BIO 111 - Laboratory # 9 : Animal Behavior

- **Assigned pages**: Mader, S., et al. 2008. Inquiry of Life. **pp. C63-C68**
  - ✓ **Do NOT let crickets escape - keep them in the containers or CATCH THEM!**
  - ✓ **QUIZ #2 is NEXT WEEK, week of 7 April. It covers the GOALS for labs 7, 8, and 9.**
  - ✓ **PLAN for the practical:** The practical will be given on **May 5th and May 6th** and no other dates. If you are in a Wednesday section, plan ahead for either Monday or Tuesday. Please, let me know as soon as possible when you will be taking the practical.

I. Animal Behavior - Crickets:

1. GOALS:

Objectives - at the end of laboratory #9 you should be able to:

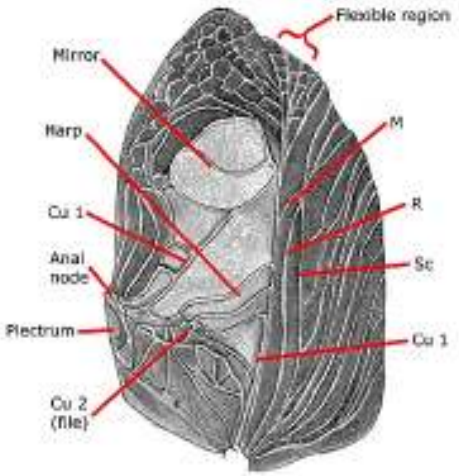
1.) distinguish the physical differences between female and male crickets (see diagram on P. 4)
2.) use correct scientific terms to explain how crickets create and sense sound
3.) label two diagrams that show: (1) the file and scrapper and (2) the tympanic membrane
4.) describe the differences between the three type of cricket sounds
5.) compare and contrast the behavior of the male cricket during: (1) isolation, (2) introduction of a female cricket, and (3) introduction of another male cricket
6.) use your observations of cricket behavior to identify crickets that exhibit submission, aggression, and courtship
7.) describe the experiment you conducted to determine a cricket's response to light and explain how you would modify this experiment to make even more valid conclusions about cricket behavior
8.) describe the independent experiment you designed and summarize your results

Key terms - you should be able to define:

"pecking order"	aggressive behavior	aggressive song	atennation
calling song	cerci	courtship song	experimental control
file	fleeing	grooming	hypothesis
hypothesis	isolated male behaviors	mandibles	ovipositor
palps	scraper	spermatophore	stridulation
submissive behavior	tympanic membrane	orientation	anthropomorphism

2. Introduction:

1.) **p. C-63**: Read the introduction and make sure you are familiar with the terms
2.) **Observe** the cricket wing under the dissecting scope and **MAKE A SKETCH** (**LABEL** the "file" and "scraper")
3.) **Observe** the tympanic membrane under the dissecting scope and **MAKE a SKETCH**
4.) **p. C67**: **Answer** questions 1 & 2, for #V ("Anatomy")

