environmental and economic sustainability of these types of animal production systems. Management intensive grazing is a grazing system in which animals at a high stocking density are rotated through several paddocks at short time intervals (12-24 h) so that animal performance is maximized. Although MIG has the potential to increase dairy farm profitability in the northeast US, recent work in this region has shown that a substantial amount of N applied as fertilizer is leached below the root zone of orchardgrass (Dactyls glomerata L., (cv.) 'Pennlate') managed as an intensive pasture. How much N is leached from other forage species managed as intensive pasture under the climatic conditions of the northeast US is not known. A field study was conducted using large drainage lysimeters to measure NO3-N leaching loss from six pasture swards: orchardgrass + N, orchardgrass + alfalfa (Medicago sativa L., (cv.) Alfagraze), orchardgrass + Ladino type white clover (Trifolium repens L.), Ryegrass (Lolium perrene L, (cv.) Citadel) + N, ryegrass + alfalfa, and ryegrass + white clover. The study site was located in central Pennsylvania on a Hagerstown silt loam soil (fine, mixed, mesic Typic Hapludalf). Nitrate-N leaching losses were most consistent under N fertilized swards where the amount of N could be adjusted for yearly weather conditions. In a drought year, NO3-N leaching increased dramatically in swards containing alfalfa or white clover. Sward type and stocking density need to be taken into consideration when developing an animal production system that will be both environmentally and economically sustainable.
This citation is from AGRICOLA.

153. **Water quality improvement program effectiveness for carbonate aquifers in grazed land watersheds.**
Boyer, D. G.
Journal of the American Water Resources Association 41(2): 291-300. (2005)
NAL Call #: GB651.W315; *ISSN:* 1093-474X
Descriptors: water quality/ aquifers/ livestock/ catchments/ fecal coliforms/ basins/ water resources/ drainage/ dairies/ watersheds/ environmental quality/ cattle/ water wells/ agriculture/ water quality control/ best management practices/ karst/ catchment areas/ catchment basins/ grazing/ forages/ indicators/ rivers/ coliforms/ USA, West Virginia, Greenbrier R.
Abstract: Water quality indicators of two agriculturally impacted karst areas in southeastern West Virginia were studied to determine the water quality effects of grazing agriculture and water quality trends following initiation of water quality improvement programs. Both areas are tributaries of the Greenbrier River and received funding for best management practices under the President's Initiative for Water Quality and then under the Environmental Quality Incentives Program (EQIP). After 11 years of study there was little evidence to suggest that water quality improved in one area. Three and a half years of study in the other area showed little evidence of consistent water quality improvement under EQIP. Lack of consistent water quality improvement at the catchment scale does not imply that the voluntary programs were failures. Increased livestock numbers as a result of successful changes in forage management practices may have overridden water quality improvements achieved through best management practices. Practices that target well defined contributing areas significantly impacting aquifer water quality might be one way to improve water quality at catchment scales in karst basins. For example, a significant decrease in fecal coliform concentrations was observed in subterranean drainage from one targeted sinkhole after dairy cattle were permanently excluded from the sinkhole.

154. **Will a water trough reduce the amount of time hay-fed livestock spend in the stream (and therefore improve water quality)?**
Miner, J. R.; Buckhouse, J. C.; and Moore, J. A.
Rangelands 14(1): 35-38. (1992)
NAL Call #: SF85.A1R32; *ISSN:* 0190-0528
Descriptors: water quality/ cattle/ water troughs/ streams/ environmental impact/ Oregon/ fecal flora
This citation is from AGRICOLA.

Fish and Wildlife Effects

155. **Alfalfa weevil (Coleoptera: Curculionidae) management in alfalfa by spring grazing with cattle.**
Buntin, G. D. and Bouton, J. H.
Journal of Economic Entomology 89(6): 1631-1637. (1996)
NAL Call #: 421 J822; *ISSN:* 0022-0493
Descriptors: alfalfa cultivar Alfagraze/ alfalfa cultivar Apollo/ biobusiness/ carbofuran/ economic entomology/ grazing/ grazing tolerance/ host/ insecticide/ integrated pest management/ larva/ larval density/ permethrin/ pest/ pest management
Abstract: The effect of continuous, intensive grazing by cattle in the 1st alfalfa growth cycle on larval densities of the alfalfa weevil, Hyera postica (Gyllenhal), was evaluated in 'Alfagraze' and 'Apollo' alfalfa, which are tolerant and not tolerant to grazing, respectively. In small-cage exclusion trials, grazing reduced larval numbers in 1991 by 65% in Alfagraze and by 32% in Apollo. Larval numbers in 1992 were low (ltoreq 0.6 larvae per stem) and were not reduced significantly by grazing. Grazing and use of early insecticide treatments of permethrin or carbofuran at low rates with ltoreq 7-d grazing restrictions to suppress larval numbers before grazing also were examined in large-plot exclusion trails in 1993 and 1994. Grazing reduced larval densities by 60% in 1993 and 45% in 1994 during a 3-wk period beginning 3 wk after grazing was initiated. However, alfalfa weevil larvae caused moderate leaf injury in 1993 and severe injury in 1994 before grazing reduced larval numbers. Use of permethrin at 0.11 kg (AI)/ha or carbofuran or chlorpyrifos at 0.28 kg(AI)/ha effectively reduced larval numbers and prevented leaf injury before grazing began. Therefore, a combination of an early application of an insecticide treatment with a short grazing

restriction followed by continuous grazing will control alfalfa weevil larvae while allowing cattle to graze and directly use forage of grazing-tolerant alfalfa.

156. **Aphid (Homoptera: Aphididae) management in alfalfa by spring grazing with cattle.**
Buntin, G. D. and Bouton, J. H.
Journal of Entomological Science 32(3): 332-342. (1997)
NAL Call #: QL461.G4; *ISSN:* 0749-8004
Descriptors: aphid management/ integrated pest management/ spring grazing
Abstract: The effect of continuous, intensive grazing by cattle on aphid populations was examined in the first growth cycle of 'Alfagraze' and 'Apollo' alfalfa which are tolerant and not tolerant to grazing, respectively. Populations were almost entirely pea aphid Acyrthosiphon pisum (Harris). The effect of grazing on aphid population, was examined in small plot exclusion studies in 1991 and 1992, and the effects of grazing and use of an early insecticide application with ltoreq 7 day grazing restriction were examined in large plot exclusion trials in 1993 and 1994. Grazing reduced aphid populations by 66% to 90% when numbers exceeded -1 aphid per stem. Populations were not significantly reduced by grazing when numbers did not exceed 1 per stem. Permethrin reduced aphid numbers for up to 7 wks and was more effective than carbofuran. Effects of grazing were similar regardless grazed than ungrazed plots when aphid numbers were reduced by grazing in 1993, but were not greatly affected by grazing in 1994 when aphid numbers were low. Coccinellid numbers paralleled trends in aphid numbers. Continuous, intensive grazing or the early application of an insecticide at a low rate followed by grazing were effective approaches for suppressing pea aphid in alfalfa.

157. **Benefits of rotational grazing and dense nesting cover for island-nesting waterfowl in southern Quebec.**
Lapointe, S.; Giroux, J.-F.; Belanger, L.; and Filion, B.
Agriculture, Ecosystems & Environment 78(3): 261-272. (2000)
NAL Call #: S601 .A34; *ISSN:* 0167-8809
Descriptors: grazing/ nests/ agricultural practices/ wildlife management/ environment management/ nature conservation/ aquatic birds/ breeding sites/ islands/ population density/ population structure/ dominant species/ habitat improvement/ vegetation cover/ herbivores/ agriculture/ man-induced effects/ Anatidae/ Anas strepera/ Anas acuta/ Canada, Quebec/ Canada, St. Lawrence R./ Canada/ ducks/ cattle grazing/ rotational grazing/ dense nesting cover/ northern pintail/ gadwall
Abstract: Intensification of agricultural practices is an important factor responsible for the decline of duck populations throughout North America. More than 200 islands covering a total of 5000 ha are found in the St. Lawrence River between Montreal and Trois-Rivieres in southern Quebec. The value of these islands as duck nesting habitat, however, is often limited by cattle grazing. The effects of two types of habitat improvements, rotational grazing and establishment of dense nesting cover (DNC), on island-nesting waterfowl was studied from 1992 to 1994. Four treatments were compared: idle fields with no vegetation improvement but exclusion of cattle, improved pastures with seeding of forage plants for cattle, DNC fields with improved cover for ducks and exclusion of cattle and unimproved pastures used after the duck nesting season. Before habitat improvements, grazing by cattle reduced dry mass of green vegetation by 53% relative to ungrazed plots. No difference was found in the biomass of live (green) and dead (residual) vegetation among the islands' sections before treatments. Nest density and the number of expected nests based on the area covered by each habitat were also similar among sections before treatment. Gadwall (Anas strepera L.), mallard (Anas platyrhynchos L.), and pintail (Anas acuta L.) were the most abundant species nesting on the islands and this was not affected by treatments. Two years after habitat improvements, the number of duck nests increased. Idle fields and 2-year old DNC had greater visual obstruction, more residual vegetation and more litter. Densities of 2.8 and 7.0 nests ha super(-1) with 69 and 82% Mayfield nest success were recorded in the idle and DNC fields, respectively. Nest success was low in improved pasture where a large proportion of nests were trampled (33%) or depredated (28%). Fencing permitted growth of emergent vegetation which enabled over-water nesting by ducks. These results indicate that with appropriate management, coexistence of cattle and nesting waterfowl is possible on islands of the St. Lawrence River.

158. **Biological response of aquatic communities to streambank fencing in selected streams impacted by agricultural grazing.**
Argent, D. G. and Lenig, A.
In: Proceedings of the 2005 Watershed Management Conference: Managing Watersheds for Human and Natural Impacts: Engineering, Ecological, and Economic Challenges. (Held 19 Jul 2005-22 Jul 2005 at Williamsburg, VA.); pp. 967-978; 2005.
Abstract: Streams impacted by agricultural grazing experience compromised functioning because of physical degradation and various pollutants (e.g., nitrates and fecal coliforms). The objective of this study was to determine if stream functioning could be significantly improved with the removal of livestock from the adjacent corridor. In 1999, four grazed pastures that contained meadow streams received streambank fencing through the Partners for Fish and Wildlife Program (treatment sites). These streams exhibited unstable streambanks and elevated nitrate and fecal coliform levels as a direct result of cattle impacts on the stream. Concurrent with streambank fencing, we established monitoring stations that were 100-m long within each stream. In addition, several control streams were monitored that had (a) no history of grazing and no fencing (control streams) or (b) a history of grazing and no fencing (control farms). At each station seasonal collections were made for benthic macroinvertebrates and fishes; and various water chemistry parameters (TKN, nitrates, ammonia, phosphates, fecal coliforms, and turbidity). Over the course of this study, nitrates have remained reasonably constant during the spring season and declined significantly during the summer and fall seasons; TKN, and phosphorus have not changed appreciably during the spring collection periods at treatment sites, but were slightly elevated during the summer sampling period. Turbidity has declined significantly during the spring sampling period, but remains elevated during the summer and fall periods. Fecal coliform concentrations continue to be quite high in treatment farm

streams, but fluctuate, seasonally. Treatment sites contain a good diversity and abundance of macroinvertebrates and fish that are comparable to those found in control streams. Our findings to date suggest that streams impacted by agricultural grazing may require appreciable periods of time to experience improved stream functioning.

159. **A brief survey of the insects of river banks with or without grazing along the River Itchen.**
Drake, Martin
English Nature Research Reports 135: 1-25. (1995); *ISSN:* 0967-876X
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/ United Kingdom/ Insecta/ Coleoptera/ Diptera: farming and agriculture/ trampling by cattle/ effect on river bank species diversity/ habitat management/ endangered status/ nationally rare species recorded/ species diversity/ river bank fauna/ riparian habitat/ river bank/ effect of trampling by cattle/ England/ Hampshire/ River Itchen/ river bank species diversity/ list and effect of trampling by cattle/ Insecta/ arthropods/ coleopterans beetles/ dipterans true flies/ insects/ invertebrates

160. **Burning and grazing effects on bobwhite foods in the Southeastern Coastal Plain.**
Lewis, C. E. and Harshbarger, T. J.
Wildlife Society Bulletin 14(4): 455-459. (1986)
NAL Call #: SK357.A1W5; *ISSN:* 0091-7648
Descriptors: Pinus palustris/ Pinus elliottii/ Colinus virginianus/ prescribed burning/ habitat destruction/ wildlife management/ grazing/ Georgia
This citation is from AGRICOLA.

161. **Cattle grazing and avian communities of the St. Lawrence River islands.**
Belanger, L. and Picard, M.
Journal of Range Management 52(4): 332-338. (1999)
NAL Call #: 60.18 J82; *ISSN:* 0022-409X
http://jrm.library.arizona.edu/data/1999/524/332-338_belanger.pdf
Descriptors: Phragmites australis/ cows/ islands/ prairies/ grazing intensity/ wild birds/ range management/ wildlife management/ Phalaris arundinacea/ Passeriformes/ canopy/ habitats/ species diversity/ waterfowl/ nesting/ Quebec
Abstract: Three hundred islands are found along the St. Lawrence River in Quebec. Among these islands, over 5,000 ha are used for agricultural purposes and 32% of this total is devoted to communal pasture, a traditional practice in this part of the river. In 1993 and 1994, we compared the avian communities of 500 ha natural spring flooded prairie islands subjected to different degrees of grazing pressure. Three islands were divided into 12 sectors, in which 108 sample plots of 0.5 ha were selected. Results show that the degree of visual obstruction by herbaceous vegetation and the percentage of shrub cover were higher on ungrazed and on moderately grazed prairie (< 1 cow/ha/year) as compared with intensively grazed prairie (> 1 cow/ha/year). More than 1,650 observations of passerines were made and 13 species were identified. The Swamp Sparrow (Melospiza georgiana), Savannah Sparrow (Passerculus sandwichensis), Red-winged Blackbird (Agelais phoeniceus), and Bobolink (Dolichonyx oryzivorus) were the 4 most abundant species, accounting for over 80% of all birds counted. Ungrazed and moderately grazed prairie contained 6 times more birds than intensively grazed prairie (10.4 birds/ha and 11.7 birds/ha vs 1.6 birds/ha). We also recorded 167 and 113 dabbling duck (anatinae) nests in 1993 and 1994 respectively. Moderately grazed and ungrazed prairies had a nest density nearly 10 times higher than that of intensively grazed prairie (0.50 +/- 0.01 and 0.30 +/- 0.01 nest/ha vs 0.05 +/- 0.01 nest/ha). Our study shows that grazing pressure on prairies of the studied islands largely determined the type of bird species present. However, prairie subjected to excessive grazing pressure is not suitable for waterfowl nesting. Various recommendations are provided for integrated management of wildlife and agriculture on the St. Lawrence River communal pasture islands.
This citation is from AGRICOLA.

