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Physiological Ecology of Four Ulvoid Green Algae[1]

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Abstract

The net photosynthesis of four ulvoid green algae [*Monostroma grevillei* (Thuret) Wittrock, *M. pulchrum* Farlow, *Ulvaria obscura* (Kütz.) Gayral var. *blyttii* (Aresch.) Bliding and *U. oxysperma* (Kütz.) Bliding] that exhibit different patterns of seasonal occurrence and local distributions within coastal and estuarine habitats of northern New England, USA were evaluated under various light, temperature and salinity conditions. *Monostroma pulchrum* had the highest light compensation level (*i.e.* 20–40 $\mu E\ m^{-2}\ s^{-1}$), while the other three species had compensation points of 3–8 $\mu E\ m^{-2}\ s^{-1}$. The light saturation values for the different species varied from 40 $\mu E\ m^{-2}\ s^{-1}$ (*U. oxysperma*) to more than 564 $\mu E\ m^{-2}\ s^{-1}$ (*M. grevillei* and *M. pulchrum*), with *U. obscura* var. *blyttii* exhibiting intermediate light optima (120 $\mu E\ m^{-2}\ s^{-1}$). The temperature optima and tolerances of the various species were closely related to their patterns of seasonal occurrences. Thus, the winter-spring annuals *M. grevillei* and *M. pulchrum* exhibited low thermal optima (5–10 °C) and salinity tolerances (*M. grevillei*, 18 °C at 10‰ and 21 °C at 30‰; *M. pulchrum*, 22 °C at 10‰ and 24 °C at 30‰), while the summer annual *U. oxysperma* exhibited higher temperature optima (15–25 °C) and tolerances (about 32 °C). The aseasonal annual *U. obscura* var. *blyttii* had variable and intermediate temperature optima (10–25 °C) throughout the year but a consistent lethal temperature of 30 °C. Most of the species showed net photosynthesis after 24 hours in 0–100‰ salinity; thereafter the tolerance patterns were variable depending upon the species and collection sites. Three patterns of salinity and temperature interactions were evident: (1) at low temperatures the photosynthetic responses of *M. grevillei* and *M. pulchrum* were similar at 10 and 30‰, while low salinities were detrimental at high temperatures; (2) at low temperatures *U. oxysperma* had higher net photosynthesis at 10 than 30‰, while no conspicuous differential was evident at high temperatures; and (3) at 10 and 30‰ under all temperatures *U. obscura* responded similarly.

Introduction

As noted by Lobban *et al.* (1985), several abiotic factors can influence the species composition, phenology and distributional patterns of seaweeds. Temperature is often considered the primary factor determining the growth, reproduction and distribution of seaweeds, particularly within open coastal habitats (*cf.* Druehl 1981, Emery and Stevenson 1957, Hoek 1982, Scagel 1963, Setchell 1893, 1920). By contrast, within embayments or estuaries, a variety of physical extremes (*e.g.* temperature, salinity and light) may cause diminution of species numbers and perennial taxa upstream, as well as the ultimate dominance of green algae at tidal headwaters (*cf.* Doty and Newhouse 1954, Hartog 1971, Josselyn and West 1985, Ketchum 1983, Mathieson *et al.* 1981, Mathieson and Penniman 1986, 1991, Wilkinson 1980). That is, the physical extremes inherent within estuaries may determine the distributional limits of species because their physiological tolerances are approached (*cf.*

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