

Zooxanthellae Densities are Highest in Summer Months in Equatorial Corals in Kenya

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Tropical reef-building corals contain micro-algae known as zooxanthellae (*Symbiodinium* sp.) within their tissue with which they exist in an obligate symbiosis. Zooxanthellae are crucial to coral polyps because they provide them with photosynthates, energy, oxygen and pigmentation.

Several studies from around the world have observed that zooxanthellae population densities can undergo marked seasonal fluctuations. Research in Israel (Shenkar et al., 2006) Thailand (Brown et al., 1999), Mauritius (Fagoonnee et al., 1999), the Bahamas (Fitt et al., 2000; Warner et al., 2002) and Hawaii (Stimson, 1997) has shown that zooxanthellae population densities are highest during colder months and lowest during warmer months, with intermediate densities in between. These fluctuations have mostly been explained in terms of temperature and solar irradiance that affect the zooxanthellae's capacity to photosynthesise (Brown et al., 1999; Fitt et al., 2000; Shenkar et al., 2006; Stimson, 1997; Warner et al., 2002). However, these studies were conducted at higher latitude sites where seasonal environmental

parameters are more variable and the difference between summer and winter conditions is more marked than at sites closer to the equator.

CORDIO collected zooxanthellae density and mitotic index data for eleven species of scleractinian coral (*Acropora* sp., *Echinopora gemmacea*, *Favia* sp., *Galaxea fascicularis*, *Hydnophora microconos*, *Montipora aequituberculata*, *Pavona decussata*, *Pocillopora damicornis*, *Pocillopora eydouxi* *Porites cylindrica* and *Porites lutea*) in the Mombasa Marine Park from 1998 to 2006. Four main seasons are distinguished for analysis, the northeast monsoon (16 December – 15 March), the late northeast monsoon (16 March – 30 April), the southeast monsoon (1 May – 31 October), and the transitional period (1 November – 15 December). The late northeast monsoon and the transitional period are doldrum periods when warming of surface waters is most intense between the two winds. Temperatures (Fig. 1) and radiation levels (Fig. 2) are lowest during the southeast monsoon and highest during the late northeast monsoon.

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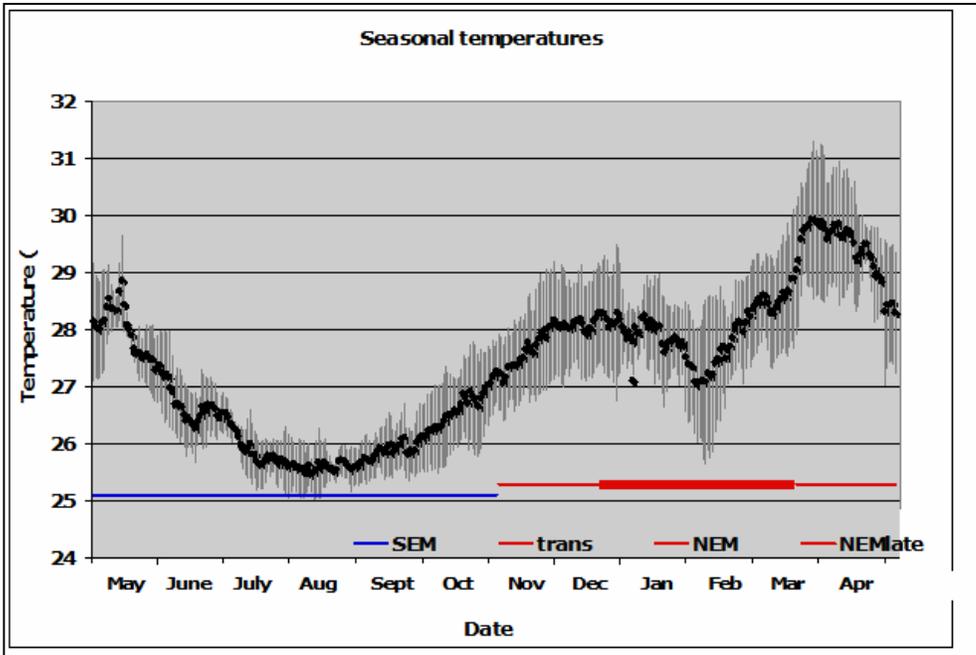


Figure 1. Temperature data for the Mombasa Marine Park showing daily means and standard deviation for 1999-2005. Horizontal bars show seasons described in the text.

