



DESIGN AND THE BUILT ENVIRONMENT OF THE ARCTIC

Edited by **LEENA CHO** and **MATTHEW JULT**



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Design and the Built Environment of the Arctic is a concise introductory guide to the design and planning of the built environments in the Arctic region.

As the global forces of change are becoming more pronounced in the Arctic, the future trajectories for living environments, city-making processes, and their adaptive capacities need to be addressed directly. This book presents 11 new and original contributions from both leading and emerging scholars and practitioners, positioning the Arctic as a dynamic, diverse, and lived place at the nexus of unprecedented socio-environmental transformations. The volume offers key concepts for understanding and spatializing Arctic cities and landscapes; similarities and differences in the development of design and planning approaches responsive to specific climatic and cultural conditions; and historical and geographic case studies that provide unique perspectives for the management of the built environment, from the scales of a building and infrastructure to cities and territories. Altogether, the contributions expand regional Arctic design scholarship to understand how the variability of the Arctic context influences the designed urban, architecture, and landscape systems, and offer numerous lessons for design and other forms of spatial practice both within and beyond the Arctic.

This is a unique resource for researchers, creative practitioners, policymakers, and community decision-makers, as well as for advanced undergraduate and graduate students.

Leena Cho is an Associate Professor of Landscape Architecture at the University of Virginia School of Architecture, co-director of Arctic Design Group (ADG), and co-principal of the design practice Kutonotuk. Her research centers on material agencies, urban landscapes, and scientific sites in the Arctic environments.

Matthew Jull, Ph.D., is an Associate Professor of Architecture at the University of Virginia School of Architecture, co-director of Arctic Design Group (ADG), and co-principal of the design practice Kutonotuk. Merging backgrounds in both architecture and as a research scientist in geophysics, his work examines the design of cities and buildings in extreme environments.

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Edited by Leena Cho and Matthew Jul/

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6

GREEN SPACES IN THE CONTEXT OF CHANGING HUMAN-ENVIRONMENT RELATIONS IN SIBERIAN CITIES

Vera Kuklina, Roman Fedorov, Oleg Sizov and Elena Rasputina

Abstract

This essay explores human-environment relations through the history of transformations of green spaces in Sub-Arctic Siberian cities. We examine a variety of relations drawing on the examples of cities of Tyumen, one of the oldest created during the Russian colonization of Siberia in 1586, and Nadym, officially founded during Soviet "mastering of the North" in 1972. Using secondary sources on history of urban development and urban planning standards, interviews with local residents and personal observations, we reconstruct and analyze utilization of native and introduced trees for creation and maintenance of green spaces. Using this analysis, we can trace how migration of humans and plants from elsewhere transformed lands of Siberian Tatar, Nenets, Kami and other Indigenous nomadic peoples into urban modern landscapes. As urban planners grapple with the challenges of climate change, they need to take into account the unique local climate and environmental conditions that have emerged within cities, setting them apart from natural landscapes.

Introduction

Any urban landscape while being an inherent part of nature is also materialization of certain cultural values, economic prosperity, technological advances, intellectual ideas and power relations. This situation is especially clearly reflected in the green spaces of cities. Looking at the history of their formation, one can trace how dominating ideas about urban environment, plans of the socioeconomic development of the city, urban planning norms and standards interact with national and local cultures and natural climatic conditions. In Russia, these interactions changed significantly during different stages of history. While we do not have well-preserved historical records of those interactions during the period of colonization, at the end of the 19th century, with development of capitalism and increasing participation of Russia in trade, some Russian cities became more involved in circulation of ideas evolving in Europe and North America. In particular, important to

both settlers in Nebraska (Arbor Day 2023) and Siberia (Kaptsevich 1906) was the idea of celebrating Arbor Days for planting trees in unfamiliar landscapes. In Russia, its celebration was centralized since the end of 19th century when the Ministry of Public initiated and supervised Arbor Day across the country (Sulimov 2017). In addition, in Russia, the practices of landscaping territories with the help of schoolchildren were consistently developed both by forestry scientists (Tursky 1892) and educators (Bystrov 1903; Selivanovsky 1901). For example, writer and teacher Klavdia Vladimirovna Lukashevich published the book where she explained to schoolchildren the utilitarian and aesthetic value of trees and provided practical advice on landscaping areas near churches, schools and village houses (Lukashevich 1911).

With the establishment of Soviet power in 1918, authorities started to consider architecture and built environment as an arena of ideology (Humphrey 2005; Meerovich 2017). Utopian ideas of Ebenezer Howard's book *Garden Cities of To-Morrow* (1898) with unified general plans of compact development, collective ownership of land and housing and creation of green spaces were translated into Russian and published in Russia in 1911, but in the Soviet time, became widely appreciated as an "innovation of the social order" and "man-made nature" (Meerovich 2017). Meanwhile, green spaces were often parts of discussions about quality of life and environmental prospects (Ianitskii 1987; Stas 2014; Yanitsky and Usacheva 2017). The greening of cities was mainly guided by the regulations established by the People's Commissariat for Public Utilities of the Russian Federation (Danilov 1936). New landscape gardening zones were formed to embody new functional tasks of the public spaces of the Soviet city that assigned sanitary and hygienic, reclamation, architectural, decorative, and economic performances to landscapes (Danilov 1936). It had recommended norms of green spaces for different types of urban development. For example, it was recommended that the average size for the green spaces in a city with parks of culture and recreation be approximately 25 square meters per person, not counting gardening within courtyards where the norm of green spaces per person ranged from 12 square meters to 20 square meters (Danilov 1936). In addition to the requirements for intracity plantings, recommendations were developed for formation of citywide protected zones. Green zones were to be created on the windward side and make up at least one-third of the city perimeter, having a width of 50 meters to 70 meters. Near industrial enterprises, the width of the green zone was to be at least 2 kilometers (Danilov 1936). More detailed norms and requirements for green spaces provision in cities according to specific climatic zones were formulated and included in the building codes and regulations (Construction Norms and Regulations - SNIPs) at the national scale (Construction norms and rules 1954).

Currently, both in Russia as in other parts of the world, a growing body of literature considers green spaces as providers of ecosystem services that can satisfy certain utilitarian and cultural needs of urban residents (Krekel, Kolbe and Wiistemann 2016; Latham and Layton 2019). At the same time, with climate change, there is a growing understanding of the need to heal human-environment relations that were disrupted by colonization and extractivism (Cowen 2020). In this regard, we need to reconsider urban development to understand agency of local environment. The latter is especially visible in the Arctic and Sub-Arctic, where the idea of cities themselves has been brought and materialized by settlers in Russia - Cossacks and peasants migrated from European Russia and their descendants (Forsyth 1989). As a result, in addition to regular modification of the built

environment as well as green spaces from surrounding natural landscapes, the settlers cities have served as hubs of colonization.

