

# HABITAT AND FLORA MONITORING IN THE REGIONAL NATURE RESERVE OF "PALUDE DEL CONTE E DUNA COSTIERA DI PORTO CESAREO" (PUGLIA, ITALY)

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**Abstract** – This study describes the results of the monitoring activity on habitats and plant species in the Regional Nature Reserve of "Palude del Conte e Duna Costiera di Porto Cesareo" (Puglia, Italy) and in the adjoining special areas of conservation (SACs). This activity was carried out in the period April-December 2018.

The methods followed the ISPRA guidelines concerning the monitoring of the Directive 92/43/EEC (Habitats) species and habitats. The activity combined field vegetation surveys and interpretation of orthophotos on a GIS system.

The resulting vegetation map represents 21 vegetation types. The habitat map was derived from the vegetation map and represents the spatial distribution of 18 Directive habitat types. The total cover of these habitat types is 444.0 ha, equal to 37.0 % of the study area. The priority types are in number of 5; they have a total cover of 91.8 ha, equal to 7.6 % of the study area.

In comparison with the previous available habitat maps of the study area, there is some substantial differences. Particularly, compared to the last map dating back to 2003, main results are the cover increase of rush saltmarshes (Natura 2000 code: 1410) and the cover decrease of steppes (Natura 2000 code: 6220\*).

The study identifies the pressure and threat factors that negatively affect the conservation of habitats and provides management indications. All the sites used to access the beaches have been located and classified. 34 % of them were classified as highly critical for the conservation of dune habitats.

With reference to the flora, a number of 240 taxa was recorded, equal to 38 % of all taxa known for the study area. The new data allow to extend the list of well-known species of greater conservation interest for the study area. Exactly, there are 8 new noteworthy species, including the red-list species *Elatine macropoda* and *Lythrum thymifolia*.

## Introduction

The Article 17 of the Habitats Directive regulates the need to conduct monitoring activities on habitats and species of Community interest. This monitoring is carried out by the EU's member states and, in the specific case of Italy, by the regions that have ministerial delegation in the environmental field. The monitoring results are used to report information relating to the conservation status of habitats and species, their trend, as well as the pressures and threats that affect the conservation of these ecological entities [17].

The conservation status of a habitat of Community interest is a concept defined by the Article 1 of the Habitats Directive, which also establishes the criteria for considering that status as satisfactory, based on structural (such as measurable areal properties) and functional properties. Similar criteria are also given for species.

In the Puglia Region (in the southern Italy), monitoring activities are encouraged in the context of specific administrative tools. In particular, the Prioritized Action Framework (PAF) of the period 2014-2020 prioritizes the measures to be implemented for the conservation of habitats and species of Habitats and Wild Birds directives. The Regional Regulation n. 6/2016 contains the conservation measures for the Special Area of Conservation (SACs) of Puglia. Both tools indicate that monitoring and updates are needed for all habitats and species of the EU directives.

The present study pursues the purposes of this regional regulation in a protected natural area in Puglia, and concerns a monitoring campaign carried out in 2018. The objectives of the study were to represent the spatial distribution of the habitats of the Directive, identify the main environmental factors that affect the conservation status of these habitats and acquire new information on the flora of greater conservation interest.

## **Materials and Methods**

### **The Study Area**

This study focused on a terrestrial area located in the municipality of Porto Cesareo. The study area is the result of the union of three partially overlapping protected areas, namely the Regional Nature Reserve of "Palude del Conte and Duna Costiera di Porto Cesareo" and the two SACs of "Palude del Conte, Dunes of Punta Prosciutto" (IT9150027) and "Porto Cesareo" (IT9150028), limited to the land and island surface falling within the municipal jurisdiction (Figure 1).

The study area has a coverage of 1200.7 ha, in the range of distance from the coast line of 0 ÷ 4.7 km and in the altitude range of 0 ÷ 46 m a.s.l. It covers 27 km of coast, which is partly rocky and low, and sandy for the rest, related to dune systems. There are three main wetlands. Having been subject to hydraulic reclamation in the last century, they are crossed by artificial canals connected to tidal basins. The main housing settlements, mainly agglomerations of summer houses and facilities for tourist accommodation, are located outside the study area. The inland potential vegetation is represented by holm oak woods; on the coast there are three series of vegetation, that is the hygrophilous, the psammophilous and the chasmophytic vegetation [8].

The study area is "well known" from a floristic point of view [1]. In fact, the botanical research that has been carried out in the past is numerous. Leaving aside the oldest studies, the progress on the floristic knowledge of the study area, as well as on vegetation and habitats, is divided into a series of stages which are the years 1978 [11], 1980 [19], 2003 [5] and 2007 [4]. Each of these researches proposes a habitat distribution map. The most recent synthesis [2] returns a landscape with a number of 16 habitat types of the Habitats Directive (including cave habitats) and with an overall vascular richness of 627 taxa.

