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Invited Review

# Hunting as sustainable wildlife management

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**Abstract.** During 1650–2015, in the territory of the former Soviet Union, numbers and distribution of game species fluctuated from abundance to extirpation to restore. I developed an index of abundance for the 'tsar' year and used modern estimations of game animal's numbers for the later period. In addition, I collected data on annual harvest of fur animal's pelts. My analysis illustrates periods of famine and social turbulent times strongly influenced subsistence hunting. I observe that totalitarian regime of Soviet Union ensured restoration of game species but after socio-economic revolution of 1991 led to the new decline occurred as a result of limited game management. There are a number of potential causes for this trend, and professional hunting negatively impacted populations. My 300-year-long data set of wildlife management demonstrates the role of regulated hunting as a necessary method of sustainable wildlife management.

**Key words:** game management, hunting, long-term data, Russia.

Many factors affect the game populations: climate, land cover change, interspecific relationship, agriculture, forestry, and hunting (Reinmoser et al. 2013). Using the Russian experience, I am going to demonstrate that hunting is the most important factor of game animals' dynamics and, therefore is the most important method of the game management. Uncontrolled hunting leads to decline of useful game species and increase of the harmful large predators. Hunting reinforces the fear of predators to human.

European and Siberian regions of Russia have rather different environmental conditions. They have different climate, vegetation, and human population densities. In addition, during the common social history, the turbulent times of social development influenced simultaneously. Disorders of the game management happened in the same times, as well as declines and restorations of the species.

Subsistence hunting always has been important for rural Russians, especially in turbulent times of the Russian history. Even during recent 1990s, subsistence hunting was important for inhabitants of remote areas, especially indigenous peoples. According to the latest Russian hunting law (Russian Federation 2009), the state grants indigenous peoples an exclusive right to engage in subsistence hunting on public lands.

During the last millennium numbers and distribution of game experienced extreme fluctuations from extraordinary abundance to vanishing. Before 1600s, the exploitation of game resources developed slowly. And, the decline of fur-bearing animals and ungulates have been observed since that time. In the early 1700s, the state adopted the first hunting regulations. Despite that, to the last of Tsarist Russia, many species have become rare or almost extinct (Baskin 1998). During 1917–1921, two revolutions and the Civilian war happened in Russia. Economic hardship and famine initiated the intensive subsistence hunting. Hunting management had stopped.

During 1921–1960s, the Soviet leaders made efforts to restore game animals. Hunting of many species was banned, and plenty of Nature Reserves where any hunting was forbidden were established. Reintroduction of extinct species was conducted on a large scale (Pavlov et al. 1974). Since early 1960s, hunters had needed to receive licenses to hunt valuable animals. During 1991–1999, the new social-economic revolution destroyed hunting management. Since early 2000s, hunting management was recovering. The reconstruction of game management was over in 2009 when the new Russian hunting law (Russian Federation 2009) was accepted.

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## Materials and methods

In this paper, I reviewed the population dynamics and distribution of hunting animals in Russia since 1650 up to now. The two revolutions occurred during this period (in 1917 and 1991, Fig. 1). I examined the periods of decline and growth in the number of game animals. For this work, I selected five important game species: sable (*Martes zibellina*), moose (*Alces alces*), reindeer (*Rangifer tarandus*), wolf (*Canis lupus*), and brown bear (*Ursus arctos*). I used the number and harvest data of these species to characterize abundance as well as the hunting pressure.

Since 1964, the Winter Track Count (WTC) as all-Russian event has been conducted, even during the turbulent 1991–1999 years. The special state center ("Tsentrokhotcontrol") has been collecting the data and calculated numbers of 23 game species in each of 1,815 districts of Russia (Mirutenko et al. 2009).

Since that time, I have numerical data on the abundance of five focused species. Annually, ca. 50,000 winter track counts (10 km length each) are conducted by hunting managers and hunters. WTC are accompanied and verified by aerial surveys, surveys on established plots, written surveys completed by hunters, and fall surveys of upland game (Gubar 2007; Mirutenko et al. 2009).

Other than WTC data, additional data of each species are obtained as follows. For sable, statistics of harvest are refered from Silantjev (1898), Monakhov and Bakeev (1981), Kaplin (1960), and Lomanova (2011). Then, I compared the sable fluctuations with data of the turbulent times of the Russian history (wars and revolutions).

