Assessment methods of recreational potential of water objects

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Abstract. The article proposes a methodology for assessing the recreational potential of water objects and their coasts. Such an assessment makes it possible to identify territories and water areas in which maximum concentrations of natural properties useful for recreational activities are localized. This is important when making investment decisions. The evaluation method proposed by the authors is based on a point approach, which allows combining difficultly comparable properties of aquatic (and near-aquatic) geosystems. Evaluation criteria for the methodology are selected using the expert method. For this purpose, a group of international experts in the field of recreational geography was involved in the study. The ranking of criteria by a degree of priority was carried out using the hierarchy analysis method (and using the Expert Choice software). As a result, 27 of the most significant criteria were selected, allowing evaluation of the water body (with its coastal zone) in terms of its suitability for beach-bathing, balneological, hunting and fishing recreation, eco-tourism, as well as physical and landscape-aesthetic properties. The received score on all indicators allows carrying the estimated water object to this or that rank of usefulness for the organization of recreational activity with the help to the corresponding scale of ranging.

1. Introduction
Rational use of water bodies, first of all, involves the analysis of all possible options for their operation. The great interest is the involvement of aquatic geosystems in tourist and recreational activities. Due to its natural properties, water bodies become a kind of nodes and axes of the planning framework of territorial recreational systems, attracting the main elements of the tourist infrastructure. Currently, the vast majority of tourism and recreation institutions (resorts, holiday homes, camp sites, etc.) are located either directly on the banks of water bodies, or near them [1-3]. The inclusion of aquatic geosystems in recreational nature management involves the use of their recreational potential, which is understood as "the whole set of natural, cultural, historical and socio-economic prerequisites for the organization of recreational activities in a certain area" [4]. The recreational potential of the territory (water area) includes a lot of individual recreational resources, which means objects, phenomena and properties of nature, as well as the results of human activity, which are used or can be used to meet the needs of people for rest, recovery and tourism. A feature of recreational resources is that they include many rather specific and difficult to assess properties of the geographical environment. For example, the category of recreational resources includes such an intangible characteristic of the landscape as its aesthetic appeal [5]. In addition, with rare exceptions (for
example, mineral water reserves or therapeutic mud), recreational resources, subject to their rational use, are inexhaustible. Thus, they are the basis for the sustainable economic development of the territory. Moreover, rational recreational nature management a priori assumes the ecological stability of the territory since the ecological state of landscapes and trends in their dynamics are clearly correlated with their recreational attractiveness [1, 6, 7].

The development of any resource should be preceded by a thorough evaluation carried out using the relevant methodology [3, 7, 8]. This article proposes the author's method of assessing the recreational potential of water bodies.

2. Models and methods

The peculiarity of water recreational resources is their suitability for the organization of a wide variety of leisure activities. The most common of them are swimming, sunbathing and air bathing, sailing and water-motor sports, boating and water skiing, diving, rafting, fishing and hunting for wetland game. All these activities have their specifics and have different requirements for the characteristics of water bodies. For each type of water-recreational activity, an individual method for assessing the suitability of the water body can be used [2]. However, when assessing the overall recreational potential of the object, it is necessary to take into account all significant factors that allow developing all possible directions of tourist and recreational activities [9].

A recreational assessment of water objects includes not only analysis of water areas of water bodies but also coastal areas, as most of the time the recreants spend there. Therefore, we are talking about the assessment of aquatic and near-aquatic landscapes, functionally coupled in a single territorial recreational system.

The territory of coastal recreation is reasonable to limit to the zone of one-hour walking distance from the water body's shoreline (which corresponds to an average of five kilometers) since this space is intensively used by vacationers.

When analyzing the recreational potential, it is advisable to use a score assessment, which makes it possible to "lead to a common denominator" completely different in physical characteristics and genesis of the properties of water bodies (for example, water temperature and depth). To carry out a score assessment, significant indicators should be identified that characterize their manifestation in the conditions of a particular aquatic geosystem, the potential favorability of its recreational use [10].

The scoring assessment identifies the significant indicators characterizing its manifestation in the context of specific aquatic geosystems, the potential favorability of its recreational use. Scores across the aggregate valuation characteristics obtained are summed and the final scores are ranking of the objects according to the degree of favorability for this activity (this also being the final scale ranking) [5].

For various types of recreational activities that can potentially develop in the water area or coastal zone of the water body, the selection of appropriate estimates is necessary. They reflect natural and socio-economic characteristics that hinder or contribute to the development of different types of recreation. In addition, estimates should characterize the properties of recreational landscapes that make them attractive or unattractive for tourists.

