Carpathian Journal of Earth and Environmental Sciences, February 2019, Vol. 14, No. 1, p. 67 - 76; DOI:10.26471/cjees/2019/014/059

SPATIAL ASSESSMENT OF RECREATIONAL ECOSYSTEM SERVICES IN THE LARGE INLAND RIVER BASIN (UPPER OB, RUSSIA)

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Abstract: The rapid development of near water recreation and the need for integrated coastal management have boosted new discussions on the assessment of cultural ecosystem services of water bodies. Experts state that the related theory and methodology are undeveloped because of few practical assessments available for theoretical generalization. In particular, there are no examples of evaluation of large inland regions, which are remote from seas and oceans, and where recreation opportunities are concentrated on numerous rivers and lakes. Obtaining the knowledge on spatial features of recreational ecosystem services is complicated because of scarcity of field data required for the analysis and impossibility to obtain them in situ. To minimize such a gap, we share our experience in assessing the recreational opportunities in the Upper Ob basin (Western Siberia, Russia). In its area of 2.99 million km^2, 300 thousand of lakes and 150 thousand of rivers are situated. We propose to consider the potential of recreational water use geographically as a spatial (valley-floodplain) phenomenon described by a minimum number of water and near water conditions, significant in recreation. Thus, this potential can be estimated qualitatively and quantitatively using landscape indication tools, a multi-criteria analysis and GIS. For evaluation, we use three integral criteria and a three-point scale of significance (insignificant, less significant, significant). Each of the integral criteria is a complex physical – geographical characteristic bound to the data from landscape, topographic and geological maps. An appearance criterion describes the types of shores and bottoms; a functional criterion – the flow rate, the length of rivers, the water area of lakes, the depth of water objects; a psychological criterion – near water and external landscape contacts through the vegetation. The performed assessment has provided territorial planning in the region with qualitative and quantitative descriptions of ecosystem services of water bodies, established their spatial regularities and specified probable points of growth in water recreation infrastructure.

Keywords: recreational water use, water resource potential, ecosystem servises, spatial assessment, Upper Ob.

1. INTRODUCTION

Over the past decade, tourism has become the third export sector in the world (after fuel and chemical industries) and the backbone of many national economies. Traditionally, the highest rates of international tourism are recorded in the coastal areas. The national tourism is much more popular than the international one; it is even more associated with shores (Lankia et al., 2015; Blignaut et al., 2016). When on holiday, people often do not leave their places of residence and satisfy their recreational needs at the nearest water reservoirs (Curtis et al., 2017; Pinto & Maheshwari 2016).

Large water bodies become the recreational objects on a mass scale particularly in the rapidly growing urban and suburban areas (Brabyn & Sutton 2013; Ezebilo et al., 2015) already burdened with architectural and environmental problems. Actually, the development of new territories or the increased anthropogenic load on the previously developed spaces and resources is often ahead of planning and contradicts the idea of "green infrastructure" or "blue-green infrastructure". Risks of conflicts in land use arise (Hersperger et al., 2015). Conflicts in recreational water use are induced by resources reduction in growing cities, interest collision of land users, underestimation and unsystematic development of the existing resource potential. The best way to settle the problem is to redistribute the recreational flows within the adjacent and undeveloped territories.

In the concept of “green infrastructure”, water bodies along with forests, parks and protected areas create a basis for the solution of spatial problems of cities in accordance with the principle of "building with nature" (The value., 2010). The “green infrastructure” as an urban plan framework allows before the project implementation to separate the territories of special ecological importance from those suitable for public housing (Benedict & McMahone, 2006) thus providing the urban environment with necessary ecosystem services.

One of the most famous ecosystem services of water bodies and related ecosystems (floodplains, deltas, wetlands, etc.) is the recreation opportunity considered as a cultural ecosystem service having the beneficial effect on health, aesthetic satisfaction and cognition (EC, 2013). Cultural ecosystem services of water objects and coasts are perceived inseparably by users in the course of the recreational water use, and can be described by various sets of biophysical (individual attributes of landscapes), social (a degree of privacy or some difference from routine life) and infrastructural elements (Chan et al., 2011).

In recent years, many scientific disciplines (from ecology to landscape architecture) have focused on “green infrastructure” and its elements. Assessment of the role of “green infrastructure” elements ensuring the quality of life as well as the problems of their design and performance are of special interest. Urban green spaces most often serve as the objects of a multi-scale assessment of cultural ecosystem services (Artmann et al., 2017; Zwierzchowska et al., 2018). It should be noted that rapid development of the near water tourism and recreation, including the need for the integrated management of coastal areas have markedly revived the discussions on the evaluation of cultural ecosystem services of water bodies (Granek et al., 2009; Arkema et al., 2015; Hattam et al., 2015). The sea and ocean coasts with their obvious recreational advantages much often become the objects of research. In studies of the Venetian lagoon in Italy (Rova et al., 2015) and the sub-Antarctic part of Chile (Nahuelhual et al., 2017), for example, such assessments are based on biophysical and infrastructural indicators. The recreational value of coral reefs in the Mexican Pacific is defined due to willingness of tourists to pay for their impressions (Robes-Zavala & Reynoso, 2018). It is recognized that the gained practice is insufficient for making theoretical generalizations, and the estimation theory and methodology for recreational services related to water bodies have not been developed properly yet (Saunders et al., 2015).

