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Game species fodder conditions in Eastern Siberia and Amur region

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Abstract. Hunting farms can serve as a source of primary data on the state of natural resources. Taking into account the increasing anthropogenic impact on the environment, it is necessary to constantly monitor the situation with food for ungulates and predators in order to be able to take timely measures to improve the quality of habitat for wild fauna. Populations of wild large animals live in the host landscapes of so reduced that animals population become extremely vulnerable and unstable, signs of crisis can be seen in the data on the number of animals. Lack of natural food is a serious deterrent, especially in difficult times of the year, such as winter and spring. An analysis of the situation with food for a particular species will allow hunting farms to properly plan their feeding and other activities throughout the year in order to maintain a population of certain species on their territory and minimize the migration of species outside the protected areas. The aim of our work was to create a baseline for tracking data on the characteristics of wildlife animals. The research results allow hunting farms to use the data of animal feeding preferences during different seasons of the year for better organization of their biotechnical measures and improvement of feeding conditions for such species as red deer (*Cervus elaphus*), elk (*Cervus canadensis*), roe deer (*Capreolus pygargus*) and bear(*Ursus arctos*).

Key words: Amur region, brown bear, Eastern Siberia, fodder base, Siberian roe deer.

INTRODUCTION

The study of wild ungulates is environmental and economic value. Increasing the number of wild ungulates, their preservation, carrying out high-quality biotechnical and protective measures are important tasks of hunting. A detailed study of the food supply of ungulates in different seasons of the year will allow the specialists of the hunting farms to carry out biotechnical measures correctly and in a timely manner, and most importantly, to use the feed needed to maintain the animal in a certain period of the year.

To study feeding situation of wild animals and predators in Eastern Siberia and Amur region in order to develop effective feeding depending on the season. The founders of game management on the territory of the former USSR were Lobachev & Stakhrovsky (1932), Danilov (1960), Danilov & Rusanov (1966). Game management is based on the hunting grounds' quality assessment and calculation of game species appraisal on a five-point scale selected as an approach that is familiar to the local population (i.e. the local secondary schools also use a five-point grading scale). A typology of hunting grounds must be determined first for these computations.

The study and improvement of methods for determining the typology of hunting grounds were carried out by Martynov & Masaytis (2002), Plaksa (2005), and Kozlov (2007).

Various researchers, such as Danilov (1953), Danilov & Rusanov (1966), Dementiev (1973); Kuzyakin (1974), and Kluchev (2003) devoted their work to the calculation of hunting ground appraisal for hunting species. However, there is no consensus regarding the definition of hunting ground quality. According to Danilov & Rusanov (1966) hunting ground quality is determined by the optimal number of animals per area unit; according to Yurgenson (1969) it is an indicator of hunting ground capacity. Kuzyakin (1974) considers ecological standards of species' population to be more correct. For Melnikov & Melnikov (2008) the quality of hunting grounds is the economically feasible density of species population, while Kluchev (2003) and Kozlov (2007) used hunting ground productivity.

We believe that the hunting grounds' appraisal should be calculated using an output expressed by a number of species per one thousand hectares. A natural output should be distinguished from an actual one. The natural output is species population density (number), determined by the hunting grounds' quality without taking biotechnology and poaching into account. It is consonant with the concepts of optimal abundance, hunting capacity and environmental standards of species population.

We investigated the variety and composition of feedstuff during different seasons of the year. We determined the most preferable and less preferable, so called secondary feedstuff, as well as feeds for the most difficult periods of animal life, i.e. ‘limiting feeds’. We conducted a comparative analysis of animal populations inhabiting the territories of the Republic of Buryatia and Amur region based on land and forage condition quality in the studied regions of the Russian Federation. The importance of mineral feeding for ungulates has been studied as well.

We believe that any successful conservation program should be based on a clear understanding of the environment in which the species live, i.e., on the systematic collection of qualitative and quantitative data regarding the living conditions of these species. Without this fundamental knowledge needed to conserve any species, it is easy to move away from the main areas of activity necessary for the conservation, preservation and restoration of the animal population. Therefore, our study aimed to outline the current situation, development trends, and characteristics of the given land from the perspective of the carrying capacity of a particular species living in a specific environment. What are the characteristics of the living environment? What are the trends? We are looking for answers to these questions and believe that without them, any conservation program will not be successful.

MATERIAL AND METHODS

Hoofed animals and large predators are valuable objects of the hunting fauna of Eastern Siberia and Amur region. The study of the forage conditions of hunting grounds for these species in different seasons of the year is an important aspect of their ecology. The food base determines the spatial distribution, affects the population indicators of all animals, without exception. An actual output is species population density (number), currently prevailing in the hunting grounds, which depends not only on the quality of the hunting grounds, but also on the anthropogenic impact. We studied scientific works about food supply of ungulates in Yakutia (Antipov, 1976), Krasnoyarsk region (Subbotin, 1980), Irkutsk region (Kozlovskiy, 1997), Amur region (Morozov, 1982; Danilkin, 1999), the Republic of Buryatia (Noskov, 2008; Antropov et al., 2013), the Trans-Baikal region (Sandakov et al., 2015), Khabarovsk (Senchik & Guretskaya, 2017) and Primorsky regions (Smirnov, 2000). Argunov & Stepanov (2011) and Kucherenko (1981) in their studies showed that foodstuff's composition for ungulates includes some other plants that we have not identified. We identified 116 species of plants used by Siberian roe deer for feeding (Antipov, 1976; Korenyuk, 1989).

We studied and analyzed scientific works on brown bear feeding in Yakutia, North-Eastern Siberia, Primorsky, Khabarovsk regions, Kamchatka and Amur region (Chernyavsky & Krechmar, 2001; Seryodkin et al., 2006; Veklich & Darman, 2013; Johansson et al., 2016; Senchik et al., 2017). Special attention was paid to feeds of plant origin, since during bears' active life period their condition is the most stable for this type of species in Amur region.

As a result of the analysis of scientific works, especially of the Far Eastern authors, it has been established that the diet of a brown bear living in adjacent territories also includes some other plant species that also grow in Amur region. However, they were not found by us. We have identified 107 species that can be included in a brown bear diet.

We studied feeding situation in the hunting grounds of Eastern Siberia and Amur region for wild ungulates, such as elk (*Cervus canadensis*), red deer (*Cervus elaphus*), roe deer (*Capreolus pygargus*) as well as large predators – wolf (*Canis lupus*) and brown bear (*Ursus arctos*). Their habitat has been specified, food supplies have been studied, species assessment has been carried out, their population and its density on the given territory have been determined (Forest, 1979; Starchenko, 2008; Treves & Bruskotter, 2014).

Wildlife technicians employed at the hunting farms conducted the field studies within the territory of their employers. They had a walk along the given routes and recorded the traces of animals alongside the coordinates of their detection as well as the landscape features. Using these primary records allowed us to define the status of the environment and its carrying capacity on a larger scale.

