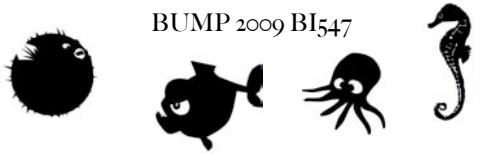
Effect of the parasitic sea anemone Edwardsiella lineata on regeneration and body size in the comb jelly Mnemiopsis leidyi.

Italicize species names.

Kayla Connor, Mike O'Boyle, Sarah Stark, Stephanie Tougas

BUMP 2009 BI547

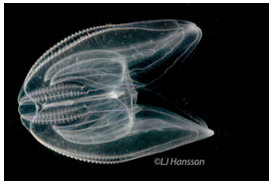


No cteno or anemone on the intro slide?

Background

Phylum CTENOPHORA (80 species described)

- Mnemiopsis leidyi
  - Ctene rows with cilia.
  - Oral lobes
  - Diploblastic (ectoderm & endoderm)
  - Through gut
    - Mouth
    - two anal pores
  - Nerve and muscle cells
  - Apical organ
    - Main regulatory organ
    - Controls regeneration (Coonfield, 1936)



http://www.Mvtimes.com

Economic and Ecological impacts

- Invasion of Mnemiopsis into the Black Sea
  - Mnemiopsis alters trophic interactions
    - Zooplankton and fish population decreases
    - Mnemiopsis biomass increases
  - The consumption of zooplankton by fishes was half of that eaten by Mnemiopsis during the time of its mass development in 1989. (Vinogradov, Shushkina et. al, 1996)
  - Fishing industry impacted from decrease in planktivorous fish.
  - Biological controls.

Very good level of detail in your background.

Edwardsiella and Mnemiopsis Fitness

- Edwardsiella lineata "Lined Sea Anemone"
  - Adult E. lineata produces pre-parasitic planula stage.
  - Planula enters host M. leidyi through oral openings or ectodermal layer.
  - Parasitic E. lineata lives just outside of host gut, living off injested zooplankton until the host dies.
  - How parasitism effects M. leidyi fitness?
    - Indirect measurements of fitness: ability to regenerate lost parts, and ability to grow in size
    - Rate of regeneration in unparasitized and parasitized M. leidyi
    - Percent change in body size of unparasitized and parasitized M. leidyi

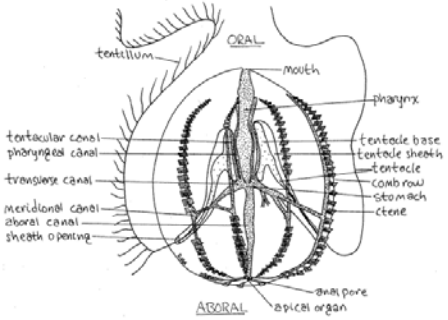
A visual aid is helpful when discussing a life cycle.

"At very low food concentrations, growth efficiency ranges between 20 and 45%. Mnemiopsis, begins to produce eggs at a size much less than its maximum". (Reeve, Syms, Kremer,1989)

Reference Bumann & Puls growth results.

Hypotheses

1. E. lineata will have a negative effect on the ability of M. leidyi to grow in body size.
2. E. lineata will have a negative effect on the ability of M. leidyi to regenerate a ctene row that was cut.



http://webs.lander.edu/rsfox/rsfoximages1/cten12L_x550_x_403x.gif

Materials and Methods

Collection of ctenophores

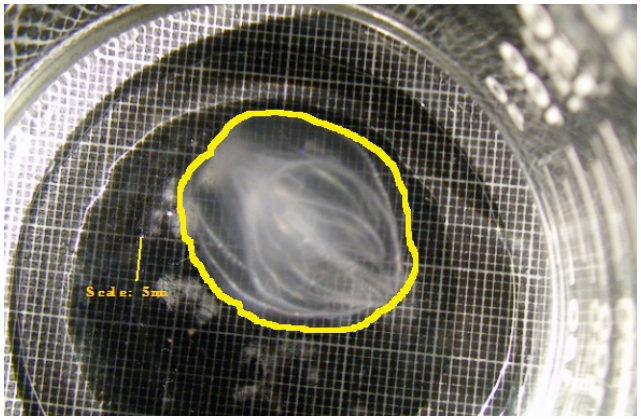
- ☞ Great Harbor, Woods Hole MA
- ☞Plankton nets, 2 large buckets

