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A new methodology to assess landscape reserves in Lithuania

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Abstract. The first state reserve in Lithuania was established in 1960; however, no detailed assessments of changes in the state of the protected values therein have been performed ever since. Landscape reserves are the most complex ones and they pursue the twofold goal – to conserve the values and to use them sustainably. In order to be resilient themselves, thus contributing to broader objectives of social-ecological resilience, the reserves should be able to adapt to ever-changing social and ecological conditions in a way that supports the long-term persistence of population, communities, and ecosystems of conservation concern. Therefore, it is necessary to update information on the status of values protected in the reserves. The article addresses this need by offering a concise and user-friendly methodology for assessing the status of landscape reserves. The methodology focuses on three main components: (1) general features of the landscape structure, (2) the effectiveness of protection of values and (3) the pressures and threats they experience. Two state landscape reserves were selected for testing the applicability of the methodology: one in Vilnius city, the other 50 km to the west, in the countryside. Application of the common methodology will allow to assess the condition of landscape reserves in the country. Further development of the methodology could include evaluation of external pressures (e.g. urbanization) as well as addition of remote sensing techniques.

Keywords*: protected areas; landscape reserves; landscape resilience; assessment methodology, spatial resilience*

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INTRODUCTION

Lithuania has its own system of protected areas and long-standing traditions of the protection of natural and cultural heritage. All national categories of protected areas in Lithuania and their compatibility with the IUCN categories (Day *et al.* 2013) are listed in Table 1. The system of protected areas covers objects, sites and areas of natural and cultural heritage, including elements of living and inanimate nature, unique and inherent landscape complexes (from natural to urbanized), and consists of four categories of protected areas listed in Table 1. Occupying 17.65% of the country's area, the Lithuanian system of protected areas consists of five strict reserves (two of them cultural), 514 reserves, five national parks (including one historical), thirty regional parks (only one among them historical), one biosphere reserve, 32 biosphere polygons, three restoration plots and many heritage sites (Baskyte *et al*. 2006).

In Lithuania, reserves served as a basis for the formation of the current system of protected areas. The vast majority of state parks are set up on the basis of nature reserves. According to the Law on Protected Areas of Lithuanian Republic (Republic of Lithuania Law… 1993) the reserves are created to protect the areas possessing scientifically and educationally important natural and/or cultural heritage values, as well as in order to protect landscape, biological diversity and the gene pool. At present, 514 reserves cover 2.25% of the country (Fig. 1).

According to the particular process of establishment and management organization, reserves can be further divided into the following groups: standalone state reserves, municipality reserves and reserves located within the state parks (national and regional) or

Table 1 Categories of protected areas in Lithuania (data source: State Cadastre of Protected Areas, 2020)

National categories of protected areas in Lithuania	Types of protected areas			IUCN categories of protected areas in Lithuania*
Areas of conservational protection priority	Strict reserves	Nature		Ia
		Culture		V
	Reserves	Nature	Geological, geomorphological, pedological, telmological, talasological, botanical, zoological, botanical-zoological	**V**
		Culture	Archaeological, memorial, ethnocultural, landscape, architectural, urban	**V**
		Complex	Landscape	**V**
	Objects of heritage/ monuments	Nature	Geological, geomorphological, hydrographical, hydrogeological, botanical, zoological	III
		Culture	Archaeological, memorial, ethnocultural, architectural, technical	III
Territories of ecological protection priority	Protected zones	Protected zones of general ecological protection Buffer zones Protected zones of physical protection Protected zones of visual protection Sanitarian protected zones		VI
Areas of restorative protection priority	Plots of natural resources	For flora and fauna resources, marshes, underground water resources recuperation		VI
	Genetic plots	For genetic resources recuperation		VI
Integrated (complex) protected areas	State parks	National	Historic National	V (incl. Ia)
		Regional	Historic Regional	**V** (incl. Ia)
	Biosphere monitoring areas	Biosphere reserve		VI (incl. Ia)
		Biosphere polygons		VI

* IUCN categories: Ia – Strict Nature Reserve, Ib – Wilderness Area (this category is not assigned in Lithuania), II – National Park, III – Natural Monument or Feature, IV – Habitat/Species Management Area, V – Protected Landscape/Seascape, VI – Protected Area with Sustainable Use of Natural Resources (data source: www.iucn.com, 11 02 2020).

biosphere monitoring territories (biosphere reserves and biosphere polygons). Standalone state reserves have no administrative structures of their own; therefore, their management, including the assessment of status, is assigned to directorates of state parks, strict nature reserves or the biosphere reserve. A number of state reserves have management plans that provide for the necessary measures of their management. However, management plans are not obligatory, as the economic activities can be carried out in accordance with national legislation or the area specific territorial planning documents.

Landscape reserves are established for protection of areas of valuable natural and/or cultural landscape (Baskyte *et al*. 2006). The first reserves which were established in 1960 were specifically designed to protect the landscape. 136 landscape reserves were turned into state parks in 1992. Landscape reserves constitute the largest and most important category of reserves aimed at protection of both unique and typical natural and cultural landscape complexes in Lithuania. Currently, there are 69 standalone landscape state reserves in Lithuania (Fig. 2), covering 0.83% of the country's territory.

The landscape reserves are the most complex. Subject to specific values to be protected, they are further subdivided into 'nature' or 'culture' reserves and combine goals both of protection and sustainable use, thus falling under Category V (Protected Landscape/Seascape) of the IUCN classification.

Simultaneously, the majority of landscape reserves have been designated both as sites important for birds and as habitats of Community importance, and they constitute a part of the Natura 2000 network (European Commission… 1993) in Lithuania. Within the reserves the Natura 2000 sites are monitored as per EU requirements; however, the set of indicators does not cover landscape status (Rašomavičius *et al*. 2012). Generally, the methodology for habitat identification and data collection for assessment differ by country (Alberdi *et al.* 2019).

