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The effects of in situ shading on the growth of a seagrass, *Syringodium isoetifolium*

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Abstract

The effect of light reduction on a tropical seagrass, *Syringodium isoetifolium*, was examined over a period of six months (July 2001 to December 2001) in relation to leaf elongation rates, shoot densities and chlorophyll content of the leaf blades. The experiment was carried out at Poste Lafayette, Mauritius, in winter (July to September) and summer (October to December) in the same seagrass meadow. In both seasons three plots were shaded with Sarlon cloth (75% light cut-off), with three unshaded plots as controls. The growth rate for both winter and summer was higher in the shaded plots than in the control. Leaf elongation rates were higher in shaded plots in summer than in the shaded plots in winter. Blade chlorophyll was also higher in the shaded plots than in unshaded plots both in winter and in summer. There was no significant difference in the shoot density between plots. These results are consistent with the suggestion that high irradiance brings about a reduction in seagrass growth. The results also show that light is one of the factors that control the vertical growth response of *S. isoetifolium* as well as its photoreceptors.

Keywords: *Syringodium isoetifolium*; light; growth; season; physico-chemical parameters; Mauritius

1. Introduction

Seagrasses are submerged marine angiosperms vital to the marine ecosystem. They are among the most productive in the biosphere. The growth and distribution of seagrasses are controlled by a number of physical parameters such as water temperature, nutrient availability, salinity, sediment type and light regime. Light availability is the most important factor regulating the depth distribution, abundance and productivity of submerged aquatic macrophytes that inhabit critical yet extremely fragile ecosystems (Dennison and Alberte, 1982, 1985, 1986; Duarte, 1991).

Clear water is increasingly recognised as a key requisite for the development and maintenance of healthy seagrass meadow and thus a decrease in seagrass biomass may be attributed to decrease water clarity. The causes of the reduced water clarity range from nutrient enrichment to increased suspended loads of sediment. In most cases the process of water clarity loss and seagrass decline has been the result of anthropogenic factors and modifications.

Seagrasses are adapted to absorb both a wide variety of wavelengths and light intensities (Drew, 1979). Seagrasses would appear to be shade plants, normally having a protective layer of water, which absorbs a large proportion of incident light. However, on those occasions, when the protective blanket of water is decreased, elevated irradiation levels may result in damage to the seagrasses photosynthetic tissue. Reliance on leaf

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photosynthesis measurements has in the past given the impression that seagrasses were low-light adapted plants (Drew, 1979). But seagrasses have a large amount of non-photosynthetic tissue, which increases their whole plant light compensation point (Fourqurean and Zieman, 1991). Autotrophs adapt their photosynthetic pigments to maximize light absorption in poor or variable light environments (Kirk, 1983).

In Mauritius, six species of seagrasses from the two families Potamogetonaceae and Hydrocharitaceae have been identified, namely *Syringodium isoetifolium, Thalassodendron ciliatum, Halodule uninervis, Halodule wrightii, Halophila ovalis* and *Halophila stipulacea*. These seagrasses are found in lagoons which are generally subjected to anthropogenic activities such as water sports, dredging, sewage disposal, waste inputs from sugar factories as well as water run-off containing a high level of nutrients from agricultural fields. Only a few of the lagoons in Mauritius harbouring seagrasses are still unpolluted, and this is the case for the site chosen at Poste Lafayette.

Seagrass bed monitoring is important in the integrated coastal zone management in Mauritius due to seagrasses' many functions. Seagrasses stabilise and hold sediments, thus preventing erosion. They are the nursery ground for a number of marine organisms. They are highly involved in the detritus food web and play an important role in returning nutrients to the seawater.

Mauritius being a tropical island, it is expected that light availability is not a limiting factor in the growth of the seagrasses. Furthermore, since most of the lagoons are relatively shallow it is expected that vertical growth response of the seagrasses will not be limited by light. In summer more particularly the amount of sunlight reaching the seagrass blades, especially at low tide, might even be in excess in certain regions, thus causing the development of photoinhibitory responses.

2. Materials and methods

2.1. Study site

Mauritius is a volcanic island situated on the Mascarene plateau in the Indian Ocean. It has an area of 1865 km^2 and a coastline of about 300 km. It has 243 km^2 of lagoons mostly fringed by coral reefs. It has a tropical climate with average annual temperature of 23 °C and annual precipitation of about 1000 mm on the coast. Though Mauritius is surrounded by the sea, the seagrasses are not widely spread in the lagoons. The site chosen is located in the north east of Mauritius. Fig. 1 gives the location of Poste Lafayette on a map of Mauritius at latitude 20°17′ S and longitude 57°33′ E. The shore is rocky and rarely visited by the public for recreational activities and so it is little affected by anthropogenic factors. At the study site there are no hotels, bungalows, industries and agricultural land, thus leaving the lagoon relatively unpolluted. The site is mostly affected by natural phenomena such as cyclones and the south-east trade winds.

The site chosen was at about 100 m from the shore at a depth of about 150 cm. Here *Syringodium isoetifolium* grow in large patches mainly on sandy mounds. The site was also not exposed at all, even during low tide to the atmosphere. This precaution was taken so the experimental set was not visible from the shore and thus would remain undisturbed.

2.2. Species of seagrass used

Syringodium isoetifolium was used as it grows in large patches at the chosen site and it is relatively easy to monitor. The leaf blade can be easily cut off using a pair of scissors, and monitoring during summer and winter can be done in the same patch. In this way parameters such as sediment characteristics will be unaltered.

2.3. Experimental design

Syringodium isoetifolium was exposed to two different light regimes (using Sarlon shade cloth) during winter and summer, each for a period of about two and a half months. The shading experiment was started in July 2001, for the winter season. Six plots, 50×50 cm, were chosen within a large patch of *S. isoetifolium* at Poste Lafayette. The first three plots, CW1, CW2 and CW3, acted as controls and thus remained unshaded. It was ensured that the shading equipment did not shade the control plots.

In the plots SW1, SW2 and SW3 plants were shaded using a 1×1×0.6 m frame on which Sarlorn cloth was stretched. The Sarlon cloth was completely inert and did not affect the experiment in any way apart from obstructing light. The entire structure was immersed in the water.

The seagrasses found in the six plots were trimmed to their bases so that they were about 1 cm long, using a pair of scissors. The control plots CW1, CW2 and CW3 were demarcated by markers placed at the corner of the plots. After cutting the seagrasses in plots SW1, SW2 and SW3, the shading frames were placed over the plots and the four legs of each metal structure were inserted into the sediment so that they did not get washed away or displaced by the wave action. The perimeter of each treatment plot was also demarcated by a burrow to ensure the physiological independence of the plants.

The same experiment was repeated in the same patch of *S. isoetifolium* but in different plots. This experiment was started at the end of October and lasted for about two and a half months. CS1, CS2 and CS3 were the