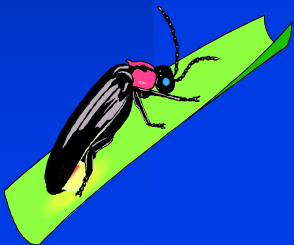


Natural History of Fireflies/ Lightning Bugs

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Fireflies : beetles

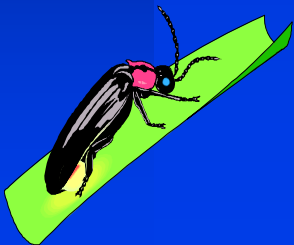
(Coleoptera, Lampyridae + Elateridae)

World wide distribution

- 92 genera
- 1900 species

United States

- 20 genera
- 150 species



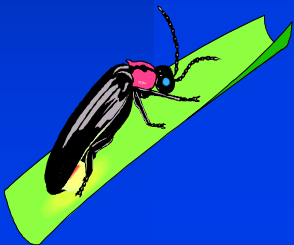
Major North American Genera

Photinus

- black and pink
- “small”
- great behavior, great biochemistry, rotten physiology
- taste bad

Photuris

- brown or tan
- “big”
- great physiology, good pharmacology, rotten behavior



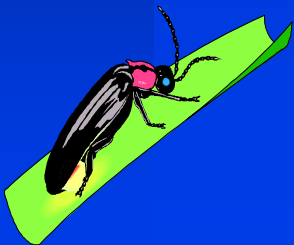
- male *Photinus carolinus*



female *Photinus carolinus*



Photinus carolinus



Photuris sp.

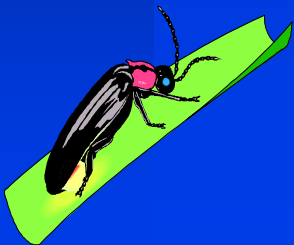


Ellychnia
diurnal firefly



Fireflies are in the business of

- ~~eating~~
- avoiding being eaten
- mating



eating

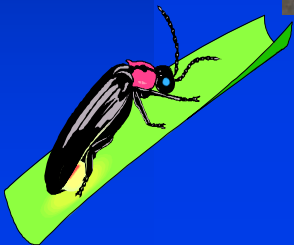


(Lloyd, 1981)



eaten

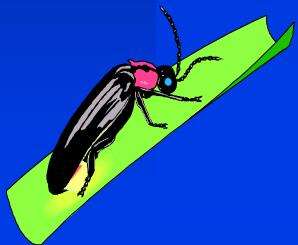
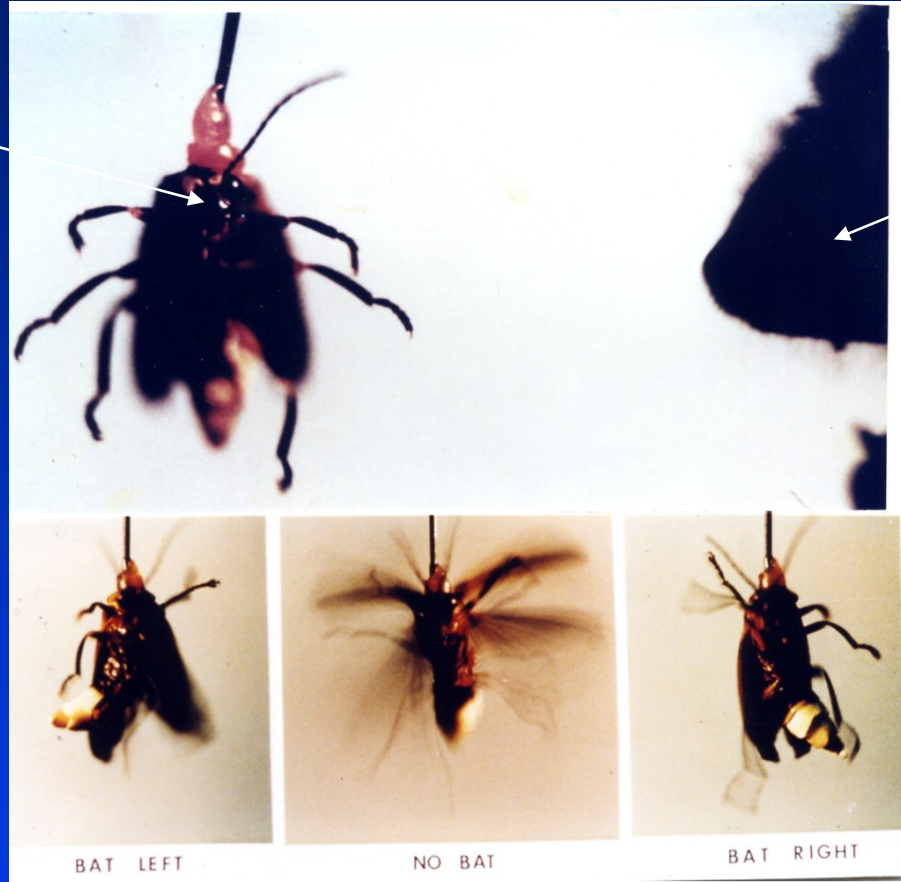






