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Tesi di Laurea

Assessment of the Ecosystem Services
provided by the dune habitats
in Natura 2000 sites along the Veneto coast

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Abstract

The present research about the assessment of the ecosystems services (ES) supplied by coastal habitats has been carried out within the context of the LIFEREDUNE project (LIFE NAT/IT/000589), with the aim to provide the ex-ante evaluation of the area.

Here, we focused on three ES: (i) row materials (biomass, fibers and other materials from plants and algae for direct use and processing), belonging to the provisioning services group; (ii) carbon storage and sequestration belonging to the regulating and maintenance services group; (iii) recreational and leisure time activities belonging to the cultural services group. The Natura 2000 sites investigated are Cavallino, Laguna del Mort (Eraclea) and Vallevecchia (Caorle) along the Veneto coast in north-eastern Italy. In each case study the ES have been assessed, by using the analytical framework for ecosystem assessments Mapping and Assessment of Ecosystems and their Services (MAES) and methodologies developed by the Making Good Natura LIFE project. Row materials and carbon sequestration have been assessed through plot-based sampling activities; whereas, the cultural services have been quantified by questionnaires submitted to both tourists and stakeholders.

The provisioning services assessment allowed to quantify the amount and type of materials that contributes most to the accumulation. In the context of regulating and maintenance services, the carbon stock and flow have been estimated for 27 species based on dry biomass, relative growth rate, spatial distribution and percentage coverage for each one, taking into the account different habitats. Finally, cultural services have been quantified through the assessment of the recreational value: the supply and the demand for recreational activities have been explored. Information about distance travelled to the site, daily expense, number of days of the visit and accommodation selected allowed to calculate the cost of the trip and willingness to pay.

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1. Introduction

1.1 Context

North Adriatic dune systems have peculiar ecological characteristics, due to climate (temperate instead of Mediterranean), geographical location and the presence of many river mouths. Vegetation is characterized by the contemporary presence of alpine, Mediterranean and eastern species. A large number of endemic species are present. Veneto coasts are very important also for fauna, as they are the final destination point of shelter in a plain, which is becoming more and more urbanised, and are located along the migratory route from Africa to Northern Europe (Virgilietti, 2010).

After Second World War most dunes were destroyed to leave place to buildings and tourist infrastructures, only a few places remained almost untouched where it is still possible to observe the natural succession of pioneer, shifting and fixed dunes and of interdunal lowlands. Nowadays, along the Northern Adriatic coast an intense anthropic use and a high naturalistic value coexist (Virgilietti, 2010).

Veneto Region coasts are characterised by long sandy beaches; there is estimation of circa 1500 hectares of Nature 2000 habitats in the dune category, for a linear development of about 40 kilometers of coasts with dune habitats, including the dunes in the long sandy islands of Po delta (Virgilietti, 2010). As argued by Drius et al. (2016) Veneto's coastal Natura 2000 network hosts a valuable portion of mobile dunes, wooded dunes and fixed dunes that are present in scattered stations along Veneto.

This is the context of the project LIFE REDUNE *"Restoration of dune habitats in Natura 2000 sites of the Veneto coast"* (no. NAT/IT/000589) is co-financed by European LIFE+ fund and it is coordinated by the Ca Foscari University of Venice. It was launched in September 2017, with the aim to restore and maintain the ecological integrity of a full set of **dune habitats** listed in the Habitats Directive along with the population of endemic species of the dunes of the north-east of Italy, listed as a priority species for conservation. In addition, by combining networking and communication actions, the project is expected to favor the habitats' natural dynamics and its recovery as well as to mitigate the risk of the negative interference caused by humans.

LIFE REDUNE project involved 4 Natura 2000 sites (Figure 1) of the Veneto coast:

- Laguna di Caorle - Foce del Tagliamento (IT3250033),
- Laguna del Mort e Pinete di Eraclea (IT3250013),
- Penisola del Cavallino (IT3250003),
- Bosco Nordio (IT3250032).

Figure 1. Map of the sites investigated by the project LIFE REDUNE (retrieved from www.liferedune.it*)*

The network in this study area extends for 160 ha and concern the first three sites. The following section depicts the description of each site provided by Virgilietti (2010).

The area of Laguna di Caorle - Foce del Tagliamento (IT3250033) is located in the Municipalities of Caorle and San Michele al Tagliamento - VE). This research involves the area of Vallevecchia, a large area located in the central stretch of the sandy coast between the Livenza and Tagliamento rivers and characterized by a significant system of sand dunes and interdunal and retrodunal depressions. This area is entirely managed by the Azienda Regionale Veneto Agricoltura, which over the years has also carried out restoration work on the lagoon located behind the coast, as well as targeted conservation measures for the dunes and improvement of the dense artificial pinewood.

The area of laguna del Mort e Pinete di Eraclea (IT3250013) is located in the Municipalities of Eraclea, Caorle and Jesolo - VE. The laguna del Mort is located at the mouth of the Piave and consists of a narrow sandy cord that separates the sea from a lagoon of limited extension and a system of relict dunes. The lagoon is connected to the sea by a single access and it is bounded by a consolidated dune with an artificial pine forest. The south of the lagoon presents a rich mosaic of biotopes. The area is managed by the Forest Service for the Provinces of Treviso and Venice.

The area of Penisola del Cavallino (IT3250003) is located in the Municipality of Cavallino. This area consists of a complex system of dunes formed by the accumulation of sand close to the northern dike of the port mouth of Lido in the Venice lagoon. Here, the extensive retrodunal humid grasslands and the pine forest, with strips of hygrophilous vegetation are relevant. On the site, the Regional Forest Service of Treviso and Venice carries out regular management.

From the socio-economic point of view, information by sector of economic activity obtained from national statistics (Istat, 2017 retrieved from: dati-censimentopopolazione.istat.it) shows that agriculture, forestry and fishing, transportation and storage, financial and insurance activities are less widespread than accommodation and food service activities, in all the municipalities taken into account. The number of total employed varies from 4,5 to 5,6 thousand. The share of commercial hospitality in total employment is very high for the Municipality of Caorle (more than 4000 employed) and between 1500 and 2100 employed for other municipalities.

1.2 Ecosystem services background

Defining ecosystem services

The focus on ecosystem services has been adopted widely among the scientific and policy communities and has resulted in new approaches for research, conservation, and development (Daily et al., 2008).

Maes et al. (2013) introduced a conceptual framework for documenting, analysing, and understanding the effects of environmental change on ecosystems and human well-being. According to these authors the simplest conceptual framework links socio-economic systems with ecosystems via the flow of ecosystem services, and through the drivers of change that affect ecosystems either as consequence of using the services or as indirect impacts due to human activities in general (Figure 2).
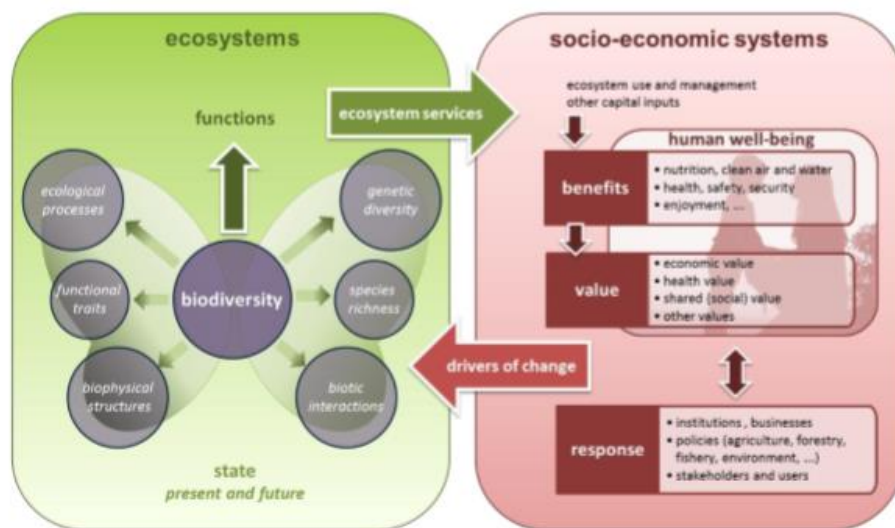

Figure 2. Conceptual framework for EU wide ecosystem assessments. Source: Maes et al. (2013)

Ecosystem functions are defined as the capacity or the potential to deliver ecosystem services. Ecosystem services are, in turn, derived from ecosystem functions and represent the realized flow of services for which there is demand. Functions here are constituted by different combinations of processes, traits and structures and represent the potential that ecosystems have to deliver services, irrespective whether or not they are useful for humans. In contrast to ecosystem functions, ecosystem services imply access and demand by humans.

According to Carpenter et al. (2009), rigorous evaluation of ES requires appropriate reference systems and before–after data that are often absent. This type of evaluation needs basic information on the dynamics of social–ecological systems and the relationships of ecosystem services to human well-being.

The Millennium Ecosystem Assessment (MEA, 2003) was the first large scale ecosystem assessment and it provided a framework that has been adopted and further refined by the Common International Classification of Ecosystem Services (CICES) that have been used in this research. The MA organised ecosystem services into four well known groups: (i) provisioning services, (ii) regulating services, (iii) cultural services, (iii) supporting services.

The Common International Classification of Ecosystem Services (CICES)

According to Burkhard and Maes (2017) CICES was originally developed as part of the work on the System of integrated Environmental and Economic Accounting (SEEA) led by the United Nations Statistical Division (UNSD), but it has been used by the wider ecosystem services community to help define indicators of ES or map them. In designing it, the intention was to provide a way of characterising *final services*, namely those that interface between ecosystems and society. However, it did try to use as much of the terminology that was already widely employed and so used the categorisation of *provisioning*, *regulating* and *cultural* services that were made familiar by the MA. According to the description provided by Maes et al. (2013) and CICES (http://cices.eu/) provisioning services include material and energetic outputs from ecosystems from which goods and products are derived; within the provisioning service section, three major divisions of services are nutrition, materials and energy. Regulating services categories refer to all the ways that ecosystems can mediate the environment in which people live or depend on in some way and therefore benefit from them in terms of health or security, for example. Within the regulating and maintenance section, three major service divisions are recognised: mediation of waste, toxics and other nuisances; mediation of flows; maintenance of physical, chemical, biological conditions. Finally, the cultural category identified all the non-material characteristics of ecosystems that contribute to, or are important for people's intellectual well-being. Within the cultural service section, two major divisions of services are recognised: Physical and intellectual interactions with biota, ecosystems, and land-/seascapes and Spiritual, symbolic and other interactions with biota, ecosystems, and land-/seascapes.

Maes et al. (2013) highlighted that the CICES classification provides a flexible and hierarchical classification that can be adapted to the specific situation and needs of Member States. CICES is hierarchical in structure, since it splits the major *sections* into five level hierarchical structure (*section – division – group – class – class type*). Therefore, the use of a common classification, i.e. CICES, in mapping, assessment and accounting would provide an integrated and holistic perspective. According to Maes et al. (2013) using a five-level hierarchical structure is in line with United Nations Statistical Division (UNSD) best practice guidance as it allows the five level structure to be used for ecosystem mapping and assessment.

Assessment and mapping of Ecosystem Services

An ecosystem assessment needs to provide both an analysis of the natural environment by looking at the state of biodiversity and ecosystems (ecosystem assessment in sensu stricto) and by evaluating the level of ecosystem services provided to people (ecosystem service assessment) (Maes et al., 2013). This means that it needs to consider both the ecosystem from which the services are derived and also the people who depend on and are affected by changes in the supply of services, thereby connecting environmental and development sectors.
According to De Groot et al. (2002) the first step towards a comprehensive assessment of ecosystem services involves the translation of ecological complexity (structures and processes) into a more limited number of ecosystem functions. These functions, in turn, provide the services that are valued by humans. Once the functions of an ecosystem are known, the nature and magnitude of value to human society can be analyzed and assessed through the goods and services provided by the functional aspects of the ecosystem. The importance (or 'value') of ecosystems is roughly divided into three types: ecological, socio-cultural and economic value (discussed in detail in the papers by Farber et al., 2002, Limburg et al., 2002, Howarth and Farber 2002, Wilson and Howarth 2002).

Ecosystem services assessment need to be integrated with ecosystem mapping, environmental accounting and economic valuation and the potential benefits this can deliver. ES maps constitute a very important tool to bring ES into practical application. Traun et al. (2017) explained mapping is about the graphical representation of spatio-temporal phenomena and illustrate the environment by symbols and map that reflect the ES. In this regard, Maes et al. (2013) argued that maps are useful for spatially explicit prioritisation and problem identification, especially in relation to synergies and trade-offs among different ecosystem services and maps can be used as a communication tool to initiate discussions with stakeholders, visualizing the locations where valuable ecosystem services are produced or used and explaining the relevance of ecosystem services to the public in their territory.

Coastal ecosystem services

Coastal regions can be considered as the areas of greatest exchange of energy and matter in the whole Earth system, particularly due to their interconnection with components of the geo-, hydro- and atmosphere (Brandão, 2008). As described by Gray (2004), this dynamicity and the geological history of the coastal zone itself is what allowed for this region to develop such high geodiversity, meaning a great richness of geological features, which in turn modelled the evolution of this region regarding the uses of the area and, consequently, the ecosystem services delivered.

By considering the ecosystem services supplied by the coastal zone, Elliff et al. (2015) explained that according to the study performed by Costanza et al. (1997), 63% of all economic value found for global natural capital and ecosystem services come from the marine environment, of which a large portion of this percentage is attributable to the coastal zone. Martínez et al. (2007), in a more recent study, estimated that the coastal zone (considered as up to 100 km from the shoreline), including both natural terrestrial and aquatic environments and also human-altered environments, was responsible for 77% of the global value calculated by Costanza et al. (1997).

A synthesis of the main ecosystem services delivered by some coastal ecosystems, based on the surveys by UNEP (2006), revised by Elliff et al. (2015), is presented in Table 1.

Table 1. Examples of ecosystem services delivered in different coastal zone

Ecosystem service		Coastal ecosystem
Provisioning services	Food provisioning	Estuaries, mangroves, coastal lagoons, intertidal, Kelp forests, coral reefs, rocky shores, seagrass
	Water resources	Rivers, lakes, aquifers
	Ornamental resources	Beaches, estuaries, coral reefs
	Genetic resources	Coral reefs, estuaries, mangroves, inner continental shelf
Regulation services	Erosion control	Beaches, estuaries, mangroves, coastal lagoons, seagrass, coral reefs
	Aquifer recharge and hydric balance	Marine terraces, estuaries, coastal lagoons
	Biological regulation	Estuaries, mangroves, coastal lagoons, intertidal, rocky shores, coral reefs
	Atmospheric and climate regulation	Estuaries, mangroves, coastal lagoons, intertidal, rocky shores, seagrass, coral reefs, continental shelf
	Waste processing	Estuaries, mangroves, coastal lagoons, wetlands, seagrass, coral reefs
	Flood and storm protection	Beaches, estuaries, mangroves, coastal lagoons, intertidal, Kelp forests, rocky shores, seagrass, coral reefs
Supporting services	Ecosystem maintenance	Beaches, estuaries, mangroves, coastal lagoons, intertidal, rocky shores, seagrass, coral reefs
	Nutrient cycling	Estuaries, mangroves, coastal lagoons, intertidal, Kelp forests, rocky shores, coral reefs, inner continental shelf
Cultural services	Recreation and tourism	Beaches, estuaries, mangroves, coastal lagoons, Kelp forests, rocky shores, coral reefs
	Scenic quality	Beaches, estuaries, mangroves, coastal lagoons, Kelp forests, rocky shores, coral reefs
	Education and research	Beaches, estuaries, mangroves, coastal lagoons, Kelp forests, rocky shores, seagrass, coral reefs, inner continental shelf

Sand beaches and dunes

Coastal sand beaches and dunes are important elements of coastal ecosystem services, defined "dynamic systems ruled by a steep environmental sea-inland gradient, which host unique habitat mosaics, with a greatly specialized fauna and flora" by Acosta et al. (2009). As explained by Barbier et al. (2011) they form at low-lying coastal margins where sand transported by oceanic waves and wind combine with vegetation to produce dynamic geomorphic structures. Sandy beaches and dunes include both marine and terrestrial components, occur at all latitudes on earth and cover roughly 34% of the world's ice-free coastlines (Hardisty, 1994).

These systems guarantee fundamental services with significant socio-economic impacts (Everard et al., 2010; Millennium Ecosystem Assessment, 2005). As highlighted by Carter (1990) and Pye and Tsoar (1990), due to their unique position between ocean and land, coastal beaches and dunes have provided humans with important services such as raw materials, coastal protection, erosion control, water catchment and purification, maintenance of wildlife, carbon sequestration, and tourism, recreation, education, and research (Table 2).

Table 2. Ecosystem services, processes and functions of ecosystem change for sand beaches and dunes (revised version of Barbier et al., 2011).

Ecosystem services	Ecosystem processes and functions
Raw materials	Provides sand of particular grain size, proportion of minerals
Coastal protection	Attenuates and/or dissipates waves and reduces flooding and spray from sea
Erosion control	Provides sediment stabilization and soil retention in vegetation root structure
Water catchment and purification	Stores and filters water through sand; raises water table
Maintenance of wildlife	Biological productivity and diversity, habitat for wild and cultivated animal and plant species
Carbon sequestration	Generates biological productivity, biogeochemical activity
Recreational and leisure time activities	Provides unique and aesthetic landscapes, suitable habitat for diverse fauna and flora

The most relevant services are coastal defense, groundwater storage and water purification (Rhymes et al., 2015), tourism, recreation and mental well-being (Doody, 1997), storm protection, nutrient cycling (MEA, 2005; Drius et al., 2013).

Beaches and dunes provide raw materials in the form of sand. Coastal protection is arguably one of the most valuable services provided by sand shore ecosystems especially in the face of extreme storms, tsunamis, and sea level rise. Beaches and sand dunes provide sediment stabilization and soil retention in vegetation root structure. Another important service of coastal sand ecosystems is water catchment: sand dunes are able to store significant amounts of water that can serve as aquifers for coastal populations (Carter 1990). Coastal dunes can provide maintenance of wildlife in the form of habitat for birds, rodents, and ungulates, which have been captured or cultivated for food since humans first colonized the coast (Carter 1990, Pye and Tsoar 1990). Dunes that encourage vegetation growth and productivity will also assist in carbon sequestration, although this process is likely to vary with the type of vegetation, sediment deposition and subsidence, and coastal geo- morphology (Barbier et al., 2011). Beaches and dunes also supply important recreational benefits. Boating, fishing, swimming, scuba diving, walking, beachcombing, and sunbathing are among the numerous recreational and scenic opportunities that are provided by beach and dune access.

Sand dunes were shown to provide a wide range of provisioning, regulatory, cultural and supporting services, but many remain substantially overlooked (Everard et al. 2010, Barbier et al., 2011).

By considering costal protection: this service has not been valued directly (Barbier et al., 2011), but there have been a growing number of studies that value the benefits gained from erosion control programs that either preserve or nourish existing beaches and dunes (Landry et al. 2003, Kriesel and Landry 2004, Huang et al. 2007, Whitehead et al. 2008, Morgan and Hamilton 2010). About water catchment and wildlife maintenance: Carter (1990) highlight their relevance but argued that there are no reliable estimates on the value of beaches and dunes as a source of habitat for wildlife.

A recent study (Drius et al., 2016) specified that while services such as coastal defense, groundwater storage and water purification are clearly recognized and integrated into the coastal management of many sites (French, 2001; Rhymes et al. 2015; Van Dijk, 1989), rather less is known about supporting ecosystem services such as nutrient cycling, soil formation and climate regulation (Barbier et al., 2011). For example, Everard et al. (2010) explained that in the context of widespread coastal habitat loss and land-use change at fine scale, and within a wider context of habitat management for multiple benefits, dune habitats' role in regulating greenhouse gas emissions is worth taking into consideration. A consistent approach to measure and assess carbon storage service in coastal dunes is still lacking (Laffoley and Grimsditch, 2009; Beaumont et al., 2014). Drius et al. (2016) created the first inventory of carbon stocks for the coastal dunes of Adriatic Natura 2000 sites. The capacity of carbon storage of dune habitats has been explored in the Atlantic coastal dune ecosystems, where changes in the carbon sequestration service have been projected under different scenarios of coastal alteration, by Beaumont et al. (2014). However according to Drius et al. (2016), in the Mediterranean coasts, the contribution of dune habitats to soil carbon pool needs further research and according to (Carranza M. et al., 2018) the specific effect of urban expansion on carbon nutrient cycling and on climate regulation has not been explored yet.

1.3 Objectives and outline

This thesis represents the first ecosystem services assessment for the targeted area and a baseline to explore the impact of the project actions on ecosystems and their services. The essential challenge of the research is to allow the monitoring of the ecological state through the assessment of the ecosystem services of the targeted area and to check the achievement of the original goals after the interventions of the project.

