

soils and glacial lake shores left behind the melting ice. Compounds of this boreal landscape survive in glaciated Ohio today as relic kettle lake bog and fen communities, comprised of highly diversified and fascinating boreal, Atlantic Coastal Plain, and prairie species. (25 min. audio-visual)

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DENNY, GUY L. Division of Natural Areas & Preserves, Ohio Department of Natural Resources, Fountain Square, Columbus, OH 43224. - Ohio's endangered plants: Their origin and ecology.

Presently the ODNR, Division of Natural Areas & Preserves officially lists 177 endangered and 173 threatened plant taxa for the State of Ohio. The majority of these taxa occur in very specific landscape types, many of which are nearly as rare as the species they support. This diversity of rare species and relic landscape types are primarily the result of major geological and climatological events which took place from the close of the Tertiary Period to present. (25 min. audio-visual)

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FLYNN, MIKE. Freelance Photographer and Naturalist, 8117 Manitou Dr., Westerville, OH 43081. - Pickerington Ponds Wetland Wildlife Refuge.

Pickerington Ponds in central Ohio is now preserved through the efforts of the Nature Conservancy and Metro Parks of Columbus and Franklin County. The 360 acres of wetlands and bordering uplands are relics of Wisconsinan glaciation. The wide variety of habitats on the site contribute to a diversity of species. Since 1968, some 257 species of birds have been recorded, either as migrants or as permanent residents and nesters. Thirtyfive species of mammals, approx. 200 species of vascular plants, large numbers of reptiles, amphibians and fish, along with a profusion of aquatic invertebrates inhabit the area. The 25-minute audio-visual presentation set to inspiring music, depicts the life of this natural system. The call of the loon introduces the program beginning with daybreak; sunrise cuts through morning fog, and the daytime activities on the site, ending with dusk and moonlight lighting the night. The resource management program at Pickerington Ponds, since August 1986, will be discussed: insurance of continued diversification of the many successional habitats, control of aggressive non-native plant and animal species, and reintroduction of native species.

ECOLOGICAL SECTION CONTRIBUTED PAPERS

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BAKER, HERBERT G. AND IRENE BAKER. Department of Botany, University of California, Berkeley, CA 94720. - The predictability of pollinator type by the chemistry of nectar.

The prediction of pollinator type from the morphology of flowers and the biochemical constitution of its nectar has been successful in many cases that have been investigated. Particularly this is true of tropical plants. Sucrose rich or dominant nectar is provided by flowers pollinated by hawkmoths and those receiving visits from hummingbirds. By contrast, flowers of the species that are visited (pollinated) by passerine (perching) birds are hexose rich. The correlations are perfect in Erythrina (Fabaceae). In Puya (Bromeliaceae) the gigantic P. raimondii (subgenus Eupuya) flowered after 28 years growing in the U.C. Botanical Garden. From the morphology of the inflorescence coupled with hexose-rich nectar, it is predicted that the main pollinator will be passerine birds. This has yet to be observed in Peru but the closely related P. chilensis has been observed by three zoologists to be pollinated by blackbirds. Puyas in other subgenera with more tubular flowers are hummingbird pollinated and have sucrose-rich nectar.

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BARRIE, FRED R.* AND MARK A. SCHLESSMAN. Department of Botany, The University of Texas at Austin, TX 78712 and Department of Biology, Vassar College, Poughkeepsie, NY 12601. The incidence of protogyny in the North American species of Apioideae (Apiaceae).

Until recently, protogyny was considered rare in the Apioideae. Within the past decade, however, several studies have documented its presence in certain North American species. This study explored the degree to which protogyny occurs in the perennial species of the subfamily Apioideae in North America. Through an examination of field populations and herbarium specimens, and a review of pertinent literature, we determined the within-flower gender sequence for 258 species of 30 genera. Results show that the timing of gender expression is consistent for all species within a genus. The genera represented in both the Old and New World floras are protandrous, but the majority of genera endemic to North America are protogynous. Protogynous species flower earlier in the year, and, for the most part, inhabit drier sites than do protandrous species.

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BENTLEY, BARBARA L.*, NELSON D. JOHNSON, AND LISA RIGBY. Department of Ecology and Evolution, State University of New York at Stony Brook, Stony Brook, NY 11794. - Short-term induction of alkaloids in leaf tissue of *Lupinus* following experimental defoliation.

N₂ fixation and inorganic nitrogen are nearly equivalent as nitrogen sources for *Lupinus* in the absence of defoliation. However, defoliation affects plants relying on N₂-fixation to a much greater extent: defoliated N₂-fixing plants were stunted, and had much lower levels of both tissue nitrogen and alkaloids. Relatively small differences in nitrogen were magnified into large differences in some alkaloids, particularly sparteine.

Alkaloid levels in *Lupinus* foliage increases following artificial defoliation. The amount of induction depends on the levels of alkaloids in the tissue prior to damage. Thus foliage with low levels of alkaloids did not demonstrate induction.

The magnitudes of these changes are sufficient to affect herbivore growth and survival.

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BROYLES, STEVEN B.*, AND ROBERT WYATT. Department of Botany, University of Georgia, Athens, GA 30602. - Adaptive design of the floral display of Poke Milkweed (*Asclepias exaltata* L.)

We investigated the effects of umbel size (5, 10, 15 and 20 flowers), number of flowers per stem (30 vs. 60), and number of umbels per stem (3 vs. 6) on male and female reproductive success in *Asclepias exaltata*. Total numbers of pollinaria removed, fruits initiated, and fruits matured all increased with increased umbel size. Rates of pollinaria removal and fruit initiation per flower also increased with umbel size, but rate of fruit maturation per flower decreased. Stems with 60 flowers experienced a two-fold increase in pollinaria removal, fruit initiation, and fruit maturation. For constant flower number per stem reproductive success was greater for stems with 6, versus 3, umbels. Fruit abortion was more common in umbels that initiated a larger than average number of fruit. Furthermore, fruits maturing in such umbels contained more seeds than did fruits with no abortion. Thus, larger floral displays of *Asclepias exaltata* not only dispersed more pollen, but also initiated more fruits and matured fruits with more seeds.

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BYERS, DIANE L.*, AND JAMES A. QUINN. Department of Biological Sciences, Rutgers University, Piscataway, NJ 08854. - The effect of habitat variation in *Alliaria petiolata* on life history characteristics.

