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African Sesamiina: the cremaster and the genus (Lepidoptera: Noctuidae).

Pascal Moyal

IRD, 32 avenue Henri-Varagnat, 93140 Bondy, France.

pascal.moyal@ird.fr

Abstract

Delimitation of genera solely on the basis of adult morphology is difficult in the Sesamiina and was the cause of some mistakes in the past. In this study we examine whether the pupal morphology, particularly the shape of the cremaster, can help define the genera in this sub-tribe of Noctuids. Observation shows that the cremaster is homogeneous within each genus. So this structure allows characterization of genera in this group, in which the birth of species was first influenced by major palaeo-climatic events. The only genus that is an exception is *Pirateolea*, in which several types of cremasters are observed. This suggests that the ancestor of this genus might result from a palaeo-climatic event older than that at the origin of the other genera. The cremaster of *Sesamia sylvata* Janse differs from that of the other *Sesamia* species, which is in agreement with the results of a previous molecular phylogenetic analysis that had showed that this species does not belong to the genus *Sesamia*. In some genera the cremaster is lacking, and, in several other genera the shape of the cremaster is similar, which may indicate common ancestry of the genera in each of these groups and help define the taxonomic ranks higher to genus.

Introduction

The grouping of species of African Sesamiina into genera based on adult morphology is a difficult exercise. The wings are often uniform, tawny or more or less clear brown and have few distinguishing features. The genitalia sometimes have deceptive similarities. This difficulty has led many authors to limit themselves to place species in the genera already described even if the characteristics of the species did not fit strictly the genus definition (1). In other cases, authors have thought they were classifying the species correctly based primarily on the morphology of genitalia. This was for example the case of Fletcher (2), who placed in the genus *Sciomesa* a species he named *Sciomesa Nyei* whose genitalia seemed to him typical of the genus, while more comprehensive subsequent studies, using particularly molecular data (3), showed that this species was very distant from this genus, and had to be included in a new genus, *Feraxinia*.

The grouping of species into genera based only on adult morphology has therefore been the source of several mistakes in the past. One may wonder if it would not be possible to improve this morphological classification by observing the pre-imaginal characters.

The eggs of these insects are mostly unknown and those that are known have too few features to help classifying (see for example in Figure 1 the eggs of *Busseola fusca* (Fuller)).



Figure 1. Egg mass of *Busseola fusca*.

Larvae are more varied and sometimes have characteristics that can help distinguish the genera. Thus, the larvae of the fore-mentioned species, *F. Nyei*, and of other species placed in the genus *Feraxinia*, have a habitus very different from that of the larvae of *Sciomesa* (3), and, from this criterion alone, it could be possible to infer that these species probably do not belong to the genus *Sciomesa*. However, the larvae of many Sesamiina have a habitus similar to that of *Sciomesa*, for instance those of the genera *Sesamia*, *Busseola*, *Carelis*, *Pirateolea*. In this case, the habitus alone does not enable a reliable distinction of the genera. The study of larval chaetotaxy, including the microscopic one (4), further showed that it was difficult to distinguish between genera: thus, both species of pests, *Sesamia calamistis* Hampson and *Busseola fusca*, have exactly the same number of setae on each segment.

Therefore, larval morphology seems in most cases unable to help the grouping into genera; Now, what about the pupal morphology? The tip of the abdomen of the

pupa of some Lepidoptera, and particularly of the Sesamiina, may end with a structure called the cremaster, whose observation shows that it could perhaps provide a distinguishing criterion of genera. This article aims to present the cremaster of the African Sesamiina and examine to what extent this structure could enable the grouping of species into homogeneous sets.

Materials and Methods

Larvae of the studied stem borers were collected within their host plants in East Africa and southern Africa. They were reared on artificial diet (5) until pupation and the species were identified after emergence of the adults.

Results

Various shapes of the tip of the abdomen of the pupae of African Sesamiina were observed:

1- No cremaster

Some genera, of which we have observed only one species, have pupae with no cremaster (figure 2): this is the case of *Poeonoma* (species *Poeonoma serrata* (Hampson)), of *Poecopa* (species *Poecopa mediopuncta* Bowden), and of *Conicofrontia* (species *Conicofrontia sesamoïdes* Hampson).

