Zsuzsanna Antal

University of Debrecen, Centre of Agricultural Sciences and Engineering
Faculty of Agricultural Science
Department of Nature Conservation Zoology and Game Management
138. Böszörményistreet, 4032 Debrecen, Hungary
antalzs@agr.unideb.hu

Harmonizing nature conservation and agricultural activity for the sustainable utilization of protected grasslands

Abstract: *Agricultural production is going on at the significant part of the total area of Hungary, thus it is understandable that nature conservation activity is dependent on the cooperation with agriculture. The cooperation of these two activities is extremely important in the case of protected grasslands. On one hand because from a nature conservation point of view, the grassland management systems own the biggest importance of the inland agricultural systems in Hungary and on the other hand because in the conservation of these areas grazing animal husbandry could hold a determinative role.*

Being aware of the importance of the harmonization of these two areas, I would like to emphasize the common interests of these mutually dependent activities and promote the bilateral cooperation. My main research aim was to create a grass production model for a protected pasture which model could serve as a tool for determining animal carrying capacity. Although the prepared grass model requires further validation, methodical grazing upon strict regulation could be suggested. My grassland management suggestions satisfy predominantly nature conservation objectives but do not neglect the rural and regional development aspects. According to my suggestions over and also under grazing of the examined pasture could be avoided what is very important in the conservation of the significant plant and animal species attached to this habitat. Besides, I also would like to promote local farmers in planning their activity, to get the proper number of grazing animals that could be kept on the exact protected grassland year by year.

Keywords: *nature conservation, protected grasslands, grazing animal husbandry*

Introduction

As agricultural production is going on at the significant part of the total area of Hungary, it is understandable that nature conservation activity is dependent on the cooperation with agriculture. The conservation and if it is necessary, the restoration of the protected areas are amongst the important elements of the management methods of these areas. These activities cannot be achieved without ecological farming methods. However a viable activity from also an economic view can be only imagined with the harmonization of agricultural and nature conservation interests, as the efficiency of agriculture decisively depends on the state and quality of the environment, and thus of nature resources.

According to Béri et al. (2004), from a nature conservation point of view, the grassland management systems own the biggest importance of the inland agricultural systems in Hungary, because great part of the protected plant and animal species are attached to them. From the extensive grasslands in Hungary more than 200 thousand hectares are under nature protection. In the conservation of these areas grazing animal husbandry could own a determinative role (Bodó 2005; Stefler & Vinczeffy 2001). The opinion of Kárpáti (2001) is that there is a high need for a nature conservation grassland management, where the aim is not to reach the possibly highest economic advance but to conserve the biodiversity and through this, the habitats of protected species. More authors argue this statement, according to Gencsi (2003) methodical grazing is not only a tool for the management of protected grasslands but with the attendance of the local population it is food production also. Furthermore, the food produced in an environmentally conscious way has an added value compared to food produced in a traditional way. The issues 'health' and 'safety' might contribute to this added value (Husti 2006). Agricultural activity also plays a critical role in influencing the ability of ecosystems to provide services for the society and to support human well-being (Fekete-Farkas et al. 2006). Dömsödi (2006) also states that beside nature conservation activity the appearing economic result could promote the protection of the nature conservation values financially. According to all what have been mentioned so far, it can be stated that however nature conservation activity is prominently important, it is not suitable also for the economically suitable management of protected grasslands per se. With my examinations I would like to emphasize the common interests of these mutually dependent activities and promote the bilateral cooperation.

Taking into consideration the opposite or sometimes the parallel opinion of some regarded professionals my aim is to model the grass production of a certain pasture in Hungary, namely the Lesser Mole Rat Reservation of Hajdúbagos Nature Conservation Area, viz. of the great pasture of Hajdúbagos. My overall objective is to elaborate the management plan for the examined pasture by my examination results.

