Directional Movement of *Urticina crassicornis* in the Presence of a Conspecific

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Abstract

Many sea anemones aggregate, including *Urticina crassicornis* (common name: the Christmas or painted anemone). This species occurs on the docks and shores of the Friday Harbor Laboratories as well as the intertidal zones around San Juan Island, Washington. There are many benefits to grouping behavior, such as protection from predators, and propinquity to other reproductive conspecifics. To test wether *U. crassicornis* migrates in the direction of conspecifics, two anemones of this species were placed in different sections of a Y-maze. The distance traveled by both anemones was recorded. *Urticina crassicornis* does move; however the context of that movement is unclear. The results are especially interesting in the context of potentially adaptive behavior of anemones as a phylogenetic group.

Introduction

Sea anemones of the species *Urticina crassicornis* form aggregations on the docks of Friday Harbor Lab as well as the intertidal zones of San Juan Island, Washington. They can be found attached directly to the wood, or tires that line the sides of the dock. Anemones in the genus *Metridium* are also found attached to the docks. In Monterey Bay, California *M. senile,* Linneaeus, 1761, has been shown to migrate across an "anemone free zone," coming into contact with nonclonemates of the same species (Purcell & Kitting, 1982).

The many benefits of aggregating are discussed in Francis (1973): An anemone in close proximity to another individual lessens the likelihood of being chosen prey. It is also less likely that an organism of another taxa will attach, reducing interspecific competition for space. In addition, tight groupings reduce risk of desiccation during low tide.

All of the advantages just mentioned can be applied to *U. crassicornis.* Unlike *M. senile*, which can reproduce sexually and asexually, *U. crassicornis* only reproduces sexually by free spawning on Friday Harbor (Chia & Spaulding, 1972). This mode of reproduction becomes less effective when reproductive members of a community are settled too far a part (Levitan & Sewell, 1998). Therefore, the fitness of individuals increases as distances between them is reduced. It is evolutionarily advantageous for free spawning species to settle near conspecifics. For these reasons, I hypothesized that individuals of *U. crassicornis* would move in a way that diminishes the distance between them.

Materials and Methods

This study was conducted at the Friday Harbor Laboratories, San Juan Island, Washington. Specimens were collected off the sides of the docks in front of the laboratories as well as the tires hanging off of the docks. Testing was performed through 5 trials with a Y-maze constructed out of acrylic. At the top of each branch of the maze, an incurrent flow of seawater entered at a rate of 41.74 mL/s. Plastic tubes divided the water source so that equal amounts of seawater could be distributed through both sides of the Y branches. The branches were also elevated 7.5 cm.

Each trial included a pair of anemones, each adhering to a square glazed ceramic tile. Each pair were chosen by their similarities in column height, and base diameter. One animal was placed at the top right branch of the Y-Maze, and the other (the "test" anemone) downstream at the intersection of the branches (Figure 1). The anemones were blocked from sunlight using a plastic tarp and sheets of wood to hold the tarp in place, to create a more hospitable environment for the anemones (they are normally found in shady or dark environments). A different pair of anemones was used for each trial, except for trial 4, which reused an anemone from the previous trial. In trial 4, the trial 3 anemone was placed at the inflow position, whereas it had been placed downstream at the intersection in the previous trial. Each trial ran for 24 hours, except for trial 1, which ran for 48 hours.

Photographs of the anemones were taken at the beginning and end of each trial. Using ImageJ, I measured the anemone movement by calculating the change in distance (in mm) between the two anemones, as well as the test anemone to an unchanging point of reference, the edge of its tile (in the upstream direction) closest to the base. Nearest neighbor distance was measured in reference to the individual's bases. Analysis of measurements was performed using the One Sample T-test

Results

The overall distance between two anemones decreased (One Sample T-test, $P = 0.011$), while the "test" anemone moved in the upstream direction in a way that was statistically significant (One Sample T-test, $p = 0.053$). However, the upstream anemones moved a significant amount, more than those of the test anemones, with aaverage distance downstream = 8.8 mm compared to 1.71 mm upstream (Tables 1 and 2). Nor did the test anemones move a distance large enough to pass the intersection of the branches of the Y-maze.

