Review

Mapping and Assessing Cultural Ecosystem Services to Inform Maritime Spatial Planning: A Systematic Review

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Abstract: Socio-cultural dimensions and values in maritime spatial planning (MSP) are gaining momentum worldwide and especially in the European Union (EU), since it is acknowledged that they are the "missing layer" of maritime spatial plans (MSPlans). These values are partly explored through cultural ecosystem services (CES). Coastal and marine CES refer to the benefits that humans derive from the coastal and marine environments in recreational, artistic, spiritual, and educational terms. They reflect the ways in which coastal and marine ecosystems contribute to human well-being, cultural identity, and interactions with nature. The research question is how to map and assess coastal/marine ecosystem services and to integrate them in the MSPlans. Thus, this systematic review sheds light on methodological and technical issues with CES mapping and assessment and provides guidance on how to incorporate CES in MSP for future research. Publications dealing with the spatial aspects of CES were examined with an extra focus on participatory mapping approaches. Initially, 199 articles were identified, and 50 articles were ultimately eligible for the analysis. Papers were concentrated in the European Atlantic, whilst their scope was either local or regional. A large number of articles consider the contribution of CES to efficient marine management rather than to achieving an integrated and coordinated MSP. Social and mixed mapping approaches were met with the most often, especially participatory mapping approaches. Also, non-monetary valuation was prevailing, and a multitude of techniques, tools, and statistical software were used. In most of the cases, the distribution of values in relation to environmental, socio-economic, and demographic factors was examined. This article concludes that an effective integration of CES into MSP is crucial for creating prospects of a more sustainable and inclusive approach to coastal/marine planning and for the well-being of ecosystems and communities both currently and for future generations. This knowledge should become "property" of the maritime spatial planners.

Keywords: maritime spatial planning; ecosystem services; cultural ecosystem services; CES mapping; CES assessment; participatory mapping; public participation geographic information systems (PPGIS); coastal and marine ecosystems

1. Introduction

Coastal and marine cultural ecosystem services (CES) refer to the various benefits that humans get from the coastal and marine environments in recreational, artistic, spiritual, and educational terms. These services reflect the ways in which coastal and marine ecosystems contribute to human well-being, cultural identity, and interactions with nature. These cultural ecosystem services can involve activities such as coastal tourism, recreational fishing, marine-based education and research, spiritual and religious practices, traditional cultural practices, and the aesthetic appreciation of coastal landscapes and seascapes.

However, coastal and marine ecosystems are exposed to a growing number of human uses and pressures such as exploitation of marine resources, climate change impacts, several types of pollution, and urban expansion [1]. In the marine space, human activities have greatly expanded, and few areas have remained unaffected. Especially in the coastal zone, rivalry for space and resources is even higher, which gives rise to the need for more effective management of coastal ecosystems [2]. This management is also relevant to maritime spatial planning (MSP), which is meant to encourage the sustainable use of marine resources. By following its elemental principles, i.e., to achieve balance between the activities of the potentially conflicting maritime industries, and to protect or even restore the marine ecosystem, MSP should sustain and maintain, either directly or indirectly, the provision of the coastal/marine ecosystem services.

In institutional terms, the Maritime Spatial Planning Directive (MSPD), which aims to support the allocation of maritime activities in a peaceful and synergistic manner and in harmony with the marine ecosystem, encourages the sustainable use of marine resources and the conservation of the marine ecosystem and the services it provides. In this ecosystem approach, consideration of ecosystem services is regarded to be crucial.

One of the critical components of the ecosystem approach (EA) is the inclusion of ecosystem services into management decisions. The EA ideally takes a multi-sectoral focus, incorporates considerations of ecosystems services, and acknowledges the tight pairing between social and ecological systems [3]. Hence, ecosystem services (hereafter ES) are important for MSP since they emphasize the connection between human and natural systems and the significance of ecosystems functions and processes for human prosperity [4]. Furthermore, assessing ES can be a useful approach to make visible the trade-offs between different sectors and activities by illustrating the gains and losses of different alternatives to society [5].

Mapping is a precondition for marine ecosystem services' efficient assessment. This is necessary in order to prepare economically, environmentally, societally, and culturally relevant plans for the exploitation of marine resources, i.e., MSPlans. On the other hand, socio-cultural dimensions of MSP are gaining momentum worldwide, and especially in the EU, since it is acknowledged that they are the "missing layer" of MSPlans [6]. Hence, the concept of cultural ecosystem services (hereafter CES) is predominantly relevant to MSP in that its focus is the socio-cultural benefits people derive from nature. Nevertheless, compared with to other three ecosystem service categories, CES are the most challenging in terms of their identification, mapping, assessment, and valuation. Another MSP-related challenge is that the environmental state of the sea is essentially induced by transboundary pressures, and many complications need to be tackled in the framework of transboundary MSP [7]. Therefore, a common understanding of how ecosystem services can be used as a tool in MSP could be a starting point in addressing these challenges. For the Nordic countries, international cooperation is easier given the common challenges of the North and Baltic sea-basins and shared marine areas [5]. This is not, however, the case in the Mediterranean, where geopolitical struggles are often prevailing.

As a result, the mapping and assessment of coastal and marine ES is growing into a very important matter for decision-making on the sustainable management of coastal areas, and it may be an essential contribution to MSP [8], including transboundary MSP. Several papers highlight the value of the ES concept for MSP [8–12]. Also, the multi-functional role of ES is being acknowledged, both as a tool to feed MSP with spatial data on marine ecosystems and as a method to assess the impact of marine uses on the supply of ES during strategic environmental assessment (SEA) [13]. Moreover, the ES are considered as a tool to assess the efficiency and the potential impact of policies imposed on both the Natura 2000 and the UNESCO sites [13]. Finally, the ES concept is considered prominent for the overall implementation of MSP [12,13], since the ES framework may enable the explicit consideration of trade-offs in services and can provide a quantitative method for comparing the value of MSP versus sectoral or uncoordinated planning. To this end, a marine integrated valuation of ecosystem services and tradeoffs (InVEST) was designed with the aim

to assess the multiple services provided by marine ecosystems. Several relevant programs are included in the European MSP Platform; for example, the Project "Ecosystem Services in Marine Spatial Planning" funded by the European Maritime Fisheries Fund (EMFF), the BalticAPP (Wellbeing from the Baltic Sea—applications combining natural sciences and economics), the RECOMPRA (Reef ecology and design of marine protected areas) and the MAREA (from marine ecosystem accounting to integrated governance for sustainable planning of marine and coastal areas) projects [14].

2. Cultural Ecosystem Services: Are They Significant to MSP?

Cultural ecosystem services (CES) are formally defined as "the non-material benefits that humans obtain from ecosystems through spiritual enrichment, cognitive development, reflection, recreation, and aesthetic experiences" [15]. In practice, they may signify cultural diversity and cultural heritage values, including spiritual and religious values, social knowledge systems and learning values, social relations, inspiration, aesthetic values, regeneration, and sense of place. Since the publication of the Millennium Ecosystem Assessment [15], CES has been the most challenging sort of ES [16], with many attempts being made to articulate relationships between culture and other services [17]. In another overview of ES [18], it was observed that, even though CES was the least-matured category when the MA was launched, a voluminous number of papers on CES have been published since. Besides, mapping and assessment of ecosystem services (ES), including CES, was one of the core actions (Action 5) of the EU Biodiversity Strategy 2020 [19], which aimed at stopping biodiversity loss and the deprivation of ecosystem services in the EU by 2020.

However, explicitly measuring cultural ecosystem services (CES) is not an easy task. Research on ecosystem services [20] showed that, despite the focus on the supporting, provisioning, and regulating ecosystem services and their assessment, the quantification of this intangible kind of ES is extremely limited. A series of issues were identified by [9] that hamper the development of both indicators and a framework within which CES can find their place. The reasons reported were mainly the difficulty in applying or using monetary value for CES, the complications in linking cultural benefits with a specific change in a social–ecological system, the fact that cultural benefits and values do not come exclusively from CES, and finally, the confusion concerning the meaning of "services", "values", and "benefits" [21,22]. However, despite the above constraints in assessing CES and their value, it is argued [9] that CES cannot be left out of the decision-making processes, since these intangible benefits are very frequently more essential to people than material profits [22].

For cultural services, a broad set of measures is being used; however, only 23% of the papers included in a review article [23] used spatially explicit information. Indicators are essential, as most CES and their values are not directly perceptible in the landscape, and their enclosure in analyses depends on the use of indicator measures. A relevant approach is participatory mapping, where the required data on values are fed by the empirical research, spatially [24,25].

Concerning the application of CES in MSP, it is essential to note that there are many similar, pertaining challenges.. It is noteworthy that although the roots of ES can be found in economics and natural science, in recent years, a closer engagement with the social sciences is evident, with particular focus on "values" [26–28]. In this case, emphasis is given to the efficient incorporation of social data into decision-making processes and the use of the concepts of "marine socio-ecological systems" and "integrated ecosystem assessment". In this context, a dilemma is highlighted between the need to produce indicators to cope with complexity and the risk of valuing only what is quantifiable (also in terms of economic valuation). Mixed methods using quantitative and qualitative approaches are suggested as a solution to overcome this dilemma.

However, across diverse world studies, there persist several worries regarding the capacity of ES to effectively represent socio-cultural viewpoints. An example is the Inter-governmental Science–Policy Platform on Biodiversity and Ecosystem Services (IPBES), a joint global work by academia, civil society, and governments to assess and stimulate

knowledge of biodiversity and ecosystems and their contribution to human societies to inform policy making [29]. The IPBES framework introduces the concept of "nature's contributions to people (NCP)", which builds on the ecosystem service concept, also recognizing the key role that culture plays in defining the links between people and nature. The NCP raises, emphasizes, and makes operational the role of indigenous and local knowledge in understanding nature's contribution to people. However, the strong criticism towards this approach [30] proved that there are also opposing opinions and that this concept is rapidly changing.

In conclusion, there are several examples of published works that explicitly connect CES and MSP, and a fast-growing body of work considers CES in coastal and marine areas. Several examples can be detected [11], considering that MSP should follow a holistic approach including ecological, economic, and socio-cultural aspects. It is noteworthy that cultural services were incorporated in the InVEST framework and it was acknowledged that understanding and reporting on cultural values (such as existence, subsistence, and aesthetic values) are fundamentally important for coastal communities. InVEST was designed to provide results grounded in both local ecological knowledge and, also, to reflect diverse values, conflicts, and aspirations.

In contrast, according to [31], cultural values associated with the sea tend to be a neglected aspect in MSP. A simple CES approach is judged only as a starting point for thinking about how communities are connected to the sea. In this case study, a method for developing "spatialized" community-based narratives is initiated, to identify "culturally significant areas". In another study [32], the ecosystem-based management being a priority issue in the MSP process, should be protective for critical ES; a key problem is how to measure and compare very different ES i.e., immaterial cultural values versus tangible provisioning ES that are easily marketable. MSP is also seen as an important step in the implementation of a comprehensive ecosystem-based management. Another approach is the consideration of CES in the context of marine protected areas (MPAs) and marine habitats [33,34]. These essays point out the links with human activities such as sport, recreation, and nature watching, but all highlight the scarcity of data available for making assessments. Specifically, a study of marine CES in the Black Sea [33] highlighted the lack of characterization or valuation of CES mainly because they are hard to identify. CES are often left out of assessments, and this runs the risk of the ES frameworks not being utilized to their full potential. This research demonstrates the broad range of sociocultural considerations that are relevant to MSP, beyond leisure and recreational opportunities. It highlights the deep sense of connectivity with the sea [24] and explores the importance of developing participatory mapping of ES to navigate coastal values, suggesting, at the same time, that monetary and biophysical dimensions tend to dominate spatial planning. "Social value mapping methods" are used to explore associations of tangible and intangible values with places, stressing the significance of ecosystems to people. The paper concludes that despite the attachment of strong and diverse values to nature by people, spatial identification and quantification of the significance of places is only possible for certain values. Moreover, the inclusion of a deliberative component in planning and decision-making is judged as most effective and appropriate.

Apart from the literature that explicitly frames a socio-cultural approach to ES in the context of MSP, there is a growing body of literature dealing with the ES of marine and coastal spaces which might find application in MSP. CES are present to a lesser or greater extent, often mentioned in broader policy contexts. These approaches range from a broad overview of the value of coastal ES [35,36] to more specific findings like the lack of social information in the context of coastal ES data [37] or the fact that coastal zone ES may be valued in economic terms with CES considered as significant places providing a lot of benefits [38]. Another paper [2] examines ES both broadly in the marine environment and through a case example of the Dogger Bank in more detail. Furthermore, a methodology was provided [39] for exploring deeply rooted cultural values through the community voice method (CVM) in the framework of deliberative–democratic context for decision-

making regarding MPAs. Others [40] develop and test a pathway to the identification and non-market economic valuation of CES, considering culture as a generator of ES in a marine environment. Their approach is demonstrated through a case study in Turkey emphasizing advances in the food web of the Black Sea. A recent article [41] argues that it is essential to engage local stakeholders, especially among the youths, to explore governance complexities of MPAs and better understand CES.

Another study [42] conducted a triple-choice experiment with modelling of participatory systems, participatory mapping, and psychometric analyses in a coastal area in Scotland. Interestingly, the paper explicitly considers the role of shared values in decision-making. Finally, an evaluation of the benefits produced by CES in 151 marine recreational sites in the UK [43] recognizes the complications in assessing CES and suggests an original framework developed by the UK National Ecosystem Assessment (UKNEA).

Hence, there is plenty of evidence that CES are considered in various ways in the context of coastal and marine management. On the other hand, purely understood MSP—aiming to allocate space in the marine environment for various uses while minimizing conflicts and promoting synergies—seems to progressively acknowledge CES. Its role in enriching human well-being and sustaining community resilience is often highlighted in the context of MSP [44,45].

The research question of the current review is whether incorporating CES into the planning process, most frequently through participatory methods, may promote sustainable management of the sea and the coasts. Therefore, the aim of this review paper is to conduct an in-depth examination of all recent endeavors that include methods, techniques, and tools used for mapping and assessment of coastal and marine CES, with the goal to inform MSP processes and provide guidance to marine spatial planners.

3. Materials and Methods

This systematic literature review was conducted following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement. The scientific papers were retrieved from the bibliographic databases "Science Direct", "Scopus" and "Web of Sciences". First, a search was performed for publications containing the keywords "cultural ecosystem services", "cultural ecosystem values", "intangible benefits", and "non-material benefits" in combination with 'marine/maritime spatial planning' OR 'coastal planning' (Search 1, Table 1). Then, a second search was performed (Search 2, Table 1) to detect any additional coastal or marine participatory mapping-related papers. The last update of the search took place on 18 October 2023.

Table 1. Search queries.

Search 1	Find Articles with these terms:	"marine spatial planning" OR "maritime spatial planning" OR "marine planning" OR "coastal planning"
	AND Search in Title, Abstract, Keywords for:	"cultural ecosystem services" OR "cultural ecosystem values" OR "intangible benefits" OR "non-material benefits"
Search 2	Search in Title, Abstract, Keywords for:	("cultural ecosystem services" OR "cultural ecosystem values" OR "intangible benefits" OR "non-material benefits") AND (marine OR coastal) AND ("participatory mapping" OR "Participatory GIS" OR PGIS OR "Public Participation GIS" OR PPGIS)
Search 3	Projects, Report Summaries:	("ecosystem services" OR "cultural ecosystem services" OR "cultural eco-system values" OR "cultural values" OR "landscape values" OR "intangible benefits" OR "non-material benefits" OR "natural heritage" OR "eco-heritage") AND ("participatory mapping" OR "Participatory GIS" OR PGIS OR "Public Participation GIS" OR PPGIS OR "marine spatial planning" OR MSP)
Search 4	Find Articles with these terms:	("cultural ecosystem services" OR "cultural ecosystem values" OR "intangible benefits" OR "non-material benefits") AND (marine OR coastal)
	AND Search in Title, Abstract, Keywords for:	"ecosystem services" AND (webGIS OR "web-GIS")

The total number of articles obtained from the literature investigation was 199 (Figure 1). After removing duplicates and those that were not accessible, a first screening of the articles to exclude publications followed using the following criteria:

- written in a language other than English;
- not related to CES;
- theoretical articles—opinion papers and reviews, etc.;
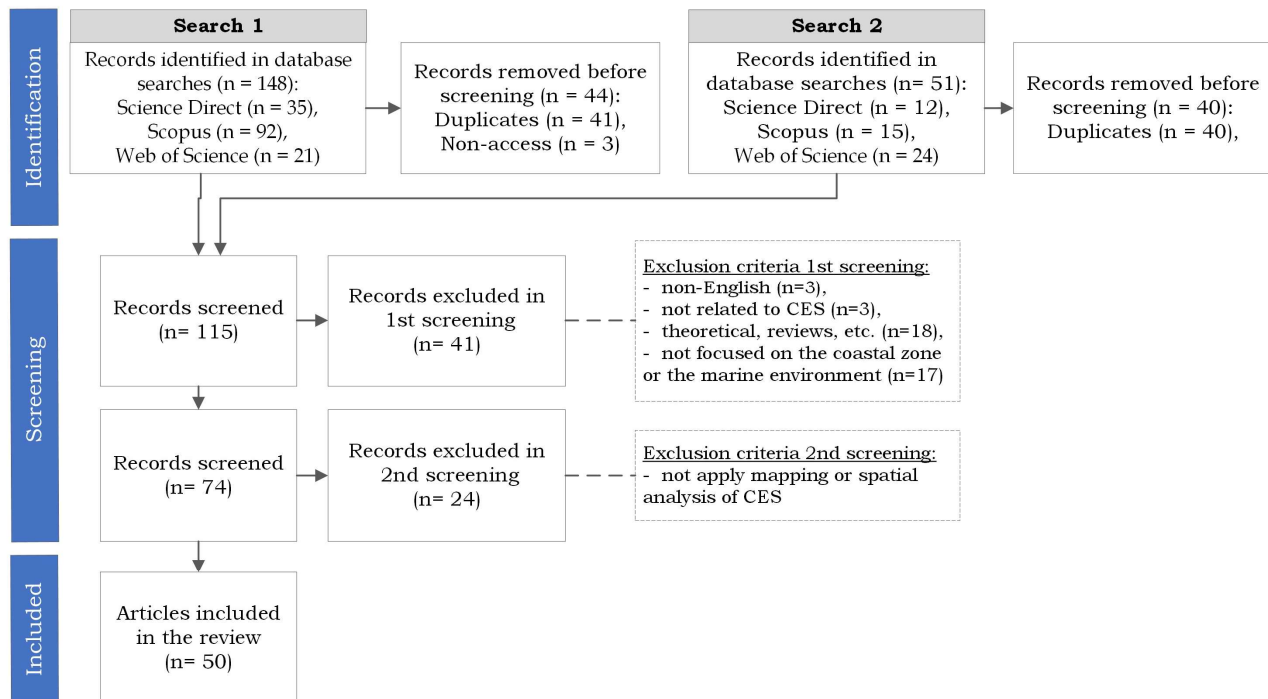- focused on other environments than the coastal zone or the marine environment.

