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WP3 DEFINITION AND MONITORING OF CLIMATE ADAPTATION PLANS
Activity 3.2 CLIMATE ADAPTATION PLANS

Climate Adaptation Plans

REGIONAL NATURAL PARK "COASTAL DUNES FROM TORRE CANNE TO TORRE SAN LEONARDO"

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1. INTRODUCTION

The area of the Regional Natural Park "Coastal Dunes from Torre Canne to Torre San Leonardo" falls within the area identified by the Regional Territorial Landscape Plan of the "Murgia dei Trulli" and in particular within the sub-area " Plain of centuries-old olive groves ".

The park is crossed by the Plain of monumental olive trees, recognized as a historic rural landscape by the Ministry and which represents the summit surface of a large sandstone - calcarenitic bank that slopes towards the sea. Its morphological-visual limit, to the west, is constituted by the slope of the Murgia plateau, covered by woodland vegetation, which gradually goes down along the Brindisi coastline. In the Park there is also the presence of a cultural heritage with monuments and sites, and the Traiana Road that connected Rome to Brindisi, now inserted in the European itinerary of "Via Francigena del Sud"

The Park occupies about 935 hectares of the Plain within the territories of the municipalities of Ostuni and Fasano, extending along approximately 8 kilometers of coast of the inlet defined by the promontories of Torre Canne and Torre San Leonardo and bounded by the continuous dune cordon that separates the beach from the retrodunal wetlands, to then advance towards the internal agricultural areas occupied by centuries-old olive groves. The limit of the Park follows the course of the "blades" towards the internal areas, erosive canals that ply the Plain from the Murgia plateau to the sea, and therefore has a jagged perimeter that measures about 55 kilometers.

The Park is characterized by a high diversity of natural and semi-natural environments that are articulated in the system of coastal dunes, retrodunal wetlands (Fiume Piccolo , Fiume Grande, Fiume Morello), fossil dunes and part of the main erosive furrows (Lamacornola , Lama Torre Bianca, Lama Defense of Malta, Lama Rosa Marina), closely interconnected with the aforementioned systems from the hydrogeomorphological and ecological-naturalistic point of view.

The Regional Natural Park "Dune Costiere from Torre Canne to Torre San Leonardo" was created by Regional Law n. 31 of 27 October 2006, with the aim of conserving and recovering the habitats and the animal and plant species indicated in the Community Directives 79/409 / EEC and 92/43 / EEC present within it, as well as safeguarding the landscape values and the superficial and underground ecological, hydrogeological equilibria.

The importance of the habitats present in the Park is also evidenced by the fact that it is also a Site of Community Importance (SCI) included in the European Natura 2000 network. The SCI "Litorale brindisino" in addition to protecting habitats of Community interest and priority habitats present in the Park such as the mobile dunes (2120), the Mediterranean flooded pastures (1410), the Mediterranean savory steppes (* 1510), the coastal dunes with Juniperus spp. (* 2250), the annual vegetation of the marine deposit lines (1210) and coastal lagoons (* 1150), also protects the submerged habitat of the Posidonia meadows (* 1120) present in the stretch of sea in front of the Park.

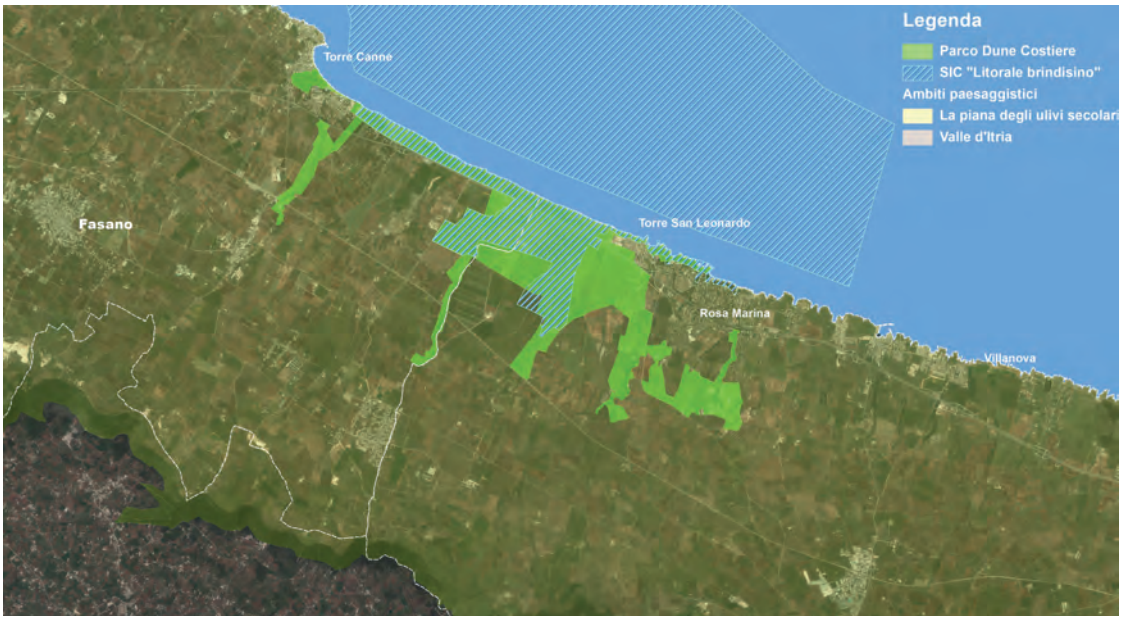


Fig.1: The Regional Natural Park "Coastal Dunes from Torre Canne to Torre San Leonardo"

2. ANALYSIS

CLIMATE

The territory of the Park is part of the Mediterranean climate and in particular it belongs to the xerothermic region (in which the period of dryness corresponds to the summer months), a thermo-Mediterranean sub-region, as far as the coastal strip is concerned.

In the thermo-Mediterranean sub-region the dry period is quite pronounced and has a duration varying from three to five consecutive months with an average of more than four months. Precipitation is concentrated in the winter period with an eminent stormy character and has an annual average of around 500 mm. The average annual temperature is quite high, equal to 16.8 ° C. From the point of view of vegetation, this region is characterized by evergreen thermophilic formations dominated by wild olive (*Olea oleaster*), carob (*Ceratonia siliqua L.)* and lentisk (*Pistacia lentiscus* L.) and is part of the climax of the wild olive and of the carrub (*Oleo – Ceratonion*).

Along the coastal strip that wedges between the Adriatic and the south-eastern reliefs of the Murge falls the optimum for the affirmation of a spontaneous vegetation characterized by the scrubland of Quercus ilex (holm oak) and of evergreen sclerophilous formations. In the past, the holm oaks were the most common spontaneous tree formations in this area. Remnants of these are in fact still present on the sides of the hills that slope down to the Adriatic and represent the last evidence of a large wood that from the lowlands of Murgia had to reach the Adriatic plain, where the holm oak is still found today sheltered on the sides and bottom of blades and in some limited areas of the background.

NATURE AND ENVIRONMENT

The areas with a specific natural interest along the coastal strip of the Municipalities of Fasano and Ostuni, in particular in the stretch affected by the presence of the regional protected area. The site is complex and articulated and includes a strictly coastal strip with low cliff areas, some retrodunal wetlands (Fiume Grande, Fiume Piccolo, Fiume Morello), a long dune cordon with both herbaceous vegetation and juniper and sclerophilous vegetation, the juniper forest in the village of Pilone, the pseudosteppa and garrigue in the area of "Difesa di Malta", a series of blades in the hinterland that constitute preferential lines of water flow and areas suitable for the conservation of residual areas of spontaneous vegetation in the Mediterranean scrub.

Fig.2: Habitat distribution in the Regional Natural Park of Coastal Dunes

Area with cliff vegetation near Torre Canne

This is an area with sparse, discontinuous and tenacious vegetation that colonizes the low cliffs subject to wave motion. It has halophilic characteristics and is generally characterized by high crassiness. Among the most representative species we could mention: *Inula crithmoides, Crithmum maritimum, Suaeda fruticosa*, *Allium commutatum and Limonium apulum*.

Area with marshy vegetation in the Fiume Grande area

It is a short stream blocked by a sluice and with banks contained by embankments along which a thick reed bed develops with a prevalence of marshy reed (*Phragmites australis*). The stream is characterized by submerged and floating vegetation of *Brasca pettinata* (*Potamogeton pectinatus*).

Area with marshy vegetation in Fiume Piccolo

The area of Fiume Piccolo, depending on the presence of a substratum with extremely variable salinity, is characterized by two different types of vegetation: the marshy area with low salinity and prevalence of swamp straw (*Phragmites*

australis) and the marshy area with more pronounced salinity with halophilic vegetation and presence of salicornia (*Arthrocnemum glaucum*) and atriplice portulacoide (*Atriplex portulacoides*).

Area with marshy vegetation in the Fiume Morello area

It is a retrodunal pond fed by some springs surrounded and delimited by arable areas and that presents a typical vegetation of high salinity environments with different herbaceous halophilic such as Salicornia glauca, *samphire,Limonium* sp., Maritime reed, Marsh reed. These environments are characterized by extreme dryness in the summer while they are often submerged in water in the winter period. Defined salt steppes constitute priority habitat

Area with psammophilous vegetation in "Posto di Tavernese"

In the "Posto di Tavernese" site there is a patch of pseudo-steely vegetation on the sand with *Plantago albicans*, while the dune is characterized by ammophiletes.

Area with dune vegetation between Torre Canne and Torre S. Leonardo

The dune cord runs along a mainly sandy stretch of coast: along the shoreline, due to the too many waste that the sea deposits and the dynamics connected to tourist use, the vegetation belt of the *Cakiletum* is almost completely missing; more internally traces of the *Agropyretum* can be found, with the characteristic *Agropyron* species *junceum*.

Well represented in that part of the dune where the action of sea storms comes alone in exceptional cases is the *Ammophiletum*, characterized by *Ammophila arenaria,* or sparto pungente, a graminaceous with a bushy habit, with long roots that hold the grains of sand thus favoring the dune consolidation; to it are associated *Eryngium maritimum Medicago marina and Crithmum maritimum.*

The summit of the dune, which also reaches 10 meters in height (on average 7 meters high), is mostly colonized by pads of shrubby and prostrate vegetation constituted by *Juniperus oxycedrus* subsp. *macrocarpa, Pistacia lentiscus*, *Phillyrea latifolia* and *Myrtus communis*.

Juniper wood in the Pilone area

Behind the dunes, there is another important wood of about 1 hectare with Phoenician juniper (*Juniperus) phoenicea* L. or *Juniperus turbinata*), a species that moves more towards the interior than the juniper cuddle (*Juniperus oxycedrus* var. *macrocarpa* L.), is present in the locality Pilone.

The juniper wood with *Juniperus turbinata forms* part of a phytosociological association of particular conservation importance, the *Pistacio – Juniperetum phoenicea*, a forest formation of stable dunes whose species is *Pistacia lentiscus*and *Juniperus turbinata*. Several specimens of Holm oak (*Quercus)* are also found in the arboreal layer *ilex* THE.). According to Pedrotti and Cortini (1982) the association "*Juniperetum macrocarpe – phoeniceae* represents an important phase of the succession dynamic vegetation preceded by the ammophileto and that would evolve in the absence of disturbance towards a vegetation not distinctly coast which is the holm oak and in particular in the *Viburnum – quercetum ilicis* (Br-Bl., 1936) Rivas Martinez (1975). In the past the area had to be much more extensive until it reached, in an ecological and phlogistic continuum, the nearby village of Rosa Marina, but as evidenced in a scientific study of 1986 (*Vita e Leone*) vegetation due to the impact of 'tourist-residential activity (opening of passages, trampling, breaking of the stability of the dune, small phenomena of grazing) has undergone a progressive decrease in juniper-tree cover, enriched with shrubs and xerophilous and heliophilous herbs (rosemary, thyme, lentisk, myrtle, cisto, etc.).

The Pseudostappa area in locality of "Defense of Malta"

In the area of "Defense of Malta", in the territory of Fasano, close to the sea, there are a series of undulations of the land on which there is a semi-natural vegetation, represented by low garrigue with shrub thyme (*Thymus capitatus*), and a vegetation of pseudosteppa.

In the areas of pseudosteppa, a perennial graminacea prevails, the Cymbopogon *hirtus* (L.), with marked thermo-xerophilous needs, typical of soils poor in humus and with rocky outcrops; the site shows the presence of *Serapiasorientalis* subsp. *Apulica* (Baumann & Kunkele, 1989), species included in the National Red List.

Areas with garrigue and pseudosteppe of the fossil dunes

The system of fossil dunes located just beyond the route of the SS 379 are characterized by vast areas of garrigue, in which the shrub thyme (*Thymus capitatus*) and the *Euphorbia spinosa* , and a pseudosteppa , which host splendid orchid blooms in spring, including rare and endemic species such as the *Serapias orientalis* and the *Serapias politisii* .

The vegetation of the "Lame"

The blades, thanks to their uneven conformation, have partly escaped the cultivation and, often, they preserve the only wrecks of naturalness in territories for the rest strongly anthropized, revealing a perfect ecological corridor for animal and plant species. There are numerous environments that can be found in the different sections of the same blade: from the environment of the cultivated trees, arborated and not, to that of the pasture meadows and the pseudosteppa , from the typically Mediterranean environment of the garigue, characterized by herbaceous plants and sparse shrubs that colonize the outcrop rock, to that of the Mediterranean scrub, from the typical rupicolous environment of the rock stands to the wooded one, although increasingly rare.

Where the walls have a greater depth than the ground level, there is also the phenomenon of thermal inversion, characterized by greater permanence of cold air and greater humidity in the lower layers, also due to the lower insolation of the bottom compared to the surface , microclimatic conditions that favor the development on the bottom of the blade of mesophilic and sciaphilous species; sometimes at the bottom of the blade there remain temporary pools of water that determine the development of a typical hygrophilous vegetation and allow the life of a series of animals typical of temporarily submerged environments.

The Lama of Torre Bianca , about three kilometers long, is covered by a substeppica herbaceous vegetation and, in limited areas, from garrigue to thyme.

The Lama of Lamacornola it is characterized by greater depth and strongly uneven stretches. These characteristics determine a significant difference between the wall, which is exposed to the north, more shady and with a cooler microclimate, which allows the development, at times, of a high bush vegetation with holm oak and oak trees, and the south-facing slope, colonized by a more xerophilous vegetation, with dominance of species such as wild olive, broom and cistus and large tracts occupied by asphodel meadows. On the bottom of the blade, in its terminal section near the Pilone, two monumental downy oaks are found , an interesting presence from a botanical point of view and symptomatic of the ecological connections with the innermost areas of the Ostuni territory.

The Lama of Rosa Marina , also deep and bumpy, has various stretches with impenetrable vegetation; the upstream section is covered by a low scrub with a strong presence of olive trees, while, proceeding towards the sea, the vegetation evolves towards a high spot, with a greater presence of holm oaks; finally, the last part of the blade is characterized by the presence of large specimens of tall oak, which tightened between the rock walls, contribute to maintaining a particularly mesophilic microclimate

The beach and the sea: the importance of the "Posidonia oceanica"

The seagrass Posidonia constitute one of the most important habitats of the Mediterranean, and assume a fundamental role in the marine ecosystem with regard to primary production, biodiversity, the balance of sedimentation dynamics. They also represent an excellent indicator of the quality of the marine environment as a whole. The ecological role played by the Posidonia meadows , vis-à-vis the coastal system, is in fact of fundamental importance: it is a structuring species with consolidation and enrichment action of the substrate and with a protective function, so as to represent a real area of refuge for many species of fish, as well as offering shelter and food to adult specimens; with photosynthesis, the plant produces a large amount of organic matter which is a direct and indirect source of food for many organisms and the starting point of a complex trophic network. With regard to the management of the coastal strip, the prairie plays a fundamental role in containing and protecting the coasts from the erosive action of the wave motion. The plant dampens the hydrodynamism and, by trapping the finest sediment between the rhizomes, it consolidates the substratum and the dead leaves, dislodging, can form formations called banquettes , which protect the coast from the erosive phenomena caused by the wave motion. The Posidonia it is generally found in well-oxygenated waters, it tolerates relatively wide variations in temperature and hydrodynamism , but it is sensitive to desalination (normally it requires a salinity of between 36 and 39 da, so as to disappear in the areas in front of the mouths of the water courses), pollution, anchoring boats, laying submarine cables, invading alien rhizophytic species, altering the sedimentary regime.