While there have already been successful examples of urban planning for harsh climatic conditions such as in the Arctic (Chapman et al. 2018; Costamagna, Lind and Stjernstrom 2019; Pressman 1995), ideas of celebration and appreciation of northern landscapes often remain foreign to settler population. Moreover, quite often local specificities in Arctic cities are overlooked by planners who are predominantly from the national centers located in milder climates. To understand the vast potential of ideas of centralized planning, one must look no further than the Soviet experience of urban development. The scale and extent of how far these ideas could reach are best demonstrated by the Soviet Union's ambitious and extensive urban development initiatives. From the construction of towering high-rise buildings to the development of entire cities, the Soviet Union's approach to urban development serves as a prime example of the potential impact of centralized planning on a grand scale in general and in Arctic cities (Jull 2017). While the creation of built environment was successfully implemented, modification of nature in the form of green spaces has raised another set of issues. In the Arctic cities, particular attention has been paid to improving and gardening of northern landscapes through geobotanical surveys of state and conditions of green spaces with particular attention paid to specific species that could adapt both to local climate and urban environment (Chindyaeva et al. 2018; Mamaev 1978; Mindovskiy 1947; Pomazkova 1962; Srodnykh 2005).

This chapter presents a case study of open green spaces transformations in two cities in Western Siberia - Tyumen and Nadym - that exemplify the ways settlers transform nature over longer (over four centuries) or shorter (about 50 years) periods of time and how these transformations were subject of changing perceptions of nature, ideology, regulations and settlers' imaginaries about city and nature. We particularly focus on histories of trees and tall shrubs used for greening of public spaces, since their longer lifespan allows us to consider them as witnesses of different epochs.

Some general understanding on what Tyumen and its streets and parks looked like at the turn of the 19th and 20th centuries can be obtained from popular books (Klyueva 2002; Kubochkin 2002). Sulimov (2017) has explored what role schools played in greening practices in Tyumen and Western Siberia. In addition, a number of geobotanical studies assessing the dynamics of species composition, quality and ecological functions of green spaces in Tyumen have been conducted (Glazunov et al. 2020; Kazantsev and Kazantseva 2009; Vidyakina and Semenova 2009). The ecology of the city of Nadym has been systematically studied over the past ten years by the Tyumen State University, the Scientific Center for the Study of the Arctic and a number of other research teams of geobotanists and geoecologists (Kirilyuk 2006; Kirilyuk and Bugarov 2007, 2008; Krasnenko et al. 2018, 2019; Pechkina et al. 2016; Pechkin et al. 2018; Pismarkina and Bystrushkin 2019; Popov et al. 2014; Yakubson et al. 2012). From 2020 to 2022, we conducted studies of the socio-ecological aspects of the development of open public spaces in Nadym, which included the integration of the results of geoecological and socio-anthropological studies (Fedorov et al. 2021; Kuklina, Sizov and Fedorov 2021; Sizov et al. 2022). While parks play the central role in discussions, the residents have also emphasized the variety of green spaces that local residents benefited from. Continuing these studies of public spaces in the Russian Arctic cities, we trace the evolution of settlers' imaginaries of nature through their relations with green spaces.

Study areas

Tyumen and Nadym, two cities located in Western Siberia, provide illustration of two different trends of green space development in quite similar socioeconomic and administrative-political conditions. They are both located in the Tyumen region, one of the largest regions of the USSR, occupying an area of 1,464,173 square kilometers, similar to the size of Alaska. The northern boundaries lay over islands in the Arctic Ocean while the southern ones are formed by border with Kazakhstan (Figure 6.1). The lands of Siberian Tatars - reindeer herding, fishing and hunting of Indigenous peoples Khanty, Mansi, Nenets and Komi-Zyryans - were included in the region (Forsyth 1992). The regional governance has a nested structure: Khanty-Mansi Autonomous okrug - Yugra and Yamalo-Nenets Autonomous Okrug have some level of cultural autonomy, although politically are part of the Tyumen region.

As in many other Arctic regions, while the large urban centers grow, such as Tyumen, smaller cities and rural areas are losing population. However, due to oil and gas industrial development, the population of Nadym remains quite stable (Figure 6.2).

Founded in 1586, Tyumen (57.1553°N, 65.5619°E) is the first Russian city in the Asian part of Russia built as a military-defense fort on the site of the former capital of the Siberian Tatars Tyumen ulus of the Golden Horde - Chingy-Tura (Belich 2009). It is located in the sub-taiga with continental climate which, depending on topography and soil, allows the growth of aspen-birch forests, pine forests, alder forests, willows, wetlands and grassy meadows (Klyueva 2002). From the moment of its foundation, the city has served as one of the most important centers of Russian colonization of the north of Western Siberia, settled mostly by Cossacks and "men of service" at the beginning, and later joined by peasants from the European parts of Russia (Forsyth 1992). With the construction of the Trans-Siberian Railway (1893-1896), Tyumen became the largest economic center of the region due to the active development of trade and industry and a migration point for peasants from the European part of Russia to Siberia (Wolmar 2014). The administrative and economic importance of Tyumen increased during the Soviet period with relocation here of the heavy industry during World War II. After discovery of the largest oil and gas reserves in the country in the 1950s and 1960s in these lands, Tyumen became the center for an oil and gas production complex in Siberia with regional authorities and industry design institutes that managed and planned the industrial development of the Arctic territories. The aviation transportation hub was established to connect the city with other regions in the area, facilitating movement of people, goods and ideas. The informal name, "Tyumen North," was often used in relation to the Khanty-Mansiysk and Yamalo-Nenets Autonomous Okrugs. In turn, settlers of the Tyumen North often call Tyumen "the mainland" not only because this city was a development base and had all the attributes of a full-fledged regional center (developed social, industrial and transport infrastructure), but also because of its location in the south of the region in the zone of temperate climate and mixed forests. Tyumen materialized for many people in the region a visual image of standard urban nature and its traditional utilitarian functions - such as the possibility to engage in agriculture, to have personal plots and "dachas" or summer cottages - similar to the central zone of Russia. By the beginning of the 21st century, it became one of the most dynamically developing administrative centers of Russia expanding across 48,556.4 hectares area.

