

## ОБЗОРНЫЕ СТАТЬИ

## REVIEW ARTICLES

THE WILD REINDEER (*RANGIFER TARANDUS*: CERVIDAE, MAMMALIA)  
ON THE ARCTIC ISLANDS OF RUSSIA: A REVIEWIvan A. Mizin<sup>1</sup>, Taras P. Sipko<sup>2</sup>, Andrey V. Davydov<sup>3</sup>, Alexander R. Gruzdev<sup>4</sup><sup>1</sup>Russian Arctic National Park, Russia

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The article presents summary data on the wild reindeer's (*Rangifer tarandus*) distribution on islands in the Russian Arctic. It discusses the abundance, diet, and general state of knowledge about the species in remote areas, especially on Novaya Zemlya and Wrangel Island. Brief data are provided about domestic reindeer grazing on the Arctic islands. Literature data are complemented with research findings in recent years. A negative trend is demonstrated in the wild reindeer abundance; also the need for studying isolated populations is emphasised.

**Key words:** abundance, Arctic, distribution, domestic and wild reindeer, living environment, Novaya Zemlya, nutrition peculiarities, Wrangel Island

### Introduction

Currently, information about the reindeer (*Rangifer tarandus* (Linnaeus, 1758)) on the Arctic islands is fragmented and scarce. The populations of these reindeer are under the impact of extreme conditions of high latitudes, and are not numerous. The natural fluctuations typical of this species can reach extremely low numbers. In the last twenty years, we have observed adverse trends both in the reindeer abundance and in deterioration of the suitable habitats. Also, recently, industrial development of the Arctic has increased, resulting in a rise of anthropogenic impact. The general climate warming trend alongside the rise of weather condition's variability is having additional impact on the survival rate of the island reindeer, and the consequences are not sufficiently studied or clear (Yannic et al., 2014).

The taxonomic status of reindeer on many islands remains unknown, which causes a certain problem. The history of origin and evolution of reindeer population on each island has its own peculiarities. For example, the populations whose taxonomy has been described (on Spitsbergen and Novaya Zemlya Archipelagos) have been assigned a subspecies status (*R. t. platyrhynchus* (Vrolik, 1829) and *R. t. pearsoni* Lydekker, 1903, respectively). Data

on other populations are not available, although it seems likely that the taxonomic status of the reindeer on the Arctic islands is significantly different.

Studies of reindeer inhabiting the Russian islands are utterly scarce, and they do not cover all aspects of the species' biology. Some archipelagos remain practically uninvestigated.

Thus, we have identified the purpose of this review, which is to collect all the available information and to analyse the current situation of the reindeer on the Arctic islands.

### Material and Methods

Reindeer on the Arctic islands in Eurasia, in the Russian Arctic, have been selected as the object of this review. At the same time, reindeer on the Spitsbergen Archipelago have been excluded from this study because reindeer on this Archipelago are well-studied and protected (see for example, <http://www.npolar.no/en/species/svalbard-reindeer.html>). This publication includes the authors' observations, and information collected by way of survey or from different publications and official documents.

Nutrition of reindeer on the Novaya Zemlya Archipelago was studied by S. Rozenfeld based on analysis of fecal pellet samples according to

the previously described method (Rozenfeld et al., 2012). The samples for that study were collected by the authors.

### General information

In the previous centuries, the number of reindeer in the Russian territory was estimated at 4 millions (Andreev, 1968) to 5–7 millions (Syroechkovsky, 1986). Presently, their number amounts to 1 565 900 domestic reindeer and 939 500 wild reindeer (Fig. 1). The number of reindeer inhabiting Arctic islands – both wild and domestic – is noticeably lower; this is true in the past, and this ratio has remained until today. However, in specific years in summer large islands (for example, in the New Siberian Archipelago) are visited, or used to be visited, by thousands of animals. On the other hand, in some years there are very few reindeer on islands.

The history of origin and expansion of reindeer on different islands is significantly different (Lorenzen et al., 2011). On the Franz Joseph Land Archipelago reindeer are not found today, but they inhabited those islands approximately 2–5 thousand years ago, and then became extinct (Grosvald et al., 1961). Also, reindeer died out on Wrangel Island about 2.5–3.0 thousand years ago (Gruzdev & Sipko, 2007; Stishov, 2004). Domestic reindeer were brought there in the middle of

20th century, then they went wild and since then they have lived there freely.

In the Arctic sector of Eurasia, the wild reindeer inhabits the large archipelagos (Svalbard, Novaya Zemlya, Severnaya Zemlya, New Siberian Islands). Most certainly, a majority of these reindeer have been reproductively isolated from other populations. Based on genetic studies, one is able to assume that the reindeer living on these islands have a common origin (Kvie et al., 2016). Most likely, their ancestors evolved on the north of «Beringia» on the then glaciers-free valleys that are mostly covered with oceans today. How these reindeer were expanding on those islands is yet to be investigated.

Also, it is known that in the early 20<sup>th</sup> century a large group of domestic reindeer was brought to the Novaya Zemlya and released on Southern Island, while reindeer were not brought to the Northern Island of this archipelago. There is an assumption that Russian Pomors also brought reindeer to Svalbard because they are known to have appeared there already in the 12<sup>th</sup> century, and since the 17<sup>th</sup> century, permanent settlements were established there (Starkov, 1998). The Russian Pomors in the north commonly kept and relocated domestic animals, and that reindeer were introduced to the Solovetsky Archipelago in the White Sea since the 16<sup>th</sup> century (Korepanov et al., 2003).

