

ECOLOGICAL observing System in the Adriatic Sea: oceanographic observations for biodiversity

Priority Axis 3: Environment and cultural heritage

Specific Objective 3.2: Contribute to protect and restore biodiversity

D4.1.2 Report on the relationships between ecosystem-level management goals with ecological variables and oceanographic processes and the performance indicators

WP4 – Establishing the Ecological Observing System in the Adriatic Sea (ECOAdS)

A4.1– Characterization of the Natura 2000 study sites

PP1 OGS / Bruno Cataletto, Vinko Bandelj, Fabrizio Gianni

Other involved partners: LP, PP4, PP5, PP6 and PP7

Final version

Public

30th June 2019

CONTENT

1. INTRODUCTION.....	3
2. RELATIONSHIPS BETWEEN ECOSYSTEM-LEVEL MANAGEMENT GOALS WITH ECOLOGICAL VARIABLES AND OCEANOGRAPHIC PROCESSES.....	6
2.1. HR3000469 Viški akvatorij and HR3000161 Cres-Lošinj.....	6
2.1.1. Information about the site.....	7
2.1.2. Relationships analysis.....	8
2.1.3. Performance indicators.....	10
2.2. HR4000015 Malostoski zaljev.....	12
2.2.1. Information about the site.....	13
2.2.2. Relationships analysis.....	15
2.2.3. Performance indicators.....	16
2.3. IT3330009 Trezze San Pietro e Bardelli and IT3250047 Tegnùe di Chioggia.....	17
2.3.1. Information about the site.....	18
2.3.2. Relationships analysis.....	20
2.3.3. Performance indicators.....	21
2.4. IT3270023 Delta del Po and IT3270017 Delta del Po: tratto terminale e delta Veneto ...	23
2.4.1. Information about the site.....	24
2.4.2. Relationships analysis.....	27
2.4.3. Performance indicators.....	29
3. CONCLUSIONS.....	30

1. INTRODUCTION

Within the frame of the Activity 4.1 - Characterization of the Natura 2000 study sites of the project ECOlogical observing System in the Adriatic Sea: oceanographic observations for biodiversity (ECOSS), this report aims to individuate the main management questions of the selected Natura 2000 sites. It practically defines the relationships between ecosystem-level management goals, ecological variables ecosystem services and oceanographic processes with the identification of the appropriate performance indicators.

The report was drafted using primarily information from the “Questionnaire on ecological monitoring programmes and observing systems, Natura 2000 sites on going monitoring activities and conservation strategies and data/information availability and infrastructure/tools requirements”. The Questionnaire was agreed upon at the ECOSSE Kick-off meeting, and compiled by a joint effort of WP3, W4, WP5. The questionnaire was sent to all project partners in order to share among all of them the available information on the Natura 2000 sites included in the project (Figure 1), on monitoring programs and observing systems already in place, and on data infrastructure where useful information can be retrieved.

While all partners sent back the completed questionnaires, many answers were lacking, in particular those regarding the ecological processes, the management questions and the performance indicators. For several Natura 2000 sites in fact an operative managing authority is lacking (Tegnùe, Trezze), or, if it is defined, a management plan is still lacking (Delta del Po, Delta del Po: tratto terminale e delta Veneto, Viški akvatorij, Cres-Lošinj, Malostonski zaljev). None of the 7 Natura 2000 sites included in the project has an approved management plan in which clear management goals, questions and performance indicators would be defined.

Thus, in order to perform the analysis of the relationships between ecosystem-level management goals, ecological variables, oceanographic processes, with also the identification of the appropriate

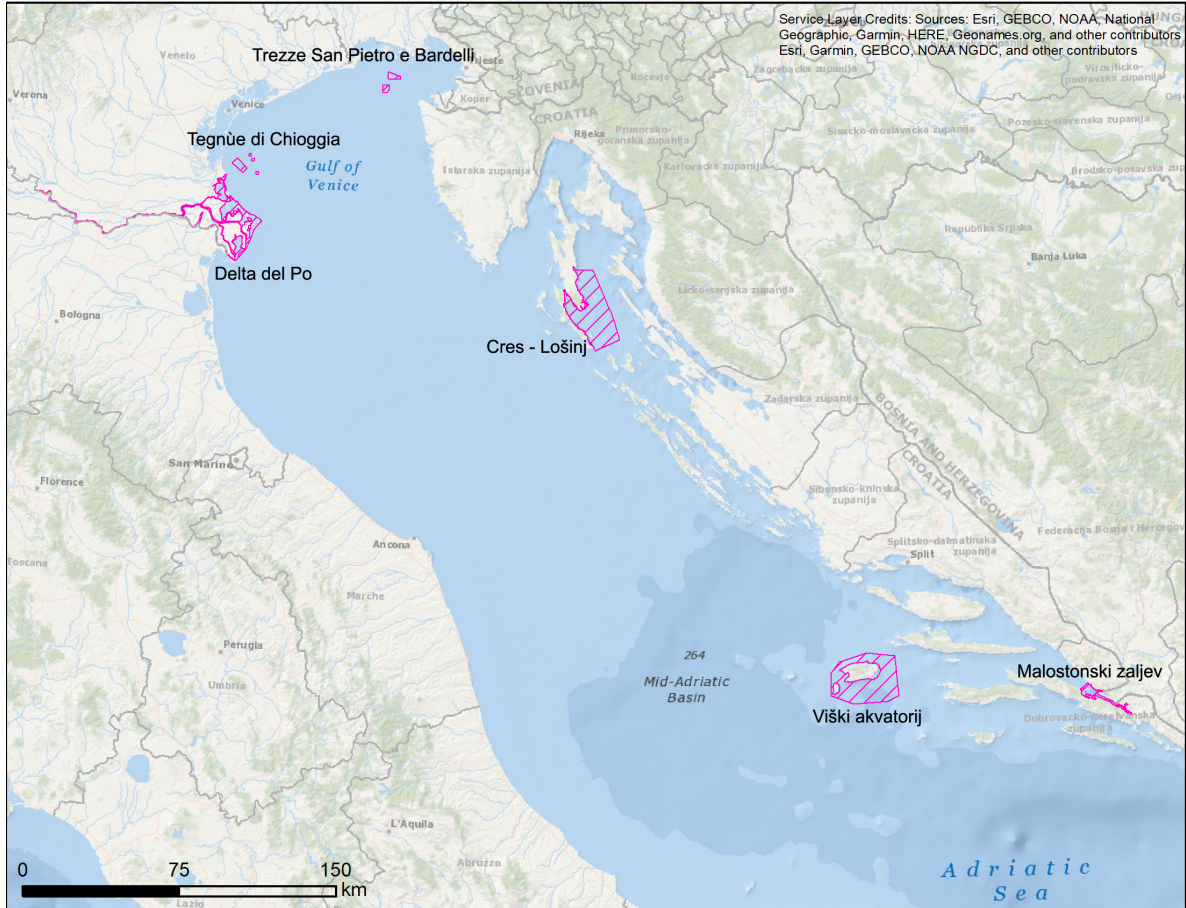
performance indicators, we complemented the information from the Questionnaires with scientific literature, Standard Data Forms for selected NATURA 2000 sites and online portals.

