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Resilience in the Theory and Practice of Arctic Communities' Adaptation to Environmental Challenges *

¹ Marina V. Nenasheva ✉, Cand. Sci. (Phil.), Associate Professor

¹ Northern (Arctic) Federal University named after M.V. Lomonosov, Naberezhnaya Severnoy Dviny, 17, Arkhangelsk, 163002, Russia

¹ m.nenasheva@narfu.ru ✉, ORCID: <https://orcid.org/0000-0002-2875-5638>

Abstract. The aim of this study is to describe the individual and collective characteristics of the rural population of the Russian Arctic, which determine their vital activity and are internal factors of adaptation to climate change. The scientific novelty of the study consists in describing the phenomenon of resilience on the example of island and coastal communities of the Primorskiy district of the Arkhangelsk Oblast, which are characterized by high natural and socio-economic instability. Based on the empirical data, it is shown that the territorial and socio-cultural integrity of the living space of local communities, the integrality of self-existence and self-consciousness of local residents, cooperative coexistence, as well as proactivity of life support create the foundation for the resilience of local communities and contribute to their social adaptation to the effects of climate change. Particular attention is paid to the issue of understanding the culture of mobility of northern communities in the face of increasing cases of adverse weather events due to climate change. Based on the results of an empirical study, an approach to adaptation to climate change based on the use of the knowledge potential of local communities is proposed. The results of the study can be used to develop the theory of the development of the North of Russia, as well as the development of specific measures for adaptation to climate change at the local level.

Keywords: rural settlement, climate change, adaptation, resilience, Russian Arctic, Arkhangelsk region

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Introduction

In the 20th century, the economic development of the North and the Arctic was one of the priorities of the Soviet state policy [1; 2]. The collapse of the USSR led to qualitative changes in the economic and social structure of the Russian state [3]. The negative consequences of socio-economic transformations in post-Soviet Russia include a reduction in number and a decrease in living standard of the rural population. These trends have been especially strong in the northern regions of Russia, where the social and economic viability of the population has been supported by the state for many years [4].

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In addition to economic difficulties, climate change has been affecting the livelihoods of local communities in recent years [5]. According to the reports of Roshydromet, as well the materials of specialized institutes of the Russian Academy of Sciences, such as Yu. A. Izrael Institute of Global Climate and Ecology, the Arctic is warming twice as fast as other regions of the Earth¹. This conclusion is supported by data from the Intergovernmental Panel on Climate Change².

The consequences of global warming include the reduction of the Arctic ice cover, the earlier opening of most rivers out of ice, the later rate of ice formation, the increase in frequency and severity of meteorological anomalous phenomena arising from climate change, such as fogs, storm winds, floods, avalanches etc. [6]. In turn, the effects of climate change have a negative impact on the socio-economic situation of the northern territories. For example, an unstable or “jumpy” ice condition develops on the northern rivers in spring and autumn, affecting navigation and mobility of local communities of coastal and island territories, which are dependent on a continuous connection with the mainland. The residents of the Russian Arctic are particularly vulnerable to these negative trends [7]. In this regard, the issues of social adaptation to climate change and the development of measures to prevent the consequences of these changes become relevant.

The concept of adaptation was first discussed in detail in natural sciences, where it is traditionally defined as the genetic ability of living organisms to survive in the natural environment under the influence of external factors that emerged in the evolution process. Today, the concept of adaptation is used in various fields of scientific knowledge; there are many definitions and modifications of this phenomenon, which depend on the nature of the adapting objects, the reasons causing the need for adaptation, as well as the adaptation methods and mechanisms. Depending on the system, physical, biological, psychological and social adaptation types are distinguished.

For the purposes of this study, let us refer to the concept of social adaptation, which is understood as the process of person's adapting to various changes that occur in his natural, social, political, and economic environment. The process of social adaptation is well studied in sociology. For example, E. Durkheim characterizes it as an individual process of responding to the impact of external factors, which can be expressed both in adaptation to the environment and in its change [8]. N. Luhmann, the creator of the theory of social systems, defines adaptation as a process of evolution, during which an adapting system adjusts to the environment by complicating its internal structure [9]. The American philosopher E. Toffler considers that any changes, both external and internal, are an ontologically rooted characteristic of human life, therefore adaptation is life [10]. Thus, external factors are decisive in a person's (society's) choice of ways of social adaptation

¹ Доклад об особенностях климата на территории Российской Федерации за 2020 год [Report on climate features in the Russian Federation for 2020]. URL: http://climatechange.igce.ru/index.php?option=com_docman&Itemid=73&gid=27&lang=ru (accessed 25 August 2021).

