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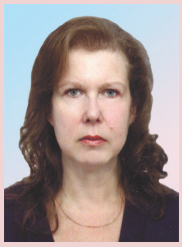
Several approaches to the determination of the southern border of the Arctic zone of the Russian Federation



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The article presents a research into the approaches to the zoning of the Russian Federation aimed at defining the southern border of the Arctic zone. The conducted analysis of legal documents and scientific literature devoted to the substantiation of the Arctic zone revealed the lack of definite criteria for determining the list of territories included in this zone. As a result of the research, several recommendations have been worked out that substantiate the inclusion of specific administrative-territorial formations of the Russian Federation in the Arctic zone.

Arctic zone of the Russian Federation, region, zoning, criteria.

Arctic territories, which possess significant natural resource potential, enjoy heightened attention on the part of international community. Several major world powers link their strategic economic development and the enhancement of their geopolitical position to the development of the unique Arctic resources. This has led to intensifying the activities aimed at the improvement of the legislative framework for regulating the development of the Arctic territories In Russia this process was accompanied by the adoption of such documents as the "Fundamental principles of state policy of the Russian Federation in the Arctic up to 2020 and for further outlook" [23] and the "Strategy for the development of the Arctic zone of the Russian Federation and provision of national security" [29]. However, the Arctic zone of the Russian Federation, being the object of state regulation, still has no clearly defined territorial boundaries. Over the last 15 years several attempts have been made to legally establish the southern border of the Arctic zone of Russia; as a result, the territorial composition of the zone was constantly changed. In our opinion, one of the key reasons for this situation lies in the absence of a scientifically grounded approach to defining a clear set of criteria that will make it possible to determine the borders of the Arctic zone of the Russian Federation. The complexity of the problems identified, and the importance of their solution for the socio-economic development of the Arctic territories prove the relevance of this study, the purpose of which is to substantiate the approach to the determination of the southern border of the Arctic zone of the Russian Federation.

Domestic and foreign research practice has several approaches to the zoning of the Northern territories and the allocation of the Arctic zone.

Scientific substantiation of the zoning of the Northern territories of the USSR was carried out by S.V. Slavin in the 1930s; he suggested a zoning scheme that takes into account two categories of characteristics: natural and climatic, and economic and geographical. According to S.V. Slavin, the North includes the sparsely populated and underdeveloped regions located to the north of economically developed regions that were settled long ago. S.V. Slavin defined the most important features of the North as follows: low population density (less than 5 people/km^2), and the severity of climatic conditions that restricts the cultivation of crops. Depending on the degree of manifestation of these characteristics, the North is divided into the Near North and the Far North [26, 27].

Attempts to zone the Northern territories were made in the works of foreign researchers. For instance, in 1955 some research work of the American Geographical Society considered that the North included not only the high-latitude territories of the USSR, but also the south of Siberia, the Leningrad Oblast, and some territories in the south of Canada. In 1950–1970 foreign researchers (K.J. Ree, R. Gaida) adhered to the territorial-administrative principle and determined the Northern territories as those located above the latitude of 60 degrees [28]. In 1964 Canadian researcher L.-E. Hamelin used quantitative scores to determine 6 natural geographical and 4 economic

geographical characteristics of zoning; on this basis he defined the Middle North, the Far North and the Extreme North [7].

T. Armstrong, G. Rogers and G. Rowley in their fundamental work point out that the North comprises the geographically determined Arctic and Sub-Arctic. In such a broad sense, the North occupies 5% of the world ocean and 15% of Earth's land [1].

According to the plans for the development of the Arctic elaborated in the United States in the mid-1980s, the Arctic territories comprise the regions located to the north of the Arctic Circle (66,33'N).

V.S. Selin and V.V. Vasilyev [28] argue that currently the most scientifically grounded foreign approaches to the zoning of the Northern territories are developed for enhancing the implementation of regional policies (for example, subsidization of territories in Sweden).

The "Regulations on isolated settlements" [17] adopted in Canada in 1991 provide for the benefits and allowances to the employees of organizations operating in the Arctic and Northern Canada. The document considers the following groups of allowances: for the quality of the environment, for the difference in the cost of living, cost of fuel and communal services, for the special location and temporary separate residence.

