

# The impact of technogenesis and economic activities of the indigenous peoples of the North Russia on the environmental status of the Yamal region

*Sergei Petrov*<sup>1\*</sup>, *Natali Mamaeva*<sup>1,2</sup>, and *Maksim Narushko*<sup>1</sup>

<sup>1</sup>Tyumen Scientific Center, SB RAS, Malygina str. 86, 625026, Tyumen, Russia

<sup>2</sup>Industrial University of Tyumen, Volodarskogo str. 38, 625000, Tyumen, Russia

**Abstract.** The article studies the issue of the protection of the land and the coastal part of the Kara Sea and the role of specially protected natural territories, trading posts of small indigenous peoples of the North (SIPN) located within the boundaries of the state biological reserve of regional importance Yamalskiy. It is shown that the consolidation of administrative and production resources and academic science in order to study the influence of natural and anthropogenic factors on the biogeocenosis of the Arctic and the sociogenesis of the peoples of the North will allow solving specific tasks of developing and using the Arctic zone of the Russian Federation and preserving the ethnic and cultural development of the SIPN, protecting their original habitat and traditional lifestyle.

## 1 Introduction

Yamalo-Nenets Autonomous Okrug (YNAO) - the main gas production region in Russia with severe climatic conditions [1], where indigenous minorities of the North (IPN) engaged in traditional activities live. As is known, the development of hydrocarbon deposits is accompanied by a complex of exploration, drilling and construction works, the laying of trunk pipelines, the growth of cities and towns, etc. Therefore, within the oil and gas producing territories, there are a significant number of sources and types of anthropogenic impact on the environment that are diverse in the way and nature of their manifestation [2]. In recent years, the oil and gas provinces of the Far North are rapidly developing, including the land and the coastal part of the Kara Sea - the marginal sea of the Arctic Ocean, which washes the coast of the YNAO from the north.

Of course, almost all technological processes of oil and gas production are potential sources of anthropogenic pollution of the environment, which adversely affects the natural northern landscapes. This is manifested in high levels of air pollution, soil of water bodies, causes a critical state of ecosystems, the deterioration and depletion of natural resources [2].

The development of the infrastructure of the oil and gas complex and the strengthening of economic activity require maintaining ecological balance and preserving the

---

\* Corresponding author: [tumuki@yandex.ru](mailto:tumuki@yandex.ru)

environment. One of the areas in the field of environmental safety is the creation of specially protected natural reservation (SPNR) - land, water surface and airspace above them, where natural complexes and objects are located that have special environmental, scientific, cultural, aesthetic, recreational and recreational value [3]. SPNR are removed by decisions of public authorities in whole or in part from economic use and for which special protection is established. Taking into account the peculiarities of the special protection regime, the following categories of SPNRs are distinguished: state nature reserves, national parks, nature parks, state nature reserves, natural monuments, dendrological parks and botanical gardens [3].

On the territory of the Yamal district of the Yamal-Nenets Autonomous District, a state biological (botanical and zoological) reserve of regional (district) value "Yamalskiy" has been established. According to legal documents [4, 5], the area of the Yamalsky reserve is 4113685.68 hectares and consists of two sections: the South Yamal area (located in the Yamal district of the Yamal-Nenets Autonomous District (including the sea area along the coastline)) the basins of the Naduyyakha, Mordyyakha, Yasaveyyakha rivers, the lower reaches of the Yuribey river and the Yaroto lake system) and the North Yamal region (located in the north of the Yamalo-Nenets Autonomous District on Bely Island and on the north-eastern tip of the Yamal Peninsula, part of the water area in the Malygin Strait also applies). The reserve was created to preserve the biota characteristic of the subzones of the Arctic and subarctic tundras of biota, the reproduction of fish stocks, the restoration of the most valuable animals, the protection of rare animals listed in the Red Book of the Russian Federation, the Red Book of the Yamalo-Nenets Autonomous District and the IUCN [6]. In order to achieve this goal, the zakaznik solves the following tasks: preservation, restoration and reproduction of objects of the animal world, including aquatic biological resources, maintaining the ecological balance; conservation of habitat and migration routes of wildlife objects; conducting research; environmental monitoring; ecological education and development of tourism [4].

