

**Mediated Settlement Agreement for Sequoia National Forest,
Section B. Giant Sequoia Groves
Master Bibliography**

In the process of data compilation for the evaluation of giant sequoia groves under the Mediated Settlement Agreement, we compiled a digital bibliography for giant sequoia groves on the Sequoia National Forest and for the entire Sierra Nevada. This was done using the bibliographic database program EndNote 2. This master bibliography consists of data that we were not able to include in the printed report due to space constraints. There are over 700 references on giant sequoia ecology and management in the database and an output file of them follows. The data are also contained in the ~ADDENDUM/~A_C08DAT directory in three formats: EndNote 2 database (GS_BIB.EN2), ASCII text (GS_BIB.TXT), and Microsoft Word 6.0 (GS_BIB.DOC).

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Litterfall, decomposition of fine fuel, calorific value of fuel and fuel reduction by controlled burning were studied in plots in pure stands of ponderosa pine, sugar pine (*Pinus lambertiana*), white fir (*Abies concolor*), and giant sequoia (*Sequoiadendron giganteum*) in California. The implications of the results are discussed for fire management in these forest types.
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Baerlocher, F. and J. J. Oertli (1978a). Colonization of conifer needles by aquatic hyphomycetes. *Canadian Journal of Botany* 56(1): 57-62.

Dead needles of *Abies alba*, *Pinus sylvestris*, *P. leucodermis* and *Sequoia gigantea* were immersed in a stream for 28 days and then examined for conidiophores of aquatic hyphomycetes. These fungi colonize untreated needles. Numbers of species and conidiophores were significantly higher on needles treated with steam before immersion than on untreated needles; both values were also higher on cut surfaces (mesophyll) than on intact surfaces (epidermis with cuticle) of longitudinally halved needles. Addition of untreated needle powder (*Sequoia*, *P. leucodermis*) to malt extract agar depressed linear growth of pure cultures of 5 aquatic hyphomycetes [*Anquillospora pseudolongissima*, *Clavariopsis aquatica*, *Lemonniera aquatica*, *Tetracladium marchalianum*, *Tricladium angulatum*]. The inhibition persisted when a 0.1 μm membrane filter was placed between medium and fungal cultures. On water agar, by itself unsuitable for growth, low doses of needle powder allowed growth of the same fungi. At higher doses, inhibition again became predominant. Steam distillation of needle powder yielded 3 fractions: solid residue, soluble residue and steam distillate. Steam distillate did not influence fungal growth on the 2 media, while the other 2 fractions supported growth on water agar but did not lead to a clear dosage-effect curve on malt extract agar

Baerlocher, F. and J. J. Oertli (1978b). Inhibitors of aquatic hyphomycetes in dead conifer needles. *Switz. Mycologia* 70(5): 964-974.

Needle powders of *Pinus leucodermis* and *Sequoia gigantea* were extracted with petroleum ether, ethanol, methanol, or distilled water. After evaporating the solvents, extracts and extracted powder were added to nutrient medium to examine their effect on linear expansion of 5 aquatic Hyphomycetes [*Anquillospora pseudolongissima*, *Clavariopsis aquatica*, *Lemonniera aquatica*, *Tetracladium marchalianum* and *Tricladium angulatum*]. All extracts depressed fungal growth, the inhibition being strongest with the 2 alcoholic extracts. The FeCl_3 test indicated phenolic compounds in the alcohol and water but not in the petroleum-ether extracts. There was no correlation between the colorimetrically determined phenol content of an extract and its antifungal activity. Untreated needle powder strongly inhibited fungal growth, as did petroleum-ether or water-extracted powder. By contrast, alcohol-extracted powder did not inhibit fungal growth. The inhibitory effect of methanol extract was much more pronounced at a pH range of 4.0-4.5 than at 5.5-6.5

