Editor: Karel Hůrka
Executive editor: David Král

Editorial board: Petr Benda, Jan Buchar, Ivo Hodek, Jaroslav Hrbáček, František Moravec,
Vladimir J. A. Novák, Josef Rusek, František Sládeček, Jiří Vávra, Zdeněk Veselovský, Jan
Zima

Published and distributed by the Czech Zoological Society. Orders should be sent to the Czech Zoological Society,
Viničná 7, CZ-128 00 Praha 2, Czech Republic. Print by the Čihák tisk, Štěrboholská 21, CZ-102 00 Praha 10,
Czech Republic.

Annual subscription (Volume 60, 1996, 4 issues)
Institutional subscription: Europe: USD 80.00
Other countries: USD 90.00
Private subscription: Europe: USD 40.00
Other countries: USD 50.00

This issue was supported by the Ministry of Education (MŠMT ČR).

© Czech Zoological Society, Praha, 1996

A direct continuation of:
This issue is dedicated to Professor Karel Hůrka
on occasion of his 65th birthday
Professor Karel Hůrka 65 years old

We like to think that we are in control of our destiny, or that we are least able to influence the direction of our future. Needless to say, this is far from the truth.

In 1941, during the Second World War, under the influence of my father and at the tender age of 10 years, I decided to collect beetles, a decision that was considered by most of my young friends as absolutely foolish. Little did I know at that time that this decision was one of the most fundamental decisions I ever made, that would profoundly influence my entire life. There were many of us at that time; for most, the interest to collect insects was just a temporary fascination, but many persisted. I was one of them, to a great extent thanks to the unconditional support of my father, and also to the fact that in my home town, Hradec Králové in eastern Bohemia, there were two coleopterists who put me on the right track from the beginning. As many other did, I turned my attention to the ground beetles and slowly, after lots of frustration, I was even able to put names on many of them. Again, little did I know at that time that at the opposite end of Bohemia, there was another youngster, who was making a similar decision which, as in my case, also significantly influenced his entire life. And yet, you guessed correctly, the other youngster was Karel Hůrka, and he is actually the reason why I am writing all this.

We first met at a meeting of the Entomological Society in Prague; then we occasionally met during the regular meetings of the Society, but eventually our relationship developed into friendship. When Karel started to study the carabid fauna of the Soos natural reserve (Sphagnum bog) near Františkovy Lázně in western Bohemia in the late fifties, I realized that this unique biotope might also reveal interesting species of Staphylinidae (a family to which I switched in the meantime). A joint collecting trip with Karel to Soos followed in the spring of 1960 that immediately reconfirmed the uniqueness of this habitat by producing the first record for the former Czechoslovakia of Stenus hercynicus, a typophilous species whose occurrence in Bohemia I expected for some time. More collecting trips followed. One of them led us to eastern Slovakia in the spring of 1966 to collect in flood debris of the Latorica river to find Pterostichus latoricus recently described from that area by Pupkin (now known as P. piceus latoricus), with some additional collecting in southern Slovakia. After one of us discovered Divaldis subterraneus in eastern Slovakia for the first time, near Nová Sedlica, we decided to jointly revise the Carpathian species of the Procarus group. I still vividly remember the long evenings hours spent in Karel’s office working on this project, while munching enormous amounts of peanuts that somehow were always available! We continued the study of trocheids by working on another revision, this time of the Procarus group of the genus Paederusphantalus.

This revision was the first step in the improvement of our knowledge of the trocheids of the caves of the Slovak Karst, that has made such incredible progress recently. But this second paper was published while I was already in Canada; for political reasons, and after mutual agreement, Karel appeared as the sole author of it.

After I left Prague to take permanent residency in Canada, I was convinced that my „carabid days“ were definitely over. I was wrong once again. In time I got involved, as a co-author, in papers on Blehaeus, Pterostichus, Parapatrichus, etc., and quite recently on Elaphrus. During these times my contact with Karel was just occasional and we met only once, during the International Congress of Entomology in 1984 in Hamburg. Shortly after the downfall of the communist regime in the former Czechoslovakia, I visited Prague in the fall of 1990. Karel was one of the first of my entomological friends I visited, I caught him by surprise in his office at Viničná, that looked almost exactly as it did 30 years ago when we were munching peanuts there while working on our trocheids! I enjoyed our long discussion in which Karel filled me in on all the progress achieved during my thirty-year absence, including his work on his carabid book, and on all those wonderful species of ground beetles I would never have dreamed could be found in this small territory. I then realized that, although my interest had turned to other families of beetles, whether for scientific or existential reasons, I actually stayed faithful to my „first love“, the ground beetles; and, little did I know at that time that I would eventually become closely involved with Karel’s carabid book.
During my recent visit to Prague in the fall of 1995, I was asked if I could read and correct the English translation of Karel’s book on the ground beetles of the Czech and Slovak Republics. This task intimidated me somewhat at first, but I accepted it, and never regretted it. Not only did I learn a lot about carabids, but I also realized that I was actually quite privileged to be the first within the scientific community to have the opportunity to read this outstanding book. With every page I read, I further appreciated the amount of work that went into this project and the tremendous contribution this book would bring to the knowledge of the ground beetles not only of the former Czechoslovakia, but also of Central Europe in general. And again, I felt privileged to be able to contribute, at least in a small personal way.

There is not much left to say, except to congratulate Karel on his important life anniversary that finds him in excellent health, and to acknowledge his exceptional, varied achievements, both scientific and pedagogical, that are addressed in more detail elsewhere. There is no doubt in my mind that Karel will continue with undiminished energy on the same path in the future, and for that I wish him, as one of his friends, lots of energy and enthusiasm for many years to come. And, please, do not forget age; to a great extent, is a state of mind and that there is no reason why it should stand in your way for whatever you decide to do.

Ottawa, March 31, 1996

A Smirnova

I am honoured that I was given the opportunity to join in the celebration of the significant anniversary of professor Hůrka by trying to describe my personal experience and appreciation of professor Hůrka. I studied under him and I finished both my diploma and PhD theses under his leadership. I know him from lecture rooms, from excursions, I shared his office for several years, I played basketball and cards with him, we explored the caves of the Slovak Karst together, and we also used to drink beer in pubs.

Professor Karel Hůrka was born on June 2, 1931 in Domažlice, a town surrounded by the rough, picturesque nature of the Český les hills. And it was there where his love of nature was also born. While still a young child, he already started to collect rocks, plants, butterflies, and later on, when he acquired a collection of beetles of the Plzeň area through his father, especially the beetles. His father, a bank clerk, supported him tremendously. Professor Hůrka often tells about the beetle collecting trips he undertook together with his father and he still safeguards his first entomological collection box, made by his uncle who was a book binder. It was his father, who travelled to Prague in 1947 to personally visit Dr. Leo Heyrovský, who at that time was the Secretary of the Entomological Society, to secure his son’s membership in the Society. At the same time, he also bought the newly-published „Key to the family Carabidae“ by Karel Kuhl for his son, which in fact initiated Hůrka’s interest in ground beetles. Due to the relocation of the Domažlice branch of the bank his father worked for, after the annexation of the Sudety by Germany, the Hůrka family moved to Plzeň and spent the war years there. After the war, the family returned to Domažlice. Unfortunately, Hůrka’s father died in 1949. His mother, a pharmacist, provided an equal amount of support and managed to secure her son’s education at the Charles University in Prague; and so, after his graduation from the J. Š. Fučík high school in Domažlice, Karel Hůrka enrolled into the study program at the Faculty of Natural Sciences of the Charles University in Prague, choosing the field of special zoology with specialization in entomology. He studied with Prof. Julius Komárek, who deeply influenced his future activities.

Another important stimulus was provided by the lectures of Prof. Jan Obenberger. Hůrka finished his studies in 1954 by successfully defending his diploma thesis dealing with the postembryonic development of may-beetles species Melolontha hippocastani. This topic apparently had direct influence on his subsequent decision to concentrate on the study of insect ontogeny. In 1960, Hůrka successfully defended his candidate thesis dealing with the taxonomy, biology and ecology of the ectoparasitic insects of bats. This thesis was suggested by Prof. J. Komárek, who initiated a complex study of bats, a highly interesting and until then neglected group of animals. This thesis initiated one part of our jubilarian’s research activities that resulted in over 40 original papers, dealing with the comprehensive study of the flies of the family Isonychiidae and flies of the families Nycerinidae and Streblidae.

In 1969 Hůrka was given the title of assistant professor, after successfully defending his habilitation paper on larval taxonomy and reproductive cycles of the central European species of the genus Carabus. This work started another field of study: larval taxonomy and biology of the reproduction of holometabo-
lous insects, mainly of the order Coleoptera, and of the family Carabidae in particular. Up to now, Prof. Hůrka has supervised 63 diploma theses, 22 of which were based on this topic, and out of 10 PhD and doctorate theses under his supervision, another five deal with the same topic.

The study of the family Carabidae became the dominant field of our jubilant's scientific activities, it includes not only the taxonomy of adults, but also faunistics and biogeography of the family, particularly within the Palearctic Region. In 1989 Prof. Hůrka was awarded the DrSc degree after successful defence of a comprehensive work summarizing his broad knowledge of the breeding types and reproduction biology of the family Carabidae.

Prof. Hůrka's involvement with the Faculty of Natural Sciences of the Charles University goes back almost 43 years. He started to work as a part-time assistant at the Department of Systematic Zoology when he still was a grade 4 student, in 1954-1958 he worked as the assistant, and in 1958-1977 as special assistant. He was awarded the title of assistant professor in 1969, but it was not until 1977 when he was actually appointed as the assistant professor at the Department of Systematic Zoology. After the long desired political change in the country he was named the professor of Entomology. From 1990 until 1994 professor Hůrka served as the head of Department of Zoology and at present he serves in the capacity of the deputy head of the department.

It is hard to believe that it will be 50 years next year, since professor Hůrka joined the Czech Entomological Society. He served for many years as the scientific secretary, then as the president and now as the vice president of the Society. He also serves as the vice-president of the Czech Zoological Society and he is the chief editor of the journal Acta Societatis Zoologicae Bohemicae. He also is a member of the editorial board of the journal Kytara and since 1986 he is the permanent member of the organizing committee of the International symposia on the entomofauna of central Europe (SIEEC).

During recent times, Czech entomology had only very few personalities of Hůrka's distinctiveness and broad knowledge of the entire zoology. After aiding jubilant's vast and intensive pedagogical activity, we are looking also at a career of an outstanding university teacher, who established his own, distinctive entomological school, oriented particularly toward larval morphology and taxonomy, and adult taxonomy of Coleoptera. Tens of specialists, many of them now recognized worldwide, graduated from this school.

For the future, we particularly wish professor Hůrka good health and continuous success in his scientific and pedagogical activities, and at the same time also enough time to pursue his varied interests and hobbies.

Prague, February 2, 1996

Svatopluk Bily

BIBLIOGRAPHY OF ZOOLOGICAL PUBLICATIONS BY KAREL HŮRKA

Scientific papers (including short notes and abstracts from congresses)

1952

1953

1955


1956

1956

1957
13 Hůrka K. 1957. Experimentelle Untersuchungen über die Ökologie der Mäuse (Motelona hippocastani). Z Angew Entomol. 41: 1–16
14 Hůrka K. 1957. Přispěvky k systematické, faunistické, biogeografické a ekologické studii dýmech v ČSR (Betrachtung zur Systematik, Faunistik, Biogeographie und Ökologie der Dymočkové in der Tschechoslowakei) Čs. Parazitol. 4: 145–166 (in Czech, Rus., and Germ. abstr.)

1958

1959

1961

1962

1963


1965


1966


1969


1967


1969


1970


Anniversaries and obituaries


Book reviews


David Král
Description and key of larval Cicindelidae from Brazil (Coleoptera: Caraboida)

Erik Arndt1, Wilfried Paarmann2, & Joachim Adis3

1Universität Leipzig, Institut für Zoologie, Talstraße 35, D-04103 Leipzig, Germany
2FHS Hildesheim/Holzhausen, FB Forstwissenschaften, Bälerweg 4, D-37077 Göttingen, Germany
3Max-Planck-Institut für Limnologie, AG Tropenwissenschaft, Postfach 165, D-24302 Plön, Germany

Received May 26, 1996, accepted June 27, 1996
Published December 27, 1996

Abstract: The larvae of 15 species from 7 genera are described, including the first larval descriptions of representatives of Anurae Hope, 1838 (Megasceaphala), Chelonycha Lacordaire, 1843, and Cenothyla Rivalier, 1869 (Cicindelid). Larval characters of Anurae are very similar to those of Megasceaphala Latreille 1802, the gular suture is V-shaped and the ventral double sclerite on the prothorax is lacking. The beak-like pronotum and the absence of a spine on the maxillary palpomere distinguish the larvae of Anurae from those of Megasceaphala. Chelonycha and Cenothyla both have larval characters typical of the Cicindela subtribe Promyctina. The gular suture is U-shaped and two parts of hooks are present on the prothorax V’. Larvae of Cenothyla are distinguished from those of the similar genera Odontoclea Castelnau, 1834, Cenothyla and Pentacoma Bates, 1872 by less sclerotized, indented abdominal sclerites and by a pronotum with more than 40 setae and a sinus posterior-lateral keel. It is possible to distinguish all described species of Cenothyla, Cenothyla and Petersoma in the larval stage, but impossible to separate the larvae of these three genera at the generic level Cenothyla varanum (Gory, 1833) is different from the known larvae of Odontoclea and Pentacoma by the following character combination: yellow head capsule—prothorax with conspicuous long and dark setae anteriorly flattened setae lacking. Short ecological notes on the species are given. A larval key is presented at the generic level, containing 12 of the 16 Brazilian cicindelid genera.

Larvae, larval key, Coleoptera, Cicindelidae, Neotropical region

INTRODUCTION

The tiger beetles (Cicindelidae) are a peculiar, worldwide adephagan group with about 120 genera and 2000 species. All tiger beetles are insect predators, and their larvae burrow characteristic holes where they wait for prey. More and more, tiger beetles are gaining importance in ecological and nature conservation research (Paarmann in press, Pearson 1980, 1988, 1992, Pearson et al. 1988, 1992). However, the larval knowledge is far from complete, especially in tropical groups (for a summary see Putchkov & Arndt 1994).

According to Reichardt (1977), 17 genera of Cicindelidae occur in Brazil. However, it is very unlikely that genus Prasonychaella Guérin, 1839 occurs in Brazil (Castelhano pers. comm.). Zikan (1929) first gave detailed information about the biology of several Brazilian Cicindelidae, including data on the biology, illustrations of larval holes, and brief descriptions of the larval morphology of 9 genera. Using Zikan’s material, van Emde (1935) provided more detailed descriptions of the larvae of Collyriniae with the Brazilian genus Ctenonoma Klug, 1821. A description of larval Megasceaphala Latreille, 1802, including both subgenera occurring in Brazil (Phaeoxantha Clas喋or, 1850 and Tetracha Hope, 1838) was prepared by Putchkov & Arndt (in press). It is the aim of the present paper to describe the larvae of the genera Anurae Hope, 1838 (Megasceaphala), Chelonycha Lacordaire, 1843, and Cenothyla Rivalier, 1969 (Cicindelini).
for the first time and to describe new larvae of the genera Pentacoma Bates, 1872, Odontochelina Castelnau, 1834, Cylindera Westwood, 1831, and Brasilica Rivalier, 1954. So far, the larvae of 12 (75%) of the Brazilian Cicindelidae genera are known. A larval key to these genera is presented.

MATERIAL AND METHODS

The descriptions are based on the following larval material (L, L, L refer to the larval instars I, II, and III): Aniara septentralis (5 L, 9 L, 3 L), Brazil, Manaus, Reserva Florestal Dace, 1995; Odontochelina castelnau (3 L, 4 L, 6 L), Brazil, Manaus, Reserva Florestal Dace, 1992-1994; O. chrysa (5 L, 4 L), Brazil, Manaus, Reserva Florestal Dace, 1992; O. confusa (4 L, 2 L), Brazil, Manaus, Várzea of Solonóis River 1994; O. lundae (4 L, 6 L), Brazil, Manaus, Reserva Florestal Dace, 1995; O. marginata (14 L, 15 L, 7 L), Brazil, Manaus, Reserva Florestal Dace, 1992-1994; Conchylia varia (10 L, 7 L, 15 L), Brazil, Manaus, Reserva Florestal Dace, 1992-1995; Pentacoma aggregata (1 L, 1 L, 4 L), Brazil, Manaus, Várzea of Solonóis River 1992; Pentacoma abbreviata (1 L, 7 L), Brazil, Manaus, Reserva Florestal Dace, 1992-1995; Pentacoma approximata (1 L), Brazil, Manaus, Reserva Florestal Dace, 1992-1995; Cylindera auripes (1 L), Brazil, Marajó, Município Jacundá, São Francisco 17 10 89; C. chalybea (2 L, 3 L), Brazil, S3, Guaíra de Santa Barbara, Campo São, col. L. R. Fuentes 31 12 89. Larvae and adults of both Chelomyces species were collected on termite hills Cylindera auripes (6 L, 4 L, 1 L), Brazil, Manaus, Várzea of Solonóis River 1994, 1995; C. auripes (2 L), Brazil, Manaus, Reserva Florestal Dace, 1992, 01 08 1995; Brasilica argentinata (3 L, 2 L, 1 L), Brazil, Manaus, Reserva Florestal Dace, 09/12 1992, 02 08 1995.

Material of all species includes exuviae and field collected larvae, except that of Odontochelina lundae and O. chrysa (exuviae only) and that of both Conchylia species (field collected only). Larval specimens of all species are in the collection of INPA, Manaus, and in the collection of R. Arist (Leipzig), except those of Conchylia varia (MNHP) and C. chalybea which are in the collection of the ZMUSP.

Larvae of the Brazilian genera Conchylia (6 species), Megacephala (4 subgenera, 9 species), Cylindera Dejean, 1825 (O. tropis Fabricius, 1775), Empusaspis Dejean, 1825 (2 species), Empusaspis Dejean, 1831 (3 species), Cylindera (3 subgenera, 4 species), and Brasilica (2 species), and representatives of 17 further genera were available for comparison.


Abbreviations: INPA – Instituto Nacional de Pesquisas da Amazônia (Manaus), ZMUSP – Museu de Zoologia da Universidade de São Paulo.

Characters of chaetotaxy (see Bouquet & Goullet 1964): gMX – setae group on tergites dorsally and laterally; TB – small seta on tergites I–VII posteriorly in the middle.

Note: number, size, and position of sternites, and the shape of the mandible and legs are equally in all described taxa. These characters are typically for all Cicindelidae larvae (see e.g., Hamilton 1925 or Kinsley & Pearson 1984).

DESCRIPTIONS

Megacephalini

Aniara septentralis (Fabricius, 1801)
(Figs 1-4, 33)

Instar III

COLORATION: Head dark brown with metallic bronze lustre dorsally, light brown ventrally, pronotum bicolored, medial and anterior parts dark brown with bronze lustre, lateral and posterior margin pearl-white, legs and anterior part of mesonotum brown, rest of thoracic and abdominal sclerites pale; all setae dark brown.

HEAD: Nasal produced, wide, anterior smooth, limited on outer side by two large teeth; coronal suture very short; ridge on posterior part of frontal transverse, continued with ridge on vertex, each side of vertex ridge with 2, frontal ridge with 3 setae; between sterna I and II a small tubercle with 2 setae. Ventral part of head bug-shaped enlarged in posterior direction (visible from lateral view), gular suture Y-shaped. Antennomeres I and II much thicker than antennomeres II, III, and IV. Antennomeres V, VI, and VII each with 6 articles, antennomere VII and VIII with 5 articles, antennomere IX with 4 articles, antennomere X with 3 articles. Antennomere II with 2 setae, antennomere III, IV, V, and VI with 3 setae; antennomere VII with 4 setae; antennomere VIII with 5 setae; antennomere IX with 6 setae; antennomere X with 7 setae. Labial palp with 5 articles, labial palp article I with 2 setae, labial palp article II with 3 setae, labial palp article III with 4 setae, labial palp article IV with 5 setae, labial palp article V with 6 setae. Maxillary palp with 3 articles, maxillary palp article I with 1 seta, maxillary palp article II with 2 setae, maxillary palp article III with 3 setae. Antennae with 8 setae, antennomeres I and II with 2 setae, antennomeres III and IV with 3 setae, antennomeres V through VIII with 4 setae, antennomere IX with 5 setae, antennomere X with 6 setae. Proboscis with 3 articles, proboscis article I with 1 seta, proboscis article II and III with 2 setae. Mandibles with 5 teeth, mandibles with 2 setae on outer side of incisor tooth.

LABIUM: Labrum with 20 setae, labrum with 3 setae on inner side of incisor tooth. Labial palp with 5 articles, labial palp article I with 2 setae, labial palp article II with 3 setae, labial palp article III with 4 setae, labial palp article IV with 5 setae, labial palp article V with 6 setae. Maxillary palp with 3 articles, maxillary palp article I with 1 seta, maxillary palp article II with 2 setae, maxillary palp article III with 3 setae. Antennae with 8 setae, antennomeres I and II with 2 setae, antennomeres III and IV with 3 setae, antennomeres V through VIII with 4 setae, antennomere IX with 5 setae, antennomere X with 6 setae. Proboscis with 3 articles, proboscis article I with 1 seta, proboscis article II and III with 2 setae. Mandibles with 5 teeth, mandibles with 2 setae on outer side of incisor tooth.

PROBOSCIS: Proboscis with 3 articles, proboscis article I with 1 seta, proboscis article II and III with 2 setae.

LABIUM: Labrum with 20 setae, labrum with 3 setae on inner side of incisor tooth. Labial palp with 5 articles, labial palp article I with 2 setae, labial palp article II with 3 setae, labial palp article III with 4 setae, labial palp article IV with 5 setae, labial palp article V with 6 setae. Maxillary palp with 3 articles, maxillary palp article I with 1 seta, maxillary palp article II with 2 setae, maxillary palp article III with 3 setae. Antennae with 8 setae, antennomeres I and II with 2 setae, antennomeres III and IV with 3 setae, antennomeres V through VIII with 4 setae, antennomere IX with 5 setae, antennomere X with 6 setae. Proboscis with 3 articles, proboscis article I with 1 seta, proboscis article II and III with 2 setae. Mandibles with 5 teeth, mandibles with 2 setae on outer side of incisor tooth.

PALP: Palp with 5 articles, palp article I with 2 setae, palp article II with 3 setae, palp article III with 4 setae, palp article IV with 5 setae, palp article V with 6 setae. Maxillary palp with 3 articles, maxillary palp article I with 1 seta, maxillary palp article II with 2 setae, maxillary palp article III with 3 setae. Antennae with 8 setae, antennomeres I and II with 2 setae, antennomeres III and IV with 3 setae, antennomeres V through VIII with 4 setae, antennomere IX with 5 setae, antennomere X with 6 setae. Proboscis with 3 articles, proboscis article I with 1 seta, proboscis article II and III with 2 setae. Mandibles with 5 teeth, mandibles with 2 setae on outer side of incisor tooth.

LABIUM: Labrum with 20 setae, labrum with 3 setae on inner side of incisor tooth. Labial palp with 5 articles, labial palp article I with 2 setae, labial palp article II with 3 setae, labial palp article III with 4 setae, labial palp article IV with 5 setae, labial palp article V with 6 setae. Maxillary palp with 3 articles, maxillary palp article I with 1 seta, maxillary palp article II with 2 setae, maxillary palp article III with 3 setae. Antennae with 8 setae, antennomeres I and II with 2 setae, antennomeres III and IV with 3 setae, antennomeres V through VIII with 4 setae, antennomere IX with 5 setae, antennomere X with 6 setae. Proboscis with 3 articles, proboscis article I with 1 seta, proboscis article II and III with 2 setae. Mandibles with 5 teeth, mandibles with 2 setae on outer side of incisor tooth.
meres III and IV, IV a little shorter than III and half as long as long than II and I; antennomeres I and II each with 8 or more setae, appendage on antennomere III lacking; maxilla with 2-segmented cardo, dorsal part ring-shaped, ventral part of cardo triangular, inner margin of stipes with 2 or 3 distinct spines, setal group gMX with 40–45 setae, lacina lacking; stipes with a sclerotized ber apically, palpifer with 8 setae and attaching the galea; galeomere I with 3 large and 1 small setae, galeomere II with 7 setae; ventral double sclerite on prementum lacking (Fig. 33), labial palpomere I with 2 setae apically, palpomere II with 1 seta mesally. Setae of normal shape, not flattened.

Thorax: Pronotum (Fig. 1) comparatively stout with a distinct groove on disk and 11–12 strong setae on each half; anterolateral angles produced. Setae on pronotum not flattened.

Abdomen: Tergites I–IV with 12–18 long and 14–20 short setae; segment V comparatively strong enlarged dorsally, tergite V (Fig. 2) 3-segmented with 2 pairs of hooks; inner hooks long and slender with 2 nearly reduced setae, median hooks slender and straight with 1 bristle basally; anterior part of tergite V with 8 or more setae, not completely separate from lateral part, the latter with 4–7 long setae, posterior part with 20–22 bristles and some fine and short setae. Epipleuron and hypopleuron each consisting of 2 sclerites with 4–8 (rarely more) setae. Posterior margin of tergite IX with 6 long setae. Pygopod with 8–10 strong and 10 or more fine setae dorsally and 16–18 bristles on apical margin.

Fig. 1–4. *Anura semplicula*. 1 – pronotum L., 2 – abdominal tergite V, right side L., 3 – pronotum L., 4 – abdominal tergite V, right side L. (th – inner hook, mh – median hook) (scales in mm).
Instar II

The following character states are different from the third instar larva.

**Head** Antennomere I and II each with 5–7 setae, galeomere I with 3 bristles, galeomere II with 5 bristles, palpifer with 5 setae, setal group gMX on stipes with 32–38 setae.

**Abdomen** Tergites I–IV with 8–10 long and 6–8 short setae. Lateral part of tegite V with less setae.

Instar I

The following character states are different from the second instar larva.

**Coloration** Pronotum uncolored, head pronotum, mesonotum and legs dark brown.

**Head** Antennomere I without setae, antennomere II with 2 setae, galeomere I with 1 seta, galeomere II with 3 bristles, palpifer with 1 seta, stipes with 1 spine basally, setal group gMX on stipes with 20–25 setae.

**Thorax** Pronotum (Fig. 3) without groove or elevations, each side with 9 setae, anterolateral angles rounded.

**Abdomen** Tergite I with 2 long and 5 short setae, tergites II–IV with 3 long and 3 short setae. Tergite V (Fig. 4) with 6–8 setae on anterior part and 2 on lateral part, setae lacking on posterior part, bristles on inner hooks large, not reduced. Epipleuron and hypopleuron each with 1 large sclerite with 2–3 setae. Small sclerite not distinct. Pygopod with 2 setae dorsally, 10 on apical margin.

**Remarks**

The larva of *Anura sepulcralis* is very similar to larvae of *Megacephala* (see Putchkov & Arndt in press). The gular suture is Y-shaped and the ventral double sclerite on the prementum is lacking in both genera. Contrary to the known larvae of *Megacephala*, the larva of *Anura* has a boocored pronotum. Larvae of *Megacephala* are characterized by a spine on the lateroapical side of maxillary palpomere I, which is lacking in *Anura*.

The larvae of *Anura sepulcralis* were found in an area with sparse vegetation near Manaus. The clay soil was covered with a 10 cm deep sand layer at the locality. The larval holes are slightly oblique and have a depth of only 6 cm in the first instar and 12–15 cm in the last instar.

*Citrodelma*

**Odontocheila cayennensis** (Fabricius, 1787)

(Figs 5–8)

Instar III

**Coloration** Head brown to dark brown with green lustre, pronotum yellow brown, rest of sclerites light brown. Setae pale or brown.

**Head** Nasale produced, wide, anterior smooth, limited on outer sides by two large teeth, coronal suture very short, ridge on posterior part of frontal U-shaped, not continued with ridge on vertex, frontal ridge and each side of vertex ridge with 2 setae. Setae on head capsule not flattened. Ventral part of head not enlarged in posterior direction, gular suture T-shaped. Antennomere I with 4 setae, 3 long setae on inner margin, antennomere II with 5 setae, appendage on antennomere III lacking, maxilla with 2-segmented cardo, dorsal part ring-shaped, ventral part of cardo triangular, inner margin of stipes with 3 distinct spines, setal group gMX with 35–40 setae, lacuna lacking, stipes with a sclerotized bar apically, palpifer with 5 setae and attaching the galea, galeomere I with 3 strong setae, galeomere II with 4 bristles, ventral double sclerite on
prementum present, labial palpomere I with 4 setae and 3 spines apically, palpomere II with 1 seta basally.

THORAX. Pronotum: (Fig. 5) with anterolateral angles produced, rounded; chaetotaxy of pronotum reduced, only 3 short setae per half distinct. Setae of pronotum not flattened; no grooves or elevations distinct.

ABDOMEN. Tergites I-IV only with primary 4 long and 2-4 very short setae; tergite V (Fig. 6) with 3 separate parts and 2 pairs of hooks; inner hooks with 2 strong bristles, median hooks long and slender with 2 bristles, anterior part of tergite V with 10-14 long setae, lateral part with 5-7 long setae, posterior part with 12-17 bristles and 4-7 thin setae. Hypopleuron and epipleuron each with 1 large and 1 small sclerite, the large sclerite of epipleuron with 6-7, that of hypopleuron with 5-8 setae; the small sclerites each with 1 seta. Posterior margin of tergite IX with 2 pairs of long setae. Pygopod with 8 strong setae dorsally, 14-16 on apical margin and a lot of short, thin setae laterally and ventrally.

Instar II

The following character states are different from the third instar larva:

HEAD. Galeomere 1 with 2, galeomere 11 with 4 setae, palpen with 3-4 setae, gMX group with about 25-30 setae, labial palpomere I with 3 setae and 3 spines.

Figs 5-8. Odontosechela caucanensis. 5 - pronotum L., 6 - abdominal tergite V, right side L., 7 - pronotum L., 8 - abdominal tergite V, right side L. (ih - inner hook, mh - median hook) (scales in mm).
Abdomen. Anterior part of tergite V with 10–12 long setae, lateral part with 3 setae, posterior part with 10–14 bristles. Epipleuron with 4–5 setae on the large and 1 seta on the small sclerite, hypopleuron with 3–6 setae on the large and 1 seta on the small sclerite. Pygopod with 12 setae apically.

Instar I
The following character states are different from the second instar larva:

**Coloration.** Head paler brown.

**Head.** Frontal part of ridge without setae. Setae near eyes flattened. Antennomere 1 without setae, antennomere II with 2 setae, galeomere I with 1 seta, galeomere II with 3 bristles, palpifer with 1 seta, stripes with 1 spine basally, setal group gMX on stripes with about 20 setae, labial palpmere I ventroapically with 3 spines but without setae.

**Thorax.** Pronotum (Fig. 7) with 5 distinct, flattened setae.

**Abdomen.** Tergite I with 3 long and 4 short setae, seta T(1)11 reduced, pore-like, tergites II–IV with 3 long and 2 short setae. Tergite V (Fig. 8) with 4 setae on anterior part and 1 seta on lateral part, setae lacking on posterior part. Median hooks with 1 bristle. Epipleuron and hypopleuron each with 2–3 setae on large sclerite and without setae on small sclerite. Pygopod with 4 long setae dorsally, 6 on apical margin.

*Odontocheila confusa* (Dejean, 1825)
(Figs 9, 10)

Instar III

**Coloration.** Head and pronotum yellow brown, only region of eyes dark brown, rest of sclerites light brown. Setae striking dark brown.

**Head.** Nasale produced, wide, anterior smooth, limited on outer sides by two large teeth; coronal suture very short; ridge on posterior part of frontale U-shaped, not continued with ridge on vertex, frontal ridge and each side of vertex ridge with 2 setae. Setae on head capsule in part flattened. Ventral part of head not enlarged in posterior direction, gular suture T-shaped. Antennomere I with 4 setae, 3 long setae on inner margin, antennomere II with 5 setae; appendage on antennomere III lacking; maxilla with 2-segmented cardo, dorsal part ring-shaped, ventral part of cardo triangular, inner margin of stripes with 3 distinct spines, setal group gMX with about 25 setae, lamina lacking; stripes with a sclerotized bar apically, palpifer with 6–7 setae and attaching the galea; galeomere I with 3 strong setae, galeomere II with 5 bristles; ventral double sclerite on prementum present, labial palpmere I with 4 setae and 3 spines apically, palpmere II with 1 seta below the middle.

**Thorax.** Pronotum (Fig. 9) with anterolateral angles produced, rounded, 14–16 distinct setae per half, setae in part flattened; no grooves or elevations distinct. Meso- and metanotum with a number of long, striking dark setae.

**Abdomen.** Tergites I–IV with 8–10 setae arranged in 3 groups, base of setal groups distinctly more sclerotized than rest of tergites; tergite V (Fig. 10) with 3 separate parts and 2 pairs of hooks; inner hooks slender with 2 bristles, median hooks long and slender with 2 bristles; anterior part of tergite V with 10–12 long setae, lateral part with 4–6 long setae, posterior part with 14–16 bristles and setae. Hypopleuron and epipleuron each with 1 large and 1 small sclerite, the large sclerite of epipleuron with 4–5, that of hypopleuron with 5–8 setae; the small sclerites each with 1 seta. Posterior margin of tergite IX with 2 pairs of long setae. Pygopod with 6 long setae dorsally, 14 on apical margin.
Instar II
The following character states are different from the third instar larva:
HEAD. Galeomere I with 2, galeomere II with 4 setae, palpifer with 3 setae, gMX group with about 20–25 setae, stipes with 2 spines, labial palpomere 1 with 3 setae and 3 spines.
ABDOMEN. Pygopod with 12 setae apically.

*Odontochaeta luridipes* (Dejean, 1825)
(Figs 11, 12)

Instar II
COLORATION. Head and pronotum pale yellow brown, only region of eyes dark brown to black, rest of sclerites pale yellow. Setae pale brown.
HEAD. Nasale produced, wide, anterior smooth, limited on outer sides by two large teeth; coronal suture very short, ridge on posterior part of frontale U-shaped, not continued with ridge on vertex, frontal ridge and each side of vertex ridge with 2 setae. Setae near eyes flattened. Ventral part of head not enlarged in posterior direction, gular suture T-shaped. Antennomere I with 4 setae, 3 long setae on inner margin, antennomere II with 4–5 setae; appendage on antennomere III lacking, maxilla with 2-segmented cardo, dorsal part ring-shaped, ventral part of cardo triangular, inner margin of stipes with 2 distinct spines, setal group gMX with less than 16 setae.
lacunicia lacking; stipes with a sclerotized bar apically, palpiifer with 3–4 setae and attaching the galea; galeomere I with 2 strong setae, galeomere II with 4 bristles; ventral double sclerite on prementum present, labial palpmere I with 3 setae and 3 spines apically, palpmere II with 1 seta basally.

Thorax. Anterior margin of pronotum (cf. Fig. 9) strongly arched with anterolateral angles prominent, 14–20 setae per half distinct, some of them flattened; no grooves or elevations distinct.

Abdomen. First abdominal tergites with 5 (tergite I) to 8 (tergite IV) long setae and 2–4 very short setae; tergite V (cf. Fig. 10) with 3 slightly sclerotized and slightly distinct parts and 2 pairs of hooks; both hooks with 2 bristles basally, median hooks comparable stout and arched; anterior part of tergite V with 10 or more fine setae, lateral part with 4–5 setae, posterior part with 11–16 bristles. Hypopleuron and epipleuron each with 1 large and 1 small sclerite, the large sclerite of epipleuron with 3–5, that of hypopleuron with 5–8 setae; the small sclerites each with 1–2 seta. Posterior margin of tergite IX with 2 pairs of long setae. Pygopod with 6 long setae dorsally, 12–16 on apical margin.

Instar I
The following characteristic states are different from the second instar larva:

Head. Frontal part of ridge without setae. Antennomere I without setae, II with 2 setae, galeomere I with 1 seta, galeomere II with 3 bristles, palpiifer with 1 seta, stipes with 1 spine basally, setal group gMX on stipes with about 10–15 setae, labial palpmere I ventroapically with 3 spines but without setae.

Thorax. Pronotum (Fig. 11) with 7 distinct, flattened setae.

Abdomen. Tergite I with 3 long and 4 short setae, seta TE11 reduced, pore-like, tergites II–IV with 3 long and 2 short setae. Tergite V (Fig. 12) with 4 setae on anterior part and 1 seta on lateral part, setae lacking on posterior part. Median hooks with 1 bristle. Epipleuron and hypopleuron each with 2–3 setae on large sclerite and without setae on small sclerite. Pygopod with 4 long setae dorsally, 6 on apical margin.

Odontocheila marginoguttata (Dejean, 1825)
(Figs 13, 14)

Instar III
Coloration. Head, pronotum and mesonotum dark brown with green-bronze lustre; rest of sclerites light brown. Setae pale brown.

Head. Nasale produced, wide, anterior smooth, limited on outer sides by two large teeth; coronal suture very short; ridge on posterior part of frontale U-shaped, not continued with ridge on vertex, frontal ridge and each side of vertex ridge with 2 setae. Setae on head capsule in part flattened. Ventral part of head not enlarged in posterior direction, gular suture T-shaped. Antennomere I with 4 setae, 3 long setae on inner margin, antennomere II with 5 setae; appendage on antennomere III lacking; maxilla with 2-segmented cardo, dorsal part ring-shaped, ventral part of cardo triangular, inner margin of stipes with 3 distinct spines, setal group gMX with about 20 setae, lacunicia lacking; stipes with a sclerotized bar apically, palpiifer with 6–7 setae and attaching the galea; galeomere I with 3 strong setae, galeomere II with 5 bristles; ventral double sclerite on prementum present, labial palpmere I with 4 setae and 3 spines apically, palpmere II with 1 seta basally.

Thorax. Pronotum (Fig. 13) with anterolateral angles prominent, 10–14 setae per half, setae in part flattened; anterior margin with several obvious long and pale setae; no grooves or eleva-
tions distinct. Lateral margin of pronotum in posterior part with separate edge, posterior angles with a tuft of pale setae. Meson- and metanotum with comparable few setae.

**ABDOMEN.** Tergites I–IV with 5 long and a number of very short setae; tergite V (Fig. 14) with 3 separate parts and 2 pairs of hooks; inner hooks with 2 strong bristles, median hooks long and slender with of 2 bristles; anterior part of tergite V with 12–15 setae, lateral part with 4–6 setae, posterior part with 10–14 bristles and 6–10 thinner setae. Hypopleuron and epipleuron each with 1 large and 1 small sclerite, the large sclerite of epipleuron with 5–6, that of hypopleuron with 4–5 setae; the small sclerites each with 1 seta. Posterior margin of tergite IX with 2 pairs of long setae. Pygopod with 6 long and several short setae dorsally, 14–16 on apical margin and a lot of short, thin setae laterally and ventrally.

**Instar II**

The following character states are different from the third instar larva:

**Head.** Galeomere I with 2, galeomere II with 5 setae, palpi with 4 setae, stipes with 2–3 spines, setal group gMX with about 15 setae, labial palpmere I with 3 setae and 3 spines.

**Thorax.** Pronotum with 8 distinct setae per half.

**Abdomen.** Anterior part of tergite V with 10–14 long setae, lateral part with 3–4 setae, posterior part with 14–17 setae and bristles. Pygopod with only 6 long 12 setae dorsally and 12–14 apically.

**Instar I**

The following character states are different from the second instar larva:

**Coloration.** Head, pronotum and mesonotum paler brown, head and pronotum with slightly lustre, mesonotum without lustre.

**Head.** Frontal part of ridge without setae. Setae near eyes flattened. Antennomere I without setae, antennomere II with 2 setae, galeomere I with 1 seta, galeomere II with 3 bristles, palpi with 1 seta, stipes with 1 spine basally, labial palpmere I ventroapically with 3 spines but without setae.

**Thorax.** Pronotum (cf. Fig. 17) including the anterior margin with 10 flattened setae, anterior margin in the middle with obviously long, dark setae.

---

Abdomen. Tergite I with 3 long and 4 short setae, seta TE1 reduced, pore-like, tergites II–IV with 3 long and 2 short setae. Tergite V (cf. Fig. 18) with 5 setae on anterior part and 1 seta on lateral part, setae lacking on posterior part. Median hooks with 1 bristle. Epipleuron with 2 setae on large sclerite; without setae on small sclerite, hypopleuron with 1 seta on large sclerite and without setae on small sclerite. Pygopod with 4 long setae dorsally, 6 on apical margin.

Remarks
The second instar specimens of Odontocheilus chrysos (Fabricius, 1801) studied are very similar to the second instar of O. marginiguttata. Only the measurements (see Table 1) and the slightly different number of pronomal setae (O. chrysos 11, O. marginiguttata 8 in second instar) distinguish both species.

Larvae of Odontocheilus cayennensis, O. luridipes, and O. marginiguttata were collected on places without leaf litter in the examined Terra Firme forest near Manaus. Larvae of O. marginiguttata show a preference of ground elevations like termite nests. The three species are associated with Cenothyla varians and Pentacoma (Poeciloclita) lacordairei (Gory, 1833) (see Paarmann et al. in press).

Cenothyla varians (Gory, 1833)
(Figs 15–18, 34)

Instar III
Coloration. Head and pronotum pale reddish-brown without distinct lustre, only region near eyes dark brown, rest of sclerites light brown. Setae yellow to dark brown.

Head. Nasale produced, wide, anterior smooth, limited on outer sides by two large teeth; coronal suture very short; ridge on posterior part of frontale U-shaped, not continued with ridge on vertex, frontal ridge and each side of vertex ridge with 2 setae. Setae on head capsule not flattened. Ventral part of head not enlarged in posterior direction, gular suture T-shaped. Antennomere I with 4 setae, 3 long setae on inner margin, antennomere II with 5 setae; appendage on antennomere III lacking; maxilla with 2-segmented cardo, dorsal part ring-shaped, ventral part of cardo triangular, inner margin of stipes with 2–3 spines, setal group gMX with about 20 setae, lacina lacking, stipes with a sclerotized bar apically, palpirer with 5 setae and attaching the galea; galeomere I with 3 strong setae, galeomere II with 5 bristles; ventral double sclerite on prementum present, labial palpomere I with 4 setae and 3 spines apically, palpomere II with 1 seta distally.

Thorax. Pronotum (Fig. 15) with anterolateral angles triangular, 12–18 setae per half, anterior margin with a row of obvious long and dark setae, setae not flattened, all setae pale except the dark setae on anterior margin; posterior angles with a tuft of pale setae; no grooves or elevations distinct on pronotum.

Abdomen. Tergites I–IV with about 8 long and 2–4 very short setae; tergite V (Fig. 16) with 3 separate parts and 2 pairs of hooks; inner hooks with 2 strong bristles, median hook stout with 2 bristles near the middle; anterior part of tergite V with 10–14 setae, lateral part with 5–6 setae; posterior part with 12–16 bristles and 2–4 thinner setae. Hypopleuron and epipleuron each with 1 large and 1 small sclerite, the large sclerites with 4–7, the small sclerites each with 1 seta. Posterior margin of tergite IX with 2 pairs of long setae. Pygopod with 6 long and several short setae dorsally, 14–16 on apical margin.
Instar II
The following character states are different from the third instar larva:
HEAD. Galeomere I with 2, galeomere II with 5 setae, palpifer with 2 setae, stipes with 2 spines, setal group gMX with 12-15 setae, labial palpomere I with 2-3 setae and 3 spines.
ABDOMEN. Anterior part of tergite V with 10-14 long setae (like third instar), lateral part with 3-5 setae, posterior part with 8-10 bristles and 2 setae. Pygopod with 12 setae dorsally and 12 apically.

Instar I
The following character states are different from the second instar larva:
COLORATION. Head, pronotum and mesonotum paler brown, head and pronotum with slightly lustre, mesonotum without lustre.
HEAD. Frontal part of ridge without setae. Seate in part flattened. Antennomere I without setae, antennomere II with 2 setae, galeomere I with 1 seta, galeomere II with 3 bristles, palpifer without setae, stipes with 1 spine basally, setal group gMX with 8-10 setae, labial palpomere I ventrally with 3 spines but without setae.
THORAX. Pronotum (Fig. 17) including the anterior margin with 10 flattened setae, anterior margin in the middle with 2 obviously long and dark setae.

Figs 15-18. Cenothyla varians, 15 – pronotum L.0, 16 – abdominal tergite V, right side L.0, 17 – pronotum L.0, 18 – abdominal tergite V, right side L.0, (scales in mm).
Tab. 1. Measurements of examined Cichindelidae larvae, all data in mm, average in parentheses

<table>
<thead>
<tr>
<th></th>
<th>Head width</th>
<th>Frontal width</th>
<th>Pronotal width</th>
<th>Pronotal length</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anima septica</td>
<td>2.64–2.92 (2.77)</td>
<td>1.64–1.80 (1.76)</td>
<td>2.60–2.92 (2.71)</td>
<td>1.96–2.12 (2.03)</td>
</tr>
<tr>
<td>L2</td>
<td>1.72–1.92 (1.83)</td>
<td>1.12–1.16 (1.14)</td>
<td>1.72–1.84 (1.76)</td>
<td>1.24–1.36 (1.31)</td>
</tr>
<tr>
<td>L1</td>
<td>1.18–1.24</td>
<td>0.76–0.80</td>
<td>1.12–1.16</td>
<td>0.82–0.94</td>
</tr>
<tr>
<td>Odontocheila cayennensis</td>
<td>3.31</td>
<td>1.93–2.00 (1.97)</td>
<td>3.43–3.50 (3.48)</td>
<td>2.06–2.19 (2.16)</td>
</tr>
<tr>
<td>L2</td>
<td>2.12–2.24 (2.18)</td>
<td>1.28–1.36 (1.32)</td>
<td>2.15–2.20 (2.18)</td>
<td>1.29–1.28 (1.24)</td>
</tr>
<tr>
<td>L1</td>
<td>1.40–1.52 (1.48)</td>
<td>0.84–0.88 (0.87)</td>
<td>1.20–1.48 (1.39)</td>
<td>0.80–0.88 (0.84)</td>
</tr>
<tr>
<td>Odontocheila chrysus</td>
<td>1.36–1.38 (1.37)</td>
<td>0.72–0.76 (0.74)</td>
<td>1.40–1.44 (1.42)</td>
<td>0.80–0.84 (0.82)</td>
</tr>
<tr>
<td>L2</td>
<td>2.80</td>
<td>1.60</td>
<td>3.08</td>
<td>2.08</td>
</tr>
<tr>
<td>L1</td>
<td>1.84–1.92 (1.88)</td>
<td>1.00–1.08 (1.04)</td>
<td>1.84–1.92 (1.88)</td>
<td>1.28</td>
</tr>
<tr>
<td>Odontocheila burdigesis</td>
<td>1.76–1.88 (1.82)</td>
<td>0.88–1.00 (0.92)</td>
<td>1.84–1.92 (1.87)</td>
<td>1.10–1.16 (1.12)</td>
</tr>
<tr>
<td>L2</td>
<td>1.12–1.20 (1.16)</td>
<td>0.60–0.64 (0.62)</td>
<td>1.08–1.20 (1.14)</td>
<td>0.64–0.76 (0.70)</td>
</tr>
<tr>
<td>Odontocheila marginata</td>
<td>2.28–2.60 (2.42)</td>
<td>1.36–1.44 (1.40)</td>
<td>2.44–2.60 (2.51)</td>
<td>1.54–1.68 (1.61)</td>
</tr>
<tr>
<td>L2</td>
<td>1.48–1.56 (1.53)</td>
<td>0.84–0.96 (0.90)</td>
<td>1.48–1.68 (1.54)</td>
<td>0.92–1.04 (0.96)</td>
</tr>
<tr>
<td>L1</td>
<td>0.90–1.06 (0.98)</td>
<td>0.50–0.60 (0.55)</td>
<td>0.94–1.02 (0.93)</td>
<td>0.50–0.60 (0.57)</td>
</tr>
<tr>
<td>Centrolycha varians</td>
<td>2.32–2.60 (2.46)</td>
<td>1.28–1.44 (1.38)</td>
<td>2.40–2.64 (2.53)</td>
<td>1.60–1.72 (1.67)</td>
</tr>
<tr>
<td>L2</td>
<td>1.28–1.44 (1.39)</td>
<td>0.80–0.84 (0.83)</td>
<td>1.48–1.56 (1.51)</td>
<td>0.92–1.00 (0.97)</td>
</tr>
<tr>
<td>L1</td>
<td>0.70–0.98 (0.84)</td>
<td>0.48–0.58 (0.51)</td>
<td>0.80–0.96 (0.90)</td>
<td>0.54–0.60 (0.57)</td>
</tr>
<tr>
<td>Pentacoma egregia</td>
<td>2.00</td>
<td>1.16</td>
<td>2.08</td>
<td>1.28</td>
</tr>
<tr>
<td>L2</td>
<td>1.20</td>
<td>0.88</td>
<td>1.20</td>
<td>0.80</td>
</tr>
<tr>
<td>L1</td>
<td>0.68–0.72 (0.70)</td>
<td>0.40</td>
<td>0.65–0.68 (0.66)</td>
<td>0.42–0.43 (0.42)</td>
</tr>
<tr>
<td>Pentacoma lacordaire</td>
<td>1.01</td>
<td>1.11</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>L2</td>
<td>0.68–0.78 (0.71)</td>
<td>0.50–0.58 (0.54)</td>
<td>0.70–0.74 (0.72)</td>
<td>0.42</td>
</tr>
<tr>
<td>Pentacoma ventralis</td>
<td>2.32–2.64 (2.50)</td>
<td>1.28–1.44 (1.37)</td>
<td>2.40–2.64 (2.52)</td>
<td>1.52–1.60 (1.56)</td>
</tr>
<tr>
<td>L2</td>
<td>1.56–1.64 (1.61)</td>
<td>0.77–0.80 (0.79)</td>
<td>1.52–1.64 (1.60)</td>
<td>1.05–1.08 (1.07)</td>
</tr>
<tr>
<td>L1</td>
<td>1.00–1.12 (1.01)</td>
<td>0.52</td>
<td>0.92–0.98 (0.96)</td>
<td>0.88</td>
</tr>
<tr>
<td>Chelonycha auripennis</td>
<td>2.81</td>
<td>1.62</td>
<td>3.00</td>
<td>2.25</td>
</tr>
<tr>
<td>Chelonycha chalybea</td>
<td>2.94–3.60</td>
<td>1.75–1.75</td>
<td>3.15–3.25</td>
<td>2.25–2.25</td>
</tr>
<tr>
<td>L1</td>
<td>1.75–1.97 (1.88)</td>
<td>1.06–1.19 (1.12)</td>
<td>1.93–2.08 (2.02)</td>
<td>1.34–1.38 (1.36)</td>
</tr>
<tr>
<td>Cylindera morta</td>
<td>2.08</td>
<td>1.20</td>
<td>2.08</td>
<td>1.32</td>
</tr>
<tr>
<td>Cylindera naturalis</td>
<td>2.00–2.20 (2.10)</td>
<td>1.20–1.28 (1.24)</td>
<td>1.92–2.08 (2.00)</td>
<td>1.20–1.24 (1.23)</td>
</tr>
<tr>
<td>L2</td>
<td>1.42–1.48 (1.46)</td>
<td>0.88–0.90 (0.94)</td>
<td>1.32–1.40 (1.36)</td>
<td>0.86–0.92 (0.90)</td>
</tr>
<tr>
<td>L1</td>
<td>1.02</td>
<td>0.60</td>
<td>0.90</td>
<td>0.58</td>
</tr>
<tr>
<td>Brassella argentata</td>
<td>1.56–1.68 (1.61)</td>
<td>0.85–0.90 (0.88)</td>
<td>1.48–1.64 (1.55)</td>
<td>0.85–0.92 (0.88)</td>
</tr>
<tr>
<td>L2</td>
<td>0.99–1.01 (1.00)</td>
<td>0.57–0.61 (0.60)</td>
<td>0.93–1.00 (0.98)</td>
<td>0.61–0.65 (0.63)</td>
</tr>
<tr>
<td>L1</td>
<td>0.62</td>
<td>0.36</td>
<td>0.59</td>
<td>0.36</td>
</tr>
</tbody>
</table>
Abdomen Tergite I with 3 long and 4 short setae, seta TE11 reduced, pore-like, tergites II–IV with 3 long and 2 short setae. Tergite V (Fig 18) with 2–6 setae on anterior part and 1 long and 1 short seta on lateral part, setae lacking on posterior part. Median hooks short, strongly arched with 1 short bristle. Epipleuron with 2 setae on large sclerite, without setae on small sclerite, hypopleuron with 1 long and 1 pore-like seta on large sclerite and without setae on small sclerite. Pygopod with 4 long setae dorsally, 6 on apical margin.