The complexity of landscape structure in state landscape reserves owes to the ongoing anthropogenic changes affecting them. To be resilient (and to contribute to a broader social-ecological resilience), their landscapes must be able to adapt to changing social and ecological conditions in a way that supports the long-term persistence of populations, communities, and ecosystems of conservation concern (Fischer *et al.* 2009). Therefore, it is necessary to timely update information on the values protected in the reserves, including the assessment of their condition, and, if

Fig. 1 Map of reserves in Lithuania (data source: State Cadastre of Protected Areas in Lithuania, 2020)

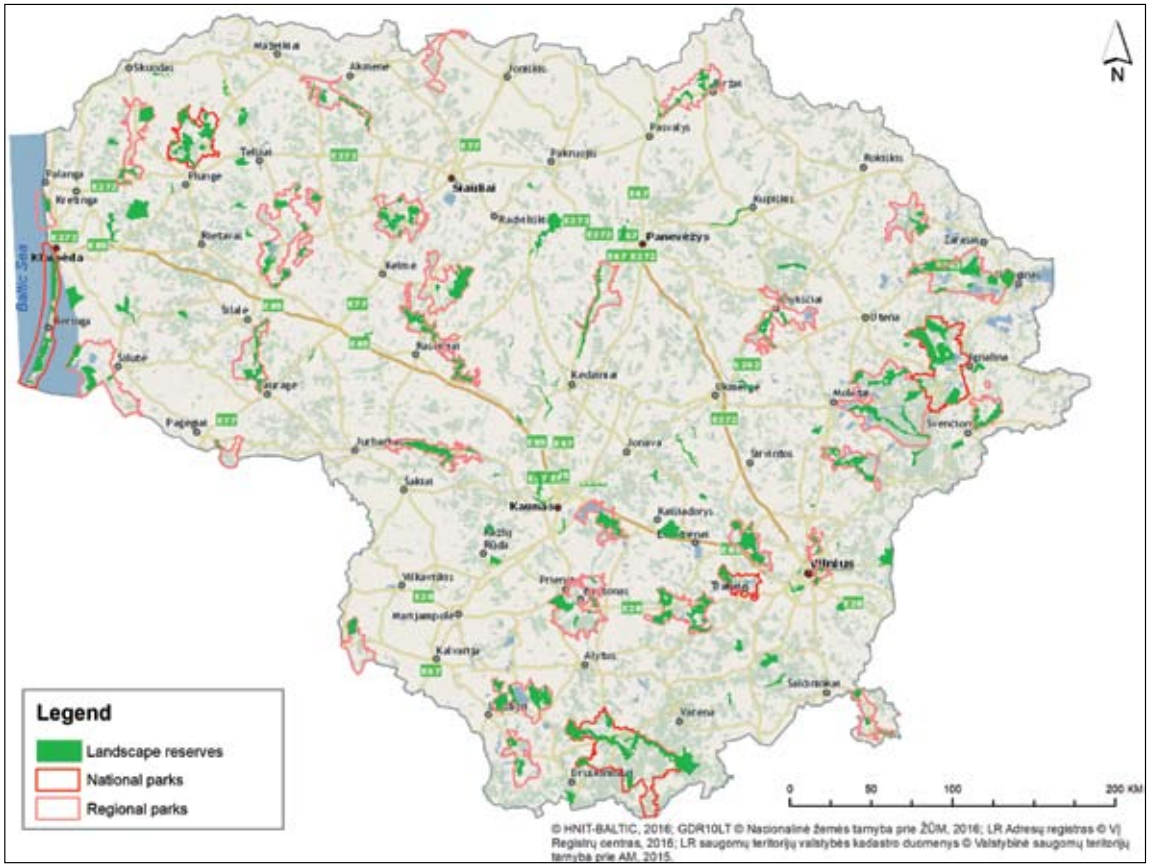

Fig. 2 Landscape reserves by specific features of establishment and activities in Lithuania (data source: State Cadastre of Protected Areas in Lithuania, 2020)

necessary, to adjust their spatial boundaries and/or management regulations (Ministry of Environment… 2015). An earlier attempt to formalize the procedure for assessing the status of the nature and landscape reserves (Ministry of Environment… 2015) failed. It neither contained the status indicators nor clear evaluation criteria and was abolished in 2006.

Presently, the assessment of the status of state reserves is being periodically commissioned by the responsible staff of managing directorates as per their own understanding of the matter, limited mostly to the inventory of legal act violations revealed during the inspections. Up to now, there has been no specific study nor any official common methodology for a qualitative assessment of the condition of landscape reserves.

We attempt to fill the gap by presenting the experience-based methodology for assessment of the status of landscape reserves in Lithuania, hopefully with international applicability. For the clarification of terms, we accept that the status of a landscape reserve in this paper is understood as a summarized characteristic of the physical condition, effectiveness of protection measures and aggressiveness of external threats and pressures, including all the three aspects into the methodology agenda.

The goal of the article, thus, is to develop a methodology for assessing the condition of landscape reserves and the threats they face. In order to achieve the goal, it was necessary to: a) review the development of landscape reserves in Lithuania, b) evaluate the national and international scientific papers presenting experiences of assessing the condition of reserves or the status of protected areas, and c) develop a concept for the assessment of the condition of landscape reserves and to test it in a selected area.

An appropriate methodology will ensure smooth work and enable planning of nature management activities for the preservation or restoration of landscape complexes or particular landscape values (objects). In order to have a consistent overview of the state of all the values protected in landscape reserves across the country, the data should be collected and presented in a uniform format. The newly collected data will document the values of landscape reserves for their better long-term conservation. Also, if presented in an adapted way it will contribute to increasing public awareness.

MATERIALS AND METHODS

Protected landscape status assessment experience in Lithuania

The studies of Lithuanian landscape have a rather long and controversial history, dating back to the fifties of the 20th century (Kavaliauskas P., Kavaliauskas N. 2019). While implementing the obligations under European Landscape Convention (ELC), the National Landscape Management Plan as the most important document for the landscape management policies with territorially differentiated and science-based strategies for the use and protection of the landscape (Lietuvos Respublikos… 2015). The methodology used for the designation of landscape management zones allowed to identify the most important directions for the formation of the cultural landscape of the country and to elaborate the main principles of landscape models (types of landscape management zones), while specification of their [internal?] structure remains a subject for lower levels of spatial planning process (Kavaliauskas 2014).