We have been investigating food conditions in two regions of Russia for 7 years. Studies were conducted in all seasons of the year. Among other things, we analyzed the data provided by hunting farms, in the appendix to the article one can see examples of the primary working documentation of hunting staff and wildlife officers who made regular rounds of wild lands, recorded and determined the ownership of traces of wild animals and recorded everything in their records. We have laid routes in a large part of Eastern Siberia and Amur region, suitable for ungulates and predators. The routes were covered with the use of motor vehicles and by foot, on skis and on snowmobiles during

winter. An average length of hiking routes was 5 to 15 km. More than 20,000 km were covered as a result. More than 6,000 winter record cards, indicating the number of ungulates and wolves met at specific route points, were also analyzed annually (Annex 1, 2, 3, 4, 5, 6, 7). Cards were chosen from each district and from almost all hunting users of Amur region and the Republic of Buryatia. More than 5,000 photos and 1,500 videos were collected and analyzed. These video and photographs provide evidence on the presence of ungulates and predatory species in the area. Animals were captured on camera during feeding, resting, and migration. Some photos and videos were made specifically for this study, some provided by amateur hunters and specialists from hunting farms. The research results allow hunting farms to improve the system of biotechnical and reproductive activities, with the aim of increasing the number of ungulates, as well as improving the quality of hunting territory. A collection of materials on survey data and questionnaires was done. The profile contains data on animal feed options, time when the animal was caught, and stomach content. More than 1,800 hunters were interviewed. For 7 years we annually analyzed 100% of elk, red deer, and roe deer hunting permits, returned by hunters to federal services for protection of wildlife objects of the Republic of Buryatia and Amur region.

To determine the diet of ungulates and predatory animals, the analysis of excrements found in different regions of the Republic of Buryatia and Amur region was carried out. Feeding elements were determined by explicit fragments, as well as by conventional methods. The diet of ungulates was studied according to methods of Novikov (1953), Lebedeva (1965), and Smirnov (1977). The composition of feedstuff was studied using the method of counting animal bites on various trees and shrubs along featured model territories and on cut-tape samples (Novikov, 1953; Lebedeva, 1965; Smirnov, 1977). These studies allowed us to determine the basic feedstuff of elk, red deer, Siberian roe deer, wolf and brown bear, as well as their choice of feeding during different seasons (Vorob'ev et al., 1989; Namzalov et al., 1997; Wäber & Dolman, 2015).

Studies of hunting grounds' typology have been conducted in Amur region and Eastern Siberia. We have determined hunting grounds division in percentage by quality types and classes as a result. Using Danilov & Rusanov's (1966) method we determined the weighted average quality assessment of hunting grounds for elk, red deer, roe deer, wolf, bear in two regions. Experts, acknowledged about environmental conditions in the area, classified hunting grounds by the number/size of animals using a common five-point scale, where 1 *is the most valuable for hunting* and 5 *is the least valuable for hunting.*

RESULTS

Flora and climate of the studied region

In this section we give, as far as possible, a general, holistic presentation of the habitat of animals. such a statement may seem redundant, but we wanted to give the picture in its entirety.

Eastern Siberia flora is very rich and diverse. There are all major ecosystems of the northern hemisphere: steppes, forests, wetlands, meadows, alpine tundra and alpine wastelands with unique floristic complexes. The uniqueness of Buryatia biotopes is founded on the paradoxical characteristics of the regional position of the lake Baikal in Eurasian mainland.

Buryatia's flora includes 2,128 species and subspecies belonging to 585 classes and 127 families. This richness can be explained by its natural features - predominance of the mountain relief, diversity of its forms and natural vegetation zones. All that contributed to the preservation of a greater number of relict species (up to 70) and the presence of endemics (about 130).

I. Bald mountain (mountain-tundra) and sub-mountain vegetation types. Sub-mountain soils are represented by the combinations of tundra, dry-peaty, broken stone primitive, as well as a mosaic of mountain-meadow turfy and gley soils of tundra permafrost soils.

II. Baikal-Dzhugdzhursky taiga-mountain type of vegetation is represented by forests, which are mostly distributed on the mountain plateaus and spur slopes, in the large river valleys of Buryatia's main mountain systems in its northern and north-eastern parts, and also in the Eastern Sayan, Zakamensky, Dzhidinsky and Tunkinsky districts. This forest vegetation cover is subdivided according to the landscape.

III. South Siberian types of mountain-taiga vegetation are found in the Central part of the republic in the basins and watersheds of Kurba, Turka, Uda, Selenga rivers, some fragments of these types of vegetation are in the valleys of the northern rivers of Upper Angara, Barguzin.

IV. North Asian steppe plant communities. The vegetation is represented by the west-trans-baikal daurian type of flora, which is found in the valleys and river mouths of Jida and Selenga rivers, in the lower basin of Hilok river in the valleys of Uda, Kurba rivers, some fragments are found in the valleys of Barguzin, Irkut, Dibi, Oka rivers (Shaposhnikov, 1953; Mironova, 2001; The scheme of placement, use and protection of hunting grounds in the territory of the Republic of Buryatia, 2017).

In general, Buryatia's forest soils are relatively barren, which affects forest productivity. Steppe and forest-steppe soil types lack moisture, permafrost soils lack warmth and the soils of light mechanical composition as well as low-productive, stony ones – lack nutrients.

The flora and vegetation of Amur region are characterized by significant wealth and diversity, which is mainly due to the following factors: the main part of the region lies in Amur basin and it is situated on the border of East Asian and Boreal floral territories.

The vegetation is represented by East-Siberian flora (Gmelina larch (*Lárix gmélinii*), Siberian spruce (*Pícea obováta*) and others), Manchurian (Amoor cork tree (*Phellodendron amurense*), Chinese Magnolia vine (*Schizandra chinensis*) and others), Okhotsko-Kamchatky (Ayan spruce (*Picea ajanensis*), Khingam fir (*Abies nephrolepis*) and others), Mongol-Daurian (bush-clover (*Lespedeza cuneata*), feather-grass (*Stipa baicalensis*) and others), Pacific (mountain pine (*Pinus koraiensis*), black-fruited crowberry (*Empetrum nigrum*)).

There are three natural and climatic zones in Amur region:

1. Coniferous forest zone (taiga zone). It covers the territory of Tynda, Zeya, Selemdzhinsky, Skovorodinsky, Magdagachinsky and a part of Shimanovsky municipal districts. This zone is divided into subzones of middle and southern taiga. In the South (below 54 degrees of northern latitude) such broad-leaved representatives as oak, elm, maple, ash-tree are met. In mountainous areas in the lower belt – mountain larch forest, then goes the belt of dwarf Siberian pine; and above 1,300 m - mountain tundra.

2. The zone of mixed coniferous-broadleaved forests. Arkharinsky, Blagoveschensky, Bureysky, Zavitinsky, Mazanovsky, Svobodnensky, Romnensky and part of Schymanovsky municipal districts belong to it. This zone is divided into Amur and Far-eastern provinces. The vegetation composition of Amur province consists of open oak-larch and oak-pine communities. A lot of Daurian (black) birch. Underbrush - heterophyllous hazel and bush-clover. The Far-eastern province is characteristic only for the Eastern part of Bureya and Arkharinsky districts, and is rich floristically: forests of Manchurian type with a mixture of Okhotsk-Kamchatka, East Siberian, Mongolian, Daurian flora. It is characterized by Korean pine, Amur linden, Manchurian ash, Manchurian walnut, Amur cork tree, Mongolian oak, Dahurian larch, Abies Nephrolepis; in the undergrowth – heterophyllous hazel and Manchurian hazel, bush-clover, Eleutherococcus senticosus, spruce and fine-leaved mock oranges. Vines are presented by Chinese Magnolia vine, Amur grape, Actinidia kolomikta.

