

Plant Ecology, Biodiversity, and Other Environmental Effects

234. Achievements in management and utilization of southern grasslands.

Hoveland, C. S.

Journal of Range Management 53(1): 17-22. (2000)

NAL Call #: 60.18 J82; ISSN: 0022-409X

http://jrm.library.arizona.edu/data/2000/531/17-22_hoveland.pdf

Descriptors: humid zones/ Festuca/ Festuca arundinacea/ Neotyphodium coenophialum/ agricultural research/ Paspalum notatum/ grazing/ plant breeding/ gypsum/ transgenic plants/ beef cattle/ Southeastern United States
Abstract: Grasslands in the humid southern USA are utilized primarily for grazing on improved pastures, most of which were developed since the 1930s and 1940s. Virtually all of these grasslands were developed from species introduced from other areas of the world. Major achievements in successful developing these grasslands, often on eroded cropland, were: (a) introduction of Kentucky 31 tall fescue (*Festuca arundinacea* Schreb.); (b) introduction of Pensacola bahiagrass (*Paspalum notatum* Flugge); (c) breeding of Coastal bermudagrass [*Cynodon dactylon* (L.) Pers.]; (d) fertilizer and lime use along with availability of low-cost N; (e) no-till planting of winter annual grasses; (f) pasture renovation with legumes; (g) herbicides for weed control; (h) recycling of agricultural wastes in forage production; (i) development of round hay baler; (j) controlled grazing; (k) discovery of the tall fescue fungal endophyte and its effect on livestock and the grass plant; (l) development of grazing-tolerant alfalfa; (m) improved cool season annual grasses and legumes for winter grazing; and (n) near infrared reflectance spectroscopy for rapid and low-cost forage analysis. Future areas of emphasis in improvement of these grasslands may include: (a) greater use of grazing-tolerant grasses and legumes; (b) stress-tolerant tall fescue with "friendly" non-toxic endophytes; (c) feed antidotes to the toxins of endophyte-infected tall fescue; (d) use of herbicide- and pest-resistant biotechnology genes in forage plants; (e) use of gypsum to alleviate subsoil acidity and improve rooting depth of aluminum-sensitive forage cultivars; (f) greater use of computers in information access and decision making by livestock producers; (g) greater use of forages for wildlife food; (h) breeding of pasture plants with greater winter productivity; (i) development of a perennial grass biomass energy industry for electrical generation and liquid fuel production.

This citation is from AGRICOLA.

235. Alternative management on fens: Response of vegetation to grazing and mowing.

Stammel, Barbara; Kiehl, Kathrin; and Pfadenhauer, Joerg
Applied Vegetation Science 6(2): 245-254. (2003)

NAL Call #: QK900 .A66; ISSN: 1402-2001

Descriptors: alternative fen management/ calcareous fen characteristics/ clonal growth/ fen meadow/ grazing effect/ growth form/ mowing effect/ pasture/ plant functional types/ reproduction/ species composition/ species traits/ vegetation response

Abstract: The impact of cattle grazing on the vegetation of calcareous fens was compared to the effects of traditional autumn mowing in southern Germany. Vegetation composition was studied in adjacent pairs of fen meadows and pastures with similar environmental conditions and

biomass production. Vegetation data were analysed with respect to species richness, species composition and response of species traits to disturbance, including morphology, defence mechanisms, clonal growth form and generative reproduction. Species richness was significantly reduced by grazing, but the percentage of typical fen species or Red Data Book species was not affected by land use type. Detrended Correspondence Analysis indicated that species composition could best be explained in terms of a land use gradient. Species traits showed a clear trend in their response to land use type. Grazing favoured grasses and small forbs. Only a few species with defence mechanisms against foraging were more frequent or abundant on pastures. Many other species with defence mechanisms, however, did not have an advantage on pastures. Flowering and seed dispersal traits did not respond significantly to grazing or mowing. Species with fast spreading stem derived clonal organs were favoured on pastures, whereas all other clonal growth forms and, particularly, non-clonal species were more abundant on meadows. More indicator species of wet soil conditions and species adapted to flooding were found on pastures. Grazing can be recommended as an alternative land use to mowing in contrast to abandonment, but a reduction in species richness and changes in species composition and species traits may occur.

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236. Ammonia volatilization from grassland receiving nitrogen fertilizer and rotationally grazed by dairy cattle.

Bussink, D. W.

Fertilizer Research 33(3): 257-266. (1992)

NAL Call #: S631.F422; ISSN: 0167-1731

Descriptors: grassland soils/ ammonia/ volatilization/ losses from soil/ rotational grazing/ calcium ammonium nitrate/ biogeochemical cycles/ application rate/ cattle manure

Abstract: The micrometeorological mass balance method was used to measure ammonia (NH₃) volatilization from rotationally grazed swards throughout the 1987 and 1988 growing seasons. In both years the swards were dressed with calcium ammonium nitrate (CAN) split over 7 dressings. In 1987 the sward received a total of 550 kg N ha⁻¹, in 1988 a total of 550 or 250 kg N ha⁻¹. For the 550 kg N ha⁻¹ treatments there were 8 and 9 grazing cycles, respectively, in 1987 and 1988 and 7 for the 250 kg N ha⁻¹ treatment. Losses from the 550 N sward were 42.2 and 39.2 kg N ha⁻¹ in 1987 and 1988, respectively; this was equivalent to 8.5 and 7.7% of the N returned to the sward in the excreta of the grazing cattle. The NH₃ loss from the 250 N sward was 8.1 kg N ha⁻¹ in 1988, which was equivalent to 3.1% of the N returned to the sward in excreta during the growing season. There was a wide variation in NH₃ volatilization between the individual grazing periods. This indicates the necessity of continued measurements throughout the growing season to obtain reliable data on NH₃ volatilization. Soil humidity is suggested to be a key factor, because emissions were high from wet soil, and low

from drier soil. Results of a Monte Carlo simulation study showed that the measured NH₃ loss from the 250 and 550 N swards had a standard deviation of 13 and 5% of the mean, respectively.

This citation is from AGRICOLA.

237. Animal and plant response on renovated pastures in western Canada.

McCartney, D. H.; Waddington, J.; and Lefkovitch, L. P. *Journal of Range Management* 52(1): 19-26. (1999)
 NAL Call #: 60.18 J82; ISSN: 0022-409X
http://jrm.library.arizona.edu/data/1999/521/19-26_mccartney.pdf

Descriptors: beef cows/ rotational grazing/ grazing intensity/ nitrogen fertilizers/ phosphorus fertilizers/ calves/ liveweight gain/ botanical composition/ *Bromus inermis*/ *Agropyron cristatum*/ *Psathyrostachys juncea*/ Canada
Abstract: Extending the present 4 month grazing season in the Aspen parklands of western Canada is of major economic interest to cow-calf producers. A long-term experiment was conducted on 375 ha to compare the present practice of continuous grazing with no fertilizer to a rotational grazing system of 4 paddocks fertilized in alternate years with 90 kg N, 45 kg P₂O₅, 10 kg S ha⁻¹ and a 6 paddocks rotational grazing system including fertilizing and species replacement by cultivation and reseeding. Compared to the continuously-grazed control, the grazing period was extended by 14-days on the 4-paddock rotation system, and by a further 15-days on the 6-paddock rotation system, divided about equally between spring and fall. Forage yield, cow weight gains and calf growth were significantly improved, and year-to-year variation in forage yield and animal weight gain was reduced. In the 6-paddock rotation system, breaking 1 paddock at a time in summer after grazing, and reseeding the following spring caused no noticeable reduction in grazing capacity. Replacing the brome grass (*Bromus inermis* Leyss.) dominated vegetation in 1 of the 6 paddocks with an early-growing grass contributed to the grazing season extension. Crested wheatgrass (*Agropyron cristatum* (L.) Gaertn.) performed well in this role; Russian wildrye (*Psathyrostachys juncea* (Fisch.) Nevski) died out within 6 years of seeding.

This citation is from AGRICOLA.

238. An attempt to restore a central European species-rich mountain grassland through grazing.

Matejkova, Ivona; Van Diggelen, Rudy; and Prach, Karel *Applied Vegetation Science* 6(2): 161-168. (2003)
 NAL Call #: QK900 .A66; ISSN: 1402-2001

Descriptors: violion caninae stand/ food selectivity/ grassland management/ grazing impact/ seed dispersal/ soil seed bank/ species rich mountain grassland restoration/ target species response

Abstract: This paper describes the effects of re-establishing seasonal cattle grazing by 0.7 animal.ha⁻¹ on vegetation in a long-term abandoned, and partly degraded, semi-natural mountain pasture in the Sumava National Park, Czech Republic. There was very uneven grazing intensity inside the locality, and grazing preference changed during the season: cattle grazed most of the time in productive but species-poor *Deschampsia cespitosa* swards, but changed to a species-rich *Violion caninae* stand in the middle of the summer. A species-rich *Carex rostrata* community was only grazed at the end of the

season. Species-poor swards dominated by *Nardus stricta* and *Carex brizoides* were mainly used as resting areas. Both grazing and excluding from grazing had a negative effect on species diversity of the *Deschampsia cespitosa* swards. The soil seed bank contained only few species that are characteristic of mountain grassland communities, and seed dispersal of the target species by cattle dung was also found to be very limited. Thus both grazing and exclusion from grazing are probably of limited value for the restoration of species-rich grasslands from species-poor *Deschampsia cespitosa* swards in this case.

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239. Avoidance of degradation of Alpine pasture through grazing management: Investigations of change in vegetation nutrition characteristics as a consequence of sheep grazing at different periods of the growing season.

Andrighetto, I.; Cozzi, G.; Berzaghi, P.; and Zancan, M. *Land Degradation & Rehabilitation* 4(1): 37-43. (1993)
 NAL Call #: S622.L26; ISSN: 0898-5812

Descriptors: sheep/ grazing/ animal husbandry/ highlands/ mountains/ Italy

This citation is from AGRICOLA.

240. Bermudagrass management in the southern piedmont USA: Coastal productivity and persistence in response to fertilization and defoliation regimes.

Franzluebbers, A. J.; Wilkinson, S. R.; and Stuedemann, J. A.

Agronomy Journal 96(5): 1400-1411. (2004)
 NAL Call #: 4 AM34P; ISSN: 0002-1962

Descriptors: fertilization: applied and field techniques/ defoliation regime: animal grazing/ fertilization regime/ soil
Abstract: Productivity, quality, and persistence of 'Coastal' bermudagrass (*Cynodon dactylon* (L.) Pers.) pastures are affected by fertilization, but possible interactions with defoliation regime including animal grazing are not fully known. We evaluated three sources of fertilization with equivalent N rates (inorganic, crimson clover (*Trifolium incarnatum* L.) cover crop plus inorganic, and chicken (*Gallus gallus*) broiler litter) factorially arranged with four defoliation regimes (unharvested, cattle (*Bos taurus*) grazing to maintain high (4.5 +/- 1.6 Mg ha⁻¹) and low (2.5 +/- 1.1 Mg ha⁻¹) forage mass, and bayed monthly) on estimated forage dry matter production, forage and surface residue C/N ratio, and ground cover of pastures on a Typic Kanhapludult in Georgia during 5 yr. Mean annual forage dry matter production was 7.5 +/- 0.7 Mg ha⁻¹ with hay harvest but declined (1.3 Mg ha⁻¹ yr⁻¹) significantly with time as a result of lower precipitation. With grazing, estimated production was 8.3 +/- 1.0 Mg ha⁻¹ and did not change with time, suggesting that grazing cattle sustained forage productivity by recycling nutrients and creating better surface soil conditions. Coastal bermudagrass as a percentage of ground cover (initially 81%) declined 5 +/- 2% yr⁻¹ with unharvested and grazing to maintain low forage mass, declined 3 +/- 1% yr⁻¹ with haying, and remained unchanged (-1 +/- 1% yr⁻¹) with grazing to maintain high forage mass. Pastures with high forage mass were more productive than with low forage mass (9.2 +/- 1.6 vs. 7.5 +/- 1.1 Mg ha⁻¹) from a forage sustainability perspective, primarily by avoiding encroachment of undesirable plant species.

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241. Biodiversity in intensive grasslands: Effect of management, improvement and challenges.

Plantureux, S.; Peeters, A.; and Mccracken, D.

Agronomy Research 3(2): 153-164. (2005)

NAL Call #: SB13 .A57; ISSN: 1406-894X

Descriptors: fertilization: applied and field techniques/ cutting management: applied and field techniques/ grazing/ biodiversity/ intensified grassland

Abstract: Intensified grasslands are usually the dominant type of grassland in many countries in Europe but are generally of poor ecological value. Several management factors may affect biodiversity of these grasslands including fertilisation, grazing and cutting management. Their effects on grassland biodiversity are described in this paper. In most cases, intensive and profitable grass production from semi-natural grasslands appears to be incompatible with maintaining a high level of biodiversity. Two key questions then arise: how to restore biodiversity in intensive grasslands while limiting the technical and economical consequences? How to choose the target species on an objective basis? Some solutions are considered in the paper but it is suggested that 1) new tools (i.e. indicators) are required to evaluate the functions of biodiversity and to achieve biodiversity restoration goals and 2) in the short-term the research priority is to understand and predict biodiversity at the field and farm-scale.

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242. Biological control of Canada thistle in temperate pastures using high density rotational cattle grazing.

Bruijn, S. L. and Bork, E. W.

Biological Control 36(3): 305-315. (2006)

NAL Call #: SB925.B5; ISSN: 1049-9644

Descriptors: beef cattle/ biological control/ flowering/ forage/ grazing/ pastures/ shoots/ weed control/ weeds

Abstract: Extensive research exists on the effects of Canada thistle [*Cirsium arvense* (L.) Scop.] (CT) in annual cropland, but few studies have examined CT impacts on pasture and rangeland. While it is known that grazing impacts weed presence and abundance, little is understood about how specific grazing systems can be used as a prescriptive tool to alter weed populations, including CT.

The purpose of this study was to experimentally test three cattle grazing systems, including (1) continuous or season-long grazing (SL), (2) short duration (SD) (or low intensity-high frequency) rotational grazing, and (3) high intensity-low frequency (HILF) rotational grazing, for their ability to reduce CT and release non-CT herbage within permanent pastures of central Alberta, Canada. A secondary objective was to evaluate season-long changes in the quality of CT shoots as potential forage throughout the growing season. Results showed that SL grazing maintained or increased severe CT infestations and reduced forage yield. In contrast, the HILF rotational system reduced CT shoot density and biomass, as well as flowering, and resulted in greater weed suppression than the SD system. Two intense defoliations annually over 2-3 years nearly eliminated CT stems. Remaining CT shoots were also primarily vegetative and greater in forage quality under HILF grazing. As a weed biological control tool for CT, prescribed grazing with an HILF system may be particularly important in areas where other control options, including the use of herbicides, are not possible due to environmental restrictions or inaccessibility to equipment.

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243. Biomass of grazed, burned, and undisturbed paramo grasslands, Colombia: Aboveground vegetation.

Hofstede, Robert G. M.; Castillo, M. Ximena Mondragon; and Osorio, Constanza M. Rocha

Arctic and Alpine Research 27(1): 1-12. (1995)

NAL Call #: GB395.A73; ISSN: 0004-0851

Descriptors: burning history/ ecosystem stability/ grazing management

Abstract: Estimations of the amount of aboveground vegetation mass were made for four paramo grassland sites with different grazing management and burning histories in the Central Cordillera of Colombia. The total mass of live plus dead grassland vegetation showed a decrease from 2820 +- 190 g m⁻² at the undisturbed to 868 +- 73 g m⁻² at the intensively grazed and burned sites. Stem rosette mass was highest at both the undisturbed and the heavily grazed sites (666 +- 168 and 1029 +- 245 g m⁻², respectively), but considerably lower at the burned sites (397 +- 94 and 285 +- 78 g m⁻²). Eighty percent of the total undisturbed vegetation mass consisted of standing dead material and litter. The decrease of dead material mass along the disturbance gradient may have large implications for ecosystem stability. The proportion of live material increased along the grazing and burning gradient, resulting in a similar live material mass at all sites. Under high grazing intensities and in the absence of burning, the vegetation can transform into ground-covering mats, attaining a moderately high biomass. Where burning took place, this transformation does not occur, and both grassland and stem rosette biomass were reduced, leaving many patches of bare ground.

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244. Biomass of grazed, burned, and undisturbed paramo grasslands, Colombia: Root mass and aboveground: Belowground ratio.

Hofstede, Robert G. M. and Rossenaar, Arnout J. G. A.

Arctic and Alpine Research 27(1): 13-18. (1995)

NAL Call #: GB395.A73; ISSN: 0004-0851

Descriptors: burning management/ grazing management/ root distribution/ seasonality

Abstract: In a Neotropical alpine grassland (paramo) in the Colombian Central Cordillera, the root mass, root distribution, and aboveground: belowground (A:B) ratio were determined at four sites with different grazing and burning management. Compared to grasslands at other latitudes, paramos have a relatively low belowground biomass and, due to the combination with a high aboveground biomass, a high A:B ratio. This is attributed to a low productivity and a lack of seasonality. Effects of grazing disturbance on the root system could be observed at a site without burning history, where the tussock grass vegetation was transformed into ground covering mats. Here, belowground biomass increased from 1.2 to 2.1 kg m⁻², which was more concentrated in the upper 10 cm of the soil. An undisturbed and two other grazed sites did not show differences in root mass or distribution, in response to disturbance. Nevertheless, A:B ratios decreased clearly towards more managed sites, as a result of decreased aboveground biomass.

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245. Botanical composition, soil and forage quality under different management regimes in Russian grasslands.

Mikhailova, E. A.; Bryant, R. B.; Cherney, D. J. R.; Post, C. J.; and Vassenev, I. I.

Agriculture, Ecosystems & Environment 80(3): 213-226. (2000)

NAL Call #: S601 .A34; ISSN: 0167-8809

Descriptors: botanical composition/ cutting/ forage quality/ grassland management regime/ grazing/ soil quality

Abstract: Little is known on how management of Russian native grasslands affects botanical composition, soil and forage properties. Three fields were sampled in the V.V. Alekhin Central-Chernozem Biosphere State Reserve in the Kursk region of Russia: a native grassland (not cultivated for at least 300 years), a grazed/hay field with 4 years of annual harvest followed by 1 year of rest (periodically-cut grazed/hay field), and a yearly-cut grazed/hay field. Soil samples were collected from the top 10 cm and analyzed. Plant species were identified at the sampling sites and this plant material was used to determine total elemental analysis of forage, crude protein (CP), neutral detergent fiber (NDF), acid detergent fiber (ADF), in vitro true digestibility (IVTD) and lignin concentrations. Above-ground live and dead plant material and roots were analyzed for C, N and lignin. Soil sample analysis showed that fields were comparable in terms of soil chemical and physical properties. SOC and N contents were not statistically different in the native and yearly grazed/hay fields. Soil bulk density significantly increased as a result of utilization, from 0.80+-0.09 Mg m⁻³ for the native grassland to 0.97+-0.06 Mg m⁻³ for the yearly grazed/hay field. A total of 107 different plant species were recorded at the three fields. There were changes in plant composition among the fields. The native grassland field had the least number of plant species (41) followed by the yearly-cut grazed/hay field (68), and the periodically-cut grazed/hay field (87). There was a greater proportion of grass species (20%) in the native grassland field. Dead plant biomass and roots from the grazed/hay fields were higher in N and lignin concentrations. Forage mineral concentration was highest in the periodically-cut hay field. No significant differences were observed in terms of forage properties.

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246. Burning and exclosure can rehabilitate degraded black speargrass (*Heteropogon contortus*) pastures.

Orr, D. M.; McKeon, G. M.; and Day, K. A.

Tropical Grasslands 25(4): 333-336. (1991)

NAL Call #: SB197.A1T7; ISSN: 0049-4763

Descriptors: botanical composition/ grasslands/ burning/ control/ weed control/ cultural control/ grazing/ fodder plants

Abstract: A 30 x 30 m site on an *Aristida* spp.-dominated *H. contortus* pasture at Gayndah was burnt and fenced in Oct. 1986 and then left ungrazed for 4 years. Two plots within the site were burnt annually in spring and a 3rd plot left unburnt. Plots in an adjacent grazed area were burnt in Oct. 1986 and 1989 as part of normal management practice. Protection from grazing and annual burning increased the proportion of *H. contortus* from 20 to 70% by weight (15 to 57% by basal area) and decreased the proportion of *Aristida* spp. from 70 to 16% by weight or 68 to 37% by basal area. Neither burning once in exclosure nor burning twice under continuous grazing had major effects on pasture composition. It was suggested that while

exclosure for 3-4 years would be economically unviable, pasture rehabilitation may be possible using spring burning for 2-3 years and lenient stocking or deferred grazing in the summer.

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247. Carbon exchange rates in grazed and ungrazed pastures of Wyoming.

Lecain, D. R.; Morgan, J. A.; Schuman, G. E.; Reeder, J. D.; and Hart, R. H.

Journal of Range Management 53(2): 199-206. (2000)

NAL Call #: 60.18 J82; ISSN: 0022-409X

http://jrm.library.arizona.edu/data/2000/532/199-206_lecain.pdf

Descriptors: beef cattle/ prairies/ grazing intensity/ biogeochemical cycles/ photosynthesis/ carbon dioxide/ gas exchange/ botanical composition/ rain/ air temperature/ soil water/ *Carex*/ *Artemisia frigida*/ *Sphaeralcea coccinea*/ *Hesperostipa comata*/ *Pascopyrum smithii*/ Wyoming

Abstract: The influence of cattle grazing on carbon cycling in the mixed grass prairie was investigated by measuring the CO₂ exchange rate in pastures with a 13 year history of heavy or light grazing and an ungrazed exclosure at the High Plains Grasslands Research Station near Cheyenne, Wyo. In 1995, 1996 and 1997 a closed system chamber, which covered 1 m² of ground, was used every 3 weeks from April to October to measure midday CO₂ exchange rate. Green vegetation index (similar to leaf area index), soil respiration rate, species composition, soil water content, soil temperature, and air temperature were also measured to relate to CO₂ exchange rates of the 3 grazing treatments. Treatment differences varied among years, but overall early season (mid April to mid June) CO₂ exchange rates in the grazed pastures were higher (up to 2.5 X) than in the exclosure. Higher early season CO₂ exchange rates were associated with earlier spring green-up in grazed pastures, measured as higher green vegetation index. As the growing season progressed, green vegetation index increased in all pastures, but more so in the ungrazed exclosure, resulting in occasionally higher (up to 2 X) CO₂ exchange rate compared with grazed pastures late in the season. Seasonal treatment differences were not associated with soil temperature, soil respiration rate, or air temperature, nor was there a substantial change in species composition due to grazing. We hypothesize that early spring green-up and higher early season CO₂ exchange rate in grazed pastures may be due to better light penetration and a warmer microclimate near the soil surface because of less litter and standing dead compared to the ungrazed pastures. When all the measurements were averaged over the entire season, there was no difference in CO₂ exchange rate between heavily grazed, lightly grazed and ungrazed pastures in this ecosystem. This citation is from AGRICOLA.

248. Cattle and weedy shrubs as restoration tools of tropical montane rainforest.

Posada, Juan M.; Aide, T. Mitchell; and Cavelier, Jaime

Restoration Ecology 8(4): 370-379. (2000)

NAL Call #: QH541.15.R45R515; ISSN: 1061-2971

Descriptors: abundance/ forest regeneration/ grazing/ microhabitat/ species diversity/ species establishment/ species richness/ stocking density/ tropical montane rainforest

Abstract: Over the last 150 years, a large proportion of forests in Latin America have been converted to pastures. When these pastures are abandoned, grasses may slow reestablishment of woody species and limit forest regeneration. In this study, we explored the use of cattle in facilitating the establishment of woody vegetation in Colombian montane pastures, dominated by the African grasses *Pennisetum clandestinum* (Kikuyo) and *Melinis minutiflora* (Yaragua). First, we described woody and herbaceous vegetation in grazed and non-grazed pastures. Second, we tested the effect of grazing and seed addition on the establishment and growth of woody species. We also determined if the effect of grazing was different in *P. clandestinum* and *M. minutiflora* pastures. We found that low stocking density of cattle greatly increased density, number of branches per individual (a measure of "shrubbiness"), and basal area of woody species, but also reduced woody plant species richness and diversity. In the grazed area, the shrubs *Baccharis latifolia* (Chilca) and *Salvia* sp. (*Salvia*) were the most abundant. The combined effect of grazing and shading from the shrubs reduced herbaceous vegetation by 52 to 92%. In the grazing/seed addition experiment, grazing increased establishment of woody seedlings, particularly of the shrub *Verbesina arborea* (camargo), but the largest effect was seed addition. Where grasses are an important barrier to regeneration, grazing can facilitate the establishment of shrubs that create a microhabitat more suitable for the establishment of montane forest tree species.

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249. Cattle grazing a riparian mountain meadow: Effects of low and moderate stocking density on nutrition, behavior, diet selection, and plant growth response.

Huber, S. A.; Judkins, M. B.; Krysl, L. J.; Svejcar, T. J.; Hess, B. W.; and Holcombe, D. W.

Journal of Animal Science 73(12): 3752-3765. (1995)

NAL Call #: 49 J82; ISSN: 0021-8812

Descriptors: cattle industry/ forage quality/ grazing management

Abstract: Twelve ruminally cannulated and six intact crossbred beef steers were used in a randomized complete block design to evaluate the effects of stocking density of a riparian pasture in the Sierra Nevada mountains on grazing behavior, dietary selection, forage intake, digesta kinetics, and growth rates of *Carex nebraskensis* and *Juncus balticus*. Nine .5-ha pastures were assigned to one of three treatments: ungrazed (CON) or grazed to leave either 1,500 kg/ha (LOW) or 1,000 kg/ha (MOD). Two collections were conducted during the summer of 1992 (following winter drought) and 1993 (following above-average winter precipitation). Standing crop biomass was greater (P < .05) in grazed pastures than in CON pastures at initiation of grazing in 1992 but not in 1993. After grazing in both 1992 and 1993, a treatment times intrapasture location interaction was noted (P < .05). Tiller growth rates in both 1992 and 1993 were affected (P < .05) by a treatment times growth period interaction. Stocking density did not alter (P > .10) botanical or chemical composition of the diet in 1992, and only minor differences were noted (P < .05) in 1993. Forage intake, passage rate measures, and total time spent loafing did not differ (P > .10) between LOW and MOD steers. Within the midmeadow area in 1992, loafing time was greater (P < .05) for MOD steers than for LOW

steers. In 1993, a treatment times trial interaction was noted for loafing time in all three areas. Total time spent grazing was greater (P < .05) for MOD steers than for LOW steers in 1992 and was affected (P < .05) by a treatment times trial interaction in 1993. In 1992 grazing time along the streamside was greater (P < .05) for LOW steers than for MOD steers, and significant treatment times trial interactions were noted for grazing time spent along the forest edge and mid-meadow areas. In 1993, only streamside grazing time was influenced by treatment being greater (P < .05) for MOD steers than for LOW steers. In general, our data suggest that management decisions to reduce stocking densities may force cattle to congregate along streambanks and to concentrate grazing and loafing activities in those areas.

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250. Cattle management for biodiversity conservation in an alpine pasture.

Gianelle, D.; Guastella, F.; and Vescovo, L.

In: Integrating efficient grassland farming and biodiversity: Proceedings of the 13th International Occasional Symposium of the European Grassland Federation. (Held 29 Aug 2005-31 Aug 2005 at Tartu, Estonia.); pp. 112-115; 2005.

NAL Call #: SB202.E85 E87 2005

Descriptors: alpine grasslands/ biodiversity/ botanical composition/ cows/ dairy farming/ feeding behaviour/ feeding habits/ grassland management/ grasslands/ grazing/ mountain areas/ mountain grasslands/ nature conservation/ supplementary feeding

Abstract: The aim of this work was to evaluate different management techniques of dairy farming on alpine pastures in order to ensure grassland biodiversity conservation in a Central-East Alps alpine mountain barn (Malga Juribello, Trento, Italy). The experimental area was 40 ha, and its altitude ranged between 1,820 and 2,230 m a.s.l. The pasture was divided in two 20 ha paddocks and each was grazed by 12 cattle for 40 days. One group (paddock B) received 2 Kg of supplementary feeding per day, while the other group (paddock A) received 6 Kg per day. To analyze vegetation dynamics, 13 exclusion cages were placed in each paddock. Phytomass samples inside and outside the cages were collected to determine herbage utilisation rates. Vegetation was analysed inside and outside the cages to assess animal selectivity. Species composition and grassland grazing were strongly influenced by the two different feeding rates. Low rates of supplementary feeding seemed to force the cows to graze higher phytomass rates (68% in paddock B and 47% in paddock A), while high concentrate rates allowed the cows to make preferential choices. Low-fed animals were less selective and ate the less palatable plants such as *Deschampsia caespitosa* and *Nardus stricta* resulting in an increase of the number of species in paddock B.

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251. Changes in plant population density, composition and sward structure of a hill pasture during a pastoral fallow.

Nie, Z. N.; Mackay, A. D.; Barker, D. J.; Valentine, I.; and Hodgson, J.

Grass and Forage Science 52(2): 190-198. (1997)

NAL Call #: 60.19 B773; ISSN: 0142-5242

Descriptors: plant density/ fallow/ phosphorus fertilizers/

sulfur fertilizers/ tillers/ aspect/ grasslands/ hill grasslands/ fertilizers/ phosphorus/ sulfur/ grazing systems/ grassland improvement/ population dynamics

Abstract: A field study was conducted on two aspects (shady and sunny) of moist, low-fertility hill country with or without added fertilizer (phosphorus and sulphur) in the southern North Island of New Zealand, to investigate the changes in plant population density and sward structure during a full or partial pastoral fallow (in which pasture is not defoliated for a period from late spring/early summer to autumn), compared with a rotationally grazed pasture. A 7-month (October to May) pastoral fallow dramatically decreased the densities of grass tillers by 72% ($P < 0.01$), white clover (*Trifolium repens*) growing points by 87% ($P < 0.01$) and other species by 87% ($P < 0.05$). The decline in tiller density by pastoral fallow was enhanced on the shady aspect. Fertilizer application increased white clover growing-point density on the shady aspect ($P < 0.05$) and grass tiller density on the sunny aspect ($P < 0.05$). Decreased plant density during pastoral fallowing was attributed to above-ground biomass accumulation, which altered sward structure, leading to interplant competition and mortality by self-thinning and completion of the life cycle of some matured plants. The plant size-density relationship during pastoral fallowing in this mixed-species sward followed the self-thinning rule, particularly when the calculation was based on all plant species rather than grass alone. There was no significant ($P > 0.05$) difference in final plant population density between the 7-month pastoral fallow and a shorter term (October to December) pastoral fallow. It is concluded that pastoral fallowing effectively reduced the plant population density and altered sward structure of a hill pasture. Such changes create a more favourable environment for the introduction of improved forage species.

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252. Colonization of grassland by sown species: Dispersal versus microsite limitation in responses to management.

Coulson, Sarah J.; Bullock, James M.; Stevenson, Mark J.; and Pywell, Richard F.

Journal of Applied Ecology 38(1): 204-216. (2001)

NAL Call #: 410 J828; ISSN: 0021-8901

Descriptors: habitat diversification/ hay cutting/ management method/ seed sowing/ management method/ grassland colonization/ grazing/ inverse power models/ management responses/ microsite limitation/ seed dispersal distance/ seed production/ seed set/ seedling establishment/ survival

Abstract: 1. Diversification of species-poor grassland often requires the introduction of desirable species by sowing seed. Little is known about the factors controlling the spread of introduced species, or how these interact with management. We determined whether management affected spread rates of two grassland species by modifying seed dispersal or seedling establishment. 2. An experiment was set up in 1995 on a species-poor grassland. It comprised five blocks, each with four treatments: (1) autumn grazed only; (2) cut July; (3) cut July and September; (4) cut July and aftermath grazed. Twenty-two plant species were separately slot-seeded into each treatment plot, providing discrete linear colonization foci. 3. The mechanisms controlling spread were studied in two species: *Rhinanthus minor*, an annual with large seeds

adapted for wind dispersal; and *Leucanthemum vulgare*, a perennial with small seeds with no obvious dispersal adaptations. 4. Perpendicular spread of each species by 1998 was described well by a simple inverse power model. *Rhinanthus* had spread further in the hay-cut treatments (2-4) than in the grazed treatment (1). *Leucanthemum* spread poorly in all plots, with no treatment effects. 5. Seed dispersal from source slots was also described well by the inverse power model. Dispersal curves for *Rhinanthus* were much longer in the hay-cut treatment (3) than in the grazed treatment (1), because more seed dispersed during hay cutting than before, and cutting dispersed seed longer distances. There was no dispersal by grazing animals. Dispersal showed directional effects: seeds travelled further in the prevailing wind direction before the hay-cut and in the grazed treatment; dispersal by hay cutting was further in the cut direction than in the opposite direction. 6. *Leucanthemum* showed poor dispersal, with no treatment effects, except that more seeds were dispersed in the grazed (1) than the hay-cut (3) treatment. 7. The establishment and survival of sown seeds showed no treatment effects for either species. 8. Management effects on the spread of *Rhinanthus* reflected effects on dispersal, rather than establishment. *Leucanthemum* showed poor dispersal but good establishment in all treatments, suggesting its spread may also have been dispersal-limited. *Rhinanthus* was positively affected by hay cutting because it set seed at the time of cutting, whereas *Leucanthemum* set seed later and cutting reduced its seed production. 9. The results indicate that management of grassland to enhance the colonization of sown species might be best targeted at enhancing seed-dispersal distances. Hay cutting can do this, but must coincide with seed set.

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253. Community structure in montane grasslands of central Argentina in relation to land use.

Diaz, Sandra; Acosta, Alicia; and Cabido, Marcelo
Journal of Vegetation Science 5(4): 483-488. (1994)

NAL Call #: QK900.J67; ISSN: 1100-9233

Descriptors: cultivation/ disturbance history/ grazing/ livestock raising

Abstract: We compared the responses of natural montane grasslands in central Argentina to two land-use patterns: cultivation - high intensity, low frequency, and short history of disturbance - and livestock raising - low intensity, high frequency and long history of disturbance. We analysed species composition, richness, and architectural traits in seven neighbouring sites under different land use. There were sharp floristic discontinuities between post-agricultural stages, whereas only minor shifts occurred among different grazing situations. Unlike cultivation, grazing did not produce significant differences in species richness and allowed very slight invasion by exotics. In post-cultivation situations, architectural differences were accounted for by species composition. In the case of different grazing intensities, they were mainly explained by morphological differences among populations of the same dominants. In view of the historical information and current ideas, we suggest that the differential responses to both land uses can be explained not only by the different frequencies and intensities of disturbance they represent, but also by their

contrasting histories in the area. Accordingly, herbivory by ungulates should not be considered as a disturbance in these montane grasslands.

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254. A comparison between continuous and controlled grazing on a red duplex soil: Subsequent effects on seedbed conditions, crop establishment and growth.

Proffitt, A. P. B.; Bendotti, S.; and Riethmuller, G. P.

Soil and Tillage Research 35(4): 211-225. (1995)

NAL Call #: S590.S48; ISSN: 0167-1987

Descriptors: controlled grazing/ direct drilling/ grain protein/ no grazing/ plastic limit/ scarification/ set stocking/ trampling/ yield

Abstract: The effects of past grazing management practice on subsequent seedbed condition, draft requirements, fuel consumption, crop establishment and growth, and grain yield and quality were examined using three tillage systems on two sowing dates. The crop was wheat (*Triticum aestivum*), sown on a fragile sandy clay loam (red duplex soil) in a dryland agricultural area (307 mm average annual rainfall) of Western Australia. The three tillage-sowing systems investigated were: (i) scarifying followed by sowing with wide (180 mm) points; (ii) direct drilling with wide (180 mm) points; (iii) direct drilling with narrow (50 mm) inverted 'T'-shaped Super-Seeder points. The two sowing dates provided differences in seedbed water content at sowing time. The three grazing management strategies practiced in the previous pasture year were: (i) traditional set-stocking (where sheep were grazed continuously for 17 weeks, beginning soon after the start of the early winter rains); (ii) controlled grazing (where sheep were temporarily removed from the enclosure when the topsoil was close to its plastic limit); (iii) no grazing (where the pasture was mown to simulate grazing without trampling). Tillage prior to sowing with wide points reduced the mechanical impedance of the soil following set-stocking and provided a good seedbed for successful crop establishment and growth. In both the controlled-grazing management treatment and the treatment where the pasture had been mown the soil was suitable for direct drilling with both wide and narrow points (i.e. no pre-sowing tillage was required). The use of narrow points had the added advantage of requiring less fuel, but the need for a suitable implement to cover seeds was more critical than for wider sowing points. There were no advantages with respect to grain yield from adopting a controlled-grazing management practice owing to the lack of finishing rainfall. However, grain protein levels were higher in both the controlled and ungrazed treatments compared with the set-stocking treatment.

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255. Comparison of herbage production on moderately grazed and ungrazed western ranges.

Lacey, J. R. and Van Poollen, H. W.

Journal of Range Management 34(3): 210-212. (1981)

NAL Call #: 60.18 J82; ISSN: 0022-409X

<http://jrm.library.arizona.edu/data/1981/343/10lace.pdf>

This citation is from AGRICOLA.

256. Comparison of herbage production under continuous stocking and intermittent grazing.

Grant, S. A.; Barthram, G. T.; Torvell, L.; King, J.; and Elston, D. A.

Grass and Forage Science 43(1): 29-39. (1988)

NAL Call #: 60.19 B773; ISSN: 0142-5242

Descriptors: sheep/ *Lolium perenne*/ forage/ stocking rate/ sward/ grazing intensity/ crop production/ grazing/ range management/ Scotland

This citation is from AGRICOLA.

257. A comparison of methane emissions from sheep grazing pastures with differing management intensities.

Murray, P. J.; Gill, E.; Balsdon, S. L.; and Jarvis, S. C.

Nutrient Cycling in Agroecosystems 60(1/3): 93-97. (2001)

NAL Call #: S631.F422; ISSN: 1385-1314

Descriptors: sheep/ pastures/ grazing/ range management/ methane/ botanical composition/ *Trifolium repens*/ body weight/ diurnal variation/ nitrogen fertilizers/ application rate

Abstract: Methane emissions were measured from sheep grazing on pastures that received one of three managements, either 70 or 270 kg N fertiliser ha⁻¹ or one which had a high proportion of white clover present. A system for measuring the emissions is described which enables measurements to be made under near natural grazing conditions. Continuous measurements of emissions were made over periods of 4 days. There were no significant differences in the amount of CH₄ produced per unit body weight over the study period. Animals feeding on both the grass pastures showed strong diurnal patterns of CH₄ emission with peak emissions between 15:00 and 17:00 h and levels gradually falling throughout the night before starting to rise at around 08:00 h. Those animals feeding on the clover swards also had peak emissions at around the same time in the afternoon, however, levels of CH₄ production did not decline over the night and peaked again in the morning before falling sharply to a low at noon. It is concluded from the present studies that the level of inputs to the sward tends to play little part in the overall levels of CH₄ emissions from grazing sheep, but can influence the diurnal pattern of CH₄ production. This citation is from AGRICOLA.

258. The conservation management of mesotrophic (meadow) grassland in northern England: Effects of grazing, cutting date and fertilizer on the vegetation of a traditionally managed sward.

Smith, R. S.; Buckingham, H.; Bullard, M. J.; Shiel, R. S.; and Younger, A.

Grass and Forage Science 51(3): 278-291. (1996)

NAL Call #: 60.19 B773; ISSN: 0142-5242

Descriptors: agronomy/ conservation management/ cutting date/ fertilizer/ grazing/ meadow/ mesotrophic grassland/ nitrogen/ phosphorus/ potassium/ traditionally managed sward/ vegetation

Abstract: The results are reported from an experiment on the effects of cutting date (14 June, 21 July and 1 September), fertilizer application (none or 80 kg ha⁻¹ N plus 40 kg ha⁻¹ P and K) and grazing treatments (none, autumn or autumn plus spring) on the vegetation of an upland mesotrophic grassland in Upper Teesdale, northern England, UK. Effects on plant species number and cover are reported for 4 years (1989-93) of treatment. Effects on 'species-attributes' are given for the fourth year. The cessation of grazing combined with the use of fertilizer progressively reduced species number by about 25%. Under traditional management (no fertilizer, cutting date on 21 July, autumn and spring grazing) the species number and cover remained relatively static over the 4 years.

Comparison between treatments in the fourth year showed a reduction in species number under the fertilizer application, cutting date on 1 September and no-grazing treatments. Fertilizer use together with cutting date on 1 September particularly lowered species number and cover. Analysis of variance was used to assess the effect of treatment on species that occurred frequently in the sward. A cutting date of 1 September favoured *Agrostis capillaris*, *Alopecurus pratensis*, *Poa trivialis*, *Phleum pratense* and *Trisetum flavescens*. The absence of grazing favoured *Dactylis glomerata* and *Holcus lanatus*. The use of fertilizer particularly favoured *A. pratensis* and *H. lanatus*. Ordination methods were used to assess the effect of treatment on the less frequent species. These were primarily associated with the treatment combination that matched 'traditional' management. Deviations from this 'traditional' regime acted separately, rather than in combination, and favoured different grass species. Traditional management was associated with ruderal, stress-tolerant ruderal and competitive ruderal strategists and with longer seed germination times, heavier seeds, some of which needed scarifying or chilling to break dormancy, and transient seed banks that germinated in the autumn. The original sward was an *Anthoxanthum odoratum*-*Geranium sylvaticum* grassland, *Briza media* subcommunity (MG3b). After 4 years, *Festuca ovina*-*Agrostis capillaris*-*Galium saxatile* grassland, *Holcus lanatus*-*Trifolium repens* subcommunity (U4b) and *Lolium perenne*-*Alopecurus pratensis*-*Festuca pratensis* grassland (MG7c) were found in many of the fertilized and late-cutting treatments.
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259. The conservation management of mesotrophic (meadow) grassland in northern England: Effects of grazing, cutting date, fertilizer and seed application on the vegetation of an agriculturally improved sward.

Smith, R. S.; Corkhill, P.; Shiel, R. S.; and Millward, D. *Grass and Forage Science* 51(3): 292-305. (1996)
NAL Call #: 60.19 B773; ISSN: 0142-5242
Descriptors: agronomy/ conservation management/ cutting date/ fertilizer/ grazing/ meadow/ mesotrophic grassland/ nitrogen/ phosphorus/ potassium/ seed applications/ traditionally managed sward/ vegetation
Abstract: The plant species number and composition, and yield of herbage biomass of an agriculturally improved hay meadow were assessed after 4 years under various combinations of grazing, fertilizer application, cutting date and seed addition treatments in a replicated split-plot design. Grazing treatments consisted of either autumn grazing with cattle and sheep, spring grazing with sheep or both regimes. Fertilizer application treatments consisted of either 25 kg ha⁻¹ N plus 12.5 kg ha⁻¹ P and K or no fertilizer. Cutting date treatments consisted of cuts on either 14 June, 21 July or 1 September. Seed addition treatments consisted of either no addition or sowing with a range of meadow species in the autumn. Data analysis was by correspondence analysis and analysis of variance. Species number decreased with fertilizer use and when the cutting date was 1 September. A range of species was affected by the main treatments and there were some first-order interactions, mainly between cutting date and fertilizer application. *Rhinanthus minor* was particularly favoured by the seed addition treatment. Species attributes in the regenerative and established phase were related to treatments and their effect on species composition. The

National Vegetation Classification communities were associated with particular treatment regimes. The 21 July cutting date favoured 'improved' over 'unimproved-traditional' swards, with spring grazing favouring 'unimproved-traditional' swards. Lowest yields of herbage biomass were associated with autumn and spring grazing, the 14 June cutting date and no fertilizer treatments. The fertilizer, 1 September cutting date and autumn grazing treatments gave the highest yields. The implications of these results are discussed in terms of the conservation management required to return agriculturally improved mesotrophic grassland to a species composition similar to that of traditionally managed grassland.
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260. Conservation of plant diversity in grassland under grazing management.