Massive contributions or substantial depletion of the sediment and prolonged low light regimes, deriving above all from anthropic causes, such as in particular incorrect beach nourishment practices, can provoke a rapid regression of the prairies

THE ASPECTS OF GEOLOGY, GEOMORPHOLOGY AND HYDROMORPHOLOGY

The area of the Park of the Coastal Dunes extends along the Adriatic coast in a south-eastern direction compared to the Murge plateau. The widest territorial arrangement within which the Coastal Dune Park develops can be morphologically divided into three different areas by characteristics and extension:

- The SW section of the Murgian escarpment that extends up to maximum altitudes above 400 m asl; in this first area, as well as in the whole investigated territory, there is a purely karstic morphology with numerous dolines and karstic polje also of considerable size (karst polje of Canale di Pirro whose extension is about 2 km with rather steep walls and practically flat internal morphology);

- The foothill area, understood as the territorial portion that develops from NE to SW, between sea level and isipsa 150 m asl; this surface is constantly tilted to the NE, with a slight NW component parallel to the coast and has been affected by several cycles of marine ingressions which have left traces of terracing still quite evident. The entire area is characterized by steep walls even up to 10-15 meters (also called "blades") that cross it in directions of maximum slope and that tend to a base level that corresponds to the next marine abrasion surface. The appearance that follows is rather unique in that alluvial deposits are divided between parallel lines corresponding to the feet of the terraces. *It is within this second morphological portion that the entire perimeter of the Coastal Dune Park develops;*

- The third portion is the one between the two already described and is constituted by a very steep morphological strip with slopes that reach locally even 60% (stretch of the Murgian escarpment).

The steps of the marine terraces, as well as the current morphology of the entire coastal area (beach, dune and retrodunal), represent the product of the interaction between the general elevation of the region (started in the Pleistocene epoch with lifting values of about 0.5 mm / year) and the glacioeustatic variations that have manifested themselves over time through the various cycles of transgression and regression of the sea. In this regard it should be pointed out that the last regressive cycle brought the sea level 2 or 3 meters below its current position; in this phase the large uncovered surfaces have favored the contribution of most of the sands that today constitute the current beaches. All the described terraces are engraved on calcarenitic sediments of the Plio- Pististocene epoch (Calcareniti di Gravina).

In correspondence of the lowest of the abrasion surfaces described, it will retain beach sediments, as well as dune deposits and behind the dunes; the oldest dune (dune fossil) forms an elongated cord in the NO-SE direction, parallel to the coastline, and reaches the height of 17 meters in the central part of the bay of Torre Canne and the maximum amplitude at the southern end of the same bay (G. Mastronuzzi et al., 2001). Along the bay of Torre Canne we can also recognize the remains of two other dune cordons, although of a more recent age than the one described above; of the two dunes, the oldest one extends to sea level or slightly below it, while the second one extends to heights of about 5-6 meters, resting in some sections on the previous dune cordon (edges of this overlap are still visible in some stretches of the coast located north of Torre San Leonardo).

This last dune appears on several fronts to be deeply eroded by the sea, while in others it is now completely removed from the same, as currently the coastal area investigated is in an advanced stage of erosion (transgressive phase of the sea). The oldest of the described dune cordons is engraved with fluvial furrows, corresponding to the extension towards the sea of the "blades" of tectonic-karstic origin. More generally the whole territorial area within which the Coastal Dune Park develops is characterized by a morphology strongly conditioned by the karst nature of the same, due to the presence in particular of the erosion grooves previously described (more or less extensive and deep) and of numerous ravines, which represent the testimony of an ancient karst activity. These karstic cavities often appear with red earth inclusions, above all in correspondence of fractures and fissures that represent preferential ways for the surface and underground flow of meteoric waters; the latter chemically and mechanically attack the limestone lithologies modeling over time the erosive furrows through which they will be conveyed to the sea.

The major examples of the aforementioned erosive grooves are represented by the blades: Lamacornola, Difesa di Malta, Torre Bianca.

Fig.3: Geological aspects of the Regional Natural Park of Coastal Dunes

The hydrogeology of the Park area, as well as that of the wider territorial area within which it is inserted, is closely linked to geology and its structural characteristics. The emerging lithologies, while guaranteeing good characteristics of water absorption, nevertheless show a different degree of permeability; it is good to distinguish between primary and secondary permeability: the first is typical of porous rocks, the second of originally compact rocks that have become permeable due to cracking and fracturing. Cretaceous limestones are characterized by very low primary permeability where they are compact and homogeneous, while generally they show a high secondary permeability directly connected to the presence of tectonic and karstic fractures; these fractures determine the formation of a diffused network of underground channels that allow water circulation. The overlying calcarenitic roofs and, in part, the deposits of calcareous sands, on the other hand, have an exclusively primary permeability, typical of porous rocks whose texture is characterized above all by the presence of inter-granular communicating spaces between them. The alluvial deposits are variously located on the area of the Park, as they are mostly made up of red earths with discrete quantities of silty-clayey soils, above all in the area behind the dunes . The Mesozoic carbonate units are the site of an extensive water table, whose characteristics are mainly linked to the presence of structural discontinuities, preferential routes for the development of karst processes.

There is no real superficial aquifer, but only possible and isolated lenses of water, whose formation depends on the presence or absence of permeability thresholds due to the different degree of fracturing and / or karst dissolution of the limestone. The deep aquifer is generally confined to the Mesozoic calcareous substrate; however, as the shoreline approaches the coast, it partly circulates also in the calcarenitic coverings. It is sustained by the sea water that invades the continent and has as its base level the average sea level; it circulates at free hair, or slightly under pressure, due to the presence of limestone layers which, where compact and homogeneous, are little or not at all permeable or due to the presence of calcarenitic deposits, which are also not very permeable. The depth of the deep aquifer compared

to the countryside level varies from one area to another as a result of the structural heterogeneity of the carbonatic aquifer, due to the different effects of the karst and tectonic processes; the piezometric loads are generally of the order of about 0.5 meters immediately near the coastal strip, while they show values of approximately 1.5-2.0 meters at the Bari-Lecce railway line, increasing rather regularly as that moves to the most internal areas. The hydrogeological structure just described gives the local aquifer system a characteristic "lens" conformation, with the edge placed in correspondence with the coastline; said conformation determines the subsidence between the fresh and less dense groundwater and the underlying waters of marine intrusion, having higher densities and, for this reason, heavier. As far as the average vertical distribution of the salt content of the aquifer is concerned, it can be said that the area of the diffusion and / or transition is limited to a few meters of thickness, rapidly passing to the basic salt water level.

The dynamics of movement of the aquifer at sea are manifested through the numerous emergencies, more or less evident along the entire coastal area (underwater and / or subaerial); the same show that sea outflows occur, in some cases, along preferential lanes, thus resulting in a punctual type, while in others they show a rather widespread emergency at sea. The most obvious events in the area of the Park are the Fiume Grande and Fiume Piccolo springs located near the town of Torre Canne and Fiume Morello, located just north-west of the built-up area of Pilone and Torre S. Leonardo (may be considered karst sources of overflow due to the blocking of the calcarenites of a fossil dune cord); among the minor springs a special mention deserves the outcropping in Tavernese. The overall distribution of the salinity of the groundwater shows changes in the salt content as a function of the distance from the coast, presenting the highest values near the same, where the effects of sea intrusion are evidently more intense. It should be noted that this trend is often modified by the conditioning operated by the coastal springs, which push the isoaline towards the interior, confirming that the areas with greater drainage also represent preferential ways of penetrating the salt contamination due to the greater communicability of the aquifer with the sea and the different filtration speed of the aquifer.

European Regional Development Fund

Fig.4: Geomorphological aspects of the Regional Natural Park of Coastal Dunes

The superficial hydrography

The karst processes and the permeability characteristics of the emerging lithologies condition the entire hydrographic structure of the Park territory. Superficial hydrography is almost non-existent (except in the back- dune wetlands of Sorgente origin) as a result of the remarkable ability to absorb soil and the karst nature of the rocky substrate. In the area there is no real superficial hydrographic network as generally understood and recognized in the scientific literature: the lines of watersheds of different hierarchical order do not always constitute continuous paths and are not always actually recognizable on the territory. The hydrographic network is represented by more or less extensive erosive furrows, generally with a flat bottom and moderately inclined sides, through which the outflow of meteoric waters is expressed. The blades generally appear dry and generally not deeper than 10 - 15 meters, assuming rather modest connotations and generally not very hierarchical; they develop in the south-west-north-east direction causing a superficial flow that finds its natural outlet to the sea. The water outflow therefore appears "temporary and / or episodic", typical of a "young" hydrographic network: only on the occasion of the most intense meteorological events does surface water complete the entire hydraulic course; where the dynamic- tars dynamics have not given rise to the formation of erosive furrows, the movement of these waters is expressed by a type of flow rather more widespread in the territory. However, given the considerable and already mentioned ability to absorb soil and subsoil, the surface runoff of meteoric waters, whether widespread or punctual, is almost immediately interrupted by the presence of karst cavities and fractures that favor a rapid infiltration into the underground towards the deep aquifer.

3. PLANNING RECOGNICTION

There are many different planning tools and projects at regional or local level that directly or indirectly intervene in the territory of Regional Natural Park in order to counter or mitigate the effects deriving from climate change.

In particular, in the Park area there are plans ("*Regional Natural Park of Coastal Dune Territorial Plan*", "*SCI Litorale brindisino (IT 9140002) management plan*") and projects more specifically aimed at protecting habitats and conserving biodiversity.

Among the plans that deal directly with addressing and mitigating the impacts of climate change, the "Local Action Plan for the fight against drought and desertification in the Puglia region" identifies the areas sensitive to the desertification identifying specific actions to be implemented for each homogeneous territorial area through the European Agricultural Fund for Rural Development (EAFRD) funds.

The "Regional Coastal Plan" instead identifies the areas of the shoreline that are most critical to erosion and those with greater environmental sensitivity in order to limit the tourist-seaside facilities, but does not identify interventions for the mitigation of impacts due to coastal erosion.

The "Hydrogeological plan", approved in 2005, is a tool of the Puglia Region Basin Authority, continuously updated, that constantly monitors areas at risk of landslides and hydraulic risks regulating their use and proposing interventions for the arrangement, conservation and recovery of soil in river basins, for the defense, arrangement and regulation of watercourses and for the defense and consolidation of slopes and unstable areas.

The "Water Protection Plan" (PTA), is a dynamic tool of knowledge and planning, which has as its objective the integrated protection of the qualitative and quantitative aspects of water resources, in order to pursue a healthy and sustainable use.

There are also several projects for the reuse of waste water in agriculture carried out by local authorities in implementation of the water saving strategy indicated by the PTA: the project "Forcatella Lake: water purification and refinement plant", carried out by the Municipality of Fasano, and the "Extension of the irrigation network for the reuse of waste water from the municipal purifier", made by the Municipality of Ostuni.

Decision Makers	**Date of implementation**	**Name**	**Relation with CC**	**Typology** *(Plan, policy, strategy, action, tool, project, initiative)*
Puglia Basin Authority	30/11/2005	Hydrogeological plan (PAI)	– Increased coastal erosion	Plan
Puglia Region ENEA	2008	Local Action Plan for the fight against drought and desertification in Puglia	– Increase of drought – Variation in crop yield	
Puglia Region	06/06/2006	Regional Water Protection Plan (PTA)	– Increase of drought – Variation in crop yield	Plan

Puglia Region	13/10/2011	Regional Coastal Plan	– Increased coastal erosion	Plan
Puglia Region	02/08/2013	Regional Territorial Landscape Plan (PPTR)	– Loss of habitat	Plan
Province of Brindisi	04/06/2009	Site of Community Interest "Litorale brindisino" (IT 9140002) management plan	– Increased coastal erosion – Loss of habitat – Increase of drought – Variation in crop yield	Plan
Province of Brindisi	22/02/2012	Provincial Territorial Coordination Plan (PTCP)		Plan
Municipality of Ostuni	1977 Update 1995 Update 2001	The General Regulation Town Plan (PRG)	– Loss of habitat	Plan
Municipality of Fasano	2001	The General Regulation Town Plan (PRG)	– Loss of habitat	Plan
PDC	2013	Regional Natural Park of Coastal Dune territorial Plan	– Loss of habitat	Plan
Province of Brindisi / Municipality of Ostuni	2008	"COLECOMAN: (COLlaborative ECOsystem MANagement)	– Loss of habitat	Project
Province of Brindisi / Municipality of Ostuni	2008	Amjowels (Adriatico Meridionale e Jonio wet lands system)	– Increased coastal erosion – Loss of habitat	Project
Municipality of Ostuni / PDC	2009	Nat - PRO (Strategic plans for restoration, protection & eco tourism promotion in Natura 2000 sites)	– Loss of habitat	Project
Municipality of Fasano	2016	"Forcatella Lake": water purification and refinement plant	– Increase of drought – Variation in crop yield	Project
Municipality of Ostuni	2018	Extension of the irrigation network for the reuse of waste water from the municipal purifier	– Increase of drought – Variation in crop yield	Project
Gargano National Park / PDC	2019	LIFE Diomedee	– Loss of habitat	Project
Municipality of Ostuni / PDC	2019	Integrated strategic project to strengthen the ecological connection and improve the quality of sustainable tourism use between the Coastal Dune Park and the Archaeological and Natural Park of Santa Maria d'Agnano	– Loss of habitat	Project

Table 1: Plans/Projects related with CC

4. SELECTION OF THE IMPACTS

4.1 Summary of the process that led the selection of the most relevant CC impacts

In order to develop an appropriate analysis for each different location, it was decided, in agreement with all partners to focus on 4 main climate change impacts (and related hazards) identified as the most relevant for the pilot areas.

The detection of the hazards and the potential impacts is based on two phases: a) identification of a broader group of hazards and climate change impacts; b) the selection of a narrower set of hazards and impacts that are considered to be more relevant for the pilot areas based on local expert's knowledge.

Hazards that contribute to climate change impacts that have been considered in this project are: increasing temperature; decreasing temperature; increasing extreme atmospheric events; increasing windstorms; increasing precipitations; decreasing precipitations; sea level rise. Each of these hazards, singularly or jointly, are considered to insist in different ways and with different intensity on certain macro-areas or sectors. Macro-areas that can be affected by climate change and that have been considered in this project are: agriculture; ecosystem & environment; energy; coastal areas; hydrology & water resources; socio-economic. For each sector, a set of impacts considered more relevant for the Adriatic Region have been identified (Table 1). The larger list of sectors and impacts listed in Table 1 was largely drawn from the United States Environment Protection Agency guidelines (EPA, 2018).

Sector	Impacts
Agriculture	Variation in crop yield
	Variation in livestock production
	Increased irrigation demand
Hydrology and water resources	Increase of drought
	Increase of flooding
	Increased competition for water
	Increase of urban flooding
Coasts	Increased erosion
	Coastal flooding
	Damage to costal human infrastructures
	Damage to costal natural environments
Energy	Impacts on energy infrastructures (energy plants, etc)
	Increased energy demand for cooling
Socio-economic	Increased Urban Heat Island effect
	Impacts on weakest group of people
	Impacts on commercial activities
	Impacts on public services

	Impacts on industrial activities
	Impacts on transportation network
	Impacts on tourism sector
Ecosystems and environment	Loss of species
	Loss of habitat
	Increased forest fires
	Increase of invasive species and parasites
Other	Other

Table 2: First list of climate change impacts from which the PPs are asked to choose.

In order to make a selection of the most relevant impacts, based on elements of scientific relevance for the specific physical and environmental situation of the Park of the Coastal Dunes' area, were examined all the studies and analyzes carried out over the last few years on the Park area and on the its territorial context.

In particular, as regards the plans, projects and actions specifically addressed, in whole or in part, to the mitigation of the impacts deriving from the climate change, not only were their parts of cognitive analysis explored, but an evaluation was also carried out of the effects of the interventions already did on the reduction of the impacts selected.

Even if on the one hand the infrastructural interventions aimed at reducing the hydro-geological risk due to extreme atmospheric events (channel arrangement and construction of expansion and rolling tanks) have allowed a considerable reduction of the flooding events, which have almost completely eliminated the impacts on infrastructures and on economic activities, on the other hand the implementation of interventions to upgrade the treatment plants and refinement of urban waste water and the extension of the irrigation network for their reuse, has not yet sufficiently reduced the problems deriving from the increase in drought with consequent excessive water extraction for irrigation uses that led to a salinization of the groundwater, which in turn led to an increase in the desertification process.

