LIFE PRESPA WATERBIRDS ECOSYSTEM SERVICES ASSESSMENT






Society for the Protection of Prespa

September 2021

Acknowledgements

The assessment of ecosystem services undertaken within the LIFE15 NAT/GR/000936 – Prespa Waterbirds project has been enhanced by the attendance of project staff at the Ecosystem Services online course offered by the Stockholm Resilience Centre (November 2020). Furthermore, the joint methodology for assessing ecosystem services in Greece, as presented in a networking event for LIFE Nature and LIFE biodiversity projects in Greece, jointly organised by the Integrated Project LIFE-IP 4 NATURA - Natura 2000" and the LIFE Capacity Building project "Greek LIFE Task Force" (October 2019), and the resulting guidelines were also useful for the assessment.

In addition, the authors would like to thank the staff of Nature Conservation Consultants - NCC Ltd, working for the LIFE16 NAT/GR/606 – LIFE Andros Park project, for sharing some concepts and thoughts on ecosystems services assessments within LIFE projects at an early stage of the assessment.

Finally, thanks are extended to Dr. Giorgos Catsadorakis, scientific expert to the Society for the Protection of Prespa, for sharing interesting and useful remarks on the final report.

Proposed citation

Koutseri, I., Henderson, J. and Papanousi, F. 2021. Assessment of ecosystem functions and services within the LIFE Prespa Waterbirds Project. LIFE12 NAT/GR/000936. Society for the Protection of Prespa, Greece.

SOCIETY FOR THE PROTECTION OF PRESPA

CONTENTS

1. INTRODUCTION: SCOPE AND CONTEXT

1.1 INTRODUCTION

Within the five-year period 2016-2021, the Society for the Protection of Prespa, along with its project partners/associated beneficiaries, the Fondation Tour du Valat (France) and the National Observatory of Athens (Greece), implemented a LIFE funded project entitled "Bird conservation in Lesser Prespa: benefiting local communities and building a climate change resilient ecosystem", known in short as the LIFE Prespa Waterbirds project.

The LIFE Prespa Waterbirds project aimed to contribute to the conservation of nine rare waterbird species in Lesser Prespa Lake, by restoring important wetland functions through multipurpose and large-scale littoral vegetation management, while also considering overall effects of climate change on wetland ecosystems. As acknowledged in the project's full title, right from the start it was expected that the objectives of waterbird conservation, i.e. the restoration of certain functions, the means used for wetland management, such as the cutting of vegetation, and the knowledge generated, would confer benefits to the local community.

This report presents an assessment of the ecosystem services that were directly related to the project aims and actions, an analysis of their trends after the five-year implementation period based on specific indicators, and ultimately, an evaluation of why and how the project has benefitted people. The data and results from the management work are drawn from other project reports for the purpose of providing values to assess indicators and are discussed, but the implementation of management per se is not assessed within this report.

1.2 LESSER PRESPA LAKE

The Prespa basin is located in the south-western part of the Balkan peninsula and is shared between three countries, Greece, North Macedonia and Albania. The two lakes at the centre of the basin, Lesser and Great Prespa, are surrounded by high mountains and are only separated by a narrow strip of land. This transboundary basin is relatively small in surface area, but known for its rich and unique biodiversity. More than 1,800 plant species (Strid et al 2020), at least 34 Annex I habitat types under the EU Habitats Directive 92/43/EEC and at least 9 additional Greek habitat types not listed in the Directive's annex have been described in the Greek part alone (Vrahnakis et al 2011; Strid et al 2020), while the watershed holds 9 fish species endemic to the area or the southwestern Balkans (Crivelli et al 1997; Markova et al 2010).

Lesser Prespa Lake lies largely within Greece (~44 km^2), with a small part extending into Albania (~4 km^2). It is widely acknowledged for its important waterbird populations, holding the largest colony of Dalmatian pelicans in the world, with more than 1,200 pairs arriving in late winter to breed. Alongside them, great white pelicans migrate into the area in spring to breed, while noteworthy numbers of herons, glossy ibis, pygmy cormorant, and ferruginous duck choose these wetlands for their breeding every year. The position of the Prespa basin and the Lesser Prespa Lake study area in South-eastern Europe is depicted in Map 1.

Map 1: The Lesser Prespa Lake study area in a south European and transboundary context

A recent assessment has recorded ten different wetland habitat types around Lesser Prespa Lake, which may support biodiversity at different stages of the life cycle depending upon annual conditions. For example, reedbeds act as important breeding grounds for waterbird populations, while reed-free wet meadows need to be maintained and flooded in spring to ensure their function as fish spawning grounds and waterbird feeding grounds; equally important for biodiversity are other habitats that exhibit high floristic diversity or provide habitat for wildlife. Some of these wetland habitats are highly dynamic and their extent changes at regular intervals, depending on water level conditions and the degree of management that is applied around the lakeshore (Fotiadis et al 2021).

The water level of the lake reaches its peak in spring each year, flooding the land around it to the maximum extent for the year, with the upper water level managed by a sluice gate controlling the only surface outflow into Great Prespa Lake. Years can be categorised as either dry or wet, with dry conditions being unpredictable but ever more frequent in recent years, mostly attributed to climate change induced variations in precipitation and temperature. In fact, a vulnerability assessment of the effects of climate change on the ecosystem of Lesser Prespa Lake, states that wetland management (i.e. management of the water level and vegetation) should be adapted in the future to ameliorate the effects of reduced water levels in spring, by expanding the altitudinal range of shorelines free of reed vegetation, ensuring that flooded wet meadows and open shallows will be available under all projected future water levels (National Observatory of Athens 2018).

1.3 THREATS AND PRESSURES ON THE ECOSYSTEM OF LESSER PRESPA LAKE

1.3.1 THREATS TO THE ECOSYSTEM

Current threats to the ecosystems of Lesser Prespa Lake relate to the dynamics between vital littoral habitats, originating in a long-term loss of the traditional activities that would have largely regulated shoreline vegetation in the past, as well as to water management regimes in the light of climate change.

A major threat affecting the habitats and important species of the lake ecosystem is the **over-expansion of *Phragmites australis* reedbeds.** Past interventions around the lake, such as cutting reeds for fodder and construction material and using the land as grazing grounds, along with burning to remove old reed stems to facilitate local fishing methods, had direct economic benefits, while sustaining a mosaic of habitats. Socio-economic developments and changes in livelihood resulted in the abandonment of traditional uses, leaving the littoral shallow zone of the lake without any other management interventions, except for sporadic uncontrolled fires. As a result, the reedbed gradually started to encroach on the littoral zone, leading to a **shrinkage of open shallow areas around the edges of the lake**, which would otherwise flood in spring and constitute important habitats, in the absence of reeds.

In addition, the dry standing biomass of the reedbeds that encroach the littoral zone, is susceptible to burning under climatic conditions such as prolonged droughts, while the **expansion of wildfires across large and key areas of reedbeds may threaten the breeding output of waterbirds** that start reproduction early in the season. In addition, deviations from the patterns of natural water level fluctuation to which habitats and biodiversity have been adapted over the centuries, also lead to **reduced flooding of the littoral zone in spring**. Water level management regimes, aiming to sustain the surface area of Lesser Prespa Lake and simultaneously avert flooding of the agricultural zone, as well as climatic effects, such as decreased rain and snowmelt entering the lakes and higher evaporation rates, both lead to smaller water-level fluctuations and thus to reduced flooding of open areas and meadows outside the reedbed in years with low spring water levels.

Accordingly, restoring important habitats, maintaining a habitat mosaic and adapting management interventions to expected climate change effects in the future are the key guiding principles for the restoration and conservation of the lake's wetland ecosystems.

1.3.2 CRITICAL ISSUES AND PRESSURES

Climate change

Climate change is a highly significant issue for the area, driving change in many sectors. In the context of the project and the wetlands the climate crisis is resulting in locally reduced precipitation in the winter, affecting

water levels with differing outcomes in both lakes. In the shallower Lesser Prespa Lake, seasonal spring flooding has been reduced as a result of lower water levels, thus not allowing the inundation of important littoral habitats. In the larger Great Prespa Lake, however, which has a markedly different hydrology, the reduction in water levels has led to the exposure of marshy habitats around the lake, which provide important feeding habitats for waterbirds.

Local decision making

The existence of a local, participatory, multi-stakeholder governance scheme, in the form of the Wetland Management Committee, as further discussed below, is exceptionally important for strengthening local co-operation and decision-making regarding the wetlands, and stands in contrast to the overall weakness of local institutions to implement conservation action.

Rural isolation and declining population

The Prespa region saw substantial population decline over the latter half of the 20th century and the area is characterised by its rural isolation, some significant distance from the nearest urban centres of note. Population decline continues to be an important pressure, with young people leaving the area at the earliest opportunity and incomers rarely settling, a factor which is affected by the low socio-economic status of local stakeholders, and in turn contributes to this status through the lack of opportunities, facilities and investment consequent on low population levels.

1.4 WETLAND CONSERVATION AND THE LIFE PRESPA WATERBIRDS PROJECT

The LIFE Prespa Waterbirds project was set up to contribute to the conservation of nine rare water bird species which breed at Lesser Prespa Lake, while also aiming to create benefits for the local community from the management interventions. In addition, the critical issue of climate change was taken into consideration, with the intention of adapting conservation activities accordingly, and ameliorating its effects on the ecosystem.

The project aimed to **restore important wetland functions** in the project study area, by: increasing suitable feeding habitats such as wet meadows and stream mouths; improving spawning grounds and increasing food availability for waterbirds; supporting target waterbird populations by minimising egg and chick mortality due to fire; and, increasing ecosystem resilience to climate change by applying tailored management interventions. Restoring these functions has entailed implementing large-scale vegetation management to restore wet meadows through cutting and removing reed biomass, as well as enhancing grazing in the littoral zone, cutting reed vegetation perpendicular to the lake to create firebreaks in key areas and to create deeper areas of open water for fish spawning and waterbird feeding in spring, and restoring the flow of two streams at their outlets to the lake with technical interventions and vegetation removal. Owing to the benefits derived from the extracted reed and wetland vegetation biomass, some of these activities have been implemented by local stakeholders (particularly stockbreeders), enhancing their participation in the project and the outcomes of conservation actions and incentivising the continuation of prescribed activities beyond the implementation of the project.

A platform for local co-operation had already been established with the long-standing operation of the Wetland Management Committee (WMC), a **local decision-making forum**, encompassing representatives from the Ministry of Environment, the Regional Authority for Western Macedonia (Water and Environmental Planning Departments), the Municipality of Prespa, the local Land Reclamation Service, the SPP and representatives from local animal husbandry and fishing co-operatives, whose activities relate to wetland management. The WMC has operated as an advisory body since 2008, under the auspices of the Management Body for the Prespa National Park, which holds the main responsibility for managing the wetlands of Lesser Prespa Lake. The committee makes its decisions taking into account both the development of primary sector activities in and around the wetland and the maintenance of its good ecological status. Such procedures require the participants to study the issues and to take an integrated approach; often the process requires mutual concessions from all sides, with a view to formulating joint positions acceptable to all. Inevitably, the issues discussed within the WMC include water level management, wetland vegetation management and fishery considerations.

Furthermore, acknowledging the role of wetland habitats, reedbeds and other areas of both lakes across the basin, throughout the project significant efforts have been made to co-operate, exchange information and

expertise and implement join action with counterpart organisations and authorities active in the Albanian and North Macedonian parts of the lake. Through the creation of a related transboundary forum for wetland management, as well as the organisation of workshops and summer schools on wetland management and monitoring for the wider transboundary audience, encompassing both students and site managers from Greece and the other two countries, the project aimed at ensuring **transferability, and replicability of project methods**, as well as **increasing awareness locally, nationally and internationally**.

1.5 MAES ECOSYSTEM TYPES AT LESSER PRESPA LAKE

For the scope of this study, and in accordance with the analytical framework for ecosystem assessments (Maes et al 2013), as suggested by the related guidelines for assessing ecosystems and their services in LIFE projects (EC 2018), it was firstly necessary to identify ecosystem types within the study area. The ecosystem types were identified, mapped and classified according to the typology of ecosystem types described in Maes et al 2013, while for the classification the corresponding linkages of habitat types of Directive 92/43/EC found in Greece to the MAES ecosystem types were used (as described in Dimopoulos et al 2018). Inevitably, the most recent mapping and assessment of habitat types (Fotiadis et al 2021) was used to classify the different ecosystem types within Lesser Prespa Lake, focusing on the study area selected for the LIFE Prespa Waterbirds project.

The ecosystem type with by far the largest surface area is ***lakes and rivers***, comprising 79.1% of the study area, and mostly made up of the open water surface of the lake and eutrophic shallows with floating vegetation.

Wetlands, the ecosystem at the interface between water and drier elevations around the lakeshore, comprises another 14.5% but constitutes the most important type of ecosystem for this assessment. ***Grasslands*** make up another 4.5% and refer directly to specific parts of the littoral land at higher and drier elevations, where land use, as well as water level, largely affect the character of these areas; the vegetation in these locations is defined by the degree of management taking place in them, such as grazing or cutting, and the water level in spring, which defines whether they flood or not. Both of these ecosystem types are very important for this assessment, as most of the interventions and restoration activities under the LIFE Prespa Waterbirds project have taken place in the grasslands and wetlands ecosystem types. Furthermore, these two ecosystem types are usually found adjacent to each other (Map 2) along the littoral zone; they are interchangeably dynamic and prone to changes, with each one expanding over the other, according to the management activities occurring at the interface between land and water.

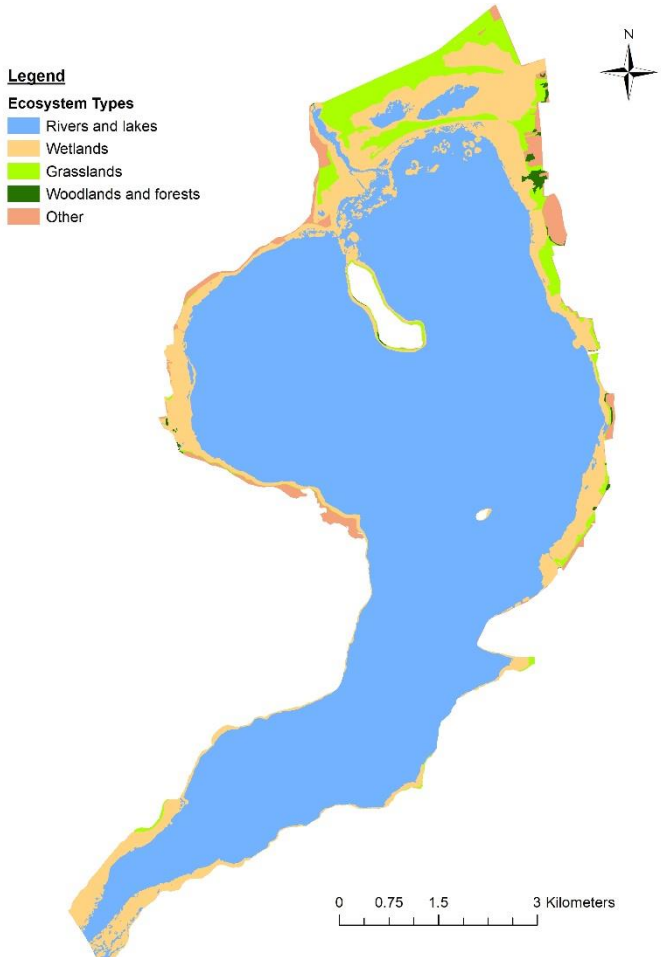
In addition, a mere 0.3% has been mapped as ***woodlands and forests*** and notably such ecosystems have been mapped mainly along specific stream mouths that discharge into the lake on the eastern side of the lake.