Naito, K.
In: Conservation and utilization of land resources in less favored areas with special emphasis on the roles of livestock and technology. (Held 20 Sep 1999-23 Sep 1999 at Matsue and Oda, Japan.); pp. 84-91; 2000.
Notes: Proceedings of the International Workshop
Descriptors: grasslands/ grazing/ pastures/ seed production/ seedlings/ species diversity/ natural grasslands
Abstract: The semi-natural grasslands in Japan dramatically decreased in area after the Second World War. A recent survey has revealed that a considerable number of plant species in semi-natural grasslands have become threatened due to changes in land use. The effects of cattle grazing on plant diversity in grasslands was studied at the western foot (Nishinohara) of Mt. Sanbe, in southwestern Japan, where grazing was reintroduced after a break of 24 years. Within a few years of the reintroduction of cattle, the tall *Miscanthus sinensis* grassland had changed to a mosaic made up of tall ungrazed areas and short heavily grazed areas due to selective grazing. In the pasture, a threatened perennial, *Pulsatilla cernua* (Ranunculaceae), recovered after the reintroduction of grazing. The patch structure minimized plant injury by grazing, as the ungrazed patches in the pasture were suitable habitat for the individuals. Other plant species also showed features relative to the mosaic pattern of vegetation. In particular, autumn-flowering plants were significantly influenced by the mosaic pattern. In another grassland grazed for more than several decades at the eastern foot (Higashinohara) of Mt. Sanbe, the stem densities of most autumn-flowering species were higher in the tall area than in the short area. A more obvious trend was recognized when the density of the flowering stems was compared rather than the total number of stems, suggesting that seed production was higher in the tall area, which is important for the maintenance of plant diversity. Based on these results, cattle grazing seems to have the potential to restore a high level of plant diversity to the grassland community. Further studies on grazing systems and/or vegetation dynamics are still needed in order to develop specific management programs.
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261. Conserving biodiversity on calcareous grasslands in the Franconian Jura by grazing: A comprehensive approach.

Dolek, Matthias and Geyer, Adi

Biological Conservation 104(3): 351-360. (2002)

NAL Call #: S900.B5; ISSN: 0006-3207

Descriptors: grazing: economics, management method, practicability, regulations/ biodiversity conservation/ calcareous grasslands: diverse habitat, species rich habitat/ lamb: meat product/ sales premium/ state subsidies
Abstract: Calcareous grasslands, as extraordinarily species-rich and diverse habitats of northern and central Europe, need some management for their long-term conservation. Traditionally, they have been used as pastures, mainly with sheep, but goats are important, because they mainly browse and climb rocks. This study presents a comprehensive approach to the conservation of these sites, including the requirements of shepherds, which were obtained by a questionnaire, together with autecological information on the habitat requirements of species. Grazing is a central option, which has to be regulated in timing, intensity and spatial distribution, to gain optimum results. Nevertheless, local regulations must consider the requirements of the shepherds regarding infrastructure and social conditions, so that grazing remains practicable. Additionally, sheep-farming on conservation sites is presently unprofitable and therefore needs financial support. This support is supplied by state subsidies in Bavaria (Vertragsnaturschutzprogramm), and in the study area by a lamb-meat sales premium, which allows the shepherds to charge higher prices for lamb-meat produced under the premium regulations. The success of the overall strategy is only possible given a well adjusted interplay of influencing factors.

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262. Continuous and rotational grazing of dairy cows: The interactions of grazing system with level of milk yield, sward height and concentrate level.

Pulido, R. G. and Leaver, J. D.

Grass and Forage Science 58(3): 265-275. (2003)

NAL Call #: 60.19 B773; ISSN: 0142-5242

Descriptors: continuous grazing: applied and field techniques/ rotational grazing: applied and field techniques/ grazing system interaction: concentrate level, milk yield, sward height

Abstract: An experiment was conducted to test the hypothesis that for cows with high levels of milk yield, rotational grazing produces higher milk yields than continuous grazing. The comparison of grazing systems was made at two levels of milk yield (initially 20.3 and 32.5 kg d⁻¹), and interactions with sward height and concentrate level were also examined. The study used 48 multiparous Holstein Friesian cows over a period of 62 d. Mean milk yield, its persistency and composition, live weight, body condition score and liveweight gain were not significantly affected by grazing system at either level of milk yield. There were no significant interactions between grazing system and sward height or concentrate level for any milk production measurement. Mean estimated herbage and total dry matter (DM) intake (P<0.01), grazing time (P<0.05) and ruminating time (P<0.01) were significantly greater on the continuous grazing system. The cows in the higher milk yield group and those grazed at the higher sward height had a significantly (P<0.05) higher estimated daily herbage

DM intake and rate of herbage intake on the continuous grazing system than those on the rotational grazing system. There was no evidence to support the hypothesis that rotational grazing systems support higher levels of milk production than continuous grazing for cows of high milk yield. The shorter grazing time on the rotational grazing system indicated that cows may anticipate the timing of the daily movement of the electric fence, and this reduces their time spent grazing residual herbage.

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263. Contrasting responses of plant and insect diversity to variation in grazing intensity.

Kruess, Andreas and Tschamtkke, Teja

Biological Conservation 106(3): 293-302. (2002)

NAL Call #: S900.B5; ISSN: 0006-3207

Descriptors: animals and man/ disturbance by man/ commercial activities/ conservation/ conservation measures/ ecology/ community structure/ habitat/ terrestrial habitat/ land and freshwater zones/ Palaearctic Region/ Europe/ Coleoptera: farming and agriculture/ cattle grazing/ habitat management/ significance of grazing intensity effects on community ecology/ trophic structure/ grazing intensity influences and conservation implications/ species diversity/ grazing intensity effects and conservation implications/ grassland/ grazing intensity effects on community ecology/ conservation implications/ Germany/ Schleswig Holstein/ grazing intensity effects on community ecology and conservation implications/ Coleoptera/ Insecta/ arthropods/ coleopterans beetles/ hemipterans true bugs/ hymenopterans/ insects/ invertebrates

Abstract: The effects of grazing intensity on plant and insect diversity were examined in four different types of grassland (intensively and extensively cattle-grazed pastures, short-term and long-term ungrazed grassland; 24 study sites). Vegetation complexity (plant species richness, vegetation height, vegetation heterogeneity) was significantly higher on ungrazed grasslands compared to pastures but did not differ between intensively and extensively grazed pastures. However, insect species richness was higher on extensively than on intensively grazed pastures, established by suction sampling of four insect taxa (Auchenorrhyncha, Heteroptera, Coleoptera, Hymenoptera Parasitica). This may be due to intensive grazing disrupting plant-insect associations as predicted by a "trophic-level" hypothesis. Local persistence and small-scale recolonization of insects on plants appeared to be difficult in the highly disturbed environment of intensive grazing. Insect diversity increased across the four treatments in the following order: intensively grazed < extensively grazed < short-term ungrazed < long-term ungrazed. The major predictor variable of differences in species diversity was found to be vegetation height. Predator-prey ratios within the investigated insect groups were not affected by grazing intensity.

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264. Control of sward conditions and apparent utilization of energy in the buffer grazing system.

Illius, A. W.; Lowman, B. G.; and Hunter, E. A.

Grass and Forage Science 42(3): 283-296. (1987)

NAL Call #: 60.19 B773; ISSN: 0142-5242

Descriptors: cattle/ nitrogen/ silage yield/ viability/ land use
Abstract: Experiments were carried out over four years to develop a system of buffer grazing. Groups of 16 cattle

were set stocked with or without buffer areas formed by withholding a proportion of the grazing area by electric fence. It was found that buffers should be grazed if sward height, measured by rising plate meter, was reduced below 5 cm, or otherwise cut for silage. Increasing the area of the buffer reduced cattle gains but increased silage yield and sward quality, and the best compromise over 4 years was a buffer area of 25-30% of the initial grazing area. Buffer treatments gave higher UME and financial output than controls, due to the value of silage from the buffers and to the higher nitrogen inputs which were successfully managed under buffer grazing. The higher outputs over 4 years were also associated with lower viability and therefore lower levels of risk, resulting from a number of compensating processes at sward and animal level. There was no indication that grazed UME was higher on buffer treatments at a given level of nitrogen, suggesting that any increased grazing efficiency must be offset by other disadvantages when comparing intensive with lax defoliation regimes. The results suggest that there is considerable stability in grazing systems which may frustrate attempts to improve their biological efficiency, although there is some scope for manipulating the seasonal pattern of land use and animal performance.

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265. Controlled grazing studies on Molinia grassland: Effects of different seasonal patterns and levels of defoliation on Molina growth and responses of swards to controlled grazing by cattle.

Grant, Sheila A.; Torvell, Lynne; Common, T. G.; Sim, Evelyn M.; and Small, J. L.

Journal of Applied Ecology 33(6): 1267-1280. (1996)
NAL Call #: 410 J828; ISSN: 0021-8901

Descriptors: agriculture/ defoliation/ food/ grazer/ growth rate/ pasture management/ seasonality

Abstract: 1. Experiments were carried out at three sites in southern Scotland to determine the suitability of Molinia grassland for sustained use in providing summer grazing for cattle, and to investigate grazing control as a tool to manipulate the species composition of hill pastures in Britain. 2. Cutting experiments showed that frequency and severity of defoliation were more important than timing in their effects on Molinia. Weights of clippings declined in successive years only in response to treatments that involved repeated within-season cutting. 3. Three years of repeated light defoliation (33% lamina length removed each June, July and August), compared with uncut controls, reduced leaf production in a fourth uninterrupted growing season by 40%, while repeated heavy defoliation (66% lamina removal) reduced it by 78%. Reductions in both the numbers and the size of tillers contributed to this result. Single annual cuts only reduced leaf production at 66% lamina removal when they took place late in the season. 4. Plots grazed by cattle at two sites for 6 years compared treatments where 66% rather than 33% of the herbage was removed by grazing. The rates of leaf extension in Molinia were reduced at the higher level of use. In comparison with areas protected from grazing during the final year of treatment only, the biomass of Molinia and other grasses in areas open to grazing showed that the taller Molinia was utilized to a much greater extent than the other grasses. After 6 years of grazing, the biomass of Molinia at 33% utilization was reduced by 46-65% compared with ungrazed exclosures, while at 66% utilization it was reduced by 86%.

5. Basal internode size was greatly reduced in the grazed plots compared with the ungrazed exclosures, with effects on tiller base size being more important than variation in concentrations in determining amounts of starch, total water soluble carbohydrates, N, P and K on a per tiller basis. Site times management interactions for concentrations could be interpreted in terms of variations in stage of maturity, potential for growth and plant/animal nutrient cycling pathways. 6. Floristic diversity was increased on grazed compared with ungrazed areas. The cover of Molinia was decreased and that of other broad-leaved grasses increased by grazing. At 33% utilization, the cover of Molinia appeared to be levelling off (at around 60-65% after 3-5 years) while at 66% utilization a continued downward trend was evident. Species trends were also influenced by site factors, with exclusion of grazing leading to a reduced cover of *Festuca ovina* only where conditions were favourable for high yields of taller grasses. 7. The responses of Molinia to defoliation are discussed in relation to its pattern of growth and low rate of leaf and tiller turnover and to its responses to soil and climatic factors. The effects of grazing on nutrient cycling and sward canopy structure, in influencing competitive relationships with other species, are considered and the wider issues relevant to management protocols are outlined.

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266. Decline of landscape-scale habitat and species diversity after the end of cattle grazing.

Luoto, Miska; Pykala, Juha; and Kuussaari, Mikko
Journal for Nature Conservation 11(3): 171-178. (2003);
ISSN: 1617-1381

Descriptors: grazing/ grazing management/ habitat mosaics/ landscape scale/ landscape scale habitat diversity/ semi natural grassland/ species diversity

Abstract: A decrease of habitat and species diversity in agricultural landscapes, mainly as a result of the decline of semi-natural grasslands, has been shown in several studies. However, no studies have linked the effects of decrease of grassland management with landscape structure and plant and bird species diversity on the landscape scale in a spatial grid system. In this study we examined the differences in the present habitat and species diversity (number of total and rare plant and bird species) among agricultural landscapes differing in their management history. We compared areas of 0.25 km² (n=34) with different grazing history in the Rekijoki river valley, SW Finland. The grazed area decreased to one fifth over 30 years (1960-1990) in our study area. The earlier interconnected network of grazed patches was disrupted, resulting in an isolated grazing pattern. There were statistical differences in the habitat structure and plant species diversity between the landscapes with different management histories, but no difference in bird diversity was observed. The number of rare plant species/0.25 km² was 45% less in areas of 20-40 years of abandonment compared to squares with continuously grazed patches. The results address the importance of grazing management for maintaining heterogeneous habitat mosaics and plant diversity on the landscape scale.

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267. Density of *Trifolium repens* plants in mixed swards under intensive grazing by sheep.

Hay, M. J. M.; Brock, J. L.; and Thomas, V. J.

Journal of Agricultural Science 113(1): 81-86. (1989)

NAL Call #: 10 J822; ISSN: 0021-8596

Descriptors: stolon/ growing points/ pasture management/ agriculture/ crop intensity/ New Zealand/ livestock industry
Abstract: Densities of physiologically independent plants of white clover were studied in New Zealand in pastures stocked at 22.5 ewes plus lambs/ha by set stocking, rotational grazing or a combination of both systems. Plants were sampled once a month for 1 year (1984/85) by taking turves and washing out the plants. Numbers of growing points and stolon dry weight per plant were obtained. At each sampling fifty, 50 mm diameter pasture plugs were taken from each sward and growing point density and stolon mass/m² of white clover were measured. The density of white clover plants in the swards was estimated on the basis of both stolon dry weight and number of growing points. The two estimates gave similar results. There was a trend of lowest densities in set-stocked pastures (334/m²), intermediate densities in combination management pastures (431/m²) and highest densities in the rotationally grazed pastures (553/m²). The overall mean density of white clover plants was 439/m² and the range was 193-811/m². The structure of swards under the three systems of grazing differed and this was considered to contribute towards the variation in density of white clover plants in the various swards.

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268. Determining the effectiveness of grazing and trampling by livestock in transmitting white clover mosaic and subterranean clover mottle viruses.

Mckirdy, S. J.; Jones, R. A. C.; and Sivasithamparam, K.

Annals of Applied Biology 132(1): 91-105. (1998)

NAL Call #: 442.8 An72; ISSN: 0003-4746

Descriptors: agriculture/ disease transmission/ grazing/ mowing/ pasture conditions/ trampling/ wounding
Abstract: Glasshouse and mini-sward experiments were done to determine the relative roles of grazing and trampling by livestock in transmitting white clover mosaic (WCIMV) and subterranean clover mottle (SCMoV) viruses between clover plants in pastures. Wounding due to grazing was simulated by repeatedly cutting plants with serrated scissors (glasshouse) or mowing (mini-swards), while wounding due to trampling was simulated by repeatedly bashing plants with the flat end of a wooden hammer handle (glasshouse) or rolling (mini-swards). In glasshouse experiments, cutting was more effective than bashing in transmitting WCIMV to white clover (*Trifolium repens*) plants but cutting and bashing transmitted it to subterranean clover (*T. subterraneum*) plants at similar rates. In an experiment with white clover mini-swards, mowing was more effective than rolling in transmitting WCIMV, and when both were combined, initially spread exceeded that obtained when the spread from mowing and rolling alone was added together. In glasshouse experiments, bashing was more effective than cutting in transmitting SCSMoV to subterranean clover plants. In one experiment, neither mowing nor rolling spread SCSMoV in mini-swards of subterranean clover. When transmission to subterranean clover cultivars which were 'susceptible' or 'moderately susceptible' to SCSMoV was compared in glasshouse experiments, repeated bashing spread the virus

more slowly to the 'moderately susceptible' cultivars. When mixed with ruminant saliva, infective sap containing WCIMV or SCSMoV was still infective to clover plants after 4 wk storage at room temperature. When infective sap was allowed to dry naturally on a metal surface, SCSMoV still infected clover plants when the dried sap was taken up in tap water after 4 but not 14 days, while WCIMV was infective after 24 h but not 4 days. These results suggest that grazing and mowing are more effective than trampling at transmitting WCIMV to white clover plants in pastures, while trampling is more effective at spreading SCSMoV to subterranean clover. However, both transmitted WCIMV to subterranean clover at similar rates. Possible reasons for these differences are discussed in relation to differences in clover plant morphology and virus-specific factors.

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269. Development removal and death of white clover (*Trifolium repens*) leaves under 3 grazing managements in hill country.

Chapman, D. F.

New Zealand Journal of Agricultural Research 29(1):

39-48. (1986)

NAL Call #: 23 N4892; ISSN: 0028-8233

Descriptors: sheep/ cattle/ set stocking/ rotational grazing/ grassland management

Abstract: The development and fate of white clover leaves in hill country swards under each of 3 grazing managements (set stocking or rotational grazing with sheep, rotational grazing with cattle) were studied for 16 months. Managements did not consistently influence the rate at which leaves matured. Maximum individual leaf areas were reached in 9-11 days in summer and 22-28 days in winter. Over the entire observation period, 61-65% of leaves produced were removed by stock. Differences between managements were relatively small, except in winter when long rotations (63-70 days) allowed considerable leaf death between grazings in the rotational treatments. Over all, the number of leaves per stolon was greater under cattle than sheep grazing (3.05 v. 2.49-2.78) because of longer defoliation intervals in some seasons. However, when defoliation intervals were similar between managements, leaf number differences largely disappeared. Differences in defoliation patterns between managements were not considered large enough to cause substantial differences in plant performance, though greater leaf numbers per stolon under cattle grazing offer a partial explanation for the better clover growth observed under this treatment. The results also demonstrate that, despite high stocking rates, none of the managements were likely to have restricted assimilate supply through excessive leaf removal, as leaves were able to export assimilate for an estimated mean period of 15-17 days before being removed.

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270. Differences in the nitrogen use efficiency of perennial ryegrass varieties under simulated rotational grazing and their effects on nitrogen recovery and herbage nitrogen content.

Wilkins, P. W.; Allen, D. K.; and Mytton, L. R.

Grass and Forage Science 55(1): 69-76. (2000)

NAL Call #: 60.19 B773; ISSN: 0142-5242

Descriptors: simulated rotational grazing: clipping, field method/ nitrogen use efficiency

Abstract: Eight varieties of perennial ryegrass (six new varieties and two old ones) grown at five levels of applied fertilizer (100, 200, 300, 400 and 500 kg of N ha⁻¹) were cut monthly during two growing seasons (March to October in 1997 and 1998) and their herbage dry-matter (DM) yield and nitrogen (N) content were determined. Herbage leaf content and the N content of young fully expanded leaves were also measured in 1997, and monthly recovery of applied N was determined in both the first and second harvest years by using ¹⁵N. The rank order of varieties was similar for annual yield of DM and N at all five fertilizer levels. Proportional differences between varieties in DM yield were greatest in the first cut of each year, the late-heading candidate variety Ba12151 out-yielding the old late-heading variety S23 by more than 70%. However, differences in annual DM yield were much more modest than in early spring yield, up to 10% in 1997 and up to 21% in 1998. The relatively small differences in total annual DM yield were attributed to only a small proportion of the applied N being recovered during a single regrowth period, most of the remainder becoming available for uptake in subsequent regrowth periods. There were small but highly statistically significant differences among varieties in the N content of their leaves, leaf N content being inversely related to yield of DM and N. This lends further support to the hypothesis that the metabolic cost of protein synthesis and turnover is a key factor controlling genetic variation both in leaf yield and in annual DM and N yield under frequent harvesting. Seasonal variation in herbage N content was much greater than differences among varieties in mean N content over all harvests. In May of both years at all applied fertilizer levels, herbage N content fell below the 20 g N kg⁻¹ DM level required by productive grazing animals.

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271. Dry-matter yield and herbage quality of a perennial ryegrass/white clover sward in a rotational grazing and cutting system.

Schils, R. L. M.; Vellinga, T. V.; and Kraak, T. *Grass and Forage Science* 54(1): 19-29. (1999)
 NAL Call #: 60.19 B773; ISSN: 0142-5242

Descriptors: *Lolium perenne*/ *Trifolium repens*/ yields/ forage/ rotational grazing/ cutting/ nitrogen fertilizers/ silage/ botanical composition/ in vitro digestibility/ dairy cows/ application rate/ Netherlands

Abstract: The expected reduction in the use of fertilizer nitrogen (N) on grassland in the Netherlands has led to renewed interest in white clover. Therefore, the performance of a newly sown perennial ryegrass/white clover sward on clay soil was assessed during 4 consecutive years. The experiment consisted of all combinations of two defoliation systems, i.e. one or two silage cuts per year (S1, S2), spring N application rate, i.e. 0 or 50 kg ha⁻¹ year⁻¹ (N0, N50), and the management system, i.e. rotational grazing and cutting, or cutting only (RGC, CO). The overall mean white clover cover was 30%. All treatments affected white clover cover, which was 8% higher with S2 than with S1 6% higher with N0 than with N50 and 12% higher with CO than with RGC. The overall mean annual dry-matter (DM) yield (13(.1) t ha⁻¹ year⁻¹) was significantly affected only by the management system: in two relatively wetter years, the annual DM yield was 1(.19) t ha⁻¹ higher with RGC than with CO, whereas there was no difference in two relatively drier years. Nitrogen

application increased the DM yield in the first cut by 7(.0) kg kg⁻¹ N applied, but had no significant effect on the annual DM yield. Herbage quality was not affected by the experimental treatments. The average in vitro organic matter digestibility was 0.801, and the average crude protein content was 193 g kg⁻¹ DM. With the expected reduction in the use of fertilizer N, perennial ryegrass/white clover swards should be seriously considered as an alternative option to perennial ryegrass swards on these clay soils.

This citation is from AGRICOLA.

272. Dynamics of heterogeneity in a grazed sward.

Parsons, A. J.; Carrere, P.; and Schwinning, S.
 In: *Grassland ecophysiology and grazing ecology*/ Lemaire, Gilles.
 New York: CABI, 2000; pp. 289-315.

Notes: ISBN: 0851994520

NAL Call #: SF84.84 .G68 2000

Descriptors: grasslands/ grazing/ grazing systems/ selective grazing/ rotational grazing/ continuous grazing/ models/ intake/ crop yield

Abstract: This chapter considers biting (defoliation) as a source of heterogeneity in the grazed sward, with consequent effects on grass growth and animal intake. Three contrasting methods of spatially exploiting the sward (sequential grazing, random grazing and selective grazing) and models of the impact of these methods on bite-sized patches of sward are discussed. The role of heterogeneity in yield and stability is considered and it is suggested that continuous and rotational grazing systems may not be consistently better than each other.

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273. Early changes in species composition of upland sown grassland under extensive grazing management.

Marriott, Carol A.; Bolton, G. R.; Barthram, G. T.; Fisher, J. M.; and Hood, K.

Applied Vegetation Science 5(1): 87-98. (2002)

NAL Call #: QK900 .A66; ISSN: 1402-2001

Descriptors: grazing management: management method/ biodiversity/ grazing/ seed bank/ species abundance/ species composition/ swards: unfertilized, ungrazed/ upland sown grassland/ vegetation change

Abstract: Due to economic pressures and policy changes *Lolium perenne*-*Trifolium repens* sown swards in upland UK sheep systems are likely to become less intensively managed. We present results from the first 5 yr of a long-term experiment studying vegetation change under more extensive grazing management at three sites. One treatment was representative of current, intensive management and 5 were unfertilized with different intensities of seasonal grazing. The species composition of unfertilized, ungrazed swards changed dramatically within 2 yr and the sown species had virtually disappeared by year 5. *Ranunculus repens*, *Poa trivialis*, *Agrostis gigantea*, *Juncus* spp. and *Carex* spp. became dominant at the wettest site. Grasses were dominant at the other sites. In contrast, the sown species were retained in the unfertilized, grazed treatments; there were small shifts in abundance of the species present initially and few additions or losses of species. Some colonizing species were present in the seed bank whereas others with a transient seed bank appeared

to have invaded from neighbouring vegetation. Implications of these results for compensation schemes to reduce animal output and increase biodiversity are discussed.

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274. Ecology and grazing management of alfalfa pastures in the subtropics.

Leach, G. J. and Clements, R. J.

Advances in Agronomy 37: 127-154. (1984)

NAL Call #: 30 AD9; ISSN: 0065-2113

Descriptors: forage legumes/ grazing/ *Medicago sativa*/ range management/ plant ecology/ subtropics

This citation is from AGRICOLA.

275. Effect of continuous and time-control grazing on grassland components in south-eastern Australia.

Dowling, P. M.; Kemp, D. R.; Ball, P. D.; Langford, C. M.; Michalk, D. L.; Millar, G. D.; Simpson, P. C.; and Thompson, R. P.

Australian Journal of Experimental Agriculture 45(4): 369-382. (2005)

NAL Call #: 23 Au792; ISSN: 0816-1089

Descriptors: grasslands/ grazing management/ rotational grazing/ grazing/ pasture management/ forage grasses/ pasture plants/ perennials/ sheep/ cattle/ vegetation cover/ pastures/ botanical composition/ on-farm research/ New South Wales/ Victoria (Australia)/ Tasmania

This citation is from AGRICOLA.

276. Effect of deferred grazing during summer on white clover content of Waikato dairy pastures, New Zealand.

Harris, S. L.; Waugh, C. D.; McCabe, R. J.; and Vught, V. T.

New Zealand Journal of Agricultural Research 42(1): 1-7. (1999)

NAL Call #: 23 N4892; ISSN: 0028-8233

Descriptors: grazing/ grazing intensity/ grazing systems/ rotational grazing/ dairy cattle/ seedlings/ soil water/ survival/ temperature/ tillers/ population dynamics/ persistence/ deferred-rotation-grazing

Abstract: New Zealand dairy pastures rotationally grazed at intervals of 25 to 30 days to low residual herbage masses (<1400 kg DM/ha) over summer often suffer white clover loss. An experiment was conducted over 1994-97 in mixed perennial ryegrass [*Lolium perenne*]/white clover [*Trifolium repens*] dairy pastures to examine the effects of deferred grazing, the practice of holding over pasture in situ for 50, 75, or 100 days over summer, on white clover growth compared with a more common 25-day grazing interval. Additional pasture cover built up in 100-day deferred (100D) plots resulted in significantly lower soil temperatures and higher soil moisture than in the 25D treatment. Clover stolon survival was up to 63% higher in deferred pastures than the 25D treatment. This, combined with higher clover seedling density, resulted in significantly higher clover contents in pastures following deferral compared with the 25D grazed pasture. These differences did not persist through to the following spring. Deferred grazing also resulted in small increases in total herbage accumulation but had little effect on ryegrass tiller density.

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277. Effect of enclosure on soils, biomass, plant nutrients, and vegetation, on unfertilised steeplands, Upper Waitaki District, South Island, New Zealand.

McIntosh, P. D. and Allen, R. B.

New Zealand Journal of Ecology 22(2): 209-217. (1998)

NAL Call #: QH540.N43; ISSN: 0110-6465

Descriptors: biomass/ floristics/ grazing/ high country/ nutrients/ rehabilitation/ soil

Abstract: We sampled soils and vegetation within and outside two sheep and rabbit enclosures, fenced in 1979, on steep sunny and shady slopes at 770 m altitude on seasonally-dry pastoral steeplands. The vegetation of sunny aspects was characterised by higher floristic diversity, annual species, and low plant cover. Here the exotic grass *Anthoxanthum odoratum* dominated on grazed treatments, and the exotic forb *Hieracium pilosella* on ungrazed. Shady aspects supported fewer, and almost entirely perennial, species. Here *Hieracium pilosella* dominated grazed treatments, but co-dominated with the exotic forb *H. praealtum* and the native grass *Festuca novae-zelandiae* on ungrazed treatments. There was 43% more biomass in enclosures ($P < 0.01$). Most of the biomass difference (4285 kg/ha) was from greater root mass (2400 kg/ha). 1385 kg/ha of the difference was from herbage and the remainder (500 kg/ha) from litter. Enclosures had 50 to 100% more Ca, Mg, K and P in the biomass ($P < 0.05$), but the effect on soils was limited to significantly higher concentrations of total N ($P < 0.05$) and exchangeable Mg ($P < 0.01$) in 0-7.5 cm soils. We conclude that stopping grazing for 16 years on seasonally-dry steeplands results in greater plant cover, approximately double the biomass of standing vegetation, greater biomass in roots, and more biomass nutrients relative to grazed areas. However, it does not favour native species and has little effect on soil nutrients or soil carbon. Stopping grazing alone therefore cannot be regarded as a comprehensive short- or medium-term vegetation or soil rehabilitation option.

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278. Effect of fertilizer application and grazing management on grazed New Zealand hill country.

Lambert, M. G. and Clark, D. A.

In: Proceedings of the 39th Southern Pasture and Forage Crop Improvement Conference. (Held 23 May 1983-26 May 1983 at Oklahoma City, Okla.); Vol. 39.

New Orleans, La.: U.S. Department of Agriculture; pp. 108-114; 1983.

Notes: ISSN: 0193-6425

NAL Call #: 60.19 SO83

Descriptors: New Zealand

This citation is from AGRICOLA.

279. Effect of grazing intensity and applied fertilizers on pasture production and animal gain.

Sigurbjornsson, B.; Gudmundsson, O.; Arnalds, A.; Thorsteinsson, I.; and Eiriksson, T.

In: Nuclear techniques in improving pasture management: Proceedings. (Held 10 Nov 1980-14 Nov 1980 at Vienna: International Atomic Energy Agency; pp. 165-174; 1983.

NAL Call #: SB199.A34 1980

Descriptors: fertilizer application/ forage/ yields/ grazing intensity/ lambs/ liveweight gain/ carcass weight/ pastures/ Iceland

This citation is from AGRICOLA.

280. Effect of land management on ecosystem carbon fluxes at a subalpine grassland site in the Swiss Alps.

Rogiers, N.; Eugster, W.; Furger, M.; and Siegwolf, R. *Theoretical and Applied Climatology* 80(2-4): 187-203. (2005); ISSN: 0177-798X

Descriptors: mathematical modeling: mathematical and computer techniques/ land management: applied and field techniques/ seasonal variation/ subalpine grassland/ grazing disturbance/ grass cutting

Abstract: The influence of agricultural management on the CO₂ budget of a typical subalpine grassland was investigated at the Swiss CARBOMONT site at Rigi-Seebodenalp (1025 m a.s.l.) in Central Switzerland. Eddy covariance flux measurements obtained during the first growing season from the mid of spring until the first snow fall (17 Mai to 25 September 2002) are reported. With respect to the 10-year average 1992-2001, we found that this growing season had started 10 days earlier than normal, but was close to average temperature with above-normal precipitation (100-255% depending on month). Using a footprint model we found that a simple approach using wind direction sectors was adequate to classify our CO₂ fluxes as being controlled by either meadow or pasture. Two significantly different light response curves could be determined: one for periods with external interventions (grass cutting, cattle grazing) and the other for periods without external interventions. Other than this, meadow and pasture were similar, with a net carbon gain of -128 +/- 17 C m⁻² on the undisturbed meadow, and a net carbon loss of 79 17 C m⁻² on the managed meadow, and 270 +/- 24 g C m⁻² on the pasture during 131 days of the growing season, respectively. The grass cut in June reduced the CO₂ uptake of the meadow by 50 +/- 2% until regrowth of the vegetation. Cattle grazing reduced gross uptake over the whole vegetation period (37 2%), but left respiration at a similar level as observed in the meadow.

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281. Effect of low-intensity grazing on the species-rich vegetation of traditionally mown subalpine meadows.

Fischer, Markus and Wipf, Sonja

Biological Conservation 104(1): 1-11. (2002)

NAL Call #: S900.B5; ISSN: 0006-3207

Descriptors: mowing: management method/ agricultural quality/ biodiversity/ botanical richness/ ecological compensation measures/ grazing intensity/ ground cover/ land use: low intensity/ species evenness/ species richness/ subalpine meadows/ temporal variation/ vegetation change

Abstract: Subalpine meadows, which traditionally were mown every other year, are particularly rich in plant species, especially forbs. Near Davos (Switzerland) we compared the vegetation of mown sites with that of sites grazed for up to 50 years by non-lactating cows. We recorded an overall mean of 51.5 plant species per 4X4 m plot. Among grazed sites, evenness decreased with time since conversion to grazing (-0.11 in 50 years; P < 0.05), suggesting progressive vegetation change, which may eventually result in the loss of species. Ground cover by forbs tended to be higher in mown than in grazed sites (by 7.2%; P < 0.1). The proportion of not-clonally colonizing perennial species decreased after conversion to grazing (-7.72%; in 50 years, P < 0.05), while the cover by graminoid species increased (+14.2% in 50 years; P < 0.1). More intensively grazed sites had a lower cover of dwarf shrubs

and higher cover of legume species (P < 0.05). Because grazing negatively affects both botanical richness and agricultural quality, mowing of traditionally mown subalpine meadows should be maintained, and recently grazed meadows should be reconverted to mowing.

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282. Effect of rotational and continuous grazing on vegetation of an upland grassland in the Jizerske Hory Mts., Czech Republic.

Pavlu, Vilem; Hejzman, Michal; Pavlu, Lenka; and Gaisler, Jan

Folia Geobotanica 38(1): 21-34. (2003)

NAL Call #: QK339.C95 F6; ISSN: 1211-9520

Descriptors: permanent plot sampling: applied and field techniques/ upland grassland vegetation: continuous grazing effect, rotational grazing effect

Abstract: The effect of different grazing regimes on pasture vegetation was studied during the intensive grazing of heifers in the Jizerske hory mountains during 1993-1997. The vegetation was monitored in 3 pairs of permanent 1 X 1 m plots using a continuous grid of nine 0.33 X 0.33 m subplots. We applied continuous stocking and rotational grazing. Vegetation varied as a result of time and differences between treatments. Several prostrate dicotyledonous species (*Trifolium repens*, *Taraxacum* sp., *Bellis perennis* and *Leontodon autumnalis*) increased under continuous stocking. This treatment also promoted the growth of the perennial grass *Lolium perenne*, which was able to cope with frequent defoliation. Tall grasses sensitive to frequent defoliation (*Poa trivialis*, *Holcus mollis*, *Alopecurus pratensis*, *Dactylis glomerata* and *Elytrigia repens*) were more abundant in rotationally grazed paddocks. Species diversity was not significantly influenced by the different grazing systems. The decrease in the potential sward height under continuous stocking revealed the replacing of tall dominants by lower species. Our results indicate that different grazing systems alter the composition and structure of grassland vegetation. Defining the intensity of grazing under continuous stocking or rotational grazing is complex due to the different stocking rates and the heights of sward during a grazing season. Information about pasture management should therefore involve not only grazing intensity but also the grazing system used.

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283. The effect of sheep and goat grazing on variegated thistle (*Silybum marianum*) populations in annual pastures.

Stanley, D. F.; Holst, P. J.; and Allan, C. J.

Plant Protection Quarterly 15(3): 116-118. (2000)

NAL Call #: SB950.3.A8P535; ISSN: 0815-2195

Descriptors: grazing behavior

Abstract: The effect of sheep and goat grazing on variegated thistle was studied over two years when sheep alone was compared with two ratios of sheep and goats. Measurements were taken on pasture production, thistle plants and thistle seeds in soil. Thistle measurements along a fixed transect included height and width, eaten score, capitula number and number of flowering stems eaten. In each of the two years, sheep ate little variegated thistle whereas goats significantly (P<0.001) contained plant size and consumed all capitula (year 2; mature capitula per plant 5.41 v 0.0 for sheep and goats respectively). After two years, viable seed reserves in soil were 497 +/- 157 in the

sheep treatments and 126 +/- 66 in the goat treatments ($P < 0.05$) with no difference between a high or low ratio of goats. It was concluded that sheep had relatively little impact on variegated thistle whereas goats preferentially grazed the thistle. The goats were particularly effective in reducing the number of capitula and the number of capitula consumed was a function of goat grazing pressure. Removal of capitula would reduce seed production and subsequent population of the thistle.

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284. The effect of sheep trampling and grazing on soil physical properties and pasture growth for a red-brown earth.

Proffitt, A. P. B.; Bendotti, S.; Howell, M. R.; and Eastham, J.

Australian Journal of Agricultural Research 44(2): 317-331. (1993)

NAL Call #: 23 Au783; ISSN: 0004-9409

Descriptors: grazing date/ trampling/ grazing systems/ deferred-grazing

Abstract: In field experiments at Merredin in 1988-90 on a structurally unstable sandy clay loam (a calcic red-brown earth) sown to *Medicago polymorpha*, deferred grazing was investigated as a management option to reduce structural deterioration at the soil surface. Changes in soil physical properties as a result of trampling were related to soil water storage and pasture productivity. Infiltration rates were reduced as a result of sheep trampling, but there were no measurable changes in soil bulk density. Differences in pasture production between continuously grazed and ungrazed treatments were related to the amount of stored soil water, which in turn was related to infiltration rates. Pasture root growth during the season was also reduced as a result of trampling. Deferred grazing yielded the same quantity of biomass for feed over the reduced period available for grazing and proved to be a beneficial management practice since reasonably high infiltration rates were maintained. Results also indicated that pasture must be adequately grazed to reduce leaf area later in the season when evaporative demand increases. A high leaf area over this time period may result in early pasture senescence.

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285. Effect of soil-N and urine-N on nitrate leaching under pure grass, pure clover and mixed grass/clover swards.

Loiseau, P.; Carrere, P.; Lafarge, M.; Delpy, R.; and Dublanquet, J.

European Journal of Agronomy 14(2): 113-121. (2001)

NAL Call #: SB13.E97; ISSN: 1161-0301

Descriptors: rotational grazing system/ soil properties: drainage

Abstract: During six annual drainage periods (DPO to DP5), the drainage water, the NO₃ concentration of the drainage water and the total leached N were compared under bare soils and under ryegrass/white clover, pure ryegrass and pure white clover stands in 80 deep lysimeters with 3m² area. For each soil cover, the sensitivity of the variables to the soil N supplying capacity at sowing was measured, using a set up of 32 lysimeters. This initial capacity to supply mineral N (SoilN) varied from 90 to 230 kg N ha⁻¹ year⁻¹. The stands were managed in a simulated rotational grazing system, without addition of

fertilizer N. During the first drainage period after sowing (DPO), N leaching increased significantly with the initial SoilN under the bare soils, the pure grass and the mixture, but was not influenced under the pure clover. In the following drainage periods, N leaching increased according to the sequence pure grass (1-5 kg N ha⁻¹ year⁻¹), mixed swards (1-19 kg N), pure white clover (28-140 kg N) and bare soils (84-149 kgN ha⁻¹ year⁻¹). It was only slightly greater under the mixture than under the pure grass, despite the N harvest and the N animal returns were much higher. Under the mixed stands, N leaching became independent of the initial SoilN in DP1 and DP2 and decreased with increasing initial SoilN in DP3, DP4 and DP5. This inversion of the SoilN effect in time and the limited amounts of leached N demonstrated that adaptations in the ecosystem tend to counteract the SoilN effect on the N losses. In the mixed stands, the accumulated N leaching represented 12 and 21% of the accumulated N at harvest for the initially rich and poor soils, respectively and 32% of the accumulated N harvest in the mixed clover, whatever the initial SoilN. N leaching also represented 13% of the urine-N above 80 kgN ha⁻¹ year⁻¹. The low values of N leaching under the mixed swards make them sustainable for environment quality. Mechanisms which regulate the N fluxes are discussed, using published data on the soil and some results concerning the harvests in the same experiment.

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286. Effect of spring grazing management of perennial ryegrass and ryegrass-white clover pastures: Tissue turnover and herbage accumulation.

Hernandez Garay, A.; Hodgson, J.; and Matthew, C.

New Zealand Journal of Agricultural Research 40(1): 25-35. (1997)

NAL Call #: 23 N4892; ISSN: 0028-8233

Descriptors: crop industry/ agronomy/ biobusiness/ forage crop/ herbage accumulation/ spring grazing management/ tissue turnover

Abstract: The aim of this study was to investigate the effects of timing and duration of lax spring grazing on rates of leaf growth, botanical composition, and pasture production in perennial ryegrass swards, with and without white clover. In the first field experiment (September 1992-March 1993), swards of perennial ryegrass with and without white clover were rotationally grazed by sheep every 21 days to residual heights of 70-100 mm (lax) and every 14 days to 30-50 mm (hard). Two periods of lax grazing-short release (SR) from 26 October to 8 December and long release (LR) from 15 September to 8 December-were compared with conventional hard grazing throughout-early control (EC). All treatments were grazed to 30-50 mm every 14 days from 8 December until the end of March. Swards without white clover received 28 kg nitrogen (N)/ha every 2 weeks as urea. Treatments were arranged in a factorial design with three replicates. Overall, herbage accumulation in the SR and LR treatments was increased by 20 and 30%, respectively, compared to the EC treatment ($P < 0.001$). Leaf growth in ryegrass and white clover was also increased following lax grazing. In the second field experiment (September 1993-April 1994) plots were subjected to similar grazing managements, though all spring treatments were imposed at a consistent grazing interval of 21 days and N use on non-clover swards was reduced to 14 kg/ha every 2 weeks. SR and LR treatments

increased herbage production during spring by 24 and 28%, respectively, by increasing tiller weight, and during summer and autumn by 16 and 26% by enhancing tiller population density and leaf growth per tiller and/or stolon. Spring management effects were similar for swards with and without white clover. It is concluded that lax spring grazing management of ryegrass-white clover swards followed by hard grazing at the time of anthesis enhances pasture production, particularly during the summer-autumn period, by increasing both tiller population density and net leaf growth per tiller. Effects were larger following an extended spell of lax grazing. Contribution of tiller population density differences to these responses is discussed in the second paper in this series (Hernandez et al. 1997, this issue).

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287. Effect of spring grazing management on perennial ryegrass and ryegrass-white clover pastures: Tiller and growing point densities and population dynamics.