The analysis of several approaches to the zoning of the territory and to the allocation of the Arctic zone made it possible to define the following approaches: astronomical, climatic, physical and geographical, bioclimatic, economic, administrative, medical and biological, and integrated.

The astronomical approach uses the Arctic Circle (66,33'N) as the main criterion for allocating the Arctic zone [20].

According to the climatic approach, the recommended criteria may be as follows:

– isotherms of the warmest month +10°C [15];

– the Nordenskjold criterion (the ratio of the temperature of July to the temperature of the coldest winter month) [24];

– radiation balance 10 kcal/cm^2 [31] or 15 kcal/cm^2 per year [18, 19];

– general climatic indices that take into account wind velocity in the cold period, average air temperature and the amount of precipitation during the cold period [5];

– summer position of the arctic climatological front [2].

The physical and geographical approach defines the Arctic zone using the basic parameters of landscapes, and it determines the southern border of the Arctic along the southern border of tundra [12, 13].

The bioclimatic approach is based on the concept of stress, which occurs under the influence of the environment due to the lack of solar radiation, the prevalence of low air temperatures with harsh wind, high humidity and high probability of snow in summer, lack of woody and shrub vegetation [20]. By applying this approach, one can define the boundary of the Arctic zone by the total bioclimatic index, which includes the index of heat content, Bodman's weather severity index, the index of moist wind cooling for the monthly average characteristics of the climate in winter (January) and transitional seasons (the average between April and October). The authors of this approach distinguish the High Arctic and the Subarctic.

In the framework of the bioclimatic approach we should also consider the method of zoning proposed by O.R. Nazarevskiy. According to this method, the parameters of natural environment are considered from the point of view of assessing the natural living conditions of population. All parameters are divided into extra-climatic (length of day and night, annual amount of solar radiation, height above sea level, depth of relief dissection, seismicity, etc.) and climatic (temperature

regime in winter and summer, duration of extreme period, intensity of wind, etc.) conditions [21].

The bioclimatic approach, in our opinion, should include the zoning of the Northern territories proposed by A.N. Krenke and A.N. Zolotokrylin. The zoning is based on the zonal and azonal criteria of discomfort of climatic living conditions. As a result of the further refinement of the approach, the authors (A.N. Zolotokrylin, A.N. Krenke, V.V. Vinogradov) suggested a modern system of independent (or loose) indicators. In addition, they substantiated the threshold values of indicators for defining the southern border of the North zone and determined the zone of absolute discomfort in Russia's North [10, 11].

To determine the boundaries of the Arctic zone, some authors also recommend the bioclimatic index of severity of weather conditions (BISWC), which takes into account the set of climatic indicators: air temperature; wind speed; humidity; atmospheric pressure; the level of direct solar radiation. In this case, the Arctic zone (the Arctic North) is the area, for which the BISWC values are 4–4.99 points [28].

The economic approach to the zoning of territories takes into account the priority strategic guidelines of the socio-economic development of individual regions. Thus, I.S. Gramberg, I.A. Dodin and others, on the basis of regularities of location of mineral deposits, defined the boundaries of Russia's segment of the Arctic planetary mineragenic belt with a list of territories included in the Arctic zone [3].

The administrative approach is used to substantiate the Arctic zone in legal and regulatory documents that define the socio-economic development of the regions included in this zone. Over the decades of formation of the legislative base, there was no unity in the substantiation of the list of regions included in the Arctic zone and, in our opinion, there was no scientific criteria for their selection.

According to the Decision of the State Commission under the Council of Ministers of the USSR on Arctic Affairs dated April 22, 1989 (hereinafter – the Decision), we can assume that the access to the seas of the Arctic Ocean has become the main criterion for inclusion of territories in the Arctic zone. However, judging by the composition of administrative-territorial units of the Arctic zone, this approach has not taken into account those territories that have access to the White Sea of the Arctic basin. As a result, the territory of the Murmansk and Arkhangelsk oblasts and Karelia Republic were not included in the Arctic zone. Due to the changes in the administrative-territorial division and the creation of municipal formations within Yamalo-Nenets and Chukotka autonomous okrugs (that are now fully included in the Arctic zone in compliance with the Decision), several land-locked municipal districts turned out to be outside this zone.