162. **Cattle grazing and management of dusky seaside sparrow habitat.**
Holder, Gregory L.; Johnson, Mark K.; and Baker, James L.
Wildlife Society Bulletin 8(2): 105-109. (1980)
NAL Call #: SK357.A1W5; *ISSN:* 0091-7648
Descriptors: Fringillidae/ Passeriformes/ Ammodramus maritimus nigrescens/ dusky seaside sparrow/ seaside sparrow/ fires/ burns/ grazing/ habitat alterations/ cattle/ sparrow habitat/ endangered species/ St. Johns River Basin, Florida/ natural resources/ animal science - animal nutrition/ plant science (general) - plant ecology/ North America/ United States/ Florida

163. **Cattle trampling of simulated ground nests in rotationally grazed pastures.**
Paine, L.; Undersander, D. J.; Sample, D. W.; Bartelt, G. A.; and Schatteman, T. A.
Journal of Range Management 49(4): 294-300. (1996)
NAL Call #: 60.18 J82; *ISSN:* 0022-409X
http://jrm.library.arizona.edu/data/1996/494/294-300_paine.pdf
Descriptors: cattle/ pheasants/ rotational grazing/ wild birds/ stocking rate/ grazing intensity/ Wisconsin
Abstract: For many grassland songbird species, pastures represent some of the best available breeding habitat in the Upper Midwest. Increasing interest in intensive rotational grazing (IRG) among midwestern livestock farmers may result in an expansion of pasture hectares in the region. We evaluated the effects of several cattle stocking densities on ground nest survival in rotationally grazed cool-season pastures in southwestern Wisconsin. Ground nests were simulated with clutches of 3 unwashed pheasant eggs. We tested 3 rotational grazing systems: a 1-day dairy rotation stocked at 60 head ha-1; a 4-day beef rotation at 15 head ha-1; and a traditional, non-intensive 7-day rotation at 8 head ha-1. Paddock size (1.2 ha) and nest density (15 nests paddock(-1)) were held constant. The simulated nests were observed 4 times day(-1) to document trampling patterns during the herds' diurnal grazing and rumination cycles. Trampling damaged a mean of 75% (+/- 3.1%) of the nests for all 3 treatments during 8 consecutive replications. While the 7-day treatment exhibited a pattern of greater nest trampling during cattle grazing periods than

during rumination periods, this pattern was less evident in the 4-day treatment and absent in the 1-day treatment. Increasing vegetation height-density and percent vegetation cover were associated with reduced nest trampling rates, but pasture forage production and removal were not associated with nest damage.
This citation is from AGRICOLA.

164. **Changes in spider araneae assemblages in relation to succession and grazing management.**
Gibson, C. W. D.; Hambler, C.; and Brown, V. K.
Journal of Applied Ecology 29(1): 132-142. (1992)
NAL Call #: 410 J828; *ISSN:* 0021-8901
Descriptors: Linyphiidae/ sheep grazing/ invertebrates/ plant species composition arable land/ grassland/ disturbed land/ species accumulation
Abstract: Spiders were sampled, by suction (D-vac) and direct counts of their webs, in a controlled sheep grazing experiment on calcareous ex-arable land and in old calcareous grassland. Results from 1985-89 are presented. Heavily grazed assemblages were dominated by a group of Linyphiidae, also characteristic of disturbed land. Large web-spinners were most sensitive to grazing, preferring ungrazed controls because of their dependence of rigid plant structures. DCA ordination of D-vac data suggested that only heavy grazing (in spring and autumn) produced a distinct asemblage. Three other grazed treatments produced impoverished versions of ungrazed control assemblages. The dominant successional trend was a gradual accumulation of species, especially in ungrazed controls. This process was incomplete by 1989: old grasslands contained many species, including some characteristics of calcareous grassland, which had failed to colonize the ex-arable field 7 years after abandonment. Most features of the assemblages could be explained by the effects of grazing on plant architecture, in contrast to other invertebrates studied in the same system, which were more strongly affected by plant species composition.

165. **Changes in the status of two endangered butterflies over two decades and the influence of grazing management.**
Bourn, N. A. D.; Pearman, G. S.; Gooder, B.; Warren, M. S.; and Thomas, J. A.
In: Grazing Management. (Held 2 Feb 1929-2 Mar 2000 at Harrogate, United Kingdom.) Rook, A. J. and Penning, P. D. (eds.); pp. 141-146; 2000.
NAL Call #: SB197.B7; *ISBN:* 0905944542

166. **Consequences for biodiversity of reducing inputs to upland temperate pastures: Effects on beetles (Coleoptera) of cessation of nitrogen fertilizer application and reductions in stocking rates of sheep.**
Dennis, P.; Doering, J.; Stockan, J. A.; Jones, J. R.; Rees, M. E.; Vale, J. E.; and Sibbald, A. R.
Grass and Forage Science 59(2): 121-135. (2004)
NAL Call #: 60.19 B773; *ISSN:* 0142-5242
Descriptors: grasslands/ grazing intensity/ grazing management/ sward/ height/ species diversity/ Coleoptera/ sown pastures/ stocking rate/ permanent grasslands/ nitrogen fertilizers/ application rate/ pasture management/ sheep/ Carabidae/ Staphylinidae/ botanical composition/ Trifolium repens/ extensive farming/ Wales
Abstract: Current policies for upland pasture management in the UK encourage the integration of environmental objectives with livestock production through extensification of grazing systems. This study tested the hypothesis that a greater sward height in the summer would increase the diversity and abundance of grassland beetles (Coleoptera) as has been demonstrated for insects of indigenous grasslands. The hypothesis was tested with an experiment on an upland sheep pasture in mid-Wales. experimental treatments received different nitrogen fertilizer inputs (0 or 50 kg ha-1), sheep stocking densities (12 or 9 ewes ha-1) and average sward heights in summer were constrained to 3.5 or 5.5 cm by conserving surplus grass for silage in subplots. Five treatments, replicated in three randomized blocks, combined the two stocking densities and two sward heights without nitrogen fertilizer inputs, with the fifth combining the higher stocking density, shortest sward height and the nitrogen fertilizer input. Beetles were sampled with twelve pitfall traps in each of the fifteen plots from June to September in 1993 and 1995. In years 1 (1993) and 3 (1995) of the experiment, more Coleoptera species occurred in the tall sward (an average of nine species in addition to the forty-one species present in the sward with the conventional sward height). Continuously grazed as opposed to ensiled subplots supported more beetle species but fewer individuals. Species composition of ground (Carabidae) and rove (Staphylinidae) beetles varied between treatments more than the arithmetic differences in species number. The experimental results supported the hypothesis but the benefits of taller swards to species diversity were small in the sown pastures of the study compared with indigenous upland grasslands (c. 33% fewer species). Inheritance effects of drainage, fertilizer and lime inputs, and the different species and management of cultivated pastures, may constrain the conservation benefits of altered pasture management compared with indigenous grasslands.
This citation is from AGRICOLA.

167. **Conserving the new forest burnet moth (Zygaena viciae ((Denis and Schiffermueller))) in Scotland; responses to grazing reduction and consequent vegetation changes.**
Young, Mark R. and Barbour, David A.
Journal of Insect Conservation 8(2-3): 137-148. (2004)
NAL Call #: QL362.J68; *ISSN:* 1366-638X
Descriptors: grazing reduction: applied and field techniques/ conservation/ vegetation
Abstract: Zygaena viciae, the New Forest burnet moth, has only one population in Britain, in western Scotland. Here it was discovered in 1963 and its population sustained itself, before declining seriously from 1980 to 1990. A survey in 1990 discovered at most 20 adult moths and it was clear that the site had become seriously over-grazed. A fence was erected to exclude sheep, with variable success until 1996, since when it has remained effective. Vegetation speedily changed from 1990 onwards, including re-establishment and spread of the main larval foodplant, Lathyrus pratensis. The moth population remained low until 1997, since which time it has dramatically increased, reaching an estimated 8500-10,200 in 2003. However, with only one site the moth remains threatened and establishment on new sites is now a priority.

168. **Contribution of paddock trees to the conservation of terrestrial invertebrate biodiversity within grazed native pastures.**
Oliver, Ian; Pearce, Sarina; Greenslade, Penelope J. M.; and Britton, David R.
Austral Ecology 31(1): 1-12. (2006)
NAL Call #: QH540 .A8; *ISSN:* 1442-9985
Descriptors: univariate analysis: mathematical and computer techniques/ multivariate analysis: mathematical and computer techniques/ conservation/ biodiversity/ grazed landscape
Abstract: Paddock trees are a common feature in the agricultural landscapes of Australia. Recent studies have demonstrated the value of scattered paddock trees for soil fertility, native pasture plants and arboreal faunas; however, the degree to which scattered paddock trees contribute to the conservation of terrestrial invertebrate biodiversity within grazed landscapes remains unknown. We ask three questions: (i) Is there a difference between the terrestrial invertebrate assemblages found under paddock trees compared with surrounding grazed native pastures? (ii) Can gradients in soil and litter variables from the base of trees explain patterns in invertebrate assemblages? and (iii) Does the presence of scattered paddock trees have implications for the conservation of terrestrial invertebrate biodiversity within grazed native pastures? We used pitfall trapping and extraction from soil cores to sample the invertebrate assemblages under six New England Peppermint trees (Eucalyptus nova-anglica Deane and Maiden) and compared them with assemblages sampled from the open paddock. Formicidae and Collembola univariate and multivariate data were analysed along with a range of soil and litter variables. We found (i) significant differences in the assemblages of invertebrates under trees compared with surrounding grazed pastures; (ii) that most soil and litter variables revealed gradients away from tree bases and these variables explained significant variation in invertebrate assemblages; and (iii) more native invertebrates and more species of invertebrates were found under trees compared with the surrounding pastures. We discuss the relationships between paddock trees, the ground and soil environments and the invertebrate communities that inhabit these environments, and conclude with a discussion of the future for paddock trees and the biota supported by them.

169. **Daytime activity of white-tailed deer in response to short-duration and continuous grazing.**
Cohen, W. E.; Reiner, R. J.; Bryant, F. C.; Drawe, D. L.; and Bradley, L. C.
Southwestern Naturalist 34(3): 428-431. (1989)
NAL Call #: 409.6 SO8; *ISSN:* 0038-4909
Descriptors: Odocoileus virginianus/ pastures/ wildlife management/ Texas
This citation is from AGRICOLA.

170. **Deer and cattle diets on heavily grazed pine-bluestem range.**
Thill, R. E. and Martin, A.
Journal of Wildlife Management 53(3): 540-548. (1989)
NAL Call #: 410 J827; *ISSN:* 0022-541X
Descriptors: Odocoileus virginianus/ Pinus palustris/ Andropogon sp./ seasonality/ feeding preference/ range management/ Louisiana/ USA
Abstract: We studied dietary overlap between captive white-tailed deer (n = 3) (Odocoileus virginianus) and cattle (n = 4) for 3 years on 2 rotationally burned, 54-ha longleaf pine (Pinus palustris)-bluestem (Andropogon spp.) pastures in central Louisiana [USA]. A third of each pasture was burned each year in late February. One pasture was grazed heavily (61-77% herbage use) yearlong; the other was grazed heavily (50-67% use) from mid-April to 1 November. Deer diets were dominated yearlong by a mixture of browse (49.3-83.2%) and forbs (11.2-47.1%). Cattle consumed mostly grasses during spring and summer and 60 and 40% browse and herbage, during fall and winter, respectively. Cattle consumed more herbage on first-year burns. Dietary overlap under heavy yearlong grazing averaged 25.8, 11.8, 26.0, and 30.7% during spring, summer, fall, and winter, respectively. Overlap under heavy seasonal grazing averaged 18.5, 7.4, and 22.6% during spring, summer, and fall, respectively. Diets of both animals were diverse and overlap generally resulted from sharing small amounts of many plant taxa. Except on recent burns during summer, dietary overlap under heavy yearlong grazing was comparable to that observed under moderate yearlong grazing at half the cattle stocking rate. Moderate grazing (40-50% herbage removal) of similar range from late spring through early fall should have little negative impact on deer forage availability. Grazing during late fall and winter reduces an already limited supply of deer forage by reducing availability of evergreen browse and herbaceous winter rosettes.

171. **Development of earthworm populations in abandoned arable fields under grazing management.**
Eijsackers, H. J. P.
In: Earthworm ecology: From Darwin to vermiculture/ Satchell, J. E.
London: Chapman and Hall, 1983; pp. 241-246
NAL Call #: QL391.A6E27
Descriptors: Oligochaeta/ population dynamics/ physicochemical properties/ Netherlands
This citation is from AGRICOLA.

172. **Effect of a reduction in cattle stocking rate on brown-headed cowbird activity.**
Kostecke, Richard M.; Koloszar, James A.; and Dearborn, Donald C.
Wildlife Society Bulletin 31(4): 1083-1091. (2003)
NAL Call #: SK357.A1W5; *ISSN:* 0091-7648
Descriptors: breeding activity/ breeding areas/ brood parasitism/ cattle stocking rate/ commute distance/ cowbird removal programs/ foraging activity/ grazing pressure/ host parasite interaction/ population sustainability/ songbird conservation/ stocking rate reduction
Abstract: Brood-parasitic cowbirds (Molothrus spp.) can severely impact host populations. Cowbird removal is the primary means of reducing parasitism. As an alternative to removal, we evaluated the reduction of cattle stocking rate as a tool to shift cowbird-breeding activity away from a breeding area of a sensitive host. Activity of radiotagged, female brown-headed cowbirds (M. ater) breeding on Fort Hood, Texas, a United States Army installation that contains a large population of federally endangered black-capped vireos (Vireo atricapilla), was monitored 2 years before and 2 years after a reduction in cattle stocking rate. We predicted that cowbirds would respond to the reduction

by shifting both foraging and breeding activities toward more distant herds of cattle. Reduction in stocking rate did not have the desired effect of shifting cowbird breeding areas off the study area, though parasitism rates were lower following the reduction. Following the reduction, cowbirds eventually shifted foraging activity off the study area to sites where more cattle were present and tended to commute greater distances between breeding and foraging sites. Assuming that commute distance between breeding and foraging sites was energetically limiting, the cost of the increased commute may have reduced the number of eggs produced by female cowbirds over the breeding season, thus reducing parasitism. Effectiveness of our stocking rate reduction, even when applied at a large scale (9,622 ha), was reduced by the presence of alternative foraging sites within distances that cowbirds were willing to commute. Removal of cowbirds by trapping likely will remain the most effective means of maintaining a sustainable black-capped vireo population on Fort Hood.

173. **Effect of dairy cattle husbandry on behavioural patterns of red deer (Cervus elaphus) in the Italian Alps.**
Mattiello, S.; Redaelli, W.; Carenzi, C.; and Crimella, C.
Applied Animal Behaviour Science 79(4): 299-310. (2002)
NAL Call #: QL750.A6; *ISSN:* 0168-1591
Descriptors: focal animal sampling: sampling method/ aggression/ behavioral pattern/ feeding/ land management/ lying/ pasture grazing/ play/ resting/ ruminating/ self grooming/ social interaction
Abstract: The present study aimed to investigate in the field the effect of the presence of cattle on red deer behavioural patterns, in order to provide information that could be used to improve land management strategies. The research was carried out in a summer range at 1500 m a.s.1. in the Italian Central Alps. Observations were conducted at dawn and at dusk from June to September for four consecutive years. Using a focal animal sampling technique, 179 focal observations were made on deer for 10 min each. On the summer range, overall deer spent most of their time feeding (52.86% of time) and moving (24.95% of time), showing that the study site was used principally as a feeding area. The proportion of time dedicated to resting and comfort behaviours (lying, ruminating and self-grooming) was very low. The general presence of cattle on the summer range did not affect most behavioural patterns of deer, except for the percentage of time spent alert, which was higher in the presence of cattle (P<0.05). Deer observed in the same square grid unit (GU; 6.25 ha) with cattle spent more time standing (P<0.01), moving (P<0.001) and alert (P<0.05) and less time feeding (P<0.001) than deer further away from cattle. The time spent performing resting and comfort behaviours was higher when deer were far from cattle, although these differences were not statistically significant. Despite this, when cattle were present on the summer range, about one third of the deer were observed close to them. Independently from the contingent presence or absence of cattle or from their proximity, deer spent more time feeding (P<0.001) and less time moving (P<0.001) and standing (P<0.001) in areas subjected to higher cattle grazing pressure (with an index of presence of cattle higher than 0.5 animals/h/ha), suggesting that these areas were preferred for feeding activity, probably due the fact that cattle grazing helps to improve the quality of the pasture. Only six "aggressive" interactions without physical contact and one "play" interaction were recorded between deer and cattle over the whole study period. Deer were never observed to win an interaction with cattle, possibly due to their smaller body size. Despite modifications to red deer behaviour in response to cattle proximity, the general disturbance produced by cattle is limited and their presence may be tolerated by deer.

