

The Influence of the Brown Bear (*Ursus arctos*) Population Increase on the Populations of Wild Ungulates in the Republic of Buryatia and the Amur Region

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Abstract: The purpose of this work is to determine the effect of brown bear population growth on the population of wild ungulates by the example of Amur Region and the Republic of Buryatia. Studies were conducted in spring, summer, autumn and winter by routing bear trails and natural habitat areas and collecting animal activity observations. The sizes of individual species' habitats were determined as well as predator's influence on wild ungulates, living on the same territories, was studied. During research studies, conducted over a period of 10 years, a direct relation between bear population growth and wild ungulates' population decrease on the territories under consideration was established, and, in case of active predator population control, an inverse relationship was revealed as well.

Key words: Brown bear, number of species, population, Eastern Siberia, Amur region, elk, red deer, Siberian roe deer.

Introduction

A definite increase of brown bear population is being observed in the Russian Federation from the mid-90s of the last century. This fact brings a number of problems to many regions in the country. In addition to the main problem, which is human-bear relations, the predator exerts a negative impact upon hunting economics. It directly affects wild ungulates population, which, in their turn, are main source of income to amateur and professional hunters and hunting societies. As a result

of an influence of different anthropogenic factors, such as fires, city territory expansion, construction of large technological facilities, highways and pipelines, the biodiversity of biotic communities are constantly shrinking. Thus, for example, the largest in the last 30 years forest fire on one of the territories under study, Skovorodinsky district in Amur region, during spring of 2013 had burned out over 50% of its territory. All forest layers were damaged by the fire, especially shrub layer, grass, moss and lichen layers, whose representatives are the most important foraging feed for brown bear

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(cowberry, blueberry, strawberry, honeysuckle, etc.). It was observed that due to this situation brown bears started coming near human settlements and on the neighbouring territories in search of food during the same year. Somewhat later, similar situation was observed after forest fires in the neighbouring regions of Yakutia and Trans-Baikal region. Thus, unfavourable conditions take shape for both the species under study and for humans.

This article tries to investigate food and protective conditions of brown bear—main habitats in Amur Region and Eastern Siberia. An analysis of species' population size and their density was carried out; the main aspects of habitat environment and relationships between brown bears and other members of biocenosis, like wild ungulates inhabiting the territory of hunting grounds in the regions under study, were studied in particular. Close attention was paid to revealing brown bear influence on the population of wild ungulates, such as elk, red deer, roe deer, their sizes and structure.

Brown bear is poorly studied in Amur region, which is quite the opposite with the adjacent territories of the Russian Far East where a lot of scientific work in this field is being done. The most detailed research of this question was made in the works of I.V. Serdykina, D. Pachkovsky, V.P. Shuntova, G.R. Rygorodetsky (2006) about Kamchatka species population. This article also relies on works of A.K. Akhremenko, V.T. Sedalisheva (2001), F.B. Chernyavsky, M.A. Krechmar (Akhremenko and Sedalishchev, 2008), II. Mordasova (Tumanov, 2014) in what they studied about the species in Yakutia and North-Eastern Siberia; Y. Sato (Sato et al., 2000; 2004; Kitamura et al., 2010; Itoh et al., 2012) in his study of brown bears and their effect on ecosystems on the island of Hokkaido (Japan). To determine a research structure articles of IL. Tumanov, V.S. Pazhetov, K.F. Tyrronen (Hall and Ktison, 1959; Berns et al., 1980; Craighead and Mitchell, 1982) were used. While analyzing scientific works of the above-mentioned authors, certain similarities in many aspects of brown bear activities were traced, except for hibernation timing, eating habits and diet in certain periods of the year, as well as certain behavioural features, such as the choice of places for arranging dens.

