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Morphometry and relation patterns in male genitalia of noctuids (Lepidoptera: Noctuidae)

M. Lödl

Abstract

The morphometric base of male genitalia of Noctuidae is presented. The difficulties of measuring are discussed and a catalogue of mainly used measurements is presented.

Zusammenfassung

Die morphometrische Basis der Vermessung von männlichen Noctuidae-Genitalien wird präsentiert. Die Schwierigkeiten der Meßarbeit werden diskutiert. Ein Katalog der gängigen Meßstrecken wird vorgelegt.

Key words: genitalia, morphology, morphometry, Noctuidae.

Introduction

Although the major part of the research on quadrifine noctuids is confined to alpha-taxonomic level, in some genera there is a certain approach to beta- and gamma-taxonomy. Morphometry and the evaluation of relation patterns in the genitalia system clearly reach or even surpass the borderline between beta- and gamma-taxonomy. Morphometry is in common use in groups with gamma-taxonomic background (e.g. NEMESCHKAL 1999 uses morphometric correlation patterns of adult birds to mirror the expression of developmental genes). This paper is the first attempt to introduce a reliable morphometric system to define and characterize male genitalia of noctuids. While obtaining data from skeletal structures is a more or less easy undertaking, measuring of weak and distortable organs is a challenge. Although sclerotized, genitalia are three-dimensional structures which are normally available as microscopic preparations only. That clearly means that we have an encouraging amount of different possible measurings but projected into the 2nd dimension. Genitalia are fixed and pressed, the slides are projections of a primary three-dimensional system. So one of the major problems is an exact ranging, is to find a method of reliable interpretation of the three-dimensional copulation organs.

KLOTS in TUXEN (1956) and of course recent publications like KITCHING & RAWLINS in KRISTENSEN (1999) and SCOBLE (1992), are still the morphological base of this paper.

However, the basis of a reliable measurement system is still the detailed knowledge of the genitalia tract, a knowledge which requires detailed studies during preparation and which requires much

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information gathered in situ situations. Only the exact knowlegde of the real situation in the abdominal lumen and in the genitalia corpus enables us to estimate and to calculate reliable figures.

Morphometry

This chapter presents a commented survey of the tested measurements in male genitalia of quadrifine noctuids. The problems of measuring and the possible problems in interpreting the projection from 3rd to 2nd dimension are discussed. Examples are given which information value can be gathered from each measurement. The listing is completed by a catalogue of relational indices which have proved to be of taxonomic importance.

The male genitalia corpus (Fig. 1):

The male genitalia corpus is a clasping organ which - in a general view - consists of a frame (tegumen and vinculum) and a clasping system. The clasping system contains a pair of (normally symmetrical) valves articulating at the sides of the tegumen-vinculum-complex and the uncus which originates at the caudal end of the tegumen. In its middle there is a system of skinny folds and shields (anellus, juxta, diaphragma) which holds and guides the aedeagus.

ul (length of uncus) (Fig. 4): The major caudal part of the 10th tergite is called uncus, although part of it is incorporated into the tegumen (SCOBLE 1992). Different accessory or associated structures occur around the uncus. These structures are difficult to define and quite different from species to species. The normal case is an uncus which is a more or less curved hook. Unci can be club-shaped, finger-like, can be slim and slender or bulky, unci can have blunt or fine pointed terminal ends, can exhibit long and strongly sclerotized tips or can be reduced to small and insignificant knobs. Some unci wear helmets, others have enlargements on their ventral surfaces.

Here the length of the uncus is defined as the length from the dorsal surface of the insertion in the tegumen to the distal end. This is a projection into the 2nd dimension and a real side view length and not the real length of the hook itself. We have difficulties with unci with a frontal overhang. In this case the uncus length would not be measured exactly by our definition (Fig. 12). In these cases detailed studies require the splitting in an **uncus net length (unl)** (Fig. 12) and an **uncus gross length (ugl)** (Fig. 12). The first still gives the length as defined above, the second measures the distance from the insertion to the farthest point on the uncus vertex.

As stated unci are normally well sclerotized and hold their structure when pressed into the 2nd dimension. Very often unci in slides keep their shape and character in regard to their curvature. Sometimes unci are too weak and – especially when weakly sclerotized in the basal part – tend to bend in an artificial way (e.g. in the herminiine genus *Hydrillodes* GUENÉE, 1854). Measurements of these preparations are difficult and require a precise knowledge of the natural curvature of the uncus. Some species of *Rhynchina* GUENÉE, 1854 and *Zekelita* WALKER, 1863 tend to have these problems. An especially serious situation is found in species with very weak, finger-like unci which definitely do not hold their curvature (or even do not have one, because the natural position is a loose hanging or a strict pocket-knife position in relation to the ventral surface of the teguminal pads). Such an example is *Rhynchina martonhreblayi* LÖDL, 1999 (LÖDL 1999: figs. 2-4). The uncus of this species is a weakly sclerotized finger normally clapped to the tegumen, slightly flattened dorsoventrally and therefore very difficult to measure. A "normal" curvature of the uncus does not exist in this species. A similar situation in two *Hypena* species is demonstrated in figs. 8-9.

Figs. 1-3 *Zekelita antiqualis* (HÜBNER, 1809), ♂, NHMW gen. praep. M. Lödl no. 667 (next page / nächste Seite):

Fig. 1: Measurements on corpus genitalis. Scale = 0.5 mm.- **Fig. 2**: Measurements of left valve; valve in dark field illumination. Scale = 0.1 mm.- **Fig. 3**: Central part of corpus genitalis and measurement of width of valve-base; TeE = teguminal ear. Scale = 0.1 mm

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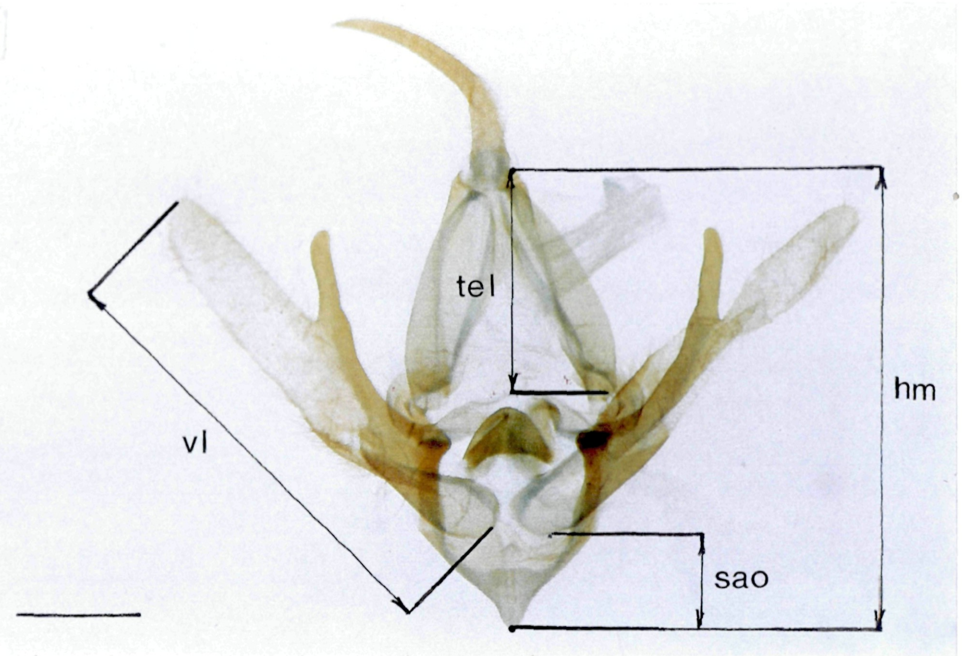

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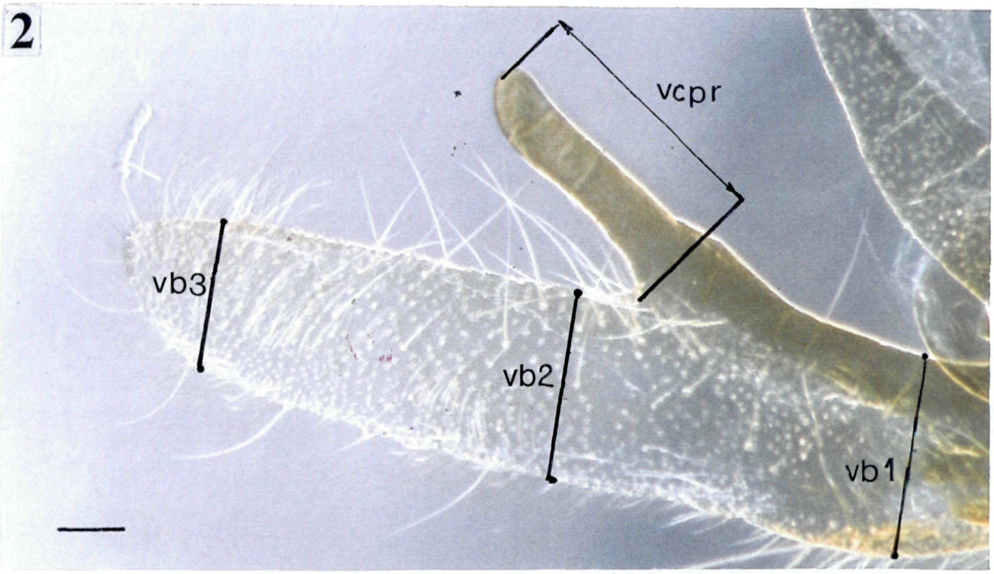

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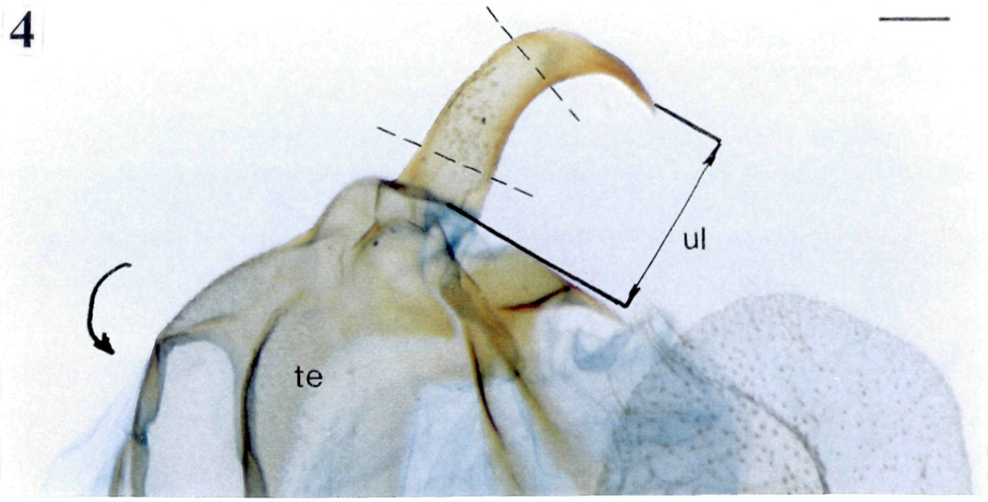

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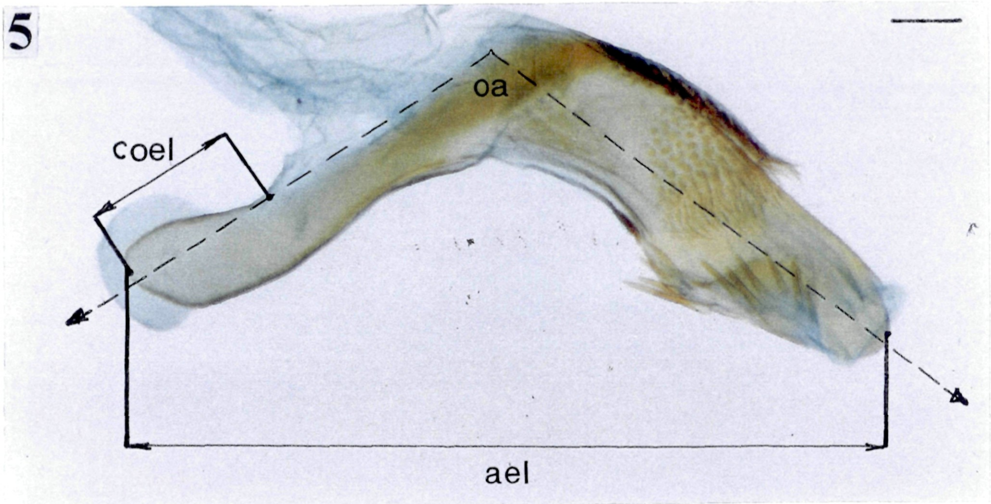

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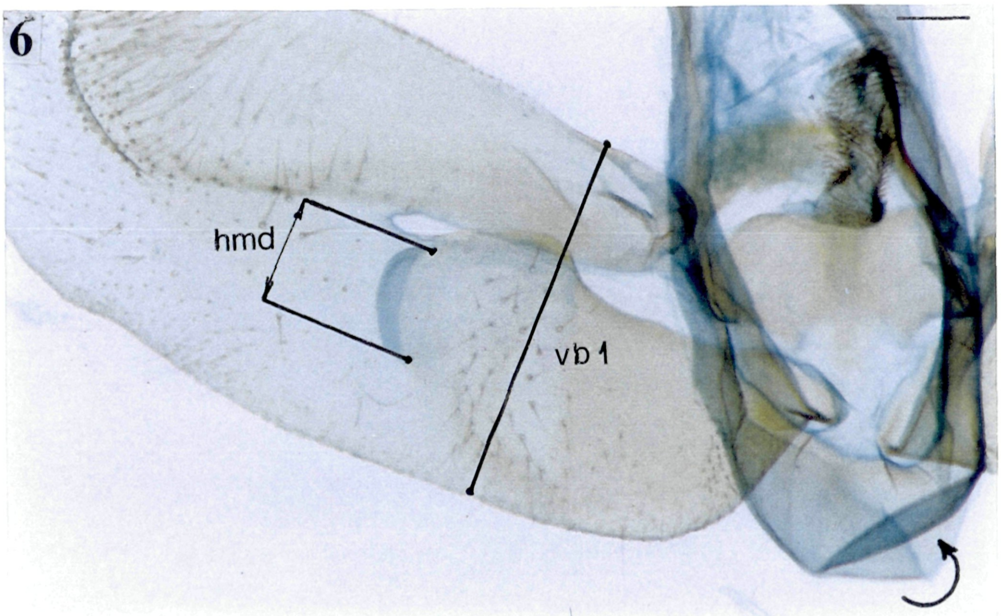

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Figs. 4-6: *Hypena* (*Tetrastictypena*) *orthographa* TURNER, 1932, ♂-lectotype, NHMW gen. praep. M. Lödl no. 637 (scale = 0.1 mm) (previous page / vorige Seite):

Fig. 4: Distal part of the corpus genitalis (te = tegumen) and uncus. The dotted lines indicate the measurement of the width of the uncus. Arrow marks the artificial distortion of the voluminous tegumen-pads.- **Fig. 5**: Aedeagus. Length of aedeagus and length of coecum are indicated. Dotted line shows the opening angle.- **Fig. 6**: Left valve with basal width measurement and measurement of the half moon disc. Arrow indicates the part of the skinny saccus, clapped ventrocaudally.

