Trophic Web Functioning of *Thalassia testudinum* Seagrass Beds in Guadeloupe (Lesser Antilles) Using Stable Isotopes and Fatty Acids

Funcionamento de las Praderas de *Thalassia testudinum*: Uso de Ácidos Grasos como Biomarcadores e Isótopos Estables

Fonctionnement des Réseaux Trophiques des Herbiers à *Thalassia testudinum* en Guadeloupe (Petites Antilles): Apports des Isotopes Stables et des Acides Gras

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ABSTRACT

In seagrass beds, vagile epifauna plays a major role in the energy transfer from primary producers to higher trophic levels. The main aim of the work was to examine the relationship between the seagrass complexity and the vagile epifauna community structure, and to study the role of this compartment within the food web of *Thalassia testudinum* seagrass beds. Two seagrass sites were compared, one near the coastal mangrove and another one near the barrier reef, during two seasons. Trophic resources used by primary consumers were assessed by combining stable isotopes analysis and fatty acid compositions. The coastal seagrass bed is complex due to its long leaves and its great biomass of litter and epiphytes. It shelters a great abundance and diversity of Crustaceans. The feeding preference of them for micro-algae and detrital particles promotes biofilm contribution to food web of the coastal seagrass bed. The seagrass bed located seawards, lesser complex, harbors an Invertebrate community dominated by the Gastropods Cerithiidae. The reduced food availability in that seagrass bed explains the higher contribution of litter and *Thalassia* leaves to that food web compared to the coastal seagrass bed. By coupling stable isotopes and stomach contents analyses, it was possible to highlight the major role of shrimps in the feeding diet of fishes. The coastal seagrass bed, where the trophic resources are more abundant and diverse, better plays its role of nursery for juveniles fishes than the seaward seagrass bed.

KEY WORDS: Caribbean, *Thalassia testudinum* seagrass beds, mobile epifauna, food web

INTRODUCTION

Seagrass beds constitute one of the most important components of coastal aquatic ecosystems due to their role as nurseries and food resources for numerous invertebrates and fishes (Thayer et al., 1984; Heck et al., 2003). In the Caribbean area, *Thalassia testudinum* seagrass beds harbor juvenile fish, fifty percent of which belong to first order carnivores, which means that they consume invertebrates from mobile epifauna (Bouchon-Navaro et al., 2004; Kopp et al., 2007). Mobile epifauna is defined as small mobile invertebrates able to live on seagrass leaves and (or) within the litter and is supposed to be an essential trophic link, from primary producers to first order carnivorous fish. The aim of this study is to highlight the trophic functioning of *Thalassia testudinum* seagrass beds. The three following questions were addressed:

i) What are the food sources available?
ii) What are the main food sources used by mobile epifauna? and
iii) How fish adapt their diet to the variability in the mobile epifauna community?

METHODS

Investigations were carried out in the Bay of Grand-Cul-de-Sac Marin located in Guadeloupe Island (Lesser Antilles). Two seagrass beds were studied: one located near the coastal mangroves in sheltered waters and another one close to the barrier reef, bathed by oceanic water and subjected to more choppy sea conditions. Samples were collected during the dry season. Potential food sources such as leaves of *Thalassia testudinum*, epiphytes organisms on them, litter of dead seagrass leaves, dead leaves of *Rhizophora mangle*, biofilm and suspended particulate organic matter (SPOM) were collected. Mobile epifauna and fish were collected using an epibenthic havenet and a seine-net respectively. Stable isotopes ($\delta^{13}C$ and $\delta^{15}N$) and fatty acid analyses were conducted on both food sources and mobile epifauna. Stable isotopes ($\delta^{13}C$ and $\delta^{15}N$) were also conducted on fish samples. In addition, stomach content analyses were carried out from 133 individuals of *Ocyurus chrysurus*, the most abundant species of first order carnivores.

RESULTS

Carbon isotopic signatures and fatty acid composition allow to distinguish food sources. Carbon signatures of *Thalassia* and litter were significantly different between sites with higher $\delta^{13}C$ values in the reef site than in the coastal site (Figure 1). *Thalassia* and *Rhizophora* leaves are characterized by vascular plant fatty acid markers while epiphytes are composed of Diatom and Red and Brown Algae fatty acid markers. Biofilm and litter are characterized by bacteria markers and SPOM by Dinoflagellate markers. Moreover, epiphytes and biofilm from the coastal seagrass beds present higher nutritive quality, in term of fatty acids, compared to the other sources and to those from the reef seagrass beds. That is due to their higher proportions of diatoms, algae and bacteria fatty acid markers.