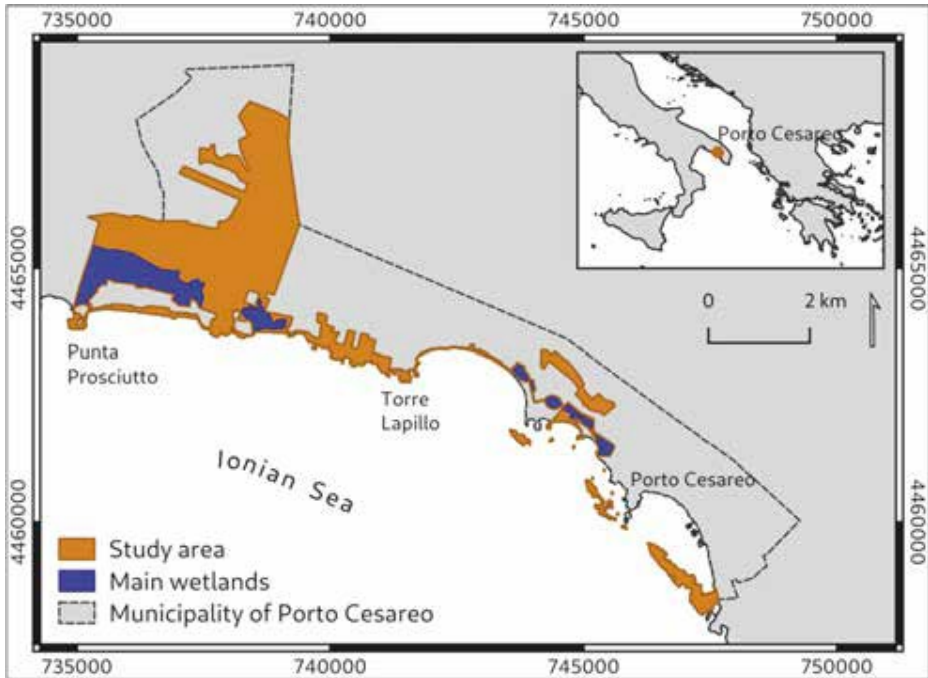


Figure 1 - The study area with the location of main wetlands (coordinate system UTM 33 WGS84).

### Field data

Field surveys were carried out in the period April-December 2018, respecting the sampling guidelines of ISPRA [3, 13]. The vegetation surveys were conducted with the cover class method [10], which consists of positioning a rectangular plot on the ground, identifying all the vascular species present inside and assigning a cover value to each species according to the ordinal scale of abundance of Braun-Blanquet. The dimensions of the plots depend on the type of vegetation and are between 2 m<sup>2</sup> for small herbaceous vegetation and 16 m<sup>2</sup> for shrub vegetation [3, 10].

Plant specimens were determined in the laboratory with the use of [22, 25]. The nomenclature followed is that of An Archive for Botanical Data [20].

Protected species [23, 27], endangered species [6, 12, 24] and rare species have been treated as a particular category called *species of greater conservation interest*. Data on the origin and invasiveness of exotic species are taken from [16] for the Apulian flora.

During the surveys, evidence was also recorded on the presence of pressures and threats. While *pressures* are natural or anthropogenic factors that affect the conservation of habitats, *threats* are natural or anthropogenic potential factors. For this data, the European pressures / threats classification system used for the monitoring of species and habitats of EU directives has been adopted [17].

## Data processing

Patches of different types of vegetation were identified and classified on the basis of field data and through visual photointerpretation of orthorectified aerial photographs from 2016. The resulting vegetation map illustrates the spatial distribution of the vegetation types. The definitions attributed to the vegetation types are based on the descriptions reported by [7], on an adequate compromise between semantic accuracy and cartographic precision, given the scale of the map.

The habitats map illustrates the spatial distribution of the habitat types of the Habitats Directive. It was elaborated through the reclassification of the vegetation map. The reclassification criteria are those defined by [7, 8, 14]. Marine and cave habitats, which have not been studied, are excluded.

With regard to the analysis of pressures and threats, a particular processing was conducted for the dune accesses. These accesses, which people use to reach the beaches, were located during the field surveys and through visual photointerpretation. The accesses have been classified according to the danger they represent for the local conservation of habitats (pressure). The pressure was expressed on an ordinal scale with two values: high and low. The classification is based on the following criteria, assessed empirically and jointly: the length of the passage (long passage → high pressure), the width of the passage (wide passage → high pressure), the depth of the passage with respect to the top of the dune (deep passage → high pressure), local density of accesses (very close accesses → high pressure), proximity to priority habitats (accesses adjacent to habitat 2250 \* → high pressure), presence / absence of a footbridge (absence of footbridge → high pressure).

