

**A selection of 66 references about fruit consumption and seed dispersal by Deer**  
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**Record 1 of 66**

**Author(s):** Pakeman, RJ (Pakeman, R. J.); Small, JL (Small, J. L.)

**Title:** Potential and realised contribution of endozoochory to seedling establishment

**Source:** BASIC AND APPLIED ECOLOGY, 10 (7): 656-661 2009

**Abstract:** Many plant species have been shown to be dispersed by large herbivores through endozoochory, but there have been few studies that have demonstrated the ecological significance of this dispersal method. Known quantities of seeds were fed to sheep and the emergence of seeds germinating from dung in the field and glasshouse were compared with emergence in the field after direct sowing. All 12 species studied showed potential endozoochory as they germinated and grew from dung in the glasshouse. Six species showed no emergence in the field from either dung or direct sowing. Of the remaining, three did not emerge from dung in the field but did from direct sowing indicating a very high cost of dispersal (one other species showed this pattern but not significantly), one emerged in the field from dung but at comparatively low rates and one showed no cost to endozoochory as it emerged equally well from dung or after direct sowing. The results indicate that potential endozoochory, as measured by germination from dung in the glasshouse, over-estimates likely rates of establishment in the field. The results also indicate that there are potentially high costs to endozoochory that have to be balanced against the benefits of long-distance dispersal by large herbivores. (c) 2009 Gesellschaft für Ökologie. Published by Elsevier GmbH. All rights reserved.

**DOI:** 10.1016/j.baec.2009.03.007

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**Record 2 of 66**

**Author(s):** Takatsuki, S (Takatsuki, Seiki)

**Title:** Effects of sika deer on vegetation in Japan: A review

**Source:** BIOLOGICAL CONSERVATION, 142 (9): 1922-1929 Sp. Iss. SI SEP 2009

**Abstract:** The Japanese sika deer *Cervus nippon* has expanded its range by nearly 70% during the last two decades. Browsing by sika deer affects vegetation in both agricultural and forested habitats. Effects of sika deer on vegetation are conspicuous on deer-inhabited islands: forest structure and composition are altered by deer grazing and browsing, and consequently regeneration is prevented. By felling of old trees, forest gaps are formed, but since sapling recruitment is prevented, shade intolerant plants invade. Unpalatable forbs like ragwort *Senecio cannabifolius* and ferns like bracken *Pteridium aquilinum* (Dennstaedtiaceae) become dominants in open habitats. At the places of highest deer density, the *Zoysia japonica* community, a low growing grass mat, develops. Sika deer function as a seed dispersal agent of this grass. Indirect effects of sika deer are not well studied, but some studies have shown reduction of understory bamboo cover, which in turn improves the survival of tree seedlings and declines of wood mice *Apodemus* spp. Japanese forests in lower mountainous areas were widely logged during the 1940s and 1950s. These areas were not well planted during the war and until 1950, but thereafter intensively planted to alter to conifer plantation as a nationwide

campaign. For several decades after the war, rodents and hares grazed planted trees. According to growth of the planted trees to form canopy, which is unfavorable for rodents and hares, their damage declined. After the 1960s, old-growth forests in high mountainous areas were logged, and conifers were planted. Animals causing forestry damage were replaced by sika deer during the 1980s. Sika deer eat a wide variety of foods, and are gregarious, which causes heavy impacts on vegetation. Effects of sika deer are expanding to natural forests, alpine vegetation, and marshes. To reduce damages on forestry and natural vegetation, as many as 100,000 sika deer are culled every year. However, the hunter population is rapidly declining, and it is expected population control by culling will be insufficient. Although sika deer are an important component of Japanese forests, current population densities exceed the capacity of many ecosystems to tolerate herbivory. (C) 2009 Elsevier Ltd. All rights reserved.  
**DOI:** 10.1016/j.biocon.2009.02.011

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### **Record 3 of 66**

**Author(s):** Spear, D (Spear, D.); Chown, SL (Chown, S. L.)

**Title:** Non-indigenous ungulates as a threat to biodiversity

**Source:** JOURNAL OF ZOOLOGY, 279 (1): 1-17 SEP 2009

**Abstract:** Non-indigenous ungulate species pose a problem for conservation. They can be socially and economically valuable, but are also potentially harmful to biodiversity. Therefore, their introduction requires an explicit assessment of risk relative to benefit. To conduct such risk assessments, information regarding the impacts of non-indigenous ungulates on biodiversity is required. Here, we review the available evidence for the biodiversity impacts of non-indigenous ungulates. Hybridization, exploitation and apparent competition, vegetation impacts, predation, facilitation, trophic cascades and soil system functioning were assessed using a hierarchical set of criteria for the strength of the evidence. Strong evidence was lacking for risks posed by competition. Numerous reports exist of hybridization in captivity between ungulate species that normally do not co-occur, but conclusive evidence for introgression in the wild was restricted to one case. Strong evidence (using exclosure experiments) for the impacts of introduced ungulates on vegetation structure and composition was found and in some cases introduced ungulates caused the extirpation of plant species. Predation by *Sus scrofa* is a substantial threat to island faunas and systems, and impacts on soil system functioning elsewhere have also been found. Facilitation by ungulates has been shown to be substantial in promoting invasive plant species. By contrast, little evidence exists for apparent competition. The largest impacts from introduced ungulates are likely to be in cases where they perform novel functions in the new environment. However, to determine which types of impacts are likely to be most problematic, further evidence is required, ideally from well-designed field experiments.

**DOI:** 10.1111/j.1469-7998.2009.00604.x

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### **Record 4 of 66**

**Author(s):** Brodie, JF (Brodie, Jedediah F.); Helmy, OE (Helmy, Olga E.); Brockelman, WY (Brockelman, Warren Y.); Maron, JL (Maron, John L.)

**Title:** Bushmeat poaching reduces the seed dispersal and population growth rate of a mammal-dispersed tree

**Source:** ECOLOGICAL APPLICATIONS, 19 (4): 854-863 JUL 2009

**Abstract:** Myriad tropical vertebrates are threatened by overharvest. Whether this harvest has indirect effects on nonhunted organisms that interact with the game species is a critical

question. Many tropical birds and mammals disperse seeds. Their overhunting in forests can cause zoochorous trees to suffer from reduced seed dispersal. Yet how these reductions in seed dispersal influence tree abundance and population dynamics remains unclear. Reproductive parameters in long-lived organisms often have very low elasticities; indeed the demographic importance of seed dispersal is an open question. We asked how variation in hunting pressure across four national parks with seasonal forest in northern Thailand influenced the relative abundance of gibbons, muntjac deer, and sambar deer, the sole dispersers of seeds of the canopy tree *Choerospondias axillaris*. We quantified how variation in disperser numbers affected *C. axillaris* seed dispersal and seedling abundance across the four parks. We then used these data in a structured population model based on vital rates measured in Khao Yai National Park (where poaching pressure is minimal) to explore how variation in illegal hunting pressure might influence *C. axillaris* population growth and persistence. Densities of the mammals varied strongly across the parks, from relatively high in Khao Yai to essentially zero in Doi Suthep-Pui. Levels of *C. axillaris* seed dispersal and seedling abundance positively tracked mammal density. If hunting in Khao Yai were to increase to the levels seen in the other parks, *C. axillaris* population growth rate would decline, but only slightly. Extinction of *C. axillaris* is a real possibility, but may take many decades. Recent and ongoing extirpations of vertebrates in many tropical forests could be creating an extinction debt for zoochorous trees whose vulnerability is belied by their current abundance.

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#### **Record 5 of 66**

**Author(s):** Brodie, JF (Brodie, Jedediah F.); Helmy, OE (Helmy, Olga E.); Brockelman, WY (Brockelman, Warren Y.); Maron, JL (Maron, John L.)

**Title:** Functional differences within a guild of tropical mammalian frugivores

**Source:** ECOLOGY, 90 (3): 688-698 MAR 2009

**Abstract:** Many plants interact with groups of mutualist pollinators and seed dispersers. A key issue for both basic ecology and conservation is whether the different species within these guilds of mutualist animals are functionally equivalent. Comparing the relative effects of sympatric mutualists is important for understanding the evolution of multispecies mutualisms and for predicting mutualism stability in the face of anthropogenic change. However, empirical comparisons of the population-level impacts of mutualist animals on their host plant are rare, particularly for seed dispersal mutualisms in species-rich ecosystems. We compared the influence of three seed-dispersing tropical mammals, lar gibbons (*Hylobates lar*), sambar deer (*Rusa unicolor*), and red muntjac deer (*Muntiacus muntjak*), on the demography of a shared host tree in Thailand, *Choerospondias axillaris* (*Anacardiaceae*). Sambar and muntjac dispersed far more *C. axillaris* seeds than did gibbons. While sambar deposited many seeds under female tree canopies, muntjac were the only disperser to move seeds to open microhabitats, where *C. axillaris* seed germination, seedling survival, and initial growth are enhanced. Using stage-based population models, we assessed how disperser-specific seed dispersal, variation in the frequency of canopy gap formation, and their interaction influenced the potential population growth of *C. axillaris*. Large differences in dispersal quantity and small differences in dispersal quality among sambar and gibbons resulted in similar and negligible impacts on the tree's population dynamics. Muntjac, by taking some of the seeds to open microhabitats, are projected to have a greater positive impact on *C. axillaris* demography than either sambar or gibbons. Model comparisons of population-level species impacts may allow us to predict which ecological interactions are at risk from loss of critical species.

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#### **Record 6 of 66**

**Author(s):** Hygnstrom, SE (Hygnstrom, Scott E.); Skelton, PD (Skelton, Peter D.); Josiah, SJ (Josiah, Scott J.); Gilsdorf, JM (Gilsdorf, Jason M.); Virchow, DR (Virchow, Dallas R.); Brandle, JA (Brandle, James A.); Jayaprakash, AK (Jayaprakash, Anit K.); Eskridge, KM (Eskridge, Kent M.); VerCautren, KC (VerCautren, Kurt C.)

**Title:** White-tailed Deer Browsing and Rubbing Preferences for Trees and Shrubs That Produce Nontimber Forest Products

**Source:** HORTTECHNOLOGY, 19 (1): 204-211 JAN-MAR 2009

**Abstract:** Nontimber forest products (food, herbal medicinals, and woody floral and handicraft products) produced in forest, agroforestry, and horticultural systems can be important sources of income to landowners. White-tailed (Odocoileus virginianus) can reduce the quality, quantity, and profitability of forest products by browsing twigs and rubbing stems, resulting in direct and indirect losses to production enterprises. We evaluated deer damage (frequency and intensity of browsing and rubbing) sustained by 26 species of trees and shrubs, the relationships among morphological features of trees and shrubs to damage levels, and the economic impacts of deer damage on the production of nontimber forest products. Levels of browsing were high (frequency > 93% and intensity > 50%) in most species of trees and shrubs, with the highest intensity (> 60%) occurring in chinese chestnut (*Castanea mollissima*) and dogwood (*Cornus* spp.), and the lowest (< 20%) in ginkgo (*Ginkgo biloba*), curly willow (*Salix matsudana*), 'Scarlet Curls' curly willow, smooth sumac (*Rhus glabra*), and pussy willow (*Salix caprea*). Species of trees or shrubs with one or a few stout stems unprotected by dense branching [e.g., american elderberry (*Sambucus canadensis*), smooth sumac, and curly willow] sustained the most damage by rubbing. Trees and shrubs with many small diameter stems or with dense tangled branching [e.g. redozier dogwood (*Cornus sericea*), forsythia (*Forsythia suspensa*), 'Flame' willow (*Salix alba*), and 'Streamco' basket willow (*Salix purpurea*)] were damaged the least by rubbing. Annual economic costs of deer damage to producers of nontimber forest products can range from \$26/acre for pussy willow to \$1595/acre for curly willow.

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### Record 7 of 66

**Author(s):** Parks, CG (Parks, Catherine G.); Endress, BA (Endress, Bryan A.); Vavra, M (Vavra, Martin); McInnis, ML (McInnis, Michael L.); Naylor, BJ (Naylor, Bridgett J.)

**Title:** Cattle, Deer, and Elk Grazing of the Invasive Plant Sulfur Cinquefoil

**Source:** NATURAL AREAS JOURNAL, 28 (4): 404-409 OCT 2008

**Abstract:** The role Of ungulates as contributors to establishment and spread of non-native invasive plants in natural areas is not well known. The objective, of this study Were to document whether or not sulfur cinquefoil (*Potentilla recta* L.) is grazed by ungulates and to quantify the effects of ungulate herbivory on the density and demography of sulfur cinquefoil. Despite reports suggesting sulfur cinquefoil is minimally,razed, our results indicate that substantial grazing of sulfur cinquefoil occurs in a northeastern Oregon natural area. The number Of Sulfur cinquefoil flowers and seed heads differed significantly ( $P < 0.0001$ ) among all grazing treatments at all sampling periods. Cattle (*Bos Taurus*) grazed sulfur cinquefoil throughout earl), summer, resulting in smaller plants with few flowers and subsequent seed heads. Sulfur cinquefoil was g-razed by deer (*Odocoileus heminous* and *O. virginianus*) and elk (*Cervus elaphus*) primarily in the fall and winter by specifically removing just the seed heads. As sulfur cinquefoil reproduces only by seed and seeds typically fall within 3 in of a parent plant. grazing by ungulates and Subsequent deposition of the seeds by endozoochory may explain the establishment of satellite infestations across. susceptible natural areas.