Hernandez Garay, A.; Matthew, C.; and Hodgson, J. *New Zealand Journal of Agricultural Research* 40(1): 37-50. (1997)

NAL Call #: 23 N4892; ISSN: 0028-8233

Descriptors: crop industry/ agronomy/ biobusiness/ forage crop/ growing point density/ population dynamics/ spring grazing management/ tiller density

Abstract: The objective of this study was to investigate the effects of timing and duration of lax spring grazing on tiller dynamics in perennial ryegrass swards, with and without white clover. Two periods of lax grazing-short release (SR) from 26 October to 8 December and long release (LR) from 15 September to 8 December-were compared with a conventional hard grazing-early control (EC). These treatments were applied to swards of perennial ryegrass, with and without white clover, and grazed by sheep. Tiller weight, tiller population density, tiller appearance and death, and stolon population were analysed in a factorial design with three (Experiment 1) and four (Experiment 2) replicates. Tiller weight was increased during the reproductive period, particularly in SR and LR treatments. Also, tiller appearance rate increased in all treatments from September to late January, and was particularly high late in December after grazing of the apices of the main group of reproductive tillers. Lax grazing management increased tiller appearance rate by 53% (P ltoreq 0.05) in Experiment 1 and 23% (P gtoreq 0.05) in Experiment 2, and tiller loss rate by 40% in Experiment 1 (P gtoreq 0.05) and 23% in Experiment 2 (P ltoreq 0.05). Over 6 weeks following the return to hard grazing, these effects were reflected in increased tiller population densities of 170, 147, and 115% in LR, SR, and EC treatments respectively in Experiment 1 (P gtoreq 0.05), and 97, 110.5, and 36.5% in LR, SR, and EC treatments respectively in Experiment 2 (P ltoreq 0.05). It is concluded that the increases in herbage production observed in summer-autumn following imposition of managements which combined lax spring grazing and hard grazing at the time of anthesis, can be attributed to increased tiller densities. The increase was most marked when the period of lax grazing was longer.

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288. Effect of two grazing intensities on the rotational grazing method with dairy cattle: Balance of nitrogen, phosphorus and potassium in the system and its components.

Reyes, J. J.; Vidal, Ibis; Gonzalez, Maria R.; Gonzalez, Rosa M.; and Fonte, Damaris

Cuban Journal of Agricultural Science 37(3): 255-263. (2003)

NAL Call #: S1.R4; ISSN: 0864-0408

Descriptors: fertilization: applied and field techniques/ rotational grazing: applied and field techniques/ grazing intensity/ nutrient balance/ red ferralic soil

Abstract: The balance of nitrogen, phosphorus and potassium (N, P and K) was studied for four years in a dairy unit, established with star grass (*Cynodon nlemfuensis*). A completely randomized design with four repetitions was used on a red ferralic soil. Two grazing methods with 9 ha each and commercial Holstein cows were used. The high intensity (HI) method had 184.4 LAU/ha and 3.7 LAU/ha/year of stocking rate and that of low intensity (LI) had 101.2 LAU/ha and 3.2 LAU/ha/year of stocking rate. The mathematical analysis was carried out according to a simple classification model. The soil, in both methods, showed negative balances and was higher in the HI method for nitrogen (P<0.01) (-55.6 vs -45.8 kg/ha/year) and potassium (P<0.05) (-146.2 vs -118.9 kg/ha/year), not differing for phosphorus (-14.9 vs -13.8 kg/ha/year). The component plant showed positive values in both methods, that of LI reached better (P<0.05) balance of N, P and K. In the component animal, the balance was negative and there was no difference between the treatments. In the system in general, there were negative values, being higher in the HI grazing for nitrogen (P<0.01) and potassium (P<0.001), without differences for phosphorus (-20.6 vs -5.9, -95.8 vs -49.3 and -7.0 vs -3.7 kg/ha/year for N,P and K in HI and LI, respectively). This suggests the need for establishing management practices that collect and return efficiently the excretions deposited outside the grazing area, mainly in the rainy season, as well as making changes in the management system that allow animals to remain the longest possible time in the paddocks. Also, the utilization of legumes is proposed for Cuban systems of cattle production and the strategical use of chemical fertilization.

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289. Effectiveness of grazing and herbicide treatments for lucerne removal before cropping in southern New South Wales.

Davies, S. L.; Virgona, J. M.; McCallum, M. H.; Swan, A. D.; and Peoples, M. B.

Australian Journal of Experimental Agriculture 45(9): 1147-1155. (2005)

NAL Call #: 23 Au792; ISSN: 0816-1089

Descriptors: Medicago sativa/ forage legumes/ forage crops/ pastures/ plant cultural practices/ site preparation/ stocking rate/ grazing/ sheep/ herbicides/ cultivars/ mowing/ rain/ grazing management/ New South Wales/ Australian Capital Territory

This citation is from AGRICOLA.

290. Effects of autumn deferment of grazing on subsequent growth, botanical composition and quality of two types of irrigated pasture.

Stockdale, C. R. and King, K. R.

Australian Journal of Experimental Agriculture 25(1): 47-53. (1985)

NAL Call #: 23 Au792; ISSN: 0045-060X

Descriptors: range management/ irrigated conditions/ botanical composition/ dairy cows/ grazing/ forage/ autumn/ pastures/ Australia

This citation is from AGRICOLA.

291. Effects of burning and grazing on carbon sequestration in a Pennine blanket bog, UK.

Garnett, M. H.; Ineson, P.; and Stevenson, A. C.

Holocene 10(6): 729-736. (2000); ISSN: 0959-6836

Descriptors: peatlands/ carbon/ bioaccumulation/ agriculture/ combustion/ bogs/ storage/ wetlands/ marshes/ peat/ nutrient cycles/ carbon cycle/ man-induced effects/ grazing/ fire/ carbon dioxide/ atmospheric chemistry/ air pollution/ British Isles, England, Pennine Mts./ British Isles, England, Pennine Chain/ carbon storage/ sheep

Abstract: Terrestrial ecosystems contain large amounts of carbon (C) and have the potential to significantly increase atmospheric carbon dioxide (CO₂) concentrations. Peatlands are particularly important for C storage, although little is known about the effects of anthropogenic activities on C balance in these ecosystems. Sheep-grazing and rotational burning are widely practised on blanket peat moorlands in the United Kingdom. The effects of these activities on C sequestration in peat has been investigated with a long-term randomized block experiment with treatments: (a) grazed + unburnt; (b) grazed + burnt every ten years; (c) ungrazed + unburnt. C accumulation under these treatments was compared by identifying a chronologically synchronous horizon within the peat common to all treatment plots. This fixed point was defined by the 'take-off' in concentration of spheroidal carbonaceous particles and was supported by the record of charcoal fragments. There was no significant difference in recent C accumulation rates between lightly grazed and ungrazed plots. In contrast, after 30 years there was significantly less C stored in the blanket peat in plots which had been burned every ten years. The results indicate that light sheep-grazing at this site did not affect rates of C accumulation in blanket peat, but decadal burning of moorland reduced C sequestration.

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292. The effects of burning, grazing and herbicide treatments on restored and remnant populations of *Nassella pulchra* at Beale Air Force Base, California.

Marty, Jaymee T.; Rice, Kevin J.; and Collinge, Sharon K.

Grasslands 13(2): 1, 4-9. (2003); ISSN: 1540-6857

Descriptors: burning effects/ grazing effects

Abstract: In two experiments conducted at Beale Air Force Base, Yuba County California, we studied the effects of grazing, fire, and herbicide spraying on restored and remnant populations of *Nassella pulchra*. For the restored population, we planted into herbicide-sprayed and unsprayed plots. We allowed the seedlings to establish for one growing season and then subjected the grasses to various cattle grazing treatments. At the end of the first growing season, seedlings in the sprayed plots were larger, exhibited higher reproductive output and had lower

mortality rates than seedlings in the unsprayed plots.

Grazing did not significantly affect the growth or survival of the bunchgrasses, but grazing did decrease the reproductive output of the grasses. Although grasses in most of the treatment plots produced viable seeds during the experiment, only two seedling recruits were found around parent plants at the end of the experiment. In a separate experiment involving a remnant population of *N. pulchra*, we tagged and measured burning and grazing effects on over 1,900 adult plants. Burning had a more pronounced effect on the grass population than grazing. Bunchgrass mortality was 10 percent higher in burned versus unburned plots but was not significantly different among grazing treatments. Bunchgrass density did not differ significantly in any of the treatments but decreased significantly over time. Seedling density was 100 percent higher in burned versus unburned plots 2 years after the burn; however, seedling densities never attained pre-burn levels. Seedling densities did not differ significantly among grazing treatments, but grazing reduced the height and reproduction of the mature bunchgrasses. The growth survival, and reproduction of the bunchgrasses followed a similar pattern over the 4 years of the experiment regardless of treatment. We believe above-average rainfall and below average temperatures experienced late in the growing season in 1998 provided conditions that favored the native grasses. Although grazing and burning affected growth, reproduction, and mortality of the bunchgrasses in this experiment, it was clear that climatic variability had a stronger and, more ubiquitous effect on the grasses. None of the management treatments tested effectively increased seedling recruitment in the populations. Since native grasses like *N. pulchra* can live for many years or perhaps decades, successful seedling establishment every year may not be necessary for long-term population-viability.
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293. Effects of complementary grazing by goats on sward composition and on sheep performance managed during lactation in perennial ryegrass and white clover pastures.

Del Pozo, M.; Osoro, K.; and Celaya, R.

Small Ruminant Research 29(2): 173-184. (1998)

NAL Call #: SF380.I52; ISSN: 0921-4488

Descriptors: grazing management/ lactation/ perennial ryegrass pasture/ sheep performance/ sward composition/ white clover pasture

Abstract: The liveweight (LW) response of Gallega and Lacha ewes with their single suckling lambs when grazing with a mob of goats on perennial ryegrass (*Lolium perenne* L.)/white clover (*Trifolium repens* L.) pastures and its consequence on sward composition were analysed. From early March (turnout) to mid-June (lamb weaning), swards were grazed either simultaneously mixed in a 1:1 goat to sheep ratio or separately in a goat-first and sheep-last sequential grazing at 6 or 8 cm sward heights or in a 4-paddock rotation where goats grazed swards from 9 to 7 cm followed by sheep from 7 to 4 cm. Changes in botanical composition and in sheep liveweight performance were more significantly affected by the management and species grazing than by the sward height treatment. Swards where goats were last in had higher herbage masses, higher live clover and lower dead and stem proportions than swards where sheep and goats were mixed or sheep were last in. As a consequence of a sward clover enhancement over all

treatments, ewe and lamb performances were benefitted especially in the Lacha genotype, with the rotational and sequential managements having, respectively, an output of 298 and 252 kg LW/ha greater than the mixed management. These results suggest that goats could be used as a pasture management tool when integrated with sheep under these different grazing systems to enhance ovine performance during lactation.

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294. Effects of continuous sheep grazing and cattle rotational grazing on sward floristic composition.

Rogalski, M. T.; Kryszak, J.; and Kos, J. M.

In: Management for grassland biodiversity. (Held 19 May 1997-23 May 1997 at Warszawa omza, Poland.); pp. 103-107; 1997.

Notes: Proceedings of the International Occasional Symposium of the European Grassland Federation
NAL Call #: SB202.E85 E87 1997

Descriptors: grazing/ grazing systems/ continuous grazing/ rotational grazing/ botanical composition/ grasslands/ permanent grasslands/ weeds/ population dynamics/ fodder plants

Abstract: During 1994-96 two systems of sheep continuous grazing at sward heights of 5 and 9 cm and a rotational system of dairy cattle grazing were compared on permanent grasslands at Brody, Poland. In all three experimental grazing systems the amount of *Lolium perenne* in swards decreased, especially when swards were grazed by cattle. Continuous grazing at 5 cm by sheep was favourable for the development of *Poa pratensis*. *Dactylis glomerata* disappeared from the pasture grazed by sheep, while in the pasture grazed by cattle, *Agrostis gigantea* decreased. After three years of grazing, there was an increase in the number of forb and weed species from one species before the initiation of the experiment to nine species in the sward of pastures for sheep and six species in cattle pastures. *Taraxacum officinale* appeared to have responded exceptionally well to the experimental grazing conditions since its share in the sward increased 3-fold in the case of sheep grazing and 6-fold on pastures grazed by cattle.

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295. Effects of cutting or grazing grass swards on herbage yield, nitrogen uptake and residual soil nitrate at different levels of N fertilization.

Nevens, F. and Rehuel, D.

Grass and Forage Science 58(4): 431-449. (2003)

NAL Call #: 60.19 B773; *ISSN:* 0142-5242

Descriptors: cutting effect/ grass sward/ grassland management/ grazing effect/ herbage yield

Abstract: On a Flemish sandy loam soil, cut and grazed swards were compared at different levels of mineral nitrogen (N) fertilization. Economically optimal N fertilization rates were 400 (or more) and 200 kg N ha⁻¹ yr⁻¹ on cut and grazed swards respectively. Considering the amounts of residual soil nitrate-N in autumn, these N rates also met the current Flemish legal provisions, i.e. no more than 90 kg ha⁻¹ nitrate-N present in the 0-90 cm soil layer, measured between 1 October and 15 November. The N use efficiency was considerably higher in cut grassland systems than in grazed systems, even when the animal component of a cut and conservation system was included. The results indicate that, for cut grasslands, two N application rates should be

considered: intensively managed grasslands with high amounts of N (400 kg ha⁻¹ yr⁻¹ or more) or extensively managed grasslands with white clover and no more than 100 kg N ha⁻¹ yr⁻¹.

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296. Effects of different management methods on the floral composition of pastures on Asiago plateau (NE Italy).

Ronch, F.; Stern, G. R.; and Ziliotto, U.

Options Mediterraneennes Serie A, Seminaires

Mediterraneennes(67): 99-104. (2005)

NAL Call #: S19.O681; *ISSN:* 1016-121X

Descriptors: botanical composition/ feed supplements/ grassland management/ grasslands/ grazing/ pastures/ surveys/ vegetation/ grazing-management

Abstract: With the aim of learning more about the effects of supplementing the diet of grazing animals with food concentrates on the floral composition in mountain pastures, two neighbouring malghe were chosen in three different areas of the Asiago plateau. In the previous six years one of these malghe had been grazed by cattle which had been supplied concentrates and the other by animals that did not received the supplement. Based on 19 floral surveys done in the 6 malghe, it emerged that in the zone characterized by a mesophil climate and shallow soils, the use of concentrates increases the cover of species that are favoured by high nutrient contents in the soil, without increasing the pastoral value. Instead, in the areas with a fresher climate and deeper soils, the number of nitrophilous species increases with the use of concentrates.

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297. Effects of fertiliser and grazing on the arthropod communities of a native grassland in south-eastern Australia.

Oliver, Ian; Garden, Denys; Greenslade, Penelope J.; Haller, Bronwyn; Rodgers, Denis; Seeman, Owen; and Johnston, Bill

Agriculture, Ecosystems & Environment 109(3-4):

323-334. (2005)

NAL Call #: S601 .A34; *ISSN:* 0167-8809

Descriptors: animals and man/ disturbance by man/ commercial activities/ ecology/ habitat/ terrestrial habitat/ abiotic factors/ chemical factors/ land zones/ Australasian Region/ Australasia/ Australia/ Arthropoda: farming and agriculture/ fertilizer application and grazing/ community structure/ effects of fertiliser and grazing/ grassland/ native grassland/ effects of fertiliser and grazing on community structure/ fertilizers and pesticides/ effects on native grassland community structure/ New South Wales/ Yass Area/ effects of fertiliser and grazing on native grassland community structure/ arthropods/ invertebrates

Abstract: An experiment commenced in 1998 to test the effects of superphosphate fertiliser application and grazing on production and botanical composition of a native grassland in south-eastern Australia. Superphosphate application resulted in an increase in sheep production but a decline in native perennial grasses and an increase in exotic annual grasses. The study reported here aimed to determine if arthropod assemblages showed changes in community composition on the same experimental plots. The experiment was conducted in grassland dominated by the native perennial wallaby grass, *Austrodanthonia duttoniana*, and consisted of six replicated treatments that

were designed to improve grassland and domestic livestock productivity. Treatments consisted of a control (no fertiliser), three levels of annually applied superphosphate (62.5, 125, and 250 kg ha⁻¹), and two treatments aimed to raise soil pH (superphosphate plus lime, and sewage ash). Soil properties were measured annually and sheep stocking rates were increased over the duration of the experiment according to increases in available forage. Soil and ground-active arthropod populations were sampled from all plots in spring 2001. Fertiliser application and grazing increased the relative abundance of introduced Acari and Collembola, and changed the community composition of Formicidae and Coleoptera. Lime and sewage treatments had variable effects on taxa. Improving the productivity of native grassland with superphosphate led to a decline in plant and arthropod biodiversity through reduced abundance and/or local extinction of native species and increased dominance of introduced species. These findings support the need to protect and restore a representative network of native grassland ecosystems within the agricultural zone of south-eastern Australia. Crown Copyright [copyright] 2005 Published by Elsevier B.V. All rights reserved. © The Thomson Corporation

298. Effects of grazing and management on herbage mass, persistence, animal production and soil water content of native pastures: A mixed native pasture, Manilla, North West Slopes, New South Wales.

Lodge, G. M.; Murphy, S. R.; and Harden, S.
Australian Journal of Experimental Agriculture 43(7-8): 891-905. (2003)

NAL Call #: 23 Au792; ISSN: 0816-1089

Descriptors: animal production/ annual wool production/ grazing effects/ herbage mass/ management effects/ native pasture/ persistence/ red chromosol/ resource management/ soil water content/ stocking rate

Abstract: As part of the Sustainable Grazing Systems (SGS) National Experiment a study was conducted on a native pasture in the Manilla district of northern New South Wales to examine the effects of 5 grazing treatments on total herbage mass, litter mass, basal cover, ground cover, sheep liveweight, wool production and soil water content (SWC, mm) at different depths. The pasture was a mixture of native perennial grasses, with redgrass (*Bothriochloa macra*) and wiregrass (*Aristida ramosa*) dominant on a red Chromosol soil type and bluegrass (*Dichanthium sericeum*) on a brown Vertosol. Wallaby grasses (*Austrodanthonia richardsonii* and *A. bipartita*) were common on both soils. Plots were grazed with Merino wethers and data collected from spring 1997 to spring 2001 were analysed to determine the effect of treatments on both production and sustainability. Five grazing treatments were applied in a randomised 3 replicate design. Grazing treatments were: continuous grazing at 3.1 and 6.2 sheep/ha (C3 and C6), continuous grazing at 9.2 sheep/ha, with subterranean clover (*Trifolium subterraneum*) oversown and fertiliser applied (C9+sub) and rotational grazing at an annual stocking rate of 3.1 sheep/ha with pasture grazed for 4 weeks and rested for 4 weeks (R4/4), or rested for 12 weeks (R4/12). Over time, treatments had no significant effect on either total pasture herbage mass (compared with the C3 control) or the basal cover of the major perennial grasses. Treatments had inconsistent significant effects on ground cover, litter mass, sheep liveweight and wool production (kg/head) over time. Compared with all other

treatments ground cover was less ($P < 0.05$) in the C6 treatment in only May and September 2000 and litter mass less ($P < 0.05$) in only December 1998 and March 1999. Treatment sheep liveweights were not significantly different from the C3 treatment from September 1997 to 1999. However, from October 1999 to October 2001 sheep liveweight in the C6 treatment was significantly less than in the C3 treatment, while in the C9+sub and R4/12 treatments it was significantly greater than the control. In 1999, wool production per head was higher ($P < 0.05$) in the C9+sub and R4/12 treatments compared with all other treatments but treatment differences were not significant in all other years. Significant differences in SWC only occurred at the 0-30 cm depth between the C3 and the C6 and R4/12 treatments, but were predicted to be < 1.5 mm/year. A sustainability index derived from economic (equivalent annual net return (dollar sign/ha) for a 10-year period), animal production, pasture, soil health and soil water data indicated that the overall indices were lowest for the C3, C6 and C9+sub treatments and highest for the R4/4 and R4/12 treatments.

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299. Effects of grazing and management on herbage mass, persistence, animal production and soil water content of native pastures: A redgrass-wallaby grass pasture, Barraba, North West Slopes, New South Wales.

Lodge, G. M.; Murphy, S. R.; and Harden, S.
Australian Journal of Experimental Agriculture 43(7-8): 875-890. (2003)

NAL Call #: 23 Au792; ISSN: 0816-1089

Descriptors: biophysical model: mathematical and computer techniques/ animal production/ annual wool production/ grazing effects/ herbage mass/ management effects/ native pasture/ persistence/ resource management/ soil water content/ stocking rate

Abstract: A study was conducted on a native pasture (dominated by redgrass, *Bothriochloa macra*) in the Barraba district of northern New South Wales to examine the effects of 5 grazing treatments on total herbage mass, litter mass, basal cover, ground cover, sheep liveweight, wool production and soil water content (SWC, mm) at different depths. Plots were grazed with Merino wethers and data were collected from spring 1997 to spring 2001 and analysed to determine the effects of treatments on both production and sustainability. Five grazing treatments were applied in a randomised 3 replicate design. Grazing treatments were: continuous grazing at 4 and 6 sheep/ha (C4 and C6), continuous grazing at 8 sheep/ha, with subterranean clover (*Trifolium subterraneum*) oversown and fertiliser applied (C8+sub), and, rotational grazing at an annual stocking rate of 4 sheep/ha with pasture grazed for 4 weeks and rested for 4 weeks (R4/4), or rested for 12 weeks (R4/12). Total herbage mass declined in the C4 (control) treatment throughout the experiment and, compared with this treatment, the C6 treatment had less ($P < 0.007$) linear trend over time, while the R4/12 treatment had a greater ($P < 0.001$) linear trend. Stocking rates could not be maintained in the C4 and C6 treatments and sheep were supplementary fed or removed from these treatments for a total of 133 and 263 days, respectively. For ground cover, the linear trend was greater ($P < 0.05$) in the C8+sub, R4/4, and R4/12 treatments compared with the continuously grazed C4 and C6 treatments and for litter

mass this trend was also greater ($P < 0.05$) for the R4/12 treatment than the C4 treatment. Basal cover of wiregrass (*Aristida ramosa*), wallaby grass (*Austrodanthonia* spp.) and windmill grass (*Chloris truncata*) was not affected by grazing treatment but for redgrass the linear trend was greater ($P < 0.05$) in the C8+sub, R4/4, and R4/12 treatments compared with the C4 and C6 treatments. Sheep liveweight (kg/head) was greater ($P < 0.001$) in the C8+sub treatment compared with the C4 treatment. Annual wool production (kg/head) was also higher ($P < 0.05$) in the C8+sub treatment compared with all other treatments. Compared with the C4 treatment, significant differences in soil water content occurred in the R4/12 and C8+sub treatments, but these were predicted to be only 2.9 mm per year for the R4/12 treatment (0-30 cm depth) and 5.7 mm per year for the C8+sub treatment (30-170 cm). Use of a biophysical model indicated that evapotranspiration was the largest output term in the soil water balance and that both drainage and surface runoff of water were episodic events. A sustainability index derived from economic (equivalent annual net return (dollar sign/ha) for a 10-year period), animal production, pasture, soil health and soil water data indicated that the C4 and C6 treatments had the lowest scores for each of these parameters and the lowest overall indices. These scores were highly correlated with subjective assessments of the impact of the treatments ($r = 0.93$). Overall, these data indicated substantial benefits of either rotationally grazing or the addition of fertiliser and subterranean clover to the production and sustainability of the native pasture studied.

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300. Effects of grazing by horses and/or cattle on the diversity of coastal grasslands in western France.

Loucougaray, G.; Bonis, A.; and Bouzille, J.-B.

Biological Conservation 116(1): 59-71. (2004)

NAL Call #: S900.B5; ISSN: 0006-3207

Descriptors: additive and compensatory effects/ foraging behaviour/ grazing management/ herbivore species/ plant diversity

Abstract: In the coastal grasslands of western France, extensive mixed grazing by cattle and horses has been practised for many centuries. The vegetation of these old embanked grasslands varies along a topographical gradient with a hygrophilous plant community in low-lying depressions seasonally flooded, a mesophilous community on high level flats that are never flooded, and a meso-hygrophilous community on slopes where the soil remains saline. Recently, fewer horses have been grazed on these pastures and so a 6-year study was designed to investigate the effects of monospecific and mixed grazing by horses and cattle on plant community structure, composition and diversity. Mixed grazing produced the most species-rich and structurally diverse swards. Mixed grazing enhanced the development of rosette, sub-halophyte and halophyte species where the soil is saline, due to additive effects between the two herbivore species. Mixed grazing also limited the strongly competitive *Elymus repens* and *Agrostis stolonifera* on horse latrine areas, cattle grazing, thus showing a compensatory effect. The combination of additive and compensatory effects with mixed grazing could be used to manage plant diversity, heterogeneity in

vegetation structure and communities of conservation value at the scale of the grassland ecosystem. © 2003 Elsevier Ltd. All rights reserved.

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301. Effects of grazing by large herbivores on nitrogen cycling in agricultural ecosystems.

Floate, M. J. S.

In: *Terrestrial nitrogen cycles: Processes, ecosystem strategies and management impacts/* Clark, F. E. and Rosswall, T.; Series: *Ecological Bulletins*.

Stockholm: Swedish Natural Science Research Council, 1981; pp. 585-601.

Notes: ISSN: 0346-6868

NAL Call #: QH540.S7 no.33

This citation is from AGRICOLA.

302. The effects of grazing exclusion and blade-ploughing on semi-arid woodland vegetation in north-western New South Wales over 30 months.

Robson, A. D.

Rangeland Journal 17(2): 111-127. (1995)

NAL Call #: SF85.4.A8A97; ISSN: 1036-9872

Descriptors: woody weeds/ semiarid zones/ brush control/ biomass/ grazing intensity/ rain/ botanical composition/ palatability/ grazing/ New South Wales

This citation is from AGRICOLA.

303. Effects of grazing management and soil amendment on hill land pasture botanical composition.

Bryan, W. B.; Mills, T. A.; and Rosica, F. X.

Applied Agricultural Research 1(5): 297-302. (1987)

NAL Call #: S539.5.A77; ISSN: 0179-0374

Descriptors: Kentucky bluegrass/ meadow fescue/ white clover/ broadleaf weeds/ cattle/ lime/ phosphorus/ in vitro digestibility

Abstract: Grazing management and soil amendments are two of the more easily controlled components of a pasture/livestock production system. In this experiment, effects of continuous stocking at low grazing pressure (less than 2 cows per 1000 kg (2200 lb) of herbage), rotational grazing at high grazing pressure (more than 100 cows per 1000 kg of herbage), and once-a-year grazing at high grazing pressure (more than 80 cows per 1000 kg of herbage) and lime and P application on percentage legume, weeds, grass, and base ground in a hill land pasture were compared over a 4-year period. The pasture consisted mostly of Kentucky bluegrass, meadow fescue, white clover, and broadleaf weeds and was located on a Culleoka-Westmoreland complex soil. Herbage mass, in vitro digestibility, and herbage accumulation were estimated. Grazing management influenced botanical composition of hill land pasture much more than lime and P application. Compared with continuous stocking, rotational grazing resulted in a higher percentage of legumes and bare ground but a lower percentage of grass and tall-growing weeds. Rotationally grazed pasture had a higher in vitro digestibility than pasture stocked continuously or grazed once a year. Lime and P application tended to increase percentage legume ($P < 0.10$) and decreased percentage bare ground, especially in rotationally grazed pasture.

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304. Effects of grazing management on botanical composition of native grass-based pastures in temperate south-east Australia.

Garden, D. L.; Lodge, G. M.; Friend, D. A.; Dowling, P. M.; and Orchard, B. A.

Australian Journal of Experimental Agriculture 40(2): 225-245. (2000)

NAL Call #: 23 Au792; ISSN: 0816-1089

Descriptors: grazing management: botanical composition effects, management method/ native grass based pasture: botanical composition, stability

Abstract: Grazing management strategies to alter botanical composition of native pastures were investigated at 4 locations in the high rainfall zone of south-east Australia, including Tasmania. These studies were conducted as part of the Temperate Pasture Sustainability Key Program, which evaluated the effects of grazing management on a wide range of pasture types between 1993 and 1996. Pastures in this study were based on *Aristida ramosa*/*Bothriochloa macra*, *Microlaena stipoides*-*Austrodanthonia* spp. or *Themeda triandra*-*Austrodanthonia* spp. Seasonal rests, increased grazing pressure in spring, mob stocking and cutting for hay were compared to continuous grazing at all sites. In addition, specific local treatments were tested at individual sites. Changes in composition resulting from the treatments were minimal at most sites. This may have been due to a combination of the inherent stability of the pastures, the relatively short duration of the experiments, and the drought conditions experienced, which minimized differences between treatments. Some strategies to alter composition of natural pastures are suggested. In the *Aristida*-*Bothriochloa* pasture there was a general decrease in *Aristida* and an increase in *Bothriochloa*, which was largely unaffected by the type of grazing management applied. The combination of drought conditions and increasing grazing pressure was sufficient to alter composition without specific management strategies being necessary. In the *Themeda*-*Austrodanthonia* pasture, resting in spring, 12-month rests or cutting for hay (which involved a spring rest) allowed *Themeda* to increase in the pasture. The *Microlaena*-*Austrodanthonia* pastures were very stable, especially where annual grass content was low. However, certain treatments allowed *Microlaena* to increase, a result which is regarded as being favourable. The major effects in these latter pastures were on undesirable species. *Vulpia* spp. were reduced by resting in autumn and increased spring grazing pressure, while *Holcus lanatus* was increased dramatically by resting in spring and was also increased by resting in autumn or winter, but only when conditions were suitable for growth of this species. In many cases, treatment differences were only expressed following recovery from drought, showing that timing of grazing management to achieve change is critical.

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305. Effects of grazing management on establishment and productivity of aeschynomene overseeded in limpgrass pastures.

Sollenberger, L. E.; Quesenberry, K. H.; and Moore, J. E.

Agronomy Journal 79(1): 78-82. (1987)

NAL Call #: 4 AM34P; ISSN: 0002-1962

Descriptors: *Hemarthria altissima*/ Florida/ USA/ herbage consumption/ regrowth/ crop industry

Abstract: Low protein concentration in limpgrass [*Hemarthria altissima* (Poir.) Stapf et C.E. Hubb.]herbage is thought to limit the performance of grazing animals. In 1983 and 1984 an experiment was conducted on a sandy, siliceous, hyperthermic Ultic Haplaquod soil to evaluate effects of grazing management on establishment and productivity of the legume aeschynomene (*Aeschynomene americana* L.) seeded in limpgrass. Existing limpgrass pastures were grazed in the spring to 75- to 150-mm stubble heights. After broadcast seeding aeschynomene, stubble heights were maintained by grazing until (i) legume cotyledons were exerted, (ii) two true leaves were present, or (iii) 2 weeks after the two-leaf stage. Summer grazing was initiated when aeschynomene plants were 0.20, 0.40, or 0.80 m tall in 1983 and 0.20, 0.40, or 0.60 m tall in 1984. After initiation of grazing, pastures were grazed every 5 weeks. Limpgrass stubble height during legume establishment did not affect legume productivity, but there was a trend favoring the 75-mm level. Extending the period of early season grazing of limpgrass until aeschynomene seedlings reached at least the two-leaf stage controlled grass competition and maximized legume performance. Legume dry matter (DM) accumulation was greatest if initiation of summer grazing was delayed until aeschynomene was 0.80 (1983) or 0.60 (1984) m tall. Initiation of grazing when aeschynomene was 0.20 to 0.40 m tall resulted in more uniform distribution of total and legume DM, higher efficiency of grazing, more vigorous legume regrowth, and a trend toward greater total herbage consumption. These data indicate that aeschynomene can be established into limpgrass sods under grazing, and that this association has potential on the large expanses of poorly drained soils in Florida [USA].

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306. Effects of grazing management on herbage production and botanical composition of grasslands nui ryegrass-paspalum-white clover pasture: Effect of intensity of grazing by cattle in different seasons.

Weeda, W. C. and During, C.

New Zealand Journal of Agricultural Research 30(4): 423-430. (1987)

NAL Call #: 23 N4892; ISSN: 0028-8233

Descriptors: *Paspalum dilatatum*/ *Lolium perenne*/ *Trifolium repens*/ cattle industry/ agriculture

Abstract: The effects of high and medium grazing intensities at different times of the year (except from mid October to end of November) on composition and on net herbage increments (NHI) of a perennial ryegrass-paspalum-white clover pasture was measured at a site near Hamilton. Store cattle were used and the experiment continued for 3.5 years. No treatment, even high grazing intensity from mid March to mid October, significantly affected annual NHI. Possible reasons for this are proposed. High grazing intensity in early summer increased the percentage of paspalum (*Paspalum dilatatum* Poir.) at the expense of 'Grasslands Nui' ryegrass (*Lolium perenne* L.). The effect was marked where hard grazing was continued throughout the summer. In early spring, hard grazing raised the proportion of paspalum in the sward provided temperatures were high enough for this species to take advantage of the weakened competition from ryegrass. An increase in the proportion of paspalum depressed NHI in early winter without increasing NHI in summer. Therefore, paspalum is considered an undesirable

species under the conditions tested. High grazing intensity in late summer and autumn increased the proportion of *Poa annua* in the sward but without effect on subsequent NHI.

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307. Effects of grazing management on seasonal variation in nitrogen fixation.

Brock, J. L.; Hoglund, J. H.; and Fletcher, R. H.
In: Proceedings of the XVI International Grassland Congress. (Held 15 Jun 1981-24 Jun 1981 at Lexington, Kentucky, USA.) Smith, J. Allan and Hays, Virgil W. (eds.) Boulder, Colo.: Westview Press; pp. p. 339-341; 1983.
NAL Call #: SB197.I5 1981a
This citation is from AGRICOLA.

308. Effects of grazing management on Sirosa phalaris herbage mass and persistence in a predominantly summer rainfall environment.

Lodge, G. M. and Orchard, B. A.
Australian Journal of Experimental Agriculture 40(2): 155-169. (2000)
NAL Call #: 23 Au792; ISSN: 0816-1089
Descriptors: grazing management: management method/ pasture/ summer rainfall environment
Abstract: Herbage mass, plant frequency and basal cover data collected from September 1993 to August 1996 were used to compare the effects of various seasonal closures with continuous grazing on the persistence of *Sirosa phalaris* (*Phalaris aquatica* cv. *Sirosa*) at 3 sites on the North West Slopes of New South Wales. Sites were on-farm and consisted of up to 10 treatments with 2 replicates and treatments were initially imposed in 2 different years. Pastures were either newly sown (3 years old) and grazed by either sheep or cattle, or degraded (14 years old) and grazed by sheep. Drought conditions prevailed in 1994-95, confounding the interpretation of the importance of treatments that involved long periods of closure, since significant effects could be attributed to both grazing exclusion and the timing of the closure in relation to plant phenology. However, across all sites and years, fitted values for *phalaris* herbage mass were generally significantly higher than the continuously grazed control in only 2 treatments: spring closure (at 1 site) and an extended spring closure combined with an autumn closure (at all sites). At the end of these studies *phalaris* herbage mass in spring-autumn closures was 4-32 times higher than the control plots. These results were confirmed by analysis of initial and final plant frequency data. At all sites, no recruitment of *Sirosa* seedlings occurred in any treatment. These data support the hypothesis that for increased persistence in a summer rainfall environment *Sirosa phalaris* requires some form of grazing management that involves the exclusion of grazing in the critical periods of spring and autumn.

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309. Effects of grazing management on the botanical composition of a lucerne pasture in south-eastern Queensland.

Leach, G. J.; Dale, M. B.; and Ratcliff, D.
Australian Journal of Experimental Agriculture and Animal Husbandry 24(124): 93-103. (1984)
NAL Call #: 23 AU792; ISSN: 0045-060X
Descriptors: Queensland
This citation is from AGRICOLA.

310. The effects of grazing management on the vegetation of mesotrophic (meadow) grassland in northern England.

Smith, R. S. and Rushton, S. P.
Journal of Applied Ecology 31(1): 13-24. (1994)
NAL Call #: 410 J828; ISSN: 0021-8901
Descriptors: plant species diversity/ species composition
Abstract: 1. Haymeadows in the Yorkshire Dales and the North Pennines in Northern England are grazed with cattle and sheep outside the 2-3-month summer period, when a hay or silage crop is grown. Experimental enclosures were used from August 1987 to June 1991 to prevent this grazing for various periods in the year in a meadow at Ravenstonedale, Cumbria. Vegetation change was investigated using biomass samples taken in June of each year. 2. Experimental treatments were: (i) no grazing at any time of the year; (ii) no grazing from the time of the hay cut until 1 January; (iii) no grazing from 1 January to the time of the hay cut; (iv) control plots in which the normal grazing regime was followed each year. All other management factors were kept constant. 3. All plots showed vegetation changes related to treatment and to time. The main trend was the treatment effect, with the greatest reduction in species richness occurring in the ungrazed plots. Changes in the species composition of the plots were associated with species' strategies (sensu Grime 1979) in the established and regenerative phase. 4. The results are discussed in the context of management designed to manipulate plant species composition in old meadowland.
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311. Effects of grazing on plant and soil nitrogen relations of pasture-crop rotations.

Unkovich, Murray; Sanford, Paul; Pate, John; and Hyder, Mike
Australian Journal of Agricultural Research 49(3): 475-485. (1998)
NAL Call #: 23 Au783; ISSN: 0004-9409
Descriptors: crop rotation/ pasture crop rotation: agronomic method/ crop industry/ grazing: soil nitrogen relations
Abstract: Plant and soil nitrogen (N) fluxes were assessed in subterranean clover (*Trifolium subterraneum* L.) based pastures set-stocked at 8 sheep per hectare (light grazing) or grazed at a much higher, but variable, intensity to maintain 1400 kg standing dry matter per hectare (intensive grazing) through the addition or removal of sheep. Pasture composition and biomass production, herbage N concentration, plant nitrate (NO₃-) utilization, and N₂ fixation by clover were assessed at 3-weekly intervals over the growing season. Soil ammonium (NH₄⁺) and NO₃-availability were assessed at similar intervals using soil coring and in situ incubation cores. Seasonal pasture yield under light grazing was 11.5 t dry matter/ha compared with 7.9 t/ha under intensive grazing, the difference being mostly attributable to reduced grass growth under intensive grazing. However, there was essentially no difference between the pastures in total N accumulation (300 kg N/ha in the lightly grazed and 302 kg N/ha in the intensively grazed pastures). The lesser dry matter production under intensive grazing was compensated for by higher N concentration and increased clover content of the sward, and faster clover growth late in the growing season. N₂ fixation by clover under intensive grazing (153 kg N/ha) was slightly greater than under light grazing (131 kg N/ha). Proportional dependence of clover on N₂ fixation (%Ndfa)

was similar under intensive grazing (78%) and light grazing (84%), despite higher continued availability of soil mineral N under intensive grazing. Uptake of soil N by the grass component amounted to 147 kg N/ha under light grazing v. 96 kg N/ha in the intensively grazed pasture, and for the clover was 18 and 40 kg N/ha, respectively. Capeweed (*Arctotheca calendula* L.), a common weed of south-west Australian pastures, was extraordinarily active in absorbing, storing, and reducing soil NO₃⁻, especially when subjected to intensive grazing. After the 3 years of the grazing trial, the pastures were cultivated and cropped to oats, triticale, and canola and the biomass and N uptake of each crop assessed. Intensive grazing in the previous pasture resulted in increased availability of soil mineral N in the subsequent cropping phase and accordingly augmented crop N uptake and eventual grain protein levels relative to crops following lightly grazed pasture. The study indicated that intensive grazing before cropping may offer a useful management tool for improving N nutrition and yields of non-leguminous crops in pasture-crop rotations under the conditions prevailing in the south-west of Australia.

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312. Effects of grazing system and phosphorus application on pasture quality.

Frame, H.; Warn, L.; and McLarty, G.

Wool Technology and Sheep Breeding 50(3): 465-470. (2002)

NAL Call #: 304.8 W888; ISSN: 0043-7875

Descriptors: crude protein/ dry matter/ fibre/ grazing/ grazing systems/ nutritive value/ pastures/ phosphorus
Abstract: An experiment at Broadford, Victoria, compared crude protein (CP), digestible dry matter (DDM) and neutral detergent fibre (NDF) of pasture under three grazing systems (continuous grazing, a "Simple" time-based rotation, and an "Intensive" plant-based rotation). Each of these grazing systems received either a "Low" (6 kg/ha) or a "High" (25 kg/ha) annual application of phosphorus. CP concentrations of the green pasture component as a whole, the dead pasture component, the green clover component, and the green grass component under a continuous grazing system were each significantly ($P=0.05$) higher throughout the year than under either of the rotation systems. There were no consistent differences in DDM between grazing systems. The NDF concentrations of both the green and dead pasture components under a continuous grazing system were each significantly ($P=0.05$) lower throughout the year than under either of the rotations. The green grass component of the pasture that received High P had significantly ($P=0.05$) higher CP concentrations than the green grass component of the pasture that received Low P. There were no consistent differences in DDM between phosphorus inputs. There were no significant ($P=0.05$) differences in NDF between phosphorus inputs. The combination of continuous grazing and High P tended to have the highest CP and lowest NDF in each pasture component measured. The results highlight that, although grazing system impacted CP and NDF, there was no effect on DDM.

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313. Effects of initial sowing rate and subsequent grazing management on the growth and clover content of irrigated white clover-perennial ryegrass swards in northern Victoria.

Kelly, K. B.; Stockdale, C. R.; and Mason, W. K.

Australian Journal of Experimental Agriculture 45(12): 1595-1602. (2005)

NAL Call #: 23 Au792; ISSN: 0816-1089

Descriptors: irrigation: applied and field techniques/ grazing management: applied and field techniques/ photosynthesis/ defoliation

Abstract: Two experiments were conducted over 3 years. One was of factorial design involving 2 sowing rates of white clover (*Trifolium repens* L. cv. Haifa; sown at 8 or 3 kg/ha) and perennial ryegrass (*Lolium perenne* L. cv. Grasslands Nui; sown at 5 or 15 kg/ha) grazed by dairy cows at 2 frequencies [frequent (2 - 3 weeks in spring/autumn) and infrequent (4 - 6 weeks in spring/autumn)] and 2 intensities [hard (residual rising plate meter heights of less than 4 cm) and lax (residual rising plate meter heights of more than 5 cm)]; and the second was a regression design involving 5 sowing rates of white clover and ryegrass ranging from pure clover to pure ryegrass (sown at 10/0 through to 0/20 kg/ha), all grazed frequently and at a hard intensity. The hypotheses tested were that (1) pure white clover swards would be at least as productive as those that contained ryegrass, and (2) more frequent grazing would result in greater quantities of DM removed, while hard grazing would maintain a higher clover content. In general, the hypotheses were confirmed. Over the 3 years of the experiments, pure white clover swards were at least as productive as mixed swards in a situation where no nitrogen fertiliser was applied. In the first year, the amount of DM removed declined ($P < 0.05$) as the ryegrass sowing rate increased, but by year 3, the pure clover treatment out-yielded the other treatments. Except for the first year, frequent grazing resulted in more ($P < 0.05$) DM removed than did infrequent grazing. Frequently grazed swards also had higher daily net photosynthesis after grazing than did the swards in infrequently grazed treatments, and achieved maximum levels of photosynthesis more quickly. There was no difference in photosynthesis rate, despite significant differences in clover content, between sowing rate treatments, regardless of grazing management. Initial sowing rate had a large effect on clover content in year 1, but by year 3, most of this had disappeared as clover contents rapidly converged. Frequency of grazing had its greatest effect on clover content in year 1, with infrequent grazing resulting ($P < 0.05$) in the greatest clover contents. Grazing intensity was an important determinant of clover content in years 2 and 3, where hard grazing resulted ($P < 0.05$) in higher clover content. Digestibility of the herbage on offer ranged from 65 to 80%, and crude protein concentrations varied from 12 to 26%. In general, frequent grazing resulted in a digestibility of 2 - 4 percentage units higher than infrequent grazing, with hard grazing also tending to increase digestibility. Hard grazed treatments always had high crude protein concentrations in the herbage present before grazing, and there was a slightly higher concentration in frequently grazed herbage compared with herbage that was grazed less frequently. The white clover - perennial ryegrass swards generally responded best to a combination of frequent and hard grazing. However, neither white clover nor perennial ryegrass appears to be well adapted to the combination of soils, climate, irrigation and grazing by dairy

cows that occurs in the northern irrigation region of Victoria, as evidenced by a rapid influx of weeds and the general decline in productivity over the duration of the experiment.
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314. Effects of large-scale cattle grazing on Orthoptera (Saltatoria et Mantodea) on pastures in Georgia (Caucasus).