The state of landscape at the national level has been analyzed in several landscape monitoring studies. The first report retrospectively analyzed the land use / land cover patterns and their changes in 100 reference sites (2.5 km^2 each) based on soviet topographic maps of 1976–1986 and aerial views of 2005–2006 (Geologijos… 2008). The second study was carried out in 2015–2016 and provided with an updated land use / land cover situation of 2012–2013, as depicted in aerial views (Lietuvos geografų… 2016).

In 2018–2019, a landscape structure analysis of all Lithuanian state parks was commissioned by the State Service for Protected Areas. The uniqueness of the landscape of state parks was assessed in two aspects: a) through a variety of differences in morphological structures and b) within the identified morphological landscape – the relative complex value of the structure (Kavaliauskas P., Kavaliauskas N. 2019).

The reserves (landscape reserves) are small-scale and are intended for preservation of scientifically and cognitively valuable natural and/or cultural places, their natural and cultural heritage values, landscape and biodiversity and genetic resources. This geographical and size difference means that the methodologies developed for the assessment of complex protected areas cannot be directly applied to small areas like landscape reserves. There are separate assessment studies for individual reserves, but the purpose of an integrated assessment is completely different from e.g. soil quality research (Tuskenyte, Volungevicius 2016) or assessment of the landscape's aesthetic potential (Budriunas, Eringis 2000).

Protected landscape status assessment experience in European countries

There are merely individual studies applicable for the assessment of the landscape in large protected areas. European countries in different regions were selected for a comparison of landscape assessments or

Table 2 Review of existing methods of landscape assessment and evaluation in United Kingdom, Spain and Germany and the main assessment criteria that were used in compiling the assessment methodology for landscape reserves in Lithuania. The main criteria are in bold (data source: Landscape Observatory 2016; Tudor 2014; Landscape Institute… 2013; Heiland *et al.* 2012)

	United Kingdom	Germany	Spain
Title of methodology	Landscape Character Assessment	Evaluation of German National Parks	Landscape Catalogues of Catalonia. Methodology
Number of stages	• **baseline review: natural factors** • **baseline review: cultural/ social factors** • cultural associations • **review of policy and designations** • stakeholder's involvement	• **review of policy and management issues** • stakeholder's involvement	• **type of the landscape;** • **conservation status;** • recommendations for improving the quality of the landscape
Number of criteria	19 criteria	10 criteria	14 criteria
Methods used	• Desk study • Field study • Spatial analysis	• Desk study • Field study	• Desk study • Field study • Spatial analysis
The scale at which the assessment was made	• national/regional level 1:250,000 • county level 1:50,000 • district level 1:20,000–1:10,000	No maps were prepared	• regional level 1:50,000–1:25 000

survey practices. An abridged overview of the British (Tudor 2014; Landscape Institute… 2013), German (Heiland *et al.* 2012) and Spanish (Landscape Observatory 2016) experiences is provided in Table 2. Some of the Landscape Resilience Framework tools are also used. Unfortunately, neither country has developed a special methodology for assessing the condition of relatively small areas like reserves. However, these countries have made a significant progress in the knowledge of their landscapes, and their experience can be useful in Lithuania.

British and Spanish methodologies are close to each other. Landscape units in both United Kingdom and Spain are understood as a part of the territory that is characterized by a specific combination of environmental, cultural, perceptual and symbolic features of the landscape with clearly recognizable signs of dynamics and differences from the rest of the area (Nogué *et al.* 2016). Great attention is paid to landscape assessment. The value of a landscape is determined by various attributes: natural factors that determine the quality of the environment and their natural or ecological value; aesthetics that determine the sense of beauty (configuration, land cover diversity, uniqueness); historical attraction; recreational attraction; symbolic or associative importance; economic productivity (Nogué, Vicente 2004). The identification of landscape units is based on the totality of natural, heritage, visual and mental elements that distinguish these areas from the surrounding environment (Fanghan *et al.* 2018). The methodology of Spain sought to combine objective criteria of physical characteristics with the results of subjective assessment, which was given a special, often decisive role (The Landscape… 2016; Langemeyer *et al.* 2018).

Each protected area may be assessed accordingly in accordance with a national assessment programme (UK 2019). The Cairngorms National Park Authority produced a "Landscape Character Assessment" document in 2009, designed to produce an accurate and detailed description of landscape types (Cairngorms 2009). From this assessment a planning framework and a set of guiding landscape principles have been developed. This study contains detailed descriptions of the Landscape Character Areas with the Park – all of which are formed by the topography, land use history, settlement and development pattern and the way in which people experience the landscape (Fanghan *et al.* 2018). Such a tool is very handy when preparing spatial planning documents or deciding on possible activities in the area.

Since 2008, EUROPARC Germany has reviewed the management effectiveness of all fourteen German national parks on behalf of the German Government. These standards qualify as the optimal conditions to be achieved by a national park, jointly defined by the involved participants (Evaluation 2008). A questionnaire with open-ended questions and indicators was used to examine actual current conditions in the national parks and to compare these with the target conditions set out in the standards (Heiland *et al.* 2012). This questionnaire served as the uniform basis for all the national park evaluations. This method is well suited for large-area complexes that have separate administrative authorities, but small-area protected areas where no intensive conservation and management measures are in place could not be judged by this methodology.

METHODOLOGY FOR ASSESSING THE STATUS OF LANDSCAPE RESERVES IN LITHUANIA

In this methodology, landscape quality (or condition) is determined by the physical state of the landscape, as well as by its intactness from visual, func-

tional, and ecological perspectives. It also reflects the state of repair of individual features and elements which make up the character of the place (The Landscape… 2002). Landscape reserve state is the status where the overall impact is the past and its type of representativeness may have a long-term effect on its natural distribution, structures and functions and its typical other long-term survival.

The methodology for assessing the status of landscape reserves in Lithuania is based on methodologies developed and applied by other countries, which have old traditions in landscape research; the methodologies and programmes for effective management evaluation of protected areas in Lithuania were also assessed (Table 2).

Taking into account that the assessment of the status of reserves is performed by specialists of state park directorates, we used SMART criteria (Bogue 2013) and also, for practical reasons, the methodology that had to be:

- easily understood by non-specialists,
- relatively quick and easy to complete by the staff of protected areas, and
- easy to repeat in 5 years to record the changes over time.

