GRAZER INDUCED RESPONSES IN MARINE PHYTOPLANKTON

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ABSTRACT

Phytoplankton are the most important primary producers in the world's oceans, yet little is known of how they avoid the constant threats from the pelagic grazers. From land it is well known that plants defend themselves by having thorns or producing compounds unpalatable to grazers. This thesis shows how different species of phytoplankton cope with different threats from pelagic grazers.

In paper I the focus was on the dinoflagellate *Alexandrium minutum*, a producer of the highly potent neurotoxins paralytic shellfish toxins (PST). These toxins can cause mass mortalities in marine mammals and can be deadly to humans, who ingest the toxins via filter feeders that accumulate the toxins from algae in their diet. The suggested purpose of these toxins is to act as a defence against zooplankton grazers, like copepods. It has been shown that *A. minutum* is able to sense water borne cues from the copepods and respond by an increase in PST production. The results of paper I show that not only is *A. minutum* able to sense copepods, it can also recognize different species and respond by either increasing PST production or not. Cues from one of the copepod species tested, *Centropages typicus*, resulted in a more than 20 fold increase in PST, whereas another copepod, *Pseudocalanus sp.,* did not have any effect on the PST content. It seems likely that *A. minutum* can recognize copepods that have the same distribution area as itself, these species would be the most significant grazers on *A. minutum* and a defence against them would benefit the alga. This strengthens the suggested role of PST as a grazer deterrent.

Another group of substances that have been suggested to act as defence against grazers are the polyunsaturated aldehydes (PUA) produced by some phytoplankton, among others, diatoms. The role of PUA has been debated and various effects have been shown for a number of organisms. PUA has been shown to have negative effect on the reproduction of copepods, but results are contradictory. In paper II we investigate another possible defencive effect of PUA, as a structuring agent on the microbial community of bacteria and viruses. Bacteria can infect diatoms or compete for nutrients, and viral infections can terminate phytoplankton blooms. Compounds that affect these organisms can be of great benefit for the producing organism. The results in paper II show that PUA have no effect on either bacteria or viruses, and further questions the role of these compounds.

Perhaps the most interesting findings in this thesis are the ones presented in paper III and IV, where diatoms are shown to use chain length plasticity as a defence against copepods. Previously, different factor such as nutrient uptake and flotation has been suggested to be the driving force behind chain formation, but chain formation as a defence has been suggested before. Here I present further support for this. The diatoms responded to cues from copepods by reducing their chain length, and thereby size, with reduced grazing as a result. Reducing chains to single cells would make the diatom *Skeletonema marinoi* to small for copepods to handle, while larger species like *Thalassiosira rotula* would still be large enough to be caught. But by reducing chain length the diatoms also reduce the encounter rate with grazers, and thus larger species like *T. rotula* can escape grazing. Lower grazing rates were also observed on single cells than longer chains. All diatoms did not respond to grazer cues in the same way, *Chaetoceros affinis* did not reduce chain length when subjected to copepods. *C. affinis* has long spines that may act a as a defence which could be the reason why it does not reduce its size. I suggest that chain length plasticity may be an evolutionarily adopted trait in chain forming diatoms and that size-selective predation may have played a key role in the evolution of chain formation and chain length plasticity in diatoms.