It is also the case for all the species of the genus *Acrapex* we could observe, not only the species whose picture is presented, *Acrapex syscia* Fletcher, but also several close species such as *Acrapex brunnea* Hampson and some new species.

Except *Acrapex*, these genera include few species, even only one in the case of *Poecopa*.



Poenonoma serrata



Poecopa mediopuncta



Acrapex syscia



Conicofrontia sesamoides

Figure 2. Species with no cremaster.

The pupae have no cremaster in the genus *Carelis* also. Figure 3 shows the abdominal tips of *Carelis biluma* (Nye), *Carelis australis* Moyal and *Carelis transversa* Moyal. The tip of the abdomen is however rather pointed in *Carelis* whereas it is rounded, even sometimes flat, in the previous genera.



Carelis biluma



Carelis australis



Carelis transversa

Figure 3. Tip of the abdomen of pupae of *Carelis*.

2- Cremaster with two spines

2-1 Short spines

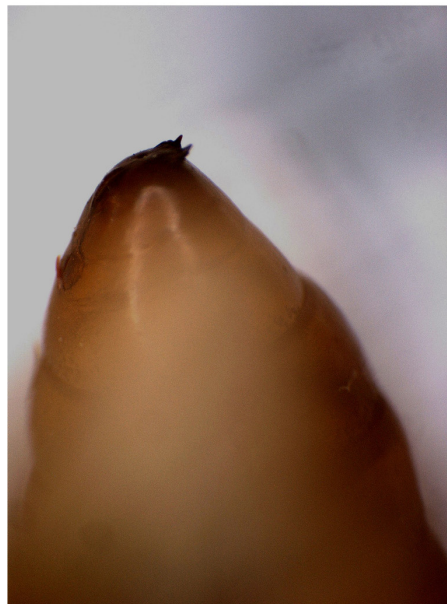
Three genera have pupae whose cremaster has two short spines: *Buakea* (figure 4), *Busseola* (figure 5) and *Manga* (figure 6) (only *Manga nubifera* (Hampson) is shown but the close species *Manga melanodonta* (Hampson) has the same cremaster). The pupae of two new species of *Busseola* are shown in addition to the pupae of the two known species *B. fusca* and *Busseola phaia* Bowden.



Buakea obliquifascia



Buakea kaeuae



Buakea venusta

Figure 4. Cremasters of *Buakea*.