The purpose of this work is to provide an overview of selected ecological services of sand beaches and dunes: (i) investigating qualitatively and quantitatively raw materials (biomass, fibers and other materials from plants and algae on the beaches); (ii) evaluating carbon storage and sequestration through the assessment of two proxies; (iii) assessing recreational value and leisure time activities on the sites.

The ES will be assessed by using the analytical framework for ecosystem assessments Mapping and Assessment of Ecosystems and their Services (MAES) under Action 5 of the EU Biodiversity Strategy to 2020 and the Making Good Natura LIFE project, which developed methodologies for qualitative and quantitative ecosystem service assessment.

The results of this mapping and assessment aim to provide the first assessment of ES for the areas and meanwhile to support the maintenance and restoration of ecosystems and their services.

2. Materials and methods
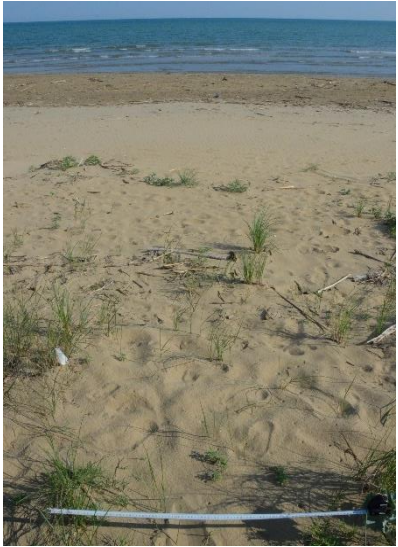
Selection of ecosystem services

The first analysis of the research consisted of the study of existing relationships between ecological and environmental and socio-economic aspects of the study are.

The main ES were selected on the basis of the socio-economic and environmental characteristics of the sites, considering critical issues and opportunities for the development of the territory.

In this research were selected three key ecosystem services (Figure 3): (i) row materials (biomass, fibers and other materials from plants and algae for direct use and processing), belonging to the provisioning services group; (ii) carbon storage and sequestration belonging to the regulating and maintenance services group; (iii) recreational and leisure time activities belonging to the cultural services group.
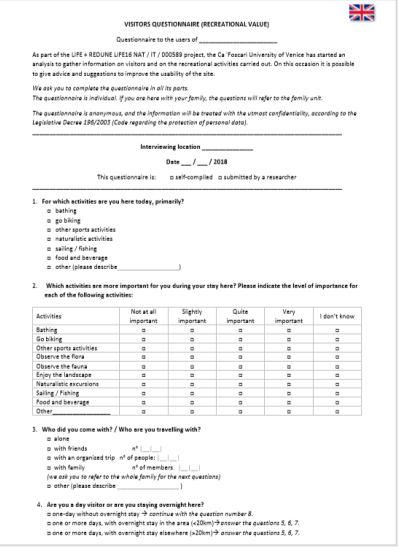

Figure 3. Ecosystem services analysis and methodology

Table 3 describes the analyzed services, providing the definition of the service themes and classes and the rationale that underpins them; the hierarchical classification requires that all the divisions are further divided into service groups, classes and class types.

Table 3. Ecosystem services according to CICES (assessed in this research)

Section	Division	Group	Class	Class type	Action
This column lists the three main categories of ecosystem service	*This column divides section categories into main types of output or process.*	*This column splits division categories by biological, physical or cultural type or process.*	*The class level provides a further sub-division of group categories into biological or material outputs and biophysical and cultural processes that can be linked back to concrete identifiable service sources.*	*Class categories into further individual entities and suggest ways of measuring the associated ecosystem service output.*	*Key components for the research*
Provisioning services	Materials	Biomass	Biomass (fibres and other materials from plants, algae and animals for direct use and processing)	Material by amount, type, use, media (land, soil, freshwater, marine)	Fibres, wood, timber, flowers, skin, bones, sponges and other products, which are not further processed
Regulating and maintenance services	Maintenance of physical, chemical, biological conditions	Atmospheric composition and climate regulation	Global climate regulation by reduction of greenhouse gas concentrations	Amount, concentration or climatic parameter	Carbon sequestration by terrestrial ecosystem
Cultural services	Physical and intellectual interactions with biota, ecosystems, and land/seascapes [environmental settings]	Physical and experiential interactions	Experiential use of plants, animals and land-/seascapes in different environmental settings and physical use of land-/seascapes in different environmental settings	Visits/use data, plants, animals, ecosystem type	Visits/use data, recreational and leisure time activities
		Intellectual and representational interactions	- Scientific - Educational - Heritage cultural - Entertainment - Aesthetic	Use/citation, plants, animals, ecosystem type	Experience of natural world, records, cultural heritage

2.1 Provisioning services: raw materials, plants, woods, fibres

The presence or accumulation of biomass (wood, fibres, algae) on the beach involved the entire coast. The phenomenon is due to the synergistic effect between the presence of plant species, their biological cycles, the hydro dynamism, as well as the coast morphology. The presence of this materials can provide an ecosystem service related to the provisioning of biomass that can be exploited. The main characteristics of this ES are described in Table 4.

Table 4. Features of biomass (fibres and other materials from plants, algae and animals)

Type of service	Provisioning Service
Measure unit	Type of materials and percentage of beach cover
Interest scale	Local
Typology of goods	Rival, non-excludable* (regulated access)
Functional areas	Entire site
Beneficiaries	Citizens, visitors, stakeholders
Use of the evaluation	Management, development, conservation of the site

Source: Schirpke et al. (2014), revised version

*Rival because consumption by one individual makes the good unavailable for consumption by the others and non-excludable because individuals cannot be kept away from consuming (Perman et al., 2003)

Study area and field procedures

To assess provisioning services and explore the presence of biomass (fibres, wood, timber, flowers, skin, bones, sponges and other products, which are not further processed), plot-based sampling have been conducted (see Figures 4 and 5) and drone images have been analysed (Figure 6). Plot-based sampling was based on line transect randomly selected and the use of plots positioned along the transect, in proximity of the materials.

Three linear transects have been effectuated two-fold for each of the following sites: Penisola del Cavallino (IT3250003), Laguna del Mort e Pinete di Eraclea (IT3250013), Laguna di Caorle - Foce del Tagliamento (IT3250033). The location of plots along these transects has been measured. Plots or observation points were spaced at specified distances along the transect.

On the other hand, drone images have been analysed to assess the presence and the area (m^2) covered by materials.

These samplings have been effectuated during May and June, just before the beginning of the tourist season.

Data collection

The **linear transects** have been design for measuring surface and composition of materials on the beaches. To designing and implementing monitoring studies, photographs have been taken to portraying resource values (Figure 4) and conditions and code sheets have been used to collect data.

Figure 4. Study layout for the linear technique (*Penisola del Cavallino*, IT3250003)

Figure 5. Plot-based sampling example

The **drone images** have been analysed by using QGIS 3.2.3 2.18.24 LTR (Figure 6). In this case images have been used to determine the area covered by materials and the ratio between the surface covered and the surface where there were no materials.
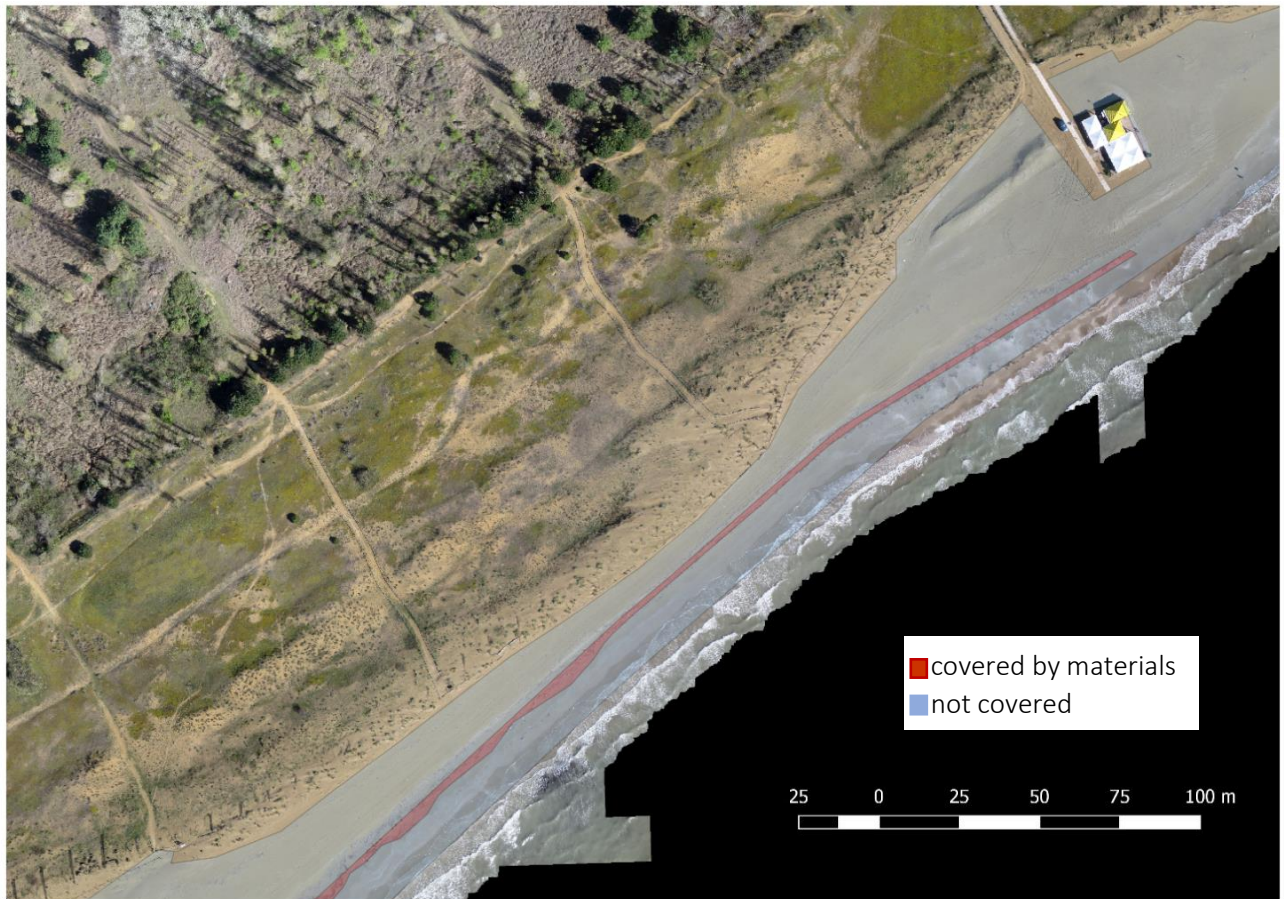

Figure 6. Study layout for drone images (*Penisola del Cavallino*, IT3250003). Red area covered by materials, blue area not covered.

2.2 Regulating and maintenance services: *carbon storage and sequestration*

Among the regulating services, we considered the climate regulation ES that control climate change through carbon sequestration (Zhu et al., 2010). Carbon sequestration involves the removal and the storage of carbon from the atmosphere in carbon sinks (such as oceans, vegetation and soils) through physical or biological processes.

Carbon (C) enters the ecosystem primarily from the atmosphere in the form of carbon dioxide (CO_2) and is taken up by plants and converted into biomass (Atkin et al., 2009). The notion of *stocks* and *flows* is crucial for accounting purposes. According to Burkhard and Maes (2017), *flows* are dynamic over time and therefore difficult to capture on maps; *stocks* exhibit less dynamics and are therefore easier to map. The size of the *stock* is not necessarily related to the magnitude of ES *flows*, so this challenge needs to be addressed when ES maps are applied in decision-making contexts.

In this case study, the ability of ecosystems to fix carbon (C) from the atmosphere becomes a service because this process can be helpful in mitigating elevated CO_2 concentrations in the atmosphere which are responsible for global temperature rises (Burkhard, & Maes, 2017). The main characteristics of this ES are described in Table 5.

Table 5. Features of carbon sequestration

Type of service	Regulating and Maintenance Service
Measure unit	Biomass and primary production per habitat type
Interest scale	Global
Typology of goods	Non-rival, non-excludable
Functional areas	Vegetation
Beneficiaries	Global community
Use of the evaluation	Management, development, conservation of the site

Source:Schirpke et al. (2014), Revised version

Study area and field procedures

The purpose of this section is to assess the ES of carbon storage and sequestration provided by the key species that are considered an important component of a plant community of the area. This type of samplings has taken place in the area Penisola del Cavallino (IT3250003), that can be considered a key area, that is sensitive to management changes and representative of the most important ecological sites within the unit, can be used to get maximum amounts of information from a minimum of monitoring locations (Smith and Ruyle, 1991).

This vegetation sampling has been effectuated during June, July and August. According to Smith and Ruyle (1991) the best time of year to sample vegetation monitoring plots may depend on growing season and to reduce observer errors in species identification it is usually best to sample plots near the time of peak growing season.

Figure 7. Plot representation. Source : Coulloudon et al. (1999)

The Appendix 1 presents the sampling protocol. Data has been collected using plots. The sample size was 25 cm by 25 cm, a surface that should contain three species (Coulloudon et al., 1999). The procedure required to collect the above ground biomass included in the vertical projection of the plot (Figure 7).
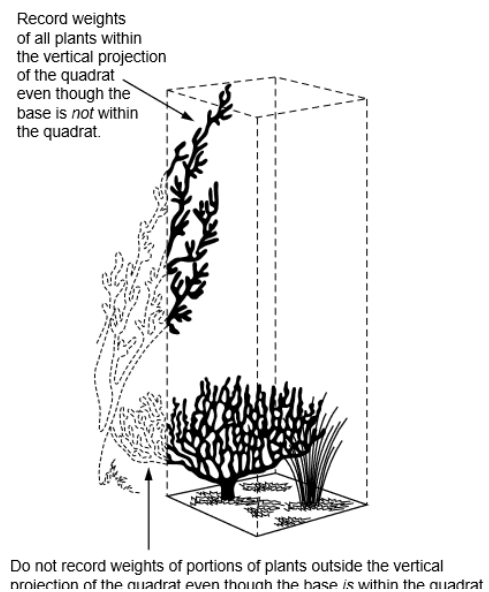
Data collection

The location of plots has been randomly selected. In order to obtain the portrayal of resource values and conditions and furnish visual evidence of vegetation, photos have been taken (see Figure 8). As explained by Coulloudon et al. (1999) it is important to establish a photo plot and take both close-up and general view photographs. The composition of each species in terms of % cover has been assessed by dividing the plots in sub-plot (as showed in Figure 8). After that, above ground biomass collected samples have been dried in an oven set to 70 °C for 48 hours and dry weight of each species has been measured. The dry weight has been used to determine species composition.

Figure 8. Sub-plot example

According to Smith and Ruyle (1991), management objectives and the type of vegetation involved influence the most useful attributes to measure. In order to estimate the carbon sequestration by dune vegetation, the following attributes have been assessed:

1. **Production**: the relative production of different species in a plant community represents a measure of these species' roles in the ecosystem. Biomass, the total weight of living organisms in the ecosystem, is related to production.

2. **Cover**: It can be used in various ways to determine the contribution of each species to a plant community. Cover is generally referred to as the percentage of ground surface covered by vegetation. However, it can be expressed in absolute terms (square meters).

3. **Composition**: is a calculated attribute rather than one that is directly collected in the field. It is the proportion of various plant species in relation to the total of a given area. It may be expressed in terms of relative cover, relative density, relative weight, etc. Composition has been used extensively to describe ecological sites and to evaluate rangeland condition. To calculate composition, the individual value (weight, density, percent cover) for a species or group of species is divided by the total value of the entire population. As explained by Despain et al. (1991), composition by weight is probably the best measure of the relative importance of a plant in the community; in this case study the species-specific dry weight has been used to determine species composition together with the percent composition of species per plot (Coulloudon et al., 1999).

Sequestration of carbon assessment

Sequestration of carbon has been calculated separately as *stocks* (quantity of C stored in tissue) and as processes or *flows* (annual amount of carbon sequestration).

In this regard, Schirpke et al. (2014) argued that one of the tools recognised and used by the scientific community to quantify the fixation of carbon in the phytomass is the use of biomass factors (at ecosystem, population or individual scale). In this case study, carbon *stock* and carbon *flow* refer respectively to the *biomass* and *primary production* expresssed in grams.

According to Make Good Natura Manual (2016), the quantification of the *stock* (*biomass*) corresponds to the sum of above ground biomass and below ground biomass, weighted by the area, as follows:

> **Biomass** = (Above ground biomass x Area) + (Below ground biomass x Area)

On the other hand, the quantification of *flow* (*primary production*) depends on the increment in above and below ground plant volume per region per vegetation type, as follows:

> **Production/time** = (Relative grow rate) x (Above + Below ground biomass x Area)

Data collected with plot-based sampling (squared sampling units of 25 cm x 25 cm), along with the use of data gathered from literature, allowed the estimation of a proxy of carbon storage and carbon sequestration through the use of the formulas mentioned above.

The first step involves estimating a specie-specific value of above and below ground biomass and a specie-specific value of the increment in above and below ground plant volume respectively for the quantification of carbon storage and carbon sequestration's proxy.

For the quantification of carbon *stock*, a mean value of the **above ground biomass** for different species has been calculated from data collected with plot-based samplings. Furthermore, data gathered from the scientific literature have been used: the **below ground biomass** for each species has been assessed considering a generalized **root: shoot ratio** (root dry weight per shoot dry weight, $g \times g^{-1}$) and the above ground biomass obtained from samplings. We used the root: shoot ratio reported by Mokany et al. (2006) for shrubland, equal to $1,87 \ g \times g^{-1}$.

To achieve the quantification of the carbon *flow*, the primary production has been estimated based on the **relative growth rate** (RGR) of each species retrieved in literature (whose references are provided in Appendix 2, Table 13). In this approach growth is calculated as the increase in biomass per unit plant weight already present and per unit of time. RGR measures the average efficiency of each unit of dry matter in the rate of production of new dry matter. It is calculated as the slope of the regression between the logarithm of plant weight and time at steady-state growth (Glimskär, 2000). Units can be expressed as $g \times g^{-1} \times d^{-1}$ (gram increase per gram dry mass present and per unit of time).

Once the carbon *stock* and *flow* have been estimated for each species, based on above ground biomass, below ground biomass and relative growth rate, it has been possible to conduct the final step, which involved using selected **habitat type's composition** to assess the biomass and the primary production per m^2 for different habitat types. Data derived from action D2 of the project have been used to gathered information about the composition of each habitat and the average percent cover for each species in each habitat.

Thus, using the mean values of species-specific *biomass* and *primary production*, carbon storage and carbon sequestration for selected habitat types within each coastal dune site in the study area were calculated.

In this respect, we used data collected by way of plot-based sampling (squared sampling units of 1 m x 1 m) in 4 Habitat types with the following distribution: 4 on shifting dunes along the shoreline with *Ammophila arenaria* - white dunes (2120), 34 on fixed coastal dunes with herbaceous vegetation - grey dunes (2130 Fumanetosum and Avellinetosum), 2 on coastal dunes with *Juniperus* spp (2250), and 2 on mediterranean tall humid herb grasslands of the *Molinio-Holoschoenion* (6420).

These data allowed to quantify carbon sequestration for each habitat type based on their plant species composition. The average percent cover assessed corresponds to the sum of the percent cover of the species that compose the targeted habitat; a mean value based on 1m x 1m plots has been calculated for each habitat.

On the other hand, we took into account the sum of species that compose the habitat, considering that in some case habitats include species whose biomass haven't been evaluated.

Combining habitat type's composition and specie *biomass* and *primary production*, we obtained a quantification of carbon storage and sequestration. Thus, the total carbon *stock* and *flow* (expressed respectively in *biomass* and *primary production*) for selected habitat types have been estimated based on spatial distribution and percent cover of each species.

Thereafter, a **map on carbon sequestration** has been designed for each targeted area, considering the surface occupied by each habitat. This data of habitat's spatial distribution (derived from action D2 of the project) along with the estimation of carbon sequestration per habitat type (based on their plant species composition) have been used to map the carbon flow of the three targeted areas.

Additionally, a value of **biomass per one linear meter of coastline** has been assessed dividing the total amount of *stock* and *flow* provided by the selected habitat types and estimated for each targeted area by the length of the coastline sampled for each area, counted using a geographic information system (QGIS).

In order to be able to compare the results with previous studies and researches that assessed carbon storage and sequestration, we converted *biomass* and *primary production* estimated in tons of **carbon per site** and tons of **carbon per year per site** through a coefficient of 0,475, as fraction of dry oven biomass (Schlesinger, 1991; Beaumont et al., 2014; Magnussen and Reed, 2015;). Moreover, CO_2 sequestration rates can be calculated for each habitat using the conversion factor: 1tC = 3,67 t CO_2 (Drius, M. et al., 2016).

2.3 Cultural services: recreational and leisure time activities

Among the cultural ES, the recreational and leisure ES, whose characteristics are described in Table 6, has been assessed.

