

Anthrax in Yamal: An Ecological View on Traditional Reindeer Husbandry

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Abstract—The critical situation with traditional reindeer husbandry in the Yamal district of the Yamalo-Nenets Autonomous Area, indicated by an anthrax epizootic, is analyzed from an ecological viewpoint. The phenomenon of epizootic is regarded as an ecosystemic homeostatic mechanism operating to prevent excess population growth and maintain ecosystem integrity. The shutdown of this mechanism by means of vaccination, with the proportion of reindeer removed from slaughter remaining low, has resulted in an increased grazing load of rangelands and their consequent severe degradation. These events have been aggravated due to change in the type of ownership in reindeer husbandry during the reforms of the 1990s. The ecological situation is classified as critical, posing a real hazard to this particular ethnic form of economy. It is concluded that the period of extensive/expansive development of Yamal reindeer husbandry has come to an end. Socio-psychological attitudes of the Nenets, acquired when biological resources were abundant, contradict with the principles of ecosystem existence and functioning in the period of resource depletion. The maintenance of reindeer husbandry in the traditional form requires increasing material, labor, and financial investments, but positive results are unlikely to be obtained because of ecological constraints.

Keywords: traditional natural resource use, reindeer husbandry, epizootics, ecosystem stability, the Nenets, anthrax, the Yamal Peninsula

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The 2016 outbreak of anthrax in the Yamal district of the Yamalo-Nenets Autonomous Area (YNAA), which has evoked public concern, is a reflection of the critical situation in reindeer husbandry, a traditional economic activity for indigenous peoples living in the tundra. To explain this situation from the ecological viewpoint, consideration in this paper is given to the ecological efficiency of the economy related to natural resource use.

In itself, the phenomenon of anthrax in Yamal is by no means unusual. This infection has a cosmopolitan range corresponding to the zoogeographic distribution of herbivores [1]. About 2000 to 20000 cases of anthrax per year are recorded in the world [2], averaging 250–300 cases [1]. Massive outbreaks of anthrax in the tundra and forest–tundra zones of Western Siberia and northern Europe occurred at the turn of the 19th and 20th centuries. The loss of reindeer in the Bol'shezemel'skaya and Malozemel'skaya tundras amounted to approximately 1100 thousand head over 22 years (1896–1917) [3]; in Yamal, to 400 thousand head over 27 years (1889–1915) [4], with about 100 thousand (almost half of the total Yamal stock) having died in 1911 [5]. The last outbreak in the YNAA occurred in 1941, when 6700 reindeer died [6]. Taking into account these figures, the absence of proper disposal

of dead animals, abundant spore formation by the pathogen of anthrax (*Bacillus anthracis*), and the ability of spores to retain pathogenicity for thousands of years, it can be concluded that almost the entire Yamal territory is potentially dangerous in terms of anthrax infection.

At the same time, such a situation may be regarded as natural for pastoral ecosystems: epizootics (including anthrax outbreaks) are an ecosystemic homeostatic mechanism aimed to suppress animal population growth when the holding capacity of habitats is exceeded. The pathogen as a component of harmoniously coordinated system manifests its pathological properties when the population of dominant species reaches high density and exerts excess pressure on its own environment. The pathogen alleviates this pressure and thereby preserves ecosystem integrity. The reliable effect of epizootics in ecosystems is provided for by a complex of pathogens that manifest their activity under different conditions and in different circumstances (in the case of reindeer, these are etiological agents of anthrax, necrobacillosis, foot-and-mouth disease, and brucellosis). Therefore, the process in the system anthrax–herbivore, as well as other epizootics, can be justly regarded as a real ecological phenomenon referred to as parasitic biosystem [1, 7],

