Sukzession des Haarwechsels: er beginnt auf den Mandibeln und auf der Schnauze, auf der Ventralseite des Halses und auf den Extremitäten, erstreckt sich dann auf die Keulen und Kaudalseite des Rumpfes. Die letzte Stelle der Umhaarung ist der Bauch.

DISKUSSION

Die Zebras sind nach den morphologischen Merkmalen in zwei Untergruppen geteilt, sogenannte „Esel-Zebras“, *Dolichohippus*, wohin die Art

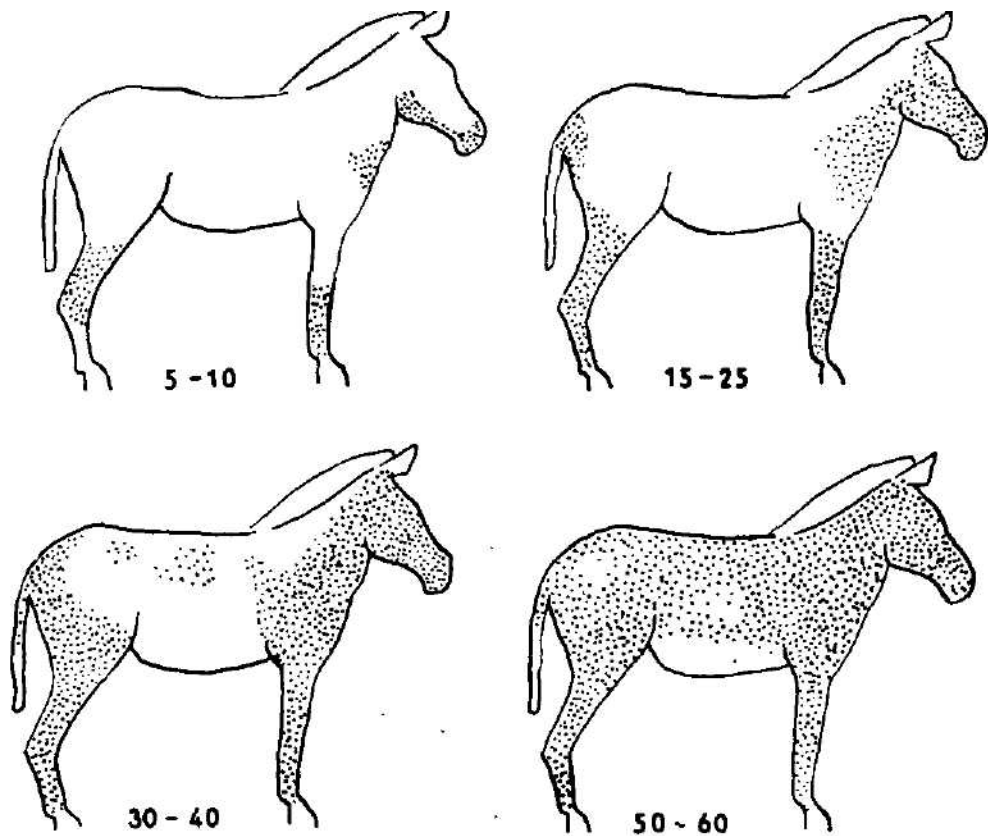


Abb. 2. Sukzession des Haarwechsels bei *Equus grevyi*. Die Nummer geben die Tagesanzahl nach dem Haarwechselbeginn an.

E. grevyi gehört und „Pferde-Zebras“, *Hippotigris*, wo die übrigen Arten stehen.

Es ist interessant, dass auch der Haarwechsel zwei verschiedene Typen hat, die den beiden Untergattungen entsprechen. Wenn wir den Haarwechsel der Zebras mit dem der Arten *Equus hemionus* und *Equus kiang* vergleichen (Mazák, 1961, 1962a, 1962b), sehen wir, dass an der einen Seite *E. grevyi* und *E. kiang*, an der anderen *E. burchelli*, *E. zebra* und *E. hemionus* nach dem gleichen Prinzip das Haar wechseln. Beide Typen unterscheiden sich aber wesentlich vom Haarwechsel des Pferdes (Mazák, 1961, 1962a).

Das Grevy-Zebra als Vertreter der Untergattung *Dolichohippus* ist offensichtlich eine sehr alte, primitive Art (Thenius, 1969). Die „Pferde-Zebras“ der Untergattung *Hippotigris* entwickelten sich auf dem amerikanischen Kontinent aus der gleichen Linie etwas später und weisen mehr spezialisierte Merkmale auf. Die Differenzierung der beiden Untergattungen soll die erste in der Gattung *Equus* sein und die übrigen Untergattungen, i. e. *Asinus* (inclusive *Hemionus*) und *Equus sensu stricto* soll man von *Hippotigris* abzuleiten. Wir wissen nicht, in welcher Weise die Differenzierung und die

Entwicklung der *Hemionus*-Gruppe ging. Wenn wir aber analogisch mit den Zebras und dem Haarwechsel nach beurteilen dürfen, scheint es uns wahrscheinlich, dass auch die Differenzierung der *Hemionus*-Gruppe auf dem amerikanischen Kontinent im Pleistozän stattfand (cf. Quinn, 1957; Mazák, 1962b). Nur in dieser Weise kann man die Ähnlichkeit des Haarwechsels bei verschiedenen Vertretern der Zebras und der Halbesel erklären.

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Anschrift des Verfassers: RNDr. L. J. Dobroruka, Národní museum, Václavské nám. 68, 115 79 Praha 1, Tschechoslowakei.

Institute of Entomology, Czechoslovak Academy of Sciences

**DIAPAUSE DEVELOPMENT IN AELIA ACUMINATA FEMALES
(HETEROPTERA)**

Ivo HODEK

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Abstract: Samples of diapausing *Aelia acuminata* (L.) were transferred to laboratory at various dates between mid-August and late December. Simple transfers to either short day (12L : 12D) and 25° or long day (18L : 6D) and 25° were compared with exposures to +5° or 15°. Durations of the pre-oviposition, oviposition and post-oviposition periods, fecundity and intensity of oviposition were recorded as indications of reproductive activity.

These parameters indicate that "diapause development" proceeds less before late October than in the next period. Although this might suggest a necessity of low temperatures for "diapause development", short-day activation is possible in most females kept steadily at 25°. „Diapause development" proceeds well under 15°; in early diapause before mid-October and in the transitory period in late winter this temperature is even more favourable than +5°.

Transfer to laboratory short day constitutes an unnatural combination of inhibiting photophase and a stimulating effect of other environmental cues. This results in an early but transient oviposition in one part of population. The other females, less sensitive to the stimulation, apparently wait with their oviposition until the adequate decrease in diapause intensity with time; their response is late, but definitive.

A model is proposed where three mechanisms are interrelated in the activation of diapausing *A. acuminata*: photoperiodic stimulation, stimulation by other environmental stimuli such as increase in temperature, availability of suitable food, etc., and the gradual decrease in the intrinsic inhibition. These mechanisms were separated experimentally; outdoors they are all combined in spring activation of *A. acuminata*.

INTRODUCTION

The gradual decrease in diapause intensity in the course of adult dormancy has been studied in many insects. As a measure of diapause intensity, duration of the interval between the start of activation and the first oviposition has been used by some authors (e.g. Tauber & Tauber, 1973a, c). In most reported studies, "diapause development" is considered as completed, when the adult insects can be activated without any delay in comparison with development without diapause (Girardie & Granier, 1973; Nguyen & Ledoux, 1973). Sometimes the loss of all response to photoperiod is regarded as a criterion of the end of diapause (Poras, 1973; Tauber & Tauber, 1973a, b, c).

When transferring adults of *Pyrrhocoris apterus* to laboratory short day, we found (Hodek, 1974a and unpubl.) that in some females the oviposition is resumed only temporarily (they laid eggs only once or twice), apparently stimulated by an improvement of environmental conditions at transfer.

In January, oviposition is achieved in all *P. apterus* females transferred from outside to laboratory short day. This is not a proof of diapause completion, as in the subsequent three months the reproductive activity of females activated under short day continues to increase. The measures of diapause development and termination appear to be controversial particularly in adult diapause. This is discussed elsewhere in more detail (Hodek, 1976).

We followed this question in *Aelia acuminata* (L.) in which there is a high individual variability in diapause duration (Hodek & Honěk, 1970), and photoperiodic response seemingly differs during dormancy (Hodek, 1974b) and after its termination in spring (Hodek, 1971b). A range of temperatures favourable to diapause development was sought, because preliminary experiments (Hodek, 1974b) had revealed low positive temperatures near 0°C unsuitable.

MATERIAL AND METHODS

Sampling

The insects were sampled by sweeping at the hibernation quarters in the clearings on Little-Carpathian ridges (Malé Karpaty — near the village of Lumbach or Jablonové, SW Slovakia near Bratislava) in late summer and in autumn. The insects were collected on August 12 and 13, 1969, October 18, 1969, August 30 and 31, 1970, August 25 and 26, 1971, September 26 and 27, 1972, and September 4–6, 1973. In 1971 and 1972 the insects were also sampled in a thin mixed forest near the village Plavecký Štvrtok in the Záhorie lowland region (also in SW Slovakia near Bratislava). The differences between these two populations of *Aelia acuminata* were discussed earlier (Hodek & Honěk, 1970).

Rearing conditions

In most cases, the activation started within 2–5 days after sampling. Before the experiments started in mid December 1973 the animals were kept outdoors in almost natural conditions, at 1.5 m above soil in a cabin with partly open walls where insolation and precipitations and also temperature extremes were excluded. For a low temperature exposure, a refrigerator with $+5^{\circ} \pm 1.5^{\circ}$ was used. As a moderately high temperature, $15 \pm 1^{\circ}$ was used in 1972 and $14 \pm 1.5^{\circ}$ in 1973, produced in a cooled laboratory. In a normal laboratory the insects were reared at $25 \pm 1^{\circ}\text{C}$ as a series of 30 isolated pairs on seedlings and grains of wheat as described in detail elsewhere (Hodek & Honěk, 1970). In all temperatures the light regimen was automatically controlled. As "short" day, a photoperiod with 12 hr photophase (12L : 12D) was used and as "long" days, a photoperiod with 18 hr photophase (18L : 6D).

Characteristics compared

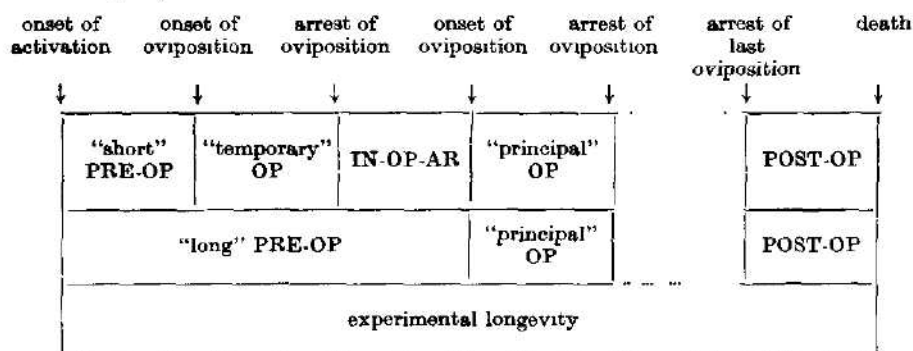
Already earlier we realized (Hodek, 1974a, b) that activation of diapausing adults cannot be understood with enough precision, if merely oviposition onset is recorded and thus only two parameters measured: duration of the pre-oviposition period (PRE-OP) and incidence of females which began laying eggs.

A similar view has recently been maintained by other authors. Working also with a Heteropteran, Dingle (1974) used the time course of egg laying as a measure of the rate of emergence from diapause. To score the "quality" of diapause development in a Lepidopteran egg, Wall (1974) considers it ideal to follow the developmental success of hatched larvae.

Several average values for PRE-OP are given: arithmetical mean, median, i.e. the middle of all values, and the period after which 50% of living females started laying eggs. When longevity of non-ovipositing females was high (e.g. sample of 27 Aug. or 2 Oct.), the last value considerably exceeded the median or average.

Parasitized females or females with a much reduced vitality, which had died very soon after transfer to activating conditions (before the onset of egg laying in 50% of females), were excluded from calculations of oviposition incidence. The activated bugs were reared until their death; this enabled to measure further parameters: duration of oviposition period (OP), fecundity (total number of eggs/♀) (F), experimental longevity (L), intensity of oviposition $\left(I = \frac{F}{L - \text{PRE-OP}} \right)$, duration of periods without egg laying, i.e. post-oviposition period (POST-OP) and interovipositional arrest (IN-OP-AR). (Periods longer than 10 days have been regarded as IN-OP-AR).

PRE-OP before the 1st "temporary" OP has been called "short" PRE-OP. For recording the responsiveness of a sample, "long" PRE-OP appeared to be suitable, i.e. the period between activation onset and start of the "principal" OP. For a better understanding, these periods are schematically depicted below.



RESULTS

Direct transfers to long day

Almost all females, transferred between mid-August and late October from the open to laboratory long-day conditions, laid eggs. Incidence of egg-laying females was rather constant, ranging between 83 and 88% in samples from hills, and between 96 and 100% in insects from lowland.

Activation rate increases during September and October according to all parameters. It is best shown in the period after which 50% of females began to oviposit. Activation rate first rises between mid-August and late August and then gradually decreases (Tab. 1). Average and median of the length of PRE-OP show the same trend. The values of the lowland population somewhat diverge from this tendency.

The intensity of oviposition at first sharply decreases during the second half of August and then it slowly rises till late October when it resumes its initial value (Tab. 1).

The increase in activation rate is indicated also by reduction of periods without oviposition, as POST-OP and IN-OP-AR. The latter phenomenon is very rare under long day (in contrast to activation under short day — see next chapter). In the sample collected in late August, 2 out of 26 ovipositing females had very long periods without egg laying, lasting 168 and 109 days. In the sample from early September, IN-OP-AR occurred also in 2 females but it was shorter — 18 and 20 days. No long-lasting IN-OP-AR took place in insects collected in late October.

Fecundity depends on the interaction of more factors. Besides activation rate, it depends also on experimental longevity and amount of reserves. Fecundity is therefore the highest at diapause onset when the reserves are large and diapause has not been established. It was strikingly low in females of early September, which had relatively short longevity.

Direct transfers to short day

Similarly as in 1969–1971 (Hodek, 1974b), also in next two years a high incidence of ovipositing females was achieved in spite of short day

Tab. 1. Direct transfer of *Aetia acuminata* females from outside to laboratory long day (18L : 6D)

Activation onset Origin of sample n	Aug. 14, 1969 hills 26	Aug. 27, 1971 hills 30	Aug. 27, 1971 lowland 24	Sep. 3, 1970 hills 24	Oct. 2, 1972 lowland 26	Oct. 20, 1969 hills 18
Cumulative oviposition incidences (%)						
all ovipositing ♀♀	88	87	96	83	100	83
♀♀ laying > 50 eggs	85	77	96	83	92	72
Duration of PRE-OP (days)						
all ovipositing ♀♀ - aver.	40	33	36	29	27	27
- range	(13-161)	(12-54)	(20-64)	(17-51)	(16-43)	(16-51)
- median	30	35.6	34.5	27.5	27.5	23
onset of OP in 50% of ♀♀	32	37	35	33	28	23
Fecundity (eggs/♀)	670	523	546	450	583	479
- range	(10-1104)	(70-362)	(288-838)	(150-895)	(225-825)	(12-954)
Oviposition intensity (eggs/♀/day)						
- aver.	7.7	5.3	5.9	6.9	4.8	7.8
- range	(3.3-11.4)	(2.6-8.5)	(3.0-7.8)	(3.3-9.7)	(2.5-6.6)	(4.3-10.8)

Tab. 2. Direct transfers of *Aetia acuminata* females from outside to laboratory short day (12L : 12D)

Activation onset Origin of sample n	Aug. 14, 1969 hills 30	Aug. 27, 1971 hills 30	Sep. 3, 1970 hills 27	Oct. 2, 1972 lowland 28	Oct. 20, 1969 hills 28	Dec. 13, 1973 hills 25
Cumulative oviposition incidences (%)						
all ovipositing ♀♀	93	70	67	57	71	88
♀♀ laying > 50 eggs	73	67	44	50	61	76
Duration of PRE-OP (days)						
all ovipositing ♀♀ - aver.	144	143	120	167	137	118
- range	(55-258)	(61-340)	(46-259)	(53-298)	(51-193)	(27-264)
- median	129	98	112	158	138	128
onset of OP in 50% of ♀♀	129	153	119	234	165	130
Fecundity (eggs/♀)	246	284	163	270	294	295
- range	(5-749)	(39-584)	(8-673)	(24-690)	(12-568)	(13-913)
Oviposition intensity (eggs/♀/day)						
- aver.	2.6	2.0	2.5	2.8	3.9	4.0
- range	(0.1-6.7)	(0.5-3.9)	(0.1-6.0)	(0.5-7.3)	(0.4-10.0)	(0.7-8.9)

(Tab. 2). In samples transferred from the hills to laboratory between late August and late October, 67–71% of females started laying eggs. In the very early sample (mid-August), as well as in the last sample (mid-December), practically all females laid eggs (93 and 88%, resp.). The incidence of females, which started oviposition, gradually increased with time of activation, as shown in Fig. 1.

Such a high incidence of ovipositing females was achieved thanks to very long rearing; this can be seen from rather high maximum values of PRE-OP (Tab. 2). Due to this fact, the values concerning all egg laying females, such as the cumulative incidence of oviposition or the average duration of PRE-OP, depend on viability and experimental longevity.

That is why also characteristics were applied which do not involve females with extremely delayed oviposition. These characteristics enable a comparison with reported data for other insects because in most studies the activated specimens were not reared till death. Such values are: median of PRE-OP and the period after which 50% of surviving females started oviposition.

While cumulative incidence of egg-laying females is in all four middle samples similar, these samples differ in the duration of PRE-OP. The sample taken on 2 October is distinctly different; its characteristics of PRE-OP indicate a substantially slower activation, caused by 2° lower breeding temperature. This sample had also a different origin — from a lowland forest. By all parameters, females from 3 September had the quickest activation of the remaining 3 samples. The rapid activation, however, was connected with very short longevity (182 days, compared with 228–298 days in other series) and extremely low fecundity (Tab. 2).

Between late August and mid-December, oviposition incidence and duration of PRE-OP do not give evidence of other important trends than is the increase in activation rate after 20 October.

Also POST-OP duration can indicate the rate of the resumed development. In each experiment, duration of POST-OP is liable to a considerable variability ranging from values near zero to values between 50 and 100 days. The average duration of POST-OP decreased from 12 days to 6 days between late August and mid-December. The "lowland" sample (2 December) and the sample with rapid activation (3 September) have, however, a very high average duration of POST-OP, 22 and 21 days, resp.

Intensity of oviposition shows the expected trend as well. It gradually rises from the low value of 2 eggs per female and day and achieves a doubled value in October or December (Tab. 2).

Average fecundity fluctuated between 250 and 300 eggs with the exception of the sample from 3 September (Tab. 2). Those females had a considerably lower fecundity in accordance with their short longevity and with low fecundity shown also under long day.

The decrease in diapause intensity in the period between late August and mid-December was thus evidenced by fall in the duration of PRE-OP and POST-OP, and by the increase in cumulative incidence of activated females and in oviposition intensity.

- Oviposition under short day

In the previous chapter we compared values calculated for all females in the sample. These characteristics do not allow a good insight into the development of diapause, because the responses within each sample were very variable, as is shown in Fig. 1. Difference between maximum and minimum

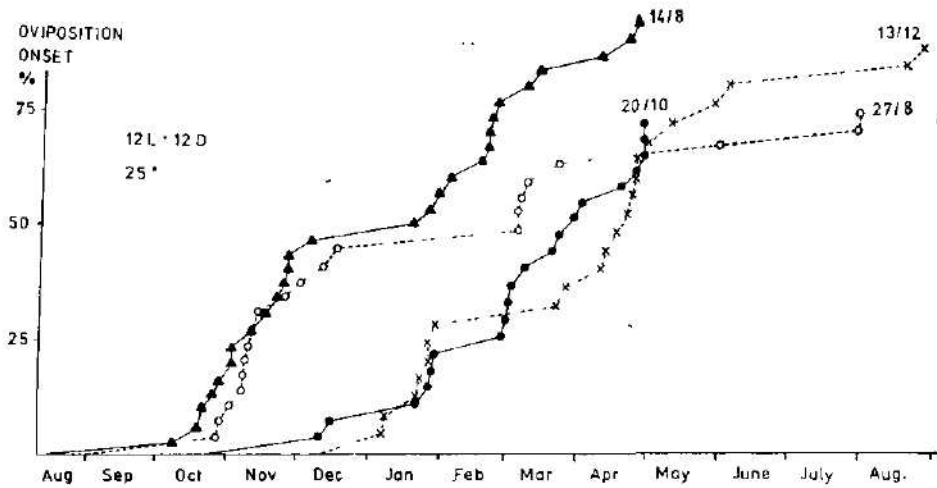


Fig. 1. Cumulative incidence of *A. acuminata* females which started oviposition under 12L: 12D and 25°. Thus only PRE-OP is shown and not the subsequent arrest of oviposition.

duration of PRE-OP under short day was larger than 200 days (with the exception of only one sample).

In all four samples from mountain-tops (which had normal mortality, except the sample from 3 September) the great majority of females (72–81%) had one of two responses described further (Fig. 2). 32–50% of females exhibited a “short-delay” response: after a short PRE-OP, short OP followed which was succeeded by a long ovipositional arrest. Then a rather long “principal” OP followed (Fig. 2, type 2). 25–42% of females had a “long-delay” response: a long PRE-OP was followed directly by a long “principal” OP (Fig. 2, type 4).

The difference between the longest “short” PRE-OP and the shortest “long” PRE-OP is large, amounting to 25 days in the sample of 20 October, 47 days in the sample of 14 August, 55 days in the sample of 13 December and 94 days in the sample of 27 August. The division of the population is thus natural and distinct.

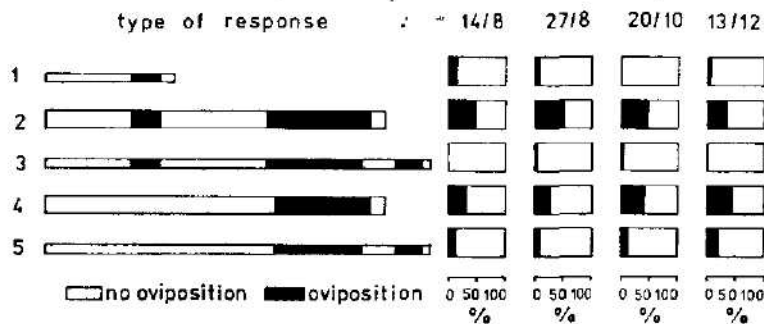


Fig. 2. Diagrammatic representation of activation responses and their proportion in samples of *A. acuminata* transferred to 12L : 12D and 25°.

There is a near resemblance between the duration of "principal" OP of both "short-delay" and "long-delay" females as well as between the intervals from transfer to laboratory to the onset of "principal" OP in both types (2 and 4).