For moose, to the 1960s, most of the data are from hunter records on the moose abundance and hunting success. Aspisov (1930), Kulagin (1932), Jurgenson (1935), Danilov (1949), and Kirikov (1966) gathered data in Russian archives describing the moose abundances in the European part of the USSR. To evaluate these verbal descriptions I used a point scale as follows; no moose: 0; very few: 0.5 moose/10 km$^2$ of forested area; scattered but permanent populations with limited hunting: 1.0 moose/10 km$^2$; moderate densities, moose are usually hunted with each hunter killing one or two moose: 3.0 moose/10 km$^2$; high density, moose hunting grounds are evaluated from an economical perspective, hunting success reaches 5–6/hunter/winter: 5.0 moose/10 km$^2$; very high density with some hunters killing more than a dozen moose per winter: 7.0 moose/10 km$^2$ of forested area.

For reindeer, the results from aerial surveys are used.

For wolf, the statistics of wolf skins harvest and wolf number are refered from Pavlov (1990), Gubar (2007), and Lomanova (2011).

Annually, brown bear counts by footprints on mud have been conducted over all Russia. To evaluate brown bear numbers in each district, hunting managers, mountain rangers, and hunters have been used to count bear tracks and measure the width of bear tracks when present during the snowless period. These data have been placed on maps. They also have tracked bears in the spring before snow melting when the animals leave the dens. In open landscapes (tundra areas, mountain alpine zone, croplands, and river shores during spawning of salmon fishes) the observers have conducted visual counts of bears (Gubar and Baskin 2007).

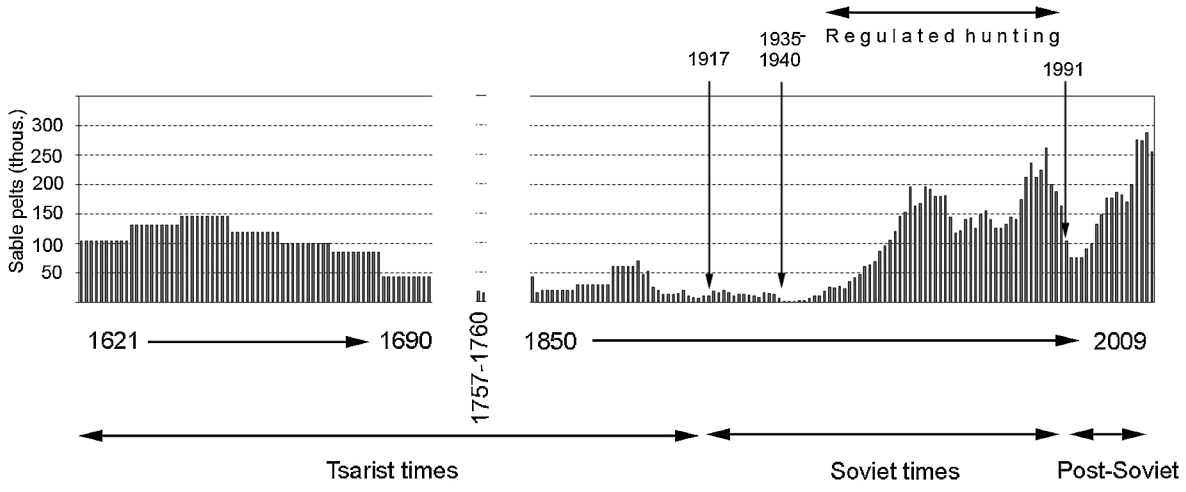


**Fig. 1.** Sable pelt harvest in Russia during 1650–2009 (Data Source; Silantjev 1898; Kaplin 1960; Monakhov and Bakeev 1981; Borisov 2011).

## Results

*Case study: Sable*

Sable is the best fur-bearing animal of Russia. The intensive hunting diminished the sable populations (period 1621–1700, Fig. 1). To conserve the species, the czarist government banned hunting sables in some territories. The first nature reserve in Russia (Barguzinsky Nature Reserve) was established in 1916 to conserve the valuable sable race inhabiting the Baikal Lake shores. During the Soviet time some more nature reserves were established. However, the sable numbers continued to decline or remain low (period 1917–1950, Fig. 1).

