

PAPER • OPEN ACCESS

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To cite this article: L S Marsadolov *et al* 2019 *IOP Conf. Ser.: Earth Environ. Sci.* **302** 012149

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Problems of preservation of prehistoric cultural heritage objects in the Arctic

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Abstract. Problems of preservation and research of prehistoric cultural heritage objects in the Arctic are reviewed in the article. To determine the priority tasks in the field of preserving the heritage of this region, the most probable risks of physical loss and loss of quality of objects associated with natural and anthropogenic factors are analyzed. A special feature of the Arctic is its increased sensitivity to anthropogenic influence and climate change. Therefore, in the context of global warming, the risks of losing the cultural wealth of a region and a planet increase substantially. An important role in the preservation of heritage sites can be played by measures to ensure conservation status, involvement in tourism and recreation development projects. One of the aspects of the conservation problem is that the cultural heritage objects of the Arctic region are still poorly understood as a valuable resource of information about nature and society. New methods developed by the authors of the article allow us to consider prehistoric heritage sites as functional elements of the ancient life support system and the modern geocultural space. The use of these methods allows us to zone the territory with the allocation of sustainable areas, which have been performing environmental and informational social functions for thousands of years. It is on these sites that ancient heritage objects are located. Correctly holding the boundaries of prehistoric cultural heritage objects (in the natural boundaries of natural systems) allows us to save information about the functional relationships in the socio-natural system. The article shows that the application of the methodology and research methods developed by the authors of the article will significantly reduce the risks of losing cultural heritage in the Arctic and other regions

1. Introduction

Prehistoric objects of cultural heritage were created throughout the whole non-literate period of human development. These objects of material and spiritual culture have been preserved thanks to their resistance to destructive environmental factors and their enduring value for humans. At the UNESCO World Conference on Tourism, in the “C” declaration, it was noted that cultural and sacred sites “... *deserve special attention as places of civilization*” (Manila, Philippines, September 27 - October 10, 1980). Article 44 of the “Constitution of the Russian Federation” declares: “*Everyone must take care of the preservation of the historical and cultural heritage, protect historical and cultural monuments*”. (adopted by referendum dated 12.12.1993 and edited 30.12.2008) [10, 23].

The topic “Protection and study of objects of natural and cultural heritage” should be included in educational programs as special lessons, lectures and special courses, starting from school and up to higher education, especially in geography and history lessons, in the work of school study groups and regional organizations for tourism and local history [22].



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It is obvious that the prehistoric cultural heritage is an invaluable resource of information about nature and culture that has been accumulated throughout the history of mankind, and that today, in the face of increasing anthropogenic influence, we can lose it. Such a loss is irreplaceable and is associated with a number of negative social consequences. In the most general terms, the relevance of the problem of preservation of the prehistoric heritage reveals three aspects: civilizational, economic and moral. Let us explain each of these aspects. The loss of heritage objects leads to the loss of stability of the global socio-natural system, since cultural diversity is a form of energy storage and protects society from numerous natural, anthropogenic and natural anthropogenic resonances. The economic aspect reveals the well-known remark of the mathematician A.N. Kolmogorov that it is impossible to control the system without knowing its genesis – the origin and development. The moral aspect is most important because respect for people is the main condition for progress.

The article analyzes the issues of preservation of cultural heritage in general and specific problems associated with the identification, study and preservation of prehistoric objects in the Arctic

2. Region, objects and research methods

Ecosystems of the Arctic region are highly sensitive to climate change. They are most vulnerable to global warming and a sharp increase in anthropogenic pressures. It is commonly agreed that the main social function of this region is the indication of the rhythms of the planet and global climate trends [4, 5]. Specialists in the area of socio-economic geography have created a concept of the protected Arctic – a territory that performs only environmental and informational functions in the global system [1, 2, 8, 18]. For economists and politicians, a damage assessment included in the sum of expected returns from resource development can be a convincing argument in defense of the natural and cultural heritage of the region. But, obviously, these consequences will fall on the shoulders of future generations. Of great importance in forecasts modeling is information about the features of the development of the system in the past, which is preserved in the structure of prehistoric objects.