In the course of diapause, the aver. "long" delay gradually decreases from the values of August which represent 206 and 213 days, over 186 days on

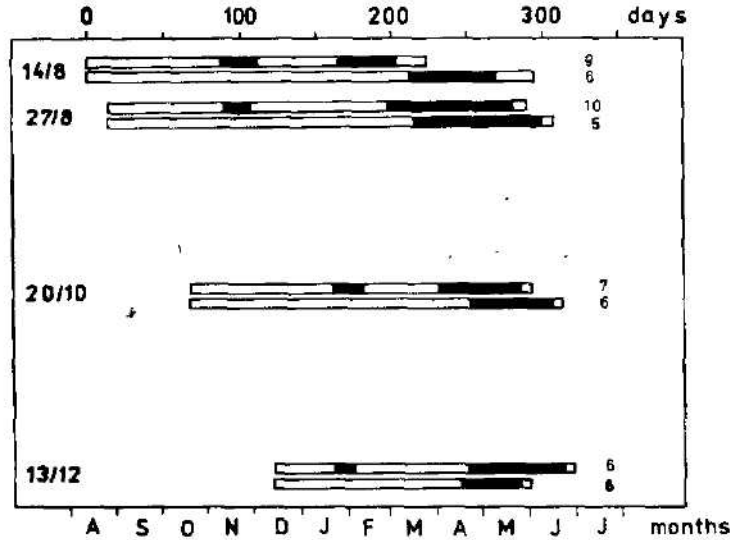


Fig. 3. Activation responses in samples of *A. acuminata* transferred to 12L : 12D and 25°. Upper bars represent the "short-delay" response (type 2 in Fig. 2), lower bars the "long-delay" response (type 4 in Fig. 2). Open bars represent the period without oviposition, black bars the period with oviposition. Arithmetical means were used to define the start and end of oviposition periods. Numbers on the left: dates of transfer from outside to the laboratory. Numbers on the right: n.

20 December, to 125 days, recorded in the sample of 10 Dec. (Fig. 3, lower bars of each pair). The duration of the interval between transfer to laboratory and the onset of "principal" OP in "short-delay" females has a similar course (Fig. 3, upper bars of each pair). This period lasts in aver. 187 days on 27 August, 163 days 20 December, and 129 days 10 December. The value of 166 days, ascertained in the sample taken on 14 August, apparently indicates that diapause was not yet established, similarly as it is shown in this sample by other parameters from both short- and long-day regimens.

Besides females which responded according to the above two schemes (2 and 4), there were still other females in the shortday series, but in substantially lower numbers (forming 19–29% Fig. 2). Some "short-delay" females did not resume egg laying for the second time, mostly because of early death (type 1 : 0–15%). By contrast, in some "long-delay" females "principal" OP was succeeded, after a short ovipositional arrest, by another OP, shorter this time (type 5 : 10 to 21%). "Short-delay" females very rarely achieved a third OP (type 3 : 0–6%).

There is an interval of 54 days between sampling on 27 August and 20 October and the same interval separates also the last sample of 13 December (Fig. 3). A clearly more important shortening of all kinds of PRE-OP occurred in the course of the second interval than during the first interval: from October

Tab. 3. Exposure of *Aetia acuminata* females to moderate and low temperatures¹⁾

	Control	Experimental treatment (in weeks)			
16°	—	9	13	11	15
$+5^{\circ}$	—	2	2	—	—
n	28	25	27	27	26
Cumulative oviposition incidence (%)					
not ovipositing ♀♀	43	12	22	26	4
♀♀ laying < 50 eggs	7	12	11	7	23
♀♀ laying > 50 eggs	50	78	67	67	73
after "short" PRE-OP		21	52	52	50
after "long" PRE-OP		29	24	15	23
Duration of PRE-OP (days)					
all ovipositing ♀♀	167	58	47	45	62
— aver.	158	24	17	19	17
"short" PRE-OP		78	16	18	14
— aver.		(53-94)	(9-32)	(12-27)	(8-20)
— range		239	152	130	112
"long" PRE-OP		(157-288)	(91-194)	(77-176)	(106-123)
— aver.		270	207	226	180
— range		(24-690)	(19-729)	(17-495)	(16-497)
Fecundity (eggs/♀)					
— aver.		2.4	2.0	1.9	1.7
— range		(0.5-7.3)	(0.4-7.2)	(0.6-5.8)	(0.3-8.6)
Oviposition intensity (eggs/♀/day)					
— aver.		2.4	2.0	1.9	1.7
— range		(0.5-7.3)	(0.4-7.2)	(0.6-5.8)	(0.3-8.6)

¹⁾ Sample of Sep. 26-27, 1972, kept outdoors until Oct. 2, 1972, when the experiment started. Exposure to 16° was combined with 12L : 12D, and 5° with 0L : 24D. Activation at 25° and 12L : 12D.

to December the "long" PRE-OP shortened by 61 days, the "short" PRE-OP shortened by 54 days and the period from the beginning of experiment to the onset of the "principal" OP of "short-delay" females by 34 days. By contrast, between the samples of August and October the delays of "principal" OP were reduced only by 24 and 27 days; duration of "short" PRE-OP was even 18 days longer.

Calendrically, the postponement of transfer by 8 weeks from 27 August to 20 October results in a 5 weeks delay of the onset of "principal" OP in both population segments. A further postponement to 13 December does not bring about any further delay, due to the substantial shortening of PRE-OP. In the samples from 20 October and 13 December "principal" OP started between 5 and 25 April.

Effect of temperature treatments

Sample of late September 1972 (Tab. 3).

Two groups of females collected in a lowland forest were exposed (2 October) to 15° for either 11 or 15 weeks and then activated at 25°. Other two groups of the same origin were exposed to 15° either for 9 or 13 weeks and before transfer to 25° they were chilled at +5° for two weeks. Short-day conditions (12L : 12D) were combined with both 15 and 25° and darkness with +5°. Control females were transferred directly (2 October) to 25° with either short- or longday conditions (18L : 6D).

A high proportion of females (74–96%) oviposited in all experimental series; control females had a markedly lower activation incidence (57%). The difference is even more striking if the ovipositing females are grouped according to the number of eggs laid and to the duration of PRE-OP (Tab. 3). More than half of experimental females laid over 50 eggs after "short" delay, in contrast to only one fifth of control animals.

Activation of experimental females under short day was quite fast. Average PRE-OP amounted to 45–62 days. This is only 1.5–2 times more than under long-day activation of control females. The effect of the experimental treatment on the whole population is better evidenced by median which is not affected by extreme values of exceptional individuals. The medians of PRE-OP in experimental females activated under short day are lower (17 to 24 days) than in control females activated under long day (28 days). Activation of control insects under short day was still very slow after the early October transfer. PRE-OP lasted 167 days in aver. and median was 158 days. Even if the period of 11 or 15 weeks is subtracted (time between transfers to 25° of control and experimental insects), an important prolongation of the response remains, amounting to 62 or 90 days (aver.) and to 53 or 81 days (median).

Again, like in the previous chapter, we may distinguish two main patterns of oviposition response of activated females. Here, however, "short-delay" females prevailed in experimental series (50–52% oviposited after a very short PRE-OP ranging between 8–32 days) over "long-delay" females (15–24% laid eggs with a delay of 77–194 days).

Index of reproductive activity (Table 3) in experimental females was about half of the value found in short-day controls. Oviposition intensity of the experimental series with the shortest exposure to 15° (9 weeks) was the same as in control. It decreased with prolongation of

Tab. 4. Exposure of *Aetia acuminata* females to moderate or low temperatures 1)

n.	Control		Exposure of 5 weeks to	
	25	14° and 12L : 12D 25	+5° and 12L : 12D 29	+5° and 18L : 6D 28
Cumulative oviposition incidence (%)				
♀♀ not ovipositing before day 300	12	16	38	14
♀♀ laying < 50 eggs	12	4	0	4
♀♀ laying > 50 eggs after "short" PRE-OP	76	80	62	82
after "long" PRE-OP			31	29
		48	31	54
Duration of PRE-OP (days) ²⁾				
♀♀ laying > 50 eggs				
— aver.	107	54	63	78
— median	123	25	49	76
after "short" PRE-OP				
— aver.		42		21
— range		(27-51)		(14-32)
— median		44		25
after "long" PRE-OP				
— aver.		145		104
— range		(103-255)		(66-162)
— median		137		102
Fecundity (eggs/♀) ³⁾				
— aver.	295	393	316	357
— range	(66-913)	(118-745)	(84-1022)	(70-878)
Oviposition intensity (eggs/♀/day)				
— aver.	4.0	4.6	4.3	4.7
— range	(0.7-8.9)	(0.6-12.9)	(0.8-9.9)	(0.8-12.0)

1) Sample of Sept. 4-6, 1973, kept outdoors until Dec. 13, 1973, when the experiments started. Activation at 25° and 12L : 12D.

2) Females with PRE-OP longer than 300 days were regarded as not ovipositing. Such cases were exceptional: one female from 14° (336 days) and two females from 5° and 12L : 12D (311 and 410 days).

3) Females with less than 50 eggs were not considered.

exposure to 15°. The same applied to the total amount of eggs laid by one female.

We can conclude that in comparison with controls the experimental exposure to 15° (either with or without chilling) lowered the percentage of non-reproductive females, i.e. so called "diapause incidence" and increased the rate of subsequent activation, i.e. reduced the duration of PRE-OP, usually considered as a measure of "diapause intensity". But this treatment, if too long, reduced fecundity and reproductive intensity.

In the following year, only shorter exposure was applied (5 weeks) and the effect of 15° and +5° was compared separately.

Sample of mid-December 1973 (Tab. 4).

Insects collected in early September were kept in almost natural conditions (see Methods). The experiment started with a 5 weeks exposure either to 14° or to +5°. Chilling was combined with long or short day. After these 5 weeks, all three experimental series were activated at 25° and under short day. Control females were transferred to these activating conditions directly on 13 December, when the experimental insects were exposed to +5° or 15°.

Exposure to moderately high temperature improved considerably all parameters, with the exception of oviposition incidence which remained the same as in control (Tab. 4). Duration of PRE-OP was considerably reduced: average to about a half, median to only one fifth. Duration of OP and fecundity increased by 25%.

In 1973, short exposure to 14° was considerably more effective in females with rather advanced diapause than the longer, much earlier treatment with 15° in 1972. No negative side effects on fecundity and reproductive intensity were observed.

All characteristics indicated that the exposure to moderate temperature was much more efficient than chilling at +5° (Tab. 4).

The difference, produced by different photoperiods during chilling at +5° is less marked than the effect of temperature. Both the median and average of PRE-OP were higher when chilling was combined with long day. The slower rate of activation concerns the "long-delay" females and can be related to the unnatural interference between the negative signal of decrease in day length and the positive stimulus of temperature increase. The females, chilled under long day, had a higher reproductive activity: longer OP, shorter POST-OP and higher fecundity.

CONCLUSIONS AND DISCUSSION

Progress of "diapause development"

The activation under long day of insects sampled between late August and late October evidenced a gradual increase in activation rate and in oviposition intensity (Tab. 1), shortening of POST-OP and elimination of temporary ovipositional arrest.

Under short day, these indications of "diapause development" were less conspicuous before late October. During the 8 weeks period between late October and mid-December, however, the incidence of ovipositing females, the activation rate and the oviposition intensity increased markedly. The gradual shortening of "long" PRE-OP was very regular (Tab. 2).

The evidence from both short- and long-day activation shows that "diapause development" (Andrewartha, 1952) proceeds in the period of late summer, autumn and winter, and appears to be more intensive in the second phase of the period under study. This might suggest the necessity or suitability of low positive temperature for this process. On the contrary, shortday activations of very early samples proved that a high proportion of females can spend the whole diapause and terminate it at warm constant temperatures around 25°. Duration of PRE-OP, oviposition intensity and fecundity are naturally less favourable than with long-day activations (Tab. 2).

Effect of low or moderately high temperatures

The exposure to +5° was found ineffective for diapause development in the first period of diapause (Hodek, 1974b). While neither duration of PRE-OP nor the intensity of oviposition were increased by a 7 weeks chilling starting in early September, fecundity did increase in connection with the prolongation of longevity.

Additional two weeks chilling, after 9 or 13 weeks spent at moderate temperature, did not accelerate the rate of activation, in comparison with controls left for these two weeks at unchanged moderate temperature, but also in this case fecundity was raised.

In the period between early October and late December, the exposure to constant, moderately high temperature (Tab. 3, 11 weeks replicate) proved to be much more effective for the shortening of PRE-OP than the action of natural conditions (Tab. 4, control). Between mid-December and mid-January the 5 weeks exposure to moderate temperature was clearly better than chilling, also for fecundity.

This evidence suggests that the previous exposure to constant moderate temperature better facilitates the activation after a transfer to warm temperatures, than previous chilling at low positive temperatures in the region of +5°. Usually the rate of activation is used as a criterion of diapause intensity. Temperatures around 15° might thus be considered as more favourable for diapause development in *A. acuminata* than chilling at +5°.

Various phases of "diapause development" of *A. acuminata* apparently have different temperature requirements. Exposure to +5° is evidently unfavourable, if used very early in diapause when the insect has not yet undergone adaptive changes to cold. In late winter "diapause development" gradually changes into the normal morphogenesis with other environmental, esp. temperature demands. The exposure to a moderately high temperature is apparently favourable for such a transitory period.

Sensitivity to photoperiod

Females of *A. acuminata* show a certain sensitivity to photoperiod both during and after diapause. The sensitivity indicated by different levels of reproductive activity in females activated under short and long day has been found in this study by transfers performed before mid-December, and in unpubl. results also in late February. The sensitivity to photoperiod is shown also by suppression of oviposition under short day in spring, after diapause (Hodek, 1971b).

Photoperiodic sensitivity is less intensive than in some other insects, e.g. in *Pyrrhocoris apterus* where it prevents reproduction completely in the first phase of diapause (Hodek, 1971a, 1974a). In *A. acuminata*, oviposition can be achieved also in the first period of diapause in a proportion of females after a rather short PRE-OP lasting about 50 days (min. PRE-OP in Tab. 2). The sensitivity to photoperiod is retained very long, until April or May, at least in some individuals, activated and reared under shortday conditions. Such a persisting sensitivity was evidenced when oviposition, which had begun after "long" PRE-OP, was arrested (Fig. 2, types 3 and esp. 5).

These observations on *A. acuminata* lead to the assumption that although the sensitivity to photoperiod diminishes with the decrease in diapause intensity, it does not disappear.

Under natural conditions, the females begin to oviposit in mid-May or in late May, i. e. under stimulating long day with photophase lasting 16 h 40 min or 17 h 30 min resp. Their reproduction cannot be thus hindered by their retaining the photoperiodic sensitivity.

Regulation of reproductive activity in diapausing *A. acuminata*

A model is proposed in which at least four mechanisms are interrelated in the activation of *A. acuminata*.

1a) Temperature dependent reduction of inhibition

We established a gradual decrease in intensity of endogenous inhibition of reproduction under natural conditions by comparative activation of samples taken between August and December (Tab. 1, 2). Temperatures in the region of 15° appear to favour the mechanisms involved.

1b) Spontaneous reduction of inhibition

An important reduction of the reproductive blockage is evidenced after a long storage (in spite of short day and constant 25°) by a "spontaneous" onset of oviposition. This event occurred in the same period, mostly in April or early May, in females either transferred simply from the open or exposed to +5° or 15° for various time. Females showing the type 2 or 4 start the "principal" OP simultaneously. As also the females in nature begin to lay eggs at the same time, this "end of diapause" does not appear to be dependent on special environmental cues. It is not excluded that the fall in inhibition below the critical level is to a certain extent ruled by a "timing mechanism".

The same event was observed also in *Pyrrhocoris apterus*, where other traits of diapause differ (Hodek, 1971a, 1974a).

2a) Photoperiodic stimulation

At any time of diapause, an intensive and long-lasting oviposition can be achieved in practically all females early after the transfer to long day and 25° (Hodek, 1974b, Tab. 1 and p. 180).

The onset of oviposition in the field occurs under long day; although the photophase outdoors is about 1 hr shorter than the day length in our experiments, it is still above the critical photoperiod. It is not excluded that also the increase in photophase has an additive effect in the field. We have established (Hodek & Honěk, 1976) that the change from short day to long day usually reduces the percentage of diapause induction in the species.

2b) Stimulation by temperature, food, etc.

Transfer of insects from the open to laboratory constitutes several environmental changes which may lead to the increase in metabolic rate: increase in temperature (especially important in winter), increase in light intensity, presence of physiologically young host-plant which is obligatorily sucked for

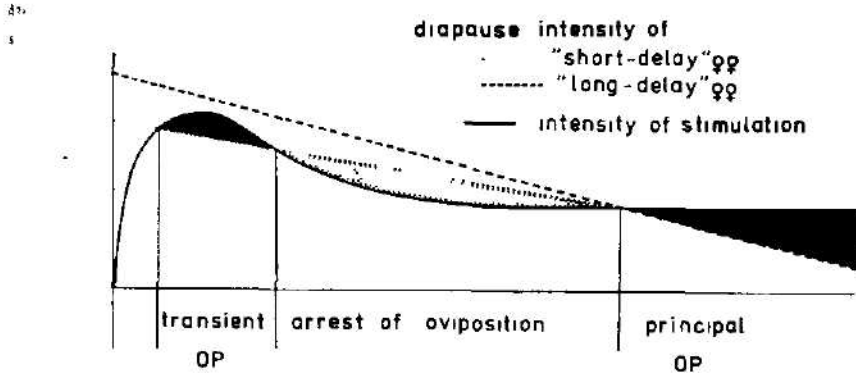


Fig. 4. A hypothetic model of activation under short-day conditions. Reproduction is enabled when stimulation prevails over diapause intensity.

drinking, a disturbance every 7 days, when the food is exchanged. This complex of factors is apparently responsible for the onset of "early" OP of "short-delay" females.

Under natural conditions all these four mechanisms, revealed in our experiments as isolated factors, work together to assure an intensive oviposition and high fecundity. In the induction of oviposition in the field, behavioural factors evidently cooperate: the sequence of instincts starting with the emergence from the soil and migration to the lowland with fields — at least in a proportion of population (Hodek & Honěk, 1970). These factors have not been considered in this study.

Comparison with other insects

For the characterization of adult diapause in *Aelia acuminata*, three traits are essential:

- 1) possibility of photoperiodic activation (by long day) from the very onset of diapause;
- 2) no necessity of previous cooling for a normal resumption of development under short day;
- 3) possibility of a transient activation by warm temperatures, food, etc. in a proportion of females.

Photoperiodic activation is a common phenomenon. This process may be considered as an intensification of "diapause development" or as an alternative way of the resumption of morphogenesis. The photoperiodic activation becomes more rapid when started later in the season. Thus it seems to be regulated from the same centrum as "diapause development".

Also the second characteristic has been evidenced in some insects. In *Jalysus spinosus* (Heteroptera: Berytidae; Elsey, 1974) oviposition was achieved at the beginning of diapause by transfers to short day and warm temperatures. At 24° PRE-OP lasted 81 days, i.e. about four times longer than under long day. Similarly in *Anaphothrips obscurus* (Thysanoptera: Thripidae; Kamm, 1972) adult diapause ended early under short day: at 21° the oviposition delay was 60 days. Also the adult diapause of *Chrysopa carnea* (Neuroptera: Chrysopidae; Tauber & Tauber, 1973a, c) completed its development under short day. At 24° and 8L : 16D PRE-OP lasted in aver. 99 or 91 days in insects in which diapause was induced artificially in the laboratory. The prolongation of photophase under short-day regimen shortened PRE-OP in activated females: under 10L : 14D it lasted 64 days, under 11L : 13D — 57 days, under 12L : 12D — 39 days. Tauber & Tauber (1973c) reported no effect of a 7 week exposure at 4° on the aver. duration of PRE-OP. By this treatment the range of PRE-OP duration was, however, much reduced from 60 to 27 days, and very probably also the characteristics of reproduction were improved; they are not given.

Moderately high temperatures are more favourable than chilling for diapause development also of other insect stages, as mentioned already by Lees (1955). Recently, it has been well proved in diapause of coarctate larvae in *Epicauta segmenta* (Coleoptera: Meloidae; Selander & Weddle, 1972). For its diapause development, 15° is at or near the optimum, 10° is decidedly inferior and 6° is ineffective. While the Meloid was studied in Texas (with aver. temperature 12.8° at 3 — in. soil level for the season October—March), our insects originated from a much colder region of western Slovakia (aver. year temperature of air: 9.0°). Vinogradova (1974) found, however, that even near the northern limit of distribution area, warm temperatures were favourable for activation of diapausing larvae of *Calliphora vicina* (Diptera: Calliphoridae) without any previous cooling.

The third expression of diapause in *A. acuminata* cannot be compared with many data of other authors. Whether the activation response to activation by temperature under short day is transient or "definitive" remains to be checked in nearly all diapausing adults studied because the experiments were discontinued early after the onset of OP. In a very "weak" diapause of *Onco-peltus fasciatus* (Heteroptera: Lygaeidae; Dingle, 1974) the oviposition response seems to be "definitive".

Specificity of adult diapause

Our system of concepts and definitions was constructed by Andrewartha (1952), Lees (1955) and Danilevski (1961) when the mechanisms regulating induction and termination of adult diapause were still poorly understood. The stress was therefore put on similarities with diapause of other stages and special traits of adult diapause were not emphasized. We would like to draw attention to two characteristic expressions of adult diapause which are important for activation by temperature. Already Norris (1964) warned that in diapausing adults "the developmental processes respond more easily to changes in the environment". (This is probably similar in diapausing larvae.)

A methodically important dissimilarity of adult diapause lies in the fact that the process arrested by it — reproduction — is long termed and can be

affected by environmental factors during its entire duration (Hodek, 1974a). By contrast, eclosion of larvae from eggs, emergence of adults from pupae or pupation can be triggered by a merely transient resumption of development. In adult diapause, we are able to differentiate between a transitional and "definitive" resumption of development when measuring the reproductive activity of experimental insects. If the oviposition is terminated early, it seems reasonable to conclude that the females were activated by temperature and/or by other environmental stimuli, without having had their diapause development completed. Such a phenomenon has been observed not only in this study in *A. acuminata* but also in *Pyrrhocoris apterus* (Heteroptera: Pyrrhocoridae; Hodek, 1974a) and might be quite common. It is warned, therefore, that the mere evidence of oviposition onset can lead to misinterpretation as far as duration of diapause is concerned.

Acknowledgement

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Author's address: RNDr. I. Hodek, CSc., Institute of Entomology, Czechoslovak Academy of Sciences, Viničná 7, 128 00 Praha 2.

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Institute of Systematic Zoology, Charles University, Prague

NOTES ON THE ECOLOGY OF BATS OF THE GENUS
PLECOTUS GEOFFROY, 1818 (MAMMALIA: CHIROPTERA)

IVAN HORÁČEK

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Abstract: Results are presented of a seven-year study on the biology of two bat sibling species — *Plecotus auritus* and *Plecotus austriacus*, with particular attention to differences in seasonal course of inhabiting the roosts of various types. The importance and possible cause of differences observed in the biology and ecology of both species are discussed in the text.

