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AFROTROPICAL BEES NOW: WHAT NEXT ?

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ABSTRACT

Bees are an important group of pollinators and indispensable in agriculture and for maintaining biological diversity. Although indigenous honeybees are used extensively as pollinators in commercial agriculture in africa, other bees are also important pollinators for both commercial and small-scale farming. Although less abundant they are more effective pollinators of many plants. In the afrotropical region bees appear to inhabit all the different biomes, making them an important reference group for biodiversity studies. Besides, they are an effective indicator group because of their sensitivity to environmental degradation. A detailed knowledge of the systematics of bees is clearly vital for the sustainable use of genetic resources in africa. There are 129 bee genera in sub-saharan africa, of which 83 (64%) have been revised since 1965, and 25 (19%) are currently being studied. Of the 73 genera of long-tongued bees in sub-saharan africa 72 either have been revised or are receiving attention. It is therefore possible to identify most of the long-tongued bees. The short-tongued bees, which are more common and also very important pollinators, are less well known. No systematic research is currently being conducted on 33% (18 of the 55 genera) of the genera. It is imperative that africa does not lose its expertise in bee systematics, which is pivoted on a few individuals, if advances are to be made in pollination biology.

INTRODUCTION

Bees feed their progeny on pollen and nectar, and some bees also use plant oils. These products are mostly collected from flowers by the bees that utilize them. This behaviour often results in bees pollinating the flowers they visit, which gives them the potential to play a major role in enabling seed production and determining patterns of gene flow in populations of many species of flowering plants. Bees therefore have a strong influence on patterns of diversification and distribution of the species of flowering plants with which they are associated. Flowering plants, however, are an important group of primary producers, and factors affecting their distribution and abundance may have ramifications throughout the communities to which they belong. Whereas some bees visit and pollinate a broad spectrum of flowers, and some flowers are visited by many different pollinator species, other bees and plants appear to be highly specialized resulting in a narrow spectrum of host plants or pollinators. Therefore the ecological role of bees within the community may be disproportionate to their absolute numbers, as either species or individuals. As many agricultural crops depend on pollination for fruit and/or seed production, the maintenance of diverse bee populations in agro-ecosystems is essential for sustainable agriculture.

Indigenous African honeybees (*Apis mellifera* Linnaeus), because of the technology associated with honey production, can be easily moved to agricultural fields in large numbers. This has resulted in honeybees being the most important, possibly the only, commercially managed pollinator in Africa. Although they have the advantage that large numbers can be easily manipulated, they are not efficient pollinators of many crops (Westerkamp 1991; Eardley & Mansell 1996a & b). This is due to their size, method of carrying pollen and reluctance to visit the flowers of certain plant species. Bees that have loosely packed pollen on the hind legs and on the ventral surface of the metasoma appeared to be more effective pollinators than honeybees of litchi, avocado and mango in South Africa (unpublished observations).

An accurate knowledge of the systematics of bees is essential for ecological research aimed at understanding their role in natural communities. Fortunately the systematics of bees has always received a disproportionate high level of attention relative to other groups of Afrotropical insects. This unfortunately has not been accompanied by an equivalent interest in their biology, including pollination biology. Most studies on pollination biology, other than that on the honeybee, have either been descriptive and concerned with interesting insect-plant relationships and not on pollination of agriculturally important plants, or have not been published.

Non-domesticated bees are responsible for much of the pollination of agricultural crops in Sub-saharan Africa, and their population densities are reduced by intensive and indiscriminate farming practices. Evidence of this is in a reduction in the number and diversity of pollinators in avocado, litchi and mango orchards (own observation & M. Mansell, personal communications) and lower seed set in sunflower (A du Toit, personal communication) in some extensively cultivated areas. For commercial crops this necessitates hiring bee-keepers to bring in honeybees. Such resources may not be available, which may result in reduced production. In South African semi-deserts insect-pollinated plants predominant as pasture. The Karoo climax community grasses have largely been replaced with pioneer insect pollinated plants. Insect-pollinated plants also form a major component of Namaqualand's natural vegetation. Current stock farming practices often result in changes in available nesting sites, water, mud and vegetation, which impact negatively on the bee populations that are responsible for much pollination in these area (Gess & Gess 1993). Research on the natural pollinator's biology is vital to prevent these semi-deserts from becoming denuded of vegetation due to a lack of pollinators. This cannot be done without a good knowledge of the systematics of the insects involved, especially bees.