Field data were managed with the anArchive for Botanical Data system ([www.anarchive.it](http://www.anarchive.it)) [20]. The cartographic processing and the areal analysis were carried out with the software QGIS ver. 3.4 and GRASS ver. 7.2.

## Results

71 vegetation surveys were carried out. The vegetation map consists of 21 vegetation types. The types with the greatest coverage are communities with weeds of the cultivated fields (30.5 % of the study area), Mediterranean bush (19.8 %), holm oak wood (10.0 %), reed-bed (8.7 %) and anthropogenic nitrophilic communities (7.6 %).

The habitats map is made up of 15 classes, corresponding to a total of 18 habitat types of the Directive. Indeed, some habitat types are grouped into a single class, since they constitute mosaics that cannot be resolved spatially at the scale of the map. The total coverage of the habitats of the Directive amounts to 444.0 ha (equal to 37.0 % of the study area) (Table 1). The priority types are 5; they have a total coverage of 91.8 ha (equal to 7.6 % of the study area).

With reference to the flora, a total of 240 taxa were detected. Among the various species of greater conservation interest, 8 had never been observed previously for the area. These are the endangered species *Elatine macropoda* Guss. and *Lythrum thymifolia* L., and the rare species *Juncus capitatus* Weigel, *Lysimachia minima* (L.) U.Manns & Anderb., *Lythrum borysthenicum* (Schrank) Litv., *Ranunculus saniculifolius* Viv., *Silene niceensis* All. and *Solenopsis laurentia* (L.) C. Presl.

The pressures/threats detected for the different habitat types are described in Table 2.

Table 1 - The habitat types in the study area, with their respective coverage values. The asterisk next to the Natura 2000 code designates the priority types.

Habitat types of the Habitats Directive	Area (ha)	Area (%)
1150*: Coastal lagoons	23,6	2,0
1210: Annual vegetation of drift lines	16,7	1,4
1240: Vegetated sea cliffs of the Mediterranean coasts with endemic <i>Limonium</i> spp.	40,6	3,4
1410: Mediterranean salt meadows ( <i>Juncetalia maritimi</i> )	104,9	8,7
1310: <i>Salicornia</i> and other annuals colonizing mud and sand; 1420: Mediterranean and thermo-Atlantic halophilous scrubs ( <i>Sarcocornetia fruticosi</i> )	23,9	2,0
2110: Embryonic shifting dunes; 2120: Shifting dunes along the shoreline with <i>Ammophila arenaria</i> (white dunes)	1,7	0,1
2230: <i>Malcolmietalia</i> dune grasslands; 2240: <i>Brachypodietalia</i> dune grasslands with annuals	25,7	2,1
2250*: Coastal dunes with <i>Juniperus</i> spp.	16,8	1,4
2260: <i>Cisto-Lavanduletalia</i> dune sclerophyllous scrubs	0,4	0,0
3170*: Mediterranean temporary ponds	0,6	0,0
3260: Water courses of plain to montane levels with the <i>Ranunculion fluitantis</i> and <i>Callitriche-Batrachion</i> vegetation	1,5	0,1
6220*: Pseudo-steppe with grasses and annuals of the <i>Thero-Brachypodietea</i>	49,7	4,1
6420: Mediterranean tall humid herb grasslands of the <i>Molinio-Holoschoenion [pro parte]</i>	17,0	1,4
7210*: Calcareous fens with <i>Cladium mariscus</i> and species of the <i>Caricion davallianae</i>	1,1	0,1
9340: <i>Quercus ilex</i> and <i>Quercus rotundifolia</i> forests	119,8	10,0
Total	444,0	37,0

Table 2 - Pressures / threats detected and corresponding affected habitat types.

Pressures / threats	Habitat types
A02.03: Grassland removal for arable land	6220*
A04.03: Abandonment of pastoral systems, lack of grazing	6220*
D01.03: Car parks and parking areas	1310, 1410, 1420, 6420
E01.02: Discontinuous urbanisation	1210, 1310, 1410, 1420, 2110, 2120, 2230, 2240, 2250*, 6220*, 6420
G05.01: Trampling, overuse	1210, 1310, 1410, 1420, 2110, 2120, 2230, 2240, 2250*, 6420
H05.01: Garbage and solid waste	1150*, 2110, 2120, 2230, 2240, 2250*, 3260
I01: Invasive non-native species	1310, 1410, 1420, 2120, 2230, 2240, 2250*, 6420
I02: Problematic native species	1310, 1410, 1420, 6420
J02.01: Landfill, land reclamation and drying out, general	1150*, 3260

The detected problematic native and invasive non-native species (to which the pressures / threats I01 and I02 refer) are the invasive neophytes *Ailanthus altissima* (Mill.) Swingle, *Carpobrotus edulis* (L.) N.E. Br., *Erigeron bonariensis* L., *Euphorbia maculata* L., *Euphorbia prostrata* Aiton, *Oxalis pes-caprae* L., *Symphyotrichum squamatum* (Spreng.) G.L. Nesom, the casual archeophyte *Phoenix dactylifera* L., and the locally introduced problematic autochthonous *Chamaerops humilis* L.

