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European LIFE Projects Dedicated to Ecological Restoration in Mediterranean and Black Sea Coastal Lagoons

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Abstract: This paper discusses how ecological restoration has been pursued through projects financed by *L'Instrument Financier pour l'Environnement* (LIFE) of the European Commission in Mediterranean and Black Sea coastal lagoon sites affiliated with the Natura 2000 network. While the LIFE programme started in 1992, the first project focusing on ecological restoration in a coastal lagoon setting in this eco-region was attributed in 1995. In total, 50% (27) of the 54 LIFE projects in the Mediterranean and Black Sea coastal lagoons comprised a worksite on ecological restoration. Eighteen finalized projects, all realized after 2008, have been sufficiently documented for our analysis. The ecological restoration works included (i) removing solid waste and alien invasive species, (ii) re-building lagoons, (iii) creating islets for bird colonies, (iv) restoring the hydrodynamics of the lagoons, and (v) restoring and protecting vegetation. The latter includes submerged aquatic vegetation in the lagoons, halophytes on tidal flats and in fringing salt marshes, freshwater marsh plants, and dune vegetation. Abandoned salt works (Salinas), originally created within the coastal lagoons or on their shoreline, represent significant areas that can be managed for conservation or restoration. Coastal lagoons are transitional waters, and successful restoration of water quality and aquatic communities must include the concept of the aquatic continuum. Combating eutrophication requires managing the watersheds of the lagoons to drastically decrease nutrient loadings. Unfortunately, these issues have only been marginally addressed by the LIFE projects, as they were too often limited by the perimeter of the Natura 2000 sites. In principle, the Water Framework Directive takes care of these issues and, according to an integrative vision, links them with the protected Natura 2000 sites. In practice, however, the LIFE projects and the water policies in the member states still suffer from sectorial approaches.

Keywords: aquatic continuum; coastal lagoons; dunes; LIFE programme; Natura 2000 network; Salinas; salt marshes

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1. Introduction

In the European Union, coastal lagoons are priority habitats (i.e., listed as *1150) according to the Habitats Directive (1992). A definition for coastal lagoons was proposed by Kjerve [1] as "*inland water bodies, found on all continents, usually oriented parallel to the coast, separated from the ocean by a barrier, connected to the ocean by one or more restricted inlets which remain open at least intermittently, and have water depths which seldom exceed a few meters*". As priority habitats, most of these water bodies, together with their coastal barriers and fringing wetlands, are now protected in the EU as Natura 2000 sites, belonging to the Natura 2000 network with over 27,852 protected sites [2]. Combining the coastal lagoon water bodies with their coastal barriers and fringing wetlands allows for the creation of landscape entities that can be studied and managed according to a functional approach based on landscape ecology, geomorphology, and ecohydrology. In contrast, the Implementation Manual of European Union Habitats of the European Commission [3] uses a definition of coastal lagoons as water bodies distinguished by their phytosociological features. Hence,

this definition is not operational for the functional approach, and, therefore, we privilege the use of the abovementioned definition by Kjerve [1], which accommodates coastal lagoons as landscape entities.

According to the EU Natura 2000 portal (https://ec.europa.eu/environment/nature/natura2000/index_en.htm, accessed on 22 May 2023), "*Stretching over 18% of the EU's land area and more than 8% of its marine territory, Natura 2000 is the largest coordinated network of protected areas in the world. It offers a haven to Europe's most valuable and threatened species and habitats. In practice, Natura 2000 is a network of core breeding and resting sites for rare and threatened species, and some rare natural habitat types which are protected in their own right. It stretches across all 27 EU countries, both on land and at sea. The aim of the network is to ensure the long-term survival of Europe's most valuable and threatened species and habitats, listed under both the Birds Directive and the Habitats Directive.*"

In the European Union, the Financial Instrument for the Environment, better known by its acronym LIFE, derived from its French name, *L'Instrument Financier pour l'Environnement*, has provided funds since 1992 for nature conservation and biodiversity, primarily focused on the Natura 2000 sites in the EU member states. The scheme has encompassed five successive funding periods. Hence, more than 5,400 projects were co-financed, representing 6.5 billion €. Since the second phase started in 1996, the LIFE programme has been split into different categories: LIFE-Nature (LIFE + Nature and Biodiversity from 2007) dedicated to nature and conservation actions, LIFE-Environment (LIFE + Environment Policy and Governance from 2007) dedicated to actions to implement EU environment policy and legislation, and LIFE + Information (LIFE + Information and Communication since 2007) that disseminate information and raise the profile of environmental issues. Specific sub-programmes have also been introduced, such as the sub-programme for climate actions, since 2014. LIFE-Third countries, which addressed actions in those countries that are not members of the EU, have been financed in the Mediterranean and Baltic regions.

This study focuses on different ecological restoration projects in coastal lagoon landscapes financed by the LIFE programme, and adopts the functional approach mentioned above. Ecological restoration has been defined by the Society for Ecological Restoration in its International Primer [4] as "*the process of assisting the recovery of an ecosystem that has been degraded, damaged, or destroyed.*" Furthermore, this document [4] states that "*Restoration attempts to return an ecosystem to its historic trajectory. Historic conditions are therefore the ideal starting point for restoration design.*" Hence, knowledge of how coastal lagoons have been modified, used, impacted, and degraded by humans in the last centuries is important for the design of their ecological restoration projects.

The aim of this study is to: (1) compile a list of LIFE projects that have been dedicated to coastal lagoons along the shores of the Mediterranean and Black Sea regions, (2) study when the concept of ecological restoration emerged among these LIFE projects dedicated to these coastal lagoons, and (3) provide a descriptive overview of the different actions undertaken as ecological restoration. The LIFE public database (https://webgate.ec.europa.eu/life/publicWebsite/search, accessed on 22 May 2023), which became operational in 2021, provides an inventory of all the LIFE projects realized so far. Nevertheless, for the three first funding periods, the database comprises only an Abstract and some basic data (funding amount, localization, etc.). Hence, more detailed analyses were only possible for the projects started after 2009, when projects were requested to publish and maintain a project website and provide a Layman's report for long-term storage. In this paper, we include a Section 2 describing the historic conditions, human uses, and anthropogenic modifications of the coastal lagoons, followed by a Section 3 where we describe the methods, starting with the use of the LIFE public database. We present and discuss the textual output from this database and combine it with additional information to provide for the eighteen selected projects a descriptive overview of the different actions undertaken (Section 4), and finally, we conclude (Section 5).

2. Historic Conditions, Human Uses, and Anthropogenic Modifications of Mediterranean and Black Sea Coastal Lagoons

Coastal lagoons are ephemeral ecosystems on a geological timescale that are rearranged and transformed in response to changing sea levels and sediment transport. Thus, in response to relative sea-level rise, natural barriers show a tendency to move inland [5,6]. On the inland side, the lagoons can expand by submerging the surrounding uplands. Hence, coastal lagoons dynamically change in response to sediment loading and relative sea level rise [5,6]; ecological restoration projects should, therefore, consider their targeted return to a historic trajectory in view of global change [7].

The geomorphology of most Mediterranean and Black Sea coastal lagoons has been strongly modified by humans since historic times. Salinas, which are artificial systems for salt extraction comprising a series of salt ponds, have been built directly within the lagoons or at the expense of their fringing wetlands [5,8,9]. Coastal lagoons are sheltered habitats and present ideal sites for navigation and port developments, provided that the water depth is sufficient. Important urban centers settled along the shores or on islands within the lagoons; the most emblematic case is the city of Venice (Italy). In the lagoon, close to Montpellier (France), a Romanesque cathedral was built during the 12th century on an island (Figure 1).