A very specialized situation is found in the genus *Catada* WALKER, [1859] 1858 (LÖDL 2001): A completely aberrant uncus, like a helmet with a slim and rounded distal part and a blown up basal part, exists. The scaphium which in fact looks like an uncus-hook, is claw-like and sclerotized. Fig. 7 gives a good example of the measurement problems in this genus. The insertion of the scaphium sclerite is pressed into an artificial position (the arrow in fig. 7 marks the correct position of the scaphium base). The measurements of this complicated case are demonstrated.

uh (height of the uncus) (Figs. 10, 28): The height of the uncus is precisely the height of the curvature, that means the distance from the (imaginary) baseline "insertion of uncus to vertex of uncus" up to the highest point of the uncus. Unci which are extraordinarily hook-shaped (like species of the genera *Harita* MOORE, 1882 or *Ricla* WALKER, 1869) have a remarkable height of the uncus, many Herminiinae which exhibit a club-shaped uncus which is kneed at the base do not have such a striking curvature and therefore have a lower figure (Fig. 28).

ub (width of the uncus) (Fig. 7, 11): We can measure all unci which follow the definition of above: Well sclerotized hooks with more or less defined curvature projected in the flat slide position. Difficult to measure are all flattened and all reduced unci, knob-like forms which follow their own guide-lines. The width is the shortest distance between the dorsal and the ventral surface from the side view (Fig.). The width can be taken on different locations on the uncus.

We normally use **ub1 (width of the uncus at the base)** (Fig. 11). This is defined as the width in the first fifth or sixth of the length of the uncus. Additionally we use **ub2 (width of the uncus in the middle)** (Fig. 11) which normally is synonymous with the width on the broadest point. If this is not the case in certain groups ub2 remains to be measured in the middle and **ubm (maximum width of the uncus)** is gathered additionally. This is necessary in species with helmet-like unci which have their maximum width near the distal end or species with blown up distal tips. **ub3 (width of the uncus at the distal fifth)** can be measured additionally and makes sense in not typically sharp pointed, hook shaped unci (Fig. 7). Very difficult is the measuring of species with partly flattened unci or unci with wing-like processes on the sides of the uncus (e.g. *Phanaspa* WALKER, [1866] 1865 (LÖDL 1995)).

Accessory or associated structures of the uncus:

Around the uncus different accessory or associated structures occur. These structures are difficult to define and quite different from species to species. The following definitions for these allied structures can be presented:

Socii: A couple of more or less hairy lobes on both sides of the uncus base. The derivation is uncertain (SCOBLE 1992), sometimes they are prominent sometimes they are very small. Generally they are considered to be modifications of the 10th tergite or the intersegmental membrane of the 9th and 10th abdominal segment, or of the cerci (appendages of the 11th abdominal segment). An impressive example for socii directly deriving from the base of the uncus corpus is *Nolasena ferrifervens* WALKER, [1858] 1857.

Gnathos: A pair of sclerites derived from the 10th sternite, closely associated to the uncus. This sclerites may be fused to one single structure or may be reduced or absent. This structure is different from sclerotizations of the anal tube.

Scaphium: Sclerotizations of the dorsal part of the tuba analis.

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Scaphium: Sclerotizations of the dorsal part of the tuba analis.

Subscaphium: Sclerotizations of the ventral part of the tuba analis.

Teguminal processes: These are structures clearly deriving from the tegumen, standing closely to the uncus. A spectacular form of this rare modification was found in *Rhynchina martonhreblayi* LÖDL, 1999. In this species the uncus is reduced to a weak finger linked to the ventral surface of the tegumen like a hinged arm. The two long teguminal processes are stiff and are extending forward. The corresponding features in the female are unclear, the female is not known yet. Clear is that this finger-like uncus cannot have any progressive pushing or clasping function. Probably the directive habit of opening and widening the ostium cave is managed by the two teguminal arms.

All structures mentioned above can be measured with their length or width, the measurement must be in accordance to the taxonomic nessecities of the group under investigation. The following measurement is an example:

scl (length of scaphium) (Fig. 7): The sclerotized, dorsal part of the scaphium is of different length. This measurement has proved to be of importance for a sort of secondary lock-and-key system between the uncus and the scaphium (LÖDL 2000). The scaphium in some cases seems to be a shield preventing the tuba analis for being pierced by a strongly sclerotized hook of the uncus. Of particular interest are correlations between the length of the uncus and the length of the scaphium.

hm (length of the corpus genitalis) (Fig. 1): This is one of the most important measurements as it is the base of many relational indices. A lot of different measurements on the male genitalia have to be calculated with the hm. The hm is the "height of the male genitalia corpus" as it is projected into the 2nd dimension and is measured from the cephal end of the vinculum (saccus) to the end of the tegumen (normally the insertion of the uncus). Difficulties are coming up with extreme three-dimensional genitalia or weak genitalia which tend to deformation of the corpus genitalis while pressed into the slide dimension. Experience and a certain knowledge of the original "three-dimensional type" of genitalia is necessary to come to reliable results. The teguminal frame (sometimes with enlarged pads with tufts) and the vinculum sometimes have a complicated three-dimensional position to each other. However, normally both sclerotized frames can be pressed into the 2nd dimension without loss of too much morphological information. The "normal" genitalia shows a vinculum which claps ventrally when pressed. Artificially deformed or clapped vinculi have to be ignored or have to be extrapolated when enough knowledge about the natural position of the male genitalia in the abdominal lumen is gathered.

tel (length of tegumen) (Fig. 1): The tegumen is formed by the 9th tergite and cephalic elements of the 10th tergite. It forms (together with the vinculum (quadrifine noctuids) and together with a paratergal sclerite and the vinculum (trifine noctuids)) the central frame of the corpus genitalis. On its distal end the uncus is inserted and it extends with its ventro-cephalic arms, the pedunculi, to the dorsal articulation of the valve. Normally the tegumen is well sclerotized, in many noctuids it consists of two sclerotized, frame-like pads which can be enlarged and wear tufts of hairs. In the middle there is a skinny diaphragma. The length of the tegumen is measured from the insertion of the uncus to the beginning of the vinculum frame. Problems are coming up when the tegumen is very bulky and forms thick and broad pads which tend to distortion during the preparation process. If the tegumen is pressed carefully and the projection is a clear dorsoventral view the measuring of the length of the tegumen is easy. The relation of the length of the tegumen to other parts of the genitalia corpus is of great importance. The tegumen can occupy the major part of the length of the genitalia (e.g. species of the genera *Harita* and *Ricla*) or the tegumen can be quite inferior (many species of the genus *Catocala* SCHRANK, 1802).

sal (length of saccus) (Fig. 27): The saccus is the cephalic portion of the vinculum, sometimes a broad sac, sometimes a pointed evagination like an ice-cone. The length of this cephalad protrusion can be quite different, especially the protrusion in relation to the articulation of the valves and the remaining genitalia corpus. The exact diagnostic difference between the vinculum itself and the cephalic evagination called saccus can be difficult. We define the saccus as the clearly visible evagination following proximally the pure vinculum frame. Some groups (e.g. the genus group *Idia* HÜBNER, [1813] of the Herminiinae) have typical cone-shaped sacci, others have quite reduced, rounded and insignificant sacci (e.g. genus *Harita*). If the saccus is well sclerotized there are no problems in measuring.

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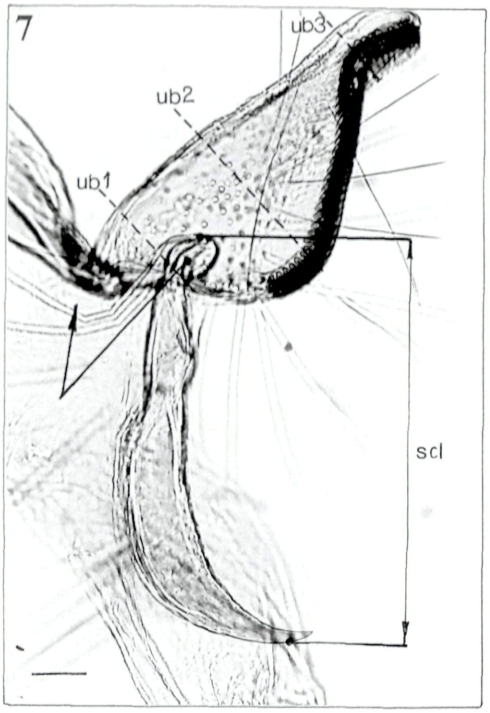

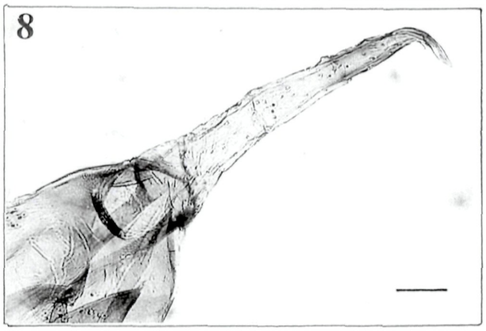

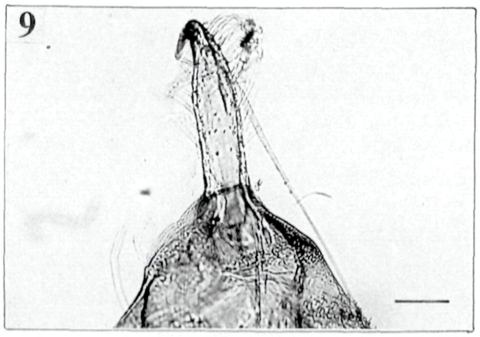

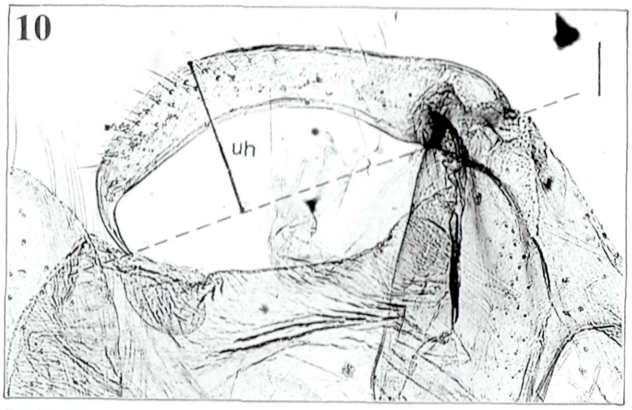

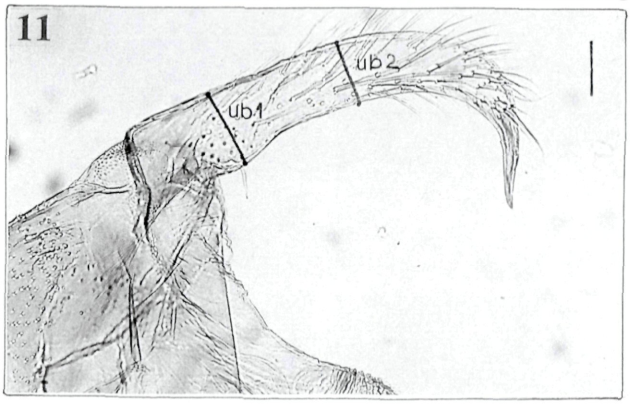

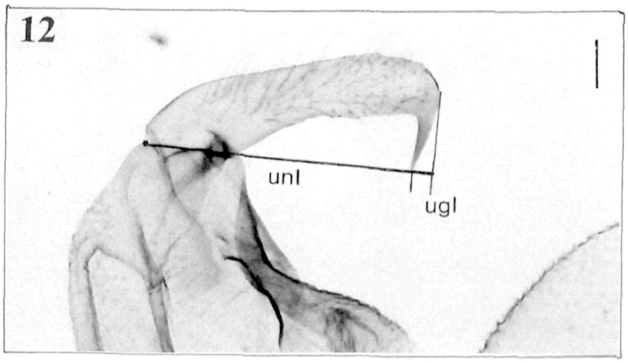

Figs. 7-12 Different uncus situations (scale = 0.1 mm):
Fig. 7: *Catada vagalis* (WALKER, [1859] 1858), holotype, Noctuidae Brit. Mus. slide No. 16026, width of uncus and scaphium length.- **Fig. 8**: *Hypena laetalimaior* LÖDL, 1995, NHMW gen. praep. M. Lödl no. 327, distorted uncus.- **Fig. 9**: *Hypena biangulatoides* POOLE, 1989, NHMW gen. praep. M. Lödl no. 271, distorted uncus.- **Fig. 10**: *Dichromia mesomelaena* (HAMPSON, 1902), Noctuidae Brit. Mus. slide No. 15289, height of uncus.- **Fig. 11**: *Hypena striolalis* AURIVILLIUS, 1910, NHMW gen. praep. M. Lödl 398, width of uncus.- **Fig. 12**: *Hypena pelodes* TURNER, 1932, lectotype, NHMW gen. praep. M. Lödl no. 647, uncus net length and uncus gross length.

