

# Impact of rafting marine debris and non-indigenous species in the marine protected areas of the Madeira archipelago (NE Atlantic).

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## Introduction

At present, ongoing monitoring surveys of non-indigenous species (NIS) along the coast of Madeira island, Portugal, located in the Northeast Atlantic, are confirming **anthropogenic marine debris (AMD) as a potential introduction vector for NIS arrivals in Madeira island**. The constant presence of AMDs in oceanic waters makes on-debris transport of fouling species **a matter of particular concern in marine protected areas (MPAs)**. In this context, we are conducting a pilot study in a MPA of the island. **We evaluated how marine fouling communities from a marine reserve will be affected by settlement and/or expansion of NIS**, and present here preliminary results.

## Material and methods

After an **initial 6-month colonization period at both the Funchal marina and a MPA** (Fig. 1), 10 PVC settling plates from the MPA were transferred to Funchal marina to be exposed to high levels of NIS propagule pressure and lateral expansion. Fouling communities from the **MPA, Funchal marina and bare plates were combined in four different PVC plate treatments** (i.e. T1, T2, T3 and T4, n = 5 Fig. 2). Five replicates of each plate treatment were randomly deployed in the marina. After two months, abundance and species identity were examined on inner plates. Data were analysed with multivariate (PERMANOVA) technique.