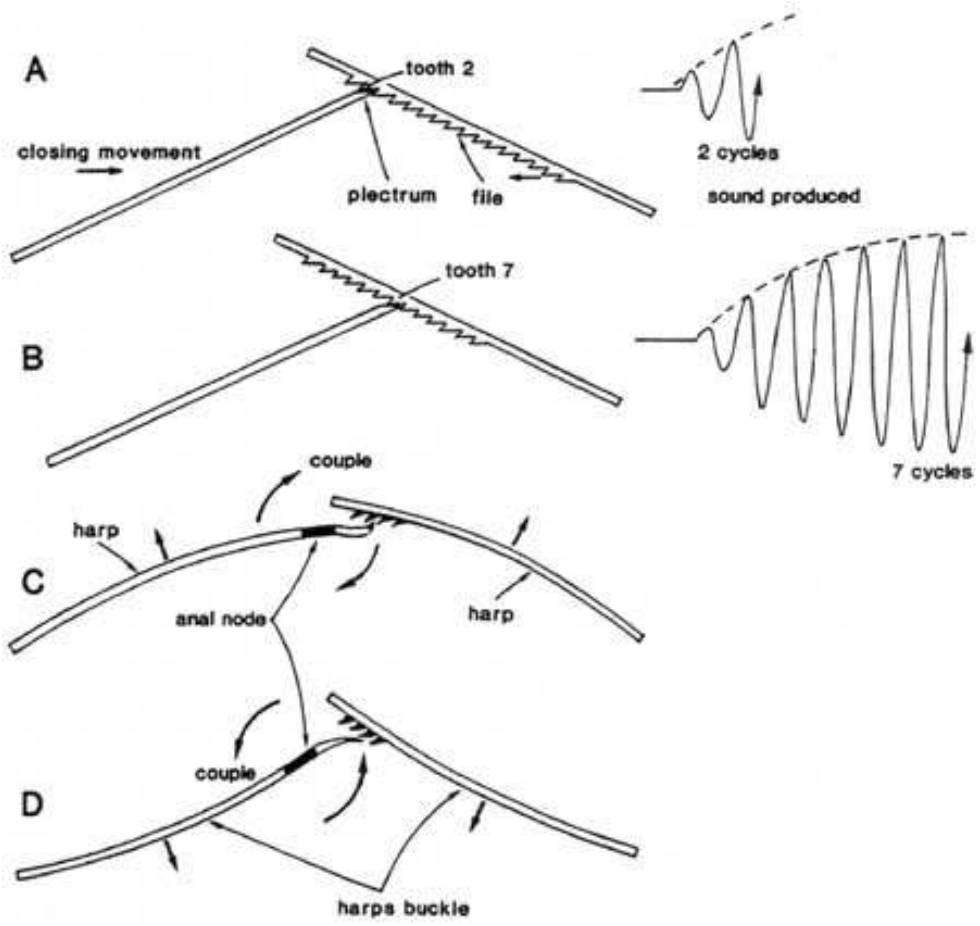


Sound apparatus on male wing of *Gryllus* field cricket (separated from rest of wing by flexible cuticle). Harp and mirror are resonators.

Diagram and information on this page from webpage:
http://www.google.com/imgres?imgurl=http://crawford.tardigrade.net/bugs/figures/malewing.jpg&imgrefurl=http://crawford.tardigrade.net/bugs/BugofMonth31.html&h=123&w=118&sz=50&tbnid=BbrKXWi4BLMJ:&tbnh=123&tbnw=118&prev=/images%3Fq%3Dinsect%2Bcricket%2Bchirp%2Bdescription%2Bdiagram&sa=X&oi=image_result&resnum=1&ct=image&cd=2

Generally, only male crickets **stridulate** or sing. Additionally, the relative amount of sound production varies within a population, some males being better songsters than others. And in a few species, the ability to produce sound has been lost altogether. A cricket song is distinct for each species, and indeed, the discriminating field biologist can tell how many species of crickets there are in an area simply by listening, somewhat like a good birder!

Cricket songs are produced with the forewings, or tegmina. The vein Cu2 of the tegmina is sclerotized in a series of sharp teeth to form a **file**. Further, a sharp-edged sclerotized ridge on the outer edge of the wing forms a plectrum, or **scraper**. By moving the scraper across the other wing's file, a vibration is set up which resonates on an area of the wing known as the harp. See wing diagram (above) and figure at right from Bennet-Clark (1989) and use your imagination! As far as I can tell, there is both a file and a plectrum on each wing. This would mean that a cricket could produce either a left-winged or a right-winged song. Now I could think of a few great research projects, especially for audiophiles. Perhaps there is a difference in the sound produced by left-winged versus right-winged stridulations? Wow, and you thought people raised crickets just for fun.
Cricket song has two components, one influenced by the plectrum-file strike rate and the other related to the subalar air space between the wing and the abdomen. Some have suggested that cricket song is a dynamic process involving auditory feedback control (Stephen & Hartley, 1995). Can't you just see cricket choir practice? By Jimminy, just listen to yourselves! Your strike rates aren't at all synchronized, and you're all on different keys.



Diagrams of the file-and-scraper (plectrum) mechanism and of sound production in crickets. Each file tooth is dropped in synchrony with the sound wave form and sustains the oscillation. A, After two teeth have been dropped, two cycles of sound have been produced. B, When seven teeth have been dropped, seven cycles of sound have been produced; the sound amplitude builds exponentially. C, D, Model of escapement mechanism: C, closing movement buckles the file of the upper tegmen upward and distorts the plectrum (scraper) of the lower tegmen, producing a couple around the anal node, which tends to buckle the harp of the lower tegmen upward so both harps buckle in phase; D, after the file tooth has been dropped, the harps buckle in the opposite sense, elastically, and the scraper (plectrum) returns elastically to a position (like C) in which it can engage the next file tooth

References

Bennett-Clark, H.C. 1989. Songs and the physics of sound production. In: Cricket Behavior and Neurobiology. (ed. F. Hubrer, T.E. Moore and W. Loher), pp. 227-261. Ithaca, New York: Cornell University Press.

