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DISCUSSING INDICATORS FOR SOME LESS STUDIED CULTURAL ECOSYSTEM SERVICES PROVIDED BY FORESTS: EXAMPLE FROM LATVIA

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Cultural ecosystem services (CES) are as important for human well-being as other ecosystem service groups, but they are underrepresented in the current evaluation frameworks that mostly include a limited set of CES, typically focusing on recreation and aesthetic experiences derived from nature. Thus, several significant CES are routinely omitted, especially those unsuitable for mapping and evaluation in pre-defined spatial units. In this paper we discuss four categories of forest CES, three of them related to the visual representation of forest and one – to the use of forest ecosystems in education. Drawing on examples from Latvia, we propose indicators for their evaluation, provide examples of possible application and briefly discuss challenges and uncertainties. We conclude that: 1) services pertaining to visual representation of forest ecosystems and forest ecosystem use in education are highly relevant in our region, 2) creativity-related ecosystem services present classification challenges, 3) quantification of CES, despite evaluation uncertainties, helps to highlight their importance, and 4) further work and interdisciplinary collaboration in the field of CES is needed to encompass stakeholder involvement and representation, as well as the complex relationships between the ecosystem services themselves.

Keywords: *forest ecosystem, nonmaterial benefits, education, visual representation, creativity*

INTRODUCTION

Cultural ecosystem services (CES), one of the three major ecosystem service groups along with provisioning and regulating services (CICES, 2017), pertain to nonmaterial benefits from ecosystems, such as recreation opportunities, spiritual enrichment, aesthetic experience, cognitive development, and reflection (MEA, 2005). CES are complicated to evaluate quantitatively. While their importance is consistently recognized, they are often described as intangible, non-material and complex in terms of biophysical or economic evaluation. Therefore, compared to other ecosystem service groups, they remain poorly understood and under-evaluated (Martín-López et al., 2009; Tilliger et al., 2015), despite the wide range of monetary and non-monetary methods used for evaluation (Hirons et al., 2016; Christie, et al. 2012). Recreation and aesthetic values are the most frequently studied cultural ecosystem services (Milcu et al., 2013; Chang et al., 2019; Kosanic and Petzold, 2020), and stated preference methods, mainly interviews and questionnaires, dominate the studies (Chang et al. 2019; Kosanic and Petzold 2020).

The low availability of quantitative information and difficulties in the interpretation of qualitative data hinders a full-scale evaluation (Gee and Burkhard, 2010; Brown et al., 2016). Frequent overlapping of the CES categories constitutes additional challenge: the same service may simultaneously render recreational, aesthetic, educational and spiritual benefits, inducing the problem of double-accounting (Fu et al., 2011; Satz et al., 2013). Moreover, the perceived value of the CES is subjective, derived from social constructs and traditions in a particular society, as well as from purely personal preferences (Daniel et al., 2012). Therefore, interdisciplinary approach and collaboration between environmental, economic and social sciences usually present the best results in disentangling the multiple meanings of CES (Daniel et al., 2012; Katz-Gerro and Orenstein, 2015; Cabana et al., 2020).

During the recent decade, ecosystem service assessment has evolved into a practical tool for policy support and land management planning. In Latvia, though no nation-wide ecosystem service mapping has been carried out, several sectoral initiatives have developed methodologies and instruments for decision support in grasslands (Villoslada et al., 2018), peatlands (Konstantinova et al., 2019), coastal areas (Konstantinova et al., 2017), and marine environment (Veidemane et al., 2017). Several collaboration initiatives related to the integration of forest ES assessment in forest management planning are underway, following an expert-approved approach, validated in a ~3000 ha large forested catchment in state forests (PROGRESS, 2021).

The above-mentioned methodology for the assessment of forest ES is based on a simplified framework proposed by Burkhard et al. (2018), with application of matrix model and ES evaluation scores bound to spatial units (forest compartments) (Jūrmalis et al., submitted). This evaluation framework, intended to serve as the first step in a practically applicable decision-making process, includes only two cultural ecosystem services – recreational suitability and visual quality of forest. Thus it has a limited applicability to some regulating and cultural ES that are not bound to compartment boundaries. It also provides information only on the ES potential, but not on their flow or demand - aspects that are especially important in understanding the social significance of nature's contributions (Jacobs et al., 2015; Katz-Gerro and Orenstein, 2015).