Yudin (1993) was engaged in studying brown bears in detail in Amur region and in the Far East. In recent years, bear studies were episodic. Some aspects of its ecology and nutrition were described in the articles of Konstantinova and Cheremkina (2016). Konstantinov and Chernykin found no food of animal origin in brown bear diet, but other authors in their works (Chernyavsky

and Krechmar, 2001; Serdykina et al., 2006; Kitamura et al., 2010) established that wild ungulates play an important role in brown bear feeding, regardless of other fodders, especially during spring and late autumn period. According to our data, wild ungulates are present in brown bear ration, but its proportion has not yet been determined.

Brown bear age identification according to the skulls of hunted animals was made by using the craniological method, developed by Zavatsky (Pazhetnov, 2016). Using his method, the approximate structure of brown bear population in Amur region was determined. According to the obtained data, 2/3 of the population are adult animals, 2.5 to 5 years of age.

Brown bear anatomy is described in detail by Shevchenko (2003) and by other authors.

An analysis biocenosis of plant communities which make up fodder and protective conditions was carried out using articles by Starchenko (2008) and Veklich and Darman (2013). It was established that the most suitable habitat for brown bears is southern regions, where the vegetative period starts earlier. However, with absence of good protective conditions, these territories are less preferred in comparison with the northern ones, which are more severe in terms of feeding situation, but better in terms of protection.

An analysis of wild ungulates population dynamics was carried out with the help of Danilkin's works (Zavatsky, 1986). Changes in wild ungulates behaviour in their selection of individual habitats, how they behave on salt licks spots and feeding grounds were studied. This also included studies of brown bear behaviour on these biotechnological objects.

Methods of Research

Brown bear is one of the main objects in biocenoses of Eastern Siberia and Amur region. It needs to be studied more thoroughly, since it is one of the few wild animal species that makes a serious impact on wild ungulates' populations. Particular attention should be paid to the situation with forage resources, since forage base strongly influences the predator's behaviour. It is also impossible to forget about protective conditions for animals on hunting grounds and about urbanization of the territories, since it is unlikely for a bear to stay on the areas with excellent food conditions but without good natural protection.

Within nine years, animal protective and feeding conditions in Amur region and Eastern Siberia were researched. An analysis of animal population, its

structure for wild ungulates and brown bear species was done. Effects of anthropogenic factors, like forest fires, upon brown bear population were studied as well. Special attention was also paid to the study of brown bear diseases.

Throughout the year, hunting grounds were surveyed on foot and with the help of vehicles. Routes were planned both along poorly accessible terrain, and along forest roads of different status (abandoned, serviced). Cross-country route lengths along hunting grounds varied from 5 to 15 km. In total, more than 5,000 km have been covered in Amur region and more than 20,000 km in Eastern Siberia for eight years.

Practical data about wild ungulates' population was collected during winter surveillance and registration work. Their population structure was determined by the fresh trails that animals leave on the snow, as well as by data from photo and video recording devices installed on salt licks, feeding grounds and along forest roads.

Brown bear population was determined according to data of surveillance records done by hunting organizations who operate on the hunting territories under research. The population structure was determined by visual observations and with the use of photo and video recorders, installed near animal resting places, salt licks, feeding grounds and along forest roads. In addition, craniological investigation of bear skulls was carried out.

The protective and feeding conditions for brown bears were observed by surveying the hunting territories. The predator's diet was studied by scientific research literature, as well as by studying hunted animals and feces, found during field trips. Bear diseases were examined in veterinary laboratories with the use of samples taken from hunted animals.

832 hunters from Amur region and the Republic of Buryatia were questioned during the research. The authors also used their experience gained during joint Russian-Japanese studies of brown bear on the island of Kunashir (the Kuriles, Russia) and on the Japanese island of Hokkaido.

Results and Discussion

Bears have a significant impact on ungulates' population in spring-summer period. What is this fact connected with? Let's consider the predator's biology.

Brown bear (*Ursus arctos*) is one of the largest predators. The length of its body reaches 2.5 m, it can weigh up to 700 kg, but most commonly met species weigh about 150-300 kg. Male species are much larger

than females (Kolstadet et al., 1986; Itoh et al., 2009; Pavlov and Senchik, 2013).

