



THE USE OF BIOTOPES IN CONSERVATION AND MANAGEMENT OF MARINE PROTECTED AREAS

Juliana Dalmolin 1,*

Nuno Vaz Álvaro 1; Ana Isabel Neto 2

¹Grupo de Biologia Marinha and CIRN (Centro de Investigação de Recursos Naturais), Departamento de Biologia, Universidade dos Açores, Rua Mãe de Deus 58, Ponta Delgada, São Miguel, Açores, Apart. 1422, P - 9502, Portugal
*julianadalmolin@yahoo.com.br

²Laboratório de Investigação Aquática Insular do CIIMAR (Centro Interdisciplinar de Investigação Marinha e Ambiental) and CIRN (Centro de Investigação de Recursos Naturais), Departamento de Biologia, Universidade dos Açores, Rua Mãe de Deus 58, Ponta Delgada, São Miguel, Açores, Apart. 1422, P - 9502, Portugal.

INTRODUÇÃO

The establishment and management of Marine Protected Areas (MPAs) require information on the marine benthic habitats and associated biota. Nevertheless, MPAs in the Azores have been mostly established with poor knowledge of the sea bottom substrate and the associated biological communities. This is particularly true for Vila Franca do Campo Islet, the published studies being exclusively on the biota and merely descriptive (e.g. Martins *et al.*, 2009; Martins 2004; Ferreira 1989).

The nature reserve of Vila Franca do Campo Islet, created in 1983 (Regional Legislative Decree No. 3/83/A) and reclassified in 2004 (Regional Legislative Decree No. 22/2004/A), was included in the Natural Park of the Island of São Miguel in 2008 (Regional Legislative Decree No. 19/2008/A), and reclassified as a protected area for the management of habitats or species of the Islet of Vila Franca do Campo. With an approximate area of 6.2 ha, is located 500 meters from the coast of the island, south of the village that gave it the name. The rock structure is divided into two fractions, the big Islet, situated to the west, with an approximate area of 53,000 m² and the small Islet, which comprises the eastern portion with an approximate area of 9,500 m². Inside, there is a small lagoon with an almost perfect circular shape with an area of 17,000 m². Six underwater channels provide water and sediment exchanges between the inside lake and the Islet sur-

rounding area. The Islet is dominated by vertical walls of bedrock and boulders which sit on a sand dominated seabed (Alvaro *et al.*, 2010). It has no human occupation but is used as a bathing area during the months of June to September. Amateur scuba diving is allowed around the outside of the Islet throughout the year with greater intensity in the summer months.

OBJETIVOS

The present study provides a characterization of the Islet of Vila Franca do Campo subtidal biota, complemented with information on the Islet biotope.

MATERIAL E MÉTODOS

The fieldwork was done in the spring of 2011 in the four quadrants of the Vila Franca do Campo Islet (North, N; West, W; East, E and South, S) and in São Roque, situated in the south of the Island and chosen as a control site (Control, C). A stratified sampling design with depth as a single factor was used, following Wallenstein *et al.*, (2008a). At the Islet three levels (6 - 8, 12 - 14 and 20 - 22m) were sampled. At São Roque, due to site limitations, the deeper level was disregarded. Each depth level was replicated with multiple samplings. In each sampling site nine replicate readings of 0.50m x 0.50m quadrants were randomly placed around the diving location (Wallenstein *et al.*, 2008a, Wallenstein *et*

al., 2009). Algae and sessile invertebrates (eg. sponges, hydrozoans and bryozoans) frequencies were recorded using 36 intersection point - to - point quadrant method (Wallenstein *et al.*, 2008b).

For biotope definition, the algal ecological categories defined in the work of Wallenstein *et al.*, (2008b) were adopted, e.g.: Calcareous turf; Non calcareous turf; Calcareous crusts; Erect calcareous. The erect calcareous, if exhibiting an obviously erect growth form, were named after the dominant genus present. The calcareous turf was used to name the algal turf in which the erect calcareous species were visually dominant, but did not exhibit a frondose growth form; the non calcareous turf was applied to the algal turf without the dominance of calcareous species. When present, filamentous algae were also considered. The macroinvertebrate frequencies were recorded within a minimal sampling area of 1.5 m x 15 m, replicated 3 times (Martins *et al.*, 2005) in each sampling site. The ichthyofauna was recorded following the methodology defined by Azevedo (2000). At each sampling site three 5 minutes transects were made. In the first transept all species found were counted, in the second transept only species not found in the first transept were accounted and in the third transept only those species not found in the first two transects were counted. This method was repeated twice in each sampling site.