To address these shortcomings and to complement the evaluation framework, we have identified five additional CES, three of these referring to visual representation of ecosystems, and two – to their educational importance, and proposed indicators for evaluating their supply, flow and demand. Drawing on data of several mini-studies performed in Latvia, we present examples of their possible application and discuss some evaluation challenges.

RESEARCH METHODS

Study area

Latvia is located in the hemiboreal zone, on the eastern shore of the Baltic Sea. Forest covers 53% of the land area, and forest sector is important for the national economy constituting 6.5% of the GDP (Ministry of Agriculture, 2023). Main tree species are Scots pine (*Pinus sylvestris* L.), Norway spruce (*Picea abies* (L.). Karst.) and birch (*Betula* sp.), the prevalent management system is uniform regeneration felling in small compartments (average compartment size – 1.1 ha), with subsequent mandatory reforestation, by planting or sowing or enhancing natural reforestration (Cabinet of Ministers of the Republic of Latvia, 2000, 2012, 2013). The total area of forest with various degrees of management restrictions to protect and enhance biodiversity exceeds 25% of the total forest area (Ministry of Agriculture, 2023).

Forests in Latvia provide a broad range of provisioning, regulating and cultural ES. While timber and energy wood are economically important, also non-wood forest products have high economic, social and cultural significance. According to Lovrić et al. (2020), more than 60% of the households in Latvia gather non-wood forest products. Forests are an important carbon sink, and research results suggest that clean air and water purification are among regulating services with especially high societal relevance (Liepa et al., 2023). The same study reveals that residents highly value such CES as education, knowledge and health benefits. Forests, especially those located close to waterbodies, are favoured recreational destinations (Jūrmalis et al., 2022), and forest is included in the Latvia's Cultural Canon as an integral part of the cultural environment of the country (Nikodemus, 2023)

CES identification and indicator development

The CES to be included in the analysis were identified by the research team according to three criteria: 1) relevance on national and preferably regional scale; 2) data availability on national scale; 3) unsuitability for mapping on a forest compartment scale. The first criterion means that the specific service reflects the social and cultural processes at least in Latvia, but preferably in the Baltic Sea Region countries. The second criterion means that data for a quantitative assessment are available. The third criterion denotes unsuitability for mapping in small spatial units - forest compartments typically used in management planning.

We applied Common International Classification of Ecosystem Services v5.1 (CICES, 2017) for identification of groups and classes of forest CES. For each of the identified CES we proposed indicators suitable for assessing their potential and, where possible, also flow and demand. Ecosystem service supply depends on the ecosystem functions and expresses the amount of the ES provided, while ecosystem service flow describes the actually used amount of the specific service, and demand – the need for the specific service (Burkhard et al., 2014; Potschin-Young, 2018).

Examples of indicator application

We demonstrated the possible application of the selected indicators of CES in three distinct aspects: creativity, marketing and education. The creativity aspect was covered by art and cinematography fields, the marketing aspect included analysis of promotional materials, and education aspect included formal and informal part. The data reflect the situation in 2021.

Art. Forest representation in art was studied in two datasets of paintings from 20th and 21st century: the collection of the Artists' Union of Latvia (512 paintings) and websites of art auction houses (3131 paintings auctioned since 2005), by visual analysis and identification of forests and their elements. Forest representation was detailed as: no forest, conifer forest, deciduous forest, mixed forest, abstract representation of forest and forest elements in a different type of landscape. In this paper these results are presented only briefly and in comparison, as they are already published in Pauliņa and Lībiete (2019).

Cinematography. Forest representation in cinematography was analysed in 70 classical and contemporary films, included in "Latvian Film Selection" (10 feature films, 16 documentary films and 44 animation films), selected by the

National Film Centre and representing most important cinematic trends in Latvian cinematography. The length of screen time with forest or forest elements was registered for each film using the same categories of forest representation. Similarly to artwork analysis, the categories were: no forest, conifer forest, deciduous forest, mixed forest, abstract representation of forest and forest elements in a different type of landscape.

