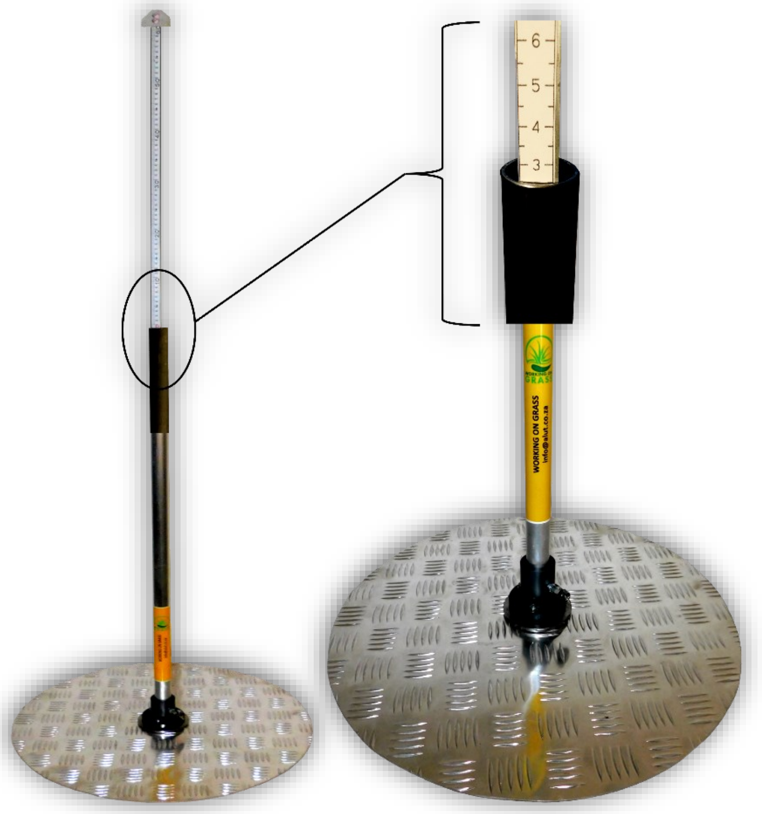
DISC PASTURE METER

FOR NATURAL RANGELAND



USER'S GUIDE

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1. INTRODUCTION

The Disc Pasture Meter (DPM) originated in New Zealand during the 1970s as a tool for estimating grass biomass in cultivated pastures. Its versatility led to adaptations for natural rangelands by Bransby and Tainton in 1977. Since then, it has found widespread use in grassland and savanna regions, notably in southern and East Africa. The rangeland version of the DPM is slightly larger and heavier than the ones designed for planted pastures.

The primary use of the DPM is to determine grass biomass production, typically expressed in kilograms of dry grass matter per hectare (kg DM/ha). This data serves various purposes, including assessing rangeland conditions, estimating grazing capacity, and making decisions related to prescribed burning.

Rangeland scientists have developed various calibration equations for different ecological regions, while custom calibration equations can also be established for specific areas (e.g. Trollope *et al*, 2000).

