Week 4
BIO-1306 - Biology 2 – ICB textbook

Hello and Welcome to the weekly resources for BIO-1306 - Biology 2 – ICB textbook!

This week is Week 4 of class, and typically in this week of the semester, your professors are covering these topics below. If you do not see the topics your particular section of class is learning this week, please take a look at other weekly resources listed on our website for additional topics throughout of the semester.

We also invite you to **look at the group tutoring chart on our website to see if this course has a group tutoring session offered this semester**.

If you have any questions about these study guides, group tutoring sessions, private 30 minute tutoring appointments, the Baylor Tutoring YouTube channel or any tutoring services we offer, please visit our website www.baylor.edu/tutoring or call our drop in center during open business hours. M-Th 9am-8pm on class days 254-710-4135.

***Keywords*:** Information, Communication, Prey, Predators, Shannon Diversity Index, Ecological Systems

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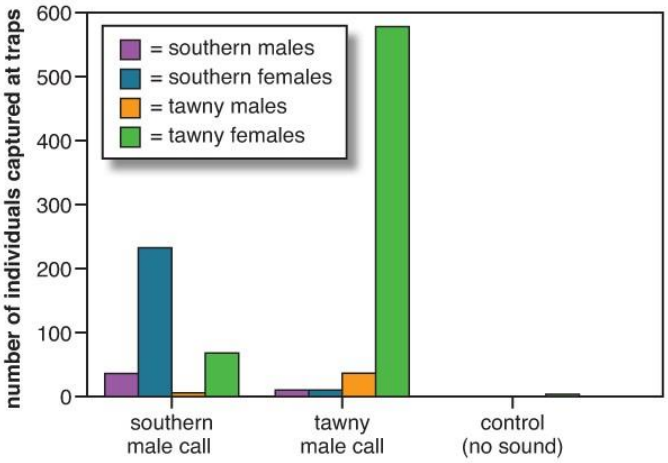
TOPIC OF THE WEEK

Communication Within and Between Species

This week we will be looking at the advantages/disadvantages of communication within a system along with how the communication connects multiple parts of a biological system together.

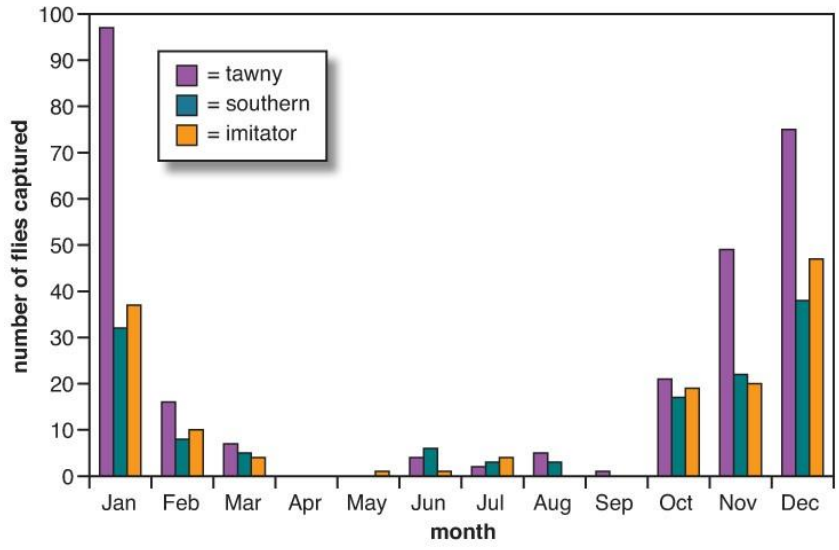
Highlight 1:



One study conducted by Ulagaraj and Walker observed the male vocalizations of two mole cricket species: the **southern mole cricket and tawny mole cricket.** Recordings of each species' **male vocalizations** were placed into two separate funnels. A third funnel without any recording was also placed as a **control.** Crickets from each funnel were collected and the **number, species, and gender** of crickets were recorded. **What did they find?** Most of the crickets collected in each funnel were **females,** specifically those belonging to the **same species as the male recordings** played. **This provided evidence** for species-specificity of mole cricket communication, mainly for the males to attract females. While this is **beneficial,** what happens when **predators** and/or **parasites** recognize these sounds as well?