Difficulty in applying the mentioned technique to large areas, with previously undone recreational water use planning is an essential gap. Indeed, the given examples and other studies are focused on urban spaces and popular tourist destinations (urban and natural parks, resort areas, beaches), and reflect the local specifics. The evaluation of remote (from sea and ocean coasts) inland regions, where the recreational potential is concentrated on rivers and lakes, is not covered at all.

The effective application of field methods for obtaining reliable source data to be used for further analysis is a common feature of the mentioned practices. This approach does not work in national planning or planning at the level of large inland regions (which have just started water resources development for recreation purposes) because of lack or even impossibility to get field data in situ. In this case, the landscape planning theory (Ahern, 1999; Steiner, 2000; Steinitz, 1995) representing practical results in the format of specialized natural plans, maps and program activities can be a proper framework. Unfortunately, such a theoretical basis is hardly comprehensive and universal because of a great variety of natural, social, cultural and economic conditions as well as specific administrative, organizational and legislative frameworks.

Clearly, the prospects and specificity of recreational water use inevitably lead to the aggregation and adaptation of available scientific knowledge for the analysis of interactions between tourism and water-related ecosystems. Until the current developments are clarified and systematized, many researchers will find difficulty in assessing these interactions at all levels of spatial organization. In this regard, one of the tasks of the scientific community dealing with studying water recreational resources is to fill a so-called "Bank of practice" with a maximum variety of different-scale estimates in various specific areas. This paper presents the results obtained for a vast inland area – the Upper Ob basin in the south of Western Siberia (Russia).

2. CASE STUDY AREAS

The Ob is one of the largest world rivers; it runs through the territory of Western Siberia and flows into the Arctic Ocean. Its basin, that covers 15% of Russia, is home to 10% of its population. The majority of the population is concentrated in the south of the region, dwelling along large rivers. The extractive industries and agriculture dominate in the region’s economy. Continental climate with short hot summers and long frosty winters, sharp contrasts of temperature, strong seasonality of atmospheric and hydrological processes is responsible for complicated living conditions and nature management. Such conditions force the Siberians to use recreational opportunities in summer in the most effective way, namely, through a direct contact with the environment (the sun, sand, water).

It was analytically found that approximately 7 million inhabitants of the region are involved in recreational water use. Most of them live in the south, in the upper reaches of the Ob basin. Administratively, this territory belongs to Altai Krai, the Republic of Altai, Novosibirsk, Tomsk and Kemerovo oblasts of Russia; in natural terms it is called the Upper Ob. Despite the obvious demand, a large-scale resource assessment for recreational water use has not been made yet.

In Russia, the legislation on landscape planning does not exist. The immediate Russian analogue to the international landscape planning is territorial integrated schemes for nature protection, including regional surface layouts as planning tools, which are not currently relevant. Thus, all these objective circumstances were decisive in choosing the topic and the territory under study. First, previously undone assessment design of resources for strategic planning of recreational water use in Russia is not supported legally. Second, in the Upper Ob regions, the Strategies of Socio-Economic Development to 2025-2030 are currently implemented. Here, the role of tourism is determined rather vague and without involvement of scientists and specialists; for instance, it is proposed to develop tourism in almost all municipalities. Mapping of strategic provisions turned out to be uninformative; it did not reveal both the planning structure and core areas for tourism development. Thirdly, tourism as one of economic sectors of Siberian regions has been developing for about 10 years and has not yet been fully formed. Its planned development will ensure the adjustment and the improvement of strategic plans for the results optimization and coordination with the concept of ecosystem services. Fourthly, the water and near water recreation is not differentiated in the strategies, although this need is objectively justified. Fifth, a sufficient amount of qualitative and uniform data to be used for the detailed analysis of the resources and the situation in the regions of Siberia is not available. Obtaining the in situ field data is impossible due to a huge size of the study territory and the procedure complexity.

Therefore, there is an obvious need to consider the region in a general geographical aspect making the resource assessment on a landscape basis. This approach is common for the land assessment. We use it as a basis for studying the resource potential distribution and water recreation because it thoroughly evaluates any site. The assessment results obtained due to the landscape-geographical method can be applied to the evaluation of effectiveness of the socio-economic development strategies of the regions, and, if necessary, to the adjustment of the related guidance documents.

3. METHODS AND MATERIALS

Narrowing the study subject up to the assessment of recreational water use potential in the regions of the Upper Ob, our methodological choice falls on the Russian research made in applied landscape science. They generalize the centuries-old history of the improvement of natural conditions for agriculture and water management in Russia (Isachenko, 2008; Solntsev, 2001; Sochava, 1978; Preobrazhensky et al., 1988). These developments define the study concept as a comprehensive (system) analysis of a natural landscape.

For the procedural part, the K. Steinitz framework method (Steinitz, 1995) providing the flexibility in landscape evaluation by bringing in the views of scientific experts, specialists and land users is optimal. This allows to take into account the strategic objectives and different options for the territory development. What counts is this method does not require a detailed inventory of landscape properties, factors of its formation, landscape processes and phenomena. A landscape information basis with the data on lithology, soil, water and flora will suffice for the problem understanding and its solution in the best way.