Data treatment

Data were assembled in an Excel spreadsheet comprising species and their DAFOR abundances at every depth at each study site. These data were analyzed numerically using the PRIMER v6 software package (CLARKE and WARWICK, 2001). Non - metric multidimensional scaling (nmMDS) was used to express the similarity of depth recordings at sites based on the species present and their abundance. Results were expressed as two - dimensional plots in which the separation of sample points indicated the degree of similarity. Points in the plots were subsequently labelled with geographical, substratum and depth information to facilitate interpretation. ANOSIM, a non parametric procedure applied to the rank similarity matrix underlying the ordination of site recordings was used to test the significance of the grouping in the nmMDS plot of sample points against abiotic factors. The SIMPER analysis, species contribution to similarity, was used to identify the species responsible for separating the sampling sites. Taxa/ecological categories relevant for biotope definition were chosen according two criteria (a: Average abundance $\geq 0,55$ for presence/absence data and b: % Contribution $\geq 9,5\%$ for untransformed data). Identified biotopes were given code names according to the criteria defined by Connor *et al.*, (2004): I (infralittoral) for subtidal zone; E for exposed and moderately exposed shores; and R for rocky substrata. Abbrevi-

ations for taxa/ecological categories and genus/species were as follows: T (Turf); Dictyota (Dic); Calcareous turf (CalT); Non calcareous turf (NCalT); Calcareous crust (CalC); and Erect calcareous (EreCal).

RESULTADOS

The low values of Global R obtained for algae (R: 0.105), invertebrates (R: 0.199) and fishes (R: 0.206) support the null hypothesis (Clarke 1993) that there are no main differences within the Islet across depth levels, neither at the control site (Global R: 0.135 for algae, 0.436 for invertebrates and 0.431 for fish). No major differences were recorded also between Islet quadrants. Differences were, however, found between the algal species distribution and relative abundance between the Islet and the Island nearby and a new biotope was defined for the Islet and São Roque. This biotope was named after the dominant taxa as CalCDic - Calcareous crusts and *Dictyota* on exposed infralittoral vertical walls. It is distributed from surface to sea bottom on the vertical walls of the studied sites and is different from the previously defined by Wallenstein *et al.*, (2008b, 2009) for the archipelago. A possible explanation for such difference might be the fact that the work developed by Wallenstein *et al.*, (2008b) was carried out in horizontal surfaces. Further studies involving the characterization of vertical walls in other locations are needed to evaluate the presence of this biotope in the island of São Miguel and remaining islands of the archipelago. Vertical walls are typically covered with dense and diverse suspension - feeding sessile invertebrate - dominant communities, especially ascidians, sponges, bryozoans, and cnidarians, while nearby horizontal rock surfaces are dominated by algae in temperate seas or corals in the tropics (Witman 1985). Light and grazing are believed to be among the primary factors responsible for differences in species composition between horizontal and vertical subtidal surfaces (Sebens 1986). Horizontal substrates receive direct sunlight favorable for algal growth, which may allow algae to outcompete sessile invertebrates for space (e.g Witman 1987), and inhibit invertebrate recruitment (Young & Chiao 1984, Raimondi and Morse 2000). Selection of shaded substrates, such as vertical walls, by photonegative invertebrate larvae may be an adaptive response to higher survival rates on these surfaces, making light an indicator of favorable habitat, and reinforcing vertical - horizontal community differences (e.g., Witman & Cooper 1983, Young & Chiao 1984).

A striking feature in this survey is the large abundance of Non calcareous turf at the MPA of Vila Franca do Campo Islet that might be explained by the absence of limpets (*Patella* spp.) which have been overharvested (Martins *et al.*, 2008). Additionally the dense cover of

algal turf keeps densities low by not allowing for example the erect coralline to fix because of its slow growth (Neto 1997). The pattern observed in Vila Franca do Campo Islet suggests that effective management procedures are necessary in order to guarantee sustainable development and to ensure conservation of species and habitats in the face of human impacts as defended by Goodland (1995), Sherman (1994) and Kelleher (1999).

CONCLUSÃO

A new biotope was defined for coastal shallow vertical walls in the Azores archipelago. Effective management procedures are necessary in order to guarantee sustainable development and to ensure conservation of species and habitats in the face of human impacts in the studied MPA.

REFERÊNCIAS

Álvaro, N.V., A.C.L. Prestes & A.I. Neto 2010. Sea bed mapping and subtidal communities identification in Azorean MPAs Preliminary results providing tools for marine resources conservation. International Meeting on Marine Resources, Peniche.

Azevedo, J. M. N. 2000. Now you see me, now you don't: A case study of the effect of the sampling method on the perceived structure of ichthyological communities. Arquipélago. Life and Marine Sciences. Supplement 2 (Part A): 133 - 143.