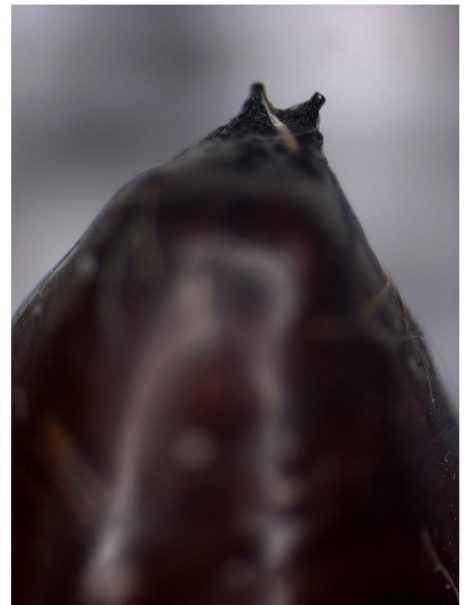
Busseola fusca



Busseola phaia

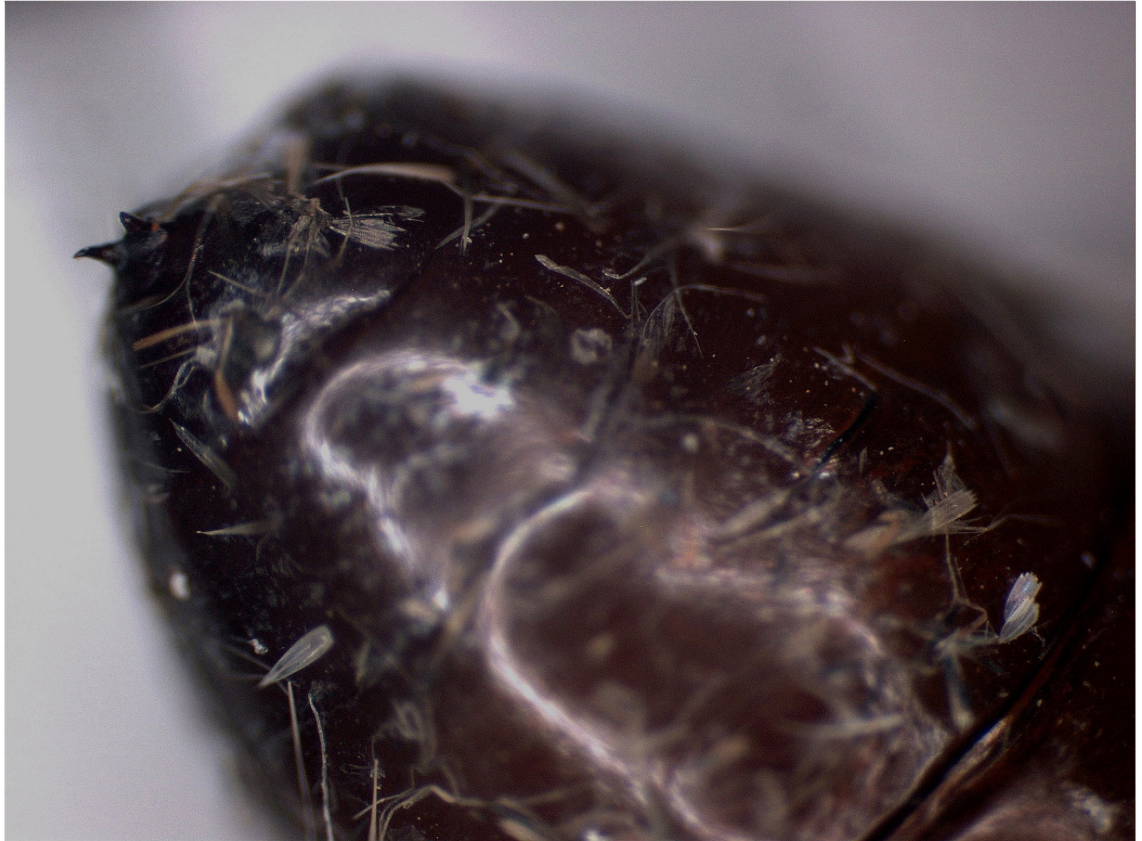


Busseola sp. nov. 1



Busseola sp. nov. 2

Figure 5. Cremasters of *Busseola*.



Manga nubifera

Figure 6. Cremaster of *Manga nubifera*.

2-2 Long and thin spines

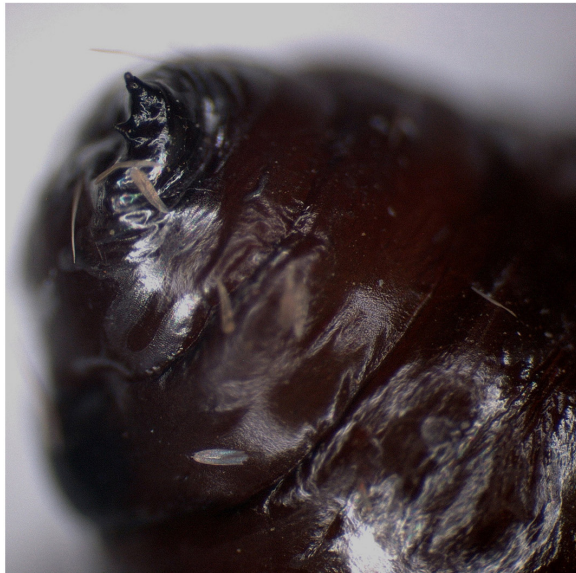
The genus *Sciomesa* (figure 7) and the genus *Feraxinia* (figure 8) have pupae whose cremaster has two long and thin spines.



Sciomesa mesophaea



Sciomesa bua



Sciomesa gnosis



Sciomesa scotochroa

Figure 7. Cremasters of *Sciomesa*.