Only since 1950s, when state licenses for hunting sables had been introduced and the numbers of the issued licenses were regulated according to data of WTC, the fast growth of sable populations took place (period 1950–1991, Fig. 1). Then, the new revolution happened in Russia. The total disorganization of hunting management existed up to 2000. Later the state hunting management again restored the sable populations (2000–2009, Fig. 1).

*Case study: Moose*

One of the important causes of the first moose decline was harvest to use moose skins for cavalry breeches. Also, I can propose some general causes of the first decline: immanent fluctuation of the species abundance or a climate change. The climatic cooling observed in the middle of the 18th century was the strongest in the last millennium. The first great decline of the Eastern European moose population commenced at the beginning of the 18th century. The Russian czars in the central provinces of the Russian empire practiced bans of moose hunting to conserve this species. In spite of these initiatives, in the 1790s and early 1800s moose totally disappeared in many areas. Moose had remained depressed in most areas until about 1850 (Fig. 2). The important feature of the first great decline was total extinction that occurred in many areas.

The second great depression (Fig. 2) occurred from 1920–1928 (Jurgenson 1935; Danilov 1949). The specific feature associated with the second depression was excessive human use caused by economic hardship and famine. The important measure taken to restore moose populations was a total ban of hunting. Only since 1950s the permanent growth of moose populations started (1950–1990, Fig. 2). Mostly, this was achieved by licensing of moose hunting. The number of the issued licenses depended on the results of WTC in the previous winter. The breakdown of the Russian hunting management after 1991 resulted in the new decline of moose numbers.

*Case study: Reindeer*

In Russia, the reindeer population management has been ineffective. The species inhabits remote and sparsely populated areas where tight control of hunting is not possible. In addition, Russian reindeer management system has been archaic. Counts, modelling, and hunting licensing of reindeer have been carried out on the regional level. In other countries, management is carried out at the population level.

The reindeer inhabiting the Taymyr peninsula can account for 60% of the total number of wild reindeer in Russia, and the Yakutian reindeer can account for 20% (see Fig. 3 for these localities). Two aerial survey methods have been used in Taymyr. The first involves animal counting on routes with use of fixed-wing aircraft.

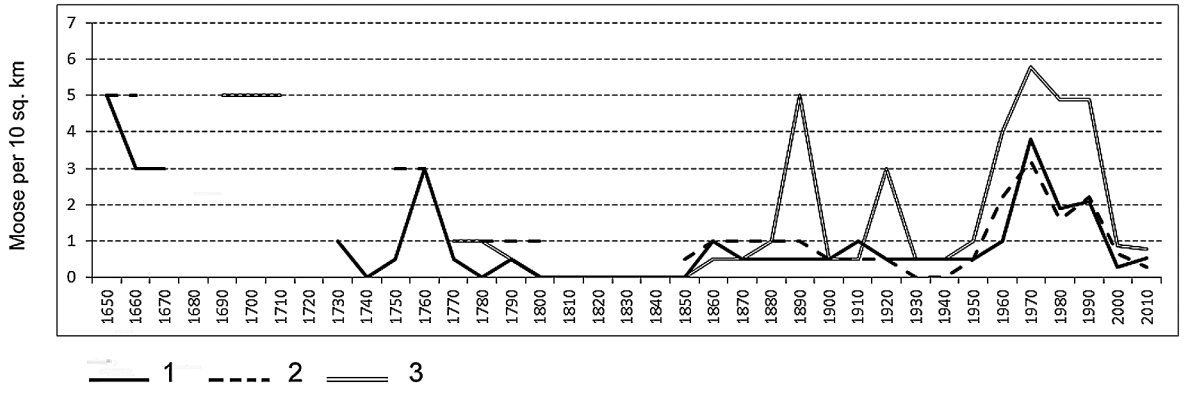


**Fig. 2.** Moose dynamics during 1650–2010 in Southern European Russian regions near the southern border of the moose range (Data Source; Aspisov 1930; Kulagin 1932; Jurgenson 1935; Danilov 1949; Kirikov 1966; Lomanov and Lomanova 1996, 2004; Lomanova 2007, 2011). 1 (Black line): Kursk oblast, 2 (Dashed line): Voronezh oblast, 3 (Gray line): Tambov oblast.