A large amount of information about the evolution of the landscape, life, knowledge and semiotics of prehistoric society are saved by petroglyphs, mounds, megaliths, revered groves, forms of relief and objects of hydrography. Among the listed objects, the megaliths are the least studied – large monoliths of rocks, processed by human hands to varying degrees, and greatly modified by time. Often they are little noticed or perceived as a “play of nature”. However, unlike randomly scattered boulders, elements of megalithic complexes shape a system: links between large and small stones, relief, cardinal points, and astronomically significant points of the horizon are traced. The authors of the article have developed the fundamentals of the theory of cultural heritage and the method of interdisciplinary complex research, which allows us to describe the prehistoric objects and correctly identify their boundaries.

This technique includes an analysis of the enclosing landscape, with the selection of linear relief elements (building lineament roses), measuring the line of the physical horizon (circular panorama method), astro-archaeological and metrological studies. Astronomical observations and calculations make it possible to identify the lines of sight of important astronomical events, including the points of sunrise and sunset at the days of the solstices and equinoxes. Metrological analysis reflects the results of a comparison of dimensions and distances measured on site with archaic systems of measures (anthropometric units of measurement). The results of the research make it possible to determine whether the ancient stones retained their original location, were shifted or established by a natural process. This technique has been successfully tested on the archaeological monuments of Siberia, North-West Russia and other regions [6, 7, 11, 12, 15, 16].

3. The risk system in the area of protection, scientific research and economic use of objects of cultural heritage

3.1. Approaches to risk assessment

The concept of risk is used in various areas of knowledge to describe the uncertainty or probability of the occurrence of an event, entailing adverse consequences. In economics, the category of “risk” is used

to describe the likelihood of events involving damage, usually in financial terms. There is a practice of assessing damages associated with the physical loss of an object or its loss of sociocultural value [13]. In our opinion, the use of the categories "financial evaluation" and "loss of value" in relation to prehistoric objects is completely excluded, but it is possible to calculate the amount lost by regional economies due to the inability to service these objects and related recreational activities.

In this study, the concept of "risk" is used to describe the probability of events without an assessment of economic damage. The distribution of risks depending on the status of objects is analyzed: protected – not protected, known – unknown to researchers.

3.1.1. Risks of complete or partial loss of protected objects are considered depending on their modern location – at historical sites or in museums.

Heritage objects are protected at places of creation and use if they cannot be moved to a designated area (burial mounds, petroglyphs, natural and man-made sculpture). Such objects are destroyed due to the lack of security and monitoring services, arrangement and information, violation of the rules of land use. Examples include the sale of land plots with stone cups in the Leningrad Region for country house construction – nowadays; destruction by religious fanatics of menhirs in Akhunovo (Bashkiria) in 2010; the movement of stones in the space of the White Sea petroglyphs for the "historical reconstructions" with the participation of the KarRC of RAS in 2015; the construction in 2017 of springboards for riding bicycles on Dyakovo Mound, a monument of federal importance in the Kolomenskoye Reserve museum.

When protecting cultural heritage objects on site, monitoring the state of the surrounding landscape is of great importance. The location of the object and the nearest landscape environment have a direct and indirect impact on its preservation: degradation of vegetation, disturbance of soil and groundwater level and surface runoff can cause erosion, changes in the hydro-thermal regime of the surface and microclimate, increasing the rate of weathering of mountain rocks. It is important to understand that there can be no template for determining the boundaries of the protected area, its arrangement, area and nature management regime in the buffer zone. In different natural zones and geotopes (locations), the level of danger is different and can only be determined in the course of field research of the landscape. As a vivid example of the insufficient area of the object, the lack of a buffer zone and a high level of load on the surrounding landscape, we can consider mounds in the fields and gardens where the reduction of natural vegetation and regular plowing is accompanied by increased water and wind erosion and objects that have stood for hundreds and thousands of years today in front of one generation. In the regions of the Arctic, the above-mentioned risks are increased by substantial mosaic structure of the soil and vegetation cover, as well as the acceleration of landscape restructuring and the enhancement of thermokarst under global warming conditions.