Finally, it should be mentioned that about 2.1% is made up of hilly areas, which are not affected by wetland conditions, the few crops that remain marginal to the objectives of project management, and a small part consisting of built infrastructure, which are all grouped together in an ad hoc category ***other***, as the activities in them do not relate to the project or the assessment of ecosystem services. Table 1 below summarises the data on ecosystem types, which are also depicted on Map 2.

Table 1: Summary of data on MAES ecosystem types in the LIFE Prespa Waterbirds study area

MAES ecosystem type		Corresponding habitat types (Directive 92/43/EC)	Size of ecosystem type in study area	
Level 1	**Level 2**		**Surface area (ha)**	**% Coverage**
Freshwater	Rivers and lakes	3150+, 3190, 3260+	3,974	79.1%
Terrestrial	Wetlands	72A0, 72B0	708	**14.1%**
	Grassland	6260*, 6420+, 6450	225	**4.5%**
	Woodlands and forests	91E0*, 92A0+	13	0.3%
	Other (incl. settlements/crops)	-	104	2.1%

1.6 ECOSYSTEM TYPES INFLUENCED BY THE PROJECT



Map 2: Map showing MAES ecosystem types in the LIFE Prespa Waterbirds study area

The LIFE Prespa Waterbirds project aimed at the conservation of nine target waterbirds species, all of which share common characteristics in their life-cycle: breeding in the reedbeds and feeding in shallow open areas, with low herbaceous vegetation, that remain flooded during the breeding season. These two characteristics were taken into account when determining the ecosystem types affected by the project; in essence the protection of breeding grounds in reedbeds was implemented in "wetlands", while the restoration/conservation of feeding habitats was implemented in "grasslands", i.e., the littoral land that is seasonally flooded. In parallel, the project actions, which included interventions in selected stream mouths found in the wetland ecosystem, also aimed at restoring fish spawning grounds, thus boosting the provision of high-quality feeding sites for all target waterbird species.

As flooding is seasonal, and obviously affected by the water level of the lake, the "rivers and lakes" ecosystem type affects the functionality of both ecosystem types. Nevertheless, despite a linkage between these three ecosystem types, it is not considered that the project has affected "river and lakes", but it should be noted that the project has taken into account limitations relating to droughts and water shortages as an effect of climate change, with the incorporation of "climate-proof" solutions to the best possible extent.

Lastly, the "woodland and forest" ecosystem type comprises a very small part of the study area and refers to small and scattered wooded areas found along the littoral zone and the reedbed, including a priority habitat of alder forest formations (91E0). Although this ecosystem type was not directly targeted by the project, it was expected that it would be better protected through the implementation of fire prevention measures in the reedbed.

In conclusion, the project implemented actions in reedbeds, littoral areas and in two stream mouths, which are all classified as terrestrial ecosystems, under the categories ***wetlands*** and ***grasslands*** and comprise 18.6% of the Lesser Prespa Lake study area. Both ecosystem types, and some of the ecosystem services they provide, have been influenced by the project and in chapter 2.2 we present the flow of project-specific benefits (ecosystem services) from the underlying biophysical structures (ecosystem types), processes and functions, and the limitations presented by specific drivers of change (such as pressures and threats) in depth.

1.7 ECOSYSTEM SERVICES ASSESSMENT

1.7.1 THE NEED FOR AN ECOSYSTEM SERVICES ASSESSMENT

As described above, the LIFE Prespa Waterbirds project has employed restoration and conservation actions to improve the conservation status of targeted waterbird species in the wetlands of Lesser Prespa Lake, working against several threats to the ecosystem, including climate change. As discussed above, several stakeholders are ***AFFECTED*** by water and wetland management, whilst also simultaneously ***AFFECTING*** those same wetland management activities.

In this context an ecosystem services assessment has been undertaken to:

- Assess the **IMPACT** of the project's conservation actions, identifying whether there has been a positive, or negative, effect on the trends of specific ecosystem services relating to wetland conservation.
- Assess **INCENTIVE**, examining whether any positive effect that has been observed with regard to these specific ecosystem services also increases incentives for stakeholder participation in wetland vegetation management and its continuation beyond the life of the project.

The assessment aims to examine whether the environmental management decisions made in the project have enhanced, maintained or diminished the flow of benefits from certain ecosystem services. This has required a consideration of ecosystem functions and how these functions generate the services which provide benefits, as well as how those benefits are distributed to society.

Widely and long accepted as a concept which can support conservation work through highlighting to policy makers the importance of the environment and biodiversity to human wellbeing (SCBD 2004; Maes et al 2016), there have been many different frameworks, definitions, interpretations and applications of the concept of ecosystem services since the landmark 2005 Millennium Ecosystem Services Assessment (MA 2005), creating a sense of inconsistency and ambiguity in the literature and practice (Potschin and Haines-Young 2016, La Notte et al 2017). This assessment follows the definitions laid out in the Common International Classification of Ecosystem Services (CICES) version 5.1 (Haines-Young and Potschin 2018, Maes et al 2014), influenced by the Haines-Young & Potschin cascade model (Haines-Young and Potschin 2010). CICES groups services into three classes – ***PROVISIONING*** services, which provide goods such as food and water, as well as other benefits that can be extracted from nature; ***REGULATING*** services, which support and underpin the regulation and maintenance of ecosystem processes; and ***CULTURAL*** services, which are the non-material benefits people obtain from nature – and makes a clear distinction between ecosystem services and the benefits or goods they provide. Furthermore, ecosystem services are defined as being based on ecosystem functions, i.e. the capacities, properties and behaviours that make an ecosystem useful to people and that arise from the underlying biophysical structures and processes found in any given area (Haines-Young and Potschin 2010).

Lastly, the assessment follows the guidelines set out in the LIFE programme document "Assessing ecosystems and their services in LIFE projects: A guide for beneficiaries" (EC 2018), and is similarly informed by the ecosystem services assessment toolkit (VNCST 2017) prepared for the Canadian government.

1.7.2 SCALE OF THE ASSESSMENT

In this assessment, provisioning services are considered mainly at the local scale, at the level of the local stakeholders who receive the goods and benefits, as well as local decision-making bodies and institutions that affect the services as drivers of change. Regulating services, on the other hand, not only relate to the same local scale, but are also considered at the national, European and global scales, particularly in relation to improving the conservation status of important waterbird species and priority habitats that are protected by the EU Birds and Habitats Directives, as well as by national and international designations and conventions. The assessment of cultural services is relevant at the scale of local community stakeholders, but also at a wider scale in terms of visitors to the area. However, primary consideration is given throughout to the benefits investigated in relation to the local society.

1.7.3 DECISION-MAKING CONTEXT

The implementation of the LIFE Prespa Waterbirds project required the participation of the main authorities that play an important role in local decision-making relating to wetland conservation at Lesser Prespa Lake.

The **Management Body for the Prespa National Park (MBPNP)** was established by Law 3044/2002 as an obligation under the provisions of Law 2742/1999 of the Greek legislation and Directives 92/43 and 79/409 of the European Union. The MBPNP is the competent authority for the conservation management of the natural environment of Prespa and the promotion of the sustainable development and holds a vital position, as it is the main co-ordinating authority for crucial conservation decisions such as the water management of Lesser Prespa Lake, the aversion of illegal actions such as reedbed fires, and the issuing of approval for management interventions. Importantly, the MBPNP is a multi-stakeholder body; its Management Board consists of representatives from the Ministry of Environment and Energy, the Prefecture of Florina, the Municipality of Prespa, the Union of Hellenic Chambers of Commerce, the SPP (representing NGOs/ civil society), as well as two selected representatives of the scientific community. Accordingly, the MBPNP is one of the most important stakeholder authorities partaking in decision making regarding the management of Lesser Prespa Lake. As noted above, the work of the MBPNP on wetland management is supplemented by the advisory Wetland Management Committee, which was created in 2008 to involve stakeholders in decision-making on wetland management of Lesser Prespa Lake as a result of a previously implemented LIFE project (LIFE08 NAT/GR/8494).

The **Municipality of Prespa** (**MoP**) also has a direct interest in, and responsibility for, issues that relate to wetland management. In addition to the MoP's responsibility for the overall management of the area, it also participates in the Management Board of the MBPNP, thus playing a significant decision-making role in the environmental issues of the area. Furthermore, the MoP is involved in, influences and is expected to promote the development of the area, especially in relation to primary sector activities taking place in the area of its jurisdiction; for example, on several occasions it has promoted the wise use of wetland resources (e.g. lobbying with related stakeholders for drip irrigation or promoting the use of wetland biomass), eco-tourism activities in the lake (e.g. providing trips with solar-powered boats) and the organisation of primary sector activities around the lake and the entire municipality (such as promoting the implementation of grazing management plans).

The **Local Land Reclamation Service** (**LLRS**) is the entity responsible for the operation and maintenance of the irrigation system, and its members include all farmers in the Prespa area. Therefore, the LLRS represents an important stakeholder group, since its activities are directly related to issues concerning water management, as well as the vegetation management of drainage ditches. As a key local agency, the LLRS participates in decision making for the management of the wetland by being a member of the MBPNP Wetland Management Committee. Moreover, under the recent decentralisation "Law 3852/2010 Kallikratis" the LLRS functions under the auspices of the Municipality of Prespa, thus serving the dual role of representing farmers' interests and affecting decision-making at the local level.

Specific departments of the **Regional Authority of Western Macedonia** (**RAWM**) have also played a role in the project; for example, the Environment and Spatial Planning Directorate was the competent authority for issuing the relevant permissions and environmental terms for medium-sized technical works needed for the restoration of the function of stream mouths, while other departments such as the Department of Topography, Settlement and Land Reclamation of the Florina Directorate of Agricultural Economy and the Public Real Estate Service of Florina have enabled the implementation of activities on public land under their jurisdiction and the use of biomass.

1.7.4 SOCIO-ECONOMIC CONTEXT

With regard to the socio-economic context, the economic activities practised by the key stakeholder groups identified in the table below (Table 2) were considered in the light of the effects of the project, particularly their dependence or otherwise on ecosystem services addressed by project actions.

Farming

The agricultural sector is highly dependent on ecosystem services related to the management of the water level of Lesser Prespa Lake, with low water levels potentially creating issues in water abstraction, whilst high water levels can flood farmland, leading to conflict. At a lesser level of dependence, the local farming community may benefit from biomass extracted under the project being used as a soil conditioner in the cultivation of the area's staple bean crop, with such alternative farming practices having been promoted within the project's pilot actions and related studies. Within the limited timeframe of the project, it has been possible to describe the positive results of the application of reed biomass as soil conditioner, whilst also discussing the feasibility of the application, in terms of the necessary equipment, timing and dosage of the application, providing all available information to farmers for future uptake of this practice (Papathanasiou et al 2021).

Table 2: Stakeholder groupings at Lesser Prespa Lake wetlands and the project-related issues within which they play a role

Scope	Stakeholder grouping	Role/project issues or actions affecting the grouping/benefits
LOCAL	Farmers	Active adjacent to the wetlands; affected by water management and locally by littoral land management; benefiting from biomass production
	Stockbreeders	Active within and around the wetlands, participating in conservation actions; affected by littoral land and vegetation management; significant beneficiaries of biomass production and grazing within managed areas
	Fishermen	Active in the lake; affected by littoral land and vegetation management relating to fish spawning; benefiting from increased fish spawning
	Tourism businesses	Active in the local area; affected by increased awareness; benefiting from tourism
	Pupils	Active in the local area and the wetlands; recipients of knowledge and skills, affected by increased awareness; benefiting from environmental education and training
REGIONAL/NATIONAL	Visitors	Active in the local area and wetlands; affected by increased awareness; benefiting from improved tourism infrastructure and conservation gains
	Scientists & site managers	Active in the wetlands; affected by research requirements and knowledge gains; benefiting from increased knowledge underpinning conservation work
	Students & conservation professionals	Active in the local area and the wetlands; recipients of knowledge and skills, affected by increased awareness; benefitting from environmental education and training

Stockbreeding

Stockbreeders gain significant benefits from the availability of grazing land within the wetlands, which offers an important alternative to moving herds to mountain pastures in the summer, as well as water availability for their herds. There is, however, a conflict issue between the stockbreeders' free-ranging animals and farmers' crops in the adjacent farmland. Meanwhile, these stakeholders have a medium dependency on provisioning services related to biomass use resulting from wetland vegetation management by cutting, which produces a supplementary winter feed, reducing expenses. In order to further promote the use of reed biomass as fodder, the project compared the quality characteristics of biomass removed in summer and in autumn (Papathanasiou 2021).

Fisheries

Prespa's commercial fisheries have a high dependency on the maintenance or increase of fish populations, an issue addressed through the project's actions to create and maintain spawning grounds around the littoral zone, as well as efforts to increase upstream spawning by clearing vegetation which was blocking the entrance to streams in the area. Fishing is carried out by about 8% of the population in the Greek part of the Prespa basin, though this tends to be a supplementary occupation (Catsadorakis et al 2018), with carp fishing often used by local fisheries to augment income from tourism activities, as it comprises a well-known dish in the local cuisine.

Tourism

The local tourism sector is comparatively small-scale for the country, but crucial for the area, and is dependent to a medium to high degree on the cultural services related to nature tourism and the aesthetics of the area, particularly on the lakes, wetlands and waterbird species – notably pelicans – for which the area is renowned. In addition, it appears that local hotel owners consider that there is "considerable potential for further promotion of ecotourism and leisure activities in the area, which should be achieved through better co-

operation between stakeholders", as well as through encouraging the development of ecotourism activities and enterprises (Latinopoulos 2019).

2. ECOSYSTEM SERVICES: LESSER PRESPA LAKE CASE STUDY

2.1 LESSER PRESPA LAKE ECOSYSTEM SERVICES

Wetlands have long been acknowledged as providing many valuable ecosystem services (Costanza et al 1997, Costanza et al 2014, de Groot et al 2012) including, but not limited to, flood control and storm protection, groundwater replenishment, sediment and nutrient retention, and water purification, whilst also acting as reservoirs of biodiversity and offering cultural services from recreational use to spiritual and aesthetic values (Ramsar Convention on Wetlands 2011). However, more than 15 years ago the Millennium Ecosystem Assessment (MA 2005) found that, globally, wetlands were being degraded faster than other ecosystems, despite their disproportionally high service provision (Zedler and Kercher 2005), mostly due to expanding population growth and the pressure of economic development. The increasing impact of climate change was expected to exacerbate the loss and degradation of wetlands, reducing the provision of ecosystem services in the face of likely escalating demand, with water scarcity and access playing a crucial role.