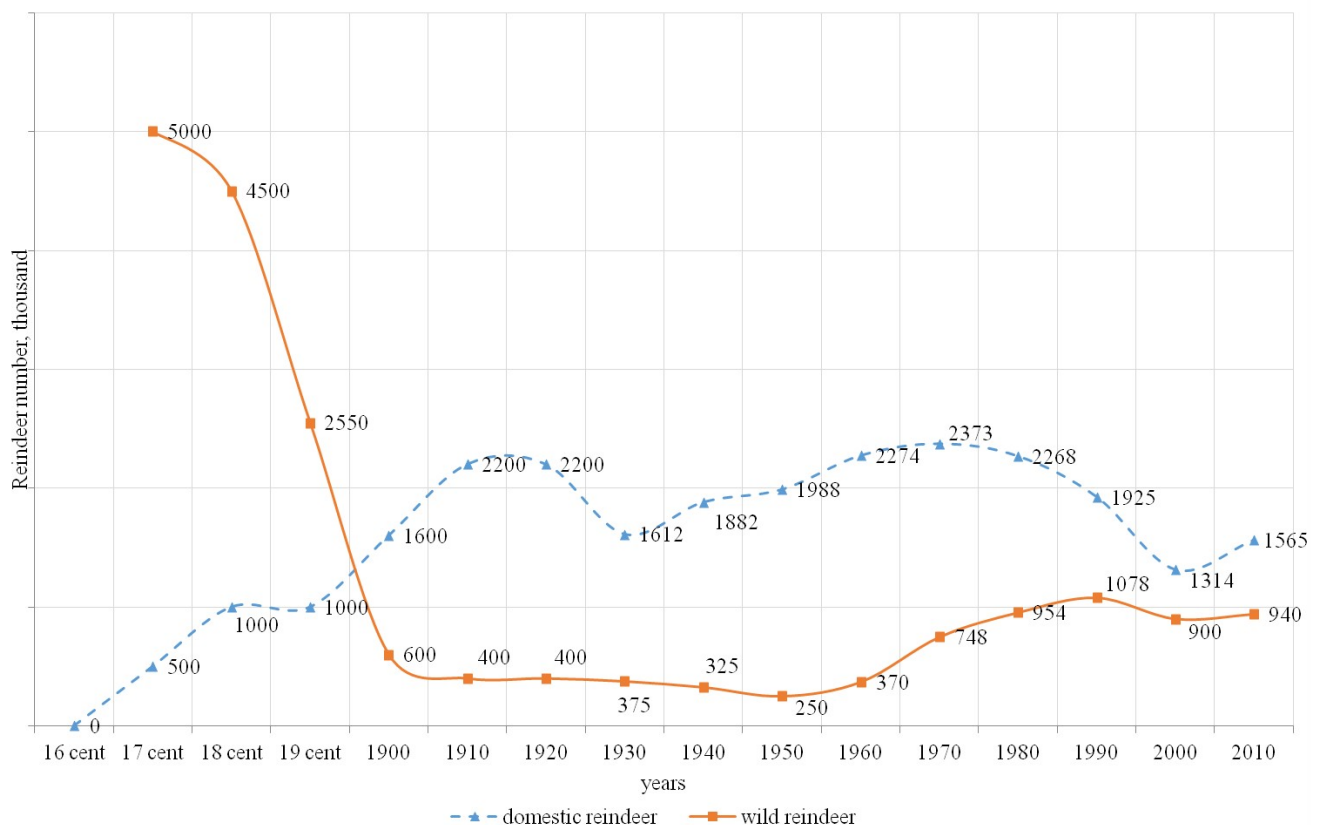


Fig. 1. Dynamics of reindeer abundance in Russia.

On small islands situated near the mainland (Bely, Shokalsky, Neupokoev, Sibiryakov and others) reindeer also live in small groups. But these reindeer arrive from the mainland, usually across the ice-covered areas, or sometimes swimming. They may stay on the islands for a long time or inhabit them periodically, moving from one island to another and returning back to the mainland.

Reindeer also used to live on large islands situated relatively close to the mainland shoreline: on Islands Kildin, Kolguev, and Vaigach, Begichev (Geptner et al., 1961), and Ayon. However, presently reindeer are not found on these islands and their territory is used as pastures for domestic reindeer.

### *The Novaya Zemlya Archipelago*

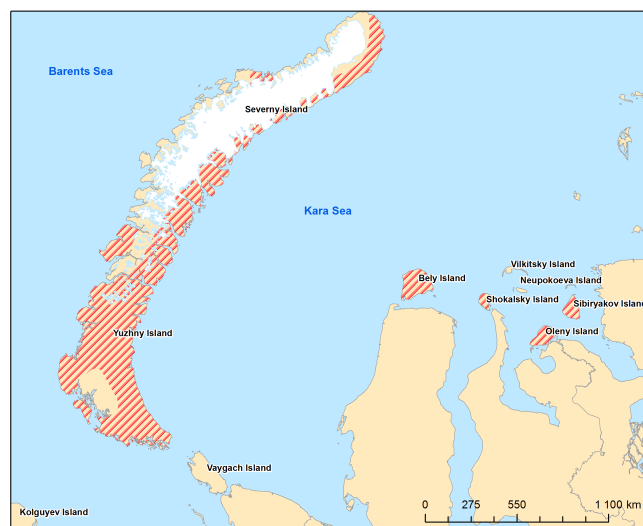
There is no exact information about the time of appearance of reindeer on the Novaya Zemlya archipelago. However, it is known that reindeer appeared on the islands of this region in the Atlantic period of the Middle Holocene, i.e. approximately 7–5 thousand years ago (Grosvald et al., 1961). In the conditions of long-term isolation they obtained a specific phenotypical appearance which became a reason to identify them as a separate subspecies *R. t. pearsoni*. This subspecies is included in the Red Data Book of the Russian Federation (2001) where it is regarded as restored but rare. Some zoologists and reindeer experts believe that the today's status of Novaya Zemlya reindeer is not completely identified, or, more than that, disputable (Novikov et al., 1982; Novikov, 1983; Danilkin, 1999; Tikhonov & Khakhin, 2003). In their opinion, the aboriginal reindeer that should be regarded as *pearsoni*, did not survive (or the remaining individuals are extremely few), and the reindeer inhabiting the archipelago are formerly domestic reindeer that have become wild, possibly partly mixed with the aboriginal wild reindeer. To assume this, it is enough to know that about 10% of Novaya Zemlya reindeer have features of domestic ones – first of all, individuals of mottled colour can be found. In addition, many reindeer have a dark stripe on their side. At the same time, the diagnostic feature of this subspecies is that it does not have such stripe (Novikov, 1983). However, there is hope that a part of the aboriginal reindeer have managed to survive (although, not absolutely «pure»), and reside permanently on the Northern Island and