3. Forest-steppe and forest-meadow zone. Konstantinovsky, Tambovsky, Belogorsky, Ivanovsky, Octyabrsky, Seryshevsky and Mikhailovsky municipal districts are included in this zone. Previously, it was a part of broad-leaved forests, but due to human activity, its forestation decreased and the territory, previously covered with forest, transformed into farmland. Part of it is occupied by floodplain meadows in combination with bushes.

The choice of feeding depends on the physical and geographical distribution of animals, the time of year, the biological condition of an animal and other factors.

Elk

Amur region is a home to Ussuri subspecies of elk (*Alces alces cescameloides*).

Elk is exclusively a forest dweller. Its favorite places are old forest fire-sites, wood-cutting areas, forest river banks, streams, lakes and marshy swamps. Unlike other ungulates, its nutrition is less diverse. In summer elk mainly eats herbaceous near-water plants (*Herbaceum* semi-aquatilium plantis). In autumn mushrooms occupy a certain place in its diet – cepe (*Fungos-albus*), brown cap boletus (Birch), orange-cap boletus (*Aspen*), russule (*Russula*) and even fly agaric (*Fuge agaric*). In winter, the bark and branches of young trees and shrubs (*Cortice et ramis iuvenes arbores et frutices*), mosses (*Muscos*) and lichens (*Lichenas*) serve as fodder for elk. Despite its size, this forest giant feeds very delicately, trying not to touch bushes and trees that were damaged or heavily eaten by other animals.

Elk is distributed throughout Amur region and the Republic of Buryatia, with the exception of some areas. The most preferred habitats during this period are riverine forests in the valleys of Nora river and its tributaries (Meun, Burunda and other rivers). This is due to the fact that their valleys are wide, the floodplain is well expressed, there are islands, canals and bays. All this creates favorable conditions for the development of near – water herbaceous and woody vegetation, and the abundance of water makes it comfortable for the animals. The valleys in the basin of Selemdzha river are narrower, with steep rocky slopes, and their area is small and located mainly along the tributaries (Budaki, Orlovka, Oschmin rivers).

In winter, the area inhabited by elk is reduced as it depends on the snow height. Most animals during this period, as well as in summer, stay in valleys. With a shortage of feedstuff elk begin eating birch shoots, bark, spruce shoots. By the end of winter

animals eat mostly tree-bush vegetation. Their diet includes pine, willow, aspen, rowan, bird cherry tree, alder and others.

It should be noted that over the past two years (2016–2017) there were some changes in the species' behavior in winter. According to our observations, animals stayed for a long time on small isolated forest areas, usually in densely grown stalks, or in the thickets of alder on top of small springs with sufficient food base, thus avoiding open swampy complexes, which used to be the main habitats of the animals in the previous years at this time of the year. Animals remained in these places even during severe frosts.

Elk is one of the few deer species that has adapted to the digestion of a significant amount of wood, although it prefers green parts of woody and herbaceous plants, for example: bark, needles, root parts of sedge (Sedge), pond grass (Pondweed), horsetails (Horsetails). The animals eat these feedstuffs during prolonged and volatile months of recent winters.

In the result of our research on classification of hunting grounds and the appraisal of lands of the Republic of Buryatia it was determined that the areas of elk's main habitat belong to the III class of locality quality. Their square size equals 21,305.5 thousand hectors with the exception of Mukhorshibirsky and Tarbagataysky districts where elk does not live (Table 1).

Table 1. Locality quality of hunting grounds for elk in the Republic of Buryatia with limitation factors

No.	Municipal district	Category of land (thousand hectares)			Territories, characteristic for species (thousand ha)	Weighted average indices of land quality	Land/Territory appraisal (average)	Land quality appraisal with limiting factors
		good	satisfactory	bad				
1	Barguzinsky	-	671.8	2.6	674.4	100	III	IV
2	Bauntovsky	-	5,299.1	103.3	5,402.4	98	III	III
3	Bichursky	-	413.1	12.4	425.5	98	III	IV
4	Dzhidinsky	-	463.8	0.8	464.6	100	III	IV
5	Eravninsky	-	2,055.1	4.8	2,059.9	100	III	III
6	Zaigraevsky	-	498	18	516	97	III	V
7	Zakamensky	-	1,354.3	15.9	1,370.2	99	III	IV
8	Ivolginsky	-	190	5.4	195.4	98	III	V
9	Kabansky	-	560.3	3.4	563.7	99	III	III
10	Kizhinginsky	-	590.8	12.5	603.3	98	III	IV
11	Kyahtinsky	-	204.8	3.1	207.9	99	III	V
12	Kurumkansky	-	860.2	6.3	866.5	99	III	IV
13	Mukhorshibirsky	-	-	-	-	-	-	-
14	Muisky	-	1,128.7	149.1	1,277.8	90	III	IV
15	Okinsky	-	1,252	2.3	1,254.3	100	III	IV
16	Pribaikalcky	-	1,215.8	25.3	1,241.1	98	III	III
17	Selenginsky	-	448.9	8.9	457.8	98	III	V
18	Severo-Baikalsky	-	2,593	52.7	2,645.7	98	III	III
19	Tarbagataisky	-	-	-	-	-	-	-
20	Horinsky	-	1,075.7	3.3	1,079	100	III	IV
	Total	-	20,875.4	430.1	21,305.5	98	III	IV

In Amur region, the elk habitat territories mainly belong to the II class of of locality quality. The exceptions are Zeysky, Selemdzhinsky and Tyndinsky districts where hunting performance territories is 1 class lower.

Deer

Deer's modesty in its choice of terrain is also reflected in the choice of food, as it is also not particularly demanding. It eats not only almost everything that grows, but sometimes even the soil and turf. According to most authors, stalks of herbs, branches, needles, bark of trees and bushes, leaves and algae, mosses and lichens are included in the deer's annual diet, where an individual plant's value and their palatability is directly proportional to the types of land, preferred by animals. Still it is necessary to divide all these feeds for the seasons of the year.

With the advent of young green vegetation, red deer completely switches to the spring ration of food, which until the middle of summer consists mainly of herbaceous plants, and also partly of woody fodder and bark. A significant place in the diet is given to sedges and Langsdorf reed grass, which are widely distributed in most areas in combination with all types of birch and mound spaces, forming the basis of the grassy cover of Eastern Siberia and Amur region.

In spring red deer willingly adds bark of young trees to the 'list' of its feedstuff. It is also noted for consuming of young needles of larch, pine, spruce. However, the bark of larch and aspen is also used for food. The fact is that in the spring and autumn, in contrast to the winter, the bark is much softer, and therefore its palatability increases. Although in the literature there are data that in winter the South side of the tree trunk was marked with fresh bites of crust, but, apparently, it is connected in individual cases with the lack of available feed. In Eastern Siberia, deer willingly eats cow parsnip (*Heracleum*), yarrow (*Achillea*), shepherd's bag (*Capsella*), bell (*Campanula*), clover (*Trifolium*) and other plants.