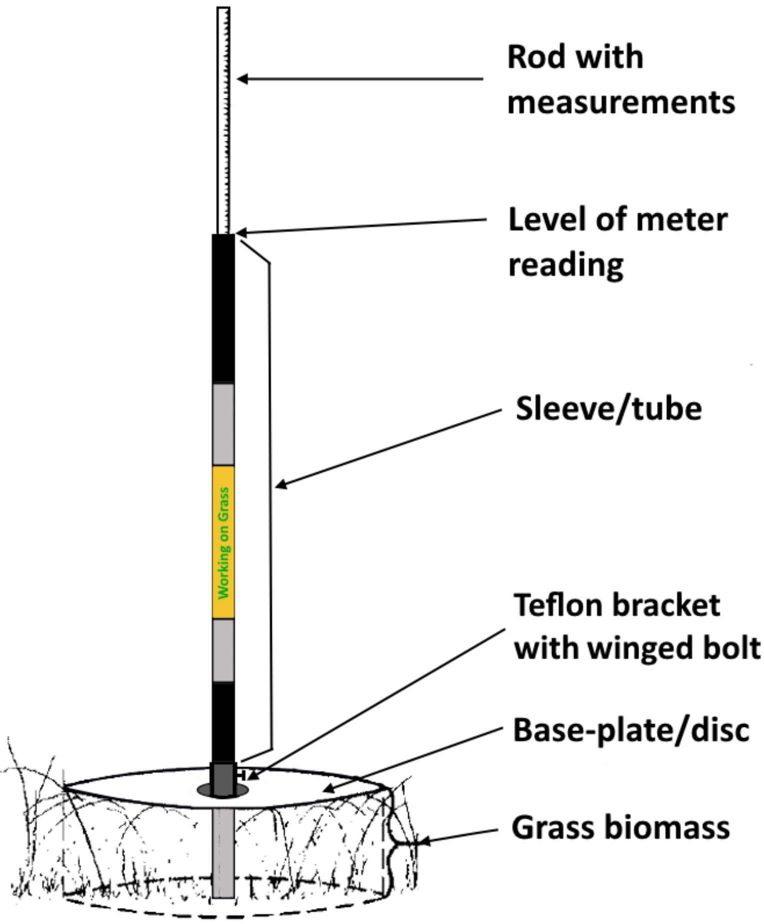
Using a DPM in conjunction with an appropriate equation is considered a quicker alternative to the traditional method of clipping, drying, and weighing plant material to estimate biomass production.

2. PARTS OF THE DPM

The Disc Pasture Meter consists of two main components. Firstly, it features an aluminium disc (base plate) with an aluminium sleeve (tube) attached to its top. The sleeve is attached to the disc via a teflon bracket fastened by a winged bolt. The top and lower part of the sleeve is covered with plastic tubing to prevent smearing.

Secondly, it includes a rod that slides into the sleeve. The upper 60 cm portion of the rod is marked with measurements in centimetres, indicated in half-centimetre increments, moving in an upward direction.

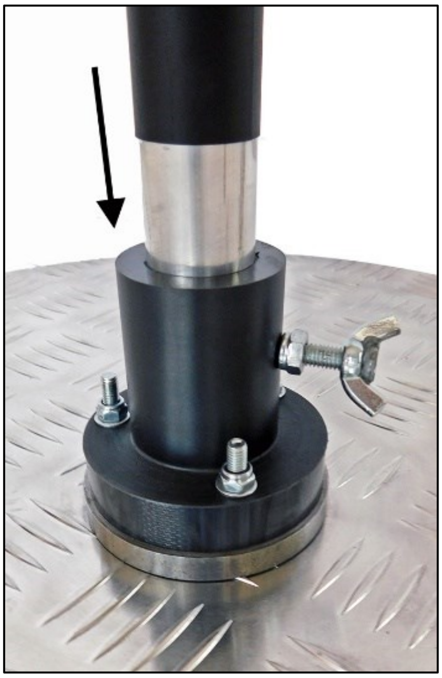
The different parts of the DPM →



3. ASSEMBLY OF THE DPM

To facilitate shipment, the instrument is divided into four separate components: the disc plate, the tube, the upper part of the rod, and the lower part of the rod. To assemble and prepare the instrument for use, follow these assembly steps:

