Lingua Botanica

A Journal for FS Botanists & Plant Ecologists

I love Autumn. It's easily my favorite season. I love autumn for the same reasons that I love prickly and formidable plants. On my office wall hangs a little frame with a collection of thorns, prickles, and jabby plant parts from exotic places around the world, many of which were gifts from "understanding" friends. When I visit botanical gardens and arboreta I always seek out the well-armed plants to caress. There is something undeniable about pointy phyto-appendages, something dangerous, something forbidden, something experiential about them. And sometimes sensation demands more than a little drop of blood. If you ever visit the gulf coastal plain of Texas or Louisiana, please seek out *Cnidoscolus texanus*, also known as bull nettle. It's a gorgeous, leafy euphorb with uncharacteristically large flowers and stinging hairs that burn so hot that the average *Urtica dioica* seems like *Verbascum thapsis* by comparison. Kind of like getting a habenero when you were expecting a pepperoncini. Kind of like forgetting your jacket on the first frosty morning of fall. It's good to feel absolutely, positively alive. The sweltering field and garden labors of summer can dull one's senses; just as they can become dulled by too many office days and not enough time in the woods. The first frost of the year is absolutely invigorating. Am I a hedonist? Perhaps. Demented? Yes, but not because of this. Neurotransmitter depleted? Sometimes. The truth is, a little discomfort can enliven a day rich in tedium. Read any captivating EISs lately? How was your last ID team meeting, or two-hour conference call? Looking forward to that three hour meeting with a pack of OGC lawyers! So, what I'm trying to tell you is, if you can't go outside and play in the leaf-dropping, ear-burning cold as often as you'd like this autumn, start carrying a *Robinia* thorn around in your pocket. It'll change your life, for the better.   the editor.

Concession to reality: After the events of 11 September, I considered not running the above editorial, which I wrote over the Labor Day weekend. I decided to go with it, and I hope that nobody is uncomfortable with it. It's good to feel absolutely, positively alive. Also, messages of condolences from botanists around the world have been posted on all of the international botany list-serves. Thanks go out to all our international colleagues for their warm and gracious thoughts during this time of national mourning.

In this Issue

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The Fall Foliage Hotline: 1.800.354.4595

Useful URLs

Monitoring Resources on the Web: Visit the Southern Region Natural Resources webpage, and click on the link "Monitoring and Inventory Resources" to view an extensive, annotated page of links to a treasure-trove of useful information, tools, and guides for all your inventory and monitoring needs.
http://www.southernregion.fs.fed.us/resources/default.htm

How much paper can be made from a tree? Check out the link below to see…
http://www.conservatree.com/learn/Enviro_Issues/TreeStats.shtml

Medical Botany of the Confederate States (1863): The actual title of this fascinating book by Francis Peyer Porcher is, as was typical of the time, much longer. It contains extensive information about native and introduced species, agricultural economics, and medical lore. The number of species addressed is very large.
http://docsouth.unc.edu/imls/porcher/porcher.html

Biological Soil Crusts – Ecology and Management: BLM Technical Manual 1730-2 2001 presents the state of the art in crypto-crust knowledge. Download it here!.
http://www.id.blm.gov/publications/data/Crust%20Manual.pdf

Iowa Farmer's Corn Cam: If you haven't been there lately, go back and see the corn before its turned into silage!
http://www.iowafarmer.com/corncam/corn.html

Hot Peppers Pack an Evolutionary Punch

Environmental News Service, 9 August 2001

GAINESVILLE, Florida - The zing in a chili pepper helps the plant spread its seeds more efficiently, a new study reveals.

Working with the ancestor of most varieties of chili pepper plants, a University of Florida researcher has shown that the plant relies on its spiciness to ensure the survival of its species.

In an article in the July 26 issue of the journal "Nature," Josh Tewksbury, a UF postdoctoral researcher in zoology, and coauthor Gary Nabhan, an ethnobotanist at Northern Arizona University, conclude that mammals, sensitive to the chemical that makes peppers taste hot, avoid the *Capsicum annuum* pepper.

Birds, however, are unaffected by the chemical, known as capsaicin, and eat the peppers. This is essential for the plant, since birds release the seeds in their droppings ready to germinate. If mammals ate the seeds, they would crunch them up or render them infertile, the researchers report.

"The upshot is that it's very beneficial for the pepper to have mammals avoid its fruit and have birds attracted to them," Tewksbury said.

Plants that produce poisonous or undesirable fruits - the edible reproductive body of a seed plant - have long puzzled biologists. Evolutionary theory says the main reason that plants create fruits is to encourage animals to eat them, so that the animals will disperse the plant's seeds.

Why, biologists wonder, would plants go to the trouble of making a fruit, only to use chemicals to deter an animal and potential seed distributor?

Evolutionary biologist Dan Janson proposed in the late 1960s that plants may use chemicals to deter some animals without deterring others, selecting only preferred seed distributors. Known as "directed deterrence," this theory received very little attention and was never observed in nature, and it gathered dust until Tewksbury and Nabhan decided to see if it might hold true in chili peppers.

Using video cameras trained on chili pepper plants in a southern Arizona field, the researchers discovered that birds - in particular, the curve billed thrasher - were the only animals eating the small, red peppers. Pack rats and cactus mice, the dominant fruit or seed eating mammals in the area, avoided the peppers altogether.

The team then fed an unusual pepper - one that lacks capsaicin - to packrats, mice and birds in labs. Analyzing the droppings of the birds and rodents, the researchers discovered that the birds passed the seeds whole and capable of germinating.

The rodents, however, chewed up most of the seeds, and any that remained were too damaged to germinate.

"From the pepper's perspective, it's very beneficial to get pooped out as a seed underneath a shrub, particularly a shrub that has fleshy fruits itself, and that's just where the thrashers deposit the seed," Tewksbury said.

NEVADA RARE PLANT ATLAS

James D. Morefield, from BEN 272

The Nevada Rare Plant Atlas is a new publication of the Nevada Natural Heritage Program (NNHP), with major funding provided by the U.S. Fish and Wildlife Service. It provides Nevada distribution maps and fact sheets for 249 of the 297 plants and lichens currently on the Sensitive and Watch lists of NNHP, with more to be added or revised as future time and funding permit.

The fact sheets include information on conservation and population status, known threats and impacts, inventory effort, land management, geographic range, habitat and elevations, phenology, life form and habit, and descriptive and biological characteristics. Sources of photographs and drawings are also cited or linked when known, and additional literature citations are provided for further information on each taxon.

An on-line version of the Atlas is now available at:

http://www.state.nv.us/nvnhp/atlas/atlas.html

The maps and fact sheets are generated by automated means directly from the data currently entered in the NNHP databases. This means that relatively recent data for some taxa may not yet be reflected in the Atlas, if they are still awaiting entry. The on-line maps have much lower resolution than paper versions, but should be sufficiently readable to meet most needs.