On the territory of the Yamal region of the Yamalo-Nenets Autonomous District, to provide life support systems and social conditions aimed at supporting the livelihoods of people from the small indigenous peoples of the North engaged in traditional types of economic activities, trading posts are created that play an important role for the population leading a nomadic lifestyle in providing them with necessary food and non-food products, fuel, as well as goods of national demand. Trading posts is the link between the indigenous populations of the nomadic world [7].

Under the conditions of modern technogenesis, the question of the state of ecological safety and harmonious development of the "man-nature" relationship in the Arctic zone of the Russian Federation is urgent. Nevertheless, in the literature, insufficient attention is paid to the influence of the anthropogenic factor associated with the industrial development of the Arctic zone of the Russian Federation and the economic activities of the small peoples of North on the sustainability of the ecological systems of the northern territories that determine the biological balance and climate of the Earth, and their dependence even on minor anthropogenic influences.

Therefore, the purpose of this work was to assess the impact of the anthropogenic factor on the ecosystems of the Yamal region of the YNAO associated with the industrial development of the region.

## **2 Material and methods**

Data on the state of the environment in the Yamal region of the Yamalo-Nenets Autonomous District are obtained from the annual Reports on the environmental situation in the Yamalo-Nenets Autonomous District for 2013–2016. [6, 8–10]. The following

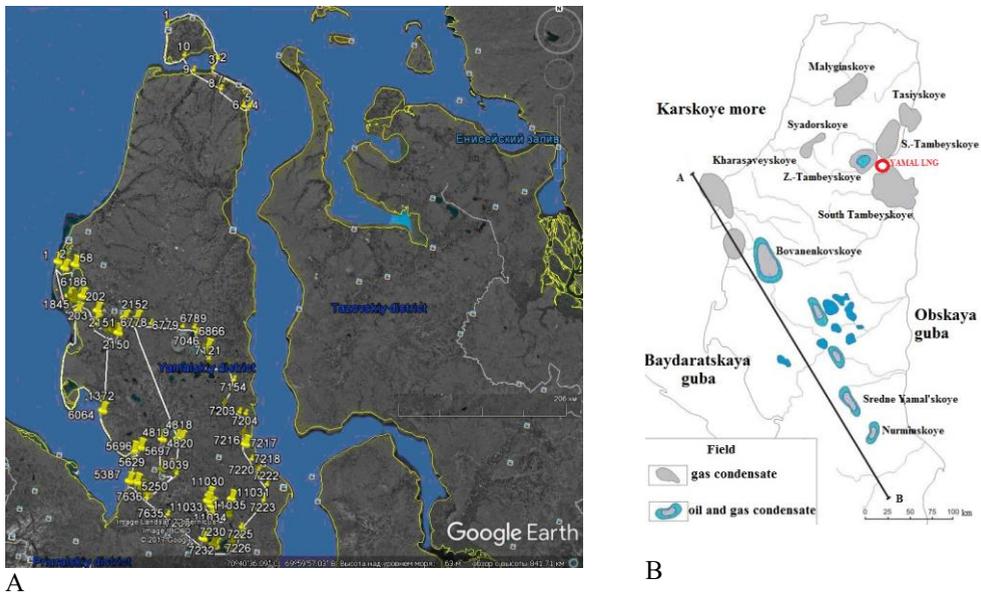
indicators were analyzed: the number of objects with emissions of pollutants and sources of air pollution, the volume of gross emissions from stationary sources for various activities, the number of vehicles, and the mass emissions of pollutants. Demographic indicators for the small peoples of the North of the Yamalo-Nenets Autonomous District were estimated by the Outcomes of the 2010 All-Russian Census [11].

When compiling maps, Google Earth was used. In the designation of hydrocarbon deposits, a map from the site is used [12].

The obtained quantitative data were subjected to statistical processing using the integrated software package "IBM SPSS Statistics 21". In the normal distribution, the following statistical parameters were used: mean value (arithmetic average value), variance and its derivative (standard deviation).

