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A RESEARCH PROJECT AIMING AT REDUCTION OF DEER-INDUCED FOREST DAMAGE

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Analyses conducted on 17 experimental sites showed that deer-induced damage in forests is influenced to the greatest extent by the abundance and quality of their feed base. The research project carried out at one experimental site confirmed high effectiveness of supplemental feeding using a specialist feed mix in limiting the area affected by deer-induced damage. It is planned to conduct studies over a higher number of experimental sites to ensure reliability of the results and facilitate their extensive applicability.

Causes of deer-induced tree damage are complex. Among them the relationship between deer density and the abundance and quality of their feed base is considered to be most important. Optimal stocking of deer in deer game management was established in Poland 50 years ago based on the occurrence and shares of individual forest site types. Valuation of these forest site types was conducted on the basis of food abundance for deer in the winter season. The age structure of forests also plays a considerable role, since the smallest food amounts are found in 30–50-year old stands, while food is most abundant in cultures of the seedling establishment stage (up to 10 years old), sapling stands and old stands (over 100 years). At present this concept has been rejected due to the effect of other factors. Food preferences concerning consumed plant species are essential, since differences are observed between animal species and between seasons of the year. An important role is also played by the quantitative structure of deer living in a given forest complex in view of the type of caused damage and differences in food preferences (Kramer at al. 2006). Due to stress induced in animals by various anthropogenic factors as well as pressure of wolves, deer respond by gathering in small, safe forest areas and staying there over a certain period of time. Forest management also affects abundance of the food base mainly as a result of introduced admixtures of deciduous tree and shrub species, silvicultural measures performed in various seasons and leaving organic residue from tending operations, primarily thinning. The size of the forest complex and its shape (expressed as the forest perimeter: area ratio) are also of importance in this respect. Game management, including among other things the establishment of an additional food base through game feed plots, forest meadows and supplemental feeding are also crucial for the problem of tree damage. Moreover, deer feeding on crops grown in the vicinity of forests influences the volume of forest damage (Kuijper at al. 2009). In Poland protection of forests against damage, apart from interfering with some of the above-mentioned causes, consists primarily in fencing the most valuable and most threatened areas.

Other methods include the application of taste or odour repellents as well as plastic sleeves to protect sapling stems. Physical costs of forest protection are covered from the funds of the State Forests and the annual expenditure related to forest protection reaches 180 million PLN (approx. 40 million Euro).

Within the framework of the research project commissioned by the State Forests and conducted in 17 experimental sites in Poland the level of damage was analysed along with the effect of environmental and climatic factors on damage levels (Dziedzic et al. 2018). Experimental sites were located in representative natural forest regions of Poland, with each site

comprising a hunting district (several thousand hectares) and one forest unit (approx. 1500 ha) considered characteristic to that hunting district. Field studies lasted 2 seasons, with forest damage and food abundance for deer estimated in each experimental site. Documentation covered the period of 6 years, elaboration of the results included presentation of individual indexes, correlations between them and analyses of multiple regression aiming at the identification of dependencies between damage and the investigated environmental and climatic factors. The study showed that per 1000 ha of total area of seedling cultures and sampling stands damage was recorded in 17.4 % area. The greatest degree of damage in sapling stands amounted to 58.5 %, followed by seedling cultures at 23.0 %, natural seeding at 16.3 % and undergrowth at 2.2 %.

Damage was observed in non-fenced areas amounting to 88.8 % total damaged area and in fenced areas at 11.2 % damaged area. In terms of the type of damage bark stripping was most common at 52.2 %, followed by nibbling at 45.2 %, while the share of broken and stripped branches was maximum 2 %. /In the case of damage caused by nibbling 3 classes were distinguished, class I (nibbling of lateral shoots recorded in 45.6 % of total nibbled area, class II (nibbling of the main shoot at 27.2 %) and class III (nibbling of the main and lateral shoots at 27.2 %). Damage caused as a result of bark stripping in class I (damage up to 1/3 stem circumference) was recorded in 56.4 % total area of bark stripping damage. In class II (damage up to ½ stem circumference) it was 27.4 % and in class III (over ½ stem circumference) it was 16.2 % total area damaged as a result of bark stripping.

