a Sperry apparatus, we measured maximum hydraulic conductivities (mg mm s^{-1} KPa^{-1}) for detached first and second year leaves. No significant differences were found (0.379 ± 0.044 vs 0.406 ± 0.027 for first and second year leaves, respectively, N=18). Next, we measured conductivities of each leaf age class, but this time included the rhizome in the water path, in order to see if the rhizome was a significant resistance to water flow. We found no differences in conductivity for the two age classes, but inclusion of the rhizome in the pathway greatly reduced conductivities (0.064 ± 0.005 vs 0.077 ± 0.010, for first and second year leaves, respectively, N=11). We then investigated whether ageing might change the susceptibility of the petioles to cavitation. Using two different methods for introducing embolisms into the xylem, centrifugation and air injection (both yielded similar, but not identical results), we found no difference in susceptibility to cavitation between leaf age classes. Cavitation did not begin until leaf water potentials reached approximately -2.5 MPa, and conductances were still 57% ± 3% of maximum at -4.0 MPa. Iin the field, water potentials in *Galax* rarely decrease below -1.6 MPa, thus this species would almost never suffer embolisms under typical growing season field conditions. Even under the most severe drought conditions, water flow could still be maintained to the leaves. The ability to resist cavitation in this species rivals that for plants more typical of desert habitats.

SOBRADO, M. A. Universidad Simon Bolivar, Caracas, Venezuela. **Relation of water transport to leaf gas exchange properties in three mangrove species**

Mangrove species more tolerant to salinity may function with less efficient water transport, which may be related to more conservative water use. To test the hypothesis, we investigated the gas exchange and hydraulic properties of three mangrove species: *Rhyzophora mangle* L.,*Laguncularia racemosa* Gaert and *Avicennia germinans* (L.) L. Experiments were performed with adult plants growing naturally in the field under a salinity of 35 parts per thousand. Gas exchange parameters showed that *A. germinans* had significantly higher photosynthetic rates, and lower stomatal conductance and transpiration rates, compared to the other two mangroves. In concert with this, instantaneous water use efficiency was significantly high in *A. germinans*, intermediate in *L. racemosa* and lowest in *R. mangle*. The hydraulic parameters of the three mangrove species were in the lowest end of the range reported for tropical trees. However, the three mangrove species exhibited measurable differences in hydraulic parameters related to the control of water requirements for maintenance of carbon gain. *L. racemosa* and *A. germinans* showed less efficient water transport at shoot level but were the most efficient species in water use at the leaf level in comparison to *R. mangle*.

SOWA, S.[1] and K. F. CONNOR.[2,3] [1]Indiana University of PA, Indiana, PA 15705 USA; [2]USDA-FS, Mississippi State, MS 39762 USA; [3]Center for Bottomland Hardwoods Research, Mississippi State, MS 39762 USA. **Recalcitrant behavior of cherrybark oak seed.**

The recalcitrant behavior of cherrybark (*Quercus pagoda Raf*) acorns was examined in terms of effects of moisture content on germination and biomolecular structure. Seed samples collected over two consecutive years (1998, 1999) were fully hydrated, then subjected to drying under ambient conditions of temperature and relative humidity on the lab bench and sampled regularly for moisture determination (gravimetric analysis), germination (greenhouse conditions) and changes in macromolecular structure determined by Fourier transform infrared (FTIR) transmission spectroscopy of separate embryo and cotyledon tissues. Germination was highly dependent on moisture content, and severely declined when seed moisture dropped below 17% (fresh weight basis). FTIR spectroscopic analysis revealed significant differences in moisture and lipid profiles between embryo and cotyledon tissue during drying. A strong absorbance near 1740 cm^{-1} in cotyledon tissue indicated a high presence of ester carbonyl groups (storage lipids). Membrane lipid structure exhibited reversible shifts between gel and liquid crystalline phases upon drying and rehydration in both embryos and cotyledons. Irreversible changes in protein secondary structure, illustrated by shifts in the amide absorbance near 1650 cm^{-1}, were the most sensitive indicators of viability loss.

