
Abstract

The present thesis shows that some dinoflagellates are able to sense and respond to waterborne cues from their natural enemies. Exposure to cues from copepod grazers resulted in an up to 28 fold increase in paralytic shellfish toxin (PST) content in the dinoflagellate *Alexandrium minutum* compared to unexposed controls. Furthermore, copepod grazers discriminated against induced, more toxic *A. minutum* cells in feeding preference experiments. It is suggested that the grazer induced increase in PSTs in *A. minutum* constitutes an inducible defense against copepod grazers and that the mechanism may facilitate the formation of harmful algal blooms of *A. minutum* by redirecting grazing pressure to less defended species. The relative importance of grazer induced toxin increase was compared to the effects of nitrate and phosphate concentrations in factorial experiments. It was concluded that grazer induced PST increase is dependent on available nitrogen, because no significant increase in PST occurred in nitrogen limited medium, whereas copepod cues had a strong effect in nitrate rich medium. The magnitude of this effect was comparable to the effect of nitrogen availability alone, which has previously been found to be one of the most important factors affecting cell specific PST content in *Alexandrium* spp. The inducing copepod cue was partially isolated and suggested to be low volatile, moderately lipophilic, and probably consisting of more than one compound. The cue was shown to be highly grazer specific, where *Centropages typicus* induced the strongest increase in toxicity of the copepod species tested, while two species of *Acartia* spp. had an intermediate effect, and *Pseudocalanus* sp. did not induce increased PST production in *A. minutum*. Theory predicts that induced defenses should be associated with a cost to be favored in front of constitutional defenses. Still, no cost in terms of reduced growth could be detected in any of the experiments in this thesis. Grazer induced increase in PST, however, necessarily involves a redirection of resources from other cellular processes, and it is speculated that this redirection may result in fitness-related costs, that are not detectable in terms of growth in laboratory experiments. Furthermore it is shown that the allelopathic effect of *Alexandrium* is not correlated to the specific PST concentration which supports the idea that allelopathy is likely to be caused by some other, unknown compound(s). The addition of cell free filtrates to natural communities corresponding to natural densities of *Alexandrium* cells had a strong negative impact on many organisms. Ciliates and small flagellates were especially vulnerable to *Alexandrium* allelochemicals, which may benefit *Alexandrium* sp. by reducing both competition and protozooplankton grazing pressure in natural populations.

In conclusion, the results of this thesis suggest that chemical mediation of ecological interactions in *Alexandrium* spp., i.e. inducible production of feeding deterrents and release of allelochemicals, can be important factors affecting *Alexandrium* spp. population dynamics, and even contribute to the formation of harmful algal blooms.