Materials and methods

According to my overall objective, to gain weather, territorial, land historical, botanical and grass production data were necessary for the model development and for the elaboration of the management plan, as well as for determining the animal carrying capacity of the examined pasture.
The algorithms necessary for modelling the grass production had been integrated into MS Excel programme. The algorithms were inserted to the model in two large groups, as functions (Atmosphere, Soil, Plant) and processes (Weather, Soil, Plant).
To create the input weather database of the model I used the global solar radiation data [MJ m-2 day-1], the daily minimum, maximum and average temperature [°C], the daily precipitation sum [mm], the daily relative air humidity [%] and the average daily wind speed [m s-1] data as inputs, from the Debrecen Weather Station of the Hungarian Meteorological Service. The interval of the weather data is 01.01.2005 to 31.12.2007.
To gain land historical data I carried out archival examinations during which I aimed to survey the characteristics and changes of livestock of the examined area from the 1750's. I also did GIS examinations on maps from different eras, as historical and present maps representing the examined area tell a lot about land use changes.
I carried out the botanical survey according to the Balázs quadrate method (Balázs, 1949). I worked with 1x1 metre sized examination quadrates. Due to the overall research aims all together 34, uniformly 1 square metre sized quadrate were developed. I located the exact geographical situation of the quadrates by GPS device (Figure 1).

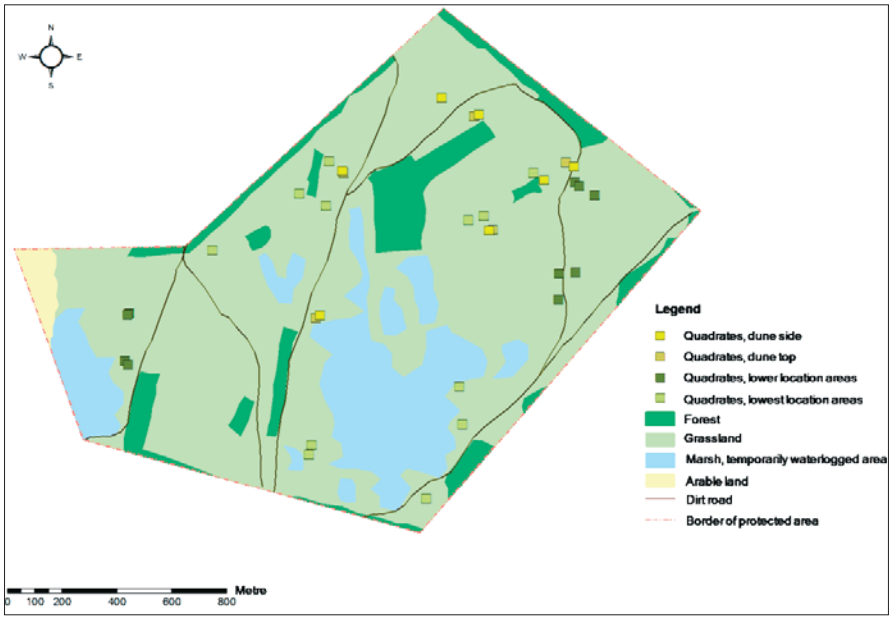

Figure 1. Examination quadrates on the studied pasture

On the developed quadrates I carried out two coenological surveys, the first was in 2006 representing the late spring – early summer aspect, while the second showed the late summer – early autumn aspect and was made in 2007. By the results of the botanical examinations the botanical character of the great pasture of Hajdúbagos could have been stated.
I collected the realized grass production data by the series of test reaping in the developed examination quadrates throughout the year 2006 and 2007, during which I also measured the average grass height in each quadrates before reaping. After removing the grass I measured the green and after drying the dry volume of the samples.
The last part of my examinations was to determine the animal carrying capacity of the studied pasture upon the collected data and the developed grass model, to be able to set a management suggestion for the examined protected grassland. I took the fodder amount requirements of sheep and cattle into consideration by literature recommendation (Kertész 1993; Béri 1993).