Nadym (65.5345°N, 72.5045°E) was built in the forest-tundra zone in the West Siberian Plain, where the Nenets conducted their traditional economic activities, about

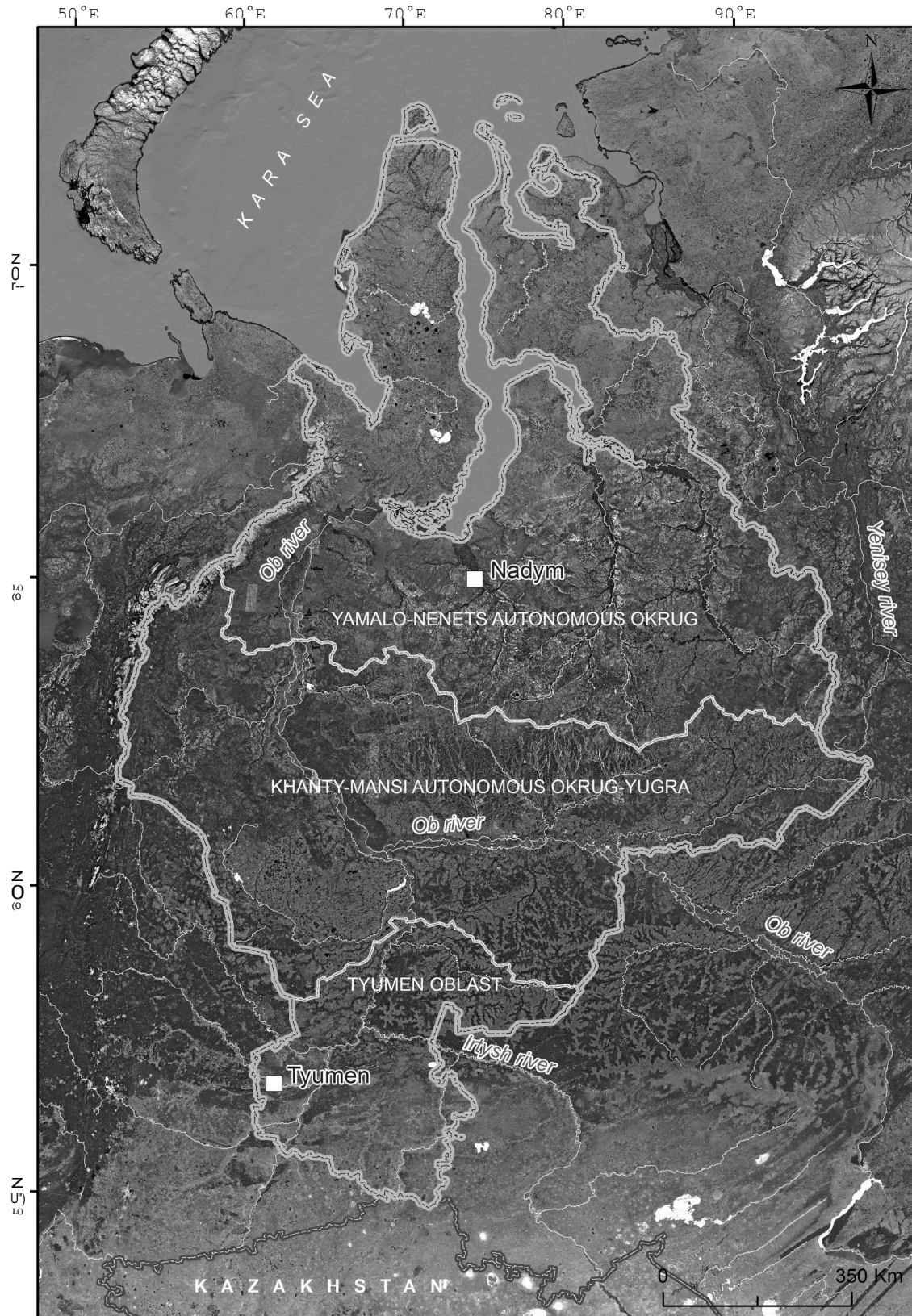


FIGURE 6.1 Study area. Map created by Oleg Sizov.

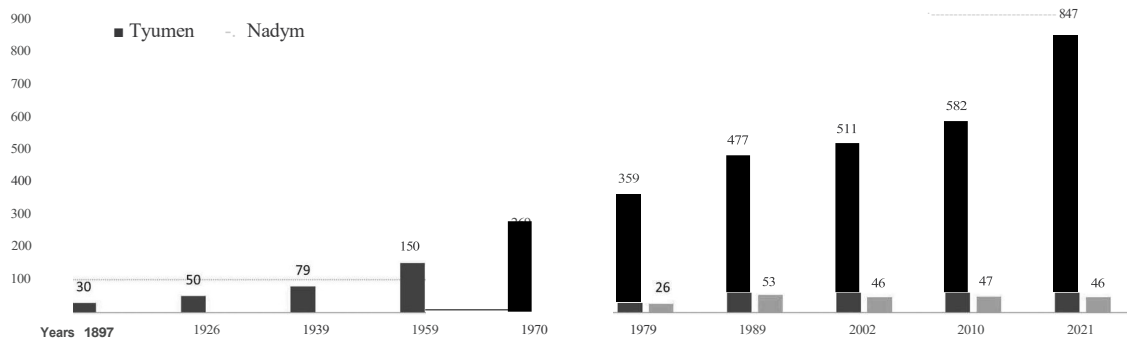


FIGURE 6.2 Population dynamics in Tyumen and Nadym (1,000 people). Source: Histogram by Vera Kuklina based on the population data retrieved in 2023 from general population census of the Russian Federation (General Population Census 1897, 1926, 1939, 1959, 1970, 1979, 1989, 2002, 2010a, 2010b).

100 kilometers south from the Arctic Circle. It is one of the typical young Arctic cities located on the territory of the Yamalo-Nenets Autonomous District of the Tyumen Region. The city was officially founded in 1972 for the permanent residence of families of gas production workers. Thousands of people participated in its construction, and in a couple of decades population reached 46,000, outnumbering local Indigenous population that hardly reached 844 people or about 2% by 2020 (Territorial plan for Nadym municipality 2020). The Nadym municipal area spans over 3,700 hectares and consists of the city of Nadym, an airport, the Nadym railroad station and an industrial area referred to as "the 107th km." Among these, only the city has residential and business sectors that have been developed according to a master plan, incorporating designated open public spaces. The urban green spaces in the city encompass natural vegetation found on the outskirts as well as deliberately planted vegetation, primarily including white birch trees, various types of willow trees and flowers, along the main streets and squares (Pechkina 2019). For this study, we are specifically concentrating on the city itself and the neighboring industrial zone, amounting to a combined area of 839.8 hectares. Construction of the city and infrastructure disrupted reindeer migration routes, pasturelands and hunting grounds and depleted subsistence resources, such as game and fish, berries and mushrooms around the city (Forbes et al. 2009). Very few Indigenous people live in the city itself, even less are involved in extractive industries. Therefore, both Tyumen and Nadym are the examples of settler cities differed by the duration of colonization, transportation accessibility and socioeconomic functions.

Methods

For understanding transformations in human-environment relations in the cities, we studied the effects of intellectual ideas, regulations and local initiatives that determined the character of green spaces in Tsarist time, Soviet period and with market reforms and global changes in Tyumen and later on in Nadym, with a focus on what was similar and what was developed differently. Further, we examined the socio-ecological ties between Tyumen and Nadym that allowed us to understand the impact of their connectivities on the movement of people and plants.

