The image contains a research project report on the Plausibility of Benthic Sea Floor Ranching using sea cucumbers. The main focus is on investigating the barriers to juvenile California Sea Cucumbers, *Parastichopus californicus*, in a sea floor ranching environment.

### Background
Integrated Multi-Trophic Aquaculture (IMTA) is a polyculture of organisms which feed at different trophic levels. It is an ecosystem based management practice where one organism’s waste becomes a food source for another. Most of the waste particles generated from fish farms settle directly beneath the pens. Detritus feeding organisms cultured below fish pens would help recycle the waste. A promising detritus feeding species for an IMTA system is the California sea cucumber, *Parastichopus californicus*, due to its high market price and its ability to absorb fish feces.

Benthic Ranching is an ideal culture method because it would allow for optimal waste removal as well as being the most affordable method. However, there has been little research on how to restrict sea cucumber movement to the farm tenure.

### Laboratory Experiment
**Objective:**
Observe and record sea cucumber location in tanks after 24 hour lab trials.

**Experimental Design:**
Substrates tested were silt, fine sand, coarse sand, oyster shells, and silt with oyster shells. Two size classes were Small (5 cm) and Large (10 cm). Sea cucumbers placed on a hard PVC sheet to act as a desirable substrate.

### Size Class Results

**Figure 2.** The mean percent of ‘Small’ (5 cm) and ‘Large’ (10 cm) juvenile sea cucumbers on the PVC sheet and oyster shells after 24 hours with standard error bars. The sample size was 5 sea cucumbers per size class and data were analyzed with a two-way ANOVA.

**Take Away:** Analysis revealed that when oyster shells were present, there was significantly less sea cucumbers on the sediments than the other treatments.

### Treatment Results

**Figure 1.** The mean percent of juvenile sea cucumbers on the PVC sheet and oyster shells after 24 hours with standard error bars. The sample size was 10 sea cucumbers per treatment and data were analyzed with a two-way ANOVA and Tukey HSD post-hoc test.

**Take Away:** Analysis revealed that when oyster shells were present, there was significantly less sea cucumbers on the sediments than the other treatments.

### Implications
Sediments do not restrict movement, but the presence of a preferred substrate, oyster shells, do.

Size class is important when considering movement and behavior.

Future work should include adult sea cucumbers and a field study is highly recommended.

### Literature Cited

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### Research Question
Is there a substrate type that is a biological barrier for juvenile California sea cucumbers that could naturally restrict their movement in a sea ranching environment?

### Literature Cited


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