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Network Platform for Tourism Sector: Transformation and Interpretation of Multifaceted Data

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Abstract: Modern network science has become a prominent concept, attracting diverse scientific societies to solve a wide spectrum of theoretical and practical problems. Tourism is a sphere wherein the outlines of the network's scope are distinct. In the study, the network approach was applied in its dual form for both network-like regional tourism data (NLRTD) and network-unlike regional tourism data (NURTD), to explore the tourism destination of Baikal natural territory, Russia, in regard to the challenges of the general sustainability of regional socio-ecological systems. The aim of the study is to elaborate a comprehensive network platform to harmonize such complex and fragile systems as Baikal natural territory. Saturated with networking ideology, the approach spans a huge set of interacting social, technological and ecological elements of the comprehensive system in order to support its functionality and sustainability in general. Particularly, the paper utilizes data from interviews done in Olkhon island (2017–2018), and publicly available textual, spatial and temporal data. NLRTD with pertinent networkization procedures was utilized in transportation schemes, while the NURTD concept implies the networkalization of landscape and land use maps. The platform provides researchers and stakeholders with concentrated information which might be not only effectively processed, but also intelligible, and correctly compared and implemented in contiguous spheres.

Keywords: socio-environmental systems; Baikal natural territory; sustainability; tourism; comprehensive network scope; network-like data; networkization; network-unlike data; networkalization

1. Introduction

Lake Baikal is globally known as the largest fresh water reserve. The UNESCO World Heritage Committee recognized Lake Baikal as an example of an outstanding freshwater ecosystem, and included it in the List of World Heritage Sites. In legislative order, this was reflected on 2 April 1999, when the State Duma of the Russian Federation adopted the federal law "On the Protection of Lake Baikal". At the 37th Plenary Assembly of the World Federation of United Nations Associations (Barcelona, 11 May 2003), it was decided to recognize Lake Baikal and the Baikal natural territory (BNT) as the target territory

for the sustainable development of world significance, as part of the UN's program on sustainable development. To achieve this goal, there is the need to understand the interactions of ecology, economy and society within the region and its communities. A socio-ecological system approach is the way to understand the interactions between social and natural systems.

The socio-ecological systems of BNT are both complex and fragile. There is a significant amount of natural resources located within the BNT boundaries. Local communities of BNT experience a large differentiation in socio-economic, natural resource and transport access conditions. In addition, they underwent a sharp transformation during the late 20th–early 21st centuries. Studying what influence industrialized zones (mining), agricultural, tourism and sparsely populated areas have on each other in their proximities (e.g., on BNT) is of particular interest at present. Naturally, the relationship between socio-economic reality, cultural traditions, climatic and institutional conditions and infrastructural support requires pertinent management cultures in order to make socio-ecological systems sustainable.

The basic hypothesis of the work follows is considered as follows: as a result of external influence, mainly external demand for certain resources, as well as an increase in individual requests for improving the quality of life, socio-ecological systems themselves may lose their sustainability. Possessing modelling methods, the analysis of the relationships and interdependencies between many different components is quite feasible. In regard to the sustainability of socio-ecological systems, the tourism phenomena impacts and changes the systems to some extent, and might serve as an indicator of the changes as well. As a tourism industry becomes more complex, ubiquitous and intangible, it requires relevant approaches and techniques to be scrutinized relevantly. Among diverse approaches, it seems attractive to develop and apply powerful network instruments and tools based on relevant concept-networking in the tourism domain, with regard to a comprehensive assessment of the sustainability of socio-ecological systems undergoing socio-economic and natural-climatic changes in the BNT.

Network theory, with complex systems as its fundamental worldview, has attracted experts from diverse domains, with their differing viable capacities. Academics have depicted effectively synthetic and real Information in terms of networks, and designed capable applications for advancing the viable examination provided by graph theory, probability theory and linear algebra. Notably, the higher the number of agents in a framework that are comprised, the more one justifies the utilization of the network platform to consider the system. Numerous frameworks with their natural web spanners have been deciphered as networks, e.g., transportation, communication and other instances of critical infrastructures. These include tourism [1], commuting [2], exchanging [3]—exercises associated with voyages moreover are displayed by systems consistently. Similar sociable contacts [4,5] and relevant spread structures for data and contaminations [6] are of the same profile. Such frameworks and information represent the entities that are described by network-like data (NLD) [7]. The investigation of network-like substances [8] comes to be of extraordinary interest for assorted areas, both hypothetical and viable [9,10]. It could be a routine approach to depict these in the form of a chart hypothesis, and further to mesh the words of the last mentioned and network science, i.e., vertex vs. node, edge vs. link, degree vs. connectivity.

However, it is of value to put a boundary between math and network science so as to indicate which domain the issues center on. The complex networks expand the domain of graph theory by inserting measures, methods and tools based on critical properties of real entities. An instrument for transforming network-like information has been given in [8]. Therefore, the network science concept is more useful than that of graphs for application in an interdisciplinary area.