174. **The effect of riparian grazing on brown trout, salmo trutta, and juvenile atlantic salmon, salmo salar, in an English chalk stream.**
Summers, D. W.; Giles, N.; and Stubbing, D. N.
Fisheries Management and Ecology 12(6): 403-405. (2005)
NAL Call #: SH328.F574; *ISSN:* 0969-997X
Descriptors: habitat use/ chalk/ riparian grazing

175. **Effect of streambank fencing on herpetofauna in pasture stream zones.**
Homyack, J. D. and Giuliano, W. M.
Wildlife Society Bulletin 30(2): 361-369. (2002)
NAL Call #: SK357.A1W5; *ISSN:* 0091-7648
Descriptors: riparian environments/ range management/ species richness/ abundance/ biomass/ herpetofauna/ ecosystem management/ ecosystem disturbance/ agriculture/ population density/ community composition/ species diversity/ riparian vegetation/ water quality/ animal populations/ man-induced effects/ stream banks/ ecology/ amphibians/ Regina septemvittata/ Thamnophis sirtalis/ Amphibia/ Reptilia/ queen snake/ common garter snake/ reptiles/ streambank fencing/ livestock grazing/ USA
Abstract: Grazing livestock in streams and associated riparian zones may negatively impact a variety of wildlife through direct disturbance and alteration of environmental conditions. To evaluate streambank fencing as a management tool, we measured the richness, abundance, and biomass of reptile and amphibian species on 10 grazed streams and associated riparian areas and 10 similar areas that were recently fenced (1-2 yrs) to exclude livestock, during spring and summer of 1998 and 1999. Effects of streambank fencing on vegetation, water quality, and macroinvertebrate populations also were examined because livestock grazing may indirectly impact communities of herpetofauna through their influence on these factors. We found no difference in species richness, abundance of all species combined, or biomass of herpetofauna between fenced and unfenced streams. However, northern queen snakes (Regina septemvittata) and eastern garter snakes (Thamnophis sirtalis) were more abundant on fenced than unfenced sites. Percent litter cover and vertical obstruction were higher on fenced sites, terrestrial macroinvertebrate biomass was greater on unfenced sites, and water-quality variables did not differ between site types. Although some species (e.g., birds) responded quickly (<4 yrs) to streambank fencing, it appeared that herpetofauna might require a longer recovery time (>4 yrs). The length of time since livestock were excluded, dispersal ability, reproductive potential, and distance to the nearest remnant population may be important factors in reptile and amphibian recovery in grazed stream and riparian zones.

176. **Effects of agricultural management on the use of lowland grassland by foraging birds.**
Buckingham, Dave L.; Peach, Will J.; and Fox, Derren S.
Agriculture, Ecosystems & Environment 112(1): 21-40. (2006)
NAL Call #: S601 .A34; *ISSN:* 0167-8809
Descriptors: animals and man/ disturbance by man/ commercial activities/ nutrition/ feeding behaviour/ ecology/ habitat/ terrestrial habitat/ man made habitat/ land zones/ Palaearctic Region/ Eurasia/ United Kingdom/ Europe/ Aves: farming and agriculture/ lowland grassland agricultural management/ effects on habitat use/ diet/ diet related habitat use/ lowland grassland under agricultural management/ food availability/ foraging/ foraging habitat use/ lowland grassland/ habitat utilization/ grassland/ lowland grassland habitat use/ cultivated land habitat/ lowland grassland agricultural management effects on habitat use/ England/ West Midlands/ lowland grassland use/ related to diet/ effects of agricultural management/ Aves/ birds/ chordates/ vertebrates
Abstract: A field-scale correlative study was used to identify which factors had the greatest influence on the usage of agricultural grassland by foraging birds in the English West Midlands. The study extended previous work by directly comparing a more complete range of lowland grassland management practises, bird species and seasons. Sward structure had more influence on bird usage than botanical composition. Bird species fell into two groups based on their sward structure preferences, which closely reflected where they obtained their food. Species that feed on soil-dwelling invertebrates selected short swards, while species that feed on sward-dwelling invertebrates or seeds selected taller swards with greater spatial heterogeneity. Grazing had a greater influence on grassland usage than sward age and other management practices. Birds mainly responded positively to grazing, especially by cattle. Weed control reduced the usage of grass fields by granivorous birds during summer and winter. Intensive grazing systems create and maintain short, uniform swards that favour bird species foraging for soil-dwelling invertebrates, but not those reliant on seeds or sward-dwelling invertebrates. It is proposed that excessive defoliation of agricultural grasslands (associated with intensive grazing and mowing regimes) impacts granivorous birds by reducing prey abundance. Reductions in grazing intensity and the avoidance of weed control should increase food availability for granivorous and insectivorous birds on grass fields. [copyright] 2005 Elsevier B.V. All rights reserved.

177. **The effects of bankside management on chalk stream invertebrate communities.**
Harrison, Simon S C. and Harris, Iain T.
Freshwater Biology 47(11): 2233-2245. (2002)
NAL Call #: QH96.F6; *ISSN:* 0046-5070
Descriptors: bankside management: applied and field techniques/ Shannon diversity/ bankside vegetation types/ chalk stream invertebrate communities/ chalk streams/ grazing/ mid channel gravel/ simply structured grazed grass vegetation/ species abundance/ species richness/ structurally complex herbaceous vegetation/ terrestrial adult phase/ terrestrial phases
Abstract: 1. Communities of aquatic macroinvertebrates and the terrestrial adult phases of aquatic insects were investigated from short stretches of English chalk streams with two different bankside vegetation types: simply structured grazed grass (grazed) and structurally complex herbaceous vegetation with scattered trees (ungrazed). Macroinvertebrates were sampled in spring, summer, autumn and winter 1996-97 from three aquatic habitats: mid-channel gravel, patches of the aquatic macrophyte Ranunculus and marginal emergent macrophytes. The terrestrial adult phases of aquatic insects were sampled in spring, summer and autumn from bankside vegetation. 2. Total macroinvertebrate abundance did not differ between stretches with different bankside vegetation. Taxon richness of mid-channel gravel was, however, significantly higher in ungrazed compared with grazed stretches and Shannon diversity (H') of mid-channel gravel and marginal vegetation was significantly higher in ungrazed compared with grazed stretches. Total abundance, taxon richness and Shannon diversity (H') of the terrestrial adult phases of aquatic insect were significantly higher from the bankside vegetation of ungrazed compared with grazed stretches. 3. Ordination of communities of aquatic macroinvertebrates and terrestrial adults demonstrated that individual families of both groups were generally more abundant in ungrazed stretches. Many more families were significantly associated with ungrazed stretches than with grazed stretches. 4. This investigation has shown that high structural diversity of bankside vegetation along lowland chalk streams is accompanied at the reach scale by increased diversity of both aquatic macroinvertebrates and the terrestrial adult phases of aquatic insects. The conservation potential of such streams may thus be lowered by management practices that result in the removal or simplification of bankside vegetation along extensive stream stretches.

178. **Effects of cattle on duck food plants in southern Texas.**
Whyte, R. J. and Silvy, N. J.
Journal of Wildlife Management 45(2): 512-515. (1981)
NAL Call #: 410 J827; *ISSN:* 0022-541X
Descriptors: Texas
This citation is from AGRICOLA.

179. **Effects of grazing and haying on arthropod diversity in North Dakota Conservation Reserve Program grasslands.**
Hoernemann, C. K.; Johnson, P. J.; and Higgins, K. F.
Proceedings of the South Dakota Academy of Science 80: 283-308. (2001)
NAL Call #: 500 So82; *ISSN:* 0096-378X
Descriptors: species diversity/ Conservation Reserve Program/ grazing/ arthropods/ conservation practices

180. **Effects of grazing intensity on bird assemblages and populations of Hungarian grasslands.**
Baldi, Andras; Batary, Peter; and Erdos, Sarolta
Agriculture, Ecosystems & Environment 108(3): 251-263. (2005)
NAL Call #: S601 .A34; *ISSN:* 0167-8809
Descriptors: grazing intensity/ meadow/ alkali steppe
Abstract: Agricultural intensification is responsible for the dramatic decline of farmland bird populations in the European Union (EU). The joining of eight Central and Eastern European (CEE) countries to the EU will re-structure agriculture there. One of the main threats is the intensification of farmland management. Can agri-

environmental programs balance the expected decline in bird assemblages of the CEE countries if farming will be intensified? We studied this question by comparing bird assemblages of 42 extensively and intensively grazed paired fields in three regions of Hungary (alkali steppes and meadows in Central Hungary and alkali steppes in Eastern Hungary). Bird assemblages varied significantly across regions and grazing intensity. Intensively grazed sites showed a higher species number and diversity, but lower densities than the extensive sites. This is probably the consequence of higher landscape diversity of intensive sites, which included farm buildings, shelters, wells and other structures. Several bird species, mainly with European conservation concern, showed contrasting responses to grazing intensity in the three regions, including key grassland species (black-tailed godwit Limosa limosa, redshank Tringa totanus, skylark Alauda arvensis and corn bunting Emberiza calandra). Therefore, threat and sensitivity to grassland characteristics are correlating. Although many of the declining species of Western Europe are still abundant in Hungarian grasslands, our results project the threat of the expected intensification. This study showed that it is not possible to provide a general grassland management scheme that will favour all bird species in all regions of Hungary. In the process of integrating to the EU and restructuring agriculture, the establishment of scientifically sound schemes is urgent. (c) 2005 Elsevier B.V. All rights reserved.

181. **Effects of habitat management on vegetation and above-ground nesting bees and wasps of orchard meadows in central Europe.**
Steffan Dewenter, Ingolf and Leschke, Kathleen
Biodiversity and Conservation 12(9): 1953-1968. (2003)
NAL Call #: QH75.A1B562; *ISSN:* 0960-3115
Descriptors: mowing: applied and field techniques/ above ground nesting behavior/ agricultural landscapes/ community composition/ grazing impact/ habitat management/ orchard meadows: habitat/ species abundance/ species richness/ vegetation
Abstract: We studied the vegetation, stand structure and communities of above-ground nesting bees and wasps in 45 orchard meadows that were grazed, mown or abandoned (15 of each) in an agricultural landscape near Goettingen, Germany. Total species richness of plants was significantly lower and the proportion of dead wood was significantly higher on abandoned meadows compared to mown or grazed meadows. Species richness of bees, eumenid wasps and sphecid wasps did not differ between the three management types. Abundance of sphecid wasps was significantly higher on abandoned than on managed orchard meadows. Landscape context did not affect management type. The results suggest that management practises affect vegetation more significantly than the studied insect groups.

182. **Effects of livestock breed and stocking rate on sustainable grazing systems: Butterfly diversity and abundance.**
WallisDeVries, M. F.; Tallowin, J. R. B.; Dulphy, J. P.; Sayer, M.; and Diana, E.
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. 227-230; 2005.
NAL Call #: SB202.E85 E87 2005
Descriptors: animals and man/ disturbance by man/ commercial activities/ ecology/ habitat/ terrestrial habitat/ man made habitat/ land zones/ Palaearctic Region/ Eurasia/ Europe/ Papilionoidea: farming and agriculture/ grazing livestock breed and stocking rate/ community structure/ Italy and United Kingdom/ grassland/ cultivated land habitat/ France/ Germany/ Italy/ United Kingdom/ grazing livestock breed and stocking rate relationship/ Papilionoidea/ Heteroneura/ Glossata/ Lepidoptera/ Insecta/ arthropods/ insects/ invertebrates/ lepidopterans
Abstract: Finding an optimal balance between livestock production and the impact of grazing on animal biodiversity is an important issue in the development of sustainable grazing systems. Butterflies are suitable indicators of grazing impact. Here, we consider the results of similarly designed grazing experiments, carried out over three years in the United Kingdom, France, Germany and Italy. All sites involved a comparison of three treatments, replicated threefold in a randomized block design: 1) a moderate stocking rate with a commercial breed, 2) a low stocking rate with a commercial breed and 3) a low stocking rate with a traditional breed. Butterfly species richness and abundance were assessed by bi-weekly transect counts. Although countries differed in species composition and butterfly numbers, the effect of the various treatments showed a consistent pattern across countries. Species richness and abundance of butterflies were enhanced by the low stocking rate compared to the moderate stocking rate, but no clear difference between breeds emerged. Both butterfly species preferring short grasslands and those preferring tall grasslands benefited from the lower stocking rate. This project showed that butterfly diversity on grasslands increased within three years by reducing stocking rates.

183. **Effects of livestock breed and stocking rate on sustainable grazing systems: Short-term effects on fauna.**
WallisDe Vries, M. F.; Tallowin, J. R. B.; Dulphy, J. P.; Sayer, M.; and Diana, E.
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. 626-628; 2004.
Descriptors: animal production/ breed differences/ fauna/ livestock/ species richness/ stocking rate/ butterflies/ grasshoppers
Abstract: Finding an optimal balance of the impact of grazing on animal biodiversity is an important issue in the development of sustainable grazing systems. Here, we consider the first year results of grazing experiments conducted in four countries (UK, France, Germany and Italy). All sites involved three treatments: (1) moderate stocking rate with a commercial breed, (2) low stocking rate with a commercial breed and (3) low stocking rate with a traditional breed. Animal biodiversity was studied at the species level for birds, hares, butterflies, grasshoppers and at higher taxonomic level for ground-dwelling arthropods. Bird and hare numbers were low and revealed no treatment effects. Butterflies and grasshoppers showed lower species

richness and abundance at moderate stocking rate but no difference between breeds appeared. In contrast, the number of ground-dwelling arthropod groups was higher at moderate stocking rate, but treatment effects on abundance could not be detected at the family level yet. It is concluded that butterflies and grasshoppers show a quick response to variation in stocking rate. This effect is expected to develop over the next years for other animal groups.

184. **Effects of plant cover improvements for nesting ducks on grassland songbirds.**
Lapointe, S.; Belanger, L.; Giroux, J.-F.; and Filion, B.
Canadian Field-Naturalist 117(2): 167-172. (2003)
NAL Call #: 410.9 Ot8; *ISSN:* 0008-3550
Descriptors: aquatic birds/ nesting/ Canada, Quebec, St. Lawrence R., Varenne I.
Abstract: Several islands located along the St. Lawrence River in southern Quebec have been used as natural pastureland by cattle for decades. Recently, a rest-rotation grazing system and dense nesting cover were established on four islands near Varennes to improve duck nesting conditions. The effects of these two plant cover improvements on the abundance of grassland songbirds were assessed through four treatments: 1) idle fields with no vegetation improvement but exclusion of cattle (IDLE), 2) improved pastures with seeding of forage plants for cattle (IMPP), 3) dense seeded nesting cover fields improved for ducks and where cattle were excluded (DNC), and 4) natural or unimproved pastures grazed by cattle after the duck nesting season (UIPP). The overall abundance of birds was similar among treatments before cover improvements as well as two years after.

185. **Effects of prescribed burning and cattle grazing on deer diets in Louisiana.**
Thill, R. E.; Martin, A.; Morris, H. F.; and Harrel, A. T.
New Orleans, LA: U.S Dept. of Agriculture Southern Forest Experiment Station, 1995. 13 p. Research Paper.
NAL Call #: A99.9 F7628Us
http://www.srs.fs.usda.gov/pubs/rp/rp_so289.pdf
Descriptors: Odocoileus virginianus/ forage/ nutritive value/ prescribed burning/ grazing/ cattle/ nutrient content/ crude protein/ phosphorus/ calcium/ Louisiana
Abstract: A study was conducted on the dietary and nutritional effects of cattle grazing and rotational prescribed burning on the diets of three to five captive white-tailed deer (Odocoileus virginianus) on longleaf pine (Pinuspalustris Mill.)_bluestem (Andropogon spp. and Schizachyrium spp.) sites in central Louisiana from October 1980 through February 1987. Deer diets were evaluated under ungrazed, moderate year-long, heavy seasonal, and heavy yearlong cattle grazing treatments. Deer diets were composed mostly of browse and forbs under all grazing treatments, but were less diverse under heavy grazing when compared with moderate and no grazing treatments. Foraging efficiency (computed as the ratio of forage intake per 30-minute trial to the distance traveled)
was comparable among treatments during spring and fall but was lower under the heavy grazing treatment during summer and winter. Diets selected under ungrazed conditions contained the highest percentage of uncommon and ephemeral plant taxa during all seasons except fall. Dietary crude protein (CP), phosphorus (P), and calcium-to-phosphorus ratios varied significantly under various grazing treatments for certain seasons. Prescribed burning did not significantly affect diet diversity; however, diets from areas of first-year burns were higher in CP and P than from areas of older burns during spring and summer, but these differences disappeared by the first fall after burning. From a nutritional standpoint, burning and seasonal influences generally had more
impact than grazing treatments on deer diets. No evidence was found that seasonal or yearlong cattle grazing at moderate levels (40- to 50-percent herbage removal) adversely affected deer nutrition.
This citation is from AGRICOLA.

