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The Accompanying Fauna of Honey Bee Colonies (*Apis mellifera*) in Kenya

Die Begleitfauna in Völkern der Honigbiene (*Apis mellifera*) in Kenia

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Summary: In more than twelve years of research on the accompanying fauna of bee colonies in Kenya, kept in four different types of hives, six vertebrates and over 50 species of arthropods were recorded. Of these the greater wax moth *Galleria melonella* poses the most serious economic threat to bee keepers. The braconid *Apanteles galleriae*, a parasitoid of the greater wax moth, has been detected for the first time in Kenya. There is no evidence of the presence of the ectoparasitic mite *Varroa destructor*.

Keywords: Honey bee, accompanying fauna, predators, commensales, inquilines

Zusammenfassung: Die über zwölf Jahre untersuchte Begleitfauna von Bienenvölkern in Kenia, die in vier verschiedenen Beutentypen gehalten werden, enthielt neben sechs Wirbeltier-Arten mehr als fünfzig Arthropoden-Arten, von denen die Große Wachsmotte, *Galleria melonella*, ein für die Imker existenzbedrohender Schädling ist. Die Schlupfwespe *Apanteles galleriae*, ein Parasitoid der Großen Wachsmotte, konnte erstmals für Kenia nachgewiesen werden. Bisher nicht gefunden wurde die ektoparasitische Milbe *Varroa destructor*.

Schlüsselwörter: Honigbiene, Begleitfauna, Prädatoren, Kommensale, Inquiline

1. Introduction

It is reckoned that Kenya's bee keepers look after about 2 million bee colonies which produce some one hundred thousand tons of honey annually (KIGATIRA, 1980). Honey bees are kept in four types of hives: the traditional log hive (Figs. 1, 2), the more modern Kenya top bar hive (KTBH) (Figs. 3,4), which is accessible from above, the Langstroth hive (Fig. 5), which is growing in popularity, and finally the soil-block hive (Figs. 6,7), which is used only in a few areas. Traditional hives cannot be inspected as easily as modern types of hives, e.g. Langstroth hives, because of their construction. An infestation with the greater wax moth, for example, will only be noticed after the bees already have left the hive.

A survey of bee keepers and persons involved in bee keeping based on questionaires had been carried out even before investigation of the accompanying fauna of bee colonies began. It has been shown that insect pests posed a serious problem in the beehives. It was already well-known that certain species of moths, namely the greater wax moth (*Galleria mellonella*), the lesser wax moth (*Achroia grisella*) and the death-head hawk moth (*Acherontia atropos*) were responsible for significant losses in the production of honey, pollen and wax (ROGER 1978; JEAN-PROST & MEDORI 1994). The aim of the investigation on hand was to create a commented species list of the accompanying fauna of the honey bee colonies in Kenya. The main focus was set not only on destructive pests and natural enemies, but concentrates equally on commensal and inquiline organisms.

2. Research areas and methods

In 1997 the investigation began in the three administrative districts of Kilifi, Makueni and Laikipia. These districts represent three different climatic zones. Kilifi lies on the coast and is influenced by the Indian ocean, Makueni in the semi-arid area to the north-east of Kilimanjaro and Laikipia in the highlands to the west of Mount Kenya (Fig. 8). In the highlands the most important nectar flow plants are various species of *Acacia,* which are responsible for a very sweet honey. In the coastal regions various flowering plants, for example mango (*Mangifera* spp.) and orange (*Citrus* spp.) provide nectar to bees.

To register the bee hive fauna a questionnaire was sent to the bee breeding advisors in the above mentioned districts. They were to list the insect pests, describe the degree of damage caused and include information about seasonal fluctuations, if available. During the author's field visits the bee keepers were questioned about their own observations of the hives. Bee keepers' reports and experiences with pests and other organisms were documented. Thereafter the hives were opened by the bee breeding advisors and inspected with use of typical bee keeper protective clothing. Arthropods were collected in glass jars with ethanol (75%) for preservation. Samples of honey combs were taken to the laboratory. There the combs were placed into an insect cage composed of sixteen compartments. Each compartment was fitted with a tightly closed door and on the rear side a 10 cm wide hole leading by means of a tube to a plastic bag in which hatching arthropods could be separated. Reports from other districts completed and broadened the results obtained from Kilifi, Laikipia and Makueni.

Insect voucher specimens are deposited at the National Museums of Kenya (NMK) in Nairobi and also, in lesser numbers, in the collection of the Zoological Research Museum Alexander Koenig in Bonn/Germany.