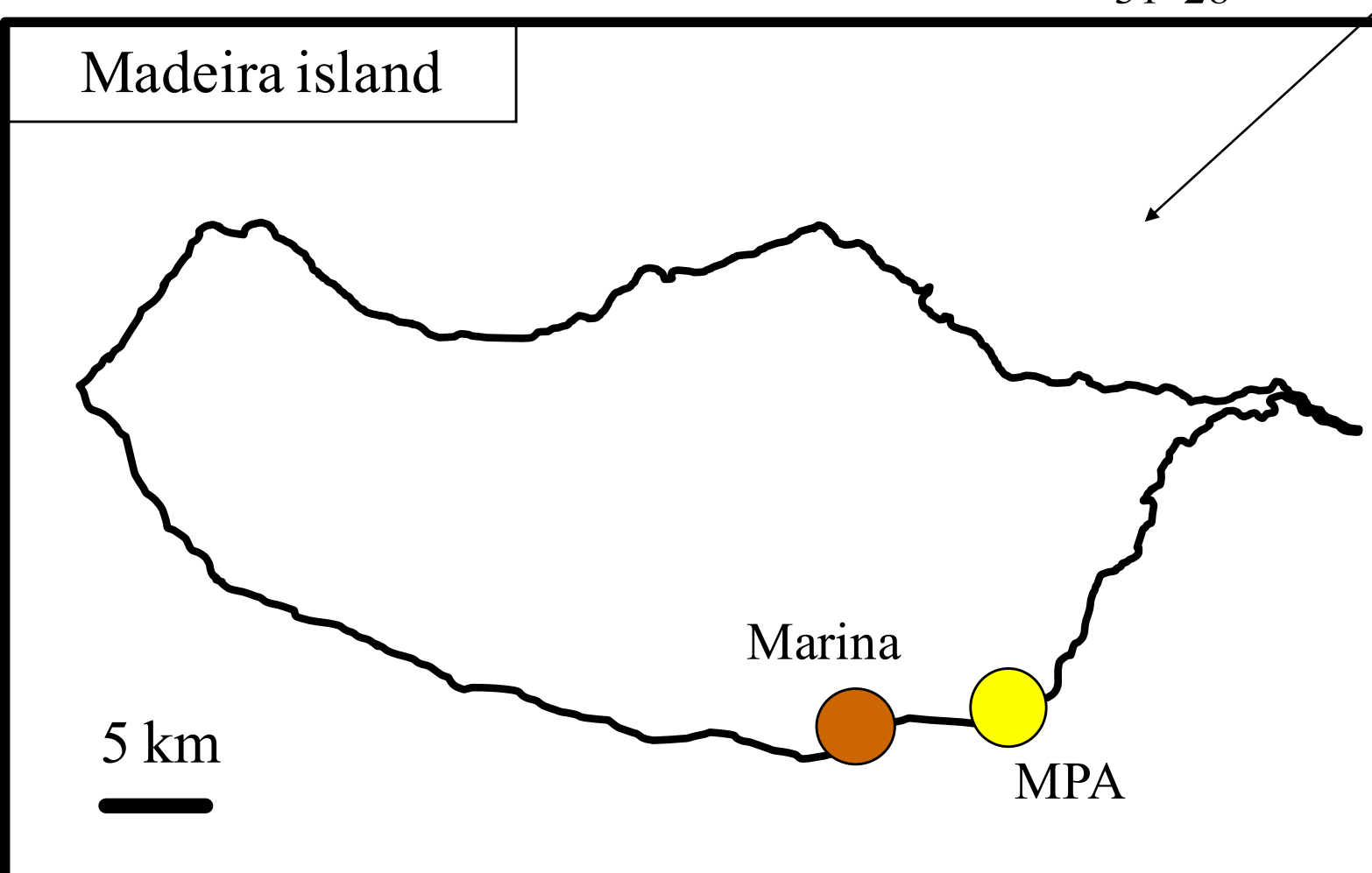
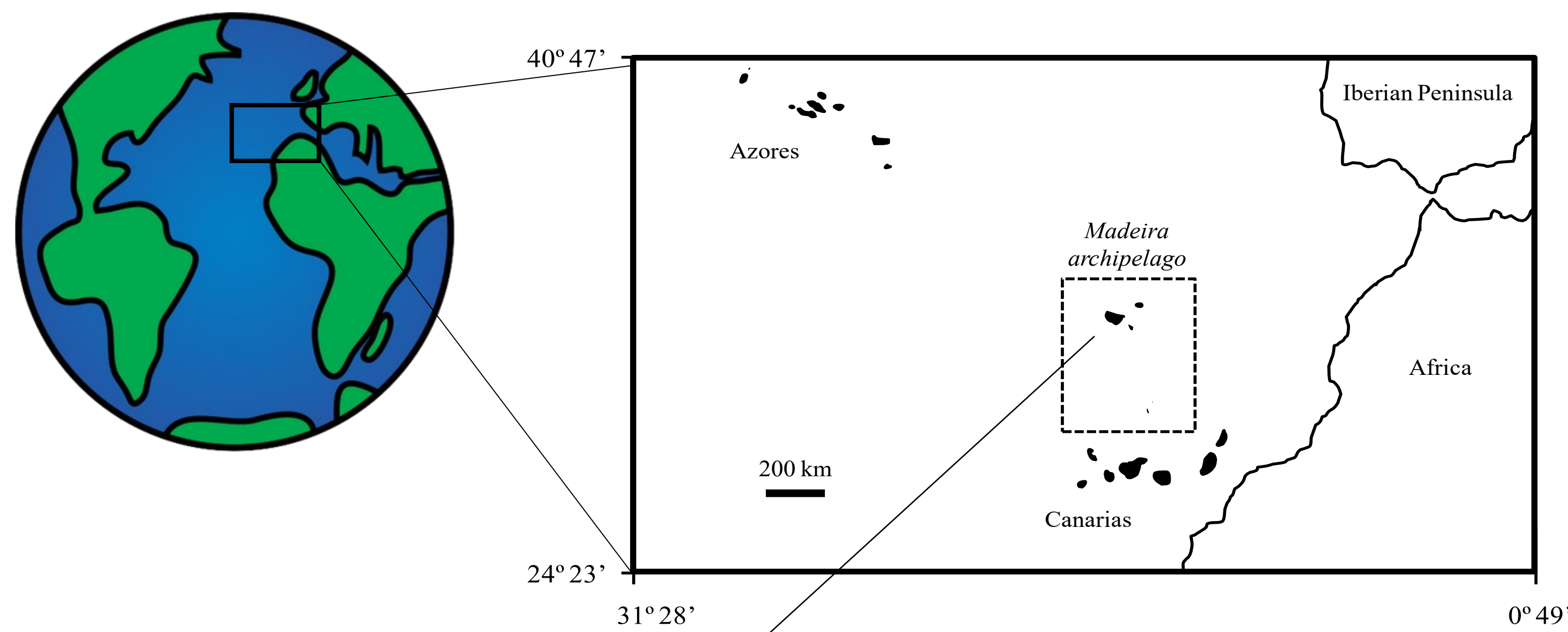


Figure 1. Map of the study area showing the location of the Madeira archipelago in the Northeast Atlantic. Map also showing the Funchal marina and the Garajau MPA in the south coast of Madeira.