186. **Effects of reduced grazing on population density and breeding success of black grouse in northern England.**
Calladine, John; Baines, David; and Warren, Philip
Journal of Applied Ecology 39(5): 772-780. (2002)
NAL Call #: 410 J828; *ISSN:* 0021-8901
Descriptors: agri environment schemes/ breeding success/ conservation biology/ grazing intensity/ marginal uplands/ moorlands/ pastoral landscapes/ population density/ seasonality
Abstract: 1. The maintenance or modification of grazing regimes is frequently advocated to deliver conservation targets in pastoral landscapes, but there are few quantitative studies of the effects of grazing on upland birds. This is particularly true with respect to grazing management in agri-environmental schemes. 2. Numbers of black grouse Tetrao tetrix and their breeding success were therefore monitored at 20 sites in the north of England from 1996 to 2000. Ten treatment sites included areas where grazing was reduced before and during the study to <1.1 sheep ha-1 in summer and <0.5 sheep ha-1 in winter. Each was paired with a reference site that held sheep at two (summer) to three times (winter) the density on the experimental sites. The reduced grazing sites ranged from 0.4 to 3.2 km2 in size and most were part of existing agreements within agri-environment schemes that had been in place for 1-5 years before 1996. 3. Numbers of black grouse males displaying increased by an average of 4.6% (SE = 2.1) year-1 at the 10 sites with reduced grazing. Displaying male trends differed significantly between treatment and normally grazed reference sites, where numbers declined annually on average by 1.7% (SE = 1.4). 4. Summer black grouse hen densities showed the greatest rate of increase where grazing was restricted on smaller areas of ground (0.4 km2). Declines occurred at sites where the area of restricted grazing exceeded about 1 km2. The rates of change in population density, as indicated by numbers of displaying males, peaked in the early years of grazing reduction and then declined after c. 5-7 years. 5. The proportion of females that retained broods during the late chick-rearing period was 54% (SE = 0.06) at sites with reduced grazing, significantly greater than the 32% (SE = 0.06) at normally grazed reference sites. There was no difference in the size of broods between grazing treatments. 6. This study demonstrates that agri-environment schemes, which encourage extensive management of grazing land, can benefit at least some organisms of conservation importance and lead to some recovery of populations. There is a need, however, for further understanding of how such benefits can be

maintained at a landscape scale and over the greater time scales involved in vegetation dynamics and bird population processes.

187. **Effects of riparian grazing and channelisation on streams in Southland, New Zealand: Benthic invertebrates.**
Quinn, J. M.; Williamson, R. B.; Smith, R. K.; and Vickers, M. L.
New Zealand Journal of Marine and Freshwater Research 26(2): 259-273. (1992)
NAL Call #: QH91.57.A1N4; *ISSN:* 0028-8330
Descriptors: grazing/ benthos/ agriculture/ environmental protection/ river banks/ temperature effects/ vegetation cover/ zoobenthos/ riparian environments/ community composition/ invertebrata/ streams/ freshwater environments/ Invertebrata/ New Zealand, South I., Southland/ New Zealand/ channelization/ riparian grazing/ streams/ freshwater environments/ invertebrata/ grazing/ river banks/ temperature effects/ vegetation cover
Abstract: A survey of benthic invertebrate faunas in riparian-protected, riparian-grazed, and channelised reaches of five Southland streams with catchment sizes of 3-37 km super(2) was carried out. In small streams (catchment areas 3-10 km super(2); widths 1-4 m), channelisation or intensive grazing by cattle greatly reduced shading by riparian vegetation, resulting in substantial increases in daily maximum temperatures during summer. Channelisation also caused gross changes in channel morphology and intensive grazing of a reach with moist streamside soils was associated with increased bed sedimentation and bank damage. Marked changes in invertebrate communities were associated with these habitat modifications. In general, taxa favoured by cool water and low periphyton abundance (e.g., Plecoptera, Paraleptamphopus caeruleus, Deleatidium) sp., and Helicopsyche albescens) decreased in density, whereas densities of taxa favoured by an abundance of periphyton (e.g., Chironomidae and Oxyethira albiceps) increased. Shade provided by riparian vegetation appears to play a vital role in maintaining cool, headwater, stream habitats for benthic invertebrate communities in these streams.

188. **Effects of sheep stocking rates and management on the abundance of a pasture-feeding caterpillar Metacrias huttoni.**
White, E. G.
New Zealand Journal of Experimental Agriculture 13(3): 271-276. (1985)
NAL Call #: S542.A1N45; *ISSN:* 0301-5521
Descriptors: grazing management/ livestock industry/ crop industry/ New Zealand
Abstract: Merino hogget stocking rates and management (continuous stocking, 2-rotation, and 6-rotation) are shown to interact with the abundance of a pasture-feeding insect Metacrias huttoni (Butler) (Lepidoptera: Arctiidae) in a predictable manner [New Zealand]. The 6-year study of 9 grazing treatments demonstrates progressive variations in insect abundance over local space and over time. A multivariate estimator, S, of spatio-abundance is derived over the full range of treatments.

189. **Evaluation of the impacts of grazing on grassland wildlife populations: Evaluation of vegetation structure and floristic composition on continuous and rotational grazing systems with 4 different stocking rates in north central Missouri.**
Schulz, J. H. Missouri Department of Conservation, 2002. 52 pp. Annual Report.
Descriptors: grazing/ grassland/ vegetation/ invertebrates/ habitat/ cattle/ size/ statistics/ sampling/ livestock/ North America/ United States/ Missouri/ North-Central Region/ Linn County

190. **Field-scale effects of farming practices on linyphiid spider populations in grass and cereals.**
Thomas, C. F. G. and Jepson, P. C.
Entomologia Experimentalis et Applicata 84(1): 59-69. (1997)
NAL Call #: 421 En895; *ISSN:* 0013-8703
Descriptors: cutting/ dispersal/ farming practices/ field scale effects/ grazing/ insecticide application/ linyphiid spider/ population dynamics/ population studies/ spatial structure/ spatially dynamic model
Abstract: Linyphiid spiders were sampled in three grass and four cereal fields, between October 1989-October 1990, and from one grass and one cereal field, from June-August 1991. Population growth and decline were characteristic of field type and pattern of management. Agricultural operations caused large population depletions: insecticide applications, cutting grass for silage and autumn cultivations reduced spider populations by 56% to 96%; heavy grazing caused virtual extinction. Aerial dispersal activity, monitored by water traps, showed high dispersal frequency with highest intensity in June, July and August. The results are discussed with reference to the large-scale spatial structure of linyphiid spider populations and the use of spatially dynamic models to predict metapopulation size as a function of patterns of crop management, land-use and landscape structure.

191. **Grassland birds associated with agricultural riparian practices in southwestern Wisconsin.**
Renfrew, R. B. and Ribic, C. A.
Journal of Range Management 54(5): 546-552. (2001)
NAL Call #: 60.18 J82; *ISSN:* 0022-409X
Descriptors: grasslands/ population density/ riparian grasslands/ rotational grazing/ species richness
Abstract: Rotational grazing has been proposed as a Best Management Practice for minimizing runoff in Wisconsin agricultural riparian areas. The influence of this land management practice on grassland birds has not been evaluated in relation to more traditional agricultural land management systems in Midwestern riparian areas. This study compared the grassland bird community in riparian areas in Wisconsin, USA that were rotationally grazed to 2 common land use practices along streams in Wisconsin: continuously grazed pastures and rowcrop fields with 10-m-wide ungrazed buffer strips located along the stream. We calculated total number of birds, the Berger-Parker Index of Dominance, and number of birds ha-1 for each site. Vegetation variables used were height-density, litter depth, and percent bare ground. Bird species richness, species dominance, and density did not differ among land use types. In contrast, grassland bird species of management

concern (Savannah Sparrow (Passerculus sandwichensis), Eastern Meadowlark (Sturnella magna), and Bobolink (Dolichonyx oryzivorus)) were found on continuous and rotational pastures but very rarely or never occurred on buffer strips. Contrary to previous research, however, rotationally grazed pastures did not support more of these species than continuously grazed pastures. Bird density was related to vegetation structure, with higher densities found on sites with deeper litter. Within the pasture land use types, there were no consistent differences between species richness and density near the stream (<10 m) and away (>10 m).

192. **Grassland management for the conservation of songbirds in the Midwestern USA.**
Walk, Jeffery W. and Warner, Richard E.
Biological Conservation 94(2): 165-172. (2000)
NAL Call #: S900.B5; *ISSN:* 0006-3207
Descriptors: abundance/ grassland management/ grazing/ habitat type/ mowing/ prescribed burning
Abstract: We monitored breeding eastern meadowlarks, dickcissels, Henslow's sparrows, grasshopper sparrows and field sparrows using strip transect surveys in 1995 and 1996. The 473-ha study area was an array of 3-ha management units of burned, mowed, hayed, grazed and undisturbed (>1 year) cool- and warm-season grasses and annual weeds. Management units grouped by habitat type (management regime and grass type) had different (P < 0.05) abundances of each species. Eastern meadowlarks and dickcissels were most frequently observed in grazed warm-season grasses. Observation rates of Henslow's sparrows and field sparrows were highest in undisturbed warm-season grasses, whereas eastern meadowlarks and grasshopper sparrows were observed least often in this habitat type. Grasshopper sparrows were observed most frequently in annual weeds; Henslow's sparrows and field sparrows were not observed in this habitat type. Overall avian abundance was lowest in recently burned cool-season grasses. The low-intensity, late-season grazing system was important for creating a heterogeneous habitat mosaic attractive to the five species studied.

193. **Grazing and burning impacts on deer diets on Louisiana pine-bluestem range.**
Thill, R. E.; Martin, A.; Morris, H. F.; and Mccune, E. D.
Journal of Wildlife Management 51(4): 873-880. (1987)
NAL Call #: 410 J827; *ISSN:* 0022-541X
Descriptors: Odocoileus virginianus/ plant composition/ diet quality/ foraging selectivity/ feeding efficiency/ seasonality/ management/ protein/ phosphorus/ calcium
Abstract: Diets of 3-5 tame white-tailed deer (Odocoileus virginianus) on adjacent ungrazed and continuously grazed (35% herbage removal by late Oct) forested pastures were compared for forage-class use, botanical similarities, foraging selectivity and efficiency, and diet quality. Both pastures were divided into 3 burning subunits and burned in late February on a 3-year rotation. Botanical composition of diets differed between and within pastures, but forage-class use was similar except during winter, when deer selected more browse on ungrazed subunits. Grazing had no effect on dietary protein, phosphorus (P), or calcium (Ca) levels, but diets from ungrazed subunits wree higher in digestibility (except during summer), and contained more uncommon plant taxa. Deer foraged more efficiently on grazed than on ungrazed subunits but were less efficient on recent than on older burns. Diets from 1st-year burns were higher in protein during spring and summer and higher in P during spring.

194. **Grazing effects on between-year variation of farmland bird communities.**
Soderstrom, Bo; Part, Tomas; and Linnarsson, Erik
Ecological Applications 11(4): 1141-1150. (2001)
NAL Call #: QH540.E23; *ISSN:* 1051-0761
Descriptors: Kendall's coefficient of concordance/ between year variation/ body mass/ community variability/ farmland bird communities/ grazing effects/ grazing intensity/ grazing pressure/ habitat composition/ land use/ local extinction/ population decline/ recolonization/ species abundance/ vegetation structure
Abstract: Livestock grazing is the dominant land use in the remaining seminatural grasslands in Europe. Abandonment of grasslands and, conversely, intensified grazing by livestock have been suggested as possible causes for the widespread population declines of many farmland birds, although the direct impact of grazing on farmland birds is poorly known. Here, we use a comprehensive, long-term data set (20 pastures surveyed over five years) to test the effects of changes in grazing intensities in seminatural dry pastures on between-year variation of the farmland bird community, functional groups of species, and individual species. Bird communities in all 20 seminatural pastures showed a low degree of temporal variability (Kendall's coefficient of concordance on ranked abundances: mean W = 0.72, range = 0.58-0.89). Community variability was not significantly related to site area, grazing pressure, vegetation structure, or adjacent habitat composition. However, analyses of functional groups of species categorized according to body mass and breeding diet showed that different species subsets had differential responses to between-year changes in grazing pressure (as reflected by changes in grass height). Local extinction and recolonization of ground-feeding insectivorous bird species were affected by yearly changes in grazing pressure, but there was no effect of grazing on ground-feeding species that fed on a mixed diet or on species that foraged in trees and shrubs. In general, large insectivores (>30 g) preferred moderately grazed pastures, and small insectivores (ltoreq30 g) preferred pastures with intensive grazing pressure. We propose that current intensive grazing should be relaxed (i.e., by reducing the number of stock per hectare or by within-season rotational grazing) so that with a given stock size, larger areas of seminatural dry pastures could be grazed. This would decrease the rate of habitat loss and conserve a larger part of the farmland bird community breeding in this habitat.

195. **Grazing management as a means of regulating spittlebug (Homoptera: Cercopidae) numbers in central Brazil.**
Hewitt, G. B.
Pesquisa Agropecuaria Brasileira 23(7): 697-708. (1989)
NAL Call #: S15 .P452; *ISSN:* 0100-204X
Descriptors: cattle/ nymphal density/ oviposition/ egg survival/ pest/ crop industry/ agriculture
Abstract: Short duration, high intensity grazing was

evaluated as a method of reducing spittlebug numbers in central Brazil. Intense grazing perssure during the nymphal period resulted in a temporary reduction in nymphal density but additional hatching of eggs allowed the density to increase. Intense grazing during the last generation of adults, prior to the start of the dry season drastically reduced the nymphal population. Grazing by cattle in general provided an unsuitable habitat for spittlebug egg survival as both grass height and plant cover decreased under all grazing treatments. In heavily infested pastures (> 20 nymphs/m2) it is recommended to graze the grass short (< 10 cm) during the last generation of adults (April-July) in order to discourage oviposition by adults laying diapause eggs and to expose eggs to detrimental conditions during the dry season. In pastures with low spittlebug density (< 20 nymphs/m2) it is recommended to maintain the forage height at 15 cm-20 cm during the rainy season for maximum production and efficient use of the forage resource.

196. **Grazing management of calcareous grasslands and its implications for the conservation of beetle communities.**
Woodcock, B. A.; Pywell, R. F.; Roy, D. B.; Rose, R. J.; and Bell, D.
Biological Conservation 125(2): 193-202. (2005)
NAL Call #: S900.B5; *ISSN:* 0006-3207
Descriptors: grazing management: applied and field techniques/ species richness/ calcareous grassland
Abstract: Calcareous grasslands are an important habitat for floral and faunal communities in the UK and Europe. Declines due to changes in management, scrub invasion and agricultural improvement have left much of the remnants of this habitat in a degraded and fragmented state. Grazing, by cattle or sheep, is one of the main management practices used to maintain and improve the floral and faunal quality of calcareous grassland. The long-term impacts of different grazing regimes, however, are poorly understood, particularly in terms of the invertebrate communities. This study contrasted the impacts of recently introduced and long-term sheep or cattle grazing on beetle communities present on one of the largest areas of calcareous grassland in Europe, the Salisbury Plain military training Area, UK. No effects of grazing management on beetle abundance, species. richness or evenness were found, but plant diversity and overall percentage cover of grasses did influence beetle diversity. Proportions of the total number of individuals and overall species richness within beetle guilds (predatory, phytophagous, flower/seed feeders, root feeders and foliage feeders) were strongly influenced by both the duration and type of grazing animal. At the species level, beetle community structure showed significant differences between ungrazed, long-term cattle and long-term sheep grazing treatments. Changes in plant community structure were found to influence beetle community structure. The significance of these results is discussed in terms of the long-term impacts of grazing on beetle community structure, and the benefits of different grazing regimes for the conservation management of calcareous grasslands. (c) 2005 Elsevier Ltd. All rights reserved.