The activities of museumification bring objects closer to the infrastructure of protection, but at the same time new risks arise, such as separation from the natural and cultural context necessary for the correct and full disclosure of their scientific value – information potential (for example, for the study of rational designation, form of semantics and ornamentation). The transfer of objects to urban museums is associated with a change of microclimate and the impact of a whole complex of environmentally unfriendly conditions (pollution of all environments, road dust, vibration and vehicle exhaust gases). The consequence of isolation in the storerooms is the impossibility of performing the basic social functions of cultural objects

It should be emphasized that only the spatial position (geographic coordinates) can provide answers to questions about the role of an object in the geo-cultural space (*geo-cultural space* – an integral system of landscape and culture [21]), about the primary rational functions of the object and genetically related to us symbolism. Practice shows that it is the *spatial reference of objects that is lost during the museumification of objects*, since only the administrative region, settlement or large natural object associated with its location is indicated; in the presence of a topographic plan – the direction to the magnetic pole without specifying the year and the magnetic declination for the time of surveying. Therefore, as far as possible, museums need to record the exact coordinates of heritage objects, place

photographs of the surrounding landscape on the exposition, as well as space or aerial photographs of their places of origin, and leave a copy of the object or a memorial plaque in the landscape.

3.1.2. Risks of loss of heritage objects without protection status.

Very often, only one object is protected, recognized as the most important by a complex of archaeological, historical and ethnographic criteria. At the same time, the surrounding, functionally related, objects that determine its functions and safety are ignored. These can be as artificial elements – menhirs, “glacial” boulders, processed rocky outcrops (marked with barbs, figured chips), or landscape components (relief, tectonic cracks, hydrographic elements). An example is the Bolshoy Salbyk Kurgan in Khakassia: the main protected object and the surrounding landscape with a unique kurgan complex are separated by a fence. For the further development of this project, it should be noted that the adjacent parts of the Salbyk Basin and the mountains surrounding it represent integrity: the paragenetic complex (its parts are developing together), a system of landscape landmarks fixing the dates of the astronomical calendar, and a characteristic landscape. In the modern geography of culture, the landscape is considered as an independent value, deserving protection status [3].

Another example is the revered stone of St. Paraskeva Pyatnitsa in the Luga district of the Leningrad region. The stone itself has a protection status, and the spatial complex, of which it is a part, does not have such status and is subject to negative impacts in the process of agricultural and recreational use of nature (small stones are displaced during plowing, and near large stones tourists light bonfires).

3.1.3. Objects that are unknown for science or have not been studied may be lost because of ignorance due to the insufficiency of classical archeology methods and the lack of comprehensive research. In the Arctic, in the wake of the economic development of extremely unstable landscapes, prehistoric objects can be lost before they are discovered, just as the still undiscovered biological species are lost forever during fire, logging and the creation of agricultural land in equatorial tropical forests. The real threat of such losses aims at preemptive studies of the territory with the involvement of specialists of different profiles – not only archaeologists, but also geographers, geologists, and engineers.

3.2. Problems of scientific research of the prehistoric cultural heritage of the Arctic

Comprehensive methodology is based on the definition of culture as an experience of adaptation to nature, and an interdisciplinary approach, which is implemented in a combination of methods of humanitarian and natural science research. The differences between the classical humanitarian and integrated approaches to the study of cultural heritage are well illustrated by the example of the interpretation of stone labyrinths located on the territory of the Solovetsky State Historical-Architectural and Natural Museum-Reserve. 10 years ago, using the main trigonometric function and astro-calculator, the labyrinth-gnomon formula was calculated, which shows its rational primary purpose as a solar calendar, where arcs mark the annual displacement of the midday shadow from a stone installed in the center. In the process of field and experimental observations, the algorithm of operation of these tools, essential for ensuring security and rational organization of economic activity, was checked and refined and data on objects-analogues in other regions of Europe were collected [9, 15]. But archaeologists and historians, not bothering with evidence, argue that the stone labyrinth is only a solar sign. With an integrated approach, on the basis of natural science methods, you can find a reasonable compromise of opinions, in which the ancient symbols acquire a rational fundamental principle, and signs – an astronomical nature.

The least studied today are the insufficiently processed large stone objects of the Paleolithic, which amounts for 99% of the time of anthropogenesis. Objective factors that impede the study of ancient and ancient objects and technologies can be divided into three groups: general (global), regional and local.

