

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

## D3.2.1. Report on the ecological monitoring, conservation strategies and management questions of Natura 2000 marine sites

WP3 – Design of the Ecological Observing System in the Adriatic Sea (ECOAds)  
A3.2. – Ecological monitoring, conservation strategies and management questions of Natura 2000 marine site

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Other partners involved: LP, PP1, PP2, PP3, PP4, PP5, PP7, PP8 and PP9

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## 1. INTRODUCTION

### 1.1. Activity 3.2 and deliverable 3.2.1

This deliverable is the result of the Activity 3.2 „Ecological monitoring, conservation strategies and management questions of Natura 2000 (N2K) marine sites“. It was prepared by the University of Dubrovnik, external experts hired by Public institution for the management of protected natural areas of Dubrovnik-Neretva County (PIDNIC), with inputs from all the ECOSSE partners.

In accordance with what is reported in the ECOSSE project application form, this deliverable aims at assessing the current conservation status of the marine N2K sites considered in the project, the main management questions and the on going monitoring activities. The deliverable will analyse and evaluate the main bottlenecks and gaps and it will suggest strategies to overcome them in the perspective of a better management and possible expansion of the marine sites.

### 1.2. Work outline

The present deliverable is divided into several sections. In the first part (paragraph 2) we explain the definitions used in this deliverable, such as target species and target habitats, ecological monitoring, marine nature protection and conservation, management goals and objectives etc. This paragraph is important to make understandable each element of this deliverable. Some of the definitions were recalled from the previous deliverables of the ECOSSE Project, in particular the definition of ecological monitoring and target species from deliverable 3.3.1, while other definitions were recalled from scientific articles.

In paragraph 3, we present the main ongoing ecological monitoring programmes in each N2K site included in ECOSSE and propose improvements for future monitoring programmes.

In paragraph 4, for each N2K site selected as case study within ECOSSE, we identify current status of protection and conservation and propose potential conservation strategies for future conservation planning.

In paragraph 5, for each N2K site selected as case study within ECOSSE, we identify management goals and objectives and propose potential management strategies for future management planning.

## 2. DEFINITIONS

This paragraph provides the definitions of key elements used in this report aiming at linking monitoring programmes, conservation strategies and management strategies for the N2K sites selected as case studies within the ECOSSE project. The definitions are a framework for all the ECOSSE activities and, while most of them are taken from published scientific literature, others are taken from the ECOSSE deliverables that were already approved.

### 2.1. Adriatic Sea

The Adriatic Sea is a mostly shallow, semi-enclosed and elongated basin located in the Mediterranean Sea between the Italian and the Balkan peninsulas. It is over 800 km long and around 150–200 km wide, with major axis in the northwest–southeast direction. It can be divided into three sections, with increasing depth from North to South, with different characteristics, different widths and topographic gradients (United Nations, 2015).

The Adriatic Sea has been recently identified by many research institutions and organizations as one of the Mediterranean Sea areas most worth of protection, though which of the zones are more vulnerable or optimal for conservation motivations remains to be identified. The Adriatic basin is probably the most fished area, in relation to its size, by large fleets of trawlers and industrial fishing due to its high productivity and commercial value (United Nations, 2015). The Adriatic basin is considered a highly productive sea; where the central western coasts are hyperproductive and the southern coasts are more oligotrophic. The distinction on the levels of primary production is due mainly to river inputs and the continuous mixing of the waters. Eastern areas of the northern Adriatic Sea are oligotrophic, while the western ones are mesotrophic, with eutrophic zones off and south of the Po Delta (United Nations, 2015).

The northern section, occupying the flooded seaward extension of the Po Plain and reaching an average bottom depth of about 35 m, is the most extensive continental shelf of the entire Mediterranean Sea. The central Adriatic shows an average depth of 130-150 m. This is also a key area for cetaceans, and birds feeding during migration due to its high productivity. The southern area shows a wide depression 1218-1225 m deep and contains a comparatively large bathyal basin, by shelf surfaces of varying width; the continental shelf is wider in the Manfredonia Gulf (ca. 70–80 km), it becomes narrower further to the south (less than 30–40 km) and it is limited

by the Ionian Sea, in the Otranto Channel, 800 metres deep and 72 kilometers wide, where important water exchanges take place (United Nations, 2015).

According to geophysical and geological information, the Adriatic Sea and the Po Valley are associated with a tectonic microplate—identified as the Apulian or Adriatic Plate—that separated from the African Plate during the Mesozoic era (~220 million years ago). The geomorphology of the western part of the Adriatic is characterized by low, sediment-loaded coasts, which originate from strong Pleistocene to Holocene river discharge. The Adriatic seabed sediments are predominantly sandy–muddy (Brambati and Venzo, 1967; Brambati et al., 1983), while the main clastic sources are located along the western side (Tesi et al., 2007). While the Italian coast has sedimentary tracts, the Balkan coast is rugged and rocky, separated at the northernmost point of the Adriatic, by Monfalcone that marks the abrupt change between the Italian coast to the southwest and the Balkan one southeast (McKinney, 2007).

The numerous rivers discharging into the basin plus underground freshwater seeping into the sea along the eastern coast affect both the sedimentation and the circulation of the coasts. This effect is particularly evident in the northern basin for the presence of the Po River and in the southern basin because of the Neretva River and a group of Albanian rivers (Brambati et al., 1983), which deliver more sediment than the Po River (Simeoni et al., 1997).

The circulation of the Adriatic surface water is affected by the inflow of freshwater from diverse point sources, particularly the Po River, the inflow of Mediterranean water through the Otranto Strait, and the wind shear.

## **2.2. Marine protected areas (MPAs)**

IUCN defines MPAs as “a clearly defined geographical space, recognised, dedicated and managed, through legal or other effective means, to achieve the long-term conservation of nature with associated ecosystem services and cultural values”.

Marine Protected Areas (MPAs) are globally recognised as one of the most effective ways for the conservation and protection of the marine environment when they are managed effectively and have sufficient resources to address local management issues. MPAs can provide a wide variety of benefits ranging from the conservation of whole areas that are home to important biodiversity, serving as nursery grounds for fisheries and enhancing fish stocks. They can also provide more

sustainable tourism and recreational benefits, as well as enhance other non-use values such as cultural and heritage values (OECD, 2017).

While MPAs are crucial components to help ensure marine conservation and sustainable use, they are not sufficient to ensure that the broader environmental goal is achieved. Efforts to address multiple pressures simultaneously need to be intensified in order to improve the effectiveness and resiliency of MPAs in achieving their intended objectives.

### **2.3. European ecological network Natura 2000**

The European Commission considers the N2K network as the “centrepiece of EU nature and biodiversity policy” and has reunited in the Directive 2009/147/EC, both the Habitats Directive (92/43/CEE) and the Birds Directive (79/409/CEE and 2009/147/CE) aiming to conserve and assure the survival of threatened habitats and species.

The N2K network, concerning terrestrial and marine environments, focuses on the future sustainable management of protected areas and on the establishment of protected areas as part of its obligations for the UN Convention of Biological Diversity. The aim of N2K is to preserve the natural values triggering the designation of these sites while keeping human activities in a sustainable way.

These areas have to be delimited geographically, based on the ecological necessities of the species that have been declared as of community interest, and evaluated and managed as important sites. The Birds Directive establishes that the designation of the areas important for birds are based on the number and occupied surface of bird individuals and communities as well as for the groups migrating in the area. Bird conservation areas in the Adriatic include Special Protection Areas for birds (SPA-IBA) and Ramsar Sites, which concern either migrating stops, nesting zones or accumulation sites for feeding (<https://natura2000.eea.europa.eu/>).

The N2K network includes two types of protection areas: Sites of Community Importance (SCIs) under the Habitats Directive (92/43/EC), and Special Protection Areas (SPAs) under the Birds Directive (2009/147/EC). The protection and conservation of natural areas is regulated by the Directive 92/43/EEC, for which each member state (EU) provides and establishes areas aimed to restore and guarantee the best conservation status of the wild flora and fauna as well as their habitats.

### 2.3.1. N2K target species and target habitats

Target species of N2K ecological network are all rare, threatened or endemic animals and plants targeted for conservation under the Habitats Directive (HD, 92/43/EEC) and Birds Directive (BD, 2009/147/EC). Their protection or re-establishment represents the primary management goal of the N2K network. The HD protects over 1200 target species, which are often collectively referred to as species of European importance. The Birds Directive covers all bird species that are naturally present in the EU. A list of target species presented inside N2K sites, compiled before their establishment, is reported in the Standard Data Forms (SDF) available at <https://natura2000.eea.europa.eu/>. In this deliverable, we present a list of target species of each N2K site within the ECOSSE project.

Different types of ecosystems are included in the N2K sites, including terrestrial, freshwater and marine ecosystems. An ecosystem can include one or many different habitats and usually hosts a diverse community of plants and animals. However, some ecosystems are more abundant than other in the N2K network. For example, Forest ecosystems represent about 50% of the network's surface while agro-ecosystems (pastureland and other agricultural areas) cover about 40% of the network. The total coverage of EU seas covered by marine protected areas has more than doubled in the last six years, primarily due to the expansion of the Natura 2000 network – the largest coordinated network of conservation areas in the world. The Habitats Directive lists nine marine habitat types and 16 species for which marine site designation is required, whilst the Birds Directive lists a further 60 bird species whose conservation requires marine site protection. To date (end 2018), more than 3150 marine Natura 2000 sites have been designated, which cover almost 10% of the total EU marine area (over 550,000 km<sup>2</sup>) (<https://natura2000.eea.europa.eu/>).

### 2.3.2. N2K areas involved in ECOSSE project

Seven marine and coastal protected areas included in the N2K network were used as case studies in the ECOSSE project (Figure 1). Diverse oceanographic, ecological and anthropogenic features of these sites were used to investigate their conservation requirements and extrapolate the lessons learned to other N2K sites in the Adriatic. N2K case studies of ECOSSE project are:

***Po River delta Tratto Terminale Delta Veneto (IT3270017) and Po River delta (IT3270023):*** with Po being the most significant river flowing into the Adriatic Sea, this river delta is an excellent case to study the links between the land and the sea.



***Tegnùe di Chioggia (IT3250047)***: the isolated rocky substrates in predominantly muddy surroundings provide a natural support for sessile benthic organisms, making this site a real micro-hotspot for biodiversity.

***Trezze San Pietro e Bardelli (IT3330009)***: this unique site features coralligenous algae that provide a suitable habitat for numerous demersal and benthic fish species in an otherwise monotonous environment.

***Cres-Lošinj (HR3000161)***: this area is home to a resident sub-population of bottlenose dolphins, counting approximately 200 individuals. Studied since 1987, this sub-population is among the best-known ones in the Mediterranean.

***Viški akvatorij (HR3000469)***: waters around the island of Vis are among the most pristine habitats of bottlenose dolphins in the Adriatic and a biodiversity hotspot.

***Malostonski zaljev (HR4000015)***: this area is under significant influence of freshwaters and the specific environmental conditions result in specific biodiversity dominated by bivalve cultivation, especially European Flat Oyster.

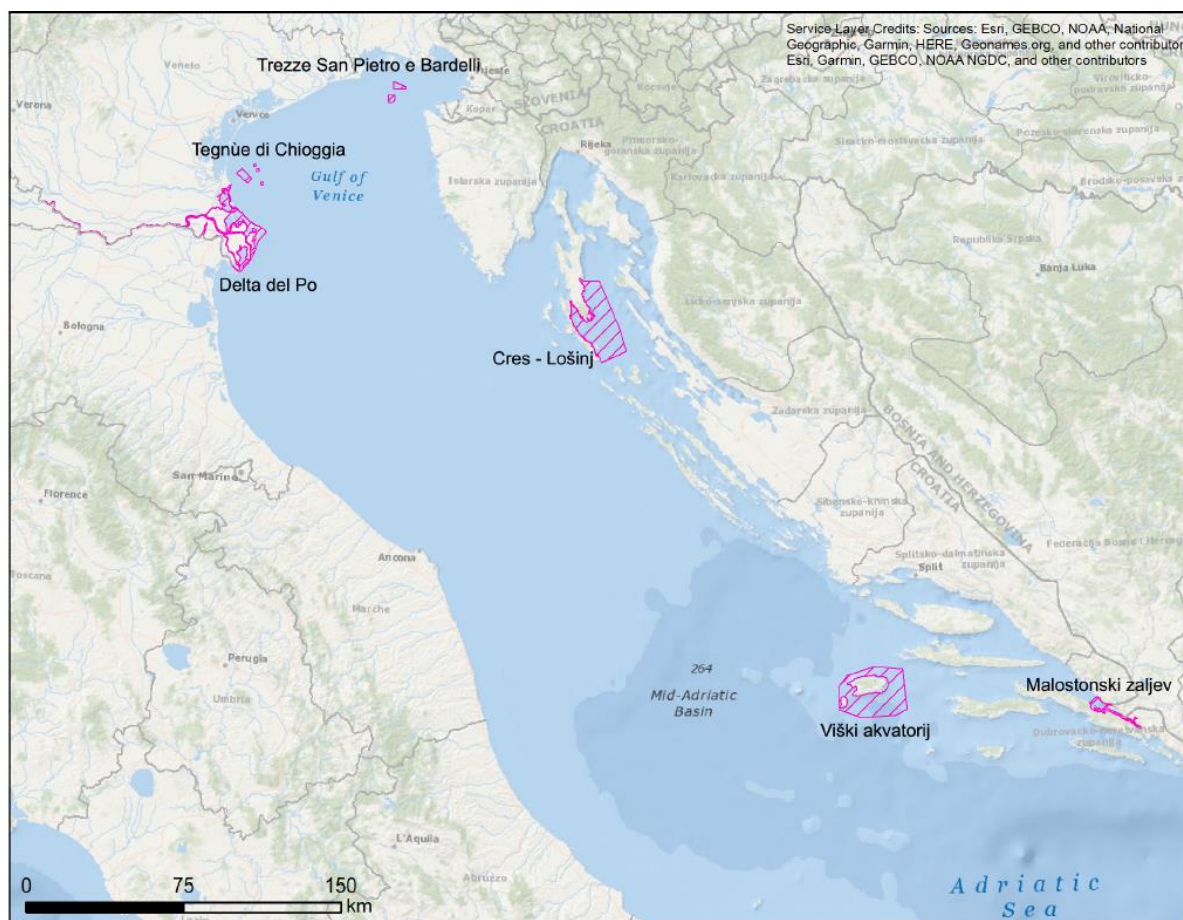


Figure 1. Map of the N2K sites studied in ECOS project.