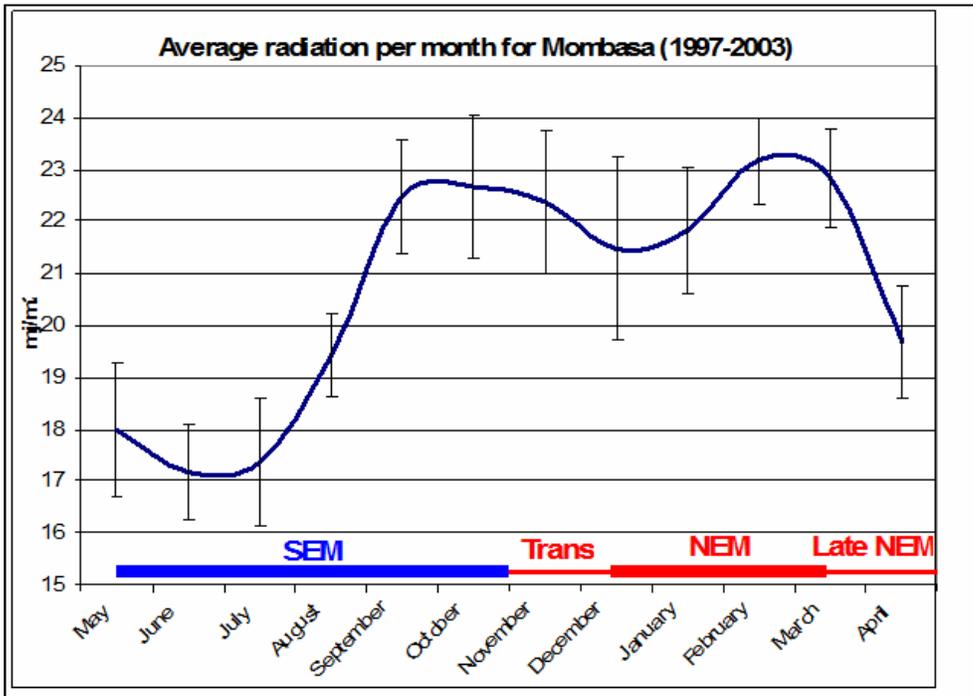


Figure 2. Radiation data for Mombasa showing monthly means and standard deviation for 1997-2003. Horizontal bars show seasons described in the text. Data courtesy of Mombasa Meteorological Office.

