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The State of Populations and Selective Hunting of Game Ungulates in the Middle Urals

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Abstract—The population dynamics of moose, wild boar, and roe deer in the Middle Urals and changes in the proportion of females among the animals taken by hunters were analyzed. For all the three species, a tendency toward selective hunting for females was revealed. In this situation, the proportion of females in a population decreases with time, and its reproductive potential is impaired.

Key words: dynamics, numbers, sex ratio, selective hunting, moose, wild boar, roe deer.

The problem of correspondence between sample structure and population structure in ungulates has been repeatedly discussed in the literature. Many authors have agreed that the sex and age ratios in population samples are often biased because of the prevailing removal of certain sex or age cohorts (Buturlin, 1934; Yazan, 1967, 1975; Yurgenson, 1968; Timofeeva, 1974; Glushkov, 1975, 1982, Vereshchagin and Rusakov, 1979). Most specialists believe that, in the absence of special hunting quotas on young and adult ungulates, the latter are hunted selectively. As to the sex ratio among animals taken, the accepted standpoint is that hunting for males prevails in the case of at least one species, the moose. According to several authors (Briedermann, 1986; Chervonnyi, 1980; Prostavok, 1996), the same applies to wild boar hunting.

The regular depletion of a certain cohort in a population should result, sooner or later, in the prevalence of other cohorts. In particular, the aforementioned selective hunting for males in the moose and wild boar should lead to an increase in the proportions of females in their populations.

Studies on the sex ratio in moose revealed a fairly contradictory pattern of its dynamics. Over three decades (from the 1950s through the 1970s), no marked shift toward the prevalence of females in the sample or the entire population has occurred in a considerable part of the species range. Only the extreme cases of selective hunting for animals of a certain sex proved to result in the obvious prevalence of the other sex in the population. For example, this occurred after a ban on hunting female moose was imposed in several countries, including Russia, in the early 20th century. Timofeeva (1974) noted that such measures can rapidly distort the sex structure of the population, with the male-to-female ratio shifting to 1 : 2.4, 1 : 3, and even 1 : 9. As polygamy is not characteristic of moose, these shifts reduce the reproductive potential of the population and

lead to its degradation. She compared the proportion of males among moose taken by hunters with that estimated by visual observations in Leningrad oblast in the 1960s (55.5 and 52.1%, respectively) and concluded that male moose are killed more often. Another conclusion, based on the analysis of data obtained by other authors, was that only a part of the species range is inhabited by populations with a male-biased sex ratio.

According to Bol'shakov and Kubantsev (1984), females prevailed in moose populations, but the sex ratio generally remained above 1 : 1.5 (the proportion of females did not exceed 60%). In publications analyzed by Lebedeva (1986), the prevalence of females was observed in five out of nine cases. Kheruvimov (1969) noted that prevalence of females over males in the moose population of Tambov oblast was confirmed by both visual observations and the results of nonselective shooting.

On the whole, the data described above suggest that selective hunting for male moose did not result in serious disturbances of population structure. A slight prevalence of male embryos—from 46 to 58%, averaging 53–54% (Timofeeva, 1974; Vereshchagin and Rusakov, 1979)—was counterbalanced by selective removal of adult males by hunters. As commercial hunting in those years was not intensive, the prevalence of females over males in the moose population was relatively weak.

The sex ratio in the populations of European and Siberian roe deer also deviated from 1 : 1 toward a higher proportion of females. In the greater part of European Russia, this proportion among roe deer fluctuated from 54 to 68% (Geptner *et al.*, 1961); in Estonia, it was 64.5% (Randveer, 1989). In Denmark, the male-to-female ratio was 1 : 2 (Strandgaard, 1972; cited from Filonov, 1993). The prevalence of adult males over females in the roe deer population was detected only in Sweden (Borg, 1970; cited from Filonov, 1993).

The same is true of Siberian roe deer. Data on the sex ratio among roe deer of the Il'men Nature Reserve (the Southern Urals) show that females began to prevail there in the mid-1940s (Ushkov, 1947; Averin, 1949), and their proportion in the late 1960s was 69% (Dvornikov, 1984). In the Khingan Nature Reserve (the Russian Far East), the proportions of males and females were 45 and 55%, respectively (Darman, 1986). Smirnov (1978) provided similar data on western Transbaikalia (southern Siberia). Data presented by Danilkin (1992) confirm the tendency toward the prevalence of females in roe deer populations: they indicate that the proportion of females is always equal to or greater than the proportion of males, regardless of population density.