3.1. Tube attachment

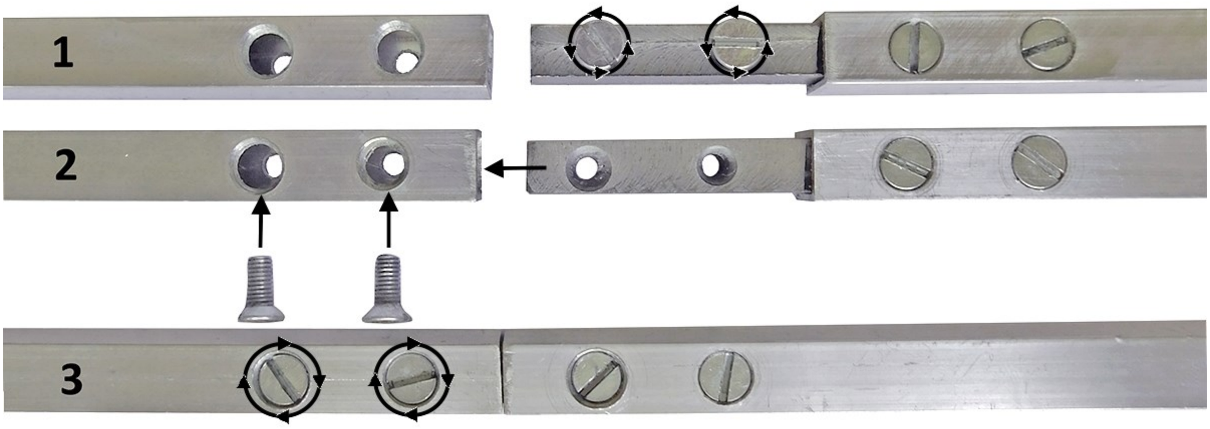


Begin by attaching the tube to the disc. Insert the lower part of the tube (the shorter section without the black plastic coverage) into the teflon bracket fixed on top of the disc plate. Ensure that the winged bolt on the bracket is fully extended before proceeding. Make sure the tube is inserted to its lowest position. Afterward, fasten the winged bolt, ensuring it is not overly tightened to prevent damage to the tube.

3.2. Rod connection

Join the two parts of the rod. There is a short solid metal bracket affixed to one half of the rod. Using a flat-tipped screwdriver, remove the two bolts that are directly attached to this bracket. Slide this bracket into the other half of the rod, which already has the bracket fixed (using the same type of bolts). Ensure that the threaded holes in the bracket align with the holes in the aluminium rod. Use the bolts previously removed to secure the two parts of the rod together.

Note: The instrument can be disassembled and reassembled for easy transportation.



Connecting the two halves of the rod.

4. HOW TO USE THE DPM

The following steps can be used to operate the Disc Pasture Meter:

1. Hold the central rod perpendicular to the ground surface. When using it on uneven terrain, ensure that the lower end of the rod does not enter a hole or rest on top of a mound or tuft of grass.
2. Release the sleeve with the attached disc onto the grass sward from a position where the upper end of the rod is level with the top of the sleeve. This ensures that the disc is consistently released from a standard height of 60 cm above the ground. Select a point where only grass occur to prevent non-grass plants from influencing the settling height.
3. Read the settling height of the disc from the rod, corresponding to the upper end of the sleeve.
4. For each sample, record at least 100 or 50 readings along a straight-line transect, typically at one-step or one-meter intervals.
5. After recording the data, calculate the average settling height (in centimetres) for each sample site.
6. Apply a suitable equation to convert the average settling height to the estimated grass biomass production (in kg DM/ha) for each sample site.

5. MAINTENANCE OF THE DPM

To ensure the DPM remains in optimal condition for long-term use, consider the following maintenance guidelines:

- Only release the disc plate onto grass biomass. Avoid dropping it onto rocks or other hard materials.
- Before usage, check that all bolts are securely fastened. This includes the bolts securing the Teflon bracket to the disc, the winged bolt on the side of the bracket holding the sleeve at its lowest position, and the bolts connecting the two halves of the rod.
- When disassembling the tube from the disc, avoid standing on the disc and pulling the tube out of the bracket. Instead, hold the disc in one hand and arm while pulling and twisting the tube with the other hand. Ensure that the winged bolt on the bracket's side is released.
- If the black plastic tube coverings on the tube become loose, they can be reattached using clear adhesive. To do this, remove the covering, apply a thin layer of adhesive to the aluminium tube, and then slide the plastic cover back into place. Allow 12 hours for the adhesive to dry.

6. CALIBRATION EQUATIONS

As mentioned, various calibration equations have been developed and published for use with the DPM. The references list, provided at the end of this document, contains article references to the equations developed for the DPM. Below follows calibration table based on most of the equation available.

