

Absconding and migratory behaviors of feral Africanized honey bee (*Apis mellifera* L.) colonies in NE Brazil

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ABSTRACT. We investigated the annual movements of feral Africanized honey bee (*Apis mellifera* L.) colonies in the state of Ceará, Brazil, aiming to understand seasonal variations in their population. Arrival and absconding of Africanized honey bee (AHB) colonies in the semiarid municipality of Canindé and the coastal humid city of Fortaleza (120 km apart) were recorded weekly from January 1999 to December 2001, and the data compared to rainfall records in both areas. Results showed that AHB colonies only nest in the semiarid during the rainy season and abscond during the dry season, the opposite from observations taken in Fortaleza. Only 5% of colonies remained in the semiarid area for the entire year due to ant (*Camponotus* sp.) attacks and shortage of nectar and water during the dry season, with most colonies migrating to coastal areas where the weather is milder and many plant species bloom at that time of year. Excessive rainfall probably pushes AHB colonies back to the semiarid during the rainy season. We concluded that absconding and migration are strategies that allow AHB colonies to survive in the semiarid NE of Brazil, contrary to European honeybees, which have never succeeded in establishing wild colonies in the region.

Key words: absconding, migration, semiarid, survival strategy.

RESUMO. Comportamentos de abandono e migração de colônias silvestres da abelha melífera africanizada (*Apis mellifera* L.) no nordeste do Brasil. Os movimentos de colônias silvestres da abelha melífera africanizada (*Apis mellifera* L.) no Estado do Ceará, Brasil, foram investigados com o objetivo de compreender variações anuais em sua população. A chegada e a partida de colônias de abelhas africanizadas (AHB), no município semi-árido de Canindé e na úmida cidade litorânea de Fortaleza (separadas por 120 km), foram monitoradas semanalmente, de janeiro de 1999 a dezembro de 2001, e comparados com os dados pluviométricos de chuvas em ambas as áreas. Os resultados demonstraram que as abelhas africanizadas somente nidificaram no semi-árido durante a estação chuvosa e o abandonaram na estação seca, ao contrário do observado em Fortaleza. Apenas 5% das colônias permaneceram na área semi-árida por todo o ano, por causa dos ataques de formigas (*Camponotus* sp.) e carência de néctar e água na estação seca. A maioria das colônias migrou para as áreas litorâneas onde o clima é mais ameno e muitas espécies vegetais florescem nesta época do ano. O excesso de chuvas provavelmente forçava as colônias africanizadas a migrarem de volta ao semi-árido durante a estação chuvosa. Conclui-se que o abandono e a migração são estratégias que permitem às abelhas africanizadas sobreviverem no semi-árido nordestino, em contraste com as raças européias que nunca conseguiram estabelecer populações silvestres na região.

Palavras-chave: abandono, migração, semi-árido, estratégias de sobrevivência.

Introduction

The honeybee (*Apis mellifera* L.) is an exotic bee species introduced to Brazil in the mid 1800's by Portuguese settlers. These first colonies of European origin were brought to the state of Rio de Janeiro, and quickly spread throughout the southern parts of the country (Wiese, 2005). But European honeybees (EHB) never succeeded in establishing feral colonies in NE Brazil due to the semiarid climate prevailing in most parts of this region. Because of this fact,

beekeeping in NE Brazil was restricted to a few coastal or mountain areas, where environmental conditions were tolerated by EHB. Only after the arrival of African/Africanized honeybees (AHB) in the 1960's was a feral population established in caatinga and beekeeping activity thrived (Freitas, 1991).

Caatinga is a scrub vegetation which covers most of NE Brazil, with an approximate area of 834,000 km² (Andrade-Lima, 1981). The climate is semiarid, with two distinct seasons along the year: the rainy

(4-6 months) and dry (8-6 months) seasons, depending on the year. During the dry season, sunlight is intense, temperatures rise up to 37°C, water becomes scarce and most plant species drop down their leaves (Araújo Filho, 1990).

The term *caatinga* comes from an Indian language called Tupi. According to Andrade-Lima (1981), *caatinga* derives from the words *caa* = vegetation or forest and *tinga* = white, and means white or pale forest. But Lima-Verde (Personal communication) believes the term is originated from the words *caa* and *tinga* = dry, meaning dry forest. The last explanation seems more likely because of the arid conditions prevailing in the area during most of the year.