² Intergovernmental Panel on Climate Change. URL: <https://www.ipcc.ch> (accessed 27 August 2021).

to changing conditions. At the same time, the process of adaptation is influenced by subjective factors associated with the values of a person and society, their interests and goals.

In the 1930s, in connection with the active development of the North and the Arctic by the Soviet state, the study of the problem of human adaptation in the northern conditions began [11]. Then, in the 1960–1980s, due to the creation of large industrial and production complexes in the Far North, the issues of human adaptation to the conditions of the Far North were addressed by researchers under the guidance of Academician V.P. Kaznacheev [12]. Z.P. Sokolova is one of the authors who has examined in detail the problem of adaptation of the peoples of the North in nature and society. In work “Adaptive properties of the culture of the peoples of the North”, the author singled out the dependence of people and their life activities on nature as one of the adaptation aspects [13]. The researcher points out that for many centuries, the northern people created a special folk culture (as a set of material and non-material (spiritual) subsystems), which allowed them to adapt to harsh natural conditions [13]. Subsequently, other Russian authors pointed out the adaptive properties of the culture of the peoples of the North, emphasizing that during the entire period of human development, culture allowed to maintain the stability and sustainability of society [14].

It is important to note that despite the growing attention to the theory of social adaptation, there is no consensus among researchers concerning its definition. This is due to the fact that human adaptation is carried out in different ways and is often a manifestation of individual qualities in a changing natural environment and in everyday life. Adaptation can go both passively (tolerant type), by adapting, subordinating to adverse environmental factors, and actively (resistant type), by resisting negative external factors and developing mechanisms to preserve vital functions. The fundamental point in consideration of social adaptation is that the existence of a person as a social being is often abstracted from the outside world, so this process is not so much about the natural environment but about the adaptation of the environment to human needs [15, p. 201–212]. A person changes his attitude to the environment in order to make it a place suitable for life. Man observes nature, forms knowledge and then uses this knowledge for his own purposes for his life support. The advantage of this approach of considering social adaptation is that it provides the potential to study the place-specific abilities of the population to adapt to the negative consequences of these changes.

In 1992, when the United Nations Framework Convention on Climate Change was created, the concept of adaptation was also applied to responses to climate change, focusing on the individual and collective capacity to reduce vulnerability caused by the effects of changing weather patterns. This aspect of adaptation, which in foreign literature is expressed by the term “resilience”, is becoming increasingly relevant for the northern territories and the Arctic due to global climate change. In fact, it represents adaptive capacity — “the ability of a system to adapt to climate

change in order to mitigate potential damage, use existing opportunities or cope with the consequences" [16].

Russian studies of the concept of resilience in the context of socio-economic and environmental problems are still limited [17; 18; 19; 20; 21]. They are mainly focused on the content of the concepts of resilience, urban resilience, regional resilience and practically do not affect the features of resilience at the local level in relation to certain factors, for example, the resilience of rural settlements in the northern territories in the context of climate change. In their works, researchers note the substantive difference between the concept of "resilience" (or, "resistance", "shock resistance", "viability"), from the concept of "sustainability" [21]. The concept of "sustainability" or "sustainable development" was developed in the late 1980s in connection with the growth of environmental problems and the need to develop new approaches to the harmonious co-development of the economy and society without harming the natural environment [22]. In turn, resilience is the ability of a system (for example, natural, social) to anticipate and resist, adapt and respond, and recover in response to external influences [21]. Such an expanded understanding places emphasis on a particular approach to the phenomenon of resilience — socio-cultural, which makes it possible to conduct various quantitative and qualitative assessments. Based on the assessment of the degree of impact of external factors, the degree of vulnerability of the system, the adaptive capacity of the system, it is also possible to develop strategies and measures for adaptation to climate change at different levels: global (on a global scale), regional (at the level of macroregions), national (at the state level), local (at the county, municipality level). It is worth noting that, so far, in the Russian Arctic, the response adaptation is most common, which is expressed in taking measures to address the consequences of climate change after they have been discovered.

