Notes to accompany individual slides in the PowerPoint presentation, Niche of a Generalist Apex Predator (presentation)

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Slide #1

The case for the importance of predators in controlling structure and function of lower trophic levels in ecosystems has gained considerable currency in recent years.

- Predators control biodiversity through direct and indirect interactions with other organisms in their ecosystem and influence community structure
- Most animals are insects
- Most predators are generalists, meaning that they feed on multiple trophic levels.
- It is difficult to determine the direct effect of these apex predators on their ecosystems,
- We used stable isotope analysis of praying mantids and their prey to provide a model for generalist apex predators

Slide #2

- Our study animal is the praying mantis because it is a good model for apex predators.
- They have been shown to exert top-down trophic control on their ecosystem, and it is known that they are able to feed on three trophic levels.
- However, the frequency with which they feed on various trophic levels is unknown.

Slide #3

- Mantids are semelparous.
- They hatch from egg cases in the spring, mature throughout the summer, and reproduce in the fall before being killed with the first frost.
- They can grow from ~9 mm to ~10 cm.
- Because they are present and developing through a wide temporal range, they impact prey assemblages from spring to fall.

http://upload.wikimedia.org/wikipedia/en/3/31/NG-PrayingMantis.jpg

Slide #4

- This is a measurement of mantid body length over the weeks of study, ranging from hatchlings to adults
- The small axes indicate the proportion of mantids caught that were a certain body length.
- The numbers above the small axes reflect the number of mantids caught that week
- Body length is a measure of the stage of development that the mantids have reached. As the season progresses, body size also increases.

Slide #5

http://geosciences.uark.edu/UASIL_2008a.jpg

- We used SIA to determine the trophic position of praying mantids raised in the lab and praying mantids raised in the field.
- Because animals incorporate C13 and N15 into their tissues throughout the lifespan, it gives insight into how an organism's diet changes over time.
- SIA uses C13 to determine the ultimate source of carbon in a food web. N15 is used to determine the trophic level in a food web.
- Because it is unknown exactly what praying mantids eat, we compared the signatures of mantids raised in the lab and fed known diets to the signatures of mantids caught from the field.

Slide #6

This is a sample SIA graph. N and C increase with increasing trophic level.

- There is usually a 1-2 ppm separation of C between trophic levels.
- A difference of 2.5-4 ppm N is shown to separate trophic levels.
- As the tern is the apex predator of this sample ecosystem, it obtains increasing isotopic enrichment through consumption of prey.

Slide #7

- This is a plot of isotopic signatures of prey items used in the lab.
- We see that sap feeders and plant chewers, which comprise herbivores like aphids and grasshoppers occupy the lowest trophic level.
- Each successive trophic level is evident through enrichment of at least 2.5 ppm in the heavy isotope of N and 1 ppm in the heavy isotope of C. Each different color denotes a different trophic level.
- In the lab, we were able to detect four trophic levels.
- We were able to determine that the signatures of prey items show trophic position.

Slide #8

- This figure shows that nitrogen values of mantids fed known prey in the lab correlate with the values of the prey items.
- In plant chewers, there is a 2.5 ppm enrichment of N and a similar level of enrichment of C.
- Mantids that were fed plant chewers showed the expected trophic level difference as to occupy one trophic level above their prey.
- We found that out of the four trophic levels we found in the lab, mantids in the field were feeding on three of those trophic levels.

Slide #9

- This is a plot of the isotopic signatures of field-caught mantids, irrespective of when they were caught.
- There is an extreme range in the data, so mantids are feeding on anything from herbivores to carnivores.
- Mantids are generalists.
- There doesn't seem to be any type of pattern except when…

Slide #10

- When we plot those data with respect to time, we can see a definite pattern in the change of 15N enrichment from hatching to death.
- We think that while the mantids are developing in their egg cases, they are feeding on the protein-rich material inside of the egg cases which was invested by the mothers.
- After this nourishment is no longer available to them, the mantids show a precipitous drop in enrichment of the heavy nitrogen isotope.
- They begin starving or feeding on a low trophic level.
- This drop continues until the third instar, at which time the enrichment in the heavy N isotope begins to increase throughout the rest of the growing season.
- This shows that mantids are eating different prey at different times, with a diversified diet that increasingly incorporates carnivores enriched in 15N.
- Mantids have an impact on community assemblage that is not the same over time.

Slide #11

- In summary, we were able to:
    - Determine trophic level of mantids and their prey using SIA
    - Show that isotopic enrichment of mantids depend on the isotopic enrichment of their prey
    - Find that mantids become enriched in 15N as they feed on higher trophic levels
    - Determine that mantids feed on different trophic levels throughout the growing season
    - Show that mantids impact their community structure through growth, development, and adulthood

- Thank you for your attention during this presentation.
- I would be happy to answer any questions you might have.

Slide #15

Percentage of abundance of three arthropod guilds collected from the field throughout the 2012 growing season. Solid bars = sap feeders (e.g., Acanalonia bivittata); hatched bars = carnivores (e.g., Hogna helluo); open bars = plant chewers(e.g., Melanoplus spp)