It should be noted that network-like information, such as that created by transportation, entities ought to be completely analyzed. The specialists must take under consideration the reality that not all complex network scopes are valid within the concrete transportation context, so that a few adjustments may well be required [11]. Thus, complementary models are normally considered for transportation frameworks, at least those of L- and P- [12], as shown in [13] for Russian railroads. For given network-unlike data (NUD) (textual, spatial and temporal data), their network restoration

is seriously complex, and experts confront the intense issue of which transformation procedure one ought to apply so as to ensure a better result.

In the current work, we focused on tourism as a sensitive area, and one of the growing industrial sectors within BNT, which is impacting on the territory more and more. Tourism, according to one of the most prominent experts in this domain, is both a vague and inspiring phenomenon [14]. At the same time, it seems feasible to highlight some characteristics that provide an understanding of the phenomenon, and the possibility of controlling it. As the works [15,16] underline, the interconnection between the actors in the field is a key factor for individual and cooperative participants to develop in the chosen tourism destination. The author of [14] noted that it is of value to perceive that the tourism destination is a kind of complex phenomenon, and multifaceted analysis of the destination is of key value for the regional society. It should be emphasized that the tourism destination is a complex system, combined from a set of interconnected and interdependent components. Numerous intradisciplinary studies have been devoted to diverse aspects of tourism destinations, by exploration of their actors (individual tourists and tourism groups, tourism agents, transportation companies, internet providers, local power corporations, residents, etc.) and the pertinent relations among them and with the environment as well. Moreover, such papers as [17,18] have focused their vision on the dynamic nature of a tourism destination. Intradisciplinary investigations have proposed numerous methods to scrutinize destination systems, such as [19–24]. Nevertheless, it might be asserted that a network platform shows its power in the exploration of a wide spectrum of complex systems, including those of tourism destinations.

Based on the network approach applied in the domain, a great deal of research was performed in [25–30]. Within the network ontology, the nodes were chosen as the principal tourism providers of each destination: tour operators and separate suppliers (travel agencies, transportation companies, information resources, etc.). Thus, transportation problems in tourism destinations were described in reference [31], which examined tourist spots around the world as a complex network structure. In this regard, we set the aim of clarifying if the network format of data is applicable to monitoring the domain, and thus could be of value to the sustainability of the regional socio-ecological system in general.

Within a wide spectrum of studies on the sustainability of tourism per se, and of destination territories, many papers are based on narratives, qualitative or semi-quantitative methods [32–35]. In order to examine the relationship between tourism and economic development quantitatively, and to understand the socio-economic impact of tourism, some investigations utilized a series of statistical techniques [36–39]. It is necessary to note that, despite the fact that network science is advanced in many research disciplines, it lacks a focus on sustainability analysis for territories with tourism activities. Few scientists pay attention to the role of tourism in the sustainable socio-economic development of Siberian regions [40]. In this regard, the authors hypothetically considered correlations between the indicators of recreation and tourism development, and the indicators of sustainable development. However, the relationship between these indicators was vague and unclear in its nature, and must be treated in a more transparent way. Several papers were devoted to the sustainability of the BNT; for example, the authors of [41] presented in narrative form the social aspects of tourism. Their multidisciplinary description, though, lacks criteria and metrics to assess the components of the system and their links. Meanwhile, the impact of recreation and tourism on sustainable regional development was analyzed, and some strong correlation between them was noted in the case of BNT [42].

2. Materials and Methods

The research is based on field studies and network analysis. The field studies were conducted in 2017 and 2018 on tourism activities in the village of Khuzhir, on Olkhon Island. The interviewees were found using snowball method and former social networks. The duration of interviews ranged from 25 to 90 minutes, and averaged 50 to 60 minutes. For analysis in this paper, we included 19 in-depth interviews with locals (4 interviews), community leaders (3 interviews), municipal authorities, "tabletka" drivers (5 interviews), government official (2 interviews) and owners of tourist hostels

(5 interviews). "Tabletka" cars (4WD Russian vans adjusted for bumpy local roads) on Olkhon Island provide tourists with rides to attractive places, and transportation between the ferry and the places of visitors' accommodation. In particular, we analyzed the interviews wherein respondents were discussing the benefits and problems of tourism activities, and environmental degradation by the development of tourism activities. The interviews were transcribed, anonymized and coded using NVivo to explore specific discourses related to the types of tourism activities.