Observations from mid-summer showed that deer switched to leaves and shoots of trees and shrubs, and by the end of August actively eats berries, mushrooms, and in the presence of the acorn harvest in the Amur region gladly goes to it. It seems that such unpretentiousness in the choice of food is caused by the preparation for the rut, before which it is fed up to 30–40 kg of fat and during which it practically eats nothing. But it is known that mushrooms are rich in protein and mineral substances. In the same connection berries are willingly eaten: blueberries, cranberries, strawberries, etc. During the rut bulls eat very little, mainly focusing on the search for females. However, a little 'cooled down' during the rut, red deer switches to tree and shrub forages which are the basis of power the whole autumn-winter period. Thanks to them, the deer in the harsh conditions of winter finds all the necessary organic substances to maintain life. According to our observations, with a high density of the beast, on the willow and aspen fields, the whole young shoots are eaten. It should be mentioned that the animal eats plants at a height of up to 2.5 meters, while the shoots of willow and young aspen deer bites at a height of up to 4 meters, bending branches and making creases.

In the end, in the winter, the importance in choosing the type of food depends on the depth of the snow cover. Herbaceous plants in the form of dried grass and in the autumn-winter remain part of the diet. So, at a small height of snow cover, usually at the beginning of winter, deer in addition to the branch feed, eats a sufficient amount of foot feed, where in addition to dry rags in the ground cover is a large number of plants in

green, covered with snow and gladly dug out and eaten by the beast. Such vegetation includes all kinds of sedge, pear and other herbaceous plants. We often found the animal's digging, which he did in the snow to find berries and leaves of blueberries and cranberries. With a significant increase in the height of the snow cover, towards the end of winter, the difficulties in extracting feed resources from under the snow and the almost complete absence of foot vegetation on the surface of the snow cover, make the animal completely switch to the branch feed.

In general, if we give a description of willow-culture, then, in our opinion, and the opinion of many far Eastern researchers, it is out of competition with the rest of the branch feed, being the most favorite, nutritious and affordable type of feed for deer. And undoubtedly refers to the limiting winter feed.

The whole territory of the Republic of Buryatia belongs to the III land quality class for red deer, the area of which is 26,312 thousand hectares (Table 2.) Much of the land in Amur region estimated to have the IV class, which is 14,955.45 thousand hectares of land in two areas of the Amur – Blagoveschensk and Svobodnensky belonging to the third class of land quality, their area equals 48,094 thousand hectares.

Table 2. Land quality of hunting grounds for red deer in the Republic of Buryatia with limitation factors

No.	Municipal district	Category of land (thousand hectares)			Territories, characteristic for species (thousand ha)	Weighted average indices of land quality	Land/Territory appraisal (average)	Land quality appraisal with limiting factors
		good	satisfactory	bad				
1	Municipal district	78	595	174.3	847.3	96	III	IV
2	Barguzinsky	45.8	5,253.3	1,233.4	6,532.5	85	III	IV
3	Bauntovsky	-	413.1	103.2	516.3	83	III	III
4	Bichursky	-	463.8	118.7	582.5	83	III	IV
5	Dzhidinsky	80.7	1,974.4	272.8	2,327.9	95	III	V
6	Eravninsky	-	498	69.7	567.7	90	III	IV
7	Zaigraevsky	-	1,354.3	42	1,396.3	97	III	III
8	Zakamensky	-	190	24.8	214.8	90	III	III
9	Ivolginsky	-	585.6	52.7	638.3	93	III	IV
10	Kabansky	21.1	569.7	96.3	687.1	93	III	IV
11	Kizhinginsky	0	204.8	93.6	298.4	73	III	IV
12	Kyahtinsky	90.2	770	54.3	914.5	110	III	IV
13	Kurumkansky	-	171.7	51.2	222.9	80	III	III
14	Mukhorshibirsky	63.2	1,065.5	671.8	1,800.5	74	III	IV
15	Muisky	-	1,541.9	170	1,711.9	92	III	IV
16	Okinsky	42.8	1,181.7	85.1	1,309.6	99	III	III
17	Pribaikalcky	-	448.9	114.8	563.7	83	III	III
18	Selenginsky	345.5	2,289.4	1,059.3	3,694.2	90	III	V
19	Severo-Baikalsky	-	199.9	71.5	271.4	78	III	V
20	Tarbagataisky	186.3	889.4	138.5	1,214.2	113	III	III
	Total	953.6	20,660.4	4,698	2,631.2	90	III	IV

Other ungulates

The ungulates' feeding is influenced by temperature, anxiety factors, insects. Therefore, ungulates feeding activity is observed in the morning and evening hours.

Siberian roe deer lives almost on the whole territory of the Republic of Buryatia and Amur region and is considered a background species. Due to large areas of unusual land and disturbance factors, the area is not uniform. Siberian roe deer refers to herbivorous animals. Its food base is very diverse. The feed composition of Siberian roe deer includes 599 plant species. In Eastern Siberia, it eats 130–140 species of plants (Table 2). Given the harsh climatic conditions of the Republic, the winter period is very difficult in the animal life. Roe deer is forced to eat scant on the composition of feed. Digging snow with a height of about 30–35 cm front hooves in search of food animals produce leaves, stems, stunted shrubs, fully eating them. More willingly than usual, visits roe deer salted haystack, eating in them plants with developed foliage: clover (*Trifolium*), melilotus (*Melilotus*), alfalfa (*Medicago*), geranium (*Geranium*), vasilistnik (*Thalictrum*), gorichnik (*Peucedanum*), sochevichnik (*Lathyrus vernus*), astragalus (*Astragalus*), alfalfa (*Medicago*) wormwood (*Artemisia*), plantain (*Plantago*), wheatgrass (*Elytrigia*). The diet of roe deer includes tree bark, aspen branches (*Populus tremula*) and birch (*Betula*), pine needles (*Pinus*) and larch (*Larix*). For feeding ungulates species annually harvesting hay:

- in the Republic of Buryatia in 2015 harvested 954 centners, in 2016 – 477 centners, in 2017 – 788 centners;

- in Amur region in 2015, harvested of 67.2 tons, in 2016 – 38.9 tons in 2017 of 70.7 t.

Spring feed of roe deer consists of branches of aspen, birch, larch, willow (*Salix*), Daurian rhododendron (*Rhododendron dauricum*), alder (*Alnus*). With the advent of green vegetation animals eat all green shoots of species such as sedges (*Carex*), veinik (*Calamagrostis*), then go snowdrop (*Galanthus*), dandelion (*Taraxacum*). In late spring, early summer ungulates need quality food, which will depend the development and growth of young. In the summer, the animals move to herbal feed. Due to the fact that in the country the summer is short and the plants wither quickly, the roe deer eats with plants rich in nutrients. In summer the diet roe deer includes and flowers, such as geraniums (*Geranium*), clover (*Trifolium*), yellow lily (*Hemerocallis lilio-asphodelus*), wild lily (*Lilium martagon*), lungwort (*Pulmonaria*), Columbine (*Aquilegia*), Windflower (*Anemone*), vasilistnik, common goutweed (*Aegopodium podagraria*), Hogweed (*Heracleum*), yarrow (*Achillea*), shepherd's purse (*Capsella*), Bellflower (*Campanula*), and others (Sand et al., 2008).