Stable isotope and fatty acid analyses have revealed a clear distinction between the diet of Crustaceans and Gastropods (Figure 2). In the coastal seagrass beds, mobile epifauna, dominated by Crustaceans (Peracarids and Shrimps), consume mainly detrital particles from biofilm and diatoms from epiphytes. On the contrary, in the reef seagrass beds, Gastropods, that dominate the mobile epifauna community, have a diet preference for epiphytic algae and also assimilate *Thalassia* leaves. Shrimps present in this site also complete their diet with *Thalassia* leaves to compensate the low availability of food.

Stomach content and stable isotope analyses show that Crustaceans constitute the essential prey ingested and assimilated by the first order carnivorous fish, including *Ocyurus chrysurus*. Fish preferentially consume Peracarids when they are present, as in the coastal seagrass beds, and, rather Shrimps, if they are absent, as in the reef ones. As a result, fish diet depends on the community structure of Crustaceans in mobile epifauna.

Finally, this study has shown that abundances of epiphytic organisms and Crustaceans can be used as indicators to evaluate the nursery efficiency of a seagrass bed for juvenile fishes, in association with its physical shelter capacity.

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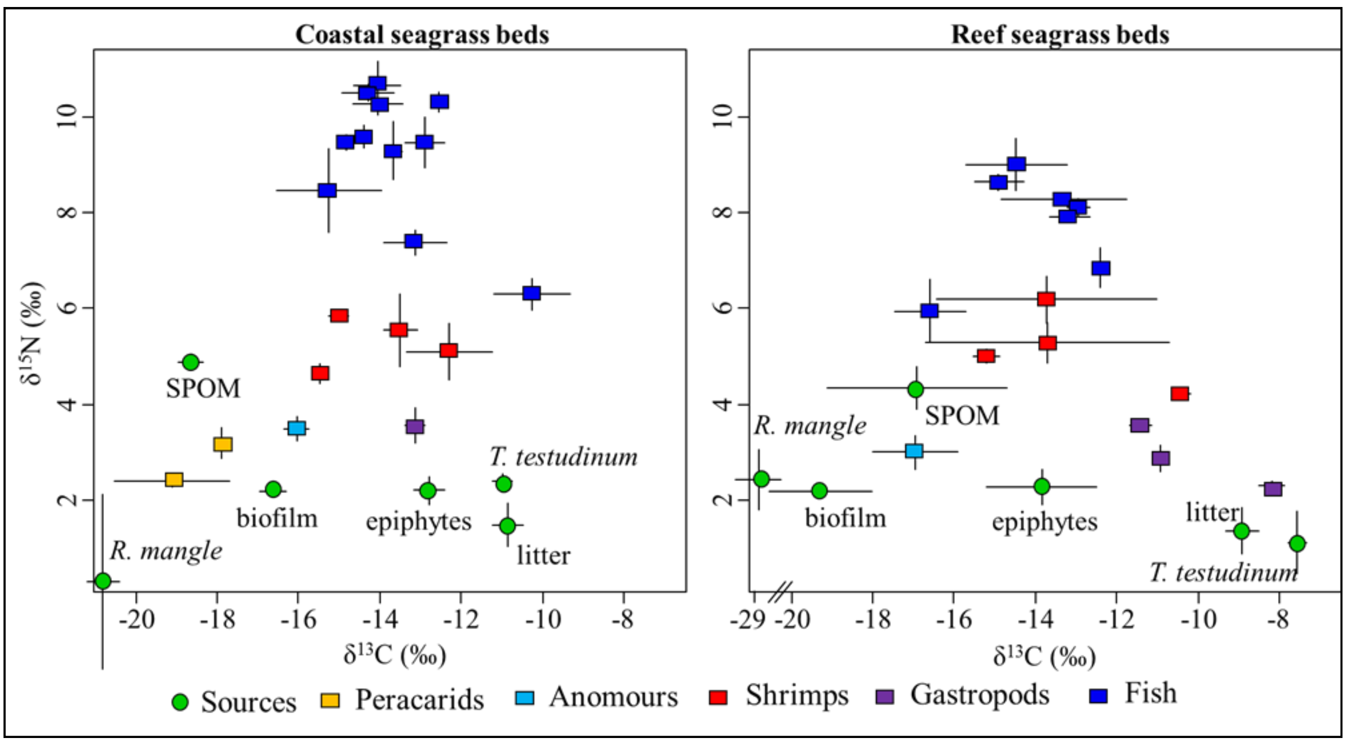