In this article, we propose to address social adaptation to climate change by examining the livelihoods of the people of the island and coastal regions of the Russian North, and by looking at how resilience to the challenges of nature is manifested in practice. The relevance of the task is determined, firstly, by the fundamental nature of the problem of the socio-cultural organization of the northern territories and the insufficient study of the concept of the resilience of the rural population as the ability to withstand external influences; secondly, the need to create a new theory, as well as a model for the development of the northern and Arctic territories based on the study of the potential of local communities [23]; and thirdly, the significance of the research results for the modern development of the territories of the Russian Arctic.

Materials and methods

The Arkhangelsk Oblast includes several districts of the Arctic zone of the Russian Federation. Among them is the Primorskiy district, which includes islands in the delta of the Northern Dvina river and coastal areas of the summer and winter shores of the Onega Peninsula of the

White Sea. In summer 2019–2021, sociological studies were conducted in the settlements of these territories (hamlets: Kegostrov, Konetsdvorye, Lastola, Pustosh, Vyselki, Odinochka, Andrianovo, Pushhlakhta, Letnyaya Zolotitsa, Letniy Navolok, Lopshenga, Yarenga; villages: Voznesenye and Pertominsk) to collect data about the socio-cultural organization and lifestyle of local communities, identifying and describing the individual and collective characteristics of their life, social perceptions and expectations regarding the needs, prospects and acceptable ways of developing rural space in a changing climate. It should be noted that on the coast of the White Sea, complex field studies had significant limitations, consisting in difficult transport accessibility of coastal settlements.

The empirical study was carried out using the method of qualitative semi-structured interviews with local residents. The selection of respondents and the survey was carried out using the “snowball” method, when the respondents, selected at random (in households, on the streets, in grocery stores, at the post office, in the local administration), suggested other potential candidates for the study.

Table 1

The number of interviews conducted in settlements of the island and coastal territories of the Arkhangelsk Oblast in 2019–2021

No.	Settlements of the island and coastal territories of the Arkhangelsk Oblast	Number of interviews
1	Kegostrov	7
2	Pustosh	2
3	Vyselki	2
4	Odinochka	2
5	Voznesenye	8
6	Andrianovo	1
7	Lastola	4
8	Konetsdvorye	3
10	Pushlakhta	7
11	Letnyaya Zolotitsa	6
12	Letniy Navolok	1
13	Lopshenga	9
14	Yarenga	1
15	Pertominsk	4
Total		57

Almost all interviews, with the exception of cases where the respondents refused to talk using audio equipment, were recorded, transcribed and analyzed. In addition to interviewing, the study used a simple, non-standardized real-time observation of the everyday life of villagers. The materials obtained during the expeditions were supplemented with secondary data, namely historical information on the development of the islands and coastal territories of the Primorskiy district of Arkhangelsk Oblast, ethnographic and statistical data on population composition and size, data from scientific reports on climate change, as well as social information from the media.

Results

The hamlets of Konetsdvorye, Lastola, Pustosh, Vyselki, Odinochka, Andrianovo and the village of Voznesenye are located on the islands of the Northern Dvina River delta and are part of the Ostrovnoe municipality of the Primorskiy municipal district of the Arkhangelsk Oblast. They are the largest settlements with a permanent population remaining on their territory. In total, Ostrovnoe municipality includes 49 settlements. As of January 1, 2019, the indigenous population of Ostrovnoe municipality was 1896 people. According to official data, no population census is conducted for the individual villages of the municipality. This information was confirmed by a representative of the local administration, according to whom “the population has not been registered since 2014, because these powers were transferred to the passport office, which does not have these data”.

Historically, the territory of the Northern Dvina delta islands was inhabited by the Verkhovenskiy Pomors (who lived in the upper reaches of the northern rivers), the mention of whom dates back to the 12th century. According to the All-Russian population census, in 2010, 504 people who identified themselves as Pomors lived in Primorskiy district of Arkhangelsk Oblast, which includes Ostrovnoe municipality³.

The geographical feature of the island territories is their remoteness from the regional center and limited transport accessibility. During the navigation period from early May to late October, the connection between the islands and Arkhangelsk is maintained by regular river transport, and in winter — via ice crossings or winter roads, which the locals call “roads of life” [7].