Sediment loading from river tributaries frequently results in the infilling of the lagoons [6] and decreasing water depth may obstruct navigation and access to harbors. Rivers were commonly diverted to place their outflow outside the lagoon. Diverting river inflow also allowed the maintenance of high salinities in the lagoons for salt extraction in Salinas. For example, from the 14th to the 17th centuries, the Brenta, Piave, and Sile rivers were diverted to protect the navigation channels and harbor of Venice [10]. As a result of longshore sediment transport, the natural inlets of the lagoons often move in space and can close off access. Therefore, humans have often interfered to maintain permanent connections, and as a result, most coastal lagoons in S. France currently have artificially fixed inlets [9]. In some inlets, the water exchange flow between the lagoon and the sea is even regulated. Figure 1 illustrates, as an example, many of these changes for the coastal lagoon complex close to Montpellier. In this case, a navigation canal was built in the 18th century, and the original single lagoon has been compartmentalized into nine different water bodies. Aquaculture has been increasingly developed in coastal lagoons during the last hundred and fifty years. Particularly the introduction of foreign species, e.g., the Japanese oyster, *Magallana gigas* (Thunberg, 1793), often referred to by its synonym *Crassostrea gigas*, in shellfish culture represented a vector for the introduction of exotic species, some of which are invasive [11].

Coastal lagoon landscapes have seen intensive infrastructure development to support tourism and an increase in coastal residents since the 1950s, with urban sprawling particularly after 1975 [12]. As a result, important habitats for dune and marsh plants have been destroyed, and many bird colonies have suffered from disturbance [13]. Since the 1960s, anthropogenic eutrophication has dramatically increased and resulted in previously established aquatic plant communities being replaced by floating algae or dense phytoplankton [9,14].

The aforementioned capacity of coastal lagoons to adapt to sea-level rise can be impaired by human-built structures. Hence, coastal lagoons can be subjected to surface reduction by a phenomenon known as 'coastal squeeze' [5,15]. In addition, there is a dynamic balance between sediment infilling and relative sea level rise that could favour the sustainability of coastal lagoons. Whereas infilling tends to convert coastal lagoons into land, the relative sea-level rise facilitates erosion processes, which may result in the conversion of the coastal lagoon into an open bay [6].

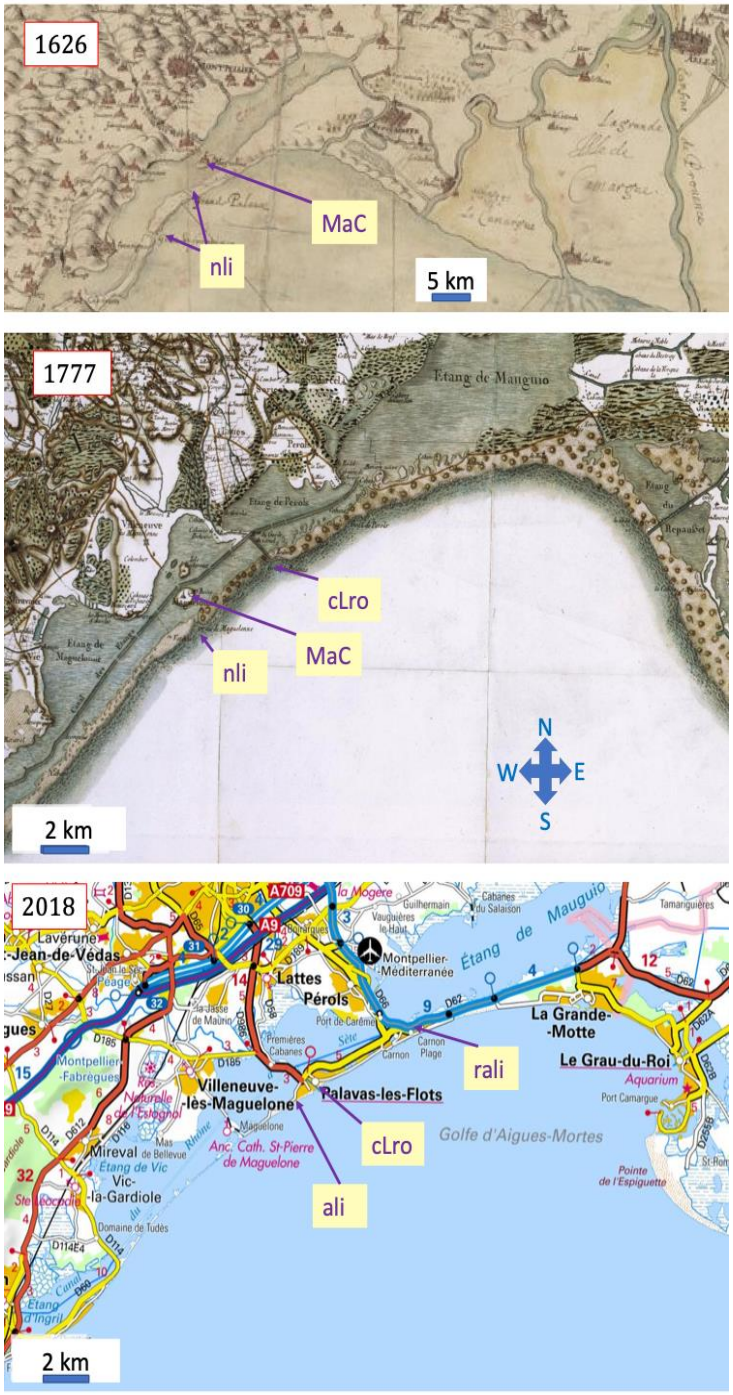

Figure 1. Human modifications in the lagoon close to Montpellier (S. France), as shown by different maps. The map of the year 1626 represents a part of the map of the 'Bas Languedoc' drawn by Jean Beins (source Gallica, Bibliothèque Nationale de France) and shows a single lagoon ranging from Sète to the Camargue. Note that four river tributaries occur along the northern shoreline. The map of the year 1777 by Cassini shows the partly achieved Rhône-to-Sète canal and the canalization of the Lez river. The topographic map of the year 2018 shows a highly fragmented lagoon complex, with its surroundings strongly urbanized (both maps source Géoportail, French National Geographic Institute, IGN). MaC = Maguelone Cathedral on the island in the lagoon, nli = natural lagoon inlet, ali = artificial lagoon inlet, rali = regulated artificial lagoon inlet, cLro = canalized Lez river with its outlet diverted to the Mediterranean Sea.

Coastal lagoon salinities are highly variable as they depend on the mix of seawater and freshwater inputs from their continental watersheds, modified by the balance between precipitation and evaporation. Pristine coastal lagoons are home to meadows of submerged aquatic angiosperms, with their species composition depending on the salinity [9,14]. Coastal lagoons are home to juvenile fish populations, which use them as nurseries [16] and are important for water birds. For the latter reason, many coastal lagoons have been identified as wetlands of international importance according to the Ramsar Convention, and in the EU, many have been designated as Special Protection Areas according to the Birds Directive [17]. Tidal flats develop in lagoons of the northern Adriatic Sea, e.g., Venice lagoon (Italy), where the tidal differences are about one meter. The coastal barriers consist most often of sand, but in some cases also of shingle or a combination of both [5,18]. From sea to lagoon, sandy coastal barriers consist of beaches, dune systems (sometimes well-developed with dune slacks), and marshes [5]. Marshes also occur as fringing wetlands along the interior shores of the lagoons. Rivers that have their outflow within the lagoons provide freshwater and sediment inputs and create deltas with interesting freshwater-saltwater ecotones. Reed beds (*Phragmites australis* (Cav.) Steud) occur at salinities below 15 g/L.