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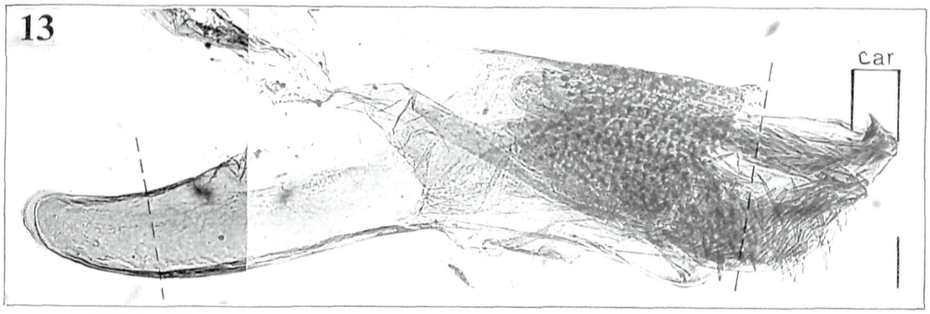

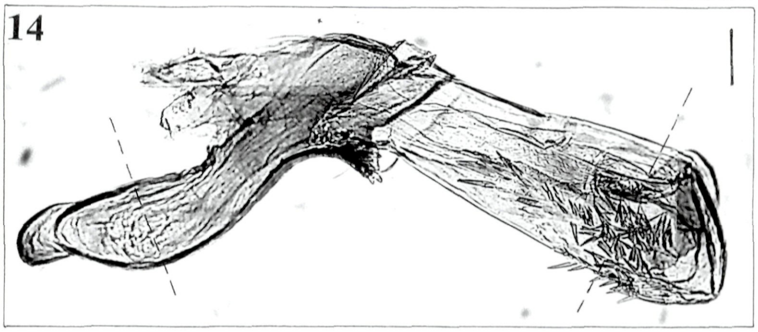

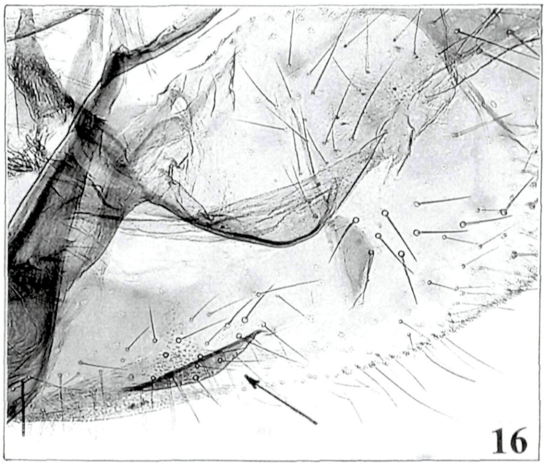

Figs. 13-17 Different measurements on adeagus and valve (scale = 0.1 mm):
Fig. 13: *Hypena extremipalpis* LÖDL, 1994, holotype, NHMW gen. praep. M. Lödl no. 261, dotted lines indicate width of aedeagus; length of carina.- **Fig. 14**: *Hypena erikae* LÖDL, 1994, paratype, NHMW gen. praep. M. Lödl no. 376, curious proportion of aedeagus; dotted lines indicate width of aedeagus.- **Fig. 15**: *Hypena biangulatoides*, NHMW gen. praep. M. Lödl no. 292, collapsed sacculus lobe on left valve.- **Fig. 16**: dto.- fully evaginated sacculus lobe on right valve.- **Fig. 17**: *Hypena bonaberi* STRAND, 1915, Friese gen. praep. no. 764, sacculus lobe on left valve.

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We have difficulties with species with weak sacci which tend to be distorted, folded or clapped during preparation. This matter is especially sensible when the mazeration process was too intensive. KOH weakens the genitalia corpus, especially the self consistence of the tegumen-vinculum-frame thus distorted vinculi and "middle-folded" genitalia are common. These cases should be excluded from taking measurements.

sab (width of saccus) (Fig. 34): The definition of "saccus" is given above. Sacci can be of quite different shapes, as mentioned before there are broad or fine pointed, long or stout sacci. The width is measured on three different saccus regions: **sab1 (width of saccus taken at its caudal end)**; normally this is between the ventral articulation of the valves)), **sab2 (width of saccus taken in its middle)**; **sab3 (width of saccus taken about 5-10% of sal caudad from the cephal end)**. The first measurement (sab1) is necessary to define the width of the saccus at its beginning, the second (sab2) defines the progress of the pointedness, the last measurement (sab3) is important for defining the sharpness of the point.

sao (cephalic overhang of saccus) (Figs. 1, 34): The saccus protrudes proximally and in some groups extends significantly beyond the most cephal parts of the valves. This "overhang" is defined as the "overhang of saccus". This measurement is easy to determine in groups with broad articulations of the valve or well formed and sclerotized valves which do not allow collapsed tissues in this part of the genitalia. Genitalia with eversible sacculi, collapsible, weak valves and weakly inserted valves in the tegumen-vinculum-frame are very difficult to measure. Normally the overhang of the saccus is positive (saccus extends beyond the remaining parts of the genitalia) or can be negative (saccus is exceeded by parts of the genitalia, e.g. the valves (genus *Dichromia*)). If parts of the valves are distorted or even the valve is artificially turned backwards the overhang of the saccus must be interpolated carefully. The "true" figure of the overhang of the saccus is most important in groups with "typically" long overhang (many Herminiinae (e.g. *Cristatopalpus olivens* BETHUNE-BAKER, 1908 (Fig. 34) and Catocalinae).

var (distance between ventral and dorsal articulation of valve at the genitalia corpus) (Fig. 33): The dorsal connection of the valve with the genitalia corpus is normally situated on the tegumen, the ventral one mostly sits on the vinculum. These connections are more or less membranous or realized as knotted articulations. The distance between the dorsal and ventral articulation can be very different. Sometimes it is a typical feature of a genus to have a short distance (like the subgenus *Trichypena* JOANNIS, 1915 (of *Hypena*) or the genus *Harita*) or a long distance (like the subgenus *Extremypena* LÖDL, 1994 (of *Hypena*) or *Britha*).

This measurement is a typical measurement of a projection because the articulations of the valves are lying on quite distant points. They mirror the three-dimensional situation of the curved tegumen-vinculum frame and depend further on the dorso-ventral amplification of the genitalia corpus. So it can be difficult to standardize this measurement between the genera. The measurement within one genus is not the problem, because the effect of deformation turns out to be a calculable one.

The valves:

The valves are paired clasping organs and organs for gathering sensitive information during the copulation. Valves are more or less membranous and sometimes wear striking processes and coremata which function as scent disseminating organs. The valves and their relational indices are one of the most important features of the genitalia to measure. Flat and two-dimensional valves are best for taking measurements, highly three-dimensional valves are problematic because unfortunately they tend to have significant deformation during the preparation.

vl (length of valve) (Fig. 1): The length of the valve is measured from its distal end to the ventral articulation of the valve at the vinculum. This has proved to be most significant. Coremata or extended sacculi are not regarded for this measurement because they are too weak and do not offer an essential point. In case of long valve processes the valve itself has to be measured, sometimes it is difficult to decide which evagination is the corpus valvae and which is the process (e.g. *Brontypena exima* (PAGENSTECHER, 1886) (= *Corcobara longipennis* SWINHOE, 1902) (Fig.). Long pad-like sacculi lead to a far cephalic articulation point of the valve (e.g. *Aulocheta* A.E. PROUT, 1927 (LÖDL 1996)). Also difficult to measure are valves which tend to have a certain bending due to morphological speciality. So

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the members of the genus *Pinacia* HÜBNER, [1831] 1825 have a specific bend at the distal third of the slender and flabby valve which induces a remarkable knee of the longitudinal axis of the valve. However in this case the length of the valve can be extrapolated.

vb (width of valve) (Figs. 2, 3, 6): We face a similar situation with the width of the valve as we have with the length. Valves of two-dimensional character can be quite better measured than three-dimensional ones. The width of the valve gives useful information about the proportion of the valve itself. Therefore we suggest measurements at three distinct points.

vb1 (width of valve at sacculus) (Figs. 2, 3, 6): This means the width at the base of the valve and means further a measurement of the corpus valvae itself, it does not mean diverse extensions and evaginations of the sacculus. Coremata tubes or tuft organs are definitely excluded from measurement, they proved to be too insignificant, too weak and flabby to offer reliable results. The broad and flat valves of *Dichromia*-species as an example are easily measured even with their broad sacculi. But these sacculi are not protruding and are not eversible and so part of the corpus valvae. Very problematic are the proximally enlarged genitalia of *Herminia* LATREILLE, 1802 / *Polypogon* SCHRANK, 1802 s.str. Particularly the species near *Herminia tarsicrinalis* (KNOCH, 1782), e.g. *H. satakei* OWADA, 1982, *H. ryukyuensis* OWADA, 1982 and *H. arenosa* BUTLER, 1878, have a skinny, dorso-ventrally enlarged sacculus which resists all attempts of being properly projected to the 2nd dimension. The ventral margin of the sacculus crosses the significantly broadened vinculum-saccus area and inserts far in the middle of the corpus (OWADA 1987: figs. 293-295, 300). This causes regularly so much distortion of the genitalia tract that the measurement of vb1 (and sometimes vb2) must be taken from in situ preparations or must be extrapolated carefully by doubling the figure of the folded part of the sacculus. We face a similar situation in the genus *Hydrillodes*, the vinculum area is also massive and broad and the skinny sacculus region is enlarged. The insertion on the genitalia corpus does not allow a proper measurement of vb1 and vb2.

vb2 (width of valve in the middle) (Fig. 2): A measurement in the middle turned out to be of good significance. Many species have dented margins of their valves in the middle, others show smoothly pointed valves. So the measurement in the middle is necessary to gather information about the proportion of the valve. The same is true for the other valve measurements: Only the corpus valvae has to be taken into consideration, processes of the sacculus which often extend up to the middle of the valve are not part of the valve in this sense.

vb3 (width of valve at distal fourth) (Fig. 2): The "distal fourth" is the weakest of these three definitions. It means a measurement defining the sharpness of a valve therefore it is not necessary to define an absolute exact point of measuring. Difficulties exist if processes of the margin or lobes of the margin hide the situation. Part of our definition is the "corpus valvae itself" that means that a distinct process or lobe has not to be counted. A general lobe-like extension or broadening of the valve is part of the corpus valvae and therefore has to be counted. So in the subgenus *Ophiuche* HÜBNER, [1825] 1816 of the genus *Hypena* the lobe of the dorsal margin of the valve is a distinct valve process, the ventral extension of the valve of the genus *Xoria* NYE, 1975 clearly is part of the valve itself.

col (length of the corona): The corona is a typical feature of trifine noctuids. It is a marginal lace of strong setae or sclerotized teeth on the cucullus. These setae are significantly arranged in a line. The net length of this curved lace along the cucullus is an important character in trifine Noctuidae. In quadrifine noctuids this measurement always counts "0". Best is to calculate this measurement in relation to the length of the valve.

The processes of the valves:

A wide variety of processes and lobes exists. The major problem is to find out homologous structures. Even standing on the same place we cannot be sure that a process is homologous to another, similar one. That forces us to very careful investigation. Under one measurement (so far possible) only homologous structures should be considered. Structures typical for a genus or another monophyletic unit must be found and identified as a certain type of process and must be defined. In the genus *Rhynchina* for instance two types of processes, a sacculus process (sometimes fused with the central portion of the valve) and a valve process are repeated in different combinations (MAYERL & LÖDL 1999).

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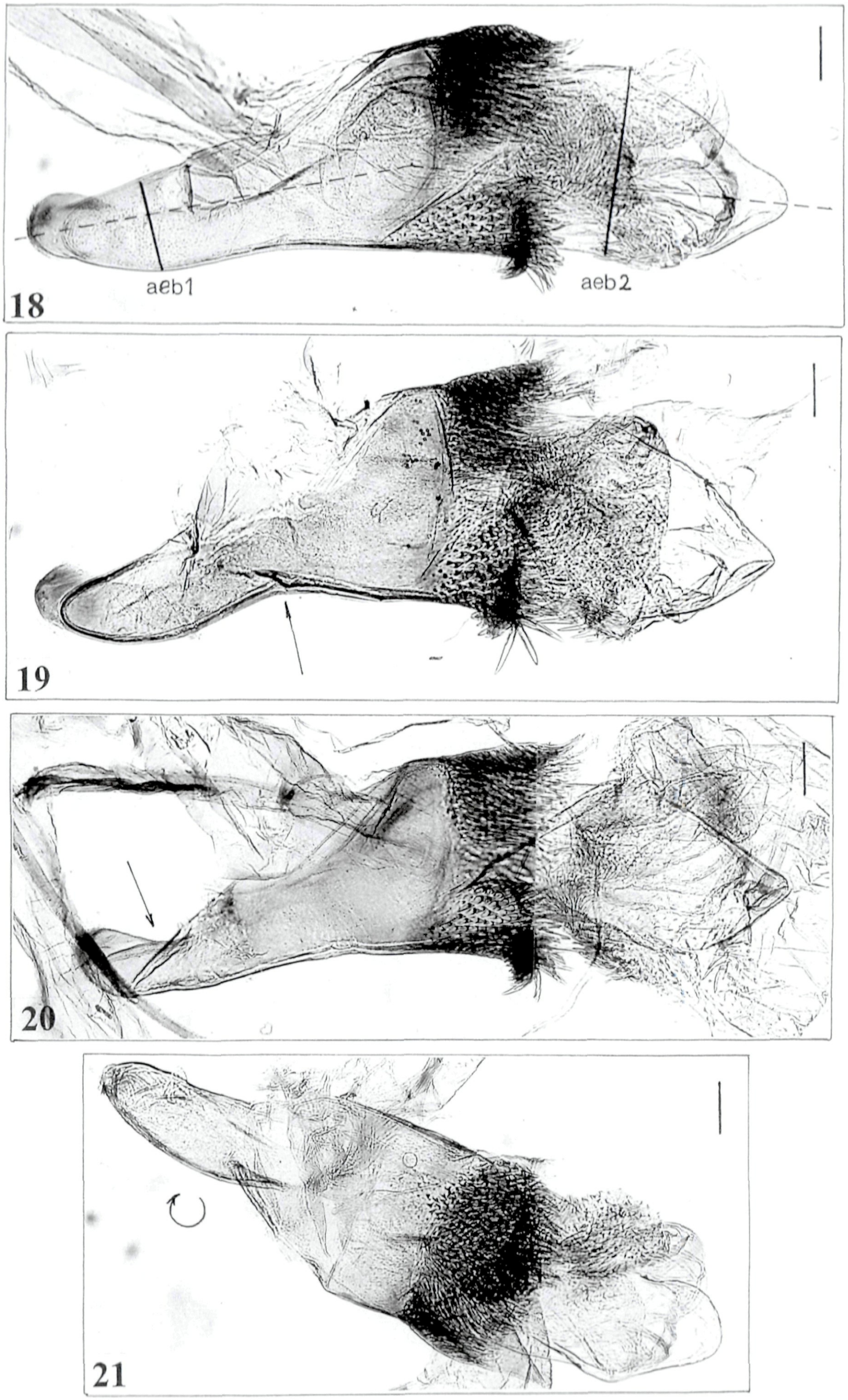

Figs. 18-21 *Hypena laceratalis* WALKER, [1859] 1858, width of aedeagus; the arrows mark regions of distortion (scale = 0.1 mm):
Fig. 18: NHMW gen. praep. M. Lödl no. 410. Dotted line show ideal measuring of the opening angle.- **Fig. 19**: NHMW gen. praep. M. Lödl no. 414. Coecal portion kneed artificially.- **Fig. 20**: NHMW gen. praep. M. Lödl no. 426. Coecum kneed upwards.- **Fig. 21**: NHMW gen. praep. M. Lödl no. 406. Central portion of aedeagus completely distorted.