The hamlets of Pushlakhta, Letnyaya Zolotitsa, Letniy Navolok, Lopshenga, Yarenga and the village of Pertominsk are located along the coast of the Onega Peninsula of the White Sea. Geographically, they are also part of the Primorskiy district of the Arkhangelsk Oblast. The White Sea coast was settled during the 12th–17th centuries as a result of Novgorod colonization and foundation of monasteries. Since ancient times, these territories were inhabited by Pomors, whose main occupations were navigation, sea fishing, and salt production [24]. After the collapse of the Soviet Union, the population decreased considerably.

Table 2

Size of the permanent population of the island and coastal territories of the Arkhangelsk Oblast

No.	Name of the settlement	Population as of 01.01.2021 (people)
1	Pustosh	221
2	Vyselki	25
3	Odinochka	30
4	Voznesenye	412
5	Andrianovo	23

³ Distribution of the population by the most numerous nationalities in the Arkhangelsk region according to the results of the 2010 All-Russian Population Census. Office of the Federal State Statistics Service for the Arkhangelsk Region and the Nenets Autonomous Okrug. URL: <https://arhangelskstat.gks.ru/search?q=поморы> (accessed 18 July 2021).

6	Lastola	432
7	Konetsdvorye	31
8	Pushlakhta	31
9	Letnyaya Zolotitsa	102
10	Letniy Navolok	5
11	Lopshenga	187
12	Yarenga	74
13	Pertominsk	245

The traditional occupations of the indigenous population of the islands are fishing and collecting wild plants. The extraction of algae is developing on the coast of the White Sea, and hunting for sea seals is being developed in the village of Letnyaya Zolotitsa. During the Soviet period, agriculture was well developed on the island and coastal territories of the Arkhangelsk Oblast. With the transition to a market economy, the collective farms went bankrupt. Today, agriculture, fishing, sea animal and algae harvesting are carried out by private farm enterprises, the number of which has noticeably decreased in recent years. Thus, in the early 2000s, there were 22 private farms in Ostrovnoe municipality, today there is only one in the hamlet of Andrianovo. In Letnyaya Zolotitsa hamlet, there is a fishing collective farm and a private enterprise for the extraction of White Sea algae; the local residents of Pushlakhta harvest firewood for the needs of the Solovetsky Monastery. Each of the surveyed villages, with the exception of the hamlet of Letniy Navolok, which has a permanent population of only 5 people, has a small general store, and some of them have a post office.

Most households have small boats — small rowing and motor boats that are used by local residents to travel to neighboring villages: to visit, to relax, to pick mushrooms, berries or to go fishing. As one respondent noted, “private boats for locals are like a car for the population in the city”. A resident of the Vyselki hamlet confirms: “A steamboat goes here, and residents from other distant villages — Kalchino, Zalakhati — come to us in the winter with sledges for shopping, and in summer they come by boat”.

According to respondents, navigation plays an important role in the life of Pomor villages. In the Soviet years, the regularity and frequency of river transportation of passengers was supported by the state. “The ship used to run every half an hour”, notes one of the respondents. With the transition to a market economy and the massive outflow of the rural population to the cities, river transportation became unprofitable and is maintained at the expense of subsidies from the local budget.

In recent years, climate change has affected navigation conditions. Based on personal observations, the majority of respondents noted that winters used to be colder, but now they are milder, everything melts faster. Climate warming results in shifting the opening and closing dates of navigation, as well as cases of forced opening of navigation in December and January. According to an official representative of the Arkhangelsk River Port, “while the opening of navigation traditionally takes place at the end of April or the beginning of May, its closure depends on the actual

onset of winter, but the timing of the opening of navigation has not changed significantly over the past 20 years. However, in recent years, navigation had to be opened in winter for several days or weeks after they were closed due to winter thaws". Despite the stability of passenger ships, residents report cases of cancelled voyages due to storms, ice conditions and fog. Forced closure of navigation due to storms and fogs occurs in the autumn season, but can also occur in the summer.

During the winter season, weather fluctuations often result in the occurrence of mudflows, which often cut off the inhabitants of the islands and the White Sea coastline from the mainland. In recent years, thaw has become a frequent phenomenon due to noticeable changes in climate and ice conditions occurring in the autumn-spring period. "Before, muddy weather took two to three weeks, but now it takes up to two months," said one of the residents. In autumn, the thaw lasts from the day when passenger ships stop moving on the river until the river ice becomes safe enough for winter roads to open, and vice versa in the spring. For example, in 2019, stable ice formation was not observed until the New Year⁴. During the thaw, communication with the islands is carried out by ice-class passenger ships — tugboats. Changes in the ice conditions have a significant impact on the livelihoods of the population of Pomor villages: "During the thaw, we are cut off from life for two weeks, or even a month."