Promotional materials. Forest representation in promotional materials was studied from materials in the online catalogue of rural hospitality businesses (www.viesunamiem.lv) containing 1061 entries about rural accommodation possibilities in Latvia. We analysed the use of forest photos in promotional materials of guesthouses, the geospatial location of guesthouses in relation to forest and additional forest-related services offered to visitors (forest trails, forest berry and mushroom picking, hunting etc.).

Education. Importance of forest ecosystems was studied separately in formal and informal education. Professional and university-level education programs related to forest management, forest science and wood processing, as well as certified life-long learning programmes for adults were identified for the formal education part. For informal education, we analysed publicly available information about forest museums, forest education centres and outdoor forest trails.

RESEARCH RESULTS AND DISCUSSION

Visual representation

We have identified three CES classes in two CES groups referring to visual representation of forests and their elements in the aspects of creativity and marketing and proposed nine indicators for their assessment. It was possible to develop indicators of all levels for the marketing-related service, but only supply and flow indicators are proposed for the creativity-related services (Table 1).

Table 1. Classification of CES referring to visual representation of forests and their elements (according to CICES v5.1, 2017).

Division	Group	Class (with code)	Description	Suggested indicator - supply	Suggested indicator(s) - flow	Suggested indicator(s) - demand
Direct, in-situ and outdoor interactions with living systems that depend on presence in the environmental setting	Intellectual and representative interactions with natural environment	3.1.2.4. Characteristics of living systems that enable aesthetic experiences	Use of forests or their elements as inspiration for art	Area of (accessible) forest providing inspiration; expressed as ha, relative to the area of country, region, etc. or calculated per number of inhabitants in the country, region etc.	Number of landscape paintings showing forests or their elements; expressed as % of the total number of paintings in a given collection, museum, gallery, auction house etc. Number/value of purchased paintings depicting forest; expressed as % from the total number or monetary value of paintings sold in the given gallery, auction house etc.	-
Indirect, remote, often indoor interactions with living systems that do not require presence in the environmental setting	Spiritual, symbolic and other interactions with natural environment	3.2.1.3. Elements of living systems used for entertainment or representation	Use of forests or their elements in cinematography	Area of (accessible) forest suitable for filmmaking; expressed as ha, relative to the area of country, region, etc. or calculated per number of inhabitants in the	Relative screen time showing forest or its elements; expressed as %, from the total screen time	-

				country, region etc.		
Indirect, remote, often indoor interactions with living systems that do not require presence in the environmental setting	Spiritual, symbolic and other interactions with natural environment	3.2.1.3. Elements of living systems used for entertainment or representation	Use of forests or their elements in promotional materials	Area available for establishing rural hospitality businesses in the proximity of forest; expressed as ha, relative to the area of country, region, etc. or calculated per number of inhabitants in the country, region etc.	Relative number of advertisements using forests or their elements; expressed as %, of the total number of advertisements for any specified business Number/value of additional forest-related services purchased by visitors; expressed as % of the total number of visitors	Visitor preferences for forest environment in immediate vicinity of accommodation

A closer look at the classification immediately reveals several challenges, especially in relation to the creativity-related CES. Results of the visual analysis of paintings created in Latvia during 20th and 21st century clearly confirm the importance of forests and their elements in the artistic representation of landscape (Pauliņa and Lībiete, 2019). The assignment of the indicator to a particular indicator group, however, is complicated. While using forests and their elements for artistic inspiration may be described as "direct, in-situ and outdoor interactions with living systems that depend on presence in the environmental setting" and characterised as "intellectual and representative interaction with natural environment", this classification may also be contested. Firstly, the creative process is not merely "intellectual", often it is intuitive, symbolic and deeply spiritual. Secondly, not all artists create in the outdoor environment, many use photographic references, moreover, contemporary art takes many forms and frequently incorporates technological elements, such as video capture or graphic simulations, and the inspiration may be drawn rather from the idea about the forest ecosystem than the ecosystem itself. Also, inspiration for an artwork may be drawn from another artwork (Ishiguro and Okada, 2020), and creativity is a complex phenomenon overall, resulting from inner processes and from encounters with the outside world likewise, as well as from the combination of both (Ishiguro and Okada, 2022).