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- The selections of trees and shrubs which are most valuable and most adapted to local site conditions were described. The list contained 669 spp. and varieties of woody plants. This is connected with the need to popularize many new ornamental varieties and new varieties adapted to particularly difficult urban environments. The tree plantings in the new open municipal districts require diversification since a greater assortment of various species and varieties is possible. In Poland, 5 climatic regions were delineated: the western zone, the transitory zone, the eastern zone, the southern sub-montane zone and the montane zone. The western climatic zone favored the introduction of many ornamental trees and shrubs known for their sensitivity to winter frosts although exotic trees such as ebony (*Diospyros lotus*), bamboos (*Sinarundinaria nitida*) or sequoias (*Sequoiadendron giganteum*) can be grown. The transitory zone has an intermediate climate. The eastern zone has a cold, more continental climate. The vegetative period is almost 2 mo. shorter than within the neighboring zones (Tarnow, Pszczyna). Only woody plants can grow there which are adapted to long lasting very cold and windy winters, e.g., *Acer negundo*, *Physocarpus opulifolius* and *Rhus typhina*. The submontane zone is defined by other climatic factors. The Subcarpathian valleys and the Silesian lowland belong to the warmest regions of Poland. This characteristic, the abundance of precipitation and the most intense solar radiation throughout Poland permit the introduction of many valuable trees and shrubs from genera *Magnolia*, *Deutzia*, *Weigela*, *Juglans* and others. The montane zone is different, covering the lower reaches of the Carpathian and Sudety Mountains. Successful cultivation of various species including some evergreen ones like those from genera *Rhododendron*, *Pieris* and *Chamaecyparis* is possible
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- The beneficial influence of activated charcoal (AC) (20 gl-1), added to the basal culture medium, was noted for in vitro growth and further rooting of microcuttings collected from juvenile clones of *Sequoiadendron giganteum*. During the elongation phase on the medium containing AC, the growing upper part of the juvenile clone microcuttings contained less polyphenols than the lower part, while this difference was not observed in mature material. Plantlets growing on AC-free medium had almost identical polyphenol levels, which greatly increased after the seventh week of culture both in the tissues and the medium. The effect of AC on microcutting growth as well as the significance of polyphenols for micropropagation are discussed
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Adenine and guanine nucleotide contents of isolated apices collected from a juvenile and a mature clone of *Sequoiadendron giganteum* (Lindl.) Buchholz during budbreak were determined. GDP and GTP contents were significantly higher in the juvenile clone apex than in the mature ones, whereas there was no difference in ATP concentration between the two materials. In vivo, induction of protein synthesis was similar in the two clones after 10 min of [³⁵S]-methionine labeling. The increase of [³⁵S]-methionine-tRNAs and labeled proteins continued up to 30 min for the juvenile clone. They markedly declined for the mature clone after 10 min. Only the diminution of this in vivo protein synthesis was well correlated with a decrease in GTP content

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Bonnicksen, T. M. and E. C. Stone (1980). Reconstructing presettlement forests in National Parks: a new approach. 2nd Conference on Scientific Research in National Parks, San Francisco, CA, National Park Service.

Bonnicksen, T. and E. C. Stone (1981). The giant sequoia - mixed conifer forest community characterized through pattern analysis as a mosaic of aggregations. *Forest Ecology and Management* 3(4): 307-328.

This hypothesis was examined using 5-point pattern analysis techniques. The results showed statistically significant levels of contagion for most of the tree classes analyzed, thereby demonstrating the presence of aggregations in the giant sequoia-mixed conifer forest community. Both distance and quadrat methods of analysis also showed that older and larger trees have a tendency to be uniformly dispersed. Aggregations tended to decrease in size as the age of the trees increased. However, giant sequoia was unique in that its aggregations did not tend to decrease in size as the trees grew older. The quadrat methods also showed that most aggregations in the giant sequoia-mixed conifer forest community range in size 135-1600 m². These results are compared with the pattern produced by a prescribed burn designed to reduce fuels and restore natural conditions. The prescribed burn reduced the density of trees but it did not significantly alter the pattern of trees in the 41-60 yr and older age classes. The management implications of these findings are discussed

Bonnicksen, T. M. and E. C. Stone (1982a). Managing vegetation within U.S. National Parks: A policy analysis. *Environmental Management* 6(2): 101-102 and 109-122.

