

Symposium 3

Swarming, Migrating and Absconding of *Apis dorsata* Colonies

J Woyke¹, J Wilde² and M Wilde²

¹ Dabur Apicultural Centre, Jugedi, Chitwan, Nepal

² Bee Division, WM University, Olsztyn, Poland

SUMMARY

Little is known of the biology of the *Apis dorsata*. About 150 *A. dorsata* colonies were observed during seven months in 1999/2000 in Chitwan region, Nepal. After a swarm started to settle three to eight parallel curtains could be distinguished. Later the curtains united. Some swarms emigrated leaving small white combs behind. When the honey flow started, the colonies grew up and prepared themselves for swarming. Characteristic cones of bees covering the queen cells hang down on the lower edges of the nests. After a swarm left a colony, the curtain became thinner. After several swarms left the nest, the curtain disappeared and only one layer of workers remained. The bees migrated when all or almost all workers emerged from the combs. Some new queens started to lay eggs into the combs. Those colonies emigrated when the honey flow was over.

INTRODUCTION

Apis dorsata bees migrate regularly during the year. The swarms migrate to new areas when nectar sources become available there. The colonies swarm during favourable nectar and pollen flow and the bees emigrate when the flow is finished. Some facts concerning these phenomena were described by Lindauer (1957), Koeniger and Koeniger (1980), Reddy (1980), Dyer and Seeley (1994) and Thapa et al (2000). However, many questions concerning these events are unanswered. We investigated the rate of immigration and emigration, as well as the relations between swarming and emigrating.

MATERIALS AND METHODS

These observations were conducted in Rampur and Bharatpur in Chitwan district, Nepal from 7 January to 3 May 1999 and from 11 October, 1999 to 15 January, 2000. *Apis dorsata* nests were observed on a hospital water tank tower in Bharatpur, on two other water tank towers, and on two houses on the campus of Tribhuvan University, Institute of Agriculture and Animal Science in Rampur and on one house in the Agriculture Research Station in Rampur. Together about 150 *A. dorsata* nests were observed. Nests on the two towers on the university campus were observed from the ground, through binoculars. The other nests

were accessible to close observation. Some of them were periodically smoked and the contents of the combs recorded.

RESULTS

Arrival of Colonies

At the beginning of the investigations in October, only rice was cultivated in the neighbouring fields. Very few flowers could be found while in the gardens there were some vegetables (cucumbers, pumpkins and others) or ornamental trees.

The first autumn observations on *Apis dorsata* nests were conducted 14 October 1999. Table 1 shows that 9 nests were found on the high tower. Of these, 4 had the typical shape of elongated semicircles. The other 5 nests were flat and wide. Apparently the very flat ones had no combs. The little elongated ones could have small combs. A flat nest (approximately 40 cm long, 30 cm wide and 20 cm deep) was also found on one house. Seven white small combs approximately 15 x 15 to 20 x 30 cm were also found on the tower. In three of them, the upper part was orange coloured. It seems that honey was stored there. No signs of brood were noticed. Four days later, two new swarms arrived in our presence: one on the high tower and the other on the low one.

One week later, on 25 October, it appeared that three colonies emigrated. One of them was the new colony, which arrived one week earlier. All three left small white combs behind. However, at the same time five new swarms arrived. Three old nests were still flat, as well as the one on the house. As time passed most of the nests became deeper and slimmer. Apparently the workers constructed combs inside.

There was a poor nectar flow until 22 November. Table 1 shows, that at this time, new swarms were arriving, however, at the same time other colonies emigrated. They left small white combs behind. However one colony left a comb of approximate size 50 x 50 cm. That comb was light brown. Few sealed brood cells were visible in the middle of the comb, as well as a very narrow rim of 1 - 2 cells on the edges of that comb. Apparently brood was already reared in that comb.

All the results show that during scarce nectar flow some swarms were arriving, the workers constructed combs and the queen laid eggs. However, at the same time other colonies emigrated, leaving small white combs behind. It may happen that an established colony interrupts its brood rearing and emigrates.

At the end of November, mustard started to bloom. by 7 December one quarter of the fields around Bharatpur, and Rampur were in blossom. Table 1 shows, that a large number of swarms arrived at this time. The number of nests on the high tower increased from 29 to 65 within 2 weeks. In successive weeks in December the blooming mustard field increased to 1/3, 1/2 and 1/1 of the total area. Table 1 shows, that the most attractive nesting site - the high tower - was filled with new colonies at the beginning of the nectar flow and later on, no further settlement of new swarms was recorded. In the less attractive sites, new swarms were arriving till the end of the year. In the most attractive site on the high water tower, really very little space was available after the initial large increase of settled swarms. At the end of December the blooming of some mustard fields was over. Then buckwheat started to bloom. During the nectar flow, no emigration of colonies was recorded.