The assessment indicators were selected using the expert method, for which 15 recognized specialists in the field of recreational geography from Russia (7 people), Belarus (1), Kazakhstan (1), Ukraine (2), Germany (1), Poland (2), and Finland (1) were involved. Each of them formed an individual list of criteria important for water and near-water recreation, indicating their priority, as well as possible options for negative, positive and most optimal manifestations. Then, each expert analyzed the total array of proposed criteria (63 in total). Using the hierarchy analysis method (and using the Expert Choice software product), the criteria were ranked by priority. Thus, some of the least significant indicators were excluded from the methodology to avoid its "overload". As a result of these actions, the most significant assessment criteria were selected (27 in total) and a scoring assessment of their manifestations (from 0 to 2 points) was proposed.
3. Results and discussion
The result of the study was the assessment method of recreational potential for water bodies based on the component analysis of the manifestation significant factors for the development of tourism and recreation. These factors (assessment criteria) are presented in table 1.

**Table 1. Indicators for assessment of water bodies' recreational potential**

| Characteristics                                    | Point |
|---------------------------------------------------|-------|
| Costal                                            |       |
| Dry gently sloping or terraced, with no steep descents | 2     |
| Dry, but steep, often steep                        | 1     |
| The banks are either swampy or very steep with a high cliff | 0     |
| Beaches                                           |       |
| Sand, small pebbles                                | 2     |
| Grass, large pebbles                               | 1     |
| Clay, peat, large stones                           | 0     |
| The nature of the bottom                           |       |
| Sand and small pebbles                             | 2     |
| Large pebbles, silted Sands, boulders              | 1     |
| Silt, clay, large sharp stone, plates covered with water organisms and shells | 0     |
| The relief of the bottom                           |       |
| Smooth the bottom with a gradual decrease           | 2     |
| The bottom is lowered by ledges, there are pits    | 1     |
| Frequent pits, pools, snags, etc.                  | 0     |
| Speed river current (only for rivers)              |       |
| < 0.3 m/s                                          | 2     |
| 0.3-0.5 m/s                                       | 1     |
| > 0.5 m/s                                         | 0     |
| Duration of the swimming season (°C)               |       |
| More than 90 days                                  | 2     |
| 70-90 days                                        | 1     |
| Less than 70 days                                  | 0     |
| Water temperature during the swimming season, °C   |       |
| 18-24 °                                           | 2     |
| 16-17 °; 25-26 °                                  | 1     |
| < 16 °; > 26 °                                    | 0     |
| Average air temperature in July, °C               |       |
| 20-25 °                                           | 2     |
| 16-19 °                                           | 1     |
| < 16 °; > 26 °                                    | 0     |
| Springs of mineral water in the coastal zone       |       |
| > 1, drinking, curative and/or prevention action   | 2     |
| 1 spring, non-drinking curative-prevention action or drinking prevention action | 1    |
| Mineral-water springs are absent                   | 0     |
| The object of mud therapy (therapeutic muds)       |       |
| The volume is more than 1000 cubic meters, and/or access is easy | 2     |
| Volume less than 1000 cubic meters, and/or access is difficult | 1     |
| Therapeutic muds are absent                        | 0     |
| Sanitary and hygienic conditions                   |       |
| Clean, no sources of pollution                     | 2     |
| Minor, easily disposable contaminations            | 1     |
| Pollution exceed the maximum permissible concentration, the banks are cluttered with garbage | 0     |
| Red book’s species of flora and fauna              |       |
| More then 5 species                                | 2     |
| 1-5 species                                        | 1     |
| Rare species of flora and fauna are absent          | 0     |
| Variety of game animals and birds                  |       |
| At least 10-15 species of game                     | 2     |
| 5-9 main game species                              | 1     |
| Less than 5 game species                           | 0     |
| Hunting areas productivity                         |       |
| More than 1500 kg/1000 hectare                    | 2     |
| 250-1500 kg/1000 hectare                          | 1     |
| Criteria                        | Options                                      | Points |
|--------------------------------|----------------------------------------------|--------|
| Hunting mode                   | Less than 250 kg/1000 hectare               | 0      |
|                                | In all seasons there is a possibility of hunting | 2      |
|                                | There are periods when hunting is closed for any game | 1      |
|                                | Hunting is possible only 4-6 weeks a year    | 0      |
| Diversity of fish fauna        | More 5 species                              | 2      |
|                                | 3-5 species                                  | 1      |
|                                | Less than 3 species                          | 0      |
| Productivity of fish stock     | 15 kg/hectare and more                       | 2      |
|                                | 5-14 kg/hectare                             | 1      |
|                                | Less than 5 kg/hectare                       | 0      |
| Variety of wild fruit and berry plants | At least 10-15 species                        | 2      |
|                                | 5-9 main species                             | 1      |
|                                | Less than 5 species                          | 0      |
| Productivity of fruit and berry plants | More than 150 kg/hectare                     | 2      |
|                                | 50-150 kg/hectare                            | 1      |
|                                | Less than 50 kg/hectare                      | 0      |
| Variety of mushrooms           | At least 7 species                           | 2      |
|                                | 4-6 main species                             | 1      |
|                                | Less than 3 species                          | 0      |
| Productivity of mushrooms      | More than 150 kg/hectare                     | 2      |
|                                | 50-150 kg/hectare                            | 1      |
|                                | Less than 50 kg/hectare                      | 0      |
| Variety of landscapes          | More than 5 types of different ecotopes      | 2      |
|                                | 3-5 types of ecotopes                        | 1      |
|                                | Less than 3 types of ecotopes                | 0      |
| Intra-landscape visual variety | More than 5 contrasting visually distinguishable landscape elements | 2      |
|                                | 4-5 distinct landscape elements              | 1      |
|                                | Less than 4 visually recognizable landscape elements | 0      |
| The presence of visual dominants | 3-5                                           | 2      |
|                                | 1-2; 6-7                                     | 1      |
|                                | 0; >7                                        | 0      |
| Depth and variety of visual perspectives | Near, middle, far                           | 2      |
|                                | Only near and middle; only near and far      | 1      |
|                                | Only near                                    | 0      |
| Degree of shoreline indentation | Numerous bays and peninsulas of complex configuration | 2      |
|                                | Peninsulas and bays are usually of a simple configuration meet no more than 1/km | 1      |
|                                | Peninsulas and bays are not more common than 1/10km | 0      |
| Forest area share, %           | 30-70                                        | 2      |
|                                | 15-29; 71-85                                 | 1      |
|                                | 0-14; 86-100                                 | 0      |

