Original Scientific Paper
DOI: 10.7251/AGRENG1602095S
UDC 630*231:599.735.3(474.5)

HIGH DENSITIES OF *CERVIDAE* EFFECT TO FOREST REGENERATION IN MIXED BROADLEAF FOREST IN SOUTH PART OF LITHUANIA

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ABSTRACT

The abundance of *Cervidae* species is increasing in Lithuania as well as in the whole Baltic region. High densities of forest ruminants: Moose (*Alces alces*), Red deer (*Cervus elaphus*), Roe deer (*Capreolus capreolus*), Fallow deer (*Dama dama*) and European bison (*Bison bonasus*) cause a significant damage both to natural forest regeneration and afforestation. Strong negative impact on forest regeneration lead to increased costs of forest regeneration, formation and maintenance. Thus, the balance among intensive silviculture and big game management must be found for sustainable use of environment recourses. In our study, we observed the influence of cervids density increment to natural forest regeneration in mixed broadleaf forest, which is located near the Zuvintas strict reserve, and in landscape point of view connected with other forest arrays by natural migration corridors. We found that natural regenerated forest understory is hardly damaged as well as cultural forest plantations. Thus, hunting pressure in our research area is obviously too low and the current abundance of wild ruminants will not allow the economically effective intensive silviculture. After investigation we found a steady *Cervidae* abundance, not exceeding the highest optimal densities. Cervid winter pasture quality is relatively good – economically and browsing very intensively did not effect ecologically important tree species regeneration in forest understory. However, damage degree to forest regeneration in our observed stands was very high. Natural as well as artificial forest regeneration is rather difficult, thus cervid densities should be reduced of expensive protection tools should be implemented in forest regeneration stands.

Keywords: *cervids, afforestation, damage to forest regeneration, hunting pressure.*

INTRODUCTION

The intensive forest management has promoted rapid increase of population size of ungulates in Lithuania. Higher population densities cause major damage to forest regeneration. Population densities of cervid species, specially moose and red deer are spread not evenly. Moose herbivory plays an essential role in the dynamic of

natural forests (Risenhoover and Maass 1987). The feeding behavior of ruminants is regulated by the amount and quality of the food available (Heikila 1990).In the long term, high-density moose populations can damage forest habitats in the absence of predation or human control (McLaren et al 2004). Our research area is highly managed Bukta forest, represented by wet and fertile soils, preferred by moose and red deer in winter period regarding rich feed supply. Therefore, natural and artificial forest regeneration suffers in Bukta forest in winter period. Nature conservation preserves are often located in close proximity to managed forests that are occupied by moose (Heikkila and Tuominen 2009), Bukta forest is located near Zuvintas wetland strict reserve, thus moose population is naturally high in our research area. The main objective of our work was to determine the role of moose population size in browsing and bark stripping intensity and damage extent in rich mixed deciduous forest.

MATERIALS AND METHODS

The abundance of cervid population was determined by annual reports of hunters. As a control, we performed cervid census in April of 2016, using R. McCain pellet-counting method (McCain 1948) by line transects of 4 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, 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 deer) 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. Total length of our transect was 26.1 km.

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

Moose damage to forest regeneration was evaluated according to methodology approved by Ministry of Environment (2001 Feb. 28. No 120, Vilnius). For investigation of moose impact to forest regeneration we have chosen stands by criteria: no protection used in stands (fence or repellents), average height of understory trees and shrubs was 0.2 – 1.6 m for browsing and more then 4 m for bark stripping. In every stand included in our research we established 4 – 6 (depending on stand area) sample plots of 100 sq. m. area; in each sample plot we have estimated every tree or shrub. Trees were divided to four categories according to damage degree: (1) healthy and little damaged trees, (2) weakly damaged trees, (3) average damaged trees, (4) hardly damaged trees. Totally 6 forest stands were investigated. The criteria of stands are given in Table 1. The investigation was started in June 2010 y., four forest stands were selected for moose damage evaluation. In 2011 the investigation was repeated in the same 4 stands and two more stands were added. Investigation was repeated in exactly the same sample plots (the center of sample plot was marked by GPS and also by wood paints) in 2012, 2014 and 2016 y.