7. CALIBRATION TABLE

	Convert centimetres disc height to kg DM/ha											
	Savanna biome						Grassland biome			Planted pasture		
Disc height (cm)	Subtropical Kruger Park (Trollope)	Subtropical Kruger Park (Zambatis)	Kalahari duneveld (Harmse)	Woodland Caprivi (Trollope)	Meru Kenya (Botha)	Masai Mara Kenya (van Essen)	KZN Midlands (Klug)	Highland sourveld (Kreuter)	Zululand coast (Brockett)	Kikuyu (Bartho-lomew)	Ryegrass (Bartho-lomew)	Eragrostis (Bransby & Tainton)
0,5	0	7	210	0	0	188	37	0	1 156	871	1 179	0
1,0	0	104	317	158	0	511	142	0	1 312	992	1 257	0
1,5	0	279	423	561	0	759	246	0	1 469	1 114	1 335	0
2,0	177	480	530	900	0	968	351	0	1 626	1 235	1 413	0
2,5	554	683	637	1 199	333	1 152	456	0	1 783	1 357	1 491	0
3,0	895	881	744	1 469	684	1 319	561	85	1 940	1 478	1 569	93
3,5	1 209	1 071	850	1 718	1 006	1 472	665	223	2 097	1 599	1 647	243
4,0	1 501	1 252	957	1 949	1 306	1 614	770	362	2 254	1 721	1 725	392
4,5	1 775	1 426	1 064	2 166	1 588	1 748	875	500	2 410	1 842	1 803	542
5,0	2 035	1 592	1 170	2 372	1 854	1 874	979	638	2 567	1 964	1 881	691
5,5	2 281	1 751	1 277	2 567	2 108	1 995	1 084	777	2 724	2 085	1 959	841
6,0	2 517	1 903	1 384	2 754	2 350	2 110	1 189	915	2 881	2 206	2 037	990
6,5	2 743	2 050	1 490	2 933	2 583	2 220	1 294	1 053	3 038	2 328	2 115	1 140
7,0	2 960	2 192	1 597	3 106	2 806	2 326	1 398	1 192	3 195	2 449	2 193	1 289
7,5	3 170	2 330	1 704	3 272	3 022	2 429	1 503	1 330	3 352	2 570	2 272	1 439
8,0	3 373	2 463	1 810	3 433	3 230	2 528	1 608	1 468	3 508	2 692	2 350	1 588
8,5	3 570	2 591	1 917	3 589	3 433	2 624	1 712	1 607	3 665	2 813	2 428	1 738
9,0	3 761	2 717	2 024	3 740	3 629	2 717	1 817	1 745	3 822	2 935	2 506	1 887
9,5	3 947	2 839	2 130	3 887	3 820	2 808	1 922	1 883	3 979	3 056	2 584	2 037
10,0	4 128	2 958	2 237	4 031	4 006	2 896	2 027	2 022	4 136	3 177	2 662	2 186
10,5	4 304	3 073	2 344	4 171	4 187	2 982	2 131	2 160	4 293	3 299	2 740	2 336

