What distance from water should we use to estimate paddock carrying capacity?

Robyn A Cowley[A], Dale Jenner[B] and Dionne Walsh[A]

[A]Department of Primary Industry and Fisheries, GPO Box 3000, Darwin NT 0801. E: robyn.cowley@nt.gov.au,M: 0419 829 493

[B]Department of Primary Industry and Fisheries, PO Box 8760, Alice Springs, NT, 0871. E: dale.jenner@nt.gov.au, Ph: 08 8951 8152

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Abstract

Large, extensively grazed paddocks in Australian rangelands are often poorly watered, which causes overgrazing close to water and relatively ungrazed areas further from water. To adjust for watered area when estimating carrying capacity, estimates within 0 to 3 km and 0 to 5 km from water are typically used. We calculated the proportion of total forage consumed with distance from water in grazing trials in the Victoria River District and Barkly regions of the Northern Territory, by multiplying average defoliation estimates within 500m distance to water (DTW) bands by area of DTW bands. Cattle grazed further from water in less well watered paddocks, with more cattle per water point and with lower available forage per head. 90% of grazing occurred within 3km of well watered paddocks but within 5km from water in poorly watered paddocks. However, even in large poorly watered paddocks at least 70% of grazing occurred within 3km from water. This study confirms our current approach of calculating carrying capacity within a 3km grazing radius in well watered paddocks. Applying a 5km grazing radius when calculating carrying capacity in poorly watered paddocks will account for the greater distances travelled by cattle in these circumstances, but will result in very high utilisation and poor land condition closer to water, and is not recommended.

Introduction

An important component of estimating a paddock or station livestock carrying capacity, is taking into account how animals use paddocks in relation to water distribution. Cattle in northern Australia typically walk between 6-7km a day (e.g. Hunt *et al.* 2013), returning to water most days resulting in defoliation decreasing further from water (e.g. Fisher 2001). There is ongoing debate about whether carrying capacity should be calculated within 3 or 5km from water. This study reviews recent grazing trials in the NT to determine what proportion of the total forage consumed occurs at different distances from water, adjusting for the increasing areas with distance from water. Should 3km, 5km or some other grazing radius be assumed for calculating carrying capacity?

Methods

There were 9 study sites (Table 1) from 3 stations in two regions of the Northern Territory. All paddocks were composed of predominantly vertosol soils and were continuously grazed. The proportion of all paddocks in each 0.5km distance band from water was calculated in ArcMap. Distance to water bands were intersected with on-ground monitoring points (using their GPS locations) from grazing trials to provide DTW for each ground datum point. Grazing scores (with equivalent defoliation levels shown in brackets) [0- (0%), 1- (1–5%), 2- (6–25%), 3- (26–50%), 4- (51–75%), 5- (76–100%)] were then averaged for each DTW band. Average grazing scores were converted to the corresponding defoliation values. Calculated defoliation was multiplied by the area of each distance band to give the proportion of total forage consumed with distance from water.

Table 1: Characteristics of study sites. Stocking strategies include F-fluctuating to match seasonal conditions, I – increasing, S – set stocked. a- Hunt et al. 2013, b- Walsh unpublished, c-Scott et al. unpublished.

Region	Paddock (data source)	Stocking strategy	Number of years data	Paddock area (km^2)	Number of waters	Maximum distance from water (km)	% paddock within 3km from water	% paddock > 5km from water
VRD	1[a]	F	5	9	1	2.4	100	0
VRD	2[a]	F	5	34	2	3.4	97	0
VRD	3[a]	F	5	21	1	3.9	93	0
VRD	4[a]	F	5	20	1	3.9	88	0
VRD	5[a]	F	5	57	5	5.3	83	0.2
VRD	6[a]	F	5	21	1	4.9	77	0
VRD	7[a]	F	5	34	1	4.6	72	0
Barkly	8[b]	I	5	703	20	7.1	57	4
Barkly	9[c]	S	2	56	2	10	41	19

Results

Water availability was expressed as either maximum distance from water or % of paddock further than 3km from water. Both measures were highly correlated, despite varying paddock shapes, sizes and number of waters (r^2=0.92, p<0.0001, n=9), and both were predictors of paddock use by cattle with distance from water. Paddock use in relation to distance from water was expressed as the proportion of total forage consumed within 3km from water and the distance at which 90% of total forage was consumed. Forage was more likely to be consumed further from water when paddocks were less well watered, although there was some variation year to year for each paddock (Table 2).

Table 2. The proportion of total forage consumed with distance from water. na - not applicable because paddocks did not extend beyond specified distance from water. Average of all years.