197. **Ground beetle distribution of distinct size and feeding type due to grassland management treatments in orchards (Coleoptera: Carabidae).**
Glueck, Erich and Deuschle, Juorgen
Entomologia Generalis 28(1): 39-63. (2005)
NAL Call #: QL461.E582; *ISSN:* 0171-8177
Descriptors: animals and man/ disturbance by man/ commercial activities/ ecology/ population dynamics/ habitat utilization/ habitat/ man made habitat/ land zones/ Palaearctic Region/ Eurasia/ Europe/ Carabidae: farming and agriculture/ community structure/ population density/ distribution within habitat/ habitat colonization/ cultivated land habitat/ orchards/ Germany/ Weilheim/ Limburg Nature Reserve/ grassland management treatment effect on orchard community structure/ Carabidae/ Caraboidea/ Adephaga/ Coleoptera/ Insecta/ arthropods/ beetles/ insects/ invertebrates
Abstract: From April 1995 to November 1997 the following investigation was carried out on 62.7 ha of the nature reserve 'Limburg' (48.36 N/9.23E): data on the type and frequency of grassland use was collected and mapped as well as data on the carabid fauna. 17 sample plots were selected. Parts of the plots have had 25 years of unchanged management regimes.The regimes included three-cutting meadows (3), two-cutting meadows (3), mulched meadows (4), abandoned meadows (3), a horse pasture, a sheep pasture with rotational grazing, a continuously grazed sheep pasture, and a sheep pasture which had been abandoned in 1994. 5229 beetles representing 68 Carabidae species were caught in pitfall traps during the three years of investigation, 18 species (26%) could only be verified by one single individium. Meadows cut once or twice a year did not differ substantially from pastures regarding their mean number of species. But these three management forms show a significant higher number of species compared to mulched meadows or abandoned plots. The number of species on sample plots diminishes with decreasing land use intensity. The carabid species caught were divided into 5 classes according to their size: Large species (SCI, SC II) held percentages between 6 and 29% and between 0 and 29% respectively. Medium-sized and smaller species (SC III, SC IV) were more abundant with 8-54% and 15-63%. Very small species (SC V) were less frequent 0-19%. The percentage of large species increased along the gradient of land use intensity, while the percentage of medium-sized species decreased. Two classes were built regarding the food preferences of carabids: Phytohagous species held percentages between 14 and 41%, predominantly zoophagous species between 54 and 86%. The distribution of food preferences does not show any land use-specific influence. Three discriminant functions on the basis of 20 characters (variables) of the carabid assemblage were extracted, which significantly separated the carabid assemblages from the live groups of management forms. The ecological characteristics of the assemblages in the orchard habitat are quite different.

198. **Habitat preference of Lestes barbarus (Fabricius, 1798) (Odonata, Lestidae) on a low-intensity cattle pasture in the Sava floodplain (Croatia).**
Hill, Benjamin T.; Beinlich, Burkhard; and Plachter, Harald.
In: Verhandlungen der Gesellschaft fuer Oekologie. (Held 7 Sep 1998-7 Sep 1998 at Ulm, Germany.); Vol. 29.

Heidelberg, Germany: Spektrum Akademischer Verlag; pp. 539-545; 1998.
Notes: Meeting Information: 28th Annual Conference of the Society for Ecology (Gesellschaft fuer Oekologie)
NAL Call #: QH540 .G4 Bd. 29; *ISBN:* 3827407850
Descriptors: floodplains grazing systems/ groundwater level/ habitat preference/ land use practice/ limnic habitat/ low intensity cattle pasture/ book chapter/ meeting paper

199. **The impact of buffer strips and stream-side grazing on small mammals in southwestern Wisconsin.**
Chapman, E. W. and Ribic, C. A.
Agriculture, Ecosystems & Environment 88(1): 49-59. (2002)
NAL Call #: S601 .A34; *ISSN:* 0167-8809
Descriptors: pastures/ habitats/ cattle/ small mammals/ ecosystems/ streams/ animal husbandry/ rotational grazing/ species diversity/ farm management/ riparian buffers/ plant litter/ intensive livestock farming
Abstract: The practice of continuously grazing cattle along streams has caused extensive degradation of riparian habitats. Buffer strips and managed intensive rotational grazing (MIRG) have been proposed to protect and restore stream ecosystems in Wisconsin. However, the ecological implications of a switch from traditional livestock management to MIRG or buffer strip establishment have not been investigated. Differences in small mammal communities associated with riparian areas on continuously grazed and MIRG pastures, as well as vegetative buffer strips adjacent to row crops, were investigated in southwestern Wisconsin during May-September 1997 and 1998. More species (mean of 6-7) were found on the buffer sites than on the pasture sites (mean of 2-5). Total small mammal abundance on buffer sites was greater than on the pastures as well; there were 3-5 times as many animals on the buffer sites compared to the pasture sites, depending on year. There were no differences in species richness or total abundance between MIRG and continuously grazed pastures in either year. Total small mammal abundance was greater near the stream than away from the stream, regardless of farm management practice but there were no differences in species richness. Buffer strips appear to support a particularly rich and abundant small mammal community. Although results did not detect a difference in small mammal use between pasture types, farm-wide implications of a conversion from continuous to MIRG styles of grazing may benefit small mammals indirectly by causing an increase in the prevalence of pasture in the agricultural landscape.
This citation is from AGRICOLA.

200. **The impact of grazing animals on nesting success of grassland passerines in farmland and natural habitats: A field experiment.**
Pavel, Vaclav
Folia Zoologica 53(2): 171-178. (2004)
NAL Call #: 410 Z792; *ISSN:* 0139-7893
Descriptors: simulated nest method: applied and field techniques/ farmlands/ natural habitats/ nesting success: grassland passerines, grazing animal impact/ trampling: nest damage/ unmanaged alpine meadow
Abstract: A study was made of the influence of trampling by grazing animals on the nesting success of real nests (meadow pipit, Anthus pratensis; water pipit, Anthus spinoletta; and skylark, Alauda arvensis) and simulated nests (caps from jam-jars filled by green plasticine) on pasture in the Orlicke Mountains and on unmanaged alpine meadows in the Jeseniky Mountains (Czech Republic, Central Europe). While the pasture was continuously grazed by livestock at high densities, unmanaged alpine meadow was grazed only by wild large herbivores at far lower densities. Trampling was the primary cause of nest failure in the Orlicke Mountains, but was infrequent in the Jeseniky Mountains. The number of real nests lost by trampling corresponded to simulated nests within the localities. Spatial distribution of simulated nests had no effect on their survival on intensively grazed fields. The results indicate that grazing animals negatively influenced the nesting success of real and simulated nests of grassland passerines on continuously grazed mountain pasture. The use of simulated nests was an adequate method of predicting trampling losses by natural nests.

201. **Impact of grazing systems on insects and spiders.**
Dennis, P.; Bentley, C.; and Jones, J. R.
In: Livestock farming systems: Research, development socio-economics and land management. (Held 1 Sep 1994-2 Sep 1994 at Aberdeen, Scotland.) Dent, J. B. (eds.); pp. 220-226; 1996.
Notes: Proceedings of the Third International Symposium
NAL Call #: 49.9 Eu7 no.79
Descriptors: grasslands/ surveys/ stocking rate/ nitrogen fertilizers/ grazing/ predators/ predatory arthropods/ natural enemies
Abstract: A field study was carried out during 1993 in Wales, UK, to investigate the effects of grazing by sheep (9 or 12 ewes/ha) on Araneae and Coleoptera in grasslands. The total number of species was 40 for Araneae and Opiliones, and 89 for Carabidae and Staphylinidae. More species were found in plots without nitrogen application. Lower stocking rates and taller sward height had a positive effect on the number of species.

202. **The importance of grazed habitat for foraging choughs Pyrrhocorax pyrrhocorax, and its implication for agri-environment schemes.**
Johnstone, I.; Whitehead, S.; and Lamacraft, D.
Aspects of Applied Biology(67): 59-66. (2002)
NAL Call #: QH301.A76; *ISSN:* 0265-1491
Descriptors: breeding places/ foraging/ grazing/ habitat selection/ heathlands/ pastures/ wildlife conservation/ Pyrrhocorax/ Pyrrhocorax pyrrhocorax
Abstract: Although the chough is of high conservation priority throughout its North West European range, its' breeding habitat requirements may conflict with other land uses. To assess this, the foraging habitat selection of 14 pairs of breeding choughs in coastal north Wales was measured. The results showed selection for heath and pasture with short swards produced by grazing. However, few choughs nest on nature reserves. In the wider countryside, there is a general trend towards promoting reductions in grazing, and these results suggest that this may be detrimental to choughs. Therefore, if the conservation status of this important farmland bird is to improve, grazing prescriptions appropriate to breeding

choughs should be available within relevant agri-environment schemes, along with the ability to target them effectively.

203. **Improving habitat quality of rotationally grazed pastures for grassland birds.**
Wisconsin Department of Natural Resources Wisconsin Dept. Nat. Res., 1997. 7 p.
Descriptors: livestock/ population density/ population loss/ vegetation/ North America/ United States/ Wisconsin

204. **Indirect effects of grazing and nutrient addition on the hemipteran community of heather moorlands.**
Hartley, S. E.; Gardner, S. M.; and Mitchell, R. J.
Journal of Applied Ecology 40(5): 793-803. (2003)
NAL Call #: 410 J828; *ISSN:* 0021-8901
Descriptors: fencing: applied and field techniques/ fertilization: applied and field techniques/ nutrient addition/ conservation biology/ grazing behavior/ heather moorlands: habitat/ indirect effects/ management implications/ mineral soils/ nutrient deposition/ species abundance/ species richness/ vegetation: composition, nutritional quality, structure
Abstract: 1. Moorlands dominated by heather Calluna vulgar is are of international conservation importance, but are declining as a result of increased grazing pressure and deposition of atmospheric pollutants. Grazing and nutrient deposition can alter the composition, structure and nutritional quality of the vegetation, which may affect the diversity of herbivorous insects. However, the drivers of insect community diversity in moorlands remain poorly understood. 2. Here we quantify the changes in moorland vegetation caused by grazing and nutrient addition, together with the effects of these changes on the community structure of a major group of herbivorous insects on moorlands, the Hemiptera. Fencing and fertilizer treatments were used to test the hypotheses that: (1) hemipteran species richness is related to plant species richness; (2) fertilizer addition increases host plant quality and hence the abundance and diversity of Hemiptera; and (3) a reduction in grazing alters vegetation structure and hence the composition of the hemipteran community. 3. Sites with more mineral soils had the most plant species and the largest species richness and abundance of Hemiptera, supporting hypothesis 1. Fertilizer increased the nitrogen content of both grasses and Calluna and significantly increased Hemiptera abundance and species richness (hypothesis 2), although the effect of fertilizer on diversity was smaller than that of site-based factors such as plant species richness. 4. Grazing altered vegetation structure (hypothesis 3): fenced plots increased Calluna ground cover, height and canopy occupancy but reduced grass cover. Four months after the fencing and fertilizer treatments, the level of grazing on Calluna was the prime factor influencing the composition of the hemipteran community. However, after 2 years of the treatments, soil organic content and prevalence of Nardus and new-growth Calluna had become the greatest influence on community composition. 5. Synthesis and applications: Grazing and nitrogen deposition alter the vegetation of moorland landscapes and this study shows that these factors also have significant effects on the abundance, species richness and species composition of moorland invertebrates. However, site-based factors such as soil organic content and plant species richness had the greatest impact on the hemipteran community because plant diversity appears to be the most important driver of hemipteran diversity. Moorland managers may be able to maximize hemipteran species richness using a grazing regime that maintains a mosaic of dwarf shrub and grass cover. Site-specific factors such as soil type need to be considered when managing moorlands for conservation.

205. **Influence of cattle grazing and pasture land use on macroinvertebrate communities in freshwater wetlands.**
Steinman, A. D.; Conklin, J.; Bohlen, P. J.; and Uzarski, D. G.
Wetlands 23(4): 877-889. (2003)
NAL Call #: QH75.A1W47; *ISSN:* 0277-5212
Descriptors: community structure/ species richness/ nutrient concentrations/ water column/ wetlands/ freshwater environments/ grazing/ stocking rates/ land use/ pasture/ pastures/ invertebrates/ nutrients/ cattle/ livestock/ environmental effects/ ostracods/ macroinvertebrates/ midges/ bioindicators/ eutrophication/ aquatic insects/ freshwater crustaceans/ zoobenthos/ population structure/ community composition/ species diversity/ biotic factors/ dominant species/ aquatic plants/ stocking density/ stocks/ agriculture/ indicator species/ pollution indicators/ Invertebrata/ Culicidae/ Juncus effusus/ Polygonum/ Panicum hemitomon/ USA, Florida/ cattle/ cattle stocking/ mosquitoes
Abstract: Responses of wetland abiotic variables and aquatic invertebrate community structure to cattle stocking density, pasture type, and dominant vegetation were evaluated in subtropical pastures. Cattle were stocked at four treatment levels on improved (fertilized) and semi-native (unfertilized) pastures in south-central Florida, USA. Improved pasture wetlands were dominated either by Panicum hemitomon (maidencane) or by a mixture of Polygonum spp. (smartweed) and Juncus effusus; semi-native pasture wetlands were dominated mainly by maidencane. Cattle stocking density had few significant effects on water-column nutrient concentration or invertebrate community structure. However, water-column nutrient concentrations were significantly greater in the wetlands on improved pastures compared to semi-native pastures. Invertebrate richness and diversity were greater in wetlands on semi-native pastures than on improved pastures, despite lower nutrient concentrations in the former. Overall, the cattle stocking treatment had little impact on invertebrate community structure in these systems relative to prior pasture land use. However, vegetation type influenced invertebrate communities and explained some of the differences between pasture types. Semi-native (lower nutrient) wetland pastures dominated by maidencane had significantly greater invertebrate richness and diversity than improved (higher nutrient) wetland pastures dominated by mixed vegetation but showed no difference when compared to improved wetland pastures dominated by maidencane. Chironomids were the dominant invertebrate in wetlands of both pasture types. Correspondence analysis revealed that ostracods and

Culicidae larvae might be useful as bioindicators of subtropical wetlands that are experiencing cultural eutrophication.

206. **The influence of cattle grazing intensity on grasshopper abundance (Orthoptera: Acrididae).**
Wingerden, W. K. R. E.; Musters, J. C. M.; Kleukers, R. M. J. C.; Bongers, W.; and Biezen, J. B.
Proceedings of the Section Experimental and Applied Entomology of the Netherlands Entomological Society(2): 28-34. (1991)
NAL Call #: QL461.P76
Descriptors: nature conservation/ farming systems/ ecology/ grazing/ grasslands/ fodder plants/ biology/ agricultural entomology/ Netherlands Entomological Society
Abstract: With special reference to nature conservation, the effects of grazing on Acrididae were studied in grasslands in the Netherlands. Under excessive vegetation egg development was hindered, but with shortage of vegetation the shelter for nymphs and adults was lost. These diverging effects are explained by a model in which the relationship between grasshopper abundance and the amount of vegetation remaining after grazing follows an optimum curve. This paper was presented at an annual meeting of the Netherlands Entomological Society on 14 December 1990 in Utrecht, Netherlands.

207. **The influence of livestock management on habitat quality for farmland birds.**
Buckingham, D. L. and Peach, W. J.
Animal Science 81(2): 199-203. (Oct. 2005)
NAL Call #: SF1.A56; *ISSN:* 1357-7298
Descriptors: wild birds/ grazing management/ habitat preferences/ soil invertebrates/ foraging/ wildlife habitats/ United Kingdom
Abstract: This review covers research linking foraging habitat quality for birds to livestock management in lowland farmland. Based on this research we propose a framework for predicting the value of grazing systems to birds. This predictive framework is needed to guide the development of agri-environment measures to address farmland bird declines in pastoral areas. We show that the exacting requirements of declining granivorous birds pose the greatest challenges, while the needs of soil invertebrate feeding species are more easily met.
This citation is from AGRICOLA.