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**Record 8 of 66**

**Author(s):** Chanthorn, W (Chanthorn, Wirong); Brockelman, WY (Brockelman, Warren Y.)

**Title:** Seed dispersal and seedling recruitment in the light-demanding tree *Choerospondias axillaris* in old-growth forest in Thailand

**Source:** SCIENCEASIA, 34 (2): 129-135 JUN 2008

**Abstract:** As seeds are the only movable stage in the plant life-cycle, their dispersal determines the chances of recruitment and survival away from the parent trees and the distribution of the next generation. We studied the light-demanding tree, *Choerospondias axillaris* (Anacardiaceae), whose pyrenes ("seeds") are dispersed mainly by deer and gibbons, to determine if seed dispersal is random with respect to parent trees and preferred germination and recruitment sites. Research was carried out during 2004 and 2005 on the Mo Singto 30-ha Forest dynamics plot, Khao Yai National Park, in which all trees down to 1 cm in diameter are mapped and measured. The species has a relatively large number of adults but very few juveniles 1-10 cm in diameter and appears not to be replacing itself in this old-growth forest. Dispersal into gaps is essential for recruitment, but gaps make up less than 10% of the area. Dispersal by sambar (Cervus unicolor), barking deer (*Muntiacus muntjak*), and gibbons (*Hylobates lar*) is almost random over the plot and not directed to gaps. In the 2 years of the study, less than 1% of seeds found in sub-quadrat samples were in gaps, but in the following year, approximately half of 1-year old seedlings were found in gaps. While 4.5% of the 750 sub-quadrats contained seedlings, the percentage of sub-quadrats in gaps containing seedlings was 11% and 23% in the 2 years of census. Only seedlings in gaps survived to the second year. In this population, recruitment is limited by a shortage of gaps in which seedlings can grow. Both the size distribution of adults and the dependence of seedling recruitment on light in gaps suggest that this tree population may depend on episodic forest disturbances large enough to create much larger gaps in order to maintain itself. If so, this species cannot maintain itself in mature forest and may be in perpetual disequilibrium.

**DOI:** 10.2306/scienceasia1513-1874.2008.34.129

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**Record 9 of 66**

**Author(s):** Di Bitetti, MS (Di Bitetti, Mario S.); Paviolo, A (Paviolo, Agustin); Ferrari, CA (Ferrari, Carolina A.); De Angelo, C (De Angelo, Carlos); Di Blanco, Y (Di Blanco, Yamil)

**Title:** Differential responses to hunting in two sympatric species of brocket deer (*Mazama americana* and *M. nana*)

**Source:** BIOTROPICA, 40 (5): 636-645 SEP 2008

**Abstract:** Hunting by humans may affect the abundance and activity patterns of game species. We examined the effect of hunting on the abundance and activity patterns of sympatric red brocket deer *Mazama americana* and dwarf brocket deer *M. nana*. We conducted four camera-trap surveys (158 sampling stations, 10,244 trap-days, total area sampled 1200 km<sup>2</sup>) in three areas within the Atlantic Forest of Misiones, Argentina, that differ in protection and hunting pressure. We used logistic regression and tests of independence to evaluate if protection, hunting pressure, and other independent variables affect the probability of recording each species and their recording rate. We used the Mardia-Watson-Wheeler test to examine if the daily activity pattern differs between species and changes with hunting pressure. Red brocket deer were more frequently recorded (397 records, 58% of stations) than dwarf brocket deer (100 records, 37% of stations). The probability of recording red brockets was higher in areas with better protection and increased with the distance to the main accesses used by poachers. The probability of recording dwarf brockets

was higher in areas with low protection. Red brockets were more nocturnal than dwarf brockets, a difference that may reduce interspecific competition. However, red brockets were more diurnal in the best-protected areas, suggesting that they can adjust their activity to local hunting pressure. Hunting has opposite effects on the abundance of these deer and may facilitate their coexistence. Hunting should be carefully controlled or managed to ensure the conservation of these little known species.

**DOI:** 10.1111/j.1744-7429.2008.00413.x

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#### **Record 10 of 66**

**Author(s):** Will, H (Will, Heidrun); Tackenberg, O (Tackenberg, Oliver)

**Title:** A mechanistic simulation model of seed dispersal by animals

**Source:** JOURNAL OF ECOLOGY, 96 (5): 1011-1022 SEP 2008

**Abstract:** 1. In order to investigate seed dispersal by animals on a landscape scale, we developed the spatially explicit, individual-based mechanistic model SEED (Simulation of Epi- and Endozoochorous Seed Dispersal). The purpose of the model is to predict patterns and densities of seeds dispersed by animals (especially mammals) within a simulated landscape. 2. The model was parameterized for sheep, cattle and deer as vectors but may be applied to other animals if data for parameterization is available. The model data base currently includes parameter values for about 100 plant species. 3. Seed attachment to and seed detachment from the fur, as well as seed excretion after passage through the gut, are explicitly simulated by drawing randomly from distributions that were determined by standardized experiments. Animal movement is simulated as a correlated random walk, but to increase reality of the model, radio-tracking data of animals can also be used. 4. A sensitivity analysis of SEED was conducted to identify the relative importance of plant and animal traits. The analysis highlighted where the main gaps in our knowledge of seed dispersal processes lie. Even though in our study endozoochorous dispersal had the higher potential for long-distance dispersal compared to epizoochory, there is only scarce knowledge about seed production and especially about the proportion of seeds eaten by an animal, parameters which were shown to be of major importance for dispersal. 5. A comparison of variation in plant and animal traits, respectively, showed that dispersal kernels depend more on changes in the animal vector than on the comparably little variation a particular plant species can exhibit. For this reason, animal movement is, from all the dispersal-relevant parameters, the one for which more exact data is most urgently needed. 6. Synthesis. The newly developed simulation model will help to understand, quantify and predict long-distance seed dispersal by animals. The possibility to incorporate real landscapes and movement data from very different animals makes the model generalizable and possibly applicable to a wide range of scientific and applied questions.

**DOI:** 10.1111/j.1365-2745.2007.01341.x

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#### **Record 11 of 66**

**Author(s):** Dolman, PM (Dolman, Paul M.); Waber, K (Waeber, Kristin)

**Title:** Ecosystem and competition impacts of introduced deer

**Source:** WILDLIFE RESEARCH, 35 (3): 202-214 2008

**Abstract:** Numerous deer species have been introduced beyond their native range into ecosystems around the world. Their economic value leads to further accidental and deliberate releases and lack of control is contributing to range expansion in Australia, South America

and Europe. Despite localised or regional concern, the scale and generality of detrimental impacts have not been widely recognised. We review the direct and indirect impacts on ecosystems and evidence for interspecific effects on native deer. In New Zealand, where large herbivores were previously absent, severe and novel impacts have been found in susceptible forests. Even where ecosystems contain native deer, invasion by taxonomically exotic deer species carries the risk of cascade effects on spatial plant dynamics and forest composition. In Patagonia, introduced deer have disrupted forest composition, whereas in Europe, ecosystem impacts of introduced species can differ from those of over-abundant native deer. Introduced Chinese muntjac (*Muntiacus reevesi*) within a coniferous forestry landscape in eastern England differ from native European roe deer (*Capreolus capreolus*) in their distribution of herbivory among differing habitats, and provide much lower rates of endozoochorous seed dispersal. Frequent concern is expressed that introduced deer species may have detrimental effects on native deer and other ungulates, although potential epidemiological effects have not been investigated. Apparent competition, with introduced prey resulting in increased predation rates on native deer, may be occurring between South American huemul (*Hippocamelus bisulcus*) and southern pudu (*Pudu puda*). Habitat and dietary overlap is often substantial among native and introduced ungulates, including deer, and exploitation competition is likely. Evidence includes spatial responses of native to non-native deer and negatively correlated changes in population abundance, but demographic mechanisms have not been demonstrated previously. In a coniferous forestry landscape in eastern England, substantial habitat and dietary overlap occurs between native roe deer and high-density introduced Chinese muntjac. This roe deer population has shown a reduction in body weight and fertility following establishment and increasing abundance of non-native Chinese muntjac, compatible with interspecific competition. European roe deer also appear susceptible to competition from larger grazing deer, including native red deer (*Cervus elaphus*) and introduced fallow (*Dama dama*). The widely introduced fallow deer may be a particularly effective competitor in sympatry with intermediate or concentrate feeders. There is need for further investigation of potential interactions of introduced and native deer species, and a wider recognition of the ecological impacts of introduced deer.

**DOI:** 10.1071/WR07114

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## **Record 12 of 66**

**Author(s):** Bartuszevige, AM (Bartuszevige, Anne M.); Endress, BA (Endress, Bryan A.)

**Title:** Do ungulates facilitate native and exotic plant spread? Seed dispersal by cattle, elk and deer in northeastern Oregon

**Source:** JOURNAL OF ARID ENVIRONMENTS, 72 (6): 904-913 JUN 2008

**Abstract:** Large domestic and native ungulates have the potential to disperse large quantities of seeds throughout the landscape. Many studies have found that ungulates are capable of dispersing seeds but few quantify the relative importance of ungulate dispersal across the landscape. We investigated the potential for cattle, elk, and deer to disperse native and exotic plants in two different western North American ecosystems in northeast Oregon. We collected fecal samples of cattle, elk and deer that had been deposited during the current growing season. In the greenhouse we monitored the density and species richness of seedlings that germinated from the fecal samples. All three species act as seed dispersers for native and exotic plants. Cattle fecal pats had a higher species richness and density of exotic grasses germinating compared to the other ungulates; elk had a higher species richness and density of native and exotic forbs compared to the other ungulates. We then projected the number of seeds that each animal could disperse during a growing season. We predict that cattle disperse more than an order of magnitude more seeds than elk and deer per animal. Cattle, elk and deer

interact with the landscape in different ways and this can have important ramifications for plant communities at local and regional scales. (C) 2007 Elsevier Ltd. All rights reserved.

**DOI:** 10.1016/j.jaridenv.2007.11.007

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### **Record 13 of 66**

**Author(s):** Williams, SC (Williams, Scott C.); Ward, JS (Ward, Jeffrey S.); Ramakrishnan, U (Ramakrishnan, Uma)

**Title:** Endozoochory by white-tailed deer (*Odocoileus virginianus*) across a suburban/woodland interface

**Source:** FOREST ECOLOGY AND MANAGEMENT, 255 (3-4): 940-947 MAR 20 2008

**Abstract:** We examined the role of white-tailed deer (*Odocoileus virginianus*) in the dispersal of viable seeds in an intact forest bordered by medium-density housing in southern Connecticut. Estimated deer density on site was 23 deer/km<sup>2</sup> with higher local densities along the suburban/woodland interface. A total of 566 pellet groups were gathered in summers through early winters of 2002-2005. After vernalization at 5 degrees C for 60 days, pellet groups were placed in a growing medium in a temperature controlled greenhouse for 6 months. A total of 11,512 seedlings germinated from 61% of pellet groups, which included 86 taxa. Seeds of 40 species confirmed not native to the United States germinated from pellet groups. Given mean germination data of more than 20 germinants/pellet group and deer population estimate, each deer on site during the sampling interval had the potential to disperse over 500 viable seeds/day, which included approximately 350 seeds of exotic species. Median maximum travel distance of does for a 24-h period was 568 m with a maximum distance of 5932 m. Deer were likely consuming seeds in disturbed and/or edge habitats, which are often adjacent to residential housing, and transporting them into forested areas where exotic plants are not as prevalent. Birds, small mammals, and abiotic factors are known dispersal agents for plants. These results indicate that white-tailed deer are another important dispersal agent of seeds, particularly exotics. Thus, white-tailed deer may not only alter vegetation structure through direct browse damage of established plants, but also indirectly by lowering reproductive output of native plants and simultaneously distributing seeds of exotic species. (C) 2007 Published by Elsevier B.V.

**DOI:** 10.1016/j.foreco.2007.10.003

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### **Record 14 of 66**

**Author(s):** Grote, PJ (Grote, Paul J.)

**Editor(s):** Jarzen, DM; Manchester, SR; Retallack, GJ; Jarzen, SA

**Title:** Studies of fruits and seeds from the pleistocene of northeastern Thailand

**Source:** ADVANCES IN ANGIOSPERM PALEOBOTANY AND PALEOCLIMATIC RECONSTRUCTION - CONTRIBUTIONS HONOURING DAVID L DILCHER AND JACK A WOLFE , 258: 171-181 2007

**Book series title:** COURIER FORSCHUNGSINSTITUT SENCKENBERG SERIES

**Conference Title:** Advances in Paleobotany Conference 2006

**Conference Date:** MAR 12-14, 2006

**Conference Location:** Gainesville, FL

**Conference Host:** Florida Museum Nat Hist

**Abstract:** A remarkable assemblage of plant and animal fossils has recently been discovered in Nakhon Ratchasima province in Northeast Thailand. The fossils were deposited in a fluvial

system considered to be Middle Pleistocene in age. Plant remains include fruits, seeds, leaves, wood, tubers, amber, and pollen. The most common fruit type is preserved either as an elliptic endocarp with three or four valves or as a whole fruit with mesocarp and exocarp present and a suprabasal rim above the peduncle. These fruits are proposed as a new species of *Ziziphus* (Rhamnaceae). A second type consists of a globose fruit surrounded by five rather narrow wings and is considered to belong to *Dipterocarpus costatus* (Dipterocarpaceae). A third type is an elliptic endocarp with five elongate ridges and a central cavity apical to the locules. The endocarp dehisces at least partly into five valves. This type is considered to belong to *Melia azedarach* (Meliaceae). A fourth type consists of a fragment of a lenticular endocarp showing affinity to *Dracontomelon dao* (Anacardiaceae). Tubers have also been recovered that are similar to those of *Cyperus* or *Bolboschoenus* (Cyperaceae). Clear resin, which may have come from trees of Dipterocarpaceae or Burseraceae, as well as very well preserved leaves and wood, has also been found. The above specimens suggest the presence of tropical mixed deciduous and dry evergreen forests during the Middle Pleistocene. In addition to plant fossils, a number of vertebrate fossils have also been recovered from the site, including bones, teeth, or other remains of fish, soft-shelled and other turtles, gavials, bovids, deer, *Slegodon*, and a hyena.