The biennial, *Alliaria petiolata* (Cruciferae), formerly considered a plant of floodplains and moist woods, has become common in a wider range of habitats in New Jersey. Expansion of *A. petiolata* into the drier and more open habitats may affect life history characteristics. To test this hypothesis, four sites were selected to represent the present range of habitats for *A. petiolata* in central New Jersey. Survivorship was not significantly different among populations, and all populations had the highest mortality in the drier months. In the driest and most disturbed site the plants did, however, allocate a greater percentage of their resources (dry weight) to fruits. Seed weight did not differ among populations. At 20/10 C, populations also differed significantly in percentage germination with the floodplain population (most mesic site) exhibiting the highest germination; there were also significant differences in germination among families within populations.

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CHEPLICK, GREGORY P. Department of Biology, Indiana University, Bloomington, IN 47405. - Influence of environment and source population on survivorship and reproduction in reciprocal transplants of annual peanutgrass.

Reciprocal transplants of both seeds and seedlings were utilized to determine whether populations of the annual grass *Amphicarpum purshii* have become locally adapted to specific habitats due to the consistent production of cleistogamous subterranean spikelets from year to year. The hypothesis was that subterranean seeds placed in the same habitat as the parents will produce seedlings of greater vigor and adults of higher reproductive capacity than those from subterranean seeds in a different habitat far removed from the parents. For both seed and seedling transplant experiments involving three sites in the Pine Barrens of New Jersey, USA, the effects of site on the measured characters were generally much more significant than the effects of source population. With one exception, there was no tendency for seedlings or seeds replanted into their home sites to outperform alien seedlings or seeds transplanted into these same sites. The overriding importance of environmental factors (relative to genetic differences between populations) in determining the phenotypic expression of life history characters, and selection occurring during succession at a site may retard the evolution of genetic adaptation to local habitat conditions in this species.

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DEMAURO, MARCELLA M. Department of Biological Sciences, University of Illinois at Chicago, Chicago, IL 60680. - Investigation of Self-Incompatibility in *Hymenoxys acaulis* (Pursh) Parker var. *glabra* (Gray) Parker.

Hymenoxys acaulis var. *glabra* is a herbaceous, polycarpic, perennial composite which is endangered in Illinois and Ohio. A study of the reproduction biology was initiated after a recovery program failed for the last Illinois population. Hand selfed- and outcrossed- pollinations were conducted with four Illinois and 16 Ohio plants. It was found that *H. acaulis* var. *glabra* exhibits sporophytic self-incompatibility. Fourteen mating groups were found among the twenty families tested. Plants crossed within a mating group showed an incompatible response. Only crosses between plants from different mating groups were compatible and produced seed. The Illinois plants belong to a single mating group; this would explain lack of seed production in that population. Hand-pollinated full sib and backcrosses were conducted with F₁ progeny to determine the behavior of incompatibility alleles. Initial results suggest the alleles appear to vary in their dominance and independence among the families tested.

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DIGGLE, PAMELA K. Department of Botany, University of California, Berkeley, CA 94720.

Labile sex expression in the andromonoecious *Solanum hirtum*.

Recent hypotheses for the evolution of andromonoecy have suggested that it provides a mechanism to adjust fruit set to available resources without limiting male reproduction. This hypothesis predicts that sex expression is labile, i.e., during a growing season the sex of new flowers could be continually adjusted in response to the individual's ability to support additional developing fruit. I have examined the effect of fruit set on subsequent floral sex expression in the andromonoecious *Solanum hirtum*. Individual plants flower continuously throughout a growing season. As a result, branches may bear fruit, open flowers, and developing floral buds simultaneously. Manipulation of fruit set of greenhouse grown plants shows that significant numbers of staminate flowers are produced only by individuals already bearing fruit. Unpollinated plants (bearing no fruit) produce few, if any, staminate flowers. Removal of fruit from plants producing staminate flowers indicates that sex expression of developing floral buds is not determined until buds are greater than 7-8mm long (45-50 % of final bud length). I conclude that sex expression of individual floral primordia as well as of individual plants is labile.

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DUDASH, MICHELE R. Department of Biological Sciences, University of Illinois at Chicago, Chicago, IL 60680. - Relative fitness of selfed and outcrossed progeny in a self-compatible, protandrous species, *Sabatia angularis* L.

(Gentianaceae): a comparison in three environments.

The consequences of selfing were examined by hand-pollinating field-collected plants in the greenhouse to produce selfed progeny and outcrossed progeny from parents separated by 5 and 80 meters in the field. The three types of progeny were grown in the greenhouse, a garden plot, and their original field habitat. Multiplicative fitness functions were calculated to compare the total relative fitness of progeny in each environment. The multiplicative fitness function determination was based on seed production per hand-pollination, germination, rosette formation, survivorship, and reproduction by the progeny. The multiplicative fitness function comparison in each of the three environments demonstrated significant inbreeding depression. The field results showed a greater than 50% decrease in relative fitness of the selfed progeny when compared to both outcrossed progeny. The magnitude of the inbreeding depression expressed was the greatest in the field, intermediate in the garden plot, and the least in the greenhouse.

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EVANS, CARLA S.*, ROBIN RELI, Department of Geology, University of Maryland, College Park, MD 20742, and Geophysics Branch, NASA/Goddard Space Flight Center, Greenbelt, MD 20771. - Remotely detected phenological and assemblage variations of forest canopies in heavy metal soils.

Aircraft multispectral digital data were assessed for ability to detect spring and fall phenological offsets of *Quercus* spp. dominated forests associated with natural heavy metal soil enrichment. An unsupervised classification algorithm was applied to four multitemporal data sets collected over the Mineral Sulfide District in Virginia. Six meter resolution data analyzed sixteen square kilometers of deciduous mixed pine forest canopies including ground truth sites used in previous studies. Resulting thematic categories were color coded using relative spectral signatures and color infrared photography to identify species assemblages and/or phenological differences. Interpretation was based upon characteristics exhibited by ground truth sites of background and elevated levels of soil heavy-metals. A separation of forest spectral information into two categories based upon association with soil heavy-metal chemistry was visually assessed. Ninety-seven percent of forested areas rooted in heavy-metal enriched soils was distinguishable in the multispectral data.

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EYSTER-SMITH, NANCY M. Bentley College, Waltham, MA 02254-9001, USA.

Tallgrass prairies and the effects of management practices.

Tallgrass prairies are mostly managed by haying, burning, seasonal grazing, or a combination. Statistical analysis of a number of vegetational parameters with management practices in 77 tallgrass prairies reveals some significant results.

(1) The mean number of species sampled by line-intercept is highest in prairies that are hayed or burned and lowest in those that have light summer grazing (no heavily grazed sites were studied). (2) Total percent cover is highest in burned prairies and lowest in those few prairies with no management and in one that was plowed for a few years 75 years prior. (3) A variety of diversity indices are all significantly different for the various management practices.

