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Methods

Mapping and assessment of cultural ecosystem services of Latvian coastal areas

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Abstract

Mapping of cultural ecosystem services (CES) in marine and coastal areas is still recognised as a conceptually and technically challenging task, due to the difficulties in establishing a link between the biophysical features of the coastal ecosystem and the supply of services such as recreation and tourism, bird watching and enjoyment of other assets of nature. This was also one of the major challenges in ecosystem service mapping for *the Maritime Spatial Plan for Internal Waters, Territorial Waters and Economic Exclusive Zone of the Republic of Latvia.* Suitability of the coastal areas for marine tourism and leisure activities was chosen as an indicator to map the CES – physical and experiential interactions. The method involved the compilation of field data from a survey of visitors at the beach and on coastal infrastructure, serving as the input for the multi-criteria assessment of CES. Four criteria were applied to assess the suitability of the coastal areas for marine tourism and leisure activities: i) accessibility; ii) proximity to densely populated areas; iii) suitability of the area for a particular (niche) tourism or leisure activity; and iv) recreational use. The selected criteria provide an overall assessment framework, which integrates the ecosystem service potential, benefiting areas, flow and demand aspects. The CES mapping and assessment results were applied to the maritime spatial planning for proposing areas of priority for tourism development, as well as assessing the impacts of the proposed solutions for other uses of the sea. The Latvian approach for mapping of the

cultural services in coastal areas was selected as the ESMERALDA case study and examined at the stakeholder workshop in Prague, September 2016.

Keywords

Cultural ecosystem services; mapping and assessment; maritime spatial planning; tourism potential; multi-criteria analysis

Introduction

Coastal ecosystems are amongst the most productive in the world, generating different ecological functions and services essential for human well-being (Drakou et al. 2017). This also includes recreational opportunities that can be used for tourism development. At the same time, coastal areas are experiencing increasing pressure from various sea and land use activities, also having an impact on the supply of ecosystem services (Bryce et al. 2016, Brown and Hausner 2017). The importance of sustainable use of marine goods and services has also been highlighted by the marine and maritime policies of the European Union (European Parliament and the Council of the European Union (EP CEU) 2008, European Parliament and the Council of the European Union (EP CEU) 2014). Thus mapping and assessment of the coastal ecosystem service supply is becoming extremely important within the science-policy-practices interface for supporting decision-making on the management and sustainable use of coastal areas (Veidemane et al. 2017, Drakou et al. 2018). The mapping results can provide an essential contribution to maritime spatial planning (MSP) – an established decision-making process that applies research data and geospatial information for addressing the sea use conflicts and organising human activities in order to avoid negative impacts on marine health, functions and services (Center for Ocean Solutions 2011). The ecosystem service approach is established as a framework or even as a core requirement for the ecosystem-based management of marine and coastal areas as well as for implementation of the MSP (Rees et al. 2010, Guerry et al. 2012, Nahuelhual et al. 2017).

Coastal tourism and recreation represent the Cultural Ecosystem Services (CES) of high relevance for MSP and coastal zone management. Remarkable growth of the tourism sector in Southern Europe, as well as the countries around the North Sea and the Baltic Sea, has increased its role as a major driver for local employment and regional economic development and, at the same time, increasing the pressure on the environment (Ghermandi 2015). Marine and coastal tourism has also been defined as one of the focus areas of the EU Blue Growth strategy (European Commission 2012). Mapping and assessment of recreational services offers improved evaluation of marine resource uses, their impacts and trade-offs (Nahuelhual et al. 2017) and thus facilitates development of more sustainable sea use solutions.

Despite the high decision-making relevance for coastal and maritime spatial planning, the mapping of CES in coastal areas is still recognised as a conceptually and technically challenging task and is consequently under-represented in the overall efforts of ecosystem

service mapping and assessment (Martin et al. 2016, Nahuelhual et al. 2017). This can be explained by the intangible character of CES and difficulties in quantifying these non-material benefits and capturing them in a spatially-explicit way (Bryce et al. 2016, Fish et al. 2016, Kopperoinen et al. 2017). The intangibility of CES is strongly related to the way they have been defined in the Millennium Assessment - as the "non-material benefits obtained from ecosystems through spiritual enrichment, cognitive development, reflection, recreation, and aesthetic experiences" (Millennium Ecosystem Assessment 2005). However, Fish et al. (2016) have worked further on the concept of the CES, describing them as interactions between an environmental space or its physical settings and the cultural or recreational practices that take place there.