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**Record 15 of 66**

**Author(s):** Brathen, KA (Brathen, Kari Anne); Ims, RA (Ims, Rolf A.); Yoccoz, NG (Yoccoz, Nigel G.); Fauchald, P (Fauchald, Per); Tveraa, T (Tveraa, Torkild); Hausner, VH (Hausner, Vera H.)

**Title:** Induced shift in ecosystem productivity ? Extensive scale effects of abundant large herbivores

**Source:** ECOSYSTEMS, 10 (5): 773-789 AUG 2007

**Abstract:** Abundant large herbivores can strongly alter vegetation composition, shifting the ecosystem into a lasting state of changed productivity. Previous studies of the effects of abundant reindeer on alpine and arctic vegetation have yielded equivocal results, probably due to differing environmental contexts. To overcome context dependency we devised a large-scale survey in the region of Finnmark, northern Norway, possessing some of the most densely stocked reindeer herds in the world. The effects of reindeer abundance on summer pasture vegetation were assessed by employing a quasi-experimental design, including site fertility as a potential modifier of the reindeer-vegetation interaction. The study design comprised ten pairs of neighboring management districts (encompassing 18,003 km<sup>2</sup>), where over the two last decades a high-density district on average had reindeer densities more than twice as high and calf weights consistently lower than the low-density district. The abundance of different plant functional groups, ranging from those having facilitating to retarding effects on ecosystem productivity, were quantified by the point intercept method on plots selected according to a hierarchical, stratified random sampling design. Species with strong retarding effects on ecosystem productivity (for example, ericoids) were by far the most abundant. However, we found no consistent effects of reindeer density on their abundance. The most consistent differences between high- and low-density districts were found in plant functional groups with facilitating to neutral effects on ecosystem productivity. In particular, the abundance of N-facilitators, large dicotyledons and grasses were substantially reduced in the high-density districts. However, this reduction was restricted to fertile sites. Thus, reindeer when present at high densities have homogenized the biomass of palatable plants across environmental productivity gradients according to predictions from exploitation ecosystem models. Such reduction of plants with facilitating to neutral effects on ecosystem productivity indicates a reduced state of ecosystem productivity in high-density

districts.

**DOI:** 10.1007/s10021-007-9058-3

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### **Record 16 of 66**

**Author(s):** Ims, RA (Ims, Rolf A.); Yoccoz, NG (Yoccoz, Nigel G.); Brathen, KA (Brathen, Kari Anne); Fauchald, P (Fauchald, Per); Tveraa, T (Tveraa, Torkild); Hausner, V (Hausner, Vera)

**Title:** Can reindeer overabundance cause a trophic cascade?

**Source:** ECOSYSTEMS, 10 (4): 607-622 JUN 2007

**Abstract:** The region Finnmark, in northernmost Europe, harbors dense populations of semi-domestic reindeer of which some exhibit characteristics of overabundance. Whereas overabundance is evident in terms of density-dependent reductions in reindeer body mass, population growth and abundance of forage plants, claims have been made that this reindeer overabundance also has caused a trophic cascade. These claims are based on the main premise that reindeer overgrazing negatively impacts small-sized, keystone tundra herbivores. We tested this premise by a large-scale study in which the abundance of small rodents, hares and ptarmigans was indexed across reindeer management districts with strong differences in stocking densities. We examined the scale-dependent relations between reindeer, vegetation and these small-sized herbivores by employing a spatially hierarchical sampling design within the management districts. A negative impact of reindeer on ptarmigan, probably as a result of browsing reducing tall *Salix*, was indicated. However, small rodents (voles and lemmings), which are usually the keystone herbivores in the plant-based tundra food web, were not negatively impacted. On the contrary, there was a strong positive relationship between small rodents and reindeer, both at the scale of landscape areas and local patches, with characteristics of snow-bed vegetation, suggesting facilitation between Norwegian lemmings and reindeer. We conclude that the recent dampening of the vole and lemming population cycle with concurrent declines of rodent predators in northernmost Europe were not caused by large herbivore overgrazing.

**DOI:** 10.1007/s10021-007-9060-9

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### **Record 17 of 66**

**Author(s):** Will, H (Will, Heidrun); Maussner, S (Maussner, Stefanie); Tackenberg, O (Tackenberg, Oliver)

**Title:** Experimental studies of diaspore attachment to animal coats: predicting epizoochorous dispersal potential

**Source:** OECOLOGIA, 153 (2): 331-339 AUG 2007

**Abstract:** The transport of diaspores on animal hairs depends on the ability of a diaspore to attach to the hair and to be retained in it over longer periods of time. Whereas several studies of diaspore retention on animal hairs have been conducted recently, the process of diaspore attachment to the hair has not yet been studied systematically. We describe a new method to quantify the attachment potential (AtP) of plant diaspores. Attachment potential was measured as the proportion of diaspores of a given species that attached to pieces of an animal coat in a standardised experiment. The experiment was conducted for 58 plant species (herbs and grasses) and three different coat types: sheep wool, cattle and roe deer hair. Attachment potentials differed widely between the three coat types, but also between plant species. We found diaspore surface structure (a quantitative measure of diaspore morphology) and diaspore exposition (describing the morphology of the infructescence) to be the most

important plant traits regulating AtP. An influence of seed mass on attachment potential could not be detected. For sheep wool, a general linear model (with diaspore exposure as a factor and diaspore surface structure as covariate) explained 77% of the variation in AtPs. To validate this model, we predicted AtPs for 27 additional species and compared these to the measured AtPs; the predicted and measured AtPs correlated significantly with  $r(s) = 0.68$ . A comparison of attachment and retention potentials to sheep wool for 127 randomly selected plant species showed that attachment and retention are only very weakly correlated, indicating that both processes act rather independently of each other. Since many diaspores seem to perform well in only one of these processes, attachment can be considered to be as equally as decisive as retention in terms of epizoochorous dispersal.

**DOI:** 10.1007/s00442-007-0731-1

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### **Record 18 of 66**

**Author(s):** Brathen, KA (Brathen, Kari Anne); Gonzalez, VT (Gonzalez, Victoria T.); Iversen, M (Iversen, Marianne); Killengreen, S (Killengreen, Siw); Ravolainen, VT (Ravolainen, Virve T.); Ims, RA (Ims, Rolf A.); Yoccoz, NG (Yoccoz, Nigel G.)

**Title:** Endozoochory varies with ecological scale and context

**Source:** ECOGRAPHY, 30 (2): 308-320 APR 2007

**Abstract:** Several studies on endozoochory have established large herbivores as important for seed dispersal, yet no studies have evaluated how endozoochory is dependent on ecological scale and context. Here we address effects of reindeer density on endozoochory in a hierarchical, multi-scale study, encompassing several ecological contexts.

We found reindeer density effects on endozoochory to vary with spatial scale. Higher reindeer densities at the level of landscape areas, as indexed through faeces abundance, were related to both less species and lower abundance of emerging plants from faeces. In contrast, there was no effect of higher reindeer densities at the level of herding districts (i.e. large scale assemblages of landscapes). Lack of consistency between scales reflects ecological hierarchy, indicating that reindeer density effects on endozoochory best matches at the scale of landscapes.

Pasture seed plant composition was only partly an important ecological factor. That is, ericoid species, the dominating plants in the pastures, were also the most abundant seed plants found to emerge from the faeces. However, most herbaceous seed plant species in the pastures were not emerging from the faeces and the few that emerged were positively related to the site fertility and altitude of the pasture.

Studies addressing endozoochory of ruminants are typically concerned with seed plants, whereas in this study we also found indications of that diaspores of ferns are viable after passing the digestive tract of large herbivores. Vascular spore plants were even more abundant in the faeces than were vascular seed plants.

Results from this study demonstrate that reindeer may counteract a potentially negative impact on seed limitation from their grazing by returning viable seeds in their faeces. However, in Finnmark, northern Norway, this effect is only marginal, relates only to a very few species and individuals and shows ecological scale and context dependence.

**DOI:** 10.1111/j.2007.0906-7590.04976.x

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### **Record 19 of 66**

**Author(s):** Peco, B (Peco, B.); Lopez-Merino, L (Lopez-Merino, L.); Alvir, M (Alvir, M.)

**Title:** Survival and germination of Mediterranean grassland species after simulated sheep ingestion: ecological correlates with seed traits

**Source:** ACTA OECOLOGICA-INTERNATIONAL JOURNAL OF ECOLOGY, 30 (2): 269-275 SEP-OCT 2006

**Abstract:** Large amounts of viable seeds from Mediterranean grassland species have been found in herbivore dung; however which species produce seeds that can survive and germinate after ingestion by herbivores is still not well understood. This paper evaluates the importance of seed size, shape and coat impermeability in the endozoochorous dispersal process of 20 abundant species from central Iberian rangelands. Seed survival, germination percentages and germination speed were analysed in controlled experiments on the chewing and gut passage process by inserting seeds in the rumen of fistulated sheep, followed by simulated acid-pepsin digestion. Higher germination percentages in the control than the simulated sheep ingestion treatment were found in 75% of seeds. All species showed lower survival following the treatment, two species had a higher germination speed and five had a lower rate. Large-seeded species generally had higher survival percentages than small-seeded species. Species with impermeable seed coats had higher germination percentages following treatment although no significant differences were noted for either seed survival or germination speed. (c) 2006 Elsevier Masson SAS. All rights reserved.

**DOI:** 10.1016/j.actao.2006.05.004

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#### **Record 20 of 66**

**Author(s):** Prasad, S (Prasad, Soumya); Krishnaswamy, J (Krishnaswamy, Jagdish); Chellam, R (Chellam, Ravi); Goyal, SP (Goyal, Surendra Prakash)

**Title:** Ruminant-mediated seed dispersal of an economically valuable tree in indian dry forests

**Source:** BIOTROPICA, 38 (5): 679-682 SEP 2006

**Abstract:** Ruminant-mediated seed dispersal, an understudied process in tropical forests, was examined via *Phyllanthus emblica*-*Axis axis* interaction. A captive *Axis* deer regurgitated intact *P. emblica* seeds after retaining them in the rumen for 7-27 h. At Rajaji National Park, a considerable fraction (22%) of deer-regurgitated *P. emblica* seeds germinated, although lower than unconsumed seeds (72%). The size and strength of seeds like *P. emblica* might ensure that ruminants regurgitate them intact instead of defecating them.

**DOI:** 10.1111/j.1744-7429.2006.00182.x

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#### **Record 21 of 66**

**Author(s):** Ramos, ME; Robles, AB; Castro, J

**Title:** Efficiency of endozoochorous seed dispersal in six dry-fruited species (Cistaceae): from seed ingestion to early seedling establishment

**Source:** PLANT ECOLOGY, 185 (1): 97-106 JUL 2006

**Abstract:** We combined laboratory and nursery experiments to analyse the effectiveness of sheep as endozoochorous seed dispersers of six native shrubby Cistaceae species collected in SE Spain (*Helianthemum apenninum* (L.) Mill., *H. violaceum* (Cav.) Pers., *Fumana ericoides* (Cav.) Grand., *F. thymifolia* (L.) Spach, *Cistus monspeliensis* L. and *C. laurifolius* L.), considering the main stages after seed ingestion, i.e. seed recovery, seed germination, seedling emergence and early seedling establishment. Seed recovery after gut passage was high (around 40%) for all the species, except *F. thymifolia* (12%). Most seeds (ca. 90%) were recovered within 48 h after ingestion for all the species, although seeds were still recovered up to 96 h after ingestion. Gut passage increased germination up to seven-fold compared to non-ingested seeds. Furthermore, seedling emergence from seeds contained in pellets was

overall similar (intact pellets) to or higher (crumbled pellets) than emergence from seeds without dung. Survival of emerged seedlings and mass of seedlings after 20 days were not reduced by dung. Sheep act therefore as effective dispersers of these Cistaceae species by scattering seeds and promoting germination, while faeces do not hamper seedling establishment. We conclude that the interaction between herbivorous ungulates and these dry-fruited species may be considered a mutualism qualitatively similar to the mutualism between frugivorous vertebrates and fleshy-fruited plants.

**DOI:** 10.1007/s11258-005-9087-y

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### **Record 22 of 66**

**Author(s):** Vellend, M; Knight, TM; Drake, JM

**Title:** Antagonistic effects of seed dispersal and herbivory on plant migration

**Source:** ECOLOGY LETTERS, 9 (3): 316-323 MAR 2006

**Abstract:** The two factors that determine plant migration rates - seed dispersal and population growth - are generally treated independently, despite the fact that many animals simultaneously enhance plant migration rate via seed dispersal, and decrease it via negative effects of herbivory on population growth. Using extensive empirical data, we modelled the antagonistic effects of seed dispersal and herbivory by white-tailed deer on potential migration rates of *Trillium grandiflorum*, a forest herb in eastern North America. This novel antagonistic interaction is illustrated by maximum migration rates occurring at intermediate, but low herbivory (< 15%). Assuming herbivory < 20% and favourable conditions for population growth during post-glacial migration, seed dispersal by deer can explain rates of migration achieved in the past, in contrast to previous models of forest herb migration. However, relatively unfavourable conditions for population growth and increasingly intense herbivory by deer may compromise plant migration in the face of present and future climate change.