In the wild boar populations of Europe and European Russia, either the sex ratio is about 1 : 1 (Briedermann, 1986; Prostavok, 1996) or males prevail (Ivanova, 1980; Vatolin, 1980). In the samples of wild boar taken by commercial hunters, these authors revealed the obvious prevalence of males: in most cases, the observed sex ratio was no less than 2 : 1. Prostavok (1996) analyzed the long-term dynamics of sex ratio in nature and in such samples and found that the proportion of males among wild boar taken by hunters is higher than in wild populations. On this basis, he made the conclusion concerning selective hunting for males. Briedermann (1986) arrived at the same conclusion after comparing sex ratios among captured and killed animals. However, Rusakov and Timofeeva (1984) obtained different results. They analyzed sex ratios in the samples of wild boar taken by commercial hunters in northwestern Russia at different stages of population dynamics and found that males prevailed in all these samples, without any increase in the proportion of females. Hence, these authors supposed that a greater proportion of males is a general characteristic of the wild boar populations living near the northern boundary of the species range, and the prevalence of males in the sample does not indicate their selective removal by hunters.

This work is an attempt to analyze the dynamics of sex ratio among adult animals in three ungulate species inhabiting Sverdlovsk oblast and to estimate the direction and degree of selective hunting for males or females (if any) and its possible consequences.

MATERIAL AND METHODS

The system of ungulate population harvesting is based on issuing licenses for individual hunters and their groups. In the Soviet period, there were licenses of two categories: sports hunting and commercial hunting.¹ Until 1996, the main controlling factor was the proportion of animals removed from the population

¹ A hunter with a commercial license had to sell the meat of a killed animal to the purchasing agency owned by the state. In sports hunting, a hunter paid for the license and could use the meat at his discretion.

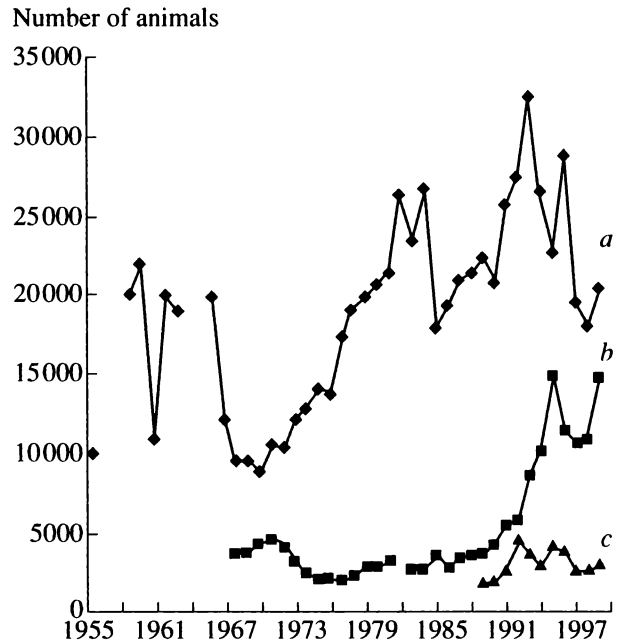


Fig. 1. Population dynamics of (a) moose, (b) roe deer, and (c) wild boar.

(the removal rate). On average, this parameter did not exceed 10–15% for moose and roe deer and 20–30% for wild boar. In that period, there were no restrictions on hunting animals of certain sex or age.

We analyzed information on the dates of hunting and the sex and age of killed animals, which was obtained from hunting licenses (Table 1). The method proposed by Smirnov and Korytin (1979) was used to reveal the fact of predominant removal of a certain structural group from the population. The method is based on examining the ratio of these groups among animals taken at the beginning, in the middle, and at the end of the hunting season. The randomly fluctuating or unchanging ratio is evidence for the absence of selectiveness in hunting, whereas a decrease in the proportion of a certain group during the season confirms the fact of its selective elimination. A bias in the population structure manifests itself most clearly in the sample taken at the end of the season under conditions of a high removal rate. In such an approach, the basic assumption is that the probability of being killed for an animal from the selectively hunted group exceeds that for an animal from the group hunted at random by the value that remains constant throughout the hunting season. We divided the hunting season into three equal parts with regard to the number of animals taken (rather than chronologically) in order to level off differences in the removal rate during the hunting season and in the length of this season in different years.

In 1997, hunting for the adult females of all the three species was banned, and separate hunting quotas for young and adult animals were established, the former quota being significantly higher than the latter.

