Online Resource 3

Conserving Red List plant species by managing landscape fragmentation and permeability

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Landscape Ecology

Methods Applied for Calculating Permeability Scores

Calculation of Livestock Grazing Load

To quantify the grazing pressure on the land, the livestock load (LU/ha) was calculated. This represents the number of standardized animal units per hectare of available pasture area.

- LU= Livestock Unit.
- General formula:

$$LU/ha = \frac{Number\ of\ animals\ \times Animal\ LU\ coefficient}{Pasture\ area\ (ha)}$$

Where,
Number of animals = the actual number of animals on the land (cattle, sheep, goats)
Animal LU coefficient = conversion factor (e.g., cattle = 1 LU, sheep/goats = 0.15 LU)
Pasture area (ha) = the land area available for grazing

The calculation of the grazing load was performed at the commune level (Romanian territorial administrative unit).

Table 3 presents the data, calculations, and results for the livestock grazing load.

Table 3. Data, Calculations, and Results of Livestock Grazing Load (LU/ha) at the Commune Level

Commune (Romanian territorial administrative unit)	Cattle	Sheep	Goats	Livestock Unit Coefficient for Cattle	Livestock Unit Coefficient for Sheep	Livestock Unit Coefficient for Goats	Pasture Area (ha)	Total Livestock Units (LU)	Stocking Rate (LU/ha)
Aiton	429	2576	345	1	0.15	0.15	1355	867.15	0.64
Aiud	1717	3880	90	1	0.15	0.15	1700	2312.5	1.36
Alțina	574	3965	0	1	0.15	0.15	3662	1168.75	0.32
Apahida	949	8481	183	1	0.15	0.15	3437	2248.6	0.65
Aşchileu	576	6946	41	1	0.15	0.15	1826	1624.05	0.89
Baciu	822	9144	76	1	0.15	0.15	2470	2205	0.89
Blaj	2817	8750	614	1	0.15	0.15	2619	4221.6	1.61
Bonțida	224	530	0	1	0.15	0.15	3165	303.5	0.10
Borșa	621	6989	1013	1	0.15	0.15	2336	1821.3	0.78
Căianu	1101	4374	0	1	0.15	0.15	1089	1757.1	1.61
Ceanu Mare	2082	4170	0	1	0.15	0.15	2039	2707.5	1.33
Cetatea de Baltă	712	2336	69	1	0.15	0.15	1262	1072.75	0.85
Chinteni	1725	8798	200	1	0.15	0.15	3663	3074.7	0.84
Ciurila	434	8686	643	1	0.15	0.15	2435	1833.35	0.75
Cluj-Napoca	2504	10192	0	1	0.15	0.15	1692	4032.8	2.38
Cojocna	1765	7555	0	1	0.15	0.15	4490	2898.25	0.65
Cornești	1055	4500	0	1	0.15	0.15	2803	1730	0.62
Crăciunelu de Jos	701	3520	0	1	0.15	0.15	721	1229	1.70
Dăbâca	215	1200	0	1	0.15	0.15	1322	395	0.30
Fărău	1329	8078	0	1	0.15	0.15	2866	2540.7	0.89
Feleacu	840	12824	0	1	0.15	0.15	1616	2763.6	1.71
Fizeșu Gherlii	418	4601	370	1	0.15	0.15	1618	1163.65	0.72
Florești	543	5505	249	1	0.15	0.15	1881	1406.1	0.75
Gherla	547	5621	22	1	0.15	0.15	872	1393.45	1.60
Hopârta	722	4640	0	1	0.15	0.15	2092	1418	0.68
Iara	300	1664	257	1	0.15	0.15	4128	588.15	0.14
Iclod	1496	3380	0	1	0.15	0.15	1808	2003	1.11
Jidvei	943	5940	0	1	0.15	0.15	2116	1834	0.87
Jucu	1928	7368	0	1	0.15	0.15	3131	3033.2	0.97
Loamneș	249	22096	16	1	0.15	0.15	4386	3565.8	0.81
Lopadea Nouă	690	3800	120	1	0.15	0.15	2792	1278	0.46