The numerous experimental interventions carried out with the aim of protecting dunes and coastal habitats from marine erosion are proving to be effective, but they need to be continually strengthened and integrated with further types of intervention to restore and maintain a correct balance of the sea-beach-dune system, as well as habitat protection interventions are not yet sufficient to contain the proliferation of alien plant and animal species that causes habitat loss.

An important confirmation of the correct selection of impacts included in the project, related to climate change, is derived from the analysis of data deriving from questionnaires administered to key players and stakeholders. The increase in coastal erosion, the increase in drought and the decrease in crop yield are in fact impacts that are already producing visible negative consequences also on the economic activities that operate in the Park.

If the increase of the drought is a particularly worrying impact for farmers in the area of the Park for the consequent loss of crop yield caused by climate change, the increase in coastal erosion with the gradual erosion of the string of dunes is a phenomenon that directly impacts on service operators for beach tourism. Tourism service associations and

cooperatives are mainly concerned with the gradual reduction of habitats as an inestimable loss for the Park's great biodiversity heritage.

In particular in the area of the Park, in addition to the impacts deriving from climate change, even the anthropic pressures on the habitats present have led over the years to particular "regressive" dynamics such as: the **reduction** of habitats by subtraction of areas for the purpose of carrying out works related to urbanization or agricultural use, the **alteration** of vegetation, determined by pedestrian transit and, even more, vehicular; the **simplification** of vegetation, with the intrusion of anthropic and often exotic species and with a removal of the present fauna, due to the proximity with the houses and roads; finally the **fragmentation** of natural areas.

For all the above considerations, the impacts of climate change selected as more relevant for the Regional Natural Park of the Coastal Dunes' pilot area are:

- ***Variation in crop yield***
- ***Increase of drought***
- ***Coastal erosion***
- ***Loss of habitat***

4.2 Summary and description of the decision-makers and stakeholders identified

The process of selecting Decision Makers and Stakeholders was based on the choice of public bodies, institutions, universities, cultural institutions, associations, companies that in the past have already had relations with the Park, know the territory and the protected area in question, have participated in sustainable development and land conservation projects.

The Decision Makers chosen are all those Public Bodies that have the capacity to implement policies centered on the project theme and give the go-ahead for the implementation of specific actions on the territory in question. Most of them have worked together for years in planning in the Coastal Dune Park and fully share the mission of the Park Authority, the predisposition and vocation of the territory to certain development plans with a view to the future.

Even the University has had in the past - and still has - a decisive role for the Park, as numerous collaborations and experimental projects have been carried out in the areas affected by this project, for monitoring coastal erosion and stretches of coastal dunes at high risk.

Similarly, for example, there have been other projects realized with L'A.R.I.F. on sections of dune and backwaters completely or partially compromised by erosion, through the planting of Mediterranean Maquis species useful for the nourishment of the stretch of eroded dune, or projects didactics aimed at focusing the attention of communities, tourists, associations or operators on the importance of the conservation of coastal and retrodunal habitats to preserve both the coastal area and the hinterland.

The selected Stakeholders belong to the large community of the Park and are economic operators, companies, trade associations or associations of ordinary citizens who put the Park's policies into practice, make them their own, share them with the bodies in question and benefit directly or indirectly from the effects of the resulting actions.

They have a decisive role in the implementation of the design ideas that start from the Decision Makers and are at the forefront in the operational implementation of conservation and development projects, becoming the guardians of the territory and the primary vehicle of choral vision based on sustainable growth and the protection of environment and habitats at risk.

#	Organization name / Media name	Contact name (if applicable)	Email address	Other
1	Comune di Ostuni	*Federico Ciraci*	federico.ciraci@comune.ostuni.br.it	*Decision Maker*
2	Comune di Fasano	*Donato Montanaro*	donatomontanaro@comune.fasano.br.it	*Decision Maker*
3	Parco Regionale Naturale delle Dune Costiere	*Direttore Gianfranco Ciola*	info@parcodunecostiere.org	*Decision Maker*
4	Regione Puglia: Dipartimento Agricoltura, Sviluppo rurale ed ambientale	*Cosimo Roberto Sallustio*	c.sallustio@regione.puglia.it	*Decision Maker*
5	Regione Puglia: Dipartimento Agricoltura, Sviluppo rurale ed ambientale	*Luigi Trotta*	l.trotta@regione.puglia.it	*Decision Maker*
6	Regione Puglia: Ufficio Demanio e Patrimonio		dre.pugliabasilicata@agenziademanio.it	*Decision Maker*
7	Regione Puglia: Dipartimento mobilità, Qualità urbana, Opere pubbliche, ecologia e paesaggio	*Direttore Barbara Valenzano*	dipartimento.mobilitaqualurboppubbpaesaggio@regione.puglia.it	*Stakeholder*
8	Università di Bari - Dipartimento di Scienze della Terra e Geoambientali	*Prof. Mastronuzzi Giuseppe*	giuseppeantonio.mastronuzzi@uniba.it	*Stakeholder*
9	Agenzia Regionale per la Protezione Ambientale - A.R.P.A.	*Nicola Ungaro*	ambienti.naturali@arpa.puglia.it	*Stakeholder*
10	Agenzia Regionale per le attività Irrigue e Forestali - A.R.I.F.	*Ennio Santoro*	santoro.ennio@gmail.com	*Stakeholder*
11	Autorità di Bacino - Puglia		protocollo@pec.autoritalgv.it	*Stakeholder*
12	Provincia di Brindisi - Settore Ambiente ed Ecologia	*Responsabile Dott. Pasquale Epifani*	pasquale.epifani@provincia.brindisi.it	*Stakeholder*
13	Capitaneria di Porto di Brindisi		cp-brindisi@pec.mit.gov.it	*Stakeholder*
14	GAL Alto Salento 2020		info@galaltosalento.it	*Stakeholder*

15	GAL Valle d'Itria	*Antonio Cardone*	info@galvalleditria.it	*Stakeholder*
16	Carabinieri Forestali Brindisi	*Ruggiero Capone*	ruggiero.capone@carabinieri.it	*Stakeholder*
17	Consorzio di Bonifica Arneo		areaamministrativa.arneo.nardo@pec.rupar.puglia.it	*Stakeholder*
18	Associazioni di protezione civile della Provincia di Brindisi	*Giannicola D'Amico*	gian.damic@libero.it	*Stakeholder*
19	Confederazione Italiana Agricoltori CIA	*Giannicola D'Amico*	g.damico@cia.it	*Stakeholder*
20	Federazione Regionale Coldiretti Puglia	*Filippo de Miccolis Angelini*	filippo.demiccolis@coldiretti.it	*Stakeholder*
21	WWF	*Gianni Grassi*	trulliegravine@wwf.it	*Stakeholder*
22	Legambiente Puglia	*Francesco Tarantini*	legambientepugliaonlus@gmail.com	*Stakeholder*
23	Associazione DunAmare	*Eliseo Gallo*	associazionedunamare@gmail.com	*Stakeholder*
24	Masseria Il Frantoio	*Armando Balestrazzi*	prenota@masseriailfrantoio.it	*Stakeholder*
25	Olerè	*Carmela Riccardi*	masseriaolere@gmail.com	*Stakeholder*
26	Azienda agricola Martucci	*Angela Maria Melpignano*	m.martucci@ostunipalace.com	*Stakeholder*
27	Masseria Brancati	*Corrado Rodio*	info@masseriabrancati.com	*Stakeholder*
28	Pastificio Cardone	*Enzo Cardone*	pastificiocardone@libero.it	*Stakeholder*
29	A.S.D. Centro Sportivo Parco di Mare	*Quirico Santoro*	parcodimare@libero.it	*Stakeholder*
30	Azienda Apistica Alveare Bianco	*Maria Donnaloia*	mariadonnaloia90@gmail.com	*Stakeholder*
31	Lido Morelli	*Gianfranco Gallo*	GGIANFRANCO81@GMAIL.COM	*Stakeholder*
32	Lido Kipos	*Oronzo Blonda*	enblo@hotmail.it	*Stakeholder*
33	Lido Bosco Verde	*Giuseppe Rubino*	lidoboscoverde@gmail.com	*Stakeholder*
34	Villaggio Turistico Oasi Le Dune	*Brigida Calamo*	info@villaggioledune.com	*Stakeholder*
35	Lido Onda Blu	*Pasqua Gallo*	pasquagallo69@gmail.com	*Stakeholder*
36	Lido El Cohiba	*Antonia Gallo*	elcohibaostuni@gmail.com	*Stakeholder*
37	Lido Bizzarro	*Giuseppe Laghezza*	info@lidobizzarro.it	*Stakeholder*
38	Lido Tavernese	*Nicola Leone*	nicola.leone90@libero.it	*Stakeholder*
39	Lido Stella	*Cesare Cecere*	cesarececere@gmail.com	*Stakeholder*
40	Cooperativa Solequo	*Antonio Capriglia*	biosolequocoop@gmail.com	*Stakeholder*
41	CIHEAM Bari	*Lamberto Lamberti*	lamberti@iamb.it	*Stakeholder*

42	Dottorando Geologia - Università di Bari	Cosimo Gagnazzo	cagnazzocosimo@libero.it	*Stakeholder*
43	Aeronatutica militare - Sezione Meteo	Nicola Semeraro	nicolasemerarometeo@libero.it	*Stakeholder*
44	Hotel Canne Bianche	Silvia Lacitignola	amministrazione@cannebianche.com	*Stakeholder*
45	Cooperativa Serapia	Pietro Chiatante	info@cooperativaserapia.it	*Stakeholder*
46	Associazione di radioamatori volontari di Protezione Civile	ERA sezione Provinciale Brindisi	erabrindisi@libero.it	*Stakeholder*

Table 3: Decision-makers and stakeholders identified.

4.3 Results of the interviews

In order to have a clear vision of what is the governance system for each project area, it has been proposed an interview module that each PP spread through its network.

Hazards, macro-areas and specific impacts have been organized in the format of a questionnaire. The questionnaire has been than submitted to local experts for each pilot areas. The local experts have been asked to complete the questionnaire indicating which hazard and (no more than 4) impacts are more relevant for their territories, also linking each selected impact to the most relevant hazards.

In the Fac-Simile reported below there are the main questions posed to the interview:

1. Sei tu – o la tua organizzazione – consapevole degli impatti del cambiamento climatico nel tuo territorio?

☐ SI

☐ NO

Se SI, che livello di conoscenza reputi di avere?

☐ SCARSA

☐ MEDIA

☐ BUONA

☐ ECCELLENTE

2. Ritieni che il tuo territorio sia – o sarà – soggetto ad impatti legati al cambiamento climatico?

☐ SI

☐ NO

Se SI, in quale modo? (risposta aperta)

.....

.....

.....

Se NO, Perchè?

.....

.....

.....

3. Ritieni che il cambiamento climatico possa avere effetti negativi anche nel tuo contesto lavorativo?

☐ SI

☐ NO

Se SI, in quale modo? Si prega di spiegare quale tipologia di impatto, e a che livello di importanza:

.....

.....

.....

4. Pensi che la tua attività possa in qualche modo mitigare il cambiamento climatico (riduzione gas climalteranti) e/o aumentare la capacità di adattamento agli effetti dei cambiamenti climatici?

☐ SI

☐ NO

Se SI, Si prega di spiegare in quale modo o attraverso quali attività:

.....

.....

.....

5. La tua organizzazione / attività possiede specifiche risorse o strumenti dedicati ad affrontare il Cambiamento Climatico?

☐ SI

☐ NO

Se SI, si prega di spiegare quali sono:

.....

.....

.....

Se NO, ritieni che alcuni strumenti / risorse sarebbero utili alla tua attività / organizzazione?

.....

.....

.....

6. Lavori/collabori con altre realtà sulle tematiche del cambiamento climatico?

☐ SI

☐ NO

Se SI, con quali?

.....

.....

.....

Se NO, Ritieni sarebbe utile lavorare/collaborare con altre realtà? Quali?

.....

.....

.....

7.Vorresti essere coinvolto in attività / incontri sul tema Cambiamento Climatico?

☐ SI

☐ NO

Se SI, come vorresti essere coinvolto?

ECONOMICO

☐ COSTI DI IMPLEMENTAZIONE (€)
☐ COSTI DI GESTIONE (€)
☐ RICAVI (€)
☐ DISTRIBUZIONE RICAVI (n. di soggetti coinvolti)
☐ AZIENDE SUPPORTATE (n. di aziende)
☐ NUOVE AZIENDE (n. di aziende)
☐ COLTURE TRADIZIONALI (ton/ANNO)

LEGALE, ISTITUZIONALE E PERCETTIVO

☐ FATTIBILITÀ LEGALE (bassa-medio-alta)
☐ AUTORIZZAZIONI RICHIESTE (numero di permessi)
☐ TEMPISTICHE PROCEDURALI (giorni)
☐ TEMPO DI IMPLEMENTAZIONE (giorni)
☐ ACCETTABILITÀ SOCIALE (bassa-media-alta)
☐ ACCETTABILITÀ POLITICA (bassa-media-alta)

4. Vuoi aggiungere altri importanti indicatori che ritieni mancanti dall'elenco sopra? Se sì, quali?

1. Si prega di ordinare I seguenti impatti dal più (1) al meno (4) importante dal tuo punto di vista:

☐ aumento dell'erosione (in particolare della fascia costiera)
☐ variazione nella resa delle colture
☐ aumento della siccità
☐ perdita di habitat

Perchè?

.....

.....

.....

2. Quale tipo di indicatore ritieni sia più rilevante per comprendere se le azioni di adattamento al cambiamento climatico che saranno implementate saranno utili?

☐ AMBIENTALE
☐ SOCIALE
☐ ECONOMICO
☐ LEGALE, ISTITUZIONALE E PERCETTUALE

si prega di dettagliare la risposta scelta:

.....

.....

.....

3.Si prega di selezionare 3 indicatori per ogni categoria e ordinarli dal più (1) al meno importante (3):

AMBIENTALE

☐ ESTENSIONE DELL'EROSIONE COSTIERA (m^2)
☐ SUOLO AFFETTO DA SICCITÀ (m^2)
☐ TASSO DI IMPERMEABILIZZAZIONE DEL SUOLO (m^2)
☐ AREE SOGGETTE AD ESONDAZIONE (m^2)
☐ RACCOLTA ACQUA PIVANA (m^3/year)
☐ RIUTILIZZO DELLE ACQUE (m^3/year)
☐ CONSUMO IDRICO
☐ CONSERVAZIONE DEGLI HABITAT NATURALI (m^2)
☐ RIDUZIONE DELL'EFFETTO "ISOLA DI CALORE URBANO" (C°)
☐ RIDUZIONE DEL CONSUMO ENERGETICO (%)

SOCIALE

☐ POPOLAZIONE BENEFICIARIA DI AZIONI (numero di persone)
☐ POPOLAZIONE MAGGIORMENTE VULNERABILE CHE BENEFICERÀ DELLE AZIONI (numero di persone)
☐ NUOVI POSTI DI LAVORO GENERATI DALLE AZIONI (numero)
☐ INFRASTRUTTURE MIGLIORATE (km)
☐ NUOVE INFRASTRUTTURE (km)

The document has been divided into two parts, the one dedicated to the stakeholders and the other to the decision makers. The differences between the questions posed to the one category and the other are related to the need of identifying the field of interest of each subject and in which way it is linked to the others.

Moreover, the interviewees were asked to describe also their inner resources and the main hazard/impact that they consider to be related to their activity.

The output of the process is the maps reported below, where are proposed the different hierarchy of governance. The governance map is used to describe the hierarchy of the governance system of each territory, and it is used inside this assessment to identify the decisionmakers and the stakeholders who have been asked to answer the questionnaires.