**DOI:** 10.1111/j.1461-0248.2005.00878.x

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### **Record 23 of 66**

**Author(s):** Eycott, AE; Watkinson, AR; Dolman, PM

**Editor(s):** Smithers, R

**Title:** Deer as vectors of plant dispersal in woodland networks

**Source:** LANDSCAPE ECOLOGY OF TREES AND FORESTS: 50-57 2004

**Conference Title:** 12th Annual Conference of the International-Association-for-Landscape-Ecology

**Conference Date:** JUN 21-24, 2004

**Conference Location:** Cirencester, ENGLAND

**Conference Host:** Royal Agr Coll

**Abstract:** Dispersal is a key process in fragmented landscapes. Deer and lagomorph species may have a significant role in the creation and development of plant assemblages of a range of forest habitats, as they deposit viable seeds of a number of species in their faecal pellet groups. We present data from a large study of the viable seed content of herbivore faecal matter. 84 vascular plant species were recorded, including seeds with a variety of physical dispersal mechanisms. Herbivore functional groups may differ in their role in the dynamics of forest plant assemblages. Large-bodied grazing deer had a greater seed and species content per pellet group, and dispersed a greater number of species, than browsing deer or

lagomorphs. Faecal deposition rates and population density estimates are used to estimate the seed rain from the different deer functional groups; roe deer (*Capreolus capreolus*) deposit the most seeds per square metre in our study area.

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#### **Record 24 of 66**

**Author(s):** Wald, EJ; Kronberg, SL; Larson, GE; Johnson, WC

**Title:** Dispersal of leafy Spurge (*Euphorbia esula* L.) seeds in the feces of wildlife

**Source:** AMERICAN MIDLAND NATURALIST, 154 (2): 342-357 OCT 2005

**Abstract:** Leafy spurge (*Euphorbia esula*) is an exotic, perennial, invasive weed in many areas of the northern United States and Canada. There are many instances in pastures and wildlands where individual or small clusters of leafy spurge plants are distant and upslope from larger patches, and wildlife have been suspected as seed dispersal agents. Wildlife can disperse seeds by ingestion then excretion of seeds in their feces. Fecal deposits of free-ranging deer (*Odocoileus hemionus* and *O. virginianus*; n = 176), sharp-tailed grouse (*Tympanuchus phasianellus*; n = 201) and wild turkeys (*Meleagris gallopavo*; n = 206) were collected during a summer in Theodore Roosevelt National Park (TRNP) in western North Dakota, and for deer only in Medicine Lake National Wildlife Refuge (MLNWR) in northeastern Montana. Feces were analyzed for the presence of leafy spurge seeds and any seeds found were tested for germinability and viability. Only one intact leafy spurge seed was found in one grouse fecal deposit and it was not viable. No leafy spurge seed was found in turkey feces. Two seeds that appeared to be immature leafy spurge seeds were found in one deer fecal deposit in TRNP, but neither seed was viable. One leafy spurge seed was found in each of four deer fecal deposits from MLNWR, but only one seed was viable and germinated. Seed-feeding trials with captive deer (n = 4), sharp-tailed grouse (n = 4) and wild turkeys (n = 4) were conducted to determine how leafy spurge seeds interact with the digestive systems of these animals. The only viable seeds defecated by grouse and turkeys were seeds excreted one day after ingestion. Two turkeys did not excrete any leafy spurge seeds and only a few viable seeds were defecated by the other two. One grouse defecated a larger number of viable seeds, but the other three grouse excreted only a few. Deer defecated viable seeds each of 4 d after ingesting them with most viable seed excreted on the first 2 d. These findings, along with those for the free-ranging animals, indicate that wild turkeys probably do not disperse leafy spurge seed while sharp-tailed grouse and deer may do so on a limited basis.

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#### **Record 25 of 66**

**Author(s):** Vander Wall, SB; Kuhn, KM; Gworek, JR

**Title:** Two-phase seed dispersal: linking the effects of frugivorous birds and seed-caching rodents

**Source:** OECOLOGIA, 145 (2): 282-287 SEP 2005

**Abstract:** Frugivorous birds disperse the seeds of many fruit-bearing plants, but the fate of seeds after defecation or regurgitation is often unknown. Some rodents gather and scatter hoard seeds, and some of these may be overlooked, germinate, and establish plants. We show that these two disparate modes of seed dispersal are linked in some plants. Rodents removed large (> 25 mg) seeds from simulated bird feces (pseudofeces) at rates of 8-50%/day and scatter hoarded them in soil. Ants (*Formica sibylla*) also harvested some seeds and carried them to their nests. Rodents carried seeds 2.5 +/- 3.2 m to cache sites (maximum 12 in) and buried seeds at 8 +/- 7 min depth. Enclosure studies suggest that yellow pine chipmunks (*Tamias amoenus*) and deer mice (*Peromyscus maniculatus*) made the caches. In spring, some seeds germinated from rodent caches and established seedlings, but no seedlings established

directly from pseudofeces. This form of two-phase seed dispersal is important because each phase offers different benefits to plants. Frugivory by birds permits relatively long-range dispersal and potential colonization of new sites, whereas rodent caching moves seeds from exposed, low-quality sites (bird feces on the ground surface) to a soil environment that may help maintain seed viability and promote successful seedling establishment.

**DOI:** 10.1007/s00442-005-0125-1

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### **Record 26 of 66**

**Author(s):** Mouissie, AM; Lengkeek, W; van Diggelen, R

**Title:** Estimating adhesive seed-dispersal distances: field experiments and correlated random walks

**Source:** FUNCTIONAL ECOLOGY, 19 (3): 478-486 JUN 2005

**Abstract:** 1. In this study we aimed to estimate distance distributions of adhesively dispersed seeds and the factors that determine them.

2. Seed attachment and detachment were studied using field experiments with a real sheep, a sheep dummy and a cattle dummy. Seed-retention data were used in correlated random walk models to simulate adhesive seed dispersal.

3. Seed attachment to the sheep dummy was larger in quantity and in number of species, and stronger in relation to seed density in the vegetation, than was seed attachment to the cattle dummy. Species found on the real sheep were also found on the sheep dummy.

4. Detachment from sheep wool differed little between smooth, bristly, small or large seeds, but smooth seeds detached from cattle fur within a few metres. Seeds applied within reach of vegetation detached sooner than seeds applied higher on the dummy.

5. The simulations showed that sheep are long-distance seed-dispersal vectors for seeds of any morphology (99 percentile distance, 2.9 km). The virtual cattle and Fallow Deer dispersed bristly and hooked seeds over long distances (99 percentile distance, 435-840 m), but not smooth seeds. Wood Mouse simulations generated only short-distance dispersal (99 percentile distance, 12 m).

**DOI:** 10.1111/j.1365-2435.2005.00992.x

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### **Record 27 of 66**

**Author(s):** Mouissie, AM; Van der Veen, CEJ; Veen, GF; Van Diggelen, R

**Title:** Ecological correlates of seed survival after ingestion by Fallow Deer

**Source:** FUNCTIONAL ECOLOGY, 19 (2): 284-290 APR 2005

**Abstract:** 1. The survival and retention of seeds was studied by feeding known quantities of seeds of 25 species to four captive Fallow Deer (*Dama dama* L.). To test for ecological correlates, plant species were selected to represent large variation in seed size, seed shape, seed longevity and habitat fertility.

2. Seeds of 24 out of 25 fed plant species survived ingestion and defecation by Fallow Deer. Seed survival ranged between 0.5 and 42% of germinable seeds fed. Time to recover 50% of all seeds defecated by Fallow Deer in faeces averaged 25 h, and ranged from 13 to 38 h.

3. Seed survival was negatively related to seed mass ( $R = 0.65$ ) and variance of unit seed dimensions ( $R = -0.56$ ), and positively related to seed longevity ( $R = 0.40$ ), but not related to habitat fertility.  $\log_{10}$  of (seed mass  $\times$  variance of seed dimensions) was the best predictor of seed survival ( $R = -0.68$ ).

4. The ecological correlates of seed survival presented here can help us to estimate the ability of plant species to disperse seeds over long distances.

**Record 28 of 66**

**Author(s):** Keith, D; Pellow, B

**Title:** Effects of Javan rusa deer (*Cervus timorensis*) on native plant species in the Jibbon-Bundeena Area, Royal National Park, New South Wales

**Source:** PROCEEDINGS OF THE LINNEAN SOCIETY OF NEW SOUTH WALES, 126: 99-110 MAR 20 2005

**Abstract:** A reconnaissance survey and enclosure experiment were carried out to examine the effects of Javan rusa deer on native flora and vegetation in Royal National Park on the southern outskirts of Sydney, Australia. Of 78 native plant species examined during the survey, only nine showed no evidence of vertebrate herbivory or physical damage and the majority of these plants were ferns and sedges. The other 69 species showed effects that included defoliation (young and/or old leaves), removal of shoots, bark-stripping, stem breakages and destruction or consumption of reproductive material. These effects varied in severity between species and from place to place, and were inferred to have been caused by deer based on the local abundance of deer droppings, footprints and the scarcity of other vertebrate herbivores in the area. The survey also revealed localised soil erosion associated with high densities of deer footprints and droppings. An unreplicated enclosure experiment showed that planted saplings of *Syzygium paniculatum*, a threatened rainforest tree, suffered major defoliation, bark stripping, stem breakages and some mortality when exposed to deer for several months. Many of the surviving plants showed signs of recovery when deer were subsequently excluded, although full recovery of their leaf canopies could take several seasons. The observed effects on vegetation and individual plant species are consistent with studies on several other deer species in a range of ecosystems overseas. A model of the effects of deer herbivory based on plant life-history suggests that curtailment of seed production and seedling recruitment are likely to be the major impacts of deer on plant population viability. Reductions in net growth and survival of established plants and possibly post-dispersal predation of seeds are less likely to be significant influences.

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**Record 29 of 66**

**Author(s):** Vellend, M

**Title:** Land-use history and plant performance in populations of *Trillium grandiflorum*

**Source:** BIOLOGICAL CONSERVATION, 124 (2): 217-224 JUL 2005

**Abstract:** Many forest herbs show reduced frequency in forests growing on former agricultural land (secondary forests) relative to forests that were never cleared for agriculture (primary forests). To explain this pattern, studies of secondary forest colonization by forest herbs have stressed the role of limited seed dispersal, though environmental conditions may also limit colonization. Here I demonstrate that adult plant performance of *Trillium grandiflorum* is significantly reduced in secondary vs. primary forests in central New York State, USA. Comparing primary and secondary sites both with relatively high soil pH, *T. grandiflorum* populations were more dense, and individual plants were larger and more likely to be flowering in primary than secondary forests. Using counts of annual leaf scars on the rhizome, I demonstrate that this result is not due to secondary populations being younger than primary populations. Age-specific leaf area was significantly greater in primary than secondary stands at high soil pH, and the data suggest slightly reduced seed set in secondary stands as well. These results point to a more important role for environmental conditions in limiting forest-herb colonization of secondary forests than has been previously appreciated.

Restoration and conservation of forest herbs in post-agricultural forests will require more than simply overcoming dispersal limitation. (c) 2005 Elsevier Ltd. All rights reserved.

**DOI:** 10.1016/j.biocon.2005.01.027

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### **Record 30 of 66**

**Author(s):** von Oheimb, G; Schmidt, M; Kriebitzsch, WU; Ellenberg, H

**Title:** Dispersal of vascular plants by game in northern Germany. Part II: Red deer (*Cervus elaphus*)

**Source:** EUROPEAN JOURNAL OF FOREST RESEARCH, 124 (1): 55-65 APR 2005

**Abstract:** The endozoochorous dispersal of vascular plant species by red deer (*Cervus elaphus*) was investigated in three forest areas of Schleswig-Holstein and Lower Saxony. The primary aim of this study was to determine of which plant species and in what numbers diaspores are dispersed by red deer, an animal with eminently large home ranges during a single day as well as over the year. A second aim was to examine the significance of endozoochory for plant species composition and diversity in forests. Special emphasis was placed on whether there are differences between the three study sites and in the course of the vegetation period. Freshly deposited faecal pellet groups were collected in the forests on five dates between May and November 2002 and viable seed content was determined by greenhouse germination (seedling emergence method). A total of 28,009 individuals representing 59 vascular plant species were detected in 220 dung samples. Red deer appears thus as an important vector for endozoochorous dispersal of plants. The number of seedlings found in the faecal pellets differs between plant species and research areas as well as in the course of the vegetation period. Dung seed content is largely dominated by one species, *Urtica dioica*. Grouping the species found in dung according to their habitat preference showed that mainly species that occur in forests as well as in open vegetation and non-forest species were dispersed endozoochorously, while species occurring mainly under a closed canopy were present in the excrements only in low numbers.

