A scientific note on Varroa destructor found in East Africa; threat or opportunity?

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Scientific note

A scientific note on *Varroa destructor* found in East Africa; threat or opportunity?*

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***Varroa destructor* / *Apis mellifera scutellata* / *Apis mellifera monticola* / hygienic behavior**

In many areas of the world where it is managed, the honeybee, *Apis mellifera*, has been plagued by diseases, pests and parasites. Of these, the parasitic mite, *Varroa destructor* Anderson and Truman (Acari:Varroidae), is considered by many as the most devastating. We found this mite in honeybee colonies throughout Kenya and in Tanzania for the first time in early 2009. Beekeepers surveyed were neither aware of the mite's presence nor had they observed any negative impact on the survival and/or productivity of their bees.

In March of 2009, we sampled 38 honeybee colonies (likely *A. m. scutellata*, and possibly *A. m. scutellata* hybrids) in seven locations in Central and Eastern Kenya. We employed a common sampling technique to determine mite presence/absence that utilizes powdered sugar to dislodge mites from adult bees (Macedo et al., 2002). An average of 717 ± 43 bees per colony were sampled and *Varroa* mites were found in all 38 colonies examined with numbers ranging from 3–108 per sample and averaging 26.3 ± 25.9 per colony. In a further similar survey (April–May, 2009) of 125 additional colonies located in the eastern, western and coastal regions of Kenya (69 colonies in 18 locations), coastal Tanzania (18 colonies in 4 locations) including Ugunja and Pemba Islands, collectively referred to as Zanzibar (likely *A.m. litorea)*, and Western Uganda (14 colonies in 4 locations), 87% of the colonies tested positive for *Varroa* (Fig. 1). Only the 14 colonies surveyed in western Uganda and two of the Zanzibar colonies tested negative for mites. A limited survey of colonies in eastern Ghana (4 locations) found low numbers of *Varroa* in 2 out of 12 colonies sampled, suggesting that the mite has also spread to certain parts of West Africa.

Fourteen *Varroa* mites were analyzed via partial sequencing of the cytochrome oxidase 1 gene (CO1). For all mites, CO1 sequence between primer sites Co1F.F and Co1N.R (Evans and Lopez, 2002) was identical with the South Korean haplotype of *Varroa destructor* (Genbank entry AF106899), the predominant *V. destructor* lineage worldwide.

The presence of this mite in Africa is highly significant. Honeybees of several different races are native to Africa and their geographic distributions have been partially mapped (Ruttner, 1975). These various races of honeybees are reportedly responsible for pollinating 40–70% of indigenous plants, including some important commercial crops (Allsopp, 2004). If *Apis* colonies in Africa succumb to *Varroa* as they have in other parts of the world, the results could be devastating to both agricultural production and non-agricultural ecosystems. The introduction of *Varroa* into South Africa in 1997, coupled with the spread of *A. m. capensis* led to an initial rapid decline in native honeybee populations over seven years (Allsopp, 2004). Yet 12 years after the mite's introduction, honeybees of both *A. m. capensis* and *A. m. scutellata*, feral and managed populations alike appear to exhibit levels of

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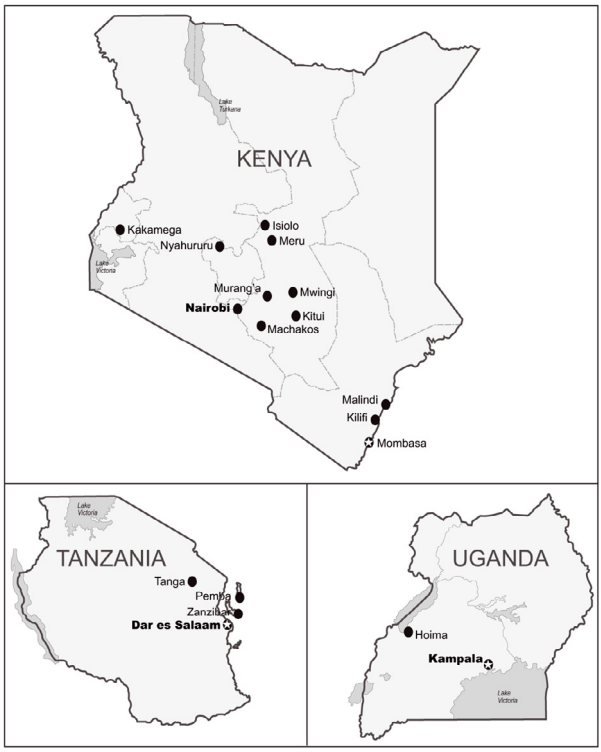

Figure 1. *Varroa* sampling locations in Kenya, Tanzania and Uganda.

tolerance that have reduced the pest status of this mite to "incidental" according to Allsopp (2006). He further speculates that increased hygienic behavior and a lack of chemical control used by beekeepers, is in part, responsible for this tolerance.