In developing the methodology, the greatest challenge was to select an appropriate assessment scale, aspects, criteria and indicators that adequately reflect the status and diversity of landscape reserves. In order to qualitatively assess the condition of landscape reserves for national comparison purposes, three main areas of assessment were suggested:

1) identification of the general physical condition of the reserve,
2) assessment of the level of adequacy of protection of the territory, and
3) identification of key pressures and threats.

The principal scheme (Fig. 3) of assessment of the status of landscape reserves (as well as the methodology itself) focuses on these three assessment directions (components) split into different criteria.

The first component is the general physical features of the area, which assesses landscape structure through natural and cultural assessment directions, covering both natural and cultural protected values of the reserve. Freely accessible land cover data sets (like CORINE), aerial photography (European Commission 1993) or even satellite images (like Landsat or Sentinel) could be used to assess the land cover diversity, naturalness of landscape and coherence of built-up territories (3 criteria in total).

The second important component is assessing the effectiveness of the protection of values. The criteria of this assessment component represent compliance with legislation in the territory, quality of implementation of territorial planning documents and effectiveness of area management. The assessment of protection effectiveness is structured along 6 criteria presented in Table 3, all of which should be completed.

The third component assesses pressures and threats which have an impact on landscape values (Schulze *et al.* 2017). It is important to identify the potential linkages between the quality of management of the reserve and arising threats. It is recommended to use the Impact and Threat List (version of 05/07/2018) used by the European Environment Agency and adapted to the Habitats Directive.

The main threats to be considered, as well as the criteria for determining their significance on target habitats are presented in Table 3. The authors distinguish the greatest threats to landscape reserves:

- The conversion of a landscape reserve or parts thereof into cultivated fields poses a significant threat to the very existence of values (relief of terrain, biodiversity); therefore, the use of this type of land and the intensity of this process should be regulated.
- In landscape reserves where the area is dominated by agrarian forests, the non-mowing of meadows becomes an important threat, which creates preconditions for overgrowing of the area with woody vegetation. This in turn degrades the landscape of reserves, the visibility of values and the overall visual quality.
- Clear-cutting in landscape reserve areas not only has a negative visual impact, but also due to the use of heavy machinery creates real preconditions for surface deterioration and change of relief forms, as well as increases the risk of surface erosion.
- Although mining in landscape reserves is not permitted, the illegal exploitation of minerals for private or commercial uses and the operation of quarries opened before the establishment of the reserve may cause or are causing significant damage to the values protected in the reserve.

Threats that have not been discussed but are identified in the assessment should also be assessed in terms of materiality, with the threat code, title and commentary on materiality assessment. In individual cases, where threats are closely interlinked and their effects are difficult to distinguish, it is recommended to show several related threats on a single line and provide an overall assessment. Rapid threat assessment indicators are identified and analyzed when there is no information and/or expertise required for a detailed assessment.

At the beginning of the assessment, possible anthropogenic infringements and cases of deforestation should be identified. Potential problem situations are identified to help decide on assessment points for the condition.

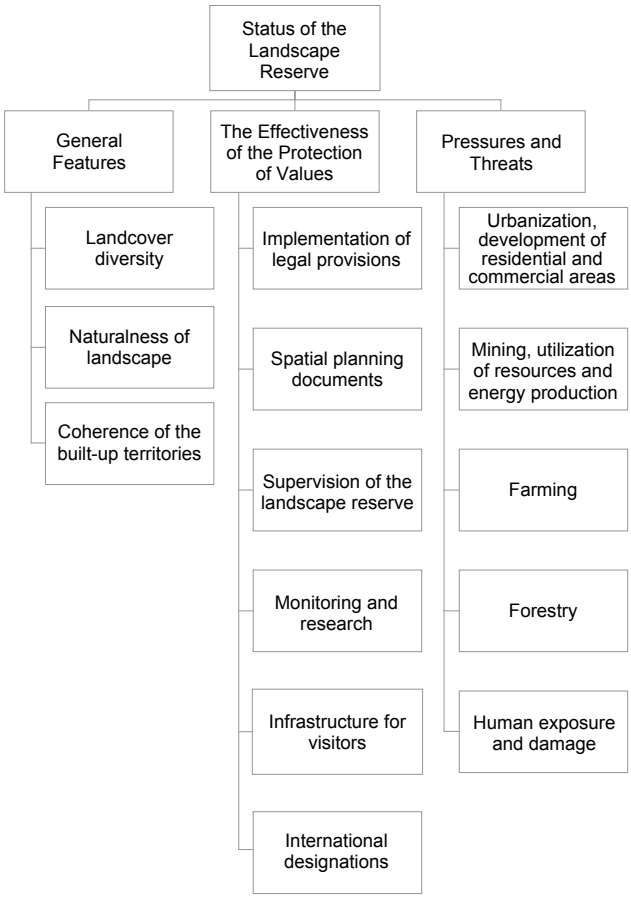

Fig. 3 Principal scheme of the assessment of the status of landscape reserves

The assessment of general features and of effectiveness of the protection of values is performed by simple scoring, ranging from 0 as poor to 3 as excellent. It is suggested that evaluators choose the answer that is the nearest and use the Comment section (Table 3) to elaborate. The maximum score of both components is 27. If the criteria do not represent conditions in protected areas, it is recommended to choose the answer that is the nearest and use the Comment section to elaborate. The scores will be summed up. The assessment of pressures and threats is also performed by simple scoring, ranging from 0 as poor to 3 as excellent. But this score will be always negative. It is not possible to determine the maximum score of this component because the threats are identified for each reserve individually. The scores will also be summed up. The overall assessment of the area is written in two numbers, e.g. A (-B), where A stands for the sum of general features of the area and effectiveness of protection of values and (-B) stands for pressures and threats.

Following the deskwork, the assessment should be continued in the field.

For purposes of evaluation, at least three vantage points should be selected:

- if the landscape of the reserve is dominated by a natural structure, in order to assess the naturalness at least one vantage point has to be selected at the site of potential anthropogenic digression;
- if the landscape of the reserve is equally shared by both natural and anthropogenized structures, then two vantage points have to be natural ones, and the third has to be at the point of potential anthropogenic digression.