Tourism and recreation is a category of the CES, which is conceptually easier to identify and measure (Kopperoinen et al. 2017) and is consequently investigated more (Milcu et al. 2013, Martin et al. 2016, Kulczyk et al. 2018). Following the ecosystem service concept, which emphasises the natural environment as a provider of benefits to society, the recreational potential of land has often been mapped based on physical attributes, e.g. land cover and distance to roads (Martínez-Harms and Balvanera 2012, Scholte et al. 2018). At the same time Scholte et al. (2018) argue that such a mechanistic approach, when researchers decide which physical attributes have a higher recreational potential, fails to incorporate the experiences and perceptions of the public and, therefore, participatory mapping methods are recommended to study the spatial distribution of recreational experiences. The participatory methods are commonly used in order to capture people's perception on plurality of the CES values (Martin et al. 2016). This approach has also been followed by several studies addressing marine and coastal ecosystems, which demonstrate the multiple values of CES based on interviews and participatory mapping (e.g. Gee and Burkhard 2010, Klain and Chan 2012, Brown and Hausner 2017) or geo-tagged social media analysis (Depellegrin et al. 2012).

The CES mapping approaches are often trans-disciplinary, covering bio-physical, socio-cultural as well as economic dimensions (Paracchini et al. 2014). An integrated modelling framework for quantifying the outdoor recreation potential at EU level has been developed by Paracchini et al. (2014) and served as input to an outdoor recreational model within the Ecosystem Services Mapping tool - ESTIMAP (Zulian et al. 2014). This model integrates the biophysical attributes (e.g. natural value and accessibility) characterising recreational potential as well as behavioural data derived from surveys and population, characterising recreational demand. The benefits of coastal recreation in Europe have also been assessed in the study by Ghermandi (2015), by combining bio-physical mapping with several economic valuation methods within a meta-analytical value transfer framework. The recreational value of the Baltic Sea has been assessed by using economic valuation - the travel cost method (Czajkowski et al. 2015).

The suitability of the Latvian coastal areas for tourism and leisure activities was one of the ecosystem services mapped for the development of the draft Maritime Spatial Plan for Latvian marine waters in 2015 (subsequently referred to as – the Latvian MSP case), carried out from January 2015 to May 2016 (Veidemane et al. 2017). Besides the characterisation of the ecosystem service supply in the coastal areas, the purpose of this

mapping exercise was also to identify the areas where the priority in the MSP would be given to tourism development. The assessment was performed in collaboration between ecosystem service and tourism experts, based on existing knowledge and available data sets. The method for assessing the suitability of the areas for tourism and leisure activities was built on the concept of holistic tourism system performance and place attraction (Leiper 1979, Leiper 1990, Gunn 1993). This involved assessment of physical attributes characterising the potential of area to attract visitors (accessibility; proximity to densely populated areas; and suitability of the area for a particular tourism or leisure activity) as well as existing field survey data on actual recreational use of the areas. The latest one demonstrated the actual preference of the visitors for particular areas, therefore replacing the need to apply the labour intensive participatory mapping methods, like participatory GIS or geo-tagged social media analysis, which would not be possible to carry out within the Latvian MSP case due to the very tight time schedule of the planning process. A spatial multi-criteria assessment framework was applied to prioritise the areas for their suitability to supply the recreational services based on the criteria described above. Thus, the applied method relates to the Multi-Criteria Decision Analysis (MCDA), which has been commonly applied for integrating ecosystem service assessment into land use planning (Langemeyer et al. 2016, Esmail and Geneletti 2018).

The aim of this paper is to demonstrate an approach of mapping the suitability of the coastal areas for the recreational services supply by applying the multi-criteria assessment framework built on the tourism theory of place attraction. The integration of the tourism theory with the ecosystem service concept is undertaken as a novel inter-disciplinary approach, which can enhance the understanding of the CES supply and demand relationships. The advantages and shortcomings of applying this approach within the Latvian MSP case are discussed in the paper.

Theoretical background for assessing tourism and recreational services

The specificity of CES, related to tourism and recreation, is that the place of service production and where the benefits are realised (Fisher et al. 2009, Syrbe and Walz 2012, Kulczyk et al. 2018) is always the same – *in situ* as resources are consumed in the same location. This also includes the surrounding landscape, which serves as a background for in situ experiences (Fisher et al. 2009). Therefore, mapping of the supply potential and demand for this service is interwoven (Kopperoinen et al. 2017). This was also considered in this study, when selecting the criteria for assessing the suitability of the coastal areas for marine tourism and leisure activities.