in the north-east of the Southern Island (Tikhonov & Khakhin, 2003). According to the latest observations, reindeer are regularly seen in the area of Litke Peninsula – Russian Harbour, and, obviously, live here all year round (Mizin, 2015). This reindeer's habitation area is situated in a rather large and ice-free territory, also with relatively good pastures (Fig. 2).

Late in the 19 century when the first colonists were settling on Novaya Zemlya, the number of wild reindeer on the archipelago amounted to 20 thousand animals (Khakhin, 1984). Since then intensive hunting began. By 1930s the number of animals decreased to a critical level. In 1934 the Arctic Institute Bulletin informed that reindeer could be found only on the unexploited shore of the Northern Island (Vekhov, 2013). In 1935 hunting was banned on the Southern Island but illegal hunting continued on a large rather scale (Khakhin, 1984; Vekhov, 2013).

The total area of Novaya Zemlya is 81 300 km<sup>2</sup>, and glaciers cover approximately 29 000 km<sup>2</sup>. They are located mainly on the Northern Island (Kholomyanskiy, 2009).

600 domestic reindeer have been brought to the Southern Island from Kolguev Island in 1928–1933. But they were not strictly protected. At the same time reindeer were not brought to the Northern Island. In the 1940s reindeer herding was no longer practiced; the reindeer were left unattended and have partially mixed with aboriginal reindeer. Also, the Russian Empire Academy of Science released 18 domestic reindeer in 1896. Their fate is not known. In 1980 partial air survey of Novaya Zemlya reindeer was carried out. The number of reindeer was estimated at 4500 animals.



**Fig. 2.** Habitats of wild reindeer on Novaya Zemlya and small islands in the Kara Sea.



The explorer of Novaya Zemlya, Vekhov (2013), reports his encounters with reindeer in the 1990s. Tracks of small herds (4–10 animals) were found on the Northern Island near the Polar station Russian Harbor, Karlsen Cape, the Beluzhya Bay, Cape Zhelaniya, and on the Southern Island near the River Abrosimova, in the upper streams of the River Nekhvatova and Savina, on the shore of Lake Nekhvanovy, on the Kara coast from the River Savina estuary to Litke's factory.

In 1998 the number of reindeer on the archipelago was estimated 15 000, which 2.5 times exceeded the forage capacity of the pastures (Tikhonov & Khakhin, 2003). This number is most likely overestimated because the survey was not conducted in the whole area, and the method of data extrapolation to the whole area is doubtful. Also, one should keep in mind that the forage capacity was estimated only for the prospects of keeping domestic reindeer on the Southern Island.

The studies of the Novaya Zemlya reindeer performed in the recent years by the personnel of the Russian Arctic National Park have identified at least three of their habitats on the Northern Island: 1) the area of Litke Peninsula – Russian Harbour; 2) the area of Cape Konstantin in the northern part of the island; 3) the area on the Kara side between the Rusanova and Medvezhy Bays where, supposedly, calving takes place. According to the current estimate (data provided by the Russian Federation's Nuclear North Test Site to the **Federal Supervisory Natural Resources Management Service** for obtaining a permit for annual killing of 50 animals for radiological monitoring), the number of reindeer on the archipelago is ca. 5 thousand animals.

The main portion is concentrated on the Southern Island (Mizin, 2015).

The most favourable living conditions for the Novaya Zemlya reindeer are found on the western side of the Southern Island. Already in the late 19 – early 20 century the largest herds of these animals were observed in the area of Gusinaya Zemlya, Beluzhy Peninsula, the Rogachev Bay, and Mezhdusharsky Island (Nasimovich, 1955). Air surveys performed on Novaya Zemlya late in the last century, have shown that these areas still remain preferred by the reindeer (Matveev, 1981; Tikhonov & Khakhin, 2003). These areas attract reindeer with plentiful tundra grasses and shrubs; also there are many bogs with such vegetation as cotton grass (*Eriophorum* sp.) and Dupontia (*Dupontia* sp.) (Aleksandrova, 1935). In spring and summer some of the reindeer leave these areas: some animals move to the Kara side (Fig. 3), others migrate northward in small groups, cross the Matochkin Shar Strait and move along the sea shore to the intermountain valleys and the northernmost point of the Northern Island – Cape Zhelaniya (Nasimovich, 1955; Matveev, 1981).

Females concentrate in the calving areas on the foothills of the western and eastern slopes of the Northern Island from the Brandt Bay in the north to the River Vtoraya Savina in the south (Novikov, 1983). In December most of the reindeer return, while just a small portion stays on the Kara side (Matveev, 1981). On Gusinaya Zemlya Peninsula in winter the reindeer stay on the slopes and on plateaus where the snow cover does not exceed 30 cm and lichens are readily available, amounting to 30–40% of all vegetation (Syroechkovsky, 1986).



Fig. 3. Reindeer near Cape Zhelania in September, 2014. Photo: Ivan Mizin.