## 2.4. EU directives

The 2008 Marine Strategy Framework Directive 2008/56/EC, the 2014 Directive on establishing a framework for maritime spatial planning 2014/89/EU, and the 2002 EU Recommendation on Integrated Coastal Zone Management 2002/413/EC offer a comprehensive and integrated approach to the protection and sustainable exploitation of all European coasts and marine waters. In addition, there are a number of complementary policies: the EU Habitats Directive (see above), the EU Directive on the conservation of wild birds, regulation of fisheries through the Common Fisheries Policy, EU biodiversity strategy to 2020, EU Regulation 1143/2014 on Invasive Alien

Species, and the control of input of nutrients and chemicals into waters through the Water Framework Directive, Nitrates Directive and EU Common Agricultural Policy (OECD, 2017). The EU sees marine spatial planning as a fundamental requirement for the integrated management of a growing and increasingly competitive maritime economy, while at the same time safeguarding marine biodiversity. The EU Marine Strategy Framework Directive, the environmental pillar of the EU Maritime Policy, introduced the principle of ecosystem-based marine spatial planning and provides a supportive framework for national initiatives toward spatial planning, designed for achieving a good status for the environment (OECD, 2017).

In Italy, the BD and HD have been transposed by the Government with the Framework Law 157/1992, and the DRP 357/1997 later modified with the DRP 120/2003, respectively. . The WFD was transposed with the legislative decree of 3 April 2006, n. 152. Specifically, Art. 64 divided the national territory into 8 River Basin Districts (map: <https://www.minambiente.it/direttive/recepimento-della-direttiva-italia>) and assigned to District Authorities the responsibility to draft management plans for each district. However, only with the law 13/2009 ('Special measures on water resources and environment protection'), the River Basin Authorities had the power to develop the management plan, working together with the regional representatives. The MSFD was transposed with the legislative decree 190/2010. The Italian Ministry of Environment, Land and Sea (IMELS) is the responsible Authority for the implementation of the Directive. IMELS has charged a Technical Committee for the definition of the marine strategy documents (Art. 5), while the Italian National Institute for Environmental Protection and Research (ISPRA) offers the scientific-technical support (website: [www.strategiamarina.isprambiente.it](http://www.strategiamarina.isprambiente.it)) (D.3.3.1).

Croatia has partially met HD and BD through the Nature Protection Act and its additional emendations (OG 80/2013, 15/2018, 14/2019, 127/2019), while the WFD was transposed through the Water Act (OG 66/2019). There are two River Basin Districts: the Danube River Basin and the Adriatic Sea Basin. At national scale, the Croatian Waters (CW) developed a single management plan in June 2013 for both districts. CW is responsible for river maintenance and flood protection, drainage system maintenance, management of public water, water use and water protection. CW also externalizes some activities, such as monitoring to scientists and

environmental impact companies. At present, Croatia adopted and reported the second generation of River Basin Management Plan (RBMP) under the WFD and the EC assessed the status and the development since the adoption of the first RBMP, including suggested actions in the 2017 EIR. The country transposed the MSFD through the 'Regulation establishing the framework for action of the Republic of Croatia in protection of marine environment' (OG 136/2011) and the 'Regulation on preparation and implementation of documents under the Marine Environment and Coastal Area Management Strategy' (OG 112/2014, 39/2017, 112/2018). Within the framework of the Strategy development, and based on its preparatory documents defining the Initial Assessment, Good Environmental Status (GEnS) and Goals related to achieving GEnS in marine environment, the Croatian Government adopted two important documents: 'System for marine environment surveillance and monitoring' (OG 153/2014) and 'Programme of Measures for the Protection and Management of the Marine Environment and Coastal Zone of the Republic of Croatia' (OG 97/2017). The competent authority for implementing the Regulation is the Ministry of Economy and Sustainable development, which is at the same time also the coordinator for collaboration with other competent bodies (D.3.3.1).

## **2.5. Ecological monitoring**

Referring to the ECOS deliverable D.3.3.1, ecological monitoring is defined as the process of periodical observations conducted at different spatial and temporal scales, giving information on environmental status. It is particularly important since it gives information on the status of ecological processes and target species in selected areas by using descriptive indicators (or variables). Each monitoring programme presents a pool of investigated variables, chiefly in accordance with the most important European Directives, such as: population size and structure, habitat characterization, diversity indices, species composition, distribution, density and coverage. In the N2K sites selected as case studies in ECOS, the descriptive indicators are the ecological parameters, which give information on the state of target species and ecological processes, and on the level of natural and anthropogenic pressures that might affect them.

## **2.6. Marine Nature Conservation and conservation measures**

The increasingly intensive use of the Adriatic Sea makes protecting the marine environment more and more important. Marine nature conservation must strike a balance between the aim of

protecting and conserving marine biodiversity and the desire for sustainable, ecosystem-friendly use of the sea for the benefit of humanity. The priority task consists of implementing statutory requirements, directives, strategies and international agreements, and closing knowledge gaps. EU member states assign responsible administrators to achieve and evaluate the conservation purposes of the designated N2K network areas.

While there is no Adriatic agreement on protection of biodiversity at the basin level, there are multiple initiatives, such as the EU Strategy for the Adriatic-Ionian (EUSAIR, adopted by the Commission on June 2014 and endorsed by the EU Council on October 2014) as a platform for cross-border/international collaboration between Albania, Croatia, Greece, Italy, Montenegro, and Slovenia.

Article six of the HD requires that ‘for special areas of conservation, member states, shall establish the necessary conservation measures involving, if need be, appropriate management plans specifically designed for the sites or integrated into other development plans, and appropriate statutory, administrative or contractual measures [...]’. The HD also identifies ‘the conservation measures as a series of measures required to maintain or restore the natural habitats and the populations of species of wild fauna and flora at a favourable status [...]’. Thus, conservation measures adopted in N2K sites can be identified as management plans or any appropriate statutory, administrative or contractual measures, defined by the law of each MS, that are finalized to regulate activities, uses and collection of organisms in the protected sites, and maintain biodiversity (D.3.3.1).

Management plans for N2K sites are strongly suggested and should establish both spatial and management measures for the conservation of species and habitats in need of protection and to the sustainable use of natural resources. The effect of these measures has to be periodically monitored, by using performance indicators, with the aim to assess the management effectiveness and, in case, arrange adequate changes.

## **2.7. Management of the MPAs and management authority**

Over recent years there has been a move towards more holistic approach when it comes to the management of the marine environment endorsing the ecosystem-based management approach.

This is exemplified by the Marine Strategy Framework Directive, which requires member states to achieve 'Good Environmental Status' (GES) within their seas by 2020.

In this deliverable we define as public/management authority, any public institution, private company, NGO, organization or association responsible to manage a protected area and, specifically in ECOSSE, the N2K sites used as case studies. For each N2K site, the responsible management authority is reported in the SDF, section 1.6 "RESPONDENT(S)", which member states (MS) transmit to the Commission in accordance with 97/266/EC Commission Decision of 18 December 1996 (Official Journal L 107, 24/04/1997).

In the ECOSSE deliverable D.3.3.1 it is reported that In Italy, according to the Decree of the Republic President (DRP) n° 357/97, Regions and Autonomous Provinces are in charge of the implementation of all conservation measures to protect and monitor the N2K sites within six years from the adoption of the EC lists of Sites of Community Importance and six months from their establishment. Furthermore, Regions and Autonomous Provinces are firstly responsible to assess if the existing conservation measures are appropriate and, if not, to put in place further measures (e.g. management plans). However, Regions and Autonomous Provinces can also adopt a specific legislation on N2K site management and delegate other authorities (Provinces, Municipalities, local communities, management bodies of protected areas) the assessment of the existing conservation measures, the implementation of management plans or any other action that should be carried out in order to guarantee N2K site protection. The designated authorities can be different depending on the site location and the type of action. In case a N2K site falls within another protected natural area, the managing authority of the protected area identifies conservation measures as part of its own regulation and planning instruments (D.3.3.1). If the N2K site falls partially within another protected natural area, DRP 357/1997 specifies that "for the portion falling outside the perimeter of the protected natural area, the Region or autonomous Province shall adopt, after consultation with the relevant local bodies and the managing body of the protected area, all opportune conservation measures and management norms" (D.3.3.1). Thus, the adoption and approval of the conservation measures, always requires the involvement of the Regions/Autonomous Provinces, in collaboration with the State and local authorities. Finally, Regions, Autonomous Provinces and the managing body of the protected area can agree

that the management of the N2K site, both the portion within the perimeter of the already existing protected area and the portion outside it, is entrusted to the managing body of the protected area (D.3.3.1). Regions and Autonomous Provinces are also obliged to yearly assess the conservation state of biodiversity in each N2K site and, based on the scientific results, they can propose new N2K sites, and modification of their borders or of the information contained in the SDF. The Italian Ministry of Environment submits the proposal to the European Commission (EC), and after approval, the Ministry implements changes by decree.

In Croatia according to the Nature Protection Act and OG 80/2019, N2K sites are managed by Public Institutions (PI). A single PI may manage numerous sites. If a N2K site is also protected in the category of the national or nature park, or is within a park, bordering it or in larger territory overlapping with a park, park's PI is responsible for management. If a N2K site is protected in another category, County PI is responsible for management. If a N2K site is situated on the territory of more than one county – County PIs are managing it together. Management plans are mandatory for N2K sites and are adopted by PIs. Management plan for marine N2K sites, which are partly or entirely outside of Croatian territorial waters, but within sea borders under national jurisdiction, are delivered by the Ministry of Economy and sustainable development, which is responsible for nature conservation. Governance of protected areas can be also (partially) delegated. e.g. to NGOs (D.3.3.1).

## **2.8. Protected areas management goals and objectives**

According to Thomas & Middleton (2003) management goal of a protected area is a long-term objective that describes or envisages the expected conservation state that protected area policies want to achieve and maintain. It generally takes the form of a broad statement and its purpose is to give a coherent direction to the management plan and objectives. It should not change over time in order to give continuity to the conservation measures.

Also, management goals can be described as a set of economic, social, and environmental aspirations that could set targets or standards in several areas as ecosystem functioning, biodiversity conservation, local community participation, sustainability (Pomeroy et al 2004).

Management goals and objectives should relate to the key values of the protected areas (i.e. target species or habitats) or to major areas of management activity (i.e. tourism, education) and

they are formulated to cover different aspects such as habitat and species protection, education, tourism management, protected area services, research and monitoring, social and cultural features. They are specific, measurable, achievable, realistic and time-limited.

## **2.9. Threats to Marine Protected Areas**

As a threat to MPAs, we could treat any action or process, caused by human activities or natural processes, which may have a negative impact on the protected area. For example, rapid globalization and increasing trends of trade, travel, and transport in recent decades have accelerated the rates of marine biological invasions and thus may be seen as a threats to protected areas because they increase the risk for endangered species and habitats, and hamper conservation efforts. Also, alien species can be threats because they can completely restructure ecological communities, which can lead to drastic changes in ecosystems.

The most common pressures (threats) on marine ecosystems according to OECD (2017) are listed in Figure 2.



<p><b>Overfishing and exploitation</b></p>	<p>In 2013, 31% of fish stocks were estimated as fished at biologically unsustainable levels (i.e., over-fished), compared to 10% in 1974. Of the total number of stocks assessed in 2013, fully fished stocks accounted for 58% and under-fished stocks 11% (FAO, 2016). Illegal, unreported and unregulated (IUU) fishing also continues to present challenges. About 11-26 million tonnes of fish is lost to IUU annually representing a mean loss of 18% across all fisheries (Agnew et al., 2009).</p>
<p><b>Pollution</b></p>	<p>Marine pollution occurs when harmful, or potentially harmful, effects result from the entry into the ocean of chemicals, particles, industrial, agricultural and residential waste, noise, or the spread of invasive organisms. Most sources of marine pollution (80%) are land based often from nonpoint sources such as agricultural runoff (GOC, 2014).</p>
<p><b>Habitat destruction</b></p>	<p>Habitat destruction along the coast and in the ocean results from harmful fishing practices such as trawling or dynamite fishing; poor land use practices in agriculture, coastal development and forestry sectors; and other human activities such as mining, dredging and anchoring, as well as tourism and coastal encroachment.</p>
<p><b>Climate change</b></p>	<p>Climate change is rapidly impacting species and ecosystems that are already under stress from other pressures. Climate change impacts to marine ecosystems have already resulted in either loss or degradation of 50% of salt marshes, 35% of mangroves, 30% of coral reefs and 20% of seagrass worldwide (Doney et al., 2012).</p>
<p><b>Invasive alien species</b></p>	<p>These foreign organisms are responsible for severe environmental impacts such as altering native ecosystems by disrupting native habitats, extinction of some marine flora and fauna, decreased water quality, increasing competition and predation among species, and spread of disease.</p>

Figure 2. Key pressures (threats) on marine ecosystems from OECD, 2017.

## 2.10. ECOSSE project

Project “ECOLOGICAL Observing System in the Adriatic Sea: oceanographic observations for biodiversity”, ECOSSE, is a collaboration among 10 organizations from Italy and Croatia, co-funded by Interreg Italy-Croatia CBC Programme. Project ECOSSE aims to provide an essential contribution for improving the conservation status of the habitat types and species of the marine N2K sites in the Adriatic Sea. To achieve this, ECOSSE is: Integrating knowledge through a series of case studies, assess the current state of knowledge, merge the existing data infrastructures and create a basis for integrated future ecological and oceanographic monitoring in the Adriatic. Successful marine conservation relies on much more than just ecology and oceanography. Therefore, ECOSSE will involve stakeholders from scientific community, governance, local economies and general public. Investing in our future Current marine conservation initiatives is meaningful only in the long run. This is why ECOSSE will produce educational materials to engage future generations of marine scientists and conservationists. (D.3.3.1 and ECOSSE Brochure).

The ECOSSE project, through the establishment of ECOAdS, aims at supporting the realization of an ad-hoc monitoring approach able to describe the environmental state of N2K sites in the Adriatic Sea and to identify humans’ derived pressures acting on them, and at helping the implementation of N2K network by informing the present and future conservation and management goals and sustaining the achievement of EU Nature directives’ objectives (D.3.3.1).