The seaside operates as a nature-based tourism destination where different recreational forms evolve and develop around natural attractions embedded in the ecosystem. The potential of a destination to attract tourists (or recreational potential) depends on the inherent capacity of a location to support recreational activities and thus can be determined by location-specific characteristics of the environment, such as the biophysical attributes of

attractions (i.e. scenic attractions) (Chhetri and Arrowsmith 2008), spatial distribution of attractions and their accessibility for visitors, similarly to the ecosystem service potential characterising the hypothetical maximum yield of ecosystem services used for recreational purposes. Locations with easy access to various tourist attractions may have greater potential than those with more difficult access. This is ultimately related to the functionality of tourism systems (Leiper 1979, Leiper 1990), where a destination as a spatial unit is characterised by such key elements as attractions (in this case meaning the physical environment in general and it can be assumed that this should be attractive in varying degrees that can be assessed), access, amenities and ancillary services (Cooper et al. 1998). Thus, the natural quality and supporting infrastructure and amenities of particular places and their comparison with other similar locations can be assessed as suitability of the area for a particular tourism or leisure activity.

The seaside is characterised as a tourism destination, but it could also be linked to a smaller unit, namely, a recreational area serving certain needs of the local population (Gunn 1979, Smith 1995). A destination is an open system, where visitors can designate their own borders and create relationships amongst these various elements (Murphy et al. 2000, Framke 2002, Cooper and Hall 2008). Based on this concept of a destination, the distance between the place of origin of visitors and their travel destination is another important criterion to assess, revealing potential recreational demand for visits to tourism destinations. Spatial data on settlement patterns and population sizes allow areas to be determined where tourist attractions are spatially dispersed and require relatively longer travel times between them than those with a greater concentration of attractions. This is particularly important for short trips, such as single-day visits or recreational practices of daily routine. Therefore, certain undeveloped natural coastal areas, located close to densely populated places, host a high recreational potential *per se*, where accessibility and infrastructure are key elements of development. These should be considered as important ecosystem service benefiting areas with the potential to serve the demand for ES. Chhetri and Arrowsmith (2008) stated that “varying recreational potential of areas in turn holds different degrees of the likelihood of visits”. A larger amount of people living in the vicinity of contrastingly wild areas will provide a higher degree of potential visits there. The close proximity of an “urban wilderness” is linked to the hope that people will eventually be persuaded against taking long journeys to experience nature and wilderness (Rink and Emmrich 2005). Urban wilderness provides higher opportunities for recreation and, according to Rink and Emmrich (2005), a higher potential for environmental education. The quality of infrastructure between settlement and destination characterises connectivity, vital for the usability of these places for various leisure and recreational purposes. Infrastructure provides higher safety, ensures accessibility and shortens the time of travel between places.

Existing habits of using various areas for tourism and leisure purposes characterise the recreational demand for them and this has been studied in certain areas by Villamagna et al. (2014), Peña et al. (2015) and others. At the same time, according to the ecosystem service concept, the recreational use of the area can be attributed to the flow of the service.

Methodology

The choice of the methods for ecosystem service mapping and assessment within the Latvian MSP case was determined by limited data and time resources. Therefore, the tiered approach was followed (Maes et al. 2014, Grêt-Regamey et al. 2017) by using the expert knowledge-based Tier 1 method for mapping regulating and maintenance services, whereas Tier 2 was more appropriate in the case of provisioning and cultural services. Suitability of the coastal areas for marine tourism and leisure activities were selected as indicators to map the cultural services, by combining two ecosystem service classes - experiential and physical use of land-/seascapes (according to the Common International Classification of Ecosystem Services (CICES), version 4.3; Haines-Young and Potschin 2013).

The method for assessment of the suitability of the Latvian coastal areas for tourism and leisure activities was designed by applying the spatial multi-criteria assessment framework, which allows integration of the various information sources from a socio-ecological perspective (Koschke et al. 2012, Langemeyer et al. 2016). The methodological approach presented here has provided a tool for logical and comprehensive spatial analysis of variables, characterising tourism and leisure suitability, visitor frequency and infrastructure and nature assets.

Criteria selection to assess CES – tourism and recreation in coastal areas

Based on the above-described concept of holistic tourism system performance and place attraction (Leiper 1979, Leiper 1990), four criteria groups were chosen for the multi-criteria assessment (Table 1). The selected criteria provide an overall framework for assessment of recreational services, which integrates the ES potential, flow and demand aspects. ES supply is demonstrated by accessibility as well as suitability of the area for a particular tourism or leisure activity, the actual recreational use of the area represents the flow of the service, while proximity to densely populated areas characterises the potential recreational demand.

Table 1.

Criteria groups used for assessment of CES – “Suitability of the coastal areas for marine tourism and leisure activities”, definition of criteria and variables used in the assessment.