Bontjer, Andrea and Plachter, Harald
In: Pasture landscapes and nature conservation/ Redecker, Bernd; Finck, Peter; Haerdle, Werner; Riecken, Uwe; and Schroeder, Eckhard.

Berlin: Springer, 2002; pp. 355-366

NAL Call #: SF140.P38 W672 2001

Descriptors: animals and man/ disturbance by man/ commercial activities/ ecology/ habitat utilization/ habitat/ terrestrial habitat/ land zones/ Palaearctic Region/ Eurasia/ Asia/ Orthoptera: farming and agriculture/ large scale cattle grazing/ community structure/ distributional communities/ effects of large scale cattle grazing/ distribution within habitat/ habitat preference/ grassland/ pasture/ Georgia (Asia)/ Tbilisi area/ pastures/ large scale cattle grazing effects on habitats and distributional communities/ Orthoptera/ Insecta/ arthropods/ insects/ invertebrates
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315. Effects of late summer cattle grazing on the diversity of riparian pasture vegetation in an upland conifer forest.

Humphrey, J. W. and Patterson, G. S.

Journal of Applied Ecology 37(6): 986-996. (2000)

NAL Call #: 410 J828; ISSN: 0021-8901

Descriptors: biodiversity conservation/ calcareous springs/ economics/ forage availability/ grasslands: habitat/ grazing management/ litter cover/ riparian pastures/ species abundance/ species richness/ stock husbandry/ stocking density/ upland conifer forests: habitat/ vegetation composition/ water table depths

Abstract: 1. Species-rich grassland is important for biodiversity in upland forests, particularly within riparian zones. Prior to afforestation, the botanical diversity of these grasslands was maintained by domestic stock grazing, but without active management many will revert to coarse, species-poor grassland and eventually to scrub. The reintroduction of stock grazing is a potential solution to this problem, but has not been tested in upland forests. Here we present results from 9 years of monitoring the effects of cattle grazing on the diversity and composition of riparian pasture vegetation in an upland conifer forest in northern Scotland. 2. There were two treatments, late summer grazing and ungrazed. The average stocking density in the grazed treatment was 2.25-2.5 cows ha⁻¹. The cattle were free to range over the entirety of the 40-ha experimental site from early August to late September each year. 3. Assessments of plant species richness and abundance were made in 1988 (prior to the commencement of grazing), 1991 and 1997, in three of the main riparian vegetation types. These were 'Flush' vegetation associated with calcareous springs, acid *Agrostis capillaris*-*Festuca ovina* grassland ('Grass'), and *Juncus effusus* rush pasture ('*Juncus*'). Assessments were also made of grazing impacts, cattle usage and water table depths. 4. Grazing had a significant effect on plant species richness, which declined in ungrazed plots and remained static in grazed plots over the 1988-97 period. There were no recorded

effects of grazing on species abundance, nor on the frequency of rare sedges and herbs of particular conservation importance. Litter cover (dead plant material) was significantly higher in ungrazed plots, which may be a causal factor in declining richness values. 5. Cattle utilized Grass and Flush vegetation to a significantly greater degree than *Juncus* vegetation, and this appeared to be related to forage availability rather than wetness as represented by water table depth. 6. Cattle grazing is of potential value as a management tool for species-rich grasslands in upland forests provided that: areas to be grazed are large enough to minimize localized impacts and allow free ranging of the cattle; the economics and practicalities of stock husbandry are considered; the type of grazing management used is linked clearly to management objectives.
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316. Effects of livestock breed and stocking rate on sustainable grazing systems: Short-term effects on vegetation.

Scimone, M.; Smith, R. E. N.; Garel, J. P.; and Sahin, N.
In: Land use systems in grassland dominated regions: Proceedings of the 20th General Meeting of the European Grassland Federation. (Held 21 Jun 2004-24 Jun 2004 at Luzern, Switzerland.); pp. 623-625; 2004.

Descriptors: animal production/ biodiversity/ breed differences/ grazing/ livestock/ stocking rate/ vegetation
Abstract: This work is part of the EU project FORBIOBEN, which analyses the impact of commercial and traditional breeds with different stocking rates on biodiversity at different levels. This study was conducted to verify the different experimental grazing systems significantly affect the vegetation diversity during the first grazing season and to what extent this happens in different countries (France, Germany, Italy, UK and Spain). Three grazing management systems were compared in five countries in a 3 year experiment, (i) moderate grazing/commercial breed, (ii) low grazing/commercial breed, and (iii) low grazing/traditional breed. The experiments were carried out using cattle in UK, France and Germany; sheep in Italy and goats in Spain. The effect of grazing systems on specific and structural diversity of vegetation was analysed after one year. The responses mainly depend on the background difference of the countries, and resulted to different patterns. The treatment effect appeared to be more evident as a whole with not much difference between levels. A general decrease of the specific biodiversity with grazing pressure was found in all cases, except for the most biodiverse site (France). An increase in structural diversity, especially in the least biodiverse site (UK), for the relatively high impact grazing system was also noticed. The local within treatment variability was high. It is concluded that after the first grazing season, there is a clear change in vegetation diversity in all treatments over time but little evidence of the treatment effects.
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317. Effects of livestock exclusion on the ground flora and regeneration of an upland *Alnus glutinosa* woodland.

Latham, J. and Blackstock, T. H.

Forestry 71(3): 191-197. (1998)

NAL Call #: 99.8 F767; ISSN: 0015-752X

Descriptors: *Alnus glutinosa*/ *Fraxinus excelsior*/ livestock/ grazing intensity/ flora/ natural regeneration/ woodlands/

botanical composition/ sheep/ horses/ grasses/ predation/ seeds/ species diversity/ plant litter/ Bryopsida/ Wales
Abstract: Vegetation composition and tree regeneration were compared between grazing exclosures and unfenced areas of an hillside alder (*Alnus glutinosa*) woodland, at Coedydd Aber, North Wales. Sheep and ponies have had unrestricted access to the unfenced woodland throughout the 20 years since the exclosures were erected. The exclosures had a well developed field layer with significantly higher cover of plant litter, dead wood, bryophytes and woodland species; the unfenced woodland had a sparse field layer and significantly higher cover of bare soil, grasses and wet pasture species. These changes appear to be a consequence of the removal of both herbivory and physical disturbance caused by large herbivores. Tree regeneration from seed was virtually absent from the unfenced areas, and no alder regeneration was recorded in the woodland study plots. The exclosures contained high densities of young ash (*Fraxinus excelsior*), and it is possible that, in the long term, ash will replace alder as the dominant tree in these stands.
 This citation is from AGRICOLA.

318. Effects of management on plant production and nutrient cycling on two annual grassland sites.

Center, D. M.; Vaughn, C. E.; and Jones, M. B.
Hilgardia 57(1): 1-40. (1989)
 NAL Call #: 100 C12H; ISSN: 0073-2230
Descriptors: sheep grazing/ plant biomass/ growing season/ ecological energetics/ fertilization/ leaching/ nitrogen/ mineralization/ resource availability
Abstract: Nutrient (nitrogen, phosphorus, sulfur, potassium, and calcium) dynamics and primary productivity were compared in adjacent sheep-grazed and ungrazed and adjacent subclover-seeded and unseeded annual grassland ecosystems. Aboveground and belowground total plant biomass and nutrient concentrations were measured monthly for two years, and nutrient content of various ecosystem components determined. Nutrient budgets were also developed to compare the effects of the grazing and seeding management practices. Exclusion of sheep grazing had little effect on the system variables we measured. There were only slight differences between the grazed and ungrazed pastures in aboveground and belowground biomass production and nutrient uptake in either year. There were no substantive between-site differences in nutrient transfers. Subclover growth, accompanied by biennial P and S fertilization, resulted in very large increases in biomass production and much larger flows of all nutrients in both years. The largest nutrient fluxes on all sites were the transfers of mineralized nutrients through the soil available pool to live plants during the growing season. Most of this actively cycling nutrient supply was stored in standing dead material and litter, and was thus retained against leaching between growing seasons. The subsequent fate of these nutrients was then determined by new plant uptake and leaching demands, which showed much annual variation.

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319. Effects of management on species dynamics of Canadian aspen parkland pastures.

Waddington, J.; McCartney, D. H.; and Lefkovitch, L. P.
Journal of Range Management 52(1): 60-67. (1999)
 NAL Call #: 60.18 J82; ISSN: 0022-409X

http://jrm.library.arizona.edu/data/1999/521/60-67_waddington.pdf

Descriptors: botanical composition/ vegetation/ pastures/ rain/ rotational grazing/ forbs/ *Bromus inermis*/ *Poa pratensis*/ *Festuca rubra*/ *Medicago sativa*/ Saskatchewan
Abstract: The effects of grazing, fertilizing, and seeding on persistence of herbaceous species was monitored by point quadrat about every second year from 1975 to 1989 in a low-fertility pasture in the aspen parkland vegetation zone of east-central Saskatchewan, Canada. Ground cover response to continuous grazing was contrasted with that of 4- and 6-paddock rotationally-grazed areas fertilized in the fall of every other year with 90 kg N, 45 kg P₂O₅, 10 kg S ha⁻¹. The original vegetation in 2 paddocks of the 6-paddock system was replaced with Russian wildrye (*Psathyrostachys juncea* (Fisch.) Nevski) in 1976, and in 1 of the other 4 paddocks in turn with smooth brome (*Bromus inermis* Leyss.)-alfalfa (*Medicago sativa* L.) in 1979 and 1981, crested wheatgrass (*Agropyron cristatum* (L.) Gaertn.) in 1983, and a meadow brome (*Bromus riparius* Rehm.)-alfalfa mix in 1985. Initially, smooth brome and creeping red fescue (*Festuca rubra* L.) dominated the vegetation with ground cover estimates of 10-20% and 40-60%, respectively. Alfalfa ground cover was less than 1%. With the changes in management, Kentucky bluegrass (*Poa pratensis* L.) replaced creeping red fescue. Alfalfa increased until 1980 and then declined to its original level, apparently in response to precipitation trends. Russian wildrye almost died out and was replaced by brome and Kentucky bluegrass. Reseeding with smooth brome-grass-alfalfa did not consistently increase brome ground cover beyond that obtained by rotational grazing and fertilization, and increased alfalfa only temporarily. Cultivation during the summer before spring seeding resulted in partial recovery of the old vegetation and invasion by Kentucky blue-grass. Total ground cover varied from year to year in response to spring precipitation. Forbs usually increased after reseeding, but declined to their original levels within 5 years.

This citation is from AGRICOLA.

320. Effects of nitrogen input and grazing on methane fluxes of extensively and intensively managed grasslands in the Netherlands.

Pol-van Dasselaar, A. van den; Beusichem, M. L. van; and Oenema, O.
Biology and Fertility of Soils 29(1): 24-30. (1999)
 NAL Call #: QH84.8.B46; ISSN: 0178-2762
Descriptors: range management/ grazing/ mowing/ soil amendments/ nitrogen fertilizers/ quantitative analysis/ nutrient uptake/ seasonal variation/ soil organic matter/ soil pH/ soil water content/ groundwater/ cattle manure/ application rate/ methane/ methane production/ Netherlands
Abstract: Generally, grasslands are considered as sinks for atmospheric CH₄, and N input as a factor which reduces CH₄ uptake by soils. We aimed to assess the short- and long-term effects of a wide range of N inputs, and of grazing versus mowing, on net CH₄ emissions of grasslands in the Netherlands. These grasslands are mostly intensively managed with a total N input via fertilisation and atmospheric deposition in the range of 300-500 kg N ha⁻¹ year⁻¹. Net CH₄ emissions were measured with vented, closed flux chambers at four contrasting sites, which were chosen to represent a range

of N inputs. There were no significant effects of grazing versus mowing, stocking density, and withholding N fertilisation for 3-9 years, on net CH₄ emissions. When the ground-water level was close to the soil surface, the injection of cattle slurry resulted in a significant net CH₄ production. The highest atmospheric CH₄ uptake was found at the site with the lowest N input and the lowest ground-water level, with an annual CH₄ uptake of 1.1 kg CH₄ ha⁻¹ year⁻¹. This is assumed to be the upper limit of CH₄ uptake by grasslands in the Netherlands. We conclude that grasslands in the Netherlands are a net sink of CH₄, with an estimated CH₄ uptake of 0.5 Gg CH₄ year⁻¹. At the current rates of total N input, the overall effect of N fertilisation on net CH₄ emissions from grasslands is thought to be small or negligible. This citation is from AGRICOLA.

321. Effects of November-April grazing pressure on hill country pastures: 1. Pasture structure and net accumulation rates.

Sheath, G. W. and Boom, R. C.
New Zealand Journal of Experimental Agriculture 13(4): 317-327. (1985)
 NAL Call #: S542.A1N45; ISSN: 0301-5521
 Descriptors: range management/ grazing/ grazing intensity/ botanical composition/ dry matter accumulation/ regeneration/ seasonal variation/ pastures/ New Zealand
 This citation is from AGRICOLA.

322. Effects of November-April grazing pressure on hill country pastures: 2. Pasture species composition.

Sheath, G. W. and Boom, R. C.
New Zealand Journal of Experimental Agriculture 13(4): 329-340. (1985)
 NAL Call #: S542.A1N45; ISSN: 0301-5521
 Descriptors: range management/ grazing/ botanical composition/ grasses/ legumes/ grazing intensity/ seasonal variation/ pastures/ New Zealand
 This citation is from AGRICOLA.

323. Effects of November-April grazing pressure on hill country pastures: 3. Interrelationship with soil and pasture variation.

Sheath, G. W. and Boom, R. C.
New Zealand Journal of Experimental Agriculture 13(4): 341-349. (1985)
 NAL Call #: S542.A1N45; ISSN: 0301-5521
 Descriptors: range management/ grazing/ soil water content/ soil temperature/ nutrient content/ botanical composition/ pastures/ New Zealand
 This citation is from AGRICOLA.

324. Effects of pasture species, fertiliser, and grazing management on the survival of gorse seedlings.

Hartley, M. J. and Thai, P. H.
New Zealand Journal of Experimental Agriculture 10(2): 193-196. (1982)
 NAL Call #: S542.A1N45; ISSN: 0301-5521
 Descriptors: New Zealand
 This citation is from AGRICOLA.

325. Effects of restoration with cattle grazing on plant species composition and richness of semi-natural grasslands.

Pykala, J.
Biodiversity and Conservation 12(11): 2211-2226. (Nov. 2003)
 NAL Call #: QH75.A1B562; ISSN: 0960-3115
 Descriptors: range management/ botanical composition/ species diversity/ biodiversity/ plant ecology/ Finland
 This citation is from AGRICOLA.

326. Effects of rotational grazing and set stocking on pasture production under sheep grazing.

Baars, J. A.; Jagusch, K. T.; Littler, R. A.; and Farquhar, P. A.
Proceedings Annual Conference Agronomy Society of New Zealand 14: 131-134. (1984)
 NAL Call #: S3.A37; ISSN: 0110-6589
 Descriptors: range management/ sheep feeding/ rotational grazing/ stocking rate/ tillering/ *Lolium perenne*/ *Trifolium repens*/ New Zealand
 This citation is from AGRICOLA.

327. The effects of sowing time, sowing technique and grazing on tall fescue (*Festuca arundinacea* Schreb.) establishment.

Charles, G. W.; Blair, G. J.; and Andrews, A. C.
Australian Journal of Experimental Agriculture 32(5): 627-632. (1992)
 NAL Call #: 23 Au792; ISSN: 0816-1089
 Descriptors: crop industry/ agriculture/ herbicide
 Abstract: The effects of sowing time (autumn and spring) and technique (conventional cultivation, inverted T direct drill, triple disc direct drill and aerial seeding), on the establishment of tall fescue into a weed infested pasture on the Northern Tablelands of New South Wales (Australia) were examined. A pre-sowing herbicide treatment was included in the 2 direct drilling treatments, and heavy pre-sowing grazing was used in the autumn sowing. The design used 38 plots of 0.12 ha, analyzed as 2 separate, complete block experiments, with some common treatments. Tall fescue establishment, 120 days after the autumn sowing, averaged 48 seedlings/m² on the inverted T treatment (16% establishment). Establishment was improved by 63%, to 78 seedlings/m², with herbicide and 46%, to 70 seedlings/m², by heavy grazing. These effects were additive, giving 105 seedlings/m² for the combined treatments. Only 52 seedlings/m² established on the triple disc treatment with heavy grazing and herbicide, while establishment on the cultivated seedbed was not different from the inverted T (93 seedlings/m²). There was no establishment after the aerial seeding at either sowing. Fescue establishment showed the same trends in the spring sowing, with 140 seedlings/m² on the inverted T treatment with pre-sowing herbicide, which was higher than the establishment of 107 seedlings/m² on the cultivated seedbed. The fescue yield, 18 months after the autumn sowing, was highest in the autumn sown, inverted T treatment with pre-sowing herbicide and heavy grazing (123 kg/ha). In the spring sowing, fescue was recorded only on the cultivated treatment (84 kg/ha) and on the inverted T treatment with pre-sowing herbicide (39 kg/ha). These results show that tall fescue can be re-established into weed dominated pastures on the Northern Tablelands with

direct drilling, in either autumn or spring, and that heavy, pre-sowing grazing and herbicide increase fescue establishment.

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328. Effects of summer irrigation and trampling in dairy pastures on soil physical properties and earthworm number and species composition.

Lobry De Bruyn, Lisa A. and Kingston, T. J.

Australian Journal of Agricultural Research 48(7): 1059-1079. (1997)

NAL Call #: 23 Au783; ISSN: 0004-9409

Descriptors: agriculture/ agronomy/ animal husbandry/ biobusiness/ dairy pasture/ earthworm number/ earthworm species composition/ female/ grazing/ soil physical properties/ soil science/ summer irrigation/ terrestrial ecology/ trampling

Abstract: In 1989 a replicated split-plot trial on a Krasnozem soil was established at Elliott Research Station (ERS) in the north-west of Tasmania, as well as 14 on-farm trials in newly irrigated pastures on 3 different soil types (Alluvial, Podzolic, Krasnozem) in the dairy districts of Scottsdale, Smithton, and Deloraine. There were 3 main treatments at ERS: irrigated before grazing, irrigated after grazing, and grazed and not irrigated. Part of each main plot was fenced to prevent trampling but still allowed grazing. Effects of summer irrigation and trampling by dairy cows were examined for pasture production, and soil chemical and structural properties. Summer irrigation at ERS and on-farm trials has led to a decline in soil structure indicated by slower ponded water infiltration rates on irrigated plots compared with the dryland plots. The decline in ponded water infiltration rates suggests a reduction in macroporosity, especially in the soil surface. However, other indicators for soil structural change in the top 100 mm-percentage water-stable aggregates (> 2.5 mm) and bulk density-revealed no significant variation between the irrigated and dryland paddocks. There were, however, higher water infiltration rates and lower bulk densities in the untrampled areas than the trampled areas at ERS. Pasture production at ERS was about 50% more with irrigation in each of the 2 years of the study. Data collected at ERS in autumn and spring on the numbers of Aporectodea caliginosa (Savigny) and Lumbricus rubellus (Hoffmeister) earthworms showed that they respond quite differently to irrigation. After 2 irrigation seasons, A. caliginosa numbers in irrigated plots dropped by over 50%, whereas in the dryland plots densities of this earthworm have remained around 390 earthworms/m². In contrast the densities of L. rubellus at ERS rose under irrigation practices, especially in the autumn-winter sampling period. Therefore, with the advent of summer irrigation at ERS, there was a shift in earthworm composition from a fauna dominated by A. caliginosa to a fauna with an increasing proportion of L. rubellus and a decreasing number of A. caliginosa. The typical dairy pasture in the on-farm trials recorded 2 main species, A. caliginosa (70%) and L. rubellus (30%). Total earthworm densities were highest in the north-west (Smithton) region of the State (293-351 earthworms/m²) regardless of soil type, and the lowest densities were recorded in the Alluvial soils of Deloraine (96 earthworms/m²). The north-west area also had the most diverse earthworm fauna, with 5 species recorded in one site: A. caliginosa, A. longa, Allolobophora chlorotica, L.

rubellus, and O. cyaneum. Summer irrigation effects after 2 seasons on earthworm composition and abundance on dairy farms caused no significant change in A. caliginosa numbers, but there was a 45% increase in the numbers of L. rubellus in irrigated treatments. L. rubellus was considerably more active over summer in irrigated paddocks (25 earthworms/m²) than in non-irrigated paddocks (7 earthworms/m²). In contrast the number of A. caliginosa recorded in dryland paddocks was not statistically different to the irrigated paddocks, but the A. caliginosa in dryland paddocks were mostly inactive 8-20 mm from the soil surface.

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329. Establishing tallgrass prairie on grazed permanent pasture in the Upper Midwest.

Jackson, Laura L.

Restoration Ecology 7(2): 127-138. (1999)

NAL Call #: QH541.15.R45R515; ISSN: 1061-2971

Descriptors: grazed permanent pasture/ restoration ecology/ tallgrass prairie establishment/ vegetation

Abstract: The goal of the study was to learn whether native prairie grasses and, eventually, a diverse mixture of native forbs could be incorporated in permanent pastures by means of rotational grazing by cattle. An experiment was established on a farm in northeastern Iowa on a pasture that had never been plowed but had been grazed since the 1880s. One treatment was protected from grazing to test for the presence of remnant vegetation. Andropogon gerardii, Sorghastrum nutans, Panicum virgatum, and Desmanthus illinoensis were introduced in plots first treated with glyphosate; seeds were either drilled (DR) or hand-broadcast and incorporated by controlled cattle trampling (BT). Seedling establishment and aboveground biomass were followed over 3 years. There was no evidence for remnant native plants on uplands, but seven species of native forbs and four native graminoids flowered in enclosures erected within waterways. D. illinoensis initially established up to 12 seedlings/m² but had disappeared from all but one plot by the third year. Variation in native grass establishment among replicate plots within treatments was very high, ranging initially from 0.2 to 9.9 plants/m². In August of the second year, native grasses made up only 8% of the available forage in DR plots and 1% of BT plots. One year later, however, native grasses made up 56% of the available forage in DR plots and 37% of BT plots, and these differences were significant ($p = 0.05$). A pilot study seeded in late winter (frost seeding) suggested that seeds spread after cattle trampling produced five times more seedlings (2.5/m²) than seeds spread before cattle trampling (0.5/m²). Frost seeding had advantages because it did not require herbicide for sod suppression or tractor access to the site. New plantings could be safely grazed in early spring and late fall, before and after most native grass growth, to offset the negative economic impact of protecting new plantings from burning during the growing season. But this practice precluded subsequent prescribed burning. I propose a strategy for incorporating native wildflowers into the pasture over time with minimum cost.

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330. Establishment of corn in rotation and alfalfa and rye: Influence of grazing, tillage, and herbicides.

Morris, Jennifer L.; Allen, Vivien G.; Vaughan, David H.; Luna, John M.; and Cochran, Michele A.

Agronomy Journal 90(6): 837-844. (1998)

NAL Call #: 4 AM34P; ISSN: 0002-1962

Descriptors: crop rotation: agronomic method/ discing: tillage method

Abstract: Integrating livestock into crop rotations offers alternatives for grazing and crop management. Grazing, tillage, and herbicides were evaluated in a randomized block design with four replications for transition from alfalfa (*Medicago sativa* L.) to corn (*Zea mays* L.). For the control (T1), alfalfa was overseeded with rye (*Secale cereale* L.) in October, and corn was no-till established in early May. For alternative treatments, alfalfa was grazed by cattle (*Bos taurus*) from July until October. Treatments were: T2, disking prior to rye planting, grazing rye for 12.5 d prior to corn planting, with dicamba (3,6-dichloro-2-methoxybenzoic acid) applied after corn planting; T3, no spring grazing, with glyphosate (N-(phosphonomethyl)glycine) applied before corn planting; T4, same as T3 plus grazing rye for 1.8 d in early spring; T5, autumn application of glyphosate to alfalfa before planting a rye-hairy vetch (*Vicia villosa* Roth) cover crop; and T6, autumn disking before planting rye-hairy vetch with no herbicides used. System T2 increased suppression of alfalfa and corn plant populations compared with shorter grazing periods. System T4 increased corn plant populations compared with no spring grazing (T3; 3.5 vs. 3.0 plants m⁻¹). Autumn disking (T6) generally provided less control of alfalfa than autumn application of glyphosate (T5). Applying glyphosate before corn planting (T3 and T4) improved corn populations and growth, compared with autumn glyphosate or disking (T5 and T6), and resulted in corn forage yield (23 Mg ha⁻¹) similar to conventional no-till establishment (T1; 22 Mg ha⁻¹). Herbicides completely killed alfalfa, but grazing alfalfa and rye reduced alfalfa persistence. Grazing could provide benefits to corn production systems while providing forage for cattle.

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331. Experimental determination of the effects of cattle stocking density and grazing period on forest regeneration on a subalpine wood pasture.

Mayer, Andrea C.; Estermann, Beda L.; Stoeckli, Veronika; and Kreuzer, Michael

Animal Research 54(3): 153-171. (2005)

NAL Call #: SF1 .A64; ISSN: 1627-3583

Descriptors: stocking density/ germination rate/ grazing period/ herbage quality/ subalpine wood pasture

Abstract: The influence of cattle stocking density and the length of the grazing period on the extent of tree damage on subalpine wood pastures was assessed. An experiment was carried out on four adjoining fields, grazed by zero, three, six and nine heifers. The fields were grazed until herbage resources were exploited. Spruce seeds were seeded, spruce saplings (*Picea abies* (L.) Karst. (average height of 14 cm) as well as young spruces, larches (*Larix decidua* Miller) and rowans (*Sorbus aucuparia* L.) of 42 cm height were planted. The experimental site was situated at 1900 m a. s. l.; 20% of the area was forest. Browsing and other damage on planted spruce saplings and young spruces, larches and rowans were recorded. The germination rate of spruce seeds was recorded and the

survival rate of the seedlings germinated was analysed.

The heifers spent around 30% of the time under the tree canopies, both for resting and grazing, instead of the expected 20% based on the relative forest cover. Since the herbage quality was found to be similar in the forest and on the open pasture and since there was no effect of stocking density on herbage intake and digestibility as assessed in the first week of the experiment, the effects on the trees were considered independent from herbage quality.

Grazing at high stocking densities enhanced the germination of spruce seedlings. Rowan was browsed most frequently, depending on stocking density and grazing period. Also larch was browsed frequently. With increasing grazing time, even spruces of 14 cm and 42 cm height were frequently browsed, but there was no clear relationship to stocking density. The observations showed that individual animals that have developed a specific preference for spruce needles may play a decisive role in the extent of browsing on spruce. In conclusion, guidelines for a sustainable use of subalpine wood pastures require restrictions either in stocking density or in the length of the grazing period or in both.

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332. An experimental study of the effects of sheep grazing on vegetation change in a species-poor grassland and the role of seedling recruitment into gaps.

Bullock, J. M.; Hill, B. Clear; Dale, M. P.; and Silvertown, J.

Journal of Applied Ecology 31(3): 493-507. (1994)

NAL Call #: 410 J828; ISSN: 0021-8901

Descriptors: dicotyledon/ fertility/ fertilizer application/ seasonality/ seed rain/ sheep grazing management/ species composition/ sterile loam

Abstract: 1. An experiment was set up in 1986 on a species-poor grassland in Oxfordshire to determine the effect of sheep grazing management on vegetation change after cessation of fertilizer applications. Three seasons of grazing (winter, spring and summer) were applied, each with two grazing intensities, in a 2 times 2 times 2 factorial design with two blocks in 16 paddocks. 2. Point quadrat surveys in 1990 showed that the grassland vegetation was dominated by perennial grasses and that the frequency distribution of species was highly skewed. Dicotyledonous species ('dicots') were extremely rare, having an overall frequency of only 0.43%. 3. The frequencies of eight of the 10 dominant grasses were significantly affected by grazing intensity although these effects depended on the grazing season, were species-specific and were generally small. 4. Intensive surveys of the dicots in 1990-91 discovered 40 species although most of these were rare. The dicots exhibited stronger and more consistent responses than the grasses. Their abundances being significantly increased by increased grazing in one or more grazing periods. Dicot species number was significantly increased by increased grazing intensity in all periods. 5. The potential was studied for seedling establishment in gaps to bring about vegetation change. Regular monitoring of the natural recruitment of seedlings into artificially created gaps was carried out in each paddock. Comparison between the species composition of seedlings emerging in gaps where the soil had been replaced with a sterile loam and that of gaps formed over the original soil showed no evidence of a persistent seed bank and that all seeds were probably derived from recent seed rain. 6. No species novel to the

vegetation emerged in the gaps and the species composition of seedlings in the gaps was significantly and positively correlated with that of the vegetation in a majority of the paddocks. However, some species differences in the contribution to the seed rain were noted. In particular, the dicots were overrepresented. The number of grass seedlings in the gaps was decreased by increased summer grazing. Therefore, grazing had complex effects on vegetation change. Change is likely to be slow, especially while fertility is high, because of the small responses of the grasses to the grazing treatments and the lack of input of novel species from a seed bank. However, the dicots may continue to increase under increased grazing because of their high seed production and the effects of grazing in increasing cap frequencies.

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333. Factors affecting the productivity of irrigated annual pastures: Defoliation by dairy cows.

Stockdale, C. R.

Australian Journal of Experimental Agriculture 26(3): 305-314. (1986)

NAL Call #: 23 Au792; ISSN: 0816-1089

Descriptors: Trifolium subterraneum/ grass/ weed/ botanical composition/ grazing intensity/ regeneration/ Victoria/ Australia

Abstract: The influence of grazing intensity on the productivity of an irrigated annual pasture was studied for 3 years in northern Victoria [Australia] Lax-, medium- and hard-grazing intensities were described by post-grazing pasture heights of 7.2, 5.2 and 3.0 cm, respectively. Also, one instance of variable grazing frequency occurred, in winter of year 1. Hard-grazed plots produced 13 and 17% less herbage in years 1 and 2, respectively, than did lax- and medium-grazed plots, which produced similar amounts of herbage. When the interval between grazings was extended, the variation in productivity was reversed; lax grazing resulted in 9% less total production than heavier grazing. In years 1 and 2, there was little effect of grazing treatment on botanical composition until spring, at which time there was a marked reduction in the amount of subterranean clover (*Trifolium subterraneum*) in the hard-grazed plots, with a concomitant increase in grass content. There were no significant effects of grazing intensity on the amounts of weeds in either year. However, in year 3, weeds were important contributors to pasture production early in the season. This, together with reduced clover seed reserves and increased incidence of disease in subterranean clover with hard grazing, suggests that the long-term regenerating ability of an annual pasture may be impaired if severely grazed at regular intervals.

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334. Fall-grazing management effects on production and persistence of tall fescue, perennial ryegrass, and prairie grass.

Hall, M. H.; Levan, P. J.; Cash, E. H.; Harpster, H. W.; and Fales, S. L.

Journal of Production Agriculture 11(4): 487-491. (1998)

NAL Call #: S539.5.J68; ISSN: 0890-8524

Descriptors: fall grazing management: agronomic method
Abstract: Extending the grazing season for livestock into late fall or early winter can substantially reduce production costs compared with ending the grazing season in October. Most of the published research about fall or early-winter

production of grasses was derived from simulated grazing studies (i.e., frequent mechanical harvesting) and may not be indicative of results obtained with actual grazing. The objective of this research was to evaluate the whole-year production of perennial ryegrass (*Lolium perenne* L.), prairie grass (*Bromus unioloides* (Willd.) H.B.K.; syn. *B. willdenowii* Kunth), and tall fescue (*Festuca arundinacea* Schreb.) under different fall grazing management schemes. In 1994, 1995, and 1996 fall grazing treatments consisting of: 1. stockpile (accumulation forage in the field after the August grazing and then grazing once in November); 2. lax (grazing once in September and then not grazing again until spring); and 3. intensive (continue grazing on approximately 30 d schedule through November) were imposed on established stands of 'Barcel' tall fescue, 'Citadel' perennial ryegrass, and 'Grasslands Matua' prairie grass at the Haller Livestock and Forage Research Center near State College, PA. Perennial ryegrass and tall fescue responded similarly within and across grazing treatments. Total season yield (averaged 7490 lb/acre per year) and persistence of perennial ryegrass were equal to tall fescue regardless of the fall grazing management. During the first year after implementing the grazing treatments, prairie grass survival was only 15% in the stockpile treatment and by the second year, prairie grass had not survived in any of the grazing treatments. Fall grazing and stockpiling tall fescue or perennial ryegrass lengthened the grazing season. However, this increased fall production resulted in 15% less forage production the following spring than pastures not grazed in the fall. A combination of lax, intensive, and stockpile grazing in separate paddocks may be most desirable. Intensive and stockpile grazing would allow continued grazing into the fall and early winter, respectively, and lax grazing would permit early spring grazing while the fall-grazed pastures recover.

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335. Forages and pasture management: Sequential grazing of cool- and warm-season pastures.

Moore, K. J.; White, T. A.; Hintz, R. L.; Patrick, P. K.; and Brummer, E. C.

Agronomy Journal 96(4): 1103-1111. (2004)

NAL Call #: 4 AM34P; ISSN: 0002-1962

Descriptors: cattle grazing sequences/ pasture: management, nutritive value, productivity, sequence/ stocking rate

Abstract: Pasture productivity in Iowa is often limited by low productivity of cool-season grasses during summer. Our overall objectives were to (i) evaluate the impact of legumes on the productivity and nutritive value of cool-season pastures, (ii) evaluate warm-season grasses for summer grazing, and (iii) determine the effects of pasture sequence on the productivity of season-long grazing systems. Cool-season pastures consisted of smooth bromegrass (*Bromus inermis* Leyss.) alone or in mixture with birdsfoot trefoil (*Lotus corniculatus* L.), alfalfa (*Medicago sativa* L.), or kura clover (*Trifolium ambiguum* M. Bieb.). Warm-season pastures were monocultures of big bluestem (*Andropogon gerardii* Vitman) or switchgrass (*Panicum virgatum* L.). Kura clover was the only legume that persisted well over time, and because of this, pastures interseeded with kura clover maintained a higher nutritive value than either those interseeded with alfalfa or birdsfoot trefoil. This resulted in higher total liveweight gains for cattle grazing sequences that included pastures interseeded with

kura clover. In general, rotating cattle to warm-season grass pastures during summer was less advantageous than having them remain on cool-season pastures at a lower stocking rate because warm-season pasture nutritive value was lower and declined more rapidly. However, despite lower nutritive value and consequently animal performance, sequences with warm-season grass pastures did perform well under some conditions and may be a desirable alternative under some circumstances. Having a warm-season grass pasture in the grazing sequence provides an opportunity to relieve cool-season pastures when growth conditions become limiting and introduces flexibility into the management system.

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336. Grazed grassland management and nitrogen losses: An overview.

Jarvis, S. C.

Aspects of Applied Biology 30: 207-214. (1992)

NAL Call #: QH301.A76; ISSN: 0265-1491

Descriptors: grasslands/ leaching/ mineralization/ nitrates/ biogeochemical cycles/ nitrogen fertilizers/ nitrogen/ grazing

This citation is from AGRICOLA.

337. Grazing as a management tool in the restoration of species-rich grasslands.

Bakker, J. P.

Proceedings of the Koninklijke Nederlandse Akademie van Wetenschappen Series C Biological and Medical Sciences 90(4): 403-430. (1987)

NAL Call #: 442.9 AM8; ISSN: 0023-3374

Descriptors: livestock/ community diversity/ soil salination/ nature conservation

Abstract: The possibilities of restoration of species-poor abandoned and fertilized grasslands to communities with a higher diversity are discussed. The management practices grazing with domestic live-stock and hay-making were compared. Although species diversity increased with both practices, more species indicating nutrient poor soil conditions in inland and more species indicating salt conditions in coastal areas appeared with grazing than with hay-making. The structure of the canopy played a more important part than impoverishing or salination of the soil. The community diversity particularly increased with grazing due to the emergence of a mosaic of heavily grazed areas and lightly grazed patches.

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338. Grazing intensity effects on weed populations in annual and perennial pasture systems.

Harker, K. Neil; Baron, Vern S.; Chanasyk, David S.; Naeth, M. Anne; and Stevenson, F. Craig

Weed Science 48(2): 231-238. (2000)

NAL Call #: 79.8 W41; ISSN: 0043-1745

Descriptors: pasture system weed populations: grazing intensity

Abstract: Few studies report animal grazing effects on weed populations. A study was conducted to assess weed populations in annual and perennial forage grasses grazed at various intensities by cattle over a 4-yr period. The perennial forages were *Bromus inermis* and *Bromus riparius*, and the annual forages were winter *Triticosecale* and a mixture of *Hordeum vulgare* and winter *Triticosecale*. With few exceptions, results from the two annual pastures could be adequately described as a group, as could the

results from the two perennial pastures. The two most prevalent weed species were *Capsella bursa-pastoris* and *Taraxacum officinale*; other species encountered over the course of the study were analyzed as a group. Tillage (seedbed preparation) in the annual system supported a proliferation of annual weeds in the spring. In the perennial pasture system, a lack of tillage and spring MCPA allowed *T. officinale* to increase as the study progressed, especially at the highest grazing intensity. In the perennial pastures, each unit increase in grazing intensity led to 51 more *C. bursa-pastoris* m⁻² and 4 more *T. officinale* m⁻². At lower levels of grazing intensity, *C. bursa-pastoris* and other species were most abundant in the annual pastures. Weed population shifts in response to grazing pressure in the annual pasture systems were restricted because of annual tillage and MCPA. Therefore, pasture managers may subject annual pastures to heavy grazing pressure with less negative weed population consequences than perennial pastures where herbicides are not applied.

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339. Grazing intensity impacts on pasture carbon and nitrogen flow.

Baron, V. S.; Mapfumo, E.; Dick, A. C.; Naeth, M. A.; Okine, E. K.; and Chanasyk, D. S.

Journal of Range Management 55(6): 535-541. (2002)

NAL Call #: 60.18 J82; ISSN: 0022-409X

Descriptors: range management/ grazing intensity/ *Bromus riparius*/ beef cattle/ pastures/ leaf area index/ in vitro digestibility/ forage/ biogeochemical cycles/ urine/ sward/ plant litter/ Alberta

Abstract: There is little information on the impact of grazing intensity on productivity and sustainability of intensively managed pastures in the humid, short-season parkland of the Canadian prairies. Our hypothesis was that above-ground productivity of dry matter, carbon, nitrogen, and in vitro digestible organic matter would be reduced proportionately with increasing grazing intensity. The study was conducted on a Typic Haplustoll at Lacombe, Alberta. Paddocks of meadow brome grass (*Bromus riparius* Rhem.), replicated 4 times, were subjected to heavy, medium and light grazing intensities. Measurements and analyses were carried out for 3 years. Yields of dry matter, carbon, nitrogen, and in vitro digestible organic matter before and after grazing were determined and seasonal pools of above ground production, disappearance and residual were calculated. Concentrations of acid and neutral detergent fiber and lignin were also determined before and after grazing. Increasing grazing intensity tended to increase nitrogen and decrease fiber concentrations for available and residual forage. Heavy and medium grazing intensities produced 83 and 90% as much above ground dry matter and 87 and 90% above ground carbon as the light intensity. All disappearance pools were similar among grazing intensities except in vitro digestible organic matter, where heavy was 116% of light. Heavy grazing reduced the contribution of vegetative dry matter, in vitro digestible organic matter, carbon and nitrogen to the residual to 41, 50, 36, and 52% of that for light grazing. Adding estimated fecal-carbon to the residual significantly increased total residual carbon. Estimated fecal-carbon represented 68, 51, and 42% of all carbon inputs to litter for heavy, medium and light grazing, respectively. Grazing

intensity did not affect estimated pools of excreted nitrogen, but increased estimated percent of nitrogen excreted as urine.

This citation is from AGRICOLA.

340. The grazing management of sheep on grass-white clover permanent pasture.

Laws, J. A. and Newton, J. E.

Irish Journal of Agricultural and Food Research 31(2): 143-156. (1992)

NAL Call #: S539.5.I74; ISSN: 0791-6833

Descriptors: feed quality/ grazing management/ livestock production/ productivity/ seasonality

Abstract: A 2-year experiment was designed to examine the effects of grazing management (rotational or continuous) and number of paddocks (3 or 6) on a lowland sheep system using a permanent grass sward into which white clover had been sown. No nitrogen fertilizer was applied. There were two rotational treatments; one was based on a fixed number of grazing days per paddock (RF) whilst on the other the sheep were moved when residual sward height fell below 5 cm (RH). A third treatment involved continuous grazing until weaning followed by rotational grazing based on a fixed number of grazing days (CRF). There was significantly more clover on RH than on RF or CRF and on 6- than on 3-paddock systems. During the course of the experiment ryegrass increased and bare ground decreased on all three grazing treatments. Lambs on RH grew faster than those on RF or CRF from birth to sale and particularly from weaning to sale, and the lambs on the 6-paddock system grew significantly faster than those on the 3-paddock system. The percentage of lambs finished and sold on RH was 90% in the first year and 88% in the second. On the 6-paddock system 89% and 95% of lambs were sold compared with 66% and 58% on the 3-paddock system. Ewe weight was also heaviest on RH and on the 6-paddock system. Other measures of productivity, the quantity of silage made and the number of grazing days in the autumn were also highest, and the amount of supplementary feed was lowest on RH-6 treatment combination, indicating advantages from this more flexible method of grazing management.

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341. Grazing management of temperate pastures: Literature reviews and grazing guidelines for major species.

Fitzgerald, R. D. and Lodge, G. M.

Sydney: NSW Agriculture; 47, 1997. NSW Agriculture Technical Bulletin.

Notes: ISSN: 1039-2602

NAL Call #: S383.A3N44 no.47

Descriptors: agronomy/ cocksfoot/ forage crop/ grazing management/ guidelines/ native species/ phalaris/ temperate pastures

Abstract: Grazing management studies within the Temperate Pasture Sustainability Key Program located at 22 sites throughout south-eastern Australia are described. Experimental treatments on these sites commenced in spring 1993. Plant production and persistence data collected until spring 1995, were presented at a workshop in Launceston in October 1995. From these data, published information and anecdotal evidence, seasonal grazing management guidelines were proposed for pastures dominated by perennial ryegrass, winter active phalaris, tall

fescue, cocksfoot and Danthonia (wallaby grass) - Microlaena (weeping grass) and Aristida (wiregrass) native pastures. These guidelines cover not only the perennial grass component of the pastures, but also management guides for legumes, annual grasses and weeds. Similar grazing management guidelines were also prepared for controlling broadleaf weeds in pastures. These grazing plans are the first such guidelines to be devised for perennial grass-based pastures in the temperate regions of Australia. To support these guidelines literature reviews on the effects of grazing on perennial ryegrass, phalaris, tall fescue, cocksfoot, native grass-based pastures, white clover, subterranean clover annual grass weeds, perennial grass weeds and broadleaf weeds are also presented.