In the context of this disturbing picture of wetland loss at global level – no less discouraging at a national level, with around ⅔ of Greek wetlands drained during the 20th century alone (MEPPPW 1999) – the wetlands of Prespa, located largely within Lesser Prespa Lake in Greece, have enjoyed relative stability, likely due to their geographical isolation, in combination with a decades-long history of conservation efforts, thus largely preserving the ecosystem services they provide, which are of local importance and, in several cases, of global significance. These services remain, however, under several pressures, including the ongoing climate crisis, as recognised by the LIFE Prespa Waterbirds project and described above.

Although less studied than wetlands, it is also widely accepted that grasslands provide a variety of ecosystem services; at the same time grasslands are considered as one of the major ecosystems of the world, covering close to ⅓ of the Earth's terrestrial surface (Bengtsson et al 2019), while if defined more broadly to include "rangelands and additional herbaceous vegetation types", they take up 40.5% of the world's land area not covered by ice (Zhao et al 2020). The decline of grasslands over the last century has occurred mainly owing to conversion to arable land, and although there are trade-offs between the ecosystem services provided by grasslands and those provided by agricultural systems (Bengtsson et al 2019), the importance of grasslands in ecosystem services supply cannot be overlooked.

At Lesser Prespa Lake grasslands may make up a small proportion of the study area, but the ecosystem type is situated at the interface between wet and dry conditions, at elevations that are affected by water level in spring; it covers an area that throughout history has interchangeably been used as low intensity traditional agricultural land (Catsadorakis et al 2021), as grazing grounds for local cattle herds and even buffalo herds in the past, as high intensity agricultural land in dry conditions and as traditional fishing grounds in wet conditions in the past (Catsadorakis 1996). It is therefore important to assess the ecosystem services they currently provide, under given pressures, including climate change. Tables 3-5 provide an overview of the main ecosystem services provided at Lesser Prespa Lake by both wetlands and littoral grasslands, following CICES version 5.1 (Haines-Young and Potschin 2018). It is reminded here that while ecosystems have many ecological functions, which in this context refer to their capacity to directly or indirectly provide goods and services that satisfy human needs, ecosystem services are the results of functions which are actually utilised or valued by people, in other words they are inherently anthropocentric in character (de Groot et al 2002).

2.1.1 PROVISIONING SERVICES

In terms of provisioning services, the Lesser Prespa Lake wetlands provide food in the form of wild fish species harvested by both commercial fisheries and amateur fishermen, and utilised by the local tourism sector, particularly in the case of carp (CICES 1.1.6.2), whereas grasslands provide the meat and dairy products arising from cattle, sheep, goats and pigs grazed in the littoral land and wet meadows (CICES 1.1.3.1). In addition to the use of littoral grazing pasture, vegetation biomass cut by local stakeholders and under the project for use as fodder also forms a service benefit for stockbreeders, whilst the same biomass has been trialled for use by bean farmers as a soil conditioner, in addition to minor local use as a building and fencing material (CICES 1.1.5.2).

Lastly, the lake water is used extensively for the purposes of irrigation in the agricultural zone, currently through a network of irrigation channels, which will be replaced by a drip irrigation system in the near future (CICES 4.2.1.2).

Table 3: Provisioning ecosystem services provided by Lesser Prespa Lake, in accordance with CICES definitions

CICES code	Division	Group	Class (Service)
PROVISIONING SERVICES			
1.1.3.1	Biomass	Reared animals for nutrition, materials or energy	Animals reared for nutritional purposes
1.1.5.2	Biomass	Wild plants for nutrition, materials or energy	Materials from wild plants
1.1.6.2	Biomass	Wild animals for nutrition, materials or energy	Food from wild animals
4.2.1.2	Water	Surface water used for nutrition, materials or energy	Surface water for non-drinking purposes

2.1.2 REGULATING SERVICES

Underpinning the aforementioned provisioning ecosystem services, the seven regulating services noted below include those relating to water, either maintaining water flows and the hydrological cycle (CICES 2.2.1.3) or maintaining water quality (CICES 2.2.5.1), as well as to soil, either decomposition processes relating to soil formation (CICES 2.2.4.2) or the stabilisation and trapping of sediment, and prevention of soil erosion (CICES 2.2.1.1). The wetlands and littoral grasslands also absorb nutrients, a significant portion of which arise from local agriculture, as well as other wastes (CICES 2.1.1.2). Significantly, in relation to the climate crisis, the wetlands and grasslands carry out carbon sequestration, thus constituting a carbon sink (CICES 2.2.6.1), though research is yet needed to understand the dynamics of this function in Prespa. Lastly, the wetlands and grasslands of Lesser Prespa Lake provide a crucial 'nursery' service, in the habitats which maintain both wild plants and animals, many of which are useful to people, particularly in supporting the associated cultural services discussed below (CICES 2.2.2.3). It is noted here that the LIFE Prespa Waterbirds project has the protection of biodiversity, and nine species of waterbirds in particular, at its heart, in addition to the benefits it brings to the local community, and beyond the consideration of any services these species provide.

Table 4: Regulating ecosystem services provided by Lesser Prespa Lake, in accordance with CICES definitions

CICES code	Division	Group	Class (Service)
REGULATING SERVICES			
2.1.1.2	Transformation of biochemical or physical inputs to systems	Mediation of wastes or toxic substances of anthropogenic origin by living processes	Filtering wastes
2.2.1.1	Regulation of physical, chemical, biological conditions	Regulation of baseline flows or extreme events	Controlling or preventing soil loss
2.2.1.3	Regulation of physical, chemical, biological conditions	Regulation of baseline flows or extreme events	Regulating the flows of water in the environment
2.2.2.3	Regulation of physical, chemical, biological conditions	Lifecycle maintenance, habitat and gene pool protection	Providing habitats for wild plants and animals that can be useful to people

2.2.4.2	Regulation of physical, chemical, biological conditions	Regulation of the soil quality	Ensuring the organic matter in soils is maintained
2.2.5.1	Regulation of physical, chemical, biological conditions	Water conditions	Controlling the chemical quality of freshwater
2.2.6.1	Regulation of physical, chemical, biological conditions	Atmospheric composition and conditions	Regulating the global climate

2.1.3 CULTURAL SERVICES

A number of cultural services are offered by the littoral ecosystem types of Lesser Prespa Lake, from recreational opportunities, such as hiking along the shorelines (CICES 3.1.1.1), as well as birdwatching and the enjoyment of nature to unwind (CICES 3.1.1.2), to intellectual interactions that include both scientific research (CICES 3.1.2.1) and environmental education programmes and activities (CICES 3.1.2.2). In addition, the lakes and littoral wetlands and grasslands stand as a signifier of local culture and identity (CICES 3.1.2.3), while pelicans in particular are an emblematic species for the area (CICES 3.2.1.1). Many visitors appreciate the natural beauty of the Lesser Prespa landscape (CICES 3.1.2.4), as have local communities over many centuries, establishing a number of wetland and island churches indicating their spiritual significance (CICES 3.2.1.2), whilst a number of books, films and regular fine and applied arts seminars bear witness to the artistic inspiration provided by the wetlands and other lake ecosystem types (CICES 3.2.1.3). Lastly, the numerous national, transboundary and international protection regimes applied to the wetlands and the associated landscape, as well as the active presence of conservation NGOS and many volunteers are a testament to the existence and bequest services that hold the wetland ecosystem in value in both the present and the future (CICES 3.2.2.1 & 3.2.2.2 respectively).

Table 5: Cultural ecosystem services provided by Lesser Prespa Lake, in accordance with CICES definitions

CICES code	Division	Group	Class (Service)
CULTURAL SERVICES			
3.1.1.1	Direct, in-situ and outdoor interactions with living systems that depend on presence in the environmental setting	Physical and experiential interactions with natural environment	Using the environment for sport and recreation; using nature to help stay fit
3.1.1.2	Direct, in-situ and outdoor interactions with living systems that depend on presence in the environmental setting	Physical and experiential interactions with natural environment	Watching plants and animals where they live; using nature to destress
3.1.2.1	Direct, in-situ and outdoor interactions with living systems that depend on presence in the environmental setting	Intellectual and representative interactions with natural environment	Researching nature
3.1.2.2	Direct, in-situ and outdoor interactions with living systems that depend on presence in the environmental setting	Intellectual and representative interactions with natural environment	Studying nature

3.1.2.3	Direct, in-situ and outdoor interactions with living systems that depend on presence in the environmental setting	Intellectual and representative interactions with natural environment	The things in nature that help people identify with the history or culture of where they live or come from
3.1.2.4	Direct, in-situ and outdoor interactions with living systems that depend on presence in the environmental setting	Intellectual and representative interactions with natural environment	The beauty of nature
3.2.1.1	Indirect, remote, often indoor interactions with living systems that do not require presence in the environmental setting	Spiritual, symbolic and other interactions with natural environment	Using nature as a national or local emblem
3.2.1.2	Indirect, remote, often indoor interactions with living systems that do not require presence in the environmental setting	Spiritual, symbolic and other interactions with natural environment	The things in nature that have spiritual importance for people
3.2.1.3	Indirect, remote, often indoor interactions with living systems that do not require presence in the environmental setting	Spiritual, symbolic and other interactions with natural environment	The things in nature used to make films or to write books
3.2.2.1	Indirect, remote, often indoor interactions with living systems that do not require presence in the environmental setting	Other biotic characteristics that have a non-use value	The things in nature that we think should be conserved
3.2.2.2	Indirect, remote, often indoor interactions with living systems that do not require presence in the environmental setting	Other biotic characteristics that have a non-use value	The things in nature that we want future generations to enjoy or use

2.2 ECOSYSTEM SERVICES WITHIN LIFE PRESPA WATERBIRDS

From the services described above the authors focused on 6 in particular, as of specific relevance to the project actions, objectives and results of the LIFE Prespa Waterbirds project. These comprise 2 provisioning services, 1 regulating service and 3 cultural services, which are laid out in Tables 6-8 together with the project indicators which have been used to assess their status. The six services were selected on the basis of their direct applicability to the evaluation of the impact of the project on ecosystem service provision, as well as their relevance to measuring incentives for stakeholder participation in the project actions and their continuation in the After-LIFE period.

The selection of indicators for each service is discussed in detail in chapter 3 below, together with the data sources and assessment methods used.

Table 6: Provisioning ecosystem services addressed by the LIFE Prespa Waterbirds project and indicators used to measure the impact of the project actions on the service trend

PROVISIONING SERVICES	
LIFE Prespa Waterbirds Provisioning Ecosystem Service 1 (PES1) – Materials from wild plants	
Indicator	***Unit***
Surface area of reedbed/littoral wetland vegetation annually managed by cutting	Hectares
Reed biomass extracted and used by farmers/stockbreeders	Tonnes
Grassland (6420+) habitat surface area managed by cattle grazing	Hectares
Grassland (6420+) habitat surface area managed by cattle grazing	Number of animals
LIFE Prespa Waterbirds Provisioning Ecosystem Service 2 (PES2) – Food from wild animals	
Indicator	***Unit***
Estimated surface area of wet meadows/open sites that would be flooded at maximum water level	Hectares
Surface area of wet meadows/ open sites that has flooded annually (water level dependent)	Hectares
Fish species spawning upstream	No. of species
Carp spawning in restored littoral land	No of spawning attempts

Table 7: Regulating ecosystem services addressed by the LIFE Prespa Waterbirds project and indicators used to measure the impact of the project actions on the service trend

REGULATING SERVICES	
LIFE Prespa Waterbirds Regulating Ecosystem Service 1 (RES1) – Providing habitats for wild plants and animals that can be useful to us	
Indicator	***Unit***
Breeding populations of target waterbird species (nine species)	No. of breeding pairs
Wet meadow habitat (habitat type 6420+) created	Hectares
Wet meadow habitat (habitat type 6420+) flooded per year to create waterbird feeding grounds and fish spawning grounds	Hectares
Protection of reedbed colonies against wildfires (reduction in surface area burnt by fires)	Hectares

Table 8: Cultural ecosystem services addressed by the LIFE Prespa Waterbirds project and indicators used to measure the impact of the project actions on the service trend

CULTURAL SERVICES	
LIFE Prespa Waterbirds Cultural Ecosystem Service 1 (CES1) – Watching plants and animals where they live; using nature to destress	
Indicator	***Unit***
People visiting the area	Overnight stays
Quantity of onsite birdwatching and environmental information available relating to wetland ecosystems	No. of information posts (related to wetlands)
LIFE Prespa Waterbirds Cultural Ecosystem Service 2 (CES2) – Researching nature	

Indicator	*Unit*
Surface area of monitoring sites	Hectares
Assessments, studies and technical reports related to wetland, produced on an annual basis	No. of documents
LIFE Prespa Waterbirds Cultural Ecosystem Service 3 (CES3) – Studying nature	
Indicator	*Unit*
Number of visiting participants in wetland-related educational activities	No. of participant/days
Number of pupils participating in wetland-related educational activities	No. of pupil/days

2.3 CHARACTERISATION OF THE SELECTED ECOSYSTEM SERVICES

As noted in section 1.6.1, ecosystem services flow from the underlying biophysical structures, processes and functions, a relationship which has been illustrated by Haines-Young and Potschin (2010) in their cascade model (Figure 1) and which allows us to consider the degree to which the factors affecting the services are inter-related, and their further relationship to the landscape and drivers of change. In accordance with the cascade model, within a social-ecological system ecosystem services arise from the biophysical structures and processes of ecosystems via the functions that these give rise to, and the production or reduction of services from ecosystem functions are often mediated by human interventions. Ecosystem services provide benefits to humans, which are significant for well-being (VNCST 2017). These benefits can also be valued, either non-materially or economically, however this kind of valuation is not within the scope of this assessment.

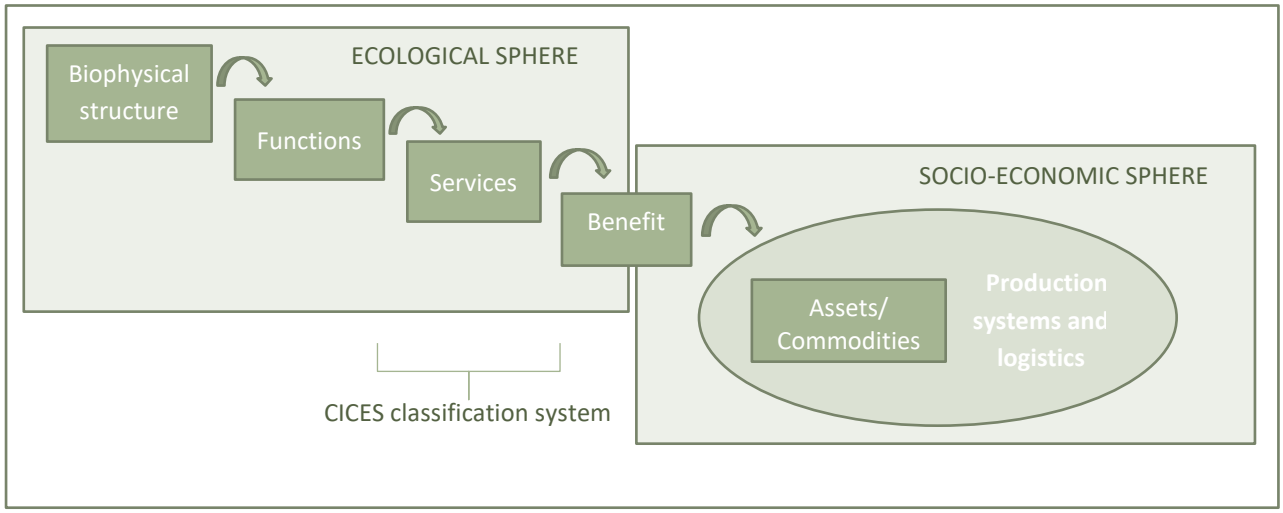


Figure 1: Cascade model after Haines-Young & Potschin, adapted to show ecological and socio-economic spheres (La Notte et al 2017)

In carrying out this assessment, the authors utilised the Cascade Tool provided by the VNCST Toolkit (2017) in order to illustrate and explore these connections and relationships. The completed tool for each selected ecosystem service can be found in Annex I of this report.