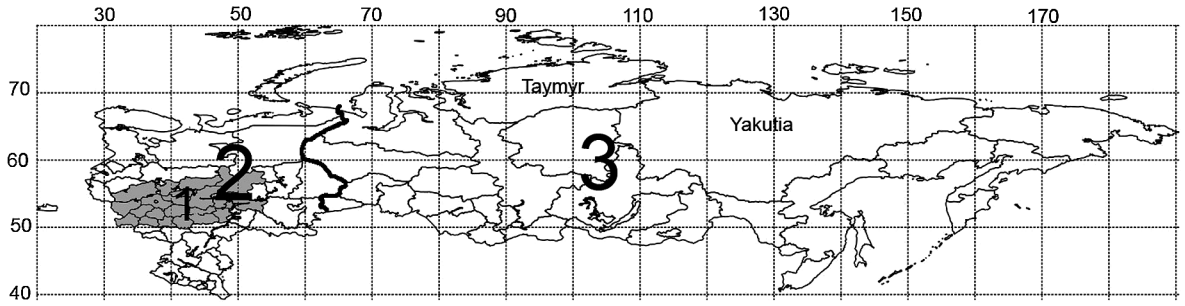


**Fig. 3.** The study areas of brown bear (1: Central European Russia, 2: European Russia, 3: Siberia and Far East) and reindeer (Taymyr and Yakutia) reviews.

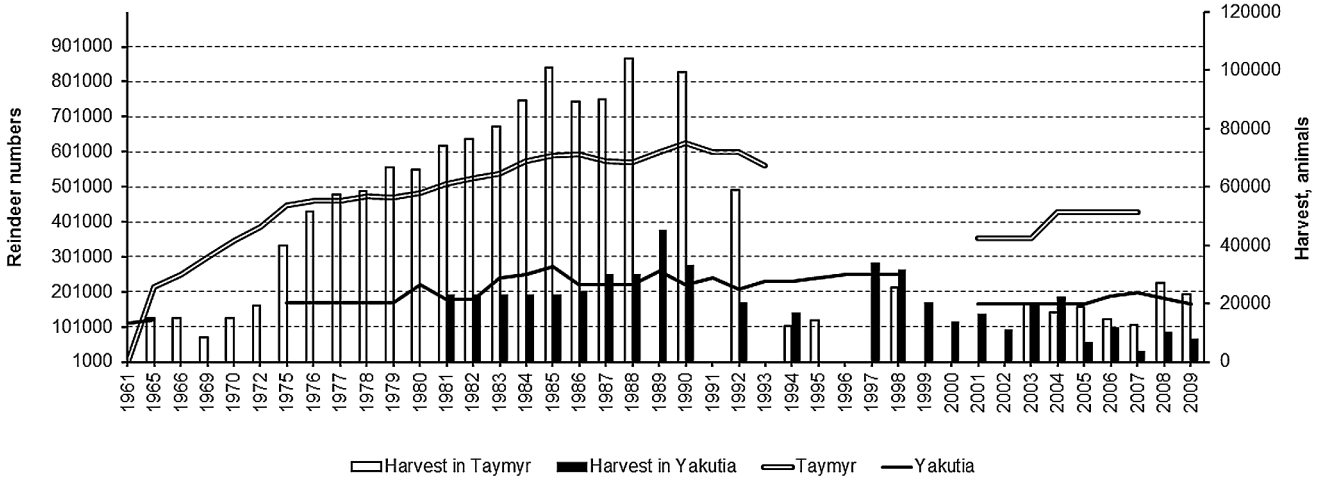


**Fig. 4.** Dynamics of the reindeer populations in Taymyr and Yakutia and harvest during 1961–2009 (Data Source: Mikhailov et al. 1990; Pavlov et al. 1996; Baskin and Danell 2003; Tikhonov et al. 2003; Kolpashchikov et al. 2003; Safronov 2005; Paponov 2007; Krivoshapkin 2013). White bar: harvested numbers in Taymyr, Black bar: harvested number in Yakutia, Outlined line: counted number in Taymyr. Black line: counted number in Yakutia.

