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ZOOGEOGRAPHY AND BIODIVERSITY OF SYRPHIDAE (DIPTERA) IN EAST AFRICA

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ABSTRACT

This paper reports on the occurrence of Syrphidae in East Africa (Kenya, Tanzania, Uganda), based on 5,600 specimen records incorporated in the biodiversity database of the National Museums of Kenya. In total, 219 species are reported from the region with 171 in Kenya, 123 in Tanzania and 127 in Uganda. The similarities between the faunal composition of the three countries, as well as the endemicity are discussed. Based on GIS mapping of the database records, distribution patterns and zoogeographical relationships are discussed.

INTRODUCTION

Syrphidae belong to the Aschiza, Brachycera within the order Diptera. They can be differentiated from other Diptera by the wing venation (presence of *vena spuria* or false vein, and a false wing margin formed by the posterior veins). Hoverflies are considered an important group of insects in agriculture. They play a major role as pollinators, showing some degree of flower constancy. Larvae of the subfamily Syrphinae are known as predators of aphids and have been studied as potential biocontrol agents of agricultural aphid pests. Other syrphid larvae are phytophagous, or live in compost-like materials. Yet others are found in association with ant nests or feed on plant tissue in bulbs of Liliaceae and Amaryllidaceae (Smith & Vockeroth, 1980).

Recently a relational database was set up for biodiversity purposes at the National Museums of Kenya (NMK). Because of existing taxonomic expertise and the size of the group, the family Syrphidae was chosen as a pilot group to develop and test the database. In this paper we present some preliminary findings on zoogeography and biodiversity of Syrphidae in East Africa (= Kenya, Tanzania and Uganda), based on the data so far incorporated in that database.

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MATERIAL AND METHODS

The relational database was developed using the software Access® (version 2.0). A full account of the objectives, structure, and design are given by Criel, Vanden Berghe and Sequeira (1995). Data included in the specimen database were linked to an established locality gazetteer for the region (also in Access®). The combined information on specimen records and their collecting locality was exported to GIS software Mapinfo® (version 3.0) for plotting distribution maps.

Data incorporated in the database come from two different sources: collection specimens and literature references. The East African specimens of the following collections are included in this database: NMK (National Museums of Kenya, Nairobi, Kenya), NHM (Natural History Museum, London, UK), NMSA (Natal Museum, Pietermaritzburg, South Africa), and KMMA (Koninklijk Museum voor Midden Afrika, Tervuren, Belgium).

Literature references are either from new descriptions, fauna records or more general ecological works containing details on observation and sampling records. All records were accepted as given in the literature: none of these were re-identified. In addition, country references as listed in the Catalogue for the Afrotropical Region (Smith & Vockeroth, 1980) are included.

In total, more than 5,600 syrphid specimens, grouped in approximately 2,500 block records, are now incorporated in the database.

RESULTS

Comparison of three East African countries

More than 5,000 syrphid species are reported world-wide, of which about 500 occur in the Afrotropical Region. The number of species occurring in East Africa is 219: 171 in Kenya, 123 in Tanzania, and 127 in Uganda. Figure 1 shows how the three countries share species. The bias towards Kenya is partly due to recent emphasis on collection of Syrphidae in this country; moreover the database is mostly based on the collection of NMK, which was already biased towards Kenyan specimens. A third of the fauna is widely distributed and occurs in all three countries. Kenya shows a higher overlap with either Tanzania or Uganda than the latter two have with each other. This tendency is also observed in the overall Diptera fauna (Vanden Berghe & De Meyer, 1995).

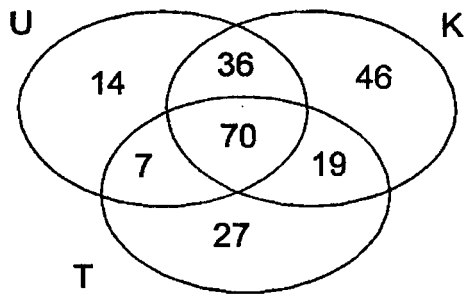

Figure 1: Number of species in three East African countries (K=Kenya, T=Tanzania, U=Uganda)

Considering the ratio of number of species to country surface (table 1), Uganda shows the highest ratio. This could be a reflection of the heterogeneity of habitats confined within the limited area. Table 2 summarises the dissimilarity index (binary Lance and Williams) for the three countries involved. All have a more or less equal dissimilarity (slightly lower dissimilarity between Kenya and Uganda).