Life in the *caatinga* during the dry season is difficult for honeybee colonies, due to the long period without rain and scanty blooming. Nevertheless, AHB are among the most common inhabitants of *caatinga* nowadays. Preliminary observations have shown that the presence of wild AHB colonies in *caatinga* is strong during the rainy season, but they become scarce in the dry season (Kerr, 1971; Sousa *et al.*, 2000). Predatory honey hunting has been blamed for the strong reduction in the numbers of colonies residing in *caatinga* after the rainy season, but a study by Sousa *et al.* (2000) in the municipality of Caridade, state of Ceará, monitoring 31 wild colonies protected from the action of honey hunters showed that only 10% of those colonies did not abscond or died during the dry season. Kerr (1971) suggested that AHB colonies could migrate from *caatinga* to areas where environmental conditions are less inclement during the leanest period of the year.

Behaviors such as swarming, absconding and migration have been largely used in bee literature and frequently employed as synonyms, though they mean distinct events. In this paper, we understand swarming as the reproductive division of an AHB colony, by which part of the workers leaves with the older queen and the others remain in the nest with the new queen; absconding as the abandonment of a nest by the entire AHB colony; whereas migration means the movement of an AHB colony between distinct ecological regions. Behaviors of absconding and migration have been reported for other honeybee species in other parts of the world (Seeley, 1985; Ahmad, 1989a and b; Winston, 1991). But little is known about the survival strategies of AHB in the semiarid NE Brazil, which allowed them to colonize and thrive in *caatinga*, whereas EHB – despite its earlier introduction to the area – failed to get established.

Material and methods

In order to study the movements of AHB colonies within the state of Ceará and their role in the ability of AHB to survive wildly in the semiarid NE Brazil, we made observations in the cities of Fortaleza (03°43'02" S and 38°32'35" W) and Canindé (04°21'32" S and 39°18'42" W). Fortaleza is the capital of the state of Ceará, situated by the coast and covering an area of 336 km². It has an average temperature of 23°C, and plenty of trees blooming during the dry season, such as mango (*Mangifera indica* L.), cashew (*Anacardium occidentale* L.), coconut (*Cocos nucifera* L.), and others. Canindé is situated 120 km south of Fortaleza, in the *caatinga* area, has a semiarid climate with an average temperature of 27°C, and its plants bloom mainly during the rainy season (Freitas, 1991; Funceme, 1997).

The arrival and absconding of AHB colonies to an area of 1 km² in Canindé were recorded weekly for three years; from January 1999 to December 2001. Colonies were also monitored to record flight activity and for attacks of predators and pests. During the same period of time, every legitimate call asking to remove bee swarms received by the fire brigade of Fortaleza was checked and recorded. This method of monitoring the arrival of swarms to Fortaleza proved to be very efficient because no citizen wanted to have 'killer bees' around and notified their presence to the fire brigade as soon as any swarm was seen. Data collected in Canindé and Fortaleza were compared to rainfall records in both areas.

Results and discussion

Observations showed that rainfall in the town of Canindé during the period of study was lower than the historical mean (35 years) of the area, especially in 1999 and 2001 (Table 1). But in Fortaleza, rainfall between 1999 and 2001 was similar to the historical mean (Table 2). Arrival and nesting of AHB swarms in Canindé took place only during the rainy season, between the months of January and May (Table 3).

Table 1. Rainfall (mm) in the town of Canindé, Ceará, Brazil, between 1999 and 2001, and the historical mean over a period of 35 years.

Year	Month												Total
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
1999	8.8	32.0	152.9	28.4	67.2	17.2	0	0	0	0	18.5	45.0	370.0
2000	124.4	120.9	122.3	154.5	38.5	56.0	45.5	59.2	0	0	0	9.2	730.5
2001	23.9	6.4	113.5	220.2	5.0	0	0	0	0	0	0	0	369.0
Mean	52.4	53.1	129.5	134.4	36.9	24.4	15.2	19.7	0	0	6.2	18.0	489.8
Historical Mean	83.3	146.8	185.6	169.7	89.0	42.5	13.4	5.6	0.3	0.6	3.4	15.9	756.1

Table 2. Rainfall (mm) in the city of Fortaleza, Ceará, Brazil, between 1999 and 2001, and the historical mean over a period of 35 years.

