THE PHOTOBIOLOGY OF THE REEF CORAL

Pocillopora damicornis

AND SYMBIOTIC ZOOXANTHELLAE

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BY

Paul L. Jokiel

Dissertation Committee

Edward A. Laws, Chairman

Keith E. Chave

Douglas Friend

Richard W. Grigg

Stephen V. Smith

Richard E. Young

ABSTRACT

The reef coral *Pocillopora damicornis* and its symbiotic algae (zooxanthellae) shows strong biological responses to subtle changes in the spectrum, intensity and modulation of the natural radiation environment in the 280 nm to 700 nm range. Corals and *in vitro* cultures of zooxanthellae were grown in full spectrum solar radiation and in filtered sunlight having the same Photosynthetically Active Radiance (PAR) but lacking ultraviolet (UV) radiation. Skeletal growth rate of the corals was decreased by approximately 50% in the treatment with full solar UV radiation. Corals grown in the treatment without solar UV radiation contained less of the "S-320" UV-absorbing substances. The UV-screening material apparently protected both the contained symbiotic algae and the host from the detrimental effects of UV radiation. *In vivo* zooxanthellae apparently were protected by the S-320 pigments of the host and were not damaged by UV radiation. In contrast, cultures of the algae grown *in vitro* in UV-transparent quartz vessels were severely inhibited by solar UV radiation. The impact of UV was far more severe in a "shade-loving" genetic strain of zooxanthellae than in a "sun-loving" strain. Growth of cultures of zooxanthellae and other unicellular algae was not inhibited even at full solar intensity if the UV portion of the spectrum was blocked with a filter.

Corals and *in vitro* cultures of zooxanthellae were also grown under identical levels of PAR but with different regimes of spectral composition. Corals and algae showed maximal growth rate and photosynthetic pigment concentration under conditions of "blue" PAR. Growth and pigmentation was extremely low when the organisms were grown under prolonged exposure to "red" PAR. An intermediate response was observed under conditions of "white" and "green" PAR.

All of the basic parameters that define the photosynthesis-irradiance relationships in coral are influenced by the size of the coral. Maximum photosynthetic rate, saturation constant, and the photosynthesis to respiration ratio increased with increasing size of the coral. Initial slope (alpha) of the P-I curve and oxygen consumption per unit biomass in darkness decreased as a functon of size. Net primary production of the coral per unit reef area increased dramatically with increasing size.

The "lunar cycle" of coral reproduction is controlled by night irradiance. Alteration of the night pattern of "lunar" irradiance caused the coral to shift reproductive periodicity. Lack of a regular lunar signal eliminated reproductive synchronization.