Body Size Experiment

- ☞Measured change in body size over 48 hour period of 15 uninfected and 15 infected (manually) M. leidyi
- ☞Stored in individual 250 ml beakers in 13.7°C room
- ☞Fed 0.5ml of artemia at 0 hours and 24 hours
- ☞Photographs of individuals taken against a 18 x 25 cm grid directly post infection and 48 hours after

The overall size of the graph paper is not what matters, it's the scale of the grid (1mm squares) that matters more.

Measuring Area Using Image J



Thinner yellow line would let viewer see the outline of the animal and have greater confidence in your method.

Methods cont'd...

Manual infection of ctenophores

- ☞ E. lineata excised from already infected ctenophores
- ☞ E. lineata given one day to turn back into planulae (Reitzel, et al. 2007)
- ☞ introduced to M. leidyi for infected group by placing a planula near the mouth or on the top (Reitzel, et al. 2007)
- ☞ once all infected, placed into Crisel tank for storage

It's "kreisel."

http://www1.fccj.edu/dbyres/images/planula.jpg

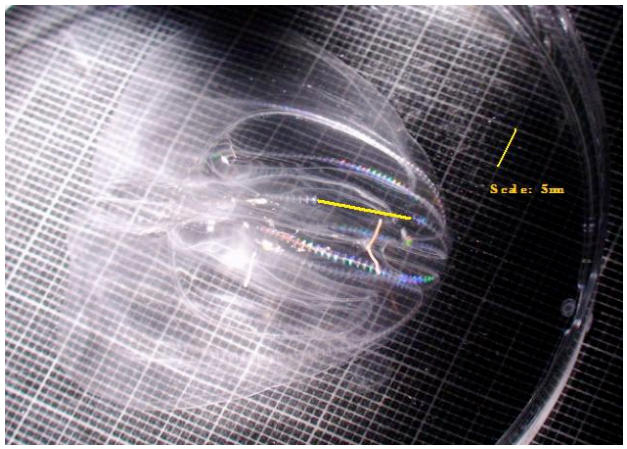
Why was it important/necessary to infect ctenophores? Why not use already infected specimens?

Methods cont'd...

Regeneration Experiment

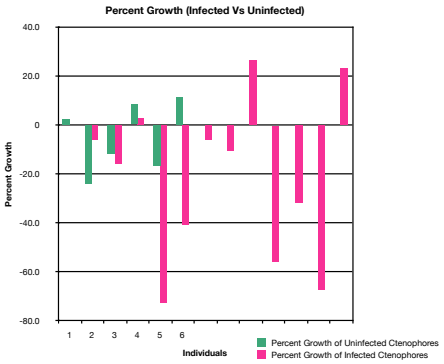
- 15 uninfected and 15 infected (not manually) M. leidyi
- removal of one ctene row (Coonfield 1937)
- 4 measurements taken over 3 hour period (time of cut at 0 hour, 1 hour, 2 hour and 3 hour)
- photographs taken of individuals at each time interval against 18 x 25 cm grid
- measurements taken from photographs using Image J by measuring the gap(mm) between the regenerating ends of the ctene row

Measuring Ctene Row Cuts Using Image J



The photo is very helpful.

Results

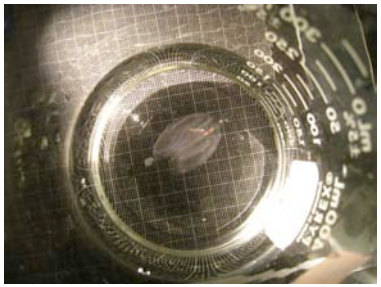


Body Size Comparison Infected Vs. Uninfected

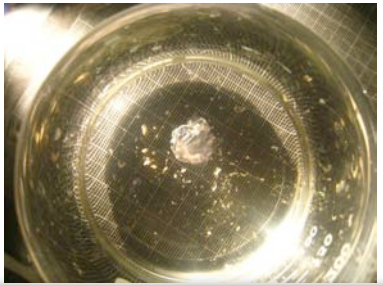
- On average, uninfected ctenophores decreased in size by 5.0 % (SD:14.53%)
- Infected ctenophores decreased in size by 21.2 % (SD:33.0 %)
- p = 0.27 using one tailed t-test
  - Statistically insignificant

I like that you showed individual animals and not just the mean values. But why is the data displayed in this order? For example, why not put all the uninfected animals in one part of the graph and all the infected animals in another part of the graph. What about the places without bars (are those zero values)?

