Biodiversity associated with the seagrass beds of the invasive species *Halophila stipulacea* in Guadeloupe Island (Lesser Antilles)

Biodiversidad asociada con las praderas marinas de la especie invasora *Halophila stipulacea* en la isla de Guadeloupe (Antillas Menores)

Biodiversité associée aux herbiers de la Phanérogame marine envahissante *Halophila stipulacea* dans l'île de Guadeloupe (Petites Antilles)

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EXTENDED ABSTRACT

In the lesser Antilles, five species of native Phanerogams occur: *Halophila decipiens, Halodule wrightii, Ruppia maritima, Syringodium filiforme* and *Thalassia testudinum*. *S. filiforme* (pioneer species) and *T. testudinum* (climacic species) were at the origin of the most extended seagrass, before the introduction of *Halophila stipulacea*, from Indian Ocean and Red Sea origin, that has invaded the Lesser Antilles since 2004 (Ruiz et Ballantine, 2004). The vector of the invasion was attributed to sailing boats traveling through the Atlantic Ocean from the Mediterranean Sea and then cruising between the islands of the West Indies (Ruiz & Ballantine, 2004; Willette & Ambrose, 2009). The success of this plant as an invasive species has been attributed to its ability to expand rapidly by asexual reproduction (Marba & Duarte, 1998). Its root system is weak. Waves and currents uproot fragments of the plant including leaves, rhizomes and roots. These have neutral buoyancy and are carried away by currents. The survival time of such fragments exceeds ten days while maintaining the ability to re-root (Hall *et al.*, 2006; Smulders *et al*., 2017; Willette *et al.*, 2020). Man participates in this propagation through the action of fishing traps and nets (Willette & Ambrose, 2009, 2012), boat propellers, anchoring in seagrass beds, divers... This phenomenon of fragmentation is the main mode of invasion of the species. So far, no signs of sexual reproduction have been found for this species in the Caribbean region (Vera *et al*., 2014; Willette *et al*., 2014).

In Guadeloupe Island, *H. stipulacea* mainly colonized the sheltered leeward coasts and embayments between the surface to 60 m deep. On the leeward coast, native *Syringodium filiforme* and *Halophila decipiens* were widely eradicated. *Thalassia testudinum* seagrass beds better resisted, due to the strong developed structures of their rhizosphere. Nevertheless, the present study has highlighted a slow and gradual erosion of *Thalassia* meadows by *Halophila*. Given its bathymetric and geographical extension and its rapid mode of propagation by cuttings, the eradication of *H. stipulacea* is not possible and *Halophila* seagrass beds constitute nowadays the largest surface of seagrass beds on the coasts of Guadeloupe Island.

Benthic and fish communities associated with *Halophila stipulacea* were studied and their biodiversity compared to those of the main native seagrass beds (*Thalassia testudinum* and *Syringodium filiforme)*.

The biodiversity of seagrass communities was investigated by roving techniques for both benthic and fish communities. Furthermore, benthic communities were quantitatively studied by counting organisms on band-transects. Fishes were quantitatively investigated using a seine net with a known sampling surface.

Concerning benthic communities, 161 macroorganisms (48 algae and 113 animals) were identified in the three types of seagrass beds: 135 in *Thalassia*, 72 in *Halophila* and 48 in *Syringodium* seagrass beds. The community of *Halophila* seagrass beds appeared to be an impoverished subset of that of *Thalassia*. All plant and animal species found in association with the invasive species have a Caribbean origin. Quantitatively, benthic organisms are less abundant in *Halophila* seagrass beds than in those of *Thalassia* located in more choppy areas. On the other hand, in sheltered habitats, the abundance of benthic macroorganisms was very close between the two types of seagrass beds.

Concerning fish biodiversity, a total of 181 species was recorded: 153 associated with *Thalassia*, 88 with *Halophila* and 19 with *Syringodium* seagrass beds. Most of them were juveniles. In *Halophila* seagrass beds, fish abundance, in numbers and biomass, was similar to that found in *Thalassia* seagrass beds and higher than that of *Syringodium* seagrass beds. Juvenile fish abundance was equivalent in the seagrass beds of *Thalassia* and *Halophila*. This confers an important role of "nursery" to the *Halophila* meadows. In seagrass beds dominated by juvenile fishes, the proportions of species of commercial interest correspond to 55% of fish abundance in *Halophila* and 40% in *Thalassia* meadows.

Invasive species are considered harmful and therefore doomed to eradication (unreasonable for *Halophila stipulacea*). It is unusual to investigate whether they provide ecosystem services (Pejchar and Mooney, 2009; Storkey *et al.,* 2013) and more particularly the marine Phanerogams (Viana *et al*., 2019). However, these functions are not necessarily related to a species but rather to the biological system they help to create.

From a practical point of view, considering the inevitability of the extension of *Halophila stipulacea* seagrass beds, it is important to take into consideration the ecosystem services they provide (increase in the biodiversity of sedimentary colonized bottoms, attenuation of swells and currents, oxygen production by photosynthesis, role of nursery for benthic organisms and fish, some of them of commercial interest, food source for invertebrates, fishes, turtles …).

Thus, in spite of the detrimental effect of *H. stipulacea* on native seagrass we suggest that, given the knowledge gained during this study on this invasive species, now naturalized, environmental managers should focus on re-examining its status, in order to take into consideration the ecosystem services *Halophila* seagrass beds provide and to manage them pragmatically.

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KEYWORDS: Invasive species, *Halophila stipulacea*, Lesser Antilles, benthic communities, fish assemblages

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