As would be expected, all the selected services are dependent on the biophysical structure of the Lesser Prespa wetlands and grasslands for their production, particularly the wet meadows and reedbeds, as well as the ecological process of the hydrological cycle. Drivers of change affecting the wetlands thus affect all the selected services, including the most pressing factor of climate change, already identified earlier in this report as a critical issue, which negatively affects the hydrological cycle with impacts such as increased frequency and intensity of droughts. It is noted here that these same droughts may, however, have a positive effect on PES1 “Materials from wild plants”, as lack of flooding increases and the surface area of dry littoral areas and the amount of time that can be invested in reed cutting and grazing activities, thus increasing the benefits of this service, standing in particular contrast to PES2 “Food from wild animals”, which is dependent on flooding for increased fish spawning grounds.

Land use changes also affect all the services, with the abandonment of traditional practices in the wetlands discussed in section 1.3 being a specific factor, affecting the production of provisioning services in particular. Another key driver of change is local decision making, with wetland/littoral area management under the remit of the Management Body for the Prespa National Park (MBPNP), through the multi-stakeholder Wetland Management Committee, the role of which is discussed in section 1.6.3. Also of note as a driver of change affecting the selected services are wildfires, resulting in habitat and landscape degradation, strongly affecting the functions underlying the regulating service, as well as threatening the biodiversity on which the selected cultural services also depend.

Of particular importance to all the selected ecosystem services are the nursery and refugium functions (De Groot 2002) that arise from the wetlands and littoral areas, which provide living space for wild plants and animals, as well as suitable habitat for reproduction, with nutrient regulation and food/raw materials production functions also playing a significant role in the selected provisioning services.

In terms of the human and built capital which contributes to service provision, stakeholders in local decision making and conservation such as the MBPNP and the SPP, play a particularly important role, as do those stakeholders directly involved in wetland management activities, such as stockbreeders and farmers, whilst tourism stakeholders also contribute to the recreational cultural service (CES1).

As is apparent from the brief review above (see also Annex I), there are significant similarities between the structural and ecological factors affecting the selected ecosystem services, and they are largely positively inter-related, with only one important trade-off being seen between PES1 and PES2, as noted above and discussed in more detail in section 5. In other words, factors and interventions positively affecting one ecosystem service will also positively affect several others to a greater or lesser degree, with the work of the LIFE Prespa Waterbirds project reflecting this connectivity between the services, 5 of which can therefore be said to be showing bundling behaviour in the context of this assessment. Consequently, a degree of agreement in the effect of the project on the trends of the selected services is to be expected.

As noted in section 1.6.1, the key questions to be addressed by the assessment are whether the project has positively impacted the provision of key ecosystem services in the wetlands of Lesser Prespa Lake, and whether any positive impact has also increased the incentive for stakeholder participation in wetland conservation.

3. INDICATOR SELECTION, DATA SOURCES AND ASSESSMENT METHODS

In selecting indicators it should be noted that the authors drew heavily on guidance provided in “Assessing ecosystems and their services in LIFE projects: A guide for beneficiaries” (EC 2018) and the MAES list therein (Maes et al 2014).

Two **provisioning ecosystem services** were selected, because of their direct relation to the outcomes of project conservation actions to the provision of biomass:

(a) **PES1: Materials from wild plants**: this provisioning service relates to the extracted by-products (mainly reed biomass) of the management of wetland vegetation and their use in animal husbandry and farming. Wetland conservation requires controlling the reed from expanding in the littoral zone, either by grazing cattle or the direct removal of the vegetation through cutting. As the reed and wetland vegetation can be used both in situ by grazing animals or secondarily as winter fodder extracted after cutting, both uses were considered indicators for assessing this ecosystem service. In particular, we used two indicators to assess the direct use of extracted material as fodder, by (i) comparing the surface area regularly cut before and during the project (in hectares) and (ii) the amount of extracted biomass used by stockbreeders and farmers (in metric tonnes). It is noted here that during the project a small amount of biomass (2.5%) was used by farmers in the pilot application as soil conditioner in bean cultivation.

For grazing, we used (i) the surface area of grassland habitat being used by cattle and (ii) the number of animals noted grazing in the littoral zone before and after management interventions.

All four indicators and their values resulted from primary data and GIS analysis, derived from two of the project’s concrete conservation actions, relating to wetland vegetation management and to biomass use. In addition, the

results of an assessment on the socio-economic impact of the project, and in particular the outcomes of focus group discussions with stockbreeders and farmers, which took place in the latter stages of the project (Latinopoulos and Bithas 2021), were also used to support or interpret the outcomes of the ES assessment.

(b) **PES2: Food from wild animals;** this ecosystem service relates directly to conservation actions taken to increase fish spawning grounds (as a means to also enhance the feeding potential for target waterbirds). Within the scope of the project actions, and particularly owing to the restoration of wet meadows and water flow in stream mouths, it was expected that fish spawning grounds would increase and the surface area of spawning grounds was thus used as proxy to assess the trend of this ecosystem service. However, although reed vegetation along the littoral zone may change after repeated cutting operations, in the absence of flooding and under dry conditions, the function of these areas as spawning grounds is greatly impaired. To address this, we not only used the surface area of wet meadows/open sites as an indicator, but also the surface area of **flooded** littoral land before the implementation of the action (2018) and afterwards (2021). In addition, we used the number of fish species (edible endemics only) recorded entering the two streams to spawn in spring. Lastly, in order to assess the effect of management along the littoral zone on carp populations (i.e. the most valued species in the local fishery), monitoring of spawning attempts was planned before and after the implementation of the project actions; it is noted, however, that this monitoring indicator can only be measured in flooded conditions.

The comparative values of the two indicators relating to the surface area of spawning grounds, were derived from preparatory actions, whereas the extent of wet meadows/open areas was assessed before and after any interventions. The data were derived from concrete conservation actions, wherein all managed sites were mapped, while topographic and water level data were analysed in GIS to calculate the extent of flooding. Lastly, fish data drawn from monitoring reports on the use of stream mouths by fish were also used. The views of fishermen, and the outcomes of the respective target group discussion from the assessment of the socio-economic impact of the project (Latinopoulos and Bithas 2021) were also used to interpret the ecosystem service assessment results.

To assess the nursery and refugium functions (De Groot 2002) that arise from the wetlands, which provide living space for wild plants and animals, we also selected a regulating ecosystem service that relates the intrinsic value of habitats supporting biodiversity and of wild animals, however always keeping in mind that beyond the intrinsic value, these selected **species/ habitats can be useful to people in various ways (RES1)**. It is noted that the indicators refer mainly to ecosystem or to ecosystem constituent condition, but the contribution of the actual ecosystem "maintenance of nursery populations and habitats" can be explicitly connected to human well-being (as proposed in Liquette et al 2015), as they are used or enjoyed by people in various ways, connecting also to other provisional or cultural ecosystem services.

In particular, we selected as indicators of this regulating ecosystem service:

(a) the number of breeding pairs of the nine target waterbird species (i.e. three-year average values prior to and following action implementation);

(b) the extent of flooding of habitat type 6420+, as a means to assess its parallel functions as fish spawning grounds and waterbird feeding grounds, before and after project implementation;

(c) the average surface area of reedbed wildfires in a three-year period before any firebreaks were created and in the three-year period of project implementation, in order to assess the function of the reedbed as a safe breeding ground for waterbirds; and

(d) the extent of an Annex I habitat type (EU Habitats Directive), 6420+ Mediterranean tall humid grasslands of the Molinio-Holoschoenion wet meadows, which is already recognised for its ecological importance and is a target habitat of the project.

To assess the above-mentioned indicators, data were drawn from preparatory actions dedicated to the mapping and assessment of wetland habitat types (Fotiadis 2021), project monitoring reports on wildfires (Willm et al 2021) and on target waterbird species' phenology, feeding and populations (Catsadorakis et al 2021), and finally topographic and water level data were analysed in GIS to calculate the extent of flooding.

Cultural ecosystem services have been described as generating experiences that people feel internally – emotionally or intellectually – that are both individual and shared, and that support core human needs for connection, growth and creativity (VNCST 2017). The three cultural services under assessment were largely chosen to correspond to the target audiences addressed by the dissemination actions of the project, in addition to the collaborating stakeholders.

In assessing ***CES1: Watching plants and animals where they live*; *using nature to destress***, we used the "number of people visiting the area" and the "quantity of onsite birdwatching and environmental information available" as indicators. For the first indicator, values were drawn from the assessment of the socio-economic benefits of the project (Latinopoulos and Bithas 2021), which in turn drew on data from the Hellenic Statistical Authority for the years prior to the COVID-19 outbreak that resulted in movement restrictions. For the second indicator, values refer to the existence of information boards across key areas in the Prespa basin, that are accessible to visitors and provide information on birdwatching around the lakes, the wetland ecosystem and habitats and other wetland related information before and after the project.

For ***CES2: researching nature***, we evaluated whether the project has increased monitoring efforts for habitats and species and promoted the expansion and dissemination of knowledge by: (a) calculating the surface area of monitoring sites before and after the start of the project; and, (b) comparing the average number of assessments, studies and technical reports, relating to all aspects of wetland management and monitoring, produced annually within the project and in the five-year period prior to its implementation.

For ***CES3: studying nature***, we refer both to environmental education for school children and to adult education relating to *wetland management and monitoring* and we assessed this ecosystem service by: (a) calculating average **participant days** (8-hour sessions x number of participants) in adult training activities (i.e. summer schools) between 2016-2018 and between 2019-2021, the latter period referring to project-related training sessions; and, (b) calculating **pupil days** (8-hour sessions x number of participating pupils) in 2016 and comparing the value with the average annual number of pupil days for the project period (2017-2021).

All indicators were normalised, with normalised indicator status being allocated on a scale of 1 to 5 (with 1 being most negative and 5 being most positive), according to the degree of change in percentage of the indicator (Table 9). All proposed indicators were equally weighted, as they were considered equally important, and each one was selected to measure a different aspect or benefit of the specific ecosystem service.

Table 9: Normalised indicator status and corresponding change in percentage of the indicator

Normalised indicator status	Range of change in percentage of indicator
1	–100% → –61%
2	–60% → –16%
3	–15% → 15%
4	16% → 60%
5	61% → 100%+

The overall status of the trend for each ecosystem service was then allocated on a scale from 'strongly declining' to 'strongly enhancing, according to the average value of all its contributing indicators (Table 10). It is noted here that average values of indicator status for the assessment of the service trend are typically rounded up at values equal to or above 0.5, and rounded down at values below 0.5.

Table 10: Overall ecosystem service trend and corresponding average indicator status value

Overall status of service trend	Average value of indicator status
Strongly declining	1
Declining	2
Stable	3
Enhancing	4
Strongly enhancing	5

4. ANALYSIS AND ASSESSMENT OF ECOSYSTEM SERVICES IN LIFE PRESPA WATERBIRDS

Whilst section 5 will consider overall conclusions from the analysis, in section 4 the selected ecosystem services are presented one by one, together with their indicators, and the results of the assessment are discussed, with each part of the section taking the following format:

- Classification of the ecosystem service, following CICES v5.1 (Haines-Young and Potschin 2018), and related ecosystem function (de Groot et al 2002)
- Short description of the service and benefits in Prespa
- Table of indicators related to the service, with the symbol ★being used to denote indicators originating from the MAES list (Maes et al 2014, EC 2018)
- Table of indicators with baseline and final data, percentage of change, normalised indicator status and overall status of the service trend
- Discussion of the overall trend of the ecosystem service and significant factors in the trend, considering the impact of the project upon the service and whether any positive impact has provided an incentive for stakeholder participation

At the stage of analysis and assessment, it was evident that climate change effects, and in particular the prolonged drought and subsequent low spring water levels of Lake Lesser Prespa for three consecutive years, had influenced both the project outcomes and the monitoring actions, especially in relation to fish spawning grounds and, more specifically, carp spawning. In the absence of the ability to properly measure this indicator, especially in light of the absence of official fish catch data, it was considered that the associated ecosystem service **PES2: Food from wild animals**, which was directly related to fish production, could not be robustly assessed. However, a discussion of PES2 is presented separately at the end of this chapter, in an effort to better acknowledge the effects of drought on ecosystems, their biodiversity components and socio-economic benefits.

4.1 LIFE PRESPA WATERBIRDS PROVISIONING ECOSYSTEM SERVICE 1 (PES1) – MATERIALS FROM WILD PLANTS

Table 11: Materials from wild plants ecosystem service classification

Ecosystem service				Ecosystem function	
Section	Division	Group	Class	Section	Function
Provisioning (biotic)	Biomass	Wild plants (terrestrial and aquatic) for nutrition, materials or energy	Fibres and other materials from wild plants for direct use or processing (excluding genetic materials)	Production functions	Raw materials

PES1: The wetland vegetation biomass produced as a result of the management of wetland areas for biodiversity conservation provides valuable winter fodder for local stockbreeders, and can also be utilised as a soil conditioner by the area's bean farmers, as demonstrated by the project. Furthermore, wet meadow areas (habitat type 6420+) created or maintained by the project provide good quality grazing grounds for local stockbreeders' cattle herds.