Earlier, winter migrations of reindeer from the western to the eastern part of the Southern Island were regularly observed (the winter pastures at the Kara Sea coast have less snow). When ice crust formation was intensive, many reindeer abandoned the traditional habitats both on the western and eastern sides of the Southern Island: some of them moved to the Northern Island migrating northward, others went to the very south (where the snow cover was thicker, but the snow was softer), and some even reached Vaigach Island (Nasimovich, 1955).

In 1980s the age and sex structure of the Novaya Zemlya reindeer population was studied (Novikov, 1983). The sex ratio in the mature part of population was approximately 1/2.5 in favour of females. 52.8% of adult females were pregnant. The calves amounted to 12.1% of the total population size.

The main rutting period of the Novaya Zemlya reindeer takes place in the second half of October – beginning of November, while calving takes place in June (Geptner et al., 1961 – quote of Sdobnikov, 1935; Khakhin, 1984).

#### *The New Siberian Islands*

Reindeer are found on the New Siberian Islands regularly and all year round. Besides the large islands – Lyakhovsky, Kotelny, Novaya Sibir – they seldom inhabit Stolbovoy and Belkovsky Islands, sometimes even reach Bennett Island (Fig. 4) (Safronov, 2005).

Several periods with either very high or very low abundance of reindeer have been observed on the New Siberian Islands during the last century (Labutin & Kurilyuk, 1981; Safronov, 2005). Late 1920s commercial hunters estimated the number of reindeer on the Lyakhovsky Islands at 7–8 thousand. In the mid-1930s after two winters with severe icing conditions the number of reindeer dropped to a minimum and remained at a low level until 1960s. At that time migration of the animals from the mainland almost totally stopped. In 1924 the reindeer wintering on the New Siberian Islands had to stay there until January, because the Dm. Laptev Strait remained ice-free. In addition, severe icing took place and resulted in a massive death of the animals. In 1935 a similar situation occurred again. As a result, the island population (ca. 4–5 thousand animals) died out almost entirely. (Geptner et al., 1961 – quote from Pinegin, 1932; Skalon, 1940).

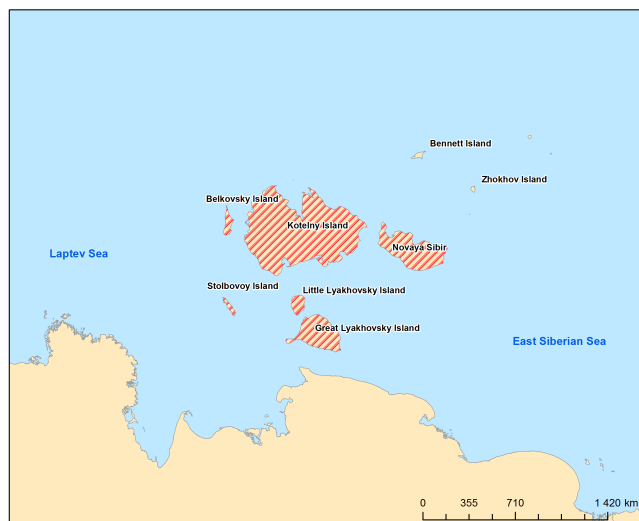


Fig. 4. Habitats of wild reindeer on the New Siberian Islands.

In the mid-1960s according to the aerial survey data (Egorov & Krechmar, 1967) the number of reindeer on the archipelago reached 17–18 thousand. In the mid-1970s, the New Siberian reindeer population was tentatively estimated to have almost doubled. It was specified that reindeer's migration from the archipelago to the mainland had ceased and an isolated population had been formed (Kishchinsky, 1975).

Late 1970s the number of reindeer dropped again and was at a level of three thousand individuals, but then suddenly it skyrocketed just in two years, reaching 17 thousand (Novikov, 1983). Apparently, in some years a certain part of the island's herd (sometimes, it may be a significant portion) stay for the summer on the mainland for reasons that are not fully clear, or, vice versa, the reindeer may suddenly begin a massive migration to the islands (Labutin & Kurilyuk, 1981). Consequently, the reverse migrations from the islands may vary in intensity or cease completely.

In the last decades the number of reindeer on the archipelago has been stable at a level of 10–15 thousand. It has been noted that currently the main portion of the reindeer spend the summer on Faddeyevsky and Novaya Sibir Islands, although in the past the summer pastures mainly used to be on Kotelny Island. The relocation of summer habitat has obviously happened because of anxiety caused by the permanent presence of people (Safronov, 2005).

According to Safronov (2005), seasonal events in island reindeer take place as follows. The reindeer wintering on the mainland migrate to the islands in February – March. Generally, by the end of April the last island herds leave the mainland. Moving from the Svyatoy Nos Peninsula, they pass

to Lyakhovsky Islands, then to Kotelny Island, and across Bunge Land to Faddeyevsky Island, and further to Novaya Sibir Island (sometimes the two latter islands are reached straight across the sea, without visiting Lyakhovsky Islands and Kotelny Island). In recent years, calving and massive aggregation of animals take place on Faddeyevsky Island, and, possible, on Novaya Sibir.

Late in September – October reindeer concentrate on Kotelny Island where the rut takes place. When the straits are frozen, part of the reindeer move to the mainland via Lyakhovsky Islands, while the rest overwinter on the island.

Most certainly, the reindeer that move to the mainland do not go further south than the coastal tundra. According to the hunters from the Yukagir village, the island reindeer arrive to the mainland in November – December. Their herds graze on the shore Oyogos – Yar (east of the Svyatoy Nos Peninsula) where the tundra is covered with fruticose lichens.

Apparently, if contacts ever take place between the island and mainland (Yano – Indiga) reindeer, then they are extremely rare and only between very few animals. Obviously, sometimes some of the island reindeer stay on the mainland for the summer, where their contacts with their mainland relatives are possible. In spring, individual animals from the Yano – Indiga population may accidentally find themselves among the island reindeer migrating northward. This is confirmed by the data of commercial hunting – according to Rutilevsky (1967), in each 100 killed reindeer, 2–3 mainland animals were found at times.