In late summer and early autumn roe deer willingly eat mushrooms and berries. From mushrooms eats brown mushrooms (*Leccinum*), saffron milk caps (*Lactarius*), milk mushrooms (*Lactarius resimus*), Boletus luteus (*Suillus*). However, when opening the stomachs of roe deer we noted that the content of mushrooms did not exceed 20–30% ($n = 37$ – animals were extracted under permits during the rut, extracted by poachers and delivered to the University by order for forensic biological examinations). In our opinion, this is also due to the severe digestibility of mushrooms. From berries found in the stomachs of cranberries (*Vaccinium vitis-idaea*), blueberries (*Vaccinium myrtillus*), blueberries (*Vaccinium uliginosum)*, strawberries (*Fragaria*). Roe also willing to attend biotechnical fields sown nutritious vegetation . The effectiveness of the attendance of fodder fields depends on their location, season of the year and the abundance of wild vegetation. Typically, the tab field occurs at a distance of 1–2 km

from human settlements or forest and field roads, it is connected with the delivery of seed and technology equipment. Sowing of forage fields takes place annually on different areas of land. So, in the Republic of Buryatia in 2015 were sown 109 ha. and in 2016 – more than 31 hectares in 2017 – 62 ha.; in the Amur region in 2015 was planted 1,000 ha., and in 2016 – 655 ha., in 2017 – 517 ha. The hunters and the wildlife sanctuaries of both investigated regions try to diversify the composition of the forage fields and alternate crops. The best forage crops for ungulates are: alfalfa, rapeseed, melon, soybean, rye, vika and other plants that contain large amounts of protein.

Gradually, the animals switch to the autumn diet. The period of rut forces roe deer to go to forest areas with good protective conditions. During this period, we found leaves and stems of shrubs and shrubs: currants (*Ribes*), willow, rose (*Rosa*), Rowan (*Sorbus*), Siberian Apple (*Malus*), Daurian rhododendron, juniper (*Juniperus*) ($n = 7$ – animals were produced by permission during the rut).

When performing land quality evaluation of the Republic of Buryatia, we concluded that almost all the territory belongs to the III class for Siberian roe deer. The area of such land in the Republic is 24,548.5 ha. When accounting for limiting factors such as forage availability, predation, hunters press changes the class of land quality (Table 3).

Table 3. Hunting land evaluation for Siberian roe deer in the Republic of Buryatia with limitation factors

No.	Municipal district	Category of land (thousand hectares)			Territories, characteristic for species (thousand ha)	Weighted average indices of land quality	Land/Territory appraisal (average)	Land quality appraisal with limiting factors
		good	satisfactory	bad				
1	Municipal district	54.2	656.1	27.4	737.7	108	III	IV
2	Barguzinsky	164.4	5,880.9	103.3	6,148.6	103	III	V
3	Bauntovsky	24.4	388.7	162.6	575.7	82	III	IV
4	Bichursky	25.5	598.5	113.9	737.9	92	III	III
5	Dzhidinsky	-	2,286.8	122.6	2,409.4	96	III	III
6	Eravninsky	23.1	502.5	55.6	581.2	98	III	IV
7	Zaigraevsky	13.6	1,371.8	37.2	1,422.6	99	III	IV
8	Zakamensky	24.5	198.9	19.6	243	108	III	IV
9	Ivolginsky	72.8	532.6	11	616.4	116	III	IV
10	Kabansky	60.8	60	57.7	723.5	106	III	IV
11	Kizhinginsky	51.7	221.7	123.5	396.9	93	III	IV
12	Kyahtinsky	102.2	765.8	70.8	938.8	110	III	IV
13	Kurumkansky	38.6	182.3	111.1	332	89	III	III
14	Mukhorshibirsky	-	1,143	149.1	1,292.1	90	III	V
15	Muisky	-	1,252	2.3	1,254.3	100	III	V
16	Okinsky	17.2	1,198.6	34	1,249.8	100	III	III
17	Pribaikalcky	45.2	494.9	149.9	690	91	III	III
18	Selenginsky	196.5	2,421.7	52.7	2,670.9	109	III	V
19	Severo-Baikalsky	7.8	192.1	94.9	294.8	77	III	IV
20	Tarbagataisky	25.4	1,114.5	93	1,232.9	97	III	IV
	Total	947.9	22,008.4	1,592.2	24,548.5	100	III	IV

Hunting, typical for habitats of Siberian roe in Amur region are divided into 2 classes of class II and III, and their size, respectively, is 10,787.89 and 13,265.02 thousand ha.

The water necessary for the life of ungulates in the regions is located in sufficient quantities. On the territory of the republic of Buryatia there are about 9 thousand rivers and rivers, which belong to the basins of the Yenisei and Lena rivers. In the Amur region more than 29 thousand rivers. We noted that animals prefer running water of rivers, springs, streams.

Every hoofed animal depending on sex and age has a need in minerals associated with the change of feed rations, calving, lactation and rutting, which animals fill up on the salt marshes. In addition, in the literature there are data that the strong alkali substance is used as mechanical stimulus necessary for the normalization of the gastrointestinal tract, especially in the period of transition from rough winter fodder for juicy summer. In most areas of the Amur region and the Republic of Buryatia, there are both artificial and natural saline. The greatest number of them are in the northern regions.

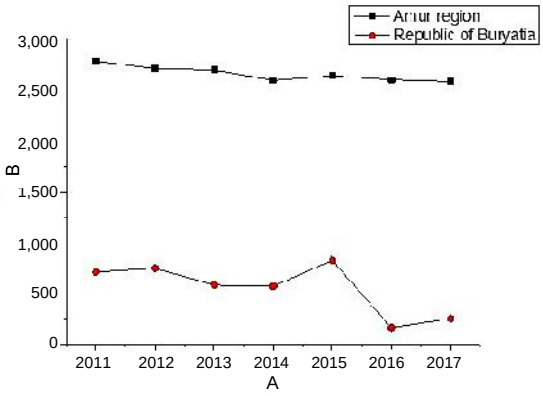

Figure 1. A number of salt licks equipped on the territory of Amur region and the Republic of Buryatia.

For many decades in the regions under study artificial salt licks have been created and updated by specialists of hunting farms and hunters (Fig. 1; Table 3).

Competition among ungulates in Eastern Siberia and Amur region is low and is observed only in snowy winters, when the basis of nutrition is forage. Deer and elk in the winter displaces of the best grassland of the Siberian roe deer. Elk has the least competitive effect on deer because the most serious eating woody food. In addition, in the Republic of Buryatia, its number is small and it does not live throughout the territory. In the southern regions of the Republic there is no competition at all. This is primarily due to the low number of species such as elk and red deer. In Amur region elk on the salt licks compete with deer, displacing them (Figs 2, 3).

It should be noted that the increase in the number of ungulates depends not on the productivity of vegetation, but on the factor of concern and the number of predators. Elk and deer are usually rarely found near settlements. The only exceptions are those villages that are located in a specially protected natural area. Ungulates are more concentrated not in the fields with a good harvest of feed, but in the lands with good protective conditions, where the concern factor is minimal.

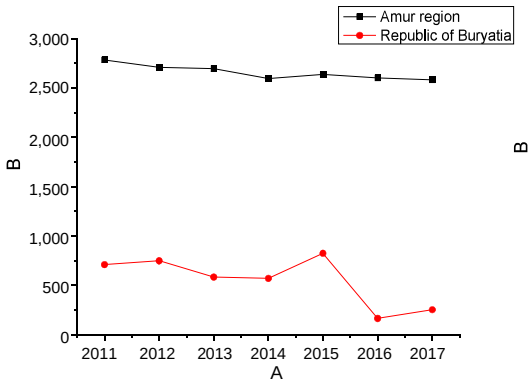

Figure 2. Dynamics of the number of hoofed animals in Amur regioon.