### 3 Results and discussion

In accordance with the Decree of the Government of the Yamalo-Nenets Autonomous District of 20.05.2013 N 352-P [4], the Decree of the Government of the Yamalo-Nenets Autonomous District of 01.09.2016 N 832-P [5] and the Cadastral Report on SPNRs [13] we compiled maps of the location of the Yamalsky reserve and the main deposits on the Yamal Peninsula (Fig. 1).



**Fig. 1.** The map shows the location of the Yamalsky reserve (A) and the main deposits on the Yamal Peninsula (B).

As can be seen from fig. 1, the main deposits of hydrocarbon raw materials are concentrated on the Yamal Peninsula, which is the abode of the small indigenous peoples of the North. According to the All-Russian Population Census (2010), out of the total number of Nenets in Russia (44640 people) [11], about 67% of them live in the YNAO, with primary residence in the following municipal districts: Yamal (33.5%), Tazovsky (29.8%) and Purovsky (11.5%). As is known, the most important basis for the livelihood of the indigenous peoples of the North are their traditional activities - reindeer herding, hunting and fishing, gathering wild plants and natural materials. The legal basis for the formation, protection and use of traditional territories of indigenous minorities of the North, Siberia

and the Far East of the Russian Federation to maintain traditional environmental management and traditional way of life in these territories is governed by Federal Law of 07.05.2001 N 49-FL "On the territories of traditional nature use of the small indigenous peoples of the North, Siberia and the Far East of the Russian Federation" [14].

In this regard, indigenous peoples get privileges when using the bioresources of a given territory in question, in particular, they are allowed without written permission [4]: hunting in order to ensure the maintenance of the traditional way of life and the implementation of traditional economic activities; reindeer herding; fisheries in order to maintain traditional lifestyles and traditional economic activities; harvesting food forest resources; entry (passage) and parking of motor vehicles, vessels and other motor vehicles, installation of national traditional dwellings (chums) associated with the implementation of authorized traditional economic activities in the reserve.

In order to facilitate the life of people from the number of indigenous peoples living in the autonomous region and leading the traditional lifestyle of indigenous people, other people not related to indigenous people who permanently live in the autonomous district and leading the traditional lifestyle of indigenous people in recent years have created trading posts - created by legal entities and (or) individual entrepreneurs in the traditional places of residence and traditional economic activities of the SIPN items (property complex) [15]. As of 2015, there are 52 trading posts in the Yamal-Nenets Autonomous District, including in the Yamal District - 16 [7].

We have constructed a schematic map (Fig. 2), on which we have applied trading posts located within the boundaries of the state biological reserve of regional significance "Yamalsky".



**Fig. 2.** Map of the South-Yamal site of the Yamalsky reserve, with the location of trading posts in the territory.

According to the scheme map, the following trading posts are located on the territory of the South-Yamalsite of the Yamalsky reserve: Yaroto-2, Lidino, Sosyangto, Ust-Yuribey, Huta-Yaha, Tarko-Sale, Neyto, Ude-to, Valeria. Since the number of trading posts varies, upon receipt of new data on the presence (absence) of trading posts, it is possible to

promptly enter necessary clarifications into the map. In order to determine the share of traditional economic activities of SIPN in the ecological situation of the regional (district) value reserve “Yamalsky”, the quality of atmospheric air was studied.

Atmospheric air is a vital component of the environment, an integral part of the human environment, plants and animals. Along with ecological functions, atmospheric air performs the most important economic functions, as it acts as an indispensable element of production processes, energy, transport and other human activities [9]. Air pollution in the YNAO as a result of human activity is characterized by uneven distribution, which directly depends on the intensity of economic and other activities associated with the extraction of hydrocarbons, as well as the maintenance of such activities (transport, etc.) [10]. In this regard, we considered quantitative indicators of pollutant emissions into the atmosphere in the Yamal region of the Yamal-Nenets Autonomous District (average values for 2013–2016) (Table 1).