Mihăileni	466	2550	0	1	0.15	0.15	1914	848.5	0.44
Mihalț	920	4200	0	1	0.15	0.15	1476	1550	1.05
Nocrich	1180	12150	320	1	0.15	0.15	4872	3050.5	0.63
Ocna Sibiului	487	11628	26	1	0.15	0.15	3738	2235.1	0.60
Ohaba	226	3500	0	1	0.15	0.15	986	751	0.76
Petrești de Jos	469	9715	550	1	0.15	0.15	1990	2008.75	1.01
Ploscoș	432	2878	15	1	0.15	0.15	663	865.95	1.31
Rădești	393	8529	132	1	0.15	0.15	1137	1692.15	1.49
Roșia	1730	11000	0	1	0.15	0.15	6379	3380	0.53
Sâncel	650	5600	0	1	0.15	0.15	934	1490	1.60
Sănduleşti	280	1350	0	1	0.15	0.15	482	482.5	1.00
Săvădisla	942	4630	0	1	0.15	0.15	4188	1636.5	0.39
Șeica Mare	780	7200	0	1	0.15	0.15	3157	1860	0.59
Șeica Mică	485	5792	0	1	0.15	0.15	2480	1353.8	0.55
Sibiu	1386	10958	282	1	0.15	0.15	2991	3072	1.03
Sic	465	1250	0	1	0.15	0.15	2638	652.5	0.25
Slimnic	596	23715	52	1	0.15	0.15	3138	4161.05	1.33
Șona	879	1426	427	1	0.15	0.15	2812	1156.95	0.41
Șura Mare	814	12022	309	1	0.15	0.15	1725	2663.65	1.54
Șura Mică	533	5803	36	1	0.15	0.15	1166	1408.85	1.21
Teiuș	359	3761	177	1	0.15	0.15	741	949.7	1.28
Turda	409	5331	11	1	0.15	0.15	1457	1210.3	0.83
Tureni	418	8274	0	1	0.15	0.15	1874	1659.1	0.89
Valea Lungă	272	4878	500	1	0.15	0.15	2223	1078.7	0.49
Viișoara	1341	2575	0	1	0.15	0.15	1098	1727.25	1.57
Vultureni	826	4448	0	1	0.15	0.15	2192	1493.2	0.68
Vurpăr	795	5960	0	1	0.15	0.15	2828	1689	0.60

Estimation of Permeability Scores Based on Livestock Grazing Load (LU/ha)

To transform LU/ha values into permeability scores (0–10), a Gaussian (normal) function was applied, centered on the interval considered optimal for grazing, 0.4–0.6 LU/ha (Marușca et al., 2014), corresponding to the maximum permeability value. The formula used is:

$$\text{Permeability Score} = 10 * e^{-\frac{(LU_{mean} - \mu)^2}{2\sigma^2}}$$

unde:

- LU_{mediu} = livestock grazing load for the administrative unit (LU/ha)
- μ\muμ = optimal value for grazing, , 0,5 LU/ha
- σ=0,16 = standard deviation, which controls the width of the Gaussian "curve."

Thus, parcels with LU values close to 0.5 LU/ha receive the maximum score (10), while much lower or higher values receive reduced scores, reflecting decreased permeability.

The results of these calculations are presented in Table 4.
The transformation of the livestock grazing load (LU/ha) into permeability scores (0–10) using a scaled Gaussian function, centered on the optimal μ=0.5 LU/ha, is visualized in **Figure 1**.

Table 4. Permeability Scores (0–10) Estimated from Livestock Grazing Load (LU/ha) Using a Gaussian Function

LU Interval	Mean LU	Permeability Score
0,0–0,1	0,05	1
0,1–0,2	0,15	3
0,2–0,3	0,25	5
0,3–0,4	0,35	8
0,4–0,5	0,45	10
0,5–0,6	0,55	10
0,6–0,7	0,65	8
0,7–0,8	0,75	5
0,8–0,9	0,85	3
0,9–1,0	0,95	1
Peste 1,0	1,05	0

Note: The raw values calculated with the Gaussian function were further scaled and rounded to integer scores from 0 to 10 for practical use in tables and analyses.

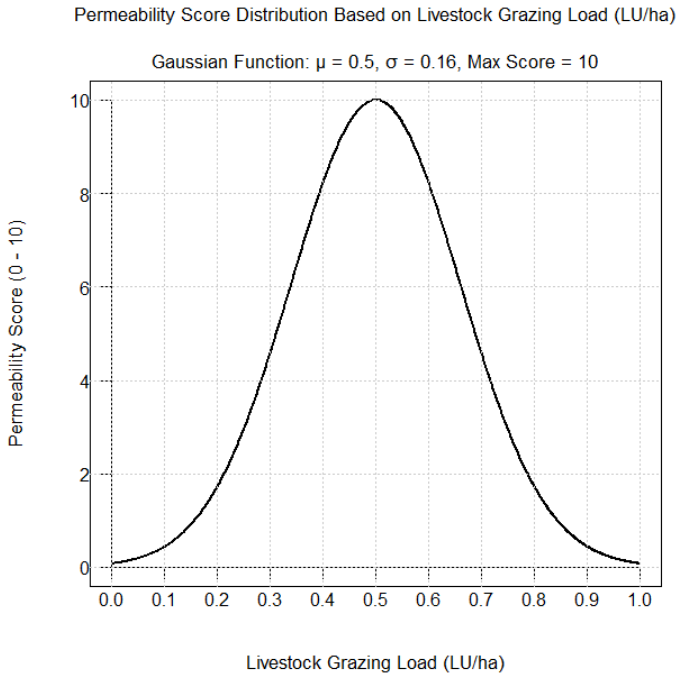

Figure 1. Scaled Gaussian Function for Estimating Permeability Scores from Livestock Grazing Load (LU/ha)