Criteria	Definition of criteria	Variables
(A) accessibility	The criterion characterises the general infrastructure in the coastal area supporting access to the recreational areas	• public access to the beach • road infrastructure • availability of public transport • presence and capacity of parking lots

Criteria	Definition of criteria	Variables
(B) proximity to densely populated areas	The criterion demonstrates potential recreational demand based on proximity to all types of settlement structures, including seasonally densely populated areas maintained for tourism and recreational purpose (e.g. camp sites)	• settlement pattern (size and distance) • population density • concentration of recreational services
(C) suitability of the area for a particular (niche) tourism or leisure activity	The criterion represents the most favourable physical & social conditions for certain niche tourism types	• natural features (e.g. "bottle neck" area of bird migration) • abiotic features (e.g. wind power, tide height) • specific supporting infrastructure & amenities
(D) recreational use	The criterion demonstrates intensity of attendance of tourists or one-day visitors at particular locations.	• numbers of tourism & leisure-related visits in a certain time period

Ecosystem typology and selection of the assessment units

Although the Latvian coastal area represents diverse marine and coastal habitats, including habitats of EU importance (e.g. coastal meadows, coastal dunes, sandy beaches with perennial vegetation or some reefs), mapping of habitats for the whole coastline has not yet been carried out. Therefore, the whole coastal area was taken as a single ecosystem – coastal ecosystem - as defined by the MAES typology (Maes et al. 2013). Specific habitats or ecosystems have seldom been assessed as suppliers of CES (Martin et al. 2016). In order to present the results in spatial dimension, a grid network was constructed for the marine and adjacent coastal terrestrial part. A spatial unit – 3 km × 2.8 km or 0.05° longitude × 0.025° latitude – was created for attributing data for each criterion. In total, grid-chains with 213 cells were used for assessment of CES in Latvian coastal areas. The assessment of other ecosystem services (provisioning and regulating) covered by the Latvian MSP, but not presented in this paper, was also performed in the same spatial resolution.

Data collection and development of the GIS data layers

The data sources, used in assessment of the performance values of the four criteria described above, included the primary field survey results on recreational activities in the coastal areas, performed within previous studies (carried out in 2015): i) visitor survey, performed in 85 field research days during which visitors were counted in three zones (water, seashore and dunes), within 25 representative samples of 1 km cut-off covering 5% of the 497 km long national coastal territory); ii) face-to-face interviews with more than 700 visitors about their motivation, leisure habits and service assessment as well as the

background segmentation data in these places; iii) secondary data from a vast database characterising tourism and recreational activities in the past (with focus on number of visits to different coastal places, recreational use of different services, consumption seasonality). That dataset was complemented with the spatial data on settlement structure, infrastructure and natural features of the places available from topographic maps, local and regional spatial planning documents, database of protected areas and several thematic maps on tourism development.

Firstly, the following available data sets on tourism and recreational activities have been compiled:

1. Long-term quantitative data series (dating back to 1995 or later) characterising the number of visits in various coastal and marine places – tourist attractions (per year or per event) as geo-located GIS points.
2. Long-term quantitative data series about overnight stays and supporting infrastructure (e.g. parking lots, road statistics, equipment rentals etc.).
3. Primary data from the visitor survey on intensity, concentration and duration of visits.
4. Primary data from the face-to-face interviews on motivation to visit the place, expectations and degree of satisfaction, service assessment and segmentation information.

A large amount of spatial data about visiting certain areas in combination with their accessibility, distance from nearest settlements, infrastructure, nature resources and amenities not only provide analyses for intensity of attendance in each of the places, but also allows it to be generalised for similar situations.

Furthermore, for characterisation of the natural features and assets, determining the suitability of the area for a particular (niche) tourism or leisure activity, the spatial data on Natura 2000 sites and landscape-protected areas, as well as specific infrastructures related to certain nature resources (e.g. bird watching tower on migratory routes or waterfowl, wader bird areas) were compiled.

Subsequently, a number of visits as variable (categorised in five intensity classes) was analysed with a set of other variables (distance to the nearest road, presence of different infrastructure, services and other variables described above) seeking correlation agreement and spatial regularity using ArcGIS software. Strong correlation agreement was indicated between real recreational use to the other three criteria included as well as with some other parameters (no-rain, air temperature above +20 C, wind speed below 10 m/s). The impact on visiting habits was explained in depth from the face-to-face interviews with visitors. Finally, using ArcGIS spatial analyst tools, values were applied for each coastal-marine spatial assessment unit described above.

Assessment scheme of the selected criteria, aggregation of values and attribution to the spatial assessment units

The performance values of the four criteria at each grid cell were obtained by standardisation of the variables' data, attributed to each criterion, in three value groups (i.e. assigning scores 1-3). Assumptions applied for assigning the value of each criterion to the spatial assessment units (grid cells) are presented in Fig. 1.