Results and discussions

With the help of the hypothetic grass model elaborated to the examined pasture the potential grass production have been calculated. The potential grass production is determined by the photosynthetic active radiation, the temperature and also limited by the precipitation and the water management characteristics of the soil.

The actual grass production data are not taking into consideration the nutrient supplying ability of the soil, but comparing it to the realized production data and other research results it can be stated that the values are rather close to reality. However the model requires further validation it can be stated that it could serve as a good tool for determining animal carrying capacity of the examined pasture. By the simulated actual grass production data the animal carrying capacity of the examined pasture is 2.28-6.11 ewe ha-1, and 0.27-0.71 cow ha-1 during the studied years. However between the certain increments of the examination years there are significant differences (Table 1).

According to the production values simulated by the model I also stated that the optimal usage for the grass flora is 6 rotations by 35 days within the general 210 days sheep grazing period, namely the highest grass yield can be ensured with this utilization schedule independently from the effect of the different annual weather circumstances. It is certified that the carrying capacity calculated by increments gives more accurate results, as the carrying capacity of the whole grazing period assumes the balanced distribution of the annual grass yield.

Table 1. Simulated potential and actual grass production in the examined years

Simulated grass production			Sheep carrying capacity [ewe ha^{-1}]	Cattle carrying capacity [cow ha^{-1}]
Date of simulated grazing/reaping	Green grass production [g m^{-2}]	Green grass production [kg ha^{-1}]		
20.04.2005	0	0,00	0.00	0.00
25.05.2005	117	1168.41	4.77	0.56
29.06.2005	181	1812.27	7.40	0.86
03.08.2005	233	2327.69	9.50	1.11
07.09.2005	222	2216.38	9.05	1.06
12.10.2005	121	1212.01	4.95	0.58
16.11.2005	1	8.39		
21.12.2005	0	0.00		
2005	Σ ***875***	Σ ***8745.17***	$\bar{x}$ ***5.94***	$\bar{x}$ ***0.69***
25.01.2006	0	0.00		
01.03.2006	0	0.00		
05.04.2006	0	4.69		
10.05.2006	342	3421.27	13.96	1.63
14.06.2006	370	3703.18	15.12	1.76
19.07.2006	23	226.37	0.92	0.11
23.08.2006	123	1233.07	5.03	0.59
27.09.2006	23	233.52	0.95	0.11
01.11.2006	17	171.33	0.70	0.08
06.12.2006	1	5.42		
2006	Σ ***900***	Σ ***8998.84***	$\bar{x}$ ***6.11***	$\bar{x}$ ***0.71***
10.01.2007	0	0.00		
14.02.2007	0	1.23		
21.03.2007	2	16.33		
25.04.2007	0	0.00	0.00	0.00
30.05.2007	9	93.23	0.38	0.04
04.07.2007	99	990.84	4.04	0.47
08.08.2007	36	359.48	1.47	0.17
12.09.2007	10	98.46	0.40	0.05
17.10.2007	181	1809.20	7.38	0.86
21.11.2007	1	6.00		
26.12.2007	0	0.00		
2007	Σ ***337***	Σ ***3374.78***	$\bar{x}$ ***2.28***	$\bar{x}$ ***0.27***
	$\Sigma\Sigma$ ***2112***	$\Sigma\Sigma$ ***21118.78***	$\bar{x}$ ***4.78***	$\bar{x}$ ***0.56***

Conclusions

By the animal carrying capacity calculated upon the grass yields simulated by the grass model, and by the land historical and botanical examinations I suggested the management of the examined protected pasture to be based on accurate regulation that serves predominantly nature conservation objectives but do not neglect the rural and regional development aspects. The management strategy that I suggest could promote the improvement of the possibili-

ties for the local population in agricultural production thus in income increase as well, establishing by this the synergic sustainability of nature conservation and socio-economic interests.

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