Body Size Change

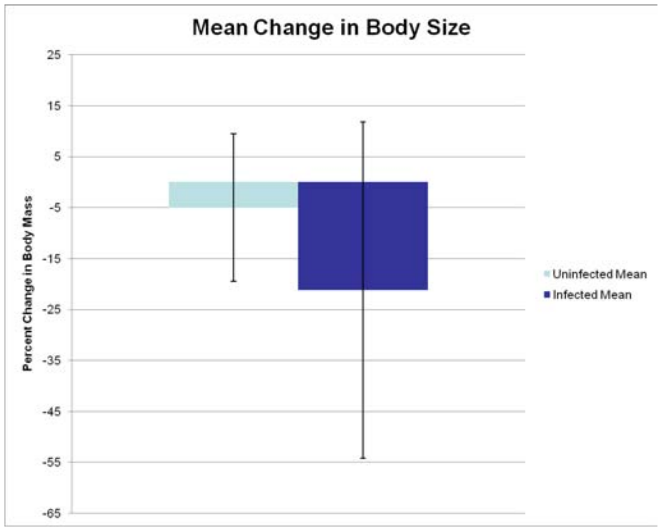


Before



After

Looks like more than shrinkage. It looks like the animal is really deteriorating. That's worth noting. Should this slide go before the previous graph?

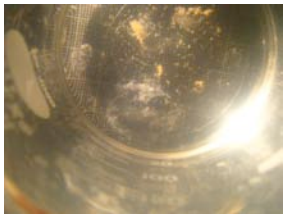


http://web2.uwindsor.ca/courses/biology/macisaac/pages/mnemiopsis.htm

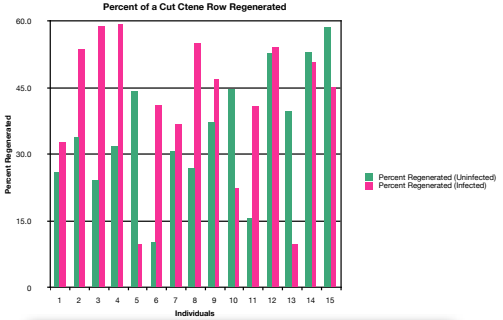
Results

Ctenophore Fatality

- Unequal fatality between two subject groups.
  - 9 deaths in uninfected
  - 3 deaths in infected
  - Chi square test suggests that not being infected significantly impacts fatality.
  - Unsure why uninfected ctenophores died more often. Perhaps more uneaten food not taken up by a parasite in beaker caused increased ammonia.



Results



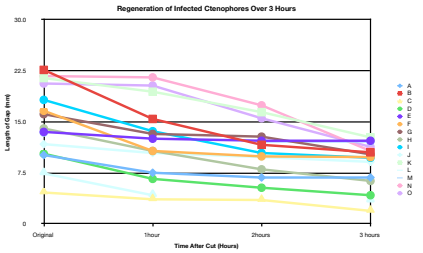
Why is the data displayed in this order? It seems like you're pairing an infected individual with an uninfected individual.

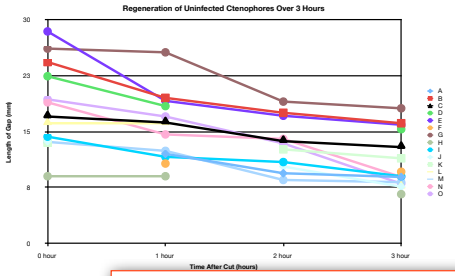
Regenerative Ability Comparison

- All ctenophores regenerated some over the three hours they were studied.
  - The uninfected ctenophores regenerated an average of 35.2% (SD:13.8) of the cut row.
  - The infected ctenophores regenerated an average of 41.0% (SD:16.3) of the cut row.
- p = 0.27 using one tailed t-test
  - Statistically insignificant

Results

Once again, I like that you presented individual results in addition to mean values.