Further, we represented network-like and network-unlike regional tourism data (NLRTD and NURTD, respectively) as networks for further effective processing, and for ultimately making them intelligible, correctly compared, and implemented in other spheres related to the tourism sector in BNT. For NURTD, a set of popular techniques might be utilized to convert textual, spatial and temporal data into complex networks. Those, as usual, include the next three stages of processing the data: segmentation according to the specified time length, coarsening of the segments, and making segments linked with corresponding weights. Among the algorithms which have theoretical and practical significance are CBS [14–16], LS [43], "boundary" and "pixel vicinity" approaches [44], and IVG/IHVG [45]. The above algorithms envisage specifically splitting a system into elements and linking "similar" elements to build a network.

It appears sensible to apply the approaches appropriate to conserving inherent properties of the considered framework (NLRTD and NURTD, both) to the utmost degree. The comparison of the techniques in their effectiveness and efficiency can be not only qualitative but quantitative as well. To convert NLRTD, we followed reference [31] and used the field data. The cities and villages are taken as nodes, N, and a link exists between nodes i and j if tourists travel from site i to site j. Contrary to reference [31], no particular attention was paid to whether the links were directed or not. To verify the information and assess its reliability concerning the relationships, we chose interviews with individuals involved in the domain of tourism.

The transformation of NURTD (collected in spatial, temporal and textual formats) into complex networks was performed with focus on scaling the data, in line with reference [46]. According to the algorithm, the transformation process implies three consequent steps, so that three types of nodes and three types of links are defined (Figure 1). We found that such tools as Gephy [47] and Neo4j [48] are useful to support the model to be processed.

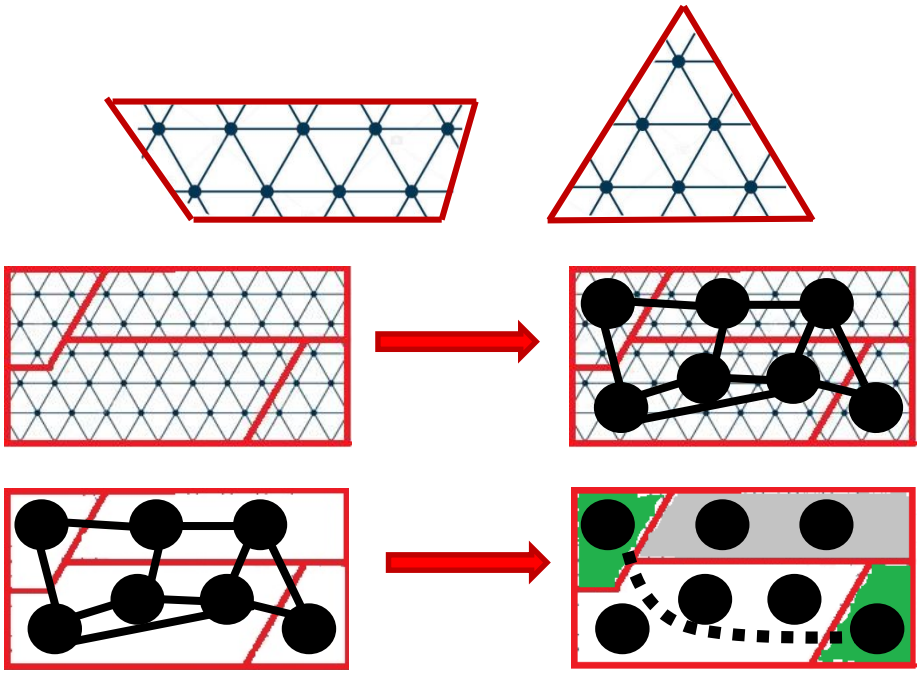

Figure 1. 3-step algorithm that converted NURTD into a complex network.

3. Results

3.1. Baikal Natural Territory as Tourism Destination Analyzed through NLRTD

Baikal natural territory is located in the southern part of eastern Siberia. It includes Lake Baikal, with islands, an adjacent water protection zone, a catchment area within the territory of the Russian Federation, as well as specially protected natural areas located on the shores of Lake Baikal, and an adjacent territory up to 200 km wide to the west and northwest (Figures 2 and 3).

