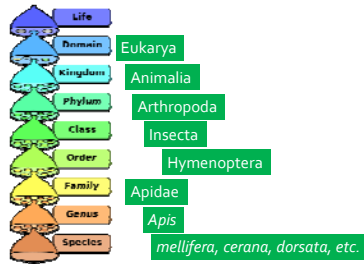


DIVERSITY WITHIN THE GENUS *APIS*

Advanced Level Training
Texas Master Beekeeper Program

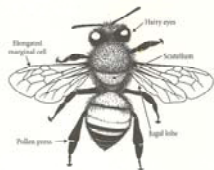


Biological Classification of *Apis*



Morphology of *Apis* Bees

To Be a Honey Bee



1. Long, erect hairs covering the compound eyes
 - Help in sensing wind speed
2. A convex scutellum
 - Constriction between the thorax and abdomen
3. The presence of a pollen press
 - Structure used to collect and transfer pollen
4. A couple of specific wing shape structures

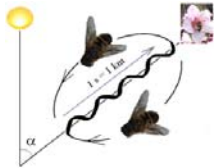
Figure 1.1 A generic worker honey bee, showing some of the key morphological characteristics of the genus *Apis*.

Behavior of *Apis* Bees

- Dance language
- Nest of vertical wax comb
- Use of the same cells for brood rearing and resource storage
- Colony level reproduction by swarming
- Old queen swarms (typically)
- Workers form clusters
- Nest thermoregulation by fanning and water evaporation
- Progressive feeding (provisioning) of larvae
- Extreme polyandry (multiple mating by the queen)

Dance Language – The Waggle Dance

- Via the waggle dance, a bee informs other nestmates about the location (distance and direction) as well as quality (abundance and sweetness) of a food source.



Nest of Vertical Wax Comb

Giant Honey Bee



Dwarf Honey Bee



Nest of Vertical Wax Comb

European Honey Bee



Cell Use in *Apis* Bees



Colony Reproduction by Swarming



A swarm cluster is known as a bivouac.



Old Queen Swarms (typically)

Honey bee colonies reproduce by fissioning

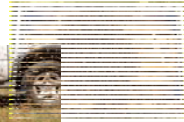


Swarm colony:
Most workers + old mother queen



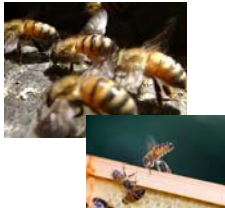
Remnant colony:
Leftover workers + daughter queen + comb + brood + food

Workers Form Clusters



Nest Thermoregulation

Fanning – evaporative cooling



Shivering – keep brood warm in winter cluster

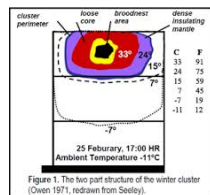


Figure 1. The bee part structure of the winter cluster (Owen 1971, redrawn from Seeley).

Progressive Feeding of Larvae



Extreme Polyandry

Insect Socialex
DOI: 10.1002/inso.1234



Short communication

A scientific note on the revised estimates of effective paternity frequency in *Apis*

By: R. R. Farjy, C. R. Nishan and D. S. Nishan

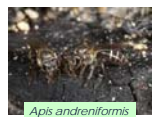
Table 1. Current estimates of parameters across honey bee colonies. Included for each species is the average (± standard deviation) worker sample size (n), observed inbreeding number (\hat{d}_{ij}) and effective paternity frequency calculated by Pando (2007) (\hat{f}_{ij}) and Nishan et al. (2007) (\hat{f}_{ij}). Also given are the average 95% confidence intervals for the two estimates of effective paternity for each species, which indicates the accuracy of individual estimates.