Table 6. Features of recreational value

Type of service	Cultural Service
Measure unit	Tourist accommodation capacity, environmental education services and recreational activities, annual tourist flow, motivations to visit and daily expense
Interest scale	Local, regional
Typology of goods	Rival, non-excludable
Functional areas	Entire site
Beneficiaries	Citizens, visitors, stakeholders
Use of the evaluation	Management, development, conservation of the site

Source: Schirpke et al. (2014), revised version

There are multiple approaches to uncover socio-cultural values of ES depending on data availability and the purpose of the valuation; in this research the methods of *preference assessment* have been used. As further explained by Burkhard & Maes (2017), *preference assessment* is a direct consultative method that assesses the individual and social importance of ES by analyzing motivations, perceptions, knowledge and associated values of ES. Data is collected through free-listing exercises, ecosystem service ranking, rating, or other selection mechanisms.

To achieve the assessment of this ES, we implemented the MGN Model methodology which requires: (i) the analysis of tourist facilities and contribution of stakeholders to ES supply, (ii) the analysis of demand and (iii) the monetary valuation. These components have been evaluated through the assessment of the following indicators:

Table 7. Indicators and sources for the quantification of cultural ES

Indicators:	Sources:		
	Stakeholders (questionnaires)	Official statistics	Visitors (questionnaires)
Analysis of tourist facilities and contribution of stakeholders to ES supply			
1. Total tourist accommodation capacity (number of structures and bed places)		x	
2. Number and type of environmental education services and recreational activities supplied	x		
3. Number and type of stakeholder external communication	x		
4. Degree of knowledge of Natura 2000 network *and* value attributed to the dune environment	x		
Analysis of demand			
1. Annual tourist flow for each type of in tourist accommodation establishments		x	
2. Primary motivations to visit and value attributed to environment and natural areas			x
3. Involvement of visitors in naturalistic activities (environmental education services)			x
4. Satisfaction survey results (natural environment, educational experience and environmental activities)			x
Monetary valuation			
1. Individual daily expense			x

To assess cultural services and explore social preferences, visitors and stakeholders have been consulted via questionnaires and interviews about their perceptions of Ecosystem Services of the study areas.
On the other hand, socio-economic data has been evaluated using data gathered from database of tourist flows obtained from regional and national statistics.

Questionnaires

The questionnaires have been formulated by following the Italian project *LIFE + Making Good Natura (LIFE MGN),* which provided guidelines for qualitative and quantitative Ecosystem Services assessment (Marino et al. 2014), and by using the methodology described by Booth (1991) in his report *Methods for conducting an on-site visitor questionnaire survey.*

The design of the questionnaire has been pre-tested providing background information about the survey in order to verify the clarity of instructions, the comprehensibility, the order and the number of questions asked. The questionnaires have been either submitted by researchers or self-compiled by respondents and published as online forms on the following link: https://questionnaire-liferedune.webs.com/ . Leaflets indicating the link targeted at visitors and stakeholders have been made available (Appendix 4.). The codes from all the questionnaires have been collated in a coding sheet.

According to Make Good Natura Manual, the recommended total number of interviews to visitors is around one-hundred. Each situation requires a different approach, as the number can vary in relation to the type and extent of the area. Nonetheless, the minimum number of interviews is kept to thirty individuals (Gaglioppa and Marino, 2016). In the case of questionnaires to be submitted to stakeholders, the minimum number of interviewees may be smaller than the one required for other groups, due to the fact that more qualitative information is explored and the fact that the target is composed by individuals occupied in specific niches. According to the authors (Gaglioppa and Marino, 2016), around twenty subjects should be sufficient in this case.

The total number of actual respondents for visitors and stakeholders' questionnaires is 94 and 38 respectively. The survey has been less effective in contacting and questioning stakeholders than visitors. The total number of stakeholders contacted is 70.

Development and structure of both questionnaires will be presented in the later section of this chapter.

Questionnaire for visitors

The survey can be administered to tourists and visitors who benefit from the site from a recreational point of view. The questionnaire for visitors (Appendix 5) has been divided into three sections: the first section explores general information on respondents' use of the area, their activities and the motivation of their visit; the second section assesses monetary values; the third section is designed to derive socio-demographic information of the respondents.

The questions included in the first section aimed to understand who these beneficiaries are and which activities they enjoy at the site (for example bathing, biking, sailing, fishing, naturalistic activities etc). It includes a satisfaction survey, that derived respondent's opinion in order to test their preferences. An important aim of this section was to gather data on initiatives in which respondents have participated and their level of satisfaction with these activities. These questions and responses provided feedback on the management and maintenance of the site.

With the second section of the questionnaire, the socio-cultural values of ecosystem services have been explored. Data on the number of person and their relative expense for equipment, access to the beach facilities, naturalistic activity, parking, food and accommodation have been collected. According to Gaglioppa and Marino (2016), this information allows to quantify results in monetary terms and assign a monetary value to ES tied to recreational value. On the other hand, information about distance travelled to the site, number of days of the visit and accommodation selected are requested in order to calculate the cost of the trip and willingness to pay.

The third section of the questionnaire collected socio-demographic data of the respondents, such as gender, age, level of education and place of residence. Another question asked about visitors' familiarity with *Natura 2000 network.* Following this, specific questions have been submitted to know if respondents were returning/regular or occasional visitors. Visitors were also asked for suggestions to improve the usability of the site and recommendations that could be used to improve opportunities offered.

Questionnaire for stakeholders

This questionnaire (Appendix 6) has been formulated for stakeholders of the targeted areas. It constituted a brief interview submitted by a researcher or self-compiled by respondents. Stakeholders are asked to indicate the type of their commercial activity and the number of employees. Tourist accommodation owners are asked to indicate the number of visitors of the previous year. The information requested regards the educational naturalistic activities or ecotourism experiences developed or offered. The interviewee was also asked about the relationship between the commercial activities and the ES provided by the dune ecosystem. Other questions focused on the values attributed to the environment and about their knowledge of *Natura 2000 network*.

Agresti (2016) argued that achieving the objectives of the project depends on the correct selection of interested actors whom should work together with the project team. The project LIFE REDUNE is expected to favor the habitats' natural dynamics and its recovery through the development of a responsible behavior towards dune ecosystem and their sustainable use by combining networking and communication actions that engage key stakeholders. For this reason, participation of stakeholders during the project development and implementation is crucial. As it has emerged from other LIFE projects, stakeholders analysis allows for identification of key social and economic actors that will be engaged in different phases in order to reach the objectives of the project.

Statistical sources

Socio-economic data

To assess cultural services, socio-economic data has been evaluated using data gathered from database of tourist flows divided by territorial area of destination of the Veneto Region (available in: statistica.regione.veneto.it) and from national statistics (retrieved from: http://dati.istat.it).

Travel Cost Method

As mentioned before, information about distance travelled to the site, daily expense and accommodation selected have been requested in order to calculate the cost of the trip and willingness to pay.

Monetary measurements of relational value of a site may be estimated from the cost of the trip. The Travel Cost Method (TCM) measures the willingness to travel in order to enjoy a site collecting information on costs and frequency of the trip, costs of travel, costs of food and accommodation, time spent travelling and kilometers crossed from the place where visitors stay. According to the analytical framework proposed by Schirpke et al. (2014) for the Make Good Natura Manual, the calculation of the total cost of the trip can be done using the following formula:

$$\boxed{\text{Total cost= Cost of travel + Extra costs}}$$

By applying this method, it has been possible to estimate the total cost. The average individual expense has been calculated separately for those who pay for overnight staying and those who do daily trip. The amount of kilometers crossed by car refers to an average value of kilometers crossed by visitors from the place where visitors were staying. So, travel costs of visitors staying overnight considered only those from the accommodation to the site. In the case of private cars or other motorised vehicles, the distance travelled was multiplied by an average cost per kilometer of 0,16 €/km (source: Da Re et al., 2015).

3. Results

3.1 Provisioning service assessment

This section aims to quantify the amount and type of materials that cover the beach in the study area. The results of transects sampling are showed in Graph 1: the materials that contributes most to the accumulation is wood, then algae and plastic. As opposed to the presence of plastic waste, the presence of wood can provide an ecosystem service related to the provisioning of biomass that can be exploited.

Graph 1. Type of materials for each area considered
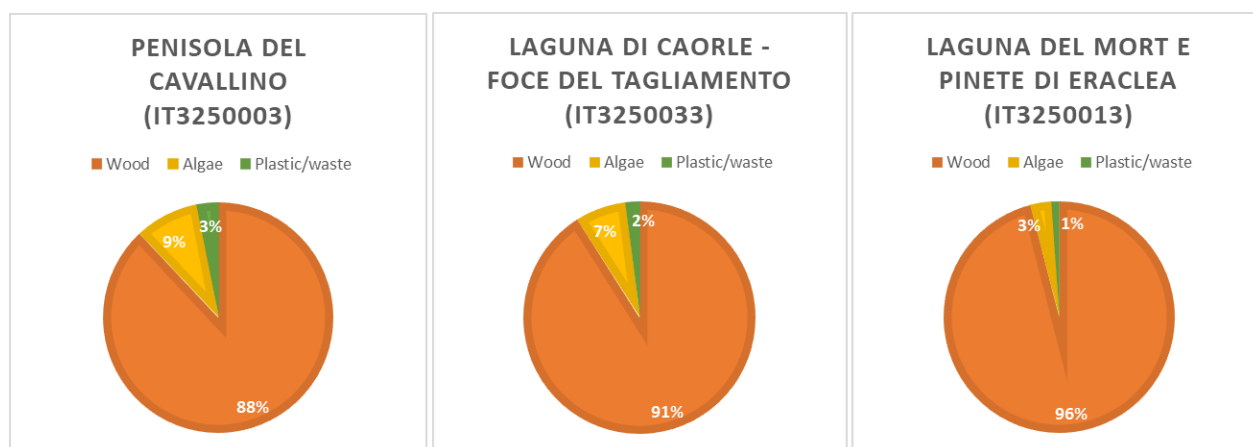
The wood fractions on beaches range from 88% to 96% and average about 92%. Action C3 of the project is expected to evaluate the possibility of exploiting this material for the interventions of the project. Considering the services currently provided by wood: we recorded the presence of wood structures or shelter for sun and wind in Vallevecchia and Laguna del Mort areas (Figure 9).


Figure 9. Example of the use of wood (Vallevecchia, 11/05/2018)

By analyzing the drone images, the assessment of the percentage of surface covered by materials has been achieved. Results are provided by the following table 8 and graph 2.

Table 8. Drone images analysis and results

Drone image	n°	Zone	Area	Total Area (m^2)	Covered Area (m^2)	Percentage covered by materials (%)
D054EB01HF5cmA	1	Laguna di Caorle - Foce del Tagliamento (IT3250033)	Faro di Punta Tagliamento	59040	2814	4,77
D054EB01HF5cmB	1					
D054EB03HF5cmA	3	Laguna di Caorle - Foce del Tagliamento (IT3250033)	S. Michele al Tagliamento	62973	2594	4,12
D054EB03HF5cmB	3					
D054EB04HF5cmA	4	Laguna di Caorle - Foce del Tagliamento (IT3250033)	Vallevecchia	48315	381	0,79
D054EB04HF5cmB	4					
D054EB05HF5cmA	5	Laguna di Caorle - Foce del Tagliamento (IT3250033)	Falconera zona umida	91892	35	0,04
D054EB05HF5cmB	5					
D054EB05HF5cmC	5					
D054EB06HF5cmA	6	Laguna del Mort e Pinete di Eraclea (IT3250013)	Eraclea mare	18336	417	2,27
D054EB08HF5cmA	8	Laguna del Mort e Pinete di Eraclea (IT3250013)	Spiaggia del Mort	33994	3116	9,17
D054EB08HF5cmB	8					
D054EB09HF5cmA	9	Penisola del Cavallino (IT3250003)	Punta Sabbioni	58207	998	1,71
D054EB09HF5cmB	9					
D054EB09HF5cmC	9					

Graph 2. Total percentage of surface covered by materials per site
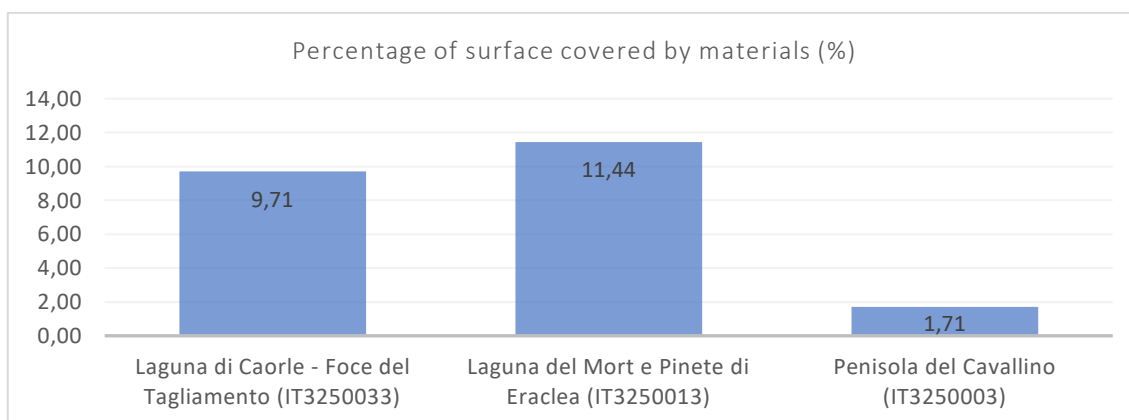
The drone images analysis shows that the beach of Laguna del Mort (municipality of Eraclea) constitutes one of the areas more extensively covered by materials. The materials that contributes most to the accumulation is wood (see Graph 1 and Figure 10).

Figure 10. Example of a drone image (*Laguna del Mort,* IT3250013)

3.2 Regulating and maintenance service assessment

Sequestration of carbon has been quantified, in the context of regulating and maintenance services, by following the Italian project *LIFE + Making Good Natura (LIFE MGN),* which provided guidelines for qualitative and quantitative Ecosystem Services assessment. By applying this method, the biomass, both above and below ground, has been calculated and the total carbon *stock* and *flow* have been estimated. Data collected using plot 25 cm by 25 cm provided the above ground biomass included in the vertical projection of 84 plots. The first step allowed determining the average value of specie-specific above ground biomass and percent cover of 27 species. These values are reported in Table 9, along with the number of samples for each species.

Table 9. Sampling species attributes collected with plot-based sampling (25 cm x 25 cm plots). All values are reported as mean ± s.d.

Species	Family	Number of samples	Mean above ground biomass (g)			Mean percent cover (%)		
Ambrosia coronopifolia	Asteraceae	23	1,04	±	1,25	11,26	±	11,35
Ammophila arenaria	Poaceae	10	18,84	±	12,54	53,70	±	27,99
Apocinum venetum	Apocynaceae	12	3,05	±	2,24	23,08	±	11,92
Asparagus maritimus	Asparagaceae	4	1,88	±	0,43	25,00	±	11,37
Cakile maritima	Brassicaceae	10	13,44	±	5,16	66,00	±	24,01
Cyperus capitatus	Cyperaceae	10	1,51	±	1,46	5,95	±	7,14
Echinophora spinosa	Apiacee	8	3,93	±	2,61	34,38	±	19,41
Erianthus ravennae	Poaceae	5	3,70	±	3,06	13,62	±	11,47
Erica carnea	Ericaceae	6	9,50	±	6,44	30,17	±	22,23
Erigeron canadensis	Asteracee	10	1,22	±	1,17	14,57	±	14,28
Eryngium maritimum	Apiacee	6	2,84	±	2,29	32,19	±	25,94
Euphorbia paralias	Euphorbiaceae	1	1,26	-		4,00	-	
Fumana procumbens	Cistaceae	10	7,82	±	3,17	45,75	±	24,50
Hypocaeris radicata	Asteraceae	2	2,24	±	0,37	7,00	±	1,41
Koeleria splendens	Poaceae	6	1,10	±	1,31	8,60	±	11,11
Medicago marina	Fabaceae	6	2,61	±	0,90	28,73	±	9,16
Oenothera stucchii	Onagraceae	9	6,20	±	6,42	28,46	±	16,40
Plantago lanceolata	Plantaginaceae	1	0,05	-		2,50	-	
Polygala comosa	Polygalaceae	1	5,09	-		25,00	-	
Sanguisorba minor	Rosaceae	3	2,12	±	1,79	14,33	±	8,02
Scabiosa triandra	Dipsacaceae	6	2,26	±	1,48	18,33	±	11,74
Schoenus nigricans	Ciperacee	6	15,59	±	6,86	43,33	±	17,80
Silene conica	Caryophyllaceae	1	0,01	-		0,10	-	
Silene vulgaris	Caryophyllaceae	1	0,56	-		4,00	-	
Teucrium polium	Labiate	10	3,32	±	2,31	15,02	±	13,33
Thymus pulegioides	Labiate	2	3,27	±	0,96	25,40	±	1,98
Vulpia membranacea	Poaceae	1	0,32	-		5,00	-	
Xanthium italicum	Asteracee	9	3,12	±	2,00	18,73	±	11,68

The range in above ground biomass across all vegetation types varied by three orders of magnitude, from as low as 0,01 and 0,05 for *Plantago lanceolata* and *Silene conica* to as high as 18,84 and 15,59 respectively for *Ammophila arenaria* and *Schoenus nigricans.* The range in percent cover across species varied equally from 0,1 to 53,70.

Next step involved using selected habitat type's composition to assess the *biomass* and the *primary production* in each habitat type. Combining habitat type's composition and specie *biomass* and *primary production*, we obtained a quantification of carbon storage and sequestration.

Considering that in some case habitats include species whose biomass haven't been evaluated, Table 10 defines the relationship between habitats' composition and our sampled species. It depicts the average percent cover derived from the sum of the percent cover of the species that compose the targeted habitat and the percent cover of the species for which the *biomass* has been estimated.

The total percentages that go over 100% depend on the overlapping of more than one species.

For Habitat types 2250 and 6420 the number of species for which the biomass has been estimated corresponds to 50%, whereas for other Habitat types it exceeds 70%. Consequently, it shall be assumed that carbon storage and sequestration for these habitat types can be underestimated. Taking into account the number of species that compose the habitat, table 10 depicts the average number of the species that compose the habitat and the average number of the species for which the above ground biomass has been evaluated. With regard to the number of species: it can be noticed that habitat types 2250 and 6420 are on average composed by 14 and 20 species, but only the 25% and the 28% have been sampled for the determination of their biomass and primary production. The number of species that compose habitat type 2120 and 2130 was on average less than 8 and in those case, more than 50 % of species have been sampled.

Table 10. Percentage of sampled species with plot-based sampling (with reference to 1m x 1m plots): percent composition and number of species

	Habitat type					
	1210	**2120**	**2130A**	**2130F**	**2250**	**6420**
Percent cover of sampled species	-	86%	72%	95%	56%	51%
Number of sampled species	-	71%	54%	56%	25%	28%

Once the carbon *stock* and *flow* have been estimated for each species, the total carbon stock and flow (expressed respectively in *biomass* and *primary production*) have been estimated based on spatial distribution and percent cover of each species in selected habitat types. The scheme reported in Graph 3 represent the distribution of our results. This scheme has been used to visually summarize and compare groups of data: the amount of *biomass* and *primary production* differentiated between above and below ground biomass and based on percent cover of species in selected habitat type.