Late 1979s the age and sex structure of the New Siberia wild reindeer population ( $n = 2919$ ) included: mature males – 13.6%; mature females – 42.4%; young animals 1–2 years old – 20.8%; calves – 23.2% (Safronov, 2005).

About 2–3% of the population of island animals is killed by hunters. The limiting impact on reindeer by wolves is difficult to assess, but packs of 10–15 predators are observed at times (Safronov, 2005).

Infectious diseases common in the mainland reindeer are not found on the islands. Also, the island reindeer are free from gadflies and warble flies. The same situation is observed on the other Arctic Islands.

#### *Wrangel Island*

Reindeer were not found on Wrangel Island until the middle of 20<sup>th</sup> century. In 1947–1948 and 1952, 115 domestic reindeer were brought to the

island from the Chukotka coast, and early in the 1970s additionally several dozens of stud bucks were brought for the purpose of selection (Ovsyukova & Novikov, 1983; Kazmin, 1986). The reindeer grazed freely and, considering the favourable conditions, their number grew rapidly. Since 1956 slaughtering had begun. By 1975, the number of reindeer on the island reached 5000. With such numbers of reindeer, apparently, the pressure on the pastures is excessive. According to estimates by Gorodkov (1939) who carried out a botanical study of Wrangel Island, the pasture conditions on the island allow year-round grazing of 1.0–1.5 thousand reindeer. Kishchinsky (1975) estimated the potential grazing capacity as ca. 3–4 thousands animals. In 1976 the Wrangel Island State Nature Reserve was founded. And a decision was made to reduce the population of reindeer down to 1.5 thousand. In the 1980s, their number was kept within the limit of two thousands. But since 1996 killing for regulation has ceased. By 2002 the reindeer population on the island grew to 8.5 thousands animals. But then, after several winters with severe icing periods the number of reindeer began to decrease: down to two thousand by 2006, and down to 450–500 by 2007 (Gruzdev & Sipko, 2007; Kazmin & Kholod, 2014). Later, until 2016, the number of reindeer has stabilised within the limits of 200–300 animals. The portion of young animals in the population is reported to be small. The impact of predators is the main reason for absence of population increase over the last decade, in the conditions of a relatively moderate climate.

Wolves have independently migrated to the island, in an amount of approximately ten individuals, and wolverines, whose number is also increasing. It should be added that early in the 1980s wolves were entirely exterminated on the island, and the population developed without their presence until recently, and for this reason the reindeer's adaptation to predators' may have decreased. In winter, the reindeer keep to the mountainous part of the island and elevated areas. In the warm season they come down to the foothills and graze in the valleys of rivers and brooks, and in the lowlands of Tundra Akademii. A tendency of herds moving (Fig. 5) from the eastern to the western part of the island in spring has been noted, in autumn – in the opposite direction (Kazmin, 1986).

The data of age and gender structure and group size of reindeer on Wrangel Island is presented in Table 1, and in Table 2.





Fig. 5. A migrating herd of reindeer on Wrangel Island. Photo: Mikhail Migutin.

Table 1. Age and sex structure of reindeer on Wrangel Island, according to commercial hunting data (1991)

Age, years	Western group				Eastern group				In two groups			
	Males		Females		Males		Females		Males		Females	
	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%
0.5	61	50.8	59	49.2	33	45.2	40	54.8	94	48.7	99	51.3
1.5	54	47.4	60	52.6	23	36.5	40	63.5	77	43.5	100	56.5
2.5	25	46.3	29	53.7	14	46.7	16	53.3	39	46.4	45	53.6
3.5	2	5.3	36	94.7	2	6.1	31	93.9	4	5.6	67	94.4
4.5	2	7.7	24	92.3	3	15.0	17	85.0	5	10.9	41	89.1
5.5	–	0.0	20	100.0	–	0.0	10	100.0	–	0.0	30	100
6.5	2	6.3	30	93.7	–	0.0	15	100.0	2	4.3	45	95.7
7.5	–	0.0	23	100.0	–	0.0	26	100.0	–	0.0	49	100.0
8.5	–	0.0	4	100.0	–	0.0	11	100.0	–	0.0	15	100.0
9.5	–	0.0	2	100.0	–	0.0	7	100.0	–	0.0	9	100.0
10.5	–	0.0	1	100.0	–	0.0	4	100.0	–	0.0	5	100.0
11.5	–	0.0	1	100.0	–	0.0	3	100.0	–	0.0	4	100.0
12.5 >	–	0.0	–	0.0	–	0.0	5	100.0	–	0.0	5	100.0
Total	146	33.6	289	66.4	75	25.0	225	75.0	221	30.1	514	69.9

Table 2. Reindeer group composition on Wrangel Island (*n* = 2244) by frequency of encountering groups and individual animals in the period 1982–2006 (Gruzdev & Sipko, 2007)

Herd size (considering single individuals), number of animals	1	2–10	11–50	51–100	> 101
Frequency of encounters, %	Ca. 4	Ca. 34	30	10	Ca. 22

The following data is available on reproduction of reindeer on Wrangel Island. The rut takes place in September until late October. The first calves are usually observed on April 22–23, and most calving takes place in May. The calving period is over by the end of June, although some cases of calving early in July are known (Kazmin, 1986). Table 3 provides pregnancy rates (embryonic fertility) for reindeer on Wrangel Island.

Table 3 demonstrates that pregnancy rate in young reindeer females on Wrangel Island is high, with a fairly high portion of females with two embryos. Such fertility figures are more typical of domestic reindeer.

The number of calves in the main herd varies from year to year. Thus, in 1981 with the reindeer population ca. 1.6 thousand, it amounted to 19%, and in 1983, with the population size 1.8–1.9 thousand, 35.5% (Kazmin, 1986).