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342. Grazing management of wet pastures in an Environmentally Sensitive Area.

Mallon, E. D.; McAdam, J. H.; and Montgomery, W. I. In: Vegetation management in forestry, amenity and conservation areas: Managing for multiple objectives; Series: Aspects of Applied Biology 44.

Warwick: Association of Applied Biologists, 1996; pp. 245-250.

Notes: ISSN: 0265-1491

NAL Call #: QH301.A76 no.44

Descriptors: natural resource management/ wildlife management

This citation is from AGRICOLA.

343. Grazing methods and stocking rates for direct-seeded alfalfa pastures: I. Plant productivity and animal performance.

Schlegel, M. L.; Wachenheim, C. J.; Benson, M. E.; Black, J. R.; Moline, W. J.; Ritchie, H. D.; Schwab, G. D.; and Rust, S. R.

Journal of Animal Science 78(8): 2192-2201. (2000)

NAL Call #: 49 J82; ISSN: 0021-8812

Descriptors: beef cattle/ steers/ Medicago sativa/ rotational grazing/ duration/ stocking rate/ forage/ biomass/ liveweight gain/ feedlots/ finishing

Abstract: A 4-yr study was conducted to determine the effects of two grazing methods (GM) at two stocking rates (SR) on alfalfa pasture plant productivity and animal performance and to ascertain the effect of grazing systems on subsequent performance of steers fed a high-concentrate diet. Eight pasture plots (.76 ha) were seeded in 1988 with alfalfa (*Medicago sativa* L. var. WL225) and divided into two blocks of four pastures each. Grazing methods consisted of a traditional four-paddock or an intensive 13-paddock system. Pastures were managed to allow a 36-d rest period with an average grazing season of 110 d. The low and high SR were 5.9 vs 11.7, 5.3 vs 10.5, 5.3 vs 7.9, and 5.3 vs 7.9 steers/ha for years 1989 to 1992, respectively. Following the grazing season, steers were placed in a feedlot and fed a high-concentrate diet (81% high-moisture corn, 14% corn silage, 5% protein-mineral supplement) for an average of 211 d. There was no effect of GM on herbage mass, pasture phase ADG, or live weight gain/hectare. Increasing the number of paddocks was beneficial when herbage mass was limited and stocking rate was above 7.9 steers/ha. Increasing SR above 7.9 steers/ha decreased herbage mass and pasture-phase ADG. As for-age allowance increased, pasture-phase ADG increased quadratically ($R^2 = .82$, $P < .001$), reached a

plateau, and then decreased. Previous grazing system did not influence the performance of steers in the feedlot or their carcass characteristics. Optimum SR is dependent on herbage mass produced.
This citation is from AGRICOLA.

344. Grazing methods and stocking rates for direct-seeded alfalfa pastures: II. Pasture quality and diet selection.

Schlegel, M. L.; Wachenheim, C. J.; Benson, M. E.; Ames, N. K.; and Rust, S. R.

Journal of Animal Science 78(8): 2202-2208. (2000)
NAL Call #: 49 J82; ISSN: 0021-8812

Descriptors: beef cattle/ rotational grazing/ stocking rate/ Medicago sativa/ canopy/ protein content/ organic matter/ in vitro digestibility/ digesta/ nutritive value

Abstract: A 2-yr study was conducted to determine the effects of two grazing methods (GM) and two stocking rates (SR) on alfalfa (*Medicago sativa* L. var. WL225) pasture quality and diet selection by Holstein steers. Eight pasture plots (.76 ha) were seeded in 1988 and divided into two blocks of four pastures each. Pastures were managed to allow a 36-d rest period with an average grazing season of 105 d. Before steers entered the next paddock, canopy heights (CH) of alfalfa plants were determined and pasture-forage samples were collected. Forage samples were analyzed for DM, OM, CP, and in vitro OM digestibility (IVOMD). At 12-d intervals beginning with the second grazing cycle, extrusa samples were collected from steers with esophageal fistulas. Extrusa samples were frozen, freeze-dried, and analyzed for OM, CP, IVOMD, in situ ruminal DM degradation, and ruminal undegradable protein. There were no effects of GM on alfalfa CH or pasture DM, OM, CP, and IVOMD. Increasing the SR increased pasture CP content in both years and increased DM, OM, and IVOMD in the 2nd yr. There was no effect of GM or SR on the quality of forage selected by esophageally fistulated steers. Esophageally fistulated steers selected forage that had greater OM, CP, and IVOMD than the average nutrient content of the forage. Although forage quality was greater when stocking rates were increased, the quantity of forage available per animal may have limited gains.

This citation is from AGRICOLA.

345. Grazing of lowland heath in England: Management methods and their effects on heathland vegetation.

Bullock, James M. and Pakeman, Robin J.

Biological Conservation 79(1): 1-13. (1997)

NAL Call #: S900.B5; ISSN: 0006-3207

Descriptors: conservation/ grazer/ grazing/ heathland vegetation/ lowland heath/ management objectives/ succession

Abstract: The disappearance of grazing from much of British lowland heathland over the last century is thought to be a major contributory factor in the loss of heath vegetation by allowing succession towards woodland. The reintroduction of grazing is hindered by the small amount of available information on grazing management methods or on the responses of lowland heath vegetation to grazing. We review a range of grazing management methods (different grazing animals, stocking rates and combination with burning or cutting), and their effects on vegetation in a number of different lowland heath types (dry, humid and wet heath, and mire) distributed across southern England. The introduction of grazing or higher stocking rates

generally increased plant species richness, and the cover of grasses, forbs, bryophytes and lichens and bare ground while reducing litter depth and the cover of dwarf shrubs and scrub species. However, precise effects on species composition varied widely between sites and grazing managements. The desirability of each of these effects is discussed in relation to the need to specify management objectives.

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346. Grazing sheep and cattle together or separately: Effect on soils and plants.

Abaye, A. O.; Allen, V. G.; and Fontenot, J. P.

Agronomy Journal 89(3): 380-386. (1997)

NAL Call #: 4 AM34P; ISSN: 0002-1962

Descriptors: grazing/ botanical composition/ bulk density/ soil density/ mixed grazing/ grazing systems/ grasslands/ sown grasslands

Abstract: Angus cows (*Bos taurus*) with calves and ewes (*Ovis aries*) (1/2 Dorset, 1/4 Finn, 1/4 Rambouillet crossbred) with lambs grazed Kentucky bluegrass-white clover (*Poa pratensis*-*Trifolium repens*) pastures from spring until autumn in a study of the effects on soils and plants of grazing cattle and sheep together and separately. The experiment was a randomized block design with three replications conducted during 1988-90 at Middleburg, Virginia. There were 6 cow-calf pairs per replication of cattle alone and 6 ewes with 11 lambs per replication of sheep alone. For the mixed-grazed pastures, there were 6 cows plus 6 ewes, each with their respective offspring, per replication. Grazing sheep alone increased soil bulk density (1.47 vs. 1.38 g cm⁻³), extractable soil P (140 vs. 80 kg ha⁻¹), and percentage bluegrass (36 vs. 25%), but decreased percentage white clover (3 vs. 10%) compared with grazing cattle alone. Grazing sheep and cattle together resulted in soil bulk density and extractable soil P of 1.45 g cm⁻³ and 115 kg ha⁻¹, respectively. Grazing sheep and cattle together resulted in a higher B horizon soil pH (6.7 vs. 6.4 and 6.5) and percentage organic matter (1.9 vs. 1.5 and 1.7) than where cattle or sheep grazed alone, respectively. Percentage bluegrass and white clover present in the sward where both animal species grazed was 37 and 5%, and there were fewer forbs (12%; $P < 0.08$) than when cattle or sheep grazed alone (18 and 15%, respectively). It is concluded that grazing both animal species together appeared to have beneficial effects on several botanical composition and soil characteristics compared with grazing cattle and sheep in separate pastures.

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347. Grazing system and stocking rate effects on the productivity, botanical composition and soil surface characteristics of alfalfa-grass pastures.

Popp, J. D.; McCaughey, W. P.; and Cohen, R. D. H.

Canadian Journal of Animal Science 77(4): 669-676. (1997)

NAL Call #: 41.8 C163; ISSN: 0008-3984

Descriptors: alfalfa grass pasture/ animal performance/ continuous grazing system/ rotational grazing system/ soil surface characteristics/ stocking rate/ weight gain

Abstract: A 4-yr experiment was conducted (1991 to 1994) near Brandon, MB, to determine the effects of grazing system (continuous and rotational) and stocking rate (light (1.1 steers ha⁻¹); heavy (2.2 steers ha⁻¹)) on the productivity, botanical composition and soil surface characteristics of an alfalfa (*Medicago sativa* L.;

approximately 70%), meadow brome (Bromus biebersteinii Roem and Schult.; 25%) and Russian wild ryegrass (Psathyrostachys juncea (Fisch.) Nevski; 5%) pasture. Grazing season length was shorter ($P < 0.05$) for cattle in continuously compared with rotationally stocked pastures in 1991, while in 1993 and 1994 it was shortest ($P < 0.05$) in heavily stocked continuously grazed pastures. Carrying capacity (steer days ha⁻¹) was greater ($P < 0.05$) in heavily stocked rotationally grazed pastures compared with other treatments in 1991, 1993 and 1994. In 1992, it was greater ($P < 0.05$) in heavy than light stocking rate treatments for both rotationally and continuously grazed pastures. Cattle usually gained more ($P < 0.05$) per day (kg d⁻¹) and during the season (kg hd⁻¹) at light than at heavy stocking rates, while total liveweight production (kg ha⁻¹) was greater ($P < 0.05$) at heavy than at light stocking rates. Forage production and disappearance did not differ ($P > 0.05$) within grazing systems and stocking rates from 1991 to 1993, but in 1994, production and disappearance were greater ($P < 0.05$) at heavy than at light stocking rates. Mean seasonal herbage mass available and carry-over were greater ($P < 0.05$) in lightly stocked pastures than heavily stocked pastures from 1991 to 1994. After the first year of grazing, the proportion of alfalfa increased ($P < 0.05$), while grasses declined ($P < 0.05$) within all grazing treatments. In subsequent years, a trend was observed, where alfalfa declined and grasses increased in all pastures, except those stocked heavily and grazed continuously, which by 1994 had the greatest ($P < 0.05$) percentage of alfalfa. As years progressed, increases ($P < 0.05$) in basal cover concurrent with declines in bare ground were recorded on all grazing treatments, while litter cover often did not differ ($P > 0.05$) within either grazing system or stocking rate, except in 1992, when basal cover was lowest ($P < 0.05$), while litter cover was greatest ($P < 0.05$) on lightly stocked continuously grazed pastures compared with other treatments. Stocking rates were a key factor to optimizing individual animal performance and/or gain per hectare on alfalfa grass pastures, however differences in the effect of continuous and rotational stocking on pasture productivity were minimal.

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348. Herbage and animal production responses to fertilizer nitrogen in perennial ryegrass swards: Continuous grazing and cutting.

Deenen, P. J. A. G. and Lantinga, E. A.

Netherlands Journal of Agricultural Science 41(3): 179-203. (1993)

NAL Call #: 12 N3892; ISSN: 0028-2928

Descriptors: tiller production

Abstract: The effects of fertilizer nitrogen (N) application on herbage intake and animal performance under a continuous grazing management with dairy cows, and on herbage accumulation under a weekly and an approximately 4-weekly cutting regime have been studied in the period 1986-1988 in reseeded perennial ryegrass on a silty loam soil in Oostelijk Flevoland. Annual fertilizer rates of N varied from 250 to 700 kg ha⁻¹ under grazing and from 0 to 700 kg ha⁻¹ under cutting. At an assumed marginal profitability of 7.5 kVEM per kg N applied the optimum N application rate was on average 511 and 308 kg ha⁻¹ yr⁻¹ for 4-weekly cutting and continuous grazing, respectively (1 kVEM = 6.9 MJ Net Energy for lactation). However, especially under grazing, there was a great variation in response to N

between years which could be related to soil N availability, length of the growing season and sward quality.

Throughout the experimental period the mean tiller density in the grazed swards was hardly affected by the level of N application. However, there were temporary differences in openness of the sward which increased with the level of N application, leading to a loss of productivity as a result of impeded N uptake. Herbage N was poorly converted into animal products. The average efficiency of use of ingested N at a fertilizer level of 250 kg N ha⁻¹ yr⁻¹ was 23%. Higher rates of fertilizer N effected a slight decrease in fertilizer N use efficiency (19% at 700 kg N ha⁻¹ yr⁻¹) but a steep rise in the calculated amount of N excreted per ha.

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349. Herbage and animal production responses to fertilizer nitrogen in perennial ryegrass swards: Rotational grazing and cutting.

Lantinga, E. A.; Deenen, P. J. A. G.; and Van Keulen, H. *Netherlands Journal of Agricultural Science* 47(3-4): 243-261. (1999)

NAL Call #: 12 N3892; ISSN: 0028-2928

Descriptors: forage cutting; harvesting method/ rotational grazing; miscellaneous method

Abstract: The yield response of grass swards to fertilizer nitrogen (N) differs under cutting and grazing, as grazing cattle exert positive and negative effects on pasture production, with varying negative effects on different soil types. Nevertheless, current N fertilization recommendations in the Netherlands are based mainly on economic cost-benefit analyses of long-term cutting trials in small plots. To contribute to formulation of improved N fertilizer recommendations for grassland, experiments were carried out on two soil types and under different management regimes. The effect of fertilizer N application on grassland production and sward quality in perennial ryegrass swards was studied during a number of consecutive years under both rotational grazing and 4-weekly cutting. Experiment 1 was performed with dairy cows on a loam soil at 250 and 550 kg fertilizer N ha⁻¹ yr⁻¹. Experiment 2 was performed with beef cattle on a sand soil and fertilizer rates varying from 250 to 700 kg N ha⁻¹ yr⁻¹ under grazing and from 0 to 700 kg N ha⁻¹ yr⁻¹ under cutting. The results indicate that on loam, N had no effect on sward quality. In the second experimental year, total herbage yield under grazing was almost 10% higher than under cutting at 250 kg N ha⁻¹ yr⁻¹ due to recycling of N, whereas at 550 kg N ha⁻¹ yr⁻¹ the yield under grazing and cutting was the same. On sand, the economically optimum fertilizer application rate was on average 430 kg N ha⁻¹ yr⁻¹ for 4-weekly cutting. Under grazing and at whole system level (integrated grazing and mowing for silage), the optimum rate was below 250 kg N ha⁻¹ yr⁻¹. Under grazing on the sand soil, N aggravated sward deterioration due to treading, poaching and especially urine scorching. This was reflected in an increased absence frequency of rooted perennial ryegrass tillers in quadrats with an area of 1 dm² at increasing fertilizer N application rates. It is concluded that current fertilizer N recommendations for grassland can be further refined by taking into account the positive and negative effects of grazing cattle, in dependence of soil type and level of N supply.

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350. Herbage intake and N excretion by sheep grazing monocultures or a mixture of grass and white clover.

Orr, R. J.; Penning, P. D.; Parsons, A. J.; and Champion, R. A.

Grass and Forage Science 50(1): 31-40. (1995)

NAL Call #: 60.19 B773; ISSN: 0142-5242

Descriptors: fecal nitrogen/ grass swards/ management systems/ nitrogen fertilizer/ organic matter/ urinary nitrogen
Abstract: In 1988 and 1989, swards of grass (G0), white clover (C0) and grass/white clover (GC0) receiving no N fertilizer, and a grass sward supplied with 420 kg N ha⁻¹ (G420), were grazed by non-lactating sheep to maintain a sward surface height of 6 cm. Herbage organic matter (OM) intakes averaged between 1200 and 1700 g OM ewe⁻¹ d⁻¹. For treatments G0, C0, GC0 and G420 respectively, the ewes' liveweight gain was 102, 112, 100 and 110 g d⁻¹ and changes in body condition scores were +0.28, +0.52, +0.36 and +0.44 units season⁻¹. However, the effect of treatment was not significant for either variable. There were similar levels of output of faecal N ewe⁻¹ but significantly more urinary N ewe⁻¹ was excreted on treatments C0 and G420, where the concentrations of N in herbage laminae were also higher. For example, in 1989, total daily N excreted was 39.7, 64.4, 44.0 and 63.3 g N ewe⁻¹ for G0, C0, GC0 and G420 respectively. Taking into account the mean daily stocking rates, which were 19.4, 26.6, 27.2 and 36.5 ewe ha⁻¹, the total faeces and urine returns over the season were 161, 358, 249 and 484 kg N ha⁻¹ for each treatment respectively. The herbage OM intakes ewes⁻¹ d⁻¹ measured in September and October were similar for C0 and G420, and so the intake of herbage OM ha⁻¹ d⁻¹ was related to stocking rate, i. e. the estimated herbage intake ha⁻¹ over the growing season for the white clover monoculture was 73% of that for N-fertilized grass. Excretal nitrogen returns to the pasture from grazed mono-cultures of Clover were high, and similar to those from a grass sward receiving 420 kg fertilizer N ha⁻¹. Consequently potential losses of N to the environment are high under these management systems.

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351. How do severity and frequency of grazing affect sward characteristics and the choices of sheep during the grazing season?

Garcia, F.; Carrere, P.; Soussana, J. F.; and Baumont, R.

Grass and Forage Science 58(2): 138-150. (June 2003)

NAL Call #: 60.19 B773; ISSN: 0142-5242

Descriptors: sheep/ grazing intensity/ rotational grazing/ foraging/ feeding preferences/ forage quality/ seasonal variation/ sward/ maturity stage/ regrowth/ height/ biomass/ digestibility/ neutral detergent fiber/ protein content/ crude protein/ grazing management/ pasture management/ France

Abstract: The effect of grazing frequency and severity on sward characteristics and preferences by sheep was investigated from April to September. Two levels of grazing severity were imposed by varying the numbers of ewes grazing 200 m² plots for 24 h: four (S, severe) or two (L, lax) ewes. Grazing frequency was either 1 d week⁻¹ (F, frequent) or 1 d every 2 weeks (I, infrequent). By combining frequency and severity, four treatments were obtained: SF, LF, SI and LI. The six binary combinations (SF/LF, SF/SI, SF/LI, LF/SI, LF/LI and SI/LI) were studied in preference tests. Treatments LF, SI and LI were characterized by a high sward surface height, biomass and amount of

reproductive green tissues relative to treatment SF.

Herbage quality was not different between the grazing treatments between April and July. In September, after a 6-week period of regrowth, herbage quality was significantly higher for the SF treatment than the other treatments. The sheep preferred the swards grazed at a low frequency between April and July, and then changed their preference in favour of the sward with higher quality herbage (treatment SF). The relative abundance of green laminae and the relative digestibility of the swards helped to explain the preferences observed. For a low grazing pressure at the spatio-temporal scale studied, sheep should graze swards at a relatively low frequency but at a high severity of grazing rather than the reverse.

This citation is from AGRICOLA.

352. Impact of beef cattle grazing systems on treading damage and forage supply.

Sheath, G. W. and Boom, C. J.

Proceedings of the New Zealand Grassland Association 59: 87-92. (1997)

NAL Call #: 60.19 N48; ISSN: 0369-3902

Descriptors: treading/ grasslands/ permanent grasslands/ grazing/ controlled grazing/ guidelines/ steers/ liveweight/ grassland management/ environmental degradation/ soil/ beef production

Abstract: Levels of treading damage (poaching) were measured for a range of cattle feeding regimes and grazing managements which were compared during winter and spring in New Zealand. The paddock- and systems-based results provided a context within which component research on soil and plants may be interpreted. Soil surface damage was higher in farmlets with heavier cattle (390 kg vs. 200 kg steers) and on paddocks where feeding was restricted through the use of a slow rotation (100-120 days vs. 35-45 days). Where cattle grazed under wet conditions, with a pre- and post-grazing herbage mass of 2400 and 650 kg DM/ha respectively, damage levels reached 60-70% of the soil surface. Under these conditions, 300-350 kg DM/ha of initial forage on offer was pushed onto or into the surface soil; and pasture growth rates during early-mid spring were reduced by 10 kg DM/ha each day. In practice the objective of grazing plans and management should be to minimize these negative impacts within the constraints of the required feeding regimes. Recommendations are made for the alignment of stock class and enterprise with land capabilities and the feed allocation processes of a winter rotation.

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353. The impact of grazing animals on N-2 fixation in legume-based pastures and management options for improvement.

Menneer, John C.; Ledgard, Stewart; Mclay, Chris; and Silvester, Warwick

Advances in Agronomy 83: 181-241. (2004)

NAL Call #: 30 AD9; ISSN: 0065-2113

Descriptors: defoliation/ farm management/ nitrogen fixation/ excretion/ farming industry/ legume production/ treading/ legume based pasture/ edaphic feature

Abstract: Recent moves toward greater intensification of legume-based pasture systems have raised concerns regarding the impact of grazing animals on legume production and symbiotic N-2 fixation. This review uses recent research to further our understanding of grazing

animal impacts (via treading, defoliation, and excretion) on the N-2, fixing performance of legume-based pastures. Options for improving farm management to minimise adverse animal impacts and improve legume performance and N-2 fixation are also covered with emphasis on white clover (*Trifolium repens*). In general, effects on N-2 fixation involve both soil and plant processes and are mediated by large-scale changes in legume morphology and physiology and/or by influencing the legume-grass competitive interaction. For example, defoliation of legumes by grazing animals causes a marked decrease in nitrogenase activity within several hours and recovery takes anywhere from 5 to 21 days depending on the severity of defoliation. Similarly, new research has shown that animal excreta can have prolonged effects on decreasing N-2 fixation (e.g., urine decreases N, fixation by up to 70% with effects lasting for up to 286 days). The magnitude of animal impacts from treading, defoliation, and excretion, individually or as a whole varies greatly and are closely tied to farm management practices and the edaphic features of the entire farm system. Key farm/pasture management strategies identified to optimise N-2 fixation in legume-based pastures include: selecting suitable legume and grass cultivars, restricting grazing intervals, altering seasonal grazing intensity, use of mixed animal types, strategic conservation cuts, and management to reduce soil physical damage. Future research should include the use of validated dynamic models to integrate treading, defoliation, and excretion and predict effects on legume productivity and N, fixation. Such an approach provides the best opportunity to determine the overall response of the legume system and define key requirements for management strategies. (C) 2004 Elsevier Inc.
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354. Impact of phosphorus application and sheep grazing on the botanical composition of sown pasture and naturalised, native grass pasture.

Hill, J. O.; Simpson, R. J.; Moore, A. D.; Graham, P.; and Chapman, D. F.
Australian Journal of Agricultural Research 55(12): 1213-1225. (2004)
NAL Call #: 23 Au783; ISSN: 0004-9409
Descriptors: grazing pressure/ pasture production/ stocking rate
Abstract: Botanical composition (basal cover) was measured in 4 replicated pasture treatments based on *Phalaris aquatica* and *Trifolium subterraneum* at Hall, ACT (unfertilised with low and high stocking rate; fertilised with low and high stocking rate) and in 2 unreplicated pasture treatments based on native perennial grasses (*Austrodanthonia* spp. and *Microlaena stipoides*) and *T. subterraneum* at Bookham, NSW (unfertilised and low stocking rate; fertilised and high stocking rate). Current economic pressures are encouraging graziers to increase their use of phosphorus (P) fertiliser and to adopt higher stocking rates. The objective of the research was to determine the changes in botanical composition that may result from these changes in grazing systems management. At Hall, annual species differed in their responses to P fertility. Notably, basal cover of *Bromus* spp. increased significantly with P application, whereas *Vulpia* spp. decreased significantly. Basal cover of *T. subterraneum* also increased significantly with P application when stocking rate was high, but was reduced by P application if

stocking rate was low. Basal cover of perennial grasses (*P. aquatica* and *Holcus lanatus*) was significantly higher at low stocking rate when P was applied. The botanical composition of high stocking rate treatments was relatively stable over time, which contrasted with less stable composition at low stocking rate. At Bookham, fertilised pasture in unreplicated paddocks appeared to have a higher basal cover of productive annual species (i.e. *Bromus* spp. and *T. subterraneum*), but native perennial grasses appeared to have lower basal cover in comparison with the unfertilised area. These results indicated that in some cases, the influence of P fertiliser and high stocking rates on botanical composition was favourable (i.e. increased basal cover of *P. aquatica* and *T. subterraneum*) and in others it could be detrimental (i.e. lower basal cover of native perennial grasses).

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355. Impacts of grazing systems on soil compaction and pasture production in Alberta.

Donkor, N. T.; Gedir, J. V.; Hudson, R. J.; Bork, E. W.; Chanasyk, D. S.; and Naeth, M. A.
Canadian Journal of Soil Science 82(1): 1-8. (2002)
NAL Call #: 56.8 C162; ISSN: 0008-4271
Descriptors: bulk density/ *Cervus elaphus*/ moisture content/ pasture production/ penetration resistance
Abstract: Livestock trampling impacts have been assessed in many Alberta grassland ecosystems, but the impacts of animal trampling on Aspen Boreal ecosystems have not been documented. This study compared the effects of high intensity [4.16 animal unit month per ha (AUM) ha⁻¹] short-duration grazing (SDG) versus moderate intensity (2.08 AUM ha⁻¹) continuous grazing (CG) by wapiti (*Cervus elaphus canadensis*) on soil compaction as measured by bulk density at field moist condition (Dbf) and penetration resistance (PR). Herbage phytomass was also measured on grazed pastures and compared to an ungrazed control (UNG). The study was conducted at Edmonton, Alberta, on a Dark Gray Luvisolic soil of loam texture. Sampling was conducted in the spring and fall of 1997 and 1998. Soil cores were collected at 2.5-cm intervals to a depth of 15-cm for measurement of bulk density (Dbf) and moisture content. Penetration resistance to 15 cm at 2.5-cm intervals was measured with a hand-pushed cone penetrometer. The Dbf and PR of the top 10-cm of soil were significantly ($P < 0.05$) greater by 15 and 17% under SDG than CG, respectively, by wapiti. Generally, Dbf in both grazing treatments decreased over winter at the 0-7.5 cm and 12.5-15 cm depths, suggesting that freeze-thaw cycles over the winter alleviated compaction. Soil water content under SDG was significantly ($P < 0.05$) lower than CG. Total standing crop and fallen litter were significantly ($P < 0.05$) greater in CG treatment than the SDG. The SDG treatment had significantly ($P < 0.05$) less pasture herbage than CG areas in the spring (16%) and fall (26%) of 1997, and in the spring (22%) and fall (24%) of 1998, respectively. The SDG did not show any advantage over CG in improving soil physical characteristics and herbage production.
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356. Improving utilization of warm-season pastures through grazing management.

Rouquette, F. M.

Beef Cattle Science Handbook 23: 274-278. (1989)

NAL Call #: SF207.B4; ISSN: 0522-5892

Descriptors: pastures/ grazing/ range management/ cattle/ annuals/ perennials

This citation is from AGRICOLA.

357. Influence of BMPs on cattle position preference.

Agouridis, C. T.; Edwards, D. R.; Vanzant, E.; Workman, S. R.; Bicudo, J. R.; Koosra, B. K.; Taraba, J. L.; and Gates, R. S.

In: 2004 ASAE Annual International Meeting. (Held 1 Aug 2004-4 Aug 2004 at Ottawa, Ontario, Canada.);

pp. 2569-2596; 2004.

NAL Call #: S671.3 .A54

<http://www.bae.uky.edu/WQ406/publications/ASAE042182.pdf>

Descriptors: BMP/ cattle/ GPS/ grazing/ streams

Abstract: The beef industry is an important component of Kentucky's agriculture accounting for approximately 15% of the state's agricultural sales in 2000. Dairy also plays a prominent role in Kentucky's agriculture (state rank of 18th). The state's significant cattle production occurs primarily on small to mid-sized farms averaging between 25 and 40 head of cattle per operation. Considering this upward trend in cattle production along with Kentucky's 140,000 km of rivers and streams, rolling pastures and karst geology, the potential for damage to riparian ecosystems from uncontrolled livestock access is high. The objective of this project was to determine the influence of alternate management strategies such as off-stream water, fencing, shade (permanent and movable), and pasture improvements on cattle behavior in grazed pastures of the humid region of the U.S. The project site, located on the University of Kentucky's Animal Research Center, consisted of two replications of three treatments: control, selected BMPs with free access to the stream, and selected BMPs with limited access to the stream. Cattle placed on the research pastures were fitted with GPS collars to track their positions. The use of GPS collars for tracking animal movements and behaviors eliminates errors often introduced in human observations. GPS collar data was collected at five minute intervals for seven sampling events over a two year period. Results indicated that the BMP systems (i.e. treatments) did not affect cattle position preference, and as such, these BMP systems did not decrease the amount of time cattle spent along the streambanks. However, significant time effects were noted the cooling pasture feature trees as cattle sought relief from the heat and humidity. Increased cattle presence along the streambank during the daytime period was linked to longer day light hours, but the impractical nature of the model indicated that additional independent variables were required. For the nighttime data set, the significant seasonal variable was solar radiation, as decreases in solar radiation resulted in the model predicting that cattle would tend to avoid the pasture feature trees. The majority of non-zero solar radiation values, while relatively small in comparison to the daytime values, were in the periods dividing daytime and nighttime (i.e. dawn and dusk). Thus, the primary driving factor with regards to cattle position preference appeared to be a desire to avoid trees, a pasture feature often associated with loafing, possibly in

favor of grazing. While the results of this study indicated that no significant treatment effects were present, the significant time effects suggest that the strategic development of 1) cooling features such as shade, wading ponds or water misters and 2) areas of high forage quality and quantity may influence cattle position preference.

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358. Influence of burning and grazing on soil nutrient properties and tree growth on a Georgia Coastal Plain site after 40 years.

McKee, W. H. and Lewis, C. E.

In: Proceedings of the Second Biennial Southern Silvicultural Research Conference. (Held 4 Nov 1982-5 Nov 1982 at Atlanta, Georgia.) Jones, Earle P. (eds.)

Asheville, N.C.: U.S. Dept. of Agriculture, Forest Service, Southeastern Forest Experiment Station; pp. 79-86; 1983.

NAL Call #: aSD433.A53 no.24

Descriptors: soil chemistry/ forestry practices/ controlled burning/ grazing/ Animal husbandry/ soil/ ecology/ conifers

Abstract: Soil analysis of a study area in the Coastal Plain of Georgia indicates that 40 years of grazing and prescribed burning have had no adverse effect on concentrations of total nitrogen, available phosphorus, exchangeable bases, or organic matter in mineral soil. Burning alone reduced organic matter and nutrients in the forest floor and tended to increase them in the surface 6 inches of mineral soil. Grazing did not affect soil nutrient properties nor did grazing interact significantly with prescribed burning. Results indicate that well-managed grazing in conjunction with prescribed burning has no adverse effects on site quality for longleaf-slash pine-wiregrass sites.

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359. Influence of fertilizer and grazing management on North Island moist hill country: Herbage accumulation.

Lambert, M. G.; Clark, D. A.; Grant, D. A.; Costall, D. A.; and Fletcher, R. H.

New Zealand Journal of Agricultural Research 26(1): 95-108. (1983)

NAL Call #: 23 N4892; ISSN: 0028-8233

Descriptors: cattle/ sheep/ grass/ growth/ super phosphate/ rainfall

Abstract: A grazing trial was conducted on 99 ha of moist, low-fertility hill country near Woodville, New Zealand, during 1975-1981. Treatments were low fertilizer (125 kg/ha per annum superphosphate (9% P, 10% S)) and high fertilizer (average 630 kg/ha per annum superphosphate, plus lime) application rates and 3 grazing managements, rotational grazing by sheep and by cattle, and set-stocking by sheep. Some replication was included in the design, 10 self-contained farmlets being used. Over a 6-yr period stocking rate was increased from 6.5-12.0 and from 8.8-16.1 s.u. [stocking unit]/ha on low and high fertilizer farmlets, respectively. Over this period, and also in the 3 previous yr, herbage accumulation was measured, using grazing exclosures and a trim technique. Nov.-April rainfall had a large effect on herbage accumulation rate (HAR), causing year-to-year variation of 23% about mean annual herbage accumulation. The high fertilizer treatment grew 9% more herbage than low fertilizer in the 1st yr after differential application, and 21-50% more in the last 5 yr. The main effect of the grazing management treatments was that annual herbage accumulation in the rotationally grazed

cattle pastures was depressed 12% compared with the sheep-grazed pastures, presumed to be a result of severe treading damage. Differences in HAR between rotationally grazed and set-stocked sheep pastures were not detected. The trim technique used probably overestimated HAR of set-stocked pastures during the reproductive phase of grass growth. Measurements of herbage mass suggested that rotationally grazed sheep pastures grew about 20% more herbage over spring-early summer than set-stocked sheep pastures, or about 12% more on an annual basis. Slope of measurement site, on a within-hillside microtopographic basis, had a strong negative relationship with HAR. For the linear part (15-27 degree slope) of the cubic function used, annual herbage accumulation decreased about 370 kg DM [dry matter]/ha per annum per degree slope increase. Aspect influences on HAR were less marked than those of slope. Northwest and east aspect classes showed similar annual accumulation and pattern of seasonal accumulation. Southwest aspects had higher HAR than northwest aspects for 2-4 mo. in Jan.-April and lower (20-40%) HAR for most of the remainder of the year. Seasonal spread of annual herbage accumulation was also influenced by grazing management, but was not influenced by fertilizer treatment or slope.

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360. Influence of fertilizer and grazing management on North Island moist hill country: Pasture botanical composition.

Lambert, M. G.; Clark, D. A.; Grant, D. A.; and Costall, D. A.

New Zealand Journal of Agricultural Research 29(1): 1-10. (1986)

NAL Call #: 23 N4892; ISSN: 0028-8233

Descriptors: Lolium perenne/ Agrostis capillaris/ Anthoxanthum odoratum/ weeds/ legumes/ sheep/ cattle/ lime/ superphosphate/ soil/ nitrogen availability/ slope aspect

Abstract: A grazing trial was conducted on 99 ha of steep, low fertility hill country in southern Hawke's Bay, during 1975-81. There were 2 fertiliser treatments: low (LF) and high (HF) superphosphate application (plus lime on HF), and 3 grazing managements .sbd. rotational grazing by sheep (RGS) or cattle (RGC), and set stocking by sheep (SSS). As part of a larger measurement programme botanical composition of pastures was monitored over the 6-year period. HF pastures had a greater content of ryegrass (*Lolium perenne* L.) and legumes than LF pastures and a small content of low fertility tolerant (LFT) grasses (e.g., browntop, *Agrostis capillaris* L.; sweet vernal, *Anthoxanthum odoratum* L.) and weed species. Ryegrass content of pasture under the 3 managements was in the order RGC > RGS > SSS. RGC pastures had a smaller content of LFT grasses, and a greater content of legumes than sheep-grazed pastures. SSS pastures were more weedy than those rotationally grazed. Slope and aspect of measurement site also influenced botanical composition. As the trial proceeded, legume content rose then fell in all treatments. The decline was attributed to increased competitiveness of associated grasses as symbiotically fixed N was cycled and soil N availability increased. This phenomenon places limitations on the use of fertiliser P to promote and maintain legume dominance.

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361. Influence of fertilizer and grazing management on North Island moist hill country: Pasture species abundance.

Lambert, M. G.; Clark, D. A.; Grant, D. A.; Costall, D. A.; and Gray, Y. S.

New Zealand Journal of Agricultural Research 29(1): 23-32. (1986)

NAL Call #: 23 N4892; ISSN: 0028-8233

Descriptors: white clover/ moss productivity/ sheep/ cattle/ lime/ superphosphate/ plant unit density/ thinning law/ herbage accumulation/ treading damage/ aspect slope
Abstract: A grazing trial was conducted on steep, moist, low fertility hill country in the southern Hawke's Bay during 1975-81. There were 2 fertiliser treatments: low (LF) and high (HF) superphosphate application (plus lime on HF), and 3 grazing managements-rotational grazing by sheep (RGS) or cattle (RGC), and set stocking by sheep (SSS). Annual measurements of pasture species abundance (plant unit density and size) were made in each year during 1976-81. Density of plant units was greater in HF than LF (27.8 cf. 25.3 times. 103/m²) pastures and, for the 3 different grazing managements, SSS > RGS > RGC (30.1, 25.2, and 17.1 times. 103/m² respectively). In addition, plant density decreased with increasing slope of measurement site, and was influenced by aspect. In most instances, lower plant unit density was compensated for by increases in plant unit size, in accordance with the '3/2 thinning law'. This did not occur under RGC because of severe treading damage, and the depression in herbage accumulation rate in these pastures was attributed to this lack of complete compensation. Density of species categories within the total pasture was closely related to botanical composition results presented elsewhere. Moss incidence in pastures was decreased by HF application and RGC management. Several white clover stolon characteristics were measured, of which manipulation of stolon length per unit area of pasture was thought most likely to have effects on white clover productivity.

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362. Influence of fertilizer and grazing management on North Island moist hill country: Performance of introduced and resident legumes.

Lambert, M. G.; Clark, D. A.; Grant, D. A.; and Costall, D. A.

New Zealand Journal of Agricultural Research 29(1): 11-22. (1986)

NAL Call #: 23 N4892; ISSN: 0028-8233

Descriptors: Trifolium repens/ Trifolium dubium/ Trifolium pratense/ Trifolium subterraneum/ Lotus pedunculatus/ sheep/ cattle/ superphosphate/ lime/ herbage accumulation/ slope aspect

Abstract: A grazing trial was conducted on 99 ha of steep, low fertility hill country in southern Hawke's Bay, during 1975-81. There were 2 fertiliser treatments: low (LF) and high (HF) superphosphate application (plus lime on HF), and 3 grazing managements-rotational grazing by sheep (RGS) or cattle (RGC), and set stocking by sheep (SSS). A white clover (*Trifolium repens* L.) similar to Kent wild white, and annual suckling clover (*T. dubium* Sibth.) were already present in the pastures in small amounts. 'Grasslands Huia' white clover, 'Grasslands Turoa' red clover (*T. pratense* L.), 'Grasslands Maku' lotus (*Lotus pedunculatus* Cav.), and Woogenellup subterranean clover (*T. subterraneum* L.) were oversown into the pasture in 1974. Huia, Turoa, and Grasslands 4703 lotus were oversown again in 1977.

Woogenellup subterranean clover was found to be unsuited to the environment. Lotus plants established, but contributed little to total herbage accumulation. Red clover was most important in RGC pastures. Its contribution was short-lived in sheep-grazed pastures, but was significant in the year after oversowing where fertiliser application history was short. Suckling clover produced a significant amount of herbage on steep NW sites during spring. Huia white clover was the most productive of the oversown legumes. However, the resident white clover was more production than Huia in sheep-grazed pastures but not in RGC pastures. Huia was more responsive to HF (compared with LF) application in RGC than in sheep-grazed pastures-the converse applied for the resident genotype.
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363. The influence of grazing management on weed invasion of *Lolium perenne* pastures under subtropical conditions in South Africa.

Mckenzie, F. R.

Tropical Grasslands 31(1): 24-30. (1997)

NAL Call #: SB197.A1T7; ISSN: 0049-4763

Descriptors: agronomy/ climatology/ ecology/ grazing management/ subtropical condition/ weed invasion

Abstract: *Lolium perenne* (perennial ryegrass) exhibits poor persistence in subtropical environments and this is often characterized by weed invasion. Grazing management may enhance the potential of perennial ryegrass to successfully outcompete weeds. Perennial ryegrass pastures were subjected to various grazing frequencies and intensities and the level of weed invasion monitored over 2 years. The proportional contribution of weed species tillers to total sward tillers was higher during late summer and autumn (4-20%), than winter (2-10%) or spring (1-4%). Pastures infrequently grazed incurred lower levels of weed invasion (56-256 weed tillers/m² in Year 1, and 105-623 tillers/m² in Year 2) than those frequently grazed (105-625 tillers/m² in Year 1, and 256-2489 tillers/m² in Year 2). Grazing intensity, however, did not influence the level of weed invasion. It is concluded that the invasion of perennial ryegrass pastures by weed species, particularly during the summer, can be minimized by sufficiently long grazing intervals (gt 21 days).

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364. Influence of intensive rotational grazing on bank erosion, fish habitat quality, and fish communities in southwestern Wisconsin trout streams.

Lyons, J.; Weigel, B. M.; Paine, L. K.; and Undersander, D. J.

Journal of Soil and Water Conservation 55(3): 271-276. (2000)

NAL Call #: 56.8 J822; ISSN: 0022-4561

Descriptors: rotational grazing/ stream erosion/ streams/ habitats/ water quality/ *Oncorhynchus mykiss*/ depth/ sediments/ width/ Wisconsin

This citation is from AGRICOLA.

365. Influence of seedbed preparation and grazing management on seed production of four tropical legumes in the establishment year.

Mcdonald, C. K.; Jones, R. M.; and Cook, S. J.

Tropical Grasslands 37(2): 111-118. (2003)

NAL Call #: SB197.A1T7; ISSN: 0049-4763

Descriptors: grazing management: applied and field

techniques/ seedbed preparation: applied and field techniques/ seed production/ soil seed bank: pasture legume persistence

Abstract: Two studies in subcoastal south-east Queensland examined factors affecting the seed production of legumes in the first 15 months after being sown into native speargrass (*Heteropogon contortus*) pasture. Both experiments were sown to a mixture of legumes: roundleaf cassia (*Chamaecrista rotundifolia*) cv. Wynn, siratro (*Macroptilium atropurpureum*) cv. Siratro, shrubby stylo (*Stylosanthes scabra*) cv. Seca and fine-stem stylo (*S. hippocampoides*). The first experiment compared the effectiveness of sowing into 5 different seed-beds: complete cultivation, 3 methods of minimum disturbance, and broadcasting seed into undisturbed pasture. There were 2 sowings a year, at the start and in the middle of the growing season, in each of 5 years. Four of the 5 years experienced well below average rainfall. The only species that consistently produced seed in the year of sowing was Wynn cassia, and then only in the fully cultivated seedbed where seed reserves in sowings made early in the growing season averaged about 3000 seeds/m². Seed production in treatments with minimum or zero disturbance was negligible. The second experiment examined the effect of grazing on the seed production of legumes oversown using a minimum-cultivation technique where legumes were sown in a shallow groove in a herbicide-treated strip in an otherwise undisturbed native pasture. Grazing, at 0.65 head/ha, was imposed immediately after sowing or after 3, 8 or 15 months. Two other treatments examined the effect of a high stocking rate (1.2 head/ha) imposed immediately after sowing and of complete exclusion from stock. As in Experiment 1, Wynn cassia produced by far the most seed, followed by fine-stem stylo. Seca and siratro produced very little seed. Cassia produced seed in all treatments, with seed reserves 18 months after sowing ranging from 250 seeds/m² at the high stocking rate to 770 seeds/m² in the absence of grazing. The implications of the results for successful oversowing of legumes into native pasture are discussed.

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366. Influences of mowing and grazing on plant species composition in calcareous grassland.