Multi-criteria analysis is used as an assessment tool, reliability of which has been proved its by different-aspect studies of land use (Ioja et al., 2014; Gradinaru et al., 2017), including tourism. A wide range of indicators is used in the works focused on mapping the ecosystem services of water and near water specifics. For planning sustainable coastal tourism in the region of Chahnime-Zabol (Iran), Erfani et al., (2015) uses such criteria as soil, distance to surface water resources, slope and slope exposure, geological stability, vegetation, roads, distances to political boundaries and other. Ghermandi (2015) considers the recreational services of the European coastal regions through climate, biodiversity, accessibility and anthropogenic pressure. In the study of coastal and marine resources of Abu Dhabi, Blignaut, et al. (2016) uses the criteria of beach and ocean views, opportunities for recreation and sports, including attractions. In conducting research in Argentina, Weyland & Laterra (2014) availed themselves of nine landscape criteria and campsites data. For ecosystem services evaluation in Sub-Antarctic Chile, Nahuelhual et al., (2017) use the data on land uses and covers, channels and fjords, open sea, forest of high interest, points of observation of nesting areas, whales, dolphins, pinnipeds and other. By convention, the latter approach is the most conceptually close to ours.

Geographic information systems (GIS), which convert the data on landscapes and landscape preferences in outdoor recreation into mapping a degree of landscape suitability, serve as technical tools in the approaches for spatial assessment. As a result, we can identify the loci of potential conflicts in land use or between groups of recreants who pursue different interests (Woźniak et al., 2018), landscape preferences of tourists (Komossa et al., 2018), and the resource potential of recreation areas (Priskin, 2001; Anfuso et al., 2014). Gradation of landscapes is usually presented as categories of attractiveness (3-5 points) - from extremely attractive to unattractive ones. In the study Nahuelhuala, et al., (2017) used a five-step scale (from 0 to 100).

Recreational water use is recreation, tourism, sports, amateur fishing and hunting on water bodies and in a shoreline of 30-50 m wide, remote up to 1.5-2 km from the water edge (sites of long walks) that geographically corresponds to valleys and floodplains. Consistency with the concept of ecosystem services makes it possible to consider water resource potential as a spatial (territorial) phenomenon, which can be described by a set of recreationally significant characteristics of any water body, its floodplains and valleys.

The main hypothesis of the presented study is that the floodplain or valley landscape, understood as a relatively homogeneous area of the Earth surface with a peculiar combination of natural components, has an individual appearance and an internal structure. Thus, at the regional level the conditions of recreational water use can be also considered as relatively homogeneous.

The transition from local (point, object) to regional level of assessment involves the analysis of numerous water bodies, including those not previously used in recreation. It may bring to data scarcity or even to their total lack. Since field techniques give limited initial data and require the application of analytical methods (to solve geographical problems) and maps (to access to integrated sources of information), we use the cartographic and landscape indication methods along with the system analysis. They make it possible to identify reliably the conditions of recreational water use, which are hard to observe and measure in situ, but are clearly visible due to external nature components displayed on the maps. The USSR landscape map (scale 1:2 500 000), the maps from the RF Atlas of Soils (electronic version) https://soilatlas.ru) and topographical maps were used to test the landscape-geographical method. The assessment procedure is shown in Figure 1.

The target indicators are the criteria commonly used in Russia for the recreational assessment of local water objects (Mukhina et al., 1974; Kotlyarov, 1978; Kolotova, 1999). To make spatial estimation at a local level, these criteria were adapted by means of the comparative-geographical analysis and generalization (Table 1). The criteria are of geographical nature; they correlate with a landscape description and can be mapped.

The choice of the criteria for the analysis of water resource potential of landscapes is associated with a number of circumstances. First, a limited (minimum) number of characteristics simplifies the evaluation process and increases its efficiency. Secondly, the selected criteria present in the generally accepted methods have proved their reliability and correctly reflect the water recreation resources. Third, their spatial nature is preserved at the regional scale of the study; the detailed information is contained in open cartographic sources that is very important in case of data scarcity. The regional scale allows to filter out the details of the local (object) level. For this reason, we do not use such generally accepted evaluation criteria as types of shallow water, water temperature and sanitary conditions. It is just impossible to obtain these data for a large territory.

In the study, we apply a three-level scale, widely spread in estimates of tourism resources. The same scale is used in major national methods and is graded on the basis of economic expediency: 3-maximum, 2 – moderate, 1 – the least one (Kolotova, 1999).

As far as the criteria themselves and the scale of their assessment are identical, it is possible to compare both the methods themselves and the different levels of spatial territory organization. In our case, a three-point evaluation scale is used at each assessment level. If you receive a value greater than 3 at any level (elementary, total, integral on the landscape as a whole), it is necessary to make a to make a conversion as shown in Table 2 to avoid excessive detailing of the results, not required under panoramic assessment.

For the process optimization and for better clarity, the selected basic criteria are consolidated. They are grouped into three integral criteria described by a limited number of characteristics present in maps.

