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Chapter 1 : Tree Growth Study

GROWTH STUDIES IN FOREST TREES 2. PINUS STROBUS L. H. P. BROWN Object and scope of the investigation (WITH PLATES XIII AND XIV AND TWO GRAPHS).

Search Forests Growth Rates of Old vs. Young Trees -- Summary The planting and preservation of forests has long been acknowledged to be an effective and environmentally-friendly means for slowing climate-model-predicted CO_2-induced global warming. This prescription for moderating potential climate change is based on two well-established and very straightforward facts: Although simple enough that a child can understand it, this potential partial solution to the putative global warming problem has been under attack for several years by people who seek to address the issue solely on the basis of forced reductions in anthropogenic CO_2 emissions see Pearce, The tack they take in this campaign is to claim that carbon sequestration by forests is only viable when forests are young and growing vigorously; for as forests age, according to the regulatory-minded pundits, they gradually lose their carbon sequestering prowess, such that forests more than one hundred years old become essentially useless for removing CO_2 from the air, as they claim that such old and decrepit stands yearly lose as much CO_2 via respiration as what they acquire via photosynthesis. As with all things, thankfully, real-world data typically tell the truth. So what do we learn about the matter from actual measurements made on older real-world trees? In Panama Condit et al. At a hundred or so years of age, these super-slurpers of CO_2 are mere youngsters. And in their really old age, their appetite for the vital gas, though diminished, is not lost. In fact, Chambers et al. And the protracted slow growth evident in yearly increasing trunk diameters of very old and large trees can absorb a huge amount of CO_2 out of the air each year, especially when - as noted by Chanbers et al. Consequently, since the life span of these massive long-lived trees is considerably greater than the projected life span of the entire "Age of Fossil Fuels," their cultivation and preservation represents an essentially permanent partial solution to the perceived problem of the dreaded global warming that climate alarmists ascribe to anthropogenic CO_2 emissions. This little-acknowledged piece of information is the fact that it is the forest itself - conceptualized as a huge super-organism, if you will - that is the unit of primary importance when it comes to determining the ultimate amount of carbon that can be sequestered on a unit area of land. That this difference in perspective can have enormous consequences was demonstrated quite clearly by Cary et al. So what was the explanation for the huge discrepancy? They also noted that by not including effects of size- or age-dependent decreases in stem and branch respiration per unit of sapwood volume in models of forest growth, respiration in older stands can be over-estimated by a factor of two to five. How serious are these model shortcomings? For the real-world forests studied by Cary et al. And as the forests grew older still, the difference between reality and model projections grew right along with them. Another study about the suitability of forests to act as long-term carbon sinks was conducted by Lou et al. A number of papers describing different facets of this long-term study have been published; and as recounted by Lou et al. Another study that supports the long-term viability of carbon sequestration by forests was conducted by Paw U et al. Throughout this period, the fourteen scientists reported "there were no monthly averages with net release of CO_2," and that the cumulative net ecosystem exchange showed "remarkable sequestration of carbon, comparable to many younger forests. Consequently, in response to the question they posed when embarking on their study - "Do old forests gain or lose carbon? Similar results were obtained by Hollinger et al. The answer is rather simple. For any tree of age years or more, the greater portion of its life at least two-thirds of it was spent in an atmosphere of much-reduced CO_2 content. And for older trees, even greater portions of their lives were spent in air of even lower CO_2 concentration. Hence, the "intervention" that has given new life to old trees and allows them to "live long and prosper," would appear to be the aerial fertilization effect produced by the flooding of the air with the CO_2 that resulted from the Industrial Revolution and that is currently being maintained by its ever-expanding aftermath Idso, Based on these many observations, as well as the results of the study of Greenep et al. And subsequent reports have validated this assessment. Forging forward, for example, Zhou et al. In doing so, they determined that "in forests between 15 and years old, the NEP is usually positive; that is, the forests are CO_2 sinks. About this same time, Phillips et al. They went on, however, to demonstrate that this view was far from the truth. The three researchers begin their analysis of the subject by stating that "hydraulic constraints in tall trees," such as those of great age, "constitute a fundamental form of water limitation; indeed, one that is indistinguishable from soil water limitations," citing the work of Koch et al. They also reported that "recent research indicates that tree size and its hydraulic correlates, rather than age per se, controls carbon gain in old trees," as indicated by the study of Mencuccini et