Closer examination of the nests showed that at first worker brood only was reared in the new comb. A belt about 10 - 15 cm wide containing sealed brood of both workers and drones was recorded at the end of December. This means, that rearing of drone brood was started about 10 days earlier. Thus, the colonies started to rear drones about two to three weeks after their arrival. Some drone brood was recorded as early as 15 November in a comb of a colony in the low tower.

Settlement of Immigrating Swarms

Eight swarms arrived in our presence. We video recorded settlement places 1 hour before arrival of new swarms. At first a dozen or so workers appeared on a place. They were flying around, searching for landing and behaving in an agitated manner. On the high water tank tower many parts of old combs or traces of wax from previous years were present. However, the scout bees were landing and aggregating on places free of any traces of combs from previous years. Next the number of workers increased to few hundreds 10 - 20 min before arrival of the swarm. Then the number decreased to a dozen 2 - 5 minutes before arrival of the swarm. The swarm arrived as a mass of bees in the form of a sphere of about 20 m diameter. The workers

started to cluster on the selected place in an area of about 30 - 50 x 15 cm. The cluster prolonged quickly downwards. After a few minutes three parallel curtains could be distinguished more or less distinctly. When the longitudinal axis of the settlement place was across the slope of a surface (perpendicular to the inclination), then up to 6 to 8 parallel curtains could be distinguished. The edges of the curtains were not semicircular, but in a form of zigzag. The cluster reached its final size in about 5 to 10 minutes after arrival. However, the surface was still in disorder. The curtains and the zigzag edges continued to unite. This resulted in several holes of about 5 cm diameter, leading from the outermost surface to the inside of the cluster. Within 15 to 30 minutes after arrival the order of the curtains was established. The workers were hanging vertically in the upper part of the curtain and the disordered mouth was present in the lower part.

One of the swarm settled very near to an abandoned small white comb. When the cluster had grown it enclosed that comb. However, the workers did not sit on that comb. The same phenomenon was visible in some other nests. There were nests, which included two new small abandoned combs. Nevertheless, the bees of those nests did not sit on those combs. Observation of settling places of other nests revealed that the swarms never settled exactly on the traces of cells of combs from the previous year. However, when the nests grew they included those traces.

Honey Harvest

Honey was harvested from colonies on the house on 25 December and from the low tower at the beginning of January. Colonies from which a part of comb containing honey was cut out, did not abscond. However, colonies from which the whole comb was cut mostly absconded. On the house, out of 18 colonies, 3 without combs absconded within 2 days after harvest, 3 within 3-7 days and one very small colony without comb was still present 17 days after harvest. It was probably without a queen. However, on two occasions, the bees did not abscond in spite of the whole combs being cut and found on the ground. Those nests were flat after the harvest, and became elongated semicircular later, indicating the construction of new combs.

In the high tower, honey was harvested from some colonies at the end of March 1999 (not in Table 1). Two of these colonies absconded in our presence, on 26 March. Small pieces of uncut comb were left behind.

Swarming of *Apis dorsata*

At the end of December worker bees emerged from the central upper parts of the combs. The area of empty cells had a semicircular shape of about 25 cm diameter. As the time passed, the area of empty cells enlarged. In the middle of January characteristic pattern of brood was found in all the colonies. No brood was present in the upper middle part of the combs. However, a belt of brood 10 – 15 - 20 cm wide was observed along the edges of different combs. The oldest brood consisting of emerging workers was present towards the middle of the combs. Younger brood was at the edges of the combs. Eggs were present in the most outside part of the comb. They were deposited in the edge of the comb into white new built cells, which were drawn to 1/3 or 1/2 of their height. The workers were enlarging the combs by constructing new cells along the edges. The queens were laying their eggs, but not in the upper middle part of the combs.

According to the literature (Ruttner 1992), adult drones are present in the upper part of the nests. However, we could not find any drones there. We found adult drones only on the brood belt along the bottom and sides of the combs.