INTRODUCTION

In recent years, studies on closely related and morphologically similar species, the so-called sibling species, have received increased attention. Most of these studies, however, deal with problems of systematics, distribution and morphology of these forms, and little information is available on their biology and ecological requirements.

A similar situation occurred with the Palearctic members of the genus *Plecotus*, i.e., *P. auritus* (Linnaeus, 1758) and *P. austriacus* (Fischer, 1829) which, until recently, have been considered to be a single species — *Plecotus auritus* (Linnaeus, 1758). The necessity of a taxonomic differentiation of these species has first been suggested as late as in 1960 (Bauer, 1960; Hanák, 1960, 1962, 1966; Lanza, 1960; etc.).

In association with suggestions for a differentiation of the two species the need was felt for an elucidation of the ecological and biological differences in these two species and for a revision of earlier knowledge concerning the biology and ecology of *Plecotus* bats (Abelencev et al., 1956; Beron, 1958; Birulja, 1914; Eisentraut, 1937, 1957; Kuzjakin, 1950; Moffat, 1922; and others).

Information on the biology of bats of the genus *Plecotus* from Czechoslovakia was given by Souček and Novotný (1970) and Húrka (1971). However, these papers, similar to the majority of papers by foreign authors (Aellen, 1971; Beron, 1964; Piechocki, 1966; Ruprecht, 1965; Stebbings, 1967; and others) were concerned mainly with the regional incidence, biometrics and the taxonomy of these species. More detailed data on the biology and ecology of bats of the genus *Plecotus* have been given by Stebbings (1966, 1970) who studied a locality shared by the two species. For conditions in Czechoslovakia, the most important study is that by Hanák (1969) who surveyed all knowledge available on the ecological requirements

of the two species under consideration on the basis of a detailed analysis of their incidence in the various localities in Czechoslovakia.

MATERIAL AND METHODS

This study is based on the results of a regular observation of bats performed from 1966 to 1973 in central Bohemia (Fig. 1), in addition to an occasional observation in other areas (the Czech-Moravian Upland, Slovakia).

In central Bohemia, in the summer season, we found a total of 8 summer colonies and 6 solitary individuals of *P. auritus*, and 13 summer colonies and 12 solitary individuals of *P. austriacus*. All colonies were located in the lofts of buildings. An occasional investigation was performed of other possible roosting sites — tree cavities, boxes, but the results as well as results of net-hunting in the vicinity of these roosts were always negative.

We have included in our results also observations of 3 summer colonies and 3 solitary individuals of *P. austriacus* from the Czech-Moravian Upland and 1 summer colony of *P. auritus* and 3 summer colonies and one individual of *P. austriacus* from Slovakia.

A larger number of bats were caught from several colonies only. Generally, the colonies remained undisturbed. Mostly we caught only 1–3 specimens for the identification of the species and the size of the colony was estimated (our data refer to the total number of adult and subadult individuals in the colony).

During the winter season (September to April) of the years 1966–1973, the total finding of *P. auritus* in winter roosts of central Bohemia was 86 specimens (54 ♂♂, 32 ♀♀), that of *P. austriacus* 217 specimens (126 ♂♂, 91 ♀♀). Detailed data of most of these findings in the individual winter roosts are given in papers by Hanák & Gaisler (1972) and Gaisler & Hanák (1972).

The temperature in the roosting sites of the individual bats were measured with a mercury thermometer, the glass bulb containing mercury was held close to the hibernating animal without touching it. In this way we were able to assess the temperature of the inside spaces through crevices etc.

The knowledge on the life of bats in the period of seasonal migrations was obtained from the results of observations in transient roosting sites (lofts, caverns, caves and galleries), and from the results of our catches in Japanese mist nets placed at the entrance to the caves (Srbsko: Srbské cave, Barrandevova cave, galleries of the quarry Kozel, etc.). The method employed generally for netting the bats was this: the nets were stretched over the main opening and the remaining openings were covered with either nets or blankets, branches etc. Any bat caught in the net was immediately banded and let out in the opposite side of net. The operation was started approximately half an hour before sunset, and was continued until night, 1–4 o'clock a. m. Sometimes, it continued throughout the night, sometimes the nets were removed before midnight. In central Bohemia, during the years 1970–1972, these operations were carried out 21 times (Table 6).

RESULTS

Summer incidence (May–July)

Although it has not been my intention to discuss faunistic aspects in this paper, it might be of interest to note that in central Bohemia, where one would expect an absolute praedominance of *Plecotus austriacus*, the incidence of *Plecotus auritus* was not infrequent as evidenced from the considerably numerous findings of this species in the summer season (Fig. 1). Summer nursing colonies of *P. auritus* are present even in areas without continuous forest stands (Hořovice, Dolní Hbity, Nový Knín). In several instances, individuals or colonies of both species shared the same locality (Křivoklát, Rataje n. Sázavou, Český Šternberk — the lofts of the castles). In central Bohemia, both species were found in altitudes ranging from 200–500 m.

Summer nursing colonies

Plecotus auritus

The summer colonies inspected consisted mostly of 5–10 specimens (Table 1) except for one colony harbouring 20–25 specimens (Krásná Hora,

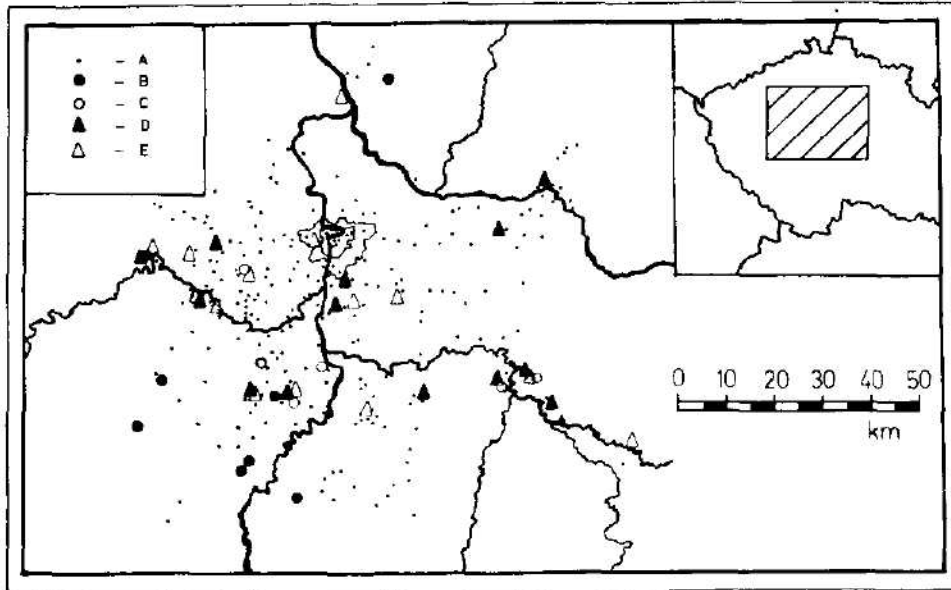


Fig. 1. Occurrence of the *Plecotus* bats during the summer period in the area investigated. Explanations: A — visited places of possible summer roosting of *Plecotus* bats, B — locality occupied by summer colony of *Plecotus auritus*, C — locality inhabited by solitary individual of *Plecotus auritus*, D — locality occupied by summer colony of *Plecotus austriacus*, E — locality inhabited by solitary individual of *Plecotus austriacus*.

district Havlíčkův Brod). The most frequent roosting sites of the colonies were fissures in rafters (Fig. 2, Table 2), i.e. typical "fissure" roosts as suggested by Gaisler (1966).

Plecotus austriacus

The number of specimens in the colonies ranged from 10–20 (Table 1). In most instances, these were "space" roosting sites (a term suggested by Gaisler, 1966), most frequently on the saddle of the roof (Fig. 2, Table 2).

Solitary individuals

Plecotus auritus

We found a total of 9 specimens, i.e. 5 adult males, 2 subadult males, 1 adult female, 1 subadult female. Fissure roosts: between the rafters (5 spe-

Table 1. Size of summer (nursing) colonies

Species	Size of colony				Σ
	5–10 spec.	10–20 spec.	20–30 spec.	30–40 spec.	
<i>Plecotus auritus</i>	11	0	1	0	12
<i>Plecotus austriacus</i>	2	14	3	1	20

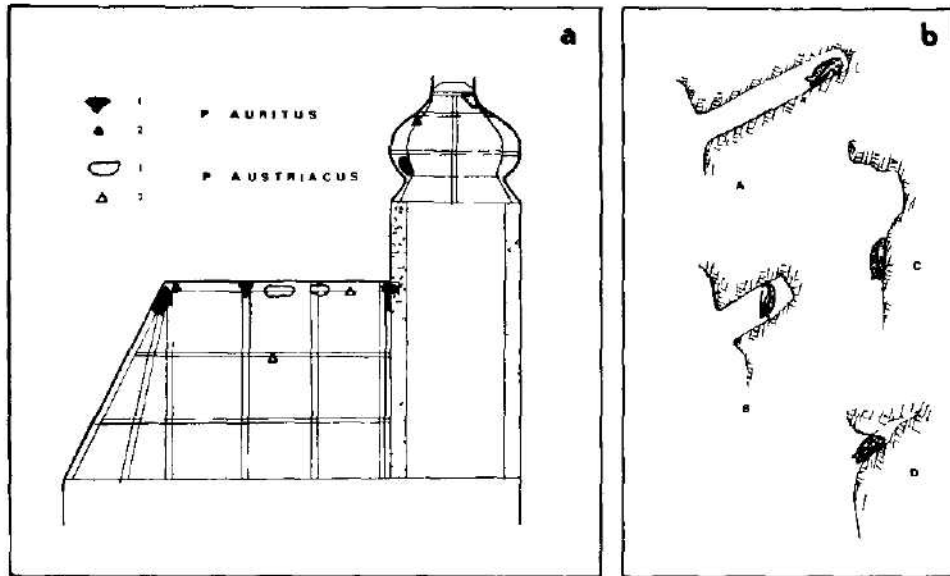


Fig. 2. The most frequent roosting sites of the *Plecotus* bats in the summer (2a) and winter (2b) roosts.
 Explanations: a — 1: roosting site of summer colony, 2: roosting site of solitary individual; b — A, B: the most frequent type of roosting in *Plecotus auritus* in the winter roosts, C, D: the most frequent type of roosting in *Plecotus austriacus* in large winterquarters (C) and in smaller localities (D).

cimens), in crevices between the wall and the rafters (2 specimens) (Fig. 2, Table 2). Three of these solitary specimens, i.e. 2 adult males and 1 subadult male, were found in close vicinity to the summer colony.

Plecotus austriacus

We found a total of 15 specimens: 6 adult males, 2 subadult males, 2 subadult females, and 5 specimens sex ind. Space roosts. on the saddle of the

Table 2. Roosting sites of summer colonies and solitary individuals of *Plecotus* — bats found in central Bohemia, 1966 — 1973

	summer colonies			solitary individuals			Total		
	fissure	space	total	fissure	space	total	fissure	space	total
<i>Plecotus auritus</i>	8	0	8	4	2	6	12	2	14
<i>Plecotus austriacus</i>	5	8	13	4	8	12	9	16	25
Total	13	8	21	8	10	18	21	18	39

Table 3. Number of *Plecotus* — bats found in winter roosts of three fundamental types, in central Bohemia, 1966 — 1973

Species		Type of roost:											
		large galleries and caves			little galleries and caverns			cellars			Total		
		♂	♀	Σ	♂	♀	Σ	♂	♀	Σ	♂	♀	Σ
<i>Plecotus auritus</i>	n	39	24	63	8	3	11	7	5	12	54	32	86
	%			73.3			12.8			13.9			100.0
<i>Plecotus austriacus</i>	n	57	30	87	3	1	4	66	60	126	126	91	217
	%			40.0			1.9			58.1			100.0
Total	n			150			15			138			303

Note: Findings of *Plecotus auritus* in small galleries and caverns were obtained mostly from the period of autumn and spring migrations

roof (6 specimens), on the roof covering or on the wall (5 specimens). Fissure roosts: in fissures between the rafters, between the rafters and the roof covering (3 specimens) (Fig. 2, Table 2).

In none of these cases did we find another individual of this species in the loft. However, in several instances, solitary individuals were found in former roosting sites of summer colonies.

Winter incidence (December to January)

Plecotus auritus

Regularly present in larger galleries (Karlštejn: galleries of the quarry Amerika; Srbsko: galleries of the quarry Kozel; Jilové: gallery Barbora, Teresie, galleries at Studenský brook), with an occasional finding in other localities. The individual bats overwintered mostly in fissures or boring holes, mostly at a considerable depth.

Table 4. Roosting sites of *Plecotus* bats found during the winter periods 1966 — 1973 in two large galleries in central Bohemia (galleries of the quarry Amerika, galleries of the quarry Kozel)

	fissure			space			Total		
	♂	♀	Σ	♂	♀	Σ	♂	♀	Σ
<i>Plecotus auritus</i>	9	3	12	1	2	3	10	5	15
<i>Plecotus austriacus</i>	6	1	7	12	8	20	18	9	27
Total			19			23			42

Plecotus austriacus

This species was found frequently in a number of localities of a different type: large galleries (Karlštejn: galleries of the quarry Amerika; Srbsko: galleries of the quarry Kozel; Jilové: galleries near the Studenský brook, gallery Teresie), large caves (Srbsko: Barrandeova cave; Koněprusy: Nová

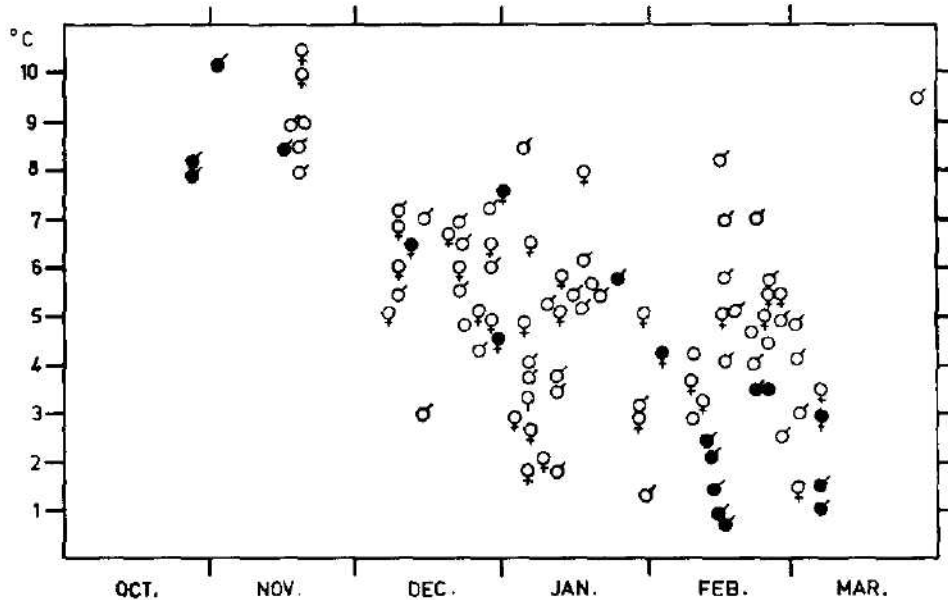


Fig. 3. The air temperature in the roosting sites of hibernating *Plecotus* bats in central Bohemia. Explanations: open bands — air temperature in the roosting site of an individual of *Plecotus austriacus*; black bands — air temperature in the roosting site of an individual of *Plecotus auritus*

jeskyně cave, Nová propast cave), basements (the castles at Zbraslav, Mníšek pod Brdy, Konopiště), often small cellars (cellars of houses at Poříčany, Šázava, Poděbrady, Kyje, etc.).

In its choice of winter roost this species shows a more marked affinity to artificial underground spaces (particular cellars) than the foregoing species (Table 3).

Generally, it hides in fissures in cellars and small galleries, not very deep (up to 20 cm); in larger winterquarters, it mostly sits or hangs on the wall (Table 4, Fig. 2b).

Data on the air temperature at the roosting sites of hibernating individuals of *P. austriacus* are surveyed in Fig. 3. It is demonstrated that the bats in the period mentioned (December to January) were found at roosting sites with the widely various air temperature (2°C to 9°C), also in sites where the temperature showed considerable fluctuations.

Transient seasonal incidence

Departure from the summer roosts and arrival at the winter roosts (August to November)

Plecotus auritus

We were unable to obtain concrete data on the course of departure from the summer roosts. No bats were found in an occasional check of the roosts of summer colonies during September (twice) and October (once) in central Bohemia.

Valuable data on the course of occupying roosts of the winter type were obtained from nettings at cave entrances. *Plecotus auritus* was one of the most frequently caught species (Table 6). Contrary to other species it was netted with considerable frequency even in the summer months (August, the end of July). The sample of netted bats consisted practically of adult males and subadult animals only.

During this period, specimens of *P. auritus* were found also in underground spaces (most frequently close to the entrances) — Table 5. In this period, numerous specimens of this species were found in small galleries and caverns, generally uninhabited by bats in the winter (entrance tunnel to the quarry at the hill Kobyla near Koněprusy, cave under the Střevíc hill at Šrbsko, etc.). We assume that in most cases these sites are short-term (one-day) transient roosts, as confirmed also by negative results of repeated checks.

Plecotus austriacus

The desintegration of summer colonies starts, similar to that in other species, apparently after the young have become more or less capable to look

Table 5. Number of the findings of *Plecotus* bats in underground cavities of central Bohemia in autumn, winter and spring periods 1966–1973

Species	Period											
	IX–X–XI 1966–1972			XII–I 1966–1973			II–III–IV 1966–1973			Total 1966–1973		
	♂	♀	Σ	♂	♀	Σ	♂	♀	Σ	♂	♀	Σ
<i>Plecotus auritus</i>	n 18	5	23	13	8	21	23	19	42	54	32	86
	%		27.0			23.9			49.1			100.0
<i>Plecotus austriacus</i>	n 18	10	28	78	59	137	30	22	52	126	91	217
	%		12.9			63.1			24.0			100.0
Total No. of bats of all species	n		380			539			586			1505
	%		25.1			35.9			39.0			100.0
Total No. of <i>Plecotus</i> bats	n		15			158			94			303
	%		13.4			29.3			16.1			29.1

after themselves, i.e. approximately at the beginning of August. This assumption is supported by the finding of adult female and juvenile specimen in the loft of the church at Rataje n. Sázavou on August 8, 1973 (in 1969, 1970 this locality had been occupied by summer colony of this species; in 1973 — May 6, July 15 — it was found unoccupied). On the other hand, the roosts of summer colonies may still be occupied at as late a time as October (finding of 5 specimens in the loft of a house at Kácov on October 8, 1972). At this time, individual bats were found also in lofts unoccupied by colonies (sub-adult female, November 26, 1972, loft of a school at Beroun).

The results of our netting at cave entrances indicate that during July and August members of this species (by contrast to *Plecotus auritus*) do not look for winter roosts at all. This suggestion has been confirmed by our results from nettings in Slovakia and Bulgaria, where *P. austriacus* was not encountered at cave entrances, although it was one of the dominant species in the areas under consideration (Horáček et al., 1974; Horáček & Červený, in. prep.).

Although individual bats were present in underground spaces from the beginning of September already, larger numbers of them were found there as late as at the end of October and the beginning of November. According to our results, at this time, *P. austriacus* was not found to occupy sites near the entrances to underground spaces or other microclimatically similar localities more frequently than at any other season.

Departure from the winter roosts and arrival at the summer roosts (February to April)

Plecotus auritus

¶ While in December, January and the beginning of February, all members of this species were found deep in larger galleries and caves, at the end of the wintering season (i.e. at the end of February and in March) most of the individuals occupied sites close to the entrance of winter roosts and also caverns and small galleries generally occupying shallow fissures. By contrast to other species, *P. auritus*, having left its winter quarter, seems to move frequently from one short-term roosting sites of the types described earlier in the text to another; this observation has also been confirmed by our results of net catching (Table 6).

The lofts of buildings are occupied by *P. auritus* apparently as late as the second half of April (the earliest finding: April 15, 1968 — a lethargic adult male in the loft of a church at Kytín; summer colonies were found at a much later time — in the middle of May).

Plecotus austriacus

Clear differences could be found from *P. auritus* in the course of departure from the winter roosts. Individuals of *P. austriacus* are, most probably, not changing their short-term roosts with the same intensiveness as does *P. auritus*. No specimen of *P. austriacus* was caught in nets even in localities where this species generally overwinter — e.g. Barrande cave (Table 6). The number of animals found in winter roosts during March (especially in the second half) was remarkably smaller than the number of animals found in these winter roosts during February (departure from the winter roosts?). However, indi-

vidual bats were found in underground spaces at as late a time as the end of March. It appears that individuals of the species *Plecotus austriacus* do not change for roosts with a lower temperature at the end of winter (February) as do bats of the species *Plecotus auritus* (Fig. 3).

The earlier findings in summer roosts (lofts) were undertaken at the beginning of May (May 2, 1969; May 10, 1968; May 15, 1971 — colonies; May 13, 1967 — a solitary individual); judging from the number of fresh faeces under the roosting sites, this have been occupied for approximately 1–2 weeks, as a rule.

DISCUSSION

Differences between the two species as regards their distribution in different types of the landscape have been observed by Bauer (1960) and particularly by Hanák (1969): during the summer, *Plecotus auritus* lives mainly in mountainous woodland areas, while *Plecotus austriacus* prefers the open country of a steppe character.

In a variegated landscape, however, this fact appears to be rather a tendency as indicated also by our results from central Bohemia. This accounts for the common incidence of both species in most areas of Europe, whereby *P. auritus* is the dominant species in mountainous woodland areas (e.g. the Krkonoše and Jeseníky Mts.), while *P. austriacus* is the dominant species in completely cultivated lowland areas (e.g. the basin of the river Labe).

Both foregoing authors and a number of other authors emphasized the fact that in central Europe *Plecotus austriacus* displayed a higher affinity to buildings both for its summer and winter roosts than does *Plecotus auritus*.

Summer incidence

According to the authors mentioned, colonies and individuals of *Plecotus austriacus* occupy synanthropic roosts (lofts of buildings) during the summer season, while *Plecotus auritus* occupies, in addition to these roosts, also natural roosts, or roosts of the natural type — tree cavities and boxes. As far as we had been able to assess from our finding in central Bohemia, *Plecotus auritus*, similar to *Plecotus austriacus*, is bound to synanthropic roosts in these areas. Moreover, at present, populations of this species live mainly synanthropically even in areas with a relatively large number of potential natural roosts, i.e., in western Bohemia (Hůrka, 1971), the Jeseníky Mts. (Souček & Novotný, 1969), the Šumava Mts. (Červený in litt.).

Individuals as well as colonies of *Plecotus auritus* were found mainly in "fissure" roosts during the summer, while the roosts of *Plecotus austriacus* were located mostly in open spaces (cf. Gaisler, 1966). This fact is in agreement with information on the original (praesynanthropic) roosts of these species: for *P. auritus* small cavities in trees and fissures, for *P. austriacus* probably spacious caves (see also Gaisler & Hanák, 1964).

Similarly to the observations by Stebbings (1970), it has been suggested by our results that the males of *P. austriacus* show a higher degree of intraspecific territoriality in the choice of their summer roosts than do males of *P. auritus*.