Table 1. Numbers of animals in the samples included in analysis

Species	Hunting season, years									
	1983/84	1984/85	1985/86	1988/89	1990/91	1991/92	1992/93	1993/94	1994/95	1995/96
Moose	>2000	>2000	>2000	1897	–	–	2823	2799	1689	1213
Wild boar	–	–	–	–	289	–	255	358	261	260
Roe deer	–	–	–	–	–	565	530	593	–	–

Table 2. Sex ratio among adult moose taken in Sverdlovsk oblast

Index	Hunting season, years								
	1983/84	1984/85	1985/86	1988/89	1992/93	1993/94	1994/95	1995/96	
Proportion of females	0.456	0.438	0.427	0.415	0.437	0.438	0.392	0.372	
<i>N</i>	>2000	>2000	>2000	1897	2823	2799	1689	1213	

RESULTS AND DISCUSSION

The population dynamics of ungulates in Sverdlovsk oblast were analyzed on the basis of official data collected during the winter route counts. In the moose, population size changed as follows. After reaching a relatively high level (about 20 000 animals) in the late 1950s and early 1960s, it drastically decreased by the late 1960s (Fig. 1, curve *a*). The following slow and long-term population growth continued until 1983, when the number of animals reached a peak of 27 000 (according to other data, 40 000). In the mid-1980s, it decreased to approximately 20 000. The late 1980s and early 1990s were the years of a slow population growth, with a peak in 1992. Since then, population decline (with a slight increase in 1995) has been observed. In 1997, the size of the moose population was approximately 55–60% of its maximum.

The size of the roe deer population remained fairly small (about 4000 animals) for a long time (we had data on the period since the late 1960s) (Fig. 1, curve *b*). Its vigorous growth began in 1990, and a peak of 15 000 animals was reached in 1994. This growth coincided with an increase in the numbers of roe deer in Kurgan and Chelyabinsk oblasts, which are located south of Sverdlovsk oblast.

The wild boar is a new species in Sverdlovsk oblast. It appeared there as a result of both its introduction and natural expansion to new areas in northern and north-

eastern regions of European Russia and over the Urals. The work on wild boar introduction was performed in the 1970s, and individual cases of spontaneous migration of these animals to Sverdlovsk oblast were recorded in the same period (Kiselev, 1986; Markov, 1997a, 1997b). After a peak in 1991, the numbers of wild boar have been gradually decreasing (Fig. 1, curve *c*). Hunting has been allowed since 1987.

Our results showed that the proportion of males among moose taken in Sverdlovsk oblast is significantly greater. This fact completely agreed with data of many other authors. The difference from these data was that the proportion of adult females had a tendency to decrease gradually over the period from 1983 to 1996 (Table 2); this tendency, however, was slightly disturbed in the seasons of 1992/1993 and 1993/1994. On the whole, the proportion of females among moose taken during the hunting season decreased from 45.6% in 1983/1984 to 37.2% in 1995/1996 (in other words, by 9% over 12 years). This decrease is statistically significant, as large amounts of data were analyzed.

A similar process (probably, of even greater magnitude) was revealed in the wild boar population: after six hunting seasons (from 1990 to 1995/1996), the proportion of females in the kill decreased from 37.4 to 25.8%, i.e., by 11% (Table 3).

The question arises as to whether the decrease in the proportion of adult females in the samples reflected the process actually occurring in the population or resulted from selective hunting for males.

Let us consider how the proportion of females in the kill changed during the hunting season. Remember that the constancy or random fluctuations of this proportion are evidence for the absence of selectiveness in hunting, whereas its decrease indicates selective killing of females. As follows from Fig. 2a, the proportion of females in the kill decreased slightly (but distinctly) by the end of each of the five hunting seasons. These

Table 3. Sex ratio among adult wild boar taken in Sverdlovsk oblast

Index	Hunting season, years				
	1990/91	1992/93	1993/94	1994/95	1995/96
Proportion of females	0.374	0.345	0.3	0.28	0.258
<i>N</i>	289	255	358	261	260

results proved to be identical to those obtained previously by a slightly different method of data processing (Pogodin and Korytin, 1997). Moreover, the analysis of our data from the neighboring Perm oblast produced virtually the same results concerning the decrease in the proportion of females.

The same pattern of changes was also fairly distinct in the roe deer population (Fig. 2b): during each of the three hunting seasons, the proportion of females decreased gradually. This was conclusive evidence for their selective elimination.

The data on the wild boar population proved to be contradictory to some extent (Fig. 2c). In the first year of the study period, the proportion of females increased by the end of the hunting season, indicating selective elimination of males from the population. However, this proportion remained virtually constant in the second season and obviously decreased by the end of the three subsequent seasons.

Thus, in two out of the three ungulate species studied in Sverdlovsk oblast—moose and roe deer—the proportion of females in the kill proved to decrease during the hunting season. The analysis of wild boar hunting licenses revealed a similar decrease during three out of the five hunting seasons and a decrease in the proportion of males by the end of one season.

These results allow the conclusion that females are selectively removed from the ungulate populations inhabiting Sverdlovsk oblast. However, the observed decrease in the proportion of females taken by the end of the hunting season is slight, which is evidence for a low degree of selectiveness. In other words, the probability of being killed for a female in the case of selective hunting is only slightly higher than in the case of non-selective hunting, in contrast to the situation with the populations of carnivores (Smirnov and Korytin, 1979). Hence, the consequences of these process may manifest themselves only after several years, the more so that the average rate of animal removal from the ungulate populations is generally low (for the moose in Sverdlovsk oblast, no more than 10–15%).