Observations in the Comment section provide more confidence to the results of the assessment, thus making the decision-making more transparent. Observations might cover a reference document, monitoring results or external studies and assessments. The point is to give anyone reading the report an idea of why particular scores were awarded. Also, it is possible to mention in the section any proposed actions that would improve management performance.

After evaluating the territory of the reserve in three aspects, the general condition of the territory can be assessed in the conclusions:

I. Good status. Very expressive and diverse landscape structure, the area has its naturalness, shorelines have not been manipulated. There are small human settlements with vague urban structure. Preventive activities are often carried out in the area, so there are no violations and area surveys are carried out regularly. Cognitive infrastructure is in place and is properly maintained. Not more than two low-scale risks were identified.

II. Mediocre status. Expressive but not so diverse landscape structure, natural landscape prevails (forests-swamps and waters occupy 30–80%), some shorelines have been modified. There are small human settlements with vague urban structure. Site management and supervision is lacking. Preventive activities are carried out in the territory once a year, therefore, violations are recorded. The area was surveyed more than 10 years ago. Cognitive infrastructure is in place but not maintained. One high-level, two or more medium-level threats were identified.

III. Poor status. Monotonous landscape structure, the area has lost its naturalness, up to 30% of shorelines have been modified as a result of direct or indirect human activity (straightened river beds, artificial ponds, as a result of land reclamation activities or because of eutrophication due to diffused pollution from agricultural fields). There are many urban areas that have not maintained their original structure. Preventive activities are not carried out in the area, so there are many violations and important protected values have been significantly damaged. No surveys have been carried out on the site since its establishment. More than three significant threats have been identified.

Table 3 Assessment form of the status of landscape reserves

Name of landscape reserve				
Issue	1. Criteria	2. Score: tick only one box per question		Comment
I. GENERAL FEATURES OF THE AREA*				
1. Land cover diversity Land use type, speed of changes (Assessment using Corine data)	One type of monotonous land use.	0		
	Several large land uses in the analysed area, thus creating poor scenery of landscape.	1		
	Medium-sized land plots, which give a modest pictoriality.	2		
	Large land use mosaic, manifested in small plots of various earthworks.	3		
2. Naturalness of landscape The proportion of natural and sub-natural components (forests, wetlands, water bodies) in the territory	Landscape has no or no relative naturalness.	0		
	Less area of natural landscape (forests-swamps and waters <30%).	1		
	Partly natural landscape (forests-swamps and waters 30–80%) dominates.	2		
	Relatively natural landscape (forests-swamps and waters 80–100%) dominates.	3		
3. Coherence of the built-up territories	Bright urban structure, striking ethnographic elements.	0		
	Undefined urban structure, ethnographic elements expressed.	1		
	Unexplained urban structure, no significant ethnicity.	2		
	No residential areas.	3		
	Total score of general features of the area (0–9):			
II. THE EFFECTIVENESS OF PROTECTION OF VALUES				
4. Implementation of legal provisions Measures and quantities of environmental damage	The staff have no resources to enforce protected area legislation and regulations.	0		
	There are major deficiencies in staff capacity/resources to enforce protected area legislation and regulations (e.g. lack of skills, no budget for control, lack of institutional support).	1		
	The staff have acceptable capacity/resources to enforce protected area legislation and regulations but some deficiencies remain.	2		
	The staff have excellent capacity/resources to enforce protected area legislation and regulations.	3		
5. Spatial planning documents	The area does not have any planning documents.	0		
	The area does not have a management plan, but the measures are included in other planning documents.	1		
	Territorial planning documents are in place but measures are not implemented.	2		
	The planning document of a reserve has been approved and is being implemented in the territory.	3		
6. Supervision of the landscape reserve	Territory is not supervised	0		
	Staff of protected areas pay a site visit to the territory at least once a year.	1		
	Staff of the protected areas pay at least 3 site visits per year, but maintenance is poor.	2		
	The territory is permanently supervised, maintenance is regular.	3		
7. Monitoring and research Information on surveys and monitoring in the area	Territory is not a subject to research and monitoring; no data is available.	0		
	Research and monitoring were performed in the territory more than 10 years ago. Data is available, need to be updated.	1		
	Only monitoring of species and habitats (Natura 2000) is carried out in the area	2		
	The territory is constantly undergoing research and monitoring, data is available.	3		
8. Infrastructure forvisitors	There are no visitor facilities, and needs have not been identified.	0		
	There is a need for visitor facilities, but the area is not equipped with cognitive tourism infrastructure. Recreational digression is visible.	1		
	The area is adapted for cognitive tourism, but infrastructure is poorly maintained.	2		
	The territory has a cognitive tourism infrastructure, it is constantly maintained.	3		