In January the colonies started to prepare to swarm. *A. dorsata* nests of colonies preparing to swarm are characterised by a cone of bees hanging down on the lower edge of the nest. The cone consists of young bees whose abdomens are covered by light (yellow) hairs. After the bees were smoked out from 7 nests, we found 3, 4, 6, 8, 9, 12 and 13 queen cells.

Four colonies swarmed in our presence. At first disorder of the curtain appeared. Next the bees started to fly close to the nest as they do during orientation flight. Then their number increased. A loud sound "wuum" could be heard and a cloud of bees became airborne. The bees started to be aggressive. The mass of flying bees increased. They created a sphere of about 20 m diameter, and then flew away. We did not notice a congregation of the bees on a nearby place forming a temporary cluster such as happens in *A. mellifera*. The bees appeared to fly directly to a previously selected place.

All three queen cells found in one nest were cut from the comb after the colony swarmed. They looked very short. They extruded above the edge of the comb by 1 cm. However, the inside depth of the cells was 2,5 cm. This means, that together with the elongation of the queen cells containing the growing larva,

the construction of new cells was continued along the edge of the comb. The queen cells were put in an incubator. The queens emerged after 2 and 3 days. Thus, that colony swarmed 2 days before the new queen emerged. This is later than *A. mellifera*.

After the first swarm left a nest, the curtain of bees covering the comb became distinctly thinner. However, the whole comb was covered by a curtain of worker bees. After more swarms left the nest, the curtain became very thin. In some nests, after all the brood emerged, the last swarms left the comb together with all the workers. One such colony migrated at our presence on 2 April, 1999 at 0815 h. At first the bees started to fly like in an orientation flight, then the bees left the comb within 1 min. They did not congregate nearby but flew straight away. The abandoned comb, was of light brown colour. Neither stores nor brood were present. At the lower edge 5 open queen cells were found, from which the queens had already emerged. Other abandoned combs were also light brown and empty queen cells were found in the bottom edges of all these combs.

Sometimes so many bees left the nests with the previous swarms, that only one or two layers of bees were left to cover the comb. No real curtain was present. The edges of comb remained uncovered to a width of about 5 cm. Queen cells, from which queens had already emerged were visible in all those combs. In the upper part of the comb, the few workers, that remained were unable to cover the whole honey stores. White cappings of sealed honey cells were distinctly visible.

At the end of January, in February and in March, the nectar resources were weaker than in December. However, some buckwheat fields were still blooming. There started to blossom orchard trees like litchi and many other plants.

Out of 26 colonies observed on two houses, the first abandoned empty comb was found 26 March on house No 2. One week later, 2 April, two empty combs were found on house No 1 and one on house No 2. Table 2 shows that out of 19 nests on house No 1, only 13 were present 9 April. Of these only 3 were still thick – about 15 cm in the lower and middle part and about 30 cm in the upper part. The curtains on the others were thin or very thin. Apparently several swarms had already left the nests. At the end of the month, 27 April 11 nests were still present. However on house No 2, only 2 remained out of 7. One month later, 31 May, 10 colonies were present on house No 1 and only 1 on house No 2. It appears that emigration was linked with swarming in about half the number of the colonies. The last young queens did not start to lay eggs in the old nests but emigrated with the rest of the workers. It seems that when most of the workers swarmed, those remaining were not able to create a curtain of sufficient density to secure the nest.

Young queens remained in April in about half the number of the colonies on house No 1. They found here the conditions necessary to lay eggs and rear brood. Examination of such colonies revealed, that new queens started egg laying from the upper middle part of the combs. A belt of empty cells of varying width was present along the edges of the combs. Now, adult drones were found in the upper area of the nests. After the brood area expanded, it reached the edges of the combs. When workers emerged from the upper middle part of the combs the queens returned there laying new eggs. A belt of empty cells was present between the emerging brood of the previous term of egg laying and the recently laid ones.

Table 2 shows, that in April some nests continued to be thin. Only two colonies emigrated. However, the other nests which were very thin at the beginning of April, were growing. They became thin medium and even thick at the end of May. Apparently they did not swarm during the last period.

Unfortunately, the next observation was not conducted until 5 August. At this time not one colony remained. The abandoned combs were dark brown. Apparently several generations of bees were reared here. In Chitwan, the rainy season starts from June and continues to September. At this time nectar and pollen is almost unavailable. Therefore, the colonies must emigrate.