Discussion

While the p-value of the test anemones shows a significant amount of movement, these anemones did not move enough to show a preference for either branch of the Y-maze. It is not clear if they moved in response to the upstream anemone or the incurrent flow from either branch of the Y-maze, independent of conspecific odors in the incurrent flow. If they had moved a distance great enough to pass into a specific branch of the Y-maze, preference for the left or right branch may have been determinable. Though the anemones did move (Tables 1 & 2), I cannot support the biological significance of this movement. For this reason. I also can not I reject the hypothesis that members of *U. crassicornis* move in a way that diminishes the distance between conspecifics.

The upstream Anemones moved a greater distance than the test anemones. However, they could not detect the downstream anemones, as the current flowed in only one direction. It is possible that they were moving in response to being in the immediate vicinity of the incurrent water opening. In this case, the upstream anemones were not moving in a way that would decrease the distance between conspecifics.

Other organisms, including various species of anemones including *U. crassicornis*, have been found to grow inside and around the pipes that supply seawater to the lab (Kevin Turner). It is very possible that the "odor" of other *U. crassicornis* specimens could have affected the results. The odor of the upstream anemone combined with those external to the Y-maze could have influence the movement of the test anemone in the upstream direction towards conspecifics, while the blast of seawater containing the smell of other members of *U.crassicornis* in conjunction with turbulence onto the upstream anemones could have influenced their movement in the downstream direction.

Urticina crassicornis does move, but the cause of movement is unclear. A greater number of trials, a larger sample size, and a more secure testing environment where incurrent flow of seawater has not been in contact with organisms external to the experiment would be needed. If the hypothesis that *U. crassicornis* moves in the direction of conspecifics is not supported given further testing, how do they end up living in such close proximity to one another? Do they settle there randomly or can they sense each other during the initial settling period? If further testing yields similar results and it can be concluded the *U.crassicornis* does move in a way to reduce distance between conspecifics, we can postulate the significance of this aggregating behavior.

Figure 1. Pair of *U. crassicornis* specimens in Y-maze.

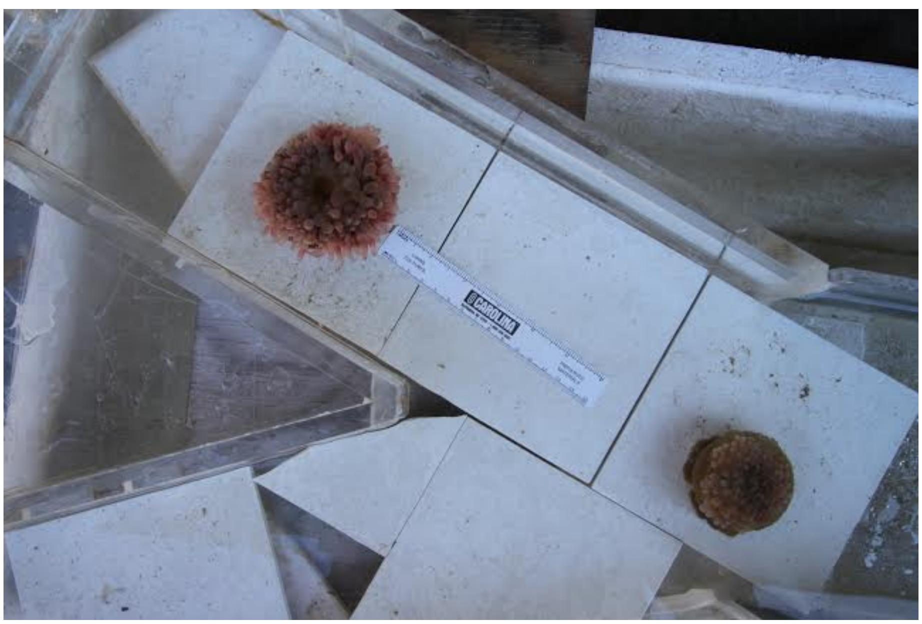

Table 1. Change in Distance Between Two Anemones (mm)

Trial 1	14.52
Trial 2	9.45
Trial 3	3.29
Trial 4	8.68
Trial 5	16.63

Table 2. Change in Distance of Downstream Anemone (mm)

Trial 1	2.44
Trial 2	0.17
Trial 3	1.88
Trial 4	3.58
Trial 5	0.50

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Citations

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