

The efficacy of using targeted grazing for vegetation management: a meta-analysis

Katherine M Marchetto^{1*}, Daniel J. Larkin², Tiffany M. Wolf¹

1. Veterinary Population Medicine, 225 Veterinary Medical Center, 1365 Gortner Ave.,
University of Minnesota, St. Paul, MN 55108

2. Department of Fisheries, Wildlife, and Conservation Biology, 135 Skok Hall, 2003
Upper Buford Circle, University of Minnesota, St. Paul, MN 55108

*Communicating author (E: march313@umn.edu; T: +1 (551) 427-1156)

Studies included in the meta-analysis:

Ajorlo M, Abdullah R, Halim RA, and Ebrahimian M (2014) Cattle grazing effect on *Mimosa pudica* L. in tropical pasture system. *Pertanika Journal of Tropical Agricultural Science* **37**:249-261

Andersen UV (1994) Sheep grazing as a method of controlling *Heracleum mantegazzianum*. Pages 77-91 In: De Waal LC, Child LE, Wade CPM and Brock JH, (eds) *Ecology and management of invasive riverside plants*. Wiley, Chichester

Beattie KC, Karberg JM, Omand KA, and O'Dell DI (2017) Sheep Grazing as a Grassland Management Tool: Lessons Learned on Nantucket Island, Massachusetts. *Northeastern Naturalist* **24**:45-66

Boggs LL, Muir JP, and Dunn JW (2012) Greenbriar suppression with goat mob browsing. *Livestock Research for Rural Development* **24**

Brabec J, and Pysek P (2000) Establishment and survival of three invasive taxa of the genus *Reynoutria* (Polygonaceae) in mesic mown meadows: A field experimental study. *Folia Geobotanica* **35**:27-42

Castillo JM, McAdams A, Nakahara M, Weise D, and Enriques G (2006) Effects of Prescribed Grazing and Burning Treatments on Fire Regimes in Alien Grass-dominated Wildland-Urban Interface Areas, Leeward Hawaii

Catorci A, Antolini E, Tardella FM, and Scocco P (2014) Assessment of interaction between sheep and poorly palatable grass: a key tool for grassland management and restoration. *Journal of Plant Interactions* **9**:112-121

Cornett MW, Bauman PJ, and Breyfogle DD (2006) Can we control leafy spurge? Adaptive management and the recovery of native vegetation. *Ecological Restoration* **24**:145-150

Davy JS, Roche LM, Robertson AV, Nay DE, and Tate KW (2015) Introducing cattle grazing to a noxious weed-dominated rangeland shifts plant communities. *California Agriculture* **69**:230-236

Decker T (2018) Targeted-grazing as a fuels reduction treatment: evaluation of vegetation dynamics and utilization levels. Utah State University, Logan, Utah, USA

DiTomaso JM, Kyser GB, George MR, Doran MP, and Laca EA (2008) Control of medusahead (*Taeniatherum caput-medusae*) using timely sheep grazing. *Invasive Plant Science and Management* **1**:241-247

Elias D, and Tischew S (2016) Goat pasturing—A biological solution to counteract shrub encroachment on abandoned dry grasslands in Central Europe? *Agriculture, Ecosystems and Environment* **234**:98-106

Gabay O, Perevolotsky A, Bar Massada A, Carmel Y, and Shachak M (2011) Differential effects of goat browsing on herbaceous plant community in a two-phase mosaic. *Plant Ecology* **212**:1643-1653

Gardener MR, Whalley RDB, and Sindel BM (2003) Ecology of *Nassella neesiana*, Chilean needle grass, in pastures on the Northern Tablelands of New South Wales. I. Seed production and dispersal. *Australian Journal of Agricultural Research* **54**:613-619

Girard-Cartier CB, and Kleppel GS (2015) Grazing as a control for the spread of mile-a-minute (*Persicaria perfoliata*) and the restoration of biodiversity in plant communities in a lower New York State parkland. *Ecological Restoration* **33**:82-89

Goehring BJ, Launchbaugh KL, and Wilson LM (2010) Late-season targeted grazing of yellow starthistle (*Centaurea solstitialis*) with goats in Idaho. *Invasive Plant Science and Management* **3**:148-154

Harrington JA, and Kathol E (2009) Responses of Shrub Midstory and Herbaceous Layers to Managed Grazing and Fire in a North American Savanna (Oak Woodland) and Prairie Landscape. *Restoration Ecology* **17**:234-244