Highlight 2:

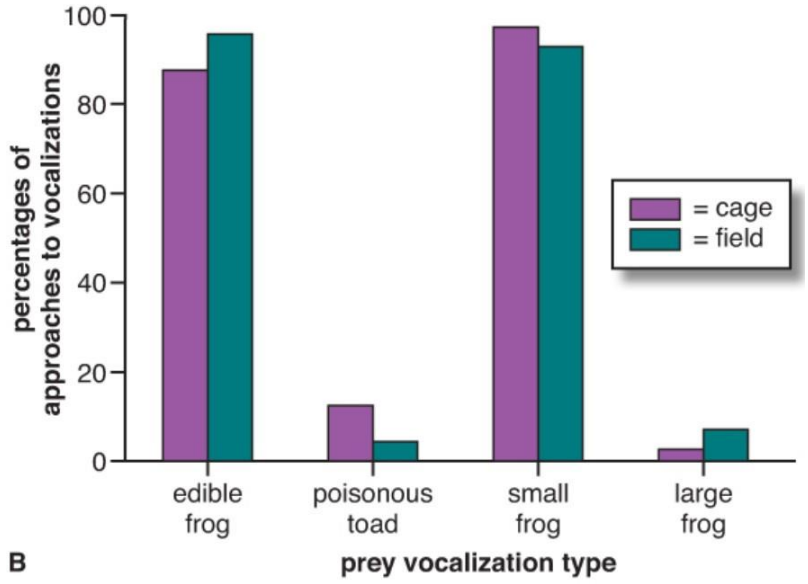
A famous parasite fly, *O. deplete*, was found to be attracted to mole crickets' songs and to lay their eggs on the crickets, feeding on cricket tissue. Scientists performed an experiment in which they collected and counted the number of flies based on each cricket species vocalization.



The figure above shows that **not every single time of the year has the same intensity of fly-cricket interactions**, so **how is this important?** The months of November, December and January are the seasons where more cricket vocalization occur. This is often related to the cricket's mating season, so their chirping is higher. What's interesting, however, is the ***O. deplete* flies that lay eggs on mole crickets have evolved** so that adults are active at the **same time of year** that male mole crickets are vocalizing to attract females. They are now able to locate the mole crickets easily and lay their parasitic eggs on them.
This way, it's easier for them to recognize where the mole crickets are and quickly lay their eggs. This is direct evidence of how non-heritable communication was used by one species to take an ecological advantage over another. This once again shows that while these mating calls are beneficial and essential for mole crickets to reproduce, it also introduces new costs such as predation.

Highlight 3:

Vocalizations can not only help predators locate prey but also help aids in **discerning their prey of choice from similar organisms**. For example, researchers studied how **fringe-lipped bats** use vocalization to find their prey. Wild bats from their natural environment and caged bats were used. Researchers played sounds of either **edible or poisonous toads** and recorded the number and category of bats that approached the vocalization. They then played sounds of either **big or small toads** and recorded the same thing.



What does this show?
Surprisingly, the fringe-lipped bats were able to **discriminate between vocalizations of edible and poisonous frogs**, along with vocalizations between small and large frogs. These not only help them locate the toads, but also provide information on

the types of toads available to them. As amazing as this ability is, **are the bats born with it or do they learn from other bats?**

Highlight 4:

To answer this question, researchers studied **caged fringe-lipped bats** who had not yet learned how to discern between vocalizations of toads. A primary group of toads were **trained** to approach a speaker playing cane toad vocalizations. Once they approached that speaker, they were rewarded with raw fish as a form of reinforcement. These were considered **trained and experienced bats**.

Inexperienced/untrained bats were **either alone, paired with another inexperienced bat, or paired with an experienced bat**. The number of trials it took for the untrained bats to approach the speaker with cane toad vocalizations three times were recorded.

treatment	mean number of trials	standard error	sample size
inexperienced bat with experienced bat	5.3	1.7	10
two inexperienced bats	96.8	3.2	5
one inexperienced bat	96.2	3.8	5

What do we see? When paired with experienced bats, inexperienced bats took a **lot less tries to successfully approach the cane toad speaker**. The two groups without any experienced bats, however**, took a lot longer to repeatedly approach the cane toad speaker**. **This shows** that fringe-lipped bats can learn from other fringe-lipped bats through observation. Although the attraction to the toads' vocalization may be an innate trait, they **have the ability to learn how to discriminate between types of prey through observation.**

These experiments exemplify how information passes to organisms of the same and different species, while also highlighting the benefits and costs associated with communication.