The situation is even more dramatic in the villages located on the Onega coast of the White Sea. During the navigation period (from May till the end of September), passengers and cargo are transported to the villages of the summer and winter coasts of the Onega Peninsula once a month by the Belomorye motor ship. During the thaw, the population of seaside villages is "cut off" from the mainland for a long time, so from the beginning of autumn to the beginning of spring navigation, local residents try to leave for the cities. For those who stay in villages for the winter period, communication and delivery of the necessary goods is carried out through winter roads by snowmobiles.

Climate change affects not only the mobility of the Pomor population, but also traditional economic activities, such as fishing. Residents of the White Sea coast have noted a significant warming of sea water in recent years. It causes migration to the north of such cold-blooded fish species as cod, which seriously affects the possibility of its recreational fishing. At the same time, villagers notice that in recent years, there has been an increase in the population of pink salmon, which "used to come to spawn once every four years, and now — once every two years". This fact was also recorded in the territory of indigenous peoples in the Nenets Autonomous Okrug [25].

As the surveys have shown, most of the rural population is anxious about unpredictable changes in navigation conditions, as well as the lack of measures to support public mobility in the form of regular water, land and air transport, as well as transport infrastructure. As rightly noted

⁴ Zhiteli Pomor'ya ostanutsya bez ledovykh pereprav do Novogo goda [Residents of Pomorye will be left without ice crossings until the New Year]. Rossiyskaya gazeta, 2019. URL: <https://news.rambler.ru/other/43372591-zhiteli-pomorya-ostanutsya-bez-ledovykh-pereprav-do-novogo-goda/items/> (accessed 20 December 2019).

by A.N. Pilyasov, this is due to the fact that a significant part of the population of the North of Russia has an “innate desire for mobility”, which is not only an important component of the culture and life of northern communities, but also the basis for overcoming peripheries and reducing the sense of isolation and detachment of territories from the rest of the country [26].

Changes in the conditions of mobility and traditional economic activities due to climate warming necessitate social adaptation of the inhabitants of the island and coastal territories in the Primorskiy district of the Arkhangelsk Oblast to new natural challenges. To date, social adaptation of local communities is usually a “response” to climate challenges that takes place after the effects of climate change have been discovered, and it is usually associated with adaptation of individuals, households or local authorities.

After analyzing the results of the empirical study, we identified the following factors that form the basis of community resilience and contribute to social adaptation to the impacts of climate change:

1) The system of natural, individual, socio-cultural and spiritual values of local residents that has developed over the years, which is decisive in choosing strategies for further actions. These include “connection with the parental home, village”, “modest beauty of nature”, “peace and quiet”, “solitude”. The results of the interviews showed that despite difficult economic conditions and limited transport accessibility, local residents do not want to leave their native villages. Closeness to nature, memories of a past life, as well as the hope for village revival keep them in their native lands. In most of the surveyed villages, we met initiative citizens who play an important role in maintaining the socio-cultural life. As a rule, these are people who were born and lived all their lives in their native village. Being retired, they are engaged in the revival and preservation of the history and culture of their native village, and also solve many organizational issues of the socio-economic life of residents. The integrity of the social and cultural structure of local communities increases the ability of local people to adapt to external influences.

2) The social collectivity of the local population. Most inhabitants of island and coastal territories are characterized by special forms of social organization, the main features of which are social community that ensures close ties and contacts of local residents, as well as special forms of human communication, significantly different from those that are formed in urban culture. In the village, social groups and collectives have more or less explicit control over all aspects of the livelihood of its inhabitants. The “village” is characterized by openness of communication: everyone’s private life is visible at a glance. The consciousness of rural residents is formed with this “transparency” of behavior in mind; it is subject to direct regulation by society and is strongly oriented towards the opinion and assessment of its members. The basis of survival is personal connections, as well as a circle of friends and relatives, which contributes to a sense of security in a situation of uncertainty. In conditions of limited and unstable transport communication, remoteness of territories, social community and mutual assistance allow maintaining constant transport mobility of

rural residents, which is based on personal (good-neighborly) ties. The interviews with respondents show that in summer, in case of cancellation of the regular riverboat trip, the residents of the Northern Dvina river delta island territories use the services of acquaintances, private carriers who have small vessels to get to the city. On the coast of the White Sea, private motor boats are currently the only means of transporting local residents along the White Sea.

