

CHARACTERS STUDIED

ADULT

A. Size : All the species dealt with here fall within the range of length of 1.36 to 4.47 mm. Majority lie between 2.00 to 3.00 mm. Consequently size is rarely a very useful character in identification of species.

B. Colour : The prevalent colour of the species is reddish brown and sometimes yellowish or blackish. Some species namely, Monanus concinnulus, Psammoecus spp. and Cryptamorpha spp. have their characteristic black markings on elytra, which often provide an useful character for distinguishing the species.

C. Shape : General body shape is elongated and varies from somewhat ovoid (Ahasverus, Silvanolomus, Psammoecus) to nearly parallel-sided (Silvanus, Silvanoprus, Protosilvanus, Cathartus, Oryzaephilus). The dorsal surface is rather markedly flat in Protosilvanus, Monanus (Monanops) himalayicus sp.nov. and more or less convex in Ahasverus, Silvanolomus, Psammoecus. Most of the genera can be recognised by their general facies.

D. Head :

1. Antenna - The antenna is 11-jointed and inserted under projection of frons in Silvaninae, insertion is rather dorsal in Psammoecinae. Antennal joints are usually moniliform in Silvaninae

and filiform and rather elongated in Psammoecinae and Cryptamorphinae. In Silvanopsis and Monanus concinnulus joints are short. Usually apical three joints form a distinct antennal club in Silvaninae which is not distinguishable in Psammoecinae and Cryptamorphinae. Within Silvaninae there are differences in the degree and development of the antennal club. The apical joint of the club is usually transverse or as wide as long. In some species the apical joint is more robust and more strongly elongated as found in Airaphilus serricollis, A. abnormis and Monanus (Monanops) himalayicus sp.nov. In some species namely, Ahasverus advena, Silvanopsis grouvelli sp.nov., S. nepalensis sp. nov. the basal joint of the club (joint 9) is markedly narrower than the middle one (joint 10).

2. Eyes and Temples - The eyes are usually uniform throughout the family; large, round and coarsely faceted. In Cryptamorphia infans, Psammoecus complexus sp.nov. the eyes are somewhat conical.

The temples are usually little developed and extended slightly laterally. In the genera Protosilvanus, Silvanoides these are prominent, extended laterally slightly beyond the margins of eyes and distinct platform-like. Usually the temples are about as long as one or two eye facets and are much shorter than the eyes. In some species namely, Oryzaephilus surinamensis, Silvanoprus longicollis, S. palnicus sp.nov. the temples are well-developed,

long and more or less as long as the eyes. The proportion of the lengths of eye and temple is used in separating two closely related species O. surinamensis and O. mercator. The length of temple in relation to length of eye facet is also used in differentiating the species Silvanus lewisi and Silvanus bidentatus. The comparison of temple with eye facets are often a useful character for separating a few closely related species.

3. Fronto-clypeal suture - This suture is well-marked in the subfamilies Psammoecinae and Cryptamorphinae and absent in Silvaninae. It is one of the prominent characters by which the former two subfamilies can be easily separated from the latter one.

4. Transverse impressed line on vertex - This line on the posterior side of vertex behind eyes is very conspicuous in the genera Silvanus, Silvanoprus, Protosilvanus etc. and indistinct in the genera Oryzaephilus, Monanus (Monanops) etc. This is a useful character and seen when the specimen is studied by making slide preparation.

5. Neck - Usually the neck is more or less constricted and almost uniform throughout the family.

6. Gular sutures - The gular sutures are widely separated and uniform throughout the family.

7. Tentorium - The tentorium is composed of two longitudinal tentorial arms which are usually connected by a transverse bridge near middle as in Silvanus, Silvanoprus, Silvanopsis, Monanus. Rarely, as in Protosilvanus this transverse connection is absent. Lateral extensions from the longitudinal arms are found only in Oryzaephilus.

8. Mouthparts :

Mandible - Each mandible is usually with three apical teeth and well-developed mola. The dorsal side of the basal half is hollowed out as dorsal mandibular cavity in the genera Airaphilus, Psammoecus and Cryptamorpha. This mandibular cavity is usually vestigial in Silvaninae, whereas well-developed in Psammoecinae and Cryptamorphinae.

Maxilla - The lacinia is long, narrow and fringed with fine setae and apical spine absent; rarely, in Airaphilus has a distinct apical spine. First segment of the maxillary palpus is small, other three segments are variable length and shape. The apical segment is usually fusiform, rarely securiform as in Psammoecinae. Unlike other Silvaninae the apical segment is shorter than segment 2 in Protosilvanus. The palpi are often pubescent and rarely glabrous as in, Silvanopsis. Securiform apical segment separates the subfamily Psammoecinae from Silvaninae and Cryptamorphinae.