3.2.1. General (global) problems of research. The most common problems are related to the age of cultural heritage sites: the earliest of them may be of the same age as anthropogenesis (about 3 million years). It can be assumed that homo sapiens was the most active in arranging the living space (more than

30 thousand liters), while the youngest and best preserved part of the objects belongs to the Holocene (about 10 thousand years). The state of the objects is a serious obstacle for research – they are brought in by sedimentary rocks or badly destroyed, visually and physically merged with the landscape. The similarity of artificial objects and a natural substrate is enhanced by simple tools and a special mentality of the creators. A person immersed in the natural environment easily distinguishes any introduction in it, and this largely determines his behavior: firstly, he does not want to reveal himself for security reasons; secondly, the holistic consciousness allows us to imagine not only closer, but also more distant in space and time results of any insignificant impact. So, for example, stone processing is associated with an increase in its fracturing and durability, and changes in the direction of water and air flow may, in time, negate all the efforts expended on the creation of an object. As an echo of archaic technologies, one can consider a taboo on the number of strikes on natural stone, preserved in traditional culture.

Common problems include the fact that the diverse activities of an ancient person, aimed at life support, are studied mainly by humanitarian methods, developed mainly to meet the needs of social adaptation. Since, unlike animals, human mastered the environment instrumentally and technologically, then it is necessary to explore these objects on the basis of knowledge of technology, geology, geography and astronomy. The insensitivity of classical archeology to solving technological problems is clearly manifested in the lack of attention to the first largest instruments of the ancient navigation system, which were vital to the ancient man for movement and orientation in space-time (navigation). The relevance of navigation especially increased in the context of a changing global climate – at the beginning of the Pleistocene and at the beginning of the Holocene. The most promising research regions are hot and cold regions of the Earth

3.2.2. *Regional specifics.*

The regional specificity of the objects of prehistoric cultural heritage is related to differences in lighting modes, and the direction and speed of landscape changes along seasonal and long-period rhythms (1850-year Shnitnikov-Maksimov moistening rhythm, 26,000-year precession cycle of the equinoxes, 41,000-year Milankovich cycle, etc.).

The main feature of the Arctic is dynamism, therefore, cultural objects of this region could accumulate the largest amount of information (*information* is any heterogeneity in the distribution of matter and energy in space and time). It is known that in the Holocene the most favorable period for life in the Arctic was the climatic optimum of the Holocene 7000 years ago, at this time the highest temperatures, the absence of a continuous sea ice cover, high productivity of the landscape and rich ancient heritage (menhirs, labyrinths, petroglyphs) were observed.

Petroglyphs and labyrinths located in the Kola Peninsula, the White Sea and Karelia (about 6,000 years old – the oldest in Northern Europe), represent scenes of hunting and sea fishing, a high level of navigation. Astroarchaeological and geographical studies have shown that these objects act as sundial-calendar scales [16, 17].

The priority of orientation by the Sun in the Arctic is associated with the phenomena of polar days and white nights, which fall on the summer period of vigorous economic activity. The most significant dates of the calendar in extreme climatic conditions are the equinoxes that separate the warm and cold half of the year. In addition, at the latitude of the polar circle every day at 18 o'clock of Astral time, one can observe all the zodiac constellations simultaneously [19, p. 127]. The severity of nature, the variability of the landscape and the special conditions of astronomical observations well explain the high level of navigational knowledge noted by ancient authors for the peoples of the North of Eastern Europe.

Another feature of the Arctic is the nature's vulnerability (thermokarst, low speed of the biological cycle, low biomass), its sensitivity to global processes. The current increase in global temperatures will cause the most noticeable changes here: the acceleration of all natural processes, the restructuring of indigenous landscapes, the increase in anthropogenic pressures. All this represents a serious threat to the timely identification and preservation of objects of prehistoric heritage.

3.2.3. *Local problems.*

The results of research of ancient navigation tools show that objects are unique, and technologies are universal. The methods and methodology of integrated interdisciplinary research, developed by the authors, allows to take into account the features associated with the influence of a complex of factors: geographical latitude, horizon shape, height above sea level and the position of the earth's axis at the time the object is created, information resources of local nature (phenological cycle, pattern of landscape drawing and geological substrate), to analyze the ancient metrological standards, technologies, economic and calendar traditions laid in the object [11, 12, 14-16, 20]. V.L. Gorshkov and S.S. Smirnov, the scientists of scientific staff of The Central Astronomical Observatory of the Russian Academy of Sciences at Pulkovo, took an active part in development of the methods

Comprehensive studies conducted at different sites of Eurasia showed that the monumentality, stability, safety and continuity of their status in a series of alternating, sometimes antagonistic, cultures are associated precisely with solving technical problems – these are tools of astronomical orientation and storage of metrological standards of their time [11, 12, 14-16]. It is characteristic that similar results were obtained at prehistoric objects in many regions of the world and at UNESCO objects [20].