**DOI:** 10.1007/s10342-005-0053-y

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### **Record 31 of 66**

**Author(s):** Schmidt, M; Sommer, K; Kriebitzsch, WU; Ellenberg, H; von Oheimb, G

**Title:** Dispersal of vascular plants by game in northern Germany. Part I: Roe deer (*Capreolus capreolus*) and wild boar (*Sus scrofa*)

**Source:** EUROPEAN JOURNAL OF FOREST RESEARCH, 123 (2): 167-176 SEP 2004

**Abstract:** The endozoochorous and epizoochorous dispersal of vascular plant species by roe deer (*Capreolus capreolus*) and wild boar (*Sus scrofa*) was investigated in forest areas of Schleswig-Holstein and Lower Saxony, Germany. The primary aim of this study was to learn about which plant species and in what numbers diaspores are dispersed by the two wild ungulate species. In particular, the significance of zoochory for species composition and biodiversity of forests was evaluated. Fresh faecal pellets were collected from April-November 2001 in the forests of the two study areas. In addition, the coats and hooves of shot roe deer and wild boar were brushed out. The number of viable seeds was determined by greenhouse germination (seedling emergence method). The samples were spread in trays over sterilized soil from the study forests and were kept under controlled conditions in the greenhouse for 12 months. A total of 2,473 individuals from 77 vascular plant species were recorded. While roe deer exceeded wild boar concerning seed contents in the faeces, the significance of roe deer for epizoochorous dispersal was relatively low compared with wild

boar. An analysis of the habitat preference of the vascular plant species dispersed by the two ungulate species revealed a high proportion of species growing in forests as well as in the open landscape, and also of non-forest species, while woody plants and herbaceous species closely tied to forest habitats were severely underrepresented. We also discuss consequences for forest ecology and nature conservation.

**DOI:** 10.1007/s10342-004-0029-3

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### **Record 32 of 66**

**Author(s):** Kellogg, CH; Bridgham, SD

**Title:** Disturbance, herbivory, and propagule dispersal control dominance of an invasive grass

**Source:** BIOLOGICAL INVASIONS, 6 (3): 319-329 2004

**Abstract:** Despite the dramatic changes invasive plants cause to ecosystems and communities, factors that control dominance of invasive species after establishment in a community are poorly understood. Most active management relies on catastrophic disturbances of invasive-dominated communities to increase richness and diversity of plant communities. This study examines the importance of propagule dispersal and deer herbivory on continued dominance of *Phalaris arundinacea* after a non-catastrophic, short-term disturbance to monotypic stands of this invasive grass. The disturbance caused no change in *R. arundinacea* cover among treatments during any year of the study and, thus, simulates disturbance intensity more likely to be encountered in unmanaged settings. Despite the small disturbance, the combinations of disturbance + seeding and disturbance + seeding + deer exclusion caused greater species richness than controls even three years after disturbance. Increased invasion of *P. arundinacea* stands caused few effects on the dominant, as *R. arundinacea* biomass was unaffected after the first year. Selective herbivory by deer of species other than *R. arundinacea* increased the effects of disturbance and seeding, and aided in continued dominance of the grass. The tolerance of *R. arundinacea* for direct anthropogenic effects, including poor water quality and hydroperiod fluctuations, and indirect effects, such as increased herbivory by historically high deer populations, indicates the complexity of determining persistence of invasive species.

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### **Record 33 of 66**

**Author(s):** Myers, JA; Vellend, M; Gardescu, S; Marks, PL

**Title:** Seed dispersal by white-tailed deer: implications for long-distance dispersal, invasion, and migration of plants in eastern North America

**Source:** OECOLOGIA, 139 (1): 35-44 MAR 2004

**Abstract:** For many plant species in eastern North America, short observed seed dispersal distances (ranging up to a few tens of meters) fail to explain rapid rates of invasion and migration. This discrepancy points to a substantial gap in our knowledge of the mechanisms by which seeds are dispersed long distances. We investigated the potential for white-tailed deer (*Odocoileus virginianus* Zimm.), the dominant large herbivore in much of eastern North America, to disperse seeds via endozoochory. This is the first comprehensive study of seed dispersal by white-tailed deer, despite a vast body of research on other aspects of their ecology. More than 70 plant species germinated from deer feces collected over a 1-year period in central New York State, USA. Viable seeds included native and alien herbs, shrubs, and trees, including several invasive introduced species, from the full range of habitat types in the local flora. A mean of >30 seeds germinated per fecal pellet group, and seeds were dispersed during all months of the year. A wide variety of presumed dispersal modes were

represented (endo- and exozoochory, wind, ballistic, ant, and unassisted). The majority were species with small-seeded fruits having no obvious adaptations for dispersal, underscoring the difficulty of inferring dispersal ability from diaspore morphology. Due to their broad diet, wide-ranging movements, and relatively long gut retention times, white-tailed deer have tremendous potential for effecting long-distance seed dispersal via ingestion and defecation. We conclude that white-tailed deer represent a significant and previously unappreciated vector of seed dispersal across the North American landscape, probably contributing an important long-distance component to the seed shadows of hundreds of plant species, and providing a mechanism to help explain rapid rates of plant migration.

**DOI:** 10.1007/s00442-003-1474-2

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### **Record 34 of 66**

**Author(s):** Kneuper, CL; Scott, CB; Pinchak, WE

**Title:** Consumption and dispersion of mesquite seeds by ruminants

**Source:** JOURNAL OF RANGE MANAGEMENT, 56 (3): 255-259 MAY 2003

**Abstract:** Consumption of mesquite (*Prosopis glandulosa* Torr. var *glandulosa*) fruit by ruminants is an important component of seed dispersal. Two experiments were conducted to estimate the role of livestock and wildlife in the dispersion of mesquite fruit. In Experiment 1, 3 trials were conducted to determine preference for mesquite fruit by different species of livestock, intake relative to fruit maturity, and seed survival of digestion. Cattle, sheep, and goats were offered immature (IM), mature off the tree (XIT), or mature off the ground (MG) fruit to quantify intake and seed survival of digestion. Germination of seeds surviving digestion was also assessed. Experiment 2 assessed rate of pod disappearance from pastures with and without livestock grazing and attempted to quantify seed loss to wildlife. In Experiment 1, livestock consumed more ( $P < 0.05$ ) mature than immature fruit; sheep and goats consumed more fruit than cattle on a body weight basis. Seed survival was greater ( $P < 0.05$ ) from cattle than from sheep or goats. The number of seeds remaining intact after digestion was greater for mature fruit. Germination of seeds surviving digestion was similar ( $P > 0.05$ ) to seeds that experienced natural weathering for 6 months. In Experiment 2, the presence or absence of livestock did not affect the disappearance of seeds; seeds disappeared from the ground within 3 weeks in 1999 and 5 weeks in 2000 presumably by wildlife. Deer, raccoons, skunks, bobcats, turkeys, and other birds visited plots with fresh mesquite fruit. Collectively, these results suggest that cattle readily consume and disperse viable mesquite seeds; sheep and goat consumption of mesquite fruit may reduce the number of viable seeds; and mesquite fruit may only remain on the ground for a short period of time even without livestock grazing because of consumption by wildlife.

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### **Record 35 of 66**

**Author(s):** Vellend, M; Myers, JA; Gardescu, S; Marks, PL

**Title:** Dispersal of Trillium seeds by deer: Implications for long-distance migration of forest herbs

**Source:** ECOLOGY, 84 (4): 1067-1072 APR 2003

**Abstract:** Theoretical models of plant range expansion require the assumption of occasional long-distance seed-dispersal events to explain post-glacial migration rates. For the many forest herbs whose seeds are dispersed primarily by ants, there are few documented mechanisms of occasional long-distance dispersal, so models of forest-herb migration have been largely phenomenological. Here we show that viable seeds of *Trillium grandiflorum*, an

ant-dispersed forest herb in eastern North America, are dispersed via ingestion and defecation by white-tailed deer. We also use data from the literature on movement patterns and gut retention times to model a deer-generated seed shadow, showing that most seeds dispersed by deer should travel at least several hundred meters from parent plants, and occasionally >3 km. Our results provide a mechanism of long-distance dispersal that has likely contributed to rates of post-glacial migration and post-agricultural forest colonization.

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#### **Record 36 of 66**

**Author(s):** Ford, WM; Madarish, D; Schuler, TM; Castleberry, SB

**Title:** Influence of white-tailed deer digestion on running buffalo clover (*Trifolium stoloniferum* : Fabaceae Muhl. ex A. Eaton) Germination

**Source:** AMERICAN MIDLAND NATURALIST, 149 (2): 425-428 APR 2003

**Abstract:** We compared the germination rates of running buffalo clover (*Trifolium stoloniferum*) seeds that had been passed through the digestive tract of a captive white-tailed deer (*Odocoileus virginianus*), with those that had not. We found no significant difference among germination rates of seeds passed through deer and those not, nor with seeds that were cold-stratified prior to planting and those that were not. Although white-tailed deer are viable vectors for running buffalo clover seed, our data suggest that the rates of ingested seed germination and survival are low. Dispersal and establishment of new populations by white-tailed deer herbivory may not contribute quickly or significantly to the recovery of running buffalo clover at present.

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#### **Record 37 of 66**

**Author(s):** Laughlin, DC

**Title:** Geographic distribution and dispersal mechanisms of *Bouteloua curtipendula* in the Appalachian Mountains

**Source:** AMERICAN MIDLAND NATURALIST, 149 (2): 268-281 APR 2003

**Abstract:** The distribution of *Bouteloua curtipendula* in the eastern United States is generally limited to small and isolated populations on limestone-derived valley soils within the Ridge and Valley Physiographic Province in the Appalachian Mountains. In Pennsylvania, populations are <0.3 ha in extent and at least >16 km apart. *Bouteloua curtipendula* is found on extremely xeric sites: shallow, rocky, slightly alkaline, clay loams on south-southwest facing slopes. Diaspores of *B. curtipendula* can only travel at most a few meters on the wind and seeds are destroyed in the rumens of grazing ungulates; therefore, the long-distance dispersal mechanism is primarily by adhesion to animal fur. Two experiments tested the adhesion of *B. curtipendula* diaspores to eight mammal furs: coyote, red fox, rabbit, white-tailed deer, elk, bison, cattle and horse. A new index, the Dispersal Index (the product of "% diaspores that attached" and "% diaspores that remained after shaking"), was generated to represent the percentage of all diaspores that came into contact with the furs that remained attached. Bison and elk furs scored the highest on the Dispersal Index, suggesting that these two wild ungulates were important for *B. curtipendula* dispersal. However, both ungulates have been extirpated from most of their presettlement ranges in the Appalachians. According to herbarium records and modern field data, population numbers have declined by 48% during the past century mostly due to agriculture, development and Woody plant invasion due to fire suppression. Due to the absence of long-distance dispersers and the scattered distribution of suitable edaphic conditions, *B. curtipendula* is "trapped" on small sites that are shrinking due to woody plant invasion.

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**Record 38 of 66**

**Author(s):** Heinken, T; Hanspach, H; Raudnitschka, D; Schaumann, F

**Title:** Dispersal of vascular plants by four species of wild mammals in a deciduous forest in NE Germany

**Source:** PHYTOCOENOLOGIA, 32 (4): 627-643 DEC 10 2002

**Conference Title:** 44th Symposium of the International Association of Vegetation Science

**Conference Date:** JUL 29-AUG 04, 2001

**Conference Location:** FREISING, GERMANY

**Abstract:** The dispersal of vascular plant diaspores by common wild herbivorous and omnivorous mammals with a large home range was investigated in a 6.5-km<sup>2</sup>-forest area in NE Germany dominated by mesophilous deciduous forests. Endozoochory was studied by collecting faeces from roe deer, hare, wild boar and martens throughout one vegetation period. Epizoochory was investigated by brushing out the diaspores from the coats and hooves of shot roe deer and wild boar. The results were compared with the forest vegetation of the study area. The content of viable seeds was considerable in the faeces of herbivores (mainly weeds), low in the faeces of wild boar, and high in the scats of martens (mostly fleshy fruits). Whilst wild boar transported large amounts of various diaspores in the coat, the significance of roe deer for epizoochory was low. Altogether, 80 vascular plant species were dispersed; 38 species internally, and 55 externally. The open landscape was the most important source of dispersed seeds, and only a small proportion of the seeds came from the forest. Thus, most plants growing in the study forest received no effective dispersal by the four species of mammals, although most forest species were very abundant in the herb layer of the study area. We conclude that wild mammals are more effective in dispersal of ruderal and grassland species in central Europe. As epi- and endozoochory by large mammals are important mechanisms for long-distance dispersal of plants, we hypothesise that many herbaceous plants of mesophilous deciduous forests only have low dispersal potentials.

**DOI:** 10.1127/0340-269X/2002/0032-0627

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**Record 39 of 66**

**Author(s):** Kitamura, S; Yumoto, T; Poonswad, P; Chuailua, P; Plongmai, K; Maruhashi, T; Noma, N

**Title:** Interactions between fleshy fruits and frugivores in a tropical seasonal forest in Thailand

**Source:** OECOLOGIA, 133 (4): 559-572 DEC 2002

**Abstract:** Large frugivores are considered to be important seed dispersers for many tropical plant species. Their roles as seed dispersers are not well known in Southeast Asia, where degraded landscapes typically lack these animals. Interactions between 259 (65 families) vertebrate-dispersed fruits and frugivorous animals (including 7 species of bulbul, 1 species of pigeon, 4 species of hornbill, 2 species of squirrel, 3 species of civet, 2 species of gibbon, 1 species of macaque, 2 species of bear, 2 species of deer, and 1 species of elephant) were studied for 3 years in a tropical seasonal forest in Kbao Yai National Park, Thailand. The purpose was to examine the dietary overlaps among the large frugivores and the characteristics of fruits they consumed. Most fruit species are eaten by various kinds of frugivores; no close relationship between a particular fruit and a frugivore was found. The number of frugivore groups that served a given plant species was negatively correlated with seed size. Additionally, the fruit/seed diameters consumed by bulbuls were significantly smaller than consumed by the other nine groups. These trends of fruit characteristics were

consistent with those observed elsewhere in Southeast Asia: small fruits and large, soft fruits with many small seeds are consumed by a wide spectrum of frugivores while larger fruits with a single large seed are consumed by relatively few potential dispersers. Importantly, these large, single-seed fruits are not consumed by the small frugivores that thrive in small forest fragments and degraded areas in Southeast Asia. To insure the natural seed dispersal process in the forest, an evaluation of all frugivore groups in the forest is urgently needed in Southeast Asia.