Winter incidence

Similar to summer roosts there is an evident affinity of *Plecotus austriacus* to artificial winter roosts (basements and cellars), although this is consider-

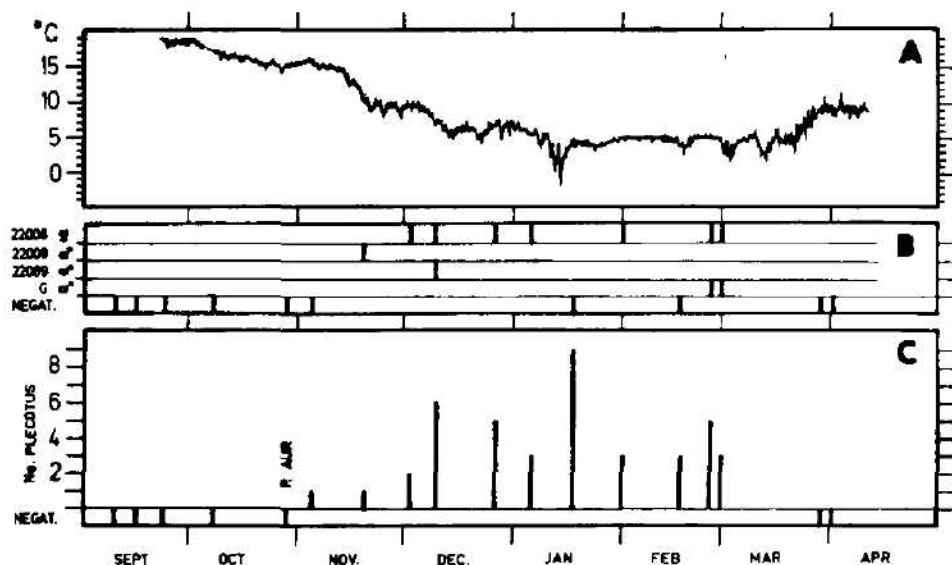


Fig. 4. Results of the observations on hibernating *Plecotus* bats at a basement of the castle in Zbraslav n. Vitavou during the winter 1967/1968.

Explanations: A — course of the air temperature at one of chambers (registered by bimetallic thermograph "Metra"); B — occurrence of four colour-banded specimens of *Plecotus austriacus* at that chamber. (Left: No. of band, sex of the individual specimens; short horizontal line in graph: presence of bat or negative result of control — in row "Negat."); C — total number of *Plecotus* bats (already *Plecotus austriacus*, with exception of one finding of *Plecotus auritus* at November 11) in whole basement in individual controls in the winter 1967/1968.

Note: Bat No. 22008 (female *Plecotus austriacus*) was found everytime at the same roosting site (except the control on December 10) — it might be assumed that this site was not left by the bat during time of great temperature fluctuation (January, the end of February). Similar situation occurred in male *Plecotus austriacus* with green band (G) at the end of February.

ably less marked than in the summer season. Generally, individuals of this species do not choose perfect hiding places in their winter roosts. Specimens of *Plecotus auritus*, however choose mainly deep fissures inside large galleries and caves for their wintering. During this season a hypsometrical and topical differentiation in the findings of both species is not very marked (Hanák, 1969; Hürka, 1971; and others).

Numerous literary data on the thermopreferendum of *Plecotus* bats are often slightly diverse: *P. auritus*: 2°–7°C (Gaisler, 1970), 2°–4°C, 5°–7°C (Gaisler & Hanák, 1969), 4°–5°C (Souček & Novotný, 1969), approximately 6°C (Stebbings, 1970). *P. austriacus*: 2°–6°C (Gaisler, 1970), 3°–5°C (Gaisler & Hanák, 1969), approximately 12°C (Stebbings, 1970). Most authors consider *Plecotus austriacus* to be the more thermophilic species.

On the basis of our observations, the difference in temperature requirements of the two species may be interpreted in a slightly different way: *Plecotus auritus* overwinters mainly in fissures, i.e., in sites with a remarkably stable ultramicroclimate, in spaces with very small temperature changes (4°–7.5°C in central Bohemia) and, hence, is in general a stenotherm, while *Plecotus austriacus* overwinters in sites exposed to considerable temperature changes

(2°–9°C in central Bohemia) sometimes with considerable fluctuation (Fig. 4). In comparison with the foregoing species, this species is more eurythermic.

Similarly to Stebbings (1966) we observed that both species changed their roosting sites inside the winter roosts (internal migrations). The average values of air temperature are almost stable at the roosting sites of the individual specimens of *P. austriacus* from December to February inclusive, whereby, towards the end of the winter, these bats do not display an increased affinity to sites with a lower temperature as this was observed in *P. auritus* (Fig. 3).

Transient incidence

The most marked differences in the biology of the species under consideration were observed within the period of changing their permanent summer and winter roosts, i.e., within the course of occupying transient roosts, in particular those of the type of winter roosts. Based on the results of our nettings at entrances to potential transient roosts, it was possible to determine the period of these seasonal migrations: *Plecotus auritus* — autumn flights: (from the early summer), end of August, September, October; spring flights: middle of February, March. *Plecotus austriacus* — autumn flights: September, beginning of October; spring flights not observed.

Similar results have been obtained by Červený (in litt.) from observations in the piedmont of the Šumava Mts.

In my opinion, the reasons for this seasonal transmigrational activity could be explained in these ways:

1) Searching for contact with individuals of the opposite sex for the purpose of mating.

The intensiveness of transmigratory activity — i.e., the intensiveness in the changing of roosts — may be considered, from this aspect, to be correlated with sexual activity. According to our observations, the mating period in *Plecotus auritus* may be estimated to take place from the end of August till October and from the end of February throughout March; in *Plecotus austriacus* only September and October. Our hypothesis is in accord with the data by Stebbings (1970) for the mating period of *P. auritus*: the beginning of September to the end of October, March; for *P. austriacus*: the beginning of September till the middle of October.

2) The search of roosts for a long-term occupancy during the winter period or the selection of an optimal winter roost.

This applies to autumn flights only and concerns mainly young individuals probably, because older animals have already "their" places in certain winter quarters to which they return, often for a number of years. We have been unable as yet to support this hypothesis for lack of material.

3) Subsequent adaptation (or arrangement of metabolic functions) to conditions of prolonged hibernation or to active life.

Our results might give the impression that the transition from active life to prolonged lethargy and vice versa occurs more slowly and more gradually in *Plecotus auritus* than in *Plecotus austriacus*. Knowledge of the actual course of this transitional period will have to be based on the results of detailed ecological studies and compared with those on physiological studies of the species under consideration, which, to my knowledge, are still lacking.

A survey of the knowledge available supports that up to date one positive correlation only has been found, and that is that between the period of sexual activity and the intensiveness of trans migratory activity during this period. This leads to the provisional assumption that these flights are closely associated with searching for contact with individuals of the opposite sex for the purpose of mating. Our hypothesis is supported by the fact that the absolute majority of animals caught in the nets were sexually active adult and sub-adult males.

A disputable and important problem is the fact that *Plecotus auritus* displays a remarkably higher trans migratory activity during the period of occupying transient roosts of the winter type than does *Plecotus austriacus*. A possible interpretation of this fact may be as follows:

1) It manifest a more primitive capability of *Plecotus auritus* to contact other members of its population (intraspecific communicability).

In this aspect, information on the activity of the facial (or supernasal) gland in *Plecotus auritus* may be of interest: according to the observations by Stebbings (1966) and to occasional observations made by us, this gland release an oily, pungant secretion in the autumn (we observed it at the end of July already). This phenomenon has been discussed into great details by Stebbings (1966) who concluded that the release of the strongly odorous secretion is probably of importance in the search of the individual bats for one another; in my opinion -- in order to mark potential "mating roosts". In *Plecotus austriacus* from central Bohemia, I have never observed such activity of this gland.

Hence, it may be assumed that *P. auritus* has to visit and inspect a number of roosts which it recognizes as the actual roosts of members of the species only by the presence of fresh secretion from the facial gland. *P. austriacus*, however, has a more perfect outfit for recognizing, or finding, potential or actual roosts of members of its own population.

2) Mating of *Plecotus austriacus* occurs mainly in roosts of the summer type (compare the presence of individuals of this species in lofts in September and October), while *Plecotus auritus* mates mainly in roosts of the winter type (empty lofts in autumn, and intensive search of sites of the winter roost type).

It has to be emphasized that this treatise is purely hypothetical and will have to be confirmed by a study on a much larger material than the one which was at my disposal at the time of this study.

FINAL NOTE

Studying the reasons and mechanisms of the origin of the observed ecological and biological differences between the two species under consideration, I suppose a look at differences between them from the point of view of their evolution will be of some interest.

While *Plecotus auritus* is an old species of central European origin probably (it is known from there already from the pliocene -- cf. e.g. Heller, 1936, and forms a considerable part in practically all European Quaternary materials), *Plecotus austriacus* appears to be one of latest species in our fauna. Absolute absence of *Plecotus austriacus* in all (also almost recent) holocene materials in the area of Czechoslovakia (Table 7), as well as in all known fossil and subfossil materials from Europe (cf. e.g. Woloszyn, 1970), suggests

Table 7. *Plecotus* bats in some fossil and subfossil bat materials from Czechoslovakia

Stratum — Locality	Author	No. of bat spp.	<i>Plecotus</i>			
			sp.	<i>abeli</i>	<i>auritus</i>	<i>austriacus</i>
Pliocene						
Ivanovce near Trenčín	Horáček	8	+	—	—	—
Pleistocene — oldest						
Kolmány (Slovakia)	Horáček	4	—	—	—	—
Plešivec (Slovakia)	Horáček	6	—	—	—	—
Pleistocene — old						
Srbsko — 6. cave (Bohemia)	Horáček	3	—	+	+	—
Koněprusy — Southern chimney (Bohemia)	Horáček	9	—	+	—	—
Koněprusy — C 718 (Bohemia)	Kowalski (1962)	7	—	—	+	—
Pleistocene — middle						
Dobrkovice II (s. Bohemia)	Horáček	3	—	—	+	—
Holocene						
Sudslavice (s. Bohemia)	Horáček	10	—	—	+	—
Malenice (s. Bohemia)	Horáček	2	—	—	+	—
Belanská cave (Slov.)	Horáček	8	—	—	+	—
Barrandé cave (c. Boh.)	Horáček	6	—	—	—	—
Srbsko — SN cave (c. Boh.)	Horáček	6	—	—	+	—
Srbsko — 1st cave (c. Boh.)	Horáček	5	—	—	+	—
Alabastrová cave (n. Slovakia)	Horáček	8	—	—	+	—
Dobšinská Ice cave (Slovakia)	Horáček	12	—	—	+	—
Domica cave (s. Slov.)	Horáček	4	—	—	—	—
Týnčany — 1. cave (c. Boh.)	Horáček	5	—	—	+	—
Vošmenda (n. Bohemia)	Rybář (1970)	6	—	—	+	—
Muráň (n. Slovakia)	Schaefer (1974)	13	—	—	+	—

Explanations: + = presence, — = absence.

that it spread, in Europe, as late as in the historical period. This fact should be considered when judging the ecological differentiation of both the species as well as searching its reasons.

While ecology of *Plecotus auritus* is that of an old, however still relatively adaptable plastic species, the ecology of *Plecotus austriacus* is that of the species expressively new, spreading only recently. Thus, detailed complex study of the problems mentioned might bring valuable information also from the theoretical viewpoint.

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SUMMARY

Present paper deals with the preliminary results of investigating the ecology and biology of two bat sibling species — *Plecotus auritus* and *Plecotus austriacus*, that has been undertaken during the years 1966 to 1973 in central Bohemia (Fig. 1) and in some others areas of Czechoslovakia. Results are discussed from the point of view of ecological differentiation of these species. Some more important differences found between the two species are reviewed in the following table.

	<i>Plecotus auritus</i>	<i>Plecotus austriacus</i>
Summer roosts	roosts occupied 1) synanthropic 2) original — tree cavities	synanthropic only
roosting sites	fissure	space
average size of summer colonies	5 — 10 specimens	10 — 20 specimens
intraspecific territoriality in males in summer roosts	—	+
Winter roosts	roosts occupied large galleries and caves, less cellars	more synanthropic — — cellars, less caves and galleries
roosting sites	mostly fissure	mostly space
thermopreferendum in hibernacula	stenothermic 4° — 7.5°C	eurythermic 2° — 9°C
transmigratory activity	autumn very high August to October	lesser September to October
	spring lesser (comparing with autumn) half of February — March	not observed
period of mating	September to October, March	September to half of October
origin	European	Asian
occurrence in Europe	from pliocene, one commones Quaternary bat species	remarkably new, spreading itself in historical time
general view	old but still plastic species	new, progresive culturophilic

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Author's address: Ivan Horáček, Sídl. Michelská 1182, 145 00 Praha 4, Czechoslovakia.

Pädagogische Fakultät, Ostrava
Geologisches Institut der Tschechoslowakischen Akademie der Wissenschaften, Praha

**CYPRIA HELOKRENICA SP. N.,
EINE NEUE OSTRACODEN-ART DER QUELLFAUNA**

JAN KANTOREK & ADOLF ABSOLON

Eingegangen am 7. Januar 1974

Die Ostracodenfauna von Quellen besteht einerseits aus typischen Quellbewohnern, andererseits aus Arten, die eine grosse ökologische Plastizität aufweisen und gleichfalls in anderen Wasserbiotopen häufig vorkommen. Es handelt sich besonders um die Arten *Candona neglecta*, *Cypria ophthalmica* und *Cyclocypris ovum*. Es ist anzunehmen, dass unter diesen Namen mehrere auch ökologisch verschieden anspruchsvolle Arten eingeschlossen werden, wie schon bei der Art *Candona neglecta* von Petkovski (1959) nachgewiesen wurde.

Wir haben unser Augenmerk auf die Art *Cypria ophthalmica* gerichtet und haben festgestellt, dass sie in Quellen tatsächlich auftritt, aber neben ihr auch eine andere, bisher unbeschriebene Art der Gattung *Cypria* vorkommt. Diese wurde zum erstenmal von Dr. J. Kantorek bei Untersuchungen in der Umgebung von Ostrava und in den Mährisch-schlesischen Beskiden erkannt. Weiter wurde sie von Dr. A. Absolon im Naturschutzgebiet "Sulov-Felsen" (Westslowakei) und von beiden Autoren im Naturschutzgebiet „Rozsutec“ (Westslowakei) ziemlich häufig gefunden. Insgesamt fanden wir die neue *Cypria* an 16 Lokalitäten und gewannen Hunderte von Exemplaren. Die neue Art benannten wir nach dem Biotop, den sie bevorzugt, als *Cypria helokrenica*.

Unterfamilie: Cyclocypridinae Kaufmann, 1900

Gattung: *Cypria* Zenker, 1854

Cypria helokrenica sp. n.

Diagnose: Gehäuse in der Seitenansicht etwa dreieckig; in der Dorsalan-sicht stark komprimiert; Innenlamelle sehr breit; Schwimmborsten der 2. Antene reichen nur bis zum $\frac{1}{3}$ der Endklauen; zwei kurze Borsten des Putzfussendgliedes verschieden lang — die kürzere hakenförmig beendet; Stamm der Furka mit 3 Reihen von Borsten versehen.

Holotypus: 1 Weibchen (Abb. 1a, b), dessen Klappen und Weichteile als Dauerpräparat im National-Museum Prag unter Nr. Evert. III, 1011 aufbewahrt sind.

Locus typicus: Ostrava-Zábřeh, ein Helokrenon in der Aue des Oder-Flusses.

Beschreibung der Klappen: Das Gehäuse des Weibchens ist in der Seitenansicht etwa dreieckig; die grösste Höhe liegt dicht hinter der Mitte auf einem breit gewölbten Gipfel, wovon der Rückenrand nach vorn und nach hinten steil abfällt und in den Vorder- und Hinterrand fliessend übergeht. Der Vorder- und Hinterrand sind nicht nur im Umriss, sondern auch in der Form der Innenlamelle und des hyalinen Saumes fast symmetrisch

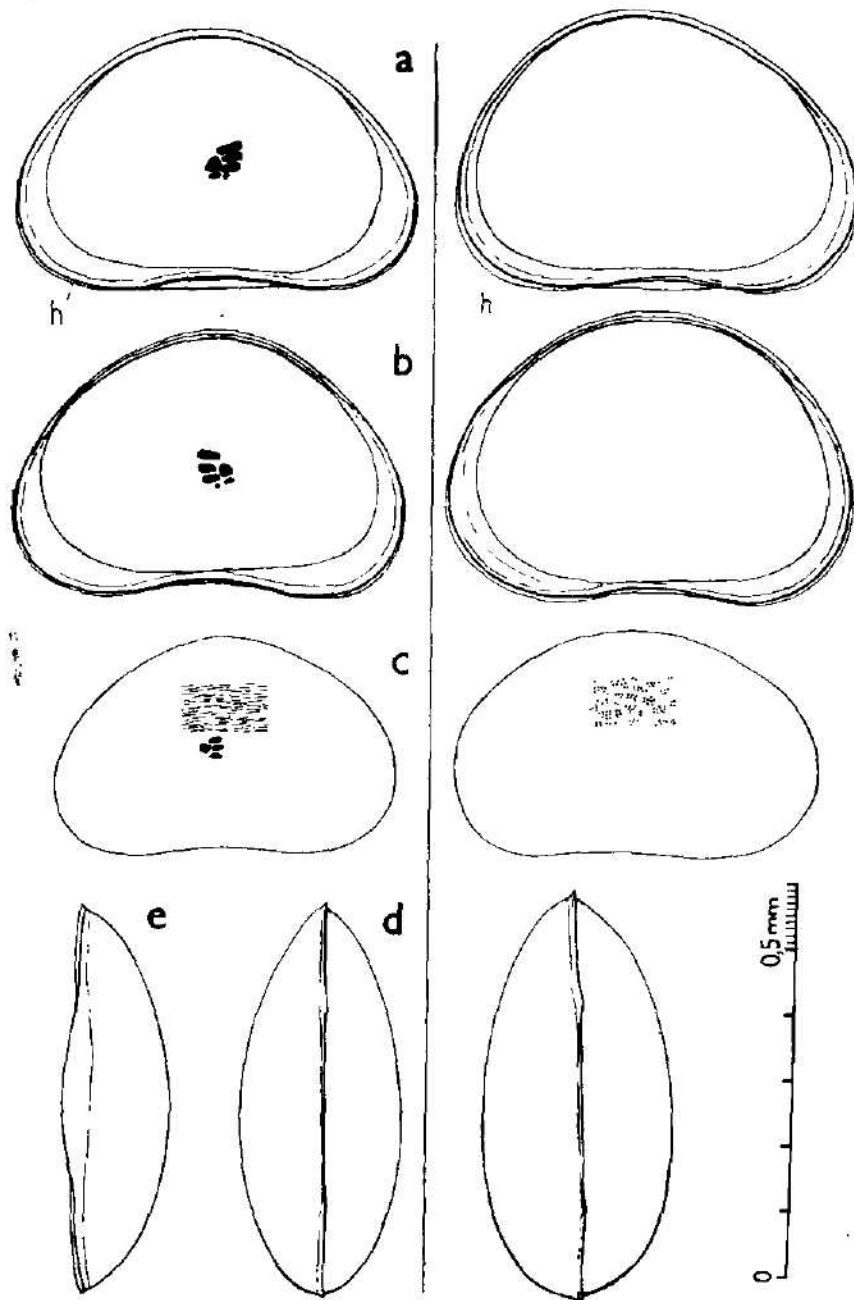


Abb. 1. — *Cypria helokrynica* sp. n. (linke Spalte) im Vergleich mit *Cypria ophthalmica* (rechte Spalte). a — linke Klappe von innen (h = hyaliner Saum); b — rechte Klappe von innen; c — letztes Larvenstadium; d — Rückenansicht; e — linke Klappe in der Bauchansicht (Orig. Absclon).

gebaut. Der Hinterrand ist nur etwa höher und die hintere Innenlamelle ist höher in den Rücken zu verfolgen (Abb. 1a, b). Der Bauchrand ist bei der rechten und linken Klappe verschieden gebildet. Während er bei der linken Klappe fast gerade ist, weist bei der rechten Klappe eine ziemlich tiefe Einbuchtung auf. Von unten sieht man, dass die linke Klappe einen breiten Lappen trägt, der zum besseren Zusperrn der linken Klappe über die rechte dient (Abb. 1e).

Von oben gesehen ist das Gehäuse stark komprimiert; seine grösste Breite liegt dicht hinter der Mitte. Das Vorderende ist mehr als das Hinterende zugespitzt (Abb. 1d). Die Innenlamelle ist sowie vorn als auch hinten relativ breit, sie nimmt 9,5 % bzw. 8 % der gesamten Länge der Klappe ein.

Die Oberfläche der Klappen ist vollkommen glatt, nur bei Larven ist eine feine Retikulation in der Form länglicher Rillen zu beobachten. Dieselbe Retikulation ist für die Art *Cypria exsculpta* kennzeichnend (Abb. 1c).

Das männliche Gehäuse weist nur geringe morphologische Unterschiede auf. Es ist im Durchschnitt unerheblich kleiner und vollkommen symmetrisch, sodass seine grösste Höhe in der Mitte liegt. Das L/H Verhältnis bleibt dabei erhalten (Tafel, Abb. a, b).

Massen: (im Vergleich mit anderen europäischen *Cypria*-Arten)

Art	Länge	Höhe	Breite	H/L	B/L	Innenlamelle	
						vorn	hinten
<i>C. helokrenua</i> sp. n.	0,62	0,41	0,26	66/100	42/100	9,5 %	8,0 %
<i>C. stygia</i> (nach Klie, 1935)	0,58	0,39	0,29	87/100	48/100	7,5 %*	7,0 %*
<i>C. reptans</i> (nach Bronstein, 1928, 1947)	0,65	0,45	0,25*	69/100	43/100*	?	?
<i>C. inversa</i> (nach Klie, 1941)	0,58	0,41	0,28	70/100	48/100	7,0*	4,0*
<i>C. ophthalmica</i>	0,65	0,46	0,29	71/100	47/100	6,5	3,5
<i>C. obliqua</i> (nach Klie, 1939)	0,56	0,40	0,24	71/100	42/100	7,0*	7,0*
<i>C. curvifurcata</i> (nach Bronstein, 1947)	0,70	0,50	0,42	71/100	60/100	?	?
<i>C. exsculpta</i>	0,78	0,56	0,37	72/100	48/100	5,5	5,0

(* — den Abbildungen entnommen)

Beschreibung der Gliedmassen: Erste Antene, Mandibel, Maxille und erste und zweite thorakale Gliedmassen weisen Kennzeichen der Gattung *Cypria* auf. Ausgeprägte und konstante Unterschiede wurden bei der zweiten Antene, beim Putzfuss und bei der Furka festgestellt.

Die Schwimmborsten der zweiten Antene sind verkümmert; sie reichen nur bis zu $\frac{1}{3}$ der Endklauen. Diese verkümmerten Schwimmborsten besitzen sowie Weibchen als auch Männchen. Bei Männchen sind die Tastborsten auffallend entwickelt — sie reichen bis zum distalen Rand des Endgliedes (Tafel, Abb. c).

