History of the systematics of the *Sesamia sensu lato* group of African noctuid stem borers of monocotyledonous plants (Lepidoptera)

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Abstract. From the description of the genus *Sesamia* Guenée in 1852 to the latest work on the African species, the history of the systematics of this difficult group of African noctuid stem borers is recounted. The misidentifications that confused the taxonomy of these taxa and the new light shed when genitalia observation was first used are described. Some difficulties that still remain in classifying the 157 species described to date are emphasised and possible improvement by the combined use of morphological and molecular analyses is stressed.

Résumé. Histoire de la systématique des noctuelles africaines (groupe *Sesamia sensu lato*) foreuses de plantes monocotylédones (Lepidoptera : Noctuidae). L'histoire de la systématique du difficile groupe des noctuelles africaines foreuses de monocotylédones est présentée, depuis la description du genre *Sesamia* Guenée en 1852 jusqu'aux dernières diagnoses d'espèces. Les erreurs d'identification qui ont contribué à créer la confusion dans ce groupe sont décrites ainsi que les éclaircissements apportés par l'introduction de l'étude des genitalia. Les quelques difficultés qui demeurent pour classer les 157 espèces actuellement décrites sont indiquées. L'utilisation conjointe de l'observation morphologique et de l'outil moléculaire est préconisée afin d'améliorer la connaissance systématique du groupe.

Keywords: Lepidoptera, Noctuidae, stem borer, systematics, *Africa*.

Noctuid stem borers of monocotyledonous plants can be divided into two groups, which differ not only in their morphology but also in their geographical distribution and their evolutionary history. One of these groups is present mainly in temperate regions: it is comprised of 20 genera such as *Nonagria* Ochsenheimer 1816, *Archanara* Walker 1866, *Arenostola* Hampson 1910, *Apamea* Ochsenheimer 1816, *Oligia* Hübner 1816, and others. Some of these are found in Africa. For instance, *Apamea* includes 131 species among which eight are from Africa (two from Eritrea, three from Madagascar, and one each from Kenya, Mauritius and Reunion); *Oligia* is highly diversified in Africa with 34 species out of a total of 71 species in the genus described from various countries of Africa (the others are mainly from North America); *Mesoligia* Boursin 1965, a small genus close to *Oligia*, includes five species, two of which are described from Tanzania, two from Europe and one from Saudi Arabia. These genera are either mainly holoarctic or cosmopolitan and likely have a paleoarctic origin. The situation is quite different for the intertropical group of stem borers, the so-called *Sesamia sensu lato* group (Holloway 1998). It has typical particular morphological characteristics, and is limited to the intertropical regions of the Old World with the exception of some rare species of *Sesamia* Guenée 1852, that can be found in Mediterranean regions. The purpose of the present paper is to recount the history of the systematics of this intertropical group and to examine how knowledge progressed and was sometimes stopped for decades. The difficulties in deciphering the taxonomic relationships that still remain today are highlighted.

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Results

The origins

Although two species of African noctuid stem borers were described in 1790 (*Phalaena vuteria* Stoll, later named *Speia vuteria*) and in 1827 (*Cossus nonagrioides* Lefebvre, the future *Sesamia nonagrioides*), the systematics of intertropical noctuid stem borers was really born in 1852 with the creation by Guenée (1852) of the genus *Sesamia* , with the species type *S. nonagrioides*. From this time, this group has been distinguished and recognised as a special taxonomic entity. This was the only contribution of Guenée to this group of intertropical noctuids, and it concerned the only species present in southern Europe. A few other descriptions of African noctuid stem borer species appeared at the end of the century, and preceded the monumental work of Hampson (1910) done at the British Museum during the last decade of the 19th Century and the first 20 years of the 20th Century.