3. Methods

This study used the LIFE public database (https://webgate.ec.europa.eu/life/publicWebsite/search (accessed on 22 May 2023) to extract the LIFE projects dedicated to coastal lagoons in the Mediterranean and Black Sea regions using the search term "coastal lagoon". The last extraction was performed on 22 March 2023. This way, we retrieved ninety-four LIFE projects. Thirty-three of these projects were focused on sites in the Atlantic or Baltic Sea eco-regions without any study sites in the Mediterranean or Black Sea regions, which have, therefore, been discarded for analysis. Furthermore, five entries were eliminated as these corresponded to duplicates. Among the fifty-six remaining, five additional projects were discarded because three of those were not focused on coastal lagoons but rather on other aquatic systems (LIFE19 CCM/ES/001235, LIFE03 NAT/E/000055, LIFE20 NAT/ES/000035), while two projects represented chemical engineering projects that are of marginal interest to coastal lagoons (LIFE10 ENV/IT/000321, LIFE19 ENV/ES/000447). The remaining fifty-one LIFE projects dedicated to coastal lagoons in the Mediterranean and Black Sea regions are listed in Appendix A Table A1.

The fifty-one projects listed in Table A1 were screened in their Abstracts and titles, and projects with a strong focus on ecological restoration were selected. The projects had to include at least one worksite where ecological restoration was put into practice, and, hence, the projects that only considered governance and knowledge aspects and used a more theoretical point of view have been excluded from the analysis (e.g., LIFE13 NAT/IT/000115, LIFE16 IPE/FR/000001). This resulted in a selection of six projects that were attributed between 2000 and 2002 (in red in Table A1, i.e., not containing sufficient information) and sixteen selected projects that were attributed between 2007 and 2017. Fifteen of the latter contained sufficient information for our analysis (in green, normal police in Table A1). These fifteen selected projects have been enriched by including three additional projects that we considered highly relevant for coastal lagoons (LIFE09 NAT/SI/000376, LIFE16 NAT/IT/000589, LIFE17 NAT/ES/000184). Two of those projects focused on Salinas created within or along the shoreline of a coastal lagoon. The total set of eighteen selected projects was analyzed in more detail, specifying the execution period (starting dates are often one or two years after attribution), worksites, and ecological restoration practices, as well as links to websites and possibilities to download the Layman reports. A preliminary study was performed in 2020, and we discovered that five of the projects' websites still accessible on 14 May 2020 have been abandoned since. Two projects attributed to 2019 were still running and have, therefore, not been analyzed.

For a first screening to highlight differences and singularities among the common features of these 18 projects, we used a lexical analysis with IRaMuTeQ (open source

software) of the text provided in the LIFE public database. The text fields for each project description in this database comprise Background, Objectives, and Results. This analysis focused on the subject of ecological restoration and the measures that were undertaken at the field sites. There were significant differences in the English terminology used in the different countries, which created noise. To avoid the noise and given the limited power of this computerized lexical analysis for small sample sizes, we instead operated in a Bayesian spirit with an *a priori* assessment of categories. Hence, we considered that *ex-ante* knowledge of lagoon studies was more efficient than categories extracted by statistical lexical analysis from the available set of projects. Using another software (QSR® N'Vivo), we then performed a detailed textual analysis of the LIFE public database project descriptions by coding the entries according to the following categories: (1) Cleaning and rebuilding coastal lagoons, (2) Ecological restoration focused on birds and other opportunities in abandoned Salinas, (3) Interventions in Hydrodynamics for ecological restoration, (4) Vegetation on intertidal flats and submerged in the lagoons, (5) Ecological restoration of dune systems on the coastal barriers, and (6) Ecological restoration of water quality and quantity in coastal lagoons based on the aquatic continuum concept. For coding the latter category, we included all references to the objectives of the Water Framework Directive [19], even when the term "water quality" was not explicitly used. After this semi-quantitative overview, we enriched the descriptions with material made available through project websites and associated publications.

4. Results and Discussion

Fifty-four of the more than 5400 LIFE projects (i.e., about 1%) were focused on Mediterranean and Black Sea lagoons. Among these 54, two projects were financed by the LIFE Third Countries programme, in Tunisia and Turkey, respectively. These 54 projects compare favorably with the 33 LIFE projects in the Atlantic and Baltic Sea eco-regions. While at the start, the LIFE projects were more focused on classical conservation issues, governance, and communication, the first project focusing on ecological restoration in a coastal lagoon setting was attributed to 1995 (LIFE Trapani e Marsala), and its number strongly increased after 2007. In total, half of the 54 projects dealt with this subject, among which 18 were analyzed in more detail. A map showing the worksites of these 18 selected projects is shown in Figure 2.

The textual analysis is depicted in Figure 3. The top panel of Figure 3 showed that category 2, Ecological restoration focused on birds and other opportunities in abandoned Salinas was the most often cited, followed by category 3, Interventions in Hydrodynamics for ecological restoration. However, this information is of relative value as some projects comprised a large number, i.e., up to seven entries for category 2. It is more interesting to see how the categories were distributed among the different projects and how different categories emerge within each project, which is depicted in the bottom panel of Figure 3. Category 2 was addressed by ten of the eighteen projects. Category 1, cleaning and rebuilding coastal lagoons, which included actions to fight against invasive species, was particularly present in the early projects and cited in nine projects. Category 3 was even cited by twelve projects. The ecological restoration of dune systems on the coastal barriers (category 5) was cited in seven projects, in five cases even together with category 3. This shows that these projects were indeed adopting a functional landscape ecology approach, concerned both with the terrestrial coastal barrier and the aquatic systems. Four projects showed a focus on vegetation on the intertidal flats or submerged in the lagoon, and it was the main subject in two, i.e., LIFE-VIMINE and LIFE-SeResto. Surprisingly, only six projects mentioned a focus on the ecological restoration of water quantity and quality (category 6), three projects directly mentioned water quality, and three projects implicitly referred to the WFD. In conclusion, Figure 3 shows that the categorization proposed in the methods is instrumental in describing the variability among these eighteen projects.

Table 1. Eighteen selected LIFE projects performed in Mediterranean and Black Sea coastal lagoons, which included a worksite with actions of ecological restoration. All websites listed have been accessed on 3 April 2023.