Remarks
The larva of Pentacomia (Poeciloclithra) lacordairei (only first and second instars were available) is very similar to that of Cenothyla varans. The first instar of both species is distinguished only by measurements (see Table 1), the second instar is distinguished beside the measurements, by the mesonotum and metanotum of P. lacordairei having fewer setae and median hooks only with one seta, but only 1 second instar specimen of P. lacordairei was examined. Pentacomia ventralis (Dejean, 1825) is distinguished from P. lacordairei (same subgenus) by the slender median hooks, more setae on first antennomeres and palpi, the multisetose posterior margin of the mesonotum and the third pair of setae on posterior margin of abdominal tergite IX. Cenothyla varans and P. lacordairei occur together in the examined Terra Firma forest near Manaus. Larvae of both species were collected on places without leaf litter in the forest Pentacomia lacordairei was also collected in inundation forests of the Solimoes River near Manaus (see Adis et al. in press).

Pentacomia (s. str.) egregia (Chaudor, 1835)
(Figs 19–22)

Instar III
Coloration: Head dark brown to black with slightly metallic lustre, pronotum brown, anterolateral angles of pronotum yellowish, rest of sclerites brown. Setae brown, pale or black.
Head: Nasal produced, wide, anterior smooth, limited on outer sides by two large teeth, coronal suture very short, ridge on posterior part of frontale U-shaped, not continued with ridge on vertex, frontal ridge and each side of vertex ridge with 2 setae, posterior part of head with flattened setae. Ventral part of head not enlarged in posterior direction, gular suture T-shaped. Antennomere 1 with 6–8 setae, 3 of them long setae and on inner margin, antennomere II with 6–7 setae, the posteroapical seta obviously flattened and contrary to the other setae black, appendage on antennomere III lacking. Maxilla with 2-segmented cardo, dorsal part ring-shaped, ventral part of cardo triangular, inner margin of stipes with 2 distinct spines, setal group gMX with 16–20 setae, lacinia lacking, stipes with a sclerotized bar apically, palpifer with 6 setae and attaching the galea, galeomere 1 with 3 strong setae, galeomere II with 5 bristles, ventral double sclerite on chelate present, labial palpmere 1 with 4 setae and 3 spines apically, palpmere II with 1 seta below the middle.
Thorax: Pronotum (Fig. 19) with anterolateral angles prominent, only 10 setae on each half, the anterior 3 together with 3 on anterior margin flattened, and contrary to the pale and thin other setae black coloured, no grooves or elevations distinct.
Abdomen: Tergites I–IV with 16–26 setae per half, tergite V (Fig 20) with 3 separate parts and 2 pairs of hooks, both hooks long and slender, with 2 bristles, median hooks with 1 bristle on the apical half and the other basally, anterior part of tergite V with 6–8 thin setae, lateral part with 3–4 setae, posterior part with 7–8 bristles and 7–8 setae. Hypopleuron and epipleuron each with 1 large and 1 small sclerite, the large sclerites with 8–10, the small with 2–3 setae. Posterior
margin of tergite IX with 3 pairs of long setae. Pygopod with about 10 distinct and some thin and very short setae dorsally and 14-16 on apical margin.

**Instar II**

The following character states are different from the third instar larva:

**HEAD.** Antennomere I with 6, antennomere II with 5 setae, the black and flattened setae less distinct, galeomere I with 2 setae, palpifer with 3 setae.

**THORAX.** Pronotum with less distinct flattened black setae in anterior region.

**ABDOMEN.** Anterior part of tergite V like third instar with 6-8 long setae, but lateral part with 2-3 setae, posterior part with 6-8 bristles and 6-8 thin setae.

**Instar I**

The following character states are different from the second instar larva:

**HEAD.** Frontal part of ridge without setae. Antennomere I without setae, antennomere II with 2 setae, galeomere I with 1 seta, galeomere II with 3 bristles, palpifer with 1 seta, stipes with 1 spine basally, setal group gMX on stipes with less than 16 setae, labial palpomere I ventromedially with 3 spines but without setae.

**THORAX.** Pronotum (Fig. 21) with 10 setae, anterior like those of head long and flattened, but black and darker than the rest of setae.

**ABDOMEN.** Tergite I with 3 long and 4 short setae, seta TE11 reduced, pore-like, tergites II-IV with 3 long and 2 short setae. Tergite V (Fig. 22) with 3-4 setae on anterior part and 1 seta on

lateral part, setae lacking on posterior part. Median hooks with 1 seta. Epipleuron and hypopleuron each with 1 large and 1 small sclerite, the large sclerites with 2 setae, the small sclerites without setae. All abdominal setae comparatively long. Pygopod with 4 long setae dorsally, 8 on apical margin.

*Pentacoma (Poecilochila) ventralis* (Dejean, 1825)  
(Figs 23–26)

**Instar III**

**Coloration.** Head and pronotum brown, region near eyes darker, brown to black with green lustre; anterolateral angles of pronotum and appendages of head paler; rest of thoracic and abdominal sclerites light brown. Setae pale or brown.

**Head.** Nasale produced, wide, anterior smooth, limited on outer sides by two large teeth; coronal suture very short; ridge on posterior part of frontale U-shaped, not continued with ridge on vertex, frontal ridge and each side of vertex ridge with 2–3 flattened setae, setae on head capsule pale, those near eyes flattened. Ventral part of head not enlarged in posterior direction, gular suture T-shaped. Antennomeres I and II much thicker than III and IV, I–III of nearly the same

---

length, antennomere IV about 0.6 as long as the other segments; antennomere I with 7–8 setae, 4 long setae on inner margin, antennomere II with 7–8 setae; appendage on antennomere III lacking, maxilla with 2-segmented cardo, dorsal part ring-shaped, ventral part of cardo triangular, inner margin of stipes with 2–3 distinct spines, setal group gMX with about 40 setae, laciniaria lacking, stipes with a sclerotized bar apically, palpifer with 7 setae and attaching the galea; galeomere I with 3 strong setae, galeomere II with 5 bristles; ventral double sclerite on prementum present, labial palpmere I with 4 setae and 3–4 spines apically, palpmere II with 1 seta below the middle.

**Thorax.** Pronotum (Fig. 23) with anterolateral angles produced, sharp; 12–15 long and 10–20 very short setae on each half; long setae in part flattened; no grooves or elevations distinct. Mesonotum with a multisetos posterior margin. Metanotum without a multisetos posterior margin.

**Abdomen.** Tergites I–IV with 4–5 long and 6–12 very short setae; tergite V (Fig. 24) with 3 separate parts and 2 pairs of hooks; inner hooks with 2 strong bristles, median hooks long and slender with a row of 4–5 setae; anterior part of tergite V with 10–14 long setae, lateral part with 4–5 long setae, posterior part with 10–14 bristles and 8–12 thin setae. Hypopleuron and epipleuron each with 1 large and 1 small sclerite, the large sclerite with 4–5, the small with 1–2 setae. Posterior margin of tergite IX with 3 pairs of setae, the outer very long, the inner shorter and thicker. Pygopod with 8–14 strong setae dorsally and 16 on apical margin.

**Instar II**
The following character states are different from the third instar larva:

**Head.** Antennomeres I and II with 5–6 setae, antennomere I with 3 long setae on inner margin, galeomere I with 2 setae, palpifer with 4–5, gMX group with about 30 setae.

**Thorax.** Pronotum with 5–7 long and 10–12 short setae on each side.

**Abdomen.** Anterior part of tergite V with 4–5 long setae, lateral part with 2 setae, posterior part with 6–8 setae. Median hooks with 2 bristles.

**Instar I**
The following character states are different from the second instar larva:

**Head.** Frontal part of ridge without setae. Antennomere I without setae, antennomere II with 2 setae, galeomere I with 1 seta, galeomere II with 3 bristles, palpifer without setae, stipes with 1 spine basally, setal group gMX on stipes with about 10 setae, labial palpmere I ventrally with 3 spines but without setae.

**Thorax.** Pronotum (Fig. 25) with 7 setae, most of them flattened. Posterior margin of mesonotum not multisetos, but with distinct more setae than on the rest of metanotum.

**Abdomen.** Tergite I with 3 long and 4 short setae, seta T2II1 reduced, pore-like, tergites II–IV with 3 long and 2 short setae. Tergite V (Fig. 26) with 5 setae on anterior part and 1 seta on lateral part, setae lacking on posterior part. Median hooks with 1 seta. Epipleuron and hypopleuron each with 1 large sclerite with 2–3 setae. Small sclerite not distinct. Pygopod with 6 long setae dorsally, 8 on apical margin.

**Remarks**
All examined species of the closely related genera Odontocheila, Cenothyla and Pentacomaia are distinguished in larval instar III. However, at present it seems impossible to separate the larvae at the generic level.

**Odontocheila cayennensis** is distinguished from the rest of species by the reduced chaetotaxy of pronotum. *Pentacomaia ventralis* and *P. egregria* have, contrary to the other species, more...
than 5 setae on antennomeres I and II, and peculiar character states on the median hooks. *Pentacoma ventralis* has a slender median hook with 4–5 setae, and *P. egregria* a slender median hook with 1 seta basally and 1 seta in the apical half. The rest of the species have 2 bristles, usually near the middle on the median hooks. Moreover, *P. egregria* has a conspicuously flattened and black seta on antennomere II. *Odontocheila chrysia* and *O. marginiguttata* are distinguished by the dark head and pronotum from the remaining species with yellow-brown heads and pronotum (see remarks of *O. marginiguttata*). *Odontocheila confusa* and *O. luridipes* have a few flattened setae on head and pronotum. *Odontocheila confusa* has slender median hooks with 2 bristles in the middle, while *O. luridipes* stout median hooks with 2 bristles basally. Contrary to these species, *Ctenothyla varians* and *Pentacoma lacordairei* lack flattened setae in third instar. For distinguishing both species see the discussion of *Ctenothyla varians*.

Larvae of *P. ventralis* were collected on a small, dry clay area free of vegetation in the Terra Firme forest near Manaus. The larval holes are very short (only 4 cm in the third instar). The larvae are associated with those of *Brastella argentata* Fabricius, 1801.

*Pentacoma egregria* was collected in inundation forests of the Solimões River near Manaus (Amorim et al. in press).

*Chilomycha chalybea* (Dejean, 1825)
(Figs 27, 28)

**Instar III**

**Coloration.** Head and pronotum brown, region near eyes darker; brown to black without or with slightly green lustre, rest of thoracic and abdominal sclerites light brown and little distinct, only tergites VIII and IX darker than previous, yellow-brown. Setae pale.

**Head.** Nasale produced, wide, anterior smooth, limited on outer side by two large teeth; coronal suture short but distinct, about as long as antennomere III wide; ridge on posterior part of frontale U-shaped, not continued with ridge on vertex, frontal ridge and each side of vertex ridge with 2 setae. Ventral part of head not enlarged in posterior direction, gular suture T-shaped. Antennomeres I and II distinct longer and wider than antennomeres III and IV; antennomeres I with 4 setae, 3 on inner margin, I ventrally, antennomere II with 5 setae; appendage on antennomere III lacking; maxilla with 2-segmented cardo, dorsal part ring-shaped, ventral

![Image](image-url)

part of cardo triangular, inner margin of stipes with 2-3 distinct spines, lacinia lacking; stipes with a sclerotized bar apically, palpifer with 3 setae and attached the galea; galeomere 1 with 3 large, galeomere II with 3 setae; ventral double sclerite on prementum present, labial palpomere I with 3-4 setae and 3 spines apically, palpomere II with 1 seta basally. A part of the setae near eyes and on vertex ridge flattened.

**Thorax.** Pronotum (Fig. 27) covered with clay rests frequently. Anterolateral angles produced, sharp, with some flattened setae; disk with deep impressions; pronotum with a keel along lateral margin, the keel bearing a row of 16-20 setae; the rest of pronotum with 40-50 setae on each half.

**Abdomen.** Tergites I-IV with 4 long and a number of very short, pale and undistinct setae; sterna and sternites little sclerotized and undistinct; tergite V (Fig. 28) 3-segmented with 2 pairs of hooks; inner hooks stout with 1-2 stout bristles basally, median hooks stout and strongly arched with 2-3 strong bristles and 1-2 thin setae; anterior part of tergite V indistinct with 6-10 long setae, lateral part with 4-5 long setae, posterior part with 2 rows of 8-10 bristles. Hypopleuron and epipleuron like tergites not distinct, with 1 large (and 1 small?) sclerite. Tergites VIII and IX stronger sclerotized than previous, posterior margin of tergite IX with 2 pairs of long setae 1 pair of stout bristles in the middle. Pygopod with 16-20 setae dorsally and 16-22 bristles on apical margin.

**Instar II**

The following character states are different from the third instar larva:

**Head.** Galeomere I with 2 bristles, palpifer with 3 setae.

**Thorax.** Pronotum with 8-10 setae on the keel, and about 25 setae on the rest of pronotum.

**Abdomen.** Anterior part of tergite V with 4-5 long setae, lateral part with 2 setae, posterior part with 6-8 bristles. Median hooks with 2 bristles.

**Remarks**

One third instar specimen of *Cheilonycha auripennis* Lucas, 1857 was examined. It is distinguished from *C. chalybea* by having only 8 bristles on the posterior part of tergite V. It will require more material to determine if this character is of specific value.

Wasmann (1895a, b) and Berg (1900) report about the hunting behaviour of *Cheilonycha* adults on termite hills, but did not find the larvae. The larvae described herein were collected on termite hills (probably of *Cornitermes* species). Their larval holes were close to the holes of luminescent larvae of Elateridae (Costa, pers. comm.).

**Cylindera (Plectographa) suturalis** (Fabricius, 1798)

(Figs 29-32)

**Instar III**

**Coloration.** Head and pronotum brown, with distinct metallic-green lustre; anterolateral angles of pronotum pale without green lustre, rest of sclerites brown without lustre. Setae pale yellow to pale brown.

**Head.** Nasale produced, wide, anterior smooth, limited on outer sides by two large teeth; coronal suture very short; ridge on posterior part of frontale U-shaped, not continued with ridge on vertex, frontal ridge and each side of vertex ridge with 2 setae, setae on head capsule not flattened. Ventral part of head not enlarged in posterior direction, gular suture T-shaped. Antennomere I with 5-6 setae, 3 long setae on inner margin, antennomere II with 5-7 setae; appendage on antennomere III lacking; maxilla with 2-segmented carido, dorsal part ring-shaped, ventral
part of carap triangular, inner margin of stipes with 3 distinct spines, setal group gMX with about 30 setae, macula lacking; stipes with a sclerotized bar apically, palpifer with 6–7 setae and attaching the galea; galeomere I with 3 strong setae, galeomere II with 5 bristles; ventral double sclerite on prementum present, labial palpomere I with 4 setae and 3–4 spines apically, palpomere II with 1 setae in the middle.

**Thorax.** Pronotum (Fig. 29) with anterolateral angles produced, sharp; 8–12 long setae on each half; setae not flattened; no grooves or elevations distinct.

**Abdomen.** Tergites I–IV with 5–6 long and 4–5 short setae; tergite V (Fig. 30) with 3 parts, lateral and posterior part attaching and much stronger sclerotized than the separate anterior part; anterior part of tergite V with 4–8 setae, lateral part with 3 setae, posterior part with 12–18 bristles and 4–8 thin setae; 2 pairs of hooks present; inner hooks reduced, very short with 2 short bristles, bristles distinctly longer than apical spike of inner hooks; median hooks very long and slender compared with those of previous species, strongly arched with 3–5 long setae. Hypopleuron and epipleuron each with 1 large and 1 small sclerite, the large sclerite with 4–6, the small with 1 seta. Posterior margin of tergite IX with 3 pairs of setae. Pygopod with 16–22 setae of variable size dorsally and 14–16 on apical margin.

**Instar II**
The following character states are different from the third instar larva:

**Coloration.** Pronotum not bicolored, like on head brown with green lustre without pale margin.

---

HEAD. Antennomeres I and II with 4–5 setae, galeomere I with 2 setae, palpuser with 4–5; labial palpmere I with 3 setae and 3 spines.

THORAX. Pronotum with 10 setae on each side (cf. Fig. 31). Abdomen. Anterior part of tergite V with 2–3 setae, lateral part with 2 setae, posterior part with 10–12 bristles and 4–8 thin setae. Median hooks with 3 setae. Hypopleuron and epipleuron each with 3–4 setae on large and 1 seta on small sclerite. Pygopod with 12–14 setae dorsally and 12–14 setae on apical margin.

Instar I

The following character states are different from the second instar larva:

HEAD. Frontal part of ridge without setae. Antennomere I without setae, antennomere II with 2 setae, galeomere I with 1 seta, galeomere II with 3 bristles, palpuser without setae, stipes with 1 spine basally, setal group of M and M on stipes with about 15 setae, labial palpmere I ventrally with 3 spines but without setae.

THORAX. Pronotum (Fig. 31) with 10 setae on each side, anterior margin in the middle with a strong and flattened seta.

ABDOMEN. Tergite I with 3 long and 5 short setae, seta TE1 reduced, pore-like, tergites II–IV with 3 long and 3 short setae. Tergite V (Fig. 32) with 2 setae on anterior part and 1–2 setae on lateral part, setae lacking on posterior part. Inner hooks more distinct, apical spine half as long as the setae of the hooks, median hooks with 1 seta. Epipleuron and hypopleuron each with 2 setae on the large sclerite and without setae on the small sclerite. Tergite IX with 2 pairs of setae on apical margin. Pygopod with 6 long setae dorsally, 8 on apical margin.

Fig. 33. Anoplophora septentrionalis, labium, ventral aspect, L4. 34 – Ctenomyda varians, labium, ventral aspect L4 (vs – ventral double sclerite) (scales in mm).

312
Remarks

The larvae of *Brassilia argentina* and *Cylindera (Cylindera) morio* (Klug, 1834) are very similar to the described larva of *C. suturalis*. *Brassilia argentina* is distinguished by the measurements (see Table 1). 2 setae more on anteroneure I and II in second and third instar, and the less sclerotized anterior part of tergite V. The anterior part of tergite V is practically 2-segmented in *B. argentina*, and the median hooks always have 3 setae in second and third instar. *Cylindera suturalis* is more similar to *B. argentina* than to *C. morio*, even though the former two species are placed in separate genera. Contrary to *C. suturalis*, the third instar of *C. morio* has 12–16 setae on abdominal tergites I–IV, the lateral and posterior parts of tergite V are fused completely, and all parts of tergite V are well sclerotized, with the anterior part having 18–22 setae, and the posterolateral part 16–22 spines and 16–22 thinner setae.

Larvae of *C. suturalis* were collected on sandy beaches of the Solimões River near Manaus. Larvae of *C. morio* were collected in areas with sparse vegetation in the Terra Firme forest near Manaus, where the clay soil is covered with a 10 cm deep layer of sand. The larval holes of the third instar are about 15 cm deep and perpendicular.

Larvae of *B. argentina* were collected on a small, dry clay area free of vegetation in the Terra Firme forest near Manaus. The larval holes are very short (only 4 cm in the third instar), and the larvae are associated with those of *Pentacoma ventralis*.

**Key to the second and third instar larvae of Brazilian genera of Cleinidelidae**

REM A R K S: Larval instars can be distinguished by the number of setae on galeomere I: instar III with 3 setae (4 in Megacephalini), instar II with 2 setae (3 in Megacephalini), instar I with 1 seta on galeomere I. First instar larvae of most genera are not distinguishable.

1(2) Head and pronotum slender, not wider than abdomen. Abdominal segment V only slightly enlarged, tergite V with 3 pairs of hooks, median hooks stout, pressed to the body. Legs short, tarsi reduced, claws not distinctly separate from tarsi, larva therefore unable to run on a plain surface. Larval holes in branches of rotten wood

2(1) Head and pronotum wide, distinctly wider than abdomen. Abdominal segment V strongly enlarged in dorsal direction, building a "jumping" tergite V with 2 or 3 pairs of hooks, median hooks slender and not pressed to the body. Legs long, tarsi not reduced with distinctly separate claws. Larval holes in soil

3(6) Gular sutures U-shaped, ventral double scollets on pronotum lacking (Fig. 32). Medium hooks of abdominal tergite V straight or only slightly arched, often spine-shaped on the top (Fig. 2). Antennomeres I and II very thick, 3–5 tergites without antennomeres III

4(5) Pronotum unicicolored, dark, in part with metallic lustre or covered with numerous white and flattened setae. Maxillary palps not potent on outer side... *Megacephalus Lateraldae*

5(4) Pronotum bicolored, medial and anterior parts dark brown with bronze lustre, lateral and posterior margins pearl-white. Setae on pronotum not pale or flattened. Setae on outer side of maxillary palps I lacking

6(3) Gular sutures T-shaped, ventral double scollets on pronotum present (Fig. 34). Medium hooks of abdominal tergite V slender, arched (Figs. 10, 14, 16, 20, 24, 28, 30). Antennomeres I and II not obviously wide; less than 2 times wider than antennomere III

7(10) Abdominal tergite V with 2 pairs of hooks, cornual suture distinct and only slightly shorter than last antennomere, antennomeres I–III of about equal length

8(9) First maxillary palpomere with a small spine apically; antennomeres I and II with 7–8 setae; median hooks with 6–6 (rarely 3) stout setae; posterior margin of sternite IX with 8–10 long setae

9(8) First maxillary palpomere without spine; antennomeres I and II with 4–5 setae; median hooks with not more than 3 stout setae; posterior margin of sternite IX with 6–7 long setae

10(7) Abdominal tergite V with 2 pairs of hooks (Figs. 10, 14, 24, 28, 30), cornual suture very short or absent; antennomeres I and II slightly longer and about 2 times wider than antennomere III
11 (14) All setae on median hooks are stout bristles; apical spine of inner hooks comparable long (Figs 10, 14, 16, 20, 24, 28). Labial palpomere II with 1 seta in basal half of the segment. 

12 (13) Protornism with more than 40 setae per half and a slender keel posterolateral (Fig. 27). Abdominal tergites slightly sclerotized, undistinct. Larval hosts on termite tunnels in the Southern part of Brazil. 

13 (12) Protornism with less than 30 setae per half and without slender keel posterolateral (Figs 9, 15, 25). Abdominal tergites distinct.

14 (11) Most or all setae on median hooks thin and long; apical spine of inner hooks usually shorter than lateral setae (Fig. 30). Labial palpomere II with 1 seta near the middle of the segment.

Acknowledgements

We are deeply indebted to Prof. C. Costa (ZMUP, São Paulo) for loan and gift of valuable larval material. The study was supported by grant No. 23/81-2 and Pa 9915-1, 2, 3, 4 of the German Research Society (Deutsche Forschungsgemeinschaft). We wish to thank very much Prof. C. Costa (ZMUP, São Paulo), M.Sc. M. A. Amorim, Dr. C. Ruy V. da Fonseca, and Dr. C. Martins (INPA, Manaus) for their support during this stay in Brazil. Finally, we thank Dr. D. Polhemus (Washington) for linguistic corrections of the manuscript as well as Dr. P. Cassola (Rome) and Prof. D. L. Pearson (Tempe, Arizona) for the determination of selected species.

REFERENCES


* Larvae of these genera are not to distinguish doubts at general level, see remarks in the description.

314


BOOK REVIEW


The first author is professor at the Chair of special Zoology and Parasitology in Bochum. The other two authors are renowned investigators at the pharmaceutical research of the Hoechst Company in Frankfurt on the Main. As emphasized in the preface, the first edition aroused a great interest. Moreover, Spanish and English translations appeared in print. The names of parasitic diseases are presented here according to the standardized nomenclature of animal parasitic diseases (SNOPAD) published (Proc Zool., 29, 1988, 299-326) by the expert committee, appointed by the Executive Committee of the World Association for the Advancement of Veterinary Parasitology. The volume consists of 11 chapters which are subdivided using the decimal system.

Chapter 1 is intended to give an introduction to laboratory methods for identification of parasites. Microscopical methods cover the preparation and staining of flukes, tapeworms and roundworms. Microscopical methods deal with examinations of blood, saliva, lymph, urine, mucous membrane and tumors, further on with examinations of excretates, etc. sample and feed-stuffs. Antibody tests, with animal experiments (identification in vivo) and sampling specimen to a reference laboratory. Among microscopical methods located at are the anal swabs, wet mounts, concentration techniques, cultivation, stained films, and histological techniques. Chemicals and solutions for the preparation of reagents are also presented here. In the chapters 2 to 11 listed here are the parasites of dogs and cats, of swine, poultry, birds, mammals, etc. The chapters are subdivided into the different life forms, occurring in tissues or in the intestine, in blood, in the saliva, in the urine and in various organs - in the liver, spleen, in the muscle tissue, in the stomach, in the brain and eyes, in the trachea, in the genital and on the body surface in the skin, in hair and feathers. In each chapter keys for determination of parasites are situated.

Parasitic diseases are described in detail in their most frequent host or in place of other most probable findings. In particular parasitic diseases due to protozoa, helminths or arthropods the geographical distribution in Europe, the morphological and biological characteristics of the pathogen and clinical symptoms are listed. Diagnosis includes references to the causative life form of particular parasites and to the diagnostic method. Moreover, listed are the transmission ways, the prophylaxis, prevent and treatment and specific treatment.

The volume is extensively augmented by 206 high-quality line drawings, and light transmission or scanning electron micrographs which characterize the host or parasite animals as a whole or in detail, dissected organs and histological structures. Many of them constitute full-page plates composed of several pictures. In 17 tabular reviews there are instructions for the therapy. This book presents a practical laboratory manual. It is primarily designed for veterinary parasitologists. Moreover, it can be of great value for biologists and medical professionals interested in parasitic diseases and zootechnics.

Jindrich Jina
Larvae of genera *Eurythyrea* and *Phaenops* from Central Europe (Coleoptera: Buprestidae)

Svatopluk Bily

Department of Entomology, National Museum, Kuntnerova 1, CZ–148 00 Praha 4, Czech Republic

Received July 16, 1996, accepted August 8, 1996
Published December 27, 1996

Abstract: Adult larvae of *Eurythyrea austriaca* Linnæus, 1767 and *Phaenops knotecki hellenica* Obenberger, 1944 are described and illustrated. Keys to larvae of both genera from Central Europe are given.

Larvae, descriptions, morphology, keys, Palaeartic region

Although more than 50% of buprestid larvae from Central Europe have been described up to now, only a few papers have dealt with particular genera giving keys allowing a determination of larvae. The first and very poor description of larva of *Eurythyrea* Lacordaire, 1835 was published by Schöder (1870) for the larva of *E. micans* (Fabricius, 1792) (– *E. marginata* Olivier, 1790). Larvae of *E. quercus* (Herbst, 1790) and *E. aurata* (Pallas, 1776) were perfectly described by Volkovitch (1975) and larvae of the whole genus were characterized by Schaefer (1947) and Bily (1994). Larva of the last species from Central Europe, *E. austriaca*, has remained undescribed so far and it is described here.

The first descriptions of larvae of the genus *Phaenops* Lacordaire, 1857 were published by Perris (1854, 1877) and subsequently by Richter (1949) (all for *P. cyanea* Fabricius, 1775). The descriptions are quite insufficient and the first full description of *Phaenops* larva was published by Schaefer (1937) who described larva of *P. formosae* Lavigne-Théry, 1942. The next larval descriptions were published by Alexeev (1964) (*P. cyanea* and *P. guttulata* Gebler, 1830) and the larval characteristics of the genus was published by Bily (1994). A larva of the last species from Central Europe, *P. knotecki* Reitter, 1898, is described in the present paper (*P. knotecki hellenica*).

The present paper is a part of the Grant No. 513/96/0004 of the Czech Grant Agency.

METHODS

Larvae were collected in the field to the Khaol liquid and transferred to 75% alcohol in laboratory. After having studied external structures the larvae were dissected and mouth parts, antennae, spiracles and proventriculus were mounted separately in Swars liquid for microscopical studies.

All material is deposited in the collection of the National Museum, Praha.

The morphological terminology is taken from the papers of Volkovitch (1979), Bily (1994) and Volkovitch & Hawkeswood (1987, 1992).

*Eurythyrea austriaca* (Linnæus, 1767) — adult larva

(Figs 1–19)

Material studied: Slovakia, Nické Tatry Mts., vii.1972, F. Navratil leg., 1 spec. of adult larva from *Abies alba*, the same date, 1 spec. of pupa.
Length of the last instar: 31.0 mm; width of prothorax: 5.9 mm.

Larva is of the usual buprestoid type, whitish with enlarged prothorax, corresponding to the second morpho-ecological type of Buprestid-larvae (Bilby 1982, 1984).

**Head and Mouthparts.** Epistome (Fig. 7) brown, about 10 times as wide as long in the middle, its anterior margin deeply and widely incurved between mandibular condyles which are relatively small with obtuse antero-lateral projections; posterior margin of epistome straight, latero-posterior corners sharp-angled; middle part of epistome with two groups of epistomal sensillae (Fig. 7), each group consisting of one campaniform and two short trichoid sensillae. Clypeus narrow, membranous, nearly straight anteriorly.

Labrum (Fig. 17) slightly transverse, its anterior margin nearly straight, antero-lateral corners obtuse and lateral margins deeply incurved; palantinae sclerites with both branches well-sclerotized; each medial branch bears one campaniform and three trichoid sensillae, each lateral branch bears two trichoid sensillae; there are also two campaniform sensillae situated between lateral and medial branches of palantinae sclerites; ventral surface of labrum (epipharynx) with two longitudinal bands of microspinulae.

Antennae (Fig. 16) two-segmented, situated in the latero-posterior incisure of epistome; first segment broadly cylindrical, slightly bent, not invaginated into basal membrane, about 1.5 times as long as wide; apex of the first segment with a ring of microspinulae surrounding the basis of the second segment and with a large campaniform sensilla on external side; second antennal

![Diagram of larval head and mouthparts](image-url)

Figs 1-6. 1–3: pronotal plates. 1 = *Euphydra australis*; 2 = *E. quercus*; 3 = *E. aurata*. 4–6: prosternal plates. 4 = *E. australis*; 5 = *E. quercus*; 6 = *E. aurata.*
segment 1.5 times as long as wide, slightly enlarged apically with a deep, apical cavity, apex of the 2nd segment with a ring of very fine microspinulae surrounding the apical cavity and with long, trichoid setae, apical cavity contains a sensory appendage, one small basiconic sensillum and two palmate sensilla (Fig 16).

Mandibles (Fig 13) strongly sclerotized, almost black with nearly straight outer margin, apex of mandibles with two obtuse teeth, cutting edge with four small and obtuse teeth.

Labiomaxillary complex. Maxillae cardo membranous with small, well-sclerotized sclerite bearing two long trichoid setae and two campaniform setae, stipites (Fig 15) with less sclerotized inner sclerite and strongly sclerotized, prolonged outer sclerite which bears one campaniform sensilla and one apical seta, next two setae are situated at the base of mala, mala subcylindrical, about 1.5 times as long as wide, bearing 7 long and thick setae and several microspinulae at its apex, maxillary palpus two segmented, first segment short, nearly triangular, bearing long, apical, outer seta, second segment of maxillary palpus conical (Fig 15) with one curved, inner, seta and one campaniform, outer sensilla, apex of segment with several peg-like sensilla and microspinulae.

Labium (Fig. 14) slightly longer than wide with deep medial incision and subparallel lateral margins, corner sclerites of labium feebly sclerotized, prolonged and enlarged anteriorly, enlarged anterior part bearing one long seta and 3 campaniform sensilla, anterior margin and

Figs 7-12. 7  Epistome  7—Eurythrea antennae, 8  E. quercus, 9  E. aurata 10  asperities and microspinulae along the posterior groove of E. antennae, 11—inner structure of proventriculus of E. antennae, 12—same, spines near pylorus.

319
antero-lateral, obtuse angles of labrum bearing short but dense hairs and microsetae; both internal and external surfaces of labrum with a group of microspinulae.

Thorax. Pronotal plate (Fig. 1) with well-developed V-shaped groove, its branches somewhat convergent posteriorly; grooves are surrounded by the field of fine, brown asperities forming net-like structure; space between both branches of V-shaped groove covered with microspinulae, asperities developed only along the grooves (Fig. 10). Prosternal plate (Fig. 4) with well-developed medial groove which is somewhat enlarged anteriorly; surface of plate covered with microspinulae except from two oval and glabrous depressions; brown asperities developed only around apical part of medial groove and at its basis; medial part of groove margined only by one row of asperities.

Rest of prothorax, mesothorax and metathorax covered with dense microspinulae and short and very sparse hairs.

Spiracles. Meso thoracic spiracles (Fig. 18) large, prolonged, about 6 times as long as wide with feebly sclerotized peritreme and with dense trubeculae which are densely branched; abdominal


320
spireacles (Fig. 19) much smaller, reniform, about 2.5 times as long as wide with simple, not branched trabeculae.

**Proventriculus.** Inner surface of proventriculus covered with membranous tubercles bearing small, sclerotized spines (Fig. 11); near pylorus there is a prolonged field of long, sharp and feebly sclerotized bristles (Fig. 12).

**Abdominal segments.** Shortly cylindrical, somewhat longer than wide, covered with microspinitae and sparse, short hairs; anal segment conical without spireacles; abdominal spireacles situated in anterior part of lateral depressions.

**Prepupa.** Pro-, meso- and metasternum of prepupa with rudiments of two-segmented appendages, abdominal segments of prepupa slightly wider than long.

### Key to *Eurythryaeus* larvae from Central Europe

1 (2) Asperities surrounding proventral and prosternal grooves forming net-like structure (Figs. 1, 2); epistome widely incurved between mandibular canydes and nearly straight on posterior margin (Fig. 7), host plant: *Abies alba*

2 (1) Asperities surrounding proventral and prosternal grooves not forming net-like structure (Figs. 2, 3, 5, 6); epistome of different shape (Figs. 8, 9)

3 (4) Epistome with irregularly rounded posterior margin (Fig. 8); mesothoracic spiracle narrow, about 6 times as long as wide, prosternal plate Fig. 2; proventral plate Fig. 5; host plant: *Quercus esp.*; Castanea sativa

3 (4) Epistome with deeply incurved posterior margin (Fig. 9); mesothoracic spiracle shorter, only 3 times as long as wide, prosternal plate Fig. 3; proventral plate Fig. 6; host plant: *Populus spp.*

4 (3) Epistome of *E. australis* (Casteln.)

### Phaenops knoteki hellenica Obenberger, 1944 - adult larva


Length of the last instar: 23.0–25.0 mm; width of prothorax: 4.0–4.5 mm.

Larva is of the usual barkestroid type, whitish or cream-coloured, corresponding to the second morpho-ecological type of Buprestis-larvae (Blay 1982, 1994).

**Head and mouthparts.** Epistome (Fig. 20) dark brown, about 4 times as wide as long in the middle, anterior margin widely and shallowly incurved between mandibular canydes which are large and spherical, with obtuse antero-lateral projections; posterior margin nearly straight with sharp, almost rectangular latero-posterior angles; middle part of epistome with two groups of epistomal sensillae, each group consisting of one campaniform and two short, trichoid sensillae (Fig. 26). Clypeus membranous with straight anterior margin (Fig. 27).

Labrum (Fig. 27) slightly transverse, its anterior margin feebly bimargin, covered with nearly triangular field of fine hairs and microsetae; lateral margins of labrum converging posteriorly, slightly incurved; palatineae sclerites prolonged, their inner branches somewhat less sclerotized than outer ones; each inner branch bears one campaniform sensilla and one bristle apically and four campaniform sensillae at the middle; outer branches bear one apical bristle and one short, trichoid sensilla at the base; between inner branches there is one pair of short, stout trichoid sensillae; antero-lateral corners of labrum with two bristles and several trichoid sensillae; ventral side of labrum (epipharynx) with two longitudinal bands of microspinulae.

**Antennae.** (Fig. 29) two-segmented, situated in the latero-posterior incisure of epistome; first segment somewhat longer than wide and enlarged anteriorly, bearing one large campaniform sensilla on outer margin; apex of the first segment with a shallow cavity which is surrounded by a ring of fine microspinulae; the second segment about 1.5 times as long as wide, distinctly
enlarged apically with deep apical cavity which is surrounded by a ring of microspinulae; anterior margin of the second segment with a long bristle near apex; apical cavity of the second segment contains a sensory appendage, one basiconic sensilla and two palinate sensilla at the bottom.

Mandibles (Fig. 28) black, strongly sclerotized, nearly triangular with slightly arched outer margin; both apical teeth rather obtuse, cutting edge without distinct teeth only with small, obtuse tubercles.

Labiomaxillary complex. Maxillae: cardo membranous with small, oval sclerite bearing two trichoid and one campaniform sensillae; stipites (Fig. 29) somewhat longer than wide and enlarged apically with an apical ring of fine hairs and microspines; outer sclerite with a large campaniform sensilla, inner sclerite with long and thick apical seta; inner margin of stipites with a field of fine bristles and hairs; mala 1.5 times as long as wide, enlarged apically, with 6 long and thick bristles and several apical microspinulae.

Maxillary palp (Fig. 29) two-segmented, the first segment subcylindrical bearing long outer seta and a field of fine hairs on outer margin; the second segment small, conical with short and thick curved seta on inner margin; apex of the second segment with several peg-like sensillae and microspinulae (Fig. 29).

Labium (Fig. 30) membranous, nearly subcordiform with widely rounded antero-lateral corners; corner sclerites of labium slender, feebly sclerotized, somewhat enlarged apically; apical (enlarged) parts of these sclerites bearing three campaniform sensillae and one long, trichoid sensillum; middle part of sclerites with two small campaniform sensillae; anterior margin and antero-lateral corners of labium covered with fine hairs and microsetae, both internal and external surfaces of labium with fields of microspinulae.

THORAX. Pronotal plate (Fig. 20) with its lateral sides slightly diverging posteriorly, posterior margin arched; V-shaped groove well-developed, its branches feebly bent outwards; prosternal plate (Fig. 23) bell-shaped with straight posterior margin, medial groove well-developed; both prosternal and pronotal plates covered with brown, well-sclerotized, transverse asperities (Fig. 35). Rest of thorax covered with dense, fine microspinulae and very sparse, short hairs.

SPIRACLES. Mesothoracic spiracles (Fig. 31) broadly reniform, about twice as long as wide with dense, branched trabeculae; peritreme only feebly sclerotized; abdominal spiracles (Fig. 32) of the same type and shape but smaller.

PROVENTRICULUS. Inner wall of proventriculus covered with dense membranous tubercles bearing short, sclerotized spinae and laminae (Fig. 34).

ABDOMINAL SEGMENTS. Shortly subcylindrical with dorsolateral depressions which bear abdominal spiracles in their anterior third.

Key to Phaenops larvae from Central Europe

1 (2) Pronotal plate narrow, its lateral sides concave (Fig. 22); pronotal plate nearly parallel-sided in anterior half (Fig. 25), host plant Puss spp. ........................................... P. formanekii Lowry & Thöry  
2 (1) Pronotal plate wide, its lateral sides convex or nearly straight (Figs 20, 21); pronotal plate wider, bell-shaped (Fig. 23) or regularly enlarged posteriorly (Fig. 24).

3 (4) Pronotal plate very wide, its lateral sides nearly straight (Fig. 20); pronotal plate bell-shaped with straight posterior margin (Fig. 23), host plant Abies alba, A. cephalonica .. ........................................... P. krzycki hellmanni Oberberger  
4 (3) Pronotal plate narrower, its lateral sides convex (Fig. 21), pronotal plate narrower, nearly pear-shaped, its posterior margin convex (Fig. 24), host plant Puss spp. ........................................... P. cyanus (Fabricius)

REFERENCES


Revision, reclassification and larval morphology of the genus *Paratassa* 
(Coleoptera: Buprestidae: Paratassini tribus n.)

Svatopluk Bily\(^1\) & Mark G. Volkovitsh\(^2\)

\(^1\)Department of Entomology, National Museum, Kamarovice 1, CZ-148 00 Praha 4, Czech Republic
\(^2\)Zoological Institute, Russian Academy of Sciences, Universitetskaya nab. 1, 199 034 Sankt Petersburg, Russia

Received April 19, 1996, accepted June 27, 1996
Published December 27, 1996

**Abstract.** The genus *Paratassa* Marshul, 1882 is transferred from Babassini to Paratassini tribus n. Eight new species are described and illustrated: *P. occidentalis* sp. n. and *P. melitonassensis* sp. n. from Morocco, *P. aurillanthasp. n* and *P. meridianasp. n* from Algeria, *P. tensuasp. n* from Tunisia, *P. aegyptiacaasp. n* from Egypt, *P. armillatusasp. n* from Israel, *P. arubacta sp. n* from Saudi Arabia and *P. orientalisasp. n* from Iran. Larva of *P. corahbiformis* (Fairmaire, 1875) is described and all species are keyed.

**Taxonomy, new species, reclassification, biology, larval morphology, key, Palaeartic region**

The present study was initiated by the discovery of two new species of *Paratassa* in Morocco and the larva of *P. corahbiformis* in Algeria. Having studied both male and female genitalia, we have decided to split this previously monotypic genus into ten species. Moreover, after having studied the larval morphology of *P. corahbiformis* and the antennae of *Paratassa* and related genera, we have decided to remove this genus from its traditional placement in the tribe Babassini and place it in a new tribe, Paratassini, described below.

**MATERIAL AND METHODS**


All species of *Paratassa* are morphologically very similar to each other so only one species (*P. corahbiformis*) is described in detail. The descriptions of new species are shortened in the form of differential diagnosis not to repeat many times the same morphological features.

For the definition of the surface structures of the adults we used the terminology of Hans (1979).

**RESULTS**

The systematic position of *Paratassa*

The type species of *Paratassa* Marshul, 1882, *P. corahbiformis* (Fairmaire, 1875), from „North Africa”, was originally described in the genus *Sphenoecus* Solier, 1833. Later, Marshul (1882) separated it as a distinct genus, which has remained monotypic. Marshul pointed out that the structure of the clypeus, prostem and antennal depressions as the basic diagnostic features. Kerremans (1903) positioned *Paratassa* into the group Buprestis of the tribe Buprestini between *Aristostoma* Thomson, 1879 and *Philanthus* Deyrolle, 1864. In the generic key from that work, Kerremans placed *Paratassa* adjacent to *Buprestis* Laporte & Gory, 1836 and *Euryapillus* Lacordaire, 1857 because of the similarity in the pronotal shape. Based on characters such as the
shape of body and prothorax, pronotal sculpture, disposition of antennal sensory pits, structure of larval claws, elytral apices and scutellum. Obenberger (1920) placed *Paratazza* together with the Australian genera *Bubastes*, *Euryphus*, *Nerodia* Thery, 1910 (= *Bubastes*) and *Neourbya* Thery, 1910 (= *Euryphus*) in the new tribe *Bubastini* *Paratazza* therewith was contrasted with the Australian genera by having the scutellum triangular and pointed apically, posterior pronotal corners not projecting outward, and the antennae broadened from the 4th antennomere, while the Australian genera have the antennae broadened from either the 5th or 6th antennomeres. Later on additional Australian genera of *Bubastini* were described *Strandhola* Obenberger, 1920, *Notobubastes* Carter, 1924 and *Eububastes* Obenberger, 1928. The genus *Casta nella* Obenberger, 1924 (= *Casta nella* Obenberger, 1924 (= *Casta nella* Obenberger, 1923, name praeocc., = *Neobubastes* Blackburn, 1892) was originally placed in this group but was later transferred to the Buprestini by Obenberger (1930). Holynski (1988) regarded *Notobubastes* as a subspecies of *Psiloptera* Solier, 1833 (Psilopterini).

The integration of Australian and Palaearctic genera within *Bubastini* has been followed by all subsequent authors (e.g. Obenberger 1930, Blandy 1985). Moreover, Holynski (1988) regarded *Bubastini* as a subtribe of *Anthaxius*, and then (Holynski 1993) combined it with the tribe *subtribe according to Holynski*) *Thomassetia* Blandy, 1987 (= *Phalanaxina* Holynski, 1988), and even attributing *Nearctic* genus *Chrysolophus* Le Conte, 1860 (*Polycestinae: Polycestinae*) to its composition which does not correspond with our results.

Scanning electron microscope study of buprestid antennae has cast some doubts upon the monophyly of *Bubastini*. The examination of the larvae of Australian genera *Neocesta* Fairmaire, 1877 (Volkovitsh & Hawkeswood 1987), *Amita* Thomas, 1879 (Volkovitsh & Hawkeswood 1993) and *Melobanes* Laporte & Gory, 1837 (Volkovitsh & Hawkeswood 1993), which have been traditionally attributed to *Anthaxius* and *Melanophlum*, has shown that these genera, at least regarding to larval characters, were not closely related to *Holartic*, *Ethiopian* and *Oriental* representatives of indicated tribes. From our viewpoint the external resemblance of adult beetles of Australian and non-Australian genera resulted from parallel evolution and convergence of autochthonous Australian groups (in much the same way as it occurs in the mammals), although there are other than autochthonous taxa in Australian fauna – as a rule they belong to wide distributed genera (*Strongoptera* Dejean 1837, *Chrysochlamyda* Laporte & Gory 1835, *Chrysophorus* Eschscholtz 1829, *Agrilus* Curtis, 1825, etc) with mainly *Oriental* relations. The autochthonous origin of the majority of Australian genera is confirmed with paleogeographic and palaeoclimatic data which point out to the fact of the long-term isolation of Australian biota.

Unfortunately, the larvae of Australian *Bubastini* remain unknown up to date, so our opinion on the polyphylly of this tribe is based mainly on the results of comparative morphological study of antennal sensory formations. Apart from *Paratazza* the antennae of *Neocesta australasiae* (Obenberger, 1922), *Eububastes nickeri* Obenberger, 1928, *Euryphus sp., Bubastes tridentis* Thery, 1910, *Bubastes sp.* ("inconsistans" Blackburn, 1888), as well as of many other Buprestinae and Chalcophorinae genera were studied and compared. It was found that each of these subfamilies is characterized by its own evolutionary trend in specialization of antennal sensory formations, which we called buprestidend and chalcophoroid ones correspondingly. Some separate conditions of morphologies might be partly conserved in both taxa. Chalcophoroid type is characterized by dispersion of peg-like coeloconic sensilla, arising one by one or by groups from small cuticular depressions, over both antennomere's surfaces (Figs 46–51). The further specialization leads to the fusion of separate elements (oligomerization) into either large apical depression, which is usually shifted to internal surface (Fig 53) (Splienopterini, Chalcophorinae).
phorella Kerremans, 1903 and some others), or into numerous small depressions dispersed over both internal and external surfaces. In many cases both types of depressions are presented together. Buprestinoid type is characterized by the presence of singular large apical or subapical depression and field of peg-like basiconic or styloconic sensillae, arising from surface or the tops of cuticular tubercles, on the internal antennomere’s surface only. Sometimes the additional large depressions arise in place of sensillar fields. Coeloonic sensilla are rather rare in occurrence (Fig. 52) (no coeloonic sensillae were found among other Bubastini studied). Further specialization of buprestinoid type of antennae leads to forming of regular in shape subapical (some Buprestini, Stigmoderini, Diocerini, etc.) or apical fossae (Kisentholbin, Anthaxtini, Amtala Thomson, 1879 Neocuris Fairmaire, 1877, etc.) and cavities (Melanophilliini, Melobastis Lopardi & Gory, 1837, Merinna Thomson, 1878, Chrysobothris, etc.).

Comparative morphological analysis has shown that the antennae of Paratassa (Figs 46, 47) belong to chalcophorinoid type while antennal structure of Bubastis (Fig. 52) and other members of Bubastini correspond to buprestinoid one. There is obvious resemblance between sensory formations of Bubastini and those of some other Australian Buprestini, among them Microcesta Heller, 1891 and Buprestinaa d’Ouenberger, 1923. Paratassa is also characterized by the sex-associated variation of antennae, which is manifested itself as a size and form of antennomeres (Figs 46, 47). Otherwise the antennae of Paratassa are markedly similar to those of Namularia

Figs 1-4 Body shape of Paratassa spp 1- P. eucalymnia sp. n., holotype, 8.9 mm 2- P. tenuispp. n., holotype, 7.3 mm 3- P. acuminitus sp. n., holotype, 5.5 mm 4- P. orientalis sp. n., holotype, 6.4 mm.
Casey (Figs 48, 49), Amplheremus Fall, 1917 (Figs 50, 51), Sphenopterini (Fig. 53), Chalcoplia Thomson, 1881 and some other genera of Catoxanthini and Chalcophorini. Among Sphenoptera the change may be observed from undifferentiated, irregular subapical fossae (S (Sphenoptera) Volkovith Kalandian, 1994, Genesys Thery, 1923) to well differentiated, regularly round fossae (Fig. 53) (S. (Sphenoptera), Evagoras Kertesz, 1893, Armenosoma Waterhouse, 1887). The antennal sensory formations of above-mentioned genera correspond to mostly generalized, primitive condition of chalcophoroid type, which is characterized by antennomeres transversely broadened, mainly singular sensillae more or less evenly dispersed over surface, and poorly differentiated, irregular subapical fossa. By this means the similarity of antennal structure of these genera based on a symplesiomorphy.

