REGIONAL ECONOMICS

Urban Agglomerations in the Settlement System of the North of Russia*

Viktor V.
FAUZER
Institute of Socio-Economic and Energy Problems of the North of the Komi
Research Center of the Ural Branch of the Russian Academy of Sciences
Syktyvkar, Russian Fedaeration
e-mail: fauzer.viktor@yandex.ru
ORCID: 0000-0002-8901-4817; ResearcherID: N-9048-2017

Andrei V.
SMIRNOV
Institute of Socio-Economic and Energy Problems of the North of the Komi
Research Center of the Ural Branch of the Russian Academy of Sciences
Syktyvkar, Russian Federation
e-mail: av.smirnov.ru@gmail.com
ORCID: 0000-0001-6952-6834; ResearcherID: N-8102-2017

Tat'yana S.
LYTKINA
Institute of Socio-Economic and Energy Problems of the North of the Komi
Research Center of the Ural Branch of the Russian Academy of Sciences
Syktyvkar, Russian Federation
e-mail: tlytkina@yandex.ru
ORCID: 0000-0003-1972-9080; ResearcherID: N-9076-2017

Galina N.
FAUZER
Institute of Socio-Economic and Energy Problems of the North of the Komi
Research Center of the Ural Branch of the Russian Academy of Sciences
Syktyvkar, Russian Federation
e-mail: gfauzer@iespn.komisc.ru
ResearcherID: H-5021-2018

Abstract. The article examines the evolution of the formation of cities and urban agglomerations in the North of Russia. The aim is to identify cities that meet the criteria of "northern urban agglomeration" from the large cities in the North of Russia. We propose criteria and indicators that make it possible to distinguish urban agglomerations in the urban space; it is noted that for northern urban agglomerations the evaluation criteria can be applied less strictly and indicators less important. We analyze the urban settlement of northern Russia, focusing on northern cities, their structure and the average density of settlements; we consider separately urban-type settlements that contribute to the population density of northern territories, increasing the density of settlements. The focus is on 18 cities with more than 100,000 inhabitants and four cities with a population of a hundred thousand in different years, the core cities have at least two satellite settlements, according to the criteria proposed, they correspond to the concept of an urban agglomeration core city. We consider and group the selected urban agglomerations according to the structure of satellite settlements and the population living in the zones located within 50, 100 and 150 km from the core. With the help of a review of domestic and foreign literature, we have revealed the essence and content of the category "agglomeration effect". The article identifies three types of agglomeration effects: local objects sharing; cost reduction; and labor pooling. There are two types of effects: localization (clustering) and urbanization effects; the localization effect is the result of enterprises working together in a common area, the urbanization effect is the concentration of organizations in one area, regardless of whether there is thematic proximity between them. Along with the advantages, urban agglomerations cause environmental, economic, political and social problems and pose threats to the stability of small and medium-sized cities; increasing rural deprivation; which will cause further depopulation of large parts of the country, putting the security and integrity of the country at risk.

Key words: the North of Russia, population, settlement system, cities, urban settlements, criteria and indicators, urban agglomerations, agglomeration effect.

Introduction

The colonization and settlement of the European North began in the 10th and 12th centuries; Siberia and the Far East were annexed later (from the late 16th and early 17th centuries to the middle of the 19th century). The incoming population, mastering new, outlying territories, built ostrogs/ fortresses, where the resident population was formed. These settlements were considered cities by their status, regardless of the number of inhabitants. Among the first cities founded in the North of Russia were Arkhangelsk in 1584, Yakutsk in 1643, Yeniseisk in 1676, Kirensk in 1775, Petrozavodsk in 1777, and Syktyvkar in 1780. A total of 26 cities were formed prior to the period of contemporary history of Russia (before 1917) [1, pp. 113–116]. Today, five of them are big, three are large, one is medium, and 17 are small. The city of Arkhangelsk has become the most populous not only in the North of Russia, but also in the World Arctic, with 346,979 people (2020). The foreign North and the World Arctic are significantly inferior to the northern and Arctic regions of Russia by the number of urban settlements and average population [2, pp. 10–14].

Industrialization of the country, extensive development of natural resources of peripheral territories and, as a consequence, the formation of an extensive network of urban settlements by the end of the 20th century turned the North of Russia into a highly urbanized region [3]. Despite the successes of industrialization, it remained agrarian in 1939, with the rural population of 65.9% and the urban population of 34.1%. In subsequent years,

the proportion of the urban population increased rapidly: 1959 − 61.0%, 1970 − 67.1%, 1989 − 77.1%, 2020 − 79.2%. At present, the urbanization rate (74%) in the North of Russia is a little lower than in the Nordic countries: Denmark with 88%, Sweden with 88%, Norway with 82%, and Canada with 81%[1].

In the North of Russia from 1939 to 2020 the number of cities has increased from 40 to 141, and the average population − from 27.5 to 48.7 thousand people. The number of big and large cities has grown from 2 to 18, but their population has remained virtually unchanged: in 1939 − 200.8, and in 2020 − 218.3 thousand people − 218.3 thousand people.

Our goal is to identify cities that meet the criteria of "northern urban agglomeration" among the big and large cities of the North of Russia. This requires solving a number of tasks: to determine the criteria and indicators that allow distinguishing urban agglomerations among cities; to compare the main characteristics of the northern urban agglomerations, to briefly present the fields of their specialization.

The object of the study is urban settlements of 13 regions, the territories of which fully belong to the Far North and areas equated to them[2], and 11 regions, the territories of which partially belong to the Far North and areas equated to them. The subject of the study is the Northern urban agglomerations and the agglomeration effect on satellite settlements located in the temporal and transport accessibility from the core.

The relevance of the study lies in the fact that with the reduction in urban population, the number of large and small cities, urban-type settlements, the North more than ever needs the socio-economic

resources and innovation concentration centers. This role can be played by "northern urban agglomerations", which are formed not by absorbing the neighboring settlements, but, on the contrary, contribute to their development. The elements of novelty of the work include the substantiation of criteria and indicators for defining "northern urban agglomerations"; the identification of 19 agglomerations and their classification by the weight of the core, the number of adjacent settlements, industry specialization; the assessment of demographic dynamics of agglomeration cores in the context of high migration outflows from the northern territories.

Urban agglomerations: definition, criteria, indicators

The term "agglomeration" comes from the Latin "agglomero" − "I attach, accumulate, join". It was introduced in 1909 by A. Weber, who defined agglomeration as "the concentration of economic activity or entities in particular localities" [4]. A. Marshall made a significant contribution to the development of agglomeration theory, identifying it with a "localized industry" and proving the existence of agglomeration effect arising from the economy of localization, scale and urbanization [5]. The need for the development of urban agglomerations meets the strategic interests of the state, contributes to the development of all the territories of the agglomeration area, transport infrastructure, the creation of a supporting framework [6, p. 13].

There are many definitions of "urban agglomeration" in the literature. According to A.N. Clark, "an agglomeration is an urbanized area without clear boundaries, consisting of several settlements and their suburbs, united in the process of expansion of individual cities"[3]. The UN considers an agglomeration as an urbanized area

---

[1] D*emoscope Weekly*. Available at: http://www.demoscope.ru/weekly/app/world2020_0.php. 2020. No. 879-880 (accessed: December 10, 2020).

[2] The authors use the phrase "Russian North" when referring to 13 regions and "North of Russia" when referring to all 24 subjects.

[3] Clark A.N. *The Penguin Dictionary of Geography*. L., 1998. P. 19.

consisting of a large city in the center and a complex of settlements around it[4]. Agglomeration is "a territorially compact location of various settlements, actually merging and united into a complex, multi-component socio-economic system with active internal production and cooperation, transport and socio-cultural ties" [7, p. 11]. Agglomeration is a process of concentration of new settlements and old single-industry towns around certain cities and involvement of suburbs, nearby towns and urban settlements in the functioning of the core city [8, p. 134; 9, p. 299]. There are big (500 thousand to 1 million people) and large (more than 1 million people) urban agglomerations[5]. This classification does not coincide with the classification of cities: large – from 250 thousand to 1 million people, the largest – with a population over 1 million people[6]. But this is the population of cities without adjacent settlements. We suggest considering urban agglomerations as small – with a population of up to 250 thousand people, medium – from 250 to 500 thousand people, and large – from 500 thousand to 1 million people.