In this Report, the analysis of the seven selected Adriatic Natura 2000 sites has been done: 4 SCIs - HR3000469 Viški akvatorij, HR3000161 Cres-Lošinj, HR4000015 Malostonski zaljev, IT3330009 Trezze San Pietro e Bardelli, 2 SACs - IT3250047 Tegnue di Chioggia and IT 3270017 Delta del Po: tratto terminale e delta Veneto and 1 SPA IT3270023 Delta del Po.

These last two sites, both included in the wider Regional Park of the Po Delta, constitute formally two different Natura 2000 sites. Actually, they are closely connected, constituting a single river-delta-sea system, sharing many of the habitats and species, and they are also managed by the same authority (the Institution for parks and biodiversity management Po Delta Emilia Romagna). For these reasons in the main project output indicators they are merged into one unique indicator, for a total of six. Thus, a single analysis of the relationships between ecosystem-level management goals with ecological variables and oceanographic processes was performed for the two sites IT 3270017 Delta del Po: tratto terminale e delta Veneto and IT3270023 Delta del Po.

IT3330009 Trezze San Pietro e Bardelli and IT3250047 Tegnue di Chioggia are two sites designed to protect the same habitat type, the rich hard substrate communities on mesophotic biogenic reefs, in the same area, the Northern Adriatic Sea. They share many characteristic species and are subjected to similar forcing and pressures, thus they were analysed together.

Also HR3000469 Viški akvatorij and HR3000161 Cres-Lošinj were instituted to protect the populations of the same species, the bottlenose dolphin. Being both areas around or close to islands characterized by important touristic and other anthropic activities and sharing the main chemical and physical characteristics of the water, they are also analysed together.

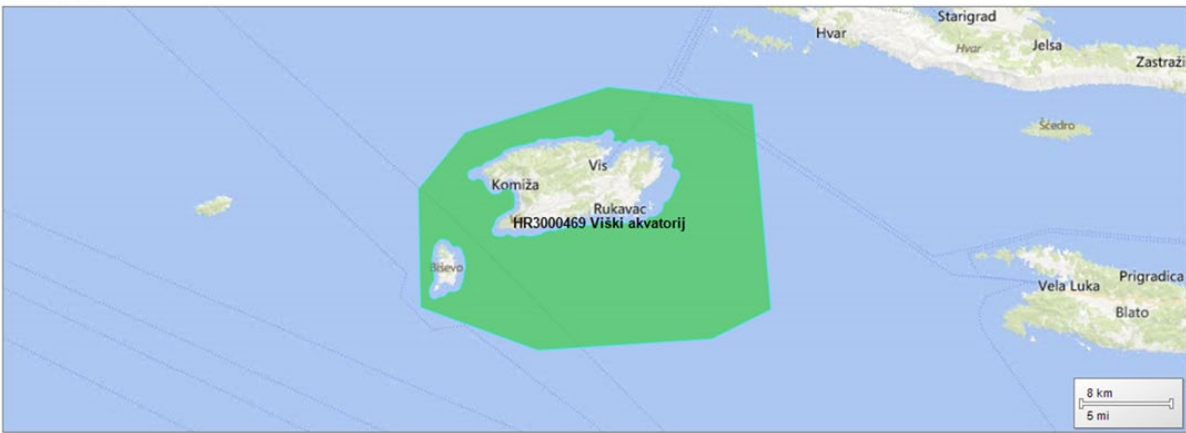


Map of the Natura2000 sites considered in the ECOS project.

2. RELATIONSHIPS BETWEEN ECOSYSTEM-LEVEL MANAGEMENT GOALS WITH ECOLOGICAL VARIABLES AND OCEANOGRAPHIC PROCESSES

2.1. HR3000469 Viški akvatorij and HR3000161 Cres-Lošinj

SITE DISPLAY



SITE DISPLAY



2.1.1. Information about the site

	HR3000469 Viški akvatorij	HR3000161 Cres-Lošinj
SITE IDENTIFICATION		
TYPE	B	B
FIRST COMPILATION	12/1/2012	12/1/2012
RESPONDENT	Ministry of Environment Protection and Energy, Directorate for Nature Protection, Radnička cesta 80/VII, Zagreb Ex: <i>Croatian Agency for the Environment and Nature, Radnička cesta 80/VII, Zagreb</i>	Ministry of Environment Protection and Energy, Directorate for Nature Protection, Radnička cesta 80/VII, Zagreb Ex: <i>Croatian Agency for the Environment and Nature, Radnička cesta 80/VII, Zagreb</i>
DATE SITE PROPOSED AS	7/1/2013	7/1/2013
DATE CONFIRMED AS SCI	12/1/2014	12/1/2014
National legal reference of SAC designation:	no	no
SITE LOCATION		
SITE CENTRE LOCATION (decimal degrees)		
Longitude	16,19338531	14,56751043
Latitude	43,00452649	44,59979562
AREA (HA)	51876,6486	52574,6384
MARINE AREA (%)	100	100
SITE LENGTH (km)	0	0
ADMINISTRATIVE REGION CODE AND NAME		

Nuts level II code	HRZZ	HRZZ
Region Name	Extra-Regio	Extra-Regio
BIOGEOGRAPHICAL REGION(S)		
Region Code	16	16
Region Name	Marine Mediterranean	Marine Mediterranean
SITE MANAGEMENT		
Target goals at the NATURA 2000 site	preservation of favourable state of natural habitat for the common bottlenose dolphins	preservation of favourable state of natural habitat for the common bottlenose dolphins
Key ecological processes	Not known	Not known.
Key management issues/goals at the NATURA 2000	Key management issue is the lack of management plan	Key management issue is the lack of management plan
List and describe performance indicators monitored at the NATURA 2000 site	Not defined	Not defined

2.1.2. Relationships analysis

The analysis of the relationships between ecosystem-level management goals with ecological variables, oceanographic processes and performance indicators for the two sites HR3000161 Cres-Lošinj and HR3000469 Viški akvatorij, was performed together. The two sites, both located around or close to islands along the eastern coast of the Adriatic Sea, were designated primarily in order to preserve a favourable state of natural habitats for the same species, the common bottlenose dolphins, *Tursiops truncatus*. These sites present important populations of *T. truncatus* and they are regarded also as biodiversity hotspots. They were subject to several research projects (e.g. Adriatic Dolphin Project) and

there are ongoing research activities monitoring the status of the bottlenose dolphin communities along the eastern Adriatic coast. Thanks to the monitoring activities spatial-temporal distribution maps, demographic parameters and social structure of the population of *T. truncatus* were estimated and their long-term dynamics assessed.