(4) Management practices are not significantly correlated with standard Importance Values for all monocots or the four main grasses (little bluestem, big bluestem, Indian grass, switch grass). Consideration of these results should accompany management decisions for prairie preserves and agro-ecosystems.

150

FENSTER, CHARLES B. Department of Biology, The University of Chicago, Chicago, IL. 60637. - Gene flow and population differentiation in *Chamaecrista* (=Cassia) *fasciculata* (Leguminosae).

Gene flow was measured as the product of two forces, gene dispersal and gene establishment, with gene establishment conditional on gene dispersal, in a natural population of the self-compatible annual, *C. fasciculata*. Gene dispersal was measured by quantifying the distance of pollinator movements, determining the amount of pollen carry-over and measuring seed dispersal in the field. Given that a pollen grain or seed has travelled a given distance, gene establishment was measured in terms of the probability of the pollen grain fertilizing an ovule and the fitness of the resultant zygote. In *C. fasciculata* most of gene flow is through pollen dispersal and is limited. The size of the basic breeding unit, the neighborhood, is approximately 40 sq. m, encompassing approximately 100 individuals. Electrophoresis was used to determine the organization of genetic variability. The population is highly genetically subdivided, probably as a result of limited gene flow.

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FERNALD, ANNE S. Department of Environmental, Population, and Organismic Biology, University of Colorado, Boulder, CO 80309.

- Abiotic determinants of plant distribution in two desert marshes.

Many ecologists have noted distinct zonation patterns in wetland vegetation. To determine whether the zonation patterns reflect discrete plant communities, I examined the relationship between abiotic factors (e.g. water depth, canopy, soil moisture) and plant distribution in two cienagas (desert marshes). Aerial photographs of the Canelo Hills Cienaga and the Babacomari Cienaga, Santa Cruz County, Arizona, show four well-differentiated vegetation zones. At each cienaga data were recorded on 16 abiotic factors and on the 30 most abundant plant species from 79 1 m² quadrats. Results from cluster analysis and principle components analysis provide supporting evidence that cienaga vegetation comprises distinct plant communities superimposed upon a complex of abiotic factors.

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FERRARA, LISA S. * and J. A. QUINN. Department of Biological Sciences, Rutgers University, Piscataway, NJ 08854. - Environment and seed size effects on germination and growth in *Polygala paucifolia*, a perennial forest herb.

Polygala paucifolia produces seeds from both cleistogamous (CL) and chasmogamous (CH) flowers. In all populations examined, CH seeds were significantly larger than CL seeds. There was no significant difference in germination percentage between collections of freshly harvested CL and CH seeds. However, mean germination time is consistently 2 days shorter for CH seeds across all seed size categories. For seeds dry-stored for 4 months before placement into 25/15 C (14h light/10h dark) conditions, germination percentage increased with seed size for both CL and CH seeds. With the exception of one population with a very small sample size, CH seeds had a higher germination percentage than CL seeds. Several weeks after transplanting to greenhouse flats, CH seedlings were significantly larger and had produced more leaves than CL seedlings. Both in natural populations and in greenhouse experiments, soil moisture appeared to be the most important factor for establishment and growth of Polygala seedlings.

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FOX, GORDON A., Dept. of Ecology and Evolutionary Biology, University of Arizona, Tucson, AZ. 85721, USA.—Life history variations between and within populations of a desert herb.

Two years' data on large cohorts of marked individuals from two populations of Eriogonum abertianum suggest that between-population life history differences are consistent with an adaptive hypothesis. At Sonoran and Chihuahuan desert sites, individuals germinate with winter rains and begin flowering either in spring or after summer rains. Length and severity of spring/summer droughts and consequent mortality (Sonoran > Chihuahuan), are related to proportion of spring flowerers (Sonoran > Chihuahuan), average size of spring flowerers (Chihuahuan > Sonoran), and occasional perennation by Sonoran plants. The same patterns are repeated in the greenhouse, suggesting a genetic basis. Within populations, age and size at first flowering, and longevity and length of reproductive interval, are phenotypically plastic, as indicated by considerable within-family variance in greenhouse experiments. These variable responses to the environment, and between-population differences in these responses, may be adaptive given the range of environmental conditions in the habitats studied.

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GALEN, CANDACE. Department of Biological Sciences, Bowling Green State University, Bowling Green, OH 43403-0212. - What's in a limiting factor: pollination quality and seed set in an alpine plant, *Polemonium viscosum*.

Traditionally, ecologists have looked for single components of the environment limiting to growth and reproduction. Those interested in flowering plants have dichotomized the regulation of seed set as either "pollination" or "resource" driven. Typically, pollination limitation is tested by a comparison of natural seed set to that sustained when compatible pollination is experimentally supplemented. Earlier work with P. viscosum showed that seed set is strongly "pollination limited". However, supplementing pollination can change several properties of the pollen load simultaneously, including: (1) the amount of compatible pollen delivered; (2) the total amount of conspecific pollen present; and (3) the ratio of conspecific to foreign pollen in mixed loads. To address current theories on the evolution of flower traits we need to know which of these components of pollination influence seed set and, in addition, how variation in flower traits affects their delivery. Censuses of pollen receipt in natural populations of P. viscosum show that flowers receiving heavy conspecific pollen loads accumulate more compatible grains and purer pollen mixtures than those receiving light loads. Furthermore, seed set is significantly greater when flowers receive more compatible grains and less pollen from neighboring species. Thus, pollination limitation may reflect not only inadequate pollinator visitation, but competition from heterospecific neighbors, as well. Flower traits that influence a plant's success in either regard are likely to have fitness consequences in this system.

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GERNES, MARK*, JAMES HENSON and JULIE KOIS. The Land Institute, 2440 East Waterwell Road, Salina, KS 67401. - Relationship of cultural practices with stem density and yield components in *Helianthus maximiliani* Schrad.
 Maximilian sunflower (*Helianthus maximiliani* Schrad.) is a highly rhizomatous perennial sunflower, native to the great plains. At the Land Institute we are assessing this plants yield and growth components with an aim toward using it in an agricultural perennial polyculture. In 1986 we determined the effect of second-year *H. maximiliani* stalk density reduction by splitting first-year plots into thinned and not-thinned sections. Second-year stalks were thinned by hand and by rototilling, over the row, in the spring. Seed yield was not different ($P < 0.05$) among plant densities of 89,000, 133,000, 222,000 and 670,000 plants / ha. There was a significant difference ($P < 0.05$) over these densities for seed heads per stalk and stalk height. Year to year differences were noted only for, number of branches / stalk and stalk height. The high plant density, not-thinned treatment, had approximately three times less seed yield than the thinned control. A plant density-stalk density reduction interaction was noted for all traits. Early season rototilling reduced second-year stalk density and increased second-year yield and growth components.