The development of management policies is briefly traced from 1872, and ambiguities in legislation are described and partially resolved. Alternative objectives put forward by the Park Service, aiming at restoring or maintaining natural conditions, are evaluated using data from a giant sequoia (*Sequoiadendron giganteum*)/mixed conifer forest in Kings Canyon National Park, California [see FA 43, 2232]. It is concluded that structural maintenance objectives (those aiming to maintain the vegetation in its current state, or restore it to its presettlement state and maintain it there) are not biologically feasible since this forest community is not in a steady state. Process maintenance objectives, allowing succession to continue in the current vegetation, or after restoration to a presettlement condition, are, therefore, preferred. A new option is also presented, based on a high resolution description of the presettlement forest community and named the reconstruction-simulation approach.

Bonnicksen, T. M. and E. C. Stone (1982b). Reconstruction of a presettlement giant sequoia-mixed conifer forest community using the aggregation approach. *Ecology* 63(4): 1134-1148.

The presettlement state of a giant sequoia-mixed conifer forest community in the Redwood Creek watershed, Kings Canyon National Park [USA] is reconstructed using a backward projection in time of plant aggregations. The most conspicuous change in the forest community from the presettlement condition (.apprx. = 1890) was a general increase in the area of aggregations dominated by pole-size trees and mature trees, and a corresponding decrease in the area of aggregations dominated by sapling- and seedling-size trees. Aggregations dominated by white fir had both the greatest decline in area for sapling and seedling aggregations and the greatest increase in area for large mature, mature, and pole aggregations of any species in the watershed. The area of aggregations dominated by shrubs also declined, with manzanita aggregations showing the largest loss in area for any shrub species. Hardwoods were also a far more important part of the presettlement forest community than they are today

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Second-stage larvae of *R. sequoiae* tunnel through the cortex of the redwood *Sequoia sempervirens* (D. Don) Endl. root to the vascular tissue where each developing female induces a single ovoid or occasionally spherical giant cell with a single ovoid to spherical nucleus containing 1-4 enlarged nucleoli. Nematode tunnels are filled with a gel material and often contain 2nd-stage larvae and males. There is tissue necrosis around females, and cortical tissue is destroyed after infection by many 2nd-stage larvae. *R. sequoiae* females developed to maturity on *S. sempervirens*, *Acer macrophyllum* Pursh, *Alnus rhombifolia* Nutt., *Libocedrus Torr*, *Pseudotsuga menziesii* (Mirb.) Franco and *Sequoiadendron giganteum* (Lindl.) Decne. In the Marin County, California [USA], forest mature females were also found naturally infecting *Lithocarpus densiflorus* (Hook and Arn.) Rehd., *Umbellularia californica* (Hook and Arn.) Nutt., and *Arbutus menziesii* Pursh
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Tests on samples removed from bolts cut at 8 ft and 20 ft above stump level from a leaning suppressed tree and tested by ASTM methods indicated that many of the strength properties of compression wood in both the green and dry state were at least equal, if not considerably superior, to those of the matched samples of normal wood. However, when specific strengths and stiffness were compared, the compression-wood samples showed lower values than normal wood, which in turn showed lower values than opposite or tension wood.
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Reports a detailed anatomical study of compression wood in *Sequoia gigantea*, in which it is an uncommon feature. Late-wood tracheids in compression wood had pit canals that flared towards the lumen. Boiling and drying of compression-wood blocks induced split extensions at the pit-aperture grooves. The mean S2 fibril angle of 21-25 deg (maximum 32 deg) was considerably lower than the value (45 deg) reported in other species. The greater fibril angles of compression wood may be responsible for greater axial shrinkage and lower tangential shrinkage. The low tangential/radial shrinkage ratio is an important physical deviation from normal wood. The magnitude of shrinkage is influenced by the manner of drying, and differs between sapwood and heartwood.

