Population studies can be very instrumental in learning about how an organism functions. Where they are and their environment decides how they interact with the organisms around them and how they live. Population studies can show an organism�s eating or reproductive habits, or their dependence to sunlight or water and how their environment has effected their development. By studying the anthopleura xanthogammica, or the giant green sea anemone, I hope to understand how certain factors affect its distribution. By comparing the depths, sizes, and exposure to sunlight of anemones at Pilliar Point in Half Moon Bay, I hope to learn more about how and to what extent each impacts them. In order to understand why sunlight and depth might affect where the anemone lives within the tidal region one must know a little about the anemone itself and how it lives.

The anthopleura xanthogammica or the great green sea anemone is a beautiful creature that lives along the coast all the way from Alaska to Panama, and is very abundant in the tide pools of Half Moon Bay. The great green sea anemone is a fairly simple organism. They are radially symettrical invertebrates and have no skeletal system at all. Their body wall is two cellular layers thick, and their stomach is their only cavity. Also, they have only one opening that they use to bring in food and get rid of wastes since they have no anus. Water is always going in and out of the anemone through the gullet. It helps to bring in oxygen and take wastes out. They use the salt water like most animals use blood. Since the anemone doesn�t have blood or a circulatory system, they use the water to bathe their cells and move things throughout their bodies.� Also, the anemones are osmotic conformers which means that they are �unable to control osmotic flooding of their tissues� (<http://www.ma.org/classes/oceanography/mireson/anemone.html>) so the salinity of their bodies is dependent on the salinity of the water that surrounds them. However, large changes in the ionic concentration of the water doesn�t hurt them.

�They belong to the phylum cnidaria, which refers to the nematocysts or cnidae that are in the tips of their tentacles that they use to sting their prey. It is also called Coelenterata which is in reference to the one gastrovascular cavity that the creature has that serves as its lung, intestine, and stomach. Other than anemones, there are also jellyfish, corals, and hydras in the phylum cnidaria. Within this phylum, there are two variations; the creature can be a polyp or a medusa. Polyps are circular creatures that attach to the substratum or a hard surface on the substratum. An example of this would be the anemone. A medusa is like a polyp, but it doesn�t attach to anything, and remains free-floating. An example of a medusa would be a jellyfish. Anemones belong to the class anthozoa which literally means from Greek, �flower animals�. All anthozoans are polyps. It is very common for polyps to have a symbiotic relationship with other organisms around them. The anthopleura xanthogammica shares a symbiotic relationship with a photosynthetic algae that is not essential to its survival, but very helpful. Because of this, being in the sun would be advantageous for this type of anemone. However, the anemone also needs to avoid too much sunlight so that it can stay alive and prevent desiccation. These two characteristics would influence the distribution of the anemone within a tide pool.

Tide pools are generally divided into four different zones. There is the splash zone, the high intertidal zone, the middle intertidal zone, and the low intertidal zone. The splash zone is the area that usually isn�t even covered by the really high tides. The only time that it really gets wet is when water splashes up from the ocean, or it rains. There are few organisms that live here, most of which are algae or marine lichen that cover themselves in slimy cases so they can be protected from the sun. The high intertidal zone has a little more life. Shore crabs and many barnacles live there. It is covered with water only about 10 percent of the time, and is almost as dry as the splash zone. The middle intertidal zone is always changing, and deserves the name �intertidal� more than any of the other zones. Almost daily, it goes from being completely covered with water, to being totally exposed. The animals that live there are mostly dependent on the water, but unlike the animals in the low intertidal zone, they can tolerate more exposure to air. The low intertidal zone is the part that is almost always covered, and is only out during the lowest parts of the tide. This is the area where most of the life of the tide pools tends to be, including the creatures that the sea anemone preys on.