There are monocentric (single-center) urban agglomerations with one core city, which subordinates all other settlements located in its suburban area and far exceeds them in size and economic potential, and there are polycentric (multicenter) urban agglomerations with several interconnected city centers[7].

_____

[4] *World Urbanization Prospects: The 2007 Revision. Highlights.* New York: United Nations, 2008. P. 11. Available at: http://www.un.org/desa/population/publications/wup2007/2007WUP_Highlights_web.pdf (accessed: March 10, 2021).

[5] On the approval of the spatial development strategy in the Russian Federation for the period up to 2025: Government Order no. 207-p, dated February 13, 2019.

[6] "Urban development. Urban and rural planning and development": Set of rules, SP 42.13330.2016. Revised edition of SNiP 2.07.01-89. Available at: http://docs.cntd.ru/document/456054209 (accessed: December 1, 2020).

[7] Ed. by Valenteya D.I. *Demographic Encyclopedic Dictionary*. Moscow: Sovetskaya entsiklopediya, 1985. P. 98.

The formation of agglomerations is a natural, objective process of concentration of human, material and financial resources for the rational use of not only the territory potential, but also urban industrial infrastructure, engineering networks, knowledge and technology [8, p. 135].

Urban agglomerations are "the most important nodes of the settlement supporting framework, their territories represent the most valuable, significant spaces of the country, concentrating its socio-economic, scientific, educational and demographic potential" [10, p. 28].

Almost every "large city with a population over 100 thousand people has a real prerequisite to create around itself associated satellite cities to form a large urban agglomeration. Urbanization processes can proceed both extensively and intensively" [11, p. 136]. An urban agglomeration is, first of all, "a complex settlement structure, for the identification of which a peculiar set of methods, mainly from economic geography, spatial planning and urban planning are used" [12, p. 182]. In foreign countries, the "economic approach" is widely used in the allocation of urban agglomerations due to the active development of theoretical foundations within the concepts of spatial economics [13] and new economic geography [14].

The formation of megacities or urban agglomerations, along with the positive moments (the demand for labor resources grows, labor productivity increases) has a number of negative moments: the environmental impact, the increase in mental illnesses and criminalization of society [15, p. 82]. The pros and cons of urban agglomerations are noted by O.A. Kozlova and O.N. Sos'kova. They refer "changes in the population way of life, a significant increase in life expectancy, the spread of literacy, the growth of the population educational and culture level" to the positive aspects. At the same time, an urban agglomeration "generates

environmental, economic, political and social problems, creates stability problems for small and medium-sized cities" [16, p. 66].

"Agglomerations themselves are incapable of normal reproduction, they draw into themselves the population of the surrounding territories, especially young people in active reproductive age, as a result, deepening the depressed state of the surrounding territories" [17, p. 57, 59]. Focusing on "the development of large urban agglomerations is a way to eliminate small and medium-sized cities, to increase the damage of rural areas; it will cause further depopulation of a large part of the territories, will call into question the security and integrity of the country" [18, p. 6]. E.I. Weinberg sees the negative consequences of the agglomerations sprawl in the fact that within them "the load on the territory increases, many environmental problems appear. Their development increases time expenditures on transportation, transport fatigue grows, the population concentrates in a limited number of areas, increasing the polarization of space, there is a reduction in the developed space" [19, p. 32−33]. The consequences of the cities "shrinkage" at the present stage are considered in [20].

When creating agglomerations it is necessary to meet a number of conditions: the center of the agglomeration should not increase by administrative means; the suburbs to be incorporated remain legally and administratively outside the urban core; accession is physical, by building spaces between settlements and the core, transport links [21, p. 88]. Agglomeration processes are hindered by a number of factors: "the spatial isolation of urban settlements, the presence of large uninhabited spaces in the zone of their influence; the fear of municipalities to lose independence; a possible conflict of interests between the center and the periphery; increased load on transport and engineering infrastructure of the territory" [22, p. 419].

Urban agglomerations can be created both naturally (absorption and merger) and artificially, when weak municipalities are part of strong ones. In any case, the consolidation of efforts will "contribute to solving the problems of creating new jobs, the efficient use of all resources, which will help avoid crisis processes that begin to be felt at the grassroots level earlier than in large cities, and even more so in agglomerations" [8, p. 136].

Western researchers G. Duranton and D. Puga write that the ratio of urban systems (their size) is largely determined by the history of development of territories, their industry specialization and the network of transport infrastructure. But there is also an inverse relationship: the urban structure sets the spatial framework, reserves and limitations of development. Large cities have the agglomeration economy resources and benefits of economy of scope [23]. Urban agglomerations are more sustainable than other cities for the reason that they have an equal development of all processes: economic, socio-demographic and environmental [24, p. 112].

Criteria and indicators for distinguishing urban agglomerations. In order to include a city or urban settlements in an urban agglomeration, it is necessary to follow certain criteria and indicators. F.M. Listengurt proposed the following criteria for distinguishing and classifying urban agglomerations: 1) urban population over 110 thousand people with a minimum central city of 100 thousand people; 2) the time spent on regular access to the center (stations) of the main city − 2 hours gross; 3) the proportion of the urban settlements population in the outer zone in the total urban population of the agglomeration (agglomeration index) minimum 10%; 4) the number of urban settlements in the outer zone of agglomeration minimum three; 5) the abstract indicator of the degree and character of the urban settlements concentration in the

agglomeration outer zone (the agglomeration coefficient is the ratio of the urban settlements density to the average shortest distance between them) is minimum 0.1 [25, p. 45].

In order to define agglomerations the following indicators are most often used: the threshold population of the core is 50–250 thousand people, in adjacent settlements (satellites) – at least 50 thousand people, located in 1.5–2 hour transport accessibility [12, p. 185–186, 189] or located within 50, 100 and 150 km from a large city.[9, p. 299]. The "growth corridor", the distance of a satellite city from the core, can range from 50 to 200 km [26, p. 183].

When distinguishing urban agglomerations, one should take into account that at present they are moving to a new level, from the scalar form (point agglomerations) to the vector form – the formation and development of agglomerative corridors [16, p. 67].

Thus, selecting and analyzing urban agglomerations, we previously considered cities and urban-type settlements in all 294 urban and municipal districts belonging to the North of Russia. The data on the population density of the settlements were obtained from the censuses of 1939–2010[8], as well as from the current statistical records at the beginning of the year 2020[9]. Information on changes in the categories of settlements and their economic specialization is taken from the encyclopedia "All Russia. Cities and towns"[10], and from official websites of regions and municipalities. The data on the geographic coordinates of the settlements were obtained from the GeoNames geographic database[11].

---

[8] Censuses of the Russian Empire, the USSR, the 15 newly independent states. *Demoscope Weekly.* Available at: http://www.demoscope.ru/weekly/ssp/census.php

[9] Bulletin "Population of the Russian Federation by municipalities". Available at: https://rosstat.gov.ru/compendium/document/13282

[10] *All Russia. Cities and Towns.* Encyclopedia. Moscow: Institut ekonomiki i upravleniya v promyshlennosti, 2001. 575 p.

[11] *The GeoNames geographical database.* Available at: https://www.geonames.org

---

The cities with a maximum population over 100 thousand inhabitants, which are the largest settlements in their 150–kilometer neighborhoods, while at the same time they are not the only settlements there, are selected as the cores of the northern agglomerations. Then a list of urban satellite settlements by zones of accessibility (50, 100 and 150 km) was formed. The settlements that were in the accessibility zone of two agglomerations at once were assigned to one of them on the basis of economic specialization and spatial proximity. The calculations were performed using the algorithm implemented in the Julia programming language, using the Geodesy.jl (to estimate distances between settlements) and VegaLite.jl (to create map schemes).

Northern agglomerations are characterized by a number of features: 1) smaller population of both the core and satellites; 2) the number of satellites is not strictly limited; 3) they play a major role on the scale of the northern region, as well as having all-Russian significance in the division of labor, sectoral specialization [27, p. 11].

Agglomeration effect as a factor in the transformation of the settlement system: from simple forms to agglomerations. Agglomeration effect (agglomeration economies) is an economic benefit from the territorial concentration of industries and other economic objects in cities and agglomerations, in relatively close to each other points. The agglomeration effect manifests the totality and interaction of external economy factors for different objects included in the agglomeration[12]. The creation of urban agglomerations involves obtaining "a synergistic effect that significantly increases the efficiency of economic processes and social development of the territories that make up the agglomeration" [7, p. 10].