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Seven packrat midden samples make possible a comparison between the modern and late Pleistocene vegetation in Kings Canyon on the western side of the southern Sierra Nevada. One modern sample contains macrofossils and pollen derived from the present-day oak-chaparral vegetation. Macrofossils from the 6 late Pleistocene samples record a mixed coniferous forest dominated by the xerophytic conifers *Juniperus occidentalis*, *Pinus* cf. *ponderosa* and *P. monophylla*. The pollen spectra of these Pleistocene middens are dominated by *Pinus* sp., *Taxodiaceae-Cupressaceae-Taxaceae* (TCT) and *Artemisia* sp. Mesophytic conifers are represented by low macrofossil concentrations. *Sequoiadendron giganteum* is presented by a few pollen grains in the full glacial. Edaphic and snow dispersal are the most likely causes of these mixed assemblages. The dominant macrofossils record a more xeric plant community than those that now occur on similar substrates at higher elevations or latitudes in the Sierra Nevada. These assemblages suggest that late Wisconsin climates were cold with mean annual precipitation not necessarily greater than modern values. A model of low summer ablation allowing for the persistence of the glaciers at higher elevations during the late Wisconsin was supported. *S. giganteum* may have grown at lower elevations along the western side of the range and *P. monophylla* may have been more widely distributed in cismontane California during the Pleistocene

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Results are reported from 2 plots out of 9 established in 1952-3 to observe growth and mortality. These contained high proportions of second growth Sierra redwood (*Sequoiadendron giganteum*): 45% in one plot (31-yr-old); and 90% in the other (86-yr-old). Total vol., ingrowth, mortality and p.a.i. and m.a.i. are tabulated for stand ages of 7 to 86 years. Growth rates were similar to those of second growth mixed conifer stands in the Westside Sierra region.

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- The establishment of the botanic garden of the Higher Institute of Forest Engineering, Sofia, dates since 1964. Investigations are conducted on the growth in height and diameter of the oldest trees from 19 gymnospermous exotic species: *Abies cephalonica* Loud., *Abies concolor* Lindl. et Gord., *Abies nordmanniana* (Stev.) Spach., *Cedrus libani* Laws., *Chamaecyparis lawsoniana* Parl., *Chamaecyparis pisifera* (S. et Z.) Endl., *Ginkgo biloba*, L., *Libocedrus decurrens* Torr., *Metasequoia glyptostroboides* Hu et Cheng., *Picea pungens* Dougl., *Pinus ponderosa* Dougl., *Pinus strobus* L., *Pseudotsuga menziesii* (Mirb.) Franco, ssp. *glaucescens*, *Pseudotsuga menziesii* (Mirb.) Franco, ssp. *menziesii*, *Sequoiadendron giganteum* (Lindl.) Buchh., *Taxodium distichum* (L.) Rich., *Thuja gigantea* Nutt., *Thuja occidentalis* L., *Thuja orientalis* L. Most intensive growth in diameter is manifested by *Sequoiadendron giganteum*. s.d. 1,25 cm mean annual increment at the age of 20 years and *Cedrus libani*. s.d. 1,00 cm at the same age. Most intensive growth in height is manifested by *Cedrus libani*. s.d. 49 cm mean annual increment at the age of 20 years and *Pinus strobus*. s.d. 14 cm at the same age
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Reports the results of experiments in which 1-month-old seedlings of *Sequoia sempervirens* and *S. gigantea* were exposed to seven species of plant-parasitic nematodes. *Heterodera schachtii* was the only species that had not infected the trees after 2 months. The top-growth of both tree species was reduced by *Pratylenchus penetrans* and *P. vulnus*. The development of these nematodes on both tree species may hinder natural or artificial regeneration.
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Not all forest bird species breeding on Redwood Mountain, Tulare County, California [SA] in the 1930s are still there in the 1980s. Over the 50 years virgin giant sequoia forest of the saddle and east slope (within Kings Canyon National Park) remains unchanged but has lost the Olive-sided Flycatcher (*Contopus borealis*). The mixture of old and second-growth sequoias of Whitaker's Forest, where pines and undergrowth were removed and snags eliminated, is missing the Mountain Quail (*Oreotyx pictus*), Flammulated Owl (*Otus flammeolus*), North Pygmy-Owl (*Glaucidium gnoma*), Spotted Owl (*Strix occidentalis*), Hairy Woodpecker (*Picoides villosus*), and Olive-sided Flycatcher. Though unchanged today, the riparian alders of Eshom Creek on the west slope have lost Swainson's Thrush (*Catharus ustulatus*). Drastic logging by Sequoia National Forest has driven all of the above from the west slope ponderosa pine forest that surrounds Whitaker's Forest. New birds established at Whitaker's Forest by 1986 are the Common Raven (*Corvus corax*), House Wren (*Troglodytes aedon*), and Lincoln's Sparrow (*Melospiza lincolni*). Intrusion of Brown-headed Cowbirds (*Molothrus ater*) has begun within yet affecting two abundant species of vireos. The Pileated Woodpecker (*Dryocopus pileatus*) is reduced; the Winter Wren (*Troglodytes troglodytes*) has greatly increased. I attempt to explain avifaunal changes by comparing habitats over the 50-year interval. Disappearance of the flycatcher and thrush from unchanged, prime habitat must be caused by destruction of corresponding forests in Central America, where these birds maintain their winter territories

