High resolution observations of a pelagic tunicate bloom in a warm water filament using a video plankton recorder: development, fate, and effect on biogeochemical cycles and planktonic food webs

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An important goal of marine ecology studies is to understand the distribution patterns of marine organisms and the structure and functioning of pelagic ecosystems, as doing so can be used to predict how environmental changes and human activities will impact the distribution patterns of marine fauna and the biology of the ocean. Within this context, the ephemeral, patchy, and sporadic nature of pelagic tunicate blooms makes these events very difficult to investigate in any detail. This is largely because of the conventional plankton-net sampling which only covers < 1 m^2 water column at several ten-km scale do not match with the spatiotemporal scale of oceanographic event to control the pelagic tunicate bloom. To tackle the problem, we investigated distribution patterns of a doliolid (*Dolioletta gegenbauri*) bloom in relation to the physical environment using a video plankton recorder in the Oyashio–Kuroshio mixed water region. Using 12 km transects, doliolid blooms were encountered at a horizontal scale of about 2–3 km, which corresponds to submesoscale physical events. Doliolids were also consistently encountered in the subsurface layer above the pycnocline in warmer (> 14ºC) and higher-salinity (> 34) water masses, and seawater density was the most critical factor affecting distribution depth. Compared to previous studies, the density and biomass of the blooms observed in this study (77 mgC m^{-3} and 4600 inds m^{-3}) were highest in the open ocean. Bloom formation consisted of two phases; first, the seeding population of a nurse stage increased rapidly to 2000 inds m_{-3} by asexual reproduction, followed by asexual production of phorozooids. Estimated population clearance rates revealed that these dense patches could potentially sweep the surrounding water within 2–3 d. The incidence of exhausted and shrunken zooids was significantly correlated with patch density, suggesting that mortality was due to overgrazing. Shrunken doliolids appeared to sink below the pycnocline, corresponding to 8–17% of the particulate organic carbon flux at 150 m. Hydromedusae, pelagic polycheates, and sapphirinid copepods preyed on the doliolids. These results indicate that doliolids, which were seeded by populations originating from the Kuroshio, formed dense blooms in response to submesoscale physical events and would alter the sinking particle properties (i.e., biological pump) and the epipelagic food web structure through their grazing and mortality.

Keywords: Plankton, Sub-mesoscale, biological pump