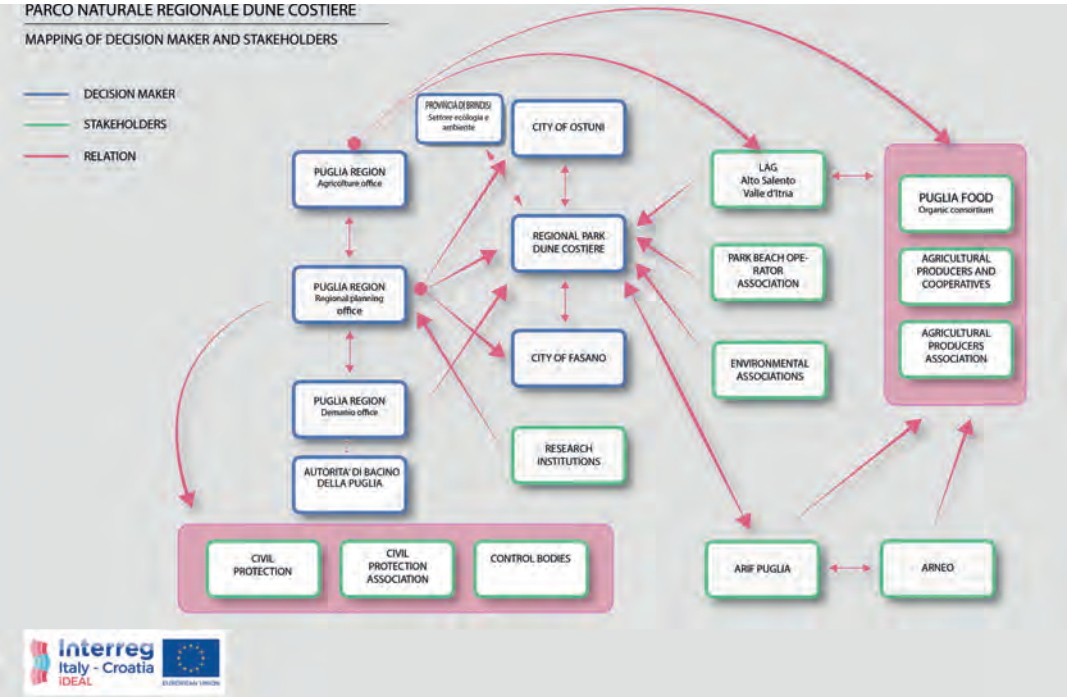
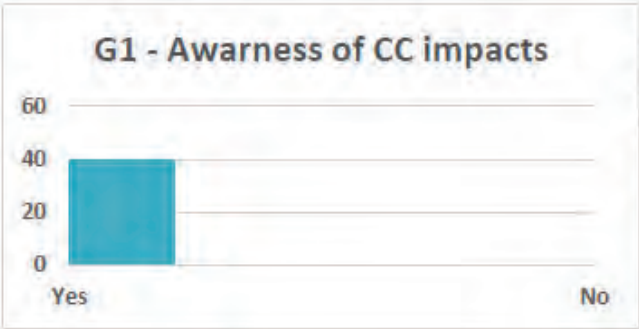
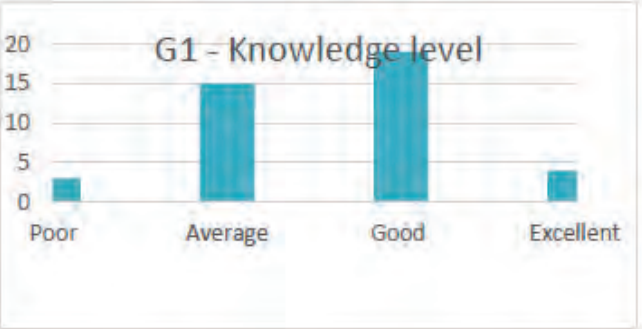


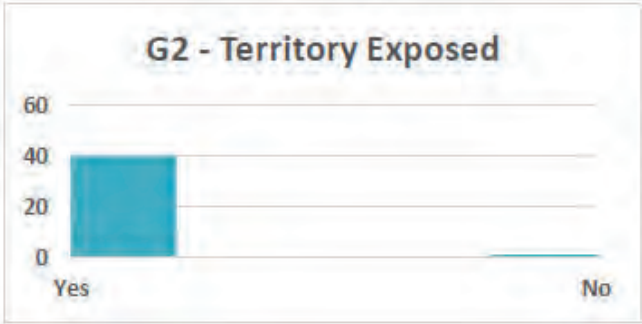
Fig. 5: Mapping of decision makers and stakeholders

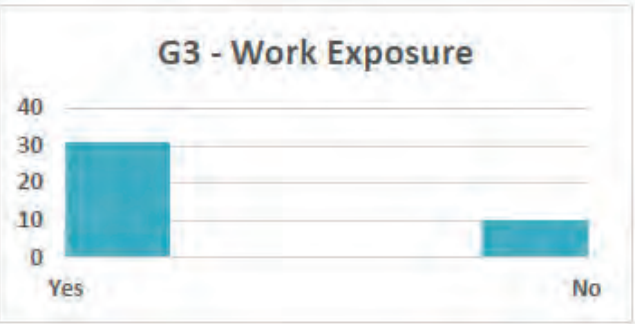
In the Regional Natural Park of Coastal Dunes, from the answers to the surveys provided by a total of 35 stakeholders and 6 decision makers, it appears that the totality, not only of decision makers but also of stakeholders, is aware of the impacts on their territory due to climate change and has a good knowledge of the dynamics in progress.



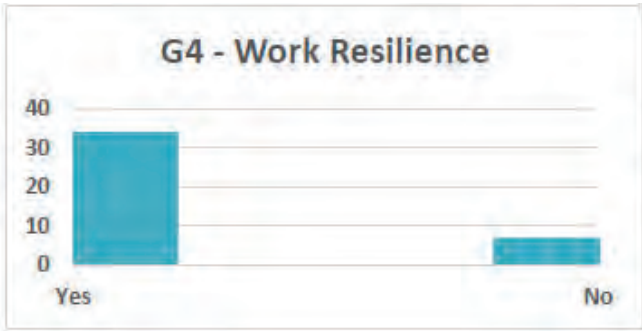


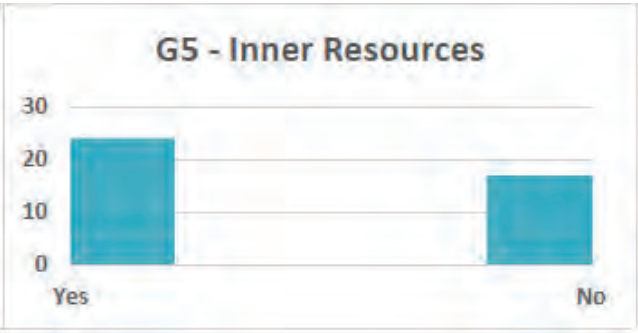
Furthermore, all the interviewees believe that the Park territory is already exposed to the effects of climate change through coastal erosion, the increase in anomalous meteorological phenomena and the increase in soil drought, which in most cases have direct negative effects also on their own economic activities, whether they are agricultural or seaside tourism services.



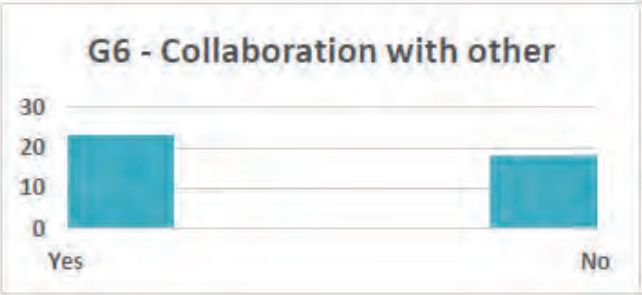


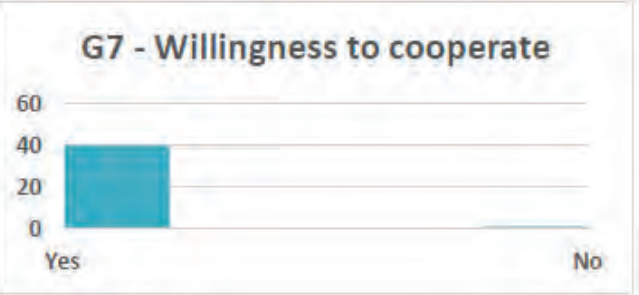
Among the interviewees, there is also a good awareness that their activity can contribute to the mitigation of climate change or that at least specific practices can be adopted so that the activity itself can increase its ability to adapt to climate change. Many of the stakeholders are already starting to implement actions and to equip themselves with tools to deal with the effects of climate change.



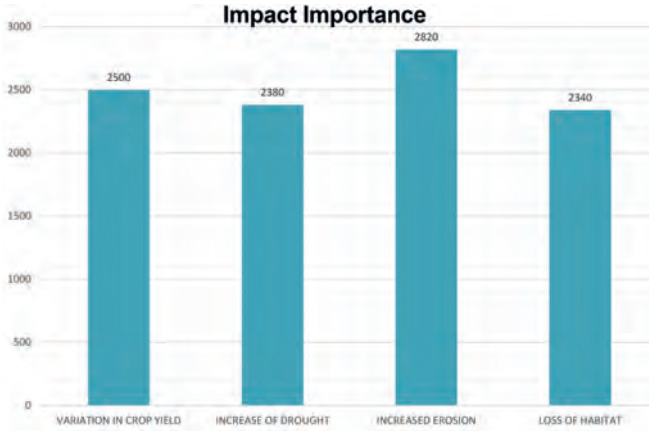


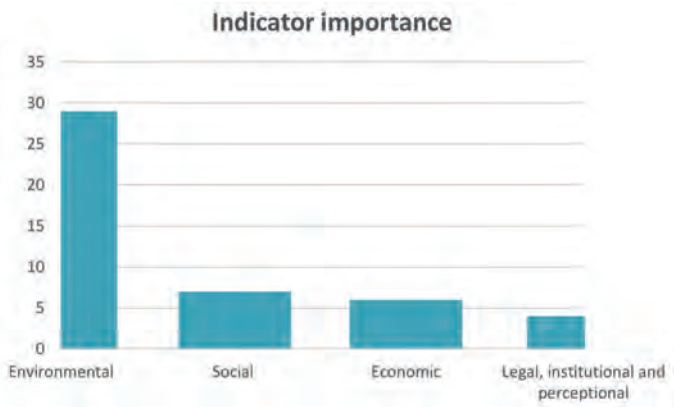
Almost all the interviewees understand the need to activate collaborations with the other actors of the territory to face the problems linked to the CCs, and in fact, many of them already do so thanks to the Coastal Dune Park, which carries out a considerable territorial animation and action.





As highlighted in deliverable 4.1.2 “A report on selected indicators”, for the stakeholders interviewed, the selected impacts all have great relevance, almost equivalent. In particular the "increased erosion" and the "crop variation", but also "increased drought" and "habitat loss".





Among the indicators, environmental ones are of fundamental importance to understand if the actions for the climate change adaptation implemented will be useful. The social and economic aspect are important too, but they are strictly dependent on environmental ones.

5. METHODOLOGY

5.1 Methodology and the data sheets

Based on the results from the first round of climate change impacts identification, the methodology of data selection and collection activities were initiated. All Project Partners (PPs) were asked to provide data and information that were considered necessary in order to proceed with the development of the risk and vulnerability assessment.

Data and information requested were specific for each areas and they were a consequence of the impacts identified. Data requested to each partner, which can be found in ANNEX III, vary from climate data (e.g. historical series of precipitation and temperature), to cartographic data to be used in GIS environment (e.g. shape files of buildings,

transport networks, land use, hydrology, etc…). The vulnerability and risk assessment are meant to be based on a GIS environment in which vulnerability and risk are geographically spatialised and visible in a set of maps. However, this is not possible for those impacts that are not possible to link to specific geographic areas.

The bulk of data and information that were initially considered useful for the analysis and that were therefore requested to the PPs were:

- DSM (Digital Surface Model) and/or
- DTM (Digital Terrain Model) (raster)
- Land Cover (.SHP)
- Land Use (.SHP)
- Protected Areas, ZPS, SIC (.SHP)
- Soil Type and geological map (.SHP)
- Administrative unit boundaries (.SHP)
- Population census data (.SHP, DATA)
- Buildings and infrastructures (street and railway, etc.) (.SHP)
- Slow mobility network
- Hydrology map (.SHP)
- Beach Nourishment Plan (.SHP, DATA)
- Cadastral data (commercial tourism activities, residential etc.) (.SHP)
- Cultural and Natural Heritage
- Tourist numbers data
- Tourist infrastructures and buildings (.SHP)
- Water consumption by sector (as detailed as possible)
- Energy Performance Certificate for Building
- Agriculture typology map
- Daily Precipitation and temperature data 1990 – 2017

Slight differences about the data requested can be found between partners, see ANNEX III for more details.

After this phase of data selection and collection some first challenges emerged particularly in the case of the Croatian pilot areas. In some cases, data required were not available in GIS file format or they were not available at all. The impacts that would be possible to analyze were then reconsidered and discussed with PPs.

In the case of the pilot area of the Park of Coastal Dune, the impacts analyzed to determine the vulnerability of the territory have been the “Variation in crop yield”, the “Increase of drought”, the “Increased coastal erosion” and the “Loss of habitat”.

5.2 Indicators for action evaluation (DSS)

From the indicators presented in the project TERRE, 25 of them were selected to describe the territories and the necessities of each Project Partner. Maintaining the same "aspects" described in the previous deliverable, here are reported the unity of measurement and the indicators chosen after the meeting that took place in Ostuni /Pesaro) on the projects meeting. The evaluation of each indicator was made in relationship with the four tailored impacts selected by each PP.

Thus, through the inteviews proposed to the stakeholders and the decisionmakers, a further weighing has been made with the purpose to adjust the DSS. This elaboration will allow the project partner to use their tailored decision support system to analyze the validity - and the performances - of the adaptation measures that they would use to cope with the climate change effects.

Aspect	Indicator	Unit of measurement
A. Environmental	Soil coastal erosion	m2
	Soil drought	m2
	Impermeability ratio	m2
	Flooding area	m2
	Collected rain water	m3/year
	Reused water	m3/year
	Water consumption	m3/year
	Habitat maintenance	m2
	Uhi reduction	c°
	Energy use reduction	%
B. Social	People who will benefit from the actions n. Of people)	n. Of people
	Most vulnerable people who will benefit from the actions	n. Of people
	New job created by the actions	n. Of job
	Km - upgraded infrastructure	km
	New infrastructure	km
C. Economic	Implementation cost	€
	Management cost	€
	Revenues	€
	Revenues distribution	n. Of actors
	Enterprises supported	n. Of enterprises
	New enterprises	n. Of enterprises
	Traditional crops	ton/year
D. Legal, institutional and perceptional	Legal feasibility	low-medium-high
	Required permits	n. Of permits
	Procedural time	days
	Life time	days
	Peple acceptability	low-medium-high
	Political acceptability	low-medium-high

This set of indicators is connected to the set of impacts that each partner has identify. Below are proposed the four group of impacts selected for each of the partner.

Partner	Impact Importance			
Irena	Increased competition for water	Increased energy demand for cooling	Coastal flooding	Damage to coastal human infrastructures
Dune	Increased erosion	Increase of drought	Variation in crop yield	Loss of habitat
Dura	Increased erosion	Increased energy demand for cooling	Impact on tourism sector	Impact on trasportantion network
Pesaro	Increased erosion	Increased energy demand for cooling	Impacts on tourism sector	Impacts on energy infrastructure
Misano adriatico	Increased erosion	Increased energy demand for cooling	Impact on tourism sector	Impact on trasportantion network

A planning process to be effective and adherent to the needs of a territory, cannot disregard the involvement of all the local actors involved without however the institutional bodies delegating its decision-making function.

Therefore, the selection of the indicators and the weighting of the objectives and criteria for the action evaluation trough the DSS was determined by the institutional representatives of the Regional Natural Park “Coastal dunes” as decision-making bodies, but based on the results of the involvement phase of the key players and of the stakeholders reported in the "Summary of assessment".

The priority institutional objective of the Coastal Dune Park is the protection of habitats present and the conservation of their biodiversity. Therefore in the weighting of the objectives of the Plan for adapting to climate change, it was decided to assign a greater weight (0.4) to the “Environmental aspect” objective, as well as to consider as a priority the interventions to be carried out, in the vulnerable areas to the effects of climate change, assigning a significant weight (0.2) also to the “Adaptation, Mitigation and Resilience” objective.

A similar importance (0.2) was also given to the objective "Legal, institutional and perceptional aspects", because the management strategy of the Park since its establishment to date has been precisely based on the importance of implementing actions and interventions that were of immediate implementation and that they could count on wide sharing with all the actors who live and/or operate in the Park area; a strategy that has led over time to the construction of a "Park community" aware of the importance of working in concert with the Park institution for the protection of habitats and biodiversity.

As also effectively reported in the stakeholders surveys, in the context of the Coastal Dune Park, the social and economic aspects, are perceived as secondary aspects that derive from an effective conservation of biodiversity and agro-biodiversity present, and therefore a lower weight (0.1) was assigned to the "Social aspect" and "Economic aspect" objectives.

Similar considerations were the basis of the weighting of the criteria.

Within the objective "Environmental aspect", a greater weight was given to the conservation of habitats (0.4) as an element of priority importance also capable of performing a resilient function with respect to the increase in coastal erosion (0.3) and soil drought (0.3).

