

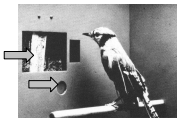
**Predators vs. Prey and Parasites vs. Hosts:
A Perpetual Arms Race**

Mechanisms Used by Predators

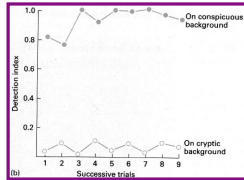
- (1.) Learning (i.e., search images)
- (2.) Detoxification of prey defensive compounds
- (3.) Exploitation of prey mating signals

Learning in Predators (i.e., search images)

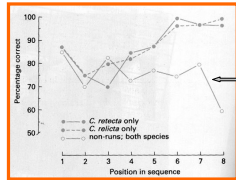
(Pietrewicz & Kamil 1981)



Monomorphic Moth Study



Polymorphic Moth Study



Detoxification of prey defensive compounds

Horned Lizard (Predator)



Harvester Ant (Prey)



TABLE 1. LETHALITIES OF HARVESTER ANT (*Pogonomyrmex maricopa*) VENOM, TO MICE AND TO TWO IGUANID LIZARDS, *Sceloporus jarrovi* AND *Phrynosoma cornutum*.

Venom source	Route injected	Species injected	Animals/dose	LD ₅₀ (µg/g)	95% CI (µg/g)
<i>P. maricopa</i>	iv	mice	6	0.119	0.072-0.197
<i>P. maricopa</i>	ip	mice	12	0.103	0.067-0.161
<i>P. maricopa</i>	ip	<i>S. jarrovi</i>	4	98	10-82
<i>P. maricopa</i>	ip	<i>Ph. cornutum</i>	4	162	61-432

(Schmidt et al. 1989)

Predators exploiting mating signals (Fireflies)



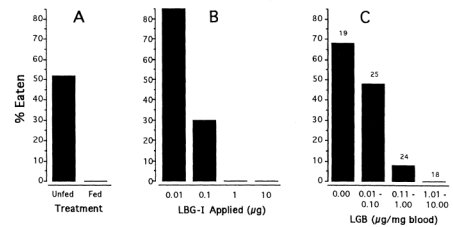
⇒ Female *Photuris* lures and eats male *Photinus*



⇒ Female *Photuris* acquire defensive compounds from prey

⇒ Lucibufagin (LBG) = Cardiotonic Steroid

Predators exploiting mating signals (Fireflies)



A = Lab-fed *Photuris*; B = LBG applied to *Drosophilla*; C = Field-caught *Photuris* (Eisner et al. 1997)

⇒ Defensive compound (LBG) at high levels is effective against spider predation

Mechanisms Used by Prey

(1.) Crypsis & Startling Behavior

(2.) Prey defensive compounds

- Batesian mimicry
- Mullerian mimicry

(3.) Defensive hairs

(4.) Surface adhesion and shielding

Crypsis & Startling Behavior (Lepidoptera)

Cryptic Phase



Startle Phase



Prey defensive compounds

Warning Coloration



Prey defensive compounds

Batesian mimicry = mimic is not poisonous



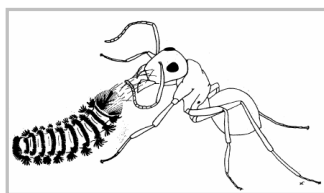
Left = Viceroy
Right = Monarch

Müllerian mimicry = mimic is also poisonous



Queen Butterfly

Defensive hairs of prey (*Polyxenus fasciculatus*)



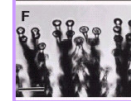
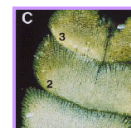
(Eisner et al. 1996)



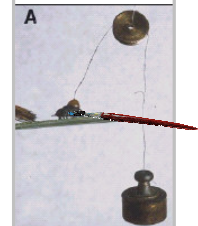
Surface adhesion and shielding (Tortoise Beetles)

***Hemisphaerota cyanea* (Adults)**

(Eisner & Aneshansley 2000)