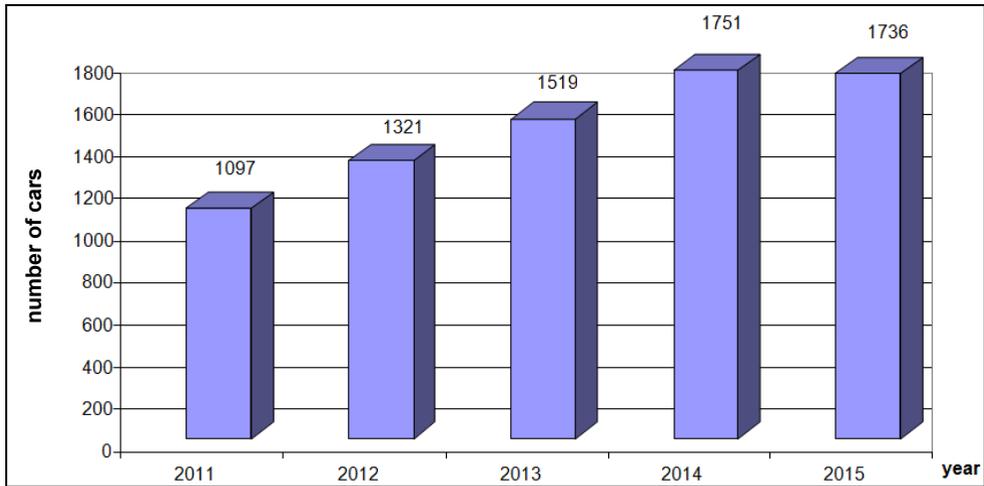
**Table 1.** Quantitative indicators of emissions of pollutants into the atmosphere on the territory of the Yamal district of the Yamalo-Nenets Autonomous District (average values for 2013–2016).

No	Indicator	Value
1	The number of objects with emissions of pollutants, units	$25.75 \pm 3.42$
2	The number of stationary sources of air pollution, units	$2336 \pm 472.05$
3	Gross emissions from stationary sources, including by type of activity, thousand tons:	$35.99 \pm 13.35$
3.1	agriculture, hunting and forestry	$0.006 \pm 0.003$
3.2	mining	$22.30 \pm 10.59$
3.3	manufacturing industries	0
3.4	production and distribution of electricity, gas and water	$5.17 \pm 2.57$
3.5	transportation and communication	$5.37 \pm 1.74$
3.6	real estate transactions	$0.003 \pm 0.001$
3.7	provision of other services	0
3.8	other economic activities	$3.15 \pm 0.70$

The data in table 1 show that for 2013–2016 in the Yamal region of the Yamal-Nenets Autonomous District, the share of traditional economic activities of indigenous peoples in air pollution is less than 0.02%. The largest contribution to the level of air pollution from stationary sources is made by enterprises engaged in the extraction of mineral resources ( $22.30 \pm 10.59$  thousand tons), transport and communications ( $5.37 \pm 1.74$  thousand tons), as well as the production and distribution of electricity, gas and water ( $5.17 \pm 2.57$  thousand tons). About 30 hydrocarbon fields are concentrated on the Yamal Peninsula and adjacent water areas, some of which are located in the Ob Bay and the Kara Sea [16] including Bovanenkovskoye, a large gas field on the Yamal Peninsula, which is located about 40 kilometers from the Kara Sea coast. The Kara Sea shelf is the northern continuation of the West Siberian oil and gas province, which includes the South Kara oil and gas region - located in the southern part of the Kara Sea. In this area, 4 fields have been discovered, of which 3 are gas (Rusanovskoye, Leningradskoye, Kharasaveyskoye) and 1 oil (Beloostrovskoye). Resources are estimated at 10-50 trillion m<sup>3</sup> of natural gas and 3-10 billion tons of oil. Promising oil and gas structures of the basin are considered to be the University, Närmeyskaya, Kropotkinskaya, Vikulovskaya, and others [17].

