**Supplemental Material Table 1**. Studies with changes in grazing pattern complexity. Studies that also had extended rest treatments are indicated with an “E”. Abbreviations used in this and following tables include: Livestock: C(cattle), M(mixed), S(sheep), G(goats), L(livestock); Dur (Y) = treatment duration in years; Trt=Grazing system treatment: C(continuous), R(rotational), Ada (adaptive), For (agroforestry); SR =stocking rate: L(low), M(moderate), H(heavy), if “n/a”, M was used for analysis; “d/y” = number of grazing days per year; rest (d) = number of days per year; % red. SR = percent that SRs (ha/AU/y) were reduced. Specific grazing systems were noted if mentioned clearly by authors: HILF: High intensity low frequency, DR: Deferred rotation, SD: Short duration, PMR: Planned multi-paddock rotational, Rot: Rotational, Res: Residual biomass. Vegetation column highlights select features described by authors.

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| **\*** | **First Author** | **Year Pub.** | **Site** | **Prec (mm)** | **Livestock** | **Vegetation** | **Dur (Y)** | **Trt** | **SR** | **(Orig) AU/ha** | **d/y** | **ha/AU/y** | **(Trt) AU/ha** | **d/y** | **ha/AU/y** | **rest (d)** | **% red. SR** | **NOTES** |
|  | Sharrow | 2007 | US, OR | 1085 | S | Pasture (Clover, Perennial ryegrass, annual grasses) | 11 | For | n/a | 60.00 | 8 | 1 | - | - | - | - | - | 300-400 ewes/ha; Apr, Jun; 4:60; res:5 cm |
| E | Dedjir Gamougoun | 1984 | US, NM | 384 | L | Prairie (Shortgrass prairie, grasses, forbs) | 12 | R | H | 0.08 | 270 | 17 | 0.18 | 120 | 17.3 | 91 | 0 | Rot (4-3) |
|  | Kumar | 2012 | US, MO | 967 | C (Beef, 520 kg) | Pasture (tall fescue, red clover,) | 3 | R | M | - | 210 | - | - | 35 | - | 17.5 | 0 | Rot (6-paddock, 3 cattle) |
| E | McGinty | 1978 | US, TX | 572 | M (C,S,G; 3:1:1) | Woody (mesquite, threeawn, sideoats) | 7 | R | H | 0.23 | 315 | 5 | 0.26 | 274 | 5.2 | 91 | 4 | DR (4-3) |
| E | Pluhar | 1987 | US, TX | 680 | C (Cow-Calf) | Prairie (midgrass, shortgrass, native) | 24 | R | M | 0.20 | 315 | 5.8 | 0.30 | 274 | 5.8 | 91 | 0 | DR (4-3) |
|  | Proffitt | 1995 | Australia | 307 | S | Pasture (annual legume pasture-wheat) | 1 | Ada | n/a | 1.40 | 119 | 2.2 | 1.40 | 81 | 3.2 | 3 | 48 | Removed occasionally based on soil moisture |
| E | Tadesse (a) | 2002 | Ethiopia | 1360 | M (C,S,G) | Perennial (native grasses, forbs) | 4 | R | H | 21.95 | 365 | 0.02 | 65.97 | 156 | 0.01 | 4 | 603 | 3d/wk |
|  | Teague | 2010 | US, TX | 648 | C (Beef) | Woody (mesquite savanna, grass & forbs) | 3 | R | M | 0.12 | 220 | 14 | 0.95 | 28 | 14.0 | 68 | 0 | Rot (8-1); based on res |
| E | Teague | 2011 | US, TX | 820 | C (Cow-Calf) | Prairie (Tall grass) | 9 | R | H | 0.45 | 220 | 3.7 | 12.32 | 8 | 3.7 | 55 | 0 | PMR (based on res) |
| E | Thurow | 1986 | US, TX | 609 | M (C,S,G) | Woody (oak mottes, bunchgrass, sodgrass) | 4 | R | H | 0.33 | 240 | 4.6 | 4.46 | 18 | 4.6 | 50 | 0 | SD (14-1; 4:50d) |
| E | Weltz | 1986 | US, NM | 426 | C | Woody (Blue grama, grasses, forbs) | 2 | R | H | 0.07 | 365 | 13.5 | - | - | 14.0 | 50 | 4 | SD (4d graze) |
| E | " | " | " | " | " | " | 3 | R | M | 0.04 | 365 | 26.6 | - | - | 13.3 | 50 | -50 | SD (3d graze) |
| E | Wood | 1981 | US, TX | 680 | C (Cow-Calf) | Woody (Wintergrass, sideoats grama) | 4 | R | M | 0.29 | 200 | 6.2 | 3.30 | 17 | 6.5 | 119 | 5 | HILF; 8-1; 17:119 |
| E | " | " | " | " | " | " | 20 | R | M | 0.29 | 200 | 6.2 | 0.16 | 365 | 6.2 | 120 | 0 | DR (4-3, 12:4m) |