Hampson comes into the picture

Hampson (1910), who was the great specialist of moths at the turn of the 20th Century, described four new genera of African stem borers: *Acrapex* Hampson 1894 (fig. 1), *Conicofrontia* Hampson 1902 (fig. 2), *Phragmatiphila* Hampson 1908 and *Calamistis* Hampson 1908. The only African *Phragmatiphila* species was later transferred to *Poeonoma* Tams & Bowden 1953 (Tams & Bowden 1953), while the genus *Calamistis* is no longer used. The species type of this latter genus was *C fusca* Hampson 1902, a species that Hampson described in 1902 as *Sesamia fusca*. In 1904, however, Thurau described what he thought to be a new species, for which he created the genus *Busseola* Thurau 1904: *B. sorghicida*. This species was a synonym of *S. fusca*. Therefore, since in systematics there is a priority rule when both species are recognized as synonyms, the species took the name *fusca* and kept the genus name *Busseola*. Since *Calamistis* had the species type *C. fusca*, all the species in this genus were transferred to *Busseola*, which had priority. In his catalogue of the Lepidoptera Phalaenae in the British Museum, Hampson (1910) described these new genera and transferred some species to them. This resulted altogether in one species in *Phragmatiphila*, four species in *Conicofrontia*, eight species in *Acrapex*, seven in *Calamistis* and 10 in *Sesamia*. By 1920 Hampson had added three new African species to *Sesamia*, four to *Busseola* and six to *Acrapex* (or that were later transferred to *Acrapex*). Hampson alone described 40 new species of African noctuid stem borers, which is the major contribution to this group. The only other important work in the field before the Second World War was that of Janse (1939), who described six species of *Acrapex* and two species of *Sesamia* from South Africa. The total number of species described was by then 63, but later two of them sank as synonyms, so the number of valid species at the time amounted to 61. Fourteen years passed before a substantial new event occurred.

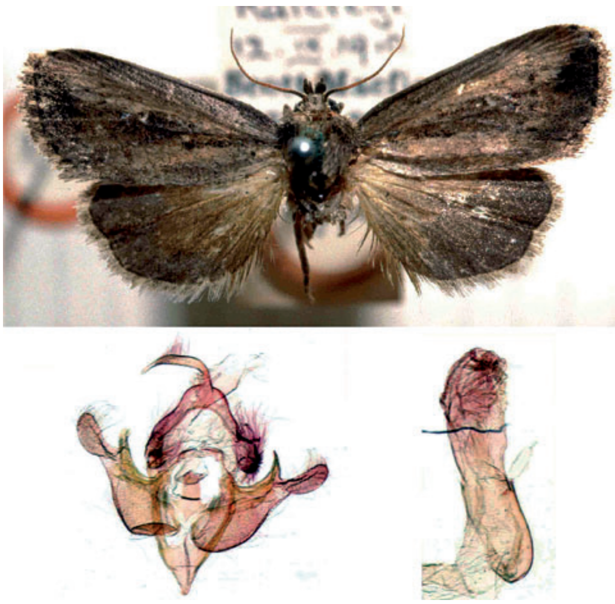

Figure 1
Acrapex hemiphlebia (Hampson 1914) (A: adult.; B: male genitalia; C: aedeagus).

Figure 2
Conicofrontia diamesa (Hampson 1920) (A: adult; B: male genitalia; C aedeagus).

Tams & Bowden, and the revision of African Sesamia

The work by Tams & Bowden (1953) and the subsequent one by Bowden (1956) mark a turning point in the African studies of noctuid stem borers. These authors shed new light on the topic thanks to the observation of the genitalia, which enabled an easier separation of the species. The first use of genitalia was by Janse (1939), but in some cases he did not observe the types and made some mistakes. For instance, he attributed the name *Sesamia calamistis* Hampson 1910 to a different species that was later named *Sesamia jansei* by Tams & Bowden in 1953; he also presented pictures of genitalia often in a profile view that did not enable easy species identification. Tams & Bowden (1953) checked the genitalia of many types in the British Museum, and presented them in a fashion that enabled, in most cases, a fairly easy determination of the species by field entomologists. This accurate study enabled them to demonstrate a major error in Hampson's work. In the Catalogue, this last author has put in synonymy *Sesamia nonagrioides* and *Phalaena vuteria* Stoll, which has priority, resulting in *S. vuteria* becoming the new species type of the genus *Sesamia* (Hampson 1910). Tams & Bowden (1953) showed that *Phalaena vuteria* was a different species and did not belong at all to *Sesamia* and thus created the genus *Speia* Tams & Bowden 1953 (fig. 3) for it. *S. nonagrioides* was then rehabilitated, as well as *Sesamia madagascariensis* Saalmüller 1891, which also had been sunk as a synonym of *S. vuteria* by Hampson (1910). Tams and Bowden created two other genera, (i) *Poeonoma* Tams & Bowden 1953 (fig. 4), in which to place the species *P. serrata* (which Hampson had originally put in *Phragmatiphila)* and two other new species, and (ii) *Sciomesa* Tams & Bowden 1953 (fig. 5) to include three species that Hampson had placed in *Conicofrontia*. They

