CONTRIBUTIONS TO THE EVALUATION OF PASTURE PRODUCTIVITY USING THE FLORISTIC RELEVE

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Abstract

The paper presents in premier an indirect method for evaluating the productivity of pastures based on floral releve. The calculation of the pastoral value and the grass yield of the pasture is based on the scale of appreciation of the abundance of the dominance of the species found in the grassy carpet, transformed into percentages of participation, together with the feed quality and useful phytomass indices. Comparing the direct method for assesing pasture production through mowing sample plot and the indirect method which is based on floristic releve, we observe a production difference found within the limit of errors, meaning below 10%. This indirect method will primarily serve pastoral planners and other specialists who valorize the pasture floristic releve in order to determine some economic indicators.

Keywords: pasture evaluation, feed value, productivity, animal density

INTRODUCTION

The classic method for determining the green or grass mass production of pastures and their forage quality involves mowing on surfaces enclosed through a fixed fence or under metal cages in order to keep them away from grazing animals.

For pastures managed as hayfields, productivity and quality determination are greatly releaved, the fencing against grazing animals not being needed.

Fencing the experimental plot set up in pastures in at least three replicates for each type or uniform habitat of pasture, requires investment and, in particular, guard, along syde with the effort to harvest and weigh the grass 2 to 5 times/year depending on the physical geographic area, sample sampling and on the chemical analysis of fodder quality. In many situations, especially isolated, this method of determining pasture productivity is almost impossible to be done, reason why pastoralists or other people involved make an indirect appreciation of this indispensable economic index, mostly using methods read from the books or just randomly making great errors, their results being far from the reality found in the field. Due to these impediments in determining pasture productivity, a new method is proposed. This is based on the

floristic or botanical releve which describes the species found in the grassy carpet in percentage of participation.

When geobotanists intend to determine the abundance-dominance (AD) index after the phytosociological scale (Braun - Blanquet) they have to transform it in percentage of participation of the species in the grassy carpet (Cristea *et al*., 2004; table 1).

Table 1

Scale for abundance-dominance evaluation (AD)
in Braun – Blanquet system completed by Tűxen and Ellenberg (1937)

Scale for AD evaluation	Conversion to %	
	Coverage interval AD	Average
5	75 – 100	87,5
4	50 – 75	62,5
3	25 – 50	37,5
2	10 – 25	17,5
1	1 – 10	5,0
+	0,1 – 1	0,5
r	0,01 - 0,1	0,05

In this conversion the very high differences between AD grades are easy to be noticed, particularly between 4 to 5 and 3 to 4, when they could score up to 25% differences as well as between 2 and 3 interval where the differences could be up to 20%. Thus, no matter how good observer the biologist – botanist, agronomist or a forestry expert specialized in vegetation studies could be – he can very easily appreciate or misinterpret a nearby grade with quite high errors when he converts the Braun - Blanquet scale into percentages of participation. Therefore, for the agro-productive study of pastures, it is more useful to mark directly after the Klapp-Ellenberg method, as we can not mistake the participation of a species in the grassy carpet with 20-25%. Even bigger problems arise when we try to convert intervals for AD from synthetic flora surveys - where there are AD intervals, into percentage. From our calculations after transformation of the AD appreciation marks into percentages of participation most of the time, 100% is not reached, requiring additional adjustments.

MATERIAL AND METHOD

In order to elaborate a new method for the evaluation of pastures productivity we used the book "Pastures and hay fields from R.P.

Romania" (Puscaru - Soroceanu *et al*., 1963), where both synthetic flora and plant production results are presented. In this case, an improved formula for converting the AD intervals into percentages is discussed, taking into account also the general frequency (the K constant) of the respective species (table 2).