3. Results and discussion

The results of the survey have shown that most of the arthropods and also most of the vertebrates which were detected in the bee colonies are widely distributed in Kenya. It was observed by the bee keepers that the population density of some species of honey bee pests is prone to strong seasonal changes. Especially Arthropod species are more numerous shortly after the rainy season. It was noticeable that well-cared-for colonies were only slightly infested and poorly-kept hives were more receptive to honey bee pests. As mentioned above the modern beehives Kenyan top bar hive (KTBH) and Langstroth hive simplify bee keeping in terms of pest control and hygiene. The ectoparasitic mite *Varroa destructor* has not yet been detected in Kenya despite its having been detected in South Africa in 1997. This finding was confirmed by NDIRANGU& SESSIONS (2009) for the highlands and by KITSAO (2009) for the coastal region. Since 1976 in Europe it is considered to be, from an economic point of view, the most serious honey bee pest, causing high financial losses year after year. *V. destructor* was first introduced to Bulgaria from Asia in 1970 and became established all over Europe within six years (RADEMACHER, 1990). Similar distribution patterns may be expected for Africa.

The accompanying fauna of bee colonies in Kenya is shown in table 1. It contains important pests as well as commensal and inquiline species which use the hive as a shelter. The honey badger (*Mellivora capensis*), active in all regions of Kenya, is the vertebrate which causes the most serious damage. It knocks over and demolishes hives resulting in the complete destruction of the respective colony. The dormouse (*Graphiurus murinus*) is actually only inquiline (Fig. 9). Nevertheless, it pollutes the hive with urine and droppings which have a repellent effect on the bees, causing them to abandon their hive. The bee-eaters capture bees in front of the hives;

Fig. 1: Traditional log hives in a Baobab tree, Makueni district (Photo: J. SCHLIESSKE).
Abb. 1: Traditionelle Klotzbeuten in einem Baobab, Makueni district (Foto: J. SCHLIESSKE).

Fig. 2: Traditional log hive in detail, Kilifi district (Photo: J. SCHLIESSKE).
Abb. 2: Traditionelle Klotzbeute im Detail, Kilifi district (Foto: J. SCHLIESSKE).

Fig. 3: Kenya top bar hive (KTBH), Laikipia district (Photo: J. Schliesske).
Abb. 3: Kenianische Oberträgerbeute, Laikipia district (Foto: J. Schliesske).

Fig. 4: The bee keeper Cristopher Ndirangu, checking wax combs from a Kenyan top bar hive, Laikipia district (Photo: J. Schliesske).
Abb. 4: Der Imker Cristopher Ndirangu überprüft die Waben in einer kenianischen Oberträgerbeute, Laikipia district (Foto: J. Schliesske).

Fig. 5: Langstroth hives in the forest, Kilifi district (Photo: J. SCHLIESSKE).
Abb. 5: Langstroth Beuten im Wald, Kilifi district (Foto: J. SCHLIESSKE).

Fig. 6: A hut in a village with a bee entrance to inside deposited soil block hives (Photo: M. MUNGAI).
Abb. 6: Flugloch zu den in einer Hütte aufgestellten Lehmbeuten (Foto: M. MUNGAI).

Fig. 7: Soil block hive placed in the hut (Photo: M. MUNGAI).
Abb. 7: Lehmbeute in einer Hütte (Foto: M. MUNGAI).

Merops albicollis is capable of causing serious damage by reducing bee population densities (NDIRANGU & SESSION 2009). The greater honey guide (*Indicator indicator*) through its conspicuous behaviour draws the attention of honey gatherers, such as the honey badger and human beings, to the hive. The grey lizard (*Hemidactylus mabouia*) lives mainly underneath the Kenyan top bar hive where it preys on bees. It is also known to enter hives where it causes damage to the bee brood. Some species of monkeys occasionally take an interest in plundering honey and bee brood. Among the arthropods the insects account for the mass of accompanying fauna.