**Supplemental Material Table 2.** Studies with changes in stocking rates without other major changes to the complexity of grazing patterns. “Variable changed” as reported by authors is listed, along with the original value (V0) of that variable and the % reduction of all available treatment measurements (V1, V2, V3). Abbreviations are as noted above.

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|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | **% reduction** | | |  |
|  | **First Author** | **Year** | **Site** | **Prec (mm)** | **Livestock** | **Vegetation** | **Dur (Y)** | **Sys** | **SR (Orig)** | **SR (Trt)** | **(Orig) AU/ha** | **d/y** | **ha/AU/y** | **Variable changed** | **V0** | **V1** | **V2** | **V3** | **NOTES** |
| E | Bari | 1993 | Pakistan | 625 | L | Grass (grasses, forbes) | 2 | C | H | M,L | - | - | - | Res phytomass (kg/ha) | 624 | 65 | 131 | - |  |
|  | Chartier | 2011 | Argentina | 258 | S | Woody (Grass to shrub steppe; perennial grasses) | - | C | H | M,L | 0.1 | 365 | 16.7 | Veg | Grass steppe | Grass steppe | Shrub steppe | - | 0.3 S/ha common |
| E | Dedjir Gamougoun | 1984 | US, NM | 384 | L | Prairie (Shortgrass prairie, grasses, forbs) | 3 | C | H | M | - | - | 17.3 | ha/AU | 17 | 25 | - | - | M SR = 75% H SR |
| E | du Toit | 2009 | S Africa | 366 | S | Woody (Common shrubs, Karoo bushes, grasses) | 2 | C | H | M,L | 1.8 | 30 | 6.8 | SSU/ha | 16 | 50 | 75 | - |  |
| E | Franzluebbers | 2011 | US, GA | 1250 | C (yearl. steers) | Pasture (bermuda grass, tall fescue; hayed 1/mo to 5cm | 12 | C | H | L | 4.1 | 270 | 0.3 | steer/ha | 9 | 33 | - | - |  |
| E | Mwendera | 1997 | Ethiopia | 1000 | C (cows, oxen) | Perennial (Native grasses) | 1 | C | V | L,M,H | - | 365 | 0.8 | AUM/ha | 4 | 29 | 57 | 86 |  |
| E | Pluhar | 1987 | US, TX | 680 | C (Cow-Calf) | Prairie (midgrass, shortgrass, native range) | 1 | R | V | H | 12.5 | 8 | 3.6 | ha/cow/y | 13 | 66 | - | - | both rot; SR constant |
| E | Savodogo | 2007 | Burkina Faso | 841 | M (C, S, G, wild) | Woody (savanna, annual/perennial grass) | 1 | R | V | L,M,H | 0.2 | 40 | 45.6 | 280kg/d/ha | 8 | 25 | 50 | 75 | 10d grz/mo; 4 mo |
| E | Tadesse (a) | 2003 | Ethiopia | 1095 | C (cow) | Perennial (Native grasses, forbs) | 2 | C | H | M | - | 365 | 3.4 | AUM/ha | 4 | 57 | - | - |  |
| E | Taddese (b) | 2002 | Ethiopia | 1000 | C (cow, oxen) | Perennial (Native grasses) | 1 | C | V | L,M,H | - | 365 | 3.4 | AUM/ha | 4 | 29 | 57 | 86 |  |
| E | Teague | 2011 | US, TX | 820 | C (Cow-Calf) | Prairie (Tall grass prairie) | 9 | C | H | L | 0.4 | 220 | 3.7 | AU/100ha | 27 | 48 | - | - |  |
| E | Thurow | 1986 | US, TX | 609 | M (C, G, S) | Woody (oak mottes, bunchgrass, sodgrass) | 6 | C | H | M | 0.3 | 240 | 4.6 | ha/AU/y | 5 | 43 | - | - |  |
| E | Warren (a) | 1986 | US, TX | 609 | C (heifers) | Bare (herbicide + drought ) | 1 | R | V | M,H | 6.8 | 20 | 2.7 | ha/AU/y | 2.7 | 34 | 67 | - | pre/post &wet/dry |
|  | Warren (b) | 1986 | US, TX | 609 | M (C,G,S; 1.63:1:1) | Woody (Live oak, grass, savanna) | 2 | R | H | M,L | 2.9 | 26 | 4.8 | ha/AU | 0.3 | 37 | 53 | - | all rot; SR const. |
| E | Weltz | 1986 | US, NM | 426 | C | Woody (Blue grama, grasses, forbs, etc.) | 18 | C | H | M | 0.1 | 365 | 13.5 | ha/AU | 14 | 25 | - | - |  |
| E | Wood | 1981 | US, TX | 680 | C(Cow-Calf) | Woody (Winter grass, sideoats grama, mesquite) | 20 | C | H | M | 0.2 | 365 | 4.6 | ha/AU | 5 | 25 | - |  |  |
| E | Zhou | 2010 | China | 505 | M (G,S, 4:1) | Grass | 13 | C | H | M | 0.2 | 365 | - | trampling | H | M | - | - | path vs. pasture |