Paddock	Average (min -max) % total forage consumed 0-3km	Average (min-max) % total forage consumed > 3km	Average (min-max) % total forage consumed >5km	Average (min-max) distance >=90% forage consumed (km)
1	100(100-100)	na	na	2.0(2-2)
2	97(92-100)	3(0-8)	na	3.0(3-3)
3	99(99-99)	1(1-1)	na	2.8(2.5-3)
4	90(85-96)	10(4-15)	na	3.2(3-3.5)
5	92(89-98)	8(3-12)	0(0-0)	3.0(2.5-4)
6	90(79-96)	10(4-21)	na	3.3(3-4)
7	81(69-94)	19(6-31)	na	3.5(2.5-4)
8	75(66-86)	25(14-34)	na	4.2(3.5-4.5)
9	69(56-82)	31(18-44)	11(3-18)	5.0(4-6)

When sites were averaged across all years, the proportion of total forage consumed further than 3km from water, and the distance from water at which at least 90% of total forage was consumed increased with the proportion of the paddock that was further than 3km from water (r^2=0.95, p=0.0001, r^2=0.91, p<0.0001, respectively, n=9, Fig. 1a) and with increasing maximum distance from water in a paddock (r^2=0.81, p<0.001, r^2=0.89, p=0.0001, respectively, n=9, not shown), but not paddock size, number of waters, TSDM or stocking rate (not shown).

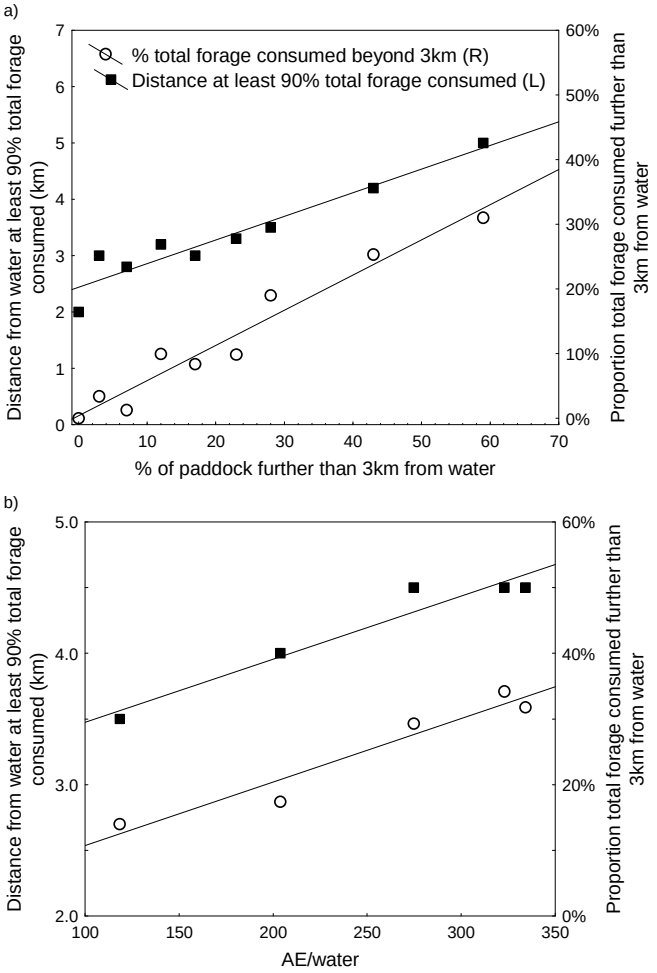

Fig. 1. Relationship between the distance from water cattle grazed and a) the proportion of the paddock that was further than 3km from water and b) stocking rate per water point for paddock 8. Left axis black squares, right axis open circles.

Factors influencing year to year variation in where forage was consumed in a paddock were examined for the largest paddock (Fig. 1b). The proportion of total forage consumed further than 3km from water and the distance from water at which 90% of total forage was consumed increased with increasing paddock stocking rate and AE/water (r^2=0.93, p=0.008, r^2=0.94, p=0.007 respectively, n=5) and lower TSDM/AE (although not quite significant r^2=0.74, p=0.06, n=5), but was not correlated with seasonal conditions (rainfall or average paddock TSDM in May).

Discussion

This analysis suggests that how far cattle graze from water is partly dependent on water availability in the paddock. In poorly watered paddocks, cattle grazed further from water. This explains the disparity in cattle use with DTW found at smaller research sites versus anecdotal and documented evidence in the Barkly (Fisher 2001) that cattle walk much further in commercial paddocks, which tend to be larger and less well watered.

Although grazing extended further than 3km from water in the less well watered paddocks, at least 70% of total forage consumption was still within 3km, even in the most poorly watered paddocks. The distance at which 90% forage was consumed in the least well watered paddock was similar to where 90% of cattle activity was found in poorly watered commercial paddocks in the Barkly (5 vs. 5-6km, Fisher 2001) and in the VRD (5.3km, Hunt *et al.* 2013). That cattle grazed further from water with higher AE per waterpoint and lower available forage per head, suggests cattle walk further from water when forage becomes limiting closer to water. Higher distances travelled are likely to have a cost to productivity.

Conclusion

Despite cattle altering their behaviour in poorly watered paddocks, most grazing still occurred within 3km from water. Reducing AE per water either by adding waters, or reducing paddock stocking rates will reduce distance walked by cattle to graze in large poorly watered paddocks. This study confirms our current approach of calculating carrying capacity within a 3km grazing radius in well watered paddocks. Applying a 5km grazing radius when calculating carrying capacity in poorly watered paddocks will account for the greater distances travelled by cattle in these circumstances, but given that most grazing still occurred within 3km, stocking paddocks to the carrying capacity based on a 5km grazing radius will result in very high utilisation and poor land condition closer to water, hence is not recommended.

References

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