Lepidoptera: The two wax moth species destroy honey combs and enmesh the frames with cocoons. The larvae of the lesser wax moth (*Achroia grisella*) are to be found largely between the dividing walls of the combs. Already weakened colonies, i.e. colonies in which the offsprings are not sufficiently fed by worker bees, usually suffer total destruction through wax moth infestation. The greater wax moth (*Galleria melonella*),

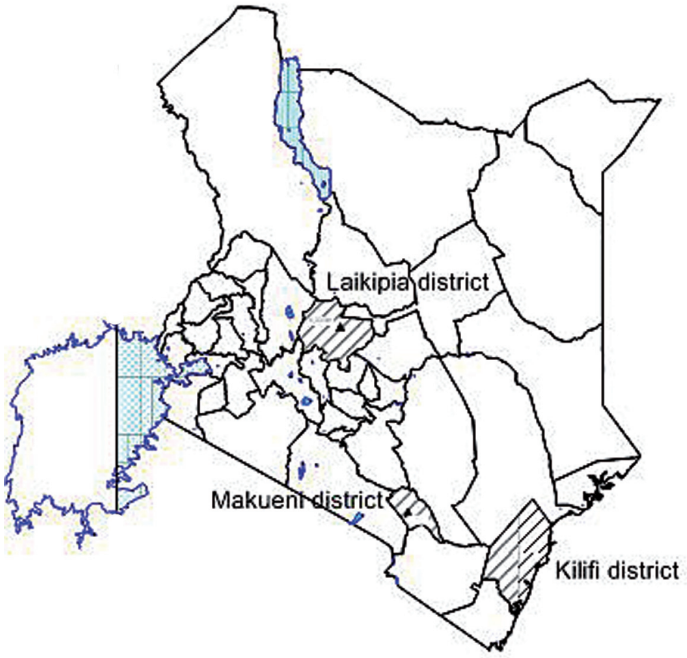

Fig. 8: Study areas (hatched) in Kenya.
Abb. 8: Untersuchungsgebiete (schraffiert) in Kenia.

constructs very conspicuous cocoon clusters (Figs. 10, 11). 81% of the honey combs (taken from 38 samples) which were examined in the laboratories were infested by wax moths, of these 73% by the greater wax moth and 67% by the lesser wax moth. The wax moth infestation of honey bee combs can be reduced by the activities of the parasitic braconid *Apanteles galleriae* detected here for the first time in Kenya. It is probable that it is distributed throughout Kenya but owing to its small size has remained unnoticed. The deaths-head hawk moth (*Acherontia atropos*) forces its way into the hives to get at the honey. As the bee keepers observed, it is usually killed by the bees and then covered with a layer of wax.

Coleoptera: The small hive beetle (*Aethina tumida*) is widely distributed but occurs in low numbers, as the African bees have developed defensive strategies against it (Neumann et al. 2001). Adults and larvae live in the hive; the pupation takes place in the soil beneath the hive. The striped hive beetle (*Macromoides heroldi*) takes honey and pollen but seldom occurs in large numbers. The other listed beetle species feed mainly on litter from the floor of the hives as well as on dead bees and bee larvae.

Hymenoptera: According to KITSAO (2009) a hive is usually totally destroyed when safari ants (*Dorylus nigricans molestus*) invade in large numbers. This is not only on account of the plundering of honey reserves and bee brood but due to the absconding of the bee colony. The extremely aggressive tailor ant (*Oecophylla* longinoda), which is widely distributed predominantly in the coastal regions, builds leaf nests from which it raids bee hives (Fig. 12). The large sugar ants (*Camponotus maculatus*), which nest in the soil, are widely distributed and raid bee hives to plunder honey (Fig. 13). The small sugar ant (*Camponotus braunsi*) can also be quite troublesome. The pirate wasp (*Palarus latifrons*), a type of hermit wasp, is widely distributed and can be a serious robber causing considerable disruption by its constant presence in the vicinity of hives. The very small bigheaded ant (*Pheidole megacephala*) feeds on honey and dead bees. It is considered to be an omnivorous household pest and is listed as an invasive species in the USA (WARNER & SCHEFFRAAN 2007). Together with the previously mentioned braconid *Apanteles galleriae* the hyperparasitoid *Nesolynx phaesoma* has also been documented in Kenya for the first time.

Diptera: The minute, 1.5 mm long bee louse (*Braula coeca*) takes honey directly from the bee's mouthparts and lays its eggs on the comb. The larvae bore through the lids of the cells to gain access to honey and pollen.

The tachinid fly (*Rondanioestrus* sp.) is an endoparasitoid of adult bees. The female flies, when in flight, lay their egg larvae on the bees. According to MORSE & NOWOGRODZKI (1990) the larvae bore into the abdomen of the bees in order to complete their larval stage within. After the death of the bee pupation takes place in the soil.

