

Group Decision Making in Swarms of Honey Bees

Paper by Thomas D. Seeley and Susannah C. Buhrman

Moving Hives

- Bees occasionally decide to move to a new hive location
- Scout bees find new possible locations for the hive
 - Advertise locations to others through a waggle dance
 - How do they decide on a single location for the new hive?



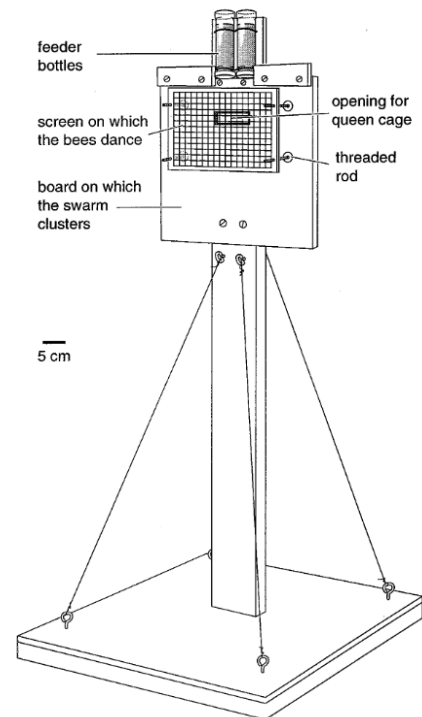
Review of the Waggle Dance

- Bees dance to show the location and quality of a new possible nest location
- This is used to “advertise” locations to other bees



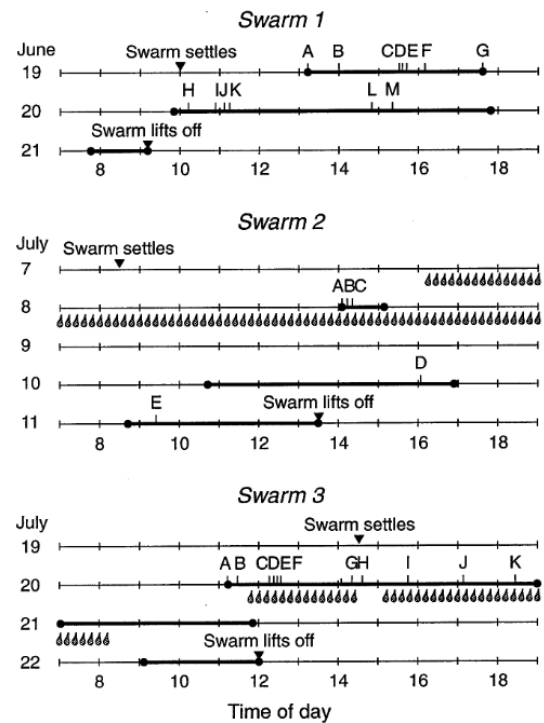
Experimental Setup

- Study how waggle dancing is used to decide on a hive location
- They set up 3 artificial swarms to find new sites
- Each bee was tagged so that researchers could identify them
- Sites were determined by analysing waggle dances and the time of the dance



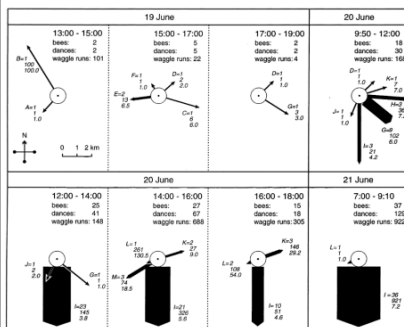
Site Dances Over Time

- Capital Letters indicate the first time a site was “advertised”
- Raindrops show when it was raining
- Bold lines show when dancing happened