Bear's annual life cycle is divided mainly into two periods: full activity period (from spring to early winter) and hibernation (from the beginning of winter to spring). Bears can migrate in search of food during summer.

Brown bears have well developed hearing and smell, but their vision is much weaker. Their usual step is slow and calm; however they can run at a speed of up to 50 km/h, if necessary (Herrero, 1972; Sato et al., 2005; Pavlov and Senchik, 2013).

They are omnivorous predators. The structure of their teeth indicates a stronger adaptation to vegetable food rather than to animal one. The authors have studied 18 brown bear skulls from Skovorodinsky and Bureya districts of Amur Region.

Female species throw once in 2-4 years, as a rule. Their mating period lasts from May to July, for 10-30 days. The pregnancy has a latent stage, when an embryo is not developing before November, when the female lies in a den. Total pregnancy period lasts for 6-8 months, and birth occurs between January and March, when the female is still in the den. Bears reach their sexual maturity when they are 4-6 years old, but they keep growing up until 10-11 years. Bear life expectancy in the natural habitat is 20-30 years; in captivity it can reach up to 47-50 years (Sato et al., 2005; Pavlov and Senchik, 2013; Itoh et al., 2013).

Bears have very few competitors. Sometimes wolf packs may attack a bear. They are rarely attacked by tigers, but a large brown bear turns out to be a very serious opponent for a tiger (Sato et al., 2005; Pavlov and Senchik, 2013; Itoh et al., 2013).

Thus, we are dealing with a predator who is quite adapted to external conditions. It is able to quickly recover after any consequences of a negative impact on its population, because it is fertile, omnivorous and has no natural enemies. Taking into account the lack of interest for bear hunting among professionals and general public in Russia, which would naturally regulate its population, there are no factors to reduce bear population at the moment (including epizootics, cases of which have not been registered for more than 30 years on the territories under study).

Bears' population, hunting quotas and actual hunting numbers are shown in Figures 1-3 (Departmental documentation of the Republican Service for the Protection; Danilkin, 1999).

A comparison between brown bear population and numbers of hunted animals (Figures 1 and 3) showed a direct relation between the population increase and

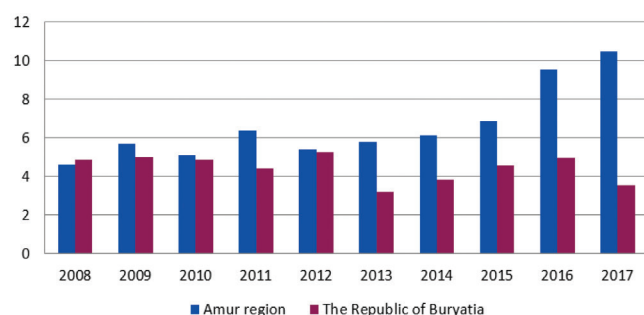


Figure 1: The number of brown bear in the Amur Region and the Republic of Buryatia.

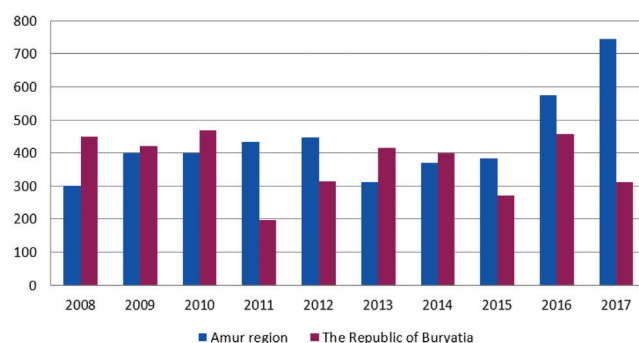


Figure 2: Limits of hunting for brown bear in the Amur Region and the Republic of Buryatia.