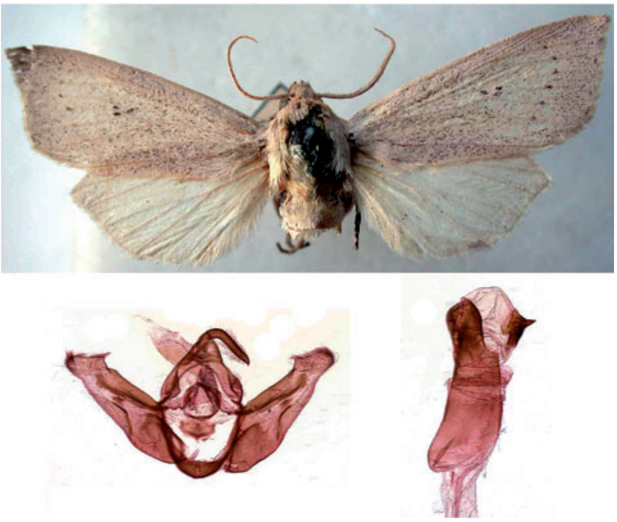

Figure 3
Speia vuteria (Stoll 1790) (A: adult; B: male genitalia; C: aedeagus).

Figure 5
Sciomesa mesophaea (Hampson 1910) (A: adult; B: male genitalia; C: aedeagus).

described also five new species of *Sesamia*. In 1956 Bowden described three new genera, *Carelis* Bowden 1956 (fig. 6), *Manga* Bowden 1956 and *Poecopa* Bowden 1956 (fig. 7), that were the last described genera in the group of African noctuid stem borers; he also described six new species. Not only was this work a masterpiece in systematics, but it was also the first time that wild host plants of many borers were recorded, and the papers by Tams & Bowden (1953) and Bowden (1956) remained until recently the most complete sources of information on the ecology of noctuid stem borers in natural habitats (Holloway 1998).

Figure 4
Poeonoma serrata (Hampson 1910) (A: adult.; B: male genitalia; C: aedeagus).

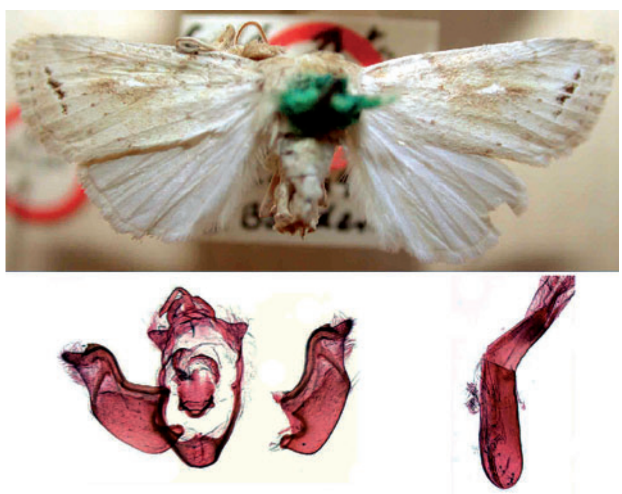

Figure 6
Carelis albula Bowden 1956 (A: adult; B: male genitalia; C: aedeagus).