Hewett DG (1985) GRAZING AND MOWING AS MANAGEMENT TOOLS ON DUNES. *Vegetatio* **62**:441-448

Hickman KR, Hartnett DC, Cochran RC, and Owensby CE (2004) Grazing management effects on plant species diversity in tallgrass prairie. *Journal of Range Management* **57**:58-65

Hillhouse HL, Tunnell SJ, and Stubbendieck J (2010) Spring grazing impacts on the vegetation of reed canarygrass-invaded wetlands. *Rangeland Ecology & Management* **63**:581-587

Holst P, and Allan C (1996) Targeted grazing of thistles using sheep and goats. *Plant Protection Quarterly* **11**:271-273

Ingham CS (2014) Himalaya blackberry (*Rubus armeniacus*) response to goat browsing and mowing. *Invasive Plant Science and Management* **7**:532-539

Ingham CS, and Borman MM (2010) English ivy (*Hedera spp.*, Araliaceae) response to goat browsing. *Invasive Plant Science and Management* **3**:178-181

James JJ, Davy J, Doran MP, Becchetti T, Brownsey P, and Laca EA (2017) Targeted grazing impacts on invasive and native plant abundance change with grazing duration and stocking density. *Rangeland Ecology & Management* **70**:465-468

Kleppel GS, and LaBarge E (2011) Using sheep to control purple loosestrife (*Lythrum salicaria*). *Invasive Plant Science and Management* **4**:50-57

Krahulec F, Skalova H, Herben T, Hadincova V, Wildova R, and Pechackova S (2001) Vegetation changes following sheep grazing in abandoned mountain meadows. *Applied Vegetation Science* **4**:97-102

Lacey JR, and Sheley RL (1996) Leafy spurge and grass response to picloram and intensive grazing. *Journal of Range Management* **49**:311-314

Lagendijk DDG, Howison RA, Esselink P, Ubels R, and Smit C (2017) Rotation grazing as a conservation management tool: Vegetation changes after six years of application in a salt marsh ecosystem. *Agriculture Ecosystems & Environment* **246**:361-366

Lym RG, Sedivec KK, and Kirby DR (1997) Leafy spurge control with angora goats and herbicides. *Journal of Range Management*:123-128

Magadlela A, Dabaan M, Bryan W, Prigge E, Skousen J, D'Souza G, Arbogast B, and Flores G (1995) Brush clearing on hill land pasture with sheep and goats. *Journal of Agronomy and Crop Science* **174**:1-8

Mancilla-Leyton JM, Mejias RP, and Vicente AM (2013) Do goats preserve the forest? Evaluating the effects of grazing goats on combustible Mediterranean scrub. *Applied Vegetation Science* **16**:63-73

Mosley JC, Frost RA, Roeder BL, and Kott RW (2017) Targeted sheep grazing to suppress sulfur cinquefoil (*Potentilla recta*) on northwestern Montana rangeland. *Rangeland Ecology & Management* **70**:560-568

Nolden C (2019) Goat dietary selections, performance and browsing effects on a brush-invaded oak savanna in southwest Wisconsin. University of Wisconsin, Madison, Wisconsin, USA

Oliver PA, Orwin DA, Beauchamp MJ, and Bullock DJ (2001) The potential use of the goat (*Capra Hirus*) for the restoration of scrub-invaded chalk grassland. *Land Contamination and Reclamation* **9**:225-231

Olson BE, and Wallander RT (1998) Effect of sheep grazing on a leafy spurge-infested Idaho fescue community. *Journal of Range Management* **51**:247-252

Olson BE, Wallander RT, and Fay PK (1997) Intensive cattle grazing of oxeye daisy (*Chrysanthemum leucanthemum*). *Weed Technology* **11**:176-181

Pfister JA, Gardner DR, and Panter KE (2010) Consumption of low larkspur (*Delphinium nuttallianum*) by grazing sheep. *Rangeland Ecology and Management* **63**:263-266

Probo M, Ascoli D, Lonati M, Marzano R, and Lombardi G (2017) Restoration treatments to control *Molinia arundinacea* and woody and alien species encroachment in

Calluna vulgaris heathlands at the southern edge of their distribution. *Biological Conservation* **211**:102-109

Ralphs MH, Wiedmeier RD, and Banks JE (2007) Decreasing forage allowance can force cattle to graze broom snakeweed (*Gutierrezia sarothrae*) as a potential biological control. *Rangeland Ecology and Management* **60**:487-497

