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**A. I. Kozorez**

Belarusian State Technological University

**GRAZING STRATEGY OF THE EUROPEAN BISON, RED DEER AND ROE DEER**

All herbivorous hoofed animals are divided in accordance to their influence on vegetation: grazers, mix-feeders and browsers. These groups of herbivorous provide formation of highly productive and heterogeneous ecosystems. For the purpose of defining of hoofed animals to this or that group researches on two experimental plots of “Naliboksky” reserve were conducted. The researches were held by character and duration of grazing photofixation. As a result of researches it was confirmed, that the roe deer is a typical browser, bison and red deer are mix-feeders. Also it was found out that phytomass withdrawal on forest meadows by these species is minimal, and doesn't lead to degradation of forest meadows, as well as doesn't utilize all growth gain of vegetation. It leads to accumulation of vegetation on meadows and to gradual reduction of their fodder. Restoration of highly productive forest meadows and maintenance of heterogeneity in forest ecosystems requires installation of grazer species of herbivorous.

**Key words:** bison, red deer, roe deer, grazers, browsers, mix-feeders.

**Introduction.** All herbivores species co-evolved in Belarusian forest ecosystem and now occupy their own ecological niche. All large herbivores are divided into three groups: browsers, grazers and mix-feeders, that are in-between [1]. They all in different ways effect on phytocoenosis and their condition. High-productive heterogeneous environment was supported by high species diversity of large herbivores from different groups. It was important to conserve forests and open-space areas. Meadows served as inhabitations for light-loving flora and fauna. However loss of some large herbivores, especially grazing species, such as Caucasian tur and wild horses, led to the decrease of environmental heterogeneity and ecosystem productivity and to exclusion of grazing food webs. To a certain extent domestic herbivores (heavy beasts and domestic horses) took the place of disappeared wild herbivores. However live-stock grazing in some cases leads to ecological problems. Now the questions about the gradual overgrowing of bottom-land meadows and fens, loss of forest grasslands productivity due to overgrowing with shrub and woody vegetation arise [2]. The disappearance of the forest glades reduces the mosaic and as a consequence leads to reduction of territorial biodiversity as in this case edge effect and useful biotopes for light-loving species of flora and fauna disappear.

**Main part.** In order to obtain data on the impact of herbivores on the formation of the environment we have carried out a study on the grazing strategies of hoofed herbivores living in forest ecosystems of Belarus and also we have made an attempt to find out their role in the maintenance of open areas (forest meadows), that form the heterogeneity of forest ecosystems. For this purpose in the pasture areas photo fixation cameras were installed. These cameras recorded the length of the grazing period. While fixing only facts about animal feeding were taken into account. Facts about animals that were just anxiously passing

through the territory or that were lying on the ground were excluded.

Photo fixation was carried out on two experimental plots located in permanent study area “Tyakovo” in the northern part of the National Landscape Reserve “Naliboksky”. Size of the areas is 25×25 m (0.0625) ha. The first area (known as “Polyana”, State Forestry Agency – “Volozhin Forestry”, experimental forestry enterprise of Rumsk, 109 qtr. division 24) represents a zoogene meadow with a total area of 0.08 ha. This area is located on the outskirts of drained swamp massif, the place where in the past extraction of oil was carried out. To the north and west meadow adjoins forest (composition –8B2E.ald., age – 30), and to the south and east it adjoins boggy areas of former peat extraction. The second area (“Bushnel”, “Vologin” forestry, “Rumskoje” forest district qtr. 108 district. 11) is represented by a part of vast hayfield and for now it is removed from economic turnover. On the west side the area adjoins reclamation canal and forest massif (composition 7B2E.ald.1F, age – 30). Observations were carried out in the “Polyana” area during 2014–2015 and in the “Bushnel” area only in 2015.

For the purpose of regeneration in both areas once a year plants were mowed. On this experimental plot all wild hooves species that are present in Belarus were observed: bison, elk, red deer, roe deer, wild boar. Even in the vegetation period elk prefers tree-shrub sprigs that is why the facts connected with elk's grazing weren't recorded. It was observed only in the transition period. In its turn wild boars prefer get fodder from vegetable soil and slightly consume grass fodder. Due to this fact only grazing habit of bison, red deer and roe deer was studied. Grazing of these species was registered during the period of April to the beginning of November on both areas. In winter especially with the snowfall grazing of mentioned species was ceased.