Figure 1. Mean isotopic signatures (± SD) of carbon and nitrogen, measured in fish and invertebrates muscles and food sources collected in seagrass beds near the coastal mangrove and the other one close to the barrier reef in the GCSM Bay.

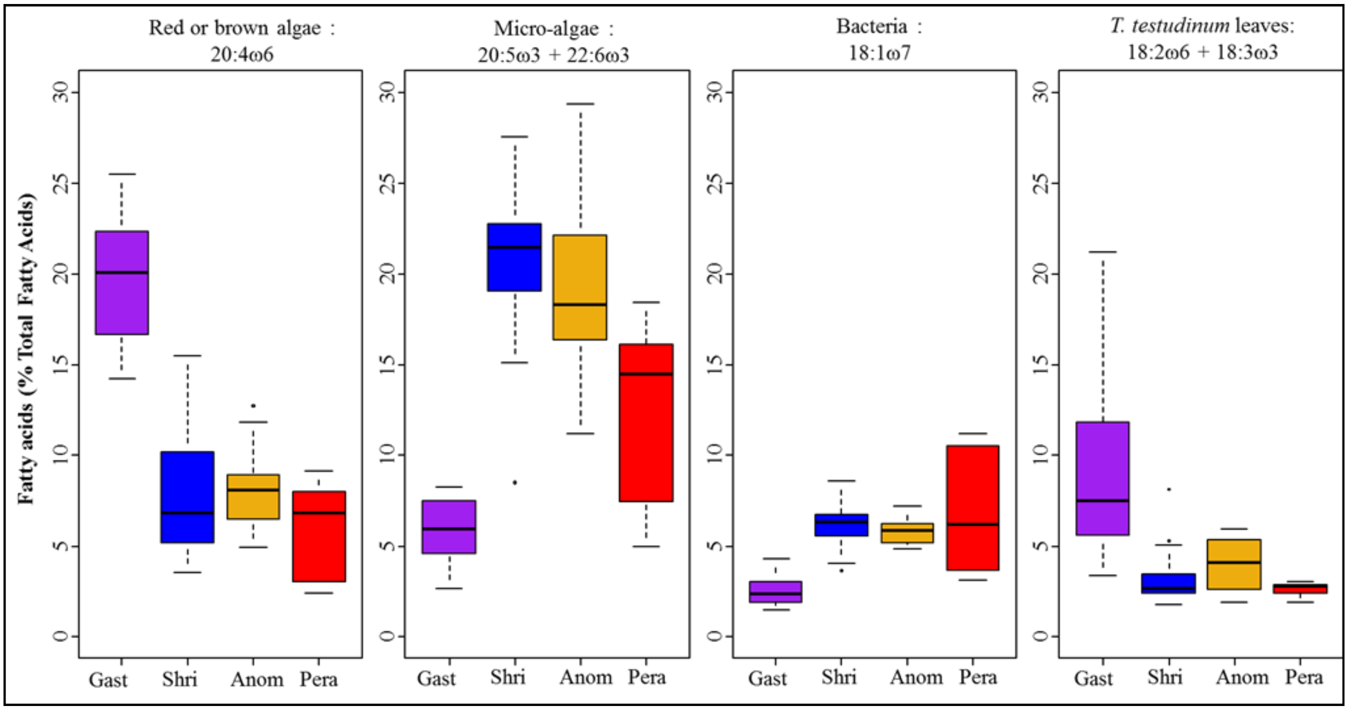

Figure 2. Relative proportions of the main fatty acid markers in Gastropods (Gast), Shrimps (Shri), Anomours (Anom) and Peracarids (Pera).