Schlapfer, M.; Zoller, H.; and Korner, C.

Botanica Helvetica 108(1): 57-67. (1998)

NAL Call #: 451 Sch9; ISSN: 0253-1453

Descriptors: grasslands/ grazing/ cutting/ meadows/ pastures/ plant communities/ species diversity/ trampling/ botanical composition/ management/ grassland management/ surveys/ calcareous grasslands

Abstract: In the Jura mountains in north-western Switzerland extensive management has created some of the species-richest plant communities of central Europe: calcareous grasslands of the *Teucrio-Mesobrometum* type. Evidence from a survey on the influence of contrasting management practices on species diversity and species abundance in these grasslands was summarized. Based on phyto-sociological areas (each ca. 0.1 ha) of 72 sites, 46 of which were regularly grazed by cattle and 26 were cut, it is shown that pastures tend to be richer in species (on average 59 versus 46 species in meadows). 90% of all 137 species recorded occurred in both types of grassland. The higher species diversity in pastures is explained by greater spatial heterogeneity due to micropatterns of grazing,

trampling and dung deposition. It is concluded that only a minor set of species can be considered to be management-specific while the majority of species is equally abundant in both types of grassland. Hence, responses of the vegetation to a change in management are likely to cause only small alterations in community structure, at least for periods of several years to a few decades.

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367. Intensive cattle grazing of oxeye daisy (*Chrysanthemum leucanthemum*).

Olson, Bret E.; Wallander, Roseann T.; and Fay, Peter K. *Weed Technology* 11(1): 176-181. (1997)

NAL Call #: SB610.W39; ISSN: 0890-037X

Descriptors: agronomy/ grazing effects/ herbivore/ oxeye daisy/ pest management/ soil seedbank size/ weed control
Abstract: Oxeye daisy has invaded seeded pastures, roadsides, and mountain rangelands in western Montana. In 1990, we began a study to: (1) determine use of oxeye daisy and introduced perennial grasses by cattle; (2) determine effects of intensive cattle grazing on the number of oxeye daisy seeds in the soil; and (3) assess effects of intensive grazing on year-to-year changes in oxeye daisy and associated perennial grasses. Cattle grazed oxeye daisy but much of their impact was from trampling or removing stems. The number of oxeye daisy seeds in the soil seedbank was lower in 1992 than in 1990 in grazed areas, whereas the number was higher in ungrazed areas. Two years of intensive grazing reduced densities of oxeye daisy seedlings and rosettes, but did not change densities of mature stems. Intensive grazing had minimal impact on the introduced grasses.

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368. "Late control" spring grazing management of perennial ryegrass swards: Effect on sward structure and botanical composition.

Matthew, C.; Hernandez Garay, A.; and Hodgson, J. *Agronomy New Zealand* 30: 121-127. (2000);

ISSN: 0110-6589

Descriptors: botanical composition/ grass sward/ grassland management/ grasslands/ grazing/ tillers

Abstract: A series of experiments was conducted at Massey University, New Zealand between 1985 and 1997 to investigate the increased herbage accumulation rate under laxer spring grazing. This approach to spring grazing management was popularly termed 'late control'. One of the experiments is described in detail and previously unpublished point quadrat data on sward botanical composition are presented. The objective of this experiment was to study the influence of spring grazing management on sward structure, and on herbage production, in perennial ryegrass (*Lolium perenne*) dominant swards with and without white clover (*Trifolium repens*). In one grazing treatment, swards were grazed by sheep to 30-50 mm every 14 days from 15 September to late March (Early Control-EC). In two other grazing treatments, swards were grazed every 21 days to 70-90 mm for periods of 6 weeks (short release-SR) or 12 weeks (long release-LR) before returning to 30-50 mm grazing as in EC from 8 December. The three grazing treatments were applied to plots with or without white clover (N applied to replace clover fixation) making six treatments in all, arranged in a randomized block design with three replicates. Changes in sward structure were reflected in herbage production before

(spring) and after 8 December (summer-autumn). During spring, herbage mass and herbage production on the release treatments was increased as a consequence of an increase in tiller weight. During the summer, herbage production was increased in release treatments, and this was attributable primarily to increased tiller production. Release treatments decreased Poa content of swards, especially on plots without clover. A significant increase in ryegrass stem occurrence was detected in only one of the four release treatments, and there was no indication of clover suppression.

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369. Leaf age structure and canopy photosynthesis in rotationally and continuously grazed swards.

Parsons, A. J.; Johnson, I. R.; and Williams, J. H. H. *Grass and Forage Science* 43(1): 1-14. (1988)

NAL Call #: 60.19 B773; ISSN: 0142-5242

Descriptors: ryegrass/ sheep/ regrowth yield/ mathematical model

Abstract: The leaf age structure of ryegrass canopies and its role in canopy photosynthesis were compared under continuous and rotational grazing by sheep. Under continuous grazing, an increase in the intensity of grazing increased the proportion (by leaf area) of young leaves in the sward. A mechanistic mathematical model was used to demonstrate how this may have arisen, even though it would largely have been the young leaves that were eaten. However, the observations do not confirm the hypothesis that continuously grazed swards have a characteristically greater proportion of young leaves, and so a greater photosynthetic potential, than rotationally grazed ones. The proportion of young leaves increased during regrowth following severe rotational grazing (residual LAI < 0.5) and the photosynthetic potential of the canopy became greater than under continuous grazing. A model of canopy photosynthesis was used to demonstrate that the observed difference in the proportion of young leaves alone was unlikely to account for all the differences in canopy photosynthesis between managements, and further differences in canopy structure were evaluated. Despite the delay in the restoration of leaf area following severe grazing in a rotation, the total photosynthetic uptake of a system involving some 12-13 days regrowth and 3 days grazing exceeded that of a well-utilized continuously grazed sward. Regrowths of longer duration led to progressively greater total photosynthetic uptake, though this was not considered synonymous with greater yield.

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370. Long-term effects of sheep grazing on coastal sandplain vegetation.

Dunwiddie, Peter W.

Natural Areas Journal 17(3): 261-264. (1997)

NAL Call #: QH76.N37; ISSN: 0885-8608

Descriptors: coastal sandplain/ conservation/ habitat/ sheep grazing/ shrub encroachment/ species abundance/ vegetation effects

Abstract: In 1990, vegetation cover and frequency in thirty-one 0.2-m² quadrats in an ungrazed coastal sandplain in Massachusetts (USA) were compared with cover and frequency in matched quadrats in an adjacent grassland that had been used as a sheep pasture until 1948. Species that had significantly higher values of cover or frequency in the former pasture included *Schizachyrium scoparium*,

Comptonia peregrina, *Cladina* spp., and *Helianthemum dumosum*. Four shrubs and a grass-*Myrica pensylvanica*, *Quercus ilicifolia*, *Rosa carolina*, *Vaccinium angustifolium*, and *Festuca ovina*-were more abundant in the ungrazed vegetation. Two dominant species that showed no differences in either abundance measure between the grazed and ungrazed sites were *Gaylussacia baccata* and *Carex pensylvanica*. These results suggest that sheep grazing may be a valuable tool for arresting shrub encroachment into native coastal sandplain grasslands.
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371. The long-term effects on upland sheep production in the UK of a change to extensive management.

Barthram, G. T.; Marriott, C. A.; Common, T. G.; and Bolton, G. R.

Grass and Forage Science 57(2): 124-136. (2002)

NAL Call #: 60.19 B773; ISSN: 0142-5242

Descriptors: extensification/ extensive management/ grazing/ liveweight/ pasture management/ upland livestock production: long term effects

Abstract: Extensification (a reduction in fertilizer inputs and stocking rate of grassland) is seen as one way of increasing the conservation value and of reducing the environmental impact of upland sheep production in the UK, but little is known about the consequences of such a change. This study determines the changes in animal production over ten years following the introduction of four extensive grazing management strategies to perennial ryegrass/white clover pastures at two upland sites. Fertilizer-free treatments were maintained with sward heights of: 4 cm (treatment 4/4U) or 8 cm (8/8U) during the whole of the grazing year, 4 cm during summer and 8 cm during autumn (4/8U) and 8 cm during summer and 4 cm during autumn (8/4U). A control treatment that received 140 kg N ha⁻¹ year⁻¹ was also maintained with a sward surface height of 4 cm (4/4F). Scottish Blackface sheep grazed all treatments. The 4/4F treatment carried the greatest number of animals (3746 grazing days ha⁻¹ year⁻¹); the 4/4U and the 8/8U treatments carried 0.73 and 0.43 of this number respectively. The number on the 4/8U treatment was similar to that on the 4/4U while the 8/4U treatment carried 1.41 of that on the 8/8U treatment (0.61 of 4/4F). Mean individual animal performance was greatest on the 8 cm swards and tended to be lowest on the 4/4F treatment. However, the 4/4F treatment produced the greatest live weight of lamb (623 kg ha⁻¹ year⁻¹) with the 4/4U producing 0.77, and the 8/8U producing 0.55, of this amount. Although there was year-to-year variation in agricultural output, it was concluded that the lower levels of sheep production that result from a change to extensive systems of grazing management can be maintained for at least 10 years.
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372. The long-term impact of nitrogen fertiliser on perennial ryegrass tiller and white clover growing point densities in grazed dairy pastures in south-western Victoria.

Mckenzie, F. R.; Jacobs, J. L.; and Kearney, G.

Australian Journal of Agricultural Research 53(11): 1203-1209. (2002)

NAL Call #: 23 Au783; ISSN: 0004-9409

Descriptors: 3 year grazing experiment: applied and field techniques/ annual pasture dry matter yields/ climatic effects/ grazed dairy pastures/ grazing herbage mass/

grazing management effects/ randomized block design
Abstract: A 3-year grazing experiment determined the impact of multiple applications of different rates of nitrogen (N) fertiliser, applied over autumn and winter in 1997, 1998, and 1999, on perennial ryegrass (*Lolium perenne*)/white clover (*Trifolium repens*) tiller and growing point densities (stolon apices with at least 2 nodes). Annual pasture dry matter (DM) yields were also monitored. Four treatments were replicated 3 times in a randomised block design and included: 0 N (A); 3 applications of 25 kg N/ha (B); 3 applications of 50 kg N/ha (C); and 3 applications of 75 kg N/ha (D). Urea (46% N) was the N source. Grazing of treatment plots occurred at a pre-grazing herbage mass of 2200-2500 kg DM/ha. Over 3 years, N applications consistently increased annual pasture DM yields by 0.9-3.3 t/ha when a total of 75-225 kg N/ha was applied annually. Generally, treatments B, C, and D resulted in higher perennial ryegrass tiller densities than treatment A. An exception occurred from July 1998 in Year 2 to July 1999 in Year 3, when all perennial ryegrass densities were similar. Nitrogen fertiliser generally produced no consistent effect on white clover growing point density, with the exception of July-December in Year 2 when treatments B, C, and D resulted in lower growing point densities than treatment A. Clover growing point density decreased over the trial period irrespective of treatment. There were no N fertiliser effects on 'other' grasses and broadleaved weeds. 'Other' grasses (mainly winter grass, *Poa annua*) did, however, peak in density (up to 2500 tillers/m²) from July to September each year. Seasonally, the peak perennial ryegrass tiller density was similar each year and occurred during late winter-early spring (5450 tillers/m² in July 1997; 6200 tillers/m² in August 1998; 5400 tillers/m² in July 1999). This was followed by a trough over midsummer (800 tillers/m² in January 1998; 725 tillers/m² in January 1999). White clover growing point density declined over 3 years. During this decline there were peaks in June 1997 (2650 growing points/m²), November 1997 (1600 growing points/m²), June 1998 (1250 growing points/m²), April 1999 (1050 growing points/m²), and November 1999 (850 growing points/m²). Troughs occurred in January 1998 (530 growing points/m²) and February 1999 (380 growing points/m²). It is concluded that although increasing applications of N increased annual pasture DM yields and generally increased perennial ryegrass tiller densities, with little effect on clover growing point densities, there is little to suggest that N fertiliser alone would enhance the persistence of these pasture species. Persistence is likely to be influenced by a combination of factors including grazing management and climatic effects, rather than N fertiliser alone.
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373. Managing heterogeneity: The importance of grazing and environmental variation on post-fire succession in heathlands.

Vandvik, Vigdis; Heegaard, Einar; Maaren, Inger Elisabeth; and Aarrestad, Per Arild

Journal of Applied Ecology 42(1): 139-149. (2005)

NAL Call #: 410 J828; ISSN: 0021-8901

Descriptors: grazing/ fires/ conservation/ succession/ species composition/ burning/ ordination

Abstract: Semi-natural habitats have been shaped by human disturbance regimes for centuries. Spatially and temporally heterogeneous land-use practices, such as

cutting, burning, grazing and turf-cutting, have resulted in complex mosaic landscapes that are of high priority for conservation in Europe. Contemporary conservation subjects these systems to management regimes that are generally less diverse, in terms of disturbances and fine-scale temporal and spatial variability, than traditional land use, but the ecological consequences of these simplifications are unclear. We investigated the interactive effects of fire and grazing on plant species composition and diversity along local environmental (moisture) gradients in coastal heathlands. A replicated series of post-fire successions (n = 12) was initiated in three heathland habitats and the areas subjected to two grazing regimes. Floristic and environmental data were recorded in permanent plots over a 5-year period. Community data were analysed using multivariate ordination techniques (principal components analysis, partial redundancy analyses, and principal response curves) and generalized linear models. Fire induced strong successional trends in the species composition of the heathlands. These trends differed among heathland habitats, and with grazing. Strong interactions between fire, habitat and grazing implied that the effect of grazing on the successional dynamics differed among habitats. Species diversity decreased in the first year after fire but increased beyond the pre-fire levels during succession. This trend was not affected by local environment or grazing, although there were main effect differences in diversity between environments and grazing regimes. Synthesis and applications. Our results demonstrate that the two management practices do not have simple additive effects within the semi-natural system studied, as grazing created ecological opportunities for additional sets of species, increased variability among habitats, and added complexity to the post-fire successional dynamics. In order to preserve diversity, conservation management should thus aim to preserve the level of complexity of the traditional management regimes, both in terms of the actual disturbances (e.g. fire and grazing) as well as the spatial scales at which they are applied. Further, the considerable change in these effects along the local environmental gradient brings into question the efficiency of general management prescriptions, and indicates that local environmental variability should be taken into account in the conservation of semi-natural habitats.

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374. Managing rotationally grazed pastures for forage production and grassland birds.

Paine, L. K.; Undersander, D. J.; Temple, S. A.; and Sample, D. W.

American Forage and Grassland Council Proceedings 6: 54-58. (1997)

NAL Call #: SB193.F59

Descriptors: range management/ rotational grazing/ birds/ nesting

This citation is from AGRICOLA.

375. Managing saffron thistle in pastures with strategic grazing.

Grace, B. S.; Whalley, R. D. B.; Sheppard, A. W.; and Sindel, B. M.

Rangeland Journal 24(2): 313-325. (2002)

NAL Call #: SF85.4.A8A97; ISSN: 1036-9872

Descriptors: *Carthamus lanatus*/ invasive species/ weed control/ rotational grazing/ sheep/ stocking rate/ plant

competition/ plant litter/ ground vegetation/ pasture management/ cattle/ mortality/ perennials/ forage grasses/ forage legumes/ New South Wales

This citation is from AGRICOLA.

376. Managing the composition of native and naturalised pastures with grazing.

Kemp, D. R.; Dowling, P. M.; and Michalk, D. L.

New Zealand Journal of Agricultural Research 39(4): 569-578. (1996)

NAL Call #: 23 N4892; ISSN: 0028-8233

Descriptors: crop industry/ agronomy/ biobusiness/ native pasture/ naturalized pasture/ pasture composition management

Abstract: Many native, naturalized, and low-input pastures have a low proportion of desirable species. Under the prevailing economic conditions, it is unlikely that these pastures would be replaced with sown native species as there may not be seed of suitable cultivars available and costs would exceed returns. Better management is a preferable strategy to improve the proportion of desirable components. Grazing tactics are central to any improved management strategies for these pastures as they offer a lower cost option for land managers. Additional tactics, which will vary depending upon specific circumstances, include some use of fertilizer (to increase the rate of change), herbicides (where weed problems are particularly severe and animals are unlikely to eat the "weeds"), and fire (to reduce dead material and seed numbers and produce green leaf for grazing). Several examples of manipulating pasture composition are considered. In situations where the desirable species are C-3 perennial grasses (e.g., *Danthonia* spp., *Microlaena*, and *Dactylis*), and the less desirable are C-3 annual species (e.g., *Vulpia*), rests over the summer period, especially in wetter years, improved the perennial grass content. In addition, extra grazing pressure in spring limits seed set by annual grasses. Where the undesirable species are C-4 perennial grasses (e.g., *Bothriochloa* and *Aristida*), heavy summer grazing is more important. In some instances, the timing of a heavy grazing period will depend upon monitoring the plant community to find the "window of opportunity" when the desirable species have completed flowering and seed set but when the less-desirable species are starting to flower. Further development of improved management systems will require knowledge of the ecology of the principal species. Any release of new cultivars of native and low-input species should be supported by knowledge of the better management practices to maintain those species in the pasture.

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377. Manipulation of nutrients and grazing levels on heather moorland: Changes in *Calluna* dominance and consequences for community composition.

Hartley, S. E. and Mitchell, R. J.

Journal of Ecology 93(5): 990-1004. (2005)

NAL Call #: 450 J829; ISSN: 0022-0477

Descriptors: botanical composition/ fencing/ grazing/ mineralization/ moorlands/ nitrogen/ nitrogen fertilizers/ nutrients/ phosphorus/ population decrease/ potassium/ soil organic matter/ soil water/ vascular-plants

Abstract: Experimental studies of the combined effects of herbivory and the availability of nutrients on semi-natural communities remain relatively scarce. Here we report the

effects of 6 years of nutrient addition (N, P and K) and protection from grazing on moorland plant communities in the Scottish uplands, particularly on the cover of the dominant *Calluna vulgaris*. We also recorded the cover of vascular plants and bryophytes, to assess the impact of changes in *Calluna* dominance on competing species. Grazing in combination with nitrogen addition caused the greatest decline in *Calluna* cover, typically 40-50%, but nitrogen addition did not cause a significant decline in *Calluna* on plots protected from grazing. More *Calluna* shoots were browsed on nitrogen-treated plots than on unfertilized ones, presumably because grazing animals preferred fertilized *Calluna*. Nitrogen addition allowed grasses to increase in cover, especially on grazed plots. However, *Nardus stricta*, *Festuca ovina* and *Agrostis* sp. all declined in fenced areas but increased in grazed plots, whereas *Deschampsia flexuosa* and *Festuca rubra* increased in fenced plots. The effects of grazing and nutrient addition varied markedly between sites, possibly because of differences in soil moisture and organic matter. Nitrogen addition, however, increased soil nitrogen mineralization rates in both glens. Fencing increased the cover of grazing-intolerant plants with low nutrient demands (as classified by Ellenberg and suited species scores) that were categorized as competitive plants by Grime's CSR model. Plots receiving nitrogen and phosphorus had more nutrient-demanding plants able to tolerate high grazing pressure that were often classified as ruderals. The impact of nitrogen addition on the cover of *Calluna* and on competing grass species in the community critically depends on the level of grazing. Changes in community composition caused by grazing and fertilizer addition can be explained in terms of the ecological tolerances of individual species, allowing us to predict the types of plants that are likely to increase or decrease in cover.
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378. Methane emissions of beef cattle grazing tall fescue pastures at three levels of endophyte infestation.

Pavao Zuckerman, Mitchell A.; Waller, John C.; Ingle, Teri; and Fribourg, Henry A.
Journal of Environmental Quality 28(6): 1963-1969. (1999)
NAL Call #: QH540.J6; ISSN: 0047-2425
Descriptors: infestation level variation/ pasture
Abstract: Methane (CH₄) is produced by fermentation in the rumen of cattle. Methane may play a part in global warming scenarios. Tall fescue (*Festuca arundinacea* Schreb.) is an important forage in the eastern United States. The toxic syndrome associated with the endophytic fungus *Neotyphodium coenophialum* (E+) can be mitigated with management strategies that improve forage quality of E+ tall fescue pastures and animal performance. The sulfur hexafluoride (SF₆) tracer technique was used to determine the effects of tall fescue pasture management on CH₄ production in 1997-1998. Two steers (*Bos taurus*) on two pastures each of E+ tall fescue, of endophyte free (E-) tall fescue, of E+/E-(1:1 ratio), and of E+/ladino white clover (*Trifolium repens* L.), and four steers and four lactating cows with nursing calves grazing either unimproved (UP) or best management practices (BMP) pastures were used to collect eructated CH₄ samples. Daily CH₄ emissions were about 95 to 200 g d⁻¹ for steers and 150 to 240 g d⁻¹ for cows. Steers grazing E+/clover pastures emitted 20% less CH₄ kg⁻¹ d⁻¹ than steers grazing E+, E-, or E+/E- in

summer. Season and animal size were the major factors affecting CH₄ emissions. This first estimation of CH₄ emissions from free-roaming cattle grazing tall fescue pastures indicates that (i) improved forage management strategies have little effect on daily emissions per animal that are primarily a function of rumen size and intake, and (ii) the amount of emission per unit of animal product is reduced when improved practices are implemented.
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379. Methane emissions of beef cattle on forages: Efficiency of grazing management systems.

Deramus, H. Alan; Clement, Terry C.; Giampola, Dean D.; and Dickison, Peter C.
Journal of Environmental Quality 32(1): 269-277. (2003)
NAL Call #: QH540.J6; ISSN: 0047-2425
Descriptors: sulfur hexafluoride tracer technique: applied and field techniques/ bahiagrass hay: animal feed/ beef: meat product/ best management practices grazing: methane production effects/ continuous grazing: methane production effects/ cottonseed meal and corn: animal feed/ efficient beef production strategies/ fermentation: methane production/ grazing management strategies/ limited ryegrass grazing/ management intensive grazing/ milk: dairy product/ protein molasses blocks: animal feed/ urea and corn [URC]: animal feed
Abstract: Fermentation in the rumen of cattle produces methane (CH₄). Methane may play a role in global warming scenarios. The linking of grazing management strategies to more efficient beef production while reducing the CH₄ emitted by beef cattle is important. The sulfur hexafluoride (SF₆) tracer technique was used to determine the effects of best management practices (BMP) grazing compared with continuous grazing on CH₄ production in several Louisiana forages during 1996-1998. Cows and heifers (*Bos taurus*) grazed common bermudagrass (*Cynodon dactylon* (L.) Pers.), bahiagrass (*Paspalum notatum* Flugge), and ryegrass (*Lolium multiflorum* Lam.) pastures and were wintered on bahiagrass hay with supplements of protein molasses blocks (PMB), cottonseed meal and corn (CSMC), urea and corn (URC), or limited ryegrass grazing (LRG). Daily CH₄ emissions were between 89 and 180 g d⁻¹ for young growing heifers and 165 to 294 g d⁻¹ for mature Simbrah cows. Heifers on "ad lib" ryegrass in March and April produced only one-tenth the CH₄ per kg of gain as heifers on LRG of 1 h. Using BMP significantly reduced the emission of CH₄ per unit of animal weight gain. Management-intensive grazing (MIG) is a BMP that offers the potential for more efficient utilization of grazed forage crops via controlled rotational grazing and more efficient conversion of forage into meat and milk. Projected CH₄ annual emissions in cows reflect a 22% reduction from BMP when compared with continuous grazing in this study. With the BMP application of MIG, less methane was produced per kilogram of beef gain.
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380. Mitigation of nitrous oxide emissions in spray-irrigated grazed grassland by treating the soil with dicyandiamide, a nitrification inhibitor.

Di, H. J. and Cameron, K. C.
Soil Use and Management 19(4): 284-290. (2003)
NAL Call #: S590.S68; ISSN: 0266-0032
Descriptors: spray irrigation: applied and field techniques/ animal excreta/ animal urine patches/ free draining lismore

stony silt loam: udic haplustept loamy skeletal/ global warming/ grazed pasture systems/ greenhouse gas inventory/ spray irrigated grazed grassland

Abstract: Nitrous oxide (N₂O) from animal excreta in grazed pasture systems makes up a significant component (c. 10%) of New Zealand's total greenhouse gas inventory. We report an effective method to decrease N₂O emissions from animal urine patches by treating the soil with the nitrification inhibitor dicyandiamide (DCD), in a simulated grazed dairy pasture system under spray irrigation. The soil was a free-draining Lismore stony silt loam (Udic Haplustept loamy skeletal) and the pasture was a mixture of perennial ryegrass (*Lolium perenne*) and white clover (*Trifolium repens*). By treating the soil with DCD, N₂O emissions were decreased by 76% following urine application in the autumn, from 26.7 kg N₂O-N ha⁻¹ without DCD to an average of 6.4 kg N₂O-N ha⁻¹ with DCD over the 6-month experimental period. N₂O flux was decreased by 78% following urine application in the spring, from 18 kg N₂O-N ha⁻¹ without DCD to 3.9 kg N₂O-N ha⁻¹ with the application of DCD over the 3-month period. A single application of DCD immediately after urine was sufficient to effectively mitigate N₂O emissions from the urine. The results showed that repeated applications of DCD after urine application, or mixing DCD with urine, offered no advantage over a single application of DCD immediately after urine deposition.

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381. A model of ammonia volatilization from a grazing livestock farm.

Hutchings, N. J.; Sommer, S. G.; and Jarvis, S. C. *Atmospheric Environment* 30(4): 589-599. (1996)
NAL Call #: TD881.A822; ISSN: 1352-2310

Descriptors: air pollution/ animal housing/ control measures/ manure/ mathematical model/ nitrogen/ slurry handling/ urine

Abstract: A dynamic model was developed to predict the ammonia volatilization from grazing livestock farms and to allow potential control measures to be evaluated. The relationships within the model were based on the underlying physical and chemical processes but empirically based factors were used to reduce the demand for input data and where the understanding of the underlying processes was inadequate. On a daily basis, the model simulates the partitioning of dietary nitrogen into dung and urine and its subsequent fate within the pasture or the slurry handling system. The fate of dry matter and water added in dung, urine and from other sources is also predicted. The model illustrates the indirect interactions between ammonia sources, highlights the influence of slurry management on ammonia losses, stresses the need for integrated, whole farm measurements and demonstrates that assessments of the impact of control measures may be misleading unless considered at the scale of the whole farm.

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382. Modelling the effects of landscape pattern and grazing regimes on the persistence of plant species with high conservation value in grasslands in south-eastern Sweden.

Cousins, Sara A. O.; Lavorel, Sandra; and Davies, Ian *Landscape Ecology* 18(3): 315-332. (2003)
NAL Call #: QH541.15.L35 L36; ISSN: 0921-2973

Descriptors: LAMOS: landscape modelling shell, computer software/ landscape model: mathematical and computer techniques/ landscape modelling: mathematical and computer techniques/ cadastral maps/ competition sensitive groups/ disturbance responses/ grassland pattern effects/ grassland size effects/ grazing frequency effects/ grazing intensity effects/ grazing regimes/ lack of management/ land use change/ landscape pattern effects/ landscape time layers: historical, pre modern, present day/ light requirements/ local dispersal/ local grazing disturbance/ local succession/ plant functional groups/ semi natural grasslands/ vegetation dynamics

Abstract: Semi-natural grasslands in Sweden are threatened by land-use change and lack of management with attendant risk to their biodiversity. We present a model to explore the effects of grazing frequency and intensity on plant species persistence, and the relative effects of grassland size and pattern. We used a landscape modelling platform, LAMOS (Landscape MOdelling Shell), to design a landscape model of vegetation dynamics incorporating the effects of local succession, dispersal and grazing disturbance. Five plant functional groups (PFG), representing various combinations of persistence and dispersal character, light requirements and disturbance responses, were defined to model species dynamics. Based on old cadastral maps three different landscapes were designed representing specific time-layers, i.e., a historical (17th to 18th century), a pre-modern (1940s) and a present-day landscape. Simulations showed that a threshold was crossed when grasslands decreased in area to about 10-30% of the modelled area, and as a consequence the biomass of grassland-specific PFGs was strongly reduced. These competition sensitive groups did not persist in the model even with intense grazing in the present-day landscape, where grasslands occupy 11% of the total area. However, all grassland species would have been able to persist in the historical landscape, where grasslands occupied 59% of the total area, even without grazing. Our results suggest that continuous but low-intensity grazing is more positive for grassland PFGs than discontinuous but highly intensive grazing. This effect was particularly strong when the frequency and/or intensity of grazing dropped below a threshold of 20%. Simulations using three landscape maps designed to explore effects of further fragmentation and habitat loss showed that the spatial pattern of remaining grasslands is important for the persistence of grassland-specific PFG. The model presented here is an advance towards more realistic grazing models to explore the effects of prescribed grazing and landscape fragmentation on the persistence species or plant functional groups.

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383. Modelling the structural changes in vegetation under different grazing regimes.

Thalen, D. C. P.; Poorter, H.; Lotz, L. A. P.; and Oosterveld, P.

Geobotany 10: 167-183. (1987)

NAL Call #: QK901.G45

Descriptors: natural resource management/ simulation models/ grazing/ Netherlands

This citation is from AGRICOLA.

384. The need for a new approach to grazing management—is cell grazing the answer?

Earl, J. M. and Jones, C. E.

Rangeland Journal 18(2): 327-350. (1996)

NAL Call #: SF85.4.A8A97; ISSN: 1036-9872

Descriptors: rotational grazing/ botanical composition/ New South Wales

This citation is from AGRICOLA.

385. Net primary production and carbon stocks in differently managed grasslands: Simulation of site-specific sensitivity to an increase in atmospheric CO₂ and to climate change.

Riedo, Marcel; Gyalistras, Dimitrios; and Fuhrer, Jurg

Ecological Modelling 134(2-3): 207-227. (2000)

NAL Call #: QH541.15.M3E25; ISSN: 0304-3800

Descriptors: pasim pasture model: mathematical model/ carbon dynamics/ climate change/ cutting/ grazing/ managed grasslands/ management options/ net primary production/ precipitation/ soil organic matter

Abstract: Elevated atmospheric CO₂ and climate changes are expected to influence managed grassland ecosystems. The mechanistic pasture simulation model (PaSim) was used to quantify effects on net primary productivity (NPP) and carbon (C) stocks at three locations differing in climate and soil type. An earlier model version was modified to enable long-term simulations at different altitudes, and to consider management in the form of either cutting or grazing by lactating cows. Results from simulations under current conditions agreed favourably with measured data for yield and C stocks, and model behaviour appeared to be plausible. Elevated CO₂ alone or in combination with increased temperature stimulated NPP at all sites. The stimulation was positively related to increasing precipitation at dry sites, but negatively at cool sites. Climate change scenarios in combination with elevated CO₂ led to increase C stocks. The sensitivity of C stocks to changes in temperature and precipitation was similar, and much larger than to management. Grazing led to higher C stocks compared with cutting, depending mainly on the difference in NPP between the management options. Grazing had a positive effect on C stocks under cool conditions, but the effect tended to become negative with increasing temperature. Comparing different sites revealed that local conditions affect system behaviour qualitatively. In quantitative terms, the results confirm that the combination of elevated CO₂ and climate change affects NPP and C stocks, and that the influence of management is site-specific.

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386. Nitrogen and mineral composition of autumn-grazed pasture.

Belesky, D. P.; Turner, K. E.; and Fedders, J. M.

Communications in Soil Science and Plant Analysis 26(17/18): 2941-2959. (1995)

NAL Call #: S590.C63; ISSN: 0010-3624

Descriptors: pastures/ range management/ autumn/ botanical composition/ mineral content/ sheep/ grazing/ chemical constituents of plants

Abstract: Grazing management in autumn can influence the botanical composition and productivity of a sward. Cycling of nutrients as a result of grazing livestock activity and variable canopy growth rates may influence mineral nutrient supply and demand in a dynamic canopy. An

experiment was conducted to determine the influence of autumn grazing practices on the growth and composition, including minerals in terms of ruminant requirements, of a grass/legume sward. Paddocks were established and three replicates grazed by growing lambs for 30-, 60-, or 90-d intervals beginning in late summer. Herbage samples were collected at the beginning of the grazing interval and at the end of each interval (closing date). Herbage mass, and nitrogen (N), phosphorus (P), potassium (K), magnesium (Mg), calcium (Ca), and sulfur (S), as well as copper (Cu) and zinc (Zn) were examined in terms of the influence of sampling date, closing date, year, and the interaction of these factors from stockpiled and grazed canopies. Soil mineral composition was determined as well.

Concentrations of all minerals declined with increasing soil depth and P, Na, Mg, and Ca increased in soil over the course of the experiment. Soil N concentration was reflected in the pattern of herbage growth in autumn. In general, closing date had no influence on herbage mineral composition and concentrations were within the recommended levels for a range of livestock. Phosphorus was the exception and concentrations in herbage were low in terms of requirements for high producing livestock such as lactating dairy cattle. Uptake or mineral reallocation within the plant remained constant during the autumn growth interval, since mineral yields were stable as growth rates declined in 1991 and increased when growth rates were stable in 1992. Mineral related nutritional problems in grazed mixed-species pasture, would most likely be a function of mineral bioavailability or interactions, rather than low concentrations in the herbage.

This citation is from AGRICOLA.

387. Nitrogen fixation during improvement of North Island hill country pastures.

Lambert, M. G.

New Zealand Journal of Experimental Agriculture 15(3): 267-270. (1987)

NAL Call #: S542.A1N45; ISSN: 0301-5521

Descriptors: legumes/ sheep/ fertilizer/ grazing management/ livestock industry/ crop industry/ agriculture
Abstract: Nitrogen (N) fixation was measured, using the acetylene reduction assay, in hill pastures at the Ballantrae Hill Country Research Station near Woodville.

Measurements were made over a 12 month period starting in September 1976, on sunny and shady aspects of the six fertiliser .times. grazing management treatment combinations of a larger grazing trial. Fertiliser treatments were LF (750 kg/ha superphosphate total over the previous 4 years) and HF (1800 kg/ha total plus 1250 kg/ha ground limestone). Grazing managements were set stocking with sheep (SSS), and rotational grazing with sheep (RGS) or cattle (RGC). Annual fixation averaged 103 kg N/ha in LF and 201 kg N/ha in HF pastures, and 105, 129 and 224 kg N/ha in SSS, RGS, and RGC pastures respectively. These levels were in contrast to an annual level of 34 kg N/ha measured within the same area 2 years previously, when pasture improvement was much less advanced. Annual N fixation was similar on sunny and shady aspects, but the pattern of seasonal fixation differed. In particular, fixation on shady sites was greater than on sunny sites in summer and autumn. N fixation was closely related to measured rate of legume herbage accumulation.

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388. Nutrient content, dry matter yield, and species composition of cool-season pasture with management-intensive grazing.

Martz, F. A.; Gerrish, J.; Belyea, R.; and Tate, V.
Journal of Dairy Science 82(7): 1538-1544. (1999)
NAL Call #: 44.8 J822; ISSN: 0022-0302

Descriptors: heifers/ steers/ rotational grazing/ stocking rate/ grazing intensity/ botanical composition/ liveweight gain/ seasonal variation/ nutrient content/ fiber content/ crude protein/ digestibility/ energy content/ hemicellulose/ Missouri

Abstract: The objective of this study was to determine changes in the nutrient content, available pasture, and species stand counts of cool season pastures during the grazing season. Four replicated pastures were flexibly subdivided into 18 to 36 paddocks and grazed rotationally from late April to November in each of 2 yr. Steers were grazed with fresh pasture offered each 1 to 2 d, which resulted in rest periods for paddocks of 17 to 35 d. Samples used to determine the nutrient content of pasture forage dry matter (DM) were collected from two grazing rumen-fistulated heifers that had empty, clean rumens at initiation of the sampling period. Mean stand counts in long-term established pastures for the grazing season were 24% legumes, 45% grasses, 8% grassy weeds, 10% bare ground, 11% broadleaf weeds, and 1% dung piles. Stand counts did not differ between years. Mean DM utilization of pasture per grazing cycle was 1103 kg/ha, and total DM temporal utilization per season was 6624 kg/ha, which was 35% of the pasture available for each grazing. Pasture content of neutral detergent fiber, crude protein, in situ digestible DM, and net energy for lactation did not differ between years but did differ among months of harvest: neutral detergent fiber decreased, crude protein and in situ digestible DM increased, and acid detergent fiber and estimated net energy for lactation remained relatively constant over the grazing season. The content of measured nutrients in ingested herbage did not differ among heifers sampled. These results indicate that individual cattle select similar quality diets from given pastures and nutrient differences occurred among months of sampling. Even though differences among months of season were statistically different, actual differences were small. Management-intensive grazing of pastures was uniform enough over season, and animal selectivity was strong enough over season to result in constant quality of consumed pasture.

This citation is from AGRICOLA.

389. Observed spatial and seasonal patterns of cattle activity versus simulated effects in an enclosure experiment.

Buttler, A.; Kohler, F.; Wagner, H.; and Gillet, F.
In: Land use systems in grassland dominated regions: Proceedings of the 20th General Meeting of the European Grassland Federation. (Held 21 Jun 2004-24 Jun 2004 at Luzern, Switzerland.); pp. 578-580; 2004.

Descriptors: animal behaviour/ cattle dung/ environmental factors/ foraging/ grazing/ pastures/ seasonal variation/ shrubs/ slope/ spatial variation/ temporal variation/ trampling/ trees/ vegetation

Abstract: Cattle activity or grazing s.l. can be subdivided into three components: dung deposition, herbage removal (foraging or grazing s.s.) and trampling. All these actions modify vegetation. At medium or large scale, the pattern of

cattle activity is generally described only as the foraging behaviour. Such a description implicitly consider grazing as the principal behaviour of the three primary activities. Our purpose was first to determine in an observational study the medium-scale distributions of dung-pat density, trampling effect and herbage removal in a mountain wooded pasture. These distributions were related to 'natural structures', such as slope, vegetation openness, cover of trees, shrubs and rock outcrops, fodder potential, and 'management-induced structures', such as distance to fence or to the nearest watering place. Results showed that the three variables describing cattle activity exhibited significantly different spatio-temporal patterns. Moreover, the relative influence of environmental factors was different for each activity. Secondly, in an enclosure experiment we simulated the fine scale effects of these factors, separately or in combination, and compared them with cattle grazing over a one-year period. Multivariate analyses of vegetation data in the first year showed an overwhelming seasonal shift and significant differences induced by treatments. Thus, grazing alone appears to be an unrealistic indicator of cattle activity and it might be necessary to consider dunging, trampling and grazing separately in spatially explicit models of vegetation dynamics.

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390. An on-farm test of perennial forage grass varieties under management intensive grazing.

Casler, M. D.; Undersander, D. J.; Fredericks, C.; Combs, D. K.; and Reed, J. D.
Journal of Production Agriculture 11(1): 92-99. (1998)
NAL Call #: S539.5.J68; ISSN: 0890-8524

Descriptors: crop industry/ available forage/ forage intake/ intensive grazing systems

Abstract: Perennial cool-season grasses have historically been bred and evaluated strictly under hay managements with mechanical harvesting. Forage yield and persistence data collected under such circumstances may have little value in choosing cultivars for management intensive grazing (MIG) systems. The objectives of this study were to begin developing a database of cool-season grass cultivars for MIG and a protocol for expansion of the database: Ninety-one grass varieties were planted in randomized complete block designs in 1990 on three dairy farms in southern Wisconsin (Fayette silt loam and Dubuque loam-both fine-silty, mixed, mesic Typic Hapludalfs). Each study was rotationally grazed rive or six times in 1991 and 1992. Compressed pasture heights (bulk density) were measured on each plot immediately before and after each grazing event and converted to estimates of available forage using a linear regression calibration. Apparent intake of each plot was computed as the difference between pre- and postgrazing estimates of available forage. Across all varieties, available forage ranged from 1.2 to 1.7 tons/acre, apparent intake ranged from 0.45 to 0.82 tons/acre, and ground cover (fall 1992) ranged from 18 to 93%, with significant differences observed among species and within several species. Reed canarygrass (*Phalaris arundinacea* L.) had markedly greater available forage and apparent intake than the other very hardy species. Creeping foxtail (*Alopecurus arundinaceus* Poir.) had very high apparent intake (0.70 tons/acre) and Kentucky bluegrass (*Poa pratensis* L.) had very low apparent intake (0.57 tons/acre) although their available forage differed by only 0.05 tons/acre. Timothy (*Phleum pratense* L.) varieties

were highly variable, while smooth brome grass (*Bromus inermis* Leyss.) varieties did not show marked differences. Many orchardgrass (*Dactylis glomerata* L.) varieties had extremely high available forage and apparent intake, always higher in apparent intake than tall fescue (*Festuca arundinacea* Schreb.) for the same level of available forage. Similarly, perennial ryegrass (*Lolium perenne* L.) had higher apparent intake than meadow fescue (*F. pratensis* Huds.) for the same level of available forage. Intermediate and Italian ryegrasses (*L. multiflorum* Lam.), festulolium (*Festulolium braunii* K-A.), and 'Matua' prairie brome (*Bromus unioloides* (Willd.) H.B.K.) were not well adapted to the combination of MIG and harsh, relatively snow-free winters. The study provided the beginning of a database that will be extremely useful in developing credible recommendations of perennial grasses for cool-season pastures.

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391. Pasture growth, production, and quality under rotational and continuous grazing management.

Paine, L. K.; Undersander, D.; and Casler, M. D. *Journal of Production Agriculture* 12(4): 569-577. (1999)
NAL Call #: S539.5.J68; ISSN: 0890-8524

Descriptors: pastures/ rotational grazing/ grazing/ range management/ animal husbandry/ forage/ nutritive value/ crude protein/ seasonal variation/ dietary fiber/ Wisconsin
Abstract: Management intensive rotational grazing (MIRG) is an expanding practice among dairy farmers in the Upper Midwest. Despite the high productivity associated with MIRG pastures, many acres of unmanaged, continuously grazed pastures still exist. Our goal was to document relationships between forage growth, production, and quality in rotational and continuous grazing systems and to evaluate the role that management plays in the productivity of these pastures. Forages were monitored under farmer management on three MIRG dairy farms and on three continuously grazed pastures (CON) on conventional livestock farms in 1994 and 1995. Evaluation of the results was complicated by the range of conditions and management practices that characterized the study's participants. As is typical for this region, CON pastures in this study were unmanaged. In contrast, MIRG pastures were monitored daily by their owners and sward health was maintained through movement of the herd and such practices as interseeding legumes. Forage mass for MIRG pastures was greater than CON every week of the 24-wk grazing season, averaging 1763 lb/acre for ready-to-graze MIRG paddocks vs. 850 lb/acre for CON. Crude protein averaged 16.6% for MIRG vs. 15.3% for CON. Seasonal average ADF values were 34.2% for MIRG and 34.1% for CON. Average NDF values were 53.4% for MIRG and 56.8% for CON. Forage mass between 1300 and 1900 lb/acre appeared to provide a balance between yield and quality on MIRG pastures. Cooperating farmers most often chose to graze paddocks at this level. For CON, forage quality decreased as forage biomass increased. Ready-to-graze MIRG paddocks had significantly higher quality than CON pastures at equivalent levels of forage biomass. It was not possible in this study to isolate individual management practices and test them separately, so no one factor can be viewed as responsible for the differences we observed. Indeed, these differences probably are the result

of the interaction among several management practices on MIRG farms and the lack of pasture management on CON farms.