3) Preventive life support. During the Soviet era, there was a well-developed system of “northern delivery” of food, industrial goods and energy resources. With the transition to a market economy, state support for the northern regions was curtailed. Today, local residents of the island and coastal areas in most cases ensure their own food, industrial and energy security by planning the delivery of necessary products, goods and energy resources in advance. An important source of livelihood is subsistence farming, coastal fishing and harvesting of wild plants. In addition, the islands are supplied with food and manufactured goods by individual entrepreneurs with small shops in the larger villages. The consumer basket is formed according to the requests of the residents: “In winter, the villagers order canned food, frozen foods and juices”. In summer, the store sells freshly caught and slightly salted fish, berries and mushrooms, which the locals deliver for sale. From conversations with shopkeepers, we found out that in recent years, climate change has had a negative impact on the supply chain of goods to the islands. Since the period of thaw has increased significantly, supplies are stocked for at least a month in the spring before the rivers are cleared of ice and in the autumn before the freeze-up. In the coastal villages of the White Sea, a significant role in the supply of goods is played by the Union of Consumer Societies of the Arkhangelsk Oblast, which has small shops in Pomor villages. From a conversation with the seller of one of the stores, we have learned that in summer, goods are imported once a month on a ship that belongs to the fishing collective farm, and in winter — on snowstorms. During a thaw, a store can be left without food for a month or even two.

4) Reliance on the experience of observing weather and natural conditions. Conversations with respondents revealed that locals often lack official information about weather and natural conditions to make decisions about river, sea trips or traditional fishing activities, so they often use knowledge based on their own observations of natural phenomena to determine navigational conditions. It should be noted that historically the life of the Pomors, who inhabited the riverine and coastal territories of the Arkhangelsk Oblast, was closely connected with navigation along the northern rivers and seas. Systematic observations of the natural environment led to the accumulation of practical knowledge about the dependence of navigation on weather conditions, which was passed down from generation to generation and was an element of traditional Pomor culture. The interviews with modern Pomors clarified that local residents still use knowledge based on their own observations of natural phenomena (the state of water bodies, tides, wind direction) to determine navigation conditions and engage in traditional crafts. “Those who live on the islands don’t need any tips, as we know what will happen tomorrow by the color of water,” said a resi-

dent of the Pustosh hamlet, answering a question about how the local population determines when the ice is melting or forming. She continued: "The people who live here have kept records since ancient times, analyzing and documenting everything. They were family sailing pilots, but today people keep notebooks and just study the weather: on such and such date the river has risen, on such and such date it has opened up". Local knowledge of the weather is used not only for forecasting, but also to cope with dangerous weather conditions as they arise, especially far from settlements when updates of official forecasts are not always available due to the fact that cellular phones do not receive signals. For example, in the hamlet of Lopshenga, one of the fishermen said that when they are in the sea and such a natural phenomenon as a "wall in the sea" appears, then "one should immediately swim away, because there will be either fog or a storm". Local knowledge of weather and natural conditions was found to be usually the result of systematic observation of the natural environment, comparing it with already existing knowledge and testing it in a specific location. In most cases, this knowledge is individual, not collective. They are recorded, preserved by individual modern residents of Pomor villages due to the existing long-term tradition and, in combination with official meteorological data, are used to predict and overcome dangerous weather and natural conditions. Of course, we are not suggesting that folk knowledge of weather can be considered as recommendations for making significant management decisions (this would be too bold and even dangerous), but they may be complementary to scientific knowledge and combined with official data to develop strategies for adapting to changing environmental conditions. For example, scientific meteorology can use people's knowledge of weather conditions to add empirical material on the current state of natural features (such as ice conditions) that are beyond official instrumental observations. Such examples already exist in other Arctic countries. For example, the Regos Internet platform in Norway (<https://www.regobs.no/>) allows local residents to register their environmental observations through a special application on a phone or personal computer. These observations are then used by national services to generate more specific forecasts and rapid notifications of possible changes in the natural environment. Despite the positive examples already available in world practice, questions about the objectivity, methods of assessment and applicability of local knowledge for predicting natural phenomena remain open. In order to address these issues, Canadian researchers propose setting up advisory groups to discuss how local weather knowledge can be incorporated into instrumental meteorological observations [27].