In regard to larval structures, Paratassa is characterized by the set of autapomorphies, which correspond to most primitive conditions of some characters among Chalcophorinae and Buprestinae. They are as follows: the absence of developed apical cavity on the top of 2nd segment of antennae (Fig. 35) (this condition is characteristic of agroloid taxa), palatine sclerites of labrum (Fig. 36) with poorly developed lateral branches (Fig. 36, lb) and, on the other hand, well-developed median branches (Fig. 36, mb) (among the known larvae the similar condition was found in Kisanthobiza only), poorly developed armature of external surfaces of labrum and labium, consisting only of microsetae along the anterior margin (Figs 36, 38) (similar condition is characteristic of some Polycestinae while Acanthoderini and Anthaxini have labrum and labium completely glabrous externally). The presence of long bristles on the postmentum (Fig. 38, ps) (the same was found in Australian Prosphera Thomson, 1878, Neocurus Fairmaire, 1877 and Melobas Laporte & Gory - these bristles are strongly reduced or absent in all the other known representatives of buprestoid complex). Spiracles without inner trabeculae (Figs 39, 40) correspond to intermediate condition from un- and multineurrate spiracles of many Acanthoderini, as well as Prosphera Solier, 1833 and Thricophyge LeConte, 1837 to ones of general buprestoid type, which are characterized by slot-like peritreme (Fig. 39) and strongly branching, abundant inner

Figs 5-10 5 - male antenna of P aurulenta sp. n. 6 - scutellum of P. aurulenta sp. n 7 - the same, P. corymbiforme (Fairmaire) 8 - the same, P. occidentalis sp. n 9 - aedagus of P. aurulenta sp. n, dorsal view 10 - the same, lateral view
trabeulate. Prothoracic plates have no sclerotized tubercles or asperities and they are incompletely covered only with homogenous micromegethes together with vast glabrous areas (Figs 41-43) (similarly to *Thricopycye and Proptebad*)

As for the possible relationship of *Paratassa* to other buprestid taxa besides the resemblance in antennal structure, the following characters should be noted: only vaguely resemblance in the structure of pronotal grooves with *Neolutara*, Sphenoptera and some other Chalcophorinae, obvious similarity in the shape of labrum and labium with *Nanularia* (but the latter clearly differs by microspinulatated external surfaces of both labrum and labium, and palantine sciclet of labrum with normally developed lateral branches) *Nanularia* also differs by absence of projections on the posterior margin of epistome and disposition of epistomial sensillae, prothoracic plates evenly covered with micromegethes, and some other features.

In conclusion it may be said that by the antennal structure and larval features *Paratassa* is characterized by the set of autapomorphies and occupy the isolated position at the base of the chalcophoroid lineage of buprestoid complex, having some vague resemblance to *Nanularia*, though their close relationship is rather doubtful. From our viewpoint *Paratassa* should be separated as a distinct tribe Paratassini tribe now of the same status as Sphenoptera

*Paratassa* Marseul, 1882

*Type species* *Sphenoptera caroli* Marseul, 1882 168

**Description** Medium-sized, cylindrical, very convex species with metallic colouration (Figs 1–4) golden green, blue-green, coppery-bronze or reddish-bronze. Ventral side usually covered with more or less developed whiteomentum. Frons and lateral pronotal margins with short, promont disc and elytra with very short, white and sparse pubescence. Ventral side with sparse but long and semi-erected, white pubescence.

Head rather large, frons shallowly depressed, flat or slightly convex, vertex convex. Epistome very wide with broadly and shallowly incurved anterior margin. Eyes small, elliptical, not projecting beyond outline of head. Antennae long, reaching posterior pronontal angles in male, distinctly shorter in female. First antennal segment very long, bent or nearly straight, sometimes slightly claviform. Segments 4–10 very enlarged in male, moderately enlarged in female, always wider than long (Fig 5). Sculpture of head consisting of rounded, deep and dense cup-like punctures (densely foveolate according to Harris 1979).

Pronotum 1.20–1.35 times as wide as long, very convex, sometimes nearly ball-shaped. Anterior pronotal margin regularly arched or distinctly lobate, posterior margin straight with two lateral incursions at posterior angles (Figs 1–4). Lateral pronotal margins regularly rounded in anterior half, straight or slightly incurved in posterior half, sometimes pronotum a little bell-shaped. Very rarely there are two small, rounded and shallow depresions on the disc. Pronotal sculpture consisting of rounded or transversely slightly enlarged, deep punctures (densely foveolate) of the same type as those on head. These punctures form rather often transverse wrinkles on basal half of pronotum (striae). Pronotum bordered by fine, sharp keel reaching from posterior angles as far as to anterior angles. Scutellum subcircular with long and sharp posterior apex. Anterior margin of scutellum nearly straight or more or less incurved (Figs 6–8).

Elytra 1.7–2.0 times as wide as humeral part with well-developed humeral swellings, subparallel or distinctly wedge-shaped (Figs 1–4). Each elytron rounded separately, sometimes elytra with traces of longitudinal grooves. Subhumeral lobe large, reaching the level of hind
coxae, epipleurae missing. Elytral sculpture (foveolate: Harris 1979) consisting of deep and large, cup-like punctures, sometimes with slight transverse wrinkles on humeral part. Lateral margins of elytra very feebly serrate at apical third.

Ventral side of prothorax roughly, abdominal sternites finely punctured. Prosternum margined anteriorly, prosternal process wide and convex. Anal sternite widely rounded in both sexes. White tomentum covering ventral half of most species is well-visible only in fresh and well-preserved specimens (except *P. auriculata* sp. n. where the tomentum is very thick and stable). Legs rather short and slender, tarsi very long, usually as long as tibiae, only posterior tarsi distinctly shorter than tibiae. Anterior tibiae straight or slightly arched on outer margin in male, with large and sharp grains or small spines (Figs 28–30).

Aedeagus (Figs 9–19) flattened, somewhat spatulate, very often Y-shaped or V-shaped, ones or twice dorso-laterally bent (lateral view). Ovipositor (Figs 20–27) short and rather sclerotized with well-developed outer pubescence and terminal setae.

Bionomy. All species of the genus seem to be associated with desert and semidesert Brassicaceae (genera *Oudheira*, *Diplotaxis*, *Lunaeza*, *Morticandia*, *Crambe*, *Lepidum* etc.). Larvae take their development in roots of these plants, flying holes are usually situated at the level of soil surface. The general form of ovipositor indicates ovipositing at the base of plant through the layer of sand or soil. Adults are not good flyers, flying usually only on short distance during the warmest hours of the day.

Distribution (Fig. 31). The genus is distributed from Morocco to south Iran, inhabiting desert and semidesert regions usually in lower elevations (except *P. occidentalis* sp. n. and *P. mediterranica* sp. n. occurring on mountain steppes of the High and Middle Atlas).

### Key to species of *Paratassa*

1. (2) Promontum finely granulated in posterior half, grains are somewhat transverse on prosternal region. Anterior margin of scutellum deeply recessed (Fig. 6). Anterior male tibia distinctly bent and shorter than tarsi (Fig. 28). Golden-bronze or red-bronze species. *Aegeus caspicus* sp. n., *Aegeus P. auriculata* sp. n.
2. (1) Promontum with rather deep, rounded or oval punctures which are sometimes changed into transverse wrinkles on prosternal region. Anterior margin of scutellum straight or feebly in curved (Figs 7, 8). Anterior tibiae almost straight (Figs 29, 30), as long as tarsi or slightly longer. Golden green, blue-green, rarely bronze-green species
3. (8) Body stout, short and robust, elytron only 1.7–1.8 times as long as wide at humeral part (Figs 2, 3); pronotum very convex
4. (5) More acuminate species, fromo with shallow and wide depression (Fig. 3). Elytron with slight traces of longitudinal grooves. Bronze-green or blue-green, lustrous species. *Aegeus caspicus* sp. n., *P. auriculata* sp. n., *P. occidentalis* sp. n., *P. mediterranica* sp. n.
5. (4) Shorter, subparallel and more robust species, fromo flat or very slightly depressed (Fig. 2). Elytron without any traces of longitudinal grooves
6. (7) Smaller species, lateral pronotal margins straight in posterior half (Fig. 2). Sculpture of basal half of pronotum consisting of regular, slightly transversely elongated punctures. Blue-green, rather dark and matt species. *Aegeus caspicus* sp. n., *P. auriculata* sp. n., *P. occidentalis* sp. n., *P. mediterranica* sp. n.
7. (6) Larger species, lateral pronotal margins slightly recurved before posterior angles. Basal part of pronotum with transverse wrinkles between prosternal part and posterior angles. Matt, bronze-green species. *Aegeus caspicus* sp. n., *P. auriculata* sp. n., *P. occidentalis* sp. n., *P. mediterranica* sp. n.
8. (3) Body more slender and less robust, elytron 1.6–2.0 times as long as wide at humeral part (Figs 1, 4). Pronotum less convex, rarely with two, small, indistinct and rounded depressions on anterior half
9. (14) Elytron with or without marginal sutures (Fig. 4). Golden-green, rarely blue-green species with golden luster
10. (11) Elytron flat, the widest part of pronotum at base, pronotum very slightly bell-shaped. Male protuberance on outer margin (Fig. 20). *Aegeus caspicus* sp. n., *P. auriculata* sp. n., *P. occidentalis* sp. n., *P. mediterranica* sp. n.
11. (10) Elytron convex, without marginal sutures (Fig. 4). *P. auriculata* sp. n., *P. occidentalis* sp. n., *P. mediterranica* sp. n.
11 (10) Frons slightly convex (Fig. 4), lateral pronotal margins subparallel or nearly subparallel, male prothoracic more convex on outer margin (Fig. 29)  
12 (13) Lateral pronotal margins nearly subparallel in posterior half and less rounded at anterior half (Fig. 4). Sculpture of posterior half of pronotum consisting of regular, rounded or slightly transverse punctures. Blue-green, rather narrow species with indistinct golden lustre. Aedeagus Fig. 14, ovipositor Fig. 24. 6.5–8.2 mm. SW Iran.  P. orientalis sp. n.  
13 (12) Lateral pronotal margins parallel in posterior half, posterior angles somewhat prominent. Anterior half of pronotal margins strongly rounded. Punctures on posterior part of pronotum transversely furred, forming short wrinkles. Golden green, more hexagonal species. Aedeagus Fig. 19, ovipositor Fig. 23. 6.5–8.0 mm. S Algeria (Tassili M'zab).  P. meridionalis sp. n.

Figs 11–19. Aedeagi of Paratissia spp. (dorsal view — left, lateral view — right). 11– P. corneaformis (Poirier) 12– P. occidentalis sp. n. 13– P. medivitacea sp. n. 14– P. orientalis sp. n. 15– P. acuminata sp. n. 16– P. arctica sp. n. 17– P. gigaspinosa sp. n. 18– P. tunnelata sp. n. 19– P. meridionalis sp. n.
Medium-sized, subcylindrical and lustrous species, dorsal side blue-green, golden green sometimes with golden tinge. Ventral side golden green, less lustrous. Head and lateral pronotal margins with short, white pubescence, disc of pronotum and elytra with very short, white pubescence. Ventral side and legs with rather long and sparse, white pubescence, ventral side usually covered with white setae.

Head rather large, frons flat or shallowly, triangularly depressed between eyes. Clypeus very broad, its anterior margin widely and shallowly incurved. Eyes very small, widely elliptical, not projecting beyond outline of head. Antennae long, reaching posterior pronotal angles in male, slightly shorter in female. First antennal segment very long and slightly bent, somewhat claviform, second segment very short, almost spherical, third segment twice as long as wide, slightly angular. Segments 4–10 enlarged, 1.5 times as wide as long, somewhat oval-shaped in male, last segment pear-shaped in both sexes. Sculpture of head consisting of small, deep, rounded and very dense cup-like punctures.

Pronotum strongly convex, slightly bell-shaped, 1.3 times as wide as long with broadly arched anterior margin. Posterior margin nearly straight in middle and widely incurved near posterior angles. Lateral pronotal margins rounded in anterior half, nearly straight in posterior half and slightly incurved before posterior angles. The widest part of pronotum at the base. Pronotal sculpture consisting of punctures which are similar to those on head but not so dense, punctures on posterior half of pronotum somewhat transversely enlarged forming sometimes short wrinkles. Scutellum subcordiform (Fig. 7), slightly incurved anteriorly, prolonged and sharply pointed apically.

Elytra very convex, subcylindrical, 1.9–2.0 times as long as wide at humeral part, humeral swellings small but well-developed, each elytron separately rounded apically and very finely serrate in posterior third. Elytra deeply, irregularly punctured, punctures became finer and smaller towards elytral apex. The widest part of elytra at humeri, else elytra slightly tapering posteriorly to the apical two-thirds. Posterior third of elytra nearly straightly tapering to their tips, elytra with slight traces of longitudinal grooves.

Ventral side deeply and densely punctured, last abdominal sternite widely rounded in both sexes. Legs long and slender, all tibiae of both sexes sharply granulated, nearly serrate on outer margin (Fig. 29). Tarsi very long, anterior and middle tarsi as long as tibiae, posterior tarsi slightly shorter.
Anceagus (Fig. 11) enlarged, spatulate, basal part of parameres conspicuously bent (lateral view) Ovipositor Fig. 25

Length 6.5–10.0 mm, width 1.6–3.0 mm

Sexual dimorphism Female differs from male only by shorter and less enlarged antennae and usually by larger size

Biological Larva develops in roots of Launaea arborescens, according to Théry (1930) also in Monandria arvensis (Brassicaceae)

Distribution (Fig. 31) Northern Algeria, Tunis

Note Théry (1930) studied the type specimen of Paratassius coraeiformis (MCSN) and compared it with the type of P. caroli (MNHN) and he did not find any differences and supposed them to be conspecific. We have studied the type in MNHN and also according to the Marseul's description (Marseul, 1882) there is no doubt about the conspecificity of both species

Material examined Algeria: Bou Saada, 3 vi 1987, S. Bily and V. Kubat leg (23 spec.), Guerda 2 vi 1987, S. Bily leg (2 spec.), El Glas, 5 vi 1987 (5 spec.), Oumacha, Dr. Martin leg (1 spec.), Berka, Dr. Martin leg (7 spec.), Am Sefta, Thery leg (2 spec.), Birani, v 1985, L. Blais leg (5 spec.), Am Sefta, Bir-enna, 30 vii 1986 (11 spec.), Bihar, Marrakes, 5 vi 1986 (1 spec.), Bata El Kandara, 29 vi 1986 (6 spec.), Algeria (without more detailed data) 23 spec Tunes, Tarragha, A. Kerim leg (1 spec.), Tunis (without more detailed data) 3 spec

Description of larva

**Material examined:** 2 larvae and 1 prepupa. Algeria, Ghadames, 2 v. 1987, ex *Launaea arborescens*, S. Bily leg. (2 larvae) Algeria, Ghadames, 2 v. 1987, ex *Launaea arborescens*, V. Koblentz leg. Specimens deposited at ZMAS and NMPC.

Length of different instar larvae 10.9 – 16.9 mm. Larva (Fig 41) is of the usual pupated type with moderately enlarged prothorax, corresponding to the 2nd morpho-eccological type of *Acmacoderella* larva (Volkovitch 1979). Body of preserved larvae white to dirty-cream with brownish mouthparts and spiracles. Segments of prepupa are distinctly transverse while larval segments are longitudinal.

**Head and mouthparts:** Epistoma (Fig 32) about 4.5 times as wide as long. Anterior margin slightly angularly emarginated between the mandibular condyles which are large, bearing strong antero-lateral projections (Fig 32, ep) and deep emarginations between these projections and mandibular condyles. Posterior margin deeply bisinuate, latero-posterior corners blunt, weakly obtuse-angled, nearly rectangular and projecting. Lateral margins with deep, oblique anterior incisure, epistome bearing 2 groups of 3 epistomial sensillae (Fig 32, es) arranged in a trapezoid shape divided by sclerotized strip in the middle. Each group consists of 3 short trichoid and 1 campaniform sensilla, the latest disposed slightly above and middleward anterior pair of trichoid sensilla. Clypeus (Fig 36) narrow, membranous, glabrous, with anterior margin nearly straight.

Labrum (Fig 36) slightly transverse, its anterior margin slightly convex between angularly rounded antero-lateral margins, without lateral lobes and with slightly curved, nearly parallel sides. Palantine sclerites large, well marked, transverse, with strong sclerotized median branches (Fig 36, mb) (terminology follows Volkovitch & Hawkeswood 1995) and hardly developed, weakly sclerotized lateral ones (Fig 36, lb) which are not jointed each other. Each of median branches bearing dorsally 3 median sensillae of labrum (Fig 36, msl). 1 long apical seta which extends the anterior margin of labrum and 2 campaniform sensillae situated below apical setae posteriorly of midline of labrum almost on the same level. The distance between apical seta and both campaniform sensilla almost equal. Antero-lateral sensillae (Fig 36, asl) includes 3 sharp seta and 1 campaniform sensilla externally and 3 blunt setae near the antero-lateral margin and 1 campaniform sensilla on each side internally. External sensillae arranged as follows on either side: one seta and campaniform sensilla situated next each other just above the apices of median branches of palantine sclerite, 1 sharp seta near the antero-lateral corners of labrum and 1 sharp seta on the lateral branches near their apices. The position of antero-lateral sensillae is as follows:

\[(1, 2c) + 3l + 4\]

\[1h + 2t = 3l + 4c\]

with external sensillae designations in the numerator and internal ones in the denominator. (1, 2, 3, 4, 5, 6, 7) – the ordinal number of sensilla from most median to lateral ones, which may be not homologous in different taxa: 1 – trichoid, 2 – campaniform sensilla, 3 – with fused bases, 4 – with closed bases, 5 – with distal bases, 6 – with distant bases see Volkovitch & Hawkeswood 1995). External surface of labrum also with narrow transverse band of microsetae along the middle of anterior margin, with almost straight posterior margin which is situated about 1/4 the distance from the anterior margin of the labrum to the bases of apical median sensilla, remaining surface glabrous. Labrum ventrally (epipharynx) with narrow, almost subparallel bands of microspinulae extending from the anterior margin to the base of the labrum and surrounding the pharynx.

Antennae (Fig 35) two-segmented, situated in the deep postero-lateral incisure of epistome. Articulae membrane glabrous, not forming a cover around 1st segment which is only hardly...
envaginated to membrane with its basis. First segment broadly cylindrical, slightly broadened toward the apex, hardly longer than segment 2, about as long as wide, strongly sclerotized. First segment with a narrow fringe of rather dense microspinulae along the anterior margin surrounding the basis of the 2nd segment, with a campaniform sensilla externally approximately in the middle and another one internally near the apex and external margin. Second segment cylindrical, slightly longer than wide with glabrous anterior margin, with very long sharp trichosensilla which is approximately 2 times longer than the length of 2nd segment and with practically undeveloped apical cavity. The apex of 2nd segment partly covered with membrana anteriorly, bearing a sensory appendage (Fig. 35, sa) (often regarded as 3rd antennal segment) extending outside the membrana, and basiconic sensilla (Fig. 35, bs) at its basis - both structures are situated on the apex of tubercle. There are also 2 small palinate sensilla next to the basis of tubercle.

Mandibles (Figs 33, 34): almost black at anterior half, lighter at the basis, strongly sclerotized, broadened at the basis, triangular and nearly as long as wide. Cutting edge with 6 markedly developed teeth, apical tooth is the biggest, sharpened at its apex. Ventral edge bearing 2 teeth situated on the common basis, dorsal edge with 2 teeth situated on the common basis and with a little additional tooth below them.

Hyponotome. Slightly sclerotized except for condylar recesses to attaching of mandibles, bearing singular trichoid and campaniform sensilla situated on the different levels. Pleurostome bearing weakly sclerotized structures which are supposedly the ocelli (Fig. 32, o).
Labiomaxillary complex (Figs 37, 38) Maxillae (Fig 37) Maxillary cardo membraneous glabrous, with 2 long, sharp setae and one campaniform sensilla situated on a distinct, isolated, rather large and well sclerotized sclerite (Fig 37, isl) in the posterolateral corners near the cardo basis. Stipes with a strongly sclerotized internal sclerite bearing one campaniform sensilla closer to external margin, one very short sharp seta near the latero-external margin above the anterior margin of internal sclerite and one long sharp seta near the anterior margin below the basis of maxillary palpus, extending to about a half of 2nd segment. Anterior margin externally with a fringe of rather long, sharp microsetulae arising from membranous tubercles, denser on the external corners. Stipes internally with short and sparse microsetulae along internal and anterior margins, extending to the male. Maxillary palpus two-segmented. Basal segment strongly sclerotized, nearly triangular bearing a long, sharp seta arising from near the antero-lateral corner, not extending the apex of segment 2, and a campaniform sensilla situated closer to the middle of external margin. Anterior margin with sparse, rather short microsetulae arising from the membranous tubercules. Second segment elongate, about 1.5 times longer than wide. Markedly sclerotized, with one long modified and curved sensilla (Fig 37, cs) internally, one campaniform sensilla externally, and about 7 small conical sensory structures (Fig 37, sc) at its apex. Male markedly sclerotized with a broad internal sclerite, almost rectangular and parallel-sided, about 1.3 times as long as wide. Male externally with one campaniform sensilla at the middle, 2 long sharp setae near the apex and 2 closed and short, peg-like sensilla at the apex. Internally male bears 6 long, thick spinae situated along the anterior and internal margins and very sparse microsetulae.

Labium (Fig 38) slightly transverse, prementum about 1.4 times as wide as long with markedly margined anterior margin, broadly rounded antero-lateral corners and feebly emarginate lateral sides. External surface of prementum glabrous except for narrow zone of dense microsetae along its anterior margin. Internal surface with the same microsetae at the anterolateral corners and sparse microsetulae along the lateral sides. Corner sclerites of prementum (Fig 38, esp) each bearing one long, sharp, anteriorly directed setae extending the anterior margin and 5 small, campaniform sensilla. Postmentum with 2 long, sharp setae (Fig 38, ps) extending the posterior 1/3 of corner sclerites of prementum.

Thorax (Figs 41–43) Pronotal and prosternal plates poorly developed, irregularly covered with dense homogenous and feebly sclerotized microsetae, arising from the membranous tubercule (Figs 41 e, 42, 43, mz) and sparse, short bristles (Fig 41, f) which are most dense on prosternal plate. Pronotum with glabrous areas surrounding the anterior part and the apices of branches of pronotal grooves (Fig 42, gc) Prosternum with a vast glabrous area around the anterior part of prosternal groove and two oblique, variable, glabrous zones beginning from vast area and nearly reaching the basis of prosternal plate (Fig 43, gc) Sides of prothorax with transverse microsetulose zone anteriorly (Fig 41, a), remaining parts glabrous with sparse bristles (Fig 41, c) Anterior prothoracic membrane irregularly covered with microsetulae forming the transverse zone and sparse bristles (Fig 41, b) along the anterior margin. Microsetulae poorly developed at the middle (Fig 41, a) Sides of prothorax, posteriorly of microsetulose zone, glabrous with sparse bristles (Fig 41, c) Prothoracic grooves (Figs 42, 43) brownish, markedly sclerotized. Pronotal groove (Fig 42) inverted Y-shaped forming a sharp angle, moderately or strongly sclerotized with strongly umbrella-like broadened, yellowish or brownish apical part divided into 2 slightly curved, closely situated branches in anterior 1/3. Prosternal groove (Fig 43) narrow, unramous, irregularly sclerotized, yellowish or brownish, strongly umbrella-like broadened at the apical part and angularly broadened at the basis, divided there into two hardly sclerotized transverse branches.
Figs 32-40 Larva of *Paratassa corniciformis* (Furamae), mouth parts and spines. 32 - epistome (ep - epistomal sensilla α-β cells) 33 - right mandible 34 - left mandible 35 - right antenna (ba - basiconic sensilla, ps - palpalate sensilla, sa - sensory appendage) 36 - labrum (asl - anterior lateral sensilla of labrum, lb - lateral branch of palpamere sclerite, mb - median branch of palpamere sclerite, ml - median sensilla of labrum) 37 - right maxilla (es - curved sensilla, ss - isolated sensilla of cardo, se - sensory cone) 38 - labrum (cap - corner sensilla of prementum, ps - postmental seta) 39 - right thoracic spiracle (cas - closing apparatus, p - prementum) 40 - right abdominal spiracle
Mesothorax without distinct ambulatory pads on both surfaces, nearly completely covered with microspinulæ except for areas around the spiracles and transverse strip at the base.

Metathorax with poorly marked glabrous ambulatory pads on the both surfaces, remaining surface microspinulæ. Thoracic segments without rudiments of legs, with sparse, short bristles (Fig. 10, c) which are denser and longer on the lateral margins.

**Abdomen (Figs 41, 44).** Abdominal segments longer than wide, flattened with longitudinal, depressed zones laterally.

The first segment with distinct ambulatory pads ventrally, divided into three small tubercles (Fig. 44) with triangular membrane covered with poorly developed microtubercles between them. Segments 2-9 without ambulatory pads, irregularly covered with poorly developed microspinulæ and sparse, short bristles which are denser on the lateral margins than in the middle.

**Spiracles** (Figs 39, 40). Thoracic spiracles (Fig. 39) nearly lenticulate or irregularly ovoid, about 1.7 times as long as wide, with markedly developed and weakly sclerotized peritremæ and without any trace of inner trabeulæe. Peritremæ (Fig. 39, p) bearing a few chinked slots arranged nearly parallelly to each other and bordered with narrow, strongly sclerotized zones. The closing apparatus of spiracle (Fig. 39, c) only weakly sclerotized.

Abdominal spiracles (Fig. 40) very variable, circular, oval or irregular in shape, about 1.4 times as long as wide. They differ from the thoracic spiracles only in their shape and size.

**Proventriculus** (Fig. 45). The morphology of the inner fields and their armature are rather ordinary. The armature includes microspinulæ, microsetæ and well-developed, sclerotized microtæeth situated mainly one by one on the apices of scale-shaped tubercles with sclerotized bases. The groups of microspinulæ, microsetæ and microtæeth form a complicate pattern. Glabrous areas are rather broad, additional fields poorly developed.

The main diagnostic characters of *Paratassa*-larvae allowing clearly distinguish them from any other known buprestid-larvae are as follows: epistome (Fig. 32) bearing strong antero-lateral projections (Fig. 32, ep) and deep emarginations between these projections and mandibular condyles as well as epistomial sensillæ arranged in shape of trapeze (Fig. 32, es); palatinate sclerites of labrum (Fig. 36) with well-developed, strong sclerotized median branches bearing the posterior projections (Fig. 36, mb) and hardly developed, weakly sclerotized lateral branches (Fig. 36, lb), medial and lateral branches not jointed each other (the similar situation is found in *Risanohobia* only — in other buprestoid taxa the lateral branches are developed much better than medial ones, jointed to them and bearing posterior projections; the medial branches usually weakly sclerotized and without posterior projections); 2nd segment of antennæ with practically undeveloped apical cavity (Fig. 35) bearing sensillæ organs (Figs 35, bs, ps, sa) on its apex which is anteriorly only partly covered with membrane (this condition is characteristic of agriloid taxa); spiracles without any trace of inner branched trabeulæe, with peritremæ bearing a few chinked slots arranged nearly parallelly to each other (Figs 39, 40) (by their structure the spiracles of *Paratassa* bear a superficial resemblance to the spiracles of *Pisosima* (Bily 1972) and *Thrincopege* (Bily 1986) occupying the intermediate position between those and spiracles of general buprestoid type which is characterized by cancellate peritremæ and strongly branched inner trabeulæe); prothoracic plates incompletely covered with homogenous microtæeth (Figs 41-43) which remains glabrous areas surrounding the grooves and two oblique, variable and glabrous areas on prosternal plate (Fig. 43).

Additional diagnostic characters are as follows: mandibles with 6 strongly developed teeth on the cutting edge (Figs 33, 34), the external surface of labrum and labium which are mostly glabrous (Figs 36, 38) except from narrow strips of microsetæ along the anterior margin, the presence of long bristles on the postmentum (Fig. 38, ps) and the armature of proventriculus (Fig. 45).
*Paratassa occidentalis* sp. n.
(Figs 1, 8, 12, 21)

Diagnosis. One of the largest species of the genus. Blue-green species with golden tinge which is more distinct on elytra than that on pronotum. It differs from other species of the genus by large, nearly parallel body, widely depressed frons (Fig. 1) and first of all by the shape of aedeagus (Fig. 12). Anterior margin of scutellum is nearly straight or very slightly incurved, elytra 1.9

---

Figs 41-45. Larva of *Paratassa conoidea*. 41 - larva, dorsal view (16.9 mm), 42 - proanterior groove (gz - glabrous zones, mz - microtoothed zones), 43 - prosternal groove (gz - glabrous zones, mz - microtoothed zones), 44 - left ambulatory pad of 1st abdominal segment, ventral view, 45 - section of proventriculus showing different types of its inner armature.
times as long as wide with fine but distinct, longitudinal grooves which are hardly visible or missing in other species. Ventral side with sparse, white tomentum only on meso- and metasternum, abdomen without tomentum only with long, sparse, white pubescence.

Aedeagus (Figs 12, ovipositor Fig. 21.

For the differential diagnosis see the key.

Length: 7.0–10.0 mm (holotype 8.6 mm), width: 2.2–3.0 mm (holotype 2.9 mm).


Holotype and allotype deposed in NMPC, paratypes in NMPC, coll. Rušek, Fyman and Pokorný (Prague), Nieder (Alsweiler) and Mühls (Munich).

Bionomy. All specimens were collected by sweeping of Crambe filiformis (Brassicaceae) in the elevation about 2500 m, larva takes its development in the carrot-like roots of this plant.

Name derivation. The specific name indicates the most western distribution of the genus.

Paratassa medioatlantica sp. n.

(Fig. 13)

Diagnosis. Small and very slender species, very similar to P. occidentalis sp. n. from which it differs, besides smaller and more slender body, by less depressed frons and by somewhat longer elytra (2.0 times as long as wide) without any traces of longitudinal grooves. Ventral side quite without white tomentum.

Aedeagus (Fig. 13) with nearly Y-shaped parameres with straight outer margins (x laterally convex parameres in P. occidentalis sp. n.). Female unknown.

For the differential diagnosis see the key.

Length: 5.0–6.4 mm (holotype 5.0 mm), width: 1.7–2.1 mm (holotype 1.7 mm).

Material examined: Holotype (male). Morocco, Middle Atlas, Azrou, 7 vi. 1995, S. Pokorny leg. Paratypes (3 males). The same data (J. Ramsauer leg.)

Holotype and allotype deposed in NMPC, paratypes in coll. J. Ramsauer (Šišurova, Slovakia).

Bionomy. Also type specimens of this species were collected by sweeping of Crambe filiformis (Brassicaceae) which is the host plant of this species.

Name derivation. The specific name is derived from the locality: the Middle Atlas.

Paratassa meridionalis sp. n.

(Figs 19, 23)

Diagnosis. Rather large, golden green species with moderately acumined elytra which are 1.95–2.0 times as long as wide. Frons convex, scutellum only very slightly incurved anteriorly. Lateral pronotal margins nearly parallel in posterior half, posterior pronotal angles slightly prominent. Ventral side completely covered with white tomentum.

Aedeagus (Fig. 19) with nearly subparallel parameres, rather differing from other species of the genus. Ovipositor Fig. 23.

For the differential diagnosis see the key.

Length: 6.5–8.1 mm (holotype 6.5 mm), width: 2.1–3.1 mm (holotype 2.1 mm).

Material examined: Holotype (male) Tassili orient., Amgueli, 27 april 1928, Pansett. Allotype (female) Tassili n’Ajjer, Tamri, 1700 m, 6-8 v. 1987, M. Škopik leg., coll. Lambeleg. Paratype (male). The same data as allotype (P. Navrátil leg.)

Holotype deposed in NMPC, allotype in coll. M. Škopik (Znojmo), paratype in coll. P. Navrátil (Brno).
Figs 46–49. Antennal structures. 46—*Pareatassa coraeiformis* (Fairmaire), 8–11th segments of male, internal view, ×170. 47—the same, female, ×200. 48—*Nenularis brunnea* Knall, 7–11th segments of male, internal view, ×100. 49—the same, ×3000.
Figs 50-53. Antennal structures. 50- *Amphivenus cylindricollis* Fall, 6-11th segments, internal view, ×250. 51- the same, 6-8th segments, ×500. 52- *Bubastes* (?*inconstans*), 6-11th segments, internal view, ×170. 53- *Sphenopteru* (s. str.) *glaibrata* Ménétriés, 7th segment, internal view, ×400.
**Paratassa aurulenta** sp. n.

(Figs 5, 6, 9, 10, 20, 28)

Keremans (1903) mentioned under *P. coroebiformis* also *var. aurulenta* Théry,*"* without any comment. Théry (1930) published *var. aurulenta* Chabaut and mentioned that his authorship in Keremans (1903) is wrong. In the collection of MNHN there is a specimen labelled *"aurulenta" Chabaut* but Chabaut had never described any variety or species in the genus *Paratassa*. Neither Keremans (1903) nor Théry (1930) described this variety (Théry only indicates the locality: Gardaia) so we suppose it to be a nomen nudum. Because we suppose this form to be a distinct species and we have found in various collections several specimens determined as *"aurulenta"* with Chabaut, Keremans or Théry as authors, we preserve the name *"aurulenta"* for this new species to avoid any confusion in the future.

**Diagnosis.** The largest and most robust species of the genus. Due to its size, bright red-coppery colouration and pronotal sculpture there is very easy to recognize this species. Posterior half of pronotum with fine, granary sculpture which is somewhat transverse on prescutellar region. Anterior male tubae convex on outer margin (Fig. 28) and shorter than tarsi. Ventral side completely covered with dense, white tomentum.

Aedeagus Figs 9, 10, ovipositor Fig. 20.

For the differential diagnosis see the key.

Length: 8.5–12.0 mm (holotype 8.5 mm), width: 2.9–3.5 mm (holotype 2.9 mm).

**Material Examined.** Holotype (male), Algeria, Sahara, El Golea, 29–30 iv 1987, M. Skorpik leg. Allotype (female) Algeria, Reuter (1 male, 4 females) (specimens of *Oudinae africana* n. 1987 (3 further very destroyed females not included among paratypes).) Holotype and allotype deposited in NMPC, paratypes in NMPC, ZMAS, MNHN, coll. M. Skorpik (Zoological) and G. Magné (Cosenza).

**Bionomy.** Holotype and one paratype were reared from the roots of *Lautana arborescens*, one paratype from *Oudinae africana* (both Brassicaceae).

**Name derivation.** The specific name is derived from the Latin adjective *aurulens* = golden.

---

**Paratassa tunesiaca** sp. n.

(Figs 2, 18, 26)

**Diagnosis.** Short, robust and cylindrical species (Fig. 2). Whole body dark blue-green, rather matt. Pro-, meso-, and metasternum with sparse, white tomentum, abdomen only with small, irregular patches of tomentum. Frons flat or slightly convex, elytra 1.7 times as long as wide, slightly tapering posteriorly without any traces of longitudinal grooves. Pronotum very convex, 1.2 as wide as long, lateral pronotal margins parallel in posterior half (Fig. 2). Sculpture of posterior half of pronotum consisting of regular, transversely enlarged, deep punctures. Aedeagus (Fig. 18) with laterally convex parameres, ovipositor Fig. 26.

For the differential diagnosis see the key.

Length: 6.0–7.0 mm (holotype 6.7 mm), width: 2.3–2.7 mm (holotype 2.4 mm).
Paratassa acuminata sp. n.
(Figs 3, 15, 22)

Diagnosis. The smallest species of the genus with bronze-green (male) or blue-green (female) body. Frons broadly and shallowly depressed, pronotum parallel-sided in posterior half, its anterior margin widely lobate in the middle (Fig. 3). Pronotum regularly, deeply punctured, 1.35 times as wide as long. Elytra 1.9 times as long as wide, slightly wedge-shaped (Fig. 3) with nearly indistinct traces of longitudinal grooves. Ventral side with white tonnem which is rather sparse on abdominal sternites.

Aedeagus (Fig. 15) nearly Y-shaped, parameres with nearly straight outer margins, ovipositor Fig. 22.

For the differential diagnosis see the key.

Length: 5.0–7.0 mm (holotype 5.7 mm), width: 1.8–2.9 mm (holotype 1.9 mm).

Paratassa aegyptiaca sp. n.
(Figs 17, 27)

Diagnosis. Large and robust, dark golden green and matt species. Ventral side with large patches of white tonnem which is well-developed mainly on prosternum. Frons slightly convex, pronotum very convex, nearly ball-shaped, its lateral margins slightly incurved before posterior angles. Pronotal sculpture consisting of deep, transversely enlarged punctures which form distinct transverse wrinkles between prescutellar region and posterior angles. Elytra short, only 1.7 times as long as wide, gradually tapering from humeri to apex without any traces of longitudinal grooves.

Aedeagus (Fig. 17) V-shaped, parameres with straight outer margins, ovipositor Fig. 27.

For the differential diagnosis see the key.

Length: 7.3–9.0 mm (holotype 7.3 mm), width: 2.6–3.5 mm (holotype 2.6 mm).
Biography. Unknown.

Name derivation. The specific name is derived from the country of origin (Egypt).

**Paratassa arabica** sp. n.  
(Fig. 16)

Diagnosis. Medium-sized, blue-green and glossy species, resembling by its body-shape *P. acuminata* sp. n. from which it differs by slightly bell-shaped pronotum which bears short, transverse wrinkles on prescutellar part and by the form and structure of male genitalia. Ventral side completely covered by sparse, homogenous, white tomentum.

Aedeagus (Fig. 16) V-shaped, resembling that of *P. aegyptiaca* sp. n.

For the differential diagnosis see the key.

Length: 6.5 mm, width: 2.4 mm.

Material examined. Holotype (male): El Hauta (Saudi Arabia)

Holotype deposited in NMPC

Biography. Unknown.

Female. Unknown.

Name derivation. The specific name is derived from the country of origin (Arabia).

**Paratassa orientalis** sp. n.  
(Figs 4, 14, 24, 29)

Diagnosis. Medium-sized, subparallel, matt and blue-green species with glossy luster (Fig. 4). Ventral side completely covered with white, rather sparse tomentum. By its body-shape and coloration it resembles *P. medioullassica* sp. n. from which it differs by flat frons; anteriorly less rounded pronotum with posteriorly slightly diverging lateral margins, simple pronotal punctuation and by different form of male genitalia.

Aedeagus (Fig. 14) short, nearly Y-shaped, parameres with convex outer margins, ovipositor Fig. 24.

For the differential diagnosis see the key.

Length: 6.5-8.2 mm (holotype 7.2 mm), width: 1.9-2.8 mm (holotype 2.3 mm).

Holotype (male): SW Iran, Mollasari, 45 km NW Ahvaz, 13-14 vi 1977, loc no 288, Exp Nat Mus Praha Allotype (female): the same data Paratypes (1 male, 1 female): the same data (3 males) Iran, Ahvaz/Ramshir, 100 m, 11 vi 1978, Resaanger leg (female).

Holotype and allotype deposited in NMPC, paratypes in NMPC and coll. H. Miikle (Munich)

Biography. All specimens collected by the expedition of the National Museum Praha were taken from *Diptotaxis hana*.

Name derivation. The specific name indicates the most eastern distribution of the genus.

Note. This species was erroneously treated as *P. coraeiformis* (Fairmaire) by Bily (1983).

Acknowledgements

We are very obliged to J. Mease (MNHN) and J. Coots (ESNID) for the possibility to study type material deposited in their institutions and to our colleagues H. Meisner (Munich), J. Fyman (Praha), S. Polomny (Praha), J. Kolzik (Praha), J. Romanauer (Stàndava, Slovakia), M. Skorpik (Znojmo, Czech Republic) and V. Kubik (Brno) who supplied us with the material from their collections.

345
REFERENCES


Description of the larva of *Schizogenius lineolatus* (Coleoptera: Carabidae: Clivinini)

Yves BOUSQUET

Plant Protection Division, Eastern Cereal and Oilseed Research Centre, Agriculture and Agri-Food Canada, Ottawa, Ontario, Canada K1A 0C6

*Received January 15, 1996, accepted June 27, 1996 Published December 27, 1996*

**Abstract** The larva of *Schizogenius lineolatus* Say, 1823, the first of the genus *Schizogenius* Puzzeys, 1846 is described and the main character states are illustrated. The larvae of *Schizogenius* differ from those of *Clivina lateralis*, 1802 and *Dischirius Bonella*, 1810, the two other genera of Clivinini described larvae, by the presence of a small apical process on each urogomphus, by the presence of two inserted claws, and by the presence of an hymenopterous structure on each claw. A key to the larvae of the three genera of Clivinini is provided.

**Larval description, key, Carabidae, Clivinini, Schizogenius, Neartic region**

**INTRODUCTION**

The genus *Schizogenius* Puzzeys, 1846 belongs to the tribe Clivinini. It is distributed from southern Canada south to central Argentina, with one species, known only from the holotype, found in the Fiji Islands (Baehr 1983). Most species live along rivers or streams on barren gravel or on sand. Whitehead (1972) revised the North American fauna and treated many of the South American species. The author recognized then two subgenera: *Genioschizius* Whitehead, 1972 with 10 species and *Schizogenius* s.str. with about 65 species. Later, Whitehead & Reichardt (1977) reclassified *Listrops* Puzzeys, 1863, until now treated as a valid genus, as a subgenus of *Schizogenius*. As pointed out by Whitehead (1966), *Schizogenius* is closely related to the genus *Halocoryza* Alluaud, 1919, which occurs on various islands in the western part of the Indian Ocean and the southern part of the Red Sea (Bastlewsly 1973), and in the West Indies, Mexico (Yucatán Peninsula), and southern Florida (Whitehead 1969).

Larvae of *Schizogenius* are unknown. The purpose of this paper is to describe the larva of *S. lineolatus* and point out its main characteristics.

**MATERIAL AND METHODS**

The study is based on examination of 7 L₁ reared from eggs laid by adults collected at Cap-Rouge, Quebec, and from 12 larvae collected in the field by the author from the following localities: CANADA: Quebec: Abercorn, Bronte C.D., 1 VII 1983 (1L₁), 9 VII 1983 (3L₁), Cap-Rouge, Quebec, C.D., 27 VI 1983 (4L₁), St-Augustin, Portmout C.D., 4 VIII 1983 (4L₁), Rigaud, Vaudreuil C.D., 14 VI 1978 (1L₁). All specimens are deposited in the Canadian National Collection of Insects, Ottawa.

Two L₁ and three L₂ were cleared in hot 10% KOH, impregnated with glycerin (see Goulet 1977), slide-mounted in glycerin, and studied under an interference contrast microscope at 100-400×. Three L₁ and one L₂ were critical-point dried using CO₂, mounted with double-sided tape on SEM stubs, and coated with gold. They were observed with a Zeiss 940A DSM scanning electron microscope at an accelerating voltage of 10 kV. Other larvae were observed uncoated under a stereo microscope.

Notation of primary setae and pores follows that of Bousquet & Goulet (1984), notation of secondary setae follows that of Bousquet (1985).
Larva of *Schizogenius lineolatus* Say, 1823

**Recognition.** The larva of *Schizogenius* differs from those of *Clivina* Latreille, 1802 and *Dasychiura* Bonelli, 1810 by the presence of a small apical process on the urogomphi, by the presence of two incised claws, and by the presence of an hyaline structure on each claw.

**Description**

**First instar**

**Measurement.** Width of cephalic capsule: 0.33–0.35 mm (n=3).

**Color.** Cephalic capsule yellow to brownish yellow; antennae, mandibles, and maxillae somewhat brownish; abdomen, including urogomphi, pale yellow.

**ChaptoLOGY.** Setae FR, on frontale relatively long; setae FR, FR, and FR, subequal in length, about 0.5× length of FR; setae PA and PA, on parietale subequal in length, about 0.4–0.5× length of PA; setae PA, posterior to level of PA, pore MN, on mandible about same level as MN, gMX on stipes with about 1.5 setae; length of seta MX, about 0.6× that of MX; seta MX, short, not or barely exceeding extremity of lacina, located at basis of lacina. Setae PR, PR, PR, and PR, on pronotum relatively long, as long as PR, length of seta ME, on meso- and metanota 0.8–1.0× that of ME, length of ME, 0.7–0.8× that of ME, Seta TE, on tergites subequal in length to TE, length of seta TE, 0.6–0.8× that of TE, length of seta UR, on tergite 9 about 0.4–0.6× that of UR; urogomphi with 5 long setae (UR,UR,) (Fig. 5). Inner sternite with one additional seta. Seta TA, on tarsus close to TA, and TA,.


**Head.** Cephalic capsule subquadrate, without basal constriction (Fig. 1). Nasale (Fig. 2) slightly protruding, its apical margin more or less truncate, without any projections or protuberances, egg-hurters consisting of 2–4 microspinulae transversally arranged on each side at base of frontale; frontal suture sinuate in posterior half; coronal suture relatively long, subequal in length to antennomere 4. Parietale with one ocellus on each side (Fig. 9) (see „Remarks” section); cervical groove present, extending laterally up to level of seta PA,1. Length of antennomere 1 about 1.4× that of antennomeres 2 and 4, and about 0.7× that of antennomere 3; sensorial appendage on antennomere 3 somewhat elongate. Mandible falciform; penicillus present, unisetose (Fig. 8); retinaculum simple, with posterior edge smooth; terebra with medial margin finely serrulate (Fig. 7). Maxilla (Fig. 3) with stipes about 2.5× longer than wide, without distinct membranous notch laterally or ventrally; lacina distinct, consisting of small, acuminate cone; length of galeomere 1 about 0.8× that of galeomere 2; length of maxillary palpomere 2 about 2.2× that of palpomere 3, about 1.2× that of palpomere 4. Premaxilla (Fig. 4) without ligula; length of labial palpomere 1 about 1.4× that of palpomere 2.

**Thorax.** Notal carinae present.

**Abdomen.** Tergal carinae present, not extended laterally. Urogomphi fixed, not segmented, relatively long, more or less parallel, with small, perpendicular process near apex (Figs 5–10). Pygidium elongate, subequal in length to urogomphi (Fig. 5).

**Legs.** Tibia shorter than tarsus. Pretarsus with 2 claws, subequal in length, each with indentation near middle bearing elongate, hyaline structure (Fig. 11).
Figs 1–6. *Schizogomus formicatus* Say: 1 - cephalic capsule, left antenna, and right mandible (dorsal view), L., 2 - adnasalia and nasale (dorsal view), L., 3 - right maxilla (dorsal view), L., 4 - labrum (dorsal view), L., 5 - right urogomphus and pygophurn (lateral view), L., 6 - mouth siphon and urogonphus (dorsal view), L.
Figs 7–11. *Schizogaster lineolatus* Say. 7 – terebra and retinaculum of left mandible (dorsal view), L.; 8 – penicillus of right mandible (dorsal view), L.; 9 – ocular area, right side (dorsal view), L.; 10 – extremity of right urogomphus (oblique dorsal view), L.; 11 – claws of left middle leg (lateral view), L.;
Second and third instars

**Measurement**
- Width of cephalic capsule: 0.54–0.58 mm \(n=6\), 0.68–0.70 mm \(n=2\)
- Color: Cephalic capsule yellow to brownish yellow, antennae, mandibles, and maxillae somewhat brownish, abdomen, including urogomphi, yellow to brownish yellow

**Chaetotaxy**
- Frontale without secondary setae
- Parietale with several secondary setae on lateral parts
- Mandibles and antennae without secondary setae
- Stipes with one secondary, small seta posterior to MX, length of MX, 6–0.8 \(x\) that of MX, seta MX, short, 0.2–0.3 \(x\) length of MX, located at basis of lacina, gMX with about 15 setae
- Prementum with 4–5 secondary setae laterally
- Pro-, meso- and metanota with numerous secondary setae
- Tergites 1–8 with numerous secondary setae
- Length of seta UR, on tergite 9 about 0.4 \(x\) that of UR, urogomphi (Fig. 6) with 9 long setae, including 4 secondary ones (UR,–UR,), and several small ones, seta UR, smaller than UR, UR, and UR, somewhat spine-like
- Median, inner, and outer sternites, hypopleurite and epipleurite on abdominal segments 1–7 with several secondary setae
- Pygidium with several secondary setae
- Femur with one pair of secondary, spine-like setae on posterior side, tibia and tarsus without secondary setae

**Microsculpture**
- Frontale without microsculpture, parietale dorsosubally with small patch on each side of irregular, somewhat transverse microsculpture
- Pronotum without microsculpture
- Meso- and metanota with pointed microsculpture mainly on lateral parts
- Tergites 1–8 with pointed and multipointed microsculpture over posterior subscutellar area
- Urogomphi with sparse, wart-like microsculpture on basal half
- Pygidium with multipointed (basal half) and wart-like microsculpture

**Head**
- Nasale slightly protruding, its apical margin more or less truncate to slightly rounded, frontal suture sinuate in posterior half, coronal suture relatively long, slightly longer than antennomere 4
- Parietale with one ocellus on each side (see „Remarks” section), with two longitudinal sulci on each side, one ventrad, one lateral running from level of PA, to level of PA, cervical groove present, extending lateroventrally up to level of seta PA,Length of antennomere 1 \(0.8–0.9 \times\) that of antennomere 2, 0.6–0.7 \(x\) that of antennomere 3, and 1.0–1.2 \(x\) that of antennomere 4, sensorial appendage on antennomere 3 somewhat elongate
- Mandible falciform, penicillus present, unisetose, retinaculum simple, with posterior edge smooth, terebra with medial margin finely serrulate (more or less abraded on basal half in specimens studied)
- Maxilla with stipes 4–4.7 \(x\) longer than wide, without distinct membranous notch laterally or ventrally, lacina distinct, consisting of small, acuminate cone, length of galeomere 1 about 0.9 \(x\) that of galeomere 2, length of maxillary palpmere 2 about 3.0 \(x\) that of palpmere 3, about 1.8 \(x\) that of palpmere 4
- Prementum (Fig. 4) without ligula, length of labial palpmere 1 about 1.5 \(x\) that of palpmere 2

**Thorax**
- Notal carina present

**Abdomen**
- Tergal carina present, not extended laterally
- Urogomphi (Fig. 6) fixed, not segmented, relatively long, slightly convergent in apical half, with small, perpendicular process at apex
- Pygidium elongate, subequal in length to urogomphi

**Legs**
- Tibia shorter than tarsus
- Pretarsus with 2 claws, subequal in length, each with indentation near middle bearing elongate, hyaline structure

**Remarks**
- It is not clear whether or not the ocellus is functional
- I have not observed any pigment spot in the ocular area under the stereo microscope, using uncleared specimens
DISCUSSION

The tribe Clivinini includes about 70 genera in the World. In addition to Schizogenius, larvae are known for only three genera, namely Halocoryza (Vinson 1956), Clivina (Boving 1911; van Emde 1942, Sharova, 1958, 1964; Luff 1978; Húkka 1978; Varěk 1984; Arrntd 1991; Luff 1993), and Dyschirius (van Emde 1942; Sharova, 1958, 1964; Luff 1978; Húkka 1978; Arrntd 1991; Luff 1993). Unfortunately, the description by Vinson (1956) of Halocoryza jeannevi Vinson, 1956 (=H. matronum Alluaud, 1919) is short, superficial, and does not allow comparison.