It has been used in the surveys conducted by the National authority (Tsentrokhotkontrol) that is responsible for game animal counting (Tikhonov et al. 2003; Paponov 2007; Volodina 2011). The second method was developed by Taymyr scientists (Pavlov et al. 1996). These aerial censuses have been carried out in the hottest period of summer (latter July–early August) when reindeer under insect harassment gather in herds of hundreds and thousands. The scientists attempt to enlarge reindeer concentrations by circling around the herds in airplanes. During 1970–1993, they photographed these gatherings and later counted animals on the photos. After 1993, the size of herds was determined only by visual estimation from the aircraft, which could lead to serious errors in the estimates (Baskin 2005). Therefore, I excluded the unreliable data of 1994–2000 from consideration (Fig. 4).

Stabbing reindeer with spears while animals are crossing rivers is well known in the history of indigenous people over Eurasia (Baskin 2003). In Soviet time as well as now, Russian hunting regulations prohibit hunting at river-crossings because swimming animals are considered extremely vulnerable. In 1950s, the numbers of Taymyr reindeer increased, and scientists and local authorities received permission to use the traditional method of hunting at river-crossings. Since 1970, the ban for slaughtering at river crossings has been canceled, and the Taymyr State Game Husbandry Department was established. Up to 500 hunters participated in the slaughters. During 25 years, ca. 1.5 million of reindeer were harvested there (Pavlov et al. 1996). In 1993, as reindeer had not returned to river-crossings and changed their migratory routes, a crash of the Game Husbandry had occurred (Fig. 4). In Taymyr, the harvest has declined to 15–25 thousands of reindeer per year (Paponov 2007).

Commercial hunting of reindeer in Yakutia continues today, in spite of the great decline of the reindeer numbers (Fig. 4). Yet, in 1980s there were large reindeer populations migrating between tundra and taiga zones. Now

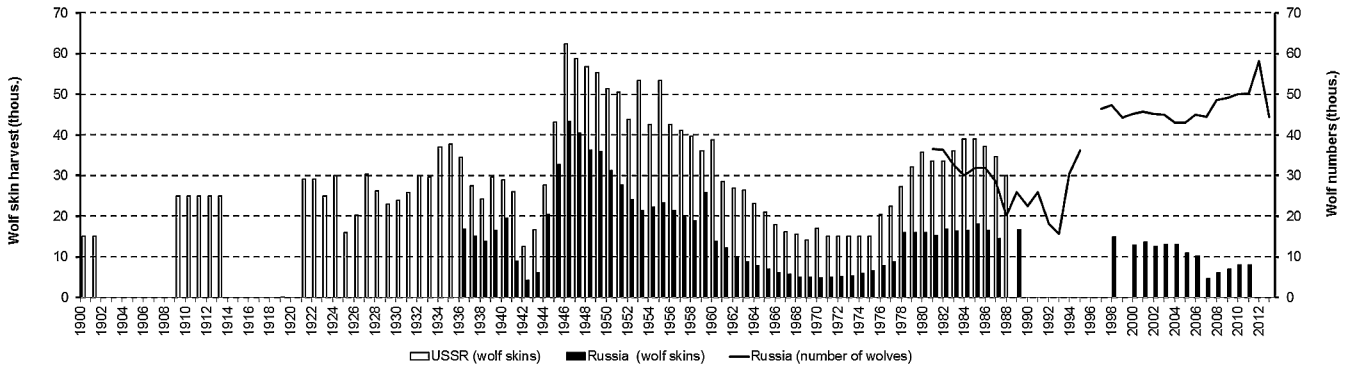


**Fig. 5.** Harvested number of wolves for skin and counted wolf numbers in the USSR and Russia during 1900–2013 (Data source: Kaplin 1960; Pavlov 1990; Borisov et al. 1992; Graves 2007; Gubar 2011; Tishkov 2015). White bar: harvested number in USSR, Black bar: harvested number in Russia, Black line: counted number in Russia.

some of these populations have been wiped out. For example, the reindeer population inhabiting the basins of Yana and Indigirka Rivers numbered 130,000. Now, only 2,000 were found by avian counts of 2012 (Krivoshapkin 2013). The obvious cause of the population crash is hunting by the indigenous people. They provide meat to the workers of diamond and other mines which are numerous at the Yakutia North. According to the all-Russian laws of hunting (since 1600 to now) the indigenous people have the right of subsistence hunting without any restrictions. They use opportunity to sell the meat to inhabitants of the miners' settlements.