Table 1: number of species per country in East Africa and number of species per 1000 km²

	N. Spec	N. Spec/A
Kenya	171	.29
Uganda	127	.54
Tanzania	123	.13
Total	219	.12

Table 2: Binary Lance and Williams dissimilarity matrix for species in the three countries

	Kenya	Tanzania
Kenya		
Tanzania	.41	
Uganda	.31	.39

Distribution patterns

Figure 2 shows all collecting localities for which syrphid records are entered in the database. From this map, it is clear that the coverage of sampling is unequal, biased towards Kenya and with large gaps in some areas (like Northeast Kenya, western and southern Tanzania). This fact and the limited number of actual records, makes any conclusions on distribution patterns preliminary. However, some tendencies are apparent, as discussed below.

Endemicity: Figure 3 shows how the three countries share the 44 species endemic to East Africa. Considering the specimens/country size ratio (table 3), all countries have a more or less similar rate of endemicity. The major tendencies are the same as observed in the main comparison. The region as a whole has an endemicity ratio almost twice as high as the average of the individual countries, reflecting the fact that a number of particular habitats

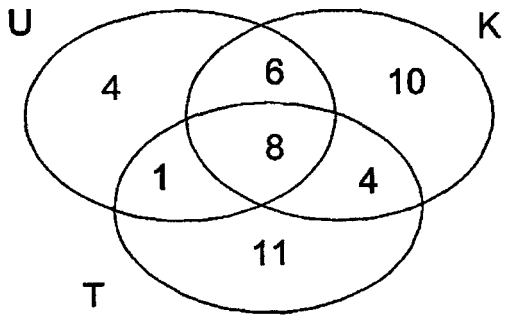

Fig. 3: Number of endemic species shared by three East African countries (abbreviations as in Fig. 1).

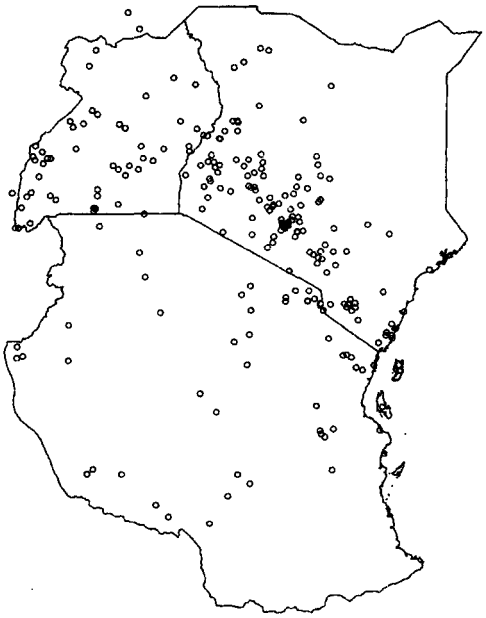

Fig. 2: All localities for which syrphid records are entered in the database

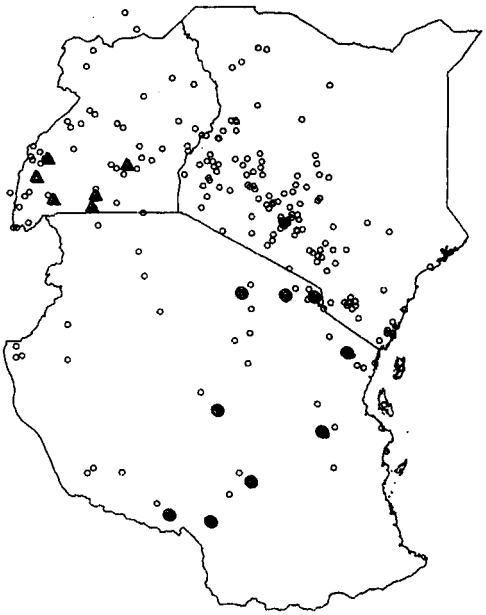

Fig. 4: Distribution of Microdon mydas *(solid triangles) and* Graptomyza perforata *(solid circles; open circles as in fig. 2)*