Figure 1. Flowchart of the current systematic literature review process, according to the PRISMA protocol.

Then, in a second screening of the articles, those that did not apply mapping or spatial analysis of CES were excluded as well. Detailed information on the articles selected or excluded based on the exclusion criteria is provided in Appendix B, Table A3. The remaining 50 articles included in this review were classified according to the criteria presented in Table 2. During full-text analysis, all relevant information was extracted by a single reviewer and was imported to Excel spreadsheets where the statistical analysis was performed. When there was doubt regarding the categorization of information, consultation between the authors took place.

First, the temporal and spatial distribution of the papers (when and where) was determined. Afterwards, questions of who and what (focus of papers) were answered. The focus of the papers can be either ecosystems, marine/maritime spatial planning, or simply cultural ecosystem services (CES).

This article follows a classification of mapping approaches based on the ones presented by [46–49]. Table 3 summarizes these different methods.

Next, each mapping approach was divided to further sub-categories of methods (see Table 3). Mixed PPGIS approaches were differentiated from other types of mixed approaches to give a picture of the established work. The classification was strictly focused on methods used for CES mapping and assessment. Methods used for the mapping of other categories of ES were not considered, except for cases in which there was an aggregation of results (e.g., hotspots and cold spots of cultural and biophysical ES) [50].

Table 2. Method of analysis.

Criteria	Categories
Year of publication	without time frame
Who	scientific community, government/regional/local authorities, other
Ocean/sea	NW Atlantic, West Mediterranean, etc.
Continent/country	Asia/China, Europe/UK, Australia/New Zealand, North America/USA, etc.
Scale of paper	Basin-centered, national, regional (region of country, county of region, etc.), Local (1 or more municipalities), coastal zone (landwards and seawards), Multi-scale, comparative papers.
Ecosystem assessed	coastal, marine, coastal and marine
MSP focused	yes, no
CES focused	Yes, no
Stakeholders category	residents, specific stakeholders, scientists, mixed groups of stakeholders, no stakeholder's engagement
Mapping approaches & methods (focused on CES)	Social methods (participatory mapping, social media-based, etc.), Economic methods (hedonic pricing, value transfer, etc.), Mixed methods (mixed participatory mapping, other).
Valuation types & methods	Monetary (hedonic pricing, travel cost, deliberative valuation, etc.), Non-monetary (participatory mapping, personal interviews, questionnaires, etc.), Combination of both.

Table 3. Classification and description of the mapping approaches.

Type of Method	Description
Biophysical methods	These include direct (e.g., remote sensing and earth observation) or indirect measurement (remote sensing and earth observation derivatives, use of statistical data, and spatial proxy methods) and modelling (e.g., macro-ecological models, statistical models, and conceptual models).
Social methods	These measure individual and collective preferences for mapping and assessing ES (e.g., official statistics, personal interviews, participatory mapping, and focus groups)
Economic methods	This is a group of methods developed for estimating the economic value of ES (e.g., hedonic pricing, market value, and value transfer);
Mixed methods	These refer to mapping approaches that link or integrate methods and information from different disciplines (e.g., biophysical, social, and economic)

Next followed the classification of valuation methods into three general categories—monetary, non-monetary, or combination of both—as well as further sub-categories of methods based on the categorization of valuation methods presented by [51] (see Table 3).

Then, in order to present the various methods, techniques, models, and tools applied and relate them with the relevant software, they were all classified into four main categories of Desk analysis:

(1) Spatial analysis (GIS), which refers to any technique or tool applied in a GIS environment.
(2) Statistical analysis, which signifies any statistical method applied in a statistical software;
(3) Modelling for ES, meaning software tools developed specifically for ES assessment, such as the InVEST[1] (Integrated Valuation of Ecosystem Services and Tradeoffs). InVEST is a set of free, open-source software models that "enables decision-makers to quantify the importance of natural capital, to assess the trade-offs associated with alternative choices, and to integrate conservation and human development".

SolVES (Social Values for Ecosystem Services), is "a fully open-source, GIS-based tool designed to aid in the creation of quantitative, spatially explicit models of the nonmonetary values attributed to CES, specifically to facilitate their incorporation into larger ecosystem service assessments" [52]; and

(4) other type of analysis, which refers to any other method, technique or tool applied that does not fall into the previous categories. Participatory techniques, tools, and software regarding decision-making techniques and web-based surveys for data collection were collected as well.

Ultimately, bringing into focus the subject of PPGIS/webGIS, we identified and discussed relevant EU-funded projects. The projects were retrieved from CORDIS[2] (Community Research and Development Information Service), the European Commission's primary source of results for projects funded by the EU's framework programs for research and innovation (from the FP1 to "Horizon Europe"). We used various terms which may, directly or indirectly, be related to CES (Table 1, Search 3), such as "ecosystem services", "cultural ecosystem values", "intangible benefits", etc. A broad search was performed, for projects related to one of these terms, along with various terms for "participatory mapping" or "marine spatial planning". Next followed a screening of the reports of all the projects listed, with the aim to exclude those not directly (via the ES) or indirectly related to CES (focused on another framework, e.g., landscape values) and to existing PPGIS/webGIS platforms. Finally, a last search was performed (Table 1, Search 4) in "Science Direct" and "Scopus" to detect any additional webGIS studies. This last search resulted in only one publication that was already included in previous searches. The results of the 3rd search were not included in the statistical analysis.

4. Results

4.1. Spatial and Temporal Distribution of the Papers

Ninety percent of the articles (Figure 2) were published from 2017 to 2023. There was a rapid rise in the number of publications from 2016 and 2019 and a rapid drop from 18% in 2021 to 10% in 2022. Articles were published in a range of scientific journals, among which almost 60% were the following: "Ocean and Coastal Management" (20%), "Ecosystem Services" (14%), "Journal of Environmental Management" (10%), "Marine Policy" (8%), and "Ecological Indicators" (8%). A total of 70% of the articles were authored by the scientific community, whilst 30% resulted from the collaboration between academics and government/authorities, or/and other organizations (e.g., NGOs or private companies) [10,53,54].
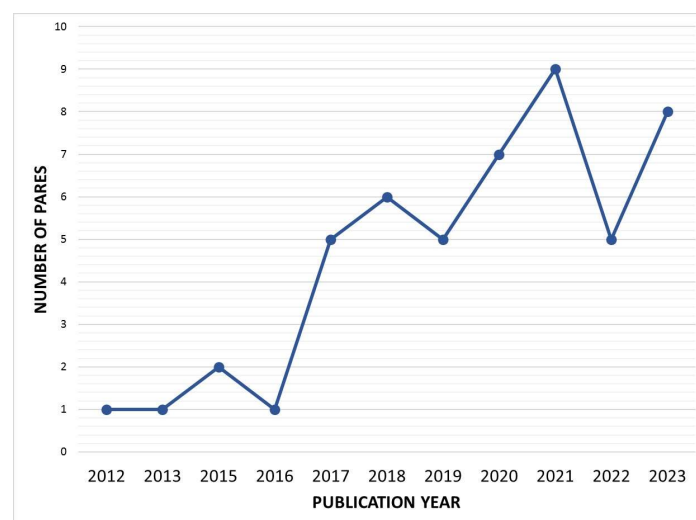

Figure 2. Temporal distribution of the examined papers.

The spatial distribution of the papers is presented in Figures 3 and 4. As seen in the graph, more than 46% were located in the NE Atlantic (21%), SW Atlantic (11%), NW Atlantic (7%), and the Baltic Sea (7%); 41% of the papers concerned Europe, 78% of which were in the United Kingdom (43%), Italy (15%), Lithuania (10%), and Portugal (10%). Another portion of papers (20%) was placed in Asia, whilst 14% were in South America (mainly in Brazil), 12% in North America, 12% in Australia, and 2% in Africa (Morocco).
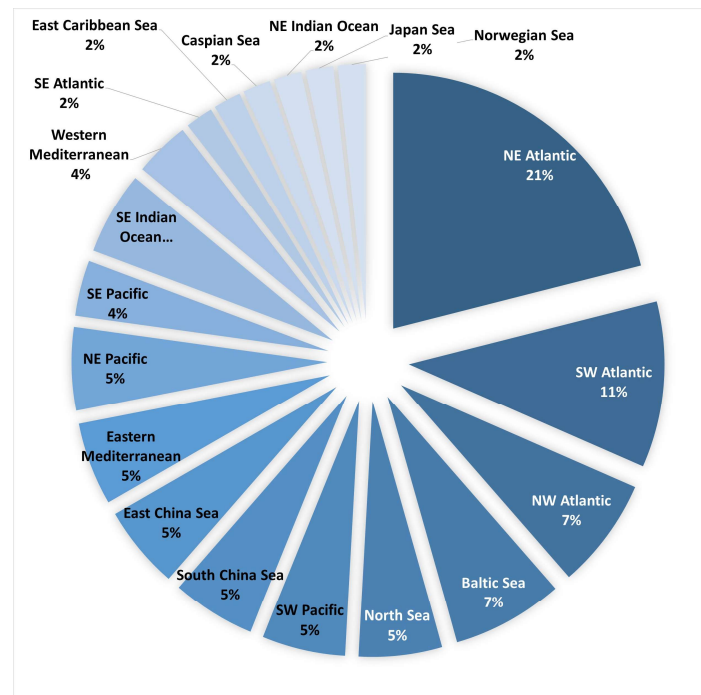

Figure 3. Spatial distribution of the papers per sea-basin/ocean-sea.
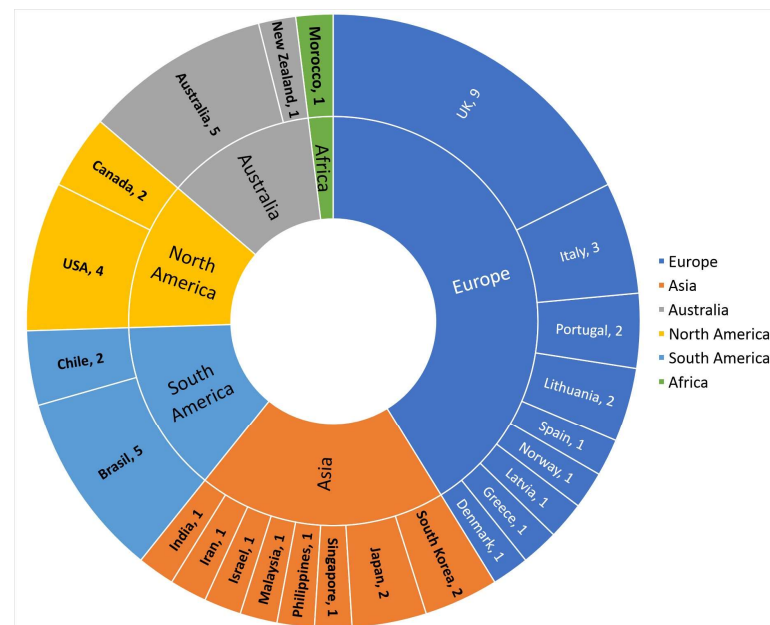

Figure 4. Spatial distribution of the papers per country and continent.

Most of the papers (70%) had either a local (36%) or a regional (32%) scope, and only 18% had a national scope (located mainly in Europe and in Asia). There were also sea-basin-centered papers (6%), such as those referring to the North Sea [55] and to the

Atlantic Ocean [56], whilst another 8% (in equal percentages) applied coastal zone [57] or comparative [58] or multi-scale analysis [59].

4.2. Focus of the Papers

As expected, due to the focus of the search, 80% of the articles explicitly emphasized CES, whilst 20% assessed CES along with other categories of ES [56,60–62]. The ecosystems assessed were as follows: 42% purely coastal [63], 38% coastal and marine [44,64], and 20% purely marine ones [65–67] (Figure 5).
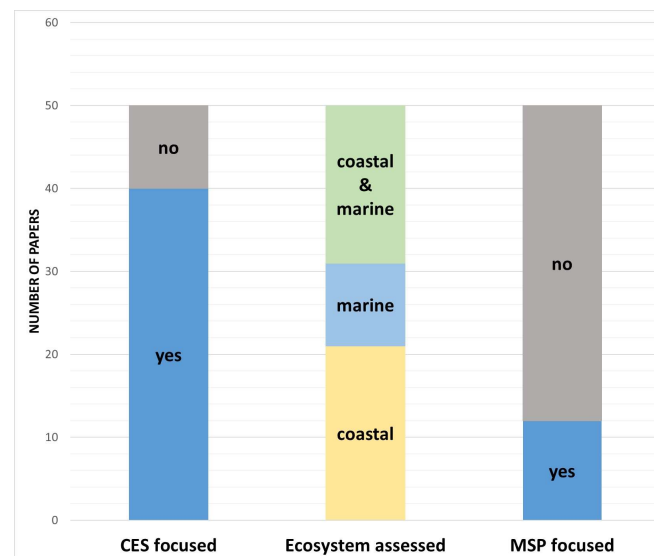

Figure 5. Focus of papers.

A high percentage of the papers examined (76%) utilized another focus than MSP, such as "natural resources management", "management of MPAs", "vulnerability and risk assessment", or "ecosystem services" in general [59,60,68,69].

Only 24% of the papers explicitly focused on MSP [24,44,70,71], concerning specific MSP-related fields like "incorporation of socio-cultural values and CES in MSP", "recreation opportunities", "tourism", "marine biodiversity" "MPAs management", "preservation of marine ES", etc.

4.3. Type of Engaged Stakeholders

As displayed in Figure 6 below, a high percentage of the papers (70%) involved stakeholders in the assessment of CES, including 18% of residents [72], 28% of specific stakeholders, mainly recreational groups, residents, and tourists [73,74]; and 2% were scientists [10]. Finally, almost one quarter (22%) of the publications involved mixed groups of stakeholders [9,24,70,71], including Aboriginal Traditional Owners; residents; user groups and professionals; federal, state, and local government; or different groups of marine-related professionals.

4.4. Mapping Approaches

In Figure 7, the percentages for each mapping approach/method used are displayed. As already stated, the papers were classified following the key mapping approaches (biophysical methods, social methods, economic methods, and mixed methods) and were then further sub-categorized.
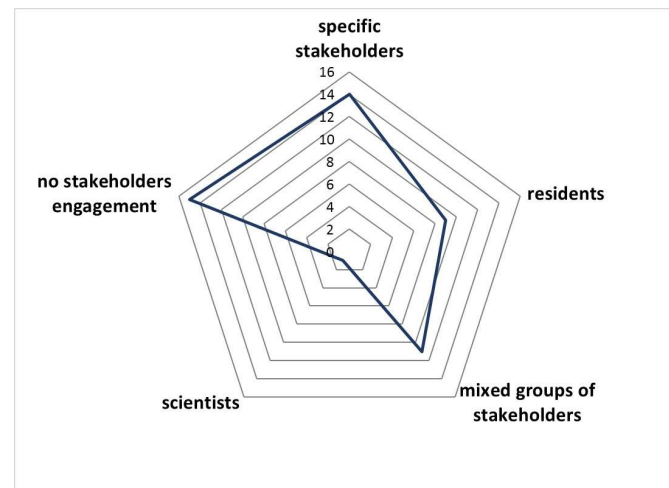
Figure 6. The number of papers per category of stakeholders engaged in the participatory assessment process.
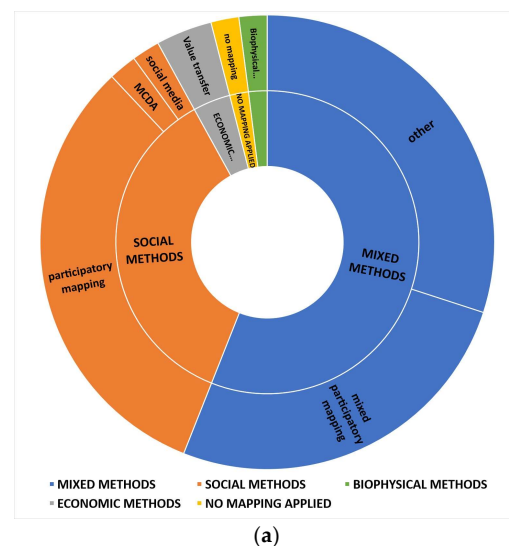
(**a**)
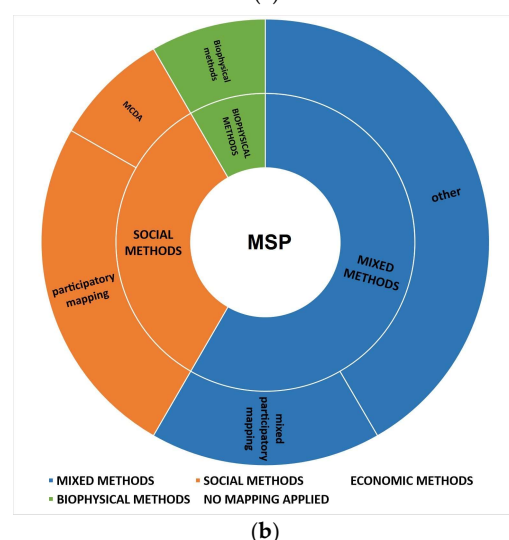
(**b**)

Figure 7. The percentages of (**a**) all papers vs. (**b**) MSP-related papers per general mapping approach/method divided into (1) mixed methods (blue color), (2) social methods (orange color; MCDA: multi-criteria decision analysis), (3) economic methods (grey color), or (4) no mapping applied (light orange color).

As observed in Figure 7a, almost 36% of the papers applied social methods (orange color); among them, 32% were participatory mapping approaches, and 4% used social media analysis [69] and multicriteria criteria analysis (MCA) [8] to map and assess CES. A relatively low percentage of the papers (6%) applied strictly economic (grey color) or biophysical methods (green color) [3,56,75], while 56% of the papers used mixed mapping approaches (blue color): 26% were mixed participatory mapping and 30% were other types of mixed mapping (e.g., InVEST or composite indicators). Finally, almost 2% of the papers (light orange color) did not apply mapping at all [76].

It should be noted that they were cases of papers that, even if they did not explicitly mention participatory mapping [11,68], were classified as such. In one of the cases, respondents were asked to select cells on the map of areas they had visited the most and this distribution of the activity was mapped, while in another, the most-visited diving sites were identified and mapped through questionnaires (without including a map).