The anemone tends to be primarily in the intertidal area, and isn�t found much over 50 fathoms underwater. (Johnson/Snook 86) This is largely due to what they eat. They�re carnivores that eat whatever they can sting with their tentacles and engulf. This includes mussels, crabs, fish and other things that the tide brings to them. The anemones wait for the tide to bring them food or for their prey to wander over. Since they eat mostly what the tide brings them, they live predominatly at the bottom of surge channels where there is maximum water flow. They are also often found near mussel beds where they settle as larvae. They start out as eggs that develop into larvae that swim around for a few hours or days until they attach to something and start to develop into an adult. When their prey comes to them, they use the tiny cilia and nemotocysts that are in their tentacles to sting it and bring it inside the one opening that it has. Scientists have also observed that maybe they have a sort of suction mechanism in their tentacles as well (Kozloff 166). The cilia on the tentacles are always beating towards the tip, and if something crawls over to them that they don�t want to eat, the cilia push it to the tip of the tentacle where it falls back into the water. However, if the anemone senses something that they do want, then the tentacles point themselves towards the mouth and the cilia continue beating towards the tip, but since the tip is now facing the mouth, the food gets dropped in, and it goes down to the gullet to the stomach cavity, where there are strong enzymes to break it down. There are no cilia on the disk of the anemone so anything that lands there, such as grains of sand, usually stay there. The tentacles are usually out, but when the anemone is eating or when it is dark outside, it will close up. If a green sea anemone is kept in an aquarium in a dark room, it will stay closed. Most species of anemones will close during the day time to keep itself from drying out, but the xanthogrammica stays open in the sunlight so that the algae that it lives with can use the sunlight for energy. However, if they are in a place that is relatively dry, they will remain closed and cover themselves with pieces of sea shells and pebbles to reflect the light and protect them from drying out.

An anemone eating a crab.

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Many species of anemones that are symbiotic with other organisms are symbiotic with types of fish that hide in the tentacles of the anemone and attract prey for or protect the anemone, but the xanthogrammica is symbiotic with algae. The two types of algae that the anemone shares a relationship with are the zoochlorellae and the zooxanthellae. �One or both can become concentrated in the tissue lining the digestive track, branches of which are in the core of each tentacle.� (the intertidal wilderness). Since the digestive tract runs through each tentacle, the tentacles of an anemone with the algae will be green because the color will show through the top layer of tissue. Zoochlorellae is a bright green color, where zooxanthellae is a yellow brown color since is has pigments that hide chlorophyll. Zooxanthellae are dinoflagellates which are unicellular eukaryotes that have a pair of flagella, unless they are in the symbiotic stage and then they have none. �Zooxanthellae is also found in some corals in their gastrodermis. The algae helps the coral get nutrients and grow fast enough to make reefs, which is very important to their survival. For the anemone, the algae serves a very similar function. The algae produces organic compounds and wastes that the anemone uses to promote growth. In return, the algae uses the carbon dioxide and nitrogenous wastes that the anemone produces for photosynthesis. The anemone is less dependent on the algae than the coral is, but it is still important for its growth since the algae helps to provide nutrients. If the anemone is in a shadier place and the algae can�t survive, then it will be less of a dark green or brownish color, and more white sometimes with a tint of pink or lavender. But, since they are receiving less nutrients, instead of growing larger, they can shrink in size until they die.

the picture above is of one of the anemones from the tide pools that was found in a sunny place, so the algae receive plenty of sun to carry out photosynthesis.

This anemone was found in a much shadier place, and as a result can�t support the algae, making it much paler than those found in a sunnier area.

By examining the a. xanthogammica at Pillar Point in Half Moon Bay, I hope to get a better understanding of the extent to which the symbiotic relationship with the algae will affect the anemone by looking at their distribution in a shady area and comparing it to their distribution in a sunnier place right next to it. By looking at the sizes, numbers, and relative depth of the anemones in each area I will hopefully have a clearer idea of how they cope with supporting algae while preventing dehydration. The anemones must avoid too much harsh sunlight otherwise they will dry up, but they will receive less nutrients and grow less if they avoid the sun altogether because the algae will be unable to survive.