Genetic Variation and Population Structure of the Rare California Plant *Collomia rawsoniana* (Polemoniaceae)

Introduction

Collomia rawsoniana E. Greene (Rawson's Flaming Trumpet) is a rare herbaceous perennial plant endemic to Madera County, California. Most individuals grow within the Sierra National Forest. Nearly all *C. rawsoniana* populations occur in the northwest portion of the upper San Joaquin River drainage (Taylor et al. 1985), although two population are known outside that drainage, at Nelder Creek and Mammoth Pool (Liskey 1993). The species is restricted to riparian habitats and meadows in conifer forests at elevations of 3000 to 7000 feet (= 900 to 2000 meters). *Collomia rawsoniana* grows in large patches that are produced at least in part by clonal spread through rhizomes. Patches vary from 0.1 to 32 m2, with a mean of 6.3 m2, and larger patches have a higher proportion of flowering stems (Taylor et al. 1985). Patches may be 200 m or more apart, especially at low elevations, but are often much closer (Taylor et al. 1985). Patches inhabit a variety of microhabitats where moisture stress is reduced by availability of groundwater or by shade (Liskey 1993). *Collomia rawsoniana* produces showy, red, tubular, hummingbird-pollinated flowers in June and July, and sets seed in September. The species is capable of producing seeds through self-pollination, but the sequence of floral development minimizes or prevents self-pollination within a single flower and rates of seed set from cross-pollination are much higher than for self-pollination (Hevron 1989). Flowers within a patch tend to bloom synchronously, but different patches bloom at different times (Hevron 1989). Fruits are explosively dehiscent, throwing seeds as much as 1 meter (Liskey 1993). Seeds germinate best on bare mineral soils. Seeds often germinate within the parental patch, where competition with the established mat of rhizomes is great and the seedlings usually die (Hevron 1989). Therefore, seedling establishment is rare (Hevron 1989). No information on the population genetics of this rare species is available. Most *C. rawsoniana* populations are located within grazing allotments in areas actively managed for timber harvest. Cattle grazing and trampling can have severe negative effects on *C. rawsoniana* (Liskey 1993). In particular, once an herbivore removes a flowering stalk, that stalk does not recover sufficiently to flower (Liskey 1993). Herbivores may remove most or all the flowering stalks in a patch, but grazing is not uniform among patches. The effect of grazing on the genetic diversity essential for the species' long term survival is difficult to assess because genetic individuals can not be recognized in the field. Are patches single genetic individuals (single clones)? Is the genetic variation in this species spread throughout the population, so that complete failure of seed set in some patches has little effect on the variation in the seeds that are formed? Or are patches genetically differentiated, so that failure of seed set prevents important components of genetic variation from being passed on to the next generation? This isozyme study of *C. rawsoniana* was initiated in order to answer some of these questions.

Methods

In August 1999, leaf samples were collected from 21 patches collected at six locations in the Sierra National Forest (Table 1). Patch size and distance between patches varied. Five moderate-sized to large patches were sampled at each location. However, few patches of any size grew in three locations (CC, MP, and NC) and therefore all moderate-sized to large patches at those location were sampled. Each patch was divided into twelve sections, four near the center and eight around the outside (diagrammed in Fig. 2). Sampling was done on the same pattern no matter how big the patch was. Therefore, samples were further apart in large patches than in small ones. In most cases, one sample was collected in each of twelve portions of the patch, but only ten samples were collected from the patches at NC due to very uneven distribution of stems within the patches there. Samples were placed in plastic bags with wet paper towels and kept on ice in the field. Sample Preparation. Two medium sized (ca. 3 cm long) leaves were ground in liquid nitrogen. Then 250 µl of a Tris buffer pH 7.5 (Gottlieb 1981) was added to the powdered leaf and the slurry was transferred to microtiter plate wells and frozen at -70°C. On the morning of electrophoresis, the slurry was thawed and absorbed onto three 3-mm wide wicks prepared from Whatman 3mm chromatography paper. Electrophoresis. Methods of electrophoresis are outlined in Anonymous (1995), and follow the general methodology of Conkle et al. (1982) except that most enzyme stains are modified. The following enzymes were examined: aconitase (ACO), catalase (CAT), diaphorase (DIA), florescent esterase (FEST), glucose-6-phosphate dehydrogenase (G6PDH), glutamate-oxaloacetate transaminase (GOT), isocitrate dehydrogenase (IDH), leucine aminopeptidase (LAP), malate dehydrogenase (MDH), malic enzyme (ME), phosphoglucomutase (PGM), phosphogluconate dehydrogenase (6PGD), phosphoglucose isomerase (PGI), shikimic acid dehydrogenase (SKD), triosephosphate isomerase (TPI), and uridine diphosphoglucose pyrophosphorylase (UGPP). A total of 24 loci resolved sufficiently well to use in genetic analysis. A lithium borate electrode buffer (pH 8.3) was used with a Tris citrate gel buffer (pH 8.3) (Conkle et al. 1982) to resolve ACO, ME7, PGI-1, PGI-2, PGM-1, and PGM-2. A sodium borate electrode buffer (pH 8.0) was used with a Tris citrate gel buffer (pH 8.8) (Conkle et al. 1982) to resolve CAT, GOT-1, GOT-2, G6PDH, TPI-1, TPI-2, TPI-3, and UGPP-1. A morpholine citrate electrode and gel buffer (pH 8.0) (Anon. 1985) was used to resolve DIA-1, DIA-2, FEST-3, IDH, MDH-1, MDH-2, MDH-3, MDH-4, 6PGD-1, 6PGD-2, 6PGD-3, and SKD. All enzymes were resolved on 11% starch gels. Enzyme stain recipes follow Anonymous (1995) except that GOT was stained using the recipe from Wendel and Weeden (1989). Two people independently scored each gel. When they disagreed, a third person resolved the conflict. For quality control, 10% of the individuals were run and scored twice. Data Analysis. Genetic interpretations were inferred directly from isozyme phenotypes. Most California *Collomia* are diploids with 2n = 16 (Wilken 1993), but we are not aware of a chromosome count for *C. rawsoniana*. We are not aware of any information about the genetics of isozymes in *Collomia*, although alleles of eight isozyme loci are known to be inherited in Mendelian fashion in the *Ipomopsis aggregata* (Pursh) V. Grant complex (Polemoniaceae) (Wolf et al. 1991). Therefore, genetic interpretations were based on the assumption of *C. rawsoniana* is diploid, plus knowledge of the generally conserved enzyme substructure, compartmentalization, and isozyme number in higher plants (Gottlieb 1981, 1982; Weeden and Wendel 1989). Results were analyzed using Popgene version 1.21 (Yeh et al. 1997). A locus was considered polymorphic if an alternate allele occurred even once. Statistics calculated included unbiased genetic distances (Nei 1978), expected heterozygosity (Nei 1973), expected number of alleles/locus (Kimura and Crow 1964), and gene flow (Nm = 0.25[1/Fs]/Fst; Slatkin and Barton 1989). A dendrogram was generated in Popgene using UPGMA and Nei's unbiased genetic distances. Hierarchical F statistics (Wright 1978) were generated using Biosys-1, version 1.7 (Swofford and Selander 1989), except that F statistics for the three-level hierarchy (Table 3) were generated using the method of Weir (1990) using Popgene (Yeh et al. 1997). Clonal structure of the population was measured by the "proportion detected" (Ellstrand and Roose 1987), for which 1 = all genotypes distinct and 0 = a monoclonal population. One multilocus genotype occurred in two patches. The probability of that genotype occurring twice by seedling establishment was estimated by the method of Parks and Werth (1993), using allele frequencies within the Whiskey Creek population (calculated using each genotype once per patch) and a sample size of 52 (the number of samples collected in Whiskey Creek, minus those in patch WC-P4, where that genotype was common).