Reichardt (1977) recognized six subtribes within Scaritini (sensu lato): Pasimachina, Scarnina, Forcipatorina, Dyschirina, Clivirina, and Salcediina. Some recent authors, such as Erwin (1991) and Bouquet & Larochelle (1993), prefer to recognize two distinct tribes, Scaritini (including Pasimachina) and Clivirini (including Forcipatorina, Dyschirina, and Salcediina). Schizogenius and Clivina belong to the subtribe Clivinina. Larvae of both genera have reduced number of ocelli, a cervical groove on the parietal, and a unisetose penicillus. These character states are likely apomorphic for the Scaritini-Clivirini lineage. However, they occur in other, unrelated groups of Carabidae, and could be subject to convergence. Dyschirius and Clivina share the presence of a single tarsal claw, an apomorphic state that also occurs in a few other groups, such as Boscini, Bembidini, Pogonini, and Trechinae. At this time, little could be said about the classification of the Clivinini using larval characters. However, based on character states found in the three known genera, larval characters could be useful in an attempt at the classification and phylogeny of members of Clivinini.

A key to larvae of the three genera of Clivinini follows:

   - Cervical groove present, extended intercervically. Parietals at most with one ocellus on each side. Lacinia present as small, acuminate cone. Perisoma unisetose. Urogomphi as long as pygidium. ......................... 2

   2. Pedipalps with one simple claw. Urogomphi without apical process. Lacinia present. ......................... Clivina Larochelle
      - Pedipalps with 2 maxillar claws. Urogomphi with papillocarinate apical process. Lacinia absent. Schizogenius Bouquet

CONCLUDING REMARKS

The tribe Clivinini is a good example of how poorly known carabid larvae are. The group includes about 70 genera and yet larvae of only three of them have been adequately described. I hope this small contribution will stimulate others to rear, collect, and study clivinine larvae, so that eventually enough information will be available to test the current classification of Clivinini.

Acknowledgements

I thank H. Goette, S. Laplante, L. LeSage, and A. Simonet of the Eastern Forest and Rural Research Centre, Ottawa, for reviewing the manuscript. The inking of the line drawings was done by G. Sato of the same establishment.

REFERENCES


352
BOOK REVIEW


The editorial is professor emeritus at the Regional Institute of Public Health (Landesuntersuchungsanstalt) in Erlangen. This volume is organized into nine parts compiled by 58 experts, mostly university professors from western federal states of Germany, further on from Denmark, Liechtenstein and Switzerland. Basic concepts of this book follow previous editions in 1974 on clinical mycology which again was preceded by three editions dealing with bacteriology and serology. As stated in the preface, during the period which has elapsed since the publication of the last edition, mycological diagnosis has undergone remarkable developments and found its way in many branches of medicine and biological sciences. Many new species of microorganisms have emerged as pathogenic agents. Other organisms became opportunistic pathogens in immunocompromised patients. Many new laboratory procedures have been adopted, including DNA and RNA probes and electronic data processing. High level of this publication has been maintained by favorable choice of continuing contributors.

Part I provides a general overview of the importance of pathogenic microorganisms for the human health. Described here are collections, handling, disposal and evaluation of materials to be examined, blood, cerebrospinal fluid and CNS tissues, ocular fluids and tissues, miscellaneous exudates, secretions and fluids from organs and body cavities, sputum, pus, skin hairs and nails, urine, feces and other materials.

Part 2 deals with the mycology. It is the most extensive part embracing 270 pages or approximately one third of the contents. Listed here are 29 material families, genera or species including the Streptomyces, Microsporum, Nocardia, gram-negative rods, pathogenic viruses, Enterobacteriaceae with 18 genera of medical importance, Legionellaceae with 29 species, Brucella and Bordetella, Pasteurellaceae, slowly growing gram-negative rods, anaerobic bacteria, fungi, and chytridiomycetes. Bacillus, pathogenic aerobic actinomycetes, mycobacteria, spirochetes, mycoplasma and other bacteria. Particular groups of bacteria have been featured from the viewpoint of collecting and disposal of materials to be examined, microscopic photography, cultural, biochemical and serological methods, antigen and toxin production, serological tests and other laboratory procedures. Tests for resistance to antibiotics and other antibacterial drugs are also included here.

Part 3 is concerned with the virology. Described here are general biology and structure of viruses, multiplication in the host cell and transmission. A review of particular viral groups following the entroviruses, bunyaviruses, parvoviruses, rubuloviruses and other groups. The diagnosis includes cultivation and identification of viruses and antibody tests, also the modern virology – immunoblotting, DNA probes and the polymerase chain reaction.

Part 4 is devoted to the mycology. Described here are the dermatophytes, a large group of fungi, most of them belonging to the genus Epidermothyphium, Microsporum and Trichophyton. Further on the the Zygomycetes, Rhizopus and Monilia. Mycology and phycology of yeasts with 56 genera, and Blastomyces with 14 genera. Those pathogenic fungi cause diseases of the skin and mucous membranes. Dermatophytes (genus Botryomyces, Paracoccidioides, Histoplasma, Cryptococcus, Sporothrix) are presented here as causative agents of systemic mycoses. This part is concluded with a glossary of mycological terms.

Part 5 is intended to give an introduction to laboratory methods for identification of groups of protozoan parasites and helminths. 1 Protozoan occurring in feces, urine and vaginal secretions, as Entamoeba histolytica, Trichomonas, vaginal leucocytes, eschweileri, endameba and flagellates, vaginal leucocytes and flagellates, vaginal leucocytes and flagellates, vaginal leucocytes and flagellates, vaginal leucocytes and flagellates, vaginal leucocytes and flagellates. Among helminths there are some flukes, tapeworms and roundworm species. 2 Among blood and tissue-dwelling parasites listed are the malarial plasmodium, trypanosomes, Leishmania, plasmodia, toxoplasma, free-living amoebae, filarial worms, echinococcosis, toxocara and other helminths are described here as tissue parasites.

Part 6 focuses on immunology concerning miscellaneous factors of nonspecific and specific defense mechanisms and antibody tests. Concluding two parts provide insights into the general laboratory organization, elementary mycology and special procedures when describing the preparation of culture media, biochemical analyses of microorganisms, biological staining, rapid and automated techniques, antigen identification, testing of drugs, histological methods of tissue. Additionally, two parts provide information on some pathological methods, preparation of diagnostic sera and vaccines, and some mathematical methods. An annex laboratory safety precautions, imported species, inclusion of solutions, and useful addresses are given.

This volume is extensively illustrated with 256 pictorial groups composed of 354 partly colored figures presenting schematic line drawings, diagrams, macrophotographs of miscellaneous bacterial colonies, light and electron microphotographs and schemes of laboratory procedures. Moreover, there are 192 tabular reviews of microorganisms, identification keys, syndromes and clinical pictures, and epidemiological data. As reference material, this attractively produced book will also be of extraordinary use for biologists, microbiologists, parasitologists, epidemiologists and immunologists of various profiles.

Jindrich Jirásek

354
Carabid communities in two biotopes of the Marano lagoon (Italy) 
(Coleoptera: Carabidae)

Pietro Brandmayr\textsuperscript{1}, Giorgio Coombetta\textsuperscript{2} & Roberto Pizzolotto\textsuperscript{1}

\textsuperscript{1}Università della Calabria, Dipartimento Ecologia, 87036 Rende CS, Italy 
\textsuperscript{2}Via Elia 2, 1-34100 Trieste, Italy

Received May 28, 1996. accepted June 27, 1996
Published December 27, 1996

Abstract Two habitats of the Marano lagoon (north Italy) were sampled by means of pitfall traps to study the carabid beetle species harboured by a reed and a shelf site. The analysis of data showed that two carabid groupings characterize the sampled sites. The reed community is the more species rich, with sets of species showing heterogeneous ecological requirements. The shelf grouping is very poor in species, but it harbours only species tied to brackish environments. Differences between the two carabid groupings were also revealed in the period of activity of the species, showing the reed phytocenosis an autumn peak and the shelf assemblage a dominance of spring activity.

Assemblages, marsh, soil salinity, flood tide, human disturbance, Coleoptera, Carabidae, Palaeartic Region

INTRODUCTION

The investigation of the carabid groupings of humid environments is quite difficult to be performed because of the great diversity of ecological niches characterizing these habitats. This holds true mainly for lagoons, where freshwater and seashore ecosystems are strictly in contact.

General topics on carabid assemblages in marine littoral zones have been outlined firstly by Verder & Quixet (1951), while Thiele (1977) gives a short synthesis for freshwater. A lot of works, carried on in many European countries, followed these studies (e.g., Heydemann 1962, Obrtel 1972). In Italy, the Venice lagoon got more attention than the Marano one (see Ratti, 1979, 1981, 1983). So, we gathered here original data collected in the years 1984/85 for a contribution to the knowledge of carabid groupings of the latter brackish water environment, not only from the faunistical point of view, but also from the ecological one.

We are honoured to give this contribution for the „Festschrift“ of Prof. Karel Hůrka, to whom this paper is dedicated.

MATERIAL AND METHODS

The Marano lagoon is near the town of Grado, on the northern coast of the Adriatic sea. Two sample sites, a reed habitat and a shelf island, were chosen along its inland border, 1 km apart from the sea (Figs 1 and 2).

The reedy sample site was a small island very close to the dry land, joined to it by a manmade reed covered small bridge, rising almost 1 m above water level, and it was often inundated. It was colonized mainly by Phrynogmites (80%) and other bushy plants, growing on silty or muddy soil.

The island sample site was a small island rising 20-30 cm above water level, and very often inundated according to the flood tide. It was covered for the 40% by bushy and grass vegetation, that grow on sand-muddy soil saturated by water for the most part of the year. This site was periodically disturbed by dumping of dredged sediments to clean the adjacent shipchannel.

Samples were collected by means of pit-fall traps, i.e., plastic vessels (9 cm mouth diameter, 7.5 cm base diameter, 11 cm depth) containing 200 ml of attracting-preserving mixture of wine vinegar with 5% formalin. Traps were placed in number...
of five per site and emptied monthly from May 1984 to January 1985. The collections in each sample site were quantified as annual Activity Density (aAD) as follows:

\[ aAD = \frac{\text{total specimens captured}}{\text{US}} \]

where

\[ \text{US} = \sum_{j=1}^{m} \left( \frac{\text{traps} \times \text{days}}{10} \right) \]

with \( m \) = number of sampling periods in each site during the year.

RESULTS

Analysis and rearrangements of data are summarized in Tab. 1, in which information on some biological features of the collected species is also given. As it is clearly shown by the table, two groups of species, differing both under the qualitative (species composition) and quantitative (annual Activity Density) point of view, characterize the sampled sites.

Only four species are present in both sites. The presence among them of *Pterostichus melanarius* with very low aAD in shelf site, but not in reed site, where only one species is more abundant than it, is probably due to the wider habitat affinity of this eurytopic, manmade habitat tied beetle. *Dicheirotrichus obsolatus* behaves in the opposite way, being the dominant species in shelf site, but showing very low aAD in reed site. *Bembidion iricolor* and *Agonum duftschmidtii* has low aAD in the two sites. Among these four species it is likely that *B. iricolor* and *D. obsolatus* affect only in a marginal way the carabid assemblages of inland reedy habitats because of their ecological preference (halobiont species).


![Map of Italy showing the location of the Marano lagoon.](image)

Fig. 1. The location of the Marano lagoon.
Considering the halophily as an index of the „link“ with marine environment, the halophilous and halobiont species account for 19% of the collected species in the reed site, while for 62% in the shelf site. This difference is more evident if we focus on dominance of these species, that in the reed site accounts for only 1.9% of the collected individuals (listed as 2.0% in Table 2), while in the shelf site it accounts for nearly all (98%) of the individuals. These figures give evidence for a difference between the carabid groupings owed to different habitat affinity of the species composing them.

Fig. 2: Sample site location. The shipway near the shelf site is man-made.

To generalize, in the shelf site there are mainly species tied to brackish environment, directly affected by the sea influence (the sole halobionts account for 50% of the species), and they are also the dominant species. The reed site harbours a group of species almost indifferent to soil salinity and with wider ecological tolerance, together with halophilous species living along the rivers that play a fundamental role within the lagoon system.

In Tab. 2 the species chorology has been grouped into two categories, i. e., species with distribution limited to the Mediterranean area, and species with European or wider distribution. No endemic (Italian peninsula-) species were collected. In the reed site wide chorology prevails as much for number of species (73%) as for their dominance (98% of the collected individuals); while Mediterranean chorology accounts only for 27% of species, with 2% of dominance. In the shelf site, the 62.5% of the species has wide distribution, but it corresponds only to 2% of the collected individuals. Three species (37.5%) showed Mediterranean distribution, but they accounted for the majority of the individuals (98% dominance).
Tab. 1 Sampling results for reed and shelf Spheces (2nd column) are grouped according to their ecological requirements, i.e., the habitats in which it is more usual to find them (1st column). The fifth column shows the ecological preferences of the species as follows: e = euryvalent, hyg = hygrophilous, mud = muddy soil, ter = thermophilous, xer = xerophilous, hel = halophilous, halob = halobenthic, ps = psammophilous. Bracketed are used in case of weak preference. The last column shows the chorology of the species as follows: III = European species in the widest sense, where capital letter means cardinal point, m = restricted to the Mediterranean basin, IV = Eurasatic, Eurosiberian; V = palaeartic, holarctic.

<table>
<thead>
<tr>
<th>habitat choice</th>
<th>reed</th>
<th>shelf</th>
<th>ec. pref</th>
<th>distribute</th>
</tr>
</thead>
<tbody>
<tr>
<td>reed and shelf vegetation formations</td>
<td>Pylastrichus niger Scholl, 1781</td>
<td>4.02</td>
<td>e</td>
<td>IV</td>
</tr>
<tr>
<td></td>
<td>Pylastrichus melanarius Illiger, 1798</td>
<td>0.97</td>
<td>e (mud)</td>
<td>IV</td>
</tr>
<tr>
<td></td>
<td>Carabus granulatus L., 1758</td>
<td>0.68</td>
<td>e</td>
<td>IV</td>
</tr>
<tr>
<td></td>
<td>Badister bipustulatus Fabricius, 1792</td>
<td>0.03</td>
<td>e</td>
<td>V</td>
</tr>
<tr>
<td></td>
<td>Clivina fossor L., 1758</td>
<td>0.04</td>
<td>e</td>
<td>IV</td>
</tr>
<tr>
<td></td>
<td>Agonum duftschmidtii Schmidt, 1994</td>
<td>0.03</td>
<td>e</td>
<td>IV</td>
</tr>
<tr>
<td>bos, riverbanks, water meadows</td>
<td>Anostomus flavifrons Fabricius, 1799</td>
<td>0.04</td>
<td>(mud)</td>
<td>IV</td>
</tr>
<tr>
<td></td>
<td>Lamproclytus drenus Fabricius, 1801</td>
<td>0.01</td>
<td></td>
<td>IV</td>
</tr>
<tr>
<td></td>
<td>Pylastrichus vernalis Panzer, 1798</td>
<td>0.03</td>
<td></td>
<td>V</td>
</tr>
<tr>
<td></td>
<td>Dryops dentatus Rossi, 1790</td>
<td>0.01</td>
<td>ig (mud)</td>
<td>IV</td>
</tr>
<tr>
<td></td>
<td>Bombus quadrivittatus (L., 1761)</td>
<td>0.01</td>
<td>ig</td>
<td>V</td>
</tr>
<tr>
<td>fields and open veg. formations</td>
<td>Harpalus rufipes De Geer, 1774</td>
<td>0.08</td>
<td>ther xer</td>
<td>V</td>
</tr>
<tr>
<td></td>
<td>Harpalus rubrinubes Dufschmid, 1812</td>
<td>0.01</td>
<td>ther (mud)</td>
<td>III</td>
</tr>
<tr>
<td></td>
<td>Callarchus cincus Motschulskii, 1856</td>
<td>0.01</td>
<td>ther</td>
<td>III</td>
</tr>
<tr>
<td></td>
<td>Pycnus capraeus (L., 1758)</td>
<td>0.11</td>
<td>ther</td>
<td>IV</td>
</tr>
<tr>
<td></td>
<td>Dromius haearus Olivier, 1795</td>
<td>0.01</td>
<td>ther</td>
<td>III Sm</td>
</tr>
<tr>
<td>clamps, grasslands and open veg. formations in sunny places</td>
<td>Harpalus rufipes form Dufschmid, 1812</td>
<td>0.03</td>
<td>helob</td>
<td>III</td>
</tr>
<tr>
<td></td>
<td>Cicindela germanica L., 1758</td>
<td>0.02</td>
<td>helob</td>
<td>IV</td>
</tr>
<tr>
<td></td>
<td>Bembidion postornament Stephens, 1826</td>
<td>0.01</td>
<td>helob</td>
<td>IV</td>
</tr>
<tr>
<td>mediterranean open land</td>
<td>Amara montana Dejean, 1828</td>
<td>0.01</td>
<td></td>
<td>III m</td>
</tr>
<tr>
<td>shores, bogs, Molina formations</td>
<td>Microlaelaps cornucophila Dufschmid, 1820</td>
<td>0.01</td>
<td>halophil (ps)</td>
<td>V</td>
</tr>
<tr>
<td></td>
<td>Bryoclytus distinguished Dejean, 1829</td>
<td>0.01</td>
<td>halop</td>
<td>III Wh</td>
</tr>
<tr>
<td></td>
<td>Pterostichus cursor Dejean, 1828</td>
<td>0.03</td>
<td>halop</td>
<td>III Wh</td>
</tr>
<tr>
<td></td>
<td>Bembidion truncorum Dejean, 1829</td>
<td>0.03</td>
<td>halob</td>
<td>III Wh</td>
</tr>
<tr>
<td></td>
<td>Dicerosceres obscurus Dejean, 1829</td>
<td>0.03</td>
<td>halob mud</td>
<td>III Wh</td>
</tr>
<tr>
<td></td>
<td>Pogonomus rarius Dejean, 1828</td>
<td>0.17</td>
<td>halob mud</td>
<td>III Wh</td>
</tr>
<tr>
<td></td>
<td>Anostomus pascualis Stephens, 1828</td>
<td>0.02</td>
<td>helob</td>
<td>III</td>
</tr>
<tr>
<td></td>
<td>Odius gracilis Villa, 1833</td>
<td>0.01</td>
<td>helob</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pylastrichus stramineus Panzer, 1797</td>
<td>0.02</td>
<td>ig</td>
<td>IV</td>
</tr>
<tr>
<td></td>
<td>Platynthus acerifer Fabricius, 1810</td>
<td>0.01</td>
<td></td>
<td></td>
</tr>
<tr>
<td>total aAD</td>
<td>6.26</td>
<td>3.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>number of species</td>
<td>25</td>
<td>8</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

DISCUSSION

By the help of literature information, and on the basis of our knowledge, five sets of the sampled species have been proposed in Tab. 1.

In the reed site a group of six species is tied to the agricultural landscape, from where they spread. They all have a wide ecological tolerance, that facilitate the colonization of several humid habitats. Three species show the maximum aAD, i.e., *Pylastrichus melanarius*, *P. niger* and *Carabus granulatus*. It is likely that they come from the surrounding fields, but probably
Tab. 2: Importance of the halo-preference and Mediterranean distribution in percentage of species and individuals in the reed and shell sites

<table>
<thead>
<tr>
<th></th>
<th>Reed site</th>
<th>Shell site</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>species</td>
<td>individuals</td>
</tr>
<tr>
<td>Halo-philous and halo-hoint</td>
<td>19% 2%</td>
<td>62% 98%</td>
</tr>
<tr>
<td>wide distribution</td>
<td>73% 98%</td>
<td>62% 2%</td>
</tr>
<tr>
<td>Mediterranean distribution (semiaquatic)</td>
<td>27% 2%</td>
<td>37% 98%</td>
</tr>
</tbody>
</table>

they also inhabited the now disappeared ancient lowland forests. *Clivina fossor* and *Agonum duschkmidt* are tied to field and to open-structure vegetation habitats, but they are also well adapted to the riverside environments or water meadow-forests (especially the latter).

The second and third set of species seem to be favoured by the microclimatic conditions that characterize different part of the year.

In the second set we have grouped the species known for their hygrophilia, like *Pterostichus vernalis*, *Drypsa dentata* and *Bembidion quadrinaculatum*. In the lagoon they find satisfying conditions for their ecological requirements, being it a place in which deposition of slime and clay takes place, with the consequent formation of fine texture soils. They are active mainly in spring and at the beginning of the summer (see Fig. 3), then, when during the summer the temperature rises and ground water decreases, it is likely that they migrate in areas fulfilling their ecological needs.

The areas more elevated over the ground water level and with scarce vegetation cover are characterized by summer aridity. This probably explain the presence of the thermophilous and xerophilous species in the third set, i.e., *Harpalus rufipes*, *H. rubripes* and *Calathus cinctus*, that are active from August to September (see the phenogram of *H. rufipes* in Fig. 3).

![Fig. 3](image)

Fig. 3. The activity period of *Pterostichus vernalis* Panzer and *Harpalus rufipes* De Geer, that have different ecological preferences, mirrors the seasonal variation in the reed site.

359
The second and third species sets mirror the seasonal variation of the main abiotic factors, temperature and humidity, under the phenological point of view also, being the second a set of spring breeders, and the third a set of autumn breeders.

The rarefaction of vegetation cover together with soil water storage, give an explanation to presence on the lagoon banks of heliophilous species as *Harpalus litteicornis*, *Cicindela germanica* and *Bembidion quadrimaculatum*, that are found in wood clearings or in vegetation-less open land, with clayey or fine-grained soil (see table 1).

The species of the sixth set are more strictly tied to seashore or to salinity, that is the factor conditioning the presence of these species in the inland. The set of the shelf site is not so heterogeneous as for the reed site, being formed almost entirely by flying halo-requiring species, coming from coast environments. The shelf site gives favourable conditions particularly to *Dicheirirotrichus obsoletus*, sporadically found also in the reed site, and *Pogonus riparius*, exclusively found in the shelf site. The only not halo-requiring species found in the shelf site are *P. melanarius* and *Agonum dignicornum*, captured there during their seasonal peak of activity. The shelf environments show a particular lagoon feature, in which the species grouping is strongly affected by soil salinity and warm humid microclimatic conditions. It is to be noted the instability of this carabid grouping, owed to the floodtide that frequently cause a complete abandonment of the colonized shelves.

The difference between reed and shelf carabid groupings is evident taking into account also the carabid seasonal activity in the sites (see Fig. 4).

The phenogram for the reed site is mainly depending on the activity of *P. niger* and *P. melanarius*, autumn breeders, accounting for the 79% of the captured individuals. The other species have low aAD, they are mainly spring breeders, as *Carabus granulatus*, that for a large part is responsible for the second peak in the phenogram of Fig. 4.

Summer seems to be the unfavourable season for the shelf site. The peak of carabid activity is in spring, when the emerging of the adults of the dominant species takes places. During the
summer the low and scattered vegetation is insufficient to regulate the microclimate during
and high temperature. Only in the autumn a second peak takes place, but the carabid activity is
hampered by the ground water rise, as a consequence of the increased river flow typical for this
season.

The presence of *Platynus acrobaticus*, species of the upland forests, and of *P. steganus*,
montane species tied to humid broadleaf woods, is probably due to accidental river downloading,
as suggested by Ratti (1986) for the Venice lagoon (last species group in Table 1).

**CONCLUSIONS**

The sampled sites harbour two different carabid groupings, as it has been found by the qualitative
and the quantitative data (aAD, chorology, phenology) analysis. It could be suggested that
their species composition is at wide scale affected by the oceanic/continental features of the climate,
while at the niche level a fundamental role is played by soil salinity.

The reed site, and probably all the inland banks of the lagoon, harbours a group of species
that seems to be the result of an “intersection” among different sets of species coming from the
environments surrounding the lagoon. The species of wetmeadow forests, dwelling also in the
fields, showed to be the dominant or abundant species in the reed site, they play the role of
historical indicators (Brandmayr & Pizzolotto 1988, Pizzolotto & Brandmayr 1990), inherited
from the ancient lowland landscape, now disappeared as a consequence of the agricultural
exploitation. Anyway, some species more typical of reed swamps could not have been captured by
pitfalls.

The shelf site carabid grouping is the only harbouring typical species of the marshy and
brackish biotopes. The main ecological factors influencing this environment are the temperate
climate, with strong sun influence, and the flood tide. The absence of species as *Clivina
triginta* (Latreille et Dejean, 1822) and *Clivina punctata* (Dejean, 1831) and perhaps of other
*Dichetirichus Duval, 1857 spp.* should be interpreted as the consequence of a strong anthropic
disturbance (sediment dumping). This species grouping is to be related to the first steps of the
shelf colonization.

It is likely that almost the same species, with similar quantitative relationships, be present in
lagoon shelf environments, as general feature of them. If we consider a carabid community as an
assemblage of species definable on a faunistc (list of species) and statistical (the “weight” of
each species) basis, correlated with definite bioecological factors (Pizzolotto 1994), then we can
say that data from the shelf site give a picture of some important features characterizing the
carabid community(ies) of shelf environments, where *Dichetirichus obsoletus* and *Pogonus
riparius* are the leading species.

**REFERENCES**

- **BRANDMAYR P. & SERIANI M. 1981**: Schede ecologico-biogeo grafiche su coleotteri Carnoidi 1 - Chirini, Platynius, Platynus
- **BRANDMAYR P. & PIZZOLOTTO R. 1988**: Indicatori “di stazion” ed ecologi nella coltivazione timone della foresta
  Franz Steiner Verlag, 177 pp.

361


Life history and pre-imaginal stages of *Dromius meridionalis* (Coleoptera: Carabidae: Dromiini) in Sardinia

Achille Casale¹, Pier Mauro Giachino² & Roberto Pantaleoni¹

¹Istituto di Zoologia, Università di Sassari, Via Muroni 25, I-07100 Sassari, Italy
²Museo Regionale di Scienze Naturali, Via Giulietti 36, I-10123 Torino, Italy

Received July 13, 1996; accepted August 8, 1996

Published December 27, 1996

Abstract. Adults and larvae of *Dromius meridionalis* Dejean, 1825 were collected throughout the year with corrugated cardboard „trapping-bands“ on lime-trees (*Tilia platyphyllos*) in Sassari (Sardinia, Italy). The larval and pupal characters of this trunk-dwelling, undercanopy species are described and discussed. Its life cycle displays a summer broader element, its prey is identified as Lepidoptera larvae from the Pyralidae and Oecophoridae families.

Pre-imaginal stages, life history, Coleoptera, Carabidae, Dromiini, *Dromius meridionalis*, Palaearctic region

INTRODUCTION

Many Carabidae species are currently described as „arboreal“ beetles, often trunk-dwelling, undercanopy or canopy specialists, in tropical forests (Erwin 1979a), whereas in the temperate regions of the Holarctic Carabidae are normally identified as true „ground-beetles“ (Laufkäfer – running beetles – in the German literature) (Thiele 1977), though many species, often waterside generalists or lowland dwellers in unstable environments, have retained a winged or pteropodomorphic condition (Brandmayr 1991, Boer et al. 1980), and a high ability to disperse by flying. There are, however, several winged Carabidae species in these regions that usually complete part or the whole of their life cycle on or under the bark and on the foliage of plants of different species and sizes. In Europe and throughout the Mediterranean area, these are nearly all Lebiinae (sensu lattissimo: Casale et al. 1982, Basilewsky 1984) (= Lebiini of other authors), Lebiini and Dromiini (excluding Lionychinae), in particular, are often arboreal beetles (see for example Burmeister (1939) and Jeannel (1942). For this very reason, however, carabidologists are unfamiliar with many of their species, since they are accustomed to collecting insects under stones and dead trees, or in pit-traps. Arboreal species, therefore, are more often collected by those who specialise in phytophagous insects.

The life history and cycle of several Lebiina and Dromiina are unknown. In Europe, Silvestri (1904) was the first to illustrate the hypometabolistic cycle of *Lebias scapularis* (Fourcroy, 1785) and its association with the leaf beetle *Galerucella luteola* (O. F. Müller, 1776). Lindroth (1971) has discussed possible instances of Batesian mimicry of Chrysomelidae by Lebiinae.

In tropical forests, Erwin (1979b) and Erwin & Erwin (1976) have described highly interesting, sometimes parasitoid adaptive specializations in arboreal Carabidae. Much fresh information concerning these climbing and flying insects will undoubtedly be provided by further investigation of their place in canopy environments.

The present paper is a contribution to the knowledge of the immature stages and life cycle of *Dromius meridionalis* Dejean, 1825, a common Euro-Mediterranean, arboreal Dromiina species.
MATERIALS AND METHODS

During a long-term investigation of phytophagous insects in a lime-tree (Tilia platyphyllos) avenue in the city of Sassari (Sardinia, Italy), several larval and adult specimens of Carabidae were collected with corrugated cardboard trap bands fastened round the trunks about 3 m above the ground. Specimens were found in the spring (April 19, and May 3 and 10, 1995), autumn (November 3, 16 and 29, 1995) and winter (January 9, and March 8, 1996). Only adults were present from May to July.

The adults and some larvae were preserved in 70% ethanol. The remaining larvae were bred in glass capsules at 22 °C. They accepted no food in autumn and spring. Pupae were obtained in April 1995 from hibernating larvae, whereas the larvae collected in autumn did not breed.

Three pupae were preserved in 70% ethanol. Two Dromius meridionalis adults were obtained from the others. One pupa (not described) was smaller and displayed highly different chaetotaxic characters. It was probably a Philorhina pensa, since this species is common on the local Tilia.

Drawings were made with a stereomicroscope Wild M5 and microscope Leitz Dialux 20 BB.

RESULTS

Pre-imaginal stages

Egg

No eggs were obtained. Several years ago, however, one of the present authors (A.C.) identified some D. meridionalis adults collected by Bin on Monte Peglia (500–600 m, Province of Perugia, central Italy), where two egg-cases attributed to Dromius Bonelli, 1810 (D. meridionalis or D. quadrimaculatus (L., 1758)) were observed in autumn on two Gypsy Moth (Lymantria dispar L., 1758) egg-masses on oak trees and described by Bin (1980) as made of a waxy material completely wrapping the egg, thinner on the ventral than the basal side. 1 mm long × 0.5 mm wide, with a thin, virtually smooth chorion. From the eggs, Bin obtained adults of Xenomeldrus ergynna Walker (Hymenoptera: Scelionidae, of the Xenomelinae tribe, a specialized group of egg parasites associated with Carabidae).

3rd-instar larva

The terms used are taken from Boving (1911), Bousquet & Goulet (1984) and Giachino (1989).

Larva bicapsid, from pale to darker brown, dark red-brown head. Length: 5.9–7.5 mm from apex of mandible to apex of urogomphi, excluding the macrochaetes.

Head (Fig. 1). Elongated, L/W ratio 1.48. Frontal sutures clearly visible, bent back, sinuous and almost angular at the centre. Metopical suture perfectly distinguishable along about one-tenth of the eye-cypsaxis-cervix distance. Chaetotaxy of the cephalic region shown in fig. 1. Setae FR1 and FR3 located well forward (almost at the insertion of the antennae). Straight row of 4–6 small setae running from FR4 to the centre of the frontale.

Antennal edge of the epistoma ("nasale"): trilobate. Distinctly protruding side lobes, with subrectilinear, forward-converging side lobes bearing two dorsal setae, one long (FR5), the other shorter (FR4), incised, but rounded, at the median lobe, where there is also a seta (FR1) about as long as FR4. Central lobe protruding well beyond the side lobes and formed of two subacuminate, symmetric, subtriangular teeth separated by a distinct, deep V-shape groove. FR6 and FR7 set well forward, with FR1 very long.

Eye area, prominent, with five sterna and two setae. Parietal lacks PA1, PA2 and PA3.

Antennae (Fig. 2): short, about the same length as the mandibles, or a little less (a/M ratio 1.06). First, second, third antennomeres subcylindrical, second and third almost imperceptibly dilated at the apex, fourth cylindrical and subtruncated at the apex. Third antennomere nearly twice as long as the first. Chaetotaxy as proposed by Bousquet & Goulet (1984), except for the absence of AN1. Distinctly and markedly squamous antennal microsulcature.

364
Figs 1–5. *Dromius noridionalis* Dejean, mature larva, morphology: head in dorsal view (1), right antenna in dorsal view (2), anal claw (3), telson in dorsal view (4), right maxilla in dorsal view (5). Scale: 0.1 mm.
Mandibles very arcuate, with strong reitmaculum and almost smooth inner edge, external marginal seta (MN) located before the half-length point.

Maxillae (Fig. 5) distinctly longer than the mandibles (m/M ratio 1.23). Large, stubby styles, slightly dilated distally, 6-7 mastatory setae (gMX), with well-developed MX. Galea with second segment distinctly longer than the first. First segment of the maxillary palp short and subquadrate, second and third subequal and decidedly longer, fourth about a third longer than the third.

Lower labium decidedly trileteate, with setae LA, at the apex of the side lobes. Central lobe wide with evident and very prominent membranous lobe, at whose sides setae LA6 are in an abnormal position and preceding by setae LA1 in a very advanced position. No setae on the palpi of two segments. First segment distinctly longer than the second.

Pronotum Lateral series of 5-7 setae and pores not directly referable to the pupal setae.

Legs Long, relatively robust. Trochanter, femur, tibia, and tarsus with lengthwise rows of setae Chaetotaxy similar to that proposed by Jeannel (1942) and Bousquet & Goulet (1984). Finely denticulate taral claws (Fig 3) different in size, unlike those of D. agilis (Fabricius, 1785) as described by Jeannel (1942, fig. 339f).

Telson (Fig. 4) with two strong, short urogomphi, salient and well separated from the base Chaetotaxy similar to that proposed by Bousquet & Goulet (1984)

Pupa
White, translucent, eyes, pronotum, and apex of mandibles darker, brownish in the more mature specimen. Pupa exarata with free appendages, body elongated and depressed (Figs 6-7). Total length 5.5 mm.

Head Hypognathous (Fig. 6). General characters as in the adult, but with a peculiar chaetotaxy. Four long setae on vertex, inserted on conical tubercles, six setae near the anterior margin of frons, one seta (corresponding to the posterior suprornital seta) on the inner proximal side of each eye, and two setae close to the anterior margin of the eye.

Pronotum highly transverse, width/length ratio 1.5. Row of 6 long setae inserted on prominent tubercles on each lateral side of the theca covering the underlying adult pronotum. One anterior and two basal setae on each side, also on tubercles. The entire surface of the disk is densely punctate and finely pubescent. The median groove is wide, whitish and glabrous.

Mesonotum with two lateral (one large, one smaller) and one small posteralmedian seta on each side. Two small spots of very short pubescence near the middle. Metanotum same, but without these spots.

Pterotheca short and arcuate. Legs, in the podothecae, with finely denticulate claws, as in the adult.

Abdomen Tergites I-VI with posterolateral brush of long, erected hairs on each side. Tergites VII and VIII with row of long setae along the posterior side. Tergites from II to VIII with 2 long lateroventral setae on each side, inserted on large, subcircular pleural protuberances. No cerci.

Life cycle (Fig. 8)
Our adult and larval collection times and laboratory breeding data show that in northern Sardinia D. mediterranea is a summer breeder with larval (and adult) dormancy (Hürka 1986). This cycle is probably the same as that of other species of arboreal Mediterranean Drosmia. Conversely, the larva of North American species Drosmia piceus Dejean, 1825, living on white and red oaks and jack pine, pupate in August - September (Mahar et al. 1983).

In natural conditions, therefore, they evidently feed and breed under the bark and in canopy of living trees.
Adults emerge at the end of April or beginning of May and disperse by flying and climbing on trees. In June and July, they were collected on the trees where the larva completed their cycle. In summer and autumn, isolated flying specimens were collected by night at the black light.

Figs 6–7  *Dromus monachalis* Dejean, pupa, ventral side (6), dorsal side (7). Length 5.5 mm.
Eggs are laid on the bark in summer (sometimes on supports, such as egg-masses of Lymantria dispar; see above, and Bin (1980)). Parasitized eggs have been found in late autumn (Bin 1980). L. dispar, however, is rare or absent on this Tilia avenue and eggs are probably laid in bark fissures or moss on the trunks. No eggs, in fact, were found.

It cannot yet be determined whether adults breed in their first summer or only after the winter dormancy, or both. Larvae evidently complete their entire cycle on the trees, since these flank an avenue with heavy foot and wheeled traffic, and their bases are surrounded by concrete and stones with no room for suitable vegetation.

Absence of most instars in summer and early autumn, is probably due to their preying on Lepidoptera larvae on branches and foliage. In November, mature, 3rd-instar larvae (in Dromius, the cycle is a normal one composed of three instars) sheltered under the bands with the adults to hibernate. Their diapause, like that of the adults, may be interrupted or irregular. One larva, in fact, and some adults, were collected in January from under bands applied monthly. They had stopped feeding, all larvae taken in autumn and winter died without metamorphosis.

In March – April, larvae and adults begin to be active. The larva do not eat and metamorphose. In nature, they probably look for a sheltered fissure and scales in the bark or trunk in which to pupate. In the laboratory, adults appeared in 12–14 days 17–24 April to 3–6 May, and 24–26 April to 6–7 May.

Food
On finding Dromius (probably D. meridionalis) egg-cases on Lymantria dispar egg-masses, Bin (1980) suggested that this oviposition could be casual, but the formation of an egg-case, regarded as a form of parental care, and possibly also the place chosen for egg laying could be closely related to the diet of larvae. Therefore, larvae of Dromius sp. could be predators of the Gypsy Moth eggs, or newly hatched larvae. As already stated, L. dispar is rare on the Sambian lime-trees, whereas adults and larva of D. meridionalis (and other Lobeinae, see section Associated Carabidae) are rather abundant. The only food available to the plentiful larvae of two small moths, Ephesia elutella pterogrsella Roslerl (Pyralidae, Phycitinae) and Denisonia sp. (Oecophoridae) Several of their larvae were collected in the company of Dromius larvae and adults, and adults were obtained in March and April from hibernating larvae.

It cannot yet be shown whether D. meridionalis larvae or adults prey on eggs or newly hatched larvae of a so large moth as L. dispar, whose newly hatched larvae is the same size as the mature Dromius larva and becomes many times larger in a few days. The observation of D. meridionalis egg-cases and oviposition on L. dispar egg-masses could thus be a simple, although very interesting, shelter form for the eggs, without any parental care.

Associated Carabidae
We also found the following Lobeinae species: Philotrates crucifer crucifer (Lucas, 1846) (the most common, in all seasons), Calodromus bifasciatus (Dejean, 1825) (7 August 1 specimen, 27 October 1 specimen), Paradromus linearis (Olivier, 1785) (28 July 1 specimen, 12 October 1 specimen), and Lebila scapularis (Fourcroy, 1785) (2 June 1 specimen).

There was also a single specimen of Phyla tethys (Netolitsky, 1926) (6 October), a winged species of Bembidium very common in Sardina, the occurrence of which is certainly casual. Also the presence of P. linearis, too, is rather unusual in these "arbores" conditions, since it is normally riparian, common on sandy shores along rivers and marshes, often on or near Carex spp and Phragmites aquatic plants.

368
DISCUSSION AND CONCLUDING REMARKS

In Europe and the Mediterranean Region, Dromius (sensu stricto, excluding lionychina, which are terrestrial, sandy dwellers both as adults and larvae) are represented by some genera, with several species more or less adapted to live in vegetation.

Four genera in particular are close to each other:

1) *Paradromius* Fowler, 1886, with *P. lineatis* and *P. longiceps* (Dejean, 1826), both tied to moist environments, along rivers and marshes, sometimes climbing on aquatic plants. Eggs are laid in the soil and larvae are terrestrial (Jeanmel 1942).


3) *Calodromius* Reitter, 1905, with two species in Italy (Vigha Taglianti 1993) both living in vegetation.

4) *Dromius* with several species (five in Italy: Vigha Taglianti 1993), all winged and normally associated with arboREAL plants, in both lowland and in highland forests.

As mentioned in the Introduction, Dromini have been observed several times on trunks and foliage. Some species (Habu 1967 ex Hicks, Casale, 1983) have been collected in bird's nests. Jeanmel (1942) lists scolytid beetles as possible preys of *D. marginellus* Fabricius, 1794 (= *D. schneideri* Crotch, 1870).

Burmeister (1939) and Jeanmel (1942 ex Perris) report larvae and adult specimens of *Calodromius spondus* (Illiger, 1798) (= *C. quadriradiatus* Panzer, 1801) feeding on young larvae of the weevil *Pissodes rotatus* (Fabricius, 1787).

Bisio (1996) has found large numbers of adults of several *Dromius* and *Philorhizus* species hibernating under the bark of living trees at a rather high altitude in the Western Alps.

---

<table>
<thead>
<tr>
<th></th>
<th>Spring</th>
<th>Summer</th>
<th>Autumn</th>
<th>Winter</th>
<th>Spring</th>
</tr>
</thead>
<tbody>
<tr>
<td>egg</td>
<td></td>
<td></td>
<td></td>
<td>dormancy</td>
<td></td>
</tr>
<tr>
<td>larva</td>
<td></td>
<td></td>
<td></td>
<td>dormancy</td>
<td></td>
</tr>
<tr>
<td>pupa</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>adult</td>
<td>Diaperal and breeding</td>
<td></td>
<td></td>
<td>dormancy</td>
<td>?</td>
</tr>
</tbody>
</table>

Fig. 8. Reconstructed life cycle in northern Sardinia (Italy) of *Dromius meridionalis* Dejean, an under-canopy, trunk dweller casul beetle.
This study of *D. meridionalis* has shown that:

1. it is a developmental type with larval dormancy;
2. it has a poorly specialized way of life, since it can also colonize cultivated trees along avenues in the heart of a city;
3. it may prey on Lepidoptera larvae from the Pyralidae (*Ephesia elutella pterogrisea Roesler*) and Oecophoridae (*Denisa* sp.). Predation on moth larvae from various families has been demonstrated several times for the Lebiinae, for example *Calleida* (Andrewes 1933, Habu 1967, Zhou & Goyer 1993).

A more varied diet (larvae of xylophagous, subcorticolous beetles) seems not impossible, in our opinion, for the more generalist species. The xylophagous Scoyliidae or Curculionidae reported as possible preys of other *Dromius* species, however, were not found on the Sassari lime-trees.

The larval morphological characters were in line with those illustrated for other European *Dromius* species (Jeanne 1942 ex Schööle, van Emden 1942, Sharova 1958).

The tarsal claws of mature *D. linearis* larvae are toothed and peculiarly asymmetrical. In *D. pictus*, two ventral teeth on each claw are present (Maher et al. 1983).

The pupa of *D. meridionalis* is described for the first time in this paper. It displays several peculiar features compared with another obtained from another (not bred) larva, which probably belonged to *Philothiurus crucifer*.

As several authors have remarked, the pupal morphology of carabid beetles is so poorly known because the complete development of many species is very difficult to achieve in the laboratory.

**Acknowledgements**

We thank Dr. J. Mocch (Sassari) for his help in the elaboration of figures of the life cycle and Dr. O. Bassi (Trento) for the identification of associated Lepidoptera.

**REFERENCES**


BOOK REVIEW


The author is a professor emeritus and director at the Institute of Genetics of the University in Bonn (Germany). Previous editions of this book occurred in print in 1978 (a reprint in 1982 – also translations in Japanese and Spanish), further on in 1984 and in 1989. As stated in the preface, last decades have seen major advances in the field of molecular genetics and the gene physiology. Today, it is hardly possible to embrace the whole range of genotypes in a single volume. Thus, the subjects of classical genotypes are generally treated only in a very limited frame. The reader might get a distorted idea that the classical genetics represents a closed field of scientific activity. However, this idea is incorrect. It is to be emphasized that modern molecular genetics is built up on classical genetics and both scientific branches are closely interrelated. In the introduction listed are basic biological disciplines the knowledge of which for geneticians essential is – the cytology, karyology, biochemistry, physiology, microbiology, cultivation of plants and animals, and biometry. From plant and animal experiments conclusions may be drawn to the human geneticians. The volume consists of 13 chapters.

The introductory chapter deals with prokaryotes and eukaryotes as subjects of genetic investigations. In the chapter 2, analyzed are the cellular basis of genotypes, the sexual and sexual types of reproduction, exchange of generations, nuclear division – mitosis and meiosis, spore formation, the effect of mutagens, and genotypic regulation of microorganisms. In the chapter 3, genetic material, genes and exons, chemical structure of genes, DNA replication, transformation, transduction and transposition, and chromosome size and genotypes are examined. Chapter 4 focuses on the influence of external environment upon the genotype and phenotype modifications. Chapter 5 is devoted to general laws in classical genetics – to Mendelian principles of inheritance and genetic terms when discussing genetic linkage, intrachromosomal recombination, gene location, positive and negative types of recombination, inheritance related to sex, and miscellaneous gene functions. In chapter 6 discussed are the gene, chromosome and genome structure, pathways of mutagenic effects and DNA repair. Following four chapters provide insights into fundamental principles of evolution, sex determination, extrachromosomal inheritance, genetic regulation of biosynthesis, and transcription and translation as principal steps for protein biosynthesis. Chapter 12 covers the regulation of gene activity in prokaryotes and eukaryotes. Concluding chapter 13 gives an overview of methods used in genetic manipulations, genetic isolation and cloning, integration of eukaryotic genes into prokaryotic systems, transgenic organisms, and genome manipulations (genetic engineering) in microorganisms.

This book is based on a continuing tradition of four editions and international translations within 16 years. It is illustrated by 120 figures composed of 262 line drawings and photographs. These figures present the chromosomes, phases of mitosis biological cycles in organisms with different chromosome complement, diagrammatic representation of gene maps, production of germinal cells, modes of genetic recombination and associations of genetic processes and procedures. In addition, there are 13 tables summarizing miscellaneous genetic phenomena and abnormalities. This successful text has a practical pocket format – it offers a slight dimension and an easy-to-follow language a good amount of principal and updated informations on classical genetics.

SandFisch Jurz
Description of the first instar larva of *Thalassophilus longicornis* (Coleoptera: Carabidae: Trechodina)

Vasily V. GREBENNIKOV

Department of Zoology and Ecology, Moscow State Pedagogical University, Kubacheva str. 6/5, ROS-129278 Moscow, Russia

Received May 28, 1996, accepted June 27, 1996 Published December 27, 1996

Abstract The first instar larva of *Thalassophilus longicornis* (Sturm, 1825) is described, representing the second species of Trechina known in the larval stage. A preliminary diagnosis of the genus *Thalassophilus* Wollast, 1854 on the basis of larval features is given. Lack of the lacina, pores PR, PR, PR, PR, on the pronotum, ME, ME, on the naso- and metasternum, testa ES, on the metasternum and pore TB1, on all abdominal tergites in *Thalassophilus* are typical features for all known Trechina larvae. On the other hand two unequal clavae with a very long angle clavae seta, absence of the pore PA, on paranotal, testa FM, on meso- and metasternum, testa FP, on ninth abdominal segment and some other unique larval features within Trechina show the isolated position of *T. longicornis* within all other known Trechina larvae.

Larva, description, morphology, Coleoptera, Carabidae, Trechina, *Thalassophilus*, Palearctic region

INTRODUCTION

The group of the subtribes Perileptina, Trechina and Trechina is, from a taxonomic viewpoint, one of the most intricate within the Carabidae. Undoubtedly, these taxa are more related to each other, than to other Trechina tribes known in the larval stage (Bembidini, Tachyini, Pogonini) and some authors consider them as a large tribe Trechina (s. l.) (Jeannel 1926, Kryzanovskij 1983). Phylogenetic relationships between these three groups are treated by various specialists in different ways, as discussed by Belostov & Kabak (1993).

The subtribe Trechina occurr, gondwanienre indo-africano-austral-malagache, avec un genre (*Thalassophilus*) emergre en Europe ou la limite nord de son aire a été remaniée par le Glaciage" (Jeannel 1926). Now some new interesting data have been published Trechina from Russian Far East (Moravec & Wrase 1995, Ueno et al. 1995). Very little has been published about the larvae of Trechina and the third instar larva have been described only of *Amblyostegium pacificum* (Putzey, 1870) (larva was originally described as *A. murcium* Enderlein, 1905) (Drygalski 1909, Womersley 1937, Jeannel 1941). This taxon was included by van Emden (1942) in his study of Carabidae larvae.

MATERIAL AND METHODS

This study is based on a single raised ex ov Bro first instar larva of *Thalassophilus longicornis*. Adults were collected by the author on April 14, 1995, on the sand-dwelled beach of the middle course of the Belaja River (West Caucasus). The larva was dissected on May 26 and fixed on May 28.

The larva was mounted on a permanent microscope slide with Ferro-Beige liquid and studied under a light stereo-microscope at 200 or 900x. Notation of the primary setae and pores follows Bousquet & Goulard (1984). An asterisk (*) after a number means that the homology of the sets is uncertain. The larva is deposited in the author's collection.
RESULTS

Description of the first instar larva of *Thalassophilius longicornis* Sturm, 1825

Habitus (Fig. 1). Larva slightly sclerotized, very slight; tergites without keels; main part of setae longer than in usual Trechinae larvae.

Cephalic capsule (Figs 2, 3) subquadrate (width 0.30 mm, length 0.29 mm); flat, parallel-sided anteriorly and slightly convergent posteriorly; ocellar tubercles, ocelli, postocellar and cervical grooves absent; egg-bursurers and teeth-like or pointed microsculpture on head absent; epicranial suture long (ratio epicranial suture length / head length 0.18); frontal suture slightly covered; apical part of frontal wide and less protruding; nasale (Fig. 8) less protruding, with two rows of teeth anteriorly.

Microsculpture on parietale transverse; covering all of parietale (including near setae PA9, and lateral and ventral surfaces); shape of parietal microsculpture equal dorsally, ventrally, and laterally; frontal with transverse microsculpture in basal part (at base of setae FR, and FR); frontal along medial line smooth, without microsculpture; Clypeus with slightly developed transverse microsculpture.

Chaetotaxy of cephalic capsule. All primary setae and pores (except PA9) present; additional sensilla absent; length of setae PA9 = 0.5 length PA9; length of setae PA9 and PA9 = 0.6-0.8 length PA9; setae PA9 and PA9 longest on head; distance PA9 = PA9 = 3× distance PA9, PA9, setae FR, and FR9 long, subequal to PA9, and = 0.5 length FR9, setae FR and FR not together; distance FR9 – FR9 = 1.5× distance FR9 – FR9 and = 2× distance FR9 – FR9; pore FR9 and seta FR9, drawn to together, distance from frontal suture to FR9 = 2.5× distance FR9 – FR9; seta FR9 very small, subequal to seta FR9, pore FR9, and seta FR9 drawn together; length of seta FR9 = 0.3 length FR9; setae FR9 and FR9 not drawn together, distance FR9 = FR9 = 2× distance FR9 – FR9; pore FR9 at level of pore FR9, seta FR9 at margin of frontal; ventral surface of paraclypeus with two small setae on each side (Fig. 4); small sensillum between pores FR9 and FR9 present; seta FR9 longer then FR9, anterior angles of hypopharynx with 12 round sensilla on each side (Fig. 4).

Appendages of head with all primary setae and pores; without additional sensilla.

Antenna (Fig. 5): proportions of articles 1:6:1:3:3:0:1:3; apical part of antennomere 3 very long, its lateral surface sclerotized; sensilla on antennomeres 3 and 4 well developed; both bell-like sensilla on antennomere 3 long (ratio length / width 4–6); sensorial appendage on antennomere 3 very elongated, as long as antennomere 4; all three basiconical sensilla of antennomere 4 dorsal and very long.

