Abstract

Observations of several species from a taxonomically diverse group of amphibians, reptiles, arachnids, coleopterans, lapidopods and molluscs have suggested that clustering of eggs is a survival strategy through which rates of predation or desiccation are decreased. The dogwhelk Nucella lapillus is an intertidal predatory snail that deposits egg capsules under intertidal rocks in clusters of up to 1000 capsules. These benthic egg capsules are then left to develop undefended for up to four months. This study investigated the adaptive significance of clustering eggs capsules by manipulating cluster size in the field over a five week span. In this study and previous work it was found that capsules themselves provide little direct protection against predators. However, it was found that clustering of egg capsules is beneficial and significantly reduces predation relative to uniformly spaced egg capsules. Similarly, it appears that encapsulation is an ineffective means to prevent desiccation induced mortality in the embryos. However, this study found that clustering of capsules significantly reduced mortality due to desiccation. Overall, clustering increased survival among egg capsules and the increase in survival was roughly proportional to cluster size. In addition we conducted laboratory predation trials to identify potential predators on N. lapillus egg capsules. We found that lobsters, green crabs and rock crabs all consumed N. lapillus capsules in the lab but hermit crabs did not.

Introduction

Nucella lapillus is a common predatory snail in the rocky intertidal throughout the North Atlantic. N. lapillus deposits small egg capsules, approximately 10 mm high and 3 mm in diameter, from which 12-36 juveniles emerge (Feare 1970; Crothers 1985; Costello and Henry, 1971). Encapsulation of the embryos alone has proved to be ineffective at deterring predation as well as desiccation (LDA unpub., Spight 1977, Schecken 1983). Adult cluster these capsules in aggregations, which can grow to be quite large and contain over 1000 egg capsules (Crothers 1985). In some amphibian and insect species clustered eggs have greater rates of survival when climate conditions promote water loss (Clark and Faeth1998). Observations of several species have shown that clustered eggs have lowered rates of predation (Agarwala and Dixon 1993, Farag et al. 2002). We tested whether the size of egg capsule clusters affected rates of mortality due to predation and desiccation.

Methods

Field Experiments

- Egg capsules were glued onto rocks in 3 possible arrangements: 1 cluster of 100 capsules, 2 clusters of 50 capsules, and 100 capsules uniformly spaced 1 cm apart
- Rocks were deployed at the low tide line
- The number of capsules that were clipped, missing or discolored were recorded every day for four days
- The number of capsules eaten were recorded every week for 5 weeks
- Rocks were deployed one meter higher in the intertidal one week later on July 8, 2010. Each rock had two clusters of 50 capsules, one cluster of 100 capsules, and 100 eggs in an uniform distribution.

Lab Experiments

- Hermit crabs, lobsters, green crabs, and rock crabs were placed in cages with 9 egg capsules spaced on a rack in a uniform distribution
- The number of capsules eaten were recorded every day for four days

Results

Clustering Reduces Egg Capsule Predation

![Fig. 2](image)

Week

1 2 3 4 5

Percent Capsule and Missing

0 10 20 30 40 50 60 70

Uniform 100 Cluster of 50 Cluster of 100

Clustering Increases Survivorship

![Fig. 4](image)

Week

1 2 3 4 5

Percent Capsule and Missing

0 20 40 60 80 100

Clustering Reduces Desiccation Mortality

![Fig. 5](image)

Week

1 2 3 4 5

Percent Capsule and Missing

0 20 40 60 80 100

Conclusions

- Increasing cluster size increases egg capsule survivorship
- Clustering decreases the rate of predation on egg capsules
- Clustering reduces the rate of desiccation experienced by egg capsules
- There are high rates of mortality for capsules deposited in the intertidal zone regardless of cluster size
- Desiccation and predation appear to be roughly equal threats to encapsulated embryos.
- Green crabs, rock crabs, and juvenile lobsters are likely natural predators on egg capsules

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References