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The Ecology of a New Invasion by *Bellamya japonica* In the Savannah River Basin

Introduction to Aquatic Research BIOSC 494

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Abstract: Since the discovery of *Bellamaya japonic*a a new invasive species to the Savannah River Basin in 2006, the dispersal and ecological characteristics of this exotic species have largely been unknown. Aside from impacts to the HVAC systems for Clemson University, the effects of this new invasive species are still under investigation. Our studies have shown negative phototaxis, indeifference with respect to geotaxis, and now include experiments regarding fecundity, dispersal in a controlled environment, and metabolic rates. Using individual tags and an experimental pond segmented into observation regions, we will follow hundreds of individual snails, their locations, their individual growth, and individual reproduction over their entire lives. This is the first comprehensive study of its kind for a new invasive species in a newly invaded habitat. We will also study the factors influencing their metabolism in laboratory experiments.

Definitions:

Fecundity: the ability to produce offspring; the ability to cause growth; the number, rate, or capacity of offspring production; the rate of production of young by a female

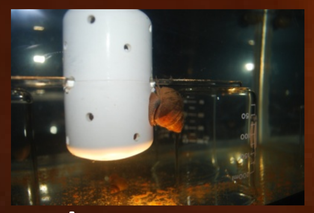
Mark-Recapture Method: A sampling technique used to estimate wildlife populations.

Introduction:

***Bellamya japonica*, the Japanese mystery snail, was first discovered in Lake Hartwell in 2006. Their dispersal has been slow and we have followed their distribution throughout this time. While previous studies focused on behavior, this study focused primarily on population dynamics of *B. japonica,* population size estimates, distribution, and fecundity. A fecundity test was conducted to determine the population estimate of *B. japonica* as a species, however, fecundity tests do not assist in determining the starting population estimate within the pond; the mark and recapture method was utilized to determine the initial population of *B. japonica* within the experimental pond.**

Previous Work:

Previous studies on *B. japonica* in Clemson University concluded that the snails exhibited a negative phototactic response in the presence of light. It was also concluded that the snails displayed a negative geotactic response, and displayed no preference in their positioning on a rocky substrate through the influence of gravity



Current Experiments:

To determine the fecundity of the snails, twenty-five females were isolated into separate chambers equipped with lids to prevent their escape.

To determine the sex of the snails, we collected dozens of them from the Lake Hartwell and the experimental pond, and transferred them to a tank within the lab of the aquatic facility. We then employed the sexual dimophism in which the right tentacle of the males was different from the females' right tentacle.

Each bucket was numbered, which made them distinguishable from one another. Each bucket also was weighted to ensure that it would sink to the bottom of the pond, and remain stationary. The buckets were also pierced with numerous small holes, which allowed fresh water and oxygen to pass through the buckets constantly. Each week, the buckets were removed from the experimental pond and were checked for the presence of offspring by each female. If offspring were present, they were taken to the lab, where we measured and recorded their weight, followed by releasing them directly into the experimental pond. The females were then replaced into their corresponding buckets, and placed back into the pond, where the process would then repeat every week.

Figure 1 **portrays the amount of offspring produced among all the females within the two weeks, when they were collected and observed. The female in Bucket 21 produced the most offspring in both weeks with eight in the first and six in the second, while Buckets: 2, 4, 5, 6, 7, 11, 12, 13, 15, 23 and 24 failed to produce any offspring within the two week period.**