---

[12] Lopatnikov L.I. *Economic and Mathematical Dictionary: Dictionary of modern Economic Science.* 5th ed., reprint. and add. Moscow: Delo, 2003. 520 p.

There are two types of agglomeration effects: localization (clustering) and urbanization effects; the localization effect is the result of joint activities of enterprises in a common area, the urbanization effect is the concentration of organizations in one area, regardless of whether there is thematic proximity between them. To evaluate the localization and urbanization effects, the following indicators are used: labor productivity, added value, employment, wage level, number of issued patents [28, pp. 318, 323].

A key advantage of concentration in an urban environment is proximity, which makes it easy for subjects to interact between firms, individuals, institutions, etc. This interaction, in turn, allows the economy and production output to exceed the sum of the parts, for reasons that include specialization, shared values and practices, and face-to-face contacts. In addition, urban interaction stimulates the dynamic forces of problem solving, cooperation, learning, competition and technical innovation [29; 30]. The advantages of cities for the development of the economy and from the point of view of the quality of life are the consequence of a more compact economic agents' location [31]. This saves on transportation costs, increases the exchange of information and practices, and makes it easier to find employees [32].

The economic benefits fade with distance from the agglomeration center [33]. This fact is also confirmed in domestic studies, where it is indicated that at distances of more than 60 km from the center the effects weaken. At the same time, when the population of an agglomeration doubles, factor productivity in various sectors of economic activity increases by 2−10%. The territories where 100 thousand people live within an hour and a half accessibility demonstrate a local maximum of labor productivity in industry and a significantly lower one in services sector [32, p. 52, 56, 57].

Modern agglomerations are more sustainable in their development. This is related to a more efficient use of human, material and financial resources, as well as the synergy effect from the rational use of not only the territory resources, but also the resources of the productive urban infrastructure, engineering networks, knowledge and technology [9, p. 299]. Sustainable development of northern agglomerations is possible only with the rational formation of the settlement system, considering demographic potential, settlement economic specialization [34] and territory natural features.

The agglomeration economy provides its members with a number of advantages: "lower costs of access to the market of goods and raw materials, infrastructure development, matching supply and demand for labor, which is stimulated by high wages; concentration and diversification of resources make it possible to save on scale and combine production factors" [35, p. 92]. Agglomeration effect shows as concentration of final goods and services producers and an increase in real income. There are three types of agglomeration effect: joint use of local facilities; reduction of costs; pooling of labor [36, p. 423].

Cities and agglomerations in the settlement system of the North of Russia. Before we consider urban agglomerations, let us explain that by "northern urban agglomeration" we mean the concentration of urban population around the core city, which has a population over 100 thousand people, and at least two urban settlements within a radius of 150 km. As an exception, we refer to the northern urban agglomerations those agglomerations with core cities that in different years had a population of one hundred thousand people. The northern urban agglomeration provides adjacent areas with the "agglomeration effect" through the transfer of innovation and the latest technology, offering a wide range of socio-cultural

and educational services. Given the underdeveloped road network, scattered and remote settlements, only a core city can provide a range of emergency medical services, aviation services.

In the North of Russia there are 141 cities, six of them are large (Surgut, Arkhangelsk, Yakutsk, Murmansk, Petrozavodsk and Nizhnevartovsk), 12 are big and medium-sized, 111 — small and 234 — urban-type settlements. In the structure of cities prevail small and medium-sized cities — 123 (87.2%). The proportion of big and large cities is 12.8%, with almost half of the population living there — 39.8%. The population of all groups was growing until 1989, and then followed a decline, the same can be said about the average populousness of settlements *(Tab. 1).*

The peak in city formation in the North of Russia occurred between 1939 and 1959 (45 cities). The city formation took place after the collapse of the Soviet Union. From 1989 to 2002, 18 cities emerged. In the following decades, however, only one new city emerged, it was Tarko-Sale in the Yamalo-Nenets Autonomous Okrug. Eight settlements were deprived of city status. In

2004, the cities of Talnakh and Kayerkan were incorporated into Norilsk. The towns of Lesogorsk, Krasnogorsk, Gornozavodsk, Chekhov (Sakhalin Oblast), and Klyuchi (Kamchatka Krai) became rural settlements between 1993 and 2004. The town of Shakhtersk, Sakhalin Oblast, was incorporated as an urban settlement in 2017 *(Tab. 2).* The data show that cities in the North represent a more stable form of settlement than urban-type settlements. The average populousness there increases from 47.7 thousand people in 2002 to 48.7 in 2020.

Along with small and medium-sized cities, urban-type settlements contribute to the cohesion and population density of the northern territories. In a number of urban areas, the settlement system consists of one support city and a network of small urban settlements connected with it. In some northern and arctic territories there are no cities, and the role of supporting settlements for the development of the North and life support of people is performed by urban-type settlements. Such settlements include Anadyr, Igarka, Pevek and Tiksi [37, p. 37]. In the North of Russia, the peak in the formation of settlements fell on the period from

Table 1. Population and settlement indicators of the North of Russia, 1939–2020*

Indicator	1939	1959	1970	1979	1989	2002	2010	2020
Population, thou. people, including:	**4 232.0**	**6 907.3**	**8 417.1**	**10 181.0**	**12 807.8**	**10 818.9**	**10 158.4**	**9 858.5**
cities	1 100.7	2 651.1	3 834.5	5 279.6	7 482.6	7 005.3	6 830.5	6 861.9
urban-type settlements	342.0	1 563.1	1 809.2	2 138.1	2 392.4	1 385.6	1 077.1	950.3
rural settlements	2 789.3	2 693.1	2 773.4	2 763.3	2 932.8	2 428.0	2 250.8	2 046.3
Urban settlements, units	**104**	**411**	**487**	**544**	**588**	**494**	**404**	**375**
cities, incl.	40	85	99	110	130	147	142	141
large (more than 250 thou. people)	1	1	2	3	8	6	7	6
big (100–250 thou. people)	1	4	9	12	9	11	10	12
medium (50–100 thou. people)	3	9	6	10	21	14	12	12
small (less than 50 thou. people)	35	71	82	85	92	116	113	111
urban-type settlements	64	326	388	434	458	347	262	234
Average populousness, people								
cities	27 519	31 189	38 733	47 996	57 558	47 655	48 103	48 666
urban-type settlements	5 343	4 795	4 663	4 927	5 224	3 993	4 111	4 061

* Censuses 1939–1979 – present population; censuses 1989–2010, current statistics 2020 – resident population. Sources: Censuses of the Russian Empire, the USSR, and the 15 newly independent states. Demoscope Weekly. Available at: http://www.demoscope.ru/weekly/ssp/census.php; The population of the Russian Federation by municipality: bulletin. Available at: https://rosstat.gov.ru/compendium/document/13282

Table 2. Dynamics of the number of cities in the North of Russia, 1939–2020, units

Administrative-territorial transformation	1939	1959	1970	1979	1989	2002	2010	2020	In total
Cities, in total	40	85	99	110	130	147	142	141	149
Change in the number of cities since the previous census									
Retained the status of the city (without transformations)	–	40	85	99	110	129	141	141	141
New cities formed	–	45	14	11	20	18	1	0	149
Deprived of the status of a city, of which:	–	0	0	0	0	1	6	1	8
– merged with other cities	–	0	0	0	0	0	2	0	2
– converted into an urban-type settlement	–	0	0	0	0	0	0	1	1
– converted into rural settlements	–	0	0	0	0	1	4	0	5
Source: Censuses of the Russian Empire, the USSR, and the 15 newly independent states. Demoscope Weekly. Available at: http://www.demoscope.ru/weekly/ssp/census.php; The population of the Russian Federation by municipality: bulletin. Available at: https://rosstat.gov.ru/compendium/document/13282									

1939 to 1959 (279 urban settlements). Then this process gradually slowed down. Only 10 urban-type settlements were formed in modern Russia.

It was assumed that urban-type settlements would eventually be transformed into cities as the population grew. However, in the North only 54 out of 581 (9.3%) became cities. Another 29 urban-type settlements (5.0%) were merged with other cities or towns. By 2020, 234 settlements (40.3%) retained their urban-type status, while the majority were deprived of this status. 37.7% were transformed into rural settlements, and 7.7% were abolished (more than half of them were abolished in 1989–2010). Since 1989, statistics began to record urban-type settlements without population, which, however, were not officially abolished. In 2020, there were 10 urban-type settlements without population in the North *(Tab. 3)*.