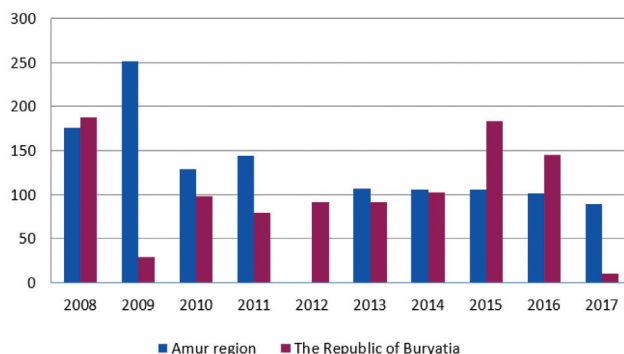


Figure 3: The real hunting for the brown bear in the Amur region and the Republic of Buryatia.

the number of hunted animals. A terminated bear hunting permit is not an absolute proof of a successful hunting, but nevertheless the authors decided to consider the animal to be hunted if the permit is terminated. According to data from the Republic of Buryatia an increase in bear hunts leads to a decline in its population number and, on the contrary, a decrease in hunting below their reproduction rate leads to an increment of their population, as it is in Amur Region. After a statistical data analysis, it was concluded that regional brown bear hunting quotas are being claimed by less than 50%. The authors believe that this is mainly

due to the lack of interest in that type of hunting and the general difficulty of the process. An absence of epizootics and predator-human pressing, an abundance of feeding reserves are the factors that together create favourable conditions for brown bear population growth. From 2008 to the present time bear population in Amur Region grew by more than 5.5 thousand animals, which is more than two times.

Brown bears exert definite influence upon wild ungulates' population. They begin hibernating by the end of November and wake up in late March-early April. Their wake-up period coincides with quite a tough season for all animals in the wild nature. After a long and cold winter with a lot of snow, food resources appear to be limited for many animals, forcing them to migrate in search of a board. This time is the most severe during annual cycle for bears as there are no vegetable feeds that are usual in their diet. Considering rapidly changing climatic conditions, the vegetative period in many regions under study begins no earlier than May. The most accessible fodder for brown bears during this period of the year are wild hoofed animals—elk, reindeer, and roe deer—who stay in valleys and floodplains of various rivers and lakes.

Thus, for example, adult female roe deer separate from their flocks about one month before fawning and occupy relatively small parturient territories. A pregnant female chooses a territory according to three main factors: protective and feeding conditions availability and proximity to a body of water (Zavatsky, 1986). According to these criteria, floodplain field complexes are most suitable for adult female roe deer in comparison with other biotopes during spring season. With higher humidity they are abundant in fodder and vegetation, which, in their turn play a protective role. A close presence of moisture, which amounts up to 90% in roe deer and other hoofed animals' stomachs (elk, red deer) plays an indisputably important role.

Floodplain complexes and river valleys are even more important for an elk than for a roe deer or a red deer. Elks in Siberia and the Far East stay mostly around lakes and rivers, where they eagerly feed on water resources and escape from blood-sucking insects during summer (Zavatsky, 1986).

Wild ungulates' tendency to stay in or near floodplain complexes during early spring is explained primarily by early appearance of water and fresh green fodder at the beginning of vegetative period. This is especially significant for pregnant and nursing females. The same factors attract brown bears there. And this is where they commonly make for some time after leaving their den.

