School of Life, Health and Chemical Sciences

Doctor of Philosophy (Ph.D.)

Taxonomy and Ecology of the Highly Diverse Planktonic Diatom Genus *Chaetoceros*

Alessandra Mussi

Director of Studies
Dr. Wiebe H.C.F. Kooistra
Stazione Zoologica Anton Dohrn, IT

External Supervisor
Dr Bente Edvardsen
University of Oslo, NO

Internal Supervisor
Dr. Diana Sarno
Stazione Zoologica Anton Dohrn, IT

September 2025

Abstract

Chaetoceros is one of the most diverse and widely distributed genera of marine planktonic diatoms, with over 250 described species. It shows high morphological variability, with cells connected into chains through tubular silica extensions called setae. Many *Chaetoceros* species are abundant and recurrent across seasonal cycles and blooms. In addition, many of its recognised and defined species consist of complexes of biologically and genetically distinct, but morphologically highly similar taxa. These features make *Chaetoceros* a valuable model for ecological and evolutionary studies in marine phytoplankton. My research into the biodiversity and evolution focuses on two sections within the genus *Chaetoceros*, the sections *Cylindrica* and *Stenocincta.* By combining molecular data (phylogenetics, ITS2 structure), morphological analysis (LM, EM), and environmental context (Tara Oceans data), I identified and described five new species within section *Cylindrica* and assessed their biogeographic distribution and ecological niches.

Various stresses and disturbances affect the morphology and ultrastructure of *Chaetoceros* species, with responses differing among species. Nitrate limitation causes both morphological and physiological stress responses, and secondary compounds exuded by copepods induce a variety of defensive traits. To find out how, I cultivated a strain of the planktonic diatom *Chaetoceros schuettii*, belonging to section *Stenocincta*, in media with different nitrate concentrations and with or without herbivorous copepods (*Temora stylifera*). Under nitrate starvation chains became shorter, exhibited longer setae and contracted chloroplasts. Instead, in the presence of copepods the cells developed more robust setae. These results indicate that setae hinder grazers and take up nutrients, making their shape a compromise among various functions in the face of environmental pressures. These findings highlight the need for integrative approaches, combining genetics, morphology and physiology, to fully understand the evolution, ecological role and adaptations of diatom taxa. Comparative genomics and transcriptomics will be fundamental for species delineation and ecological characterization, especially in the context of a rapidly changing ocean.