**DOI:** 10.1007/s00442-002-1073-7

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#### **Record 40 of 66**

**Author(s):** Garcia, D; Banuelos, MJ; Houle, G

**Title:** Differential effects of acorn burial and litter cover on *Quercus rubra* recruitment at the limit of its range in eastern North America

**Source:** CANADIAN JOURNAL OF BOTANY-REVUE CANADIENNE DE BOTANIQUE, 80 (10): 1115-1120 OCT 2002

**Abstract:** Primary predators or dispersers such as birds and rodents cache acorns of northern red oak (*Quercus rubra* L.). A proportion of these acorns are not retrieved, and thus, animals may favour oak regeneration by placing acorns in microsites suitable for recruitment. We experimentally investigated the effects of acorn burial and litter cover on red oak recruitment at two sites at the northern limit of the species' range in North America. Laboratory experiments also tested the effects of acorn burial and litter cover on desiccation and germinability and the influence of soil moisture on germination. Burial and litter protected acorns against predation by deer in the field. Germination was promoted by burial both in field and laboratory experiments. Germination was proportional to acorn water content and to soil moisture. Seedling emergence in the field was enhanced by burial but reduced by litter cover. Acorns buried but uncovered by litter had the highest probability of recruiting a seedling. A potential effect of seed predators or dispersers on red oak regeneration and expansion is suggested, as acorn caching by birds and rodents may actually enhance population recruitment, despite high mortality through acorn consumption.

**DOI:** 10.1139/B02-102

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#### **Record 41 of 66**

**Author(s):** Heinken, T; Raudnitschka, D

**Title:** Do wild ungulates contribute to the dispersal of vascular plants in central European forests by epizoochory? A case study in NE Germany

**Source:** FORSTWISSENSCHAFTLICHES CENTRALBLATT, 121 (4): 179-194 AUG 2002

**Abstract:** The external dispersal ("epizoochory") of vascular plant diaspores (seeds and fruits) by roe deer and wild boar (the most common wild large mammals with a large home range in central Europe) was investigated in a 6.5-km<sup>2</sup> forest area in NE Germany dominated by mesic deciduous forests. The study involved brushing out the diaspores from the coats and hooves of 25 shot roe deer and nine wild boar. The results were compared with the forest vegetation of the study area. While wild boar transported large amounts of various diaspores in the coat, the significance of roe deer for epizoochory was low due to their sleek fur and different behavior compared to wild boar. Altogether, 55 vascular plant species were transported externally. Since only a limited number of seeds came from woodland habitats, the open landscape was as important as a source of attached seeds as the forest vegetation. Thus, most plant species occurring in the studied forest area, especially characteristic

woodland herbs, showed no adaptations to epizoochorous dispersal, despite high abundance in the herb layer. We conclude that hoofed game play a particular role in the dispersal of ruderal and grassland species in the agricultural landscape of Central Europe. However, the actual spread of some herb species in forests of northern Germany, e.g. *Agrostis capillaris*, *Brachypodium sylvaticum*, *Deschampsia flexuosa*, *Galium aparine* and *Urtica dioica*, may be facilitated mainly by wild ungulates. Though dispersal by large mammals is an important mechanism for long-distance dispersal of plants in general, our results suggest that most of the characteristic herb species of mesic deciduous forests have only low epizoochorous dispersal potentials. The implications for nature conservation and silviculture are discussed.

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#### **Record 42 of 66**

**Author(s):** Vellend, M

**Title:** A pest and an invader: White-tailed deer (*Odocoileus virginianus* Zimm.) as a seed dispersal agent for honeysuckle shrubs (*Lonicera* L.)

**Source:** NATURAL AREAS JOURNAL, 22 (3): 230-234 JUL 2002

**Abstract:** Predicting and managing the spread of invasive plant species require a sound and detailed knowledge of dispersal mechanisms. I examined white-tailed deer (*Odocoileus virginianus* Zimm.) feces in five mature forest stands in central New York, USA, and found seeds of alien invasive bush honeysuckles (*Lonicera tatarica* L., *L. morrowii* A. Gray, *L. x bella* Zabel) in feces from all five stands. *Lonicera* seeds were found in 66 of 72 pellet groups examined, and the overall mean number of seeds per pellet group was 62 +/- 19 SE; within-stand means ranged from 0.6 +/- 0.3 SE to 334 +/- 165 SE. Percent germination of seeds collected in feces from one site was 70%, compared to 81% for fresh-collected seeds, and *Lonicera* seedlings were observed growing out of feces in the field. Prior to this study, the only important dispersers recognized for invasive *Lonicera* spp. have been birds. Using data from the literature on the feeding, digestive, and movement behaviors of deer vs. birds, I show that white-tailed deer have tremendous potential for contributing to the spread of invasive honeysuckles and perhaps other plant species.

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#### **Record 43 of 66**

**Author(s):** Brathen, KA; Oksanen, J

**Title:** Reindeer reduce biomass of preferred plant species

**Source:** JOURNAL OF VEGETATION SCIENCE, 12 (4): 473-480 AUG 2001

**Abstract:** Reduced weights in reindeer that graze in pastures with high reindeer densities have raised the question if coastal summer pastures are modified by grazing. To evaluate this, the impact of reindeer grazing on standing crop was measured by the plant intercept method inside and outside grazing exclosures in the understorey of a coastal mountain birch forest in northern Norway. The understoreys of coastal birch forests are dominated by vascular plants and are important summer pastures to reindeer. Based on the literature, we made a priori categorization of the vascular plant species into functional groups of preferred forage, less preferred forage and forage of unknown value to reindeer.

Intercept frequency was measured within the same plots on three occasions in the summer of 1996. At the end of the grazing season, total standing crop was 33% lower in open plots compared to plots protected by exclosures. However, the reduction varied between the functional groups, with only preferred forage plants being significantly reduced in standing crop (by 49%).

Results suggest that reindeer have a strong annual impact on most of the preferred forage species. However, some of the preferred graminoids are tolerant of grazing and dominate the

understorey despite decades of high grazing pressure. We suggest that current grazing pressure is favouring the establishment of a few grazing tolerant graminoids, and that this reduces the forage plant variability. The results are discussed in relation to the grazing optimization hypothesis and the potential importance of plant variability for pasture quality.

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#### **Record 44 of 66**

**Author(s):** Gebert, C; Verheyden-Tixier, H

**Title:** Variations of diet composition of Red Deer (*Cervus elaphus* L.) in Europe

**Source:** MAMMAL REVIEW, 31 (3): 189-201 SEP 2001

**Abstract:** To define the food resources of Red Deer (*Cervus elaphus* L.) in Europe and to detect the principal sources of variations in their diet, we reviewed field studies based on stomach content analysis. The study areas were classified into three main habitat groups (mixed-coniferous forest, mixed-deciduous forest, moorland), the food items into 13 plant categories, and we used five seasonal classes (winter, spring, summer, autumn, hunting season) for analysing the data set. For statistical analyses we used correspondence analysis and analysis of variance.

Red Deer eat a varied diet comprising at least 145 plant species. The main sources of diet variation were due to habitat, leading us to identify three habitat types characterized by the consumption of a few key species. Clear seasonal variation was observed only for the seed and fruit items which were used mainly during the hunting season.

Our results confirm that Red Deer can be classified among the intermediate feeders, with a mixed diet of grass & sedges (29%) and concentrate food items (63%). However, they also show Red Deer to be primarily a concentrate feeder (max. 75%) with no significant seasonal variation between the quantities of grass or sedges and concentrate food in the diet.

In the light of these results, we discuss potential competition with other sympatric ungulates (wild and domestic). We suggest that it may be useful to take into account key food resources in modelling population dynamics and in taking management decisions.

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#### **Record 45 of 66**

**Author(s):** Pakeman, RJ

**Title:** Plant migration rates and seed dispersal mechanisms

**Source:** JOURNAL OF BIOGEOGRAPHY, 28 (6): 795-800 JUN 2001

**Abstract:** Aim Holocene plant migration rates appear to greatly exceed measured dispersal distances. This is a feature of species with all dispersal mechanisms and in all communities. The role of dispersal by large mammalian herbivores is explored as a mechanism that accounts for the observed dispersal rates.

**Methods** A simple model was constructed that took into account herbivore dispersal and how migration rates might vary with herbivore territory size, gut survival and probability of consumption.

**Results** Even at relatively low probabilities of consumption and gut survival, dispersal by animals within large territories could account for observed rates of dispersal in the palaeorecord. Animals with small territory sizes could not produce large enough rates of dispersal.

**Main conclusions** As many modern day grassland plants appear to survive gut passage, endozoochory by large mammalian herbivores could be the main mechanism for long-distance dispersal of herbaceous species.

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**Record 46 of 66****Author(s):** Gill, RMA; Beardall, V**Title:** The impact of deer on woodlands: the effects of browsing and seed dispersal on vegetation structure and composition**Source:** FORESTRY, 74 (3): 209-218 2001**Conference Title:** Meeting of the Forest Ecology Group of the British-Ecological-Society**Conference Date:** APR, 2000**Conference Location:** NORWICH, ENGLAND**Conference Host:** UNIV E ANGLIA

**Abstract:** The effect of deer on woodland vegetation is reviewed, focusing on processes that are likely to bring about changes in structure and composition. By browsing on tree seedlings, shrubs and climbers, deer tend to reduce stem densities, limit height growth and reduce foliage density, creating a more open understorey. Light penetration to the ground can be increased, providing more plant cover close to the ground surface. Using results from 13 studies in temperate woodlands, the effects of deer browsing on the species richness and diversity of trees were analysed using general linear models. The results show that deer tend to reduce the diversity of seedlings, and that the effect is greater at higher deer densities. Differences in susceptibility of tree species were evident, with some species being depleted by deer at all sites, whereas others declined in some sites but increased in others. The effects of deer on the amount and composition of regeneration appear to depend on site characteristics, including the light regime and composition of the ground vegetation. Although few studies of seed dispersal by ungulates (endozoochory) have been made in Britain, deer have been shown to be effective seed dispersers of a number of plant species. Plants with small hard seeds are most likely to survive digestion. Most of the species known to be dispersed in this way include grasses and small herbs. In view of the fact that dispersal mechanisms of many woodland species are not well understood, endozoochory may be more important than is generally realized.

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**Record 47 of 66****Author(s):** Malo, JE; Jimenez, B; Suarez, F**Title:** Herbivore dunging and endozoochorous seed deposition in a Mediterranean dehesa**Source:** JOURNAL OF RANGE MANAGEMENT, 53 (3): 322-328 MAY 2000

**Abstract:** Spatial patterns of herbivore defecation within grazing systems are important as they directly affect pasture growth and composition. These effects are partially linked to seed dispersal in dung, a little studied process. This paper focuses on: (i) quantification of dung and seeds deposited by herbivores in a Mediterranean grazing system, and (ii) analysis of the spatial variability of dung and seeds deposited within and among plant communities. We carried out year-long monthly quantifications of the depositions of rabbit (*Oryctolagus cuniculus*), fallow deer (*Dama dama*), red deer (*Cervus elaphus*), and cow (*Bos taurus*) dung to 32 plots distributed in *Quercus rotundifolia* Lam. and *Fraxinus angustifolia* Vahl woodlands, mixed scrub, and *Cistus ladanifer* L. scrub. We also quantified the germinable seed content of dung. The results revealed differences ( $p < 0.05$ ) in dung deposition, varying (i) among the 4 species, (ii) within species (except for the red deer) among plant communities, and (iii) within plant communities. An average of 735 seeds/m<sup>2</sup> were returned to the soil via dung, with the highest numbers in open woodlands (870-1,888 seeds/m<sup>2</sup>) and the lowest numbers in scrubs (83-315 seeds/m<sup>2</sup>). Cows dispersed the most seeds (68%), followed by red deer (20%), rabbits (7%), and fallow deer (5%). Spatial variability in deposition led to

accumulations of up to several thousand seeds at points covered by the dung. The effect of seed input to the seed bank and on vegetation may be low at large and medium-sized spatial scales, but it can be very important at small scales and for colonization processes.

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#### **Record 48 of 66**

**Author(s):** Li, XJ; Baskin, JM; Baskin, CC

**Title:** Contrasting dispersal phenologies in two fleshy-fruited congeneric shrubs, *Rhus aromatica* Ait. and *Rhus glabra* L. (Anacardiaceae)

**Source:** CANADIAN JOURNAL OF BOTANY-REVUE CANADIENNE DE BOTANIQUE, 77 (7): 976-988 JUL 1999

**Abstract:** The avifrugivore availability hypothesis predicts that summer-fruiting species will have an extended fruiting season and slow fruit removal, and the foliar flag hypothesis predicts that fruit dispersal in autumn-fruiting species coincides with fall bird migration. Phenology of fruit removal from plants of the early summer-fruiting shrub *Rhus aromatica* Ait. (var. *aromatica*) and of the later summer-fruiting shrub *Rhus glabra* L. (Anacardiaceae) was studied primarily to test the avifrugivore availability and foliar flag hypotheses of fruit dispersal, respectively. Fruits of *R. aromatica* ripened synchronously in early June, and 77-89% of them were gone from the plants by the early July, thus failing to support the avifrugivore availability hypothesis. The pattern of rapid fruit removal in this species, which was consistent throughout a 3-year period, is in contrast with previous reports of dispersal until September and even the next summer. Display size (at both infructescence and clump levels) had no effect on removal rate in *R. aromatica*. Fruits of *R. glabra* matured in August, and about 20% of them remained undispersed the following spring. In both species, fruit removal was mostly due to dispersers rather than to natural fruit fall. No correlations were found between fruit characteristics (pulp weight, pulp-to-seed ratio, moisture content of pulp) and probability of removal during the dispersal season in either species. Browsing by mammals, most likely white-tailed deer, was responsible for the rapid removal of fruits from *R. aromatica* plants during the 1st week after they turned mature-red; thereafter, most fruit removal was by birds. Two removal peaks were found for *R. glabra* fruits: a small one in September and a large one in winter to early spring. These peaks correspond to the fall migration season for migratory birds and the scarcity of food for winter-resident birds, in the study area, respectively. Thus, the dispersal pattern of *R. glabra* fruits does not support the foliar flag hypothesis.

