

Monitoring regenerated nitrogen in reef food webs following *Sargassum* mass strandings

Seguimiento del nitrógeno regenerado en las redes tróficas de los arrecifes tras varamientos masivos de los Sargazos

Suivi de l'azote régénéré dans les réseaux trophiques récifaux suite aux échouages massifs de Sargasses

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EXTENDED ABSTRACT

Since 2011, the islands of the Lesser Antilles have been experiencing massive stranding episodes of holopelagic *Sargassum* (*Sargassum* spp), due to the increased inputs of nutrients into the oceans and global warming (Grower *et al.*, 2013; Wang *et al.*, 2019). Since 2018, a giant *Sargassum* raft, called the "Great Atlantic *Sargassum* belt (GASB)" has been observed every year, covering almost 9,000 km and containing more than 20 million metric tons of *Sargassum* (Wang *et al.*, 2019). The rafts generally end their migration cycle on exposed beaches and coasts, where they degrade. In addition to the economic and public health problems caused by these mass stranding, there are also ecological consequences for natural environments. *Sargassum* rafts cause a variety of damages to benthic coastal ecosystems represented by mangroves, seagrass beds and coral reef, such as shading which slows down photosynthetic activity, the inputs and transfer of metallic, chemical and/or micro-nanoplastic pollutants adsorbed on the *Sargassum* (Alleyne *et al.*, 2023, Devault *et al.*, 2023) or the transport of invasive exotic species. Moreover, *Sargassum* rafts that pass through and wash up near coastal ecosystems represent a gigantic new quantity of organic matter, which can enrich natural surrounding waters and modify the physico-chemical nature of coastal waters during degradation. During the nitrogen mineralization process of *Sargassum* decomposition, ammonia evaporates, enriching the environment with the heavier nitrogen isotope (¹⁵N). Coastal water masses mix under the effect of swells and winds and can join adjacent oligotrophic coral reefs, that usually deal with very low concentrations of nitrogen. In the present study, we hypothesized that *Sargassum* stranding and its degradation could influence the trophic food-web by modifying the nature and quantity of nitrogen absorbed by primary producers and transferred to primary consumers on coral reef.

To test our hypothesis, we selected four study sites around Guadeloupe Island: two protected sites that never experienced *Sargassum* stranding (Prot1 and Prot2), located on the northwest coast at 14 and 8m deep respectively, and two exposed sites on the southeast coast (Exp1 and Exp2) at 12 and 6 m deep. Two sampling campaigns were organized according to the amount of *Sargassum*. The first campaign was conducted in August 21, during an event of *Sargassum* stranding characterized by the presence of high biomass of *Sargassum* on the exposed beaches of the island. The second campaign has been organized in February 23, when the biomass of *Sargassum* was low. On each site, and during each campaign, we collected benthic macroalgae (*Halimeda* spp and *Dictyota* spp.) and algal turf associated with *Stegastes* territories, as well as individuals of *Stegastes diencaeus* and *S. planifrons*. Nitrogen isotopic compositions ($\delta^{15}\text{N}$ in ‰) were measured for each sample and compared between sites and campaigns using two-way ANOVAs.

Results showed that nitrogen isotopic compositions of all samples were enriched in ¹⁵N on the exposed sites compared to protected sites, whatever the amount of *Sargassum*. This result may reflect a permanent enrichment of sites on the southwest coast compared with those on the north coast, due to the proximity of these sites to human activities (settlements, agricultural activities, etc.). This enrichment seems independent to the *Sargassum* events.