Stephen, R.O. & J.C.Hartley. 1995. Sound production in crickets. Journal of Experimental Biology, 198: 2139-2152.

3. **Normal Behavior**
   1.) **pp. C63-C64** ("Normal Behavior", **#I**): **Read** the procedure and **follow** the steps for observing normal behavior of and "**isolated MALE"** cricket. The **isolated male crickets are in the Petri dishes** (with potato slices); make sure to pick a dish lined up for the day and time of this lab. **STOCK females and males are in the labeled aquarium tanks**.
   2.) **Observe** the cricket for **15 MINUTES**
   3.) BE CALM and OBSERVE FROM A SLIGHT DISTANCE (do not hang your head over the Petri dish)
   4.) **p. C66** (Observations & Questions, **# I**): **Answer** questions 1-4, for **#I**
   5.) **p. C68** (Data for Ground Cricket Behavior, Table, **column 1**): **RECORD** your observations

4. **Courtship Behavior……Remember, female crickets are, usually, larger than male crickets**
   1.) **p. C64** ("Courtship Behavior", **#II**): **Read** and **follow** the steps for observing the courtship behavior of **stock female and isolated male crickets**. **Be careful** not to damage the female during capture.
   2.) **RETURN stock female** cricket to the stock FEMALE colony tank, **KEEP** the isolated male
   3.) **p. C66** (Observations and Questions, **#II**): **Answer** questions 1-4, for **#II**
   4.) **p. C68** (Data for Ground Cricket Behavior, Table): **RECORD** your observations - **Use column 2** for the **isolated male** and **column 3** for the **stock female. Did you observe transfer of a spermatophore?**

5. **Aggressive Behavior**
   1.) **p. C64** ("Aggressive Behavior, **#III**): **Read** the procedure and **follow** the steps for observing aggressive behavior of **MALE** crickets. Make sure you can **distinguish** between the **isolated male** and the **stock male** (from stock colony) and **observe both** crickets for **15 MINUTES**
   2.) **RETURN stock male** to the stock MALE colony, **KEEP** isolate male
   3.) **pp. C66-C67** (Observations and Questions, #III): **Answer** questions 1-7, for **#III**
   4.) **p. C68** (Data for Ground Cricket Behavior, Table): **RECORD** your observations - **Use column 4** for the **isolated male** and **column 5** for the **stock male**

6. **Phototaxis (response to light) - DESIGN YOUR OWN EXPERIMENT**
   1.) **p. C64** ("Phototaxis", **#IV**): Read and follow the steps for **designing your own experiment** and **observing the effect of light** on the isolated male cricket (or a stock female or/and stock male cricket)
      (1.) **Write your hypothesis** as an "If……then……." statement
      (2.) On the bottom of p. C67, record what you might change/improve to make this experiment more accurate and scientifically valid
      (3.) Use the 3" x 5" sheet of black paper provided. You may want to try using different light intensities
   2.) **p. C67** (Observations and Questions, #IV): **Answer** questions 1-2, for **#IV**
   3.) **p. C68** (Data for Ground Cricket Behavior: **RECORD** your observations - **Use column 6** for your cricket's data (first column under "Optional")

7. **Independent Experiment - DESIGN YOUR OWN EXPERIMENT**
   1.) **p. C65**: Use the space provided at the **bottom of the page** to write out the following:
      (1.) **your hypothesis** (write this as an "If……..then……." statement)
      (2.) **your objective(s)** - What do you want to accomplish? (write this out as a sentence, "The objective(s) of this experiment is/are as follows:…....)
      (3.) **your treatment** - What is one factor are you going to vary?
      (4.) **your control** - How will you hold the factors constant for comparison with the treatment
      (5.) **a short protocol** - What steps will you use to fulfill your objective(s)
   2.) **p. C68** (Data for Ground Cricket Behavior): **RECORD** your observations - **Use column 7 & 8** for your cricket's data (last two columns under "Optional" – **ADD EXTRA COLUMNS**, as needed, to the right)
   3.) **p. C68**: space at top and/or bottom of the page: Was your hypothesis supported? Why or why not?