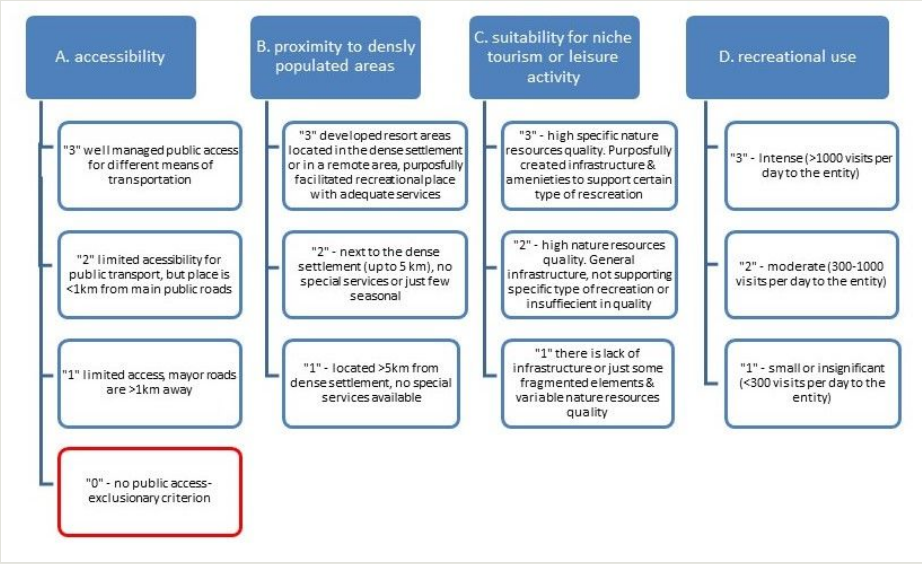

Figure 1.

Scoring of the four criteria applied in CES assessment.

Criterion (A) – "accessibility" was scored based on the distance to the general infrastructure (roads, parking lots). The places which do not provide any public access (e.g. certain harbour areas) would be scored with "0". In such cases, "accessibility" would perform as an exclusion criterion. However, in the case of the Latvian coast, such closed areas were always smaller than the selected assessment unit (grid cell – 3 km × 2.8 km), therefore such a situation does not appear in the obtained results.

Criterion (B) – "proximity to densely populated areas" is determined by the distance between the recreational area and the settlement providing the recreational demand. This refers not only to permanent settlement structures, but seasonally densely populated areas maintained for tourism and recreational purpose (e.g. camp sites).

Criterion (C) – "suitability for niche tourism or leisure activity" is measured based on the presence of natural qualities and abiotic features, as well as specific supporting infrastructures essential for the particular tourism activities. Benchmarking amongst other similar places used for the same recreational purpose was performed to identify the best place for a particular activity.

Criterion (D) – “recreational use” is determined by the number of visitors. The seasonal maximum for visits per day was used – on a regular occurrence during the high season and also three clusters were made here splitting the data.

The correlation analysis between sample variables of the four criteria calculated before this study reveals several mutual interactions between the two criteria:

1. Good accessibility has a positive impact on the growth in number of visits.
2. Good accessibility in combination with proximity to densely populated areas produces an even higher growth in number of visits.
3. Proximity to densely populated areas without accessibility reduces the number of visits to the minimum.
4. Proximity to densely populated areas with poor quality accessibility increases the anthropological impact on the environment (depletion of vegetation).
5. Poor quality accessibility and a far distance to the densely populated areas reduces the number of visits to a minimum.

Table 2.

The value aggregation in assessment classes (1-5) representing suitability of the coastal area for marine tourism and leisure activities.

Class	Class descriptor	Scores and weight of the criteria within the particular value class
5	very high 80-100%	A=3 (25%); B=3 (25%); C=2 or 3 (15 or 25%); D=2 or 3 (15 or 25%) *The highest value of accessibility with high or moderate other values*
4	High 65-80%	A=2 or 3 (15 or 25%); B=2 or 3 (15 or 25%); C=2 or 3 (15 or 25%); D=1-2 (5 or 15%) *Existing recreational use is low, but close to the sea-coast there is a larger settlement or site has public accessibility and special infrastructure facilities for certain sea-based tourism or leisure activities (e.g. birding, kitesurfing, angling, boating, nudist beach etc.) – these are amongst the best sites for practising certain activities (not necessarily mass-tourism related)*
3	Moderate 40-60%	A=3 (25%); B=1-2 (5 or 15%), C=1-2 (5 or 15%); D=1 (5%) *Existing recreational use is low and the site is far (>5 km) from larger settlements. This site is not amongst the best for certain tourism & leisure activities, but it has good public access and there is a parking lot. Mainly extensively used for traditional activities*.
2	Low 25-40%	A=1-2 (5 or 15%); B=1 (5%); C=1-2 (5 or 15%); D=1 (5%) *Existing recreational use is low and typically seasonal (between 100-300 visits per day to 1 km as a maximum in high season); it is far from larger settlements, but there are some separate tourist accommodations or private buildings nearby. There is a lack of special infrastructure and amenities, which makes accessibility limited*.
1	very low 0-20%	A=1 (5%); B=1 (5%); C=1 (5%); D=1 (5%) *Other sites with low or very low (<100 visits per day in high season) existing recreational use far from larger settlements, without direct public access from main roads and lack of any specific recreational infrastructure. However, these sites contain nature and landscape quality value and provide important connections between popular places e.g. for long-distance coastal hiking*.