Results

Allele frequencies were calculated for populations and patches of *C. rawsoniana*. Three alleles were detected only in single populations (MDH-3 allele 4 in BM, and FEST-3 allele 3 and MDH-4 allele 2 in GM). No allele was confined to a single patch. Overall, sixteen (62%) of the 24 loci were polymorphic (Table 2), with an average of 36% of loci polymorphic in an individual patch (Table 3). In 16 (76%) of the 21 patches, the observed heterozygosity was greater than the expected heterozygosity, and therefore the fixation index (F) was negative (Table 3). The patches were highly differentiated genetically, but individual samples within a patch, and collection sites within the total species were much less differentiated (Table 4). Nei's unbiased genetic identities among patches averaged 0.8954 (SD = 0.3090), with a maximum of 0.9852 and a minimum of 0.7761. The patches most similar to a given patch were not always in the same collection site. Patches from one location usually clustered together in a dendrogram based on genetic identities, but that was not always true (Fig. 1). In particular, patches from collection sites BM and WC were intermingled on the tree (Fig. 1), and genetic identities among the patches in the CC collection site averaged lower than those between the CC patches and patches in other collection sites (Table 5). A total of 177 complete multilocus genotypes were generated for 236 (94%) of the 252 samples. Therefore, there were an average of 1.33 individual samples per complete genotype. An additional nine genotypes were incomplete but unambiguously unique. If these are included, the *C. rawsoniana* patches had 1.32 individual samples per genotype, with a "proportion distinguished" (PD) (Ellstrand and Roose 1987) equal to 0.76, and 64% of the 245 samples with unambiguous genotypes were genetically unique. Each patch contained at least four different multilocus genotypes, and in three patches (BM-P5, GM-P2, and NC-P2), all sampled individuals were different. In most patches, the majority of samples were genetically distinct; the exceptions were patches MP-P1, NC-P1, and WC-P4. However, all individuals in some patches had the same heterozygous genotypes or unusual alleles at certain loci. In general, individuals with the same multilocus genotypes grew in adjacent sections of a patch (Fig. 2). Only one genotype was observed in two patches. Genotype number 59 occurred nine times in patch WC-P4 and once in patch WC-P3 (Fig. 2). The probability of second occurrence of this genotype within Whiskey by seedling establishment (Parks and Werth 1993) was 5.6 X 10-5. When each genotype was represented by a single sample, most statistics were similar to those produced when every sample was included in the analysis (data not shown). Genetic distances between patches averaged 0.9029 (SD = 0.0364), with a maximum of 0.9851 and a minimum of 0.7860.

Discussion

Genetic diversity at the species level. *Collomia rawsoniana* exhibits high levels of isozyme diversity for an endemic plant (Hamrick and Godt 1990). *Collomia rawsoniana* is more variable than any of the species in the *Ipomopsis aggregata* (Pursh) V. Grant complex and other *Ipomopsis* species studied (Wolf et al. 1991). Like *C. rawsoniana*, the *Ipomopsis* species are outcrossing perennial plants pollinated by hummingbirds, are in the family Polemoniaceae, and live in mid-successional habitats. Most *Ipomopsis* species differ from C. rawsoniana in that they are short-lived and widespread, and they do not spread clonally. Widespread, sexually reproducing plants, like *Ipomopsis* species, usually have higher levels of isozyme diversity than endemic and vegetatively spreading plants, like *Collomia rawsoniana* (Hamrick and Godt 1990). Although *C. rawsoniana* had a higher level of genetic diversity than expected for a narrowly endemic plant, this level of diversity is not unique. For example, *Hackelia venusta* (Piper) St. John, known from only one large population, is very diverse (Wilson et al. MS). In the hierarchy of individuals within patches within populations (sites) within the species, the most genetically differentiated units are the patches (Table 4). The genetic identities among *C. rawsoniana* patches averaged 0.89; genetic identities among conspecific populations usually average somewhat above 0.90 (Crawford 1990). The *C. rawsoniana* patches do not appear to be inbred. The negative fixation indices in most patches (Table 3) and negative Fis in all populations (Table 2) support earlier observational and experimental evidence that self-pollination is rare (Hevron 1989). The lack of inbreeding may suggest a strong barrier to self-pollination. *Collomia rawsoniana* exhibits very low seed set when artificially self-pollinated (Hevron 1989). All the samples from Whiskey Creek were scored as heterozygous at the PGI-2 locus. If those scores resulted from a gene duplication, the fixation index (and evidence for outcrossing) for Whiskey Creek populations was artificially inflated. However, the PGI-2 locus had a much smaller effect in other populations. Origin of patches. The hypothesis that establishment of new *C. rawsoniana* patches occurs primarily vegetatively, from rhizomes fragmented during flooding (Taylor et al. 1985), is not supported by this study. Only one multilocus genotype was detected in more than one patch (Fig. 2). However, that one multilocus genotype may well have been transported between patches WC-P3 and WC-P4 as a fragmented rhizome, because its probability of second establishment by seed was very low (5.6 X 10-5).

Genetic diversity within patches. The mat of rhizomes underlying each *C. rawsoniana* patch suggests that each patch is a single clone (Taylor et al. 1985, Hevron 1989), but that is not true. The individuals in each patch apparently arise by both sexual and asexual reproduction. The plant's strongly rhizomatous growth form and the multilocus genotypes shared by many samples within patches (Fig. 2) provide obvious evidence for asexual reproduction within patches. The pattern of within-patch genetic variation provided more subtle evidence for asexual variation. For example, Some genotypes in a clone differed by only one allele. This evidence suggested somatic mutation within ancient clones. Examples included patch WC-P1, where genotypes 64 and 66 differed from genotype 65 at one locus each, and patch NC-P1, where genotypes 118 and 120 differed from genotype 119 at one allele each. The excess of heterozygotes in most patches may provide additional evidence for clonal spread. In some patches all samples were heterozygous for the same alleles at some loci. Shared heterozygous loci would be expected from vegetative spread of a heterozygous individual, from establishment of heterozygous full sibs near their mother plant, or from selection pressures that differ in the diverse microhabitats occupied by individual *C. rawsoniana* patches. It would not result from sexual reproduction in a randomly mating population. However, a technical problem may contribute to the reported excess of heterozygotes. The apparent heterozygosity at the PGI-2 locus in all individuals in the five patches in the Whiskey Creek population may result from an unrecognized gene duplication, with different alleles fixed at the two loci, although the pattern of variation in other sampled populations does not strongly support that hypothesis. Other evidence supports the hypothesis that the genetic individuals within a patch originated from sexual reproduction. First, the proportion of distinguishable genotypes in this study was 0.76, much higher than is typical of a clonally reproducing population (Ellstrand and Roose 1987). Also, some individuals within a patch have very different multilocus genotypes. For example, in the same patch NC-P1 referred to above, the genotype N6 differs from genotype 119 at eight alleles at six loci, more than could be accounted for by somatic mutation. Seeds have been observed to germinate within patches (Hevron 1989). The observed seedlings all died, but the presence of diverse genotypes in some patches indicates that seedlings do become established in patches, at least occasionally. Apparently sexual reproduction and within-patch seedling establishment contribute importantly to the genetic diversity within patches. If genets usually originate from seeds, what explains the evidence for somatic mutation? The genetic similarity of individuals in a patch may result from their being close relatives or from selection pressure in the patch microhabitat. Alternatively, some patches may be very old, and really may include some ancient clones that have undergone somatic mutation. Accumulation of somatic mutations in a clone is a slow process. If somatic mutation explains some of the differences among some of these genotypes, some *C. rawsoniana* patches may be ancient. That may plausible, for two reasons. First, plants that spread clonally are potentially immortal. For example, some aspen clones may be 10,000 years old (Tuskan et al. 1996). Second, the *C. rawsoniana* populations grow in an area that was never glaciated (Matthes 1960, Liskey 1993). Suitable habitat for them may have been available at that site for millennia. Management implications. Preserving *Collomia rawsoniana* genetic diversity means preserving many patches, because patches are the most genetically differentiated unit within the species. *Collomia rawsoniana* populations also differ, because the patches in them are genetically differentiated (Fig. 1), and therefore preserving patches of *C. rawsoniana* results in preserving many populations. Patches are not single clones. Therefore, destroying part of a patch may result in destruction of some genetic individuals (genets). The impact of destroying part of a patch on the genetic diversity of that patch can to some extent by estimated from maps of multilocus genotypes within patches (Fig. 2). The isozyme variation within patches of *C. rawsoniana* suggests that sexual reproduction is more important for this plant's survival and spread than had been recognized previously. Seedling establishment may be rare (Hevron 1989) and perhaps episodic, but it does occur. Management activities that interfere with seed set, such as grazing (Liskey 1993), do interfere with the normal reproduction and generation of genetic diversity in this rare plant.