The era of great expeditions

The observation of genitalia was a tremendous step forward and resulted in an unquestionable clarification of the taxonomy of the group. Where the only noctuid species ever found in maize, sugar cane, sorghum and rice crops in Africa was once *Sesamia vuteria*, it was now possible to distinguish *Sesamia calamistis*, *S. nonagrioides* and *Sesamia poephaga* Tams & Bowden (1953). But all problems were not solved, and the delimiting species remained a particularly difficult task, as was quickly proved. Thus Nye (1960) sank two species described by Tams and Bowden to the rank of subspecies: *Sesamia botanephaga* Tams & Bowden 1953 became a subspecies of *S. nonagrioides* and *Busseola segeta* Bowden 1956 a subspecies of *Busseola phaia* Bowden 1956. Apart from some isolated descriptions or revisions of this kind, most of the work on noctuid stem borers after Tams and Bowden was a consequence of localised expeditions: (i) The Ruwenzori expedition of 1952, which enabled Fletcher (1961) to describe 10 new species belonging to several of the genera already mentioned, and one new species he placed in the genus *Hygrostola* Warren 1913; (ii) The Ethiopian expeditions of Rougeot from 1976 to 1982 (Rougeot, 1984) which resulted in 18 new taxa described by Laporte (1984). (iii) The study of Madagascar noctuids by Viette (1967), which was done in the interim between the above two expeditions. Considerable work was also done by Berio (1973; 1975; 1976), who described 28 new species, mainly *Acrapex* (25), collected for the most part in Congo and Tanzania. During this period of 30 years following the papers by Tams and Bowden, the number of described African noctuid stem borer species was doubled (fig. 8). This intensive descriptive work was, however, highly biased towards two genera, *Acrapex* and *Sciomesa*, which accounted for 84% of the new species described. There was apparently a trend to place the new species in these two genera, although in several cases, there was doubt about the proper position. Thus *Sciomesa piscator* Fletcher 1961 was placed "provisionally" in this genus (Fletcher 1961), where it is still today. There was also a doubt about *Sciomesa biluma* Nye 1959, a species endemic to Madagascar and described by Nye (1959); the author found that this species did not easily fit in the mould of the described *Sciomesa* genus, but was reluctant to create a new genus for only one species. This intensive descriptive work was at that time more aimed at placing taxa in existing genera, even temporarily or inaccurately, rather than trying to improve the taxonomic relationships. Following this prolific time, the systematics of the group entered a new resting period. It finally became active again in Africa, where the history continues with the recent work by Krüger (2005) on the moths of Lesotho. This is the second contribution of an African author to the knowledge of African noctuid stem borers, and comes 66 years after Janse's book. Four new species of *Sesamia* and two new species of *Acrapex* are described.

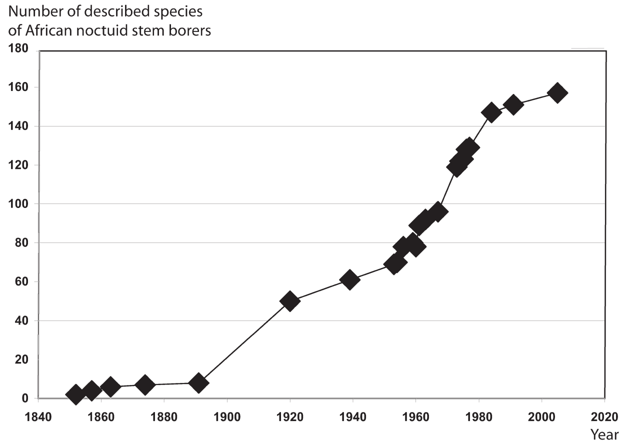

Figure 8
Progression of the number of described species of the *Sesamia sensu lato* group (Holloway 1998) of African noctuid stem borers since 1850.

Figure 7
Poecopa mediopuncta Bowden 1956 (A: adult; B: male genitalia; C: aedeagus).

Table 1. Geographic distribution of the *Sesamia sensu lato* group (Holloway 1998) of noctuid stem borers in the different regions of Africa.

Genus	Southern strictly[a]	Eastern[b] strictly	East or South	Central	Western strictly	West or East	Northern Sahara strictly	North or East	All regions sub-Sahara
Acrapex	15	37	1	12	4	1			
Busseola	2	1	1	1	3				1
Carelis					2				
Conicofrontia	2	1							
Hygrostola		1							
Manga		2		1	1				
Poecopa						1			
Poeonoma				2	2	1			
Sciomesa	2	16		2					
Sesamia	11	16	3	2	1		3	1	4
Speia			1						
Total	**32**	**74**	**6**	**20**	**13**	**3**	**3**	**1**	**5**
%	20.4	47.2	3.8	12.7	8.3	1.9	1.9	0.6	3.2

[a] "strictly" means the species is found only in this region
[b] eastern Africa includes Madagascar

Discussion

These taxonomic studies above enabled the description of 11 genera and 157 species of African noctuid stem borers of monocotyledonous plants: 70 *Acrapex*, nine *Busseola*, two *Carelis*, three *Conicofrontia*, one *Hygrostola*, four *Manga*, one *Poecopa,* five *Poeonoma*, 20 *Sciomesa*, 41 *Sesamia*, and one *Speia*. They reveal furthermore two features of these insects:

(i) From an applied point of view, few among these species are agricultural pests. Five are major pests, of which four are *Sesamia* species (*S. nonagrioides*, *S. calamistis*, *S. poephaga* and *Sesamia cretica* Lederer 1857) and one a *Busseola species*, *Busseola fusca* (Fuller 1901). Two other species appear to be of little economic importance: *Sciomesa biluma* is endemic to Madagascar where it is found on rice, maize and sorghum (Caresche & Breniere 1961; Breniere & Dubois 1965), and Manga basilinea Bowden 1956 is a pest of pearl millet, *Pennisetum glaucum* (L.) in western Africa (Bowden 1956; Harris 1962). This could be due to the host plant specialisation of most borers (Le Rü *et al.* 2006). However, several other species have been recently found in crops, particularly in maize, which suggests that they could become pests in future (Ong'amo *et al.* 2006).

(ii) From a biogeographical point of view, the borer distribution is highly biased: most borers species (71.4%) are known from eastern or southern Africa (tab. 1). Is this a consequence of poor prospecting in other parts of the continent, or is speciation favoured in the more various landscapes of these regions of Africa, or is this a combination of both factors? It is difficult to answer this question at the moment. Collecting has been very low in central Africa, and most of the data from West Africa originate from Bowden's work that was limited to Ghana, which suggests that there is still a lot to do in order to get a good picture of borer biodiversity in these regions.

Some remaining difficulties and future prospects

Although clarified by the work of all the above-mentioned taxonomists, the systematics of the group is still problematic in some cases, both at the species and genus level. Some remaining difficulties can be summed up as follows.

- For several species, only one sex is known. If it is a female (whose genitalia often have few distinctive characters), it can be difficult to decide in which genus to place it, and also to ascertain that it is not the female of a species already described elsewhere from a male specimen.
- Some species are so close, even with respect to their male genitalia, that it is not clear if they should be considered as different. For instance, Tams & Bowden said that further investigation might show *S. poephaga* and *Sesamia penniseti* Tams & Bowden 1953 to be races of one widely distributed species. Holloway (1998) in contrast suggests that possibly *S. poephaga* might be conspecific with *Sesamia epunctifera* Hampson 1902 on the one hand, and *S. penniseti* conspecific with *Sesamia poebora* Tams & Bowden 1953 on the other hand.
- How can we delimit the genera? Can we use genitalia to determine these limits? From the time of Tams and Bowden, a tendency to consider genitalia as the main criterion to group together species in genera became apparent, particularly for *Sciomesa* and *Acrapex*. However there are sometimes great morphological differences between the genitalia of species within a genus. For instance, Tams & Bowden (1953) observed such a case in the genitalial structure of *Sesamia* species, with two clear-cut groups, the *nonagrioides* and the *cretica* groups. These authors first thought of creating a new genus for the latter, but they then found that there were intermediate species, such as *S. jansei*, that have genitalia with features found in both groups; they therefore maintained one genus. But the problem is not solved in this particular case, however, since some other species placed in *Sesamia* have genitalia different from both groups, as for instance *Sesamia sciagrapha* Fletcher 1961 and *Sesamia sabulosa* Hampson 1910. Should we keep them in this genus, or is the genus paraphyletic, calling for the creation of a new one? Similar matters arise also for the other genera.

Nowadays a new tool is available that could be of considerable help in solving these questions: the use of molecular data. These techniques enable us, for instance, to attribute with certainty a female to a species. They can help in deciding whether or not two taxa should be included in the same species. They can help in understanding the evolution of the group and therefore in delimiting monophyletic sets, thus enabling the definition of natural genera. Molecular techniques can also help dramatically in the identification of pre-imaginal stages.