The results of studies on the sex ratio in moose in the 1960s and 1970s show that, most probably, males were selectively hunted in that period. In particular, Rusakov (1982) and Glushkov (1985) noted a decrease in the proportion of males in the kill by the end of the hunting season. It appears that the formation of an animal sample is determined by a number of factors, and its eventual composition depends on their interrelations.

All these factors may be divided into three large groups. In the first, following Smirnov and Korytin (1979), we include natural factors such as behavioral differences between males and females (e.g., in alertness, daily routes, etc.). Thus, according to some publications (Timofeeva, 1974; Nikulin, 1978), the daily routes of mature male moose are slightly longer. On the other hand, Gordiyuk (1993, 1994), who analyzed a considerably greater amount of data, showed that

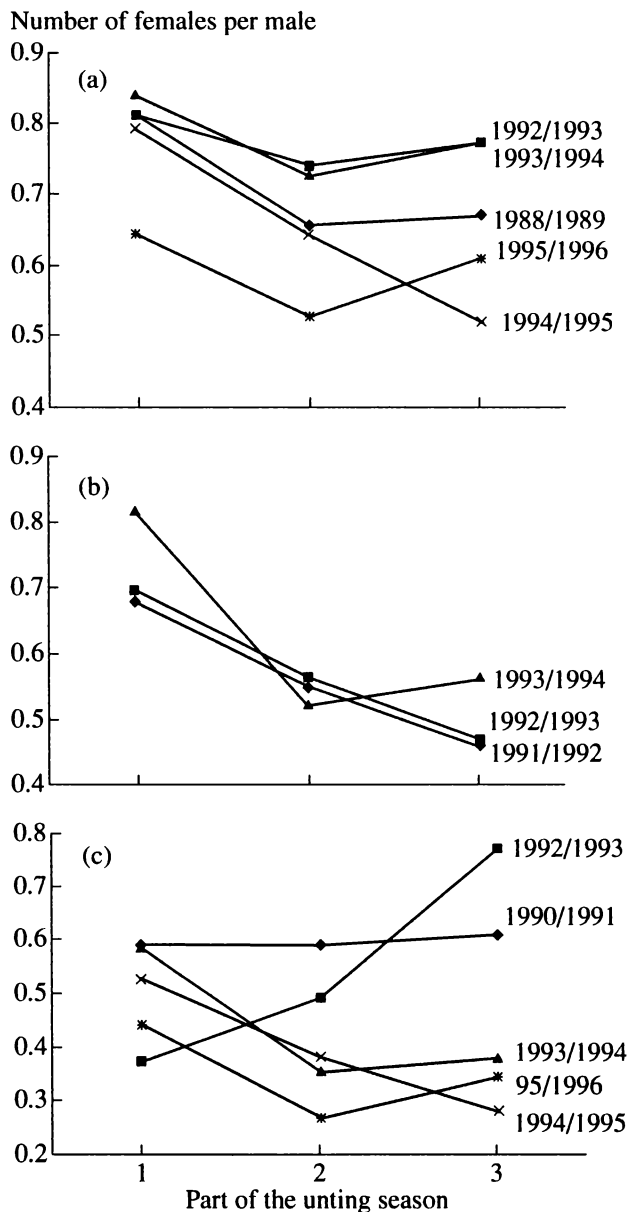


Fig. 2. Dynamics of sex ratio among (a) moose, (b) roe deer, and (c) wild boar taken by hunters.

females inhabiting a nature reserve covered the distances almost twice as long as males did during the day. Kanakov (1985) revealed a considerable sex-related difference in biotope preferences: males prevailed among moose that inhabited pine forests, whereas females prevailed in deciduous forests.

Sex-related differences in behavior were also observed in roe deer. Several authors (Flint and Krzywinsky, 1978; San Jose *et al.*, 1997) noted that males were more mobile than females during the rut and in winter and preferred a solitary mode of life to a greater extent.

According to Voronin (1980), the daily route of a wild boar herd consisting of mature females with their off-

