

## How far do honey bees forage?

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*Published as: Ratnieks, F. L. W. 2000. How far do bees forage. Bee Improvement 6: 10-11*

Members of the public usually know a bit about honey bees. But they also have some misconceptions. In my experience, one of the most common concerns the honey bee's foraging range. People often suggest to me that I put a hive in such and such a place where there are a lot of flowers, assuming that the bees only forage close to their hive. In fact, nothing could be further from the truth because honey bees will forage up to 12 kilometers or more from the hive. Taking into account the small size of the honey bee this is a remarkable distance.

That honey bees forage such long distances has been known for quite some time. Karl von Frisch, the discoverer of the honey bee dance language, trained bees from a colony to artificial syrup feeders as part of his research. By marking bees who visited the feeder with small paint dots he was able to measure the tempo of the waggle dances made by bees who had visited feeders at known distances. In this way he was able to calibrate the dance language at distances of up to 9.5km. The furthest his team was able to train bees was 12km, and the last dancing bees ceased to dance at 11km, at which distance each dance consisted of a single waggle run. Bees could only be trained to feeders at great distances during fine autumn weather when there were essentially no flowers.

In his book von Frisch (p. 66) also discussed other evidence for the furthest distance that honey bees would forage. The greatest estimate came from Eckert who studied bees in the desert in the western United States and reported that they flew up to 13.5km to the nearest irrigated area which was where flowers were located. Other convincing observations of long distance foraging that he reported were that of von Berlepsch, who imported yellow bees into his area and noted them foraging up to 7km from their apiary, and Knaff, who observed dances of bees visiting natural food sources and decoded the dances to reveal that bees went as far as 9-10km, but usually less than 2km.

Since these earlier studies, which were made made before 1950, a number of researchers have decoded dances made by bees foraging from an observation hive. One important study was carried out by Kirk Visscher and Tom Seeley in a forest in New York State. The hive was located in a forest to simulate what is thought to be the natural environment of the European honey bee. Nearly two thousand dances were recorded in the summer of 1980. Half of the bees danced for locations less than 1.6km from the hive, 5% more than 6km. The maximum distance was 10.9km and the average distance was 2.2km. This study seemed to show that long range foraging was something that bees do, but not very often. It also

agreed well with von Frisch's work inasmuch as the bees did need a language that could indicate long distances because they did sometimes fly that far. Visscher and Seeley noted that some studies that decoded dances had been made in areas where the foraging conditions were unnaturally good, for example an agricultural area, and that this had led to the incorrect conclusion that bees do not forage very far.

A few years ago I was preparing a laboratory exercise for second year zoology undergraduates at Sheffield University. The laboratory was to involve the students in decoding honey bee dances, with the dances previously videotaped using an observation hive located in my lab in Broomhill, Sheffield. The idea was that by decoding dances the students could learn about the dance language and also use data from the dances that they decoded to investigate how the bee's foraging pattern and distance changed both day to day and between August and May, and then compare their data with that collected by Visscher and Seeley. It was quite a lot of work getting everything organized during the summer before the lab was first taught. In addition to videotaping the bee dances I was also making an educational video on the bee dance with Sheffield University Television to show to the students at the start of the class. As a result, there was no time to review the videotaped dances. When the class came around the ten groups of students decoded lots of dances to reveal something quite exceptional. During August the bees were flying long distances west of Sheffield to the heather moors. It was not just one bee in hundreds that was flying a long way. Almost all of them were. Quite clearly, the fortuitous juxtaposition of the heather moors and the observation hive had resulted in the bees making long-distance flights to heather, which must have been more profitable to them than shorter flights to the Sheffield area, where, presumably, there was little in flower.

Subsequently, we got around to carefully decoding our videos of bee dances. (Most of the dance decoding was carried out by Madeleine Beekman, a Dutch researcher who is currently based in Sheffield thanks to a grant from a European Community scheme called "Training & Mobility of Researchers".) After many hours of decoding dances Madeleine was able to conclude the following about the distances bees foraged. In mid-August, half of the bees danced for locations of more than 6.1km and 10% for more than 9.5km. The average distance was 5.5km. In May, when there are plenty of flowers in Sheffield, the average distance was only 1km.

West of Sheffield the large heather moors in the Dark Peak region of the Peak District can be several kilometers across. This is probably part of the reason why the bees foraged on them—they are easy to locate after following a dance. In general, a bee cannot forage at a distance at which she cannot make a profit. That is, she must be able to collect more nectar than she uses in foraging at the patch, and in making the long trip to and from the patch. However, there is another factor to consider—the cost of finding the patch in the first place. In the honey bee the cost of finding a patch per forager bee can be low because once a scout bee has found a good flower patch she can inform the other bees via the dance language. In this way, social life and communication can make foraging more efficient and can make it

worthwhile to scout for distant patches. For a solitary bee, or a social bee that does not communicate such as the bumble bee, a scout bee would need to pay back the "cost" of locating the patch out of her own "profit". But in the honey bee the cost can be paid back in the profit of potentially thousands of recruit bees.

Every day I go to work I am reminded of the amazing foraging ability of the honey bee. This is because my house is just the other side of the heather moors and I drive the route that the bees flew. My house is almost exactly 12 km, in a bee line, from my lab and it takes me 20 minutes to drive the winding 17 km road. But in August, these little insects, each weighing only 80mg, fly this route many times per day to collect food.

**Further Reading**

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