From cities and urban settlements to the northern urban agglomerations. Out of all the cities in the North of Russia, 18 cities have a population over 100 thousand people (2020). Four cities in different years had a population of one hundred thousand, so they can claim the role of agglomeration cores

Table 3. Dynamics of the number of urban-type settlements in the North of Russia, 1939–2020, units

Administrative-territorial transformation	1939	1959	1970	1979	1989	2002	2010	2020	In total
Urban-type settlements, in total:	64	326	388	434	458	347	262	234	581
– without population	0	0	0	0	1	2	8	10	–
Changes in the number of urban-type settlements since the previous census									
Retained the status of the urban-type settlement (no transformation)	–	47	286	358	408	339	261	233	234
New settlements of urban type formed	–	279	102	76	50	8	1	1	581
Deprived of the status of the urban-type settlement of which:	–	17	40	30	26	119	86	29	347
– categorized as cities	–	6	11	9	16	11	1	0	54
– merged with other urban-type settlements or cities	–	3	6	2	2	8	7	1	29
– converted into rural settlements	–	2	18	15	6	89	64	25	219
– abolished	–	6	4	5	2	11	14	3	45
Source: Censuses of the Russian Empire, the USSR, and the 15 newly independent states. Demoscope Weekly. Available at: http://www.demoscope.ru/weekly/ssp/census.php; The population of the Russian Federation by municipality: bulletin. Available at: https://rosstat.gov.ru/compendium/document/13282									

according to the main/first criterion ("population size"). In different historical periods there were formed 22 cities: 8 during the Tsarist period and 14 during the Soviet period. The proportion of the urban population, formed during the Tsarist period (colonization of the North, 1584–1917), decreased from 40.5% to 25.4% (1939–2020), but they retained their first place. The percentage of urban residents, formed during the period of industrialization and urbanization of the North (Gulag period, 1918–1959), increased from 8.3% to 15.0%. During the period of policy change from coercion to encouragement (the period of "northern romance", 1960–1989), the proportion of the urban population increased from 1.0% to 14.0%. In general, we can note that the proportion of large cities in the urban population decreased from 36.3% (1939) to 24.3% (2020), large cities increased from 10.6% to 26.0%, and the proportion of the population "lost" by large cities increased from 1.9% to 4.1%, respectively. The proportion of the population of large cities decreased as Bratsk, Severodvinsk and Petropavlovsk-Kamchatsky left this group *(Tab. 4)*.

After 22 cities were analyzed according to the second criterion (the presence of satellites or urban-type settlements), Khanty-Mansiysk was excluded from the sample as not meeting the selection criterion. Two cities, Severodvinsk and Nefteyugansk, were included in the Arkhangelsk and Surgut urban

Table 4. Dynamics of the big and large cities population of the North of Russia, 1939–2020, people*

No.	City	Year of establishment	1939	1959	1970	1979	1989	2002	2010	2020
1	Arkhangelsk	1584	284 570	256 309	342 590	385 028	416 812	356 051	348 783	346 979
2	Yakutsk	1643	52 882	74 330	107 617	152 368	187 661	210 642	269 601	322 987
3	Petrozavodsk	1777	69 723	135 256	184 481	234 103	269 581	266 160	261 987	281 023
4	Syktyvkar	1780	25 281	64 461	125 088	170 980	231 673	230 011	235 006	244 403
5	Petropavlovsk-Kamchatsky	1812	35 373	85 582	153 885	214 977	273 368	198 028	179 780	179 586
6	Yuzhno-Sakhalinsk	1905	–	85 510	105 840	139 861	156 347	175 085	181 728	200 636
7	Kyzyl	1914	–	34 462	51 683	66 027	83 822	104 105	109 918	119 438
8	Murmansk	1916	117 069	221 874	308 642	380 817	472 274	336 137	307 257	287 847
9	Komsomolsk-on-Amur	1932	70 808	177 278	218 127	263 950	316 224	281 035	263 906	244 768
10	Severodvinsk	1938	21 304	78 657	144 672	197 232	253 864	201 551	192 353	181 990
11	Khanty-Mansiysk	1950	–	20 677	24 754	28 266	35 494	53 953	80 151	101 466
12	Norilsk	1953	–	109 442	135 487	180 358	179 757	134 832	175 365	181 830
13	Bratsk	1955	–	51 455	155 362	213 725	257 587	259 335	246 319	226 269
14	Surgut	1965	–	–	34 011	107 343	250 198	285 027	306 675	380 632
15	Nefteyugansk	1967	–	–	19 675	52 393	94 578	107 830	122 855	127 255
16	Nizhnevartovsk	1972	–	–	–	108 740	244 752	239 044	251 694	277 668
17	Novy Urengoy	1980	–	–	–	–	95 254	94 456	104 107	118 033
18	Noyabrsk	1982	–	–	–	–	87 144	96 440	110 620	106 911
Formerly big cities										
1	Magadan	1939	27 313	62 225	92 105	121 250	151 520	99 399	95 982	92 052
2	Ukhta	1943	–	36 154	62 923	87 467	112 876	103 340	99 591	93 716
3	Vorkuta	1943	–	55 668	89 742	100 210	115 329	84 917	70 548	52 776
4	Ust-Ilimsk	1973	–	–	–	68 641	110 335	100 592	86 610	80 419

* Censuses 1939–1979 – present population; censuses 1989–2010, current statistics 2020 – resident population. Sources: Censuses of the Russian Empire, the USSR, and the 15 newly independent states. Demoscope Weekly. Available at: http://www.demoscope.ru/weekly/ssp/census.php; The population of the Russian Federation by municipality: bulletin. Available at: https://rosstat.gov.ru/compendium/document/13282

agglomerations. Thus, the role of urban agglomerations is claimed by 19 cities, six in the European and 13 in the Asian part of the North of Russia. The Northern urban agglomerations include 105 urban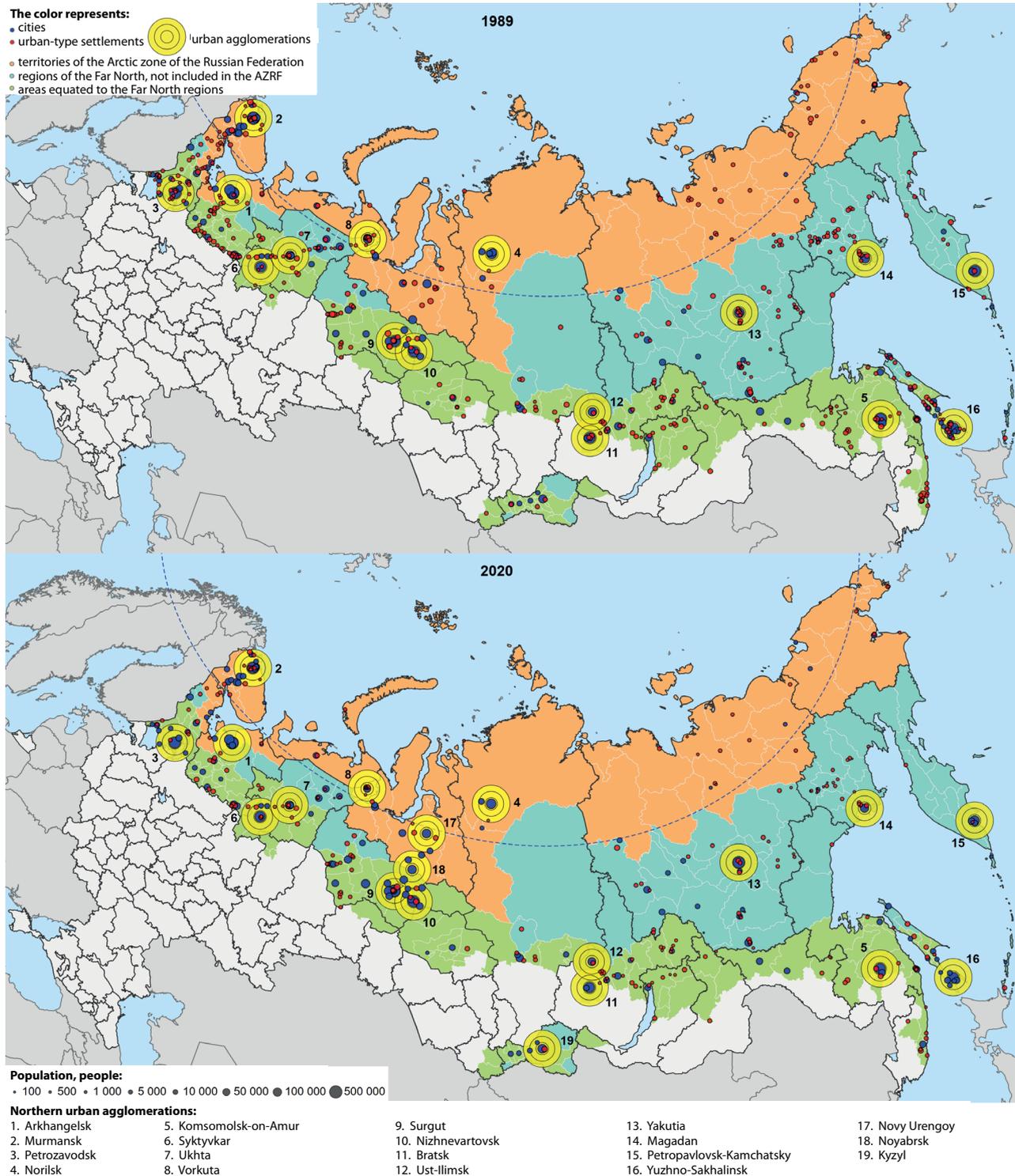 settlements (without core cities), including 46 cities and 59 urban-type settlements. And as of 1939, only two cities in the European part of the North of Russia met the criteria: Arkhangelsk and Murmansk. By 1959 they were joined by Petrozavodsk, Norilsk and Komsomolsk-on-Amur *(Fig. 1)*.