Fannia pulchra, of which the larvae are provided with fleshy appendices, seems to be an indicator for a lack of hygiene.

Sarcophaga aethiopis is an endoparasitoid. The female lays her egg larvae, in flight, between the thorax and the abdomen of the bees. After infestation the larvae develop at first in the thorax and then in the abdomen. The bee dies after two to four days and pupation of the endoparasitoids takes place in the soil.

The parasitic fat headed fly (*Physocephala rufipes*), which was described by LUNDIE (1965) from South Africa, has also been documented by us for the first time in Kenya.

Blattoptera: American cockroaches (*Periplaneta americana*) were also found, especially in soil block hives and it appears as if they are more abundant near to the coast.

Orthoptera: The detected species seem only to feed on the frass in the hive.

Mantodea: The three species observed tend to catch bees at the entrance to the hive, causing disruption which can have a lasting

Tab. 1: Accompanying fauna of honey bee colonies in Kenya.
Tab. 1: Begleitfauna in Völkern der Honigbiene in Kenia.

Mammalia

- *Mellivora capensis* (Schreber, 1776)
  Honey badger – Honigdachs
- *Graphiurus murinus* (Desmarest, 1822)
  Dormouse – Haselmaus

Aves

- *Merops apiaster* Linnaeus, 1758
  Eurasian bee-eater – Eurasischer Bienenfresser
- *Merops albicollis* Vieillot, 1817
  White–throated bee-eater – Weißkehl-Bienenfresser
- *Indicator indicator* (Sparrman, 1777)
  Greater honey guide – Großer Honiganzeiger

Squamata

- *Hemidactylus mabouia* (Moreau de Jonnes, 1818)
  Grey lizard – Hausgecko

Arthropoda

Insecta

Lepidoptera

- *Galleria melonella* (Linnaeus, 1758)
  Greater wax moth – Große Wachsmotte
- *Achroia grisella* (Fabricius, 1794)
  Lesser wax moth – Kleine Wachsmotte
- *Acherontia atropos* Linnaeus, 1758
  Deaths-head hawk moth – Totenkopf-Schwärmer

Coleoptera

- *Aethina tumida* Murray, 1867
  Small hive beetle – Kleiner Bienenbeutenkäfer
- *Macromoides haroldi* (Witte, 1880)
  Stripped hive beetle – Gestreifter Bienenbeutenkäfer
- *Pimelia angusticollis* Solier, 1836
  Darkling beetle – Schwarzkäfer
- *Onthophagus* sp. Latreille, 1862
  Dung beetle – Dungkäfer
- *Tefflus kilimanus* Kolbe, 1897
  Ground beetle – Laufkäfer
- *Carabomorphus masaicus* Allmand, 1912

Hymenoptera

- *Dorylus (Anomma) nigricans molestus (Gerstäcker, 1859)*
  Safari ant – Treiberameise
- *Oecophylla longinoda* (Latreille, 1802)
  Tailor ant – Weberameise
- *Camponotus maculatus* (Fabricius, 1782)
  Large sugar ant – Große Zuckerameise
- *Camponotus braunsi Mayr,1895*
  Small sugar ant – Kleine Zuckerameise
- *Crematogaster castanea Smith, 1858*
  Cocktail ant

Tab 1: Continued.
Tab. 1: Fortsetzung.

- *Palarus latifrons* Kohl, 1884
  Pirate wasp – Gestreifter Bienenwolf
- *Pheidole megacephala* (Fabricius, 1793)
  Bigheaded ant
- *Atopomyrmex cryptoceroides* Emery, 1892
- *Pachycondyla tarsata* (Fabricius, 1798)
- *Camponotus flavomarginatus* Mayr, 1862
- *Apanteles galleriae* Wilkinson, 1932
- *Nesolynx phaesoma* (Waterston, 1915)

Diptera

- *Braula coeca* Nitzsch, 1818
  Bee louse – Bienenlaus
- *Rondanioestrus* sp. Villeneuve, 1916
  Tachinid fly – Raupenfliege
- *Fannia perpulchra* Bezzi, 1908
  Lesser house fly – Kleine Stubenfliege
- *Sarcophaga aethiopis* Karsch, 1886
  Flesh fly – Fleischfliege
- *Physiphora senegalensis* (Enderlein, 1927
- *Drosophila* sp. Fallen, 1823
  Vinegar fly – Essigfliege
- *Physocephala rufipes* Fabricius, 1781
  Fatheaded fly – Dickkopffliege
- Phoridae spp.
  Coffin flies – Buckelfliegen