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GRACE, JAMES B. Department of Botany, Louisiana State University, Baton Rouge, LA 70803. - The effects of plant age on the ability to predict competitive outcome from monoculture growth.

In this paper I evaluate the method of Austin for predicting mixture performance (competitive outcome) from monoculture performance using data from experiments of *Typha* spp. competing along gradients in water depth. The ability to predict relative mixture performance from relative monoculture performance using Austin's method varied depending upon the age of the plants. The correlation between mixture and monoculture results was greatest for 1-year-old adults and declined strongly with increasing age. For *Typha* spp., monoculture growth early in the life of the plant predicted subsequent mixture performance for a substantial period (in this study, up to 1 year later). As plants grew older, their mixture performance became more difficult to predict from monoculture growth.

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HICKS, DAVID J.* AND JEFFREY S. LEHMAN. Department of Biology, Manchester College, North Manchester, IN 46962. - Inflorescence structure and fecundity in *Lepidium virginicum*.
Lepidium virginicum (Cruciferae) is a native annual of the eastern US. Plants were grown in growth chambers and exposed to high stress (low water/nutrient levels) or low stress (high water/nutrient levels) at the time of bolting. Low stress plants produced about 3X as many viable seeds as high stress plants. The proportion of ovules maturing and germination rate of the resulting seeds did not differ between groups. Seed production differed because of structural differences between the groups. Low stress plants produced more lateral branches. With the exception of the terminal inflorescence branch, the low stress plants produced more flowers and fruits per branch. In both groups, branches in different sections of the inflorescence differed significantly in seed and fruit production, but not in other fitness components. This weedy species appears to bet-hedge by plasticity of the inflorescence.

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Holbrook, Noel M.*, Mark W. Denny, and Mimi R.R. Koehl. Department of Botany, University of Florida, Gainesville, FL 32611, Hopkins Marine Station, Pacific Grove, CA 93950, and Department of Zoology, University of California, Berkeley, CA 94720. - Intertidal trees: biomechanical and physiological characteristics of the sea palm, *Postelsia palmaeformis*.

Sea palms (*Postelsia palmaeformis*, Phaeophyta) grow on wave swept, rocky coasts of the north Pacific, often forming dense stands up to 50 cm in height. While rarely submerged for any continuous period of time, this erect kelp is subjected to and knocked over by nearly every incoming wave. Material property testing of the stipes of these palm tree analogues indicate they are flexible (due to a low elastic modulus), have a high breaking energy (due to being highly extensible), but are brittle (i.e. have a low work of fracture). Plants growing within dense aggregations are taller and more closely approach limiting proportions for elastic stability than isolated individuals. Laboratory measurements of photosynthesis and field measurements of ambient PAR levels suggest that access to light may be an important factor in determining the morphology of these plants.

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HORN, CHARLES N. Department of Biology and Chemistry, Newberry College, Newberry, SC 29108. - A life history study of *Heteranthera seubertiana* and its implications on the rarity of *Heteranthera mexicana*.

Heteranthera mexicana S. Wats. is a rare annual aquatic of Texas and northeast Mexico. To better understand the life history traits of this species the closely related *Heteranthera seubertiana* Solms. of northeast Brasil has been greenhouse grown. Seeds germinate best submersed in water which becomes anaerobic and 30°C or higher daily. Flowering is not initiated until several linear leaves have portions floating on the water surface. Emerged plants produce inflorescences that develop over 2-4 days and have 5-12 flowers. Fruits develop and dehiscence within three weeks and have about 50 seeds each. The life history traits that appear critical to life cycle completion of *Heteranthera seubertiana* and are implied to be important in *H. mexicana* are: 1) the light intensity, temperature, and oxygen tension required for germination, 2) the time seedlings are submersed, and 3) the total time water is available for plants to develop and produce seeds.

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INOUE, DAVID W. Depts. of Zoology and of Botany, University of Maryland, College Park, MD 20742, USA, and Rocky Mt. Biological Laboratory, Crested Butte, CO 81224, USA. - The relative contributions of different components of flowering phenology to overall variation in flowering: examples from the Colorado Rocky Mountains.

Data on flowering phenology were collected from 1973-1986 from twenty-three 2x2 m plots. Approximately every other day from early June to late August all flowers in each plot were counted. For 25 herbaceous dicot species I determined both the maximum number of flowers open on any one day during each growing season, and the maximum number of flowering stalks. These data were used to investigate the relative variation in these two quantitative aspects of flowering. In 21 of the 25 cases the coefficient of variation for number of flowers was higher than the c.v. for flower stalks; the mean values were 78.1 (s.d.=28.0) and 64.9 (s.d.=26.8). The mean c.v. for date of first flowering of the same 25 species was only 12.3 (s.d.=4.2). No significant correlation was found between date of flowering and c.v. of either quantitative aspect of flowering.

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KAPUSTKA, LAWRENCE A. Botany Department, Miami University, Oxford, OH 45056. Photosynthesis and acetylene reduction rates of *Nostoc* sp. under desiccation stress conditions.

Nostoc sp. colonies are major contributors of biologically fixed N in grassland ecosystems. Rapid changes in rates of dinitrogen fixation occur under conditions of desiccation. A LiCor 6000 photosynthesis unit has been used to characterize simultaneously the rates of water loss and net photosynthesis (PS) of individual colonies. Companion measurements of acetylene reduction (AR) were used to correlate desiccation with both PS and AR activities. These data are being used to generate equations suitable for use in a model of dinitrogen fixation rates in grasslands.

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KARRON, JEFFREY D. Department of Environmental, Population, and Organismic Biology, University of Colorado, Boulder, CO 80309. - Breeding systems and inbreeding depression in locally endemic and geographically widespread species of Astragalus (Fabaceae).

Evolutionary theory predicts that rare species with few individuals will exhibit lower levels of genetic polymorphism and higher levels of inbreeding than do widespread species with many individuals. To test these predictions, I studied the ecology and genetic structure of 2 restricted and 2 widespread species of Astragalus. Using electrophoresis, I found that restricted species are not genetically impoverished, though they exhibit less genetic polymorphism than do their widespread congeners. Hand pollination studies demonstrated higher self-compatibility in the rare species than in their widespread congeners. Since the restricted species are highly self-compatible and have reduced polymorphism, theory predicts that they would exhibit low levels of inbreeding depression due to reduced genetic load. This was not the case for restricted A. linifolius. Seedlings resulting from self pollinations had a mean dry weight $< 1/2$ seedlings from outcross pollinations. This result challenges the assumption that self-compatibility can only evolve following a substantial reduction in genetic load.

