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VEGETATION MAP OF “ZONE UMIDE DELLA CAPITANATA” (SCI IT9110005)

RIASSUNTO

Questo articolo illustra la carta della vegetazione del Sito di Interesse Comunitario “Zone umide della Capitanata” (SIC IT9110005), un’area paludosa molto estesa del Sud Italia (Regione Puglia). Il SIC “Zone Umide della Capitanata” è una delle più importanti zone umide costiere italiane e si estende su circa 14.000 ha, di cui una parte è sfruttata per la produzione di sale marino. Il sito è caratterizzato da un complesso di aree umide in ambiente costiero, con un paesaggio ampiamente frammentato a causa delle attività antropiche (principalmente colture erbacee). Questo studio si propone di valutare la presenza e la distribuzione dei tipi di vegetazione che, nonostante la forte pressione antropica, ancora mantengono buone condizioni degli habitat naturali. Le carte tematiche sono state digitalizzate con il software ArcGIS 10.2 da recenti ortofoto in combinazione con carte topografiche (1:5.000). Nel caso di aree frammentate, sono stati adottati i mosaici di vegetazione. L’estensione del complesso di mosaici di vegetazione è più ampia in quelle aree in cui le attività antropiche sono più forti.

SUMMARY

This article illustrates the vegetation map of the SCI “Zone umide della Capitanata” (IT 9110005) a wetland area of South Italy (Apulia Region). The SCI “Zone Umide della Capitanata” is one of the most important Italian coastal wetlands and it covers about 14.000 ha, part of which is exploited for marine salt production. The site is characterized by a wetlands complex in coastal

environment, with highly fragmented landscape because of anthropogenic activities (mainly herbaceous crops). This study aims at assessing presence and distribution of vegetation types that, despite strong human pressure, still maintain good natural habitat conditions. Thematic maps were digitized in ArcGis 10.2 from recent orthophotos in combination with topographical maps (1:5.000). In case of fragmented areas, vegetation mosaics were adopted. The extent of complex vegetation mosaics is wider in those areas where anthropogenic activities are stronger.

INTRODUCTION

The site of Community Importance (SCI) “Zone Umide della Capitanata” (SCI IT9110005) is one of the most important Italian coastal wetlands, covering about 14.000 ha. The site includes the Special Protection Area (SPA IT9110038) “Paludi della Capitanata nel Golfo di Manfredonia”. In addition, the area is an IBA (Important Bird Areas) site, a Ramsar site and it is also partially enclosed in the Gargano National Park (Fig. 1). The site is characterized by a system of coastal lagoons, characterized by brackish or



Fig. 1. Study area.

salt waters, depending on the specific water regime. The most significant areas are:

- Saline di Margherita di Savoia, consisting of a large area (about 4.500 ha) of salt water used as evaporation basins for salt extraction. The Margherita di Savoia saltworks are currently the largest productive saltworks in Italy (ZENO, 2009).
- Lago Salso, deriving from a freshwater wetland that, at the end of XIX century covered an area of about 4.000 hectares and then was transformed and reduced as a result of a great reclamation action. Currently it covers an area of about 1.800 ha. This area falls within of the Gargano National Park and is an important WWF bird oasis.
- Palude Frattarolo, a brackish wetland next to the Lago Salso area, is considered as a relic of the ancient Salso lake (BOENZI *et al.*, 2006). At present it covers about 500 hectares, of which 257 are protected as a nature reserve for the animal population. The area is an important bird's stopover and nesting and falls within the Gargano National Park.

The whole area has been subjected to exploitation for a long time, mainly for agricultural purposes, with the conversion of large part of wetland areas in cultivated lands and with resulting reduction and fragmentation of the original natural environment. Due to this process, at present, large part of the site is composed by agricultural areas or abandoned lands. The remaining humid area is composed by a system of coastal lagoons that extend for a total length of about 40 km along the coast. The natural vegetation is represented mostly by halophytic shrub, annual pioneer communities and helophytic vegetation, typical of salt marshes.

