ANALYSIS OF GAME DAMAGE ESTIMATION METHODS IN WINTER WHEAT (*TRITICUM AESTIVUM*) THRUOGH GIS SIMULATIONS

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Wildlife damage to agriculture causes significant economic loss worldwide annually. According to the legislation, the game managers or hunters are responsible for the financial compensation of the crop damage caused by game species in several countries, including Hungary. Accredited experts estimate the level of the damage; however, currently, there are no unified methods that would be obligatory to apply. Due to the lack of studies on the accuracy and bias of the different sampling methods, the experts are often not able to choose among them on a scientifically sound basis. In order to support them with relevant results, we designed GIS simulations in winter wheat (*Triticum aestivum*), which covers a significant proportion of the arable land not only in Hungary but also globally. As several game species [e.g. Wild boar (*Sus scrofa*), Red deer (*Cervus elaphus*) and Brown hare (*Lepus europaeus*)] cause damage to the wheat, it is an essential plant species regarding the game damage estimation.
In the present study, we tested two sampling methods with three sampling plot arrangements in a GIS environment. Our questions were the following: (1) How accurate and biased are the examined samplings? (2) Does the rate or the spatial distribution of the damage (or the interaction of these factors) affect the results of the investigated methods?
We created 15 wheat field models with 1:2 side ratio, 12 cm row width and the area of 3 ha. We simulated 5 damage rates (10%, 30%, 50%, 70%, 90%) and 3 spatial damage patterns [random, aggregated in 1 and 2 field edges], of which the latter two follow the actual pattern of crop damage caused by big game species based on previous field studies. V, W and X sampling tracks were allocated on each field model, and then they were sampled with square shaped, 1 m^2 quadrats and 1 m long row sections (with 5 repetitions). The sample size was 20 and 25 plots, respectively (determined by the original description of the methods). At the sample plots, the total number of plants and the number of damaged plants were counted. We characterised the estimations by the Mean Squared Error (MSE), the Standard Error (SE) and the bias. Two-way ANOVA

was conducted to identify the factors that have a significant impact on the Percentage Relative Bias (PRB) of the estimations.

According to our results, the statistical parameters of the different samplings were similar; the difference between the best and the poorest values was low. The rate and spatial distribution of the damage, as well as their interaction, had a significant effect on the PRB of each quadrat sampling, while the row sections were significantly affected only by the damage distribution (V and W tracks) or the damage rate (X track).

According to our findings however, the difference between the labour-intensity of the two approaches can be decisive. With the sample sizes in our study, remarkably lower number of plants had to be examined in the quadrats, than along the row sections. This suggests that the experts can obtain similar quality results with less efforts, if they choose the row section sampling over the quadrats.