al. These findings implied, in their words, that "factors that alleviate internal or external resource constraints on old trees could improve physiological function and ultimately growth," which is something elevated CO_2 does quite well by increasing plant water use efficiency. In fact, they listed several phenomena that suggest "a fundamental potential for old growth trees to show greater photosynthesis and growth under industrial age increases in CO_2 than they would under constant, pre-industrial CO_2 levels. Just one year later, Phillips et al. Against the backdrop of this very positive phenomenon, the goal of Phillips et al. Adapted from Phillips et al. As may readily be seen from these real-world measurement-based results, the great Amazonian drought of resulted in only a slight hiatus in the strong upward trend of tree biomass accumulation that was exhibited over the prior two decades, which had occurred, as Phillips et al. Hence, it would appear that although extremely severe drought conditions can indeed bring a temporary halt to biomass accumulation in old growth tropical forests - and sometimes even lead to minor reductions in biomass due to selective tree mortality - the vast majority of the trees are able to regain their photosynthetic prowess and add to their prior store of biomass once the moisture stress subsides, thanks in large measure to the enhanced growth Lin et al. Additional support for this attribution is provided by the work of Lloyd and Farquhar , who concluded that "the magnitude and pattern of increases in forest dynamics across Amazonia observed over the last few decades are consistent with a CO_2-induced stimulation of tree growth," while still more support for the premise has come from the work of Phillips et al. This work revealed, as they described it, that "aboveground carbon storage in live trees increased by 0. There, in addition to their micrometeorologically-based eddy flux carbon budget estimation, the six scientists conducted a tree inventory of one hectare of forest located within the footprint of the eddy flux tower they employed in November of and again in November of , after which they compared measurements of tree diameter at breast height DBH between the two times and employed site specific allometric equations to derive mean yearly biomass production from the measurements obtained at the two times, while they also assessed aboveground litter production via the amount captured each year in 25 litter traps that were randomly distributed within the one-hectare plot. As a result of their efforts, Tan et al. Clearly, therefore, the old notion of old trees contributing next to nothing to global carbon sequestration is manifestly invalid. They are ever hard at work, doing what they do best, sucking CO_2 out of the air, and growing! Increasing biomass in Amazonian forest plots. Tree biomass and net increment in an old aspen forest in New Mexico. Forest Ecology and Management Are old forests underestimated as global carbon sinks? Global Change Biology 7: Ancient trees in Amazonia. Tree age structure in tropical forests of central Amazonia. Ecology and Conservation of a Fragmented Forest. Variability and recent trends in the African carbon balance. Mortality-rates of neotropical tree and shrub species and the impact of a severe drought. Old-growth Douglas-fir and western hemlock: Western Journal of Applied Forestry 2: Comparing net ecosystem exchange of carbon dioxide between an old-growth and mature forest in the upper Midwest, USA. Agricultural and Forest Meteorology Seasonal CO_2 assimilation and stomatal limitations in a Pinus taeda canopy with varying climate. Interannual variability of carbon and energy fluxes for an old-growth rainforest. Proceedings of the 25th Conference on Agricultural and Forest Meteorology. North American Terrestrial Vegetation. Thirty-six years of tree population change in an old-growth Pseudotsuga-Tsuga forest. Canadian Journal of Forest Research Climate-carbon cycle feedback analysis: Journal of Climate Subalpine tree growth, climate, and increasing CO_2: A network of high elevation conifers in the western US for detection of tree-ring growth response to increasing atmospheric carbon dioxide. Detecting the aerial fertilization effect of atmospheric CO_2 enrichment in tree-ring chronologies. Global Biogeochemical Cycles 7: Response of photosynthesis in second-generation Pinus radiata trees to long-term exposure to elevated carbon dioxide partial pressure. CO_2 fluxes over an old temperate mixed forest in northeastern China. Forest carbon balance under elevated CO_2. Carbon dioxide exchange between an undisturbed old-growth temperate forest and the atmosphere. Modeling the interannual variability and trends in gross and net primary productivity of tropical forests from to Global and Planetary Change CO_2 and the Biosphere: The Incredible Legacy of the Industrial Revolution. Long-term temperature trends and a positive departure from the climate-growth response since the s in high elevation lodgepole pine from California. Tree-ring analysis and conifer growth responses to increased atmospheric CO_2 levels. Detecting potential regional effects of increased atmospheric CO_2 on growth rates of western juniper. Large carbon uptake by an unmanaged year-old deciduous forest in Central Germany. The limits to tree height. Modeling nighttime ecosystem respiration by a constrained source optimization method. Global Change Biology 8: Increasing atmospheric carbon dioxide: Long-term variation in Amazon forest dynamics. Journal of Vegetation Science Inferred longevity of Amazonian rainforest trees based on a long-term demographic study. Carbon dioxide and water vapor exchange by young and old ponderosa pine ecosystems during a dry summer. Increasing carbon storage in intact African tropical forests. Concerted changes in tropical forest structure and dynamics:

Chapter 2 : Forest - Wikipedia

5. Growth in white pine is divisible into (a) growth without cell division and (b) growth with cell division. The first begins as early as March and the elements concerned (phloem) increase in radial diameter from 50 to over per cent. The awakening of growth is due apparently to the rise of soil water with an accompanying increase in temperature.

Study shows how pollution affects tree growth June 13, As trees leafed out this spring, an international group of researchers is headed to northern Wisconsin to continue a long-term study that is revealing how air pollution affects northern forests. The study also is providing insights into the role forests may play in global climate change. The scientists are finding that carbon dioxide and ozone dramatically alter tree growth, says Eric Kruger , a UWâ€"Madison forest ecologist participating in the project. The gases also may change forest ecology and diversity in the long term. Carbon dioxide is increasing around the world. Ozone levels also are rising. Elevated ozone levels are now common across much of the eastern United States. Increases in both gases can be traced to our reliance on fossil fuels. Experts predict that concentrations of these gases will double in the next years, with high ozone levels spreading over much of Wisconsin. The forest scientists are studying how quaking aspen, paper birch and sugar maple â€" major components of the forests that blanket almost half of Wisconsin â€" will respond to the levels of carbon dioxide and ozone expected in the north by Scientists already know that carbon dioxide acts like a fertilizer, stimulating plant growth, while ozone harms plants. The study now taking place on 80 acres of U. The effects on tree growth are particularly important because some people argue that forests will lessen the threat of global warming by soaking up carbon dioxide like a sponge and holding it in trees and soils. However, that view overlooks the impact of rising ozone concentrations. After preparing the entire site in , researchers planted seedling aspen, birch and maple in identical patterns in each ring. Sensors measure the carbon dioxide and ozone concentrations in each ring and computers control the levels by releasing more or less of the gases from vertical pipes that encircle each ring. The carbon dioxide concentration of the air in three of the 12 rings is maintained at parts per million â€" about 55 percent higher than the background level. Three rings have an ozone concentration 50 percent higher than the background ozone level. And three rings have elevated levels of both carbon dioxide and ozone. There is no carbon dioxide or ozone added to the air in the final three rings, which serve as a reference for comparisons. The initial results show that aspen and birch grew 20 percent to 28 percent faster with elevated carbon dioxide than they did in the reference area. The trees also produced more leaves and more fine roots, both of which they shed in fall, according to Kruger. However, adding just ozone decreased aspen and birch growth by 20 percent to 26 percent. The growth of aspen and birch when both gases were elevated was no different than when neither gas was added. Young sugar maple trees grew at the same rate in all the rings. Although some aspen are now more than 20 feet tall, researchers are cautious about projecting their results to full-grown trees. However, they suspect that the growth-promoting effects of carbon dioxide will lessen and the negative effects of ozone will increase as the trees mature. Because insects and soil processes affect the growth and survival of forest trees, the researchers are also examining those aspects of the forest community. Lindroth says that both the performance of insects, as indicated by their size, and the decay of leaf litter are influenced by the chemical composition of the leaves. And this, in turn, is affected by the carbon dioxide and ozone treatments. Lindroth says the findings are complex because different insect and tree species respond differently. For example, forest tent caterpillars, a major outbreak species in northern Wisconsin, grew larger under the high ozone treatment than in the reference areas. The researchers have found that leaves from birch trees grown under high carbon dioxide decay more slowly after they fall. Trees depend on the availability of nutrients in fallen leaves to be recycled for future growth. In the long-term, slow decay rates may tie up nutrients and slow tree growth, according to Lindroth. Unlike birch leaves, however, aspen leaves decay at the same rate regardless of the level of carbon dioxide and ozone. According to Kruger, certain aspen clones also tolerate high levels of the gases better than others. The researchers say the results suggest that increasing levels of ozone and carbon dioxide could change the makeup and biological diversity of northern forests. Only more research can provide definitive answers. Although many agencies support research at the Rhinelander site, the UWâ€"Madison scientists there are supported by state funding to the College of Agricultural and Life Sciences, and by grants from the Department of Energy and the National Science Foundation.

