Members of the family Elateridae commonly known as Click-Beetles and their larvae called Wire Worm. They are widely distributed all over the World, They are taxonomically difficult group and having ecological and economical importance. Adults are usually nocturnal hiding during day time under stones, in leaf litter, or under the bark and attracted to light. Several species are diurnal and can be found upon flowers. Body elongate, antennae long, usually11- segmented, labrum exposed, hind pronotal angles well developed, procoxal cavity open both internally and externally, posterior margin of prosternum elongated to form prosternal spine form the characteristic Jump-Click mechanism. Jumping mechanism without legs support is a unique character of adult elaterid. Most of larvae are predators; they are elongate, cylindrical to flattened body. In the present work, a contribution towards the knowledge about Elateridae of Pakistan, mainly agrypnids (Agrypninae: Agrypnini, Conoderini, Hemirhipini) have been studied.

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*TO*

*OUR HONOURABLE*

*TEACHERS*

*AND PARENTS*

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# CHAPTER 1

## THE CLICK BEETLES
## (INSECTA: COLEOPTERA: ELATERIDAE)

**Introduction:**

Elateridae is the largest family of Superfamily Elateroidea includes about more than 10,000 species under 400 genera widely distributed all over the World. They are taxonomically difficult group and having scientifically important in ecologically and economically aspects. Many common names used in English: Click beetles, Skip-jack, Spring-beetle, Clicker, or Blacksmith, while Swammerdam calls them Grasshopper or Locust-beetles and in German they are known as Schnelkäfer or Schmiede.

Adults are nocturnal hiding during day time under stones on the ground, in leaf litter, in dead tree stumps or under the bark and attracted to light where they can be collected in considerable numbers. Several species are diurnal and can be found upon flowers (*Hibiscus rosa-sinensis, Tabaernemonntana coronaria*) and tree stumps or even clustered at the tips of grass stems in the forest.

Adults are defined as possessing elongated body, antenna 11-segmented, occasionally 12-segmented, labrum exposed, hind pronotal angles well developed, procoxae globular, with highly reduced and concealed trochantins, procoxal cavities open both internally and externally, posterior margin of prosternum elongated to form a spine, mesosternum with a well developed cavity, the prosternal spine form the characteristic jump-clicking mechanism, mesocoxae usually widely separated, rarely close together, hind coxal plates well developed, tarsi each with 5 tarsomeres, abdomen with 5 ventrites, basal 4 (sternites 3-6) connate. Jumping mechanism without legs support is a unique character of adult elaterids beginning of this mechanism the body is arched, this

movement being facilitated by the loose articulation between the prothorax and mesothorax. When beetles not jump, the prosternal spine fits part way into the mesosternal cavity and the prothorax and mesothorax fit tightly together. The muscles involved in this movement are largest muscles in the prothorax and account for one third of the weight of the head and prothorax. These are able to build-up tension due to a friction hold formed by a small notch on the dorsal side of the prosternal spine resting on the anterior margin of the mesosternal cavity. The tension is released when the tip of the prosternal spine slips over the tip of the mesosternum and slides into the mesosternal cavity causing the body to jack-knife with an audible clicking noise. The principal muscles that produce the jump are the dorsal longitudinal intersegmental muscles, extending from the pronotum to the inflexed anterior margin of the mesonotum, which Larsen (1966) has designated M4. The main antagonistic muscle involved is the corresponding medio-dorsal one (M2a and b of Larsen) (Evans, 1972). The jump of click beetle is considered by many authors to be a means for beetles that have fallen on their backs to right themselves, whereas Crowson (1981) thinks that it could equally be considered as a defensive mechanism.

Larvae are elongate, cylindrical to flattened, body form with tough cuticle of many soil dwelling species has resulted in the collective term Wireworm. The French know the larval stage either as “vers fils de fer” (Iron Son) or “vers jaunes” (Yellow Son), while the Germans refer to the larvae as Drahtwürmer (Wireworms). They are generally yellow, brownish-yellow or dark brown to black in colour. The other sufficient characters are head deeply pigmented, prognathous and protracted, stemmata either absent or one on each side of the head, antenna 3-segmented, segment 2 with conical sensory papillae apically, labrum fused with fronts to form nasale, mandibles stout, maxilla either with a single mala or both galea and lacinia, maxillary palp 3 or 4-segmented, thorax with 3 subequal segments, legs well developed, 5-segmented, with claw-like

tarsungulus, abdomen with 9 segments, 9th variable, spiracle biforous, without closing apparatus and with ecdysial scar.

Over a one hundred and fifty years ago, the great coleopterist Lacordaire (1857) wrote "La classification de la famille présente des difficultés excessives et peut-être insolubles" (The Classification of the family presents under hardship and insoluble), and now a days many worker devoted most of their life's work to the classification of this family, but difficulties are still not solved completely.

Linnaeus (1758) in his 'Systema Naturea, published few names of click beetles under genus '*Elater*'. Fabricius (1775) described further species of elaterids including '*Elater fuscipes*' from South India. Leach (1815) proposed the family name Elateridae. Fairmaire (1888) described few elaterids in his work on coleopteran of Indo Chinese region. Champion (1895) in Biologia Centrali Americana described many old and new species of elateridae from Central America.

Candèze (1857-1900) was first to attempt major classification of Elateridae who divided the family into eight tribes (Agrypnides, Mélanactides, Hémirhipides, Chalcolépidiides, Oxynoptérides, Tétralobides, Élatérides vrais and Campylides). He described 200 species from India in his catalogue published in 1891. This classification was based on the characters derived from the metasternum, prosternum, mesepimeron, mandibles and antennae. Lacordaire (1857) also followed him in his Genera des Coléoptères. Schwarz (1906a, b; 1907) described the genera of Elateridae in Wytsmann Genera Insectorum, in which 28 tribes were recognized based on Candèze work but raised tribal ranks of subtribes formerly included in the Élatérides vrais.

Fleutiaux in his series of works (1889, 1895, 1902, 1903, 1905, 1914, 1916, 1918, 1924, 1926, 1927, 1930, 1931, 1933, 1936, 1940, 1941, 1942, 1947) contributed a lot to taxonomy of the elateridae of the world with major emphasis on Indo China, and other regions of Asia.

The Elaterids fauna of Pakistan was very poorly known, at the same time no work was ever undertaken to help understand characters of taxonomic importance. This apparent gap in our knowledge necessitated the present work.

Keys are formulated to tribes, genera of the tribes and to the species. All the species presently included are described in a considerable detail with special reference to the head capsule, propleurae and metasternum grooves, length and shape of antennal segments and male genitalia with aedeagus, for these important characters were entirely unexplored in the species of Pakistan.

As a result of the present studies, about 3600 specimens of the family Elateridae were collected from various localities of Pakistan and determined and classified followed the schemes of Stibick (1971, 1979a, 1979b), Von Hayek (1973, 1979), Platia and Schimmel ( 2001) and Cate (2007).

To described the species in detail, characters were undertaken, punctations on body and patterns of scales, head shape and size, frontal carina, frons convex or concave, size and shape of antennal segments, margin of mesocoxal cavity, position of lateral margins of pronotum, ventral lobe in tarsi and shape of claws.

Male genitalia in Elateridae very much vary by their different organs such as size and shape of aedeagus, tip of aedeagus, parameres size and shape, shape of basal plates, length of median struts and more taxonomic genitalial characters. Such characters in male genitalia are conspicuous in generic level played important role in the separation of species.

In Pakistan, the workers only conducted the preliminary survey which does not provide complete information about the fauna found in Pakistan and most of them reported by various investigators are not available for study and nothing is known about their locality.

The purpose of the study is to explore the Elaterids fauna of the area and to study its systematic, because most of the larvae of Elateridae are pests of

Orchids and other cereals and crops. The study is useful with a view to identify the fauna of the area.

**Material and Methods:**

The study of click-beetles (Coleoptera: Elateridae) from Pakistan, consists of three methods the research studies. The collection of beetles from different localities of Pakistan; material studies from different national and international museums and elaterids collectors; survey of literature; examination and identification of collected specimens of Elateridae by using the literature of the World. Some useful articles and books were available by internet source.

The collection of click-beetles needs different methods, because of the different groups were dealt with variable methods according to their nature and habitats. The type specimens of different known species of click beetles are available in these museums like, Pakistan Zoological Survey Museum, Karachi, Pakistan (PZSM), Natural History Museum, University of Karachi, Pakistan (NHMUK), Természettudomány Múzeum, Budapest, Hungary (TM), Platia Collection, Gatteo, Italy (CPG), Mertlik Collection, Hradec Kralove, Czech Republic (CMHK) and Akhter Collection, Pakistan (ACP).

The click-beetles were collected by hand picking, light traps, sweeping, beating the bushes, foliage and herbs, lifting the bark by butcher knife. Few beetles were also available from crop fields like maize, wheat and potato in northern areas, the species of the genus *Zorochros* and *Ligmargus* were collected under stones from Shigar, Gilgit Bultistan Province near the river.

Hand Picking Method: Elaterid beetles are best collected by hand either with the help of a fine hairbrush or by a forceps.

Light Trap: An artificial light Mercury Vapor bulb (175 Watt) placed adjacent to a 6x6x6 white cotton cloth used in field, attracts a number of elaterid beetles. The beetles attracted by the light would rest on the white cloth, from

where they were easily collected by hand. Light trap is one of the best way in which a large number of click-beetles were collected.

Sweeping: Sweeping with a proper net, is used to collect small sized elaterid beetles on wild grass from Kashmir.

Beating: Very few elaterid beetles were collected by the beating of small trees and herbs.

Preservations: The beetles were killed by exposing vapor of ethyl acetate and by 70% ethyl alcohol. The material was preserved in dry condition. After killing, they were usually relaxed; small sized beetles were mounted over a pointed part of triangular hard paper, while large sized beetles were pinned directly in metathorax for facilitating examination of the specimen from both dorsal and ventral aspects. When a beetle were preserved permanently, data labels were written on good quality board-paper with permanent ink, that contained name of the district, city and province, date of collection and name of the collector. After identification, they were labeled with complete scientific name with name of author and determination year.

Slide Preparation: The genital apparatus was dissected first to separate the terminal four or five segments in male and whole abdomen in female were dissected directly from the specimen and placed in overnight 10% KOH. Thereafter, the KOH treated parts were washed carefully in distilled water remove KOH and then passed through the grades of absolute alcohol from 30% to 90% keeping the specimens for 2 to 10 minutes in each grade of alcohol for dehydration and then fixed the body parts of the specimen using water soluble transparent glue on the pin-tag strip.

When the female organs were transferred from the KOH into water they become swelled up. The genital tract and its associated structures are mostly membranous, only the sclerotised spines and plates showed up against a white background, collateral glands and the spermathical gland were only visible

against a dark background or reflected light adjusted to give the structures a bluish appearance.

All the measurements used in this book are in millimeters (mm), and the mean value of lengths and widths for all species is given in tables (1 to 5).

**Taxonomic Characters of Family Elateridae Leach:**

General Body and Head (Fig. 1-3):

Body strongly flattened, or slightly flattened to moderately convex, or strongly convex, sides not evenly curved, not capable of conglobation, clothed with hairs, setae or scales; head not or slightly declined, or moderately to strongly declined, carina absent or present, frontal region not to moderately, gradually declined, or strongly deflexed, vertical or inflexed at apex only, or strongly deflexed, without ocelli; compound eyes present, not or only slightly protuberant, or strongly protuberant, without interfacial setae; antennae with eleven or twelve articles, extended posteriorly not reaching middle of prothorax, or reaching beyond middle of prothorax but not middle of elytra or reaching beyond middle of elytra but not elytral apices, filiform or moniliform, or serrate or pectinate or bipectinate, or flabellate of biflabeelate, or plumose or biplumose, modifications beginning on article $3^{rd}$ (rarely $2^{nd}$), or article $4^{th}$; mouth parts more or less prognathous, or inferior, labrum partly visible, or concealed beneath clypeus, or apparently absent, mandibles short and broad, or moderately elongate, or very narrow and elongate, maxillary lobe(s) not stylet-like.

Thorax and Elytra (Fig. 1-3):

Prothorax widest anteriorly, or middle, or posteriorly, sides more or less straight, or moderately to strongly curved, or straight posteriorly, curved anteriorly, or sinuate, not laterally compressed to form cavities for legs, base not or slightly narrower than elytral bases, or distinctly narrower than elytral bases,

lateral pronotal carina complete, or incomplete, or absent, anterior angles absent or not produced forward, or distinctly produced forward, posterior angles obtuse or right, or moderately to strongly acute, prosternum at middle shorter than prosternal process, or as long as prosternal process, or longer, prosternal process complete, narrowed apically, or parallel-sided, or gradually expanded and then narrowed, flat, concave, or only slightly elevated or curved behind coxae, or strongly elevated and curved dorsally behind coxae, or slightly to strongly elevated but not curved behind, apex acute or narrowly rounded, or broadly rounded, angulated or truncated, propleuron not extending to anterior edge of prothorax, procoxal cavities present, slightly transverse, or circular or longer than wide, externally open, broadly open, or narrowly open, promesothoracic clicking mechanism present; elytra apunctate, irregularly punctuate, or with five or fewer distinct punctured rows or striae, or with more than five distinct puncture rows, or with more than five distinct impressed striae, apex without internal interlocking tongue, epipleuron absent or incomplete, or complete, not or gradually narrowed, or abruptly narrowed or excavated, lateral edge straight or weakly sinute; scutellum well developed, not abruptly elevated, or abruptly elevated, different shaped.

Genitalia:

Aedeagus trilobite, symmetrical or asymmetrical; anterior edge of median lobe (phallobase) without struts, or with paired struts, without dorsal and ventral lobe; parameres individually articulated to median lobe or with base, or fused but free from one another, or partly or entirely fused together but articulated to median lobe.

## CHAPTER 2

## THE ELATERIDAE: AGRYPNINAE
## REVIEW AND HISTORY

Candèze was one of the founders of Elateridae classification. He wrote many articles and monographs on World elaterids and some on specific regions (1857, 59, 60, 63, 65, 74, 78, 81, 89). He classified Elateridae fauna into Agrypnides, Melanactides, Hemirhipides, Chalcolepidiides, Oxynopterides, Tetralobides, Elaterides Vrais and Campylides. During this work, he recognized many new species and new records, although many are transferred to other genera or changed its status but his work in this field is still helpful.

During the revision of Philippine elateridae Candèze (1875) described 36 new species. In (1880) examined elateridae from M.L.M.D' Alberttis collection and described 18 new species and in (1888) he also explored the elaterids fauna of Birmania and recognized 90 species out of which 37 were new to science. In (1891) he described elaterids from Birmese fauna at 900 to 1500 meters altitude and he was recorded some genera and in next year he described species from E.Modigliani's collection, which was collected from Sumatra. In 1889, Fleutiaux recognized some genera in Indo-China region, and also described some new species. Candèze (1893) added many new species from the Oriental region.

Fleutiaux (1903) studied the family Cicindelidae and Elateridae and he described many new species in Elateridae. In (1905) he described many species of elaterids from the Voyage of M.Maurice, and he also examined the Collection of Professor M.C.F.Baker, college of Agriculture, Banos, Philippines in (1914) and described some new species. Again he contributed Fauna of Indo-China Elaterids in 1918. In 1924 he listed melasidae and elateridae from Indo-Chinese region and described some new species of the genera *Adelocera,*

*Agraeus, Conoderus, Lacon, Campsosternus, Pectocera, Subathous, Sphenomerus, Drasterius, Elater, Megapenthus, Melanoxanthus, Melanotus, Athous, Paraathous, Corymbites, Pristilophus, Rastrocephallus, Ludius* and *Agonischius*.

Hyslop (1917, 1921) described phylogeny of elateridae based on larval characters and genotype of elateridae of the world. In coleopterum catalogus, Schenkling (1925-27) catalogued species of the world.

Fleutiaux (1926) examined 59 specimens in entomological expedition to Abyssinia and described four new species. Some new species were also added in 1927 from Indo-Chinese region. In 1930 he described six new species in the subfamily Hypolithinae and in 1931 he established the new genera in the subfamily Esthesopinae. He also described the genera of subfamily Melanotinae in 1933. He also described two new genera Thacana and Rymcobites in the subfamily Ctenicerinae in 1936 and in 1940, he studied comprehensively from Indo-China region and described many new species. In 1941 he also described some new species in the subfamily Adrastinae.

Della Beffa (1931) studied different families of coleoptera from Kashmir and described *Adelocera punctata* and *Compsolacon cashmiriensis* as new to science.

New species was also discovered during the Swedish expedition to Burma and British India by Fleutiaux (1942). In 1947 he revised the classification of Indo-China region and recognized twenty three sub-families viz., Octocryptinae, Agrypninae, Tetralobinae, Hemirrhipinae, Oxynopterinae, Ctenicerinae, Hypolithinae, Cardiophorinae, Ampedinae, Melanotinae, Monocrepidiinae, Physsorrhininae, Dicrepidinae, Athoinae, Rostricephalinae, Senodoninae, Elaterinae, Agriotinae, Adrastinae, Hemiopsinae, Toxognatinae, Plastocerinae and Anischinae.

Jagemann (1945) described four new species of the genus *Heteroderes viz., H. ras* (Abyssinia), *H. pecorkai* (Himalaya), *H. kuluensis* (Himalaya) and *H. subtilis* (India).

During the study of Japanese elaterids fauna done by Kishii (1987), he studied 60,000 specimens represent 531 species and 139 subspecies within twelve subfamilies.

Comprehensive study on the generic classification of the Negastriinae done by Stibick (1971), he listed 20 genera. A key with affinities and original references also provided.

Gur'jeva (1974) extensively studied on comparative morphological of various structures in the prothorax and mesothorax of click beetles and defined the evolutionary trends within the family. She proposed the classification in the light of thoracic structural characters and divided into subfamilies: Agrypninae, Pityobinae, Tetralobinae, Oxynopterinae, Diminae, Athoinae, Oestodinae, Elaterinae and Cardiophorinae. He also listed the species of the genera *Aeoloides* and *Drasterius* from Russian in 1995.

A very outstanding step work on wing venation in 290 species of click-beetles from 159 genera of the World fauna by Dolin (1976), provided the basis of natural classification of the family elateridae and divided into ten subfamilies. This work allowed establishing the limits of its individual unpredictability and disclosing the group.

Johnson (2001) described new species *Cryptalaus vitilevu* and he also provided distributional notes for the species of the tribe Hemirhipini from Fiji.

Kesdek et. al. (2006) studied the elateridae material collected between 1952-2005 from Turkey and recognized six subfamilies, 25 Genera and 65 species and sub-species.

Chassain (1979) collected twenty species and subspecies of elateridae from different areas of the Saudi Arabia and described eight new species and in 1983 he also described twelve species newly recorded and six new species from

the same country and also erected new genus *Saudilacon* and in 1991 he also described two new species *Calais persicus* and *Calais afghanicus* from Iran and Afghanistan.

Stibick (1979a) provided framework for elateridae classification and arranged twelve subfamilies on world basis.

Many catalogues were appeared past 250 Years of Coleoptera and some on elateridae of World as well on specific regions, now a days Cate (2007) done very important work on Palaearctic elateridae, the catalogue of Palaearctic coleoptera Vol-4 deals with the Palearctic Elateroidea, Derdontoidea, Bostrichoidea Lymexyoidea Cleroidea and Cucujoidea, the series of Palaearctic coleoptera catalogue were published in different years. The main aim of this series is to provide a list of available names, both valid and invalid, of taxa occurring in the Palaearctic Region in their verified orthography and with correct publication dates; a complete list of verified references to primary descriptions; informative distributions of the species and subspecies. In the catalogue 16 subfamilies, 27 tribes, seven subtribes, 227 genera, 57 subgenus and 3965 valid species were recognized of elateridae from Palaearctic Region.

Vats (1986-91) worked under US PL 480 research project (Project No FG-IN-635) on Systematics of Elateridae and described many new species of subfamilies; Agrypninae, Adrastinae, Ampedinae, Cardiophorinae, Cardiorhinae, Chalcolepioinae, Conoderinae, Crepidomeninae, Ctenicerinae, Denticollinae, Dicrepidiinae, Hemirrhinae, Hypnoidinae, Ludiinae, Melanotinae, Oxynopterinae, Physorrhininae, Senodoniinae and Tetralobinae.

Vats and Kashyap (1992a, b, c, d, e, f) worked on taxonomy of elateridae and many new species described in the genera *Plectrosternus* Lacordaire, *Hemiops* Castelnau, *Adelocera* Latreille, *Chalcolepis* Candèze, *Tetrigus* Candèze, *Lacon* Castelnau, *Agrypnus* Eschscholtz and described new genus *Orientis* in the subfamily Crepidomeninae which was closed with the genus *Anaissus* Candèze, but differ in the number of mesothoracic sclerites taking part

in the formation of mesocoxal cavity, shape of distal extremites of elytrae and in the absence of basal setae on claws.

Chakraborty and Chakrabarti (2006) followed Fleutiaux Classification and comprised fauna of Bengal of Click-Beetles, They recognized fourteen subfamilies, 37 genera and 173 species, they also described new species, *Adelocera prabiri, A. triptii, Agrypnus darjeelingensis, A. shyamrupi, Lanelater kalimpongensis, Cardiophorus moni, Melanotus bengalicus, (M. holzschuhi* Platia and Schimmel) *M. himalayanus*, (Now *M. hirticornis* (Herbst)), *M. kolkatai* (*M. bengalensis* Platia & Schimmel) and *Ludigenus kalpanas.*

Hashmi and Tashfeen (1992) listed elateridae on generic level in their coleoptera of Pakistan, they also recorded some species *viz, Agonischius cyanipennis* Candèze, *A. limbatus* Candèze, *A. monticola* Candèze, *Alaus senecteri* Candèze*, Aphanobius longithorax* Wied*, Cardiophorus decorates* Fleutiaux*, C. quadrillum* Candèze*, Corymbites whitei* Candèze*, Hemiops crassa* Gyll*, Heteroderes lenis* Candèze*, Megapenthus ligatus* Candèze*, Melanotus plannipennis* Candèze*, Melanoxanthus melacephalus* Fleutiaux*, Neodiploconcus miniatocollis* Hope*, Poemnites exotanus* Candèze *and Prodrasterius collaris* Candèze.

Von Hayek (1973, 1979) has done comprehensive work on Agrypninae. This group was treated tribe (Agrypnini Schwarz and Adelocerini Arnett), subtribe (Agrypnina Hyslop) or intermediate group (Agrypnitae Fleutiaux). The most important characters were used, structure of the middle coxal cavity, size and shape of the second and third antennal segments, the presence or absence of tibial spurs, the position of the propleural grooves for the reception of the tarsi in relation to the antennal groove and of the distal end of the metasternal groove for the reception of the tarsi in relation to the margin of the metasternum, on the basis of these characters, Von Hayek recognized the genera *Octocryptus* Candéze, *Lanelater* Arnett, *Trieres* Candéze, *Rismethus* Fleutiuax, *Agrypnus* Eschscholtz, *Meristhus* Candéze s. str, *Meristhus* Subgenus *Sulcimerus*

Fleutiaux, *Danosoma* Thomson, *Opatelus* Candéze, *Scaphoderus* Candéze, *Adelocera* Latrielle, *Eidolus* Candéze, *Candanius* nom.n, *Lacon* Castelnau, *Acrocryptus* Candéze, *Dilobitarsus* Latreille, *Elasmosomus* Candéze and *Hemicleus* Candéze.

During the study of subfamily Agrypninae from Korea, Lee et. al., (1987) examined specimens collected throughout Korea from 1985-1986, they were recognized 10 species and one subspecies, while *Agrypnus setigera*, *A. miyamotoi* and *A. hyponicola* first time recorded from Korea.

Platia (1988) recorded eight species (*Agrypnus cashmiriensis* (Della Befa), *Agrypnus ellipticus* (Candèze), *Agrypnus thibetanus* (Reitter), *Lanelater bipunctatus* (Candèze), *Hypnoidus cachemirensis* (Candèze), *Ligmargus margae* Stibick, *Ampedus radula* (Candèze) and *Cardiophorus klapperichi* Gurjeva first time from the Northern areas of Pakistan, with two new species of *Athousius riesei* and *Ampedus pakistanicus.*

Platia and Marini (1990) examined 1570 specimens of click-beetles collection of A. Fiori in the Museum of Zoology of the Bologna University, 222 species were identified from Palearctic region, except *Lanelater pubescens* (Candèze) and *Agrypnus foedus* (Candèze) from Ethiopian region.

Vats and Chauhan (1993) from Northern India described three new species of the genus *Heteroderes* Latereille from North-West India. Vats and Kashyap (1993) studied species of Lanelater Arnett from North-West India and described nine species, out of which six were new to science.

Vats and Kashyap (1995a,b) described new species of the genera *Octocryptus* Candèze and *Tetralobus* Lepel from India, and they were also studied species of the genus *Meristhus* Candèze from North India in 1996.

Platia and Gudenzi (1997) revised the genus *Drasterius* Eschscholtz, and recognized 12 species from Oriental region; they described *Drasterius caneparii* (Burma), *D. confusus* (India), *D. csorbai* (Pakistan), *D. fleutiuaxi* (Indonesia), *D. philippinus* (Phillipines) and *D. werneri* (India).

Chakraborty and Chakraborty (2000) revised the subfamily Agrypninae taxonomically with checklist; they explain briefly the status of subfamily with in India and also its history. They listed out 23 species of the genus *Adelocera* Latreille, 13 species from the genus *Lacon* Castelnau, 76 from the genus *Agrypnus* Eschscholtz, five from the genus *Meristhus* Candèze, one from the genus *Rismethus* Fleutiaux, 20 from the genus *Lanelater* Arnett and two from the genus *Octocryptus* Candèze.

