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Book Review

Democratic decision-making by the hive mind

Honeybee Democracy by Thomas D. Seeley. Princeton University Press, 2010. US$29.95/£20.95, hbk (280 pages) ISBN 978 1 4008 3595 9

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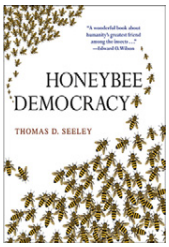

Since the discovery of the waggle dance by Nobel Laureate Karl von Frisch, honeybees have been recognised for their remarkable ability to communicate accurately the location and quality of food patches to one another. In *Honeybee Democracy*, Thomas Seeley explores another less well-known but equally remarkable facet of the communicative abilities of honeybees: collectively deciding where to establish a new nest. When a new queen is produced within the hive, half the colony leaves with the old queen to establish a new nest. Locating the perfect nest site (normally a hollow tree or sometimes, more inconveniently, a chimney stack) is of the upmost importance for the survival of this new transient colony. Too close to the ground risks easy attack from predators; too small a cavity means that not enough honey can be stored to survive the winter. Rather than hoping that the nearest available site fulfils these criteria, the transient colony spends several days as a beardlike 'swarm', hanging on a bush or branch, from which scouts set out on their own to search for promising sites. On their return, they report, by waggle dancing, the location and quality of sites that they have located. The swarm must then collectively agree on which location to relocate to. If the bees do not reach a unanimous decision, or if they deliberate for too long, they risk losing the queen or, worse, colony death.

The core theme of *Honeybee Democracy*, as its name suggests, is how this consensus is achieved. Although collective decision-making in the swarm was first observed by von Frisch's student, Martin Lindauer, it was left largely unexplored until Seeley and others started conducting experiments to determine what features a scout bee looks for in a new nest, how waggle-dance information is collated in the swarm, and how a small number of bees can guide thousands of nest mates to the correct location. The experiments are both creative (constructing artificial nest sites that systematically vary in quality) and, at times, brave (putting cyanide down tree knotholes). Seeley shows that decision-making is bottom-up and truly collective: scouts that dance longer and more vigorously in the swarm recruit the most followers, which in turn verify and reinforce the assessment of the original scouts, until a single clear winning location remains. No single bee makes this decision or has global knowledge, and the identity of the individual bee dancing for a particular site is unimportant. In this, it resembles collective decision-making in a range of other species, such as the choice of navigation routes made by flocks of migratory birds or schools of fishes [1,2].

Honeybee swarming behaviour is a prime example of social learning: the transmission of information between conspecifics, in this case information regarding the location and quality of nest sites via the waggle dance. Recent experimental and field studies have demonstrated the ubiquity of social learning in the animal kingdom [3,4], and insects are no exception [5]. In honeybees, socially learning about the location and identity of floral resources through the waggle dance and trophallaxis (mouth-to-mouth food transfer) can enable a colony to maximise its foraging efficiency. However, the nest site selection explored in *Honeybee Democracy* demonstrates that solely learning from others is seldom an appropriate strategy. Rather than readily adopting the choice of the first scout that finds a suitable location, scouts always independently verify that information, minimising the risk of erroneous informational cascades [6].

In the final chapter, Seeley draws connections between honeybee consensus building and human decision-making. He argues that the latter can be improved by learning lessons from bees, suggesting that juries, parliaments, committees, and so on, could avoid informational cascades, or self-interested manipulation by single individuals, by collating independent decisions, encouraging minority views, and requiring a democratic quorum to make a final decision. This section is more speculative than the previous chapters, and might be seen as rather too idealistic. Decades of experimental work by social psychologists has already identified the many problems with human group decision-making, from conformity to the confirmation bias. Despite this, prominent cases of flawed group decision-making persist, such as the decision to invade Iraq on the basis of flawed information regarding weapons of mass destruction. The fundamental problem here is cooperation. Honeybees make effective group decisions because high relatedness causes scouts to pool information selflessly. Human groups are rarely united by kinship, yet are often as cohesive as eusocial insect colonies. It has been suggested that human cooperation emerged partly via conformity, which binds groups together into cohesive units [7]. If so, then flawed group decision-making might be the price we pay for large-scale human cooperation.

These issues aside, Seeley's book is highly recommended to students and researchers interested in animal behaviour. It stands as a beautifully written and fascinating account of a remarkable natural phenomenon.

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