Similar discussion may be extended to the use of forests in cinematography. Also in this context forest ecosystems render an important service. A detailed analysis of classical and contemporary films reveals the importance of forest landscape elements in cinematography, mainly as a background feature. From all 70 films included in "Latvian Film Selection" (created from 1966 to 2013), 48 films or 69% contain some forest elements, moreover, the presence of forest appears to increase with time: regardless of the genre (feature film, documentary or animation), 64% of the classical films and 71% of contemporary films show some forest. The screen time with visible forest or forest elements varies, occupying up to 90% of the total screen time. The current classification lists the service as "Indirect, remote, often indoor interactions with living systems that do not require presence in the environmental setting", but, again, this classification encompasses only part of its essence. Films are usually (though not always!) viewed indoors, but filming itself may be done outdoors or in the studio (still using forest elements, for example, as background), and filmmaking simultaneously involves intellectual, representative and symbolic interactions with the environment. Also, a question arises, both for films and for art: who is the user of the service - the artist (filmmaker) or the person who purchases the artwork (attends the film)? Perhaps it is practical to stratify the users according to their "proximity" to the service by identifying the actual creators of artworks as the primary users, and people who view/buy paintings, attend exhibitions, watch films etc. as secondary users.

The third CES related to visual representation of forests in our study – use in promotional materials – is seemingly less complicated. It is certainly topical - analysis of more than 1000 entries in an online guesthouse catalogue demonstrate that 65% of rural hospitality businesses use photos of forest and forest elements in their promotional materials, often combined with waterbodies, thus reflecting the preferences for recreation settings in Latvia, both stated and revealed (Donis, 2020; Jurmalis et al., 2022). However, the development of quantitative indicators involves certain challenges in this case as well. For instance, the flow of this service may be evaluated either from the perspective of prepared promotional materials or from the perspective of the purchased additional forest-related services, and in both cases the user of the service is different (the host and the customer). In the latter context the accuracy of the indicator is again unclear, as it is difficult to identify if the customers use the additional services because they have gained the information from the promotional materials, from direct communication with the host or from other sources.

Forest education

We have identified two types of CES pertaining to education and training, distinguishing between formal and informal education, and propose 14 indicators of supply, flow and demand for the respective services (Table 2).

Table 2. Classification of CES referring to use of forests and their elements in education (according to CICES v5.1, 2017).

Division	Group	Class (with code)	Description	Suggested indicator(s) - supply	Suggested indicator(s) - flow	Suggested indicator(s) - demand
Direct, in-situ and outdoor interactions with living systems that depend on presence in the environmental setting	Intellectual and representative interactions with natural environment	3.1.2.2. Characteristics of living systems that enable education and training	Use of forests or their elements in formal education	Number/ relative length of outdoor/ forest education activities in pre-school education; expressed as % of total activities Number/ relative length of outdoor/ forest education activities in school education; expressed as % of total activities Relative amount of forest-related information in biology textbooks for schools Number of study places offered in professional education programmes concerning forests and forest management; expressed as % of the total number of study places in professional education programmes Number of study places in higher education programmes (BSc, MSc, PhD) on forests, forest science and management; expressed as % of the total number of study places in higher education programmes Number of study places in life-long learning programmes/courses related to forest and forest management; expressed as % of the total number of study places in life-	Number of students in forest-related education programmes; expressed as % of the total number of students in the country, region etc.	Willingness to enrol in forest-related education programmes Number of applicants to forest-related education programmes

				long learning programmes		
Direct, in-situ and outdoor interactions with living systems that depend on presence in the environmental setting	Intellectual and representative interactions with natural environment	3.1.2.2. Characteristics of living systems that enable education and training	Use of forests or their elements in informal education	Number of forest-related museums or forest education centres; expressed as number per country (region) area or per number of inhabitants Number and/or length of forest nature trails; expressed as number/length per country (region) area Number and capacity (planned attendance) of forest-related informative events; expressed per country (region) area per year	Number of visitors to forest-related museums, forest education centres, nature trails; per country or region per year Number of attendees of forest-related informative events; expressed per country (region) area per year	Expressed willingness to visit museums/ forest education centres/ nature trails/ forest-related events