## 2.11. ECOAdS

ECOSSE project overall objective is the establishment of an ECOLOGICAL observing system in the Adriatic Sea (ECOAdS), shared between Italy and Croatia, and eventually extended to other Adriatic countries, able to integrate the ecological and oceanographic research and monitoring with the N2K conservation strategies.

ECOAdS will tightly connect, in a permanent and stable partnership, different actors in the science-society-policy context, within each Country and across the two Countries, through a joint partnership for the monitoring of ecosystem, biodiversity, and resources to support their management. ECOAdS will be built on the facilities, infrastructures and long-term ecological monitoring and observing systems already existing in the Adriatic Sea. (D.3.3.1).

The N2K sites considered in ECOSSE will be used as case studies for the establishment of the ecological observatory ECOAdS. The development of case studies on selected N2K sites, will allow testing the usefulness and the relevance of the ecological observing system to support significant management questions in biodiversity conservation. Following the principles of open science, data collected within the frame of ECOAdS will be made, whenever possible, available publicly through an online platform, to any private and public users which might be interested in using them.

### 3. ECOLOGICAL MONITORING OF THE N2K CASE STUDIES

This paragraph provides information on ongoing monitoring programmes in each N2K case studies, gives an overview of target habitats and species of each N2K site and provide proposals for improvements for future monitoring programmes for each N2K case studies.

#### 3.1. Current status of protection and existing monitoring programmes in each N2K site

With respect to target species and habitats on each N2K site, different monitoring programmes are performed. Table 1 shows comparison of target habitat types for each N2K site. Depending on target species and habitats in each N2K site, different ecological parameters are measured.

Table 1. Comparison of the N2K sites considered in the ECOSSE project for what regards number of habitat types (Bioportal.hr; <https://natura2000.eea.europa.eu/>)

N2K site name and code	Area (Ha)	Number of habitat types
Po River delta Tratto Terminale Delta Veneto (IT3270017)	25362	20
Po river delta (IT3270023)	25012	20

Tegnùe di Chioggia (IT3250047)	2655	1
Trezze San Pietro e Bardelli (IT3330009)	2380	2
Cres-Lošinj (HR3000161)	52575	1
Viški arhipelag (HR3000469)	51889	1
Malostonski zaljev (HR4000015)	6044	2

It can be seen from Table 1 that some N2K case studies include numerous habitat types, while some of them include just 1 or 2. Nevertheless, each N2K case study of the project ECOSSE is very valuable for the Adriatic area considered in the project. In the following paragraphs, each N2K site is described in terms of their ecological value. Besides this, for each N2K site current monitoring programmes are stated. Current monitoring programmes are derived from filled questionnaires by project partners who are either in charge of management (Delta del Po, PI Sea and Karst and PIDNIC) or conduct monitoring on individual N2K sites (BWI, OGS and SHORELINE) and through online meeting held to discuss in even more detail.

### **3.1.1. IT 3270017 Po River delta Tratto Terminale Delta Veneto and IT3270023 Delta del Po**

The two Italian Delta del Po N2K sites are geographically overlapping and they compose a single river-delta-sea system with the same species. For the aim of this project and based on expert opinion, only species strongly dependent on the marine environment, where they can be observed regularly or during some stages of their life cycle, are considered. In particular, different migratory and sedentary seabirds (*Sterna albifrons*; *Sterna hirundo*; *Sterna sandvicensis*; *Sterna nilotica*; *Sterna caspia*; *Larus ridibundus*; *Larus genei*; *Larus melanocephalus*; *Phalacrocorax aristotelis*) all listed in the Annexes I and II of the BD, can be observed in colonies in lagoons, coastal dunes, and on sea water surface during different seasons while feeding, resting or nesting (D.3.3.1).

IT 3270017 Po River delta Tratto Terminale Delta Veneto is characterized by a stretch of river of considerable size and flow, with a delta system, coastal dune systems, valley wetlands, sandy formations (sandbanks) and river islands with floodplains and lakes. The site has complex vegetational associations, with extensive reeds and psammophilous and halophilic series, but also thermophilic forest flaps and hygrophilous wrecks (D.4.1.1).

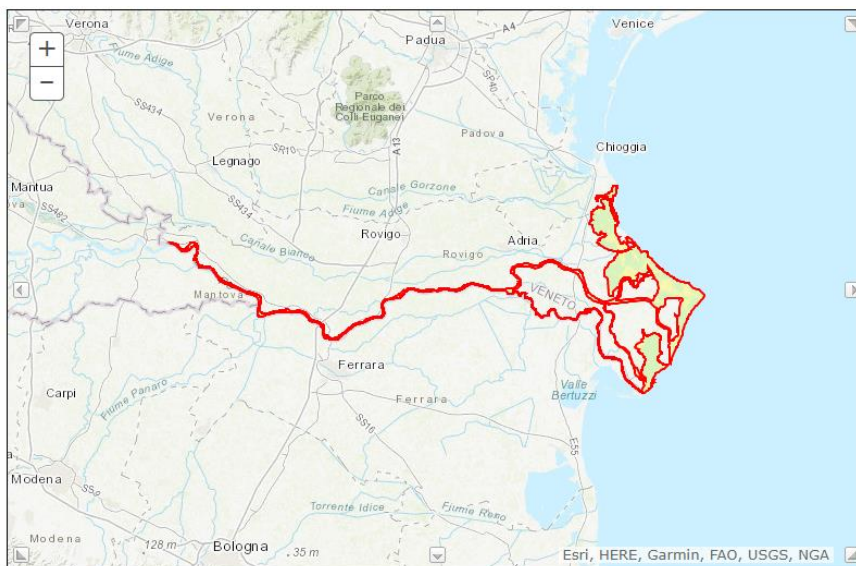


Figure 3. IT 3270017 Po River Tratto Terminale Delta Veneto. (D.4.1.1).

IT3270023 Delta del Po is characterized by a stretch of river of considerable size and flow, with a delta system, coastal dune systems, valley wetlands, sandy formations (stalls) and river islands with floodplains and lakes, with associations typically belonging to the psammophilic series and, limited to some areas, relict flaps of forests. The area constituted by the fluvial branches of the Po hosts hygrophilous woods of *Salix* sp.pl. and *Populus alba*. In the floodplains there are floating meadows of *Trapa natans*. The unique sandy formations are colonized by psammophilous and halophile vegetation. The valley part is characterized by the presence of a complex system of reeds, sandbanks, canals and marshes with large portions used mainly for fish farming. The natural landscape is characterized by free water spaces with submerged macrophytic vegetation and large, flat islets housing types and halophilic genus. It is an important site for nesting,

migration and wintering of water birds, including species from the order Charadriiformes. Some floodplain areas with vast reeds and tree cover specifically allow the nesting of Ardeidae, Rallidae and Passerines. Presence of complex vegetational associations, with extensive reeds and psammophilous and halophilic series. Forest flaps contains thermophilic and hygrophilous vegetation. Presence of rare or phytogeographically interesting plant species, many of them reported in the "Red Book of Italian Plants" (D.4.1.1).

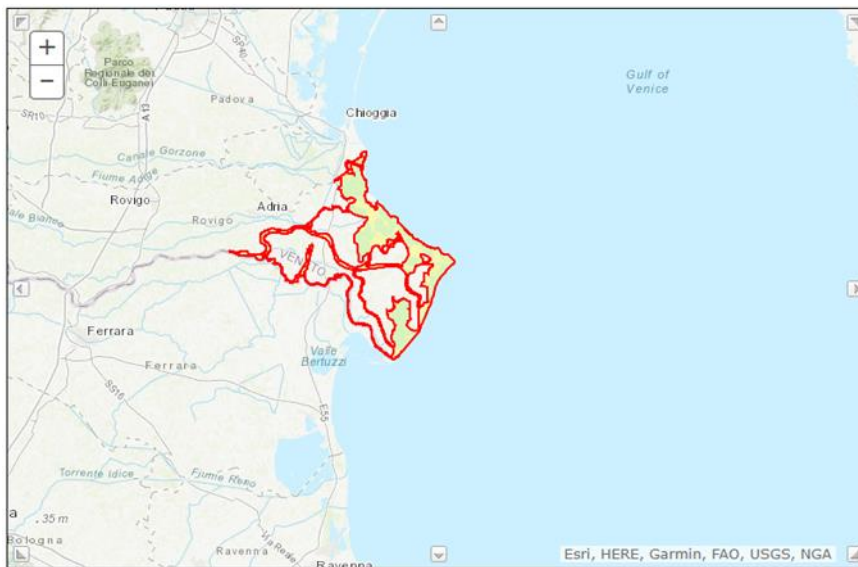


Figure 4. IT3270023 Delta del Po (D.4.1.1).

Current monitoring programmes on these two N2K sites are shown in Table 2.

Table 2. Current monitoring programmes in IT 3270017 Po river delta Tratto Terminale Delta Veneto and IT 3270023 Po river delta.

NAME OF THE MONITORING PROGRAMME	<b>Integrated monitoring programme of transitional water bodies in according to legislative decree n. 152/2006 (aimed to chemical and ecological status classification and to assessment of the quality of shellfish waters -specific destination waters)</b>	<b>Integrated monitoring programme of transitional water bodies in according to legislative decree n. 152/2006 (aimed to chemical and ecological status classification and to assessment of the quality of shellfish waters -specific destination waters)</b>
STATIONS	Coastal lagoons of Caleri, Marinetta, Vallona, Barbamarco, Canarin, Scardovari; Mouths of Po river (Po di Maistra, Po di Pila, Po di Tolle, Po di Gnocca, Po di Goro)	Coastal lagoons of Basson, Canarin, Scardovari, Vallona, Marinetta
ECOLOGICAL PARAMETERS MONITORED	Macrophytes	Temperature, pH, conductivity at 25°C, Salinity, Dissolved Oxygen mg/l
INSTITUTION IN CHARGE TO CARRY OUT THE MONITORING	ARPAV – Agenzia Regionale per la Prevenzione e Protezione Ambientale del Veneto	ARPAV – Agenzia Regionale per la Prevenzione e Protezione Ambientale del Veneto

As main deficiency in existing monitoring programmes Parco Delta del Po pointed that data are not always collected in continuous and that there's a space for improvement, which means that some lagoons need more monitoring stations.

### 3.1.2. IT 3250047 Tengùe di Chioggia

This marine environment consists of coralligenous outcrops of variable extension (from the few square meters of the smallest outcrops up to over a thousand square meters) locally called *tengùe* or *trezze*. It is possible to identify outcrops of great extent and discrete elevation that constitute the only hard substrates of natural origin in a mainly sandy-silty bottom. The presence of these structures provides a support on which sessile organisms can attach. The occasional presence

of *Chelonia mydas* has been found, although with non-significant populations. On 3 August 2002, Zona di Tutela Biologica - ZTB was established by Ministerial Decree. Professional and sport fishing are prohibited and recreational diving is regulated, allowing anchoring exclusively to special buoys upon notice to the association that manages it. (D.4.1.1).

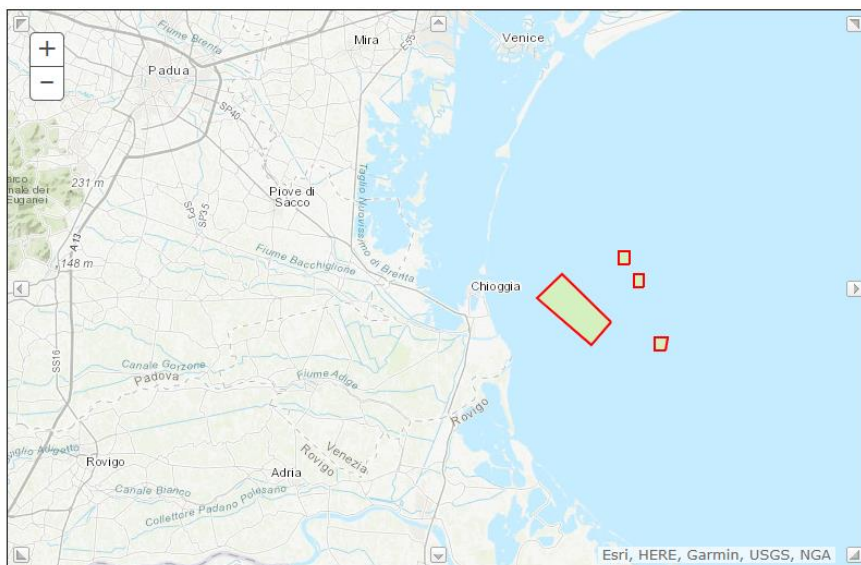


Figure 5. IT 3250047 Tegnù di Chioggia (D.4.1.1).

Current monitoring programmes in IT 3250047 Tegnù di Chioggia are shown in Table 3.

Table 3. Current monitoring programmes in IT 3250047 Tegnù di Chioggia.

NAME OF THE MONITORING PROGRAMME	Seagrasses and macroalgae monitoring UNITS and FVG Region	Coralligenous monitoring UNITS; TRETAMARA; PRIN ReefReseArch Resistance and resilience of Adriatic mesophotic biogenic habitats to human and climate change threats Research project of national interest
STATIONS	Within IT 3250047 Tegnù di Chioggia	Within IT 3250047 Tegnù di Chioggia
ECOLOGICAL PARAMETERS MONITORED	a) Biological parameters: chlorophyll a, zooplankton abundance,	Spatial distribution, species richness, density, coverage,



	<p>microphytoplankton abundance, microzooplankton abundance, picoplankton abundance, nanoplankton abundance, biomass, microphytobenthos abundance, macrozoobenthos abundance, meiobenthos abundance</p> <p>b) Biological processes: primary production, secondary production, exoenzymatic activities in water and sediment</p> <p>c) Physical parameters (atmosphere): air humidity, air temperature, air pressure, wind direction, wind speed, wind gust</p> <p>d) Physical parameters (sea): pressure, water temperature, water salinity, water transparency, conductivity, fluorescence, turbidity</p> <p>e) Chemical parameters: dissolved oxygen, pH, alkalinity, dissolved organic carbon, dissolved organic nitrogen, dissolved organic phosphorus, inorganic carbon, particulate organic carbon, particulate nitrogen, particulate phosphorus, dissolved macronutrient concentration (N-NH<sub>4</sub>, N-NO<sub>3</sub>, N-NO<sub>2</sub>, P-PO<sub>4</sub>, Si-SiO<sub>4</sub>)</p>	<p>community structure and dynamic</p>
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INSTITUTION IN CHARGE TO CARRY OUT THE MONITORING	UNITS, CNR VENICE, OGS	UNITS, OGS AND SHORELINE
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OGS pointed out deficiencies in existing monitoring programmes: inside the protected areas monitoring have been carried out only occasionally in the past and there are no long-term, continued and consistent data. In addition, water quality data, chemical and physical characteristics can be in part derived from monitoring facilities in the proximity (i.e. buoys), or from remote sensing (i.e. chl from satellite), or from modelling outputs (current field components), but which is not the case for ecological data (community structure and composition).