The study was based on the analysis of written and oral sources. The written sources included documents on administrative improvement measures for the cities of Tyumen and Nadym, stored in the State Archives of the Tyumen Region and the Municipal Archives of the Nadymsky District. In addition, we analyzed content of local history works, publications in local periodicals, Internet resources and discussions on the topic in social media. These materials were supplemented by semi-structured thematic interviews conducted in 2020-2023 with six residents of Tyumen and eight of Nadym, who from the 1970s to this day have been directly involved in the landscaping of public and private backyard spaces and have also been professionally engaged in the development of urban green infrastructure. In addition, between 2020 and 2022, the authors directly observed qualities, such as health and composition of plants, available infrastructure and usage of public green spaces, such as attendance during different times of the day and week, social composition of visitors and different activities during all seasons in Tyumen and during the summer in Nadym.

For understanding changes in green spaces within the current boundaries of the cities, we analyzed land cover change for the last decades using satellite images. For that purpose, through the Google Earth Engine (GEE) platform, we acquired the earliest and the latest available scenes, Landsat 5 (1987) and Landsat 8 (2022) respectively. We identified green spaces using Random forest classifier. We selected ten polygons for each type, year and city for training. The classification accuracy was 0.99. Based on the resulting maps of green spaces in 1987 and in 2022, we were able to calculate what gains and losses occurred with green spaces during this period in Tyumen and Nadym.

Tyumen: Green spaces from Tsarist and Soviet times

Tyumen until the early 19th century existed as a small compact settlement, so its inhabitants had access to the surrounding forests and meadows for the collection of wild edible or medicinal plants and for hunting purposes (Kubochkin 2002). The expansion of the town had mixed urban-rural character, with elements of agrarian lifestyles on the urban outskirts (Kochedamov 2021). On the photographs of Tyumen in the second half of the 19th century, it is clearly seen that there are no or very few trees along the main streets of the city (Figure 6.3). To address the issue, at the end of the 19th century, the City Council of Tyumen recommended planting poplars along the main streets of the city (GBUTO 1896. F.I-2. Op. 1. D. 526. L. 162). However, the initiative was hindered by the fact that most of the population of Tyumen lived in their own estates that were often agricultural in use: cows and goats grazed on the streets of the city and ate the seedlings, limiting the presence and maturation of street trees (Kubochkin 2002). So only fenced green spaces could be preserved and developed.

The first documented attempts to create parks and gardens in Tyumen can be traced back to 1838, when the public Country Garden was open (Kubochkin 2002). To bring the garden to life, a diverse array of trees, berry bushes and flowers were transplanted from the surrounding areas (Kubochkin 2002). Since its creation till the Soviet time, the garden was used for the most important local event - annual commemoration of the heir to the throne, Alexander Nikolayevich's historic visit to Tyumen in 1837. Since 2007, the Alexander Garden, although much smaller, had gone through a series of renovations with sculptures commemorating the Tsarist time and became one of the most popular urban public spaces (author's personal observations).

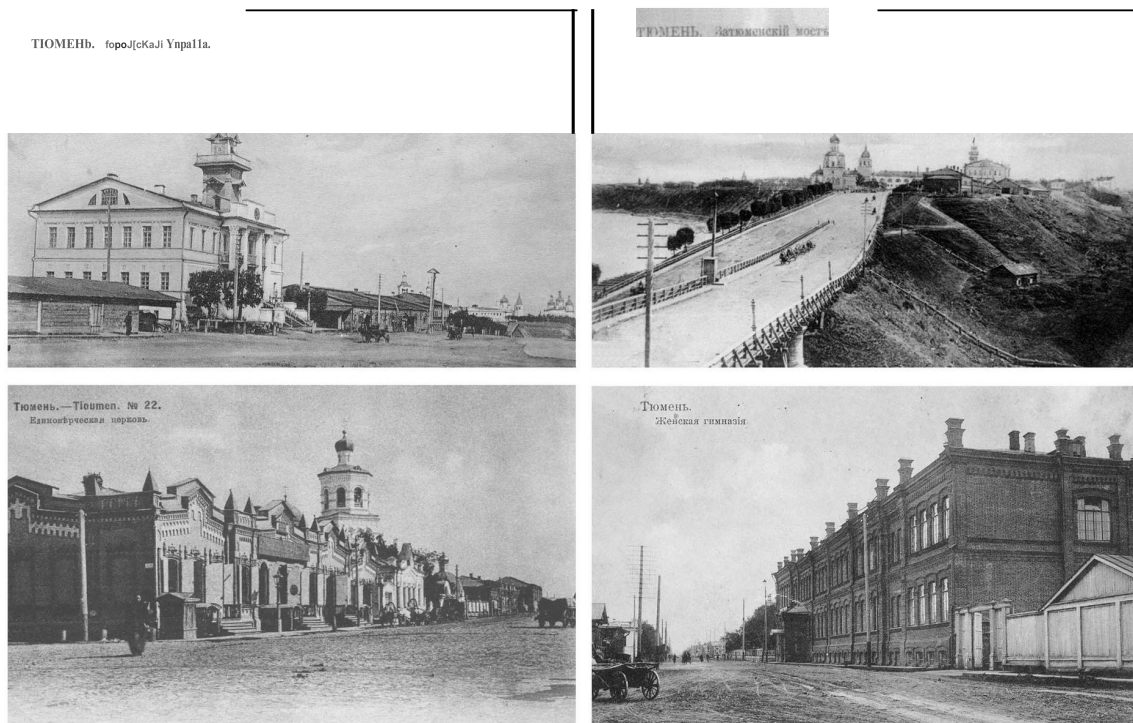


FIGURE 6.3 Views of Tyumen's main streets on postcards of the late 19th and early 20th centuries: Respubliki (former Tsarskaya) and Lenina (former Spasskaya). Source: Open social group Tyumen before our era. <https://vk.com/tyumengrad>.

There were also a few other sporadic initiatives to create smaller parks or gardens, such as that created in 1843 at the initiative of pharmacist Alexander Daudel: an apothecary garden. It grew not only medicinal plants, but also some native trees, such as lindens, birches, larches, spruces, cedars and pines, some of which still grow in the city; the street was named Daudelskaya after the pharmacist (Kubochkin 2002).

Arrival of non-native trees was related to the opening in 1895 of the Tyumen railway connection with the European part of Russia and subsequent formation of commodity market for decorative and utilitarian plants (Kubochkin 2002). While previous delivery of seedling from other regions was impossible due to long distances, now it took a few days. For example, in 1915, Aleksandrovskaya Square park opened with the introduction of non-native decorative species from Saratov's private gardening company (in the southern part of European Russia), ordered and delivered by train (GBUTO GATO. 1915. F.I-1. Op. 1. D. 366. L. 133). While none of these plants survived, the area of the former park remains a popular public place in the city (author's personal observations).