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KEELEY, JON E. AND STERLING C. KEELEY. Department of Biology, Occidental College, Los Angeles, CA 90041, and Department of Biology, Whittier College, Whittier, CA 90608. - Role of fire in the germination of California chaparral and coastal sage scrub.

Germination behavior of 45 trees, shrubs, subshrubs, and lianas from the fire-prone coastal sage scrub and chaparral was investigated. Seeds were sown on filter paper or potting soil, in the light or dark, with or without charred wood, and after heating treatments of 1 hr at 70 C, 5 min at 100 C, 5 min at 120 C, or no heat. Germination medium had a significant effect on >70% of the species. Germination of over half of the species was inhibited in the dark, but two species were light-inhibited. Charred wood enhanced the germination of >25% of the species. In some cases germination could not be induced under any condition except by application of charred wood. In other species, germination occurred readily in the light but charred wood was effective in overcoming dark inhibition. One fourth of the species exhibited heat-stimulated germination. One third of the species had seeds that germinated readily upon wetting, and germination was not further stimulated by any fire-related cue. These different germination syndromes are correlated with different life-history syndromes in which population expansion is timed to widely different disturbance regimes.

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LEE, HYESOON. Department of Biology, Boston University, Boston, MA 02215. - The relationships among reproductive characters in nine genera of the Leguminosae.

The reproductive characters of angiosperms are often considered as having evolved

independently with little relationships among themselves. Analysis of nine genera in the Leguminosae was undertaken to determine the relationships among flowers, fruits, and seeds during evolutionary radiation. Morphological evidence shows clearly that there are significant correlations in size among reproductive characters, such as the size of flowers, fruits, and seeds. For example, species with large flowers tend to have large fruits. Evolution of vegetative characters such as leaf length are also correlated with these reproductive characters. Further analysis shows that evolutionary divergence of reproductive characters has occurred with allometric constraints, yet the evolutionary patterns within each genus is unique.

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MCCARTHY, BRIAN C.* AND JAMES A. QUINN. Department of Biological Sciences, Rutgers University, Piscataway, NJ 08854. - A comparative analysis of wind pollination success and fruit set in two sympatric species of *Carya*.

Shagbark (*Carya ovata*) and mockernut (*C. tomentosa*) hickories are monoecious, wind pollinated temperate trees. A comparative approach was used to assess the importance of various model parameters in the success of pollination. Although no significant differences were observed between species in the number of male or female flowers, mockernut frequently set a greater number of fruits. Pollination interference by leaves is proposed as the mechanism involved. Unlike many other anemophilous temperate tree species, hickory has leafed-out by the time of pollination. Shagbark has a significantly larger (ca. 2X) total leaf surface area at time of pollination than does mockernut. Both species exhibited ca. 70-90% pollen viability during the pollination period. Results from hand pollinations suggest that high self- and cross-compatibility may aid in compensating for leaf interference by increasing the total number of pollen grains available for pollination.

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MCGINLEY, MARK A.. Department of Biology, University of Utah, Salt Lake City, UT 84112. - Intraplant variation in protective tissue per seed in lodgepole pine: adaptive variation or pollen limitation?

Within individual lodgepole pines (*Pinus contorta*), cone mass/seed number per cone shows an exponentially decreasing relationship suggesting that fewer seeded cones should provide better protection from seed predation by tree squirrels (*Tamiasciurus hudsonicus*). Because (1) the cone mass/seed is negatively related to the proportion of ovules in the cone which are filled, (2) the proportion of ovules filled is positively related to the proportion of ovules fertilized, and (3) the proportion of ovules fertilized is positively correlated with cone size, it suggests that few seeded cones may have high cone mass/seed because of pollen limitation. Alternatively, the pattern may have been favored by natural selection and a "threshold" model will be discussed.

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MCKENNA, MARY A. DEPARTMENT OF BOTANY, HOWARD UNIVERSITY, WASHINGTON, D.C. 20059. - Microgametophytic selection in *Dianthus chinensis* L. (Caryophyllaceae) : Effects of pollen donor and seed parent.

A series of crosses were made to investigate the effects of microgametophytic selection on offspring vigor across a range of parental genotypes. Crosses were made between clones of *Dianthus chinensis* under conditions that allowed for relatively intense or limited pollen competition. Individual pollen donors and seed parents demonstrated significant differences in the magnitude of their

response to the pollination treatment. Results of a diallel cross showed highly significant effects of pollination treatment, seed parent, and pollen parent on offspring seedling weight. Mean seedling weight of offspring derived from intense pollen competition was significantly greater than the seedling weight of offspring derived from limited pollen competition. The interaction between seed parent and pollen parent was highly significant, and other interactions were not significant. These results contribute to a further understanding of the relative effects of maternal and paternal influences on microgametophytic selection.

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MCKONE, MARK J. *, AND DAVID G. LLOYD. Department of Biology, Carleton College, Northfield, MN 55057, and Department of Plant and Microbial Sciences, University of Canterbury, Christchurch, New Zealand. - Duration of presentation of pollen and stigmas within heads of *Leptinella minor* (Hook.f.) [=Cotula minor] (Asteraceae).

Leptinella minor is a perennial, clonal herb, endemic to New Zealand. On average, heads are composed of 75.9 ± 18.5 (mean \pm SD) female flowers and 68.4 ± 15.7 male flowers. Individual heads are protogynous. Female flowers of a head present their stigmas over a period of 2.6 ± 0.8 days, whereas the male flowers present pollen over 7.1 ± 1.2 days. If pollinated, the styles of female flowers retract in 2.8 ± 1.0 days. In the field, most (90.3%, N=31) heads retract their styles before any male flowers bloom on that head. As a result, male and female phases within heads are usually completely separate in time. During male phase, heads are 21% wider and stand 24% taller than heads in female phase. Most of the time that the head is available for insect visitation, its function is to export pollen.

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MIHALIAK, CHARLES A. *, AND DAVID E. LINCOLN. Department of Biology, University of South Carolina, Columbia, SC 29208. - Plant biomass allocation in response to nitrate availability and artificial defoliation.