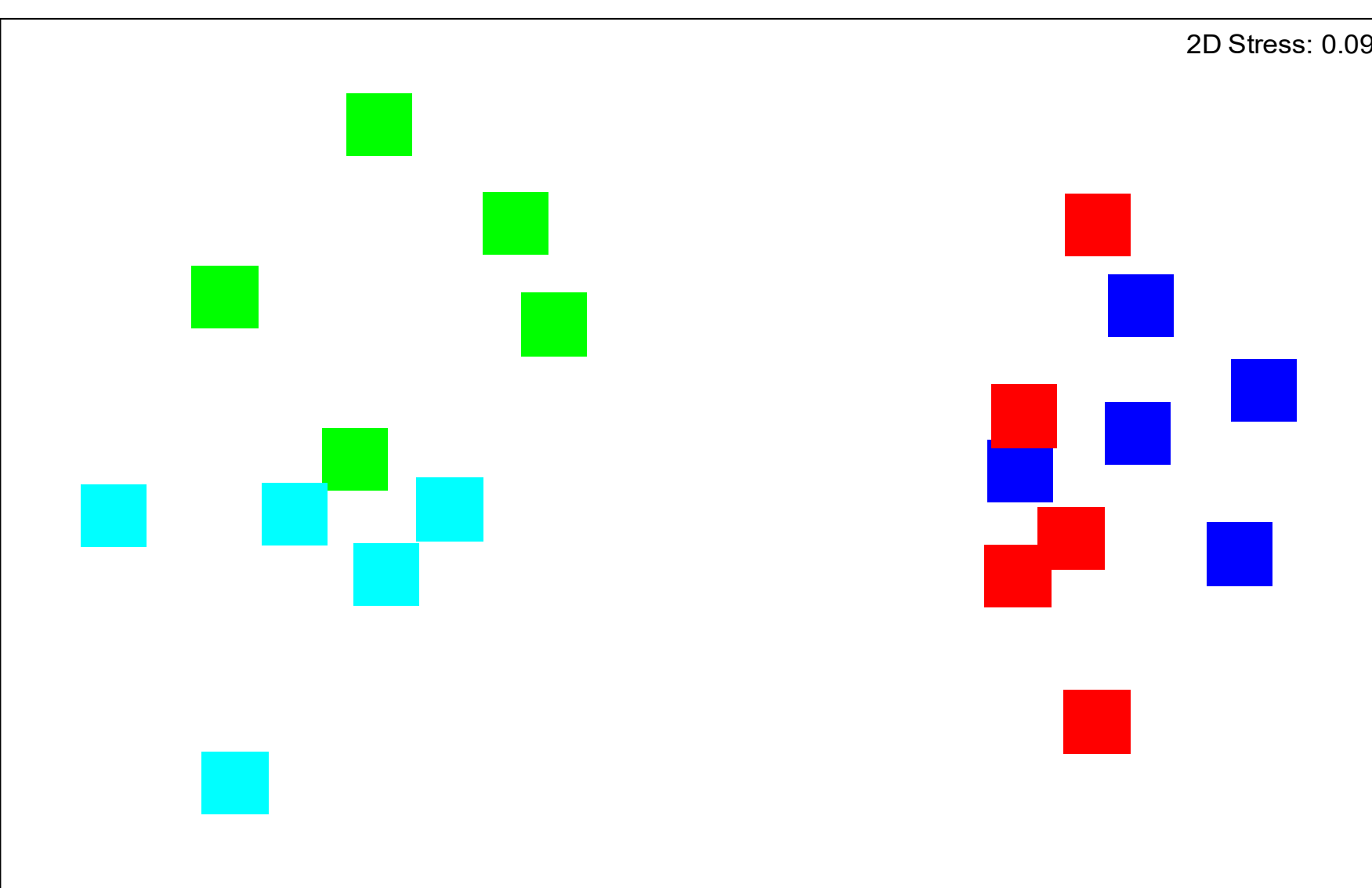


Figure 3. Non-metric multidimensional scaling (nMDS) produced by percentage values of fouling communities fixed on the inner plates (i.e. 10 x 10 cm) from the four plate treatments.