The same flaws have been noticed in a number of documents based on the Decision:

– the draft Concept for sustainable development of the Arctic zone of the Russian Federation [16];

– the fundamentals of the state policy of the Russian Federation in the Arctic until 2020 and for further perspective [23];

– the strategy for the development of the Arctic zone of the Russian Federation and provision of national security [29].

The draft Federal Law "On the Arctic zone of the Russian Federation" [22] leaves the composition of the Arctic zone areas the same, and includes two cities of the Murmansk Oblast (Severomorsk and Polyarny).

The subsequent versions of the draft federal laws "On the Arctic zone of the Russian Federation", initiated by Goskomsever (State Committee of the Russian Federation for Issues Relating to the Development of the North) (1999) and by the Federation Council (1998, 1999), have not defined clearly the criteria

for including the territories in the Arctic zone. According to the draft laws, the Arctic zone of the Russian Federation, in addition to the territorial entities that were defined by the State Commission under the Council of Ministers of the USSR on Arctic Affairs on April 22, 1989, included the city of Krasnoyarsk (Krasnoyarsk Krai), Koryak Autonomous Okrug of Kamchatka Krai, Pinezhsky and Leshukonsky districts of the Arkhangelsk Oblast. These territories are located to the south of the Arctic Circle and they do not have access to the Arctic Ocean.

In our opinion, the draft Federal Law "On the Arctic zone of the Russian Federation" dated January 23, 2013, worked out by Russia's Ministry of Regional Development, tried to use two main criteria for including an area in the Arctic zone: location of the territory on the coast (basin of the Arctic Ocean), and to the north of the Arctic Circle. However, some administrative and territorial units, a significant part of which lies to the north of the Arctic Circle, like Evenkiysky District of Krasnoyarsk Krai, Ust-Tsilemsky, Usinsky and Intinsky districts of the Komi Republic, were not included in the Arctic zone of Russia.

The medico-biological (physiological) approach to the zoning of the Northern territories substantiates the criteria (factors) that have significant biological effect. The authors point out the sharply negative impact of adverse factors on physiological development, metabolism, immune system of people living in the North [8, 9, 30].

The integrated approach makes it possible, in our opinion, to consider the various aspects of discomfort that are experienced by people living in the North: natural and climatic, economic and geographic, socio-economic aspects, and the risk of living [28]. The approach takes into account the natural and climatic conditions of the North, as well as the socio-economic specifics inherent to the Northern regions.

The complexity principle strengthens the credibility of the results; however, the use of social and economic factors requires regular updating of the indicators and clarification of boundaries of the zones. In addition, it is methodologically difficult to take into account the combination of natural, social and economic indicators. The advantage of this approach consists in the fact that it defines the Arctic zone in the zone of absolute discomfort in the North.

The analysis of different approaches that define the Arctic zone and its southern border allows the authors to make a conclusion that the application of these approaches is associated with certain difficulties, when the definite list of the territories included in this zone is established by law. It is very important to apply such key criterion as the discomfort of life of the population when defining the Arctic zone. Nevertheless, the presence of the territories that are geographically remote from the Arctic and that possess severe climatic conditions restricts the application of this criterion to a certain extent and leads to an insufficiently reasonable extension of the Arctic borders (e.g. high-altitude areas in the Central and Southern part of Siberia). The set of basic criteria that combine geographic and economic characteristics, proposed by the authors, makes it possible to include a given territory in the Russian Arctic clearly and unambiguously.

The basic criteria for defining the Arctic zone of the Russian Federation include the following: the Arctic Circle, access to the waters of the Arctic basin, the connection of administrative-territorial units to the water area of the Northern sea route.

To determine the composition of the territories of Russia's Arctic zone we suggest the basic criteria, taking into account the following methodological regulations:

– compliance with the principle of integrity (indivisibility) of administrative-territorial entities when carrying out the zoning;

– compliance of the administrative-territorial unit with at least two of the basic criteria.