In Africa indigenous honeybees will possibly always be the most important pollinators in commercial agriculture. There is a need, however, to investigate alternative indigenous pollinators to reduce the increasing dependence of agriculture on a single species of pollinator. Recently thousands of *A. mellifera scutellata* Latreille hives were invaded by *A. mellifera capensis* Eschscholtz workers, and infestations of varroa mite, which preys on honeybee larvae, have recently occurred in South Africa. The maintenance of diverse bee populations will reduce this dependence on *A. mellifera* and facilitate the pollination of wild plants, which have numerous associated benefits. These include the prevention/reduction of desertification and soil erosion, maintenance of watersheds and provision of refuges for biological control agents.

Current Systematic Knowledge

There are 128 Sub-saharan bee genera, of which 83 (64%) [66 (67%) for southern Africa] have been revised since 1965, and 24 (33%) are currently being studied. Thus 86% of the Sub-saharan bee genera are either revised or being studied (Appendix 1).

Of the 74 genera of long-tongued bees 73 have either been revised or are receiving attention. *Ctenoplectra,* which requires revision, is a small genus. Therefore it is possible to identify most of the long-tongued bees, several do however require further study. Only the southern African species of *Xylocopa*, *Amegilla* and *Anthophora* have been revised, *Megachile*, *Chalicodoma* and *Creightonella* require further study to enable their accurate identification.

The short-tongued bees, which appear to be more common and are most probably more important as pollinators due to their size and method of carrying pollen are less well known. No systematic research is currently being conducted on 33% (20 of the 60 genera) of the genera. Further, the revised genera generally comprise few species and those that require revision have many species. A need clearly exists for systematic research on the Sub-saharan short-tongued bees.

FAMILY	NUMBER OF GENERA				
	Revised whole Sub-saharan Region	**Revised only for S. Africa**	**Being Revised Sub-saharan Region**	**Unstudied**	TOTAL
Apidae	30	3	4	1	**38**
Fideliidae	-	-	2	0	**2**
Megachilidae	22	-	12		**34**
Colletidae	4	-	2	0	**6**
Andrenidae	3	-	1	0	**4**
Melittidae	11	-	2	2	**15**
Halictidae	13	-	1	16	**30**
TOTAL	**83**	**3**	**24**	**19**	**129**

TABLE 1. The number of sub-saharan bee genera, per family, that have been revised since 1965, are currently being revised and those for which there is no useful revisory study and which are not currently being studied.

Systematic research should be coordinated to ensure efficient progress. Globally coordinated systematic research will enable phylognetic relationships to be established and facilitate comparison of pollinator scenarios in different zoogeographical regions.

Little information on pollination in Africa has been published. This is partly due to insufficient knowledge on the systematics of certain bee groups, such as the Halictidae and some Megachilidae (the genera that Pasteels [1965] revised require further study), as a number of pollination studies of agricultural significance have been initiated but not completed. Short-tongued bees and megachilids are often major components of such pollinator guilds. Therefore an ability to identify a larger proportion of pollinators is needed to stimulate pollination research. As a large portion of the Afrotropical Apoidea have been revised, relatively little further investment in bee systematics will provide large returns in enabling meaningful research in sustainable agriculture and biological diversity. Comparable systematic knowledge is available in very few other insect groups.

REQUIREMENTS

The needs of pollination biologists, with respect to biosystematic science and services are:

- Easy-to-use keys to families, genera and species
- Automated identification systems
- Distribution data
- Host plant records
- Catalogues and species lists, and
- Readily available literature

Much information is available towards these ends, but is as yet unpublished. Distribution and host plant records for many species are available, but not yet published. Databases of some of the South African collections are being prepared. Catalogues and reference lists have received substantial attention. However, the time taken to complete such long-term projects is a major constraint for potential users, and often leads to a duplication of effort. It is therefore essential to disseminate information before final publication.