Tethered
Firefly

Bat



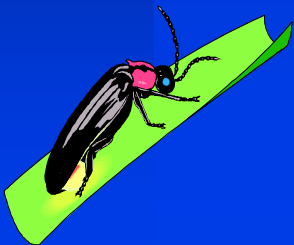
- mating
(stage I mating)



Firefly Life Cycle

egg -> larva (5-7 instars) ->
pupa -> adult
(1 - 2 years)

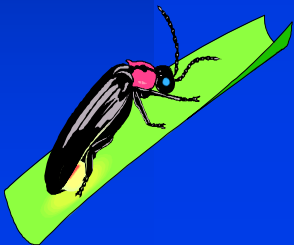
- egg: 21 days incubation + luminescent
- larva: 1 - 2 years + luminescent + terrestrial or subterranean (or aquatic) + distasteful
- adult: 21 days + luminescent + distasteful (sometime)



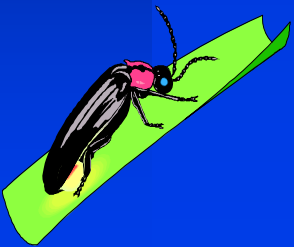
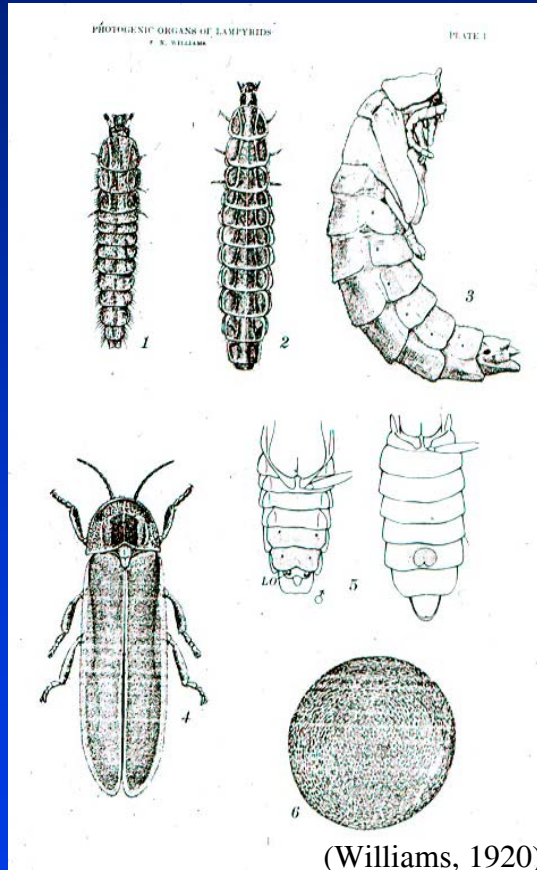
Firefly Life Cycle