Table 2

The evaluation of plant species participation from synthetic releve taking into account the abundance-dominance intervals (A+D) and the average K constant (K) for permanent grassland phytocoenosis

– Participation % –

AD	AD mark depending on K (%)				
	V (80 – 100)	IV (60 – 80)	III (40 – 60)	II (20 – 40)	I (< 20)
4 – 5	75	53	38	23	8
3 – 5	63	44	32	12	6
3 – 4	50	35	25	15	5
2 – 5	53	37	27	16	5
2 – 4	40	28	20	12	4
2 – 3	28	20	14	8	3
1 – 5	46	32	23	14	5
1 – 4	34	24	17	10	3
1 – 3	21	15	11	6	2
1 – 2	11	8	6	3	1
+ – 5	44	31	22	13	4
+ – 4	32	22	16	10	3
+ – 3	19	13	10	6	2
+ – 2	9	6	5	3	1
+ – 1	3	2	2	1	0,3
+	0,5	0,4	0,3	0,2	0,1

Thus, the AD grading averages from table 1, as percentage of participation of a species, are integral to a constant (K) of 80-100 and these percentages decrease with the decrease of the general consistency or frequency.

In this way, converting the scale with marks into percentages is closer to the reality found outside in pastures.

After we convert the scale of evaluation of the phytosociological notations into percentages of participation, for each species of the new flora releve – classified into three large feed groups: grasses, legumes and species from other botanical families (table 3) and three groups of harmful species: toxic, animal products and grass carpet (table 4) - one should write the index for feed quality (F4 - F9) and harmfull (F1 - F3) along with the index for useful feed phytomass (M1 - M9) and harmfull (M0 for F1 -F3).

Table 3

Forage plant species from grassland flora ($F_4 – F_9$)
and index for useful phytomass ($M_1 – M_9$)
(Maruşca, 2016)

GRASS	Index value		GRASS	Index value	
	F	M		F	M
Aegilops cylindrica	5	3	*Deschampsia flexuosa*	4	3
Agropyron cristatum	7	5	*Echinochloa crus – galli*	5	7
Agropyron intermedium	5	7	*Festuca airoides*	5	2
Agropyron repens	6	7	*Festuca amethystina*	5	5
Agrostis alpina	5	2	*Festuca arundinacea*	8	9
Agrostis capillaris	7	5	*Festuca callieri*	5	2
Agrostis canina	6	4	*Festuca carpatica*	7	5
Agrostis gigantea	7	7	*Festuca nigrescens*	7	6
Agrostis rupestris	5	1	*Festuca ovina*	5	4
Agrostis stolonifera	7	6	*Festuca pallens*	5	4
Alopecurus pratensis	8	7	*Festuca picta*	5	3
Alopecurus geniculatus	5	3	*Festuca pratensis*	9	8
Alopecurus ventricosus	6	7	*Festuca pseudovina*	5	3
Anthoxantum odoratum	5	3	*Festuca rubra*	7	6
Apera spica venti	5	6	*Festuca rupicola*	5	5
Arrhenatheum elatius	8	8	*Festuca vaginata*	5	4
Avenula pratensis	6	5	*Festuca valesiaca*	5	3
Avenula versicolor	5	2	*Festuca versicolor*	5	3
Beckmania eruciformis	7	8	*Glyceria aquatica*	4	7
Brachypodium pinnatum	5	7	*Holcus lanatus*	6	6
Brachypodium silvaticum	5	7	*Festuca heterophylla*	7	7
Briza media	5	2	*Hordeum bulbosum*	5	7
Bromus arvensis	5	6	*Hordeum murinum*	5	3
Bromus erectus	6	6	*Koeleria macrantha*	5	3
Bromus inermis	8	8	*Lolium multiflorum*	9	9
Bromus japonicus	5	5	*Lolium perenne*	9	8
Bromus racemosus	5	7	*Melica ciliata*	4	2
Bromus tectorum	5	2	*Oreochloa disticha*	4	4
Catabrosa aquatica	5	5	*Phalaris arundinacea*	7	9
Chrysopogon gryllus	4	7	*Phleum alpinum*	6	3
Cynodon dactylon	6	2	*Phleum hirsutum*	6	5
Cynosurus cristatus	7	4	*Phleum montanum*	6	5
Cynosurus echinatus	5	4	*Phleum phleoides*	6	4
Dactylis glomerata	9	8	*Phleum pratense*	9	8
Dactylis polygama	7	7	*Poa alpina*	7	2
Danthonia alpina	5	4	*Poa angustifolia*	7	5
Danthonia provincialis	4	3	*Poa annua*	7	2

Table 3 (continuation)