Figure 1. Urban agglomerations in the settlement system of the North of Russia, 1939 and 1959
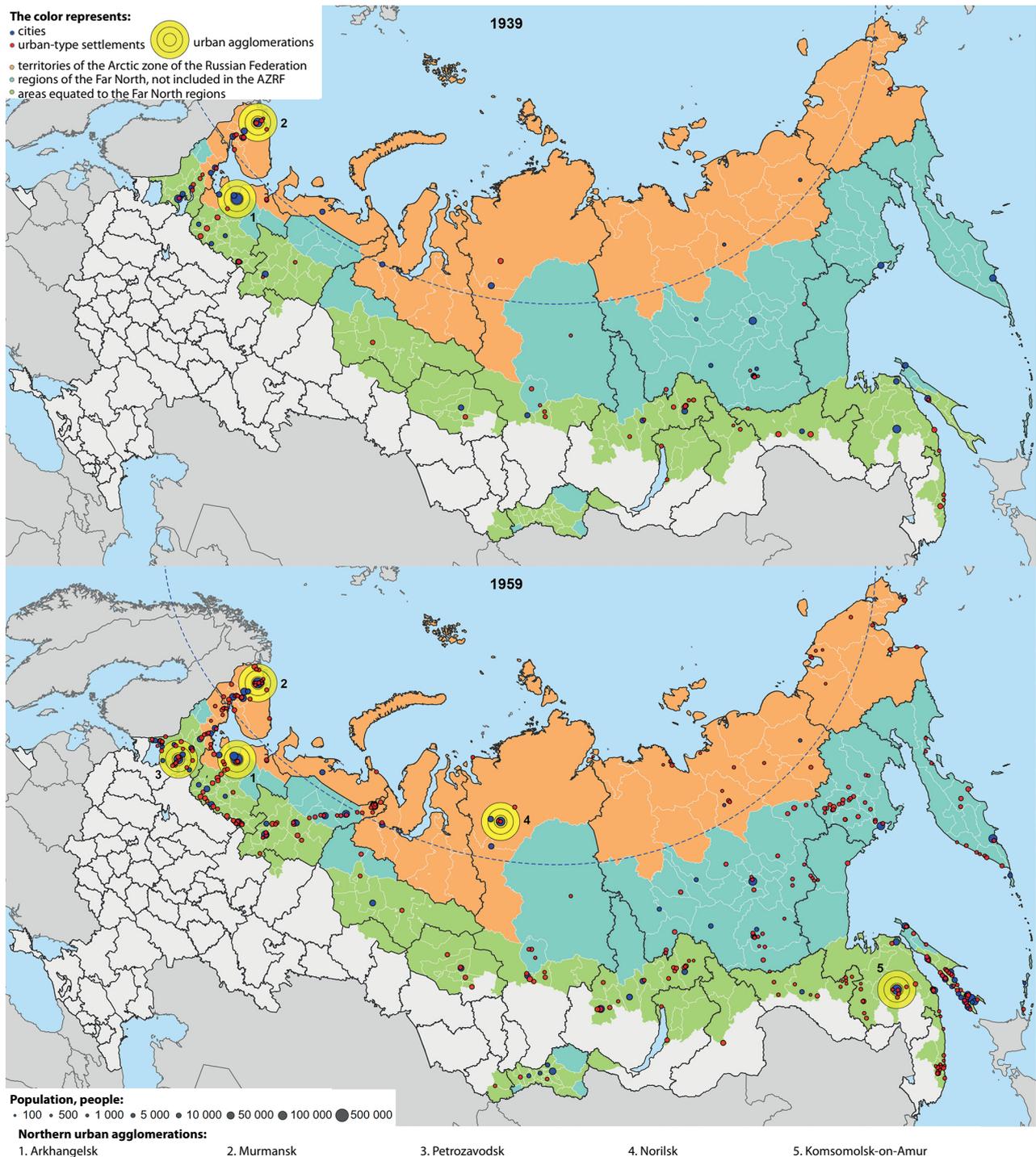
In the period from 1959 to 1989 most of the northern agglomerations (11 out of 19) were formed. Most of them (3) were in the Komi Republic. The last three core cities, which crossed the 100-thousand mark, were Novy Urengoy, Noyabrsk and Kyzyl, all in the Asian part of the North. The concentration of agglomerations in the oil and gas regions of Western Siberia has increased *(Fig. 2)*.

Figure 2. Urban agglomerations in the settlement system of the North of Russia, 1989 and 2020

Northern urban agglomerations:

1. Arkhangelsk	5. Komsomolsk-on-Amur	9. Surgut	13. Yakutia	17. Novy Urengoy
2. Murmansk	6. Syktyvkar	10. Nizhnevartovsk	14. Magadan	18. Noyabrsk
3. Petrozavodsk	7. Ukhta	11. Bratsk	15. Petropavlovsk-Kamchatsky	19. Kyzyl
4. Norilsk	8. Vorkuta	12. Ust-Ilimsk	16. Yuzhno-Sakhalinsk	

Let us compare urban agglomerations according to the following indicators: the population, including gravity zones; the core city proportion in the total population; the number of cities and urban-type settlements at the core city; the main specialization fields.

The European North of Russia includes six urban agglomerations, comprising 26 cities and 30 urban-type settlements *(Tab. 5)*. According to the distance from the core city, the population was distributed as follows: in the core city − 65.5%, in zone 1 − 23.2%, in zone 2 − 3.2% and in zone