The high importance of forests in the context of provisioning and regulating services in the country necessitates relevant education. In formal education, we identified 34 professional education programs, four bachelor level programs, three master level programs and two doctoral level programs. Life-long learning programs and courses are also available, most of them offered to forest owners by Rural Advisory and Training Centre. Information about forest ecosystems and their functioning is typically included also in school and pre-school education programs. Quantitative indicators in this case are rather straightforward, describing either number or length of forest-related activities in the school, the relative amount of forest-related information in biology textbooks and number of study places in study programmes. The flow indicates the number of people enrolling in the respective studies and activities, and demand – interest to participate in them. The latter may be assessed either through stated preferences or actual number of applications to a study programme. The selected formal education-related CES proved comparatively less complicated to quantify, even though also in this case the actual representation of forest in, for example, biology study programmes, might be discussed.

Learning in and about nature may constitute an important part of one's self-development and contribute to personal growth, empowerment and sustainability knowledge. Most significant forest-related informal education venues in Latvia include museums (13 of 186 accredited museums in Latvia use forest ecosystems as topic for their exhibitions to various extent), education centres (at least six provide information about forest ecosystems), nature trails (most of 128 screened nature trails are entirely or partially located in forest) and forest-related public events (several large-scale events per year). The supply of the informal education-related services may be quantified by number or length of educational trails and number of venues providing forest-related information and events. The flow is expressed by visitor numbers, and the demand – by stated preferences for visiting informal forest education venues and events.

Including cultural services in the ES assessment

Systematic inclusion of CES in the ES assessment may provide considerable benefits to spatial planning, management decisions and ecosystem protection (Chan et al. 2012). CES are both connected to biophysical features of the landscape and highly dependent on human practices (Bieling, 2014), and they are the ecosystem service group most often related to service innovations (Maier et al., 2021). Spatially explicit ES assessment has higher practical relevance for management planning, but in such evaluation it may be extremely difficult or even impossible to include services that are not bound to specific ecosystem boundaries (Klain et al., 2014). Hence, our set of mini-studies presents a suggestion of indicators potentially useful for the evaluation of CES not limited to specific spatial units or bound to them only partly.

In our dataset, the most extreme example of CES unrelated to specific spatial unit is the inspirational value of forest ecosystems and their elements for art and cinematography. Inspiration and artistic representation definitely constitute a very important aspect of forests' contributions to people, but they are among those most difficult to explain and analyse. The inspirational quality of forests may depend on other factors besides ecosystem features. Artistic inspiration is a blend of the qualities of the subject, its symbolic and archetypal meaning and artist's experience of their previous interaction with it. Also Katayama and Baba (2020) emphasize the highly personal nature of artistic inspiration from ecosystems. The multifaceted and complex nature of the creativity-related ecosystem services excludes a simplified approach and, by extension, a straightforward classification, and this example also reveals several uncertainties relevant for a broader set of CES. Who are the users of the service? Is it possible to assign a service to several, instead of only one classification unit? How to handle the double-counting? It is not the aim of this paper to provide answers, but, hopefully, to highlight uncertainties

and frame questions that might serve as a starting point for a meaningful further discussion and interdisciplinary collaboration, which, as stated by many researchers before (e.g., Hernández-Morcillo et al., 2013; Katz-Gerro and Orenstein, 2015; Gould et al., 2019), is a necessary prerequisite of analysing CES. An update of the current classification system, CICES v5.2, is underway, and its final version (currently only a draft is available) may bring more clarity to these complex issues.