9. International designations	There are no international designations	0		
	Inventory of Habitats of Community importance has been performed, but Natura 2000 status is not set.	1		
	The territory is important either for the Habitats Directive or the Birds Directive.	2		
	The territory is important for both Habitats and Birds directives.	3		
Total score of effectiveness of protection of values (0–18):				
Total score (0–27): *(sum of general features of the area and effectiveness of protection of values)*				
III. PRESSURES AND THREATS				
Code and title of the threat	Description of the threat	Score: tick only one box per question		Comment
A01 Conversion of natural lands into agricultural	This type of threat is not recorded in the area.	0		
	The level of threat is low – up to 10% of the reserve area are converted into arable land.	-1		
	The level of threat is average –10–30% of the reserve area are converted into arable fields.	-2		
	The level of threat is high – more than 30–80% of the reserve area are converted into arable fields.	-3		
A06 Overgrowing of meadows	Up to10% of the area of meadows and pastures in the reserve are not regularly mowed or grazed.	0		
	The level of threat is low – 10–30% of the area of meadows and pastures in the reserve are not regularly mowed or grazed.	-1		
	The level of threat is medium – 30–60% of the meadows and pastures in the reserve are not regularly mowed or grazed.	-2		
	The level of threat is high – more than 60% of the meadows and pastures in the reserve are not regularly mowed or grazed.	-3		
B09 Clear cuts	Forest management takes place in accordance with forest management projects. This type of threat is not recorded in the area.	0		
	The level of threat is low – up to 5% of the forest area consists of logging sites and 1st class stands.	-1		
	The level of threat is medium – in the reserve, 5–35% of the forest area consists of logging sites and 1st class stands.	-2		
	The level of threat is high – 35% of the forest area in the reserve consists of logging sites and 1st class stands.	-3		
C01 Mining and quarrying	Changes in the structure of vegetational cover do not exist.	0		
	The level of threat is low and hardly noticeable	-1		
	The level of threat is medium – abandoned small size unclaimed quarries are present in the reserve.	-2		
	The level of threat is high – obvious and large area (new mining and construction areas) surface relief, changes in the structure of vegetation cover, which destroy their valuable features that have formed naturally and organically over time, are recorded.	-3		
F01 Construction of areas with settlements and recreational buildings	Coherence of built-up areas with the surrounding landscape.	0		
	The level of threat is low – adjacent settlements do not discharge wastewater into adjacent water bodies, but littering has to be taken care of.	-1		
	The level of threat is medium – treated wastewater from adjacent settlements is discharged into the adjacent water body.			
	The level of threat is high – intensive construction is taking place in the vicinity of the reserve, and untreated wastewater from settlements is discharged into the surface water bodies upstream of the reserve.	-3		
Total score of effectiveness of pressures and threats (0–15). This score is always negative:				
Conclusions (assessment group and total score (0–27; -0–15):				

*criteria are evaluated for the first time only. These criteria do not reflect the state of the area, but can be used in order to compare different landscape reserves.

RESULTS

Two landscape reserves were selected for testing the methodology. GIS software was used to prepare maps for a sample report.

The first territory, the Karoliniškės State Landscape Reserve (SLR), is situated in the city of Vilnius (Fig. 4). The forested Karoliniškės erosive hills stretch for 3.2 km in the south-west-north-east direction through the Karoliniškės and Šeškinė elderships in the western part of Vilnius, on the right bank of the Neris River, in front of Vingis Park. The average width of the hills is 0.5 km, while in the widest place it reaches 0.66 km. In the south, the hills border the Lazdynai eldership, and in the east the Žvėrynas eldership. The hills are intersected by T. Narbuto Street which is one of the main streets in Vilnius connecting the city centre with its western districts. The reserve was established in order to protect the expressive valley of the Neris River, the banks of which are crisscrossed by gullies. Since the reserve is surrounded by heavily urbanized areas, it experiences heavy pressures from visitor flows and ongoing construction activities along its boundaries.

The main threats that alter, destroy or damage soil, destroy habitats and disturb species in the Karoliniškės SLR are caused by human activities (Fig. 5). They mostly stem from intensive recreational activities resulting in deliberate vandalism, destructive actions against or physical threats to staff and other visitors. The territory is heavily littered by undisciplined visitors and irresponsible residents of nearby dwellings. As steep slopes dominate in the reserve, this area is very popular with mountain bikers, who loosen up the erosion of slopes.

The second chosen pilot area, the Strošiūnai State Landscape Reserve, is located 50 km west of Vilnius (Fig. 6). It was established in order to preserve the expressive landscape of heavily eroded moraine elevation.

The economic activity within the reserve, including tree-logging, hunting, berry-picking and mushroom gathering are causing the formation of a spontaneous forest road network (Fig. 7). There are 3 derelict (excavated) sites that need to be reclaimed. The clear-cut areas in the areas within the reserve have a significant negative visual impact. Extensive use of heavy forest machinery threatens to destroy the surface relief, as well as increase the risk of erosion.

According to the performed assessment, the pilot territories differ: the total score of the Karoliniškės SLR is 16(-3); that of the Strošiūnai SLR is 14(-6), but at the same time these reserves belong to the same groups (Table 4). The Karoliniškės SLR is almost uninhabited (only in the eastern foothills, in Žvėrynas eldership, there are several homesteads), entire territory is overgrown with mixed forest. The reserve is intensively visited and is adapted for recreational purposes. Cognitive hiking trails of various lengths are in place. There are also cross-country skiing trails, bicycle paths, information stands and signs, benches for visitors, observation decks and spectacles. According to Corine Land Cover CLC2018, the reserve is dominated by green urban areas with small open meadows. The territory of the reserve is intersected by one of the main transport arteries of the city. However, the natural area is surrounded by discontinuous urban fabric. The Strošiūnai SLR is dominated by a picturesque agrarian landscape, but moraine uplands are heavily eroded. Spontaneous wooden vegetation is currently hindering the scenery of the area. Due to its structure, the landscape is abundant in mineral resources (mostly gravel); therefore, damaged, excavated areas are recorded. They should be reclaimed. There is lack of information stands and signs, so people do not know that this is a protected area and commit many violations. Half of the area is covered by forest (coniferous or mixed), some of the places are transitional woodland-shrub areas. Therefore, the performed forest management works also have a negative impact on the protected area.

Both territories have valid management plans, but only the Karoliniškės SLR management plan has been implemented. The Neris Regional Park Directorate supervises both territories, but because of lack of funds the Strošiūnai SLR gets less attention and this leads to increased numbers of violations, which have a negative effect on the protected area. The management plan of the Karoliniškės SLR has been implemented, which means that the area is adapted for cognitive tourism.

DISCUSSION AND CONCLUSIONS

The proposed concise methodology for assessing the state of landscape reserves is based on expert opinion, and it requires a site visit. To minimize subjectivity, it would be advisable to supplement the assessment with several representative short-cycle observation sequences containing continuous (seasonal) high resolution aerial photographs obtained from unmanned aerial vehicles (drones). Instances of land erosion, deflation, recreational digression, spontaneously overgrown areas with shrubs, other potentially negative or positive landscape phenomena should be assessed. Drone technologies could also be effectively complemented by integration of hyperspectral photography of land cover and the structural composition of landscape components. It would allow for recording quantitative – physical and chemical parameters of land cover components and identifying quite precisely the qualitative features (vegetational

Fig. 4 Land cover of Karoliniskes State Landscape Reserve (data source: State Cadastre of Protected Areas in Lithuania, 2019)

cover, internal structure of various land use forms (species composition of forest and cultivated fields)). Additionally, spectral photography makes it possible to distinguish automatically land cover types and landscape components, which is not possible with traditional visual spectrum images. However, more sophisticated techniques would require qualified staff, which is not always available. Particular attention should be paid to the borders of protected areas. Protected areas that are within or close to cities endure increased pressure from urbanization, but enjoy potentially better maintenance. Therefore, the world is currently observing the process of protected area downgrading, downsizing, and degazettement events that are changing the legal status of protected areas (Mascia, Pailler 2019).