Occurrence and Abundance in Georgia

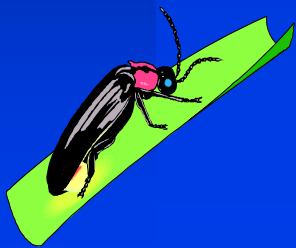
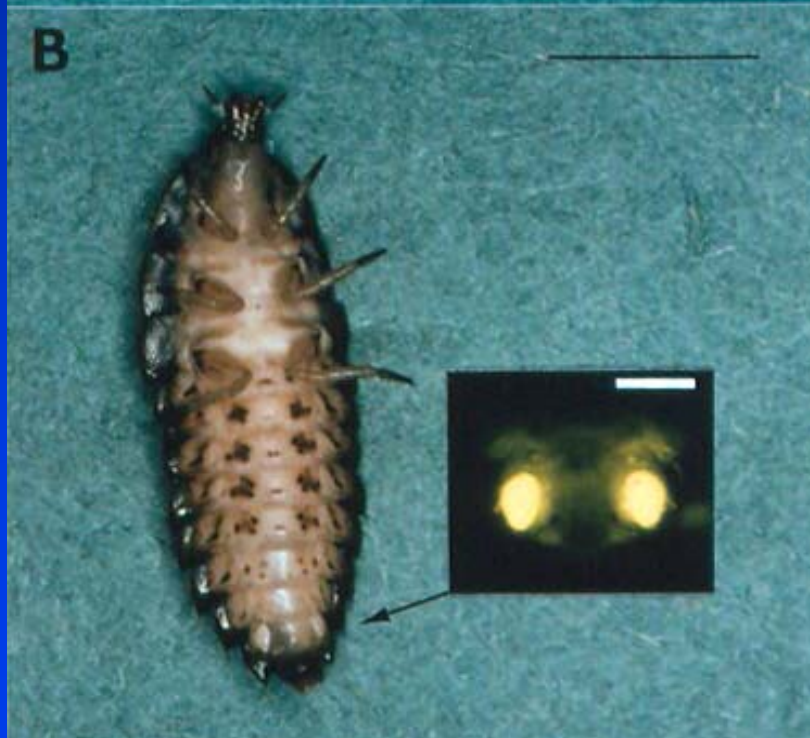
- adults: late Spring - early Summer
(any one locality: 2 - 3 weeks)
- eggs: after adult season ends
- larvae: Fall larvae and Spring



Firefly Life Cycle



Photuris family portrait



firefly larva
eating a snail



x6



x6

pupal cell and pupa

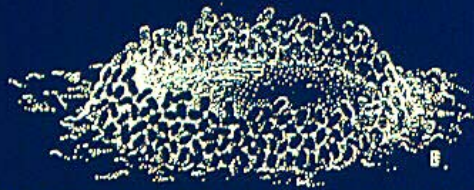


FIG. 13. *Photurus pennsylvanica* partially constructed pupal chamber.

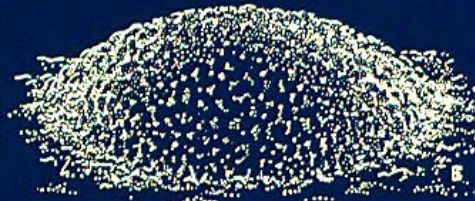
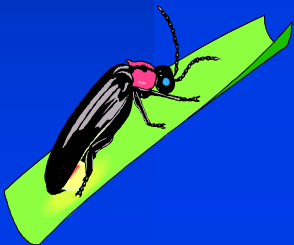


FIG. 14. *Photurus pennsylvanica* pupal chamber completed, lateral view.



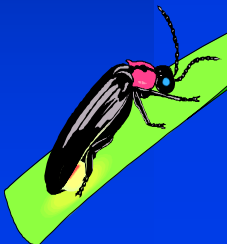
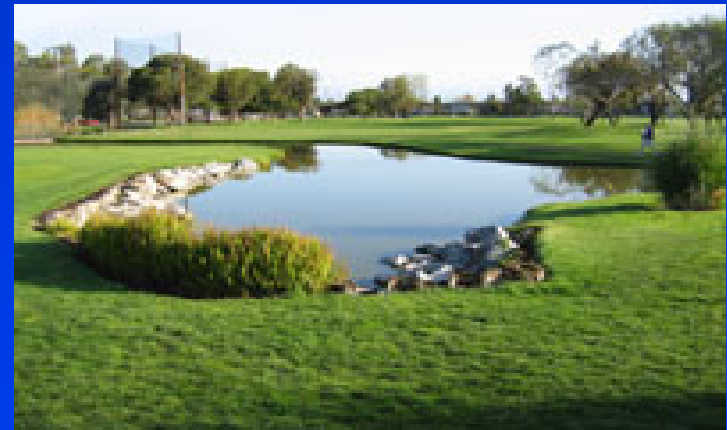
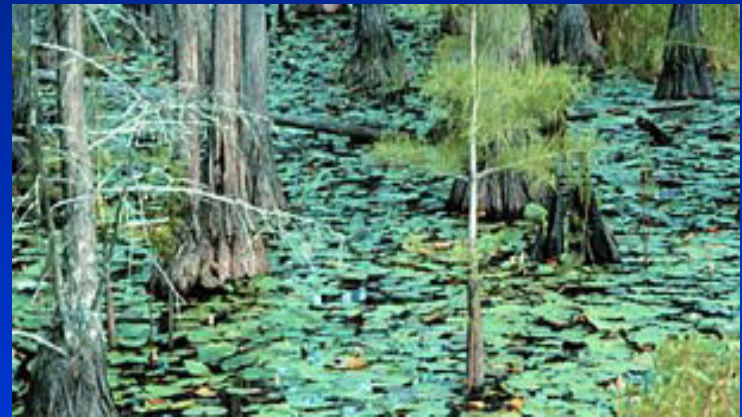
FIG. 15. *Photurus pennsylvanica* pupal chamber completed, internal view with pupa in position.



