Short communications

The territorial invasion of *Apis florea* in Africa

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Apis florea took an inadvertent leap onto the African continent and was detected in Khartoum, Sudan, for the first time in 1985 (Lord & Nagi 1987; Mogga & Ruttner 1988). The occurrence of these bees in Africa is very likely *via* global transportation. Since then, *A. florea* has been gradually expanding its territory to the whole of Sudan (Moritz *et al.* 2010) and to neighbouring countries. Moreover, in Asia *A. florea* has been steadily expanding westwards, and it is now well established in the Middle East (Hepburn *et al.* 2005; Haddad *et al.* 2009).

Very recently, in 2013, an *A. florea* colony was observed in northern Ethiopia at Yechila in Tanka-Abergele District which is about 741 km northeast of Khartoum so that the bees have expanded about 26.5 km/year, which is similar to that previously observed in Sudan (Mogga 1994; El Shafie *et al.* 2002). Assuming the territorial expansion of the species is equal in all directions, *A. florea* can be expected to colonize areas equivalent to $\pi r^2 = 3.14 \times (741)^2$, *i.e.* about 1.7 million km^2, the area of South Africa and Zimbabwe together. However, its colonization seems relatively slow compared to the expansion of *A. mellifera scutellata* in Latin America of more than 320 km/year (Spivak *et al.* 1991).

The natural distribution of *A. florea* extends from China and Vietnam in the Far East, across Southeast Asia and countries below the Himalayas (India and Pakistan) (Free 1981; Ruttner 1988; Hepburn & Radloff 2011b,c) and is now well established in Iran, Iraq, Oman and Yemen (Wongsiri *et al.* 1996; Hepburn & Radloff 2011a; Peterson 2011). After its discovery, an *A. florea* colony was observed in the Setit-Humera District of northwest Ethiopia, near the Sudan border, about 464 km from Khartoum in 2009 (G. Bezabih, pers. obs. 2009), the bees are not at all an isolated population because they have been found continuously spreading from the Sudanese border eastwards and southwards in Ethiopia (Fig. 1, Table 1), and are very probably of Sudanese origin. Because the *A. florea* samples were collected near the Eritrean border, it can also be expected to expand into the lowlands of Eritrea. In Ethiopia *A. florea* was mainly found at lower and mid-altitudes between 568 and 2212 m a.s.l., which is in agreement with other reports on altitude (Ruttner *et al.* 1995; Wongsiri *et al.* 1996; Hepburn & Hepburn 2005; Hepburn & Radloff 2011b).

In Ethiopia, *A. florea* colonies were found building single-comb nests 0.3 m to 9.0 m above the ground in trees and shrubs with dense branches, primarily in *Ziziphus spina-christi* trees (Christ's thorn jujube), a species of Rhamnaceae. We observed heavy foraging on the flowers of these trees. The *A. florea* population of Ethiopia was observed to have a high reproductive swarming tendency with about 16 queen cells per colony. This, together with migratory and comb salvage behaviour (Pirk *et al.* 2011), colonies would need to produce less wax, which may partially explain the rapid expansion of *A. florea* in the region. The colonies were observed performing well and expanding, with combs (without bees) of standard size (15.7 × 14 cm to 46.2 × 39.5 cm) and with both brood and honey stores, measurements similar to those reported by Mogga & Ruttner (1988) and Phiancharoen *et al.* (2011). The entire range of climates in Africa are comparable and less extreme than those of Asia (Walter 1970; Van Chi-Bonnardel 1973), where *A. florea* is indigenous.