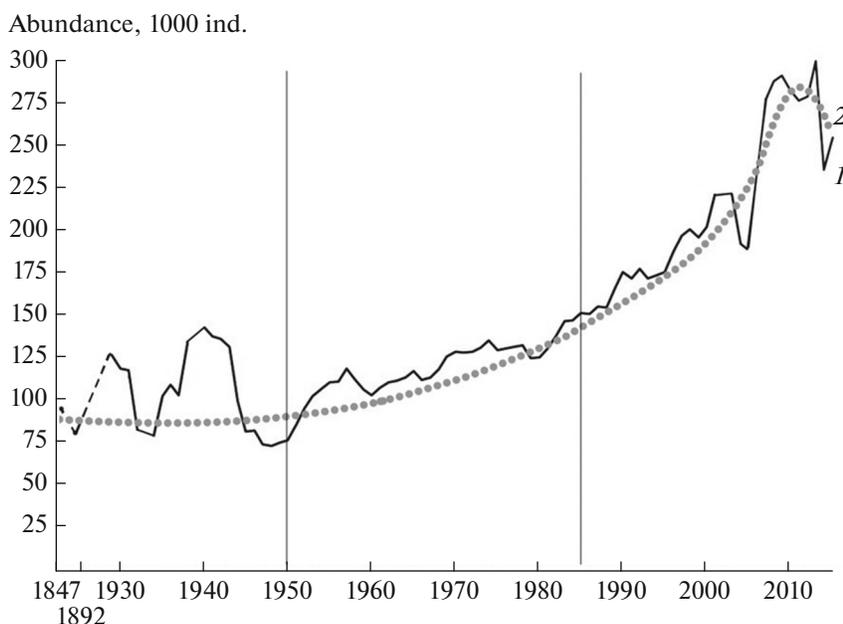


Fig. 1. Population dynamics of domesticated reindeer in the Yamal Peninsula: (1) curve of changes in animal abundance, (2) trend line (based on data from numerous statistical data sources and relevant publications).

in which obligate killing of the host followed by infestation with spores is a highly important and indispensable condition. Spores are stored in the soil and the above mechanism is activated again as soon as the plant cover is overgrazed and the soil surface is laid bare.

The anthrax infection affects mainly ungulates, although many terrestrial animal species are also involved in the epizootic process [1]. Ungulates grazing on sparse vegetation ingest or inhale soil particles containing spores, which enter the intestines or lungs. The infection then spreads via the alimentary pathway (spores enter the soil with excretions of diseased animals or from their dead bodies to be taken in by healthy animals) or is transmitted by bloodsucking insects (gadflies, stable flies, gnats, etc.). Carnivores and birds of prey feeding on the corpses of infected animals pass spores with feces, contributing to the maintenance and expansion of the disease focus. However, all these species are accidental components involved in the infection biosystem, and most of them are refractory or low susceptible to the disease [1, 6, 8]. Human anthrax infection is usually acquired occupationally, during contacts with diseased animals or infected raw materials, such as wool and skins, or consumption of raw or undercooked meat. Direct infection through the soil, even highly contaminated with spores (in the foci of anthrax), has not been reported [1, 2].

Damage from anthrax and other epizootics is mainly economic, resulting from the death of livestock. The cost of damage from large-scale epizootics may be very high. Thus, the economic losses from the 1911 anthrax outbreak in Yamal, which killed 70000 reindeer, were estimated at more than 1140 thousand

rubles (calculated as 15 rubles per head) [5]. This sum is equivalent to about 1.7 billion current rubles (1140 thousand \times 1513 rubles) [9].

Measures against epizootics taken by epidemiological agencies are aimed at suppression of disease outbreaks and permanent control of the pathogen. Success in these measures is always temporary, because they have no affect the basic cause of epizootics. Attempts to improve productivity of nomadic, free-ranging reindeer husbandry based on primitive exploitation of natural ecosystems are counteracted by the system oriented toward maintaining its own stability, in which mechanisms preventing the growth of reindeer population start to operate.

At the turn of the 19th and 20th centuries, an economic complex based on large-herd reindeer husbandry by indigenous peoples was formed in Yamal [5, 14]. At that time, the rate of regeneration processes in ecosystems of the peninsula was proportional to the rate and extent of anthropogenic disturbances. When the number of reindeer exceeded 100–120 thousand head, outbreaks of diseases occurred, and their number decreased to about 70 thousand head, which apparently corresponded to the holding capacity of pastures (Fig. 1).

In the 1950s and 1960s, collective and then state reindeer farms were organized in the Yamal district with the main purpose to increase reindeer stock. Centralized vaccination campaigns helped to reduce widespread epizootics to minor outbreaks of necrobacillosis [10, 11]. Planned slaughtering for meat was the main factor regulating the numbers of reindeer. Their stock showed a consistent growing trend leading to

increasing grazing load on rangelands and their depletion.

The reforms of the 1990s and reorganization of the farming system resulted in the transfer of hundreds of thousands of reindeer from government sector to private sector [12]. By 2010, only about 20% of the total Yamal stock remained at state agricultural enterprises, with the rest belonging to private and communal owners (Fig. 2). This resulted in practically uncontrolled growth of reindeer numbers, because the specific mental attitude of the Nenets is that they seek to simply increase the animal stock rather than to gain any profit from it [12, 14, 15]. They earn money without slaughtering reindeer but by trading in their velvet antlers, the demand for which has sharply increased with the development of transportation infrastructure for the Yamal oil and gas fields. Thus, the load on already depleted rangelands increased drastically.

