Evolution of the benthic communities of Pigeon Islets (Guadeloupe Island, Lesser Antilles) from 2012 to 2021 monitored by a photo-quadrats technique

Évolution des communautés benthiques des îlets Pigeon (île de Guadeloupe, Petites Antilles) de 2012 à 2021 suivie par la technique des photo-quadrats

Evolución de las comunidades bentónicas de los islotes Pigeon (isla de Guadeloupe, Antillas Menores) de 2012 a 2021 monitoreada por medio de foto-cuadrantes

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EXTENDED ABSTRACT

INTRODUCTION

The National Park of Guadeloupe set up a monitoring of benthic communities around Pigeon islets in 2012. Located at 1200 m from the coast, these islets constitute a protected area. The study aims to establish long-term temporal monitoring and to identify the aggressive factors disturbing the balance of the environment.

In a first step, the present study describes the evolution of benthic communities from 2016 to 2021, and secondly, focuses on a decade overview by using the data collected from 2012 to 2016 (Freschet, 2016).

MATERIALS AND METHODS

From 2016 to 2021, the benthic community was composed of 7 taxonomic groups, all quadrat data pooled. The group of Pheophyceae had the highest coverage rate (47.7 %), followed by the Scleractinians (20.3 %) and the algal turf (12.8 %). According to Friedman's analysis of variance, the order of dominance of the different groups of organisms did not vary significantly from 2016 to 2021 ($F = 6.7$; p- value = 0.751).

In contrast, the evolutionary trends of each group of organisms showed significant results. The Scleractinians had a statistically significant negative trend over the study period ($S = -0.927$; p-value = <0.0001), and the groups of Pheophyceae ($S = 0.064$; p-value = 0.031), Cyanobacteria ($S = 0.764$; p-value = 0.009) and Sponges ($S = 0.927$; p-value = <0.0001) presented a significant positive trend.

These significant trends resulted from the consequences of the apparition of a lethal Scleractinian disease named “Stony coral tissue loss disease (SCTLD)” in 2020 in Guadeloupe. The death of corals rendered the substrate available for competitors, hence the further increase of the coverage rate of Pheophyceae in 2020. They are bio-indicators of environmental eutrophication. The proliferation of Cyanobacteria reflected pollution by organic matter (Bouchon and Bouchon-Navaro, 2017).

The coral *sensu lato* community was composed of 15 species, including 13 Scleractinians, 1 species of Hydrocorals and 1 species of Zoantharia. The dominant species was Porites astreoides with 30.1% coverage followed by *Montastrea cavernosa* (16.7 %) and *Orbicella faveolata* (15.4 %). The study contains species classified as critically endangered and vulnerable by the IUCN red list, and also some corals protected by the French ministerial decree.

The Friedman tests revealed a change in the order of dominance during the study ($F = 40.574$; p-value = <0.0001) and the years 2020 and 2021 were responsible for this disparity, which corresponded to the occurrence of SCTLD. The trends according to the Spearman test *ante* disease showed that of the 15 species of corals, 13 had a non-significant trend. After the passage of SCTLD, out of the total 13 scleractinian species in our study, 8 showed a statistically significant negative trend.

The disease was responsible for 83% of tissue damage through the study period, along with a massive mortality in stony corals. Other causes of coral necrosis were predation (1%) and coral bleaching (16%). Unlike for the SCTLD event, all corals have recovered from those necroses. The coral bleaching episode was not statistically significant because it did not cause any colony loss, although that episode was severe. It was generated by a rise in sea temperature above the

tolerance threshold of 29°C for a long period of 122 days. In comparison, in 2018 when there was no recorded coral bleaching episode, the temperature only exceeded the tolerance threshold for 40 days (Malahel, 2020). There had not been such a severe episode since 2005 in Guadeloupe and the Lesser Antilles (Bouchon et al., 2008).

By combining the first results processed since the beginning of the 2012-2016 study (Freschet, 2016) and those of the present work (2016-2021), it is possible to have an overview of the evolution of benthic communities of Pigeon Islets over a decade.

The dominance structure of benthic organism groups varied between the first and the second period of the study. Between 2012 and 2016, the dominant groups of organisms were algal turf (40%), corals (29%) and Pheophyceae (14%). In the second period from 2016 to 2021, the most dominant groups were Pheophyceae (48 %), Scleractinians (20 %) and algal turf (13 %). These changes were due to disturbances occurring in the second period.

Regarding the evolutionary trends of the groups from 2012 to 2016, there is no statistically significant evolution, except for the Cyanobacteria which presented a negative trend and Sponges which had a positive trend, and which continued in the second period. Before the outbreak of SCTLD in 2020, the benthic communities of Pigeon islets were stable overall.

CONCLUSION AND PERSPECTIVES

To conclude, the present monitoring represents a real witness to the events that impacted the coral benthic communities of Guadeloupe (figure 1), namely the severe episode of coral bleaching due to the unusual rise in temperature, as well as the impact of SCTLD. At the end of the study, only 9 species of Scleractinians remained out of the 13 initially present. Indeed, among the 75 coral colonies which disappeared during the study, 42 colonies died because of SCTLD disease. In order to improve the monitoring protocol, the establishment of additional quadrats would strengthen the study of the National Park of Guadeloupe facing the loss of biodiversity revealed in the quadrats along the present study. Other comparative data could be obtained by extending this monitoring on other reefs of Guadeloupe.

KEYWORDS: Coral communities, temporal dynamics, coral bleaching, coral disease, Lesser Antilles

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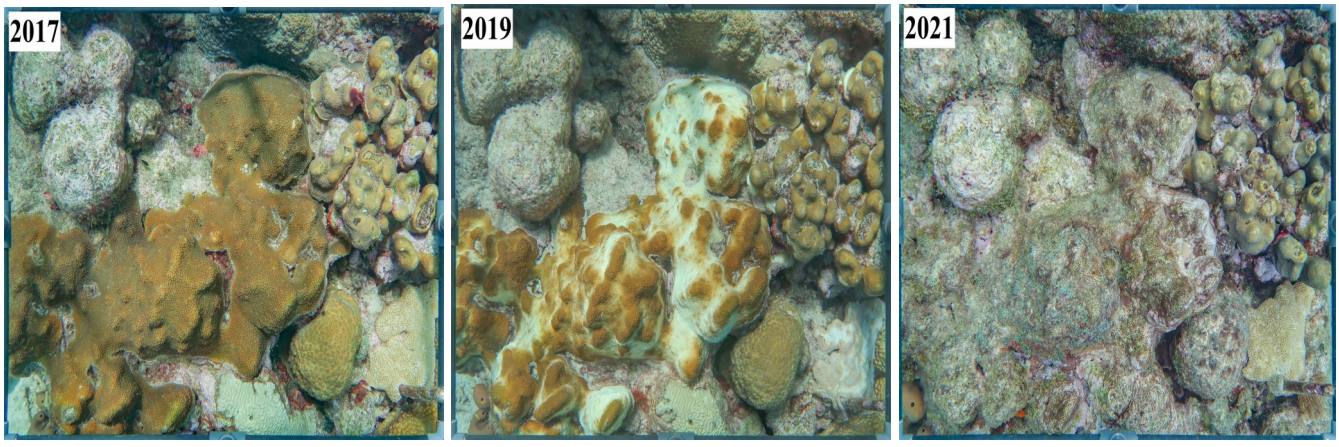

Figure 1. Example of temporal evolution of quadrat n°5