Table 12: Indicators related to the provision of wetland vegetation biomass

Indicator	Data source
★ Surface area of reedbed/littoral wetland vegetation area annually managed by cutting	Annual reports on wetland vegetation management/raw data/GIS analysis
★ Reed biomass extracted and used by farmers/ stockbreeders	Annual reports on wetland vegetation management/raw data
Grassland (6420+) habitat surface area managed by cattle grazing (hectares)	Annual reports on wetland vegetation management/raw data/GIS analysis
Grassland (6420+) habitat surface area managed by cattle grazing (number of animals)	Annual reports on wetland vegetation management/raw data/GIS analysis

Table 13: Status of indicators and overall trend of the selected ecosystem service

Indicator	Unit	Baseline value	Final Value	% Change	Indicator status
★ Surface area of reedbed/littoral wetland vegetation area managed by cutting	Ha	15	50	233%	5
★ Reed biomass extracted and used by farmers/stockbreeders	Tonnes	44	137	211%	5
Littoral areas managed by cattle grazing	Ha	121	166	37%	4
	No. of animals	260	360	38%	4
Ecosystem service			***Ecosystem service trend***		
Materials from wild plants			***STRONGLY ENHANCING***		

Overall this ecosystem service (PES1) was assessed as having a **strongly enhancing** trend due to the impact of the project, largely as a result of the very large increases in wetland vegetation being cut under the project, increasing both the surface area of wetland being managed by cutting as well as the tonnage of biomass produced. The increase in the surface area being cut causes changes in vegetation structure, reducing reed in littoral areas and increasing the area of wet meadows and open areas created, with positive conservation results for the project in terms of the habitat created for waterbird feeding grounds and fish spawning. The biomass produced from this effort has increased more than twofold during the project, providing a significant increase in winter fodder for participating stockbreeders, whilst also providing soil conditioner for farmers, though to a lesser degree, with 0.3 hectares of farmland being improved in this manner as a demonstration of its efficacy. It should also be noted here that overall in the three-year period 2018-2020 a total of 563 tonnes of biomass were produced, with only 14 tonnes (2.5%) being used by farmers as soil conditioner.

Furthermore, following the project interventions, additional areas of littoral land were made available for grazing, an important development, as summer grazing in the wetlands: (a) provides an important alternative for local stockbreeders, who would otherwise need to take their herds to high mountain summer pastures; and, (b) constitutes an alternative, supplementary management practice for maintaining wet meadows and littoral areas free of tall helophyte vegetation (reed). Taking into account the need to handle the conflict between free-ranging grazing animals and potential damage to crops in the adjacent agricultural fields, the project installed solar-powered electric fencing to enclose specific grazing areas, as an incentive and supporting measure for interested stockbreeders. Although it may be seen as a relatively slow pace of progress, with the hectares being grazed increasing from 121 to 166, and the total number of grazing cattle from 260 to 360, it should not be forgotten that in addition to conflicts with agricultural land users being eased the temporary fencing also allowed existing herds to graze in the littoral zone for longer periods of time, significantly improving the overall grazing pressure in the area, a measure necessary for the long-term conservation of wet meadows and the littoral zone in general. Nonetheless, regular monitoring and comparisons to the optimal grazing pressure for these areas are required, to ensure that the positive effects of grazing on habitat type 6420+ are maintained in the future.

In parallel with the benefit of increased fodder available for more stockbreeders, greater stockbreeder participation in the management of wetland vegetation provides additional evidence for the project's improved incentivisation of this target stakeholder group and supplements the conclusions of this report. As noted in the socio-economic impact assessment, the number of benefitting farmers receiving biomass had increased from 15 to 24 at the end of the project (Latinopoulos and Bithas 2021). However, the degree of participation in wetland vegetation cutting, collection and baling did not increase correspondingly, (Latinopoulos and Bithas 2021) as it would have required the stockbreeders to own the appropriate machinery to do so; nonetheless, it should be noted that collaboration with stockbreeders has led to about 50% of the management interventions being carried out by stockbreeders themselves, contributing to the timely completion of all activities each year (Koutseri et al 2021) and indicating a clear increasing willingness that bodes well for vegetation management in the After LIFE period. Finally, in the process of assessing the socio-economic impact of the project, and during the focus group discussion, the stockbreeders stated that: (a) the availability of reed biomass had had positive

results for their income (with the potential benefit ranging between €750-€1,250 annually, depending on the amount of biomass received); (b) implementing management by cutting in certain areas – especially if cut early – renders them appropriate for grazing lands, conferring additional advantages for cattle herds; and, (c) it is expected that continuation of the management will further improve the quality of fodder (Latinopoulos and Bithas 2021), as reed will gradually be replaced by other meadow-like vegetation, even in the absence of flooding (Grillas et al 2021).

In addition, the experimental use of reed biomass as a soil conditioner benefited three local farmers under the project and has demonstrated the potential for this aspect of service PES1 to other farmers in the area. When asked, the farmers participating in the focus group discussion stated that although they understood the potential benefits of using reed biomass as a soil conditioner, which related to improved water retention in the soil and an increase in the yield, they remained reluctant to take up the practice, due to the increased manpower required for application (Latinopoulos et al 2021), or the potential need for additional equipment (Papathanasiou et al 2021), both of which would increase the cost of cultivation.

4.2 LIFE PRESPA WATERBIRDS REGULATING ECOSYSTEM SERVICE 1 (RES1) – PROVIDING HABITATS FOR WILD PLANTS AND ANIMALS THAT CAN BE USEFUL TO US

Table 14: Classification of the ecosystem service of providing habitats for wild plants and animals that can be useful for us

Ecosystem service				Ecosystem function	
Section	Division	Group	Class	Section	Functions
Regulation & maintenance (biotic)	Regulation of physical, chemical, biological conditions	Lifecycle maintenance, habitat and gene pool protection	Maintaining nursery populations and habitats (Including gene pool protection)	Habitat functions	Nursery, refugium

RES1: The wetlands of Lesser Prespa Lake provide critical habitats for the survival of the priority species targeted by the project (nine species of waterbirds, including the Dalmatian pelican, classified by the IUCN as almost globally threatened in the category 'Near Threatened'), including important feeding grounds for these species, as well as spawning grounds for the lake's fish species. In addition to the significant conservation value of the project actions and the provision of this regulating service in its own right, the habitats provided in RES1 also underpin the provision of other services, particularly the cultural services provided by the wetlands, including all three cultural services included in this assessment.

Table 15: Indicators related to the provision of nursery and refugium habitats

Indicator	Data source
★ Breeding pairs of target waterbird species (nine species)	Waterbird monitoring reports
Wet meadow habitat (habitat type 6420+) created	Wetland habitat type assessment
Wet meadow habitat (habitat type 6420+) flooded per year to create waterbird feeding grounds and fish spawning grounds	Wetland habitat type assessment/ topographic data/ GIS analysis
Protection of reedbed colonies against wildfires	Reed assessment reports (Tour du Valat/ Waterbirds monitoring reports/ wetland vegetation management reports.

Table 16: Status of indicators and overall trend of the selected ecosystem service

Indicator	Unit		Baseline Value	Final Value	% Change	Indicator status
★ Breeding pairs of target waterbird species (nine species)	No. of pairs	Dalmatian pelican	1,301	1,453	12%	3
		Great white pelican	649	735	13%	
		Pygmy cormorant	1,492	2,172	46%	
		Great white egret	124	103	-17%	
		Little egret	117	148	26%	
		Night heron	119	216	82%	
		Squacco heron	39	59	51%	
		Ferruginous duck	6	7	17%	
		Glossy ibis	6	0	-100%	
Wet meadow habitat (habitat type 6420+) created		Ha	54	112	107%	5
Wet meadow habitat (habitat type 6420+) flooded per year to create waterbird feeding grounds and fish spawning grounds		Ha	39	7	-81%	1
Protection of reedbed colonies against wildfires (reduction in surface area of fires)		Ha	103	61	41%	4
Ecosystem service				***Ecosystem service trend***		
Habitats for wild plants and animals that can be useful for us				***STABLE***		

Overall this ecosystem service (RES1) was assessed as having a **stable** trend as a result of the impact of the project, largely due to the fact that one of the indicators has a very low value (1). The aim of the LIFE Prespa Waterbirds project was to improve the conservation status of the nine target waterbirds species and several indicators of the effect of management on the species were selected, including the number of breeding pairs, and the breeding success for specific species, the use of restored littoral land as feeding grounds and the degree of protection against reedbed fires. As already noted, except for 2018, all years were characterised by drought and low water levels; although this did not allow for the full flooding of littoral land and wet meadows, it should be considered that the management actions did ameliorate the effects of drought and had an overall positive result on target waterbirds species (Catsadorakis et al 2021b). As noted in table 16 above, population numbers remained stable or increased for most species. Two species are excluded from this trend, glossy ibis, a species greatly related to wet meadows and extensive shallow flooded sites, and great white egret, the main colony of which was greatly affected by drought (Catsadorakis et al 2021b).

Together with reedbeds for establishing breeding colonies, wet meadow habitat (6420+ Mediterranean tall humid grasslands of the Molinio-Holoschoenion) is critical to breeding waterbirds as feeding grounds, and its availability may be a factor limiting populations of wading waterbirds in Prespa (Catsadorakis & Malakou 1997). In this context, the doubling of the surface area of this habitat was an important achievement for the project in waterbird conservation terms, and it speaks eloquently to the provision of this ecosystem service. However, in assessing this ecosystem service, and in particular the extent of habitat type 6420+, the role of water level and flooding of this habitat for the functions that were expected to be restored within the project must necessarily be taken into account. Therefore, considering yet again the drought conditions of 2019-2021, and the very low output of the related indicator [wet meadow habitat (habitat type 6420+) flooded per year to create waterbird feeding grounds and fish spawning grounds], we can infer that this function has not been fully restored. Nonetheless, it is also re-stated here, that the project has created other open areas in deeper parts of the reedbeds (firebreaks) and has restored important feeding grounds in two stream mouths, all of which have acted as alternative feeding grounds for waterbirds in the absence of flooded wet meadows. As noted in section 1.3.1, wildfires have been a significant threat to the reedbeds of Prespa, with 103 ha burnt on average in the five years prior to the creation of firebreaks under the project, threatening colonies of both pelicans and herons, as well as other biodiversity harboured by the reedbeds. The LIFE Prespa Waterbirds project has carried out work to combat this threat, gradually cutting extensive firebreaks in the wetlands in order to reduce the spread of wildfires when they occur, as well as policy and awareness actions to limit the intentional setting of local fires

which can spread to the wetlands through drainage channels. Notably, the firebreaks have functioned as barriers, stopping the spread of fires, despite the fact that parts of them have not flooded, which is when they function most effectively. A decrease in the average extent of fires in 2020 and 2021 has resulted in an increase in the value of this indicator in terms of the protection of the nursery and refugium functions of these habitats, and furthermore the firebreaks have provided unanticipated additional feeding grounds for waterbirds in the drought years of 2019-2021, as discussed above, further enhancing the positive trend of RES1

Although it may appear that the ecosystem service of providing habitats for plants and animals that can be useful to us was not improved through project actions, as an effect of drought and reduced flooding of wetland habitats in spring, this exhibited stability in waterbird populations provides an important argument for the adaptation of conservation action for Lesser Prespa Lake to climate change. In the absence of management, and especially if action for the creation of firebreaks in deeper areas and in stream mouths was not implemented in the period 2018-2020, waterbird populations may have been less able to adapt and sustain their populations at higher levels.

4.3 LIFE PRESPA WATERBIRDS CULTURAL ECOSYSTEM SERVICE 1 (CES1) – WATCHING PLANTS AND ANIMALS WHERE THEY LIVE; USING NATURE TO DESTRESS

Table 17: Using nature to destress and watching plants and animals where they live ecosystem service classification

Ecosystem service				Ecosystem function	
Section	Division	Group	Class	Section	Function
Cultural (biotic)	Direct, in-situ and outdoor interactions with living systems that depend on presence in the environmental setting	Physical and experiential interactions with natural environment	Characteristics of living systems that enable activities promoting health, recuperation or enjoyment through passive or observational interactions	Information functions	Recreation

CES1: The conservation of the project's target waterbird species, as well as the management of the wetland within its actions for conservation purposes, have contributed to the provision of this cultural ecosystem service (CES1), which allows the enjoyment of nature in largely passive or observational interactions, thus promoting well-being and the well-documented associated health benefits to humans of being in nature (Hartig et al 2014).

Table 18: Indicators related to the provision of the recreational cultural ecosystem service

Indicator	Data source
★ People visiting the area	Hellenic Statistical Authority
Number of information posts about wetlands and birdwatching	Project monitoring reports, SPP progress reports, local observational survey

Table 19: Status of indicators and overall trend of the selected ecosystem service

Indicator	Unit	Baseline (2016)	2019	% change	Indicator status
★ People visiting the area	Overnight stays	1,532	2,357	54%	4
Quantity of onsite birdwatching and environmental information available relating to wetland ecosystems	Number of information posts	19	25	32%	4
Ecosystem service				***Ecosystem service trend***	
Watching plants and animals where they live; using nature to destress				***ENHANCING***	

Overall this ecosystem service (CES1) was assessed as having an **enhancing** trend due to the impact of the project, as a result of positive figures for both the indicators chosen to assess it, which combine increases in the number of visitors to the area with improved tourism infrastructure through an increase in onsite information about the wetlands and waterbirds provided to visitors.

Regarding visitor numbers, it should be noted that the figures show an increasing trend from the baseline year of 2016 until 2019, but figures are not available for 2020 and 2021 due to the large-scale and globally widespread restrictions on movement placed as a result of the Covid-19 pandemic. For the purposes of this assessment, therefore, the 2019 figure has been used. The LIFE Prespa Waterbirds project has made significant efforts to raise awareness of its actions and the values of the wetlands of Lesser Prespa, promoting the area as an ideal venue for birdwatching through various media and publicity means, with project leaflets and newsletters (7 in number) available to visitors in hospitality venues, 116 posts on social media and 90 updates of news on the website during the project timeframe, as well as promotional efforts such as the documentary (released in 2021) and the specially designed birdwatching application, which saw 260 downloads following its release on 20th March 2019.

Furthermore, the assessment of the socio-economic impact of the project (Latinopoulos and Bithas 2021) found that large numbers of tourists were associated with nature enjoyment touristic activities, with 40% of visitors citing birdwatching as one of their activities in the area and reporting a high degree of satisfaction (4.03 out of 5 on the Likert scale). The promotion of the area and the wetland for birdwatching was concluded to have played a role in this increase of visitors, together with the provision of specific information to visitors, such as the information boards placed at various wetland tourism and birdwatching points, included in this assessment as an indicator of service CES1. Lastly, it is also worth noting here that significant numbers of visitors also visit the area for recreational fishing, particularly from the nearby towns, although data on these visitors was not specifically included in the socio-economic impact assessment.

4.4 LIFE PRESPA WATERBIRDS CULTURAL ECOSYSTEM SERVICE 2 (CES2) – RESEARCHING NATURE

Table 20: Researching nature ecosystem service classification

Ecosystem service				Ecosystem function	
Section	Division	Group	Class	Section	Function
Cultural (biotic)	Direct, in-situ and outdoor interactions with living systems that depend on presence in the environmental setting	Intellectual and representative interactions with natural environment	Characteristics of living systems that enable scientific investigation or the creation of traditional ecological knowledge	Information functions	Science and education

CES2: The LIFE Prespa Waterbirds project has significantly contributed to this cultural ecosystem service (CES2), producing many pieces of scientific research and technical studies on the wetlands of Lesser Prespa Lake. The high biodiversity value of the area has been recognised by numerous international designations and conventions and provided the impetus for conservation efforts of more than three decades standing, attracting the interest of scientists from all over Europe and beyond and bearing testament to the depth of provision of CES2.