Population density of mentioned herbivores in the station (2,300 ha – station square) was deter-

mined by different accounting methods (of winter excrements, rutting season of red deer, of winter route and accounting with the help of trail cameras). Population density of bison was equal from 7.8 to 23.5 animal/thous. ha, red deer – from 30 to 54 animal/thous. ha, roe deer from 1 to 4 animal/thous. ha. It is worth mentioning that such population density especially for bison and deer is the highest in Belarus. In just two years of observing, 45 facts of bison grazing on the experimental plot were recorded (Table 1), where 33 facts of bison grazing were recorded on “Polyana” area and 12 on “Bushnel” area. In 2014 13 facts of bison grazing on “Polyana” area were recorded where 64 bison were grazing throughout 163 min. In 2015 on the same area 12 facts of bison grazing were recorded where 57 bison were grazing throughout 163 min. In 2015 12 facts of bison grazing on “Bushnel” area were recorded where 79 bison were grazing throughout 166 min.

Table 1

**Grazing index of hoofed animals  
on experimental plots**

Index	Bison	Deer	Roe deer
Length of the average grazing, min	10.4	4.3	1.8
Number of grazing cases	45	44	49
Longest grazing duration, min	55	21	15
Shortest grazing duration, min	2	1	1
Largest number of grazing animals, animal	17	5	3
Lowest number of grazing animals, animal	1	1	1
Average number of grazing animals, animal	5.1	1.8	1.4

Bison prefer to graze within a family group. Size of such a group is equal to 3–17 of individuals. An average of such bison family group which grazed on the area is 5.1 of individuals. Family groups mainly consist of adult females and their juveniles at the aged up to 2 years. Groups that contain 3–7 individuals are more typical for Nalibotskaya Pushcha, while larger groups are temporary communities of open type. In breeding period (from July to September) adult males join female groups at other times male bison tend to graze singly.

In terms of experimental plots an average size of grazing bison groups differs. Thus, for “Polyana” area in 2014 the average size of bison herd contained 4.9 of animals and in 2015 – 4.3. For “Buhnel” area the average size of grazing group contained 6.6 individuals. It is obvious that large groups of animals are grazed in the “Bushnell” area, which is a part of an extensive meadow, although these groups often form temporary nature.

Forty four facts of red deer grazing were recorded over two years where 31 species were grazing on “Polyana” area and 13 on “Bushnel” area. In whole, in 2014 on “Polyana” area 8 facts of grazing were recorded where 12 red deer were grazing throughout 60 min. In 2015 23 facts of grazing were recorded where 43 red deer were grazing throughout 87 min. On “Bushnel” area in 2015, 13 facts of grazing were recorded where 23 red deer were grazing throughout 43 min.

Roe deer tend to graze singly. Average group size of grazing roe deer is equal to 1.4 of individuals. And only female roe deer in summer period feed with their young animals.

Facts connected with mixed grazing on experimental plots weren't recorded. However at one of additional cameras of photo fixation some facts of bison and red deer grazing at insignificant distance were recorded. Constant visual observations also show that hoofed animals that are under review during grazing period don't form mixed herds. But in certain cases grazing in close vicinity between red deer and bison is noted.

As is seen from above bison and red deer are characterized by similar division on number of facts of grazing within experimental plots. At the same time according to the number of grazing facts roe deer significantly differs from previous species. Thus, red deer and bison graze mostly on “Polyana” area, while roe deer graze on “Bushnel” area. It can be a result of low population density of roe deer as well as some preferences to some grazing areas. Also there aren't any differences between size of a grazing group for red deer when for bison such differences are obvious.

According to submitted data bison has the greatest pasture impact on meadow phytocenosis. These animals spend about 10.4 min. in some spots that is in 2 times more than red deer do and in 5 times more than roe deer. According to discrete facts, duration of bison grazing reaches 55 min in one spot. Under such grazing duration some cases of bison resting on fodder plots were noticed that can't be said about red deer or roe deer. Taking into account amounts of fodder consumed by bison it's becoming apparent that bison plays a primary role in stocking level on meadow formations.

