The Purple Encrusting Sponge:

*Haliclona permollis*

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Section 04

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There are many different aspects to *Haliclona permollis*, the purple encrusting sponge. Despite the fact that *H. permollis* lacks true tissues, this animal has a lot of interesting features. This sponge is able to feed itself from its sedentary marine position just by pushing water through pores. The purple encrusting sponge has choanocytes that are derived from flagellated cells used for movement during the larval stage. The animal can live in both calm underwater areas on docks as well as in intertidal regions with intense wave action. *H. permollis* also holds fairly high levels of arsenic based compounds compared to related sponges that live in similar habitats. Another intriguing role that this sponge has is that it houses some organisms and steals substrate from others, all the while filtering out food and toxins from the sea in which it lives. All of the unique features of *H. permollis* makes it an interesting sponge to study.

*Haliclona permollis* a part of the kingdom Animalia. That means that it is a multicellular, heterotrophic eukaryote with tissues that develop from embryonic layers. Because animal cells lack cell walls, they need a unique protein, called collagen, to give cells structural support. Being heterotrophic means that animals have to consume their food, they cannot make it through photosynthesis (Campbell et. al, 2008). In this kingdom, *H. permollis* is a part of the subkingdom Radiata, and the phylum Porifera. Porifera is the basal phylum of kingdom Animalia and is made up of sponges. Sponges lack any true tissues or organs, but instead have specialized cells that do their work separately. *H. permollis* is of the class Demospongiae, the order Haplosclerida and the suborder Haplosclerina. Its family is Chalinidae and the genus is Haliclona (IT IS, 2014).

Sponges live in many different places from coral reefs to deep oceans. *H. permollis* is a sessile intertidal sea sponge, most often found in the intermediate tidal zone (Lamb and Hanby, 2005). This species grows well in areas that receive a lot of wave action like the rocky intertidal region, but also grow well in underwater environments with less wave motion like docks and
pilings. Encrusting sponges are the type of sponge that grows horizontally, staying close to their substrate with small mounds that grow to only a few centimeters in height (Levington, 2009). The encrusting mat is the part of the sponge that connects it to the substrate (Gosling and Hunter, 2005). Within the encrusting mat the sponge holds its embryos. These are often housed in clusters or groups until ready to be released into the water. The development of embryos is directly related to the abundance of food (Elvin, 1976).

_H. permollis_ is one of the few sponges to have multiple oscula on each individual organism (Gosling and Hunter, 2005). The oscula are where the sponge filters food. Water is sucked in through pores trapping food particles on the flagella of choanocytes where it is engulfed. The water is then pushed out of the osculum, which is a hole at the top of the sponge (Campbell et. al, 2008). This species uses many small oscula to acquire the necessary nutrients from the water. Separate choanocytes inside the oscula are thought to be derived from amoeboid cells that form during metamorphosis. Even though there are probably other cells types that lead to the choanocytes, the amoeboid cells have been positively identified as precursors by Amano (1996). These amoeboid cells are derived from surface flagellated cells used in locomotion when the sponge is in its larval stage. For quite a while the fate of these flagellated cells was debated because of their disappearance soon after the larvae settle, but they have two distinct markers that can be tracked. One of these is minute ellipsoid granules. These granules have been tracked through certain amoeboid cells to the choanocytes, where they can be seen within the first forty-eight hours of formation (Amano and Hori, 1996).

Like most sponges _H. permollis_ grows in one of three ways: extending its oscula outward, increasing the thickness in its body, or increasing the surface area of the encrusting mat. The oscula don’t grow much because of environmental factors such as wave action and
predators. Both wave action and predators are more likely to break off larger oscula (Gosling and Hunter, 2005). Increasing the thickness of the encrusting mat can also cause similar issues. While it does give it more surface area to absorb the nutrients if there is no open substrate around it, there are less oscula per area of encrusting mat causing a higher demand to acquire enough nutrients for the new cells. While there are some smaller areas of absorption throughout the encrusting mat they are less efficient than the flagella-osculum system. The most efficient way for the sponges to grow is along the substrate. This gives a large number of oscula to the area of the thin encrusting mat. Additionally, a thin encrusting mat is harder for predators to eat. The only problem that arises from this is that the sponges will grow into each other, becoming one large organism (Elvin, 1976).

There are many different ecological roles of *H. permollis*. The purple encrusting sponge can form symbiotic relationships with bacteria and algae. These organisms are protected inside the sponge’s body and provide it with nutrients that the sponge can use as a food source. There is some speculation that these organisms also help the sponge absorb some harmful substances from the water (Yamaoka et. al, 2006). There has also been research showing that *H. permollis* houses amphipods inside their oscula at certain times of the year (Thiel, 2000). Amphipods are small shrimp-like crustaceans that live in a variety of habitats from terrestrial to marine (Fasulo, 2011). For the most part this relationship is one sided with the sponge giving the amphipod protection and getting little in return, although the amphipods might help get rid of some unwanted bacteria or algae.

At one point, *H. permollis* symbionts were considered to cause high levels of arsenic in the sponge. Marine organisms are known to contain higher concentrations of arsenic than the seawater they are found in, and because sponges are filter feeders they tend to have fairly high
amounts of the toxins found in the water. In a study focused on different species of sponges and their arsenic levels it was found that *H. permollis* has a major amount of arsenobetaine and a significant amount of arseno-sugars. These levels were originally thought to be due to the symbiotic microalgae that live inside the sponge. Yamaoka (2006) found that these amounts were produced by the sponge themselves, not absorbed from their microalgal symbionts. While *H. permollis* did not have the highest levels of either substances, it does have much higher levels than similar sponges collected from the surrounding area (Yamoaka et. al, 2006). This means that the purple encrusting sponge can produce higher levels of arsenic based substances than the closely related sponges that live in similar habitats.

The purple encrusting sponge is an interesting species to study due to its many fascinating characteristics. Despite being part of the only animal phyla which does not have true tissues, *H. permollis* still has specialized cells that can change cell type multiple times throughout its life. It is also one of the few sponges that has multiple oscula on each individual of the species which allows it to have small oscula attached to its encrusting mat. This sponge is an integral part of its ecosystem because it houses other organisms inside of it, inhibits organisms from growing on the substrate around it, and filters toxins out of the water.


Pictures Cited


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