Table 21: Indicators related to the provision of the cultural ecosystem service of researching nature

Indicator	Data source
★ Surface area of monitoring sites	Waterbird, fish and vegetation monitoring data/GIS analysis
Assessments, studies and technical reports related to wetland, produced on an annual basis	Project monitoring reports, SPP progress reports (for baseline data)

Table 22: Status of indicators and overall trend of the selected ecosystem service

Indicator	Unit	Baseline Value	Final Value	% change	Indicator status
★ Surface area of monitoring sites	Ha	26	212	715	5
Assessments, studies and technical reports related to wetland, produced on an annual basis	No. of documents	6	14	133	5
Ecosystem service			***Ecosystem service trend***		
Researching nature			***STRONGLY ENHANCING***		

Overall this ecosystem service (CES1) is assessed as having a **strongly enhancing** trend due to the impact of the project, which carried out a substantial number of technical studies and pieces of research as part of its work and significantly increased the surface area of sites being monitored in the Lesser Prespa Wetlands.

In total, 85 assessments, studies and technical reports were published over the lifetime of the project, an average of 14 per year in comparison to the baseline figure of 6 per year, leading to a normalised status of 5 for this indicator, and representing the wealth of scientific investigation, assessment and monitoring carried out in the project actions, which largely focused on subjects such as wetland vegetation dynamics, the impact of climate change on the wetlands and studies on the biodiversity targeted by the project, as well as proposing management guidelines, annual operational plans and monitoring to assess the impact of project actions. The status of Prespa as the home of the largest colony of Dalmatian pelicans in the world, amongst many other factors, has long attracted the interest of scientists and conservationists, and the LIFE Prespa Waterbirds project, with the dynamic complexity of the wetland ecosystem at its core, has focused and galvanised this interest, resulting in a strongly positive assessment of the trend for CES2. In addition, monitoring, particularly of the target species, but also of the habitats which support them (*see also RES1 above*), has substantially increased, with an increase of 186 ha in the surface area of sites being monitored under the project, literally signifying the fact that a very large part of the ecosystem of Lake Lesser Prespa (~20%) was affected by project actions.

4.5 LIFE PRESPA WATERBIRDS CULTURAL ECOSYSTEM SERVICE 3 (CES3) – STUDYING NATURE

Table 23: Studying nature ecosystem service classification

Ecosystem service				Ecosystem function	
Section	Division	Group	Class	Section	Function
Cultural (biotic)	Direct, in-situ and outdoor interactions with living systems that depend on presence in the environmental setting	Intellectual and representative interactions with natural environment	Characteristics of living systems that enable education and training	Information functions	Science and education

CES3: This cultural ecosystem service has also received a strong boost from the project, with numerous environmental education activities over its duration. As noted above, the strong biodiversity value of the area, having been internationally recognised and motivating over 30 years of conservation efforts, has provided a wealth of educational and training opportunities under CES3, bringing benefits to the local community, as well as young conservation professionals from the three countries sharing the lakes basin.

Table 24: Indicators related to the provision of the cultural ecosystem service of studying nature

Indicator	Data source
★ Number of visiting participants in wetland-related educational activities	Project monitoring reports, student assessments; SPP progress reports (for baseline data)
Number of pupils participating in wetland-related educational activities	Project monitoring reports, SPP progress reports (for baseline data)

Table 25: Status of indicators and overall trend of the selected ecosystem service

Indicator	Unit	Baseline (2016)	2021	% change	Indicator status
★ Number of visiting participants in wetland-related educational activities	Participant days	16.6	46.4	179%	5
Number of pupils participating in wetland-related educational activities	Pupil days	27.5	44.63	62%	5
Ecosystem service			***Ecosystem service trend***		
Researching nature			***STRONGLY ENHANCING***		

Overall this ecosystem service (CES3) is assessed as having a **strongly enhancing** trend due to the impact of the project, as a result of significant increases in the amount of time spent on wetland-related environmental education activities by both schoolchildren and students or young conservation professionals, as well as the increased number of wetland-related summer schools and training seminars under the project.

The project's particular concentration on the Presplorers group of youngsters has meant a sustained engagement in their environmental education over time, with positive results for educational development as well as personal development, especially in terms of the breadth of skills encompassed by the programme. This is particularly true in light of the relative isolation of Prespa, with supplementary extra-curricular educational activities nowhere near as readily available to pupils as to their contemporaries in urban centres throughout the country. The Presplorers programme for high school children was supplemented with additional activities at the local primary school on the occasion of world days (migratory birds, wetlands), further boosting the number of pupil days under the project. All of these educational opportunities were underpinned by the cultural services provided by the wetlands of Lesser Prespa Lake, which stem from their national and international significance, as well as the exceptional biodiversity concentrated there.

The wetlands were also the focus of more academic educational activities, aimed at university students and conservation professionals active around the transboundary Prespa lakes basin, as well as from other wetland protected areas in Greece. The 3 wetland-themed summer schools or training seminars under the project – an increase from only one organised prior to the project – saw the management of the wetlands and associated conservation issues form the basis of their programme. These actions increased the number of visiting participant days by 179%, although it should be noted that the Covid-19 travel restrictions meant that some activities took place online, rendering the experience of 'visiting' the area for study a virtual one, though no less effective in terms of CES3. As was noted in section 4.3 above on RES1, and implicit in the discussion on services CES1 and CES2 above, the function of the wet meadows and reedbeds of Lesser Prespa Lake as a nursery and refugium for wild plant and animal species, including the iconic project target species, has underlain the provision of all the selected cultural services in this assessment.

4.6 ADDITIONAL ECOSYSTEM SERVICES, RELEVANT TO THE PROJECT: LIFE PRESPA WATERBIRDS

PROVISIONING ECOSYSTEM SERVICE 2 (PES2) – FOOD FROM WILD ANIMALS

Table 26: Food from wild animals ecosystem service classification

Ecosystem service				Ecosystem function	
Section	Division	Group	Class	Section	Function
Provisioning (biotic)	Biomass	Wild animals (terrestrial and aquatic) for nutrition, materials or energy	Wild animals (terrestrial and aquatic) used for nutritional purposes	Production functions	Food

PES2: Lesser Prespa Lake provides numerous edible fish species which are utilised by local fisheries, as well as caught by amateur fishermen and local stakeholders for consumption. Carp (*Cyprinus carpio*) is particularly prized for consumption and sale, and forms a staple offering of hospitality venues in the area. The project has

worked to increase spawning grounds for fish species, as well as clearing overgrown vegetation from the mouths of two streams, allowing specific "rheophilous" fish species to travel upstream for spawning.

Table 27: Indicators related to the food source of fish species in Prespa

Indicator	Data source
Estimated surface area of wet meadows/ open sites that would be flooded at maximum water level	Annual reports on wetland vegetation management/raw data/GIS analysis
Surface area of wet meadows/ open sites that has flooded annually (water level dependent)	Annual reports on wetland vegetation management/raw data/GIS analysis
Fish species spawning upstream	Monitoring reports on fish species using streams for spawning

Table 28: Status of indicators and overall trend of the selected ecosystem service

Indicator	Unit	Baseline Value	Final Value	% Change	Indicator status
Surface area of wet meadows/open sites managed by cutting that would be flooded at maximum water level	Ha	39	91	133%	5
Surface area of wet meadows/open sites that has flooded annually (water level-dependent)	Ha	39	12	-69%	1
Fish species spawning upstream	Presence/absence No. of species	Absence 0	Presence 4	4-fold increase/ 44% of endemic species[1]	4
Carp spawning in 6 restored sites in littoral land	Average intensity of spawning attempts/5 min	3.7	Unable to be measured	Unable to be assessed	
Ecosystem service				***Ecosystem service trend***	
Food from wild animals				***UNKNOWN, POTENTIALLY STABLE***	

Overall this ecosystem service (PES2) was categorised as **unknown,** or having a potentially stable trend, due to the impact of the project, on the basis of the performance seen in the three indirect project indicators used to assess the service. It is, however, acknowledged that the project has no specific data on the amount of catch by fisheries, due to the lack of official fishery landing data, while the fourth indicator could not be properly assessed due to lack of flooding, as discussed below. Consequently, the remaining measurements of the project's work on improving fish spawning are being utilised in the role of proxies only, inferring a not insignificant degree of uncertainty in the final assessment of PES2.

Monitoring of carp spawning attempts was included amongst the project's monitoring actions, but this indicator was only able to be assessed during 2018, when high water levels allowed the activity to be carried out, in an effort to create baseline data for comparison in subsequent years following the implementation of conservation actions. This assessment was carried out in 11 sampling stations in 2018, with carp spawning identified in five of them. In these five stations, the intensity of spawning ranged between 0 (zero) and 10.33 spawning events per 5 minutes per site (Catsadorakis et al 2019), or as calculated for this assessment an average of 3.7 attempts per

[1] Please note that in this indicator, % change is not being used, as it cannot be calculated starting from a zero (0) value. Instead, it is noted that the increase is 4-fold, with four out of nine endemic species found travelling upstream to spawn, i.e., 44% of all endemic species. As the percentage of endemic species found spawning in the streams after interventions is high, a value of 4 is attributed to the status of this indicator.

5 minutes per site. However, due to very low water levels in 2019-2021 the project team were unable to carry out further evaluations and consequently this valuable indicator could not be used as part of this ecosystem service assessment. The dependence of this indicator on the flooding of the littoral zone, and the consequent improved function of wet meadows/open areas as spawning grounds, highlights once again the effects of climate change and prolonged drought on the wetland ecosystem, biodiversity and ecosystem services.

Although we were unable to use the indicator relating to spawning attempts directly, we did look into the remaining indicators relating to the main spawning ground habitats: wet meadows and open sites free of reed vegetation, calculating changes in their surface area, but also estimating the surface area of **flooded** littoral land before action implementation (2018) and afterwards (2021). Wet meadow habitat provides ideal spawning habitat for several fish species in Prespa, and notably for the carp (Crivelli et al 1997). As noted in section 4.1 above, due to wetland vegetation management by cutting and grazing, the project has not only increased the surface area of this important habitat, but has also increased open areas in deeper parts of the lake, as well as access to the habitat for breeding fish by cutting firebreaks, which also act as fish access corridors, into the reedbed. However, although removing reed vegetation along the littoral zone may increase wet meadows and open areas after repeated cutting operations, in the absence of flooding and in dry conditions the function of these cut areas as spawning grounds is greatly impaired. It is therefore acknowledged that although the surface area of such sites has increased (and thus their quality characteristics may have also improved), the habitat flooding that enables their function as fish spawning grounds was nonetheless reduced by almost 70% at the low water levels experienced in the final year of the project, in comparison to the baseline value of 2018, when high water levels allowed the flooding of extensive littoral areas.

In addition, the project also proceeded with restoring the function of two stream mouths, by re-establishing water flow and removing excess vegetation from the stream bed, which had preventing fish from travelling upstream to spawn. Starting from the baseline measure of the absence of fish species at the beginning of the project (due to the complete blockage of ingress to the streams noted by the project's scientific team at that time), fish monitoring carried out in the streams in 2021 concluded that 7 distinct species were found to be moving upstream, of which 3 were invasive species and 4 were edible endemic species.

Taking into account the lack of a conclusive indicator in the form of carp-spawning data, due to lack of flooding, but considering all the above-mentioned proxies for assessing the service, its trend has been assessed as "unknown", and it has consequently not been included in the final assessment, as noted at the beginning of section 4. However, we tentatively propose that it may be considered "potentially stable", highlighting in relative terms the fact that the habitat has been improved, whilst also acknowledging that the absence of flooding has impaired full function recovery. Notably, positive conservation results for the project have been observed not only in terms of increased fish spawning grounds, but also in terms of increased feeding grounds for the target waterbird species, with waterbirds using streams and the deeper parts of firebreaks as feeding grounds.

Finally, as part of the socio-economic assessment of the project, fishermen were interviewed for the survey and a 'satisfaction index' obtained, which showed a decline over the course of the project, from 7.66 to 2.8. However, the reasons for this decline in satisfaction were attributed by the fishermen to factors outside the scope of the project, such as the absence of re-stocking processes, perceived increases in invasive species, low market prices for their catch and illegal practices or the non-observance of protective measures by fisheries in the two countries sharing the lakes basin (Albania, North Macedonia). Nonetheless, fishermen did express positive opinions of the project actions, which were perceived as being in the 'right direction', albeit needing more drastic intervention, with the removal of reed from additional areas. They also recognised that the project results were negatively affected by drought years from 2019 to 2021 and acknowledged the overall influence of climate change and reduced water level, both to the health of the ecosystem and their profession (Latinopoulos and Bithas 2021).

5. CONCLUDING REMARKS

The LIFE Prespa Waterbirds project was set up with an inherent aim to confer benefits on the local community and beyond, largely accredited to the fact that most proposed wetland conservation actions related directly to primary sector activities, and will continue to do so after the close of the project. Direct and clear benefits from

managing littoral land and wetland areas to local society were expected to be provided mainly to stockbreeders through the use of biomass and the availability of rangeland (PES1), as well as to farmers through the use of biomass as soil conditioner, and secondarily to fishermen through improved fish spawning (PES2). Indirectly, or rather in a less evident way, the local community would also benefit through the maintenance of populations and habitats, i.e. their inherent existential value which confers multiple benefits (RES1), the demonstration of project actions and results leading to increased publicity for the protected area, diversified nature activities and subsequently increased revenue from tourism (CES1), as well as increased knowledge on issues related to both biodiversity and local livelihoods, which was shared locally, nationally and at the transboundary level (CES2 and CES3).

Within the project the ecosystem services that were evaluated (PES1, RES1, CES1, CES2, CES3) were all assessed as having positive or neutral trends, either "strongly enhancing", "enhancing" or "stable" (Table 29).

Table 29: Trends in ecosystem services assessed under the LIFE Prespa Waterbirds project

	Ecosystem Service	Trend
PES1	Materials from wild plants	Strongly Enhancing
RES1	Maintaining nursery populations and habitats	Stable
CES1	Watching plants and animals where they live; Using nature to destress	Enhancing
CES2	Researching nature	Strongly Enhancing
CES3	Studying nature	Strongly Enhancing
PES2	Food from wild animals	Unknown

The trend of PES1 "Materials from wild plants" was assessed as "strongly enhancing", owing to the fact that the wetland management activities and conservation actions were directly related to the primary sector, conferring benefits to all involved stakeholders. Although the extracted biomass was not solely taken up by stockbreeders, the benefits of this biomass availability was clearly demonstrated by the fact that stockbreeders readily participated in the management (cutting and collecting) of reed/wetland vegetation by undertaking 50% of the activities. This win-win situation is considered one of the major achievements of the project, as under the umbrella of conservation objectives for wetland management, local stakeholders participated in the actions with their own equipment and at their own cost, obviously owing to the value and quality of the extracted fodder; arguably, this significant contribution of labour allowed the implementation of large-scale interventions, and in parallel led to an increase in littoral land for grazing.

Long-term solutions that are applied by stakeholders (grazing and/or cutting in the case of LIFE Prespa Waterbirds) are always more preferrable, because they secure the continuation of actions beyond the scope of a project, and in Prespa they are key to maintaining ideal wetland conditions. Participation by stakeholders was largely driven by the incentives provided, the results of ecosystem services which are beneficial for their activities. While this participation was key to the successful implementation of the project, it should always be driven by conservation objectives and organised by the site manager (currently the MBPNP). The implementation of the project and the organisation of activities within these three years, as well as the decade-long operation of the local decision-making scheme, i.e. the multi-participatory WMC committee functioning under the MBPNP, has provided a robust process for ensuring the appropriate organisation of wetland vegetation activities in the long term.