Soviet era ideas embedded public spaces in the process of social experiment. As soon as the Bolsheviks came to power in 1918, the gardens at the Real School and the Women's Gymnasium were merged with the garden on Aleksandrovskaya Square and renamed as the "Soviet Park." It ended traditions of separate girls' and boys' education and made larger areas accessible for the public (Kubochkin 2002). A new city garden, opened in the center of Tyumen in 1936, also combined recreations with sports and had areas for sports competitions, a parachute tower and a dance floor (Ivanenko 1999). Importance of green

spaces for public health was emphasized with protecting from economic development all the forests surrounding Tyumen within a radius of 10 kilometers in 1946. In 1960, the radius was increased to 30 kilometers (Ivanenko 1999).

The choice of species composition for landscaping as a rule was determined by local executive authorities: Tyumen Regional Council of Deputies and Workers and municipal service branches. The low-maintenance, rapid growth rate and high self-seeding ability led to widespread use of box elder (*Acer negundo*) for greening along the roads in the city and beyond. Its first documented use was found in the Road Construction Office of the Tyumen Regional Executive Board's documents dating back to the mid-1930s on landscaping the Tobolsk tract - a 244-kilometer road connecting Tobolsk and Tyumen (GBUTO GATO. 1934. F. R-855. Op. 1. D. 20. L. 8). The arguments for the choice of species are found in the 1958 Executive Committee of the Tyumen Regional Council of Deputies and Workers recommendation for planting gardens and squares "mainly with fruit plantations and trees with good crown (Mountain ash, Bird cherry, European ash, etc.)" (GBUTO GATO. 1959. F. R814. Op. 1. D. 3250. p. 24). While the planting of most of these species was successful, the European ash (*Fraxinus excelsior*) tree adapted poorly to the local climatic conditions and eventually disappeared from the urban landscape (author's personal observations). Finally, accessibility of native trees in the surrounding forests led to their massive use from the late 1950s to early 1960s with the development of those evacuated from the west industrial factories during the World War II and the construction of new ones (Erofeev, Nikolai. 2022. Interview by R. Fedorov. Tyumen. August 16, 2022). Most of these factories were located within the city and had assigned landscaping tasks to meet SNIP standards (Danilov 1936). They utilized extensive material and technical and human resources to bring and plant seedlings from the forest to the territories under their jurisdiction.

In the 1960s and 1970s, the nursery system of the Tyumen forestry started to experiment with the introduction of non-native woody plants mostly brought from the European part of Russia (Klyueva 2002). Balsam poplar (*Populus balsamifera*) and box elder were praised for adaptability and rapid growth; they were massively supplied from the nurseries for greening the city streets and residential yards and soon became the most common trees in the city (author's personal observations). The poplar tree was also known for its high degree of resistance to pollutants and the ability to effectively protect the air along urban roads from dust and exhaust fumes (Avdeeva 2022). Other trees and tall shrubs, such as the appleberry tree (*Malus baccata*), common lilac (*Syringa vulgaris*) and common mountain ash (*Sorbus aucuparia* L.) had more decorative values (Vidyakina and Semenova 2009). Their introduction allowed to meet requirements for every collective, be it a nonprofit organization or an educational institution, to green streets, roads and other common areas (Figure 6.4) (author's personal observations). (GBUTO GATO. 1959. F. P814. Op. 1. D. 3250. L. 40).

Native trees were preserved in the forest park zones created on the outskirts of the city. In particular, on the western and northern edges of the city the Zatyumensky forest park and the Forest Park named after Yuri Alekseevich Gagarin Dacha received the status of regional natural monuments in 1968 (GBUTO GATO. 1984. F. 1894. Op. 1. D. 1037.). In 1984, the Gilevskaya Grove, located in the east of the city, was turned into a forest park and maintenance care was taken of by several industrial enterprises adjoining it (GBUTO GATO. 1984. F. 1894. Op. 1. D. 1037. L. 76).



FIGURE 6.4 Yunosti Square in Tyumen. Left photo: A row of poplars planted by Mayak garage cooperative members in the 1970s, which evolved into the square. Right photo: A view of the same trees from the inside of the square. The trees act as a protective strip and form one of the alleys of the square at the same time. Source: Photos by Roman Fedorov (2023).

Nadym: City born by industrial development

Construction of the city disrupted reindeer migration routes, pasturelands and hunting grounds of Khanty and Nenets Indigenous peoples. Subsistence resources such as game and fish, berries and mushrooms were also depleted around the city (interview with resident, Nenets, male 50 in Nadym, 2021). The interests of these peoples were not taken into account when the city was planned and built.

Before the foundation of Nadym as a city, the projects of its development were focused on its maximal isolation from the harsh environment to the point that ideas of building a city under the dome were discussed (Leontyeva and Karpova 2016). Similar to many other cities created during the late Soviet time (from the 1960s to the 1980s), Nadym was built in accordance with a master plan developed by the Regional Research and Design Institute of Typical and Experimental Design of Residential and Public Buildings (3oml.7lhHhIH Hay<IH0-11CCJiep;oBaTeJihCKHH 11 rrpoeKTHbIH 11HCTIIT)'T TI1ITOBOrO 11 3KCrep11MeHTaJibHO rrpoeKT11poBamr)KMJihIX 11 o6rn;ecTBeHHhIX 3p;att11i1: [JIEH3H11UI3I1]). The Institute created a series of standard designs of residential and public buildings specific for Arctic climate zones, with protocols for heat insulation and snowdrift prevention in the Far North settlements (TSGANTD SPb 1957, F. R-17. Op.22. D. 425; TSGANTD SPb 1964, F. R-17. Op.24. D. 878). It paid particular attention to ensuring a high compactness and connectivity of urban infrastructure to minimize the city residents' exposure to the cold air. The city was built up by multistory (five- to nine-stories high) panel building blocks in a small area, with a population density reaching 242.32 people per square kilometer (Territorial plan for Nadym municipality 2020). Pedestrian distance to service facilities and passenger transport stops decreased in comparison with the established SnIP P-K, 2-62 by 1.7 times (The Nadym Municipal Archive 1971, F. 19, Op. 3, D. 11, p. 18). The design standard also aimed to reduce wind speed and protect open spaces from winds and snowdrifts by creating aerodynamic clusters of residential buildings, hotels, dormitories and more acting as windproof (The Nadym Municipal Archive 1971, F. 19, Op. 3, D. 11, p. 18).

While the city of Nadym followed the same norms and standards in tree planting and in *subbotniki* as in Tyumen involving large-scale industrial enterprises and schools, the local natural and climatic conditions have been less favorable being located further up north. A significant part of housing construction and street planting as well as adjacent areas of the city was carried out on bare sands to avoid swampy grounds of the surrounding tundra and permafrost conditions (Fedorov et al. 2021). According to the memories of Valery Martynov, one of the organizers of Nadym's construction, in some cases only two trees out of 100 planted in the city successfully established roots (Martynov, Valery. 2021. Interview by R. Fedorov. Nadym. October 20, 2021). Limited connectivity of the city also narrowed the choice of tree and shrub species for landscaping by the closest locations. As mentioned by Fedorov et al. (2021), the original master plan for Nadym did not include park areas within the town, but the first secretary of the Nadym City Committee, Evgenii Fedorovich Kozlov, who oversaw the town's construction, insisted on preserving the natural vegetation at the town center and suggested turning it into a park, which was subsequently named after him (Figure 6.5). Thus, despite the existing master plan created in Moscow and used for most of the city, certain influential individuals were able to introduce some changes on the local level. A second patch of natural vegetation, Cedar Grove, was preserved because it was located on the outskirts of the city.