Partitioning of plant resources is proposed to maintain a root/shoot ratio which minimizes growth constraints imposed by both above and below ground resource limitations. To test this hypothesis, seedlings of *Heterotheca subaxillaris* were grown for four months under high and low nitrate availability regimes and subjected to three levels of weekly artificial defoliation (0%, 25%, or 50% of new leaves removed). Both defoliation and nitrate-limitation reduced plant growth rates ($P < 0.001$), and nitrate-limited plants had higher root/shoot ratios than nitrate rich plants ($P < 0.001$). Despite removal of shoot material, root/shoot ratios were equivalent for defoliated and non-defoliated nitrate-rich plants. High defoliation (50%) on nitrate-limited plants significantly reduced the root/shoot ratio ($P < 0.01$). These results suggest that plant biomass is partitioned among roots and shoots to minimize multiple resource limitations. However, severe defoliation may be especially limiting to root growth under nitrogen limitation.

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MUENCHOW, GAYLE E.* AND MARCELLA GREBUS. Dept. of Botany, Ohio University, Athens, OH 45701. - The evolution of dioecy from distyly: evaluation of the loss-of-pollinators hypothesis
Dioecy has several times evolved from distyly. An hypothesis attributes this to loss of low-low pollen transfer followed by

evolutionary loss of the now-unused low parts, so that the thrum morph becomes staminate and the pin morph pistillate. We simulated this, finding that this evolutionary pathway can only be followed if the sterility mutations are very tightly linked to the distyly supergene and if the loss of the low-low pollinators is virtually complete. Review of the literature revealed little evidence that thrums had become staminate and pins pistillate. That flowers have several times become shallow with the evolution of dioecy seems to generalize to non-dystylous ancestors as well. The evolution of dioecy, an outcrossing system, from distyly, also an outcrossing system, does not refute the hypothesis that male-sterility has evolved as a means to avoid inbreeding depression -- our information is too coarse-grained to support that conclusion.

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MULE', LOUIS. Department of Biological Sciences, University of Illinois at Chicago, Chicago, IL 60607. - Some effects of sand burial on the achenes of *Liatris aspera*.

Heavier achenes of *Liatris aspera* (Compositae) may be favored over lighter achenes in habitats where drought stress or soil burial is likely. *Liatris aspera*, a long-lived perennial, demonstrates significant variation in achene mass among prairie, savanna, and dune populations. In 1986, a sand box study, using achenes from these populations, was designed to examine the effects of three burial levels on three factors: germination, growth features, and end-of-season biomass. Achenes buried at the surface germinated less frequently, produced fewer leaves and less biomass than the more deeply buried seeds. After germination, mortality was low. Overall, the heaviest achene mass class produced significantly larger seedlings than the lightest mass class. Savanna seedlings produced markedly lower biomass than other seedlings. Other differences in end-of-season biomass were few. The interaction effects of sand burial with achene mass on these factors were not as clear-cut. These data suggest that, for initial establishment, there may be an optimal achene mass for a given burial depth in a particular habitat.

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PANOS, JULIANA M.*, JOHN A. SILANDER, JR., AND STEPHEN W. PACALA. Department of Ecology and Evolutionary Biology, University of Connecticut, Storrs, CT 06268. - Variation in the architecture and performance of *Trifolium repens* clones.

White clover (*Trifolium repens*) clones show extreme variation in architecture and performance. The purpose of this study was to determine whether consistent correlations could be found between clonal architecture and performance in different environments. Performance was assessed on the basis of biomass and survival. Clone architecture was characterized by the following attributes: internode length, lateral stolon branching, nodal rooting, petiole length, leaflet area and inflorescence production. Comparisons were made of performance and architecture among 35 clones raised in replicated, spaced gardens or closed swards. Correlation analysis of the garden-raised clones revealed that all traits were positively correlated with biomass except nodal rooting. Internode length was most highly correlated with the other traits and with biomass thus providing a good index of plant architecture and predictor of plant growth. This information is essential to the understanding of clone dynamics and therefore the evolution of ramets and genets in natural populations of white clover.

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RICHARDSON, DONALD*, AND G. BRUCE WILLIAMSON. Department of Biology, University of South Florida, Tampa, FL 33620, and Department of Botany, Louisiana State University, Baton Rouge, LA 70803. - Chemical inhibition of Sandhill grasses by species of Sand Pine Scrub.

Allelopathic inhibition of seed germination and radicle growth may be partially responsible for the maintenance of the Sand Pine Scrub community in Florida. Bioassays of leachates from Scrub foliage and litter tested inhibitory activity on four target species: three sandhill grasses (Andropogon gyrans, Schizachyrium scoparium and Leptochloa dubia) and commercial lettuce (Lactuca sativa). For the grasses, inhibition of seed germination was significant by all ten leachates and was seasonally correlated with precipitation; inhibition of radicle growth was evident in only two of the leachates and was seasonally correlated with precipitation. For lettuce, seed germination was inhibited but radicle growth was stimulated by the leachates, and there were no seasonal effects. Runoff from leaf misting of both Ceratiola ericoides and Conradina canescens were applied to seedlings of A. gyrans and produced significant reductions in total dry weight relative to distilled water controls. Field transplant studies showed that dry weight of selected pines and of wiregrass (Aristida stricta) were less when grown in Scrub than when grown in Sandhill, where competition and soil type were controlled. Allelopathic inhibition of grasses by Scrub species may be one mechanism to diminish the probably of fires through reduction of fuel loads.

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SCHLICHTING, CARL D.* , AND BERNIE DEVLIN. Department of Biology, Pennsylvania State University, University Park, PA 16802, and Department of Botany and Plant Sciences, University of California, Riverside, CA 92521. - Male and female reproductive success in the hermaphroditic plant, Phlox drummondii.

Three sets of reciprocal crosses were performed among 12 plants of the hermaphroditic annual Phlox drummondii. Each plant was used as both a pollen donor and as a pollen recipient for estimation of both male and female reproductive success. For each cross, pollen germinability, the number of seeds produced, and the weight of each seed produced were measured. There was significant variation among the performances of the 12 plants as females for all traits measured for each set of crosses. Variation among plants as males was largely confined to the third cross set. The third cross set produced fewer fruits and seeds/fruit, as well as smaller seeds, than the first two cross sets, suggesting that resources had become limiting. Analysis of fruit maturation patterns indicates that females discriminated among males during the third cross set, but not the first two.

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SCHUSTER, WILLIAM S. Department of Environmental, Population, and Organismic Biology, University of Colorado, Boulder, CO 80309 - Reproductive biology of the sand lily, Leucocrinum montanum Nutt.

Leucocrinum montanum is one of the first plants to bloom in spring in the Rocky Mountain region. Early spring storms periodically decimate the flowers, but sequential flower production over several weeks enables successful reproduction. Despite a paucity of pollinators in early spring, the plants are self-incompatible. Over 90% of the floral visitors are native bees that effect pollination while foraging on pollen. Despite a large white corolla tube, no evidence of nectar production has been found, and no visits by Lepidoptera have been recorded. Seed set in unmanipulated flowers was lower than seed set in hand-pollinated flowers, and this was lower than maximum possible seed set, indicating that pollinator visitation and possibly resources limit reproduction. Work in progress is aimed at characterizing the effects of inter-plant distance on seed set, and examining seed dispersal.