MATERIAL AND METHODS

The thematic map of the study site were digitized in ArcGis 10.2 from recent colour orthophotos in combination with topographical maps (source: SIT-Puglia, <http://www.sit.puglia.it/>). Natural and semi-natural landscape elements were defined as vegetation types on a 1:5000 scale, which allowed the studied landscapes to be represented with 5m resolution. This vegetation map (Fig. 2) represented the baseline for natural and semi-natural types, defined as phytosociological units in accordance with the Zurich-Montpellier method (BRAUN-BLANQUET, 1964; WESTHOFF and VAN DER MAAREL, 1978) and referring to a previous contribution on the vegetation of the site (TOMASELLI and SCIANDRELLO, 2016). For the definition and validation of the vegetation map, field data collected in TOMASELLI and SCIANDRELLO (2016), recorded in the period between 2011 and 2013 and georeferenced by GPS (Global Position System), were used. When the adopted scale did not allow the representa-

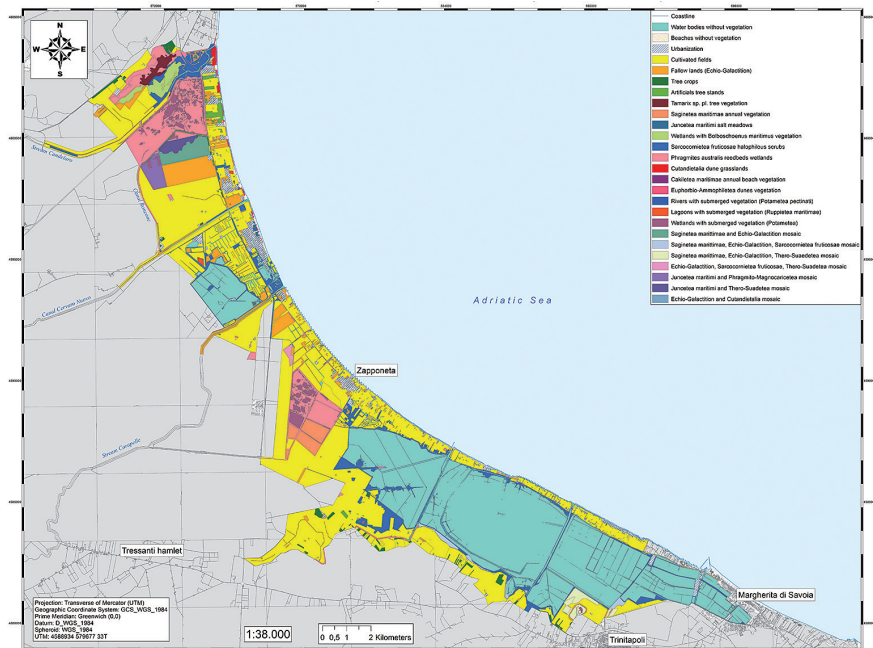


Fig. 2. Vegetation map of "Zone Umide della Capitanata" (SCI IT9110005).

tion of complex spatial pattern, as in the case of highly fragmented areas, the so called “vegetation mosaics” were adopted. In vegetation mosaics, each unit (or class) includes two or more syntaxonomical units that, in the real landscape, are fragmented in small patches and interspersed with each other, forming a chaotic spatial pattern (PEDROTTI, 2013; VAN DER MAAREL and FRANKLIN, 2012). Taxa nomenclature follows CONTI *et al.* (2005), while the *syntaxa* nomenclature follow the prodrome of Italian Vegetation (<http://www.prodromo-vegetazione-italia.org>; BIONDI *et al.*, 2014).

RESULTS AND DISCUSSION

As evidenced in the vegetation map (Fig. 2), 26 typologies, or classes, were defined (Tab. 1). Thirteen of these refer to natural vegetation types, seven are complex vegetation mosaics of two or more vegetation classes, and six are anthropogenic types, related to human activities, such as saltworks, agricultural areas (crops) and infrastructures.

As for the mapping of natural vegetation types, the scale 1:5000 was not sufficiently detailed to allow the representation of each single plant associa-