GRASS	Index value		LEGUMES	Index value	
	F	M		F	M
Poa bulbosa	6	1	*Trifolium campestre*	7	2
Poa chaixii	7	7	*Trifolium dubium*	6	2
Poa compressa	6	3	*Trifolium fragiferum*	7	3
Poa laxa	5	2	*Trifolium hybridum*	8	6
Poa media	5	2	*Trifolium medium*	6	4
Poa nemoralis	7	4	*Trifolium montanum*	7	4
Poa pratensis	8	6	*Trifolium ochroleucon*	7	4
Poa silvicola	8	6	*Trifolium pannonicum*	7	5
Poa trivialis	7	6	*Trifolium pratense*	8	7
Puccinellia distans	7	3	*Trifolium procumbens*	6	4
Puccinellia intermedia	6	4	*Trifolium repens*	8	5
Sesleria coerulans	4	3	*Trifolium resupinatum*	8	6
Sesleria rigida	5	2	*Trifolium rubens*	6	4
Trisetum flavescens	8	6	*Trifolium spadiceum*	6	3
LEGUMES			*Trifolium subterraneum*	7	2
Anthyllis vulneraria	6	5	*Vicia angustifolia*	7	3
Astragalus cicer	5	4	*Vicia cassubica*	6	4
Astragalus glycyphyllos	5	6	*Vicia cracca*	7	6
Astragalus monspessulanus	5	5	*Vicia grandiflora*	7	5
Astragalus onobrychis	5	4	*Vicia hirsuta*	6	3
Lathyrus hirsutus	6	5	*Vicia pannonica*	5	4
Lathyrus palescens	6	3	*Vicia sativa*	7	7
Lathyrus palustris	6	6	*Vicia sepium*	7	5
Lathyrus pratensis	7	6	*Vicia tetrasperma*	6	3
Lotus angustissimus	6	2	OTHER FAMILIES		
Lotus corniculatus	8	6	*Achillea collina*	6	5
Lotus tenuis	7	3	*Achillea millefolium*	6	4
Lotus uliginosus	6	4	*Achillea panonnica*	6	5
Medicago falcata	7	6	*Achillea setacea*	6	3
Medicago lupulina	8	3	*Achillea stricta*	6	6
Medicago minima	7	1	*Ajuga genevensis*	4	2
Medicago orbicularis	4	3	*Alchemilla glaucescens*	6	2
Medicago sativa	9	9	*Alchemilla mollis*	6	3
Melilotus albus	6	8	*Alchemilla vulgaris*	6	4
Melilotus officinalis	6	7	*Antennaria dioica*	4	2
Onobrychis arenaria	6	5	*Arnica montana*	4	3
Onobrychis gracilis	6	5	*Bellis perennis*	5	1
Onobrychis montana	6	2	*Betonica officinalis*	4	5
Onobrychis viciifolia	8	8	*Capsella bursa pastoris*	4	3
Oxytropis halleri	5	2	*Cardaria draba*	4	3
Tetragonolobus maritimus	6	3	*Carex curvula*	5	1
Trifolium alpestre	6	3	*Carex humilis*	4	1
Trifolium arvense	4	2	*Carex pallescens*	4	3

Table 3 (continuation)