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The endophytous mycorrhizae of vesicular-arbuscular type were described in fine roots of *S. gigantea* and *S. sempervirens*. Fine roots were of 2 types: thin smooth white, and thick and of a brown color. The mycorrhizal infection was intense in thick brown roots, whereas white roots had light infection. The optimal development of endophyte hyphae was observed in the central and inner cortical cell layers of root. There were arbuscules and vesicles in the root parenchyma. Coiled intracellular hyphae measured 3.45-8.95 μm in diameter. The roots had no root hairs

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Four provenances of giant sequoia (*Sequoiadendron giganteum* (Lindl.) Buchh.) originating from the counties Fresno, Calaveras, Tulare and from Sequoia National Forest in California [USA] were tested on three sites in the Federal Republic of Germany (Rengsdorf/Rhineland Palatinate; Reinhausen/Lower Saxony; and at Grosshansdorf/Schleswig-Holstein). At age 14 years differences in survival between locations and provenances were ascertained. At the trial in Grosshansdorf survival was influenced particularly by frost damage in a frost pocket and a following infection by *Armillaria mellea* (Vahl) Karst. In spite of the small number of provenances there were significant differences in height, d.b.h. and diameter at half tree height between provenances and locations. The provenance Tulare which is known from other trials to perform well proved to have inferior growth and survival up to age 14 years. At the trial at Rengsdorf height growth was slightly negatively correlated with the altitude at the seed origin. A prerequisite for establishing stands of giant sequoia at a commercial scale is the choice of frost hard (and well performing) provenances. Such stands might be promising at suited sites in the Federal Republic of Germany

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Seedlings of 12 species and two hybrids were grown in greenhouses with carbon-filtered air at Lake Arrowhead, S. California. Fumigation treatments were begun at 2 years old. The conditions of growth and fumigation simulated those of a mountainous area of severe O₃ damage to native species. Evaluation of needle injury (mottle, necrosis and abscission) required not less than 42 seedlings of each species. In *Pinus ponderosa*, one-year-old needles were damaged 3 times as much as current-year needles, and fumigations begun in mid-Aug. resulted in the greatest injury. The

species were, in order of decreasing susceptibility: *P. monticola*, *P. jeffreyi* X *P. coulteri*, *Abies monticola* [*A. magnifica* ?], *P. radiata* X *P. attenuata*, *P. ponderosa* [Californian], *P. coulteri*, *Pseudotsuga menziesii*, *Pinus jeffreyi*, *P. ponderosa* (Rocky Mountain), *A. concolor*, *Pseudotsuga macrocarpa*, *Pinus attenuata*, *Libocedrus decurrens*, *Pinus lambertiana*, and *Sequoia gigantea*