The use of the *Arctic Circle* as a criterion for determining the southern border of the Arctic is well-established in science and is often used by Russian and foreign researchers [20]. The Arctic zone, according to the approach that we suggest, includes the territories located to the north of the Arctic Circle (66°33′N), and also those administrative-territorial units that are crossed by the Arctic Circle.

According to this criterion, the Arctic zone of the Russian Federation includes the following administrative-territorial units:

– Murmansk Oblast (all of its administrative-territorial units);

– Yamalo-Nenets, Nenets and Chukotka autonomous okrugs (all of their administrative-territorial units);

– Komi Republic (Ust-Tsilemsky, Usinsky, Vorkutinsky, Intinsky districts);

– Krasnoyarsk Krai (Taimyrsky, Dolgano-Nenetsky, Evenkiysky and Turukhansky districts);

– Republic of Sakha (Anabarsky, Bulunsky, Ust-Yansky, Allaikhovsky, Nizhnekolymsky, Zhigansky, Abyysky, Srednekolymsky, Verkhnekolymsky districts, Olenyoksky Evenkiysky National District, Verkhoyansky, Eveno-Bytantaysky, Momsky districts).

The access of the administrative-territorial unit to the waters of the Arctic Ocean is another basic criterion for inclusion of the territory in the Arctic zone.

The disadvantage of this criterion consists in the fact that some municipalities that are actually located inside the districts with access to the waters of the Arctic Ocean, turn out to be outside the Arctic zone of Russia (for example, some of the closed administrative-territorial formations (CATF), urban districts).

According to this criterion, the Arctic zone of the Russian Federation includes the following administrative-territorial entities:

– Murmansk Oblast (Kandalakshsky, Kolsky, Lovozersky, Pechengsky, Tersky districts, CATF Alexandrovsk, CATF the settlement of Vidyayevo, CATF the town of Zaozyorsk, CATF the town of Ostrovnoy, CATF the town of Severomorsk, the city of Murmansk);

– Republic of Karelia (Loukhsky, Kemsky, Belomorsky districts);

– Arkhangelsk Oblast (Primorsky, Onezhsky, Mezensky districts, Novaya Zemlya Urban Okrug, the city of Severodvinsk, the city of Arkhangelsk);

– Nenets Autonomous Okrug (all of its administrative-territorial formations);

– Yamalo-Nenets Autonomous Okrug (Yamalsky, Tazovsky, Priuralsky, Nadymsky, Purovsky districts);

– Krasnoyarsk Krai (Taimyrsky Dolgano-Nenetsky District);

– Republic of Sakha (Anabarsky, Bulunsky, Ust-Yansky, Allaikhovsky, Nizhnekolymsky districts);

– Chukotka Autonomous Okrug (Chukotsky, Bilibinsky, Iultinsky, Chaunsky districts).

The regions and municipal formations that correspond to one, two or more criteria for their inclusion in the Arctic zone of the Russian Federation, are presented in the *table*. The municipalities that meet only one of the criteria, in our view, require additional substantiation of their inclusion in the Arctic zone.

We consider it expedient to use the following groups of criteria for additional substantiation.

I. Group of natural and climatic criteria for defining the degree of discomfort of natural-climatic conditions for living:

1. Length of day (night). Contrasting dynamics of the length of day during the year at high latitudes negatively affects people's health. The perceptible adverse impact of this indicator on the population is manifested beginning from 62°N. The length of day in early January is about four hours at this latitude [10, 11, 21].