Economic valuation of CES constitutes further complications. The "free" quality of inspiration provided by nature is ostensible. Studies performed by Coscieme (2015) who analysed the popular music database for keywords related to world's ecosystems and Jiang and Marggraf (2021) who assessed the inspirational value of Weser River in Germany on the evidence from books support this. Both analyses utilized monetary evaluation, by calculating the income generated by downloads of the songs and sales of the books, respectively. In our example, the study could be expanded, by calculating the income generated by, for example, artwork auctions or film screening.

Use-value attribution, mobilization and appropriation are relevant concepts in the context of CES in general (Spangenberg et al., 2014), but the use of forests and their elements in promotional materials is perhaps the best example from those studied. Here, the "free" features of forest environment are assigned a specific importance (use-value attribution - ecosystem function transformation into ecosystem service potential). Through the investment of resources and labour, the forest environment may be modified, for example, by thinning the undergrowth or establishing a forest walking trail in the vicinity of the guesthouse (use-value mobilization - by making part of the ecosystem service potential available for use). Spangenberg et al. (2014) argue that ecosystem services provided in a certain area are dependent rather on human agency than on ecosystem functions. Even in cases when ecosystem functions change little, changes in societal perception and different patterns of use-value attribution may considerably influence the provided ecosystem services.

Environmental education is important for the environmental literacy of the population. It contributes to awareness-rising, responsible use of natural resources and sustainable development in general (Sauvé, 1996). While educational values are mentioned as important aspect of CES (e.g., Cheng et al., 2019; Kosanic and Petzold, 2020), they are rarely studied in detail, therefore, the insight we propose may prove useful. Formal forestry education, represented in our study by available programs, highlights direct and indirect links to forest ecosystems, such as learning about the forest (from textbooks, lectures, scientific papers etc.) and learning in the forest, as the programs usually include also practical tasks in forest environment. Being in direct contact with the subject matter and gaining practical experience enhances understanding and personal involvement and establishes links with the environment. Informal forest education possibilities, such as museums, learning centres and trails, represent a blend of CES, simultaneously belonging to the category of recreational, aesthetic and educational services.

Meaningful inclusion of CES in the total evaluation of ES requires additional work and interdisciplinary collaboration, and quantitative assessment data should be complemented by participatory and interpretive research techniques, to capture the complexity underlying the human-nature relationships (Fish et al., 2016). Temporal and spatial trade-offs of CES with other ES groups need to be studied in the future, as current ES valuation methods generally tend to focus on place-based benefits and management effects, often overlooking off-site impacts (Pascual et al., 2017). Involvement and representation of the relevant stakeholder groups is a crucial aspect of ES assessment (Harrison et al., 2018; Mandle et al., 2021), and attention should be paid to the relationships of different societal groups with specific ecosystems and services provided by them, as the perceived benefits of nature's contributions to people depend on the social group, socioeconomic situation, political system and other social factors (Plieninger et al., 2013; Spangenberg et al., 2014, Fish et al., 2016). Our study certainly has limitations, pertaining, firstly, to the subjectively selected (though experience-based) set of CES, and, secondly, to the limited set of developed indicators, especially for the creativity-related services. Still, we hope our work will constitute a useful part in the growing body of scientific studies on human-environment relationships in the context of contemporary global challenges.

CONCLUSIONS

To expand the knowledge basis on CES that are still underrepresented in ecosystem service assessments, we studied some less frequently addressed services related to visual representation of forests and the role of forests in education. We conclude that CES pertaining to visual representation of forest ecosystems and forest ecosystem use in formal and informal education have high relevance in Latvia. Classification and analysis of creativity-related ecosystem services are highly complicated, as they may simultaneously refer to direct and indirect interactions with ecosystems, and the service-user relationships are complex and multi-faceted. In Latvia, forests form a natural venue for educational activities that may contribute to environmental awareness. To enhance that, critical thinking, as well as theoretical and practical aspects of sustainability should be incorporated in the already existing framework of formal and informal education. Quantification of cultural ecosystem services, by linking the biophysical ecosystem properties with their cultural significance, increases the visibility of these services and facilitates their meaningful incorporation in the ecosystem service assessment.

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