

BIOLOGY OF A HONEY BEE COLONY PART 1

Advanced Level Training
Texas Master Beekeeper Program



Outline

- Honey bee colonies as eusocial "Superorganisms"
- Age polyethism in honey bee workers
- Annual cycle of honey bee colonies
- Colony reproduction via swarming
- Nest site selection by honey bee swarms
- Communication using the dance language

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Honey Bees are Eusocial

Traits of Eusocial Species

- There is reproductive specialization
 - Reproductive caste (queens and drones)
 - Non-reproductive caste (workers)
 - Completely or partially sterile
- Adults of multiple generations coexist in same nest
- Usually live in large groups
- A colony persists beyond that of a simple parental care or familial situation
- The reproductively diminished caste (workers) care for the young
 - Cooperative brood care

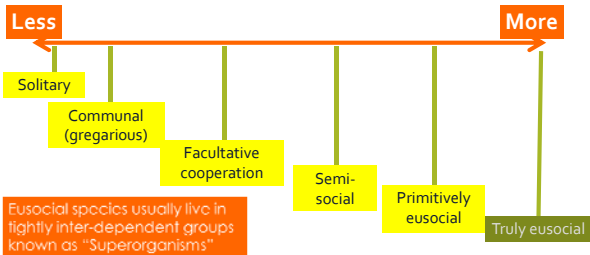


Eusocial Spp. Life History Traits

- Typically sessile
- Maintain intraorganismic homeostasis
- Well defended or hidden
- Large populations



The Eusociality Continuum



Superorganisms of the World



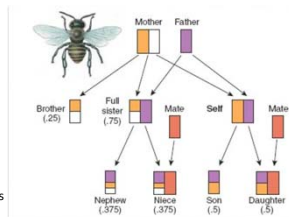
Predisposition for Eusociality

- Extended parental care
- Incentives for offspring to remain at the nest
 - Valuable, protected nests
 - Defense mechanisms
 - Foraging efficiency
 - Disease resistance
- Sib-social care
- Facultative sterility
- Relatedness asymmetries



Haplo-diploidy in honey bees

- Euploid - chromosome number that is viewed as the normal number
 - In a diploid organism, 2 sets is normal
- Polyploid - 3 or more sets of chromosomes
 - Diploid $2n$
 - Triploid $3n$
 - Tetraploid $4n$
- Haploid
 - $1n$ (one set of chromosomes)
- Haplo-diploidy in honey bees
 - Drones are haploid, with 1 set of 16 chromosomes
 - Workers and queens are diploid, with 2 sets of 16 chromosomes each, or 32 chromosomes



Honey bees: The model superorganism



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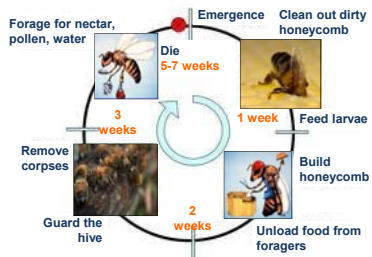
Age polyethism in honey bees

Age polyethism:

- Division of labor in the worker caste based on age
- Somewhat plastic
- Necessary to get all the tasks done around the hive
- Most tasks are performed by workers, except for reproduction (done by queen)



Age polyethism in honey bees



Duties of workers

• Various tasks done by workers:

- Clean cells
- Feed larvae tend to the queen (nurse bees)
- Secrete wax and build comb
- Guard bees
- Help heat/cool hive as needed
- Accept nectar from foragers and store it
- Pack pollen
- Orientation flights
- Forage for nectar, pollen, water, or propolis



Duties of workers: 0-2 days old

- Known as "cleaners"
- Remove debris, old skins from brood cells and prepare for queen to lay eggs in cleaned cells
- Remove dead brood and adults killed by diseases, parasites, pesticides.....
- Remove other invaders (If too large to remove it will be encase it in propolis)



Duties of workers: 3-10 days old

- Known as "nurses"
- Produce brood food using enzymes secreted by their mandibular and hypopharyngeal glands
- Feed the brood and the queen
- Keep brood warm
- Wax work