Feraxinia nyei



Feraxinia jemjemensis

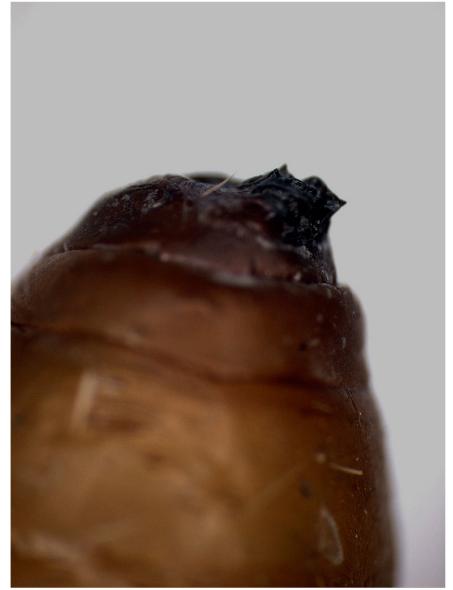
Figure 8. Cremasters of *Feraxinia*.

3- Cremaster thick with four or more very small spines: genus *Sesamia*

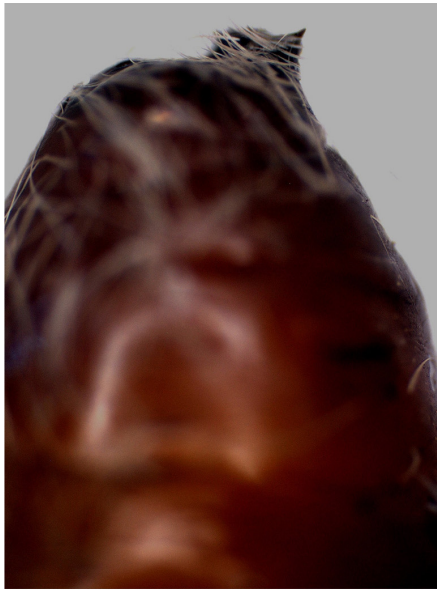
The cremaster of four species of *Sesamia* is shown in figure 9; similar cremasters are found in all *Sesamia* species, whatever the group they belong to (*nonagrioides*, *cretica* or *jansei*). This cremaster is strong, thick, often roughly parallelepiped, frequently with four strong spines in the corners, and sometimes with many small spines on its surface.



Sesamia nonagrioides



Sesamia veronica



Sesamia oriaula



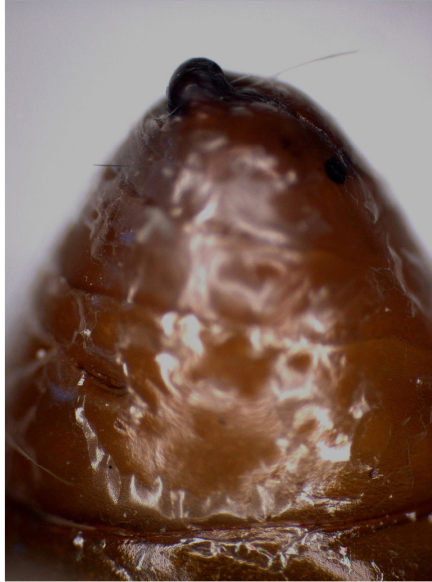
Sesamia epunctifera

Figure 9. Cremasters of *Sesamia*.

4- The genus *Pirateolea*

The three observed species of the genus *Pirateolea* have different cremasters (figure 10): *Pirateolea Piscator* (Fletcher) has virtually no cremaster,

with only a slight uneven bulge at the end of the abdomen; The cremaster of *Pirateolea argocyma* (Fletcher) is like a small bump, without spines, and *Pirateolea nola* Moyal has a cremaster with two thin spines.



Pirateolea argocyma



Pirateolea piscator



Pirateolea nola

Figure 10. Cremasters of *Pirateolea*.

Discussion

Except for the genus *Pirateolea*, whose case is discussed below, the cremaster is homogeneous within a genus. It is also sometimes similar in several genera, as for instance the one with two short spines in the genera *Busseola*, *Manga* and *Buakea*. Distinguishing the genera from such a simple morphological structure is therefore impossible in this case. In contrast, it can be concluded from the intra-genus homogeneity that a species that has a cremaster different from the typical cremaster of a genus does not belong to this genus. This was for instance the case for *Carelis biluma*: this species was originally placed in the genus *Sciomesa*, but a molecular phylogenetic study showed that it belonged in fact to the genus *Carelis* (3). It can be seen in figure 3 that the pupa of this species, which has no cremaster as well as the other *Carelis*, is different from the pupae of *Sciomesa*, which have a cremaster with two long thin spines. Similarly, another molecular phylogenetic study (6) showed that the species *Sesamia sylvata* did not belong to the genus *Sesamia*, and that a new genus should be created to place it. This species has a cremaster (figure 11) quite different from those of *Sesamia* species (figure 9), which confirms that it does not belong to the genus.