	Acronym/Reference	Title	Years	Countries–Region–Place	Ecological Restoration Actions	Project Website/Layman Reports/Scientific Publications
1	**LIFE LAG'Nature** LIFE07 NAT/F/000193	Creating an experimental and demonstrative network of lagoon and dune Natura 2000 sites on the Mediterranean coastline of Languedoc-Roussillon.	2009–2013	France (Languedoc-Roussillon, different lagoons along the shore of the Gulf of Lyon)	Restoration of dune habitat, Hydrodynamics, combating invasive species	http://www.life\T1\textquoteright.org/ (in French), English brochure at: http://www.lifelagnature.org/sites/default/files/LIFELAG%27Nature-vGB-CarteOK.pdf
2	**LIFE MANSALT** LIFE09 NAT/SI/000376	Man and Nature in Secovlje salt-pans	2010–2015	Slovenija (Sečovlje Salina Nature Park, Adriatic coast)	Hydrodynamics, reconstruction of embankments, building of artificial islets for birds, creation of wetland	http://www.kpss.si/en/the-park/park-tasks/project-work/life-mansalt
3	**LIFE FOR THE BOURGAS LAKE** LIFE08 NAT/BG/000277	Ensuring Conservation of Priority Bird Species and Coastal Habitats at the Bourgas Natura	2010–2014	Bulgaria (Bourgas lake and Mandra-Poda complex—Black sea coast)	Creating resting and roosting platforms; Repairing the dyke system at "Atanassovsko" lake; Cleaning the illegal dump sites near the lakes.	website "burgaslakes.org", still available in 2020, has been abandoned and replaced by a Bulgarian site: https://bspb.org/wp-content/uploads/2020/12/%D0%9A%D1%80%D0%B0%D1%82%D1%8A%D0%BA-%D0%BE%D1%82%D1%87%D0%B5%D1%82-%D0%BD%D0%B0-%D0%BF%D1%80%D0%BE%D0%B5%D0%BA%D1%82-%D0%96%D0%B8%D0%B2%D0%BE%D1%82-%D0%B7%D0%B0-%D0%B1%D1%83%D1%80%D0%B3%D0%B0%D1%81%D0%BA%D0%B8%D1%82%D0%B5-%D0%B5%D0%B7%D0%B5%D1%80%D0%B0.pdf
4	**LIFE ACCOLAGOONS** LIFE09 NAT/GR/000343	Actions for the conservation of coastal habitats and significant avifauna species in NATURA 2000 network sites of Epanomi and Aggelochori Laggons, Greece	2010–2015	Greece (Central Macedonia, Epanomi and Aggelochori lagoons)	Hydrodynamics, clearing the canals surrounding the lagoon of litter and debris, and creating/ building: two artificial ponds, a mudflat area, two artificial islets	website "accolagoons.gr", still available in 2020, has been abandoned Some information on: https://i-bec.org/activities/projects/co-financed-projects/accolagoons/
5	**LIFE Delta-LAGOON** LIFE09 NAT/ES/000520	Habitat restoration and management in two coastal lagoons of the Ebro Delta: Alfacada and Tancada	2010–2017	Spain (Catalonia, Ebro delta, Alfacada y Tancada lagoons)	Hydrodynamics, restoration of 62 ha rice fields back into lagoon and salt marsh habitats, restoration of abandoned salt pans into lagoonal environments.	Project website no longer available, Layman report can be downloaded at: https://ec.europa.eu/environment/life/project/Projects/index.cfm?fuseaction=home.showFile&rep=file&fil=LIFE09NATES000520LAYMAN.pdf
6	**ZONE UMIDE SIPONTINE** LIFE09 NAT/IT/000150	Conservation actions of habitats in the coastal wetlands of SCI Wetlands of Capitanata	2010–2019	Italy—Puglia	Restoration (depolderisation) of 40 ha of coastal lagoons, recovery of 110 ha of Mediterranean salt steppes (Limonietalia); Restoreation of 1500 metres of coastal dunes with *Juniperus* spp.	http://www.lifezoneumide.it/english/Layman report (in Italian): http://www.lifezoneumide.it/public/downloads/070220205551744.pdf
7	**Re.S.C.We** LIFE09 NAT/IT/000608	Restoration of Sentina coastal wetlands.	2010–2013	Italy—"Sentina" Regional Natural Reserve, Regione Marche	Hydrodynamics (restoring water flow to wetlands and creating small new coastal lagoon. Reintroduction of native plant species—(*Artemisia caerulescens*, sea lavender (*Limonium narbonense*), *Plantago cornuti* and Ravennagrass (*Erianthus ravennae*)—and the European pond turtle (*Emys orbicularis*).	Project website not available - Layman report: https://webgate.ec.europa.eu/life/publicWebsite/project/details/3233#:~:text=Final%20technical%20report-,Publication,-Layman%20report

Table 1. *Cont.*

	Acronym/Reference	Title	Years	Countries–Region–Place	Ecological Restoration Actions	Project Website/Layman Reports/Scientific Publications
8	**LIFE ST.eR.N.A.** LIFE10 NAT/IT/000244	Casaraccio lagoons, natural resources and environments	2011–2015	Italy (Sardinia, Stintino "Saline Ezzi Mannu" and the Casaraccio lagoon)	Creation of artificial floating islets for bird colonies (common and little tern)	https://www.sternalifestintino.eu/en/chi-siamo/ (*)
9	**MC-SALT** LIFE10 NAT/IT/000256	Environmental Management and Restoration of Mediterranean Salt Works and Coastal Lagoons	2011–2016	Italy (Emilia-Romagna, Po delta) with associated partners in France and Bulgaria)	Hydrodynamics: management of hydroperiod in ponds with islets for protection of bird colonies, feasibility study of restoration of natural Hydrodynamics by a modelling approach, control of invasive alien species	Main Project web site "mc-salt" abandoned in 2023, French partner hosts a web site in French with some information: http://www.parc-camargue.fr/index.php?pagendx=1080 (*)
10	**Salt of Life** LIFE11 NAT/BG/000362	Urgent Measures to Restore and Secure Long-term Preservation of the Atanasovsko Lake Coastal Lagoon	2012–2018	Bulgaria (Atanasovsko Lake Natura 2000 site, Black Sea)	Dyke and barrier restored for protection against flooding (to secured against floods and nutrients loaded water inflow from the rivers Azmak, Kurbardere and Dermerdere) and providing nesting opportunities.	http://saltoflife.biodiversity.bg/en/ (*)
11	**LIFE VIMINE** LIFE12 NAT/IT/001122	An integrated approach to the sustainable conservation of intertidal salt marshes in the lagoon of Venice	2013–2017	Italy (Veneto, Venice lagoon)	Construction of many micro soil-bioengineering works to protect salt marsh edges, using biodegradable materials with low environmental and landscape impact (mainly wood).	https://www.lifevimine.eu/en/index.php (english version) (*) [20,21].
12	**LIFE Pletera** LIFE13 NAT/ES/001001	Deurbanisation and restoration of Platera's marsh	2014–2018	Spain (Catalonia, Coasta Brava, Torroella de Montgrí)	Destruction of abandoned urban infrastructure. Re-building of the coastal lagoon system and the restoration of its ecological functionality. Restauration of dune systems.	http://lifepletera.com/en/ (*) [22].
13	**Life + ENVOLL** LIFE12 NAT/FR/000538	Network for the protection of Mediterranean coastline birds	2014–2018	France (Province-PACA, Camargue and other sites in Corsica and Occitanie)	Construction of nesting islets, hydraulic management to protect islets	Project website: https://www.marais-vigueirat.reserves-naturelles.org/ (*)
14	**LIFE-SeResto** LIFE12 NAT/IT/000331	Habitat 1150* (Coastal lagoon) recovery by SEagrass RESTOration. A new strategic approach to meet HD & WFD objectives	2014–2018	Italy (Veneto, Venice lagoon)	Transplantation of submerged aquatic angiosperms (*Zostera* spp, *Ruppia* spp. and *Cymodocea nodosa*)	http://www.lifeseresto.eu/ (*) [23–25].
15	**LIFE LAGOON REFRESH** LIFE16 NAT/IT/000663	Coastal lagoon habitat (1150*) and species recovery by restoring the salt gradient increasing fresh water input	2017–2022	Italy (Veneto, Venice lagoon)	Restoration of freshwater-saltwater gradients through diversion of a freshwater flow from the Sile river into the lagoon; planting of reed beds and submerged aquatic vegetation.	http://www.lifelagoonrefresh.eu/ (*) [26–28].
16	**LIFE REDUNE** LIFE16 NAT/IT/000589	Restoration of dune habitats in Natura 2000 sites of the Veneto coast	2017–2022	Italy (Veneto, barriers of the Caorle and Mort lagoons and other sites along the Adriatic coast of Veneto)	Restoration of dune systems (both fixed and moving dunes) by planting native species; reconnecting fragmented dune sections, special efforts to protect *Stipa veneta*, an endangered plant endemic of the dunes of northeast Italy	http://www.liferedune.it/?lang=en (*)

Table 1. *Cont.*

	Acronym/Reference	Title	Years	Countries–Region–Place	Ecological Restoration Actions	Project Website/Layman Reports/Scientific Publications
17	**Life Salinas** LIFE17 NAT/ES/000184	Conservation of habitats and acuatic birds in "Salinas y Arenales de San Pedro del Pinatar"	2018–2022	Spain (Murcia, Salina de San Pedro)	Hydrodynamics; revegetation with native species in the beach dunes; combating dune erosion, control of invasive alien species	https://lifesalinas.es/en/the-project/ (#)
18	**The Lagoon of LIFE** LIFE17 NAT/BG/000558	Maintain the Man-Lake Symbiosis for the Benefit of Species and Habitats of EU conservation concern	2018–2024	Bulgaria (Atanasovsko Lake Natura 2000 site, Black Sea)	De-polderisation and restoration of lagoon water bodies, water quality improvement using aquatic vegetation, restoration of mosaic of micro-habitats ponds and reed beds, and improved hydraulogy for great bittern (*Botaurus stellaris*)	https://lagoon.biodiversity.bg/en/ (#)

(*) Layman's report can be downloaded from the project website (3 April 2023); (#) Layman's report not yet available.