Year	Month												Total
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
1999	67.8	145.8	231.5	325.6	408.2	26.9	1.8	11.3	44.1	6.4	12.0	63.2	1344.6
2000	233.4	171.4	192.8	507.7	171.5	74.2	164.8	112.3	153.3	1.2	9.3	5.7	1797.6
2001	103.2	89.4	172.4	708.1	80.1	165.6	62.0	2.0	9.3	6.1	13.0	27.0	1438.2
Mean	134.8	135.5	198.9	513.8	219.9	88.9	76.2	41.9	68.9	4.6	11.4	32.0	1526.8
Historical Mean	116.8	199.6	339.4	349.2	220.4	162.6	82.7	33.6	26.9	12.8	12.3	41.5	1597.8

Table 3. Establishment of Africanized honeybee colonies in the municipality of Canindé, Ceará, Brazil during three years.

Year	Month												Total
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
1999	0	7	21	4	2	0	0	0	0	0	0	0	34
2000	6	9	10	7	0	0	0	0	0	0	0	0	32
2001	4	5	12	9	1	0	0	0	0	0	0	0	31
Mean	3.3	7.0	14.3	6.7	1.0	0	0	0	0	0	0	0	32.3

Colony density in the area reached its peak between April and May, with figures varying from 31 to 34 colonies km⁻², depending on the year. Absconding in Canindé happened during the dry season, mainly between July and October (Table 4).

Table 4. Absconding of Africanized honeybee colonies in the municipality of Canindé, Ceará, Brazil during three years.

Year	Month												Total
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
1999	0	0	0	0	0	0	9	11	6	3	2	0	31
2000	0	0	0	0	0	0	0	8	13	6	2	1	30
2001	0	0	0	0	0	0	12	6	7	6	0	0	31
Mean	0	0	0	0	0	0	7.0	8.3	8.7	5.0	1.3	0.3	30.7

Most colonies absconded their nests due to prolonged ant (*Camponotus* sp.) attacks observed over many nights and shortage of nectar and water, but a few colonies (average of 5%) situated in privileged sites (near rivers, wells and fresh spots) remained in the area from one year to the next. This figure is half the value found by Sousa *et al.* (2000) to the neighboring municipality of Caridade (state of Ceará), but the little rainfall over those three years of study probably played an important role in increasing colony absconding. In fact, rainfall records showed that the arrival and absconding of AHB colonies in caatinga is closely related to the season (Figure 1).

Table 5. Arrival of Africanized honeybee colonies in the county of Fortaleza, Ceará, Brazil during three years.

Year	Month												Total
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
1999	83	102	114	77	79	114	315	368	223	225	223	137	2060
2000	165	153	124	96	103	407	345	351	477	322	208	130	2881
2001	142	124	145	118	139	186	240	204	239	240	174	158	2109
Mean	130.0	126.3	127.7	97.0	107.0	325.7	300.0	307.7	313.0	262.3	201.7	141.7	2350.0

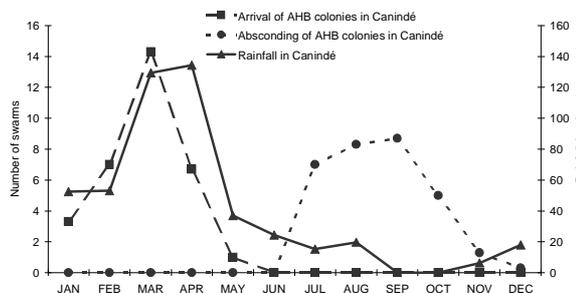


Figure 1. Mean values of arrival and absconding of Africanized honeybee colonies and rainfall (mm) in the county of Canindé, Ceará, Brazil between 1999 and 2001.

In 1999 and 2001, years of little rain and shorter rainy season, colony arrival was delayed and timid early in the season and absconding began as early as July and was finished by November. In 2000, a year in which rainfall was similar to the historical mean, AHB colonies arrived earlier and absconded later (Figure 1).

In Fortaleza, swarms arrived year-round but their numbers increased considerably during the dry season, especially between July and October (Table 5; Figure 2), the same period of greater colony absconding in Canindé (Figure 3).

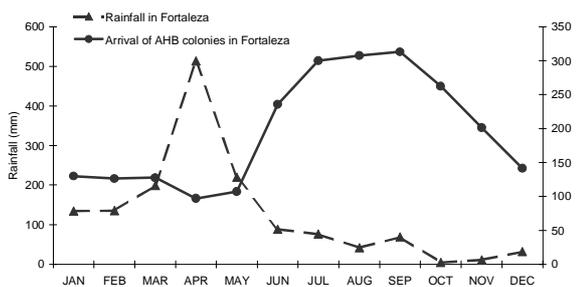


Figure 2. Mean values of arrival of Africanized honeybee colonies and rainfall (mm) in the county of Fortaleza, Ceará, Brazil between 1999 and 2001.