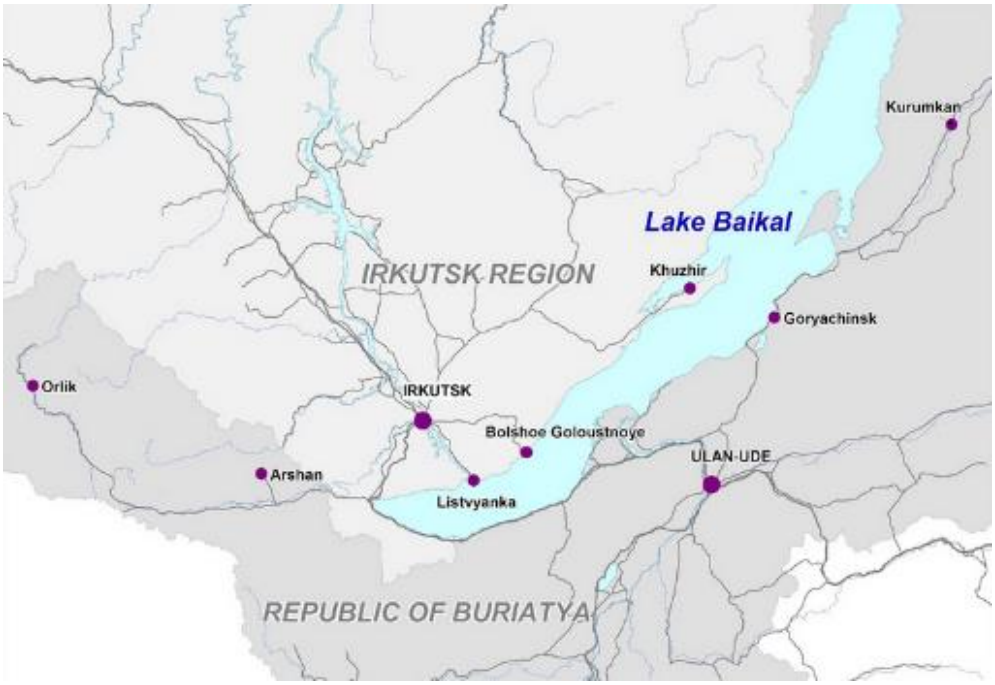

Figure 2. Map of Baikal natural territory as a tourism destination.

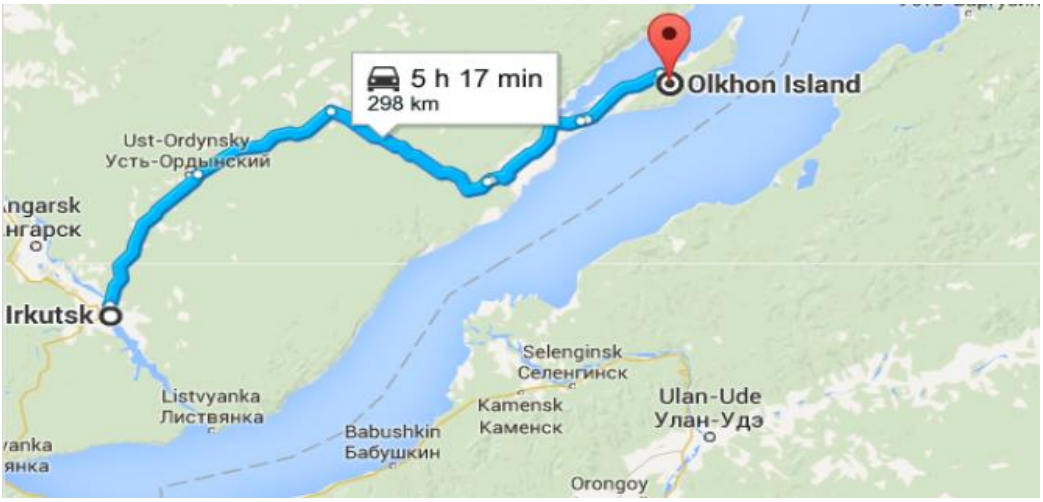

Figure 3. Olkhon Island.

Due to its location on a sufficiently large area with multi-level administrative divisions (three constituent entities of the Russian Federation, including 37 municipalities with the status of an administrative district), certain difficulties are currently arising related to the management of the Baikal natural territory. Therefore, it is necessary to create a tool for developing socioeconomic and environmental indicators of the development of the subjects of the Baikal natural territory, taking into

account the sustainable development strategy of this region in accordance with the specifics of political, economic, environmental, technological and social conditions.

A simple transportation network in the tourism destination of the Baikal natural territory was constructed (Figure 4), and thus a networkization of the NLRTD was realized. One may add that the Gephi tool builds arrows automatically if one assigns "directed" links. Concomitant values of network metrics are presented in Table 1.