Graph 3. Biomass (g/m^2) and primary production (g/m^2 year) per habitat type, differentiated between above and below ground biomass. Values are reported as mean, median and minimum and maximum of all the data.
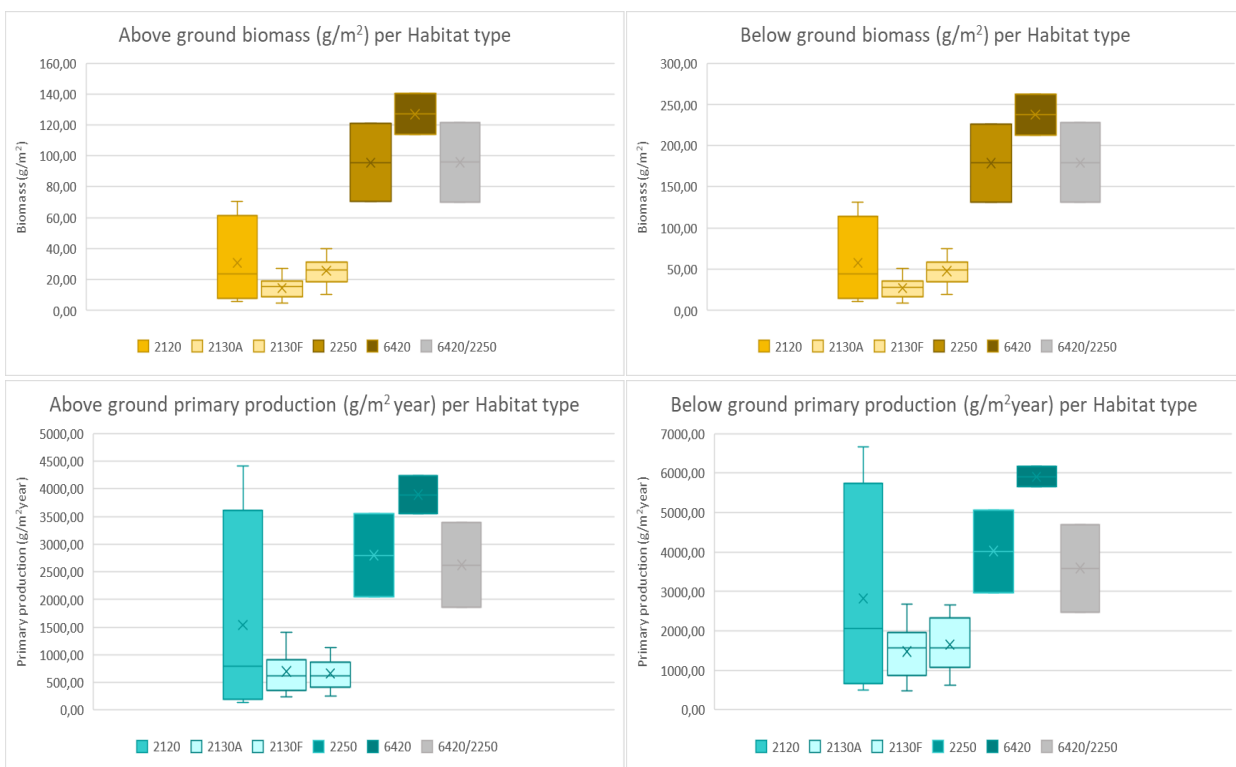
The difference between above ground and below ground values depends on the root: shoot ratio. The major amount of biomass and primary production is provided by species that compose the habitat 6420, then 2250, 2120 and 2130 (with Avelinetosum and Fumanetosum that present similar values). Even if some of these results are understated (habitat 2250 and 6420 was respectively composed by a mean value of 14 and 20 species, just the 25% and the 28% of species have been evaluated), we can assume that 2250 and 6420 are the habitat in which the totally of species provided the greatest amount of biomass and primary production.

To better represent *carbon flow* for each habitat, a spatially explicit representation of the defined habitat and the classes, as listed in Graph 3, have been used (see the Figures below). The following three Figures depict a map on carbon sequestration for each targeted area, referring to primary production expressed in g/year per m^2 (where primary production values refer to selected habitat type; for habitat type 2130 Avellinetosum and Fumanetosum a mean value has been calculated).
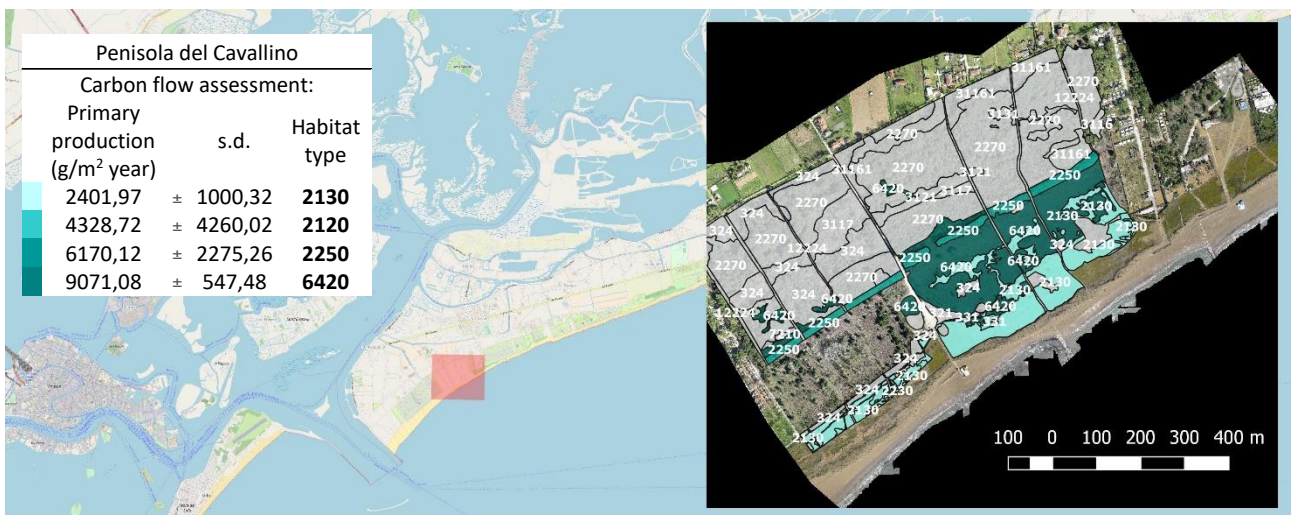

Figure 11. Representation of the defined habitat based on carbon flow (Penisola del Cavallino). All values are reported as mean ± s.d.
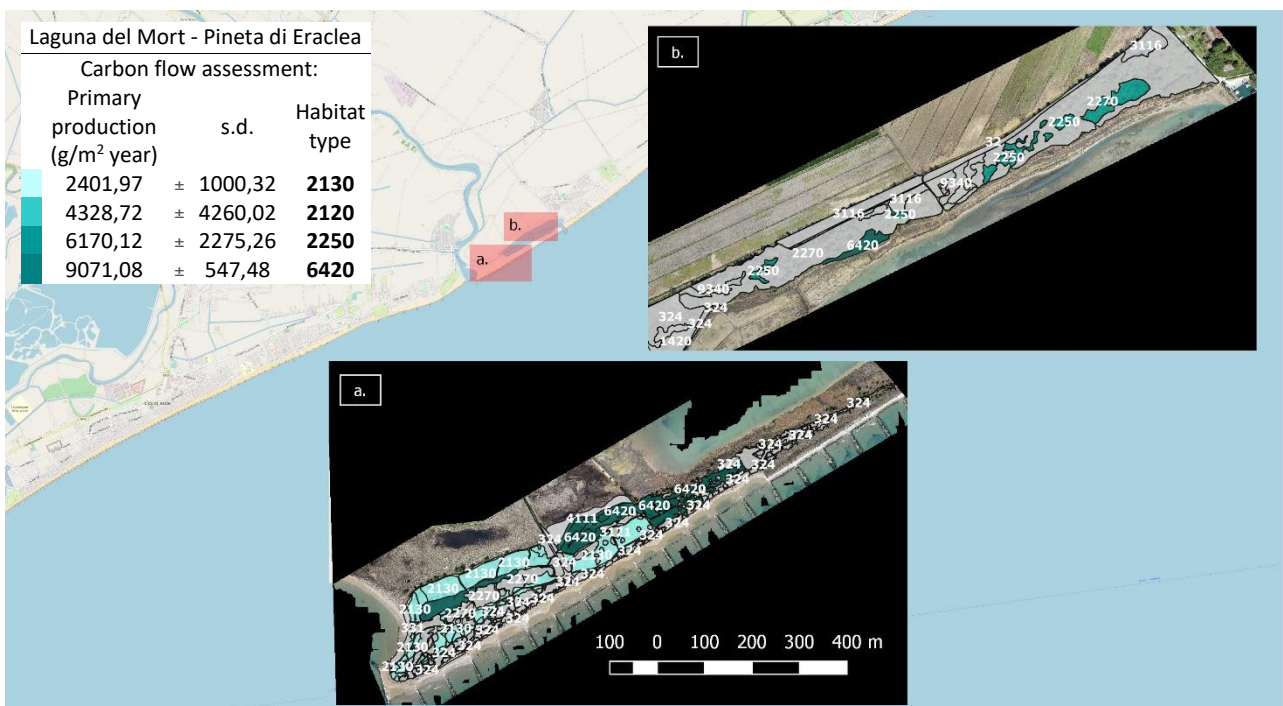

Figure 12. Representation of the defined habitat based on carbon flow (Laguna del Mort - Pinete di Eraclea). All values are reported as mean ± s.d.

Figure 13. Representation of the defined habitat based on carbon flow (Laguna di Caorle - Foce del Tagliamento). All values are reported as mean ± s.d.

Primary production values estimated range from 2,4 kg/m^2 per year (Habitat type 2130) to 9,1 kg/m^2 per year (Habitat type 6420). The coastal dune located in Penisola del Cavallino (site IT3250013) is composed by a wide surface of habitat type 6420 that strongly contribute to the total carbon sequestration; habitat type 2130 covers a considerable surface. In the coastal areas of Laguna del Mort - Pinete di Eraclea and Laguna di Caorle - Foce del Tagliamento several habitat types contribute to the carbon sequestration: among the selected habitat types, the one that contributes most is 2130 Fumanetosum. In the areas of Laguna di Caorle and Foce del Tagliamento, the habitat type 6420 is the main contributor, 2120 is the second one. The surface of selected habitat types is not wide but, as to dune habitat richness, Laguna di Caorle - Foce del Tagliamento is the most diverse area is, with four sites comprising together all the selected habitat types.

Habitat type 6420, that was found to have the highest average sequestration rate among selected habitat types, can be found in all the selected areas.

The total carbon sequestration (stock and flow) for each target area has been calculated based on the area covered by each habitat type (presented in Table 11 that shows the surface occupied by each habitat in the three targeted area, along with the area's coastline length).

Table 11. Coastline length (expressed in meters), surface of selected habitat types (expressed in square meters), biomass and primary production (expressed in t and t/year) based on spatial distribution and surface of each habitat.

| Area | Coastline lenght (m) | Surface (m²) | | | | | | Carbon stock: biomass (t) | Carbon flow: primary production (t/year) |
		1210	2120	2130A	2130F	2250	6420		
Penisola del Cavallino (IT3250003)	1218	0,00	0,00	12790,81	4716,03	15309,75	66491,89	29,31	738,56
Laguna del Mort e Pinete di Eraclea (IT3250013)	1627	775,30	0,00	2864,72	20065,14	9436,85	29365,66	14,88	382,05
Laguna di Caorle - Foce del Tagliamento (IT3250033)	6108	15575,35	37039,07	15298,55	24891,39	19481,94	50360,92	29,44	835,22

Graph 4 shows the values of carbon storage and sequestration's proxy assessed dividing the total amount by the length of the coastline sampled for each area.

Graph 4. Biomass and primary production of selected habitat types based on coastline length. Values referring to kilograms of biomass per one linear meter of coastline.
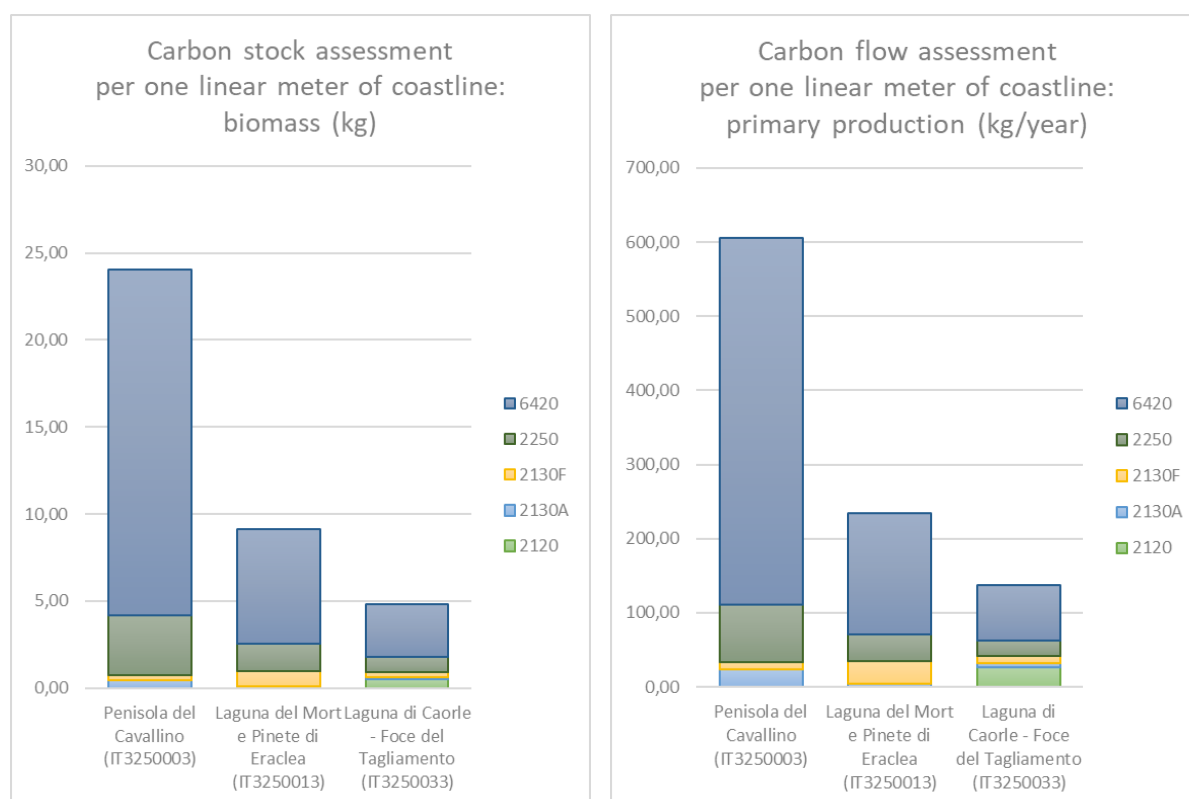
Biomass and primary production values per one linear meter of coastline estimated range from 4,81 kg (Caorle - Tagliamento) to 24,05 kg (Cavallino) and from 136,74 kg/yr (Caorle – Tagliamento) to 606,17 kg/yr (Cavallino) respectively.

The computations yielded an estimation of 929,02 t of carbon sequestered in the targeted area per year corresponding to 0,57 t CO_2 /year per one linear meter on average.

3.3 Cultural service assessment

In this study the economic quantification of cultural service (that attempts to measure the human welfare derived from the use or consumption of ES) has been evaluated in accordance with the procedures explained by Schirpke et al. (2014), in the MGN Model. The following section contains description of the results of the basic steps (analysis of tourist facilities and contribution of stakeholders to ES supply, analysis of demand, monetary valuation) for the assessing of the recreational value.

Analysis of tourist facilities and contribution of stakeholders to ES supply

This section presents the indicators throught which the analysis of tourist facilities and contribution of stakeholders to ES supply has been achieved. Here, we examine the results of questionnaire to stakeholders, researches on tourism enterprises' web sites and data gathered from statistical database of tourist flows.

1. Total tourist accommodation capacity (number of structures and bed places)

This first indicator has been evaluated trought the consultation of the official statistics. According to national statistics (Istat, 2017) in 2014) more than 25 thousand accommodation facilities (hotels, motels, camps, guesthouses, mountain shelters and other structures for short-term stays) were functioning throughout the areas and the total number of bed places were more than 290 thousand. Graph 5 shows that the number of accommodations varies from 881 (municipality of Cavallino) to 5699 (municipality of San Michele al Tagliamento) and the number of bed places varies from 9993 (Eraclea) to 83440 (San Michee al Tagliamento). With regard to the number of bed places, the municipality of San Michele al Tagliamento along with the muicipality of Cavallino, shows the higher values (between 7 and 8 thousand). The municipality of Eraclea comprised the smallest number for both accomodation and beds. The muicipality of Cavallino shows one the higher number of bed places (72676) even though it shows the smallest number of accommodation facilities.

Graph 5. Total tourist accommodation capacity in 2014, with number of structures and bed places (retrieved from ATP Provincia di Venezia, 2014; Istat, 2017)
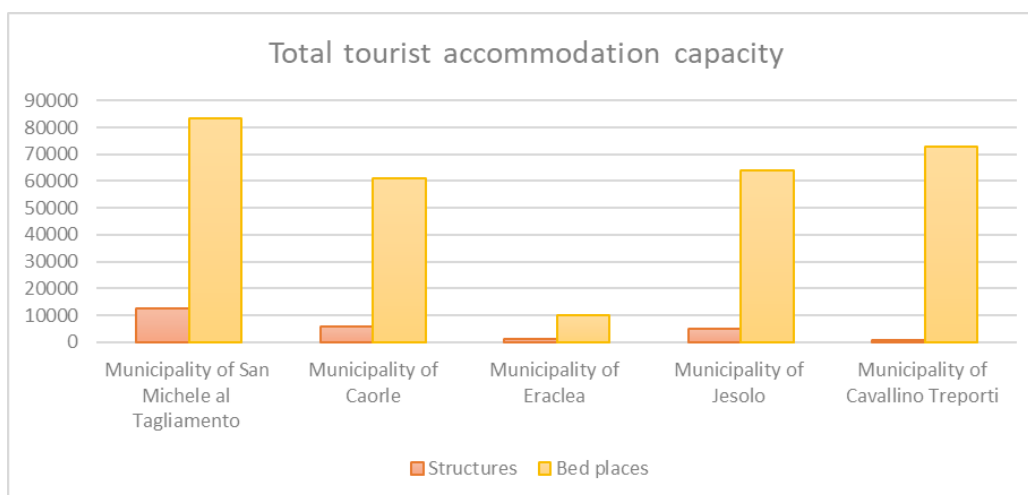
2. Number and type of environmental education services and recreational activities supplied

The supply of recreational activities has been were gathered through questionnaires for site stakeholders. Interviewees were asked to indicate if they offer educational naturalistic activities or ecotourism experiences. The following graph (6) presents the results. Less than 20% of the interviewees provides naturalistic activities to visitors. The guided tour or excursion are the most common activities.

Graph 6. Percentage of stakeholders that provide or recommend naturalistic activities.
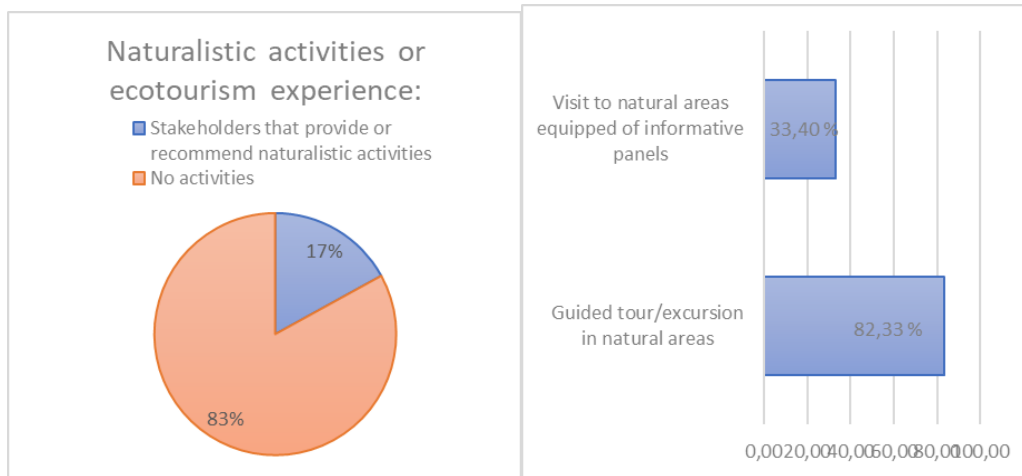
3. Number and type of stakeholder external communication

The following graphs deal with the questions that focused on the values attributed to the environment and the knowledge of *Natura 2000 network*. More than half of stakeholders declare that dune habitats contribute to making the structure more attractive, A part of them (55%) affirm that they mention dune habitats in their web sites, promotional materials or other tools.

Graph 7. Stakeholders external communication
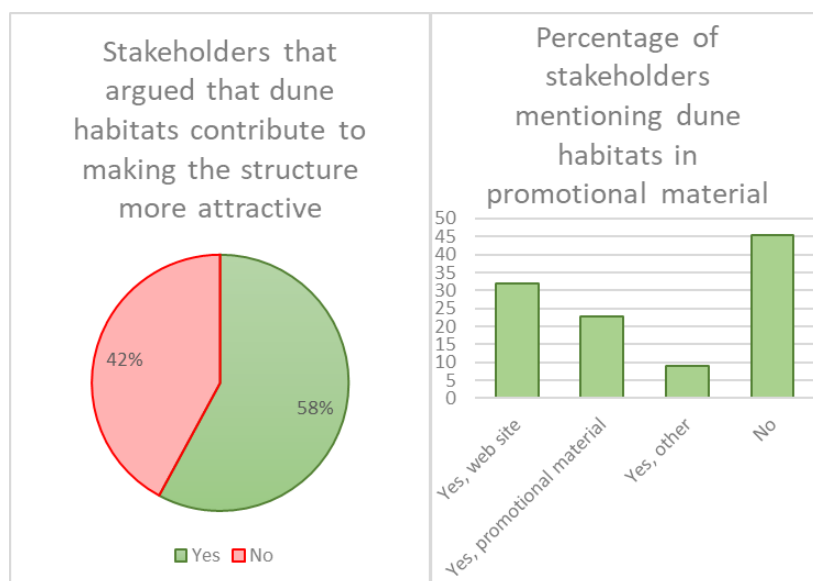
4. Degree of knowledge of Natura 2000 network and value attributed to the dune environment

Concerning the knowledge of respondents of *Natura 2000 network,* more than three quarter doesn't know the network. In regard to the importance gave to the environment and its conservation, more than 90 % of the respondent's attributes value to dune habitats but only the 12 % believes they can contribute to their conservation.