Pupa

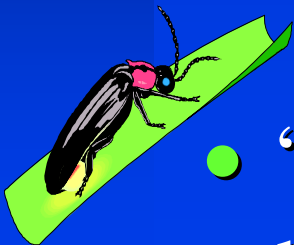


Firefly Habitats Are Associated with Water



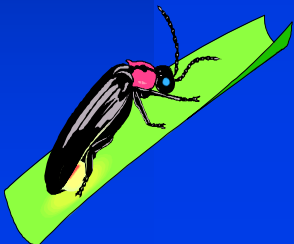
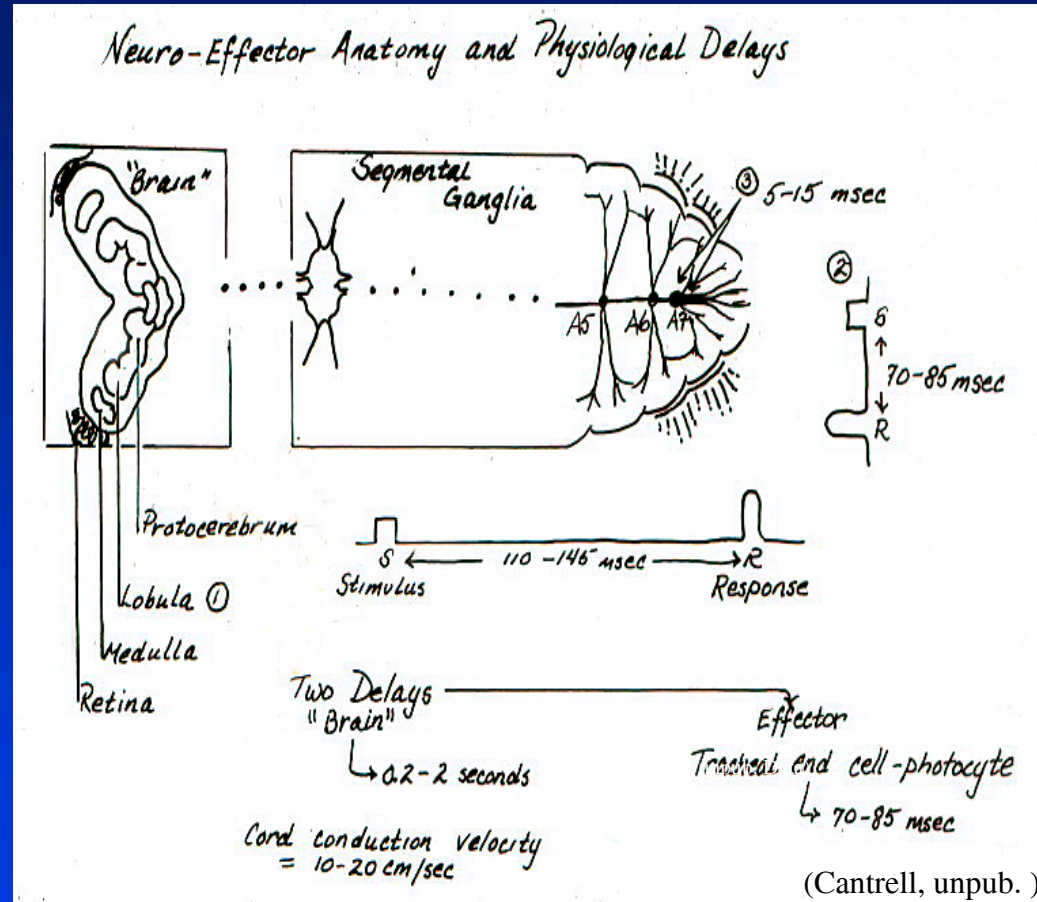
The Flashes of Fireflies Are Involved in Mating Behavior

- Flash communication: a Morse code type system in which timing (0.1 sec) is important
- “I am a male <species> and I am looking for a mate...”