Vegetation	Relative (%) area
Lagoons with submerged vegetation (<i>Ruppiaetea maritima</i>)	0.08
Wetlands with submerged vegetation (<i>Potametea</i>)	1.57
Rivers with submerged vegetation (<i>Potametea pectinati</i>)	0.11
<i>Sarcocornietea fruticosae</i> halophilous scrubs	6.29
<i>Juncetea maritima</i> salt meadows	0.04
Wetlands with <i>Bolboschoenus maritimus</i> vegetation	0.77
<i>Saginetea maritima</i> annual vegetation	0.98
<i>Tamarix</i> sp. pl. tree vegetation	0.43
<i>Phragmites australis</i> reedbeds wetlands	7.05
<i>Cakiletea maritima</i> annual beach vegetation	0.01
<i>Ammophiletea</i> dunes vegetation	0.15
<i>Cutandientalia</i> dune grasslands	0.11
Fallow lands (<i>Echio-Galactition</i>)	4.05
<i>Echio-Galactition</i> and <i>Cutandientalia</i> mosaic	0.02
<i>Saginetea maritima</i> and <i>Echio-Galactition</i> mosaic	0.88
<i>Saginetea maritima</i> , <i>Echio-Galactition</i> , <i>Sarcocornietea fruticosae</i> mosaic	0.36
<i>Saginetea maritima</i> , <i>Echio-Galactition</i> , <i>Thero-Suaedetea</i> mosaic	0.57
<i>Echio-Galactition</i> , <i>Sarcocornietea fruticosae</i> , <i>Thero-Suaedetea</i> mosaic	0.15
<i>Juncetea maritima</i> and <i>Phragmito-Magnocaricetea</i> mosaic	0.63
<i>Juncetea maritima</i> and <i>Thero-Suaedetea</i> mosaic	0.42
Sandy shores without vegetation	0.59
Water bodies	34.83
Croplands	36.00
Tree crops	0.74
Artificial tree stands	0.43
Urbanization	2.74

Tab. 1. Vegetation typologies.

tion. Therefore, in representing the different classes of the vegetation map (vegetation types), we stopped at the level of higher categories (or *syntaxon*: in general, we grouped in a single vegetated class all the associations referring to a higher taxonomic unit), and only in a few cases, it was possible to represent the individual associations. In some cases, due to the high degree of fragmentation and complexity of the landscape, the classes of “vegetation mosaics” were used, with 7 classes of vegetation mosaics on a total number of 20 classes of vegetation. The percentage of vegetation mosaics in the map covers 3.04% of the total SCI area. “Cultivated areas” (Croplands) is the predominant type in the whole area, covering the 36% of the SCI. The

second dominant type of the map is “Water bodies”, that is water surfaces without vegetation, which cover about 35% of the whole area, including the saltworks “Margherita di Savoia” (the largest water body of the site) and also other lagoons, watercourses and an intricate system of canals and pools used for the irrigation of herbaceous crops. In fact, the Capitanata site is characterized by intensive horticultural crop fields, which extend widely along the coastal area, locally called “arenili”, and mainly used to cultivate onions, potatoes and carrots. Towards the inland, graminoid crops, in some case interspersed with tree crops (olive groves, vineyards, orchards), characterize the agricultural landscape.

As regards the natural vegetation, the most extensive and representative types are reedbeds (about 7%) and halophytic shrub (6.3 %). The halophytic shrub (*Sarcocornietea fruticosae* Br.-Bl. & Tüxen ex A. Bolòs & O. Bolòs in A. Bolòs 1950 Em. Biondi, Casavecchia, Estrelles & Soriano, 2013 class) are linked to saline and hypersaline environments, such as in the Southern part of the SCI, in correspondence of the saltworks, where they colonize extensively the perimetral areas surrounding the salt flats, as well as banks and canals that form a very large and complex network throughout the area. The reedbeds (*Phragmito australis-Magnocaricetea elatae* Klika in Klika & Novák 1941 class) usually are monophytic communities of *Phragmites australis* (Cav.) Trin. ex Steud., in some cases forming mosaics with rush communities (*Juncetea maritimi* Br.-Bl. in Br.-Bl., Roussine & Nègre 1952), in wet environments and in condition of water availability and low water salinity (fresh and/or brackish water). Reedbeds are distributed mainly in the north-central part of the area and in particular in Frattarolo, Lago Salso and S. Floriano swamps, in correspondence of fresh/brackish waters and high concentration of nitrogen substances originating from the surrounding cultivated fields. Reedbeds widely grow also along canals and pools, which form a system which extends throughout the cultivated areas. Compared to the wide surfaces covered by the water bodies, the presence of hydrophytic vegetation belonging to the *Potametea pectinati* Klika in Klika & Novák 1941 class seems to be rather low (1.57%). This is probably linked to the alteration of water regime and quality, due to the extensive anthropization of these areas and the use of most of these water bodies as saltworks or as basins of fish farming and also to the water pollution arising from the agricultural areas. Mediterranean halo-nitrophilous annual pioneer communities of muds and sands (*Saginetea maritimae* Westhoff, Leeuwen & Adriani 1962 class) are common and widely distributed throughout the SCI area, including both homogeneous pure formations and complex mosaics with the communities of the fallow lands (*Echio plantaginei-Galactition tomentosae* O. Bolòs & Molinier 1969). The combination of these two aspects comes to cover nearly 2% of the site. Other vegetation types are represented with very low cover percentage, below 1%

