

A MULTIFACETED AND INTEGRATED APPROACH TO THE STUDY OF MARINE PLANKTONIC DIATOMS

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Diatoms represent the most abundant phytoplankton group at the LTER MareChiara in the Bay of Naples (Mediterranean Sea); they dominate during the spring and autumn blooms and produce minor blooms during summer stratification. Detection of microalgal distribution patterns relies on the biological units (species, populations). Results of our research uncovered cryptic diversity in all genera examined: *Skeletonema*, *Pseudo-nitzschia*, *Chaetoceros* and *Leptocylindrus*. These findings challenged our capability to monitor species with standard techniques, demonstrating the need for molecular tools such as clone libraries, microarrays, metagenomic approaches. On the other hand, detection of cryptic diversity clarified temporal and spatial patterns in morphospecies. Analysis of environmental samples using clone libraries of partial LSU rDNA confirmed distinct seasonal patterns in different *Pseudo-nitzschia* species. In *Skeletonema*, analysis of global isolates showed species-specific distribution ranges, challenging the assumption that phytoplankton species lack biogeographic structure. This broad diversity calls for integrated approaches towards delineating species, including assessment of functional differences. Screening of *Pseudo-nitzschia multistriata* population structure with microsatellites showed marked intraspecific diversity and provided evidence that genetically different metapopulations coexist in sympatry. Moreover, microsatellite profiles in culture vary over time, suggesting that the high genetic diversity depends on rapid accumulation of clonal mutations and genetic recombination during sexual reproduction.

Life cycle traits of microalgae also play an important role in regulating the dynamics of natural populations. Many diatoms at LTER-MC form resting stages, but interactions between vegetative and resting stages are complex and links between the onset of species-specific blooms and the germination of resting stages is difficult to assess. In species that do not form resting stages, gradual reduction and sudden increases in cell sizes shed light on timing for asexual and sexual phases. Analysis of cell size distribution patterns of *Pseudo-nitzschia multistriata* coupled with modeling approaches showed that the length of life cycle – from the initial cells to the smallest cell size - lasts about 4 years; if sexual reproduction does not take place, the population is condemned to local extinction.

Population dynamics represents the interplay between the organisms' complex life histories and their environment. The 'observation' of natural populations over time and space, the coupling with experimental approaches, and a deeper understanding of the organism biology – now possible with genomic approaches –allows progress in elucidating their complex dynamics.