**Supplemental Material Table 3**. All extended rest studies that were not represented in either of the first two appendices (i.e., studies that did not include a treatment representing increased grazing pattern complexity or a reduction in stocking rates or pressure). Abbreviations are as noted above.

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| **First Author** | **Year** | **Site** | **Prec (mm)** | **Livestock** | **Vegetation** | **Dur (Y)** | **Sys** | **SR (Orig)** | **AU/ha** | **d/y** | **ha/AU/y** | **GRAZING NOTES** | **EXCL. NOTES** |
| Achouri | 1984 | US, UT | 250 | C | Perennial (Crested wheatgrass) | 20 | C | M | - | 90 | 4.5 | M (1.5 ha/AUM) for several y (Jun-Aug) | ungrazed for >20 y |
| Allington | 2011 | US, AZ | 395 | C | Perennial (hairy grama, grasses, shrubs) | 40 | R | n/a | 0.1 | 7 | - | SDRG (<1wk); avg of 1AU/13ha | Research Ranch (ungrazed), across fence |
| Bharati | 2002 | US, IA | 851 | C | Pasture (grass, brome, timothy) | 6 | C | - | - | - | - | "C grazed pasture" | "Grass filter" (ungrazed area) |
| Busby | 1981 | US, UT | 345 | C | Perennial (Crested wheatgrass, deforested Pinyon-junier) | 5,1 | R? | M | - | 75 | - | "M to H" May1-Jun15 & Oct1-Nov1; 3 trt | Ex in each trt |
| Castellano | 2007 | US, AZ | 350 | L | Shrub/Desert (Acacia, etc.) | 52, 25, 10 | C | - | - | - | - | Open grz since late 1800s | 3 ex: 1997(20ha), 1993 (1ha), 1958 (9.3ha) |
| Gifford | 1982 | US, ID | 305 | C | Perennial (Crested wheatgrass, grass; rep big sagebrush) | 1,2,4,6 | C | - | - | 120 | - | Seasonal | 3 30x30m ex installed |
| Jeddi | 2010 | Tunisia | 196 | L | Steppe (arid, degraded) | 6,12 | C | - | - | - | - | C grazed area | Ex set up gradually by Sfax FS |
| Kato | 2009 | Mongolia | 181 | M(S,G,C,H) | Grass steppe (perennial grass, forbs, tallgrass) | 4 | C | V | - | 365 | - | "long been subject to intensive grazing" | 1.5m fence |
| " | " | " | 213 | " | Grass steppe | 4 | C | H | - | 365 | - | "L #'s have increased considerably" | 1.5m fence |
| " | " | " | 162 | " | Shrub/Desert (Acacia, etc.) | 4 | C | M | - | 365 | - |  | Airport grounds; trt likely >4y but not reported |
