The cellular and molecular responses of diatoms to warming temperatures

Supervisory team:
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Submit applications for this project to University of Exeter

Project description:
Photosynthetic algae underpin life in our oceans. Diatoms, characterised by their intricate silica cell walls, represent one of the most abundant algal groups in marine and freshwater ecosystems. Their unique biology means that they also have an important role in biotechnological applications, including biomineralisation and the production of biofuels. Marine and freshwater environments experience significant fluctuations in temperature that diatoms must be able to tolerate in order to survive. The frequency and extent of these temperature fluctuations is predicted to increase dramatically in the next century, which is likely to have a major impact on the physiology of diatoms. However, we currently know very little about the cellular mechanisms of thermal tolerance in diatoms.

The project will examine thermal tolerance in diatoms to better understand their physiological responses to different temperature regimes and the signalling processes that allow them to rapidly respond to temperature fluctuations In plants and algae, one of the major consequences of elevated temperatures is the production of reactive oxygen species (ROS) in the chloroplast due to thermal sensitivity of the photosynthetic machinery. High concentrations of ROS are likely to be extremely damaging to the cell and may lead to cell death. However, lower concentrations of ROS may play an important signalling role, allowing the cell to rapidly respond to thermal stress. In this project, we will use the model diatom Phaeodactylum tricornutum to examine ROS production under different temperature regimes. We have generated a range of strains expressing genetically encoded fluorescent reporters for ROS that allow monitoring of stress responses in real time in single cells.

The project will address three major themes.

1. The role of oxidative stress in determining the temperature sensitivity of in diatoms
2. ROS-dependent signalling pathways involved in sensing elevated temperatures
3. The interaction between light and temperature stress

Diatom cells will be exposed to a range of light and temperature regimes to understand how photosynthesis interacts with temperature stress to determine thermal tolerance. The project will involve a range of molecular and cell physiology techniques, including single-cell imaging and genetic manipulation. This project will identify novel aspects of cell physiology that enable diatoms to acclimate to elevated temperatures. It will provide wider understanding of the nature of thermal tolerance in photosynthetic eukaryotes, with broad implications for many research areas, from the biotechnological exploitation of algae through to their role in sustaining marine ecosystems and food resources.

Our aim as the SWBio DTP is to support students from a range of backgrounds and circumstances. Where needed, we will work with you to take into consideration reasonable project adaptations (for example to support caring responsibilities, disabilities, other significant personal circumstances) as well as flexible working and part-time study requests, to enable greater access to a PhD. All our supervisors support us with this aim, so please feel comfortable in discussing further with the listed PhD project supervisor to see what is feasible.