Preiss and Platia (2003) recorded nine species of click-beetles first time from Cyprus with two new species *Drasterius makrisi* and *Cardiophorus georgioui.*

Ohira (2004) eight species and seventeen subspecies were recorded from Japan with two new subspecies; *Agrypnus (Colaulon) tsushimensis* Kusuii and *A. (C.) miyamotoi* Senkakuanus. He also synonymised many species of *Agrypnus*.

Akhter et. al., (2006) redescribed *Lanelater bipunctatus* (Candèze) and *L. bartoni* (Fleutiaux) from Pakistan.

Platia et. al. (2006) described new species *Lanelater punjabensis* from Pakistan, male genitalia illustrated.

Platia et. al., (2007) described two new species *Agrypnus sarikamisensis* and *Athous (Orthathous) artvinensis* from Turkey. Addition of these species make total records of 36 *Athous* and 3 *Agrypnus* species from Turkey.

Nasserzadeh et. al., (2008) described *Pleurathous hyrcanicus* from Iran, They were aklso provided key to the Eastern species of *Pleurathous*. Male characters of *Calais brandti* Platia and Gudenzi were first time described by them.

Akhter et. al (2012) listed 32 species of the subfamily Agrypninae including two new species *Cryptalaus tamargrahensis* and *Agrypnus dadarensis* from Pakistan while the genus *Cryptalaus* first time recorded from Pakistan. In

same year (2012) Akhter et. al. described *Meristus (Sulcimerus) pakistanicus* as new to science and key to the known species also provided.

It appears from the critical review of the to-date literature that prior to the present studies, Elaterids fauna in Pakistan had never been taken into consideration.

## CHAPTER 3

## SYSTEMATICS OF SUBFAMILY AGRYPNINAE CANDÈZE, 1857

**Synonymies of Subfamily Agrypninae:**

Agrypnides Candèze, 1857:17; Lacordaire, 1857:137 and 138.

Agrypnites Jacquelin du Val, 1859:125 and 142; Candèze, 1874:1; 1891:1and 9.

Agrypnini Kiesenwetter, 1863:230; Reitter, 1905:4 and 6; Schwarz, 1906:5.

Agrypnina Thomson, 1864:59.

Agrypnidae Fleutiaux, 1891:387.

Adelocerini Buysson, 1893:18.

Adelocerinae Fleutiaux, 1926:92.

Agrypnitae Fleutiaux, 1941:42.

Adelocerina Blackwelder, 1944:280.

Pyrophorinae Stibick, 1979:156.

Agrypninae Shenkling, 1925:3; Fleutiaux, 1947:241; Dolin, 1973:1628; Ohira, 1973:106; Von Hayek, 1973:12; Gurjeva, 1974:71; Von Hayek, 1979:185; Kishii, 1987:16 and 41; Vats, 1991:42; Dolin and Atamuradov, 1994:25; Calder, 1996:48; Irurzun and Ruiz, 2005:241; Kesdek et. al., 2006:354; Mertlik and Platia, 2008:2; Cate, 2007:95.

**Diagnostic Characters:**

Head capsule variously developed, generally oval, deflexed, frontal carina absent or present, frons more or less concave; mouth parts inferior; antennae serrate; prosternal lobe normally arcuate, even prominent, propleuron and metasternum with deep grooves for reception of antennae, rarely grooved posteriorly for reception of tarsi; mesocoxal cavity closed or open by mesosternum, metasternum and mesepimeron; scutellum shield shaped, never

cordate; claws simple, with seta or setae at base, tibial spurse present or absent (Von Hayek, 1973; Gur'jeva, 1974; Calder, 1996; Cate, 2007).

**Key to the Tribes of Subfamily Agrypninae, found in Pakistan:**

1. Antennae received in deep prosternal pleural grooves, very rarely prosternal pleural sutures grooved for reception of anterior tarsi, mesosternum and mesepisternum all simple, without cross sutures…….……**AGRYPNINI**

- Antennae not received in deep prosternal pleural grooves……**2**

2. Frontal carina well developed above and between antennae, tarsi 4$^{th}$ segment broadened or lobed beneath…….…….……**CONODERINI**

- Frontal carina absent to prominent, tarsi simple…….……**HEMIRHIPINI**

**TRIBE 1: AGRYPNINI CANDÈZE, 1857**

Agrypnides Candèze, 1857:17.

Octocryptites Candèze, 1900:77.

Adelocerini Du Buysson, 1893:112.

Cavicoxumidae Pic, 1928:18.

Laconini Gurjeva, 1973:449.

Agrypnini Gurjeva, 1974:72; Stibick, 1979:158; Dolin and Atamuradov, 1994:25; Irurzun and Ruiz, 2005:241; Kesdek et. al., 2006:354; Platia and Gudenzi, 2006:132; Cate, 2007:95; Platia, 2008:189; Mertlik and Platia, 2008:2.

**Diagnostic Characters:**

In this tribe body covered with scales in all genus except *Lanelater*; head capsule developed, deflexed, frontal carina absent or incomplete, frons more or less concave; mouth parts inferior; prosternum simple, without cross or transverse sutures, prosternal and metasternum suture deepened into a groove of varying length, serving for insertion of antennae or tarsi; scutellum shield shaped, never cordate; claws simple with seta(e) at base (Von Hayek, 1973; Gur'jeva, 1974; Stibick, 1979b; Calder, 1996).

**Key to the Genera of Tribe Agrypnini, found in Pakistan:**

1. Mesepisternum forming part of margin of middle coxal cavity, tibial spurse present, vestiture setose, scales entirely absent……***Lanelater*** **Arnett**

- Mesepisternum not form part of margin of middle coxal cavity, tibial spurse absent, vestiture generally scaly……..……**2**

2. Tarsal claws with one basal seta, second antennomere broadened than long, third antennomere at least twice as long as second...……..…***Lacon*** **Castelnau**

- Tarsal claws with two basal setae, second antennomere as broad as long and as long as third……..…….……..……**3**

3. Scutellum simple, without carina……..……...……*Agrypnus* **Eschscholtz**

- Scutellum with longitudinal carina, propleurae with tarsal grooves……..…….……..….*Meristhus (Sulcimerus)* **Fleutiaux**

## Genus *Agrypnus* Eschscholtz, 1829

*Agrypnus* Eschscholtz, 1829:32; Westwood, 1838:26. Type species: *Elater murinus* Linnaeus, by subsequent designation of Westwood, 1838 (Europe).

*Laco*n sensu Germar, 1840:260 and subsequent authors, not Castelnau, 1836:11 [misinterpretation.] Lacordaire, 1857:141; Candèze, 1857:90; 1874:42; 1892:795; Schwarz, 1906b:18; Elston, 1924:197; Gurjeva, 1974:72; Kishii,1987:44; Laibner, 2000:50; Chakraborty and Chakraborty, 2000:76; Chakraborty and Chakrabarti, 2006:28; Kesdek et. al., 2006:354; Cate, 2007:96; Mertlik and Platia, 2008:2.

*Mecynocanthus* Hope, 1837:53. Type species: *Mecynocanthus unicolor* Hope, by monotypy. (Synonymised by Hayek, 1973:113).

*Tylotarsus* Germar, 1840:247. Type species: *Tylotarsus cinctipes* Germar, by monotypy. (Synonymised by Hayek, 1973:113).

*Titotarsus* Candèze, 1857:170. [Unjustified emendation].

*Myrmodes* Candèze, 1857:168; Schwarz, 1906b:28. Type species: *Myrmodes akidiformis* Candèze, by monotypy (Synonymised by Hayek, 1973:113).

*Archontas* Goezis, 1886:23. Type species: *Elater murinus* Linnaeus, by monotypy.

*Pseudolacon* Blackburn, 1809d:89. Type species: *Pseudolacon rufus* Blackburn, by monotypy (Synonymised by Hayek, 1973:113).

*Homeolacon* Blackburn, 1809d:90; Type species: *Homeolacon gracilis* Blackburn, by monotypy (synonymised by Hayek, 1973:113).

*Lobotarsus* Schwarz, 1898a:131. Type species: *Lobotarsus decoratus* Schwarz, by subsequent designation (Hyslop, 1921:263). (Synonymised by Hayek, 1973:113).

*Lobitarsus* Fleutiaux, 1935c:93. [unjustified emendation]

*Enoploderes* Schwarz, 1898a:131. Type species: *Elater* (*Conoderus*) *cuspidatus* Klug, by monotypy. [Junior homonym of *Enoploderes* Faldermann, 1837]

*Compsolacon* Reitter, 1905:6. Type species: *Elater crenicollis* Ménétrés, by monotypy (Caucasus) (Synonymised with *Lacon* auct. By Fleutiaux, 1918b:189).

*Paralacon* Reitter, 1905:6. Type species: *Lacon cinnamomeus* Candèze, by monotypy. (Synonymised by Hayek, 1973:113).

*Neolacon* Miwa, 1929:235. Type species: *Neolacon formosanus* Miwa, by monotypy. (Synonymised by Hayek, 1973:113).

*Colaulon* Arnett, 1952:116. Type species: *Elater rectangularis* Say, 1925, by original designation. (Synonymised by Hayek, 1973:113).

*Cryptolacon* Nakane and Kishii, 1955: 1. Type species: *Cryptolacon myamoti* Nakane and Kishii, 1955, by original designation. (Synonymised by Hayek, 1973:113).

*Sabikiorius* Nakane and Kishii, 1955: 3. [as subgenus of *Agrypnus* Eschscholtz]. Type species: *Lacon fuliginosus* Candèze, 1865:10, by original designation. (Synonymised by Hayek, 1973:113).

*Sagojyo* Kishii, 1964: 30 [as a subgenus of *Colaulon* Arnett]. Type species: *Colaulon* (*Sagojyo*) *yuppe* Kishi, by original designation. (Synonymised by Hayek, 1973:113).

*Sagojo* Ohira, 1968b:364. [Unjustified emendation]

*Archontoides* Cobos, 1966:651. Type species: *Archontoides pretoriensis* Cobos by monotypy. (Synonymised by Hayek, 1973:113).

*Pyrganus* Golbach, 1968:198. Type species: *Lacon tuspanensis* Candèze by original designation. (Synonymised by Hayek, 1973:113).

**Type Species:**

*Elater murinus* Linnaeus, by subsequent designation of Westwood, 1838 (Europe).

**Diagnostic Characters:**

Body clothed by setae, scales not form any patches; head small, concave, slightly depressed medially or some time strongly, frontal carina incomplete or absent, frons more or less concave; margin of mesocoxal cavity not composed by mesepisternum and mesepimeron, propleurae and metasternum with or without grooves, if propleural grooves or depressions present for the reception of tarsi, do not run parallel with antennal grooves, antennal groove not extending beyond the anterior two-thirds of prosternopleural sutures; antennal segment with second and third small, subequal, each smaller than fourth and following; prothorax with lateral margin carinate; scutellum variable in shape but without longitudinal carina; tibial spurse present, ventral lobe absent or present in tarsi (Von Hayek, 1973; Gur'jeva, 1974; Stibick, 1979; Calder, 1996).

**Key to the Species of the Genus *Agrypnus*, found in Pakistan:**

1. Prothorax broader than long…..……..……**2**
- Prothorax longer than broad.…….…..…..…..……**6**

2. Propleurae and metasternum with grooved…….…..……...……**3**
- Propleurae and metasternum without grooved……...……..…….…**4**

3. Propleurae with grooved for accommodating anterior tarsi…… ……...……...……***A. dadarensis* Akhter et. al.**
- Propleurae and metasternum with grooved for accommodating anterior and mid tarsi respectively, hind angles truncated……..***A. piger* (Candèze)**

4. Scutellum shield shaped……***A. himalyansis* (Jagemann)**
- Scutellum pentagonal shaped……...…….…..……**5**

5. Scutellum impunctate, depressed medially…***A. cashmiriensis*** **(Della Beffa)**

- Scutellum punctate, not depressed medially…….....***A. thibetanus*** **(Reitter)**

6. Lateral margin entire without carina, apices of elytra weakly spinose…….. …..……..……..***A. ellipticus*** **(Candèze)**

- Lateral margin crenulate with carina, apices of elytra rounded…….……..……..…***A. brachychaetus*** **(Kollar)**

Table 1: Measurements of *Agrypnus* species of Pakistan.

| Taxon Name | Length | Width |
|---|---|---|
| *A.brachychaetus* (Kollar) | 15 | 5.1 |
| *A.cashmiriensis* (Della Beffa) | 15-17 | 5.1-5.3 |
| *A.dadarensis* Akhter et. al.* | 11 | 5 |
| *A.ellipticus* (Candèze) | 14-15 | 4.5-4.75 |
| *A.himalayanus* (Jagemann) | 10.4-10.8 | 4-4.2 |
| *A.piger* (Candèze) | 12-13 | 3.5-3.7 |
| *A.thibetanus* (Reitter) | 14-15 | 4.5-4.7 |

*holotypes species

***Agrypnus brachychaetus* (Kollar, 1844)**

**(Fig: 4a-b)**

*Lacon brachycaetus* Kollar, 1844:506; Schenkling, 1925:21.
*Adelocera brachycaetus* Fleutiaux, 1926:9.
*Agrypnus brachychaetus* Hayek, 1973:133; Cate, 2007:97.

**Type Locality:** Kashmir.

**Coloration:** Female entire ferruginous brownish covered with dense, fulvous yellow scales.

**Head:** Head small, concave; frons shallow, depressed anteriorly, deep punctures; antennae exceeding just beyond the middle of pronotum, basal segment long, robust, 2$^{nd}$ and 3$^{rd}$ segments subrounded, 4$^{th}$ to 10$^{th}$ segments sinuate, laterally expanded, last segment penultimate, both sides expanded posteriorly.

**Thorax:** Pronotum slightly longer than broad, sides crenulated, hind angles rounded with a fine carina, runs up to middle of pronotum, side laterally depressed, disk evidently emerginated, convex, punctures deep and dense, covered with small scales; prosternum deeply, coarsely punctuate; propleurae and metasternum without groove for reception of anterior and middle tarsi respectively; scutellum pentagonal shaped, anteriorly with pointed, covered with scales scarcely; elytra with basal margin broader than base of pronotum, mid of broader than anterior margin behind narrower, angles of elytron emerginated, lateral margins carinate, strial margins without punctations, interstriae with dense vestiture.

**Female Genitalia:** Genitalia not available for study.

**Material Examined:** Pakistan; Kheybar Pakhton Khoa Province, Kalam, 1 ♀; 28.vi.2004, leg. Z. Ahmed (ACP).

**Comparative Remarks:** This species closely related with *A. thibetanus* in having pronotum longer than broad, antennae exceeding just beyond the middle of pronotum, but can be easily separated by basal antennal segment robust in *A. brachychaetus* but basal antennal segment cylindrical in *A. thibetanus*, sides of pronotum crenulated in *A. brachychaetus* but sides of pronotum parallel in *A. thibetanus* and margin of elytra with carina in *A. brachychaetus* but margin of elytra without carina in *A. thibetanus*.

**Distribution:** Pakistan and Indian Kashmir.

***Agrypnus cashmiriensis* (Della Beffa, 1931)**

**(Fig: 5a-c)**

*Compsolacon cashmiriensis* Della Beffa, 1931:181.
*Agrypnus cashmiriensis* Platia, 1988:6; Cate, 2007:97.

**Type Locality:** India: Kashmir.

**Coloration:** Entire chocolate brown, covered with grey, small, fulvous vestiture.

**Head:** Head rectangular, narrow, deeply punctured, a chilinised plate at base of head medially, medially shallow angulate and sides taper with rounded end, anteriorly quadrate, rapidly declivity, medially slightly concave, coarse and deep punctures; clypeus with anterior margin truncate; antennae exceeding just near the middle of pronotum, basal segment long, robust, 2nd segment broad but not globous, segment narrower than previous, 3rd segment longer and broader than all segment, remaining subequal, last segment swelled and produce a conical tip.

**Thorax:** Pronotum longer than broader, sides crenulated, rounded depressed medially, very much coarse, close punctures, covered with dense vestiture, hind angles truncated; scutellum pentagonal, impunctate, medially depressed, anteriorly emerginated; elytra shoulders broader than base of pronotum, sides subparallel, widest at middle, apices rounded, strial margin with indistinct rounded punctures, interstriae punctate, covered with dense, suberrect vestiture correlate to strial margin.

**Male Genitalia:** Aedeagus with median lobe slightly longer up to parameres from base to apex continuous width, apically slightly broad, form a spatulate tip, apex rounded; parameres with their ends distantly away, hind ends spinose, medially angulated, posteriorly broad, dilated; basal plate very much rounded at sides, base truncate; two median struts cord like, inside the parameres.

**Material Examined:** Pakistan; Kheybar Pakhton Khoa Province, Hunza, 2 ♂; 14.vii.1986, leg. F. Decatra (CPG).

**Comparative Remarks:** This species closely related with *Agrypnus thibetanus* in having by head rectangular and hind angles of pronotum truncate but can be easily separated by having last antennal segment with a conical tip in *A. cashmiriensis* but last antennal segment without conical tip in *A. thibetanus*, scutellum impunctate in *A. cashmiriensis* but scutellum punctate in *A. thibetanus* and elytral shoulders broader than base of pronotum in *A. cashmiriensis* but elytral shoulders as broad as base of pronotum in *A. thibetanus*.

**Distribution:** Pakistan.

## *Agrypnus dadarensis* Akhter et. al., 2012

**(Fig: 6a-c)**

*Agrypnus dadarensis* Akhter et. al., 2012:42.

**Type Locality:** Pakistan; Kheybar Pakhton Khoa Province, Dadar.

**Coloration:** Entire ferruginous blackish, legs and antennae blackish brown, covered with dense vestiture.

**Head:** Head small, rhomboidal, concave; frons dilated anteriorly, clypeus with anterior margin rounded and deflexed laterally, deep punctures with dense vestiture; antennae exceeding beyond the mid of pronotum, basal segment robust, 2nd and 3rd segments subrounded, last segment penultimate, slightly deflexed apically.

**Thorax:** Pronotum slightly longer than broad, sides entire, thoroughly convex on disc, gently slopes at sides, fine punctation, with dense vestiture, hind angles emerginated, subrounded; prosternum deeply punctured with dense vestiture; propleurae with grooved for reception of anterior tarsi; scutellum shield shaped, covered with dense, recumbent vestiture; elytra with basal margin broader than base of pronotum, widest at middle, narrower apically, strial margin with 6 and 7 row deep punctate, interstriae convex, impunctate.

**Male Genitalia:** Aedeagus with median lobe longer tan parameres, narrow, tubular with rounded ápex; parameres elongate, dilated at base, angulate beyond the middle; two median struts lying under the base of parameres.

**Material Examined:** Pakistan; Kheybar Pakhton Khoa Province, Dadar, Holotype 1 ♂; 10.vii.2004, Z. Ahmed (NHMUK).

**Comparative Remarks:** The new species most closely resembles *A. piger* (Candèze) in the pronotum being broader than long, propleurae with grooves for reception of anterior tarsi, antennae extended beyond the middle of pronotum, aedeagus with median lobe much narrower towards apex, acuminate, apices of parameres angulate later-ally, basal plate entirely broad, but it can easily separated by having rhomboidal head in shape, emarginated hind angles of pronotum and metasternum without grooves for accommodating the anterior tarsi, aedeagus with median lobe tubular, apex rounded, apices of parameres straight, sides of basal plate rounded, base truncate with distinct angles.

**Distribution:** Pakistan; Kheybar Pakhton Khoa Province, Dadar.

## *Agrypnus ellipticus* (Candèze, 1857)

**(Fig: 7a-c)**

*Lacon ellipticus* Candèze, 1857:135; Schenkling, 1925:24.
*Lacon propinquus* Candèze, 1857:135.
*Adelocera ellipticus* Fleutiaux, 1926:96.
*Agrypnus ellipticus* Hayek, 1973:151; Cate, 2007:97.

**Type Locality:** Himalaya; India.

**Coloration:** Ferruginous brown, covered with short, fulvous, dense pubescence.

**Head:** Head rhomboidal shaped, small; frons widely concave, depressed anteriorly, dense and coarse punctation with dense pubescence; antennae moderately long, extended beyond the middle of pronotum, basal segment cylindrical, 2$^{nd}$ and 3$^{rd}$ segments subrounded, smaller than rest segments4$^{th}$ segment laterally expended, broader than all segments, 5$^{th}$ segment slightly narrower than previous segment, 6$^{th}$ to 10$^{th}$ segments equal, last segment long, ellipsoidal.

**Thorax:** Pronotum longer than broad, sides almost parallel, hind angles distinctly rounded, acarinate, lateral margin entire, apical margins of prothorax form a hollow cavity, vestiture fine, dense punctations with pubescence, disc depressed, dense but fines punctures; prosternum densely punctate; propleurae and metasternum without groove for reception of anterior and mid tarsi respectively; scutellum small, pentagonal shaped, depressed, anterior margin slightly emerginated, feebly punctate; elytra moderately convex, sides subparallel along basal third then narrower, apices rounded with weakly spinose

at suture, lateral margins without carina, strial margins deep, coarsely punctate up to length, interstriae without punctures.

**Male Genitalia:** Aedeagus with median lobe little longer than parameres, behind dilated and very much narrower with consistency apically; parameres with apical margins rounded then pointed inner angles, apical hairs very long, basal margins of parameres dilated and eject in the middle of basal plate; basal plate evidently round with its lateral and basal margin; two median struts retain inside of parameres.

**Material Examined:** Pakistan; Punjab Province, Muree, 16 ♂, 26.vi.2004, leg. M. A. Akhter, on light; 11 ♂; 29.vi.2004, leg. M. A. Akhter, on light; 2 ♂; 10.vii.2004, leg. Z. Ahmed, on light; Kheybar Pakhton Khoa Province, Mingora; 14 ♂; 29.vi.2004, Z. Ahmed, on light (ACP).

**Comparative Remarks:** This species closely related with *A. brachychaetus* in having pronotum longer than broad, antennae exceeding just beyond the middle of pronotum, but can easily be separated by basal antennal segment cylindrical in *A. ellipticus,* but basal segment robust in *A. brachychaetus*, sides of pronotum parallel in *A. ellipticus* but sides of pronotum crannulated, margins of elytra without carina in *A. ellipticus* but margins of elytral with carina in *A.brachychaetus*.

**Distribution:** Himalaya, India, Afghanistan and Pakistan.

## *Agrypnus himalayanus* (Jagemann, 1944)

**(Fig: 8a-c)**

*Compsolacon himalyaensus* Jagemann, 1944:335.
*Agrypnus himalayanus* Hayek, 1978:222; Cate, 2007:97.

**Type Locality:** Tibet.

**Coloration:** Entire blackish with antennae and legs brown, without vestiture.

**Head:** Head small, rectangular shaped; frons medially concave, dilated, feebly punctures; antennae exceeding just beyond the middle of pronotum, basal segment robust, 2nd and 3rd segments subrounded, remain segments serrate, last segment strongly penultimate.

**Thorax:** Pronotum just broader than long, hind angles of pronotum truncate, with crenulated carina, runs up to middle of pronotum, sides crenulated, strongly convex at disc, laterally depressed, deep and dense punctures; prosternum strongly punctured; propleurae and metasternum without groove for reception of anterior and mid tarsi respectively; scutellum shield shaped, feebly punctured; elytra with basal margin broader than hind margin of pronotum, distinctly angled, parallel, narrower apically, apices rounded, strial margin indistinct, only 6 and 7 line with deep punctures scarcely, interstriae without punctation.

**Male Genitalia:** Aedeagus with median lobe apically broad, scarcely bulbous, triangularly produced, medially stout, broad, longer than parameres; parameres apically pointed, apices oblique arcuate, hind angles narrowly angulated, then

straight, angulated medially; two median struts not enter in the cavity; basal plate quadrangular, base subrounded with chitinized margins.

**Material Examined:** Pakistan; Gilgit Province, Nalter, 9 ♂; 26.vi.2004, Z. Ahmed, on light (ACP).

**Comparative Remarks:** This species closely related with *Agrypnus piger* in having head rectangular, hind angles of pronotum truncate, scutellum shield shaped and apex of elytra rounded but can be easily separated by hind angles of pronotum carinate in *A. himalayanus* but hind angles of pronotum acarinate in *A. piger*, elytral interstriae impunctate in *A. himalayanus* but elytral interstriae punctate *A. piger* and two median struts not enter in cavity of male genitalia in *A. himalayanus* but entered in cavity in *A. piger*.

**Distribution:** Himalaya; Tibet, China, Nepal and Pakistan.

## *Agrypnus piger* (Candèze, 1889)

**(Fig: 9a-c)**

*Lacon piger* Candèze, 1889:73; Schenkling, 1925:25.
*Adelocera piger* Fleutiaux, 1926:96.
*Agrypnus piger* Hayek, 1973:198; Chakraborty and Chakrabarti, 2006:51.

**Type Locality:** Bengal; Tetara.

**Coloration:** Entire blackish brown, covered with less scales, antennae and legs brown.

**Head:** Head small, rectangular shaped; frons concave, depressed in middle with incomplete frontal carina; antennae extended beyond the middle of pronotum, basal segment robust, 2$^{nd}$ segment globous, 3$^{rd}$ segment subrounded, 4$^{th}$ to 10$^{th}$ segments equal with laterally expansion, last segment ellipsoidal but laterally expanded.

**Thorax:** Pronotum broader than long, sides subparallel, hind angles truncate, slightly emerginated, a carinate, lateral margin entire, sinuate before hind angles, vestiture with thick and dense punctures; prosternum densely punctate; prosternopleural grooves extending beyond into middle of prosternopleural sutures; propleurae and metasternum with grooves for accommodating the anterior tarsi and mid tarsi respectively; scutellum shield shaped, slightly emerginated anteriorly, densely punctuate with scales; elytra convex, sides subparallel along basal third, then narrower, apices rounded and weakly spinose at suture, striae with linear arrangements of dense punctures, interstriae slightly convex with fine punctures.