Graph 8. Values attributed to the environment and knowledge of *Natura 2000 network*
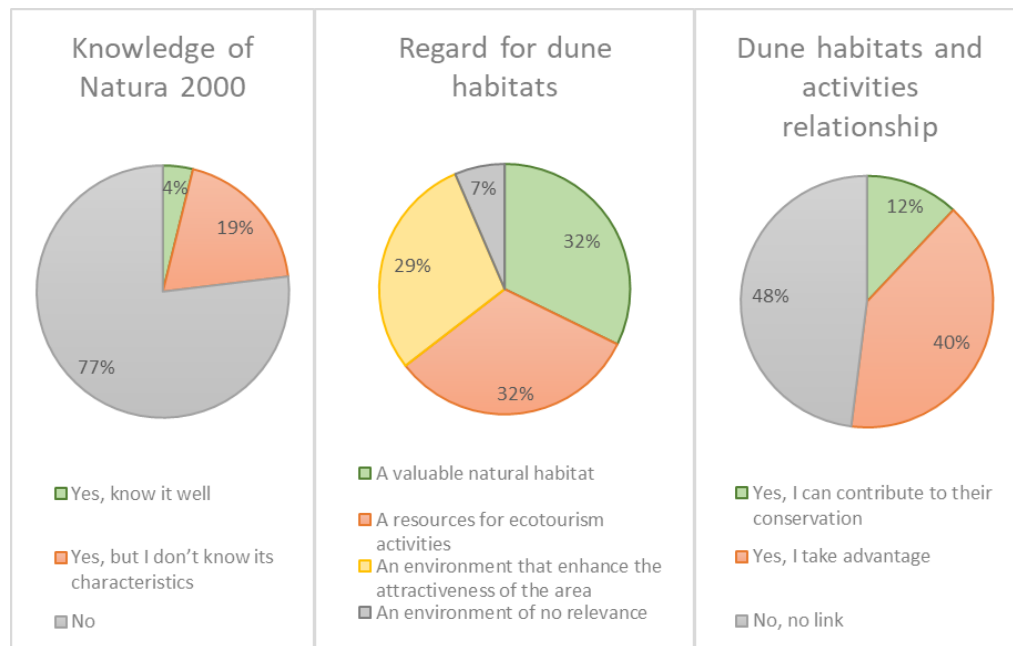
Analysis of demand

As second step, the analysis of demand has been achieved using information about tourist flow and information about visitors' motivations and interests.

1. Annual tourist flow for each type of in tourist accommodation establishments

According to regional statistics, in 2017 nights spent in tourist accommodation establishments were 17.335.578 and arrivals were 2.929.145 (Movimento turistico nel Veneto in statistica.regione.veneto.it). The following graph shows the tourist flow in 2013 for each municipality.

Graph 9. Annual tourist flow in 2013 (retrieved from ATP Provincia di Venezia, 2014)
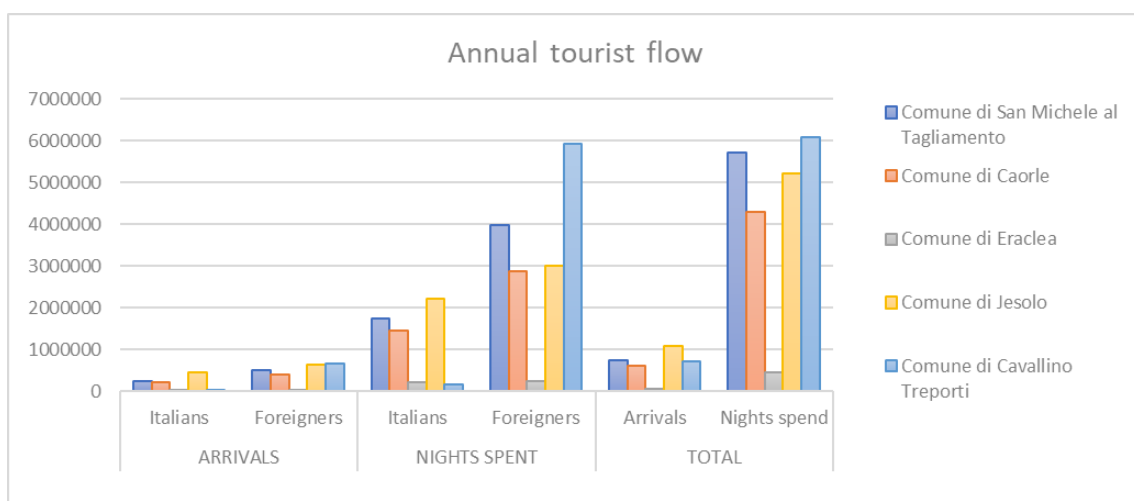
By considering the country of residence recorded in 2017 (retrieved from *Consultazioni per località di provenienza dei turisti, Comprensorio mare* in statistica.regione.veneto.it), the distribution of international tourist arrivals in the coastal zone of Veneto Region counted more than one quarter are German and Italian (32,18 % and 31,46 % respectively). Smaller groups are composed by Austrian (9,99 %), Swiss (3,65 %), Czech Republic (3,23 %), Denmark (2,43 %).

Data obtained from regional statistics (retrieved from statistica.regione.veneto.it) shows that considering trips with overnight stays, collective tourist accommodation establishments (as hotel, camping or tourist village) are the most common in the municipality of Cavallino and Caorle. Private accommodations are widely used in the municipality of Caorle.

The interviewees' duration of the visit varied from 2 days to 3 months. According to regional statistics, the collective tourist accommodation establishments show the higher value of average length of stay. In general, the average length of stay in camping (7,86 nights) and private apartments (9,02 nights) was longer than hotels (3,82 nights) (according to data retrieved from statistica.regione.veneto.it, in length of stay by type of accomodation by municipality in 2017).

2. Primary motivations to visit and value attributed to environment and natural areas

On the other hand, demand for recreational activities have been quantified through questionnaires which have been submitted to visitors to understand their motivations for their visit and with activities or attractive elements drew them to the place.

The first question of the questionnaire explored people's primary motivations to visit.

Graph 10. People's primary motivations to visit
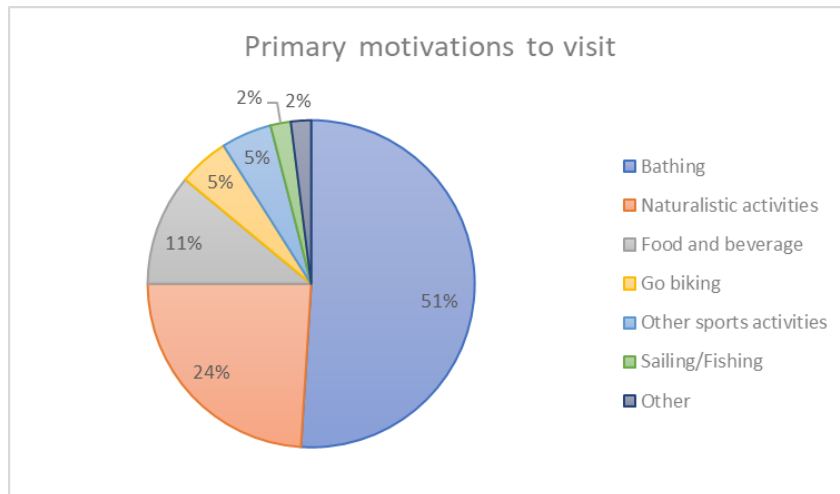
As revealed in the graph above: over half (51%) of the respondents opted for *bathing*, almost one quarter (24%) opted for *naturalistic activities* and smaller groups opted for *food and beverage* (11%), *biking* (5%), *sport activities* (5%) *or fishing and sailing* (2%).

The following graph represents the importance attached by visitors to attractive elements. More than a half of respondents shows interest for *bathing* (73%), *landscape* (83%), *biking* (66%) and *food and beverage* (53%). A small group (14%) considers *bathing* to be not important for its visit or journey.

Graph 11. Level of importance for each activity
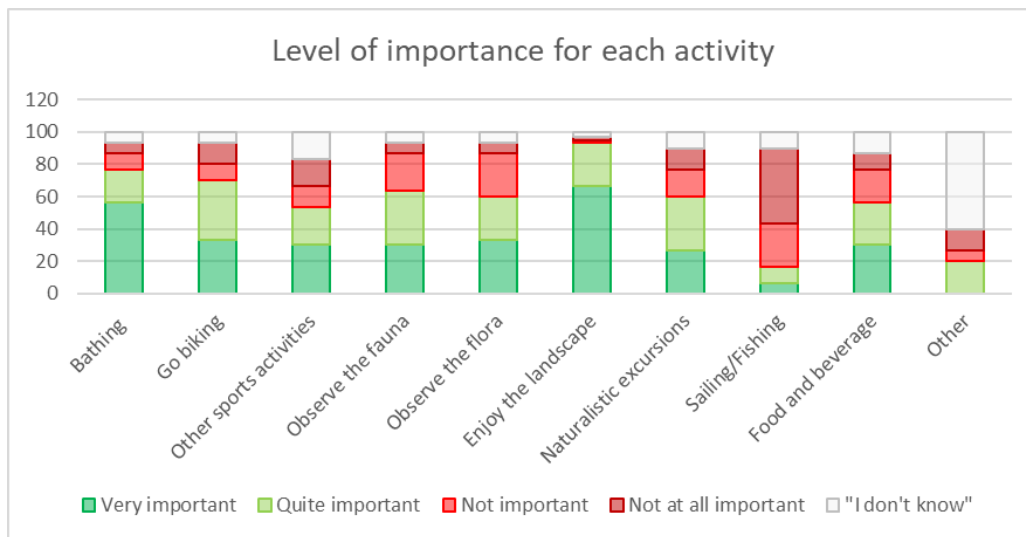
The survey highlighted that visitors value and enhance features related to the recreational use of dunal areas relevant. The 24% mentioned the naturalistic activities as their main motivation, almost all of them appreciate the landscape and over 69% consider the observation of the flora and fauna and the naturalistic activities important.

3. Involvement of visitors in naturalistic activities (environmental education services)

The graphs below present data on initiatives in which respondents have participated and their level of satisfaction with these activities. Over one quarter (29%) have participated in naturalistic activities. Concerning the activities carried out: half of participants chose a guided tour or excursion, 35 % visited area equipped of panels.
Respondents' answers show that the most common activities are guided tour or excursion and they take place mainly in dune ecosystem and lagoon ecosystem.

Graph 12. Naturalistic activities carried out by visitors
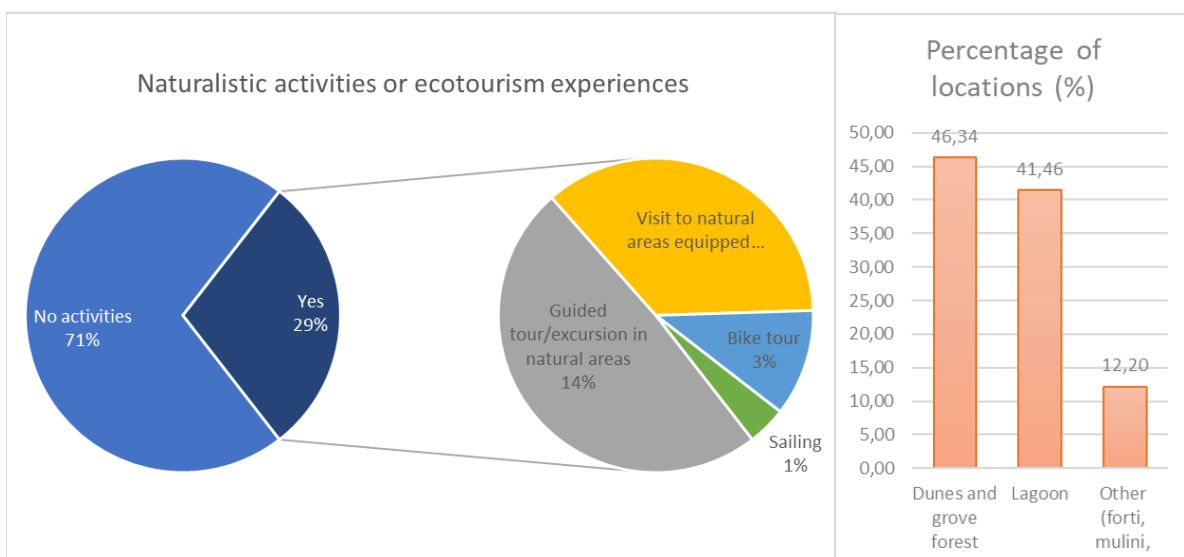
4. Satisfaction survey results (natural environment, educational experience and environmental activities

The satisfaction survey, derived respondent's opinion concerning naturalistic activities they took part: the overall level of satisfaction registered was high. Respondents' answers show that the activities have been interesting occasions for learning and that the majority (78%) would recommend them to friends.

Graph 13. Satisfaction survey results
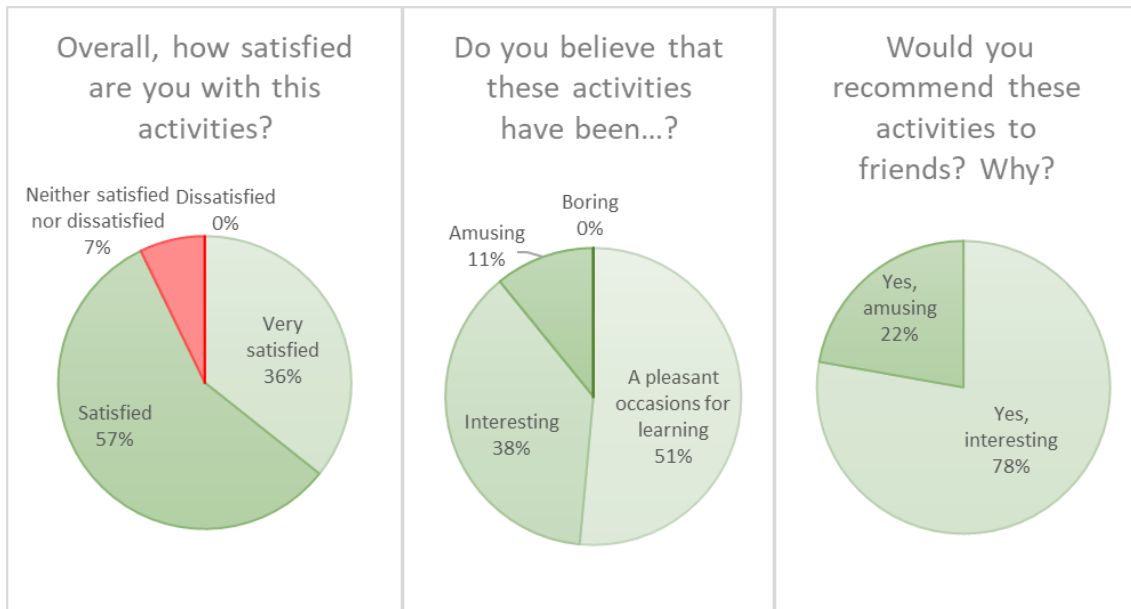
Visitors were asked for suggestions to improve the usability of the site and recommendations that could be used to improve opportunities offered. Many respondents suggested the sites could be better promoted to offer more organization, initiatives, guided tours and information.

Monetary valuation

As described in the MGN Manual, the monetary value can be assessed with data on the expenses of visitors and tourists: the questionnaires for visitors submitted provide information about all expenses for purchase of goods and services used during their visit or vacation and the following graphs show the results.

Graph 14. Individual daily expense for the overnight stay and for extra costs (eat and drink, access to the beach property, buy local products, sport activities, cultural and naturalistic activities, parking).   ,

At the site or the surroundings, visitors spent money mainly on food (90%), parking (35%) and the purchase of local products (31%). Other costs were associated mainly with rent beach umbrella or hut.
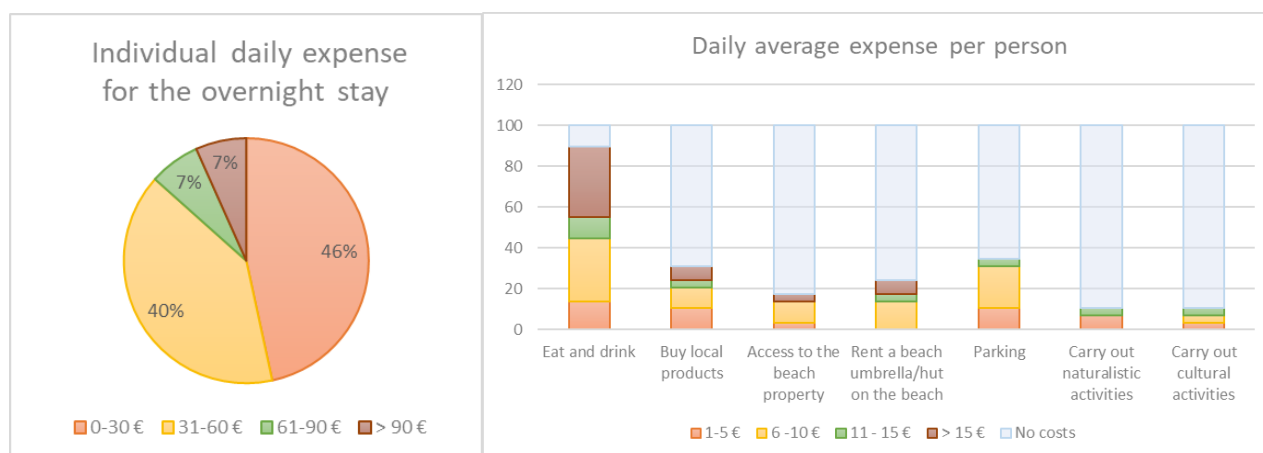
Monetary measurements of relational value of the sites has been estimated from the cost of the trip. By applying the Travel Cost Method, it has been possible to estimate the total cost presented in the following table (12).

Table 12. Average individual daily expense incurs for travelling and purchase goods and services

Cost of travel		Extra costs			Total cost
Kilometers crossed by car	Cost of fuel	Cost of accommodation	Costs of food	Other expenses	
62,30 km	9,97 €	No accommodation	11,95 € ± 6,34	11,39 € ± 17,12	= **33,31 €**
40,33 km	6,45 €	37,72 € ± 28,74	13,03 € ± 7,49	14,78 € ± 12,06	= **80,11 €**

The mean expenses per visitor and day at the site or the surroundings amounted to 33,31 € (day trip) and 80,11 € (overnight stay).

4. Discussion

The objective of this research was to provide an ex-ante valuation of the ecosystem services of LIFE REDUNE targeted areas. The analysis and the quantification of ES can be useful for the evaluation and measurement of results obtained through site management with respect to achievement of objectives defined by the project. This ex ante analysis, join to the ex post analysis, are considered an essential tool and are required in order to verify and monitor the effectiveness of these instruments in achieving identified conservation and management objectives.

Row materials *belonging to the provisioning services group*

The qualitatively and quantitatively investigation of raw materials (biomass, fibers and other materials from plants and algae for direct use and processing) provided the quantification of the amount and type of materials that cover the beach in the study area.

The evolution and analysis of the existing legislation, together with a series of correspondence between the central and local authorities, permitted to establish that the wood transported to beaches from storm, is to be considered as a resource. Especially the large quantities of wood can be managed as reusable material, reducing the overall costs of waste management (Bruschi and Pacciani 2017).

The provision of raw materials results in significant employment opportunities. The beach management plan executed by the municipality of Carrara represents an example. The plan allowed the Municipality of Carrara to manage the beached wood as raw material, through two different approaches: 1)it was allowed citizens to pick up natural wood materials for reuse as fuel also in private thermal plants; 2) where the presence of larger timbers was significant and therefore desirable from a commercial point of view, companies were allowed to pick up the wood as a raw material, with considerable savings (Bruschi and Pacciani 2017).

By contrast, we noticed that plastic waste contributes to the accumulation in the three targeted areas. The abundance and distribution of litter seemed to be particularly influenced by beach users, reflecting inadequate disposal practices (Munari et al., 2016). The project is expected to carry out implementation and enforcement of local educational and management policies, to solve this problem.

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Another ecosystem service delivered by coastal ecosystems is raw materials in the form of sand. As highlighted by Barbier et al. (2011), one of the threatened services provided by sand beaches and dunes is caused by the removal or disruption of sand and vegetation coupled with increased storm intensity and sea level rise threaten critical services provided by this ecosystem, specifically those of coastal protection (Ruggiero et al. 2010) and coastal freshwater catchment. For these reasons, the quantification of this ES could be the subject for future research.

