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Large Hive Beetles: An Emerging Serious Honey Bee Pest in the Coastal Highlands of Kenya

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Surveys in Kenya have established the main arthropod pests associated with honey bees (*Apis mellifera*) to be small hive beetles, *Aethina tumida* (Coleoptera: Nitidulidae); *Oplostomus haroldi* and *Oplostomus fuligineus* (Coleoptera: Scarabaeidae), and the ecto-parasitic mite *Varroa destructor* (Frazier et al., 2010; Torto et al., 2010). The occurrence, genetic diversity, and damage to honey bee colonies caused by scarab beetles (generally known as large hive beetles when invading honey bee colonies) under laboratory conditions in Kenya have been reported (Fombong, Hass, Ndegwa, & Irungu, 2012; Fombong, Teal, et al., 2012). There have been no long term studies done on large hive beetles under natural conditions and this has made little to no information available on the two beetle species. Two large hive beetle species, *O. haroldi* and *O. fuligineus* have been found in specific non-overlapping areas; *O. haroldi* occurred mainly in the semi-arid eastern areas of Kitui and Isiolo, while *O. fuligineus* occurred predominantly within the coastal (Taita Taveta Hills and highland areas of Muhaka of Kenya) (Fombong, Hass, et al., 2012; Fombong, Teal, et al., 2012; Torto et al. 2010). The two beetle species have been reported to occur across African countries, which include Botswana (Clauss, 1983), Uganda (Kajobe, Kato, Otim, Kasangaki, & Abila, 2016), Zambia (Silberrad, 1976), for *O. fuligineus* and for both species, Kenya (Fombong, Hass, et al., 2012; Fombong, Teal, et al., 2012; Fombong et al., 2013; Torto et al., 2010), South Africa (Johannsmeier, 1980; Oldroyd & Allsopp, 2017), southern and eastern Africa (Abou-Shaara, Ahmad, & Hava, 2018; Pirk, Strauss, Yusuf, Demares, & Human, 2016).

Adults of the two species can be distinguished from each other by the presence of portions of brown-colored exoskeleton on the lateral sides of the dorsal surface in *O. haroldi* while *O. fuliginues* is uniformly black. *O. haroldi* feed on brood (both capped and uncapped), honey and pollen while *O. fuligineus* beetles feed on brood only (Fombong, Hass, et al., 2012; Fombong, Teal, et al., 2012). The life cycle of *O. fuligineus* was studied under laboratory conditions. Adults lay eggs in the cow dung (Donaldson, 1989). The larvae feed on the dung and pupate after 30–38 days. Adults emerge after 21–29 days. Large hive beetle feeding resulted in a characteristic damage pattern consisting of either small (1–3 cells) or large (>5 cells) clusters of damaged cells. Small cell damage is derived from a beetle feeding on bee brood neighboring cells, while large cell damage results either from adult beetles burrowing into a single cell containing second or third instar larva or into capped pupa cell, and doing this over multiple cells in a delineated area. Large hive beetles consume more brood compared to honey and pollen (Fombong, Hass, et al., 2012; Fombong, Teal, et al., 2012). In December 2017, beekeepers reported an unexpected surge in the number of large hive beetles in honey bee colonies in Taita Hills, in coastal highlands, Kenya.

A follow-up field examination established that colonies were harboring high numbers (over 400 in one colony) of large hive beetles (Figure 1). We sampled four apiaries in Chawia Forest, Taita Hills (Decimal coordinates: –3.4775 38.3598, Altitude: 1347 m) and randomly inspected one colony in each. Large hive beetle numbers per inspected

Figure 1. Honeybee comb (*A. m. scutellata* colony) heavily infested by ***O. haroldi*** (black and brown colored) and ***O. fuligineus*** (uniformly black) in Chawia forest, Taita Hills (Photo: B. Wambua, 2018).

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Figure 2. Pattern of damage for *Oplostomus species* showing honey bee comb section of capped cells destroyed by large hive beetles infestation (Photo: B. Wambua, 2018).

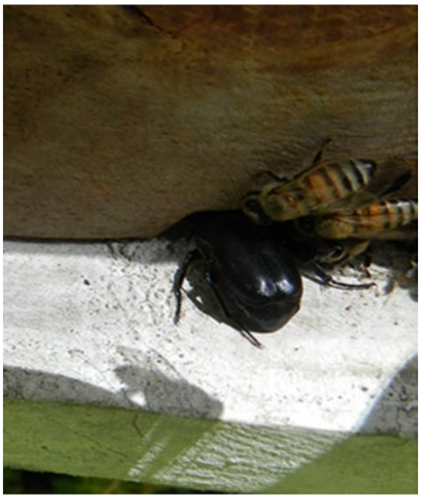

Figure 3. Adult large hive beetle (*Oplostomus fuligineus)* forcing its way to the modified beehive entrance. (Photo: B. Wambua, 2018).

colony of the four apiaries were 460, 112, 65, and 72, respectively. Collected beetle specimens were confirmed to be *O. haroldi* and *O. fuligineus* by comparing them to specimens housed at the International Center for Insect Physiology and Ecology (ICIPE) collection in Nairobi. O. *fuligineus* accounted for 59% of detected species, whereas 41% belonged to the species, *O. haroldi*. The two beekeepers owning the apiaries reported to have lost 48 colonies due to absconding presumably caused by high numbers of beetles. A similar behavior is seen in colonies infested with small hive beetles (Ellis, Hepburn, Delaplane, Neumann, & Elzen, 2003). A sugar roll test established that the colonies did not have detectable *Varroa destructor* infestations, zero count for all colonies (Muli et al., 2014).

Currently, beekeepers are managing the mixed species beetle infestation by physically removing the beetles during periodical colony inspections and crushing the beetles to death. Ongoing research is aimed at determining the seasonal occurrence of such mass infestations (Figure 2), the effect on colony performance (brood, pollen, and nectar area, colony weights), colony productivity and effectiveness of low-tech control strategies such as reduction of hive entrances (Figure 3).

We provide the first report of heavy large hive beetle infestation in *A. m. scutellata* in Taita Hills, Kenya. Of importance is the potential to affect colony productivity through interaction with other factors such as *Varroa*, pesticides, small hive beetles, pathogens, and nutritional stress.

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