In contrast, as shown in Figure 7b, 33% of the papers focusing on MSP utilized social mapping approaches (orange color); among them, 25% used participatory mapping applications, and 8% used MCA to map and assess CES [8,9,24]. The majority of the articles (58%), though, were mixed mapping approaches (blue color), either mixed participatory mapping applications (17%) or a combination of other methods (42%) [11,44,70]. Finally, 8% of the articles used biophysical approaches (green color) [3].

4.4.1. Use of Participatory Geographic Information Systems (GIS)

In most papers using PGIS, participants identified either predefined ES directly [9,64] or labeled these areas through attributing codes of values [59]. There were also papers where the locations were predefined [54].

Among other things, participants were asked to identify places of value [59], their favorite places [64], areas of ES provision [77], tangible and intangible ecosystem benefits and services and areas associated with bequest values [61], interesting special features or features that should be conserved [26], threats [77] or areas that are threatened [24] or to map activities they had performed [78].

Additionally, in some papers, participants assigned a relative value (e.g., level of attachment or level of importance) to the identified spatial features by different means, such as (1) the use of a scale by drawing with different colors of markers or by placing different colors of stickers on the map [50,64,79]; (2) by the distribution of tokens or points [24,53,66,77]; or (3) by directly ranking the spatial features (areas of value) from the most- to the least-important ones [54,74].

Finally, in some cases, participants indirectly assigned a specific value in these areas by rating the intensity of each activity performed [78] or by indicating the number of activities usually performed [63]. As a result, we came across various maps:

- hotspot maps [64];
- hot and cold spot maps [50,53];
- heat maps (density maps) [74];
- point distribution maps [9,58,80];
- cluster maps [74]; and
- maps of ES bundles [61].

For example, a research paper [64] mapped hotspots of attachment for each value and hotspots of total combined attachment in the Falkland Islands. Another study [24] made the distinction between areas important for monetary reasons (economic activities), areas important for non-monetary reasons (tangible and intangible non-monetary benefits), and areas that are threatened. They produced hotspot maps of value by number of interviewees by quantile and of absolute aggregated value in the Regional District of Mount Waddington.

On Johns Island in coastal South Carolina, the overlap of hotspots and cold spots of cultural and bio-physical ES and the overlap of cultural ES and pressures were mapped, among other things [50]. Similarly, in another case study [74], the density of CES for residents and tourists was mapped. There were also cases that mapped the distribution of

values associated with either the distance from the coast [9] or with the development/access and natural areas [58]. There was also a case of multiscale mapping in the Wadden Sea coastal area [55].

As already mentioned, there were several papers that combined participatory mapping with other types of mapping methods (Figure 8 below). Of these papers, 15% combined participatory mapping with economic procedures in order to assess the spatial distribution of recreational uses (e.g., diving and kayaking) and the economic value of marine biodiversity [11] or of specific marine habitats [68]. Another 15% of the papers combined participatory mapping with InVEST modeling to map the cumulative risk per type of habitat from activities undertaken by direct users in Brazil [67,78]. In other cases (15%), participatory mapping was combined with maximum entropy models, for instance, to map social value distributions for multiple user groups in a coastal national park in North Carolina [53]. Other papers tried to determine whether the PGIS and flicker data identified similar social and environmental drivers of the social values and produced similar predictions [71]. Moreover, 16% of the papers (in equal percentages) combined participatory mapping with other methods, i.e., with hierarchical cluster analysis based on a dissimilarity matrix to spatially group the participants based on the CES location, in the Falkland Islands [72] or with content analysis of photographs through machine learning techniques within the framework of social media-based analysis. In this case, the results were compared with those of PPGIS in order to assess CES in green and blue open spaces in a coastal city in Israel [81].
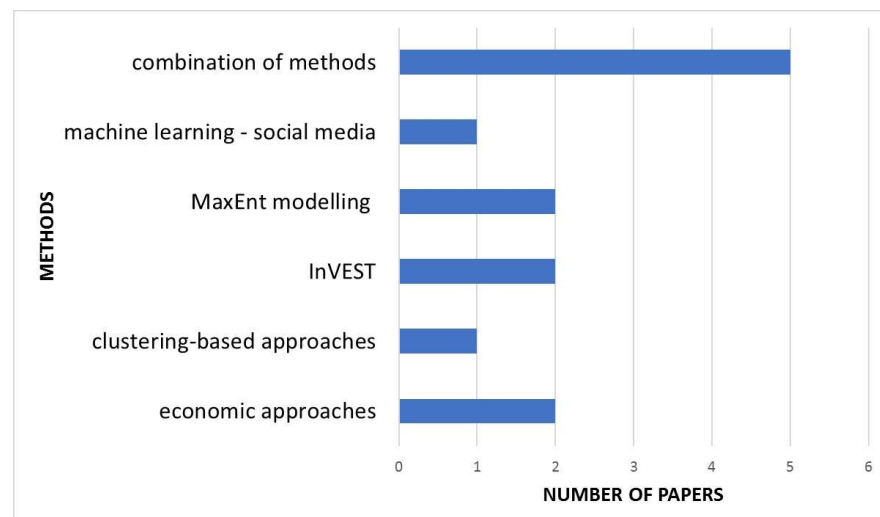

Figure 8. Number of papers per category of mixed participatory mapping approach.

Finally, most of the papers (38%) combined participatory mapping through the applications of more than one method, i.e., a paper [54] applied the inverse distance weighting (IDW) method to interpolate the values for the unmeasured locations and used Local Moran's I statistics and hotspot analysis to map hotspots of non-material values in the Indian Sundarban delta. Another study [63] applied a composite (GIS) indicator to map coastal recreation CES supply, while ES flow and demand was assessed through participatory mapping procedure. In the coastal region of Lithuania, statistical models were used to map hot and cold spots of CES supply and demand. Finally, another paper [50] used PGIS along with different types of modelling to quantify the impacts of the 'coastal squeeze' on ES.

4.4.2. Other Types of Mapping Approaches

Regarding other types of mapping approaches, a few papers (4%) applied other social methods (than PGIS) to map and assess CES, i.e.:

- social-media analysis to map the density of photographs depicting engagements with different CES [69]; or
- multi-criteria analysis to examine the suitability of the coastal areas for marine tourism and leisure activities in Latvia [8].

Moreover, there were a few strictly economic applications (4%) that applied g.lobal ecosystem service value (ESV) functions to examine ES values for three different years in relation to changes in land use, income, and population [56] or value transfer to assess the feasibility of carbon and ES payments [75], so as to reduce livestock grazing pressure on saltmarshes, using market carbon prices and social costs of carbon. There was also an example of a biophysical approach [3] which mapped the visibility characteristics of the marine environment at a national scale in Scotland.

Moreover, a high proportion of the papers (30%) were mixed mapping approaches (other than mixed PGIS), for instance, a number of papers used social media analysis coupled with maximum entropy modeling [82,83] or with machine learning (for the analysis of photographic datasets) and cluster analysis techniques [84], such as those of [82] that mapped the probability of occurrence of different types of CES in urban mangrove sites in Singapore. Others [85] investigated whether the level of protection ("strictly protected", "sustainable use", and "unprotected") was associated with affluence of CES in coastal areas of Brazil. In one case [65], permutational multivariate analysis of variance (PERMANOVA) was applied to test the influence of several attributes on the responses provided by the users in order to assess ecosystem and seascape services (from a user's perspective) and map underwater trails for snorkeling, in Cíes Archipelago, in Spain. Other papers applied composite (GIS) indicators for the assessment of CES that integrated biophysical, social, and managerial aspects [10,44,85].

Furthermore, several papers used InVEST models to map and assess CES [57,60,86]. This is the case with Dakhla Bay, Southern Morocco, where the spatial–temporal distribution of CES was mapped [57], and also with coastal areas of South Korea [60] that assessed the spatial distributions of habitat risks and ES and explored the trade-offs among them. Moreover, a comparison between social media (photograph visits, tweet visits) and telecommunication data (mobile visits) with traditional survey-based measures of visitation rates was detected [86]. The aim was to assess people's preferences for cultural and natural landscapes. Finally, one paper applied GIS modelling procedures to assess the exposure of Marine ES to threat, under different pressures, in the small Lithuanian sea space [62].

4.5. Valuation Methods Applied

Figure 9 presents the different types of valuation methods per category (monetary, non-monetary, or combination of both). A high percentage of the papers (88%) applied non-monetary methods (blue color): 37% used participatory mapping in combination with questionnaires [9,53,63] or personal interviews [24,64,72]. Another 12% applied social media-based analysis, either by applying the InVEST Recreation model, that uses social media data to assess recreation [57,59] or by categorizing and analyzing social media data (mainly photographs) directly, to assess different categories of CES [82,83]. In some cases, social media data were used to assess CES (through the InVEST recreation model) as part of an integrated ES assessment [62] or in the context of a composite indicator [44]. Moreover, 2% of the papers used questionnaires to evaluate CES [65], while another 2% applied document methods [60]. The "document method" estimates CES values from certain individuals or groups by analyzing texts, images, or other forms of materials [51].

Furthermore, 35% of the papers applied multiple non-monetary methods [8,61,70,87]. Half of these papers applied social media-based analysis in combination with other revealed preference methods (document methods, observation in the field) [57,59,62,69,86], or in some cases, with stated preference methods (e.g., expert based methods, participatory mapping) [10,71,81]. There are, though, a few papers (~11%) that applied a variety of methods, such as participatory mapping, personal interviews, participant observation, informal

discussions with local community, scenario simulation, as well as included deliberative components (e.g., focus groups/workshops) [50,61,78,87,88].
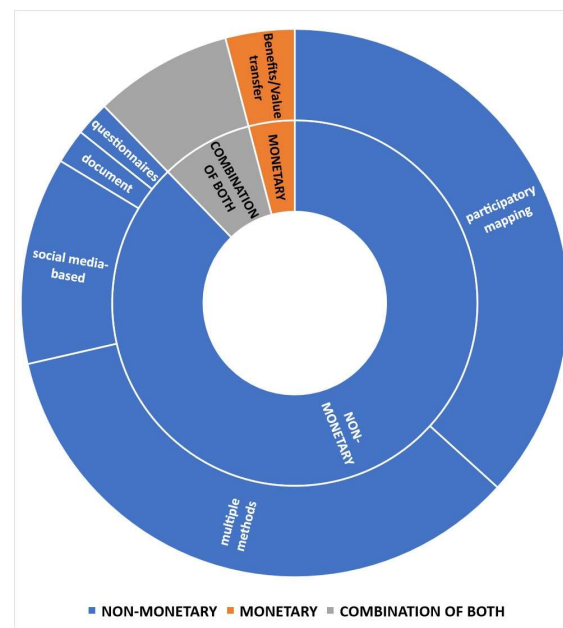

Figure 9. The percentages of papers per general valuation approach/method, divided into (1) non-monetary (blue color), (2) monetary (orange color), (3) combination of both (grey color).

Another, 4% of the papers applied monetary valuation (orange color) and specifically, the benefits/value transfer method [56,75]. Finally, 8% of the papers applied a combination of monetary and non-monetary methods (grey color). For instance, the combination of well-being indicators and Hedonic pricing to examine potential trade-offs between CES and marine activities was detected [76]. In the Firth of Forth estuary in Scotland [26], contingent valuation, participatory mapping, and deliberative assessment were combined to explore contrasts between individual willingness to pay (WTP) and shared values expressed as group-deliberated fair prices. There were also market valuation approaches that used participatory mapping to map activities' distribution [11,68].

4.6. Techniques, Tools and Software Used

4.6.1. Per Category of Desk Analysis

As already stated, techniques, tools, and software are presented for each category of analysis: spatial analysis, statistical analysis, modelling for ecosystem services, and other types of analysis (Table A4).

Over 88% of the papers applied spatial analysis, either by applying basic GIS tool and techniques to map and assess CES (e.g., map algebra, overlay techniques, buffer analysis, Euclidean distance, Kernel density analysis, or zonal statistics) [10,53,63,64] or through a more advanced type of spatial analysis, for example:

- viewshed analysis techniques [10,62];
- a variety of tools to examine spatial autocorrelation of values, such as Local Moran's I statistics [54] and Global Moran's I statistics [79] and semivariograms [24];
- cluster analysis tools to visualize clusters of high values of ES [63,79];
- interpolation methods to create a continues surface of values [54,85] land-use and land cover classification methods [63,85];
- multi-scale spatial analysis techniques [89]; or
- other techniques [85].

Regarding the type of geographic information system (GIS), 48% of these papers used ArcGIS (Figure 10), 14% the open-source software QGIS, 6% multiple software and 20%

did not specify which software they used, while 12% did not apply spatial analysis [87] or applied the InVEST software [59] (Figure 10). A high percentage of papers (74%) used statistical analysis to assess ES by applying a variety of methods (Table A4 in Appendix B), as follows:

a. Chi-square tests to check if the proportion of photographs (coming from the social media) and user counts for specific CES, varied significantly between categories or between different sites in social media analysis [69,82] or to examine the distribution of values in relation to different factors (e.g., by coastal and non-coastal areas, by type of marine protected area, by access, by population density, etc.) [9,58,74]. In some cases, the chi-square independence analysis test was applied along with proportional analysis that tests dependence [9,58].

b. Pearson correlation analysis to verify the accuracy of spatial assessment by comparing the results with existing datasets [57,60,86] or to examine for possible relationships between different coastal activities and the reasons that undermine them [73] or to evaluate spatial association between different CES [69].

c. The non-parametric Spearman's rank correlation coefficient to examine the correlation between different pairs of values (e.g., non-monetary– monetary, non-monetary– threats) [24] and between different CES and CES components (e.g., naturalness, tree density, silent areas, religious sites, and accommodation) [63].

d. Finally, canonical correlation analysis was used to investigate whether coastal activities (e.g., fishing) were correlated with stressors (e.g., overcrowded spaces) [73].
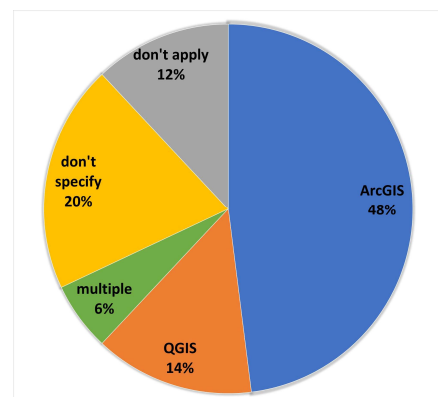

Figure 10. Papers per GIS type.

Moreover, to compare the distribution across groups, a variety of methods were applied, such as:

a. Kruskal–Wallis test, to examine influence of a hub on the likelihood of a location being valued depending on its distance to the nearest hub [64] or to compare the mean ranks of scores for different aspects (e.g., ES) of different livelihood groups [87], or to analyze the difference in the total number of CES locations between groups and to examine the effect of the number of tourist visits on the number of CES points [74];

b. The Kruskal–Wallis test was also used in combination with other tests (Dunn's posteriori tests, Steel–Dwass test) [87];

c. One-way ANOVA was used to examine potential differences in the level of habitat risks and the provision of four services between conservation-dominated and reclamation-dominated counties, as well as to examine whether several factors—including demographic, socioeconomic, and biophysical determinants—are different between groups [60] or to identify the environmental drivers (e.g., distance to nearest road, settlement, or airfield for access; distance to the nearest patch of invasive species; and mean slope) that drive the location of CES between different groups [72];

d. Analysis of similarities—ANOSIM to compare the presence/absence of biotopes between those cells used/not used by divers [11]; and

e. Permutational multivariate analysis of variance (PERMANOVA) to test for the influence of several attributes on the responses provided by the users [65].

Furthermore, among other methods applied were identified:

a. Linear regression to understand the relationship between socio-demographic variables and the perception of non-material values others used [54];

b. Multinomial regression to identify the demographic identity of each group as well as the environmental drivers that drive the location of CES for each of the groups [72];

c. Multivariate linear regression to assess tourists' preferences for cultural and natural landscapes (e.g., natural features, land-cover and land-use types, accessibility, and amenities for tourists) using multiple sources of UGC [86];

d. Hierarchical cluster analysis to identify spatial groups of participants based on the dissimilarity matrix [72] or to group similar types of photographs by using the photographs' keywords [84];

e. k-means cluster analysis of the Flickr users to better contextualize the types and association of CES engagement at the user level [69];

f. Principal component analysis (PCA) to compare the results of different methods [81];

g. Other methods for the analyses of survey data, for examining discrete choices and for text analysis of social media data (e.g., multiple group method, mixed logit models, and the Bigram language model) [26,76,83]

Regarding the tyoe of statistical software, 18% of the papers used R, (Figure 11), 14% used other statistical software (e.g., SPSS, Statistica, or SAS) or something more specialized (e.g., NLOGIT or PRIMER), and 8% used multiple software. There were also papers (34%) that did not specify the software used or even that did not apply statistical analysis at all (26%).
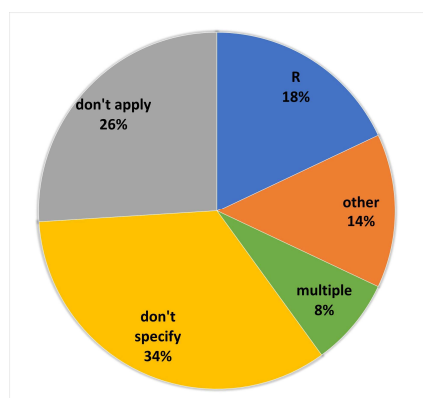

Figure 11. Papers per Statistical software.

Also, 24% of the papers used tools and software specifically developed for ES assessment (modelling for ES); see also Table A4 in Appendix B. Most of those papers (75%) used InVEST for mapping and assessing ES [57,60,62]. Among the models applied were included a recreation and overlap analysis model in the case of CES, various other models for the assessment of non-cultural categories of ES (e.g., carbon storage and sequestration, and crop production) [50,60], as well as for habitat risk assessment [60,78].

A few papers also applied InVEST linear regression analysis (included in the recreation model) to estimate the impact of potential landscape features (e.g., protected areas, beaches, campsites, roads, or attraction sites) on the distribution of visitors [57,59]. As already mentioned, there were also cases of papers (25%) that applied SoLVES (Social Values for Ecosystem Services) combined with maximum entropy modelling (MaxEnt) [53,83]. Finally, 22% applied other types of analysis that included:

- machine learning to automatically assign tags to photographs in social media analysis applications [81,84];

- macro-ecological modelling (MaxEnt) to model the spatial distribution of different CES in social-media analysis [82];
- other types of modelling (e.g., location-based pressure model orfuture dynamic land change model) to assess CES along with other ES [50,62].

Finally, there was a unique paper that applied habitat mapping using a variety of software for image and video processing (e.g., photoQuad software) [67].

