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Honey Bee: Dance Language

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Abstract

Since honeybes can't talk, they perform special dances as a means of communication. The only known bee's genus that employs nest-based communication, or "dance language," to alert nest mates of the location of resources is the honey bee (Apis sp.).

Keyword: Honeybee, Dance, Distance, Direction.

Introduction

Dance language is used by an individual worker to communicate two information to other workers: distance and direction to a location (usually a food source, such as a patch of flowers). It is most often used when an experienced forager returns to her colony with a load of food, either nectar or pollen. If the quality of the food is sufficiently high, she will often perform a "dance" on the surface of wax comb to recruit new foragers to the resource. The dance language is also used to recruit scout bees to a new nest site during the process of reproductive fission, or swarming. Recruits follow the dancing bee to obtain the information it contains, and then exit the hive to the location of interest. For his studies on the honey bee waggle dance, Austrian scientist Karl von Frisch was given the Nobel Prize in 1973. He understood how bees may advise nestmates of the location of food sources via this special style of communication. A round dance is the communicative behaviour of a foraging honey bee (Apis mellifera), in which it moves on the comb in close circles, alternating right and then left. Their "waggle dance" communicates the direction, distance, and quality of a resource to nestmates by encoding celestial cues, retinal optic flow, and relative food value into motion and sound within the nest. Food sources that are at intermediate distances, between 50 and 150 meters from the hive, are described by the sickle dance. This dance is crescent-shaped and represents a transitional dance between the round dance and a waggle dance.

Components of the Dance Language

There are two things communicated in a dance: distance and direction. These two pieces of information are translated into separate components of the dance.

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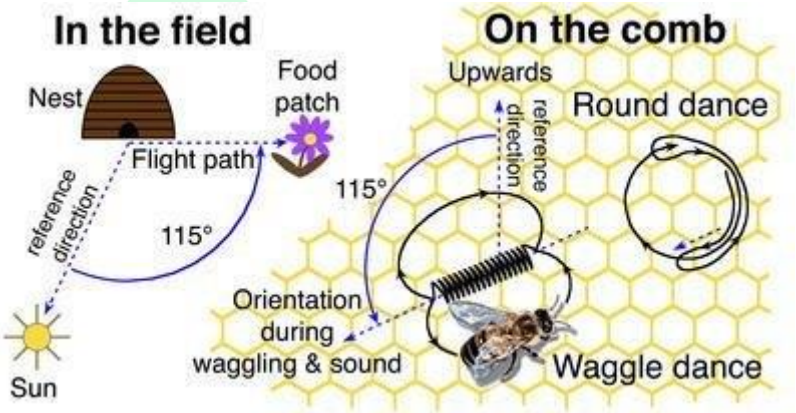
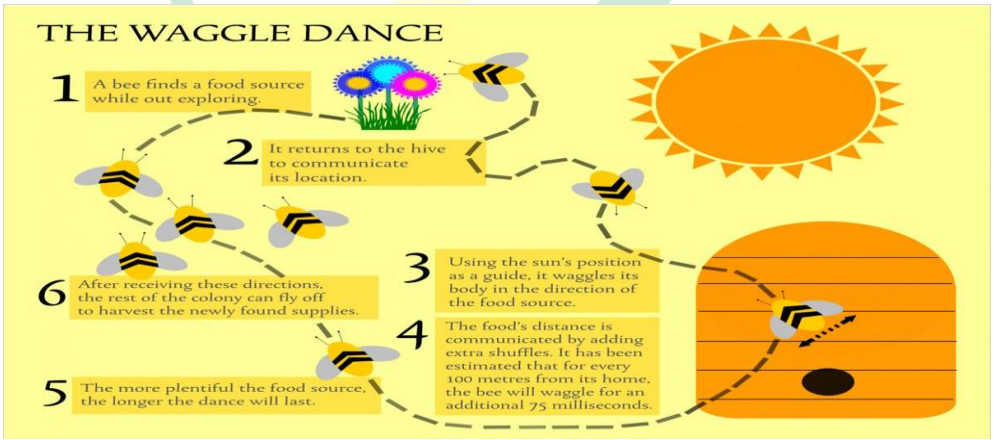
Distance