Acknowledgements

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Tables, Figures, and References can be viewed at http://dendrome.ucdavis.edu/NFGEL/79.html
Questions about NFGEL, including how you can take advantage of their facilities and expertise, should be addressed to Valerie Hipkins (530.642.5067, or vhipkins@fs.fed.us)

Researchers Turn Back the Clock on the Origin of Land Plants

Carol Kaesuk Yoon

When the first pioneering plants emerged from the earth's ancient seas and took up life on land, they turned a barren landscape green and paved the way for countless animals and other organisms to follow.

Biologists have long set the date for that momentous event somewhere around 450 million years ago, but a new study in the current issue of the journal Science suggests that plants escaped the oceans at least 700 million years ago, a radically earlier date.

In fact, the new work pushes the origin of land plants so far back in time that the authors say these plants may actually have touched off critical events that have long been thought to have predated them. One such event is the famous evolutionary proliferation of animal groups called the Cambrian explosion.

Published on Friday, the new date of 700 million years has already garnered great interest as well as healthy portions of head-shaking disbelief. The team of researchers, composed largely of undergraduates at Penn State, was led by Dr. Blair Hedges, a molecular evolutionist known for using molecular data to try to turn conventional wisdom about evolutionary history on its head.

"I thought it was very exciting," said Dr. Linda Graham, a plant evolutionary biologist at the University of Wisconsin who was not involved with the study. "It is believable, but we do need some additional corroborating evidence."

So far, the fossil record has not been obliging — the oldest fossils of land plants are around 450 million years old. One problem with the new date, researchers say, is that it means land plants would have existed on earth for 250 million years without ever leaving a fossil that scientists have been able to unearth.

"It doesn't fit," said Dr. Brent Mishler, a plant evolutionary biologist at the University of California at Berkeley. He described the methods of analysis used in the paper as outdated. The date is so unexpectedly early, he added, that "it's something that would make you suspicious."

Dr. Hedges acknowledged that the analyses required their share of corrections and estimations, but expressed confidence in the study. Speaking of the date, he said, "I think that's pretty secure."

The work is also of interest as the latest in what is becoming a long line of molecular studies that suggest ages that are inexplicably older than fossil data would suggest for various groups. Some scientists say that the molecular data are likely to be right and that paleontologists need to dig harder for those fossils. Others suggest that molecular data may be biased toward overestimating ages.

Researchers often estimate the ages of groups using what are called molecular clocks, as was done in the new study. The logic of molecular clocks is simple: when two groups split apart from each other — for example, when the human lineage split off from the chimpanzee lineage — the two groups begin to accumulate differences in their DNA and proteins. The longer the two groups are separated, the more differences they will accumulate between them.

If researchers know when two groups split, perhaps by using fossil evidence to date that split, they can then count how many differences accumulated in the groups' DNA over that number of years. By knowing how many differences accumulate, for example, every million years, researchers have calibrated their molecular clock. Then, simply by knowing the number of differences that have accumulated in the DNA of any other two groups, researchers can estimate how much time has passed since those lineages split.

But researchers are still arguing over whether molecular clocks tick regularly enough to provide accurate ages.

In their study, Dr. Hedges and colleagues analyzed more than 100 previously published protein sequences to examine the differences accumulated over time between a number of fungi and plants.

Plants are widely thought to have made the leap to land accompanied by fungi, like the fungi that today can be found living in the roots of most plants. Using a protein clock, the researchers estimated that the necessary fungi were around more than a billion years ago, setting the scene for the evolution of land plants arising at least 700 million years ago.

Dr. Blair said the work suggested that biologists might need to rethink the dating of some of the more modern groups of plants, like the flowering plants and species like corn and rice. "It could push these dates back also," he said, "and that probably will tick off a lot of people."

The broadest implication of the new study was the suggestion by the authors that these early land plants might be responsible for one of the most famous of evolutionary events, the so-called Cambrian explosion about 530 million years ago. In the past, some researchers had suggested that what touched off that rapid evolution of animal life forms was an increase in atmospheric oxygen. The authors on the new work suggest that land plants predated that major event and may well have been the source of that crucial oxygen.

Dr. John Taylor, a mycologist at the University of California at Berkeley whose own work on a more limited set of molecular data had earlier raised the possibility that land plants might be 600 million years old, urged researchers to consider the newest number, but cautiously.

"It's an estimate," he said, while praising the work, "and it has to be treated that way. Our paper wasn't the last word, and this one won't be either."

Appearance of First Fungi Studied

Randolph E. Schmid, AP/Washington Post, 10 August 2001

WASHINGTON — Fungi and early plants may have colonized land millions of years earlier than previously thought, according to scientists who say this could have had a major impact on climate and life on Earth.

Researchers at Pennsylvania State University estimate that fungi first appeared on land about 1.3 billion years ago, followed by early plants about 700 million years ago.

"We were actually quite shocked. We had no idea that fungi were quite so old," said S. Blair Hedges, who led the research team that conducted the new study.

"That really caused us to look closely at land plants, and after finding land plants were so old, that took us to another question, which was: How could the presence of these land plants have affected land and climate?" he said in a telephone interview.

The team's findings are published in Friday's issue of the journal Science.

The group studied the rate of mutations in a number of plant and fungi genes. With that, they were able to calculate back in time and estimate the point when the species separated and primitive algae colonized the then barren land.

Previous estimates based on fossils have indicated that plants and fungi appeared on land between 480 million and 460 million years ago.

The new dates led the researchers to speculate that the presence of plants, taking up carbon dioxide from the early atmosphere and adding oxygen to it, could have cooled the climate and had an impact on the further development of life, including the proliferation of animals, which need oxygen.

The cooling in particular, he said, may have been involved in a series of "snowball earth" episodes in which the planet was covered with ice between 750 million and 580 million years ago. That was followed by the Cambrian explosion of animal life, which could have been aided by the rising oxygen levels.

"We are proposing a biological explanation for these two seemingly unrelated phenomena, which before had geological explanations such as plate tectonics," he said.

"Both the lowering of the Earth's surface temperature and the evolution of many new types of animals could result from a decrease in atmospheric carbon dioxide and a rise in oxygen caused by the presence on land of lichen fungi and plants at this time, which our research suggests," said Hedges, an evolutionary biologist.

Linda Graham, a professor of botany at the University of Wisconsin in Madison, said she was surprised at the early date the team calculated for land plants.

"It's a very exciting finding," she said. "But I don't think they're entirely unreasonable, and it will stimulate a lot of new work in looking for fossils in older sediments."

Their remains might be hard to locate, though, because the population may have been very small, she said.

As to the potential effect on climate, she called it "a reasonable speculation that just requires a great deal more work."

Bette Otto-Bliesner, a paleoclimatologist at the National Center for Atmospheric Research in Colorado, said that she wouldn't go so far as to speculate that the plant-related reduction in carbon dioxide could cause a "snowball earth," but added that the general argument is plausible from a climate perspective.

"We know that atmospheric carbon dioxide is a powerful driver of climate ... and we know that land plants can accelerate weathering and draw down carbon dioxide," she said.