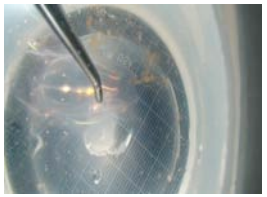




These graphs aew too small, and the type is quite a bit too small for them to be sufficiently legible. I would put one graph per slide.

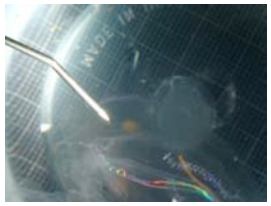
Regeneration of Infected Ctenophore

0 hour



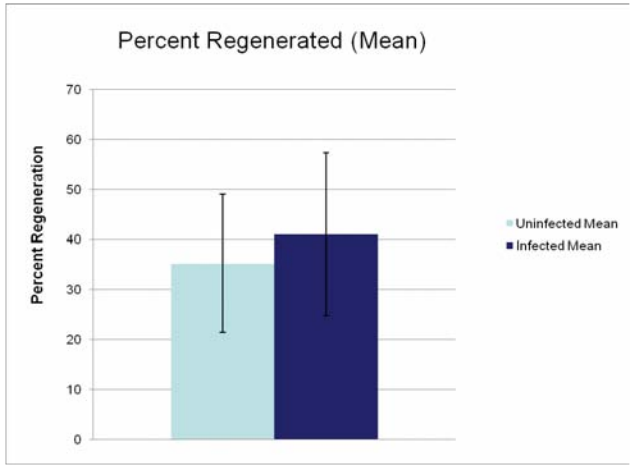
1 hour

2 hour



3 hour

Can you hi-light each cut end so it's easier for your audience to see?



Discussion

Body Size

- Uninfected ctenophores tend to shrink less
  - T test shows that this result is not significant ($p = 0.27$)
  - Other studies have shown that parasites decrease growth rate of Mnemiopsis (Bumann and Puls, 1996)
- However, the high death count in the uninfected population is a confounding factor.

Discussion

Regenerative Ability

- All ctenophores noticeably regenerated over the course of three hours.
- The differences in regenerative ability between uninfected and infected individuals are small.
  - Infected individuals regenerated slightly more, but a t-test suggests that these differences are insignificant
  - Perhaps, parasites do not have that large an impact on regenerative abilities
    - If parasitism does not affect the function of the apical organ, regeneration could also be unaffected

Problems With Our Experiment

- ☞ Finger bowls to house ctenophores
  - ☞ Need a sea water filtration system
- ☞ Human error
- ☞ Ctenophores not infected at same time
- ☞ Lack of water quality tests
- ☞ Measuring the ctenophores' body mass
  - ☞ New method for relocating ctenophores and using volume displacement
- ☞ No way to individually recognize the ctenophores
  - ☞ Dying the food they ingest

Human error, or methodological short-coming? How much variation was there from multiple measures on the same individual?

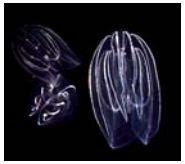
http://www.gettyimages.com/detail/200511105-002/Stone

Why aren't the children happy? They're doing science!

Possible Future Experiments

http://www.nhm.ku.edu/inverts/meg/edwardsiellalineata.jpg

- ☞ How much of an impact does E. lineata actually have on the food intake of M. leidyi?
- ☞ Does E. lineata allow M. leidyi to fully regenerate an entire ctene row, and if so, does it take the infected M. leidyi to do so?
- ☞ Does the number of E. lineata have an effect on M. leidyi in regards to the previous experiment already conducted?



http://barelyimaginedbeings.blogspot.com/2009/08/different-kind-of-ghost.html

Acknowledgements

Our group would like to thank the entire class of BI547 for help in the collection of ctenophores and parasites. We also would like to thank Tristan, Derek, and Justin for their help and guidance, along with Professor Finnerty whose infinite wisdom of every invertebrate ever was truly the guiding light down the dimly lit path of our experiment.

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