The regeneration potential of tundra vegetation is low, and overgrazing has resulted not only in a drop of productivity of rangelands but also in significant transformation of the plant cover of the peninsula [16–18]. Since the 1930s (taken as reference, because no large-scale studies on Yamal rangelands were performed prior to that time), the stocks of forage lichens vitally important for reindeer have decreased from 3–6 to 0.01–0.43 t/ha. According to calculations, their recovery will take 60–80 years in the absence of grazing [19]. This scenario is unrealistic, and it may be concluded that lichen rangelands as such are practically extinct. The total stocks of green forage are also reduced: of herbaceous plants, by a factor of 1.5–2; of low shrubs (up to 0.5 m high), by factor of 8; and of tall shrubs, by factor of 2 [17, 18]. Plant cover degradation has led to the formation of sandy outcrops on elevated topographic elements. On average, they occupy about 5.5% of the total land area of the peninsula, which is comparable to the surface area of lakes, with their proportion in some places reaching 19% [18, 20]; i.e., about 583 thousand hectares are irreversibly lost for reindeer grazing.

The Nenets consider that a herd of 300–500 adult reindeer is needed to satisfy the needs of a five-member family [21, 22]. However, the data on six rural municipalities of the Yamal district in 2007 [12] show that the number of reindeer per family averaged 132 ± 35 head, which is close to that calculated for five national councils of the district in 1932: 150 ± 35 head [23]. Apparently, this number of animals is sufficient for the family to live normal life. As follows from the above figures and the number of nomadic families (1217) recorded in 2015 [24], approximately 160–180 thousand reindeer would be sufficient for the nomadic Nenets population of the region, while their actual stock in 2015 was 254 thousand head (74–94 thousand more than needed). However, even supposing that Yamal rangelands are used only for summer grazing, their current holding capacity is approximately 1.5–2 times lower

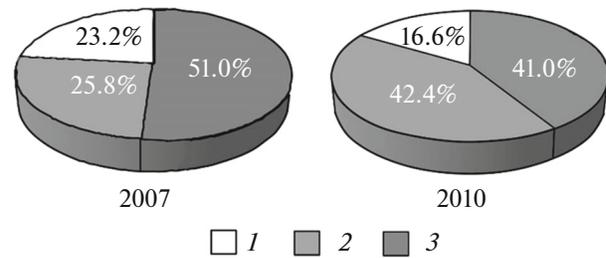


Fig. 2. Structure of domesticated reindeer stock in Yamal district with respect to the category of owners in 2007 [12] and 2010 [13]: (1) reindeer husbandry enterprises, (2) communal farms, (3) private farms.

than in the early 20th century. With reference to the 1930s, this capacity can be estimated at 54–72 thousand \pm 9–12 thousand head.

However, the Nenets show no intention to reduce the reindeer stock, which is especially true of private herders: “Unlike other reindeer -breeding peoples of Russia, the Nenets live to raise reindeer rather than raise reindeer to live on” [15, p. 55]. According to data from slaughterhouses [25], only 5–7% of the stock is slaughtered per year, whereas its annual increment is about 20% [12]. For comparison: it is almost the same proportion of reindeer stock that is annually slaughtered in the Komi Republic (on average, 20.2%), where the stock itself is significantly smaller [26]. The point is that the Komi traditionally specialize in raising reindeer for meat production [27].

An excessively high level of species abundance can be maintained only on condition of continuous input of additional nutrient energy to the ecosystem. Otherwise, the ecosystem is getting depleted, which earlier or later leads to activation of homeostatic mechanisms counteracting this process. Such response to low-level impacts may be absent until their cumulative effect becomes strong enough to induce the development of a violent dynamic process [28]. Population outbreaks are usually accompanied by outbreaks of diseases. Measures of disease control, such as vaccination of reindeer against known epizootic infections, may lead to the emergence of novel or previously undetected diseases, physiological or genetic alterations, etc.

For example, the body size of Nenets reindeer tended in pastures has decreased during the past few decades. In the 1980, the live weight of animals born in the current year reached by winter 57.1 kg in males and 52.4 kg in females, in accordance with the Nenets breed standard [29], whereas the body weight of an animal at the same age in 2007–2008 averaged 23 ± 4.2 kg. The administration of Yamal district concludes that, because of oversaturation of reindeer pastures, parameters of husbandry farm business are unlikely to reach the level achieved 20 years ago [30].

Analysis of experience in pasture farming all over the world [31] shows that this kind of nature resource use leaves behind barren landscapes. In Yamal, where lichen pastures almost disappeared, the amount of phytomass and the abundance of animals have decreased severalfold, the territory is undergoing desertification, and the ecological situation is classified as critical (grade 4 on six-grade scale [28]). It is characterized by the reversible substitution of existing ecosystems by less productive ecosystems (partial desertification) and a low amount of phytomass, which continuously decreases. Moreover, this situation is close to the next, catastrophic state (grade 5), where the establishment of low-productive ecosystems is hardly reversible (strong desertification) and the biomass and biological productivity decrease to a minimum. Then follows a collapse phase, where biological productivity is irreversibly lost and the biomass approaches zero.