208. **Influence of management on butterflies of rare grassland ecosystems in Germany.**
Dolek, Matthias and Geyer, Adi
Journal of Insect Conservation 1(2): 125-130. (1997)
NAL Call #: QL362.J68; *ISSN:* 1366-638X
Descriptors: mowing: field method/ biodiversity/ fen meadows: habitat/ grazing/ hay meadows: habitat/ species composition/ species number/ species occurrence
Abstract: Traditional hay-meadows in the Alps and fens at the edge of the Alps are habitats for many rare and endangered butterfly species. Conservation efforts aim at preserving these species, but the biotopes depend on regular mowing, which in turn requires intensive financial support. The feasibility of substituting mowing of these sites by grazing is discussed and considered as a more cost effective management type which produces agriculturally valuable goods as well. In this study the butterfly fauna of mown and grazed sites were compared. Species composition, species number, and the occurrence of rare species under the two management types were in most cases rather similar for both grassland ecosystems. Nevertheless, there are hints that for single rare species this might not be true. Additionally, at one site, grazing intensity on a former hay-meadow was too high to preserve the species-rich community. Overall the results are encouraging: grazing does not have to be as detrimental as formerly thought, although details (compartments of pastures, intensity) still have to be confirmed. Experimental grazing management of abandoned grasslands of the studied types should be started.

209. **Late fall harvest, winter grazing, and weed control for reduction of alfalfa weevil (Coleoptera: Curculionidae) populations.**
Dowdy, A. K.; Berberet, R. C.; Stritzke, J. F.; Caddel, J. L.; and Mcnew, R. W.
Journal of Economic Entomology 85(5): 1946-1953. (1992)
NAL Call #: 421 J822; *ISSN:* 0022-0493
Descriptors: cultural control/ egg deposition/ larva/ pests/ seasonality
Abstract: This study was conducted during 1983-1987 to determine influence of late fall cutting and winter grazing in combination with control of cool-season weeds on egg deposition and seasonal occurrence of peak larval populations of the alfalfa weevil, Hypera postica (Gyllenhal), in Oklahoma. Alfalfa weevil egg numbers were reduced by an average of 55% by late fall cutting and 67% by grazing in winter by cattle compared with the ungrazed treatment. However, peak larval numbers were not lower due to fall cutting and were reduced by an average of just 25% with grazing. Numbers decreased least in years when the majority of eggs were laid in late winter rather than fall or early winter. There seems to be potential to delay occurrence of peak larval numbers up to 10 d by grazing if most eggs are laid in fall or early winter. Larval numbers per stem changed little with changing stem densities and the extent of weed infestation. As a consequence, larval numbers per 0.1 m-2 tended to be higher with greater stem densities in treatment combinations that promoted stand longevity.

210. **Long-term changes in collembolan communities in grazed and non-grazed abandoned arable fields in Denmark.**
Petersen, Henning; Jucevica, Edite; and Gjelstrup, Peter
Pedobiologia 48(5-6): 559-573. (2004)
NAL Call #: 56.8 P343; *ISSN:* 0031-4056
Descriptors: animals and man/ disturbance by man/ commercial activities/ ecology/ habitat/ terrestrial habitat/ land zones/ Palaearctic Region/ Eurasia/ Europe/ Collembola: farming and agriculture/ grazing/ community structure/ grassland/ abandoned arable fields/ Denmark/ Jutland/ Mols Hills/ abandoned arable field community changes related to grazing/ long term study/ Collembola/ Insecta/ arthropods/ insects/ invertebrates
Abstract: In order to explore long-term changes in microarthropod communities after introduction of livestock grazing in abandoned fields with herb-grass vegetation at Mols, E. Jutland, Denmark, soil and litter samples were

collected from 7 pairs (blocks) of grazed and non-grazed plots over a period of 14 years. Sampling began just before fencing and initiation of cattle and sheep grazing in the spring of 1985. The total material included 76 collembolan species; 65 and 68 species were recorded in the grazed and non-grazed plots, respectively. The number of species recorded at individual sampling dates fluctuated considerably through the period. In the vegetation/litter layer the mean number of species per plot was significantly higher in the non-grazed than in the grazed plots at several sampling dates while in the soil no significant differences were observed. Grazing significantly reduced the abundance of total Collembola, three composite species groups and 12 species at one or more sampling dates. Only three species or species groups (excluding some accidental occurrences) showed significant population increment in response to grazing at one or more sampling dates, most pronounced towards the end of the study period. No species changed from being significantly highest in grazed plots to being significantly highest in the non-grazed plots or vice versa during the study period. Significant relationships between grazing pressure and grazing effect on population density were only found in the vegetation/litter layer and the combined vegetation/litter/soil strata but not in the soil. The three regularly occurring taxa that had highest population densities in the grazed plots were positively correlated with grazing intensity while this was not the case for the majority of those taxa which were most abundant in the non-grazed plots. Canonical correspondence analysis based on species composition suggests separate successional trends for grazed and non-grazed plots. Grazing pressure accumulated through the whole period from start of grazing and precipitation accumulated over one year preceding the sampling date were the most important environmental variables correlated with species composition. According to a permutation test based on a split-plot design water content of the soil measured at each sampling was not significantly correlated with the community development. [copyright] 2004 Elsevier GmbH. All rights reserved.

211. **The management of lowland neutral grasslands in Britain: Effects of agricultural practices on birds and their food resources.**
Vickery, J. A.; Tallowin, J. R.; Feber, R. E.; Asteraki, E. J.; Atkinson, P. W.; Fuller, R. J.; and Brown, V. K.
Journal of Applied Ecology 38(3): 647-664. (2001)
NAL Call #: 410 J828; *ISSN:* 0021-8901
Descriptors: agricultural practices/ ecological diversity/ ecology/ food abundance/ food resources/ grazing/ habitat deterioration: nesting, wintering/ habitat transformation/ hay/ livestock systems/ lowland neutral grasslands: habitat/ organic fertilizer inputs/ phenology/ population dynamics/ silage/ structural complexity/ sward defoliation/ vegetation
Abstract: 1. The effects of agricultural intensification on biodiversity in arable systems of western Europe have received a great deal of attention. However, the recent transformation of grassland systems has been just as profound. 2. In Britain, the management of grassland has changed substantially in the second half of the 20th century. A high proportion of lowland grassland is managed intensively. The major changes include a doubling in the use of inorganic nitrogen, a switch from hay to silage, and increased stocking densities, particularly of sheep. Structurally diverse and species-rich swards have been largely replaced by relatively dense, fast-growing and structurally uniform swards, dominated by competitive species. 3. Most of these changes have reduced the suitability of grassland as feeding and breeding habitat for birds. 4. The most important direct effects have been deterioration of the sward as nesting and wintering habitat, and loss of seed resources as food. Short uniform swards afford poor shelter and camouflage from predators, whereas increased mowing intensities and trampling by stock will destroy nests and young. Increased frequency of sward defoliation reduces flowering and seed set, and hence food availability for seed-eating birds. 5. The indirect effects of intensification of management on birds relate largely to changes in the abundance and availability of invertebrate prey. The effects of management vary with its type, timing and intensity, and with invertebrate ecology and phenology, but, in general, the abundance and diversity of invertebrates declines with reductions in sward diversity and structural complexity. 6. Low input livestock systems are likely to be central to any future management strategies designed to maintain and restore the ecological diversity of semi-natural lowland grasslands. Low additions of organic fertilizer benefit some invertebrate prey species, and moderate levels of grazing encourage sward heterogeneity. 7. There is now a need to improve understanding of how grassland management affects bird population dynamics. Particularly important areas of research include: (i) the interaction between changes in food abundance, due to changes in fertilizer inputs, and food accessibility, due to changes in sward structure; (ii) the interaction between predation rates and management-related changes in habitat; and (iii) the impact of alternative anti-helminithic treatments for livestock on invertebrates and birds.

212. **Nest-site selection by yellow-eyed penguins megadyptes antipodes on grazed farmland.**
Mckay, Rod; Lalas, Chris; Mckay, David; and Mcconkey, Shaun
Marine Ornithology 27: 29-35. (1999)
NAL Call #: QL671; *ISSN:* 1018-3337
Descriptors: avian malaria/ (malaria, avian (mesh)), parasitic disease/ breeding habitat/ disturbance/ grazed farmland: habitat/ land clearance/ nest site selection/ predation/ recruitment
Abstract: The viability of Yellow-eyed Penguins Megadyptes antipodes on South Island, New Zealand, is threatened through the loss of breeding habitat by land clearance and the loss of chicks to introduced predatory mammals. Penguin nests at Papanui Beach, Otago Peninsula, were spread through about 7 ha of grazed grassland and shrubland. Here farming and Yellow-eyed Penguin conservation were shown to be compatible through active management: the impact of farm stock was minimised by excluding cattle; predation was minimised by trapping; and disturbance by humans and dogs was minimised by prohibiting public access. Penguin nest sites varied from sites with total lateral concealment and overhead cover to fully exposed sites. Deaths attributed to avian malaria decimated the breeding population of 21 pairs in early 1990. Nest numbers recovered to 21 by the 1995/96 season but their distribution had changed. Nests lacking overhead concealment in grassland habitat

increased from two (10%) in 1989/90 to 12 (57%) in 1995/96. Unexpectedly the new generations of breeders appeared to select open, relatively exposed sites in grassland in preference to sites in dense vegetation offered by shrubland. We have not yet found an explanation for this preference. However, a relatively large number of non-breeders congregated at pastures near the sea in the 1995/96 season with the vast majority in grassland rather than shrubland. The presence of clear areas may be important for the recruitment of breeders at this location.

213. **Nesting birds and grazing cattle: Accommodating both on Midwestern pastures.**
Temple, Stanley A.; Fevold, Brick M.; Paine, Laura K.; Undersander, Daniel J.; and Sample, David W.
In: Ecology and conservation of grassland birds of the Western Hemisphere/ Vickery, Peter D. and Herkert, James R.; Vol. 19; Series: Studies in Avian Biology 19, 1999; pp. 196-202.
Notes: ISSN: 0197-9922
NAL Call #: QL671.S8
Descriptors: animals and man/ disturbance by man/ commercial activities/ conservation/ conservation measures/ reproduction/ ecology/ community structure/ population dynamics/ habitat/ terrestrial habitat/ land and freshwater zones/ Nearctic Region/ North America/ USA/ Aves: farming and agriculture/ habitat management/ pasture management/ implications of ecology and reproduction/ reproductive productivity/ species diversity/ population density/ pasture management relationships/ grassland/ Wisconsin/ green/ Iowa and Lafayette Counties/ pasture management effects on biology/ conservation implications/ Aves/ birds/ chordates/ vertebrates

214. **Pastoral management vs. land abandonment in Mediterranean uplands: Impact on land snail communities.**
Labaune, Corinne and Magnin, Frederic
Global Ecology and Biogeography 11(3): 237-245. (2002)
NAL Call #: H84 .G56; *ISSN:* 1466-822X
Descriptors: CANOCO 4.0: computer software/ canonical correspondence analysis: statistical method/ correspondence analysis: statistical method/ stratified quantitative sampling: sampling method/ mediterranean uplands/ altitude/ body size/ community impact/ dry grasslands: habitat/ grazing pressure/ habitat relationships/ land abandonment/ pastoral management/ spatial scales/ species diversity/ species equitability/ species richness/ vegetation
Abstract: The aim of the study was to assess the impact of a pastoral management chosen to limit the recent expansion of woodland on a Mediterranean mountain on land snail diversity. An additional aim was to acquire quantitative data that could be used to identify pasture environments from Holocene molluscan assemblages. The work was undertaken at the Luberon mountain, Provence, south of France. We used a stratified quantitative sampling scheme according to altitude and vegetation structure. A total of 80 sites were studied. Large species were collected within a 5 X 5-m plot. Small species were extracted from litter and surface soil. A standard procedure for site description was used based on 35 environmental variables. Grazing pressure was estimated according to the impact of grazing on the herb layer. Correspondence analysis and canonical correspondence analysis were performed using CANOCO 4.0 software. The distribution of land snails is related to altitude and grazing intensity. Large patches of grazed grassland harbour open country and mountain snail species. Thermophilic open ground species are located in grazed grasslands at lower altitude. Shade-loving species are present in ungrazed scrublands or in small clearings on the upper slopes. The lowest species richness, diversity and equitability are associated with large patches of grazed grassland, the presence of a continuous cover of short grass reinforcing this negative impact on snail diversity. Our study is consistent with similar works on land snails or other invertebrates but discordant with vegetation studies. A homogeneous grazed herb layer significantly reduces snail diversity and abundance. Heterogeneity seems to favour snail diversity both at the local and landscape scales. However, sheep grazing contributes to the expansion of suitable habitats for rare snail species.

215. **Response of birds to grazing of riparian zones.**
Popotnik, Gary J. and Giuliano, William M.
Journal of Wildlife Management 64(4): 976-982. (2000)
NAL Call #: 410 J827; *ISSN:* 0022-541X
Descriptors: avian abundance/ avian communities: bird counts, nest density, nest monitoring, reproductive success, riparian area livestock grazing impacts, species richness/ livestock grazing/ pasture/ pasture streams/ riparian areas/ vegetative cover/ vegetative structure/ wetlands
Abstract: Livestock grazing of streams and associated riparian areas may negatively impact avian communities through direct disturbance and alteration of vegetation structure. We determined the effects of grazing on vegetation, avian abundance, species richness, and reproductive success on pasture streams and associated riparian habitats in southwest Pennsylvania. Bird counts, nest monitoring, and vegetation sampling were conducted on 12 pairs (grazed and control) of streams in 1996 and 10 pairs in 1997. Compared with control streams, grazed areas had lower avian species richness and abundance. Several wetland-and riparian-dependent species (e.g., common snipe (Gallinago gallinago), great blue heron (Ardea herodias), green-backed heron (Butorides striatus), belted kingfisher (Ceryle alcyon), and solitary sandpiper (Tringa solitatia)) were found more often or only on control areas. Although nest density was higher and nest destruction rates by livestock were lower on control streams, nest success (all species combined) was not affected by grazing. Avian communities in control areas appear to benefit primarily from improved vegetative cover and structure. Thus, management should focus on excluding livestock from such areas.

216. **The response of epigeal beetles (Col.: Carabidae, Staphylinidae) to varied grazing regimes on upland Nardus stricta grasslands.**
Dennis, P.; Young, M. R.; Howard, C. L.; and Gordon, I. J.
Journal of Applied Ecology 34(2): 433-443. (1997)
NAL Call #: 410 J828; *ISSN:* 0021-8901
Descriptors: direct gradient analysis/ domestic livestock/ ground/ rove beetles/ pitfall traps/ semi-natural grassland
Abstract: 1. The effect of different livestock grazing regimes on the insect fauna of an upland, semi-natural

grassland was measured in 1993 and 1994 by a survey of the epigeal Carabidae and Staphylinidae within an experiment established in 1991. Grazing by sheep, or sheep and cattle, to achieve two different inter-tussock sward heights, provided four treatments. In addition, a further treatment was ungrazed from 1992 to test the impact on beetles of a short-term cessation of grazing, trampling and dung inputs. 2. Pitfall traps sampled Carabidae and Staphylinidae within the Nardus stricta-dominated grassland of the experiment. Data on these epigeal Coleoptera were collected from April to October in 1993 and 1994; years three and four of the experiment. 3. The epigeal Coleoptera species were ranked by decreasing abundance in traps, where the captures in traps were accumulated for both seasons. The responses to the grazing regimes were analysed using ANOVA, applied to the most abundant species (that together represented 99% of the two seasons' catch). There were significant experimental effects of grazing regime on five of these 32 Coleoptera species, namely Carabus violaceus, Othius angustus, Pterostichus strenuus, Xantholinus linearis and Olophrum piceum. 4. The ordination technique, Canonical Correspondence Analysis (CCA), was applied to the data on the Coleoptera assemblage. Variables measured to represent the experimental treatments (mean vegetation height, stocking rate and botanical diversity) and environmental covariables (altitude and aspect) were entered in the direct gradient analysis procedure of CCA. This application of CCA partialled out the effects of altitude and aspect of each plot and revealed the significant effects of vegetation structure, botanical species composition and stocking density on a larger number of Coleoptera species than suggested from ANOVA. 5. Twenty-four of the 32 most abundant Coleoptera species correlated with the effects of different grazing regimens imposed on Nardus grassland. Greater abundances of C. violaceus, O. angustus, X. linearis and T. corticinus were indicative of the typical upland grassland and heathland Coleoptera assemblage. These species could be monitored to balance the impact of grazing management on arthropod biodiversity with the need to restrict the dominance of N. stricta in drier upland grasslands, achieved in this instance, by summer grazing sheep and cattle to maintain an average, between-tussock sward height of 6-7 cm. However, the results from the direct gradient analysis suggest that the grazing regimes should be varied in rotation over time to achieve a mosaic of structurally different grassland patches (0.70-4.73 ha) because this encourages a larger overall number of beetle species.