Table 5. Urban agglomerations of the North of Russia, 2020

Core and population	Urban settlements by distance from the core and population		
	1 zone, up to 50 km	2 zone, 51–100 km	3 zone, 101–150 km
Large northern agglomerations			
Arkhangelsk 588,210 people, incl. 346,979 – core	**219,689 people, incl.:** 181,990 – Severodvinsk (34 km) 37,699 – Novodvinsk (19 km)	–	**21,542 people, incl.:** 18,493 – Onega (138 km), 3,049 – Obozersky (122 km)
Murmansk 530,495 people, incl. 287,847 – core	**133,012 people, incl.:** 53,525 – Severomorsk (16 km) 17,494 – Polar (28 km) 13,726 – Murmashi (21 km) 13,157 Gadzhievo (32 km) 12,826 – Snezhnogorsk (25 km) 9,690 – Kola (11 km) 5,726 – Safonovo (12 km) 4,927 – Molochny (14 km) 1,941 – Kildinstroy (20 km)	**34,304 people, incl.:** 20,364 – Olenegorsk (93 km) 9,246 – Zaozyorsk (54 km) 3,480 – Pechenga (97 km) 1,214 – Verkhnetulomsky (67 km)	**75,332 people, incl:** 41,145 – Monchegorsk (116 km) 14,706 – Zapolyarny (103 km) 11,012 – Nikel (124 km) 8,002 – Revda (131 km) 467 – Tumanniy (105 km)
Middle northern agglomerations			
Petrozavodsk 359,120 people, incl. 281,023 – core	**32,670 people, incl.:** 29,218 – Kondopoga (47 km) 3,452 – Pryazha (40 km)	–	**45,427 people, incl:** 14,091 – Medvezhegorsk (126 km) 8,678 – Suoyarvi (115 km) 8,606 – Pudozh (115 km) 8,026 – Olonets (116 km) 4,276 – Pindushi (127 km) 1,750 – Povenets (121 km)
Syktyvkar 292,082 people, incl. 244,403 – core	**14,482 people, incl.:** 8,471 – Krasnozatonsky (9 km) 4,196 – Verkhnyaya Maksakovka (9 km) 1,815 – Sedkyrkeshch (10 km)	**16,702 people, incl.:** 9,558 – Mikun (86 km) 7,144 – Zheshart (80 km)	**16,495 people, incl.:** 12,379 – Yemva (103 km) 4,116 – Urdoma (121 km)
Small northern agglomerations			
Ukhta 151,033 people, incl. 93,716 – core	**42,469 people, incl.:** 26,004 – Sosnogorsk (11 km) 7,321 – Yarega (16 km) 5,813 – Vodny (15 km) 3,331 – Shudayag (6 km)	**12,742 people, incl.:** 8,998 – Nizhny Odes (59 km) 2,730 – Voivozh (99 km) 1,014 – Borovoy (55 km)	**2,106 people, incl.:** 2,106 – Sindor (120 km)
Vorkuta 72,681 people, incl. 52,776 – core	**19,389 people, incl.:** 9,442 – Vorgashor (15 km) 8,025 – Severny (15 km) 1,362 – Zapolyarny (14 km) 560 – Komsomolsky (13 km)	**516 people, incl.:** 516 – Yeletsky (51 km)	
Source: The population of the Russian Federation by municipality: bulletin. Available at: https://rosstat.gov.ru/compendium/document/13282; The GeoNames geographical database. Available at: https://www.geonames.org			

3 – 8.1%. Three urban agglomerations belong to the Arctic Zone of the Russian Federation (AZRF). All six agglomerations meet the criteria of agglomeration even within a radius of up to 50 km.

The Arkhangelsk Arctic urban agglomeration stands out in terms of population, it consists of three cities and one urban-type settlement (the city of Severodvinsk could claim to be a core city by the first criterion). Economically, it is one of the most diversified centers in the North: shipbuilding and ship repair, education, timber industry and transport are well developed. The proportion of core-city population is 59.0%.

The Murmansk Arctic urban agglomeration takes the first place by the number of urban settlements in the satellite zone, it consists of nine cities and nine urban-type settlements. This may explain the fact that it has the lowest proportion of the core city population – 54.2%. It specializes mainly in maritime transport, fishing and fish processing, and ship repair.

The Petrozavodsk urban agglomeration includes five cities and three urban-type settlements. It is distinguished by the fact that it includes the most settlements located in the third zone – four cities and two urban-type settlements. According to the proportion of the core city population it ranks second with 78.3%. Mechanical engineering, metalworking, timber, food, light industry, transportation hub are developed here.

The Syktyvkar urban agglomeration has the highest proportion of the core city – 83.7%. This is caused by the fact that in the gravity zone there are two small cities and five small urban-type settlements. It specializes in the timber and pulp and paper industry, the production of nonwovens, and the food industry.

The Ukhta urban agglomeration has a closely located satellite town – Sosnogorsk, and seven urban-type settlements, the proportion of the core city is 62.1%. It is the center of oil and gas industry.

The Vorkuta urban agglomeration is part of the AZRF, there are five urban-type settlements in the zone of influence, the proportion of the core city is 72.6%. In 1989 the agglomeration included 12 urban-type settlements, and its population reached 216.8 thousand people. It specializes in the coal mining industry.

In the Asian part of the North there are 13 urban agglomerations, with 39 cities and 29 urban-type settlements, three agglomerations completely belong to the AZRF *(Tab. 6)*. By distance from the core city, the population was distributed as follows: in the core – 70.7%, in the first zone – 14.4%, in the second zone – 8.5% and in the third zone – 6.4%. Among 13 agglomerations meeting the criteria in a radius of up to 50 km – 7, with an increase in the radius up to 100 km – 10.

The Surgut urban agglomeration is the largest in terms of population with 729.7 thousand people, it consists of four towns and four urban-type settlements. The city of Nefteyugansk corresponds to the status of a core city in terms of population. The proportion of the core city is the lowest among the northern agglomerations – 52.1%. Surgut agglomeration has a high cohesion of settlements: the first zone has 27.5%, the second 11.1%, and the third 9.3% of the urban population. It specializes in the production and processing of oil and associated gas.

The Nizhnevartovsk urban agglomeration includes five cities and three urban-type settlements, has an even distribution of population by zones, 14.5%, 16.8% and 14.0% respectively, the core city accounts for 54.7% of the urban population. It is the center of the oil and gas industry.

Table 6. Urban agglomerations of the Asian part of the North of Russia, 2020

Core and population	Urban settlements by distance from the core and population		
	1 zone, up to 50 km	2 zone, 51–100 km	3 zone, 101–150 km
Large northern agglomerations			
Surgut 729,715 people, incl. 380,632 – core	**200,587 people, incl.:** 127,255 – Nefteyugansk (47 km) 26,328 – Poikovsky (5 km) 23,342 – Fedorovsky (43 km) 17,774 – Bely Yar (9 km) 5,888 – Barsovo (12 km)	**80,768 people, incl.:** 41,199 – Lyantor (79 km) 39,570 – Pyt-Yakh (63 km)	**67,727 people, incl.:** 67,727 – Kogalym (126 km)
Nizhnevartovsk 507,739 people, incl. 277,668 – core	**73,354 people, incl.:** 46,643 – Megion (26 km) 19,904 – Izluchinsk (21 km) 6,807 – Vysoky (40 km)	**85,476 people, incl.:** 44,646 – Langepas (81 km) 40,830 – Strezhevoy (61 km)	**71,241 people, incl.:** 43,666 – Raduzhny (138 km) 18,074 – Pokachi (108 km) 9,501 – Novoagansk (113 km)
Middle northern agglomerations			
Yakutsk 352,926 people, incl. 322,987 – core	**14,431 people, incl.:** 10,352 – Zhatai (15 km) 4,079 – Nizhny Bestyakh (12 km)	**15,508 people, incl.:** 9,385 – Pokrovsk (70 km) 6,123 – Mokhsogollokh (83 km)	–
Komsomolsk-on-Amur 306,155 people, incl. 244,768 – core	**50,514 people, incl.:** 38,913 – Amursk (36 km) 11,601 – Sunny (32 km)	**10,873 people, incl.:** 10,873 – Elban (62 km)	–
Yuzhno-Sakhalinsk 296,622 people, incl. 200,636 – core	**552 people, incl.:** 34,023 – Korsakov (36 km) 11,851 – Dolinsk (42 km) 9,378 – Aniva (31 km)	**36,963 people, incl.:** 27,148 – Kholmsk (53 km) 9,815 – Nevelsk (74 km)	**3,771 people, incl.:** 3,771 – Tomari (103 km)
Small northern agglomerations			
Bratsk 248,129 people, incl. 226,269 – core	**20,833 people, incl.:** 20,833 – Vihorevka (27 km)	**1,027 people, incl.:** 1,027 – Vidim (98 km)	–
Petropavlovsk-Kamchatsky 242,692 people, incl. 179,586 – core	**63,106 people, incl.:** 39,345 – Yelizovo (24 km) 22,223 – Vilyuchinsk (21 km) 1,538 – Vulkanny (21 km)	–	–
Norilsk 203,300 people, incl. 181,830 – core	–	**20,804 people, incl.:** 20,804 – Dudinka (80 km)	**666 people, incl.:** 666 – Snezhnogorsk (142 km)
Noyabrsk 167,633 people, incl. 106,911 – core	–	**31,561 people, incl.:** 31,561 – Muravlenko (81 km)	**29,161 people, incl.:** 29,161 – Gubkinsky (148 km)
Novy Urengoy 161,495 people, incl. 118,033 – core	–	**9,997 people, incl.:** 9,997 – Urengoy (80 km)	**33,465 people, incl.:** 21,501 – Tarko-Sale (140 km) 11,140 – Pangody (101 km) 824 – Zapolyarny (132 km)
Kyzyl 154,805 people, incl. 119,438 – core	**19,282 people, incl.:** 19,282 – Kaa-Khem (20 km)	**4,903 people, incl.:** 4,903 – Turan (61 km)	**11,182 people, incl.:** 11,182 – Shagonar (107 km)
Magadan 110,237 people, incl. 92,052 – core	**12,931 people, incl.:** 6,070 – Ola (28 km) 4,811 – Sokol (40 km) 2,050 – Uptar (38 km)	**5,254 people, incl.:** 3,555 – Tent (60 km) 1,699 – Glass (54 km)	–
Ust-Ilimsk 100,628 people, incl. 80,419 – core	**6,319 people, incl.:** 6,319 – Railway (13 km)	**883 people, incl.:** 883 – Radishchev (99 km)	**13,007 people, incl.:** 9,112 – Novaya Igirma (122 km) 2,983 – Rudnogorsk (105 km) 912 – Yangel (121 km)
References: The population of the Russian Federation by municipality: bulletin. Available at: https://rosstat.gov.ru/compendium/document/13282; The GeoNames geographical database. Available at: https://www.geonames.org			