But "there are still some substantial gaps in our understanding of the details of how atmospheric carbon dioxide regulates climate when we go to the distant past. The landmasses were shifted in their locations, geography was quite different," she said.

The New U.S. Botanic Garden Conservatory

Holly H. Shimizu, Friends of the National Arboretum, Fall 2001

The visitor coming into the newly renovated Conservatory of the U.S. Botanic Garden will, at first glance, think it is the same place it was prior to its closing in 1997. Architecturally, we have respected the historic integrity of the building's original design.

The visitor's experience, however, will be a very different one. Staff has had many years to plan some exciting changes and to incorporate cutting edge technology and design into each of the greenhouse spaces. We are using water throughout the Conservatory and are committed to changing exhibits through the year. Our interpretive master plan has assisted us in delivering a cohesive message regarding the importance of plants to both the people and the environment. And for those who come to the Garden for colorful splashes we will continue to celebrate the seasons with specialty crops.

Upon entering the Conservatory, the visitor will notice that the Orangarie has been converted into a garden store that features books, garden supplies, and tools. Beyond it the Garden Court still has the beautiful long rectangular pools with blue tile and gentle water sounds. Plant collections in this house are entirely based on economic plants with emphasis on plants that have been used for fiber, wood, food, flavor, and industrial products.

Attracting the eye out from the Garden Court is the towering dome of the Jungle. Perhaps the most exciting space within our Conservatory, this are has been designed so that it appears to have been a plantation garden that has been abandoned, and the jungle has taken over. It is created as a metaphor for the global clash between humans and nature. Plantings will resemble those of a tropical rain forest with large canopy trees, multiple layers, and epiphytes throughout. A mezzanine allows visitors to get higher up in the canopy and look down into the jungle.

The overriding design and interpretive messages of the Conservatory have been divided so that those greenhouse spaces in the west side are devoted to plants and their relationships to humans. Exhibits on the east side focus on plants and their relationships in the environment.

Beginning on the east side, the Ecology House opens with an exhibit on plant adaptations focusing on plants with significant symbiotic relationships with mycorrhizal fungi.

Enter into the Garden Primeval. This is a recreation of a primeval forest as it might have appeared in the mid-Jurassic period of the Mesozoic era. A dense green, flowerless environment that is very humid and foggy in character will be home to fossils, bubbling water, and sounds of insects and amphibians.

Into the next contrasting environment, the Oasis. This representation of the desert oasis includes a rocky grotto where water seeps slowly from under a rock outcrop. The focus is on the unique adaptations that plants have made in desert areas where a small amount of water is available.

In the Desert House dramatic rock-work emulates a Sonoran desert. Plants offer more than just cacti, with an array of gorgeous succulents and desert annuals. The big message will focus on how plants adapt to the dry desert environment.

Moving to the western half of the Conservatory, we focus on plants in civilization, showing how plants have supported and shaped the development of human society. Our first area exhibits a collection of rare and endangered plants that have been obtained through the CITES (Convention on International Trade and Endangered Species) Program. In the Plant Exploration House many of the plants originally collected on the Wilkes Expedition (1842) are featured as well as changing exhibits on plant exploration, old and new. Our opening exhibit will highlight Plants of the New Millennium.

Misty with fog and fallen tress, the Orchid House will be exuberantly planted with orchids displaying their extraordinary beauty and complex biology

Within the Hall of Medicine, plant collections focus on medicinal plants from around the globe that have been scientifically documented to have use in medicines. Visitors can touch plants that have saved many lives and offer hope for the future.

Overall, I think the biggest difference in our new Conservatory is that we have a cohesive message conveying the importance of plants to people and the environment. Each space has been carefully throughout, designed, and implemented, and each greenhouse is able to have full environmental controls so that we can have variations in conditions and collections.

Our date of opening to the public is November 23rd, so mark your calendars and come see us!

Holly Shimizu is the executive director of the U.S. Botanical Garden.

Newly Introduced *Puccinia* Species

Dear colleague:

This is a request for information on two new exotic rust fungi on ground ivy (*Glechoma hederacea*), English Daisy (*Bellis perennis*), and groundsel (*Senecio* spp.) in North America.

The rust fungi are *Puccinia glechomatis* and *Puccinia lagenophorae*. Both were recently introduced to North America. To assess their present distribution in North America, their spread, and their impact on wild plants and ornamentals we need and would very much appreciate your help. At http://www.btny.purdue.edu/Herbaria/rust/ you will find descriptions of the characters of these fungi and their host plants, when and where you can find them, and how you can support us.

Please forward this information to persons who might be interested in this study or who might help us.

Markus Scholler, Ph.D.
Director, Arthur & Kriebel Herbaria
Dept. of Botany & Plant Pathology
1155 Lilly Hall
West Lafayette, IN 47907-1155

(editors note: There are two Federally Threatened, and several Forest Service and BLM Sensitive *Senecio* species around the country. Please consider contributing to this study.)

The Long Trail of *Shortia*.

Charles Elliott, Horticulture Magazine, August 2001

It doesn't sound like much, really. "A charming, small, but not easily grown evergreen perennial for the experienced plantsman," is all that one standard handbook can manage to say on its behalf. But to the great American botanists Asa Gray (1810-1888), *Shortia galacifolia* – otherwise known (if at all) as Oconee bells or little coltsfoot – was (sound of trumpets) "perhaps the most interesting plant in North America." What could have possessed him?

The story is a curious one, involving three continents, numerous frustrated plant hunters, and Charles Darwin himself. It starts back in the 18th century with the French botanical explorer and sometimes spy Andre Michaux (1746-1802?). Commissioned to scavenge the back country of the brand-new United States in the search of native trees that hight help restore France's decimated timber stock, Michaux traveled thousands of difficult miles between 1785 and 1792 collecting plants. In all, he rode, walked, or paddled through three quarters of the states and territories east of the Mississippi (as well as Quebec and the Bahamas), suffering hardships that can only be guessed at from the laconic entries in his surviving journals. His most frequent complaint, in fact, is that his horses keep straying at night and take hours to find again.

Michaux's favorite collecting area was the Carolina's and Georgia, partly because from 1786 on he made Charleston, South Carolina, his base. Again and again he trekked northwards across the Carolina Piedmont to scour the high mountains east of what is now Asheville, North Carolina: Roan Mountain, Grandfather Mountain, and others. He also went into the Smokies and to the headwaters of the Savannah River. And somewhere in this country he found and preserved a specimen of a plant new to him. It was incomplete, consisting only of leaves, stem, and a single fruit. Along with his many other more impressive discoveries, the specimen eventually found a place in the Musee National d'Histoire Naturelle in Paris, identified only by a location tag reading "*Hautes montagnes de Carolinie*."

Now we move on to 1839. Young Asa Gray was traveling in Europe, ostensibly buying scientific books for the fledgling University of Michigan, but in fact indulging his first love by meeting botanists and investigating herbaria. In the Michaux Herbarium he came upon the still unclassified plant from Carolina and realized with excitement that it represented a new genus. The find also suggested that the Carolina mountains were an area ripe for botanical explorations.

But the mysterious plant proved to be elusive. In 1841 Gray made the first of several trips into the region, despite warnings from an acquaintance that "you will be obliged to put up with accommodations on the way, such as you have never dreamed of," while letters of recommendation to locals wouldn't be needed, because "I doubt if they can read." In any case, Gray couldn't find the plant, search as he would through the rhododendron-choked valleys and along the rocky cliffs. In 1842, however, he ventured to publish with his colleague John Torrey, a description based on the sketchy material in Paris. Having claimed "the right of discoverer" to name it, he called it *Shortia galacifolia* after Dr. A. W. Short, a will-known Kentucky amateur botanist and galax-shaped leaves.