Table 1. Correlation of parameters of object/spatial estimate of water resources potential for recreational water use

Evaluation criteria	Type of evaluation	Resource potential importance		
		suitable in OA/significant in LO, 3 points	conditionally suitable in OA / less significant in LO, 2 points	hardly suitable in OA / insignificant in LO, 1 point
Shore type	OA [1]	dry terraced, no steep slopes, suitable for the use in the natural state	dry and sloping, often steep, the development of which requires the construction of simple facilities for access to the water	swampy or very steep with a high cliff
	LA	dry flat surfaces; herbaceous and forested	moistened, mildly sloping and gently inclined grassy surfaces	swampy, saline, steep grassy and bushy surfaces
Bottom type	OA [1]	sand, small pebbles	large pebbles, silted sands, boulders	silt, stone, clay, large sharp stones, large slabs covered with aquatic organisms
	LA	mainly sands and sandy loam	mainly loams, pebbles and boulders	mainly peat and silty loam, loess-like loam, silt and clay, crashed loam
Flow velocity, m/s	OA [2]	<0.3	0.3-0.5	>0.5
	LA	0.4-1.0 (the whole spectrum of near-water recreation)	1.1-3.0 (sport, tourism)	≤0.3 and >3 (only a contemplative rest)
Water area	OA [1]	100-200 persons/ha	300-500 persons/ha	>500 persons/ha
		0.5-2 boats/ha	2-5 boats/ha	>5 boats/ha
	LA	fresh with a sandy or a firm bottom, large salty and brackish	fresh with a viscous bottom	small salty and brackish with marshes and solonchaks along the banks
Depth of water body, m	OA [2]	≥1.5	0.8-1.5	<0.8
	LA	>1.5 (multifunctional recreation)	0.5-1.5 (monofunctional recreation)	<0.5 (near-water recreation)
River length, km	OA [2]	>150	100-150	<100
	LA	>150 (trans-and inter-regional recreation)	100-150 (regional recreation)	<100 (local recreation)
Landscape aesthetics	OA [3]	water body-forest; forest 30-50%	water body-forest (field); forest 16-30%, 61-85%	water body-shrubs
	LA	near-water landscape contact		
		water body- forest	water body-meadow; water body-steppe	water body-shrubs; water body-swamp; water body- agricultural lands
		external (panoramic) landscape contact		
		meadow-forest; steppe-forest; forest-sands	meadow-bush; steppe-bush; agricultural lands-forest; solonchaks-forest, swamp-forest; tundra-forest; meadow-sands; steppe-sands; bush-sands	meadow-steppe, meadow-meadow, steppe-steppe, shrub-shrub, swamp- steppe, swamp-meadow, agricultural lands-meadow, agricultural lands-steppe, solonchaks-meadow, solonchaks -steppe, solonchaks-agricultural lands, forest-forest, shrub-agricultural lands; shrub-swamp; shrub-tundra, shrub-forest; tundra-steppe, tundra-meadow, sand-swamp, agricultural lands-sands
		number of external contacts		
		≥7	4-6	1-3

OA – object assessment, LA –landscape (spatial) assessment, 1 – criteria by Mukhina (1974), 2 – Kotlyarov (1978), 5 – Kolotova (1999)