In the next stage, an assessment scale was created to provide an aggregated CES value of each grid cell, which was further used for decision-making in MSP. Assessment classes

from 1 to 5 were defined by integrating scores of the four criteria. Value “1” means very low suitability for tourism and leisure activities and “5” – very high suitability. The importance of each criterion was weighted separately for each value class based on expert judgement (see Table 2). The linear additive value function of the criteria scores and weights, which is commonly applied in multi-criteria decision analysis (MCDA) (e.g. Koschke et al. 2012), was not suitable for this assessment, considering the complexity of the selected criteria and availability of data on recreational use and demand. For example, in the study of Koschke et al. (2012), the suitability for outdoor recreation is used as an indicator to estimate the capacity of land cover class to provide recreation and ecotourism ES and serves as one of the criteria, besides other ecosystem services, applied within MCDA. Weighting of the criteria in this case (Koschke et al. 2012) is performed by stakeholders in order to compare the importance of different ecosystem services, whereas in this study, scores and weights of the selected criteria are defined for assessing the suitability of the coastal area for marine tourism and leisure activities, based on the functionality of the tourism system.

Public involvment

Although the presented study did not include participatory mapping methods or stakeholder involvement in the multi-criteria assessment (e.g. by weighting of the selected criteria), the information on public preference for the recreational areas has been included in the assessment by applying the survey data from the visitor counting along the coastline of Latvia and 700 face-to-face interviews with visitors, revealing the motivation to visit the place, expectations and degree of satisfaction.

Furthermore, the mapping results were presented at the public hearing of the draft MSP, which included four regional meetings, involving a total of 137 participants (e.g. representatives from municipalities’ administrations, port authorities, nature conservation authorities, tourism entrepreneurs, fishermen etc.). Participants of the public hearing meetings had the opportunity to comment on the ES mapping results as well as to propose adjustments to the identified priority areas for tourism development. Thus, stakeholder engagement through the public hearing process served as verification of the CES mapping results. The proposals from the public hearing meetings were taken into account when developing the proposed sea use solutions of the draft MSP.

Obtained results

The highest CES values are distributed in the capital city Riga and in the adjacent area covering about a 30-40 km radius. The area is intensively visited for short-duration trips, including single-day visits. Similar high CES values were obtained in areas around two other larger cities of the country – Liepaja and Ventspils. Both cities have a high number of local visitors, as well as organised festivals and other seasonal attractions to increase the number of beach visitors through offered social attractions. The urban coastal zones are also classified as bathing waters, having adequate facilities to serve a large number of visitors.

Several “hot spot” areas stand out, where unique natural phenomena (e.g. areas of outstanding geomorphological features and scenic landscape) can be observed or enjoyed. These areas also have scenic beauty and attractions that contribute to the overall CES of the location. One of them is the Cape of Kolka, where the open Baltic Sea waters meet with the Gulf of Riga waters. This is one of the top tourism destinations, having good public access and infrastructure, as well as providing opportunities for various niche tourism activities. Overall, approximately 27% of the coastal area represents very high suitability for marine and leisure activities.

These are areas which are not so intensively used, although accessibility, infrastructure and nature-based attractions are available. These sites have high potential to become intensively used in future years.

Areas assessed as having very low values (class 1) made up almost one-third of the spatial units. The low value is mainly related to remoteness, poor accessibility andspecific nature conditions (e.g. wet coastal meadows). Coastal areas, assessed as low and medium suitability, take up about 10% each.