Duties of workers: 11-20 days old

- Known as "builders"
- Nectar processing:
 - honey ripening process
 - receive nectar and spread into cells to reduce moisture, add enzyme
- Pollen processing
 - foragers drop pollen pellets in cell, house bees pack it
- Guarding the hive entrance
- Undertaking

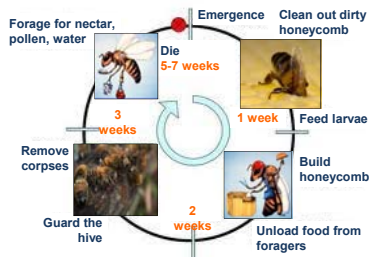


Duties of workers: 21-35 days

- Known as "foragers"
- Forage for resources, including water, nectar, pollen, propolis
- Nest-site scouts during house-hunting
- Colony defense (soldiering)
- Usually die off in the field from old age



Age polyethism in honey bees



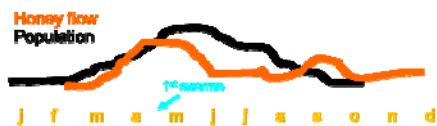
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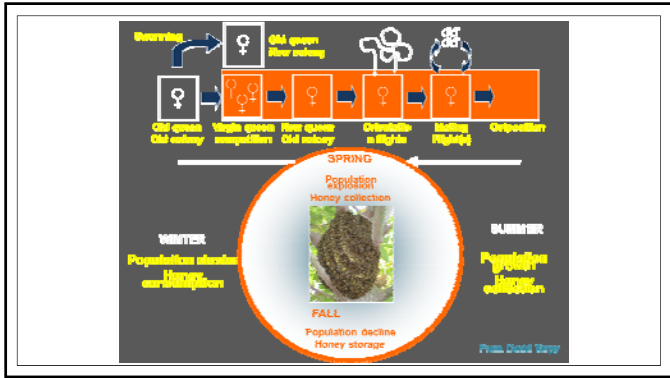
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Annual cycle of honey bee colonies

Life history of the colony

- Seasonal cycle
- Honey flows
- Swarming ???





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Colony reproduction via swarming

Honey bee colonies reproduce by fissioning (swarming)

Swarm colony: ≈75% workers + mother queen

Remnant colony: Leftover workers + daughter queen + comb + brood + food

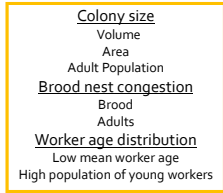
Colony reproduction via swarming

Stimuli for queen rearing:

Resource abundance

Nectar

Pollen



Reduced transmission of queen pheromones

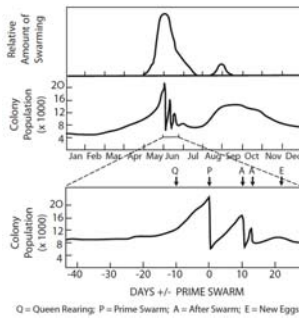
Workers constructing cups
Queen rearing begins

Swarming

Redrawn from Winston (1987)

Colony reproduction via swarming

Temporal patterns of colony fissioning in the temperate region of the United States



Modified from Winston (1987)

Colony reproduction via swarming

Proportion of workers leaving with primary swarm

# of colonies used (n)	Total number of workers in colony prior to swarming	Values for SWARM COLONY		Values for REMNANT COLONY		Author(s), year
		Number of workers leaving with swarm	Proportion of workers leaving	Number of workers staying in old nest	Proportion of workers staying	
9	26,653	17,571	0.66	9,082	0.34	Martin, 1963
8	6,632	5,220	0.79	1,412	0.21	
2	33,500	24,100	0.72	9,400	0.28	Getz, 1982
n/a	n/a	n/a	0.70	n/a	0.30	Winston, 1987
5	7,580	5,692	0.75	1,888	0.25	Rangel & Seeley, 2000*

HOW DO SWARMS FIND A NEW HOME??