OTHER FAMILIES	Index value		OTHER FAMILIES	Index value	
	F	M		F	M
Carex praecox	4	2	*Pimpinella major*	5	6
Carex sempervirens	4	2	*Pimpinella saxifraga*	5	3
Carex vulpina	4	5	*Plantago altissima*	6	4
Carum carvi	6	3	*Plantago argentea*	5	2
Centaurea jacea	4	6	*Plantago atrata*	6	1
Cichorium intybus	5	6	*Plantago lanceolata*	6	1
Crepis biennis	4	5	*Plantago major*	5	3
Convolvulus arvensis	7	6	*Plantago media*	6	2
Daucus carota	6	5	*Polygala vulgaris*	4	1
Daucus guttatus	6	5	*Polygonum aviculare*	5	3
Echium vulgare	4	3	*Polygonum bistorta*	5	4
Epilobium palustre	4	4	*Potentilla argentea*	4	2
Filipendula vulgaris	5	4	*Potentilla erecta*	5	2
Fragaria vesca	5	1	*Potentilla ternata*	4	1
Fragaria viridis	4	1	*Prunella vulgaris*	4	2
Galium verum	5	4	*Pulicaria dysenterica*	4	4
Gentiana lutea	4	5	*Ranunculus polyanthemos*	4	4
Gentiana pneumonanthe	4	3	*Rorippa austriaca*	4	5
Geranium pratense	4	4	*Rumex acetosa*	4	5
Geum montanum	4	1	*Rumex obtusifolius*	4	6
Helianthemum nummularium	4	2	*Salicornia europaea*	4	2
Helianthus tuberosus	5	8	*Salvia pratensis*	4	4
Hieracium aurantiacum	4	2	*Sanguisorba minor*	6	3
Hieracium pilosella	4	1	*Sanguisorba officinalis*	7	5
Inula britanica	4	4	*Scabiosa ochroleuca*	4	4
Juncus gerardi	4	2	*Symphytum officinale*	5	5
Juncus trifidus	4	1	*Taraxacum bessarabicum*	6	1
Knautia arvensis	4	4	*Taraxacum erythrospermum*	6	1
Leontodon autumnalis	5	3	*Taraxacum officinale*	7	3
Leontodon crispus	5	3	*Taraxacum palustre*	5	2
Leucanthemum vulgare	5	5	*Taraxacum serotinum*	5	2
Ligusticum mutellina	7	1	*Thymus montanus*	4	2
Limonium gmelini	4	4	*Thymus zygioides*	4	1
Luzula campestris	4	2	*Tragopogon pratensis*	5	5
Lychnis flos cuculi	4	4	*Tragopogon dubius*	5	5
Lysimachia vulgaris	4	7	*Urtica dioica*	5	7
Lythrum salicaria	4	7	*Verbena officinalis*	4	4
Mentha longifolia	4	6	*Veronica chamaedrys*	4	2
Origanum vulgare	4	4	*Viola canina*	4	1

F = index for feed value

M = index for the value of useful phytomass

Table 4

Harmfull plant species from grassland flora ($F_1 – F_3$)
without useful feed production (M_0)
(Maruşca, 2016)

TOXIC SPECIES (F_1), (M_0)	SPECIES HARMFULL TO THE GRASSY CARPET (F_3), (M_0)
Adonis vernalis	*Alnus glutinosa*
Aconitum tauricum	*Alnus incana*
Caltha laeta	*Amorpha fruticosa*
Chelidonium majus	*Asperula cynanchica*
Cicuta virosa	*Betula pendula*
Colchicum autumnale	*Botriochloa ischaemum*
Conium maculatum	*Bruckenthalia spiculifolia*
Coronilla varia	*Calamagrostis arundinacea*
Equisetum palustre	*Calamagrostis epigeios*
Euphorbia cyparissias	*Calluna vulgaris*
Euphorbia nicaeensis	*Camphorosma annua*
Galega officinalis	*Carduus nutans*
Gratiola officinalis	*Carex ligerica*
Helleborus purpurascens	*Carlina acaulis*
Hypericum perforatum	*Carlina vulgaris*
Pteridium aquilinum	*Carpinus betulus*
Ranunculus acer	*Cirsium vulgare*
Ranunculus sceleratus	*Cornus mas*
Stellaria graminea	*Corylus avellana*
Thalictrum aquilegifolium	*Crambe maritima*
Trollius europaeus	*Crataegus monogyna*
Veratrum album	*Deschampsia caespitosa*
Verbascum phlomoides	*Dipsacus sylvestris*
ANIMAL PRODUCTS (F_2), (M_0)	*Dyras octopetala*
Alliaria officinalis	*Eleagnus angustifolia*
Allium ursinum	*Elymus sabulosus*
Arctium lappa	*Eryngium campestre*
Artemisia austriaca	*Fagus silvatica*
Bidens tripartitus	*Filipendula ulmaria*
Carduus acanthoides	*Genista tinctoria*
Centaurea solstitialis	*Genistella sagittalis*
Lepidium ruderale	*Halimione verrucifera*
Onopordon acanthium	*Heracleum sphondylium*
Rumex acetosella	*Hippophae rhamnoides*
Thlaspi arvense	*Juncus conglomeratus*
Xanthium strumarium	*Juncus effusus*

Table 4 (continuation)