Red deer was grazing in a plot about 4.3 min. In 2015 maximum grazing duration of an adult buck was 21 min. In October four facts of five concerning grazing was equal to 9 min. In other words, the longest grazing period accounts for late autumn. At this particular time animals strive to maximize their stored fat before coming winter time. In comparison with above-mentioned hoofed animals grazing duration of roe deer is the shortest – 1.8 min. Roe deer, as a rule, pass through the feeding area just breaking off the leaves. Longtime feeding or grazing in one particular area isn't

common for roe deer. Such behavior is more typical for browser animals.

Both red deer and bison prefer young plants, or to be exact plants that contain less cellular tissue. That is why they return over and over again in the areas with young plants that were eaten off and grown again. Animals don't eat plants that are near to burst into bloom or that hadn't been eaten off earlier and that is why became rough. Thus, paddocks become patchy. Roe deer pick off plants including rough ones along the path without intensive grazing.

While grazing, animals not only eat grass they also trample it. Trampling is considered to be an important factor of paddock like plant formation. As a result of trampling, rough wild grasses and coach grass vanish and grazing enduring plants like Kentucky bluegrass, lamb suckling, English bluegrass and Timothy-grass start to prevail [3]. According to the experiment, bison mostly have an effect on meadows by trampling because these particular animals tend to graze within large herds (herds containing 50 heads were noted during grazing time).

Provided herbivorous animals (bison, red deer and roe deer) form patchiness on meadows which is formed by patches with trampled, eaten off and regenerated grass and also by patches with rough and overgrown grass. Such meadows are highly productive. They are formed only in the places of mixed grazing of bison and red deer.

There isn't enough data about fodder consumption duration by herbivores, especially by bison, red deer and roe deer. But there is some information about livestock. It is well known that wild herbivores are active in foraging, it's time is from 8 till 15 h per day. Also there is some information about their average daily amount of fodder consumption [4,5]. According to this data we have calculated fodder amount consumed by animals per 1 min. (Table 2). Little number values of such consumption are consistent with grazing features of wild animals because even in foddering herbivores find enough time for examination, passing and etc.

Table 2  
Phytomass intake by grazing animals

Index	Bison	Red deer	Roe deer
Feed intake by an individual animal, g/min	45.0	25.0	10.0
Feed intake on a plot, g	42,145	3,956	159
Average amount of feed intake by all hoofed animals, kg/ha	740.2		

Thus, on the basis of received data total volume of withdrawn phytomass can reach 700 kg/ha. But in view of patchy character of bison grazing and red deer consumption volume per 1 ha will be much less. Taking into consideration total account of grassy plants on meadows of Naliboksky Forest that is equal to 6,900–9,100 kg/ha [5], we can make a conclusion that provided wild herbivores (bison – red deer – roe deer) even at relatively high population density, neither lead to lowering of fodder consumption on meadows nor to utilization of necessary vegetative mass for pasture improvement and their maintenance in high-productive condition that is necessary for pasture food chains. Key element is that animals don't graze on these areas in winter time. That leads to accumulation of vegetative mass on meadows, to felt formation from plant litter and to loss of meadow productivity as a result.

**Conclusion.** Findings support conclusions [1] that roe deer is a typical browser animal, red deer and bison are mix-feeders while bison stands closer to pasture species but still isn't a typical representative of this group. Thus today the natural ecosystems of Belarus are deprived of pasture species of large herbivores. Consequently natural pasture and open areas are necessary for light-demanding flora and fauna and for heterogeneity increase in forest geobio-coenosis. For its revival it is required to maintain pasture species of huge herbivores. At the same time provided wild herbivores (bison – red deer – roe deer) are able only for some pastures improvement.

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## Information about the author

**Kozorez Aleksandr Ivanovich** – PhD (Agriculture), Head of the Department of Hunting Science. Belarusian State Technological University (13a, Sverdlova str., 220006, Minsk, Republic of Belarus). E-mail: s\_kozorez@mail.ru

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