Mandibles (Fig. 6) slightly covered; retinaculum perpendicular; penicillus not extended to retinaculum; terebra with 2–3 larger and 9–12 smaller teeth; dorsal keel slightly developed, dorsal surface near pore MN smooth, without teeth.

Maxillae (Fig. 7): cardo without teeth; stipes narrow (ratio length / width 3.5); without large teeth on base; with 12–15 small teeth of microsculpture at level MX9; dorsal side fully sclerotized, without membranous surface; pore MX9 slightly apical to MX9; group gMX with 9–11 setae; apical seta of this group beyond level of MX9; other setae of gMX basally level of MX9; seta MX9 small, its length = 0.5 length of MX9, seta MX9 small, its apex not extending to inner
Figs 1–7. First instar larva of *Thalassasphilitus longicornis* (Sturm). 1—general view, 2—cephalic capsule (dorsal view), 3—cephalic capsule (ventral view), 4—right anterior angle of frontale, 5—left antenna, 6—mandibles, 7—left maxilla. Notation of the primary setae and pores follows Bousquet & Goulet (1985). Scale bars: Fig. 1—0.5 mm; Figs 2–7—0.1 mm; Figs 5, 6, 7—0.1 mm.
margin of s tipes; galea long, its length = 2/3 length of maxillary palp; length of galeomere 1 = 0.5 length of galeomere 2; galeomere 2 very narrow (ratio length / width 9); seta MX8 small, no longer than width of galeomere 2; seta MX9 in proximal quarter of galeomere 2; seta MX10 situated at top of galeomere 2; proportions of maxillary palpomeres 1:2:1:1, setae MX1 and MX10 very small, no longer than 0.1 width of palpomere 3; palpomere 4 normal, not divided into secondary sclerites.

Labium (Fig. 9) with very small teeth on lateral sides of dorsal surface; ligula protruding, not sclerotized (Fig. 10); palpomere 2 normal, not divided into secondary joints; seta LA1 long, extending to apex of palpomere 1; setae LA2 and LA3 small, subequal in width to base of palpomere 1; seta LA4 on dorsal side of ligula; setae LA5 and LA6 flat, not extending to apex of palpomere 1.

Thorax (Fig. 13): transverse microsculpture developed only on pretergites of meso- and metanotum; additional sensilla absent.

Prothorax with all primary setae and pores (except PR1, PR2, PR3, PR4, and 3PS); setae PR1, PR2, and PR3 subequal to each other; seta PR4 removed basally; seta PR5 comparatively long, subequal to 4 diameters of seta PR6 at base; pore PR7, beyond to level of PR8, episternites, epimerites and sternites of pronotum with all primary setae and pores.

Meso- and metanotum with all primary setae and pores on tergites (except pores ME1 and ME2); setae ME1,2 on meso- and metanotum comparatively long, subequal to 3 diameters of seta ME1 at base; length of seta ME6 = 0.8 length ME1; setae ME1,2, ME3,4 and pores ME5, ME6 removed to medial line; lateral and ventral surfaces of meso- and metanotum with setae ST1, ST2, PL1, TS1, MS1, MS2, MS3, MS4, MS5; setae ES1, EM1, and 3MS1 absent.

Legs (Fig. 11): with two unequal claws (anterior claw longer than posterior one); with a single claw seta subequal to posterior claw; all other articles with all primary setae and pores, without additional sensilla; seta TA1 in proximal one-sixth of tarsus; tibia short; setae TI1 and TI2 very thin and long; setae TI3, TI4, TI5, TI6, TI7, and TI8 thick and short; setae TI9 and TI10 longer than TI5, TI6, and TI7; seta FE1 very small; length of seta FE2 = 3× length FE1; setae FE3 and FE4 thin and long; setae FE5 and FE6 thick and short; seta TR4 long, subequal to TR5.

Abdomen (Figs 12, 13): first abdominal segment with all primary setae and pores (except pore TE1, and one setae of ST1 or ST2), without additional sensilla; segments 2–8 with all primary setae and pores (except setae TE1, TE2, and pore TE3), segments 2–7 with one additional seta on median sclerites on each side; eighth segment without additional setae; length of seta TE1 = 0.9 length TE2; setae TE3 comparatively long, subequal to 3 diameters of seta TE3 at base; tergites 1–8 smooth, without microsculpture, base of urogomphi and dorsal side of pygidium with slightly developed pointed microsculpture; urogomphi (Fig. 12) thin and straight; their length = 1.2 length of pygidium, urogomphi and pygidium with all primary setae and pores (except EP1, on ninth abdominal segment); sternal sclerite of ninth abdominal segment with a single unsymmetrical additional setae on left side; seta UR1* near UR4; setae UR2* and UR3* comparatively long, their length = 2× width of apex of urogomphi; seta PY1 long, extending to apex of pygidium.

Preliminary larval diagnosis of the genus Thalassophilus Wollaston, 1854

Within the supertribe Tachitidae (sensu Kryzanovskij 1983) only the larva of Thalassophilus longicornis is characterized by: egg-bursters and teeth-like or pointed microsculpture on the head absent; transverse microsculpture on parietal covering all the sclerites (including place near seta PA8, lateral and ventral surfaces); shape of transverse microsculpture subequal on all surface of parietal; pore PA9 absent; sensorial appendage on antennomere 3 very elongate (ratio length / width 3.5); seta MX8 in proximal quarter of galeomere 2; galea very long, its length
Figs 8–13 First instar larva of *Thaumesthes longicornis* (Suhr) 8 – maxilla 9 – labium 10 – legula 11 – leg 12 – urogomphi and pygostum (dorsal and ventral view) 13 – pronotum, metasternum and fourth abdominal segment (dorsal and ventral view) Notation of the primary setae and pores follows Bonnequet & Goulet (1990) Scale bars: Figs 8, 9, 11–0.1 mm, Figs 12, 13–0.1 mm
0.6 length of maxillary palp; galeomere 2 very narrow (ratio length/width 9); setae ME_h, ME_b, and pores ME_s, ME_r removed to median line; setae EM on meso- and metanotum absent; legs with two unequal claws; single claw setae very long; abdominal segments 2–7 with one additional seta on median sclerite on each side; seta EP_t on ninth abdominal segment absent; seta UR_s* near UR_s. Additionally, the larva of *Thallastophilus longicornis* is distinguishable from all Trechini larvae known to me by the normal maxillary palpmere 4 and labial palpmere 2, which are not divided into secondary sclerites.

**DISCUSSION**

The lack of lacina, pores PR_s, PR_c, PR_p, PR_r on pronotum, ME_c, ME_s on meso- and metanotum, seta ES_s on metanotum and pore TE_s on all abdominal tergites of *Thallastophilus* are typical features for all Trechitae larvae known to me.

It is possible to distinguish three main groups of the features of the first instar larva of *Thallastophilus longicornis*:

1. The adaptive features: slightly sclerotized and very slight body; tergites without keels; all setae more long than usual for Trechitae larvae; cephalic capsule flat, parallel-sided; ocellar tubercules, ocelli, post-oecellar and cervical grooves absent; apical part of antennomere 3 very long, its lateral surface sclerotized; sensilla on antennomere 3 and 4 well developed; both bell-like sensilla on antennomere 3 long; sensorial appendage on antennomere 3 very long and narrow, as long as antennomere 4; dorsal side of stipes fully sclerotized, without membranous surface. All these features are more or less developed within all other Trechitae larvae with a special way of life (main part of Trechini; some Bembidini (sg. *Synechistletes* Mothschinski, 1864 and *Pseudolimnaea* Kraatz, 1888 of the genus *Bembidion*).

It is possible that the absence of egg-bursters and teeth-like or pointed microsculpture on the head; the absence of small teeth on dorsal surface of mandible near pore MN_s, and the very narrow joints of maxillae (particularly the galeomere 2) are also adaptive features.

2. The features, sometimes marked within other Trechitae taxa: pore FR_s removed to level of pore FR_h, setae T_h and T_l, very thin and long (*Aepus robinii*); terebra with large teeth (*Poratophyes bicuspidatus* (Nicolai, 1822), *Paratacycys* spp.); maxillary palpmere 4 and labial palpmere 2 normal, not divided into secondary joints, (*Bembidini, Tachyni, Pogonini*); setae LA_s and LA_r, flat (sg. *Synechistletes* and *Pseudolimnaea* of the genus *Bembidion*); seta ES_s on metanotum absent (*Aepus robinii*).

3. Unique features within the supertribe Trechitae: lacking of pore PA_s on parietale, setae EM, on meso- and metanotum and EP_s on ninth abdominal segment; setae MX_s in proximal quarter of galeomere 2; abdominal segments 2–7 with one additional seta on each side of median sclerite; seta UR_s* on urogomphi near UR_s.

Presence of two unequal claws with single long claw setae is of a great interest. The main part of so far known Trechitae larvae have one claw with one short claw seta. Larvae of *Perileptus areolatus* (Creutzer, 1799) (Perileptina) have two claws equal to each other with two long flat claw setae (Bördellöf 1936, Luft 1955). Larvae of *Amblytogenium pacificum* (Trechidina) have „the tarsus ends in two claws, one being slightly longer than other” (Womersley 1937). It is not possible now to mark one of these states as apomorphic or plesiomorphic.

Lack of the setae PS_t on pronotum and MS_s on meso- and metanotum is a very remarkable feature. Usually, the set of setae on the ventral surface of the thorax is very constant. These setae
are present within all Trechita larvae known to me, but I cannot find them on the single microscopical slide. It is possible that absence of these setae is only an individual aberration.

A very remarkable feature of seta UR, must be stressed. Within all Trechita larvae known to me the shape and location of the seta UR is a generalized type (Bousquet & Goulet 1984) and are urogonoph without any additional setae. Is the short seta on the outer side of urogonoph near UR homologized to the seta UR, or not? Can the seta UR be removed to the level UR, or is this seta an additional sensillum and the seta UR, is reduced? I do not know and I hope, that future investigation will answer this question.

Unfortunately, it is nothing known to me about way of life of Thalassophilus larvae. The raising in the Petri-dish does not show the behavior of it. But morphologically, the Thalassophilus larva is one of the most highly specialized of all Trechita larvae known to me. Is it microcavericolous, interstitial or anything else? How is the morphology connected with the larval way of life? Is there any connection between the presence of two claws within Trechita larvae and living on sand-alluvial beaches?

From all the facts stated above, the following conclusion can be drawn. The larva of Thalassophilus longicornis is one of the most highly specialized of all so far known larvae of Trechita and shares a set of adaptive features, some of them unique within Trechita larvae. Besides that, there are some original features that are also marked within the other Trechita groups. There are many Trechita taxa having still unknown larval stages. Thus the relationships between Thalassophilus and other Trechita cannot be discussed now. I hope, however, that these questions will stimulate entomologists to rear and study the morphology and behavior of Carabidae larvae, particularly Trechita.

Acknowledgements
I am very grateful to my scientific chief Professor I. K. Sharov and also to Dr K. V. Makarov (all from Moscow) for their help and advice. I also express my sincere thanks to Dr. M. L. Luff (Newcastle upon Tyne), who kindly provided me with larvae of Anaxius minutus and some other Trechita for rearing and corrected my English. This study was supported by the Russian Foundation for Basic Research (93-04-00191).

REFERENCES
BOOK REVIEW


The authors are professors at the university in Bochum, the first at Chair of Special Zoology and Parasitology, the second at Chair of Cell Morphology. As indicated in the preface, free-living protozoans play a major role in the food chain. Parasitic forms expose to danger plants and human and animal health. The volume consists of five chapters which are subdivided using the decimal system. Each chapter is concluded with an extensive list of references to the primary literature.

Chapter 1 is intended to give a brief introduction to the protozoa and protozoology. Discussed here are the terms „protozoa“ and „protozoology“. Chapter 2 presents a protozoa classification scheme embracing all of the higher-level groups. Listed here are the phyla, subphyla, superfamilies, classes and orders of protozoa. Each systematic group is featured by a description of general morphological and biological characteristics together with a list of representative genera and species. Among the phyla, seven phyla are recognized: the Sarcomastigophora, Labrhomastigophora, Apicomplexa (syn. Sporozoa), Microspora, sarcocystosis, Ciliophora and Spirocytozoa. Principal for the human and veterinary pathologist is the class of Zoonomastigophora which comprises the trypanosomatids, leishmanias, trichomonads, giardias and some intestinal flagellates. Among the class of Leishmaniasis registered are the cystogenic amoebaeEntamoeba histolytica, Acanthamoeba castellani and Naegleria gruberi. Cystogenic protozoa of uncertain systematic affiliation are also mentioned here: Blastocystis hominis and Pneumocystis carinii. The subclades of eukaryotic parasites includes the euglenids, toxoplasmas, sarcocystosis, cryptosporidias, microspora, plasmodia and sialodacida. Some representatives of the Microspora have been recognized as opportunistic pathogens in immunocompromised patients. Finally, the relations are looked at here.

Chapter 3 is devoted to the free-living protozoans and their functional morphology, to the cell membrane, cytokinesis, cytoplasm, miscellaneous organelles and to the nucleus. Other parts of this chapter discuss the multiplication, the energy exchanges and locomotion, and the role of protozoans in the ecosystems.

Chapter 4 examines the parasitic protozoa. Described here are the various forms of parasitism and the architecture of these organisms: the cells for compartmentation, surface coat, the nucleus and various cellular organelles, cytoskeleton, the reproduction, metabolism, the ways of transmission, cryptosporidiosis, pathogenic effects, in vitro cultivation, immune reactions against the pathogenic protozoa, diagnostic procedures and chemotherapy. Chapter 5 and the appendix contain a list of textbooks and monographs and instructions for the cultivation of free-living protozoa. The volume concludes with taxonomic and subject indexes.

The textual information in this volume is extensively supported by 181 informative figures composed of schematic line drawings and light and electron microscope photographs. Moreover, there are five tables summarizing the chromosome structure in some parasitic protozoa, the glucose metabolism, cryptosporidiosis and cultivation, and selection of appropriate antiprotozoal drugs. The authors offer a readable and well-arranged compendium for scientists who wish to become familiar with the taxonomy and biology of protozoa.

Jindřich Jirásek
Description of the first larval instar of Aptinus bombarda (Coleoptera: Carabidae: Brachinini)

Oldrich HOVORKA

Insect Chemical Ecology Unit, Institute of Organic Chemistry and Biochemistry, AS CR, Flemingovo nam. 2, CZ-166 10 Praha 6, Czech Republic

Received April 17, 1996, accepted June 27, 1996
Published December 27, 1996

Abstract The first instar larva of Aptinus bombarda (Illiger, 1806) is described and illustrated. It is compared with the only other species of this genus known in larval stage, Aptinus displasor (Dufour, 1811). A. bombarda differs from this species in the larval stage by presence of egg hatching teeth, by only two pairs of setae on prementum absent, and by reduced sternites.

Description, larval morphology, Coleoptera, Carabidae, Aptinus, Palearctic region

The genus Aptinus Bonelli, 1810 is represented by nine species in the western part of the Palearctic region, exactly in the northern part of the Mediterranean subregion. It is the only genus of the subtribe Aptinina represented in this region (Erwin 1970). The genus was divided in two subgenera, Aptinus s. str. and monotypical Aptinidius Jeannel, 1942 with the species A. displasor. The latter subgenus was synonymised with the Aptinus s. str. by Erwin (1970) in his reclassification of the subfamily Brachininae (given as division Brachinida).

Very little has been published about the larvae of Brachininae and mostly first instar larvae are described only. The problem is that the larvae of the species belonging to this subfamily are, as far as it is known, ectoparasitic (Erwin 1967, Habu & Sadanaga 1969, Hůrka 1978, Bousquet 1991 etc.). The hosts or the other than first instar larvae are not known for any European species of Brachininae. The only so far known larva of genus Aptinus is that of A. displasor (Dufour, 1811) (Wautier & Viela 1967). The first instar larvae of several Palearctic species of related genus Brachinus Weber, 1801 (Brachinina) were described by Emden (1942), Wautier (1963, 1964) and Habu & Sadanaga (1965) and those of genus Pheropsophus Soeller, 1833 (Pheropsophini) by Emden (1942) and Habu & Sadanaga (1965, 1969).

MATERIAL AND METHODS

The studied larvae were reared in 1990 at the Department of Zoology, Charles University, Prague from eggs laid by captured adults. The origin of the adults was as follows: Slovakia: 1 male, Kovačov, (8178) 14.v 1990, O. Hůrka leg. 2 males and 1 female.

The method of rearing was as described by Hůrka (1972).

The larvae were fixed and preserved in 70% alcohol and some were mounted in Canada balsam. The material is deposited in collection of author (five first instar larvae).

Terminology of morphology and chaetotaxy is adopted from Bousquet & Goulet (1984). The methodology of measurement of some body parts was as in Hůrka (1991)
First instar larva of *Aptinus bombarda* (Illiger, 1800)

Total length 2.1–2.2 mm; head width 0.29–0.30 mm. 

**Color.** Mandibles brownish, head, pronotum and prosternite yellowish, antennae, maxillae, labium, legs, meso- and metathorax and abdomen paler.

**Head capsule** (Fig. 1). Subquadrate, as long as wide or 1.1 times longer than wide. Frontal suture S-shaped, coronal suture absent. Ocular tubercle and stemmata absent, no traces of pigmentation are present. Cervical groove absent. Frontale: setae FR\(_1\) and FR\(_2\) large, as long as (FR\(_3\)) or longer than (FR\(_3\)) first antennal segment. Setae FR\(_4\), FR\(_5\), FR\(_6\), FR\(_7\) and FR\(_8\) very short, seta FR\(_9\) pore-like. Setae FR\(_9\) and FR\(_10\) absent, anteriorly to seta FR\(_8\) are present only 2 extremely small sensillae (such sensillum placed between FR\(_8\) and FR\(_9\), too). Pore FR\(_{10}\) absent. Two pairs of egg-burster teeth are present on posterior part of frontale. Parietale: ancestral setae are present only. Setae PA\(_{1}\), PA\(_{2}\) and PA\(_{10}\) are longest on dorsal side of parietale, there are approximately as long as first and second antennal segments together. Other setae on dorsal, lateral and ventral parts of parietale are moderately long, longer than diameter of the first antennal segment (with exception of PA\(_{1}\), PA\(_{2}\) and PA\(_{10}\)).

**Mandible** (Fig. 3). Long, slender, without penicillus. Retinaculum is small, 5–6 times shorter than width of mandibular base.

**Antenna** (Fig. 4). Without additional setae. Third antennal segment is the longest and the widest, length ratio of antennal segments 1.4:0.6:2.3:1.

**Maxilla** (Fig. 5). Stipes without setal group gMX, 1.4–1.7 times longer than wide. Lacinia not entirely reduced, visible as small basolateral projection near base of seta MX\(_4\). Galea distinctly two-segmented with distal segment very long, 2.5–2.8 times longer than basal segment. Seta MX\(_4\) inserted ventrally, approximately as long as distal segment of galea. Apex of distal segment of galea bearing two additional setae and small sensillum. Maxillary palpus without additional setae, length ratio of its segments 0.7:0.8:0.5:1.

**Labium** (Fig. 2). Prementum with only 4 primary ancestral setae on each side, setae LA\(_1\), and LA\(_{10}\) absent. Labial palpus without additional setae. Basal segment of labial palpus as long as second and 1.5–1.7 times wider than second segment, which is bearing large apical sensillum.

**Thorax.** Prothoracic sclerites without additional setae. Proepisternum with only 1 primary ancestral seta (ES\(_1\)). Seta PS\(_1\) on prosternite very small, pore-like. The largest setae on pronotum are PR\(_3\) and PR\(_6\), which are as long as or longer than first and second ancestral segments together, setae PR\(_7\)–PR\(_9\), PR\(_{10}\), PR\(_{10}\)–PR\(_{14}\) some shorter, subequal in length. Meso- and metathoracic sclerites without additional setae. The biggest seta on meso- and metanotum is MPE\(_{1}\), which is approximately as long as setae PR\(_{1}\) or PR\(_{9}\). Legs without additional setae. Tarsus bearing only one claw, this claw without any seta (Fig. 6).

**Abdomen.** Abdominal tergites without additional setae. Setae TE\(_7\)–TE\(_{14}\) and TE\(_{15}\) are small, almost as long as PA\(_{1}\) or shorter than this seta, setae TE\(_{1}\), TE\(_{10}\), TE\(_{11}\), TE\(_{12}\)–TE\(_{14}\) are moderately long. Epipleurite with both setae of equal length or the dorsal anterior seta EP\(_{1}\), a little longer than EP\(_{2}\). Sternal sclerites without additional setae. Urogomphi very short, only 1.3–1.5 times longer than wide, seta UR\(_{1}\) inserted on ninth tergite. Sternal sclerites without additional setae.

**Discussion**

The larva of *A. bombarda* differs from that of *A. displosor* by presence of egg bursting teeth, absence of stemmata and by presence of setae LA\(_{1}\) and LA\(_{10}\) on prementum (see Wautier & Viala 1967, Arndt 1991).
The paired egg-bursting teeth are unique within Brachimini (see Emden 1942, Wautier 1963, 1964, Wautier & Viala 1967, Habu & Sadanaga 1965, 1969, Hürka 1978, Arndt 1991). There are no egg-bursters in nearest relative A. displosor or in any Brachinus species, and one unpaired egg-burster in Pheropsophus species. This fact seems to support the possibility of subgeneric validity of Aptinidius, but it is necessary to know the state of this character in other species of the genus, and, moreover to find any other, not reductive in character.

The mentioned presence of seta LA5 on prementum doesn’t agree with data published by Wautier & Viala (1967) and subsequently by other authors (e.g. Arndt 1991). The absence of setae LA4-LA5 is by Arndt used as typical character state for genus Aptinus Bonelli, 1810 and

Figs 1-7. Aptinus bombardae (Illiger), first larval instar. 1 - head capsule, dv, 2 - labrum, dv, 3 - right mandible, dv, 4 - left antenna, dv, 5 - left maxilla, dv, 6 - head tarsus, lv, 7 - ninth abdominal segment and pygidium, dv. Scale: 0.1 mm (dv - dorsal view, lv - lateral view)
Brachinus Weber, 1801 1 found this sets, which is small and indistinct, in all specimens of studied species and moreover on my material of larvae of Brachinus creptans (Linnaeus, 1758) and Brachinus explodens Duftschmid, 1812

It is obvious that some details published in descriptions of the larvae of Brachinim are not exact. Only next studies can bring exact data and, maybe, help us to resolve some taxonomical problems and find affinities within this unique group of carabid beetles.

REFERENCES


EMDEN T VAN 1942 A key to the genera of larval Carabidae (Col.) Trans Roy Entomol Soc London 92 1-99


ERWIN T L. 1970 A reclassification of bombardier beetles and a taxonomic revision of the North and Middle American species (Carabidae Brachinidae) *Quest Entomol* 6: 4-215

HARU A & SADANAGA K. 1965 Illustrations for identification of larvae of the Carabidae found in cultivated field and paddy fields (II) Bull Nat Inst Agric Sci (C) 19: 81-216

HARU A & SADANAGA K. 1969 Illustrations for identification of larvae of the Carabidae found in cultivated field and paddy fields (Suppl 1) Bull Nat Inst Agric Sci (C) 23: 111-143


HURKA K. 1972 Über Ergebnisse der Aufzucht von mitteleuropäischen Laufkäfern der Gattung Carabus (Coleoptera) *Pflanzenkunde* 12: 244-253


WAUTER V 1963 La larve de Brachinus (Brachynius) longicornis Gebler (Coleoptere Carabique) *Bull Mens Soc Linn Lyon* 32: 13-20

WAUTER V 1964 Les larves de Brachinus (Carabipe Carabique) obtenues en élevage *Bull Mens Soc Linn Lyon* 33: 350-362

WAUTER V & VIJLAC C. 1967 Les larves de Brachinus (Aptinae desilusor (Dufour), Coleoptere Carabique *Bull Mens Soc Linn Lyon* 36: 624-634
Biology and description of the larva of *Platytonus tibialis* (Coleoptera: Aphodiidae: Rhyssemina)

Jean-Pierre LUMARET & Fabrice LAVALETTE

Laboratoire de Zoogéographie, Université Paul Valéry, B. P. 5043, F-34032 Montpellier Cedex 1, France

Received May 16, 1996, accepted June 27, 1996
Published December 27, 1996

Abstract. *Platytonus tibialis* (Fabricius, 1798) is mainly spread throughout the whole Mediterranean area. Biological observations were made in Southern France, in a site situated along the Rhone river. From September to May, adults remained in the soil, and their activity was reduced. Beetles were mostly active at the end of spring and in summer, and they were found at this moment under animal droppings (horses, but also cattle and sheep), where they searched for humidity. Mating and oviposition occurred in soil, consisting in a foliated mixture of sand, silt and compost. Larval development required one month. The first description of the larva of a species of the genus *Platytonus* Mulsant, 1842 is given. Larval morphological characters are very similar to those in the genus *Pterophorus* Mulsant, 1842 of the same subtribe Rhyssemina, sensu Pittino & Mariani (1986).

Larval morphology, taxonomic status, ecology, Coleoptera, Aphodiidae, Psammochini, *Platytonus tibialis*, Palaearctic region

INTRODUCTION

The genus *Platytonus* Mulsant, 1842, in its actual position within the subtribe Rhyssemina as discussed by Pittino and Mariani (1986), is widespread throughout almost the whole Mediterranean basin as well as the Australian, Nearctic and Neotropical regions. It is also sparsely occurring in western parts of the Equatorial Africa, the Mascarenes as well as in Palaearctic Asia and Oriental Asia. Ten species are actually known from the Old World (Pittino & Mariani 1986). *Platytonus tibialis* (Fabricius, 1798) is spread throughout the whole Mediterranean area, including the Atlantic Islands, and also extending across West Palaearctic Asia eastwards to Central Asia. It was also found in the Western Australia (Raković 1981) and in California (Pittino & Mariani 1986).

Very few data are currently known on the biology of *Platytonus* species. The Mediterranean species inhabit humid and/or arid sandy areas near the sea level to an elevation of about 2000 m. Adults may be collected numerously by sifting sand under vegetal debris or among grass roots. At occasional occurrence, adults have been found under dried dung and stones, possibly connected with search for humidity (Pittino & Mariani 1986). Larval stages were unknown up to now.

We had the opportunity to observe during one year a large population of *Platytonus tibialis* in Southern France. The aim of the present paper is to precise the biology of both adults and larvae, and to describe the third larval stage of this species.
MATERIAL AND METHODS

Site description
The observations were carried out in Fourques (Gard Département), 2 km North of Arles, Southern France. Site consisted of a large horse enclosure lined with Populus alba, Salix sp. and shrubs of Rosa sp. Vegetation intercepted large amounts of organic matter: dead leaves, rotten trunks, and many organic debris coming from the Rhone river which flowed all along the site. The sandy bank went up slightly as far as the horse enclosure. The substratum consisted of a compact sandy silty soil, directly exposed to sun, with high seasonal variations of temperature. Horse droppings were present in the whole park, but were more abundant where horses were fed. Platypusus ibialis were only present on that part of the enclosure, and was neither present in the organic rubbish accumulated along the river banks, nor in the sandy banks.

Biological observations
Monthly observations were made from November 1994 to September 1995. Fifteen adults were collected in February 6th 1995 and bred in the laboratory in a silty, rotten leaves and old horse dropping mixture. Larvae were obtained at the beginning of April and were fixed on April 21, 1995, in a KAAD solution (Carn 1951) when they reached the third larval stage.

RESULTS

Biology
From September to May, beetles remained in the soil, consisting of a foliated mixture of sand, compost (dry horse droppings, straw, dead leaves) and silt. Beetles were distributed among the different layers, either isolated or in groups of two or three individuals, some of them in short horizontal galleries. They moved slowly when excavated, and tried to escape by digging compost. Beetles had a crepuscular and nocturnal activity. Oviposition occurred in early spring.

In May, when soil temperature increased, P. ibialis was very active at dusk. Beetles were found until the end of August under fresh horse droppings (about 5 individuals on average under each dropping). They exploited recent droppings, dry in surface but humid below, and always remained at the interface between the soil and the dropping. They moved horizontally but they

Figs 1, 5 Platypusus ibialis (Fabricius). 1 - head, 5 - epipharynx.

386
never made their way into dung. Larvae were never observed under horse droppings. In Morocco, *P. thalassus* was observed under cattle dung pats and sheep pellets, and possibly dung was searched by adults only for humidity rather with specialised biological requirements, as suggested by Paulian & Boursin (1982). Mating and oviposition occurred only in the foliated mixture of sand and leaves which accommodated adults from September to May.

**Larval morphology**

**Material examined.** Seven third stage larvae, obtained in April 1995 from adults kept in laboratory conditions.

**Origin.** Fournes, Southern France. Material deposited in the collection of the Laboratoire de Zoologie, Montpellier.

**Description.** Larvae white, very small, 4.30 mm on average from the mouth parts to the anal slit. Maximum width of head capsule 0.90 to 0.91 mm (Fig. 1). Cranium yellowish brown, surface smooth, without depression on each side on the frons. Frontal suture distinct, 12 dorsoepicranial setae and 23 microsensilliæ on each side. First antennal segment larger than second; second and third segments subequal. Third antennal segment with four distal setae and a large ventral apical process, nearly half long as the third segment (Fig. 2).

Frons, on each side, with 2 setae. Each antennal base with 2 long setae, one long seta dorsally and one short seta extrolaterally. Clypeus not distinctly divided into preclypeus and postclypeus. Each side of clypeus with 3 setae. Labrum with 2 central setae and 3 setae extrolaterally on each side.

Mandibles yellowish brown, with scissor and molar area, acia and brustia dark brown. Each mandible dorsally with 2 setae and ventrally with a patch of 3 short setae (Figs 8–13).

Maxilla with galea and lacinia distinctly separate but close together (Fig. 3). Palpiger distinct. Plecetum with 2 large setae; maxillary striulatory teeth absent. Galea dorsally with a row of 3 large setae; ventrally with one long seta and 2 short setae. Lacinia dorsally with a row of 5 long setae near the mesal edge and one short seta posteriorly. Lacinia with an apical uncus.

Figs 2–4, 6, 7. *Platydorus australis* (Fabricius). 2 – last two segments of antenna, 3 – left maxilla, dorsal view, 4 – hypopharynx, dorsal view, 6 – thoracic suture, 7 – ventral of last abdominal segment.
Hypopharynx with 3 setae on the exterior side of each labial palpus. Four macrosetae and 2 setae on the central part of glossa. Glossa, anteriorly to the onyli, with a transverse row of spinelike setae and 3 setae on each side (Fig. 4).

Epipharynx scarcely trilobed, pedium surrounded by phlobae. Protophora bistrichous on the left and monostichous on the right; protophora with 13–14 microsetae. Crepidae small, semicircular, with 2 microsetae on it and 2 on either side of it. Dextioroma produced cephalic and caudal; laeotorma smaller than dextioroma (Fig. 5).

Legs four segmented, with well developed claws each with 2 short ventral setae (Figs 14–15).

Dorsal annullets of abdominal segments 15 with setation as follows: each prescutum with 4 short setae, each scutum with 3 long and 5 short setae on each side, and each scutellum with 7 short setae. Abdominal spiracle-bearing area each with 1 seta ventrally and 1 dorsal seta. Concavities of respiratory plates of thoracic spiracles facing posteriorly, those of abdominal segments facing ventrally (Fig. 6).

Raskets with teges of 32–33 hamate setae scattered irregularly on the ventre of the 10th abdominal segment, three or four long setae on either side (Fig. 7). Lower anal lobe divided into two sublobes placed adjacent to each other.

DISCUSSION

Jerath (1960) and Richter (1966) gave a key to genera and tribes of Psammochariidae based on larval characters. Psammochoriini differ from Aphodiina and some Euparini (gen. Saprosites Redtenbacher, 1858) by the presence of two anal lobes, a gula with ventrally one long seta and a row of two or three short setae and the maxillary stridulatory area without teeth or a patch of very minute teeth. *Platyptus tubalis* presents these morphological characters.

The key established by Jerath (1960) to larvae of genera of the tribe Psammochariini can be completed as follows:

1. Gula ventrally with a long seta and a row of three or more setae; each abdominal spiracle bearing area with 6–7 setae ventrally and 2 setae dorsally .............................................................. subtribe Psammochariini

- Gula ventrally with a long seta and two short setae; each abdominal spiracle bearing area with 12 setae ventrally and one seta dorsally .............................................................. subtribe Rhyncomitra

2. Each abdominal spiracle bearing area with 2 setae ventrally and one seta dorsally, each mandible dorsally with one or two setae .............................................................. Pleurophorus multisetus ........................................ 3

- Each abdominal spiracle bearing area with one seta ventrally and one seta dorsally; each mandible dorsally with two setae .............................................................. *Platyptus tubalis* (Fabricius, 1798)

3. Second and third antennal segments subequal, first long; labocera small as compared to dextocera in size; each mandible dorsally with a single seta .............................................................. Pleurophorus caucinus (Creutzer, 1796)

- First and third antennal segments subequal, second short, labocera and dextocera more or less similar in size; each mandible dorsally with two setae .............................................................. *Platyptus longipalpus* Carver, 1948

REFERENCES


Patterns of chaetome modifications in ground-beetle larvae (Coleoptera: Carabidae)

Kirill V. MAKAROV

Department of Zoology & Ecology, Moscow State Pedagogical University, Kvaschchuyo str 6/5, ROS-129278 Moscow, Russia

Received July 1, 1996 accepted August 8, 1996
Published December 27, 1996

Abstract Important features of larval chaetome in Carabidae (Coleoptera), and principles of identification and homologisation of elements have been analysed. Satisfactory homologisation of certain chaetome structures is possible only when additional markers, i.e. signals are used in analysis. Typology and topology of chaetome are described. New designations for a number of structures are suggested. Functional model of carabid larval chaetome is discussed in its adaptive integrity based on correspondence of structure and functions of sensilla. Main chaetome functions are described, i.e. covering, sensory, locomotory, and feeding related, different types of their realization are considered. Main ways of chaetome restructuring are distinguished and described. It is shown, that possibilities of chaetome modification in carabid larvae are restricted in general to three main types: elongatechaetome, heteropolychaetome, and homopolychaetome, they are specific within taxa of tribe rank. Chaetome modification type has to be taken into account in the studies of larval taxonomy and in elaboration of identification keys. "Primary" set of sensilla as by Bousquet & Goulet (1984) is not pleomorphic for carabids. It is suggested that primitive state of chaetome is characterized by irregular distribution of sensilla, and by slight differentiation of general structures. Key direction of chaetome evolution is optimization of sensory and covering functions, morphologically it is expressed in stabilization of chaetome and in formation of constant complexes of different sensillum. Ways of chaetome modifications are specific for certain taxa, and their analysis can be used for elaboration of relationship scheme in carabids.

Chaetotaxy, morphology, larva, Coleoptera, Carabidae

INTRODUCTION

Characters of chaetotaxy have been used in the systematics of ground-beetle larvae since the beginning of this century. However, their applicability has been hampered by the lack of a convenient system of designations. The attempts undertaken have mainly pursued but utility goals, that is, brevity of a description and/or compilation of keys to species of individual genera (e.g., Fiedler 1935 for Cicindelinae allochotomus sensu Horn 1926, Nieschulz 1936 for Antennarius Banniger, 1937) carabid larval chaetome being highly diverse and variable, this has not allowed to apply these schemes for other genera. It has long been quite clear, however, that a universal model of chaetotaxy can be developed concerning only a restricted set of number of setae. Designating only the biggest cephalic setae, Habu & Sadanaga (1961) have pioneered this work. This scheme has been applied to various ground-beetle groups (Habu 1973, 1981, Habu & Sadanaga 1961, 1965, 1970, Harris 1978, Zettu Brandmayr & Brandmayr 1978). A different practice of limiting the number of designated elements, which lies in using the chaetome of instar I, has been developed by Goulet (1982). In a modified way (Bousquet & Goulet 1984) that designation approach of the "primary setae and pores" has gained the general acceptance. However, an over decade-long usage of that classification has revealed a number of defects which considerably restrict its applicability. First of all, this concerns the ambiguous term "pore" (Makarov 1990, 1991, Madsen 1993) and highly formally criteria for delimiting "primary"
structures (Makarov 1991, 1993). This creates difficulties in designating the setae in larvae with strongly modified chaetome forcing some modern authors (e.g., Moore & Lawrence 1994) even to abandon approach of Bousquet & Goulet (1984) altogether.

According to Bousquet & Goulet (1984: 574), "setae and pores on the first instar larvae and their homologous structure on subsequent instars" are just primary. Yet such a criterion of priority fails very many cases.

First, among some ground-beetle larvae from the tribes Cicindelini, Elaphrini, Anthiiini, Helcetini, etc., instar I displays more or less numerous accessory setae. Second, contrary trend is observed in a number of groups (Carabini – Makarov (1993), Hembidini – Maddison (1993), Tenebrionini – Grebennikov (1995), with instar I without some chaetome elements. A "primary" set of pores is currently perceived as mainly plesiomorphic, though with neither proper embryological nor paleontological background, e.g., Arndt (1993). However, a study of well-preserved fossils (Makarov 1995) reveals that this requires confirmation.

It is thus reasonable to consider the scheme by Bousquet & Goulet (1984) as designating the most common set of cuticular sensory structures in carabid larvae. In this connection, below I shall avoid the notion "primary", instead using "general" as applied to the primary structures in the sense of Bousquet & Goulet (1984).

It is also noteworthy that technical difficulties in studying the carabid larval chaetotaxy force many authors to use traditional, largely macrostructural features as the leading diagnostic characters (Arndt 1993, Makarov 1994). Hence, chaetome characters serve rather for unravelling the relationships and for constructing phylogenetic trees or clades. In this way, chaetome structures require further investigations. Discarding phyletic schools, the basic characters underlying a phylogenetic reconstruction ought to meet a number of rather serious demands: (a) reliable homologization, (b) an exact revelation of the polarity/modality of a variation series, and (c) a low probability of a character's reversed condition (Ax 1987, Pesenko 1993). Though a phylogenetic importance of larval features has been repeatedly discussed (Goulet 1978, Arndt 1989, 1993, Makarov 1990), to the best of knowledge, no special evaluation of chaetome characters has hitherto been performed.

MATERIAL AND METHODS

Material serving the basis for this work is housed in the collection of Zoology and Ecology Department of the Moscow Teachers' Training University. This material comprises 453 species from 84 genera and 39 tribes, mostly fixed in 70% ethanol. Besides, larvae of beetles from other families have been studied (Dytiscidae – 4 species, Hydrophilidae – 4, Staphylinidae – 5, Histeridae – 2, Dytiscidae – 1, Carabidae – 2, Elateridae – 3, Tenebrionidae – 2) as well as larvae of all the Neuroptera (Omylidae, Ascalaphidae and Myrmeleontidae – one species each), for detailed list of material examined see Appendix. A proportion of samples is mounted as separate micropreparations with the Faure-Berteau medium or as temporary micropreparations with glycerol, according to the conventional techniques. Altogether, 1780 specimens have been treated. Larvae were examined under MBS-1, MB-2 and P-16 stereomicroscopes at magnifications ranging from 4x to 900x.

Some fine structures of larvae were studied with a Cambridge StereoScan 250MX and Hitachi S-450 scanning electron microscopes.

Statistics was performed for revealing the variation range of setal size groups. For this purpose, 8 model species (Niphona longicornis, Dinechus fasciatus, Blepharis nigricosta, Elaphrus hypogonis, Cleora faser, Arthrodon flavipes, Agonum Muelleri, Harpalus rufigenes, Patanastes crassus, Cystinea lateralis) were chosen for measuring the length of the setae on the frontal and parietal sclerites, on the pronotum, on abdominal tergite and sternite IV and on the urogomphi. From 6 to 25 setae have been measured on each of the sclerites, with their relative lengths considered as percentage of the longest (100%). Grouping was undertaken using K-means clustering with the program STATISTICA 4.5.

Supragenetic taxa accepted here are mainly according to the system proposed by Kryzhonsky (1983) and Kryzhonsky et al. (1995). Notation of setae and pores follows that of Bousquet & Goulet (1984).
RESULTS

Phylogenetic evaluation of chaetome features

A study of the topography of larval sensillae in various beetle families (Hydrophilidae, Staphylinidae, Dytiscidae) shows that numerous, particularly soil-dwelling forms display a chaetotaxy often thoroughly similar to that typically occurring in ground-beetles. And several complexes of sensillae (e.g., PA₁₂₃₄; PA₆₇₈₉; FR₁₅) are traceable even among such taxa phylogenetically remote from ground-beetles as Tenebrionidae. For example, when comparing with the generalized carabid type, 16 out of 19 setae and 7 out of 15 „pores” are reliably identifiable in the larvae of *Helophorus* (Hydrophilidae) (Fig. 2). A similar pattern is observed also among certain larvae of *Staphylinidae* (Figs 3, 4) and even in Elateridae (Fig. 12). The chaetome of tergites and sternites is often even more alike (Figs 5–11). For comparative purposes, it suffices to recall that, among the Carabini larvae, there are only 15 setae and 10 „pores” on the parietal scerites. Amongst lesser larvae of the supertribe Trechitae, a considerably reduced set of pores is marked (Grebenikov 1995), and soon.

Hence, as regard a similarity of larval chaetomes of various beetle families, only two hypotheses seem admissible: either the tipization is possible only at the order level (this being a fundamental feature of all beetle larvae), or the chaetome’s adaptive modifications exceed significantly the extent of inadaptive restructurings within the family.

The larval chaetome of ground-beetles poorly resembling that of aquatic Adephaga (Dytiscidae, Gyrinidae), this is rather evidence favoring the second alternative. Thus, the resemblance between the generalized chaetome larval types of carabid and the typical diving beetle genus *Hybopus* (Adephaga: Dytiscidae) is significantly less than, for example, with the near-water genus *Helophorus* (Polyphaga: Hydrophilidae) (Figs 1, 2, 5, 6, 8, 11). More often these are sensillae which location is restricted to the sigilla both of the larger muscles (abductors and adductors of the mandibles, etc.) and endoskeleton.

Consequently one may speculate that, the structure of a chaetome is significantly determined by the way of larval life. The structural particularities are displayed only at the level of most strongly interrelated complexes of sensillae and sigilla. Thus, a generalized chaetome in the sense Bousquet & Goulet (1984) cannot be regarded ancestral to ground-beetles.

One more problem of a phylogenetic interpretation of chaetome characters is related to the difficulties in evaluating the plesiomorphies. The fact that a number of „primary” sensillae are
lacking while „secondary“ setae are present in instar I larvae of certain tribes (Carabini, Cyphini, Brachini, Dyschirini, etc.) means that a generalized chaetome in the initial sense (Bousquet & Goutet 1984) is treated perhaps too formally and includes also „secondary“ structures. Besides that, in the cases when some chaetome elements are missing, it appears impossible to attribute that to convergences (homoplasies) or to symplesiomorphies, and this can result in wrong kinship evaluations. In addition, a possible instatation has been demonstrated for a number of insect structures, that is, repeated origins of a phenotypically lost feature due to conservation of genetic copies; setae thereby appear particularly strongly inclined to that process (Emelyanov 1987).

All this evidently questions the utility of the chaetome for studies on carabid phylogeny. In my opinion, the only way out lies in modifying the methodology of evolutionary reconstruction of larvae.

To a considerable extent, imaginal evolution is related to the development of reproductive isolation mechanisms, often without expressed adaptive roles. In contrast, the evolution of preimaginal stages is mainly adaptive. A natural way of reconstructing their phylogeny would lie in an analysis of their adaptive systems and functions.

As applied to arthropods, an evolutionary method of phylogenetic reconstructions based on an interpretation of adaptive traits of functional systems has been developed by Manton (1959, 1977). As regards ground-beetles, these problems have been analyzed mainly by Evans (Evans 1980, 1982, 1986, Evans & Pocytche 1984), the locomotor system of the image taken as an example. It has been noted therewith that adaptive systems display polarity more readily and are not subjected to reversions (the law of progressive specialization). No study of larvae in this aspect has hitherto been conducted.

Hence, the objective of the present work can be defined both as a morphofunctional description of the chaetome and an analysis of its modifications.

Chaetome as a whole
The chaetome in a strict sense is understood here as all cuticular structures associated with primary external receptors, i.e. sensillae. Hence, the main function of a chaetome is sensory. In a broad sense, the chaetome also encompasses microtrichia (Fig. 44a) and spines (Fig. 29), i.e. a number of cuticular derivatives closely interacting with sensory elements. Multifunctionality of many sensillae and their interactions with non-sensory structures extend significantly the set of the functions carried out by a chaetome (see below).

In general, a ground-beetle larval chaetome can be characterized by the following particulars: (a) great diversity of sensillae, with numeral dominance of trichoid and basiconical mechanoreceptors; (b) low number of sensillae-distant receptors; (c) infrequent occurrence of complex setae of complex form; (d) absence of compound sensory organs (chordotonal and others al.), their functions taken up by individual sensillae.

From a standpoint of adaptive value, adaptive and largely inadaptive structures can be distinguished in a chaetome (Makarov 1990, 1991). A chaetome’s functional integrity is evident, for such alterations as an increased number of setae, changes in their mean length, the formation of bristly setae, etc., take place coordinately in various sclerites. Often they are accompanied also by modifications of the sculpture, while changes in inadaptive structures are less evident. However, an analysis of the known patterns of reduction (Makarov 1991, 1993, Grebennikov 1995) shows that sensillae get lost in a regular way. Thus, Carabini display a reduced discal complex, whereas among Trechitae the reductions concern the posteralateral groups of sensillae of the thoracic and abdominal tergites.

394
Figs 1–12. Chaetotaxy of the separate body parts of Coleoptera larvae in different families (schematic). 1–4, 12—cephalic capsule (left—ventral view, right—dorsal view), 5–7—right half of pronotum, dorsally, 8, 9—abdominal tergites IV, dorsally, 10, 11—abdominal segments IV, ventrally. 1, 5, 8, 10—Hylus fulguriferus (Fabricius), L3 (Dytiscidae), 2, 6, 9, 11—Helophorus aquaticus (L.), L3 (Hydrophilidae), 3—Tanymopus sp., L3 (Staphylinidae), 4, 7—Phalacrus sp., L3 (Staphylinidae), 12—Atelops sp., L2 (Blisteridae). Sensilla, corresponding to generalized type are shown as solid, other sensilla as dotted.
Hence, the larval chaetome of Carabidae can be considered as an integral system exhibiting its own patterns of change.

Below, the basics are briefly presented of a formal classification of chaetome elements.

The principles of identification and homologization of chaetome elements

In the framework of cladistics (Ax 1987) and considering the newest requirements of the hypothetico-deductive methodology (Pensonko 1993), the first condition of adequacy of a cladistic reconstruction is character analysis aimed at a revelation of homoplasies and of initial and derived states.

The specificity of larval stages (scarcity of fossil evidence, poorly developed biochemical and genetic approaches) greatly restrict the set of the methods admitted to establish the homologies. In fact only three Remane’s criteria remain (Remane 1956, with consideration of additions by Pensonko 1993): resemblance of position, resemblance of special quality, and transitions through intermediate forms. Applicability of the latter criterion thereby faces additional difficulties, because even in well-studied carabid groups, larvae are known for less than 30% species.

At the same time, owing to both a well-expressed embryogenesis and a number of structures getting considerably modified in the course of carabid larval development, ontogenetic criteria appear partly useful as well in unravelling homologies by origin and polarities by antecedence.

Homologization of chaetome elements in ground-beetles is generally based on the fact of retention of sensillae innervation along with growth and development (Wigglesworth 1953). The known patterns of aberrations conserved for stage to stage (for example, duplicated setae PR₁ in Carabus granulatus) can be evidence of ontogenetic succession of chaetome elements as well.

Below, the main aspects of classification of chaetome elements and the methods of homologization are briefly considered.

Typology

The generally accepted classification of Bousquet & Goulet (1984) discriminated two classes of sensillae: setae and pores. Yet whereas a seta largely implied a trichoid-type sensilla, pores were understood as embracing all structures with a small agle portion: conical, campiform, and placoid sensillae. A number of basiconical sensillae (PR₁, ME₁₀, TE₄) were therewith designated as setae, while a bit lesser sensillae (FR₁) as pores.

The typological classification of sensory structures of ground-beetles presented here roots in classics of insect morphology (Snodgrass 1935, Slifer 1970, Melver 1975, etc.), external receptor structures encountered in carabid larvae can be divided into functional groups with distinct morphological characters.

Mechanoreceptors. Formed on the basis of a bipolar neuron, associated with cuticular structures of three types:

(a) Trichoid sensilla or setae (hair sensilla, seta, sensilla chaetica, sensilla trichoidae), the biggest and the most thick-walled, often with an apical pore, they can also perform the function of a contact chemoreceptor (Melver 1975, Spence & Sutcliffe 1982). Receptor fields perceiving jowls’ articulation and typical in the imago are unknown in larvae. The only possible exception is gPS. These fields’ function is carried out by individual sensillae located so that their contact to the environment is limited. Such are PY₁, TE₃, CO₁, CO₄, CO₆, possible PA₃. Other proprioreceptors are represented by campiform sensillae (see below).

Accessory setae differ in shape: needlelike, dasy, bacilliform and phylloid, boughform, spines etc. (Figs. 13−17).
Usually, larval setae differ in size quite considerably. A statistical analysis carried out has revealed that among them three groups can be reliably distinguished. I designate these groups as micro-, meso-, and macrosetae, respectively. The border between first two groups setae approach each other and, no differentiation into micro- or mesosetae being possible in some particular cases (Fig. 22).

The size restricts the morphological diversity of setae. Thus, only microsetae appear to display a bacilliform or phylloid appearance. In contrast, only meso- or macrosetae can be bacilliform or drusy.

![Diagram of setae and their sizes](image)

Figs 13–23 Types of sensilla in carabid larvae. 13–17 - true setae sensilla of different shape (13 - needleform (typical) seta, 14 - bacilliform, 15 - drumiform, 16 - phylloid, 17 - boughiform), 18 - conical sensilla, 19 - campaniform sensilla, 20 - placoid sensilla, 21 - "lyriform organs" (deepened campaniform sensilla). Fig. 22 Scatter-diagram of the lengths of three dimensional setae group (explanation in text) Fig. 23 Unit of different sensilla on the top of last joint of labial palp in *Agonum muelleri* (Herbst). L3 Abbreviations: co - conical sensille, cf - campaniform sensilla, ch - placoid sensilla.

397
(b) Campaniform sensilla (Fig 19), described already by Berlese (1910), are homologs of setae (Snodgrass 1935, Schmidt 1973). Their function is proprioceptors. Both special sensilla TpE (Fig 21) and 'lyriform organs' on legs and tergites are referred here. Campaniform sensilla are widespread in beetle larvae (Zacharuk 1962), often being associated in functional units (Mössner 1975).

(c) Denticiform sensilla are specialized derivatives of setae on mouthpart appendages. Despite an apical pore, they are only mechanoreceptor (Zacharuk et al. 1977). Apparently, they serve for orientation in soil tunnels, perceiving the vibration of walls emitted by the victim. Similar structures are known in the imagos as well, although their function is olfactory (Honos-Mikloch 1980).