This citation is from AGRICOLA.

392. Pasture management.

Murphy, B.
In: Sustainable agriculture in temperate zones/
Francis, C. A.; Flora, C. B.; and King, L. D.
New York: John Wiley and Sons, 1990; pp. 231-262.
Notes: ISBN 0471622273
NAL Call #: S494.5.S86S87
Descriptors: sward dynamics/ grazing/ paddock layout/ fencing
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393. Pasture management in semi-arid tropical woodlands: Effects on species diversity.

Mcivor, John G.
Australian Journal of Ecology 23(4): 349-364. (1998)
NAL Call #: QH540.A8; ISSN: 0307-692X
Descriptors: fertilizer application: field method, pasture management method/ introduced species sowing: field method, pasture management method/ timber treatment: field method, pasture management method/ grazing pressure/ semi arid tropical woodland: pasture management
Abstract: The effects of pasture management options (sowing introduced legumes and grasses, timber treatment, applying fertilizer, cultivation before sowing, and stocking rate) on species diversity were measured at two experimental sites (Hillgrove and Cardigan) near Charters Towers, northeast Queensland. Species were divided into three groups (sown, native and exotic) and diversity was measured as species density (number of species recorded in each plot and number of species/quadrat) annually from 1982 to 1992. The responses of individual native and naturalized species to treatment were also determined. All management options affected diversity but the responses varied with site and season, and with the different measurement scales. The density of sown species either increased or was unaffected by all the management options; there were no significant decreases. The density of native species showed both positive and negative responses; it increased at high stocking rates and with tree killing at Hillgrove, and decreased with pasture sowing and cultivation. The density of exotic species increased as stocking rate was increased and decreased when pastures were sown (although not at the quadrat scale at Hillgrove). Overall the most diverse vegetation was on plots grazed at high stocking rates; at the plot scale these were native pastures but at the quadrat scale the sown pastures had more species. Among the native and naturalized species, only *Portulaca* spp. were more frequent on the oversown plots than the native pasture plots; 48% (Hillgrove) and 68% (Cardigan) of the species were less frequent on the oversown plots. Fertilizer application had little effect on species frequencies, while timber treatment resulted in both increases and decreases in frequency of a small number of species. The species were divided into four groups on the basis of their responses to stocking rate: a grazing-sensitive group (e.g. *Themeda triandra*), two grazing-tolerant groups which either slightly decreased (e.g. *Chrysopogon fallax*) or slightly increased (e.g. *Sida spinosa*) in frequency as stocking rate increased, and a

fourth group of species which were frequent only at high stocking rates (e.g. *Bothriochloa pertusa*). There were no close relationships between herbage yield and species density.

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394. Pasture management in semi-arid tropical woodlands: Regeneration of degraded pastures protected from grazing.

Mcivor, J. G.

Australian Journal of Experimental Agriculture 41(4): 487-496. (2001)

NAL Call #: 23 Au792; ISSN: 0816-1089

Descriptors: botanical composition/ grass basal area/ grazing/ ground cover/ pasture degradation/ pasture regeneration/ semi arid tropical woodland/ soil cover/ soil seed bank

Abstract: Regeneration of native and oversown pastures following exclusion of grazing was studied over 3 years on a fertile soil at Hillgrove, near Charters Towers, north-east Queensland. The pastures covered a wide range of initial conditions reflecting the grazing pressures they had been exposed to during 2 dry years before enclosure. Pasture measurements made before the exclusion of grazing (yield, botanical composition, basal area, ground cover, height, soil seed banks) were related by regression analysis to subsequent changes in site condition described by a site condition value, calculated from herbage yields and botanical composition, to determine suitable predictors of regeneration during resting from grazing. The pastures recovered (increases in soil cover, grass basal area and the proportion of desirable species) under the generally favourable growing conditions during the period of enclosure although some plots, initially in poor condition, had not recovered after 3 years. There were only minor differences between the native and oversown pasture types in their recovery. Relative yields and site condition values were not affected by pasture type and botanical composition index values differed with pasture type in 1989 only. The site condition values of both pasture types after the first year of enclosure were closely and positively related to all the pasture characteristics measured the previous year except for soil seed numbers in the native pastures. All characteristics could be used to predict site condition value and potential of the pasture to regenerate, and their merits are discussed. The proportion of desirable species in the pasture combined with level of ground cover is suggested as a useful means of predicting regeneration and potential for future grazing.

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395. Pasture production in cleared and uncleared grazing systems of central Queensland, Australia.

Kaur, K.; Jalota, R. K.; Midmore, D. J.; and Rolfe, J.

Rangeland Journal 27(2): 143-149. (2005)

NAL Call #: SF85.4.A8A97; ISSN: 1036-9872

Descriptors: agroforestry/ agroforestry systems/ biomass/ botanical composition/ grassland soils/ grazing/ grazing systems/ land clearance/ silvopastoral systems/ soil pH/ soil types/ species diversity/ sustainability/ microbial biomass

Abstract: Clearing land of trees and introducing exotic pastures to enhance pasture and cattle production and hence enterprise financial performance are widely practised in Queensland. The results from many previous studies on tree clearing have emphasised the gains in pasture

production, but over periods of less than 10-15 years after clearing. The present study questioned the sustainability of pasture production in cleared systems over a longer time-frame (>10 years of clearing). For this, three different age groups of clearing i.e. 5 year, 11-13 year and 33 year were selected in each of 3 major types of tree communities i.e. *Eucalyptus populnea*, *E. melanophloia* and *Acacia harpophylla* in central Queensland. Paired comparisons of cleared and uncleared (intact) pasture systems were selected for each age group of clearing. The results suggest that the initial gains in pasture production upon clearing were compatible with published studies. However, for longer periods of time since clearing, the gains in pasture production were not sustained and were accompanied by risks of land degradation and loss of pasture plant diversity. For *E. populnea* and *A. harpophylla*, the maximum benefits from clearing were achieved at 13-15 years whereas for *E. melanophloia*, any benefits existed only over a short period of 5-6 years. The study emphasises that each tree community exhibits a specific response with regard to the duration of increased pasture production following clearing. To estimate the total benefits from tree clearing in pasture development, it is important to consider both monetary benefits and non-monetary losses from clearing for different types of tree communities.

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396. Pasture renovation and grazing management impacts on cool-season grass pastures.

Cuomo, G. J.; Johnson, D. G.; Forcella, F.; Rudstrom, M. V.; Lemme, G. D.; and Martin, N. P.

Journal of Production Agriculture 12(4): 564-569. (1999)

NAL Call #: S539.5.J68; ISSN: 0890-8524

Descriptors: pastures/ grazing/ range management/ *Medicago sativa*/ *Trifolium pratense*/ *Lotus corniculatus*/ botanical composition/ forage/ dairy cows/ glyphosate/ Fabaceae/ grasses/ sowing/ *Carduus*/ *Cirsium*/ weeds/ economic analysis/ plant communities/ Minnesota

Abstract: Legumes have been shown to increase production in cool-season grass pastures. However, they are included in relatively few acres of pasture. A split plot experiment with six replications was conducted to evaluate the impact of pasture renovation and grazing management on forage production and species composition of cool-season grass pastures. Grazing management main plots were grazed to leave low (2-4 in.), medium (4-6 in.), or high (6-8 in.) residue levels. Main plots were intensively grazed (50 000-70 000 lb of cows per acre) five or six times per grazing season by lactating Holstein cows. Subplot pasture renovation treatments were (i) an untreated check, or sprayed with glyphosate and interseeded with (ii) alfalfa (*Medicago sativa* L.), (iii) red clover (*Trifolium pratense* L.) and birdsfoot trefoil (*Lotus corniculatus* L.), or (iv) "graziers mix" (a mixture of legumes and grasses). Areas that were grazed to leave low residue level produced less forage mass (4.7 ton/acre) than areas grazed to medium (5.4 ton/acre) or high (5.5 ton/acre) residue levels. When averaged across years and grazing management treatments, renovated areas produced 1.8 ton/acre (46%) more forage than the control. Of interseeded species, alfalfa, red clover, and orchardgrass persisted through the study (more than 25% of the dry matter in at least one of the pasture renovation treatments). By June 1998, thistle (*Carduus* and *Cirsium* spp.) was present in all treatments. Fewer thistle was present in areas that were grazed to

leave low residue (10 sq yd) than high residue (18 sq yd) and in renovated areas (9 sq yd) than the control (22 sq yd). The additional forage produced as a result of pasture renovation cost from \$8.07/ton to \$12.81/ton. This study indicates that pasture renovation can be a valuable tool for increasing forage production in cool-season grass pastures. This citation is from AGRICOLA.

397. Pasture yield and composition changes in a central Queensland black speargrass (*Heteropogon contortus*) pasture in relation to grazing management options.

Orr, D. M.; Burrows, W. H.; Hendricksen, R. E.; Clem, R. L.; Rutherford, M. T.; Conway, M. J.; Myles, D. J.; Back, P. V.; and Paton, C. J.

Australian Journal of Experimental Agriculture 41(4): 477-485. (2001)

NAL Call #: 23 Au792; ISSN: 0816-1089

Descriptors: pasture composition/ pasture yield/ rainfall/ stocking rate

Abstract: A grazing study commenced in 1988 at Calliope, Central Queensland, measured the effects of stocking rate, legume over-sowing and animal diet supplements/burning on pasture and animal production in a native black speargrass (*Heteropogon contortus*) pasture. This paper reflects on changes in yield and pasture composition between 1988 and 1996, during which time the seasonal rainfall was below average. At the pasture community scale, the highest stocking rate of 1 steer/2 ha reduced pasture yield but had little impact on pasture composition. The frequency of *H. contortus* showed no clear differences due to stocking rate although there was a slight overall trend for it to decline with time. The frequency of increaser species such as *Chloris divaricata* was highest at the highest stocking rate. At the individual plant scale, the density of *H. contortus* plants declined at high stocking rate. The proportion of the sown legume *Stylosanthes scabra* cv. *Seca* increased with time reaching a density of 15 plants/m² and contributing 33% to the total yield in the legume treatments. Burning has reduced the occurrence of *H. contortus* compared with that in unburnt native pasture and this may be due to the stocking rates being too high following the fire. These results indicate the stability of pasture composition across a 4-fold range of stocking rates from 1988 to 1996. This study needs to continue, at least through a period of above average rainfall, to determine further effects of stocking rate and pasture type on pasture composition.

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398. Persistence and productivity of perennial ryegrass in sheep pastures in south-western Victoria: A review.

Waller, R. A. and Sale, P. W. G.

Australian Journal of Experimental Agriculture 41(1): 117-144. (2001)

NAL Call #: 23 Au792; ISSN: 0816-1089

Descriptors: climate/ environmental conditions/ grazing management/ rotational grazing

Abstract: Loss of perennial ryegrass (*Lolium perenne* L.) from the pasture within several years of sowing is a common problem in the higher rainfall (550-750 mm annual rainfall), summer-dry regions of south-eastern Australia. This pasture grass came to Australia from northern Europe, where it mostly grows from spring to autumn under mild climatic conditions. In contrast, the summers are generally

much drier and hotter in this region of south-eastern Australia. This 'mismatch' between genotype and environment may be the fundamental reason for the poor persistence. There is hope that the recently released cultivars, Fitzroy and Avalon, selected and developed from naturalised ryegrass pastures in south-eastern Australia for improved winter growth and persistence will improve the performance of perennial ryegrass in the region. Soon-to-be released cultivars, developed from Mediterranean germplasm, may also bridge the climatic gap between where perennial ryegrass originated and where it is grown in south-eastern Australia. Other factors that influence perennial ryegrass persistence and productivity can be managed to some extent by the landholder. Nutrient status of the soil is important since perennial ryegrass performance improves relative to many other pasture species with increasing nitrogen and phosphorus supply. It appears that high soil exchangeable aluminium levels are also reducing ryegrass performance in parts of the region. The use of lime may resolve problems with high aluminium levels. Weeds that compete with perennial ryegrass become prevalent where bare patches occur in the pasture; they have the opportunity to invade pastures at the opening rains each year. Maintaining some herbage cover over summer and autumn should reduce weed establishment. Diseases of ryegrass are best managed by using resistant cultivars. Insect pests may be best managed by understanding and monitoring their biology to ensure timely application of pesticides and by manipulating herbage mass to alter feed sources and habitat. Grazing management has potential to improve perennial ryegrass performance as frequency and intensity of defoliation affect dry matter production and have been linked to ryegrass persistence, particularly under moisture deficit and high temperature stress. There is some disagreement as to the merit of rotational stocking with sheep, since the results of grazing experiments vary markedly depending on the rotational strategy used, climate, timing of the opening rains, stock class and supplementary feeding policy. We conclude that flexibility of grazing management strategies is important. These strategies should be able to be varied during the year depending on climatic conditions, herbage mass, and plant physiology and stock requirements. Two grazing strategies that show potential are a short rest from grazing the pasture at the opening rains until the pasture has gained some leaf area, in years when the opening rains are late. The second strategy is to allow ryegrass to flower late in the season, preventing new vegetative growth, and perhaps allowing for tiller buds to be preserved in a dormant state over the summer. An extension of this strategy would be to delay grazing until after the ryegrass seed heads have matured and seed has shed from the inflorescences. This has the potential to increase ryegrass density in the following growing season from seedling recruitment. A number of research opportunities have been identified from this review for improving ryegrass persistence. One area would be to investigate the potential for using grazing management to allow late development of ryegrass seed heads to preserve tiller buds in a dormant state over the summer. Another option is to investigate the potential, and subsequently develop grazing procedures, to allow seed maturation and recruitment of ryegrass seedlings after the autumn rains.

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399. Phalaris persistence under rotational grazing on a highly acidic soil on the south-west slopes of New South Wales.

Li, G. D.; Helyar, K. R.; Conyers, M. K.; Cullis, B. R.; Poile, G. J.; and Knight, P. G.

Australian Journal of Experimental Agriculture 44(8): 771-778. (2004)

NAL Call #: 23 Au792; ISSN: 0816-1089

Descriptors: acid soil/ feed scarcity/ rotational grazing
Abstract: Phalaris (*Phalaris aquatica* L.)-based pastures were established with and without lime in 1992 as a part of a long-term pasture-crop rotation experiment (Managing Acid Soils Through Efficient Rotations). Pre- and post-grazing pasture dry matter, phalaris basal cover and proportion of phalaris in sward were measured since 1992. In general, phalaris persisted well and its productivity was high on the highly acidic soil studied in the current experiment, and this was improved on the limed treatment. After establishment in 1992, the average proportion of phalaris in spring 2001 was 32.1% in the limed treatment and 15.6% in the unlimed treatment. Basal cover at the end of summer 2002 was 4.5% and 2.0% for the limed and unlimed treatments, respectively. The results from the current experiment showed that subsurface acidity (low pH_{Ca} and high exchangeable aluminium percentage in the 10 - 30 cm soil depth) had significant impacts on phalaris persistence. It is concluded that subsurface pH was one of the major constraints for the persistence of phalaris. The long-term management of soil acidity should aim to eliminate the exchangeable aluminium from the soil profile by maintaining a high pH_{Ca} (5.5 or above) in the 0 - 10 cm soil depth. Rainfall during growing season had no direct effect on phalaris persistence. Nevertheless, feed scarcity in dry years due to moisture stress often exacerbated grazing pressure on phalaris, which may affect the phalaris persistence indirectly. It is the grazing management in autumn and summer that had significant effects on phalaris persistence. It is suggested that rotational grazing plus strategic rest if possible in autumn could prolong the life of phalaris-based pastures. Repeated heavy grazing should be avoided during summer, particularly after light to moderate summer rainfall events have stimulated sprouting.

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400. A pilot scale long-term experimental study on the effects of grazing and gap creation on burren grassland dynamics: Implications for conservation.

Moles, R.; Breen, J.; and O'regan, B.

Biology and Environment 105B(1): 15-32. (2005);

ISSN: 0791-7945

Descriptors: vegetation dynamics/ grazing effect/ limestone pavement

Abstract: Burren grassland is an important habitat for biodiversity conservation, but studies to date have not provided sufficient scientific understanding of vegetation dynamics to inform selection of appropriate management prescriptions. This paper reports on a pilot scale study on a small grassland patch on limestone pavement near Mullach More in the Burren National Park. Through experimental manipulation, it examines the effects of grazing and bare soil gap creation on vegetation dynamics and reproductive success over six years, with a focus on temporal changes in cover, species richness, flowering rates, turnover and mobility. Cessation of grazing resulted in very marked

frequency reductions for most species, but increases for some grasses and increased flowering frequency in some forb species. Gap creation resulted in vegetation change that persisted for at least two years under ungrazed treatment, but for six years in grazed sward. Soil depth decreased under grazing but increased under ungrazed treatment. The grassland patch had attributes suggestive of both equilibrium and non-equilibrium vegetation dynamics. As the small study area selected may not be fully representative of the markedly heterogeneous Burren landscape, this paper does not arrive at conclusions in relation to all Burren grasslands and their conservation, but rather identifies some attributes important in informing prescription selection that require further testing at larger scale.

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401. Plant responses to grazing, and opportunities for manipulation.

Bullock, J. M. and Marriott, C. A.

In: *Grazing management*. (Held 2 Feb 1929-2 Mar 2000 at Harrogate, United Kingdom.) Rook, A. J. and Penning, P. D. (eds.); pp. 17-26; 2000.

NAL Call #: SB197.B7; ISBN: 0905944542

402. Plant species diversity and management of temperate forage and grazing land ecosystems.

Sanderson, M. A.; Skinner, R. H.; Barker, D. J.; Edwards, G. R.; Tracy, B. F.; and Wedin, D. A.

Crop Science 44(4): 1132-1144. (July 2004-Aug. 2004)

NAL Call #: 64.8 C883; ISSN: 0011-183X

Descriptors: literature reviews/ temperate zones/ grasslands/ pastures/ species diversity/ ecosystem management/ pasture management/ forage production/ plant communities/ forage/ grazing/ ecological function/ economic impact/ environmental impact/ biogeochemical cycles/ animal production

Abstract: More than a century since Charles Darwin stated that diverse grasslands produce more herbage than monocultures, scientists still debate the relationship between species diversity and ecosystem function.

Postulated benefits of diversity in experimental grasslands include greater and more stable primary production along with more efficient nutrient use. These benefits have been extrapolated to forage and grazing land systems with little supporting objective data. Most information on the potential benefits of increased plant diversity comes from studies of synthesized grasslands that have not included domestic grazing animals. We explore this debate relative to the management of temperate forage and grazing lands. Plant species diversity refers to the number of species (richness) and their relative abundance (evenness) within a defined area. Plant relations influence biodiversity responses through positive (e.g., facilitation, N₂ fixation, hydraulic lift) and negative interactions (e.g., competitive exclusion, allelopathy). Early 20th century research on complex mixtures of forage species (limited to grasses and legumes) for pasture indicated equivocal results regarding benefits of species-rich mixtures and typically recommended using the best adapted species in simple grass-legume mixtures. Recent research indicates potential herbage yield benefits from species-rich mixtures for pastures. Limited animal productivity research on species-rich mixtures indicates variable responses and much more research is needed. Grazing land productivity is a primary focus for biodiversity

benefits because of the direct economic relevance to producers. However, taking a broader view of the multifunctionality of grazing lands to include environmental and aesthetic benefits to humans reveals a great scope for using biodiversity in grazing land management. This citation is from AGRICOLA.

403. Plant species responses to cattle grazing in mesic semi-natural grassland.

Pykala, J.

Agriculture, Ecosystems & Environment 108(2): 109-117. (2005)

NAL Call #: S601 .A34; ISSN: 0167-8809

Descriptors: grasslands/ range management/ cattle feeding/ grazing/ agroecosystems/ ecological restoration/ species diversity/ plant ecology

Abstract: Cattle grazing is generally recommended for management of semi-natural grassland, but its effects on flora are insufficiently studied in northern Europe. Plant species responses to cattle grazing of mesic semi-natural grasslands were studied in SW Finland managed by private farmers under three kinds of management: old (continuously grazed, n = 10), restored new (grazing restarted 3-8 years ago, n = 10) and abandoned pastures (grazing ceased >10 years ago, n = 11). Positive effects of cattle grazing were observed on most grassland plants, 34 species being significantly more frequent in grazed than in abandoned grassland and four in abandoned than in grazed grassland. The frequencies of most species in restored new pastures were between those observed in old and in abandoned pastures. Changes in species number with different Ellenberg indicator values showed that grazing increased the number of species indicating nitrogen-poor soils, high light intensity and low soil moisture, but decreased species indicating nitrogen-rich soils. Grazing was beneficial to indicator species of both high and low pH. Species numbers in new pastures were consistently between those of old and abandoned pastures. Based on Ellenberg indicator values, restored grazing changed species assemblages towards that of old pastures. Many grassland species seem to recover under grazing regimes applied by private farmers, but insufficient management quality may prevent full success of restoration.

This citation is from AGRICOLA.

404. Post-pastoral changes in composition and guilds in a semi-arid conservation area, Central Otago, New Zealand.

Walker, Susan

New Zealand Journal of Ecology 24(2): 123-137. (2000)

NAL Call #: QH540.N43; ISSN: 0110-6465

Descriptors: competition/ exotic species/ grazing cessation/ guild composition/ post pastoral succession/ semi arid conservation area: post pastoral change/ species diversity/ species invasion/ species richness

Abstract: Changes in the vegetation of Flat Top Hill, a highly modified conservation area in semi-arid Central Otago, New Zealand, are described four years after the cessation of sheep and rabbit grazing. Unusually moist weather conditions coincide with the four-year period of change in response to the cessation of grazing. Between 1993 and 1997, the average richness and diversity (H') of species increased, and the average proportion of native species decreased significantly. The vegetation was

significantly richer in exotic annual and perennial grass species, exotic perennial forbs, exotic woody species and native tussock grasses in 1997 than in 1993. Eight response guilds of species are identified. Most "remnant" native shrubs and forbs were stable, in that they remained restricted to local refugia and showed little change in local frequency. However, taller native grass species increased, some locally, and others over wide environmental ranges. Rare native annual forbs and several native perennial species from "induced" xeric communities decreased, and this may be a consequence of competition from exotic perennial grasses in the absence of grazing. The invasive exotic herb *Sedum acre* decreased in abundance between 1993 and 1997, but several other prominent exotic species increased substantially in range and local frequency over a wide range of sites. Exotic woody species, and dense, sward-forming grasses are identified as potential threats to native vegetation recovery.

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405. The productivity of irrigated legumes in northern Victoria: Effect of grazing management.

Kelly, K. B.; Stockdale, C. R.; and Mason, W. K.

Australian Journal of Experimental Agriculture 45(12): 1577-1585. (2005)

NAL Call #: 23 Au792; ISSN: 0816-1089

Descriptors: biomass production/ carbon/ crop establishment/ defoliation/ dry matter/ grass sward/ grassland management/ grasslands/ grazing/ grazing intensity/ growth rate/ irrigated conditions/ leaf area/ legumes/ lucerne/ persistence/ photosynthesis/ regrowth/ seasonal variation/ sown grasslands/ stolons

Abstract: The productivity of irrigated white (*Trifolium repens* L.) and red (*Trifolium pratense* L.) clover swards was compared in an experiment of more than 3 years duration. It was hypothesised that white clover would be more productive than red clover when defoliation was frequent and intense, and less productive when defoliation was infrequent and lax. The experiment was a factorial design involving 2 species of clover [white clover (cv. Haifa) and red clover (cv. Redquin)], 2 grazing frequencies and 2 grazing intensities (with the criteria for both being based on quantities of herbage present before/after grazing). There were 4 extra treatments sown: perennial ryegrass (*Lolium perenne* L. cv. Grasslands Nui) and white clover (cv. Haifa), lucerne (*Medicago sativa* L. cv. Validor), Persian clover (*Trifolium resupinatum* L. cv. Maral) or subterranean clover (*Trifolium subterraneum* L. cv. Trikkala), but only 1 defoliation treatment was used for each of these treatments. There were 4 replicated blocks of all treatments. Apparent growth rates [calculated from measurements of dry matter (DM) removed by grazing] of white clover ranged from a low of 10 kg DM/ha.day in winter to a high of 70 kg DM/ha.day in summer. The growth rates of white clover swards were superior to those of ryegrass and white clover swards over summer, but were generally lower from May to October. In 2 of the 4 years, frequent grazing of white clover resulted in greater (P<0.05) production than infrequent grazing (average of 12.8 v. 10.7 t DM/ha) whereas intensity of grazing only affected DM net accumulation in the first year (P<0.05). The data show no evidence of a decline in productivity over time. Sward structure of white clover was influenced by grazing treatment with the numerically highest yielding treatment (frequent and hard) having the highest density of stolon tips

(vegetative buds). In relation to days of regrowth, the frequently grazed treatment had higher levels of net photosynthesis in spring and summer compared with the infrequently grazed treatment. The frequently grazed treatment achieved positive carbon balance immediately after grazing and reached maximum levels of photosynthesis at 8-10 days, whereas the infrequent treatment showed negative carbon balance for the first 2-3 days after grazing with maximum photosynthesis being achieved later than in the frequently grazed treatment. When net photosynthesis was related to leaf area, there were fewer differences between the 2 treatments. The exception was in spring when photosynthesis was lowest where the initial leaf area was highest in the infrequent and hard treatment. Maximum photosynthesis was achieved at diminishing leaf area index from spring through to winter. Red clover was the most productive legume in the first year after establishment, but it did not persist beyond the second year and its DM net accumulation was reduced by more frequent grazing (12.4 v. 15.3 t DM/ha in the first year and 6.1 v. 9.1 t DM/ha in the second year; $P < 0.05$). The DM net accumulation of lucerne was greater than that in any other treatment (an average of 16.7 t DM/ha in the 2 completed years), whereas the annual legumes, subterranean clover and Persian clover, averaged 6.6 and 10.7 t DM/ha.year, respectively. The seasonal growth rate data showed that lucerne had very good summer production whereas the annuals tended to be at least as good as the perennials from May to October.

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406. Quantity and quality changes of autumn-saved pasture in a high country winter.

Abrahamson, M. and Talbot, J.

New Zealand Journal of Experimental Agriculture 14(3): 247-256. (1986)

NAL Call #: S542.A1N45; ISSN: 0301-5521

Descriptors: Poaceae/ Trifolium/ botanical composition/ highlands/ crop quality/ quantitative analysis/ digestibility/ range management/ grazing/ New Zealand

This citation is from AGRICOLA.

407. Recent changes in grassland management and their effects on botanical composition.

Hopkins, A.; Bunce, R. G. H.; and Smart, S. M.

Journal of the Royal Agricultural Society of England 161: 210-223. (2000)

NAL Call #: 10 R81; ISSN: 0080-4134

Descriptors: biodiversity/ botanical composition/ drainage/ fertilizers/ grassland management/ grasslands/ nature conservation/ pest control/ pesticides/ pests/ reviews/ weeds/ intensification/ carrying capacity/ grazing

Abstract: This article discusses the factors that have led to the evolution of grass and arable land in British landscape, and examines the evidence from surveys of the changes to grassland that agriculture has brought about in recent decades. The effects of the various components of grassland management and how they have contributed to the present situation, and some comments on the effects of future developments, are also considered. The losses of natural and semi-natural grasslands, and reduction in biological diversity with increased intensification are outlined. Grassland management practices covered are:

ploughing and reseeded; land drainage; fertilizers; stocking rates and grazing pressure; weeds and pests and their control.

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408. Recovery of short tussock and woody species guilds in ungrazed *Festuca novae-zelandiae* short tussock grassland with fertiliser or irrigation.

Walker, S.; Wilson, J. B.; and Lee, W. G.

New Zealand Journal of Ecology 27(2): 179-189. (2003)

NAL Call #: QH540.N43; ISSN: 0110-6465

Descriptors: fertilization: applied and field techniques/ irrigation: applied and field techniques/ conservation management/ grasslands/ grazing/ guild recovery/ native cover/ pastoral management/ soil nutrients/ species richness/ succession

Abstract: In a *Festuca novae-zelandiae* short tussock grassland in South Island, New Zealand, we tested the propositions (1) that present regional trends in vascular plant species-richness in tussock grasslands are independent of current pastoral management, and (2) that grazing retards the invasion and dominance of non-native species, particularly where soil resources are not limiting. Sheep and rabbit-grazed, ungrazed, ungrazed+fertilised and ungrazed+irrigated treatments were applied in a replicated experiment that was sampled annually from 1988 to 2000. Native species richness and native forb cover decreased, and exotic grasses increased in all treatments, with no significant differences between grazed and ungrazed treatments in either trends or final cover. Exotic species richness decreased in the ungrazed, ungrazed+fertilised and ungrazed+irrigated treatments but showed no trend in grazed vegetation. Cover of native tussock grasses and the tall shrub *Carmichaelia petriei* decreased in the grazed treatment, remained steady in the ungrazed treatment and increased in the ungrazed+fertilised and ungrazed+irrigated treatments. Native subshrubs decreased in the grazed, ungrazed+fertilised and ungrazed+irrigated treatments but not in the ungrazed treatment. The invasive forb *Hieracium pilosella* increased with time in grazed, ungrazed, and ungrazed+irrigated treatments, but after 10 years it decreased in the ungrazed+fertilised treatment and its cover was negligible there after 12 years. Grazing appeared to reduce the cover of tussocks and certain woody species, and we conclude that current management affected vegetation trends. Grazing did not decrease the dominance of exotic species, or maintain native species richness at a higher level than in ungrazed vegetation. There was limited recovery of taller native species with grazing removal alone. However, grazing removal plus 12 years of resource enrichment promoted the growth of native tall shrubs and tussocks and did not result in physiognomic dominance by exotic species. Succession towards taller native tussock-shrubland communities may be an appropriate goal for conservation management of short tussock grasslands, and nutrient enrichment in the absence of grazing may be an appropriate management device in some circumstances.

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409. Relationships between ammonia volatilization and nitrogen fertilizer application rate, intake and excretion of herbage nitrogen by cattle on grazed swards.

Bussink, D. W.

Fertilizer Research 38(2): 111-121. (1994)

NAL Call #: S631.F422; ISSN: 0167-1731

Descriptors: grassland soils/ ammonia/ volatilization/ losses from soil/ nitrogen fertilizers/ cattle/ rotational grazing/ forage/ nitrogen/ nutrient intake/ nutrient retention/ excreta/ range management/ meteorological parameters/ cation exchange capacity/ application rate/ mathematics and statistics

Abstract: Grazed pastures emit ammonia (NH₃) into the atmosphere; the size of the NH₃ loss appears to be related to nitrogen (N) application rate. The micrometeorological mass balance method was used to measure NH₃ volatilization from rotationally grazed swards on three plots in the autumn of 1989 and throughout the 1990 growing season. The aim of the research was to derive a mathematical relationship between NH₃ volatilization and N application rate, which would vary between soil type and weather conditions. In both years the plots received a total of 250, 400 or 550 kg N ha⁻¹ as calcium ammonium nitrate (CAN) split over 6 to 8 dressings. The number of grazing cycles ranged from 7 to 9 for the three N plots. In the last two grazing cycles of 1989, NH₃ losses were 3.8, 12.0 and 14.7 kg N ha⁻¹ for the 250N, 400N and 550N plots, which was equivalent to 5.3%, 13.9% and 14.4% of the amount of N excreted on the sward, respectively. In 1990, NH₃ losses were 9.1, 27.0 and 32.8 kg N ha⁻¹ for the 250N, 400N and 550N plots, which was equivalent to 3.3%, 6.9% and 6.9% of the N excreted, respectively. Differences in urine composition between the plots were relatively small. Rainfall and sward management affected the size of the NH₃ volatilization rate. Volatilization of NH₃ was related to N excretion and N application rate. A calculation procedure is given to enable the estimation of NH₃ volatilization from N application rate. Adjustments can be made for grazing efficiency, grazing selectivity, N retention in milk and liveweight gain, concentrate N intake and milking duration. Losses of NH₃ increase progressively with an increase in N application rate until herbage yield reaches a maximum at an application rate of about 500 kg N ha⁻¹ yr⁻¹.

This citation is from AGRICOLA.

410. Relationships between soil biota, nitrogen and phosphorus availability, and pasture growth under organic and conventional management.

Parfitt, R. L.; Yeates, G. W.; Ross, D. J.; Mackay, A. D.; and Budding, P. J.

Applied Soil Ecology 28(1): 1-13. (2005)

NAL Call #: QH541.5.S6 A67; ISSN: 0929-1393

Descriptors: animals and man/ disturbance by man/ commercial activities/ ecology/ population dynamics/ habitat/ terrestrial habitat/ abiotic factors/ land zones/ Australasian Region/ Australasia/ Nematoda: farming and agriculture/ community structure/ population density/ soil fauna/ grassland/ pasture/ soil community composition and densities/ habitat management and nutrient availability relationships/ soil habitat/ community composition and densities/ pasture management and nutrient availability relationships/ chemical factors/ soil nutrient availability/ pasture management and soil community relationships/ New Zealand/ Ballantrae/ pasture management/ soil community and nutrient availability relationships/

Nematoda/ annelids/ invertebrates/ nematodes

Abstract: Legume-based pastures generally rely on soil biological activity to provide nitrogen (N) for plants. This study examined seasonal pasture growth in nine adjacent hill pastures, under sheep or beef, with different long-term managements, including certified organic, no fertilizer, and conventional fertilizer application, that formed a sod-fertility sequence. We determined relationships between net N mineralization, as a measure of soil biological activity and N availability, and microbial biomass, soil organic matter, and fauna. Net N mineralization generally explained differences in pasture production ($r = 0.87$). On an areal basis, net N mineralization was strongly related ($r = 0.93$) to total soil N (0-200 mm depth) and negatively related ($r = -0.92$) to soil C:N ratio, but not to soil C. Total N and C:N ratios were related to soil phosphorus (P) status and probably past N fixation by legumes. Where labile P was low, the N:P ratios of both soil microbes and enchytraeids were wide, and the organisms appeared to be P limited, possibly competing with plants for P. Faunal grazing on soil micro-organisms appeared to release P. We could find no convincing evidence that net N mineralization, pasture growth or soil biological diversity increased under organic farming. Rather, the data from organic pastures followed similar trend lines to data from pastures under conventional management. Copyright 2004 Elsevier B. V. All rights reserved.

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411. Restricted autumn grazing to reduce nitrous oxide emissions from dairy pastures in Southland, New Zealand.

De Klein, C. A. M.; Smith, L. C. B.; and Monaghan, R. M. *Agriculture, Ecosystems & Environment* 112(2-3, Sp. Iss. SI): 192-199. (2006)

NAL Call #: S601 .A34; ISSN: 0167-8809

Descriptors: greenhouse gas emissions/ dairy pastures/ restricted autumn grazing

Abstract: Animal excreta deposited on pasture during grazing represent the single largest source of N₂O emissions in New Zealand. These emissions are highest when pastures are grazed during the wet autumn/winter season. The strategic use of a feed pad on dairy farms could restrict the amount of excreta N returned to pasture during this time of year, and thus reduce N₂O emissions and other environmental losses. The effect of restricting autumn grazing to 3 h per day on N₂O emissions and NO₃ leaching losses was measured in a 3-year field study. Nitrous oxide emissions were measured weekly between April and September using a soil cover methodology. Nitrate leaching losses were measured from the NO₃ concentration of drainage water that was collected from the hydrologically isolated and artificially drained field plots. Restricted autumn grazing reduced both N₂O emissions and NO₃ leaching losses from grazed pasture by about 40%. The effect of this grazing regime on total on-farm N₂O emissions was estimated using the field measurements and the New Zealand IPCC inventory methodology. These calculations indicated that restricted autumn grazing could reduce direct and indirect on-farm N₂O emissions by 7-11%, and could thus be an effective tool for reducing N₂O emissions, while also reducing NO₃ leaching losses, and preventing soil and sward damage. The study further highlighted that the currently used IPCC inventory methodology cannot easily account for reductions in

national N₂O emission following adoption of N₂O mitigation strategies. It also reinforced the need for assessing the impact of mitigation strategies at a whole farm level. (c) 2005 Elsevier B.V. All rights reserved.
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412. A review of cattle grazing effects on lake margin vegetation with observations from dune lakes in Northland, New Zealand.

Tanner, C. C.

New Zealand Natural Sciences 19: 1-14. (1992);
ISSN: 0113-7492

Descriptors: bacterial contamination/ endangered plant/ erosion/ native vegetation/ trampling/ wildlife habitat
Abstract: Lake margin vegetation has become increasingly valued as a habitat for wildlife and as a moderator of sediment and nutrient inputs from surrounding catchments. This has encouraged action to exclude livestock from Lake shorelines. Cattle grazing effects are reviewed in relation to natural grazing of lake margin vegetation. Direct consumption and trampling of plant biomass by livestock affects the structure, diversity, productivity, succession and nutrient dynamics of plant communities. In addition, livestock grazing may affect lake marginal vegetation and water quality by pugging and erosion of lakeshores, nutrient addition, bacterial contamination and promotion of weed invasion. Agricultural modification of surrounding catchments also causes many indirect effects such as increased nutrient runoff and changed hydrological regimes. However, low levels of grazing can result in beneficial changes in lake margin vegetation by reducing domination by tall rank species and increasing plant and habitat diversity. Observations of cattle grazing impacts on the lake margin vegetation of Northland dune lakes showed a graded range of effects dependant largely on grazing pressure. Ungrazed, agriculturally undeveloped shortlines were characterised by *Leptospermum scoparium* growing to the wetted margin, grading into an inshore zone of mixed sedges (*Baumea juncea*, *B. huttonii*, *Leptocarpus similis*, and *Eleocharis acuta*) to 0.3-0.8 m depth, an outer sedge zone of *Eleocharis sphacelata* to 1-2 m depth, then a sharp boundary into fully submerged communities of charophytes and *Potamogeton* spp. in deeper water. At sites subject to heavy grazing pressure inshore sedge communities were absent, leaving only a remnant outer zone of emergent *E. sphacelata* in water too deep to graze. Sites with light to moderate grazing pressure were associated with more open inshore sedge zones showing an increased diversity and abundance of short shallow-water species including *Miriophyllum*, *Potamogeton*, *Lilaeopsis*, *Juncus* and *Triglochin* spp., and in some areas the endangered species *Hydatella inconspicua*. It is concluded that although heavy grazing of lakeshores is clearly detrimental to marginal vegetation, low levels of grazing may be an appropriate management tool in areas of some lakes to promote more diverse inshore habitats for plants and wildlife.

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413. Role of grazing management in manipulating the balance of rye grass (*Lolium* spp.) and paspalum (*Paspalum dilatatum*) in pastures.

Percival, N. S. and McClintock, M. B.

New Zealand Journal of Experimental Agriculture 10(4): 365-370. (1982)

NAL Call #: S542.A1N45; ISSN: 0301-5521

Descriptors: productivity/ New Zealand

Abstract: The effects of 2 spring and 4 summer grazing managements on the productivity and composition of a ryegrass-paspalum pasture are described. Lax spring grazing decreased paspalum content and increased that of ryegrass, whereas hard spring grazing had the opposite effect. Very hard summer grazing increased tillering of paspalum, but had no effect on its contribution to yield. Very lax summer grazing maximized content of paspalum. Management induced differences in paspalum content of mixed pasture had no effect on pasture yield. This was contrary to the pattern of previous New Zealand studies, and may be related to moisture availability of the soil type on which the trial was located. The role of paspalum in New Zealand pastures is discussed, and reasons are advanced to explain its decreasing abundance.

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414. The role of white clover in the loss of diversity in grassland habitat restoration.

Warren, John M.

Restoration Ecology 8(3): 318-323. (2000)

NAL Call #: QH541.15.R45R515; ISSN: 1061-2971

Descriptors: abundance/ community diversity/ cutting intensity/ grassland habitat restoration/ grazing/ habitat creation/ sowing density/ species richness

Abstract: A field experiment was designed to recreate a species-rich mesotrophic grassland community of conservation worth. *Trifolium repens* (white clover) was observed to increase significantly in both frequency and abundance in sown plots grazed by cattle, but not in plots cut in June and subsequently grazed by cattle. In both these treatments permanent quadrats containing clover patches were found to be lower in species richness than were quadrats without clover. In both treatments botanical diversity was seen to decline over time. In the grazed-only treatment the loss of diversity may be linked to the increase in clover. In the cut and grazed plots, *T. repens* did not become so abundant but diversity was still seen to decline, possibly due to the loss of low growing species from the taller sward. A pot experiment which varied the sowing density of a mix of seven wild flower species in full factorial combination with cutting frequency was established on soils from an arable field also sown with a single density of clover. *T. repens* was seen to decline from initial high cover estimates in infrequently cut and uncut treatments. In the pot experiment where a grass component to the vegetation was absent, clover was seen to have less impact on the other forbs than it did in the field. It is suggested that, being a nitrogen fixer, *T. repens* may have a competitive edge in ex-arable soils low in available nitrogen. The observed reduction in botanical diversity may be a result of this increase in available nitrogen, facilitating the spread of the sown grasses and preventing the recovery of the sown forbs that were excluded by the invasion of *T. repens*. It is suggested that reducing the proportion of grass in the seed mixtures during grassland habitat creation on these soils may help reduce or delay this effect.

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415. Seasonal changes in quality and botanical composition of a rotationally grazed grass-legume pasture in southern Ontario.

Marshall, S. A.; Campbell, C. P.; and Buchanan-Smith, J. G.

Canadian Journal of Animal Science 78(2): 205-210. (1998)

NAL Call #: 41.8 C163; ISSN: 0008-3984

Descriptors: pastures/ Poaceae/ Fabaceae/ rotational grazing/ forage/ botanical composition/ seasonal variation/ cattle/ grazing intensity/ weeds/ crude protein/ in vitro digestibility/ protein content/ rumen fermentation/ energy content/ metabolizable energy/ dietary fiber/ Ontario

Abstract: Seasonal changes in quality and botanical composition of a grass-legume pasture were investigated under a controlled rotationally grazed system. A 19.2-ha area divided into sixteen 1.2-ha fields, each subdivided into eight paddocks, was grazed by 40 cows with calves over three consecutive summers. Grazing was managed by setting target sward heights for exit of each paddock between 8 and 10 cm and allowing at least 25 to 30 d for regrowth. Herbage growth in those paddocks not grazed by cow-calf pairs was consumed by yearling heifers on a "put and take" basis. Paddocks were topclipped at 10 cm and fertilized with 34 kg ha⁻¹ of N immediately following the second grazing cycle. Botanical composition changed both within and among the grazing seasons. Legume content of the pasture increased ($P < 0.05$) throughout the grazing season, while grass content declined ($P < 0.05$) across all 3 yr. The amount of weeds and dead material averaged 8.9 and 3.8%, respectively, over the 3 yr. Crude protein (CP), in vitro organic matter digestibility (IVOMD), soluble protein (% total CP), rumen degradable protein (RDP) (% total CP) and metabolizable energy (ME) decreased ($P < 0.05$) from May to June in each season and then increased ($P < 0.05$) to or surpassed levels seen at the beginning of the grazing seasons (May). Neutral detergent fibre (NDF) and acid detergent fibre (ADF) content increased ($P < 0.05$) during June and July and were lowest in the spring and the fall across all 3 yr. Mean entry sward heights were 24.8, 30.3 and 28.1 cm for years 1, 2 and 3, respectively. Pre-grazing sward height was negatively correlated to CP ($n = 786$, $r = -0.38$, $P < 0.0001$) and IVOMD ($n = 786$, $r = -0.45$, $P < 0.0001$), but positively related to NDF ($n = 786$, $r = 0.43$, $P < 0.0001$) and ADF ($n = 786$, $r = 0.68$, $P < 0.0001$) across all 3 yr. The highest CP and IVOMD of the pasture were measured at a sward height of between 12 and 15 cm. Pasture quality varied both within and across all three grazing seasons but remained relatively high and was influenced by botanical composition and sward surface height.