The support for Siberian pine trees stretched beyond a simple preservation of this native species in the city. For instance, in Kozlov Park, they face unfavorable growing conditions due to the Arctic climate and human activity. Maintenance specialists and arborists found that changes in soil structure and moisture content as well as in the urban microclimate with nearby high-rise buildings have negatively impacted the cedars (Shvetsov, Sergei. 2020. Interview by R. Fedorov. Tyumen. October 15, 2020). Additionally, visitors' frequent walks near the trees have caused both soil erosion and denudation, exposing tree roots to the ground surface (Fedorov et al. 2021) (Figure 6.6). The city administration has had to artificially maintain the presence of cedars by cutting birch trees that in natural conditions usually grow in disturbed areas (Shvetsov, Sergei. 2020. Interview by R. Fedorov. Tyumen. October 15, 2020). Therefore, in urban conditions, Siberian pine becomes one of cultivated species that cannot survive without human intervention.

It is important to note that in an Arctic city such as Nadym, appreciation of trees increases significantly. Most of these residents are settlers who have migrated from southern regions, and the presence of vegetated urban parks and squares, they note, brings them closer to the familiar images of their homeland landscapes (Fedorov et al. 2021). Many interviewees expressed nostalgia for certain plants that grow in their homeland, for example, poplar, chestnut, lilac and other ornamental shrubs and flowers.

During the city construction, residents planted seeds brought from the southern regions and experimented with the plants' adaptability to new growing conditions (Pechkina, Yulia. 2021. Interview by R. Fedorov. Nadym. September 9, 2021). They used the natural landscapes surrounding the city for recreation as well as for subsistence (Pechkina, Yulia. 2021. Interview by R. Fedorov. Nadym. September 9, 2021). Senior residents have noted that the diversity of herbaceous plants increased significantly with urban development due to the artificially improved soil quality and introduction of seeds of new species, including weeds that were purposefully or accidentally brought into the city by its residents (Esau and Miles 2016). Thus, while greening the cities during the Soviet time was a part of



FIGURE 6.5 Kozlov Park (left) and Cedar Grove (right). Photos by Roman Fedorov (2022).

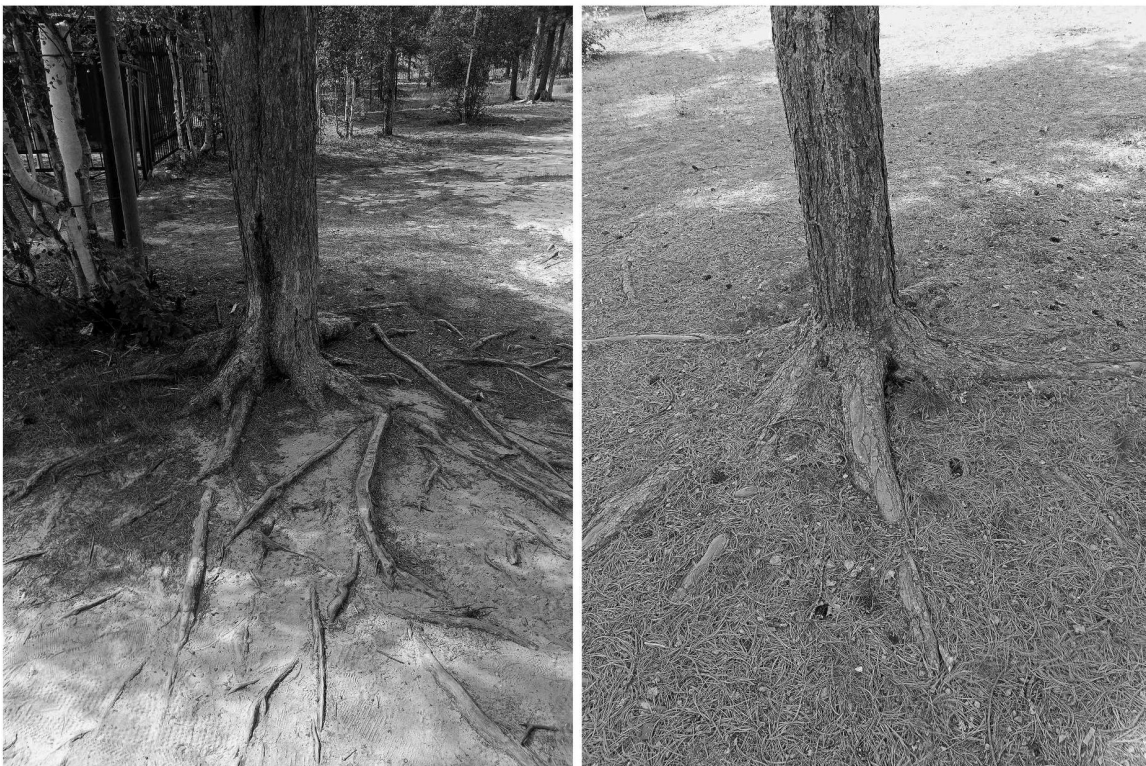


FIGURE 6.6 Examples of soil denudation and exposed tree roots in Cedar Grove. Photos by Roman Fedorov (2022).

"top-down" organization of creating collective public works and standards (*subbotniki*, month-long tree planting campaigns, SNIP etc.), there were also individualized "bottom-up" local efforts that protected green spaces in the city.

Green spaces of Tyumen and Nadym with market transitions

The collapse of the USSR in 1991 was reflected in the green spaces in a variety of ways. For Tyumen and Nadym in the 1990s, it meant lack of maintenance and monitoring. Nature in the form of plants - shrubs and trees - started to reclaim abandoned places, such as

wastelands, ravines, buffer zones along railways, heating pipes, fences and other structures that were left behind without maintenance and control (author's personal observations). At the same time, due to the weakening and sometimes complete cessation of control over green spaces, yards surrounding residential buildings often turned into informal parking lots cleared of trees (author's personal observations). The process of urban densification and commercial development at the expense of green areas continued in Tyumen into the 2000s due to its rapid growth (Krjahtunov, Bogdanova and Zaharov 2019).

Analysis of tree cover changes on the territory of the current cities during the last 35 years shows that it decreased both in Tyumen and Nadym (Figure 6.7). In Nadym, changes are more dramatic (more than two times) because in 1987 the city was still growing, building new houses in previously forested areas. While the city has regained 13.2% of green spaces, it lost a much larger area. Tyumen lost relatively less; however, the amount of lost green spaces accounts for over 10,000 hectares (Table 6.1).