**Chemoreceptors.** Chemoreceptors are less diverse in ground-beetle larvae. Morphologically, most can be attributed to a group of contact sensilla (Slifer 1970, Tyschenko 1986) represented by microsetae, conical and, less frequently, placoid sensilla. Microsetae are located at the apices of the antennae and urogomphi as well as on sides of tergites. Basal- and coeloconical sensilla (Fig 18) are usually placed on the head capsule and both on thoracic and abdominal sclerites. They form most of 'secondary pores.' Placoid sensilla (Fig 20) seem to be the most highly specialized chemoreceptors (e.g., ANe, d) Maddison (1993) believes that they represent chordotonal organs.

The large basiconical sensilla on antennomere 3, known as 'sensillum', is also referred to the group of chemoreceptors. Apparently, it performs a hygroreceptor function.

Regularly, chemo- and mechanoreceptors jointly form the functional groups. For example, there is a mechanoreceptor surrounded by campaniform mechanoreceptors at the apices of the antennae, maxillary and labial palps (Fig 23).

Intermediate sensilla forms are possible only amongst poorly specialized sensilla of trichoid or conical type.

**Topology.**

The system of chaetome designations as developed by Bousquet & Goulet (1984) is based only upon the elements' dispositions. In so doing at least for two reasons, there are difficulties in an exact designation of sensilla: (a) a strong structural reorganization of larval body when the habitual system of topographic correlations is lost (e.g., Cienchelm), (b) substitution of one sensilla type by other one and (c) absence of individual chaetome elements (e.g. reduced tergal setae in Carabini), also deteriorating the system of designations. Subsequently, due to adoption of designations for some 'secondary' setae (like ANi, the latter have been tended to be treated as homologous elements along with 'primary' setae (Arndt 1993). Recently, based on a statistic analysis of morphometric characters (Briney 1995), the extent of correlation among setae has been shown to be independent from the distance between ones. Hence, identification of the setae based solely on their interpositions is insecure.

To overcome these difficulties, additional markers have been used for the determination of chaetome elements. The method of zigglatox (Makarov 1989, 1991, 1993) is based on the utilization of zigglas as markers for the sites of muscle attachment to the endoskeleton, all well distinguishable by a well-developed primary microsculpture. Another technique lies in using for diagnostic the rather stable functional complexes (usually, this is a trichoid sensilla in combination with a campaniform one). In both cases, a secure identification (and thus homologization) becomes possible of almost of structures of a chaetome.

As regards the larvae with a complex chaetome (e.g., Elphrhmy, Callisti, Calerini, Antheni, numerous Harpalini and Lebani, etc.), the problem of an exact homologization cannot be
solved at the level of individual elements. The notion of a group of sensillae has been introduced for such cases (Makarov 1993), meaning a unit of the chaetome structures delimited by demarcation zones (usually, by sigillae). In the norm, the groups are designated by the „primary“ setae, e. g. gPRi in Elaphrus (Fig. 24). More seldom, a group encompasses several setae (gPRi, Fig. 25). Finally, in extreme cases of chaetome complication, one must speak only about the complexes of sensillae: anterolateral, anterodiscal, etc. (Fig. 26). Since it is sensillae innervation that is at the base of their homology, we consider the homology of an individual seta and a respective group as possible.

It is noteworthy that some sensillae retaining relative stability in structure and position remain undesigned (Maddison 1993). This mainly concerns complexes of sensillae of antennomeres 3 and 4 as well as of the buccal cavity.

The complex of sensillae of antennomere 3 comprises a big campaniform sensillum and a group of 1–3 sensillae placed more dorsally. The group usually encompasses two conical and/or bacilliform as well as one spherical or placoid sensillum. Modifications of this complex (besides the above variations in the sensorium) are reduced to a dwindling number of sensillae up to their complete decline.

In a typical case, the terminal complex on the antenna includes one apical seta AN, two dorsal conical and one ventral bacilliform sensilla. This set is relatively stable within the family. The modifications known to us lie in the bacilliform sensilla being substituted by campaniform ones, one of the conical sensillae reduced, and the length ratios changed in the chitinuous derivatives of the tormogenous and trichogenous cells (Figs 27, 28).

The absence of additional markers in the apical part of antennomeres 3 and 4 makes it impossible to homologize the sensillae in case of any reduced or considerably modified elements. Hence, in contrast to the opinion of Maddison (1993) it appears hopeless to introduce designations for such structures. In their descriptions, it is advisable to use such toponymic notions as, e. g., a „medial conical sensillum“.

Finally, the buccal cavity supports its own complex of sensillae. Their main part (a group of conical and campaniform sensillae) are placed on the epipharynx, only two pairs of campaniform sensillae being located on the cibarium. The latter sensillae are highly stable throughout the family, while the epipharyngeal ones are highly variable. Among them, more or less constantly distinguishable is only a short lateral seta. In general, the remaining group forms a more or less distinct row of FK setae to the fore angles of the cibarium, which is sometimes clearly divided by a medial impression of the epipharynx into an anterior and a posterior groups. Relative constancy of some mouthpart sensillae enables to give designations for them (Fig. 29). Analogously to Bousquet & Goullet (1984) lateral seta is called CI, (from cibarium), sensillae of cibarium itself are CI, and CI, while epipharynx group of sensillae is gCI (and could be divided into subgroups gCI, and gCI).

One more sensillum, that has not yet been defined (Maddison 1993), lays on the front edge of paralytrypos in the area of FKN seta. It is rather constant, and in some cases could be considered as marker sensillae, dividing the groups of seta FK from FK (Fig. 29). It is suggested to define this sensillum as FRi.

Topology of specialized sensillae (mostly distant chemo- and hygroeceptors) is more constant that the topology of little specialized trichoid and conical sensillae. Chaetome modification happens mainly due to contact chemo- and mechanoreceptors, which include typical seta and different conical and campaniform sensillae.
Functional model of chaetome

Functions of certain chaetome elements of carabid larvae are almost unknown, and special physiological experiments are needed to study them. However, more or less precision relationship between structure and function has been revealed for the majority of cuticle sensory structures of insects (Snodgrass 1935, Dethier 1963, Tystchenko 1986). Therefore already now it is possible to describe the general model of carabid larval chaetome.

This model is based on the following statements:
- all cuticle structures including the number of derivative setae are sensory
- most trichoid sensilla, judging by SEM data do not have apical pore, and thus are considered as mechanoreceptors
- distal receptors are lacking in typical cases
- Chaetome as well as other derivatives of cuticle contributes to four functions, discussed below in order of their importance.

Covering structures

In this group we include trichoid sensilla of different size and microtrichia. Their presence in large numbers ensures isolation of larval body from the environment, that is realized in three ways:
- The most hygrophilous forms which live in permanent contact with water (Callistini, Elaphebrini) are characterized by noticeably different in size, "general" setae, numerous additional seta, and by development of isolating chaetome on the appendages (Callistini: Callistus).
- In xerophytic and psammophytic larvae (Anthini, part of Zabridi and Harpalini) macrosetae prevail in secondary chaetome; sometimes their size is comparable to "general" seta.
- In Orthogonius and Cychrus larvae very peculiar thin and dense protrusions are formed on sclerites on intercalerite membranes; the latter are microtrichia but not sensilla.

Locomotory and bulldozer structures

As locomotory we consider the structures of chaetome, which are helpful for larval movements over or in the substrate. They are localized on appendages, and in excavating forms also on urogomphi and rarely on abdominal tergits. Excavatory structures which enable to move apart dense portions of substrate are treated as separate variant (Lyubarskiy 1992); they are located mainly on the head and anterior margin of pronotum.

Movements on solid dense substrates leads to elongation of distal parts of appendages and to development of more or less parallel rows of spines (gTA, gFE, UN1,psetae on pretarsus are modified as well (Figs 39–41).

On the contrary, in excavatory forms one can observe shortened distal parts of appendages (Figs 32–34), as well as formation of apical crown of spines (gTA, gFE, UN3). Quite often non-allied forms have similar structure of appendages (for example Omophorion, Cicindela, Scarites, Orthogonius). Unlike the surface-dwelling larvae, adaptations in excavatory ones cover a number of structures. Thus, besides appendages, urogomphi and abdominal tergits are adaptively modified as well (Figs 45, 46). Chaetome modifications are similar in all cases. Development of supporting structures such as spines and/or seta (Figs 42–44) on medium abdominal tergits (II–VI in Omophorion, Daptes and Orthogonius, IV–V in Brullea (Harris 1978)) could be considered the most interesting. It is possible that specific structure of fifth abdominal segment in Cicindelini larvae represents the extreme variant of such specialization.
Figs 42–48. Supporting and habituating structures on dorsal surface in carabid larvae. 42–45 – abdominal tergum IV, right half, dorsally (44a – magnified part of Fig. 44), 46 – right half of abdominal tergum IX and right urogomphi, dorsally, 47 – cephalic capsule, right aspect, 48 – head and anterior margin of prothorax, anterolateral aspect. 42 – Onoepheon limbatum (F.), L2, 43 – Dexitius vittatus Fischer von Waldheim, L3, 44 – Orthogonus tenuitarsus Chaudoir, L2, 45, 46 – Callistethes semenovae Motschulsky, L3, 47 – Brulloa antarctica (F.), L3, 48 – Zabrus spinipes (F.), L2. (47 after Harris (1978), other – orig.).
Within one type of locomotor chaetome adaptations free combinations of different element functions can take place. Thus, in majority of ground-beetle larvae setae TA2, on the end of leg are modified into spines, while seta TA3, fulfill sensory function (Fig. 36). In Tricholycus and Masoreus on the contrary TA2 fulfill sensory function, while TA3 is used in locomotion (Figs 37, 38). Similar alteration of functions is observed in appendages chaetome of Thalassophila (Grebenikov 1996) and Orthognathus (Fig. 34).

It is necessary to mention, that the number of claws, although seeming to be adaptive feature, is not directly related with locomotion type.

Bulbifer structures are usually represented by rows of strong seta and spicules on the head, mandibles, and rarely on other appendages (Figs 47, 48). Sometimes modifications are found also in upper prothorax (for example thickened seta in front corners of prothorax found in Epaphius).

Specialized sensory structures

This group includes only sensillae, specialized for analysis of certain signals. They are localized mostly on head, appendages, at the edges of tergites, and are represented by enlarged trichoid sensillae (mechanoreceptors), as well as by basicomical, conical and placoid sensillae which act as chemoreceptors.

Comparison of chaetome in representatives of different tribes together with analysis of ite ontogenetic changes enables to outline the following main trends in development of sensory complex of carabid larvae:

a) Increase in active zone of sensillae. Usually this is reached through prolongation of periphery trichoid sensillae mainly on head appendages and on urogomphi (for example in Notiophila, Leisus, Nebria, Loricera, Galeria). In open-living forms with short seta (some Callistini and Carabini) compensatory elongation of seta-bearing appendages is observed.

b) Concentration of different sensillae into sensory fields, that sometimes coincide with increase in their size and number. The latter is most well expressed for groups of basicomical sensillae, located at apical segments of labial and maxillary palps. In the most simple case two or three basicomical sensillae form diffused lateral group at the base of segment, other sensillae (conical and placoid) are located distally (Fig. 53). Complexity increases to to enlarged number and/or size of basicomical sensillae; they form more or less compact group which position shifts to distal (Fig. 54). Other types of sensillae are also included in this group. Such structure is characteristic mostly for open-living predatory larvae. Apical sensillae complexes on labial and maxillary palps develop similarly.

On the periphery of tergites trends of sensillae concentration are less pronounced. The best example is found in Leiciini tribe: dense concentrations of sensillae are formed on epipleurites, and seta EP, and IY are noticeably prolonged.

Specific variant of increased complexity in antennae chaetome is found in Scaritini larvae, and also in some Harpalini and Pterostichini. In these cases different modifications of sensillarium at the third antennal segment takes place, such as flattening, increase in size, or formation of a group of flat sensillae at the place of sensillarium. These changes are characteristic mostly to the forms with slightly sclerotised covering which inhabit and landscapes. It can be thus suggested that this trend is r related to the need of precise orientation after humidity gradient.

c) Mobilization of sensory complexes. It is expressed in development of pseudosegment on head appendages. Four different variants of this trend have been found in carabid larvae: 1) separation of sensillae group in the apical part of labiule palp (Callistini – Fig. 52); 2) separation of antennal circle and formation of additional segment at the base of antennae (Pterostichini: Mol-

(S2 after Makarova & Makarov (1996), other – orig.)
ops, Abax; Licinini: Tricholicinus – Figs 49, 50); 3) separation of the upper part of the 3rd antennae segment (Badister – Fig. 51., probably also Ambystogentum – as from incomplete description by Womersley 1937); and 4) indistinct separation of distal segment of labial and maxillary palps into 2–3 segments (Treichini – Figs 55, 56, some Clivinini). These variants are realized only in predatory forms, both open-living and typical geobionts.

Structures, used in the feeding process

Following Striganova (1966) mouthpart apparatus of Carabidae larvae is characterized as cutting or puncture-cutting. Morphological feeding-related adaptations are realized in carabid larvae mainly at the level of macrostructures, such as nasale and mouth appendages. Chaetome modifications only follow modifications of mouthparts, and happen in specific sensory apparatus for catching (but not for locating) the prey, and in mechanical structures for manipulating with food.

Analysis of mouthpart chaetome enables to distinguish in carabid larvae three main morphological types which can be considered as the extreme achievements in adaptive radiation of feeding-related structures.

a) Catching apparatus. Here protrusion of sensory structures which control quick closing of mandibles at the contact with prey are characteristic (Spence & Sutcliffe 1982): elongation of nasale teeth carrying FR10,1 seta and of front corners of paracylites, enlarged MN, gMX seta with small number of thick long setae located mostly in the distal part of stipes (Fig. 57). This type is typical for larvae of Notiophilus, Loricera, Leistus, Galeria. Usually it is accompanied by restructurisation of sensory sensillae complex for increase of sensory active zone. Interaction of sensory and feeding-related structures during hunting of these larvae has been described in details (Bauer 1979, Spence & Sutcliffe 1982, Bauer & Kreuder 1988).

b) Cutting-filtering type of mouthpart structure is common for predatory larvae of ground-beetles. This type is characterized by moderate development of FR10,1 seta, and by presence of Y-shaped setae functioning as food filters in gMX. In representatives of Lebini tribe which have reduced gMX seta filtration function is carried by penicillus. The extreme development of this type is found in larvae of Licinini and Panagiemini tribes, which have rows of numerous teeth (Figs 58, 60–62) of different or in almost in all mouthpart appendages.

c) Chewing-cracking type of mouthpart structure is developed in forms which feed on solid food. This type is characterized by smaller FR10,1 setae (often they are completely hidden in the massive multirow nasale), and by differentiated apical group of thick setae in gMX (Fig. 59) or cone-like lobe on cardo. Almost all Zabrnini and Harpalini, Orthogonius are typical representatives of this type.

Quite important, that separate functional blocks of chaetome are not equal as related to their possibility for modification. Thus, subordinate character of feeding-related chaetome to relevant macro-morphological structures is obvious. At the same time covering complex is modified rather autonomously.

Presence of similar chaetome modifications in representatives of different carabid taxa proves its significant functional flexibility and large adaptive importance.

Morphological restructurisations of chaetome and their significance

Generalizing all the above it is possible to reveal two main process of chaetome changes: changes in number of elements or qualitative transformations (unformation and diversification of sensillae).
Changes in number of elements

Reduction is observed in carabid larvae rather rarely. Two kinds of this process can be distinguished:

1. Disappearance of certain chaetome elements. Usually it is observed within genera, or even in smaller taxonomic units. Although chaetome remains typical for the group in whole, some species can lack few elements of "general" structure. These are the examples with absence of $\text{PR}_{13}$ seta in several *Amara* species, setae $\text{MX}_1$ and $\text{MX}_2$ in some *Callistini*. Reduction of one certain sensillae very rarely can act as diagnoses for higher taxa (for example *Brachinini*, *Callistini*).

![Diagram of Carabid Larval Mouthparts](image)

Fig. 63. Chaetome changes of abdominal tergum IV during ontogenesis of larvae in tribe Elaphrini.

2. Disappearance of smaller or larger complexes of seta and pores. Most often this kind of reduction is connected with overall enlargement and thickening of cuticle (tribes Carabini, Cyclini). As a rule oligomerisation involves chaetome of dorsal, more rarely of pleural and ventral sclerites. There reduction in number of "general" seta coincides with appearance of numerous small conical sensillae, so that overall density of sensory elements on larval body does not decrease (Table 1).

In some cases reduction of chaetome is natural. Thus, in larvae of Trechitae supertribe (Grebennikov 1995) lacking structures are those connected mostly with posterolateral corners of tergites.

Processes of reduction result in what could be called oligochaetosis, or in extreme cases achaetosis. The latter has recently only one described example, that is very simplified chaetome of larvae of Cyclus.

Now it is quite difficult to define the reasons for chaetome reduction. It seems obvious that minimization of body size does not lead directly to chaetome reduction. Anyway, in smallest carabid larvae (Trechitae, many Lebiini, 1 instar of Brachinini) all variants of chaetome deve-
development can be observed, i.e. from complete (*Microlestes*, *Synthomus*) to more or less reduced (*Brachinus*, Trechitae, especially Trechodini – Grebennikov 1996). Adaptive role of reduction is rather doubtful, and no correlations were found with larval habits either. Absence of some elements can be in principle the result of mutation. Reduction of large setal complexes probably has different explanation. Two possible reasons could be suggested: (1) laconization of chaetome during phylogensis, (2) general simplification of larval organization due to desembryonization of development. The latter suggestion can be proved by noticeable reduction of chaetome in larvae with one claw (supertribe Trechitae, genus *Brachinus*), which indicates an emerging from eggs on earlier stages of development (Tikhomirova 1992). It could be possible to evaluate the reduction of sensillae numbers during evolution only after the ancestral state of chaetome (see below) is identified; thus recently it cannot yet be done.

Multiplication (polymerization) of sensillae is more or less characteristic to larvae of most carabids. This process is realized in ontogenesis almost always, when single sensillum of first instar larvae are altered in consequent instars with groups of homologous formations (Fig. 26). However quite often happens that already at the first stage of larval development number of

Figs 64–67. Cases of primitive (64, 66) and advanced (65, 67) chaetome patterns. 64, 65 – cephalic capsule, dorsally, 66, 67 – IV abdominal tergite, dorsally 64, 66 – *Leiusus teretitarsus* (Holmgren in Penzer), L2, 65, 67 – *Paradromus linearis* (Oliver), L3.
sensillae is noticeably larger. This tendency is most expressed in representatives of Helluoanni and Anth unicola tribes, whose "primary" chaetome consists only of groups of seta.

This result with increased number of sensillae we call polychaetosis (or hyperchaetosis).

Diversification or uniformation

Multiplication of chaetome elements can coincide with appearance of new kinds of sensillae compared to original ones. Therefore two variants of hyperchaetosis (Figs 30, 31) are distinguished: (1) homochaetosis, when new formations are analogous to original structures and do not differ in size from them, and (2) heterochaetosis, when new sensillae are either noticeably smaller in size than original ones, or belong to different sensillae type. In the latter case, for example additional phylloid seta on pleurites of Carabinae, cadiiform setae of Chlaenius) is worth to distinguish ordinary (basic) chaetome corresponding to "general" type, and idiochaetome, which includes new formations Homoachaetosis of larvae usually appears due to absence of distinct morphological boundary between groups of macro- and mesoseta.

Homoachaetosis is observed in Carabinae larvae rather rarely, and is connected with specialization to pawning of loose substrates (Anthum, some Zabruni).

Heterochaetosis is more common type of chaetome changes. It is realized differently in separate groups of carabid larvae. Thus, representatives of Callistethus, Oodim, Paragomini, many Lebunii, have firmy differentiated trichoid chaetome large "general" seta are well noticeable at the background of numerous evenly distributed small secondary setae. Formation of specialized spine-like seta on abdominal tergites (Carabinae Callistethus, Harpalini Daptus, Orthognomini Orthognomus) belongs in principle also to this type of heterochaetosis. In Harpalini and several Zabruni larvae secondary setae are distributed unevenly, they form more or less distinct groups sometimes located in depressions of cuticle. Usually these are transversal rows on forehead and tergites, and longitudinal rows on parietal sclerites, they are more expressed in pawning (excavating) forms. Together with development of secondary setae increase in number of basal and coeloconical sensillae is usually observed.

Development of idiochaetome is obviously connected in most cases with advanced specialization of larvae. These are for example drusy setae of myrmeco- or termitophilous forms (Meimacis, Graphipterus, Pseudomorpha), cadiiform setae in halophilous, digitiform of phylloid setae in some Carabinae Larvae of Asaphidion with numerous drusiform setae, are probably the only exception from this rules, although almost nothing is known yet about their habits in nature.

Very peculiar chaetome has been found in representatives of Orthognomini and Cyphonini tribes numerous microtrichia which are not related to sensory function are developed on dorsal sclerites or on interocular membrane. (Fig 44). This similarity is even more interesting if one takes into account that larvae of Cyphonini genera are specialized surface-dwelling mollusks, predators with very simplified "general" chaetome, while larvae of Orthognomus genera are termitophilous with well developed heterochaetosis. The presence of this feature in representatives of non-allied tribes indicates on its convergent origin, and thus proves relatively independent evolution of chaetome elements.

Described way of chaetome restructuration form logically a natural row from simple forms of chaetome organization to complex ones. At the level of certain taxa this row is certainly determined both by ontogenetic development and simultaneously by phylogenetic trends. Thus, on the example of Elaphrinium tribe larvae (Fig 63) it can be observed, that very complicated chaetome of most specialized forms is connected with "general" type by continuous row of ontophylogenetic anabolic modifications. Similar schemes could be produced for other taxa and for other features as well (for example IX-X segments in Chiluma, heterochaetosis in Callistethus and
Lebitini (Cynindis), some Calleidini (Pterostichini, Harpalini) chaetome structure which is close to general one often prevails; it is very similar to chaetome of upper Jura larvae of Carabolarva (which belongs probably to allied Eodromeinae group - Makarov 1995). Therefore it can be supposed that simplification or increased complexity of chaetome does not reflect general phylogenetic trends in the whole family.

Comparison of chaetome structure in larvae from tribes which are traditionally considered as most primitive among carabids (Nebrini, Carabini) has revealed one common peculiarity: very little difference in the structure of 'primary' and 'secondary' sensillae (especially of campaniform sensillae, which sometimes cannot be distinguished from each other - Figs 64, 66*), and relatively larger variability in their localization and distribution. On the contrary, in evolutionary progressive taxa these differences are pronounced, and characteristic groups of sensillae and sensillae of different types are more distinct (Figs 65, 66). This trend can be observed in the structures of three different functional blocks - covering, sensory, and locomotory.

Therefore it can be suggested that evolution of carabid larvae chaetome has in the background the principle of optimization of sensory functions, expressed morphologically in stabilization of chaetome and in formation of constant complexes of different sensillae (like trichoid FR₁ - campaniform FR₁). At the background of this main trend subordinate morphological peculiarities, such as oligomerisation of chaetome, homo- and hetero-chaetosis, are realized in different taxa. Ways of modifications depend on certain taxa, and their analysis can be used for elaboration of relationship scheme in carabids. Phylogenetic taxonomic aspects of this problem will be covered in a separate paper. Finally it is worth to add that all these trends can be revealed based on descriptions of elder instar larvae as well, this contradicts to the usual practice of recent decade to describe only 1st instar larvae.

Acknowledgments

I am very grateful to Prof. Dr. K. H. Harzsch and Prof. Dr. H. H. F. Bolívar for their permanent support. Certain statements of the manuscript were kindly discussed with Dr. V. V. Grechennikov, Dr. O. L. Makarova, and Dr. A. M. Zaitseva. Many thanks to Dr. S. G. Golenischev and Dr. E. A. Lebedeva for corrections and for translation of this paper into English. The author is obliged also to many carabologists, as owing to their philanthropy work large material used in the base for this study was collected. We also thank Dr. S. N. Jordansky and Dr. I. P. Voronov for preparing the scanning electron micrographs.

This research is carried out with financial support from the Russian Fund for Fundamental Research (92-04-20191) and State Scientific Research and Technical Programme of Russia, "Biological Diversity"

REFERENCES


* The larvae of two species invoiced for comparison are similar in way of living (agile, living in surface, hibernate) and in body size, both species collected in one biotope.
BOUSQUET Y 1987 Description of the larva of Heteromorphodes prasinus bicolor Harris with comments on the relationships of the Heteromorphodes (Coleoptera: Carabidae) Can Entomol 119 921-930

BOUSQUET Y & GUILLOT H 1984 Notation of primary action and pores on larvae of Carabidae (Coleoptera: Adephaga) Can Entomol 116 573-588

BULYS 1985 Larvae of the genus Amara (subgenus Cola Zimm.) from Central Europe (Coleoptera, Carabidae) Studia Cracoviensia 36 1-74


DASHER S 1983 The morphology of insect Sense New York: Wiley, 266 pp

EMLANKOVA A F 1987 Phylogenetic evidence of functional characters in ground beetles (Coleoptera, Carabidae) Entomol General 6 303-310


EVANS M E G & FORSYTHE T G 1984 A comparison of adaptations to running, pushing and burrowing in some adult Coleoptera, especially Carabidae J Zool Lond 202 513-534

EVANS M E G & FORSYTHE T G 1985 Feeding mechanisms, and their variation in form, of some adult ground-beetles (Coleoptera: Carabidae) J Zool Lond 206 133-143

GOLLER H 1977 Technique for the study of immature coleoptera in glycocen Coleopt. Bull 31 381-382


GOLLER H 1983 The genera of holocarce Elaphrus and species of Elaphrus Fabrers (Coleoptera, Carabidae) classification, phylogeny and geography Oecolent 19 219-482

GRISHINNIVICH V V 1995 Larvae of Balkarina (Coleoptera, Carabidae) 1 Diagnosis of tribe and genera Proceedings of 3rd International Symposium of Carabology, p 24

GRISHINNIVICH V V 1996 Description of the first larval of Thalessiosphus longicornis (Coleoptera Carabidae) Trechoderidae) Allo Soc Zool Bonom 60 373-379

HABU A 1973 Carabidae, Harpalinae (Insecta, Coleoptera) Fauna-Japanica Tokyo: Kogakusha, 430 pp

HABU A 1981 Larvae of two species of Lebdum (Coleoptera, Carabidae) Entomol Rev Japan 36 63-73

HABU A & SADANAGA K 1964 Illustration for identification of larvae of Carabidae found in cultivated fields and paddy fields (I) Bull Natl Inst Agric Sci (Ser C) 13 212-222

HABU A & SADANAGA K 1965 Illustration for identification of larvae of Carabidae found in cultivated fields and paddy fields (II) Bull Natl Inst Agric Sci (Ser C) 13 223-246, 247-265

HABU A & SADANAGA K 1970 Description of some larvae of Carabidae found in cultivated fields and paddy fields Kyogyo 38 9-23

HARRIS A C 1978 The larva of Brulica antarctica (Coleoptera Carabidae Brulicinae) N Zool Entomol 6 401-405

HASEGAWA K 1980 Die digastrischen Schellen auf dem Maxilla Ipolyi von Coleoptera 1 Vergleichende-topographische Untersuchung des Unterkiefer Apparates Zool 204 14-1-2

KILER S 1953 Entomologisches Wörterbuch 3 Aufl Berlin Akademische Verlag, 679 pp


LIU ZHANG K Y 1992 Functional morphology of builder structures and diversity of total forms in the family Cryptophagidae (Coleoptera: Cryptozoa) Acta Zool Jilin 1 3-26 (in Russian, Engl. abstr.)

MADSEN D R 1960 Systematics of the Holocarce beetle subgenus Holarctic and related Balkarina (Coleoptera Carabidae) Bull Mus Comp Zool 153 143-299

MAKAROV K V 1990 [The role of the micromorphologic signs of larvae in the systematic of ground-beetles of the Carabinae (Coleoptera Carabidae)] The success of the entomology in the USSR Carabidae insects. The materials of the IX congress VEG 11-15 September 1989 LENINGRAD ZIN AN USSR, pp 84-87 (in Russian)


Tyschenko V. V. 1986. [Physiology of insects.] Moskva: Vysshaya Shkola, 303 pp. (in Russian)


APPENDIX

MATERIAL EXAMINED

COLEOPTERA
ADEPHAGA
HALIPIDAE
Haliphus sp
DYTISCIDAE
Hyphiusus ovalis (L., 1761), Hydroporus sp., Hydinus fuliginosus (Fabricius, 1762), Acilius annulatus (Nicola, 1822)
CARABIDAE
Cicindelinae

Cicindelidae

Megalopterus Megacephala euphretica Dejean, 1822

Cicindelidus Cicindela (Bennica) germanica L., 1758, C (Cephalina) desertiocula Feldermann, 1836, C (Cicindela) arenatae Fasculi, 1775, C (C) submaculata Solisky, 1874, C (Leptyria) fischeri Adams, 1817, C (s str.) Hybula L., 1758, C (s str.) albopterae Dokhturoff, 1885, C (s str.) bivittata L., 1758, C (s str.) solutae Latreille et Dejean, 1822, C (s str.) carampotrata L., 1758, C (s str.) aristapectus Balion, 1876, C (s str.) elypeste Fischer von Waldheim, 1831

OMPHRIONINAE

Omphroninus Omphroninus (s str.) Jambusia (Fabricius, 1775)

Carabinae*

Nebriae

Pelophilinae Pelophila borealis (Paykull, 1790)

Pelophila Leucon (s str.) ferrugineus (L., 1758), L (s str.) tenuis (Hollingworth in Panzer, 1793), L (s str.) fulvipes Chaudier, 1846, L (s str.) niger Gebler, 1847, Nebria (Bennica) nigerrimus Chaudier, 1846, N (E) prominulophila Solisky, 1874, N (E) fusciseta Shilenkov, 1982, N (Pacerastra) fridii (L., 1758), N (Pacerastra) nigricornis R. Salberg, 1984, N (B) reticulata (Strom, 1768), N (B) nigra (Paykull, 1790), N (B) sublaticornis Motschulsky, 1844, N (s str.) brevicollis (Fabricius, 1792), N (Alpaca) hirtella (Adams, 1817), N (A) proboscidea Chaudier, 1850

Netophila

Netophiinae Netophila (s str.) spiculata (L., 1758), N (s str.) longistriolus Motschulsky, 1862, N (s str.) alata (Balschmitt, 1812), N (s str.) germanicae Fauvel, 1863, N (Leptaphila) biguttata Fabricius, 1779, N (L) retroversa Spalath, 1899, N (Makarova) rufipes Curtits, 1829

Cambieae

Cambidae Carnioma (s str.) poecilophora (L., 1758), C (Cicindelina) squassata (L., 1758), C (Campelius) diurnus (Horbat, 1784), C (C) chinesis Kirby, 1817, C (C) maculatae Gebler, 1833, C (C) retorios (Heinecke, 1807, C (C) raymondi Motschulsky, 1859, C (s str.) schachowskii Balion, 1870, C (s str.) paracladopoda Sceneces, 1928, C (s str.) rugosulous Motschulsky, 1874, C (C) acerinae Guen, Fischer von Waldheim, 1862, C (A) caesithecumene Smirnov, 1955, C (Zosteria) arcuataicles Herbst, 1828, C (E) tachyopoda Mannhorn, 1827, C (E) bilobata Mannhorn, 1827, C (E) ruwenzori Fischer von Waldheim, 1823, C (E) tenuis Gebler, 1824, C (A) advena Fischer von Waldheim, 1822, C (M) arcuata Fischer von Waldheim, 1823, C (M) arcuata Fischer von Waldheim, 1822, C (M) arcuata Fischer von Waldheim, 1823, C (M) advena Fischer von Waldheim, 1817, C (M) advena Motschulsky, 1844, C (M) pseudarcuata Khryzenovsky et Mateev, 1995, C (M) muschelbachii Kabak, 1992, C (M) muschelbachii

* Larvae belong to tribe Opisthini, Colluxina, Clerostomina, Pamborina, Megalopsina, Promerosina, Sagenini, Erociina, Pseudomorphina, Metrini, Pydrini, Pachyini, Abyssornini, Chirocanthini, Odacanthini, Lachynophiini, Zaphini, Tetramorini, Helocorini, Mennomyini, subfamily Pausianinae and family Trischypnidae are known to me only on publication.
Rhipipterae


Lororrhini

Loricera (s.str.) pseudorum (Fabricius, 1775)

Scaritae


Clivinae

Clivina fuscata (L., 1758), *C. sp. Dejean, 1829

Dyschirini

Dyschira nigra (Sturm, 1842), *D. (s.str.) nigriceps* (Dejean, 1825), *D. (s.str.) chalcis* (Erichsen, 1857), *D. (s.str.) nigriceps* (Matschulsky, 1844)

Brosiidae


Trechinae


Tachynae

Tachyina sp. Tachyina nana (Gyllenhall, 1810)


Pogonini

Pogonius (Pogonini) rufiferus (Gemmell, 1922)

Petrophiinae

Petrophila Petrophila elata (Sturm, 1768), *P. acronotus Dejean, 1828, Diplosia depressa* (Gebler, 1829)

Deltemorini Deltemorus elongatus Dejean, 1831, *D. abius* Reitter, 1887

Pterostichinae

Monomorini Monomorus sp.

Pterostichini Pseustus (s.str.) longus (L., 1758), *P. (s.str.) niger* (L., 1758), *P. (s.str.) fuscus* Chandon, 1850, *P. (s.str.) punctitatus* (Schaller, 1783), *P. (s.str.) flavipes* (Chandon, 1850), *P. (s.str.) nigricula* (Schaller, 1783), *P. (s.str.) fuscus* (Chandon, 1850), *P. (s.str.) niger* (L., 1758), *P. (s.str.) nigricula* (Schaller, 1783), *P. (s.str.) fuscus* (Chandon, 1850), *P. (s.str.) nigricula* (Schaller, 1783), *P. (s.str.) fuscus* (Chandon, 1850)

Sphodrina Calathus (s.str.) rufipes (Sturm, 1824), *C. (s.str.) fuscus* Goeze, 1777, *C. (s.str.) angustipennis* (Paykull, 1790), *C. (Neocallathus) ambigus* (Paykull, 1790), *C. (Neocallathus) nigriceps* (Sturm, 1824), *C. (Neocallathus) melanocephalus* (L., 1758), *C. (Neocallathus) microstomus* (Dufourcund, 1812), *C. (Neocallathus) melanocephalus* (L., 1758)
Lebetinae

Orthogoninae *Orthogonius* *acutangulus* Chaudaur, 1852

Anthina *Anthus monnerthi* Chaudaur, 1842, *A. masoleata* ayglene Koebe, 1906

Helluoidea *Helluxodes cappabanae* Westwood, 1834

Galerinae *Galerina feal Bates*, 1883, *Galerina* sp

Drypta *Drypta dentata* (Rossi, 1790)

Brachyidae

Brachius *Brachius crepitans* (L., 1758), *B. expulsum* Duval-Chaudoir, 1812

POLYPHAGA

HYDROPHILIDAE

*Helophorus aquaticus* (L., 1758), *Helophorus* spp, *Berosus* *puncticollis* (Charpentier, 1825), *Hydrobasus fuscipes* (L., 1758)

STAPHYLINIDAE


HISTERIDAE

*Margaromius* sp, *Paromalus* sp

DRYLLIDAE

*Drylla* sp

CANTHARIDAE

*Canthurus* sp, *Mazonyches* sp

ELATERIDAE

*Athodes* sp, *Selatosomus* sp, *Amnotus obscurus* (L., 1758)

TENERBRIONIDAE

*Pediculus* sp, *Pasterotinus* sp

NEUROPTERA

OSMYLIDAE

*Osmia* sp

ASCALAPHIDAE

*Ascalaphus* sp

MYRMELEONIDAE

Myrmeleonidea gen. sp
Review of the Palearctic larvae of the genus Stenolophus (Coleoptera: Carabidae: Harpalini)

Andrey V. Matalin

Zoology and Ecology Department, Moscow State Pedagogical University, Khabalinostr str. 6/5, ROC-129278 Moscow, Russia

Received May 29, 1996, accepted June 27, 1996. Published December 27, 1996

Abstract. A review of the Palearctic larvae of the genus Stenolophus Stephens, 1828 is given. All larval instars of Stenolophus (s. str.) nevadensis Masson, 1844 are described for the first time. Differential diagnoses of the subgenera Stenolophus (s. str.) Artemonimus Habu, 1973, Egadromus Motschulsky, 1855 and the genus Stenolophus, as well as the keys to the subgenera and species based on first, second and third larval instars characters are given. Possible phylogenetical relationships of the species of the genus, based on larval characters, are discussed.

Larval morphology, key to all larval instars, Carabidae, Stenolophus, Palearctic region

INTRODUCTION

The genus Stenolophus includes 60 to 140 species worldwide, reflecting different concepts of different researchers. Lindroth (1968) subdivided the genus into two subgenera (Stenolophus s. str. and Agonoderus Dejean, 1829) and one species group. Habu (1973) and Noonan (1976) treated it in broader sense: with five subgenera (including Egadromus) and one species group. Kataev (in Kryzanovskij et al., 1995) followed this concept, but Kryzanovskij (1983), on the other hand, considered Egadromus as a separate genus.


This paper offers a detailed review of the Palearctic larvae of the genus Stenolophus (sensu Noonan 1976). The descriptions and redescriptions of the species are uniform, and follow those of Bousquet & Goulet (1984). The descriptions of the Neotropic species (Chu 1945) were critically analyzed using the sample approach. Possible phylogenetical relationships within the genus, based on larval characters are discussed.

MATERIAL AND METHODS

This study is based on the examination of 40 larvae belonging to eight species: Stenolophus (s. str.) nevadensis (Schrank, 1781) - 1 Ls, S (s. str.) peregrinus Mannerheim, 1844 - S, 4 Ls, 4 Lm, S (s. str.) dactylicus Fischer von Waldheim, 1823 - 4 Ls, 2 Lm, S (s. str.) consobrinus Brettschneider, 1873 - 1 Lm, S (s. str.) pygmaeus A. Morawetz, 1862 - 1 Lm, S (s. str.) maximus...
(Herbst, 1784) – 15 L., 3 L., 1 L. S. (Aenostephanus) fitzingeri Bates, 1873 – 1 L., and S. (Eugadromus) quinquemaculatus (Wiedemann, 1823) – 1 L. The larvae of S. pentus, S. discophora and S. musus were obtained from adult kept during 1990–1991 under laboratory conditions, as well as the larvae of S. pentus, S. discophora and S. musus, received from D. N. Fedorovskii (Institute of Ecology and Evolutionary Problem, Moscow, Russia), S. V. Uptovenkig (Rostov Pedagogical Institute, Rostov-on-Don, Russia) and A. G. Koval (All-Russian Institute of Plant Protection, Pushkino, Russia). The larvae of S. comandaria, S. propinquus, S. fulvescens and S. quinquemaculatus were provided by Takashi Matsuzuma (National Institute of Agro-Environmental Sciences, Tsukuba, Japan). Data about the larvae of S. (ser. st.) tristcolor Rodhain, 1867 and S. (Eugadromus) difficilis (Hope, 1845) were taken from Huber (1973), those about the second instar larva of S. (s. st.) discophora from Arndt (1991), and those about S. (Agonostemon) linearis (Fabelius, 1972), S. (Agonostemon) palpites (Fabelius, 1972) and S. (s. st.) sp. from Chn (1945). The material used for this study is kept in the collections of the Zoology and Ecology Department, Moscow State Pedagogical University (Moscow, Russia), of the Zoological Institute of the Russian Academy of Science (Saint-Petersburg, Russia) and of the National Institute of Agro-Environmental Sciences (Tsukuba, Japan).

The larvae were examined at magnifications of 55.5x, 120x, 150x and 600x with the aid of a contrast microscope. For examination of the chelate oxys 25 total preparations in the Fauri-Borinse liquid were made. Measurements were made using an ocular micrometer of a contrast microscope at magnifications of 55.5-150x. The notation of primary setae and pores follows that of Boursiquot & Gelei (1984): notation of secondary setae on the mandible and urogomphi follows that of Boursiquot (1985), classification of sensilla follows that of Snodgrass (1935) and notation of seta-groups follows that of Makarova (1993).

Cluster analyses (method of Bogurov unweighted means) were used to estimate the reciprocal percentage of the species and subgenera. The power of resemblance was evaluated using the Jacae-coefficient.

**DESCRIPTION**

**Genus Stenolophus Stephens, 1828**

Cephalic capsule transversal (W/L=1.23-1.50), slightly round by sides, with well-developed microstructure or lacking microsculpture. Nasale projected, with the larger central portion and two strong teeth on each side of it. Eye-bursters of first instar larvae consisting of 8–15 minute, equidistant teeth of different size (smaller ones at base of frontal suture) on each side along frontal sutures. Coronal suture distinct, cervical groove present, extended dorsoceally near PA1 and ventrolly near PA1, ocular groove absent. Adnasale apart from FR1 and FR2, with one additional seta on each side and one basiconical sensilla, located basal of FR4 and FR4 (Fig. 1). Sensilla FR1 basiconical. Mandibles massive, retinaculum large, located near base, cutting edges of mandibles and retinaculum smooth. Seta MN, absent. Antennae not, or slightly longer than mandibles. Antennomeres I and II without or with additional setae, ventral side of antennomere II with one or two additional basiconical sensilla. Lacinia slender, with strongly acuminate apex and with powerful seta MX, as long as seta MX (Fig. 2); gMX with 25–44 setae, no unequal numbers of setae in gMX. Submentum subquadrate or distinctly longitudinal. Ligula with blunt or sharp apex, seta 1.L, absent. Labial palpomere I without additional setae. Thoracic tergites transversal (W/L of prothorax=1.55–2.0, W/L of meso- and metathorax=2.95–4.0), sclerotised, with clear borders (Figs 3–4). Numerous proprioceptors along front and basal sides of prothorax. Femur with three to eight secondary spiniform setae on ventral side, trochanter with two or three secondary setae or asetose. Abdominal tergites distinctly transversal (W/L=3.0–4.0), poorly sclerotised, with or without microsculpture, without transversal keel separating prueterum from tergum, posterior borders indistinct (Fig. 5). Seta TE1, as long as seta TE2. Secondary setae on thoracic and abdominal tergites very numerous, both long and short. Sternites poorly sclerotised, with borders very indistinct (Figs 6–7). Urogomphi not less than 1.7 times longer than pygidium. Seta UR1 present, single or as a group of setae.
Figs 1–11. Species of the genus Stemolephas Stephens—third instar larvae. 1—left adanal plate, dorsal view; 2—lacinia, dorsal view; 3—pronotum, dorsal view; 4—mesonotum; 8–11 integria, dorsal view. Explanations: as—anterior sternite, mes—median sternite, is—outer sternite, hy—hypopleurite, EP—epipenite, sa—stigma. 1, 8–S (s. str.) propangua A. Morawitz; 2, 10–S (Antemolephas) fuscoceras Bates; 3, 9–S (s. str.) persiusc Mannerheim; 4–S (s. str.) mixitus Herbst; 5, 11–S (Eugnolema) quinquemustulata (Wiedemann); 6–S (s. str.) tonomus (Schrank); 7–S (s. str.) connotatus Bates. Scales: 1–2, 7–11; II–3, 5–6; III–4, IV–1.
Subgenus *Stenolophus* s. str.

Head dark reddish-brown to yellowish-brown; thoracic tergites reddish-brown to pale yellowish-brown; abdominal tergites brownish-yellow to yellowish-white; urogomphi yellowish to white. Head with well-developed microsculpture or practically lacking microsculpture. Nasale narrow, distinctly projected: distance between pores FR₁ not more than 1.3 times longer than distance from pore FR₁ to adnasale plate; height of median area 1.6–2.2 times smaller than distance between pores FR₁ (Figs 12–17). Egg-bursers consisting of 8–15 minute teeth on each side along frontal sutures. Coronal suture long, as long as labial palpomere I. Antennomere I with 1–2, antennomere II with 3–5 additional setae (Figs 23–24) or without additional setae (Fig. 25); antennomere II distinctly longer than antennomere IV. Stipes slender (L/W=2.6–3.0), gMX with 25–44 setae. Submentum subquadrate (L/W=0.9–1.1) or distinctly longitudinal (L/W=1.30–1.36). Apex of ligula blunt (Fig. 8) or sharp (Fig. 9), setae LA₂ located dorsally. Abdominal tergites with well-developed microsculpture or lacking microsculpture. Femur as long as tarsus and tibia combined (Fig. 20), with 3–8 secondary spiniform setae on ventral side, trochanter with 1–3 secondary setae or without it. Six to ten pairs of long setae along anterior tergal borders, 8–12 pairs of setae along posterior borders. Hyposcutellum with 5–11 setae, median sternite with 3–10 pairs of setae, inner sternite with 2–6 and outer sternite with 3–5 setae. Urogomphi much shorter, not more than 1.9 times longer than pygidium. UR, present as a single seta or as a group of setae.

*Stenolophus* (s. str.) *discophorus* Fischer von Waldheim, 1823

(Figs 12, 23, 31, 39, 47, 57)

Head pale brown, thoracic tergites yellowish, abdominal tergites and urogomphi yellowish-white. Surface of head with rough isodiometric microsculpture, except for areas near setae FR₁, FR₅, FR₆, FR₇, PA₁, and PA₄, occiput distinctly wrinkled. Nasale with united group of teeth in medial area (Fig. 12). Retinaculum very wide (Fig. 28). Antennomere I with 1–2, antennomere II with 4–5 additional setae (Fig. 23). Stipes slender (L/W=3.4–3.6), with five setae on outer side, gMX with 36–39 setae (Fig. 31). Submentum distinctly longitudinal (L/W=1.30–1.31), with 25–27 setae on dorso-lateral surface, gLA₅ with 2 setae, ligula with blunt apex (Fig. 39). Femur with 10 secondary spiniform setae ventrally, trochanter with 7 secondary setae. Hyposcutellum with 10 setae, median sternite with 10 pairs of setae, inner sternite with 6 and outer sternite with 5 setae. gUR, with 2 long setae. Pygidium slender (L/W=2.0–2.1), sternal side with 8 long setae. **AGE DIFFERENCES.** In second-instar larva antennomere II with 2 additional setae, antennomere I without additional setae. Femur with 6 secondary spiniform setae on ventral side.

In first-instar larva head with very poor isodiometric microsculpture in basal area of frontal sclerite. Egg-bursers consisting of 13–15 minute teeth on each side (Fig. 47). Retinaculum moderately wide. Stipes more stocky (L/W=2.19–2.20), gMX with 30–31 setae.

*Stenolophus* (s. str.) *connotatus* Bates, 1873

(Figs 7, 13, 20, 24, 28, 32, 40, 48)

Head yellowish-brown, thoracic tergites paler than head, abdominal tergites much paler yellowish-brown, urogomphi yellowish-white. Head with well-developed isodiometric microsculpture in the basal area of frontal sclerite, between setae FR₁–FR₄, FR₅–FR₆, FR₇–FR₈, PA₁–PA₃–PA₄, PA₅–PA₆, and along posterior edge of cervical groove; occiput wrinkled. Thoracic and abdominal tergites with multipointed microsculpture. Nasale with united group of teeth in me
dial area (Fig. 13). Retinaculum very wide (Fig. 28). Antennomere II with 3–4 additional setae (Fig. 34). Stipes slender (L/W=3.4), with 6 setae on outer side, gMX with 41–44 setae (Fig. 32). Submentum distinctly longitudinal (L/W=1.36), with 39–40 setae on dorso-lateral surface, gLA9 with 2 setae, ligula with sharp apex (Fig. 40). Femur with 8 secondary spiniform setae on ventral side, trochanter with 3 secondary setae. Hypopleurite with 8 setae, median sternite with 4 pairs of setae, inner sternite with 2 and outer sternite with 3 setae, later in form and size of hypopleurite (Fig. 7). Seta U1X single, long. Pygidium stocky (L/W=2.0–2.1), sternite with 8 setae.

Ade differences. In first-instar larva egg-bursters consisting of 9 minute teeth on each side along frontal sutures (Fig. 48). Retinaculum moderately wide.

*Stenolophus* (s. str.) *propinquus* A. Morawitz, 1862
(Figs 1, 8, 14, 33, 41, 49)

Head and prothorax reddish-brown, meso- and metathorax pale yellowish-brown, abdominal tergites paler yellowish-brown or brownish-yellow, urogomphi white. Head with well developed microsculpture: isodiamic on frontal sclerite, in area of coronal suture, near setae PA7, between setae PA1–PA4–PA6, PA4–PA4–PA6, and finely wrinkled near setae PA3–PA4. Nasale with united group of teeth in medial area (Fig. 14). Stipes stocky (L/W=2.6), with 4 setae on outer side, gMX with 26–30 setae (Fig. 33). Submentum subquadrate (L/W=1.05), with 16–17 setae on dorso-lateral surface, ligula with blunt apex (Fig. 41). Femur with 5 secondary spiniform setae on ventral side, trochanter without secondary setae, Hypopleurite with 8 setae, median sternite with 6 pairs of setae, inner sternite with 4 and outer sternite with 5 setae, gUR, with 2 long setae. Pygidium stocky (L/W=1.60–1.65), sternite with 5 long setae.

Ade differences. In first-instar larva egg-bursters consisting of 7–8 minute teeth on each side of frontal suture, front tooth slightly distant from frontal suture (Fig. 49).

*Stenolophus* (s. str.) *persecus* Mannerheim, 1844
(Figs 3, 9, 15, 25, 29, 34, 42, 50, 56)

Head dark reddish-brown, thoracic tergites pale reddish-brown, abdominal tergites brownish-yellow, urogomphi yellowish. Head with fine isodiamic microsculpture near setae FR3 and PA4, and also between setae PA1–PA4; posterior edge of cervical groove a finely wrinkled. Thoracic and abdominal tergites with distinct multipointed microsculpture. Nasale incised at middle, so teeth divided into two groups (Fig. 15). Head with furrow near seta PA3 (Fig. 29). Stipes slender (L/W=3.36–3.38), with 5 setae on outer side, gMX with 33–35 setae (Fig. 34). Submentum subquadrate (L/W=0.90–0.92), with 13–15 setae on dorso-lateral surface, ligula with sharp apex (Fig. 42). Pores PRb and PRc located near setae PR2 and PR3, respectively. Femur with 5–6 secondary spiniform setae on ventral side, trochanter with 2 secondary setae. Hypopleurite with 5 setae, median sternite with 3 pairs of setae, inner and outer sternites with 5 setae each. gUR, with 2 long setae. Pygidium slender (L/W=2.0–2.1), sternite with 4 long setae.

Ade differences. In second-instar larva head with fine microsculpture near setae FR2, FR3 and PA4. Stipes stocky (L/W=2.80–2.83), gMX with 30–32 setae. Submentum with 10–11 setae on dorso-lateral surface. Pores PR, and PRb located between setae PR2, PR3, and PRb–PRc, respectively. Trochanter with 1 secondary spiniform setae on ventral side. Inner and outer sternites with 4 setae each.