4.6.2. Participatory Techniques, Tools, and Software

Almost 4% of the papers applied decision-making techniques and software, such as the GIS-based Technique for Order Preference by Similarity to Ideal Solution [GeoTOPSIS] [70], as well as other methods to support decision making (analytic hierarchy process—AHP, analytic network process—ANP, or the strategic options development analysis—SODA—approach) [10,70] (Table 4).

Table 4. Participatory methods, techniques tools, and software.

Participatory	Methods, Techniques, Tools	Software Used
Decision making	GIS-based Technique for Order Preference by Similarity to Ideal Solution [GeoTOPSIS] [1], Analytic Hierarchy Process (AHP) [2], Analytic Network Process (ANP) method [3], Strategic Options Development Analysis (SODA) approach [4],	QGIS [1], IDRISI SELVA [2], Super Decisions software [3], Decision Explorer software [4]
Web-based surveys	Google Maps platform, Scribble Maps, ESRI 's Survey123, Greenmapper survey tool, SeaSketch	

The numbers in brackets are used to associate methods and corresponding software.

Moreover, almost 29% of the participatory mapping applications used web-based surveys for data collection. Most of these studies used the Google Maps tool [9,53,58]. Among the other technologies used were Scribble Maps [81], ESRI's Survey 123 for the ArcGIS platform [63], the Greenmapper survey tool [55], and SeaSketch [66], the latter being a web-based tool for participatory marine spatial planning (Table 4).

5. Discussion

Nowadays, there is an increasing research interest in ES and CES, especially in the field of coastal and marine management. However, most of the existing research considers CES in the context of marine and coastal environments for efficient marine management (ecosystem-based management, MPAs, etc.) [8,9,62,64,71]. CES are usually neglected in the process of achieving integrated and strategic maritime spatial planning (MSP). MSP considers a wide range of marine activities and aims to create a framework for coordinated place-based and sustainable development in the marine space, and our research revealed only a few direct attempts to reflect on ES and integrate them in MSP (e.g., [3,5,6,10,12,13]).

Hence, this review aspired to provide guidance to the future inclusion of CES in the MSP process. Specifically, its novelty is the systematic gathering of experiences and methods used for the integration of CES into marine and coastal management from a purely methodological and technical point of view so as to inform MSP on how to use CES. To this end, all papers presenting methods of mapping and assessing CES were retrieved and analyzed.

Most of the retrieved papers were authored by the scientific and research community. Concerning their geographic distribution, a high percentage was focused on the Atlantic Ocean and especially on its Northeast part (mostly in the UK), while other sea-basins, such as the Mediterranean Sea, remain under-studied; most of the Mediterranean case studies were performed in Italy, Greece, and Israel [44,68,70,80,81,90,91]. In 2016, it was reported by a review paper [92] that most of the publications were identified in Europe, and specifically in the UK. In our times (seven years later), though, a relatively high number of publications were also found in other continents, such as in Asia, a few in America (Brazil), as well as in Africa (Morocco). Most of these papers are of regional or local scope,

while applications at the national scale are mostly located in the UK, Europe, Latvia, and Lithuania as well as in Asia and another in Brazil [11,60,62,63,76,82,84]. In addition, there is a lack of sea-basin-centered studies and coastal zone applications. It should be noted that, in this case, the publications were categorized based on administrative levels.

Furthermore, more than one third of the articles shed light on coastal and marine ecosystems, whilst only one fifth specifically concerned the marine environment. Also, a few papers assessed the usage of CES (mostly recreational activity) in relation to specific coastal and marine habitats (e.g., mangroves, reefs, etc.) [67,68,82].

Interestingly, a high number of publications (70%) involved stakeholders, and specifically, more than one fifth of the papers involved highly diverse groups of stakeholders (mixed groups) [9,70,71,81]. It becomes evident that stakeholders' involvement is an important component of effective mapping and assessment of CES, particularly during the MSP process [93], and that potential isolation of user groups fails to address potential conflicts and may misdirect planning and development.

It is also impressive that almost half of the studies used mixed mapping approaches, such as participatory mapping or social media analysis (coupled with other types of mapping) [11,83], InVEST modelling [60], composite indicators [10,44], modelling procedures [62], or combinations of the above [50,62,63,86]. A high percentage (>50%) of these approaches were participatory mapping applications. Besides, the coupling of participatory mapping with other methods served as a means, for:

- evaluating differences between user groups in the spatial distribution of CES values and the environmental drivers that influence it [53,72];
- assessing clustering of ES values in relation to land use and land cover categories [54,79];
- assessing the economic value of recreational uses [11,68];
- comparing the results of different methods [71,81];
- mapping different aspects of ES (supply, demand, and flow) [63];
- assessing risk from undertaken activities [50,67,78] or threats from specific pressures.

Follow the social mapping approaches, with participatory mapping being applied on most occasions, whilst strictly economic approaches appear in a few cases of benefit transfer valuation [56,75]. The results from the examination of the MSP-related articles (that were not influenced by search 2) agree with the previous remark; almost half of the relevant publications chose participatory mapping to map and assess CES. This is also confirmed by [94], stating that the preferred mapping approaches were either social value mapping or indicators based on touristic preference.

Another interesting point is that the integration of socio-cultural values into coastal/ marine management and the consequent CES assessment based upon their importance to the communities rather than to monetary terms, has grown into a major issue. Nevertheless, several factors influencing participatory mapping outcomes should be considered, such as the social value concept and typology, the spatial scale, the familiarity with the study area, the background of stakeholders, elicitation questions, and others [95,96].

Moreover, social media analysis is the next method in line for mapping and assessing CES, either by applying the InVEST recreation model or by analyzing social media data directly in a GIS application. According to [82], such data could become an important tool in CES assessment, as they can deliver a good overview of the cultural uses on a site. Moreover, the information on CES as to their type, volume, and scale, deriving from social media data is far more valuable than the one resulting from traditional survey methods [69]. Nevertheless, the results of social media analysis may not be representative of all social groups [97]. Besides, the use of benefit indicators (e.g., visitation data) to map CES supply could prove misleading during planning [44]. As pointed out by [82], social media data may not be viable in remote areas. It could be used, though, as a proxy to map the density of infrastructures regarding recreation [98]. Overall, social media data, and, in general, benefit indicators [11], are more suitable measures of CES demand [86].

Regarding valuation, a relatively low percentage of papers (~11%) applied a series of non-monetary methods as well as deliberative components [50,61,78,87]. According to [24],

especially in the case of many intangible values (such as spiritual, education, or sense of place), which are spatially and quantitatively underrepresented, the use of deliberative methods is necessary for their proper inclusion into planning. Additionally, in a deliberative process, people may come to express shared values instead of individual ones [95].

The discussion over shared values is important, especially where there is evidence of potential synergies or conflicts [92]. According to [95], the combination of different social valuation methods could provide different insights by addressing different aspects of socio-cultural values. Nevertheless, participatory mapping in a deliberative context could influence the map outcomes [96], thus demanding experienced facilitators [95].

In contrast, monetary valuation papers were "value transfer" applications [56,75]. Primary monetary valuation studies were mostly applied at the local scale, while the information for decision-making is mostly needed on national and regional scales. Value transfers provide the means to obtain this information [97]. However, some methodological challenges regarding value transfer should be considered [99]. Also, a few papers combined monetary and non-monetary methods [11,26,68,76], two of which were based on market price valuation of recreation and tourism [11,68]. As argued by [100], market price valuation cannot account for several use values that provide considerable well-being, while stated preference methods (such as contingent valuation) can elicit either use or non-use values.

An important paper [26] assessed shared values of ES by combining deliberative monetary valuation, systems modelling, and participatory mapping. Its results suggested that many of these place-based CES would have been underestimated by monetary valuation alone and that deliberation process could have an impact on value formation. As stated by [95], the integration of monetary valuations and ecological assessments with socio-cultural valuations does not only imply adding the different parts, but also seizing the interactions between them.

Furthermore, a multitude of techniques and tools for mapping and assessing CES were identified as well as a variety of software, especially statistical. Most of these techniques and tools were based on spatial and statistical analysis. A notable number of publications [9,11,54,57–59,63,64,69,74,82,86] applied statistical analysis with the main goal to examine the distribution of values in relation to various factors such as:

a.   environmental factors (distance to protected areas and ecosystems, naturalness, presence/absence of biotopes, etc.);
b.   socio-economic factors (land-cover and land-use types, distance to hubs, access, population density, etc.); as well as
c.   demographic factors (age, gender, employment, education, etc.) [54,64].

According to [95], information about the association of social values with spatial characteristics can better inform spatial planning. Based on the results of [9], the location of values is greatly influenced by aspects of policy and planning, such as access, population density, and tenure. According to them, places where diverse values are encountered present greater potential for conflict, and a deliberative approach is necessary, especially in the zone within a 2 km distance of the coast [9].

Finally, it seems that there is a gap in PPGIS/WebGIS applications concerning the assessment of coastal and marine ES (Appendix A, Table A2). The majority of the projects assessed CES as a subset of other conceptual frameworks (e.g., cultural landscapes). Additionally, only two of the projects were focusing on the coastal or marine environment and on ICZM or MSP. On a European level, the PERICLES project focused on better understanding tangible and intangible coastal and maritime heritage, including cultural, industrial, and natural heritage [101]. There is also the example of the WebGIS-based project for the Falkland Islands, which provided spatial data on the social values of CES [64,102]. The availability of efficient decision-support tools to enhance stakeholders' engagement is a prerequisite for a successful MSP. Participatory internet-based tools can assist the expression of many different views and their inclusion in planning and management [103].

Finally, this review certainly presents some limitations. First, publications that did not refer to MSP-related terms (such as "marine spatial planning", "coastal planning", etc.)

were excluded from the search. Nevertheless, the overall results on the favored mapping approaches regarding CES agree with those of [92] conducted in 2016.

Second, the review also focused on publications dealing with the spatial dimension of CES with an extra focus on participatory mapping approaches. As a result, the percentages concerning stakeholders' involvement and other evaluation methods used, i.e., the number of papers that included deliberative components or applied monetary methods, would be, in some cases, under- or overestimated.

Third, there are key analytical methods that did not appear through this review, such as cost–benefit and cost–effectiveness analyses (CBA and CEA, respectively) and input–output methods. Also, the social impact assessment method (SIA) is not met in the examined literature although it is crucial for evaluating the social effects of development decisions. Furthermore, the DELFI method, which is one of the fundamental qualitative methods in making development decisions, is merely mentioned in some papers. The fact that these methods did not appear through the current analysis of articles does not mean that they cannot be included in further research that will specify the whole spectrum of methods that are necessary in order to reinforce the place-based and the ecosystems approach of MSP.

6. Conclusions

The current review drew an, as far as possible, extensive, and in-depth scanning of the methods, techniques, tools, and software used for mapping and assessing cultural ecosystem services (CES) and provided a detailed presentation of the work established so far. The purpose of this review was to provide guidance to future research on CES in coastal and marine areas and, more specifically, to inform MSP processes and steps from a methodological and technical point of view on how to use CES.

For instance, in the MSP process, people and stakeholders are often called to value particular locations, e.g., those accessible to recreation or "culturally significant areas", and this review provided sufficient evidence on how this can be achieved in an extremely place-based and concrete manner. This means that the concept of CES may interestingly provide an important aid to the "place-based" approach upon which MSP is shaped. In this sense, the assessment of CES may result as an expression of cultural landscapes produced from the interaction between humans and nature. The CES concept can equally support the ecosystem approach principle, fully integrated in MSP, as well as the Maritime Spatial Planning Directive (MSPD). Naturally, one of the critical components of the ecosystem approach is the inclusion of ecosystem services into management decisions.

Furthermore, mapping, and valuing CES is extremely important when planning or implementing MSP at the lower scales (local, regional), in order to consider how people value the landscapes and seascapes, especially when new marine activities (e.g., offshore wind parks) may negatively impact these landscapes. This local knowledge, deriving from local people and communities should be integrated into MSP, and this could certainly define its responsiveness towards the various sea uses and the potential conflicts between these uses and, hence, its efficiency in maximizing synergies.

The very particular nature of CES also implies that much of their value may be underestimated by monetary methods and probably also by instrumental non-monetary approaches. That is why, in conclusion, it is important to collect and analyze practical experiences of their mapping and assessment. In this sense, reviews like the current one may be useful to MSP planners and practitioners since they are shedding light on this basic evidence.

It is important to note that this practical knowledge is not usually "property" of the marine spatial planners since it was traditionally produced in the context of coastal and marine management. Thus, a recommendation of this paper is that a systematic discussion should open for planners on these very important issues that are mostly defining the success of the MSPlans, including their social acceptance. CES inclusion in MSP should be part of the capacity building in MSP, especially on the regional and local levels of governance. On the transnational scale, the recently created Community of Practice (CoP)

for MSP in the Mediterranean would also do well to challenge these methodologies and techniques with a view to maritime spatial planning in the Common Sea, strongly infused with cultural values.

Appendix A

Table A1. List of abbreviations.

AHP	Analytic Hierarchy Process
ANOSIM	Analysis of similarities—ANOSIM
ANP	Analytic Network Process
CA	Correspondence analysis
CFA	Confirmatory factor analysis
CES	Cultural Ecosystem Services
CoP	Community of practice
EA	Ecosystem Approach
EMFF	European Maritime Fisheries Fund
ES	Ecosystem Services
EU	European Union
GIS	Geographic Information Systems
IDW	Inverse Distance Weighting
InVEST	Integrated Valuation of Ecosystem Services and Tradeoffs
MCA	Multi-criteria analysis
MCDA	Multi-criteria Decision Analysis
MEA	Millenium Ecosystem Assessment
MSP	Marine/Maritime Spatial Planning
MSPD	Maritime Spatial Planning Directive (MSPD),
MSPlans	Marine/Maritime Spatial Plans
MGWR	Multiscale Geographically Weighted Regression
NDVI	Normalized Difference Vegetation Index
PCA	Principal Component Analysis

Table A1. *Cont.*

PERMANOVA	Permutational Multivariate Analysis of Variance
PPGIS	Public Participation Geographic Information Systems
SEA	Strategic Environmental Assessment
SMCDA	Spatial Multi-Criteria Decision Analysis
SODA	Strategic Options Development Analysis
SoLVES	Social Values for Ecosystem Services
UNESCO	United Nations Educational, Scientific and Cultural Organization

Table A2. European funded PPGIS/WebGIS platforms related to CES, built by EU funded projects.

Title, Acronym, Duration and Lead Partner of the Project	Focus	Innovation Acheivement	References
HERCULES, 2013–2016 HERitage in CULtural landscapES Humboldt University in Berlin	Focused on preserving cultural landscapes through the empowerment of public and private actors. Use of PPGIS and crowdsourcing for the assessment of cultural landscapes in different spatial scales (local, national, pan-European). Case studies in 8 different countries (Estonia, Greece, Switzerland, France, Spain, UK, Netherlands, and Sweden).	Use of innovative technologies and tools. Communication amongst stakeholders and the general public through the Knowledge Hub platform.	[104,105]
LIFE-IP 4 Natura Project, 2018–2025 Integrated actions for the conservation and management of Natura 2000 sites, species, habitats and ecosystems.	Provided a web-based PPGIS, developed by Greek academia, government and NGOs.	PPGIS/webGIS which presents ES provided by Greek ecosystems (such as timber production, climate regulation, tourism and recreation) and is available for governmental, professional and public use.	[106]
Mare Nostrum funded by the EC under the ENPI CBCMED Programme	A cross-border project exploring new ways of protecting the Mediterranean coastline	A web-based PPGIS was developed in order to collect local knowledge and draw eco-heritage trails in the Grand Harbour of Malta	[107]
Horizon 2020 REINVENT, 2016–2018 Re-inventory-ing Heritage: Exploring the potential of PPGIS to capture heritage values and dissonance, (Marie Sklodowska-Curie grant agreement)	Addressed challenges related to the management of cultural heritage in Europe in a cross-border context, using as case study the city of Derry~Londonderry in North West Ireland.	Through MyValuedPlaces (a web-based pilot survey) communities' values are captured (such as, recreation, spiritual, therapeutic) at multiple scales. The project developed "the first cross-border cultural heritage atlas".	[108,109]
PERICLES project 2018–2021 Preserving and sustainably governing cultural heritage and landscapes in European coastal and maritime regions, Funded by Horizon 2020.	PERICLES promoted sustainable, participatory governance of maritime cultural heritage in European coastal and maritime regions through an interdisciplinary and geo-graphically wide-ranging approach.	The project developed an online mapping platform called "MapYourHeritage" for the collection of data on tangible and intangible cultural heritage on eight European regions (e.g., Aegean Sea, Brittany, Denmark). The aim of the portal was to provide an opportunity for the public to engage with coastal and marine cultural heritage.	[101]

Appendix B

Table A3. The publications selected or excluded based on the exclusion criteria.

a/a	Publications	Included, Excluded	Criterion of Exclusion
1	Agnew, S., Kopke, K., Power, O.-P., Troya, M.D.C., Dozier, A., 2022. Transdisciplinary Research: Can Citizen Science Support Effective Decision-Making for Coastal Infrastructure Management, Front. Mar. Sci. 9, 809284. https://doi.org/10.3389/fmars.2022.809284	EXCLUDED	Theoretical articles, discussions, reviews, etc.
2	Ainsworth, G.B., Kenter, J.O., O'Connor, S., Daunt, F., Young, J.C., 2019. A fulfilled human life: Eliciting sense of place and cultural identity in two UK marine environments through the Community Voice Method. Ecosystem Services 39, 100992. https://doi.org/10.1016/j.ecoser.2019.100992	EXCLUDED	Does not apply spatial analysis or mapping
3	Anbleyth-Evans, J., Lacy, S.N., Aguirre-Muñoz, C., Tredinnick-Rowe, J., 2020. Port dumping and participation in England: Developing an ecosystem approach through local ecological knowledge. Ocean & Coastal Management 192, 105195. https://doi.org/10.1016/j.ocecoaman.2020.105195	INCLUDED	
4	Ancona, Z.H., Bagstad, K.J., Le, L., Semmens, D.J., Sherrouse, B.C., Murray, G., Cook, P.S., DiDonato, E., 2022. Spatial social value distributions for multiple user groups in a coastal national park. Ocean & Coastal Management 222, 106126. https://doi.org/10.1016/j.ocecoaman.2022.106126	INCLUDED	
5	Andreeva, I., 2019. SPATIAL ASSESSMENT OF RECREATIONAL ECOSYSTEM SERVICES IN THE LARGE INLAND RIVER BASIN (UPPER OB, RUSSIA). Carpath. J. Earth Environ. Sci. 14, 67–76. https://doi.org/10.26471/cjees/2019/014/059	EXCLUDED	Does not focus on the coastal zone or the marine environment
6	Auer, A., Nahuelhual, L., Maceira, N., 2018. Cultural ecosystem services trade-offs arising from agriculturization in Argentina: A case study in Mar Chiquita Basin. Applied Geography 91, 45–54. https://doi.org/10.1016/j.apgeog.2017.12.025	EXCLUDED	Does not focus on the coastal zone or the marine environment
7	Banela, M., Kitsiou, D., 2023. Mapping cultural ecosystem services: A case study in Lesvos Island, Greece. Ocean & Coastal Management 246, 106883. https://doi.org/10.1016/j.ocecoaman.2023.106883	INCLUDED	
8	Baulcomb, C., Fletcher, R., Lewis, A., Akoglu, E., Robinson, L., von Almen, A., Hussain, S., Glenk, K., 2015. A pathway to identifying and valuing cultural ecosystem services: An application to marine food webs. Ecosystem Services 11, 128–139. https://doi.org/10.1016/j.ecoser.2014.10.013	EXCLUDED	Does not apply spatial analysis or mapping
9	Blake, D., Carver, S., Ziv, G., 2021. Demographic, natural and anthropogenic drivers for coastal Cultural ecosystem services in the Falkland Islands. Ecological Indicators 130, 108087. https://doi.org/10.1016/j.ecolind.2021.108087	INCLUDED	
10	Blake, D., Augé, A. A., & Sherren, K. (2017). Participatory mapping to elicit cultural coastal values for marine spatial planning in a remote archipelago. Ocean and Coastal Management, 148, 195–203. https://doi.org/10.1016/j.ocecoaman.2017.08.010	INCLUDED	
11	Börger, T., Hooper, T. L., Austen, M. C., Marcone, O., & Rendón, O. (2020). Using stated preference valuation in the offshore environment to support marine planning. Journal of Environmental Management, 265 https://doi.org/10.1016/j.jenvman.2020.110520	EXCLUDED	Does not apply spatial analysis or mapping