Experimental Setup



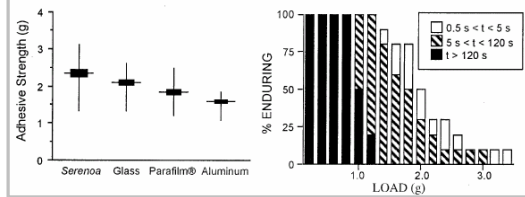
☞ Most likely using oily liquid for adhesion

Surface adhesion and shielding (Tortoise Beetles)

Hemisphaerota cyanea (Adults)

(Eisner & Aneshansley 2000)

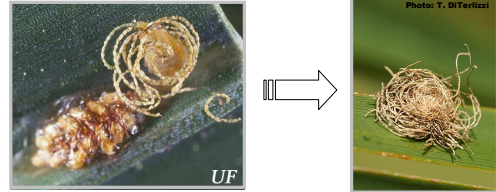
Results



⇒ Adult beetles weigh **only about 0.01gr !!**

Protective shielding (Tortoise Beetles)

Hemisphaerota cyanea (Larvae)



⇒ Makes shield out of frass!!

Mechanisms Used by Parasites Against Hosts

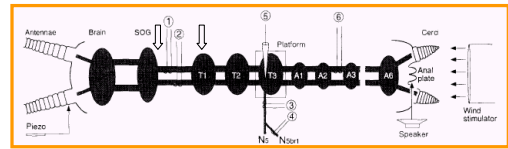
- (1.) Manipulation of host locomotion/neural systems
- (2.) Visual mimicry
- (3.) Chemical Camouflage
- (4.) Locomotion mimicry

Manipulation of host locomotion/neural systems

Hymenoptera: *Ampulex compressa*



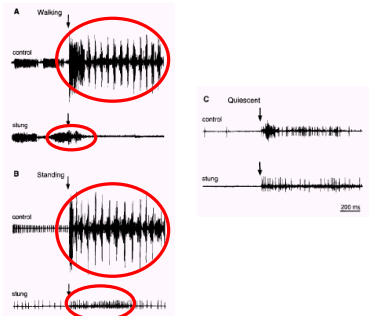
- ⇒ First sting is at prothoracic region
- ⇒ Second sting is near the subesophageal ganglion region
- ⇒ Then, roach becomes the wasp's puppet zombie



(Fouad et al. 1996)

Manipulation of host locomotion/neural systems

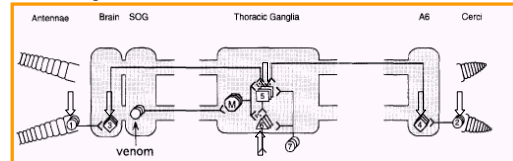
Hymenoptera: *Ampulex compressa* (Fouad et al. 1996)



Manipulation of host locomotion/neural systems

Hymenoptera: *Ampulex compressa* (Fouad et al. 1996)

Possible target areas of venom



- (A.) Antennae and cerci mechanoreceptors (1 & 2)
- (B.) Descending mechanoreceptive interneurons & Giant interneurons (3 & 4)
- (C.) Thoracic interneurons (5)
- (D.) Leg motoneurons (6)

Parasites of ants that use visual/tactile mimicry

Pselaphinae (Coleoptera: Staphylinidae)



(Hölldobler & Wilson 1990)

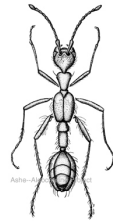
Parasites of ants that use visual/tactile mimicry

Coleoptera: Staphylinidae

Mimeciton zikani



Creमतoxenus aenigma



Mimanomma spectram



(Hölldobler & Wilson 1990)

Parasites of ants that use chemical camouflage

Creमतocheilus lengi (Coleoptera: Scarabaeidae)



(Hölldobler & Wilson 1990)

Parasites of ants that mimic colony movement

Myrmecophila sp. (Orthoptera: Gryllidae)



(Hölldobler & Wilson 1990)

Discussion Questions:

- (1.) Did parasitism evolve from predation or vice versa? Or did they evolve independently?
- (2.) Is co-evolution more difficult in parasite-host systems versus predator-prey systems? Why or why not?
- (3.) Did mutualistic endosymbiotic systems evolve from detrimental parasitic systems? If so, what are the possible processes involved in the transition?