All the criteria in this methodology have been assigned an equal weight. It would be rational to introduce weighting factors for the further development of this methodology and its practical application. Weighting factors are estimated values indicating the relative importance or impact of each criteria

Fig. 5 Visual assessment of Karoliniskes State Landscape Reserve, 19 06 2019 (photos by A. Jasinavičiūtė)

Fig. 6 Visual assessment of Strosiunai State Landscape Reserve, 09 10 2019 (photos by A. Jasinavičiūtė from the DJI drone)

in a methodology as compared to the other criteria. The appropriate use of priority weighting factors for staff members is an important conversation between the supervisor and a staff member to reach understanding and agreement on work priorities for each performance management cycle. Threat assessment outside the protected area should also be carried out in the future. A particular buffer in which to assess the threat factor can be chosen. The authors accept any valuable remark and will work with it in the future.

As an approximation, landscape reserves represent the diversity of landscape and habitats in the country. Regularly collected monitoring data can be used in assessing the resilience degree of the landscape. Effective monitoring and management of the landscape is primarily about having a good understanding of the processes (Dzhengiz, Niesten 2020) taking place in the landscape, and not just those that depend on people. The landscape includes biological processes, which we do not yet fully recognize, and human activities, which are only partly directed by political and economic decisions. In order to ensure the stability of the landscape, to preserve its values and condition, it is necessary to have high-quality and comprehensive information on changes in the structure of the landscape provided by systemic landscape monitoring (Simensen *et al.* 2018).

Well prepared information about landscape reserves and their status gives positive impact not only

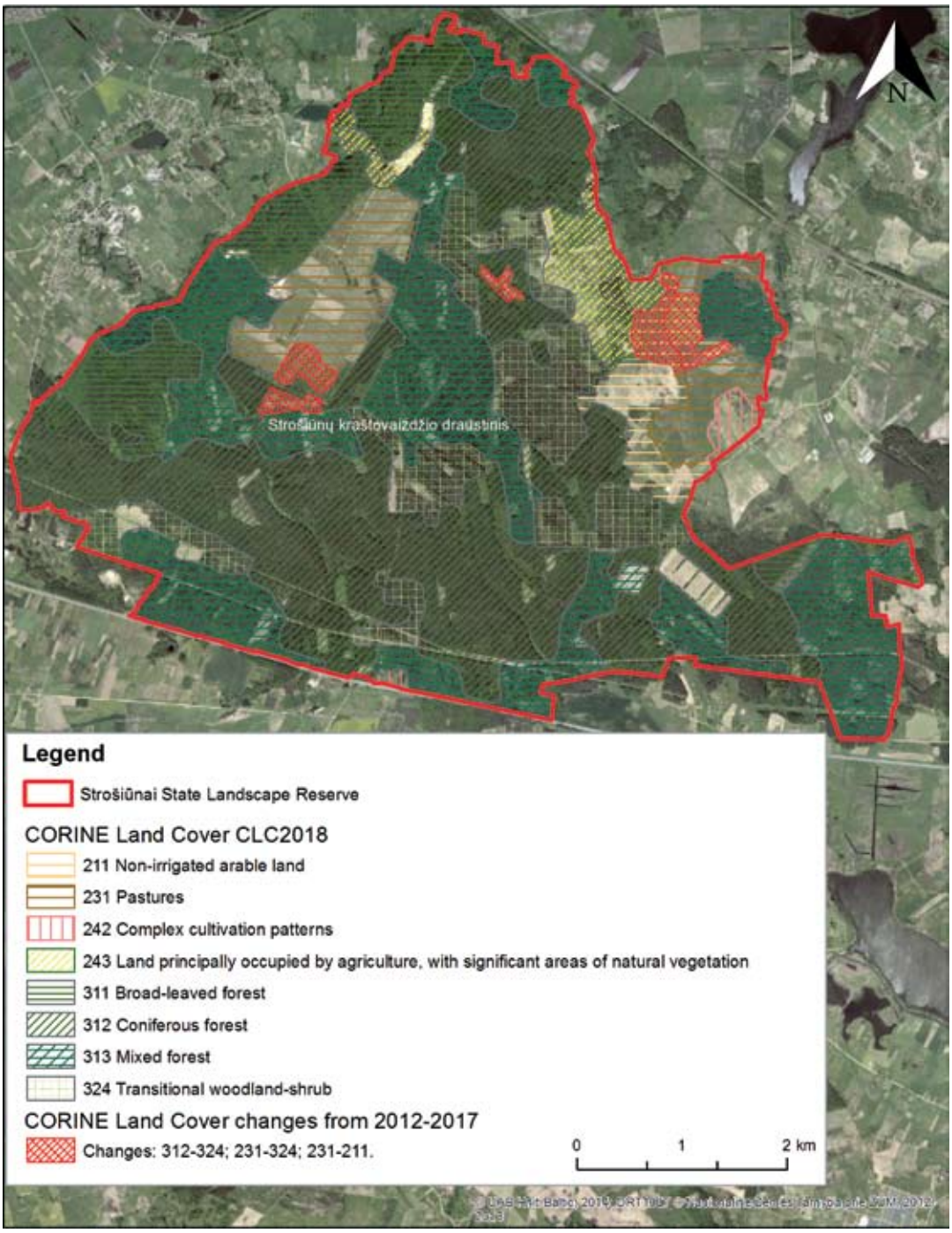

Fig. 7 Land cover of Strosiunai State Landscape Reserve (data source: State Cadastre of Protected Areas in Lithuania, 2019)

for the specialist of protected areas but also for society. Also, it could be much easier to plan specific requirements of the landscape policy implementation. Balanced and rational use of landscape in protected areas, its correct understanding will help ensure natural relationships between ecosystems and society (Defries *et al.* 2007).