Furthermore, OGS recommended additional monitoring programme because for ecological data (community structure and composition) a continuous/recurring monitoring should be implemented. OGS also recommend that at least the visual observation of the accumulation of marine litter should be carried out and that the effect of human activities (i.e. poaching, scuba diving, commercial fishing) on target species should be assessed.

### 3.1.3. IT3330009 Trezze san Pietro e Bardelli

The site is based around rocky outcrops known locally as trezze, characterized by substrates of various origins (clastic sedimentary, sedimentary sediments, organogenic) and with extent ranging from a few to several hundred meters. The geological nature of the outcrops reveals that not all of them can be attributed to bioconstruction, but there are also slabs deriving from the cementation of sand or rocks by methane gas. From recent research, around 250 outcrops have been identified only in the Gulf of Trieste between Punta Sdobba and Punta Tagliamento; the most widespread range of these outcrops is on the seabed in front of the lagoon of Grado and Marano at a distance from the coastline of between 2 and 17 km, and a depth varying between 8,3 and 21,5 m. The areas involved in rocky outcrops extend from the Gulf of Trieste to the coast of Ancona, along the entire north-western and western coast of the North Adriatic. The calcareous concretions are attributable to corallinaceous algae and secondly to bryozoa, molluscs (*Arca noae*, *Chama gryphoides*), anthozoans (*Cladocora caespitosa*), serpulids (*Serpula concharum*, *Serpula vermicularis*, *Pomatoceros triqueter*, *Rotula* sp.plur.). The typology of the San Pietro and

Bardelli trezze is of the tabular type consisting of a fractioned set of many outcrops of the same type, however there are some major elements of larger dimensions (D.4.1.1).

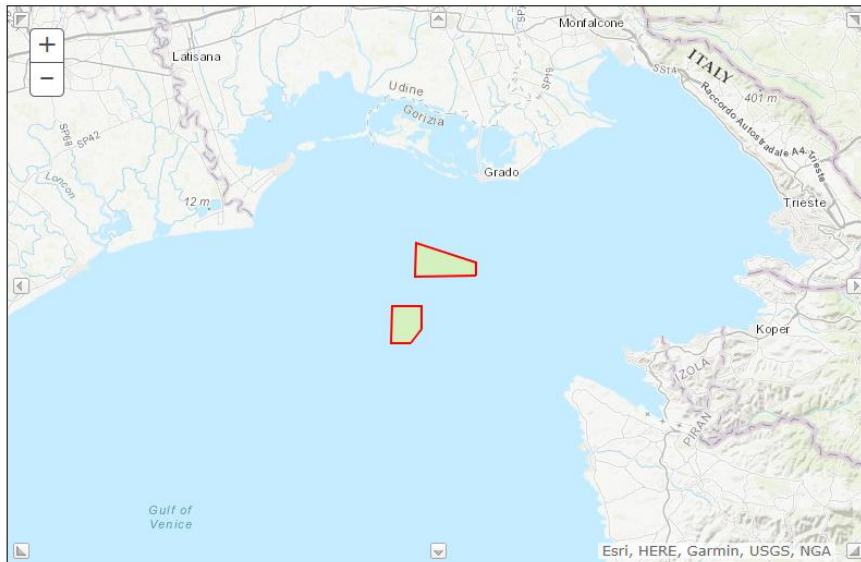


Figure 6. IT3330009 Trezze san Pietro e Bardelli (D.4.1.1).

Current monitoring programmes in IT 3330009 Trezze San Pietro e Bardelli are shown in table 4.

Table 4. Current monitoring programmes in IT 3330009 Trezze San Pietro e Bardelli.

NAME OF THE MONITORING PROGRAMME	Adrireef - Interreg ITA/CRO	TRETAMARA - Interreg ITA/SLO	RESTORFAN – Medpan project	Marine Strategy – Minambiente	Visual census of the seafloor by ROV	Seagrasses and macroalgae monitoring UNITS (University of Trieste) and FVG Region	Coralligenous monitoring UNITS; TRETAMARA; PRIN ReefReseArch Resistance and resilience of Adriatic mesophotic biogenic habitats to human and climate change threats Research project of national interest
STATIONS	San Pietro	San Pietro and Bardelli	San Pietro and Bardelli	San Pietro and Bardelli	Gulf of Trieste, in three areas (one area designed to study Maerl habitat and two areas to study human impacts on the seafloor). Every area has three sampling stations	Gulf of Trieste	Gulf of Trieste
ECOLOGICAL PARAMETERS MONITORED	Monitoring of fishes and macrofauna	Monitoring of fishes, macrofauna, <i>Pinna nobilis</i> and <i>Cladocora coespitosa</i>	Monitoring of <i>Pinna nobilis</i>	Monitoring of <i>Pinna nobilis</i>	Calcareous red-algae (Maerl/Rodoliths) distribution and human impacts on the seafloor (e.g. trawling)	a)Biological parameters: chlorophyll a, zooplankton abundance, microphytoplankton abundance, microzooplankton abundance, picoplankton abundance, nanoplankton abundance, biomass, microphytobenthos abundance, macrozoobenthos abundance, meiobenthos abundance; b)Biological processes: primary production, secondary production, exoenzymatic activities in water and sediment; c)Physical parameters (atmosphere): air humidity, air temperature, air pressure, wind direction, wind speed, wind gust; d)Physical parameters (sea): pressure, water temperature, water salinity, water transparency, conductivity, fluorescence, turbidity; e)Chemical parameters: dissolved oxygen, pH, alkalinity, dissolved organic carbon, dissolved organic nitrogen, dissolved organic phosphorus, inorganic carbon, particulate organic carbon, particulate nitrogen, particulate phosphorus, dissolved macronutrient concentration (N-NH4, N-NO3, N-NO2, P-PO4, Si-SiO4)	Spatial distribution, species richness, density, coverage, community structure and dynamic
INSTITUTION IN CHARGE TO CARRY OUT THE MONITORING	Istituto Nazionale di Oceanografia e di Geofisica Sperimentale	Istituto Nazionale di Oceanografia e di Geofisica Sperimentale	WWF Miramare Marine Protected Area (SHORELINE)	ARPAFVG (Agenzia Regionale per la Protezione dell'Ambiente del Friuli Venezia Giulia)	ARPAFVG	UNITS, OGS	UNITS, OGS AND SHORELINE

Shoreline pointed out, as a main deficiency in existing monitoring programmes, the low frequency and recommended additional monitoring programme of cetaceans and pelagic fauna.

As for Tegnùe, OGS pointed out deficiencies in existing monitoring programmes: inside the protected areas monitoring have been carried out only occasionally in the past and there are no long-term, continued and consistent data. In addition, water quality data, chemical and physical characteristics can be in part derived from monitoring facilities in the proximity (i.e. buoys), or from remote sensing (i.e. chl from satellite), or from modelling outputs (current field components), but which is not the case for ecological data (community structure and composition).

Furthermore, OGS recommended additional monitoring programme because for ecological data (community structure and composition) a continuous/recurring monitoring should be implemented. Also, OGS recommend at least visual observation of the accumulation of marine litter should be carried out and that the effect of human activities (i.e. poaching, scuba diving, commercial fishing) on target species should be assessed.

#### **3.1.4. HR3000161 Cres-Lošinj**

This large marine site is located in the Kvarner area around the sheltered coast and waters of the eastern part of the Lošinj and Cres archipelago (Figure 5). It is one of the most important feeding and breeding areas for bottlenose dolphins (*Tursiops truncatus*) in the Eastern Adriatic. Lithostratigraphic units represented on the coast are dolomites and post sedimentary diagenetic breccia (upper Albian, lower Cenomanian), rudist limestones (Cenomanian-Maastrichtian). Soils on the coast are rocky ground, anthropogenic soil on karst. In July 2006, a preventive protection of a part of the Kvarner region (Cres-Lošinj Special Marine Reserve – CLSMR) was declared for 3 years as a Special Marine Reserve (D.4.1.1).

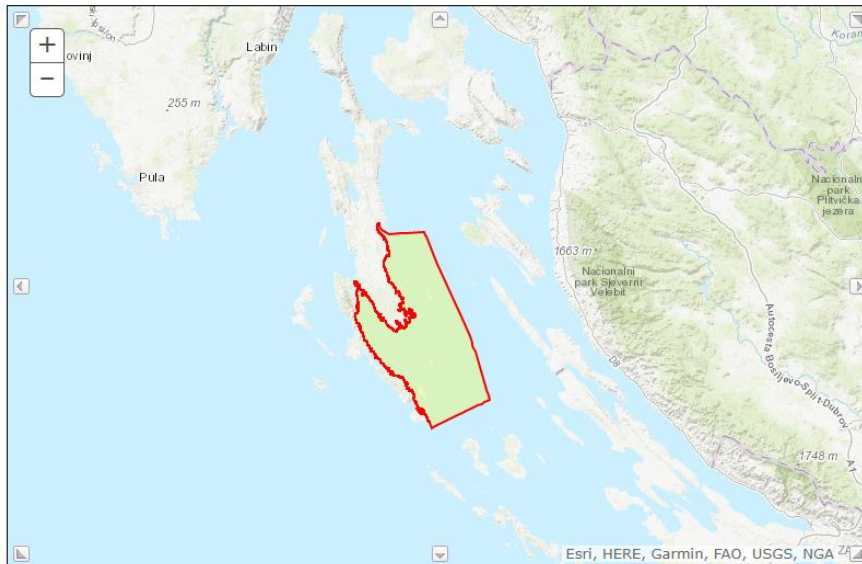


Figure 7. HR3000161 Cres – Lošinj (D.4.1.1).

This area is an important site for the Mediterranean population of the loggerhead sea turtle (*Caretta caretta*), Mediterranean endemic seagrass (*Posidonia oceanica*), coral biocenoses, and nesting sites of the common European Shag (*Phalacrocorax aristotelis*).

The target species of the site is the bottlenosed dolphin (*Tursiops truncatus*). Due to the continuous research effort by the BWI, there has been more recent data on the target population suggesting that Kvarnerić hosts a discrete, resident bottlenose dolphin population of around 200 individuals. It is important to emphasize that presence of mother–calf pairs in all years indicates the importance of this area for all stages of this species life cycle (D.4.1.1).

Current monitoring programmes in HR3000161 Cres-Lošinj are shown in table 5.

Table 5. Current monitoring programmes in HR3000161 Cres-Lošinj.

NAME OF THE MONITORING PROGRAMME	<b>Adriatic Dolphin Project</b>
STATIONS	Mostly concentrated within the Cres-Lošinj site, with significant parts of surrounding areas also covered, albeit with less intensity
ECOLOGICAL PARAMETERS MONITORED	Population dynamics, Population structure, Habitat use, Spatial distribution, Foraging
INSTITUTION WHO'S IN CHARGE TO CARRY OUT THE MONITORING	BWI

The main deficiency in the current monitoring program, as BWI pointed out, is the lack of genetic data on the target species and of fine-scale environmental and fisheries data that would help describe ecology of the target species. In addition, BWI recommended additional monitoring programmes: biopsy sampling is required to obtain samples for genetic analyses, in order to better understand processes affecting the well-being of the local, resident bottlenose dolphin community inhabiting this N2K site.

### 3.1.5. HR3000469 Viški akvatorij

This large marine site covers a wider marine area around the Island of Vis and the Island of Biševo, except the marine areas surround the same islands in a buffer 500 m from the coast, which are covered by other N2K sites. This marine site has an area of 51.888,50 hectares.

In 2003, the international ecological organization World Wildlife Fund declared the Vis archipelago one of the 10 “last paradise oases of the Mediterranean”, thus including it, together with the islands of Mljet and Lastovo, in the “Adriatic Blue Corridor”, based on scientific research which revealed that this maritime zone has the largest biodiversity in the Mediterranean. In 2019, due to significant geological and geomorphological importance of the Vis archipelago, it has been designated officially as a UNESCO Global Geopark (D.4.1.1).



Figure 8. HR3000469 Viški akvatorij (D.4.1.1).

The target species of the site is the bottlenose dolphin (*Tursiops truncatus*). In the area of the Vis Archipelago some other Cetacean species are seen: the striped dolphin (*Stenella coeruleoalba*), fin whale (*Balaenoptera physalus*) and Risso's dolphin (*Grampus griseus*). It is an area of high underwater biodiversity importance.

During research performed by the BWI, several other species were observed: giant devil rays (*Mobula mobular*), blue-fin tuna (*Thunnus thynnus*), swordfish (*Xiphias gladius*), Eleonora's falcons (*Falco eleonora*), Mediterranean flying fish (*Cheilopogon heterurus*), Yelkouan shearwater (*Puffinus yelkouan*) and Scopoli's shearwaters (*Calonectris diomedea*), and European shags (*Phalacrocorax aristotelis*) among others. There are also occasional unconfirmed reports of sightings of monk seals (*Monachus monachus*), great white sharks (*Carcharodon carcharias*) and other endangered animals (D.4.1.1). Table 6. shows current monitoring programmes in HR 3000469 Viški akvatorij.



Table 6. Current monitoring programmes in HR 3000469 Viški akvatorij.