Carbon storage and sequestration *belonging to the regulating and maintenance services group*

Here, the carbon sequestration service provided by a set of coastal dune EU habitat types within Natura 2000 network along the Northern Adriatic Sea has been assessed both as the amount of carbon stored into biomass (stock) and as yearly sequestration rate (process). The quantification of the stock has been achieved through the sum of above ground biomass and below ground biomass, weighted by the area. On the other hand, the quantification of process has been evaluated considering the increment in above ground plant volume per species.

In total, 4 habitat types that compose Natura 2000 coastal dune sites, have been characterized for carbon storage and sequestration based on biomass and primary production.

The studied habitat types showed different characteristics in terms of carbon storage potential. The mean biomass estimated for habitat categories ranges from 41,6 to 364,4 g/m^2 for habitat 2130 Avellinetosum and 6420 respectively. The mean primary production ranges from 2264,3 to 9071,1 g/m^2 per year.
Carbon values are much higher in the sites where habitat type 6420 occur massively. Habitat types 2120 and 2130 showed the lower values of sequestration. In this regard, Drius et al. (2016) that deals with soil organic carbon content, argued that the embryo (habitat type 2110) and mobile dunes (habitat type 2120) have low organic carbon content. Fixed dunes (habitat type 2250) and bare sand were significantly higher than embryo and mobile dunes for both soil C density and soil %C.

In order to be able to compare the results with previous studies and researches that assessed carbon storage and sequestration, *biomass* and *primary production* estimated values have been converted in tons of carbon per site and tons of carbon per year per site. Carbon stock estimated for selected dune habitat types range from 19,8 g C/m^2 (habitat type 2130 Avellinetosum) to 173,1 g C/m^2 (habitat type 6420). Carbon flow estimated ranges from 1075,54 to 4308,8 g C/m^2 per year.
The values for carbon flow obtained is comparable to salt marshes that, by providing a sequestration of 3900 g C/ m^2 per year, represent one of the most productive ecosystems in the world (Mitsch and Gosselink 2008; Barbier et al., 2011).

With respect to coastal dune sequestration, Beaumont et al. (2014) explored the capacity of carbon storage of dune habitats in the Atlantic coastal dune ecosystems, where changes in the carbon sequestration service have been projected under different scenarios of coastal alteration. Drius et al. (2016) created the first inventory of soil carbon stocks for the coastal dunes of Adriatic Natura 2000 sites. Carranza et al., (2018) propose a procedure that combining experimental data of soil carbon stocks and multi-temporal cover maps allows to assess C stock variation over time in Mediterranean sandy coast.
This study assessed a quantity of carbon stored by plant biomass of 35 t C and a carbon sequestration of 929 t C/year. Compared with Beaumont et al. (2014), Drius (2016) and Carranza et al. (2018), our values for carbon stock and sequestration refer to biomass carbon content instead of soil carbon content. The Adriatic costal dune Natura 2000 network soil stock counted 74889 t C (Drius, 2016) and the UK fixed dune grassland soil C stock counted 1442900 t C (Beaumont et al., 2014),

The estimated total carbon stock for our 4 selected habitat types of the 3 sites within Veneto coastal dune Natura 2000 network is smaller than the quantity of carbon stored by plant biomass of 279565 t C and the yearly carbon sequestration of 5268 tC in SCI Corno della Marogna and the quantity of carbon stored by plant biomass of 499317 t C and the yearly carbon sequestration of 9454 tC in SCI Valvestino (assessed by a study performed by LIFE11 ENV/IT/000168 in Lombardia), due to the smaller extent of study area and the partial value obtained (4 habitat types has been taken into account).

By considering CO_2 sequestration, selected sites sequestered amounts to 3409 t CO_2 per year (with reference to 4 selected habitats). According to Drius et al. (2016) Italian Adriatic coastal dune Natura 2000 sites sequester 4998 t of CO_2 per year, with the majority in wooded dunes that showed significantly higher soil carbon density than the other dune habitats.

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There is considerable potential to improve the estimates of carbon sequestration rates through the assessment procedure improvement. To compare habitat types' relative contribution, future analysis should quantify carbon storage and sequestration provided by all the plants that compose them. On the other hand, it should be noticed that area covered by habitat types selected represent the 29% of the total habitat types that composed the three targeted areas. On the other hand, due to the high variability in the relationship between root and shoot biomass, a specie-specific root:shoot ratio could provide a more accurate estimate of below ground biomass (Mokany et al., 2006). Since the most realistic estimates of carbon stock changes have to be derived by yield models (Federici et al. 2008), future analyses are expected to assess the growth rate and the root:shoot ratio for each key species with laboratory researches.

Recognition of the C sequestration value of vegetated coastal ecosystems provides a strong argument for their protection and restoration (Mcleod, 2011).

The high unitary carbon content revealed for the natural dunes of the Mediterranean coast highlights their underestimated role as soil carbon sinks. According to the study performed by Drius et al. (2016), the area of Veneto region is one of the most significant for soil carbon storage. Carranza (2018) argued that based on such observations and considering the widespread presence of coastal dunes worldwide, it would be advisable to include them in the carbon pool global inventory, thus acknowledging their contribution to climate regulation.

In this context, this case study enhanced our understanding of the Italian coastal dune habitats' role in carbon storage and sequestration.

Recreational and leisure time activities belonging to the cultural services group

Among the large empirical literature studying the recreational value of beaches and dunes, this work aimed to assess the recreational and leisure time activities of dune habitats in Natura 2000 sites of the Veneto coast.

Recreational ecosystem services of protected areas and its values were assessed in various studies (e.g. Fleming & Cook, 2008; Larsen et al., 2008), but the sites of the Natura 2000 network are less regarded in studies about ecosystem services. Recent efforts related to the assessment of ecosystem services in Natura 2000 sites mainly addressed the potential to provide specific services, concentrating often on provisioning and regulating services, and discussing the role of biodiversity (Bastian, 2013, Castro et al., 2015). Only few studies specifically examined visitors to Natura 2000 sites by mapping potential beneficiaries (Schirpke et al. 2018) or analysing particular recreational activities (Torbidoni, 2011), but according to Schirpke et al., 2015, socio-economic information on the usage and expenditure of visitors to these sites is still incomplete.

This study focused at analysing visitors and stakeholders of Natura 2000 sites in Veneto coast using on-site surveys in 3 different sites integrating the ongoing research in recreational ecosystem services.

Concerning visitors, the study analysed 1) recreational activities, 2) the level of satisfaction with activities, 3) the level of knowledge of the Natura 2000 network and 4) average daily expenditure, e.g. for accommodation, travel or extra cost. With respect to stakeholders, this research documents local stakeholder perceptions of ecosystem services provided by coastal habitats and educational naturalistic activities or ecotourism experiences developed or offered.

By considering recreational activities, our results revealed that the most frequent respondents' primary motivation to visit is bathing (51%). Naturalistic activities (23%) represents one of the attractive elements that drew visitors to the places. Furthermore, over 69% of respondents consider the observation of the flora and fauna and the naturalistic activities important.

The satisfaction survey derived a high level of visitor satisfaction concerning initiatives in which respondents have participated. On the other hand, many respondents suggested the sites could be better promoted to offer more organization, initiatives, guided tours and information.

In this context, this research and the project itself, aim to contribute to enhancing the promotion of naturalistic activities and ecotourism experiences. Our results demonstrate that less than 20% of the stakeholders interviewed provides naturalistic activities to visitors.

In contrast to large protected areas, such as national parks, attracting many visitors (Arnberger et al., 2012, Mayer et al., 2010, Siikamäki et al., 2015), our results uncovered poor knowledge about the Natura 2000 network from both visitors and stakeholders.

Data from the surveys demonstrated that stakeholders agree that dune habitats contribute to making their structures more attractive and more than 90 % of the respondent's attributes value to dune habitats. At the same time, less than 15 % of respondents believes to be able to contribute to their conservation.

In this regard, the development of the LIFE Redune project, together with this first ES assessment, might help to increase knowledge about the Natura 2000 network and raise visitors' awareness of environmental issues.

The analysis and monetary valuation of recreational value carried out in the project context aimed at assessing the monetary value of the cultural service. According to findings on tourism statistics (Department of Economic and Social Affairs, 2010), the expenses involved in tourism represent the real value of tourism products, which for protected areas, is comparable to the recreational value for a site. The analysis of data collected revealed an individual average expense of 24,04 € per day for day trips (for goods, services and food) and 65,37 € for overnight stays (for goods, services, accommodation and food). The expenses for travelling were higher for day-trippers than for overnight visitors, because for these we considered only the distance from the accommodation to the study site, disregarding the distance from the place of residence to the accommodation. Hence, our results may underestimate travel costs for this type of visitor.

Furthermore, we did not intend to estimate recreational ecosystem services in monetary terms, reducing the intrinsic worth of nature to that which can be monetized (Adams, 2014), but to assess different types of expenditure related to the visit to Natura 2000 sites, which may be used for communicating the local benefits and developing more effective conservation strategies.

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Methods used to conduct the present study can be refined and expanded. Our results might be more representative if more than 90 visitors would be interviewed, and thus, supplementary surveys would be needed to involve more respondents and to obtain reliable data. On the other hand, more stakeholders have to be involved in the project. Actually, participation of stakeholders during the project development and implementation is crucial, but their involvement in this case has been difficult.
An in-depth study could further identify strategies for best promoting the appreciation and the sustainable use of the environment, promotion the circle that links tourist attraction and economic support to the management of the protected area itself. One of the further steps could be to identify and quantify ecosystem service supply at the local level which is a knowledge gap identified by the Millennium Ecosystem Assessment (Hutchison et al., 2013).

5. Conclusion

This report is a resource document that collects background information and provides the assessment of selected ecosystem services (ES) supplied by the area. The objective of this research was to provide an ex-ante valuation of the ecosystem services of LIFE REDUNE targeted areas. This work aimed to provides an initial qualification of the value of the ES for three Veneto coast Natura 2000 sites.

The research has been successful in assessing of three ecosystem services: *raw materials, carbon storage and sequestration, recreational value.* The result of this research show that the ES assessment is crucial for a systematic approach to environmental accountability that evaluates the management effectiveness of a project as LIFE REDUNE.

The qualitatively and quantitatively investigation of raw materials provided the quantification of the amount and type of materials that cover the beach in the study area. Carbon storage and sequestration evaluation through the assessment of two proxies and EU habitat type extents produced in this study constitute one of the first inventories for dune systems in the Veneto coast. Concerning the assessing recreational value and leisure time activities on the sites: demand for recreational activities have been quantified and the level of satisfaction with site-specific facilities and activities was generally high; the main motivations to visit have been explored; finally types of expenditure have been assessed.

Due to the experimental nature of this study, the results require further development and additional data is needed to valuing and assess costal protection ecosystem service. Although further analyses of additional services would be desirable for a more comprehensive assessment, this work offers interesting insights from an applied research perspective. In particular, by combining LIFE project with ecosystem services measurements we enhanced our understanding of transformation processes on coastal dunes and laid the basis for developing models of sustainable ecosystem government at landscape and environmental level.

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References

Acosta A., Carranza M. L., Izzi C.F. (2009) Are there habitats that contribute best to plant species diversity in coastal dunes?

Adams W. M. (2014) The value of valuing nature. Science, 346(6209), 549–551.

Agresti L., Ferroni F. (2016) Beneficiaries and stakeholders: selection and engagement. In: Manual for the valuation of ecosystem services and implementation of PES schemes in agricultural and forest landscapes – Application of the governance model "Making Good Natura" in natura 2000 sites and other areas.

Arnberger A., Eder, R., Allex, B., Sterl, P., & Burns, R. C. (2012) Relationships between national-park affinity and attitudes towards protected area management of visitors to the Gesaeuse National Park, Austria. Forest Policy and Economics, 19,48–55.

Atkin B., Gong T., Harmon J., Theodore M.G. (2009) Carbon sequestration method.

ATP provincia di Venezia (2014) 10 anni di turismo in Provincia di Venezia, flussi e trend del decennio 2004-2013

Barbier E. B., Hacker S. D. Kennedy C., Koch E. W., Stier A. C., & Silliman B. R. (2011) The value of estuarine and coastal ecosystem services, 81(2), 169–193.

Bastian O. (2013) The role of biodiversity in supporting ecosystem services in Natura 2000 sites. Ecological Indicators, 24,12–22

Beaumont N. J., Jones, L., Garbutt, A., Hansom, J. D., & Toberman, M. (2014) Estuarine, Coastal and Shelf Science The value of carbon sequestration and storage in coastal habitats. Estuarine, Coastal and Shelf Science, 137, 32–40

Booth K. L. (1991) Methods for conducting an on-site visitor questionnaire survey (Second Edition), Science & Research Internal Report no.102

Brandão R.L. (2008) Regiões costeiras. In: Silva, C.R. (Ed.), Geodiversidade do Brasil: conhecer o passado, para entender o presente e prever o future. CPRM, Rio de Janeiro, pp. 89–98. Brilha,

Bruschi G. and Pacciani A. (2017) La gestione dei materiali legnosi spiaggiati sugli arenili. L'esperienza di Marina di Carrara

Burkhard B., & Maes J. (2017) Mapping ecosystem services, Pensoft Publishers, 374

Carpenter S. R., Mooney, H. A., Agard, J., Capistrano, D., DeFries, R. S., Diaz, S., … Whyte, A. (2009) Science for managing ecosystem services: Beyond the Millennium Ecosystem Assessment. Proceedings of the National Academy of Sciences, 106(5), 1305–1312.

Carranza M. L., Drius, M., Malavasi, M., Frate, L., Stanisci, A., & Acosta, A. T. R. (2018) Assessing land take and its e ff ects on dune carbon pools . An insight into the Mediterranean coastline. Ecological Indicators, 85(September 2017), 951–955.

Carter R. W. G. (1990) Coastal environments: an introduction to the physical, ecological and cultural systems of coastlines. Academic Press, London, UK.

Castro A. J., Martín-López, B., López, E., Plieninger, T., Alcaraz-Segura, D., Vaughn, C. C., & Cabello, J. (2015) Do protected areas networks ensure the supply of ecosystem services? Spatial patterns of two nature reserve systems in semi-arid Spain. Applied Geography, 60,1–9.

Cornelissen J. H. C., Castro Diez P. and Hunt R. (1996) Seedling Growth, Allocation and Leaf Attributes in a Wide Range of Woody Plant Species and Types, Journal of Ecology, Vol. 84, No. 5, pp. 755-765

Costanza R., Arge R., Groot R. De Farber S., Grasso M., Hannon B., Sutton P. (1997) The value of the world's ecosystem services and natural capital. Nature 387, 253–260.

Coulloudon B., Eshelman K., Gianola J., Shaver P (1999) Sampling vegetation attributes. By: U.S. Department of Agriculture, Natural Resource Conservation Service, Grazing Land Technology Institute

Da Re R. and Gallo D., Masiero M. (2015) Analisi e stima economica del servizio turistico-ricreativo offerto da quattro aree-studio delle foreste di Lombardia. ETIFOR Srl – Spin-off dell'Università di Padova.

Daily G.C., Matson P.A. (2008) Ecosystem services: From theory to implementation. Proc Natl Acad Sci USA 105:9455–9456.

De Groot R. S., Wilson A. M. and Boumans M.J. (2002) A Typology for the Classification Description and Valuation of Ecosystem Functions, Goods and Services, Ecological economics, volume 41, 3, 393-408

Department of Economic and Social Affairs (2010) International Recommendations for Tourism Statistics 2008, New York, US: UNWTO.

Despain D.W., P.R. Ogden, and Smith E.L. (1991) Plant frequency sampling for monitoring rangelands. In: G.B. Ruyle, ed. Some Methods for Monitoring Rangelands and other Natural Area Vegetation. Extension Report 9043, University of Arizona, College of Agriculture, Tucson, AZ.

Doody J.P., (1997) Coastal Dunes of Europe – Recreational Impacts and Nature Conservation. In: Drees, J.M. (Ed.), Coastal Dunes, Recreation and Planning, EUCC Services, Leiden, pp. 50–59.

Drius M., Carranza M.L., Stanisci A., Jones L. (2016) The role of Italian coastal dunes as carbon sinks and diversity sources: a multi-service perspective. Appl. Geogr. 75, 127–136.

Drius M., Malavasi M., Acosta A. T. R., Ricotta C.,Carranza M.L. (2013) Boundary-based analysis for the assessment of coastal dune landscape integrity over time. Appl. Geogr. 45, 41–48.

Elliff C. I., & Kikuchi, R. K. P. (2015) The ecosystem service approach and its application as a tool for integrated coastal management. Natureza e Conservacao, 13(2), 105–111.

Everard M., Jones, L., & Watts, B. (2010) Have we neglected the societal importance of sand dunes? - An ecosystem services perspective. Aquatic Conservation: Marine and Freshwater Ecosystems, 20, 476e487

Faber S., Costanza R., Wilson M. (2002) Economic and Ecological for Valuing Ecosystem Services. Ecological Economics, Volume 41, 3, 375-392

Federici S; Vitullo, M; Tulipano, S; De Lauretis, R., & Seufert, G. (2008) An approach to estimate carbon stocks change in forest carbon pools under the UNFCCC : the Italian case. IForest - Biogeosciences and Forestry, 1(2), 86–95.

Fleming C. M., & Cook, A. (2008) The recreational value of Lake McKenzie, Fraser Island: An application of the travel cost method. Tourism Management, 29, 1197–1205.

French P. W. (2001) Coastal Defences: Processes, problems and solutions. London: Routledge

Gaglioppa P. and Marino D. (2016) Manual for the valuation of ecosystem services and implementation of PES schemes in agricultural and forest landscapes – Application of the governance model "Making Good Natura" in natura 2000 sites and other areas, with contributions by Pierluca Gaglioppa, Ambra Forconi, Angelo Marucci, Davide Pellegrino, Margherita Palmieri, Rossella Guadagno, Davide Marino, Stefano Picchi,

Natalia Marzia Gusmerotti, Alessandra Borghini, Catie Burlando, Nathan Deutsch, Caterina Caraucasi, Franco Ferroni Luigi Agresti, Uta Schirpke, Rocco Scolozzi - CURSA, Rome, 171.

Glimskär A. (2000) Estimates of root system topology of five plant species grown at steady-state nutrition

Glimskär A. and Ericsson T. (2000) Relative nitrogen limitation at steady-state nutrition as a determinant of plasticity in five grassland plant species. Ann. Bot. 84, 413–420

Gratani L., Crescente M.F., Varone L. (2007) Ecologia della duna: ritmo fenologico delle specie psammofile, Fitosociologia vol. 44 (1), 11-16

Gray M., (2004) Geodiversity: Valuing and Conserving Abiotic Nature. John Wiley & Sons, London.

Grime J.P. and Hunt R. (1975) Relative growth-rate: its range and adaptive significance in a local flora, Sheffield, 393-422

Hardisty J. (1994) Beach and nearshore sediment transport in K. Pye, editor. Sediment transport and depositional processes. Blackwell, London, UK, 216–255

Howarth R. and Farber S. (2002) Accounting for the Value of Ecosystem Services, Ecological economics, Volume 41, 3, 421-429

Huang J.-C., P. J. Poor and M. Q. Zhao (2007) Economic valuation of beach erosion control. Marine Resource Economics 32:221–238.

Hunt R. and J. H. C. Cornelissen (1997) Components of relative growth rate and their interrelations in 59 temperate plant species

Hutchison L., Montagna, P., & Yoskowitz, D. (2013) Stakeholder Perceptions of Coastal Habitat Ecosystem Services, 38.

Istituto Nazionale di Statistica, ISTAT (2017) Annuario statistico italiano (Italian statistical yearbook). Rome, Italy.

Kriesel W., and C. E. Landry (2004) Participation in the National Flood Insurance Program: an empirical analysis for coastal properties. Journal of Risk and Insurance 71:405– 420.

Laffoley D. & Grimsditch G. (2009) The management of natural coastal carbon sinks. Gland, Switzerland: IUCN, 53 pp.

Landry C. E., A. G. Keeler and W. Kriesel (2003) An economic evaluation of beach erosion management alterna- tives. Marine Resource Economics 18:105–127.

Larsen F., Petersen, A., Strange, N., Lund, M., & Rahbek, C. (2008) A quantitative analysis of biodiversity and the recreational value of potential national parks in Denmark. Environmental Management, 41, 685–695.

Lee W. G., Mark, A. F., Wilson, J. B., Lee, W. G., Mark, A. F., & Ecotypic, J. B. W. (2012) Ecotypic differentiation in the ultramafic flora of the South Island , New Zealand Ecotvpic differentiation in the ultramafic flora of the South Island , New Zealand, 8643.

