LARGE HERBIVORE ABUNDANCE, DISTRIBUTION AND WINTER PASTURE QUALITY IN TWO GAME FARMS IN NORTH KAZAKHSTAN

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The abundance and distribution of large herbivores were investigated in two private game farms in North Kazakhstan. The abundance of large herbivores were determined using R. McCain method, winter pasture quality were determined using S. Aldous method. “Bulandy” game farm is 8589 ha size forest area with gaps and pastures, about 150 km far North from Astana city. This game farm is presented by native large herbivore species: Moose (*Alces alces,* L.), Red deer (*Cervus elaphus,* L.), Siberian roe deer (*Capreolus pygargus* P.) and alien species - Fallow deer (*Dama dama* L.) and American bison (*Bison bison* L.). Alien animals are kept in enclosures. “Zerenda” game farm is 6917 ha size area with hilly landscape about 250 km far to North-West from Astana city. This farm is presented by native large herbivore species: Moose, Red deer, Siberian roe deer and alien species – Sika deer (*Cervus nippon,* T). Sika deer is kept in enclosure, while native species are living free. However, density of large herbivores is much higher in “Bulandy’ game farm. We found that in “Bulandy” game farm as well as in “Zerenda” game farm during 130 days period of wintertime, large herbivores intensively used many understory species in winter pastures, indicating hard interruption to forest regeneration and natural species succession. In “Bulandy” game farm large herbivores in their winter pastures intensively used *Caragana, Spirea, Populus, Cotoneaster, Pyrus, Malus* understory species. In “Zerenda” game farm large herbivores intensively used broadleaved species such as *Spirea, Cerasus, Cotoneaster, Populus* and *Betula* species.

Key words: Large herbivores, winter pastures, alien species.

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INTRODUCTION

Reliable estimates of deer populations are important for a variety of reasons including hunting and herd management. Efficient and accurate population density estimates of wildlife species are an important aspect of management planning (Thompson et al. 1998). In areas where direct observation of animals is difficult, due to either low local abundance of the species, secretive behavior, low visibility, or human distrurbance, the use of indirect methods such as the quantification of tracs and feces (pellet groups) can be more appropriate (Campbell et al 2004, Mandujano 2005). Changes in population can indicate changes in predators, as well as changes in the environment such as vegetation composition (Allen & Solchik 2003). McCain introduced the pellet count method in 1940 and its reliability for population estimation has been well investigated. One benefit of using this method is that it depends on deer presence in an area over an extended period of time and does not depend on highly varying factors such as deer activity. However, studies have also shown that factors such as observer error, pellet deterioration and incorrect pellet identification can give unsatisfactory census results.

Large herbivores affect the the morphology and productivity of their food plants, which in turn affects food availability and foraging efficiency. These effects can occur directly, through tissue removal, or indirectly through additions of nutrients in dung and urine (Persson et al 2005).

MATERIAL AND METHODS

Wildlife census counts in two game farms in North Kazakhstan were performed on May 2014, using R. McCain pellet counting method (McCain 1948) by line transects of 2 meters width. This method is used as one of the most accurate for cervid census. The aim of this method is to count pellets in a transect line. Particular shape pellets are left during one winter season of 130 days in North Kazakhstan, when animals are using winter pastures – shoots and bark of young trees and bushes. During a winter season, in average one moose is leaving 2800 pellets, one red deer (maral) is leaving 2085 pellets and one roe deer is leaving 2028 pellets (Balčiauskas 2004). To get the result as accurate as possible, transects must cover not less than 1.2 % of area. For this purpose total length of transect in "Bulandy" game farm was 86 km and transect length in "Zerenda" game farm was 70 km. The transect line must include any kind of forest biotype available in a research area. During a census performance, pellets were marked in each 100 meters (using GPS). We were able to distinguish moose and red deer pellets by gender: male, female and juvenile and roe deer by age - adult or juvenile. Total amount of pellets in all research area was counted using formula: S=P/s/p, were: S – total number of pellets in all the research area; P – total area; p – area of transects; s – pellets amount in transect. Amount of wintering animals by separate species were counted in area using formula: G=S/n; were: G – amount of wintering animals; S – pellets amount multiplied to all the research area; n – amount of pellets left by one individual during the winter.
Cervid winter pasture quality was evaluated according to S. Aldous method (Aldous 1944), by regenerated forest understory (up to 4 meter height), the presence (S) and abundance (G) of understory species in cervid wintering places, the intensity (I) of understory use and each understory species portion in total winter feed balance (Q) were evaluated during the investigation. Winter pasture quality was evaluated together with pellet counting census. In each 200 meters of transect, 5,65 diameter sample plots were defined. In these sample plots (100 sq m diameter) all healthy and damaged (twig breaking, shoot browsing and bark scratching) understory trees and bushes were counted.