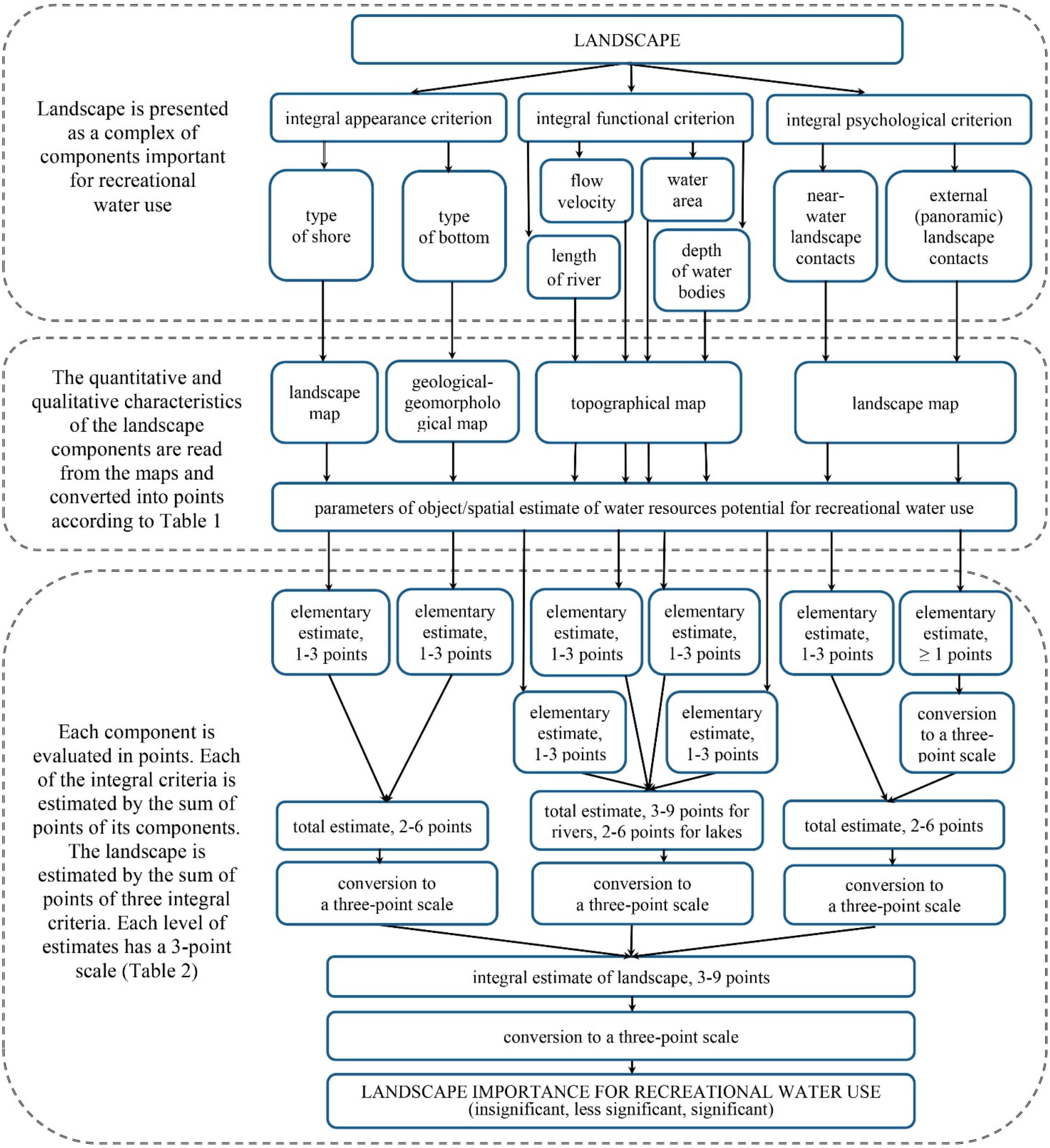

Figure 1. Scheme for assessment of landscape importance for recreational water use.

Table 2. Transfer of total estimate into integral

Total	Integral		
Type of estimate	Suitable, 3 points	Conditionally suitable, 2 points	Hardly suitable, 1 point
Appearance	5–6	3–4	2
Psychological	> 7	4–6	1-3
Functional: river	7–9	4–6	3
lake	5–6	3–4	2
Resulting regional	7–9	5–6	3–4

The integral appearance criterion determines the target suitability of a territory and a water body. It combines such characteristics as types of shores, beaches and bottoms, access to water and is evaluated due to landscape maps of geological-geomorphological conditions of valley landscapes and the data on lithological composition of Quaternary sediments. The integral functional criterion shows the suitability of a water body for private recreation purposes. It involves the data on flow velocity, water area, length of rivers, depth of water bodies and is evaluated due to topographical and general geographical maps.

The integral psychological criterion defines the resource use efficiency through aesthetic appeal. It includes the features of near water and external (panoramic) landscape contacts through vegetation and is estimated with the use of landscape maps containing geobotanical data and combinations of contacting pairs of natural complexes (Andreeva & Tsilikina 2017a; 2017b).

The criteria represented as landscape components assure reading out the quantitative characteristics of water objects and their shores from the topographical, while qualitative ones - from the applied maps. Spatial interpolation and geographical analogy methods provide the data on water bodies for the whole territory.

The GIS-based evaluation results allow to visualize for the first time the regional landscape-water recreational structure (framework) of the territory, a mosaic of landscape units with different water resource potential. GIS tools made it possible to define quantitative parameters for the description of water resource potential in the region (i.e. the area of coastal landscapes with different suitability, the length of river sites and water bodies as well as internal water areas) and to consider spatial peculiarities of its distribution.

4. RESULTS AND DISCUSSION

The actual data were received due to a targeted map analysis. Natural complexes of a "landscape" size act as operational territorial units for the assessment of water resource potential. According to the map, there are 41 valley and floodplain landscapes representing the natural (restored) complexes.

For the analysis of the appearance of the near water recreational sites, the description of a shore type was taken from the landscape map legend. Thus, 7 shore types were identified, namely- flat dry grassy or woody (3 points), flat moist grassy or woody (2), boggy flat (1), gently sloping dry herbal or woody (3), gently sloping moist grassy or woody (2), boggy gently sloping (1), hillside grassy, bushy or woody (1). The description is supplemented with the lithological data to clarify the bottom characteristics of water bodies. By the predominance of soil-forming rocks responsible for a specific stratification of bottom sediments, we defined 7 types of bottom surface, i.e. sands (3 points), sands with medium and light loam (3), light and medium loam (2), boulders and pebbles (2), loam with boulders and gravel (1), clay, heavy and silty loam (1), silty loam with boulders and pebbles (1). The total appearance evaluation of the landscape consists of two elementary estimates (each with a 3-point maximum) and can take a value from 2 to 6.