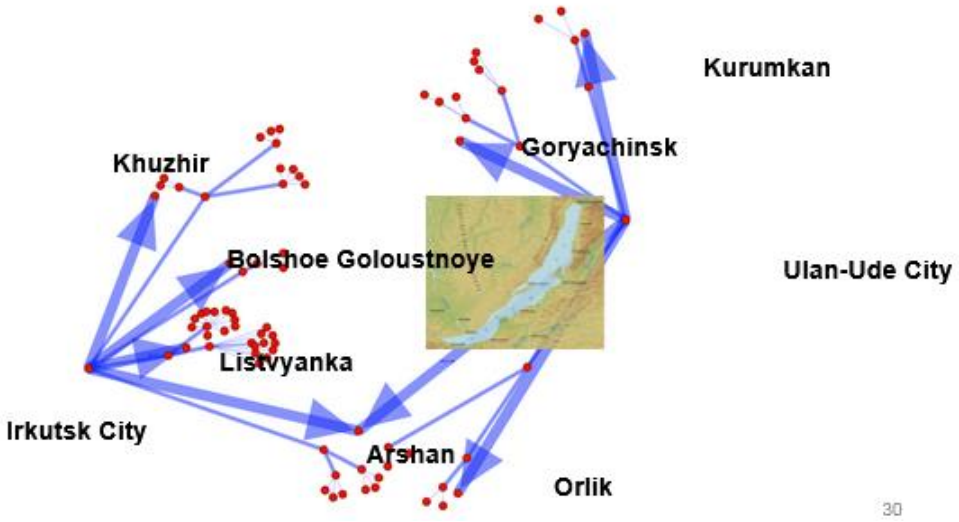

Figure 4. Network scope of tourism destinations and regular transportation services in the Baikal region.

Table 1. Metrics of the tourism destination network for the Baikal natural territory.

No. p/p	Metric	Value
1	nodes	81
2	links	80
3	average degree	1975
4	diameter	8
5	radius	4
6	average path length	5.23
7	density	0.025
8	modularity	0.717
9	number of communities	9
10	number of weakly connected components	1
11	average clustering coefficient	0.000

It is not surprising that a hierarchical network is revealed in such a transportation organization (Table 1). It was noted that real-world networks tend to develop as modular ones [49]. The network we explored has nine tangible communities or groups of nodes, such that the density of links amongst nodes within each group is higher than between nodes of different groups. Modularity is a common characteristic of diverse real-world network systems. Network clustering portrays the cliquishness of the network system, and its average coefficient equaling zero indicates no dependence between links. Thus, the network clustering level is lower compared even to a pertinent random network. As it possesses a tree network topology, its structure reflects the area's significant topological vulnerability to intentional anthropogenic threats. Simultaneously, the network is robust when exposed to natural disasters.

3.2. NURTD of the Baikal Natural Territory as a Tourism Destination

Geography is a core aspect of tourism, which consists of the exploration of an area and travelling between specific places. It seems reasonable to study maps of regional tourism destinations and apply

the aforementioned scale-based algorithm for their networkalization. Accordingly, landscape and land-use maps (Olkhon county, Irkutsk region, RF within Baikal natural territory) were converted into complex networks, as Figures 5 and 6 portray.

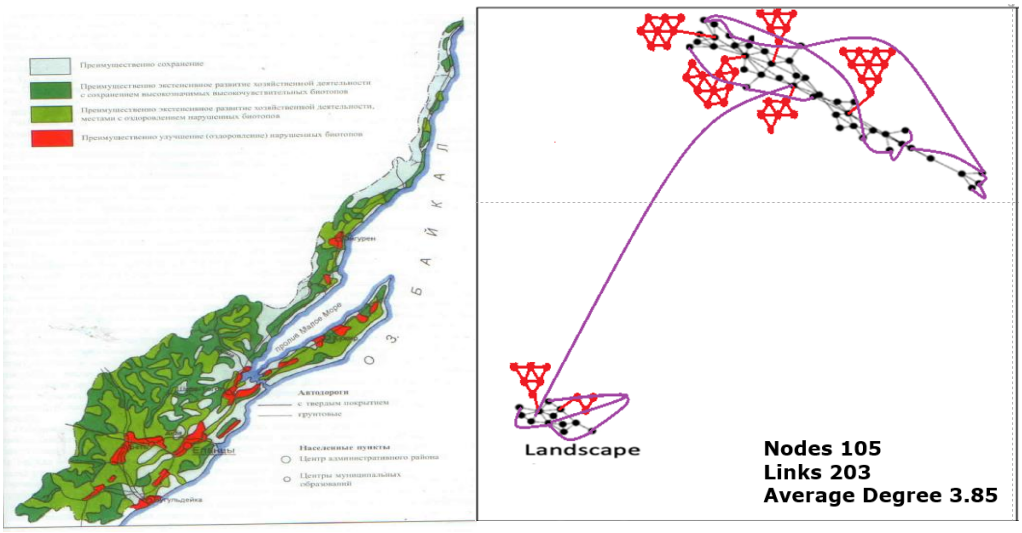

Figure 5. Networkized landscape map of tourism sub-destination (Olkhon subarea, Baikal natural territory).