The presence (S) of particular understory species was counted using formula: S=(n/N)x100%, were: n – the number of sample plots, where each understory species was present; N – total number of sample plots. The abundance (G) of particular understory species in winter pastures was counted by formula: G=(A/C) x 100%, were: A – total number of particular understory species in all sample plots; C – total number of all understory species in all sample plots. The intensity of understory use in winter pastures was counted by formula: I=(B/A) x 100%, were: B – the number of damaged understory by particular species in all sample plots; A – total number of particular understory species in all sample plots. The utilization factor (U) of particular understory species was counted by formula: U=G x I %, were: G - the abundance of particular understory species, %; I - the intensity of understory use, %. each understory species

Table 1. Cervid abundance in "Bulandy" game farm

Moose			Red deer (Maral)			Siberian Roe deer	
Male ♂	Female ♀	Juvenile	Male ♂	Female ♀	Juvenile	Adult	Juvenile
27	19	9	27	27	10	174	30
55			**64**			**204**	

Table 2. Cervid abundance in „Zerenda" game farm

Moose			Red deer (Maral)			Siberian Roe deer	
Male ♂	Female ♀	Juvenile	Male ♂	Female ♀	Juvenile	Adult	Juvenile
2	3	2	46	42	20	34	10
7			**108**			**44**	

portion in total winter feed balance (Q) was counted by formula: $Q=(U/\sum U) \times 100\%$, were: U - the utilization factor of particular understory species, %; $\sum U$ – the sum of utilization factor of all understory species.

RESULTS AND DISCUSSION

Abundance of large herbivores

The name of "Bulandy" game farm in Kazakhian language has an important meaning – "moose place". This name has occurred long time ago, because of abundant moose population in surrounding areas. However, according to forest type classification to suitability for cervids (by Padaiga (1996)), we can assign "Bulandy" game farm forest to II forest group – Mixed coniferous forest with broadleaves admixture. This forest type is mostly suitable for moose and roe deer. According to Padaiga (1996), the highest cervid density in II forest group is 3 moose, 12 red deer and 45 roe deer per 1000 ha of forest. Our results shows that in 8589 ha size "Bulandy" game farm 2013/2014 year were wintering 55 moose (27♂, 19♀, 9 juv.), 64 red reed (27♂, 27♀, 10 juv.) and 204 Siberian roe deer (174 ad., 30 juv.) (Table 1).

Thus, cervid density in "Bulandy" game farm was 6.4 moose, 7.5 red deer and 23.8 roe deer per 1000 hectares. Moose population in "Bulandy" game farm exceeds highest population density twice, while red deer and roe deer populations are twice smaller. High moose population indicates damage possibility to forest regeneration. Alien large herbivores are kept in separate enclosures and intensively fed additionally. There are two fenced enclosures in the center of game farm, one is occupied by 12 American bison individuals, other is occupied by 45 fallow deer individuals. "Zerenda" game farm is presented by hilly landscape and mostly mixed coniferous forest composition. This forest type can be assigned to III forest group – mixed coniferous forest with insignificant broadleaves admixture. Such forest type is mostly suitable for red deer (maral). The highest cervid density in III forest group is 2 moose, 12 red deer and 35 roe deer per 1000 hectares forest. The capacity to feed cervids during winter in coniferous forest is smaller in comparison to forest with higher broadleaves percentage. Our results shows that cervid abundance in "Zerenda" game farm during winter 2013/2014 year was: 7 moose (2♂, 3♀, 2 juv.), 108 red deer (46♂, 42♀, 20 juv.) and Siberian roe deer 44 (34 ad., 10 juv.) (Table 2). Thus, cervids density in Zerenda is 1 moose, 15.6 red reed and 6.4 roe deer. Only red deer population exceed highest density by 3.6 individuals indicating small damage possibility to forest regeneration in "Zerenda" game farm forest. 45 individuals of sika deer (alien species) are kept in fenced enclosure.