The information for the analysis was partially derived from the “Questionnaire on ecological monitoring programs and observing systems, Natura 2000 sites on going monitoring activities and conservation strategies and data/information availability and infrastructure/tools requirements”, which were sent to all ECOS partners.

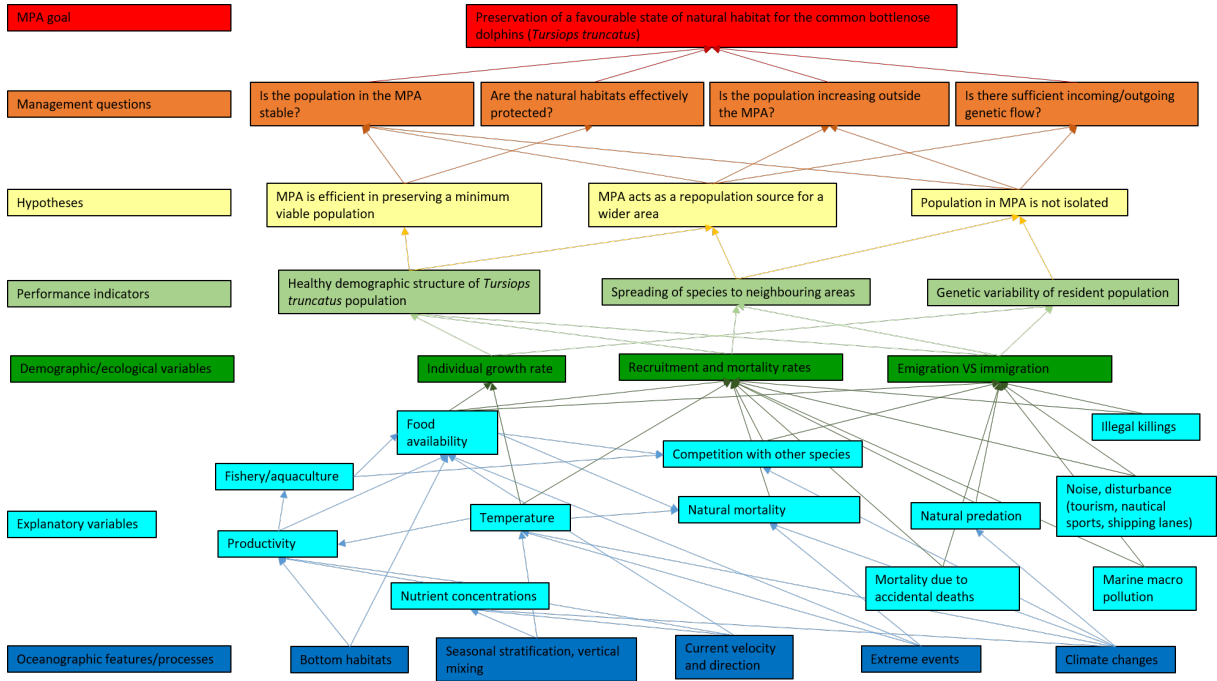
The area of the two Natura 2000 sites, HR3000161 Cres-Lošinj and HR3000469 Viški akvatorij, is subject to the general Adriatic circulation and the seasonality, with stratification of the water column in warmer months and vertical mixing in colder months. Big scale changes such as the occurrence of extreme events and global climate changes are increasingly impacting the Adriatic Sea, and thus also the areas devoted to the protection of the bottlenose dolphin. Moreover, Cres, Lošinj and Vis are well known touristic destinations in Croatia, with increasing pressure especially in summer months. Noise and intentional (dolphin watching) or unintentional (nautical sports, shipping lanes) disturbance may represent a pressure factor for the well-being of dolphin populations. Contributing to the noise and disturbance are the fishery and aquaculture activities present in these areas. Occasionally, too close encounters of dolphins with ships and vessels may end up in physical damage or death of specimen. Coastal settlements, touristic activities, shipping lanes, fishery and aquaculture are all also possible sources of marine macro-pollution: plastic macro-litter may be ingested by marine mammals, negatively affecting their health and feeding behavior.

The problematic coexistence of important human activities in the area and the need to protect the dolphin populations should be regulated by management plan, which is still lacking. The main management questions in our opinion should be: has the population in the this Natura 2000 site a healthy demographic structure; are the natural habitats inside this Natura 2000 site efficiently protected; is the population of *T. truncatus* increasing outside this Natura 2000 site; is there sufficient

incoming/outgoing genetic flow. In fact the rationale behind the institution of the protected areas is to protect the natural habitats of the dolphins and ensure thus a stable and healthy resident population. A positive outcome of the setup of an area of protection for a species should be also the outflow of specimen and possibly the establishment of new populations outside the protected area. Isolated populations risk to be depleted in their genetic variability because of interbreeding, thus the long-term health of a population is guaranteed by the exchange of genes with other populations.

2.1.3. Performance indicators

Given the lack of a management plan, there are as yet no performance indicators mandatorily measured in order to verify the achievement of the conservation goals in the two sites HR3000161 Cres-Lošinj and HR3000469 Viški akvatorij. Nevertheless, based on the analysis of the relationships between management goals, ecological variables and oceanographic processes, we suggest three possible performance indicators: a healthy demographic structure of the *T. truncatus* population inside the protected area; the monitoring of the spreading of specimen outside the Natura 2000 sites; and the monitoring of the genetic variability in the populations. A more feasible approximation for this latter is the monitoring of the mixing of individuals from population inside and outside the protected area. As for the first two performance indicators they may be derived from the data produced by the monitoring activities of the Blue World Institute in both Natura 2000 sites, and to a lesser extent in the respective neighboring areas.



