

Progression of *Aggregata* Infections in *Octopus bimaculoides* During the Senescent Period

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1. Senescence in Octopuses

After reproducing, octopuses enter a final life stage called senescence in which they undergo physiological, behavioral, and immunological changes, such as:

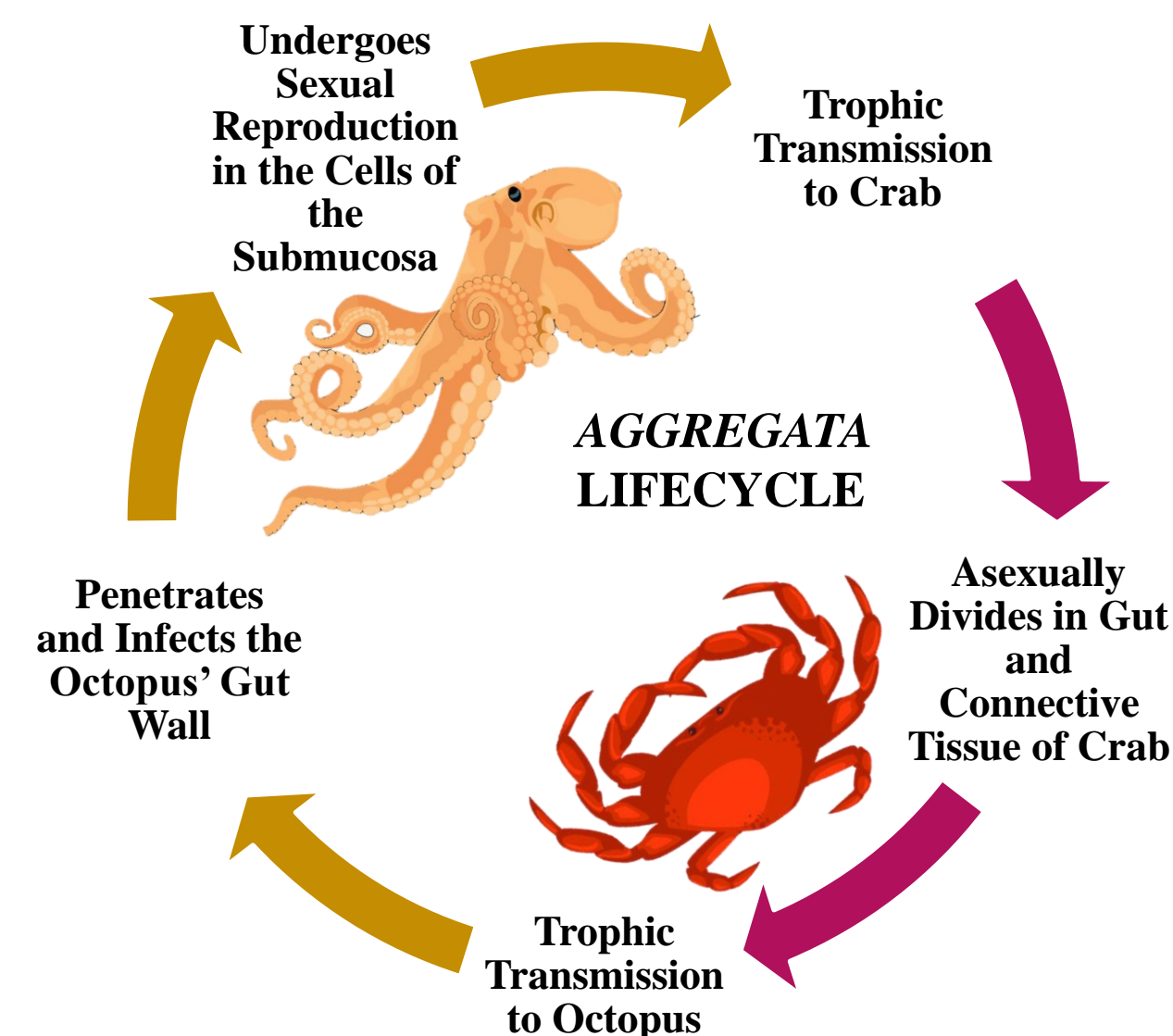
Loss of Appetite	Loss of Coordination	Skin Lesions
Loss of Long-Term Memory	Inability to Heal	Loss of Ability to Regenerate Arms

However, few studies have addressed immunodeficiency in senescent octopuses or its implications for disease.

2. Lifecycle of *Aggregata* Parasites

Aggregata must infect both an octopus and crab host via trophic transmission to complete its lifecycle.

- Trophic Transmission is a process by which a parasite reaches its next host through the consumption of its current host.



- The crab is a normal part of an octopus' diet, but a crab can only consume an already deceased octopus.

How do *Aggregata* parasites ensure their transmission from a dead host to their next host?

3. The Hypothesis

Older, senescent octopuses will have greater densities of *Aggregata* parasites and more organs that are infected.

- Octopus**
 - Using parasite expansion as a metric, octopuses become progressively more immunocompromised during senescence.
- Aggregata* Parasites**
 - Aggregata* parasites take advantage of immunodeficient octopuses by expanding their infection in order to increase the likelihood of being transmitted to a crab after the death of the octopus.

4. Methodology

- 10 adult, female specimens of *Octopus bimaculoides* will be collected from the Santa Barbara Channel.