Species	Colonies	Worker sample size (n)	\hat{d}_{ij}	\hat{f}_{ij}	Average 95% C.I. \hat{f}_{ij}	Average 95% C.I. \hat{f}_{ij}	
<i>A. andreniformis</i>	4	60 ± 13.1	13.5 ± 4.53	19.6 ± 1.88	2.22	19.7 ± 1.89	2.29
<i>A. cerana</i>	4	76 ± 10.4	18.0 ± 5.26	14.2 ± 1.93	2.07	14.1 ± 1.93	2.07
<i>A. dorsata</i>	23	140 ± 54.6	54.0 ± 17.40	64.7 ± 27.08	6.67	64.2 ± 27.15	6.79
<i>A. florea</i>	11	61 ± 8.5	17.6 ± 5.07	7.9 ± 3.11	1.47	7.9 ± 3.11	1.47
<i>A. koschovskoi</i>	4	74 ± 21.3	16.2 ± 10.23	13.8 ± 13.43	3.06	13.7 ± 13.18	3.00
<i>A. laboriosa</i>	2	51 ± 21.5	22.0 ± 14.1	24.6 ± 12.7	3.77	24.4 ± 12.1	3.56
<i>A. mellifera</i>	123	61 ± 22.6	12.0 ± 6.32	12.1 ± 8.37	3.17	11.8 ± 7.90	2.97
<i>A. nigrocincta</i>	4	130 ± 17.6	34.0 ± 11.52	40.7 ± 23.58	6.96	40.3 ± 23.39	6.90

Dwarf Honey Bees

- Nest of single comb built around small tree branch
- Foragers depart from the crown of the nest
- Workers are tiny at 7-10 mm long and 25-5 mg
- Drones and Queens are ~ 3x the size of workers
- Distributed throughout the Indian subcontinent and Southeast Asia

- Apis florea*
 - Means: "Flower bee"
 - Red dwarf honey bee
- Apis andreniformis*
 - Black dwarf honey bee

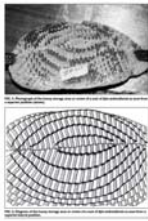


Distinguishing the Dwarf Bees

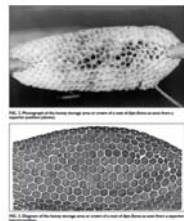
- Coloration
 - *A. florea* is red overall
 - *A. andreniformis* is black
- Nest Shape: Open nesters
- Dance language
 - *A. florea* dances on top of the crown of the nest with the dance pointing directly at the food source
 - *A. andreniformis* dances on the face of the vertical comb



Top-down View, Dwarf Honey Bee Nests

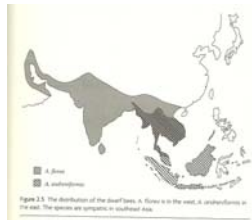


Apis andreniformis



Apis florea

Dwarf Honey Bee Biogeography



- Note that *A. florea* is found more northerly through Myanmar and Southern China and west throughout India and as far west as the Persian Gulf coast.
- *A. Adreniformis* is more restricted to Malaysia and Western Indonesia.
- The species are **sympatric**, meaning they coexist, in Thailand, Laos, Cambodia, and Vietnam.

Giant Honey Bees

- Nest on single combs, 1.5m x 1 m in size
- Workers large at 17 mm long
- Queens not appreciably larger than workers
- Hairy wings
- *Apis laboriosa*
 - Means "work bee" or Himalayan honey bee
- *Apis dorsata*
 - Means "Big-back bee" or Giant honey bee



Giant honey bee nests: *Apis laboriosa*

- The giant honey bees both build nests consisting of a single large comb hanging below a tree limb in the case of *A. dorsata*, or on a cliff face in the case of *A. laboriosa*.
- *A. dorsata*, uniquely among the genus, tends to aggregate with up to several hundred colonies on a single tree.
- Both bees are strongly defensive and since their colonies can be quite large, they are often quite dangerous.