Table A3. *Cont.*

a/a	Publications	Included, Excluded	Criterion of Exclusion
12	Brown, G., & Hausner, V. H. (2017). An empirical analysis of cultural ecosystem values in coastal landscapes. Ocean and Coastal Management, 142, 49–60. https://doi.org/10.1016/j.ocecoaman.2017.03.019	INCLUDED	
13	Bryce, R., Irvine, K. N., Church, A., Fish, R., Ranger, S., & Kenter, J. O. (2016). Subjective well-being indicators for large-scale assessment of cultural ecosystem services. Ecosystem Services, 21, 258–269. https://doi.org/10.1016/j.ecoser.2016.07.015	EXCLUDED	Does not apply spatial analysis or mapping
14	Cerreta, M., Clemente, M., Ettorre, B., Poli, G., 2021. A Multidimensional Approach for Cultural Ecosystem Services (CES) Assessment: The Cilento Coast Case Study (Italy), in: Computational Science and Its Applications—ICCSA 2021: 21st International Conference, Cagliari, Italy, September 13–16, 2021, Proceedings, Part VII, pp. 490–503. https://doi.org/10.1007/978-3-030-87007-2_35	INCLUDED	
15	Chakraborty, S., Gasparatos, A., 2019. Community values and traditional knowledge for coastal ecosystem services management in the "satoumi" seascape of Himeshima island, Japan. Ecosystem Services 37, 100940. https://doi.org/10.1016/j.ecoser.2019.100940	INCLUDED	
16	Chang, P., Olafsson, A.S., 2022. The scale effects of landscape variables on landscape experiences: a multi-scale spatial analysis of social media data in an urban nature park context. Landsc Ecol 37, 1271–1291. https://doi.org/10.1007/s10980-022-01402-2	INCLUDED	
17	Cheng, X., Van Damme, S., Li, L., Uyttenhove, P., 2022. Cultural ecosystem services in an urban park: understanding bundles, trade-offs, and synergies. Landsc Ecol 37, 1693–1705. https://doi.org/10.1007/s10980-022-01434-8	EXCLUDED	Does not focus on the coastal zone or the marine environment
18	Chimienti, G., Stithou, M., Mura, I.D., Mastrototaro, F., D'Onghia, G., Tursi, A., Izzi, C., Fraschetti, S., 2017. An Explorative Assessment of the Importance of Mediterranean Coralligenous Habitat to Local Economy: The Case of Recreational Diving. JEAM 5, 315–325. https://doi.org/10.5890/JEAM.2017.12.004	INCLUDED	
19	Chung, M.G., Kang, H., Choi, S.-U., 2015. Assessment of Coastal Ecosystem Services for Conservation Strategies in South Korea. PLOS ONE 10, e0133856. https://doi.org/10.1371/journal.pone.0133856	INCLUDED	
20	Clarke, B., Thet, A.K., Sandhu, H., Dittmann, S., 2021. Integrating Cultural Ecosystem Services valuation into coastal wetlands restoration: A case study from South Australia. Environmental Science & Policy 116, 220–229. https://doi.org/10.1016/j.envsci.2020.11.014	EXCLUDED	Does not apply spatial analysis or mapping
21	Conejo-Watt, H., Muench, A., Mangi, S.C., Jeffery, K., Hyder, K., 2021. Fishers perspectives on the barriers for the English inshore fleet to diversify into aquaculture. Marine Policy 131, 104610. https://doi.org/10.1016/j.marpol.2021.104610	EXCLUDED	Does not apply spatial analysis or mapping
22	Cunha, J., Elliott, M., & Ramos, S. (2018). Linking modelling and empirical data to assess recreation services provided by coastal habitats: The case of NW portugal. Ocean and Coastal Management, 162, 60–70. https://doi.org/10.1016/j.ocecoaman.2017.12.022	INCLUDED	

Table A3. *Cont.*

a/a	Publications	Included, Excluded	Criterion of Exclusion
23	Dasgupta, R., Hashimoto, S., Basu, M., Okuro, T., Johnson, B.A., Kumar, P., Dhyani, S., 2022. Spatial characterization of non-material values across multiple coastal production landscapes in the Indian Sundarban delta. Sustain Sci 17, 725–738. https://doi.org/10.1007/s11625-020-00899-3	INCLUDED	
24	Daymond, T., Andrew, M.E., Kobryn, H.T., 2023. Crowdsourcing social values data: Flickr and public participation GIS provide different perspectives of ecosystem services in a remote coastal region. Ecosystem Services 64, 101566. https://doi.org/10.1016/j.ecoser.2023.101566	INCLUDED	
25	Depellegrin, D., Menegon, S., Gusatu, L., Roy, S., & Misiunė, I. (2020). Assessing marine ecosystem services richness and exposure to anthropogenic threats in small sea areas: A case study for the lithuanian sea space. Ecological Indicators, 108 https://doi.org/10.1016/j.ecolind.2019.105730	INCLUDED	
26	Depietri, Y., Ghermandi, A., Campisi-Pinto, S., Orenstein, D.E., 2021. Public participation GIS versus geolocated social media data to assess urban cultural ecosystem services: Instances of complementarity. Ecosystem Services 50, 101277. https://doi.org/10.1016/j.ecoser.2021.101277	INCLUDED	
27	Donahue, M.L., Keeler, B.L., Wood, S.A., Fisher, D.M., Hamstead, Z.A., McPhearson, T., 2018. Using social media to understand drivers of urban park visitation in the Twin Cities, MN. Landscape and Urban Planning 175, 1–10. https://doi.org/10.1016/j.landurbplan.2018.02.006	EXCLUDED	Does not focus on the coastal zone or the marine environment
28	Egarter Vigl, L., Depellegrin, D., Pereira, P., de Groot, R., Tappeiner, U., 2017. Mapping the ecosystem service delivery chain: Capacity, flow, and demand pertaining to aesthetic experiences in mountain landscapes. Science of The Total Environment 574, 422–436. https://doi.org/10.1016/j.scitotenv.2016.08.209	EXCLUDED	Does not focus on the coastal zone or the marine environment
29	Elwell, T.L., López-Carr, D., Gelcich, S., Gaines, S.D., 2020. The importance of cultural ecosystem services in natural resource-dependent communities: Implications for management. Ecosystem Services 44, 101123. https://doi.org/10.1016/j.ecoser.2020.101123	INCLUDED	
30	Fairchild, T.P., Weedon, J., Griffin, J.N., 2022. Species diversity enhances perceptions of urban coastlines at multiple scales. People and Nature 4, 931–948. https://doi.org/10.1002/pan3.10330	EXCLUDED	Does not apply spatial analysis or mapping
31	Filho, L.M., Roebeling, P., Villasante, S., Bastos, M.I., 2022. Ecosystem services values and changes across the Atlantic coastal zone: Considerations and implications. Marine Policy 145, 105265. https://doi.org/10.1016/j.marpol.2022.105265	INCLUDED	
32	Fisher, D.M., Wood, S.A., Roh, Y.-H., Kim, C.-K., 2019. The Geographic Spread and Preferences of Tourists Revealed by User-Generated Information on Jeju Island, South Korea. Land 8, 73. https://doi.org/10.3390/land8050073	INCLUDED	
33	Fletcher, R., Baulcomb, C., Hall, C., Hussain, S., 2014. Revealing marine cultural ecosystem services in the Black Sea. Marine Policy 50, 151–161. https://doi.org/10.1016/j.marpol.2014.05.001	EXCLUDED	Does not apply spatial analysis or mapping

Table A3. *Cont.*

a/a	Publications	Included, Excluded	Criterion of Exclusion
34	Gajardo, L.J., Sumeldan, J., Sajorne, R., Madarcos, J.R., Goh, H.C., Culhane, F., Langmead, O., Creencia, L., 2023. Cultural values of ecosystem services from coastal marine areas: Case of Taytay Bay, Palawan, Philippines. Environmental Science & Policy 142, 12–20. https://doi.org/10.1016/j.envsci.2023.01.004	INCLUDED	
35	Garcia, X., Benages-Albert, M., Vall-Casas, P., 2018. Landscape conflict assessment based on a mixed methods analysis of qualitative PPGIS data. Ecosystem Services 32, 112–124. https://doi.org/10.1016/j.ecoser.2018.07.003	EXCLUDED	Does not focus on the coastal zone or the marine environment
36	Gee, K., Kannen, A., Adlam, R., Brooks, C., Chapman, M., Cormier, R., Fischer, C., Fletcher, S., Gubbins, M., Shucksmith, R., Shellock, R., 2017. Identifying culturally significant areas for marine spatial planning. Ocean & Coastal Management 136, 139–147. https://doi.org/10.1016/j.ocecoaman.2016.11.026	EXCLUDED	Theoretical articles, discussions, reviews, etc.
37	Gee K., Burkhard B., 2017. Tracing regime shifts in the provision of coastal-marine cultural ecosystem services. Offshore Energy and Marine Spatial Planning, pp. 113–131, https://doi.org/10.4324/9781315666877	NO ACCESS	
38	Ghasemi, M., Charrahy, Z., González-García, A., 2023. Mapping cultural ecosystem services provision: An integrated model of recreation and ecotourism opportunities. Land Use Policy 131, 106732. https://doi.org/10.1016/j.landusepol.2023.106732	INCLUDED	
39	Gould, R.K., Klain, S.C., Ardoin, N.M., Satterfield, T., Woodside, U., Hannahs, N., Daily, G.C., Chan, K.M., 2015. A protocol for eliciting nonmaterial values through a cultural ecosystem services frame. Conservation Biology 29, 575–586. https://doi.org/10.1111/cobi.12407	EXCLUDED	Does not apply spatial analysis or mapping
40	Gould, R.K., Ardoin, N.M., Woodside, U., Satterfield, T., Hannahs, N., Daily, G.C., 2014. The forest has a story: cultural ecosystem services in Kona, Hawai'i. E&S 19, art55. https://doi.org/10.5751/ES-06893-190355	EXCLUDED	Does not focus in the coastal zone or the marine environment
41	Herbst, D. F., Gerhardinger, L. C., Vila-Nova, D. A., de Carvalho, F. G., & Hanazaki, N. (2020). Integrated and deliberative multidimensional assessment of a subtropical coastal-marine ecosystem (babitonga bay, brazil). Ocean and Coastal Management, 196 https://doi.org/10.1016/j.ocecoaman.2020.105279	INCLUDED	
42	Hilmi, N., Sutherland, M., Farahmand, S., Haraldsson, G., Van Doorn, E., Ernst, E., Wisz, M.S., Claudel Rusin, A., Elsler, L.G., Levin, L.A., 2023. Deep sea nature-based solutions to climate change. Front. Clim. 5, 1169665. https://doi.org/10.3389/fclim.2023.1169665	EXCLUDED	Theoretical articles, discussions, reviews, etc.
43	Hyytiäinen, K., Bauer, B., Bly Joyce, K., Ehrnsten, E., Eilola, K., Gustafsson, B. G.,. . . Zandersen, M. (2021). Provision of aquatic ecosystem services as a consequence of societal changes: The case of the baltic sea. Population Ecology, 63(1), 61–74. https://doi.org/doi:10.1002/1438-390X.12033	EXCLUDED	Does not apply spatial analysis or mapping
44	Inácio, M., Gomes, E., Bogdzevič, K., Kalinauskas, M., Zhao, W., Pereira, P., 2022. Mapping and assessing coastal recreation cultural ecosystem services supply, flow, and demand in Lithuania. Journal of Environmental Management 323, 116175. https://doi.org/10.1016/j.jenvman.2022.116175	INCLUDED	

Table A3. *Cont.*

a/a	Publications	Included, Excluded	Criterion of Exclusion
45	Jardeweski, C.L.F., Marenzi, R.C., Garcia, J.R., 2021. Impact assessment of the Arvoredo Marine Biological Reserve on ecosystem services and its stakeholders—Análise de impactos da Reserva Biológica Marinha do Arvoredo sobre os serviços ecossistêmicos e os stakeholders. Desenvolv. Meio Ambiente 58. https://doi.org/10.5380/dma.v58i0.75786	EXCLUDED	non-English
46	Jobstvogt, N., Watson, V., Kenter, J.O., 2014. Looking below the surface: The cultural ecosystem service values of UK marine protected areas (MPAs). Ecosystem Services 10, 97–110. https://doi.org/10.1016/j.ecoser.2014.09.006	EXCLUDED	Does not apply spatial analysis or mapping
47	Kalinauskas, M., Mikša, K., Inácio, M., Gomes, E., Pereira, P., 2021. Mapping and assessment of landscape aesthetic quality in Lithuania. Journal of Environmental Management 286, 112239. https://doi.org/10.1016/j.jenvman.2021.112239	EXCLUDED	Does not focus on the coastal zone or the marine environment
48	Kenter, J. O., Integrating deliberative monetary valuation, systems modelling and participatory mapping to assess shared values of ecosystem services, Ecosystem Services, Volume 21, Part B, 2016, Pages 291–307, ISSN 2212-0416, https://doi.org/10.1016/j.ecoser.2016.06.010	INCLUDED	
49	Kim, M., Lee, S., Oh, C.-O., 2021. Assessing Tradeoffs between Development and Conservation: A Case of Land Use Change in a National Park of Korea. Land 10, 152. https://doi.org/10.3390/land10020152	EXCLUDED	not related to CES
50	Klain, S. C., & Chan, K. M. A. (2012). Navigating coastal values: Participatory mapping of ecosystem services for spatial planning. Ecological Economics, 82, 104–113. https://doi.org/10.1016/j.ecolecon.2012.07.008	INCLUDED	
51	Klain, S.C., Satterfield, T.A., Chan, K.M.A., 2014. What matters and why? Ecosystem services and their bundled qualities. Ecological Economics 107, 310–320. https://doi.org/10.1016/j.ecolecon.2014.09.003	EXCLUDED	Does not apply spatial analysis or mapping
52	Kobryn, H. T., Brown, G., Munro, J., & Moore, S. A. (2018). Cultural ecosystem values of the kimberley coastline: An empirical analysis with implications for coastal and marine policy. Ocean and Coastal Management, 162, https://doi.org/10.1016/j.ocecoaman.2017.09.002	INCLUDED	
53	Kochalski, S. Carsten Riepe, Robert Arlinghaus; Perceived socio-cultural ecosystem services provided by wild Atlantic Salmon populations in four European countries. Aquatic Ecosystem Health & Management 1 July 2022; 25 (3): 12–21. doi: https://doi.org/10.14321/aehm.025.03.12	NO ACCESS	
54	Kochalski, S., Riepe, C., Arlinghaus, R., 2022. Perceived socio-cultural ecosystem services provided by wild Atlantic Salmon populations in four European countries. Aquatic Ecosystem Health & Management (2022) 25 (3): 12–21. https://doi.org/10.14321/aehm.025.03.12	NO ACCESS	
55	Kovács, B., Marquez-Linares, M.A., Rodriguez-Espinosa, P.F., Gutierrez-Yurrita, P.J., Perez-Verdin, G., 2021. Analysis of cultural ecosystem services of rock climbing settings in Mexico City: the case of Los Dinamos Recreational Park. Ecosystems and People 17, 370–382. https://doi.org/10.1080/26395916.2021.1946594	EXCLUDED	Does not focus on the coastal zone or the marine environment