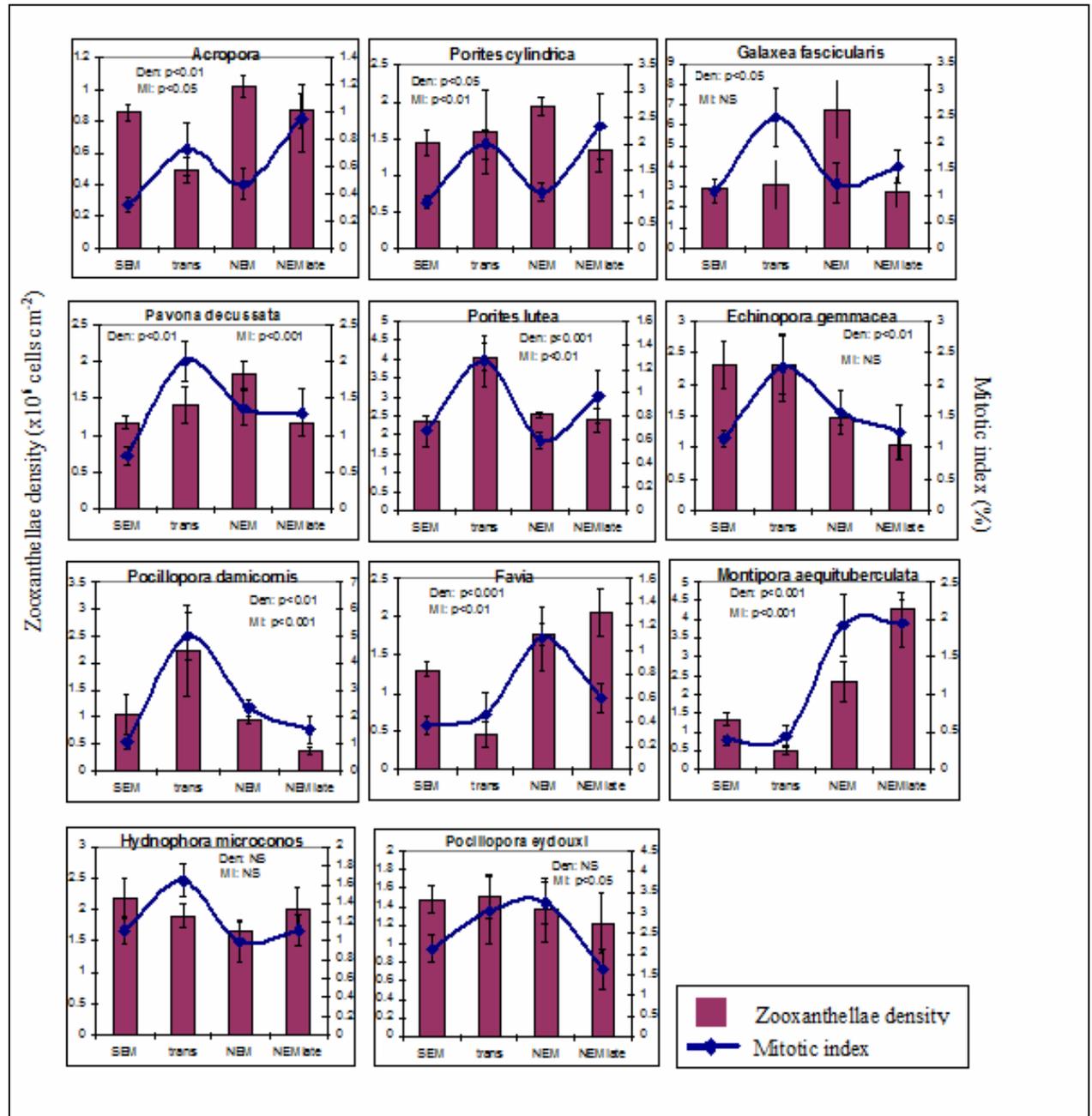


Figure 3. Average seasonal zooxanthellae densities and mitotic indices for all species. SEM = Southeast monsoon. Trans = Transitional period between monsoons. NEM = Northeast monsoon. NEMlate = Late Northeast monsoon. ANOVA values are also shown to illustrate significant differences between seasons. Den = Zooxanthellae density. MI = Mitotic index.

Although different zooxanthellae densities in different species peaked in different months, all species displayed highest densities at some point during the overall northeast monsoon season (1st November to 30th April) and most displayed highest mitotic indices during the transitional period directly preceding the Northeast monsoon (1st November to 15th December) (Fig 3). The higher densities found during the northeast monsoon (when temperatures and radiation levels are higher) are surprising as they are contrary to trends found at higher latitudes. It is possible that at higher latitudes seasonal variability of temperature and light is so great that it dictates zooxanthellae density fluctuations, while corals closer to equator may be less influenced by seasonal variability of temperature and light, and other factors may have a greater influence on population dynamics.

This study thus highlights the degree of variability in zooxanthellae population dynamics there may be among coral species and between sites at widely different geographic locations.

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