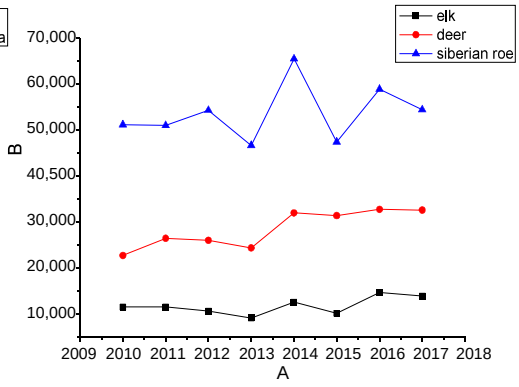

Figure 3. Dynamics of the number of ungulates in the Republic of Buryatia.

Wolf and brown bear

Large predators in Eastern Siberia and Amur region are represented by such hunting species as wolf and brown bear.

Wolf lives throughout both regions. In the Republic, it is most numerous on the Vitimskom plateau, in the Eastern Sayan (Okinskiy and Tunkinsky districts) and in the North of the Republic. The smallest number in the southern and Central regions. The number of wolves is periodically supported by individuals migrating from the territory bordering Mongolia. On the Vitimskom plateau, the high number of predators is explained by the abundance of ungulates, relatively low rainfall in winter. In the Northern regions of the Republic – Severobaikalskom and Muyskom areas, the wolf population is large. Due to the difficult terrain ungulates are concentrated in floodplains, where they become prey.

The basis of the power of the wolf are ungulates: roe deer, red deer, elk, wild boar, reindeer. In 'hungry years' predators and domestic animals willingly eat home animals. The damage done by the wolf to hunting and agriculture is great. Every year in the Republic are held events for shooting the wolf.

The food of the wolf is different in different seasons of the year. In the warm season, predators are sedentary and spend less energy. With low temperatures the wolves become more active and move to a nomadic lifestyle.

In spring and summer calving ungulate species in the diet of the wolf includes young roe deer and red deer. Summer prey includes rabbits, mice, badgers, marmots, and masonry upland game. Some sources indicate that the wolf eats insects such as locusts. At the end of the summer, the diet of the predator includes berries.

In the fall, during ungulates' rutting, when the animals become vulnerable, wolves readily attack adults. With the loss of snow, the choice of feed is significantly reduced. Ungulates become the main food of the predator in winter.

Wolves in Eastern Siberia feed on wild ungulates in the valleys of the river Svetlaya, Barguzin and its tributaries, upstream of Shai, Pravoy Mamy on the rivers Zaza, Kydzhimitu, Conde. Significant damage to wild ungulates wolves inflict on the river valleys of Snezhnaya, Temnik, Dzhida, several other places of ungulates' concentration.

In Amur region on 30-kilometer routes were found up to 9 roe deer, torn by wolves. In the Far East, two or three predators per day attack up to 12–14 animals, in places of winter concentration, each destroys 20–30 during the snow period, and up to 35–45 individuals per year.

A red deer is an easy prey for a wolf. Wolves hunt for them in large numbers and more often in comparison to elk or roe deer. A large number of individuals die from a predator in snowy winters and during icy period.

Many sources indicate that wolf predation is selective, and depends on the condition, gender and age of the animal. However, during the study period, we recorded cases of ungulates from the wolf of different age groups and regardless of the physical condition of the victim.

The usual habitat of wolf are open areas of steppe and forest-steppe regions. In the forest zone it is characterized by floodplains, wetlands, areas where ungulates concentrate. Our calculations of territory quality for wolves showed that the whole territory of the Republic of Buryatia belongs to the III class. The square area of this territory is 26,881.3 thousand hectares.

Except wolves hoofed animals suffer from bears. Bear is the largest predator. In the Far East this species reaches the largest size. Brown bear refers to omnivorous animals. It eats both large elk and small insects. In the Amur region and Eastern Siberia, brown bear food is both vegetable and animal feed, depending on their availability and the season of the year. The diet of the brown bear includes ungulates such as roe deer, elk, wild reindeer, wild boar, and raisins.

According to survey data received from hunters and our observations there noted some cases of successful hunting of brown bear on wild reindeer in Tyndinskom district, wild boar – in Arkharinskom, Bureyskom, Blagoveshchenskom, Svobodnenskom districts of the Amur region. Cases of attacks on elk and red deer in the Arkharinskom district of the Amur region. Registration of such cases, as a rule, is difficult due to the fact that these species live in remote places, and they can be accurately established only by anatomical study of the extracted individuals.

Insects, mouse-like rodents, fish and other types of feed, which make up a small part in different seasons, are also found in the diet of the bear (Belikov et al., 1993; Chernyavsky & Krechmar, 2001; Brown bear of Kamchatka, 2006; Zimmermann et al., 2014). The fish, which gets into the food of the bear in Siberia and the Amur region, is usually overseas (Veklich & Darman, 2013; State report of the Amur region MPR on environmental protection and ecological situation in the Amur region for 2011, 2012). Facts of expertise to bear on the kind of food we have not yet determined.

It is difficult to name the preferred habitat of the bear, as he leads a wandering life. In winter, the animals go a long distance from the summer area. However, the bear lives where the abundance of berries and nuts.

The bear's diet depends on the season and harvest. In the spring, after hibernation, the bear eagerly eats asp shoots and dead animals that died during winter. Starts preying on ungulate species. After the snow cover melts, the diet of the bear includes overwintered berries, then growing grass, aspen leaves, small animals and birds.

In summer, eat a variety of berries, pine nuts. In years with a low harvest of these species, the bear goes to feed on oats and maize. Given that the size of the bear is large, it needs a large amount of food. Most of the feed is processed into fat, which is so necessary for the winter of the animal.

The conducted work allowed to establish that in territory of the Amur region main vegetable foods in the diet of the brown bear are parts of plants or their derivatives of the following types: koreyanka toloknyanolistnaya (*Chosenia arbutifolia*), a hidden willow (*Salix abscondita*), goat willow (*Sálix cáprea*), Bebba willow (*Salix bebbiana*), korotonozhkina willow (*Salix brachypoda*), Schwerin willow (*Salix schwerinii*), blueberry willow (*Salix myrtilloides*), willow rosistaya (*Salix rorida*), udskaya willow (*Salix udensis*), trembling poplar (*Pópulus trémula*), Mongolian oak *(Quercus mongolica*), leschina raznolistnaya (*Corylus heterophylla*), edible honeysuckle (*Lonicera edulis*), Manchurian leschina (*Corylus mandshurica*), Amur Linden (*Tilia amurensis*), svida white (*Córnus álba)*, strawberry Eastern (*Fragária orientális*), Asian bird cherry (*Padus asiatica*), raspberry (*Rúbus árcticus*), koctyanika schelistnaya (*Rubus humilifolius*), Komarov raspberry (*Rubus komarovii*), Sakhalin raspberry (*Rubus matsumuranus*), krovohlebka lekarstvennaya (*Sanguisórba officinális*), kostyanika ordinary (*Rubus saxatilis*), dudnik Chernyaeva (*Angelica czernaevia*), dudnik Maksimova (*Angelica maximowiczii*), small sedge (*Carex minuta*), dirty sedge (*Carex sordida*), Sedakova sedge (*Carex sedakowii*), sedge gladkachyayschaya (*Carex laevissima*), sedge Schmidt (*Carexsch midtii*), sedge puzyrevataya (*Carex vesicaria*), borschevik rassechenniy (*Heracleum dissectum*), vaccinium topyanoy *(Vaccinum uliginosum*), schisandra chinensis (*Schisándra chinénsis*), Daurian hellebore (*Veratrum dahuricum*), hellebore Maaka (*Veratrum maackii*), cotton grass *(Erióphorum vaginátum*), kedroviy stlannik (*Pinus pumila*), kedr Korean (*Pínus koraiénsis*). We found parts of these plants in the excrement of a brown bear, or observed traces of brown bears eating.