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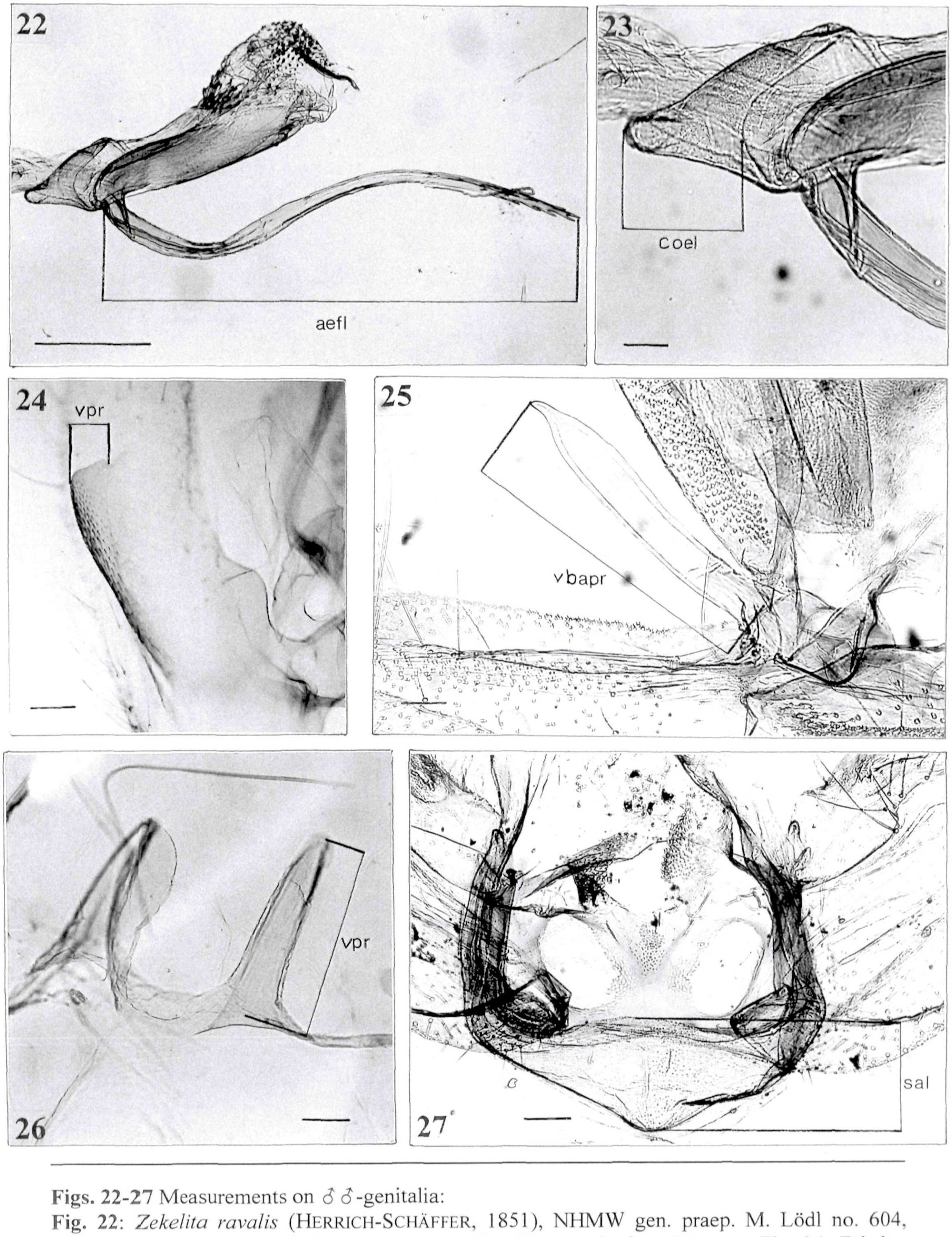

Figs. 22-27 Measurements on ♂♂-genitalia:
Fig. 22: *Zekelita ravalis* (HERRICH-SCHÄFFER, 1851), NHMW gen. praep. M. Lödl no. 604, measurements on aedeagus. Scale = 0.5 mm.- **Fig. 23**: dto.- Scale = 0.1 mm.- **Fig. 24**: *Zekelita leucodonta* (HAMPSON, 1910), Noctuidae Brit. Mus. slide No. 16391. Central process of valve. Scale = 0.1 mm.- **Fig. 25**: *Phanaspa derasalis* (GUENÉE, 1854), paralectotype, NHMW gen. praep. M. Lödl no. 257. Basal process of valve. Scale = 0.1 mm.- **Fig. 26**: *Anoratha costalis* MOORE, 1867, lectotype, Noctuidae Brit. Mus. slide No. 15360. Central process of valve. Scale = 0.1 mm.- **Fig. 27**: *Hypena extremipalpis* LÖDL, 1994, holotype, Noctuidae Brit. Mus. slide No. 15274. Length of saccus. Scale = 0.1 mm.

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A similar situation is found in the genus *Perciana* WALKER, 1865 (LÖDL 1999d). The following list gives some examples of measurements which have proved to be of significance for some monophyletic units. Measurements of this wide field of different processes and lobes give a broad view over the relational factors which define the valves of the different groups and help to find out which features sketch an evolutive line on species or higher taxonomic levels.

scpr (length of sacculus process) (Fig. 29): The sacculus process is one of the processes which can be determined relatively easily. The sacculus is well defined and normally sacculus processes evaginate directly from the sacculus and have the same direction as the valve. Good examples are the sacculus processes of many Herminiinae (mainly the *Idia*-group) and the sacculus processes of the *Rhynchina*-species.

saclo (width of sacculuslobe) (Fig. 17): This defines a special situation found in the subgenus *Jussalypena* LÖDL, 1994 of the genus *Hypena*. This group exhibits skinny lobes which are covered with bristles on the ventral surface of the sacculi. The width of these lobes is of taxonomic importance. Sometimes it is difficult to decide if a sacculus lobe is fully everted and therefore the 2nd dimensional projection guarantees a correct image or if the lobe is collapsed (Figs. 15-16). An "in situ check" during the prparation process is advisable.

vpr (length of central process of valve) (Figs. 24, 26, 30): Processes deriving from the inner, central surface of the valve are numerous. Best is to define valve processes distinctly in each monophyletic group. We have experiences with the typical valve processes of the subgenus *Jussalypena* of *Hypena*. These are processes standing at or near the distal end of the valve and sometimes are serrated.

vbapr (length of the basal process of valve) (Fig. 25): In the genus *Phanaspa* e.g. there are found processes deriving from the most basal inner portions of the valves where the tegumen-vinculum-frame meets these inner regions of the valve surface.

vcpr (length of costal process of valve) (Fig. 2): In many species the costal margin of the valves species wears a process or lobe. Long and significant processes occur in the genera *Rhynchina* and *Zekelita*.

hmd (width of half-moon disc) (Fig. 6): Especially within the genus *Hypena* an unpretentious but remarkable, skinny lobe exists in the middle of the outer surface of the valve. This was described as half-moon disc ("Halbmondlappen"; LÖDL 1994a). The width of this lobe is interestingly different in different subgenera. While insignificant in the subgenus *Trichypena*, it is significant in many *Jussalypena*-species, is broad in *Ophiuche* and very broad in *Tetrastictypena* LÖDL, 1994.

vdl (length of the longest distal lobe of the valves). Especially in the Herminiinae (e.g. in the genera *Polypogon* or *Sinarella* BRYK, 1949 or others) the membranous distal part of the valves is split into several skinny lobes or prongs. This pronged distal end of the valve can be divided into two or three or more lobes and they are characterized as terminal lobes in contrast to lobes or processes of the costal margin of the valves. Many of the distal lobes of the valves within the herminiine genera are considered as homologous and therefore here defined as a distinct type of "lobes".

The aedeagus corpus:

The corpus aedeagi, the penis is a sclerotized tube and is standing in the centre or the middle of the genitalia corpus. It is inserted in the diaphragma (most likely the intersegmental membrane). This diaphragma is doubly folded around the phallus and forms here the fultura superior (dorsally) and the fultura inferior (ventrally). If sclerotizations are found they are called transtilla (dorsally), anellus (directly around the perforation) and juxta (ventrally). These structures are structures for guiding and hiding the aedeagus. The aedeagus itself is a tube containing an endophallic sac called vesica. The vesica originated from the distal margin of the aedeagus tube and extends proximally. This vesica sac meets cephalad of the aedeagus the distal end of the ductus ejaculatorius within the bulbus ejaculatorius.

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ael (length of aedeagus) (Fig. 5): The aedeagus is a sclerotized tube, measuring is easy in most cases. The projection to the 2nd dimension is unproblematic, the typical side-view allows to take measuring from the coecal point to the distal end of the aedeagus. We measure exactly the projected length of the aedeagus not the real length. The exact finding of the distal end can be difficult. It is sometimes hidden by a partly everted vesica and therefore cryptic. A protruding vesica can camouflage the real distal end. Additionally the distal end is often weak and not so sclerotized as the remaining tube is.

The length of the aedeagus is very important for a wide variety of calculations. The proportions of the aedeagus itself as well as the relation of the corpus penis to the corpus genitalis are based on this measurement.

aeb1 (width of aedeagus at coecal end) (Fig. 18): There are remarkable differences in the width of the coecal end, some species are markedly pointed, others have a blunt and broadened coecal end. So this is an important measurement, sometimes on species level, sometimes on genus level.

Special difficulties are present in genera with specialized aedeagi, e.g. in the genus *Zekelita*. *Zekelita* species often have short, robust and dorsoventrally flattened aedeagus tubes. They cannot be embedded laterally, the view is always a dorsoventral one. In this case (and typical for the genus) the width of the aedeagus does not figure the lateral view but the dorso-ventral view. *Phanaspa* and *Anoratha* MOORE, 1867 represent similar cases: the coecum is flattened and enlarged laterally. Measurements have to be taken from the dorso-ventral view and are of taxonomic interest.

aeb2 (width of aedeagus at distal fourth) (Fig. 18): In many species the aedeagus has its broadest width at the distal fourth or fifth. If the maximum width is not found at the distal end, a **aebm (maximum width of aedeagus)** can be measured additionally. The same difficulties as in aeb1 are found in some genera with dorsoventrally flattened aedeagi (see above).

coel (length of coecum) (Fig. 23): The coecum is the hollow, cephal portion of the aedeagus, measured from the cephal end to the entry of the bulbus ejaculatorius. The length of the coecum is quite different and gives valuable information about the relation of the aedeagus. Aedeagi can have more or less reduced coeca (which is partly of importance as an attachement for muscles) or coeca can be long and of massive volume.

cl (length of cornutus): Sclerotized spines or pikes, scobinate patches or plates can sit on the vesica and are termed cornuti. They are protruding into the bursa copulatrix while the vesica is brought in during copulation. Areas with scobinate patches or teeth-like sclerotizations are difficult to measure and in most cases it will not make sense to measure smaller sclerotizations. Pike-like cornuti or longer spines can be of taxonomic importance. But the knowledge of the species is absolutely necessary. In some groups the length of the cornuti, which can be of striking size, are important features (*Rhynchina*, *Zekelita*). Sometimes cornuti get lost during copulation, they can be teared out of the vesica during the anchorage in the bursa copulatrix. So the number of cornuti can vary and if there is a bundle of cornuti of different size, the measurements can lead to erroneous results.

car (length of carina penis) (Fig. 13): The carina penis is a dorsodistal keel of the aedeagus tube. It can be of specific or higher taxonomic importance. We prefer to measure the length of the dorsodistal sclerotization which is clearly connected with the keel. A carina penis e.g. is found in the subgenus *Extremypena* of the genus *Hypena*.

Figs. 28-30, scale of all 0.1 mm (next page / nächste Seite):

Fig. 28: *Dogninades renei* GAAL-HASZLER, 2000, ♂-paratype, Noctuidae Brit. Mus. slide No. 16493. Club shaped uncus with the measurement uh (height of the uncus). - **Fig. 29**: dto.- Sacculus process.- **Fig. 30**: *Perciana marmorea* WALKER, 1865, ♂-holotype, NHMW gen. praep. M. Lödl no. 690. Central process of valve.

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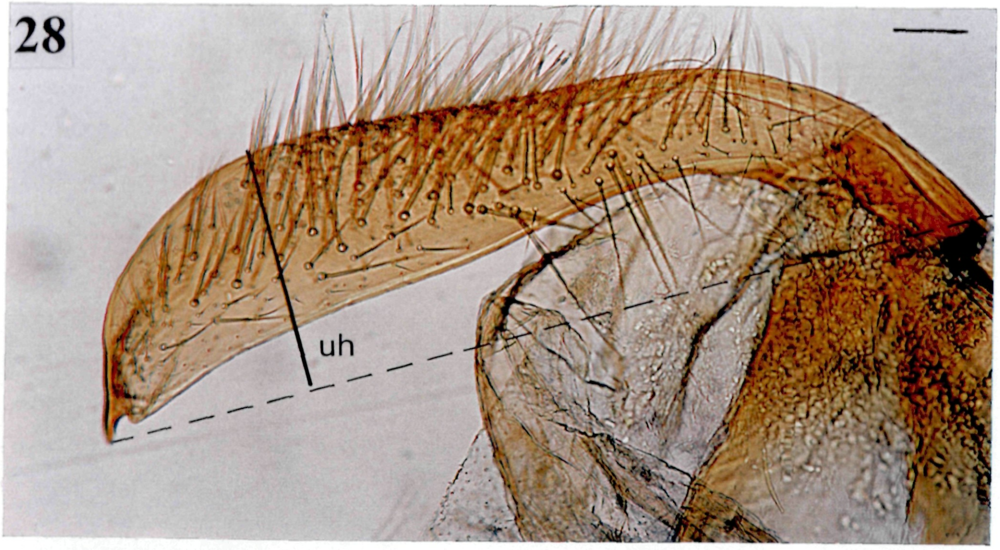