2.2. HR4000015 Malostoski zaljev

SITE DISPLAY



2.2.1. Information about the site

SITE IDENTIFICATION	
TYPE	B
FIRST COMPILATION DATE	12/1/2012
RESPONDENT	Ministry of Environment Protection and Energy, Directorate for Nature Protection , Radnička cesta 80/VII, Zagreb Ex: <i>Croatian Agency for the Environment and Nature</i> , Radnička cesta 80/VII, Zagreb
DATE SITE PROPOSED AS SCI	7/1/2013
DATE CONFIRMED AS SCI	12/1/2014
National legal reference of SAC designation:	no
SITE LOCATION	
SITE CENTRE LOCATION (decimal degrees)	
Longitude	17,54327831
Latitude	42,92067479
AREA (HA)	5717,2405
MARINE AREA (%)	100
SITE LENGTH (km)	0
ADMINISTRATIVE REGION CODE AND NAME	
Nuts level II code	HRZZ
Region Name	Extra-Regio
BIOGEOGRAPHICAL REGION(S)	
Region Code	16
Region Name	Marine Mediterranean
SITE MANAGEMENT	

Target goals at the NATURA 2000 site	Preservation of the favourable state of the key habitats in the present surface.
Key ecological processes	Ecological conditions in the bay depend mostly on influences from the mainland and partly from the open sea. External and middle part of the bay are occasionally under stronger effect of the Neretva freshwater and its inner part is less affected by freshwater Delta. Strong underwater freshwater springs in the inner part of the bay have a great impact on hydro-physical and ecological relationships in the bay. According to the concentration of nutrients and the amount of phytoplankton, the bay may qualify as a natural moderate eutrophication system. Thanks to the specific environmental conditions, the living world in a bay is extremely rich. From antique times people have been cultivating shellfish (mussels and oysters) in a bay and today it is the most important place for the cultivation of oysters in Croatia (especially European flat oyster <i>Ostrea edulis</i>). The majority of the benthic algal flora consists of <i>Cystoseira</i> settlements that grow on the rocky bottom to 5 m of depth. For the inner part of Malostonski Bay characteristic are dense populations of organisms that feed on plankton by filtering seawater (especially corals).
Key management issues/goals at the NATURA 2000	The most important is to create a knowledge base of the overall ecological present state of the Natura 2000 site that would make a foundation for a quality management plan for the area. Through the management plan key management goals will be tackled, such as collision of aquaculture, tourism and fishing with conservation objectives.
List and describe performance indicators monitored at the NATURA 2000 site	<i>not defined</i>

2.2.2. Relationships analysis

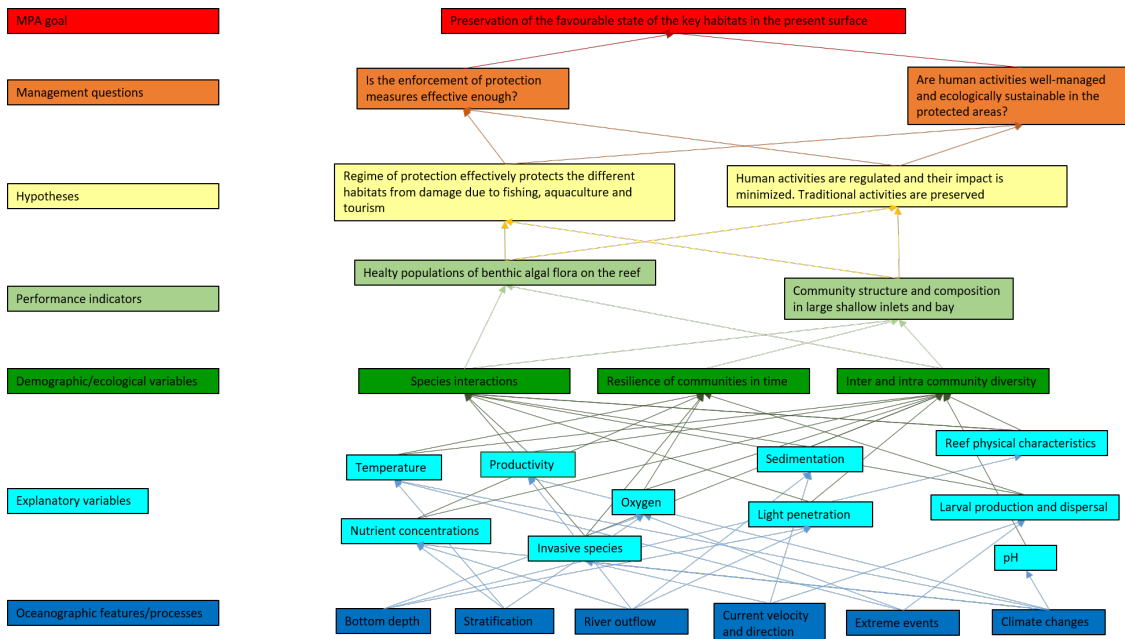
The analysis of the relationships between ecosystem-level management goals with ecological variables, oceanographic processes and performance indicators for the site HR4000015 Malostonski zaljev, was here performed. The site is located in the sea area of Dubrovnik-Neretva County, southeast of the line Sreser-Duba to the Kuta bay. The area is at the end of the Neretva channel in which the Neretva river flows. Ecological conditions in the bay depend mostly on the influences from the mainland and partly from the open sea. External and middle part of the bay are occasionally under stronger effect of the Neretva freshwater and its inner part is less affected by freshwater Delta. Strong underwater freshwater springs in the inner part of the bay have a great impact on hydro-physical and ecological relationships in the bay. According to the concentration of nutrients and the amount of phytoplankton, the bay may be qualified as a natural moderate eutrophicated system. Thanks to the specific environmental conditions, the living world in the bay is extremely rich. Since centuries people have been cultivating shellfish (mussels and oysters) in the bay and today it is the most important place for the cultivation of oysters in Croatia (especially the European flat oyster *Ostrea edulis*). The majority of the benthic algal species are represented by *Cystoseira* spp. that grow on the rocky bottom to 5 m of depth. *Posidonia oceanica* is absent. The inner part of Malostonski zaljev Bay is characterized by dense populations of benthic organisms that feed on plankton by filtering seawater (especially corals). The information for the analysis was partially derived from the “Questionnaire on ecological monitoring programs and observing systems, Natura 2000 sites on going monitoring activities and conservation strategies and data/information availability and infrastructure/tools requirements”, which were sent to all ECOS partners.

The problematic coexistence of important human activities in the area and the need to protect the two important habitats (large shallow inlets and bay and reefs) should be regulated by management plan, which is still lacking. The main management questions in our opinion should be: is the enforcement of protection measures efficient enough; are human activities well-managed and ecologically sustainable in the protected areas. The most important is to create a knowledge base of the overall ecological status of the Natura 2000 site that would make a foundation for a quality management plan of the area.