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SHERROD, K. C.* , THOMAS G. CIRAVOLO, AND KENNETH W. McLEOD. Savannah River Ecology Laboratory/University of Georgia, Aiken, SC 29801. - Growth of woody seedlings under varying light conditions.

Forest succession indicates that species replacement should be affected by the relative shade tolerances of species. In flooded habitats, the successional sequence must also be controlled by their flood tolerance. Growth of four colonizing woody species, which are all flood tolerant, were examined in

artificial environments of different light intensities. Taxodium distichum, Nyssa aquatica, Salix nigra, and Cephalanthus occidentalis seedlings were germinated and grown under 100%, 50%, 25% and 15% full sun. Height and diameter were measured bi-weekly to determine the growth pattern of these species. Biomass was determined at four times during the growing season. Water tupelo, black willow and button bush grew best in 50% sun, whereas bald cypress tended to grow better in 100% sun. Growth form of button bush, water tupelo and bald cypress seedlings was unchanged. However, black willow seedlings tended to branch more as the light intensity increased. The growth response indicated that successful reestablishment may be promoted by environments with up to 50% shade due to the increased growth. Thus, while these species are generally shade intolerant, the increased exposure to full sunlight does not necessarily promote the greatest growth.

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SHYKOFF, JACQUI AND CANDACE GALEN. Department of Biological Sciences, Bowling Green State University, Bowling Green, OH 43403.- Differential pollination efficiency of sex morphs of *Silene acaulis* L.: is sexual selection maintaining females?

Silene acaulis (Caryophyllaceae) is a gynodioecious arctic and alpine plant with sexually dimorphic populations. Here we report on a field study testing the relationship between morphological gender specialization and the timing of pollen delivery and germination. Our findings provide some novel insights on the maintenance of unisexual individuals in hermaphrodite populations. Stigmas of female flowers acquire more pollen than those of perfect flowers early in anthesis, though this difference decreases with flower age. Two mechanisms favor pollen accumulation in the female morph. First, stigmas of young female flowers have more pollen trapping surface than those of hermaphrodites. Second, bumble bees visiting *S. acaulis* spend more time probing female flowers than perfect ones, and in other systems pollen deposition increases with probing time. Differences in receptivity schedules parallel morphological gender specialization. Pollen germinates more rapidly on stigmas of female flowers than on those of perfect flowers. Variation in pollen delivery and germination between morphs yields pollen tube densities 2-3 fold higher in female flowers than perfect ones. If enhanced gametophytic competition produces offspring of higher quality, then male-sterile individuals, in providing an arena for sexual selection, may have an advantage over hermaphrodites that contributes to their maintenance in natural populations.

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SOBREVILA, CLAUDIA. Dept. of Botany, NMNH, Smithsonian Institution, Washington DC 20560.- Effects of pollen donors on ontogenetic stages of seed formation of *Espeletia schultzii* populations at different altitudes. The influence of pollen donors on seed formation was investigated in three populations of *Espeletia schultzii* (Compositae) that differ in environmental conditions and life history characteristics. Self pollen and pollen from different donors (<15m apart) within each population was used in a diallel design in order to test the genetic base of variation in seed set. Three variables were measured: 1) achene number; 2) proportion of filled achenes, which distinguishes between achenes with seeds and empty achenes; and 3) proportion of aborted seeds, which distinguishes between viable and aborted seeds. Self-pollinations resulted in empty achenes. Achene number did not vary between different pollen donors. A bimodal pattern of filled achenes was found in two populations in two successive years. On the other hand, a unimodal pattern was found in crosses between more distant individuals (>30m); each pattern implies sporophytic self-incompatibility. Seed abortion was highest at the highest elevation, and seems to be correlated with elevation rather than with any genetic effect.

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STEPHENSON, STEPHEN W. Department of Botany and Plant Pathology, Michigan State University, East Lansing, MI 48824-1312 - Experimental analysis of distribution patterns in the herb layer of a mature deciduous forest.

Underdispersion, nonrandom spatial variation in density, is typical of deciduous forest herb strata in eastern North America. A combination removal and seeding experiment was initiated in 1983 to examine the development of patchy dispersion in an herb layer dominated by Aralia nudicaulis in an old growth Quercus rubra woods in southern Lower Michigan. Seeds of the perennial Osmorhiza claytonii and the annual Galium aparine were sown singly and in combination into plots with Aralia and in which above ground Aralia was removed. Survivorship and reproductive vigor of Galium was unrelated to treatment; there was a lag-time of three growing seasons before survivorship and stage development among the initial Osmorhiza cohort demonstrated significant treatment related responses.

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Stratton, Donald A., Department of Ecology and Evolution, State University of New York, Stony Brook, NY 11794. - Germination and establishment of Erigeron annuus: measuring differences among individual genotypes.

Apomictic seed production in E. annuus allows replication and testing of specific genotypes for seed and seedling characters. In laboratory tests six genotypes (derived from a single population) differed significantly in the percent and timing of germination. Moreover, the rank-order success of genotypes varied across temperature treatments. These effects were highly repeatable among the four sibships tested for each genotype. Maternal plant vigor can affect the success of its seed progeny even though they are genetically identical. Seeds from parents grown under high nutrient conditions germinated faster and had a higher percent germination than seeds from nutrient-stressed parents. Increased maternal plant vigor also resulted in faster growth rates of the seed progeny during the first month and masked genetic differences in seedling growth rate. However after two months the maternal effect was no longer important and the nutrient treatments could not be distinguished. Basal stem diameter of the maternal plant was a good predictor of early seedling performance. In the field there were significant differences in percent germination among the six genotypes as well as among sites. The environmental differences were apparent even on a scale of 1-2 meters. Genetic differences in early seedling growth were present but weak, and were masked by much larger environmental effects.

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WAITT, DAMON E.*, AND KEITH CLAY. Department of Botany, Louisiana State University, Baton Rouge, LA 70803, and Department of Biology, Indiana University, Bloomington, IN 47405. - Differential Success of Male and Female Gametes in Carex flaccosperma Dewey. (Cyperaceae).