3.3. *Human factor*

Even a very superficial overview of the problem of the human factor shows the role of *a sense of personal responsibility*, not connected with the fear of punishment. A model of such an attitude towards heritage can be the traditional culture as a whole and its individual representatives – ordinary people. There is a story about how a peasant, showing a labyrinth in Ponoy (the Kola Peninsula), carefully returned to the place a stone hit by a boot of a highly educated visiting researcher.

3.3.1. *Mistakes of governance.*

Today, unfortunately, one can observe a careless attitude to the heritage of those who are entrusted with their protection and organization of research. So, the pits on the site of the central and northern formation in the labyrinth number 2 are still left after the excavations of archaeologist A.Ya. Bryusov; with the permission of the administration of the Solovetsky Museum, the initiative group of the RGO of Petrozavodsk (more than 20 people) sets up a tent camp on the Bolshoi Zayatsky Island for a month to conduct regular biometric studies to determine the health effects of walking on stone spirals lined 5000 years ago. And this happens on the territory of the national reserve, on the island (1.25 km²), where, according to the protection regime, during the day, no more than three or four groups of up to 15 people can pass during a 45-minute excursion, provided they move along wooden footbridge. Note that the tiny island has no firewood for the fire, no drinking water supplies and is not designed for such substantial anthropogenic loads as trampling the soil and vegetation cover and ensuring sanitary needs. Often, the cause of the destruction of monuments becomes inept management and financing. For example, in the project for the development of tourism in the North-West Federal District 2011-2018 there are no prehistoric monuments. Petroglyphs of Lake Onega and the White Sea require attention and facilities, constant protection and modern tourism infrastructure.

3.3.2. *Sense of respect and responsibility.*

Objects of ancient cultural heritage are the pride of any city, town, region or country. State and public organizations, scientific communities of various ranks, including the Academy of Sciences, are aware of the need to respect the material objects of the ancient heritage and traditional culture, especially religious and burial monuments. In most cases, economic and tourist relations do not obscure the respect for heritage sites inherent in folk tradition. The presence of the local population is often a guarantee for the additional protection of objects (on mounds, temples and shrines).

In a number of cities in the North-West of Russia, there are megalithic objects in the streets and parks – in Murmansk, Vyborg, etc. Unfortunately, many megaliths could not be saved in Staraya Russa and St. Petersburg – they were used to build foundations, fortifications, they were buried, etc. In Murmansk, a unique plateau of seids, a turtle, Crow stone, which are looked after only by the locals, can be lost.

3.3.3. Interest in information and aesthetics of prehistoric heritage objects.

Megalithic objects are an integral part of the landscape and culture: along with them are still held the main national holidays in the days of the solstices and equinoxes. A great experience of combining the protection of objects, scientific research and organized tourism has been gained in geoparks of Europe and the world. There are not many such complex projects in Russia yet. For example, in the National Park "Alkhanay" (Buryatia) ethnographic and environmental programs are successfully developed, which cover all groups of the population and have a positive effect on the education of young people. A positive example may be the experience of the Monrepo park in Vyborg: as early as in the 19th century stone objects are harmoniously included in the general plan of the park, and today they attract locals and tourists from St. Petersburg and abroad. The first steps on this path are being taken today by the natural-ethnic park in Chukotka "Beringia".

4. Conclusions

Problems of preservation of prehistoric cultural heritage sites of the Earth's regions affect not only the interests of the indigenous population, but also the entire modern civilization. Just as the disappearance of biological species and populations reduces the sustainability of the global ecological system, the loss of cultural monuments and folk traditions of the Arctic reduces the level of human adaptation in this extreme region.

An analysis of the system of risks of partial violation and complete loss of prehistoric cultural heritage objects in the Arctic, provided in the article, can be the basis for developing recommendations for the conservation and rational use of specific territories and sites.

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