Deaths of reindeer on the island are mostly associated with icing that sometimes is catastrophic for the population. After intensive icing in the winter 2005/2006 the sex and age composition of dead reindeer was investigated ( $n = 134$ ). Mature males amounted to 14.2% of all the dead animals, mature females – 49.3%, young animals 1–2 years old – 36.5% (Gruzdev & Sipko, 2007).

Presently, the predator pressure (wolves, polar bears and wolverine) on the reindeer population has decreased. Apparently, either the number of predators has stabilised, or other kinds of prey have become more available to them. The most dangerous predator for reindeer – wolves – have been rather rare on the island – only 3–5 individuals have lived on the island in recent years (Gruz-

dev & Sipko, 2007). Attacks on reindeer by polar bears are not known.

Large outbreaks of infectious diseases on the island have not been recorded. The appearance of the gadfly on the island has been a negative factor. They were brought here early 1970s together with reindeer from the mainland (Ovsyukova & Novikov, 1983).

#### *The Severnaya Zemlya Archipelago*

The data on reindeer in this territory are extremely scarce and fragmented. Reindeer are found on the Severnaya Zemlya in small numbers; it is even more unusual that they stay there for the winter (Fig. 6). During the ice reconnaissance survey in March – April 1988 on Komsomolets Island ten animals were observed, on Bolshevik Island – four animals, on Pioneer Island they were absent (Kalyakin & Belikov, 1989). It should be noted that glaciers cover approximately 47% (17.5 km<sup>2</sup>) of the Archipelago (Savatyugin & Dorozhkina, 2010).

According to other data, reindeer are present on the archipelago but with about 20–30 year intervals, their population declines (Belikov & Kupriyanov, 1985).

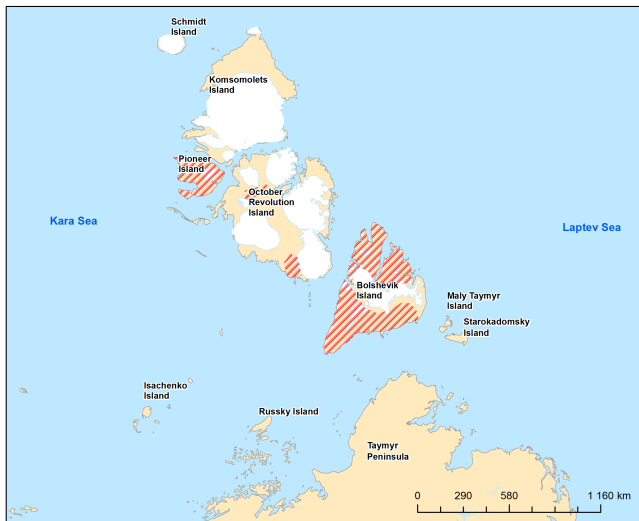
According to the personal report by L.A. Kolpaschikov (2015), currently reindeer are present on the archipelago, but their number has not been identified. Also there is information that reindeer have been noticed regularly on Bolshevik Island. This fact is associated with continuous warming in the Arctic. One can assume fairly certainly that in terms of reproduction this population is isolated from the reindeer living on the Taimyr Peninsula.

**Table 3.** Description of embryonic fertility of reindeer on Wrangel Island (1991)

Age of females, years	Portion of females without embryos		Portion of females with one embryo		Portion of females with two embryos	
	West	East	West	East	West	East
0.5	28.5	47.2	71.5	52.7	0	0
1.5	3.2	5.2	96.8	94.7	0	0
2.5	0	6.2	100.0	93.8	0	0
3.5	0	0	100.0	100.0	0	0
4.5	0	11.6	92.0	82.3	8.0	5.8
5.5	5.2	0	94.6	100.0	0	0
6.5	0	0	90.4	100.0	9.6	0
7.5	4.7	0	90.3	100.0	4.7	0
8.5	0	9.1	100.0	90.9	0	0
9.5	0	0	0.0	100.0	0	0
10.5	0	40.0	0.0	60.0	0	0
11.5	0	0	0.0	100.0	0	0
12.5 >	0	0	0.0	100.0	0	0

Note: Embryonic fertility was studied on a basis of commercial hunting in 2 groups of the island reindeer – Western and Eastern groups (their age and sex structure and numbers are specified in Tables 5 and 6). Embryonic fertility was studied in approximately 90% of all females.





**Fig. 6.** Habitats of wild reindeer on the Severnaya Zemlya Archipelago.

### Small Islands

The islands in the immediate proximity of the mainland – Bely, Shokalsky, Vilnitsky, Neupokoev, Oleniy, Dikson, Medvezhy, Nordensheld (Fig. 2) – are, as a rule, regularly inhabited by reindeer arriving from the mainland coastal tundra (Druri, 1949; Nasimovich, 1955; Geptner et al., 1961; Syroechkovsky, 1986).

According to observations from a motor hang glider, ca. 400 animals lived on Shokalsky Island in 1998–2002, and ca. 20 and 40 reindeer lived on Neupokoev and Yavey Islands, respectively (Gorchakovskiy, 2007). A wintering reindeer population has been documented on Sibiryakov Island in recent years (Makeev et al., 2014).

At the same time it has been found that ca. 50 reindeer used to live on Neupokoev Island, and ca. 500–600 – on Sibiryakov Island (Kalyakin & Belikov, 1989).

Domestic reindeer presently graze on the islands: Kolguev, Vaigach, Bolshoy Begichev, and Ayon. Domestic reindeer brought to southern Arctic islands in time grow larger than the reindeer on the mainland where they were brought from. As it was mentioned above, reindeer adjusted to the climate on Wrangel Island surpass the Chukotka domestic reindeer in size already in several years after arrival. Livestock surveys of reindeer on Kolguev and Vaigach Islands have shown that these reindeer surpass in size their mainland relatives in the territory of Nenets Autonomous Okrug (Podkorytov et al., 2004). Among the favourable factors that have positive impact on the island reindeer are: free (semi-wild) grazing, a milder climate in winter, and cool windy summer without abundant gnats, absence or low number of predators, available salts on the shore, and often pastures that are richer in terms of food supply.