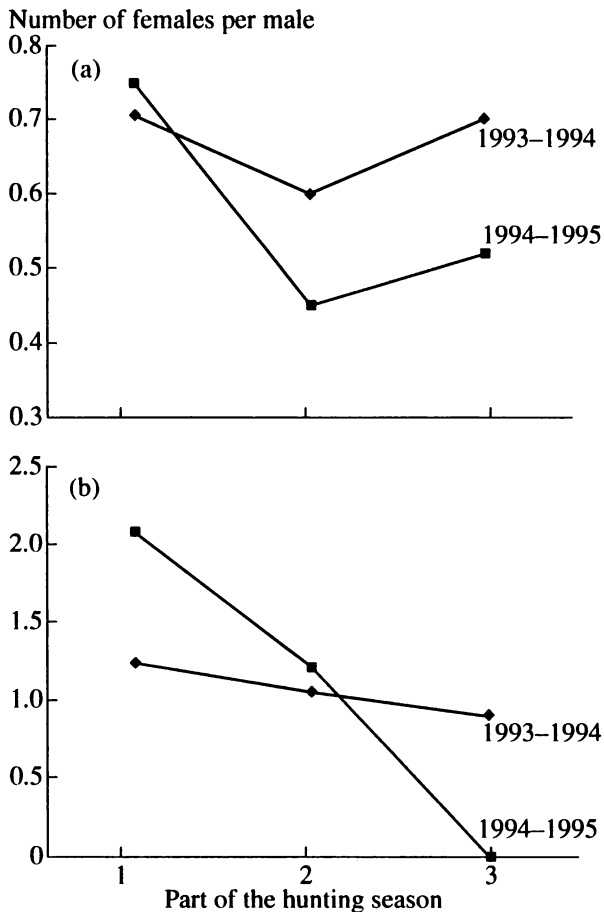


Fig. 3. Changes in sex ratio during the hunting season among moose taken by (a) commercial and (b) sport hunters.

spring and barren females is 10–12 km, whereas that of mature males (including foraging) does not exceed 4.2 km. When the group is disturbed, its daily route increases to 15–20 km, whereas a male moves away for only 1–2 km and then returns to its territory.

Therefore, sex-related differences in animal mobility and habitat distribution are characteristic of all the three species. Because of them, males and females may have different probabilities of being killed by hunters.

Factors of the second category are the methods of hunting that can result in the prevailing removal of a certain structural group from the population. When hunting moose with a lure, only males are usually

Table 4. Sex ratios among moose taken by sport and commercial hunters

Hunting season	Number of licenses included in analysis	Proportion of females taken	
		under sports licenses	under commercial licenses
1993/1994	2686	51.2	40.0
1994/1995	1720	40.7	36.0

taken. Hunting moose and wild boar with hounds results in taking mostly females (Sludskii, 1956; Rusakov and Timofeeva, 1984; Zaguzov, 1988; Varnakov, 1988; Smirnov, 1994, cited from Danilkin, 1998), especially when the young follow them. When the battue method is used, females are shot more frequently (Danilkin, 1998). Glushkov (1982) cited data showing that females prevailed among moose taken by all the main methods, including battue, stalking, and hunting with a husky.

In the third category, we included the cases when hunters' efforts are directly aimed at taking animals of a certain structural group. This primarily concerns trophy hunting. In addition, such effects manifest themselves when the samples of ungulates taken under sports and commercial hunting licenses are analyzed.

In each case, an individual combination of factors determines the sex ratio in the kill. Vereshchagin and Rusakov (1979) showed that females prevailed among moose hunted for sport (57.4%), whereas their proportion among animals taken under commercial licenses was only 39.8%. Similar results were also obtained by these authors for the wild boar. We analyzed the sex ratio among moose killed by sport and commercial hunters in Sverdlovsk oblast (Table 4). Although the difference between these samples was smaller than in the work by Vereshchagin and Rusakov, the tendency proved to be the same: the proportion of females was relatively higher among moose taken by sport hunters.

Furthermore, we performed a more detailed analysis of the sex ratio among moose killed in different periods of the same season by commercial and sport hunters (Fig. 3a). In the case of commercial hunting, the number of females per male in 1993–1994 was approximately the same at the beginning and at the end of the season; in 1994–1995, this parameter decreased slightly by the end of the season (Fig. 3a). Among moose taken by sport hunters, the proportion of females markedly decreased by the end of the season. In 1994–1995, the female-to-male ratio initially averaged 2.5 : 1, but no females were among the animals killed at the end of this season (Fig. 3b). This result provided evidence that moose hunters with sports licenses deliberately hunted for females.

For the wild boar, we managed to analyze data on only one hunting season (1990–1991). The proportions of males among animals taken by commercial and sport hunters were 67.5 and 58.9%, respectively. In the case of sport hunting, the proportion of females in the kill decreased during the season (Fig. 4a). In the case of commercial hunting, this proportion increased, whereas the proportion of males decreased (Fig. 4b). It is noteworthy that only sports licenses for wild boar hunting have been issued since the 1993–1994 season. This fact probably accounted for the distinct prevalence of females among wild boar shot in this period.

Thus, our results show that the decrease in the proportion of females among moose and wild boar taken in

Sverdlovsk oblast in the periods from 1983 to 1996 and from 1990 to 1996, respectively, reflects the change in the sex ratio that has actually occurred in their populations. This change is explained by a general (although weak) tendency toward selective hunting for females, which also applies to the roe deer population. A deficiency of females in the moose population probably began to develop before the period considered in this work. In some areas of Sverdlovsk oblast, the prevalence of males in the moose population may be even greater than in the sample taken by commercial hunters. The deficiency of females in this population, which has developed over many years, is undoubtedly among the factors responsible for its recent decline in Sverdlovsk oblast.