Within the objective "Legal, institutional and perceptional aspects" instead, considering the "park community" as an important element for management, a slightly greater weight (0.7) was assigned to the "People Acceptability" criterion, while a lower weight (0.3) to the "Procedural time" criterion.

As regards the criteria of the "Social aspect" objective, the criterion "New job created by the actions" (0.8) with respect to the "New infrastructure" criterion (0.2) was considered a priority, while for the objective criteria "Economic aspect" the "Enterprise supported" criterion assumes, as also perceived by the stakeholders involved, a greater importance (0.6) compared to the "Implementation cost" criterion (0.4).

With regard to the “Adaptation, Mitigation and Resilience” objective, to calculate if the target of the Action is a vulnerable area exposed to Climate Change Impacts, the data present in the “vulnerability assessment” have been considered by averaging the values reported for the individual cells or transects affected by the specific action and concerning the impacts that each action intends to mitigate, and then evaluating whether the average of the area of intervention was greater or less than the average of the values concerning the entire area of the Coastal Dune Park.

6. ACTIONS

6.1 Development of actions packages

Concerning to the definition of the package of actions to be included in the “Adaptation Plan to Climate Change of the Park”, the criticality analyses, the general and specific objectives of various studies and the sector plans were considered, in particular these of the Park Territorial Plan and the Plan of management of the SIC area "Litorale brindisino".

To define the types of actions to be undertaken for the mitigation of the identified impacts, in addition to the critical points, also the good practices carried out in other territorial contexts that present the same problems of the Park were considered.

As regards the identification of the areas of the Park where the actions will be implemented, the risk analyzes present in the various planning tools were taken into account, favoring the areas of highest vulnerability, and feasibility both in technical-economic terms and in terms of social and political acceptability.

Below the analysis of the critical issues and the link with the actions proposed within this Plan:

<u>The agro-forestry aspects</u>

The main dynamic recorded within the protected area consists in the diffusion, in the last few years, of new plantation intensive olive groves in substitution of arable and non-arable arable land areas, or for the thickening of pre-existing secular olive groves, as well as in the spread of crops vegetables to replace pastures and arable land. Intensive olive groves, in addition to significantly changing the traditional coastal landscape, determine a greater environmental impact depending on the need for greater external resorces, in particular water, factor that is a criticality even in the spread of horticultural crops.

The elimination of arable land areas implies, among other things, the reduction of an important trophic area for numerous animal species, in particular birdlife. The expansion of cultivable areas and plowing often involves the removal of hedges and spots, investing de fact with the use of mechanical means the habitats of community interest. The diffusion instead of aridoculture techniques, with the use also of ancient varieties, would instead allow to limit the consumption of water resources in agriculture and consequently the processes of salinization of the aquifers caused by excessive pumping, thus facing the increase in drought and at the same time also allowing an increase in the area's agro-biodiversity.

The naturalistic aspects

The territory of the park is characterized by different environments of significant wildlife interest. The retrodunal ponds as well as the seasonal swamp that is created around them, thanks to the strategic position on the main migration routes of the western Palearctic, and due to the fact of being one of the last remnants of the extended Salentine dune retreats, represent a fundamental point of refuge, rest, transit and feeding of many aquatic and limestone bird species.

In the summer period, given the karst nature of the places, it acts as the only source of fresh water for all the species of wild fauna of the area. The blade above all in the most wooded area represent ideal wintering area for the different species of turdidae that many come in the autumn-winter period, mainly playing the role of dormitory shelter in the daily commute towards the olive groves for pasture.

Thanks to the numerous cavities present in the rocky walls, moreover, they become nesting centers for the different species of nocturnal birds of prey as well as the different specimens of foxes, weasels and weasels that inhabit them undisturbed. The pseudo steppe and the arable land characterizing a large part of the internal surface of the park play the dual role of trophic resource and refuge for different species. The adoption of a river contract could allow not only an improvement in the management of water resources for agricultural purposes, but also an enhancement of ecological connections and a better protection of the habitats present.

Critical elements related to the geomorphology component

An element of certain criticality is the phenomenon of coastal erosion, which now characterizes the entire sandy coast within the Park area. The causes of erosive processes are attributable to natural phenomena as they depend on the current rise in the average sea level (marine transgression) which inevitably causes the progressive receding of the coastline. The progressive retreat of the coastline inevitably leads to the consequent retreat and / or progressive instability of the recently formed dune cordon. The state of preservation of the entire sandy coast that is part of the Park area is rather compromised also as a consequence of the anthropic impact.

A reduction of the anthropic impacts on the Oceanic Posidonia and restoration actions of the habitat, besides allowing to mitigate the reduction processes of a habitat considered a priority, would allow a greater effectiveness of the prairie in carrying out a defensive action and protection of the coastline against hydrodynamism and the phenomenon of coastal erosion thanks to the damping action of the leaf apparatus capable of restraining the wave motion. To these types of action, it would be necessary to associate actions to restore and defend the cordon dune at the points of

greatest erosion, as well as constant monitoring of the coast to assess the dynamics in progress and the results of the actions taken.

Surface hydrography

The surface hydrography of the Park area, as well as that of the entire territorial context within which it is inserted, is practically non-existent (except for wetlands of the retrodunes that have a water hole origin) due to the ability of absorbing of the soil and of the karst nature of the rocky substrate. However, although there are no perennial streams, the Park area is characterized by the presence of several erosive blade (lama) which ensure the outflow of surface waters to the sea during the most intense meteorological events.

The erosive furrows, generally with a flat bottom and moderately inclined banks, develop along the SO-NE line. The Hydrogeological Structure Plan (PAI) of the Puglia region has determined the perimeter in all the regional territory of areas with different hydraulic danger. In particular, the entire territorial surface of the Park is affected by numerous areas of "High Hydraulic Hazard" i.e. areas where the probability of the floods risk is high.

The first of these areas, for extension, are certainly the highly dangerous areas identified respectively at the source of the Fiume Grande, in the locality of Torre Canne, and the area to the south-east of the Fiume Piccolo source; other areas of high, medium and low risk, are located in correspondence with the sections of the Lamacornola, the Rosamarina and the Pilone, as well as that identified immediately south-west of Torre S. Leonardo.

Most of the areas of possible criticality have been identified within the valley sections of the hydraulic basins, where the surface water load is poured into the sea; the level of criticality depends both on the natural characteristics of the local hydrogeomorphological system (frequent presence of flood areas along the coast), and on the inadequacy of the hydrographic network caused by the level of urbanization.

The above must necessarily be assessed in relation to the considerable anthropic load of the coastal areas and that possibly will derive from future Park usability needs: the blade, in fact, once the problems of hydraulic hazard have been solved through a correct management that involves all the stakeholder through voluntary agreements such as the "river contracts", could constitute a very important element of linear connection both in terms of ecological defragmentation and in terms of usability of the natural, geological and historical archaeological resources that characterize them.

Underground hydrogeology

The aquifer is generally confined to the Mesozoic calcareous substrate; however, near the coastal strip the aquifer also circulates partly in the calcarenitic coverings. It is sustained by the sea water that invades the continent and has as its base level the average sea level; it circulates free, or slightly under pressure, due to the presence of limestone layers which, where compact and homogeneous, are little or not at all permeable or due to the presence of calcarenitic deposits, which are also very permeable.

The depth of the aquifer compared to the ground level varies from one area to another due to the structural heterogeneity of the carbonate aquifer; the piezometric levels at the park area are generally around 0.5 m immediately near the coast, while they show values of around 1.5-2.0 m at the Bari-Lecce railway line.

The movement dynamics of the aquifer at sea are manifested through the numerous emergencies, more or less evident along the entire coastal area (underwater and / or subaerial). The most obvious manifestations of the springs in the Park area are the Fiume Grande, Fiume Piccolo and Fiume Morello. The overall distribution of the salinity of the groundwater shows changes in the salt content as a function of the distance from the coast, presenting higher values near the same, where the degree of marine intrusion is evidently greater.

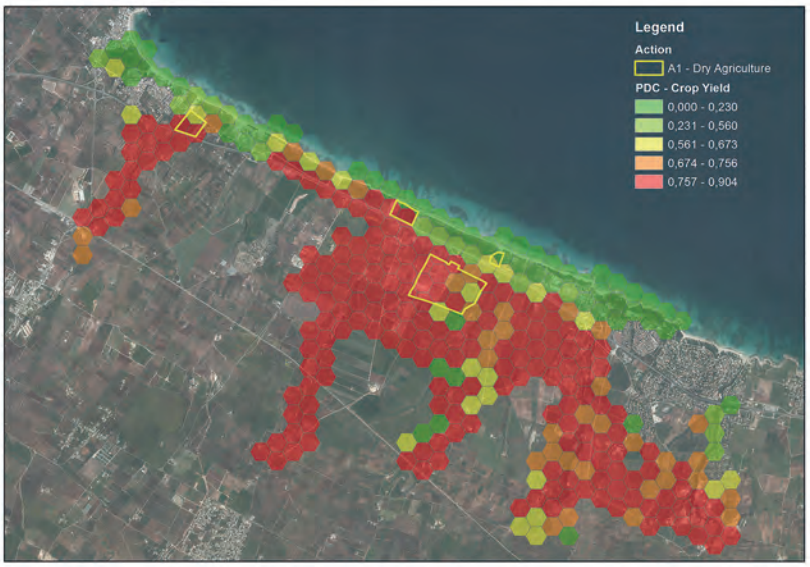
The major critical factors of the system are due to:

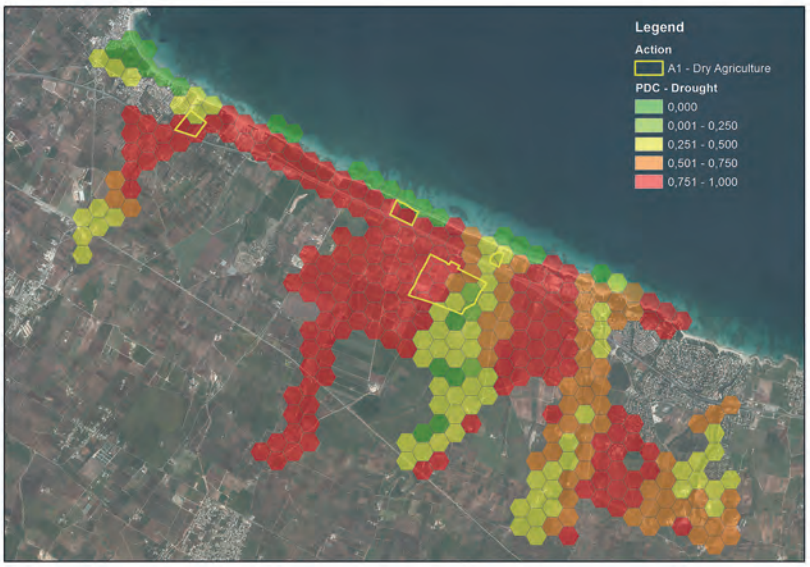
- Phenomena of salinization of the aquifer and of the springs due to marine intrusion processes and pumping procedures;
- Anthropic impact on the recent dunes (breaches-walkways) and consequent conditioning of the current ecological trim;
- Variations in the range of springs water in relation to climatic variations

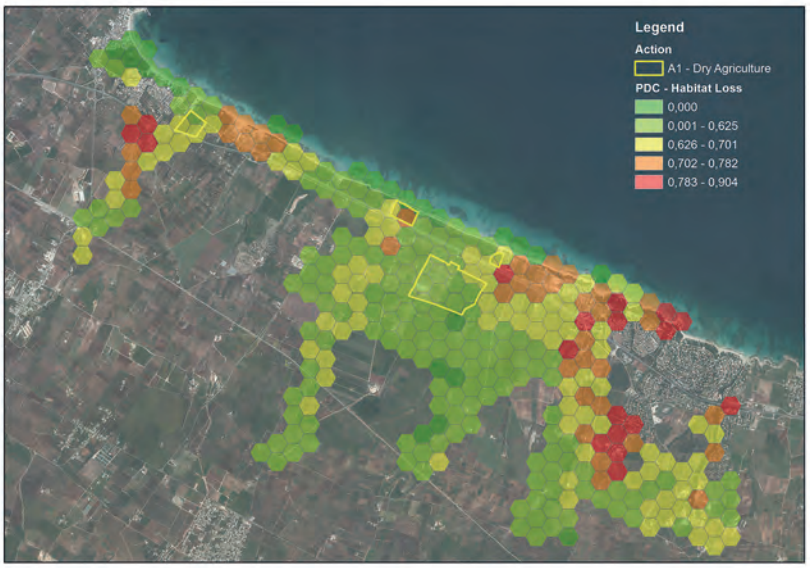
The diffusion of dry farming practices, the adoption of correct practices of water resource management through voluntary agreements, the reconstruction and defense of dunes cordon through naturalistic engineering techniques, alongside existing irrigation systems using purified and refined waste water, would allow the mitigation of the critical factors also of the underground hydrological system.

The actions developed following the needs arising both from the analysis of critical issues and from the results of the interviews with the stakeholders, and that will be evaluated through the Decision Support System for the "Adaptation Plan to Climate Change of the Park" are:

ACTION EVALUATION:n°1:

TITLE	*Dry Agriculture*	**ID HEXAGONS:**	*31,34,35,37,105,106,113,114,118,124,127,128,129; 138-141; 152-155; 164-166; 174,175,183,184*
GENERAL DESCRIPTION	*Demonstrate performances of management systems based on the integration of mitigation and adaptation measures to climate change in irrigated crops of the Mediterranean Basin.* *Establish a protocol that, based on the identified mitigation-adaptation strategies, allows technical recommendations for their adoption and monitoring of their implementation, also serving to verify the application of environmental measures and other programs related to climate change.* *Disseminate and transfer the acquired experience and management philosophy to other areas with similar circumstances, enhancing the communication channels between research, administration and farmers and technicians.*		
TECHNICAL INFORMATION	*Implementation, on a pilot scale, of a management system which brings together good agricultural practices that mitigate climate change and that favor the adaptation of the crop to its effects. For this, the use of two demonstration scenarios is contemplated, one to verify the mitigating and adaptive aptitude of the system under current climatic conditions (demonstration farm) and another to verify these aptitudes in future climatic conditions (demonstration trials in greenhouses).*		
KEYWORDS	*#Dry-farming, #Adapting crops, # extensive crops*		
LOCATION	*Address: Parco Dune Costiere* *Area: 1100 h* *Geographic coordinates: X:40.781354m; Y:17.515920m (WGS 84/UTM zone 33N)*		
MERGE WITH VULNERABILITIES			