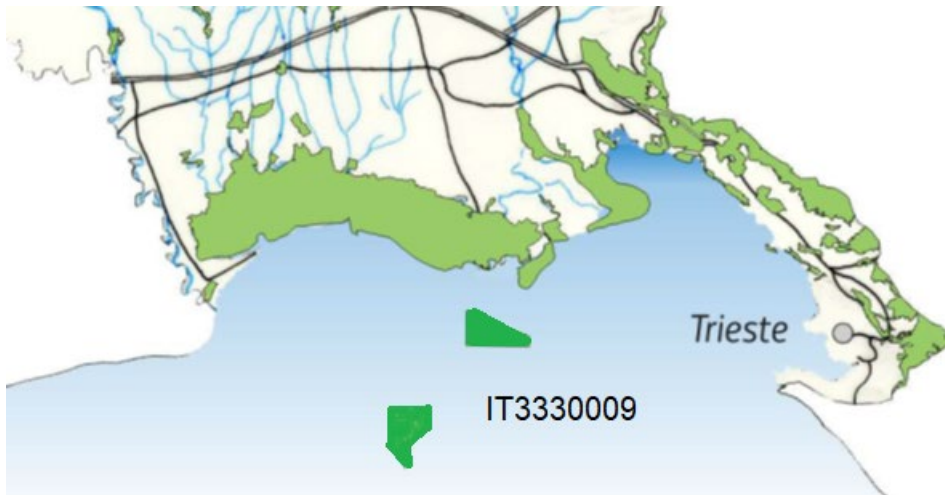
Through the management plan, the key management goals will be tackled, such as the collision of aquaculture, tourism and fishing with conservation objectives.

2.2.3. Performance indicators

Given the lack of a management plan and of regular monitoring programs, there are as yet no performance indicators measured in order to verify the achievement of the conservation goals in the site HR4000015 Malostonski zaljev. Nevertheless, based on our own expertise and on the analysis of the relationships between management goals, ecological variables and oceanographic processes, we suggest two possible performance indicators: the community structure and composition in large shallow inlets and bay, and the presence of a healthy populations of benthic algal floral on the reef. We chose these two performance indicators in relation to the key habitats at this Natura 2000 site.



2.3. IT3330009 Trezze San Pietro e Bardelli and IT3250047 Tegnùe di Chioggia



2.3.1. Information about the site

	IT3330009 Trezze San Pietro e Bardelli	IT3250047 Tegnùe di Chioggia
SITE IDENTIFICATION		
TYPE	B	B
FIRST COMPILATION DATE	09/2013	09/2010
UPDATE DATE	01/2017	10/2013
RESPONDENT	Regione Autonoma Friuli Venezia Giulia - Direzione Centrale Infrastrutture e Territorio - Servizio Paesaggio e Biodiversità	Regione Veneto Segreteria Regionale per il Bilancio - Unità di Progetto Foreste e Parchi
DATE SITE PROPOSED AS SCI	09/2013	10/2010
DATE CONFIRMED AS SCI	12/2014 ¹	
National legal reference of SAC designation:	no	08/2018 ²
SITE LOCATION		
SITE CENTRE LOCATION (decimal degrees)		
Longitude	13.410000	12.410000
Latitude	45.630000	45.202500
AREA (HA)	2380	2655.0000
MARINE AREA (%)	100	100
SITE LENGTH (km)	0	35
ADMINISTRATIVE REGION CODE AND NAME		
Nuts level II code	ITD4	

¹<https://www.regione.fvg.it/rafvfg/cms/RAFVFG/ambiente-territorio/tutela-ambiente-gestione-risorse-naturali/FOGLIA203/FOGLIA118/>

²https://www.gazzettaufficiale.it/atto/serie_generale/caricaDettaglioAtto/originario?atto.dataPubblicazioneGazzetta=2018-08-17&atto.codiceRedazionale=18A05429&elenco30giorni=true

Region Name	Friuli Venezia Giulia	
BIOGEOGRAPHICAL REGION(S)		
Region Code		
Region Name	Continental	Continental
SITE MANAGEMENT		
Target goals at the NATURA 2000 site	lack a management authority as well as a conservation and management plan. The rationale for their establishment is the protection and conservation of these unique North Adriatic habitats. They represent a biodiversity hotspot in a generally flat, sandy or muddy sea bottom. The coralligenous reefs have great importance for several pelagic and demersal species, both as spawning areas and nurseries, and as refugia for adult specimens.	lack a management authority as well as a conservation and management plan. The rationale for their establishment is the protection and conservation of these unique North Adriatic habitats. They represent a biodiversity hotspot in a generally flat, sandy or muddy sea bottom. The reefs have great importance for several pelagic and demersal species, both as spawning areas and nurseries, and as refugia for adult specimens.
Key ecological processes	Reproduction and settlement of several benthic, pelagic and demersal species	Reproduction and settlement of several benthic, pelagic and demersal species
Key management issues/goals at the NATURA 2000	lack a management authority as well as a conservation and management plan: this is at	lack a management authority as well as a conservation and management plan: this is at present the main management issue that needs to be

	present the main management issue that needs to be solved before shifting the attention to other management issues/goals	solved before shifting the attention to other management issues/goals
List and describe performance indicators monitored at the NATURA 2000 site	None	None

2.3.2. Relationships analysis

The analysis of the relationships between ecosystem-level management goals with ecological variables, oceanographic processes and performance indicators for the two sites SIC IT3250047 Tegnue di Chioggia and SIC IT3330009 Trezze di San Pietro e Bardelli was performed together. The two sites, both in the Northern Adriatic Sea, were designated in order to protect the biodiversity of the communities on the marine biogenic reefs, locally known as “trezze”, “tegnue” or “grebeni”. These sites are of extreme importance as biodiversity hotspots, emerging from the generally flat, sandy or muddy North Adriatic Sea bottom. The reefs, besides hosting a rich macrozoobenthic and macrophytobenthic community, have great importance for several pelagic and demersal species, both as spawning areas and nurseries, and as refuge for adult specimens. The Northern Adriatic biogenic reefs were subject to several publications and to several research projects (Interreg ITA-SLO TRECORALA, Italian PRIN ReefReseArch, etc.).

The information for the analysis was partially derived from the “Questionnaire on ecological monitoring programmes and observing systems, Natura 2000 sites on going monitoring activities and conservation strategies and data/information availability and infrastructure/tools requirements”, which were sent to

all ECOS partners. In part we put to good use our own expert knowledge, since OGS has been working on the Northern Adriatic reefs for a long time.