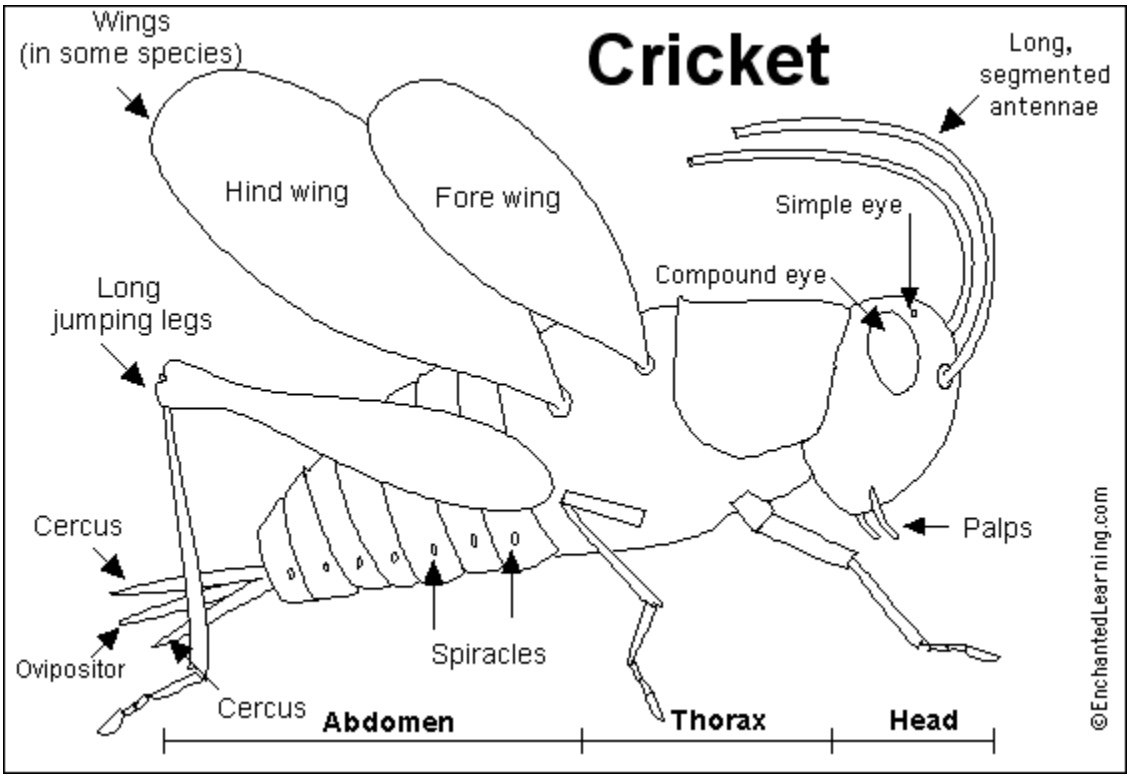
II. Animal Behavior - *Betta* fish:

1. **Goals:**

   Objectives - at the end of laboratory #9 you should be able to:
   1.) describe the aggressive behavior of the *Betta* fish

2. **Observation:**
   1.) **remove** the piece of paper between the two fish bowls and **observe** the behavior of the *Betta* fish - What did you observe?

Diagram and information (below) from the webpage:
http://www.zoomschool.com/subjects/insects/orthoptera/Cricket.shtml



NOTE: OVIPOSITOR occurs ONLY in the female cricket.

Crickets are jumping insects. Males of most cricket species make a loud chirping sound by rubbing their forewings together; they do this to attract females. Crickets chirp faster when the temperature is warmer. Crickets live under rocks and logs in fields, grasslands, and meadows. Many crickets are nocturnal (most active at night). The most common cricket in the US is the field cricket; the most common one in Europe is the house cricket (which is stockier).

Anatomy: Like all insects, crickets have a three-part body (head, thorax and abdomen), six jointed legs, and two antennae. Their body is covered with a hard exoskeleton. Crickets breathe through a series of holes called spiracles; they are located along the sides of the body. Crickets are brown or black. Crickets are very similar to grasshoppers, but the cricket's antennae are very long, the wings are held flat over the body, and the ovipositor is very long. Not all crickets have wings. Crickets sense sounds using **tympani** (hearing organs) located in their front legs.

Metamorphosis: Crickets undergo incomplete metamorphosis. They hatch from eggs that the female deposits in soil (or plant material) using her **ovipositor**. Immature crickets (called nymphs) look like small adults, but the wings and ovipositor (of the female) are not fully developed. They molt many times as they develop into adults.

Diet and Predators: Crickets are omnivores (they eat both plants and animals). They scavenge dead insects and eat decaying material, fungi and young plants. Predators of crickets include birds, rodents, reptiles, other insects (including beetles and wasps), and spiders.

Classification: Kingdom Animalia (animals), Phylum Arthropoda (arthropods), Class Insecta (insects), Order Orthoptera (crickets, grasshoppers, etc.), Suborder Ensifera, Family Gryllidae (crickets), Genera Acheta, Gryllus, Oceanthus, Myrmecophila, many species.