Clarke, K.R. & R.M. Warwick 2001. Change in Marine Communities: An Approach to Statistical Analysis and Interpretation (2nd edition). Plymouth, UK: PRIMER - E, 176pp.

Connor, D. W., J. H. Allen, N. Golding, K. L. Howell, L. M. Lieberknecht, K. O. Northen & J. B. Reker 2004. The marine habitat classification for Britain and Ireland, version 04.05. Joint Nature Conservation Committee, Peterborough, available from: www.jncc.gov.uk/ Marine Habitat Classification.

Ferreira, M. 1989. Penhascos Dourados O Ilhéu de Vila Franca. Editorial Ilha Nova da Câmara Municipal de Vila Franca do Campo. 256 pp.

Goodland, R. 1995. The concept of environmental sustainability. Annual Reviews of Ecology and Systematics: 26, 124.

Kelleher, G. (1999). Guidelines for Marine Protected Areas. IUCN, Gland, Switzerland and Cambridge, UK. xxiv +107pp.

Martins, A. M. F. 2004. O Anel da Princesa Ilhéu de Vila Franca do Campo de São Miguel - Arquipélago dos Açores - Portugal. Intermezzo, Lisboa. 100 pp.

Martins, G. M., F. F. M. M. Wallenstein, N. V. Álvaro, A. I. Neto & A. C. Costa 2005. Sampling strategies for biotope definition: minimal sampling area for selected

groups of macroinvertebrates in the rocky subtidal of São Miguel, Azores. Helgoland Marine Research 59: 219 - 22.

Martins, G. M., S. R. Jenkin, S. J. Hawkins, A. I. Neto & R. C. Thompson 2008. Exploitation of rocky intertidal grazers: population status and potential impacts on community structure and functioning. Aquat Biol 3: 1 - 10.

Martins, A. M. F., J. P. Borges, S. P. Ávila, A. C. Costa, P. Madeira & B. Morton 2009. Illustrated Checklist of the infralittoral Molluscs off Vila Franca do Campo. Açoreana: 9 - 13.

Neto A.I. 1997. Studies on algal communities of São Miguel, Azores. x+309pp. Tese de Doutoramento em Biologia, especialidade de Biologia Marinha. Universidade dos Açores, Ponta Delgada.

Raimondi, P. T. & A.N.C Morse 2000. Complex larval behavior and the vertical distribution and orientation of *Agaricia humilis* (Scleractinia). Ecology 3193 - 3211 pp.

Sebens, K. P. 1986. Community ecology of vertical rock walls in the Gulf of Maine, U.S.A: smallscale processes and alternative community states. Pages 346 - 371 in P. Moore and R. Seed, eds. Ecology of rocky coasts. Columbia Univ. Press, New York, New York. 467 pp.

Sherman, K. 1994. Sustainability, biomass yields, and health of coastal ecosystems: an ecological perspective. Marine Ecology Progress Series, 112, 277301.

Wallenstein, F. F. M. M., A. I. Neto, N. V. Álvaro & I. Tittley 2008a. Subtidal rocky shore communities of the Azores: developing a biotope survey method. Journal of Coastal Research 24: 244 - 249.

Wallenstein, F. F. M. M., A. I. Neto, N. V. Álvaro & C. I. Santos 2008b. Algae Based Biotopes of the Azores (Portugal): Spatial and Seasonal Variation. Aquatic Ecology 42: 547 - 559.

Wallenstein F. F. M. M., A.I. Neto, Álvaro N.V., I. Tittley & J. M. N Azevedo 2009. Guia para Definição de Biótopos Costeiros em Ilhas Oceânicas [Coastal Biotope Definition Manual for Oceanic Islands]. ISBN 978 972 99884 9 3. Secretaria Regional do Ambiente e do Mar, Portugal, 500 exemplares.

Witman, J. D. & R. A. Cooper 1983. Disturbance and contrasting patterns of population structure in the brachiopod *Terebratulina septentrionalis* (Couthouy) from two subtidal habitats. Mar. Biol. Ecol. 73: 57 - 79.

Witman, J. D. 1985. Refuges, biological disturbance, and rocky subtidal community structure in New England. Ecol. Monogr. 55: 421 - 445.

Witman, J.D. 1987. Subtidal coexistence: storms, grazing, mutualism and zonation of kelps and mussels. Ecol Monogr 57:167187.

Young, C. M. & E. S. Chiao 1984. Microhabitat - associated variability in survival and growth of subtidal solitary ascidians during the first 21 days after settlement. Mar. Biol. 81: 61 - 68.