Hygienic behavior is a well-documented mechanism of disease resistance in honey bees (Rothenbuhler, 1964; Spivak and Reuter, 2001). Spivak (1996) found bees bred for hygienic behavior in the US also detect and remove mite-infested pupae from their colony. Although variable, African bees may naturally exhibit a higher degree of this behavior than European bees and it may vary across races or by geographic area (e.g., Mondragon et al., 2005). In an attempt to understand the apparent absence of American Foulbrood in Africa, Fries and Raina (2003) using the pin-killed brood method, found a considerable level of hygienic behavior (removal rate of 95% in 24 hrs in 7 of 11 colonies) in colonies in an apiary north of Harare, Zimbabwe. In March 2009 we tested 10 colonies for hygienic behavior at The International Center of Insect Physiology and Ecology (*icipe*) apiary outside of Nairobi (S01°13'27.7" E36°53'50.8", elevation 1606 m) and 10 colonies in an apiary 34 km east of Mwingi (S0°48'54.1", E38°18'96.8", elevation 636 m) using the freeze-killed brood assay (Spivak and Downey, 1998). None of the colonies in the icipe apiary exhibited hygienic behavior by a strict measurement (⩾95% fully or partially removed brood in 24 hrs). However colonies in the Mwingi apiary showed higher frequency and higher levels of hygienic behavior with 50% removing ⩾ 95% of the freeze-killed brood (fully or partially) in 24 hrs (Fig. 2).

African bees appear to deal with mites more effectively than European bees. Hygienic behavior, especially the ability to detect and remove *Varroa*-infested brood is likely one important mechanism of mite tolerance in these bees. Yet hygienic behavior along with a lack of miticide use is unlikely to account for the levels of tolerance to *Varroa* expressed in the honeybees of East Africa. Other behaviors, such as grooming, increased swarming, absconding, and even management practices (or the lack of them, i.e., the use of acaricides) are likely to be important. In Brazil, Africanized honey bee populations have maintained resistance toward mites,

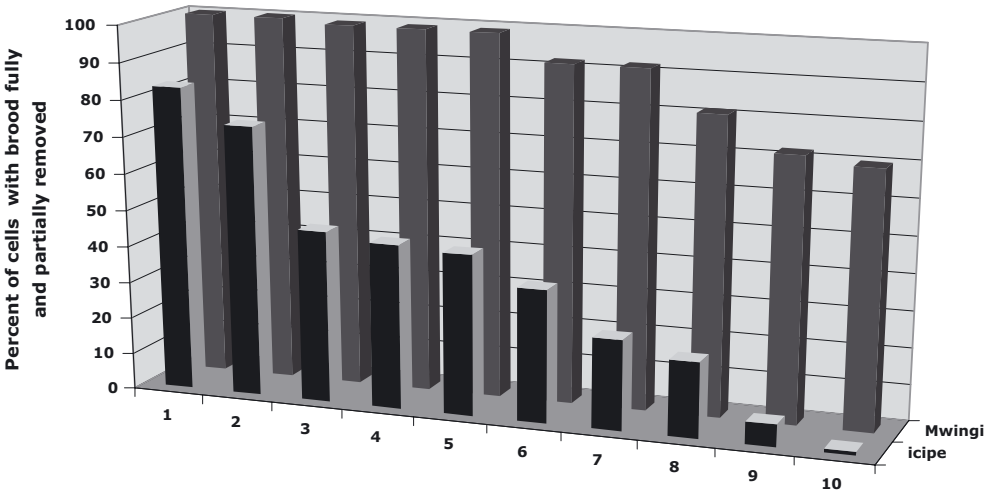

Figure 2. Frequency distribution of hygienic behavior in 20 colonies located in two apiaries in Kenya.

although the relative importance of intrinsic bee traits (Correa-Marques et al., 2003) versus selection imposed by bee management practices and the avoidance of chemical acaricides, is unclear. It may be that the highly genetically variable honeybee races in Africa contain evolutionary answers to limiting the impacts of *Varroa* mites and other major bee diseases. If so, understanding these mechanisms may be all-important not only for preserving agriculture in developed countries but also for maintaining the biological diversity of tropical ecosystems.

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Note scientifique sur *Varroa destructor* découvert en Afrique de l'Est : menace ou opportunité ?

Eine wissenschaftliche Notiz über das Auftreten von *Varroa destructor* in Ostafrika: Bedrohung oder Gelegenheit?

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