Distinguishing the Giant honey bees

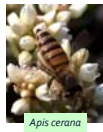
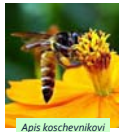
- Morphological characters blend
 - Very similar in appearance
 - *A. laboriosa* is typically larger
- Range
 - *A. laboriosa* confined to the mountains
 - lives in cool areas and high altitudes (2500-3000 m)
 - Some overlap in range
- Mating times differ
 - Behavioral isolation
- *A. dorsata* has an audible component to their dance language (a strong buzz)
- Pheromonal differences
 - Sting gland

Giant honey bee biogeography



Cavity-nesting Honey Bees

- *Apis cerana*
 - Means "wax maker" or "Asian" honey bee or "Eastern" honey bee.
- *Apis koschevnikovi*
 - "Red honey bee"
- *Apis nigrocincta*
- *Apis mellifera*
 - Called "Western" honey bee or "European" honey bee



Cavity-nesting Honey Bees

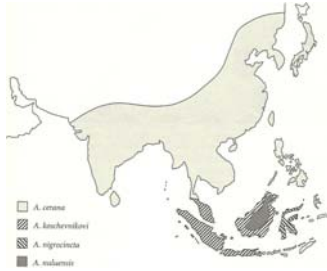
- Workers around 10 mm long
 - Queens and drones up to twice the size of workers
- All (normally) nest in cavities such as tree hollows
- Build 3+ parallel comb faces attached to the top of the cavity
- *A. mellifera* and *A. cerana* "can" mate and rarely will, but cannot produce viable offspring



Asian Honey Bees

- *Apis cerana*, *A. koschevnikovi* and *A. nigrocincta* diverged within the last 2 million years
 - Very closely related and morphologically similar
- Separate mating times and locations
- Interspecific hybrids have low fertility
- Hybrid colonies cannot survive
- Genetic differences
 - mitochondrial lineages and genetic "fingerprints"

Biogeography of the Asian *Apis* Bees



Asian Honey Bee – *Apis cerana*

- Smaller than *Apis mellifera*
- Generally form smaller colonies
- Tend not to store nectar in large quantities
- Abscond (migrate nests) frequently
- Traditionally managed in its native range



Apis mellifera caucasica

- Representative of the near East subspecies
 - Climate range universally hot summers
 - Otherwise climatologically highly variable
- Used widely in beekeeping
 - Introduced to the US around 1905
- Thought of as:
 - Relatively non-defensive
 - Slow growth (but large populations)
 - Disinclined to swarm
 - Makes extreme use of propolis



Apis mellifera ligustica

- Representative of the Central Mediterranean and Southeastern Europe subspecies
- Also called the Italian honey bee
- Imported in 1859 (remains a popular subspecies today)
- Bright yellow
- Widely kept for beekeeping
- Adaptable over wide climates
- Low swarming
- Resistant to European Foulbrood
- Defensive



Apis mellifera mellifera

- Representative of the Western Mediterranean and North European subspecies
 - Mild summer climate with rich variety of flowering plants
 - Potentially harsh winters
- The "holotype" subspecies
- First brought to US in 1622 to pollinate orchards
- Also called the German black bee
- Particularly hirsute (has longer hairs than tropical bees)



Apis mellifera scutellata

- Representative of the tropical African subspecies
 - Hot, with extensive droughts, limited nest space and spotty forage
- Forms smaller colonies
- Highly defensive
- Absconds readily
- Swarms frequently
- May even nest in the open
- Kept by beekeepers



Apis mellifera capensis

- South Africa's Western Cape province (Cape of Good Hope)
- Exhibit **thelytoky**
 - Parthenogenesis of females
 - Workers lay female eggs (or at least can)
- Internal physiology of workers queen-like
- Emergent parasitic lineage
 - Drifting workers may invade colonies of other subspecies and "take" over the colony
 - Some populations seem particularly prone to drifting, thus suggesting the evolution of a social parasite in progress
 - They even express "queen-like" pheromones to fool colonies into caring for them