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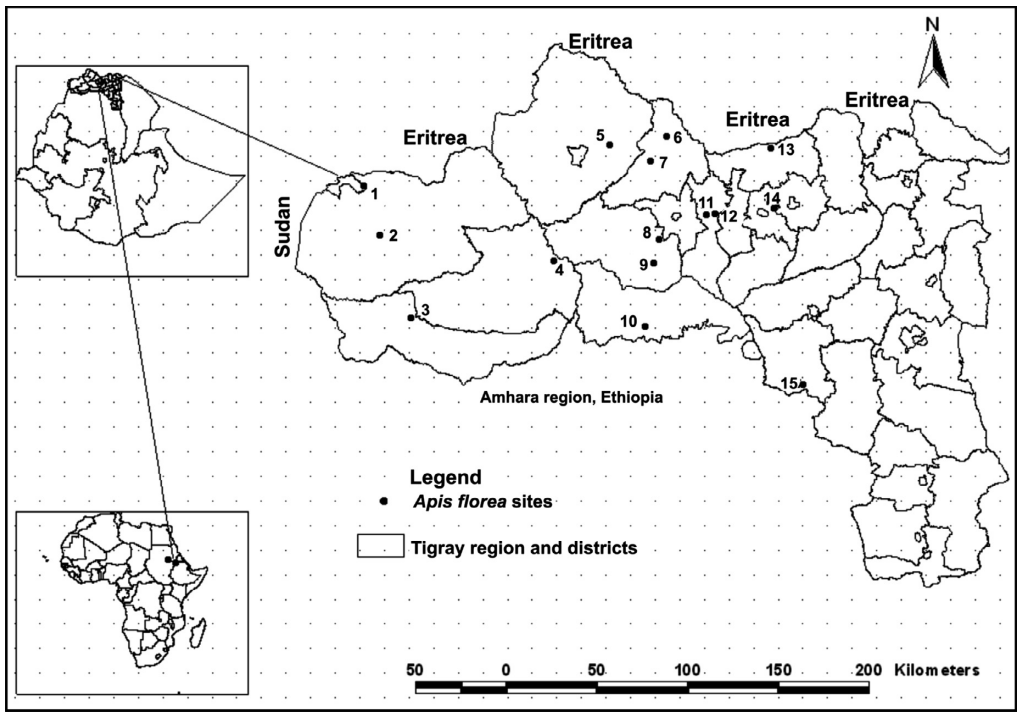

Fig. 1. Map of *Apis florea* distribution in Tigray region, northern Ethiopia.

Because most of Africa is a warm, lowland continent with year-round flowering conditions, the bees may well colonize the whole continent within the coming few decades (Dietemann *et al.* 2009). The commercial value of *A. florea* is very low and it seems there is only minor competition between *A. mellifera jemenitica* and *A. florea* for pollen (El Shafie *et al.* 2002) suggesting a reduced impact of this alien invasion. However, if that is the case with *A. m. scutellata* in Ethiopia, it has to be tested. On other hand, the expansion of the species on the continent may have positive impacts in

Table 1. Latitude, longitude and altitude (m) of sites in northern Ethiopia where *Apis florea* was found. The site numbers correspond with the numbers in Fig. 1.

Site number	Site name	Latitude	Longitude	Altitude
1	Humera research centre	14.263	36.630	608
2	May Kadra	13.985	36.849	758
3	Dancsha	13.598	36.959	752
4	May Gaba	13.856	37.685	864
5	Adi Hageray	14.455	37.984	1496
6	Adi Kahsu	14.471	38.226	1740
7	Adi Daero	14.314	38.172	1820
8	Adi Gidad	13.997	38.223	1893
9	Mizan	13.843	38.223	1642
10	May Tsebri	13.572	38.135	1368
11	Selekleka	14.115	38.475	1989
12	Akad Seat	14.130	38.507	1995
13	Rama	14.409	38.787	1387
14	Hatsebo	14.128	38.783	2113
15	Yechila	13.263	38.980	1651

adding to pollination guilds for better ecosystem functioning and improving the productivity of cultivated crops. The expansion of the species in the new habitat has to be monitored and needs to be investigated to deepen our understanding of pollinator ecology and to evaluate potential positive and negative socioeconomic and ecological impacts in the new ecosystem (Archer *et al.* 2014). That is of particular importance in areas in which the available data on pollinators and pollinator ecology is lacking or not sufficient.

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