The calculation of the bear habitat appraisal in the Republic of Buryatia in all areas is equal to the III class of bonus. The area of land peculiar to the bear is 23,921.1 ha. The exceptions are Mukhorshibirsky and Tarbagataysky areas where the bear lives. According to our calculations the land of the Amur region for the bear, too, belong to the class III site class, area 1,845,876 ha. The worst hunting grounds for the bear located in Zavetinskom and Oktyabrskom districts of the region, and the territory of the Zeysko-Bureyskoy plain is practically not typical of this type.

DISCUSSION

The highest species composition of the feed suitable for the nutrition of elk, possess the hunting grounds Mazanovskogo, Romnenskogo, Selemdzhinkogo, Tyndinskogo, Skovorodinskogo districts of the Amur region and Severobaikalskogo, Muyskogo and Bauntovskogo regions of Eastern Siberia. This is due to the presence of large areas of wet swampy forest biotopes and secondary forests. These types of land are rich in coniferous young, larch, aspen, with the presence burnt areas and clear cuttings. In addition, there are a sufficient number of rivers and lakes. The choice of animal feed depends on the season. According to our observations, the most preferred elk feed is willow and aspen. Year-round elk eats shoots of deciduous trees. Hay elk eat in exceptional cases. In difficult winter conditions elk goes to shoots and bark of spruce and pine.

Hunting areas with good forage conditions for elk located in Bauntovskom, Zakamenskom, Eravninskom, Muyskom, Pribaikalskom, Okinskom, Severobaikalskom, Horinskom areas of the Republic of Buryatia and in Tyndinskom, Skovorodinskom, Zeyskom, Magdagachinskom, Szymanowskom, Mazanovskomom, Svobodnenskom, Selemdzhinkom, Burejskom, Arkharinskom districts of the Amur region. This is due to the mountain-forest landscape, which has a positive impact on the survival of the animal. Mosaic forest and the presence burnt areas, are also located in sufficient numbers in these areas. In both regions, we carried the stems and leaves belokopitnik, wormwood, sedge, veinik as a favorite food of the red deer. When there is a shortage of feed, the deer pass to tree and shrub plants. The animal eats the hay of any quality.

Hunting grounds of the Republic of Buryatia and Amur region have good feeding conditions for siberian roe deer. The capacity of hunting grounds allows to increase the number at times. However, in winter, the snow cover forces the animals to go to the snow-covered areas. siberian roe deer prefers biotopes with a predominance of pine, larch, birch, as well as burning, cutting, steppe and meadows. Siberian roe deer prefers easily digested feed rich in nutrients. As in Eastern Siberia and in the Amur region, the animals readily eat aspen, willow, birch, fireweed, troelistka, wormwood. With a lack of the favorite forage of deer eats on pine and hay.

The main food of the wolf are ungulates, and the predator chooses habitats with the presence of high density of ungulates. This kind of territory we assign Bauntovskiy, Muyskiy, Severobaikalskiy, Okinskiy, Zakamenskiy regions of Eastern Siberia and Tyndinskom, Skovorodinskom, Magdagachinskom, Mazanovskom, Svobodnenskom, Selemdzhinkom the areas of the Amur region. According to our data, the diet of the wolf from ungulates often comes across Siberian ROE deer. We associate this primarily with the widespread distribution of ROE deer, as well as a relatively high number compared to other ungulates. When the lack of food, the predator eats livestock.

In the Amur region the most wide range of plant feed for the brown bear are presented in Selemdzhinkom, Mazanovskom, Burejskom, Romnenskom, Seryshevskom, Svobodnenskom, Skovorodinskom, Magdagachinskom, Blagoveshchenskom, Belogorskom, Ivanovskom, Zavetinskom, Konstantinovskom, Mikhaylovskom, Tambovskom and Arkharinskom. The best feeding conditions for bears in Eastern Siberia have the Severobaikalskiy, Barguzinskiy, Pribaikalskiy, Kabanskiy, Bauntovskiy, Muyskiy, Okinskiy and Horinskiy areas. The favorite food of the bear is vegetable food. To such feeds we carried nuts, b6. In General, feed conditions in both regions are represented by a wide species composition of vegetation, and for predators there is also a large selection of animal feed. On the territory of the Amur region and the Republic of Buryatia, feed is rich in nutrients and is in sufficient quantity. This is confirmed by the fact that competition among ungulates is minimal and seasonal. The capacity of hunting grounds in Eastern Siberia and the Amur region can significantly increase the number of ungulates. Adverse climatic conditions, namely high snow cover, as well as predation and poaching, do not have a positive impact on the growth of ungulates. However, the strengthening of security measures on the part of hunting farms and state services for the protection of wildlife, conducting high-quality biotechnical measures and activities related to the regulation of the number of predators can lead to a noticeable result of the hunting economy, namely the growth of the population of ungulates.

The present findings may find application within the context of other papers (Miquelle et al., 2010; Lavrillier, 2013; Sonnenburg et al., 2016). This section is aimed to demonstrate how a well-planned research can serve as a framework for the long-term conservation of species. We believe that any successful conservation program should be based on a clear understanding of the environment in which the species live, i.e., on the systematic collection of qualitative and quantitative data concerning their living conditions. Without this fundamental knowledge needed to conserve any species, it is easy to move away from the main areas of activity necessary for the conservation, preservation and restoration of the animal population. This study is an attempt to demonstrate how research and sometimes simple surveys can have important consequences if the information from them is applied for the conservation purposes. However, it is not enough to simply conduct good research and publish the findings. The research should focus on mitigating threats or at least provide information on the relative importance of these threats. Secondly, to make findings contributive, scientists need to come out from the sidelines and make active steps toward the initiation of the conservation efforts. It is the scientific community that understands the significance of their findings to the deepest level and thus should be proactively involved in the enlightening of public and key political figures and in the implementation of environmental measures.

CONCLUSIONS

The results of the research are of great practical use for hunting entities of Eastern Siberia and Amur region, especially for the application of hunting grounds description experience, conducting species hunting appraisal, improving local systems of biotechnical activities aimed at wild ungulates, studying the causes and mechanisms of feeding adaptations of ungulates and predators to the environment and seasons of the year, efficient measures to regulate predator population in Eastern regions of Russia. The research results allow hunting farms to improve the system of biotechnical and reproductive activities, with the aim of increasing the number of ungulates, as well as improving the quality of hunting territory.