- Females will be used because their entrance into senescence is marked by laying eggs which is more apparent than the behavioral symptoms that indicate senescence in males.

- The specimens will then be systematically dissected at time intervals spanning the senescent period (Image 1).

- In each octopus, the organs that have *Aggregata* lesions will be examined via squash plates. Photographs will be taken of each organ and analyzed via ImageJ, an image analysis software (Image 2, Image Analysis).



Image 1. Stomach tissue almost fully covered in white *Aggregata* lesions.

5. Image Analysis

- Using ImageJ, the ratio of the two-dimensional area covered in *Aggregata* lesions to the area of normal tissue will be calculated (Image 3 and 4).
- That ratio will then be extrapolated to represent the percent mass made up of *Aggregata* lesions in each organ.



Image 2. Unedited image of slice of an *Octopus bimaculoides* cecum. The white, circular areas are lesions formed by the *Aggregata* parasites. The opaque area is the normal tissue of the cecum.

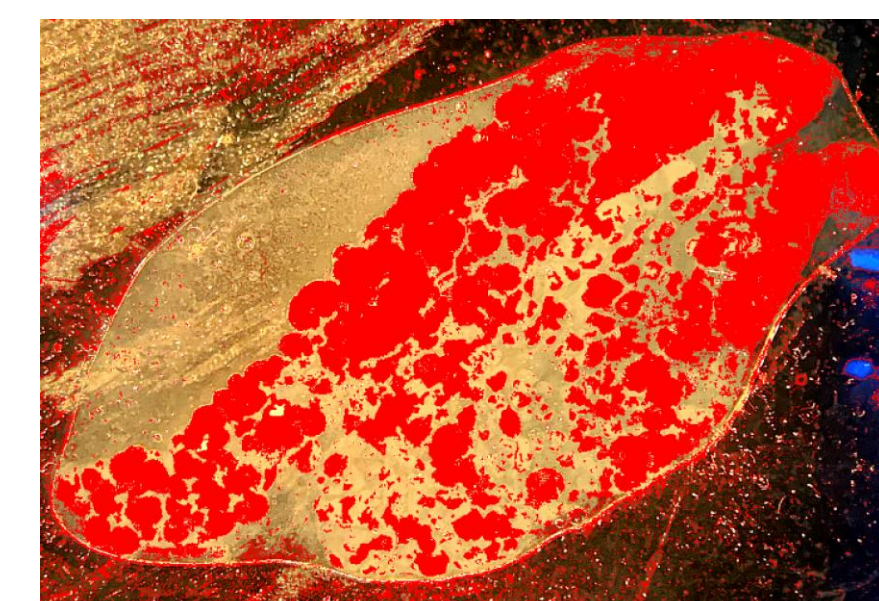


Image 3. (left) Edited Image 2 that highlights in red the area of the cecum slice that is made up of *Aggregata* lesions.

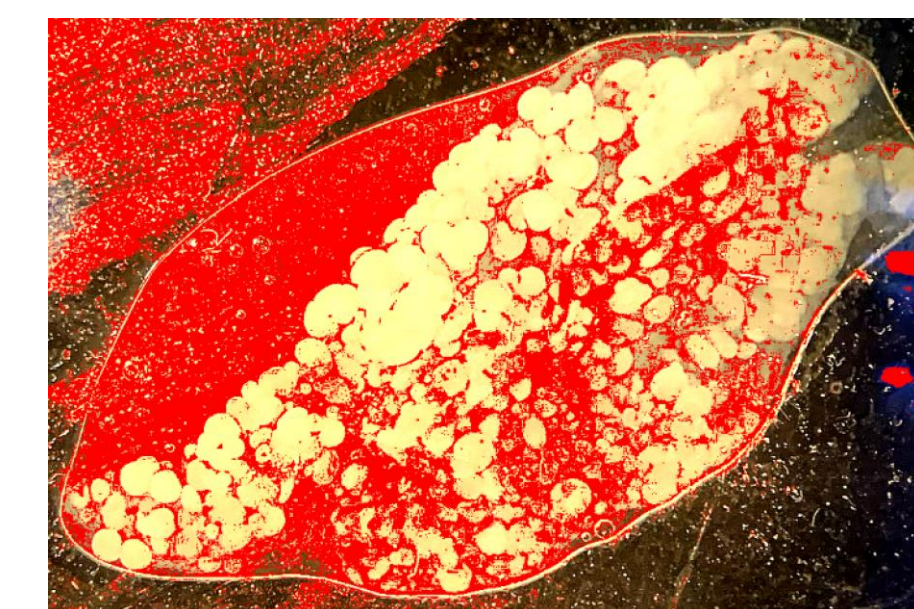


Image 4. (right) Image 2 edited to highlight in red the area of the slice that is made up of normal cecum tissue.

6. Expected Results

We expect to find that the percent mass of *Aggregata* lesions increases over time as well as the number of organs that are infected.

By tracking the changes in this proportion, we hope to illustrate possible trends in *Aggregata* infections over the course of the senescent period.

7. Relevance

- Further our understanding of octopus senescence
 - Identifying relevant changes in the octopus immune system would explain unchecked parasitic expansion.
- Sheds light on the Host-Parasite relationship
 - Taking advantage of an immunocompromised senescent octopus may be a strategy to increase the likelihood of the parasite's transmission.
- Applicable to future gerontology research
 - The study of development of immunodeficiency in octopuses may allow predictions to be made about other species that undergo senescence.

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