The results show, that two types of comb abandoning the were found. This resulted in two periods of emigrations. One period occurs during, or shortly after, the swarming period when some nectar and pollen flow still existed (April). In this case the bees swarmed totally out. The abandoned combs were light brown. The next emigration occurred when no more food was available during the monsoon time, which starts in June. The abandoned combs were dark brown.

DISCUSSION

According to Lindauer (1957) swarms which settle temporarily do not build combs. Those which started to build combs decided from the beginning on their new nesting place and the queen started immediately to lay eggs into very small combs. However, we found, similarly to Dyer and Seeley (1994), that many swarms left the place after building a small comb. The period of migration of *A. dorsata* observed in Chitwan, Nepal is very similar to that observed by Reedy (1980) in Bangalore in India. Our results do not support the conclusions of Thapa et al (2000) which stated that *Apis dorsata* migrates when the ambient temperature drops below 14°C. Such temperatures occurred in Nepal in January. This was the main honey flow period and colonies were in optimal development conditions. They migrated when forage became scarce. In some cases they migrated after several swarms left the colonies and insufficient bees remained to manage the comb even though there was some nectar and pollen available.

Woyke (1984) found that *Tropilaelaps clareae* can not survive on adult bees. Therefore the question is raised as to how can it survive during the migration period, when bee brood is absent (Ruttner 1992). The present investigations showed that immigration and emigration periods are extended. Some colonies are already well established and have brood in different stages while other swarms are arriving. Thus, *T. clareae* can pass from one colony to the other.

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Table 1 Arrival of *Apis dorsata* swarms. Number of colonies at different times in miscellaneous places in the campus of Tribhuvan University, Rampur and the hospital in Bharatpur.

Date	High tower	Low tower	House No 1	House No 2	Tower Bharatpur
14. 10. 1999	9	1	1	0	0
18. 10. 1999	* 9	* 1	1	0	0
25. 10. 1999	* 11 (-3, +5)	2	1	0	1
2. 11. 1999	23	3 (-1, +2)	1	0	1
8. 11. 1999	** 23	* 4	1	0	1
15. 11. 1999	27 (-1, +5)	5	1	0	1
22. 11. 1999	** 29 (-1, +3)	5 (-1, +1)	1	0	2
Mustard started flowering					
7. 12. 1999	65	12	14	6	9
14. 12. 1999	65	17	18	10	16
20. 12. 1999	65	17	18	12	20
Buckwheat started flowering					
27. 12. 1999	65	17	15 (harvested)	13	20
4. 1. 2000	65	17	12	13	20
Flowering of most mustard field over, Buckwheat still flowering					
11. 1. 2000	65	9 (harvested)	12	13	20

* Swarms arriving during our observations. In parenthesis changes due to emigration (-) and arrival of new swarms (+).

Table 2 The status of *A. dorsata* nests on house No 1

No.	24. 2	5. 3	19. 3	26. 3	2. 4	9. 4	15. 4	20. 4	27. 4	31. 5	5. 8
1	+	+	+	+	+	Thick	Thick	Thick	Thick	**med.	-
2	+	+	+	+	+	*Vthin	Vthin	-	-	-	-
3	+	+	+	+	+	Vthin	Vthin	Vthin	-	-	-
4	+	+	+	+	+	Thick	thin	thin	thin	Vthin	-
5	+	+	+	+	+	Thick	Thick	Thick	Thick	med.	-
6	+	+	+	+	+	Vthin	Vthin	thin	thin	med.	-
7	+	+	+	+	+	Vthin	Vthin	Vthin	thin	Thick	-
8	+	+	+	+	+	Vthin	Vthin	Vthin	thin	Thick	-
9	+	+	+	+	+	-	-	-	-	-	-
10	+	+	+	+	+	thin	thin	thin	thin	thin	-
11	+	+	+	+	+	-	-	-	-	-	-
12	+	+	+	+	-	-	-	-	-	-	-
13	+	+	+	+	+	Vthin	Vthin	thin	thin	Thick	-
14	+	+	+	+	+	-	-	-	-	-	-
15	+	+	+	+	+	med.	thin	Vthin	Vthin	Vthin	-
16	+	+	+	+	+	Vthin	Vthin	thin	Vthin	Vthin	-
17	+	+	+	+	+	-	-	-	-	-	-
18	+	+	+	+	-	-	-	-	-	-	-
19	+	+	+	+	+	Vthin	Vthin	thin	Vthin	-	-

**med. - median, *Vthin - very thin. Only presence (+) or absence (-) of colonies was recorded till April 2. Later also conditions of the nests were recorded.



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