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#### **Record 49 of 66**

**Author(s):** Hanley, TA; Barnard, JC

**Title:** Food resources and diet composition in riparian and upland habitats for Sitka Mice, *Peromyscus keeni sitkensis*

**Source:** CANADIAN FIELD-NATURALIST, 113 (3): 401-407 JUL-SEP 1999

**Abstract:** Food resources and diet composition of Sitka Mice, *Peromyscus keeni sitkensis*, were studied over a four-year period in four floodplain and upland forest habitats: old-growth Sitka Spruce (*Picea sitchensis*) floodplain; Red Alder (*Alnus rubra*) floodplain; Beaver (*Castor canadensis*)-pond floodplain; and nearby old-growth Sitka Spruce-Western Hemlock (*Tsuga heterophylla*) upland forest. Food resources in each habitat were quantified in terms of understory biomass and species richness, fruit production, tree seedfall, and relative abundance of arthropods. Diet composition was analyzed from stomach contents. Between-year differences in the availability of food resources were substantial, but between-habitat differences were minor. Diet composition differed between years and between months within

years but did not differ between habitat types or age and sex classes of mice. We conclude that floodplain habitats do not provide unique food resources for Sitka Mice in comparison to upland old-growth forests. However, spatial and temporal complexity within habitats is an important feature of habitat quality in floodplain forests for *Peromyscus* mice.

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#### **Record 50 of 66**

**Author(s):** Forget, PM; Kitajima, K; Foster, RB

**Title:** Pre- and post-dispersal seed predation in *Tachigali versicolor* (Caesalpiniaceae): effects of timing of fruiting and variation among trees

**Source:** JOURNAL OF TROPICAL ECOLOGY, 15: 61-81 Part 1 JAN 1999

**Abstract:** Fruiting phenology, habitat types and proximity to conspecific fruiting adults may influence the degree of escape from pre- and post-dispersal seed predators. Successful predator escape by means of satiation is considered to be especially important for selection of masting and monocarpic reproduction in trees, such as exhibited by *Tachigali versicolor*, a tropical canopy tree. How pre- and post-dispersal predation rates varied with dispersal timing and among trees in *T. versicolor* was examined in young and old forests on Barro Colorado Island in Panama during a 4-mo period. Seeds were collected from above-ground traps to assess predispersal predation by bruchid beetles, and from quadrats on the ground to record predation and removal by terrestrial mammals. Proportion of seeds aborted varied greatly among trees (range 6-30 %, mean 16 %), and was especially high for trees on the edge of the island with fruiting conspecifics nearby during the early part of fruiting season. The proportion of seeds killed by bruchid beetles varied less among trees (14-25 %, mean 20 %), and remained constant throughout the fruiting season. Seeds on the ground were attacked mostly by rodents, and possibly by deer (26 % of all seeds and 43 % of intact dispersed seeds). The postdispersal predation level was higher in the young forest than in the old forest (61 and 26 % of intact dispersed seeds, respectively), and was unaffected by the proximity of fruiting conspecifics. Temporal satiation of seed predators was evident only for post-dispersal mammalian predators in the old forest.

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#### **Record 51 of 66**

**Author(s):** Stromayer, KAK; Warren, RJ; Johnson, AS; Hale, PE; Rogers, CL; Tucker, CL

**Title:** Chinese privet and the feeding ecology of white-tailed deer: The role of an exotic plant

**Source:** JOURNAL OF WILDLIFE MANAGEMENT, 62 (4): 1321-1329 OCT 1998

**Abstract:** Exotic plants and overabundant wildlife are apparent indicators of disturbed habitats, yet few studies have investigated their interactions. Chinese privet (*Ligustrum sinense*) is an abundant, exotic shrub in the southeastern United States, yet little is known about its forage value to white-tailed deer (*Odocoileus virginianus*). We quantified the seasonal importance of privet browse and fruit in the food habits of deer at Chickamauga Battlefield Park (CBP) in Georgia, and we determined seasonal cycles in crude protein (CP) content from privet browse. Analyses of rumen samples from 146 deer collected during 32 consecutive months (1992-94) revealed total privet (browse and fruit) averaged 11.1% of rumen volume during fall and 13.3% during winter. Fall consumption of privet browse increased almost 2 times, and privet fruit consumption >20 times in a fall of low acorn consumption. Winter browse surveys conducted in February for 2 years revealed privet browse composed >50% of available browse and >75% of browse used. Privet browse maintained a CP content >12% in all months. These results suggest privet is an important component of the fall and winter diets of CBP deer and may serve as a nutritional buffer during years of acorn scarcity. The value of privet as a deer forage must be weighed against

the threat it poses to biodiversity conservation.

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### **Record 52 of 66**

**Author(s):** Malo, JE; Suarez, F

**Title:** The dispersal of a dry-fruited shrub by red deer in a Mediterranean ecosystem

**Source:** ECOGRAPHY, 21 (2): 204-211 APR 1998

**Abstract:** Seed dispersal of dry-fruited shrubs has received little attention in Mediterranean areas despite their frequency in the vegetation and the consideration given to the dispersal of fleshy-fruited shrubs in the area. Red deer faeces has recently been found to contain large numbers of seeds from one of the most common shrubs of this group, gum cistus *Cistus ladanifer*, although its importance in the reproduction of the species is unknown. This study examines the role of the red deer as an effective disperser of *C. ladanifer*. For this purpose, we quantify i) the *C. ladanifer* seed content in red deer dung over a year, ii) the seed shadow generated by the red deer with their faeces during the same period, and iii) the ability of the dung-borne seeds to germinate and establish as seedlings under held conditions within five years following excretion. The results reveal an extremely high seed content of the species in red deer dung (up to 80.5 +/- 41.9 germinable seeds g(-1)), which is virtually confined to the summer (July-August), when we estimate that a red deer defecates up to 24 000 seeds of the species per day. Furthermore, red deer mainly deposit gum cistus seeds amongst plant formations lacking the species: over the year, red deer excrete <2600 seeds m(-2) in *C. ladanifer*-dominated scrub and 7400-8800 seeds m(-2) in other plant formations. Under natural conditions, the dung-borne seeds have a more staggered among-pears germination pattern than free seeds in the soil. Though no seedling survived its first summer drought, the survival of seedlings sprouted from dung was significantly longer than that of control seedlings in the first and third years after deposition, and indistinguishable from it the second, fourth and fifth years. This is the first quantification of the importance of red deer to *C. ladanifer* dispersal and establishment, and suggests that endozoochory by mammalian herbivores can be very valuable for dry-fruited shrubs in the Mediterranean region.

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### **Record 53 of 66**

**Author(s):** Vila, M; D'Antonio, CM

**Title:** Fruit choice and seed dispersal of invasive vs. noninvasive *Carpobrotus* (Aizoaceae) in coastal California

**Source:** ECOLOGY, 79 (3): 1053-1060 APR 1998

**Abstract:** Natural hybridization between previously allopatric plant species can produce highly successful lineages. However, the ecological processes controlling the spread of hybrid genotypes have rarely been studied in the field. We compared fruit characteristics, fruit preference, and seed dispersal by native frugivores among the non-indigenous succulent *Carpobrotus edulis*, the putative native congener *C. chilensis*, and the hybrids resulting from introgressive hybridization. In this system, the non-native *C. edulis* and hybrids are known to be very successful invaders of California coastal plant communities. *Carpobrotus edulis* and hybrids produced more fruits per clone than *C. chilensis*, primarily as a consequence of larger clone size. Clone size and energy content of fruits were good predictors of fruit removal. Marked fruits of *C. edulis* and hybrids were removed faster than those of the other morphotypes, and *C. edulis* fruits were preferred over those of *C. chilensis* in a fruit transplant experiment. However, total fruit removal by the end of the growing season was very high for all morphotypes. Seeds from black-tailed jackrabbit (*Lepus californicus*) and mule deer (*Odocoileus hemionus*), the most common frugivores in our sites, contained more seeds from

*C. edulis* and hybrid morphotypes than from *C. chilensis*, and more than would be expected based on relative fruit abundance. Germination of seeds from *C. edulis* and hybrids was enhanced after gut passage, whereas germination of *C. chilensis* decreased after gut passage, compared to seed germination from intact fruits. The results suggest that patterns of fruit preference by native frugivores and seed survival after gut passage facilitate the successful spread of an aggressive introduced species and hybrids in contrast to the less aggressive, apparently native congener.

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#### **Record 54 of 66**

**Author(s):** Mandujano, S; MartinezRomero, LE

**Title:** Fruit fall caused by chachalacas (*Ortalis poliocephala*) on red mombin trees (*Spondias purpurea*): Impact on terrestrial fruit consumers, especially the white-tailed deer (*Odocoileus virginianus*)

**Source:** STUDIES ON NEOTROPICAL FAUNA AND ENVIRONMENT, 32 (1): 1-3 MAR 1997

**Abstract:** In the deciduous forests of the tropical area of the Mexican Pacific coast, the tree *Spondias purpurea* is fruiting at the end of the dry season. The fruits are consumed by terrestrial vertebrates including the white-tailed deer (*Odocoileus virginianus*). If no free water sources are available, the deers' liquid requirements may be met by fruit consumption. By an exclusion experiment we were able to demonstrate that foraging chachalacas (*Ortalis poliocephala*) increase the rate of fruit fall about 5 times.

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#### **Record 55 of 66**

**Author(s):** Mandujano, MD; Golubov, J; Montana, C

**Title:** Dormancy and endozoochorous dispersal of *Opuntia rastrera* seeds in the southern Chihuahuan Desert

**Source:** JOURNAL OF ARID ENVIRONMENTS, 36 (2): 259-266 JUN 1997

**Abstract:** Seed dormancy and endozoochorous dispersal have important effects on population dynamics, i.e. seed bank formation, spatial and temporal bet-hedging, avoidance of crowding and decreased sib-competition. Seeds having primary dormancy do not germinate, even if adequate environmental and dispersal conditions are met, until an after-ripening period is completed. This study examined the effects on germination rates of seed dispersal by vertebrates and primary dormancy (i.e. how germination rates changed in time) in the prickly pear *Opuntia rastrera* from the southern Chihuahuan Desert. Ripe fruits, seeds of coyote, mule deer, woodrat, common pig and pellets of the northern raven were collected in 1992 during the ripe fruit peak (August). A factorial design was used to assess the effect of disperser and seed age on germination rates using these seeds collected in 1992. In 1992, 1993 and 1994 (fresh, 1- and 2-year-old seeds, respectively) germination success after 3 months was determined for 100 seeds of each disperser, plus a control of uneaten seeds. We found differences in germination rates both between dispersers and years. All but one disperser (deer) decreased germination rates with respect to the control. Germination steadily increased with ageing of seeds, implying the presence of primary dormancy (embryo immaturity). Our results show that despite the large disperser coterie associated with *Opuntia rastrera*, seeds have an obligate primary dormancy which seems to result in seed bank formation. Seed germination and seedling establishment will depend on selection pressures caused mainly by environmental variability in deserts (unpredictable rainfall, extreme temperatures, safe-site availability). Nevertheless, endozoochorous dispersal provides some additional advantages (e.g. habitat colonization, genetic variability, avoidance of long-term local extinction) that

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### **Record 56 of 66**

**Author(s):** Tamboia, T; Cipollini, ML; Levey, DJ

**Title:** An evaluation of vertebrate seed dispersal syndromes in four species of black nightshade (*Solanum* sect *Solanum*)

**Source:** OECOLOGIA, 107 (4): 522-532 SEP 1996

**Abstract:** We examined the ecological relevance of bird versus mammal dispersal syndromes in four species of *Solanum*, *S. americanum* Type A, *S. americanum* Type B, *S. ptychanthum*, and *S. sarrachoides*. These plants were selected because their morphological characteristics, such as fruit color, mass, and persistence, resembled those typically associated with classically-defined bird and mammal dispersal syndromes. We monitored persistence of lagged fruits, compared physical and chemical characteristics, performed fruit preference trials with northern bobwhite quail (*Colinus virginianus*), deer mice (*Peromyscus maniculatus*), and American robins (*Turdus migratorius*), and assessed differences in use of olfactory cues by foraging deer mice. We predicted that principal components analysis of physical and chemical characteristics would place fruits of these species along a clear gradient from bird to mammal dispersal syndromes (*S. americanum* Type A, *S. americanum* Type B, *S. ptychanthum*, and *S. sarrachoides*). However, physical and chemical characteristics did not consistently follow the gradient. Also, contrary to expectations, both birds and mammals demonstrated a preference for *S. americanum* Types A and B, both "bird" fruits. Deer mice and bobwhite quail showed much less discrimination among fruit types than did American robins. While the relatively strong odor of the green-fruited *S. sarrachoides* suggested a mammalian attractant, deer mice discovered the relatively odorless *S. americanum* Type A significantly more quickly. We conclude that in *Solanum*, suites of morphological characteristics resembling bird and mammal dispersal syndromes are not good predictors of fruit choice by birds and mammals. We note, however, that this conclusion is based on a sample of three animal species. Alternative explanations for fruit character suites should be considered. For example, the adaptive significance for an association of green coloration of ripe fruit with imperistence (dropping when ripe), as in *S. sarrachoides* and some *S. ptychanthum*, may relate more to photosynthesis and carbon balance in detached fruits than to disperser attraction.