Table A3. *Cont.*

a/a	Publications	Included, Excluded	Criterion of Exclusion
56	Lai, S., Motroni, S., Santona, L., Schirru, M., 2021. One Place, Different Communities' Perceptions. Mapping Cultural Ecosystem Services in the Asinara National Park (Italy). In: Et al. Computational Science and Its Applications—ICCSA 2021. ICCSA 2021. Lecture Notes in Computer Science(), Vol 12955. Springer, Cham. https://doi.org/10.1007/978-3-030-87007-2_48	INCLUDED	
57	Liu, S., Shen, P., Huang, Y., Jiang, L., Feng, Y., 2022. Spatial Distribution Changes in Nature-Based Recreation Service Supply from 2008 to 2018 in Shanghai, China. Land 11, 1862. https://doi.org/10.3390/land11101862	EXCLUDED	Does not focus on the coastal zone or the marine environment
58	S. C. Mangi, "The Impact of Offshore Wind Farms on Marine Ecosystems: A Review Taking an Ecosystem Services Perspective," in Proceedings of the IEEE, vol. 101, no. 4, pp. 999–1009, April 2013, https://doi.org/doi/10.1109/JPROC.2012.2232251.	EXCLUDED	Theoretical articles, discussions, reviews, etc.
59	Martin, C.L., Momtaz, S., Gaston, T., Moltschaniwskyj, N.A., 2020. Mapping the intangibles: Cultural ecosystem services derived from Lake Macquarie estuary, New South Wales, Australia. Estuarine, Coastal and Shelf Science 243, 106885. https://doi.org/10.1016/j.ecss.2020.106885	INCLUDED	
60	Martin, C.L., Momtaz, S., Gaston, T., Moltschaniwskyj, N.A., 2016. A systematic quantitative review of coastal and marine cultural ecosystem services: Current status and future research. Marine Policy 74, 25–32. https://doi.org/10.1016/j.marpol.2016.09.004	EXCLUDED	Theoretical articles, discussions, reviews, etc.
61	Mocior, E., Kruse, M., 2016. Educational values and services of ecosystems and landscapes—An overview. Ecological Indicators 60, 137–151. https://doi.org/10.1016/j.ecolind.2015.06.031	EXCLUDED	Theoretical articles, discussions, reviews, etc.
62	Mouttaki, I., Khomalli, Y., Maanan, Mohamed, Bagdanavičiūtė, I., Rhinane, H., Kuriqi, A., Pham, Q.B., Maanan, Mehdi, 2021. A New Approach to Mapping Cultural Ecosystem Services. Environments 8, 56. https://doi.org/10.3390/environments8060056	INCLUDED	
63	Muenzel, D., Martino, S., 2018. Assessing the feasibility of carbon payments and Payments for Ecosystem Services to reduce livestock grazing pressure on saltmarshes. Journal of Environmental Management 225, 46–61. https://doi.org/10.1016/j.jenvman.2018.07.060	INCLUDED	
64	Munro, J., Kobryn, H., Palmer, D., Bayley, S., Moore, S.A., 2019. Charting the coast: spatial planning for tourism using public participation GIS. Current Issues in Tourism 22, 486–504. https://doi.org/10.1080/13683500.2017.1346589	INCLUDED	
65	Nahuelhual, L., Vergara, X., Kusch, A., Campos, G., & Droguett, D. (2017). Mapping ecosystem services for marine spatial planning: Recreation opportunities in sub-antarctic chile. Marine Policy, 81, 211–218. https://doi.org/10.1016/j.marpol.2017.03.038	INCLUDED	
66	Neill, A., O'Donoghue, C., Stout, J., 2023. Spatial analysis of cultural ecosystem services using data from social media: A guide to model selection for research and practice. OE 8, e95685. https://doi.org/10.3897/oneeco.8.e95685	EXCLUDED	Does not focus on the coastal zone or the marine environment

Table A3. *Cont.*

a/a	Publications	Included, Excluded	Criterion of Exclusion
67	Neumann, B., Ott, K., Kenchington, R., 2017. Strong sustainability in coastal areas: a conceptual interpretation of SDG 14. Sustain Sci 12, 1019–1035. https://doi.org/10.1007/s11625-017-0472-y	EXCLUDED	Theoretical articles, discussions, reviews, etc.
68	Nieminen, E., Ahtiainen, H., Lagerkvist, C.-J., Oinonen, S., 2019. The economic benefits of achieving Good Environmental Status in the Finnish marine waters of the Baltic Sea. Marine Policy 99, 181–189. https://doi.org/10.1016/j.marpol.2018.10.014	EXCLUDED	Does not apply spatial analysis or mapping
69	Niz, W.C., Laurino, I.R.A., Freitas, D.M.D., Rolim, F.A., Motta, F.S., Pereira-Filho, G.H., 2023. Modeling risks in marine protected areas: Mapping of habitats, biodiversity, and cultural ecosystem services in the southernmost atlantic coral reef. Journal of Environmental Management 345, 118855. https://doi.org/10.1016/j.jenvman.2023.118855	INCLUDED	
70	O'Higgins, T., Dunne, D., Black, K., 2018. Many Points of View: Visibility Mapping for Marine Spatial Planning. International Journal of Spatial Data Infrastructure Research 302–314. https://doi.org/10.2902/1725-0463.2018.13.art18	INCLUDED	
71	Ocelli Pinheiro, R., Triest, L., Lopes, P.F.M., 2021. Cultural ecosystem services: Linking landscape and social attributes to ecotourism in protected areas. Ecosystem Services 50, 101340. https://doi.org/10.1016/j.ecoser.2021.101340	INCLUDED	
72	Orchard-Webb, J., Kenter, J.O., Bryce, R., Church, A., 2016. Deliberative Democratic Monetary Valuation to implement the Ecosystem Approach. Ecosystem Services 21, 308–318. https://doi.org/10.1016/j.ecoser.2016.09.005	EXCLUDED	Does not apply spatial analysis or mapping
73	Papathanasopoulou, E., Beaumont, N., Hooper, T., Nunes, J., Queirós, A.M., 2015. Energy systems and their impacts on marine ecosystem services. Renewable and Sustainable Energy Reviews 52, 917–926. https://doi.org/10.1016/j.rser.2015.07.150	EXCLUDED	Theoretical articles, discussions, reviews, etc.
74	Pellowe, K.E., Leslie, H.M., 2021. Ecosystem service lens reveals diverse community values of small-scale fisheries. Ambio 50, 586–600. https://doi.org/10.1007/s13280-020-01405-w	EXCLUDED	Does not apply spatial analysis or mapping
75	Pike, K., Wright, P., Wink, B., Fletcher, S., 2015. The assessment of cultural ecosystem services in the marine environment using Q methodology. J Coast Conserv 19, 667–675. https://doi.org/10.1007/s11852-014-0350-z	EXCLUDED	Does not apply spatial analysis or mapping
76	Piñeiro-Corbeira, C., Barreiro, R., Olmedo, M., & De la Cruz-Modino, R. (2020). Recreational snorkeling activities to enhance seascape enjoyment and environmental education in the islas atlánticas de galicia national park (spain). Journal of Environmental Management, 272 https://doi.org/doi:10.1016/j.jenvman.2020.111065	INCLUDED	
77	Pouso, S., Borja, Á., Martín, J., & Uyarra, M. C. (2019). The capacity of estuary restoration to enhance ecosystem services: System dynamics modelling to simulate recreational fishing benefits. Estuarine, Coastal and Shelf Science, 217, 226–236. https://doi.org/doi:10.1016/j.ecss.2018.11.026	EXCLUDED	Does not apply spatial analysis or mapping
78	Quilliam, R.S., Kinzelman, J., Brunner, J., Oliver, D.M., 2015. Resolving conflicts in public health protection and ecosystem service provision at designated bathing waters. Journal of Environmental Management 161, 237–242. https://doi.org/10.1016/j.jenvman.2015.07.017	EXCLUDED	Theoretical articles, discussions, reviews, etc.

Table A3. *Cont.*

a/a	Publications	Included, Excluded	Criterion of Exclusion
79	Ramirez Aranda et al. (2023). Cultural ecosystem services along the Woluwe River: mapping the potential for a cross-regional green-blue network during theCOVID-19 pandemic. Journal of Environmental Planning and Management, 2023 https://doi.org/10.1080/09640568.2023.2177141	EXCLUDED	Does not focus on the coastal zone or the marine environment
80	Ranger, S., Kenter, J.O., Bryce, R., Cumming, G., Dapling, T., Lawes, E., Richardson, P.B., 2016. Forming shared values in conservation management: An interpretive-deliberative-democratic approach to including community voices. Ecosystem Services 21, 344–357. https://doi.org/10.1016/j.ecoser.2016.09.016	EXCLUDED	Does not apply spatial analysis or mapping
81	Raum, S., 2018. A framework for integrating systematic stakeholder analysis in ecosystem services research: Stakeholder mapping for forest ecosystem services in the UK. Ecosystem Services 29, 170–184. https://doi.org/10.1016/j.ecoser.2018.01.001	EXCLUDED	Does not focus on the coastal zone or the marine environment
82	Raymond, C.M., Kenter, J.O., Plieninger, T., Turner, N.J., Alexander, K.A., 2014. Comparing instrumental and deliberative paradigms underpinning the assessment of social values for cultural ecosystem services. Ecological Economics 107, 145–156. https://doi.org/10.1016/j.ecolecon.2014.07.033	EXCLUDED	Theoretical articles, discussions, reviews, etc.
83	Retka, J., Jepson, P., Ladle, R.J., Malhado, A.C.M., Vieira, F.A.S., Normande, I.C., Souza, C.N., Bragagnolo, C., Correia, R.A., 2019. Assessing cultural ecosystem services of a large marine protected area through social media photographs. Ocean & Coastal Management 176, 40–48. https://doi.org/10.1016/j.ocecoaman.2019.04.018	INCLUDED	
84	Richards, D.R., Friess, D.A., 2015. A rapid indicator of cultural ecosystem service usage at a fine spatial scale: Content analysis of social media photographs. Ecological Indicators 53, 187–195. https://doi.org/10.1016/j.ecolind.2015.01.034	INCLUDED	
85	Román, C., Borja, A., Uyarra, M.C., Pouso, S., 2022. Surfing the waves: Environmental and socio-economic aspects of surf tourism and recreation. Science of The Total Environment 826, 154122. https://doi.org/10.1016/j.scitotenv.2022.154122	EXCLUDED	Theoretical articles, discussions, reviews, etc.
86	Garcia Rodrigues, J., Conides, A., Rivero Rodriguez, S., Raicevich, S., Pita, P., Kleisner, K., Pita, C., Lopes, P., Alonso Roldán, V., Ramos, S., Klaoudatos, D., Outeiro, L., Armstrong, C., Teneva, L., Stefanski, S., Böhnke-Henrichs, A., Kruse, M., Lillebø, A., Bennett, E., Belgrano, A., Murillas, A., Sousa Pinto, I., Burkhard, B., Villasante, S., 2017. Marine and Coastal Cultural Ecosystem Services: knowledge gaps and research priorities. OE 2, e12290. https://doi.org/10.3897/oneeco.2.e12290	EXCLUDED	Theoretical articles, discussions, reviews, etc.
87	Román, C., Borja, A., Uyarra, M.C., Pouso, S., 2022. Surfing the waves: Environmental and socio-economic aspects of surf tourism and recreation. Science of The Total Environment 826, 154122. https://doi.org/10.1016/j.scitotenv.2022.154122	EXCLUDED	Theoretical articles, discussions, reviews, etc.
88	Ruiz-Frau, A., Hinz, H., Edwards-Jones, G., & Kaiser, M. J. (2013). Spatially explicit economic assessment of cultural ecosystem services: Non-extractive recreational uses of the coastal environment related to marine biodiversity. Marine Policy, 38, 90–98. https://doi.org/10.1016/j.marpol.2012.05.023	INCLUDED	

Table A3. *Cont.*

a/a	Publications	Included, Excluded	Criterion of Exclusion
89	Ruskule, A., Klepers, A., Veidemane, K., 2018. Mapping and assessment of cultural ecosystem services of Latvian coastal areas. One Ecosystem 3. https://doi.org/10.3897/oneeco.3.e25499	INCLUDED	
90	Santos Vieira, F.A., Vinhas Santos, D.T., Bragagnolo, C., Campos-Silva, J.V., Henriques Correia, R.A., Jepson, P., Mendes Malhado, A.C., Ladle, R.J., 2021. Social media data reveals multiple cultural services along the 8.500 km of Brazilian coastline. Ocean & Coastal Management 214, 105918. https://doi.org/10.1016/j.ocecoaman.2021.105918	INCLUDED	
91	Cordoves Sánchez, M.A., Vallejos Romero, A., 2019. Mapeo del valor social en el marco de los servicios ecosistémicos. IB 33, 177. https://doi.org/10.22201/iibi.24488321xe.2019.79.58008	EXCLUDED	non-English
92	Santarém, F., Saarinen, J., Brito, J.C., 2020. Mapping and analysing cultural ecosystem services in conflict areas. Ecological Indicators 110, 105943. https://doi.org/10.1016/j.ecolind.2019.105943	EXCLUDED	Does not focus on the coastal zone or the marine environment
93	Satz, D., Gould, R.K., Chan, K.M.A., Guerry, A., Norton, B., Satterfield, T., Halpern, B.S., Levine, J., Woodside, U., Hannahs, N., Basurto, X., Klain, S., 2013. The Challenges of Incorporating Cultural Ecosystem Services into Environmental Assessment. AMBIO 42, 675–684. https://doi.org/10.1007/s13280-013-0386-6	EXCLUDED	Theoretical articles, discussions, reviews, etc.
94	Scholte, S.S.K., van Teeffelen, A.J.A., Verburg, P.H., 2015. Integrating socio-cultural perspectives into ecosystem service valuation: A review of concepts and methods. Ecological Economics 114, 67–78. https://doi.org/10.1016/j.ecolecon.2015.03.007	EXCLUDED	Theoretical articles, discussions, reviews, etc.
95	Sherrouse, B.C., Semmens, D.J., Ancona, Z.H., 2022. Social Values for Ecosystem Services (SolVES): Open-source spatial modeling of cultural services. Environmental Modelling & Software 148, 105259. https://doi.org/10.1016/j.envsoft.2021.105259	EXCLUDED	Does not focus on the coastal zone or the marine environment
96	Seijo, C., Calado, H., McClintock, W., Gil, A., Fonseca, C., 2021. Mapping recreational ecosystem services from stakeholders' perspective in the Azores. OE 6, e65751. https://doi.org/10.3897/oneeco.6.e65751	INCLUDED	
97	Sijtsma, F.J., Mehnen, N., Angelstam, P., Muñoz-Rojas, J., 2019. Multi-scale mapping of cultural ecosystem services in a socio-ecological landscape: A case study of the international Wadden Sea Region. Landscape Ecol 34, 1751–1768. https://doi.org/10.1007/s10980-019-00841-8	INCLUDED	
98	Speir, C., Phillips, A., Mamula, A., Norman, K., 2023. A measure of port-level resilience to shocks in commercial fisheries. Marine Policy 151, 105575. https://doi.org/10.1016/j.marpol.2023.105575	EXCLUDED	Not related to CES
99	Smart, L. S., Vukomanovic, J., Sills, E. O., & Sanchez, G. (2021). Cultural ecosystem services caught in a 'coastal squeeze' between sea level rise and urban expansion. Global Environmental Change, 66 https://doi.org/doi:10.1016/j.gloenvcha.2020.102209	INCLUDED	

Table A3. *Cont.*

a/a	Publications	Included, Excluded	Criterion of Exclusion
100	Spalding, M.D., Longley-Wood, K., McNulty, V.P., Constantine, S., Acosta- Morel, M., Anthony, V., Cole, A.D., Hall, G., Nickel, B.A., Schill, S.R., Schuhmann, P.W., Tanner, D., 2023. Nature dependent tourism—Combining big data and local knowledge. Journal of Environmental Management 337, 117696. https://doi.org/10.1016/j.jenvman.2023.117696	INCLUDED	
101	Spanou, E., Jasper O. Kenter, Marcello Graziano, The Effects of Aquaculture and Marine Conservation on Cultural Ecosystem Services: An Integrated Hedonic—Eudaemonic Approach, Ecological Economics, Volume 176, 2020, 106757, ISSN 0921-8009, https://doi.org/10.1016/j.ecolecon.2020.106757	INCLUDED	
102	Stebbings, E., Papathanasopoulou, E., Hooper, T., Austen, M.C., Yan, X., 2020. The marine economy of the United Kingdom. Marine Policy 116, 103905. https://doi.org/10.1016/j.marpol.2020.103905	EXCLUDED	Does not apply spatial analysis or mapping
103	Strand, M., Rivers, N., Snow, B., 2023. The complexity of evaluating, categorising and quantifying marine cultural heritage. Marine Policy 148, 105449. https://doi.org/10.1016/j.marpol.2022.105449	EXCLUDED	Theoretical articles, discussions, reviews, etc.
104	Tajima, Y., Hashimoto, S., Dasgupta, R., Takahashi, Y., 2023. Spatial characterization of cultural ecosystem services in the Ishigaki Island of Japan: A comparison between residents and tourists. Ecosystem Services 60, 101520. https://doi.org/10.1016/j.ecoser.2023.101520	INCLUDED	
105	Tenerelli, P., Demšar, U., Luque, S., 2016. Crowdsourcing indicators for cultural ecosystem services: A geographically weighted approach for mountain landscapes. Ecological Indicators 64, 237–248. https://doi.org/10.1016/j.ecolind.2015.12.042	EXCLUDED	Does not focus on the coastal zone or the marine environment
106	Torralba-Burrial, A., Dopico, E., 2023. Promoting the Sustainability of Artisanal Fishing through Environmental Education with Game-Based Learning. Sustainability 15, 12905. https://doi.org/10.3390/su151712905	EXCLUDED	Does not apply spatial analysis or mapping
107	van Oudenhoven, A.P.E., Aukes, E., Bontje, L.E., Vikolainen, V., van Bodegom, P.M., Slinger, J.H., 2018. 'Mind the Gap' between ecosystem services classification and strategic decision making. Ecosystem Services 33, 77–88. https://doi.org/10.1016/j.ecoser.2018.09.003	EXCLUDED	Does not apply spatial analysis or mapping
108	Vande Velde, K., Hugé, J., Friess, D.A., Koedam, N., Dahdouh-Guebas, F., 2019. Stakeholder discourses on urban mangrove conservation and management. Ocean & Coastal Management 178, 104810. https://doi.org/10.1016/j.ocecoaman.2019.05.012	EXCLUDED	Does not apply spatial analysis or mapping
109	Van Riper, C.J., Kyle, G.T., Sherrouse, B.C., Bagstad, K.J., Sutton, S.G., 2017. Toward an integrated understanding of perceived biodiversity values and environmental conditions in a national park. Ecological Indicators 72, 278– 287. https://doi.org/10.1016/j.ecolind.2016.07.029	INCLUDED	
110	Wang, Z., Jian, Y., Huang, Z., Qureshi, S., Cheng, K., Bai, Z., Zhang, Q., 2023. Transforming Research on Recreational Ecosystem Services into Applications and Governance. Land 12, 509. https://doi.org/10.3390/land12020509	EXCLUDED	Theoretical articles, discussions, reviews, etc.

Table A3. *Cont.*

a/a	Publications	Included, Excluded	Criterion of Exclusion
111	Weslawski, J. & Andrulewicz, Eugeniusz & Boström, Christoffer & Horbowy, Jan & Linkowski, Tomasz & Mattila, Johanna & Olenin, Sergej & Piwowarczyk, Joanna & Skóra, Krzysztof. (2017). Ecosystem goods, services and management. https://doi.org/10.1007/978-94-007-0668-2_18	EXCLUDED	Theoretical articles, discussions, reviews, etc.
112	Wilkins, E.J., Chikamoto, Y., Miller, A.B., Smith, J.W., 2021. Climate change and the demand for recreational ecosystem services on public lands in the continental United States. Global Environmental Change 70, 102365. https://doi.org/10.1016/j.gloenvcha.2021.102365	EXCLUDED	Does not focus on the coastal zone or the marine environment
113	Willis, C., Papathanasopoulou, E., Russel, D., Artioli, Y., 2018. Harmful algal blooms: the impacts on cultural ecosystem services and human well-being in a case study setting, Cornwall, UK. Marine Policy 97, 232–2 https://doi.org/10.1016/j.marpol.2018.06.002	EXCLUDED	Does not apply spatial analysis or mapping
114	DAI Peichao, ZHANG Shaoliang, LIU Run, YANG Yongjun, 2019. Research advances in cultural ecosystem services—An analysis based on Web of Science, 2019,39(5):1863~1875 https://doi.org/10.5846/stxb201712262325	EXCLUDED	non-English
115	Zhao, Q., Chen, Y., Gone, K.P., Wells, E., Margeson, K., Sherren, K., 2023. Modelling cultural ecosystem services in agricultural dykelands and tidal wetlands to inform coastal infrastructure decisions: A social media data approach. Marine Policy 150, 105533. https://doi.org/10.1016/j.marpol.2023.105533	INCLUDED	

Table A4. Methods, techniques, models, and tools per type of analysis.