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- Nucleoside triphosphate and nucleic acid contents of shoot tips of juvenile and mature clones of *Sequoiadendron giganteum* Buchholz were analyzed during rest and growth phases. In both juvenile and mature clones, shoot growth activity was characterized by significant increases in ATP, non-adenylic nucleoside triphosphate (NTP) and RNA levels. During the rest period, both ATP/NTP and RNA/DNA ratios were significantly higher in the juvenile clone than in the mature clone. However, during the growth phase, only the ATP/NTP ratio was higher in the juvenile than in the mature clone. The results suggest that the physiological differences between shoot tips of juvenile and mature tissues during the rest phase tend to decline as active shoot growth commences. This conclusion is consistent with morphological observations and with the varying organogenetic capacities of in vitro cultures of explants removed from stock plants at different times
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- Pines are considered the most important group of conifers and *Cedrus deodara* the most important individual species for urban planting. *C. libani* and *C. atlantica*, *Sequoiadendron giganteum* [*Sequoia gigantea*] and *Tsuga heterophylla* are most likely to produce large specimens. *C. atlantica*, *T. canadensis* and *Abies grandis* are recommended for thin soils over chalk. *Pinus nigra* is excellent for screening and general landscaping. The advantages of 11 other *Pinus* species are discussed. *Abies*, *Picea*, *Cryptomeria*, *Calocedrus* [*Libocedrus*] and *Thuja* are more useful in formal plantings than in landscaping, but are not suitable for industrial or exposed areas. *Abies homolepis* and *A. numidica* are fairly successful under urban conditions.

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- Many phylogenetically ancient plant forms can synthesize chlorophyll in the absence of light at early ontogenetic stages. This ability was studied in the representatives of Gymnospermae, both relict and phylogenetically advanced forms. Using low-temperature fluorometry, 12 [*Ginkgo biloba*, *Podocarpus macrophyllus* D., *Picea abies* Karts., *Cedrus deodara* Lond., *Pinus sylvestris* L., *Larix sibirica* L., *Cryptomeria japonica* L., *Sciadopitys verticillata* L., *Sequoia sempervirens* Lamb., *Sequoiadendron giganteum* Linde., *Metasequoia glyptostroboides* Hu et Hung, *Cercediphyllum manigifum* Kai., *Zelcova serrata* Spach, *Arbutus andrachue* A. L. de Juss and *Callistemon lanceolata* A. L. de Juss spp. of Coniferophyta were compared. Representatives of all the families studied (Ginkgoaceae, Pinaceae, Taxodiaceae, Podocarpaceae) are able, at a stage of primary leaves, to accumulate in the dark chlorophyll forms differing in the degree of molecular aggregation. In the relict angiosperms studied this ability was absent. A nonphotochemical pathway of chlorophyll biosynthesis is apparently present at the earliest stages of the evolution of Gymnospermae, which might be connected with germination conditions of the latter. Preservation of the ability for chlorophyll synthesis in the darkness at the seedling stage in now living species of Pinaceae and Taxodiaceae might point to a considerable adaptive lability of these plants. Further investigation into the peculiarities of formation of the pigment apparatus of coniferous plants will contribute to elucidation of some plant evolution problems