SPECIES HARMFULL TO THE GRASSY CARPET (F_3), (M_0)	
Juniperus communis	*Reynoutria japonica*
Juniperus sibirica	*Rhamnus cathartica*
Ligustrum vulgare	*Rhinanthus minor*
Linaria genistifolia	*Rhododendron myrtifolium*
Loiseleuria procumbens	*Rosa canina*
Lysimachia nummularia	*Rubus sulcatus*
Molinia coerulea	*Rudbeckia laciniata*
Malus sylvestris	*Rumex alpinus*
Nardus stricta	*Salix caprea*
Ononis spinosa	*Salix cinerea*
Phragmites australis	*Salix herbacea*
Picea abies	*Sambucus ebulus*
Pinus mugo	*Scirpus silvaticus*
Populus tremula	*Solidago virgaurea*
Potentilla anserina	*Stachys germanica*
Prunus spinosa	*Stipa capillata*
Pyrus pyraster	*Suaeda maritima*
Quercus cerris	*Tanacetum vulgare*
Quercus petraea	*Teucrium chamedrys*
Quercus pedunculiflora	*Vaccinium myrtillus*
Quercus pubescens	*Vaccinium uliginosum*
Quercus robur	*Vacum vitis idaeacini*

Setting pastoral value (PV)

Pastoral value is a synthetic index aimed to characterize the quality of a pasture, evaluated through floristic methods of appreciation.

After the floral list with the species of the herbaceous carpet and their participation in the useful phytomass has been drawn up, the following step is to apply some formulas for the determination of the pastoral value, namely:

$$\mathbf{PV} = \mathbf{\Sigma}\ P\ (\%)\ x\ F/9$$

Where:

PV= index for forage value (0-100)

P = participation in the grassy carpet (%) regardless the method used for evaluation is Braun – Blanquet, Klapp – Ellenberg, Daget – Poissonet etc.

F = index for forage quality.

Index for forage value (F)

(Kovacs, 1979; Păcurar and Rotar, 2014)

1 = toxic for animals and humans;

2 = harmful for animal products;

3 = harmful for the grassy carpet;

4 = poor in forage value (ballast);
5 = medium in forage value (ex F1);
6 = average in forage value (ex F2);
7 = good in forage value (ex F3);
8 = very good in forage value (ex F4);
9 = excellent in forage value (ex F5);
X = species with unknown forage value.

Having the synthetic tables with species participation in % of species it was possible to calculate the pastoral value based on forage quality index (F), which have the value "0" for toxic species (F1), harmful to animal products (F2) and grassy carpet (F3) and positive values for the actual forage species (F4 - F9).
After determining the pastoral value index by dividing by 9 the score obtained from the multiplication P X F, after which the quality of a pasture is appreciated as follows:

0 - 5 degraded grassland
5 - 15 very poor
15 - 25 poor
25 – 40 mediocre
40 – 60 average
60 – 80 good
80 – 100 very good

Evaluation of grassland useful forage production through the floristic method

Because of some difficulties found in the land regarding fencing and guarding of the sample/plot surfaces, a new method for indirect determination of the grass yield through evaluation is proposed – which is based on the floristic releve and the production indices of the forage species (M) found in the grassy carpet (table 5). The calculation formula for determining the average index of green mass production (IGM) of phytocoenoses from permanent grasslands:

$$IGM = \frac{4xP(\%)ind.4 + 5xP(\%)ind.5 \ldots\ldots + 9\ x\ P(\%)ind.9}{100}$$

Where: 4 ….. 9 = index (marks) for evaluation of forage species
P (%) = species participation in the grassy carpet

After calculating the IGM of the association by multiplying it by the coefficients found in table 5, one can estimate the yield of phytomass releasable by animals in tonnes per hectare. By this simple method of estimating the production of green mass production (grass) that can be redeemed by animals based on the floricultural aspect of a phytocoenosis, it is essential to establish the optimal grazing capacity of the permanent pasture with the animals.