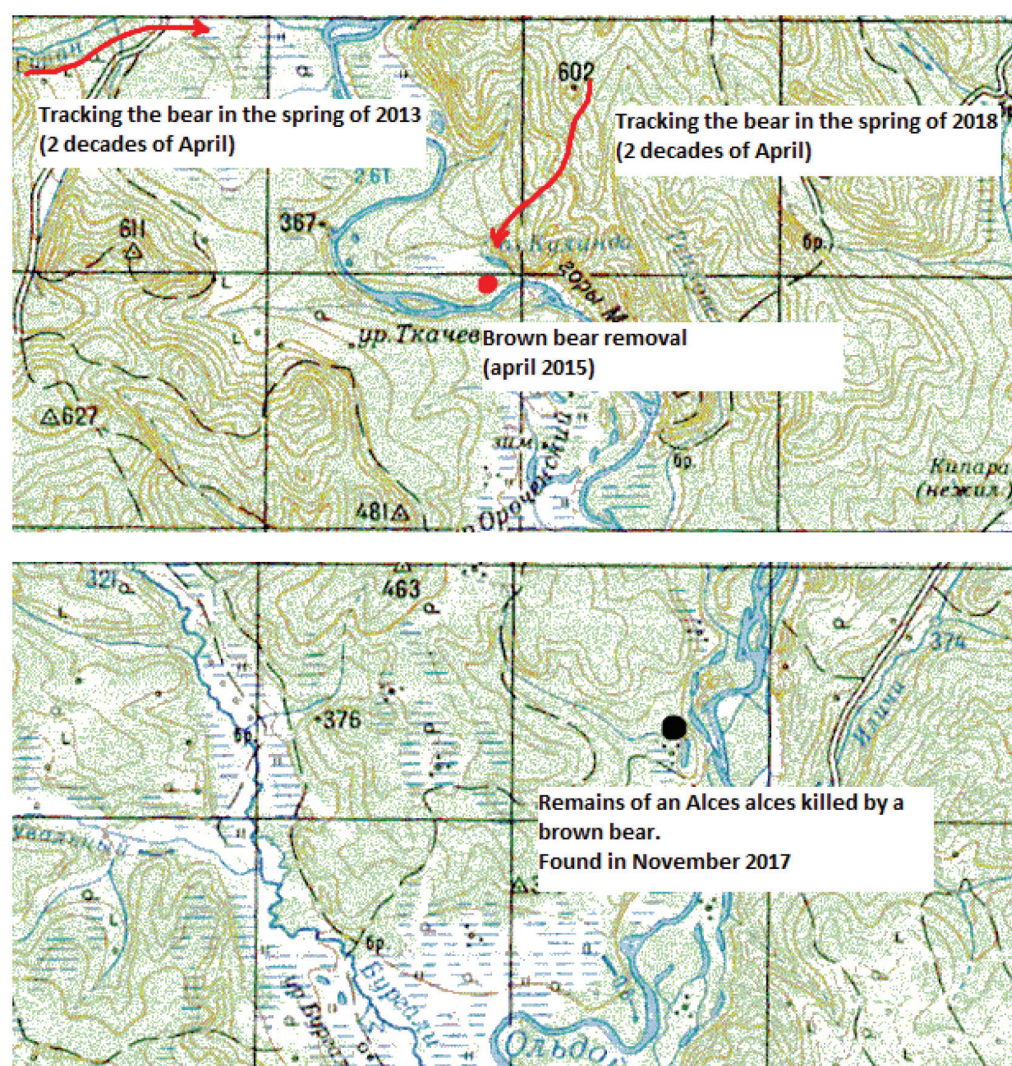


Figure 4: Meetings of the brown bear in the floodplain of the river Great Old, Amur Region.

During biotechnical activities geared at wild ungulates in summer months of June and July in the period of 2010 through 2018 and while hunting for brown bears in spring and autumn seasons on the territory of Skovorodinsky hunting grounds, the authors studied various literature sources on bear behaviour and concluded, that these animals are quite ingenious in the ways they chase and hunt for ungulates. They use many ways to hunt and three of them can be defined as most common.

The first way is that during spring season when there is still a deep and dense snow cover, bears drive ungulates into deep snow and kill them there (Mordasov, 2006).

The second way is that in late spring-early summer bears after coming out of the den can hardly find vegetable food. In the northern areas of Amur region, it

is typical for the vegetative period to start later than is the southern ones. The most accessible food for a bear during this time is wild ungulates' newborn offspring, calving or pregnant females. Bears can easily find the places where calving will take place and where pregnant females are. As it was already mentioned above, they stay on small territories in floodplains of rivers and springs. The authors examined some floodplains of Gurany spring (in June 2012, 2013 and July 2014), upstream Dorozhnaya Tipara river (in July 2015), some parts of Urka river (in July 2014), Urusha river (in June 2013, 2014, 2015), Oldoi river (in January/June 2012-2017), where they found many traces of bear activities—litter, footprints, scuffles and skeletons of killed wild ungulates.