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- The Mlynany Arboretum, founded in 1892, is the richest in respect to the number of species among the numerous parks, botanical gardens and arboreta in Slovakia [Czechoslovakia]. In 1967 there were 1658 species, varieties and forms in this arboretum. At present there are over 2000 spp. in the collection. The Kysihybel Arboretum contains 197 spp., varieties and forms. The Bratislava (638 spp.), Martin (273 spp.), Kosice (265 spp.), and Banska Stiavnica (264 spp.) Botanical Gardens and J. Kral Gardens in Bratislava (254 spp.) are worth visiting. The Topolcianky (299 spp.) and Piestany (216 spp.) parks are notable. A dendrological singularity in Slovakia, and possibly in Czechoslovakia, is a specimen of *Citrus trifoliata* L. growing in the open. The largest and oldest sequoia (*Sequoiadendron giganteum* Buchholz) is in a small park in Antol, and in Banska Stiavnica there are the largest cedars, *Cedrus atlantica* Man. and *C. libani* Loud.
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Fire suppression (100 yr) in a mixed-conifer forest which evolved with frequent natural fires has shifted successional patterns, increased the density of small trees, and produced an unnatural accumulation of ground fuels. Analysis of species composition, vegetation structure and age distribution in each of 4 forest types within the mixed-conifer zone of Sequoia and Kings Canyon National Parks, California, USA, has documented a substantial increase in young, shade tolerant white fir [*Abies concolor*] in each type. The original dominant species have decreased in relative abundance in most cases. The sequoia type has been most affected by the fire suppression policy. Giant sequoia [*Sequoiadendron giganteum*] show poor reproduction in the absence of fire. The sequoia type also exhibits the greatest accumulation of ground fuels. The ponderosa pine [*Pinus ponderosa*], white fir and mixed forest types also show successional changes as well as significant accumulations of flammable ground fuels following a century of fire exclusion. The management implications of these findings are discussed.

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A new taxodiaceous ovulate cone, AUSTROSEQUOIA wintonensis gen. et sp. nov., is described from the area of Winton, Queensland, Australia. The material is believed to come from the Upper Cretaceous but may be younger. The cones have 29-49 cone scales arranged helically around the axis. Each scale has 4-7 ovules arranged in a single row. Reproductive shoot leaves are rhomboidal with an incurved apex and a distinct keel. Comparison with extant taxodiaceous genera indicate a strong similarity to Sequoia sempervirens (D. Don) Endl. and Sequoiadendron giganteum (Lindl.) Buchholz. Only limited similarities are observed with species of the Australian endemic Athrotaxis. The deposit also contains conifer pollen cones, ferns, and angiosperm remains which are yet to be described

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Litterfall was measured for 4 years and leaf litter decomposition rates were studied for 3.6 years in two mixed conifer forests (giant sequoia - fir and fir-pine) in the southern Sierra Nevada of California. The giant sequoia - fir forest (GS site) was dominated by giant sequoia (*Sequoiadendron giganteum* (Lindl.) Buchh.), white fir (*Abies concolor* Lindl. & Gord.), and sugar pine (*Pinus lambertiana* Dougl.). The fir-pine forest (FP site) was dominated by white fir, sugar pine, and incense cedar (*Calocedrus decurrens* (Torr.) Florin). Litterfall, including large woody debris < 15.2 cm in diameter, at the GS site averaged 6364 kg .cntdot. ha-1 .cntdot. year-1 compared with 4355 kg .cntdot. ha-1 .cntdot. year-1 at the FP site. Compared with other temperate coniferous forests, annual variability in litterfall (as computed by the ratio of the annual maximum/minimum litterfall) was extremely high for the GS site (5.8:1) and moderately high for the FP site (3.4:1). In the GS site, leaf litter decomposition after 3.6 years was slowest for giant sequoia (28.2% mass loss), followed by sugar pine (34.3%) and white fir (45.1%). In the FP site, mass loss was slowest for sugar pine (40.0%), followed by white fir (45.1%), while incense cedar showed the greatest mass loss (56.9%) after 3.6 years. High litterfall rates of large woody debris (i.e., 2.5-15.2 cm diameter) and slow rates of leaf litter decomposition in the giant sequoia - fir forest type may result in higher litter accumulation rates than in the fir-pine type. Leaf litter times to 95% decay for the GS and FP sites were 30 and 27 years, respectively, if the initial 0.7-year period (a short period of rapid mass decay) was ignored in the calculation. A mass balance approach for total litterfall (< 15.2 cm diameter) decomposition yielded lower decay constants than did the litterbag study and therefore longer times to 95% decay (57 years of the GS site and 62 years for the FP site)