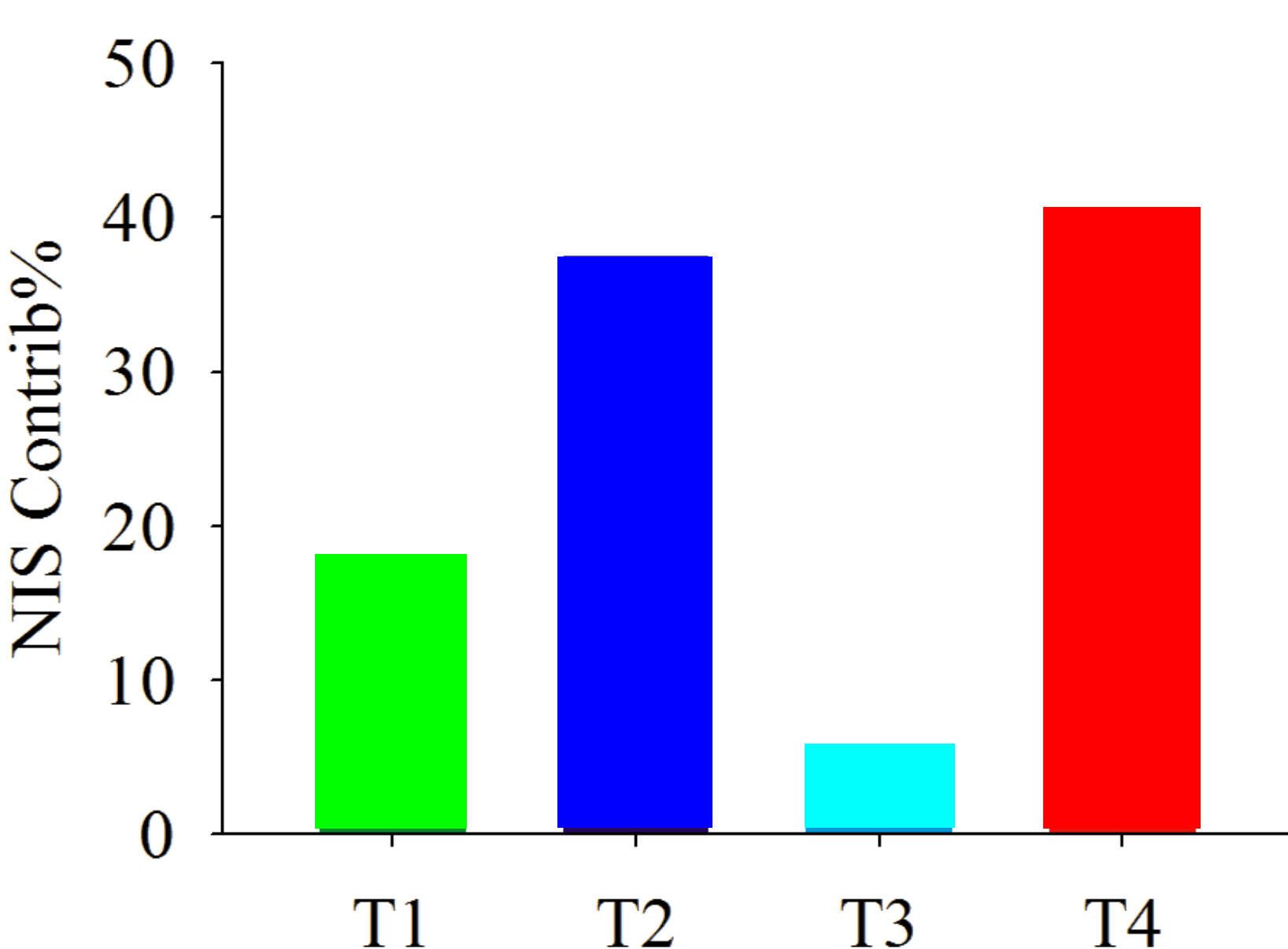


Figure 4. Percentage of contribution of NIS taxa to the average Bray-Curtis similarity of fouling communities on inner plates from each treatment (i.e. data obtained from SIMPER analysis).

