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Thermal Adaptation of Polar Macroalgae

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Principal Investigator: Davison, Ian .
Award ID: 9418033
Organization: University of Maine
Title:
Thermal Adaptation of Polar Macroalgae

Project Participants

Senior Personnel

Name: Davison, Ian
Worked for more than 160 Hours: Yes
Contribution to Project:

Post-doc

Graduate Student

Undergraduate Student

Research Experience for Undergraduates

Organizational Partners

Other Collaborators or Contacts

Activities and Findings

Research and Education Activities:
Research was carried out at Palmer station and at the University of Maine using algae transported from Antarctica. The research focused on the giant endemic Antarctic brown alga Himantothallus grandifolius and was designed to understand the effect of temperature on growth, photosynthesis and other aspects of metabolism. The research is completed and the data analyzed and results have been presented at several international and national meetings, resulting in two published abstracts. Several papers are still being prepared for publication, and these have been delayed primarily because the principal investigator (Davison) took an administrative job (as Director of Maine Sea Grant) in 1997. I anticipate that these will be completed and published within the next 12 months (by June 2002).

Findings:
Our research established that the giant endemic Antarctic brown alga Himantothallus grandifolius is well adapted to life at low temperatures and low light levels. The most significant discoveries are outlined below.

1) Light-saturated photosynthesis and respiration exhibit acclimation to changes in growth temperature over the range from -2 to 5oC (the range experienced in nature over the alga's normal distribution) that reduces the temperature dependence of these aspects of metabolism, allowing the seaweed to maintain high rates of photosynthesis and hence growth at very low temperatures. These changes are similar to the well-documented thermal acclimation in the temperate brown alga Laminaria saccharina, and as with Laminaria are attributable to increases in the activities of Rubisco and other Calvin cycle enzymes at low growth temperatures. In contrast to temperate seaweeds, there was no evidence of thermal acclimation of the light-harvesting apparatus, which maximizes light-harvesting efficiency regardless of growth temperature, presumably because Himantothallus occurs at very low light levels in nature.

2) Laboratory acclimation experiments indicate that the inability of Himantothallus to grow at temperatures above 10oC is not attributable to a dysfunction in carbon metabolism. Although growth rates were negative above 10oC, the alga maintained a positive carbon balance at 15oC. Our conclusion is that the inability to grow at temperatures above 10oC is due either to nitrogen metabolism (a hypothesis addressed by Val

Gerard) and/or a breakdown of membrane integrity.

3) Rates of protein synthesis were compared in Himantothallus grandifolius and the temperate brown alga Laminaria saccharina. Rates at 0oC were much higher in Himantothallus suggesting that acclimation of nitrogen metabolism and protein synthesis might explain the success of this species at extreme low temperatures.

Training and Development:

Outreach Activities:

Journal Publications

Grobe, C., M.E. Vayda and I.R. Davison, "Temperature effects on rates of protein synthesis in Arctic, temperate and Antarctic Seaweeds.", Plant Physiology, p. 107, vol. 1998, (117). Published Abstract

Davison, I.R., V.A. Gerard, K.H. Dunton and J.N. Heine, "Acclimation of carbon metabolism to near-freezing temperatures in the endemic Antarctic brown alga Himantothallus grandifolius.", Phycologia, p. 23, vol. 36, (1997). Published Abstract

Books or Other One-time Publications

Web/Internet Site

URL(s):

Description:

Other Specific Products

Contributions

Contributions within Discipline:

Contributions to Other Disciplines:

Contributions to Human Resource Development:

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Contributions Beyond Science and Engineering:

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