Systematic monitoring of reindeer inhabiting these islands is not carried out, that is why we are only referring to fragmented data collected in different years.

*Ayon Island.* The first mentions of this island date back to the middle of the 17<sup>th</sup> century when trade with the local population began. Probably, already at that time domestic reindeer were kept on the island. In the 20<sup>th</sup> century a reindeer herding enterprise kept ca. 22 thousand domestic reindeer. In recent years, ca. 3 thousand domestic reindeer have been kept.

*Bely Island.* It is known that in the 1930s ca. 5 thousand wild reindeer concentrated on Bely Island in summer, but «hundreds» of them stayed there in winter (Tyulin, 1938; Nasimovich, 1955 – quote from Koshkin, 1936, 1937). Late in the 1980s during ice reconnaissance survey the number of reindeer on Bely Island was identified as 300. Early 2000s information was presented that not more than 500 reindeer live on Bely Island and the northern point of Yamal (Paponov, 2005).

According to the data collected as early as in the 1930s (Tyulin, 1938; Nasimovich, 1955 – quote from Koshkin, 1936, 1937), reindeer arrive in Bely Island early in spring – at the end of March. Massive migrations from the mainland take place in April – May, but relocation from one island to another may continue until the straits are ice-free (approximately the middle of June). In autumn, in October, the reindeer begin to gather near the southern shores of the islands waiting for the ice. In November – early December their overwhelming majority return to the mainland across the ice. Only a few of the animals stay on the islands and keep in small groups on elevations feeding mostly on sedge and grass sticking out of snow. The assumption that some stray domestic reindeer join the Bely Island reindeer is yet to be confirmed.

The peak of the rut of Bely Island reindeer takes place in the second half of October – early November; and new-born calves appear early in June (Tyulin, 1938). In the autumn of 1935, the following herd structure was observed on the island: calves – 21%, young over one-year-old – 21%, mature females – 46%, mature males – 12% (Tyulin, 1938).

*Begichev Island.* Ca. 2.0–2.5 thousand wild reindeer were observed on Begichev Islands (Tyulin, 1938; Nasimovich, 1955 – quote from Koshkin, 1936, 1937). Late in the 1980s, during ice reconnaissance survey the number of reindeer was estimated 50–100. Since the beginning of 2000, a reindeer herding team has kept ca. 1.5–2.0 thousand domestic reindeer.

*Vaigach Island.* The presence of wild reindeer has been noted here before (Geptner et al., 1961). Russian commercial hunters have visited this island since the X century. Domestic reindeer were not brought here for grazing; at that time this territory was regarded as a sacred and cult area for the local people, and had no permanent population. Tame reindeer herding emerged on the island in the 1920s. In 2012, 1732 domestic reindeer were kept. In recent years the reindeer number has been decreasing and maintained at a limit of 1 thousand. The decrease of local people engaged in reindeer herding may have impact on the reindeer status.

*Kolguev Island.* Some data confirm that wild reindeer used to live here (Geptner et al., 1961). According to Sokolov (1933), reindeer herding on Kolguev Island has a relatively recent history. Wild reindeer are mentioned to have lived on Kolguev Island in the middle of the XVIII century and died out within several years. At the same time, the reasons why wild reindeer disappeared are unknown to us; also, there is no information whether small groups of wild reindeer may have survived on the island and later merged with the domestic ones. Presently, wild reindeer are absent on the island. Tame reindeer herding as an industry emerged on Kolguev Island early XIX century, when Russians brought domestic reindeer from the mainland, for commercial purpose. Later a group of Nenets people was invited to the island, to manage the herds of spreading reindeer.

In the XX century the number of domestic reindeer reached 20 thousand. Until 2012, the number of reindeer was kept at a relatively high level – 12 thousand, but later a massive death of the animals took place. By 2015, ca. 150 reindeer remained on the island. Among the reasons are both weather conditions and, apparently, errors in herd management.

### Nutrition of island reindeer

The data on the Arctic islands' reindeer nutrition are incomplete, but certainly their range of food items is not as broad as on the mainland (Table 4). Green forage generally prevails in the reindeer's diet on the Novaya Zemlya Archipelago (Table 5).

The study of reindeer nutrition on Novaya Zemlya was performed for the Southern Island, while no special study was made for the area north of 74°N. The analysis of reindeer's dry manure samples collected in 2013 and 2014 performed by S.B. Rozenfeld has shown that lichens and mosses play the main role in the summer diet. Herbs are the most common vascular plants in reindeer's

diet. The remaining portion of the diet includes plants from the families Poaceae, Fabaceae, Juncaceae, Polygonaceae, Cyperaceae, Saxifragaceae, and Caryophyllaceae. The samples included excrement found in different years, some of them almost falling apart. Curiously enough, the same ratio was confirmed by the analysis of a fresh reindeer excrement sample found in an area of migration of a small reindeer herd in September 2014 (Table 6). Description of reindeer's diet on the New Siberia Islands is presented in Table 7.

More information on forage of reindeer is available on Wrangel Island where it has been extensively studied (Zheleznov, 1990; Sipko et al., 2006; Kazmin et al., 2011, Rozenfeld et al., 2012; Kazmin & Kholod, 2014). In particular, the role of lichens in reindeer diet has not been fully identified. For example, Zheleznov (1990), analysing the contents of animals' stomachs ( $n = 17$ ), found that lichens amounted to 40.3% of all winter forage. According to other studies (Table 8), their role in reindeer diet is much lower or even very small, which can be explained by large amounts of vascular plants preferred by the animals, on the island. During the period of high numbers of the reindeer on the island, thickets of lichens were practically eradicated is yet another consideration.