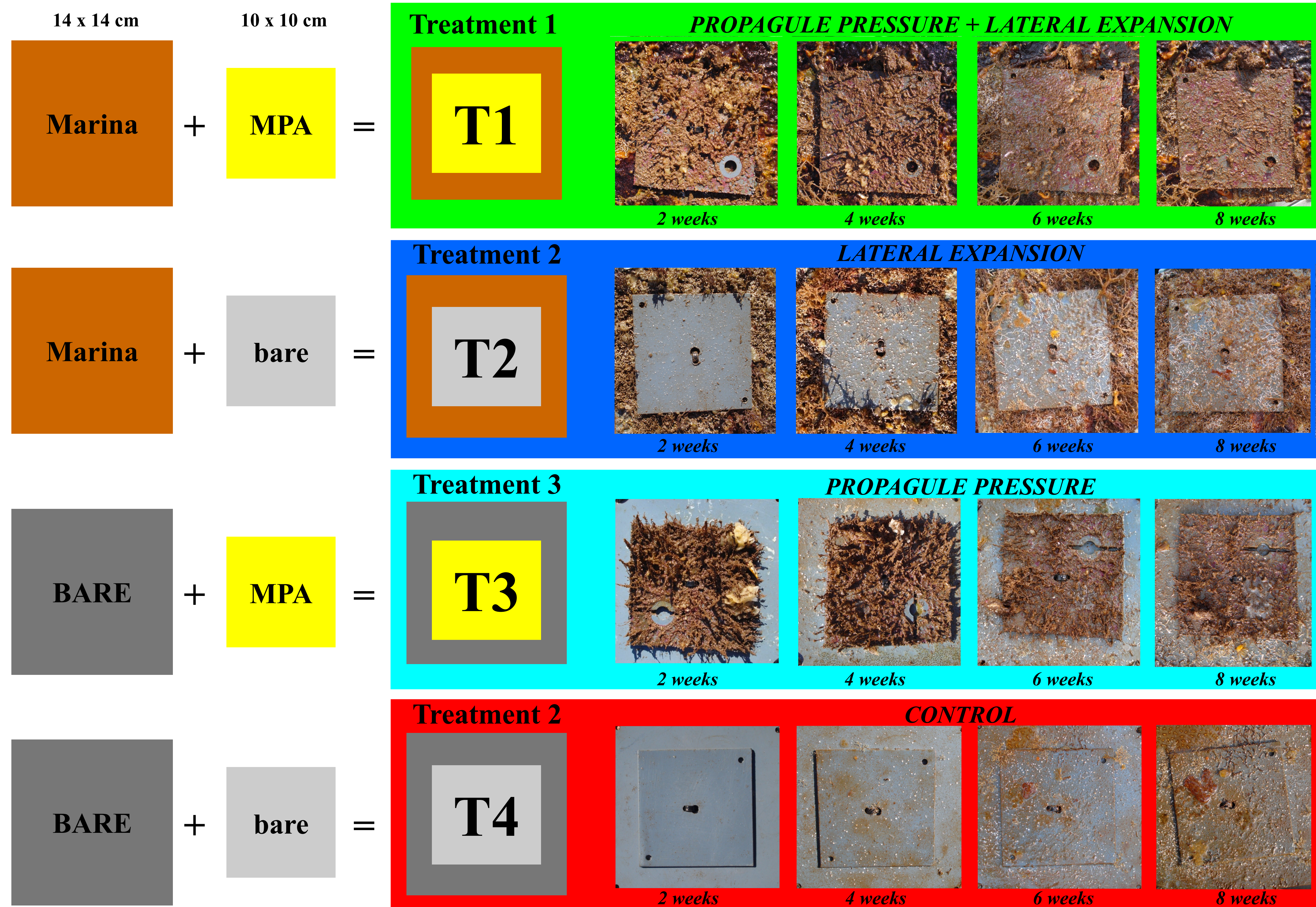


Figure 2. Diagram and photos of plates from the four different PVC treatments taken each week in the survey conducted in Funchal marina.

## Results and conclusions

- Structure and composition of **fouling communities from the MPAs differed significantly from those collected in the marina of Funchal**.
- After two months exposed to NIS pressure, **fouling communities on the MPAs plate treatments (i.e. T1 and T3) and those fixed on bare plate treatments (i.e. T2 and T4) were significantly different (Fig. 3)**.
- Fouling communities from the **MPAs showed lower percentage of NIS cover, especially those communities only under NIS propagule pressure (i.e. T3) (Fig. 4)**.
- **Mechanisms of biotic resistance by MPA fouling communities** seems to be an important factor during the invasion process in Funchal marina, and it **could alter the pattern of NIS settlement and lateral expansion in this area**.