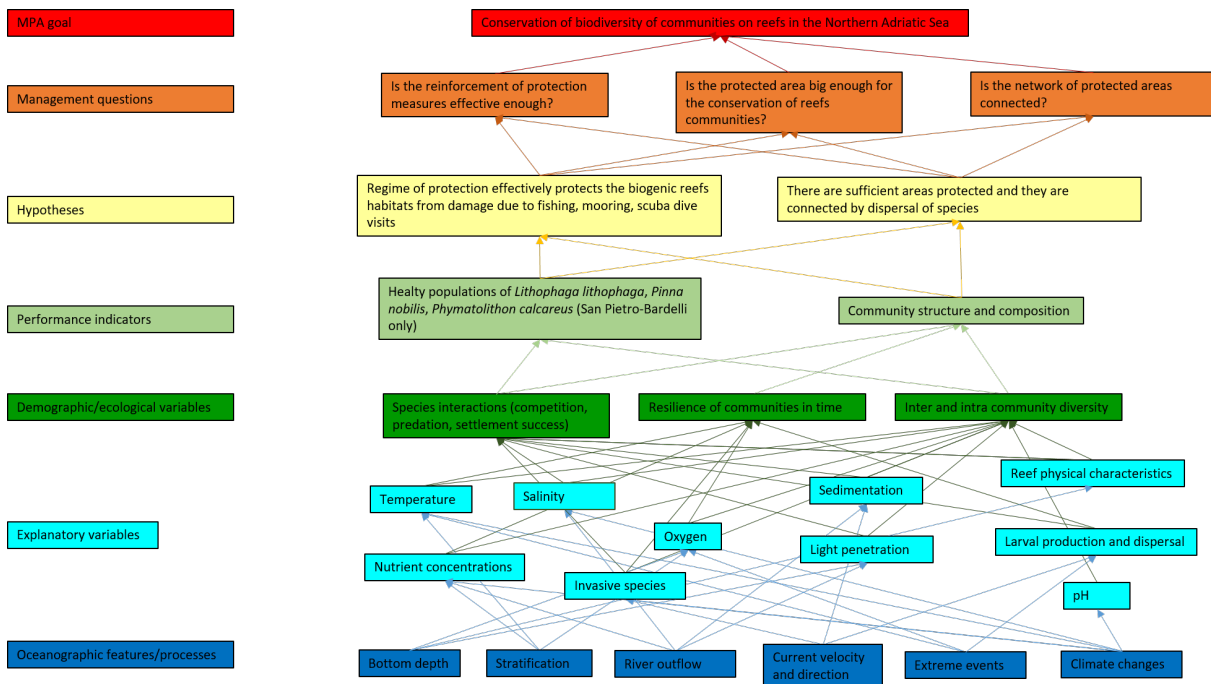
The main oceanographic features in this area is the bottom topography, with low depths (<25 m) characterizing most of the Northern Adriatic Sea, especially along the northern and western coast. Such gradient is due to the sedimentation from the river estuaries (Isonzo-Soča, Tagliamento, Brenta, Adige, Po) and the freshwater and nutrient-rich outflow from these rivers is another major oceanographic process affecting the Northern Adriatic Sea. The area is subject to the establishment of a seasonal thermocline, thus to stratification in warmer months. The global climate changes and the increase of extreme events in the last decades are also affecting the characteristics of the Northern Adriatic Sea.

The main goal of the SIC IT3250047 Tegnue di Chioggia and SIC IT3330009 Trezze di San Pietro e Bardelli is the conservation of the biodiversity of communities on the reefs. In our opinion, and lacking both an executive management authority and a management plan, the main management questions are whether the protected area is big enough to achieve the stated goal; if the MPAs constitute a connected network of sites, where long-term resistance and resilience of the communities can be ensured by the dispersal of species; and if the enforcement of the protection measures is efficient enough to prevent habitat degradation and biodiversity loss.

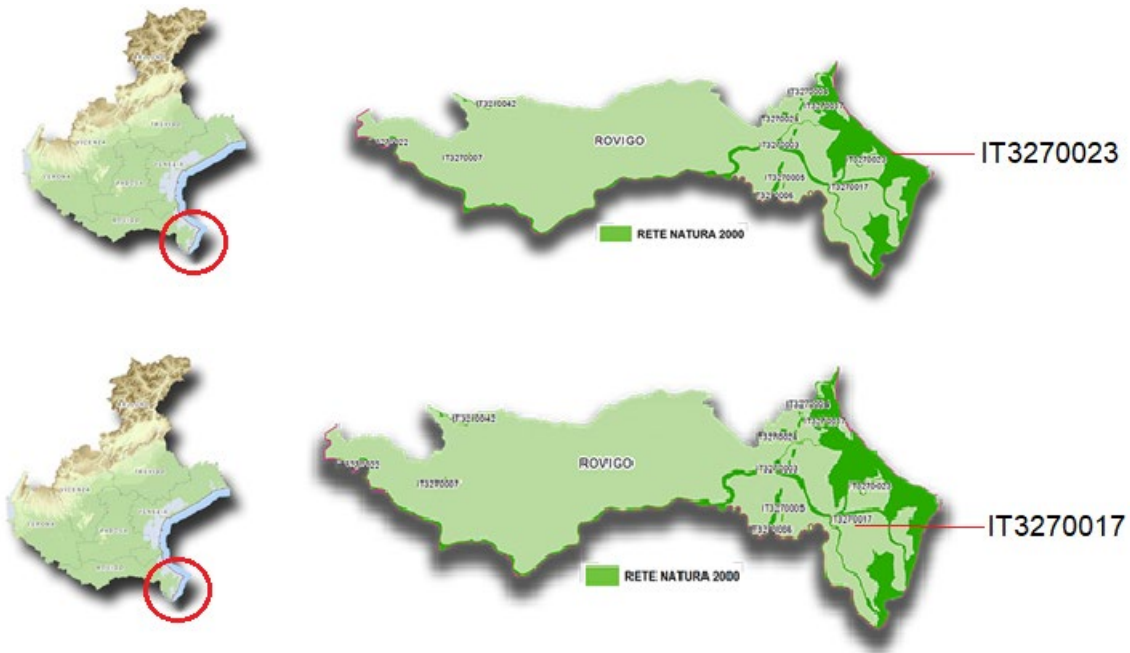
2.3.3. Performance indicators

Given the lack of a management plan and of regular monitoring programs, there are as yet no performance indicators measured in order to verify the achievement of the conservation goals in the two sites SIC IT3250047 Tegnue di Chioggia and SIC IT3330009 Trezze di San Pietro e Bardelli. Nevertheless, based on our own expertise and on the analysis of the relationships between management goals, ecological variables and oceanographic processes, we suggest two performance indicators: the community structure and composition, and the presence of a healthy population of two species cited in the with two species (*Lithophaga lithophaga* and *Pinna nobilis*) from Annex IV, present in both sites, and one species (*Phymatolithon calcareum*) and one from Annex V of Habitat Directive (2009/147/EC). We excluded from the list of monitored species *Caretta caretta* and *Tursiops truncatus*

from Annex II of Habitat Directive, since the area of the two Natura 2000 protected sites is too small to represent a significant part of the areal of presence of these two species: both *C. caretta* and *T. truncates* might be occasionally seen near the biogenic reefs, but they do not have permanent populations inside the protected areas. Same considerations apply to bird species from Annex II of Habitat Directive cited in the SIC IT3330009 Trezze di San Pietro e Bardelli Standard Data Form.