NAME OF THE MONITORING PROGRAMME	<b>Monitoring of bottlenose dolphins</b>	<b>Monitoring of parameters needed for evaluation of the state of descriptors according to Adriatic Monitoring Plan enabling fulfilment of obligations of the Republic of Croatia according to MSFD</b>	<b>Systematic research of water quality in transitional and coastal waters of the Republic of Croatia</b>
STATIONS	Mostly concentrated within the Viški akvatorij site, with significant parts of surrounding areas also covered, albeit with less intensity	Within the Viški akvatorij N2K site	Within the Viški akvatorij N2K site
ECOLOGICAL PARAMETERS MONITORED	Population dynamics, Population structure, Habitat use, Spatial distribution	Descriptors (D)5 and partly D1, D2, D4, D7, D10 and D11 from Marine Strategy Framework Directive (MSFD), Phyto- and zooplankton community; Benthic invertebrate fauna; Angiosperms; Macroalgae Migration/introduction of non-indigenous species; Angiosperms/Benthic invertebrate fauna/Macro-	Supportive physico-chemical parameters and chlorophyll a, -biological quality elements (required by the WFD), -specific RB pollutants (Zn and Cu); -hydromorphological alterations; -chemical status (priority substances in water, sediment and biota), Benthic invertebrate fauna; Macroalgae; Phytoplankton community

	on, Foraging	algae community alterations; Trophic functioning of marine food web; Ocean warming; Eutrophication; Freshwater input; Sedimentation; Water circulation, Pollution	
INSTITUTION IN CHARGE TO CARRY OUT THE MONITORING	BWI	IZOR	IZOR

As the main deficiencies in existing monitoring programme of bottlenose dolphins, PI Sea and Karst highlighted that the monitoring are not conducted on regular basis because of the lack of resources (experts for marine mammals as well as funds). Also, they pointed on restricted data and give suggestion to cooperate more with BWI.

### 3.1.6. HR400015 Malostonski zaljev

Mali Ston Bay is an elongated, narrow bay in Dubrovnik-Neretva County southeast of the Sreser-Duba line to Kuta Bay (Figure 9). The ecological conditions in the bay are greatly influenced by the surface run-off and groundwater run-off from the mainland, and by the currents coming from the open sea. The influence of the Neretva River varies, it is occasionally more pronounced in outer and middle part of Mali Ston Bay, while strong underwater freshwater springs in the inner part of the bay have a more significant impact on the inner part of the bay. Owing to the nutrient concentration and the amount of phytoplankton, Mali Ston Bay is a naturally moderate eutrophic ecosystem. Specific biocenoses are inhabited by a large number of filter feeding organisms, among them commercially significant shellfish which has been consumed and farmed from ancient times, especially European flat oyster *Ostrea edulis*. The majority of the benthic algal flora consists of *Cystoseira* settlements which grow on the rocky bottom at 5 m of depth.



Figure 9. HR4000025 Malostonski zaljev (D.4.1.1)

N2K site Malostonski zaljev (HR4000015) is a completely marine area and a part of a Special reserve in the sea Malostonski zaljev Bay declared in 1983. According to the proclamation act, Malostonski zaljev (HR4000015) belongs to the habitat class N01 Marine areas and Sea inlets, and two habitat types are present at the site: mainly 1160 large shallow inlets and bays and small area 1170 Reefs.

Mali Ston Bay HR4000015 includes only the marine area, officially protecting just two habitat types important for the European Union 1160 - large shallow bays and coves (5718.76 ha), and partially (325 ha) 1170 - reefs (Bioportal, 2020). Other habitat types and associated habitats, even those which occupy large areas, have been neglected. In the outer part of the Mali Ston Bay, habitats typical for habitat type 1150 - coastal lagoons and habitats 1120 – *Posidonia* beds and 1110 - sandy bottoms permanently covered by the sea were also recorded. The area defined as Mali Ston Bay HR4000015 is mostly a part of the Special Marine Reserve, Mali Ston Bay and Malo more, which aims to preserve traditional bivalve shellfish farming, primarily European flat oyster, the species which is regionally extinct in many parts of Europe.

Furthermore, it is necessary to take into account the present protected species among which they are: algae *Cystoseira spinosa* (*C. adriatica*), *Cystoseira foeniculacea* and *Cystoseira crinitophylla*, *Fucus virsoides*, seagrasses *Posidonia oceanica* and *Cymodocea nodosa*, sponges *Sarcotragus foetidus*, *Sarcotragus spinosulus*, *Tethya citrina*, *Tethya aurantium* and *Geodia cydonium*, a cnidarian *Cladocora caespitosa* and bivalves *Lithophaga lithophaga*, *Pholas dactylus* and *Pinna nobilis*, a fish seahorse *Hippocampus guttulatus*. Besides indigenous organisms, there are a number of non-indigenous ones, such as green algae *Caulerpa cylindracea* and *Caulerpa racemosa*, red algae *Asparagopsis armata*, a sponge *Paraleucilla magna*, a polychaete *Hydroides elegans*, nudibranchs *Bursatella leachii* and *Melibe viridis*, a bryozoan *Amathia verticillata* (Cvitković and Žuljević, personal communication).

Current monitoring programmes in HR4000015 Malostonski zaljev are listed in table 7.

Table 7. Current monitoring programmes in HR4000015 Malostonski zaljev.

NAME OF THE MONITORING PROGRAMME	Monitoring of parameters needed for evaluation of the state of descriptors according to Adriatic Monitoring Plan enabling fulfilment of obligations of the Republic of Croatia according to MSFD	Systematic research of water quality in transitional and coastal waters of the Republic of Croatia	Monitoring of the distribution of <i>Ostrea edulis</i> larvae in Mali Ston Bay	The annual plan for monitoring the quality of the sea and bivalves	Aquatic animal health monitoring	Monitoring of Mali Ston Bay - the biological state of ecosystem
STATIONS	5 marine reporting units (MAD-HR-MRU1; MAD-HR-MRU2; MAD-HR-MRU3; MAD-HR-MRU4; MAD)	25 transitional water bodies; 26 coastal water bodies (whole Croatian waters)	Mali Ston Bay	Mali Ston Bay - 43 stations	5	4
ECOLOGICAL PARAMETERS MONITORED	Descriptors (D)5 and partly D1, D2, D4, D7, D10 and D11 from Marine Strategy Framework Directive (MSFD), Phyto- and zooplankton community; Benthic invertebrate fauna; Angiosperms; Macro-algae; Migration/introduction of non-indigenous species; Angiosperms/Benthic invertebrate fauna/Macro-algae community alterations; Trophic functioning of marine food web; Ocean warming; Eutrophication; Freshwater input; Sedimentation; Water circulation, Pollution	Supportive physico-chemical parameters and chlorophyll a, -biological quality elements (required by the WFD), -specific RB pollutants (Zn and Cu); -hydromorphological alterations; -chemical status (priority substances in water, sediment and biota), Benthic invertebrate fauna; Macro-algae; Phytoplankton community	Sporadic time distribution of <i>Ostrea edulis</i> larvae during the spawning season	Microbiological quality of water, microbiological quality of bivalve tissue, biotoxins, metals, benzo(a)pyrene, benzo(a)anthracene, benzo(b)fluoranthene, chrysene, phytoplankton abundance and composition, prevalence of NoV (norovirus)	Presence of <i>Marteilia refrigens</i> and <i>Bonamia ostreae</i>	Phytoplankton abundance and composition, primary production, qualitative composition of zooplankton, salinity, temperature, nutrients
INSTITUTION IN CHARGE TO CARRY OUT THE MONITORING	IZOR	IZOR	Dubrovnik-Neretva County, Institute for sea and coastal area	Croatian Veterinary Institute and IZOR	Croatian Veterinary Institute	Institute for marine and coastal research University of Dubrovnik

### 3.2. Proposals for improvements of ecological monitoring in N2K sites

Marine protected area networks are important not only for biodiversity conservation but also as management and learning tools (Dayton et al. 2000; Guidetti 2002). Moreover, marine protected areas provide baseline information on natural systems, which assists researchers in determining ecological impacts of climate change and natural environmental variability (Dayton et al. 2000). Conducting monitoring is important for measuring success toward management objectives and for applying active adaptive management principles to marine conservation. Ecological monitoring can contribute to maintain interest and support from stakeholder groups by demonstrating short- and long-term successes. However, there are often some challenges while conducting monitoring programmes in protected areas. Mostly, they include lack of sufficient human resources (staff, capacity), financial resources, equipment and infrastructure, management plans, and knowledge (data bases). To bring out all these factors, the project partners contributed by filling a questionnaire and through an ad-hoc online meeting, which was held to discuss about D.3.2.1. According to the present target species and habitats and current monitoring programmes, and besides already proposed improvements from filled partner's questionnaire, there are some additional proposals for improvements of future ecological monitoring in N2K case studies:

- Strengthening the monitoring system of MPAs and their capacities;
- Covering all aspects of MPA governance, but also socio-economic and biological monitoring as well as any aspects linked to climate change and the arrival and evolution of invasive species in and around the MPA;
- Establishing monitoring protocols, for both Italy and Croatia, which can help to provide guidance to MPA managers, as well as to streamline monitoring methods across MPAs so as to facilitate comparison;
- Creation of national or regional online databases with openly available information, which could increase transparency and enable the sharing of information and lessons learned across different MPAs, their respective management approaches, and their effectiveness in achieving managements goals.

## 4. CONSERVATION MEASURES IN THE N2K CASE STUDIES

This paragraph presents current status of conservation in each N2K site, shows the threats for each N2K site and proposes potential future conservation strategies for N2K case studies.

### 4.1. Current status of conservation in each N2K site

As it can be seen below, it can generally be said that in both Italian and Croatian N2K SDF files conservation strategies, if defined, are focused on reducing and removing potential pressures present on individual N2K sites.

As for IT3270017 Po river delta Tratto Terminale Delta Veneto, conservation strategy for IT3270023 Delta del Po should be focused on minimizing negative impacts or preventing potential impacts on target species and habitats as listed in the N2K SDF. At the moment, both sites lack an approved conservation and management plan.

For IT3250047 Tegnùe di Chioggia there is a lack of a management plan, thus no conservation strategy is enacted at present. Some activities are forbidden/regulated: professional and sport fishing are prohibited and recreational diving is regulated, allowing anchoring exclusively to special buoys upon notice to the association that manages it (Ordinance 32/06 of the Coast Guard of Chioggia).

For IT3330009 Trezze san Pietro e Bardelli site there is currently a lack of conservation and management plan, thus no conservation strategy is enacted at present.

Conservation strategies for HR4000015 Malostonski zaljev and HR3000161 Cres-Lošinj sites also don't have official definition, but they should be generally focused on minimizing negative impacts or preventing potential impacts. Also, both N2K sites don't have management plans.

The conservation strategy for HR3000469 Viški akvatorij should be generally focused on minimizing negative impacts or preventing potential impacts, as listed in N2K SDF. The Public Institution „Sea and Karst” generally has small possibilities for active management of this site, due to its own capacities, as well as low legal authorities. Besides, some potential threats are far beyond any local level, such as marine macro-pollution. This site also doesn't have management plan.

Marine conservation is quite challenging because of knowledge gaps, methodological limitations and heterogeneity in the geographical extent of available data and collaborations. The increasing

pressures on marine biodiversity and the drivers behind these pressures can't be always effectively managed. The effectiveness of future conservation depends on understanding of ecosystem functionality and resilience across various temporal and spatial scales.

#### **4.2. Identification of threats in each N2K site**

Since conservation strategies are mainly aimed at reducing and relieving pressures on N2K sites, below the identified threats to each N2K site are presented. Threats to N2K sites, for this deliverable, were collected via online meeting with partners, which was held to discuss about D.3.2.1, and they are listed in Table 8 for each N2K site.

Also, threats are defined in order to define more clearly conservation strategies and to orient potential future management strategies for N2K case studies.



Table 8. Identified threats and pressures on N2K case studies.

Identified threats and pressures for HR3000469 Viški akvatorij	Identified threats and pressures for HR 3000161 Cres-Lošinj	Identified threats and pressures for HR4000015 Malostonski zaljev	Identified threats and pressures for IT3330009 Trezze San Pietro e Bardelli	Identified threats and pressures for IT3250047 Tegnùe di Chioggia	Identified threats and pressures for IT3270017 Delta del Po: tratto terminale e delta veneto and IT3270023 Delta del Po
Noise and disturbance from nautical tourism and recreational activities; ports, water pollution, marine litter (microplastic), commercial fishing, climate change.	Noise and disturbance from nautical tourism and recreational activities; ports, water pollution, marine litter (microplastic), commercial fishing, climate change.	Anthropogenic eutrophication and pollution from mainland, coastal development and human activities, poaching, sewage, marine litter especially from aquaculture, poaching of <i>Lithophaga lithophaga</i> , climate change, diseases of <i>Pinna nobilis</i> and <i>Ostrea edulis</i> , development of facilities on the karstic mainland, urbanisation.	Shipping lanes, ports, marine construction, water pollution, fishing, marine litter, noise pollution, aquaculture and recreational activities, nutrient load and pollution from the mainland, sczba diving disturbance, illegal fishing, burial due to bottom trawling performed in neighbouring areas, increased sea water temperature, climate change and acidification.	Shipping lanes, ports, marine construction, water pollution, fishing, marine litter, noise pollution, aquaculture and recreational activities, nutrient load and pollution from the mainland, sczba diving disturbance, illegal fishing, burial due to bottom trawling performed in neighbouring areas, increased sea water temperature, climate change and acidification.	Maintenance works in channels, soil leaching and erosion, changes in water circulation, flow and sedimentation rates, human induced changes in hydraulic conditions, rising of the salt wedge, sea level rise, climate change, invasive species, discharges and pollution, aquaculture, commercial and recreational fishing, destruction of native habitats of target species, tourism and other recreational activities, shipping lanes, ports, marine constructions, noise pollution, beach nourishment, estuarine and coastal dredging, trampling, use of fertilizers in agriculture.

### 4.3. Proposed conservation strategies for N2K case studies

All the proposed conservation strategies are listed in table 9. These were collected through a questionnaire filled by each individual partners who are either in charge of management (Delta del Po, PI Sea and karst and PIDNIC) or who conduct monitoring on individual sites (BWI, OGS and SHORELINE) and through online meeting held to discuss in even more detail.

PI Sea and Karst proposed conservation strategies for Viški akvatorij N2K site. PI sees its role in raising activities among local population and tourist agencies aimed on minimizing disturbance of dolphins by boat traffic, either intentionally (dolphin watching for tourists) or unintentionally due to heavy traffic. Intentional killing of dolphins by fishermen is not listed in SDF N2K file as threat, although this possibility should not be neglected. In any possible activity, PI should collaborate with BWI, an organisation specialised for dolphin conservation, and also should support them in carrying out regular monitoring activities. Also, PI suggests that collected data should be available to the management authority.

BWI proposed conservation strategies for the Cres-Lošinj N2K site, since the institute conducts monitoring programmes on this N2K case study. Like PI Sea and Karst, BWI proposed measures countering lethal interactions with fisheries. Also, BWI proposes introduction of measures ensuring connectivity with other Adriatic sub-populations. Furthermore, BWI pointed that Cres-Lošinj N2K site currently does not encompass the whole home range of the local resident bottlenose dolphin community so the extension of this N2K site could be revised for ensuring a wider protection if this species. Finally, BWI proposes reducing the number and/or intensity of activities that cause displacement of target species (marine traffic as underwater noise generator).

