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Physiological Ecology of the Brown Alga *Phaeostrophion irregulare* Setchell *et* Gardner: II Macroscopic Plants*

A. C. Mathieson

Department of Botany and Plant Pathology and the Jackson Estuarine Laboratory, University of New Hampshire, Durham, New Hampshire 03824, U.S.A.

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Abstract

The apparent photosynthesis of the macroscopic plants of *Phaeostrophion irregulare* is light saturated at about 700 foot-candles. The blades are the main photosynthetic organs of the plant as their rate of photosynthesis is much greater than that of the holdfast. The optimum temperature for photosynthesis for the blades and holdfasts is approximately 13.5° C, but a high rate of photosynthesis occurs over a wide range of temperatures. The respiration of the blades and holdfast is very low and it may be of some adaptive advantage to the plant in sandy habitat where it grows abundantly. Neither respiration nor apparent photosynthesis of the blades is conspicuously different between 20–40 ‰. The macroscopic plants are more tolerant than the juvenile stages to a wide range of temperature, salinity and desiccation conditions. Overall, the temperature and salinity tolerances of the macroscopic plants appear to be much greater than that required in nature, but this does not appear to be the case for resistance to desiccation. Thus, the blades often die after a dehydration of 40–60%. The holdfasts of *P. irregulare* seem to be more resistant than the blades to extreme conditions.

Introduction

The present paper is the third in a series dealing with the little known Pacific brown alga *Phaeostrophion irregulare* Setchell *et* Gardner. Previously, the field ecology of *in situ* populations of plants was described from Glacier Point, British Columbia (Mathieson 1982), as well as the physiological ecology of juvenile plants based upon extensive culture studies (Mathieson 1982, a). In the present account, a variety of photosynthetic and tolerance experiments on the macroscopic plants are outlined, in order to better interpret the pants' growth and distribution. The results of the laboratory studies on juvenile and adult plants of *P. irregulare* are also compared.

Methods and Materials

All of the specimens utilized in the present photosynthetic studies were collected at Glacier Point, British Columbia, and then transported to the laboratory in plastic bags stored in an ice chest. Transportation took approximately 4 hours. After being sorted and cleaned, a standard size (diameter 11 mm) disc was cut from both the blades and holdfasts with a cork borer. Most of the experiments were conducted 24 hours after preparing the discs, in order to avoid wound respiration. After being cut, the discs were retained at 10° C under 317 foot-candles. The rates of gaseous exchange for the samples were recorded in a Warburg Respirometer apparatus at different light intensities, temperatures and salinities. The light and temperature experiments were completed within three days of collection, while the plants were immersed in the different salinities for five days and then the rate of gaseous exchange was recorded within two further days. A salinity range of 20–40 ‰ was prepared as outlined in an earlier account (Mathieson 1982, a).

In all of the photosynthetic experiments, two discs were used per flask (average volume 18.5 ml). The discs were damp-dried and then immersed in 5 ml of buffered artificial seawater (Chapman 1962). A 2% atmosphere of carbon dioxide was provided for the flasks by adding 0.7 ml of a diethanolamine solution to the flask, with 0.4 ml to the center well and 0.3 ml to the side arm[1].

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[1] 3 g of $KHCO_3$ in 10 ml of 60% diethanolamine (2,2' Iminodiethanol), plus 4 ml of HCL and 1 ml of H_2O

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