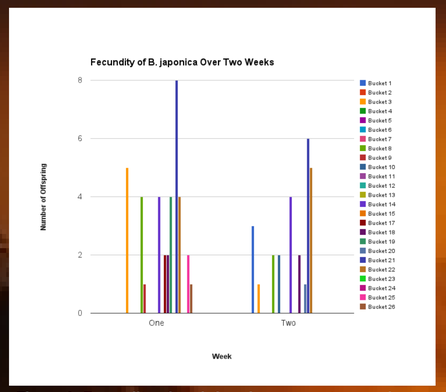


Figure 1: Fecundity of each female across a two week span

The mark and recapture method involved collecting a number of snails from the natural population (the experimental pond), returning them to that population, and then recapturing some of them. In order for this method to be effective, we experimented tagging snails with different nail polishes, and found that fluorescent nail polish, especially pink and orange, were the easiest to identify in the murky water. Along with the polish, bee tags numbered one to ninety-nine, and in various colors (blue, yellow, orange, green, and white) were super glued to the shells of the snails, just under, or above the location of the nail polish. These tags were permanent and impossible to remove from the snail once placed, however, the tags and polish had no negative effects on the snails' lives, and do not affect their overall health and survival due to the controlled environment of the pond. The pond , being thirty meters long and thirteen meter wide, was aggregated into eight equal sections (7.5 m x 6.5 m). When snails were collected from a particular section, they were tagged, weighed , and released back into the section from which they were extracted. Every time we took a new sample of snails from a different section within the pond, we tagged the new ones with nail polish and bee tags, while recaptured snails (already having been tagged) were collected, reweighed, re-measured, and their new locations were recorded. This process allowed us to track the dispersal of the tagged snails across the pond throughout the entire experiment.

In order for the mark and recapture method to work successfully, three assumptions must be satisfied: first, during the interval between the preliminary marking period and the subsequent recapture period, nothing has happened to upset the ratio of marked to unmarked animals (that is, no new individuals were born or immigrated into the population and none died or emigrated); secondly, all individuals are equally likely to be caught within each capture period. That is, marked individuals must not become either easier or more difficult to catch during the second capture period compared to unmarked individuals; lastly, sufficient time must be allowed between the initial marking period and the recapture period for all marked individuals to be randomly dispersed throughout the population (so that assumption 2 above is not violated). However, the time period must not be so long that assumption 1 fails.

The experimental pond satisfied the first assumption in that there was no immigration or emigration, as well as no predation to cause death, but with a mix of males and females together, it is a certainty that new individuals were more than likely born. The experimental pond breaks the second assumption due to the darkness of the substrate and the murkiness of the water, which made it at times impossible to see both tagged and untagged snails. Also, due to the water's turbidity, it is more than likely that snails were unseen and as a result, were not collected. Assumption three was satisfied in regards that snails were collected at least two days apart, which allowed them enough time to disperse to an adjacent section to their own, original section. However, assumption three is ultimately broken because only one to four sections were scanned and collected from at a time due to the size of the pond, the density of snails present in each section, and the increasing lack of visibility as we walked through the pond to collect the snails.

Throughout the experiment, we collected a total of 365 snails. Of the snails captured and tagged, 47 snails (12.88% of total tagged snails) were recaptured, and only 6 snails (12.77% of all snails recaptured) were recaptured twice. Table 1 depicts all the snail that were recaptured, as well as their original and newly dispersed sections within the pond. Of all the recaptured snails observed, only 10 () dispersed into a new location, indicating that we either did not see the others while recapturing, or that we did not allow enough time to lapse for them to disperse adequately.

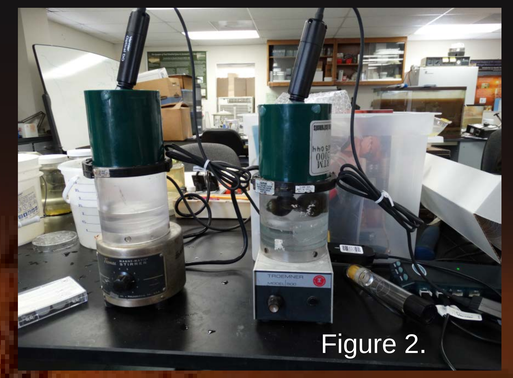


Figure 2.

Metabolic Studies:

Experimental chambers were fabricated in order to accommodate the measurement electrodes as well as the snail specimens (Figure 2). Snails were cleaned to remove biologically active material on the surface of their shells and tested to determine cleaning success.

Specimens were collected locally and allowed to acclimate do room conditions prior to measurement. Water was collected from the field and also allowed to achieve room temperatures.

In the future, multiple temperatures will be employed to determine the effect of temperature on metabolic rates. We will also attempt to measure size dependence and the relationships, if any, to other variables such as light, sex, and presence of other organisms or aquatic conditions. Typical results are shown in Figure 3.

Figure 3. Oxygen consumption by B. Japonica. The blue line is the water control treatmetn and the red line is the consumption in the chamber containing snails.