**Male Genitalia:** Aedeagus with median lobe lobulate, slightly longer than parameres, broader from apex to base; parameres with apical margins at right angles, acuminate at their inner margin, basally rounded, extended in the cavity of basal plate; basal plate anteriorly broad, base narrower; two median struts inside the parameres at base.

**Material Examined:** Pakistan; Punjab Province, Abottabad, 3 ♂; 26.vi.2004, on light, leg. M. A. Akhter (ACP).

**Comparative Remarks:** This species closely related with *A. himalayanus* in having head rectangular, hind angles of pronotum truncate, scutellum shield shaped and apex of elytra rounded but can be easily separated by hind angles of pronotum acarinate in *A. piger* but hind angles of pronotum carinate in *A. himalayanus*, elytral interstriae punctate in *A. piger* but elytral interstriae impunctate in *A. himalayanus* and two median struts enter in cavity of male genitalia in *A. piger* but two median struts not enter in cavity of male genitalia in *A. himalayanus*.

**Distribution:** Bengal, India and Pakistan.

## *Agrypnus thibetanus* (Reitter, 1913)

**(Fig: 10a-c)**

*Compsolacon crenicollis var. thibetanus* Reitter, 1913:658.
*Agrypnus thibetanus* Hayek, 1973:221; Cate, 2007:99.

**Type Locality:** West Himalaya, Tibet.

**Coloration:** Ferruginous brownish, antennae and legs brown, covered with dense vestiture.

**Head:** Head small, rectangular shaped; frons medially concave, dilated, depressed, deep and dense punctures, without frontal carina; antennae moderately long, extended just beyond the middle of pronotum, basal segment long, robust, 2$^{nd}$ and 3$^{rd}$ segment subrounded, 4$^{th}$ to 10$^{th}$ segments equal with laterally expanded, last segment ellipsoidal broad, not penultimate.

**Thorax:** Pronotum longer than broad, sides parallel, hind angles truncated as pointed, lateral margin crenulated, with carina runs up to near apex, disc strongly convex with fine, dense punctation, toward sides dense vestiture; prosternum densely punctate; propleurae and metasternum without grooves for accommodating the anterior tarsi and mid tarsi respectively; scutellum pentagonal shaped, convex, fine punctures with vestiture; elytra convex, widest at middle, narrower at end, shoulders broad as base of pronotum, apices rounded, striae punctuate with its linear arrangements, interstriae impunctate.

**Male Genitalia:** Aedeagus with median lobe broad up to apex, spatulate apically, longer than parameres; parameres strongly sinuate in the middle, apical margin elongate with acuminate, basal margin angulated and jointed in the

cavity of basal plate; basal plate strongly rounded; two median struts also inside the parameres at base.

**Material Examined:** Pakistan; Kheybar Pakhton Khoa Province, Kalam, 1 ♀; 28.vi.2004, leg. Z. Ahmed, on light; Mingora, Margazar, 13 ♂; 29.vi.2004, leg. M. A. Akhter, on light; Kalam, 17 ♂; 28.vi.2004, leg. M. A. Akhter, on light; Dadar, 1 ♂; 26.vii.2004, leg. Z. Ahmed, on light (ACP).

**Comparative Remarks:** This species closely related with *A. cashmiriensis* in having head rectangular and hind angles of pronotum truncate but can be easily separated by having last antennal segment without conical tip in *A. thibetanus* but last antennal segment with conical tip in *A. cashmiriensis*, scutellum punctuate in *A. thibetanus* but scutellum impunctate in *A. cashmiriensis* and elytral shoulders as broad as base of pronotum in *A. thibetanus* but elytral shoulders broader than base of pronotum in *A. cashmiriensis*.

**Distribution:** Himalaya, China, Afghanistan, India and Pakistan.

## Genus *Lacon* Castelnau, 1836

[*Adelocera* sensu auct., nec Latreille, 1829. Misinterpretation]

*Lepidotus* Stephens, 1830:374. Type species: *Elater varius* Oliver, 1790 [=*Lacon quercea* (Herbst, 1874)]. By subsequent designation (Hyslop, 1921: 625). [Homonym of *Lepidotus* Asso, 1801:38 (Pisces). Replaced by *Zalepia* Arnett, 1953.]

*Lacon* Castelnau, 1836:II. Type species: *Elater atomarius* Fabricius, 1789 [= *Lacon punctatus* (Herbst, 1770)]. By subsequent designation (Hyslop, 1921:652); Dolin and Atamuradov, 1994:26; Calder, 1996:97; Laibner, 2000:54; Chakraborty and Chakrabarti, 2006:60; Kedsek et. al., 2006:355; Cate, 2007:100; Mertlik and Platia, 2008:2

*Ocneus* Candèze, 1863:327. Type species: *Ocneus limbatus* Candèze, by monotypy. (Synonymised by Hayek, 1973:52).

*Scelisus* Candèze, 1863:327. Type species: *Scelisus sanguineus* Candèze, by monotypy. (Synonymised by Hayek, 1973:52).

*Alaotypus* Schwarz, 1902:307. Type species: *Alaotypus subpectinatus* Schwarz, by subsequent designation (Hyslop, 1921:625). [Synonimized with *Adelocera* sensu suct., by Fleutiaux, 1918d:183]

*Sulcilacon* Fleutiaux, 1927:65. Type species: *Adelocera geographica* Candèze, by original designation(Synonymised by Hayek, 1973:52).

*Diphyaulon* Arnett, 1952:112 [as a subgenus of *Lepidotus* Stephens]. Type species: *Adelocera pyrsolepis* LeConte, by original designation. (Synonymised by Hayek, 1973:52).

*Aulacon* Arnett, 1952:112 [as subgenus *Lepidotus* Stephens] Type species: *Adelocera nobilis* Fall, by original designation. [Raised to generic status, Arnett, 1969:II.] (Synonymised by Hayek, 1973:53).

*Zalepia* Arnett, 1953:7. [Replacement name for *Lepidotus* Stephens; as a subgenus of *Lacon* Castelnau. Raised to generic status, Arnett, 1969:II.] (Synonymised by Hayek, 1973:53).

*Kobulacon* Chujo and Ohira, 1965:2. [as subgenus of *Lacon* Castelnau]. Type species: *Lacon quadrinodatus* Lewis, by monotypy. (Synonymised by Hayek, 1973:53).

*Lepidelater* Smith, 1969:II. Type species: *Lepidelater misticius* Mignot, by monotypy. (Synonymised by Hayek, 1973:53).

*Arnettia* Golbach, 1969:155. Type species: *Adelocera aberranus* Candèze, by monotypy. (Synonymised by Hayek, 1973:53).

*Monocyrton* Golbach, 1969:156 [as a subgenus of *Lacon*]. Type species *Adelocera chabannei* Guérin, by original designation. (Synonymised by Hayek, 1973:53).

*Cornilacon* Golbich, 1969:158. [as subgenus of *Lacon*]. Type-specie: *Adelocera longicornis* Champion, by original designation. (Synonymised by Hayek, 1973:53).

*Latilacon* Golbich, 1969:158. [as subgenus of *Lacon*]. Type species: *Adelocera laticollis* Candèze, by original designation. (Synonymised by Hayek, 1973:52).

*Danosoma* Thomson, 1859:103.

**Type Species:**

*Elater atomarius* Fabricius, 1789.

**Diagnostic Characters:**

Body clothed with narrow scales or setae, both are not form any patches; head capsule developed, deflexed, frontal carina absent, frons more or less concave; margin of mesocoxal cavity composed by mesepimeron, propleurae with or without grooves or depressions for the accommodation of the anterior tarsi, metasternum with or without depressions, never well define grooves for

accommodation of the middle tarsi; antennal segment with second and third not subequal, the third resembles with forth in shape but slightly smaller in size, antennal groove in variable depth, extending at least half the length of the prosternopleural suture, in some species attaining the anterior coxae; prothorax with lateral margin carinate; scutellum simple, without longitudinal carina; tibial spurse absent, tarsi simple, without ventral lobe (Von Hayek, 1973; Gur'jeva, 1974; Stibick, 1979; Calder, 1996).

***Lacon punctatus* (Herbst, 1779)**

**(Fig: 11a-c)**

*Elater punctatus* Herbst, 1779:316; pl. 7. fig.1. [Synonymized with *atomarius* Fabricius by Panzer, 1801:1]
*Elater carbonarius* Schrank, 1781:184. [Synonymized with *punctatus* Herbst by Herbst]
*Elater pilverulentus* Panzer, 1795:235. [synonymised with *atomarius* Fabricius by Panzer]
*Elater atomarius* Fabricius, 1798:139.
*Adelocera punctatus* (Herbst) Seidlitz, 1888:168; Bodemeyer, 1900:115; Schenkling, 1925:10.
*Lacon punctatus* (Herbst) Fleutiaux, 1926:94; Von Hayek,1973:76; Guglielmi and Platia,1985:170; Kesdek et. al., 2006:355; Cate 2007:101; Mertlik and Platia, 2008:3.

**Type Locality:** Unknown. (Von Hayek (1973) designated Lectotype in the absence of any authentic material)

**Coloration:** Entire blackish, claws only brown, without vestiture.

**Measurement:** Length 19.5-21.0; width 5.5-5.8.

**Head:** Head small, trapezoid form, sulcate medially; frons concave, dilated anteriorly, strongly punctate, contiguous; antennae extended just beyond the middle of pronotum, basal segment robust, 2$^{nd}$ segment smaller than others, globous, 3$^{rd}$ segment longer than 4$^{th}$, 4$^{th}$ to 10$^{th}$ segments broadly serrate, subequal, last segment spatulate.

**Thorax:** Pronotum longer than broad, without impressions, anteriorly bisinuate with medially emerginated, longitudinally concave on disc, rapidly slopes laterally, sides crenulated, hind angles acute, truncated, deep, coarsely punctation, contiguous scarcely; scutellum nearly square shaped, coarsely punctate, posterior margins slightly convex, depressed; elytra with basal margin as broad as base of pronotum, depressed, sides parallel, gradually narrower behind, apices rounded, strial margin indistinct, much dense punctures along contiguous punctation.

**Female Genitalia:** Bursa copulatrix with sclerite suboblong with median sclerotized rod, apically with numerous chitinized spines.

**Material Examined:** Pakistan; Baluchistan Province, Hub Chocki, 2 ♀; 15.vii.2005, leg. M. A. Akhter, (ACP); Cezch Republic; 8 km E. of Savsat, 1♀; 4.vi.2000, leg. J. Mertlik, (CMHK).

**Comparative Remarks:** This species is closely related to *Lacon querceus* in having general body, antennal shaped and slightly convex posterior margin of scutellum but can be easily separated by having pronotum without impressions in *Lacon punctatus* but pronotum with two impressions on each sides in *L. querceus*, Hind angles of pronotum acute in *L. punctatus* but hind angles of pronotum rounded in *L. querceus* and scutellum nearly square in *L. punctatus* but scutellum rectangular in *L. querceus*.

**Distribution:** Europe, Cyprus, Jorden, Syria, Turkey and Morroco.

## Genus *Lanelater* Arnett, 1952

[*Agrypnus* sensu authors, nec Eschscholtz, 1819:32, misinterpretation]
*Amaurus* Castelnau, 1840:23. Type species: *Amaurus senegalensis* Castelnau, by subsequent designation of Hyslop, 1921 (Senegal). [ junior homonym of *Amaurus* Burmeister, 1835-Hemiptera]
*Lanelater* Arnett, 1952:105. Type species: *Agrypnus schotti* LeConte, by original designation (USA); Von Hayek, 1873:240; Calder, 1996:98; Chakraborty and Chakrabarti, 2006:61; Cate, 2007:102; Mertlik and Platia, 2008:2.

**Type Species:**

*Agrypnus schotti* LeConte 1853, by original destination (Hyslop, 1921).

**Diagnostic Characters:**

Body clothed with setae, not form any patches, scales entirely absent; head capsule well developed, deflexed, frontal carina absent, frons more or less concave; margin of mesocoxal cavity composed by mesepisternum and mesepimeron, propleurae and metasternum without grooves for the accommodation of anterior and middle tarsi; antennal segment with third article always different in shape by fourth segment and considerably longer then second article; prothorax with lateral margin carinate; scutellum without longitudinal carina; tibial spurse present, ventral lobes absent in tarsi (Von Hayek, 1973; Gur'jeva, 1974; Stibick, 1979; Calder, 1996).

**Key to the Species of the Genus *Lanelater* of Pakistan:**

1. Antennae reaching the middle of pronotum…….**2**
- Antennae reaching the apexes of hind angle of pronotum……..….**3**

2. Prescutelar tubercle punctured, Lateral carina up to middle of pronotum……..……..……..….***L. bartoni*** **(Fleutiaux)**

- Prescutelar tubercle smooth and shiny, Lateral carina up to apex of pronotum……..***L. fuscipes*** **(Fabricius)**

3. 3rd antennal segment equal to segment 4th, Apical margin of parameres straight……. ***L. punjabensis*** **Platia et. al.**

- 3rd antennal segment not equal to segment 4th, Apical margin of parameres truncate……..……**4**

4. Elaytral striae shallowly punctured in all surface, Pronotum without depressions……..……..***L. bipunctatus*** **(Candèze)**

- Elytral striae indistinct of all surface, Pronotum with two depressions near the basal margin……..….***L. scutopentagonus*** **Vats and Kashyap**

Table 2: Measurements of the species of *Lanelater* from Pakistan.

| Taxon Name | Length | Width |
|---|---|---|
| *L.bartoni* (Fleutiaux) | 25.5-31.5 | 5.4-8.7 |
| *L.bipunctatus* (Candèze) | 21-26.5 | 4.1-7.8 |
| *L.fuscipes* (Fabricius) | 35-38.5 | 9-11 |
| *L.punjabensis* Platia et. al. | 19*<br>16-19 | 5.8*<br>5-5.8 |
| *L.scutopentagonus* Vats and Kashyap | 28 | 9 |

*holotype species

***Lanelater bartoni* (Fleutiaux, 1902)**

**(Fig: 12a-d)**

*Agrypnus bartoni* Fleutiaux, 1902a:163.
*Lanelater bartoni* Arnett, 1952: 105; Hayek, 1973: 245; Platia, 2004: 99; Platia et. al., 2006: 208; Cate, 2007:102.

**Type Locality:** India.

**Coloration:** Entirely ferruginous with brownish shadings around the margins of body, very less recumbent yellowish pubescence on near of apex of elytra.

**Head:** Frons depressed medially from vertex to anterior margin sides in the form of ridge, coarsely punctuate with very less recumbent pubescence; antennae reaching the middle of pronotum, 1$^{st}$ segment longer and thicker than others, 2$^{nd}$ segment globous, 3$^{rd}$ and 4$^{th}$ segment subequal.

**Thorax:** Pronotum longer than wide, without depressions, conspicuously convex on disk, gently slope at sides and abruptly turn at base, depressed posteriorly, trace of long and median longitudinal carinae, prescuteller tubercle moderate, quadrate, with punctured and shiny surface, diverging with tips subrounded, lateral carina up to middle, punctures coarse, very close on disk with short recumbent pubescence; scutellum pantagonal with base triangular, flat, punctured with recumbent pubescence; Elytra 2.5 times longer than pronotum, widest at middle, gradually narrowing toward apex, striae shallowly punctured on all the surface, interstriae flat with very fine punctures, full of recumbent pubescence, subcoxal furrow straight behind mesocoxae, prosternal sutures deeply furrowed as long as prosternum.

**Male Genitalia:** Aedeagus with median lobe broad at middle, form narrow tube like structure with apex rounded; parameres broad, flat, apex truncate with slightly deflected laterally, externally longitudinal sinuate, basally separated; two median struts hanging in half of basal plate, angulate; basal plate broad, margins chitinized, a long chitinized rod on ventrally, lie between median struts, base flap like, bifurcate.

**Female Genitalia:** Ovipositor stout, sclerotized, genital coxites divided into two parts, without styli, paraprocts elongate, closely to bases of coxites, apex spatulate with margin oblique, genital tract with anterior most section of bursa copulatrix elongate, tubular, with sclerotized armature consisting of rows of spinules extending along both sides of bursa, extension of bursa copulatrix consist two sclerotised structure in internal sac, two spermatheca, distantly arise, long, tubular (3 times), attached apically to anterior most section of bursa copulatrix, sternite consist elongated shaft and dilated basal plate, shaft jointly bifurcate, great distance at base, apex rounded, basal plat sheath like, long brsitles on base of sheath.

**Material Examined:** Pakistan; Sindh Province, Dhabeji, 14 ♂, 2 ♀; 15.iv.2003, leg. A. Affan, on light (ACP); Karachi, 12 ♂, 1 ♀; 23.ii.1992, leg. Bushra, on light; 3 ♂; 17.x.1979, leg. Irshad; 1 ♂; 1981, leg. S. Almas; 1 ♂; 1980, leg. Rahila; 1 ♀; 8.x.1982, leg. Rafique; 1 ♂, 1 ♀; 12.i.1974, leg. A. Khan; 1 ♂; 9.iii.1971, leg. Ehsan; 41♂, 1 ♀; 11.i.1972, leg. A. Khan; 1 ♂; 13.iii.1973, leg. A. Khan; 2 ♂, 1 ♀; 23.ii.1992, leg. Bushra (NHMUK); Mirpur Khas; 1 ♂; 7.x.2006, leg. Z. Ahmed, on light; 1 ♂; 10.v.2007, leg. Z. Ahmed, on light (ACP); Tando Jam; 8 ♂, 3 ♀; 15.viii.1967, leg. Mehar (NHMUK); Thatta; 3 ♂, 1 ♀; 29.ix.1972, leg. M. Maqsood, 4 ♂, 1♀; 12.viii.1967, leg. Ehsan; 1 ♀; 10.x.1982, leg. M. Anwer, (NHMUK); Baluchistan Province, Quetta, 1 ♂;

26.vii.1972, leg. S. Tehmina, (NHMUK); Kheybar Pakhton Khoa Province, Tamargrah, 11 ♂, 5.vii.2005, leg. K. Rasheed, (ACP).

**Comparative Remarks:** This species closely related with *L. bipunctatus* like shape, setae, antennae but can be easily separated by their frons depress medially from vertex in *L. bartoni* not depressed in *L. bipunctatus*, aedeagus moderately tubular in *L. bartoni* but aedeagus evidently tubular in *L. bipunctatus*, spermatheca more than three coiling in *L. bartoni* but spermatheca coiling in three rows in *L. bipunctatus*, median paramers apically not turn in *L. bartoni* but median paramers apically turned at end in *L. bipunctatus*. This species also closed with *L. punjabensis*.

**Distribution:** Oriental, Pakistan, India, Sri Lanka, and Iran.

***Lanelater bipunctatus* (Candèze, 1857)**

**(Fig: 13a-d)**

*Agrypnus bipunctatus* Candèze, 1857: 29.
*Lanelater bipunctatus* Arnett, 1952: 105; Hayek, 1973: 245; Platia, 1988: 6; Platia, 2004: 99; Cate, 2007:102.

**Type Locality:** Sylhet (E. Pakistan).

**Coloration:** Body ferruginous with blackish shadings around the margins and scutellum, covered with dense, short, recumbent, grey pubescence.

**Head:** Frons deeply impressed, from vertex to anterior margin, clypeus anteriorly subrounded, coarsely punctuate with recumbent pubescence, lateral carinae raised diminish before base of head; labrum bent down, exerted anteriorly, prominent punctation with long erect pubescence; eyes subdorsal, slightly convex, rounded; antennae exerted anterior margins of eyes, laterally, reaching the hind angle of pronotum, 1$^{st}$ segment gradually thickened, longer than others, 2$^{nd}$ segment globous, small, 3$^{rd}$ longer than 4$^{th}$, fourth and following to tenth subquadrangular, last segment longer than penultimate, ellipsoidal and abruptly constricted at apical third.

**Thorax:** Pronotum longer than wide, without depressions, conspicuously convex on disk, smoothly sloping at sides, abruptly at base, with a trace of short and median longitudinal carinae, prescuteller tubercle moderate, subquadrate with smooth and shiny surface, sides moderately distinctly sinuate before posterior angles, feebly diverging with tips rounded to truncate, carina running subparallel to lateral margins prolonged near middle; scutellum subrectangular, flat, punctured; Elytra 2.5 times longer than pronotum, widest at

middle, gradually narrowing toward apex, striae shallowly punctured on all the surface, interstriae flat with very fine punctures, subcoxal furrow regularly curved behind mesocoxae, prosternal sutures deeply furrowed as long as prosternum.

**Male Genitalia:** Aedeagus with median lobe broad at middle, quickly turned up and form cylindrical, narrow tube; parameres evidently shorter than median lobe, basally separated at middle, apex truncate, two median struts just across base of parameres, apically broad, flat, apex truncate, a long chitinised rod along with median struts, basal piece well developed, broad, half part chitinised.

**Female Genitalia:** Ovipositor stout, heavily sclerotised, genital coxites divided into two parts, without styli, two very long paraprocts, very close to bases of coxites, apical spatulate, flattened, genital tract consist anterior most section of bursa copulatrix elongate, tubular, with sclerotised armature consisting of rows of spinules extending along both sides of bursa, extension of anterior most section of bursa copulatrix elongate, with two sclerotised structures; Two spermatheca present, short, tubular, attached apically to anterior most section of bursa copulatrix, sternite consist elongated shaft and dilated basal plate, shaft more elongate, jointly bifid, gradually away up to base, apex truncate, basal prong sheath broad with long bristles on lower surface.

**Material Examined:** Pakistan; Kheybar Pakhton Khoa Province, Dadar, 22 ♂; 10.vii.2004, leg. Z. Ahmed, on light (ACP); Tamargrah, 15 ♂, 11 ♀; 5.vi.2006, leg. Rasheed; Sindh Province, Karachi, 23 ♂; 5.vii.2005, leg. M. A. Akhter, on light; 1 ♂; 4.vi.2006, leg. Z. Ahmed, on light; 3 ♂; 10.iv.2005, leg. Z. Ahmed; 31 ♂, 14 ♀; 7.vii.2004, leg. Ijaz, A., (ACP); 3 ♂, 1 ♀; 13.vi.1987, leg. A. Masood, on light; 1 ♂; 06.iv.2004, leg. Rukhsana; 4 ♂, 1 ♀; 06.iv.2004, leg. J. Rauf, 4 ♂; 21.ii.1972, leg. S. A. Rizvi, (NHMUK); Mirpur Khas, 23 ♂;

10.v.2007, leg, Z. Ahmed, (ACP); Nagarparker, 31 ♂; 12.v.2007, leg. Z. Ahmed, (ACP); Naukot, 40 ♂, 19 ♀; 9.v.2007, leg. Z. Ahmed, (ACP); Thatta, 7 ♂; 12.viii.1967, leg. Ehsan (NHMUK); Tando Jam, 3 ♂, 1 ♀; 15.viii.1967, leg. Mehar (NHMUK).

**Comparative Remarks:** This species closely related with *L. bartoni* like shape, setae, antennae but can be easily separated by their frons depress medially from vertex in *L. bartoni* not depressed in *L. bipunctatus*, aedeagus evidently tubular in *L. bipunctatus* but moderately tubular in *L. bartoni*, spermatheca coiling in three rows in *L. bipunctatus* but more than three coiling in *L. bartoni*, median paramers apically turned at end in *L. bipunctatus* not turn in *L. bartoni.*

**Distribution:** Oriental, Pakistan, India and Iran.

***Lanelater fuscipes* (Fabricius, 1775)**

**(Fig: 14a-d)**

*Elater fuscipes,* Fabricius, 1775:211.

*Agrypnus fuscipes* Fabricius, 1840:253

*Lanelater fuscipes.* Arnett, 1952:105; Hayek, 1973: 249; 1979: 246 ; Cate, 2007:102.

**Type Locality:** India orientali.

**Coloration:** Piceous blackish with reddish brown around the margin of body; covered with week short, recumbent yellowish pubescence.

**Head:** Frons gradually impressed from vertex to anterior margin, distinct median with dilated surface, long recumbent pubescence sparse to all surface; antennae reaching the middle of prothorax, second segment smallest not globous, third, fourth and fifth segments long, cylindrical, equal, remain segments, subquadrangular, penultimate.

**Thorax:** Pronotum longer than wide, without depressions, conspicuously convex on dist, smoothly sloping at sides and base, prescutellar tubercle distinct, subquadrate, with smooth and shiny surface, sides moderately arcuate, distinctly sinuate before posterior angles; posterior angles diverging with tips, almost pointed, carinate, carina running subparall to lateral margin prolonged near to apex; coarsely punctuate to all surface; scutellum subquadrate, anteriorly depressed, shiny surface, feebly punctured; elytra 2.5 times longer than pronotum, widest at middle, gradually narrowing toward apex, striae shallowly punctured on all the surface, inter striae with very fine punctures with very short

suberrect pubescence without prominence; prosternal sutures deeply furrowed as long as prosternum.

**Male Genitalia:** Aedeagus with median lobe broad at middle, turned up and cylindrical, narrow tube; parameres broad with outer margin almost straight, posterior end of each parameres flat with subapical process; two median struts reaching the base of parameres.

**Female Genitalia:** Ovipositor sclerotised, genital coxites into two parts, without styli, two long paraprocts, apicolaterally spalulate, cylindrical; genital tract consist anterior most semicoiled bursa copulatrix, covered with rows of spinules extending to its length; a pair of spermatheca, triangular shaped, flanked in the middle of bursa and genital tract, close to each other; sternite consist elongated shaft, diverging at base, connect with a subrounded, broad, sclerotised plate, lower surface bear very short bristles.

**Material Examined:** Pakista; Sindh Province, Karachi, 9 ♂, 1 ♀; 15.vi.2005, leg. Z. Ahmed, on light (ACP); Punjab Province, Islamabad, 4 ♀; 10.vii.2007, leg. M. Rais, on light (ACP); Kalar kahar, 15 ♀; 23.vi.2007, leg. Z. Ahmed, (ACP).