In the roe deer, selective hunting for females in the early 1990s was accompanied by a rapid population growth. We believe that two factors were responsible for this contradictory situation. First, the rate of animal removal from the population was low; second, its reproductive potential could be restored owing to animal migration from the forest-steppe zone, where the density of roe deer has always been high.

In the wild boar, the proportion of females in the kill changed in slightly different ways during the five hunting seasons considered in the study. Apparently, this occurred because the ratio of sports and commercial licenses received by hunters varied from season to season. In 1993–1994 and later, wild boar were only hunted under sports licenses, and the proportion of females in the kill regularly decreased by the end of the season. In the season of 1990–1991, when the sex ratio in the total sample remained constant (Fig. 2c), the proportion of females decreased with time in the sample taken by sport hunters (Fig. 4a), and the proportion of males decreased in the sample taken by commercial hunters (Fig. 4b). Note that commercial licenses accounted for 68% of all licenses issued in this season.

Thus, the composition of ungulates taken by hunters depends on the ratio of sports and commercial licenses they receive. The proportion of sports licenses has always been smaller, and this accounts for a relatively weak manifestation of the consequences of selective hunting for females. In the regions where mostly commercial licenses were issued, the general effect might be manifested in selective elimination of males. It is necessary to note that the main factor determining the composition of ungulates in the kill is the choice of an animal by a hunter. In this respect, ungulates differ from the groups of game animals in which external differences between population groups are less distinct.

It is also important that the effect of weakly selective removal of females is augmented by the tendency toward an increased hunting load on adult animals. The resulting combined effect is a general decrease in the reproductive potential of the moose, wild boar, and roe

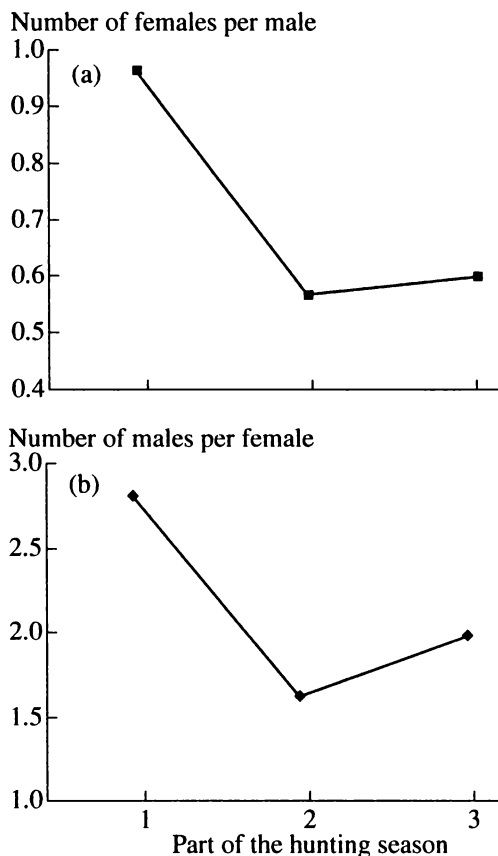


Fig. 4. Changes in sex ratio during the 1990/1991 hunting season among wild boar taken by (a) sports and (b) commercial hunters.

deer populations. This is especially hazardous to the last two species because of their low population density in Sverdlovsk oblast, at the northern boundary of their ranges.

REFERENCES

- Averin, Yu.V., The Ecology of Roe Deer (*Capreolus capreolus pygargus* Pall.) in the Il'men Reserve, *Tr. Il'men. Gos. Zap.*, 1949, no. 4, pp. 9–62.
- Bol'shakov, V.N. and Kubantsev, B.S., *Polovaya struktura populyatsii mlekopitayushchikh i ee dinamika* (Sex Structure of Mammalian Populations and Its Dynamics), Moscow: Nauka, 1984.
- Briedermann, L., *Schwarzwild*, Berlin: VEB Deutscher Landwirtschaftsverlag, 1986.
- Buturlin, S.A., *Losi* (Moose), Moscow, 1934.
- Chervonnyi, V.V., Home Range of Wild Boar in Winter, in *Kopynye fauny SSSR* (Ungulates in the Fauna of the Soviet Union), Moscow: Nauka, 1980, p. 216.
- Danilkin, A.A., Population Structure, in *Evropeiskaya i sibirskaya kosuli* (European and Siberian Roe Deer), Moscow: Nauka, 1992, pp. 160–168.
- Danilkin, A., Moose in Russia: Resources and Use, *Okhota Okhotn. Khoz.*, 1998, no. 9, pp. 8–11.