SPARKS, G. B., J. A. AMMIRATI and R. L. EDMONDS. University of Washington, Seattle, WA 98195 USA. **Diversity and consistency of fungal fruiting over three years along clearcut center to forest interior transects in western Washington.**

Timber harvesting in the Pacific Northwest has led to dramatic changes in age and structural complexity of forest stands, and has altered forest patterns at the landscape level as well. We are investigating fungal sporocarp production in mature second-growth conifer stands and adjacent recent clearcuts, particularly as affected by distance from edge. We positioned 1 by 4 m^2 sampling plots at set distances along thirteen different transects running from forest interiors to clearcut centers, and collected mushrooms from those plots during autumn in 1995-1997. Sporocarps were identified and classified by functional group and size: Ectomycorrhizal (receive carbon from tree hosts via roots), large fleshy decomposers (often found on coarse woody debris such as stumps), or small decomposers (commonly colonizing fallen needles). Each taxon on each plot also received a score for consistency, ranging from 1 to 3, depending upon how many years it was found fruiting. Total diversity per plot was occasionally greater than 30 taxa, unexpectedly high for second-growth forests. Average mycorrhizal diversity was consistently high throughout forests, but declined gradually between 1 to 10 meters into clearcuts. Deep in forest interiors (>200 m from edge), relatively few new mycorrhizal taxa were found on plots during the second or third years of sampling. At forest edges, however, nearly equal numbers of new taxa appeared each year. Diversity of large decomposers was low inside forests, but rose abruptly at forest edges and into clearcuts. Small decomposers were equally diverse everywhere along the transects, except for a marked decline in the very centers of clearcuts. Consistency of fruiting showed a similar pattern: In areas where their functional group exhibited high diversity, individual taxa also fruited more reliably from year to year. However, small decomposers were more consistent than either large decomposers or mycorrhizal taxa at any location. It appears that both diversity and consistency of fungal fruiting depends to a large extent upon resource availability, and also upon microclimatic conditions, both of which can vary considerably, sometimes over only a few meters, along forest-to-clearcut transects.

SPEARS, J. D. H., K. LAJTHA, S. B. PENNINGTON, B. A. CALDWELL and K. VANDERBILT. Oregon State University, Corvallis, OR 97331-2902 USA. **Contrasting and comparing the species effects of a nitrogen fixing species, *Ceanothus velutinus*, and a non-nitrogen-fixing species, *Psuedotsuga meziesii*, Douglas-fir, on soil phosphorus and nitrogen properties in the Oregon Cascades .**

Many authors have hypothesized that nitrogen-fixing species, as a functional group, would express different controls on soil properties and ecosystem development than non-nitrogen-fixing species. Although nitrogen (N) accretion under nitrogen-fixing tree species has been well studied, the effect of nitrogen-fixing species on other soil nutrients, such as phosphorus (P), have received less attention. We studied differences in soil phosphorus and nitrogen properties beneath *Ceanothus velutinus* (Ceanothus), a nitrogen-fixing species, and *Psuedotsuga menziesii* (Douglas-fir), a non-fixing species, in a high elevation successional watershed in the H.J. Andrews Experimental Forest, Oregon. Total P was 20 % greater in Douglas-fir soils than Ceanothus soils in surface horizons, but there was no significant difference in deeper soil horizons. Surface soils (5 and 15 cm) under Douglas-fir generally had higher concentrations of specific P fractions than surface soils under Ceanothus, but this difference either disappeared or was not as apparent at greater soil depths (30 and 60cm). Total nitrogen, and extractable ammonium and nitrate were greater in surface soils under Ceanothus than under Douglas-fir. delta^{15}N values of leaves and litter differed between Ceanothus and Douglas-fir (p-value= 0.0001, 0.03 respectively), but the delta^{15}N of bulk soil and KCl extracted nitrate and ammonium did not differ. Soil enzyme activities suggested greater mineralization of organic P (phosphatase activity) under Ceanothus in summer, but not in fall, while no significant differences in general decomposition (b-glucosidase activity) were found in soils between the two species.

SPENCER, S. M., E. E. HACKNEY and J. B. MCGRAW. West Virginia University Morgantown WV 26506 USA. **Effects of natural variation in local density on ginseng.**

The number and proximity of neighbors can have a profound effect on plant life history measures, such as survival and fecundity. Understanding