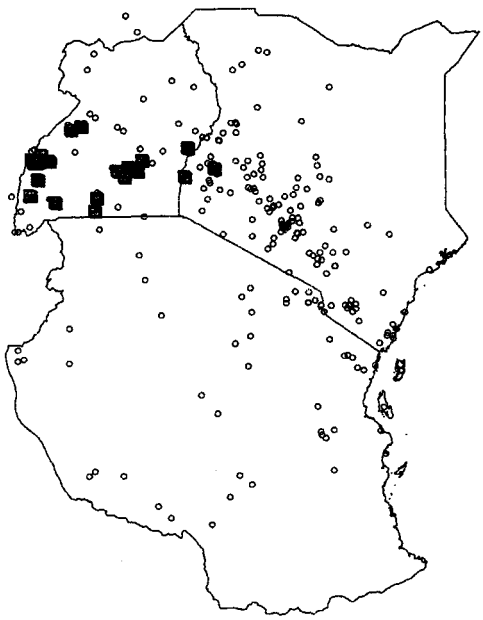

Fig. 5: Combined distribution records for Phytomia pubipennis, Pogonosyrphus overlaeti, Mesembrius rex, Milesia afra *(solid squares; open circles as in fig. 2)*

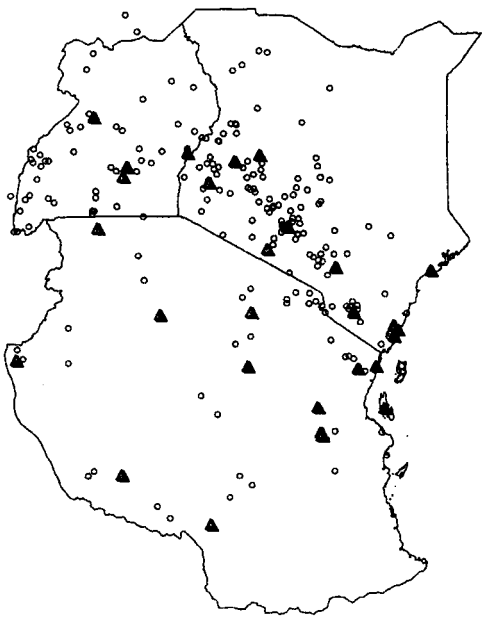

Fig. 6: Distribution of Senaspis haemorrhoa *(solid triangles; open circles as in fig. 2)*

harbouring endemic syrphid species fauna occur within the region, but are not confined to political boundaries of the individual countries. On the other hand, some species are endemic to certain areas and may be confined to particular countries (fig. 4). This is illustrated by the distribution of *Microdon mydas* (found in southeastern part of Uganda) and *Graptomyza perforata* (confined to afromontane areas in Tanzania).

The importance of the East African fauna is evident in the way in which species are shared between East Africa and neighbouring subregional faunas. To some extent there is overlap between these subregions, as is shown in the following examples.

Central African: Several species are confined to Central Africa (Zaire, Gabon, Congo) and possibly the rainforest areas of western Africa (Liberia, Ghana). Their easternmost distribution reaches Uganda (fig. 5, solid squares), with several records from this country: *Phytomia pubipennis*, *Pogonosyrphus overlaeti*, *Mesembrius rex*, *Milesia afra*. At most they reach Kakamega Forest (easternmost relict of guineo-congolian forest in Kenya and famous for its Central African rainforest fauna (Kokwaro, 1988)): *Allobaccha marginata*, *Betasyrphus inflaticornis*, *Eristalinus surcoufi*, *Graptomyza breviscutum*, *G. nigra*, and *Mesembrius tarsatus*. A recent detailed survey in Kakamega Forest (De Meyer, 1996) revealed several species with a mainly Central African distribution but so far unknown from any other locality within East Africa: *Allobaccha inversa*, *Chasmomma nigrum*, *Ersitalinus mendax*, *Eristalis apis*, *Mallota aperta*, *Xanthandrus congensis*. These species could also be expected in rainforest patches in Uganda.