Ramirez-Yanez LE, Ortega-S JA, Brennan LA, and Rasmussen GA (2007) Use of prescribed fire and cattle grazing to control guineagrass. Pages 240-245 In: Masters RE and Galley KEM, (eds) 23rd Tall Timbers Fire Ecology Conference: Fire in Grassland and Shrubland Ecosystems

Rathfon RA, Fei S, Tower J, Andries K, and Neary M (2014) Prescribed grazing for management of invasive vegetation in a hardwood forest understory. Pages 220 In: Service USF, (ed). United States Department of Agriculture, Carbondale, IL, USA

Rinella MJ (2013) Assessing invasiveness of exotic weeds outside their current invasive range. *Invasive Plant Science and Management* **6**:545-553

Rosen E, and Bakker JP (2005) Effects of agri-environment schemes on scrub clearance, livestock grazing and plant diversity in a low-intensity farming system on Oland, Sweden. *Basic and Applied Ecology* **6**:195-204

Schmelzer L, Perryman B, Bruce B, Schultz B, McAdoo K, McCuin G, Swanson S, Wilker J, and Conley K (2014) Case study: Reducing cheatgrass (*Bromus tectorum* L.) fuel loads using fall cattle grazing. *Professional Animal Scientist* **30**:270-278

Seefeldt SS, Taylor JB, and Van Vleet S (2007) Reducing *Euphorbia esula* with a combination of sheep grazing and imazapic. *Journal of Arid Environments* **69**:432-440

Sheley RL, Jacobs JS, and Martin JM (2004) Integrating 2,4-D and sheep grazing to rehabilitate spotted knapweed infestations. *Journal of Range Management* **57**:371-375

Silliman BR, Mozdzer T, Angelini C, Brundage JE, Esselink P, Bakker JP, Gedan KB, van de Koppel J, and Baldwin AH (2014) Livestock as a potential biological control agent for an invasive wetland plant. *Peerj* **2**

Stonecipher CA, Panter KE, and Villalba JJ (2016) Effect of protein supplementation on forage utilization by cattle in annual grass-dominated rangelands in the Channeled Scablands of eastern Washington. *Journal of Animal Science* **94**:2572-2582

Taylor JB, Seefeldt SS, and Thelen TM (2005) The use of short-duration intensive sheep grazing to increase sheep utilization of leafy spurge (*Euphorbia esula* L.). *Journal of Food Agriculture & Environment* **3**:323-326

Tsiouvaras C, Havlik N, and Bartolome J (1989) Effects of goats on understory vegetation and fire hazard reduction in a coastal forest in California. *Forest Science* **35**:1125-1131

Valderrabano J, and Torrano L (2000) The potential for using goats to control *Genista scorpius* shrubs in European black pine stands. *Forest Ecology and Management* **126**:377-383

Volesky JD, Young SL, and Jenkins KH (2016) Cattle grazing effects on *Phragmites australis* in Nebraska. *Invasive Plant Science and Management* **9**:121-127

Wallace JM, Wilson LM, and Launchbaugh KL (2008) The effect of targeted grazing and biological control on yellow starthistle (*Centaurea solstitialis*) in canyon grasslands of Idaho. *Rangeland Ecology & Management* **61**:314-320

Warda M, Kulik M, and Gruszecki T (2016) The impact of intensive sheep grazing in the spring on the vegetation of xerothermic grasslands in Stawska Góra nature reserve. *Ecological Questions* **23**:43-50

Webb DM (2008) Assessing the potential of mixed grazing goats with beef cattle to improve animal performance and increase the utilization of marginal pasturelands in the Appalachian coal region. Thesis

Williams CM, Holcombe DW, Hanks DR, Allen JR, Bruce LB, Perryman BL, and Fernandez G (2002) Effects of sheep grazing or mowing on the control of perennial pepperweed (*Lepidium latifolium* L.). *Proceedings of the American Society of Animal Science Western Section* **53**:350

Williams PR, Collins EM, and Grice AC (2005) Cattle grazing for para grass management in a mixed species wetland of north-eastern Australia. *Ecological Management & Restoration* **6**:75-76

Williams S, and Prather T (2006) Goats: A tool for controlling spotted knapweed. *Journal of Extension* **44**

Zhang R, Huang D, Wang K, Zhang Y, and Wang C (2011) Effect of mowing and grazing on ramet emergence of *Leymus racemosus* in the inner Mongolia steppe during the spring regreening period. *African Journal of Biotechnology* **10**:2216-2222