Chapter 3 : When a forest is burned, what comes back may not resemble what was lost | Science | AAAS

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Relationship to other branches of ecology[edit] Redwood tree in northern California forest, where many trees are managed for preservation and longevity Forest ecology is one branch of a biotically-oriented classification of types of ecological study as opposed to a classification based on organizational level or complexity, for example population or community ecology. Thus, forests are studied at a number of organizational levels, from the individual organism to the ecosystem. However, as the term forest connotes an area inhabited by more than one organism , forest ecology most often concentrates on the level of the population , community or ecosystem. Logically, trees are an important component of forest research, but the wide variety of other life forms and abiotic components in most forests means that other elements, such as wildlife or soil nutrients , are often the focal point. Thus, forest ecology is a highly diverse and important branch of ecological study. However, the presence of trees makes forest ecosystems and their study unique in numerous ways. Community diversity and complexity[edit] Since trees can grow larger than other plant life-forms, there is the potential for a wide variety of forest structures or physiognomies. The infinite number of possible spatial arrangements of trees of varying size and species makes for a highly intricate and diverse micro-environment in which environmental variables such as solar radiation , temperature, relative humidity , and wind speed can vary considerably over large and small distances. This heterogeneity in turn can enable great biodiversity of species of both plants and animals. Some structures, such as tree ferns may be keystone species for a diverse range of other species. Forest management techniques that mimic natural disturbance events variable retention forestry [5] can allow community diversity to recover rapidly for a variety of groups including beetles. Roberto Cazzolla Gatti and his colleagues tested [7] a global correlation between vascular plant species richness S and average forest canopy height H. They found a significant correlation between H and S both at global and macro-climate scales, with the strongest confidence in the tropics. The authors of this study suggested that the higher the forest canopy, the bigger the number of species a forest can host. Energy flux[edit] Forest ecologists are interested in the effects of large disturbances, such as wildfires. Montana , United States. Forests accumulate large amounts of standing biomass, and many are capable of accumulating it at high rates, i. Such high levels of biomass and tall vertical structures represent large stores of potential energy that can be converted to kinetic energy under the right circumstances. Two such conversions of great importance are fires and treefalls , both of which radically alter the biota and the physical environment where they occur. Also, in forests of high productivity, the rapid growth of the trees themselves induces biotic and environmental changes, although at a slower rate and lower intensity than relatively instantaneous disturbances such as fires. Death and regeneration[edit] Woody material, often referred to as coarse woody debris , decays relatively slowly in many forests in comparison to most other organic materials, due to a combination of environmental factors and wood chemistry see lignin. Thus, tree trunks and branches can remain on the forest floor for long periods, affecting such things as wildlife habitat , fire behavior, and tree regeneration processes. Perhaps more importantly the duff or leaf litter can form a major repository of water storage. When this litter is removed or compacted through grazing or human overuse , erosion and flooding are exacerbated as well as deprivation of dry season water for forest organisms. Ecological potential of forestal species[edit] The ecological potential of a particular species is a measure of its capacity to effectively compete in a given geographical area, ahead of other species, as they all try to occupy a natural space. Related to site requirements: Tolerance to low temperatures, tolerance to dry climate, frugality. Shade tolerance , height growth, stability, longevity, regeneration capacity. Every parameter is scored between 0 and 5 for each considered species, and then a global mean value calculated. A value above 3. In this study Fagus sylvatica has a score of 3.

