The Dynamics of Coral Disease and Bleaching

Coral reefs of the Caribbean have been severely degraded over the last few decades through the impacts of coral diseases and bleaching (Gladfelter 1982, Gardener et al. 2003, Rogers et al. 2008, Woody et al. 2008). While the proximate causes of these signs of coral impairment are sometimes known, such as temperature and irradiance initiation of coral bleaching (Glynn 1996), the direct causes of many other reduced coral health states remain enigmatic. Coral bleaching (Fig. 1) and disease outbreaks (Fig. 2 & 3) and are believed to be increasing in incidence and severity (Harvell et al. 2005; Hoegh-Gulberg et al. 2007). Paralleling this increase in causes of coral degradation, global and local stressors in waters surrounding Caribbean islands are also increasing, and their combined and synergistic impacts may be the ultimate driver of coral bleaching and disease (Knowlton 2001; Hughes et al. 2003). These stressors range from increasing sea surface temperature (Levitus et al. 2000) and ocean acidification (Gledhill et al. 2008), to already high levels of sediment loading (MacDonald et al. 1997, Smith et al. 2008), fishing (Jackson et al. 2001), and toxins (Carbery et al. 2006). A major task of modern coral reef biology is to reveal the connection between these stressors and the causes and consequences of coral disease and bleaching.
The US Virgin Islands has also suffered under the impact of coral disease and bleaching in the last few decades and is a natural laboratory for investigating these threats to coral reef persistence. In fact, many of the first and most well described examples of Caribbean disease and bleaching have come from the USVI. The Center for Marine and Environmental Studies is actively engaged in research into the connection between global and local stressors and causes and consequences of coral diseases and bleaching on scales ranging from the seascape to individual corals. This research uses high-resolution monitoring of coral stress factors, such as temperature, sediment, and nutrient-loading, and widespread coral reef sampling, such as repetitive monitoring and targeted sampling of specific events, such as disease outbreaks and mass coral bleaching episodes. We are also investigating the relationship between coral symbiont (zooxanthellae) diversity, and coral disease and bleaching.

Recent progress within this research theme has led to new insights into the seascape scale patterns of coral disease and bleaching and the processes that increase and reduce their impacts. Research highlights include:

- The susceptibility of individual coral species to coral diseases in mid-depth and deep reefs of the USVI (Calnan et al. 2008)
- Linkages between nearshore stressors and chronic low-level bleaching and partial colony mortality (Smith et al. 2008)
- Outbreaks of a widespread and highly degrading disease in mesophotic (> 30 m deep) coral reef refugia (Smith et al. in review)
- The connection between mass coral bleaching events and seascape patterns of bleaching and disease; including degradation
in a predicted coral reef refuge (Rogers et al. 2008, Woody et al. 2008, Smith et al. in prep)

- The reduction of coral bleaching due to hurricane cooling of sea surface temperatures (Manzello et al. 2007)
- The connection between symbiont diversity and susceptibility of Caribbean corals to diseases (Correa et al. 2009)
- The dynamics of coral symbiont diversity following the 2005 NE Caribbean mass bleaching event

**Partners**

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**Literature Cited and Other Relevant Publications**


Smith TB et al. (in prep) Refuges from coral bleaching may not be refuges from the effects of warming seawater temperatures