Variation in the sexual expression of diclinous species can both prevent selfing and influence the reproductive success of individuals. Charnov and Bull (1977) predict that the floral ratio in monoecious plants will be locally altered when staminate and pistillate functions experience different fitness in a common environment. Ramets of Carex flaccosperma were reciprocally transplanted in open and wooded sites to investigate the environmental and genetic determinants of phenotypic plasticity in the gender ratio. Results show the proportion of phenotypic variance in the gender ratio due to genetic variability is significantly greater in plants raised in their native habitat as opposed to genetically identical plants raised in a foreign habitat. We conclude that gender specific selection compensates for the reduced fitness of male flowers in woodland populations.

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WEINER, JACOB. Department of Biology, Swarthmore College, Swarthmore, PA, 19081. - Are plants' reproductive responses to competition part of a "strategy"?

A plant's reproductive behavior in response to competition may be the result of physiological or developmental constraints and may not represent a genetically-based "strategy". Analysis of data on size-dependent changes in reproductive allocation suggests that changes in reproductive allocation due to competition can usually be explained in terms of simple relationships between vegetative and reproductive weight. These relationships may be a reflection of inherent constraints operating on plant growth and reproduction. The reproductive behavior of plants may often be reducible to simple rules of growth rather than complex, flexible reproductive strategies.

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WILLIAMSON, G. BRUCE*, NIKOLAUS H. FISCHER, NESRIN TANRISEVER AND ANA DE LA PEÑA. Department of Botany and Department of Chemistry, Louisiana State University, Baton Rouge, LA 70803. - Ecological chemistry of inhibition of grasses and pines by shrubs of the Sand Pine Scrub community.

Isolation and identification of biologically active compounds of three shrub species (Ceratiola ericoides, Conradina canescens, and Calamintha ashei), suspected of allelopathic inhibition of grasses and pines in communities on upland sandy soils of Florida, revealed several novel and many known allelopathic compounds. Ceratiolin, a water soluble dihydrochalcone, which is leached from fresh leaves and litter, undergoes a photo-induced degradation to produce hydrocinnamic acid; ceratiolin exhibits very modest inhibition of grass germination and radicle growth, whereas hydrocinnamic acid is extremely inhibitory to both germination and radicle growth. The two mints, Conradina and Calamintha, both contain a variety of volatile monoterpenes which show inhibition of germination and radicle growth of grasses individually and in mixtures. Furthermore, the monoterpenes in mixture with ursolic acid, a triterpene found copiously in both mints, produce stronger inhibition than the monoterpenes alone, although ursolic acid does not cause inhibition. Results of mixtures of different concentrations suggest two processes that cause the synergism: first, ursolic acid operates as a surfactant to increase the solubility of the monoterpenes, and second, it operates as a biological detergent to open the cell membranes.

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Young, Helen J., Department of Botany, University of California, Davis, California 95616. - Temporal patterns of sex allocation within individuals of wild radish

Lifetime investments in pollen and ovules were determined for four unrelated individuals of wild radish (Raphanus sativus, Brassicaceae). The plants were grown in a greenhouse until flowering began, when they were moved to a growth chamber. Each individual produced several hundred flowers over a period of two months. Large buds were collected daily and ovule number, pollen number, and pollen size were determined (the latter measurements were made with a particle analysis machine). The plants were significantly different in each of the parameters measured. Each plant produced fewer ovules and smaller pollen through time, however the plants differed in the temporal pattern of pollen number: one produced fewer pollen grains with time, one produced more pollen, and two showed no significant pattern. Overall, a correlation between date and pollen number for all four plants was not significant. Therefore, the observed increase in pollen-ovule ratio with plant age was due to changes in ovule number rather than pollen number. As the flowering season progresses, individuals of wild radish maintain their potential to sire seeds via pollen but show a reduction in their potential to act as maternal parents.

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ZIMMERMAN, JESS K.* AND T. MITCHELL AIDE. Department of Biology, University of Utah, Salt Lake City, UT 84112, and Smithsonian Tropical Research Institute, APO Miami 34002. - Patterns of flower and fruit production in the orchid *Aspasia principissa* Reichb.

Many orchid species appear to be pollinator-limited within a flowering season. In a population of *Aspasia principissa* in central Panama, we found natural levels of fruit set to be 9%, while fruit set for hand-pollinated plants was 66.7%. In contrast to fruit set, 47.5% of pollinaria were removed by bee pollinators. Of 84 flowering plants in the population, only 14 produced fruit. Moreover, only 60% of plants of a reproductive size flowered. Plants producing fruit often showed a large reduction in the size of new shoots in comparison to non-fruiting plants. These results indicate that fruit production is limited to just a few individuals in the population and that both pollinator- and resource-limitation influenced patterns of flower and fruit production.

ECOLOGICAL SECTION POSTERS

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Bock, J.H. E.P.O. Biology Dept., University of Colorado, Box 334, Boulder, CO 80309. - Fire as an evolutionary force in North American grasslands.

Many records exist of prehistoric and historic fires in North American grasslands. Mechanisms which enable both woody and non-woody plants to survive fires are well documented. Less documentation exists for fire responses in grassland vertebrates. At Wind Cave National Park in South Dakota bison sought out fires and fed preferentially on the burned area for the first post-fire growing season. By the second post-fire season, the burned areas were not sought. Part of the explanation for the bison's migratory patterns may have been fire-seeking. The grazing patterns of the bison preadapted certain grasslands for domestic grazers, while areas which lacked bison, such as the grasslands of SE Arizona, may have been more rapidly destroyed by cattle introductions.

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CHIANG, Y.C. AND Y. T. KIANG. Department of Plant Science, University of New Hampshire, Durham, NH 03824. - Reproductive biology of wild soybean (*Glycine soja* Sieb. & Zucc.) populations from different geographic areas.

Twelve wild soybean seed accessions originally collected from populations in Japan and south Korea were examined for morphological and phenological variation and patterns of seed production. Twenty plants per accession were grown in the greenhouse. Eleven morphological traits (such as number of branches, leaf shape and flower size), seven phenological traits (such as number of days between anthesis and seed maturity, life span), and ten traits related to seed production (such as pattern of seed packing, total seed per plant) were examined. Except for angles and length of pubescence, all the other morphological traits studied were significantly different among the 12 accessions, but no clear north-south pattern of variation was observed. All the phenological traits examined were significantly different among the 12 populations. A significant correlation was found between the number of days to the first flower and latitude ($r = -0.955$). The life span and latitude were also significantly correlated ($r = -0.925$). The first principal component, which accounts for 59.6% of the total phenological variation, was significantly correlated with latitude ($r = -0.912$). The proportions of pods with one, two, three and four seeds were significantly different among the 12 populations. The average number of nodules per plant was positively correlated with the percents of 3-seed and 4-seed pods but negatively with that of one-seed and two-seed pods. A positive correlation also existed between flower size and percent of 3-seed and 4-seed pods.