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### **Record 57 of 66**

**Author(s):** Malo, JE; Suarez, F

**Title:** *Cistus ladanifer* recruitment - Not only fire, but also deer

**Source:** ACTA OECOLOGICA-INTERNATIONAL JOURNAL OF ECOLOGY, 17 (1): 55-60 1996

**Abstract:** The reproductive ecology of gum cistus (*Cistus ladanifer*) is usually linked to fire, although its seed dispersal by deer can play an important role in the colonizing ability of the species, and may be related to its seed dormancy. The seed content of deer pellets is analysed in seasonal terms, along with the germination of seeds produced by the plant and those dispersed in excrement. Deer disperse over 250,000 seeds per individual between February and August, mostly in summer (around 8,000 seeds individual<sup>-1</sup> day<sup>-1</sup>), in which there is a larger proportion of rapidly germinable seeds than in those gathered from the plant (46% vs. 30%). These results complement the traditional view of the species reproduction, especially with respect to patterns before the frequency of fires increased due to human activity.

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**Record 58 of 66****Author(s):** Asada, M; Ochiai, K**Title:** Food habits of sika deer on the Boso Peninsula, central Japan**Source:** ECOLOGICAL RESEARCH, 11 (1): 89-95 APR 1996

**Abstract:** The rumen contents of sika deer (*Cervus nippon* Temminck) on the Bose Peninsula, central Japan, were analyzed to identify local, sexual and age-specific differences in food habits. Graminoids and woody plants were the primary foods throughout the year. In winter, the use of evergreen broad leaves increased. The food habits of sika deer on Bose Peninsula were intermediate between those of populations inhabiting northern and southern Japan. Acorns, mainly *Lithocarpus edulis* Nakai, were consumed in fall and winter with a peak in October. Since the availability of acorns is not influenced by foraging in previous years, it can be regarded as a stable food supply and hence may be important for deer on the Bose Peninsula. The local difference between the Amatsukominato (AT) area, having a large plantation of *Lithocarpus* producing acorns, and the Kamogawa-Katsuura (KK) area, having a small plantation of *Lithocarpus*, was recognized; seeds and fruit were consumed more in AT than in KK in fall and winter. Males consumed more seeds and fruit than females at both sites in fall. This can be attributed to sexual differences in nutritional requirement.

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**Record 59 of 66****Author(s):** Kiviniemi, K**Title:** A study of adhesive seed dispersal of three species under natural conditions**Source:** ACTA BOTANICA NEERLANDICA, 45 (1): 73-83 MAR 1996

**Abstract:** Seeds of three plant species, *Agrinzonia eupatoria* L., *Geum rivale* L. and *Triglochin palustre* L., were tested for their ability to remain attached in fur of fallow deer and domestic cattle under natural conditions in the field. The plant species are relatively common in managed semi-natural pastures and all three species possess seed structures which enhance adhesive dispersal. The results indicate that seed morphology and the position of seeds on an animal's body influence the length of time that seeds are attached in fur. The relative adhesive seed dispersal ability of the plants (*A. eupatoria* > *G. rivale* > *T. palustre*) did not differ between the two investigated animal species. However, taking grooming behaviour into account, animal species may differ in dispersal efficiency. Seed morphological structures that increase the inherent capacity of adhesive dispersal may also be irritating to animals and initiate grooming. Potential dispersal distances were obtained for seeds on cattle, suggesting that adhesive seeds may disperse from tens of metres to a kilometre. The implications of the results of this study for plant dispersal in a fragmented landscape are discussed.

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**Record 60 of 66****Author(s):** MALO, JE; SUAREZ, F**Title:** HERBIVOROUS MAMMALS AS SEED DISPERSERS IN A MEDITERRANEAN DEHESA**Source:** OECOLOGIA, 104 (2): 246-255 OCT 1995

**Abstract:** Endozoochorous seed dispersal by herbivorous mammals has been verified repeatedly and its possible influence on the structure and function of herbaceous communities has been suggested. Quantitative studies, however, are lacking in the field of seed dispersal via the dung of herbivore guilds in little-altered environments. The present paper analyses seed dispersal via rabbit, fallow deer, red deer and cow dung in a Mediterranean dehesa (open woodland used for hunting and ranching) during the seeding season. Dung seed content was

determined by the glasshouse cultivation of eight dung samples from each herbivore, collected fortnightly between February and August. The four herbivores disperse many seeds (spring averages are 6-15 seeds per gram of dry dung and maxima of 25-70) from a large number of species (totals between 52 and 78). Dispersal seems to be mainly determined by seed production of the plant community. This is reflected in (i) the dissemination of a high percentage of the species present in the dehesa, (ii) great seasonal variability, related to seed production, in the amount of seeds and number of species dispersed, and (iii) a high semi-quantitative similarity of seed content in the four types of herbivore dung throughout the year. There is also important quantitative variation that depends on animal traits and feeding habits. These results and the characteristics of species found in dung suggest the adaptation of plant species to the dispersal of their seeds via herbivore gut. This process may well have profound implications for vegetation dynamics and the evolution of plant traits.

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#### **Record 61 of 66**

**Author(s):** MANDUJANO, S; GALLINA, S; BULLOCK, SH

**Title:** FRUGIVORY AND DISPERSAL OF SPONDIAS-PURPUREA (ANACARDIACEAE) IN A TROPICAL DECIDUOUS FOREST IN MEXICO

**Source:** REVISTA DE BIOLOGIA TROPICAL, 42 (1-2): 107-114 APR-AUG 1994

**Abstract:** Fruits of the tree *Spondias purpurea* L. are an attractive resource for large animals of the tropical deciduous forest in Jalisco, Mexico. Eight species of the mammals, two birds, one reptile and one ant consume the fruits; only two of these species are normally frugivorous. The fruits are moist and mature between May and June when heat stress and water scarcity are greatest. The density of adults was estimated at 7.5 +/- 2.4 (SD) trees/ha; about 50% were reproductive females. Only 38% of these bore more than 500 fruits. The mean mass of the fresh fruit was 7.5 +/- 1.9 g. Fruit production was estimated at 14.9 +/- 4.8 kg/ha. Seed packaging varied within and between trees; trees differed in number of carpels per flower and fruit weight but had a similar number of seeds per endocarp (1.2 +/- 0.4). The animals differ qualitatively and quantitatively as seed dispersers. *Odocoileus virginianus* (white-tailed deer) takes the largest quantity, and the groups of endocarps regurgitated found far than the mother tree had a modal size between 15 and 62 fruits. *Ortalis poliocephala* (chachalaca) and *Ctenosaura pectinata* (iguana) leave the large, multi-seeded endocarps more distant from each other. Germination is greater from endocarps dispersed by deer (72%) than by iguana (35%). Undispersed endocarps showed an intermediate success (63%).

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#### **Record 62 of 66**

**Author(s):** WALLANDER, RT; OLSON, BE; LACEY, JR

**Title:** SPOTTED KNAPWEED SEED VIABILITY AFTER PASSING THROUGH SHEEP AND MULE DEER

**Source:** JOURNAL OF RANGE MANAGEMENT, 48 (2): 145-149 MAR 1995

**Abstract:** Spotted knapweed (*Centaurea maculosa* Lam.), an introduced perennial plant, has invaded large areas of rangeland in the northwestern United States. Grazing animals may disseminate the weed by transporting seeds in their digestive system and depositing them in their feces. In this study percent viability and emergence of spotted knapweed seeds that passed through mule deer (*Odocoileus hemionus hemionus*) and sheep (*Ovis aries*) were determined. Percent viability included seeds that germinated and seeds that tested positive with tetrazolium. In the first trial, we pulse dosed 3 mule deer and 4 ewes with 5,000 spotted knapweed seeds each. Seed recovered from manure collected daily for 10 days after dosing was tested for percent viability. We recovered 11% of the knapweed seeds from the 3 mule

deer, and 4% from the sheep. Based on high variability in (0 to 26%) percent viability of recovered seed, we thought that our drying the manure at 50 degrees C may have killed some of the spotted knapweed embryos. To determine if drying at 50 degrees C affected viability, we pulse dosed 4 rams with 5,000 spotted knapweed seeds each in a second trial. One subsample of manure was washed the same day to recover seeds and then dried at 35 degrees C, a second subsample was dried at 50 degrees C, washed, and then dried at 35 degrees C. We recovered 17% of the spotted knapweed seeds from the 4 rams. No viable seeds were recovered from manure heated at 50 degrees C, and no viable seeds were recovered more than 2 days after dosing. Percent viability of seeds recovered from manure dried at 35 degrees C ranged from 0 to 22%. In both trials, percent viability of recovered seeds was lower compared with seeds that did not pass through animals. Sheep and mule deer can ingest, transport, and disseminate viable seeds of spotted knapweed in their feces.

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### **Record 63 of 66**

**Author(s):** HEROLDOVA, M

**Title:** THE FOOD OF RED DEER (CERVUS-ELAPHUS) IN A PART OF THE KRUSNE HORY MOUNTAINS AFFECTED BY EMISSION

**Source:** FOLIA ZOOLOGICA, 42 (4): 381-382 1993

**Abstract:** The diet consumed by 13 red deer (*Cervus elaphus*) was evaluated quantitatively and qualitatively by means of rumen content analyses. A total of 53 components were identified in the food, the most important food source in all animals was grasses (79.9% of volume); their importance index was also high (47.3). Vegetative parts of dicotyledonous forbs represented the other most frequently utilized food resources (5.4%v) whose importance index was 11.8. Seeds and fruit were consumed only in small amounts (1.1%v) but by most of the animals. That is why the importance index was so high (12.0). Sprouts of broad-leaved and coniferous trees formed 6.5% of volume, and their importance index was 14.35. The other food components were less important.

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### **Record 64 of 66**

**Author(s):** ENGLUND, R

**Title:** FRUIT REMOVAL IN VIBURNUM OPULUS - COPIOUS SEED PREDATION AND SPORADIC MASSIVE SEED DISPERSAL IN A TEMPERATE SHRUB

**Source:** OIKOS, 67 (3): 503-510 SEP 1993

**Abstract:** The fruit removal in *Viburnum opulus* (Caprifoliaceae), an animal-dispersed shrub with fleshy fruits, was studied during two fruiting seasons in central Sweden. The fruit crops were ripe in September, but mainly removed during November-December. Large infructescences were located in the upper part of shrubs and received the slowest removal rate. The removal agents were a diverse assemblage of seed predators and dispersers. At two field study-sites the most important removal agents were seed predators: bullfinches (*Pyrrhula pyrrhula*) (73% removal) and rodents, mainly bank voles (*Clethrionomys glareolus*) (26% removal). Fallow deer (*Dama dama*) infrequently contributed to fruit removal. Legitimate seed dispersers, waxwing (*Bombycilla garrulus*) and thrush species (*Turdus* spp.), removed only a small fraction of the fruit crop, 0.3%. Thus seed predation (ca 99%) copiously exceeded seed dispersal. The removal agents preferred other fruits to *V. opulus*, e.g. *Sorbus aucuparia*; when other fruit resources had been depleted they switched to *V. opulus*. At a garden-site, however, waxwings in at least four out of seven years removed all the fruits in only a few days. It is concluded that the frequently low dispersal potential of *V. opulus* because of heavy seed predation is compensated by sporadic massive dispersal by waxwings

in certain favourable years. The plant apparently exhibits a costly bet-hedging seed-dispersal strategy.

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**Record 65 of 66**

**Author(s):** BODMER, RE

**Title:** STRATEGIES OF SEED DISPERSAL AND SEED PREDATION IN AMAZONIAN UNGULATES

**Source:** BIOTROPICA, 23 (3): 255-261 SEP 1991

**Abstract:** Amazonian ungulates, which include the red brocket deer, grey brocket deer, collared peccary, white-lipped peccary, and lowland tapir, consume large quantities of fruit and maximize nutritional gain by exploiting both pulp and seed. Amazonian ungulates often disperse seeds over short distances by spitting them out during mastication. The lowland tapir is the only ungulate that frequently disperses intact seeds through the digestive tract. Brocket deer destroy most of the seeds they consume by digesting them with rumen microbes, while peccaries crack seeds using their resistant teeth, strong jaw muscles, and thick skull bones. Defensive strategies of seeds include strength, chemical toxins, mast fruiting, fibrous lignin, and size variation. Brocket deer and peccaries have pregastric fermentation that may detoxify some secondary compounds of seeds. Small seeds occasionally pass intact through brocket deer and peccary guts. However, strong palm seeds that avert many mammalian predators are often destroyed by ungulates. The fibrous lignin that protects seeds of *Jessenia bataua* (Palmae) appears to be effective against ungulates which may explain its abundance in the study area.

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**Record 66 of 66**

**Author(s):** VICKERY, RK; PHILLIPS, DR; WONSAVAGE, PR

**Title:** SEED DISPERSAL IN MIMULUS-GUTTATUS BY WIND AND DEER

**Source:** AMERICAN MIDLAND NATURALIST, 116 (1): 206-208 JUL 1986

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