While facing the deficit in taxonomists, and enthusiastic about the apparently unlimited possibilities in solving classification dilemmas through the use of molecular taxonomy, some authors have even suggested the creation of a bar-coding system based on a mitochondrial gene, Cytochrome Oxidase subunit 1 (Hebert *et al.* 2003), as a basis for the future description of Earth's animal biodiversity. This proposal has ardent promoters (Blaxter 2003, 2004; Tautz *et al.* 2003), but also strong opponents (Lipscomb *et al.* 2003; Lee 2004; Will & Rubinoff 2004). The use of molecular taxonomy alone, based on a single mitochondrial gene, has indeed serious flaws. For instance there can be introgressions of mitochondrial genes between close species that can hybridise: individuals of a species may have the mitochondrial genome of the other, which contradicts the results of morphological or nuclear data. A recent well known example is that of the African elephants (Roca *et al.* 2001; 2004); another instance in insects is the similarity of mitochondrial DNA between close species of *Drosophila* Fallen 1823 (Lachaise *et al.* 2000), which contrasts with the nuclear DNA, morphology and proven reproductive isolation, and which could be due to infection by *Wolbachia* endosymbiotic bacteria. Another problem is that copies of mitochondrial genes in the nuclear genome (called numts) sometimes occurred in the past; these can be amplified instead of the mitochondrial gene and result in wrong sequences (Richly & Leister 2004). It seems then more sensible, in our opinion, to promote a combined use of morphological and molecular observations to improve the knowledge of biodiversity. For instance, studies from DNA sequences (Moyal *in.lit.*) confirm that taxonomists were right when they were reluctant to place some species in the *Sciomesa* genus. This genus proved indeed to be paraphyletic at the molecular level. And the results of molecular analyses are congruent not only with adult morphology, but also with observations of the larval morphology, behaviour and host-plant preference (Le Rü *et al.* 2006). Therefore, just as the observation of genitalia was a great step that helped in clarifying the taxonomy based only on adult habitus, the use of molecular data in combination with morphological data (and also ecological and behavioural data, when available) should result in a new impulse in the systematics of African noctuid stem borers. Interest in such an approach for the noctuid stem borer group is exemplified by the first studies on the *Manga* genus (Moyal & Le Rü 2006).

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References

Berio E. 1973. Nuove species e generi di noctuidae africane e asiatische e note sinonimiche. Parte II. *Annali del museo civico di storia naturale „Giacomo doria"* **79**: 126-171.

Berio E. 1975. Diagnosi di nuovi taxa di noctuidae del globo (Lepidoptera). *Annali del museo civico di storia naturale „Giacomo doria"* **80**: 321-339.

Berio E. 1976. Nuovi generi e specie di noctuidae dell'Africa equatoriale. *Annali del Museo civico di storia naturale „Giacomo doria"* **81**: 96-123.

Blaxter M.L. 2003. Counting angels with DNA. *Nature* **421**: 122-124.

Blaxter M.L. 2004. The promise of a DNA taxonomy. *Philosophical Transactions of the Royal Society of London B.* **359**: 669-679.

Bowden J. 1956. New species of African stem-boring Agrotidae (Lepidoptera). *Bulletin of Entomological Research* **47(3)**: 415-428.

Breniere J., Dubois J. 1965. Catalogue des insectes nuisibles aux cultures malgaches. *Institut de Recherches Agronomiques de Madagascar* **43**: 168pp.

Caresche L., Breniere J. 1961. Liste des insectes nuisibles aux plantes cultivées à Madagascar. *Institut de Recherches Agronomiques de Madagascar* **23**: 1-21.

Fletcher D.S. 1961. Noctuidae. **1(7)** p. 177-323 *in:* **Evans G. O., Fletcher D. S. (eds.)**, *Ruwenzori expedition 1952.*British Museum (Natural History), William Clowes & Sons Ltd, London.

Guenée A. 1852. Noctuélites. **5** p. 64-111 *in:* **Boisduval J.B.A.D., Guenée A. (eds.)**, *Histoire naturelle des insectes- Species général des Lépidoptères. Tome cinquième*. Librairie encyclopédique de Roret, Paris.

Hampson G.F. 1910. *Catalogue of the Noctuidae in the Collection of the British Museum*. Taylor & Francis, London, 552 p.

Harris K.M. 1962. Lepidopterous stem borers of cereals in Nigeria. *Bulletin of Entomological Research* **53(1):** 139-172.

Hebert, P. D. N., Cywinska A., Ball S.L., Dewaard J.R. 2003. Biological identifications through DNA barcodes. *Proceedings Royal Society London B* **270**: 313-321.

Holloway J. D. 1998. *Noctuidae*. p. 79-86 *in:* **Polaszek A. (ed.)**, *African Cereal Stem Borers*. CABI, London.