The third most common way bears hunt for ungulates is catching them after being on the watch for them

on forest trails, near watering places and salt licks (Mordasov, 2006). Bears use this hunting method the year round. Most often bears attack young females or females with small calves.

During winter surveillance and registration of wild hoofed animals in Skovorodinsky hunting territory ($S =$

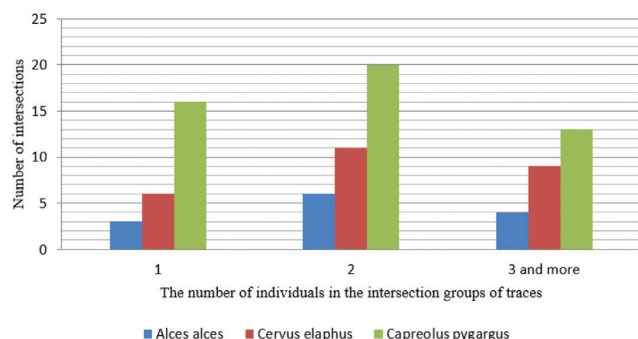


Figure 5: The number of individuals in the groups of wild hoofed animals encountered on the routes during winter registration work in 2014 (Departmental documentation of the Department for the Protection).

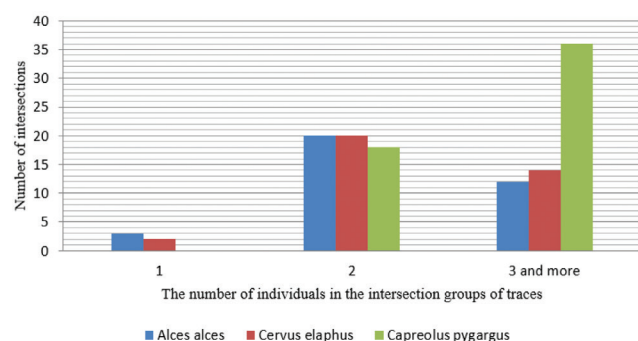


Figure 6: The number of individuals in the groups of wild hoofed animals encountered on the routes during winter registration work in 2015 (Departmental documentation of the Department for the Protection).

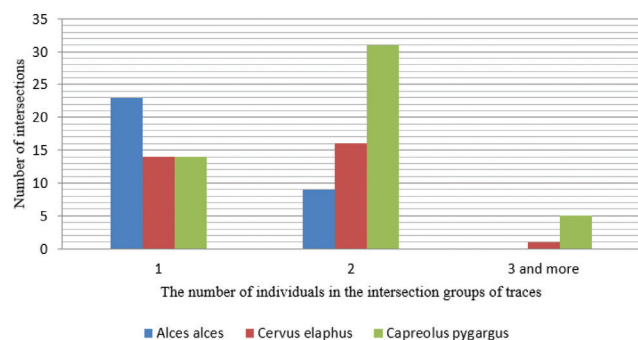


Figure 7: The number of individuals in the groups of wild hoofed animals encountered on the routes during winter registration work in 2016 (Departmental documentation of the Department for the Protection).

589 thousand ha), it was established that in year 2014, according to actual encounters with animals and their traces, 29% of elk population were young; in 2016—14%; the red deer in 2014—27%, in 2016—22%; roe deer in 2014—29%, and in 2016—21%. According to our observations in 2017, the number of young elk encounters is 4%, red deer—16%, and Siberian roe deer—13%.

The growth of wild ungulates' population is depending very significantly on young animals' survival level (Zavatsky, 1986). Based on winter surveillance and registration analysis it can be concluded that the proportion of young animals in wild ungulates' population is declining year by year and now we are seeing a large decrease in the number of elk and roe deer.