Labium - The first segment of the labial palpus is small and other two segments are variable length and shape. The apical segment is usually fusiform and sometimes securiform as in Psammoecinae; segment 2 is usually about as wide as apical one in Silvaninae and narrower in Psammoecinae, rounded and much wider than apical one in Cryptamorphinae. In all Silvaninae the apical segment is usually largest, except in Protosilvanus, where the apical segment is shorter than segment 2. The palpi are often pubescent but rarely glabrous as in Silvanopsis. The shape and size of segments are of taxonomic importance especially, in separating the subfamilies, and also used for separating the genus Protosilvanus from other related genera.

Labrum - This is transverse, with front margin usually rounded and fringed with setae and almost uniform throughout the family.

E. Prothorax : The shape of the prothorax as a whole is the most important single external character by which majority of the genera and species may be recognised. The development of spines at the front angles, the degree of curvature of lateral margin, the presence and absence or shape of lateral teeth, convexity of pronotum and shape and proportions of the prothorax are usually very useful characters for separating the species.

1. Shape and proportions of prothorax - The shape of the prothorax ranges from elongated to rather transverse. The term 'almost quadrate', 'transverse' and 'elongated' prothorax has been widely used in description and key to the genera, which is a useful character.

2. Structure of anterior spine - The prothoracic anterior spine formed by a prolongation of front angle is characteristic of the genera Silvanus, Silvanoprus, Protosilvanus and Silvanoides. In the genera Cathartus and Ahasverus it is broadly rounded. The shape, degree of development and the angle formed at the origin with the lateral margin of prothorax provide useful characters in identification of the species of these genera.

3. Lateral margins - The shape of the lateral margin has the greatest effect on the general appearance of prothorax. It may be slightly wavy as in Silvanus, Silvanoprus and Protosilvanus; rather rounded in Ahasverus and Cryptamorpha abnormis sp.nov. or somewhat parallel-sided in Cathartus. The lateral margins in Silvanus, Silvanoprus and Protosilvanus etc. are finely denticulate or serrated, whereas in others with number of large teeth. The shape and number of teeth varies. The genera Oryzaephilus, Silvanopsis and Silvanolomus possess six large teeth, whereas Airaphilus bears eight to fifteen

teeth and Monanus with eight to eleven teeth. The lateral teeth of Oryzaepphilus and Silvanolomus are usually acute and somewhat pointed, whereas in Silvanopsis these are broadly pointed or appear undulated, the lateral teeth of Airaphilus and Monanus are slightly smaller. The subfamily Silvaninae has been divided into two major divisions based on the presence or absence of lateral teeth and number of teeth. Lateral teeth of Psammoecus are variable number and form.

4. Depression on pronotal disc - There are shallow lateral depressions on either sides of the middle line in the genera Silvanus, Silvanoprus and Protosilvanus, whereas in Oryzaepphilus the pronotum is demarcated by a median and a pair of lateral longitudinal carinae and a well-marked longitudinal depression or groove on either sides of median carina. The presence of two longitudinal grooves and carinae on pronotum separates Oryzaepphilus from all other genera of Silvaninae. This depressions are less defined and variable in a few genera. This character has sometimes used as an additional character in the key. The pronotum of Cryptamorpha abnormis sp.nov. with a well-marked median longitudinal depression separates this species from other members of the genus Cryptamorpha.

5. Puncturation - The puncturation on pronotum is usually dense and coarse. Puncturation of pronotum has been compared with that of head and sometimes with that of pronotum of other species. This character has been used for separating the species Monanus concinnulus from M. longicornis and Psammoecus delicatus from P. complexus sp.nov.

6. Sternum and coxal cavities - The sterno-pleural suture may be extended to anterior margin as in Airaphilus; to front angle or spine as in Silvanus, Silvanoides, Silvanolomus; or extending to lateral margin as in Protosilvanus, Cathartus, Psammoecus, Cryptamorpha. The coxae may be widely separated as in Protosilvanus; or narrowly separated as in Silvanus, Silvanoprus and Silvanopsis; or contiguous as in Silvanolomus, Psammoecus and Cryptamorpha. These two characters have been used in the key to the genera and seem to be very useful characters.

F. Elytra :

1. Shape - The normal shape of the elytra is elongated, somewhat parallel-sided and more or less convex. In some genera the elytra are less elongated and somewhat oval as in Ahasverus, Silvanolomus and Psammoecus, while in others they are longer and more parallel-sided as in Silvanus, Protosilvanus,

Cathartus and Monanus (Monanops). In Protosilvanus and Monanus (Monanops) the dorsal surface is markedly flattened. The general shape of the elytra is occasionally sufficiently distinct to distinguish a genus. The majority show only small differences which can not be defined by measurements.