Blattoptera

- *Periplaneta americana* (Linnaeus, 1758)
  American cockroach – Amerikanische Schabe
- *Deropeltis* sp. Burmeister, 1838
  Black cockroach

Orthoptera

- *Madiga talpa* (Gerstaecker, 1869)
  Armoured cricket
- *Gryllus* sp. Linnaeus, 1758
  Ground cricket
- *Phaeophilacris* sp. Walker, 1871
  Tree cricket

Mantodea

- *Tenodera bokiana* (Giglio-Tos, 1907)
  Praying mantis
- *Sphodromantis centralis* (Rehn, 1914)
- *Tarachodes insidiator* Wood-Mason, 1882

Heteroptera

- *Platymerus rhadamanthus* (Gerstaecker, 1873)
  Assassin bug – Raubwanze

Isoptera

- *Odontotermes* sp. Holmgren ,1912
  Termite – Termite

Tab 1: Continued.
Tab. 1: Fortsetzung.

Dermaptera
- *Forficula senegalensis* Audinet-Servile, 1839
  Ear wig

Zygentoma
- unidentified species

Arachnida
Pseudoscorpionida
- unidentified species

Acarina
- unidentified species

Araneidae Orb web spiders
- *Nephila* sp. Leach, 1815
  Golden silk orb-weavers – Seidenspinne
- *Argiope* sp. Androuin, 1826

Fig. 9: The dormouse *Graphiurus murinus* on its nest inside a hive (Photo: M. MUNGAI).
Abb. 9: Die Haselmaus *Graphiurus murinus* auf ihrem Nest in einer Beute (Foto: M. MUNGAI).

effect on the development of the colony.
Heteroptera: The assassin bug (*Platymerus rhadamanthus*) preys on adult bees.
Isoptera: Termites destroy wooden hives.
Dermaptera: The earwig, *Forficula senegalensis* was found in the Uasingishu district. According to the bee keepers and their advisors it lives on frass, honey and in some

Fig. 10: Two wax combs held together by wax moth webbing (Photo: M. Mungai)
Abb. 10: Zwei durch Wachsmotten versponnene Waben (Foto: M. Mungai)

Fig. 11: Full grown larvae of the Greater wax moth ready for pupation (Photo: J. Schliesske)
Abb. 11: Verpuppungsbereite Larven der Großen Wachsmotte (Foto: J. Schliesske)

Fig. 12: Nest of the Tailor ant *Oecophylla longinoda* (Photo: J. Schliesske).
Abb. 12: Nest der Weberameise *Oecophylla longinoda* (Foto: J. Schliesske).

Fig. 13: Adults and pupae of the Larger sugar ant *Camponotus maculatus* on the top bars of a hive (Photo: M. Mungai).
Abb. 13: Imagines und Puppen der Großen Zuckerameise *Camponotus maculatus* auf den Wabenoberträgern einer Beute (Foto: M. Mungai).

cases also from weakened bee brood. This species gives off an unpleasant smell that has a repellant effect on the bees.

Zygentoma: In some cases silverfish were found in the hives.

Pseudoscorpionida: In Ol Kalou (Nyandarua district), an unidentified species of pseudoscorpion was found in a Langstroth hive. In Belgian Congo VACHON (1954) also reported of a species *Ellingsenius hendrickxi,* which also lived in hives and preyed on bees.

Acarina: No further investigation was done on the commensal and inquiline mites in the hives. It is assumed that these are store or stock mites.

Aranea: Spiders build their webs in front of the hives. Bee keepers assume that the number of bees caught by spiders has no considerable effect on the development of a bee colony.

The abundance of four important bee pests varies with the seasons. Noticeable is the increase in the numbers of safari ants in the rainy season and likewise an increase in the numbers of pirate wasps in the dry season. Wax moths and sugar ants appear in the hives throughout the year (unpublished).

In Makueni district some beekeepers own up to 100 bee colonies. Most of them use the traditional log hives and only a few use the Kenyan top bar hive. Others show a preference for the recently introduced soil-block hives. They have relatively little trouble with bee pests, because they take great care of their bee colonies. In cases where an infestation was not detected, an absconding of the bees was accounted for by weather conditions. The bee keepers believe that bees go to the hills in the dry season to search for water and nectar and then return to the hives on the plains in the rainy season. Similar assumptions are known from people in the Baringo district (GICHORA 2003).

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