Chapter 4 : Study shows how pollution affects tree growth

*Growth Studies in Forest Trees [Harry Philip Brown] on blog.quintoapp.com *FREE* shipping on qualifying offers. This work has been selected by scholars as being culturally important, and is part of the knowledge base of civilization as we know it.*

As a general rule, forests dominated by angiosperms broadleaf forests are more species-rich than those dominated by gymnosperms conifer, montane, or needleleaf forests , although exceptions exist. Forests sometimes contain many tree species within a small area as in tropical rain and temperate deciduous forests , or relatively few species over large areas e. Forests are often home to many animal and plant species, and biomass per unit area is high compared to other vegetation communities. Much of this biomass occurs below ground in the root systems and as partially decomposed plant detritus. The woody component of a forest contains lignin , which is relatively slow to decompose compared with other organic materials such as cellulose or carbohydrate. Components[edit] Even, dense old-growth stand of beech trees Fagus sylvatica prepared to be regenerated by their saplings in the understory , in the Brussels part of the Sonian Forest. A forest consists of many components that can be broadly divided into two categories that are biotic living and abiotic non-living components. The living parts include trees , shrubs , vines , grasses and other herbaceous non-woody plants, mosses , algae , fungi , insects , mammals , birds , reptiles , amphibians , and microorganisms living on the plants and animals and in the soil. Biogradska forest in Montenegro Spiny forest at Ifaty, Madagascar , featuring various Adansonia baobab species, Alluaudia procera Madagascar ocotillo and other vegetation A forest is made up of many layers. Starting from the ground level and moving up, the main layers of all forest types are the forest floor, the understory and the canopy. The emergent layer exists in tropical rainforests. Each layer has a different set of plants and animals depending upon the availability of sunlight, moisture and food. Forest floor contains decomposing leaves, animal droppings, and dead trees. Decay on the forest floor forms new soil and provides nutrients to the plants. The forest floor supports ferns, grasses, mushroom and tree seedlings. Understory is made up of bushes, shrubs, and young trees that are adapted to living in the shades of the canopy. Canopy is formed by the mass of intertwined branches, twigs and leaves of the mature trees. The crowns of the dominant trees receive most of the sunlight. This is the most productive part of the trees where maximum food is produced. The canopy forms a shady, protective "umbrella" over the rest of the forest. Emergent layer exists in the tropical rain forest and is composed of a few scattered trees that tower over the canopy. Forests can be classified in different ways and to different degrees of specificity. One such way is in terms of the biome in which they exist, combined with leaf longevity of the dominant species whether they are evergreen or deciduous. Another distinction is whether the forests are composed predominantly of broadleaf trees, coniferous needle-leaved trees, or mixed. Boreal forests occupy the subarctic zone and are generally evergreen and coniferous. Tropical and subtropical forests include tropical and subtropical moist forests , tropical and subtropical dry forests , and tropical and subtropical coniferous forests. Physiognomy classifies forests based on their overall physical structure or developmental stage e. Forests can also be classified more specifically based on the climate and the dominant tree species present, resulting in numerous different forest types e. The number of trees in the world, according to a estimate, is 3 trillion, of which 1. The estimate is about eight times higher than previous estimates, and is based on tree densities measured on over , plots. It remains subject to a wide margin of error, not least because the samples are mainly from Europe and North America. Old-growth forest contains mainly natural patterns of biodiversity in established seral patterns, and they contain mainly species native to the region and habitat. In contrast, secondary forest is regrowing forest following timber harvest and may contain species originally from other regions or habitats. These 26 major types can be reclassified into 6 broader categories: Temperate needleleaf[edit] Temperate needleleaf forests mostly occupy the higher latitude regions of the Northern Hemisphere , as well as high altitude zones and some warm temperate areas, especially on nutrient-poor or otherwise unfavourable soils. These forests are composed entirely, or nearly so, of coniferous species Coniferophyta. In the Northern Hemisphere pines Pinus , spruces Picea , larches Larix , firs Abies , Douglas firs Pseudotsuga and hemlocks Tsuga , make up the canopy, but other taxa are also important. In the Southern Hemisphere , most coniferous trees members of the Araucariaceae and Podocarpaceae occur in mixtures with broadleaf species, and are classed as broadleaf and mixed forests. They are generally characteristic of the warmer temperate latitudes, but extend to cool temperate ones, particularly in the southern hemisphere. They include such forest types as the mixed deciduous forests of the United States and their counterparts in China and Japan, the broadleaf evergreen rainforests of Japan, Chile and Tasmania , the sclerophyllous forests of Australia, central