Figure 11. Cremaster of *Sesamia sylvata*.

Using the same reasoning, it can also be concluded that the species *Acrapex fletcheri* Laporte is not an *Acrapex*. Indeed, all the pupae of *Acrapex* I have observed, those of *A. syscia* (figure 2), of *A. brunnea*, and of three new close species not yet described, have no cremaster. Now the pupa of *A. fletcheri* has a cremaster different from that of all the other species of Sesamiina, which suggests that this species should be placed in a new genus. A specific study is devoted to this species (7).

The definition of a genus is subjective. As Mayr *et al.* (8) wrote: « a genus is a systematic category including one species or a group of species of presumably common phylogenetic origin, which is separated from other similar units by a decided gap » (...) « taxonomic characters that prove generic distinctness do not exist ». They quote the following sentence from Linnaeus, 1737: «the characters do not make the genus, rather it is the genus that gives the characters».

Thus, intending to characterize a genus by means of a single criterion, such as the cremaster of the pupa, is clearly attempting the impossible. Moreover, in this particular case, the criterion is morphologically too simple to allow a characteristic inter-generic variability. Nevertheless, the present study showed that, with the exception of the genus *Pirateolea*, the cremaster is homogeneous within a genus and may enable to detect the species that are wrongly placed in a given genus. This can be explained by the evolutionary history of the African Sesamiina. Indeed, as written by Mayr *et al.* (8), « the genus, as seen by the evolutionist, is a group of species that has descended from a common ancestor. It is a phylogenetic unit. The characters of the genus are either the critical characters of the ancestral species or such characters as have been jointly acquired by all the species ». Now I have shown in several articles (9, 10, 11) that the first source of creation of new species in this group were the palaeo-climatic events. Therefore, the extant species are likely originating from ancestors that were born at the same time, during a major palaeo-climatic event. The genera in Sesamiina may well not be subjective groups, but the progenies of species that were born at the same time and that have similar temporal histories. If it is so, it is likely that most species that were born during this major palaeo-climatic event did not survive and that the cremasters have structures characteristic of ancestral species whose sister species had no progeny.

The case of *Pirateolea* is however an exception. In this genus the cremaster is not homogeneous. A possible explanation could be that the ancestor of this genus is older than the ancestors of the other genera, and was born during an earlier palaeo-climatic event. As I noted in the definition of this genus (3), the habitus of the wings is very diverse, contrary to what is observed in the other genera of African Sesamiina. Maybe, if other species of this genus could be studied, it would appear possible to divide this group into three genera, each one corresponding to one type of cremaster and being “homologous” of the other genera of African Sesamiina, i.e. with an ancestor species born during the same palaeo-climatic event.

Conversely, similarly shaped cremasters, for instance that with two small spines in *Busseola*, *Manga* and *Buakea*, might indicate common ancestry, which was not revealed by molecular phylogenetic analyses based on mitochondrial genes. The adult habitus suggests also the closeness of these three genera whose species were included in the genus *Busseola* by ancient authors.

The same goes probably for some genera with no cremaster, but not for all. Indeed, in *Carelis* the absence of cremaster results likely from convergence: this genus belongs to the *Sciomesa* genus group, and the pointed tip of the abdomen of the pupa

might indicate the loss of the cremaster that was present in the ancestor of the group. Another case of convergence is that between the cremasters of *Sciomesa* and *Feraxinia*; interestingly such convergence occurs also in the male genitalia, since it is the similarity of the genitalia of *F. nyei* with those of *Sciomesa* that led Fletcher to include this species in this genus as above-mentioned.

The phylogenetic analysis carried out in the study on *A. fletcheri* (7) shows some connections between genera that are in accordance with the cremaster structures.

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