**Comparative Remarks:** This species is closely related to *Lanelater bartoni* in having general body outline, pronotum longer than wide and antennae just exceeding beyond the middle of pronotum but can be easily separated by having longer body size (Length: 35-38.5) in *Lanelater fuscipes* but body range (25.5-31.5) in *L. bartoni*, scutellum subquadrate in *L. fuscipes* but scutellum pentagonal in *L. bartoni* and lateral carina up to apex of pronotum in *L. fuscipes* but lateral carina up to middle of pronotum in *L. bartoni*.

**Distribution:** Pakistan, India, Sri Lanka, Comores Isl, Oriental and Afrotropical Region.

***Lanelater punjabensis* Platia et. al., 2006**

**(Fig: 15a-c)**

*Lanelater punjabensis* Platia et. al., 2006: 207

**Type Locality:** Pakistan; Punjab Province, Talagang.

**Coloration:** Male. Entirely ferruginous with blackish shadings around the margins of body and scutellum; covered with dense, very short, recumbent, yellowish pubescence.

**Head:** Frons deeply impressed from vertex to anterior margin, the latter confused with clypeus, coarsely punctate, umbilicate, with shortest, shagreened interstices; antennae reaching the apices of hind angles of pronotum; 2nd segment globous, 3rd triangular, little longer than 2nd and just wider than long, equal to 4th segment, both with shiny surface, 4th and following to 10th subquadrangular, with dull surface, 4th more elongate but all longer than wide; last segment longer than penultimate, ellipsoidal and abruptly constricted at apical third.

**Thorax:** Pronotum wider than long, without depressions, conspicuously convex on disk, abruptly sloping at sides and base, with a trace of short and median longitudinal carina; prescutellar tubercle moderate, subquadrate, with smooth and shiny surface; sides moderately arcuate , more or less distinctly sinuate before posterior angles, the latter feebly diverging with tips rounded to truncate; carina running subparallel to lateral margins prolonged near middle; coarsely punctured, deep and slightly umbilicate on disk, interstices short, finely shagreened, at sides denser, more superficial, umbilicate, with shortest and shagreened interstices; scutellum subrectangular, flat to gently convex,

punctured. Elytra 2,5 times longer than pronotum, widest at middle, gradually narrowing toward apex, the latter with a very short spine; striae shallowly punctured on all the surface, interstriae flat with very fine punctures; subcoxal furrow regularly curved behind mesocoxae; prosternal sutures deeply furrowed as long as prosternum.

**Male Genitalia:** Aedeagus with median lobe diverse form, look like funnel shape, basally evidently swell up to mid, then form a narrow, tube like up to apically, longer than parameres; parameres laterally flattened, their apical margins obliquely straight, behind dilated; median struts not emerge in the cavity of basal plate; basal plate broad, basal margin subrounded.

**Female:** Unknown.

**Material Examined:** Pakistan; Punjab Province, Talagang, Holotype**:** 1 ♂; 1.vii.2004, leg. M. A. Akhter, on light (NHMUK); Paratype**:** 2 ♂; same data as Holotype (CPG).

**Comparative Remarks:** This species is closely related to *L. bartoni* in having general outline and male genitalia but can be easily separated having the longer antennae and coarser punctation of pronotum.

**Distribution:** Pakistan; Punjab Province, Talagang.

## *Lanelater scutopentagonus* Vats and Kashyap, 1993
## (Fig: 16a-c)

*Lanelater scutopentagonaus* Vats and Kashyap, 1993: 216; Cate, 2007:102.

**Type Locality:** North West India.

**Coloration:** Ferruginous with more than half elytra brown, head, thorax and scutellum blackish, covered with dense, recumbent, yellowish pubescence.

**Head:** Frons slightly impressed from vertex to anterior margin, coarsely punctuate, with long recumbent pubescence; antennae reaching the apices of hind angles of pronotum, $2^{nd}$ segment globous, $3^{rd}$ shorter than $4^{th}$ segment, $4^{th}$ and following to $10^{th}$ segments subquadrangular, last segment abruptly constricted at apical third.

**Thorax:** Pronotum evidently longer than wide, two depressions near the basal margin, convex elevation in middle, lateral margin entire, dark reddish brown, anterior margin narrow, posterior angles feebly divergent, rounded, carinate, carina running subparallel to lateral margins, slightly umbilicate on disk, long recumbent pubescence on sublaterally; prescutellar tubercle moderate with smooth surface; scutellum pentagonal, depressed, with long recumbent pubescence; elytra 2.5 times longer than pronotum, blackish brown undented at base, striae indistinct with all surface short, recumbent pubescence, prosternal suture deeply furrowed as long as prosternum.

**Male Genitalia:** Aedeagus with median lobe longer than parameres, bulbous at base, gradually narrows posteriorly with a rounded tip; parameres evidently shorter than median lobe, broad, inner margin sinuate posteriorly, posterior end

of each parameres with subapical process; two median struts slightly extending beyond the base of parameres.

**Material Examined:** Single specimen without data, (NHMUK).

**Comparative Remarks:** This species closely related to *Lanelater bipunctatus* in having by pronotum longer than wide, antennae reaching the apices of hind angles of pronotum and 3$^{rd}$ antennal segment shorter than 4$^{th}$ segment but can be easily separated by elytral striae indistinct of all surface in *L. scutopentagonus* but elytral striae shallowly punctured on all surface in *L. punctatus*, two depressions near the basal margin of pronotum in *L. scutopentagonus* but pronotum without depressions in *L. punctatus*.

**Distribution:** India. The occurrence of this species in Pakistan is unconfirmed.

## Genus *Meristhus* (*Sulcimerus)* Candèze, 1857

Subgenus *Meristhus* Candèze, 1857:162. Type species: *Elater lepidotus* Palisot de Beauvois, 1805 by original designation.
*Rhaciaspis* Arnett, 1952:121. Type species: *Elater lepidotus* Palisot de Beauvois, 1805 by original designation.
Subgenus *Sulcimerus* Fleutiaux, 1947: 255. Type species: *Meristhus quadripunctatus* Candèze, 1857 by subsequent designation (Arnett, 1955: 617).
Subgenus *Sulcimerus* Arnett, 1955: 617. Type species: *Meristhus quadripunctatus* Candèze, 1857 by original designation; Cate, 2007:102.

**Type Species:**

*Meristhus scobinula* Candèze, 1857

**Diagnostic Characters:**

Body clothed with scales; head capsule developed, usually entire, frontal carina absent, frons indistinct or rarely concave; margin of mesocoxal cavity not composed by mesepisternum and mesepimeron, propleurae without (*Meristhus* s.str) or with (Subgenus *Sulcimerus*) depression for the reception of the anterior tarsi; antennal segment with 2$^{nd}$ and 3$^{rd}$ cylindrical, not triangular, antennal groove extending beyond the anterior half of the prosternopleural suture and deep enough to accommodate the rolled antennae; prothorax with lateral margin carinate, scutellum with distinct median longitudinal carina, tibial spurs absent, tarsi simple without ventral lobe (Von Hayek, 1973; Gur'jeva, 1974; Stibick, 1979).

**Key to the Species of the Genus *Meristhus (Sulcimerus*) from Pakistan:**

1. Pronotum longer than broad, Antennae reaches beyond the middle of pronotum……..……..……**2**

- Pronotum broader than long, Antennae exceeding half of the pronotum……...……..……...***M. (S.) pakistanicus*** **Akhter et. al.**

2. Scutellum lobulate, antennal segment 2nd equal to segment 3rd……..…….....……..……***M. (S.) quadripunctatus*** **Candèze**

- Scutellum rectangular, antennal segment 2nd longer than 3rd segment…….……..……..……...***M. (S.) afghanus*** **Platia and Gudenzi**

Table 3: Measurements of the species of *Meristhus (Sulcimerus)* from Pakistan.

| Taxon Name | Length | Width |
|---|---|---|
| *M. (S.) afghanus* Platia and Gudenzi | 4 | 1.37 |
| *M. (S.) pakistanicus* Akhter et. al. | 4.62*<br>3.42 | 1.74*<br>1.14 |
| *M. (S.) quadripunctatus* Candèze | 5.1-5.56 | 1.74-1.8 |

*holotype species

## *Meristhus (Sulcimerus) afghanus* Platia and Gudenzi, 2002
## (Fig: 17a-c)

*Meristhus (Sulcimerus) afghanus* Platia and Gudenzi, 2002:78; Cate, 2007:103.

**Type Locality:** Afghanistan.

**Coloration:** Ferruginous brown, legs and antennae dull brown, covered with light grey vestiture.

**Head:** Head medium, rectangular shaped; frons with head covered by dense, large vestiture; eyes invisible; antennae extended just beyond the middle of pronotum, basal segment robust, 2nd segment longer than 3rd segment, 3rd segment smaller than others, rest segments serrate, last segment rounded with distinct apical tip.

**Thorax:** Pronotum longer than broad, sides crenulate, base without carina, rounded at middle, then interrupt before base**,** hind angles strongly truncated, coarse punctation with dense vestiture, anterior margin evidently emerginated, with shallowly at sides, medially, form a narrow plate like emergination upon head; prosternum with coarse punctation; scutellum rectangular, longitudinal median carina; elytra with base as broad as base of pronotum, widest at middle, narrowing at behind, apices rounded, striae prominent by suberrect fulvous vestiture with linear form, interstriae with fine punctation.

**Male Genitalia:** Aedeagus with median lobe very shorter than parameres, narrow spindle like; parameres with apical margin oblique with spinose behind, sides laterally flattened, almost straight; two median struts hang in the base of parameres; basal plate quadrangular, sides rounded, base straight.

**Material Examined:** Pakistan; Sindh; Nosheroferoz; 1 ♂, 1 ♀; 03.ix.2006, Akhter on light; Punjab; Kalar Kahar; 2 ♂; 15.vii.2007, Akhter on light (ACP).

**Comparative Remarks:** It is very close to *Meristhus (Sulcimerus*) *quadripunctatus* but can be separated by some distinguished characters, In *M.* (*S.*) *afghanus* body colour castaneous, antennal length just half of prothorax, pronotum with sides not sinuate, hind angles with distinct corners while in *M.* (*S.*) *quadripunctatus* body colour chocolate, antennal length 1/3$^{rd}$ of prothorax, pronotum with sides angulate, hind angles with blunt ends and also taxonomic characters noted in the description.

**Distribution:** Afghanistan and Pakistan.

## *Meristhus (Sulcimerus) pakistanicus* Akhter et. al., 2012
## (Fig: 18a-c)

*Meristhus (Sulcimerus) pakistanicus* Akhter et. al., 2012:69.

**Type Locality:** Pakistan; Punjab Province, Kalar Kahar.

**Colouration:** Entire ferruginous brown, covered with hard, yellow vestiture.

**Head:** Head small, globose, coarsely punctate, covered with dense hard vestiture; antennae exceeding just half of pronotum, basal segment long, robust, 2nd segment thicker but longer than 3rd, 5th and 10th segments broad apically, last segment penultimate with distinct tip.

**Thorax:** Pronotum broader than longer, base without carina, sides crenulate, rounded, hind angles broadly truncated, disc with deep and fine puncture, around sides feebly punctures with hard, suberrect vestiture; propleurae with depression for accommodating the anterior tarsi, base of prosternal spine with deep concavity; scutellum lobulate to subrectangular, medially keeled with dense hard vestiture; elytra widest at middle, gradually narrower behind, strial margin with grooved, interstriae with rows of hard, erect vestiture, apices rounded to truncated.

**Male Genitalia:** Aedeagus with median lobe slightly emerged between the parameres, narrower long spindle like, apically narrower long tip; parameres with apical margin rounded with laterally distinct spinose, medially narrower, sinuate, dilated posteriorly; two median struts close to each other, hanging in the cavity of basal plate, basal plate broad, sides rounded, base subrrounded, feebly sclerotised laterally.

**Material Examined:** Pakistan; Punjab Province, Kalar Kahar; **Holotype:** 1 ♂; 02.ix.2007, leg. Z. Ahmed, on light (NHMUK). **Paratype:** 1 ♂ - same data as Holotype (ACP).

**Comparative Remarks:** This species is closely related to *Meristhus (Sulcimerus*) *quadripunctatus* but can be easily separated by having antennae with 2nd antennal segment longer than 3rd segment in *M.* (*S.*) *pakistanicus* but 2nd antennal segment equal to 3rd segment in *M.* (*Sulcimerus*) *quadripunctatus*, pronotum broader than long in *M.* (*S.*) *pakistanicus* but pronotum longer than broad in *M.* (*S.*) *quadripunctatus* and aedeagus with median lobe slightly emerged between parameres *M.* (*S.*) *pakistanicus* but aedeagus with median lobe very much shorter than parameres in *M.* (*S.*) *quadripunctatus* and also taxonomic characters noted in the description.

**Distribution:** Pakistan; Punjab province; Kalar Kahar.

## *Meristhus (Sulcimerus) quadripunctatus* Candèze, 1857
## (Fig: 19a-c)

*Meristhus quadripunctatus* Candèze, 1857:163.
*Meristhus* (*Sulcimerus*) *quadripunctatus* Fleutiaux, 1924:42; Von Hayek, 1973:234; Cate, 2007:103.

**Type Locality:** India.

**Colouration:** Blackish brown, legs and antennae dark brown, covered with stiff vestiture.

**Head:** Head very small, globose with dilated laterally, coarse and close punctation, covered by dense stiff vestiture; antennae exceeding 1/3$^{rd}$ of pronotum, basal segment long, cylindrical, 2$^{nd}$ and 3$^{rd}$ segments cylindrical, equal, small, remain segments serrate, broad, last segment penultimate, distinct apical tip.

**Thorax:** Pronotum longer than broad, crenulate laterally, apico-medially emerge in plate form, hind angles angulated, before base broadly truncated with a tooth, a distinct small carina, granulate, dense punctures on convex disc, contiguous, covered with stiff vestiture; scutellum lobulate, longitudinal median carina, covered with dense long vestiture; elytra widest at middle, gradually narrower behind, apices crenulate, strial margins consist with raised granulated rows, covered with stiff vestiture, interstriae impunctate.

**Male Genitalia:** Aedeagus with median lobe very much shorter than parameres, base to apex narrower, apically with long beak like tip; parameres long, broad, apically broad apex, truncated, hind margin spinose, sides parallel; two median

struts reached near the base of parameres; basal plate with sides sclerotised, oval shaped, base rounded.

**Material Examined:** Pakistan; Punjab Province, Mianwali, 17 ♂; 22.vii.2007, leg. Z. Ahmed, on light; Kalar Kahar, 3 ♂, 2 ♀; 22.ix.2007, leg. M. A. Akhter, on light (ACP).

**Comparative Remarks:** This species is closely related to *Meristhus* (*Sulcimerus*) *afghanus* in having antennae reaches beyond the middle of pronotum and pronotum longer than broad but can be easily separated by having lobulate scutellum in *M.* (*S.*) *quadripunctatus* but rectangular scutellum in *M.* (*S.*) *afghanus*, elytral apices crenulated in *M.* (*S.*) *quadripunctatus* but elytral apices rounded in *M.* (*S.*) *afghanus* and also and also taxonomic characters noted in the description.

**Distribution:** Oriental, China, India and Pakistan.

**TRIBE 2: CONODERINI FLEUTIAUX, 1919**

Conoderinae Fleutiaux, 1919:6 and 58; 1922:407 and 434; Schenkling, 1925:103; Kishii, 1985:62.

Monocrepidiites Candèze, 1859:176; 1891:67.

Monocrepidiini Champion, 1895:341; Schwarz, 1906:4 and 88.

Conoderini Cate, 2007:103.

**Diagnostic Characters:**

Body clothed by setae or scales; frons more or less inflexed or flat, curved downwards, frontal carina across the front between eyes, more or less straight and well separate from labrum; mouth parts inferior; antennae and tarsi not received in deep grooves; prosternal sutures closed, prosternal lobe normally arcuate; meso and metasternum with distinct suture; scutellum shield shaped, never cordate; tarsi simple, decreasing regularly in length, rarely with 4$^{th}$segment broadened or lobed beneath; claws simple, setae present at base (Von Hayek, 1973; Gur'jeva, 1974; Stibick, 1979; Calder, 1996, Cate, 2007).

**Key to the Genera of Tribe Conoderini of Pakistan:**

1. Elytra usually strongly punctuate, 2-4 antennal segments almost of equal size, tarsi simple and hairy beneath…….***Drasterius*** **Eschscholtz**

- Elytra normally punctate, elytral striae punctuate strongly, 2-4 antennal segments variable in size, tarsi expanded or lobed or lamellate……**2**

2. Two basal rounded impressions inward the base of pronotum, 4$^{th}$ antennal segment weakly serrate……..…….***Aeoloides*** **Schwarz**

- Base of pronotum without impressions, antennae feebly serrate from 4$^{th}$ segments to onward……...…….……..**3**

3. Prothorax covered with double punctures, 4th segment of tarsi lamellate, antennae generally reached only the base of pronotum…..***Heteroderes*** **Latreille**

- Prothorax covered with simple or dissimilar punctures, 4th segment of tarsi broadened and more or less cordiform, non lamellate, antennae variable in length……...…….…….……***Aeoloderma*** **Fleutiaux**

Table 4: Measurements of the species of Tribe Conoderini found in Pakista.

| Taxon Name | Length | Width |
|---|---|---|
| *Aeoloderma brachmana* (Candèze) | 4.7-5 | 1-1.25 |
| *Aeoloderma crucifer* (Rossi) | 4-4.2 | 1-1.15 |
| *Aeoloides figuratus* (Germar) | 5.5-6 | 1.5-1.8 |
| *Aeoloides grisescens* (Germar) | 6.5-7 | 1.6-1.8 |
| *Drasterius collaris* Candèze | 3.7-4.3 | 1.2-1.4 |
| *Drasterius csorbai* Platia and Gudenzi | 3.5-4.5 | 1.2-1.4 |
| *Drasterius sulcatulus* Candèze | 3.7-5.3 | 1.2-1.7 |
| *Heteroderes gallagheri* Platia and Schimmel | 5-6 | 1-1.25 |
| *Heteroderes heydeni* (Reitter) | 6.5-7 | 1.5-1.75 |
| *Heteroderes lenis* Candèze | 11-13 | 3-3.5 |
| *Herteroderes spinosus* Candèze | 6-6.4 | 1.5-1.8 |
| *Heteroderes subtilis* Jagemann | 6-6.2 | 1.25-1.35 |

## Genus *Aeoloderma* Fleutiaux, 1928

*Aeoloderma* Fleutiaux, 1928:135; Miwa, 1934:18; Arnett, 1955:602; Ohira, 1962:35; 1973:320; Dolin, 1978:14; Kishii, 1987:65; Dolin and Atamuradov, 1994:40; Calder, 1996:49; Chakraborty and Chakrabarti, 2006:113; Cate, 2007:103; Mertlik and Platia, 2008:4.
*Aeolus* Eschscholtz, 1829:33; Schwarz, 1906a:101; Hyslop, 1921:624.

**Type Species:**

*Elater crucifer* Rossi, 1790:183.

**Diagnostic Characters:**

Body clothed by setae or scales; head flattened anteriorly, frons convex, rarely flat, rounded anteriorly, rarely truncated, base usually with fine longitudinally raised carina, frontal carina complete across front of frons; antennae subserrate from segment 4th, first segment sometimes rather long and somewhat curved, 2$^{nd}$ and 3$^{rd}$ subequal, combined length of 2$^{nd}$ and 3$^{rd}$ segments of antennae not shorter than 4$^{th}$ segment, exceeding apex of hind angles of pronotum, flat, surfaces without longitudinal carina; prothorax generally longer than broad, disc covered with puncture of two discrete diameters, without median longitudinal depression, anterior angles not strongly produced, hind angles with single or double carina; prosternal suture straight and continuous; meso and metasternum separated at midline by distinct external suture; tarsi simple, 4$^{th}$ segment expanded (Von Hayek, 1973; Gur'jeva, 1974; Stibick, 1979; Calder, 1996).

## *Aeoloderma brachmana* (Candèze, 1859)

**(Fig: 20a-c)**

*Aeolus brachmana* Candèze, 1859:283,345; Fleutiaux, 1918:216.
*Aeoloderma brachmana* Fleutiaux, 1929:34; Ohira, 1970:211; 1973:320; Kishii, 1987:67; Chakraborty and Chakrabarti, 2006:114; Cate, 2007:103.

**Type Locality:** Hindostan; Morad-Abad.

**Colouration:** Castaneous brown with black markings, antennae dark brown, legs castaneous brown, covered with yellow, fulvous vestiture.

**Head:** Head small, slightly emerge at base, anteriorly depressed, median groove absent, dense but fine punctures; clypeus with anterior margin subrounded; antennae exceeding by two articles of base of pronotum, basal segment robust, distinct lateral margin ventrally with long hairs, 2$^{nd}$ and 3$^{rd}$ segment equal but 3$^{rd}$segment narrower than previous, 4$^{th}$ to 10$^{th}$ segment subequal with reference to their apical width, last segment, long, cylindrical, not penultimate.

**Thorax:** Pronotum longer than broader, with two black rounded spots laterally, sides entire, hind angles truncate, medially complete broad black marking, fine punctures; Scutellum shield shaped, depressed, covered with dense vestiture; elytra sinuate at middle, than widest and narrower towards apices, long median black marking up to length, apices rounded, medially half with black broad marking posteriorly, lateral margin also with black marking, strial margin with grooved, interstriae feebly punctures, covered with dense vestiture; 4$^{th}$ tarsi broad flap but longer than 3$^{rd}$.

**Male Genitalia:** Aedeagus with median lobe stout, gradually narrowing apically, shorter than parameres; parameres narrow, thin, apically transverse with hairs; two median struts just passes in the cavity; basal plate broadly rounded with chitinized margins.

**Material Examined:** Pakistan; Sindh Province, Nosheroferoz, 13 ♂, 1 ♀; 30.ix.2006, leg. Z. Ahmed, on light; Rajan Pur; 11 ♂; 07.vii.2007, leg. Z. Ahmed, on light, (ACP).

**Comparitive Remarks:** This species is closely related to *Aeoloderma crucifer* in having head small, depressed anteriorly, 4$^{th}$ to 10$^{th}$ antennal segments subequal with reference to their apical width and hind angles of pronotum truncated but can be easily separated by having head with dense and fine punctures in *A. brachmana* but head with deep and rare punctures in *A. crucifer*, last antennal segment cylindrical in *A. brachmana* but last antennal segment penultimate in *A. crucifer* and parameres equal to aedeagus in *A. brachmana* but parameres longer than aedeagus in *A. crucifer*.

**Distribution:** Oriental, China, Japan, North India and Pakistan.

***Aeoloderma crucifer* (Rossi, 1790)**

**(Fig: 21a-c)**

*Elater crucifer* Rossi, 1790:183.

*Heteroderes crucifer* Candèze, 1959:355.

*Aeolus crucifer* Bodemeyer, 1900:115.

*Aeoloderma crucifer* Guglielmi and Platia, 1985:172; Dolin and Atamuradov, 1994:40; Cate et. al., 2002:29; Cate, 2007:103; Mertlik and Platia, 2008:4; Cate 2007:103.

**Type Locality:** Europe.

**Colouration:** Castaneous brown with black markings, antennae dark brown, legs castaneous brown, covered with yellow, fulvous vestiture.

**Head:** Head small, slightly emerged at base, anteriorly depressed, medially groove from base to apex, deep but rare punctures; clypeus with anterior margin subrounded; antennae exceeding by two articles of base of pronotum, basal segment robust, distinct lateral margin ventrally with long hairs, 2$^{nd}$ and 3$^{rd}$ segment equal but 3$^{rd}$ segment narrower than previous, 4$^{th}$ to 10$^{th}$ segment subequal with reference to their apical width, last segment penultimate.

**Thorax:** Pronotum longer than broader, sides entire, hind angles truncate, medially complete broad black marking, fine punctures; Scutellum shield shaped, depressed, feebly punctured; elytra sinuate at middle, than widest and narrower at apices, apices rounded, medially half with black broad marking posteriorly, lateral margin also with black marking, strial margin with grooved, interstriae feebly punctures, covered with dense vestiture; 1$^{st}$ tarsi longer than others, 4$^{th}$ segment leaf like, smaller than others.

**Male Genitalia:** Aedeagus with median lobe broad from 1/3$^{rd}$, form narrow beak like projection apically, almost equal to parameres; parameres narrow, long, flattened, apically curved externally scarcely with round margins; two median struts lying in the cavity; basal plate ovate with rounded base.

**Material Examined:** Pakistan; Punjab Province, Rajan Pur, 7 ♂; 07.vii.2007, leg. Z. Ahmed, on light, (ACP). Morocco; 1 ♂; 21-22.v.1995, leg. Bglirsch (CMHK).

**Comparitive Remarks:** This species is closely related to *Aeoloderma brachmana* in having head small, depressed anteriorly, 4$^{th}$ to 10$^{th}$ antennal segments subequal with reference to their apical width and hind angles of pronotum truncated but can be easily separated by having head with deep and rare punctures in *A. crucifer* but head with dense and fine punctures in *A. brachmana*, last antennal segment penultimate in *A. crucifer* but last antennal segment cylindrical in A. brachmana and parameres longer than aedeagus in *A. crucifer* but parameres equal to aedeagus in *A. brachmana.*

**Distribution:** Cyprus, Iran, Kyrgyzatan, Kazakhstan, Pakistan, Syria, Turkmenistan, Turkey, North Africa and Europe.

## Genus *Aeoloides* Schwarz, 1906

*Aeoloides* Schwarz, 1906:97; Cate, 2007:103.

**Type Species:**

*Elater crucifer* Rossi, 1790:183.