*Case study: Wolf*

Management of wolf populations means mostly control of the numbers. Wolves are regarded as a pest to be destroyed throughout the year. Wolves kill a lot of livestock, especially domestic reindeer as well as game animals. In some periods of the Russian history wolves frequently attacked people. In 1870s, the tsarist government had to send military regiments to kill wolves. The new peak abundance of wolf was in the last years of the World War II and the next several years. All investigators agree that cessation of hunting caused the wolf abundance. During the war, very few hunters remained in the rear. In the regions near Ural Mountains several hundreds people were attacked by wolves (Pavlov 1990). The intensive wolf culling was arranged (Fig. 5).

In 1968, Mowat book was translated and published in Russia (Mowat 1963). This has stimulated the company to protect the wolves. During the discussion some writers affirmed that the wolves remove sick game animals and eliminate stray dogs. For some years wolf advocates won in the public consciousness. The hunting authorities banned the use of poisons, hunting of wolves from aircraft did not receive enough money (Pavlov 1990; Graves 2007). Then the visible growth of the wolf population was observed, so that the high number of wolves existed during 1980s (Fig. 5). The new turbulent time of the Russian history happened in 1991–1999 (Fig. 5). Again the crash of hunting management has led to the wolf number growth (Bragina et al. 2015).

*Case study: Brown bear*

In the late 1960s, about 100,000 brown bears lived in Russia (Vereshchagin 1972). The number of bears is now 180,000. The bear population density in the European part of Russia is 0.4 per 10 km$^2$, and that in the Asiatic part is 0.09 per 10 km$^2$ (Gubar 2011). Since 1950s, the idea advanced that brown bear is not a pest animal but a valuable hunting trophy. Since 1981, hunters have to buy a license to hunt bear. Fig. 6 reflects the dynamics of brown bear numbers in different parts of Russia.

The professional hunting often leads to the extermination of bears. Hunters with well trained dogs easily find bears in a forest during summer. There are professionals to find bear dens for the sale. Sport hunting of bears is difficult without assistance of professional hunters.

My analysis of the bear densities in 529 districts of European Russia gave the positive correlation with forestation (0.61, $P < 0.01$) and the negative correlation with human density (–0.35, $P < 0.01$). Although both forest cover and a human abundance are the main factors affecting the bear population density, forest cover is likely a stronger factor for the bear density. In fact, some highly wooded and densely human populated areas (e.g., Leningrad and Perm' oblast', Udmurt, and Bashkir Republics) have the numerous bear populations. In woods

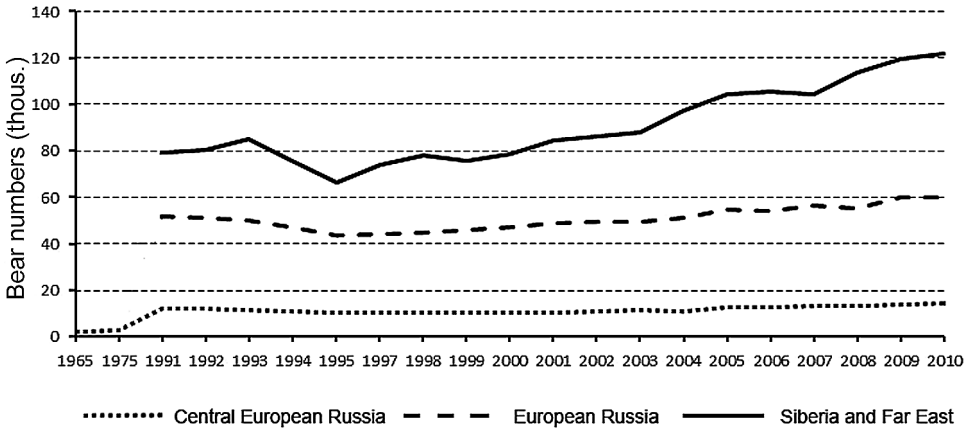


**Fig. 6.** Brown bear dynamics in the different parts of Russia during 1965–2010 (Data source: Vereshchagin 1972; Priklonsky 1967; Kashentseva 1990; Borisov et al. 1992; Baskin 1996, 1998; Gubar 1996, 2000, 2007, 2011). Dotted line: Central European Russia, Dashed line: Europian Russia, Black line: Siberia and Far East.