The methodology presented in this article will be useful in assessing the condition of landscape reserves in Lithuania.

The assessment of landscape reserves and knowledge of the current state of territories may allow to revise the objectives of establishment of these territories and, if necessary, to review them in order to ensure the protection of values. Quality information about the status of landscape reserves will allow purposefully plan budgets for the management of these areas and prepare planning documents, if needed. Specialists of protected areas will have stronger arguments about possible economic activities during the strategic environmental and environmental impact assessment processes.

Table 4 Comparison of the assessment of the status of the pilot landscape reserves

Name of landscape reserve	Criteria	Karoliniškės State Landscape Reserve		Strošiūnai State Landscape Reserve	
GENERAL FEATURES OF THE AREA*					
Land cover diversity	Several large land uses in the analyzed area, thus creating poor scenery of landscape.	1	Mature forest dominates with small open meadow areas.		
	Medium-sized land plots, which give a modest pictoriality.			2	Forests, agrarian territories, residential areas.
Naturalness of landscape	Less area of natural landscape (<30% of forests-swamps and waters).			1	There are more anthropogenic areas, also there are quarries inside the reserve.
	Relatively natural landscape (80–100% of forests-swamps and waters) dominates.	3	Despite the fact that the area is in the city, it has retained a sufficiently high naturalness. However, the fringes of the area are under great pressure.		
Coherence of the built-up territories	Undefined urban structure, ethnographic elements expressed.	1		1	
Total score of general features of the area (0–9):		5		4	
THE EFFECTIVENESS OF PROTECTION OF VALUES					
Issue	Criteria	Score	Comment	Score	Comment
Implementation of legal provisions	The staff have acceptable capacity/resources to enforce protected area legislation and regulations, but some deficiencies remain.	2	The territory is assigned to the Neris Regional Park Directorate, which has no enough resources to control the area. Because this landscape reserve is inside the capital, small damage areas are identified, usually recreational digression.	2	The territory is assigned to the Neris Regional Park Directorate, which has no enough resources to control the area. Because this landscape reserve is inside the capital, small damage areas are identified, usually recreational digression.
Spatial planning documents	Territorial planning documents are in place, but measures are not implemented.			2	The plan for the management of the Strosiunai Landscape Reserve was approved by the Minister of Environment on 11 November 2016 by Order No. D1-757. The management plan is not implemented.
	The planning document of a reserve is approved and is being implemented in the territory.	3	The plan for the management of the Karoliniškės Landscape Reserve was approved by the Minister of Environment on 26 March 2009 by Order No. D1-159 and is fully implemented.		
Supervision of the landscape reserve	Staff of protected areas pay a site visit to the territory at least once a year.			1	The Neris Regional Park Directorate is located 30 km from the landscape reserve. Because there is a lack of staff and resources, the area is visited only 1 time per year.
	Staff of protected areas pay at least 3 site visits per year, but maintenance is poor.	2	The Neris Regional Park Directorate is located 30 km from the landscape reserve. Because there is a lack of staff and resources, the area is visited 1 time per year, but a responsible specialist from Vilnius city municipality visits the area more often.		
Monitoring and research	Research and monitoring were performed in the territory more than 10 years ago. Data is available, need to be updated.	1			
	Only the monitoring of species and habitats (Natura 2000) is carried out in the area.			2	Habitats of community importance (Natura 2000) comprise only a small part of the landscape reserve, and every few years only these species are monitored.

Infrastructure for visitors	There is a need for visitor facilities, but the area is not equipped with cognitive tourism infrastructure Recreational digression is visible.			1	Presently, there is no recreational and information infrastructure, cognitive trails or trails in the reserve, cultural heritage objects are not suitable for visiting.
	The territory has a cognitive tourism infrastructure, it is constantly maintained.	3	The management plan was implemented in 2012. Cognitive trails, information stands were installed.		
International designations	There are no international designations.	0			
	The territory is important either for the Habitats Directive or the Birds Directive			2	There is a Natura 2000 area "Strosiunai pinewood" important for Habitats Directive.
Total score of effectiveness of protection of values:		11		10	
Total score (0–27): *(sum of general features of the area and effectiveness of protection of values)*		16		14	
PRESSURES AND THREATS					
Code and title of the threat	Description of the threat	Score	Comment		Comment
F07 Sports, tourism and leisure activities	The level of threat is high - uncontrolled moto-tourism takes place in the reserve, which causes recreational digression.	-1	Mountain bikes are actively used in the reserve. Arbitrary routes are created in the ravines of the reserve, trampolines are constructed. Very active pedestrian trekking, walking on slopes and ravines.	-	-
B09 Clear cuts	The level of threat is medium – in the reserve, 10–25% of the forest area consists of logging sites and 1st class stands.	-	-	-2	Clear-felling in the reserve changes the landscape. Most of the reserve is heavily affected by felling.
E08 Transport noise, light and other pollution	Noise is made in the area, light sources appear.	-1	The reserve is located in the middle of the city. In almost whole territory of the reserve, traffic noise is constantly audible and lights are visible in the evening.	-	-
C01 Mining and quarrying	The level of threat is medium – abandoned small-size unclaimed quarries are present in the reserve.	-	-	-2	In the northern part of the reserve, there is an active quarry, which is also used by ATVs and motorcyclists.
F09 Waste disposal from residential / recreational facilities		-1	Isolated litter is observed in the whole territory of the reserve.	-1	Isolated litter is observed in the whole territory of the reserve.
A06 Overgrowing of meadows	Low level of threat – 10–30% of the area of meadows and pastures in the reserve are not regularly mowed or grazed	-	-	-1	Most of the meadows in the reserve are not mowed. Meadows begin to overgrow with shrubs.
Total score of effectiveness of pressures and threats (0–15). This score is always negative:		-5		-6	
Conclusions (assessment group and total score (0–27; -0–15):		16 (-3) II Average status		14 (-6) II Average status	

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