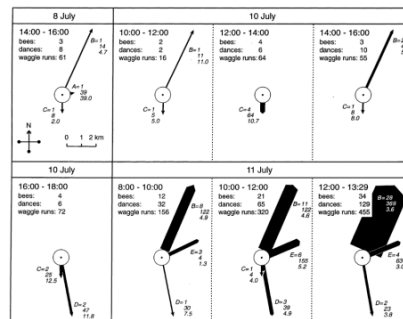


Bee Dancing Diagrams

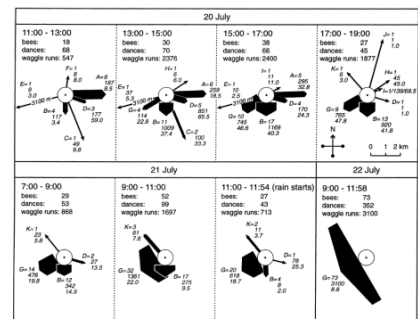
Colony 1



Colony 2



Colony 3

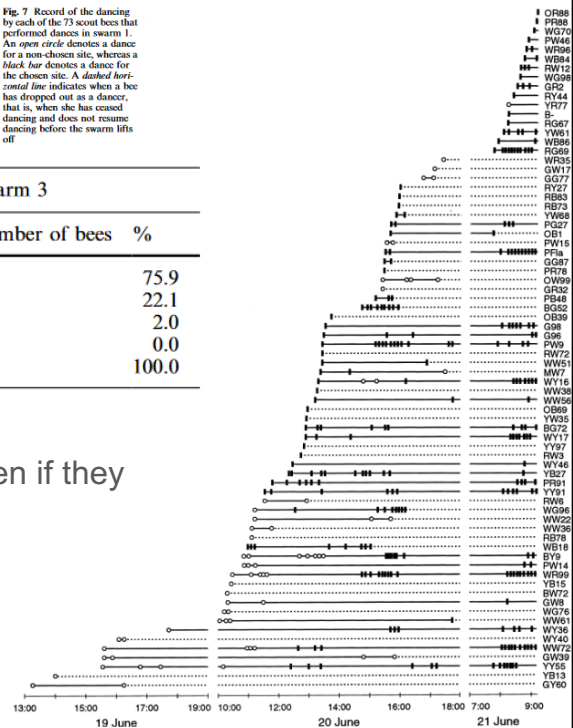


Number of Sites Danced for

Number of sites danced for by a bee	Swarm 1		Swarm 2		Swarm 3	
	Number of bees	%	Number of bees	%	Number of bees	%
1	63	86.2	39	83.0	113	75.9
2	8	11.0	7	14.9	33	22.1
3	1	1.4	1	2.1	3	2.0
4	1	1.4	0	0.0	0	0.0
Total	73	100.0	47	100.0	149	100.0

- Bees usually only advertise one site
- It is common for bees to stop dancing - even if they were dancing for the chosen site

Fig. 7 Record of the dancing by each of the 73 scout bees that performed dances in swarm 1. An open circle denotes a dance for a non-chosen site, whereas a black bar denotes a dance for the chosen site. A dashed horizontal line indicates when a bee has dropped out as a dancer, that is, when she has ceased dancing and does not resume dancing before the swarm lifts off



Site Switching

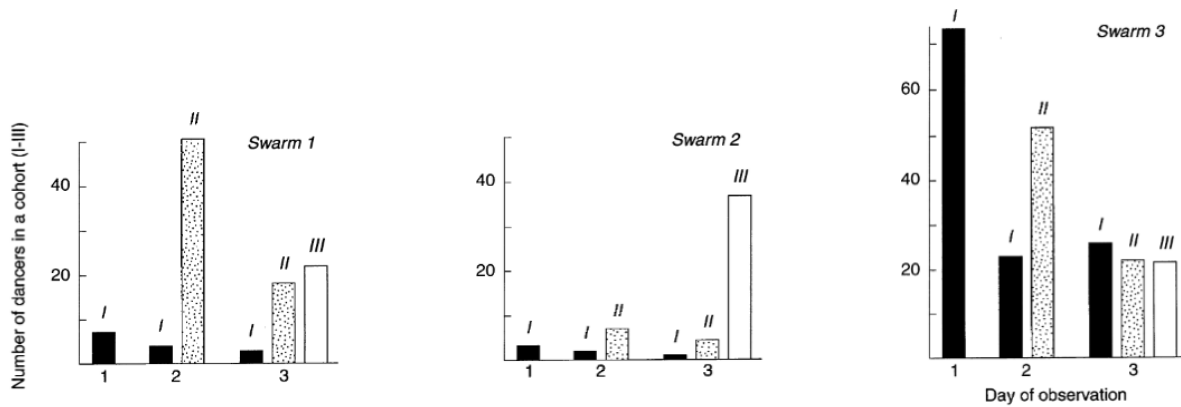
Bees were very unlikely to switch sites and were more likely to just stop dancing

Within an hour of liftoff, all dancing bees were dancing for the chosen site

	Swarm 1	Swarm 2	Swarm 3
Bees that danced initially for a non-chosen site	26 bees	15 bees	72 bees
(1) Continued dancing for such a site until end	0%	0%	0%
(2) Switched dancing to the chosen site by end	27%	20%	33%
(3) Ceased dancing by end	73%	80%	67%
Bees that danced initially for the chosen site	47 bees	32 bees	77 bees
(1) Continued dancing for this site until end	60%	81%	52%
(2) Switched dancing to a non-chosen site by end	0%	0%	0%
(3) Ceased dancing by end	40%	19%	48%

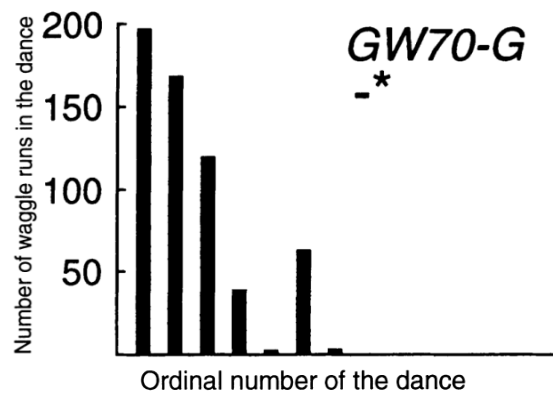
Cohort Dancers Over Time

Over time, bees stop advertising entirely



Decline in Enthusiasm

As bees dance for their site their enthusiasm generally decreases until they stop dancing for that site



Conclusions

- Decision making is accomplished by drop out rather than conversion
- Decisions (in this species) are made by consensus
- Death of scouts is likely not the cause of this behavior

FAQ:

- What Calculator did they use?
 - Hewlett-Packard 41C[®]. It can determine the sun azimuth at the time of each dance using a program.
- What video equipment did they use?
 - Panasonic WV-F250B (Video camera)
 - Panasonic AG-7450 (Docking videocassette recorder)
 - Panasonic AG-F745 (Time code generator)
 - JVC BR-S525U (Videocassette player)