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Original Research Article

Studies on Competition between Apes carina AND Apes mellifera

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Abstract

A. cerana versus *A. mellifera A. cerana*, termed the 'Asian honey bee' in Australia, is one of nine currently recognised honey bee species of the genus Apis. Eight of these, including *A. cerana,* are endemic to Asia. The only Apis species naturally occurring outside Asia is *A. mellifera*, the 'European honey bee'. *A. cerana* has been termed the Asian equivalent of *A. mellifera*, as both are cavity nesting bees that build a series of parallel combs with identical life cycles. Both can be domesticated and cover huge geographical areas with a large range of ecological and climatic conditions. Furthermore, both species can be morphologically and genetically subdivided into several strains, with tropical strains being smaller than, and different in behaviour to, temperate strains. Tropical strains of both species have very similar behaviours, in that they collect less honey and are more prone to swarming and absconding. *A. cerana* differs from *A. mellifera* in that *A. cerana* is generally slightly smaller, lives in smaller colonies and nests in smaller cavities. *A. cerana* is often found nesting in human-made structures where available (possibly due to their smaller colony size and cavity requirements), whereas wild *A. mellifera* tend to nest in tree cavities. *A. cerana* also has a smaller foraging range, possibly due to its smaller size. *A. cerana* is more prone to swarming and absconding when disturbed, whereas managed European A. mellifera tends to hoard large amounts of honey and is less prone to absconding. *A. cerana* shows greater hygienic behaviour, making it more disease resistant and enabling it to coexist with Varroa mites. Diseases and parasites have been exchanged in both directions between *A. mellifera* and *A. cerana* where they have come into contact.

Keywords: *Apis cerana*, *Apis mellifera*, Honeybee.

Introduction:

A. cerana is one of nine currently recognised honey bee species of the genus Apis (Family Apidae, Subfamily Apinae, Tribe Apini) (Arias & Sheppard, 2005; Raffiudin & Crozier, 2007). The European honey bee, *Apis mellifera*, is the only Apis honey bee species that naturally occurs outside of Asia. All other Apis species, including *A. cerana*, naturally occur in Asia. *A. cerana*, also known as the Asian honey bee, Asiatic bee, Asian hive bee, Indian honey bee, Indian bee, Chinese bee, Mee bee, Eastern honey bee, and fly bee, is endemic to most of Asia where it has been used for honey production and pollination services for thousands of years. *A. cerana* has been described as the exact equivalent of its European/African sister species *A. mellifera*, the European honey bee, showing as wide a range and capacity for variation and adaptation (Friedrich Ruttner, 1988). Similar to A. mellifera, *A. cerana* occupies a large range of climatic conditions, from cool

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regions in higher latitudes and altitudes, to dry, semi-desert environments as well as tropical climates (Friedrich Ruttner, 1988). And similar to *A. mellifera*, *A. cerana* is also genetically and morphologically subdivided into several strains that differ in their ecology and behaviour, particularly between temperate and tropical strains.

Honey bees (*Apis mellifera*) are insects of great importance for humanity. Humans have taken advantage from them from ancient times, both directly –through beekeeping‒ and indirectly –through farming, so their importance goes beyond ecology, being also economic. In spite of the growing interest and demand for honey bee byproducts, there has been a decreasing tendency for the past some 30 years on hive population in some countries (FAOSTAT, 2015). This represents an ecological challenge which also contributes to the economic losses held by the loss of honey bee individuals itself. Different factors have been explored in order to discover a cause for this tendency, including honey bee pests and infections, climate change and pesticides –mainly neonicotinoids. It is believed that every one of them plays a role on honey bee health, although no evidence has been found which connects any of them to be the only factor leading to the death of part of the honey bee population worldwide. Besides, in the year 2006 the colony collapse disorder (CCD) was first described (Cox-Foster et al., 2007).

Competition Between A. Cerana And A. Mellifera:

When species come to overlap geographically and compete for the same, limited resources, one of two things can happen: competitive exclusion, i.e. one species outcompetes the other so that one species disappears and the other thrives; or resource partitioning, where the two species partition their resources in such a way that both species can occur together (Gordon, 2000; Krebs, 1972). It is potentially possible that the ecological and behavioural differences of *A. mellifera* and *A. cerana* will result in sufficient niche partitioning that both species can co-occur successfully, as was shown in one study in India (H. K. Sharma, Gupta, & Rana, 2000a). It is also possible that both species can coexist if resources, such as flowers, are not limited. A shared resource must be limited in order for competition to occur (Krebs, 1972). The two most important resources for cavity-nesting honey bees are floral resources and nest cavities (Winston, 1987). Honey bees can compete for pollen and nectar while visiting flowers or they can attempt to rob honey from other nests (of the same of a different species). Both of these will be examined in turn. It needs to be noted here that *A. cerana* and *A. mellifera* do not naturally coexist, and so all associations between them are artificial.