**Fig. 7.** Numbers of bear attacks on humans in the Russian regions during 1990–2015 (Data sources: collection from Internet information). Numbers in each region denote the number of bear attacks.

a man can notice bears in a short distance. In 13% cases humans noticed a bear from 10 m, in 56% from a distance of 50 m, in 20% from 100 m, and in 11 % from 150 m (Loskutov et al. 1993). Only forests provide shelters for bears in the plain European Russia.

During 1990–2015, more than 300 cases of brown bear's attacks on humans were recorded in Russia. Only six of them happened in the European part of Russia (Komi Republic. Fig. 7). The largest number of attacks on people of bears were observed on Kamchatka and in Krasnoyarsky Kray (Fig. 7).

Encounters between humans and bears are common in Siberia and rare in the European part in spite of fourfold more bear density there. It proves that the Siberian bears are not shy (Zavatsky 1993; Baskin 1996). The European bears always give humans the way to hide in bushes or behind a tree. But in Central Siberia bears attack humans in 1.6% of chance encounters, and they demonstrate exploratory behavior in 15% of chance encounters (Zavatsky 1993).

In Siberia bears often attack people especially in years when their basic food is poor (Ustinov 1987). In such years, the bear terror become an important problem for local inhabitants. Food capacity of the bear habitats in the European part of the range is much higher and stable. Another important feature of environmental differences is the sparse human population in Siberia. Probably, hunting controls fearfulness of bears. According to the official data, only 2.5% of all bears are shot in Siberia annually (Gubar 2007). In the European part hunters kill 3.6% of all bears annually. Hunting success in the European part correlates with total numbers of bears ($r$ = 0.73) but in Siberia the correlation is weak ($r$ = 0.38). In the Asian part of Russia, the majority of bears inhabit the sparsely populated, remote localities.

The Siberian bears often attack men working away from villages (86% cases). Women and children become bear prey in settlements. Starvation forces bears arrive at

villages, even break into the houses. Conflicts between humans and bears occur in cemeteries where people leave food on the graves of relatives (the Russian custom). Siberian bears are so brave, and they are not afraid to attack a group of people (37% cases of the fatal attacks).

## Discussions

The Russian experience confirms the Reinmoser's conclusion (Reinmoser et al. 2013) that sustainable wildlife management requires integrated intersectoral co-operation.

In Russia, hunting management is the main factor of game species dynamics. In the turbulent times of wars and revolutions the crashes of hunting management led to decline of the species, up to their extermination. The bans of hunting restored game species slowly. Licensing of hunt produced results more quickly when it based on counts and modelling of population dynamics. By this way, some species (sable and brown bear) have reached the high productivity. Only strict regulation (licensing) of hunting sable based on modelling population dynamics demonstrated successful management and the unprecedented growth of sable populations (Fig. 1). The high number of moose in 1960–1990 was also the result of licensing of moose hunting. Later, the crash of hunting management in 1991–1999 happened in Russia that resulted in the decline of the moose population (Fig. 2).

Political and economic considerations often took negative influence on hunting management in Russia. One of examples is the attempt of 1960–1990s to overcome the food crisis by commercial hunting moose and other ungulates.

Since the 10th century until 1940s, professional hunting was one of the foundations of Russian economy. Now, professional hunting remains economically important only for indigenous people. Subsistent hunting of indigenous people is allowed without restrictions. However, in Yakutia, the modern conditions, the subsistent hunting of indigenous people become a part of the commercial hunting and harm reindeer, moose, and the Yakutian snow sheep (*Ovis nivicola lydekkeri*).

Hunting is able to control the wolf number and behavior. Cessation of hunting of wolves has repeatedly led to frequent attacks by wolves on humans. High mortalities of wolves killed by humans, 43% (in average) in the European regions and 22% (in average) in the Siberian populations, kept a high level of the alertness, and then they tend to escape from humans. However, the total number of wolves does not decline.

Controlled hunting of brown bears provided the high number of this species in Russia and expansion of the range. Brown bear alertness also depends on intensity of hunting. The fatal attacks of bears are investigated by the hunting managers, and the dangerous animals destroyed. However, the Siberian bears often attack people. Aggressiveness and cannibalism as a norm of the Siberian bear behavior depend on a shortage of environment carrying capacity.

Thereby, the regulated hunting ensures sustainable management of game species. Also, hunting keeps acceptable neighborhood of humans and large predators.

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