PIDNIC and the University of Dubrovnik proposed conservation strategies for Malostonski zaljev N2K site. As first conservation strategy, PIDNIC PIDNIC has suggested that the protection objectives be aimed at preserving the traditional values of the area such as shellfish growing. Namely, the selection of areas for the N2K network does not take into account socio-economic issues, although the coexistence of man and nature is encouraged. It means that the selection of

areas should be valuable for endangered species and habitats as well as the inclusion and the ensuring of the most harmonious development of human activities through area management mechanisms in the N2K are necessary. To make this possible, it is necessary to inventory the components of biodiversity, monitor and periodically evaluate the state of natural values, actively support sustainable bivalve shellfish farming as part of cultural heritage and traditional values that significantly affect the preservation of natural values of Mali Ston Bay. In addition, it is necessary to ensure the sustainable use of natural suppliers without significant damage to parts of nature and with the least possible disturbance of the balance of its compositions. Also, it is necessary to be more efficient in existing laws implementation in the N2K area - to control poaching more. The ecosystem in N2K site Malostonski zaljev is under crucial influence of the mainland, so the surrounding mainland must be monitored and controlled too.

OGS and SHORELINE proposed conservation strategies for Trezze San Pietro e Bardelli N2K site, since they conduct monitoring on this site. They have proposed prohibition of (i) anchorage on the rocky outcrop (thus avoiding damaging the rocky part), (ii) practicing professional fishing with trawls, blowers, dredges, purse seines, boat seines, beach seines and similar nets on seagrass meadows and on the coralligenous habitat, (iii) collection, removal, damage to rock and mineral formations, and (iv) alteration of geophysical environment cause it causes modifications of geology, geomorphology, morphology etc. Furthermore, they suggested setting low impact buoys or signalling of sites on the nautical chart in order to easily identify the N2K sites and the REF26.0 REF27.0 measure areas (N2K specific MDC). Also, they suggested two monitoring programmes - Monitoring of Annex II, Annex IV (*Lithophaga lithophaga*, *Pinna nobilis*) and Annex V (*Phymatolithon calcareum*) species of the Habitats Directive (2009/147/EC) and Monitoring of target species of the Birds Directive. By increasing the protected area size and by the creation of a network of mutually connected and protected sites (an expansion of the protected area), in their opinion, it will be guaranteed the connectivity dispersal of the populations living on them.

OGS proposed conservation strategies for Tegnùe di Chioggia N2K site. As only conservation strategies OGS proposes, just like for Trezze San Pietro e Bardelli N2K site, increasing of the protected area size and creation of a network of mutually connected and protected sites (an

expansion of the protected area in order to guarantee the connectivity dispersal of the populations living on them). Also, this could be predicted to be more effective than smaller areas at conserving biodiversity because they could include more habitat types and have smaller edge effects. An effective marine protected area must be large enough to retain a large proportion of the mobile marine organisms within its boundaries (Lundquist et al. , 2005).

Parco Delta del Po proposed conservation strategies for Delta del Po: tratto terminale e delta veneto and Delta del Po. They highlighted that N2K site Delta del Po might be extended or connected to marine site due to the presence of migratory fish species such as sturgeons (*Acipenseridae*), shad (*Alosa fallax*) and lamprey (*Petromyzon marinus*) and because coastal water and lagoons are trophic ground for *Caretta caretta*. Also, they pointed out that conservation strategies should be based on improvement of ecosystem services (especially agriculture, fishery, climate regulation, regulation of water flows) and that is important to implement monitoring continuously the target species, especially *Cretta caretta* and *Acipenser naccari*.

Besides those proposed by partners, in the paragraphs below there are some additional conservation strategies for N2K case studies.

Generally, it can be said that stakeholder involvement in marine conservation strategies could be identified as one characteristic for more successful marine conservation. Incorporating diverse interest groups should be helpful to more successful conservation planning. This involvement could foster long-term interest in protected areas, and local support expands the pool of individuals formally and informally overseeing activities in the conservation area. Fernandes et al. (2005) note that stakeholder involvement was a key to success in the Great Barrier Reef Marine Protected Area network and facilitated the incorporation of biological, socioeconomic, political, and cultural objectives in selection of the optimal network design. Stakeholder education is also important before their involvement in marine planning process. An educational program (for example educational workshops for stakeholders) could increase their understanding of socioeconomic processes that will invariably affect implementation.

Clearly defined goals and objectives could be another tool to improve the conservation level of N2K case studies. Some potential goals, as Lundquist et al. (2005) listed, and which could be used for N2K case studies are:

- (1) conserve a representative set of habitat types;
- (2) maintain and restore ecological function;
- (3) promote research and education;
- (4) establish harvest refugia;
- (5) promote integrated coastal management;
- (6) maintain aesthetic values;
- (7) maintain traditional values and
- (8) preserve cultural symbolic value of protected areas.

In this case, each objective could be accompanied by a set of measurable criteria to judge effectiveness of the protected area in meeting their objectives.

Lack of available information on local biodiversity, habitat structure, and other important ecosystem variables that influence the placement of protected areas is often a major obstacle in planning and justification of marine protected areas. Information provided by local stakeholders can be valuable in many cases where scientifically designed surveys are lacking and may help to overcome potential uncertainties, but also, scientific data should play a big role in conservation planning process. However, if data are scarce or absent in one site its management can be informed and result effective also by incorporating information from similar sites, or potentially, by adopting local knowledge, as for instance the one of local fishers.

Furthermore, guidelines for marine conservation planning processes should be accessible globally so that knowledge is transferred and local capacity is supported through global experience. These guidelines should combine knowledge from the fields of biology, biogeography, fisheries science, marine ecology, computational science and modelling, geography, spatial planning, environmental sociology, economics etc.

Development of the methods to analyse the cumulative impacts on marine biodiversity and ecosystems (e.g., fisheries, pollution, anchoring, habitat modification, biological invasions

and all other proposed prohibition for N2K case studies) could also result in more efficient conservation.

As it is a globally important threat to biodiversity to each N2K case studies, climate change also needs to be mitigated through specific conservation actions.

Integrated conservation planning across terrestrial, freshwater and marine environments (for example by investigating inter-relations among land-river-sea ecosystems), especially in case of two Delta del Po N2K sites, only if it isn't currently applicable, could also contribute to better conservation.

Table 9. Proposed conservation strategies for N2K case studies (source: filled Questionnaires from).

Recommended conservation strategies for HR3000469 Viški akvatorij	Recommended conservation strategies for HR3000161 Cres-Lošinj	Recommended conservation strategies for HR4000015 Malostonski zaljev	Recommended conservation strategies for IT3330009 Trezze San Pietro e Bardelli	Recommended conservation strategies for IT3250047 Tengue di Chioggia	Recommended conservation strategies for IT3270017 Delta del Po: tratto terminale e delta veneto and IT3270023 Delta del Po
Support Blue World Institute in carrying out regular monitoring activities	Reducing the number and intensity of activities that cause displacement of target species & marine traffic as underwater noise generator)	Adjusting the protection goals from the objectives of declaring the Special Reserve - preservation of traditional bivalve shellfish farming areas with the intension of preserving existing and future production - with the intension of preserving existing and future production - with the goals of the Natura 2000	Setting of low impact bouys or signalling of sites on the nautical chart in order to easily identify the N2K sites and the REF26.0 REF27.0 measure areas (N2K specific MDC)	Increase of the protected area size and creation of a network of mutually connected and protected sites (an expansion of the protected area in order to guarantee the connectivity dispersal of the populations living on them)	Strategies should be based on improvement of ecosystem services (especially agriculture, fishery, climate regulation, regulation of water flows)
Blue World Institute shall make all data available to the management authority	Measure countering lethal interactions with fisheries	It is necessary to create a biodiversity database, monitor and periodically evaluate the state of natural values, actively support sustainable <i>Ostrea edulis</i> farming as a part of cultural heritage and traditional values that significantly affect the preservation of natural values of Mali Ston Bay	Monitoring of Annex III, Annex IV ( <i>Lithophaga lithophaga</i> and <i>Pinna nobilis</i> ) and Annex V ( <i>Phymatolithon calcareum</i> ) species of the Habitats Directive (2009/147/EC)		Increase monitoring (implement monitoring continuously) of target species (especially <i>Caretta caretta</i> and <i>Acipenser naccarii</i> )
Raising awareness on the importance of conservation of bottlenose dolphin by educational activities for local community (especially sea users - boaters, fishermen, divers,...)	Measure ensuring connectivity with other Adriatic sub-populations	It is necessary to ensure the sustainable use of natural suppliers without significant damage to parts of nature and with the least possible disturbance of the balance of its compositions	Monitoring of target species of the Birds Directive		N2K site delta del PO might be extended or connected to marine site due to presence of migratory fish species such as sturgeons ( <i>Acipenseridae</i> ), shad ( <i>Alosa fallax</i> ) and lamprey ( <i>Petromyzon marinus</i> ) and because coastal water an lagoons are trophic ground for <i>Cretta caretta</i>
Engaging local community in bottlenose dolphin conservation activities as much as possible	This N2K site currently doesn't encompass the whole home range of the local resident bottlenose dolphin community so the extension of this N2K site would ensure that more of the natural habitat for the target species in under protection	It is necessary to be more efficient in existing laws implementation in the N2K area - to control poaching more. The ecosystem in N2K site is under crucial influence of the mainland, so the surrounding mainland must be monitored and controlled too.	Prohibition of anchorage on the rocky outcrops (thus avoiding damaging the rocky part); prohibition to practice professional fishing with trawls, blowers, dredges, purse seines, boat seines, beach seines and similar nets on seagrass meadows and on the coralligenous habitat; prohibition of collection, removal, damage to rock and mineral formations; prohibition of alteration of geophysical environment (geology, geomorphology, morphology); increase of the protected area size and creation of a network of mutually connected and protected sites (an expansion of the protected area in order to guarantee the connectivity dispersal of the populations living on them).		

## 5. MANAGEMENT OF THE N2K CASE STUDIES

In this paragraph the management goals and objectives for N2K case studies are identified and potential future management strategies for each N2K site are proposed.

### 5.1. Identification of the management goals and objectives in each N2K site

The management goals and objectives here reported for each N2K site (Table 10) were partially taken from the ECOSSE deliverable 3.3.1.

Specifically, the long-term management goals of the N2K case studies were outlined according to the requirements of the HD and BD that aim at conserving the species and habitats of protection in a favourable state. In fact, Art. 1 of the HD explicitly refers to the Favourable Conservation Status (FCS), as well as to restore and support the recovery of already degraded populations and habitats. In addition, it defines a Site of Community Importance as “a site which, in the biogeographical region or regions to which it belongs, contributes significantly to the maintenance or restoration at a favourable conservation status of a natural habitat type in Annex I or of a species in Annex II and may also contribute significantly to the coherence of N2K referred to in Article 3, and/or contributes significantly to the maintenance of biological diversity within the biogeographic region or regions concerned” (D.3.3.1).

The goals defined for N2K sites (Table 10) were focused on target species/habitats and ecological processes protected by these sites. To achieve these goals, specific and measurable objectives must be linked to them and defined in terms of what outputs and outcomes are being sought (D.3.3.1).

Also, it is important to understand the threats and pressures to each N2K site in order to understand better management goals and objectives. Here are summarized the human activities and potential pressures to biodiversity (from filled questionnaires), key ecological variables (from D.4.3.1 and D.3.3.1) as well as managing authorities in each N2K case studies:



- **Cres-Lošinj and Viški akvatorij**

Threats: noise and disturbance from nautical tourism and recreational activities; ports, water pollution, marine litter (microplastic), commercial fishing, climate change.

The managing authority of Cres-Lošinj is Public institution of Primorsko-goranska County (Public institution "Priroda").

The managing authority of Viški akvatorij is Public institution Sea and Karst.

Key ecological variables at these N2K sites are climate (water, air, temperature, pH, dissolved oxygen, rainfall, mean sea level and tidal range), interactions between organisms and movements of organisms (D.4.3.1 and D.3.3.1).

- **Malostonski zaljev**

Threats: Anthropogenic eutrophication and pollution from mainland, coastal development and human activities, poaching, sewage, marine litter especially from aquaculture, poaching of *Lithophaga lithophaga*, climate change, diseases of *Pinna nobilis* and *Ostrea edulis*, development of facilities on the karstic mainland, urbanisation.

The managing authority of Malostonski zaljev is PIDNIC.

Key ecological variables at this N2K site are: climate (water, air, temperature, pH, dissolved oxygen, rainfall, mean sea level and tidal range), space/time variability in primary production and hydrology (salinity, water level, current velocity and direction, magnitude, seasonality, rate of water flow, wave height, turbidity, sedimentation rate, thickness and distance upstream of the salt wedge and number of flood events), interaction of benthic - water column (D.4.3.1 and D.3.3.1).

- **Tegnùe di Chioggia and Trezze San Pietro e Bardelli**

Threats: shipping lanes, ports, marine construction, water pollution, fishing, marine litter, noise pollution, aquaculture and recreational activities, nutrient load and pollution from the mainland, scuba diving disturbance, illegal fishing, burial due to bottom trawling performed in neighboring areas, increased sea water temperature, climate change and acidification.

Being the site both a Site of Community Importance (SCI) and a Special Area of Conservation (SAC), the management authority of the site are both the Veneto Region and the Italian Ministry of the Environment (IMELS). The Veneto Region designated as a local authority the Municipality of Chioggia that is the only body with an operational role in the management of the site. The

managing authority of Trezze San Pietro e Bardelli is the Regione Autonoma Friuli Venezia Giulia - Direzione Centrale Infrastrutture e Territorio - Servizio Paesaggio e Biodiversità.

Key ecological variables at these 2 N2K sites are: climate (water, air, temperature, pH, dissolved oxygen, rainfall, mean sea level and tidal range), hydrology (salinity, water level, current velocity and direction, magnitude, seasonality, rate of water flow, wave height, turbidity, sedimentation rate, thickness and distance upstream of the salt wedge and number of flood events), space/time variability in primary production, interaction between organisms, movements of organisms and formation of biophysical habitats (D.4.3.1 and D.3.3.1).