11,0	4 477	3 187	2 450	4 307	4 365	3 066	2 236	2 298	4 449	3 420	2 818	2 485
11,5	4 645	3 297	2 557	4 441	4 538	3 149	2 341	2 437	4 606	3 542	2 896	2 635
12,0	4 810	3 406	2 664	4 571	4 707	3 229	2 445	2 575	4 763	3 663	2 974	2 784
12,5	4 971	3 512	2 771	4 699	4 873	3 308	2 550	2 714	4 920	3 784	3 052	2 934
13,0	5 130	3 616	2 877	4 825	5 036	3 385	2 655	2 852	5 077	3 906	3 130	3 083
13,5	5 285	3 718	2 984	4 948	5 195	3 461	2 759	2 990	5 234	4 027	3 208	3 233
14,0	5 437	3 818	3 091	5 068	5 352	3 535	2 864	3 129	5 391	4 149	3 286	3 382
14,5	5 587	3 917	3 197	5 187	5 506	3 608	2 969	3 267	5 547	4 270	3 364	3 532
15,0	5 734	4 014	3 304	5 304	5 657	3 680	3 074	3 405	5 704	4 391	3 442	3 681
15,5	5 879	4 109	3 411	5 418	5 806	3 751	3 178	3 544	5 861	4 513	3 520	3 831
16,0	6 021	4 203	3 517	5 531	5 952	3 820	3 283	3 682	6 018	4 634	3 598	3 980
16,5	6 161	4 295	3 624	5 642	6 096	3 888	3 3 88	3 820	6 175	4 756	3 676	4 130
17,0	6 299	4 386	3 731	5 752	6 238	3 956	3 4 92	3 959	6 332	4 877	3 754	4 279
17,5	6 435	4 476	3 837	5 859	6 378	4 022	3 597	4 097	6 489	4 998	3 832	4 429
18,0	6 569	4 564	3 944	5 966	6 516	4 088	3 702	4 235	6 645	5 120	3 910	4 578
18,5	6 702	4 652	4 051	6 070	6 652	4 152	3 807	4 374	6 802	5 241	3 988	4 728
19,0	6 832	4 738	4 157	6 174	6 786	4 216	3 911	4 512	6 959	5 363	4 066	4 877
19,5	6 961	4 823	4 264	6 276	6 918	4 279	4 016	4 650	7 116	5 484	4 144	5 027
20,0	7 088	4 907	4 371	6 377	7 049	4 341	4 121	4 789	7 273	5 605	4 222	5 176
25,0	8 281	5 696	5 438	7 322	8 275	4 923	5 168	6 172	8 841	6 819	5 003	6 671
30,0	9 360	6 275	6 505	8 177	9 384	5 449	6 215	7 556	10 410	8 033	5 783	8 166
40,0	11 275	6 910	8 638	9 694	11 352	6 384	8 309	10 323	13 547	10 461	7 343	11 156
50,0	12 962	7 095	10 772	11 031	13 086	7 207	10 403	13 090	16 684	12 889	8 904	14 146

Compiled by Alan Short, Themeda Eco Consulting, and Frits van Oudtshoorn, Working on Grass.
While every effort was made to ensure the accuracy of this table, the use of these data is at the user's own risk.

8. DISC PASTURE METER EQUATIONS

Vegetation type	Authors	Region	Form of equation	Units	a	b	Conversion factor
Savanna	Trollope & Potgieter, 1986	Kruger NP	$y=a\sqrt{x} + b$	kg/ha	2260	-3019	1
Savanna	Trollope, 1983	Eastern Cape	y=ax+b	kg/ha	388,3	340	1
Savanna	Botha, 1999	Meru, Kenya	$y=a\sqrt{x} + b$	kg/ha	2323	-3340	1
Savanna	Turner, 1990	Semi-arid savanna, KZN	y=ax+b	kg/ha	271	882	1
Savanna	Trollope, Undated	Caprivi, Namibia	$y=a\sqrt{x} + b$	kg/ha	1791	-1633	1
Savanna	Zambatis et al, 2006	Kruger NP	$y = [31.7176\,(0.3218^{1/x})\,x^{0.2834}]^2$			Height level < 26 cm	
			$y = [17.3543\,(0.9893^{x})\,x^{0.5413}]^2$			Height level > 26 cm	
Sour grassveld	Kreuter, 1985	Kokstad, early summer	y=(ax+b)	t/ha	0,1771	-0,3949	1000
Sour grassveld	Kreuter, 1985	Kokstad, late summer	y=ax+b	t/ha	0,2767	-0,7453	1000
Sour grassveld	Kreuter, 1985	Kokstad, autumn	y=ax+b	t/ha	0,318	0,6177	1000
Sour grassveld	Hardy & Mentis, 1985	Ukulinga TTR-TLE veld	y=ax+b	g/quadrat	4,09	8,39	60,72
Sour grassveld	Hardy & Mentis ,1985	Ukulinga TTR-TLE-AJU veld	y=ax+b	g/quadrat	4,64	4,24	60,72
Sour grassveld	Klug, 1989	Ukulinga - burn control	y=ax+b	kg/ha	238,5	-316,52	1
Sour grassveld	Klug, 1989	Ukulinga - burn 40 days	y=ax+b	kg/ha	267,56	-205,09	1
Sour grassveld	Klug, 1989	Ukulinga - burn 80 days	y=ax+b	kg/ha	154,86	174,04	1