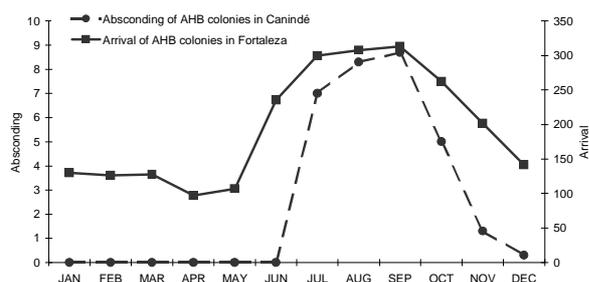


Figure 3. Mean values of absconding of Africanized honeybee colonies in the county of Canindé and arrival in the county of Fortaleza, Ceará, Brazil between 1999 and 2001.

This investigation suggests that AHB inhabits the semiarid of NE Brazil because it absconds the caatinga when conditions deteriorate, migrating to more favorable areas. However, it is not possible to state from this study that AHB colonies absconding Canindé migrated to Fortaleza. Other coastal localities or vegetation could be their destination, as well as fresh mountains situated 40 km from the studied site. Most colonies from Canindé and other counties probably flew to a range of different places, since swarm density in Fortaleza varied from only 6.1 to 8.5 swarms km⁻², between 1999 and 2001. The increase in swarm numbers arriving in Fortaleza when reproductive swarming is no longer happening in caatinga (after June), but absconding is peaking there, suggests that AHB colonies migrate to coastal areas when environmental conditions deteriorated in the semiarid caatinga, as predicted by Kerr (1971). Data obtained by Sousa *et al.* (2000) for the town of Caridade also reinforce this hypothesis.

Colony absconding in Fortaleza was not monitored because any swarm or colony found was immediately exterminated. But established colonies can still be found on the top of high trees and buildings. Many of these colonies absconded their nests during the rainy season in Fortaleza, either because they were not properly protected from intense rainfall or because of shortage of flowers and other food sources during this period of the year. The same might happen in other coastal areas of NE Brazil where most blooms concentrate in the dry season. Colonies absconding Fortaleza and other coastal areas during the rainy season migrate back to caatinga (Figure 1), closing the cycle.

The absconding and migrating behaviors shown by AHB, along with their defensiveness, have been considered undesirable traits for beekeeping (Seeley, 1985; Winston, 2003). However, absconding and migration allowed the first arrival of this bee to NE Brazil, coming from the southern parts of the country and bringing a new species to the area, which changed its ecological interactions (Taylor and Spivak, 1984).

Also, these traits have assured AHB survival in NE Brazil by colony movements between different ecological areas as their vital resources improve or deteriorate, as opposed to EHB, which perished due to its reduced colony mobility.

The arrival of AHB to NE Brazil probably affected the indigenous bee fauna, although impacts on native bee species caused by AHB introduction to the New World are still controversial (Roubik, 1992). We believe that absconding and migration of AHB colonies during the leanest period of the year avoids competition with other social and solitary bee species residing in caatinga, in accordance with Roubik *et al.* (1986).

The presence of wild AHB colonies in caatinga allowed poor people living in semiarid NE Brazil to harvest tons of honey and beeswax from their nests by the end of each rainy season, generating a new source of food and income. The successful presence of AHB colonies in the region also stimulated beekeeping among farmers and has turned into a new activity carried out in many rural properties, despite the need for good colony and vegetation managements in order to keep AHB colonies in the hives during the dry season. Absconding and migration of wild AHB colonies showed potential for migratory beekeeping and it is practiced by most professional beekeepers in NE Brazil (Souza, 2004). However, bee movement carried out by man probably has little impact in the region because beekeepers migrate to the same regions and at the same time as the wild colonies, and there are no areas in NE Brazil free of AHB colonies.

Conclusion

Absconding and migration behaviors allowed AHB colonies to establish feral populations in semiarid NE Brazil, as opposed to European honeybees, which never succeeded in establishing feral colonies in the region.

Absconding and migrating behaviors are responsible for frequent AHB colony movements in NE Brazil, and have proven to be the most important traits of feral AHB colonies in the region.

Absconding and migration of AHB colonies is closely related to the annual rain cycle.

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