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The interactions between microzooplanktonic grazers and dinoflagellates causing red tides in the open coastal waters off southern California

A dissertation submitted in partial satisfaction of the requirements for the degree

Doctor of Philosophy in Oceanography

by

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ABSTRACT OF THE DISSERTATION

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I investigated the interactions among red-tide dinoflagellates, micro- and macrozooplanktonic grazers, particularly focussing on microzooplanktonic grazers, by combining field data on their abundances measured in the open coastal waters off La Jolla, CA, during and after red tides in 1991-1993, and laboratory data on the growth and grazing by the dominant grazers in various concentrations of red-tide dinoflagellates grown in culture.

In general, the results of field observations are consistent with those of laboratory experiments. There were strong predator-prey relationships between the heterotrophic dinoflagellate genus *Protoperidinium* and the autotrophic dinoflagellate *Gonyaulax polyedra*, and between the tintinnid ciliate, *Favella*, and the mixotrophic dinoflagellate *Gymnodinium sanguineum*. However, population growth of *Protoperidinium* was

negative at high prey concentrations of *G. sanguineum*, as was that of the heterotrophic dinoflagellate *Noctiluca* at all prey concentrations.

Protoperidinium strongly selects among different red tide dinoflagellate prey, and can cannibalize conspecific cells.

In general, there was no evidence of a strong feeding preference by the copepod *Acartia tonsa* for *Protoperidinium* cf. *divergens* over *G. polyedra*. *A. tonsa* predation resulted in negative population growth of *P.* cf. *divergens* at low *G. polyedra* concentrations, but the impact decreased with increasing *G. polyedra* concentrations and was negligible at 2,200 cells ml^{-1}. In addition to being prey for copepods *Protoperidinium* is a predator on their eggs and early naupliar stages.

Favella, *Protoperidinium*, and *Noctiluca* have different feeding mechanisms on red-tide dinoflagellates common in the coastal waters off southern California; concentrations for feeding thresholds and maximum growth were clearly different.

During the red tides dominated by *Gymnodinium sanguineum* in 1991, the grazing coefficients on this population due to the populations of *Favella* spp. increased up to 0.152 day^{-1} while*G. sanguineum* concentrations decreased during the decline stage of the red tide. During the red tides dominated by *Gonyaulax polyedra* in 1992 and 1993, the grazing coefficients due to *Protoperidinium* spp. were proportional to its abundance, with the maximum values of 0.102 and 0.017 day^{-1}, respectively.

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