**Diagnostic Characters:**

Body clothed by setae or scales; head flattened anteriorly, frons convex rounded, rarely truncated, base usually with fine longitudinally raised carina, frontal carina complete across front of frons; antennae usually reach only the base of the prothorax, 4$^{th}$ segment weekly serrate, 2$^{nd}$ segment small, 3$^{rd}$ usually longer than 2$^{nd}$, but still shorter than 4$^{th}$ segment; pronotum different in length, disc covered with puncture of two discrete diameters, two basal rounded impressions inward the base, hind angles with single or double carina; prosternal suture straight and continuous; prosternum rounded, extended quit long and thin and more or less inclined or bent inwards; meso and metasternum separated at midline by distinct external suture; tarsi simple, 4$^{th}$ segment not expanded or lobed (Von Hayek, 1973; Gur'jeva, 1974; Stibick, 1979; Calder, 1996).

***Aeoloides figuratus* (Germar, 1844)**

**(Fig: 22a-c)**

*Cryptohypnus figuratus* Germar, 1844:151.
*Aeolus perscius* Motschulsky, 1860:518.
*Drasterius figuratus* Schenkling, 1925:135
*Aeoloides figuratus* Guglielm and Platia, 1985:171; Cate et. al., 2002:30 Platia, 2004:44; Cate, 2007:104; Mertlik and Platia, 2008:4;

**Type Locality:** Mesopotamia, Aegypto.

**Colouration:** Entire chocolate brown, legs dull brown, antennae bronze brown, covered with yellow, fulvous vestiture.

**Head:** Head with eyes small, globous, a median furrow from base to apex; clypeus with anterior margin truncated, close punctations; antennae extended base of pronotum, basal segment robust, 2$^{nd}$ segment thicker than 3$^{rd}$ segment, 3$^{rd}$ segment narrower, 4$^{th}$ segment longer than 3$^{rd}$, 8$^{th}$ to 10$^{th}$ segment broader than previous, last segment penultimate.

**Thorax:** Pronotum longer than broad, sides entire, parallel, hind angles acute, pointed with a long carina, two basal rounded impression inward the base of pronotum, fine and deep punctures, somewhere coarsely punctation; scutellum small, shield shaped, medially depressed; elytra as broad as base of pronotum, strial margin distinct by grooves, interstriae impunctate, sides parallel, gradually narrower at behind, apices rounded.

**Male Genitalia:** Aegeagus with median lobe broadened at base narrower apically, straight, slightly longer than parameres; parameres slightly broad,

acutely oblique with spines laterally, thin and narrower posteriorly; two median struts not enter in the cavity; basal plate with distinct sinuate at base, sides oblique.

**Material Examined:** Pakistan; Sindh Province, Nosheroferoz, 21♂; 30.ix.2006, leg. Z. Ahmed, on light; Rajan Pur, 1 ♂; 07.vii.2007, leg. Z. Ahmed, on light, (ACP); Kazackstan; 1 ♂; 14.vi.1991, leg. Odua'rka (CMHK).

**Comparitive Remarks:** This is species closely related to *Aeoloides grisescens* in having pronotum longer than broad, hind angles of pronotum acute and aedeagus longer than parameres, but can be easily separated by having head globous in *A. figuratus* but head quadrate in *A. grisescens*, last antennal segment penultimate in *A. figuratus* but last antennal segment ellipsoidal in *A. grisescens* and scutellum medially depressed in *A. figuratus* but scutellum anteriorly and posteriorly depressed in *A. grisescens.*

**Distribution:** Azerbaijan, Armenia, Georgia, Russia, Afghanistan, Iran Iraq, Kyrgyzstan, Kuwait, Pakistan, Qatar, Saudi Arabia, Syria, Tajikistan, Turkmenistan, Turkey and Uzbekistan.

## *Aeoloides grisescens* (Germar, 1844)

**(Fig: 23a-c)**

*Cryptohypnus grisescens* Germar, 1844:151.
*Heterodores grisescens* Candèze, 1859:377; Schwarz, 1906:109.
*Aeolus bicarinatus* Reitter, 1891:148.
*Aeoloides grisescens* Schenkling, 1925:138; Gurjeva, 1995:613; Guglielm and Platia, 1985:172; Cate et. al., 2002:30; Platia, 2004:44; Cate, 2007:104; Mertlik and Platia, 2008:4.

**Type Locality:** Mesopotamia, Aegypto.

**Colouration:** Entire piceous brown, legs and antennae dark brown, covered with yellow, shiny dense vestiture.

**Head:** Head quadrate, rather declivity anteriorly, basally emerged slightly, a median longitudinal line prominent from base to apex; clypeus with anterior margin subrounded with rather truncated sides, deep and fine punctures, covered with much dense vestiture anterior to half of head; antennae extended just hind margin of pronotum, basal segment long, robust, 2$^{nd}$ segment cylindrical but smaller than others, 4$^{th}$ segment evidently longer than 3$^{rd}$ and 5$^{th}$ to 10$^{th}$ segments, last segment ellipsoidal, medially dilated.

**Thorax:** Pronotum longer than broader, sides subparallel, hind angles acute, pointed with fine carina runs before middle of pronotum, two broadly rounded basal impressions, pronotum with anterior margin slightly raised at middle, fine punctation, not close punctures, covered with dense golden vestiture; scutellum shield shaped, anterior and posteriorly depressed, scarcely punctures; elytra with base slightly narrower than base of pronotum, widest apically than gradually

narrower behind, apices weakly spinose, strial margin distinct, interstriae with fine punctures, covered with much dense golden vestitures.

**Male Genitalia:** Aedeagus with median lobe, stout, slightly narrowing from base to apex, longer than parameres; parameres narrow band like, elongated, apically curved scarcely; two median struts lying in the cavity; basal plate scarcely broad, base sinuate scarcely.

**Material Examined:** Pakistan; Sindh Province, Nosheroferoz, 4 ♂; 03.ix.2006, leg. M. A. Akhter, on light; Umercot, 12 ♂; 11.v.1007, leg. Z. Ahmed, on light; Mirpurkhas, 11 ♂, 4 ♀; 10.v.2007, leg. Z. Ahmed, on light; 21 ♂; 05.vi.2007, leg. M. A. Akhter, on light, (ACP).

**Comparitive Remarks:** This is species closely related to *Aeoloides grisescens* in having pronotum longer than broad, hind angles of pronotum acute and aedeagus longer than parameres, but can be easily separated by having head quadrate in *A. grisescens* but head globous in *A. figuratus*, last antennal segment ellipsoidal in *A. grisescens* but last antennal segment penultimate in *A. figuratus* and scutellum anteriorly and posteriorly depressed in *A. grisescens* but scutellum medially depressed in *A. figuratus*.

**Distribution:** Cyprus, Iran, Kyrgyzstan, Kazakhstan, Pakistan, Syria, Turkmenistan, Turkey, Europe and Afrotropical region.

## Genus *Drasterius* Eschscholtz, 1829

*Drasterius* Eschscholtz, 1829:33; Candèze, 1891:86; Schwarz, 1906:111; Hyslop, 1921:642; Schenkling, 1925:133; Gurjeva, 1995: 614; Chakraborty and Chakrabarti, 2006:177; Kesdek et. al., 2006:355; Cate, 2007:105; Mertlik and Platia, 2008:4.

*Cryptohypnus* Germar, 1829:190.

*Monocrepidius* Le Conte, 1853:484.

**Type Species:**

*Elater bimaculatus* Rossi, 1790.

**Diagnostic Characters:**

Body clothed with setae or scales, vestiture semi decumbent, moderately dense; head more or less convex, fontal carina complete across front of frons; antennae exceeding apex of hind angles of pronotum, serrate from segment 4$^{th}$, 1$^{st}$ segment moderately large, 2$^{nd}$ and 3$^{rd}$ more or less similar and both of them together always longer than 4$^{th}$; prothorax longer than wide, without median longitudinal depression, flattened posteriorly, anterior angles not strongly produced, hind angles unicarinate, stout and short, not divergent; prosternal suture straight and almost always open in front; elytra usually strongly punctate, apex bluntly rounded; tarsi simple and hairy beneath (Von Hayek, 1973; Gur'jeva, 1974; Stibick, 1979; Calder, 1996).

**Key to the Species of Genus *Drasterius* of Pakistan:**

1. Apex of posterior angles of pronotum more sharp and more or less divergent……..**2**

- Apex of posterior angles of pronotum less sharp, not divergent……***D. sulcatulus* Candèze**

2. Antennae exerted before base of pronotum, 2nd antennomere longer and broader than 3rd segment……..……..……***D. collaris*** **Candèze**

- Antennae extended just base of pronotum, 2nd antennomere smaller than 3rd segment……***D. csorbai*** **Platia and Gudenzi**

***Drasterius collaris* Candèze, 1859**

**(Fig: 24a-c)**

*Drasterius collaris* Candèze, 1859:427; 1891:86; Fleutiaux, 1905:323; Schwarz, 1906:111; Schenkling, 1925:135; Platia and Gudenzi, 1997:407; Chakraborty and Chakrabarti, 2006:179; Cate, 2007:105.

**Type Locality:** Indes Orientales, Morad-Abad.

**Colouration:** Head black, thorax and elytra ferruginous brown with black margins, legs and antennae castaneous, covered with dense vestiture.

**Head:** Small, raised up to clypeus, less punctures with dense vestiture, clypeus exerted in sclerotized plate form anteriorly, lateral margin distinct with right angles; antennae exerted before base of pronotum, basal segment robust, 2$^{nd}$ segment longer and broader then 3$^{rd}$, 3$^{rd}$ segment longer than 4$^{th}$ segment, 4$^{th}$ to 10$^{th}$ subequal, last segment ellipsoidal with distinct tip.

**Thorax:** As long as broad, sides entire, hind angles rounded, posterior angles sharp and divergent, median broad black marking, deep and dense punctures, covered with dense vestiture laterally; Scutellum pentagonal, longer as wide, depressed; elytra with sides parallel, narrower at behind, apices rounded, strial margin distinct with grooved lines, interstriae feebly punctate, covered with dense vestiture; tarsi with 4$^{th}$ segment smallest, with short lateral flap.

**Male Genitalia:** Aedeagus with median lobe longer than parameres, smoothly broad from base to apex, apically narrow with conical tip; parameres with apical margin obsolete, narrow up to 1/3$^{rd}$ than dilated posteriorly, two median struts,

rod like, inside the base of parameres, basal plate without sclerotized, lateral margins rounded, with hind acute angles, base slightly concave, sclerotized.

**Material Examined:** Pakistan; Punjab Province, Alipur, 17 ♂, 1 ♀; 22-26.vii.2006, leg. Z. Ahmed, Kalar Khar, 10 ♂, 1 ♀; 2.ix.2007, leg. Z. Ahmed, on light (ACP).

**Comparative Remarks:** This species is closely related to *Drasterius confusus* by having pronotum normally bicoloured yellow or red-orange with dark spot more or less expanded, disk gradually sloping at base, scutellum longer than wide but can be easily separated in having size on average smaller (Length 3.7-4.3) in *D. collaris* but size on average larger (Length 4-5.4) in *D. confusus*, apex of posterior angles of pronotum sharp and divergent in *D. collaris* but apex of posterior angles of pronotum not divergent in *D. confusus*.

**Distribution:** Pakistan, India and Nepal.

## *Drasterius csorbai* Platia and Gudenzi, 1997
## (Fig: 25a-c)

*Drasterius csorbai* Platia and Gudenzi, 1997:408; Cate, 2007:106.

**Type Locality:** Pakistan; Federal Capital Islamabad.

**Colouration:** Entire blackish brown, legs and antennae castaneous, covered with dense vestiture.

**Head:** Small, globose anteriorly, depressed, coarse and deep punctation, clypeus with anterior margin truncated to rounded, angulated laterally, antennae extended just base of hind margin of pronotum, basal segment robust, 2nd segment small, broad, 3rd segment equal to 2nd but cylindrical, remains subequal, setaceous, last segment ellipsoidal, not penultimate.

**Thorax:** Pronotum longer than broad, sides entire, hind angles acute, dense, deep but fine punctures, covered with dense vestiture laterally, hind angles rounded, posterior angles slightly divergent; scutellum lobulate, depressed with dense fine punctation; elytra with sides parallel, gradually narrower behind, strial margin indistinct, interstriae with fine punctation, covered with dense vestiture, apices rounded; tarsi with 4th segment smaller than others.

**Male Genitalia:** Aedeagus with median lobe slightly shorter than parameres, almost equal width from base to apex, apically slightly narrow than form tip rapidly; parameres with apical margin distinct narrower up to base, two median struts outside from base of parameres, basal plate crescent like, without sclerotized.

**Material Examined:** Pakistan; Punjab Province, Alipur, 15♂; 22.vii.2006, leg. Z. Ahmed, Kalar Kahar, 22♂, 2 ♀; 22.vii.2007, leg. M. A. Akhter, on light; Fatehpur, 18♂, 2♀; 16.viii.2007, leg. Z. Ahmed, on light; Federal Capital Islamabad, 11♂; 12.iv.2007, leg. Rais (ACP).

**Comparative Remarks:** This species is closely related to *D. brahminus* in having intervals of pronotal punctures shiny, scutellum as long as wide, oblique but can be easily separated having apex of posterior angles of pronotum slightly divergent in *D. csorbi* but apex of posterior angles of pronotum strongly divergent in *D. brahminus* and aedeagus with median lobe slightly shorter than parameres in *D. csorbi* but aedeagus with median lobe slightly longer than parameres in *D. brahminus*.

**Distribution:** Pakistan.

***Drasterius sulcatulus* Candèze, 1859**

**(Fig: 26a-c)**

*Drasterius sulcatulus* Candèze, 1859:427; 1891:86; Schwarz, 1906:111; Fleutiaux, 1914:442; Schenkling, 1925:136; Platia and Gudenzi, 1997:411; Chakraborty and Chakrabarti, 2006:179; Cate, 2007:106.

**Type Locality:** Indes Orientales.

**Colouration:** Entire ferruginous blackish, legs and antennae castaneous, covered with less vestiture.

**Head:** Small, quadrangular, depressed with deep and fine punctation, clypeus with anterior margin truncated, finely sulcate laterally with deep punctures, covered with suberrect, long vestiture; antennae extended 1/3$^{rd}$ of Pronotum, basal segment robust, 2$^{nd}$ and 3$^{rd}$ segments equal, smaller, 4$^{th}$ segment longer than previous.

**Thorax:** Pronotum broader than longer, sides entire, hind angles acuminate, surface with deep and fine punctures, intervals of punctures shiny, covered with less vestiture laterally, posterior angles less sharp and not divergent; scutellum almost subrounded, depressed, longer than wide, oblique, punctures with long vestiture laterally; elytra with sides parallel, narrower posteriorly, apices rounded, strial margin distinct, interstrial with fine punctures without vestiture, long vestiture laterally only; tarsi with 4$^{th}$ segment smaller than previous, with short lateral flap.

**Male Genitalia:** Aedeagus with median lobe longer than parameres, smoothly broad from base to apex, apically narrow with conical tip; parameres with apical

margin distinct with round apex, narrow up to 1/3rd than dilated posteriorly, two median struts, rod like, inside the base of parameres, basal plate broad, lateral margins subrounded, with hind acute angles, base slightly concave, sclerotized.

**Material Examined:** Pakistan; Sindh Province, Karachi, 5 ♂; 22.vii.2005, leg. M. A. Akhter, on light; 7 ♂; 14.vi.2006, leg. Z. Ahmed, on light (ACP).

**Comparative Remarks:** This species is closely related to *D. brahminus* having general body shape, intervals of pronotal punctures shiny, scutellum as long as wide, oblique but can be easily separated by having apex of posterior angles of pronotum less sharp, not divergent in *D. sulcatulus* and two median struts just enter in the cavity of basal plate of male genitalia in *D. brahminus* but two median struts in male genitalia enter the cavity of basal plate in *D. sulcatulus*.

**Distribution:** Pakistan, India, Himalaya, Nepal and Bangladesh.

## Genus *Heteroderes* Latreille, 1834

*Heteroderus* Latreille, 1834: 155, Candèze, 1859: 350; Schwarz, 1906b: 105; Fleutiaux, 1919: 62; Fleutiaux, 1927a: 90; Fleutiaux, 1927b: 126; Hyslop, 1921: 649; Kihsii, 1987:63; Calder, 1996:92; Chakraborty and Chakrabarti, 2006:119; Cate, 2007:106.

*Monocrepidius* Candèze, 1858:231; Dejean, 1837:98.

*Cryptohypnus* Germar, 1858:148.

*Drasterius* Dejean, 1837:105.

*Aeolus* Candèze, 1859:283; Dejean, 1837:103.

**Type Species:**

*Heteroderus fuscus* Latreille, 1834.

**Diagnostic Characters:**

Body clothed only with setae or both scale-like setae, not form any patches, vestiture semi decumbent, moderately dense; head more or less convex, frontal carina complete across front of frons; antennae generally reach only to the base of prothorax, feebly serrate from fourth segment, 2$^{nd}$ segment small, 3$^{rd}$ usually longer than 2$^{nd}$, however always shorter than 4$^{th}$; prothorax wider than long to longer than wide, covered with two different types of punctures with two different types of pubescence, short and long, anterior angles usually not strongly produced or if produced to cover more than half of eyes, hind angles bicarinate, stout or short, moderately elongate, prosternal suture straight; elytra usually strongly punctate-striate, apex bluntly rounded and weakly spinose along suture; tarsi with segment 4$^{th}$ lamellate, segment 1-4 decreasing in length distally, segment 1$^{st}$ longer than 5$^{th}$, as long as 2-4 combined, claws simple, with one stout basal seta (Von Hayek, 1973; Gur'jeva, 1974; Stibick, 1979; Cate, 2007).

**Key to the Species of the Genus *Heterodères* of Pakistan:**

1. Pronotum without any spine…….……**2**

- Pronotum with a distinct V shape spine at base of pronotum medially…… ……...……..…….***H. spinosus*** **Candèze**

2. Pronotum with hind angles truncated…….....……..**3**

- Pronotum with hind angles pointed...……..…….…..……...**4**

3.Aedeagus with median lobe longer than parameres…….…***H. subtilis*** **Jagemann**

- Aedeagus with median lobe shorter than parameres.....……***H. lenis*** **Candèze**

4.Scutellum rounded, elytra with apices spinose…… ……..…….***H. gallagheri*** **Platia and Schimmel**

- Scutellum pentagonal, elytra with apices rounded……***H. heydeni*** **(Reitter)**

## *Heteroderes gallagheri* Platia and Schimmel, 1997
## (Fig: 27a-c)

*Heteroderes gallagheri* Platia and Schimmel, 1997:301; Cate et. al., 2002:32; Cate, 2007:106.

**Type Locality:** Oman.

**Colouration:** Ferruginous brown, legs and antennae brown, covered with dense vestiture.

**Head:** Head depressed anteriorly, clypeus with anterior margin transversely rounded with oblique sides, deep and fine punctation with dense vestiture; antennae extended 1/3$^{rd}$ of pronotum, basal segment robust, 2$^{nd}$ segment cylindrical but smaller than rest segments, 4$^{th}$ segment longer than previous segment, last segment long, cylindrical not penultimate apically.

**Thorax:** Pronotum slightly longer than broader, sides subparallel, entire, without spine at base, hind angles acute, pointed with a fine carina, on disc convex, deep and fine punctures with vestiture laterally; scutellum rounded, medially constricted, very fine punctures; elytra with base as broad as base of pronotum, sides parallel, gradually narrower posteriorly, strial margin distinct, interstriae impunctate, apices weakly spinose; tarsi with 1$^{st}$ segment longer than others, 4$^{th}$ segment more smaller than previous.

**Male Genitalia:** Aedeagus with median lobe slightly raised between parameres, long, broad, apically broad but slightly conical tip, parameres with apical margin obsolete, narrower up to base, two median struts up to base of parameres, basal plate not completed, scarcely lateral margin with truncate base.

**Material Examined:** Pakistan; Sindh Province, Karachi, 4 ♂; 27.vi.2005, leg. M. A. Akhter, on light; Nocot, 1 ♂; 10.ix.2006, leg. M. A. Akhter, on light; Nosheroferoz, 4 ♂; 03.ix.2006, leg. Z. Ahmed, on light; Kheybar Pakhton Khoa Province, Chilas, 7 ♂, 9 ♀; 01.xi.2007, leg. Z. Ahmed, on light (ACP); 5 ♂; without labelled (PZSM).

**Comparative Remarks:** This species is closely related to *Heteroderes heydeni* in having antennal segments 2nd and 3rd not equal, pronotum without spine and hind angles of pronotum acute but can be easily separated by having last antennal segment cylindrical in *H. gallagheri* but last antennal segment ellipsiodal in *H. heydeni*, elytral shoulders weakly spinose in *H. gallagheri* but elytral shoulders rounded in *H. heydeni* and aedeagus tip conical in H. *gallagheri* but aedeagus tip rounded in *H. heydeni.*

**Distribution:** The United Arab Emirates, Oman, Pakistan, Iran.

***Heteroderes heydeni* (Reitter, 1891)**

**(Fig: 28a-c)**

*Aeolus heydeni* Reitter, 1891.

*Heteroderes heydeni* Cate et. al., 2002:33; Cate, 2007:106.

**Type Locality:** Turkmenien, Turkestan.

**Colouration:** Head blackish, thorax and abdomen ferruginous brown, antennae and legs dull brown, covered with dense, yellow pubescence.

**Head:** Head globose anteriorly, posteriorly slightly convex then depressed anteriorly, clypeus uniformly rounded up to laterally, very fine punctation, covered with recumbent pubescence; antennae extended hind margin of pronotum, basal segment cylindrical, robust, 2$^{nd}$ segment cylindrical, smaller than 3$^{rd}$ segment, 5$^{th}$ to 10$^{th}$ segments subequal, apically broader, last segment ellipsoidal, apical tip scarcely long.

**Thorax:** Pronotum longer than broad, sides entire, hind angles acute, pointed with a distinct carina, without spine at base, deep and fine punctures, covered with dense, sparse vestiture; scutellum pentagonal, feebly punctures, covered anteriorly by vestiture; elytra with base as broad as base of pronotum, shoulders rounded, sides up to base uniformly parallel, narrower at posteriorly, apices rounded, striae impunctate, interstriae feebly punctured, covered with dense vestiture; tarsi with 1$^{st}$ segment longer than others, 4$^{th}$ segment cylindrical, very small.

**Male Genitalia:** Aedeagus with median lobe tubular, narrower from base to apex, apical tip obsolete, rounded, parameres with apical margin incomplete,

laterally with 7 distinct thick bristles, from apex to 1/3rd narrower, base dilated, two cord like median struts up to base of basal plate, basal plate reduced, lateral margin seem scarcely.

**Material Examined:** Iran; Baluchistan, Bampur, 2 ♂; 12-27.viii.1996, leg. Kafka on light (CMHK); Pakistan; Sindh Province, Mirpurkhas, 3♂; 05.xi.2006, leg. M. A. Akhter, on light; Nosheroferoz, 2 ♂; 13.ix.2006, leg. Z. Ahmed, on light (ACP).

**Comparative Remarks:** This species is closely related *Heteroderes gallagheri* in having antennal segments 2nd and 3rd not equal, pronotum without spine and hind angles of pronotum acute but can be easily separated by having last antennal segment ellipsiodal in *H. heydeni* but last antennal segment cylindrical in *H. gallagheri*, elytral shoulders rounded in *H. heydeni* but elytral shoulders weakly spinose in *H. gallagheri* and aedeagus tip rounded in *H. heydeni* but aedeagus tip conical in *H. gallagheri*.

**Distribution:** Afghanistan, India, Tajikistan, Turkmenistan, Pakistan and Uzbekistan.

## *Heteroderes lenis* Candèze, 1891

**(Fig: 29a-c)**

*Heteroderes lenis* Candèze, 1859:357; Candèze, 1891:83; Schwarz,1906:105; Chakraborty and Chakrabarti, 2006:121; Cate, 2007:106.

**Type Locality:** Ceylen; Negombo.

**Colouration:** Entire blackish brown, legs and antennae rusty brown, covered with less vestiture.

**Head:** Head convex, than depressed and dilated anteriorly, clypeus with anterior margin rounded, deep and fine punctation; antennae extended just base of pronotum, basal segment cylindrical, robust, 2$^{nd}$ segment smaller than 3$^{rd}$ segment, subcylindrical, 3$^{rd}$ segment slightly longer than 4$^{th}$ segment, 4$^{th}$ to 10$^{th}$ segment cylindrical, subequal.

**Thorax:** Pronotum longer than broad, sides entire, hind angles acuminate, truncate with a long distinct carina, without spine at base, disc with very fine punctation; scutellum lobate, depressed, feebly punctured; elytra with base as wide as base of pronotum, sides parallel, gradually narrower posteriorly, strial margin distinct, interstriae impunctate with less vestiture, apices rounded, well defined spines; tarsi with 1$^{st}$ segment longer than others, 4$^{th}$ segment with flap like lobe.

**Male Genitalia:** Aedeagus with median lobe shorter than parameres, basally dilated, gradually narrower but distinct width, apically broad, rounded tip, parameres with apical margin sharp, pointed, sides straight, basally hanged in

the cavity of basal plate, two median struts inside the base of parameres, basal plate not complete developed, scarcely lateral margin with rounded base.

**Material Examined:** Pakistan; Sindh Province, Tando Jam, 6 ♂, 2 ♀; 08.ix.1971, leg. Ehsan (NHMKU); Nosheroferoz, 2 ♂; 13.ix.2006, leg. Z. Ahmed, on light (ACP); 7 ♂; without data (PZSM).

**Comparative Remarks:** This species is closely related to *Heteroderes subtilis* in having clypeus with anterior margin rounded, hind angles of pronotum truncated, carinate and elytral shoulders with base as wide as base of pronotum but can be easily separated by having scutellum lobate shaped in *H. lenis* but scutellum pentagonal shaped in *H. subtilis*, pronotum longer than broad in *H. lenis* but pronotum broader than long in *H. subtilis* and aedeagus of male genitalia shorter than parameres in *H. lenis* but aedeagus of male genitalia longer than parameres in *H. subtilis*.