In first-instar larva head with very poor isodiamic microsculpture in basal area of frontal sclerite and between setae PA4, PA5. Egg-bursters consisting of 12–14 minute teeth on each side along frontal sutures (Fig. 50). Stipes more stocky (L/W=2.30–2.34), gMX with 28–30 setae.

424
Stenolophus (s. str.) teutonus (Schrank, 1781)
(Figs 6, 16, 35, 43)

Head chocolate brown, thoracic tergites pale brown, abdominal tergites yellowish, urogomphi wellowish-white. Head with rough isodiamic microsculpture in central area of frontal sclerite, along frontal sutures up to seta PA2 and between setae PA1r-PAn. Nasale with united group of teeth in medial area (Fig. 16). Stipes slender (L/W=3.0), with 5 setae on outer side, gMX with 28–30 setae (Fig. 35). Maxillary palpomere II 3.5–4.0 times longer than maxillary palpomere IV. Submentum subquadrate (L/W=0.98), with 17 setae dorso-laterally, ligula with blunt apex (Fig. 43). Femur with 7 secondary spiniform setae ventrally, trochanter with 3 secondary setae. Hypopleurite with 7 setae, median sternite with 7 pairs of setae, inner and outer sternites with 4 setae each. gUR, with 2 long and 1 short setae. Pygidium slender (L/W=2.5), sternite with 5 long setae.


426
**Stenolophus (s. str.) mixtus** (Herbst, 1784)

(Figs 4, 17, 36, 44, 51, 58)

Head pale brown, thoracic tergites pale yellowish-brown, abdominal tergites yellowish-white, urogomphi white. Head with fine isodiametric microsculpture between setae FR$_2$–FR$_3$, PA$_3$, PA$_4$, PA$_2$, and near seta PA$_2$, occupent area near setae DA$_{ab}$, PA$_1$, and PA$_2$. Finely wrinkled Nasale with united group of teeth in medial area (Fig. 17). Supes slender (L/W=3.0), with 5 setae on outer side, gMX with 33–37 setae (Fig. 36). Submentum subquadrate (L/W=0.95), with 21–23 setae on dorso-lateral surface, ligula with blunt apex (Fig. 44). Femur with 5–6 secondary spiniform setae ventrally, trochanter with 2 secondary setae. Hypopleurite with 5 setae, median sternite with 4 pairs of setae, inner and outer sternites with 3 setae each. Seta UR$_4$ single, long. Pygophurum slender (L/W=1.90–1.93), sternite with 4 long setae.
AGE DIFFERENCES. In second-instar larva microsculpture of head developed poorly. Stipes stocky (L/W=2.33-2.35), gMX with 29-32 setae. Submentum with 16 setae on dorso-lateral surface. Trochanter with 1 secondary spiniform seta ventrally.


428
In first-instar larva head with fine isodiametric microsculpture in basal area of frontal selerite and near setae PA. Egg-bursters consist of 12–15 minute teeth on each side along frontal sutures (Fig. 51). Stipes more stocky (L/W=2.2), gMX with 25–27 setae.

Subgenus *Astenolophus* Habu, 1973

*Stenolophus (Astenolophus) fulvicornis* Bates, 1873
(Figs 2, 10, 18, 21, 26, 37, 45, 53)

Head pale yellowish-brown, slightly reddish near apical margin and at central area. Pro-, meso- and metanotum pale brownish-yellow. Abdominal tergites yellowish. Head with poorly developed microsculpture, isodiametric near setae FRd, PA, and wrinkled in area of coronal suture. Nasale relatively wide, projected: distance between pores FRd not less than 1.5 times longer than distance from pore FRd to adnasal plate; height of median area 2.5 times lower than distance between pores FRd (Fig. 18). Egg-bursters consist of 8 minute teeth on each side along frontal suture, front tooth distant from seta FRd (Figs following Habu 1973) on 1/4 seta length (Fig. 53). Coronal suture short, as long as labial palpomere II. Antennemeres I and II without additional setae; antennemere II distinctly longer than antennemere IV (Fig. 26). Stipes stocky (L/W=2.0–2.3), with lateral projection near seta MXa, gMX with 25–28 setae (Fig. 37). Submentum subquadrate (L/W=1.1), ligula with blunt apex, setae LA6 located apically (Figs 10, 45). Abdominal tergites without microsculpture. Femur distinctly shorter than tarsus and tibia combined, the former with 5 secondary spiniform setae on ventral side, trochanter without secondary setae (Fig. 21). Eight pairs of long setae along both anterior and posterior tergal borders. Hypopleurite with 5 setae, median sternite with 4 pairs of setae, inner sternite with 3 and outer sternite with 6 setae. Urogomphi relatively long, not less than 2.0 times longer than pygidium. gUR, with 2 long setae.

Subgenus *Egadroma* Motschulsky, 1855

Head yellowish or pale reddish-brown. Pronotum yellowish or pale yellowish-brown, sometimes slightly reddish; meso- and metanotum paler. Tergites pale brownish-yellow or very pale yellowish-brown. Head with well developed microsculpture, Nasale wide, poorly projected: distance between pores FRd not less than 2.2 times longer than distance from pore FRd to adnasal plate; height of median area 2.5–3.0 times lower than distance between pores FRd (Fig. 19). Egg-bursters consist of 14–15 minute teeth on each side along frontal sutures. Coronal suture short, as long as labial palpomere II. Antennemeres I and II without additional setae; antennomere II as long as antennomere IV (Fig. 27). Stipes slender (L/W=2.6–3.0), gMX with 25–27 setae. Submentum subquadrate (L/W=1.04), ligula with blunt apex, seta LA6 located dorsally (Fig. 11). Abdominal tergites with developed microsculpture. Femur distinctly longer than tarsus and tibia combined, the former with 4–6 secondary spiniform setae on ventral side, trochanter with 2 secondary setae or without it (Fig. 22). Along anterior tergal borders 3–7 pairs of long setae, along posterior tergal borders 4–5 pairs. Hypopleurite with 5 setae, median sternite with 5 pairs of setae, both inner and outer sternites with 3 setae each. Urogomphi very long, not less than 2.3 times longer than pygidium. gUR, with 2 long setae.
Stenolophus (Egadroma) quinquepustulatus (Wiedemann, 1823)

Head and prothorax yellowish-brown, meso- and metathorax paler, abdominal tergites brownish-yellow, urogomphi white. All head surface with isodiamic microsculpture which is finer near setae FR, FR₁, PA₁, PA₂, and PA₃–PA₄. Thoracic and abdominal tergites with fine isodiamic microsculpture. Urogomphi distinctly microsculptured. Nasale with wide and even notch median area (Fig. 19). Head with a furrow between setae PA₁ and PA₂ (O₂–L₁), following Habu's (1973) (Fig. 30). Stipes stocky (L/W = 2.6), with 5 setae on outer side, gMX with 25–27 setae (Fig. 38). Submentum subquadrate (L/W = 1.04), with 14 setae on dorso-lateral surface, ligula with blunt apex (Fig. 46). Femur with 6 secondary spiniform setae on ventral side, trochanter with 2 secondary setae. Hypopleurite with 5 setae, median sternite with 5 pairs of setae, inner and outer sternites with 3 setae each, gUR₅ with 2 long setae. Pygidium slender (L/W = 2.3–2.4), sternite with 3 long setae.

AGE DIFFERENCES. First-instar larva paler. Nasale less projected. Egg-bursters consisting of 14–15 minute teeth on each side along frontal sutures (Fig. 55).

Key to subgenera and species of first-instar larvae of Stenolophus

1 (2) Nasale narrow, distinctly projected: distance between pores FRd not more than 1.3 times longer than distance from pore FR₁ to labial plate, height of median area 1.6–2.2 times lower than distance between pores FR₁. (Page 12–17) Coronal sutures long, as long as labial palpmere 1 Urogomphi relatively shorter, no more than 1.9 times longer than pygidium

1 (1) Nasale more rounded: distance between pores FRd more than 1.3 times longer than distance from pore FR₁ to labial plate, height of median area 1.6–2.2 times lower than distance between pores FR₁. (Page 18–19) Coronal sutures short, as long as labial palpmere 1 Urogomphi relatively longer, no more than 1.9 times longer than pygidium

430
2 (1) Nasal wide, poorly projected distance between pores FRd not less than 1.5 times longer than distance from pore FRd to adnasal plate; height of median area 2–3 times lower than distance to adnasal plate pores FRd (Figs. 18–19). Cornual surface short, as long as labial palpmere II. Urogonyma longer, not less than 2.6 times longer than pygidium.

3 (4) Antennomere II with 3–5 additional setae (Figs. 23–24). Submentum distinctly longitudinal, with more than 25 setae on dorsal-lateral surface. gl.A1 with 2 setae. ........................................ ........................... (5)

4 (3) Antennomere II without additional setae (Fig. 25). Submentum distinctly longitudinal, with less than 23 setae on dorsal-lateral surface. Seta LA1: angle ........................................ ........................... (7)

5 (6) Antennomerc I with 1–2 additional setae (Fig. 23). Stipes with 5 setae on outer side. gMX with 36-39 setae. Submentum with 25–27 setae on dorsal-lateral surface. Ligula with blunt apex. Femur with 10 secondary spiniform setae on ventral side, trochanter with 3 secondary setae. WH: L=0.96–1.11 (1.04) mm, Lm=1.47–1.55 (1.51) mm

(5) Antennomere I without additional setae (Fig. 24). Stipes with 6 setae on outer side. gMX with 41–44 setae. Submentum with 39–46 setae on dorsal-lateral surface. Ligula with sharp apex. Femur with 8 secondary spiniform setae on ventral side, trochanter with 3 secondary setae. WH: L=0.9–1.01 (0.97) mm, Lm=1.22–1.43 (1.35) mm

7 (8) Head with well developed maxillotrochanter. Stipes slender (L/W = no more than 2). Antennomere I no more than 1.6 times longer than antennomere IV. Antennomere II with 2 additional basal conical sensilla. WH: L=0.66–0.70 (0.68) mm, Lm=0.83–0.95 (0.87) mm

8 (7) Head with poorly developed maxillotrochanter. Stipes slender (L/W = no less than 3). Antennomere I no less than 2.0 times longer than antennomere IV. Antennomere II with only 1 additional basal conical sensilla

9 (12) Head and thorax tormines chocolate brown, well tesselated. Maxillary palpomere III distinctly longer than maxillary palpomere IV. Galeromere I shorter, no more than 1.5 times longer than galeromere II. Labial palpomere I shorter, no more than 1.7 times longer than labial palpomere II. gUR with 2 long setae

10 (11) Cephalic capsule wider (W/L = 0.40–0.44). Nasal not well developed, only 2 teeth divided into two groups (Fig. 15). Seta PA2 as long as setae PA1 and PA4. Head with furrow near seta PA4 (Fig. 29). Maxillary palpomere II shorter, no more than 2.5 times longer than maxillary palpomere IV. Submentum with 15–25 setae on dorsal-lateral surface. Ligula with sharp apex (Fig. 9). Along posterior tergal borders 16 pairs of setae. Hypoplectron with 5 setae, median sternite with 3 pairs of setae. Femur with 5 secondary spiniform setae on ventral side, trochanter with 2 additional setae gUR, with 2 long setae. WH: L=0.86–0.88 (0.87) mm, Lm=1.05 mm

11 (10) Cephalic capsule less wide (W/L = 0.30). Nasal with united group of teeth in median area (Fig. 16). Setae PA2 distinctly shorter than setae PA1 and PA4. Head without furrow near seta PA4. Maxillary palpomere II longer, no less than 3.5 times longer than maxillary palpomere IV. Submentum with 12–19 setae on dorsal-lateral surface.

Fig. 59 Hypothetical phylogeny of the Holoteste species of the genus Stenolophus Staphor according to the larval characters: 1 – Stenolophus (s. str.) discophorus Fischer von Waldheim, 2 – S. (s. str.) convolutus Bates, 3 – S. (s. str.) propinquus A. Morawitz, 4 – S. (s. str.) perpusillus Mannscheim, 5 – S. (s. str.) neomina (Schranks), 6 – S. (s. str.) mutus (Herbst), 7 – S. (Sal monophus) fulvocercus Bates, 8 – S. (Eugadophus) quinguepartitus (Wiedemann), 9 – S. (Aegadonodes) lineola (Fabricius), 10 – S. (Aegadonodes) palipes (Fabricius), 11 – S. (s. str.) sp.
ligula with blunt apex (Fig. 8). Along posterior tergal borders 8 pairs of long setae. Hypopygium with 7 setae; median sternite with 7 pairs of setae. Femur with 7 secondary spiniform setae on ventral side, trochanter with 3 secondary setae; gl./Re. with 2 long and 1 short setae. WH L = 1.13 mm. ...S. (st.) testans (12) (9) Head and thoracic tergites yellowish-brown, poorly sclerotised. Maxillary palpiemore III as long as maxillary palpiemore IV. Galeae more I longer, no less than 1 7 times longer than galeae more II. Labial palpiemore I longer, no less than 1 8 times longer than labial palpiemore II. Setae U. R. angule, long. ...S. (st.) testanum (13) (14) Cephalic capsule narrower (WH L = 1.20 1.23). Antennomere I 1.3.0 times longer than antennomere IV. Along anterior tergal border 9, along posteroventral tergal border 12 pairs of long setae. Femur with 5–6 secondary spiniform setae on ventral side, trochanter with 2 secondary setae. WH L = 0.74 0.76 (0.75) mm, L = 0.87 mm. ...S. (st.) mixtus (14) Cephalic capsule wider (WH L = 1.30 1.32). Antennomere I 1.2.5 times longer than antennomere IV. Along anterior tergal border 8, along posterior tergal border 6 pairs of long setae. Femur with 3 secondary spiniform setae on ventral side, trochanter without secondary setae. WH L = 0.68 0.72 (0.70) mm, L = 0.91 1.00 (0.93) mm (after Habu 1973). ...S. (st.) tricolor (15) (16) Head with poorly developed microsculpture. Antennomere II distinctly longer than antennomere IV. Setae stocky (L/W no more than 2.3 2.3), ligula with apically located setae LAc. (Fig. 19). Femur distinctly shorter than tibia and thus combined (Fig. 21). Unguiculi shorter, no more than 2.0 times longer than pygidium. WH L = 0.60 0.64 (0.62) mm, L = 0.77 0.84 (0.80) mm. ...S. (st.) testificialis, S. (st.) fulvocorpus (15) (16) Head with well-developed microsculpture. Antennomere II as long as antennomere IV. Setae slender (L/W no less than 2.6 3.0), ligula with denticulated setae LAc. (Fig. 11). Femur distinctly longer than tibia and thus combined (Fig. 22). Unguiculi longer, no less than 2.3 times longer than pygidium. ...S. (st.) fulvocorpus (16) (17) Cephalic capsule wider (WH L = 1.40 1.42). Nasale not incised at middle (Fig. 19). Head with narrow between setae PA. and PAn. (Fig. 20). Along anterior tergal border 6 pairs, along posterior border 4 pairs of long setae. Femur with 2 secondary spiniform setae, trochanter with 2 secondary setae. WH L = 0.68 0.77 (0.72) mm, L = 0.95 1.03 (1.00) mm. ...S. (st.) quinquemutilus (17)

Fig. 60. Hypothetical phylogeny of the Holcopteroid species of the subtribe Steinoptina according to the larval characters. 1 - Steinoptus (st.) zonopterus Fischer von Waldheim, 2 - S. (st.) pseudo spinatus Bates, 3 - S. (st.) propinquus A. Moernitz, 4 - S. (st.) rousseti Mannerheim, 5 - S. (st.) testans (Schranks), 6 - S. (st.) reticulatus (Herrich), 7 - S. (st.) fulvocorpus Bates, 8 - S. (Eugermos) quinquemutilus (Wadamatsu), 9 - S. (Agonopterus) lineolous (Fabricius), 10 - S. (Agonopterus) pellipes (Fabricius), 11 - S. (st.) sp., 12 - Decherrocellus (st.) sp., 13 - D. (st.) unicolor Bates, 14 - D. (st.) decolor Motschulsky, 15 - D. (st.) abdolmens Motschulsky, 16 - D. (st.) excella Bates, 17 - Bridgesia (Tachytesia) globular Bates.

432
DISCUSSION

The relationships of the Stenolophina subtribe taxa studied are presented in Figs 59–60. There are three distinct species-complexes in the genus *Stenolophus* (Fig. 59). The first complex includes the Nearctic species (the value of Jaeger-coefficient (JC) in bifurcation area=0.325), the second complex includes species of the subgenera *Asterolophus* and *Egadromia* (JC=0.430) and third one includes the Palearctic species of the nomenclatural subgenus, *Stenolophus discophorus* and *S. connatatus* in the nomenclatural subgenus are characterized as the most isolated species (JC=0.525). The comparison of the Palearctic species of the genus *Stenolophus* with the Nearctic species and with the species of the genus *Dichotomus* Jacquinon du Val. 1857 (following Kataev, in Kryzhanovskij et al. 1995) shows similar results (Fig. 60). In addition, *S. discophorus* and *S. connatatus* are isolated from the other Palearctic species to the same degree as the species of the subgenus *Asterolophus* and *Egadromia* (JC=0.560). The larvae of *S. discophorus* and *S. connatatus* display some characters of the larvae of the genus *Harpalus* Latreille, 1802. These characters, noted for the first time, are: well developed microsculpture on the head; wide, robust retinaculum; additional setae on the antennomeres I and II; longitudinal submentum, seta LA presented as a group of setae; numerous secondary setae on dorso-lateral surface of submentum, in gMX and on ventral side of femur and trochanter. These species may represent a separate species-group, or even subgenus.

Acknowledgements

I am very grateful to Takashi Matsuura, Dmitri N. Fedorenko, Sofia V. Ulanovskaya and Alexander G. Kovol, who very kindly made their materials available for study, and to Kim V. Makeev (Moscow State Pedagogical University, Russia) for several critical comments on the contents of the manuscript. This study received financial support of the Russian Foundation for Fundamental Research (93–94–20191).

REFERENCES


**Nicrophorus mexicanus** (Coleoptera: Silphidae: Nicrophorinae): larval morphology and phylogenetic considerations on the *N. investigator* group

Claudia PALESTRINI, Enrico BARBERO, Michele LUZZATTO & Marco ZUCCHELLI

Departmento di Biologia Animale, Università di Torino, via Accademia Albertina 17, 1-10123 Torino, Italy

Received May 29, 1996; accepted June 27, 1996
Published December 27, 1996

**Abstract** The authors describe and illustrate in detail the three larval stages of *Nicrophorus mexicanus* Matthews, 1888 (Coleoptera: Silphidae: Nicrophorinae), a common mexican and central-american carrion beetle. A study of the taxonomic value of larval characters, as well as the morpho-metamorphic characters of adults, enables the authors to discuss the phylogenetic relationships among the species of the *N. investigator* group, which includes *N. mexicanus*. The species seem to be closely related to *N. investigator* Zetterstedt, 1824 and *N. nigripes* Mannerheim, 1843, while the remaining two species classified in the group (*N. hybridae* Hatch & Angell, 1925, and *N. tomentosus* Weber, 1801) appear to be more primitive. Results partly confirm phylogenetic hypotheses proposed by other authors in previous papers.

**Larval morphology, phylogeny, Coleoptera, Silphidae, Nicrophorus**

**INTRODUCTION**

*Nicrophorus mexicanus* Matthews, 1888 is a large necrophagous beetle, active all year round, distributed from southwestern United States to Guatemala and El Salvador (Peck & Anderson 1985).

Building on the classic studies of Hatch (1927), Pukowski (1933, 1934) and Baldwin (1935), more recent researches have focused on the immature stages of *Nicrophorus Fabricius, 1801* species from both a morphological (Byzova 1964; Klausnitzer & Zerche 1978; Anderson 1982; Peck & Anderson 1985; Rážčka 1992) and an ethological (Rousset 1964a, b; Milne & Milne 1944, 1976; Hufnagel et al. 1993; see also the papers quoted in Huerta et al. 1992) perspective.

The three larval instars of *Nicrophorus mexicanus* are described in this paper in detail, with a view to reexamine the phylogenetic relationships of the species. Our results are compared with those of Peck & Anderson (1985) who placed five species of *Nicrophorus* (*N. hybridae* Hatch & Angell, 1925, *N. investigator* Zetterstedt, 1824, *N. mexicanus*, *N. nigripes* Mannerheim, 1843 and *N. tomentosus* Weber, 1801) — mainly from Latin America — together in the *N. investigator* group. Their study included five characters taken from larval morphoanatomy, which formed the basis of a phylogenetic hypothesis.

**MATERIALS AND METHODS**

Twelve individuals (5 females and 7 males) from the Chapultepec Wood, Mexico City, Mexico, were included in this study. The beetles were collected during the summer 1991 with pitfall traps baited with meat. Five pairs were collected and reared in controlled conditions in suitable terraria, 30 cm in diameter at the mouth, 42 cm high, 5 cm full of sweet sandy soil, at the Department of Animal Biology, University of Turin, Italy. Ground beef was used as food. Terraria were opened and observed at regular times depending on the activity of each pair. The five pairs regularly bred so that 6 first instar (*L₁*), 8 second instar (*L₂*), and 12 third instar (*L₃*) larvae were obtained (no pupa was sacrificed, so that a description of this stage is not provided). On average, the first larval instar took 7 days to develop, the second larval 4 days, the third larval 6 days, and the pupa 25 days.
DESCRIPTION

Larva eruciform and elongate (Fig. 1). Dorsoventrally depressed. Body whitish, third stage more brownish, with the head, strongly reduced ventral sclerites, regions surrounding the spiracles, urogomphi (Figs 1, 18, 38) and legs more sclerotized. Average body length: \( L_3 \) 27.8 mm, \( L_2 \) 18.8 mm, \( L_1 \) 5.2 mm.

**HEAD** (Figs 11, 12, 13, 29). Prognathous, dorsoventrally depressed. Average width: \( L_{1w} \) 2.2 mm, \( L_{2w} \) 2.1 mm, \( L_{3w} \) 1.0 mm; average length: \( L_{1l} \) 1.8 mm, \( L_{2l} \) 1.5 mm; \( L_{3l} \) 0.9 mm. Epicranial suture short, marked, straight. Frontal suture V-shaped, with branches very divergent, turned laterally near the fovea, and less conspicuous near the insertion of antennae. Frons gently convex and medially more sclerotized. Epistomal suture manifest only laterally. Foveas well marked.

**clypeus** (Figs 23, 42). Pentagonal in form, separated from labrum by a large unsclerotized band, with about six sensilla and grouped together with three pairs of setae. \( L_2 \) and \( L_3 \) clypeus less sclerotized than in \( L_1 \).

**labrum**. \( L_3 \): transverse, slightly convex apically, pentagonal in form, on the whole not very sclerotized. Central part clearly transverse, without a semicircular area. Anteriorly four strong setae, posteriorly six more, less robust, and two sensilla. \( L_3 \) and \( L_2 \), with anterior central part strongly sclerotized and directed apically, and two unsclerotized bands laterally. Anterolateral angles well-marked. Setae like in \( L_1 \), \( L_2 \): anterior margin clearly concave in the middle, very sclerotized laterally, semicircular, raised apically with two teeth.

**epipharynx**. Two longitudinal bands of dense microtrichia directed centrally, medial part glabrous. \( L_3 \): anterior medial part poorly developed, bearing centrally the first porous area, and laterally two strong, conical setae. \( L_2 \) (Fig. 25) and \( L_3 \): anteromedial concavity more evident. In all instars the first porous area divided by a longitudinal septum and bearing at least three-four pairs of sensilla. Posterior to these the second porous area, pair, with a triad of sensilla. Lateroanteriorly two pairs of conical setae. At the base, between the two longitudinal bands, an irregular, transverse row of variable numbers of sensilla (quinqueporous area) and laterally and posteriorly two groups of five sensilla, in clusters (Fig. 26).

**mandibles**. Strongly sclerotized. Coarsely pyramidal-like, without molar areas. \( L_3 \) with spinulate scissorial area in the left mandible (Figs 8, 9), slightly notched, making a small tooth, in the right one (Figs 6, 7). In \( L_2 \) mandibles bearing a scissorial area clearly divided by a big median tooth in two parts, each provided with five small teeth. Four hairs dorsolaterally in the right mandible (Figs 21, 22), only one in the left (Figs 19, 20). \( L_3 \): mandibles more slender and shorter that in \( L_2 \) and \( L_1 \). Scissorial areas slightly notched. Externally two hairs, laterally two sensilla (Figs 34, 35).

**maxillae** (Figs 28, 39). The labio-maxillary complex appears more sclerotized in \( L_3 \) than in \( L_1 \) and \( L_2 \). Cardo pyramidal with apex blunt and a posterior seta. Stipes conical, truncated, robust with five primary setae. Palpiger cylindrical, more or less equivalent in size to the first segment of palpi, separated from the maxilla by a small sclerotized area. Palpiger lacking in narrow sclerotized belt and bearing one seta. The maxillary palpi three-segmented. Segments I and II cylindrical, segment III conical. Segment I bearing two flat sensilla; II with two setae and one flat sensillum; III with apical area bearing dense microsensilla and two small setae, one distal and one proximal.
Mala bearing one strong seta inserted on the external edge with a lateral process at the base, small in L₁, stronger in L₂ and L₃. Dorsal process of mala not always clearly visible. Ventral lobe usually small. Inner basal angle sclerotized and pronounced, bearing an area densely covered with microtrichia. Base of galea less sclerotized than mala. Distal area with a transverse row of dense, strong setae. Lacina narrow and oblong, clearly bilobed. Inner lobe narrow and elongate.

Figs 1–10 *Microphorus mexicanus* Matthes, L₁: 1 – larva in toto, dorsal view, 2 – X abdominal segment, ventral view, 3 – IX abdominal segment, ventral view, 4 – left metathoracic leg, 5 – labrum, dorsal view, 6 – right mandible, dorsal view, 7 – right mandible, ventral view, 10 – mandible spurs of mesothoracic epipleurum. Line bars: 1 mm, except figs 5 and 10 (0.1 mm).
Figs 11–22. Microphorus monticolaus Matthews, L2. 11—head, dorsal view, 12—head, ventral view, 13—head lateral view, 14—left metathoracic leg, 15—three thorax and first abdominal dorsal scutal sclerites, 16—X abdominal segment, ventral view, 17—I X abdominal segment, ventral view, 18—VIII and IX abdominal segments, 19—left mandible, dorsal view, 20—left mandible, ventral view, 21—right mandible, ventral view, 22—right mandible, dorsal view. Line bars: figs 11–13, 16, 17, 19–21: 0.5 mm, fig. 14: 0.1 mm, figs 15 and 18: 1 mm.
with three strong apical teeth and membranous ventral region bearing an area of dense microtrichia. External lobe with five teeth: the tooth close to the galea more developed and stronger.

Labrum (Figs 5, 27, 41). Postmentum truncoconical with three strong setae on each side. Mentum cylindrical, short, with anterior angles rounded, sharp, and two setae on each side separated.
by a sensorial pore. Prementum transverse, more sclerotized at hind angles that bear one strong seta, and mesally convergent along two distal bands, bearing centrally a pore and a strong seta. Labial palpi two-segmented. Segment I transverse. Ventral surface sclerotized. Segments II and III more elongate, apically unsclerotized and bearing small sensilla. L1: ligula medially joined, L2 and L3: widely disjoined with thickened and short setae apically.

**ANTENNAR** (Figs 24, 32). Three-segmented. First segment cylindrical, with at least three sensilla. Second segment swollen and less sclerotized apically, with two proximal sensilla; two more apically, conical and more noticeable, of unequal size; and three setae subapically. Width of the third segment about half that of the second, inserted asymmetrically, bearing 4–5 sparse setae and, apically, two more minute setae and two small microsensilla.

**THORAX.** Dorsoventrally flattened. Dorsal scutal sclerites strongly sclerotized, medially interrupted. Pronotal sclerite more developed than the other two. Marginal regions with small, primary, reddish setae. L1: antero-lateral regions with muscle attachments visible as darker spots, not evident in L2 and L3. Posterior edge of scutum bearing no lobes or spines (Figs 15, 31).

---

**Figs 39–42. Microchoeram mexicanar Matthew, L.** 39 – left maxilla, ventral view, 40 – left metathoracic leg, 41 – labium, dorsal view, 42 – clypeus. Line bars: 0.1 mm.
Tab. 1. Characters and character states used to build the phylogenetic tree

<table>
<thead>
<tr>
<th>Character</th>
<th>Pleiomorphic state</th>
<th>Apomorphic state</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Overwintering stage</td>
<td>adult</td>
</tr>
<tr>
<td>2</td>
<td>Adult metasternum</td>
<td>lacking bold spot</td>
</tr>
<tr>
<td>3</td>
<td>Adult pronotum</td>
<td>subquadrate to coriace</td>
</tr>
<tr>
<td>4</td>
<td>Adult metathoracic pubescence</td>
<td>yellow</td>
</tr>
<tr>
<td>5</td>
<td>Apical part of venter of thorax segment, L₁</td>
<td>sclerotized</td>
</tr>
<tr>
<td>6</td>
<td>Base of larval labial palp</td>
<td>widely separated</td>
</tr>
<tr>
<td>7</td>
<td>Suture at base of urogomphi, L₂</td>
<td>complete</td>
</tr>
</tbody>
</table>

Regions of notum close to unsclerotized lateral alar lobe largest and rounded on prothorax. On meso- and metathorax shorter and wedge-shaped, dividing epipleuron into anterior and posterior parts. Anterior epipleuron of mesothorax showing an anular spiracle; a medium size hair inserted on lateral-inner edge of spiracle (Fig. 10); metathorax only with small sclerotized area corresponding to vestigial spiracle on lateral sides.

Pleuron with sclerotized episternum. Proepimeron not sclerotized, meso- and metaepimeron with triangular sclerotized area. On the ventral thoracic surface, the prothoracic prae sternum transverse, wide, swollen and with a sclerotized area laterally. L₂: prothoracic prae sternum not swollen centrally, and on the whole little sclerotized. Meso- and metathoracic prae sterna particularly developed laterally and apparently interrupted medially. Basisterna and sternalia of all segments bearing about 40 short, robust, reddish-brown setae. L₂: prothoracic basisternum more flattened medially than in L₁.

A n d o m e n. Ten-segmented. Segments I–V short, dorsoventrally flattened (Fig. 36). Segments VI–VIII gradually longer and narrower, IX considerably modified (Figs 3, 17, 33), X converted into an anal tube (Figs 2, 16, 30). L₁: segments I–IV longer and wider than segments V, VI and VII. Segment VIII clearly longer and narrower (Figs 18, 37).

A transverse suture dividing the notum dorsally into anterior scutal sclerite (prae scutum and scutum fused together) and posterior short unsclerotized scutellum. Scutal sclerite about as long as that of metathorax, but distinctly narrower, with paler medial line. L₁: sclerite reaching half the length of the notum, whereas in L₁ and L₂ it reaches the first third only. The posterior margin

Tab. 2. Data matrix

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>N. fissus</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>N. investigator</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>N. nigrita</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>N. tomentosus</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>N. hybrida</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>N. mexicana</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>P. morio (outgroup)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
extended to form one pair each of lateral and dorsal lobes or spines. Spines tubercle-shaped in segments I–II–III, elongate and pointed in remaining ones. Dorsal and lateral spines equivalent, except in segment IX where the dorsal one is clearly longer. Spines bearing a large number of short and dumpy setae. Pleural lobe with a number of small setae and lacking in oval sclerotized areas.

Laterally segments I–VIII bearing one annular, sclerotized spiracle on each side, smaller than mesothoracic ones.

Basisternum with rhomboidal, small, central sclerite, increasing in size from segments II to VII. L4: basisternum showing an anterior, vestigial line, whole in the I and II segments, mesally indistinct in remaining ones.

LEGS (Figs 4, 14, 40). Relatively short, heavily sclerotized, except for an unsclerotized medial coxal area. Coxal short, wide and trunco-conical. Trochanter short. Femur and tibiotarsus subequal in length, subcylindrical; the last one narrower. Praetarsus slender, narrow, with two small ventral setae and an acute claw. L4: medial coxal area unsclerotized; tibiotarsus bearing two setae and a crown of sensilla apically.

Identification key of larval instars

To facilitate the identification of the larval instars of N. mexicanus, we propose a key based on morphoanatomical characters. The following structures appear to carry most significance: apex of segment X, urogomphi, mandibles, maxillae, labium and antennae.

1 2nd segment of labial palp twice as long as 3rd segment of maxillary palp twice as long as 2nd. Lateral external process of maxilla minute. Lobes of ligula parallel and with distal edges not notched. Mandibles simply triangular, with apex narrow and slightly notched. Clypeus little scleritized with anterior edge rectilinear. 1st antennal segment as long as the 2nd. Tibiotarsus just longer that praetarsus. Apex of segment X ventrally scleritized. Urogomphus swollen.
   L4
2 2nd segment of labial palp about as long as the 1st. 3rd segment of maxillary palp about as long as the 2nd. Lateral external process of maxilla well-developed. Lobes of ligula clearly distinct with two notches in apical edge. Mandible with apex swollen. Clypeus very scleritized with anterior margin medially hollowed. 1st antennal segment twice as long as the 2nd. Tibiotarsus twice as long as the praetarsus. Apex of segment X unscleritized ventrally.
   L4
3 1st segment of labial palp clearly wider than the 2nd. Apex of mandible with triangular, small and irregular teeth. Clypeus quite scleritized except for a median C-shaped area. Antenna similar to L4.
   L4
4 1st segment of labial palp clearly wider than the 2nd. Apex of mandible frequently rounded through wear. Clypeus very scleritized and well-developed.
   L4

DISCUSSION

Knowledge of the preimaginal instars of N. mexicanus supplies us with further characters for assessing the systematic position of this species within the N. investigator group (sensu Peck & Anderson 1985), in addition to those adult characters that have been reported in the literature.

We generated a ten-character matrix (Tables 1, 2), and analyzed it using both the PAUP 3.0b (Swofford 1989) and Macclade 3.0 (Maddison & Maddison 1992) packages for inferring phylogenies. Character polarities were inferred by outgroup comparison with the only other genus known for the subfamily Nicrophorinae, i.e. the Asian Ptomacanthus Kraatz, commonly regarded as primitive. Following cited literature, we took into account the species P. morio Kraatz. The states of characters 6, 7, 8 and 9 were inconsistent among the three larval instars (in keeping with the findings of Růžička (1992) for the palearectic species) and therefore were analyzed separately. For larval instars unavailable to us we referred to the data published by Anderson (1982) and Peck & Anderson (1985). The polarity of characters 6 and 7 was based on the outgroup criterion, used by Peck & Anderson (1985). Our data do not confirm the polarity given by
Růžička (1992), who employed an ontogenetic criterion. Characters were considered as irreversible and the outgroup was used to root the tree. Characters 1, 9, and 10 proved to be uninformative, the last two being autopomorphies of *N. mexicanus*. The results of our phylogenetic analysis (Fig. 43) allowed us to formulate the following hypotheses:

- according to Peck & Anderson (1985), *N. tomentosus* and *N. hybridus* (both distributed in the Nearctic region) are sister taxa, and they are probably the most primitive species within the *N. investigator* group.

- the three remaining species of the group appear to be more derived and closely related.

Nevertheless, our data are not sufficient to analyze relationships among *N. nigrita*, *N. investigator* and *N. mexicanus*, and we will need further information, both on adult and larval morphology, to resolve the polytomy. At this stage of the research, we cannot confirm the phylogenetic hypothesis of Peck & Anderson (1985) (who did not take into account larval characters of *N. mexicanus*). In fact, our matrix supports three phylogenetic trees of the same length (12) and statistics (CI=0.83, RI=0.80, Rescaled CI=0.67), yielding, after a strict consensus analysis, the unresolved tree shown in Fig. 43.

---

**Fig. 43. Hypothetical phylogenetic relationships among species of the *N. investigator* Zetterstedt group.**
REFERENCES


445
Description of larva of the Cicindela (s. str.) gemmata (Coleoptera: Cicindelidae) from Russian Far East

Alexander V. Putchkov

Institute of Zoology, B. Khmelniitko str. 15, Kiev - 30, UA - 252030, Ukraine

Received June 20, 1996; accepted June 27, 1996
Published December 27, 1996

Abstract. Third instar larva of Cicindela gemmata Faidumy, 1835 is described and main characters are illustrated. It is compared with L. III of C. sylvatica L., 1758 and C. sutchalinumia Moench, 1782. Larvae of C. gemmata are characteristic by having width of pronotum more than 3.7 mm, pronotum has 23-49 setae, hypopharynx with one large and several small anterior setae. Key to six known third instar larvae of Cicindela L., 1758 s. str. from Russian Far East are given.

Larval morphology, description, key, Coleoptera, Cicindelidae, Palaeartic region

Description is based on larvae collected during the expedition to Russian Far East in 1991. Some of the larvae were reared till adults in laboratory. Moreover, material from collections of the Zoological Institute of Russia (St. Petersburg) were also studied. Terminology concerning morphology and chaetotaxy was adopted from Knisley & Pearson (1984) and Putchkov & Cassola (1994).


DESCRIPTION

Measurements (in mm). Width of fronto-clypeo-lateral area 2.10-2.56 (aver 2.3), length of fronto-clypeo-lateral area 2.10-2.56 (2.33), width of pronotum 3.91-4.33 (4.24), length of pronotum 2.10-2.68 (2.44).


Head. Setation consist mostly from long and thin setae. First segment of antennae with 9-12 setae, second with 10-16 (usually 12-14) setae. First segment of galea with 4-6 setae on inner side. U-shaped ridge low and with 2-3 long setae.

Pronotum. Setae long and thin. Callous elevations and ridges of cephalo-lateral angles very wide, directed slightly outside and no longer than anterior slightly concave margin of pronotum (Fig. 1). One half of pronotum with 14-20 (usually 16) setae, 6-8 setae along median line and 2 (rarely 3) setae on ridges of cephalo-lateral angles (Fig. 1). Basal and lateral margins without dense rows of setae.
ABDOMEN. Sclerotized areas distinctly expressed. Tergites oval, sternites longitudinally oval. Third and fourth tergites and epipleurites with 17–20 setae. Hypopleuron consist from one large and several small selerites (Fig. 2). Caudal tergites of hump of fifth abdominal segment with 32–42 stout setae. Lateral tergites slightly separated from caudal tergite and with 7–8 setae. Apical tergites large, nearly half-rounded with numerous setae and usually in contact with caudal tergites on inner margin (Fig. 3). Median hooks widened basally bearing 3–4 setae in first

Figs 1–5. 1. III of Cicindela gemata Fuldermann. 1 – pronotum, 2 – third abdominal segment, lateral aspect (right side), 3 – fifth segment of abdomen – hump (right side), 4 – ninth segment and pygopod of abdomen (dorsal part), 5 – ninth segment and pygopod of abdomen (ventral part); 1, 2, 4, 5 – scale 1 mm; 3 – scale 0.5 mm.
half. Median hooks in 2.7–3.3 times longer than inner hooks. Tops of median hooks reaching nearly middle of apical tergites (Fig. 3). Inner hooks with 2 (rarely 3) lateral setae. Central spine strong and no more than in 2.3–2.5 times shorter than lateral setae. Ninth sternite with two groups of 4 (rarely 5) setae on caudal margin. Top of pygopod with 22–26 stout setae. Dorso- and ventral parts of pygopod with numerous setae (Figs 4, 5).

Differential Diagnosis. Chaetotaxy of head, abdominal segments, hooks of the hump, colouration of head and pronotum of larva of C. gemmata are mostly similar to larvae of C. silvatica L., 1758 and C. sachalinensis Morawitz, 1862. Some differences are presented only in shape and chaetotaxy of pronotum. Larvae of C. gemmata are well distinguishable from other species of Cicindela s. str. (C. coerulea Pullus, 1777, C. transbaicalica Motschulsky 1844, C. restricta Fischer von Waldheim, 1825, C. altaica Geble, 1829), which occurs in Russian Far East by the colouration and chaetotaxy of pronotum and some abdominal sclerites (see the key).

Ecology. Larvae inhabit sandy loam or loam light soils in forests, usually near rivers. Di- meters of the burrows are 5–6 mm, their depth nearly 20–45 cm.

Key to the known third instar larvae of Cicindela s. str. from Russian Far East

1(8) Width of pronotum no less than 3.7 mm. Top of pygopod bears no less than 22 stout setae. Head and pronotum usually with light hue only.

2(9) Ninth sternite with 2 group of 4 setae on caudal margin. Pronotum dark brown, sometimes with copper-bronzed luster. Cephalolateral angles of pronotum sometimes lighter than disk. Caudal tergites of hump bear more than 10 setae. C. gemmata Felder, 1835

3(4) One half of pronotum with 14–20 setae. Hypopleuron consists of two large and several small sclerites. Apical and caudal tergites of fifth abdominal segment in contact on inner margin only. C. gemmata Felder, 1835

4(3) One half of pronotum bears no more than 10 setae. Hypopleuron consists of two large sclerites. Apical and caudal tergites of fifth abdominal segment fused on inner margin and sometimes in contact on outward side.

5(6) Anterior tergites of abdomen with no less than 20 setae. Second sclerite of hypopleuron with 5–7 setae. Tergites of hump usually completely fused and with numerous setae. Pronotum with not bright dark-green (sometimes violet) luster. Width of pronotum usually more than 4 mm. C. silvatica L., 1758

6(5) Anterior tergites of abdomen bear no more than 20 setae. Second sclerite of hypopleuron with 3–4 setae. Tergites of hump sometimes fused, but not in contact on outward side. Pronotum usually with distinct copper-red luster. Width of pronotum rarely more than 4 mm. C. sachalinensis Morawitz, 1862

7(2) Ninth sternite with 2 groups of 3 setae on caudal margin. Pronotum light brown with distinct metallic luster. Cephalolateral angles and margin of pronotum yellow. Caudal tergites of hump bear no more than 30 stout setae. C. coerulea Pullus, 1777

8(1) Width of pronotum no more than 3.5 mm. Top of pygopod bears no more than 20 stout setae. Head and especially pronotum always with bright metallic luster

9(10) One half of pronotum with no more than 12 setae. Caudal tergites of hump bear no more than 25 stout setae. C. transbaicalica Motschulsky, 1844

10(9) Pronotum with numerous setae (more than 100). Caudal tergites of hump with no less than 25 stout setae. C. restricta Fischer von Waldheim, 1825

REFERENCES


Description of larva of *Cicindela (s. str.) coerula nitida* (Cicindelidae)  

Alexander V. PUTCHKOV1 & Viktor G. SCHILENKOV1  

1Institute of Zoology, B. Khmelnyitskogo str. 15, Kiev-30, UA-252030, Ukraine  
2Irkutsk University, Irkutsk, KOS-664000, Russia  

Received May 20, 1996, accepted June 27, 1996  
Published December 27, 1996  

Abstract. The third instar larva of *Cicindela coerula nitida* Lichtenstein, 1796 is described and illustrated. It is similar to some known larvae of *C. hybridia* L., 1758 species group. 1. III of *C. coerula Pallat*, 1777 is characteristic by having yellow areas of pronotum longer than its anterior margin, width of pronotum more than 3.7 mm, the top of pygopod boots 24-26 setae, head and pronotum with metallic luster, pronotum with 22-30 white setae.  

Larval morphology, description, Coleoptera, Cicindelidae, Palaeartic region  

Description is based on larvae collected by the junior author in East Siberia (Burlatia, Zoono-Murino vill., Markasan riv., 4–6.09.1974; 28–30.08.1975, 5 ex. [LIII]). Larvae are related to *C. hybridia* L., 1758 species group and have been identified as *Cicindela coerula nitida* Lichtenstein, 1796 after comparison with other known larvae of the genus and additional knowledge of habitat and distribution areas of the tiger beetles. Terminology concerning morphology and chaetotaxy was adopted from Kniisle & Pearson (1984) and Putchkov & Cassola (1994). All material is preserved in Institute of Zoology of Ukraine (Kiev).  

DESCRIPTION  

MEASUREMENTS (in mm). Total length 20–28, width of fronto-clypeo-labral area 2.1–2.4, length of fronto-clypeo-labral area 2.1–2.3, width of pronotum 3.7–4.2, length of pronotum 2.1–2.4.  


HEAD. Most setae long and thin, a few setae short. First segment of antennae with 7–8 setae, second with 9–12 setae.  

PRONOTUM. With two kinds of setae, long and short. Callous elevations and anterior ridges of angles of pronotum distinct. Cephalolateral angles wide and directed forwards, longer than anterior margin of pronotum. One half of pronotum with 10–14 setae, 4–5 setae along median line and 2–3 on ridges of cephalolateral angles (Fig. 1). Basal and lateral margins with very dense rows of setae.  

ABDOMEN. Sclerotized areas distinctly expressed. Tergites and sclerites oval. Third and fourth tergites with 14–18 setae. Hypopleuron consists of two large sclerites (Fig. 2). Tergites of fifth abdominal segment transversal and often nearly in contact on inner margin. Caudal tergite with 25–30 stout setae (which are similar to the lateral setae of inner hooks). Lateral tergites with
Figs 1–5. III of *Cicindela cornula nitida* Lichtenstein. 1 – pronotum, 2 – third abdominal segment, lateral aspect (right side), 3 – fifth segment of abdomen – bump (left side), 4 – ninth segment and pygopod of abdomen (dorsal part), 5 – ninth segment and pygopod of abdomen (ventral part); 1, 2, 4, 5 – scale 1 mm; 3 – scale 0.5 mm.
7–8 long setae. Median hooks widened basally and with 3–4 thin setae (Fig. 3). Length of median hooks 3.0–3.5 times more than that of inner hooks. Tops of median hooks reach middle of apical tergites. Inner hooks slightly widened basally with 2 (rarely 3) lateral setae. Central spine of inner hooks strong, its length nearly 3 times less than that of lateral setae. Posterior margin of ninth sternite with 6 long setae (Fig. 5). Top of pygopod with 24–26 setae. For dorsal and ventral parts of ninth segment and pygopod see Figs 4, 5.

DIFFERENTIAL DIAGNOSIS. The larva of *C. coerulescens nitida* is morphologically related to some of known larvae of *C. hybrida* L., 1758 species group (*C. hybrida* L., 1758, *C. restricta* Fischer von Waldheim, 1825, *C. aluica* Gebler, 1829) by the shape and chaetotaxy of the hump and pygopod, colouration of the head and pronotum. Resemblance of *C. coerulescens* is less as compared with the larva of *C. gemmata* Faldermann, 1835, *C. sachalinensis* Morawitz, 1862 and *C. transbaicalica* Motschulsky, 1844 (only chaetotaxy of tergites of the hump is slightly similar to these species). Larva of *C. coerulescens* has the following characters which distinguished it from larvae of other *Cicindela* s. str.:
- width of pronotum no less than 3.7 mm;
- margin of pronotum;
- number of the setae on the top of pygopod always more than 23;
- on one half of pronotum no more than 15 setae.

REFERENCES


Description of the third instar larvae of *Anisotoma axillaris* and *A. glabra* (Coleoptera: Leiodidae), with a key to larvae of European *Anisotoma* species

Jan Řuzička

Department of Ecology, Czech Agricultural University, CZ-165 21 Praha 6, Czech Republic

Received July 29, 1996, accepted August 6, 1996
Published December 27, 1996

**Abstract.** Detailed descriptions of the third instar larvae of European species *Anisotoma axillaris* Ceylonthal, 1846 and *A. glabra* (Fabricius, 1792) including the setal pattern are given. A key to the third instar larvae of all five European species of *Anisotoma* Panzer, 1797 is provided.

**Morphology, larva, Coleoptera, Leiodidae, Anisotoma axillaris, A. glabra, Palaearctic region.**

**INTRODUCTION**


Representatives of this genus are known to be obligately associated with Myxomycetes. Both adults and larvae feed on the spores and most species can be bred on mature sporocarps (Wheeler 1984, Newton 1984). Moreover, both adult and larval stages have the molar lobe of mandible covered with dense asperities (more developed in larvae) which are usually interpreted as structures taking part in spore manipulation and crushing (Lawrence & Newton, 1980, Wheeler 1984). However, *A. plasmodiapaga* Wheeler, 1980 was observed feeding as well as bred on plasmodia (Wheeler 1980) but the molar asperities are present both in adults and in larvae of this species (Wheeler 1984). Adults of *Anisotoma* are sometimes reported to be found feeding on spores of various Basidiomycetes but no breeding record is so far known (Newton 1984).

Immature stages of the tribe Agathidiini are only poorly known. The review of older papers was given by Angelini & De Marzo (1984) and modified by Wheeler (1990). Unfortunately, most of the papers contain only a brief description with a few, sometimes even incorrectly evaluated characters of significant taxonomic value. The description of all three larval instars of *A. basalis* (LeConte, 1853) from the Neartic region by Wheeler (1990) is the first detailed description of *Anisotoma* larvae. Wheeler (1990) also introduced a chaetotaxic system based mostly on an arrangement of setae into imaginary longitudinal rows, modifying the system proposed for Staphylinidae: Aleocharinae: Aleocharinae (Ashe & Wtraîrous, 1984). So far, mature larvae of the following three European species were described in detail: *A. humeralis* (Fabricius, 1792) by Rutajczak (1995), *A. orbicularis* (Herbst, 1792) and *A. castanea castanea* (Herbst, 1792) by Rutajczak (1996).
In this paper, a detailed description of the third instar larvae of further two European species *A. axillaris* Gyllenhal, 1810 and *A. gladra* (Fabricius, 1792) is provided and a key to mature larvae of all five European species is given. The larva of *A. gladra* was briefly described by Schiöttle (1861) and was treated later several times (e.g. Vatrenahm 1917, Böving & Craighead 1930, Henriksen 1968) but only some further taxonomically important details were added. The larva of *A. axillaris* is described for the first time.

**MATERIAL AND METHODS**

I examined the following larval material:

*Anisotoma axillaris*: Bohemia mer., Klenazé env., Kleřná mt (7151). 2 viii.1986, Petr Švácha leg., on *Fagus* stamp, larvae of instar III bred from adults, 9 specimens. Two specimens were reared till adults, 1 male specimen was dissected and the identification was verified.

*A. gladra*: Bohemia mer., Hluboká and Vlatov (6952). 14 viii.1986, Petr Švácha leg., larvae of instar III bred from adults, 3 specimens; Rossua, Karcía bor., Pojakonda env. 11 vi 1982, Jan Ržička leg., mixed forest, larvae of instar III collected from roots of black *Myoxymyces* on stamag stem of *Picea* sp., 3 specimens.

The material was preserved in Pappe's fluid (after Švácha & Dendelovský 1987). The dissected larvae were mounted in Canada balsam on permanent slides and examined with a stereoscopic microscope (usually under 450x, maximum under 1000x magnification). All measurements were made using an ocular micrometer. All permanent slides are deposited in the author's collection.