Shortia became a kind of Holy Grail for collectors. In the words of Charles Sprague Sargent (whose own involvement in the story comes a bit later), "the keenest-eyed plant hunters looked for it in vain year after year in all the region in which Michaux was supposed to have traveled." Not until 1877 was it found, and then in the wrong place – not the high mountains at all, but on the banks of the Catawba River near Marion, North Carolina. A teenage boy named George Hyams gave it to his father, a professed herbalist, who didn't realize what a precious thing he had for more than a year.

Gray was delighted ("Now let me sing my nunc dimmitts," he wrote); with complete specimens in hand he could confirm and refine his description. In 1879 he went with his wife on a pilgrimage to North Carolina so that he could see the sacred spot for himself. The fate of the Catawba shortia was less happy; poachers dug up every plant they could find for sale at high prices. Attempts at garden use came to nothing, and the plant's rapic extinction appeared inevitable.

But was this the only place shortia cold be found? Gray continued to have faith in Michaux's accuracy. If Michaux said the plant had come from the high mountains, then that's where it came from. The Catawba specimens must be a separate group, perhaps washed down from the mountains immediately to the west. Searchers proceeded to cover those slopes with great care. Nothing. *Shortia* seemed doomed to be lost yet again.

In the autumn of 1886, Charles Sprague Sargent, founder of the Arnold Arboretum and by then America's most distinguished dendrologist, journeyed to the corner where Georgia, North and South Carolina come together. This mountain region, about 75 miles southwest of the point where George Hyams found shortia, was well outside the previous search range. Sargent was trying to discover something of the origins of a magnolia whose roots Michaux had collected here in December of 1788. As it turned out, there had been a confusion of names and Sargent's magnolia venture came to nothing, but in examining Michaux's journal for that period he noticed something else. On the day the explorer arrived in the mountains, hungry and cold and suffering from high fever – he had made note of a "*Nouvel Arbuste a.f. denteles rampant sur la Montange*" ("New shrub with denticulate [minutely notched] leaves flourishing on the mountain"). He apparently collected samples, but said not more about it.

Michaux's directions to the point where he ahd camped were so details that Sargent was able to follow them easily, and to trace the excursions the plant-hunter had made. At the junction of two "torrents," the Toxoway and the Horse pasture, in a "little fertile plain," Sargent discovered shortia. This was almost certainly the source of the plant Gray had come upon in the herbarium in Paris. Many more were later found in the general area (including Oconee County, South Carolina, whence its common name), although because of dam and road building, aggressive collecting and incursions of civilization in the form of farms and second homes, they have once again become rare in the wild.

Why Michaux called it a "shrub" remains a mystery – shortia is without question an herbaceous perennial, though no doubt it doesn't show its best face in December. But why Asa Gray termed it "perhaps the most interesting plant in North America" may possibly be answered. This has little to do with its beauty (modest) or its elusiveness (legendary), but rather with the role shortia played in the greatest scientific drama of the 19th century: the debate over Charles Darwin's *Origin of Species*.

In the years before Darwin published his epochal work, Asa Gray had been one of his primary correspondents, supplying him with information and exploring aspects of plant distribution and other key subjects on which Darwin's thesis would depend. He was one of the very few people to who Darwin revealed himself, and a man whose own adventurousness in building large ideas out of an infinity of close observations could match Darwin's own. In time, though the two of them were far too strong-minded and individual to align their opinions perfectly, Gray would become Darwin's principal American supporter and spokesman, at the same time doing much to create a modern scientific establishment in the United States.

In 1858, Gray was examining a group of specimens from Japan brought back by Commodore Perry's expedition. For a long time – indeed, from the time the first collectors had begun sending samples of Japanese species to Europe and America – botanists had been aware of an odd fact: certain plants could be found in Japan and in the eastern United States but nowhere else. With this flood of new material, the connection appeared even stronger. Now, suddenly, Gray recognized something familiar: a plant almost identical to his own *Shortia galacifolia*. It had been resoundingly named *Schizocodon uniflorus* by a Russian botanist (the Japanese called it *iwa-uchiwa*, or "crag fan," from the shape of its leaves), but it was without question a shortia (and would eventually go by that name too).

But how was one to account for this peculiar identity between two so widely separated flora, marooned on opposite sides of the world? Given the still primitive level of understanding about geological history at the time – Gray's explanation of the connection was brilliant. He concluded that during the last ice age, the spread of glaciers had forced plant species common to the entire North Temperate Zone of American and Asia to retreat southwards, and only where there was room for them to shelter in agreeable surroundings (as in Japan and the eastern United States) did they survive. When the glaciers melted back, changed conditions made it impossible for many species – including shortia – to follow, and they were left isolated.

Gray's thesis fit beautifully into Darwin's grander argument, and helped support it. Many plants, from pachysandra to magnolias, had been used to illustrate the Japan-America link. But shortia, still at that date blooming unseen in the Carolina mountains, already represented something special to Asa Gray. It must have fascinated him more than ever, maybe even enough to make him call it "perhaps the most interesting plant in North America."

Another Consequence of Landscape Fragmentation: Inbred Plants use Nitrogen Less Efficiently.

University of Minnesota News Service, August 9 2001

MINNEAPOLIS / ST. PAUL -- The fragmentation of landscapes by human activities creates "islands" of plants, some of which must breed only with a small number of near neighbors. This leads to inbreeding, which has been shown to reduce seed-bearing and productivity and even cause extinction. Now, a study by University of Minnesota ecology graduate student Eric Lonsdorf has indicated that in some plant species, inbreeding reduces efficiency with which the plants use nitrogen. Lonsdorf will present his work Aug. 9 at the Ecological Society of America annual meeting in Madison, Wis.

As landscapes are carved up, their makeup changes; they do not remain simple miniatures of the original landscapes. Lonsdorf said his study shows that fragmentation changes the genetic makeup of species, which in turn alters the species' interactions with their environments. Fragmentation, then, influences the course of evolution, and inbreeding is a major route.

To study the effects of inbreeding on nitrogen use efficiency, Lonsdorf worked with *Nemophila menziesii*, or baby blue eyes, a vinelike ground plant found in the grasslands of California. He compared the carbon-to-nitrogen ratio (C/N) of tissue from plants that had been outcrossed (the parent plants were unrelated) to C/N in inbred plants (from parents that were self-pollinated). He found higher C/N ratios in the outcrossed plants, indicating that the plants needed less nitrogen to store a given amount of carbon than did the inbred plants. Also, outcrossed plants had higher C/N ratios under low nutrient conditions than in nutrient-rich conditions. Inbred plants, however, showed little or no response to nutrient conditions.

His findings have implications for the restoration of fragmented landscapes, Lonsdorf said.

"There's a debate about whether to use local seed or seed from far away when restoring," he said. "If inbreeding is a concern, I'd expect you should use seed from far away. A counter argument is that seed and pollen from the local area are more adapted to the environment. To decide, you should know how your plants will be affected by inbreeding because genetic changes caused by inbreeding will affect ecological relationships." Also, he said, the fact that fragmentation affects different plants in different ways will change plant communities. Ecological relationships that existed when landscapes were undisturbed may be absent following fragmentation and restoration. For example, inbreeding that results from habitat fragmentation may alter the response of plants to competitors and other stressors.

A goal of Lonsdorf's research is to link genetic changes in populations to ecological changes. He is now studying the variation among species in their responses to fragmentation.

Mount Vernon Trees to be Cloned

Jeff Baron, Washington Post, 2 August 2001

A slender five-foot branch from near the crown of a tulip poplar plummeted to the grass below, and Francis Gouin pulled it aside and looked along the stems near the tip.