106 accesses have been identified on the dunes (to which pressures / threats G05.01 refers), 34 % of these have been classified as determining a high pressure on habitats.

## Discussion

According to the Article 1 of the Habitats Directive, cover change is one of the criteria for assessing the conservation status of a habitat. Comparing maps from different years is a suitable method for this analysis. Since a historical series of vegetation maps has been available for the study area since 1978, this seems a advantageous situation which occurs only in a few geographical areas. Nevertheless, the comparison between these maps turned out to be an operation not without difficulties.

Some of these difficulties are intrinsic to classification system and analysis scale of each study. Habitat overlaps, mosaics of several habitat types and "over-complication" in habitat definition are some of the known causes [15] which introduce uncertainty into the classification work of each researcher. Even more important is the difference between the sampling designs. The lack of a standardized sampling design, the same for all the studies, makes it difficult to establish whether the discrepancy between the data corresponds to a "transformation of the ecological system" or an "improvement of the knowledge system". Despite these difficulties, considerations are provided below on the differences found in the data extracted from the maps of the various periods, plausibly trying to discriminate "transformations of the ecological system" from "improvements of the knowledge system".



Figure 2 - Replacement of habitat 6220\* (on the right) by the cultivation.

Compared to the map of 2003 [5], there's an increase in the coverage of 1410 type of 12.0 ha. This is an interesting result, due to the replacement of the reed-bed in rush saltmarsh, apparently a positive response to a more rigorous conservation regime.

Compared to the map of 2003 [5] there's a 20.8 ha reduction in coverage of the 6220\* type. This is a value attributable to the tillage of ancient land managed with extensive grazing in favor of agriculture (Figure 2). This transformation concerns the innermost areas, in response to the loss of the economic driver of traditional grazing.

With regard to the 2230 / 2240 types, there's an increase of 23.4 ha compared to 2003. Indeed, previous studies underestimated these habitat types, as well as the 2260, 3170\*, 3260, 6420 and 7210\*.

With reference to the flora, the 240 recorded taxa correspond to 38 % of the floristic richness known for the study area [2]. The new data extend the list of species of greatest conservation interest. *Elatine macropoda* is a national red-list species with critically (CR) endangered status [24]. *Lythrum thymifolia* is a regional red-list species with endangered (EN) status [12]. With reference to the records of *Ranunculus saniculifolius* and *Silene niceensis*, these are the first data of the presence of these species in Salento (consult [21] for a comparison).

With reference to pressures and threats, the most represented type is discontinuous urbanization (E01.02). The expansion rate of the urbanized area has decreased in recent years, but the effects of past expansion weigh heavily on the conservation of natural patches, remained relatively small and fragmented in the matrix of buildings and infrastructures. How to conserve these residual natural patches is one of the main challenges for the administration body of the protected areas.

Car parks and parking areas (D01.03), Trampling, overuse (G05.01), the presence of Garbage and solid waste (H05.01), the introduction of Invasive non-native species (I01) inside the shores are all pressures / threats related to the tourist use of the coast. 34 % of the dune accesses are highly critical for the conservation of dune systems. The restoration of vegetation in these sites certainly represents an urgent measure to be put in place to protect dune habitats.

The Grassland removal for arable land (A02.03) and the Abandonment of pastoral systems, lack of grazing (A04.03) are pressures / threats related to the loss of the economic value of traditional grazing. The requalification of this activity is an urgent measure to be put in place to protect the habitat type 6220\*.

## Conclusion

The results achieved by the study increase the ecological knowledge of the protected areas of Porto Cesareo, allow to evaluate the conservation status of the habitats, highlight the environmental detrimental factors and direct towards the adoption of particular conservation measures.

On methodological issues, the difficulty of comparing the new habitat map with those developed in past years was found. The need to develop and adopt a standardized monitoring method over the long term is evident. Sample selection methods [18] and remote sensing [26] are relevant tools that must be taken into consideration for an effective monitoring plan. In this sense, the ISPRA manual [3] provides only a partial guide since, although full of fundamental information on how to study habitats, it does not propose a standardized sampling design.

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