Table 1. Criteria of investigated forest stands

Stand No.	Taxonomic stand No.	Area, ha	No of sample plots in stand	Tree species composition
1.	23 quarter, 19 stand.	2.9	4	7 aspen 1 ash 1 oak 1 birch
2.	40 quarter, 1 stand.	1.7	4	9 aspen, 1 ash
3.	62 quarter, 11 stand.	17.9	6	5 aspen, 2 ash, 2 alder, 1 hornbeam
4.	65 quarter, 14 stand.	3.3	4	3 ash, 3 aspen, 2 oak, 1 spruce, 1 alder
5.	56 quarter, 5 stand.	1.2	5	6 aspen, 2 ash, 1 spruce, 1 birch
6.	72 quarter, 5 stand.	1.4	6	6 aspen, 2 ash, 1 spruce, 1 alder

RESULTS AND DISCUSSION

Cervid abundance dynamics in Bukta forest

The results of cervid census shows that cervid abundance in Bukta forest is relatively stable (Fig.1.). Though, wintering cervid abundance in Bukta forest has decreased in the last winter of 2015/2016 y. The decrease could be related to intensified timber harvesting in recent winter – increased noise on overnight labor could have a disturbing effect to cervid population size. Our results show optimal densities of cervid species in mixed broadleaved forest, not exceeding the highest allowable limits (Kibisa et al 2015).

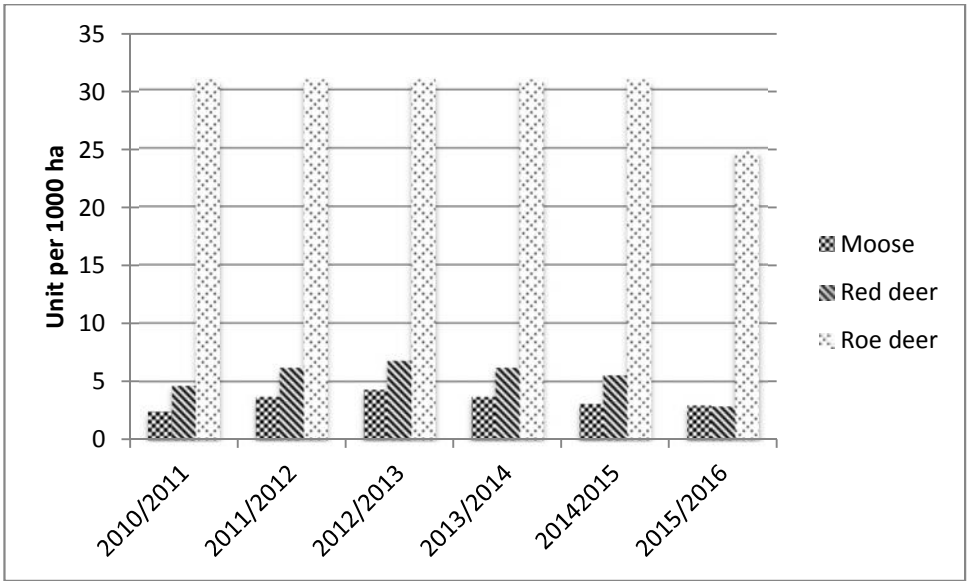

Figure 1. Wintering ervid density in Bukta forest from winter 2010/2011 to winter 2015/2016

Winter pasture quality

After investigation in Bukta forest in spring 2016 y. in cervid winter pastures we found 20 tree and shrub species (Fig. 2). The most abundant species (cover) was *Corylus avellana* (15.8%), *Lonicera xylosteum* (13,9%), *Carpinus betulus* (12,8%), *Fraxinus excelsior* (12.0%), *Betula pendula* (8.1%) and *Populus tremula* (7.8%). In cervid winter pastures most intensively was used *Salix caprea* (200%) and other *Salix* spp. (65%), *Acer platanoides* (52.2%), *Frangula alnus* (42.0%) and *Populus tremula* (33.5%), the use of other tree species did not reached 30% (Fig. 3).

Bukta forest is located in Southwest of the country, where soils are rich in fertility as well as water amount is sufficient. For this reason Bukta forest covered by mixed broadleaved species typical for rich soils as walnut, ash, hornbeam,

honeysuckle and aspen. However, economically important and abundant species are hornbeam, ash and aspen while other economically important species as oak, Norway spruce and Scots pine in Bukta forest are rare. From ecological point of view very important is the presence of ash as well as hornbeam in forest understory, as ash is very sensitive to Ash dieback disease (caused by fungus *Chalara fraxinea*) in Lithuania and hornbeam is presented in forestland only in southwest part of Lithuania.

The intensity of use of particular tree species in cervid winter pastures shows the species preference of animals. The most abundant species hazel was not used by cervids very intensively, while not so abundant Willow species were used most intensively. Economically most important tree species as Scots pine, Norway spruce and oak was used lightly, indicating that cervids do not cause significant damage to economically important tree species regeneration in Bukta forest. However, natural regeneration of ecologically important species - hornbeam tends to suffer, as the use intensity in winter pastures was nearly high (Fig 3). Natural regeneration of maple is also complicated, because the intensity of use reaches 52.2 %.