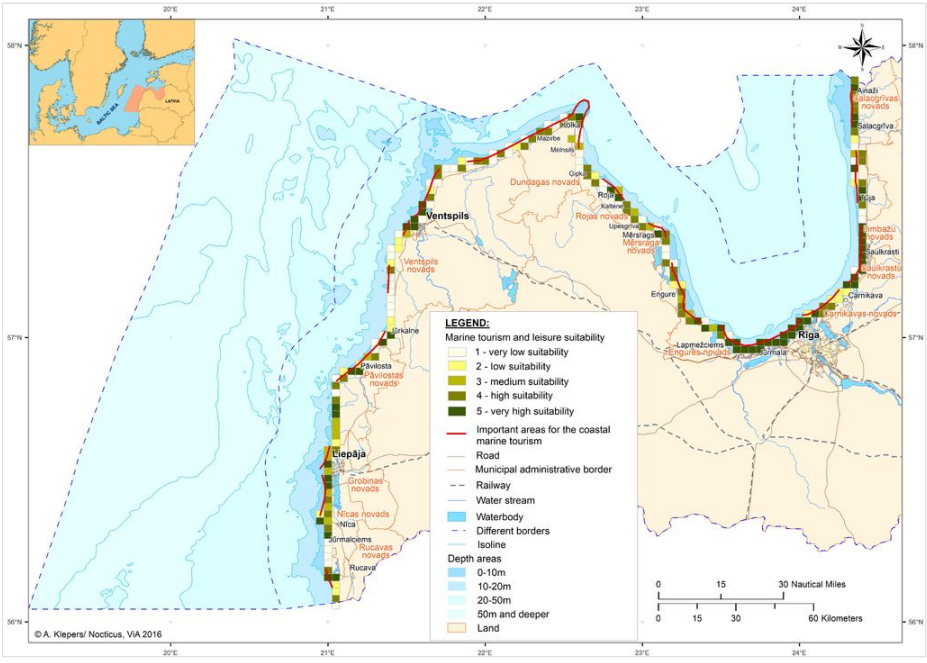

Figure 2.

Suitability of the coastal areas for marine tourism and leisure activities.

Field survey data have identified several locations near to marine waters or coastal areas where accessibility is restricted for tourists or the general public. These are military areas and custom zones in the port areas where, due to security and safety, access is highly regulated. Spatially, such zones are shorter than 3km, thus none of the spatial grid cell has

been assessed as not having any CES value. Consequently, all coastal areas supply CES, even if at a very low value.

The ES mapping and assessment provided an input for the first draft Latvian MSP. The obtained results were discussed and verified with local stakeholders (e.g. municipality and port administrations, tourism entrepreneurs etc.) and used for proposing coastal stretches to be designated as “important areas for coastal marine tourism” (see Fig. 2). This designation is very important for local communities to develop their regional or local strategies and business development plans.

Discussion and conclusions

The Latvian MSP case study demonstrates application of the multi-criteria approach in biophysical mapping of CES by prioritisation of the coastal areas according to their suitability for marine tourism and leisure activities. The applied method was based on coastal survey data and expert knowledge in assessment of the selected criteria, which were derived from the concept of holistic tourism system performance and place attraction (Leiper 1979, Leiper 1990). Thus, the applied method differs from the classical Multi Criteria Decision Analysis (MCDA), which usually involves stakeholder participation in weighting of the criteria and aims at comparing or prioritising different management alternatives or evaluating trade-offs in the supply of ES (Langemeyer et al. 2016, Esmail and Geneletti 2018, Martin and Mazzotta 2018).

From a socio-ecological perspective, tourism and recreation are tightly connected with the perception of ecosystem services’ supply and demand. Mehring et al. (2017) argue that there is a functional relationship between the two where nature and society exert a mutual influence on one another. This is followed by a statement that not only interdependent temporal and spatial dynamics exist between ES supply and demand, but also a social dimension within these dynamics subsists, which needs to be considered (Mehring et al. 2018). Consequently, the assessment of recreational ES requires incorporation of the supply and demand aspects, since in this situation (as opposed to many provisioning and regulating services), the area where service is produced and used overlaps (Kulczyk et al. 2018).

The set of criteria selected in our study allows integration into the assessment of the capacity of the ecosystem to supply and demand for tourism and recreation – “accessibility” and “suitability of the area for a particular tourism or leisure activity” refers to the ES supply, “recreational use” - to the flow of the service, while “proximity to populated areas” can be used to characterise the potential demand. Although Nahuelhual et al. (2017)argue that the demand indicators (e.g. number of visitors, tourist ship traffic etc.) are mistakenly used for representing ecosystem service flows, which in essence are supposed to be ecological phenomena, we assume that, in case of the national scale assessment of the whole coastal area, such data demonstrate the actual importance of the site and are absolutely essential from a spatial planning perspective. This also conforms with the framework for assessment of CES - outdoor recreation, proposed by Paracchini et al.

(2014), which involves three main components characterising the flow of benefits – the ecosystem function or recreational potential, accessibility, as well as potential demand and its spatial distribution.

The main strength of the method lies in its ability to provide a quick assessment of the recreational supply and demand of the coastal areas at national scale, by using survey results and expert knowledge in combination with GIS data on coastal infrastructure, settlement structure and population density. Thus, the assessment is based on empirical data, instead of using certain biophysical features (e.g. land cover or habitat type) as proxy for the ecosystem service supply. Such an evidence-based approach provides higher credibility for the spatial planning process and related decision-making on land/sea use priorities. Kopperoinen et al. (2017) have also highlighted that Tier 1 methods (spreadsheet or spatial proxy model) would not be suitable for mapping of CES due to limitations for applying land cover as proxy for service supply, therefore Tier 2, by applying more detailed and specific data for characterisation of the area, is more appropriate in case of mapping CES.