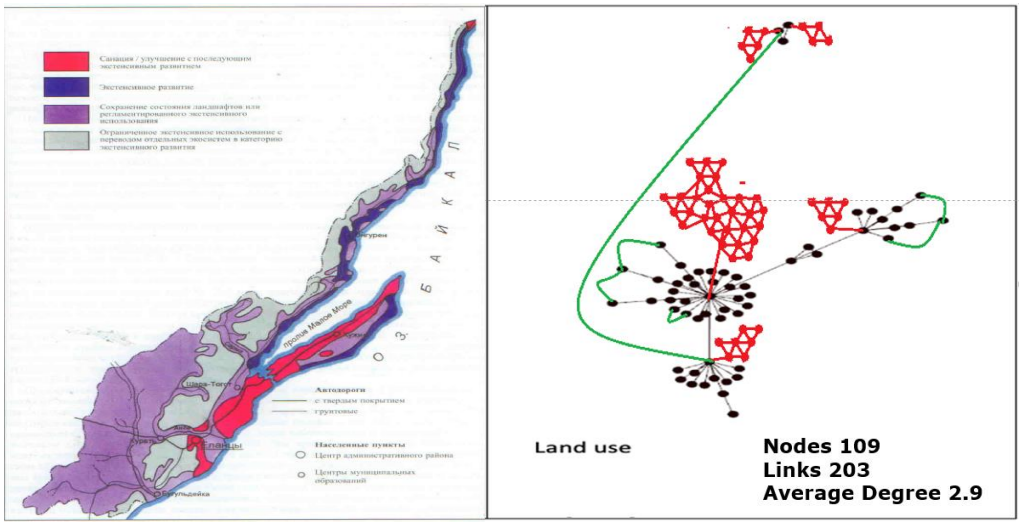

Figure 6. Networkized land use map of tourism sub-destination (Olkhon subarea, Baikal natural territory).

This weakness is exacerbated by the underdeveloped tourism infrastructure and environmental regulations. The island is connected to the mainland via ferry, and has experienced a rapid growth of tourist flows from different regions and countries. A large number of tourists are attracted by local landscapes, natural monuments, and local legends. In 2019, the island of Olkhon was visited by 142 thousand people, which is 17% more compared to the previous year [50].

The "weak" connections between nodes are indicated in the interviews with residents of the Olkhon Island, where Baikal's problems are most acute. From an interview with a representative of the administration: " . . . those who, from far away, the Russians are going to the island, because they have an understanding to look at Lake Baikal. Our Baikal is not for swimming at all, it's not the Black Sea. And this tourism is better, it clogs less, they settle in a hotel, there are fewer "wild campers" and those who leave garbage. These are people who travel for a short time and people who travel purely informative. Everything is contemplative here . . . We have cognitive, ethnic tourism, eco-tourism, in holy places, like a pilgrimage. We arrived, looked and left, lived a bit. In fact, we have nothing to do

on the island. Firstly, it is limited in space. Secondly, it is limited by the number of objects that can be viewed. Three days and all. The Chinese, the Koreans, go for one day at all. Objects can be counted on the fingers . . . " (government official, female, 46).

The main activity of people living on Olkhon is the reception and service of tourists. For the local male population on the island, one of the most popular types of activity is the transportation of tourists in "tabletka" cars from the ferry to Khuzhir, and tourist trips around the island to local attractions. Most of these drivers do not have permission to carry passengers, but despite the existing fines and bans, the number of such cars and services is growing every year, with an increase in the number of tourists and the demand for their services. From an interview with a tablet driver: " . . . driving big Korean buses here is like death. Then you won't get repairs. The suspension on both sides breaks, and UAZ ("tabletka") are private traders, what is it? They were paid money and take it anyway. Basically, drivers have their own cars . . . larger camp sites, they attract drivers to their cars. They hire drivers from Irkutsk; they are no longer local, these hired drivers" ("tabletka" driver, male, 42).

Environmental restrictions and prohibitions on construction make changes on the way of life of the local population. Together with existing restrictions, it is allowed to build on previously acquired plots, which are resold to investors from other regions. From an interview with a local resident, who first opened a camp site on the island of Olkhon, about the problems of consensus-building between local residents and environmental restrictions: "Some Muscovites came and does one from Krasnoyarsk buy land and pump money . . . Does the government need this? Does Olkhon need this? For someone to come and download money here. For nature, this is bad. He doesn't even pay taxes properly. Taxes are minimal. They all go in a row. Grab this land. Make money. But for the local resident, it's the same part anyway when we say that we need to save birds, animals, but people don't need, right? Which grew up here. It turns out so what. And the local man today is in much worse conditions than the man who arrived. He even has money. Build sewage treatment plants. And the local will not build because he does not have money. Destruction is going on . . . " (owner of tourist hostel, male, 56).

