Relating cell-level swimming behaviors to vertical population distributions in Heterosigma akashiwo (Raphidophyceae), a harmful alga

Bearon, R. N., D. Grünbaum, R. A. Cattolico

Limnol. Oceanogr., 49(2), 2004, 607-613 | DOI: 10.4319/lo.2004.49.2.0607

ABSTRACT: Cell motility may facilitate the formation of harmful algal blooms (HABs) by enabling algal cells to swim to favorable microenvironments that support explosive growth. Motility also augments the formation of algal cell aggregations that are often associated with ecological and economic consequence. In this study, we used computerized video analysis to quantify cell-level swimming characteristics by reconstructing cell trajectories in the motile raphidophyte *Heterosigma akashiwo*, a unicellular alga that forms toxic surface slicks in temperate coastal waters worldwide. *Heterosigma* cells are capable of rapid changes between at least two active swimming modes, distinguishable by the magnitude of the oscillatory component of motion. Swimming direction varied during a diurnal photoperiod, with swimming direction changing from random to upward directed shortly after the start of the light phase. Motility assays performed 6-8 h into the light phase showed that two *Heterosigma* strains from geographically distant locations differed significantly in gross swimming speeds, with mean values of 49-66 μm s^{-1} for strain CCMP452 (West Atlantic, USA), and 88-119 μm s^{-1} for strain CCAP934-1 (North Sea, Norway). A spatially explicit model of vertical distribution of *Heterosigma* cells based on strain-specific motility data suggests that cells of the two strains may diverge in water-column position within a few hours and that CCAP934-1 develops dense surface aggregations more rapidly and more robustly than CCMP452. Propensity to form toxic surface slicks, and therefore frequency and severity of HAB impacts, may vary substantially among Heterosigma strains, mediated by differences in cell-level motility.