2.4. IT3270023 Delta del Po and IT3270017 Delta del Po: tratto terminale e delta Veneto



2.4.1. Information about the site

	IT3270023 Delta del Po	IT3270017 Delta del Po: tratto terminale e delta veneto
SITE IDENTIFICATION		
TYPE	A	B
FIRST COMPILATION DATE	02/2005	06/1996
UPDATE DATE	10/2013	01/2017
RESPONDENT	Regione Veneto Segreteria Regionale per il Bilancio - Unità di Progetto Foreste e Parchi	Regione Veneto Segreteria Regionale per il Bilancio - Unità di Progetto Foreste e Parchi
DATE SITE CLASSIFIED AS SPA	02/2005	
DATE SITE PROPOSED AS SCI		09/1995
National legal reference of SAC		08/2018 ³
SITE LOCATION		
SITE CENTRE LOCATION (decimal degrees)		
Longitude	12.2676856476	11.907157
Latitude	44.9417754829	44.977424
AREA (HA)	25012.0	25362
MARINE AREA (%)	1	1
SITE LENGTH (km)	0	628

³https://www.gazzettaufficiale.it/atto/serie_generale/caricaDettaglioAtto/originario?atto.dataPubblicazioneGazzetta=2018-08-17&atto.codiceRedazionale=18A05429&elenco30giorni=true

ADMINISTRATIVE REGION CODE AND NAME		
Nuts level II code	ITD3	ITD3
Region Name	Veneto	Veneto
BIOGEOGRAPHICAL REGION(S)		
Region Code		
Region Name	Continental	Continental
SITE MANAGEMENT		
Target goals at the NATURA 2000 site	Preservation of the favourable state of the key habitats and species.	Preservation of the favourable state of the key habitats and species.
Key ecological processes	Water, sediment and nutrients inputs from the river, water circulation due to the river and from sea tide.	Water, sediment and nutrients inputs from the river, water circulation due to the river and from sea tide.
Key management issues/goals at the NATURA 2000	<ul style="list-style-type: none"> • Restoration / increase of Reed • Creation of multifunctional freshwater basins • Maintenance of water circulation in lagoons • Conservation and increase of freshwater habitats • Conservation of colonies of arboreal Ciconiiformes • Incentive to the sustainable management of rice fields • Incentive to the creation of woods in river branches • Incentive to organic farming practices; 	<ul style="list-style-type: none"> • Restoration / increase of Reed • Creation of multifunctional freshwater basins • Maintenance of water circulation in lagoons • Conservation and increase of freshwater habitats • Conservation of colonies of arboreal Ciconiiformes • Incentive to the sustainable management of rice fields • Incentive to the creation of woods in river branches • Incentive to organic farming practices; maintenance / creation of mosaic areas with uncultivated

	<p>maintenance / creation of mosaic areas with uncultivated marginal stripes, hedges and woods even with tall trees</p> <ul style="list-style-type: none"> • Monitoring of Habitat highly dynamic with variable geometry Monitoring of hunting; Monitoring of breeding waterfowls • Conservation of habitats and species present in the brackish enclosed lagoons through the conservation of traditional extensive fish farming • Regulation of recreational and tourist activities for the reduction of anthropogenic disturbance in correspondence of nesting bird colonies • Implementation of a protection and intervention plan in case of oil spillage and / or other pollutants 	<p>marginal stripes, hedges and woods even with tall trees</p> <ul style="list-style-type: none"> • Monitoring of Habitat highly dynamic with variable geometry Monitoring of hunting; Monitoring of breeding waterfowls • Conservation of habitats and species present in the brackish enclosed lagoons through the conservation of traditional extensive fish farming • Regulation of recreational and tourist activities for the reduction of anthropogenic disturbance in correspondence of nesting bird colonies Implementation of a protection and intervention plan in case of oil spillage and / or other pollutants
<p>List and describe performance indicators monitored at the NATURA 2000 site</p>	<p>No data</p>	<ul style="list-style-type: none"> • Status of implementation of the actions foreseen by the Action plan (not approved) • Respect of the time schedule • Respect for estimated costs

		Expected goals achieved
--	--	-------------------------

2.4.2. Relationships analysis

The two Natura2000 sites (cod. IT3270017 and IT3270023) of the Po Delta, included in the wider Regional Park of Po Delta, overlap almost completely, share most of the habitats and species in the region and are managed by the same authority: the Institution for parks and biodiversity management Po Delta Emilia Romagna. They mainly protect terrestrial and river habitats, while marine environments represent only 1% of the surface. A complex system of tributary fluvial branches of the Po River, channels, coastal dune systems, valley wetlands, coastal lagoons, salt marshes, sandbanks and river islands with floodplains and lakes characterizes the protected area. Twenty habitats and more than 100 species listed in the Birds and Habitats Directives (Directive 2009/147/EC, Habitats Directive 92/43/EEC) are associated to these landscapes. The dominant vegetation is diverse according to the main characteristics of the habitats: psammophilous and halophile plants on sandy formations, submerged or floating macrophytes in floodplains, thermophilic and hygrophilous vegetation in the relict forests, with many species reported in the “Red Book of Italian Plants”. Birds are also well represented, including Passeriformes, water birds, seabirds and birds of prey. Protected freshwater fish include *Alosa fallax*, *Acipenser naccarii*, *Lampetra zanandreae*, *Pomatoschistus canestrinii*, *Petromyzon marinus*, *Knipowitschia panizzae*. The Po Delta also plays an important role for numerous human activities such as tourism, marine and freshwater aquaculture (also made with traditional methods), professional and recreational fishing, and agriculture. Therefore, these two Natura2000 sites are of extreme importance for the protection of this complex delta system, the different ecosystems present in the region and human economy depending on them.