Chile, the Mediterranean and California, and the southern beech Nothofagus forests of Chile and New Zealand. Seasonal tropical forests , perhaps the best description for the colloquial term " jungle ", typically range from the rainforest zone 10 degrees north or south of the equator , to the Tropic of Cancer and Tropic of Capricorn. Forests located on mountains are also included in this category, divided largely into upper and lower montane formations on the basis of the variation of physiognomy corresponding to changes in altitude. The seasonality of rainfall is usually reflected in the deciduousness of the forest canopy, with most trees being leafless for several months of the year. However, under some conditions, e. Thorn forest , a dense forest of low stature with a high frequency of thorny or spiny species, is found where drought is prolonged, and especially where grazing animals are plentiful. On very poor soils, and especially where fire or herbivory are recurrent phenomena, savannas develop. Trees include Picea obovata dominant on right bank , Larix sibirica , Pinus sibirica , and Betula pendula. Sparse trees and savanna are forests with lower canopy cover of trees. They occur principally in areas of transition from forested to non-forested landscapes. The two major zones in which these ecosystems occur are in the boreal region and in the seasonally dry tropics. At high latitudes, north of the main zone of boreal forest, growing conditions are not adequate to maintain a continuous closed forest cover , so tree cover is both sparse and discontinuous. This vegetation is variously called open taiga , open lichen woodland, and forest tundra. A savanna is a mixed woodland grassland ecosystem characterized by the trees being sufficiently widely spaced so that the canopy does not close. The open canopy allows sufficient light to reach the ground to support an unbroken herbaceous layer consisting primarily of grasses. Savannas maintain an open canopy despite a high tree density. However, they can be managed in ways that enhance their biodiversity protection functions and they can provide ecosystem services such as maintaining nutrient capital, protecting watersheds and soil structure, and storing carbon. Forestry , Logging , and Deforestation Redwood tree in northern California redwood forest, where many redwood trees are managed for preservation and longevity, rather than being harvested for wood production Forests provide a diversity of ecosystem services including: Therefore, they are necessary for stop Climate Change. According to the Special Report on Global Warming of 1. For example a research from , show that forests induce rainfall. If the forest is cut, it can lead to drought. Some researchers state that forests do not only provide benefits, but can in certain cases also incur costs to humans. Forest management has changed considerably over the last few centuries, with rapid changes from the s onwards culminating in a practice now referred to as sustainable forest management. Forest ecologists concentrate on forest patterns and processes, usually with the aim of elucidating cause-and-effect relationships. Foresters who practice sustainable forest management focus on the integration of ecological, social, and economic values, often in consultation with local communities and other stakeholders. Priest River winding through Whitetail Butte with lots of forestry to the eastâ€"these lot patterns have existed since the midth century. The white patches reflect areas with younger, smaller trees, where winter snow cover shows up brightly to the astronauts. Dark green-brown squares are parcels Humans have generally decreased the amount of forest worldwide. Anthropogenic factors that can affect forests include logging, urban sprawl , human-caused forest fires , acid rain , invasive species , and the slash and burn practices of swidden agriculture or shifting cultivation. The loss and re-growth of forest leads to a distinction between two broad types of forest, primary or old-growth forest and secondary forest. There are also many natural factors that can cause changes in forests over time including forest fires , insects , diseases , weather, competition between species, etc. In , the United Nations Food and Agriculture Organization [42] reported that world deforestation, mainly the conversion of tropical forests to agricultural land, had decreased over the past ten years but still continues at a high rate in many countries. Globally, around 13 million hectares of forests were converted to other uses or lost through natural causes each year between and as compared to around 16 million hectares per year during the s. The study covered countries and areas. Brazil and Indonesia, which had the highest loss of forests in the s, have significantly reduced their deforestation rates. China instituted a ban on logging, beginning in , due to the erosion and flooding that it caused. As a result, the net loss of forest area was reduced to 5. In , a study for Nature Climate Change showed that the trend has recently been reversed, leading to an "overall gain" in global biomass and forests. This gain is due especially to reforestation in China and Russia. These are often created for human benefits; Attention Restoration Theory argues that spending time in nature reduces stress and improves health, while forest schools and kindergartens help young people to develop social as well as scientific skills in forests. These typically need to be close to where the children live, for practical logistics.

