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Fluorescent Pigments in Living Coral

FL-19

Introduction

The brightly-colored coral reefs that make scuba-diving and snorkeling so enjoyable are essential to the survival of much underwater life. Not only do reefs offer a haven for smaller fish to hide from larger predators, but also some fish actually survive by eating the reefs themselves. Reefs offer protection to plants and animals from the ravages of waves and ocean currents. Thus, when the reefs die, so do many other living creatures.

Photo courtesy of Dr. Charles Mazel

When Dr. Charles Mazel of Physical Sciences (Andover, MA) decided to make fluorescence measurements of corals, he began searching for the right instrument. The instrument would have to be transportable and able to withstand the pitch and yaw aboard a ship. His samples also had special requirements:

- The samples might be photosensitive, and thus could not be subjected to prolonged light exposure.
- The samples were scattered over many sites, so the instrument needed to last prolonged periods without service. System set-up had to be easy.
- Coral fluorescence could be dependent upon factors such as seawater composition and temperature, so perturbation of the corals' environment had to be minimized

At HORIBA Jobin Yvon, Dr. Mazel found our FluoroMax® spectrofluorometer. Its fast scan-rate and unmatched sensitivity allow samples to be measured faster than any other instrument without degrading data. The FluoroMax® is rugged enough to endure shipboard life and operate up to 1200 hours between lamp replacements. We even agreed to fit custom tie-downs to protect it from damage by rogue waves. A fiber-optic probe accessory let Dr. Mazel measure corals' fluorescence while they sat comfortable in a familiar bath of warm, flowing seawater.

Dr. Mazel is interested in the phenomenon of coral fluorescence, not just from chlorophyll in symbiotic algae, but also the intense, multi-hued glow from pigments in the corals' tissues themselves. How many pigments are there? What are their spectra? How do they affect coral physiology? Does fluorescence indicate coral health?

Dr. Mazel assembled a library of spectral signatures, analyzing excitation and emission spectra of various corals *in vivo* and non-destructively. His FluoroMax® has traveled to ship- and shore-based sites to study fragile corals in the Bahamas and Dry Tortugas.

Experimental set-up and results

Dr. Mazel, a scuba-diver, collected samples and maintained them in a tank of flowing seawater. Through a fiber-optic probe 2 m long, he recorded fluorescence spectra with

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bandpasses = 2 nm. For excitation spectra, λ_{em} = 490, 530, 590, and 690 nm, and integration time = 0.2 s. For emission spectra, λ_{exc} = 365, 450, and 488 nm and integration time = 0.5 s.

Just four autofluorescent pigments contribute to the observed coral fluorescence. The four pigments fluoresced at λ_{max} ~ 486, 515, 575, and 685 nm, respectively (Figs. 1–4). Chlorophyll (λ_{max} = 685 nm) existed in all samples.[1]

Besides providing insight into mechanisms of photosynthesis and a possible monitor of reef stability through bleaching, these spectra act as a catalog of coral identity to help distinguish between specific coral types.

Acknowledgment

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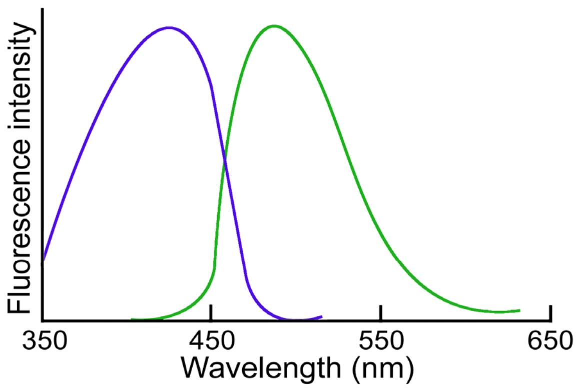

Fig. 1. Excitation and emission spectra for Agaricia coral (λ_{max} = 486 nm).

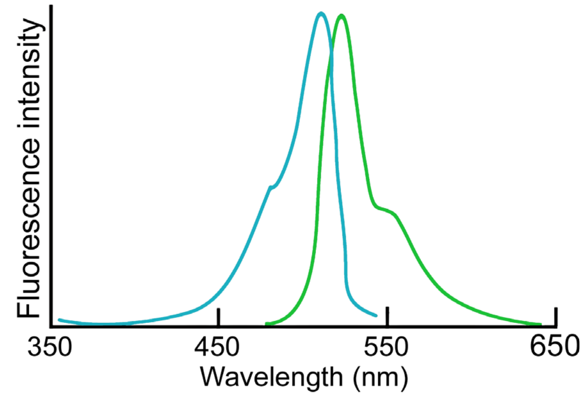

Fig. 2. Excitation and emission spectra for Mycetophyllia lamarckiana coral (λ_{max} = 515 nm).

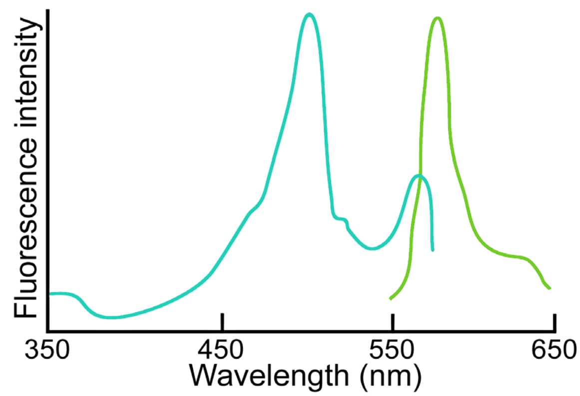

Fig. 3. Excitation and emission spectra for Montastrea cavernosa coral (λ_{max} = 575 nm).

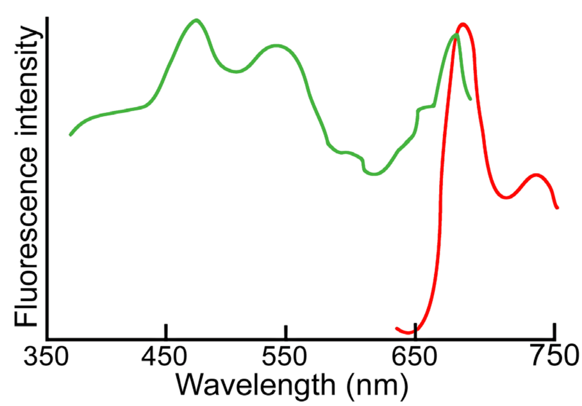

Fig. 4. Excitation and emission spectra for Montastrea annularis coral (λ_{max} = 685 nm).

[1] C.H. Mazel, in *Ocean Optics XIII*; S.G. Ackleson and R. Frouin, eds; Proc. SPIE 2963, 1997, pp. 240–245.

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