Type of Desk Analysis	Methods, Techniques, Models, Tools	Software and Tools Used
Spatial Analysis (GIS)	a. Basic techniques and tools (kernel density tool, point density tool, line density tool; zonal statistics; buffer technique; intersect; spatial join; map algebra; "XY to Line" tool; extract multivalues to points tool; bootstrap sampling technique; minimum Euclidean distance; cost distance; calculate distance band from neighbor count) b. Viewshed analysis, classification methods (supervised maximum likelihood method) c. Interpolation methods (Inverse distance weighting (IDW), Kriging method) d. Spatial autocorrelation (semivariograms, global Moran's I tool, Incremental Spatial Autocorrelation tool), e. Cluster analysis (cluster and outlier analysis (Anselin local Moran's I), Getis–Ord (Gi*), f. Multiscale geographically Weighted Regression (MGWR) (1), radiometric calibration and atmospheric correction of images (2), NDVI (normalized difference vegetation index) (2)	ArcGIS, QGIS, Python [1] (Python spatial analysis library—PySAL), ENVI [2]

Table A4. *Cont.*

Type of Desk Analysis	Methods, Techniques, Models, Tools	Software and Tools Used
Statistical Analysis	a. Chi-square test; b. Proportional analysis; c. Kruskal–Wallis test, d. Dunn test; e. Steel–Dwass test; f. One-way ANOVA; g. Analysis of similarities—ANOSIM(1), h. Analysis of similarity percentages (SIMPER) (1); i. Permutational multivariate analysis of variance (PERMANOVA)(1), j. Multinomial regression, k. Multivariate linear regression, l. Pearson's correlation, m. Spearman correlation analysis, n. Canonical correlation analysis, o. Hierarchical cluster analysis—elbow method, p. k-means cluster analysis, q. Principal component analysis (PCA), r. Correspondence analysis (CA), s. Confirmatory factor analysis (CFA) t. Multiple group method, mixed logit models (2) u. Fleiss' kappa; v. Minimum/maximum method normalization method; w. Shapiro–Wilk test; x. *t*-test; z-test; y. Wald test; Wilcoxon's rank-sum test; multicollinearity tests; z. Bigram language model; aa. Meta-regression functions; bb. Multiple hedonic pricing; cc. OLS regressions.	Microsoft Excel, R, SPSS, Statistica, SAS studio, JMP Pro, PRIMER [1], NLOGIT [2]
Modelling for Ecosystem Services	a. Overlap analysis model; b. Recreation model; c. Habitat risk assessment (HRA) model; d. Habitat quality model; e. Coastal vulnerability model.	InVEST (Integrated Valuation of Ecosystem Services and Tradeoffs), SoLVES (Social Values for Ecosystem Services)
Other	a. Machine learning to automatically assign (1), (2), b. Macro-ecological modelling (3), c. Location-based pressure model (4), d. Future dynamic land change model (5), e. Sea level rise inundation pressure—spatial model from the National Oceanic and Atmospheric Administration (NOAA) f. Image processing (6), g. MaxN routine (7)	Cloud computing platform Clarifai [1], Google Cloud Vision API [2], MaxEnt [3], python—Tools4MSP [4], FUTure Urban-Regional Environment Simulation (FUTURES) [5], photoQuad software [6], EventMeasure (SeaGIS) software [7]

The numbers in brackets are used to associate methods and corresponding software.

Notes

1   https://naturalcapitalproject.stanford.edu/software/invest, accessed on 25 September 2022.
2   https://cordis.europa.eu/about

References

1.   Cabral, H.; Fonseca, V.; Sousa, T.; Costa Leal, M. Synergistic Effects of Climate Change and Marine Pollution: An Overlooked Interaction in Coastal and Estuarine Areas. *Int. J. Environ. Res. Public Health* **2019**, *16*, 2737. [CrossRef] [PubMed]
2.   Hattam, C.; Atkins, J.P.; Beaumont, N.; Börger, T.; Böhnke-Henrichs, A.; Burdon, D.; De Groot, R.; Hoefnagel, E.; Nunes, P.A.L.D.; Piwowarczyk, J.; et al. Marine ecosystem services: Linking indicators to their classification. *Ecol. Indic.* **2015**, *49*, 61–75. [CrossRef]

3. O'Higgins, T.; Dunne, D.; Black, K. Many Points of View: Visibility Mapping for Marine Spatial Planning. *Int. J. Spat. Data Infrastruct. Res.* **2018**, *13*, 302–314. [CrossRef]

4. Sousa, L.P.; Alves, F.L. A model to integrate ecosystem services into spatial planning: Ria de Aveiro coastal lagoon study. *Ocean Coast. Manag.* **2020**, *195*, 105280. [CrossRef]

5. Ivarsson, M.; Magnussen, K.; Heiskanen, A.-S.; Ståle, N.; Viitasalo, M. *Ecosystem Services in MSP, Ecosystem Services Approach as a Common Nordic Understanding for MSP*; Nordic Council of Ministers, TemaNord: Copenhagen, Denmark, 2017; p. 536.

6. Pennino, M.G.; Brodie, S.; Frainer, A.; Lopes, P.F.M.; Lopez, J.; Ortega-Cisneros, K.; Selim, S.; Vaidianu, N. The Missing Layers: Integrating Sociocultural Values into Marine Spatial Planning. *Front. Mar. Sci.* **2021**, *8*, 633198. [CrossRef]

7. Papageorgiou, M.; Kyvelou, S. Aspects of marine spatial planning and governance: Adapting to the transboundary nature and the special conditions of the sea. *Eur. J. Environ. Sci.* **2018**, *8*, 31–37. [CrossRef]

8. Ruskule, A.; Klepers, A.; Veidemane, K. Mapping and assessment of cultural ecosystem services of Latvian coastal areas. *One Ecosyst.* **2018**, *3*, e25499. [CrossRef]

9. Kobryn, H.T.; Brown, G.; Munro, J.; Moore, S.A. Cultural ecosystem values of the Kimberley coastline: An empirical analysis with implications for coastal and marine policy. *Ocean Coast. Manag.* **2018**, *162*, 71–84. [CrossRef]

10. Nahuelhual, L.; Vergara, X.; Kusch, A.; Campos, G.; Droguett, D. Mapping ecosystem services for marine spatial planning: Recreation opportunities in Sub-Antarctic Chile. *Mar. Policy* **2017**, *81*, 211–218. [CrossRef]

11. Ruiz-Frau, A.; Hinz, H.; Edwards-Jones, G.; Kaiser, M.J. Spatially explicit economic assessment of cultural ecosystem services: Non-extractive recreational uses of the coastal environment related to marine biodiversity. *Mar. Policy* **2013**, *38*, 90–98. [CrossRef]

12. Guerry, A.D.; Ruckelshaus, M.H.; Arkema, K.K.; Bernhardt, J.R.; Guannel, G.; Kim, C.-K.; Marsik, M.; Papenfus, M.; Toft, J.E.; Verutes, G.; et al. Modeling Benefits from Nature: Using Ecosystem Services to Inform Coastal and Marine Spatial Planning. *Int. J. Biodivers. Sci. Ecosyst. Serv. Manag.* **2012**, *8*, 107–121. [CrossRef]

13. Drakou, E.G.; Kermagoret, C.; Liquete, C.; Ruiz-Frau, A.; Burkhard, K.; Lillebø, A.I.; van Oudenhoven, A.P.E.; Ballé-Béganton, J.; Rodrigues, J.G.; Nieminen, E.; et al. Marine and coastal ecosystem services on the science–policy–practice nexus: Challenges and opportunities from 11 European case studies. *Int. J. Biodivers. Sci. Ecosyst. Serv. Manag.* **2017**, *13*, 51–67. [CrossRef]

14. European MSP Platform. Available online: www.msp-platform.eu (accessed on 26 November 2023).

15. Millennium Ecosystem Assessment. *Ecosystems and Human Well-being: Synthesis*; Island Press: Washington, DC, USA, 2005.

16. Satz, D.; Gould, R.K.; Chan, K.M.A.; Guerry, A.; Norton, B.; Satterfield, T.; Halpern, B.S.; Levine, J.; Woodside, U.; Hannahs, N.; et al. The Challenges of Incorporating Cultural Ecosystem Services into Environmental Assessment. *AMBIO* **2013**, *42*, 675–684. [CrossRef] [PubMed]

17. Fish, R.; Church, A.; Willis, C.; Winter, M.; Tratalos, J.A.; Haines-Young, R.; Potschin, M. Making space for cultural ecosystem services: Insights from a study of the UK nature improvement initiative. *Ecosyst. Serv.* **2016**, *21*, 329–343. [CrossRef]

18. Costanza, R.; De Groot, R.; Braat, L.; Kubiszewski, I.; Fioramonti, L.; Sutton, P.; Farber, S.; Grasso, M. Twenty years of ecosystem services: How far have we come and how far do we still need to go? *Ecosyst. Serv.* **2017**, *28*, 1–16. [CrossRef]

19. EU Biodiversity Strategy 2020, EUR-lex. Available online: https://eur-lex.europa.eu/EN/legal-content/summary/biodiversity-strategy-for-2020.html (accessed on 26 November 2023).

20. Schaich, H.; Bieling, C.; Plieninger, T. Linking Ecosystem Services with Cultural Landscape Research. *GAIA-Ecol. Perspect. Sci. Soc.* **2010**, *19*, 269–277. [CrossRef]

21. Chan, K.M.; Satterfield, T.; Goldstein, J. Rethinking ecosystem services to better address and navigate cultural values. *Ecol. Econ.* **2012**, *74*, 8–18. [CrossRef]

22. Chan, K.M.A.; Guerry, A.D.; Balvanera, P.; Klain, S.; Satterfield, T.; Basurto, X.; Bostrom, A.; Chuenpagdee, R.; Gould, R.; Halpern, B.S.; et al. Where are Cultural and Social in Ecosystem Services? A Framework for Constructive Engagement. *BioScience* **2012**, *62*, 744–756. [CrossRef]

23. Hernández-Morcillo, M.; Plieninger, T.; Bieling, C. An empirical review of cultural ecosystem service indicators. *Ecol. Indic.* **2013**, *29*, 434–444. [CrossRef]

24. Klain, S.C.; Chan, K.M.A. Navigating coastal values: Participatory mapping of ecosystem services for spatial planning. *Ecol. Econ.* **2012**, *82*, 104–113. [CrossRef]

25. Brown, G.; Fagerholm, N. Empirical PPGIS/PGIS mapping of ecosystem services: A review and evaluation. *Ecosyst. Serv.* **2015**, *13*, 119–133. [CrossRef]

26. Kenter, J.O. Integrating Deliberative Monetary Valuation, Systems Modelling and Participatory Mapping to Assess Shared Values of Ecosystem Services. *Ecosyst. Serv.* **2016**, *21*, 291–307. [CrossRef]

27. Cooper, N.; Brady, E.; Steen, H.; Bryce, R. Aesthetic and spiritual values of ecosystems: Recognising the ontological and axiological plurality of cultural ecosystem 'services'. *Ecosyst. Serv.* **2016**, *21*, 218–229. [CrossRef]

28. Murray, G.; D'anna, L.; MacDonald, P. Measuring what we value: The utility of mixed methods approaches for incorporating values into marine social-ecological system management. *Mar. Policy* **2016**, *73*, 61–68. [CrossRef]

29. Diaz, S.; Pascual, U.; Stenseke, M.; Martín-López, B.; Watson, R.T.; Molnár, Z.; Hill, R.; Chan, K.M.A.; Baste, I.A.; Brauman, K.A.; et al. Assessing nature's contributions to people. *Science* **2018**, *359*, 270–272. [CrossRef]

30. Braat, L.C. Five reasons why the Science publication "Assessing nature's contributions to people" (Diaz et al. 2018) would not have been accepted in Ecosystem Services. *Ecosyst. Serv.* **2018**, *30*, A1–A2. [CrossRef]

31. Gee, K.; Kannen, A.; Adlam, R.; Brooks, C.; Chapman, M.; Cormier, R.; Fischer, C.; Fletcher, S.; Gubbins, M.; Shucksmith, R.; et al. Identifying culturally significant areas for marine spatial planning. *Ocean Coast. Manag.* **2017**, *136*, 139–147. [CrossRef]

32. Halpern, B.S.; Diamond, J.; Gaines, S.; Gelcich, S.; Gleason, M.; Jennings, S.; Lester, S.; Mace, A.; McCook, L.; McLeod, K.; et al. Near-term priorities for the science, policy and practice of Coastal and Marine Spatial Planning (CMSP). *Mar. Policy* **2012**, *36*, 198–205. [CrossRef]

33. Fletcher, R.; Baulcomb, C.; Hall, C.; Hussain, S. Revealing Marine Cultural Ecosystem Services in the Black Sea. *Mar. Policy* **2014**, *50*, 151–161. [CrossRef]

34. Potts, T.; Burdon, D.; Jackson, E.; Atkins, J.; Saunders, J.; Hastings, E.; Langmead, O. Do marine protected areas deliver flows of ecosystem services to support human welfare? *Mar. Policy* **2014**, *44*, 139–148. [CrossRef]

35. Turner, R.K.; Schaafsma, M. (Eds.) *Coastal Zones Ecosystem Services, From Science to Values and Decision Making*; Part of the Studies in Ecological Economics Book Series (SEEC); Springer: Berlin/Heidelberg, Germany, 2015; Volume 9. [CrossRef]

36. Barbier, E.B.; Hacker, S.D.; Kennedy, C.; Koch, E.W.; Stier, A.C.; Silliman, B.R. The value of estuarine and coastal ecosystem services. *Ecol. Monogr.* **2011**, *81*, 169–193. [CrossRef]

37. Saunders, J.; Beaumont, N.; Atkins, J.P.; Lannin, A.; Lear, D.; Ozdemiroglu, E.; Potts, T. A review of marine and coastal ecosystem services data and tools to incorporate this into decision-making. In *Coastal Zones Ecosystem Services*; Turner, R., Kerry, R.K., Schaafsma, M., Eds.; Springer International Publishing: Heidelberg/Berlin, Germany, 2015; pp. 145–165.

38. Luisetti, T.; Turner, R.; Jickells, T.; Andrews, J.; Elliott, M.; Schaafsma, M.; Beaumont, N.; Malcolm, S.; Burdon, D.; Adams, C.; et al. Coastal Zone Ecosystem Services: From science to values and decision making; a case study. *Sci. Total Environ.* **2014**, *493*, 682–693. [CrossRef] [PubMed]

39. Ranger, S.; Kenter, J.; Bryce, R.; Cumming, G.; Dapling, T.; Lawes, E.; Richardson, P. Forming shared values in conservation management: An interpretive-deliberative-democratic approach to including community voices. *Ecosyst. Serv.* **2016**, *21*, 344–357. [CrossRef]

40. Baulcomb, C.; Fletcher, R.; Lewis, A.; Akoglu, E.; Robinson, L.; von Almen, A.; Hussain, S.; Glenk, K. A pathway to identifying and valuing cultural ecosystem services: An application to marine food webs. *Ecosyst. Serv.* **2015**, *11*, 128–139. [CrossRef]

41. Noor, M.I.M.; Alagappar, P.N.; Then, A.Y.-H.; Justine, E.V.; Lim, V.-C.; Goh, H.C. Perspectives of youths on cultural ecosystem services provided by Tun Mustapha Park, Malaysia through a participatory approach. *Environ. Educ. Res.* **2023**, *29*, 63–80. [CrossRef]

42. Kenter, J.O.; Bryce, R.; Christie, M.; Cooper, N.; Hockley, N.; Irvine, K.N.; Fazey, I.; O'brien, L.; Orchard-Webb, J.; Ravenscroft, N.; et al. Shared values and deliberative valuation: Future directions. *Ecosyst. Serv.* **2016**, *21*, 358–371. [CrossRef]

43. Bryce, R.; Irvine, K.N.; Church, A.; Fish, R.; Ranger, S.; Kenter, J.O. Subjective well-being indicators for large-scale assessment of cultural ecosystem services. *Ecosyst. Serv.* **2016**, *21*, 258–269. [CrossRef]

44. Banela, M.; Kitsiou, D. Mapping cultural ecosystem services: A case study in Lesvos Island, Greece. *Ocean Coast. Manag.* **2023**, *246*, 106883. [CrossRef]

45. Barianaki, E.; Kyvelou, S.S.; Ierapetritis, D.G. How to Incorporate Cultural Values and Heritage in Maritime Spatial Planning: A Systematic Review. *Heritage* **2024**, *7*, 380–411. [CrossRef]

46. Brander, L.M.; van Beukering, P.; Balzan, M.; Broekx, S.; Liekens, I.; Marta-Pedroso, C.; Szkop, Z.; Vause, J.; Maes, J.; Santos-Martin, F.; et al. *Report on Economic Mapping and Assessment Methods for Ecosystem Services*; Deliverable D3.2 EU Horizon 2020 ESMERALDA Project. Grant Agreement No. 642007; ESMERALDA: Hannover, Germany, 2018.

47. Santos-Martín, F.; Plieninger, T.; Torralba, M.; Fagerholm, N.; Vejre, H.; Luque, S.; Weibel, B.; Rabe, S.-E.; Balzan, M.; Czúcz, B.; et al. *Report on Social Mapping and Assessment Methods*; Deliverable D3.1EU Horizon 2020 ESMERALDA Project, Grant Agreement No. 642007; ESMERALDA: Hannover, Germany, 2018.

48. Santos-Martín, F.; Brander, L.; van Beukering, P.; Vihervaara, P.; Potschin-Young, M.; Liekens, I.; Broeks, S.; Weibel, B.; Rabe, S.-E.; Mononen, L.; et al. *Guidance Report on a Multi-Tiered Flexible Methodology for Integrating Social, Economic and Biophysical Methods*; Deliverable D3.4. EU Horizon 2020 ESMERALDA Project, Grant Agreement No. 642007; ESMERALDA: Hannover, Germany, 2018.

49. Vihervaara, P.; Mononen, L.; Nedkov, S.; Viinikka, A. *Biophysical Mapping and Assessment Methods for Ecosystem Services*; Deliverable D3.3 EU Horizon 2020 ESMERALDA Project, Grant Agreement No. 642007; ESMERALDA: Hannover, Germany, 2018.