Table 3: number of endemic species per country in East Africa and number of endemic species per 1000 km².

	N. End	N. End/A
Kenya	10	.017
Uganda	4	.017
Tanzania	11	.012
Total	44	.025

Southern Africa: Although not as apparent, some southern African species (known from south of the Zambesi and Kunene rivers) seem to reach their northernmost distribution in Tanzania. This could be the case for *Pseudomicrodon illucens*, and perhaps *Sphiximorpha dilatipes*. *Senaspis haemorrhoa* is also a mainly southern African species that seems to reach its northernmost distribution in Kenya and Uganda (fig. 6, solid triangles).

Northern Africa: Some species seem to be found in Ethiopia and/or Sudan and reach their southernmost distribution in Kenya and Uganda, while being completely absent in Tanzania. This pattern is found in *Chrysotoxum continum* (fig. 7, solid triangles) and *Betasyrphus hirticeps* (solid circles).

Montane areas: East Africa comprises chains of montane regions (either older formations like the Eastern Arc mountains, or more recent ones linked with the formation of the Rift Valley). A number of species seem to be restricted to these areas within the region (fig. 8, solid squares). It is however not always clear whether their distribution is related to forests (often found in the montane regions) or actually a confinement to the Afromontane habitat. This distribution is found for *Exallandra cinctifacies*, *Phytomia fronto*, *P. fucoides*, *P. kroeberi*, *Melanostoma floripeta*.

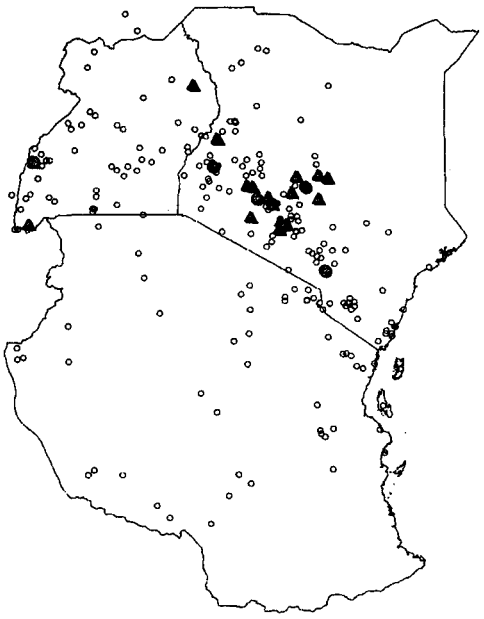

Fig. 7: Distribution of Chrysotoxum continum *(solid triangles) and* Betasyrphus hirticeps *(solid circles; open circles as in fig. 2)*

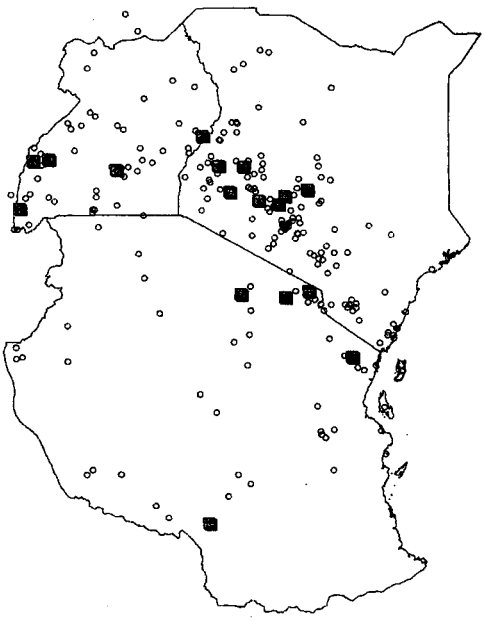

Fig. 8: Combined distribution records for Exallandra cinctifacies, Phytomia fronto, P. fucoides, P. kroeberi, Melanostoma floripeta *(solid squares; open circles as in fig. 2)*