The psychological evaluation is based on views of most researchers who give priority to landscape diversity in determining the aesthetic appeal of the territory. Aesthetic appeal depends on two types of landscape contacts, i.e. water and external ones. A near water type determines the attractiveness of the territory directly at the shoreline, whereas the external - at the border of sites used for the near water recreation and long walks. Because of several different elementary types of vegetation available on the external boundary, infinity of choice of contact pairs appears; they are different for different territories and scales of the study. For example, a near water landscape ("lake plains: flat, with swales and lakes, meadow steppes and steppe meadows, wormwood and wormwood-fescue groups" borders on six background landscapes: 1) lake-alluvial plains with agricultural lands, sites of birch and aspen forests; 2) low terraces with agricultural lands and aspen-birch sites; 3) lake plains with grass and wormwood-fescue groups; 4) lake-alluvial plains with steppes and agricultural plots, meadows; 5) loess plains with agricultural lands, some aspen-birch sites; 6) denudation plains with agricultural lands. This forms five external landscape contacts: meadow-forest, meadow-steppe, meadow-sands, meadow-swamp, meadow-agricultural lands. The presence of more than three contacts a priori create informative and visual diversity. Naturally, a greater mosaicity significantly enhances this effect.

In valley and floodplain landscapes of the Upper Ob basin, the number of external contacts varies from 1 to 17 due to physical-geographical conditions of the region located mostly on the plains and in the low mountains with monotonous natural complexes. In the mountain regions distinguished by greater landscape mosaicity, a number of contacts grows. The same effect is observed with scale increase. To adapt to the chosen scoring system, we grade the external contacts as follows: 1-3 contacts are evaluated in 1 point, 4-6 contacts- in 2 points, and more than 7 contacts- in 3 points. Similar to the appearance assessment, the psychological one consists of two elementary estimates (external and internal contacts) and takes a value from 2 to 6.

First, we made the functional assessment of certain water bodies with further results binding to the related landscapes. An importance degree of rivers was defined with the use of three (river length, river depth, flow rate), and of lakes- of two criteria (water area, depth). Therefore, the total estimate for rivers varied within 3-9 and for lakes as 2-6 points. In practice, if potential significance of objects is different, the landscape should get the highest value. For example, if a landscape has rivers rated in 1 and 3 points, its value should be 3. This accounts for hypothetically maximum importance of resource potential.

The final regional assessment is an overall index of all three types of assessment by integral scale. The appearance criterion was found to be maximum for the south-eastern part of the region, where the transition from mountains to plains occurs. In the floodplains of the Ob river and in the middle parts of its large tributaries originating in the Altai-Sayan mountains, the appearance potential was substantial. In a similar manner we estimated the largest water bodies and watercourses of the Kulunda lowland, situated in the southern steppe of the region.

The objects confined to the alluvial accumulative plains formed of light lacustrine-river sediments were ranked high due to the predominance of gently sloping shores and sandy bottom sediments. The least criterion was given to the middle mountain areas of the Altai-Salair Ridge due to objective physical-geographical conditions. In Altai, the narrow rocky valleys and boulder-gravelly beds of shallow mountain rivers prevail. In the Salair, among the hard-to-access chern taiga small streams with waterlogged loamy or muddy bottom dominate.

The psychological criterion was maximal for the floodplain of the Ob river and its first-order tributaries. In the south of the region, this is due to the presence of the ancient runoff gullies with dry pine forests of high bonitet contacting on the periphery with forb-grass meadow steppes and steppe meadows. Similarly, we evaluated the aquatic system, including lake Chany (the largest in Western Siberia) and other reservoirs of the Baraba Lowland. In the Ob floodplain, below the site of confluence of rivers Ob and Ket, pine and spruce forests mixed with some small-leaved species dominate. Here, in the south and in the mountains, the psychological estimate is low because water bodies are located within the streched monotonous closed (forest) or open (steppe, meadow) spaces with unaesthetic bogs, solonchaks and solonets complexes.

As for the functional criterion, the majority of water bodies and watercourses of the region are highly rated (2 - 3 points). Very small (sometimes intermittent and temporary) streams of the steppe (often cultivated) areas in the south and south-west as well as small lakes surrounded by wetlands and bogs get the least functional estimate.

The final assessment (scale 1: 2 500 000), which consists of three criteria, suggests only a two-gradation (significant and less significant) estimate of water resource potential. The river Ob, its large tributaries of the first order, lower and middle reaches of rivers originating in the Altai-Sayan mountains, including large and medium lakes of the southwestern part of Western Siberia, have a large water resource potential for recreational water use. The area of such landscapes amounts to 143 380 km^2. The potential of small and medium-sized lowland rivers and water bodies, and the related shores or coastal sites is significant. These objects get two least elementary estimates (functional and psychological). The area of landscapes with significant potential makes up 318 778 km^2.

The landscapes with poor water resource potential were not identified. However, our studies of Altai Krai made at a larger scale (1: 500 000) are evidence of such a probability (Andreeva & Tsilikina 2017a). This can be explained both by insufficient generalization of geographical data displayed on small-scale maps and by imperfect interpolation of object estimate parameters to the areal objects. In our case, visualization accuracy was satisfactory for the description of the background situation in the study territory that was confirmed by the expert method. The analysis of the recreational assessment practice is evidence of the preference of medium or large and, rarely, small-scale mapping. If maps become more detailed and parameter estimate more precise, the assessment accuracy of water resource potential increases.

5. CONCLUSION

The proposed materials contribute to the development of ideas on a spatial aspect of water recreational resources that is important for optimization of territorial structures of recreational water use. The method for panoramic assessment of resource potential, not supported by field findings, is applied to the large inland area, where recreational water use is implemented on rivers and lakes. The universal landscape indication concept and the consideration of water resource potential as a valley-flood plain type of a combination of significant in recreation natural conditions allow us to use publicly available maps and to assess the previously unexplored territory.