Chapter 5 : Forest ecology - Wikipedia

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Research will be conducted to develop and evaluate hydroponic systems for production of woody plants to the liner stage of growth. Research will be conducted to study the effects of nutrient enrichment of liners on their performance in outplanting in fields or in containers. Research will be conducted to study the impact of aluminum, manganese, calcium, sodium, ammonium, nitrate, and sulfate concentrations of nutrient solutions on growth of forest trees. Culture of woody plants in sand, vermiculite, perlite, gravel, or mixtures of these materials or other mineral or organic components will be conducted. These media will differ in water-holding capacity, aeration, physical stability, and chemical inertness. Nutrient solutions will be evaluated for their use in production of individual species. Growth and appearance of plants following outplanting to fields or to containers will be evaluated. Plant survival and growth as determined by plant appearance and branch elongation will be criteria for assessing performance of plants. Under Objective 2, one experiment will employ a progressive array of concentrations of nutrient solutions with each being applied continuously for a fixed time period. Another experiment will employ incremental fertilization through a progressive array of concentrations of nutrient solutions that increase with time. The plants from each of these experiments will be transplanted to field plots or containers for evaluation of their performance on outplanting as described in Objective 1. Under Objective 3, effects of aluminum, manganese, calcium, magnesium, sodium, ammonium, and nitrate will be investigated with a modification of a nutrient solution shown in Objective 1 to be optimum for growth of pine, oak, and maple in hydroponics. To study the effects of aluminum and manganese on tree growth and composition, the basic solution will be amended with aluminum sulfate or manganese sulfate. Proportions of nitrogen supplied by nitrate and ammonium will be established by varying the supply of calcium nitrate and ammonium sulfate. Sodium will be added as NaCl to vary salinity of the nutrient solutions. Ameliorative effects of calcium salts on expected restrictions of plant growth under these nut ritional stresses will be evaluated. The effects of the treatments with the different ions will be assessed by determinations of growth by root and shoot mass and by elemental N, P, K, Ca, and Mg composition of roots and shoots. Research was completed on an experiment that studied nutrient enrichment of pines for outplanting. This research studied loblolly pine Pinus taeda L. Other nutrients varied in proportion to the N supply. Plant growth in response to these treatments showed that an array of nutritional regimes from deficient to excessive fertilization resulted. The young plants were transplanted into containers of sandy loam and were grown for one more year without fertilization. Growth of each species increased with enhanced nutrient loading. The optimum concentration of N for nutrient loading was 1. Sufficient nutrient loading during nursery culture will provide transplants that enable growth for at least one year after outplanting and help to ensure establishment in the field. He performed the research on this project. His research addresseds the mineral nutrition of plants. He was assisted by undergraduates who were Work-Study students or who were working in independent study classes. These students learned about formulation of nutrient solutions, how to measure growth of plants, and how analyze plants for inorganic constituents. Nothing significant to report during this reporting period. Impacts The research demonstrated that enrichment of loblolly pine with plant nutrients increased the potential of trees to grow and be established after outplanting. Growth of plants after nutrient loading and planting into soil increased linearly with increases in plant nutrition from poorly nourished trees to well-nourished trees. Mass of trees that were well nourished prior to outplanting was triple the growth of poorly nourished trees. Good nutrition of trees for outplanting will enhance their capabilities to compete with weeds and to grow in poor soil without supplemental fertilization. The critical concentration of nitrogen in needles for optimum performance was 1. Research was completed on the an experiment that studied nutrient enrichment in pines for outplanting. Other nutrients varied in proportion to the nitrogen N concentrations. Resulting plant growth showed that an array of nutritional regimes from deficient to excessive was applied. The young plants were transplanted into containers of sandy loam and were grown for one additional year