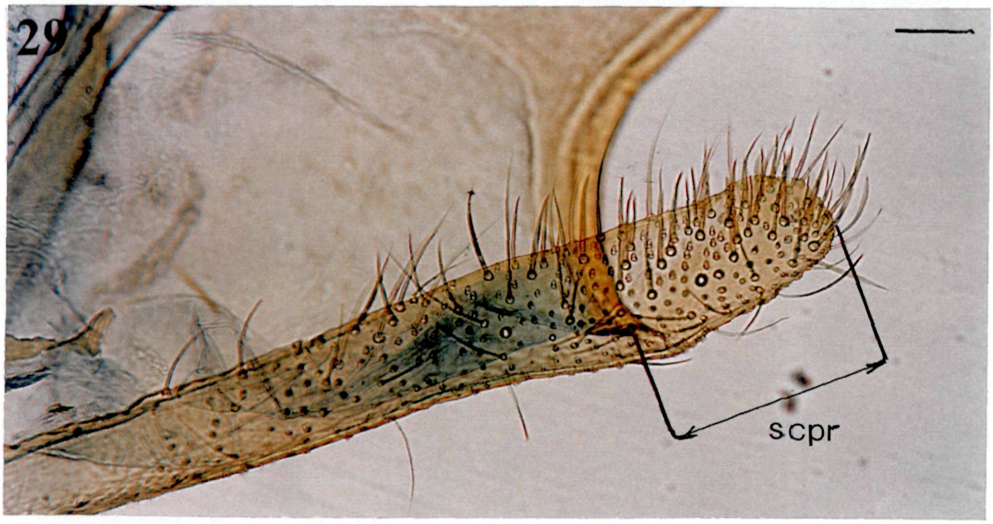

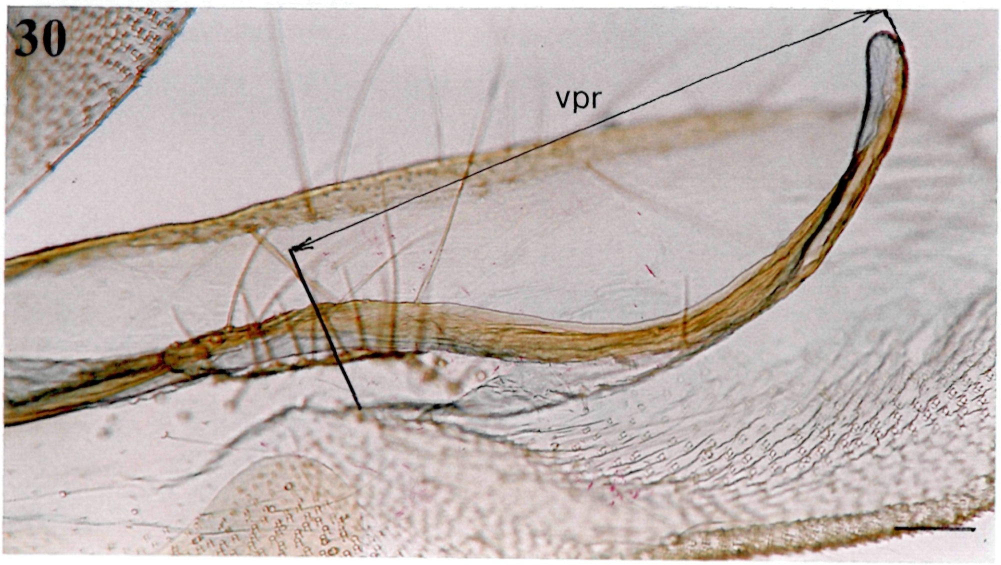

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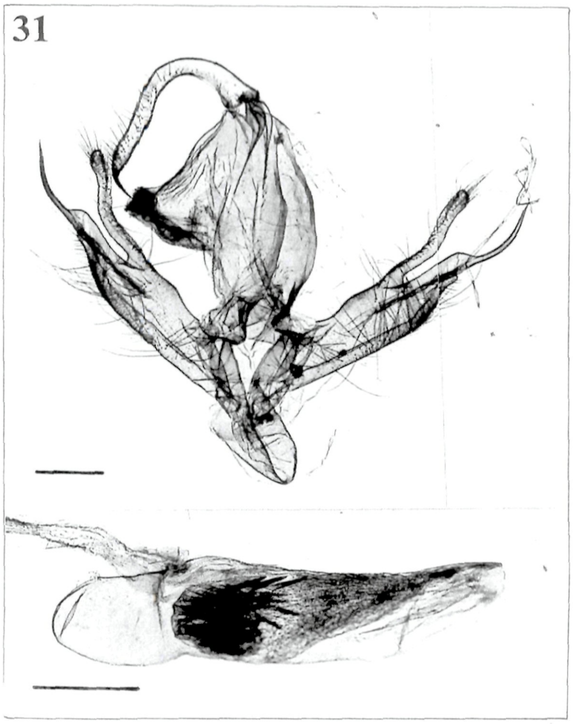

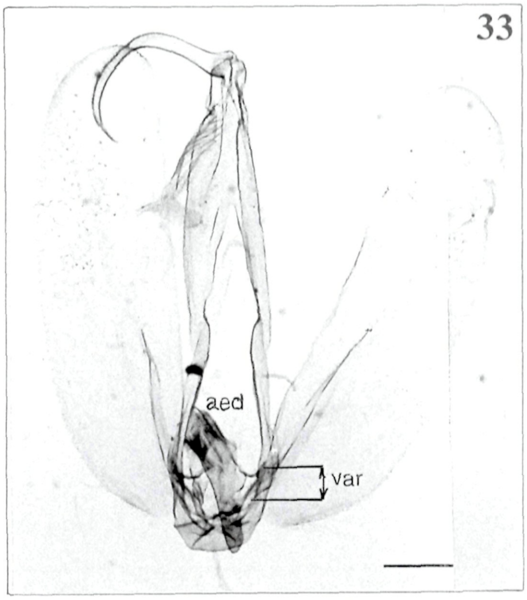

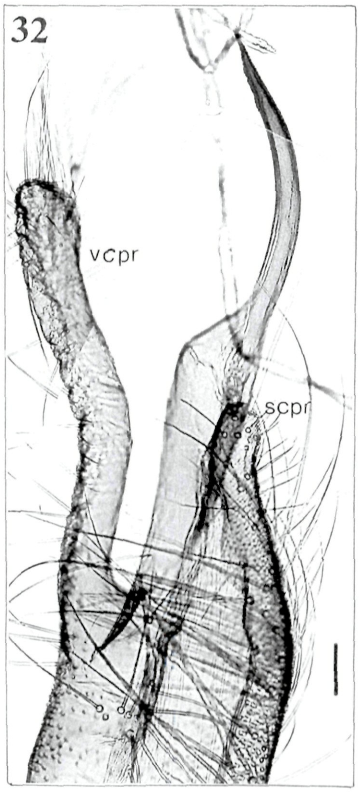

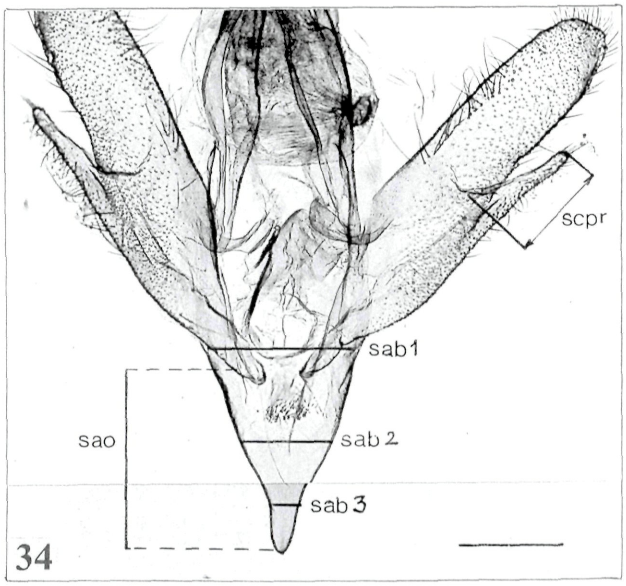

Figs. 31-34 Measurements in ♂♂-genitalia:
Fig. 31: *Brontypena exima* (PAGENSTECHER, 1886) (= *Corcobara longipennis* SWINHOE, 1902, syntype, Noctuidae Brit. Mus. slide No. 16418). Different processes of the valve. Scale = 0.5 mm.- **Fig. 32**: dto.- Valve processes in detail. Scale = 0.1 mm.- **Fig. 33**: *Harita brachyphylla* (TURNER, 1903), Noctuidae Brit. Mus. slide No. 8856 JDH. Genitalia, total. Aedeagus (aed) in situ. Scale = 0.5 mm.- **Fig. 34**: *Cristatopalpus olivens* BETHUNE-BAKER, 1908, holotype, Noctuidae Brit. Mus. slide No. 16453. Cephalic overhang of saccus and width of saccus. Scale = 0.1 mm.

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aesp (length of distal pike of aedeagus): In some species a significant distal pike, a fine pointed distal end of the aedeagus is visible. This is not identical with a carina penis which is a clear, sclerotized dorsodistal keel. The distal pike of the aedeagus ("Aedaeagus-Spieß") is a sharp-pointed end of the aedeagus tube. It occurs for example in the genera *Anoratha* (LÖDL & GAAL 1998) and *Phanaspa* (LÖDL 1995).

aepr (length of aedeagus-process): In the genus *Zekelita* (mainly in the subgenus *Tictalita* LÖDL & MAYERL, 1998) processes of the aedeagus are found which originate directly from the aedeagus tube and normally are paired. In the opinion of the author these processes are not identical with the ventral aedeagus-flagellum of the subgenus *Ravalita* LÖDL & MAYERL, 1997. The aedeagus-processes are quite different in size and shape and are of specific importance.

aefl (length of aedeagus-flagellum) (Fig. 22): In the subgenus *Ravalita* of the genus *Zekelita* a typical, long flagellum originates from the ventral surface of the aedeagus (LÖDL & MAYERL 1997, 1998: fig. 284). This flagellum is serrated at its distal portion and curved. The measurement is a net-measurement and does not mean the true length along all curves. Within the subgenus the length is of specific interest, the presence of the flagellum is – to the best of our knowledge - of subgeneric importance.

oa (opening angle of aedeagus) (Figs. 5, 18): The lateral view of aedeagi gives quite different impressions. A very important character is the type of "knee" the aedeagus exhibits. This is defined as the "opening angle of the aedeagus". There are straight aedeagi (oa = 180°), there are kneed aedeagi (oa below 180°) and there are aedeagus tubes which are concave from the dorsal view (oa over 180°). Problems of distorsion are illustrated in figs. 19-21).

Problematic are aedaeagi with a multiple oscillation along their longitudinal axis (e.g. some species of the genus *Britha* WALKER, [1866] 1865). In these cases it is advisable wether to prefer the more dominant curvature for measuring the opening angle or to measure both opening angles (**oa1, oa2**).

Relational indices

This chapter refers to the relational indices based on the measurements discussed previously. These relational characters calculate for a characterization of monophyletic units and are the base for a lot of different statistical tests.

The data are expressed preferably as percentage. This gives the possibility of a quick impression of the proportions of each couple of calculated data.

ub : ul (width of uncus in relation to length of uncus): This calculation gives an impression of the proportions of the uncus itself. Details can be gathered by using a higher number of ub-figures (ub1, ub2 .... ub_n). A first impression will be available by using two or three different width-figures. Fig. 35 gives the mean figures of the ub1ul and ub2ul calculation of several subgenera of *Hypena* and allied genera. This simple diagram demonstrates that normally the width of the uncus base is bigger than the width of the middle of the uncus. The closely related genera *Acidon* HAMPSON, 1896 and *Hiaspis* WALKER, [1866] 1865 are a little bit out of this line. At one hand the unci of *Acidon* are quite diverse (LÖDL 1998: fig. 71) and show unci with ventral extensions (the *Acidon mariae* LÖDL, 1998 – lineage (LÖDL 1998)) which clearly influences the mean figure of ub2ul and on the other hand the long and hook-shaped unci of *Hiaspis* have no sharpening from the base to its middle and are of the same width for a long distance. The most impressive difference of ub1ul and ub2ul is found in *Harita*. *Harita* has an enlarged knob-like base of the uncus and basically a very long uncus and therefore depresses the figure of ub2 in relation to ul. *Hypena* subgenera generally have short and stout and hook-shaped unci. Very stout are the unci in *Jussalypena* which prove to have the broadest unci in relation to its length as well at the base as in its middle. The scatterplot of the width-length-relations of the unci of the quite different genera *Hypena* and *Rhynchina* clearly shows that unci of *Rhynchina* are slenderer and have a markedly narrower uncus base (Fig. 37). In contrast the big and club-shaped unci of the major part of the Herminiinae increase the figure of ub2ul in relation to ub1ul.

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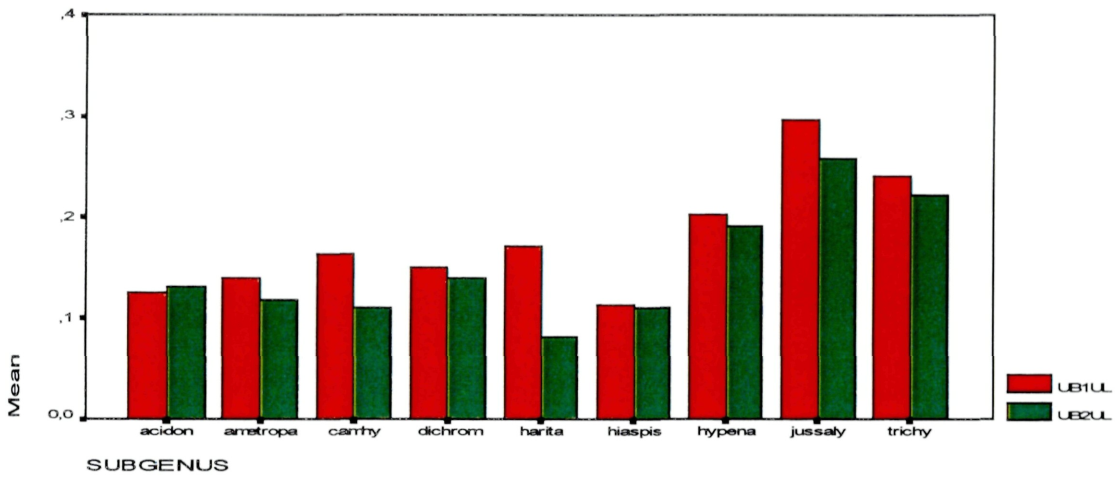

Fig. 35 ub1ul and ub2ul: bar diagram for different subgenera of Hypeninae.

uh : ul (height of uncus in relation to the length of uncus): This relation mirrors the curvature of the uncus in relation to its length, it is high in groups with long, slender and progressively curved unci (*Harita* and *Anoratha*) and groups with moderately curved but stout and short unci (subgenus *Jussalypena*). It is low in groups with kneed unci and unci with a long and straight distal portion (Herminiinae, *Rhynchina*). The boxplot of fig. 36 shows the different relations in a selection of genera and subgenera of Herminiinae and Hypeninae.