of the SCI area. This is the case of the salt meadows with rushes (*Juncetea maritimi* class) and of the annual halophytic communities (*Thero-Suadetea splendentis* Rivas-Martínez 1972) that are, usually, in mosaic with each other or with other plant communities, such as reedbeds, *Sarcocornietea fruticosae* and *Echio-Galactition* communities. The presence of a significant percentage (more than 4%) of vegetation of fallow lands and abandoned fields (*Echio-Galactition* communities) is a consequence of the impact of farming activities on the natural environment.

The sandy belt that separates the wetlands from the sea, once consisting of large dune ridges with psammophilous vegetation complexes, is very degraded at present, often turned into agricultural areas (the above mentioned "arenili") or subject to coastal erosion, or even occupied by touristic structures and facilities. As a consequence, few and fragmented patches remain of the original dune vegetation cover, represented by the annual vegetation of drift lines (*Cakiletea maritimae* Tüxen & Preising ex Br.-Bl. & Tüxen 1952 class) and by discontinuous populations of *Elymus farctus* (Viv.) Runemark ex Melderis subsp. *farctus* (*Euphorbio paraliae-Ammophiletea australis* Géhu & Rivas-Martínez in Rivas-Martínez, Asensi, Díaz-Garretas, Molero, Valle, Cano, Costa & Díaz 2011 class). The *Cakiletea maritimae* vegetation shows the lowest cover (0.01%). The *Elymus farctus* subsp. *farctus* communities represent the first stages of the perennial dune vegetation and cover about 0.15%. The severe state of reduction and fragmentation of these psammophilous communities is due to various anthropogenic activities and to the accentuation of marine erosion, which in many places has greatly reduced the extension the emerged beach and eroded the dunes area. Also in this case, ephemeral annual communities of *Cutandietalia maritimae* Rivas-Martínez, Díaz Garretas & Asensi 2002, sometimes in association with plant communities of fallow lands (*Echio-Galactition* class), colonize the interdunal depressions behind dunes, for a total coverage of 0.11%. The class "Urbanization" covers the 2.74% of the total SCI area. Besides some small municipalities, this class includes little tourist villages, scattered rural buildings and also parking areas that, in some cases, have completely invaded the dune belt. The analyses (in field and mapping) highlighted the high level of plant biodiversity (especially in terms of wetland environments) and the high level of human disturbance within the SCI IT9110005. Despite the establishment of the SCI and of more protected areas, such biodiversity is severely threatened by intensive agriculture, coastal erosion, touristic pressure and presence of various infrastructures (GÉHU *et al.*, 1984; BIONDI, 1999). Over time, such pressures have determined progressive alteration, reduction and fragmentation of the natural habitats (TOMASELLI *et al.*, 2016). Due to the complexity of the landscape, the scale adopted is not sufficiently detailed to represent each single patch of each single vegetation type, so that the use of vegetation mo-

saics was adopted as a solution. Usually, the two main factors leading to the presence of vegetation mosaics are a) temporal dynamics of disturbance and succession and b) environmental variability (VAN DER MAAREL and FRANKLIN, 2012). In the case of the studied area, the anthropogenic disturbance is the main factor underlying presence and distribution of mosaics and also plays a major role in the landscape complexity and patchiness of some areas of this site. The data show that most of the SCI area (more than 70%) is occupied by cultivated lands and saltworks. In particular, the cultivated areas have subtracted large areas of natural vegetation, and still nowadays agricultural practices continue to adversely affect the natural environment. Nevertheless, the SCI "Zone Umide della Capitanata" preserves a precious natural heritage, especially in terms of wetland environments and habitats that are of crucial importance for bird migration and nesting. Then, urgent measures of conservation should be adopted as soon as possible, aimed at launching environmentally friendly agricultural policies and at regenerating the dune belt environment.

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