However, biggest portion in cervid winter feeding balance contains ash (18.9 %), aspen (14.1 %), Salix sp. (11 %), honeysuckle (11 %), buckthorn (10.3 %), hornbeam (9.3 %) and hazel (8.5 %), other species consist negligible portion.

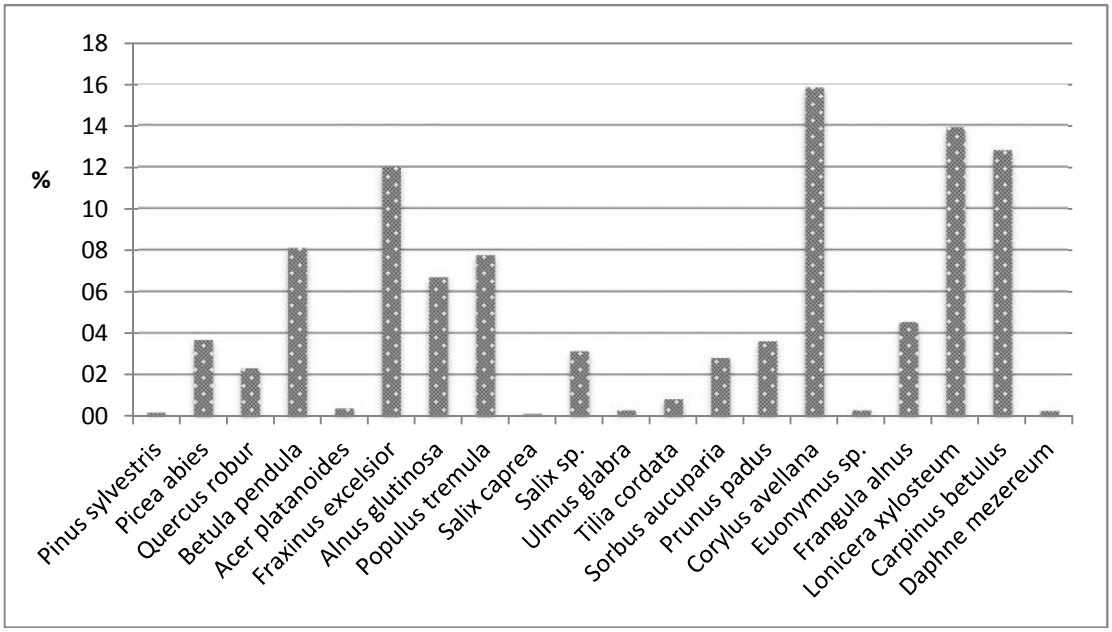

Figure 2.The abundance (G) of tree and shrub species in cervid winter pasture in understory of Bukta forest