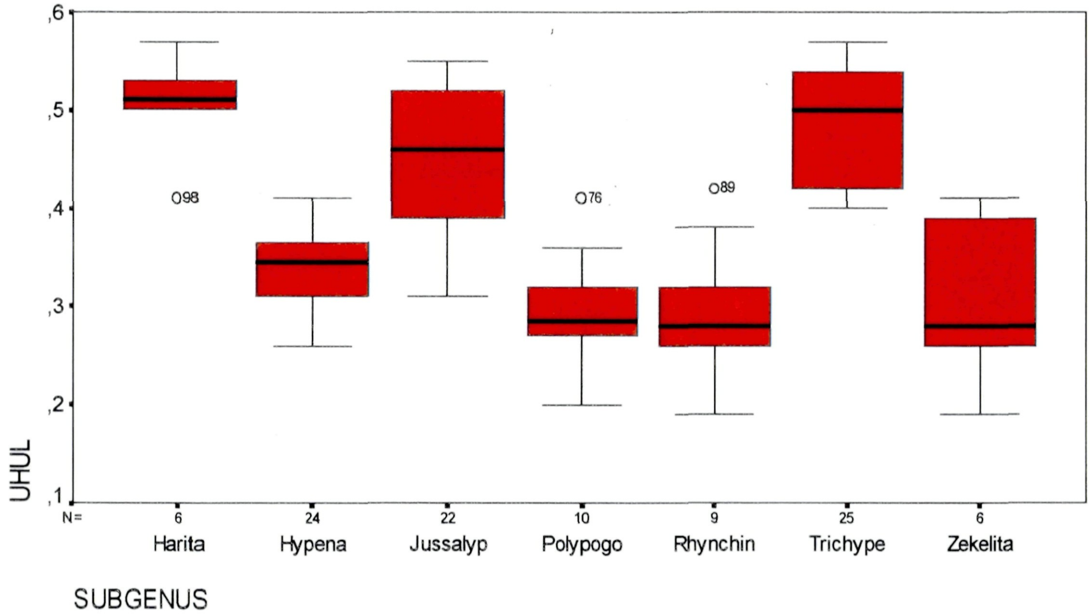

Fig. 36 boxplot of different uhul relations in genera and subgenera of Herminiinae and Hypeninae.

ul : hm (length of uncus in relation to length of corpus genitalis): Different groups have quite different length of unci in relation to total size of the genitalia corpus. So the feature "short uncus" is typical for the subgenus *Jussalypena* within the genus *Hypena*. *Hypena* s.str. have a higher mean proportion of the calculation ul : hm (Fig. 38). *Hypena* s.str. and *Harita* have a low frequency distribution in contrast to *Jussalypena* which has a lower mean calculation but a higher distribution range.

Fig. 37 (next page, top) and **Fig. 38** (next page, bottom): scatterplot and boxplot of uncus relations.

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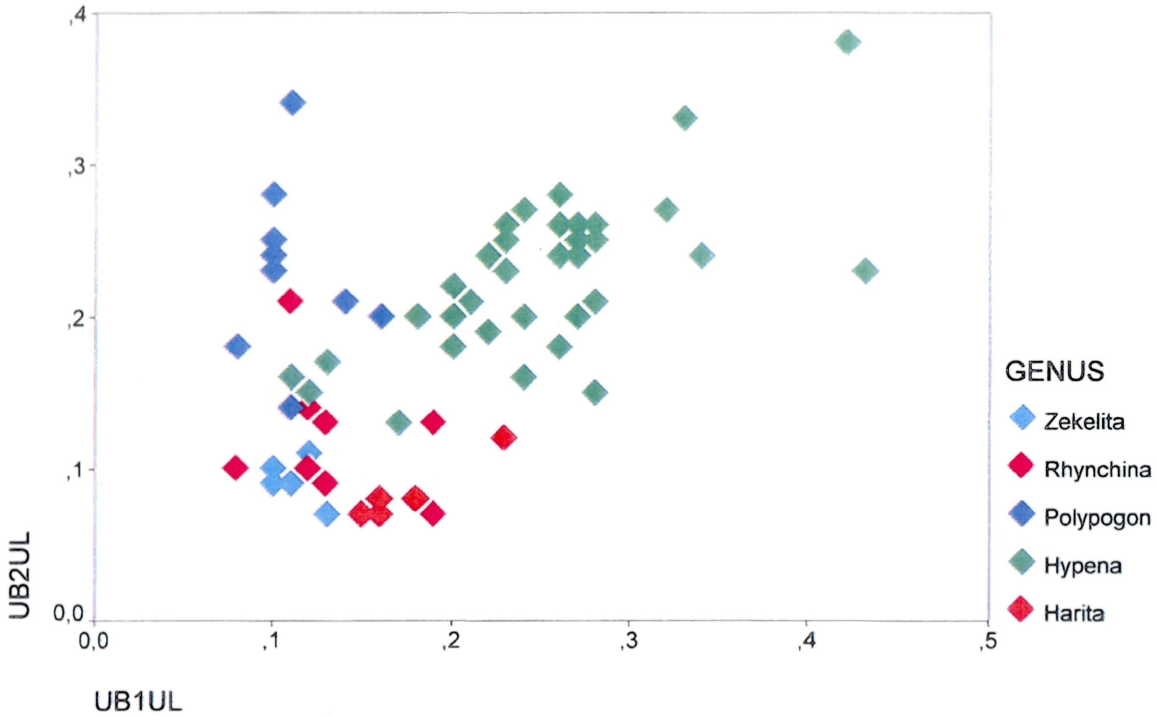

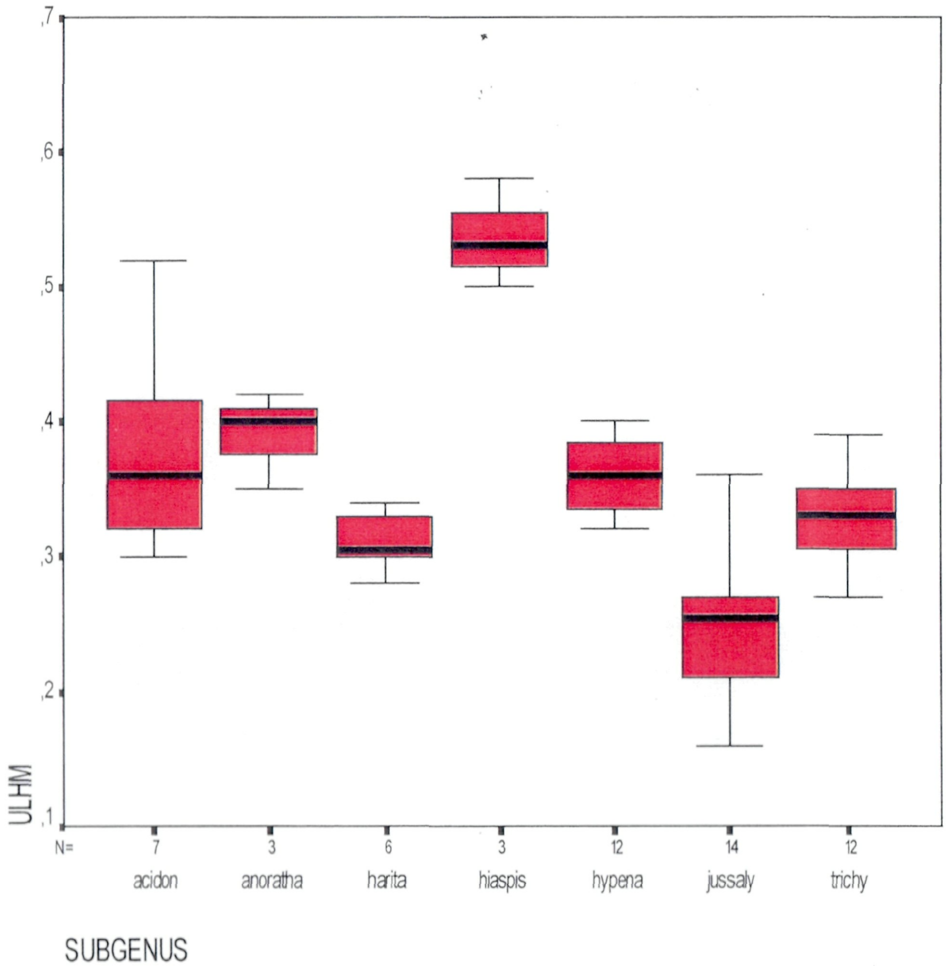

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scl : ul (length of scaphium in relation to length of uncus): LÖDL (2000) found sclerotizations of the scaphium shield which correspond significantly with the proportion of the uncus. This was interpreted as a secondary lock-and-key mechanism important for the resting position of the uncus-tuba analis complex of some species (e.g. the Calpinae *Eudocima salaminia* (CRAMER, 1777)). A figure of around "1" indicates a high correlation of the length of the sclerotized shield and the "hook". High coincidences are found in *Hypena*, *Dichromia*, *Harita* and allied genera.

tel : hm (length of tegumen in relation to length of corpus genitalis): The length of the tegumen as well as the length of the saccus (vinculum) give an impression of the proportions of the corpus genitalis. The cone-shaped, overhanging vinculi are well defined by a dominating sal and a relatively depressed tel (*Idia*), in contrast to the longer but not striking tel of the genus *Harita*, with its suppressed and minimized sal. It is obvious that in *Idia* tel : hm and sal : hm come near to each other, in *Harita* for instance they are far distant.

sal : hm (length of saccus in relation to length of corpus genitalis): This calculation is closely related to the foregoing. As mentioned above tel : hm and sal : hm define the proportion of the frame of the corpus genitalis.

var : hm (distance of valve articulation in relation to length of corpus genitalis) (Fig. 40): The relation of the distance of the valve articulation to the total length of the genitalia corpus is one of the most important. It defines the basic type of valve-base. These clasping sacs can articulate on the genitalic frame at a very concentrated and concise area (e.g. the genera *Harita* and *Ricla*) or they dominate the centre of the corpus genitalis by occupying a noticeable or even the major part of this region. If the dorsal and ventral articulation of the valve at the frame are far distant, this distance is responsible for a high var : hm figure.

vl : hm (length of valve in relation to length of corpus genitalis) (Fig. 41): The relation of the valve-length to the length of the corpus genitalis gives another important impression of the proportion of the clasping organ. The valves can be long or short and in some cases the relation gives good evidence for the diagnosis of genera. The differentiation of the genera *Hypena* and *Dichromia* is mainly based on the fact that the valves of *Hypena*-species are rather short and vl : hm never exceeds the figure "1". The elephant-ear-like valves of *Dichromia* normally do exceed "1" and this "gap" between the two taxa is to the best of our knowledge the base of the separation of the two genera (LÖDL 1994b).

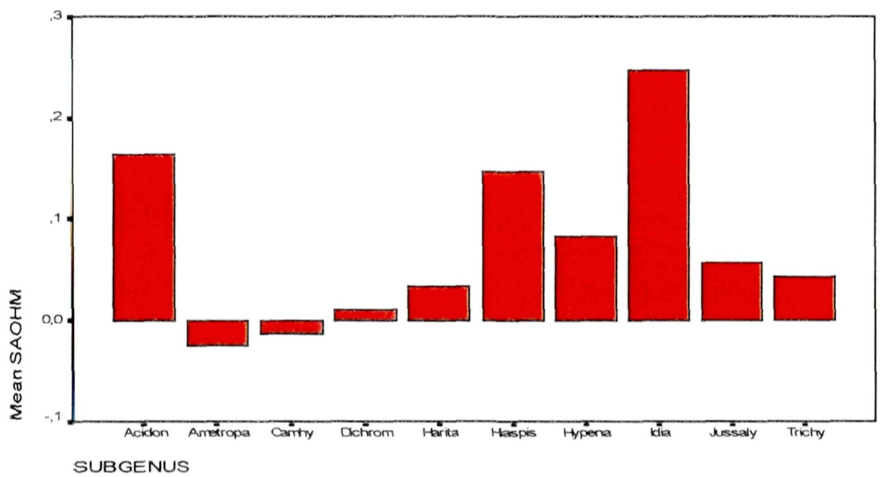

Fig. 39 bar diagram of sao : hm in different genera and subgenera of Herminiinae and Hypeninae.

sao : hm (saccus overhang in relation to length of corpus genitalis) (Fig. 39): The proportion of the saccus-overhang to the length of the corpus genitalis is one of the features of the genitalia frame. Saccus-overhang results in positive figures, the longer the saccus the higher the figure. Species with protruding sacculi induce a negative calculation. This is true for instance for *Dichromia* species.

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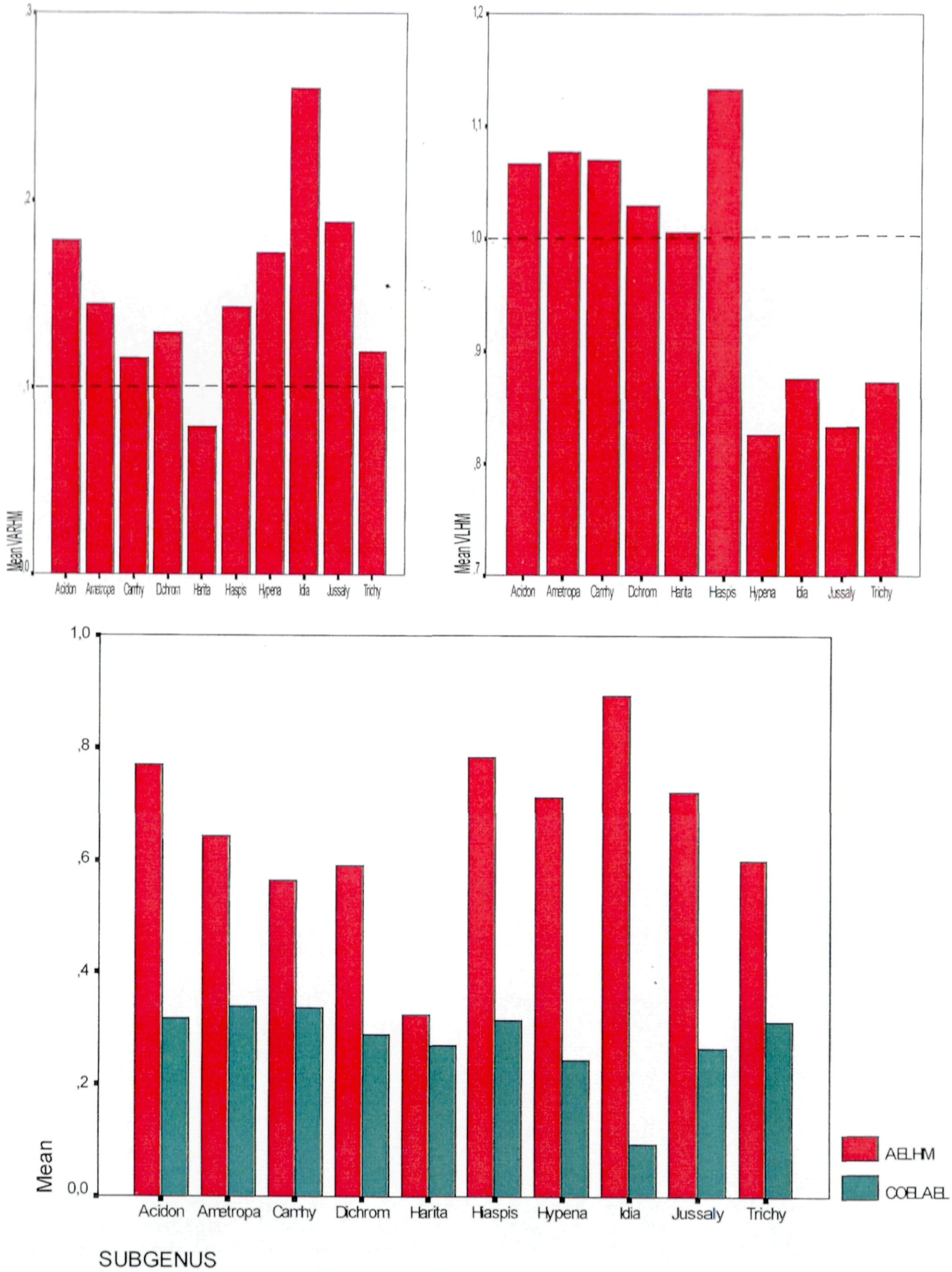

Figs. 40-42 Bar diagrams representing different relations in genera and subgenera of Herminiinae and Hypeninae:
Fig. 40 (top left): Distance of valve articulation in relation to the length of corpus genitalis. *Harita* is defined by a low figure, *Idia* is defined by a high figure.- **Fig. 41** (top right): Length of valve in relation to length of corpus genitalis. *Hiaspis* and the genus complex *Dichromia* show exorbitant long valves.- **Fig. 42** (bottom): Pairs of bars showing the length of aedeagus in relation to the length of corpus genitalis and the length of coecum in relation to the length of aedeagus.