**Distribution:** Oriental, India and Pakistan.

***Heteroderes spinosus* Candèze, 1891**

**(Fig: 30a-c)**

*Heteroderes spinosus* Candèze,1891:161; 1891:83; Schwarz, 1905:105; Chakraborty and Chakrabarti, 2006:126; Cate, 2007:106.

**Type Locality:** Bengal.

**Colouration:** Entire ferruginous brown, covered with dense, yellow vestiture.

**Head:** Head small, longer than broad, globose, dilated, anteriorly, deep and close punctures, covered with dense, recumbent vestiture; antennae extended beyond the mid of pronotum, basal segment long, robust, punctured with long hairs, 2nd and 3rd segments equal, 4th segment longer than others, last segment ellipsoidal, hairy.

**Thorax:** Pronotum longer than broad, sides entire, hind angles acute, pointed with distinct lateral carina, a well defined spine on the mid of pronotum basally, deep and coarse punctures, covered with dense, recumbent vestiture; scutellum rounded, depressed, feebly punctured; elytra with base as wide as base of pronotum, sides parallel, gradually narrowing toward apex, apices rounded, strial margins distinct by deep groove, interstriae feebly punctures, covered with dense, recumbent vestiture; tarsi with 1st segment robust, 4th segment very small with flap ventrally.

**Male Genitalia:** Aedeagus with median lobe slightly longer than parameres, medially broad, up to apically slightly narrower, junction of medially to apical sinuate; parameres indistinct apically, four hard bristles on laterally, narrower

up to base; two median struts emerge in the cavity of basal plate; basal plate with lateral margin entire, rounded, base also rounded.

**Material Examined:** Pakistan; Punjab Province, Kalar Kahar, 31 ♂, 1 ♀; 02.ix.2007, leg. Akhter, M.A. (ACP).

**Comparative Remarks:** This species closely related to *Heteroderes amaculatus* in having general body outline and well defined spine on the middle of pronotum basally but can be easily separated by having head longer than broad in *H. spinosus* but head broader than long in *H. amaculatus*, pronotum longer than broad in *H. spinosus* but pronotum longer than broad in *H. amaculatus* and scutellum rounded shaped in *H. spinosus* but scutellum pentagonal shaped in *H. amaculatus.*

**Distribution:** Bengal, India and Pakistan.

***Herteroderes subtilis* Jagemann, 1945**

**(Fig: 31a-c)**

*Heteroderes subtilis* Jagemann, 1945:40.

**Type Locality:** India; Punjab Province, Rabhancot.

**Colouration:** Entire ferruginous blackish, legs and antennae dull brown, covered with dense, yellow vestiture.

**Head:** Head with frons globous, dilated anteriorly, clypeus with anterior margin rounded with emerginated at sides, dense but fine punctation with dense vestiture; antennae extended 1/3$^{rd}$ of pronotum, basal segment robust, 2$^{nd}$ segment cylindrical, small but broad, 3$^{rd}$ segment narrower than previous, remain segments subequal, last segment very long, narrower, apical tip prominent.

**Thorax:** Pronotum broader than long, sides entire, without spine at base, hind angles truncated with a fine carina, disc with fine punctures, covered with dense vestiture laterally; scutellum pentagonal shaped, medially constricted, covered with long vestiture; elytra with base as wide as base of pronotum, sides parallel, gradually narrower posteriorly, apices rounded, strial margin distinct, interstriae with fine punctation, vestiture limited; tarsi with 1$^{st}$ segment longer than others, 4$^{th}$ segment cylindrical, very small.

**Male Genitalia:** Aedeagus with median lobe longer than parameres, much narrower from middle to apically, parameres with apical margin indistinct, much narrower up to base, basally broad, two median struts slightly emerge in

the base of parameres, basal plate complete, broad, lateral margin slightly rounded, base slightly angulated.

**Material Examined:** Pakistan; Punjab Province, Mianwali, 22 ♂, 4 ♀; 20-22.vii.2006, leg. Z. Ahmed, on light; Kalar Kahar, 20 ♂, 4 ♀; 02.ix.2007, leg. Akhter, M.A.; 5 ♂, 1 ♀; 22.vii.2007, leg. M. Rais, on light; (ACP).

**Comparative Remarks:** This species is closely related to *Heteroderes lenis* in having clypeus with anterior margin rounded, hind angles of pronotum truncated, carinate and elytral shoulders with base as wide as base of pronotum but can be easily separated by having scutellum pentagonal shaped in *H. subtilis* but scutellum lobate shaped in *H. lenis*, pronotum broader than long in *H. subtilis* but pronotum longer than broad in *H. lenis* and aedeagus of male genitalia longer than parameres in *H. subtilis* but aedeagus of male genitalia shorter than parameres in *H. lenis.*

**Distribution:** India and Pakistan.

**TRIBE 3: HEMIRHIPINI CANDÈZE, 1857**

Herirphides Candèze, 1857:15 and 199.

Hemirrhipini Rietter, 1905:5 and 6; Mertlik and Platia, 2008:2.

Hemirhipini Stibick, 1979:163: Kishii, 1987:60; Cate, 2007:107; Casari, 2008:139 and 164; Mertlik and Platia, 2008:2; Nasserzadeh et. al., 2008:293;

**Diagnostic Characters:**

Frons more or less inflexed or flat, curved downwards, frontal carina absent to prominent; mouth parts inferior; antennae and tarsi not received in deep grooves; antennae usually laminate or flabellate, rarely serrate, 2nd and 3rd segments usually subequal and moniliform, 3rd often with small tooth, rarely larger than 2nd ; pronotum without luminous spots, prosternal sutures closed, excavate or pseudoexcavate anteriorly, prosternal lobe normally arcuate to sometimes straight anteriorly; meso and metasternum with distinct suture, colourful species with horizontal mesosternal cavity and thick sides, unicolorous species with sloping mesosternal cavity and inconspicuous sides; scutellum shield-shaped, never cordate; tarsi simple; claws simple, setae present at base (Von Hayek, 1973; Gur'jeva, 1974; Stibick, 1979; Cate, 2007).

Table 5: Measurements of the species of Tribe Hemirhipini from Pakistan.

| Taxon Name | Length | Width |
|---|---|---|
| *Calais afghanicus* Chassain | 34-38 | 9-10 |
| *Cryptalaus tamargrahensis* Akhter* | 24.0 | 8.0 |
| *Cryptalaus* sp. | 33.4 | 9.55 |

*holotype species

## Genus *Calais* Laporte, 1838

*Alaus* Eschscholtz, 1829:33; Candèze, 1874:117; 1891:30; Schwarz, 1906:35.
*Calais* Castelnau, 1836:9; Laporte, 1838:9; Candèze, 1857:239; Gemminger and Harold, 1869:1501; Fleutiaux, 1942: 91; Neboiss, 1967:260; Casari-Chen, 1994:207; Chakraborty and Chakrabarti, 2006:140; Kesdek, 2006:354; Cate, 2007:107; Martlik and Platia, 2008:2.

**Type Species:**

*Calais sengalensis* Laporte, 1838 (=*Elater excavatus* Fabricius, 1801)

**Diagnostic Characters:**

Body clothed by setae or scales, form patches, wide and arched or almost parallel; integument from reddish- to dark-brown; pubescence black with rusty yellowish-brown setae forming irregular patches; 3rd antennomere of male triangular; pronotum with longitudinal elliptical groove near base; hind angles of pronotum carinate; free margin of metacoxal plate straight, borders of mesosternal cavity declivous, metasternal median suture with transversal anterior carina; elytra with apex truncate with lateral spine (Gurjeva, 1974; Stibick, 1979; Cate, 2007).

## *Calais afghanicus* Chassain, 1991

**(Fig: 32a-d)**

*Calais afghanicus* Chassain, 1991:214; Cate, 2007:107.

**Type Locality:** Afghanistan.

**Colouration:** Entirely ferrugious brown with various white scattered pubescences.

**Head:** Almost quadrangular, frons medially flat, clypeus with anterior margin evidently angulated, covered with dense vestiture: antennae extended across of mid of pronotum, basal segment long, cylindrical, 2nd article rounded, smaller than others, 3rd article smaller than 4th article, remain articles subequal, serrate, last article not serrate, elongate with pointed apex.

**Thorax:** Pronotum longer than broader, lateral margins depressed, disc prominent, a longitudinal broad, dark strip, around it two rounded, black spot each side, pronotum covered with dense white vestiture, posteriorly angulated, projection pointed, basal margin truncated medially; scutellum lobate, depressed, covered with dense vestiture; elytra with base as broad as base of pronotum, sides parallel, gradually narrower at apex, apices rounded, striae with deep punctation, two broad blackish patch just middle of elytra laterally, interstriae covered with dense white vestiture, antennal groove across the middle of surface, prosternal keel elongated, pointed, covered with white vestiture, entering in mesosternal groove, metasternum broad, dense white vestiture, median long groove, mesosternal pleurite narrower.

**Male Genitalia:** Aedeagus with median lobe slightly longer than parameres, medially broad, before apex slightly narrower, apex broad rounded; parameres apically narrower, posteriorly broad, medially sinuate, two distantly away struts, slightly passes into basal cavity, basal plate broad, entire chitinized.

**Female Genitalia:** Basal plate broad, anteriorly deeply bifurcate, with two broad arms, posteriorly rounded at middle, with rich long bristles, two chitinized parts at anterior margin of bursa copulatrix, spermatheca missed.

**Material Examined:** Pakistan; Punjab Province, Muree, 2 ♂, 1 ♀; 20.vi.2007, leg. Z. Ahmed, on light; Angori, 1 ♂; 02.vi.2007, leg. M. A. Akhter, on light; Kheybar Pakhton Khoa Province, Paras, 5 ♂, 1 ♀; 17.vii.2007, leg. M. Rais, on light; Azad Kashmir, Bagh, 11 ♂, 7 ♀; 26.vii.2008, leg. N. Khan, on light (ACP).

**Comparative Remarks:** This species closely related to *Calais sodidus* in having antennae extended across middle of pronotum, $5^{th}$ to $10^{th}$ antennal segments serrate and pronotum longer than broad, carinate but can be easily separated by having pronotum with a longitudinal broad dark stripe, around two rounded black spot on each sides in *C. afghanicus* but pronotum without longitudinal stripe and black spots, scutellum lobate shaped in *C. afghanicus* but scutellum sub-pentagonal shaped in *C. sodidus* and elytra apices rounded in *C. afghanicus* but elytra apices weakly spinose in *C. sodidus*.

**Distribution:** Afghanistan and Pakistan.

## Genus *Cryptalaus* Ohira, 1967

*Cryptalaus* Ohira, 1967:97; Cate, 2007:107.

**Type Species:**

*Alaus putridus* Candèze, 1857 sensu Ôhira, 1967 (*Alaus larvatus* Candèze, 1874).

**Diagnostic Characters:**

Body clothed by setae or scales, form patches, narrow; integument from reddish-brown to dark-brown; pubescence brownish or varied, making regular or irregular patterns; 3rd antennomere of male transverse with spiniform appendix; pronotum with rounded or elliptical discal darker spots; hind angles of pronotum not carinate; free margin of metacoxal plate with small lobe, metasternal median suture furrowed near base; third interstice raised near base forming a dentiform tubercle; apex of elytra notched with lateral angle rounded and sutural spine present (Gur'jeva, 1974; Stibick, 1979; Cate, 2007).

*Cryptalaus tamargrahensis* **Akhter et. al., 2012**

**(Fig: 33a-d)**

**Type Locality:** Pakistan, Kheybar Pakhton Khoa Province, Tamargrah.

**Coloration:** Ferruginous brown, sides blackish, legs and antennae blackish brown, covered with dense vestitures.

**Head:** Head quadrate, depressed, anteriorly; clypeus with lateral margin emerginated rounded, medially arcuate, sides angulated, deep punctures with dense vestiture at sides; antennae extended scarcely middle of pronotum, basal segment robust, 2nd segment very small, globous, 3rd segment smaller than 4th segment, 4th broader than others, remain segments serrate, last segment spatulate with apex truncate.

**Thorax:** Pronotum slightly longer than broad, hind angles emerginated, acuminate, with a fine, short carina, rounded, convex in the middle, medially emerginated, side slightly flattened, anterior margin slightly emerginated medially, bisinuate, sides entire, rounded apico-median, than angulated posteriorly, circle of disc prominent laterally, deep and fine punctures with dense vestiture somewhere; scutellum lobate, depressed with deep punctures; elytra with base as broad as base of pronotum, sinuate medially, narrower behind, apices rounded, interstriae with very fine puncture, covered with dense vestiture, striae with deep, broad punctures with its length.

**Male Genitalia:** Aedeagus with median lobe broad, elongate, evidently longer than parameres, apically slightly narrower, form a triangular, conical tip, from apex to scarcely behind, a triangular area developed by emergence of distinct angles of base of area; parameres acuminate, distance between apical margin to

inner margin very less, posteriorly gradually dilated, strongly expended in base; two median struts, cord like, entire near to base of basal plate; basal plate modified, laterally expended, basal margin cord like, sclerotized.

**Female Genitalia:** Ovipositor stout, sclerotized, paraprocts elongated, cylindrical, irregular length curved, apex only spatulated, two spermatheca arise, triangular, sclerotized margin, incomplete, attached apically to anterior most section of bursa copulatrix, sternite consist elongate shaft, medially bifurcate, distinctly away to each other posteriorly, apex truncate, basal plate broad, sheet like, rare bristles in the middle, dense on base.

**Material Examined:** Pakistan; Kheybar Pakhton Khoa Province, Tamargarah, **Holotype:** 1 ♂; July-2005, leg. M. Rasheed, (NHMKU); **Allotype:** 1 ♀; same data as Holotype, (ACP).

**Comparative Remarks:** This species closely related with *Cryptalaus enquis* in having general body outline, antennae exceeding middle of pronotum, and hind angles of pronotum with short carina but can be easily separated by 4$^{th}$ antennal article broader to others in *C. tamargrahensis* but 4$^{th}$ antennal article not broader to others in *C. enquis*, beyond the base of elytral shoulders dull white in *C. tamargrahensis* but elytral shoulders dark white in *C. enquis* and the apices of elytra dark brown in *C. tamargrahensis* but the apices of elytra dull brown in *C. enquis.*

**Distribution:** Pakistan; Kheybar Pakhton Khoa Province, Tamargrah.

***Cryptalaus* sp. Akhter et. al., 2012**

**(Fig: 34a-c)**

**Type Locality:** Pakistan.

**Coloration:** Entire ferruginous brown, covered with less dense, yellow vestitures.

**Head:** Head broad; frons straight, concave, anteriorly; clypeus with anterior margin strongly bisinuate, gently slope medially, covered with dense vestitures; antennae extended before mid of pronotum, basal segment long, cylindrical, 2nd segment small, not globous, 3rd segment longer than 2nd, slightly serrate, 4th segment longer and broader than rest segments, last segment depressed, lobate.

**Thorax:** Pronotum longer than broad, hind angles acutely projectile, pointed, deep and fine punctures, anterior margin apically with two emerginated median tubercles, close distance, medially notched, a median longitudinal carina, strongly emerginated, sides entire, subparallel; scutellum pentagonal, depressed; elytra with base as broad as base of pronotum, sides subparallel, slightly sinuate at middle, narrower at posteriorly, apices strongly truncated with two spines, striae with deep punctures with its length, two dark patches latero-medially, interstriae rugose vestiture.

**Male Genitalia:** Aedeagus with median lobe dorsally spindle like, very broad medially, apically slightly narrower, than rapidly form apical tip, behind narrower posteriorly; parameres narrower apically to inner margin, weakly oblique, inner margin concave slightly, medially sinuate; two median struts straight, runs near the base of basal plate, apices broadly spatulate; basal plate broadly rounded, lateral margins chitinized.

**Material Examined:** 2 ♂; without data on pin (NHMKU and ACP).

**Comparative Remarks:** *Cryptalaus* sp. appears close to *C. larvatus pini* (Lewis) in general habitus but is distinctive in the male genitalia. In *Cryptalaus* sp. the aedeagus has the median lobe strongly spindle shaped, medially broad, apices narrower, and the parameres with the apical margin rounded while in *C. l. pini*, the median lobe of the aedeagus from base to 1/3$^{rd}$ broad, apically with a long tip, and the parameres with the apical margin oblique.

**Distribution:** Status unconfirmed.

## SUMMARY

Members of the family Elateridae commonly known as Click-Beetles and their larvae called Wire Worm. They are widely distributed all over the World, They are taxonomically difficult group and having ecological and economical importance.

Linnaeus (1758) was the first who worked on Click-Beetles and described few species under the genus "*Elater*". Leach (1815) proposed the family name "Elateridae". The classification of Elateridae remains confused since many years. Many authors have contributed their knowledge towards the classification.

Adults are usually nocturnal hiding during day time under stones, in leaf litter, or under the bark and attracted to light. Several species are diurnal and can be found upon flowers. Body elongate, antennae long, usually11-segmented, labrum exposed, hind pronotal angles well developed, procoxal cavity open both internally and externally, posterior margin of prosternum elongated to form prosternal spine form the characteristic Jump-Click mechanism. Jumping mechanism without legs support is a unique character of adult elaterid. Most of larvae are predators; they are elongate, cylindrical to flattened body.

In the present work, a contribution towards the knowledge about Elateridae of Pakistan, mainly agrypnids (Agrypninae: Agrypnini, Conoderini, Hemirhipini) have been studied. All the included species are described in detail with special reference to their male and female genitalia. Keys to the genera and species have been formulated and species are also compared with findings reported in the existing literature.

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Fig. 26 (a-c): *Drasterius sulcatulus* Candèze, 1859, a & b. dorsal habitus, c. ♂genitalia.

Fig. 27 (a-c): *Heteroderes gallagheri* Platia and Schimmel, 1997, a & b. dorsal habitus, c. ♂genitalia.

Fig. 28 (a-c): *Heteroderes heydeni* (Reitter, 1891), a & b. dorsal habitus, c. ♂genitalia.

Fig. 29 (a-c): *Heteroderes lenis* Candèze, 1891, a & b. dorsal habitus, c. ♂genitalia.

Fig. 30 (a-c): *Heteroderes spinosus* Candèze, 1891, a & b. dorsal habitus, c. ♂genitalia.

Fig. 31 (a-c): *Heteroderes subtilis* Jagemann, 1945, a & b. dorsal habitus, c. ♂genitalia.

Fig. 32 (a-d): *Calais afghanicus* Chassain, 1991, a & b. dorsal habitus, c. ♂genitalia.

Fig. 33 (a-d): *Cryptalaus tamargrahensis* Akhter et. al., 2012, a & b. dorsal habitus, c. ♂genitalia.

Fig. 34 (a-c): *Cryptalaus* sp., Akhter et. al., 2012, a & b. dorsal habitus, c. ♂genitalia.

PLATES OF FIGURES

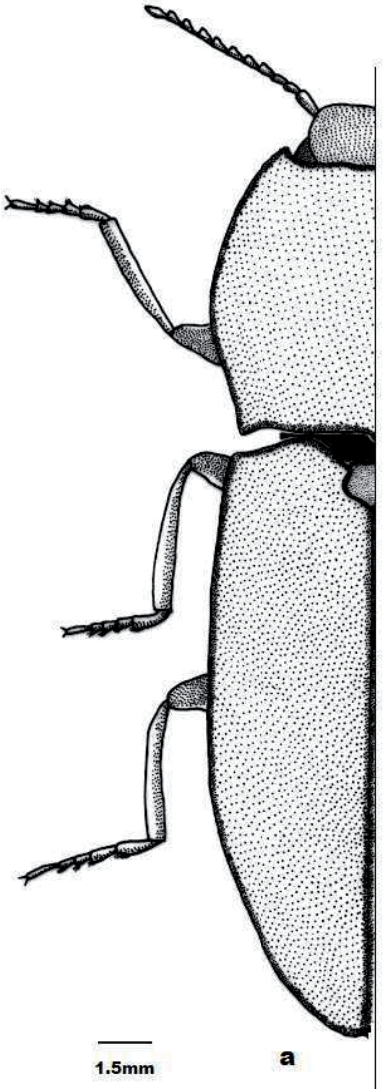
Fig. 1

Fig. 2

a

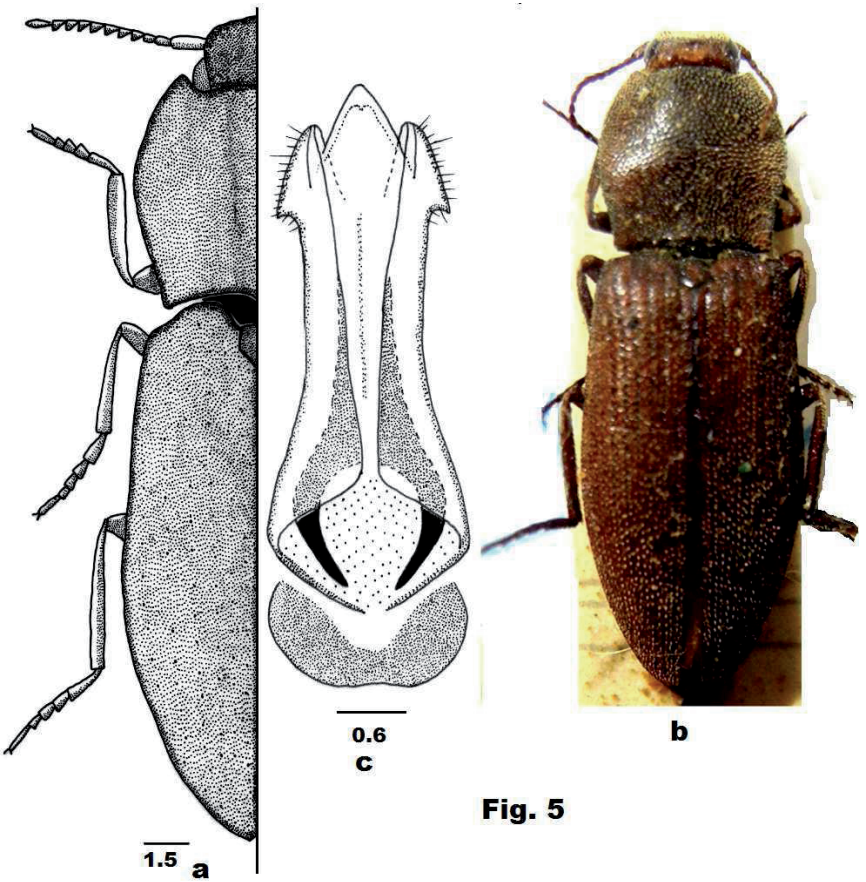
b

Fig. 3




b

**Fig. 4**

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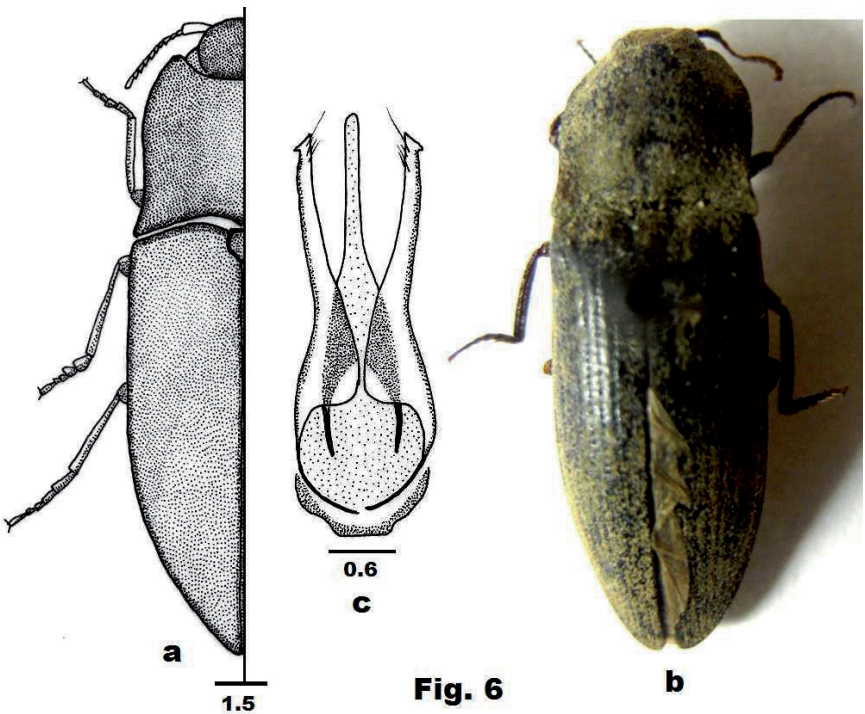