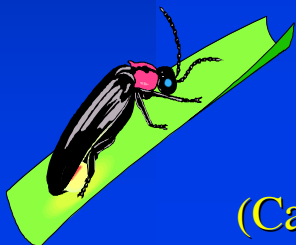


- “Hey! I’m a female <species> and I might be interested...”

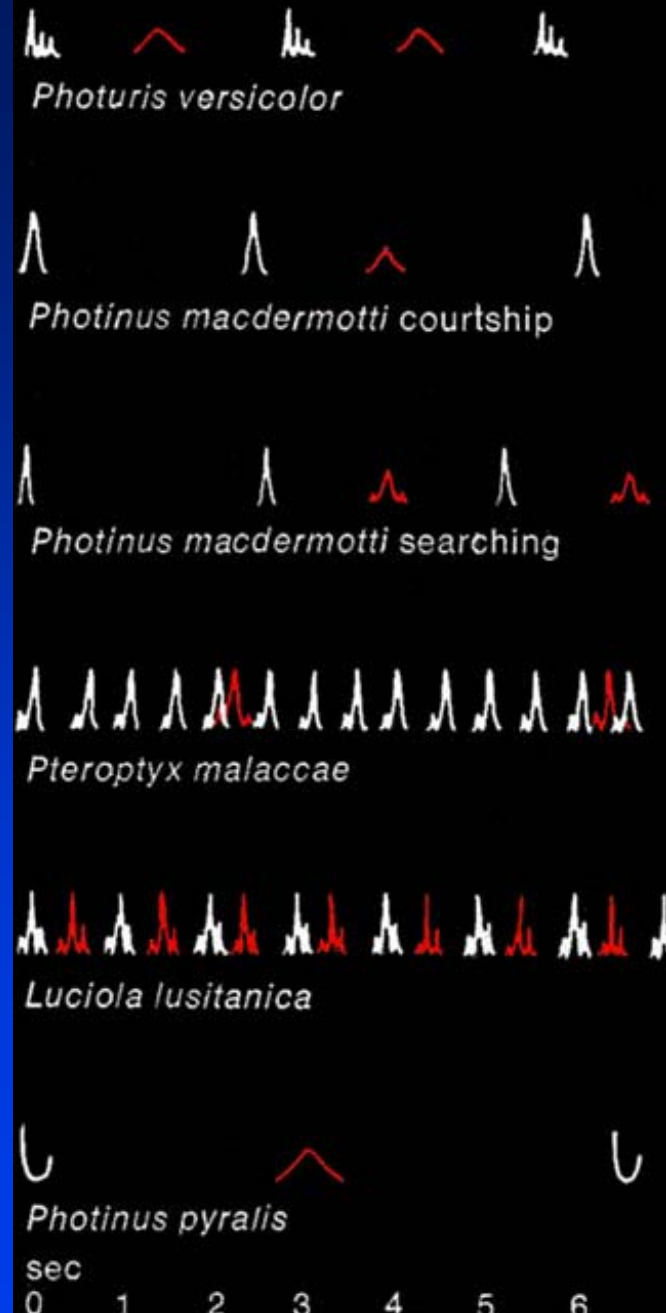
The Firefly's Nervous System Controls Flash Communication