SOLUTION

The solution appears to be in electronic media. Identifications can be facilitated by the development of electronic multi-access keys. The publication of information using inexpensive electronic media or the World Wide Web could make information such as catalogues available to users, who can identify errors and omissions, before publication. Existing publications could be placed on the Web for easy access. The electronic publication of new information would free more funds for research.

The Convention on Biological Diversity (CBD) has identified the Clearing-house Mechanism as the vehicle to achieve these objectives. Pollinators are one of two groups that have been identified by Decision III/11 (1996) of the Conference Of the Parties (COP) to the Convention on Biological Diversity, taken during their Third Meeting (COP3) in Buenos Aires, Argentina. Bee systematists have a responsibility to develop an effective global electronic information storage and retrieval system to serve the needs of systematics and pollination biology alike.

BioNET-INTERNATIONAL is one of the bodies recognised in the Darwin Declaration as an appropriate avenue for the development of biosystematic capacity. As the above issues mostly concern the development of such capacity, BioNET-INTERNATIONAL, through its developing country LOOPs (Locally Organized and Operated Partnerships), could be a suitable vehicle for the achievement of this objective.

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APPENDIX 1

The current systematic status of the Sub-saharan bees, including major revisions and specialists currently studying taxa. The Madagascan bee fauna is currently being revised (Pauly *et al.*, 2001) and is not included.

APIDAE

Acanthomelecta	Revised	Lieftinck 1972
Afromelecta	Revised	Lieftinck 1972
Allodape	Revised	Michener 1975
Allodapula	Revised	Michener 1975
Amegilla	Revised, southern Africa only	Eardley 1994
Ammobates	Revised	Eardley & Brothers 1997
Ammobatoides	Revised	Eardley & Brothers 1997
Anthophora	Revised, southern Africa only	Eardley & Brooks 1989
Apis	Revised	Ruttner, 1988
Braunsapis	Revised	Michener 1975
Ceratina	Being revised	Daly, University of California, Berkley, USA
Cleptotrigona	Revised	Michener 1990
Compsomelissa	Revised	Michener 1975
Ctenoceratina	Revised	Daly 1988
Ctenoplectra	Not revised	
Dactylarina	Revised	Michener 1990
Epeolus	Revised	Eardley 1991b
Eucara	Revised	Eardley 1989
Eucondylops	Revised	Michener 1975
Halterapis	Revised	Michener 1975

Hypotrigona	Revised	Michener 1990
Liotrigona	Revised	Michener 1990
Macrogalea	Revised	Michener 1975
Megaceratina	Revised	Daly 1985
Meliponula	Revised	Michener 1990
Nasutapis	Revised	Michener 1975
Neoceratina	Being revised	Daly
Nomada	Revised	Eardley & Schwarz 1991
Pachymelus	Revised	Eardley 1993b
Pasites	Revised	Eardley & Brothers 1997
Pithitis	Being revised	Daly
Plebeina	Revised	Michener 1990
Protopithitis	Being revised	Daly
Sphecodopsis	Revised	Eardley & Brothers 1997
Tetralonia	Revised	Eardley 1989
Tetraloniella	Revised	Eardley 1989
Thyreus	Revised	Eardley 1991a
Xylocopa	Revised, southern Africa only	Eardley 1983
FIDELIIDAE		
Fidelia	**Being revised**	**Whitehead & Eardley, in press**
MEGACHILIDAE		
Afranthidium	Being revised	Michener* & Griswold** 1994 *University of Kansas, Lawrence USA, **USDA, Bee biology & Systematics Laborastory, Logan USA Pasteels 1984
Afroheriades	Being revised	Griswold
Afrostelis	Revised	Pasteels 1984
Anthidiellum	Revised	Pasteels 1984
Anthidioma	Revised	Pasteels 1984
Anthidium	Revised	Pasteels 1984
Aspidosmia	Being revised	Griswold
Atropium	Revised	Pasteels 1984
Benanthis	Revised	Pasteels 1984
Chalicodoma	Revised	Pasteels 1965
Coelioxys	Being revised	Schwarz, Ansfelden, Austria Pasteels 1968
Creightoniella	Revised	Pasteels 1965
Cyphanthidium	Revised	Pasteels 1984
Euaspis	Revised	Pasteels 1984
Gnathanthidium	Revised	Pasteels 1984
Haetosmia	Being revised	Griswold
Heriades	Being revised	Griswold
Hoplitis	Being revised	Griswold
Larinostelis	Revised	Michener & Griswold 1994
Icteranthidium	Revised	Pasteels 1984
Lithurge	Revised	Eardley 1988
Megachile	Revised	Pasteels 1965
Noteriades	Being revised	Griswold
Ochreriades	Revised	Griswold 1984
Othinosmia	Being revised	Griswold
Pachyanthidium	Revised	Pasteels 1984