We performed the scale –based multi-criteria analysis at different hierarchical levels of the territory organization. The study results ensure the uniform and objective assessment of both administrative and natural regions with different natural conditions. The method is efficient in studies at different levels. Interestingly, any increase in scale results in landscape divisibility that brings to the detailed differentiation of the resource and better evaluation accuracy.

The practical advantage of the study is in feasible preliminary planning and system development of recreational water use. The method allows to perform a panoramic evaluation and to identify perspective territories. Since decision-making on suitability and priority in the development of such territories requires the in-depth estimates, the involvement of sociological and economic parameters could contribute to further development of this method. For instance, the characteristics of plots with different water resource potential can be supplemented by demographic and accommodation data or the information on the GPS-based tracking of recreational preferences. In such a manner, for some regions of the Upper Ob river basin we have calculated the recreational water use availability, i.e. the ratio between water supply capacity and potential needs in water and near water recreation. In turn, it is expected to involve these data in working out the recommendations on the adjustment of the region development strategies and the prevention of land use conflicts in the regions with interest collision.

REFERENCES

Ahern, J., 1999. *Spatial concepts, planning strategies and future scenarios: a framework method for integrating landscape ecology and landscape planning.* N. Y.: Springer, 175–201.

Andreeva, I.V. & Tsilikina, S.V., 2017a. *The landscape-geographical method for spatial assessment of water resource potential for recreational water use.* Water Economy of Russia, 5, 34-50.

Andreeva, I.V. & Tsilikina, S.V., 2017b. *Water resources potential for recreational water use: a concept and spatial estimates* / Water and Environmental Problems of Siberia and Central Asia: Proc. of III Russian conf. with inter. participation: Barnaul, 3, 3-15.

Anfuso, G., Williams, A.T., Cabrera Hernández J.A. & Pranzini E., 2014. *Coastal scenic assessment and tourism management in western Cuba.* Tourism Management 42, 307-320.

Arkema, K.K., Verutes, G.M., Wood, S.A., Clarke-Samuels, C., Rosado, S., Canto, M., Rosenthal, A., Ruckelshaus, M., Guannel, G., Toft, J., Faries, J., Silver, J.M., Griffin, R. & Guerry, A.D., 2015. *Embedding ecosystem services in coastal planning leads to better outcomes for people and nature,* Proc. Natl. Acad. Sci. USA 112. 7390–7395.

Artmann, M., Chen, X., Ioja, C., Hof, A., Onose, D., Ponizy, L., Lamovsek, A.Z. & Breuste, J., 2017. *The role of urban green spaces in care facilities for elderly people across European cities.* Urban forestry & Urban greening, 27, 203-213.

Benedict, M.A. & McMahone, E., 2006. *Green Infrastructure. Smart Conservation for the 21st Century.* Washington, D.C., 303 p.

Blignaut, J., Mander, M., Inglesi-Lotz, R., Glavan, J. & Parr, S., 2016. *The amenity value of Abu Dhabi's coastal and marine resources to its beach visitors.* Ecosystem Services, 19, 32-41.

Brabyn, L. & Sutton, S., 2013. *A population based assessment of the geographical accessibility of outdoor recreation opportunities in New Zealand*. Applied Geography, 41, 124-131.

Chan, K.M.A., Goldstein, J., Satterfield, T., Hannahs, N., Kikiloi, K., Naidoo, R., Vadeboncoeur, N. & Woodside, U., 2011. *Cultural services and non-use values,* in: P. Kareiva, H. Tallis, T. H. Ricketts, G. C. Daily, S. Polasky (Eds.), Natural Capital: Theory and Practice of Mapping Ecosystem Services. Oxford University Press, Oxford, 2011, 206–228.

Curtis, J., Hynes, S. & Breen, B., 2017. *Recreational boating site choice and the impact of water quality.* Heliyon 3(10). Article e00426.

EC. European Commission. Green Infrastucture – Enhancing Europe´s Natural Capital. Brussels, 2013 (May).

Erfani, M., Afrougheh, S., Ardakani, T. & Sadeghi, A. 2015. *Tourism positioning using decision support system (case study: Chahnime-Zabol, Iran).* Environmental Earth Sciences, 74 (4), 3135-3144.

Ezebilo, E.E., Boman, M., Mattsson, L., Lindhagen, A. & Mbongo, W., 2015. *Preferences and willingness to pay for close to home nature for outdoor recreation in Sweden.* Journal of environmental planning and management, 58 (2), 283-296.

Ghermandi, A., 2015. *Benefits of coastal recreation in Europe: Identifying trade-offs and priority regions for sustainable management*. Journal of Environmental Management, 152, 218-229.

Gradinaru, S., Ioja, C.I., Patru-Stupariu, I. & Hersperger, A. 2017. *Are Spatial Planning Objectives Reflected in the Evolution of Urban Landscape Patterns? A Framework for the Evaluation of Spatial Planning Outcomes.* Sustainability, 9, 8, UNSP 1279.