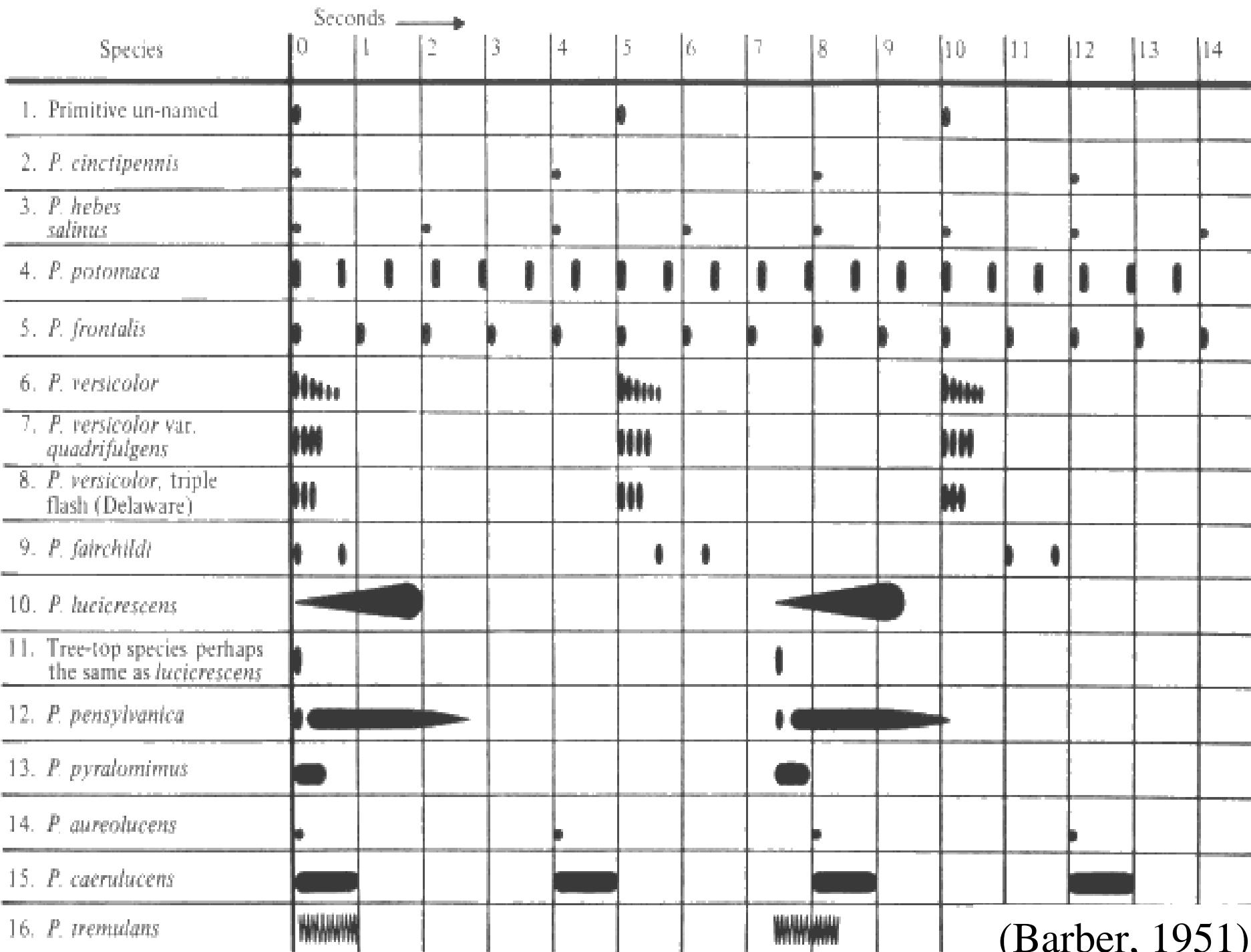


Male-Female Dialogues

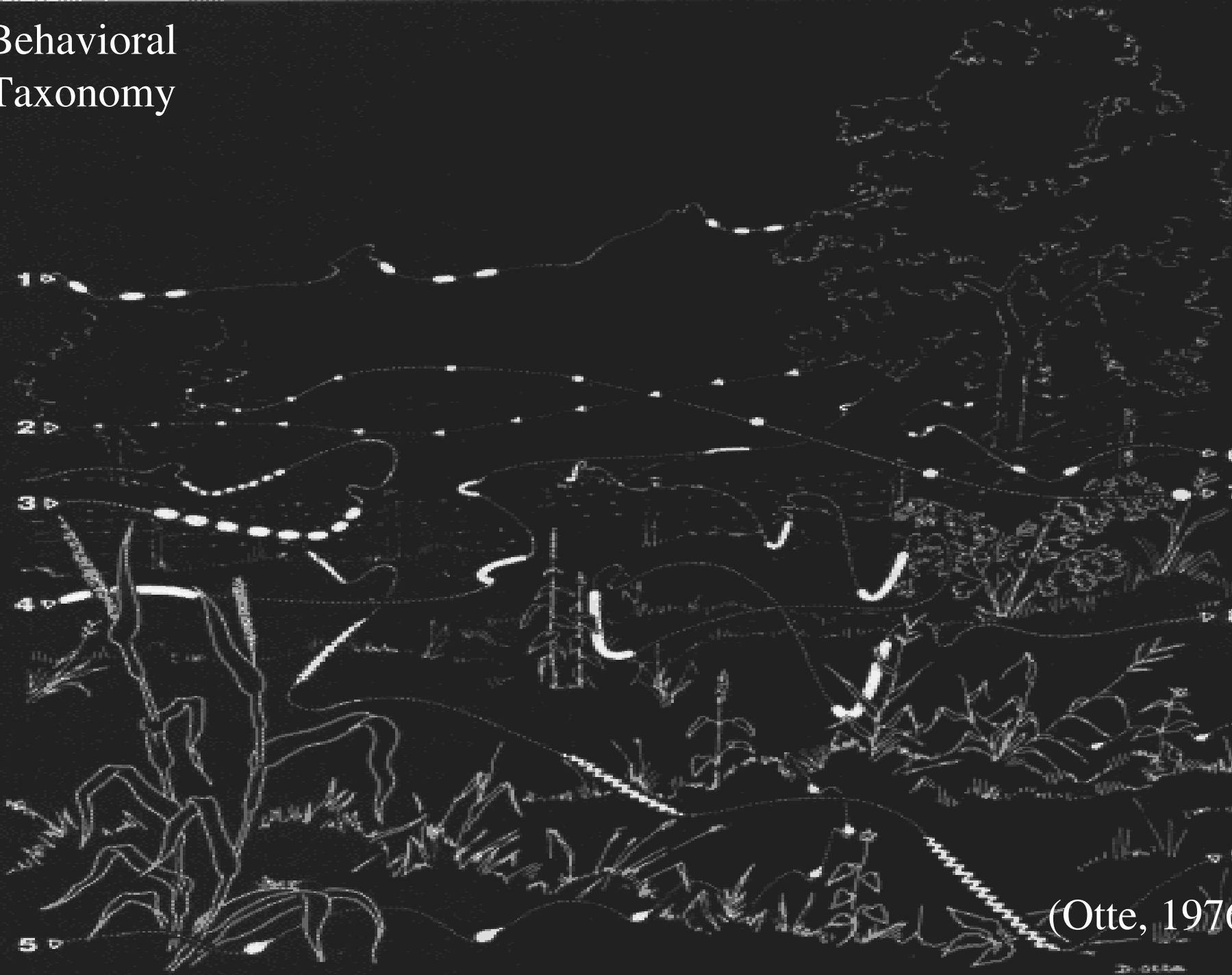


(Carlson and Copeland 1978)





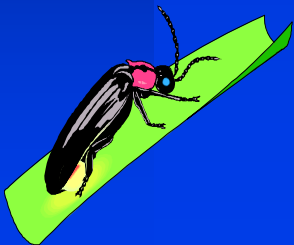
Behavioral Taxonomy



