Group Decision Making in Nest-Site Selection by Honey Bees

Paper by Thomas D. Seeley & P Kirk Visscher

Presentation by Nyomi Morris & Helen Wang

Finding an Attractive Home

Great nest location qualities

- Cavity of volume greater than 10 litres
- Entrance hole smaller than 30 sq cm
- Entrance several meters above ground
- Entrance Facing south and at floor of cavity

A little House Hunters joke

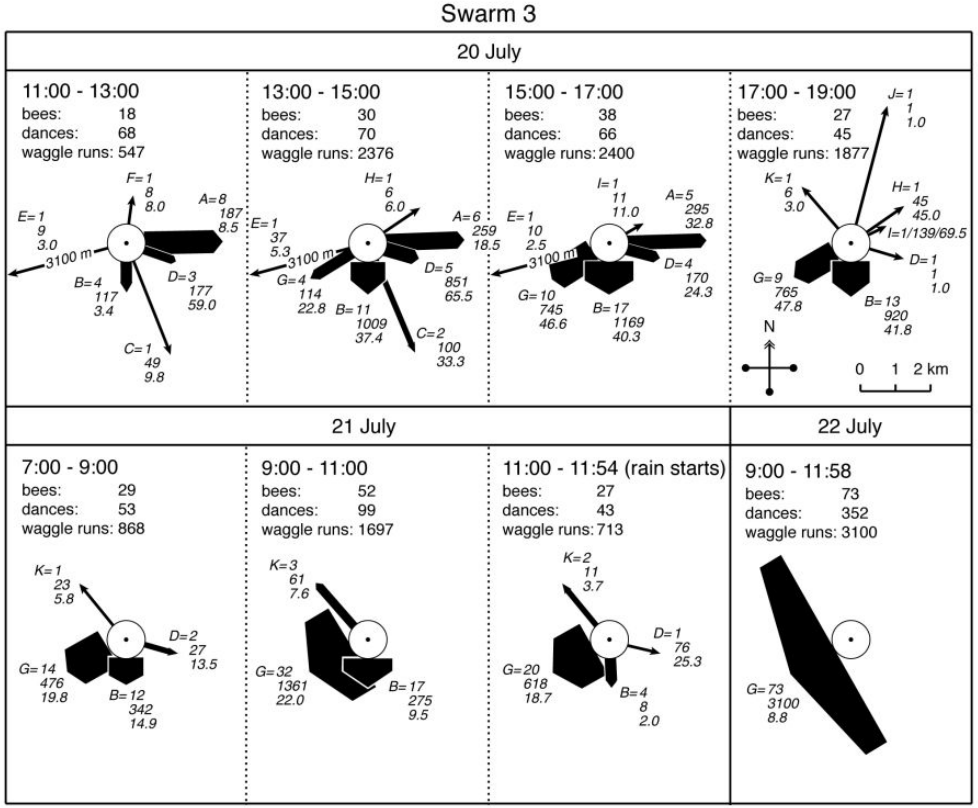
Conditions for Success

- Accurate
  - Enough space to match colony size, and eventual growth
  - Tight enough to protect from predators, robbers, harsh weather
- Speedy
  - Swarm is exposed during exploration
  - Dependent on limited resources
- Unified
  - Split decision leads to swarm fragmentation →DISASTER
  - Only one queen, therefore only one functioning colony

Only about 5% of the colony participates in scouting before calling other members to move in