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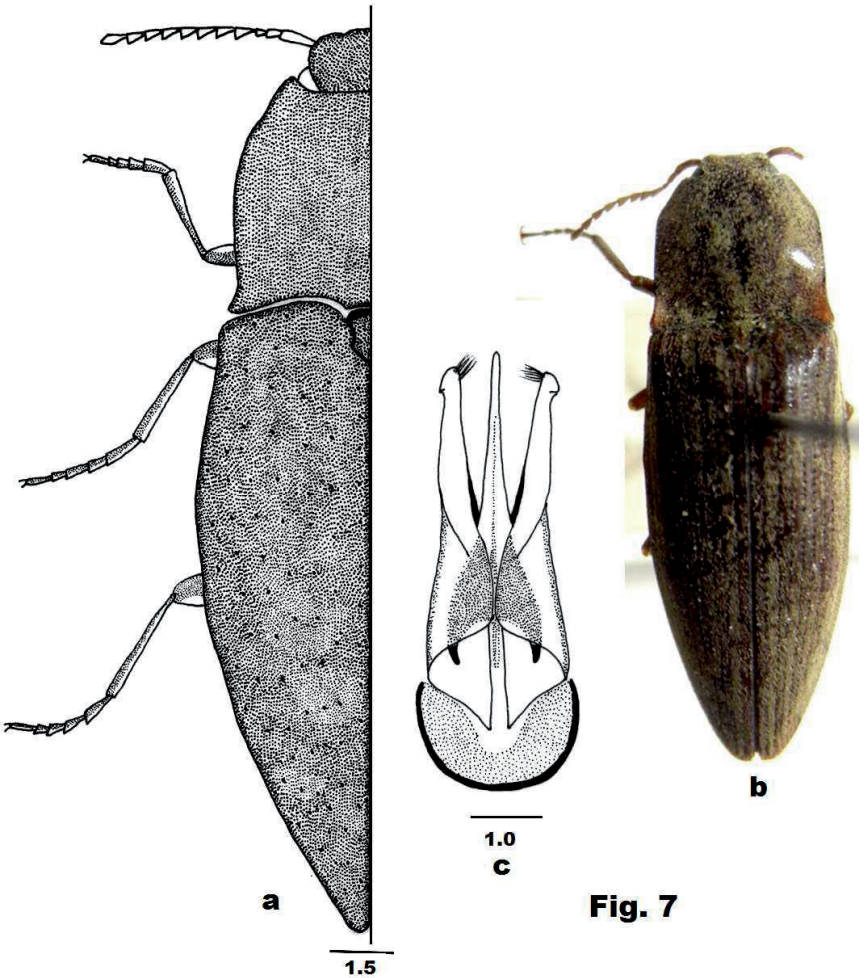
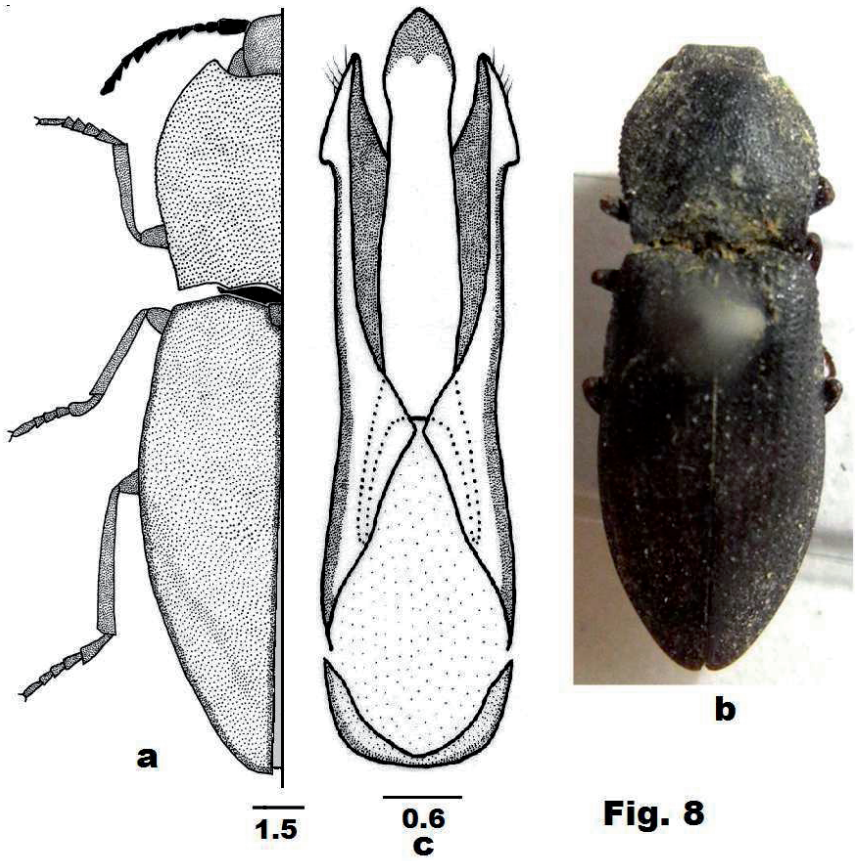



Fig. 7

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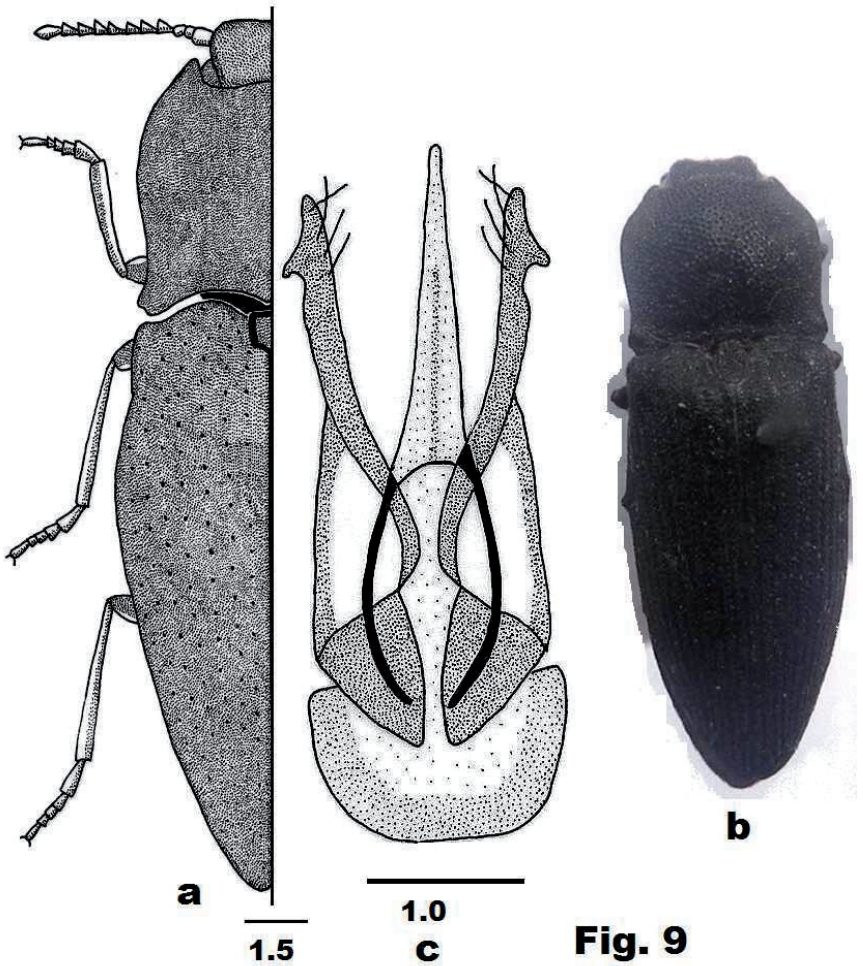


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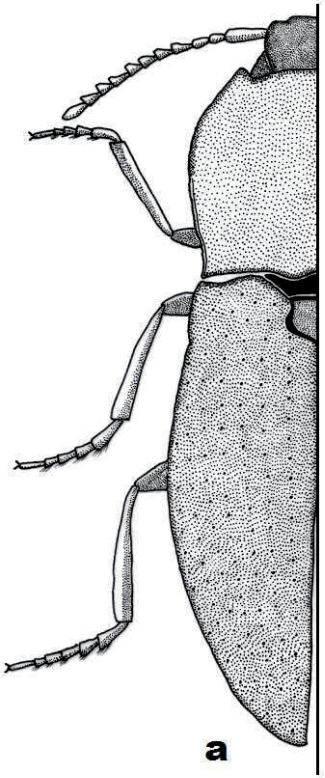

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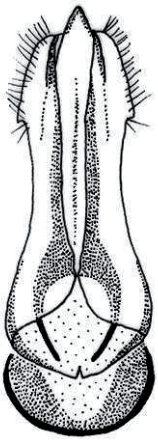
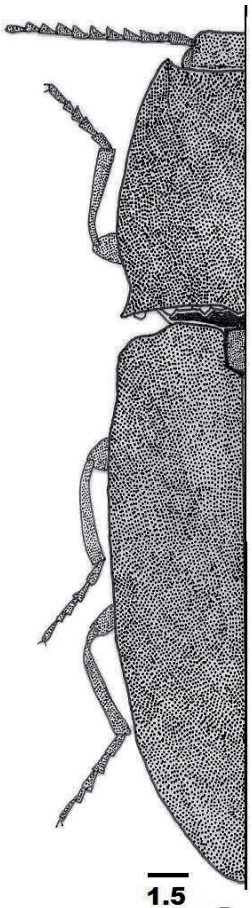


0.6

c

b

Fig. 10



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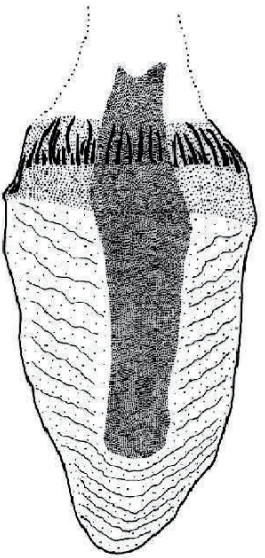

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Fig. 11

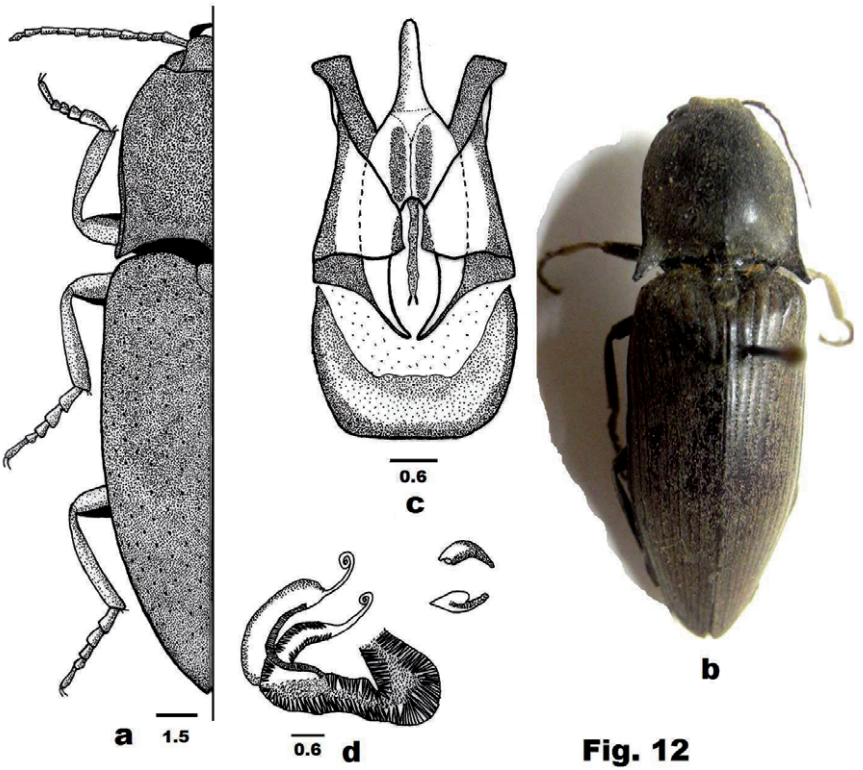



Fig. 12

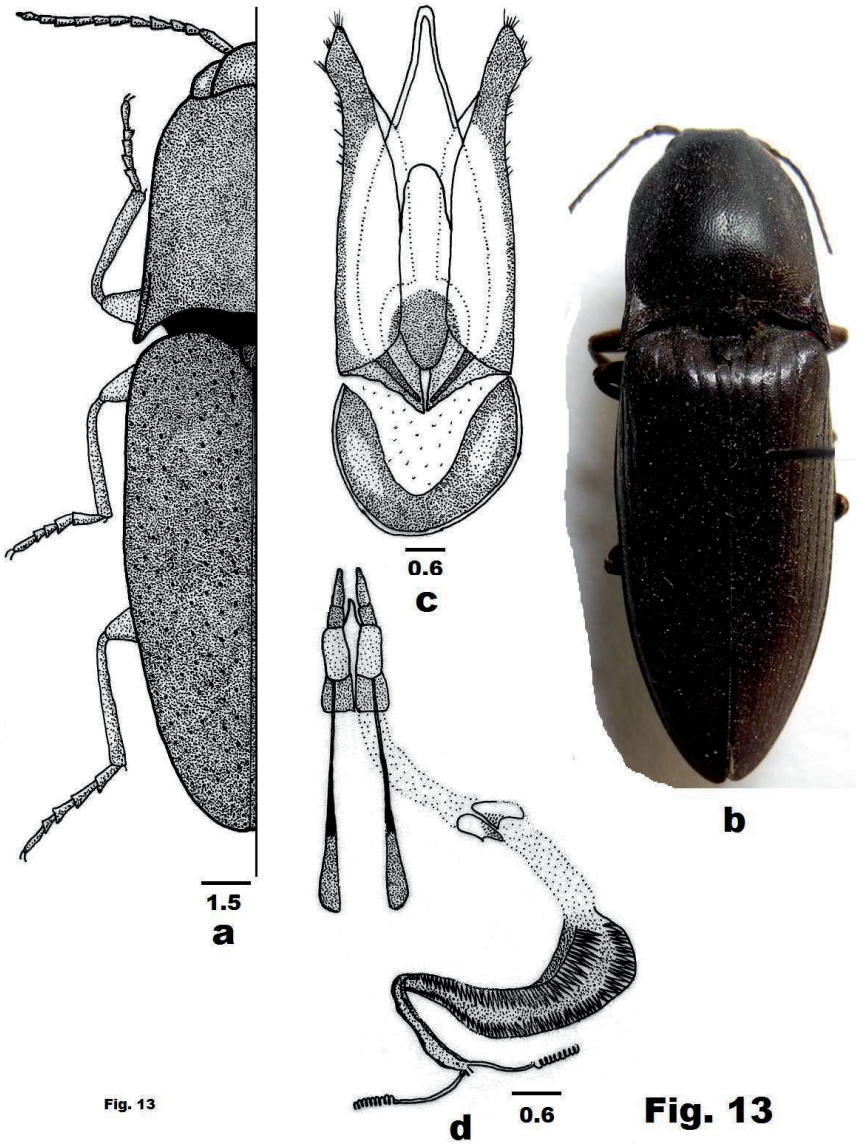



Fig. 13

Fig. 13

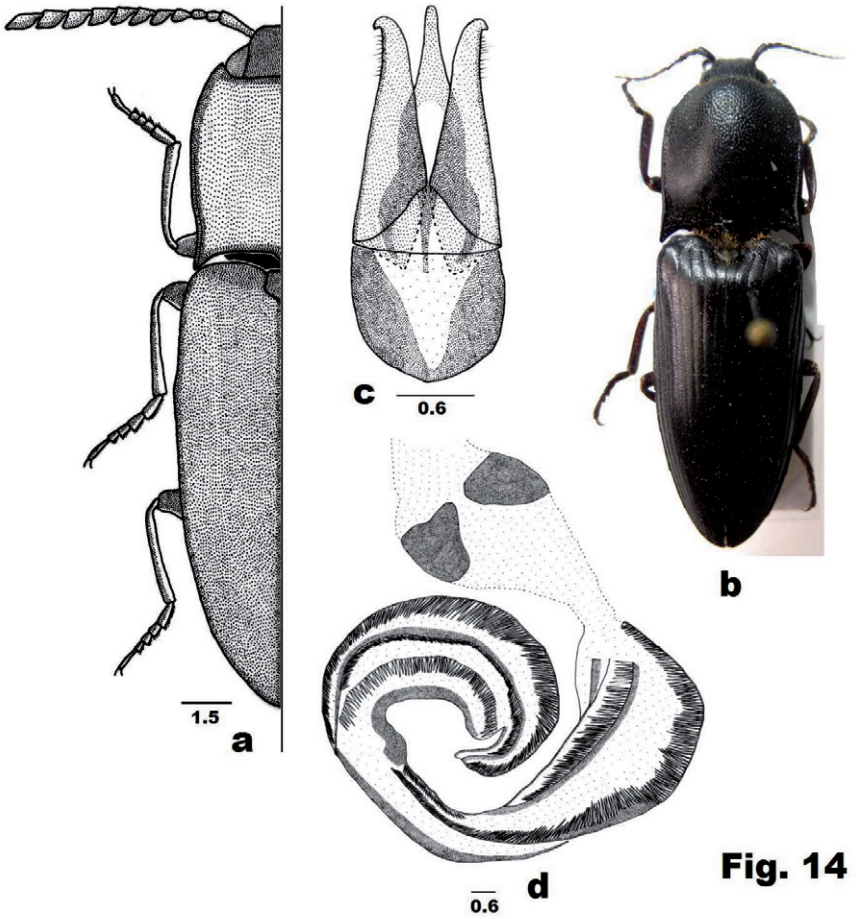



Fig. 14

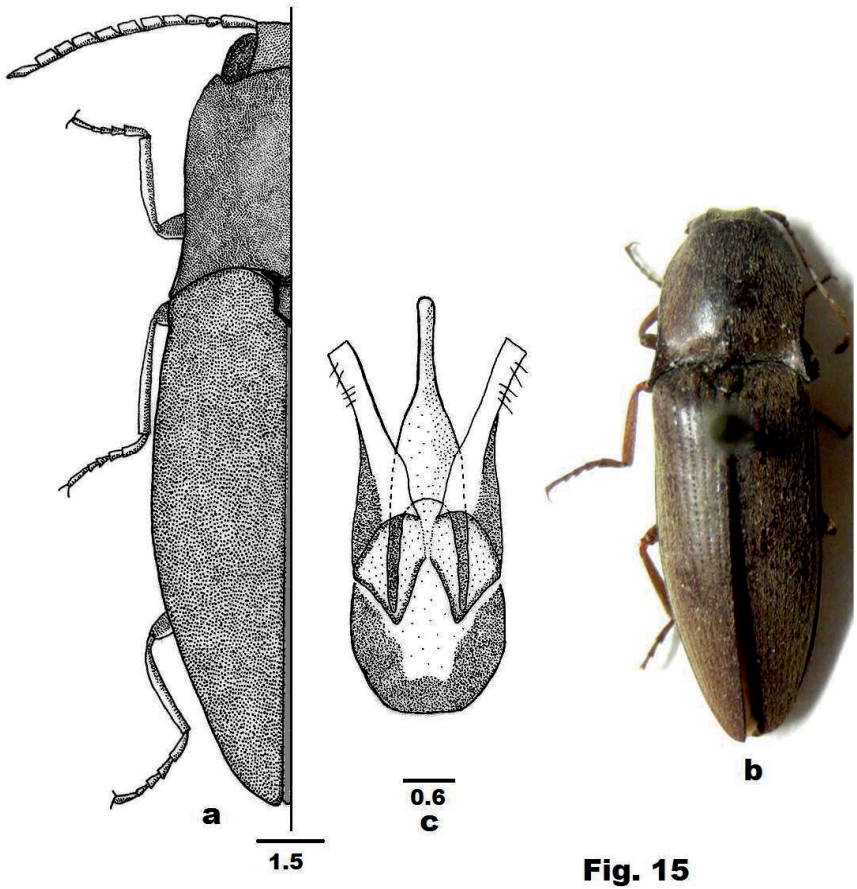
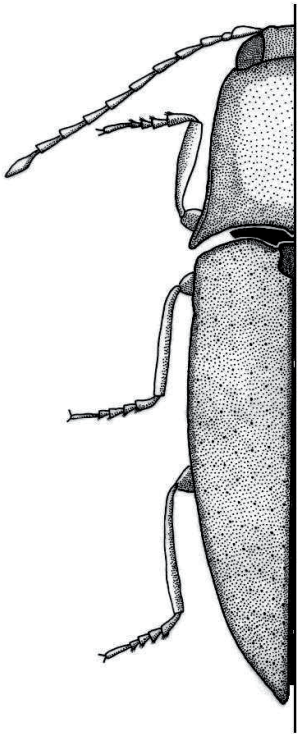



Fig. 15



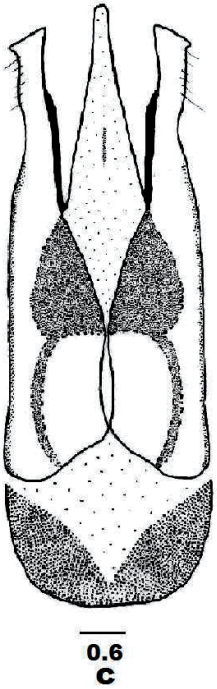
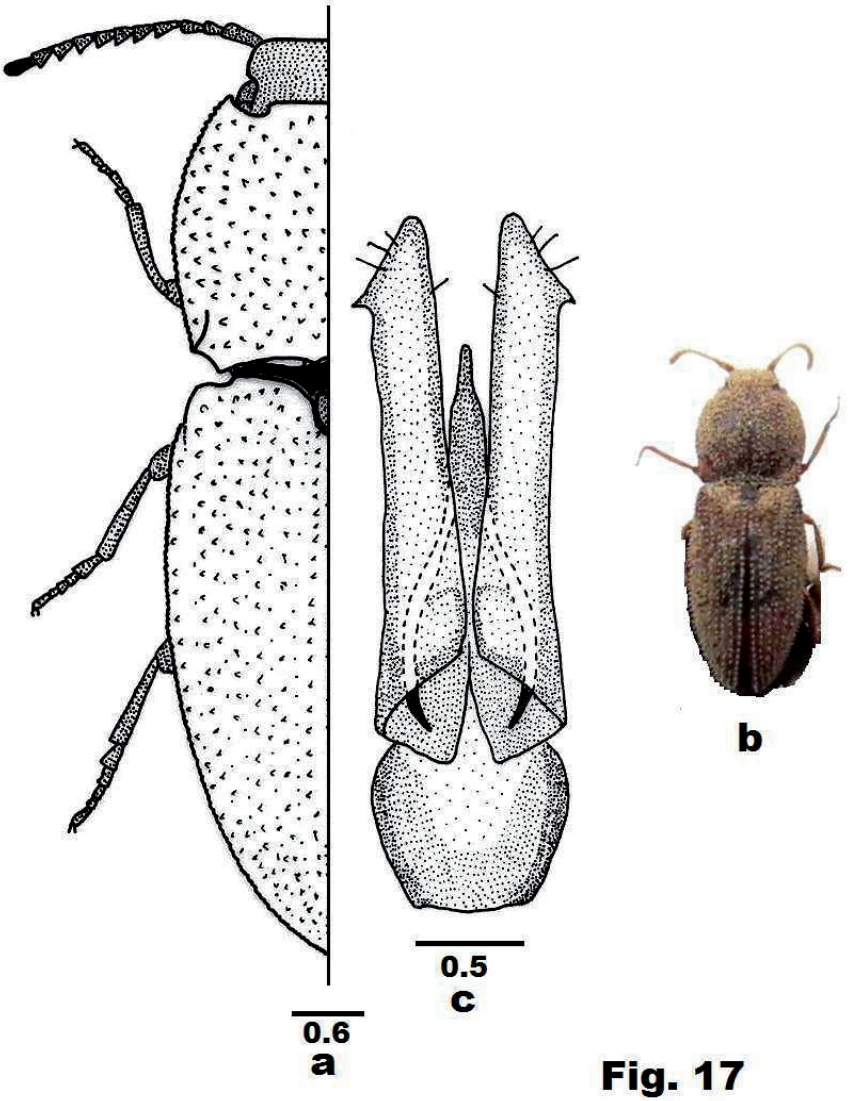





**Fig. 16**

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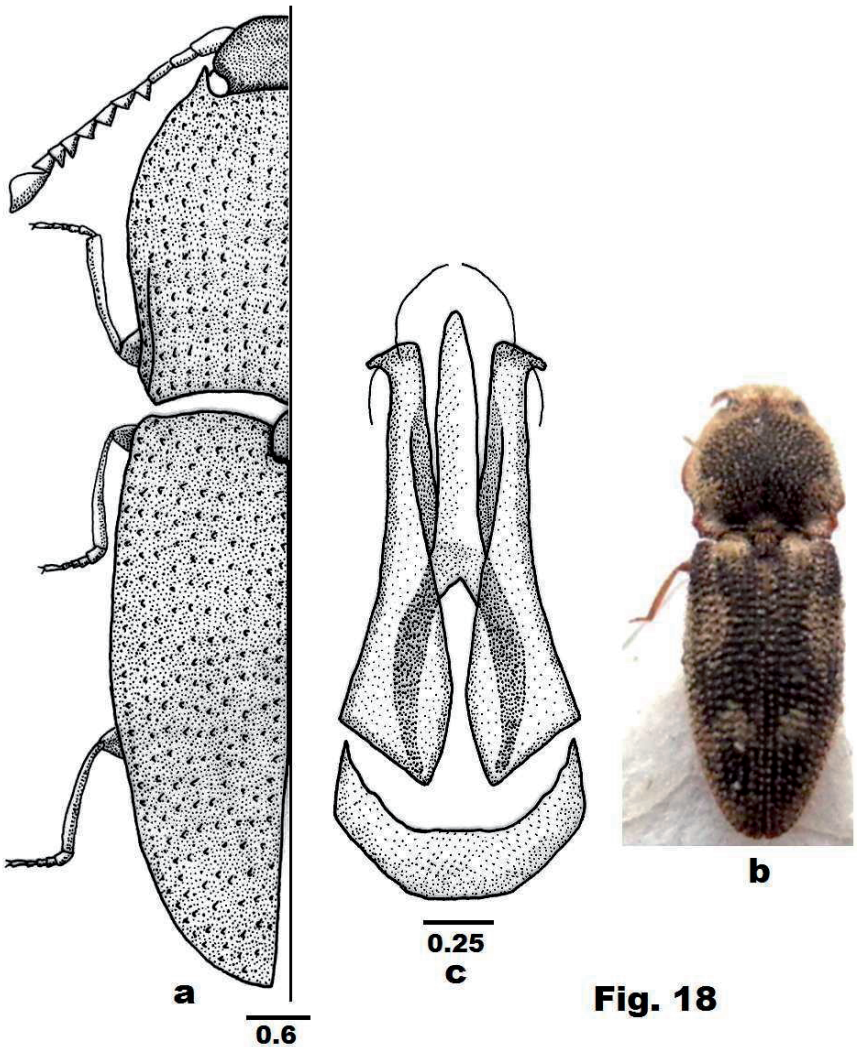
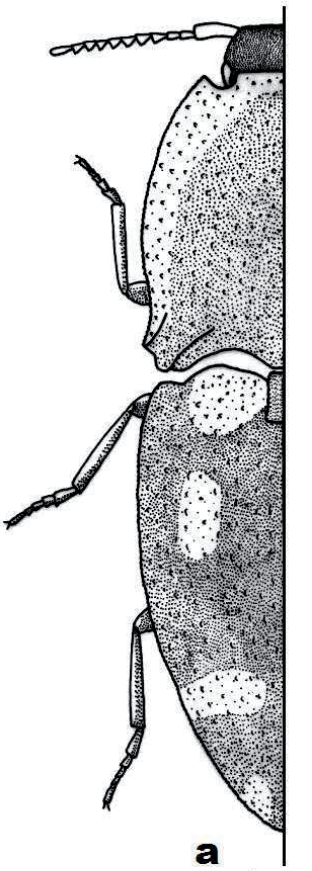