These criteria are used to assess the water bodies (rivers, lakes, reservoirs, ponds) with coastal areas or part of the coastal zones and the nearest water areas if they are large water bodies. When testing the methodology, we considered spatial divisions, which included (for very large water bodies) a 5-km segment of the coastline with an adjacent section of the coastal territory, a width of 4800 m and a section of the water area of 200-meter width. Assessment of such aquatic-territorial operating areas is carried out according to the above criteria. The points obtained for each criterion are summed up. The received sum of points on all indicators allows carrying the estimated reservoir (or its part)
with coastal territories to this or that rank of favorability of the organization of recreational activity according to table 2.

**Table 2.** Scale ranking total assessments by grade recreational value.

| Value grade | Characteristics of the value of recreational potential | Sum of points |
|-------------|--------------------------------------------------------|---------------|
| I           | Maximum                                                | More than 45  |
| II          | High                                                   | 36-45         |
| III         | Medium                                                 | 26-35         |
| IV          | Minor                                                  | 16-25         |
| V           | Minimum                                                | Less than 15  |

Direct assessment of water bodies and coastal areas can be carried out in manual mode (by analyzing the manifestation of each assessment criterion in the study area) or automatic mode (by GIS). In the second case, the manifestation of the assessment criteria in the study area is presented in the form of a GIS-database and generates the corresponding map layers in the GIS [10, 11].

### 4. Conclusion

The proposed method of integrated assessment of the recreational potential of water bodies (with coastal areas) allows for identification of the most favorable places for recreational activities and investment in this sector of the economy. Integrated assessment of recreational potential involves the most important factors that determine the development of different types of water and near-water recreation. In the proposed method, a key role play factors of the development of beach and bathing recreation, balneology, hunting-fishing and ecological tourism, and excursion activities. The list of evaluation criteria was selected by the expert method. For this purpose, specialists in the field of recreational geography from seven countries were involved in the work. The resulting list of evaluation criteria can be considered optimal in terms of the ratio the available necessary information, the labour costs of the researcher and the correctness of the obtained results. Of course, in the context of the objectives of each particular study, this list of evaluation criteria can be expanded or reduced. The use of scoring assessment allows for inclusion in the analysis of phenomena and objects completely different in their characteristics, evaluating them in a single indicator. The summation of points on all assessment criteria allows ranking water bodies with their coastal areas by the value of recreational potential (from the maximum to the minimum level).

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