Granek, E.F., Polasky, S., Kappel, C.V., Reed, D.J., Stoms, D.M., Koch, E.W., Kennedy, C.J., Cramer, L.A., Hacker, S.D., Barbier, E.B., Aswani, S., Ruckelshaus, M., Perillo, G.M.E., Silliman, B.R., Muthiga, N., Bael, D. & Wolanski, W., 2009. *Ecosystem services as a common language for coastal ecosystem-based management,* Conserv. Biol. 24. 207–216.

Hattam, C., Atkins, J.P., Beaumont, N., Borger, T.,

Bohnke-Henrichs, A., Burdon, D., de Groot, R., Hoefnagel, E., Nunes, P., Powowarczyk, J., Sastre, S. & Austen, M.C. 2015. *Marine ecosystem services: linking indicators to their classification*, Ecol. Indic., 49, 61–75.

Hersperger, A.M., Ioja, C., Steiner, F. & Tudor, C.A., 2015. *Comprehensive consideration of conflicts in the land-use planning process: a conceptual contribution.* Carpathian Journal of Earth and Environmental Sciences, 10, 4, 5-13.

Isachenko, A.G., 2008. *Landscape structure of the Earth, settlement, nature management* / S.Pt.: publ. S.Pt State University, 320 p.

Ioja, C.L., Nita, M.R., Vanau, G.O., Onose, D.A. & Gavrilidis, A.A., 2014. *Using multi-criteria analysis for the identification of spatial land-use conflicts in the Bucharest Metropolitan Area*. Ecological Indicators, 42, 112-121.

Kolotova, E.V., 1999. *Recreational resource studies.* Text book. Moscou, 217 p.

Komossa, F., van der Zanden, E.H., Schulp, C.J.E., Verburg, P.H., 2018. *Mapping landscape potential for outdoor recreation using different archetypical recreation user groups in the European Union.* Ecological Indicators, 85, 105-116.

Kotlyarov, E.A. 1978. *Recreation and Tourism Geography*. Moscou: Mysl. 238 p.

Lankia, T., Kopperoinen, L., Pouta, E. & Neuvonen, M., 2015. *Valuing recreational ecosystem service flow in Finland.* Journal of Outdoor Recreation and Tourism, 10, 14-28.

Mukhina, L.I., Vedenin, Yu.A., Danilova, N.A. & Zorin, I.V., 1974. *Approaches to recreational activities assessment*. Izvestiya of the USSR Ac. of Sc. Ser. Geogr. 112-121.

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

Pinto, U. & Maheshwari, B.L., 2016. *Community perspectives on managing health of peri-urban river system: evidence from the Hawkesbury-Nepean river catchment, Australia*. Journal of environmental planning and management, 59 (7), 1257-1276.

Preobrazhensky, V.S., Aleksandrova, T.D. & Kupriyanova, T.P. 1988. Basics of landscape analysis. Moscou: Nauka, 192 p.

Priskin, J., 2001. *Assessment of natural resources for nature-based tourism: the case of the Central Coast Region of Western Australia.* Tourism Management, 22, 6, 637-648.

Robles-Zavala, E. & Reynoso, A.G.C. 2018. *The recreational value of coral reefs in the Mexican Pacific.* Ocean & Coastal Management, 157, 1-8.

Rova, S., Pranovi, F. & Mueller, F., 2015. *Provision of ecosystem services in the lagoon of Venice (Italy): an initial spatial assessment*. Ecohydrology & Hydrobiology, 15, 1, 13-25.

Saunders J., Beaumont N., Atkins J.P., Lannin A., Lear D., Ozdemiroglu E. & Potts T. 2015. *A review of marine and coastal ecosystem services data and tools to incorporate this into decision making*, in: R.K. Turner, M. Schaasfma (Eds.), Coastal Zones Ecosystem Services: From Science to Values and Decision Making, Springer International Publishing, Switzerland, 2015, 145–164.

Solntsev, N.A., 2001. *Landscape study*. Moscou: MSU, 38 p.

Sochava, V.B., 1978. *Introduction into Geosystems study*. Novosibirsk: Nauka, 320 p.

Steiner, F., 2000. *The living landscape: an ecological approach to landscape planning.* 2nd ed. N. Y.: McGraw-Hill, 477 p.

Steinitz, C., 1995. *A framework for planning practice and education. Ecological landscape planning* / ed. M. Bunji. Tokyo: Process Architecture, 42–54.

The value of green infrastructure. A guide to recognizing its economic, environmental and so benefits. – CNT. Center for Neighbourhood Technology and American Rivers, 2010.

Weyland, F. & Laterra, P., 2014. *Recreation potential assessment at large spatial scales: A method based in the ecosystem services approach and landscape metrics.* Ecological Indicators, 39, 34-43.

Woźniak, & E., Kulczyk, S. & Derek, M., 2018. *From intrinsic to service potential: An approach to assess tourism landscape potential.* Landscape and Urban Planning 170, 209-220.

Zwierzchowska, I., Hof, A., Ioja, I.-C., Mueller, C., Ponizy, L., Breuste, J. & Mizgajski, A., 2018. *Multi-scale assessment of cultural ecosystem services of parks in Central European cities.* Urban forestry & Urban greening, 30, 84-97.

Received at: 22. 05. 2018
Revised at: 20. 09. 2018
Accepted for publication at: 25. 09. 2018
Published online at: 27. 09. 2018