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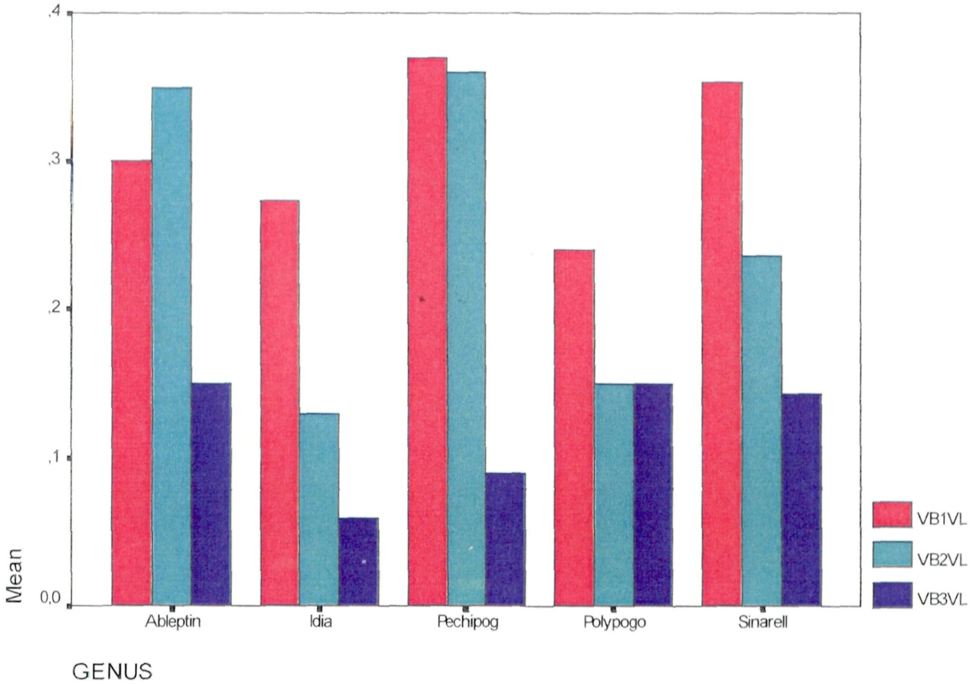

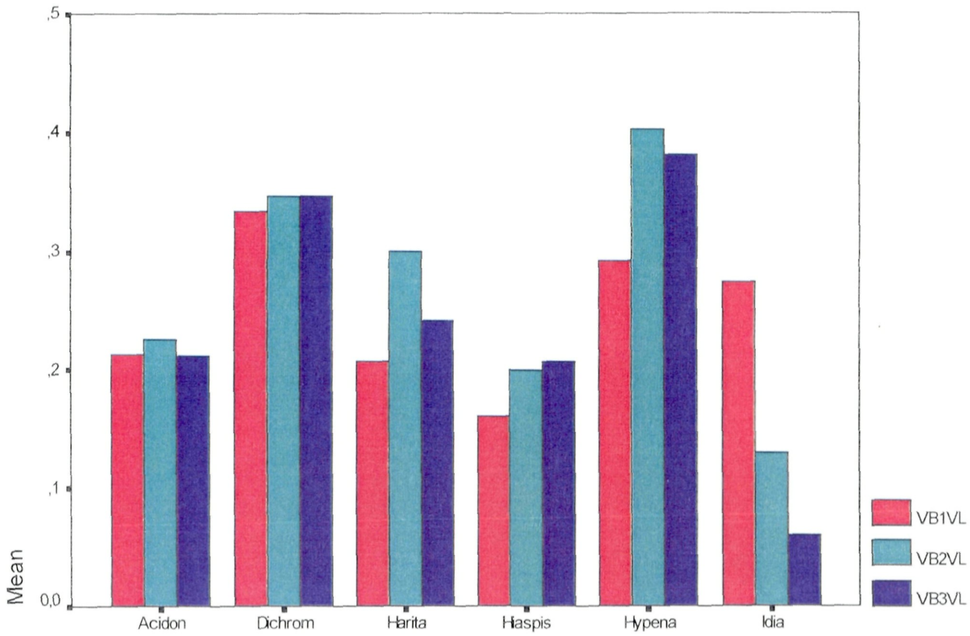

Figs. 43 (top) - **44** (bottom): Bar diagrams representing different width of valve in relation to the length of valve in genera and subgenera of Herminiinae and Hypeninae.

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Species with an extremely short and stout saccus have a very low calculation (*Harita*, *Ricla* and subgenus *Trichypena*) (Fig. 39), species with cone-shaped and protruding sacci have higher figures (*Idia*, *Mecistoptera* HAMPSON, 1893 (LÖDL 1997), *Zekelita*)

vb_n : vl (width of valve in relation to length of valve): The indices vb1, vb2, vb3 (and if necessary vb4 ... vb_n) in relation to the length of the valve mirror the proportion of the valve. Figs. 43-44 show bar diagrams presenting a three-bar display. Each bar represents one of three vb_n : vl calculations. A lot of information can be gathered out of the relation of the bars to each other. The genera *Acidon* and *Dichromia* for example have parallel ventral and dorsal margins (the bars are of similar height) of their valves but quite different proportion. The vb_n : vl figures of *Acidon* are quite lower – the valves are slender, the figures in *Dichromia* are higher – the valves are significantly broader. *Hiaspis* shows valves which enlarge continously to the distal end: the bars are like ascending steps. In *Harita* the base of the valves is narrow and *Hypena* exhibits broad and rounded valves. The broadest part is situated in the middle. The valves are more stout than in *Harita*. Low figures generally mirror slender valves, high figures represent broad and stout valves. A completely different situation is found in Herminiinae genera. The example figured is the genus *Idia*. Significant and typical for many Herminiinae is a broad base of the valve and a progressively sharpened valve to its distal end.

sab : sal (width of saccus in relation to length of saccus): This relation reflects the proportion of the cephalic part of the vinculum. The saccus can be stout and broad, as it is found in many *Hypena*-species or it can be shaped as an ice-cone (e.g. many Herminiinae). The indices sab1 : sal, sab2 : sal, sab3 : sal are enough to characterize the shape of the saccus. Figs. 45-46 give a survey over the sab : sal relations of different genera of Hypeninae and Herminiinae. Stout sacci are indicated by figures above "1". So the subgenus *Jussalypena* has sab1 and sab2 above "1" and sab3 almost reaching "1". Fine pointed sacci can be recognized by low figures of sab3: *Acidon* and *Idia*.

vpr : vl (length of central process of valve in relation to length of valve) and allied relations: Each type of processus or lobe found on the valve is generally put into a relation to the length of the valve. In this paper the additionally presented processes are **scpr (length of sacculus process), saclo (width of sacculuslobe), vcpr (length of costal process of valve), hmd (width of half-moon disc), vdl (length of the longest distal lobe of the valves).**

ael : hm (length of aedeagus in relation to length of corpus genitalis) (Figs. 42, 47): This very important relation shows how long the aedeagus is in relation to the genitalia corpus. Different groups have completely different sizes of their aedeagi. So the aedeagi of the genera *Harita* and *Ricla* are very short and tiny, the aedeagi of the subfamily Herminiinae in general very big and robust. *Britha*-species have also a long aedeagus.

aeb_n : ael (width of aedeagus in relation to length of aedeagus) (Fig. 48): The indices aeb1 and aeb2 (and if necessary aeb4 ... aeb_n) in relation to the length of the aedeagus mirror the proportion of the aedeagus. Fig. shows a bar diagram with two bar displays showing a selection of Hypeninae and Herminiinae taxa. One of the interesting fact is the reverse relation of the aeb**1** (aeb2) : ael calculation in the genera *Rhynchina* and *Zekelita*. *Rhynchina* shows a broad coecal end and a narrow distal end. The opposite is true for *Zekelita*.

coel : ael (length of coecum in relation to the length of aedeagus) (Fig. 42): This is an additional relation defining the proportion of the aedeagus. The coecal part can be of remarkable size or can be inferior (e.g. many Herminiinae).

cl : ael (length of cornutus in relation to the length of aedeagus) [or: cl : hm; length of cornutus in relation to length of corpus genitalis]: Both relations give an impression of the dominance of the cornutus. As mentioned above only significantly large cornuti are measured. The length of these cornuti can have a remarkable variance and are often of specific value.

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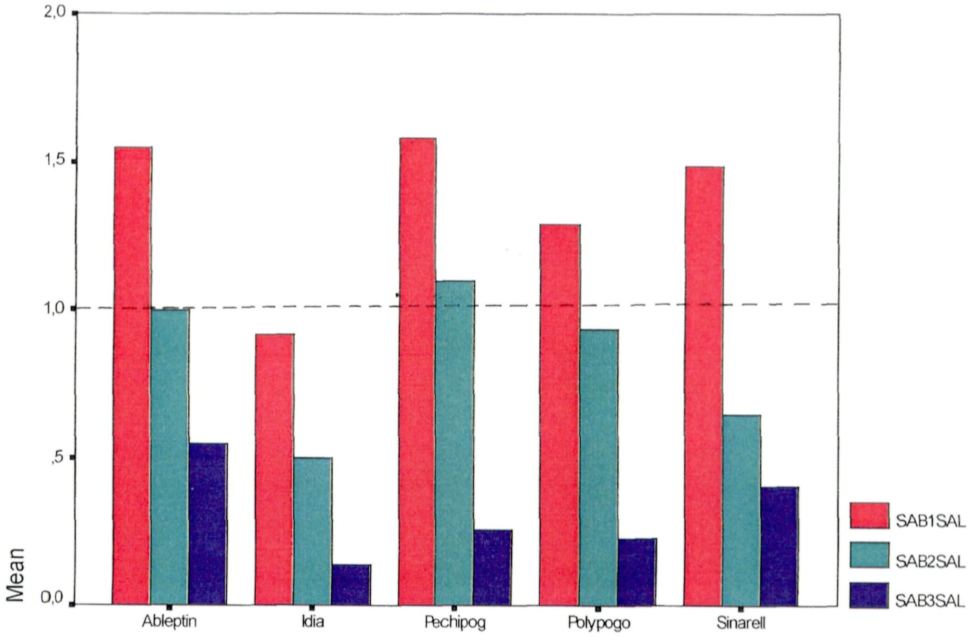

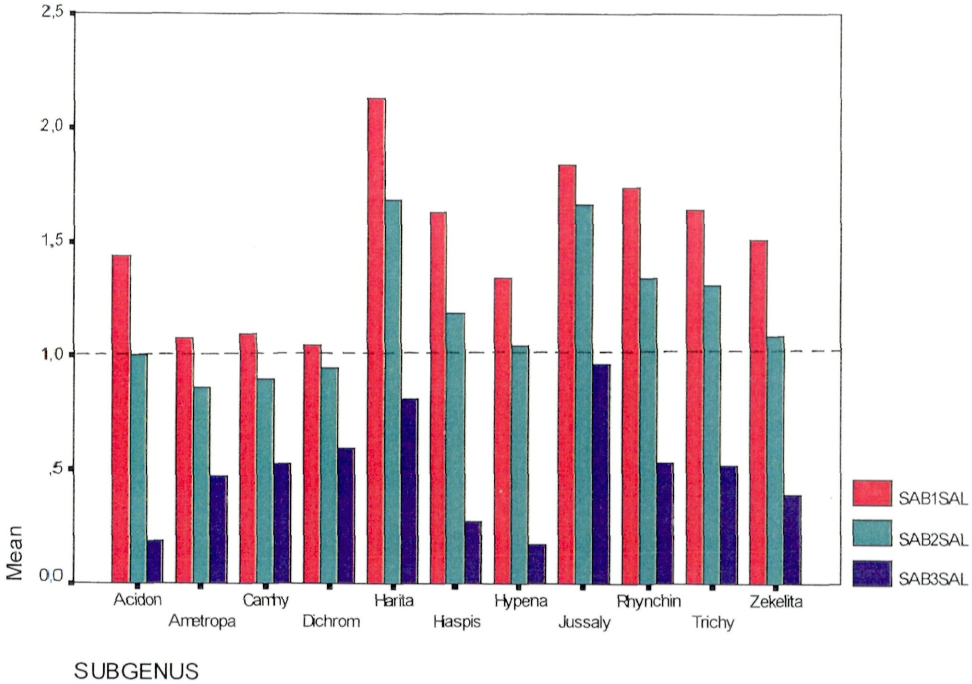

Figs. 45 (top) - **46** (bottom): Bar diagrams representing different width of saccus in relation to the length of saccus in genera and subgenera of Herminiinae (Fig. 45) and Hypeninae (Fig. 46).