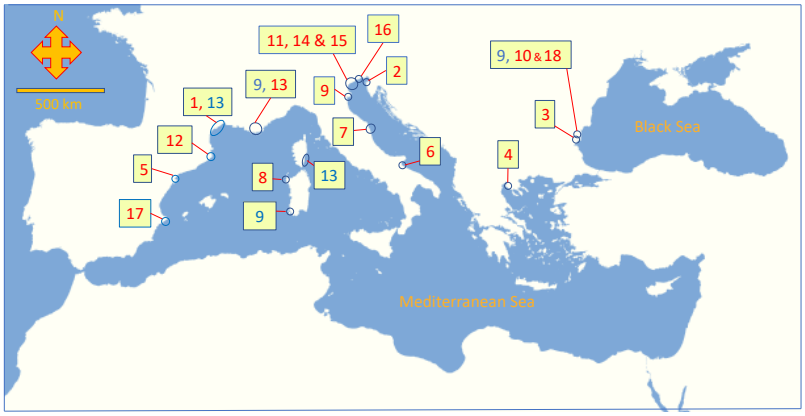

Figure 2. Distribution of worksites with actions of ecological restoration in Mediterranean and Black Sea lagoons for the eighteen selected LIFE projects (same numbering as in Figure 3 and Table 1): 1 = LAG'Nature, 2 = MANSALT, 3 = BOURGAS LAKE, 4 = ACCOLAGOONS, 5 = Delta-LAGOON, 6 = ZONE UMIDE SPONTINE, 7 = Re.S.C.We, 8 = ST.eR.N.A., 9 = MCSALT, 10 = Salt of Life, 11 = VIMINE, 12 = Pletera, 13 = ENVOLL, 14 = SeResto, 15 = LAGOON REFRESH, 16 = REDUNE, 17 = Salinas, 18 = Lagoon of Life. Number in red = main worksite of the project in the area of the project coordinator, Number in blue = secondary worksite for that project. Background from OpenStreetMap.breton (https://www.openstreetmap.fr/fonds-de-carte/ accessed 7 February 2023).

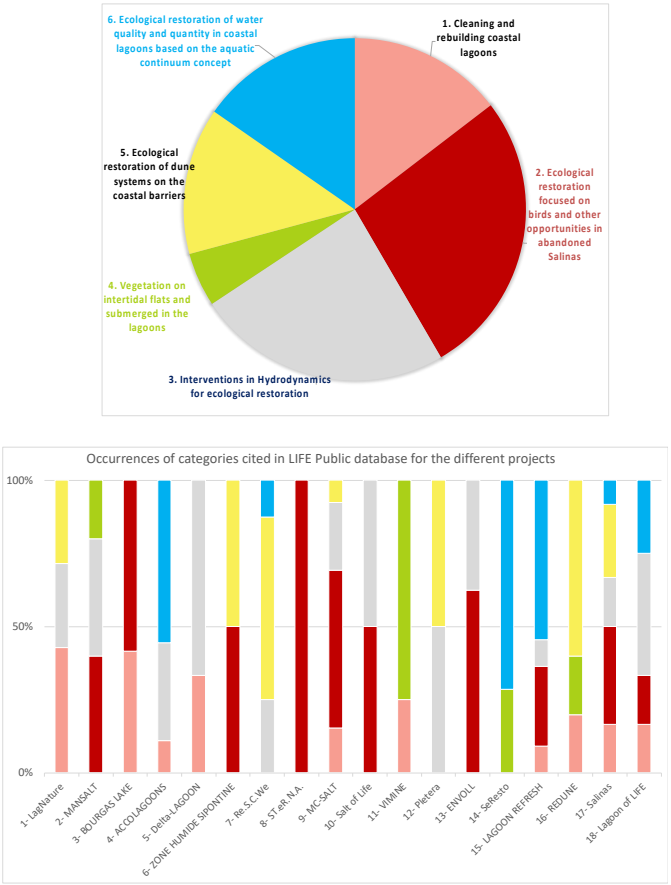

Figure 3. Results of the textual analysis N'VIVO based on six a priori defined categories; the categories are listed in top panel with their corresponding colour coding. (see Methods for detail). Top panel provides a pie chart based on the number of occurrences for the eighteen projects together. The bottom panel gives the proportion of occurrences of the different categories in the eighteen different projects (same colour coding for categories as in the top panel).

Table 1 lists the acronyms, official references, full project titles, years of execution, the ecological restoration actions and accessible documentation. Hence, using the additional information (i.e., websites, Layman reports, scientific publications) added the additional detail for the different projects, which allowed us to provide a more complete list of actions for the different projects. In the following sub-sections, we provide a descriptive review of the different projects based on the categorization used for the textual analysis (cf. Figure 3).

4.1. Cleaning and Rebuilding Coastal Lagoons

Several projects have included actions to remove illegal dumping and actions to prevent such dumping in the future (e.g., LIFE FOR THE BOURGAS LAKE, LIFE ACCO-LAGOONS), and several LIFE projects have included actions to fight alien invasive species.

In Spain, two projects involved the creation of coastal lagoons in places where the coastal lagoon landscape had been completely modified. In the Ebro delta, rice fields had been created at the expense of the marshes and a part of the Alfacada lagoon, which was reduced in surface by 80%. The LIFE Delta-LAGOON project included the restoration of 62 ha of rice fields back into the lagoon and salt marsh habitat. In addition, abandoned salt pans were restored into lagoonal environments by reconnecting them to the adjacent Tancada lagoon. On the Costa Brava, the LIFE PLETARA project realized the de-urbanisation of a coastal site where marshes and six small, interconnected lagoons were created [22]. Small new lagoons were also created in the Puglia and Marche regions of Italy in the frame of the ZONE UMIDE SIPONTINE and Re.S.C.We LIFE projects (40 ha), respectively.

4.2. Ecological Restoration Focused on Birds and Other Opportunities in Abandoned Salinas

The creation of islets for birds within lagoons and particularly in salt ponds is mentioned in six of the eighteen projects. These islets are artificial structures and novel creations, and this approach does not correspond to the ecological restoration of degraded or destroyed historic habitats but rather focuses on the biological conservation of threatened bird species. Hence, these artificial structures are very effective for providing quiet resting, roosting, and nesting places for many bird species, protected from predation by terrestrial mammals. Colonial Charadriiformes include nine protected bird species that nest in colonies often together with other species (c.f., LIFE ST.eR.N.A, LIFE + ENVOLL), comprising four terns, i.e., Common Tern, *Sterna hirundo* Linnaeus, 1758; Little Tern, *Sternula albifrons* Pallas, 1764; Sandwich Tern, *Sterna sandvicensis* Latham, 1787; Gull-billed Tern, *Gelochelidon nilotica* (Gmelin, 1789); four gulls, i.e., Audouin's Gull, *Larus audouinii* Payraudeau, 1826; Black-headed Gull, *Larus ridibundus* Linnaeus, 1766; Mediterranean Gull, *Ichthyaetus melanocephalus* (Temmick, 1820); Slender-billed Gull, *Chroicocephalus genei* (Breme, 1839); and the Pied Avocet, *Recurvirostra avosetta* Linnaeus, 1758. In addition, a typical non-colonial lagoon bird, the Black-winged Stilt, *Himantopus himantopus* (Linnaeus, 1758), also benefits from such measures. The creation of the artificial islets thus contributes to mitigating the loss of nesting places along the Mediterranean coast for these birds. In lagoons on the Black Sea coast, the Dalmatian Pelican, *Pelecanus crispus* Bruch, 1832, and the Pygmy Cormorant, *Phalacrocorax pygmaeus* (Pallas, 1773), benefit from resting and roosting on floating platforms in the lagoons built by the LIFE FOR THE BOURGAS LAKE project. An emblematic case of a bird colony on an island in a salt pond (Fangasier pond) is the Greater Flamingo, *Phoenicopter ruber* Linnaeus, 1758 colony in the Camargue. After the abandonment of this area for salt extraction, the critical issue now is to maintain a sufficiently long hydroperiod with sufficient water depths during the breeding season to isolate the area of the colony from predators (MC SALT, LIFE + ENVOLL).