Table 5

Production index for forage species and estimation of useful yield per hectare of non-fertilized permanent grasslands

Average index for green mass production (M)	Coefficients for converting into green mass production (GM)	Green mass production estimation (GM) (t/ha)	Pastoral value estimation
0,1 – 0,5 0,5 – 1,0	x 1,8 x 1,9	0,2 – 0,9 1,0 – 1,9	Very poor
1,0 – 1,5 1,5 – 2,0	x 2,0 x 2,1	2,0 – 3,0 3,2 – 4,2	Poor
2,0 – 2,5 2,5 – 3,0	x 2,2 x 2,3	4,4 – 5,5 5,8 – 6,9	Poor-average
3,0 – 3,5 3,5 – 4,0	x 2,4 x 2,5	7,2 – 8,4 8,8 – 10,0	Average
4,0 – 4,5 4,5 – 5,0	x 2,6 x 2,7	10,4 – 11,7 12,2 – 13,5	Average-good
5,0 – 5,5 5,5 – 6,0	x 2,8 x 2,9	14,0 – 15,4 16,0 – 17,4	Good
6,0 – 6,5 6,5 – 7,0	x 3,0 x 3,1	18,0 – 19,5 20,2 – 21,7	Good-very good
7,0 – 7,5 7,5 – 8,0	x 3,2 x 3,3	22,4 – 24,0 24,8 – 26,4	Very good
8,0 – 8,5 8,5 – 9,0	x 3,4 x 3,5	27,2 – 28,9 29,8 – 31,5	Excellent

Determination of grassland livestock charge or grazing capacity

After determining the green mass production or useful phytomass of a grassland, it is possible to evaluate the animal load index for a grazing season.

The duration of the optimal grazing season on grasslands, which is equal to the equal daily average air temperature or above 10 degrees C, is shown in table 6. The required grass per day for one unit of large beef is about 65 kg, taking into account the unspoilt remains and the seasonal or annual variations in production, mainly influenced by periods of drought and other weather conditions. Thus, multiplying the duration of the optimal grazing season with the daily grass requirement (65 kg / UL) results in the total grass need for the growing season.

Table 6

The optim season period for grazing

Altitude (m)	Grazing season period (days)
2200 – 2400	40
2000 – 2200	55
1800 – 2000	70
1600 – 1800	85
1400 – 1600	100
1200 – 1400	115
1000 – 1200	130
800 – 1000	145
600 – 800	160
400 – 600	175
200 – 400	190 *
0 – 200	205*
Gradients for 100 m altitude	-7,5 days

*) in meadows and irrigation conditions

If we determine the production of a pasture by mowing in fenced spaces before and after the grazing, it is more likely to establish a coefficient of actual use of a pasture (CU) according to the formula:

$$\text{CU}\ (\%) = \frac{\text{Total production} - \text{unconsumed leftovers}}{\text{Total production}}\ \text{x}\ 100$$

In this case, for the determination of the optimal animal density (OAD) or grazing capacity (GC), the following formula is applicable:

$$\text{OAD}\ (\text{head/ha}) = \frac{\text{GM}\ (\text{kg/ha})\ \ \text{x}\ \ \text{CU}\ (\%)}{\text{DN x GD x}\ 100}$$

Where: GM = total grass production
CU = coefficient for using
DN = daily grass necesary
GD = no. of grazing days (season)

Another method requires the distribution of the useful grass yield per hectare to the grass requirements/ UL/grazing season, resulting in the optimal animal density or grazing capacity of a grassland, according to the formula:

$$\text{GC (UL /ha)} = \frac{\text{Grassland useful production (t/ha)}}{\text{DN x GD x 100}}$$

In order to calculate the possible number of grazing animals by species and category it is necessary to know the transformation coefficients from and to the UL (table 7).

Table 7

Average coefficients for conversion into UVM and grass requirements of different animal species and categories

Animal species and categories	Coefficion for conversion in UL	No. of animals equivalent to 1 UL	Green mass requirements (M) kg/head/day
Cows and buffaloes with milk	1,00	1,00	65
Bovine animals of all ages	0,75	1,33	50
Bulls and thorns	1,10	0,91	70
Young cattle over 1 year old	0,60	1,67	40
Young cattle up to 1 year old	0,25	4,00	15
Sheep and goats of all ages	0,14	7,14	9
Mature sheep and goats	0,16	6,25	11
Youth ovine and goat	0,10	10,0	6
Horses of all ages	0,80	1,25	52
Traction horses	1,05	0,95	68
Youth hourse over 1 year old	0,60	1,67	40
Youth hourse up to 1 year old	0,30	3,33	20
Mature pigs	0,25	4,00	15

This is one method which delivers the direct animal density index, without further calculations which implies conversion from the total UL in the equivalent number of species and categories of animals possible to be grazed in a vegetation season on a particular phytocenosis or the type of perrmanent grassland habitat.

