

Abdominal Terminology Discussion

Several points to be considered regarding the mantodean abdominal terminology, especially considering that its development is ongoing:

(A) The abbreviated terms are fixed and are indeed the core part of the terminology, which is similar to the terminology of the wing veins, where ‘**Sc**’ is the fixed abbreviated form of ‘subcosta.’ Moreover, in many cases there are no full descriptive names that correspond with the abbreviated terms, and this is especially true for male genitalia. The reason is that there are so many formative elements and sclerites in the male genitalia of Dictyoptera that creating full names for all of them would lead to a terminological monster. The use of full names would also make any text on male genitalia extremely bulky and thus memorability would hardly be better than for standardized abbreviations. Furthermore, focusing on fixed abbreviations has the advantage that elements can be addressed by the same terms in the text and in the illustrations (e.g., what is called “process paa” in the text is labeled “paa” in the illustrations; note that in the text a specifier, such as “process” or “sclerite”, is best placed ahead of the abbreviation to improve readability). However, this does not exclude the possibility that selected elements can be given full names. This appears manageable, even for the male genitalia, within a dictyopteran subgroup whose members have fairly uniform male genitalia of comparatively limited complexity – such as the Mantodea. However, we suggest including the abbreviated term for clear reference to this terminology so as to ground it within a dictyopteran and insect context.

We also note that the use of certain traditional full names for formative elements or sclerites includes the problem of implying hypotheses of homology or homonymy that are unsupported or even clearly incorrect, while potentially veiling plausible relationships of homology or homonymy. An example for a formative element is the term ‘titillator’ (= process paa in Fig. 11a), which in different insect orders is used for a variety of non-homologous sclerotized processes of the male genitalia (expressing a presumed function of stimulating scratching; e.g., Beier 1972: p. 137 for Orthoptera). An example for a sclerite is the term ‘female subgenital plate’ (= coxosternite 7, **CS7** in Fig. 14c), which in different insect orders is used for a variety of non-homologous ventral sclerites of the genital region. The ‘supraanal plate’ (= tergite 10, **TG10**) for the posterior-most well developed tergite represents a similar case. A modern terminology should avoid the application of the same terms to non-homologous structures in different insect taxa.

(B) The framework of this terminological approach is insect-wide, and the terminology is based on conditions in Archaeognatha (Klass & Matushkina, unpublished data), as far as elements are known from this taxon. Only the sclerites and formative elements of the male genitalia are essentially limited to Dictyoptera, as most, if not all, of these elements have likely evolved within the Dictyoptera and have no homologues in other insects. The phallic organs as a whole are likely homologous throughout the insects.

(C) The use of identical terms for elements of different abdominal segments, of different sexes, or of different taxa represents the hypothesis that these elements are homonomous or homologous, respectively (in doubtful cases, a ‘?’ can be added to a term, e.g., ‘**STt8?**’). Since hypotheses on homology and homonymy can require modifications due to new evidence, the terms herein applied to Mantodea may also be subjected to changes in the future.

(D) In this terminology, the assignment of a structure to a segment essentially refers to the primary segmentation, i.e., to the embryonic division of the abdomen into somites. In the adult, the primary segmental borders are represented mainly by the antecostae (**ac**) located anteriorly upon the terga and coxosterna. The sclerotic, functional segmentation of the adult body that is mainly established by the successive terga and coxosterna is the secondary segmentation. As only the primary segmentation offers, although in an incomplete way, clear-cut borders of a uniform, serial kind and origin, only this is useful as a reference system for segmental assignment and for hypothesizing segmental homonymies. Elements located at the segmental borders, e.g., the antecostae themselves, are formally assigned to the segment following posteriorly; for instance, antecosta **ac5** represents the segmental border 4/5. Elements including a segmental border are assigned to the segment on which their larger part is located; for instance, tergum **TG5** has its larger part on segment 5 but far anteriorly includes the segmental border 4/5 (at **ac5**) and extends a bit into segment 4. This can lead to conflicts; for instance, when the area of **TG5** anterior to the antecosta (the acrotergite) is named, it should be **TG5 α** – but this part lies entirely on primary segment 4.

(E) In the abbreviated terms both for sclerotizations and formative elements, the numbers for segmental assignment can be used for various purposes. One purpose is to distinguish homonomous elements of different segments. For instance, while **TG π** and **cx** refer to each of the homonomous paratergal areas or coxal lobes, respectively, in an abdominal series, **TG8 π** and **cx8** specifically refer to the 8th-segmental elements of the series. Another purpose is to express the belonging to a particular segment of an element that only occurs in one segment. For instance, the languette sclerite **LG** and the genital fold are only known from segment 7 of the female, and in these cases the term has the same meaning with (**LG7**, **gf7**) and without (**LG**, **gf**) the segmental number. However, the terminology offers the option that if a potentially homonomous element is newly detected in another segment, this can be called e.g., **LG8** or **gf6**. This can include cases where the descriptive full name (here ‘genital fold’) is inappropriate for the newly detected homonomous structure. This is a further disadvantage of the full names: these try to convey some characteristic (structural or functional), which, however, may not always hold when knowledge increases.

(F) The abdominal terminology is still developing, and there are several aspects of this: changes will be required to comply with gradual improvement of hypotheses of homology and homonymy (see (C)). The categorization of sclerotizations in principal ones and in subdivisions of these necessarily includes some subjectivity, and increased knowledge of the early evolution of insects may suggest changes. An improved handling

of the abovementioned inconsistency regarding segmental assignment (see (D)) may lead to a systemic change. The demarcation of some part of a sclerite from the remainder of the sclerite can vary from not at all demarcated to fully detached by membrane; such variation is difficult to cover (see e.g., naming of lateral parts of tergites as paratergal areas or as paratergites). More importantly, however, across the Insecta the abdomen shows numerous subdivisions and fusions of sclerites, and the body wall area taken by a sclerite is often reduced or enlarged (as occasionally evident from the in- or exclusion of some muscle attachment or another structure in a sclerite). Many of these transformations occur convergently in different taxa. Regarding subdivisions, the lines of separation are then often in slightly different positions, and this is difficult to express in the terminology.

The abdominal terminology has led to significant progress, but as it currently stands it is not yet fully capable of adequately depicting the great structural diversity in the equipment of insects with sclerites and formative elements and the manifold relationships of homonymy and homology. A terminology having this capability, however, would likely be monstrous and unmanageable in taxonomic and morphological practice. Perhaps the state now reached represents a useful compromise.