Der Putzfuss ist bei beiden Geschlechtern übereinstimmend entwickelt. Das erste Glied ist mit drei Borsten und das zweite mit einziger Borste versehen (diese liegt am distalen Ende). Das dritte Glied trägt eine lange Borste und am distalen, fein behaarten Ende noch eine kurze Borste und zwei

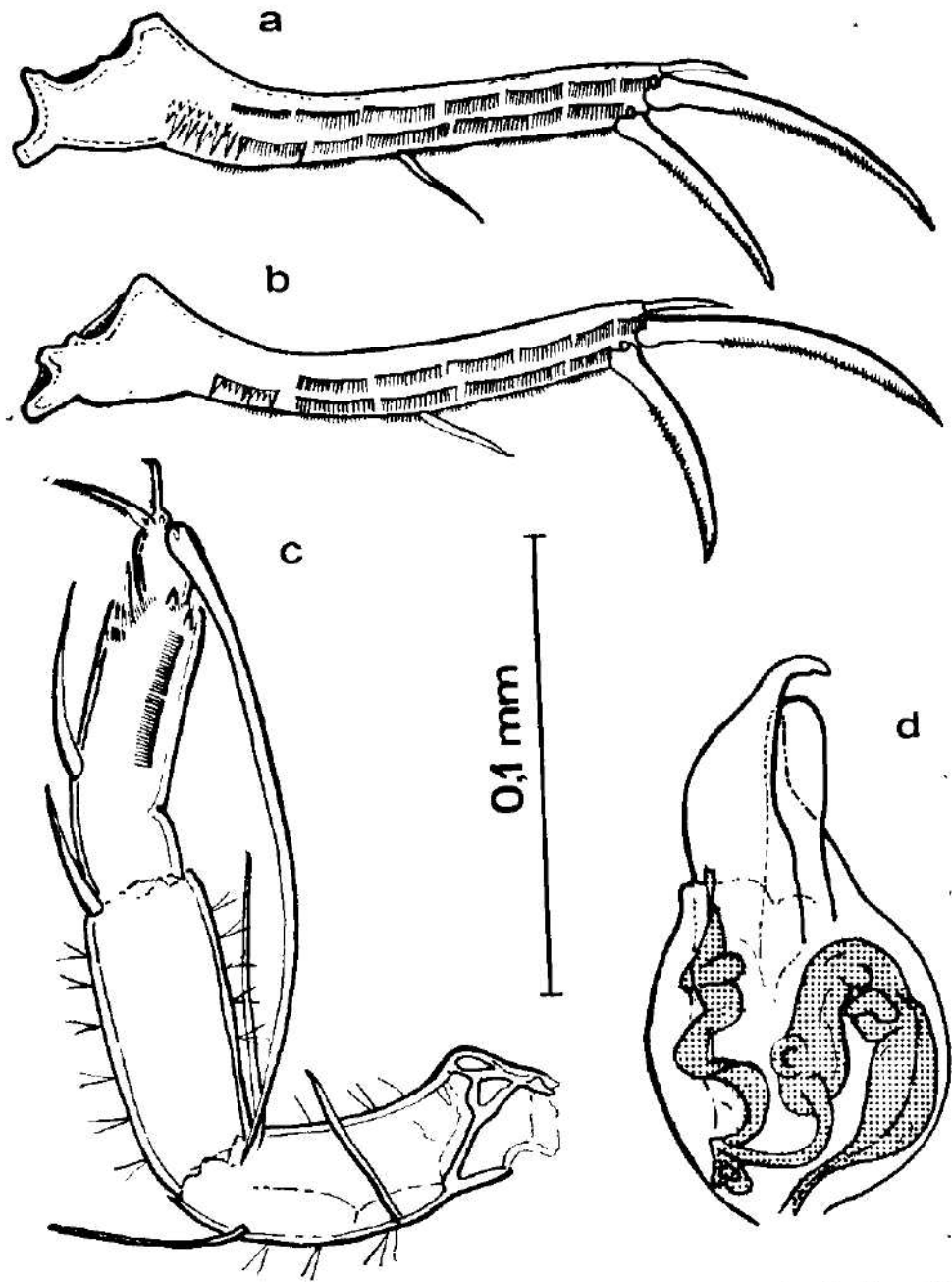


Abb. 2. — *Cypria helokrenica* sp. n. a — Furka des Weibchen; b — Furka des Mannchen;
 c — Putzfuss; d — Kopulationsorgan (Orig. Kantorek).

Dornen. Ausser diesen Borsten läuft parallel mit der Gliedachse eine in zwei Kämmchen geteilte Reihe von feinen Borsten. Das letzte Glied des Putzfusses trägt auf seiner Spitze 3 Borsten. Die langste erreicht die Basis des zweiten Gliedes; die mittellange Borste ist etwa länger als das Endglied und die kurze Borste ist dagegen etwa kürzer als das Endglied und ist auffallend hakenförmig beendet (Abb. 2c).

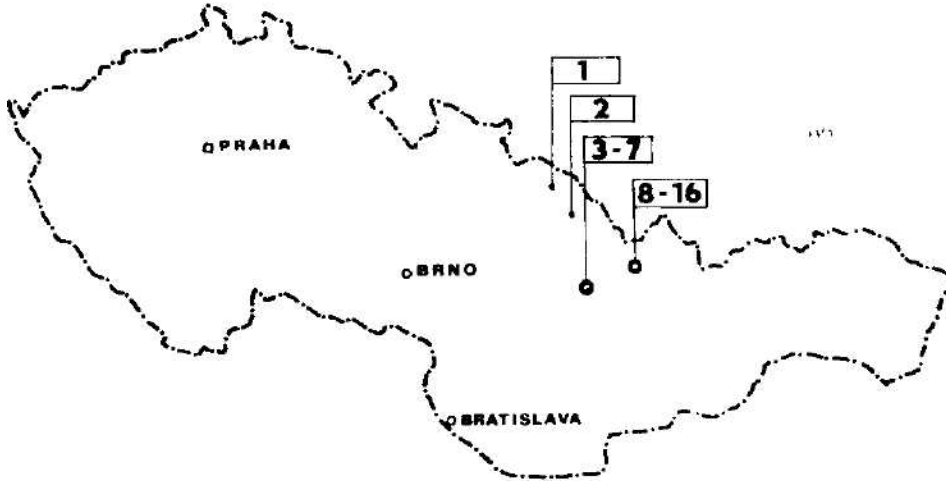


Abb. 3. — Fundstellen von *Cyprina helokrenica* sp. n. in der Tschechoslowakei. 1 — Ostrava-Zábřeh; 2 — Horní Lomná; 3 bis 7 — Naturschutzgebiet „Sulov-Felsen“; 8 bis 16 — Naturschutzgebiet „Rozsutec“.

Die Furka ist in $\frac{1}{3}$ ihres Stammes deutlich gebogen. Ihre Endklauen sind verschieden lang; die vordere ist länger, sie nimmt genau $\frac{1}{2}$ des Stammes ein. Die hintere Klaue ist um $\frac{1}{4}$ kürzer als die vordere. Die Form der Furka stimmt bei beiden Geschlechtern überein. Wir haben aber Unterschiede in der Behaarung des Stammes festgestellt. Diese Behaarung bildet drei Reihen. Die, die bei der vorderen Endklaue beginnt, bezeichnen wir als mesolaterale Reihe und die folgende, die bei der hinteren Endklaue beginnt, als metalaterale Reihe. Die dritte Reihe liegt schon dicht hinter der Dorsalkante, d. h. schon an der Innenseite der Furka. Wir bezeichnen sie als peridorsal. Alle drei Reihen sind von deutlich getrennten Kämmchen gebildet und wir haben festgestellt, dass ihre Zahl beim Weibchen und beim Männchen verschieden ist. Die Furka des Weibchens hat in der mesolateralen Reihe 7 Kämmchen; das letzte trägt aber Borsten halber Länge. Dieses letzte Kämmchen beim Männchen fehlt. Die metalaterale Reihe ist beim Weibchen von 6 Kämmchen gebildet, dabei das sechste aus einer Gruppe von verschiedenen langen Dornen besteht. Beim Männchen ist schon das fünfte Kämmchen durch Dorne ersetzt (das sechste fehlt). Die peridorsale Reihe enthält sowie beim Weibchen als auch beim Männchen 5 Kämmchen mit kurzen Borsten (Abb. 2a, b).

Die Form des Hemipenis ist von den gemeinen *Cyprina*-Arten (*C. ophthalmica* und *exsculpta*) abweichend. Sein distales Ende ist sehr langgestreckt und

sehnabelförmig gebogen. Auf ähnliche Gestaltung des Hemipenis stiessen wir bisher nur bei der Art *Physocypris kraepelini*. Der taxonomische Wert des Hemipenis ist bei der Unterfamilie Cyclocypridinae einstweilen unklar, da es nur wenig Vergleichsmaterial zur Verfügung steht.

Ökologie: Das Vorkommen von *Cypria helokrenica* sp. n. ist geographisch an die Westkarpaten beschränkt. Dort wurde diese Art sowie im Flachland (min. Seehöhe 218 m) als auch in Bergen (max. Seehöhe 1170 m) festgestellt. Sie bewohnt kleine stehende Tümpel an Quellen und Sickerquellen, fließendes Wasser meidet sie aber nicht, da sie auch in kaskadenartigen Quellabflüssen gefunden wurde (30 % der Funde). Mit ihr zusammen kamen fast immer *Cyclocypris ovum* und sehr oft *Potamocypris zschokkei*, *Ilyocypris bradyi*, *Candona neglecta* und *Cypridopsis subterranea* vor. Aus übrigen Begleitformen kann man *Candona brevicornis*, *Ilyodromus olivaceus*, *Candona albicans*, *Scottia pseudobrowniana*, *Candona vavrai*, *Potamocypris villosa* und *Ilyodromus fontinalis* anführen.

Cypria helokrenica sp. n. kann als kaltstenotherme Form bezeichnet werden (Temperaturspanne von 2 bis 14 °C). Sie tritt das ganze Jahr hindurch auf (Larven, sowie Weibchen und Männchen), nur vom Januar bis zum Anfang März sind erwachsene Männchen relativ selten anzutreffen.

Anmerkung: Arten der Gattung *Cypria* mit stark verkürzten Schwimmborsten wurden schon aus europäischem Raum beschrieben. Es handelt sich um Arten *Cypria reptans* Bronstein, 1928 aus Kaukasus und *Cypria stygia* Klie, 1935 aus jugoslawischen Höhlen. Unsere neue Art ist mit diesen Arten anatomisch, sowie ökologisch nahe verwandt. Anatomische Unterschiede, die zu ihrer selbständigen Artenstellung berechtigen, werden nachstehend tabellarisch zusammengefasst (Unterschiede in Klappen wurden schon oben angegeben).

Merkmal	<i>C. helokrenica</i>	<i>C. reptans</i>	<i>C. stygia</i>
2. Antene. Schwimmborsten erreichen:	$\frac{1}{3}$ der Endklauen	Basis der Endklauen	Mitte der Endklauen
Putzfuss. Kurze Borsten des Endgliedes sind:	verschieden lang, kürzere hakenförmig beendet	gleich lang beide geraden	verschieden lang, beide geraden
Lange Borste des Endgliedes	reicht bis zur Basis des 2. Gliedes	?	greift wesentlich über die Basis des 2. Gliedes
Einzige Borste des 2. Gliedes	am distalen Ende	?	im mittleren Teil
Furka. Verhältnis vordere Endklaue/Stamm	48–53/100	38/100	41/100

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Die Tafel ist am Ende des Heftes zu finden.

Anschrift der Verfasser: Dr. Jan Kantorek, Pedagogická fakulta, Dvořákova 7, 70 103 Ostrava. Dr. Adolf Absolon, Geologický ústav ČSAV, Trojanova 13, 120 00 Praha 2.

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Zoologische Abteilung des Nationalmuseums, Praha

**DENDROBAENA AURICULATA (ROSA, 1897) — EINE FÜR DIE ČSSR
UND DIE DDR NEUE ART DES REGENWURMS (OLIGOCHAETA:
LUMBRICIDAE)**

MARIE MIKULOVÁ

Eingegangen am 31. Juli 1974

Abstrakt: Auf 6 Lokalitäten in der ČSSR und 1 Lokalität in der DDR wurde der Regenwurm *Dendrobaena auriculata* (Rosa, 1897) gefunden, der bisher aus Österreich, Polen, Litauen und Ungarn bekannt war. In der Anatomie der untersuchten Exemplare ist im Gegensatz zu den bisher publizierten Angaben ein Unterschied in der Zahl der Paare der Samensacke festgestellt worden.

Im Herbst 1973 wurde mir die Möglichkeit geboten, 1 Monat lang im Zoosystematischen Institut der Universität L. Eötvös in Budapest zu arbeiten und zum Studium die dortigen reichen Sammlungen von Regenwürmern der Familie Lumbricidae zu verwerten. Mit seinen Erfahrungen, Ratschlägen und seiner ausserordentlichen Gefälligkeit war mir Doz. Dr. A. Zicsi behilflich, dem ich an dieser Stelle meinen aufrichtigen Dank ausspreche.

Im Material, das ich aus den Sammlungen der Zoologischen Abteilung des Prager Nationalmuseums zur neuerlichen Bestimmung mitführte, waren auch 18 Exemplare aus 5 tschechoslowakischen Lokalitäten und 1 Lokalität aus der DDR, die ich vorläufig als *D. auriculata* (Rosa, 1897) bestimmt hatte. Diese Art war aus der Literatur nur aus Österreich (Rosa, 1897; Zicsi, 1965), Polen (Plisko, 1962), Litauen (Atlavinite, Likjavičene, Strazdene, 1963) und Ungarn (Zicsi, 1964, 1966, 1968) bekannt. Da ich in unseren Sammlungen kein Vergleichsmaterial zur Verfügung hatte, konnte ich die Richtigkeit der Bestimmung dieser Exemplare erst auf Grund des reichen Vergleichsmaterials im Budapester Institut bestätigen. In der Sammlung Černosvitov fand ich noch weitere 3 adulte und 2 juvenile Stücke dieser Art, die in Böhmen bereits im Jahre 1948 gesammelt worden waren. In der nachstehenden Tabelle gebe ich eine Übersicht der Funde dieser Art, die derzeit in der ČSSR und der DDR bekannt sind.

Die ökologischen Standorte dieser Funde entsprechen den bisher beschriebenen Angaben. Unsere Fundorte waren meist humoser Boden an Ufern von Wasserläufen, in den übrigen Fällen Parkanlagen oder Gärten. In der Lokalität Praha-Troja, von der wir nähere Angaben haben, wurde auch der pH der Erde und der Gehalt an Kalzium geprüft: pH schwankt zwischen 6,0—6,5, % Ca^{2+} in der Lauge zwischen 0,27—0,72.

Lokalität	Stückzahl ad. + juv.	Datum des Fundes	Sammler
Ješovice bei Liběchov, Bez. Dubá	3 + 2	1948	Kopernický
Libá bei Cheb	3 + 1	1963	Táborský, Pfleger
Zadielská dolina bei Košice	1 + 0	1963	Táborský, Pfleger
Loutí bei Slapská přehrada	1 + 3	1967	Mikulová
Praha Troja	4 + 4	1973, 1974	Mikulová
DDR-Serrahn bei Neustrelitz	3 + 1	1965	Táborský und Pröp. Schule des Nationalmuseums

Die äusseren Merkmale bewegen sich gleichfalls in den Variationsgrenzen, die in der Literatur angeführt werden: Länge: 26–31 mm, \varnothing : 2–2,5 mm, Segmentzahl: 119–137, Clitellum: 23,1/n23, 24,25/–33,1/n34, 34, Pubertätswälle: 31–33, männliche Poren am 15. Sg. mit Drüsenhöfen, epilobisches Prostomium, geöffnet, getrennte Borsten.

In der Anatomie der untersuchten Exemplare wurde ein Unterschied in der Zahl der Paare der Samensäcke festgestellt. Im Gegensatz zu den bisher angegebenen 4 Paaren im 9.–12. Segment (Plisko, 1962; Zicsi, 1964; Wilcke, 1968), hatten alle unsere Exemplare nur 3 Paare Samensäcke im 9., 11. und 12. Segment. Nach dieser Feststellung habe ich noch weitere ca 15 Exemplare aus der ungarischen Lokalität Gödölö geöffnet. Bei einem Stück wurden vier Paare, bei einem Stück 2 Paare, bei den übrigen wieder 3 Paare von Samensäcken im 9., 11., und 12. Segment festgestellt. Es ist daher möglich, dass die Zahl der Paare der Samensäcke bei dieser Art von 2–4 variiert. Im Hinblick auf die Schwierigkeit bei der Präparation (es handelt sich um Exemplare sehr kleiner Dimensionen) ist jedoch die Möglichkeit einer Verwechslung der Samenblase im 10. Segment mit dem Samensack nicht auszuschliessen. Die Zahl und Lage der übrigen inneren Merkmale (Samentaschen, Samenblasen und Kalkdrüsen) stimmen mit den in der Literatur beschriebenen Angaben überein.

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Institute of Virology, Slovak Academy of Sciences, Bratislava

A CONTRIBUTION TO THE KNOWLEDGE OF THE COLLEMBOLAN FAUNA
IN THE DOMICA CAVE (SE SLOVAKIA)

JOSEF NOSEK

Received June 10, 1974

Abstract: *Onychiurus troglophilus* sp.n. is described and seven other species are mentioned from the Domica cave in the South Slovakian Karst.

The Grotte Domica spreads in the South Slovakian Karst and forms with Aggtélek Cave in Hungary an united subterranean system. Two collembolan species *Arrhopalites aggtelekiensis* Stach and *Onychiurus armatus* (Tullb.) are reported from Aggtélek Cave by Stach (1945, 1954). From Domica Cave two another species *Folsomia candida* (Will.) and *Heteromerus nitidus* (Templ.) are mentioned by Paclt (1957).

In April 3rd and 4th, 1974, I myself found the following species: *Hypogastrura denticulata* (Bagn.), *Onychiurus troglophilus* sp.n., *Onychiurus* sp., *Tullbergia krausbaueri* (Börn.), *Folsomia fimetaria* (L.), *Lepidocyrtus instratus* Handsch., *Neelus minimus* Will., *Arrhopalites slovacicus* Nosek.

Fauna extracted via a modified Tullgren Funnel. The material was laid on a sieve in the funnel and the animals therein were driven down by the light, heat and dehydration of a normal room

Hypogastrura (Ceratophysella) denticulata (Bagnall, 1941)

Diagnosis: One individual was found which agrees in the chaetotaxy with *H. denticulata*. Tenaculum with 4 + 4 rami, anal spines a little shorter than the third claw. 8 + 8 eyes on each side of the head. Postantennal organ very similar to that of *H. cavicola* Börn. Chaetotaxy of *H. cavicola* belongs to the *H. armata*, *armatissima* group and *Typhlogastrura* (Gisin, 1962). Troglophil.

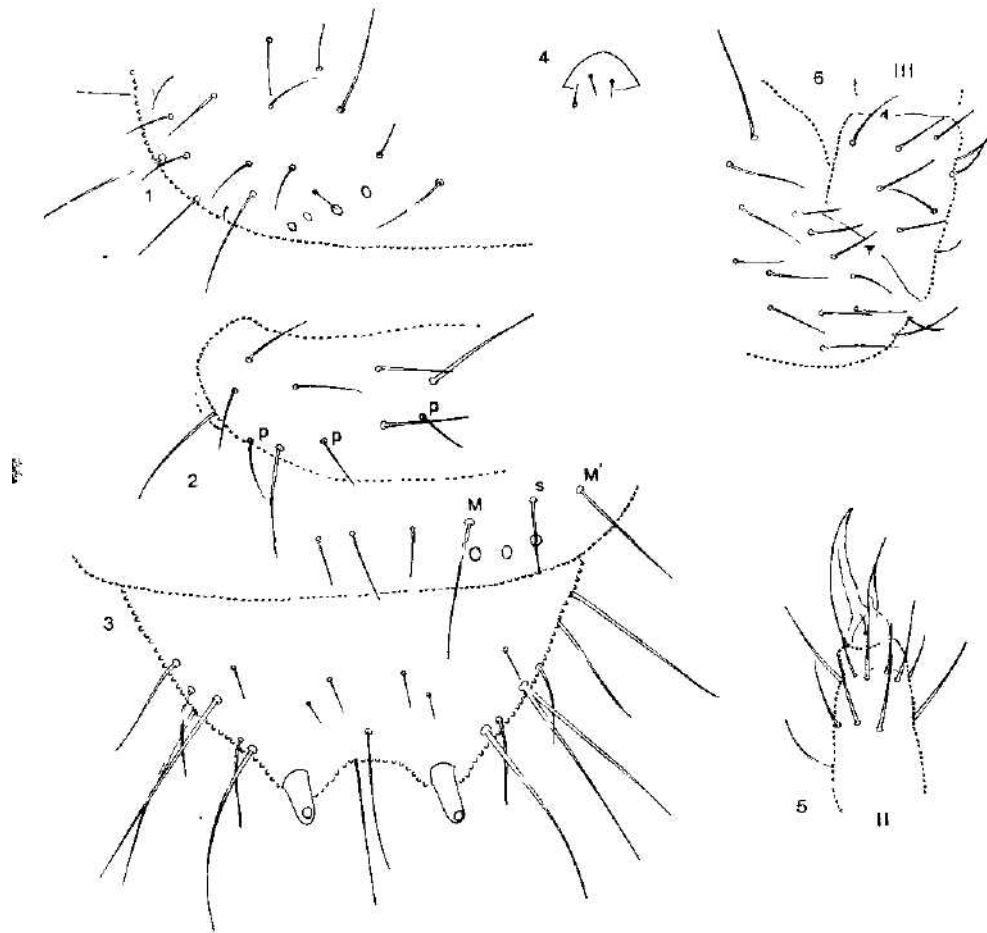
Onychiurus (Protaphorura) troglophilus sp.n.

(Figs 1—6)

The number of pseudocelli as in *O. uliginatus* Gis. and *O. subuliginatus* Gis. 34/022/33343. Ventral side of the head and coxae each with 1 Pseudocelle. M : s as 44 : 23. Three short setae in the posterior row on prothorax.

Description. Length: 1.3 mm; colour: white.