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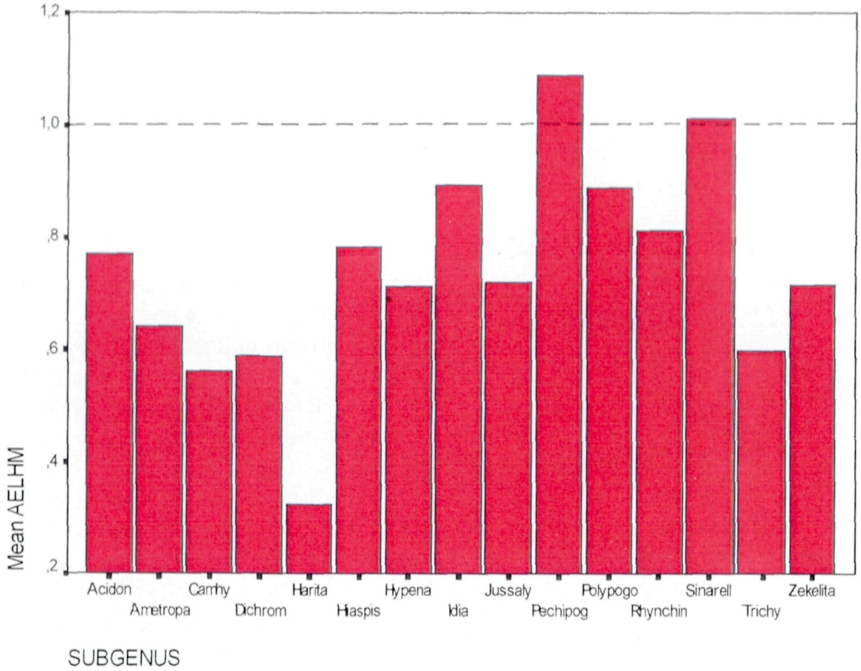

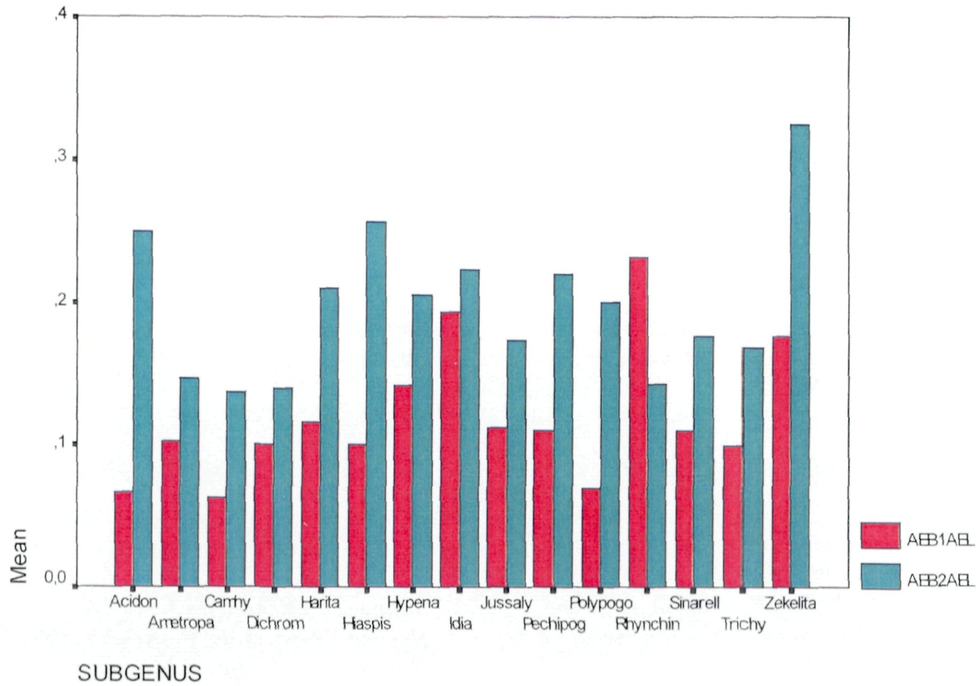

Figs. 47-48 Bar diagrams representing different relations in genera and subgenera of Herminiinae and Hypeninae:
Fig. 47 (top): Length of aedeagus in relation to the length of corpus genitalis. *Harita* is defined by an extremely low figure, Herminiinae are defined by high figures.- **Fig. 48** (bottom): Width of aedeagus in relation to length of aedeagus.

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Listing of abbreviations

Male genitalia measurements:

aeb1 width of aedeagus (at coecal end)
aeb2 width of aedeagus (at distal fourth)
aefl length of aedeagus-flagellum
ael length of aedeagus
aepr length of aedeagus-process
aesp length of distal pike of aedeagus
car length of carina penis
cl length of cornutus
coel length of coecum
gnl length of gnathos
hm length of genitalia corpus (cephal end of saccus to caudal end of tegumen)
hmd width of half moon disc
oa opening angle of aedeagus (about 180° = straight; below 180° = kneed; over 180° = concave tube from dorsal view)
sab1 width of saccus (between ventral articulation of valve)
sab2 width of saccus (in the middle)
sab3 width of saccus (5% of sal caudad from the cephal end)
saclo width of sacculuslobe
sal length of saccus (vinculum)
sao cephalic overhang of saccus
scl length of scaphium
scpr length of sacculus process
tel length of tegumen
ub1 width of uncus (at base)
ub2 width of uncus (in the middle)
uh height of uncus (from imaginary base-line to the vertex of uncus)
ul length of uncus
var distance between ventral and dorsal articulation of valve at the genitalia corpus
vb1 width of valve (at sacculus)
vb2 width of valve (in the middle)
vb3 width of valve (at distal fourth)
vcpr length of costal process of valve
vl length of valve
vpr length of central process of valve

Relations:

aeb1:ael
aeb2:ael
ael:hm
cl:ael
cl:hm
coel:ael
gnl:ul
sab1:sal
sab2:sal
sab3:sal
sal:hm
sao:hm
scl:ul
scpr:vl
tel:hm
ub1:ul
ub2:ul
uh:ul
ul:hm
var:hm
vb1:vl
vb2:vl
vb3:vl
vcpr:vl
vl:hm
vpr:vl

List of species investigated

Hypeninae:

Genus *Hypena* SCHRANK, 1802
Subgenus *Hypena* SCHRANK, 1802
Hypena cherylae LÖDL, 1995
Hypena euprepes FLETCHER, 1961
Hypena mariachristinae biocensis LÖDL, 1995
Hypena mariachristinae mariachristinae LÖDL, 1995
Hypena martinae LÖDL, 1993
Hypena muscosoides POOLE, 1989
Hypena obacerralis WALKER, [1859] 1858
Hypena padelekorum LÖDL, 1995
Hypena phricocyma melanolivida LÖDL, 1995
Hypena porphyrophaes FLETCHER, 1961
Hypena recurvata HAMPSON, 1909
Hypena scotina FLETCHER, 1961

Subgenus *Trichypena* JOANNIS, 1915
Hypena chionosticha FLETCHER, 1961
Hypena cowani VIETTE, 1968
Hypena directa FLETCHER, 1961
Hypena eucrossa FLETCHER, 1961
Hypena fuscomaculalis SAALMÜLLER, 1880
Hypena gravalis MABILLE, 1897
Hypena griveaudi VIETTE, 1968
Hypena kingdoni VIETTE, 1968
Hypena kratochvili LÖDL, 1995
Hypena malagasy (VIETTE, 1968)
Hypena monikae LÖDL, 1994

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Hypena poliopera BETHUNE-BAKER, 1909
Hypena schultzei AURIVILLIUS, 1925
Hypena toyi VIETTE, 1968

Subgenus *Ophiuche* HÜBNER, [1825] 1816
Hypena lividalis (HÜBNER, 1790)
Hypena neoplyta A.E. PROUT, 1925

Subgenus *Tetrastictypena* LÖDL, 1994
Hypena tetrasticta HAMPSON, 1910

Subgenus *Jussalypena* LÖDL, 1994
Hypena abyssinialis GUENÉE, 1854
Hypena albizona FLETCHER, 1961
Hypena bonaberi STRAND, 1915
Hypena elfriedae LÖDL, 1994
Hypena erikae LÖDL, 1994
Hypena euthygramma A.E. PROUT, 1921
Hypena holophaea HAMPSON, 1902
Hypena jussalis WALKER, [1859] 1858
Hypena laceratalis WALKER, [1859] 1858
Hypena nasutalis GUENÉE, 1862
Hypena paliscia (BETHUNE-BAKER, 1911)
Hypena prionodes FLETCHER, 1961
Hypena puncticosta A.E. PROUT, 1921
Hypena sabinis LÖDL, 1994

Subgenus *Extremypena* LÖDL, 1994
Hypena extremipalpis LÖDL, 1994
Hypena subvittalis WALKER, [1866] 1865

Subgenus *Biangulypena* LÖDL, 1994
Hypena biangulatoides POOLE, 1989

Subgenus *Conscitalypena* LÖDL, 1994
Hypena conscitalis WALKER, [1866] 1865

Subgenus *Pseudodichromia* LÖDL, 1994
Hypena laetalimaior LÖDL, 1995
Hypena laetalis WALKER, [1859] 1858

Genus *Dichromia* GUENÉE, 1854
Subgenus *Dichromia* GUENÉE, 1854
Dichromia aroa (BETHUNE-BAKER, 1908)

Subgenus *Camhypena* A.E. PROUT, 1927
Dichromia erastrialis (WALKER, [1866] 1865)
Dichromia legrosi (GUILLERMET, 1992)
Dichromia mesomelaena (HAMPSON, 1902)

Subgenus *Ametropalpis* MABILLE, 1884
Dichromia albistriga (MABILLE, 1900)
Dichromia limbopunctata (STRAND, 1915)
Dichromia mutilata (STRAND, 1909)
Dichromia nasuta (MABILLE, 1884)

Genus *Harita* MOORE, 1882
Harita brachyphylla (TURNER, 1903)
Harita irregularis HOLLOWAY, 1979
Harita nebulosa (MOORE, 1881)
Harita nodyna (BETHUNE-Baker, 1908)
Harita rectilinea MOORE, 1882
Harita sp.1
Harita sp.2

Genus *Ricla* WALKER, 1869
Ricla sp.1
Ricla sp.2 ("*devia* nom.nud.")

Genus *Acidon* HAMPSON, 1896
Acidon albolineata (HAMPSON, 1895)
Acidon evae LÖDL, 1998
Acidon hemiphaea (HAMPSON, 1906)
Acidon mariae LÖDL, 1998
Acidon mediobrunnea (HOLLOWAY, 1976)
Acidon nigrobasis (SWINHOE, 1895)
Acidon paradoxa HAMPSON, 1896

Genus *Hiaspis* WALKER, [1866] 1865
Hiaspis apicalis (SWINHOE, 1904)
Hiaspis closteroides WALKER, [1866] 1865
Hiaspis fuscobrunnea (HAMPSON, 1895)

Genus *Rhynchina* GUENÉE, 1854
Subgenus *Rhynchina* GUENÉE, 1854
Rhynchina albidula WARREN, 1913
Rhynchina caerulescens BUTLER, 1889
Rhynchina cramboides (BUTLER, 1879)
Rhynchina cretacea (WARREN, 1913)
Rhynchina innotata WARREN, 1913
Rhynchina michaelhaeupli LÖDL & GAAL, 1998
Rhynchina pionealis GUENÉE, 1854
Rhynchina striga (FELDER & ROGENHOFER, 1874)
Rhynchina uniformis BUTLER, 1889

Genus *Zekelita* WALKER, 1863
Subgenus *Zekelita* WALKER, 1863
Zekelita albiscripta (HAMPSON, 1916)
Zekelita antiqualis (HÜBNER, 1809)
Zekelita canariensis (PINKER, 1962
Zekelita crassisquamata (HAMPSON, 1910)
Zekelita equalisella WALKER, 1863
Zekelita leucodonta (HAMPSON, 1910)
Zekelita sagittalis (REBEL, 1947)

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Genus *Anoratha* MOORE, 1867
Anoratha albitibiata WILEMAN & WEST, 1930
Anoratha paritalis (WALKER, [1859] 1858
Anoratha sinuosa WILEMAN & SOUTH, 1916

Genus *Phanaspa* WALKER, [1866] 1865
Phanaspa derasalis (GUENÉE, 1854)

Genus *Brontypena* HOLLAND, 1900
Brontypena exima (PAGENSTECHER, 1886) (= *Corcobara longipennis* SWINHOE, 1902)

Herminiinae:

Genus *Perciana* WALKER, 1865
Perciana marmorea WALKER, 1865

Genus *Mecistoptera* HAMPSON, 1893
Mecistoptera franzwagneri LÖDL, 1997
Mecistoptera griseifusa HAMPSON, 1893
Mecistoptera sophiewagnerae LÖDL, 1997
Mecistoptera violescens (HAMPSON, 1906)

Genus *Herminia* LATREILLE, 1802
(*Polypogon* SCHRANK, 1802)
Herminia gryphalis HERRICH-SCHÄFFER, [1851]
Herminia helva BUTLER, 1879
Herminia leechi (SOUTH, 1905)
Herminia reticulatis (LEECH, 1900)
Herminia southi OWADA, 1982
Herminia stramentacealis BREMER, 1864
Herminia strigilata (LINNAEUS, 1758)
Herminia subgriselda (SUGI, 1959)
Herminia sugii (OWADA, 1980)
Herminia tarsipennalis TREITSCHKE, 1835

Genus *Sinarella* BRYK, 1949
Sinarella aegrota (BUTLER, 1879)
Sinarella lunifera (MOORE, [1885] 1884-1887)
Sinarella punctalis (HERZ, 1904)

Genus *Idia* HÜBNER, [1813]
Idia curvipalpis (BUTLER, 1879)
Idia fulvipicta (BUTLER, 1889)
Idia quadra (GRAESER, [1889] 1888)

Genus *Ableptina* A.E. PROUT, 1927
Ableptina delospila A.E. PROUT, 1927

Genus *Dogninades* SCHAUS, 1916
Dogninades renei GAAL-HASZLER, 2000

Genus *Cristatopalpus* BETHUNE-BAKER, 1908
Cristatopalpus olivens BETHUNE-BAKER, 1908

Heliothinae:

Genus *Helicoverpa* HARDWICK, 1965
Helicoverpa armigera (HÜBNER, [1808])
Helicoverpa assulta (GUENÉE, 1852)

Genus *Australothis* MATTHEWS, 1991
Australothis hackeri, KOBES, 1995
Australothis tertia (ROEPKE, 1941)

Genus *Adisura* MOORE, 1881
Adisura purgata WARREN, 1913

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Author's address: Mag.Dr.Martin Lödl, Naturhistorisches Museum Wien, Burgring 7, A-1014 Wien, Austria. e-mail martin.loedl @ nhm-wien.ac.at

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