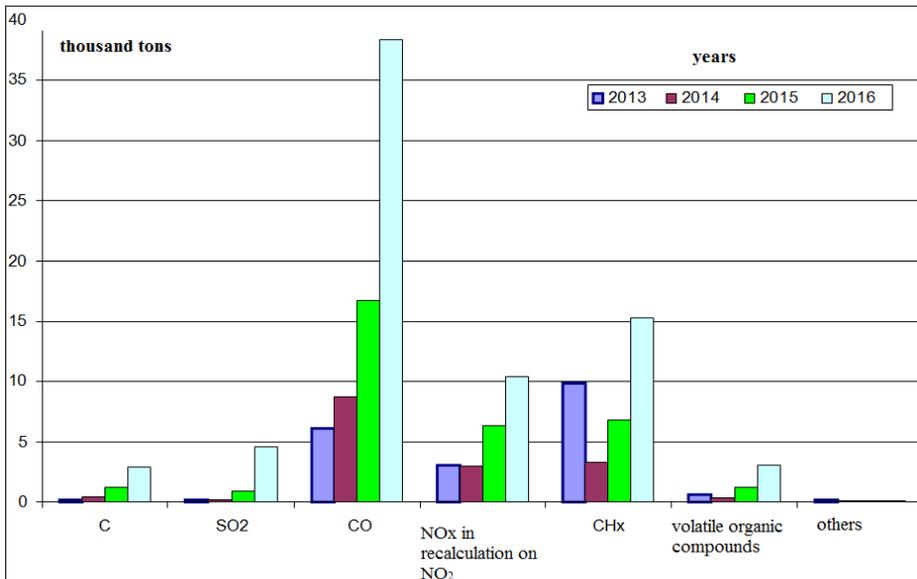
On the Yamal Peninsula, construction of liquefied natural gas (LNG) technology lines is actively underway. Yamal LNG is an integrated project for the extraction, liquefaction and supply of natural gas. The project envisages the construction of an LNG plant with a capacity of about 16.5 million tons per year at the resource base of the South Tambeyskoye field. As part of the project, a transport infrastructure is being created, including the seaport and Sabetta airport [18].

Automobile transport makes a significant contribution to air pollution (Fig. 3). It is established that the number of vehicles from 2011 to 2014 annually increased by an average of 200 cars and only in 2014–2015 stabilized (1751 and 1736, respectively).



**Fig. 3.** Dynamics of the number of cars vehicles registered in the Yamal region of the Yamal-Nenets Autonomous District for 2011–2015.

Air pollution has an adverse effect on the conservation and reproduction of Arctic flora and fauna. The priority pollutants of the atmosphere are nitrogen oxides, sulfur dioxide, carbon monoxide, suspended solids, etc. We present data on the mass of various pollutants emitted into the atmospheric air for 2013–2016 from stationary sources in the Yamal region of the Yamal-Nenets Autonomous District (Fig. 4).



**Fig. 4.** Mass emissions of pollutants for 2013–2016 from stationary sources located in the Yamal district of the Yamal.

It was revealed that the mass of CO in 2015 compared to 2014 and in 2016 compared to 2015 increased by about 2 times, the mass of NO<sub>x</sub> in recalculation on NO<sub>2</sub> in 2015

compared to 2014 also increased about 2 times. The main sources of nitrogen dioxide are motor vehicles, thermal power plants and various heating installations. This is primarily due to the increase in the number of road transport in the cities of the autonomous region. The formation of large suspended particles (fly ash) results from the burning of various hydrocarbons, including gasoline. As for the mass of CH<sub>x</sub>, in 2014 and 2015 compared to 2013, it decreased by 3 times and 1.5 times, respectively, but in 2016, the mass of CH<sub>x</sub> increased by about 2 times compared to 2015. Increase in mass emissions of pollutants for 2013–2016 from stationary sources located on the territory of the Yamal region of the YNAO, in our opinion, is associated with the development of the northern territories, the discovery of new oil and gas fields.