Head: Postantennal organ elongate, elliptical, each with about 40 simple tubercles, crowded together. Pseudocelli of antennal basis 3 and 3, posterior border of head with 4 and 4 pseudocelli (Fig. 1). Ventral side of head with 1

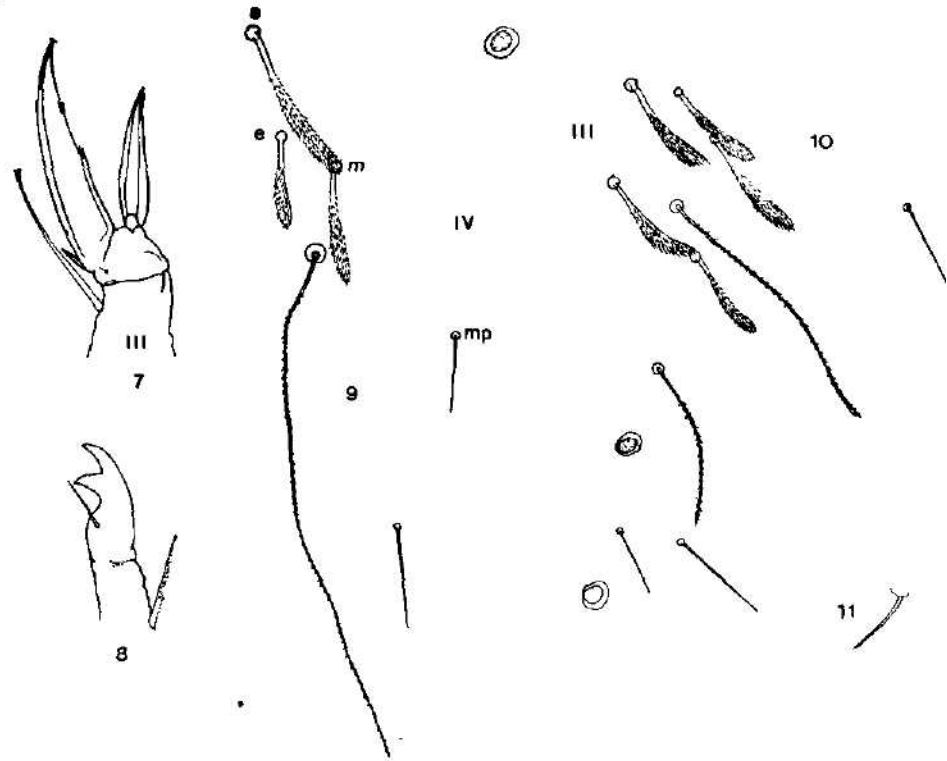


Figs 1-6: *Onychiurus troglophilus* sp.n. 1. Posterior border of the dorsal side of head. — 2. Pronotum. — 3. Pseudocell on the Abd. V and Abd. VI dorsally. — 4. Furcula. — 5. Apical part of the second leg. — 6. Trochanter and subcoxa of the third leg. (magnification $100\times$ 6).

and 1 pseudocelli. Antennae shorter than head. Sense organ of Ant. III with 5 papillae, 5 guard setae; a pair of sense rods; 2 capitate, coarsely tuberculate sense clubs; and a large subovate finely tuberculate sense clubs.

Thorax: Prothorax without pseudocelli dorsally, with 3 short setae in posterior row (Fig. 2). Meso- and metathorax with 2 and 2 pseudocelli each. Each coxa with 1 pseudocelle. Unguis (claw) unarmed. Unguiculus (empodial appendage) extending more than half as far as unguis, basally suboblong, apically tapering in a filament (Fig. 5). Trochanter and coxa with a blunt spine (Fig. 6).

Abdomen: Pseudocelli of abdominal segments as follows: 3 and 3, 3 and 3, 3 and 3, 4 and 4, 3 and 3. Tubus ventralis with 7 and 7 setae on basis, and with 2 setae on each side basally. Furcula represented by a fold (Fig. 4). The ratio $M : s$ as 44 : 23 (Fig. 3). Four short setae in front of anal spines are arranged in two convergent lines (Fig. 3).



Figs 7-10: *Lepidocyrtus instratus* Handsch. Apical part of the third leg. — 8. Mucro, (magnification 60×10). — 9. Anterior group of setae near trichobothrium on Abd. IV. — 10. Medial group of setae near trichobothria on Abd. III (magnification 100×10). Fig. 11: *Arrhopalites slovacicus* Nos. Subanal appendage (100×10).

Affinity: This species differs from *O. uliginatus* and *O. subuliginatus* in the chaetotaxy of prothorax, in arrangement of 4 short setae on Abd. VI, and in ratio $M : s$.

Derivatio nominis: It may be considered as a troglophilous animal.

Holotype: ♀ mounted in Svan's medium kept in Muséum d'Histoire naturelle de Genève.

Onychiurus (Protaphorura) sp.

Diagnosis: $M : s$ as $42 : 18$; prothorax without pseudocelli dorsally, with 2 short setae in the posterior row. The number of pseudocelli as in previous species.

Tullbergia (Mesaphorura) krausbaueri (Börner, 1901)

Diagnosis: On Abd. IV p_1 -bristle is macrochaeta, and p_2 -bristle microchaeta; sensilla b on Ant. IV thicker than the other sensillae, sensilla e long. Pseudocelli on meso- and metanotum between p_3 and p_4 bristles (Rusek, 1971). Very abundant; troglophil.

Folsomia fimetaria (Linnaeus, 1758)

Diagnosis: Unguiculus without filament; dens : mucro as 9 : 1, dentes twice as long as manubrium. Manubrium with 3 and 3 setae. It was observed as a very abundant species. Troglphil.

Lepidocyrtus instratus Handschin, 1924

(Figs 7–10)

Diagnosis: The accessoric setae on the basis of the anterior trichobothrium on Abd. IV (Fig. 9) agree with *L. lignorum*, *violaceus*, *instratus* group (Gisin, 1960b). The third claw well agrees with the reexamination of topotype. The basal tooth is inserted in about 40 % ventral length of claw (Fig. 7). 8 and 8 eyes. Colour: The thoracic tergites II–III and abdominal tergite III are slightly blue violet, and the pigment is dispersed also on the head and in the eye-spots. It differs from *L. pseudosinelloides* Gis. in chaetotaxy of Abd. II (Gisin, 1967). Troglphil.

Neelus (Megalothorax) minimus Willem, 1900

Diagnosis: Mucro narrowing suddenly in about 60 % of its length. Troglphil.

Arrhopalites slovacicus Nosek, 1975

Diagnosis: This species differs from *A. caecus* Tullb. in the arrangement of subanal appendices (Fig. 11), in the ratio of antennal segments III : IV, dens : mucro, and in eye-pigment. This species may be considered as a genuine troglobiont.

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Authors' address: J. Nosek, Institute of Virology Slovak Academy of Sciences, Bratislava 9, 80939 ČSSR.

Institute of Parasitology, Czechoslovak Academy of Sciences, Praha

BETLES (COLEOPTERA) AS NEW INTERMEDIATE HOSTS OF HELMINTHS

JAN PROKOPIČ & SVATOPLUK BÍLÝ

Received June 22, 1974

Abstract: The authors examined 3 778 beetles belonging to 56 species, from two localities in Czechoslovakia. In 13 of these 6 species of helminth stages (*Hymenolepis erinacei*, *Staphylocystis furcata*, *Soricinia diaphana*, *Choanotaenia infundibulum*, *Physocephalus sexalatus* and *Gongylonema pulchrum*) were found.

Coleoptera have been known for a long time to act as intermediate hosts for a number of helminth species of the orders Trematoda, Cestoda, Acanthocephala and Nematoda. Frequently, they are used as reservoir hosts, and sometimes they play the role of a passive vector of pathogenic organisms causing infection of domestic and production animals; thus, they represent an important epizootological factor in helminthiasis of these animals. Since little attention had been given to these problems in Czechoslovakia in the past, we started to investigate them within the framework of the state plan in 1973.

MATERIAL AND METHODS

During the year 1973, we collected and examined in postmortem a total of 3,778 beetles representing 56 species and belonging to these families: Scarabaeidae, Silphidae, Carabidae, Hydrophilidae and Histeridae (Table 1). The beetles were collected in two different localities, i.e., in sheep pastures in the vicinity of Filakovo (Slovakia), altitude 200-250 m and in a biocoenosis of coniferous forest in the vicinity of Třeboň (S.-Bohemia) altitude 400-450 m. The beetles were taken either directly from under the faeces of animals, or from cadavers, or they were baited in traps on decaying meat. After identification, the beetles were rinsed in water and simultaneously killed by drowning. The elytra were removed, the body cut open and the internal organs of the beetle were divided into several slides with saline, covered with a coverslip and inspected in the microscope at a small magnification. In the presence of larvae, the slides were rinsed in saline and the larvae isolated. If there was time, the larvae were identified alive (measured, figured, photographed), or they were fixed in formaline and identified later. In this way, we found larval helminths in 88 beetles (13 species). (Table 2).

SURVEY OF THE BEETLES EXAMINED

Of the 3,778 beetles examined (Table 1) larval helminths were found in these beetle species:

I. Scarabaeidae

All following species are coprophagous without an evident specialization to a certain kind of faeces. Several species of this family have been described

Table 1. List of examined beetles

Beetles	Numb.	Locality	Helminths	%
Scarabaeidae				
<i>Omtacellus fulvus</i> (Goeze)	20	Filakovo		
<i>Caccobius schreberi</i> (L.)	90	Filakovo		
<i>Copris lunaris</i> (L.)	52	Filakovo		
<i>Onthophagus amyntas</i> (Ol.)	4	Filakovo		
<i>fracticornis</i> (Preys.)	20	Filakovo		
<i>furcatus</i> (F.)	29	Filakovo		
<i>joanae</i> Goljan	6	Filakovo	Hymenolepididae	16.6
<i>lemur</i> (F.)	105	Filakovo		
<i>ovatus</i> (L.)	111	Filakovo	<i>Gongylonema pulchrum</i>	11.7
<i>ruficapillus</i> Brullé	424	Filakovo	Hymenolepididae	14.1
<i>taurus</i> (Schr.)	40	Filakovo		
<i>vacca</i> (L.)	23	Filakovo		
<i>vitulus</i> (F.)	4	Filakovo		
<i>Aphodius biguttatus</i> (Germ.)	28	Filakovo		
<i>coenosus</i> (Panz.)	66	Filakovo		
<i>finetarius</i> (L.)	617	Filakovo		
<i>fossor</i> (L.)	23	Filakovo	<i>Gongylonema pulchrum</i>	4.3
<i>granarius</i> (L.)	1	Filakovo		
<i>haemorrhoidalis</i> (L.)	18	Filakovo		
<i>ictericus</i> Laich.	9	Filakovo		
<i>immutatus</i> Creutz.	1	Filakovo		
<i>lugens</i> Creutz.	3	Filakovo		
<i>luridus</i> (F.)	54	Filakovo		
<i>paracoenosus</i> Balth.	1	Filakovo		
<i>pusillus</i> (Herbst)	253	Filakovo		
<i>quadrigruttatus</i> (Herbst)	34	Filakovo		
<i>rufipes</i> (L.)	2	Klec		
<i>rufus</i> Moll.	208	Filakovo		
<i>serofa</i> (F.)	1	Filakovo		
<i>scrutator</i> (Herbst)	14	Filakovo	<i>Gongylonema pulchrum</i>	7.1
<i>sordidus</i> (F.)	1	Filakovo		
<i>sticticus</i> (Panz.)	11	Filakovo		
<i>subterraneus</i> (L.)	10	Filakovo		
<i>Rhyssalus germanus</i> (L.)	1	Filakovo		
<i>Geotrupes stercorarius</i> L.	4	Klec	<i>Soricina diaphana</i>	25.0
Carabidae				
<i>Amara aenea</i> Deg.	3	Klec		
<i>Harpalus rufipes</i> Dej.	11	Klec		
<i>Pterostichus vulgaris</i> (L.)	9	Klec		
Silphidae				
<i>Oeoeptoma thoracica</i> (L.)	172	Klec	<i>Hymenolepis erinacei</i>	4.1
			<i>Staphylocystis furcata</i>	0.6
			<i>Soricina diaphana</i>	0.6
			<i>Physocephalus sexalatus</i>	1.2
			<i>Physocephalus sexalatus</i>	14.3
<i>Phosphuga atrata</i> (L.)	7	Klec		
<i>Thanatophilus rugosus</i> (L.)	15	Klec		
<i>Silpha obscura</i> L.	11	Klec		
<i>Necrophorus humator</i> Goeze	334	Klec	<i>Hymenolepis erinacei</i>	2.1
<i>interruptus</i> Steph.	106	Klec	<i>Hymenolepis erinacei</i>	15.1
			<i>Staphylocystis furcata</i>	0.9
<i>investigator</i> Zett.	3	Klec		
<i>vespillo</i> L.	94	Klec	<i>Hymenolepis erinacei</i>	15.9
<i>vespilloides</i> Herbst	278	Klec	<i>Hymenolepis erinacei</i>	1.1

Tab. 1. continuation

Beetles	Numb.	Locality	Helminths	%
<i>Neorodes litoralis</i> (L.)	108	Klec	<i>Hymenolepis crinacei</i> <i>Staphylocystis jurcata</i>	4.4 5.5
Hydrophilidae				
<i>Sphaeridium bipustulatum</i> (F.)	42	Filakovo		
<i>scarabaeoides</i> (L.)	97	Filakovo		
<i>Cereyon haemorrhoidalis</i> (F.)	11	Filakovo		
<i>pygmaeus</i> (Gyll.)	75	Filakovo		
<i>impunctatus</i> (L.)	35	Filakovo		
<i>Cryptopleurum minutum</i> (F.)	39	Filakovo		
Histeridae				
<i>Hister unematus</i> (Ill.)	31	Filakovo		
<i>Saprinus semistriatus</i> (Seriba)	9	Filakovo		

as being partly necrophagous or cadavericolous (e.g. several members of the genus *Onthophagus* and *Geotrupes*).

1. *Onthophagus ovatus* (Linné, 1767)

Upon the present knowledge, this beetle species is the intermediate host of these helminths: *Physocephalus sexalatus*, *Ascarops strongylina*, *Staphylepis cantaniana*. In our material, 13 specimens (11.7%) out of the 111 beetles of this species from S. Slovakia harboured larvae of the nematode *Gongylonema pulchrum*, the adult of which parasitizes mostly ruminants. *Onthophagus ovatus* is a new intermediate host for this helminth species.

2. *Onthophagus joanae* Goljan, 1953

This beetle species has not been recorded as yet as the intermediate host of any helminth species. In one of the six specimens of this beetle from S. Slovakia we found the cysticercoid of the cestode *Choanotaenia infundibulum* which, in its adult stage, parasitizes fowls and other birds. This is the first report on *Onthophagus joanae* as a possible intermediate host of cestodes.

3. *Onthophagus ruficapillus* Brullé, 1832

Until the present, this beetle species has been recorded as the intermediate host of these helminth species: *Physocephalus sexalatus*, *Ascarops strongylina*, *Gongylonema pulchrum* and *Staphylepis cantaniana*. In 6 (1.4%) of the 424 specimens of this beetle species from S. Slovakia, we found cysticercoids of the cestode *Choanotaenia infundibulum*, the adult of which is a parasite of fowls and other birds.

4. *Aphodius fossor* (Linné, 1758)

Until the present, this beetle species has been recorded as the intermediate host of these helminth species: *Mastophorus muris*, *Gongylonema pulchrum*, *G. mucronatum*, *Physocephalus sexalatus*, *Spirocerca lupi*, *Hymenolepis carioca*, *Raillietina cesticillus*, *Choanotaenia infundibulum*. We examined 23 specimens of this species from S. Slovakia and in one of them we found

larvae of the nematode *Gongylonema pulchrum*. This is the first finding of larvae of the nematode *G. pulchrum* in this beetle species.

5. *Aphodius scrutator* Herbst, 1789

This beetle species has not been recorded as yet as the intermediate host of helminths. In one of the 14 specimens of this species from S. Slovakia, we found larvae of the nematode *Gongylonema pulchrum*. This is the first evidence that *Aphodius scrutator* may be utilized by nematodes or helminths in general as their intermediate host.

6. *Geotrupes stercorarius* Linné, 1758

This beetle species is known as the intermediate host of these helminth species: *Mastophorus muris*, *Ascarops strongylina*, *Physocephalus sexalatus*, *Hymenolepis carioca*, *Choanotaenia infundibulum* and *Raillietina cesticillus*. We examined 4 specimens of this species from S. Bohemia and found in one of them a cysticercoïd of the cestode *Soricinia diaphana*, which in its adult stage parasitizes Soricidae. *Geotrupes stercorarius* is a new intermediate host for the cestode *S. diaphana*.

II. Silphidae

The species of this family are necrophagous, cadavericolous and carnivorous. The species identified by us as intermediate hosts are typically cadavericolous, their larvae may also be predatory.

1. *Oeceptoma thoracica* (Linné, 1758)

This beetle species is known to be utilized as an intermediate host by these helminth species: *Physocephalus sexalatus*, *Neoskrjabinolepis singularis* and *Hymenolepis erinacei*. We examined a total of 172 specimens of this beetle species from S. Bohemia. In 7 of these (4.1%) we found cysticercoïds of the cestode *Hymenolepis erinacei*, in one specimen cysticercoïds of the cestode *Staphylocystis furcata*, in another beetle cysticercoïds of *Soricinia diaphana*, and in two beetles larvae of the nematode *Physocephalus sexalatus*.

2. *Phosphuga atrata* (Linné, 1758)

This beetle species has not been recorded as yet to be the intermediate host of helminths. We found larvae of the nematode *Physocephalus sexalatus* in one out of the seven specimens of this species from a locality in S. Bohemia. This finding confirms that *Phosphuga atrata* is utilized by nematodes and helminths in general as their intermediate host.

3. *Necrophorus vespillo* Linné, 1758

This species has been recorded as the intermediate host of *Hymenolepis erinacei*; it is known also to distribute larvae of *Trichinella spiralis*. Of a total of 94 specimens of this beetle from S. Bohemia, 15 (15.9%) harboured larvae (cysticercoïds) of the cestode *Hymenolepis erinacei*.

4. *Necrophorus vespilloides* Herbst, 1784

This beetle is the intermediate host of helminths of the species *Hymenolepis erinacei* and *Staphylocystis furcata*. Cysticercoïds of the cestode *Hymeno-*

lepis erinacei were found in 3 (1.1%) out of the 278 specimens of this species from a locality in S. Bohemia.

5. *Necrophorus interruptus* Steph., 1830

This beetle species has not been recorded as yet as the intermediate host of helminths. In 16 (15.1%) out of a total of 106 specimens of this beetle species from S. Bohemia, we found cysticercoids of *Hymenolepis erinacei*, and in one specimen (0.9%) cysticercoids of *Staphylocystis furcata*. *Necrophorus interruptus* is a new intermediate host for both cestode species.

6. *Necrophorus humator* Goeze, 1777

This species is known as the intermediate host of *Hymenolepis erinacei*. We examined 334 specimens of this beetle species from a locality in S. Bohemia and found in 7 of these (2.1%) cysticercoids of the cestode *Hymenolepis erinacei*.

7. *Necrodes litoralis* (Linné, 1758)

This species had not been recorded as the intermediate host of helminths. We examined 108 specimens of this species from S. Bohemia; in 5 of these (4.4%) we found cysticercoids of the cestode *Hymenolepis erinacei*, in 6 specimens (5.5%) cysticercoids of *Staphylocystis furcata*. This is the first record of *Necrophorus litoralis* as the intermediate host of these two cestode species.

NOTES ON THE HELMINTH LARVAE RECOVERED

I. Cestoda

1. *Hymenolepis erinacei* (Gmelin, 1790)

The adult of this species parasitizes Erinacidae of the Palaearctic zone. Prokopič (1971) gave a list of the known intermediate hosts: *Oeceoptoma thoracica*, *Necrophorus germanicus*, *N. humator*, *N. vespillo*, *N. vespilloides*, *Silpha obscura* and *Geotrupes stercorosus*.

In the present study, the species was recovered from *O. thoracica*, *N. vespillo*, *N. vespilloides* and *N. interruptus*. Of these *N. interruptus* is a new intermediate host for this cestode species.

2. *Soricinia diaphana* (Cholodkowsky, 1906)

This cestode species is a common parasite of Soricidae from the Palaearctic zone. Kisielewska (1960) found its larval stages (cysticercoids) in *Geotrupes stercorosus* Panz. Prokopič (1967) found it in *Tachinus pallipes* (Staphylinidae). In our material, cysticercoids of *Soricinia diaphana* were present in *Oeceoptoma thoracica* and *Geotrupes stercorarius*, which are both new intermediate hosts of this cestode species.

3. *Staphylocystis furcata* (Stieda, 1862)

The adult of this cestode species parasitizes Soricidae from the Palaearctic zone. Kisielewska, Prokopič (1963); Ryšavý, Prokopič (1965); Prokopič (1972) listed the known intermediate hosts: *Geotrupes stercorosus*, *Pterostichus vulgaris*, *Necrophorus vespillo*, *N. vespilloides*, *Silpha obscura*, *Thannatophilus sinuatus*, *Oeceoptoma thoracica*, *Stenobothrus biguttulus* and larvae of *Tribolium castaneum* from experimental infection. In

Table 2. Survey of the helminthes and their hosts.

Helminths	Hosts	%
1. <i>Hymenolepis eriancei</i>	<i>Oeceptoma thoracica</i> <i>Necrophorus interruptus</i> <i>Necrophorus vespillo</i> <i>Necrophorus vespilloides</i> <i>Necrophorus humator</i> <i>Necrodes litoralis</i>	(4.1%) (15.1%) (15.3%) (1.1%) (2.1%) (4.4%)
2. <i>Staphylocystis furcata</i>	<i>Oeceptoma thoracica</i> <i>Necrophorus interruptus</i> <i>Necrodes litoralis</i>	(0.6%) (0.9%) (5.5%)
3. <i>Soricinia diaphana</i>	<i>Oeceptoma thoracica</i> <i>Geotrupes stercorarius</i>	(0.6%) (25.0%)
4. <i>Choanotaenia infundibulum</i>	<i>Onthophagus joanae</i> <i>Onthophagus ruficapillus</i>	(16.6%) (14.1%)
5. <i>Physocephalus sexalatus</i>	<i>Oeceptoma thoracica</i> <i>Phosphuga atrata</i>	1.2%) (14.3%)
6. <i>Gongylonema pulchrum</i>	<i>Aphodius jessor</i> <i>Aphodius scrutator</i> <i>Onthophagus ovatus</i>	(4.3%) (7.1%) (11.1%)

our material cysticercoids were recovered from *Oeceptoma thoracica* and *Necrophorus interruptus*, the latter being a new intermediate host for this cestode species (Fig. B.).

4. *Choanotaenia infundibulum* (Bloch, 1779)

The adult of this species parasitizes a number of birds such as *Gallus gallus* f. dom., *Caccabis petrosa*, *C. rufa*, *Cincus cinereus*, *Coturnix coturnix*, *Phasianus colchicus*, *Francolinus pintateanus phayrei*, *Meleagris gallopavo*, *Milvus migrans parasitus*, *Numida meleagris*, *Pavo epistacus*, *Perdix perdix* etc. It is distributed in the Palaearctic zone. Its larval stages utilize more than 70 beetle species. In Czechoslovakia, we found it for the first time in *Onthophagus joanae* and *O. ruficapillus*.

II. Nematoda

1. *Physocephalus sexalatus* (Molin, 1860)

The adult worm parasitizes the stomach of swine, *Sus scrofa*. Its larvae develop in beetles and other arthropods. It has been recorded from more than 50 beetle species (intermediate hosts). Complementary hosts are reptiles, bats, insectivores and rodents. We found larvae of this species in *Oeceptoma thoracica* and *Phosphuga atrata*, a new intermediate host of *P. sexalatus*.