Ten LIFE projects deal with Salinas, and for four of them, it is even their main focus (LIFE MANSALT, SALT FOR LIFE, MC-SALT, LIFE SALINAS). Salinas were widespread in the Mediterranean, as described for Spain, Greece, and France [8,29,30]. However, the last seventy years have seen drastic changes in this economic branch: while most of the small artisanal Salinas have been abandoned, some of the larger ones have expanded, evolving into highly mechanized industrial enterprises [8,30].

Other than their specific biodiversity values, small Salinas also represent an important cultural heritage. This raises the following questions: (i) can the exploitation of some of the smaller Salinas with particular cultural heritage values be combined with biodiversity conservation and economic sustainability (LIFE MANSALT, LIFE SALINAS)? (ii) can salt exploitation in larger Salinas be combined with species protection? (iii) what to do with abandoned Salinas (MC SALT)? In Mediterranean France, there is a growing interest in promoting spontaneous developments in Salinas, where salt extraction has been abandoned [8] and many of the ponds have developed into so-called temporary Mediterranean lagoons showing alternations between hydroperiods during the wet seasons and dry conditions in summer [31]. This is particularly the case for the smaller-sized Salinas. However, in the Camargue (France), 5000 ha of salt extraction have been abandoned in the very large exploitation of Salin-de-Giraud since 2008, and this has provided great opportunities for ecological restoration of the salt ponds back into salt marshes and temporary lagoon environments. In addition, this area will be used to experiment with nature-based solutions for coastal re-alignment and the restoration of natural hydrodynamics.

4.3. Interventions in Hydrodynamics for Ecological Restoration

Twelve of the eighteen projects mentioned interventions in hydrodynamics (see Table 1 for measures that have been identified as such). These included, among others: (i) dredging of channels to improve water circulation in the highly compartmentalized lagoon complex close to Montpellier (Figure 1) and increase freshwater inputs from the small rivers (LIFE LAG'Nature), (ii) improving lagoon sea exchanges by dredging the inlet (LIFE Salinas), and (iii) improving circulation of water through peripheral wetlands (LIFE FOR THE BOURGAS LAKE). One can question whether such actions correspond to real ecological restoration or rather to mitigation measures in a highly human-modified ecosystem.

A more ambitious program, a real ecological restoration project, has been pursued by the LIFE LAGOON REFRESH project, which aims at restoring the freshwater-saltwater gradients through the diversion of freshwater flow from the Sile river into the Venice lagoon [26–28]. This was aimed at restoring the conditions existing before the 17th century, when the Sile river was a tributary in the northern part of the lagoon [10]. Therefore, a hydraulic structure was built between August 2019 and February 2020 linking the Sile to a project site of 1900 ha in the northern part of the lagoon with the aim of restoring the freshwater—saltwater gradients and their associated habitats. The freshwater flow increased progressively from 300 L s^{-1} in May 2020 to 1000 L s^{-1} in February 2021. This project was scientifically assessed in two publications. The impact of the measure on variations of salinity in space and their fluctuations in time was studied using a before/after comparison and monitoring combined with hydrodynamic modelling [27]. The observed fluctuations corresponded quite well with the simulation results and corresponded to desired results in the field. In stations close to the freshwater input, oligohaline water stratified on top of a salt wedge. The second paper provided more information on the engineering aspects, including the hydraulic works and activities stimulating the formation of the reed beds. It further focused on describing the participatory approach [28].

A similar hydrodynamic modeling was also performed for a feasibility study of the restoration of natural hydrodynamics in the Camargue (see above) during the MC-SALT project, but during the project it did not result in concrete measures.

4.4. Vegetation on Intertidal Flats and Submerged in the Lagoons

In Venice lagoon, the LIFE VIMINE project focused on the protection of the intertidal salt marshes and the LIFE-SeResto project on the plantation of submerged aquatic angiosperms. To ensure their persistence over time, sediment deposition on intertidal saltmarshes has to pace up with relative sea-level rise, which is not the case for most intertidal flats in the Venice lagoon. The LIFE VIMINE project focused on protecting the salt marsh edges (i.e., once the edge erodes, the rest becomes unstable) by using biodegradable materials with low environmental impact [20,21]. The ZONE UMIDE SIPONTINE and

Re.S.C.We LIFE projects also contributed to restoring the vegetation of salt marsh and salt steppe habitats.

The LIFE-SeResto project planted in the lagoon two seagrasses, i.e., Dwarf Eelgrass, *Zostera noltei* Hornem., and Common Eelgrass, *Zostera marina* L. [23,24]. In addition, Widgeonweeds, *Ruppia* L. spp., and Slender Seagrass, *Cymodocea nodosa* (Ucria) Asch., were also planted locally. The aquatic angiosperms are indicator species for good water quality, and once present, they also have positive feedback on water quality by promoting sedimentation of fine particles and nutrient uptake from the water column. However, poor water quality jeopardizes colonization, and a certain mass effect is necessary to trigger positive feedback [32]. In Venice lagoon, about 700 rhizomes were planted per station, and the overall success rate was 37% [23,24]. The failures corresponded to sites where water quality was lowest (i.e., highest nutrients and suspended matter concentrations close to tributaries). Another study [25] based on monitoring macrozoobenthos communities compared these communities in 2014 (*ante operam*) and the following years until 2017, which corresponded to the first years of the *post operam* period. An increase in the total macrozoobenthos abundance was observed, particularly an increase in the total number of species, from 46 in 2014 to 64 in 2017 in the planted vegetated areas. The communities comprised, in order of abundance, respectively, crustaceans, polychaetes, gastropods, and bivalves. Among the latter, *Abra segmentum* (Récluz, 1843) and *Cerastodermum glaucum* (Brugière, 1789) were predominant. The virtual absence or very low abundance of *Loripes orbiculatus* Poli, 1795 (species is mentioned in supplementary online material) is remarkable, as this species, with its symbiontic sulfur bacteria, establishes a mutualistic network with the seagrasses, particularly with *Z. noltei* [33]. Hence, this indicates that it takes a longer time to fully restore the mutualistic networks after transferring and planting seagrasses. The experience obtained with LIFE-SeResto is currently used in the ongoing LIFE-TRANSFER project, which has sites in Spain, Italy, and Greece.

