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Exploratory 2

Preference in two sea stars, *Pycnopodia helianthoides* and *Pisaster ochraceus,* for the limpet *Acmea Mitra* (Dunce-cap)

Introduction

Coralline Algae (*Lithothamnion sp.*) occurs in multiple forms throughout the urchins beds of the pacific sea shore. Much of the pits and rocks are covered in encrusting Coralline Algae, which the urchins feed on. Camouflaged within this area is *Acmea mitra*, the Dunce-Cap limpet. Its cap looks like a Chinaman's hat, tall, wide at the bottom with a dull spire. Though normally white the shell of this limpet is commonly found covered in Encrusting Coralline Algae which it also feeds on. Having Coralline Algae growing on its shell is thought to be an adaptation to mask the scent of the limpet or make it undesirable to other predators such as *Pycnopodia helianthoides* (*Pycnopodia*) and *Pisaster ochraceus* (*P. ochraceus*). This idea was generated through an escape response experiment, which showed that *Acmea mitra* displayed no response to *Pisaster* and *Pycnopodia* inferring that it is not their natural prey (Carefoot). If this is true then some would expect the abundance of *Acmea mitra* to be greater because the rest of the commonly found specimens in dense Coralline Algae areas are the lined chiton (*Tonicella lineata*), Northern Abalone (*Haliotis kamtschatkana*), and the Purple Sea Urchin (*Strongylocentrotus purpuratus*) none of which would feed on the limpets. Birds are an unlikely predator also because these limpets are found lower in the intertidal region and have a very powerful foot that keeps them stationary against waves making it hard for the birds to pick them off. Few of the *Acmea mitra* seen lack the Coralline

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Algae growth on its shell implying that they may be easier prey, have a harder time camouflaging /deterring predators, or adopt the growth early in life.

Pycnopodia feeds on many different groups of animals. It is a fast moving predator and preys mainly on crabs and crustaceans on the pacific northwest, but can also be found feeding on squid (Paul & Feder 1975). *P. ochraceus,* a slower moving sea star, is found higher in the intertidal area and mainly feeds on mussels, barnacles, chitons, and snails (Sept 1999). Both of these predators can be found inhabiting the same area as *Acmea mitra* though are not commonly known to feed on them, it is not very clear what feeds on *A.mitra* to keeps its density so low. This investigation will be to determine whether *Pycnopodia* and *P. ochraceus* feed on *Acmea mitra* when it is not masked by Coralline Algae.

Methods

Acmea mitra was collected from urchin beds at Cape Blanco, Bandon and Middle Cove, Cape Arago, Oregon. Two limpets had no Coralline Algae on its shell and five did (Originally meant for another project). *Pycnopodia* was placed in a Y-maze with a choice of a rock with encrusting Coralline Algae on one side and a control rock on the other. This was done three times alternating the placement of the rocks to determine if the sea star avoided the Coralline Algae. Next a limpet without algae was placed on one side and one with Coralline Algae was placed on the other side. This was done to test whether or not the sea star would choose *Acmea mitra* if it didn't have the Algae. The sea stars were given as much time as was needed for it to decide on an arm of the maze, this was repeated five times. All steps were also repeated with *Pisaster ochraceus.*

Results

Pycnopodia's performance in the Y-maze experiment

Choice	Control rock vs. Rock w/ algae		*A. mitra* w/Algae vs. *A. mitra* w/o algae	
	1	2	5	2

Table 1. Displays the results then *Pycnopodia* was faced with a choice of a control rock with on Coralline Algae on one side of the Y-maze and a rock encrusted with coralline algae. The other is the results when *Pycnopodia* was faced with *Acmea mitra* with Coralline Algae encrusted on its shell and one with out.

Pisaster ochraceus performance in the Y-maze experiments

Choice	Control Rock vs. Rock w/ algae		*A.mitra* w/algae vs. *A.mitra* w/o algae	
	3	1	--	--