Limburg K.E., R.V.O' Neil, R. Costanza and S.Farber. (2002) Complex Systems and Valuation. Ecological Economics, volume 41, 3, 409-420

Maes J., Teller A., Erhard M., Liquete C., Braat L., Berry P., Egoh B., Puydarrieux P., Fiorina C., Santos F., Paracchini M.L., Keune H., Wittmer H., Hauck J., Fiala I., Verburg P.H., Condé S., Schägner J.P., San Miguel J., Estreguil C., Ostermann O., Barredo J.I., Pereira H.M., Stott A., Laporte V., Meiner A., Olah B., Royo Gelabert E., Spyropoulou R., Petersen J.E., Maguire C., Zal N., Achilleos E., Rubin A., Ledoux L., Brown C., Raes C., Jacobs S., Vandewalle M., Connor D., Bidoglio G. (2013) Mapping and Assessment of Ecosystems and their

Services. An analytical framework for ecosystem assessments under action 5 of the EU biodiversity strategy to 2020. Publications office of the European Union, Luxembourg

Magnussen S. and Reed D. (2015) Modelling for estimation and monitoring in FAO Knowledge, Food and Agriculture Organization of the United Nations Rome

Maranon T. and Grubb P. J. (1993) Physiological basis and ecological significance of the seed size and relative growth rate relationship in Mediterranean annuals

Marino D., Schirpke U., Gaglioppa P., Guadagno R., Marucci M., Palmieri M., Pellegrino D., De Marco C., Scolozzi R. (2014) Assessment and Governance of Ecosystem Services: first insights from LIFE+MakingGood Natura project, Annali Botanica, 0365-0812

Martínez M. L., Intralawan A., Vázquez G., & Pérez-maqueo O. (2007) The coasts of our world: Ecological , economic and social importance, 3(351).

Mayer M., Müller, M., Woltering, M., Arnegger, J., & Job, H. (2010). The economic impact of tourism in six German national parks. Landscape and Urban Planning, 97, 73–82. http://dx.doi.org/10.1016/j.landurbplan.2010.04.013.

Mcleod E., Chmura, G. L., Bouillon, S., Salm, R., ork, M., Duarte, C. M., et al. (2011) A blueprint for blue carbon: Toward an improved understanding of the role of vegetated coastal habitats in sequestering CO_2. Frontiers in Ecology and the Environment, 9, 552e560

Millennium Ecosystem Assessment (2003) Ecosystems and Human Well-being: A Framework for Assessment. Island Press; Washington.

Millennium Ecosystem Assessment (2005) Ecosystems and Human Well-being: Wetlands and Water. Synthesis. World Resources Institute, Washington.

Mitsch, W. J., and J. G. Gosselink. (2008) Wetlands. Van Nostrand Reinhold, New York, New York, USA.

Mokany K., Raison R. J., Prokushkin A. S. (2006) Critical analysis of root:shoot ratios I terrestrial biomes, Global Change Biology 12, 84–96

Morgan O. A. and S. E. Hamilton (2010) Estimating a payment vehicle for financing nourishment of residential beaches using a spatial-lag hedonic property price model. Coastal Management 38:65–75. Morgan,

Munari C., Corba, C., Simeon, U., & Mistr, M. (2016) Marine litter on Mediterranean shores : Analysis of composition, spatial distribution and sources in north-western Adriatic beaches. Waste Management, 49, 483–490. https://doi.org/10.1016/j.wasman.2015.12.010

Perman R., Ma, Y., McGilvray, J., & Common, M. (2003) Natural resource and environmental economics. Third edition 2003 Pearson Education Limited.

Poorter H. (1989) Interspecific variation in relative growth rate: On ecological causes and physiological consequences. In: Lambers, H., Cambridge, M. L., Konings, H. & Pons, T. L. (eds), Causes and consequences of variation in growth rate and productivity of higher plants, pp. 45-68. SPB Academic Publishing, The Hague.

Poorter H. (1993) Interspecific variation in the growth response of plants to an elevated ambient CO_2 concentration

Pye K., and Tsoar H. (1990) Aeolian sand and sand dunes. Unwin Hyman, London, UK.

Rhymes J., Jones L., Lapworth D. J., White D., Fenner N., McDonald J. E., et al. (2015) Using chemical, microbial and fluorescence techniques to understand contaminant sources and pathways towetlands in a conservation site. Science of the Total Environment, 511, 703e710.

Ruggiero, P., M. C. Buijsman, G. M. Kaminsky, and G. B. Gelfenbaum. 2010. Modeling the effect of wave climate and sediment supply variability on large scale shoreline change. Marine Geology 273:127–140.

Schirpke U., Scolozzi R., De Marco C. (2014) Modello dimostrativo di valutazione qualitativa e quantitativa dei servizi ecosistemici nei siti pilota. Parte1: Metodi di valutazione. Report del progetto Making Good Natura (LIFE+11 ENV/IT/000168), EURAC research, Bolzano, p. 75.

Schirpke U., Scolozzi, R. (2015) Software per la valutazione e quantificazione dei servizi ecosistemici. Parte 3: Modelli dinamici qualitativi. Report del progetto Making Good Natura (LIFE+11 ENV/IT/000168), EURAC research, Bolzano, p. 35.

Schirpke U., Scolozzi, R., Concetti, B., Comini, B., & Tappeiner, U. (2017) Supporting the management of ecosystem services in protected areas: Trade-offs between effort and accuracy in evaluation. J

Schirpke U., Scolozzi, R., Da Re R., Masiero M., Pellegrino D., Marino D. (2018) Recreational ecosystem services in protected areas: A survey of visitors to Natura 2000 sites in Italy

Schirpke U., Scolozzi, R., Da, R., Masiero, M., Pellegrino, D., & Marino, D. (2018) Journal of Outdoor Recreation and Tourism Recreational ecosystem services in protected areas: A survey of visitors to Natura 2000 sites in Italy. Journal of Outdoor Recreation and Tourism, 21(August 2017), 39–50.

Schirpke U., Scolozzi, R., De Marco, C., & Tappeiner, U. (2014) Mapping beneficiaries of ecosystem services flows from Natura 2000 sites. Ecosystem Services, 9, 170–179.

Schlesinger W.H. (1991) Biogeochemistry, an analysis of global change. New York, Academic Press

Shipley B. and Keddy P. A. (1988) The Relationship Between Relative Growth Rate and Sensitivity to Nutrient Stress in Twenty-Eight Species of Emergent Macrophytes

Siikamäk P., Kangas, K., Paasivaara, A., & Schroderus, S. (2015) Biodiversity attracts visitors to national parks. Biodiversity and Conservation, 24(10), 2521–2534

Smith E.L. and Despain, D.W. (1991) The dry-weight rank method of estimating plant species composition, In: G.B. Ruyle, ed. Some Methods for Monitoring Rangelands and other Natural Area Vegetation. Extension Report 9043, University of Arizona, College of Agriculture, Tucson, AZ.

Smith E.L. and Ruyle G.B. (1991) Considerations when monitoring rangeland vegetation. In: G.B. Ruyle, ed. Some Methods for Monitoring Rangelands and other Natural Area Vegetation. Extension Report 9043, University of Arizona, College of Agriculture, Tucson, AZ.

Sun S. and Frelich L. E. (2011) Flowering phenology and height growth pattern are associated with maximum plant height, relative growth rate and stem tissue mass density in herbaceous grassland species, Journal of Ecology, 99, 991–100

Torbidoni E. I. F. (2011) Managing for recreational experience opportunities: The case of hikers in protected areas in Catalonia, Spain. Environmental Management, 47(3),

Traun C., Klug H. & Burkhard B. (2017) Mapping techniques, In: Burkhard, B. & J. Maes (Eds.): Mapping Ecosystem Services. Pensoft Publishers 57-64

UNEP, United Nations Environment Programme (2006) Marine and Coastal Ecosystems and Human Wellbeing: A Synthesis Report Based on the Findings of the Millennium Ecosystem Assessment. UNEP, Nairobi.

Van Dijk, H. W. J. (1989) Ecological impact of drinking-water production in Dutch coastal dunes. In F. van der Meulen, P. D. Jungerius, & J. Visser (Eds.), Perspectives in coastal Dune management. Proceedings of the European symposium Leiden, September 7-11, 1987 (pp. 163e182). The Hague: SPB Academic Publishing.

Verdù M. (2000) Ecological and evolutionary differences between Mediterranean seeders and resprouters, (1987), 265–268.

Virgilietti, P. (2010) Le dune costiere in Veneto: stato, gestione e prospettive. Studi Costieri, 17, 53–69.

Whitehead J. C., C. F. Dumas, J. Herstine, J. Hill, and B. Buerger (2008) Valuing beach access and width with revealed and stated preference data. Marine Resource Economics 23:119–135.

Wilson M.A. and Howarth R. (2002) Discourse-based valuation of ecosystem services: establishing fair outcomes through group deliberation, Ecological economics, 431-443

Zhu Z., Bergamaschi B., Bernknopf R., Clow D., Dye D., Faulkner S., Forney W., Gleason R., Hawbaker, Todd L., Jinxun L., Shuguang, Prisley, S., Reed, Bradley, Reeves, M., Rollins, M., Sleeter, B., Sohl, T., Stackpoole S., Stehman, S., Striegl, R., Wein, A. (2010) A method for assessing carbon stocks, carbon sequestration, and greenhouse-gas fluxes in ecosystems of the United States under present conditions and future scenarios: U.S. Geological Survey Scientific Investigations Report 2010–5233, 188

Appendix 1. Biomass sampling protocol

STIMA DI BIOMASSA VEGETALE PER SPECIE
Protocollo di campionamento

- ➢ Campionare in un'area 25 cm x 25 cm
- ➢ Posizionare il quadrato casualmente
- ➢ Ripetere l'operazione in zone diverse, in modo da avere

Procedimento:

1) Registrare le coordinate dell'area in esame
2) Posizionare il quadrato e scattarne una foto
3) Prelevare la porzione epigea rientrante nell'area del quadrato di riferimento
4) Determinare le specie raccolte e indicare la serie vegetazionale (*Cakiletea maritimae, Ammophiletea, Tortulo scabioseto, Bassura umida interdunale...*)
5) Riporre i campioni in un sacchetto di plastica o carta numerato

	Coordinate	Foto	Serie	Specie
Sacchetto 1	Latitudine: 45.439299 | Longitudine: 12.454732 (Punta Sabbioni-Cavallino)		*Bassura umida interdunale*	...

Determinazione peso secco in laboratorio

6) Una volta in laboratorio, determinare il peso secco di ognuno dei campioni, suddivisi per specie, ponendoli in stufa ventilata:

Temperatura	70 °C
Tempo	48 h

<u>Strumentazione in campo</u>: macchina fotografica, GPS, sacchetti, schede di campo, forbici, quadrato 25 x 25
<u>Strumentazione in laboratorio</u>: chiavi dicotomiche, stereoscopio, vaschette in alluminio o carta, stufa

_____

Il presente lavoro mira a fornire un'analisi preliminare della biomassa floristica dei sistemi dunali della costa Veneta, coinvolti nel progetto LIFE + REDUNE LIFE16 NAT/IT/000589.

Appendix 2. Carbon storage and sequestration assessment

Table 13. Carbon stock (biomass) and carbon flow (primary production) per species assessment

Species	Above ground biomass* (g/m²)	Below ground biomass (g/m²)	RGR/d⁻¹*	References	Above ground biomass			Below ground biomass			Total		
					Biomass (g)	Production (g/day)	Production (g/yr)	Biomass (g)	Production (g/day)	Production (g/yr)	Biomass (g)	Production (g/day)	Production (g/yr)
Ambrosia coronopifolia	37,43	70,00	0,12	Poorter (1993)	37,43	4,49	1639,59	70,00	8,40	3066,04	107,43	12,89	4705,64
Ammophila arenaria	128,37	240,05	0,14	Gratani et al. (2007)	128,37	17,97	6559,79	240,05	33,61	12266,80	368,43	51,58	18826,59
Apocinum venetum	56,10	104,90	0,16	Hunt and Cornelissen (1997)	56,10	8,98	3276,13	104,90	16,78	6126,37	161,00	25,76	9402,50
Asparagus maritimus	32,05	59,93	0,11	Sun and Frelich (2011)	32,05	3,53	1286,78	59,93	6,59	2406,27	91,98	10,12	3693,05
Cakile maritima	82,20	153,71	0,10	Gratani et al. (2007)	82,20	8,22	3000,21	153,71	15,37	5610,38	235,91	23,59	8610,59
Cyperus capitatus	103,52	193,59	0,14	Shipley and Keddy (1988)	103,52	14,49	5290,03	193,59	27,10	9892,36	297,11	41,60	15182,39
Echinophora spinosa	41,65	77,89	0,12	Gratani et al. (2007)	41,65	5,00	1824,27	77,89	9,35	3411,38	119,54	14,34	5235,65
Erianthus ravennae	105,68	197,62	0,14	Gratani et al. (2007)	105,68	14,80	5400,34	197,62	27,67	10098,63	303,31	42,46	15498,96
Erica carnea	132,04	246,91	0,06	Cornelissen et al. (1996) (Erica cinerea)	132,04	7,92	2891,60	246,91	14,81	5407,29	378,94	22,74	8298,88
Erigeron canadensis	36,65	68,53	0,11	Sun and Frelich (2011)	36,65	4,03	1471,47	68,53	7,54	2751,65	105,18	11,57	4223,12
Eryngium maritimum	35,24	65,90	0,12	Gratani et al. (2007)	35,24	4,23	1543,43	65,90	7,91	2886,21	101,13	12,14	4429,64
Euphorbia paralias	126,04	235,69	0,10	Gratani et al. (2007)	126,04	12,60	4600,46	235,69	23,57	8602,86	361,73	36,17	13203,32
Fumana procumbens	73,81	138,02	0,08	Verdù M. et at. (2000) (Cystus clusii)	73,81	6,13	2236,00	138,02	11,46	4181,31	211,83	17,58	6417,31
Hypocaeris radicata	128,17	239,67	0,29	Maranon and Grubb (1993)	128,17	37,17	13566,44	239,67	69,50	25369,25	367,84	106,67	38935,69
Koeleria splendens	42,72	79,89	0,16	Hunt and Cornelissen (1997)	42,72	6,84	2495,11	79,89	12,78	4665,85	122,62	19,62	7160,96
Medicago marina	38,56	72,12	0,20	Maranon and Grubb (1993)	38,56	7,71	2815,24	72,12	14,42	5264,49	110,68	22,14	8079,73
Oenothera stucchii	76,59	143,22	0,23	Grime and Hunt (1972)	76,59	17,62	6429,49	143,22	32,94	12023,14	219,81	50,56	18452,63
Plantago lanceolata	8,61	16,10	0,20	Grime and Hunt (1972)	8,61	1,72	628,38	16,10	3,22	1175,08	24,70	4,94	1803,46
Polygala comosa	81,44	152,29	0,10	Glimskär (2000)	81,44	8,14	2972,56	152,29	15,23	5558,69	233,73	23,37	8531,25
Sanguisorba minor	50,94	95,25	0,13	Grime and Hunt (1972)	50,94	6,62	2416,98	95,25	12,38	4519,75	146,19	19,00	6936,73
Scabiosa triandra	47,47	88,77	0,18	Grime and Hunt (1972)	47,47	8,54	3118,90	88,77	15,98	5832,34	136,24	24,52	8951,24
Schoenus nigricans	142,04	265,61	0,05	Lee et al. (2012)	142,04	7,10	2592,18	265,61	13,28	4847,38	407,65	20,38	7439,57
Silene conica	24,04	44,95	0,23	Poorter (1989)	24,04	5,53	2018,16	44,95	10,34	3773,96	68,99	15,87	5792,11
Silene vulgaris	55,81	104,36	0,23	Poorter (1989)	55,81	12,84	4685,25	104,36	24,00	8761,42	160,17	36,84	13446,67
Teucrium polium	118,00	220,66	0,10	Grime and Hunt (1972)	118,00	11,80	4307,02	220,66	22,07	8054,12	338,66	33,87	12361,14
Thymus pulegioides	51,06	95,48	0,15	Grime and Hunt (1972)	51,06	7,66	2795,59	95,48	14,32	5227,75	146,54	21,98	8023,33
Vulpia membranacea	25,60	47,87	0,26	Maranon and Grubb (1993)	25,60	6,66	2429,44	47,87	12,45	4543,05	73,47	19,10	6972,49
Xanthium italicum	71,24	133,23	0,13	Shipley and Keddy (1988)	71,24	9,26	3380,52	133,23	17,32	6321,58	204,47	26,58	9702,11

Above ground biomass* (g/m²): has been calculated by using the ratio between *biomass* and *cover* for each specie in each plot 25 x 25 cm

Appendix 3. Raw materials sampling protocol

<div align="center">

STIMA MATERIALE SPIAGGIATO

Protocollo di campionamento

</div>

➢ Per ciascun sito, n. 3 transetti: larghezza 1 m, lunghezza dal margine dunale al bagnasciuga
➢ Posizionare transetti: random

Procedimento:

1) Salvare coordinate transetto ad entrambe le sue estremità
2) Stima grossolana della lunghezza del transetto (da validare successivamente in GIS sulla base delle coordinate)
3) Scattare foto panoramiche del transetto, dalle sue due estremità
4) Compilare descrizione generale:
   - Si osserva accumulo di materiale?
   - Se si, schizzo veloce con caratteristiche (presenza e numero di strisce di accumulo, materiali dominanti)
   - Eventuali note
5) Percorrere il transetto per tutta la sua lunghezza scattando foto (con metro visibile) in corrispondenza dei materiali incontrati. Annotare posizione degli scatti sullo schizzo del transetto.

Osservazione generale del sito:

1) Si osservano aree con densità particolarmente elevate di materiali spiaggiati? Se si fotografare.

2) Nei dintorni, si osserva la presenza di costruzioni di varia natura (tavoli, sedili, punti di appoggio, capanni) che potrebbero essere state costruite utilizzando (anche parzialmente) materiali spiaggiati? Se si, quante e di quale tipologia (eventualmente fotografare)?

Appendix 4. Leaflets for questionnaires and web site

QUESTIONARIO PER VISITATORI (VALORE RICREATIVO)

Questionario ai frequentatori del _____

Nell'ambito del progetto LIFE + REDUNE LIFE16 NAT/IT/000589, l'Università Ca Foscari di Venezia ha avviato un'indagine per raccogliere informazioni sui frequentatori dell'area e le attività ricreative svolte. Con l'occasione è possibile esprimere consigli e suggerimenti per migliorare la fruibilità del sito.

Le chiediamo di compilare il questionario in tutte le sue parti.
Il questionario è individuale. Nel caso fosse qui con a famiglia, le domande faranno riferimento al nucleo familiare.
Il questionario è anonimo e le informazioni saranno trattate con la massima riservatezza, secondo il D.lgs 196/2003 (Codice in materia di protezione dei dati personali).

