Hymenoptera: sawflies, ants, bees, wasps

[Images of sawflies, ants, bees, wasps]


Degrees of sociality
- **Solitary**: no features below
- **Subsocial**: some degree of parental care
- **Communal**: females use same nest without cooperation in brood care (digger bees)
- **Quasisocial**: use same nest and show cooperative brood care (euglossine bees)
- **Semisocial**: quasisocial plus worker caste (halictid bees)
- **Eusocial**: semisocial plus overlap in generations and offspring assist parents (honey bees)

Horntails
**Family Siricidae**
- **Hosts**: Dead and dying beech, elm, maple, oak, and others.
- **Life History**: Females lay eggs singly in hosts. Larvae may take two years to develop.

[Image of Horntail, *Tremex columba*]

Ichneumonid Wasps
- **Adult Ichneumonid wasps**: note the long ovipositor of the female wasp (below)

[Image of Ichneumonid wasp]

Evolution of eusociality in different taxa

<table>
<thead>
<tr>
<th>Insect order</th>
<th>Common names</th>
<th>Frequency of evolution of eusociality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hymenoptera</td>
<td>ants, wasps, bees, sawflies</td>
<td>11</td>
</tr>
<tr>
<td>Isoptera</td>
<td>termites</td>
<td>1</td>
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<tr>
<td>Hemiptera</td>
<td>gall-forming aphids</td>
<td>1</td>
</tr>
<tr>
<td>Coleoptera</td>
<td>bark-nesting weevils</td>
<td>1</td>
</tr>
<tr>
<td>Thysanoptera</td>
<td>gall-forming thrips</td>
<td>1</td>
</tr>
<tr>
<td>Non-insects</td>
<td>snapping shrimp, naked mole rats</td>
<td>2</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>17</strong></td>
</tr>
</tbody>
</table>
Altruistic suicide?

- In many social insects, workers not only forego reproduction, but also their own life, “for the good of the colony”
- Why?

Why might sterile individuals display altruism?

**Hamilton’s Rule:**

\[ rB > C \]

- **R** = relatedness (between donor and recipient)
- **C** = cost to donor
- **B** = benefit to receiver

**How did eusociality originate? Two hypotheses:**

- **Genetic hypothesis (haplodiploid hypothesis):**
  - high relatedness (high **r**)
  - promoted the evolution of eusociality
- **Ecological hypothesis:**
  - high benefit-to-cost ratio (high **B/C**)
  - promoted the evolution of eusociality

Haplodiploid sex determination in all Hymenoptera

- Haploid male copulates with diploid female -> sperm stored in spermatheca
- Female produces son by laying unfertilized (haploid) egg
- To produce female, mother adds sperm to egg

Hymenopteran phylogenies

- Degrees of sociality, stages
- Diverse solitary wasps

Hymenopteran workers more related to sisters than to their (potential) offspring

Figure 12.2 Cladogram of selected aculeate Hymenoptera depicting multiple origins of sociality (SOL, solitary; SUB, subsocial; EU, eusocial). Not all solitary groups of wasps are shown. Relationships within non-social aculeates not depicted.

http://tolweb.org/
**Vespoidea: SOL**

*Family Mutiliidae*

**Hosts:** Larvae of wasps, bees, beetles, or flies.

Larvae are parasites of other insect larvae.

**Vespoidea: SOL, SUB, EU**

*F. Vespidae*  
sF. Vespinae (highly EU)  
sF. Polistinae (primitively EU)

**Hosts:** Caterpillars and other insects.

Yellow jacket with caterpillar

**Life History:** Many have annual colonies with queens, workers, and males.

Paper wasp (*Polistes* species)

**Apoidea: SOL, SUB, EU**

*Family Sphecidae*

**Hosts:** Other arthropods.

Cicada killer: SOL  
*Sphecius speciosus*

**Apoidea: F. Sphecidae, SOL, QS**

Solitary or communal nesters: Quasisocial

Mud dauber  
*Chalybion caementarium*

Mud dauber  
*Chalybion californicum*

**Apoidea: SOL, SUB (semi-)**

*Family Apidae, sF. Halictinae*

**Hosts:** Flower nectar and pollen.

**Life History:** Annual, in cavities or underground burrows.

Often colorful, metallic

**Apoidea: SOL, COMM, QS**

*Family Apidae, sF. Xylocopinae*

**Carpenter bees:** Feed on pollen and nectar

Tunnels in redwood, cedar, cypress, and pine.

*Xylocopa virginica*
Coercion – are workers *forced* not to reproduce?

- In many species, workers *can* lay (unfertilised) eggs, which are haploid and will turn into males.
- Queens “control” reproduction of their workers by pheromones, physical “bullying” and actively eating eggs by workers.