**Diagnosis.** Two sternsata. Three small solenidia at base of digitiform solenidium of antennomere II, digitiform solenidium large, undivided. Mola (of mandible) with rows of sclerotized dense asperities. Dorsal integument of body with dense asperities, arranged into distinct transverse rows. Head with setae D1 and D2 absent, dorsally with 4 pairs of campaniform sensilla. Antennae comparatively short. Dorsal surface of labrum with a single median pair of setae. Ventral surface of mentum with 1 large and 1 small pairs of setae. Large setae on dorsal surface of thorax and abdomen long and pointed. Pronotum with seta D2 present. Dorsal transverse row of mesonotum with 5 setae. Abdominal tergum I–VIII with 6 pairs of large setae in posterior row (seta D1 absent), rarely some terga with only 5–6 large setae (the pairs are usually asymmetrical and one seta P3 is absent in this case). Abdominal tergum IX medially divided. Urogomphus comparatively short, segment I about 1.4 times as long as wide, with 7 setae.

**Description.** Body cylindrical, narrowed posteriorly, widest at metanotum. Total body length 4.0–5.5 mm (average 4.7 mm). Metanotum width 1.07–1.23 mm (average 1.15 mm).

Head (Fig. 1): cranium wider than long; HW/HL = 1.42–1.51; H1W = 0.69–0.72 mm. Chaetotaxy as follows: row D1 with 3 setae: small setae D1a and D1b on clypeus, large seta Da2 posteriorly on frons. Row D2 with 5–6 setae: large D1a, and D2b on clypeus, Db3 antero-laterally on frons; D1b, D2b and sometimes also 1 additional seta more medially in postero-lateral part of frons. Row Dc with 5 setae: small D1c laterally on clypeus, small Dc2 behind epistomal suture, large Dc3 and Dc4 on epicranium, closely to frontal suture, followed by very small Dc*p laterally to Dc4. Row Dd with 4 setae: larger Dd2 near connecting membrane of antenna, small
Figs 1–8 *Acanthocheilus* sp. Gyllenhall, larval instar III. 1 — head, dorsal aspect, 2 — left antenna, dorsal aspect, 3 — left maxilla, ventral aspect, 4 — right mandible, ventral aspect, 5 — labrum, dorsal aspect, 6 — foreleg, posterior aspect, 7 — hypopharyngeal sclerome, ventral aspect, 8 — labrum, ventral aspect
De2a anteriorly on epicranium (sometimes absent), very large De3 and large De4 on epicranium. Row De with 2 setae: large De1 and very large De2 laterally on epicranium. Lateral row with 1 large and 2 small setae. Posterior margin with 4 setae (P1–P4). Campaniform sensilla include 1 on clypeus (between Da*a and De1), 1 on frons (anteriorly from Da2), 2 on epicranium (1 laterally to De2a, 1 close to frontal suture between De3 and De4). Posterior part of frons and epicranium with moderately dense, minute asperites. Stemmata 2, laterally positioned.

Antenna (Fig. 2): antennal formula = 3.1:4.9:3.1. Comparative lengths of antennomere II : digitiform solenidium = 4.9; comparative lengths of antennomere II : antennomere III = 1.6. Antennomere I with 2 dorsal and 2 ventro-apical campaniform sensilla. Antennomere II with 2 dorsal and 1 ventral setae with 1 large, undivided thumb-like digitiform solenidium and 3 small solenidia in ventro-apical membrane area. Antennomere III with 3 larger subapical setae, with 1 subapical pointed process, with 1 subapical setiform sensillum and 2 apical peg-like sensilla.

Labrum (Fig. 5): subquadrate, lateral margins rounded. Epipharynx with median transverse row of about 13 campaniform sensilla, preceded by 3 pairs of more anteriorly placed and slightly irregularly distributed sensilla; laterally with longitudinal fields of mitrotrichiae. Dorsal surface of labrum medially with 1 pair of large setae and with 1 pair of campaniform sensilla. Lateral margin with 8 pairs of setae (1 lateral, 3 apical and 4 ventro-apical pairs), ventro-apically also with 1 pair of sensilla.

Mandible (Fig. 4): apically bidentate with internal edge serrate; prostheca pointed and sclerotized, basally with a group of regularly distributed, minute ventral spines. Mola distinct, ventrally with c. 120 visible teeth. Dorsal surface of mandible with 1 large and 4 small setae and with 1 campaniform sensillum, lateral margin with 1 large seta.

Maxilla (Fig. 3): labialia laceolate, with 8–9 mesal spines and a transverse group of small dorsal spines. Galea with spinulate, bifurcated apex, with 2 subapical setae. Segment I of maxillary palpus dorso-laterally with a group of small spines, comparative lengths of maxillary palpus segments I:II:III = 0.75:0.9:1.

Labium (Fig. 8): comparative lengths of labial palps segments I:II:III = 0.95; segment I apically with 1 campaniform sensillum and a group of sensilla; segment II antero-ventrally with 2 campaniform sensilla, antero-dorsally with 1 close-fitting digitiform sensillum and a group of apical sensilla. Praemargint with 1 ventral setae and a group of latero-apical sensilla. Ligula dorso-laterally with a pair of serrate lobes, antero-ventrally with 1 pair of small apical setae and 3 pairs of campaniform sensilla. Mentum ventro-laterally with 1 very large and 1 small pair of setae and 1 pair of campaniform sensilla; submentum ventro-laterally with a pair of very large setae. Hypopharyngeal sclerite (Fig. 7) with complete anterior and posterior bridges, strongly sclerotized.

Foreleg (Fig. 6). Coxa: large, with 9 posterior and 8 anterior setae.

Trochanter: triangular, with 2–3 postero-dorsal setae (Pd1, Pd2, sometimes more ventrally with 1 additional seta) and with 2 posterior campaniform sensilla; anteriorly with 1 antero-ventral setae (Av1), 2 antero-lateral setae (Al1, Al2), 1 antero-dorsal seta, 1 ventral seta (V1) and with 4 campaniform sensilla.

Femur: short and broad, with single long ventral setae (V1), with 1 postero-dorsal seta (Pd1) and 2–3 small dorsal setae (D), with 2 larger and 2–3 small postero-lateral setae (P1, P12, P14, P5, sometimes with 1 additional seta between P14 and P15), with 1 postero-dorsal campaniform sensillum (pds); anteriorly with 5 antero-lateral (A1H–A1S) and 2 antero-ventral setae (Av1, Av2) and with 4 antero-dorsal campaniform sensillum (ads).
Tibia: shorter and more slender than femur, with 1 postero-dorsal seta (Pd1), 1 subapical dorsal seta (D1), 1 postero-lateral seta (Pl1) and 1 postero-ventral seta (Pv1), anteriorly with 1 antero-lateral seta (Al1), 2 antero-lateral setae (Al1, Al2) and 1 antero-ventral seta (Av1), sometimes with 1 postero-dorsal campaniform sensillum near P1.

Tarsungulus: long and pointed, with a single pair of setae (Pv1, Av1).

Pronotum (Fig. 9): transverse, N1L/N1W = 2.0. Chaetotaxy: row Da with 2 setae (Da1, Da2), row Db with 2 setae (Db1, Db2), row Dc with 2 setae (Dc1, Dc2), row Dd with 2 setae (Dd1, Dd2), row De with 1 seta (De1), row L with 1 seta (L1), posterior transverse row with 4 setae (P1-P4); campaniform sensilla include 1 between Da1 and Db1 (ds1), 1 near Db1 (ds2), 1 between Dc1 and Dd1 (ds3), 1 between Dd1 and L1 (ds4), 1 near P1 (ps1), 1 between P2 and P3 (ps2), 1 between P3 and P4 (ps3) and 1 between P4 and L1 (ls1); ca. 12-13 very small setae below Da1-Dd1, ca. 9-12 very small setae above posterior transverse row, ca. 4-5 very small setae laterally between De1 and P4. Pronotal surface with sparse minute asperities, arranged into transverse rows.

Mesonotum (Fig. 10): transverse chaetotaxy as follows: row Da with 1 small seta (Da1), row Dc with 1 seta (Dc1), row Dd with 1 seta (Dd1), row L with 1 seta (L1), posterior transverse row with 3 setae (P1, P4, P5), discal transverse row with 5 setae (D); campaniform sensilla include 1 postero-medially to Da1 (ds1), 1 posteriorly to the discal transverse row (ps1), 1 laterally to P1 (ps2), 1 between P4 and P5 (ps3), 1 between P5 and L1 (ls1); ca. 10-12 small setae below Da1-Dd1, ca. 15 small setae between discal and posterior transverse rows, only 2 small setae laterally between Dd1 and P5.

Metanotum (Fig. 11): transverse, N3L/N3W = 2.5; chaetotaxy as follows: row Da with 2 setae (Da1, Da2), row Db with 1 seta (Db1), row Dc with 1 seta (Dc1), row Dd with 1 seta (Dd1), row L with 1 large seta (L1), posterior row with 5 setae (P1-P5); campaniform sensilla include 1 postero-medially to Da1 (ds1), 1 between P1 and P2 (ps1), 1 laterally to P3 (ps2), 1 postero-laterally to P4 (ps3), 1 between P5 and L1 (ls1); ca. 14 small setae posteriorly to Da1, ca. 5 small setae between P1 and P5, 2 small setae laterally between Dd1 and P5.

Abdominal tergum I (Fig. 12): A1L/A1W = 2.7; chaetotaxy as follows: row Da with 1 very small seta (Da1), row Dc with 1 seta (Dc1), row L with 1 small seta (L1), posterior row with 6 setae (P1-P6); campaniform sensilla include 1 postero-medially to Da1 (ds1), 1 between P1 and P2 (ps1), 1 laterally to P4 (ps3) and 1 postero-medially to L1 (ls1); ca. 8 very small setae between and posteriorly to Da1 and Dc1, ca. 8 very small setae between P1 and P6.

Abdominal tergum IX (Fig. 13): with 2 dorso-lateral setae (D11, D12), 1 campaniform sensillum (ds) and 15 small setae.

Urogomphus (Fig. 13): comparatively short; comparative lengths of URL:URL:URLII = 2.4:4:7:1. Urogomphal segment I about 1.4 times as long as wide, with 3 large dorsal, 3 large ventral and 1 small ventro-lateral seta, dorsally with 4-5 campaniform sensilla. Urogomphal segment II with 1 apical seta. Dorsal side of segment I with sparse asperities.

Abdominal sternum IX and anal membrane (Fig. 13): abdominal sternum IX with 1 very small antero-medial seta and posterior transverse row of 5 larger setae. Dorsum of anal membrane with 2 larger setae (D1, D2) and 1 campaniform sensillum antero-medially to D1; ventrally with ca. 11 pairs of small setae and 1 campaniform sensillum.

Anisotoma glabra (Fabricius, 1792)

Diagnosis: Two sternaria. Three small solenidia at base of digitiform solenidium of antennomere II, digitiform solenidium large, undivided. Mola (of mandible) with rows of sclerotized
dense asperities. Dorsal integument of body with dense asperities, arranged into honeycomb-like figures. Head with setae Da1 and Dd1, with numerous additional small setae and with 5 pairs of campaniform sensilla. Antennae comparatively long. Dorsal surface of labrum with 3 median pairs of setae. Ventral surface of mentum with 1 large and 2 medium pairs of setae. Large setae on dorsal

surface of thorax and abdomen short and stout, apically truncated. Terga with numerous additional very small setae. Pronotum with seta Dd2 present. Dorsal transverse row of mesonotum with 2 setae. Abdominal terga I-VIII with 5 pairs of large setae (setae Dd1 and P3 absent). Femur with additional small postero- and antero-lateral setae. Tibia with additional setae Pv2, Av2 and D2. Abdominal tergum IX medially divided. Urogomphus comparatively strongly prolonged, segment 1 about 6.1 times as long as wide, with 15 setae.

Description. Body cylindrical, narrowed posteriorly, widest at metanotum. Total body length 5.5–6.5 mm (average 6.0 mm). Metanotal width 1.23–1.38 mm (average 1.32 mm).

Head (Fig. 14): cranium wider than long; HW/HL = 1.41; HW = 0.90–0.93 mm. Chaetotaxy as follows: row Da with 7–13 setae; small setae Da*a (sometimes absent), Da*b and larger Da1 on clypeus, small Da** (sometimes absent) anteriorly on frons, large seta Da2 on frons, posteriorly with a group of 2–7 small setae (usually three – Da*c, Da*d and Da*e), epicranium posteriorly with small seta Da*b. Row Db with 8–12 setae: clypeus with large Db1 and small Db*a, Db*b and sometimes with 1 additional small seta; frons with large seta Db3 and 1–3 antero-lateral small setae (Db*c and 1–2 additional setae, usually absent) and with 2–3 more posteriorly situated, small setae (Db*b, Db** and 1 additional seta, usually absent). Row Dc with 10–13 setae: larger seta Dc1 and small Dc** laterally on clypeus, medium Dc2 behind the epistomal suture, small Dc* anteriorly on epicranium; posteriorly on epicranium with 2 large setae (Dc3, Dc4) and a group of 4–7 small setae (Dc*p, Dc*b, Dc*d, Dc*e and sometimes up to 3 additional very small setae). Row Dd with 10–14 setae: small seta Dd1 anteriorly on epicranium before the antennal insertion, very large seta Dd2 and 2 smaller setae (Dd2a, Dd2b) near antennal insertion, more posteriorly 1–3 small setae (Dd* and sometimes 1–2 additional small setae), large seta Dd3 and Dd4 dis tally on epicranium, between them with a group of 3–5 small setae (Dd*a–Dd*c and sometimes 2 additional setae). Row De with 4 setae: epicranium with 3 small (De*a, De*b and De1) and 1 large lateral seta (De2). Lateral row with about 6 small setae. Posterior margin with 4–5 setae (P1–P3, P5, sometimes 1 additional small setae). Campaniform sensilla include 1 on clypeus (between Db1 and Db2), 1 on frons (anteriorly from Da2), 2 on epicranium (1 between De*a and De*b, 1 close to frontal suture between Dc3 and Dc4). Dorsal side completely covered by aspersities arranged into honeycomb-like figures. Stemmata 2, laterally positioned.

Antennae (Fig. 15): antennal formula = 3:2:5:9:2:1:1. Comparative lengths of antennomere II: digitiform solenidion = 5.9; comparative lengths of antennomere II: antennomere III = 2.8. Antennomere I with 2 dorsal campaniform sensilla. Antennomere II with 2 dorsal and 1 ventral setae; with 1 dorsal campaniform sensillum; with 1 large, undivided thumb-like digitiform solenidion and with 3 small solenidia in ventro-apical membranous area. Antennomere III with 3 larger subapical setae, with 1 subapical pointed process, with 1 subapical setiform sensillum and 2 apical peg-like sensilla.

Labrum (Fig. 19): subquadrate, lateral margins rounded. Epipharynx with median transverse row of about 15 campaniform sensilla, preceded by 2 pairs of more anteriorly placed and slightly irregularly distributed sensilla; antero-laterally with small fields of microtrichiae. Dorsal surface of labrum medially with 1 pair of large setae and 2 pairs of small setae and with 1 pair of campaniform sensilla. Lateral margin with 8 pairs of setae (1 lateral, 3 apical and 4 ventro-apical pairs), ventro-apic ally also with 1 pair of sensilla.

Mandible (Fig. 21): apically bidentate with internal edge very slightly serrate; prostheca robust, pointed and sclerotized, basally with a group of minute ventral spines in an unsclerotized field. Mola distinct, ventrally with ca. 150 visible teeth. Dorsal surface of mandible with 1 large and 5–7 small setae and with 2 campaniform sensilla, lateral margin with 1 large seta.
Maxilla (Fig. 17): lacinal lanceolate, with 7–9 mesal spines and with a transverse group of small dorsal spines. Galea with fimbrinate, biflanged apex, subapical setae absent. Maxillary palpus relatively long, with a group of small spines dorso-laterally on segments I and II, comparative lengths of maxillary palpus segments I:II:III = 0.9:1.3:1.

Labium (Fig. 22): comparative lengths of labial palpus segments I:II = 1.3; segment 1 basally with 1 small ventral seta, apically with 1 campaniform sensillum and a group of sensilla; segment II antero-ventrally with 2 campaniform sensilla, antero-dorsally with 1 close-fitting digitiform sensillum and a group of apical sensilla. Praememum with 1 larger and 2 small ventral setae. Ligula dorso-laterally with a pair of serrate lobes, antero-ventrally with 1 pair of small apical setae and 3 pairs of campaniform sensilla. Mentum ventro-laterally with 1 very large and 1–2 smaller pairs of setae and 1 pair of campaniform sensilla; submentum ventro-laterally with a pair of very large setae. Hypopharyngeal sclerome (Fig. 16) with complete anterior and posterior bridges, strongly sclerotized.

Foreleg (Fig. 20). Coxae: large, with 13 posterior and 6 anterior setae and 1 anterior campaniform sensillum.

Trochanter: triangular, with 2 postero-dorsal setae (P11, P12) and with 2 posterior campaniform sensilla; anteriorly with 1 antero-ventral seta (Av1), 2 antero-lateral setae (A11, A12), 1 antero-dorsal seta, 2 ventral setae (V1, V2) and with 4 campaniform sensilla.

Femur: long and broad, with single ventral seta (V1), 1 postero-dorsal seta (Pd1) and 5–7 small dorsal setae (D), with 2 larger and 5–6 small postero-lateral setae (P11, P12; P13–P17), sometimes an additional seta is present between P13 and P17, with 1 postero-dorsal campaniform sensillum (pds), anteriorly with 1 large and 7–8 small antero-lateral setae (A11, A12–A19), 2 large antero-ventral setae (Av1, Av2) and with 1 antero-dorsal campaniform sensillum (ads).

Tibia: only slightly shorter than femur, slender, with 1 postero-dorsal seta (Pd1), 2 subapical dorsal setae (D1, D2), 1 postero-lateral seta (P11) and 2 postero-ventral setae (Pv1, Pv2); anteriorly with 1 antero-dorsal seta (Ad1), 2 antero-lateral setae (A11, A12) and 2 antero-ventral setae (Av1, Av2).

Tarsus: long and pointed, with a single pair of setae (Pv1, Av1).

Pronotum (Fig. 23): transverse, N1L/N1W = 1.8. Chaetotaxy: row Da with 2 setae (D1a, D2a), row Db with 2 setae (Db1, Db2), row Dc with 2 setae (Dc1, Dc2), row Dd with 2 setae (Dd1, Dd2), row De with 1 seta (De1), row L with 1 seta (L1), anterior transverse row with 4 setae (P1–P4); campaniform sensilla include 1 between D1a and D1b (ds1), 1 between D1b and D1c (ds2), 1 between Dc1 and Dc1 (ds3), 1 between Dd1 and Dd1 (ds4), 1 between P1 and P2 (ps1), 1 between P2 and P3 (ps2) and 1 between P3 and P4 (ps3); ca. 30–35 small setae below D1–Dd1, ca. 40–45 small setae above posterior transverse row and ca. 12–15 small setae laterally between D1 and P4. Pronotal surface with dense minute asperities, arranged into honeycomb-like figures.

Mesonotum (Fig. 24): transverse chaetotaxy as follows: row Da with 2 small setae (D1a, D2a), row Db with 1 seta (Db1), row Dc with 1 seta (Dc1), row Dd with 1 seta (Dd1), row L with 1 seta (L1), posterior transverse row with 3 setae (P1, P4, P5), disal transverse row with 2 setae (D1, D2); campaniform sensilla include 1 medially to D2a (ds1), 1 posteriorly to D2 (ps1), 1 laterally to P1 (ps2), 1 between P4 and P5 (ps3); ca. 35 very small setae posteriorly to Da1–Dd1, ca. 35–40 very small setae between disal and posterior transverse rows, ca. 8 small setae laterally between D1 and P5.

Metasternum (Fig. 25): transverse, N3L/N3W = 2.1; chaetotaxy as follows: row Da with 1 seta (dD1a), row Db with 1 seta (Db1), row Dc with 1 seta (Dc1), row Dd with 1 seta (Dd1), row

464
L with 1 seta (L1), posterior transverse row with 5 setae (P1–P5); campaniform sensilla include 1 postero-medially to Da1 (ds1), 1 postero-laterally to P2 (ps2), 1 between P3 and P4 (ps2), 1 between P4 and P5 (ps3); ca. 30 very small setae posteriorly to Da1, ca. 30 very small setae between P1 and P5, ca. 6 small setae laterally between Dd1 and P5.

Abdominal tergum I (Fig. 26): A1L/A1W = 3.9; chaetotaxy as follows: posterior transverse row with 5 setae (P1, P2, P4–P6); campaniform sensilla include 1 anteriorly (ds1), 1 between P1

---

Figs. 23–24 *Anisoloma glabre* (Fabricius), larval instar III. 23 – pronotum, dorsal aspect. 24 – mesonotum, dorsal aspect.

465
and P2 (ps1), 1 laterally to P3 (ps2); ca. 20–25 very small setae anteriorly, ca. 15 very small setae between and before P1 and P6, ca. 6 small setae laterally.

Abdominal tergum IX (Fig. 18): with 1 postero-medial larger seta (Da1) and 1 dorso-lateral seta (D13), with 1 campaniform sensillum (ds) and ca. 35 small setae.

Urogomphus (Fig. 18): comparatively very long; comparative lengths of URI:URII:URIII = 15.7:28.1:1. Urogomphal segment I about 6.1 times as long as wide, with 4 dorsal, 8 ventral and 2 small lateral setae, dorsally with 5 campaniform sensilla. Urogomphal segment II with 1 apical seta. Surface asperities arranged into transverse, short rows on both sides of segment I, basal part of segment II also with minute asperities.

Abdominal sternum IX and anal membrane (Fig. 18): abdominal sternum IX with 1 small antero-medial seta, posterior transverse row of 5 larger setae and a group of 8 anterior setae.
Dorsum of anal membrane with 3 larger setae (D1–D3), 3 smaller setae and 1 campaniform sensillum placed anterolaterally to D1; ventrally with ca. 21 small setae and 2 campaniform sensilla.

A key to the third instar larvae of European Anisotoma species

The following key is based on a reared larval material of instar III of all 5 European species (dissected and mounted on permanent slides) as well as on papers of Rainey (1995, 1996).

1 Urogrophi comparatively short, segment 1 1.4–1.5 times as long as wide. Body dorsum with dense asperities, arranged into distinct transverse rows ....... 2
   Urogrophi comparatively long, segment 1 3.0–6.1 times as long as wide. Body dorsum either with honeycomb-like asperities, or glabrous, without asperities ....... 3
2 Pronotum with seta D1 absent (Fig. 9). Posterior transverse row on abdominal tergite I–VIII with 7 pairs of setae (seta D1 present and shifted to posterior row), exceptionally only 6+7 setae on few segments (usually asymmetrically) ....... A. humpatiss
   Pronotum with seta D1 present. Posterior transverse row on abdominal tergite I–VIII with only 6 pairs of setae (seta D1 absent, Fig. 12), exceptionally few segments with only 5+6 setae (one seta P3 also absent in this case, usually asymmetrically) ....... A. axillaris
3 Head with seta D1 absent. Labrum with 1 pair of medial setae. Dorsal surface of thorax and abdomen with very long, pointed setae (setae D1, P3, P4 and L1 on pronotum longer than the sclerotized part of pronotum). ....... A. arctoglabra
   Head with seta D1 present. Labrum with 3–4 pairs of medial setae. Dorsal surface of thorax and abdomen either with moderately long, pointed setae (setae D1, P3, P4 and L1 on pronotum about 0.5 times as long as the sclerotized part of pronotum), or the setae are short and inconspicuous ....... 4
4 Thorax and abdomen dorsally with moderately long, pointed setae. Posterior transverse row on abdominal tergite I–VIII with 6 pairs of setae, seta P3 present ....... A. caudata caudata
   Thorax and abdomen dorsally with short, truncate setae. Dorsum with honeycomb-like asperities. Pronotum with seta D2 absent. Posterior transverse row on abdominal tergite I–VIII with 5 pairs of setae, seta P3 absent ....... A. glabra

According to Wheeler (1990), the third instar larvae of Anisotoma can be characterized by the presence of 3 small solenidia ventrally near the base of large thumb-like, digitiform, ventral solenidia on antennomere II (Figs 2, 15). Another character mentioned by Wheeler (1990) — the presence of seta P3 in transverse setal row of abdominal tergum I — can not be used as a generic character for Anisotoma as the seta P3 is absent in larvae of A. glabra (Fig. 26).

Acknowledgements

I am very much obliged to Peter Švicka (Ceske Budejovice) for the donation of material and valuable help. Many thanks are due to David Král (Prague) and David Boukal (Ceske Budejovice) for comments on the manuscript.

REFERENCES


467


BOWIN A G & CRAIGHEAD F C. 1930 An illustrated synopsis of the principal larval forms of the order Coleoptera. Entomol Am N S 11 1–351.


RATAJCAK A. 1996 Description of the third larval stage of Anistotoma arborea (Horbat) and redescription of the third larval stage of A. castanea (Herbst) (Coleoptera, Leiodidae). Genus in press.


Larval morphology and notes on bionomy of *Myas chalybaeus*  
(Coleoptera: Carabidae)

Tullia Zetto Brandmayr & Iole Marano

Dipartimento di Ecologia, Università della Calabria, I–87036 Arcavacata di Rende (Cosenza), Italy

Received June 16, 1996; accepted June 27, 1996  
Published December 27, 1996

**Abstract.** The biological cycle of *Myas chalybaeus* (Pallardi, 1825) is described. *M. chalybaeus* is a typical autumn-breeder with winter larvae and the adult phenogram is very similar to that of *Clausilia Bonelli, 1810*. In particular, the larval morphology of specimens obtained from pit-fall traps and "ex ovipositor" has received considerable attention, and some remarks are made on the state of its larval characters.

Larval morphology, bionomy. Coleoptera, Carabidae, Pterostichini, *Myas chalybaeus*, Palearctic region

**INTRODUCTION**


The genus *Myas* groups about twenty species, that inhabit especially temperate zone forests of the Northern Hemisphere. Three species are distributed in North America, about fifteen in Eastern Asia and only one species in Europe, *M. chalybaeus* (Housquet 1985). According to Magistretti (1965) this carabid beetle is found in the Balkan peninsula, on Ionian Islands, in southern Hungary, in mountain environments, and reaches its western boundary in Italy, namely in the Friuli-Venezia Giulia Region and in the western part of the Slovene Republic.

The majority of the examined specimens were captured by P. Brandmayr on Mt. Slavnik, Slovenia, 1000 m a.s.l., during a yearly field-research (1971). Although a great part of these data is still unpublished, there are aspects of community phenology that have been thoroughly dealt with (Brandmayr & Zetto Brandmayr 1986).

Among all the studied biotopes, one forest and some open grasslands, *Myas* was very abundant in the *Carici (humilis)-Seslerietum junceifolii*, on arid pasture on limestone rock, (Brandmayr 1974).

Looking at its annual activity patterns it is possible to characterize this species as an autumn breeder, with a maximum activity occurring during August/September, when most of the females showed ripe gonads (after dissection). The larvae probably overwinter in the II and III instar and from the early July to August, 15% of individuals were abundant in the population (Fig. 1).
Of the four couples reared in laboratory, only two larvae were obtained (I and II instar).

In this paper the description of the larval morphology is given, in order to define possible evolutionary relationships within pterostichine taxa. The larvae of several genera are studied in comparison, namely *Abaxetus archambaulti* (I, II, III), *Abaxetus villetisianus* Straneo (I, II, III) (reared by Paarmann), and the species of the genera *Abax*, *Molops* Bonelli, 1810, *Poecilus* Bonelli, 1810, *Orthopus* Chaudoir, 1838, and *Stomis* present in our collection. In literature descriptions of some of these taxa are reported, as Amidi (1988), Raynaud (1976), Thompson (1979a, b), Zettler Brandmayr, & Marano (1993).

**MATERIAL AND METHODS**

**Adult field activity and rearing**

In the trapped pasture, 24 pitfall traps have been employed for a period of about 8 months (April – November). The upper diameter of the plastic pitfall was 9.2 cm, each trap was constructed with a double-bottom, isolated by a thin metal net, and only the lower chamber was filled with an attractant mixture of apple, beer and sugar. On this way the beetles were kept alive at least for the short period of 4 days. Every fourth day, they were counted, sexed and released alive in the neighbourhood of the trap. Three traps were also equipped with a flat stone acting as a cover and protection against grazing animals (Brandmayr 1974).

During the estimated reproductive season, (August/October) two couples of beetles/month was transported into laboratory and dissected. The numbers of counted living specimens were transformed in individuals/trap/4 days. Ripe females (vitellogenic ovaries) were observed in August (1), September (2), October (1).

Also the reared specimens, 4 males and 4 females, were observed on this way, because it is not easy to collect *Molops* under the stones, especially in karstic environments.

The rearing conditions were natural temperature and air humidity on a terrace of the Institute of Zoology of Trieste (200 m a s l). The terrariums measured cm 24 x 40, the soil used was humus-rich rendzina with abundant stone phrictures. The beetles were fed two times in the week with little cow-meat pieces. The beetles were kept alive from September to November 1971.

**Larval morphology**

The larvae of *Myax chalybeata* (1 first instar, 1 second instar and 2 third instars), conserved in alcohol 70% in the larval collection Zettler-Brandmayr, (Istituto di Ecologia, Università della Calabria), were observed in non-permanent preparations using a Wild M5 and Zeiss R5 stereo-microscopes provided with drawing apparatus and measured with a calibrated ocular lens.

The terminology of pores and setae is according to that used by Bouquet & Gieclet (1984) and Bouquet (1985).

However, the most fundamental terms of chaetotaxy used are the following:

- FR3, setae of anterior margin of the nasale
- MX, seta of the lamina
- M1 seta on the stipes, close the lamina
- gM1 group of setae on the dorsal surface of the stipes
- PA1 seta on the dorsal side of pandurato, between stigmata and cervical groove

The I and II larvae were obtained in laboratory, ex compositione, while the two III instars were collected on Mt Slavina, Slovenia Republic, 22/10/75, during a second year of catches carried out with standard pitfall traps.

**RESULTS**

**Description of the larva**

- **First instar larva** (Figs 2–7)

  **Body size** Head width 0.9 mm, head length 0.8 mm, total length 7.5 mm

  **Colouration** Yellow ochre, head, mandibles and cerci a little darker, poorly sclerotized larva.

  **Head** Cephalic capsule subquadrate, nasale almost straight, with only little produced adnasio. Postocular groove only feebly distinguishable, cervical groove evident, but short. Frontal suture moderately sinusuated. Epicranial suture very short, scarcely longer than half the diameter of the first antennal article. Stemmata well developed. Ruptor ovi consisting of a series of
small teeth so aligned and close to each other that they form a linear keel, lightly longer than the first antennal article. Setae FR₁0,₁₁ are not distinguishable.

Antenna. Antennal articles squat, the first a little longer than the third, the second is the same length as the fourth. Hyaline vesicle dome-shaped and well developed.

Mandible. Moderately sickle-shape with retinaculum normally shaped, situated nearly in the middle of the length. Cutting edge slightly serrated. Only one seta is present on the external side. Penicillus absent.

Maxilla. Maxillary stipes are as long as palpus. Lacunia dome-shaped, but not very prominent. Seta MX₃, as long as seta MX₄; ÿMX with sparse setae (about 20) of middle size. Stipes without membranous transverse area.

Labium. Prementum trapezoidal, slightly longer than width. Palpomere of the same length. Ligula not protruding, with two short setae.

Thorax and abdomen. Pronotum with post-scutum slightly visible as a densely punctuated area. Notal groove is not very evident. Tergites only with ancestral setae, some of which reduced, distinguishable only at a higher magnification as pore with microsetae.

Legs. Tarsus with two claws of the same length, not curved.

Urogomphi. Short, slightly curved and with apex turned upwards, long one and a half time the IX segment, finely punctuated; five macrosetae are present.

Second instar larva

Body size. Head width: 1.2 mm; head length: 1 mm; total length: 10 mm.

Most of the characters are similar to those of instar I and III.

Maxilla. On the external side of the stipes a little V-shaped interruption of the sclerotized edge is visible.

Urogomphi. 9 macrosetae are present.

---

Fig. 1. Photogram of Myes chalybeatus (Fall.) in the Curcrae (humulii)-S. purpurea (1971): activity density (A.D.) of living captured adults/5 trap, mean of catches referred to each standard period of four days (right ordinate). Left ordinate (thin interrupted line) minimum air temperature at 1 cm above sea surface. (For the method see Brandmayr & Zeto (1985).) Dashed line represents the emergence period of tenebriids. Arrow indicates larval I and II, found in terrain.

471
Third instar larva (Figs 8–19)

Body size: Head width: 1.8–2 mm, head length: 1.6 mm, total length: 21 mm

Colouration: Yellow-brown; head, mandibles and cerci a little darker. Abdominal segments not uniformly coloured, with darker zones.

Head: Cephalic capsule subquadrate. Postocular groove, frontal and episternal suture similar to the first instar. Cervical groove well evident and not very curved. Nasale and adnasalia aligned.

Figs 2–7 Myas chalybonus (Pallardi), first instar larva, all figures dorsal aspect. 2 – head, 3 – pronotum, 4 – metanotum, 5 – abdominal tergum 1, 6 – abdominal tergum IX with cerci, 7 – right maxilla. Scale: Figs 2–5 – 0.5 mm, Figs 6–7 – 0.25 mm.

472
Figs 8–18 *Myias chalybeae* (Palbaró), third instar larva, all figures dorsal aspect, but 15 ventral aspect. 8 – head, 9 – right mandible, 10 – labium, 11 – pronotum, 12 – metasternum, 13 – abdominal segment I, 14 – left antenna, 15 – right maxillary stipes, 16 – right maxilla, 17 – right fore leg, 18 – abdominal segment IX without cerci. Scale: Figs 8, 11, 12, 13, 18 = 1 mm, Figs 9, 10, 14, 15, 16 = 0.25 mm, Fig 17 = 0.5 mm.
and thinly dentate, nasale slightly concave in the middle, with two protuberances on each side. Parietale with a small semicircular transverse hollow, posteriorly to PA.

**Antenna** Articles are longer than those of the first instar, article 1 is twice the -2, -2 and -3 are the same length, -4 a little shorter, setation typical on -3 and -4, one seta on the medial apex of -2, -1 glabrous with pores. Hyaline vesicle as in the first instar.

**Mandibles** Slender, with very sharpened apex. Retinaculum small. Internal edges from retinaculum to the apex are very slightly crenulated. Two setae are present on the external side. Pencillus absent.

---

*Fig. 19 Myas chalybas (Pallardi) larval habit, third instar Scale 5 mm*
Maxilla. Membranous transverse area present, which is more evident on ventral surface. Dorsal surface largely membranous. Lacinia as in the first instar with seta MX₄ well developed, a little longer than MX₂, pMX with sparse, rather big setae (about 30–40).

Labium. Sclerotized ventrally and dorsally, with a large membranous area; ligula with two well developed setae. Several secondary setae are present.

Thorax and Abdomen. Pronotum with well distinct pre- and post-septum. Notal groove very evident. Tergites anteriorly and laterally margined. Reduced chaetotaxy.

Legs. Similar to those of the first instar. Femora with two rows of setae.

Urogomphi. Short, very curved, long about twice the tergite IX. Very pronounced setiferous nodes are present. Nine setiferous pores (macrochele are lacking in our specimens).

Discussion

The larva described in the present study appears to have large similarities with Myas cyanescens Dejean, described by Thompson (1977, 1979) for the North-American fauna. The two species share the same shape of the nasale (Bousquet 1985, Makarov 1994) even though M. chalybaeus shows a less pronounced median emargination. Moreover the general form of antennae, mandibles without pectinillus and maxillae with blunt conical inner lobe, tergites margined with reduced chaetotaxy, heavily sclerotized cerci, slightly longer than X, very curved, with large setiferous nodes surrounded by membranous areas characterize both species. In the third instar larvae a membranous area is present on the maxillary stipes, distinct laterally and ventrally. However, this area is not present in the first instar, while it appears like a little V-shaped interruption of the sclerified edge in the II instar.

For Myas all the possible states of this morphological character, found nearly in all the species of the large genus Pterostichus (unpublished data of the first author) are expressed along an ontogenetical sequence.

In particular, the V-shape incision of the lateral sclerotized border in the II instar is similar to that shown by Stomis punicatus (Panzer, 1796), I, II, III instars (Zetto Brandmayr & Marano 1993).

After a further comparison with other Pterostichina genera such as Abacetus, Loxandrus (Thompson 1979b), Lesbicus Dejean, 1828 (Habu & Sadanaga 1962), it seems that some characteristics are of noticeable importance. In fact, this taxon presents some characters in their ancestral (pleiomorphic) conditions and others in derived condition (apomorphic), at least considering the postulated ancestral and derived states of the larval features of Carabidae as reported by Thompson (1979a). In order to allow a first interpretation of the taxonomic position of these larvae, we propose a brief synthesis of ancestral and derived characters for Myas chalybaeus:
In particular, the inner mandibular edge of the III instar larvae is, in similar fashion to that of *Abactetus* (Arndt, 1988), finely serrulate, as in several Agonina genera. Moreover, the shape of the cerci is not very common to the majority of Pterostichini.

In conclusion, *Myas* seems at least in the larval stage a really puzzling genus, with a mixture of ancestral and derived characters. The absence of pancellus is a quite rare character in Carabidae, and in our opinion there is some doubt about the pleisotypic status of this character. Although the short and conical lacina recalls that of *Sphodrina*, it is longer and better developed as in other Sphodrini, such as *Calathus* Bonelli, 1810 or *Platyderus* Stephens, 1827. The short, well sclerotized and nodulated cerci and the unusual dorsally sclerotized labium are rather unique, and, at this stage of our knowledge, distinct autapomorphies that suggest to locate *Myas* into a distinct Pterostichine lineage. Up today, nevertheless, there are too few larval genera known in tropical Pterostichines, so that this idea needs to be reinforced by further research, especially on *trigonognathine* genera.

It is interesting, however, to note that the reproduction rhythm of *Myas* belongs to the autumn breeder without imaginal dormancy, very similar to that of *Calathus* or of some less specialized *Sphodrina*, like *Laemostenus janthinus* (Duftschmid, 1812).

Acknowledgements

The authors are indebted to Prof. P. Brandmayr, who kindly put at their disposal a considerable part of unpublished data and thank him for the critical discussion and for the review of the manuscript.

REFERENCES


476


INSTRUCTIONS TO AUTHORS

*Acta Societatis Zoologicae Bohemicae* publishes in English, original papers on general, applied and systematic zoology, biographies and book reviews. Papers by members of the Czech Zoological Society are preferred. It is understood that manuscripts submitted are not offered to any other journal for prior or simultaneous publication.

Authors of taxonomic papers must respect the articles of the *International Code of Zoological Nomenclature* (Third Edition, 1985) and observe its recommendations. The manuscript, including footnotes, references and tables, must be typed with double spacing (30 lines per page) on side A4 paper (210 mm × 297 mm), in duplicate, and should be not longer than 30 pages. Pages must be numbered throughout the manuscript. Final version (corrected as requested by the editorial board) is preferably accepted on IBM PC - compatible 5.25" or 3.5" diskette.

**Heading**
Title of paper, full name(s) of author(s), place of work with full address – on separate line.

Abstract summarizing concisely the contents of the paper and indicating the relevance of the work, should not exceed 20 type-written lines.

**Key words** Select a set (one or two lines) of key words (index terms).

**References** Within the text – Dryden (1968), (Latynski & Naar, 1967), Liška et al. (1970). The full citation should be given in the list of references. Under the References authors should be cited in full followed by abbreviations of periodicals in accordance with The World List of Scientific Periodicals, 4th edition, London: Butterworths (1964–1985). The number is to be given in parentheses only when individual numbers are paginated independently (see example below). References to papers published in languages other than the major ones, or printed in characters other than Latin, should be quoted in English translation, with an appropriate note at the end (see examples e., f., g., h.).

**Examples**
(b) Lomberg E & Gustafsson C 1987 Contribution to the life history of the striped weasel. Ark Zool 29(7) 1–16.

Illustrations and their captions or legends must form a separate unit. Clear technically perfect line drawings and photographs (black-white, glossy) are accepted. The original drawing and photograph (one set) should be more than twice as large as when printed and preferably into blocks or plates so that the blocks of drawings or photographs may be uniformly reproduced over the age with the journal. Legends to the illustrations should be supplied on a separate sheet of paper. References to illustrations and tables in the text: Fig 1, Figs 1–2, Plate 1, Fig. 1 (for photographic plates), Table 1, Tab. 1, Tabs 1–2.

Tables including headings and explanations should be on a separate sheet of paper, numbered consequently with Arabic numerals.

Marking in the manuscript (in light pencil, not in ink or type written). In the text Latin taxa up to generic level – with wavy underlining (strokes). In the References names of periodicals (not the Latin names of taxa) with wavy underlining.

Proofs will be sent to authors. One hundred reprints are supplied free of charge. Manuscripts of published papers, diskettes and originals of illustrations are not returned unless return requested.

CONTENTS

Articles

ABNER E., PAARMANN W. & ADIS J.: Description and key of larval Cicindelidae from Brazil (Coleoptera: Carabidae) ........................................... 293
BILY S.: Larvae of genera Euryphiopsis and Phaenops from Central Europe (Coleoptera: Buprestidae) ................................................ 317
BILY B. & VOLKOVITSH M. G.: Revision, reclassification and larval morphology of the genus Parastatia (Coleoptera: Buprestidae: Parastatini tribus n.) .................................................. 325
BOSQUEY Y.: Description of the larva of Schizogenius lunolana (Coleoptera: Carabidae: Ochodidae) .................................................. 347
BRAINTMAIR P., COLOMERTTA G. & PIZZILOTTTO R.: Carabid communities in two biotopes of the Murano lagoon (Italy) (Coleoptera: Carabidae) .................................................. 355
CASSAI A., GIACINTO P. M. & PASTALDONI R.: Life history and preimaginal stages of Dromius meridionalis (Coleoptera: Carabidae: Dromiini) in Sardinia .................................................. 363
GRENONN R. V.: Description of the first instar larva of Thallusophillus longicornus (Coleoptera: Carabidae: Trachodina) .................................................. 373
HOVORKA O.: Description of the first larval instar of Aptinus bombarda (Coleoptera: Carabidae: Brachynini) .................................................. 381
LUMARET J.-P. & LAVELLETTE F.: Biology and description of the larva of Platystomus trivialis (Coleoptera: Aphodiidae: Rhyssentina) .................................................. 385
MAKARYAN K. V.: Patterns of chaetotome modications in ground-beetle larvae (Coleoptera: Carabidae) .................................................. 391
MATLII A. V.: Review of the Paleartic larvae of the genus Stenopatha (Coleoptera: Carabidae: Harpalinae) .................................................. 419
PALESTRINI C., BARBERO R., LUZZATO M. & ZUCCHETTI M.: Necrophorus ventricosus (Coleoptera: Silphidae: Necrophorinae): larval morphology and phylogenetic considerations on the N. investigator group .................................................. 435
PUTCHOV A. V.: Description of larva of the Ciicindela (s. str.) gemmata (Coleoptera: Cicindelidae) from Russian Far East .................................................. 447
PUTCHOV A. V. & SCHLENOV V. G.: Description of larva of Cicindela (s. str.) cordescis nigra (Coleoptera: Cicindelidae) .................................................. 451
RIŽIČKA J.: Description of the third instar larva of Anostoma acicillata and A. glabra (Coleoptera: Leiodidae), with a key to larvae of European Anostoma species .................................................. 455
ŽETOŠI BRANTMAIR T. & MAKAYAN L.: Larval morphology and notes on taxonomy of Myes chalybeus (Coleoptera: Carabidae) .................................................. 469

Book review

Budkhardt F.: Mikrobiologische Diagnostik – by J. Jirá, .................................................. 354
Mehlhorn H. & Riehler W.: Allgemeine Protozoologie – by J. Jirá, .................................................. 380

Anniversary

Professor Karel Hůrka 65 years old – by A. Smetana and S. Bily .................................................. 283
Bibliography of zoological publications by Karel Hůrka – by D. Král .................................................. 285

ACTA
SOCIETATIS
ZOOLOGICAE
BOHEMICAЕ

Vol. 60 – 1996

Editorial Board: Karel Hůrka (Editor in Chief), David Král (Executive Editor), Petr Benda, Jan Buchař, Ivo Hodek, Jaroslav Hrbáček, František Moravec, Vladimír Jan Amos Novák, Josef Rusák, František Sládeček, Jiří Vávra, Zdeněk Veseřovský, Jan Zima

Czech Zoological Society
Práha
CONTENTS

Articles

Asnott E., Paarmann W. & Ads J.: Description and key of larval Cicindelidae from Brazil (Coleoptera: Carabidae) .......................................................... 293

Bily S.: Larvae of genera Eurythyrea and Phaenops from Central Europe (Coleoptera: Buprestidae) .......................................................... 317

Bily B. & Volkovitsh M. G.: Revision, reclassification and larval morphology of the genus Paratassa (Coleoptera: Buprestidae; Paratassina tribus n.) .......................................................... 325

Bousquet Y.: Description of the larva of Schizogenius lineolaris (Coleoptera: Carabidae: Clivinae) .......................................................... 347

Brandmayr P., Colombetta G. & Pizzolotto R.: Carabid communities in two biotopes of the Marano lagoon (Italy) (Coleoptera: Carabidae) .......................................................... 355

Casale A., Giacinto P. M. & Pantaleone R.: Life history and pre-imaginal stages of Dromius meridionalis (Coleoptera: Carabidae: Dromiinae) .......................................................... 363

Čižková J. & Frynta D.: Abundance fluctuation in Apodemus spp. and Clethrionomyss glareolus (Mammalia: Rodentia): a seven year study in an isolated suburban wood .......................................................... 3

Flegel J.: Environmental selection, the missing term in Darwinism .......................................................... 95

Frynta D. & Čižková J.: Neutral cage interactions in Mus macedonicus (Rodentia: Muridae): an aggressive mouse? .......................................................... 97


Gebre-Mikael V. V.: Description of the first instar larva of Thalassophis longicornis (Coleoptera: Carabidae: Trechodontina) .......................................................... 373

Hanel L.: Composition and seasonal changes of soil nematode community in a South Bohemian meadow .......................................................... 103

Hanžal V. & Prchal M.: Annual course of cave visitation by bats (Mammalia: Chiroptera) in the Bohemian Karst (Czech Republic) .......................................................... 25

Heraš J.: Interspecific difference in proportions of the praesacral spine in Canisdae (Mammalia: Carnivora) .......................................................... 31

Hošek A.: The relationship between thermal constants for insects development: a verification .......................................................... 115

Horák J.: Revision of some Oriental Mordellina with description of three new species. Part 2. (Coleoptera: Mordellidae) .......................................................... 133

Hovorka O.: Description of the first larval instar of Apterius bumble (Coleoptera: Carabidae: Brachinini) .......................................................... 381


Kovařík F.: Balneolaelaps hookeri gen. et sp. n. from Pakistan, and taxonomic position of Ortholaelaps luthealis (Scoyophagidae: Buthidae) .......................................................... 177

Král D.: Antosia hepatothoracea sp. n. from Bulgaria (Coleoptera: Scarabaeidae) .......................................................... 183

Lumaret J.-P. & Lavallée F.: Biology and description of the larva of Piattonius tibialis (Coleoptera: Aphodiidae: Rhyssenina) .......................................................... 385

Makarov K. V.: Patterns of chaetome modifications in ground-beetle larvae (Coleoptera: Carabidae) .......................................................... 391
MATALIN A. V.: Review of the Palaeartic larvae of the genus Stenolophaeus (Coleoptera: Carabidae: Harpalini) .................................................. 419
MUKOVSKY J.: New data on the birds of Syria ............................................................ 37
MUKOVSKY J.: Early and middle Pleistocene birds from the Bohemian Karst, Czech Republic ......................... 187
OBUCH J. & BENDA P.: Contribution to the feeding ecology of Sterc aluco and Bubo bubo (Aves: Strigiformes) in southwestern Bulgaria .......................................................... 43
PALISINI C., BARBERO E., LIZZATTO M. & ZUCCHIELLI M.: Neuropteroidea (Coleoptera: Silphidae; Neuroptera): larval morphology and phylogenetic considerations on the N. investigator group ................................................ 435
PERAK S.: A laboratory study of the efficiency and attractiveness of pitfall traps for Paradosa sagitta (Araneae) .................................................. 191
PUTCHEV A. V.: Description of larvae of the Cicindela (s. str.) gemmata (Coleoptera: Cicindelidae) from Russian Far East ............................................. 447
PUTCHEV A. V. & SCHILDENKOV V. G.: Description of larvae of Cicindela (s. str.) coerulea n. nuda (Coleoptera: Cicindelidae) ........................................ 451
ŘEHAČK Z. & BIENES D.: Contribution to the roost ecology of Myotis brandtii (Mammalia: Chiroptera) in the Czech Republic and Slovakia ........................................ 51
ŘEHAČK Z., ZEKA J. & GAUSEL J.: Contribution to the knowledge of distribution of Myotis dasycneme (Mammalia: Chiroptera) in the Czech Republic .......... 199
RUSEK J.: New taxa of Collemboles (Entognatha) from the Czech Republic .................................................. 207
ROŠKA J.: Description of the third instar larvae of Anotomus axillaris and A. glabra (Coleoptera: Leiodidae), with a key to larvae of European Anotoma species .......................................................... 455
ŠVEC Z.: A report on Leiodidae (Coleoptera: Leiodidae) of India .......................................................... 215
VANČEKOVÁ-SKUHRAVÁ L.: Eriophyid mites (Acari: Eriophyoidae) on trees and shrubs in the Czech Republic ...... 223
TRNKOVA-HINGETOVA E. & DYLEVSKY L.: Contrasting muscles and their development in the hand of Monodelphis domestica (Mammalia: Marsupialia) .................................................. 57
UHRIN M., HORÁČEK L., ŠÍHL J. & BEGO F.: On the bats (Mammalia: Chiroptera) of Slovenia: survey of the recent records .......................................................... 63
WOLF P.: Communities of small terrestrial mammals in two lowland forest ecosystems of Litoveloke Pninová, Czech Republic .................................................. 73
ZETTO ŠKAMNYT T. & MARANO I.: Larval morphology and notes on biology of Myzus chalybeus (Coleoptera: Carabidae) .................................................. 469
ŽÍKOVÁ M. & FRYNTA D.: Reproduction in Apodemus sylvaticus (Rodentia: Muridae) in captivity .............. 83
Book review
Whelan R W  The Ecology of Fire – by P Šys  182
King M  Species Evolution The Role of Chromosome Change – by P Šys  198
Klenk H & Sítko P  Zellbiologie 3. Lehrbuch  Third revised edition – by J Jirá  206
Berquist N R (ed.)  Immunodiagnostic Approaches in Schistosomiasis – by J Jirá  280
Mehlhorn H, Duvall D & Raether W  Diagnose und Therapie der Parasitosen von Haus, Nute und Haustieren – by J Jirá  316
Burkhardt F (ed.)  Mikrobiologische Diagnostik – by J Jirá  354
Gottschalk W  Allgemeine Genetik 4th revised and extended edition – by J Jirá  372
Mehlhorn H & Ruthmann A  Allgemeine Protozoologie – by J Jirá  380
Anniversary
Professor Karel Hůrka 65 years old – by A Šneká and S Hýly  283
Bibliography of zoological publications by Karel Hůrka – by D Král  285

Data of appearance of the issues
1 – April 5, 1996
2-3 – October 29, 1996
4 – December 27, 1996