2. Puncturation - The punctures on the elytra are arranged in regular longitudinal rows. Normally in Silvaninae the number of rows is nine and in Psammoecus the number is ten. The scutellary striole is present on either side of the scutellum in Cryptamorpha. Width of each puncture is often compared with the width of interstices between the rows. In some cases, particularly in the genera Psammoecus and Cryptamorpha this character has often been used for separating a few species.

3. Interstices - The interstices are usually costate and sometimes carinate as in Protosilvanus and Oryzaephilus. These are usually alternately wider and narrower.

4. Pubescence - The pubescence are usually short and semierect and which are comparatively longer in Airaphilus and Psammoecus. A few species of Psammoecus possess double pubescence along lateral margins.

5. Epipleura - The recurved part of the elytron beneath the body at lateral side is called 'epipleuron'. This is moderately wide near shoulder and decreases gradually in width till it disappears at apex or little before apex. The epipleura are less variable within the family.

6. Scutellum - This is usually transverse, somewhat pentagonal in the genera of Silvaninae and Cryptamorphae, and rather triangular in Psammoecus.

G. Wing : Wing venation in Silvaninae and Psammoecinae is uniform; venation is reduced, usually with a single anal vein, radial cell but without subcubital fleck. In Cryptamorpha the wing is with three anal veins but without radial cell.

H. Meso-metathorax : The mesosternum is short and transverse, sternal fitting between mesocoxae is usually in a straight line in Silvaninae which is more or less emerginated or sinuated in Psammoecinae and Cryptamorphae. The lateral borders of the mesosternal process are usually more or less notched in the posterior half, which are straight or normal in case of Oryzaephilus and Silvanopsis nepalensis sp.nov.

The metasternum is more or less transverse and usually with a median longitudinal impressed line of variable length. Mesocoxal lines are usually absent, except in Ahasverus.

The mesocoxal cavities are broadly opened outwardly and mesepimera always reach the coxal cavities. The hind coxal cavities are strongly transverse and oval. The degree of separation of middle and hind coxae are of importance in the generic level.

The metendosternite is Y-shaped consisting of a broadly elongated furcal stalk, and a pair of lateral arms of furca or appophyses and which are forked at tip. The anterior tendons of metendosternite are usually obscured which are well-developed in Cryptomorpha.

I. Legs : The legs are generally moderately long. Three pairs of legs are usually similar to each other in their shape and structure.

1. Coxae - The front and middle coxae are nearly rounded and hind coxae are transverse and oval. Front and middle trochantins are hidden.

2. Trochanters - The trochanters are always short and simple. The shape of the trochanter is usually subtapezoidal with a rounded proximal margin. In Oryzaephilus, Silvanus bidentatus, S. curvispinus the hind trochanters, and in Cryptomorpha abnormis sp.nov. the middle trochanters are produced into a short spinous projection in male and thus, indicate the sexual differences.

3. Femora - The femora are almost uniform throughout the family, usually elongate and more or less cylindrical and swollen towards middle. In Silvanoides male ventral side of hind femora are ridged and in Silvanoprus cephalotes front and middle femora are armed with a short spine in both sexes.

4. Tibiae - The tibiae^{are} slender, elongated and more or less thickened at apex. The apex of tibia is usually with two normal minute spurs which are indistinct in Oryzaephilus.

5. Tarsi - The tarsal formula of the Silvanidae is always 5-5-5 in both sexes. The segment 1 is elongated, segments 2 and 3 subequal, these segments may be simple or lobed, segment 4 distinctly shorter than other segments, apical segment is elongated and cylindrical and bears a pair of claws at its apex. The structure of tarsi is very variable, which may be of following types: (a) simple as in Silvanus, Protosilvanus, Silvanoides, Oryzaephilus; (b) segment 3 lobed as in Silvanoprus, Ahasverus, Cathartus, Silvanolomus; (c) segments 2 and 3 lobed as in Monanus; (d) segments 1 to 3 lobed as in Psammoecus; (e) segments 1 and 2 lobed and segment 3 bilobed as in Cryptamorpha. The shape of the tarsi is thus of great importance and used in the key for several times to separate major divisions of the family and subfamilies.

J. Abdomen :

1. Ventriles - Abdomen is composed of five visible sternites or ventrites. Each ventrite of abdomen is freely articulated and movable; the first ventrite is longer than each one of the four succeeding ventrites; the fifth ventrite is generally semicircular or subconical in its outline, with peculiarly notched at its posterior border in Cryptamorpha abnormis sp.nov.