The difficult stance of the national park on Olkhon Island is reflected in an interview with the owner of the camp site: "Khoboy is the territory of the national park, the national park is a monopolist, so neither the local administration has any influence and even the city tourist has no influence and pressure on them. These toilets cannot be accessed. . . . So everything is filthy and flooded, nobody cleans and a huge pilgrimage goes to Cape Khoboy. Of the tourists, everyone who comes to the island, he visits Khoboy. She walked for many hours, 6–8 h . . . there's nowhere to go to the toilet on Khoboy itself" (owner of tourist hostel, female, 41). Conflicts between tourism businesses and the national park occur quite often. For example, as one interviewee put it, "The last year the leadership of the national park changed, and to avoid any problems they decided to completely ban trespassing through the park. There are only two routes that we have. One is in the southern part of the island that generally passes through the steppe zone. There is no forest. And another one is road to Khoboy that passes about three kilometers of forest. There is no other way to go around. And cars don't stop there, no one makes fires there to make tea or food there. And they simply banned it. Although the conditions for bonfires were met, that there is no entry into the forest part. So they were so reinsured and there was no explanation" (owner of tourist hostel, male, 60). The road was banned for travel in April, and reopened only in July, leaving local businesses significantly deprived of income for one of the main months of the tourist season.

Thus, the main problems that people sought to discuss in interviews were highlighted and analyzed according to the most commonly discussed problems (Table 2). From the analysis of interviews (Table 2), we can see that the problem of liquid household waste is of concern to all owners of tourist centers, since they are associated with fines and restrictions on tourist services. This problem is currently one of the most acute; it is also felt by some local residents, community leaders and representatives of the administration.

Table 2. The main problems discussed by people (v. Khuzhir).

Problems	Owners of Tourist Hostels (n = 5)	"Tabletka" Drivers (n = 5)	Locals (n = 4)	Government Official (n = 2)	Community Leaders (n = 3)	Quotes from Respondents
Liquid household waste	5	0	3	2	3	" . . . take all the waste the guys out as you want. How to take out when there is no ice and the ice is bad?" "Well, there were scandals when the violators were caught. In winter, somewhere when you can't go cross Baikal . . . "
Relationship with the national park	4	4	3	1	3	" . . . First of all, it is the relationship with the national park because the laws are not perfect. That don't protect us at all" "The National Park prohibits everything. There is no alternative"
Fishing restrictions	3	3	2	0	2	"They caught fish without control by seine, net, etc., And there is no fish for today. The plant is closed" "There used to be fishing, someone was fishing, but now it's banned, and the fish doesn't come in either . . . "

The problem of the relationship with the National Park worries most interviewed residents and entrepreneurs. Most tourists coming to Olkhon visit Cape Khoboy. The route to Khoboy is the most popular among tourists, the main source of income for local "tabletka" owners and drivers, and tourist guides. This route is also included in complex packages of tours around Lake Baikal; therefore, when this road is closed by the national park, both the business community and local residents working in the tourism sector are hurt. The regionally/federally imposed ban on catching omul affected the majority of Olkhon residents, since they used to catch omul for subsistence and selling purposes. "Tabletka" owners, local residents and community leaders have noted that, due to reductions in the amount of fish, and the ban, this type of income is now absent.

Complex relationships between people, authorities and legislation require additional data analysis tools, such as network data analysis (Figure 6). When using network analysis, it was found that the linking of coarse-grained similar areas builds the networks with their scale-free and small world properties. Such linking reduces the average shortest path length significantly, and leaves sufficiently large value of average clustering coefficient within constructed networks, and this makes their topologies very complex. A possible generalization of the map augments some of the details and repairs network prints, but does not alter topological substance of the output network.

It is of crucial importance that the networkization and networkalization concepts utilized in the study conserve the key information contained in NLRTD and NUNRTD, while transforming those into networks. It makes sense to recall that according to Gartner's IT Glossary, and comparable to its terms of "digitization" [51] and "digitalization" [52], we characterize "networkalization" as utilization of the network concept to alter a research or a practical model, and thus reach new advances in numerous dimensions; it is the method of moving to a more network-like space and society in general. On the other hand, "networkization" is merely the transition from a normal basic network-like shape to a pure network. To make it more clear, networkization takes a natural system (or a separate process or object within it) and transform it into a network structure, without any principal changes to the system entity. Thus, networkization is applied to only network-like systems, but those of a network-unlike nature require the process of networkalization. The valuable information contained in NLRTD and NURTD should be seamlessly conveyed as complex network features, i.e., to characterize sets of pertinent metrics which are clarified through pertinent network analysis.

4. Discussion

The popularity of Lake Baikal as a tourist destination is growing every year. Our studies demonstrate that the lack of necessary infrastructure does not stop people who want to get acquainted with these places. Many camp sites operate unofficially, and the types of tourist activities, such as guides, passengers, rental boats, bicycles, etc., are also unofficial. As a result, environmental problems associated with human activities, problems of garbage, waste, etc., are exacerbated. The federal and regional authorities introduced restrictions on the allocation of land to the local population, and at the same time the absence of restrictions on the construction of new tourist centers to address these problems does not take into account the social consequences of unemployment, and the lack of economic opportunities for local communities.

Given the complexity of the entanglement of social, economic and environmental problems, this article proposes to explore the problems of the analysis of informal activities and the relationship between actors of tourism activities using network analysis.