Table 2. See explanation from Table 1. Blank spaces (--) represent in consistent results.
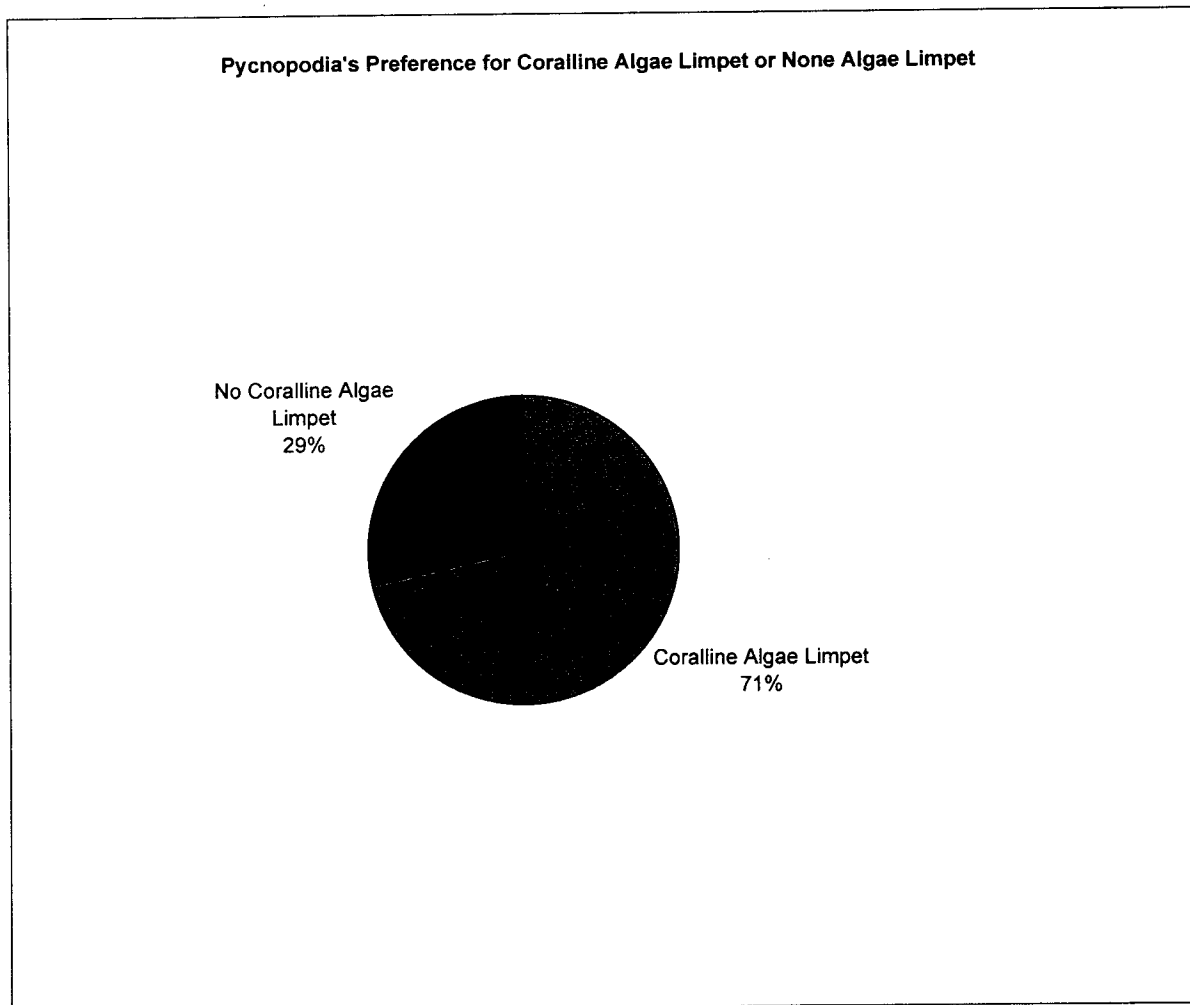

Figure 1. The percent of times *Pycnopodia* chose the Coralline Algae side of the Y-maze

Pycnopodia helianthoides chose the rock with Coralline Algae two times out of three and the Coralline Algae limpet five out of seven times (Table 1). The response of moving down one arm of the maze took between 6 minutes to 20 minutes at most for *Pycnopodia* to decide. However *P. ochraceus* presented a problem. In the preliminary trails to determine bias between the control rock and the rock with Coralline Algae *P. ochraceus* moved to one side by the thirty minute mark, but when faced with the choice between the two limpets it did not move (Table 2). *P. ochraceus* stayed at the end of the maze where it was originally placed. Even when left for 24 hours it remained, it was removed rinsed out and tried again for another 24 hours and *P. ochraceus* did not make a decision so that section of the experiment had to be abandoned.

Discussion

It is unexpected that *Pycnopodia helianthoides* would choose to follow the "scent" of the Coralline Algae. It is not common that the sea star feeds on the Algae, however it does feed on *Strongylocentrotus purpuratus* which is found in the same habitat as the Coralline Algae and *A. mitra* (Duggins 1983). *Pycnopodia* could be linking the chemicals released by the Coralline Algae to finding *S. purpuratus* because they are so commonly found together. In light of this it does not appear to be likely that *Pycnopodia* feeds on *Acmea mitra* even when the limpet is not masked by Coralline Algae. Another experiment could be preformed with *Pycnopodia*, *S. purpuratus*, and *A. mitra* all placed in a holding tank to see if the sea star prefers to eat the urchins.

Pisaster ochraceus appears to not be a predator either because it shunned the Coralline algae and did not make a decision either way between the limpet with the Coralline Algae and the limpet without. Initially *P. ochraceus* was thought the most

likely to prey on *A. mitra* because it is found in a wider span of the intertidal zone and is also more commonly seen when observing areas of greater Coralline Algae density. The results have not substantiated these assumptions. *P. ochraceus* has no interest in the *A. mitra* and isn't affected the same ways as *Pycnopodia* so they both may use different cues to attract them to food. *P. ochraceus* prefers stationary prey such as the California Mussel and Barnacles (Sept 1999), Coralline Algae doesn't grow together with these animals and may account for the lack of response. It has no association to the Coralline Algae and food like the *Pycnopodia* might have evolved.

The results also indicate that *Acmea mitra*'s feature of having Coralline Algae on its shell is not needed to deter sea stars like previously thought. This alters the thought behind this experiment leading to new ideas. The Algae growth is most likely used as camouflage and maybe protection against desiccation not defense. *A. mitra*'s shell is very thick but is naturally white allowing it to dry out more quickly and more susceptible to UV rays. This could be tested by comparing desiccation rates of *A. mitra* covered with Coralline Algae against those without the cover. In conclusion *P. Ochraceus* has no preference for the limpet *A. mitra* with or without the Coralline Algae covering and *Pycnopodia helianthoides* seems to prefer the *A. mitra* with Coralline Algae. After further testing it can be determined if this preference is for feeding on the limpet or as a cue to finding urchins instead which the sea star may prefer over the limpet.

References

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