Diversification in the shoot biomass, which animals may consume with no damage suffered by the forest per 1000 ha ranged from 15.5 ton up to 155.3 ton per 1000 ha total forested area. Red deer and roe deer were found in all the experimental sites, Eurasian elk in 8 and fallow deer in 4 experimental sites. In terms of deer stocking per unit area deer (1 deer unit = 0.3 Eurasian elk, = 1 red deer, = 2 fallow deer, = 5 roe deer) it was shown that in the investigated period stocking rates ranged from 21 to 103.4 deer units/1000 ha forested area. In the calculated correlations between stand damage and environmental factors the highest value was recorded for the correlation with the culling rates of deer (except for Eurasian elk), amounting to 0.504. Multiple regression analyses showed that damage in seedling cultures is determined to the greatest extent by forest site types (approx. 75 % effect), followed by animal stocking and culling (49 %), general habitat indexes (37 %), temperature (21 %) and damage to agricultural crops (15 %). In seedling cultures damage was determined in 90 % by the forest site types, followed by animal stocking and culling as well as general habitat indexes, at approx. 50 % each.

Higher values of regression coefficients with forest site types rather than animal stocking and culling of deer need to be interpreted as indicating the importance of forest site fertility and food abundance, as well as relatively imprecise estimation of deer population size and culling numbers, which is a derivative of their population. The limited importance of temperatures in the winter season and snow cover depth is a consequence of mild winters. Among general habitat factors the size of game feed plots, i.e. the additional food base, was distinguished as most important.

The research task commissioned by the Directorate General of the State Forests was connected with the programme aiming at the reduction of forest damage thanks to the method and organisation of winter supplemental feeding of deer (Dziedzic et al. 2014). Studies were conducted in the hunting district administered by the State Forests during 3 winter seasons. The hunting district comprised a single forest complex, including 5 forest districts. Coniferous forest sites were found in 82.7 % of its area, with the highest shares of fresh coniferous forest (51.5 %) and fresh mixed coniferous forest (29.3 %).

The additional food base was found in game feed plots (approx. 3 ha/1000 ha forest area) and forest meadows (approx. 4.5 ha/1000 ha forest area). Moreover, ungulates were provided mainly with succulent feed and concentrate as well as salt. Red deer (40/1000 ha forest), fallow deer (3.5/1000 ha) and roe deer (20/1000 ha) were found in the hunting district. Supplemental feeding in that period included pelleted feed of Polish components enriched with an addition of minerals and vitamins. The energy value of the feed mix was 6.67 MJ/kg, while fibre content was 15 %. The feeding was supplemental, since it amounted to approx. 12–15 % maintenance requirement for each deer species. The pelleted mix was provided in feeding racks starting from mid-December and finishing at the end of April. Within the hunting district covering 5 forest units the feed was provided in 2 forest units. Every year in May foresters estimated deer-induced damage. In those forest units, in which pelleted feed was not provided to animals the area of forest damage (ha) per 1000 ha forest area in 3 consecutive years was 6.85, 7.06 and 4.52. In contrast, in the two forest units where feed was provided the area of forest damage in ha per 1000 ha forest area was 0.00, 0.00 and 0.13. These results definitely indicate high efficacy of this damage reduction concept.

The experiment was conducted in one hunting district characterised by specific habitat conditions and high dominance of red deer at approx. 88 % share of red deer in relation to the total number of deer units per 1000 ha forest area. For this reason it is planned to perform analogous studies over a larger number of experimental plots with varied habitat conditions and deer species composition.

Effectiveness of supplemental feeding for deer verified using a more representative material will provide the basis for a more extensive application of this method. Estimates based on the presented experiment showed that costs of conventional protection measures may be reduced by 50 %.

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ВЛИЯНИЕ ВТОРИЧНЫХ МЕТАБОЛИТОВ БЕРЕЗЫ НА ГРИБЫ И БАКТЕРИИ IN VITRO

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INFLUENCE OF SECONDARY METABOLITES OF BIRCH FOR FUNGI AND BACTERIA IN VITRO

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The effect extracted from the leaves of birch essential oils, flavonoids and tannids on growth of two pathogenic fungi *Fusarium sambucinum* Fuck. and *Sclerotinia sclerotiorum* Fresen. and two gram-negative bacteria strain of *Escherichia coli* (Migula) Castellani et Chambers and *Ervinia caratovora* subsp. *atroseptica* (van Hall) Dye (= *Pectobacterium atrosepticum* sp. *nowa*) upon nutrient medium in vitro was investigated. The results