217. **The response of invertebrate assemblies to grazing.**
Gibson, C. W. D.; Brown, V. K.; Losito, L.; and McGavin, G. C.
Ecography 15(2): 166-176. (1992)
NAL Call #: QH540.H6; *ISSN:* 0906-7590
Descriptors: animals and man/ disturbance by man/ commercial activities/ ecology/ habitat/ terrestrial habitat/ land and freshwater zones/ Palaearctic Region/ Europe/ United Kingdom/ Invertebrata/ Hemiptera: farming and agriculture/ grazing effects on grassland communities/ community structure/ grassland/ effects of livestock grazing/ England/ grassland community responses to livestock grazing/ Coleoptera/ Insecta/ arthropods/ coleopterans beetles/ hemipterans true bugs/ insects/ invertebrates

218. **Responses of butterfly and moth species to restored cattle grazing in semi-natural grasslands.**
Poyry, Juha; Lindgren, Sami; Salminen, Jere; and Kuussaari, Mikko
Biological Conservation 122(3): 465-478. (2005)
NAL Call #: S900.B5; *ISSN:* 0006-3207
Descriptors: conservation management: applied and field techniques/ cattle grazing/ semi natural grassland
Abstract: The effects of restorative grazing on the abundance of butterfly and moth species were studied in mesic semi-natural grasslands of SW Finland differing in management history: (1) old continuously grazed, (2) restored (with ca 5 years of reinitiated grazing), and (3) abandoned former pastures. Generalized linear modelling of species abundances and indicator species analysis produced qualitatively similar results. Only three species (Polyommatus icarus, Lycaena hippothoe and Camptogramma bilineatum) were most abundant in old pastures, whereas 12 species (Polyommatus semiargus, Polyommatus amandus, Brenthis ino, Aphantopus hyperantus, Scopula immorata, Idaea serpentata, Scotopteryx chenopodiata, Epirrhoe alternata, Cybosia mesomella, Polypogon tentacularius, Hypena proboscidalis and Cryptocala chardinyi) were most abundant in abandoned pastures. None of the old-pasture species had become more abundant in restored pastures. Three species, Epirrhoe hastulata, Xanthorhoe montanata and Chiasmia clathrata. occurred equally abundantly in abandoned and in restored pastures indicating a slow progress of restoration. Species associated with old pastures differed from species associated with abandoned pastures in their recent distributional changes in Finland. The species of old pastures showed decreasing trends. whereas those of abandoned pastures showed mainly increasing trends in their distribution. In five out of I I species, the preferred successional stage differed markedly between this study and previous studies conducted in Central Europe. We conclude that (1) ca 5 years of restorative grazing in mesic grasslands has been insufficient for the colonisation of old-pasture species in the restored sites, (2) different management intensities are needed regionally for the maintenance of grassland insect diversity and (3) application of the knowledge on successional preferences of different species in conservation management. even in climatically similar regions, should be made with caution. Copyright 2004 Elsevier Ltd. All rights reserved.

219. **Restoration of butterfly and moth communities in semi-natural grasslands by cattle grazing.**
Poyry, J.; Lindgren, S.; Salminen, J.; and Kuussaari, M.
Ecological Applications 14(6): 1656-1670. (2004)
NAL Call #: QH540.E23; *ISSN:* 1051-0761
Descriptors: agriculture/ biodiversity/ biogeography/ population studies/ methods and techniques
Abstract: The effects of restorative grazing on species composition and community structure of butterflies and moths were studied in mesic semi-natural grasslands differing in their management history: (1) old continuously grazed pastures, (2) restored pastures with apprx5 yr of reinitiated grazing, and (3) abandoned former pastures.

Butterflies and moths were counted with a transect method during 1999 and 2000 in 33 study sites in southwest Finland. In a multivariate ordination (NMDS), the studied grasslands were separated from each other on the basis of their species composition so that the actively grazed pastures differed from abandoned pastures. The first ordination, axis represented most (73%) of the variation in species composition, and it was strongly correlated with variables describing the current grazing intensity. Species richness and total abundance were highest in abandoned pastures, both for all species and for grassland-preferring species. In contrast, relative diversity (N1, N2, and alpha) and evenness (Alatalo's evenness index) were in most cases highest in old pastures and lowest in abandoned pastures. Generalized linear models (GLM) were constructed for four response variables: total species richness, grassland species richness, abundance of all species, and abundance of grassland species. The derived models explained 78-84% of the total variation for species richness and 92-93% for abundance, and the type of grazing history explained the largest proportion of variation. Mean vegetation height was included in the abundance models as a quadratic function, which indicated that butterflies and moths were most abundant at an intermediate level of grazing intensity, as predicted by the "dynamic equilibrium model." The results suggest that grazing management is a useful tool in the restoration of insect communities of abandoned semi-natural grasslands. In order to enhance the survival of species suffering from continuously high grazing intensity, the existing management instructions should be developed toward construction of regional networks of semi-natural grasslands, which would allow differing grazing intensities or rotational grazing on the patch level, but simultaneously ensure continuity of varying management regimes on a regional level.

220. **Resumed forest grazing restored a population of Euphydryas aurinia (Lepidoptera Nymphalidae) in SE Finland.**
Saarinen, Kimmo; Jantunen, Juha; and Valtonen, Anu
European Journal of Entomology 102(4): 683-690. (2005)
NAL Call #: QL461.E9884; *ISSN:* 1210-5759
Descriptors: habitat restoration/ management intensity/ forest grazing
Abstract: In 1996, an old forest pasture grazed from the 1960s to 1988 was restored by coppicing, fencing and grazing by cattle to protect a local population of the endangered butterfly Euphydryas aurinia. An adjoining ungrazed meadow provided a control. In the first years, the butterfly became almost extinct due to the nearly complete consumption of the host plant of the larva, Succisa pratensis, by cattle. The butterfly population quickly recovered when the grazing pressure was lowered. Thus, the intensity of management should be adjusted by continuous monitoring of the target species. In the 2000s, the annual population was about 50 butterflies, but marked fluctuations took place, probably caused by natural factors. Grazing benefited the meadow flora and improved the habitat of butterflies in general. Extensive forest grazing clearly has the potential for enhancing biodiversity. The value of the experiment is, however, limited because only a single pair of meadows was available for comparison. In the future, it will be even more difficult to arrange a similar experiment due to the great decline in the numbers of traditional meadows and forest grazing in SE Finland.

221. **Richness and abundance of Carabidae and Staphylinidae (Coleoptera), in northeastern dairy pastures under intensive grazing.**
Byers, R. A.; Barker, G. M.; Davidson, R. L.; Hoebeke, E. R.; and Sanderson, M. A.
Great Lakes Entomologist 33(2): 81-105. (2000)
NAL Call #: QL461.M5; *ISSN:* 0090-0222
Descriptors: ecology/ habitat/ terrestrial habitat/ land and freshwater zones/ Nearctic Region/ North America/ USA/ Carabidae: community structure/ intensively grazed pastures/ Pennsylvania and Vermont/ grassland/ intensively grazed dairy pastures/ New York/ Pennsylvania/ Vermont/ new records/ community structure in intensively grazed pasture/ Carabidae/ Caraboidea/ Adephaga/ Coleoptera/ Insecta/ arthropods/ coleopterans beetles/ insects/ invertebrates
Abstract: Dairy cattle grazing has become popular to dairy farmers in the Northeast looking for management schemes to cut production costs. Carabidae (ground beetles) and Staphylinidae (rove beetles) are indicators of habitat disturbances, such as drainage of wetlands, or grassland for grazing animals, and their monitoring could provide one measure of ecosystem sustainability if intensive grazing management systems expand or intensify in the future. Our objective was to assess the abundance and species richness of these two beetle families under intensive grazing throughout Pennsylvania, southern New York and Vermont. We collected 4365 ground beetles (83 species) and 4,027 rove beetles (79 species) by pitfall traps in three years in Pennsylvania. Nine ground beetle species, Amara aenea, Poecilus chalcites, Pterostichus melanarius, Bembidion quadrimaculatum oppositum, Amara familiaris, Poecilus lucublandus, Agonum muelleri, Bembidion obtusum and Bembidion mimus represented 80% of the Carabidae collected. Five other species were new to Pennsylvania. Four rove beetle species, Philonthus cognatus, Meronera venustula, Amischa analis, and Philonthus various=(carbonarius), comprised 74% of the total Staphylinidae collected. Yearly distributions of the dominant species did not change significantly in the three years with A. aenea and P. cognatus being most abundant every year. A parasitic rove beetle, Aleochara tristis, was recovered for the first time in Pennsylvania and Vermont since its release in the 1960's to control face fly, Musca autumnalis. Similar results were found in New York and Vermont. We collected 1,984 ground beetles (68 species). Pterostichus melanarius was most abundant. Pterostichus vernalis was detected for the first time in the United States (Vermont). It was previously reported from Montreal, Canada. We collected 843 rove beetles (45 species). Philonthus cognatus was the most abundant rove beetle. In addition, Tachinus corticinus, previously known only from Canada, was discovered for the first time in the United States in Vermont. Pastures in Pennsylvania were diverse, containing 14 species of forage plants and 17 weed species. Botanical composition was similar in New York and Vermont. Sixteen species of grasses and legumes made up 90% of the plant composition and 36 species of weeds made up the remainder. This diverse plant ecosystem may explain the richness of ground and rove beetles in northeastern U.S. pastures because the

heterogeneity in the plant population provided additional resources which can support a rich assemblage of beetles. Monitoring richness and abundance of Carabidae and Staphylinidae over three years in Pennsylvania suggests intensive grazing systems are ecologically sustainable.

222. **The role of grazing in creating suitable sward structures for breeding waders in agricultural landscapes.**
Tichit, Muriel; Durant, Daphne; and Kerneis, Eric
Livestock Production Science 96(1): 119-128. (2005)
NAL Call #: SF1.L5; *ISSN:* 0301-6226
Descriptors: grazing/ habitat management/ agricultural landscape/ suitable sward structure/ breeding wader
Abstract: French wet grasslands support important populations of lapwings and other waders. Grazing management is a key issue in the use of grasslands by these birds since they are very sensitive to sward structure (height and heterogeneity). To assess the impact of different grazing regimes on sward structure during spring, sward height was repeatedly measured in a coastal marsh for 2 years. Sward structure was characterised by variables related to height classes and an index of heterogeneity. Grazing regimes were described by stocking rates per period and N fertilisation level. Heterogeneity index was quadratically related to mean sward height both years. Four types of sward structures were characterised through principal component analysis. Coinertia analysis showed a strong relationship between grazing regimes and sward structure. However, during spring, the relationship between stocking rate and sward structure differed according to year, impact of grazing being greater during drought year. Suitable sward structures were observed for both lapwings and redshanks. Wader habitat management through grazing calls for more attention to be paid to the delayed effects of autumn and winter grazing regimes. Sward heterogeneity emerges as a new characteristic to control, because it may introduce new constraints for livestock production. (c) 2005 Elsevier B.V. All rights reserved.

223. **Sheep grazing and rodent populations: Evidence of negative interactions from a landscape scale experiment.**
Steen, Harald; Mysterud, Atle; and Austrheim, Gunnar
Oecologia (Berlin) 143(3): 357-364. (2005)
NAL Call #: QL750.O3; *ISSN:* 0029-8549
Descriptors: animals and man/ disturbance by man/ commercial activities/ nutrition/ diet/ feeding behaviour/ ecology/ competition/ habitat/ terrestrial habitat/ land zones/ Palaearctic Region/ Eurasia/ Europe/ Clethrionomys glareolus/ Microtus agrestis (Muridae): farming and agriculture/ food plants/ food availability/ foraging/ population dynamics/ interspecific competition/ grassland/ mountain pastures/ mountain habitat/ Norway/ south/ Buskerud County/ Hol Municipality/ sheep grazing impact on mountain pasture populations/ landscape scale experiment/ Muridae/ Rodentia/ Mammalia/ chordates/ mammals/ rodents/ vertebrates
Abstract: Inter-specific competition, facilitation and predation influence herbivore assemblages, but no study has experimentally explored the interactions between large ungulates and small rodents. In a fully replicated, landscape scale experiment, we manipulated densities of domestic sheep in mountain pastures in Norway. We then determined population growth and densities of rodents by live trapping in each of the areas with different sheep densities. We found that the (summer) population growth rate and autumn density of the field vole (Microtus agrestis) was lower at high sheep density. This provides the first experimental evidence of negative interactions between an ungulate and small rodent species. There was no effect on the bank vole (Clethrionomys glareolus), whose diet differs from sheep. Sheep density, therefore, potentially alters the pattern of inter-specific population synchrony amongst voles. Our study shows that negative interactions between large ungulates and small rodents may be species-specific and negative population consequences for the rodent population appear above threshold ungulate densities.

224. **The short-term effect of sheep grazing on selected invertebrates (Diptera and Hemiptera) relative to other environmental factors in an alpine ecosystem.**
Mysterud, Atle; Hansen, Lars Ove; Peters, Chris; and Austrheim, Gunnar
Journal of Zoology (London) 266(4): 411-418. (2005)
NAL Call #: QL1.J68; *ISSN:* 0952-8369
Descriptors: animals and man/ disturbance by man/ commercial activities/ nutrition/ diet/ ecology/ population dynamics/ habitat/ terrestrial habitat/ abiotic factors/ land zones/ Palaearctic Region/ Eurasia/ Europe/ Diptera/ Hemiptera: farming and agriculture/ food plants/ community structure/ population density/ grassland/ mountain habitat/ abiotic factors/ Norway/ Buskerud County/ Hol Municipality/ sheep grazing short term effects relative to other environmental factors in alpine ecosystem/ Diptera/ Insecta/ arthropods/ insects/ invertebrates/ true bugs/ true flies
Abstract: Grazing by large herbivores is well-known to influence plant communities, while much fewer studies have been carried out on grazing effects on invertebrates. In Norway, some 2.2 million sheep graze on outlying pastures during summer, most of them in the alpine zone, but no study has reported the relative impact of sheep grazing on invertebrate communities relative to other environmental factors such as the plant community and altitude. A fully replicated landscape-scale experiment (2.7 km2) was performed with no, low (25 per km2) and high (80 per km2) sheep densities in an alpine habitat of Norway (1050-1300 in a.s.l.). The increased vulnerability hypothesis (HI) predicts that the more folivorous invertebrates, the higher the grazing pressure by sheep, as large herbivore grazing may stress the plants so they are more vulnerable to insect herbivory. The increased defence hypothesis (H2) predicts increased levels of general anti-herbivore defences, and thus a lower abundance of invertebrates with increasing sheep densities. Contrary to both predictions, no evidence was found that sheep grazing affected invertebrate richness, or abundance of folivorous, predatory or detritivore invertebrates - in a community dominated by Diptera and Hemiptera. Demonstrating an effect will always be a function of sample size, but at least our study shows that other environmental variables (such as plant species richness and functional plant richness) are more important determinants than sheep grazing for the selected invertebrate groups. Our study was short-term (first year of grazing) mainly designed to test specific hypotheses related to induced plant defences; long-term effects are probably

owing to the impact sheep may have on vegetation composition, primary production, litter cover and soil properties.