Conservation objectives were defined through several biodiversity, habitat and other technical assessments and studies, while the effects of actions on key habitats and species were closely monitored throughout the project, and this increased scientific scrutiny of Lesser Prespa Lake led to a "strongly enhancing" trend for both CES2 "Researching nature" and CES3 "Studying Nature".

In reporting upon the trends of ecosystem services, two overarching constraints must be taken into consideration: **climate change effects** and the **COVID-pandemic mobility restrictions** (2020 and 2021).

Climate change, and the drought conditions in particular, affected the outcomes of project actions in terms of specific functions and services, and has also been noted as a direct threat to livelihoods by local stakeholders. Although all the actions have been implemented appropriately and consequently habitats have in effect been restored, the absence of flooding conditions during the spring season over three consecutive years (2019-2021) had a direct impact on specific wetland functions (e.g. fish spawning) and affected important wildlife populations and habitats. Similarly, although the vegetation along the littoral zone was restored, leading to a doubling in extent of habitat type 6420+, it has been assessed as having only a moderate degree of conservation, as a result of the low spring water level in the last three years, which did not allow the full development of typical species and the emergence of the typical structure corresponding to the habitat type (Fotiadis et al 2021). However, although the trend of RES1 "maintaining nursery populations and habitats" was only assessed as "stable", the fact that implementation of management has resulted in the amelioration of the effects of prolonged drought on waterbird populations (Catsadorakis et al 2021b), should not be overlooked. In the absence of conservation action, there would have been no alternative feeding sites and breeding colonies would have been more susceptible to wildfires, while the drought also led to an increase in extracted material and land availability for grazing for stockbreeders.

In improved hydrological conditions (i.e. wet, spring flooding conditions), the level of management and degree of restored habitats would be expected to have strongly positive effects on conservation goals and some ecosystem services. Indeed, it should be noted that, following the management interventions, extended flooding would be expected to lead to an increase in spawning attempts with potential improvement for the local fishery, thus leading to an improved trend for PES2 "Food from wild animals", an ecosystem service that could not be assessed in the project period. However, as noted above, increased flooding could potentially reduce the outcomes of PES1 (biomass provision/grazing grounds), as the flooded littoral areas would be only accessible for cutting and grazing for a limited period of time in high water levels and waterlogged conditions. There is an obvious trade-off between obtaining biomass from the wetland (PES1) and receiving food from fish (PES2), that largely depends on the vegetation and water level management. Vegetation cutting and grazing provides biomass and creates the ideal conditions for spawning; high water levels allow the flooding of areas and allows spawning to take place in spring, but in early summer it limits the time available for the implementation of activities, possibly leading to management being implemented in smaller areas for some years. Depending on various conditions annually, different stakeholders may benefit to a different degree, and as such efforts should be made in order to keep their interest high, with implementation efforts and benefits being equitably distributed by the MBPNP.

Meanwhile, mobility restrictions related to the COVID-pandemic have affected the trends of cultural ecosystem services, especially in relation to people enjoying nature and visiting the area (CES1) while having increased access to wetland and birdwatching information through the project. The mobility restrictions of 2020 and the first half of 2021 led to a severe decrease in visitors to area during these years, a period during which information coming from the LIFE Prespa Waterbird project became gradually available to visitors locally (e.g. newsletters in public areas, smart-phone application, information posts on digital media). Nonetheless, the assessment of ecosystem service CES1 was based on an evaluation of visitor data from 2017 and 2019 (Latinopoulos and Bithas 2021), which already showed an increase in the number of visitors and an interest in environmental and birdwatching information being available. Although this result cannot be attributed solely to the project, and in the absence of an ability to assess the trend after a full five years of project implementation, this CES was classified as "enhancing", as the radical reduction of visitors was exclusively related to the COVID-19 pandemic and the information available to visitors has undeniably increased over years, responding to a genuinely evaluated interest in such material.

Interestingly, owing to adaptations in the working practices of the LIFE Prespa Waterbirds project in response to the pandemic, it was possible to continue with some specific actions that required local activities to take place, as well as holding meetings and training online. As it was possible to continue with research and monitoring activities locally, and thus produce the appropriate studies and reports, the ecosystem service CES2 "researching nature" was not affected at all and all scheduled activities and outcomes were completed as foreseen, with increased outcomes in terms of results on wetland research in comparison to the period before the project, leading to a "strongly enhancing" trend.

In terms of CES2 "studying nature", again a "strongly enhancing" trend was observed. Two training sessions in wetland management and monitoring were organised through the creation of specific online tools, videos and

platforms, both for university students and site managers of the transboundary Prespa basin, while only one summer school was organised on site in 2019. The information and training material produced by all project partners during the online training events were collated into an online Wetland Management and Monitoring Toolkit for further use by interested students and site managers. In addition, major environmental education activities were mostly implemented before the pandemic outbreak, though the Presplorers group (local high school environmental education group) were subsequently able to continue their activities online (movie editing, presentation) or in the outdoors (at times that it was allowed in summer 2020); in fact, the team took their activity one step further and participated in the WWF Panda Awards, organised online by WWF Greece and WWF Turkey, presenting their field activities and their short documentary movie "People and Naiads, Myths and Truths" and receiving awards for "effectiveness" and "duration and continuity".

In conclusion, as inherent in the proposal right from the start, the LIFE Prespa Waterbirds project did confer benefits to local society. In this assessment it has been possible to use the ecosystem services approach to further show that enhancing trends have been observed for important provisioning and cultural services, while the stability of the selected regulating service has also been recognised. The effects of climate change and the global pandemic conditions were identified as critical parameters in the provision of ecosystem services, affecting some of them to a higher degree than others. As climate change and its effects has now been recognised by all related local stakeholder as a significant pressure for the area and its primary sector activities (Latinopoulos 2019), it is considered that local co-operation, which was strengthened further through the project, and the long-standing decision-making scheme (WMC) have gone a step further towards ensuring that conservation objectives and management action will incorporate climate change considerations and adaptation in the future. The long-term maintenance of benefits from wetland management should aim to secure a diversity in the delivery of ecosystem services capable of meeting the basic demands of a variety of local stakeholders and beneficiaries on a broader scale. In this light, co-operation between all involved, both locally and regionally across the Prespa lakes basin, is important, especially as the provision of ecosystem services is already facing additional, and possibly accumulating, pressures from the effects of climatic change and will increasingly be so in the near future.

6. BIBLIOGRAPHY

Bengtsson, J., Bullock, J. M., Egoh, B., Everson, C., Everson, T., O'Connor, T., O'Farrell, P. J., Smith, H. G., & R. Lindborg. 2019. Grasslands—more important for ecosystem services than you might think. Ecosphere 10(2),

Catsadorakis, G. 1996. Fish and fisheries in Prespa. 55pp, in Greek. Society for the Protection of Prespa

Catsadorakis, G., & M. Malakou. 1997. Conservation and management issues of Prespa National Park. Hydrobiologia, Vol. 351, 175-196

Catsadorakis, G., Papadopoulou, E., Petrakos, M. & I. Koutseri. 2018. Status of Fisheries at Megali Prespa Lake and Mikri Prespa Lake, Greece, Based on a Census of Fishermen's Opinions. Environment and Ecology Research, Vol. 6 (6): 583-592

Catsadorakis, G., Nikolaou, H. & L. Nikolaou. 2019. Report on monitoring of carp spawning in the littoral zone of Lake Lesser Prespa in 2018. Society for the Protection of Prespa. LIFE15 NAT/GR/000936 – Prespa Waterbirds project.

Catsadorakis, G., Mougiakou, E. & T. Kizos. 2021a. Ridge-and-Furrow Agriculture around Lake Mikri Prespa, Greece, in a European perspective. Journal of European Landscapes, Vol. 2, 7-20. DOI:10.5117/JEL.2021.2.64206

Catsadorakis, G., Alexandrou, O., Nikolaou, H. & F. Papanousi. 2021b. Scientific monitoring of biodiversity indicators for 2021 – Waterbirds. Report within the framework of LIFE Prespa Waterbirds project. LIFE15 NAT/GR/000936. 40 pages. In Greek with English summary. Society for the Protection Prespa.

Costanza R., d'Arge R., De Groot R., Farber S., Grasso M., Hannon B., Limburg K., Naeem S., O'Neill R. V., Paruelo J., et al, 1997. The value of the world's ecosystem services and natural capital. Nature. 387:253–260. doi:10.1038/387253a0

Costanza R., De Groot R., Sutton P., Van Der Ploeg S., Anderson S. J., Kubiszewski I., Farber S. & Turner R. K., 2014. Changes in the global value of ecosystem services. Global Environ Change. 26:152–158. doi:10.1016/j.gloenvcha.2014.04.002

Crivelli, A.J., Catsadorakis, G., Malakou, M., & E. Rosecchi. 1997. Fish and fisheries of the Prespa Lakes. Hydrobiologia 351: 107–125

de Groot R., Wilson M. A. and Boumans R. M. J., 2002. A typology for the classification, description and valuation of ecosystem functions, goods and services. Ecological Economics. 41(3):393-408 doi:10.1016/S0921-8009(02)00089-7

de Groot R., Brander L., Van Der Ploeg S., Costanza R., Bernard F., Braat L., Christie M., Crossman N., Ghermandi A., Hein L., et al, 2012. Global estimates of the value of ecosystems and their services in monetary units. Ecosyst Serv. 1:50–61. doi:10.1016/j.ecoser.2012.07.005

Dimopoulos P., Mallinis G, Kokkoris I., Bekri, E., Chrisafi, E., Verde N & Th. Stampoulidis. 2018. LIFE-IP 4 NATURA: Integrated actions for the conservation and management of Natura 2000 sites, species, habitats and ecosystems in Greece. Deliverable Action A.3: Technical-Methodological Guide on the determination and assessment of the Ecosystem Types in Greece and their Ecosystem Services at national, regional and local scale. University of Patras, Democritus University of Thrace, Patras, p. 211. https://edozoume.gr/wp-content/uploads/2020/10/LIFE-IP-4-NATURA-Tehnical-methodological-guide-optimized.pdf

(EC) European Commission. 2018. Assessing ecosystems and their services in LIFE projects: A guide for beneficiaries. https://cinea.ec.europa.eu/system/files/2021-03/life_ecosystem_services_guidance.pdf

Fotiadis, G & F.N. Sakellarakis. 2021. Assessment of wetland habitat types. Report within the framework of LIFE15 NAT/GR/000936 Prespa Waterbirds project. Agricultural University of Athens, Society for the Protection of Prespa. Pp. 36. in Greek, with English summary

Grillas P., Sakellarakis F.-N., Gaëtan, L., Willm, L., Fontès, H. & C. Pechinot. 2021. Dynamics of reedbed vegetation and impacts of management in Lesser Prespa Lake wetlands - Final report and synthesis 2017 – 2021. Report within the LIFE15 NAT/GR/000936 Bird conservation in Lesser Prespa: benefiting local communities and building a climate change resilient ecosystem, pp. 104.

Haines-Young, R. and Potschin M.B., 2018. Common International Classification of Ecosystem Services (CICES) V5.1 and Guidance on the Application of the Revised Structure. Available from: www.cices.eu

Haines-Young, R.& Potschin, M.B., 2010. The links between biodiversity, ecosystem services and human well-being. In: Raffaelli, D., & Frid, C. (Eds), Ecosystem Ecology: A New Synthesis, BES Ecological Reviews Series. CUP, Cambridge.

Hartig, T., Mitchell, R., de Vries, S., & Frumkin, H. 2014. Nature and Health. *Annual Review of Public Health*, 35, 207-228. doi: 10.1146/annurev-publhealth-032013-18244

La Notte, A., D'Amato, D., Mäkinen, H., Paracchini, M. L., Liquete, C., Egoh, B., Geneletti, D., & Crossman, N. D. (2017). Ecosystem services classification: A systems ecology perspective of the cascade framework. *Ecological indicators*, *74*, 392–402. doi:10.1016/j.ecolind.2016.11.030

Latinopoulos, D. 2019. The Role of Ecotourism in the Prespa National Park in Greece. Evidence from a Travel Cost Method and Hoteliers' Perceptions. Journal of Environmental Management and Tourism, (Volume X, Winter), 8(40): 1743 - 1754. doi: 10.14505/jemt.v10.8(40).04

Latinopoulos D. & K. Bithas. 2021. Final assessment report on the socio-economic consequences of the LIFE Prespa Waterbirds project - LIFE15 NAT/GR/000936. Panteion University. Aristotelian University of Thessalonikia. Society for the Protection of Prespa. pp. 54. In Greek, with English summary. https://www.prespawaterbirds.gr/action-d3-assessment-of-the-socio-economic-impact-of-the-project--final-study-2g21-weg-60949.html

Liquette, C., Cid, N., Lanzanova, D., Grizzetti, B. & A. Reynaud. 2015. Perspectives on the link between ecosystem services and biodiversity: The assessment of the nursery function. Ecological Indicators, Vol. 63. 249-257. http://dx.doi.org/10.1016/j.ecolind.2015.11.058

Willm L., Sakellarakis F.-N., Grillas P. 2021. – Tour du Valat - Mapping wild fires in Prespa reedbeds: use of BAIS2 Index and drone images. Short-communication technical report within the framework of LIFE Project "Prespa Waterbirds"LIFE15 NAT/GR/000936. 21 pp. & annex https://www.prespawaterbirds.gr/action-d1-impacts-of-wildfires-on-the-survival-of-phragmites-australis--2g21-weg-82013.html

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. and G. Bidoglio. 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.

Maes J., Teller A., Erhard M., Murphy P., Paracchini M.,Barredo J., Grizzetti B., Cardoso A., Somma F., Petersen J. European Commission, ISBN; 2014. Mapping and Assessment of Ecosystems and Their Services—Indicators for Ecosystem Assessments Under Action 5 of the EU Biodiversity Strategy to 2020; pp. 978–992.

Maes J., Liquete C., Teller A., Erhard M., Paracchini M.L., Barredo J.I., Grizzetti B., Cardoso A., Somma F., Petersen J. 2016. An indicator framework for assessing ecosystem services in support of the EU Biodiversity Strategy to 2020. Ecosyst. Serv.;17:14–23.