## **4 Conclusion**

The rapid development of the natural resources of the Arctic is accompanied by anthropogenic pollution of its territories, which requires appropriate maintenance of the conservation of the biological diversity of the Arctic flora and fauna in the context of expanding economic activity and global climate change. Increase in mass emissions of pollutants for 2013–2016 from stationary sources located on the territory of the Yamal region of the Yamal-Nenets Autonomous District, in our opinion, is associated with the expansion of economic activities in the region, the discovery of new oil and gas fields on land and in the coastal part of the Kara Sea of the Arctic zone of the Russian Federation. At the same time, anthropogenic impact acquires an areal character, which adversely affects the biological diversity of Arctic flora and fauna, including reindeer pastures and reindeer migration routes.

In order to protect the environment and ensure environmental safety on the territory of the Yamal region of the Yamal-Nenets Autonomous District, it is planned to develop and expand the network of Arctic specially protected natural areas and waters of federal significance for the protection of unique Arctic ecosystems, including the endangered flora and fauna, the protection of declining northern populations, and also for the re-acclimatization of some living organisms. At the same time, in order to improve the quality of life of the population living and working in this region, first of all, indigenous minorities, increasing their social and cultural services, as well as ensuring positive demographic processes and the necessary social conditions of economic activity, creating trading posts is an urgent task. Trading posts allow preserving traditional types of employment of the population, despite the fact that they are located in SPNRs and do not have a significant impact on the quality of the atmospheric air of northern ecosystems.

Today, many environmental factors in relation to assessing their impact on the environmental safety of the autonomous region are not well understood and need further comprehensive assessment of their impact. Therefore, the consolidation of administrative and production resources and academic science to study the influence of natural and anthropogenic factors on the Arctic biogeocenosis and sociogenesis of the peoples of the North will solve specific tasks aimed at realizing the sovereignty and national interests of the Russian Federation in the Arctic and preserving the ethnic SIPN environment and traditional lifestyle.

## **5 Acknowledgement**

The work was performed according to the state assignment, according to the Research Plan of TyumSC of the Siberian Branch of the Russian Academy of Sciences for 2018–2020, Protocol No. 2 of December 8, 2017 (Priority Direction IX.133. Program IX.133.1. Project:

IX.133.1.4. Cryobiological processes on land and in the coastal part of the Kara Sea in conditions of increasing average annual temperatures).

## References

1. N.G. Khairullina, *Indigenous peoples of the Tyumen region: a view of a sociologist* (Tyumen, Tyumen State Oil and Gas University, 2012)
2. S.L. Dorozhukova, E.P. Yanin, *Environmental problems of oil and gas producing territories of the Tyumen region* (Moscow, IMGRE, 2004)
3. Federal Law of Russian Federation of March 14, 1995 No. 33-FL
4. Resolution of the Government of the Yamal-Nenets Autonomous District of May 20, 2013 No. 352-P
5. Resolution of the Government of the Yamalo-Nenets Autonomous District of September 1, 2016 No. 832-P
6. Report on the environmental situation in the Yamalo-Nenets Autonomous District in 2015 (Salekhard)
7. Infopmation on: <http://dkmns.ru>
8. Report on the environmental situation in the Yamalo-Nenets Autonomous District in 2013 (Salekhard)
9. Report on the environmental situation in the Yamalo-Nenets Autonomous District in 2014 (Salekhard)
10. Report on the environmental situation in the Yamalo-Nenets Autonomous District in 2016 (Salekhard)
11. Results of the All-Russian Population Census 2010, Information Statistics Center of Russia **4(3)** (2012)
12. <http://trubagaz.ru/gkm/kharasavejjskoe-gazokondensatnoe-zhdenie/>
13. <http://www.obr-yanao.ru/gosudarstvennyj-biologicheskij-zakaznik-regionalnogo-znacheniya-yamalskij1.html>
14. Federal Law of 07.05.2001 N 49-FL
15. Law of the Yamalo-Nenets Autonomous District of December 28, 2005 No. 113-LAD
16. N.I. Dementieva, S.N. Golubchikov, A.V. Koshurnikov, M.Yu. Golubchikov, S.I. Berezenko, *Energy: economics, technology, ecology* **7**, 29–37 (2013)
17. <https://ru.wikipedia.org/wiki/>
18. <http://yamallng.ru/>