| Kauffman | 2004 | US, OR | 320 | C | Meadow (dry & wet, herb. riparian plants, grass, sedge) | 7 | C | n/a | - | 75 | - | 1 site: deferred grz, summer; 2 sites: July1-Sept15); | Avg of ex at each (19,7,7), accidental and wild grazing has occurred; wet, dry meadows measured separately at each of 3 sites |
| Lavado | 1994 | Argentina | 950 | C(Cow-Calf) | Perennial (Natural vegetation, grasses) | 3, 12 | C | H | 1.4 | 365 | 0.7 | Reported in AU/ha/y; "C grz in a H SR" | 2 2-ha enclosures of different ages (3, 12 y) |
| Takar | 1990 | Somalia | 446 | M(C,G) | Grass (Shrubs, annual grass/forbs) | 3 | C | H | - | 365 | 5 | "grazed heavily w/C&G by seminomadic pastoralists" | 2-ha livestock exclosure |
| Tukel | 1984 | Turkey | 362 | L | Grass (Steppe, forage grass, shrubs) | 30 | C | H | - | 365 | - | "heavy grazing on public range" | protected area |
| Tromble | 1974 | US, AZ | 312 | M(C,G,S) | Grass (black grama, fmesquite,annuals) | 9 | - | - | - | - | - | "grazed" | "ungrazed site had been protected from livestock use for the past 9 y" |
| Wheeler | 2002 | US, CO | 407.7 | C (Steers) | Riparian (Willows, sedge) | 39 | C | H | 20.4 | 5 | - | 1x H grz (6/0.25 ha) on protected paddocks; Grz to 60-75% use; avg spring/summer grz | 3 ungrazed paddocks/trt |

**Supplemental Material Table 4**. Animal unit equivalent values used for calculating stocking rates. In cases where a value was not provided in one of the papers from our database, commonly used values were assumed (<https://www.ag.ndsu.edu/archive/streeter/2006report/aums/Doing%20the%20Math.htm>).

|  |  |  |  |
| --- | --- | --- | --- |
| **Animal** | **kg** | **AUE** | **Reference** |
| Cow-calf | 450 | 1.0 |  |
| Bull | 630 | 1.4 |  |
| Steer | 383 | 0.9 |  |
| Zebu Cows/Oxen | 380 | 0.8 | Mwendera 1997 |
| Heifer | 360 | 0.8 |  |
| Tropical LU | 250 | 0.6 | Tadesse 2003 |
| Yearling Angus Steer | 212 | 0.5 | Franzluebbers 2011 |
| Sheep | 90 | 0.2 |  |
| Small stock unit | 50 | 0.1 | du Toit 2009 |
| Sheep/Goats | 43 | 0.1 | Zhou 2012 |