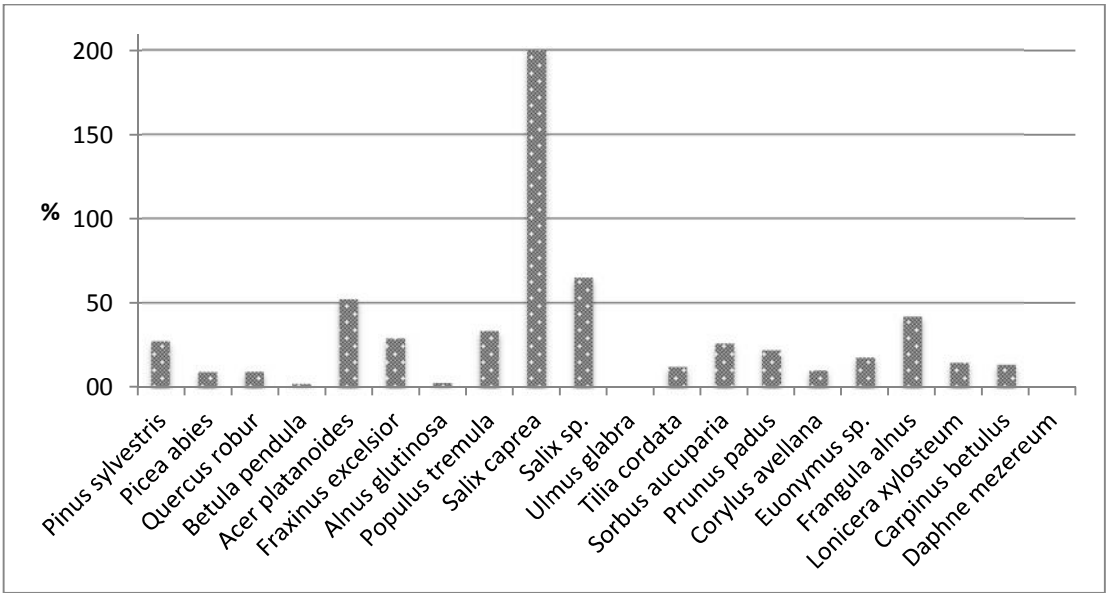

Figure 3.The intensity of use in cervid winter pastures

Moose density influence to forest regeneration on implemented stands

Our results of cervid abundance shows that moose and deer densities in Bukta forest are not exceeding the highest limit (see above), and winter pastures are in relatively good condition, surprisingly we have observed very high damage degree to forest regeneration indicating bad condition (Narauskaite et al 2011). However, damage degree was significantly decreasing every year in all investigated stands (Fig. 4) (ANOVA test: $p<0.0001$, $F=23,11$). The regeneration of economically and ecologically most important species: aspen, oak, ash and hornbeam mostly suffer of moose and deer browsing, indicating the need of cervid population reduction. The highest damage peak was observed in 2011, even 25 % of black alder was browsed by cervids. Black alder is least favorite species by cervids, thus browsing on black alder indicates the starvation period (Padaiga 2010). Smaller amount of wintering cervids in Bukta forest had a very important impact to reduction of damage degree. After winter 2015/2016 damage degree to forest regeneration dropped to 14,6%, providing a possibility to recover forest understory. Thus, our results show that current cervid population density is tolerable for successful forest regeneration in mixed broadleaved Bukta forest. Even if damage degree was reduced in recent year, earlier damage made by animals, specially bark stripping will have a negative impact to timber quality. Bark, thought to be only normally stripped from trees and eaten after all other forms of brows are depleted, is reportedly only eaten in late winter and generaly considered a “starvation food” (Renecker and Schwartz 1998). Trees, specially aspen, has a capacity to treat – regrow damaged bark, damaged bark is usually effected by fungus. Thus damaged steam will not grow a qualitative timber.

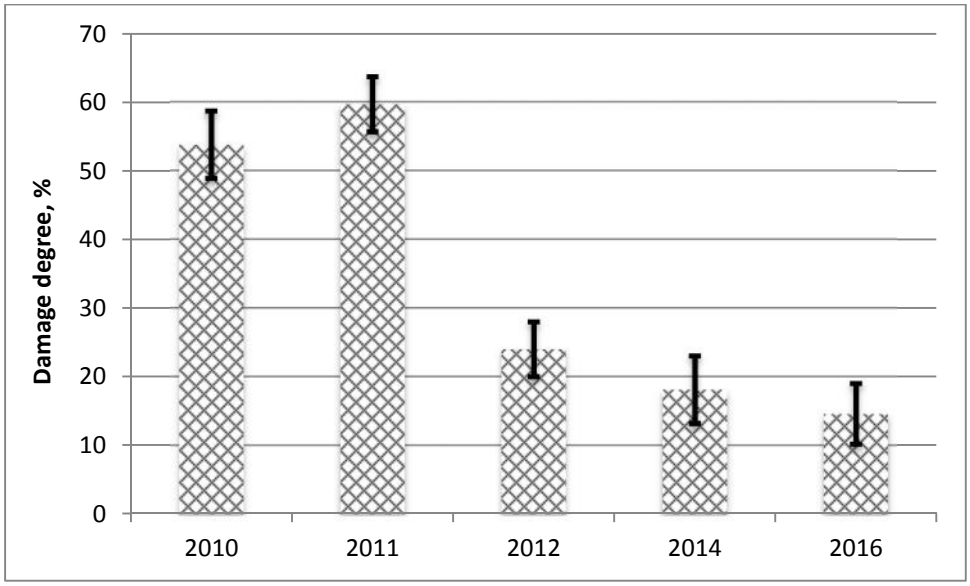

Figure 4.The change of damage degree to forest regeneration caused by *Cervidae* in Bukta forest

CONCLUSION

Cervid dencities was reduced till established optimal numbers in Bukta forest recently, due to higher hunting limits and increased bisturbance by intensive forest management (harvesting) labour. Reduced cervid dencities couse significantly smaller damage to forest regenration in comparison to last four winters. However, regeneration of economicaly most important tree species as ash, aspen and maple as well as one ecologicaly important species – hornbeam in Bukta forest still suffer from browsing and bark stripping. This results suggests that establisment of cervid optimal numbers must be re-evalueted and viewed. In order to protect unick forest of Bukta, which is located nearby Zuvintas strick nature reserve, cervid abundance must be reduced futher.

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