(Otte, 1976)

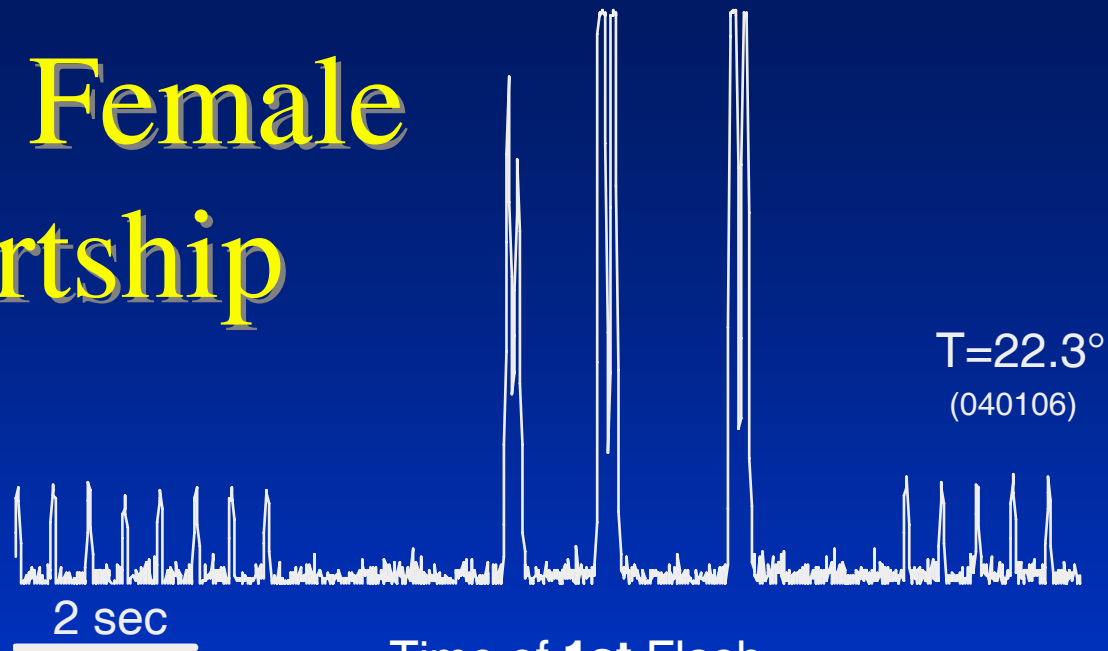
Simple Dialogues

- Males (and females) are sparsely distributed
- Male fireflies patrol independently
- Females attract individual males