Natural moose gender structure is 1♂:1.2♀, annual coefficient of offspring is 33 %. In "Bulandy" game farm moose gender structure is 1♂:0.7♀ and annual offspring coefficient is only 16.4 %. Wrong population structure may

Table 3. Tree and shrub species composition and cervid winter pasture quality in „Bulandy“ game farm

Understory species	Presence		Abundance	Intensity of use	Utiliza-tion factor	Part in feed balance
	n	S, %	G, %	I, %	U, %	Q, %
Pinus silvestris	185	52,1	**12,3**	25,4	312,9	**9,8**
Caragana arborescens	55	15,5	**30,4**	41,5	1264,1	**39,7**
Betula sp.	104	29,3	4,5	34,6	155,5	4,9
Populus tremula	89	25,1	11,3	70,4	796,7	**25,0**
Prunus virginiana	3	0,8	0,1	5,0	0,6	0,0
Pyrus sp.	7	2,0	0,2	81,7	16,2	0,5
Cotoneaster sp.	3	0,8	0,0	93,3	3,9	0,1
Spirea sp.	26	7,3	3,6	7,2	26,0	0,8
Malus sp.	2	0,6	0,1	87,5	7,8	0,2
Lonicera sp.	96	27,0	**29,7**	12,4	367,9	**11,6**
Rosa sp.	77	21,7	7,6	29,5	223,9	7,0
Ribes nigrum	3	0,8	0,2	39,0	6,4	0,2
Total:	650		100			100

occur a risk to population quality. To avoid this problem, the intensity of moose male hunting should be increased, while juvenile hunting should be limited. In “Zerenda” game farm moose gender structure is 1♂:1.5♀ annual offspring coefficient is nearly optimal 28.6 %. As moose density in “Zerenda” game farm is twice smaller then optimal, moose hunting here should be suspended. In necessarily of moose hunting, we recommend to hunt one cow.

Natural red deer gender structure is 1♂:1♀, annual coefficient of offspring is 22 - 26 %. In “Bulandy” game farm red deer gender structure is optimal 1♂:1♀, annual offspring coefficient is 15.6 %. Thus, we recommend to decrease the hunting intensity of juvenile individuals. In “Zerenda” game farm red deer gender structure is 1♂:0.9♀, annual offspring coefficient is 18.5%. Such population structure is nearly optimal.

Natural roe deer gender structure is 1♂:1.2♀, annual coefficient of offspring is 30 %. During our fieldwork we were not able to identify roe deer gender, we only could recognize adult and juvenile individuals. Our results shows that in “Bulandy” game farm Siberian roe deer annual offspring coefficient is only 14.7 %. Thus, juvenile percentage is critically to small. Hard winter with high snow layer could affect juvenile survival. In “Zerenda” game farm Siberian roe deer annual offspring coefficient is optimal 22.7 %, but having in mind that roe deer density is low, hunting of roe deer should not be intensive in “Zerenda” game farm.

Distribution of cervid animals

In “Bulandy” game farm moose distribution picture (Fig. 1) we can obviously see that highest moose concentration was found in west part of farm. Only one explanation is that in west side of game farm grows higher portion of naturally regenerated aspen stands. Moose avoided center of game farm, most likely because of fenced enclousures presence in that area. The highest red deer concentration were found in the center of forest, mainly in red deer enclosure and around it. Red deer avoided North - East corner of game farm, which is presented by wet areas and higher broadleaves (mainly birch) percentage in forest composition (Fig. 2). As it was expected, highest

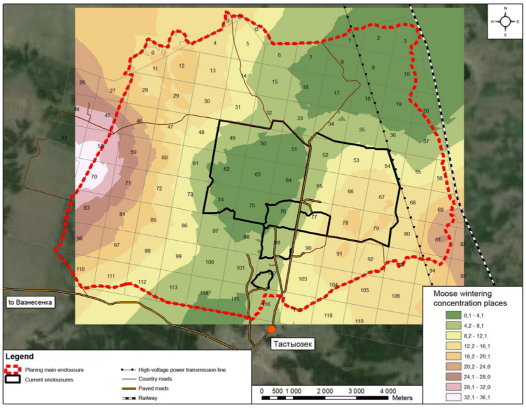

Fig. 1. Moose wintering concentration places in “Bulandy” game farm.

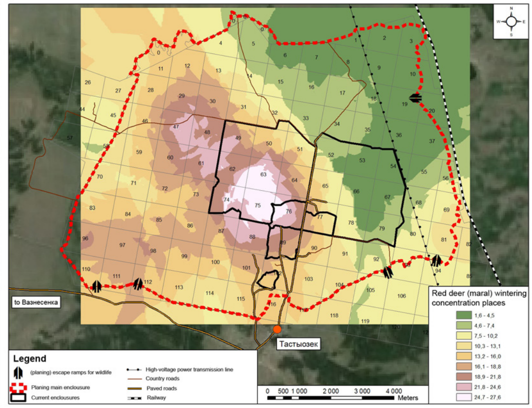

Fig. 2. Red deer (maral) wintering concentration places in “Bulandy” game farm.