The Yakutian urban agglomeration has the highest proportion of the core city population – 91.5%, it includes three urban-type settlements and one town Pokrovsk. The agglomeration has no pronounced economic specialization. Energy, trade, and the social sphere are developed here.

The Komsomolsk-on-Amur urban agglomeration includes one town Amursk and two urban-type settlements located within the first and second zones. It is the center of military-industrial complex (aircraft building, shipbuilding), metallurgy.

The Yuzhno-Sakhalinsk urban agglomeration is the only agglomeration that does not have an urban-type settlement and contains six towns. The core city accounts for 67.6% of the urban population. It is a multifunctional center with a predominance of electric power, food industry, and transportation.

The Bratsk urban agglomeration ranks second in terms of core city size (91.2% of the urban population), has a minimum of satellite settlements (Vikhorevka and Vidim). It specializes in hydro-power, timber, pulp and paper, and aluminum production.

The Petropavlovsk-Kamchatsky urban agglomeration is located within the northeast, specializing in the fish processing, ship repair, and mining industries. It includes two towns and one urban-type settlement, located in the first zone, within a radius of up to 25 km. The core city accounts for 74.0% of the urban population.

The Norilsk Arctic urban agglomeration includes one town ("Dudinka") and one urban-type settlement ("Snezhnogorsk"). The cities of the first zone Talnakh and Kaierkan were incorporated into Norilsk in 2004, so the proportion of the core city is quite high – 89.5%. The city-forming enterprise is Metals and Mining Company "Nornickel", its main products are nickel, cobalt, copper, platinum group metals, gold, silver. The enterprises employ more than 50% of the population, the city's budget depends on the tax revenues of "Nornickel" by more than 90%.

The Noyabrsk Arctic urban agglomeration has two urban settlements: Muravlenko and Gubkinsky, located in the second and third zones, respectively. It specializes in oil and gas industry.

The Novy Urengoy Arctic urban agglomeration includes one town (Tarko-Sale) and three urban-type settlements located within the second and third zones, there are no settlements adjacent to the core city, it accounts for 73.1% of the urban population. It is the center of gas production.

The Kyzyl urban agglomeration combines the nearby Kaa-Khem urban-type settlement and two towns: Turan and Shagonar. The proportion of the core city is 77.1%. Kyzyl industry is represented by small manufacturing, mining, and energy companies.

Magadan urban agglomeration has no satellite towns, five small towns are located in the first and second zones, the proportion of the core city by population is 83.5%. The economy is based on the mining and energy industries. These industries account for about 95% of annual production and employ more than 20% of the population.

The Ust-Ilimsk urban agglomeration includes five urban-type settlements, the core city accounts for 79.9% of the urban population. The basis of the economy is formed by manufacturing companies, primarily "Ilim Group".

Conclusion

Using the value of the main indicator "population size" for a core city of more than 100 thousand people and the criterion of having at least two settlements in the agglomeration corridor, we have identified 19 "northern urban agglomerations", of which six are fully included in the Russian Arctic. In terms of population size, 10 agglomerations are

small, 5 are medium-sized and 4 are large (Surgut: 729,700, Arkhangelsk: 588,200, Murmansk: 530,300 and Nizhnevartovsk: 507,700). In large agglomerations, the proportion of core cities in the population is the lowest at 54.9%, in medium-sized ones − 80.5%, and in small ones − 77.6%. There is a regularity in average population density of satellite settlements: in large agglomerations it is 27,975 people, in medium ones − 11,182, in small ones − 9,272. This pattern can be considered a manifestation of the "agglomeration effect".

The total area of the Russian North territories is 11 million 810.9 thousand square kilometers. 19 northern urban agglomerations located within a radius of 150 km, accounts for 1 million 343.0 thousand square kilometers without crossing areas, or 11.4% of the total area. This means that the developed area is small, and the process of forming northern urban agglomerations is not completed. Out of the 375 cities and towns, only 124 (33.1%) are included in the agglomerations, of 141 towns − 65 (46.1%), of 234 urban-type settlements − 59 (25.2%). Most urban settlements are located in the first and second zones (75.8%), that is, within a radius of accessibility of 100 km.

Using the cartographic method, we can see that only a small part of the Russian North is covered by urban agglomerations; the most populated is the European part, while the Asian part of the Russian North is less populated. The map clearly shows the proximity of Syktyvkar and Ukhta, Novo-Urengoi, Noyabrsk, Surgut and Nizhnevartovsk, Bratsk and Ust-Ilimsk urban agglomerations. With improved transport communications and reduced travel time between their cores, they could form new, larger agglomerations.

The analysis of works on the agglomeration effect estimation has shown that its calculation requires: 1) hard work on the collection and analysis of socio-economic information, 2) the presence of an interested customer possessing information resource or having access to it, 3) funds and human resources to carry out a sociological survey to study the pull-push migration within the agglomeration area. The experience of such work in the Sverdlovsk Oblast is presented in [38, p. 47−50]. In the future, it will be necessary to calculate the agglomeration effect for northern urban agglomerations using the proposed indicators.

References

1. Fauzer V.V., Smirnov A.V. The Russian Arctic: From ostrogs to urban agglomerations. *EKO=ECO Journal*, 2018, no. 7, pp. 112−130. DOI: 10.30680/ECO0131-7652-2018-7-112-130 (in Russian).

2. Fauzer V.V., Smirnov A.V. The World's Arctic: Natural resources, population distribution, economics. *Arktika: ekologiya i ekonomika=Arctic: Ecology and Economy*, 2018, no. 3(31), pp. 6−22. DOI: 10.25283/2223-4594-2018-3-6-22 (in Russian).

3. Fauzer V., Lytkina T., Smirnov A. Impact of migrations on the demographic structures transformation in the Russian North, 1939−2019. *Regional Science Policy and Practice,* 2020, vol. 12, issue 6. DOI: 10.1111/rsp3.12357.

4. Weber A., Friedrich C. *Theory of the Location of Industries*. Chicago: University of Chicago Press, 1929. 256 p.

5. Marshall A. *Principles of Economics*. New York: Palgrave Macmillan, 2013. 731 p.

6. Ilyin V.A., Uskova T.V. Methods of overcoming the spatial socio-economic differentiation. *Federalizm=Federalism*, 2012, no. 3(67), pp. 7−18 (in Russian).

7. Ivanov O.B., Buchvald E.M. Megacities and agglomerations in the governance and strategic development of territories. *Aktual'nye voprosy ekonomiki=Current Economic Issues*, 2020, no. 6, pp. 7−25 (in Russian).

8. Prokof'ev S.E., Popadyuk N.K., Semkina O.S. New approaches to urban and agglomeration development. *Upravlenie ustoichivym razvitiem=Sustainable Development Management,* 2015, pp. 133−143 (in Russian).

9. Nikonorov S.M., Papenov K.V. Sustainable urban development strategies in Russia. *Ekonomika ustoichivogo razvitiya=Sustainable Development Economics*, 2016, no. 3(27), pp. 296−300 (in Russian).

10. Glezer O.B., Vainberg E.I. The population's living space and settlement patterns as the factors and conditions of modernization in Russia. *Region: ekonomika i sotsiologiya= Region: Economics and Sociology*, 2013, no. 3 (79), pp. 21−38 (in Russian).