Sour grassveld	Klug, 1989	Ukulinga - burn combined	y=ax+b	kg/ha	209,42	-67,75	1
Sour grassveld	Klug, 1989	Ukulinga - mow control	y=ax+b	kg/ha	202,63	-153,68	1
Sour grassveld	Klug, 1989	Ukulinga - mow 40 days	y=ax+b	kg/ha	162,79	189,53	1
Sour grassveld	Klug, 1989	Ukulinga - mow 80 days	y=ax+b	kg/ha	243,66	-173,58	1
Sour grassveld	Klug, 1989	Ukulinga - mow combined	y=ax+b	kg/ha	212,67	-57,86	1
Sour grassveld	Klug, 1989	Ukulinga - burn-mow combined	y=ax+b	kg/ha	210,61	-60,65	1
Coastal plains	Brockett, 1996	Zululand, KZN	y-ax+b	kg/ha	313,7	998,7	1
Gordonia duneveld	Harmse et al, 2019	South-Western Kalahari	y-ax+b	kg/ha	213,37	103,36	1
Shortgrass Prairie	Trollope, undated	Konza prairie, USA	y=a√x + b	kg/ha	1586	-882	1
Eragrostis (planted)	Bransby & Tainton, 1977	Kokstad, KZN	y=ax+b	kg/ha	299	-804	1
Kikuyu (planted)	Bartholomew, 1985	Cedara, KZN	y=ax+b	kg/ha	242,79	749,5	1
Ryegrass (planted)	Bartholomew, 1985	Cedara, KZN	y=ax+b	kg/ha	156,06	1101	1

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9. REFERENCES AND ADDITIONAL INFORMATION

Below follows a list of scientific articles published on the Disc Pasture Meter.

Bartholomew PE. 1985. Beef production from kikuyu and Italian Ryegrass. PhD Thesis, University of Natal, Pietermartizburg.

Botha JO. 1999. A resource management plan for the Lewa Wildlife Conservancy in the Meru District of the central highlands of Kenya. MSc. Thesis South Africa: University of Pretoria.

Bransby DI. & Tainton, N. M. 1977. The disc pasture meter: possible applications in grazing management. Proceedings of the Grassland Society of Southern Africa, 12, 115-118.

Brockett BH. 1996. Research note: calibrating a disc pasture meter to estimate grass fuel loads on the Zululand coastal plain. African Journal of Range and Forage Science 13: 39–41.

Hardy MB & Mentis MT. 1985. The relative efficiency of three methods of estimating herbage mass in veld. JGSSA 2(1): 35-38.

Harmse CH, Dreber N & Trollope WSW. 2019. Disc pasture meter calibration to estimate grass biomass production in the arid dunefield of the southwestern Kalahari. African Journal of Range & Forage Science 2019, 36(3): 161–164.

Krueter UP. 1985. An investigation of selection by cattle under continuous and rotational grazing of sourveld. MSc Agric thesis, UNP.

Trollope WSW & Potgieter ALF. 1986. Estimating grass fuel loads with a disc pasture meter in the Kruger National Park. Journal of the Grassland Society of South Africa 3(4): 148–152.

Trollope WSW 1983. Control of bush encroachment with fire in the arid savannas of southeastern Africa. PhD thesis, UNP.

Trollope WSW, Hines CJH & Trollope LA. 2000. Simplified techniques for assessing range condition in the East Caprivi Region of Namibia. Final Report of the Namibia-Finland Forestry Programme in the East Caprivi Region of Namibia, pp. 1–67.

Turner JP. 1990. The development of stocking rate models for three veld types in Natal. PhD thesis, UNP.

Van Essen LD, Bothma JduP, van Rooyen N. & Trollope W.S.W. 2000. Estimation of the herbaceous standing crop of the grassy plains of OI Choro Oiroua in the Masai Mara region of Kenya, African Journal of Range and Forage Science, 17:1-3, 115-118.

Zimbatis N, Zacharia PJK, Morris CD & Derry JF. 2006. Re-evaluation of the disc pasture meter calibration for the Kruger National Park, South Africa. African Journal of Range and Forage Science 32(2): 85–97.