Large-scale alterations in ecosystems are not only poorly reversible but also their neutralization is difficult from the socioeconomic standpoint, since too great amounts of material and labor resources are necessary for this purpose. It becomes increasingly true that “The longer our list of deserts transformed into blooming orchards, the greater the list of orchards converted into deserts” [28, p. 120]. Moreover, desertification proceeds at a much higher rate than the creation of “blooming orchards” and, theoretically, this cannot be otherwise, because the latter process is based on the disturbance of balance between components in ecosystems.

Natural systems, being capable of self-renewal and self-development, represent a kind of perpetuum mobile and need no economic investment as long as the impact on them does not exceed their capacity for recovery. When this socioeconomic balance is upset, increasing material, financial, and labor expenditures are required for the maintenance of husbandry based on utilization of natural resources. The period of extensive/expansive development of ethnic reindeer husbandry in the Yamal has come to an end.

Reindeer husbandry in the early 20th century was highly profitable, with an annual net gain of up to 80 rubles per head [32], which is equivalent to 121 thousand in rubles as of 2016 [9]. Prime cost (grazing fee and salary for herders) was 0.8 rubles [27] (equivalent to about 1200 rubles). The gain from selling meat and skins (per head) ranged from 3.5 rubles (calf) to 11 rubles (stag) [27] (equivalent to 5295–16 643 rubles) [9].

Today, the prime cost of a reindeer with a fresh weight of about 60 kg is 7100 rubles, with the production cost of meat in 2010 being 237.76 rubles/kg [13], and the price of grade 1 meat on the market is about 315 rubles/kg [33]. It should be taken into account, however, that the greater part of reindeer meat from Yamal is of low quality: only 35–50% is of grade 1 or 2 [30]; i.e., meat production is a loss-making sector. Only trading in velvet antlers is currently profitable, because they

are in high demand. Ethnic reindeer husbandry cannot be practiced today without financial subsidies from municipal, regional, or federal budgets [13, 25, 30], which cover about 70% of total expenditures. For comparison, the profitability of reindeer husbandry in the neighboring Komi Republic is about 30% without taking into account government support [34].

The situation with reindeer husbandry in Yamal is in good agreement with the ecological model that reflects a parabolic dependence of socioeconomic efficiency of natural resource use the ratio of transformed and natural ecosystems [35, 36]. According to this model, the socioeconomic effect is the highest when the relative area of land transformed by human activities does not exceed 40–60%, sharply decreasing when this area is greater. Almost the entire territory of Yamal is exposed to heavy grazing load. Lands relatively tolerant of overgrazing, where changes in plant cover manifest themselves to a lesser extent (bogs, tall shrub thickets, forests, coastal meadows, etc.), comprise 32% of the territory, and all other lands should be classified as transformed. Therefore, any kind of financial support to reindeer husbandry as an economic sector cannot bring a positive result. On the contrary, it will contribute to further degradation of ecosystems and to decline and eventual destruction of this sector.

The wish to continue the use of natural resources by traditional methods for as long as possible, regardless of challenges from the environment, is characteristic not only of indigenous peoples of the North but also of authorities at different hierarchical levels. Natural resources are initially regarded as unlimited and inexhaustible, and the period of their exploitation is supposed to be so long that, psychologically, probable consequences appear negligible. According to the scheme of economic-ecological social relations [37], this is the stage of economic development in the absence of ecological limitations. Such quasi-prosperity leads to the formation of sustainable ecological-socioeconomic complex with the corresponding social mode of nature resource use, which is perceived as a tradition. Due to the social component, this complex is highly conservative, but it can exist only if resources are abundant. The original Nenets culture, including specific relationships with nature, was formed at exactly this stage [38, 39]. Upon change in ecological conditions (depletion of natural resources), their traditional sociopsychological conflicted with regularities of ecosystem existence and functioning. Since the Nenets strongly depend on reindeer husbandry as the basic source of sustenance, their existence as an ethnos is endangered in this situation.

When natural resources are depleted, the economy can function only under conditions of ecological limitations, which inevitably entail the necessity of economic reforms and changes in the social style of life in order to preserve the available resource supply. If this

postulate is ignored, the next stage begins, which can be defined as “everything for the sake of survival” [28, p. 170]. It involves vast expenditures for rehabilitation and artificial reproduction of the natural environment destroyed by traditional resource use practices of indigenous peoples. These expenditures may be too high for the society, and a collapse will be inevitable. Analyzing the history of rise and fall of communities and civilizations, Jared Diamond [40] concludes that the main cause of such collapses is not the paucity and complexity of the environment but rather the short-sighted and wasteful attitudes of people.

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