11. Pokshishevskii V.V. *Naselenie i geografiya. Teoreticheskie ocherki* [Population and geography. Theoretical essays]. Moscow: Izd. Mysl', 1978. 315 p.

12. Antonov E.V. Urban agglomerations: Approaches to the allocation and delimitation. *Kontury global'nykh transformatsii=Outlines of Global Transformations*, 2020, vol. 13, no. 1, pp. 180−196 (in Russian).

13. Fujita M. et al. *The Spatial Economy: Cities, Regions and International Trade.* Cambridge, Massachusetts: The MIT Press, 1999.

14. Fujita M., Krugman P. The New Economic Geography. Past, Present and the Future. In: Florax R.J.G.M., Plane D.A. (Eds.). *Fifty Years of Regional Science. Advances in Spatial Science*. Berlin, Heidelberg: Springer, 2004. Pp. 139−164.

15. Rusanovskii V.A., Markov V.A., Petrov A.M. Impact of agglomerations on the asymmetry of socio-demographic development of Russian municipalities. *Vestnik SGSEU=Vestnik of Saratov State Socio-Economic University*, 2019, no. 4 (78), pp. 81−85 (in Russian).

16. Kozlova O.A., Soskova O.N. Spatial differentiation factors of urban population density in the industrial regions of the Urals and Trans-Urals. *Ars Administrandi (Iskusstvo upravleniya)=Ars Administrandi (Art of Management)*, 2018, vol. 10, no. 1, pp. 64−79 (in Russian).

17. Soboleva S.V., Smirnova N.E., Chudaeva O.V. The demographic problems of Siberia in the context of spatial development. *EKO=ECO Journal*, 2020, no. 8, pp. 48−65 (in Russian).

18. Lyubovnyi V.Ya. Course "for space compression"? *Teoriya gradostroitel'stva=Urban Panning,* 2012, no. 4, pp. 4−13 (in Russian).

19. Vaynberg E. Space, resettlement and modernization of the Russian economy. *Federalizm=Federalism*, 2013, no. 1(69), pp. 25−38 (in Russian).

20. Shiklomanov N., Streletskiy D., Suter L., Orttung R., Zamyatina N. Dealing with the bust in Vorkuta, Russia. *Land Use Policy*, 2020, no. 103908. DOI: 10.1016/j.landusepol.2019.03.021

21. Bekbolov A.A., Abilov A.Z. Small towns as a factor of sustainable development. *Nauka i obrazovanie segodnya=Science and Education Today,* 2020, no. 6−1(53), pp. 88−91 (in Russian).

22. Shishatskii N.G. *Strukturnaya modernizatsiya kak faktor povysheniya konkurentosposobnosti regiona (na primere Krasnoyarskogo kraya)* [Structural modernisation as a factor in enhancing regional competitiveness (the Case study of the Krasnoyarsk Territory)]. Novosibirsk: Izd. IEIE SB RAS, 2020. 510 p.

23. Duranton G., Puga D. Micro-foundations of urban agglomeration economies. In: Henderson J.H., Thisse J.F. (Eds.). *Handbook of Regional and Urban Economics*. 2004. Vol. 4. Pp. 2063−2117.

24. Belkina T.D., Shcherbakova E.M., Protokalistova L.V. Imbalance between social and economic functions of cities and regions. *Problemy prognozirovaniya=Studies on Russian Economic Development*, 2019, no. 6, pp. 110−122 (in Russian).

25. Listengurt F.M. Criteria for the allocation of large-scale agglomerations in the USSR. *Izvestiya AN USSR= Bulletin of the Russian Academy of Sciences. Geographical Series*, 1975, no. 1, pp. 41−49 (in Russian).

26. Matovykh E. A. Current trends in the development of cities and urban systems. *EKO=ECO Journal,* 2012, no. 2, pp. 182—189 (in Russian).

27. Iglovskaya N.S. Features of urbanization and formation of urban agglomerations in the north of Russia. *Vestnik pomorskogo universiteta=Arctic Environmental Research*, 2011, no. 1, pp. 5—12 (in Russian).

28. Kutsenko E.S. Dependence on the previous development of the spatial distribution of economic agents and the practice of assessing agglomeration effects. In: *Materialy XIII Mezhdunarodnoi nauchnoi konferentsii po problemam razvitiya ekonomiki i obshchestva. V 4 kn. Kn. 3* [Materials of the 13th International scientific conference on the problems of economic and social development. In 4 books. Book 3]. HSE Publishing House, 2012. Pp. 317—329 (in Russian).

29. Storper M. *The Keys to the City: How Economics, Institutions, Social Interaction, and Politics Shape Development.* Princeton, NJ: Princeton University Press, 2013. 276 p.

30. Walker R. Why cities? A response. *International Journal of Urban and Regional Research*, 2016, vol. 40(1), pp. 164—180. DOI: 10.1111/1468-2427.12335

31. Scott A., Storper M. The nature of cities: The scope and limits of urban theory. *International Journal of Urban and Regional Research*, 2014, vol. 39(1), pp. 1—15. DOI: 10.1111/1468-2427.12134

32. Lavrinenko P.A., Mikhailova T.N., Romashina A.A., Chistyakov P.A. Agglomeration effect as a tool of regional development. *Problemy prognozirovaniya=Studies on Russian Economic Development,* 2019, no. 3, pp. 50—59.

33. Rosenthal S.S., Strange W.C. Evidence on the nature and sources of agglomeration economies. In: Henderson V., Thisse J.F. (Eds.). *Handbook of Regional and Urban Economics*. Amsterdam: North-Holland, 2004. Pp. 2119—2171.

34. Teras J., Salenius V., Fagerlund L., Stanionyte L. *Smart Specialisation in Sparsely Populated European Arctic Regions*. Luxembourg: Joint Research Centre, 2018. 50 p. DOI: 10.2760/960929

35. Kolomak E. Development of Russian urban system: Tendencies and determinants. *Voprosy ekonomiki=Voprosy Ekonomiki,* 2014, no. 10, pp. 82—96 (in Russian).

36. Kiseleva N.N., Bavina K.V., Karatunov A.V. Methodological approaches to the study of the nature of agglomeration processes. *Fundamental'nye issledovaniya=Fundamental Research,* 2016, no. 12—2, pp. 422—426 (in Russian).

37. Fauzer V.V., Smirnov A.V., Lytkina T.S., Fauzer G.N. Methodology for defining pivotal settlements in the Russian Arctic. *Ekonomicheskie i sotsial'nye peremeny: fakty, tendentsii, prognoz=Economic and Social Changes: Facts, Trends, Forecast*, 2019, vol. 12, no. 5, pp. 25—43. DOI: 10.15838/esc.2019.5.65.2 (in Russian).

38. Tolmachev D.E., Kuznetsov P.D., Ermal S.V. Methodology for identifying the boundaries of agglomerations based on statistical date. *Ekonomika regiona=Economy of Region*, 2021, vol. 17, issue 1, pp. 44—58. Available at: https://doi.org/10.17059/ekon.reg.2021-1-4 (in Russian).

Information about the Authors

Viktor V. Fauzer – Doctor of Sciences (Economics), Professor, Head of Laboratory, Chief Researcher, Institute of Social, Economic and Energy Problems of the North, Komi Science Center, Ural Branch of the Russian Academy of Sciences (26, Kommunisticheskaya Street, Syktyvkar, 167982, Russian Federation; e-mail: fauzer.viktor@yandex.ru)

Andrei V. Smirnov – Candidate of Sciences (Economics), Senior Researcher, Institute of Social, Economic and Energy Problems of the North, Komi Science Center, Ural Branch of the Russian Academy of Sciences (26, Kommunisticheskaya Street, Syktyvkar, 167982, Russian Federation; e-mail: av.smirnov.ru@gmail.com)

Tat'yana S. Lytkina – Candidate of Sciences (Sociology), Senior Researcher, Institute of Social, Economic and Energy Problems of the North, Komi Science Center, Ural Branch of the Russian Academy of Sciences (26, Kommunisticheskaya Street, Syktyvkar, 167982, Russian Federation; e-mail: tlytkina@yandex.ru)

Galina N. Fauzer – Researcher, Institute of Social, Economic and Energy Problems of the North, Komi Science Center, Ural Branch of the Russian Academy of Sciences (26, Kommunisticheskaya Street, Syktyvkar, 167982, Russian Federation; e-mail: gfauzer@iespn.komisc.ru)