- Darman, Yu.A., The Biology of Roe Deer in the Khingan Reserve, *Abstract of Cand. Sci. (Biol.) Dissertation*, Moscow, 1986.
- Dvornikov, M.G., The Ecology and Biocenotic Role of Ungulates in the Il'men Reserve, *Abstract of Cand. Sci. (Biol.) Dissertation*, Sverdlovsk, 1984.
- Filonov, K.P., *Otsenka sostoyaniya populyatsii olen'ikh* (Evaluation of the State of Cervid Populations), Moscow: Nauka, 1993.
- Flint, A.P.F. and Krzywinski, A., Sex Differences in Time Budgeting in Roe Deer during the Rut, *Acta Theriol.*, 1997, vol. 42, no. 3, pp. 312–320.
- Geptner, V.G., Nasimovich, A.A., and Bannikov, A.G., *Mlekovpitayushchie Sovetskogo Soyuz: Parnokopytnye i neparnokopytnye* (Mammals of the Soviet Union: Artiodactyls and Perissodactyls), Moscow: Vysshaya Shkola, 1961.
- Glushkov, V.M., On the Effect of Commercial Hunting on the Sex Structure of Population and Distribution of Moose, *Sb. NTI VNIIOZ*, Kirov, 1975, no. 5 (8), pp. 40–44.
- Glushkov, V.M., The Structure of Moose Population in the Vyatka Taiga and Its Control by Hunting, *Promyslovaya teriologiya* (Commercial Theriology), Moscow: Nauka, 1982, pp. 127–135.
- Glushkov, V.M., Moose Population Management: Biological Prerequisites and Practical Possibilities, in *Upravlenie populyatsiyami dikikh kopytnykh zivotnykh. Sb. nauchnykh trudov* (Collected Works on Wild Ungulate Population Management), TsNIL Glavokhoty RSFSR, Moscow: 1985, pp. 5–13.
- Gordiyuk, N.M., Specific Features of Feeding and Territory Use by Moose of Different Sex and Age in the Southern Urals, *Byull. Mosk. O-va. Ispyt. Prir., Otd. Biol.*, 1993, vol. 98, no. 3, pp. 80–91.
- Gordiyuk, N.M., The Ecology of Moose in the Southern Urals in Winter, in *Voprosy ekologii i okhrany okhotnich'epromyslovykh zivotnykh na Yuzhnom Urale* (Problems of Game Animal Ecology and Protection in the Southern Urals), Miass, 1994, pp. 29–42.
- Ivanova, G.I., Dynamics of Wild Boar Population Density in the European Russian Federation, in *Kopytnye fauny SSSR* (Ungulates in the Fauna of the Soviet Union), Moscow: Nauka, 1980, pp. 161–162.
- Kanakov, E.S., Biological Principles of the Rational Use of Moose Population Resources, in *Upravlenie populyatsiyami dikikh kopytnykh zivotnykh. Sb. nauchnykh trudov* (Collected Works on Wild Ungulate Population Management), TsNIL Glavokhoty RSFSR, Moscow: 1985, pp. 14–27.
- Kheruvimov, V.D., *Los'* (The Moose), Voronezh, 1969.
- Knorre, E.P., The Ecology of Moose, *Tr. Pechoro-Ilych., Gos. Zap.*, Syktyvkar, 1959, no. 7, pp. 5–122.
- Lebedeva, N.L., Population Structure, in *Biologiya i ispol'zovanie resursov losya. Obzor issledovaniy* (The Biology and Use of Moose Population Resources: A Review), Moscow: Nauka, 1986, pp. 106–109.
- Markov, N.I., Current State of Wild Boar Population in Sverdlovsk Oblast, in *Voprosy prikladnoi ekologii (prirodopol'zovaniya), okhotovedeniya i zverovodstva: Materialy nauchnoi konferentsii, posvyashchennoi 75-letiyu VNIIOZ im. prof. B.M. Zhitkova* [Problems of Applied Ecology (Nature Resource Management), Game Management, and Fur Farming: Materials of Scientific Conference Dedicated to the 75th Anniversary of Prof. B.M. Zhitkov], Kirov: VNIIOZ, 1997a, pp. 158–159.
- Markov, N.I., Population Dynamics of Wild Boar, *Sus scrofa*, in Sverdlovsk Oblast and Its Relation to Climatic Factors, *Ekologiya*, 1997b, vol. 28, no. 4, pp. 305–310.
- Nikulin, V.F., The Length of Daily Migrations of Moose in the Upper Kama Region, in *Informatsionnye materialy Instituta ekologii rastenii i zivotnykh (otchetnaya sessiya zoologicheskikh laboratorii)* (Information from the Institute of Plant and Animal Ecology: Reports of the Session of Zoological Laboratories), Sverdlovsk, 1978, p. 63.
- Pogodin, N.L. and Korytin, N.S., Selectiveness of Moose Hunting in Sverdlovsk Oblast, in *Problemy izucheniya bioraznoobraziya na populyatsionnom i ekosistemnom urovne* (Problems in Studying Biodiversity at the Population and Ecosystem Levels), Yekaterinburg, 1997, pp. 167–175.
- Prostakov, N.N., *Kopytnye zivotnye Tsentral'nogo Chernozem'ya* (Ungulates of the Central Chernozem Region), Voronezh, 1996.
- Randveer, T.E., Ecological Features and Economic Significance of Roe Deer (*Capreolus capreolus* L.) Population in Estonia, *Abstract of Cand. Sci. (Biol.) Dissertation*, Moscow, 1989.
- Rusakov, O.S., Regional Peculiarities of Hunting for Wild Ungulates in the Northwestern Soviet Union, in *Mlekovpitayushchie SSSR. III S'ezd Vsesoyuznogo teriol. O-va* (Mammals of the Soviet Union. III Congress of All-Union Theriological Society), Moscow, 1982, vol. 2, p. 247.
- Rusakov, O.S. and Timofeeva, E.K., *Kaban (ekologiya, resursy, khozyaistvennoe znachenie na Severo-Zapade SSSR)* (Wild Boar: Ecology, Population Resources, and Economic Significance in the Northwestern Soviet Union), Leningrad: Leningr. Gos. Univ., 1984.
- San Jose, C., Lovari, S., and Ferrari, N., Grouping in Roe Deer: On Effect of Habitat Openness or Cover Distribution, *Acta Theriol.*, 1997, vol. 42, no. 2, pp. 235–239.
- Sludskii, A.A., *Kaban (morfologiya, ekologiya, khozyaistvennoe i epizooticheskoe znachenie, promysel)* (Wild Boar: Morphology, Ecology, Economic and Epizootic Significance, and Hunting), Alma-Ata, 1956.
- Smirnov, M.N., *Kosulya v zapadnom Zabaikal'e* (Roe Deer in Western Transbaikalia), Novosibirsk: Nauka, 1978.
- Smirnov, V.S. and Korytin, N.S., Selectiveness of Animal Trapping and Prospects for Its Use in Ecological Studies, *Preprint*, Sverdlovsk, 1979.
- Timofeeva, E.K., *Los'* (The Moose), Leningrad: Leningr. Gos. Univ., 1974.
- Ushkov, S.L., Game Fauna of the Il'men Reserve, *Tr. Il'men. Gos. Zap.*, 1947, vol. 3 (1), pp. 87–159.
- Varnakov, A.P., On Changing the Period of Wild Boar Hunting, *Nauchno-tehnicheskii progress—v praktiku perestroiki okhotnich'ego khozyaistva. Materialy nauchnoi konferentsii* (Proc. Sci. Conf. On Achievements in Science and Technology as Applied to Reorganization of Hunting and Game Management), Moscow, 1988, pp. 100–102.
- Vatolin, B.A., Wild Boar in Bryansk Oblast: Distribution, Population Density, and Effects of Environmental Factors, in *Kopytnye fauny SSSR* (Ungulates in the Fauna of the Soviet Union), Moscow: Nauka, 1980, pp. 131–132.