Competition for Floral Resources:

Research in Nepal and India found that significantly more *A. cerana* foraged on flowers of different crops, and spent more time on each flower, when A. mellifera were absent (Partap, 1998 in Partap, 2000; H. K. Sharma et al., 2000a; M.-X. Yang, Tan, Radloff, & Hepburn, 2011), indicating that *A. mellifera* was the superior competitor. Similar results were found when both species were competing for the same sugar feeding station – A. mellifera were more aggressive and successfully and consistently excluded *A. cerana* (Sakagami, 1959; Dhaliwal & Atwal, 1970 in M.- X. Yang et al., 2011). *A. cerana* was also found to forage on a number of plant species that *A. mellifera* did not visit, and vice versa, and on those plant species that were visited by both species they avoided foraging in the presence of the other species (H. K. Sharma, Gupta, & Rana, 2000b). Two species may also avoid competition if foraging times differ (e.g. *A. cerana* and *A. mellifera* in India; Verma 1995), or if foraging is partitioned spatially (e.g. foraging at the top,

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middle or bottom of trees; *A. cerana* vs. A. koschevnikovi, Borneo; Rinderer, Marx, Gries, & Tingek, 1996). *A. cerana* had a much higher metabolic rate and foragers made many more trips within the same habitat than other species. Foragers also began foraging earlier in the day and they tolerated lower temperatures than A. mellifera (Fred C. Dyer & Thomas D. Seeley, 1991; Partap, Shukla, & Verma, 2000). *A. cerana* are also said to be more industrious while collecting pollen from scattered flowers of a variety of plant species, spending less time on each flower, whereas A. mellifera prefer big flower patches of fewer species where they spend more time on each flower (Kuang & Kuang, 2002 in Partap, 2011; Partap et al., 2000; Friedrich Ruttner, 1988; Wongsiri et al., 1986).

Robbing and Direct Fighting:

Robbing bees enter another colony's nest, kill bees and take their honey stores. The smaller the colony the more susceptible it is to robbing (Partap, 2011). Robbing usually occurs only when floral resources are low, when the nectar flow is interrupted or when a colony is weak and/or diseased (reviewed in M.-X. Yang et al., 2011). Interestingly, A. mellifera showed a much stronger defence-response to non-nest mates (of the same or different species) than any of the Asian honey bees examined, which means that A. mellifera defended their nest much more strongly than A. cerana did (Breed, Deng, & Buchwald, 2007). Studies on robbing behaviour between managed hives of *A. mellifera* and *A. cerana* kept at the same apiary showed that although *A. cerana* initiated robbing during lean times, *A. mellifera* usually won, killing the *A. cerana* colony and taking over their foraging area (Yang, 2001 in Sakagami, 1959; M.-X. Yang et al., 2011). In Japan, robbing of *A. cerana* hives by A. mellifera is much more common than robbing of *A. mellifera* hives by *A. cerana* (Sakagami, 1959). *A. cerana* were reported to have a very weak defence against intruders and were observed to feed robber bees (Friedrich Ruttner, 1988; Sakagami, 1959). Research in Japan on mixed colonies of, and competition between, *A. mellifera* ligustica and *A. cerana*, found that A. mellifera behaved much more aggressively towards *A. cerana*, and when placed in confinement together *A. mellifera* were stronger and the superior fighter to *A. cerana* (1959). However, *A. cerana* were reported to deliver a powerful bite. When competing for a sugar syrup station, *A. cerana* always lost (Sakagami, 1959). However, *A. cerana* appeared to be superior robbers of *A. mellifera* hives on the Solomon Islands (D. Anderson, 2010; Annand, 2009). In the presence of *A. cerana* and *A. dorsata, A. mellifera* also did not thrive in a forest ecosystem on the Philippines (Manila-Fajardo & Cervancia, 2003). In addition, there was some anecdotal evidence of single occurrences of *A. cerana* robbing Australian native insects (sugar ants, Camponotus sp., and a stingless bee, Trigona sp.) (Hyatt, 2011). No literature could be found with comparable evidence of *A. mellifera* robbing native insects, indicating a lack of research into whether or not *A. mellifera* rob nests of native Australian bees. However, research shows that the presence of foraging *Apis mellifera* results in reduced visitation by native bees (Gross, 2001). In addition, in the majority (91%) of interactions between *Apis mellifera* and native bees on the pioneer plant Melastoma affine in tropical north Queensland, native bees were disturbed from foraging at flowers by *Apis mellifera* (Gross & Mackay, 1998). Mating interference As discussed previously, differences in the timing of mating flights, sex attractants (pheromones) and drone congregation areas are important in establishing and maintaining isolation between different Apis species (N. Koeniger & Koeniger, 2000; Friedrich Ruttner, 1988). However, there seems to be some overlap between *A. cerana* and *A. mellifera*. *A. cerana* and *A. mellifera* have been found to have very similar drone flight timings in Europe and Japan.

Conclusion:

It has been observed that A. mellifera drones are attracted to *A. cerana* queens and vice versa, and that A. mellifera drones outcompete *A. cerana* drones when mating with A. cerana queens, with detrimental effects on *A. cerana* queens (Ruttner & Maul 1983 in Muzaffar & Ahmad, 1990; Friedrich Ruttner, 1988). In Pakistan, in the presence of A. mellifera drones in an area, virgin *A. cerana* queens did not lay at all or became drone layers (F. Ruttner et al., 1972). A. cerana queens in an A. mellifera dominated area were found to have very low success rate at mating with their own species, especially when A. mellifera colonies were in close proximity. Similarly, A. mellifera queens in an A. cerana-dominated area also had very low success rate at mating with their own species.

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