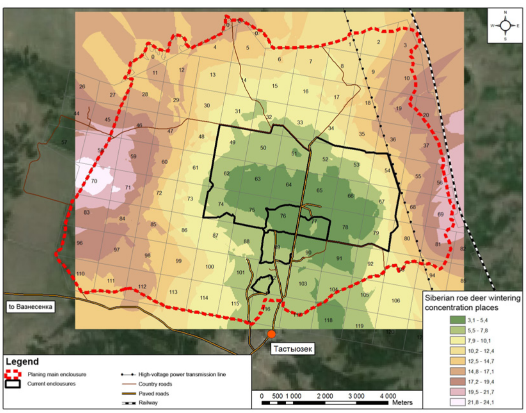

Fig. 3. Siberian roe deer wintering concentration places in “Bulandy” game farm.

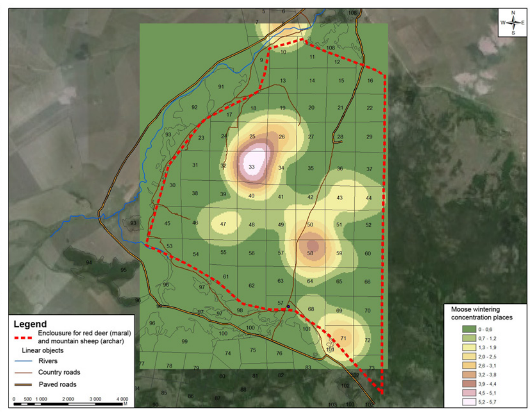

Fig.4. Moose wintering concentration places in “Zerenda” game farm.

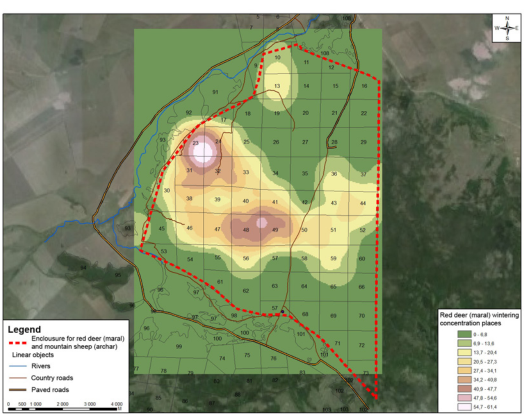

Fig. 5. Red deer (maral) wintering concentration places in “Zerenda” game farm.

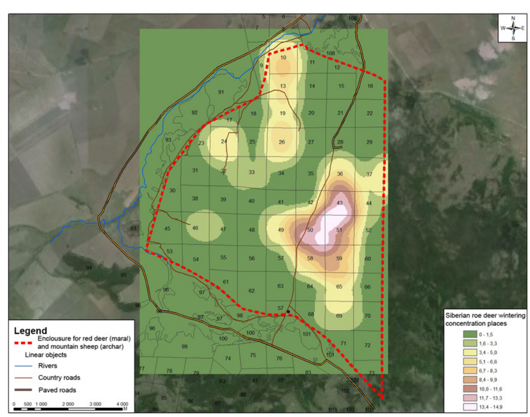

Fig. 6. Siberian roe deer wintering concentration places in “Zerenda” game farm.

Table 4. Tree and shrub species composition and cervid winter pasture quality in „Zerenda“ game farm

Understory species	Presence		Abundance	Intensity of use	Utilization factor	Part in feed balance
	n	S, %	G, %	I, %	U, %	Q, %
Pinus silvestris	97	42.2	6.9	26.2	181.5	4.7
Caragana arborescens	4	1.7	0.6	**62.4**	37.7	1.0
Betula sp.	89	38.7	4.8	**69.2**	331.7	8.6
Populus tremula	57	24.8	7.9	**83.4**	657.6	17.0
Prunus virginiana	1	0.4	0.1	**100.0**	11.1	0.3
Cotoneaster sp.	1	0.4	0.1	10.0	0.7	0.0
Prunus cerasus	30	13.0	2.8	**71.8**	198.4	5.1
Malus sp.	58	25.2	**44.2**	24.0	1062.8	27.5
Lonicera sp.	44	19.1	**17.3**	47.4	818.2	21.2
Rosa sp.	58	25.2	15.1	36.6	553.5	14.3
Ribes nigrum	3	1.3	0.2	47.1	10.4	0.3
Total:	442		100			100

Siberian roe deer concentrations was found in game farm edges (Fig. 3), but not in the central part of forest. Roe deer is common inhabitant of forest edges, bushes and mosaic landscapes (Narauskaite 2014), so center of large forest areas is not a suitable habitat for roe deer.