2. Intercoxal process and femoral lines of ventrite 1 - The apical margin of the intercoxal process may be almost straight as in Silvanolomus, Oryzaepphilus, and Airaphilus, or broadly pointed as in Silvanus, Silvanoprus, Protosilvanus and Psammoecus. This character is of value in the generic level. The femoral line is always represented on the first ventrite behind each hind coxal cavity. The femoral line may be narrowly or widely separated from the hind coxal cavity, it may be closed as in Silvanus, Silvanoprus, Oryzaepphilus, Psammoecus and Cryptamorpha or opened as in Ahasverus and Silvanoides. This feature in few instances is useful in the generic level and it separates two closely related species of Airaphilus (A. abnormis and A. serricollis)

3. Spiracles - There are seven pairs of spiracles, first six pairs lying on pleural sclerites and seventh pair on the edge of tergite 7.

4. Male genitalia - The aedeagus is uninverted Cucujoid-type and uniform throughout the family and its general structure is rather similar throughout the family. Aedeagus is composed of the following parts : (a) median lobe proper is broadly elongated, dorso-ventrally compressed chitinous structure, median sturt single and usually spatulate

at apex, (b) tegmen consists of a basal piece and a pair of parameres, the parameres bear one to many setae at their apex or margins. The structures of aedeagus in Silvanidae especially, tip of median lobe and parameres seem to be species-specific and which are very useful characters for determination of species.

5. Female genitalia - The female genital tube or ovipositor is rather less variable. The general structure of this organ is composed of a pair of paraprocts, a pair of valvifers, a pair of coxites, a pair of long styli attached on outer margin of apex of coxites.

LARVA

General appearance - The full grown larvae of Silvanidae are usually elongated, somewhat flattened, slightly narrowed in front and behind and more or less sparsely and rather characteristically setose, and sometimes with well-developed paired urogomphi on the posterior end of ninth abdominal tergite.

A. Head Capsule : The head capsule is subglobular and broader than long.

Shape of frontal suture - The frons is demarcated by the frontal suture. The frontal suture is Cucujoid-type and almost similar throughout the family and rarely indistinct.

Antenna - The antenna is usually moderately long, joint 1 slightly elongated, joint 2 markedly long, joint 3 may be minute (*Silvaninae*) or well-developed (*Psammoecinae* and *Cryptamorphinae*). The sensory appendage is usually present and minute. Antennal joint 2 is somewhat parallel-sided in Protosilvanus, Silvanoprus and Cathartus, whereas distinctly broadened towards apex in Oryzaephilus and Airaphilus.

Ocelli - Five or six ocelli are present behind antenna and their arrangement are variable.

Arrangement of setae - The arrangement and length of setae on dorsal side of head are variable.

Mandible - The mandible is with three apical teeth and their inner margins sometimes dentate. The mola is well-developed and covered with distinct curved oblique rows of asperites. Protheca is simple, somewhat triangular and apically pointed.

Maxilla - The maxillary mala is falciform, with a dorsal row of long setae along inner margin and with one to three apical spines. The number of setae on inner margin of dorsal side of mala varies from six (Airaphilus) to thirteen (Cryptamorpha), in Oryzaephilus these setae are present in two rows-six and four, often on ventral side there are one to three setae. The maxillary palpus is 3-segmented, segment 1 is markedly transverse, segments 2 and 3 are distinctly elongated,

segment 3 is slightly narrowed at apex and with fine sensorial projections at the tip; ratio of length of palpal segments is a useful character.

Labium - The labium is narrowed anteriorly. The palpi are 2-segmented, apical segment is usually narrower than segment 1.

B. Thorax :

Thoracic segments and arrangement of setae on pronotum - The segments of thorax are more or less transverse; dorsal surface of each segment bears sparse, simple and pointed setae- characteristic for each type and illustration with figure is provided. Rarely, the dorsal surface of each segment is with a transverse brownish pigmented area (Oryzaephilus and Airaphilus).

C. Abdomen :

Structure of abdominal segments - The abdomen consists of ten segments, of which nine segments are easily visible from above. The breadth of first three or four abdominal segments are more or less equal as the thoracic segments, then slightly narrowed, seventh to ninth segments are progressively narrower. The dorsal surface is rarely with transverse brownish pigmented area. The tergite of ninth segment is small; rarely with long narrow, pointed unscle-rotized urogomphi (Cryptamorpha); its sternite forms a conical pygopod-like structure and the tenth segment is represented by

a sclerite attached to the apex of pygopod-like projection.

Arrangement of setae - The type and arrangement of setae on abdominal segments are important and characteristic for each type. The characteristic appearance of individual forms are illustrated with figures.

D. Spiracles : All spiracles are annular and lying on body surface.

E. Legs : The legs are well-developed, moderately long and coxae are moderately widely separated. The claws often bear two tarsangular setae lying side by side (Oryzaeophilus) or one above the other (Airaphilus, Psammoecus, Cryptamorpha), tarsangular setae may be one (Silvanoprus, Cathartus, Ahasverus) or absent (Protosilvanus).