Due to the similarity of the two sites, a combined analysis of the relationships between ecosystem-level management goals with ecological variables, oceanographic processes and performance indicators was performed, and can be applied to both sites. The information used for this analysis was partially

collected with the “Questionnaire on ecological monitoring program and observing systems, Natura 2000 sites on going monitoring activities and conservation strategies and data/information availability and infrastructure/tools requirements”, which were sent to all ECOS partners. Other information was obtained from literature and the website of the Po Delta Park (www.parcodeltapo.it).

The main hydrographic process in this area is the water circulation characterized by continuous variation of the water level due to the river flow, tides, and alluvial deposits. Water circulation in the Po Delta is also highly changed by sluices, dykes, flooding defense and other human interventions. Nutrient concentration, contaminants and sedimentation are frequently altered by this complex fluvial system, especially during flooding and due to soil leaching and erosion. The global climate changes and the increase of extreme events in the last decades may also potentially alter the characteristics of the Po Delta, inducing loss of biodiversity, increase of invasive species, habitat reduction, temperature rising, acidification, dryness and other effects that may be affect commercial activities too.

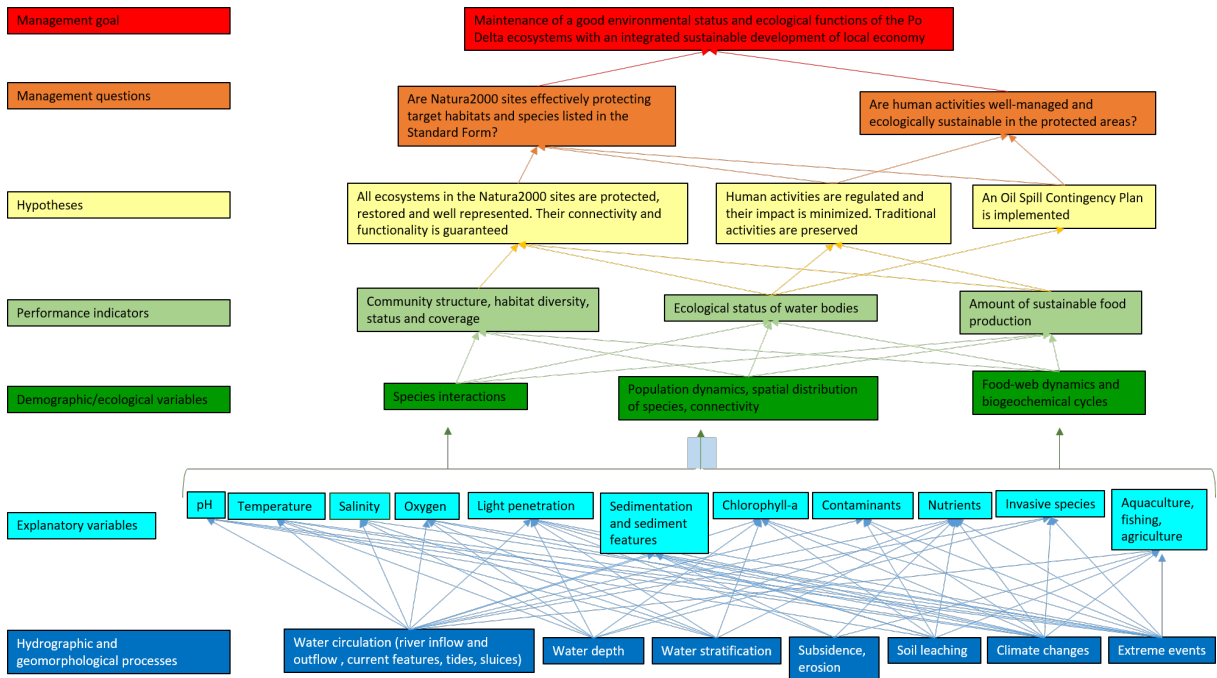
The Po Delta is also a touristic destination with increasing pressure especially in summer months. Noise pollution, trampling, water pollution, poaching, outdoor sports and other recreational activities may affect the ecosystems. Agriculture, fishing and aquaculture are also common activities in the Park, contributing to cause an impact on natural resource. In particular, agriculture is one of the main activities in the area causing eutrophication of water bodies. Finally, coastal settlements and works (e.g. discharges, beach nourishments, dredging, dumping, and modification of water circulation) are all sources of disturbance and pollution.

The problematic coexistence of important human activities in the area and the need to protect different ecosystems should be regulated by management plans, which are still lacking. The main management questions in our opinion should be: are Natura2000 sites effectively protecting target habitats and species listed in the Standard Form; are human activities well-managed and ecologically sustainable in the protected areas. In fact the main goal of the SIC IT3270017 Delta del Po: tratto terminale e delta Veneto and ZPS IT3270023 Delta del Po should be the conservation of the different species and habitats and minimizing impacts due to the intense human presence on the territory. Only with a sustainable

management of human activities based on eco-tourism, eco-labels creation, promotion of local products, and the use of resilient production methods that help increasing the quantity and quality of products and the resistance of the ecosystems, may help developing a circular economy in the Po Delta and make also possible the conservation of natural environments.

2.4.3. Performance indicators

Since the management and conservation plans for both Natura2000 sites have not been approved yet, performance indicators, necessary to verify the achievement of the conservation goals in the two sites, have been identified only for the SIC IT3270017 Delta del Po: tratto terminale e Delta Veneto, and they are only linked to the economic and management goals. Therefore, based on the analysis of the relationships between management goals, ecological variables and oceanographic processes, we suggest three possible ecological performance indicators: the community structure with the assessment of the diversity, status and coverage of the different habitats; the Ecological status of water bodies; and the assessment of the amount of sustainable food production. Regarding the first performance indicator, information and data may be derived from the monitoring activities performed by the managing authority and the Regional Agency for Environmental Protection and Prevention of the Veneto (ARPAV), and from the scientific studies already carried out in the framework of other projects in which the Park was involved. The ecological status of water bodies is annually assessed by ARPAV, based on abiotic parameters in water and sediment and the status of some organisms (named Elements of Biological Quality): phytoplankton, macrophytes, fish and macrozoobenthos. The third performance indicator may be indicative of the increase of sustainable commercial activities such as agriculture, fishing and aquaculture, whose presence in the Park is relevant and should be addressed towards a better inclusion with the conservation goals.



3. CONCLUSIONS

The results of the analysis of the relationships and the proposed performance indicators may represent a good starting point of discussion between managing authorities, stakeholders, public opinion and scientific community, in order to agree upon the management goals of the Natura 2000 sites and prepare the necessary management plans.