A forager engages in a circular dance when a food supply is relatively close to the hive (less than 50 metres away). She accomplishes this by sprinting in tight circles before abruptly turning back in the other way. She may relocate to a different site to repeat the dance or she could do both at the same spot. She frequently gives food to the bees pursuing her after the round dance is over. Therefore, a circular dance conveys distance ("close to the hive") but not direction.



The sickle dance is used to attract workers to food sources that are up to 150 metres (50 yards) distant from the hive. This dance has a crescent-shaped form and functions as a bridge between round dances and figure-eight waggle dances.



When bees are over 150 metres away from the hive and hunting for food, they engage in a waggle dance, also known as a wag-tail dance. Unlike the round and sickle dances, this one conveys to potential recruits both distance and direction. When waggle dancing, a bee first travels straight forward for a short distance, then rotates back to the beginning place in a

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semicircle, travels forward again in a straight line and finally makes a semicircle in the opposite direction to complete a full figure-eight circuit. The bee's body, particularly the abdomen, fiercely wags sideways while performing the dance in a straight line. The tail begins to wag as a result of the body vibration. The bee also produces a series of buzzing noises at a low frequency of 250–300 Hertz (cycles per second), with a pulse length of around 20 milliseconds and a repeat frequency of roughly 30 seconds. These noises are caused by wingbeats.

The length of the straight run phase of the waggle dance, measured in seconds, is the simplest and most accurate distance indication, even if numerous aspects of the waggle dance (such as dance "tempo" and buzzing sound duration) are connected with distance information. The duration of the "waggle run," or waggling element of the dance, lengthens as the distance to the food source does.

Direction

While the waggle dance's representation of distance is rather simple, the way it conveys direction is more intricate and complex. The position of the food supply in relation to the sun may be determined by the dancing bee's direction during the straight part of her waggle dance. The bee's angle in relation to vertical shows the angle of the sun's angle with respect to the flowers outside the hive. The dancing bee effectively converts the solar angle to the gravitational angle. Three instances are shown in the image below. A forager doing a dance with the waggle run segment right up on the comb will be moving towards a food source in the same direction as the sun. On the other hand, the straight run would be directed vertically downward if the food supply were situated directly in the direction of the sun. The waggle run would be 60 degrees to the left of vertical if the food supply were 60 degrees to the left of the sun.

A forager's dance for a given resource will alter over time since the direction information is relative to the sun's position rather than the compass direction. This is due to the fact that during the course of a day, the sun's position changes. For instance, foragers will dance roughly straight up in the morning at a food supply that is positioned due east because the sun rises in the east, but will dance roughly straight down in the late afternoon because the sun sets in the west. As a result, the direction information in the dance may be interpreted using the time of day (or, more significantly, the location of the sun).

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The time of year and one's geographic location both affect the position of the sun. Over the course of a day, the sun will always move from east to west. However, the sun will always be in the south above the Tropic of Cancer, and in the north below the Tropic of Capricorn. Depending on the season, the sun might rise in the tropics from either the south or the north.

Conclusions

A combination of theoretical and empirical studies has increased our understanding of why present-day honey bees dance to indicate the location of valuable resources. These studies suggest that the spatial information acquired from a dance is most valuable in environments with resources that are spatially clustered, difficult to find, temporally stable, and variable in quality. Phylogenetic studies offer support for the theory of progressing dance complexity with phylogenetic development. The fossil record of Apis has become more informative in recent years and this information suggests that the genus originated in Europe rather than in Asia. This raises the possibility that the "dance language" evolved in Europe as well. We cannot exclude that the "dance language" pre-dates the earliest Apis, but it is likely to be younger and could have evolved as recently as 20 million years ago when the extant honey bee species diverged during the early Miocene.