Fig. 18



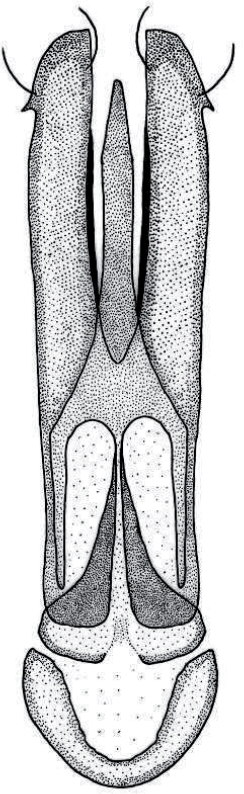
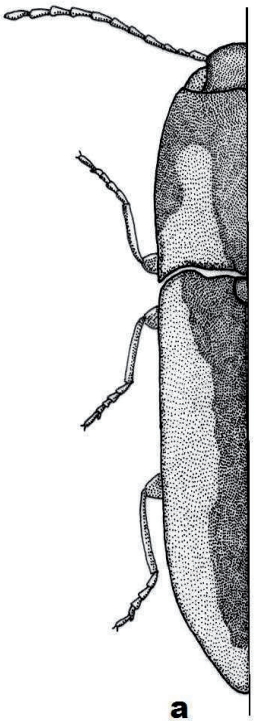
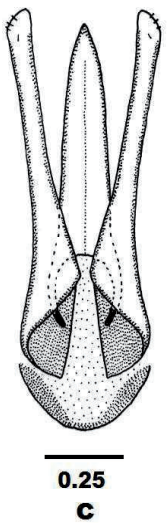





Fig. 19





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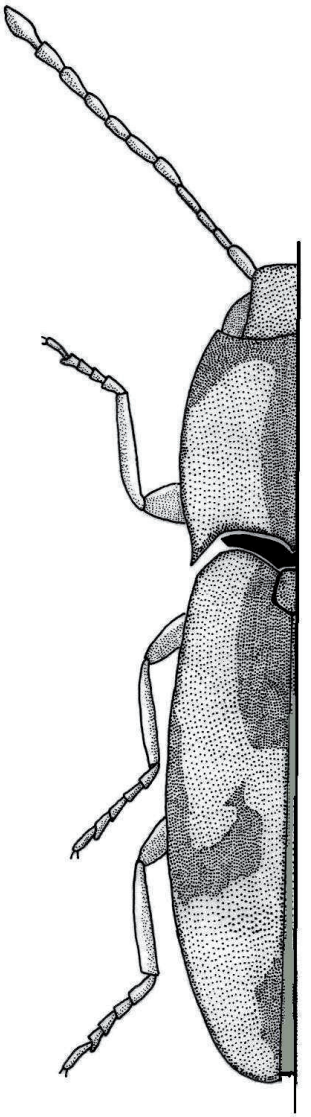
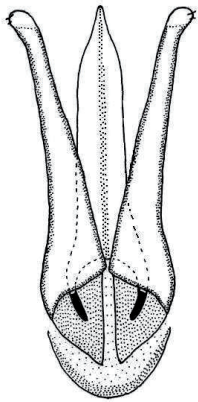



b

Fig. 21

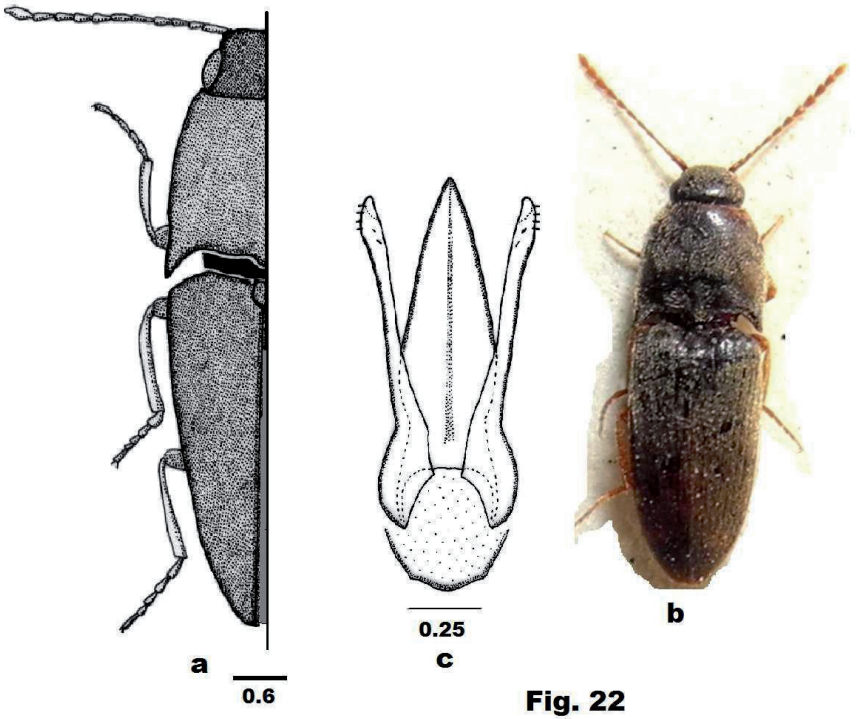



Fig. 22

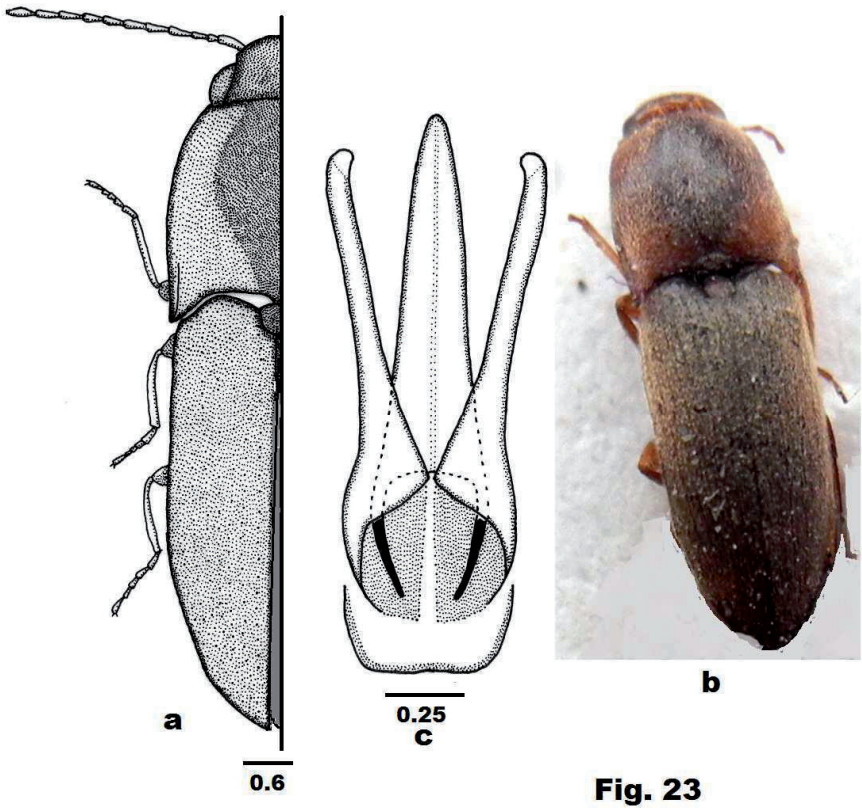
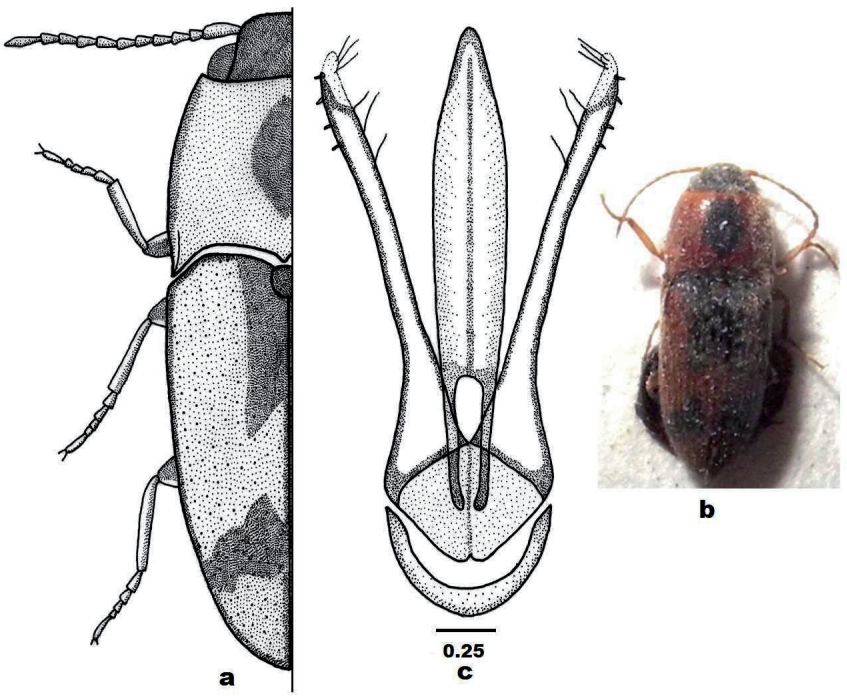



Fig. 23

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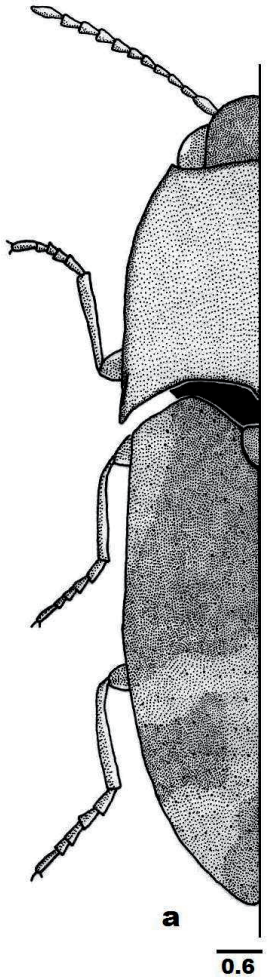


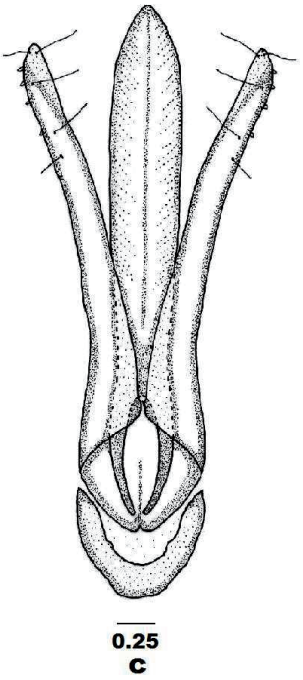



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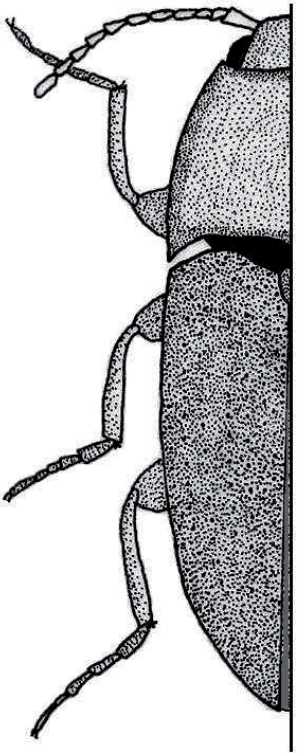

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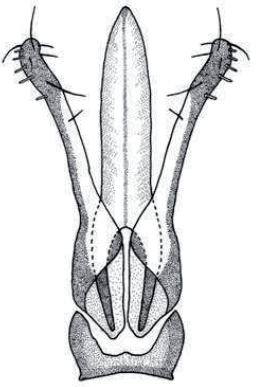

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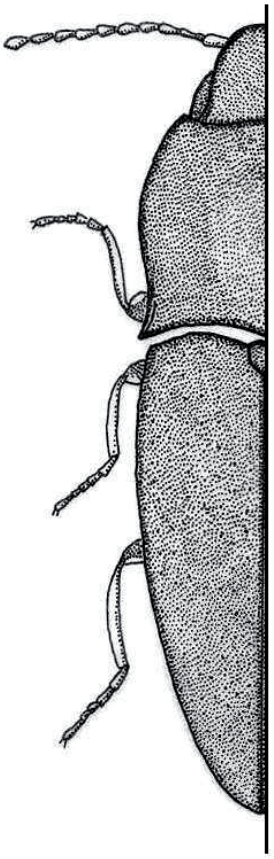
c

b

Fig. 26



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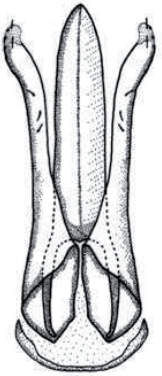

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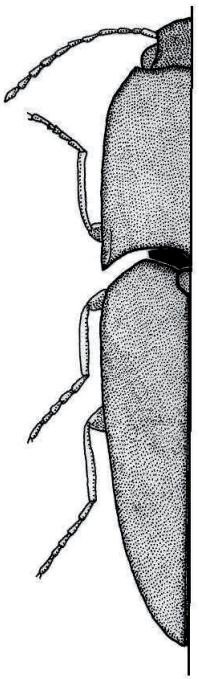
c

b

Fig. 27



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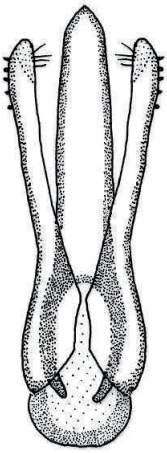

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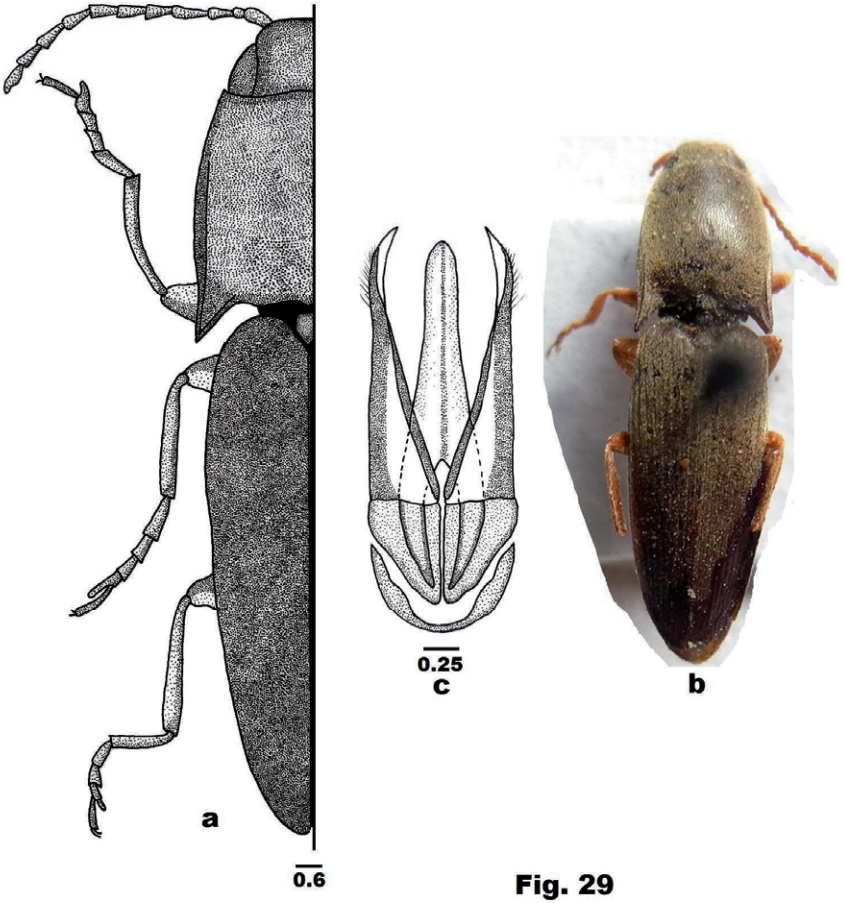
c

b

Fig. 28

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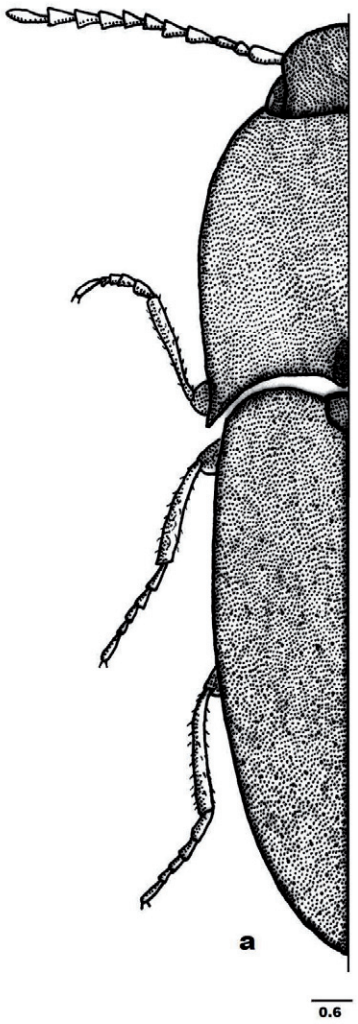




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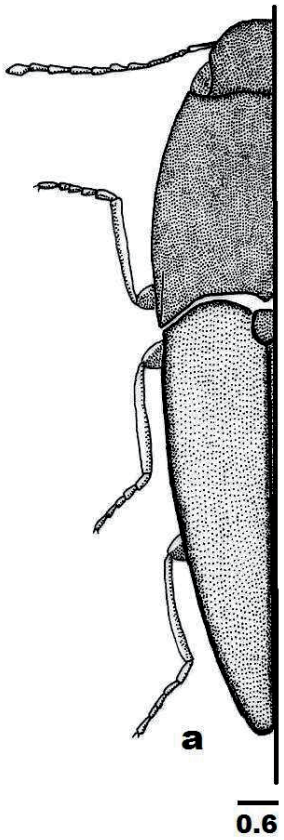


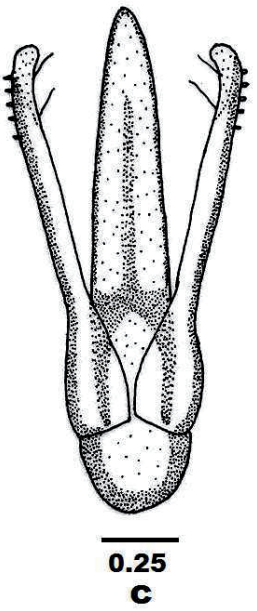



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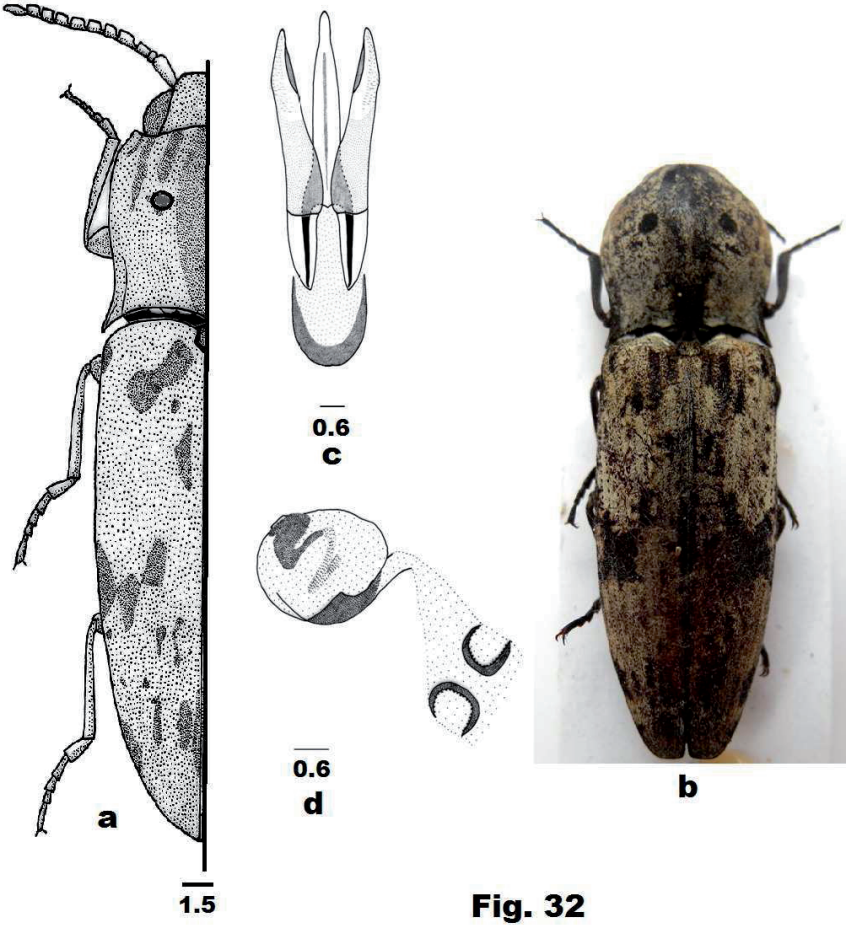


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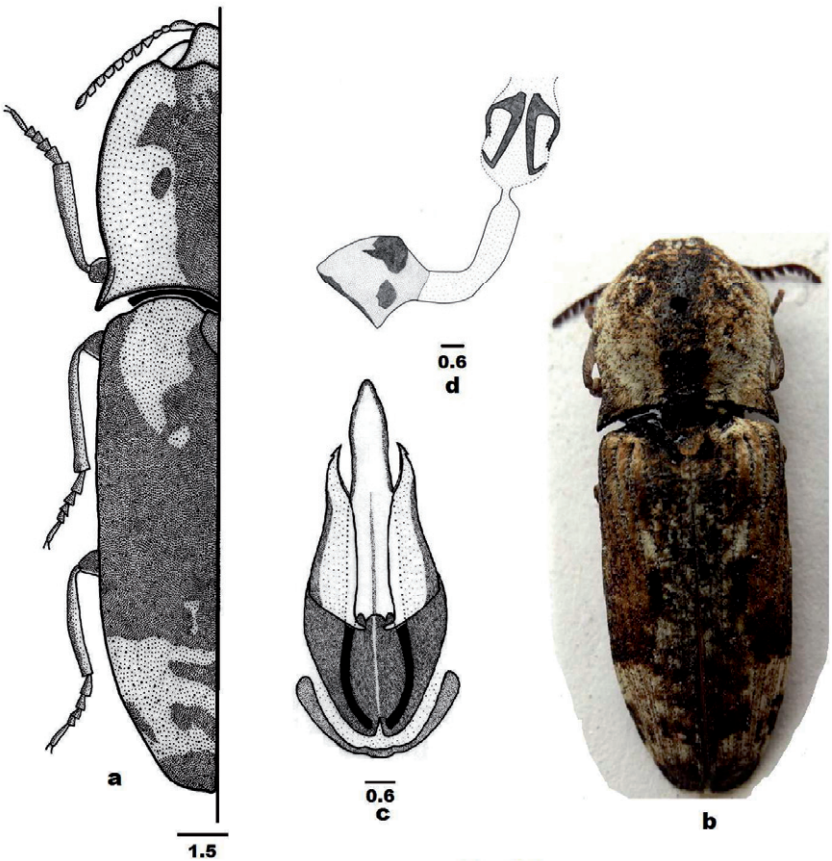


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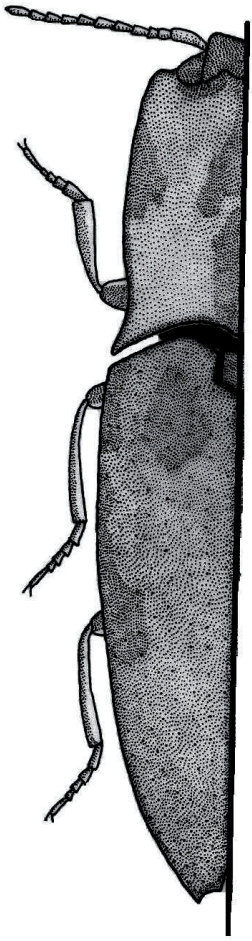

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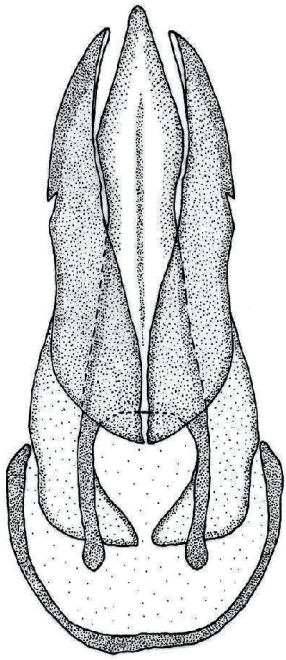

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c

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Fig. 34