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The factors influencing leaf litter decomposition and nutrient release patterns were investigated for 3.6 years in two mixed conifer forests in the southern Sierra Nevada of California. The giant sequoia - fir forest was dominated by giant sequoia (*Sequoiadendron giganteum* (Lindl.) Buchh.), white fir (*Abies concolor* Lindl. & Gord.), and sugar pine (*Pinus labertiana* Dougl.). The fir-pine forest was dominated by white fir, sugar pine, and incense cedar (*Calocedrus decurrens* (Torr.) Florin). Initial concentrations of nutrients and percent lignin, cellulose, and acid detergent fiber vary considerably in freshly abscised leaf litter of the studied species. Giant sequoia had the highest concentration of lignin (20.3%) and the lowest concentration of nitrogen (0.52%), while incense cedar had the lowest concentration of lignin (9.6%) and second lowest concentration of nitrogen (0.63%). Long-term (3.6 years) foliage decomposition rates were best correlated with initial lignin/N ($r^2 = 0.94$, $p < 0.05$), lignin-concentration ($r^2 = 0.92$, $p < 0.05$), and acid detergent fiber concentration ($r^2 = 0.80$, $p < 0.05$). Patterns of nutrient release were highly variable. Giant sequoia immobilized N and P, incense cedar immobilized N and to a lesser extent P, while sugar pine immobilized Ca. Strong linear or negative exponential relationship existed between initial concentrations of N, P, K, and Ca and percent original mass remaining of those nutrients after 3.6 years. This suggests efficient retention of these nutrients in the litter layer of these ecosystems. Nitrogen concentrations steadily increase in decomposing leaf litter, effectively reducing the C/N ratios from an initial range of 68-96 to 27-45 after 3.6 years

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Camponotus modoc was associated with numerous species of Homoptera in Giant Forest, Sequoia - Kings Canyon National Park, California [USA]. Ant-exclusion experiments and field observations indicated that survival of the abundant *Cinara occidentalis* Davidson on white fir depends on attendance by *Camponotus modoc*. More of the predators, *Neomysia oblonguttata* (Mulsant), *Deraeocoris brevis* Uhler, *Passaloecus cuspidatus* F. Smith, *Pityophyphantes* sp., were found on ant-unattended than on attended aphid colonies. As aphid populations decreased, ant attendance per aphid and number of predators/aphid increased. Attended aphid colonies were more likely to survive to produce oviparae and a lower proportion of alates

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The proportion of large *Camponotus modoc* workers returning to the nest with solid food was significantly less than that of smaller workers. The average weight of ants collected at colonies of the aphid *Cinara occidentalis* was significantly less than the average weight of ants collected in the vicinity of the ant nest. These data and additional observations suggest that small ants are more likely to attend aphids and transport solid food than are large ants. Some large ants may specialize in honeydew transport. Mark-and-recapture studies showed that workers of *Camponotus modoc* returned to the same trunk trails and aphid colonies from which they had previously been removed. When relocated to either the base of the tree or to the nest entrance, some workers demonstrated a capacity to recognize the original aphid colony from among as many as eight other colonies in the same tree. Some ants were observed on the same aphid colony for long periods

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Metasequoia glyptostroboides, K (22) =

2Am+2Bm+2Cm+2Dm+2Em+2Fm+2scGm+2Hm+2scIm+2J+m+2sc Km; *Taiwania*

cryptomerioides, K (22) = 2Am+2Bm+2scCm+2Dm+2Em+2Fm+2Gm+2Hsm+2

Ism+2Jm+2Ksm+2Ksm;

Sequoiadendron

giganteum,

K

(22)

= 2Am+2Bm+2Cm+2Dm+2Em+2Fm+2Gm+2Hm+2Ism+2Jm+2SscKm. The

karyotype of *Sequoia sempervirens* Endl. has not been determined yet, but this species has been confirmed to have 6 telomeres trabants just like *Cunninghamia lanceolata* (Lamb.) Hook.

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