Concerning general usage of networks, it makes sense to underline that they bring additional perspectives to the data we analyze. Moreover, it is a feature of data representation that makes this view "multidimensional" (i.e., we represent data in digits, by tables, by maps, by diagrams, and by networks as well).

The examples of networking (networkization and networkalization) presented above are rather simple.

The mapping of NLRTD and NURTD into multiplexes [53] or into stem structures [54] might be suggested as a promising concept for analyzing more tangled tourism systems from diverse perspectives.

Even somewhat different multiplexes (multilayer) and stem networks (e.g., in its combined format) are clarifying models that separate the relationships between actors of the same sort into pertinent domains (both for netwokization and networkalization cases).

These models have been developed as a solid platform for studying multi-actor complex systems over numerous domains, comprising living beings, artificial and natural objects, societies of people and robots, and others [55].

The collection, storage and analysis of big data in a text format (literary works, scientific articles, official reports, etc.) and in the form of spatio-temporal records (audio and video materials processed in geography, ecology, geology, meteorology and many other fields concomitant to tourism) require effective and efficient techniques and instruments to explore and use those them for regional, national and international purposes.

Networking through networkization and networkalization involve noteworthy challenges with regard to the extraction of relevant data from tremendous information assets, which incorporate network prints for each file.

Processing big NURTD data with comparisons of network metrics offers a significantly effective search procedure within the tourism domain.

An excellent instrument to realize the procedure is Neo4j, which contains a network database platform providing critical enterprise services.

Contrary to relational DBs with static tables, the user deals with a versatile network structure of nodes and links, and as a consequence Neo4j offers benefits, especially in performance.

The networking platform we proposed makes it possible to consider a huge set of interacting elements of the socio-tech-ecological system in order to support its functionality and sustainability.

The point is that the relationship between recreation/tourism development and sustainable socio-economic development exists, but its character has been vague and unclear so far.

Our approach is aimed at clarifying these inner relationships, and thus monitoring and governing the process to support this sustainability. The next step is the formalization of the complex structure of BNT via the networking technique and tools.

Despite the fact that Baikal is in the center of science and practical interests, researchers operate mostly with qualitative and narrative information in order to provide its sustainable governance [56,57].

The comprehensive platform we develop brings more formal quantitative methods and tools to the network format, which is the most effective and efficient for the comparison of diverse entities composed of numerous components. Some cases of the approach were elaborated and demonstrated in references [58,59].

Even such systems like BNT require big data technologies in all respects, however only highly trained experts in the natural sciences use the pertinent approaches and techniques to study Lake Baikal, e.g., in acoustics [60], algae and diatoms in particular [61]. The proposed platform allows to one to convert big data into networks in a wide spectrum of domains, which supports the sustainability of the BNT. These data in a network format may be involved in further considerations, in order to deepen the issue and to provide its multidimensional analysis.

Networking offers a perspective for discerning evidence of threats on regional, national and global levels caused by anthropogenic and natural factors.

An analysis of BNT's safety is of greater value: it demands the preliminary building of a comprehensive network model of the territory, with interconnected components of a social, economic and ecological nature. The next step to develop the current study is to test the model with a series of topological threats, both independent and aggregated [62]. Moreover, a clarification of the threats tourism brings to socio-cultural, economic and environmental components in their interconnection might be of special interest.

5. Conclusions

This study presents a complementary viewpoint for the deeper analysis of regional tourism peculiarities. In this regard the exemplified NLRTD on transportation and NURTD on landscape (being monitored periodically) are of value for regional tourism management. Moreover, these and other data on related industries and activities being transformed into network form give great benefit to the high-performance processing of big data. Management provides for decision makers with timely, sensitive information on the positive and negative trends in diverse regional processes, in their interconnections and interdependencies. After that society as a whole is able to counteract the threats to the sustainability of regional socio-ecological systems.

Such natural territories as BNT comprise socio-economic and ecological elements, and are jeopardized by various factors. In this connection, the system must counteract diverse threats as a whole and provide sustainability. Formal representation of the system as an interconnected multiplex or a stem network will allow one to assess topological vulnerability further. In addition, weak structural components have been found to improve its robustness, and even make the system proactive.

To aggregate all the aforementioned statements, it makes sense to highlight that the performed work justifies as a necessity paying attention to nature and the specificities of network-like data, as well as those structure that look distinct from networks while have a network structure.

The concept encourages a researcher to not avoid or reject all the multifaceted interconnected information, and maintain the network's properties for further processing and application in a chosen domain of tourism as a sensitive component of the socio-ecological system.

Being interdisciplinary, the problem of the sustainability of such complex systems as BNT requires a solution in the framework of a comprehensive network paradigm thus to be explored thoroughly in its multidimensionality.

Finally, we perceive that network representation stimulates experts to focus on intrinsic relationships within the data, in order to make inferences more reliable and robust.

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