In “Zerenda” game farm represented by hilly landscape and mainly naturally growing mixed deciduous forest, moose wintering concentrations were mainly found in lowlands and wet broadleaved forests (Fig. 4). During winter moose avoided hilly landscape. Red deer, unlike moose, were wintering in hilly landscape and avoided wet lowlands. Highest red deer concentrations we found on the highest points of hills. In “Zerenda” game farm as well as in “Bulandy” game farm Siberian roe deer has chosen open landscape for wintering (Fig. 6).

Winter pasture quality

In “Bulandy” game farm, we have found 12 understory species (Table 3). The most abundant was *Caragana* (30.4%), *Lonicera* (29.7%) species, but the intensity of their use was not very high. Most intensively cervids used *Cotoneaste*r (93.3%), *Malus* (87.5%) and *Pyrus* (81.7%) species. The highest part in winter feed balance took *Caragana* (39.7%), *Populus* (25.0%), *Lonicera* (11.6%) and *Pinus* (9.8%) species. However, high intensity use of economically important regenerating forest species *Populus tremula* (I – 70.4%) shows negative cervids impact to winter pastures. Meaning that in order to protect natural forest regeneration, cervids populations must be regulated.

In “Zerenda” game farm we have found 11 understory species (Table 4). The most abundant was *Malus* (44.2%), *Lonicera* (17.3%) and *Rosa* (15.1%) species. Most intensively were used *Prunus v.* (100 %), *Populus* (82.4%), *Prunus c.* (71.8%), *Betula* (69.4%) and *Caragana* (62.4%) species. The highest part in winter feed balance took *Malus* (27.5%), *Lonicera* (21.2%) and *Populus* (17.0%) species. High intensity of use of economically important regenerating forest species *Populus tremula* (70.4%) and *Betula sp.* (69.2%) shows that cervids winter pastures are highly negatively affected and additional tools to decrease a damage to natural forest regeneration is required.

CONCLUSSION

In 8589 ha size "Bulandy" game farm 2013/2014 year were wintering 55 moose (27♂, 19♀, 9 juv.), 64 red reed (27♂, 27♀, 10 juv.) and 204 Siberian roe deer (174 ad., 30 juv.) Moose population in "Bulandy" game farm exceeds highest population density twice, while red deer and roe deer populations are twice smaller High moose population indicates damage possibility to forest regeneration.

In "Zerenda" game farm during winter 2013/2014 year were: 7 moose (2♂, 3♀, 2 juv.), 108 red deer (46♂, 42♀, 20 juv.) and Siberian roe deer 44 (34 ad., 10 juv.) Only red deer population exceed highest density by 3.6 individuals indicating small damage possibility to forest regeneration in "Zerenda" game farm forest.

In "Bulandy" game farm moose gender structure is 1♂:0.7♀ and annual offspring coefficient is only 16.4 %. Wrong population structure may occur a risk to population quality. To avoid this problem, the intensity of moose male hunting should be increased, while juvenile hunting should be limited. In "Zerenda" game farm moose gender structure is 1♂:1.5♀ annual offspring coefficient is nearly optimal 28.6 %. As moose density in "Zerenda" game farm is twice smaller then optimal, moose hunting here should be suspended.

In "Bulandy" game farm red deer gender structure is optimal 1♂:1♀, annual offspring coefficient is 15.6 %. We recommend to decrease the hunting intensity of juvenile individuals. In "Zerenda" game farm red deer gender structure is 1♂:0.9♀, annual offspring coefficient is 18.5%. Such population structure is nearly optimal.

In "Bulandy" game farm Siberian roe deer annual offspring coefficient is only 14.7 %. Thus, juvenile percentage is critically to small. In "Zerenda" game farm Siberian roe deer annual offspring coefficient is optimal 22.7 %, but having in mind that roe deer density is low, hunting of roe deer should not be intensive.

In "Bulandy" game farm high intensity use of economically important regenerating forest species *Populus tremula* (I – 70.4%) shows negative cervids impact to winter pastures. Meaning that in order to protect natural forest regeneration, cervids populations must be regulated. In "Zerenda" game farm high intensity of use of economically important regenerating forest species *Populus tremula* (70.4%) and *Betula sp.* (69.2%) shows that cervids winter pastures are highly negatively affected and additional tools to decrease a damage to natural forest regeneration is required.

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