"You see that bud there? You see those bud scales?" he asked. "That means that bud's going dormant. That means it's all right for grafting -- it'll start up with the next growing season."

The buds, just an eighth of an inch long, are the youngest part of one of Mount Vernon's oldest trees, one of the last 13 survivors that George Washington chose for the grounds of his riverfront plantation some 215 years ago. Gouin, a retired University of Maryland horticulture professor who has developed techniques for propagating older trees, was at the Fairfax County estate yesterday choosing the buds that will become landmark Mount Vernon trees in the next century and the century after that -- all genetically identical to the originals.

More branches came down, cut and tossed by arborist Rob Springer, perched about 110 feet up the tulip poplar. From each branch, Gouin used his pocket knife to take one to three small sections of new growth, snipping off the distinctive three-lobed leaves so as not to draw moisture from the bud wood. "We're finding very little wood that has buds that are worth collecting," he said, slipping a handful of cuttings into a zip-lock bag.

That bag and others were bound for a cooler and, by the end of the day, to be shipped overnight to three out-of-state nurseries where the buds will be grafted onto rootstock of the same species.

Tree-grafting has been done for thousands of years, but harvesting buds from trees as old as Mount Vernon's original 13 is an art, said J. Dean Norton, chief horticulturist there.

The cloning is a gift from a Michigan family of nursery owners. David Milarch and his son, Jared, gained expertise in propagating old trees through the Champion Tree Project, which they founded to produce genetic duplicates of the largest specimens of 826 U.S. tree species. A thousand of those trees will be used to help restore Mount Vernon's forests in the next 10 years, and David Milarch said he volunteered to clone the estate's 13 originals -- two tulip poplars, two white ashes, a white mulberry, a hemlock and seven American hollies -- when he heard about them.

Work on the tulip poplars and ashes was completed yesterday; Norton said the rest of the bud-cutting will be done this morning.

David Milarch said the plan is to grow 50 duplicates of each tree and deliver them to Mount Vernon in two years. Norton said that should give the estate plenty of stock for replacing any original trees that die, with some sent to Harvard University's Arnold Arboretum for safekeeping.

"The reason that these trees are important to Mount Vernon is that they're the only living witnesses to the life and times of George Washington," he said.

There were far more witnesses to yesterday's tree work. Hundreds of tourists watched while standing in the sunshine awaiting admission to the Washingtons' home, and reporters and camera crews lined up on the Bowling Green that stretches out from the mansion's western front to interview Norton and ride a hoist to get a closer look at Springer aloft.

It was a rare day in the spotlight for Mount Vernon's foliage, which pleased Norton, who talked about how important the trees were to Washington, a devoted horticulturist.

"We always like to keep George Washington, his character and his times, in people's minds," Norton said. "We always like to keep trees in people's minds."

In Praise of Blue Grass

John James Ingall, Kansas Magazine, 1872

Attracted by the bland softness of an afternoon in my primeval winter in Kansas, I rode southward through the dense forest that then covered the bluffs of the North Fork of Wildcat. The ground was sodden with the ooze of melting snow. The dripping trees were as motionless as granite. The last year's leaves, tenacious lingerers, loath to leave the scene of their brief bravery, adhered to the gray boughs like fragile bronze. There were no visible indications of life, but the broad, wintry landscape was flooded with that indescribable splendor that never was on sea or shore -- a purple and silken softness, that half veiled, half disclosed the alien horizon, the vast curves of the remote river, the transient architecture of the clouds, and filled the responsive soul with a vague tumult of emotions, pensive and pathetic, in which regret and hope contended for the mastery. The dead and silent globe, with all its hidden kingdoms, seemed swimming like a bubble, suspended in an ethereal solution of amethyst and silver, compounded of the exhaling whiteness of the snow, the descending glory of the sky. A tropical atmosphere brooded upon an arctic scene, creating the strange spectacle of summer in winter, June in January, peculiar to Kansas, which unseen cannot be imagined, but once seen can never be forgotten. A sudden descent into the sheltered valley revealed an unexpected crescent of dazzling verdure, glittering like a meadow in early spring, unreal as an incantation, surprising as the sea to the soldiers of Xenophon as they stood upon the shore and shouted "Thalatta!" It was Blue Grass, unknown in Eden, the final triumph of nature, reserved to compensate her favorite offspring in the new Paradise of Kansas for the loss of the old upon the banks of the Tigris and Euphrates.

Next in importance to the divine profusion of water, light, and air, those three great physical facts which render existence possible, may be reckoned the universal beneficence of grass. Exaggerated by tropical heats and vapors to the gigantic can congested with its saccharine secretion, or dwarfed by polar rigors to the fibrous hair of northern solitudes, embracing between these extremes the maize with its resolute pennons, the rice plant of southern swamps, the wheat, rye, barley, oats, and other cereals, no less than the humbler verdure of hill-side, pasture, and prairie in the temperate zone, grass is the most widely distributed of all vegetable beings, and is at once the type of our life and the emblem of our mortality. Lying in the sunshine among the buttercups and dandelions of May, scarcely higher in intelligence than the minute tenants of that mimic wilderness, our earliest recollections are of grass; and when the fitful fever is ended, and the foolish wrangle of the market and forum is closed, grass heals over the scar which our descent into the bosom of the earth has made, and the carpet of the infant becomes the blanket of the dead.

As he reflected upon the brevity of human life, grass has been the favorite symbol of the moralist, the chosen theme of the philosopher. "All flesh is grass," said the prophet; "My days are as the grass," sighed the troubled patriarch; and the pensive Nebuchadnezar, in his penitential mood, exceeded even these, and, as the sacred historian informs us, did eat grass like an ox.

Grass is the forgiveness of nature -- her constant benediction. Fields trampled with battle, saturated with blood, torn with the ruts of cannon, grow green again with grass, and carnage is forgotten. Streets abandoned by traffic become grass-grown like rural lanes, and are obliterated. Forests decay, harvests perish, flowers vanish, but grass is immortal. Beleaguered by the sullen hosts of winter, it withdraws into the impregnable fortress of its subterranean vitality, and emerges upon the first solicitation of spring. Sown by the winds, by wandering birds, propagated by the subtle horticulture of the elements which are its ministers and servants, it softens the rude outline of the world. Its tenacious fibres hold the earth in its place, and prevent its soluble components from washing into the wasting sea. It invades the solitude of deserts, climbs the inaccessible slopes and forbidding pinnacles of mountains, modifies climates, and determines the history, character, and destiny of nations. Unobtrusive and patient, it has immortal vigor and aggression. Banished from the thoroughfare and the field, it bides its time to return, and when vigilance is relaxed, or the dynasty has perished, it silently resumes the throne from which it has been expelled, but which it never abdicates. It bears no blazonry or bloom to charm the senses with fragrance or splendor, but its homely hue is more enchanting than the lily or the rose. It yields no fruit in earth or air, and yet should its harvest fail for a single year, famine would depopulate the world.

One grass differs from another grass in glory. One is vulgar and another patrician. There are grades in its vegetable nobility. Some varieties are useful. Some are beautiful. Others combine utility and ornament. The sour, reedy herbage of swamps is baseborn. Timothy is a valuable servant. Redtop and clover are a degree higher in the social scale. But the king of them all, with genuine blood royal, is Blue Grass. why it is called blue, save that it is most vividly and intensely green, is inexplicable, but had its unknown priest baptized it with all the hues of the prism, he would not have changed its hereditary title to imperial superiority over all its humbler kin.