**Table 4.** Species structure of reindeer's diet in different areas (Sipko & Larin, 2004)

Food	Wrangel Island	Taimyr Peninsula
Mushrooms*	–	1
Algae	1	1
Lichens	11	12
Mosses	10	7
Vascular plants	125	164
Totally, species	146	185

*Note:* \* – Agaric mushrooms are found on Wrangel Island in small amounts and not every year, that is why they are not taken into consideration.

**Table 5.** Composition of forage groups in reindeer's rumens on the Novaya Zemlya (area of Gusinaya Zemlya Peninsula), % (Aleksandrova, 1937)

Forage groups	Summer	Autumn	Winter
Green forage	74	24.5	41
Mosses	12	19.5	39
Lichens	14	56	20

**Table 6.** Structure of forage plants in reindeer's diet in the area of Cape Zhelaniya, Northern Island, Novaya Zemlya, %

Group of plants	Dry excrement samples, n = 13	Fresh excrement sample
Lichenophyta	61	72
Bryophyta	15	15
Poaceae	11	5
Other vascular plants	13	8

**Table 7.** Occurrence frequency and amount ratios of various fodders in wild reindeer's rumens on the New Siberia Islands, % (Egorov, 1971)

Forage groups	Summer ( <i>n</i> = 10)		Autumn ( <i>n</i> = 2)	
	Occurrence	Amount	Occurrence	Amount
Willows (Salicaceae)	40.0	0.4	–	–
Cyperaceae and Poaceae (green)	100.0	94.1	100.0	10.0
Cyperaceae and Poaceae (dead grass)	–	–	100.0	80.0
Juncaceae	50.0	0.8	100.0	1.0
Other flowering plants	100.0	2.5	100.0	3.5
Mosses	–	–	–	–
Lichens	10.0	1.2	100.0	2.0
Mushrooms	10.0	0.1	–	–
Algae	70.0	0.9	100.0	3.5

**Table 8.** Structures of forage plants' groups in yearly diet of the reindeer on Wrangel Island, %

Groups of plants	Rozenfeld et al., 2012 (fecal pellet samples, <i>n</i> = 44)	Kazmin & Kholod, 2014 (fecal pellet samples at 18 test sites)
Willows (Salicaceae)	Spring up to 50%, summer – 11%, autumn – winter up to 30%	38–50% during the year
Cyperaceae and Juncaceae	Winter – spring – 7.5–15%, Summer – autumn – 26–40%	Summer – 11%, Autumn – winter – 4–5%
Grasses	Spring – winter – 17–18%, Summer – autumn – 23–27%	Little in winter, summer – autumn – 12%
Fabaceae	Spring – summer – 5–10%, Autumn – winter – 1.5–2%	12–24% in different seasons
Mostly grass	In spring practically not consumed, in other seasons – 4–6%	12–17% during the year
Lichens	Winter up to 20%, little in other seasons	Little during the whole year
Mosses	Spring – summer – 4–6%, Autumn – winter – ca. 11%	7–18% in different seasons

The reindeer feeds on 116 species of vegetation on Wrangel Island (Rozenfeld et al., 2012). The structure of forage plants' groups identified by different studies is presented in Table 8.

### Conclusions

Our analysis of the current situation of reindeer population status on the Russian Arctic islands has identified the following:

The degree of knowledge about the native (endemic) populations is very low, and the data on their status are fairly fragmented. At the same time, the information about introduced reindeer is considerably greater. However, the importance of studies is undoubted, because the reindeer is a good object for the study of mammals' ability to adjust to living in the conditions of the Arctic desert, and also a good marker of the ongoing climate changes.

The abundance of native (endemic) populations of reindeer is not high and is declining.

The current trend of climate warming (Uboni et al., 2016; Yannic et al., 2014) is having a controversial impact on the stability and development of the native (endemic) populations, and the associated abnormal weather phenomena pose a threat to survival of the reindeer on the islands.

The need for developing a system of measures for protection of these populations, as well as for studying their biology, is obvious. The absence of data on the island populations' status is an obstacle to rational management and efficient protection.

The Novaya Zemlya is inhabited by people. There are three settlements, military bases, and a meteorological station. Additionally, the Southern Island has become a ground for mineral extraction and accompanying infrastructure development.



Severnaya Zemlya has no settlements, there is only one large scientific base, and geological surveys (including gold mining) are underway on large territory. The New Siberian Islands do not have registered residents, however, several thousands of people come here every summer in search for mammoth tusks. Thus, future conservation and study of Arctic island populations of the reindeer requires expansion of special protected nature areas on Novaya Zemlya, Severnaya Zemlya, and establishment of a new special nature reservation on the New Siberian Islands. Without such measures, the Arctic wild reindeer will remain unstudied and their fate may be very sad.

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## СЕВЕРНЫЕ ОЛЕНИ (*RANGIFER TARANDUS*: CERVIDAE, MAMMALIA) НА АРКТИЧЕСКИХ ОСТРОВАХ РОССИИ: ОБЗОР

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В статье приводятся обзорные данные по состоянию дикого северного оленя (*Rangifer tarandus*) на островах Российской Арктики. Обсуждаются численность, питание, общая изученность вида, особенно на острове Врангеля и Новая Земля. Приведены краткие сведения о домашних северных оленях, выпасающихся на арктических островах. Литературные данные дополнены результатами исследований последних лет. Показано, что дикие северные олени имеют отрицательный тренд численности, а также подчеркивается необходимость изучения и охраны изолированных островных арктических популяций.

**Ключевые слова:** Арктика, распространение, домашний и дикий северный олень, Новая Земля, особенности питания, остров Врангеля, условия обитания, численность