2. *Gongylonema pulchrum* (Molin, 1857)

The adult worm parasitizes generally the pharynx of ruminants from the Palaearctic zone, sometimes other mammals including man. Its larvae

have been found in cockroaches of the family Blattidae. In our material we found it in *Aphodius fossor*, *A. scrutator* and *Onthophagus ovatus*. The latter two species are new intermediate hosts of *G. pulchrum*. (Fig. A).

DISCUSSION

Beetles as an epizootological factor of helminthiasis of domestic and production animals have received little attention in Czechoslovakia. Bejšovec (1962) referred to them as possible passive distributors of larval helminths of domestic and production animals. Prokopič (1967, 1968a, b) examined beetles as intermediate hosts of cestodes and recovered from 11 beetle species 6 cestode species. In the present study attention has been given to coprophagous, necrophagous and cadavericolous groups of beetles in view of their important role in the biogeocoenosis of pastures. The importance of such study has been indicated by the fact that the composition of the Coleoptera fauna varies considerably in the different biogeocoenoses and so does the degree of parasitism with larval stages of various helminth species. It has been shown by our provisional results from forest biocoenoses in S. Bohemia (surroundings of Třeboň) that larval cestodes of insectivores and those of the nematode *Physocephalus sexalatus*, a parasite of the hog (*Sus scrofa*) utilize mainly necrophagous beetles. On the other hand, in typical, warm pastures of S. Slovakia, necrophagous beetles are utilized mainly by larvae of the nematode *Gongylonema pulchrum*, a parasite of ruminants. We found also larvae of the bird cestode *Choanotaenia infundibulum*.

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

Authors' address: RNDr. Jan Prokopič, Dr. Sc., RNDr. Svatopluk Bílý, CSc, Parasitologický ústav ČSAV, Flemingovo nám, 2, 169 00 Praha 6, Czechoslovakia.

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Entomologisches Institut der Tschechoslowakischen Akademie der Wissenschaften, Praha

ZWEI NEUE TULLBERGIINAE-GATTUNGEN (APTERYGOTA : COLLEMBOLA)

JOSEF RUSEK

Eingegangen am 10. Juni 1974

Abstrakt: Es werden zwei neue Gattungen und drei neue Arten aus der Unterfamilie Tullberginae beschrieben: *Wankeliella peterseni* gen.n. sp.n., *Wankeliella mediochaeta* sp.n. und *Marcuzziella tripartita* gen.n., sp.n.

Beim Bestimmen der Collembolen zu einer synökologischen Arbeit über die Bodenfauna des Mährischen Karstes wurde ein sehr interessantes Tullbergiinae-Exemplar, das in eine neue Gattung gehörte, gefunden. Da nur ein einziges Tier vorhanden war, blieb es längere Zeit unbearbeitet. Von Herrn Kollegen Dr. H. Petersen (Dänemark) habe ich ein weiteres, umfangreicheres Tullbergiinae-Material bekommen, und es zeigte sich beim Bestimmen, dass es sich teilweise um Vertreter derselben neuen Gattung, die mir bisher nur aus dem Mährischen Karst bekannt war, handelte. Die nähere Untersuchung zeigte, dass es aber zwei verschiedene Arten sind. Als Typus der neuen Gattung *Wankeliella* gen.n. wurde die neue Art aus Dänemark festgelegt, denn sie ist durch eine grössere Individuenserie vertreten. Die zweite neue Gattung *Marcuzziella* gen.n. wird aus einem umfangreichen Collembolenmaterial aus Italien beschrieben. Dieses Material habe ich von Herrn Prof. Dr. G. Marcuzzi zum Bestimmen bekommen. Es stammt von seinen bodenbiologischen Arbeiten, die in verschiedenen Gebieten Italiens durchgeführt wurden (cf. Marcuzzi, 1968, u. a.).

Für das Material aus Dänemark und aus Italien spreche ich meinen innigsten Dank den Herren Prof. Dr. G. Marcuzzi (Padova) und Dr. H. Petersen (Femøller, Dänemark) aus. Für die sprachliche Korrektur des Manuskriptes binn ich Herrn Dr. W. Dunger (Görlitz) sehr verbunden.

BESCHREIBUNG DER NEUEN TAXA

Wankeliella gen. n.

Diagnose: Körper schlank, *Mesaphorura*-artig, 500–650 μ m lang, weiss. Antennensegment IV dorsal mit 4 deutlich verdickten Sensillen a–d; "Sensille" e in eine Borste umgewandelt. Antennalorgan III besteht aus zwei grossen Sinneskolben, zwei kleinen Sinnesstäbchen dazwischen und einer Schutzfalte. Postantennalorgan in seichter Vertiefung, 3mal länger als Pseudocellendurchmesser. Höcker im Postantennalorgan V-förmig in geringerer Zahl (6) (Abb. 2B, 4B, C). Meso- und Metanotum ohne Borsten m_2 , m_3 und p_2 . Abdomentergit IV ohne oder mit Medialborste x. Einige

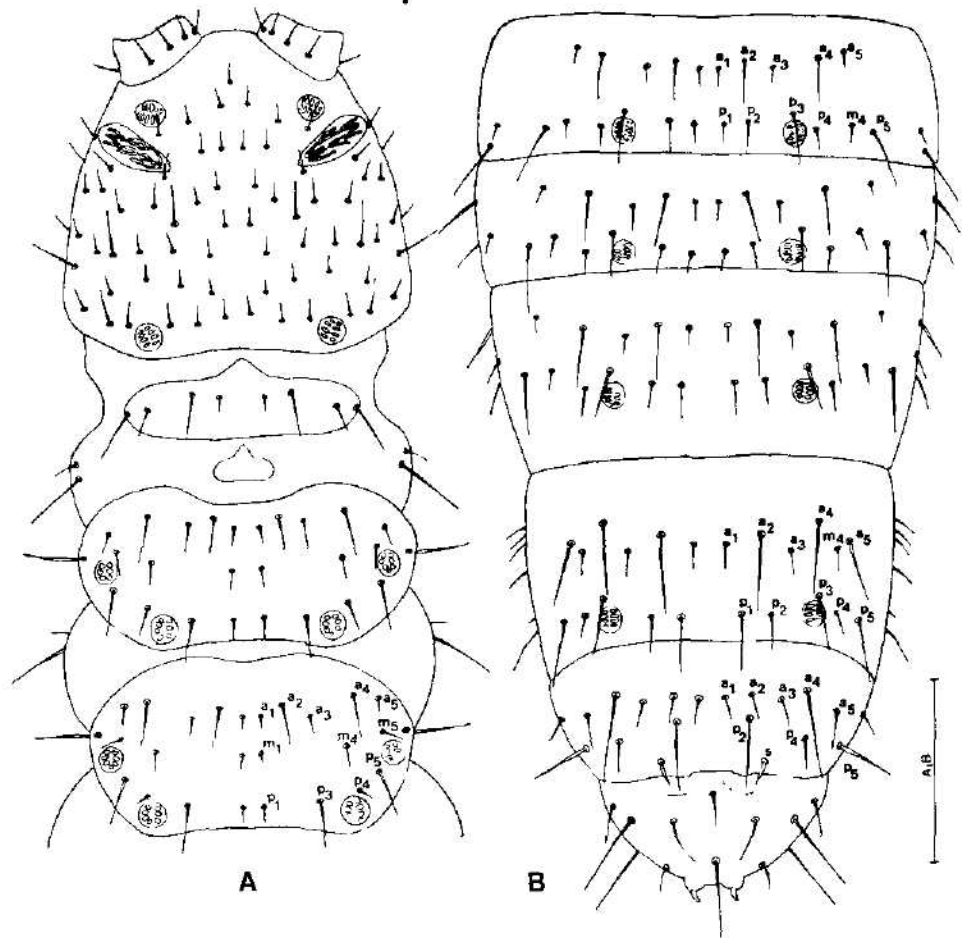


Abb. 1. *Wankeliella peterseni* gen.n., sp.n. A — Beborstung des Kopfes und des Thorax von oben, B — Abdomenbeborstung von oben. (Massstab: A, B = 50 μ m.)

Abdomentergite und Pleurite mit typischen Sensillen (Abb. 2 C—E, H). Pseudocellen undeutlich begrenzt. Zwei kleine Analdornen vorhanden.

Typische Art: *Wankeliella peterseni* gen. n., sp. n.

Verwandtschaftsbeziehungen: Am nächsten ist die neue Gattung mit *Karlstejnia* Rusek, 1974 verwandt. Sie haben gemeinsam: die Zahl der Analdornen, die Gestalt des Antennalorgans III und der Pseudocellen und 4 verdickte Sensillen a—d am Antennensegment IV. *Wankeliella* gen. n. unterscheidet sich von *Karlstejnia* Rusek, 1974 durch die V-förmigen Höcker im Postantennalorgan einwandfrei.

Derivatio nominis: Die neue Gattung wird Herrn Dr. Jindřich Wankel (*1821, †1897), dem verdienstvollen Forscher auf dem Gebiet der Speleologie und Praehistorie, der auch zur Erforschung der Collembolen bedeutungsvoll beitrug, gewidmet.

Wankeliella peterseni sp.n.

(Abb. 1-2)

Beschreibung: Körper schlank, *Mesaphorura*-artig, 640 μm lang und 95 μm breit. Farbe weiss. Granulierung fein, regelmässig verteilt. Macro-

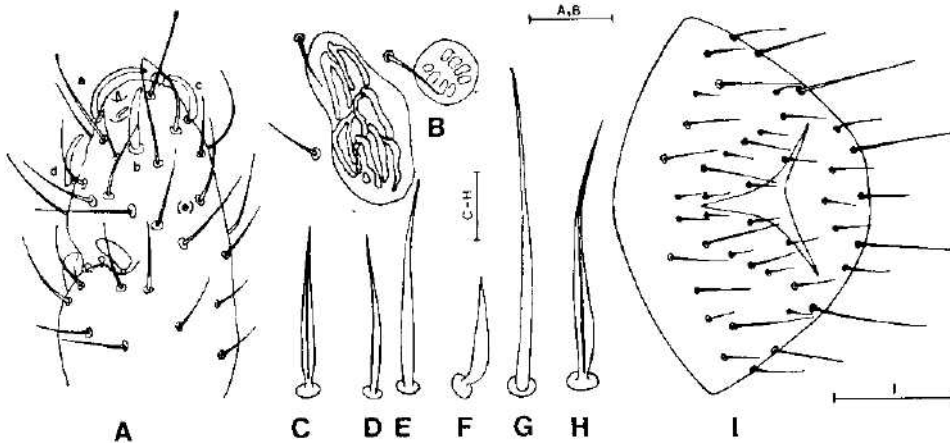


Abb. 2. *Wankeliella peterseni* gen.n., sp.n. A — Dorsalside der Antennensegmente III—V, B — Postantennalorgan und Pseudocelle, C — Pleuralsensille vom Abdomensegment II, D — Pleuralsensille vom Abdomensegment III, E — Sensilla p_3 vom Abdomentergit III, F — Spindelartige Sensille (p_3) vom Abdomentergit V, G — Borste p_2 vom Abdomentergit V, I — Beborstung der Anallappen. (Massstab: A, B = 10 μm , C—H = 5 μm , I = 20 μm .)

chaeten von den Microchaeten deutlich differenziert (Abb. 1A, B). Die Beborstung entspricht der Formel (Abb. 1A, B):

	1	2	3	I	II	III	IV	V
a	—	10	10	10	10	10	10	10
m	8	6 ¹⁾	6	2 ³⁾	2	2	2 ⁵⁾	—
p	—	8 ²⁾	8	10	10	10 ⁴⁾	10 ⁶⁾	6 ⁷⁾

¹⁾ m_2 und m_3 fehlen, ²⁾ p_2 fehlt, ³⁾ m_4 vorhanden, ⁴⁾ p_3 sensillenartig, ⁵⁾ m_4 in die Vorderreihe verschoben, ⁶⁾ p_3 borstenartig, ⁷⁾ p_5 sensillenartig.

Anallappen charakteristisch beborstet (Abb. 2 I).

Pseudocellen undeutlich mit rosettenartigem Rand begrenzt, 8 μm im Durchmesser. Pseudocellenzahl 11 022 11111. Am Meso- und am Metanotum sind sie zwischen p_3 und p_4 und zwischen p_5 und m_5 (Abb. 1A).

Antennen kürzer als Kopfdiagonale (70 μm : 85 μm). Antennensegmente I : II : III + IV wie 10 : 20 : 40 (μm). Antennensegment IV (Abb. 2A) dorsal mit 4 deutlich verdickten Sensillen a—d, zwei kurzen Sinnesstäbchen f und g und kleiner, kugelförmiger Apikalpapille. Die Sensille e ist durch eine Borste (e) vertreten. Antennalorgan III besteht aus zwei dicken, geneigten Sinneskolben, zwei kleinen Sinnesstäbchen dazwischen und aus einer Schutzfalte (Abb. 2A). Auf der Ventralseite des Antennensegmentes III ist ein dicker, schwach geneigter, ovaler Sinneskolben vorhanden.

Das Postantennalorgan (Abb. 2B) befindet sich in einer seichten, breiten Vertiefung, ist etwa 3mal länger als ein Pseudocellendurchmesser und besteht aus 6 V-förmigen Höckern. Zweige dieser Höcker zerfallen manchmal in kleinere Teile (Abb. 2B — linker Höcker unten).

Am Kopfe nur 3 + 3 Macrochaeten vorhanden (Abb. 1A). Die Beborstung des Pro-, Meso- und Metanotums ist in der oben angeführten Formel angegeben. Die laterale Sensille *s* am Meso- und Metanotum schwach verdickt, wenig länger als Macrochaete p_5 (17 μm : 16 μm); die Sensille *s* in seichter ovaler Vertiefung, 2 μm lang. Klauen ohne Zähne, 10 μm lang. Empodialanhang klein, ohne Innenlamelle.

Die Borsten p_3 am Abdomentergit III, p_5 am Abdomentergit V und die vordere Borste am Abdomenpleurit II und III sind schwach verdickt, sensillenartig (Abb. 2C, D, E, H). Abdomentergit IV ohne unpaarige Medialborste *x* (Abb. 1B). Am Hinterrande des Abdomentergits V befindet sich vor den Pseudocellen eine verdickte, spindelartige Sensille p_3 (Abb. 2F), die 8 μm lang ist und etwa 1/3 der Borste p_2 erreicht (Abb. 2G; $p_2 = 21 \mu\text{m}$). Am Abdomentergit VI sind am Vorderrande sichelförmige Wülste und am Ende auf niedrigen Papillen zwei kleine Analdornen vorhanden (Abb. 1B). Die Länge der Analdornen beträgt 5 μm ; sie sind um 50% kürzer als Klaue III. Ventraltubus mit 5 + 5 Borsten, weitere 1 + 1 Borsten daneben. Ohne Furkarudiment. Nur Weibchen vorhanden.

Locus typicus: 20. XII. 1970, 15 Ex. in Bodenproben 0–3 cm tief aus Fagetum (IBP) in Kals, Hestehave, Dänemark (Jutland), leg. H. Petersen.

Holotypus No. 20. XII. 1970/A-232 und die Paratypen in meiner Sammlung. Einige Paratypen in der Sammlung von Dr. H. Petersen.

Wankeliella mediochaeta sp.n.

(Abb. 3–4)

Beschreibung: Körper schlank, *Mesaphorura*-artig, 480 μm lang und 100 μm breit. Farbe weiss. Granulierung auf den Seitenpartien des Meso- und Metanotums und der Abdomentergite I–III und auf dem ganzen Abdomentergit VI gröber als auf der verbleibenden Oberfläche. Macrochaeten deutlich von den Microchaeten differenziert (Abb. 3A, B). Die Beborstung entspricht der Formel:

	1	2	3	I	II	III	IV	V
a	—	10	10	10	10	10	10	10
m	8	8 ¹⁾	8	2 ²⁾	4 ⁴⁾	2 ³⁾	—	—
p	—	8 ²⁾	8	10	10	10 ⁵⁾	11 ⁶⁾	6 ⁷⁾

¹⁾ m_2 und m_3 nicht vorhanden, ²⁾ p_2 nicht vorhanden, ³⁾ m_4 vorhanden, ⁴⁾ m_3 und m_4 vorhanden, ⁵⁾ p_3 sensillenartig, ⁶⁾ unpaarige Medialborste *x* vorhanden, ⁷⁾ p_5 sensillenartig.

Anallappen charakteristisch beborstet (Abb. 4D).

Pseudocellen undeutlich mit rosettenartigen Rand begrenzt, 8 μm im Durchmesser. Pseudocellenzahl 11 022 11111. Am Meso- und Metanotum sind sie zwischen p_3 und p_4 und zwischen p_5 und m_5 (Abb. 3A).

Antennen kürzer als Kopfdiagonale (73 μm : 90 μm). Antennensegmente I : II : III + IV wie 13 : 15 : 45 (μm). Antennensegment IV (Abb. 4A) dorsal mit 4 deutlich verdickten Sensillen a–d, zwei kurzen Sinnesstäbchen f und g und ohne Apikalpapille. Die Sensille e ist durch die Borste (e) ver-

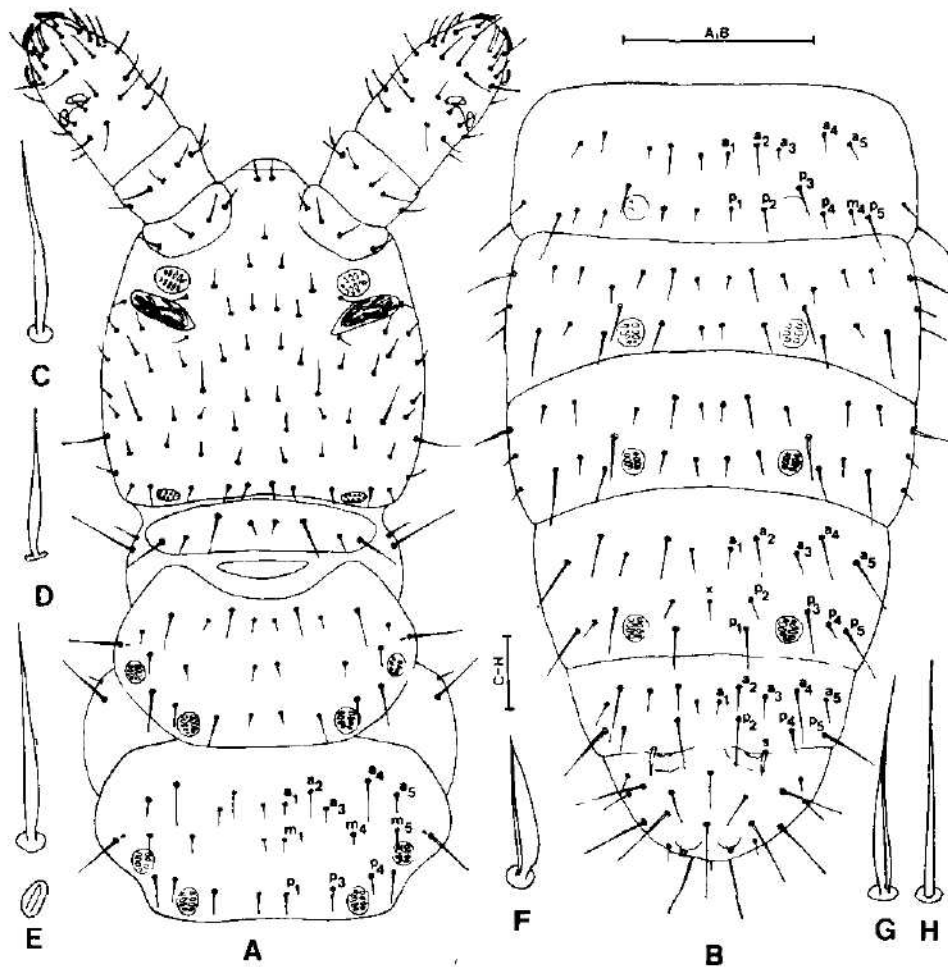


Abb. 3. *Wankeliella mediochaeta* sp.n. A — Beborstung des Kopfes und Thorax von oben, B — Abdomenbeborstung von oben, C — Sensille p_3 vom Abdomentergit III, D — Pleuralsensille vom Abdomensegment III, E — Sensillen s und s' vom Metanotum, F — Spindelartige Sensille (p_3) vom Abdomensegment V, G — Sensille p_5 vom Abdomentergit V, H — Borste p_2 vom Abdomentergit V. (Massstab: A, B = 50 μm , C—H = 5 μm .)

treten. Antennalorgan III besteht aus zwei dicken, geneigten Sinneskolben, zwei kleinen Sinnesstäbchen dazwischen und aus einer Schutzfaite (Abb. 4A). Auf der Ventralseite des Antennensegmentes III ist ein dicker, schwach geneigter, ovaler Sinneskolben vorhanden (Abb. 4A).

Das Postantennalorgan (Abb. 4B, C) befindet sich in einer seichten, breiten Vertiefung, ist etwa 2mal länger als ein Pseudocellendurchmesser und besteht aus 6 V-förmigen Höckern. Am Kopfe 3 + 3 Macrochaeten vorhanden (Abb. 3A).

Die Beborstung des Pro-, Meso- und Metanotums ist in der oben angeführten Formel angegeben. Die laterale Sensille s am Meso- und Metanotum (Abb. 3E) schwach verdickt, deutlich länger als Macrochaete p_5 (14 μm :

: 10 μm). Sensille s' in seichter, ovaler Vertiefung, 2 μm lang (Abb. 3E). Klauen ohne Zähne, 10 μm lang. Empodialanhang klein, ohne Innenlamelle.

Die Borsten p_3 am Abdomentergit III und p_5 am Abdomentergit V und die vordere Borste am Abdomenpleurit II und III sind schwach verdickt, sensillenartig (Abb. 3C, D, G). Abdomentergit IV mit unpaariger Medial-

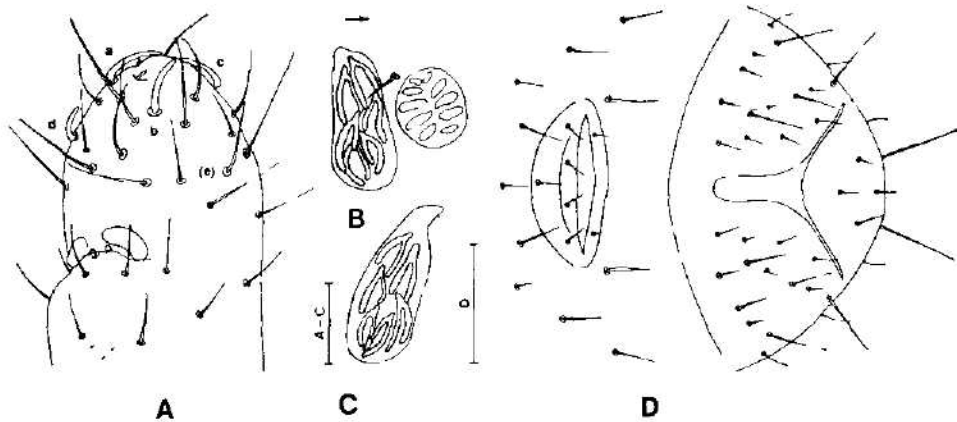


Abb. 4. *Wankeliella mediochaeta* sp.n. A — Dorsalseite der Antennensegmente III—IV, B — Postantennalorgan und Pseudocelle, C — Postantennalorgan, D — Beborstung der Anallappen und der Genitalarea der Weibchen. (Massstab: A—C = 10 μm , D = 20 μm .)

borste x (Abb. 3B). Am Hinterrande des Abdomentergits V befindet sich vor den Pseudocellen eine verdickte, spindelartige Sensilla s (Abb. 3B, F). Sie ist 8 μm lang und ist deutlich kürzer als die p_2 Borste (Abb. 3H). Am Abdomentergit VI sind am Vorderrande sichelförmige Wülste und am Ende zwei kleine Analdornen auf niedrigen Papillen vorhanden (Abb. 3B). Länge der Analdornen 6 μm ; sie sind um 40% kürzer als die Klaue III. Ventraltubus mit 5 + 5 Borsten, weitere 1 + 1 Borsten daneben. Ohne Furkarudiment. Nur Weibchen vorhanden. Weibliche Genitalplatte siehe Abb. 4D.