50. Smart, L.S.; Vukomanovic, J.; Sills, E.O.; Sanchez, G. Cultural Ecosystem Services Caught in a 'Coastal Squeeze' between Sea Level Rise and Urban Expansion. *Glob. Environ. Change* **2021**, *66*, 102209. [CrossRef]

51. Cheng, X.; Van Damme, S.; Li, L.; Uyttenhove, P. Evaluation of Cultural Ecosystem Services: A Review of Methods. *Ecosyst. Serv.* **2019**, *37*, 100925. [CrossRef]

52. Sherrouse, B.C.; Semmens, D.J.; Ancona, Z.H. Social Values for Ecosystem Services (SolVES): Open-Source Spatial Modeling of Cultural Services. *Environ. Model. Softw.* **2022**, *148*, 105259. [CrossRef]

53. Ancona, Z.H.; Bagstad, K.J.; Le, L.; Semmens, D.J.; Sherrouse, B.C.; Murray, G.; Cook, P.S.; DiDonato, E. Spatial Social Value Distributions for Multiple User Groups in a Coastal National Park. *Ocean Coast. Manag.* **2022**, *222*, 106126. [CrossRef]

54. Dasgupta, R.; Hashimoto, S.; Basu, M.; Okuro, T.; Johnson, B.A.; Kumar, P.; Dhyani, S. Spatial Characterization of Non-Material Values across Multiple Coastal Production Landscapes in the Indian Sundarban Delta. *Sustain. Sci.* **2022**, *17*, 725–738. [CrossRef]

55. Sijtsma, F.J.; Mehnen, N.; Angelstam, P.; Muñoz-Rojas, J. Multi-Scale Mapping of Cultural Ecosystem Services in a Socio-Ecological Landscape: A Case Study of the International Wadden Sea Region. *Landsc. Ecol.* **2019**, *34*, 1751–1768. [CrossRef]

56. Filho, L.M.; Roebeling, P.; Villasante, S.; Bastos, M.I. Ecosystem Services Values and Changes across the Atlantic Coastal Zone: Considerations and Implications. *Mar. Policy* **2022**, *145*, 105265. [CrossRef]

57. Mouttaki, I.; Khomalli, Y.; Maanan, M.; Bagdanavičiūtė, I.; Rhinane, H.; Kuriqi, A.; Pham, Q.B.; Maanan, M. A New Approach to Mapping Cultural Ecosystem Services. *Environments* **2021**, *8*, 56. [CrossRef]

58. Brown, G.; Hausner, V.H. An Empirical Analysis of Cultural Ecosystem Values in Coastal Landscapes. *Ocean Coast. Manag.* **2017**, *142*, 49–60. [CrossRef]

59. Cunha, J.; Elliott, M.; Ramos, S. Linking Modelling and Empirical Data to Assess Recreation Services Provided by Coastal Habitats: The Case of NW Portugal. *Ocean Coast. Manag.* **2018**, *162*, 60–70. [CrossRef]

60. Chung, M.G.; Kang, H.; Choi, S.-U. Assessment of Coastal Ecosystem Services for Conservation Strategies in South Korea. *PLoS ONE* **2015**, *10*, e0133856. [CrossRef]

61. Chakraborty, S.; Gasparatos, A. Community Values and Traditional Knowledge for Coastal Ecosystem Services Management in the "Satoumi" Seascape of Himeshima Island, Japan. *Ecosyst. Serv.* **2019**, *37*, 100940. [CrossRef]

62. Depellegrin, D.; Menegon, S.; Gusatu, L.; Roy, S.; Misiunė, I. Assessing Marine Ecosystem Services Richness and Exposure to Anthropogenic Threats in Small Sea Areas: A Case Study for the Lithuanian Sea Space. *Ecol. Indic.* **2020**, *108*, 105730. [CrossRef]

63. Inácio, M.; Gomes, E.; Bogdzevič, K.; Kalinauskas, M.; Zhao, W.; Pereira, P. Mapping and Assessing Coastal Recreation Cultural Ecosystem Services Supply, Flow, and Demand in Lithuania. *J. Environ. Manag.* **2022**, *323*, 116175. [CrossRef]

64. Blake, D.; Augé, A.A.; Sherren, K. Participatory Mapping to Elicit Cultural Coastal Values for Marine Spatial Planning in a Remote Archipelago. *Ocean Coast. Manag.* **2017**, *148*, 195–203. [CrossRef]

65. Piñeiro-Corbeira, C.; Barreiro, R.; Olmedo, M.; De la Cruz-Modino, R. Recreational Snorkeling Activities to Enhance Seascape Enjoyment and Environmental Education in the Islas Atlánticas de Galicia National Park (Spain). *J. Environ. Manag.* **2020**, *272*, 111065. [CrossRef] [PubMed]

66. Seijo, C.; Calado, H.; McClintock, W.; Gil, A.; Fonseca, C. Mapping Recreational Ecosystem Services from Stakeholders' Perspective in the Azores. *One Ecosyst.* **2021**, *6*, e65751. [CrossRef]

67. Niz, W.C.; Laurino, I.R.A.; Freitas, D.M.D.; Rolim, F.A.; Motta, F.S.; Pereira-Filho, G.H. Modeling Risks in Marine Protected Areas: Mapping of Habitats, Biodiversity, and Cultural Ecosystem Services in the Southernmost Atlantic Coral Reef. *J. Environ. Manag.* **2023**, *345*, 118855. [CrossRef]

68. Chimienti, G.; Stithou, M.; Mura, I.D.; Mastrototaro, F.; D'Onghia, G.; Tursi, A.; Izzi, C.; Fraschetti, S. An Explorative Assessment of the Importance of Mediterranean Coralligenous Habitat to Local Economy: The Case of Recreational Diving. *JEAM* **2017**, *5*, 315–325. [CrossRef]

69. Retka, J.; Jepson, P.; Ladle, R.J.; Malhado, A.C.M.; Vieira, F.A.S.; Normande, I.C.; Souza, C.N.; Bragagnolo, C.; Correia, R.A. Assessing Cultural Ecosystem Services of a Large Marine Protected Area through Social Media Photographs. *Ocean Coast. Manag.* **2019**, *176*, 40–48. [CrossRef]

70. Cerreta, M.; Clemente, M.; Ettorre, B.; Poli, G. A Multidimensional Approach for Cultural Ecosystem Services (CES) Assessment: The Cilento Coast Case Study (Italy). In Proceedings of the Computational Science and Its Applications—ICCSA 2021: 21st International Conference, Cagliari, Italy, 13–16 September 2021; pp. 490–503.

71. Daymond, T.; Andrew, M.E.; Kobryn, H.T. Crowdsourcing Social Values Data: Flickr and Public Participation GIS Provide Different Perspectives of Ecosystem Services in a Remote Coastal Region. *Ecosyst. Serv.* **2023**, *64*, 101566. [CrossRef]

72. Blake, D.; Carver, S.; Ziv, G. Demographic, Natural and Anthropogenic Drivers for Coastal Cultural Ecosystem Services in the Falkland Islands. *Ecol. Indic.* **2021**, *130*, 108087. [CrossRef]

73. Ocelli Pinheiro, R.; Triest, L.; Lopes, P.F.M. Cultural Ecosystem Services: Linking Landscape and Social Attributes to Ecotourism in Protected Areas. *Ecosyst. Serv.* **2021**, *50*, 101340. [CrossRef]

74. Tajima, Y.; Hashimoto, S.; Dasgupta, R.; Takahashi, Y. Spatial Characterization of Cultural Ecosystem Services in the Ishigaki Island of Japan: A Comparison between Residents and Tourists. *Ecosyst. Serv.* **2023**, *60*, 101520. [CrossRef]

75. Muenzel, D.; Martino, S. Assessing the Feasibility of Carbon Payments and Payments for Ecosystem Services to Reduce Livestock Grazing Pressure on Saltmarshes. *J. Environ. Manag.* **2018**, *225*, 46–61. [CrossRef] [PubMed]

76. Spanou, E.; Kenter, J.O.; Graziano, M. The Effects of Aquaculture and Marine Conservation on Cultural Ecosystem Services: An Integrated Hedonic–Eudaemonic Approach. *Ecol. Econ.* **2020**, *176*, 106757. [CrossRef]

77. Gajardo, L.J.; Sumeldan, J.; Sajorne, R.; Madarcos, J.R.; Goh, H.C.; Culhane, F.; Langmead, O.; Creencia, L. Cultural Values of Ecosystem Services from Coastal Marine Areas: Case of Taytay Bay, Palawan, Philippines. *Environ. Sci. Policy* **2023**, *142*, 12–20. [CrossRef]

78. Herbst, D.F.; Gerhardinger, L.C.; Vila-Nova, D.A.; de Carvalho, F.G.; Hanazaki, N. Integrated and Deliberative Multidimensional Assessment of a Subtropical Coastal-Marine Ecosystem (Babitonga Bay, Brazil). *Ocean Coast. Manag.* **2020**, *196*, 105279. [CrossRef]

79. Martin, C.L.; Momtaz, S.; Gaston, T.; Moltschaniwskyj, N.A. Mapping the Intangibles: Cultural Ecosystem Services Derived from Lake Macquarie Estuary, New South Wales, Australia. *Estuar. Coast. Shelf Sci.* **2020**, *243*, 106885. [CrossRef]

80. Lai, S.; Motroni, S.; Santona, L.; Schirru, M. One Place, Different Communities' Perceptions. Mapping Cultural Ecosystem Services in the Asinara National Park (Italy). In Proceedings of the Computational Science and Its Applications—ICCSA 2021: 21st International Conference, Cagliari, Italy, 13–16 September 2021; Lecture Notes in Computer Science. Springer: Cham, Switzerland, 2021; Volume 12955.

81. Depietri, Y.; Ghermandi, A.; Campisi-Pinto, S.; Orenstein, D.E. Public Participation GIS versus Geolocated Social Media Data to Assess Urban Cultural Ecosystem Services: Instances of Complementarity. *Ecosyst. Serv.* **2021**, *50*, 101277. [CrossRef]

82. Richards, D.R.; Friess, D.A. A Rapid Indicator of Cultural Ecosystem Service Usage at a Fine Spatial Scale: Content Analysis of Social Media Photographs. *Ecol. Indic.* **2015**, *53*, 187–195. [CrossRef]

83. Zhao, Q.; Chen, Y.; Gone, K.P.; Wells, E.; Margeson, K.; Sherren, K. Modelling Cultural Ecosystem Services in Agricultural Dykelands and Tidal Wetlands to Inform Coastal Infrastructure Decisions: A Social Media Data Approach. *Mar. Policy* **2023**, *150*, 105533. [CrossRef]

84. Santos Vieira, F.A.; Vinhas Santos, D.T.; Bragagnolo, C.; Campos-Silva, J.V.; Henriques Correia, R.A.; Jepson, P.; Mendes Malhado, A.C.; Ladle, R.J. Social Media Data Reveals Multiple Cultural Services along the 8.500 Kilometers of Brazilian Coastline. *Ocean Coast. Manag.* **2021**, *214*, 105918. [CrossRef]

85. Ghasemi, M.; Charrahy, Z.; González-García, A. Mapping Cultural Ecosystem Services Provision: An Integrated Model of Recreation and Ecotourism Opportunities. *Land Use Policy* **2023**, *131*, 106732. [CrossRef]

86. Fisher, D.M.; Wood, S.A.; Roh, Y.-H.; Kim, C.-K. The Geographic Spread and Preferences of Tourists Revealed by User-Generated Information on Jeju Island, South Korea. *Land* **2019**, *8*, 73. [CrossRef]

87. Elwell, T.L.; López-Carr, D.; Gelcich, S.; Gaines, S.D. The Importance of Cultural Ecosystem Services in Natural Resource-Dependent Communities: Implications for Management. *Ecosyst. Serv.* **2020**, *44*, 101123. [CrossRef]

88. Anbleyth-Evans, J.; Lacy, S.N.; Aguirre-Muñoz, C.; Tredinnick-Rowe, J. Port Dumping and Participation in England: Developing an Ecosystem Approach through Local Ecological Knowledge. *Ocean Coast. Manag.* **2020**, *192*, 105195. [CrossRef]

89. Chang, P.; Olafsson, A.S. The Scale Effects of Landscape Variables on Landscape Experiences: A Multi-Scale Spatial Analysis of Social Media Data in an Urban Nature Park Context. *Landsc. Ecol.* **2022**, *37*, 1271–1291. [CrossRef]

90. Maniatakou, S.; Berg, H.; Maneas, G.; Daw, T.M. Unravelling Diverse Values of Ecosystem Services: A Socio-Cultural Valuation Using Q Methodology in Messenia, Greece. *Sustainability* **2020**, *12*, 10320. [CrossRef]

91. Vlami, V.; Kokkoris, I.P.; Zogaris, S.; Kehayias, G.; Dimopoulos, P. Cultural Ecosystem Services in the Natura 2000 Network: Introducing Proxy Indicators and Conflict Risk in Greece. *Land* **2021**, *10*, 4. [CrossRef]

92. Martin, C.L.; Momtaz, S.; Gaston, T.; Moltschaniwskyj, N.A. A Systematic Quantitative Review of Coastal and Marine Cultural Ecosystem Services: Current Status and Future Research. *Mar. Policy* **2016**, *74*, 25–32. [CrossRef]

93. Węsławski, J.M.; Andrulewicz, E.; Boström, C.; Horbowy, J.; Linkowski, T.; Mattila, J.; Olenin, S.; Piwowarczyk, J.; Skóra, K. Ecosystem goods, services and management. In *Biological Oceanography of the Baltic Sea*; Snoeijs-Leijonmalm, P., Schubert, H., Radziejewska, T., Eds.; Springer: Dordrecht, The Netherlands, 2017. [CrossRef]

94. Nahuelhual, L.; Vergara, X.; Bozzeda, F.; Campos, G.; Subida, M.D.; Outeiro, L.; Villasante, S.; Fernández, M. Exploring Gaps in Mapping Marine Ecosystem Services: A Benchmark Analysis. *Ocean Coast. Manag.* **2020**, *192*, 105193. [CrossRef]

95. Scholte, S.S.K.; Van Teeffelen, A.J.A.; Verburg, P.H. Integrating Socio-Cultural Perspectives into Ecosystem Service Valuation: A Review of Concepts and Methods. *Ecol. Econ.* **2015**, *114*, 67–78. [CrossRef]

96. Nahuelhual, L.; Benra Ochoa, F.; Rojas, F.; Díaz, G.I.; Carmona, A. Mapping Social Values of Ecosystem Services: What Is behind the Map? *Ecol. Soc.* **2016**, *21*, 24. [CrossRef]

97. Burkhard, B.; Maes, J. *Mapping Ecosystem Services*; Pensoft Publishers: Sofia, Bulgaria, 2017.

98. Paracchini, M.L.; Zulian, G.; Kopperoinen, L.; Maes, J.; Schägner, J.P.; Termansen, M.; Zandersen, M.; Perez-Soba, M.; Scholefield, P.A.; Bidoglio, G. Mapping Cultural Ecosystem Services: A Framework to Assess the Potential for Outdoor Recreation across the EU. *Ecol. Indic.* **2014**, *45*, 371–385. [CrossRef]

99. Pinke, Z.; Vári, Á.; Kovács, E.T. Value Transfer in Economic Valuation of Ecosystem Services–Some Methodological Challenges. *Ecosyst. Serv.* **2022**, *56*, 101443. [CrossRef]

100. Jobstvogt, N.; Watson, V.; Kenter, J.O. Looking below the Surface: The Cultural Ecosystem Service Values of UK Marine Protected Areas (MPAs). *Ecosyst. Serv.* **2014**, *10*, 97–110. [CrossRef]

101. Kenter, J.; Cambridge, H. Interactive Online CH Mapping Portal. In *PrEseRvIng and Sustainably Governing Cultural Heritage and Landscapes in European Coastal and Maritime regionS*; PERICLES_D3.1_v2.0, Dissemination Level: PU; European Commission: Brussels, Belgium, 2019.

102. Golding, N.; Black, B. Final Report from the DPLUS065 Mapping Falklands and South Georgia Coastal Margins for Spatial Planning Project. SAERI. 2020, p. 102. Available online: https://www.darwininitiative.org.uk/Documents/DPLUS027/23882/DPLUS027%20FR%20-%20edited.pdf (accessed on 10 November 2023).

103. Patera, A.; Pataki, Z.; Kitsiou, D. Development of a webGIS Application to Assess Conflicting Activities in the Framework of Marine Spatial Planning. *JMSE* **2022**, *10*, 389. [CrossRef]

104. Claudia, B.; Bürgi, M.; Le Du-Blayo, L.; Martín, M.G.; Girod, G.; von Hackwitz, K.; Howard, P.; Karro, K.; Kizos, T.; de Kleijn, M.; et al. *D3.1 List and Documentation of Case Study Landscapes Selected for HERCULES, WP3 Landscape-Scale Case Studies (Short-Term History)*; HERCULES: Brussels, Belgium, 2014.

105. Trommler, K.; Plieninger, T. *Sustainable Futures for Europe's Heritage in Cultural Landscapes: Tools for Understanding, Managing, and Protecting Landscape Functions and Values*; Mid-Term Assessment Report; Hercules, FP7; Collaborative Project: Berlin, Germany; Copenhagen, Denmark, 2015.

106. Mallinis, G.; Chalkidou, S.; Roustanis, T.; Kokkoris, I.P.; Chrysafis, I.; Karolos, I.-A.; Vagiona, D.; Kavvadia, A.; Dimopoulos, P.; Mitsopoulos, I. A National Scale Web Mapping Platform for Mainstreaming Ecosystem Services in Greece. *Ecol. Inform.* **2023**, *78*, 102349. [CrossRef]

107. Pellach, C.; Carmon, D.; Teschner, N.; Boral, R. Legal-Institutional Instruments for Integrated Coastal Zone Management (ICZM) in the Mediterranean. Final Report, 2016, Mare Nostrum Project. Available online: https://curs.net.technion.ac.il/Files/2018/11/Mare-Nostrum-Final-Report.pdf (accessed on 26 November 2023).

108. McClellandb, A. *Towards a Cross-Border Cultural Heritage Atlas for the North West: Data Availability, Webhosting and Guiding Principles for the GIS Mapping of Heritage Inventory and Other Datasets*; National Institute for Regional and Spatial Analysis (NIRSA); Maynooth University Social Science Institute (MUSSI): Maynooth, Ireland, 2016.

109. McClelland, A. Spaces for Public Participation: Valuing the cross-border landscape in North West Ireland'. *Ir. Geogr.* **2019**, *52*, 193–211. [CrossRef]