Short note

Long term monitoring of the vegetation in the salt marsh of "Psili Amnos", Samos, Greece – the outlines of the monitoring project

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Abstract. This short note presents research project on SAMOS: PARALIA ALYKI in Greece. The area of the research includes salt marsh of about 500 m² which is located in the Natura 2000 protected area of the site code GR4120001. There are 150 protected birds including 57 birds in the red list of IUCN. Vegetation is quite heterogeneous and distinct in different sections. The aim of the project is to develop and implement a long term monitoring scheme for the salt marsh of "Psili Amnos" to assess changes of the vegetation over time and to assess anthropogenic and natural threat in order to take conservation measures. In a note in addition to the presentation of the site and the research aim also the methods considered for monitoring of vegetation are briefly described. To achieve optimal and universal methodology there was discussed which of the methods of data collection and processing typically used in monitoring vegetation could be used both in a project implemented at salt marsh "Psili AMNOS" as well as in studies of coastal and inland salt marshes in Poland.

Key words: saline area, halophytes, monitoring methodology, classification, ordination.

1. Introduction

Salt marshes are habitats colonised by specially adapted organisms which are able to perform their life processes under condition of increased osmotic pressure of saline environment (O'Leary & Glenn 1994; Waisel 1972). They are special sites to store genetic potential of organisms for salt stress adaptation. Therefore they are particularly valuable and worth to be protected. In such objects status and trends of vegetation is usually monitored. In Greece, one of these objects being monitored, maintained as part of the EU project, is a salt marsh "Psili AMNOS" on the island of Samos. In Poland many salt marshes, both coastal and inland, have been included in the Natura 2000 network of protected habitats. They are monitored according to UE instructions and a lot of them are objects of research coordinated by the COST action FA0901 dedicated to halophytes and saline areas (Hulisz et al. 2011).

2. The study area

In the salt marsh of "Psili Amnos" there are 150 protected birds including 57 birds in the red list of IUCN. The Great-

er flamingo here is classified as an endangered species. It used to breed in the area in the past but nowadays don't anymore. Vegetation is quite heterogeneous and distinct in different sections. Inside the marsh there is a reedbed of *Phragmites australis*. Then the vegetation is more specific to salty wetland and composed of *Plantago maritima, Salicornia europaea, Halimione portulacoides, Juncus* sp., *Limonium* sp. More in the outside of the marsh it can be observed *Pistacia lentiscus, Juncus acutus,* and even *Sarcopoterium spinosum.* On the road sides and in the cultivated land there are also orchids (more than 7 species were observed during the last 6 months of field work in 2013).

The area of the monitoring includes salt marsh of about 500 m², called SAMOS: PARALIA ALYKI, located in the Natura 2000 protected area of the site code GR4120001 (Fig.1). In the past area was used for salt production from the sea water. Now it's separated from the sea by a road. The marsh is not divided in ponds any more, it's flooded from end of autumn to late spring, and then, dry in summer. In the area are also present small cultivated lands.

3. The aim of the project

The aim is to develop and implement a long term monitoring scheme for the salt marsh of "Psili Amnos" to assess changes of the vegetation over time and to assess anthropogenic and natural threat in order to take conservation measures.