At the same time, both cities witness a growing bottom-up initiative of green space improvement with the support of municipalities. For example, municipal authorities have turned Zatyumensky Park and Gilevskaya Grove to multifunctional zones for sports and recreation. Furthermore, local activists opened a private park, "Iva-Park," in 2018 in the vicinity of Tyumen, where the canons of the Japanese garden were reinterpreted and adapted to the conditions of Siberia (Iva park 2023).

With growing travel opportunities and online communication, some residents greened the public and private spaces using imported seeds and seedlings ordered online. In Tyumen, they include English oak (*Quercus robur*) and Manchurian walnut *Uglans mandshurica*). At the same time, there is a growing awareness of the harm that introduction of new species can bring. In particular, Tyumen has just adopted landscaping strategy with plans until 2040, where box elder and balsam poplar were excluded from the main planting assortment of woody plants due to their ambiguous role in the city (Tyumen online 2023). People with asthma or allergies suffer during the balsam poplar fluffing or purposely leave the city for that period. The poplar fluff - massive amounts of seeds covered in seed hair - is highly flammable and can quickly catch fire and burn off on the streets, damaging other elements of the green infrastructure. At the same time, poplars remain one of the most effective tree species for purifying urban air (Avdeeva 2021). The box elder planted along the streets took over many unattended spaces and wastelands, and is considered by some residents as an invasive species (Sapanov and Sizemskaya 2021). However, preference in the landscaping strategy for the city is still given to common coniferous and decorative trees brought from the western parts of country (Administration of the city of Tyumen 2023).

Green spaces development in Nadym started to follow the general regional landscaping trends after the 2015 opening of the bridge over Nadym river that connected Nadym to other regions independent of seasons. Many interviewees mentioned that after its opening, they began to order many types of plant seeds online, especially frost-resistant plant varieties from other cold regions. Another popular type of green space in the city is the greenhouse created at Gazprom Transgaz Yugorsk. It was initially built as a small recreational facility in the company's administrative building in the early 1990s. At present, it has about 1,500 tropical and subtropical plants; these plants have been replenished from the St. Petersburg Botanical Garden as well as privately by Gazprom employees bringing exotic plants from vacations in the southern regions and other countries (Sherstobitova, Yulia. 2021. Interview by R. Fedorov. Nadym. July 15, 2021).

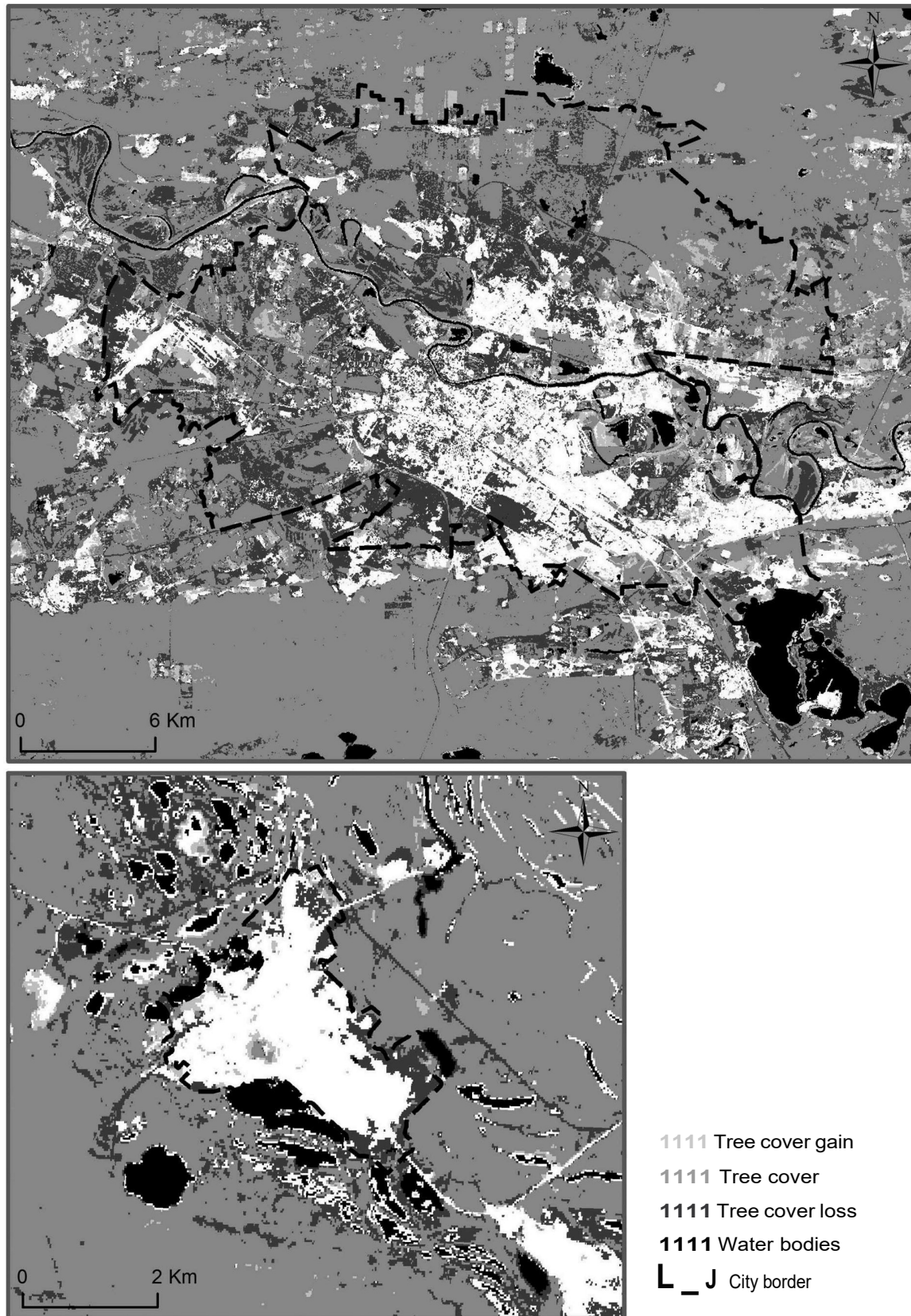


FIGURE 6.7 Green space changes in Tymen (top) and Nadym (bottom) from 1987 to 2022. Maps created by Oleg Sizov.

TABLE 6.1 Changes in green spaces between 1987 and 2022 in the cities of Tyumen and Nadym

<i>Cities</i>	<i>Study area</i>	<i>1987</i>		<i>2022</i>		<i>Lost</i>		<i>Gained</i>	
		ha	%	ha	%	ha	%	ha	%
Tyumen	48,556.4	32,800.7	67.6	22,513.9	46.4	13,436.6	37.4%	3,149.8	8.8%
Nadym	839.8	214	25.5	95	11.3	151.56	61.5%	32.53	13.2%

In recent decades, the processes of organized introduction of plants from Tyumen to Nadym have intensified; for example, in 2021, willows were brought to Nadym from the Tyumen Garden nursery (Sizov et al. 2022). Tyumen also serves as a point of reference for Nadym residents in many spheres, including greening of the city. Nadym residents have noted that unlike Tyumen, Nadym has significantly fewer allergenic plants and no poplar fluff, less invasive plant species and encephalitis-causing ticks (Shvetsov, Sergei. 2020. Interview by R. Fedorov. Tyumen. October 15, 2020). Researchers calculated that out of the 101 plant species growing in Nadym, only 11.88% are cultivated by people, 53.47% are wild plants and 34.65% are invasive species, while in Tyumen there are 225 plant species of which 21.33% are cultivated by people, 35.56% are wild and 43.11% are invasive (Glazunov et al. 2020).