- **Delta del Po: tratto terminale e delta Veneto and Delta del Po**

Threats: maintenance works in channels, soil leaching and erosion, changes in water circulation, flow and sedimentation rates, human induced changes in hydraulic conditions, rising of the salt wedge, sea level rise, climate change, invasive species, discharges and pollution, aquaculture, commercial and recreational fishing, destruction of native habitats of target species, tourism and other recreational activities, shipping lanes, ports, marine constructions, noise pollution, beach nourishment, estuarine and coastal dredging, trampling, use of fertilizers in agriculture.

The Managing authority is the Institution for parks and biodiversity management Po Delta Emilia-Romagna/ Ente di Gestione per i Parchi e la Biodiversità - Parco Delta del Po Veneto.

Key ecological variables at these N2K sites are: water, sediment and nutrients inputs from the river, water circulation due to the river and from sea tide (D.4.3.1).

The management objectives formulated for each N2K site are specifically focused on a single species, when pressures in N2K sites are expected to affect only a target species, or are more general, embracing communities or ecosystems, in case pressures are more widespread in the protected areas and expected to influence multiple species and processes (Table 10).

Table 10. Management goals and objectives for each N2K site selected as case study within ECOS project (Source: D.3.3.1).

CASE STUDY	GOAL	MANAGEMENT OBJECTIVES
Cres-Lošinj and	Preservation of the common bottlenose dolphin ( <i>Tursiops</i> )	<ul style="list-style-type: none"> <li>• Protect and increase the population of <i>T. truncatus</i></li> </ul>

<b>Viški akvatorij</b>	<i>truncatus</i> ) population at a favourable status	<ul style="list-style-type: none"> <li>• Prevent over-exploitation of prey of <i>T. truncatus</i></li> <li>• Preserve incoming/outgoing genetic flow for <i>T. truncatus</i></li> <li>• Maintain a good seawater quality</li> <li>• Decrease/regulate interactions between human activities and <i>T. truncatus</i> individuals</li> </ul>
<b>Malostonski zaljev</b>	Preservation of target habitats ('Shallow inlets and bays' and 'Reefs') at a favourable status	<ul style="list-style-type: none"> <li>• Prevent high eutrophication and pollution levels in the bay</li> <li>• Assess distribution and conservation status of the identified target benthic species</li> <li>• Maintain/restore the current status of target species populations</li> <li>• Preserve coralligenous community diversity</li> <li>• Preserve bioconstruction process</li> <li>• Prevent illegal fishing of <i>Lithophaga lithophaga</i></li> <li>• Reduce impact of finfish and tourism on target benthic species</li> <li>• Reduce impact of invasive species</li> </ul>
<b>Tegnùe di Chioggia and Trezze San Pietro e Bardelli</b>	Conservation of mesophotic biogenic reef communities at a favourable status	<ul style="list-style-type: none"> <li>• Maintain/restore the current status of target species populations</li> <li>• Preserve coralligenous community diversity and gene pool</li> <li>• Preserve bioconstruction process</li> <li>• Minimize nutrient load and pollution from coast</li> </ul>

		<ul style="list-style-type: none"> <li>• Reduce human activities inside and next to the N2K sites</li> <li>• Assess the presence and impact of invasive species</li> <li>• Reduce impact of marine debris on benthic species</li> </ul>
<p><b>Delta del Po: tratto terminale e delta Veneto and Delta del Po</b></p>	<p>Conservation of target habitats and species at a favourable status in the Po Delta</p>	<ul style="list-style-type: none"> <li>• Improve water circulation and quality</li> <li>• Reduce impact of invasive species</li> <li>• Monitor and limit fishing</li> <li>• Create/restore optimal habitats for target species (nesting/resting/feeding sites)</li> <li>• Maintain/restore the current status of target species populations</li> <li>• Increase genetic diversity of the Adriatic sturgeon</li> <li>• Decrease tourism-induced disturbance at nesting bird sites</li> <li>• Control of the yellow-legged gull population and terrestrial predators of target birds' eggs</li> <li>• Minimize the impact of artificial structures on target species (e.g. electrical cables on birds)</li> <li>• Assess distribution and status of aquatic macrophytes</li> <li>• Minimize the impact of aquaculture and maintenance works on the coast and river channels</li> <li>• Reduce the impact of shipping lanes, ports, marine constructions, noise pollution</li> <li>• Prevent soil leaching, erosion and discharges</li> </ul>

## 5.2. Proposed management strategies for each N2K site

In the table below all the proposed management strategies are listed. These were collected through a questionnaire from individual partners who are either in charge of management (case with Delta del Po, PI Sea and karst and PIDNIC) or who conducts monitoring on individual sites (BWI, OGS and SHORELINE) and through online meeting held to discuss in even more detail.

Table 11. Proposed management strategies for N2K case studies (source: filled Questionnaires from PPs).

<u>Proposed management strategies for HR3000469 Viški akvatorij</u>	<u>Proposed management strategies for HR 3000161 Cres-Lošinj</u>	<u>Proposed management strategies for HR4000015 Malostonski zaljev</u>	<u>Proposed management strategies for IT3330009 Trezze San Pietro e Bardelli</u>	<u>Proposed management strategies for IT3250047 Tegnùe di Chioggia</u>	<u>Proposed management strategies for IT3270017 Delta del Po: tratto terminale e delta veneto and IT3270023 Delta del Po</u>
Improving human capacities (rangers and experts for marine mammals) and improving equipment capacities (lack of	Adoption of the management plan with clearly defined management objectives.	Careful communication and education of the local population is needed to ensure the long-term preservation of the value of the Mali Ston Bay.	Improvement of frequency of existing monitoring programmes and recommended additional monitoring programme – monitoring of cetaceans	Arising the effectiveness of a managing authority (improve financial resources, data baselines patrolling and	Making a data baseline where data will be collected in continuous. Also, some lagoons need more monitoring stations.

speed boats).			and pelagic fauna.	purchase buoys).	
By forthcoming regulations on N2K habitats and species conservation , PI Sea and Karst should have bigger legislative power for N2K area.	Recommended additional monitoring programme – addition of biopsy sampling to the existing monitoring program to obtain samples for genetic analyses, in order to better understand processes affecting the well-being of the local, resident bottlenose dolphin community inhabiting in this N2K site.	In addition to the adoption of the regulations and management plan relating to the area of the ecological network, since the area is under national protection, according to the Nature Protection Act (OG 80/13, 15/18, 14/19, 127/19) it is necessary to adopt an ordinance on protection and preservation for protected areas of national importance.	Increasing effectiveness of managing authority (improve financial resources, data baselines patrolling and purchase buoys).	For ecological data (community structure and composition) a continuous/recurring monitoring should be implemented .	Implementation and revision of the management plan.
Greater cooperation with BWI.		Given that the nature in the marine part of Mali Ston Bay benefits changed by the millennial use of this	For ecological data (community structure and composition) a continuous/recurring	The effect of human activities (i.e. poaching, scuba diving, commercial fishing) on target species	

		area, evaluation of the situation, redefinition of objectives and planning are the most important management activities in Mali Ston Bay.	monitoring should be implemented .	should be assessed.	
Adoption of the management plan with clearly defined management objectives.		Adoption of the management plan with clearly defined management objectives.	As marine litter can impact communities and habitats, thus a recurrent and at least visual observation of the accumulation of marine litter should be carried out.	As marine litter can impact communities and habitats, thus a recurrent and at least visual observation of the accumulation of marine litter should be carried out.	
Better promotion and presence of Public institution Sean and Karst in the community (soon PI will dispose a Visitor center Blue cave-Biševo).			The effect of human activities (i.e. poaching, scuba diving, commercial fishing) on target species should be assessed.		

Improve involvement of local community in management and increase education activities for local community.					
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PI Sea and Karst proposed management strategies for Viški akvatorij N2K site. PI highlighted low human capacities (rangers and experts for marine mammals) and need for new equipment (lack of speed boats). Also, they pointed that by forthcoming regulations on N2K habitats and species conservation, PI Sea and Karst should have bigger legislative power for N2K area. Another management strategies include greater cooperation with BWI, adoption of the management plan with clearly defined management objectives and better promotion and presence of PI in the community (soon PI will dispose a Visitor center Blue cave- Biševo). In addition, PI thinks that it is important to improve involvement of local community in management and increase education activities for local community.

BWI proposed management strategies for Cres-Lošinj N2K site. Except for adoption of the management plan with clearly defined management objectives, BWI proposed additional monitoring programme, e.g.: biopsy sampling to obtain samples for genetic analyses, in order to better understand processes affecting the well-being of the local, resident bottlenose dolphin community inhabiting in this N2K site.

PIDNIC and University of Dubrovnik proposed management strategies for Malostonski zaljev N2K site. One of the most important management strategies, needed to ensure the long-term preservation of the value of the Mali Ston Bay, is the involvement of the domestic population, through communication, education and sharing of plans and activities. In addition to the adoption of the regulations and management plan relating to the area of the ecological network, since the area is under national protection, according to the Nature Protection Act (OG 80/13, 15/18, 14/19, 127/19) it is necessary to adopt an ordinance on



protection and preservation for protected areas of national importance. Furthermore, the Ordinance on protection and conservation prescribes in more detail the measures for protection, preservation, improvement and use of the protected area and the management zone of the protected area, while the decision on protection and conservation measures prescribes measures for the implementation of that decision. These are general acts of protection and preservation of a protected area, which prescribe rules of conduct in a certain protected area and restrictions for human activities depending on the management zoning and the pressure on particular sites. Given that the nature in the marine part of Mali Ston Bay benefits changed by the millennial use of this area, evaluation of the situation, redefinition of objectives and planning are the most important management activities in Mali Ston Bay.

OGS and SHORELINE proposed management strategies for Trezze San Pietro e Bardelli N2K site, which are quite similar to those for Tegnùe di Chioggia N2K: improvement of frequency of existing monitoring programmes (it is recommended additional monitoring programme – monitoring of cetaceans and pelagic fauna), increasing effectiveness of managing authority (improve financial resources, data baselines patrolling and purchase buoys), need for ecological data (community structure and composition) to have a continuous/recurring monitoring. Also, marine litter is one of the threats for this N2K site, and it can impact communities and habitats, thus a recurrent and at least visual observation of the accumulation of marine litter should be carried out. In addition, effect of human activities (i.e. poaching, scuba diving, commercial fishing) on target species should be assessed.

OGS proposed management strategies for Tegnùe di Chioggia N2K site. Improving the effectiveness of a managing authority (increase financial resources, data baselines patrolling and purchase buoys) is first on the list of management strategies for this N2K site. Also, it is necessary that for ecological data (community structure and composition) a continuous/recurring monitoring should be implemented. Furthermore, the effect of human activities (i.e. poaching, scuba diving, commercial fishing) on target species should be

assessed. In addition, marine litter can impact communities and habitats, thus a recurrent and at least visual observation of the accumulation of marine litter should be carried out.

Parco Delta del Po proposed management strategies for Delta del Po-tratto terminale e delta veneto and Delta del Po. Making a data baseline where data will be collected in continuous is one of the most important management strategies, not only for these N2K sites, but for every N2K case studies. The same is true for implementation and revision of the management plan. Also, Parco Delta highlighted that some lagoons need more monitoring stations.

Except those for proposed by partners through the questionnaire, here are some additional proposed management strategies for N2K case studies.

The first required management strategy for all the N2K sites is the development of a management plan. Figure 10 shows for all the countries with N2K sites, the ratio of the N2K areas for which there are management plans and those N2K areas which don't have the management plan (Fraschetti et al., 2018).

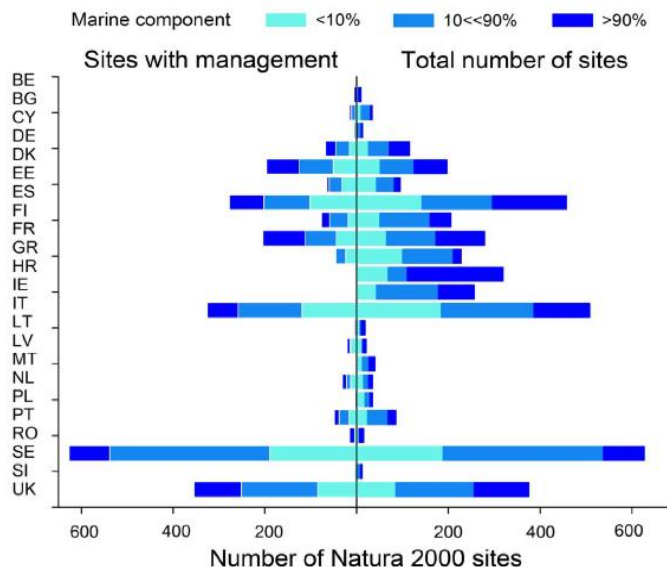


Figure 10. Number of sites of the N2K network with a marine component in each country.

The number of sites for which a management plan exists and/or official management and conservation measures are applied is also showed. The spatial borders of the N2K sites and information on site-based management plans and measures were retrieved from the official Natura 2000 database in the European Environmental Agency (EEA) website (accessed 27 October 2017). To identify the marine component of the sites, we used the digital terrestrial terrain of Europe, also retrieved from EEA (<https://www.eea.europa.eu/data-and-maps/data/eea-coastline-for-analysis-1>; accessed 27 October 2017). Country codes as follows: BE, Belgium; BG, Bulgaria; CY, Cyprus; DE, Germany; DK, Denmark; EE, Estonia; ES, Spain; FI, Finland; FR, France; GR, Greece; HR, Croatia; IE, Ireland; IT, Italy; LT, Lithuania; LV, Latvia; MT, Malta; NL, Netherlands; PL, Poland; PT, Portugal; RO, Romania; SE, Sweden; SI, Slovenia; UK, United Kingdom. (Fraschetti et al, 2018).

As fishing is present in almost all N2K case studies, and because there are potential threats, like poaching, here are some suggestions for future management strategies related to fishing:

- Encouraging sustainable artisanal fishing and aquaculture;
- Encouraging sustainable, socially responsible processing and marketing of fish;
- Education for fishers;
- Building strategic partnerships with private sector through different project for marine conservation protection;
- Education for coastal regions on adapting climate change.

Furthermore, there are more suggestions for future management planning, which could be applied to every N2K case studies of the ECOSS project:

- Strengthen the monitoring system of N2K sites and their capacities;
- Exchanging the experience (for example: mutual technical/scientific assistance);
- Establishing a continuously monitoring programmes using harmonised international standards;
- Covering all aspects of N2K areas (for example: aspects linked to climate change and the arrival of invasive species);
- Establish reliable data bases (could include both scientific and local knowledge important for management with N2K case studies);
- Establish competent management teams and provide appropriate equipment;

- Develop and regularly revise management plans according to management objectives (prioritization of objectives which are still insufficiently developed);
- Involve and educate stakeholders, integrating local knowledge and governance through “co-management”.