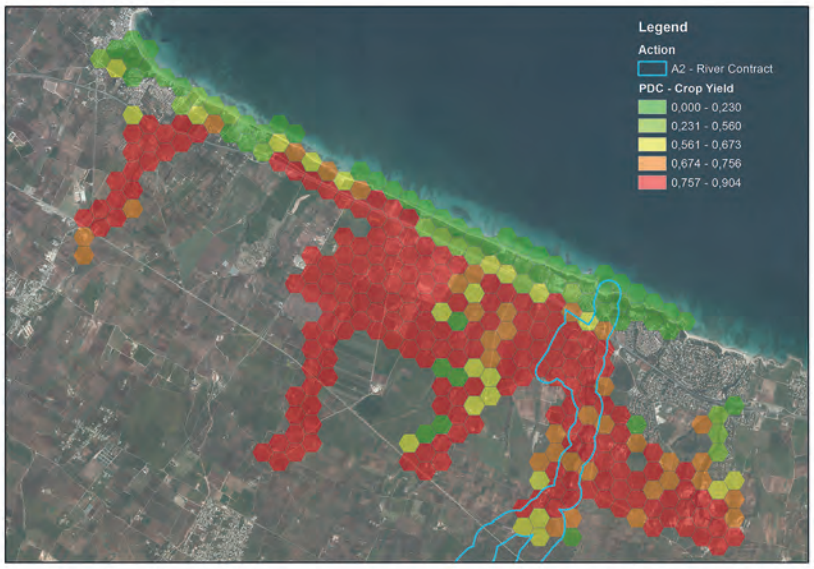


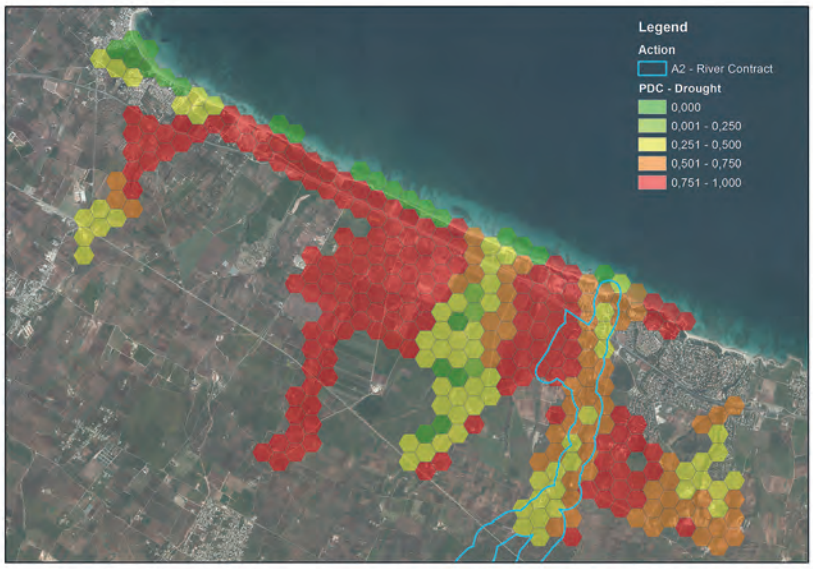


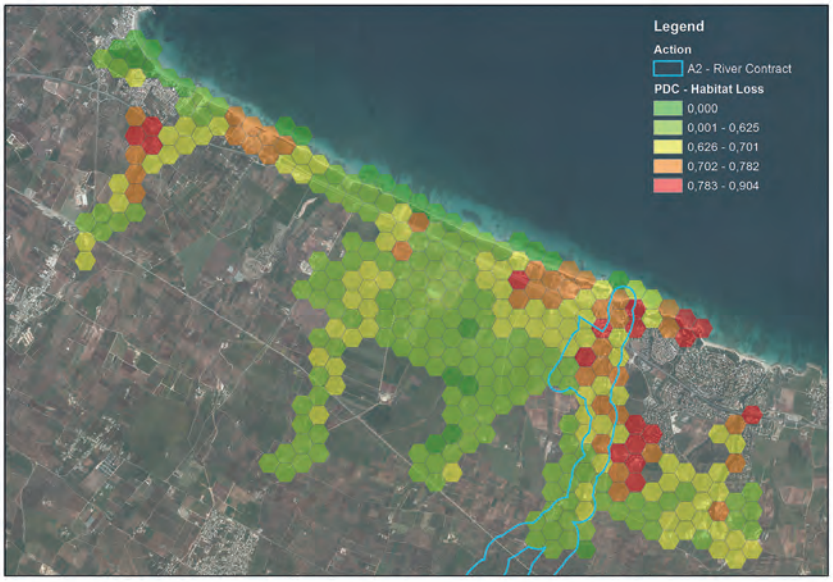
RELATED IMPACT THAT THE ACTION MITIGATES	*Variation in crop yeld*
PROJECT INITIATOR/PROMOTER	*Parco Dune Costiere*
STAKEHOLDERS INVOLVED	*CIA (Confederation of Italian farmers); Coldiretti; Public department of Agriculture*
BENEFICIARIES/TARGET GROUP	*Farmers*
TIME OF START/IMPLEMENTATION	*From 15/07/2019 to 01/04/2020*

INDICATORS OF EVALUATION	*Indicate the 6 to 10 indicators from the previous page with specific unit of measure and quantify the impact of the action (environmental, legal, institutional and perceptional, social, economic)*
A-ENVIRONMENTAL	~~1. *Soil coastal erosion*~~ 2. ***Soil drought*** 3. ***Habitat maintenance***
B-SOCIAL	~~4. *New job created by the actions*~~ ~~5. *New infrastructure*~~
C-ECONOMIC	6. ***Implementation cost*** 7. ***Enterprises supported*** 8. ***Traditional crops***
D- LEGAL, INSTITUTIONAL & PERCEPTIONAL	~~9. *Procedural time*~~ 10. ***People acceptability***

ACTION EVALUATION: n° 2:

TITLE	*River Contract*	**ID HEXAGONS:**	*199,200,206,207; 209-212; 216-219; 222-226; 229-263; 267-269*
GENERAL DESCRIPTION	*The "Contract" is set up as a voluntary agreement between all the public and private parties concerned, aimed at defining the objectives and strategies of intervention to be activated as well as establishing the mutual commitments and roles for its implementation.* *The objective is that to improve the overall ecological status of the river basin is integrated with the additional objectives of reducing hydrogeological risk, enhancing the value of water resources, and using the watercourse.*		
TECHNICAL INFORMATION	*The Action Plan is made up of various action lines to achieve the specific objectives on various scales:* *- Actions at river basin scale: actions to be implemented on a large area in order to improve the arrangement and organization of the territory.* *- Actions at scale of the hydrographic tract: interventions that, even if they can be carried out at the scale of the stretch, must be consistent with the planning and the actions implemented at the basin scale.* *- Actions on a specific scale: pilot actions of particular environmental value, to be implemented in the short or medium term.* *- Actions for the continuous monitoring of the state of implementation of the commitments made by the subscribers.*		
KEYWORDS	*#river, #participation, #governance*		
LOCATION	*Address: Parco Dune Costiere* *Area: 1100 h* *Geographic coordinates: X:40.781354m; Y:17.515920m (WGS 84/UTM zone 33N)*		
MERGE WITH VULNERABILITIES			

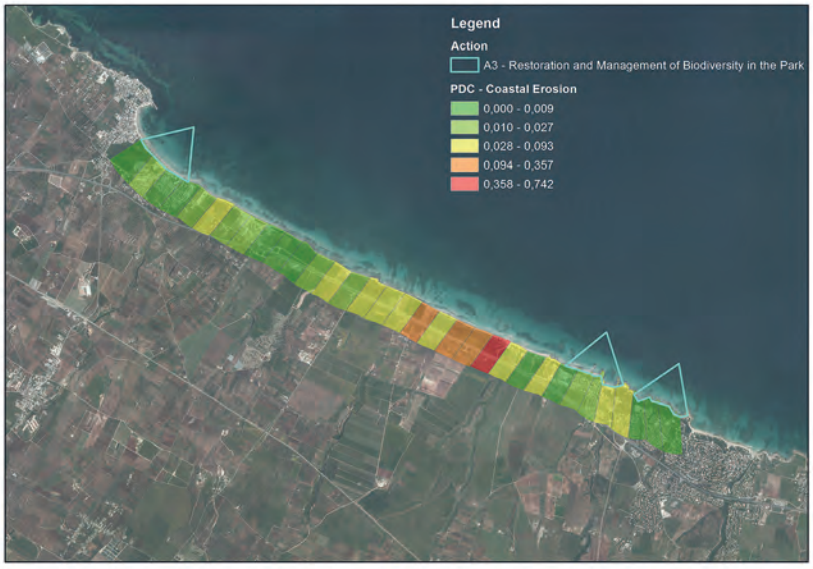




RELATED IMPACT THAT THE ACTION MITIGATES	*Increase of drought*
PROJECT INITIATOR/PROMOTER	*Parco Dune Costiere*
STAKEHOLDERS INVOLVED	*AdB Puglia (Basin authority); ARNEO (Reclamation consortium); ARIF (Regional Agency for irrigation and forestry activities); Municipality of Ostuni; CIA (Confederation of Italian farmers);*
BENEFICIARIES/TARGET GROUP	*farmers, citizens*
TIME OF START/IMPLEMENTATION	*Plan development: 2 years* *Contract signing: 3 years*

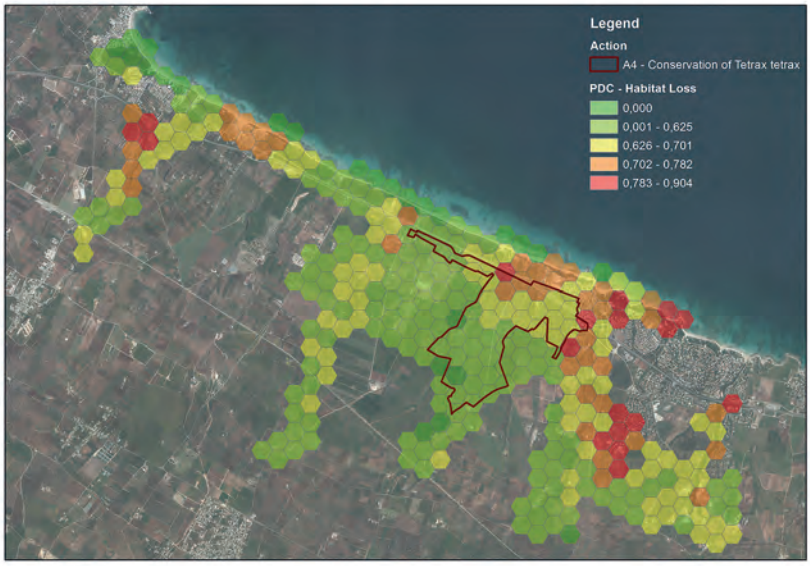
INDICATORS OF EVALUATION	*Indicate the 6 to 10 indicators from the previous page with specific unit of measure and quantify the impact of the action (environmental, legal, institutional and perceptional, social, economic)*
A-ENVIRONMENTAL	~~1. *Soil coastal erosion*~~ 2. ***Soil drought*** 3. ***Habitat maintenance***
B-SOCIAL	~~4. *New job created by the actions*~~ ~~5. *New infrastructure*~~
C-ECONOMIC	6. ***Implementation cost*** 7. ***Enterprises supported*** ~~8. *Traditional crops*~~
D- LEGAL, INSTITUTIONAL & PERCEPTIONAL	9. ***Procedural time*** 10. ***People acceptability***

ACTION EVALUATION: n° 3:

TITLE	*Restoration and Management of Biodiversity in the Park*	**ID TRANSECTS** **ID HEXAGONS**	*3-6; 28-36* *12,13,21,22,26,29,213,227,242,255, 267,268,276,277,283,290,291,296*
GENERAL DESCRIPTION	*The objective of the action is to develop and install an environmentally friendly anchoring systems (anchorages and simple signaling buoys) that can cancel or significantly reduce impacts on marine seagrass meadows caused by the anchorage of leisure boats, as well as by other minor causes (traffic, swimming and bathing, submersed garbage, diving...).*		
TECHNICAL INFORMATION	*The rationale for positioning criteria is to identify marine seagrasses distribution patterns or the presence of valuable elements (species, etc.) and the choice of areas totally or partially devoid of plant and other species. In summary, activities can be summarized as follows: site definition and installation, functionality controls (by the diver team during summer season) and winter recovery and storage of the mooring systems.*		
KEYWORDS	*#Posidonia, #protected area, #restoration measure*		
LOCATION	*Address: Parco Dune Costiere - Area: 1100 h* *Geographic coordinates: X:40.781354m; Y:17.515920m (WGS 84/UTM zone 33N)*		
MERGE WITH VULNERABILITIES			
RELATED IMPACT THAT THE ACTION MITIGATES	*Increased erosion*		
PROJECT INITIATOR/PROMOTER	*Parco Dune Costiere*		
STAKEHOLDERS INVOLVED	*CoNISMa (National university consortium for sea sciences), Municipality of Ostuni, Province of Brindisi*		
BENEFICIARIES/TARGET GROUP	*Tourism service operators,fishermen, citizens*		
TIME OF START/IMPLEMENTATION	*01/06/2019 to 01/06/2020*		

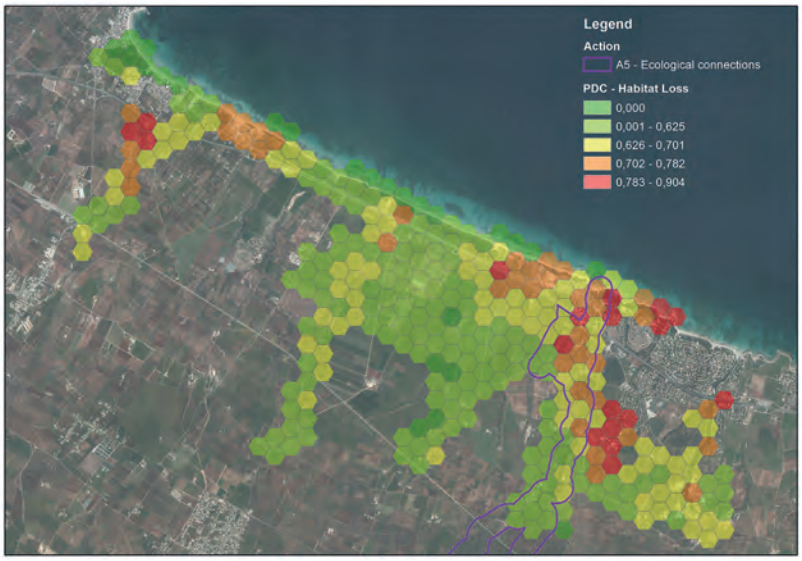
INDICATORS OF EVALUATION	*Indicate the 6 to 10 indicators from the previous page with specific unit of measure and quantify the impact of the action (environmental, legal, institutional and perceptional, social, economic)*
A-ENVIRONMENTAL	1. ***Soil coastal erosion*** ~~2. *Soil drought*~~ 3. ***Habitat maintenance***
B-SOCIAL	4. ***New job created by the actions*** 5. ~~*New infrastructure*~~
C-ECONOMIC	6. ***Implementation cost*** ~~7. *Enterprises supported*~~ ~~8. *Traditional crops*~~
D- LEGAL, INSTITUTIONAL & PERCEPTIONAL	9. ***Procedural time*** 10. ***People acceptability***

ACTION EVALUATION: n° 4:

TITLE	*Conservation of the last italianpeninsularpopulation of Tetraxtetrax*	**ID HEXAGONS**	*115,125,126,132,137,138; 142-146; 151,152; 155-160; 163-171; 174-181; 184-190; 193-196; 202-205; 214-218; 228-231; 243-245;*
GENERAL DESCRIPTION	*The pilot action will contribute to the realization of the conservation plan of a species that finds its optimal conditions in a determined natural habitat, such as that of the Pseudosteppa. To achieve the protection of habitat biodiversity it will be fundamental to guarantee favorable ecological conditions by mitigating the threat factors, through the drafting and implementation of a habitat conservation plan.*		
TECHNICAL INFORMATION	*Within the Park area the only areas left with these habitats, spared from plowing, fall within properties belonging to farms that practice sheep breeding in the wild. The pilot project will involve the activation of a series of concrete actions:* *- Encourage grazing in the wild which in turn supports the conservation of this habitat;* *- Activate a process of participation with local actors to define together with them and in particular the pastors of the Park area, the methods of rearing and pasture management;* *- Support the consumption of cheese produced with the milk of animals raised on pasture, through an appropriate communication, which highlights the importance of "yellow" milk rich in carotenoids obtained only from animals that feed on spontaneous grass and that are not fed with fodder or feed*		
KEYWORDS	*#Pseudosteppa, #habitat, #species*		
LOCATION	*Address: Parco Dune Costiere* *Area: 1100 h* *Geographic coordinates: X:40.781354m; Y:17.515920m (WGS 84/UTM zone 33N)*		
MERGE WITH VULNERABILITIES			
RELATED IMPACT THAT THE ACTION MITIGATES	*Loss of habitat*		

