A mass bleaching event involving clionaid sponges

Fig. 1 **a** Non-bleached (typical) *Cliona varians* forma *incrustans* growing over a *Montastrea cavernosa* colony (photograph by M. Hill). **b**, **c** Representative examples of bleached *C. varians* observed in October 2015 (photographs by C. Walter)

The Caribbean sponge *Cliona varians* forma *incrustans* harbors dense intracellular populations of Clade G *Symbiodinium* (Fig. 1a; Hill 1996). Symbioses between bioeroding clionaids and *Symbiodinium* spp. are typically unaffected by the environmental stressors that induce bleaching in corals (e.g., Schönberg and Suwa 2007). However, in October 2015 we observed widespread *C. varians* bleaching on reefs at 12–15 m in the lower Florida Keys (Fig. 1b, c; Electronic Supplementary Material Fig. S1). The cause of sponge bleaching appears related to water temperature. Average daily temperatures >31 °C persisted for 10 days (5–15 September) with a maximum temperature >32 °C. Sponge bleaching became obvious around the first week of October. While bleaching in *C. varians* can be induced artificially (Hill and Wilcox 1998), this appears to be the first report of a mass bleaching event involving clionaid sponges under natural conditions. Disrupting the symbiosis may have consequences for reef health if sponge filtration efficiency is impaired, rates of bioerosion are compromised, or non-native symbionts establish residency. Interestingly, the shallow-water *C. varians* forma *varians* did not bleach at an adjacent inshore site despite experiencing 17 days with average temperatures >33 °C and maximum temperatures >41 °C. While differential bleaching susceptibilities may exist among individuals and clionaid species, the observations reported here indicate that sponge–*Symbiodinium* symbioses can be destabilized by environmental stressors in a manner similar to corals. These observations are troubling given increasing intensity and frequency of warming events, the abundance of sponges in reef ecosystems, and the essential ecological role they play in coral reef productivity.

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M. Hill (✉)
Department of Biology, University of Richmond, Richmond, VA 23173, USA
e-mail: mhill2@richmond.edu

C. Walter · E. Bartels
Mote Marine Laboratory, Summerland Key, FL 33042, USA

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