Plesianthidium	Revised	Pasteels 1984
Pseudoanthidium	Revised	Pasteels 1984
Pseudoheriades	Being revised	Griswold
Serapista	Revised	Pasteels 1984
Stelis	Revised	Pasteels 1984
Stenoheriades	Being revised	Griswold
Trachusa	Revised	Pasteels 1984
Wainia	Being revised	Messinger & Griswold
COLLETIDAE		
Calloprosopis	Revised	Snelling 1985
Colletes	Being revised	Kuhlmann, Ahlem, Germany
Scrapter	Revised	Eardley 1996
Hylaeus	Revised, partly	Snelling 1985, excludes Subgenus Deranchylaeus
Nothylaeus	Being revised	Snelling, Los Angeles, USA
Psilylaeus	Revised	Snelling 1985
ANDRENIDAE		
Andrena	Not revised	
Melitturga	Revised	Eardley 1991c
Meliturgula	Revised	Eardley 1991c
Mermiglossa	Revised	Eardley 1991c
MELITTIDAE		
Agemmonia	Revised	Michener 1981
Atrosamba	Revised	Michener 1981
Capicola	Not revised	
Ceratomonia	Revised	Michener 1981
Haplomelitta	Revised	Michener 1981
Haplosamba	Revised	Michener 1981
Meganomia	Revised	Michener 1981
Melitta	Not revised	
Metasamba	Revised	Michener 1981
Promelitta	Revised	Michener 1981
Prosamba	Revised	Michener 1981
Samba	Revised	Michener 1981
Rediviva	Being revised	Whitehead
Redivivoides	Being revised	Whitehead
Uromonia	Revised	Michener 1981
HALICTIDAE		
Acunomia	Revised	Pauly 1990
Afronomia	Revised	Pauly 1990
Austronomia	Not revised	
Crocisaspidia	Revised	Pauly 1990
Eupetersia	Not revised	
Halictus	Not revised	
Lasioglossum	Revised, partly	Pauly 1980
Leuconomia	Not revised	
Lipotriches	Not revised	
Macronomia	Not revised	
Maynenomia	Revised	Pauly 1990
Nomia	Revised	Pauly 1990
Nomiapis	Not revised	
Nomioides	Being revised	Pesenko, Academy of

		Sciences, St Petersburg Russia
Nubenomia	Not revised	
Pachyhalictus	Revised	Pauly 1989
Pachynomia	Revised	Pauly 1990
Parathrincostoma	Not revised	
Patellapis	Revised	Pauly 1990
Pseudapis	Not revised	
Rophites	Not revised	
Ruginomia	Revised	Pauly 1990
Spatunomia	Revised	Pauly 1990
Sphecodes	Not revised	
Steganomus	Revised	Pauly 1990
Stictonomia	Revised	Pauly 1990
Systropha	Not revised	
Thrinchostoma	Not revised	
Trinomia	Not revised	
Zonalictus	Not revised	

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