4.5. Ecological Restoration of Dune Systems on the Coastal Barriers

LIFE REDUNE is a recently finished project focusing on the restoration of dunes on coastal barriers, i.e., of the Caorle and Mort lagoons (Veneto region, Adriatic Sea), with special efforts to protect *Stipa veneta* Moraldo, an endangered endemic plant species of the dunes of northeast Italy. Therefore, 1000 individuals in *S. veneta* raised from seed in a nursery have been planted. This should result in doubling the current world population of this endangered species. In addition, 150,000 individuals of other native plant species are being used to restore 91 ha of dunes damaged by trampling. This includes both mobile and fixed dunes. In addition, the alien invasive plant species Evening Primrose (*Oenothera stucchii* Soldano) has been eradicated. One specific action in Caorle for the restoration of mobile dunes has been described in the master's thesis of E. De Pellegrini (Università Cà Foscari, Venice) as a five-step process, i.e., (i) physical reconstruction of the dune profile, (ii) stabilization, (iii) planting of vegetation nuclei using native species typical of the restored habitats (iv) creating new beach accesses with limitations and information boards, and (v) monitoring. Interestingly, the vegetation nuclei of the four species facilitated the installation of eight other native dune species.

The LIFE projects LAG'Nature and Pletera also dedicated a part of their efforts to restoring dune systems after the destruction and clearing of bitumen parking and urban infrastructure, respectively. LIFE LAG'Nature also included the eradication of the invasive ground-dwelling Hottentot-fig (*Carbobrotus* L. spp.) from the dunes on the coastal barrier of the Salses-Leucate lagoon (S. France). Dune restoration is also part of the ongoing LIFE Salinas project.

4.6. Ecological Restoration of Water Quality and Quantity in Coastal Lagoons Based on the Aquatic Continuum Concept

Good water quality is of paramount importance for the conservation of coastal lagoons as it conditions benthic vegetation and planktonic communities [9,14]. Nevertheless, water

quality has only been marginally addressed by the LIFE projects. Nutrient over-enrichment and chemical contamination of the lagoons often originate in the watersheds of the lagoons, most of which are located outside the Natura 2000 lagoon sites. The nutrients and contaminants from point sources (i.e., collected wastewater from urban centers and industry) and diffuse non-point sources (i.e., agriculture and suburban sprawl without wastewater collection) are transported by surface and groundwater flows to the coastal lagoons. This shows the importance of considering the aquatic continuum from the land to the sea. Hence, water management is addressed by the Water Framework Directive [19] and relies on the member states for the governance of hydrographic basins. For example, in S. France, most of the coastal lagoons have been exposed to eutrophication. Since the beginning of the 21st century, public policy in the hydrographic basins has addressed this issue by improving sanitation. In many coastal lagoons, the reduction of nutrient loading has induced an oligotrophication trajectory [9]. While some of these coastal lagoons have recovered quite well, this is not the case for all of them. Several of the coastal lagoons that were hypertrophic before this reduction have not yet achieved a spontaneous recovery of the meadows of submerged aquatic angiosperms, albeit those improvements in water transparency and reduced phytoplankton were achieved in two to three years [9]. The angiosperm planting applied in Venice lagoon (LIFE-SeResto) and currently pursued in other coastal lagoons in Spain, Greece, and Italy in the frame of the LIFE-TRANSFER project are under study for their expected long-term positive impact on water quality. Nevertheless, the LIFE projects have generally been completely restricted to the Natura 2000 sites and have not sufficiently been linked to water management in hydrographic basins. This is despite the highly integrative ambition of the EU Water Framework Directive [9]; in practice, in most EU member states, water management and nature conservation are rather pursued in a sectorial way.

5. Conclusions

In conclusion, the eighteen LIFE projects have promoted, facilitated, and financially sustained a remarkable number of ecological restoration projects in coastal lagoons of Mediterranean and Black Sea member states. Italy has been most successful in obtaining this funding (i.e., eight of eighteen projects) and has addressed a large variety of issues. It should be noted that Italy's performance in this regard and its overall influence in the European LIFE Nature network have already been identified [34]. The LIFE projects are meant to be demonstration sites that should transpose and disseminate the experiences obtained with ecological restoration to other sites [34]. Therefore, networking with other professional coastal lagoon managers and communication are essential. Most of the project websites (Table 1) are of high quality and most often multilingual, and dissemination has been maintained beyond project completion. A textual analysis of the text fields for each project description, comprising Background, Objectives, and Results sections, on the LIFE public database gives a rather good impression of the diversity of ecological restoration projects that have been realized in Mediterranean and Black Sea coastal lagoons (cf. Figure 3). Nevertheless, we found that this information should be enriched by the more practical, technical, and scientific detail that we could find on the websites, Layman's reports, and scientific publications. Unfortunately, among the eighteen projects, five project websites were, regrettably, no longer available in 2023, while four of those were abandoned only after 2020. Twelve Layman reports, although one is only in Italian, are currently available, and two have been announced as future publications (cf. Table 1). So far, the impact of the demonstration sites on the other sites has been very difficult to assess. Most of the LIFE projects focused on Salinas have participated in a network of Salinas projects, and the experiences with the LIFE-SeResto project are now being used in the ongoing LIFE-TRANSFER project. Nevertheless, and despite the fact that many LIFE projects associate with academic partners, large scientific comparative assessments [35] remain scarce. There is clearly a need for scientific-based assessments and comparative studies to increase academic knowledge on this subject. This descriptive overview is a first step towards a

more comprehensive scientific assessment of what can be learned from comparing the LIFE ecological restoration projects and what generalities emerge.

The LIFE programme has been less successful in addressing the issue of water quality in coastal lagoons. Only three projects mentioned "water quality" explicitly, while three other projects claimed contributions to the WFD. Nevertheless, water quality is of paramount importance for the conservation of aquatic species and others that depend on water for their food, e.g., birds. Coastal lagoons are transitional waters, and the restoration ecology of the aquatic part, e.g., improvement of water quality and restoring freshwater–lagoon–seawater gradients, thus has to take into account the concept of the aquatic continuum. Hence, combating eutrophication and chemical contamination requires managing the watersheds of the lagoons to drastically decrease the nutrient and contaminant loadings into the coastal lagoons. This requires a better link between the objectives of the WFD and Habitats Directive, collaboration across territories, and a non-sectorial way of addressing these important issues. Finally, the issue of global change and, particularly, relative sea level rise should be addressed more systematically in future LIFE projects.

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Conflicts of Interest: The authors declare no conflict of interest.

Appendix A

Table A1. Curated Table constructed from a web search using "coastal lagoon" on the LIFE public database (https://webgate.ec.europa.eu/life/publicWebsite/search accessed on 22 May 2023) with the last extraction on 22 March 2023. Curation criteria (Mediterranean or Black Sea, ecological restoration worksites): see Methods. Seven projects in red referred to ecological restoration in title and abstract but provided too little information for a detailed analysis (projects mainly from the late 1990s to early 2000s). Fifteen projects in green (normal police) have been analyzed in detail (see Table 1 and Figure 2). Finally, two projects, including ecological restoration, have been attributed in 2019 (indicated in green italics) and are still running, which have therefore not been analyzed in detail. BG = Bulgaria, EL = Greece, ES = Spain, FR = France, IT = Italy, TR = Turkey, TN = Tunisia (Country codes according to https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Glossary:Country_codes (accessed on 22 May 2023).