When comparing each sample category between the two campaigns, characterized by different biomasses of drifting *Sargassum*, no significant differences in the $\delta^{15}\text{N}$ values were observed on shallow sites (Figure 1A and 1B). On deep sites, only algal turf exhibited a significant difference of $\delta^{15}\text{N}$ values between high and low *Sargassum* biomasses arriving on the coasts (Figure 1C and 1D). $\delta^{15}\text{N}$ values of algal turf also varied on the protected sites, indicating that these variations were independent to the *Sargassum* events. These variations can be explained by the complex and heterogeneous composition of

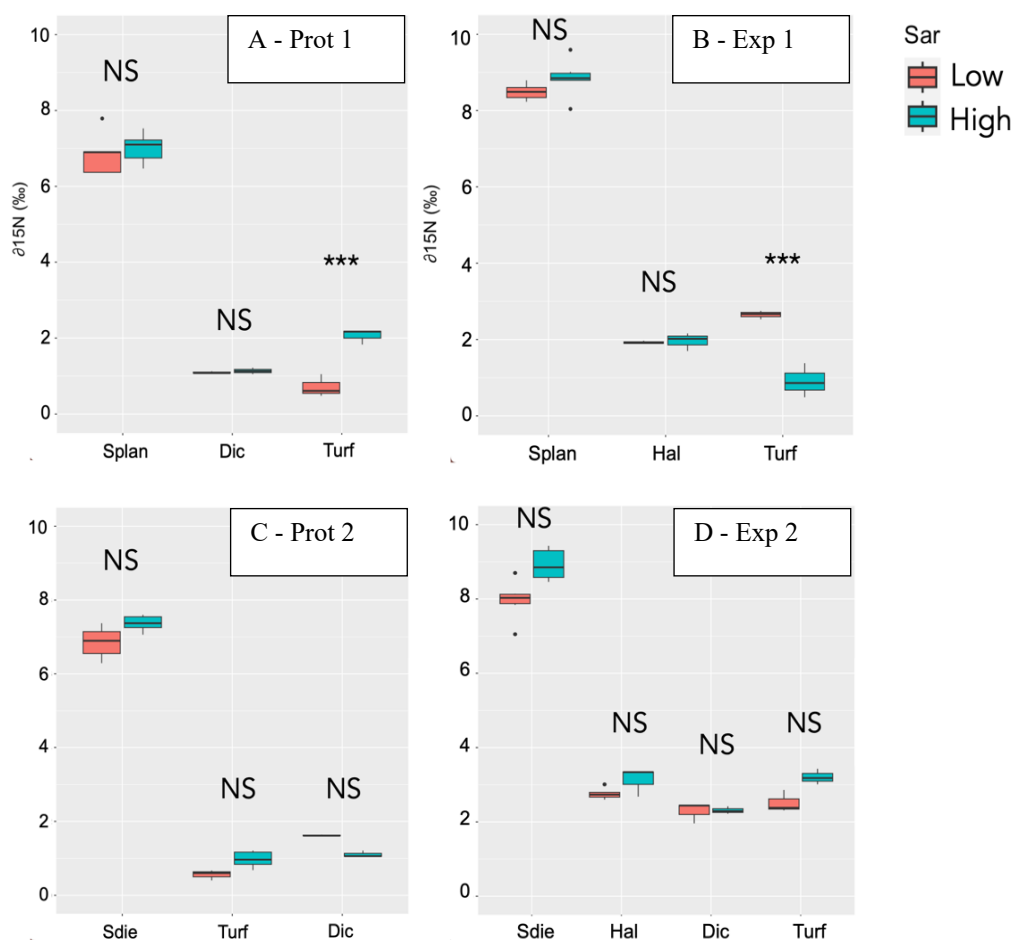


Figure 1. Nitrogen isotopic composition of macroalgae, algal turf, and fish during high (blue) and low (red) biomass *Sargassum* events, at protected sites (Prot1 and Prot2) and exposed sites (Exp1 and Exp2). NS: non-significant

this multi-species assemblage.

To conclude, the present study did not support the hypothesis that *Sargassum* stranding and its degradation could influence the nature of nitrogen absorbed by primary producers on coral reefs in Guadeloupe. These results can be explained by the fact that studied reefs are possibly too far from the coasts (5 km) to be influenced by the leachates of *Sargassum* during their coastal degradation. The environmental conditions are also probably not favorable to a dispersion of nutrients from the coast to the reefs. We can also suggest that nutrients coming from *Sargassum*'s leachates are rapidly consumed by others primary producers such as seagrass beds before reaching coral reefs.

KEYWORDS: Isotopic composition – Nitrogen transfer – Trophic food-web – Guadeloupe

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