Janse A.J.T. 1939. *The Moths of South Africa.* p. 307-435, *Volume 3. Cymatophoridae, Callidulidae and Noctuidae (partim).* E.P. & Commercial Printing Co. Ltd, Durban.

Krüger M. 2005. New genera and species of noctuid moths from Lesotho (Lepidoptera: Noctuoidea: Noctuidae). *African Entomology* **13(1):** 97-142.

Lachaise D., Harry M., Solignac M., Lemeunier F., Benassi V., Cariou M.-L. 2000. Evolutionary novelties in islands : *Drosophila santomea*, a new *melanogaster* sister species from São Tomé. *Proceedings of the Royal Society of London B.* **267**: 1487-1495.

Laporte B. 1984. Noctuidae. p. 12-51 *in:* **Rougeot P. C. (ed.)**, *Missions entomologiques en Ethiopie 1976-1982. Mémoires du Museum national d'Histoire naturelle (Nouvelle série). Volmume 128, Fascicule II.* Museum National d'Histoire Naturelle, Paris.

Lee M.S.Y. 2004. The molecularisation of taxonomy. *Invertebrate Systematics* **18**: 1-6.

Le Rü B.P., Ong'amo G.O., Moyal P., Muchugu E., Ngala L., Musyoka B., Abdullah Z., Kauma-Matama T., Lada V.Y., Pallangyo B., Omwega C.O., Schulthess F., Calatayud P.-A., Silvain J.-F. 2006 Geographic distribution and host plant ranges of East African noctuid stem borers. *Annales de la Société entomologique de France (N.S.)* **42(3-4):** 353-361.

Lipscomb D., Platnick N., Wheeler Q. 2003. The intellectual content of taxonomy: a comment on DNA taxonomy. *Trends in Ecology and Evolution* **18(2):** 65-66.

Moyal P., Le Rü B. 2006. From population to species: morphological and molecular diversity in east African stem borer species of the genus *Manga* Bowden 1956 (Lepidoptera: Noctuidae). *Annales de la Société entomologique de France (N.S.)* **42(3-4):** 293-307.

Nye I.W.B. 1959. A new species of Amphypirinae from Madagascar. *Revue française d'Entomologie* **26**: 50-52.

Nye I.W.B. 1960. *The Insect Pests of Graminaceous Crops in East Africa*. Her Majesty's Stationery Office, London, 42 p.

Ong'amo G.O., Le Rü B.P., Dupas S., Moyal P., Calatayud P.-A., Silvain J.-F. 2006. Distribution, pest status and agro-climatic preferences of lepidopteran stemborers of maize in Kenya. *Annales de la Société Entomologique de France (N.S.)* **42(2):** 171-177.

Richly E., Leister D. 2004. Numts in sequenced eukaryotic genomes. *Molecular Biology and Evolution* **21(6):** 1081-1084.

Roca A.L., Georgiadis N., Pecon-Slattery J., O'Brien S.J. 2001. Genetic evidence for two species of elephant in Africa. *Science* **293**: 1473-1477.

Roca A.L., Georgiadis N., O'Brien S.J. 2004. Cytonuclear genomic dissociation in African Elephant species. *Nature Genetics* **37(1):** 96-100.

Rougeot P.C. 1984. Missions entomologiques en Ethiopie 1976-1982. *Mémoires du Muséum National d'Histoire Naturelle (N.S.)*, **128(2):** 1-93.

Tams W.H.T., Bowden J. 1953. A revision of the African species of *Sesamia* Guenée and related genera (Agrotidae-Lepidoptera). *Bulletin of Entomological Research* **43:** 645-679.

Tautz D., Arctander P., Minelli A., Thomas R.H., Vogler A.P. 2003. A plea for DNA taxonomy. *Trends in Ecology and Evolution* **18(2):** 70-74.

Thurau F. 1904. *Busseola sorghicida*, eine neue Ost-Afrikanische Noctuide. *Berliner Entomologische Zeitschrift* **49**: 55-58.

Viette P. 1967. *Insectes Lépidoptères Noctuidae Amphipyrinae (Part.) et Melicleptriinae. Faune de Madagascar*. ORSTOM-CNRS, Paris **20(2):** 394-417.

Will K.W., Rubinoff D. 2004. Myth of the molecule: DNA barcodes for species cannot replace morphology for identification and classification. *Cladistics* **20**: 47-55.