Scout bees exposed to the elements as they search for a home

Scout Recruitment - From many homes to one

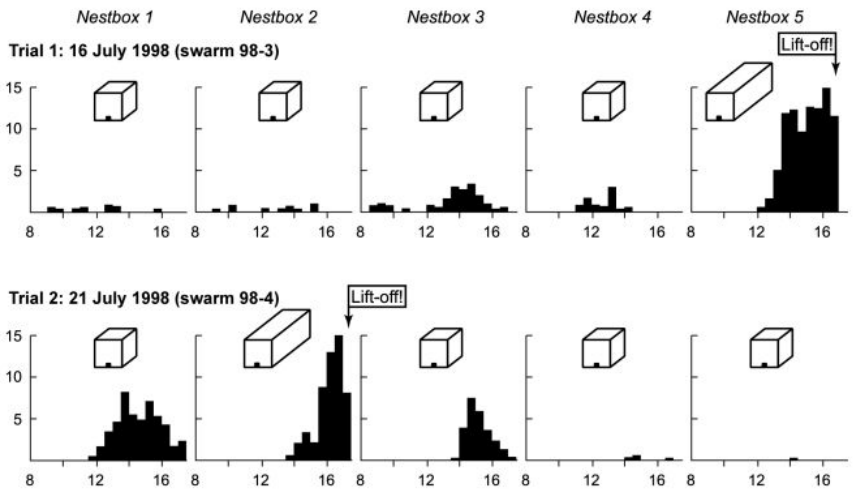


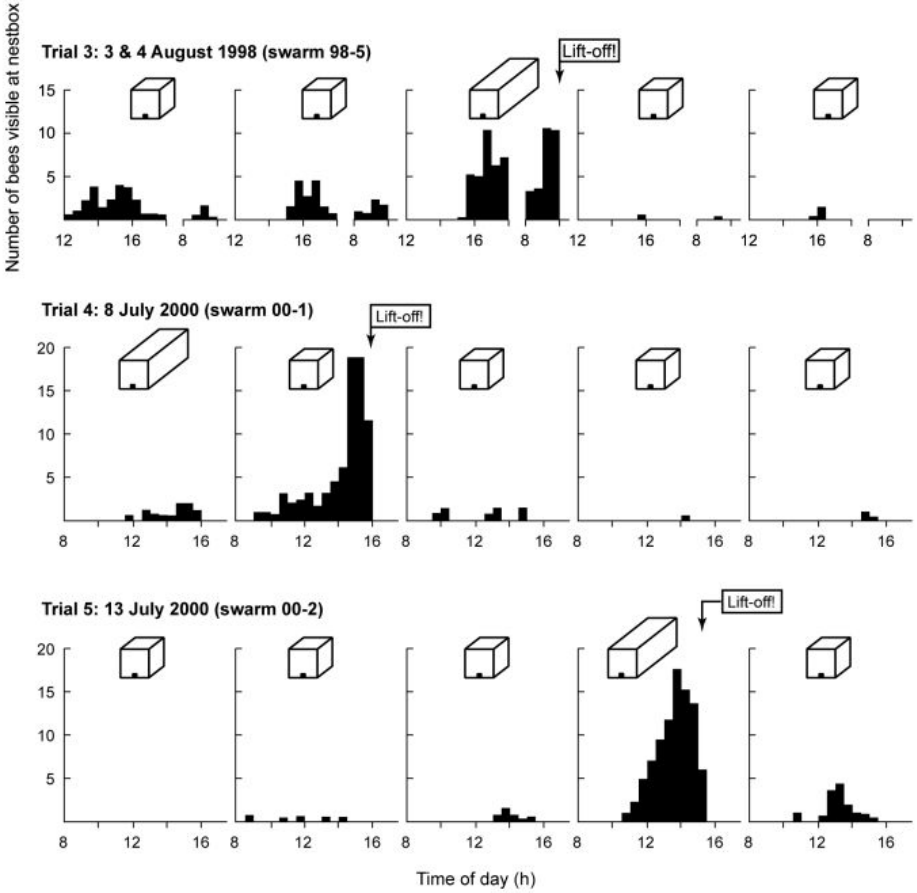
top: the number of bees that danced for the site

middle: the number of waggle runs performed for the site

bottom: the mean number of waggle runs per dance for the site

The Bees Agree! (Mostly…)