	Project Title	Reference	Acronym	Year	Lead Partner Country
1	Conservation and management of wetlands and steppic areas in Murcia	LIFE93 NAT/E/011200		1993	ES
2	Conservation programme for the geographical area of the Delta Po park (first phase)	LIFE93 NAT/IT/010500		1993	IT
3	Conservation of natural habitats and plant species in Corsica	LIFE94 NAT/F/000845		1994	FR
4	Programme to safeguard the coastal lakes of Languedoc-Roussillon	LIFE94 NAT/F/000860		1994	FR

Table A1. *Cont.*

	Project Title	Reference	Acronym	Year	Lead Partner Country
5	Conservation programme for the Po Delta park geographical area (second phase)	LIFE94 NAT/IT/000538		1994	IT
6	METAP Protection of Coastal Lagoons and Wetlands in the Hammamet Gulf (Tunisia)	LIFE95 TCY/INT/1204		1995	TN
7	Restoration project for environment and habitat in the coastal zone of Trapani and Marsala—Natural Reserve of Stagnone and Saline di Trapani—Paceco	LIFE95 NAT/IT/000804	Trapani e Marsala	1995	IT
8	Water data Acquisition in real Time for coastal Ecosystems	LIFE96 ENV/IT/000103		1996	IT
9	Improvement of habitat management in the SPA of the Ebro Delta (Catalonia, Spain)	LIFE96 NAT/E/003133	Delta del Ebro	1996	ES
10	Restoration and integrated management of the island of Buda	LIFE96 NAT/E/003180	Isla de Buda	1996	ES
11	Restoration and protection of the coastal laguna of Valdoviño	LIFE98 NAT/E/005362	Valdoviño	1998	ES
12	GILIA (a hagiotoponym originating in the early Middle Ages and used to identify the Cagliari Wetlands in their entirety).	LIFE96 NAT/IT/003106	GILIA	1996	IT
13	Maremma Park: management of wetlands and sand dunes	LIFE98 NAT/IT/005117	Parco della Maremma	1998	IT
14	Nuisance mosquito control in natural mediterranean areas: methodological proposal for the sustained management of a Ramsar site in Languedoc-Roussillon	LIFE99 ENV/F/000489	E.I.D.	1999	FR
15	Arrangement and management of the Baix Ter Coastal lagoons and marshes	LIFE99 NAT/E/006386	Baix Ter	1999	ES
16	Reclamation and environmental remediation of the Capo Feto biotope	LIFE99 NAT/IT/006270	Capo Feto	1999	IT
17	Concerted eco-development operating around the ponds and lagoons of La Narbonnaise area	LIFE00 ENV/F/000600	EDEN	2000	FR
18	Model of restoration of dunes habitats in 'L'Albufera de Valencia'	LIFE00 NAT/E/007339	Dunas Albufera	2000	ES
19	Restoration and conservation management of Drana lagoon in Evros Delta	LIFE00 NAT/GR/007198	Drana lagoon	2000	EL
20	Restoring and conserving habitats and birds in Skocjanski Zatok N.R.	LIFE00 NAT/SLO/007226	DOPPS	2000	SI
21	Urgent actions for conservation of pSCI Orbetello Lagoon	LIFE00 NAT/IT/007208	Orbetello	2000	IT
22	Habitat Management and Raptor Conservation in Nestos Delta and Gorge	LIFE02 NAT/GR/008489	Nestos	2002	EL
23	Conservation management in Strofylia-Kotychi	LIFE02 NAT/GR/008491	Strofylia-Kotychi	2002	EL
24	Environmental rehabilitation of the Natural Reserve of Tarquinia Salt-works	LIFE02 NAT/IT/008523	Tarquinia	2002	IT
25	Conservation and improvement of habitats inthe SPA of Vendicari	LIFE02 NAT/IT/008533	Vendicari	2002	IT
26	Preserving the Marine Environment of Oludeniz Lagoon	LIFE02 TCY/TR/061	LAGOON	2002	TR
27	Recovery of the littoral sand dunes with *Juniper* spp. in Valencia	LIFE04 NAT/ES/000044	Enebro Valencia	2004	ES
28	Recovery of the habitat of amphibians and *Emys orbicularis* in the Baix Ter	LIFE04 NAT/ES/000059	EmysTer	2004	ES
29	Conservation actions in NATURA 2000 sites managed by the State Forest Service	LIFE04 NAT/IT/000190	Corpo Forestale	2004	IT
30	Urgent conservation measures for biodiversity of Central Mediterranean Sea	LIFE06 NAT/IT/000050	Co.Me.Bi.S.	2006	IT
31	Creating an experimental and demonstrative network of lagoon and dune Natura 2000 sites on the Mediterranean coastline of Languedoc-Roussillon.	LIFE07 NAT/F/000193	LAG'Nature	2007	FR
32	Ensuring Conservation of Priority Bird Species and Coastal Habitats at the Bourgas Natura 2000 Wetland Sites	LIFE08 NAT/BG/000277	LIFE FOR THE BOURGAS LAKE	2008	BG
33	Oristanese land of waters: a network for the shared management of the SCIs/SPAs of the central-western coastal areas of Sardinia.	LIFE08 NAT/IT/000339	ORISTANESE	2008	IT
34	Habitat restoration and management in two coastal lagoons of the Ebro Delta: Alfacada y Tancada	LIFE09 NAT/ES/000520	Delta-LAGOON	2009	ES
35	Actions for the conservation of coastal habitats and significant avifauna species in NATURA 2000 network sites of Epanomi and Aggelochori Laggons, Greece	LIFE09 NAT/GR/000343	ACCOLAGOONS	2009	EL
36	Conservation of habitats and species in the Natura 2000 sites in the Po Delta	LIFE09 NAT/IT/000110	Natura 2000 in the Po Delta	2009	IT

Table A1. *Cont.*

	Project Title	Reference	Acronym	Year	Lead Partner Country
37	Conservation actions of habitats in the coastal wetlands of SCI Wetlands of Capitanata	LIFE09 NAT/IT/000150	ZONE UMIDE SIPONTINE	2009	IT
38	Restoration of Sentina coastal wetlands	LIFE09 NAT/IT/000608	Re.S.C.We.	2009	IT
39	LIFE+ Ponds: Environment and nature restoration in Casaraccio	LIFE10 NAT/IT/000244	ST.e.R.N.A.	2010	IT
40	Environmental Management and Restoration of Mediterranean Salt Works and Coastal Lagoons	LIFE10 NAT/IT/000256	MC-SALT	2010	IT
41	Urgent Measures to Restore and Secure Long-term Preservation of the Atanasovsko Lake Coastal Lagoon	LIFE11 NAT/BG/000362	Salt of Life	2011	BG
42	Habitat restoration actions in the SCI "Ofanto Valley—Lake Capacciotti"	LIFE11 NAT/IT/000175	LIFE AUFIDUS	2011	IT
43	Networking nesting habitats along the French Mediterranean coastline for the Conservation of Colonial Charadriiformes	LIFE12 NAT/FR/000538	LIFE+ ENVOLL	2012	FR
44	Habitat 1150* (Coastal lagoon) recovery by SEagrass RESTOration. A new strategic approach to meet HD & WFD objectives	LIFE12 NAT/IT/000331	LIFE-SeResto	2012	IT
45	An integrated approach to the sustainable conservation of intertidal salt marshes in the lagoon of Venice	LIFE12 NAT/IT/001122	LIFE VIMINE	2012	IT
46	De-urbanizing and recovering the ecological functioning of the coastal systems of La Pletera	LIFE13 NAT/ES/001001	LIFE-Pletera	2013	ES
47	Nature Integrated Project for effective and equitable management of marine habitats in France	LIFE16 IPE/FR/000001	LIFE IP Marine Habitats	2016	FR
48	Coastal lagoon habitat (1150 *) and species recovery by restoring the salt gradient increasing fresh water input	LIFE16 NAT/IT/000663	LIFE LAGOON REFRESH	2016	IT
49	Maintain the Man-Lake Symbiosis for the Benefit of Species and Habitats of EU conservation concern	LIFE17 NAT/BG/000558	the Lagoon of LIFE	2017	BG
50	*Conservation of Pomorie Lake coastal lagoon*	*LIFE19 NAT/BG/000804*	*LIFE FOR POMORIE LAGOON*	*2019*	BG
51	*Seagrass transplantation for transitional Ecosystem Recovery*	*LIFE19 NAT/IT/000264*	*LIFE-TRANSFER*	*2019*	IT

(*) Layman's report can be downloaded from the project website (3 April 2023).

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