225. **Short-term effects of cattle grazing on nematode communities in Florida pastures.**
McSorley, R. and Frederick, J. J.
Nematropica 30(2): 211-221. (2000)
NAL Call #: SB998.N4N4; *ISSN:* 0099-5444
Descriptors: animals and man/ disturbance by man/ commercial activities/ ecology/ population dynamics/ habitat/ terrestrial habitat/ land and freshwater zones/ Nearctic Region/ North America/ USA/ Nematoda: farming and agriculture/ cattle grazing/ community structure/ short term effects of cattle grazing/ pastures/ population density/ short term effects of cattle grazing in pastures/ grassland/ subtropical pasture/ Florida/ Highlands County/ Buck Island Ranch/ short term ffects of cattle grazing on community structure/ pasture/ Nematoda/ helminths/ invertebrates/ nematodes
Abstract: Effects of cattle population density on nematode community structure were evaluated in a rotational grazing study involving 16 experimental pastures (each 20-32 ha in size) at a cattle ranch in south-central Florida. Summer pastures were grazed from Apr./May to Oct./Nov. and winter pastures from Oct./Nov. to Apr./May. Experimental design was a split-plot, with two pasture locations (winter, summer) as main plots and four cattle densities (0, 15, 20, or 35 cow-calf pairs per pasture) as sub-plots. With a few exceptions, population densities of most nematode genera in winter and summer pastures were similar (P > 0.10). Cattle density had relatively little effect on population levels of individual nematode genera or on indices of nematode community structure. Of the more than 50 nematode genera found at this site, Monhystera populations were affected most frequently by the short-term (6-7 months) grazing, but the nature of the responses were inconsistent. Nematode community data showed strong seasonal trends, with many genera more abundant in autumn than in spring samples (P [ltoreq] 0.05). In this study, seasonal effects greatly overshadowed any minor effects of cattle grazing on the soil nematode community.

226. **Short-term grazing exclusion effects on riparian small mammal communities.**
Giuliano, W. M. and Homyack, J. D.
Journal of Range Management 57(4): 346-350. (2004)
NAL Call #: 60.18 J82; *ISSN:* 0022-409X
Descriptors: riparian areas/ grazing intensity/ small mammals/ species diversity/ plant litter/ ground vegetation/ height/ Pennsylvania
Abstract: Grazing of livestock in streams and associated riparian habitats (hereafter referred to as riparian zones) may affect small mammal communities by influencing vegetation, water quality, and other site characteristics. To better understand these effects, we compared vegetation structure, and abundance and richness of small mammals in grazed riparian zones and similar areas where livestock had recently (1-2 years) been excluded in southwest Pennsylvania, 1998 and 1999. Mammalian species richness and abundance (all species combined, meadow voles [Microtus pennsylvanicus Ord], and meadow jumping mice [Zapus hudsonius Zimmermann]) were greater on sites where livestock had been excluded than grazed areas. These findings are likely the result of greater litter cover and increased vertical vegetation obstruction observed on these sites. Because small mammal communities respond quickly to relaxation of grazing in riparian zones, subsidy programs exist to partially pay for fencing, and landowners may potentially benefit from fencing these areas through improved water quality, erosion control, and livestock health, fencing may be an effective wildlife and grazing management tool.
This citation is from AGRICOLA.

227. **Soil dwelling macro-invertebrates in intensively grazed dairy pastures in Pennsylvania, New York and Vermont.**
Byers, R. A. and Barker, G. M.
Grass and Forage Science 55(3): 253-270. (2000)
NAL Call #: 60.19 B773; *ISSN:* 0142-5242
Abstract: This study estimates the relative contributions of environment and farm management strategies in influencing soil faunal assemblages and attempts to identify the species with potential to affect sustainability of intensive grazing management systems in the north-eastern USA. It arises because of the change from confinement feeding of dairy cattle, consequent upon concerns about negative environmental effects, the rising costs for machinery and housing, and reduced profit margins, together with the absence of data from which the consequences of such change on the soil fauna may be predicted. Macro-invertebrates were sampled in soil from seventy-eight grazed pastures on twenty-one dairy farms in Pennsylvania, USA, in the spring of 1994. On five of these farms, macro-invertebrates were sampled (four pastures per farm) in the spring, summer and autumn seasons of 1994, 1995 and 1996. In 1997, macro-invertebrates were sampled in soil during spring, summer and autumn from (four pastures per farm) on three farms in New York, and during spring and summer on three farms in Vermont. Species richness ranged from two to twelve species (mean 6.4) per pasture site in Pennsylvania and five to eighteen species (mean 10.7) in New York and Vermont. The communities were dominated at most sites by earthworms. Earthworms were correlated with soil basal and substrate-induced respiration/carbon ratio, and soil moisture, but were negatively correlated with cows per hectare and herbage biomass in Pennsylvania. Sitona larvae were recorded at nineteen of the twenty-one farms during the spring of 1994 across Pennsylvania and occurred at populations >5 m-2 in 68% of the sampled pastures. Sitona larvae were less abundant in New York and Vermont. Elaterid larvae comprised a complex of seven species of which Aeolus melillus (Say) and Melanotus communis (Gyllenhal) comprised 35% and 39%, respectively, of the elaterids collected in Pennsylvania. Agriotes mancus (Say) and Ctenicera destructor (Brown) comprised 41% and 26%, respectively, of four species collected in New York and Vermont. Scarabaeid larvae, comprising a complex of eight species, were detected at only 27% of the seventy-eight pastures sampled in spring 1994 in Pennsylvania. Five species were collected in ten of the twelve New York pastures and four species in nine of the twelve Vermont pastures. Populations of scarabaeid larvae averaged <25 m-2 in all three states, except in three Pennsylvania pastures in spring 1994. Detrended canonical correspondence analysis (DCCA) showed pasture standing

biomass, legume diversity, pre-winter stubble height, white clover pasture content, and soil phosphorus levels influenced numbers of invertebrate species more than climatic factors, such as temperature, rainfall, altitude, latitude and seasonal water table. DCCA also showed most pastures to be dose to the average of environmental factors. The extremely low density of herbivorous macro-invertebrates in soil and the absence of pest outbreaks may indicate a stable soil ecosystem.

228. **Soil macrofauna under two grazing systems.**
Rodriguez, I.; Crespo, G.; Torres, V.; and Fraga, S.
Cuban Journal of Agricultural Science 33(4): 415-422. (1999)
NAL Call #: S1.R4; *ISSN:* 0864-0408
Descriptors: biomass/ ferrallitic soils/ grassland soils/ grazing intensity/ grazing systems/ rotational grazing/ soil fauna/ soil types/ species diversity
Abstract: The soil macrofauna of an 18 ha Cynodon nlemfuensis sward was studied for three years (September 1993-96) on a red ferrallitic soil in Cuba to compare an intensive rotational grazing system with 72 paddocks (Voisin's rational grazing) and 260 large cattle (LC) units (equivalent to liveweight of 500 kg), and a less intensive rotational grazing system with 12 paddocks and an intensity of 51 LC. Three paddocks were selected from each system in which three areas of 0.065 m2 each were sampled at 0-20 depth once each trimester to determine the number of macrofauna individuals, the biomass and soil humidity. Data were statistically analysed through a linear model and also the principal component method was used to analyse the influence of climatic factors on the variables studied and their relationship. There were no significant differences between the two grazing systems in the number of individuals (mean 4.37/m2) or in their biomass (19.9 g/m2). Results showed differences (P<0.01) between trimesters with the highest values in September-October-November and March-April-May. Annual performance of the macrofauna showed that in the first year there was a greater number of individuals (8.86 vs 2.26 and 1.96) and higher biomass (39.3 vs 2.43 and 11.07 g/m2) compared to the following years. Among the diversity of individuals there were earthworms, coleopterous larvae and other insects. The first two groups made up most of the total biomass. Results indicate that diversity and biomass of macrofauna will not increase in the short term under similar soil and climatic conditions in the grazing systems used in this study.

229. **Spatial distribution of upland beetles in relation to landform, vegetation and grazing management.**
Dennis, Peter; Aspinall, R. J.; and Gordon, Iain J.
Basic and Applied Ecology 3(2): 183-193. (2002)
NAL Call #: QH540 .B37; *ISSN:* 1439-1791
Descriptors: principle component analysis: mathematical and computer techniques/ climate change/ distance statistics/ grazing intensity/ grazing management/ land use changes/ landform management/ soil management/ soil moisture/ spatial distribution/ structural heterogeneity/ vegetation management
Abstract: We applied a novel analysis based on distance statistics to investigate how patterns of habitat heterogeneity affected the distribution of representative ground and rove beetle species (Coleoptera: Carabidae, Staphylinidae), sampled at an upland site of varied landform, soil and vegetation structure. The structural heterogeneity of the Nardus stricta-dominated grassland was further modified by varying grazing intensity with sheep, or sheep and cattle. We collected pitfall trap data from 120 sample points across the study area. Ground and rove beetle species were selected to represent the major trends in the species-trap abundance data, determined by the extent of their correlation with the main components of a factor analysis (Principal Components Analysis). The novel statistical analytical method, calculation of the Getis and Ord distance statistic, G, was applied to the distribution data of each selected species of ground and rove beetle. The distance statistic was calculated for the smallest distance to ensure that each sample point had at least one neighbour (73 m) and this distance was used to detect local spatial association and to explore the location and spatial scale of aggregations of each beetle species over the hillside. Clusters of high and low G(z) values were mapped to indicate the species' functional heterogeneity compared with habitat heterogeneity determined by landform, soils or grazing management. The small number of large aggregations indicated the sensitivity of certain species to patterns of landform (Calathus melanocephalus and Pterostichus adstrictus). More aggregations of smaller size, coinciding with the pattern of particular grazing regimes indicated species sensitive to grazing intensity and species of mammalian herbivore (Carabus problematicus and Olophrum piceum). The aggregations of Othius angustus and Philonthus decorus related to landform, and suggested these species may have been directly responding to soil moisture and patterns of trampling by grazers. The method distinguished between those species that are sensitive to land use change and those that may be affected more by climate change.

230. **Study of the population dynamics of dipterous stem-borer larvae of ryegrass swards under rotationally grazed or cut conditions.**
Moore, D. and Clements, O.
Grass and Forage Science 41(4): 289-294. (1986)
NAL Call #: 60.19 B773; *ISSN:* 0142-5242
Descriptors: Oscinella frit/ Oscinella vastator/ weather
Abstract: Observations made between 1980 and 1982 showed that dipterous stem-borers were more common in grazed than cut swards. The two forms of Oscinella frit were particularly prevalent in grazed swards but O. vastator was more evenly distributed and dominated the larval populations of the cut sward in 1981. The population dynamics of all species were probably affected by the number of days on which weather was suitable for high stem-borer adult activity. It was also found that stem-borer larval numbers could expand rapidly after periods suitable for high adult activity even when adult numbers had been low for long periods. Despite low numbers of O. vastator being present in winter 1981, their numbers increased markedly and built up to a large population which peaked in September 1981.

231. **Waterbird communities and habitat relationships in coastal pastures of northern California.**
Colwell, M. A. and Dodd, S. L.
Conservation Biology 9(4): 827-834. (1995)
NAL Call #: QH75.A1C5; *ISSN:* 0888-8892
Descriptors: pastures/ habitats/ coastal areas/ plant height/ grazing/ wild birds/ waterfowl/ grasslands/ permanent grasslands/ wetlands/ nature conservation/ wild animals
Abstract: Waterbird (including geese) assemblages (diversity, composition, and species' densities) were examined in 20 pastures near Humboldt Bay, California, in relation to habitat characteristics (vegetation height, soil penetrability, water depth), abundance of invertebrates (worms and other invertebrates), and presence of livestock. From October 1991 to May 1992, 29 species and 10 776 birds were observed, most (78%) of which foraged. Nonrandom pasture use by birds resulted in a highly clumped spatial distribution. Habitat characteristics of pastures were correlated with this nonrandom pattern: waterbird diversity and densities of three sandpiper species and one gull species correlated negatively with vegetation height; densities of two plover species correlated negatively with soil penetrability; and waterfowl densities correlated positively with water depth. Species composition varied among pastures. Wading birds used pastures with tall vegetation, shorebirds and gulls frequented short-grass pastures, and waterfowl used flooded pastures. Both the presence of waterbirds and their densities increased in association with livestock. In coastal areas where much intertidal habitat has been reclaimed as pastureland, pastures offered valuable habitats to nonbreeding waterbirds. It is suggested that grazing in coastal pastures can be used to provide a mosaic of vegetation heights, which would yield greater waterbird diversity as well as higher densities of some species.

232. **What factors determine where invertebrate-feeding birds forage in dry agricultural grasslands?**
Atkinson, Philip W.; Buckingham, David; and Morris, Antony J.
Ibis 146(Suppl. 2): 99-107. (2004); *ISSN:* 0019-1019
Descriptors: mowing: applied and field techniques/ agricultural grassland/ foraging behavior/ grazing
Abstract: Increases in the intensity of the management of agricultural grasslands over the past 50 years have reduced plant species diversity in swards and increased uniformity in structure through changes in fertilizer regimes, grazing and mowing practices. These factors, as well as increased disturbance and trampling, have reduced the number and diversity of forbs and thus the diversity and abundance of invertebrates, in particular of foliar species. Associated with these changes in management, there has been a large decline in the abundance of many species of farmland birds in pastoral areas and more local extinctions compared with arable areas. To understand the impact of these management changes on bird populations, and design measures to reverse the declines, it is necessary to identify the key factors influencing bird usage of fields. We review results from five studies, which have related fertilizer and grazing management to bird usage of grass fields. Species that fed on soil invertebrates tended to show a positive response to the amount of nitrogen fertilizer added and increased grazing pressure, although there was a high degree of correlation between these two variables. In summer, many species, including corvids, Common Blackbird Turdus merula, Common Starling Sturnus vulgaris, Pied Wagtail Motacilla alba and Hedge Accentor Prunella modularis, showed a negative relationship with sward height, and in winter more species showed a positive relationship with bare ground. Taller sward heights are associated with a greater abundance and diversity of bird invertebrate food resources, and accessibility of food items or a lower risk of predation (actual or perceived) are likely to be the reasons for birds choosing to forage on shorter swards and in areas with more bare ground. Birds feeding on soil invertebrates were found to be generally tolerant of modern management practices that maintain short swards short, as accessibility to the soil has been increased. Species that feed on foliar invertebrates or forb seeds have been affected negatively by modern grassland agricultural practices.

233. **Winter bird communities in woodland in the Forest of Dean, England, and some implications of livestock grazing.**
Hill, D. A.; Lambton, S.; Proctor, I.; and Bullock, I.
Bird Study 38(1): 57-70. (1991); *ISSN:* 0006-3657
Descriptors: conifer oak forest/ species composition/ habitat selection/ conservation/ transect method
Abstract: Winter bird communities, sampled by transect methods, were compared between 9 woodland sites (1 ungrazed oak, 4 grazed oak, 4 grazed conifer) in the Forest of Dean Gloucestershire, during 2 winters (1984/85 and 1987/88). Ungrazed oak woodland had the higherst counts of individual birds in both years. More species occurred in oak woods than in conifers. Ordination of the combined data from the 2 winters illustrated a consistent gradient of bird species composition (after the exclusion of 2 flocking species, Woodpigeon and Chaffinch), from evergreen coniferous to deciduous broadleaf. Green and Great-spotted Wood-pecker, Hawfinch, Fieldfare, Brambling, Great Tit, Magpie and Siskin occurred largely towards the deciduous broadleaf end of the gradient. Classification of the bird data split the sites firstly into deciduous broadleaf and evergreen coniferous. In further sub-divisions, one group had tree species composition consisting largely of ungrazed oak for which the indicator bird species was Hawfinch. The indicator species of the grazed conifer group were Blue Tit, Goldcrest, Coal Tit and Long-tailed Tit. The tree species composition for the 5 final groups was then related to the number of bird species in them. In both years the mean number of species in the groups increased with an increase of the dominance of oak, with the highest value in ungrazed oak. The implications of the development of further ungrazed areas for conservation purposes are discussed.