Also, as said in Katsanevakis et al. (2017), the formulation of solutions for managing marine ecosystems and species should involve collaboration between jurisdictions and across boundaries. For example, with the EU at the forefront of developing and improving the protection of the N2K areas, project ECROSS could contribute to the protection of the Adriatic Sea as a whole, not just its Croatian or Italian parts. In addition, clearly articulating the social aspects of biodiversity conservation by making explicit the human value systems and worldviews underpinning management strategies and conservation targets would contribute towards transparent and collaborative decision making (Katsanevakis et al. 2017). Making marine conservation truly interdisciplinary, through engagement with economists, anthropologists and other social scientists is critically needed, but challenging to achieve (Katsanevakis et al. 2017). Thus said, marine conservation and management in all N2K case studies are a challenge, but for a start, with human capacities, education and cooperation of stakeholders and local authorities, it is possible to move towards greater goals.

## 5. CONCLUSIONS

In this deliverable we have analyzed and evaluated the main bottlenecks and gaps in management and conservation of N2K case studies, suggested strategies to overcome them in the perspective of better management and expansion of the N2K marine sites.

The project “ECOLOGICAL Observing System in the Adriatic Sea: oceanographic observations for biodiversity”, ECROSS, is aiming to provide an essential contribution for improving the conservation status of the habitat types and species of the marine N2K sites in the Adriatic Sea by integrating knowledge and merging the existing data. Despite differences of selected N2K sites that were included in the project, as well as discrepancy among available data, lack of conservation and management plans and not defined conservation strategies,

ECOSS could be the basis of the future activities for improving management of N2K sites and minimizing negative impacts or preventing potential impacts on them. These activities should include infrastructure and create a basis for integrated future ecological and oceanographic monitoring in the Adriatic.

Owing to the diverse geomorphological structures and numerous different habitats, Adriatic Sea is recognized as a biodiversity hotspot. The local economy of the area surrounding the Adriatic Sea, directly or indirectly, relies on its ecosystem services. Thus, Adriatic ecosystems are affected by numerous impacts, such as global warming, pollution from land and sea sources, overfishing, intense maritime traffic, sea floor disturbance and damage by oil platforms as well as uncontrolled coastal development and tourism. These threats can impact habitats and biodiversity significantly.

Cumulative human impacts have led to the degradation of marine ecosystems and the decline of biodiversity. That's why effective conservation measures are needed to reverse these trends. Social, economic and political heterogeneity adds to the challenge of balancing conservation, therefore, comprehensive macro-regional coordination is needed to ensure effective conservation.

Research and monitoring of the Adriatic Sea started over a century ago, but only sporadically and at limited areas lacking systematic research programs, cross-border cooperation, as well as integration of ecological and oceanographic research with conservation programs. Additionally, managing authorities of the protected sites should be informed about researches that are being conducted in the area of competence and organize database of the area, including scientific papers and reports providing the basis for competent decision making.

Final "product" of ECOSS project will be ECOAdS, an ecological observing system, for collecting data on environmental variables to help to evaluate the effectiveness of conservation and management planning for each N2K case studies. Defining goals and objectives clearly for each N2K site is important for improving communication and standardizing expectations of stakeholder groups.

The inclusion of available science (both scientific and local knowledge) are also important tools allowing increasing of potential conservation strategies. This report highlighted a widespread shortage of information on the ecological monitoring and ecological processes and the conservation status of target species and habitats in N2K case studies, mainly due to lack of management plans and/or management bodies.

At the end, implementing adequate MPAs management plans, putting in place robust monitoring and reporting framework, ensuring solid compliance and enforcement mechanisms, mobilising sufficient finance to enable sustainable management could be some of the ways to implement a more effective management and conservation of N2K sites.

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Table 11. Proposed management strategies for N2K case studies (source: filled Questionnaires from PPs).

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I suggest to report as Annex also the questionnaire that was provided to the PPs, since it is at the foundation of this deliverable.

## ANNEXES

Filled questionnaire by BWI.

<b>The name of the Natura 2000 site, involved in ECOSSE project, where monitoring programmes are carried out (Italian or Croatian and English name)</b>	<b>Cres-Lošinj (HR3000161)</b>
<b>Existing monitoring programmes (stations, parameters, methods, equipment, full name of the institutions conducting monitoring)</b>	Adriatic Dolphin Project (conducted by the Blue World Institute of Marine Research and Conservation)
<b>Main deficiencies in existing monitoring programmes and opportunities for improvement</b>	The main deficiency in the current monitoring program is the lack of genetic data on the target species, and the lack of fine-scale environmental and fisheries data that would help describe ecology of the target species

<b>Recommended additional monitoring programmes</b>	Addition of biopsy sampling to the existing monitoring program is required to obtain samples for genetic analyses, in order to better understand processes affecting the well-being of the local, resident bottlenose dolphin community inhabiting this Natura 2000 site.
<b>Recommended conservation strategies</b>	Reducing the number and/or intensity of activities that cause displacement of target species (marine traffic as underwater noise generator); measures countering lethal interactions with fisheries; measures ensuring connectivity with other Adriatic sub-populations
<b>Main gaps in management and strategies for improvement</b>	The main gap in the management strategy is the lack of management plan with clearly defined management objectives.
<b>Potential for expansion of the N2K site (with justification)</b>	The N2K site currently does not encompass the whole home range of the local resident bottlenose dolphin community. The extension of the site would ensure that more of the natural habitat for the target species is under protection.

Filled questionnaire by OGS.

<b>The name of the Natura 2000 site, involved in ECOS project, where monitoring programmes are carried out (Italian or Croatian and English name)</b>	<b>Treze San Pietro e Bardelli (IT3330009) Tegnùe di Chioggia (IT3250047).</b>
<b>Existing monitoring programmes (stations, parameters, methods, equipment, full name of the institutions conducting monitoring)</b>	Existing monitoring programmes at the two N2K sites are reported in detail in the deliverables D3.1.1 and D4.3.1.
<b>Main deficiencies in existing monitoring programmes and opportunities for improvement</b>	Inside the protected areas monitoring have been carried out only occasionally in the past, there are no long-term, continued and consistent data. Water quality data, chemical and physical characteristics can be in part derived from monitoring facilities in the proximity (e.g. buoys), or from remote sensing (e.g. chl from satellite), or from modelling outputs (current field components). This is not true for ecological data (community structure and composition).

<b>Recommended additional monitoring programmes</b>	For ecological data (community structure and composition) a continuous/recurring monitoring should be implemented. Marine litter can impact communities on habitats protected by these two N2K sites, thus a recurrent and at least visual observation of the accumulation of marine litter should be carried out. Also the effect of human activities (i.e. poaching, scuba diving, commercial fishing) on target species should be assessed.
<b>Recommended conservation strategies</b>	Increase of the protected area size and creation of a network of mutually connected and protected sites (see below).
<b>Main gaps in management and strategies for improvement</b>	Absence of a managing authority. Absence of a management plan.
<b>Potential for expansion of the N2K site (with justification)</b>	In the Northern Adriatic there are a lot of outcrops, similar to those protected by these two areas. Bandelj et al. (2020) suggest an expansion of the protected areas in order to guarantee the connectivity dispersal of the populations living on them.

Filled questionnaire by SHORELINE.

<b>The name of the Natura 2000 site, involved in ECOS project, where monitoring programmes are carried out (Italian or Croatian and English name)</b>	<b>ZSC IT3330009 TREZZE DI SAN PIETRO E BARDELLI</b> <b>ZSC IT3330009 SAN PIETRO AND BARDELLI TREZZE</b>
<b>Existing monitoring programmes (stations, parameters, methods, equipment, full name of the institutions conducting monitoring)</b>	Adriareef - ITA/CRO Interreg - (San Pietro, ctd-fishes-macrofauna, buoy visual census and SSS with multibeam, Istituto Nazionale di Oceanografia e di Geofisica Sperimentale) TRETAMARA - ITA/SLO Interreg - (San Pietro, Bardelli ctd-fishes - macrofauna - Pinna nobilis – Cladocora coespitosa - algae, buoy visual census and SSS with multibeam, Istituto Nazionale di Oceanografia e di Geofisica Sperimentale) RESTORFAN – Medpan projectj(San Pietro, Bardelli, Pinna nobilis, visual census, WWF Miramare Marine Protected Area) Marine Strategy – Minambiente (San Pietro, Bardelli, Pinna nobilis, visual census, ARPAFVG=Agenzia

	Regionale per la Protezione dell'Ambiente del Friuli Venezia Giulia))
<b>Main deficiencies in existing monitoring programmes and opportunities for improvement</b>	Frequency
<b>Recommended additional monitoring programmes</b>	Cetaceans and pelagic fauna
<b>Recommended conservation strategies</b>	<p>Setting of low impact buoys or signalling of sites on the nautical chart in order to easily identify the Natura 2000 sites and the REF26.0 REF27.0 measure areas (CFR. N2K specific MDC (MDC in italian stands for Conservation Measures Document (this is the step before the management plan) and CFR stands for "compare"</p> <p>Monitoring of Annex II, IV and V species of the Habitats Directive and species of the Birds Directive. Prohibition of anchorage on the rocky outcrop (thus avoiding damaging the rocky part). Prohibition to practice professional fishing with trawls, blowers, dredges, purse seines, boat seines, beach seines and similar nets on seagrass meadows and on the coralligenous habitat. Prohibition of collection, removal, damage to rock and mineral formations. Prohibition of alteration geophysical environment.</p>
<b>Main gaps in management and strategies for improvement</b>	Absence of effective Management Body, of financial resources, buoys and patrolling.
<b>Potential for expansion of the N2K site (with justification)</b>	The site is quite large enough.

Filled questionnaire by Sea and Karst.

<b>The name of the Natura 2000 site, involved in ECOS project, where monitoring programmes are carried out (Italian or Croatian and English name)</b>	<b>Viški akvatorij (HR3000469)</b>
<b>Existing monitoring programmes (stations, parameters, methods, equipment, full name of the</b>	Blue World - Institute of Marine Research and Conservation is monitoring bottlenose dolphin ( <i>Tursiops truncatus</i> ) which is the only target specie for this Natura 2000 site.

<b>institutions conducting monitoring)</b>	
<b>Main deficiencies in existing monitoring programmes and opportunities for improvement</b>	Blue World is not conducting monitoring on regular bases because of the lack of resources. Data are also restricted. Sea and Karst shall improve cooperation with the Blue World in order to mobilise additional funds for regular monitoring and to capacitate its employees (expert and ranger service) in marine mammals' protection and conservation activities.
<b>Recommended additional monitoring programmes</b>	There is no need for additional monitoring of biodiversity in that specific site because its only target specie is bottlenose dolphin ( <i>Tursiops truncatus</i> ). However, monitoring shall be conducted in other Natura 2000 sites of Vis archipelago depending of targeted habitat type and specie. In respect to threats monitoring and ecological monitoring, those could be done but by other institutions because Sea and Karst is registered/funded for biodiversity monitoring only.
<b>Recommended conservation strategies</b>	Sea and Karst shall support Blue Word in carrying out regular monitoring activities and Blue Word shall make all data available to the management authority. Awareness raising and educational activities shall be conducted with local community especially sea users such as boaters, fisherman, divers on the importance of conservation of bottlenose dolphin. Also local community shall be engaged in bottlenose dolphin conservation activities as much as possible.
<b>Main gaps in management and strategies for improvement</b>	The Public Institution „Sea and Karst”, who is responsible for site management, generally has small possibilities for active protection and conservation of this site, due to its own capacities (lack of speed boat and local ranger service, as well as lack of knowledge on marine mammals), as well as week legal powers in Natura 2000 sites what is a national level problem that should be solved in medium-time period by forthcoming regulations on Natura 2000 habitats and species conservation. However Sea and Karst has marine biologist that should be capacitated in marine mammals protection and conservation activities. In any possible activity PI should closely collaborate with Blue World Institute, an organisation specialised for dolphin conservation.

	<p>Sea and Karst should soon procure speed boat in the framework of a national project carried out by the Ministry of economy and sustainable development that will improve protection and conservation activities.</p> <p>Soon we will also dispose of a Visitor center Blue cave – Biševo, that is under construction in the framework of another EU project, what will improve institution on-site presence.</p> <p>Management plan shall be prepared for the site with protection measures for target specie.</p>
<b>Potential for expansion of the N2K site (with justification)</b>	Sea and Karst does not dispose of any justification for site extension.

Filled questionnaire by Delta del Po.

<b>The name of the Natura 2000 site, involved in ECOSSE project, where monitoring programmes are carried out (Italian or Croatian and English name)</b>	<p><b>Delta del Po; Fiume Po: tratto terminale e delta Veneto.</b></p> <p><b>Po delta; Po river: terminal trait and Veneto delta. (two Natura 2000 sites, SAC and SPA, overlapping)</b></p>
<b>Existing monitoring programmes (stations, parameters, methods, equipment, full name of the institutions conducting monitoring)</b>	<p>Transitional water Stations: Caleri, Vallona, Barbamarco, Canarin, Scardovari, Marinetta. On site sampling. Parameters: Macrophytes; .</p> <p>Transitional water Stations: Basson, Canarin, Scardovari, Vallona, Marinetta. Automatic Buoy, Parameters: Temperature, pH, conductivity at 25°C, Salinity, Dissolved Oxygen mg/l.</p> <p>Institution conductin monitoring: ARPAV – Agenzia Regionale per la Prevenzione e Protezione Ambientale del Veneto</p>
<b>Main deficiencies in existing monitoring programmes and opportunities for improvement</b>	Data are not always collected in continuous. Improvement: some lagoons need more monitoring stations.
<b>Recommended additional monitoring programmes</b>	/
<b>Recommended conservation strategies</b>	Conservation strategy based on ecosystem services improvement
<b>Main gaps in management and strategies for improvement</b>	Non legal commitment for the implementation and revision of Management Plan.

**Potential for expansion of the N2K site (with justification)**

The delta Po Natura 2000 might be extended or connected to Marine site due to the presence of migratory fish species such as Sturgeons, shad, lamprey. Last but not least coastal water and lagoons are trophic ground for *Caretta caretta*.