In order to certify the new method for the evaluation of permanent grassland productivity, a case study was analysed, namely the steppe pastures from Dobrogea with 3 groups of associations (alliances).

RESULTS AND DISCUSSION

Taking into account the evaluation of grassland from Dobrogea productivity – evaluation based on floral revele - and their comparison with the production obtained by mowing and actual consumption

with animals, a great similarity was observed between these two methods (table 8). Thus, the average green mass yield of the Dobrogea steppe meadows is very low (3,05 t/ha) with a grazing utilization of 62%, resulting in 1,84 t/ha of green mass weight usable by animals.

Table 8

Average green mass production and animal density
in grassland from Dobrogea
(data recalculated and completed after Evdochia Puşcaru–Soroceanu *et al.*, 1963)

A. Associations of steppic crisp land/celery;
B. Associations of steppic follow land;
C. Associations of steppic follow land without crisp land/celery.

Specification	UM	Association groups			
		A	B	C	Average
1. EXPERIMENT, ICZ Bucureşti					
Total green mass production (GM)	t/ha	4,04	3,01	2,09	3,05
Grassland usability degree GM	%	60	48	80	62
Usable forage production GM	t/ha	2,40	1,46	1,67	1,84
2. EVALUATION, ICD Grassland Braşov					
Usefull phytomass index (M)	Ind.	1,13	0,73	0,79	0,88
Usable forage production GM	t/ha	2,26	1,39	1,50	1,72
ANIMAL DENSITY*)					
1. Experiment ICZ	UVM/ha	0,200	0,121	0,139	0,153
2. Evaluation ICDP	UVM/ha	0,188	0,117	0,125	0,143
Differences (2-1) + , -	UVM/ha	- 0,012	- 0,004	- 0,014	- 0,010
Relative difference (2-1)	%	94	97	90	93

*) calculated for 185 grazing days with a consumption of 65 kg/UVM/day, namely 12 tonnes GM/season.

The evaluation of the basic production based on flora releve shows a usable green mass of 1,72 t/ha, results almost similar to those achieved by stationary weighing.

After calculating the livestock density (UL/ha) for the 185 days of grazing season, a minimum difference of 0.010 UL/ha is observed, namely 93%, which is included within the limit of determination errors.

This example confirms that the evaluation of grassland based on flora releve is applicable with good results.

Evaluation of the deviations occur in grassland optimal load

After determining the optimal load of a pasture (OLP), it is necessary to know what is the current pasture load (CLP) of the grassland estimation on abandonment, under and overgrazing are made, or other deviations (DOG) from normality.

For the assessment on deviations, the following formula applies:

$$DOG_{OLP} = \frac{PAD \times 100}{OAL} - 100$$

Where: DOG_{OLP} = deviation from optimal grassland load

PAD = present animal density

OAL = optimal grassland load

The results should be established after table 9.

Table 9

The effect of animal density on grassland ecosystems

DEVIATION from optimal animal density (UL/ha)	EVALUATION of grassland load and its effect on ecosystem
Absent up to – 50%	Abandonment (forestation)
– 50% up to – 15%	Semiabandonment (hedges, forestation)
– 15% up to + 15%	Optim (economic)
+ 15% up to + 50%	Overgrazing (gaps in vegetation)
+ 50% up to + 100% and over	Destructive grazing (erosion, pollution, etc.)

In our case study, the deviation between the two methods of determining the livestock load is below 10% UL/ha which is considered to be within optimal limits as the economic grazing capacity.

CONCLUSIONS

Using the method of evaluating grasslands productivity based on flora releves, older or recent vegetation data can be capitalized and dynamically determine their economic value;

The difference between the indirect method for assessing grassland productivity based on floristic releve and the direct method thru mowing is within acceptable error limits;

The evaluation of grassland productivity based on floral releve method serves primarily to the pastoral planners;

The method does not completely replace the direct methods of determining grasslands yield and quality from the experimental field.

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