The regions and municipal formations that correspond to one or two criteria for inclusion in the Arctic zone of the Russian Federation

The regions and municipal formations that correspond to two (and more) criteria for inclusion in the Arctic zone of the Russian Federation	Kandalakshsky, Kolsky, Lovozersky, Pechengsky, Tersky districts, CATF Alexandrovsk, CATF the settlement of Vidyayevo, CATF the town of Zaozyorsk, CATF the town of Ostrovnoy, CATF the town of Severomorsk, the city of Murmansk (Murmansk Oblast); Novaya Zemlya Urban Okrug, Onezhsky District, the city of Arkhangelsk (Arkhangelsk Oblast); Nenets Autonomous Okrug; Yamalsky, Tazovsky, Priuralsky, Nadymsky, Purovsky districts, Salekhard and Labutnangi urban okrugs (Yamalo-Nenets Autonomous Okrug); Taimyrsky Dolgano-Nenetsky, Turukhansky districts (Krasnoyarsk Krai); Anabarsky, Bulunsky, Ust-Yansky, Allaikhovsky, Nizhnekolymsky districts (Republic of Sakha (Yakutia)); Chukotka Autonomous Okrug.
The municipal formations that correspond to one criterion for inclusion in the Arctic zone of the Russian Federation	Krasnoselkupsky, Shurushkansky districts, Gubkinsky, Muravlenko, Novy Urengoy, Noyabrsk urban okrugs (Yamalo-Nenets Autonomous Okrug); Loukhsky, Kemsky, Belomorsky districts (Republic of Karelia); Evenkiysky District (Krasnoyarsk Krai); Ust-Tsilemsky, Usinsky, Vorkutinsky, Intinsky districts (Komi Republic); Towns of Apatity, Kirovsk, Monchegorsk, Olenegorsk, Polyarnye Zori, Kovdorsky District (Murmansk Oblast); Primorsky and Mezensky districts, the city of Severodvinsk (Arkhangelsk Oblast); Zhigansky, Abyysky, Srednekolymsky, Verkhnekolymsky districts, Olenyoksky Evenkiysky National District, Verkhoyansky, Eveno-Bytantaysky, Momsky districts (Republic of Sakha (Yakutia)).

2. Duration of the period with lack of solar ultra-violet radiation per year. This indicator reflects the deficit of biologically active ultraviolet radiation of the Sun, which leads to the development of pathological reactions in man, metabolic disorders, exacerbation of chronic diseases, reduction of resistance to infection; retardation of physical development. Ultraviolet deprivation of more than one month is registered to the north of 62°N [4, 10, 11, 21, 30].

3. Duration of winter period (days). Working outdoors in the cold period sharply increases the probability of frostbite of open parts of the body. The operation of some types of machinery can also stop due to their failures and breakage [10, 11, 21, 25].

4. Expansion of permafrost. The position of the border between continuous, discontinuous and insular permafrost is taken into account [10, 11].

5. Average duration of frost-free period in the year.

6. Sum of active temperatures during vegetation period with stable temperature above +10°C. It characterizes the reserves of thermal resources for the season of active vegetation period [14]. Full development of plants of each species or varieties of agricultural crops requires a certain range of the sum of active temperatures during the vegetation season, for example, for rye – 1600–1700°C, for spring wheat – 1700–1900°C. The border of the sum of the temperature of 1600°C is viewed by some researchers as the border of the North.

7. Bodman's weather severity index – an indicator of man's sensation of cold combined with the wind [6, 10, 11]. Quantitative indicators of Bodman's index are defined in relative units, which in the middle of winter vary from 6.5 on the islands of the Arctic to 2.5–3.0 in Central Russia.

II. Socio-economic criteria that characterize the discomfort of living from the viewpoint of established social and economic conditions:

1. Population density (persons/km²) – characterizes the population of the territory.

2. Transport development of the territory – characterizes the extent of economic development of the territory together with the density of population. The index of density of hard-

surface automobile roads (km of roads/1 thousand km^2) is used for evaluating this criterion

3. Increase in the cost of living – is manifested in the increase in prices for consumer goods and services due to the impact of such factors as remoteness, weak transport development, extreme natural and climatic conditions. The ratio of the cost of the fixed set of goods and services (as a percentage of the national average value) is used to assess this criterion.

Thus, taking into account the increased interest in the Arctic zone of the Russian Federation and the outlined ways of its economic development, we can emphasize the strategic importance of establishing the borders of this territory on a legal basis. Specification of the relevant criteria in the framework of the proposed approach will make it possible to determine the specific and strictly limited list of administrative-territorial units included in the zone of the Arctic.

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