Taine, in his incomparable History of English Literature, has well said that the body of man in every country is deeply rooted in the soil of nature. He might properly have declared that men were wholly rooted in the soil, and that the character of nations, like that of forests, tubers, and grains, is entirely determined by the climate and soil in which they germinate. Dogmas grow like potatoes. Creeds and carrots, catechisms and cabbages, tenets and turnips, religions and rutabagas, governments and grasses, all depend upon the dew point and the thermal range. Give the philosopher a handful of soil, the mean annual temperature and rainfall, and his analysis would enable him to predict with absolute certainty the characteristics of the nation.

Calvinism transplanted to the plains of the Ganges would perish of inanition. Webster is as much an indigenous product of New England as its granite and its pines. Napoleon was possible only in France; Cromwell in England; Christ, and the splendid invention of immortality, alone in Palestine. Moral causes and qualities exert influences far beyond their nativity, and ideas are transplanted and exported to meet the temporary requirements of the tastes or necessities of man; as we see exotic palms in the conservatories of Chatsworth, russet apples at Surinam, and oranges in Atchison. But there is no growth: nothing but change of location. The phenomena of politics exhibit the operations of the same law....

The direct agency upon which all these conditions depend, and through which these forces operate, is food. Temperature, humidity, soil, sunlight, electricity, vital force, express themselves primarily in vegetable existence that furnishes the basis of that animal life which yields sustenance to the human race. What a man, a community, a nation can do, think, suffer, imagine or achieve depends upon what it eats.

Thanks to Julie Kierstead Nelson, who found an excerpt of *In Praise of Blue Grass* inside the front cover of *Southwest Grasses*, a booklet issued by Curtis & Curtis Seed Inc. of Clovis, New Mexico, no date given.

U.S. Fish and Wildlife Service, Conservation Groups Reach Agreement to List New Species Under The Endangered Species Act

Excerpted from USFWS news release, 29 August 2001

Interior Secretary Gale Norton today announced that the U.S. Fish and Wildlife Service and several conservation organizations have reached an agreement in principle that will enable the Service to complete work on evaluations of numerous species proposed for listing under the Endangered Species Act.

Under this agreement with the Center for Biological Diversity, Southern Appalachian Biodiversity Project, California Native Plant Society, and the Biodiversity Legal Foundation, the Service will issue final listing decisions for 14 species.

Below are the plant species to be listed under the agreement

Spalding's catchfly – *Silene spaldingii* (Idaho, Oregon, Montana, Washington, and Canada (BC)): Final Listing Determination
A member of the carnation family, the Spalding's catchfly is a long-lived perennial herb with small greenish-white flowers. The Spalding's catchfly is currently known from a total of 52 populations. This plant is threatened by a variety of factors, including habitat destruction and fragmentation from agricultural and urban development, grazing and trampling by domestic livestock and native herbivores, herbicide treatment, and competition from non-native plant species.

Showy stickseed – *Hackelia venusta* (Washington): Final Listing Determination
Washington's rarest plant, the showy stickseed, is a perennial herb about 8 to 16 inches tall, and is currently known to grow in only one location in Chelan County, Washington. It has large white five- lobed flowers, making it a showy attraction for anyone fortunate enough to see it. The population has declined to the current size of less than 300 individual plants. Threats include competition and shading from native trees and shrubs, encroachment onto the site by nonnative, noxious plant species, wildfire and fire suppression, activities associated with fire suppression, and low seedling establishment.

San Diego ambrosia – *Ambrosia pumila* (California): Final Listing Determination
The San Diego ambrosia a herbaceous, rhizomatous, perennial plant that typically grows from 2 to 12 inches tall (occasionally reaching 20 inches). This plant is restricted to San Diego and Riverside Counties, California and Baja California, Mexico, from Colonet to Lake Chapala. This species is threatened by the destruction, fragmentation, and degradation of habitat caused by recreational and commercial development; highway construction and maintenance; construction and maintenance activities associated with a utility easement; competition from non-native plants; trampling by horses and humans; and off-road vehicle use.

Golden sedge – *Carex lutea* (North Carolina): Final Listing Determination
This rare plant is presently known from only eight populations in Pender and Onslow counties, North Carolina. The golden sedge is endangered throughout its range because of habitat alteration; conversion of its limited habitat for residential, commercial, or

industrial development; mining; drainage activities associated with silviculture and agriculture; and suppression of fire.

Holmgren milk-vetch and Shivwits milk-vetch – *Astragalus homgreniorum* and *Astragalus ampullarioides* (Utah and Arizona): Final Listing Determination
These two perennial herbs, the Holmgren milk-vetch and the Shivwits milk-vetch, occur in Arizona and Utah. Three small populations of Holmgren milk-vetch exist in Washington County, Utah, and adjacent Mohave County, Arizona. Five small populations of Shivwits milk-vetch exist in Washington County, Utah. Significant portions of the habitat of both species are subject to disturbance from urban development, off-road vehicles, grazing, displacement by exotic weeds, and mineral development.

New *Lingua Botanica* Feature: Federal Botany Jobs

Check for these and other jobs of interest to botanists at http://usajobs.opm.gov/.
Remember, botanists make excellent rangers, planners, staff officers, and Forest Supervisors.

BOTANIST $35,808 GS-0430-09/ Closes: Sep 27, 2001
USDA, Forest Service R611-424-01D
Open to Everyone Grants Pass, OR

BOTANIST $43,226 - 71,224 GS-0430-09/11 Closes: Oct 25, 2001
US Army Corps of Engineers FSS101056
Open to Everyone New York, NY

BOTANIST (EAWS TEAM) $35,813 - 43,326 GS-0430-09/11 Closes: Oct 21, 2001
USDA, FOREST SERVICE R117-125-01D
Open to Everyone GRANGEVILLE, ID

BOTANIST $23,633 - 29,273 GS-0430-05/07 Closes: Sep 28, 2001
FLD OPERATING OFC OF OFC OF SEC OF ARMY SC-DEU-01-1277
Open to Everyone THROUGHOUT THE US,

Banner Plant: *Cirsium pitcheri*

Each month, a different plant graces the banner of *Lingua Botanica*.
This edition's Banner Plant image comes from PLANTS http://plants.usgs.gov
Thanks this month to Chris Frisbee and USFWS.

Pitcher's thistle is a federally listed, threatened native thistle that grows on the beaches and grassland dunes along the shorelines of Lakes Michigan, Superior, and Huron in the United States and Canada. It occurs on the Hiawatha and the Huron-Manistee National Forests in Michigan, in Region 9. Pitcher's thistle was extirpated from Illinois around 1915, but reintroduction efforts beginning in 1991 have successfully reestablished the thistle at Illinois Beach State Park, in Lake County, Illinois.

Pitcher's thistle grows for five to eight years before it flowers. Its non-flowering form is a rosette of silvery leaves and its flowering form typically has one stem with many branches. The entire flowering plant may grow to a meter in height. Flowers are cream or pink in color. Leaves are finely and deeply lobed and may be thirty centimeters long. The stems and leaves of both the flowering and non-flowering forms are covered with white hairs that give the plant a woolly white or silvery appearance. Spines are found along the edges of leaves near the base and at the tips of some of the lobes. Mature plants may have a taproot nearly two meters long.

Pitcher's thistle blooms and sets seed once during its lifetime. It blooms from June to September and flowers are visited by thirty species of insects (mainly bees). After the seeds mature, they fall or are windblown and germinate the following spring and early summer. Pitcher's thistle tends to colonize open areas or areas with low plant cover.

Afterword: Tree Dodder!

Image by Cynthia Heintze, IPM Coordinator, Houston (Texas) Parks and Recreation Department
No its not silly string. It's been tentatively identified as *Cassythia filiformis*, a dodder-like member of the Laurel family native to the Caribbean and a potential new introduction to the continental U.S.
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Sometimes it doesn't die unless you kill it. (paraphrased from A. Bradley)

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