Discussion and conclusions

Colonization and subsequent urbanization in the Russian Arctic and Sub-Arctic have brought cultures distinct from the local, with some variations on the attributes of metropole cities that are copied and transferred to new natural and climatic conditions. Over its more than 400-year history, Tyumen evolved from a small fort on the frontier of the Russian colonization of Siberia to a dynamically developing administrative and economic center of one of the largest oil and gas regions in the world. While at the beginning it adapted to the local environmental conditions, with the establishment of transportation infrastructure, trees and vegetation similar with other Russian cities were planted. From one side, tree plantings replaced natural meadow and wetland landscapes in the city (Glazunov et al. 2020), and from another, they became human allies to mitigate an increase in anthropogenic pressure on environment with air and noise pollution, heat island effects and more.

Comparing the lists of native and introduced species in Tyumen and Nadym that have been mentioned by interviewees, one can notice some asymmetries in practices of non-native species introduction. While both have specific native species, no attempts are mentioned about introducing species from Nadym in Tyumen, while almost all species native and many those that were introduced in Tyumen were also attempted to be introduced in Nadym (Table 6.2). Introduced species were brought from the European parts of Russia and not from the Asian part of Russia.

Nadym serves as an example of urbanization of the Arctic when the construction and landscaping standards were brought from Moscow. This fact reminds again that centralization efforts in the country in reality meant unification to standards imposed in the center of the country which makes the Soviet policy similar with colonial power relations. However, due to such factors as the presence of permafrost, extremely cold temperatures of atmospheric air, strong winds and the presence of polar day and night, many elements of the

TABLE 6.2 Examples of native and introduced trees and tall shrubs in Tyumen and Nadym

Cities	Native species	Introduced		
		Expanding without cultivation	Growing with cultivation	Have not adapted
Tyumen	Small-leaved linden (<i>Tilia cordata</i>);	Box elder (<i>Acer negundo</i>);	Hungarian lilac (<i>Syringa josikae</i>);	European ash
	Silver birch (<i>Betula pendula</i>);	Norway maple (<i>Acer platanoides</i>);	English oak (<i>Quercus robur</i>);	(<i>Fraxinus excelsior</i>)
	European aspen (<i>Populus tremula</i>);	Balsam poplar (<i>Populus balsamifera</i>);	Manchurian walnut <i>Uglans</i>	
	European mountain ash (<i>Sorbus aucuparia</i>);	Wych elm (<i>Ulmus glabra</i>)	<i>mandshurica</i>)	
	Bird cherry (<i>Padus avium</i>)			
Nadym	Siberian pine (<i>Pinus sibirica</i>);	Silver birch (<i>Betula pendula</i>);	Bird cherry (<i>Padus avium</i>)	English oak (<i>Quercus robur</i>)
	Downy birch (<i>Betula pubescens</i>)	European aspen (<i>Populus tremula</i>);		
		European mountain ash (<i>Sorbus aucuparia</i>)		
Both cities	Siberian larch (<i>Larix sibirica</i>);		Siberian crabapple (<i>Matus Baccata</i>);	
	Scots pine (<i>Pinus sylvestris</i>);		Common lilac (<i>Syringa vulgaris</i>)	
	Siberian spruce (<i>Picea obovata</i>)			

green infrastructure in the Arctic cities had to adapt to local natural and climatic conditions. Meanwhile, preservation of the evergreen trees in the Kozlov Park and Kedrovaya Grove that consist mainly of conifers brings the city closer to other Sub-Arctic cities with a long winter season (Chapman et al. 2018).

Therefore, analysis of formation and functioning of the green infrastructure in Tyumen and Nadym allows us to better identify various adaptation measures brought and experimented by settler populations, and to reveal future opportunities and limiting factors for the design, implementation and maintenance of green spaces in the Arctic and Sub-Arctic. Tyumen and Nadym share common trends in the historical transformations of their green spaces. At an early stage of their history, both cities were outposts of the colonization of the north of Western Siberia distant from the metropolis and had only vegetation of native species. The formation of designed green spaces in these cities was to some extent related to the transformation of these towns from frontier settlements to full-fledged urbanized communities conforming to the settlers' images of a "normal city." However, implementation of ideas and norms of greening has been highly dependent on transportation connectivity and environmental-climatic conditions of the cities. While in Tyumen some ideas about the city garden circulated among the elites, it was not until after the construction of railroads that these ideas were implemented in the city. Similarly, in Nadym, tangible introduction of new plants species in the city was made only with construction of the bridge.

Post-Soviet market reforms with global and online connectivity increased opportunities for local residents to travel and purchase agricultural and ornamental plant seeds online. Local climatic conditions would still be decisive whether these plants could grow outside, in greenhouses or in apartments. However, both global climate change and local urban heat island effects as well as anthropogenic disturbance of soils have also contributed to the expansion of southern plant species in the north and disappearance of the native ones (Fedorov et al. 2021; Pismarkina and Bystrushkin 2019). In such conditions, it is especially important to identify specific values of the native species, including their environmental (air purification, noise and wind retention, hypoallergenicity) and aesthetic (high decorative effect in different seasons) values as well as to take measures to limit the introduction of invasive species into the biomes of Arctic cities.

Some current studies started to consider ash maple and poplar as invasive allergenic species (Sapanov and Sizemskaya 2021). However, there is a lack of long-term observation to prove or deny these statements.

Studies of green space histories in Nadym and Tyumen demonstrate some parallels between the introduction of new species with growing settler population and the ways they interact with the environment. Similar with the European North, mild environmental conditions allowed the city of Tyumen to introduce trees from Western Russia. In Nadym, harsh natural and climatic conditions with a shorter growing season limit agricultural developments and plant diversity that can be used in the greening of the city. Perseverance exhibited by settler residents in transforming sandy landscapes into green spaces highlights their importance beyond utilitarian considerations. Furthermore, while Tyumen embraced the norms and standards of a typical Western Russian city, including the development of green spaces, the stark disparity between the traditional practice of reindeer herding and the urban lifestyle in Nadym has created an insurmountable obstacle to any form of harmonious coexistence. Therefore, Arctic cities such as Nadym exist as "islands" where not only population but also vegetation differs from the surrounding environment, symbolizing incompleteness of the Russian notion of Arctic colonization.

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