Optimal Foraging of Whelks in the Intertidal Zone

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Introduction

Mussel beds function as both a source of food and refuge for many intertidal species. Whelks *(Nucella emarginata)* are keystone predators in the intertidal whose primary prey are mussels. Little is known about the effect of mussel size on whelk predation. Given how important this relationship is to maintaining community diversity, understanding its dynamics is an important step in understanding intertidal community dynamics as a whole. The goal of this study was to determine the theoretical best size mussel for whelks to consume, to determine which mussel size promotes the best growth of whelks, and to conduct observations to determine which size mussels whelks are actually consuming in the field.

Figure 1: Mussel beds and the many species that inhabit them, Ellwood Beach, CA.

Figure 2: Top-bottom, measuring mussel length, weighing internal mass

Mussel Dissections

Goal: Determine relationship between mussel length and internal tissue mass to theoretically determine best size mussel to consume.
Methods: Measured length using standard digital calipers; dissected and weighed internal mass. Plotted mass vs. length to graph relationship.
Results: Relationship between mussel length and internal mass is exponential; larger mussels have proportionally more tissue mass per mm.

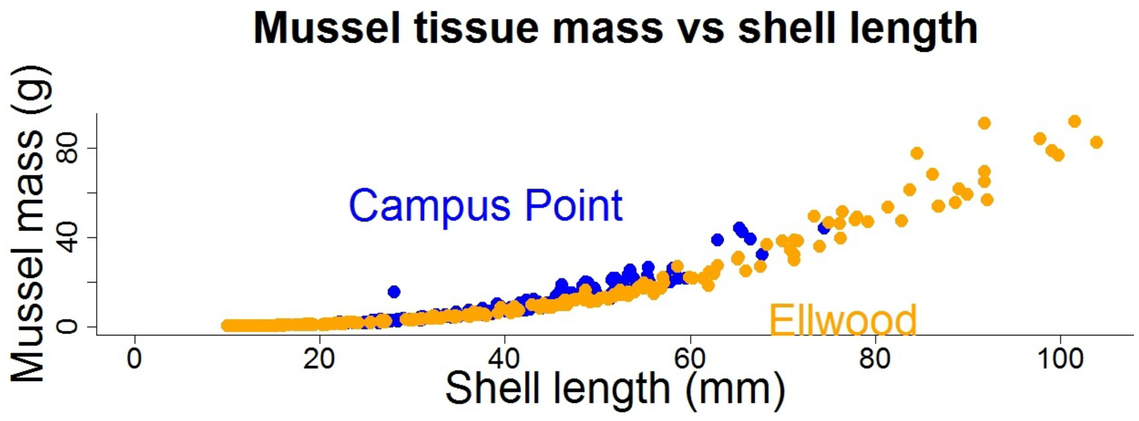

Figure 3: Plot of mussel length vs. internal mass

Growth Trials

Goal: Perform lab and field trials to determine which size mussel promotes best growth in whelks-experimentally determining if theoretical best size mussel equates to most productive food for whelk.

Methods: Devised cages to hold mussels and whelks in the field; attached to intertidal and allowed to grow for two weeks. Compiled containers with mussels and whelks in the lab, allowed to grow for one month.

Results: Whelks showed greatest growth when feeding on mussels less than 45mm.

Figure 4: From top to bottom: container setup in lab, cage attached to intertidal

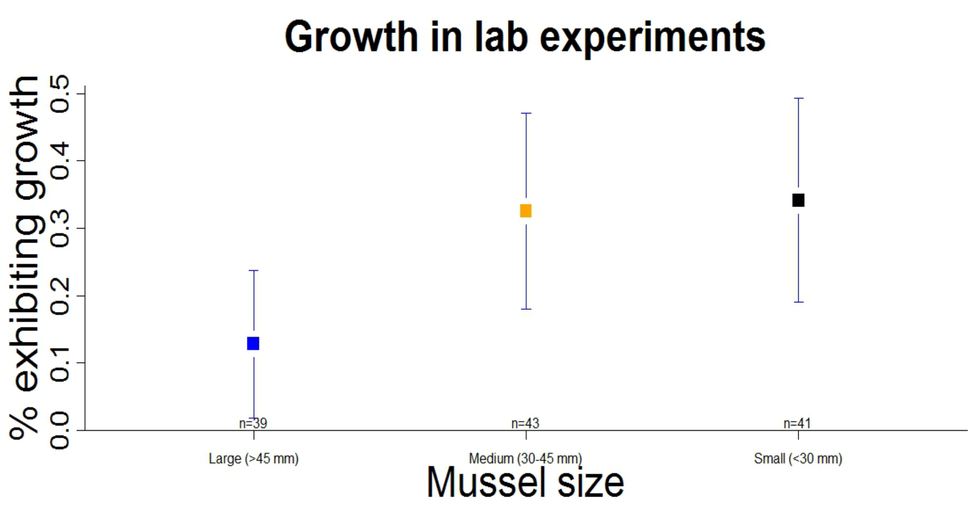

Figure 5: Percentage of whelks that grew in each mussel size range

Figure 6: A whelk resting on a mussel shell-note the hole drilled into the right side of the mussel shell, implying whelk predation

Field Observations

Goal: Determine if whelk predation is random by comparing length of eaten mussels with mussel size distribution. This would determine if whelks are capable of differentiating which size mussel optimizes their growth.
Methods: Use data from dissections to plot mussel size distribution, conduct field observations to record sizes of whelk-consumed mussel shells found in the field.
Results: Whelk choice is not random-there is a selection of mid-size range that seems to optimize calorie intake and drill time.

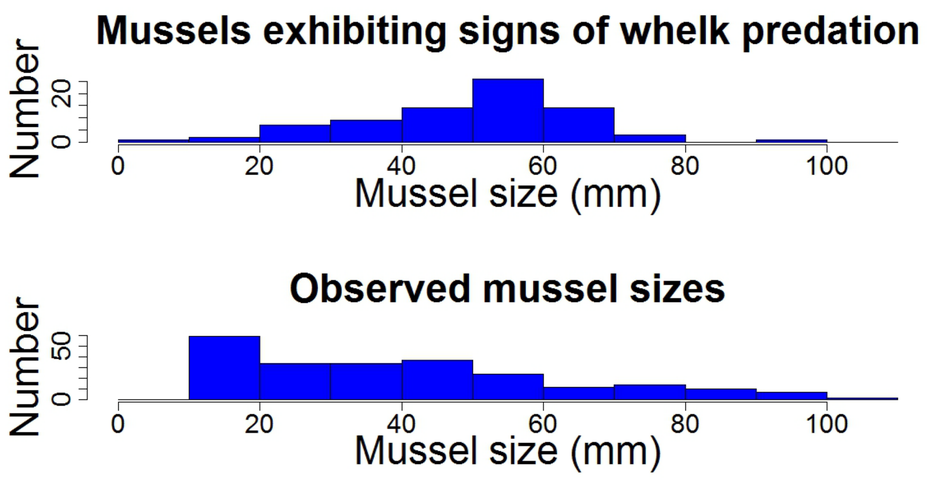

Figure 7: Comparison of mussels eaten by whelks (top) and mussel size distribution (bottom)

Discussions

Larger mussels provide proportionally more flesh for whelks to consume. However, based on our growth experiments and observations, whelks actively choose to consume smaller to mid-size mussels. Based on these results, we concluded that whelks tend to consume prey that maximizes their growth, balancing calorie intake and drill effort. These dynamics may change in the face of potential environmental change and/or ocean acidification if mussel shell composition alters, making large mussels easier to access.

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