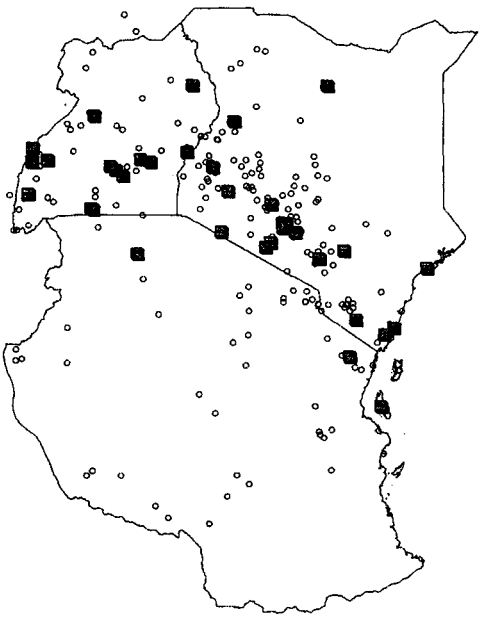

Fig. 9: Distribution of Phytomia natalensis *(solid squares; open circles as in fig. 2)*

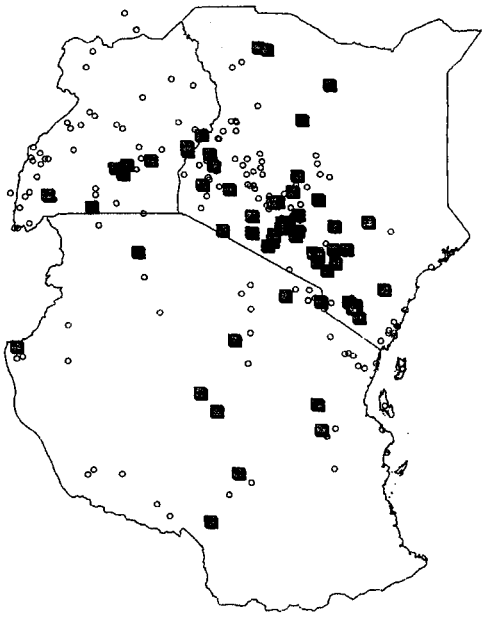

Fig. 10: Distribution of Phytomia incisa *(solid squares; open circles as in fig. 2)*

DISCUSSION

As indicated in the introduction the analysis presented here is of a preliminary nature. The specimen records are merely a reflection of where entomologists have been collecting instead of true distribution patterns. In addition, syrphids rarely were the target group of particular efforts but mainly the result of general entomological collection activities (except De Meyer, 1996, below). However, comparison between the overall distribution of the records and those for particular species does allow us to recognise certain patterns as indicated above. Besides the ones illustrated, there are some tendencies that do not show up clearly enough from the available records. There is for example a tendency of some species to occur in lowland areas, which is however obscured by possible coastal distribution and/or temperature and humidity thresholds. There is a definite need for more collecting records randomly distributed over the region, preferably combined with detailed survey of the syrphid fauna of the particular sites. A recent in-depth study of the syrphid fauna of Kakamega Forest in Kenya, showed the need for this in order to obtain a full inventory. An additional problem in this regard is the seasonality of insects. The above-mentioned study in Kakamega Forest showed that adult specimens of any particular syrphid species are usually around for a part of the year, or if they are recorded throughout the year, that the actual number differs widely according the season.

In addition to specimen records, there is also a need for more parameters to find any correlations. Insects are restricted in their distribution because of environmental thresholds. Vegetation, altitude, humidity and temperature are some of the common ones. Whittington (1994) recently demonstrated the relation between effective temperature isolines and the distribution of *Graptomyza* species in South Africa. Our preliminary analysis showed that even apparently widespread species still seem to be limited in their distribution by particular but hitherto unknown factors. This is illustrated by the comparison of the distributions of *Phytomia natalensis* and *P. incisa* (figs 9 & 10). Both are species widely distributed throughout the Afrotropical region, of approximately same size and shape, hence equally probable to be collected by random collecting efforts. *Phytomia incisa* seems to be absent in coastal records and from the northern part of the Uganda. *Phytomia natalensis* on the other hand is recorded from the coastal areas but seems to be more restricted to lower altitudes and to be generally absent from Tanzania. More in-depth studies are necessary to define the ecological parameters delimiting these distributions.

ACKNOWLEDGEMENTS

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