Thus, considering all collected and analyzed information, we can draw the following conclusions:

1. Brown bear population number directly affects the number of wild ungulates. Analyzing surveillance and registration data, it is fair to state that wild ungulates' population is decreasing in regions where brown bear population is stable or increasing, for example, in Amur Region. The opposite picture is observed in the Republic of Buryatia—the growth of wild ungulates is due to a decrease in the number of brown bears, which is also logical and confirms the trend.
2. The decrease in ungulates' number forces bears to look for new sources of food near human settlements. In years 2014–2016, in Amur Region, 11 permits were issued for brown bear hunt to regulate their population; in 2017 there were 24 permits.
3. Brown bears attack and kill young wild ungulates first of all, since they are much easier to kill. This

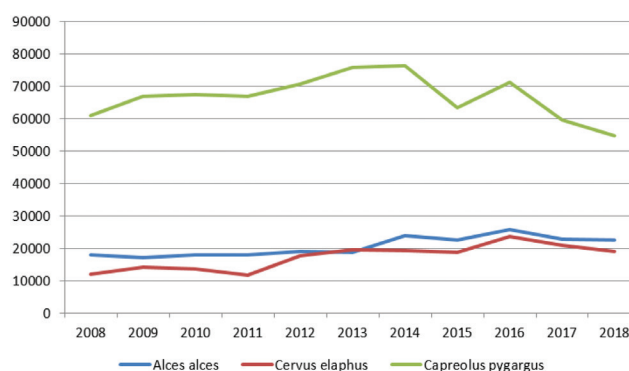


Figure 8: Dynamics of the number of elk, red deer and roe deer in the Amur Region for the period from 2008 to 2018.

fact is confirmed by results of annual surveillance and registration work, conducted on the territory of Eastern Siberia and Amur Region. The increase of red deer and roe deer populations on the surveyed territory of the Skovorodinsky area is reduced by 50% every year, and there is practically no increase in elk.

4. Bears are very flexible species, and their economic and hunting use in the last decade has been greatly diminished. It is not correct to underestimate brown bears and their negative impact on human economic activities and the environment. Population control by hunting is absent and this leads to a disturbance in stability of wild ungulates' populations, which, in turn, leads to quota reduction for hunting wild ungulates and, consequently, to serious economic losses of hunting organizations. This situation is currently observed on the territory of Amur Region. In the authors' opinion, it is necessary to use all possible methods to control brown bear population and constantly monitor them, as it is very easily and quickly restored, which is quite the opposite about the number of wild ungulates. Their population recovery process is long and influenced by other factors—anthropogenic, biotic and abiotic. Influence of the following factors—temperature regime, rainfall, construction of large technological objects, and growth of other large predators' populations—on the territory of Eastern Siberia and Amur region exert a huge impact on the populations of valuable wild ungulates! It is necessary to rationally use and regulate brown bear population, making this type of hunting profitable and more attractive for hunters by stimulating sales of bear raw materials and meat. These measures will help reduce its impact on wild ungulates' populations in Siberia and the Russian Far East.

Practical Application and Results

The study of brown bear influence on wild ungulates' populations will allow reducing the economic costs of the federal government, which are quite large now. In addition, with further decrease of wild ungulates' population going along with brown bears' population growth more frequent human-predator collisions are possible, both in and outside human settlements in the future. And this, undoubtedly, will entail a negative impact on human health and economic activity.

Brown bear's plasticity makes it possible to reduce its population to the minimum possible values, which

will not lead to the extinction of this species, since it is capable of completely recovering in a short period of time. That cannot be said about wild ungulates, which, in addition to constant brown bear influence, are also susceptible to the press of other predators and anthropogenic factors. Wild ungulates are the main hunting economic base and foundation in Siberia and the Far East of Russia. Reducing their number will lead to a decrease in hunting economy development, and consequently, to a decrease in profitability of such a widespread activity in the Russian Federation.

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