4. Discussion of proposed monitoring methodology and planned data analysis

Surveys could be conducted four times a year. Survey will be conducted by different volunteers so the methodology chosen should reduce the bias due to a change of observer to the minimum.
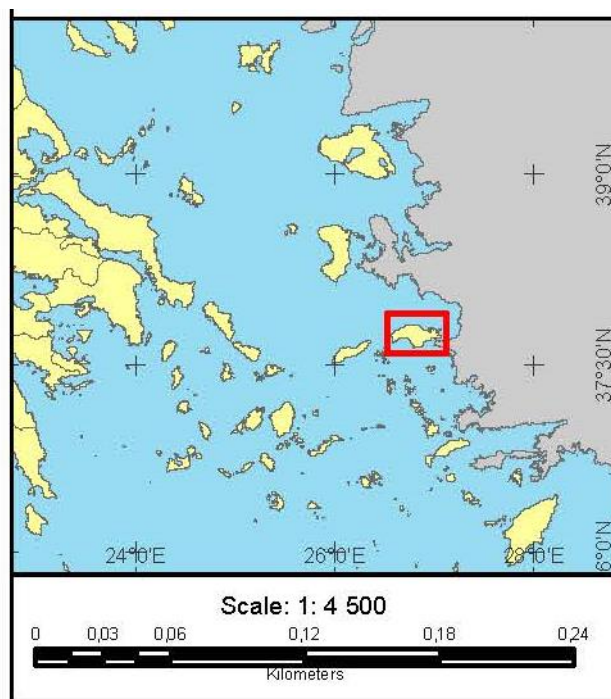

Figure 1. Location of the monitored area

All the species of plant would be monitored using permanent 1m² quadrats sampled with the point intercept method. The method of transect or random location in homogenous vegetation area is considered (Table 1).

The project to develop and implement a long term monitoring scheme for the salt marsh of "Psili Amnos" requires answers to many questions. First of all, which one of the two methods, i.e. transect or random location in homogenous vegetation area would be more appropriate? Are there any other methods that would be more appropriate? Next question is if the reedbed should be monitored with a spe-

Table 1. Considered methodology – How to place the quadrats?

	Along transects	Random location in homogenous vegetation area
method	Place transects at least 10 m apart from each other, and regularly place quadrats along it every 10 m	Delimitate the areas with different vegetation types and then place randomly quadrats in each area
+	Could go through different kind of vegetation, from outside the marsh to the inside Easy to follow and to locate the quadrats	Would allow to survey as many kind of vegetation as we want, in different locations
-	Maybe won't cross every kind of vegetation	Areas don't have exact borders, how to find a criteria to delimitate them?
Questions	Would only one transect be enough? How many quadrats?	How many quadrats per/area? Should we sample a % of the surface of each area?

cific methodology? Another one is if it is really appropriate to monitor all the different species found in a quadrat or would it be better to target only few species? Are there some species that could be good indicators and so that should be surveyed more in particular? And at the end what kind of statistical method could be used on the data?

It is really difficult to find clear answers to these questions. In Poland there is already elaborated methodology of inland and coastal monitoring (Herbich 2004; Nienartowicz & Piernik 2004a, b; Piernik 2010; Bosiacka 2011). The methods used follow EU habitat directive. In general areas ca. 0.2 ha are monitored in each stand – usually transect 10 m wide and 20 m long. The whole area is assessed according to certain parameters and certain scale. In the transect three phytosociological relevés of the size 5x5m (at the beginning, in the center and at the end of transect) are taken and marked by GPS position. The Braun-Blanquet scale is used to assess species cover/abundance (Braun-Blanquet 1964).

The area of 1 m^2 plot considered for salt marsh of "Psili Amnos" monitoring seems to be to small to assess the number of species and the diversity at certain point as both the number of species and the diversity are dependent on the quadrat area. In case of detailed monitoring few transects should be established to cover different gradients in the vegetation. Rather subjectively chosen permanent plot/transect is advised than totally random sampling. The collected data in the field then could be analysed by many statistical methods. For example species diversity could be monitored as Shannon diversity index and the number of species and compared by classical statistical methods as t-test or Anova comparison. Vegetation could be classified into communities by agglomerative or divisive classification methods e.g. MVSP and TWINSPAN packages (Kovach 1986-1999; Hill & Šmilauer 2005). The general vegetation pattern could be analyzed by indirect ordination as Correspondence Analysis (CA), Detrended Correspondence Analysis (DCA) or Principal Component Analysis (PCA), whereas vegetation-environment relations by direct ordination as Canonical Correspondence Analysis (CCA) or Redundancy Analysis (RDA) available e.g. in Canoco package (ter Braak & Šmilauer 2002; Jongman et al.1995).

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