Dimming sand halos around coral reefs in Dominica: New expansion corridors for the invasive seagrass *Halophila stipulacea*.

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Coral reefs of Dominica are restricted to the island's narrow shelf. Most of its 31 reefs and reef complexes are clustered in two areas, one in the North and one in the West (Fig. 1). Together they comprise 77 % of the total coral reef area of only 80.5 ha (Steiner, in press) and are exposed to chronic stressors due to their proximity to shore (Steiner 2003). Human activities since the 18th century have exacerbated this situation (Steiner, in press), despite Dominica's comparatively modest infrastructural development, and a low population, which peaked at close to 74,000 in the 1950s.

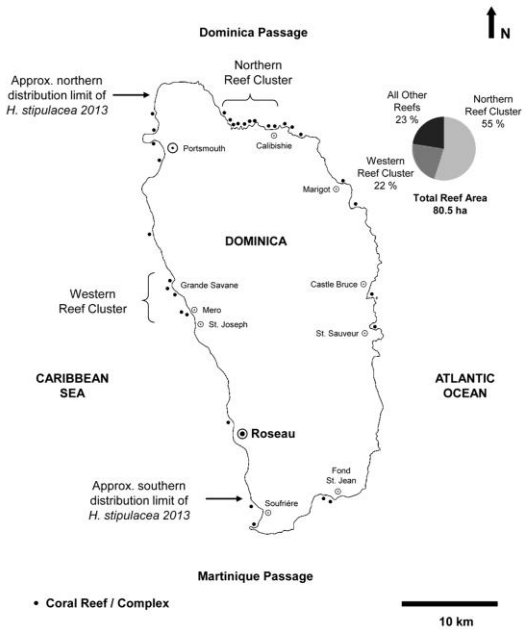

Fig. 1 Distribution of coral reefs and distribution limit of *H. stipulacea* on the west coast. Adapted from Steiner (in press).

Where coral reefs and seagrass beds co-occur, the former are commonly outlined by an unvegetated band of bare sand. This sand "halo" is in part maintained by reef-associated fishes and invertebrates that graze on seagrass and its epiphytic organisms (Ogden et al. 1973, Randall 1965, Valentine and Heck 2005) or feed on endofauna within the sediments that they bioturbate around the reef (e.g. Mullidae). Around shallow reefs the erosional effects of current eddies also play a role in maintaining sand halos.

In March 2013 we observed the uncharacteristic absence of such sand halos around coral reefs in Dominica, during surveys of the invasive seagrass *Halophila stipulacea*. This native Indian Ocean seagrass was first reported in the Caribbean in 2002 by Ruiz and Ballentine (2004), and has since been identified on at least eighteen islands (Willette et al. 2014). Its expansion in Dominica was observed as of 2007 (Willette and Ambrose 2009, Steiner et al. 2010), where it ballooned from isolated patches in 2008 to a 55 km swath along the west coast by 2013, and profoundly affected native seagrasses in replacing many (Steiner and Willette 2013). *Halophila stipulacea* had also overgrown sand halos around most reefs within its current distribution on the island, which is restricted to the western sublittoral (Fig. 1 and 2).

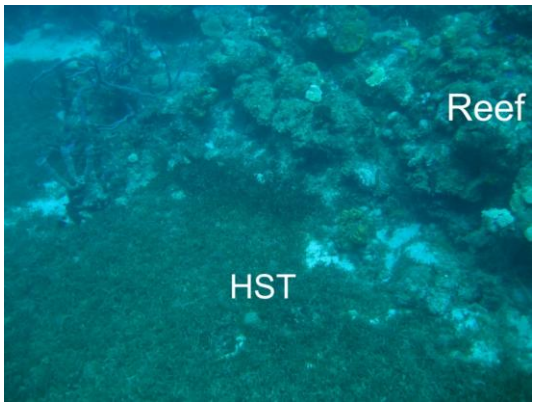

Fig. 2 *Halophila stipulacea* meadow (HST) growing up to the moribund Douglas Bay Reef in 2013

Sand and rubble-laden depressions within affected reefs were no longer seagrass-free. *Halophila stipulacea* further spread along semi-consolidated coral rubble lining dead reefs in 1-5 m depth (Fig. 3), which thus served as expansion corridors across shallow and highly disturbed sandy environments otherwise unsuitable for seagrasses.

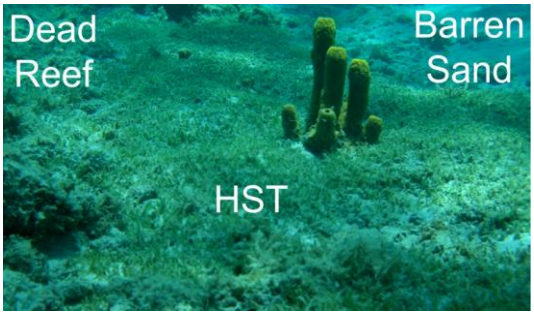

Fig. 3 Margin of dead reef in Scott's Head serving as expansion corridor for *H. stipulacea* (HST).

We found few exceptions to this pattern among individual sections in the largest west coast reefs between Grande Savane and Mero at depths of 10 to 30 m (Fig. 1 and 4). These reefs were the healthiest in Dominica with a live coral cover rarely exceeding 10 % and few living coral frameworks (Steiner in press). It remains to be determined whether the reef-associated grazers and bioturbators of such sections or other factors continue to maintain the last seagrass-free areas.

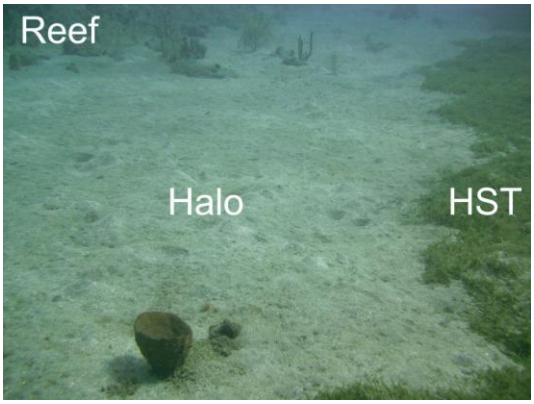

Fig.4 Bioturbated halo separating reef and the invasive *H. stipulacea* (HST) near Mero in 2013

The disappearance of sand halos illustrates one facet of rapidly changing Caribbean coral reef - seagrass landscapes. In the case of Dominica, the invasive seagrass *H. stipulacea* drastically altered native seagrass meadows in four and half years (Steiner and Willette 2013), and colonized sand halos of coral reefs. The dwindling numbers of conspicuous reef-dwelling grazers and bioturbators on the island's moribund reefs were evidently no match for the rapid lateral expansion (Willette and Ambrose 2009) of this densely growing invasive seagrass (Figs. 5 and 6).

Fig. 5 Traditional fish pot in typical Dominican *S. filiforme* bed in 2008, with 20 cm tall canopy and open spaces at Bioche.

Fig. 6 Traditional fish pot in former *S. filiforme* bed that was replaced by *H. stipulacea*'s dense mat with a 5 cm tall canopy in 2013 at Mero.

This recent seagrass invasion also shows that future attempts in preserving the remaining coral communities will have to jointly address the preservation of native seagrasses. Unfortunately, the structural and ecological alterations in Dominica's benthic habitats are currently faster than the formation of mitigation initiatives.

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