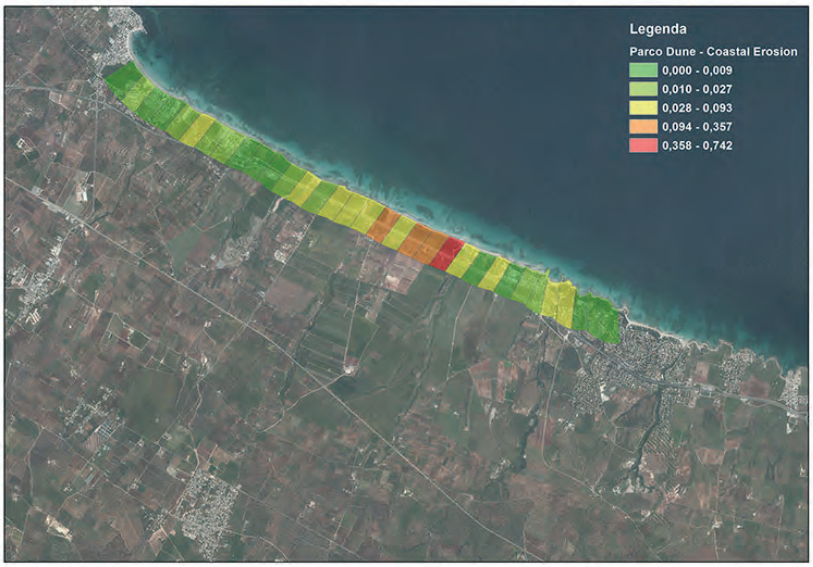
PROJECT INITIATOR/PROMOTER	*Parco Dune Costiere*
STAKEHOLDERS INVOLVED	*Farmers, ARIF (Regional Agency for irrigation and forestry activities), Municipality of Ostuni*
BENEFICIARIES/TARGET GROUP	*Farmers, Citizen*
TIME OF START/IMPLEMENTATION	*01/06/2019 to 01/06/2020*
INDICATORS OF EVALUATION	*Indicate the 6 to 10 indicators from the previous page with specific unit of measure and quantify the impact of the action (environmental, legal, institutional and perceptional, social, economic)*
A-ENVIRONMENTAL	1. ~~*Soil coastal erosion*~~ 2. ~~*Soil drought*~~ 3. ***Habitat maintenance***
B-SOCIAL	4. ***New job created by the actions*** 5. ~~*New infrastructure*~~
C-ECONOMIC	6. ***Implementation cost*** 7. ***Enterprises supported*** 8. ~~*Traditional crops*~~
D- LEGAL, INSTITUTIONAL & PERCEPTIONAL	9. ***Procedural time*** 10. ***People acceptability***

ACTION EVALUATION: n° 5

TITLE	*Ecological connections*	**ID HEXAGONS**	*199, 200, 206, 207; 209-212; 216-219; 222-226; 229-263; 267-269;*
GENERAL DESCRIPTION	*The main function of the ecological corridor is to allow the gradual passage between one habitat and another. The ecological corridors therefore have more functions, from the repopulation of certain species to the preservation of plants and territorial elements, otherwise at risk*		
TECHNICAL INFORMATION	*- To strengthen and restore the ecological connection function of the corridors, increasing their naturalness, to allow the movement of animal and plant populations within them;* *- Requalify degraded stretches through reconstructive interventions with methods and techniques of naturalistic engineering and landscape architecture;* *- Contrast the processes of fragmentation of the territory and the increase in the degree of ecological functionality and biodiversity*		
KEYWORDS	*#habitat #lama #biodiversity*		
LOCATION	*Address: Parco Dune Costiere - Area: 1100 h* *Geographic coordinates: X:40.781354m; Y:17.515920m (WGS 84/UTM zone 33N)*		
MERGE WITH VULNERABILITIES			
RELATED IMPACT THAT THE ACTION MITIGATES	*Loss of habitat*		
PROJECT INITIATOR/PROMOTER	*Municipality of Ostuni*		
STAKEHOLDERS INVOLVED	*Parco Dune Costiere, Province of Brindisi, ARIF (Regional Agency for irrigation and forestry activities), AdB Puglia (Puglia Basin Autority), ANAS (National Road Organization)*		
BENEFICIARIES/TARGET GROUP	*Citizen, economic operators of the area*		
TIME OF START/IMPLEMENTATION	*01/09/2019 to 01/09/2020*		

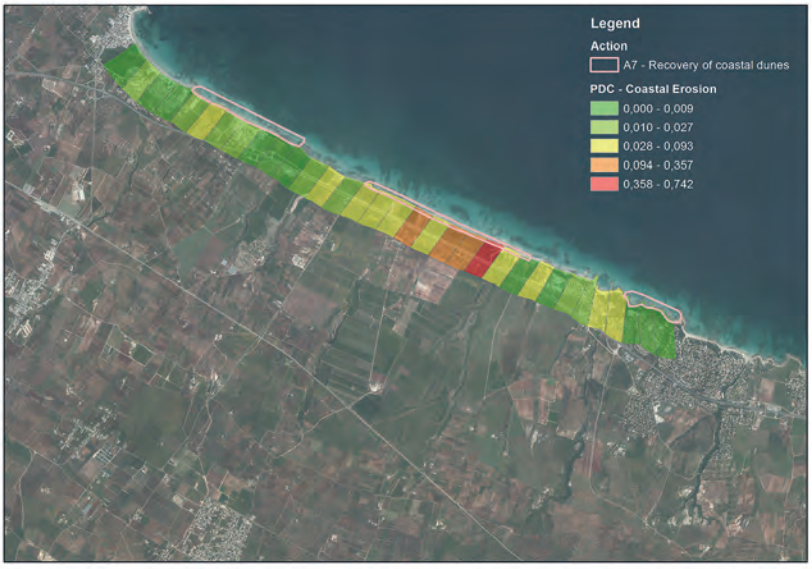
INDICATORS OF EVALUATION	*Indicate the 6 to 10 indicators from the previous page with specific unit of measure and quantify the impact of the action (environmental, legal, institutional and perceptional, social, economic)*
A-ENVIRONMENTAL	~~1. *Soil coastal erosion*~~ ~~2. *Soil drought*~~ 3. ***Habitat maintenance***
B-SOCIAL	~~4. *New job created by the actions*~~ 5. ***New infrastructure***
C-ECONOMIC	6. ***Implementation cost*** 7. ***Enterprises supported*** ~~8. *Traditional crops*~~
D- LEGAL, INSTITUTIONAL & PERCEPTIONAL	9. ***Procedural time*** 10. ***People acceptability***

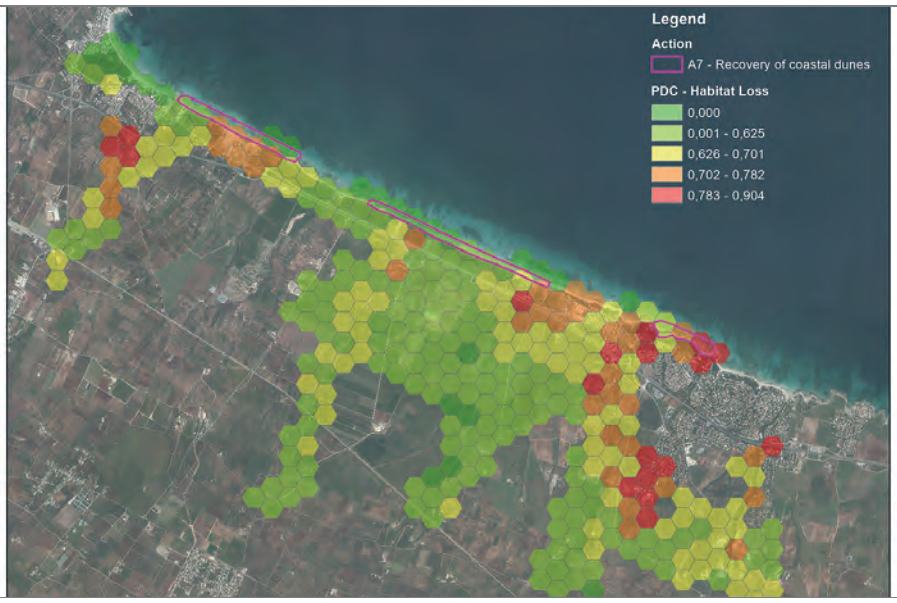
ACTION EVALUATION: n° 6

TITLE	*Coastal monitoring*	**ID TRANSECTS** **ID HEXAGONS**	*1-36*
GENERAL DESCRIPTION	*The action intends to monitor, through scientific studies in the field, the resilience capacity of the coastal habitat, through the detection of scientific data along the coast, on the dune system and in the retrodunale range.*		
TECHNICAL INFORMATION	*Stations for detecting temperature, winds and other physical parameters will be placed on the sand dunes and in several points of the park. This allows a detailed analysis of the effects of climate change along the coast. At the same time a biochemical analysis will be performed on the sand and any reactions to pollutants present in the atmosphere will be detected.*		
KEYWORDS	*#sand #dunes #sea*		
LOCATION	*Address: Parco Dune Costiere* *Area: 1100 h* *Geographic coordinates: X:40.781354m; Y:17.515920m (WGS 84/UTM zone 33N)*		
MERGE WITH VULNERABILITIES			
RELATED IMPACT THAT THE ACTION MITIGATES	*Coastal erosion*		
PROJECT INITIATOR/PROMOTER	*Geological department of Bari University*		
STAKEHOLDERS INVOLVED	*Parco Dune Costiere, Municipality of Ostuni, Municipality of Fasano, Universities*		
BENEFICIARIES/TARGET GROUP	*Citizen, economic operators of the area*		
TIME OF START/IMPLEMENTATION	*From 01/06/2019 to 01/06/2020*		
INDICATORS OF EVALUATION	*Indicate the 6 to 10 indicators from the previous page with specific unit of measure and quantify the impact of the action (environmental, legal, institutional and perceptional, social, economic)*		
A-ENVIRONMENTAL	1. ***Soil coastal erosion***		

	~~2. *Soil drought*~~ 3. ***Habitat maintenance***
B-SOCIAL	4. ***New job created by the actions*** ~~5. *New infrastructure*~~
C-ECONOMIC	6. ***Implementation cost*** ~~7. *Enterprises supported*~~ ~~8. *Traditional crops*~~
D- LEGAL, INSTITUTIONAL & PERCEPTIONAL	9. ***Procedural time*** 10. ***People acceptability***

ACTION EVALUATION: n° 7

TITLE	*Recovery of coastal dunes*	**ID TRANSECTS** **ID HEXAGONS**	*6-13; 17-26; 33,36 33-38;* *40,42,45,46,50,51,88,95,96,104,105,113,114, 125,136,150,162,173,182,183,191,192, 201,268,276,277,283,290,291,296*
GENERAL DESCRIPTION	*The action intends to protect dune habitats through an integrated series of interventions aimed at recovering and stabilizing the coastal dune system.* *Following specific detailed analysis on the morphological characteristics of the places and on the risk factors for the habitats, a series of interventions will be implemented, that will use diversified techniques in order to monitor their effectiveness for erosion control, shoreline protection, wave energy dissipation, enhanced habitat.*		
TECHNICAL INFORMATION	*The action will include, depending on the cases, different bioengineering techniques aimed to:* - *protect the foredune and the shorelinefromstorms (palisade, coir logs);* - *facilitate the deposit of sand by wind (viminate);* - *rebuild the erosion escarpment in the foredune through the storage of stranded organic material (posidoniaoceanica);* - *stabilize dune cordons by geomats and/or by planting ammophilous plant species;* - *fill up the gaps between the dunes and mitigating anthropic impacts;* - *eliminate alien plant species and weeds;*		
KEYWORDS	*#coastline defence #dunes #sea*		
LOCATION	*Address: Parco Dune Costiere* *Area: 1100 h* *Geographic coordinates: X:40.781354m; Y:17.515920m (WGS 84/UTM zone 33N)*		
MERGE WITH VULNERABILITIES			



RELATED IMPACT THAT THE ACTION MITIGATES	*Coastal erosion*
PROJECT INITIATOR/PROMOTER	*Parco Dune Costiere*
STAKEHOLDERS INVOLVED	*Municipality of Ostuni, Municipality of Fasano, Province of Brindisi, ARIF (Regional Agency for irrigation and forestry activities)*
BENEFICIARIES/TARGET GROUP	*Economic operators of the area, citizens*
TIME OF START/IMPLEMENTATION	*From 01/09/2020 to 01/05/2021*
INDICATORS OF EVALUATION	*Indicate the 6 to 10 indicators from the previous page with specific unit of measure and quantify the impact of the action (environmental, legal, institutional and perceptional, social, economic)*
A-ENVIRONMENTAL	1. ***Soil coastal erosion*** ~~2. *Soil drought*~~ 3. ***Habitat maintenance***
B-SOCIAL	~~4. *New job created by the actions*~~ 5. ***New infrastructure***
C-ECONOMIC	6. ***Implementation cost*** ~~7. *Enterprises supported*~~ ~~8. *Traditional crops*~~
D- LEGAL, INSTITUTIONAL & PERCEPTIONAL	9. ***Procedural time*** 10. ***People acceptability***

6.2 DSS: action evaluation

iDeal project aims to support local public administrations to make appropriate decisions related to climate adaptation measures and to develop coherent and tailored climate adaptation plans for both Croatian and Italian territories.

This overall objective will be achieved through a shared process of knowledge construction and the implementation of a common Decision Support System. DSS is a system that can support decision-making activities. It is an interactive system able to analyze through different criteria a set of information and support an administration in the governance process, based on the datasheets and parameters.

The prevention, or at least reduction, of most diffuse effects of climate change affecting Italy-Croatia regions (overall extreme weather events, intensification of fires, drought, flooding, landslides) should be supported by a public sector better organized in the field of data and information available and their integrated elaboration.

Climate change adaptation, together with mitigation, is a long term effort that requires alternative makers with a Decision Support System enabling informed and knowledge-based decisions. Thus, into iDEAL a more informed decisions, based on data storage linked to geographical location, evaluation of different alternatives and scenarios as well as their different socio-economic impacts, will be allowed by the envisaged DSS.

In the pilot area of Regional Natural Park of Coastal Dunes, the DSS evaluation process was based on the assignment of identical weights and targets for all actions and on the assignment of an identical minimum threshold and a maximum threshold to each criterion.

For the criteria “Soil coastal erosion”, considering that the coast subjected to coastal erosion is about 8 km, the target to be reached to minimize the impact in an acceptable way is set at a reduction to 6 km, while the target to minimize the impact in a satisfactory manner in a reduction to 4 km.

Similarly, considering an area subject to soil drought extended for about 540 hectares, the minimum target is to reduce the exposed area to 520 hectares, and the maximum target to reduce it to 500 hectares.

“Habitat maintenance” is a primary objective for the Park, and it will be an acceptable goal to achieve if the single action contributed to the preservation of at least 2 hectares and a satisfactory ones if it contributed to the preservation of at least 5 hectares.

For reach the social objectives, the minimum target for the “new job created” criteria is set at 3 unit and the maximum at 6 unit, while the minimum target for the criteria “new infrastructure” (also understood as green infrastructure) is set in 2 km and the maximum in 4 km.

Regarding the “Economic aspect”, the maximum threshold to be not reached to minimize the “implementation cost” is set in 100.000 euro and the minimum in 20.000 euro, while the minimum target for the criteria “Enterprise supported” in fixed in 2 units and the maximum target in 4 units.

Regarding the “Legal, institutional and perceptional aspects”, the “procedural time” is considered acceptable if it is contained within 360 days and satisfactory if is contained in 180 days, while the value of “people acceptability”, criteria of significant importance for the Park, is fixed at 2 on 3(medium) as minimum threshold and at 3 on 3 (hight) as maximum threshold.

After that, for each criterion, minimum and maximum thresholds have been set and for each action the result obtainable from its realization has been foreseen, inserted and then automatically evalueted by the Decision Support System.

The result of the evaluation of every single action is described in the following tables.

ACTION 1: Dry Agricolture	GOOD
A. Environmental aspect	***good***
A.1 Soil coastal erosion	*unacceptable*
A.2 Soil drought	*good*
A.8 Habitat maintenance	*good*
B. Social Aspect	***unacceptable***
B.3 New job created by the actions	*unacceptable*
B.5 New Infrastructure	*unacceptable*
C. Economic Aspect	***good***
C.1 Implementation cost	*good*
C.5 Enterprise supported	*acceptable*
D. Legal, institutional and perceptional aspects	***acceptable***
D.3 Procedural time	*acceptable*
D.5 People Acceptability	*acceptable*
E. Adaptation, Mitigation and Resilience	***good***
E. 1 The target of the Action is an area exposed to a Climate Change I	*good*

The Action 1 reaches the evaluation "good" due to the fact that the target of the action is in areas exposed to the effects of the climate change and its aim is to reduce the soil drought. At the same time, the action is able to obtain a good level of habitat maintenance and to support several agricultural and zootechnical enterprises with no relevant cost and with a good level of social acceptability.

ACTION 2: River Contract	ACCEPTABLE
A. Environmental aspect	***acceptable***
A.1 Soil coastal erosion	*unacceptable*
A.2 Soil drought	*unacceptable*
A.8 Habitat maintenance	*acceptable*
B. Social Aspect	***unacceptable***
B.3 New job created by the actions	*unacceptable*
B.5 New Infrastructure	*unacceptable*
C. Economic Aspect	***good***
C.1 Implementation cost	*acceptable*
C.5 Enterprise supported	*good*
D. Legal, institutional and perceptional aspects	***acceptable***
D.3 Procedural time	*unaccettable*
D.5 People Acceptability	*acceptable*
E. Adaptation, Mitigation and Resilience	***good***
E. 1 The target of the Action is an area exposed to a Climate Change I	*good*

The Action 2 reaches the evaluation "acceptable" because, despite having a positive assessment in a few criteria, it is an action that turns out to be effective only towards the conservation of the habitat.