However, the datasets used for assessment of the service supply within the Latvian MSP case do not demonstrate the direct connection to the coastal ecosystem features, e.g. habitat types, which could also be considered to be a shortcoming of the applied method. This problem was also pointed out during the ESMERADA workshop in Prague, 2016, where the particular case was examined.

The linkage of the CES, such as physical and experiential interactions to particular habitat type, is recognised as particularly problematic in relation to marine and coastal ecosystems (Martin et al. 2016, Drakou et al. 2017). This has also been experienced as a major challenge in the Latvian MSP case, since the vast majority of the coastline in Latvia is formed by a similar complex of habitats, including stretches of sandy beaches and wooded dunes, with prevailing accumulation processes and erosion stretches with stony beaches and moraine or sandstone cliffs (Ruskule et al. 2009). Most of these habitats are suitable for tourism and leisure activities, with the exception of very few coastal stretches, including wet coastal meadows and muddy and wet sandy beaches (e.g. habitat types 1310, 1620 according to Annex I of the EU Habitats Directive (1992/43/EEC)), which are, however, interesting for bird watching and nature tourism.

Furthermore, as noted by Kopperoinen et al. (2017), the cultural meaning of the area cannot be revealed based purely on land cover data, but by a combination of different attributes. Accessibility is an essential factor for assessment of the tourism and recreation related CES, since people need to be able to reach the site in order to benefit from this ecosystem service (Paracchini et al. 2014). This has also been demonstrated by recent CES studies in coastal areas (e.g. Nahuelhual et al. 2017). Another essential factor, determining the use, is presence of recreational facilities as proven by Kulczyk et al. (2018). In addition, our study reveals the importance of accessibility and facilities, in particular for mapping and assessment of suitability of coastal areas for marine tourism and leisure activities at a national scale, whereas the importance of particular habitat types

(e.g. sea bottom substrate, beach, dunes, coastal forests or grasslands) would be more relevant for local scale assessment.

Other factors, which are essential for assessing the suitability of the coastal areas for tourism and recreation, but not included in this study, are those related to the ecosystem condition, e.g. bathing water quality (Vesterinen et al. 2010, Pouso et al. 2018).

As noted before, due to the very tight time schedule of the Latvian MSP case, this study did not include participatory mapping methods to study the public perceptions and spatial distribution of recreational experiences, as recommended by Scholte et al. 2018. More collaborative methods with local community involvement would allow the local knowledge and values, as well as the measurement of place attachment, to be taken into consideration (Williams and Vaske 2003, Langemeyer et al. 2016) for different daily practices of leisure activities. At the same time, the visitors' survey data, used in our study, indicate the actual preference of the locations for recreational use, therefore substituting the need for the participatory mapping methods.

The main limitation of the applied method is its dependence on availability of visitor survey data and expert knowledge on distribution of the amenities related to marine tourism and leisure. The Latvian MSP case used available survey data and a tourism database developed within recent parallel studies, therefore implementation of the method was possible within the limited time period and human resources (data processing and analysis took approximately two weeks for one expert). If such data had to be collected for the purpose of the CES assessment, implementation of the method would be very costly and time-consuming.

The applied method has proven to be an effective tool for providing evidence-based information on the suitability of coastal areas for tourism and recreation and thus serves as an essential input to the Maritime Spatial Planning process for prioritisation of marine and coastal areas for certain development interests, as well as assessing impacts of the proposed spatial solutions on ecosystem service supply (Veidemane et al. 2017). It also has the potential for supporting implementation of the Maritime Strategy Framework Directive (European Parliament and the Council of the European Union (EP CEU) 2008), which requires the formulation of strategies to ensure that pressures from human activities are kept within levels compatible with the achievement of a good environmental status, while enabling the sustainable use of marine goods and services by present and future generations. However, further development of the method would be required in order to contribute to the research on CES and better demonstration of the interaction between ecological variables and the cultural aspects of human well-being (Bryce et al. 2016).

The obtained mapping results on the service supply and demand can be used to assess the relationship to the coastal habitat types and thus serves as input to other biophysical ecosystem service mapping methods, which are based on modelling. This would also ensure adjustment of the models to the local conditions and recreational patterns. Furthermore, integration with socio-cultural methods, including surveys on preference assessment or deliberative methods based on group discussions, would be beneficial for

use of the local knowledge as well as revealing peoples' views on the benefits and values associated with CES (Langemeyer et al. 2016, Martin et al. 2016, Kopperoinen et al. 2017). In addition, integration with economic assessment methods (e.g. travel cost, contingent valuation; choice modelling; ES accounting) would be possible and increase the credibility of the results for decision-making on sustainable use of the coastal areas.

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Conflicts of interest

There are no conflicts of interest.

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