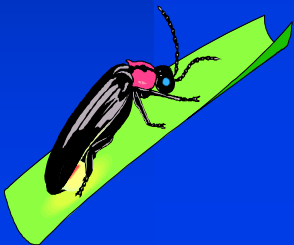
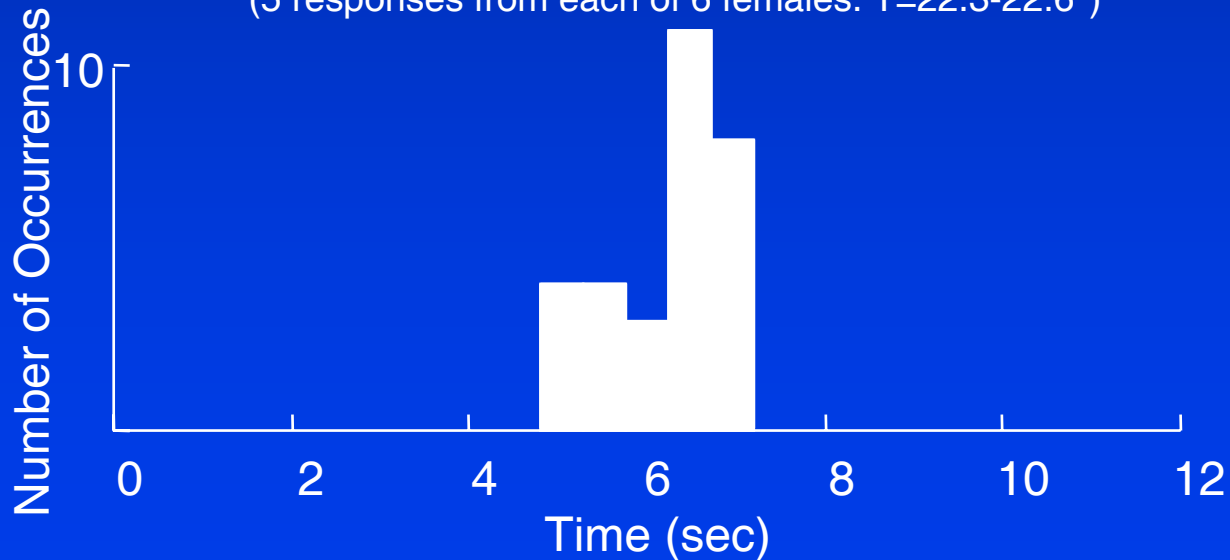
P. carolinus

Male - Female Courtship



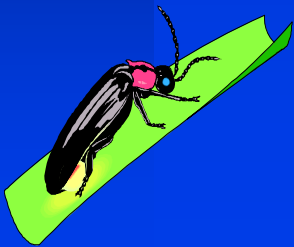
Time of 1st Flash

(5 responses from each of 6 females. $T=22.3-22.6^{\circ}$)



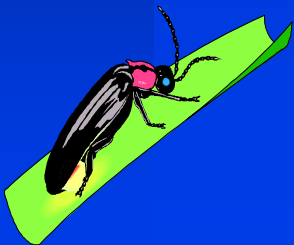
Female Flash Gesture to Male

QuickTime™ and a
Cinepak decompressor
are needed to see this picture.



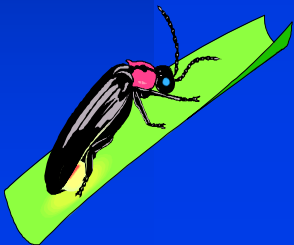
More Complex Dialogues

- Operational Sex Ratio
- *Ad hoc* group formation (flying)
- Cluster/Love knot formation (landed)
- Synchrony
- Male-male competition and female choice

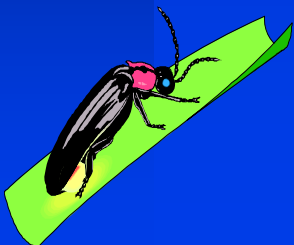


Mating Clusters

- Several Males congregate near female (6.7 ± 3 males/cluster, $N=6$)
- *Simulated Female (LED)* is sufficient to attract and maintain a cluster



Mating Cluster



Acknowledgments

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