_____

Località rilievo _____

Data ____/____/2018

Il presente questionario è stato: □ auto-compilato   □ somministrato da rilevatore

_____

1. **Per quali attività è qui oggi principalmente?**
   □ balneazione (spiaggia)
   □ bicicletta
   □ altre attività sportive
   □ attività naturalistiche
   □ nautica/pesca
   □ motivi enogastronomici
   □ altro (specificare _____)

2. **Quanto è importante ciascuna delle seguenti motivazioni nell'ambito della sua visita qui? Indichi il livello di importanza per ognuna delle seguenti motivazioni**

Motivazione	Molto poco	Poco	Abbastanza	Molto	Non so/non conosco
Balneazione (spiaggia)	□	□	□	□	□
Bicicletta	□	□	□	□	□
Altre attività sportive	□	□	□	□	□
Osservare la flora	□	□	□	□	□
Osservare la fauna	□	□	□	□	□
Ammirare il paesaggio	□	□	□	□	□
Escursioni naturalistiche	□	□	□	□	□
Nautica/pesca	□	□	□	□	□
Enogastronomia	□	□	□	□	□
Altro_____	□	□	□	□	□

3. **E' arrivato:**
   □ da solo
   □ con amici   n° amici |__|__|
   □ con un gruppo organizzato   n° persone|__|__|
   □ con familiari   n° familiari: |__|__|
   (le chiediamo di fare riferimento all'intero nucleo familiare per le prossime domande)
   □ altro (specificare _____)

4. **La sua visita a questo sito è:**
   □ giornaliera senza pernottamento → *proseguire con la domanda 8.*
   □ di uno o più giorni, con pernottamento nelle vicinanze (<20km)→*rispondere alle domande 5, 6, 7.*
   □ di uno o più giorni, con pernottamento in un altro luogo (>20km)→*rispondere alle domande 5, 6, 7.*

5. *(in caso di pernottamento turistico)* **Quanti giorni dura il suo pernottamento?** |__|__|__|

6. *(in caso di pernottamento turistico)* **In che tipo di struttura alloggia?**
   □ albergo □ bed and breakfast □ appartamento □ campeggio □ ospite da amici
   □ altro (specificare)

7. *(in caso di pernottamento turistico)* **La spesa individuale media giornaliera per il pernottamento è (indicare la fascia di spesa):**
   □ 0 - 30 € □ 31 - 60 € □ 61 - 90 € □ più di 90 €

8. **Facendo riferimento alla giornata di oggi, qual è stata la spesa media a persona che ha sostenuto nel sito (o nelle sue vicinanze) per...**

	Spesa media giornaliera a persona	
… mangiare e bere?	|__|__|__|__| €	□ nessuna spesa
… comprare prodotti tipici?	|__|__|__|__| €	□ nessuna spesa
… accedere allo stabilimento balneare?	|__|__|__|__| €	□ nessuna spesa
… affittare ombrellone/capanna?	|__|__|__|__| €	□ nessuna spesa
… il parcheggio?	|__|__|__|__| €	□ nessuna spesa
… svolgere attività naturalistiche?	|__|__|__|__| €	□ nessuna spesa
… svolgere attività culturali?	|__|__|__|__| €	□ nessuna spesa
… per altro (specificare _____)	|__|__|__|__| €	□ nessuna spesa

9. **Con quali mezzi ha raggiunto il sito?**
   □ automobile
   □ camper
   □ motocicletta
   □ bicicletta
   □ mezzo pubblico
   □ altro (specificare) _____

10. **Quanti km ha oggi approssimativamente percorso, dal luogo dove risiede o dove pernotta in questi giorni, per raggiungere questo sito?** |__|__|__| km

11. **Questo sito fa parte della Rete di aree protette denominata Natura 2000. Aveva mai sentito parlare prima di Natura 2000?**
   □ sì, la conosco bene   □ sì, ma non ne conosco le caratteristiche   □ no

12. **Durante la sua permanenza qui, ha svolto attività naturalistiche/ esperienze eco-turistiche?**
   □ no   □ sì

Se sì, quali?
   □ escursione guidata in aree naturali
   □ visita ad aree naturali attrezzate con pannelli informativi
   □ altro (specificare) _____

Se si, in quale ambiente naturale?
   □ dune
   □ pineta
   □ laguna
   □ altro (specificare) _____

13. *(In caso di risposta positiva alla domanda 12)* **Qual è il suo livello di soddisfazione complessiva?**
   □ ridotto □ discreto □ buono □ ottimo

14. *(In caso di risposta positiva alla domanda 12)* **Ritiene che le attività svolte siano state?**
   □ piacevoli occasioni di apprendimento □ interessanti □ divertenti □ banali □ noiose □ inutili

15. *(In caso di risposta positiva alla domanda 12)* **Consiglierebbe questa attività a dei suoi amici? Per quale motivo?**

   □ si, interessante □ si, divertente   □ no, noiosa □ no, troppo costosa

16. **Ha qualche suggerimento riguardo alle iniziative che si potrebbero intraprendere per valorizzare il sito?**...

....

....

A. Età (anni compiuti): □ da 0 a 17 □ da 18 a 30 □ da 31 a 45 □ da 46 a 60 □ oltre 60

B. Genere: □ maschio □ femmina

C. Titolo di studio: □ nessuno   □ licenza media   □ laurea o superiore
           □ licenza elementare □ licenza media superiore

D. Comune di residenza:

□ Nella Provincia   → Comune di _____
□ Nella Regione   → Comune di _____
□ Altra Regione italiana (specificare) _____
□ Estero   (specificare) _____

E. E' iscritto a qualche associazione?

Associazioni alpinistiche/escursionistiche (specificare) _____ si □ no □
Associazioni sportive   (specificare) _____ si □ no □
Associazioni ambientaliste   (specificare) _____ si □ no □
Altre   (specificare) _____ si □ no □

17. **Lei è un visitatore** □ occasionale □ abituale (ha già visitato questo sito in precedenza)

18. **Sarebbe disponibile a ricompilare questo questionario tra 4 anni?**
               □ no □ sì

Se si, sarebbe disponibile lascarci il suo indirizzo email *(verrà utilizzato <u>esclusivamente</u> ai fini della presente indagine)*?

            _____@_____

La ringraziamo per il suo contributo.

VISITORS QUESTIONNAIRE (RECREATIONAL VALUE)

Questionnaire to the users of _____

As part of the LIFE + REDUNE LIFE16 NAT / IT / 000589 project, the Ca 'Foscari University of Venice started an analysis to gather information on visitors and the learning activities carried out. On this occasion it is possible to give advice and suggestions to improve the usability of the site.

We ask you to complete the questionnaire in all its parts.
The questionnaire is individual. If you are here with your family, the questions will refer to the family unit.

The questionnaire is anonymous, and the information will be treated with the utmost confidentiality, according to the Legislative Decree 196/2003 (Code regarding the protection of personal data).
_____

Interviewing location _____

Date ____ / ____ / 2018

This questionnaire is: □ self-compiled   □ submitted by a researcher
_____

1. **For which activities are you here?**
   - □ bathing
   - □ bicycle
   - □ other sports activities
   - □ naturalistic activities
   - □ sailing / fishing
   - □ food and beverage
   - □ other (please describe_____)

2. **What are your main reasons for coming to this area? Please indicate the level of importance for each of the following activities:**

Activities	Not at all important	Slightly important	Quite important	Very important	I don't know
Bathing	□	□	□	□	□
Bicycle	□	□	□	□	□
Other sports activities	□	□	□	□	□
Observe the flora	□	□	□	□	□
Observe the fauna	□	□	□	□	□
Enjoy the landscape	□	□	□	□	□
Naturalistic excursions	□	□	□	□	□
Sailing / Fishing	□	□	□	□	□
Food and beverage	□	□	□	□	□
Other_____	□	□	□	□	□

3. **Who did you come with? / Who are you travelling with?**
   - □ alone
   - □ with friends   n° |__|__|
   - □ with an commercial group   n° of people: |__|__|
   - □ with family   n° of members: |__|__|
   (we ask you to refer to the whole family for the next questions)
   - □ other (please describe _____)

4. **Are you a day visitor or are you staying overnight here?**
   - □ one-day without overnight stay → *continue with the question number 8.*
   - □ one or more days, with overnight stay (<20km)→*answer the questions 5, 6, 7.*
   - □ one or more days, with overnight stay (>20km)→ *answer the questions 5, 6, 7.*

5. *(in case of overnight stay)* **How many nights are you spending here?** |__|__|__| nights

6. *(in case of overnight stay)* **What accommodation are you yourself using during your holiday?**
□ hotel □ bed and breakfast □ private home □ camping ground □ guest
□ other (please describe)

7. *(in case of overnight stay)* **Your individual daily expense for the overnight stay is around:**
□ 0 - 30 € □ 31 - 60 € □ 61 - 90 € □ more than 90 €

8. **By referring to the day of today, how much each person of your group have spent for…**

	Daily average expense per person
… eat and drink?	|__|__|__|__| € □ no costs
… buy tradicional products?	|__|__|__|__| € □ no costs
… access to the beach property?	|__|__|__|__| € □ no costs
… rent a beach umbrella / hut on the beach?	|__|__|__|__| € □ no costs
… the parking?	|__|__|__|__| € □ no costs
… carry out naturalistic activities?	|__|__|__|__| € □ no costs
… carry out cultural activities?	|__|__|__|__| € □ no costs
… other (please describe _____)	|__|__|__|__| € □ no costs

9. **How did you travel here?**
□ car
□ camper
□ motorbike
□ bicycle
□ public transport
□ other (please describe_____)

10. **How many km did you cross from the place where you live, to get here?** |__|__|__| km

11. **This area is protected under *Nature 2000 network*. Did you hear about it?**
□ yes, I know it well □ yes, but I don't know its characteristics □ no

12. **What activities have you done during your visit to the area? Did you carry out/do naturalistic activities or ecotourism experiences?** □ no □ yes

If yes, which?
□ guided tour/excursion in natural areas
□ visit to natural areas equipped of informative panels
□ other (please describe _____)

If yes, in which natural environment?
□ dunes
□ pine grove / pine forest
□ lagoon
□ other (please describe _____)

13. *(In caso di risposta positiva alla domanda 12)* **Overall, how satisfied are you with this activities?**

□ Dissatisfied □ Neither satisfied nor dissatisfied □ Satisfied □ Very satisfied

14. *(In caso di risposta positiva alla domanda 12)* **Do you believe that these activities have been…?**

□ a pleasant occasions for learning □ interesting □ amusing □ banal □ boring □ useless

15. *(In caso di risposta positiva alla domanda 12)* **Would you recommend these activities to friends? Why?**

□ yes, interesting □ yes, amusing □ no, boting □ no, too expensive

16. **Please express your opinion, especially on improvements that could be made to enhance this site**

....
....
....

Could you please tell us a little about yourself?
_____

A. In which age group are you?
□ 0 – 17 years old □ 18 - 30 years old □ 31 – 45 years old □ 46 – 60 years old □ 60+ years old

B. Are you? □ male □ female

C. What is your highest educational qualification?
□ No qualification □ Elementary school □ Higher school certificate
□ Primary school □ University degree/diploma

D. Where do you currently live?

□ in Italy (please describe) _____
□ abroad (please describe) _____

E. Do you belong to an outdoor recreation club / a conservation organisation?

Alpine / hiking associations (please describe)_____ yes □ no □
Sports associations (please describe)_____ yes □ no □
Environmental associations (please describe)_____ yes □ no □
Other (please describe)_____ yes □ no □

17. **Are you..?** □ occasional visitor □ habitual visitor (if you have already visited this site)

18. **Would you be willing to fill out again this questionnaire in 4 years?**
□ no □ yes
If yes, would you be available to leave us your email address (will it be used exclusively for the purposes of this survey)?

_____@_____

_____

La ringraziamo per il suo contributo.

FRAGEBOGEN FÜR BESUCHER (FREIZEIT-UND ERHOLUNGSWERT)

Fragebogen für Besucher des _____

Im Rahmen des Projektes *LIFE + REDUNE LIFE16 NAT/IT/000589*, hat die Universität *Ca' Foscari* von Venedig eine Untersuchung eingeleitet, um Informationen über Besucher des Gebietes und über die ausgeübten Freizeitaktivitäten zu sammeln. Bei dieser Gelegenheit ist es möglich, Ratschläge und Empfehlungen zu äußern, um die Eignung dieses Ortes zu verbessern.

Wir möchten Sie bitten, jeden Teil des Fragebogens auszufüllen.
Der Fragebogen ist persönlich. Für den Fall, dass Sie mit der Familie hier sind, beziehen sich die Fragen auf die Familie.

Der Fragebogen ist anonym und die Informationen werden mit äußerster Diskretion behandelt , gemäß D.lgs 196/2003 (Gesetz zum Schutz personenbezogener Daten).

_____

Ort der Erhebung _____

Datum ___/___/2018

Der vorliegende Fragebogen wurde: □ selbstständig ausgefüllt   □ vom Datenerheber ausgeführt
_____

1, Für welche Aktivität sind Sie heute hauptsächlich hier?
- □ baden (Strand)
- □ Fahrradfahren
- □ andere sportliche Aktivitäten
- □ naturalistische Aktivitäten
- □ Wassersport/Fischfang
- □ gastronomische Gründe
- □ andere (genauer angeben:_____)

2. **Wie wichtig ist Ihnen , im Rahmen Ihres Besuches an diesem Ort, jeder einzelne der folgenden Beweggründe?**
   Zeigen Sie den Wichtigkeitsgrad für jeden einzelnen Beweggrund an:

Beweggründe	Sehr wenig	Wenig	Ausreichend	Sehr	Weiß ich nicht/kenne ich nicht
Baden (Strand)	□	□	□	□	□
Fahrradfahren	□	□	□	□	□
Andere sportliche Aktivitäten	□	□	□	□	□
Beobachten der Pflanzenwelt	□	□	□	□	□
Beobachten der Tierwelt	□	□	□	□	□
Bewundern der Landschaft	□	□	□	□	□
Naturalistische Ausflüge	□	□	□	□	□
Wassersport/Fischfang	□	□	□	□	□
Gastronomie und Önologie	□	□	□	□	□
Andere_____	□	□	□	□	□

3. Sie sind gekommen:
- □ alleine
- □ mit Freunden, Anzahl der Freunde: |__|__|
- □ mit einer organisierten Gruppe , Anzahl der Personen: |__|__|
- □ mit Familienangehörigen, Anzahl der Familienangehörigen: |__|__|
  (wir bitten Sie, sich für die nachkommenden Fragen auf die gesamte Familie zu beziehen:
- □ andere (genauer angeben _____)

4. Ihr Besuch an diesem Ort ist:
- □ täglich ohne Übernachtung ⬜ mit Frage *8* fortfahren.
- □ ein oder zwei Tage, mit Übernachtung in der Nähe (<20km) ⬜Frage *5, 6, 7* beantworten.
- □ ein oder zwei Tage, mit Übernachtung an einem anderen Ort (>20km) ⬜Frage *5, 6, 7* beantworten.

5. *(Im Fall einer touristischen Übernachtungsform)* – **Wie viele Tage dauert Ihr Aufenthalt?** |__|__|__|

6. *(Im Fall einer touristischen Übernachtungsform)* **In welcher Art von Struktur sind sie untergebracht?**
□ Hotel □ bed and breakfast □ Ferienwohnung □ Campingplatz □ Gast bei Freunden
□ andere (genauer angeben)

7. *(Im Fall einer touristischen Übernachtungsform)* **Die Ausgaben für die Unterbringung betragen durchschnittlich pro Person und Tag (bitte den Bereich der Ausgaben angeben):**
□ 0 - 30 € □ 31 - 60 € □ 61 - 90 € □ più di 90 €

8. In Bezug auf den heutigen Tag, wie hoch waren die durchschnittlichen Ausgaben pro Person, die sie an diesem Ort (und in dessen Umgebung) ausgegeben haben für...

	Durchschnittliche tägliche Ausgaben pro Person
... Essen und Trinken?	|__|__|__|__| € □ keine Ausgaben
... Kaufen von typischen Erzeugnissen?	|__|__|__|__| € □ keine Ausgaben
... Zugang zur Strandanlage?	|__|__|__|__| € □ keine Ausgaben
... Ausleihen von Sonnenschirm/ Mieten von Strandkabine?	|__|__|__|__| € □ keine Ausgaben
... den Parkplatz?	|__|__|__|__| € □ keine Ausgaben
... Ausübung naturalistischer Aktivitäten?	|__|__|__|__| € □ keine Ausgaben
... Ausübung kultureller Aktivitäten?	|__|__|__|__| € □ keine Ausgaben
... für andere Dinge (genau angeben)_____)	|__|__|__|__| € □ keine Ausgaben

9. Mit welchen Transportmitteln haben Sie den Ort erreicht?
□ Auto
□ Wohnmobil
□ Motorrad
□ Fahrrad
□ öffentliche Verkehrsmittel
□ andere (genau angeben) _____

10. Um diesen Ort zu erreichen - Wie viele km haben sie heute ungefähr zurückgelegt, gerechnet vom Ort in dem Sie wohnen oder dem Ort, wo Sie in diesen Tagen übernachten ? |__|__|__| km

11. Dieser Ort gehört zum Netz von Schutzgebieten genannt *Natura 2000*. Haben Sie jemals zuvor von *Natura 2000* gehört?
□ ja, kenne ich gut □ ja, aber ich kenne nicht die Funktionen □ nein

12. Während Ihres Aufenthaltes, haben Sie naturalistische Aktivitäten/ Ökotourismus betrieben?
□ nein □ ja

Wenn ja, welche?
□ geführte Exkursionen in Naturgebiete
□ Besuch von Naturgebieten, die mit Informationstafeln ausgestattet sind
□ andere (genau angeben) _____

Wenn ja, in welcher natürlichen Umwelt ?
□ Dünen
□ Pinienwald
□ Lagune
□ andere (genau angeben) _____

13. *(Im Fall einer positiven Antwort auf Frage 12)* **Wie hoch ist Ihr Maß an allgemeiner Zufriedenheit?**
□ gering □ ganz gut □ gut □ sehr gut

14. *(Im Fall einer positiven Antwort auf Frage 12)* **Erachten sie die betriebenen Aktivitäten als:**
□ angenehme Gelegenheit Wissen zu erwerben □ interessant □ unterhaltsam □ banal □ langweilig □ unnütz

15. *(Im Fall einer positiven Antwort auf Frage 12)* **Würden Sie diese Aktivität Ihren Freunden empfehlen?**

Aus welchen Gründen ?

□ ja, interessant   □ ja, unterhaltsam   □ nein, langweilig   □ nein, zu teuer

16. Haben Sie einige Empfehlungen bezüglich der Initiativen, die man ergreifen könnte, um den Ort aufzuwerten?...
....
....

A. Alter (vollendetes Lebensjahr): □ von 0 bis 17   □ von 18 bis 30   □ von 31 bis 45   □ von 46 bis 60   □ über 60

B. Geschlecht: □ männlich □ weiblich

C. Schulbildung: □ keine   □ Mittelschule   □ Hochschulabschluß oder mehr
□ Grundschule   □ Abitur oder Fachabitur

D. Wohnort**:**

□ In dieser Provinz   ⬜ Gemeinde von _____
□ In dieser Region   ⬜ Gemeinde von _____
□ Andere italienische Region   (genauer angeben) _____
□ Ausland   (genauer angeben) _____

E. Sind Sie Mitglied in einem Verein / einer Organisation?

Alpen- oder Wanderverein   (genauer angeben) _____ ja □   nein □
Sportverein   (genauer angeben) _____ ja □   nein □
Umweltschutzorganisation   (genauer angeben) _____ ja □   nein □
Andere   (genauer angeben) _____ ja □   nein □

17. Sind Sie Besucher   □ gelegentlicher □ gewohnter (hat den Ort bereits zuvor besucht)

18. Würden Sie diesen Fragebogen in 4 Jahren noch einmal beantworten ?
□ nein □ ja

Wenn ja, würden Sie uns Ihre E-Mail Adresse angeben (*sie wird <u>ausschließlich</u> zum Zweck der vorliegenden Untersuchung verwendet*) ?

_____@_____

Wir danken Ihnen für Ihre Unterstützung.

Appendix 6. Questionnaire for stakeholders

<div align="center">

QUESTIONARIO PER OPERATORI TURISTICI

Nome struttura _____

</div>

Nell'ambito del progetto LIFE + REDUNE LIFE16 NAT/IT/000589, l'Università Ca Foscari di Venezia ha avviato un'indagine per raccogliere informazioni sui frequentatori dell'area, le attività ricreative svolte e le strutture turistiche. *Le chiediamo di compilare il questionario in tutte le sue parti. Il questionario è anonimo e le informazioni saranno trattate con la massima riservatezza, secondo il D.lgs 196/2003 (Codice in materia di protezione dei dati personali).*

_____

<div align="center">

Località rilievo _____

Data ___/___/2018

</div>

Il presente questionario è stato: □ auto-compilato □ somministrato da rilevatore
_____

1. **Di quale tipologia fa parte la sua struttura?**
   □ struttura ricettiva
   □ stabilimento balneare
   □ ristorazione
   □ altro (specificare) _____

2. **Quanti dipendenti lavorano nella sua struttura? |__|__| __|__|**
3. **Se struttura ricettiva, quanti posti letto offre complessivamente la sua struttura? |__|__| __|__|**
4. **Se struttura ricettiva, indicativamente, durante la stagione estiva 2017, quanti visitatori hanno pernottato nella la sua struttura al giorno? |__|__| __| __|**
5. **Questo sito fa parte della Rete di aree protette denominata Natura 2000. Ha mai sentito parlare prima di Natura 2000?**
   □ sì, la conosco bene   □ sì, ma non ne conosco le caratteristiche   □ no
6. **Allo stato attuale, ritiene che gli ambienti dunali siano:**
   □ intralcio al turismo
   □ ambiente di scarsa utilità
   □ habitat naturalistico di pregio
   □ ambiente che contribuisce all'attrattività di quest'area
   □ risorsa per attività ecoturistiche
7. **Ritiene che gli habitat dunali contribuiscano a rendere la sua struttura più attrattiva?**
   □ no   □ sì
   Se sì, ne fa riferimento nel materiale promozionale?
   □ no   □ sì
   In quale modo?
   □ nel sito web
   □ nel materiale promozionale/informativo
   □ nel logo della struttura
   □ altro (specificare) _____
8. **Vede qualche altro tipo di legame tra la sua attività e questi ambienti?**
   □ si, traggo vantaggio
   □ si, traggo svantaggio
   □ si, posso contribuire alla loro conservazione
   □ no, nessun legame
9. **La sua azienda offre servizi eco-turistici/ esperienze di educazione ambientale?**
   □ no   □ sì
   Se sì, quali?

   □ escursione guidata in aree naturali
   □ visita ad aree naturali attrezzate con pannelli informativi
   □ altro (specificare) _____   *La ringraziamo per il suo contributo.*