ACTION 3: Restoration and Management of Biodiversity in the Park	ACCEPTABLE
A. Environmental aspect	***acceptable***
A.1 Soil coastal erosion	*acceptable*
A.2 Soil drought	*unacceptable*
A.8 Habitat maintenance	*acceptable*
B. Social Aspect	***unacceptable***
B.3 New job created by the actions	*unacceptable*
B.5 New Infrastructure	*unacceptable*
C. Economic Aspect	***unacceptable***
C.1 Implementation cost	*unacceptable*
C.5 Enterprise supported	*unacceptable*
D. Legal, institutional and perceptional aspects	***good***
D.3 Procedural time	*acceptable*
D.5 People Acceptability	*good*
E. Adaptation, Mitigation and Resilience	***acceptable***
E. 1 The target of the Action is an area exposed to a Climate Change I	*acceptable*

The Action 3 reaches the evaluation "acceptable" because is an action aimed first of all at the protection and restoration of the Posidonian meadows plant and which therefore indirectly intervenes also in containing the phenomena of coastal erosion and habitat.

ACTION 4: Conservation of the last italian population of Tetrax Tetrax	GOOD
A. Environmental aspect	***acceptable***
A.1 Soil coastal erosion	*unacceptable*
A.2 Soil drought	*good*
A.8 Habitat maintenance	*good*
B. Social Aspect	***unacceptable***
B.3 New job created by the actions	*unacceptable*
B.5 New Infrastructure	*unacceptable*
C. Economic Aspect	***acceptable***
C.1 Implementation cost	*acceptable*
C.5 Enterprise supported	*acceptable*
D. Legal, institutional and perceptional aspects	***acceptable***
D.3 Procedural time	*acceptable*
D.5 People Acceptability	*acceptable*
E. Adaptation, Mitigation and Resilience	***good***
E. 1 The target of the Action is an area exposed to a Climate Change I	*good*

The Action 4 reaches the evaluation "good" because, despite having not a positive assessment in the criteria of "social aspect", it is an action aimed to the conservation of a specie included in the European Red List, trough the maintenance of his habitat and through the support to agricultural and zootechnical enterprices for the use of traditional techniques that contrast the drought of soils.

ACTION 5: Ecological connections	GOOD
A. Environmental aspect	***acceptable***
A.1 Soil coastal erosion	*unacceptable*
A.2 Soil drought	*unacceptable*
A.8 Habitat maintenance	*good*
B. Social Aspect	***good***
B.3 New job created by the actions	*acceptable*
B.5 New Infrastructure	*good*
C. Economic Aspect	***unacceptable***
C.1 Implementation cost	*unacceptable*
C.5 Enterprise supported	*unacceptable*
D. Legal, institutional and perceptional aspects	***good***
D.3 Procedural time	*unaccettable*
D.5 People Acceptability	*good*
E. Adaptation, Mitigation and Resilience	***good***
E. 1 The target of the Action is an area exposed to a Climate Change I	*good*

The Action 5 reaches the evaluation “good” because, despite it is an action that turns out to be effective only towards the conservation of the habitat, have also positive effects in social aspect.

ACTION 6: Coastal monitoring	UNACCEPTABLE
A. Environmental aspect	***unacceptable***
A.1 Soil coastal erosion	*unacceptable*
A.2 Soil drought	*unacceptable*
A.8 Habitat maintenance	*unacceptable*
B. Social Aspect	***unacceptable***
B.3 New job created by the actions	*unacceptable*
B.5 New Infrastructure	*unacceptable*
C. Economic Aspect	***acceptable***
C.1 Implementation cost	*good*
C.5 Enterprise supported	*unacceptable*
D. Legal, institutional and perceptional aspects	***good***
D.3 Procedural time	*acceptable*
D.5 People Acceptability	*good*
E. Adaptation, Mitigation and Resilience	***acceptable***
E. 1 The target of the Action is an area exposed to a Climate Change I	*acceptable*

The Action 6 the action is the only one that has been evaluated negatively (“unacceptable”), because it is an important monitoring action, which however has no direct repercussions either on the environmental aspects, neither on the economic aspect, nor on the social ones.

ACTION 7: Recovery of coastal dunes	GOOD
A. Environmental aspect	***good***
A.1 Soil coastal erosion	*good*
A.2 Soil drought	*unacceptable*
A.8 Habitat maintenance	*good*
B. Social Aspect	***unacceptable***
B.3 New job created by the actions	*unacceptable*
B.5 New Infrastructure	*good*
C. Economic Aspect	***good***
C.1 Implementation cost	*unacceptable*
C.5 Enterprise supported	*good*
D. Legal, institutional and perceptional aspects	***good***
D.3 Procedural time	*unaccettable*
D.5 People Acceptability	*good*
E. Adaptation, Mitigation and Resilience	***good***
E. 1 The target of the Action is an area exposed to a Climate Change I	*good*

The Action 7 t is the action that has obtained the best evaluation for most of the selected objectives, reaching the overall evaluation "good": the action intervenes in vulnerable contexts with the aim of defending dune habitats from coastal erosion. At the same time, several touristic enterprises could be supported in their activity on the littoral, while the high implemental cost are necessary to create a complete system of naturalistic engineering infrastructures.

6.3 Action selected for the implementation

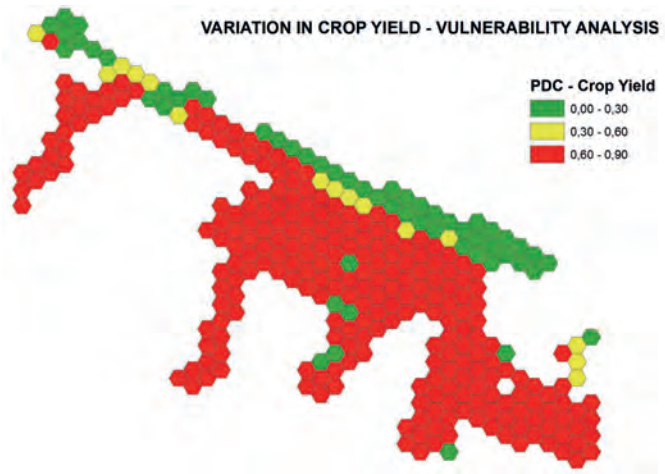
Considering the results of the evaluation carried out through the Decision Support System, it is possible to select four actions classified overall as “good”.

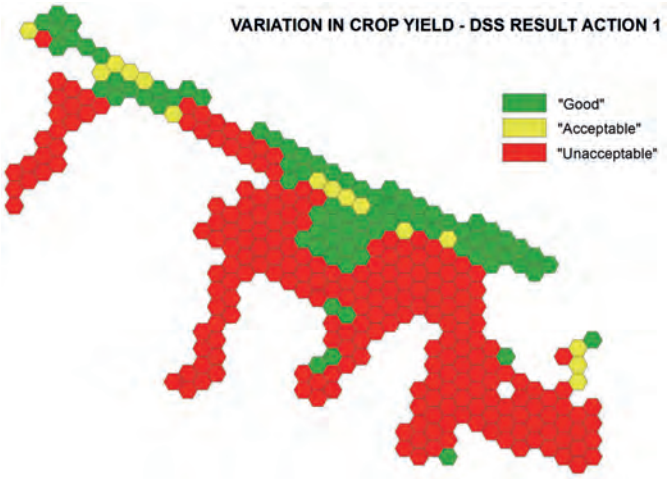
In particular, action 7 (Recovery of coastal dunes) achieved a "good" assessment in almost all objectives, except for the "social aspects" objective (despite having achieved a good result also for the "new infrastructures" criterion,

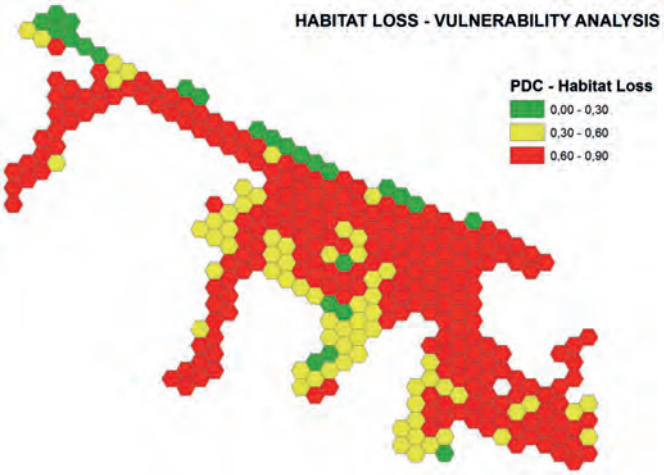
The actions 1 (Dry agriculture), 4 (Conservation of last Italian peninsular population of Tetrax Tetrax) and 5 (Ecological connections) instead reach a “good” assessment in three objectives on five.

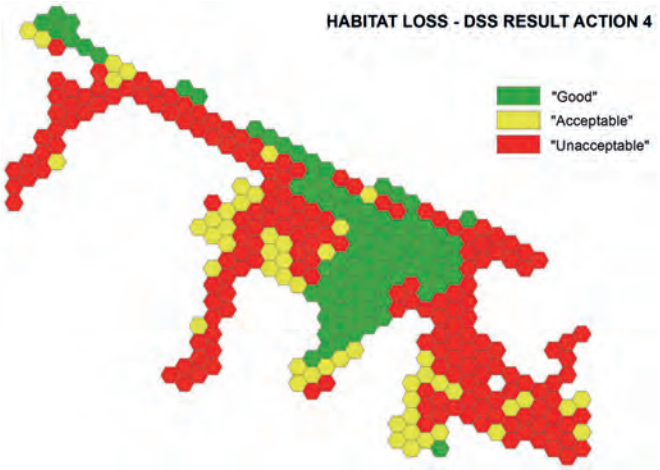
Actions / Objectives		A	B	C	D	E
Action 1:	Dry Agricolture					
Action 4:	Conservation of the last italian peninsular population of Tetrax Tetrax					
Action 5:	Ecological connections					
Action 7:	Recovery of coastal dunes					

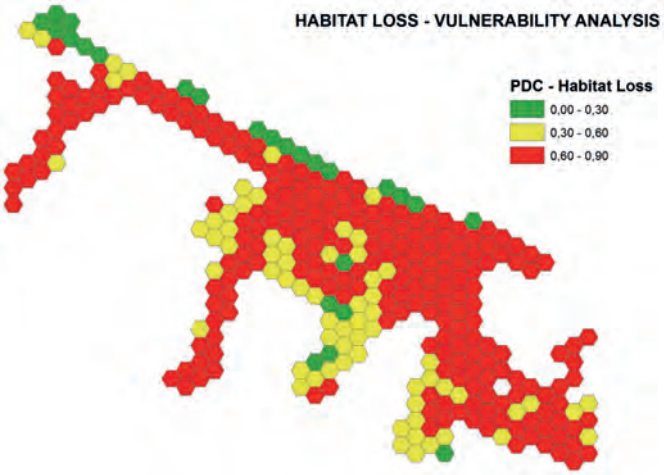
Through the intersection of the results deriving from the evaluation carried out with the DSS and of the data on the vulnerability of the territory to the impacts deriving from climate changes elaborated through GIS software, it is possible to visualize the effects deriving from the implementation of the four selected actions.

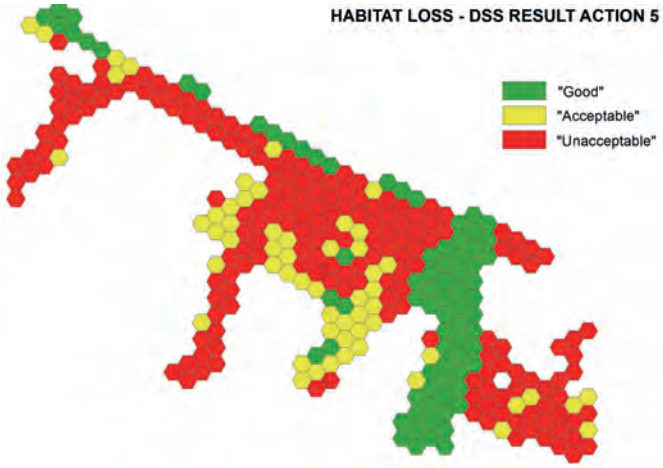


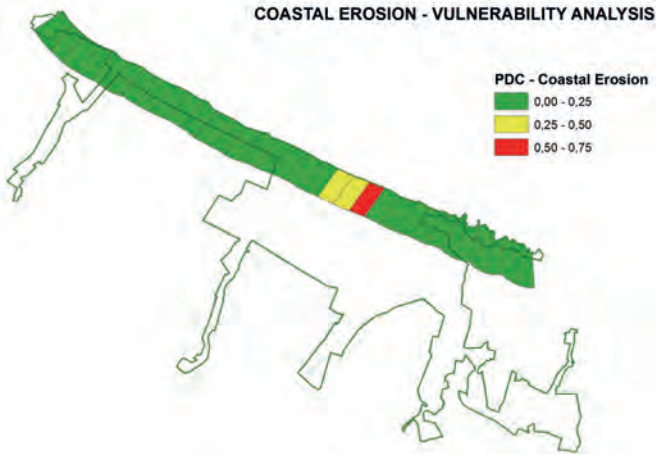


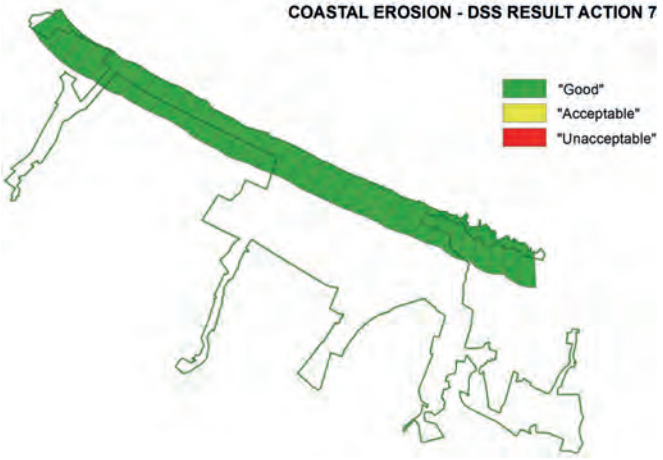

HABITAT LOSS - VULNERABILITY ANALYSIS
PDC - Habitat Loss
0,00 - 0,30
0,30 - 0,60
0,60 - 0,90


HABITAT LOSS - DSS RESULT ACTION 4
"Good"
"Acceptable"
"Unacceptable"


HABITAT LOSS - VULNERABILITY ANALYSIS
PDC - Habitat Loss
0,00 - 0,30
0,30 - 0,60
0,60 - 0,90


HABITAT LOSS - DSS RESULT ACTION 5
"Good"
"Acceptable"
"Unacceptable"


COASTAL EROSION - VULNERABILITY ANALYSIS
PDC - Coastal Erosion
0,00 - 0,25
0,25 - 0,50
0,50 - 0,75


COASTAL EROSION - DSS RESULT ACTION 7
"Good"
"Acceptable"
"Unacceptable"

The selected actions have all the characteristics to be able to form an integrated package of actions capable of positively affecting the mitigation of climate impacts in the most sensitive areas of the park.

In fact, action 7 is able to produce effects in the mitigation of coastal erosion also allowing the protection of dune habitats, while the action 1 and action 4 are involved in protecting substeppical habitats also through the recovery of traditional practices in agriculture for water saving and soil protection. Finally, the action 5 acts in the context of the ecological corridors of the blades and their ecotonal bands with positive effects also on the drought of the soils and on the conservation of habitats.

7. MONITORING SYSTEM

The monitoring systems are useful evaluation tools based on the effects foreseen by a specific project. These systems allow us to consider how the environmental variables vary based on what has been achieved. Moreover, the monitoring phases allow evaluating, from a quantitative point of view, the effectiveness of the single-action concerning the chosen impacts, whose territory is to be adapted to the negative effects.

In the case of the iDEAL project, it was decided to provide the PPs with a monitoring system specific to their set of identified actions. This system can only be used after the partial or complete implementation of iDEAL actions. This phase helps the understanding of the results, as well as the achievement of the set objectives, through graphs that allow an immediate understanding.

The monitoring system's principle is based on the same algorithms used in the GIS environment to provide the initial impact analysis, while the realization of an easy graphic interface was carried out in excel spreadsheets.