In summary, we were unable to identify any regularity in the mobility patterns of local people in a changing climate. When planning or carrying out river or sea trips, modern Pomors use rather situational and reactive approaches, starting from specific weather and natural conditions. At the same time, it was noted that local residents take a proactive approach to food security. Without thinking about the reasons, locals are increasingly recording the facts of changing navigation conditions due to climate warming, which gives them, in particular, grounds for making deci-

sions on creating stocks of food and other goods for the period of possible lack of water communication with the “mainland”.

Discussion and conclusions

As follows from the results of the study, the scientific task set is complex. It involves a wide coverage of the studied objects, phenomena and processes, starting with the analysis of various theories and models of the development of northern spaces in the historical perspective and at the present stage, studying the current socio-economic state of northern communities, climate change and their consequences, and ending with the development of the concept of resilience, social adaptation and the development of specific measures for adaptation to climate change at the local level. For this purpose, we turned to the socio-economic life of the riverine and coastal communities of the Arkhangelsk Oblast, which have not been systematically studied since the 2000s. Using the example of the life of rural island and coastal settlements of the Primorskiy district, we have shown that they are characterized by high socio-economic instability, which is expressed in the absence of industrial production, jobs, and, as a result, in depopulation. Despite economic and demographic changes, the island and coastal territories of the Primorskiy district of the Arkhangelsk Oblast still retain a permanently residing population. Basically, these are residents of retirement age who were born and raised on the islands and the coast, have similar historical destinies and socio-economic status, and are also interconnected by the duration of neighborhood and communication. Many of the indigenous people with whom we were able to talk identify themselves as Pomors, explaining this by the presence of ancestors who were engaged in traditional Pomor types of economic activity, as well as by many years of connection with the Pomor land, which was reflected in their own worldview and perception of themselves as Pomors.

Modern Pomors, like their ancestors, continue to engage in traditional economic activities: fishing, collecting wild plants, growing vegetables, but the results of this activity do not fully cover their daily needs. In this regard, the dependence of the island population on navigation and communication with the “mainland” remains high. However, due to the lack of a developed road and limited water communication, the island and coastal territories of the North of Russia are actually on the “periphery” of innovative economy and social life [28].

In addition to socio-economic challenges, climate change has been affecting the livelihoods of local communities in recent years. These changes are expressed in weather fluctuations, which make adjustments to the traditional ways of life and mobility of the Pomors. That is why the issue of adaptation of local communities to climate change is so acute, the answer to which is proposed to be sought at the local level, at the core of social organization and the foundation of the resilience of Arctic island and coastal communities. These include the territorial and socio-cultural integrity of the living space of local communities; the habituality, the traditional way of life that has been formed over the years, which determines the integrality of the self-existence and self-

awareness of local residents; cooperative coexistence, proactive life support, and reliance on traditional knowledge. The listed aspects of resilience allow modern Pomors to survive in the conditions of external challenges, and it is the survival that is expressed in slow but constant adaptation to natural and socio-economic fluctuations. This adaptation is manifested, among other things, in the presence of a hidden (not immediately obvious to an outside observer) network social organization of island and coastal communities, but modern Pomors find ground for existence in such social structure (they are “alive and strong in peace”). These factors determine the peculiarities of planning and implementation of local mobility between villages (through personal ties), the supply of food and industrial goods, the study of which is especially important in the context of strategic plans for the development of the Russian Arctic and climate change. Obviously, in the context of global natural challenges, the so-called centralized, collective mobility is possible only if there are specific measures to adapt to the consequences of climate change. The literature analysis showed that Russia has strategic plans for the development of transport infrastructure in the context of climate change⁵, but they do not take into account the real-life practice of the northern communities, which actually turned out to be “face to face” with natural challenges. In our opinion, innovative approaches to the organization of local transport communication in the new environmental conditions should be based on the study and understanding of the mobility of local communities, and, in particular, on the use of their knowledge potential and its further incorporation into existing strategies and plans for adapting to external challenges. The main advantage of local knowledge is that it can contribute to decision-making about potential environmental and climate impacts on local communities, because such forms of knowledge are directly relevant to specific places and situations. In addition, local knowledge may well complement scientific knowledge and can be used to develop strategies for adapting to changing environmental conditions.

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