Highlight 5:

Now, let's jump to our next question: **How does a change in number of species**

affect information content of an ecological system?
The general answer to this is that species losses or gains will change the information in the ecological system. **Changes in biodiversity will change the information content in an ecosystem.**

What is biodiversity? It is defined as the variety of life at all of its levels, from genes to ecological systems. In an ecological system, biodiversity is also defined as the number of species living in that system.

When looking at biodiversity in a system and how the number of species may change, there is one concept that we need to be familiar with: **The Shannon Diversity Index.**

The Shannon Diversity Index is a parameter that combines **species richness** (how many species are in a system) and **abundance** (how many individuals of each species are present in the system). The index is given by the following formula:

$$H' = -\sum_{i=1}^{S} p_i \ln p_i$$

Where:

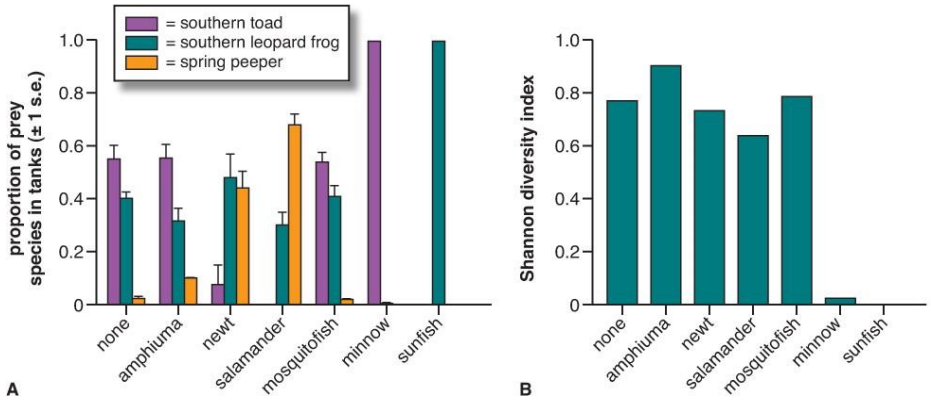
H' = Shannon diversity index
s = number of species in a system (richness)
pi = proportion of total abundance represented by it^{h} species

Want to learn more about the Shannon Diversity Index? Check out the following video https://www.youtube.com/watch?v=ghhZClDRK_g

So, **what would it happen if a species is removed or added to a system?** Let's look at the Chalcraft and Reseratits experiments in forest ponds, where they evaluated the impacts of adding predators to the ponds. These are the bases for those experiments:

1. Three prey species were evaluated: tadpoles, larvae of frogs and toads.
2. The predators tested included fish and salamanders
3. The treatments consisted in tanks with 175 tadpoles each and 2 individuals of one predator species.

4. At the end of the experiment, the remaining tadpoles were counted.



Biodiversity was affected both in the number of species and their individual proportions in the system, depending upon the identity of the predator.

Amphiumas and newts did not completely eliminate any one tadpole species, but **the other predators reduced one of the three species of tadpole to zero** or nearly zero. Additionally, **both minnows and sunfish eliminated or nearly eliminated all but one prey species**. **Notice that there is a Shannon Diversity index of zero and a dramatic decline in information content in a prey community with only one species.** A predator in that situation will encounter only one type of prey, and if the predator does not eat that type of prey, then the predator population may ultimately go extinct, further reducing the diversity of the system.

Let's test ourselves!!

1. What happened when non-heritable information is imperfectly transferred?
2. What is the mole crickets songs an example of?
3. What are the two main components of the Shannon diversity index?

Things Students May Struggle With:

1. Understanding what the Shannon Diversity Index means – A larger index means there is more biodiversity in a system
2. Interpreting the graphs – Remember to look at all the axes on the graph to understand what's being measured or changed. Don't focus too much on the small details, rather look at the big picture.

Thanks for checking out these weekly resources!
Don't forget to check out our website for group tutoring times, video tutorials and lots of other resources: www.baylor.edu/tutoring! Answers to check your learning questions are below.

Answers:

1. *Variation is produced*
2. *Species-specific communication*
3. *Richness and abundance*