Vereshchagin, N.K. and Rusakov, O.S., *Kopytnye Severo-Zapada SSSR (istoriya, obraz zhizni i khozyaistvennoe znachenie)* (Ungulates in the Northwestern Soviet Union: History, Mode of Life, and Economic Significance), Leningrad: Nauka, 1979.

Voronin, A.A., Daily Activity of Wild Boar in the Southern Nonchernozem Region, in *Kopytnye fauny SSSR* (Ungulates in the Fauna of the Soviet Union), Moscow: Nauka, 1980.

Yazan, Yu.P., Effect of Hunting on Moose Population, *Okhota Okhotn. Khoz.*, 1967, no. 10, pp. 18–19.

Yazan, Yu.P., Some Consequences of Selectiveness in Moose Hunting, in *Okhotnich'e khozyaistvo v intensivnom kompleksnom lesnom khozyaistve* (Hunting and Game Management under Conditions of Intensive Forestry), Kaunas: Girio- opis, 1975, pp. 136–138.

Yurgenson, P.B., *Okhotnich'i zveri i ptitsy (prikladnaya ekologiya)* (Game Animals and Birds: Applied Ecology), Moscow: Lesnaya Promyshlennost', 1968.

Zaguzov, A.V., On Prospects for Rational Moose Population Management in the Transural Middle Taiga, in *Voprosy dinamiki populyatsii mlekopitayushchikh* (Problems of Population Dynamics in Mammals), Sverdlovsk, 1988, pp. 30–31.