The collected data and information can also be used as lecture material in higher and professional educational institutions for the classes in biology, hunting, ecology and zoology.

The obtained data is of particular interest for collective entities and individual hunters who professionally plan their activities in the difficult climatic conditions of Siberia and Far East of Russia, as well as for the non-professional hunters who are interested in biology and ecology of wild ungulates and try to increase their level of knowledge of typology of hunting grounds, technology and production technology, and increase the efficiency of wild ungulates hunting.

Data obtained during this study can be also used when planning and implementing measures to protect the living conditions of small native peoples of Siberia and Amur Region. Native peoples still use natural resources for traditional crafts and thus their lifestyle largely depends on the wildlife situation. Without data present here, the event plans concerned with the native peoples will be considered groundless.

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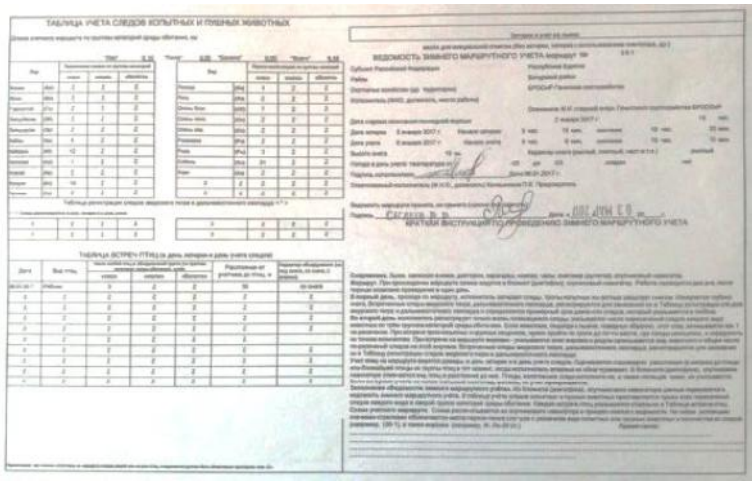
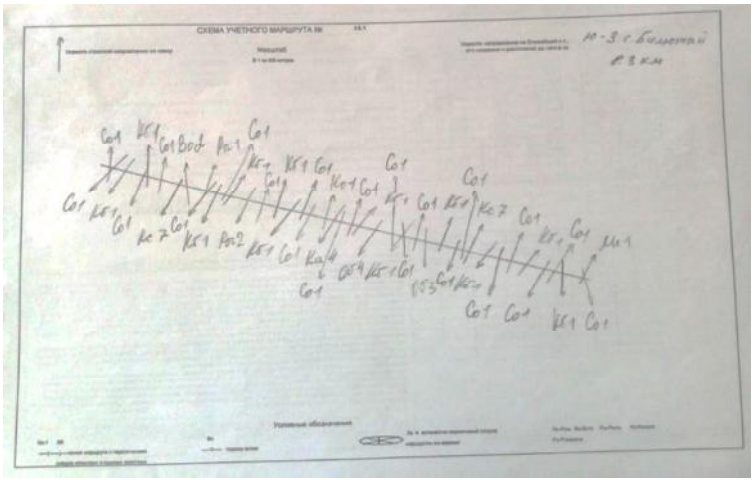
Appendix

Examples of registration cards and statements of calculating the number of animals – the primary materials of hunting farms.

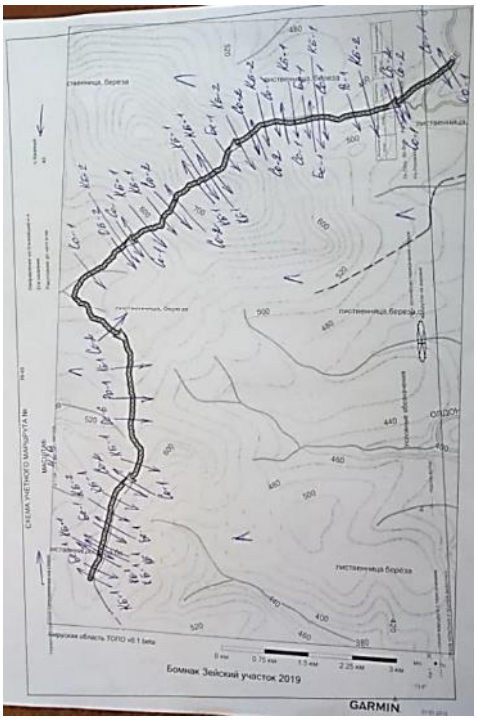


Supplementary Fig. 1.
An example of a reporting document. A similar table is filled in by the Wildlife Officer upon return. The table shows the types of animals whose tracks he met on his way, the whole table is divided into several categories, for animals, birds, and traces of the Amur tiger and Far Eastern leopard are placed in a separate category. The number of cases of observation of tracks is entered in the table, the sign 'Z' means the absence of observed tracks. The table indicates the type of animal that left traces, as well as the characteristics of the terrain (swamp, forest, etc.). After fixing the traces in his records, a Wildlife Officer destroys the traces by rubbing them in the snow, thus performing periodic walks; the Wildlife Officer fixes only new cases and thus controls the number and activity of animals.

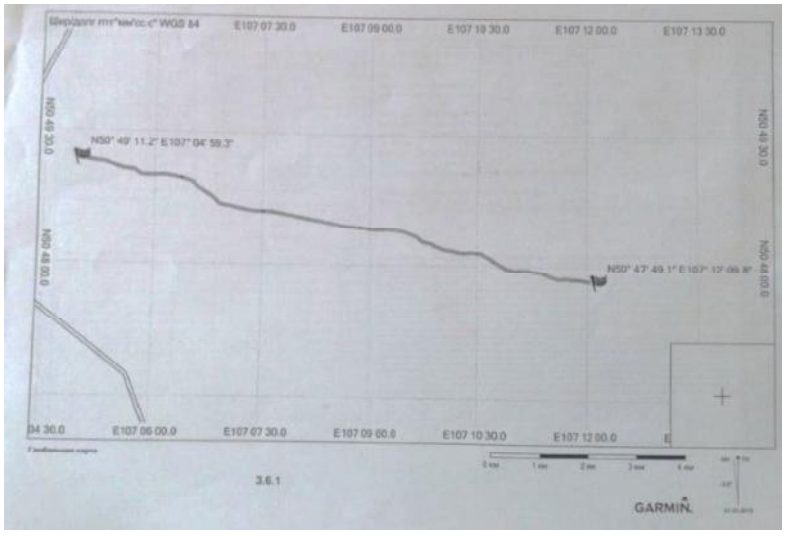


Supplementary Fig. 2.
An example of an officer's travel notes, the direction of the intersection of the path with a chain of traces and the symbol designating a living one that left traces is noted.

Supplementary Fig. 3.
Another example of filling out a table is similar to the first figure in this appendix.



Supplementary Fig. 4.
Another example of more accurate travel notes linked to the area map using GPS.



Supplementary Fig. 5.
Another example of more accurate travel notes linked to the area map using GPS.

Supplementary Fig. 6.
Another example of more accurate travel notes linked to the area map using GPS.

Supplementary Fig. 7.
An example of a statement summarizing all travel notes of all forestry officers on a specific date. This is the data that then will form the basis of statistical generalization.

Supplementary Fig. 8.
The location of the Republic of Buryatia and the Amur Region on a map of the Russian Federation.