Differentialdiagnose: Diese neue Art unterscheidet sich von *Wankeliella peterseni* sp.n. durch mehrere Merkmale. Am auffälligsten sind das Vorhandensein der Borsten m_3 am Abdomentergit II und x am Abdomentergit IV. Die Borsten a_1 — a_4 am Abdomentergit V stehen nicht in einer geraden Reihe, p_2 ist nicht deutlich länger als die Sensille p_5 . Auch die Sensillen am Antennensegment IV sind bei beiden Arten unterschiedlicher Gestalt und Länge.

Locus typicus: 15. IV. 1971, 1 Weibchen in Bodenproben aus einem Abietum von dem Karstplateau zwischen Macocha und Wilemovice. Bodentyp: Terra fusca. Moravský kras, Moravia centralis, Tschechoslowakei, leg. J. Rusek.

Holotypus No. 15. IV. 1971/A-266 in meiner Sammlung.

Marcuzziella gen.n.

Diagnose: Körper schlank, *Stenaphorura*-artig, 850—900 μm lang, weiss. Antennensegment IV dorsal mit 5 langen, verdickten Sensillen a — e . Antennalorgan III besteht aus zwei grossen Sinneskolben, zwei kleinen

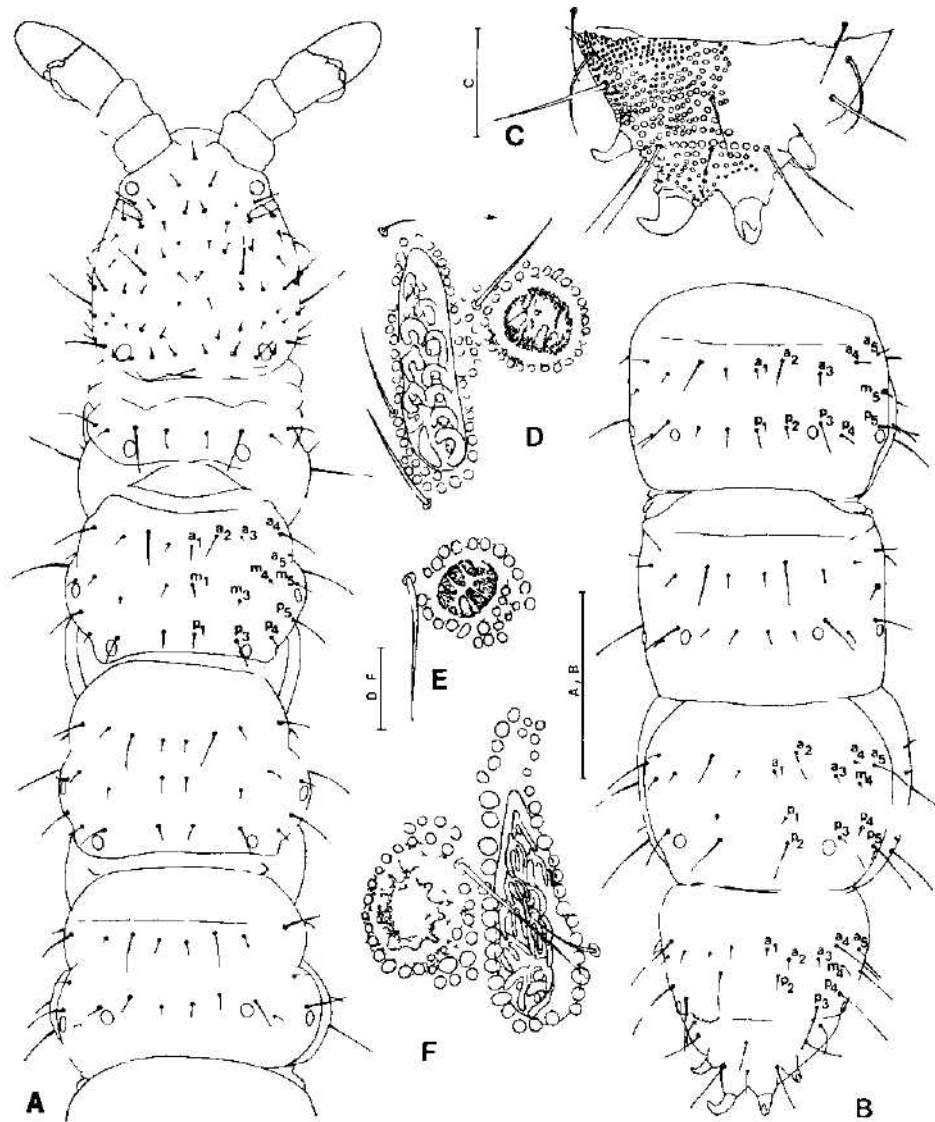


Abb 5 *Mascuzziella tripartita* gen.n., sp.n A — Dorsalbeborstung des Kopfes, Thorax und Abdomensegment I, B — Beborstung der Abdomentergite II—VI, C — Beborstung und Granulierung des Abdomentergits VI, D — Postantennalorgan mit Pseudocelle (jüngeres Exemplar), E — Pseudocelle vom Kopfhinterrand, F — Postantennalorgan mit Pseudocelle (adultes Tier). (Maßstab A, B = 100 µm, C = 30 µm, D—F = 10 µm)

Sinnesstäbchen dazwischen und zwei Schutzpapillen. Postantennalorgan in einer Vertiefung, 2—2,5mal länger als ein Pseudocellendurchmesser. Höcker im Postantennalorgan mit drei Zweigen (Abb 5F) Meso- und Metanotum ohne m_2 und p_2 Borsten Abdomentergit V ohne spindelförmigen Sensillen, p_3 dünn, lang. Pseudocellen deutlich begrenzt Abdomensegment VI mit

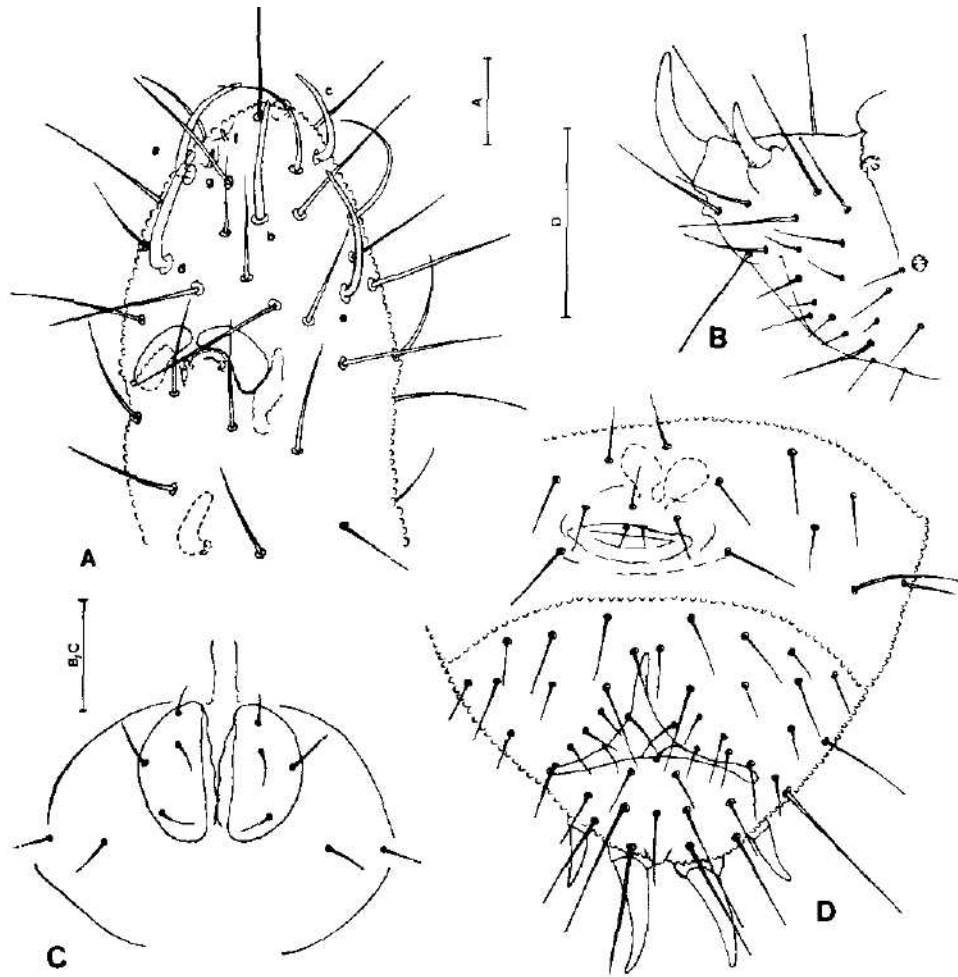


Abb. 6. *Marcuzziella tripartita* gen.n., sp.n. A — Behorftung und Sensillen auf der Dorsalseite der Antennensegmente III—IV, B — Abdomensegment VI — Lateralansicht, C — Ventraltubus, D — Ventralseite der Abdomensegmente V—VI mit der weiblichen Genitalplatte. (Massstab: A = 10 µm, B, C = 30 µm, D = 50 µm.)

vier Analdornen auf deutlichen Papillen und ventral mit einem kleinen, dornartigen, medialen Auswuchs (Abb. 6B, D).

Typische Art: *Marcuzziella tripartita* gen.n., sp.n.

Verwandtschaftsbeziehungen: Die neue Gattung ist am nächsten mit *Metaphorura* Bagnall, 1936 und *Stenaphorura* Absolon, 1900 verwandt. Der unpaarige, dornartige Auswuchs auf der Ventralseite des Abdomensegmentes VI, die Behorftung des Thorax und die Zahl und Gestalt der Sensillen an dem Antennensegment IV und das Antennalorgan III sind bei *Metaphorura* und *Marcuzziella* identisch. Die neue Gattung hat aber 4 Analdornen auf deutlichen Papillen entwickelt. *Stenaphorura* hat 4 Analdornen am Abdomensegment VI, der unpaarige, dornartige Auswuchs auf der

Ventralseite dieses Segmentes ist aber nicht entwickelt. Bei *Stenaphorura* ist auch das Antennalorgan III und das Postantennalorgan ganz anders gebaut. Im Antennalorgan sind bei dieser Gattung 3 Sinneskolben vorhanden und die Höcker im Postantennalorgan sind einfach gebaut. Am Meso- und Metanotum fehlen den *Stenaphorura*-Vertretern die Borsten m_1 , m_3 und p_2 .

Derivatio nominis: Die neue Gattung wird Herrn Prof. Dr. G. Marcuzzi (Padova), der sich um die Erforschung der Bodenfauna sehr verdient machte, gewidmet.

Marcuzziella tripartita sp.n.

(Abb. 5–6)

Beschreibung: Körper schlank, *Stenaphorura*-artig, 860–900 μm lang und 170–180 μm breit. Granulierung grob. Macrochaeten von den Microchaeten deutlich differenziert (Abb. 5A, B). Die Beborstung (Abb. 5A, B) entspricht der Formel:

	I	2	3	I	II	III	IV	V
a	—	10	10	10	10	10	10	10
m	8	8 ¹⁾	8 ¹⁾	2 ²⁾	2	2	2 ⁴⁾	2 ⁴⁾
p	—	8 ²⁾	8	10	10	10	10	5 ⁵⁾

¹⁾ m_2 fehlt, ²⁾ p_2 fehlt, ³⁾ m_5 vorhanden, ⁴⁾ m_4 vorhanden, ⁵⁾ $p_{2,3,4}$ vorhanden.

Beborstung der Anallappen siehe Abb. 6D.

Pseudocellen deutlich durch einen sklerotisierten Ring (unterhalb der Oberfläche) begrenzt (Abb. 5D–F), 10 μm im Durchmesser. Pseudocellenzahl 11 122 22222 (Abb. 5A, B).

Antennen kürzer als Kopfdiagonale (100 μm : 150 μm). Länge der Antennensegmente. I = 20 μm , II = 20 μm , III = 30 μm , IV = 30 μm . Antennensegment IV (Abb. 6A) dorsal mit 5 langen, verdickten Sinneshaaren a–e, zwei kleinen Sinnesstäbchen f und g und kleiner Apikalpapille. Das Antennalorgan III besteht aus zwei dicken, gegeneinander geneigten Sinneskolben (die äussere ist weniger dick als die innere), zwei kleinen Sinnesstäbchen dazwischen und zwei breiten Schutzpapillen (eine dritte Schutzpapille ist nur als niedrige Erhöhung des Integumentes unvollständig entwickelt). Auf der Ventralseite des Antennensegmentes III befindet sich ein dicker, grosser, geneigter Sinneskolben (Abb. 6A).

Postantennalorgan (Abb. 5D, F) in einer länglichen Vertiefung, mit 12 bis 14 Höckern. Sie sind bei subadulten Tieren hufeisenartig, innen mit weiterem kreisförmigen Höcker (Zweig) (Abb. 5D), bei den adulten Exemplaren haben aber die hufeisenartigen Höcker einen weiteren, langen Mittelast entwickelt (Abb. 5F), so dass sie an eine dreizinkige Neptungabel erinnern.

Kopfborstung mit 5 + 5 Macrochaeten (Abb. 5A). Beborstung des Pro-, Meso- und Metanotums ist in der oben angeführten Formel angegeben. Sensille s lang (35 μm), borstenartig, s' klein (3 μm), in einer ovalen Vertiefung. Klauen ohne Zähne, 25 μm lang (Dorsallänge), Empodialanhang ohne Innenlamelle, 4 μm lang.

Hinterrand des Abdomentergits V mit breiter Zone feinerer Granulierung, in der sich die inneren Pseudocellen befinden. Die Borste p_3 an demselben Tergit ist nicht spindelförmig verdickt. Sie ist schlank, 30 μm lang (a_1 = 10 μm). Abdomentergit VI ohne sichelförmige Wülste und borstentragenden Höcker, mit zwei Paaren von Analdornen (Abb. 5C, 6B, F). Alle

vier Dornen sitzen auf deutlichen Papillen, das vordere Paar kleiner, 18 μ m lang (ohne Basalpapillen), das hintere Paar 30 μ m lang.

Ventraltubus mit 5 + 5 Borsten und weiteren 1 + 1 Borsten daneben (Abb. 6C). Kein Furkarudiment vorhanden. Nur Weibchen bekannt. Die Genitalplatte mit 1 + 1 Microchaeten und weiteren 5 Borsten (Abb. 6D).

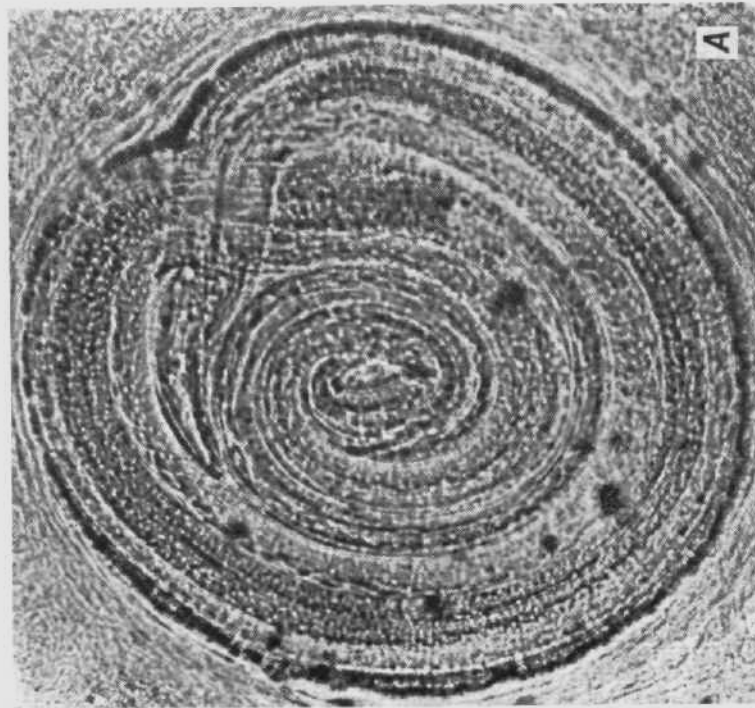
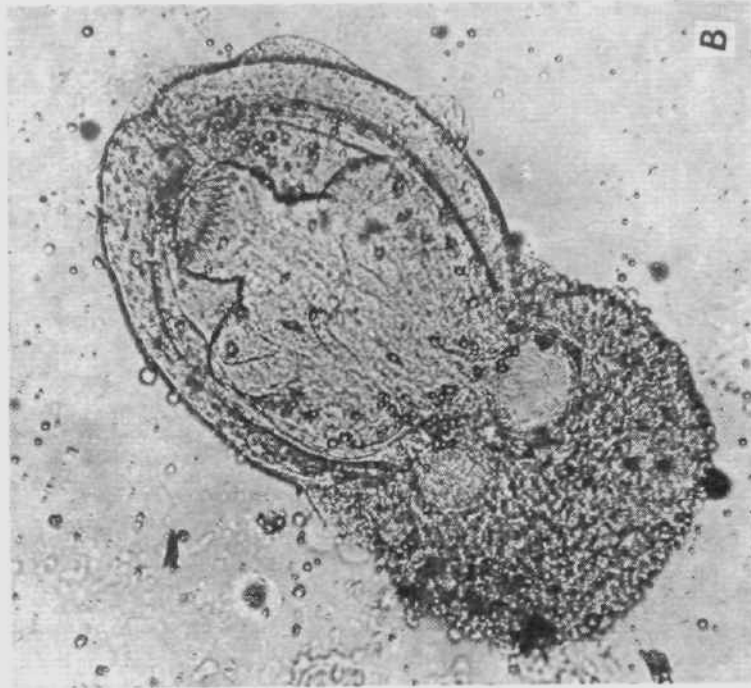
Locus typicus: Herbst 1965, 11 Ex. in Bodenproben aus *Quercetum ilicis* — Bestand (macchia mediterranea), Terracosta bei Tormo di Sangro, Italia, leg. G. Marcuzzi.

Holotypus No. autumn 1965/A 127 und die Paratypen in meiner Sammlung.

LITERATUR

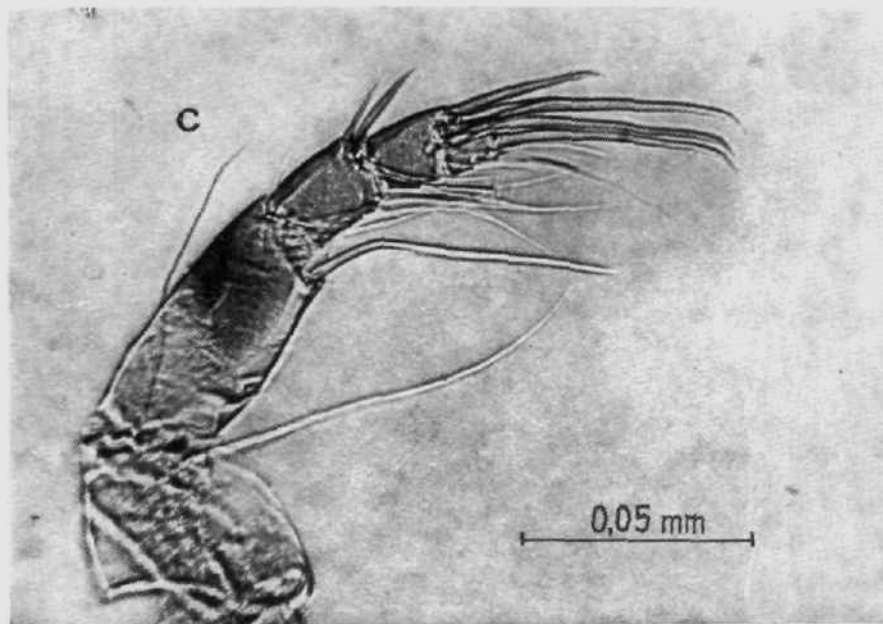
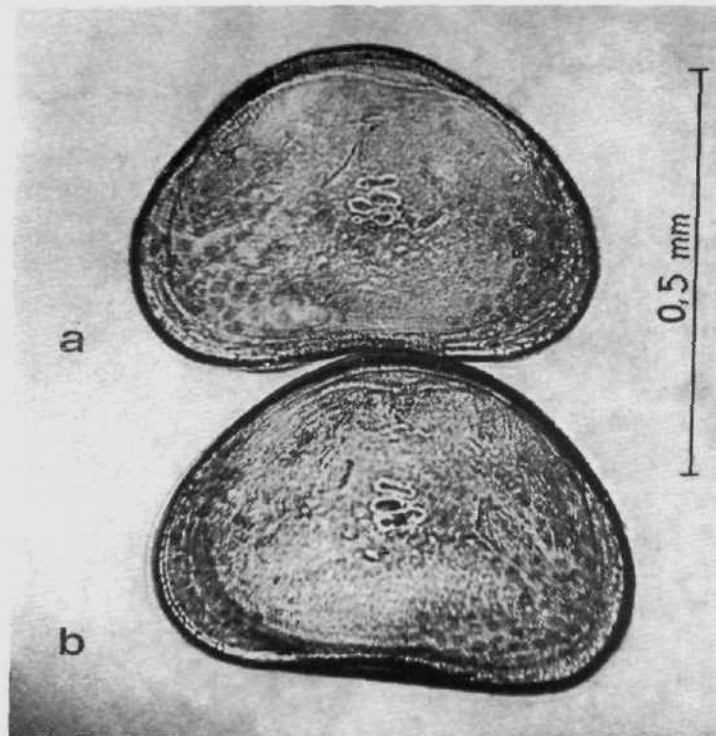
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Anschrift des Verfassers: RNDr. Josef Rusek, CSc., Entomologický ústav ČSAV, Viničná 128 00 Praha 2, Tschechoslowakei.



A. Larva of *Gongylonema pulchrum* from *Aphodius scrutator* (diam. 0.5 mm)
B. Cysticercoid of *Staphylocoystis furcata* from *Necrophorus interruptus* (length 0.35 mm).

Kantorek J., A. Absolon: *Cypria helokrenica*, sp. n. eine neue Ostracoden-Art der Quellfauna.



Männchen von *Cypria helokrenica* sp. n.: a — linke Klappe von innen; b — rechte Klappe von innen; c — zweite Antenne (Photo Párnická—Kantorek).