Modeling Recruitment

Ni is the number of scouts committed to site i

U is the number of uncommitted scouts

ri is the recruitment rate per scout committed to site i

ai is the abandonment rate per scout committed to site i

$$dN_1/dt = r_1 N_1 U - a_1 N_1 \qquad (1)$$

$$dN_2/dt = r_2 N_2 U - a_2 N_2 \qquad (2)$$

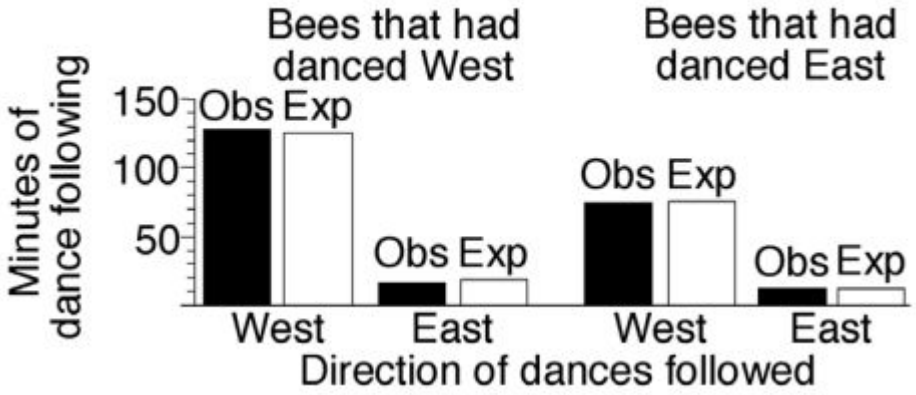
Integrating and eliminating U from the two equations yields

$$N_1^{r_2}/N_2^{r_1} = Ce^{(r_1 a_2 - r_2 a_1)t}. \qquad (3)$$

Waggle Run for your Money

The better the site the longer and livelier the dance

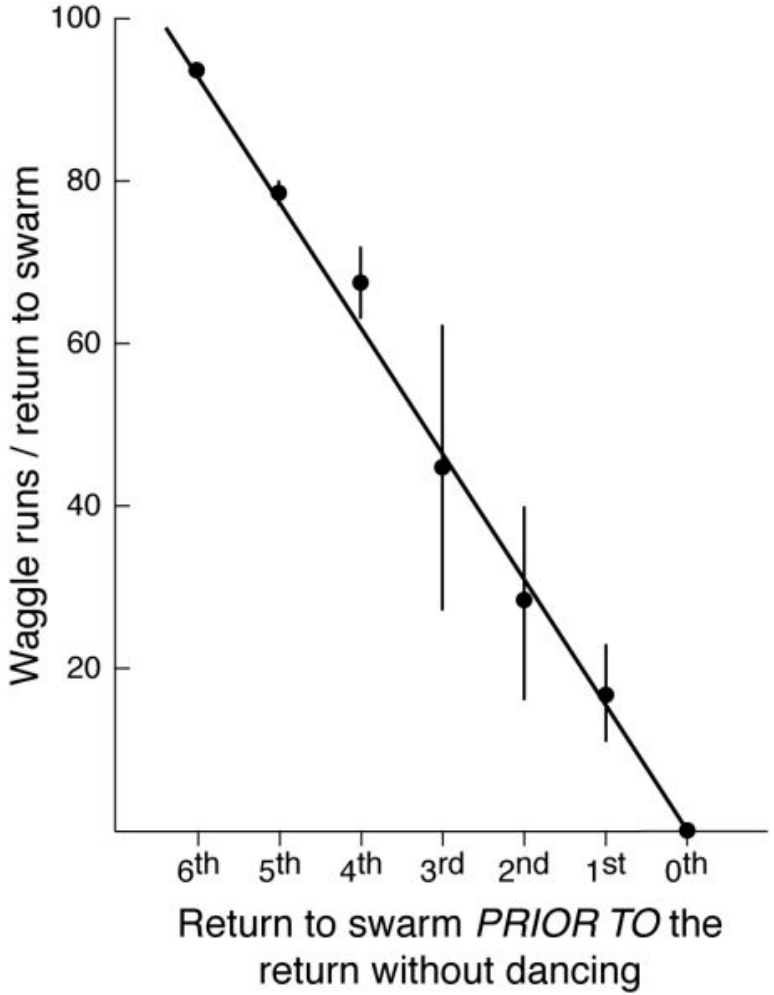
Followed dances for each site in proportion to the total amount of dancing by other bees for the site



Fading dances… Why?

H1: an internal stimulus causes her to abandon a site

H2: an external stimulus causes her to abandon a site



3…2…1….LIFTOFF! How bees make the final move

Once a consensus is reached the scouts send a piping signal to heat the swarm up

“consensus sensing”: the scouts noting when all the bees performing waggle dances are advertising just one site;

“quorum sensing”: the scouts noting when one site is being visited by a sufficiently large number of scouts.