Bioluminescent response of the dinoflagellate Lingulodinium polyedrum to developing flow: Tuning of sensitivity and the role of desensitization in controlling a defensive behavior of a planktonic cell

von Dassow, Peter, Rachel N. Bearon, Michael I. Latz

Limnol. Oceanogr., 50(2), 2005, 607-619 | DOI: 10.4319/lo.2005.50.2.0607

ABSTRACT: Dinoflagellate bioluminescence is believed to serve a defensive function, decreasing grazing at night. Previous characterization of bioluminescence stimulated by fully developed flows might have underestimated the true sensitivity of bioluminescence by not observing the initial response. Also, it has been suggested that bioluminescence may be more sensitive to time-varying flow than to constant flow conditions. We used developing laminar Couette flow to characterize the sensitivity of the initial bioluminescent response of the dinoflagellate *Lingulodinium polyedrum* in time-varying flow. Both the absolute sensitivity (threshold) and dynamic sensitivity were consistent with that determined previously in fully developed flows, although there were differences between different cultured isolates of the same species and between those isolates and cells harvested from a unialgal bloom of the same species. When the rate of increase of shear was varied while keeping the maximum shear level similar, the threshold was independent of the rate of increase of shear. Surprisingly, the integrated bioluminescence was strongly dependent on the rate of increase of shear. The mechanism behind the preferential response to rapidly increasing shear was determined to be desensitization. Desensitization may influence which naturally occurring flows strongly stimulate bioluminescence either by allowing cells to avoid producing a primary response in certain slowly changing flows or, more generally, to avoid the cost of repeated stimulation when entrained in environmental flows containing above-threshold shears.