This citation is from AGRICOLA.

416. Seasonal variations in radiocaesium uptake by reseeded hill pasture grazed at different intensities by sheep.

Salt, C. A. and Mayes, R. W.

Journal of Applied Ecology 28(3): 947-962. (1991)

NAL Call #: 410 J828; ISSN: 0021-8901

Descriptors: Lolium perenne/ Festuca rubra/ Trifolium repens/ Cerastium fontanum/ herbage content/ sward height/ soil injection/ contamination level/ toxicity/ 1986 Chernobyl nuclear accident/ Scotland/ UK/ radiocaesium

Abstract: On a reseeded hill pasture in north-east Scotland [UK], two grass/clover swards were continuously grazed by sheep to maintain sward heights of 3 and 5 cm from May to

September in 1988 and 1989. Within small areas of pasture, ¹³⁴Cs was injected into the peaty topsoil in June 1988 and the uptake by the vegetation was recorded during both years. ¹³⁴Cs concentrations in the herbage increased in spring and decreased in autumn, but considerable fluctuations occurred during the growing season. The pattern of these fluctuations and the overall concentration of ¹³⁴Cs in the herbage varied between years, whereas there was no change in ¹³⁴Cs concentration in the top 5 cm of the soil. On both swards the seasonal patterns of Lolium perenne, Festuca rubra, Trifolium repens, and Cerastium fontanum were similar. In all species except C. fontanum, ¹³⁴Cs concentrations were higher on the 5-cm sward than on the 3-cm sward. In summer, concentrations in C. fontanum were 4-6 times higher than those in the other species. Depending on season and sward height, 0.3-2% of the ¹³⁴Cs injected into the soil was present in the sward. The total amount of ¹³⁴Cs taken up by the sward during the growing season was equivalent to 1.5-8.5% of the amount injected.

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417. Seasonal vegetation changes in mountain pastures due to simulated effects of cattle grazing.

Kohler, F.; Gillet, F.; Gobat, J. M.; and Buttler, A.

Journal of Vegetation Science 15(2): 143-150. (2004)

NAL Call #: QK900.J67; ISSN: 1100-9233

Descriptors: liquid waste manuring: applied and field techniques/ mowing: applied and field techniques/ multivariate analysis: mathematical and computer techniques/ trampling simulation: applied and field techniques/ herbivore grassland dynamics interaction: dung deposition, herbage removal, trampling

Abstract: Cattle influence grassland dynamics in three ways: herbage removal, dung deposition and trampling. The objective of this study was to assess the effects of these factors, separately or in combination, and to compare them with cattle grazing over a one year period in a field experiment conducted in the Jura Mountains of northwestern Switzerland. A set of controlled treatments simulating the three factors was applied in a fenced area: (1) repeated mowing - three levels; (2) intensive trampling - two levels; (3) manuring with a liquid mixture of dung and urine - three levels. All treatments were applied homogeneously to the entire surface of each of the 40 plots inside the enclosure. Additionally, ten plots outside the fenced area represented reference plots with regular cattle pasturing. The multivariate response of species composition was assessed three times with the point-intercept method: in spring before the treatments, in autumn after one season of treatments and at the beginning of the following year after winter rest. Multivariate analyses of vegetation data in the first year showed an overwhelming seasonal shift and significant differences induced by treatments. Abandoned and manured plots showed the largest deviation from the cattle grazed reference. Herbage removal, simulated by repeated mowing, appeared to be the most important factor for maintaining vegetation texture. Seasonal treatment effects were only partially carried over to the next spring, showing an unexpected resilience of the plant community, probably due to life-history traits and competition release following climatic disturbance in winter.

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418. Seedbank diversity in grazing lands of the Northeast United States.

Tracy, B. F. and Sanderson, M. A.
Journal of Range Management 53(1): 114-118. (2000)
NAL Call #: 60.18 J82; ISSN: 0022-409X
http://jrm.library.arizona.edu/data/2000/531/114-118_tracy.pdf

Descriptors: cattle/ rotational grazing/ cutting/ *Poa pratensis*/ *Trifolium repens*/ botanical composition/ seed germination/ biomass/ Northeastern United States
Abstract: We evaluated the species composition of soil seed banks from 9 farms (36 pastures total) located in the northeast United States. Our objective was to quantify the soil seed bank composition of pastures managed for intensive grazing and hay production. Seeds from pasture soils were allowed to germinate in a greenhouse under natural light conditions. Seedlings were identified as they germinated, and the experiment was concluded after 4 months. Germinable seed was dominated by annual (40%) and perennial (23%) forbes most of which contributed little useful forage for cattle. Perennial grasses (11%), except for bluegrass (*Poa pratensis* L.), were largely absent from the terminable seed bank, while legumes (19%) were more abundant. Seed bank species composition showed little similarity (44%) to the existing vegetation. Exceptions were bluegrass, white clover (*Trifolium repens* L.), and common dandelion (*Taraxacum officinale* Weber ex Wiggers). These species were abundant in both the germinable seed bank and existing vegetation on most pastures. Overall, our study suggests that seed banks in these northeast pastures support abundant white clover and bluegrass seed, both of which are important forages for cattle. Soil seed banks, however, will not supply a diverse assemblage of useful forages. If a manager seeks to establish diverse, mixed-species pasture, then re-seeding pastures with desired mixes may be the best option.
This citation is from AGRICOLA.

419. Sequential grazing of cool- and warm-season pastures.

Moore, K. J.; White, T. A.; Hintz, R. L.; Patrick, P. K.; and Brummer, E. C.
Agronomy Journal 96(4): 1103-1111. (2004)
NAL Call #: 4 AM34P; ISSN: 0002-1962
Descriptors: *Bromus inermis*/ *Lotus corniculatus*/ *Medicago sativa*/ *Trifolium ambiguum*/ *Andropogon gerardii*/ *Panicum virgatum*/ botanical composition/ pasture plants/ pastures/ intercropping/ continuous cropping/ pasture management/ beef cattle/ rotational grazing/ liveweight gain/ summer/ spring/ autumn/ Iowa
Abstract: Pasture productivity in Iowa is often limited by low productivity of cool-season grasses during summer. Our overall objectives were to (i) evaluate the impact of legumes on the productivity and nutritive value of cool-season pastures, (ii) evaluate warm-season grasses for summer grazing, and (iii) determine the effects of pasture sequence on the productivity of season-long grazing systems. Cool-season pastures consisted of smooth brome grass (*Bromus inermis* Leyss.) alone or in mixture with birdsfoot trefoil (*Lotus corniculatus* L.), alfalfa (*Medicago sativa* L.), or kura clover (*Trifolium ambiguum* M. Bieb.). Warm-season pastures were monocultures of big bluestem (*Andropogon gerardii* Vitman) or switchgrass (*Panicum virgatum* L.). Kura clover was the only legume that persisted well over time, and because of this, pastures

interseeded with kura clover maintained a higher nutritive value than either those interseeded with alfalfa or birdsfoot trefoil. This resulted in higher total liveweight gains for cattle grazing sequences that included pastures interseeded with kura clover. In general, rotating cattle to warm-season grass pastures during summer was less advantageous than having them remain on cool-season pastures at a lower stocking rate because warm-season pasture nutritive value was lower and declined more rapidly. However, despite lower nutritive value and consequently animal performance, sequences with warm-season grass pastures did perform well under some conditions and may be a desirable alternative under some circumstances. Having a warm-season grass pasture in the grazing sequence provides an opportunity to relieve cool-season pastures when growth conditions become limiting and introduces flexibility into the management system.
This citation is from AGRICOLA.

420. Sheep grazing as a management tool for heathland conservation and regeneration in the Netherlands.

Bakker, J. P.; De Bie, S.; Dallinga, J. H.; Tjaden, P.; and De Vries, Y.
Journal of Applied Ecology 20(2): 541-560. (1983)
NAL Call #: 410 J828; ISSN: 0021-8901
Descriptors: *Lolium perenne*/ *Juncus effusus*/ *Calluna vulgaris*/ *Erica tetralix*/ vegetation/ woodland/ rosette/ plant cover/ dung/ species richness/ diversity mapping
Abstract: In 1972, 11 ha of heathland, woodland and pasture was fenced in for a sheep-grazing experiment with the aim of rejuvenating the heathland vegetation and regenerating heathland from the pasture. The research objective was to find out how far vegetation changes could be related to different grazing intensities. Comparison with a hay-making regime was also part of the design. Grazing intensity was determined for different sections of the fenced area, from the amount and dispersion of voided dung. Vegetation changes were recorded by sequential vegetation mapping and permanent plots. During the summer period, the sheep preferred pasture and during the winter period heathland and woodland. Great differences in preference for individual pasture sections were found, probably caused by the character of the vegetation. Areas with the greatest rate of dunging contained shorter pasture vegetation, higher rosette plant cover and, to a lesser degree, greater persistence of *Lolium perenne* and lower cover of *Juncus effusus*/*Agrostis tenuis*. Grazing resulted locally in an increased species diversity, greater variation of vegetation types and greater differences in height and cover of the canopy. Calculations showed that fewer nutrients were removed under grazing than under hay-making conditions, but soil chemical analyses did not reveal differences between the regimes. The process of making the sward short and open probably played an important role in the vegetation changes observed. The heathland vegetation became increasingly grassy where greater amounts of dung were found. In heathland areas with relatively small amounts of dung, *Erica tetralix* and *Calluna vulgaris* produced fresh tillers and seedlings. Young saplings were prevented from growing up.
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421. Some effects of a rotational grazing treatment on quantity and quality of available forage and amount of ground litter.

Heitschmidt, R. K.; Dowhower, S. L.; and Walker, J. W. *Journal of Range Management* 40(4): 318-321. (1987)
NAL Call #: 60.18 J82; ISSN: 0022-409X

<http://jrm.library.arizona.edu/data/1987/404/8heit.pdf>

Descriptors: cow/ crude protein/ herbage growth/ digestibility

Abstract: A 16-paddock, cell-designed, rotational grazing (RG) system was initiated in March 1981 to evaluate the effects of RG on various vegetation response variables and cow/calf production. This 20-month study was initiated in January 1983 to contrast herbage dynamics in the RG treatment to those in a yearlong continuously grazed treatment (MC). Rate of stocking in the RG treatment was 3.7 ha/cow/year as compared to a moderate rate of 5.9 ha/cow/year in the MC treatment. There was no difference between treatments in herbage growth dynamics. Total herbaceous standing crop, however, was greater in the MC treatment than the RG because of greater amounts of senesced forage. The resultant effect on forage quality, in terms of crude protein (CP) concentration and organic matter digestibility (OMD) was that they were generally greater in the RG than the MC treatment. Litter standing crop was also less in the RG than MC treatment although seasonal dynamics were similar. Results indicate differences between treatments were caused primarily by differences in stocking rates and not grazing systems.

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422. Spatiotemporal dynamics in herbage mass and tiller density in a bahiagrass (*Paspalum notatum* Flugge) pasture under cattle grazing: Results from 4-year monitoring in permanent quadrats.

Hirata, M. and Pakiding, W.

Grassland Science 50(2): 201-204. (2004);

ISSN: 0447-5933

Descriptors: biomass/ grazing/ pastures/ rotational grazing/ tillering

Abstract: A 1.06 ha *Paspalum notatum* pasture at Miyazaki University, SW Japan, was monitored in 1996-2000 under rotational grazing by Japanese Black cattle. Temporal variations in herbage mass and tiller density are presented. Tiller density was much more stable over time than herbage mass. Herbage mass tended to show greater temporal heterogeneity than spatial heterogeneity.

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423. Species diversity and functional composition of pastures that vary in landscape position and grazing management.

Guretzky, John A.; Moore, Kenneth J.; Brummer, E. Charles; and Burras, C. Lee

Crop Science 45(1): 282-289. (2005)

NAL Call #: 64.8 C883; ISSN: 0011-183X

Descriptors: continuous stocking system: applied and field techniques/ non grazed stocking system: applied and field techniques/ rotational stocking system: applied and field techniques/ grazing management/ landscape position: backslope, summit, toeslope/ pasture: functional composition/ species diversity/ vegetative cover

Abstract: The productivity of grasslands depends in part on their diversity of species and functional composition. Our objective was to examine the effects of three landscape

positions (summit, backslope, and toe- slope) and three stocking systems (continuous, rotational, and non- grazed) on species diversity and percentage of cover of grass, legume, and weed species functional types in southeastern Iowa pastures. Data were collected in 0.2-m² plots randomly distributed throughout each of four replicate pastures in spring and summer 2000 and 2001. Backslope landscape positions within pastures managed with either continuous or rotational stocking contained the greatest overall diversity of species. Across years, overall species richness under grazing averaged 4.8 on backslopes, 3.5 on summits, and 2.9 on toeslopes. Legume cover was greatest within the rotational stocking system, averaging 21% on backslopes, 10% on summits, and 3% on toeslopes across years. Cool-season grasses dominated summits and toeslopes, consisting of 88 to 94% of the cover. Weed species diversity and cover were greatest on backslopes within the continuous stocking system. Our results showed that rotational stocking had more desirable effects through greater legume cover and less weed cover on backslopes than continuous stocking. This research suggested that spatial components of pastures should be considered to optimize the production and quality of forage for grazing livestock.

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424. Stability, resilience and sustainability in pasture-based grazing systems.

Kaine, G. W. and Tozer, P. R.

Agricultural Systems 83(1): 27-48. (2005)

NAL Call #: HD1.A3; ISSN: 0308-521X

Descriptors: dynamic simulation model: mathematical and computer techniques/ beef grazing/ financial variable/ pasture envelope concept/ pasture growth rate/ rotation period/ soil nutrient/ stocking rate/ sustainability

Abstract: In this paper we employ a simple dynamic simulation model to illustrate and extend the pasture envelope concept as an approach to characterising the stability, resilience and sustainability of pasture-based beef grazing enterprises. The pasture envelope is a form of phase diagram in which the trajectories over time of key biophysical variables such as pasture biomass and composition are graphed against critical thresholds established on the basis of pasture growth rates and livestock growth requirements. We extend the concept to incorporate key financial variables such as cash flow and critical financial thresholds. The model simulates a steer fattening enterprise based on a phalaris and sub-clover pasture in the Northern Tablelands of New South Wales, Australia. The model incorporates pasture growth and senescence for the two pasture species with competition between the species for soil nutrients and light, preferential grazing of the two species by the livestock with livestock growth based on pasture consumption. The model incorporates a variety of decision rules for rotating livestock among multiple paddocks. The model did not simulate changes in soil nutrients. Scaling the seasonal growth pattern of the pasture species captured the influence of rainfall and temperature on pasture growth. Two sets of simulations were run to illustrate the use of the pasture envelope concept to explore the economic and biological stability and resilience of the pasture system. The first set was designed to explore the financial and biological stability of the enterprise and involved simulating the impact of different stocking rates and rotation period on pasture

production and composition, and cash flow. The second set of simulations was designed more to explore the resilience of the enterprise and involved introducing shocks to the enterprise in the form of 'droughts' of varying strengths. This was achieved by, for example, reducing the maximum growth rate for both pasture species by 50% but maintaining the same seasonal pattern in the maximum growth rates of each species. The first simulation showed that at low stocking rates the enterprise was biologically stable, but cash flow was also low. Increasing stocking rates increased the cash flow, but also reduced the biological stability of the pasture until at very high stocking rates the pasture system collapsed. Changing the rotation period also affected the stability of the enterprise. In situations where the rotation period was very long, greater than 120 days (or 20 days/paddock), the biological system became unsustainable due to detrimental changes in pasture composition. The enterprise was somewhat resilient to drought at stocking rates less than 1 steer/ha. At stocking rates of 1 steer/ha, the enterprise was economically and biologically unsustainable in moderate or severe droughts. At a stocking rate of 1.25 steers/ha, the enterprise was unsustainable for droughts of any severity. Copyright 2004 Elsevier Ltd. All rights reserved. © The Thomson Corporation

425. Stocking method affects plant responses of Pensacola bahiagrass pastures.

Stewart, R. L.; Dubeux, J. C. B.; Sollenberger, L. E.; Vendramini, J. M. B.; and Interrante, S. M. *Forage and Grazinglands*(October): 1-8. (2005)
 NAL Call #: SF84.82 .F67; ISSN: 1547-4631
Descriptors: chemical composition/ continuous grazing/ crude protein/ grassland management/ grasslands/ herbage/ in vitro digestibility/ nutritive value/ organic matter/ plant composition/ protein content/ rotational grazing/ stocking rate
Abstract: Stocking method is an important management tool that may affect plant responses, but there are few studies that have evaluated these responses under a wide range of stocking methods. The objective of this research was to determine the effect of different stocking methods on herbage accumulation and nutritive value. Treatments were four rotational stocking strategies differing in length of grazing period (1, 3, 7, and 21 days) but with the same resting period of 21 days, and one continuous stocking treatment of 'Pensacola' bahiagrass (*Paspalum notatum*) pastures in northeast of Gainesville, Florida, USA. Herbage accumulation did not differ among rotational strategies, but rotational stocking lead to higher herbage accumulation than continuous stocking (62 versus 37 lb/acre of dry matter per day). Herbage crude protein, P, and in vitro organic matter digestion were not affected by grazing method (continuous versus rotational) or length of grazing period (rotational treatments) in more than 1 out of 3 years. The results suggest that rotational stocking, across a range of lengths of grazing period, promotes greater herbage accumulation than continuous stocking but there is little variation among grazing methods in herbage nutritive value.
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426. Stocking rate and sustainable grazing systems.

Rickert, K. G.
 In: Grassland science in perspective; Series: Wageningen Agricultural University Papers 96.
 Wageningen, Netherlands: Wageningen Agricultural University, 1996; pp. 29-66.
Notes: Meeting Information: International Farewell Symposium for Leendert t'Mannetje, Wageningen, Netherlands; June 20, 1996; ISBN 9073348633; ISSN 0169-345X
 NAL Call #: S539.5.A35 no.96-4
Descriptors: agronomy/ animal husbandry/ stocking rate/ sustainable grazing system
 © The Thomson Corporation

427. A study of two grazing methods: Effect on star grass production and quality.

Reyes, J.; Garcia Trujillo, R.; Senra, A.; Vidal, I.; and Fonte, D.
Cuban Journal of Agricultural Science 29(2): 159-163. (1995)
 NAL Call #: S1.R4; ISSN: 0864-0408
Descriptors: agriculture/ animal husbandry/ crude protein/ field method/ food item/ grass productivity/ grass quality/ leaf percentage/ pasture availability/ rational voisin grazing/ rotational grazing
Abstract: An experiment with star grass (*Cynodon nlemfuensis*) established on a red ferralitic soil was conducted. The grazing methods were: rational Voisin grazing (RVG) with 72 paddocks (36 paddocks/group) and 0.125 ha/paddock and na intensive pressure of 280 animals/ha and traditional grazing (RG-12) with 12 paddocks (6 paddocks/group) and 0.75 ha for each one and a grazing intensity of 110 animals/ha. The objective of this study was to compare the grazing performance with two grazing methods. In both methods two groups of cows rotating in line were used. pasture availability per unit area per rotation favored RVG (P lt 0.001) in the rainy season (0.25 vs. 0.19 kg DM/m² for RVG and RG-12, respectively). The leaves in RG-12 showed a better crude protein percentage (P lt 0.05) and no differences were found with the remaining quality indices. leaf percentage in the treatments surpassed 45% and no differences were found between them. total pasture production did not differ between treatments, but both were reduced (P lt 0.01) with time. Average annual pasture availability per animal was higher with RG-12 (P lt 0.05) (36.4 vs 47.6 kg DM/cow/day for RVG and RG-12, respectively). On concluding the trial after three years no advantages were observed with RVG since pasture productivity id not augment. However, regardless the method used, a reduction of pasture production was observed.
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428. Sward quality affected by different grazing pressures on dairy systems.

Mosquera-Losada, M. R.; Gonzalez-Rodriguez, A.; and Rigueiro-Rodriguez, A.
Journal of Range Management 53(6): 603-610. (2000)
 NAL Call #: 60.18 J82; ISSN: 0022-409X
http://jrm.library.arizona.edu/data/2000/536/603-610_mosquera.pdf
Descriptors: dairy cows/ stocking rate/ rotational grazing/ sward/ Lolium perenne/ Trifolium repens/ tillering/ botanical composition/ protein content/ fiber content/ maturity stage/

seasonal variation/ rain/ heat sums/ mineral content/
calcium/ potassium/ magnesium/ phosphorus/ dietary
mineral supplements/ Spain
This citation is from AGRICOLA.

429. Tiller dynamics of grazed swards.

Matthew, C.; Assuero, S. G.; Black, C. K.; and
Hamilton, N. R. S.

In: Grassland ecophysiology and grazing ecology/
Lemaire, Gilles.

New York: CABI, 2000; pp. 127-150.

Notes: ISBN: 0851994520

NAL Call #: SF84.84 .G68 2000

Descriptors: reviews/ tillers/ plant morphology/ population
dynamics/ leaf area/ tillering/ grassland management/
sustainability/ biomass production/ grazing systems/
continuous grazing/ rotational grazing/ mixtures

Abstract: Topics discussed in this review, mainly of the
major forage grasses include tiller morphology, canopy leaf
area optimization for continuously and rotationally grazed
swards, and tiller population demography including its
manipulation and the effects of mixed species swards. It is
considered that the primary driving principle for tiller
dynamics is the optimization of leaf canopy area in relation
to defoliation intensity and available resources, such as
light and water. The concept of a multiphase size-density
compensation relationship along an environmental
boundary may rationalize otherwise conflicting observations
on tiller density and on tiller appearance and death rate and
are relevant to issues such as carrying capacity or
sustainability. There remain substantive complex
differences in tillering behaviour, often unique to a particular
species, which are best explained from a tiller demography
basis. A well-directed understanding of tiller demography
may result in significant improvements in productivity in
some situations.

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**430. Tradeoffs between pasture production and plant
diversity and soil health attributes of pasture systems
of central Queensland, Australia.**

Sangha, K. K.; Midmore, D. J.; Rolfe, J.; and Jalota, R. K.
Agriculture, Ecosystems & Environment 111(1-4):
93-103. (Dec. 2005)

NAL Call #: S601 .A34; ISSN: 0167-8809

Descriptors: pastures/ plant communities/ species
diversity/ pasture management/ soil quality/ soil fertility/
anthropogenic activities/ yields/ botanical composition/ soil
organic matter/ nitrogen/ soil pH/ soil microorganisms/ plant
litter/ mineralization/ nutrient availability/ plant ecology/
ecosystems/ Queensland

Abstract: The clearing land of trees and introduction of
exotic pastures to enhance pasture production and
associated monetary gains has been a common practise in
Queensland. Previous studies on tree clearing emphasised
the gains in pasture production, but over periods of less
than 10-15 years after clearing, thus potentially misleading
land managers who plan to continue grazing beyond that
time. The present research follows an integrated approach
to quantify the pasture yield and the effects of tree clearing
on pasture species composition, soil properties (organic
carbon, available N (NO₃-), pH(w) and microbial biomass
(C and N)), and litter production over time-since-clearing on
a grazing property in central Queensland, and to evaluate
the implications of our findings for the region. The cleared

pasture systems were taken at <5, 11-13 and >33 year age
of clearing in comparison to their paired uncleared pastures
for three major tree communities representative of the
region: Eucalyptus populnea, Eucalyptus melanophloia and
Acacia harpophylla. The paper evaluates the effects of
clearing on individual attributes as well as an integrated
effect of these attributes, i.e. overall ecological services.
Pasture production generally increased with clearing but
plant diversity, litter production and potential return of N and
P through litter decreased. Among soil attributes, clearing
of trees adversely impacted upon soil pH and microbial
biomass, which play an important role in nutrient availability
and mineralisation. This, the initial gains in pasture
production are not sustainable over time. The multivariate
analysis for such ecological attributes suggests that at the
>33 year age of clearing, the ecological state of pasture
systems changed compared to that at 5 year or 11-13 year
or to the uncleared system. A disturbed pasture system will
most likely take longer to revert to the original state
compared to the time that would have taken to harvest the
benefits. The results are important for landholders and
policy makers to comprehend the real gains and losses
following tree clearing for pasture development over the
long term.

This citation is from AGRICOLA.

**431. Tree windbreaks and shelter benefits to pasture in
temperate grazing systems.**

Bird, P. R.

Agroforestry Systems 41(1): 35-54. (1998)

NAL Call #: SD387 .M8A3; ISSN: 0167-4366

Descriptors: windbreaks/ shelter/ shelterbelts/ pastures/
climate/ effects/ models/ reviews/ silvopastoral systems/
agroforestry systems/ temperate zones

Abstract: The effects of windbreaks on pastures are
reviewed, with an emphasis on temperate grazing systems.
Mechanisms of plant response to shelter are dealt with
briefly. Few papers on measured responses of pasture
species to shelter were located in a search of the global
literature for the period 1972-97. Except in cold climates,
where the benefits of snow-trapping on water availability
can be demonstrated, there were few reports of increased
production of pasture in response to shelter. A significant
result was obtained in a summer rainfall environment in
Australia, where a 43% increase in wool production was
obtained over 3 yr in small plots sheltered with iron
sheeting on the fences. The gain was attributed to
increased pasture growth. In New Zealand, one study over
3 yr with a narrow, permeable shelterbelt in a windy, dry
summer environment showed a 60% increase in pasture
growth in the sheltered zone. However, another study on a
high rainfall site with a dense, wide shelterbelt found no
substantial shelter effect on pasture. In dry, hot and windy
climates there appears to be scope for protecting spray-
irrigated pasture with windbreaks. The feasibility of
evaluating shelter effects on pastures or crops from old
windbreaks is questioned. Variability of soil over the site
can not be satisfactorily accounted for and there are
problems in defining the true 'unsheltered' yield. Shelter
effects on pastures could best be determined by comparing
production in small completely sheltered plots and open
plots. Effects in and near the competitive zone should be
measured for living windbreaks. Modelling could then be

used to evaluate windbreak systems. It is concluded that it is not yet possible to provide unequivocal advice to farmers on windbreak outcomes for particular purposes or regions.
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432. The use of Conservation Reserve Program land for grazing cattle.

Boyles, S. L.; Stoll, B. W.; and Dobbles, T. L.
Journal of Sustainable Agriculture 18(4): 113-120. (2001)
NAL Call #: S494.5.S86S8; ISSN: 1044-0046
Descriptors: cattle/ grazing/ natural resource management/ agricultural land/ land use/ rotational grazing/ stocking rate/ liveweight gain/ crude protein/ protein intake/ nitrate nitrogen/ Ohio
Abstract: The Conservation Reserve Program (CRP) is a voluntary program under which landowners enter into contracts with the United States Department of Agriculture (USDA) to remove highly erodible and environmentally sensitive cropland from production. A 3 year project was done to evaluate intensive, rotational cattle grazing as an alternative for this land when it is removed from the federal program. A 16 ha area was divided into 28 cells for grazing. Cattle were moved to a new cell on a daily basis. A seasonal average stocking rate of 3.5 hd ha(-1) was used during the three-year study. Yearling cattle (248 +/- 17.9 kg) were placed on grass in the spring. Average daily gain was .7 +/- .03 kg d(-1). Crude protein (23 +/- 4.7%) did not change over years (P > .05). Breakeven values needed to meet direct and overhead expenses ranged from \$US 0.87 to \$US 0.73/kg gain. Based on nitrate-nitrogen levels in run-off water samples, maintaining forage on what was CRP land and using it for grazing does meet the Environmental Protection Agency (EPA) conservation compliance demands to participate in other USDA programs.
This citation is from AGRICOLA.

433. Use of fire for spelling monsoon tallgrass pasture grazed by cattle.

Andrew, M. H.
Tropical Grasslands 20(2): 69-78. (1986)
NAL Call #: SB197.A1T7; ISSN: 0049-4763
Descriptors: Australia/ crop rotation
Abstract: Continuous grazing of preferred patches in set-stocked, unburnt pastures of native monsoon tallgrass results in the death of the perennial grass plants within several years. In paddocks of this pasture type at Katherine, N.T., [Australia], in which half of each paddock was burnt in rotation each dry season, cattle strongly preferred to graze in those halves which had been most recently burnt. The other halves of these paddocks were thus spelled in a complementary rotation. This spelling appeared to enable previously grazed patches of pasture to recover, and thus pasture degradation was arrested. Data from enclosures indicated that grazing early in the rainy season (but not thereafter) depressed the final yield of individual grass plants by about 60%. However, the mean pasture yield was depressed by only about 10% because many plants were not grazed at all.
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434. Use of goats to manage vegetation in cattle pastures in the Appalachian region of North Carolina.

Luginbuhl, J. M.; Green, J. T.; Poore, M. H.; and Conrad, A. P.
Sheep & Goat Research Journal 16(3): 124-135. (2000)
NAL Call #: SF371.R47; ISSN: 1535-2587
Descriptors: goats/ cattle/ pastures/ field experimentation/ rotational grazing/ Robinia pseudoacacia/ Rosa multiflora/ canopy/ weed control/ forbs/ North Carolina
This citation is from AGRICOLA.

435. Using fire to manage species composition in Heteropogon contortus (black speargrass) pastures: Enhancing the effects of fire with grazing management.

Orr, D. M. and Paton, C. J.
Australian Journal of Agricultural Research 48(6): 803-810. (1997)
NAL Call #: 23 Au783; ISSN: 0004-9409
Descriptors: grasslands/ rangelands/ grazing/ botanical composition/ burning/ control
Abstract: Burning in spring can increase the proportion of *Heteropogon contortus* when pastures remain ungrazed following burning and to a lesser extent when the pasture is grazed. Consequently, an experiment examined the effects on pasture composition of annual spring burning followed by grazing deferment by cattle for 0, 2, 4 or 6 months or for 0 months but at half the stocking rate of the other 4 treatments in Queensland. Either deferring grazing for 4 or 6 months or halving the stocking rate after burning in spring resulted in an increase in the proportion of *H. contortus*. Burning reduced the undesirable *Aristida* spp. as a pasture component and this effect occurred independently of grazing treatment. The development of 2 cohorts of *H. contortus* seedlings was monitored for 18 months. Seedlings were selectively grazed but developed rapidly with few differences between treatments. Differences in seedling survival between years reflected differences in rainfall after establishment. It is concluded that burning in spring to increase the proportion of *H. contortus* will be more effective if followed by 4-6 months rest or by reduced grazing pressure.
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436. Using stream macroinvertebrates to compare riparian land use practices on cattle farms in southwestern Wisconsin.

Weigel, B. M.; Lyons, J.; Paine, L. K.; Dodson, S. I.; and Undersander, D. J.
Journal of Freshwater Ecology 15(1): 93-106. (2000)
NAL Call #: QH541.5.F7J68; ISSN: 0270-5060
Descriptors: benthos/ riparian environments/ land use/ agriculture/ sedimentation/ environmental effects/ Invertebrata/ USA, Wisconsin
Abstract: Vegetative riparian buffer strips are typically used to curb stream degradation due to cattle grazing, but intensive rotational grazing has shown promise as an alternative best management practice. The authors compared aquatic macroinvertebrate assemblages among stream segments within continuously grazed pastures, intensive rotationally grazed pastures, undisturbed grassy vegetative buffer strips, and undisturbed woody vegetative buffer strips. Macroinvertebrate and stream sedimentation data were collected from four streams in each land use category in two consecutive years. In an attempt to account for inherent watershed variability among streams,

watershed condition was represented with a sample collected upstream of each treatment reach. Watershed condition tended to have greater influence on macroinvertebrate measures than local riparian land use. However, local riparian land use influences were apparent if watershed condition was statistically accounted for with analysis of covariance. Stream reaches with intensive rotational grazing tended to have macroinvertebrate assemblage characteristics intermediate of the buffer and continuously grazed reaches. Although we detected some differences in macroinvertebrate assemblages that apparently reflected very local land use, our results suggest the macroinvertebrates were mostly responding to large-scale watershed influences.

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437. Variability of sward structure and plant species composition of pastures at low stocking rates.

Isselstein, J.; Correll, O.; Strodthoff, J.; Zhao, G.; and Hofmann, M.

In: Optimal forage systems for animal production and the environment: Proceedings of the 12th Symposium of the European Grassland Federation. (Held 26 May 2003-28 May 2003 at Pleven, Bulgaria.); pp. 606-609; 2003.

Descriptors: animal nutrition/ biodiversity/ botanical composition/ grass sward/ grazing/ grazing systems/ heifers/ herbage/ methodology/ nutritive value/ pastures/ spatial variation/ stand structure/ stocking rate/ temporal variation/ live-weight

Abstract: Grazing at a low stocking rate is considered a promising option to meet both the requirement for a reasonable agronomic output and the maintenance and enhancement of biodiversity. Such grazing creates a mosaic pattern of patches of variable defoliation and resulting sward height and structure. An extended rising-plate-meter method was developed to investigate the spatial and temporal variability of the grass sward and the resulting pasture and animal performance. Along permanent transect lines, a high number of fixed points is established and the following recordings are made repeatedly during the grazing season: compressed sward height, dominating plant species, development of the plant (vegetative, reproductive growth). Additional sampling at random points was used to establish a relationship between sward height and herbage mass. The nutritive value of the herbage samples was analysed. Live weights of grazers and quality of ingested herbage were measured. The data were analysed to provide information on the variability of the amount and the quality of the herbage on offer, the percentage of different dominating species in the different grazing patches, the contribution of the different patches to the nutrition of the grazing animals, and the percentage of patches with reproductive plant growth which indicates the opportunity for seedling recruitment.

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438. Vegetation change on embankments in the southwestern part of the Netherlands under the influence of different management practices in particular sheep grazing.

Sykora, K. V.; Van Der Krogt, G.; and Rademakers, J.

Biological Conservation 52(1): 49-82. (1990)

NAL Call #: S900.B5; *ISSN:* 0006-3207

Descriptors: Lolio-Cynosuretum plantagnetosum media/ Arrhenatherum elatioris alopecuretosum/ Ulmo rubetum ulmifolii/ synecology/ mowing/ burning/ conservation/ succession

Abstract: The vegetation of the embankments of the Zak van Zuid-Beveland were surveyed phytosociologically, the vegetation being assigned to the Lolio-Cynosuretum plantagnetosum mediae, Arrhenatherum elatioris picridetosum, Arrhenatherum elatioris alopecuretosum and Ulmo-Rubetum ulmifolii. In total, including the subordinate fragmentary communities and variants, 12 communities are described, together with an indication of their synecology. The composition of the vegetation in 1986 is compared to that in 1972 and the influence of different management practices, i.e. grazing, mowing, burning and no management, on the vegetation changes is illustrated. The changes in vegetation composition and structure are clearly related to management practices. This even applies to the low level of syntaxonomic hierarchy, i.e. subassociations and variants. In general the highest intensities of grazing by the flock, i.e. between 8 and more than 15 h a month by 200 sheep per 500 m of embankment, were best suited for the improvement or maintenance of the conservation value. Under the same conditions, light grazing (less than 8 hours) proved to be insufficient.

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439. Vegetation changes after cessation of grazing management in the Jizerske Mountains (Czech Republic).

Pavlu, Vilem; Hejcman, Michal; Pavlu, Lenka; Gaisler, Jan; Nezerkova, Pavla; and Andaluz, Milan Guerovich

Annales Botanici Fennici 42(5): 343-349. (2005)

NAL Call #: 450 AN79; *ISSN:* 0003-3847

Descriptors: grazing cessation/ vegetation change/ plant species diversity/ grazing management

Abstract: Vegetation changes following the cessation of grazing of highly productive pasture in the Jizerske Mountains in 1997 were studied. The experiment included three replicate pairs of plots and data were collected before and after grazing was ended. Cover was estimated in 1-m(2) permanent plots. Abandonment of the pasture resulted in a significant decrease in plant species diversity. Annuals and perennials such as *Trifolium repens* and *Poa trivialis* disappeared within three years of the end of grazing. Species scores on the first ordination axis of RDA analyses, where time was the only explanatory variable were highly positively correlated with species heights obtained from the local flora and species height was the single parameter that best explained the reaction of species to the cessation of grazing. Within five years of abandonment, differences among swards caused by continuous stocking and rotational grazing had disappeared and tall grasses and shade-tolerant forbs dominated all swards. No new species were recorded after the abandonment of the pasture. If the abandoned grasslands will not reforest, alternative management regimes must be practiced in order to prevent their degradation and spread of tall dominants.

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440. Vegetation characteristics in relation to different management regimes of calcareous grassland: A functional analysis using plant traits.

Eler, K.; Vidrih, M.; and Batic, F.

Phyton (Horn) 45(3, Sp. Iss. SI): 417-426. (2005)

NAL Call #: 450 P565; ISSN: 0079-2047

Descriptors: functional analysis: applied and field techniques/ species composition/ vegetation/ calcareous grassland/ plant trait/ grazing regime

Abstract: Designation of management strategies for preservation of calcareous grasslands demands in-depth understanding of vegetation processes. For this purpose the functional approach using plant functional types and traits has been widely promoted. In this study we focused on the analysis of CS-R established strategies and some simple plant traits to detect general trends in trait responses to abandonment on one side and to eutrophication on the other giving us a basis for future management strategies. Five treatments were applied to calcareous grassland in SW Slovenia representing different combinations of fertilization and grazing regimes. Effects of these two factors along with other environmental variables on species composition were evaluated. Trait composition of original low-intensity grazed vegetation showed importance of stress-tolerance (S component), relatively high abundance of small plants, chamaephytes, phalanx strategy and summer green plants. Abandonment increased abundance of grasses and suppressed forbs and legumes. C component, showing appearance of competitive exclusion, increased, resulting in increased average plant height. Fertilization promoted the abundance of therophytes and persistent green, mesophyllous plant species with guerrilla lateral spread. It also caused significant increase in abundance of species expressing ruderality (R component).
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441. White clover growth patterns during the grazing season in a rotationally grazed dairy pasture in New York.

Karsten, H. D. and Fick, G. W.

Grass and Forage Science 54(2): 174-183. (1999)

NAL Call #: 60.19 B773; ISSN: 0142-5242

Descriptors: rotational grazing: agronomic method, dairy pasture/ climatic influence/ soil organism activity

Abstract: White clover (*Trifolium repens* L.) is an important stoloniferous pasture legume in the Great Lakes region of the United States, but it often has limited persistence. Researchers in New Zealand and Wales have found that in spring, compared with other seasons, white clover plants have reduced branching complexity and have the fewest buds that produce leaves. They therefore suggested that in spring the plants are most vulnerable to grazing and climatic stress. Because of severe winter and cool, wet spring weather in New York State, it was hypothesized that white clover plants would also be of low branching complexity, smaller and have low axillary bud activity in spring compared with later in the grazing season. To test this, growth of white clover was monitored in an orchard grass (*Dactylis glomerata* L.)/white clover pasture in New York that was rotationally grazed with dairy cows during the 1993 and 1994 grazing seasons. Three sets of plants were sampled. The first set consisted of forty random plants sampled before each grazing event. Stolon branching order, number of each stolon branching type and area the plant occupied were determined. Approximately each

month before one grazing event, a separate set of 32 random plants was measured in the field to determine the area they occupied; these plants were then removed to the laboratory for the measurement of stolon order, number of each stolon type, stolon lengths, total number of growing points, number of taproots and adventitious roots, root position and above-ground dry matter. Once a month, 12 additional plants were removed to measure axillary bud activity at each node. Leaf development from nodes tended to increase from spring to summer. However, the stolon branching order of white clover plants was not simpler in spring compared with summer or autumn. In 1994 during and after a dry and hot period, white clover plants were smaller, of lower stolon branching order and had fewer roots. Climate and associated soil organism activity appear to explain the different white clover growth patterns observed in New York and New Zealand. Severe winters in New York limit earthworm activity and stolon burial, which is important in contributing to stolon/plant breakdown in New Zealand. During the years of this study in New York, a hot and dry period had the most negative effect on the growth pattern of white clover.

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442. White clover response to grazing method.

Brink, G. E. and Pederson, G. A.

Agronomy Journal 85(4): 791-794. (1993)

NAL Call #: 4 AM34P; ISSN: 0002-1962

Descriptors: *Trifolium repens*/ cultivars/ leaves/ *Festuca arundinacea*/ cattle/ rotational grazing/ grazing/ leaf area/ plant morphology/ stolons/ mortality/ forage/ Mississippi
Abstract: Grazing management is a major factor influencing white clover (*Trifolium repens* L.) growth. Our objective was to determine the response of white clover cultivars differing in leaf size to grazing method (continuous vs. rotational stocking) using cattle (*Bos* spp.). In each of 2 yr, a predominantly tall fescue (*Festuca arundinacea* Schreb.) sod on a Savannah flue sandy loam (fine-loamy siliceous, thermic Typic Fragiuudult) was oversown in September with 'Grasslands Huia' (medium-small leaf), 'Louisiana S-1' (medium-large leaf), and 'Regal' (large leaf) white clover. From March to August of the following year, plots of each cultivar were stocked continuously (3- to 5-cm stubble) or rotationally (grazed to 5-cm stubble every 35 to 38 d). Clover growth was measured prior to rotational grazing and stolon survival was determined in November. When precipitation during the grazing season was 59% above normal, grazing method had no influence on mean single leaf area, stolon dry weight, and stolon growing point density of white clover. In contrast, continuous stocking reduced these responses when precipitation was 32% below normal the following year. Cultivar ranking for mean single leaf area was generally the same as that for leaf size category: Grasslands Huia < Louisiana S-1 < Regal. Although stolon length and growing point density were frequently greatest for Grasslands Huia, stolon survival of Grasslands Huia was no greater than that of the larger-leaved cultivars. Despite varying effects of grazing method on growth and morphology, stolon survival of white clover was always greater under rotational stocking.

This citation is from AGRICOLA.

443. Whole-farm management of grazing systems based on native and introduced species.

Simpson, P. and Langford, C.

New Zealand Journal of Agricultural Research 39(4): 601-609. (1996)

NAL Call #: 23 N4892; ISSN: 0028-8233

Descriptors: crop industry/ livestock industry/ agronomy/ biobusiness/ grazing systems/ introduced species systems/ native species systems/ whole farm management

Abstract: For whole-farm management, there is a wide range of development and management options.

Recognizing and understanding the role of pasture species, soil types, farm physical environment, livestock enterprise needs, and farm goals are essential ingredients for successful whole-farm management. The more variable the environment, soil types, and topography then the more important pasture diversity becomes. The adoption of non-destructive pasture development and management strategies, especially for the undulating to steeper areas on acid soils with west- or north-facing slopes, are crucial. Pastures are classified into five types depending on the species present. The management implications of the relationship between pasture type, soil characteristics, and slope are discussed together with the suitability of the pasture types for different livestock performance levels. The importance of these factors, for whole-farm management is also discussed.

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