Markova, S., Sanda, R., Crivelli, A.J., Shumka, S., Wilson, I., Vukic, J., Berrebi, P. and Kotlik, P. 2010. Nuclear and mitochondrial DNA sequence data reveal the evolutionary history of Barbus (Cyprinidae) in the ancient lake systems of the Balkans. Molecular Phylogenetics and Evolution 55: 488-500

(MA) Millennium Ecosystem Assessment. 2005. Ecosystems and Human Well-being: Wetlands and Water Synthesis. World Resources Institute, Washington, DC. https://www.millenniumassessment.org/documents/document.358.aspx.pdf

(MEPPPW) Ministry for the Environment, Physical Planning and Public Works. 1999. Greece, National Strategy for Wetland Resources. pp.18. https://www.ramsar.org/sites/default/files/documents/library/national_wetland_policies_-_greece.pdf

National Observatory of Athens. 2018. Assessment of habitat vulnerability to climate change to establish "climate change proof" wetland vegetation management: final report of habitat vulnerability to climate change. LIFE15 NAT/GR/000936 – Prespa Waterbirds project. pp.82. in English. https://www.prespawaterbirds.gr/img/a9ff3d6e030b898f91cbe163c5ae68fcA6.HabitatVulnerability_ClimateChange_AssesmentReport_incl.summary.pdf

Papathanasiou, F, Papadopoulos, I., Koutseri, I. & M. Malakou. 2021a. Revised feasibility study for the use of reed biomass as soil conditioner and fodder. LIFE15 NAT/GR/000936 – Prespa Waterbirds project. University of Western Macedonia, Society for the Protection of Prespa. pp.55. in Greek. https://www.prespawaterbirds.gr/action-a4-revised-feasibility-study-on-the-use-of-reed-biomass-as-soil-conditioner-and-fodder-weg-43129.html

Papathanasiou, G. 2021. Assessment of quality characteristics of biomass extracted from wetland management for use as fodder. LIFE15 NAT/GR/000936 – Prespa Waterbirds project. University of Western Macedonia. pp 31, in Greek. https://www.prespawaterbirds.gr/action-a4-assessment-of-quality-characteristics-of-biomass-extracted-from-wetland-management-for-use-as-fodder-weg-94043.html

Potschin M., Haines-Young R. Defining and measuring ecosystem services. In: Potschin M., Haines-Young R., Fish R., Turner R.K., editors. Routledge Handbook of Ecosystem Services. Routledge, Taylor & Francis Group; London; New York: 2016.

Ramsar Convention on Wetlands, 2011. Wetland Ecosystem Services Factsheet – An Introduction. Gland, Switzerland. https://www.ramsar.org/sites/default/files/documents/library/services_00_e.pdf

Strid, A., Bergmeier, E & G. Fotiadis. 2020. Flora and vegetation of the Prespa National Park, Greece. Society for the Protection of Prespa, Greece. ISBN: 978-960-302-285-5, pp. 552

(SCBD) Secretariat of the Convention on Biological Diversity. 2004. The Ecosystem Approach, (CBD Guidelines) Montreal: Secretariat of the Convention on Biological Diversity 50 p. https://www.cbd.int/doc/publications/ea-text-en.pdf

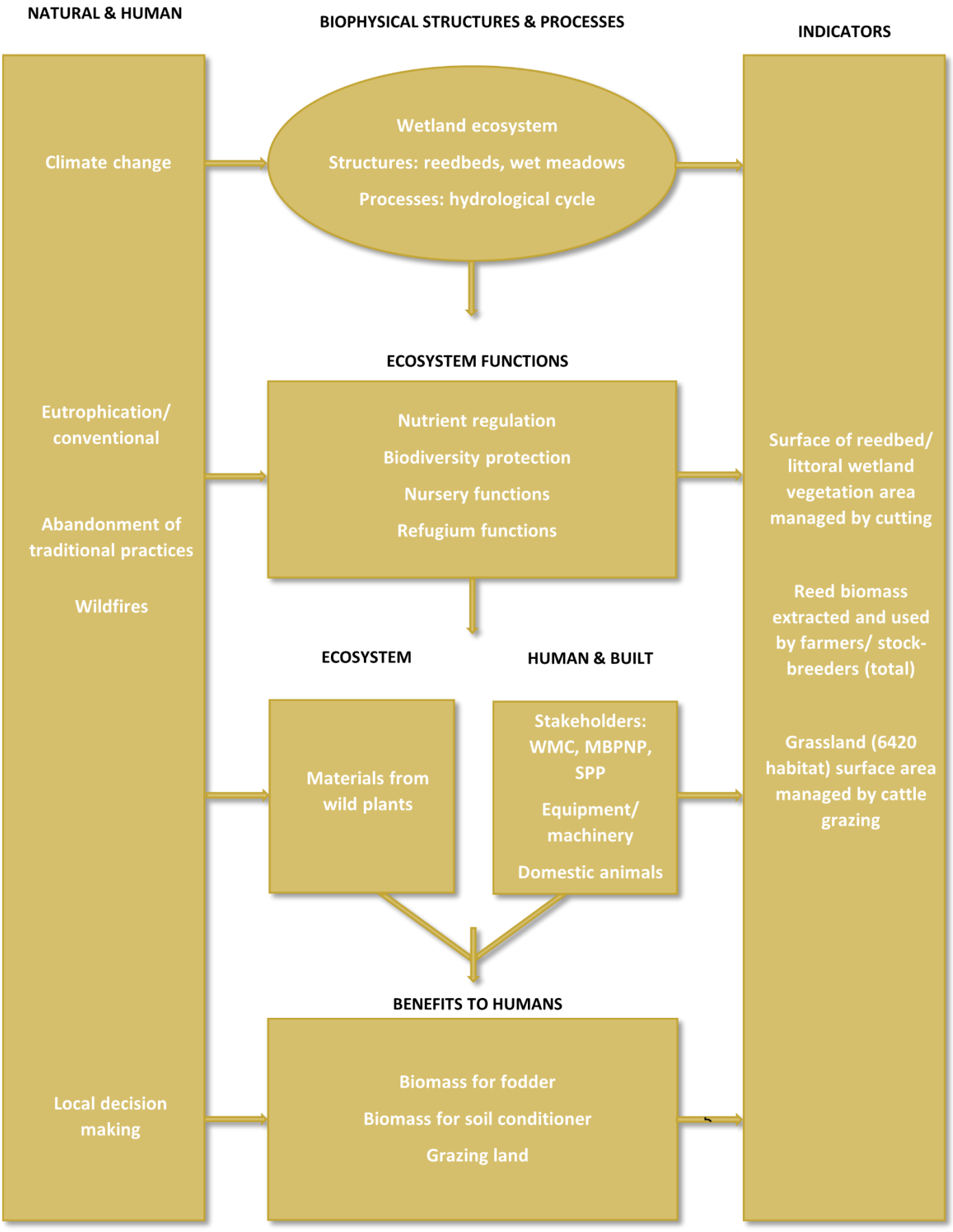
Vrahnakis, M., Fotiadis, G. and Kazoglou, Y. 2011. Habitat types of Prespa National Park, Record, Evaluation and Geographical Presentation. Society for the Protection of Prespa – TEI Larisas, pp. 124 (+ Annexes). in Greek

(VNCST) Value of Nature to Canadians Study Taskforce. 2017. Completing and Using Ecosystem Service Assessment for Decision-Making: An Interdisciplinary Toolkit for Managers and Analysts. Ottawa, ON: Federal, Provincial and Territorial Governments of Canada.

Zedler J. B. & Kercher S., 2005. Wetland resources: status, trends, ecosystem services and restorability. Annual Review of Environment and Resources. 30:39-74. doi: 10.1146/annurev.energy.30.050504.44248

Zhao, Y., Liu Z. & J. Wu. 2020. Grassland ecosystem services: a systematic review of research advances and future directions. Landscape Ecology. Vol 35, 793–814, https://doi.org/10.1007/s10980-020-00980-3(01

PES1 – Materials from wild plants

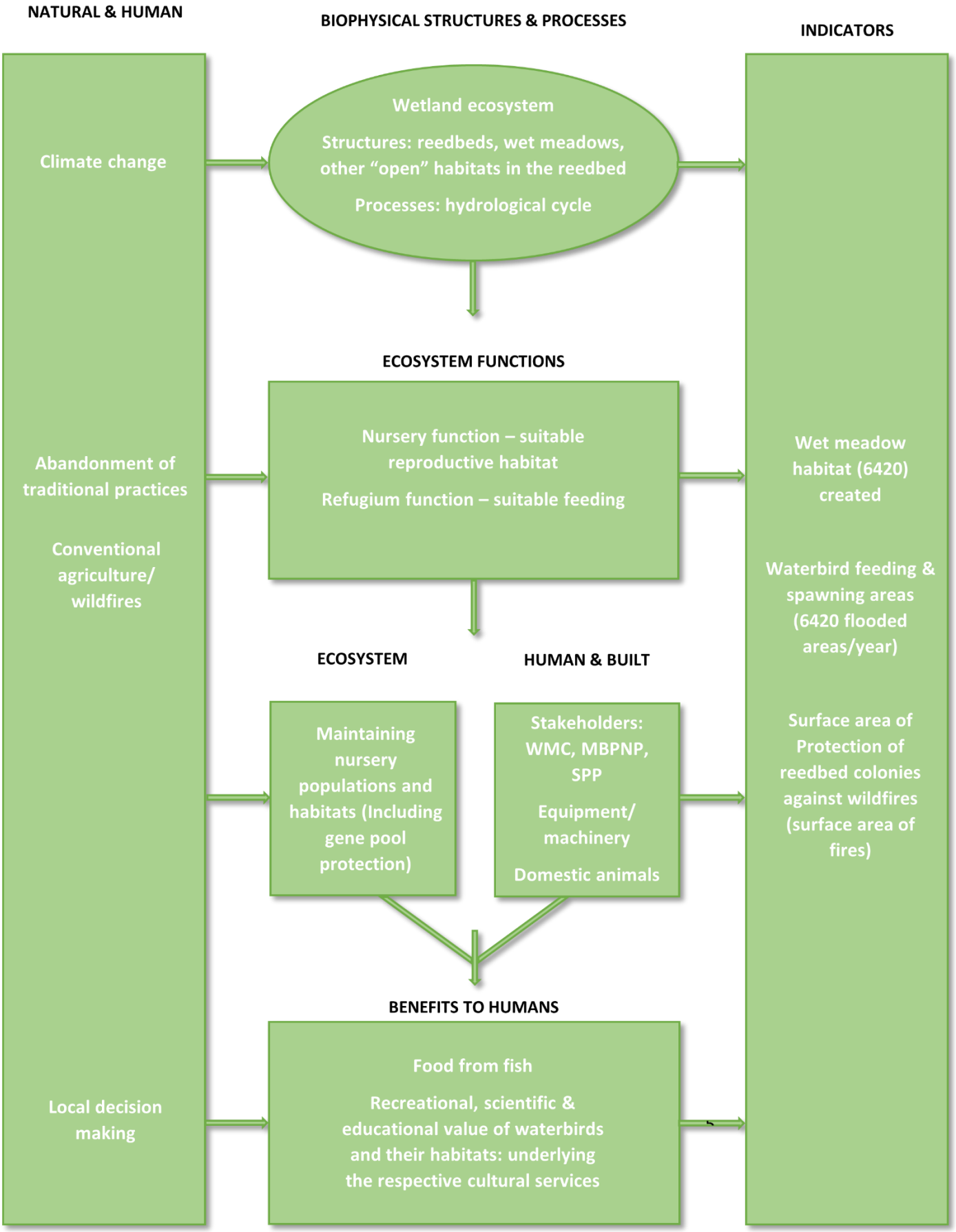


SOCIETY FOR THE PROTECTION OF PRESPA

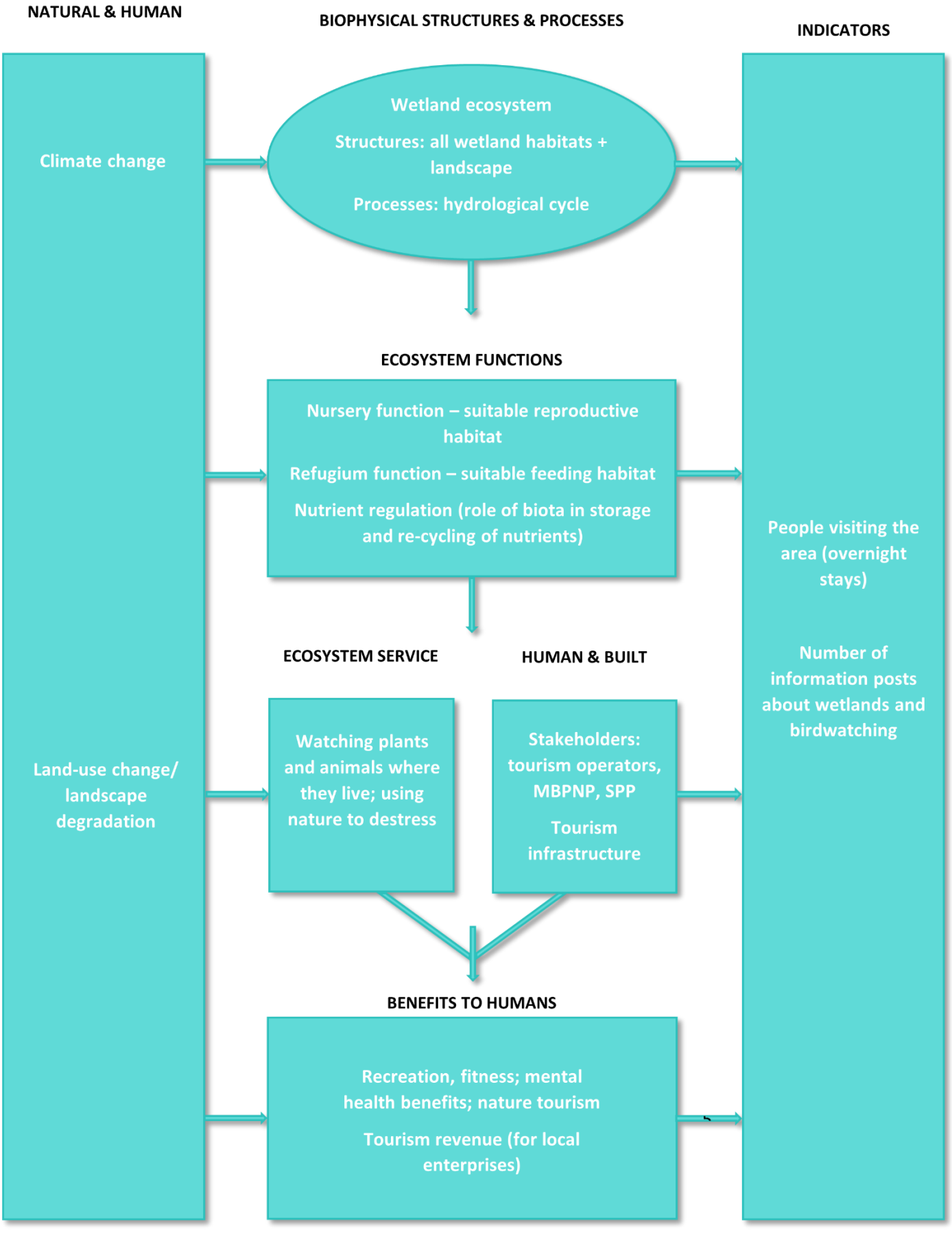
PES2 – Food from wild animals

SOCIETY FOR THE PROTECTION OF PRESPA

RES1 – Providing habitats for wild plants and animals that can be useful to us



CES1 – Watching plants and animals where they live; using nature to destress



CES2 – Researching nature

CES3 – Studying nature