

Master's Thesis



In situ optical monitoring of *Pyrodinium bahamense* in Palawan, Philippines

Scott Harper

Advised by: Halldór Pálmar Halldórsson

University of Akureyri
Faculty of Business and Science
University Centre of the Westfjords
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Abstract

Pyrodinium bahamense, a toxic dinoflagellate, is the leading cause of “red tide” algal blooms in the Philippines. Current monitoring practices do not address the need for an early warning system, due to the high costs and expertise required in the implementation of available methods. The feasibility of an inexpensive and simple method for monitoring HABs was examined. The approach was based on analysis of colour, derived from *in situ* digital images, supplemented by basic environmental measurements – salinity, temperature, and light intensity. The influence of these parameters on growth - and thus the ability to predict a bloom - was explored, alongside the notion that *P. bahamense* should alter the colour balance of a water body, indicating the initiation of a bloom. Colour was analyzed in respect to the three basic components of a digital image: Red, green, and blue. Three bodies of water and three rivers surrounding the island of Palawan, Philippines were examined. The colour balance was consistent in most cases, and a unique colour composition was found for each location. Light intensity readings were always within the optimal growth range for *P. bahamense*, and the same is true for salinity with one exception. Temperature was too high 36% of the time, but 34% of these results exceeded the optimal range by only 1°C, and samples were taken at the surface. Thus, the environmental parameters examined seemed consistently within the optimal range for *P. bahamense* growth. *In situ* optical monitoring results were encouraging, but inconclusive due to the lack of a *P. bahamense* bloom occurrence during study.

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Terms:

RGB: Abbreviation for red, green, and blue values - the way colour is organized in a digital image.

PSP: Abbreviation for “paralytic shellfish poisoning” - the result of saxitoxins. Can lead to death due to various neurotoxic effects and respiratory failure (Walsh, 2008).

HABs: A flexible term used to describe an aggregation of algae that has a detrimental effect on other species. Most commonly used to refer to toxic algae – which is the case in this study – but can also refer to a non-toxic bloom that causes harm due to its sheer density, or the creation of anoxic conditions due to oxygen depletion in bottom waters (Anderson, 2005).

IOCCG: International Ocean Colour Coordinating Group

BFAR: Acronym for Bureau of Fisheries and Aquatic Resources.

Red tide: Colloquial term for HABs, commonly used in the Philippines and other locations.

Pyrodinium bahamense: An armoured, chain-forming, bioluminescent dinoflagellate which produces saxitoxins. Responsible for most HABs in the Philippines (Usup et al., 1994).

Dinoflagellates: A phytoplankton protist, both auto- and heterotrophic, with flagellum (Anderson, 2005).

Saxitoxin: A toxin which affects sodium channels in the brain, leading to mild paralysis (Walsh, 2008).

In Situ: Latin term used in this case to describe an on-site study, rather than remote.

Upwelling light: Light that is reflected off of a surface, and backscattered (IOCCG, 2000).

Downwelling light: Light coming directly from the sun (IOCCG, 2000).

Cyst: A capsule enclosing organisms in their dormancy, or resting stage (Anderson, 1989).

Lux: The standard unit for luminance measurement – an indication of light intensity. Represents one lumen per square meter (Thimijan & Heins, 1982).

Micromoles: Linguistic representation of $\mu\text{mol m}^{-2} \text{s}^{-1}$, meaning micromoles per square meter per second. A unit used for measuring light intensity (Thimijan & Heins, 1982).

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