without fertilization. The optimum concentration of N for nutrient loading was about 1. Nutrient loading during nursery culture imparts transplants with nutrient levels that will enable growth for at least a year after outplanting. His research addresses the mineral nutrition of plants. He was assisted by undergraduates who were Work-Study students or working in independent study classes. These students learned about formulation nutrient solution, how to measure growth of plants, and how to measure inorganic constituents in plant composition. Impacts The research demonstrated that enrichment of loblolly pine with plant nutrients increased the potential of the trees to grow and be established after outplanting. Growth of outplants after nutrient loading increased linearly with increase in plant nutrition from poorly nourished trees to well-nourished trees. Mass of trees that were well-nourished prior to outplanting was triple the growth of poorly nourished trees at one year after outplanting. Good nutrition of trees to be outplants will enhance their capacities to compete with weeds and to grow in poor soils without any additional fertilization. Communications in Soil Science and Plant Analysis Loblolly pine Pinus taeda L. After a year on these treatments, the trees were outplanted into 5-gal containers filled with unamended Hadley fine sandy loam Typic Udifluvent, coarse-silty, mixed, nonacid, mesic and grown for one year. Nitrogen was measured as an index of nutrient enrichment of the trees from the array of treatments. Concentration of nitrogen in leaves at the time of transplanting ranged from about 0. At harvest, height, stem caliper 6 inches above pot level , and weight of trees were measured. The maximum plant height was about 1. This result suggests that the nitrogen accumulated in the plants with enriched nutrition was diluted by dry matter production. Not relevant to this project. Impacts The research demonstrates that enrichment of loblolly pine with plant nutrients increases the potential of the trees to grow and be established after outplanting. Growth increased linearly with increase in plant nutrition from poorly nourished trees to well-nourished trees. This research was also supported by state funding and by unrestricted extramural support awarded to the principal investigators. The plants then were planted in pots of soil mix 7 parts sandy loam: The various concentrations of nutrient solutions gave an array of plants of differing nutritional status. Leaf color was used as a visual diagnosis of plant health before outplanting. For both species of pine, green leaf color and plant heights increased as the concentrations of nutrient in solutions increased. No additional fertilization was provided to the plants following outplanting, and the plants were grown for about a year. Measurements of plant height, weight, and stem caliper indicated that well-nourished plants receiving the middle concentrations of nutrition half-strength or higher solutions were larger than those receiving low-levels of nutrition. Loblolly pine was more responsive with enhanced growth with good plant nutrition than the white pine. Leaf tissue analysis is being performed to assess the nutritional status with respect to nitrogen at harvest. Leaf tissue samples were analyzed during the experiment to document the status of the plants during their growth. Impacts Producing forest trees with high nutritional status before outplanting will help the transplanted trees compete with other vegetation in the area. This research demonstrated that well-nourished plants can be produced by hydroponic culture of trees before outplanting and that the well-nourished plants outperformed poorly nourished plants. Following this growth period, the trees were transplanted into containers of soil. These plants are growing in these containers and are being assessed for their performance relative to the nutritional regime in which they were grown in hydroponics. Observations indicate that the nutrient-enriched plants grown on enhanced nutrition are larger in height and caliper than the plants grown with the regimes of low levels of nutrition. Research is investigating the potential for using hydroponics for production of liners of oak Quercus spp. Impacts The research on production of well-nourished liners or transplants should lead to plants that perform better on outplanting into external environments than transplants that have lesser levels of nutrition. Well-nourished plants should perform well in stressful environments such as conditions that contain weeds or that are low in soil fertility. Undernourished plants may not perform well after outplanting. This research should lead to improved establishment of plants in forest and nursery operations. The formulations ranged from 0. Plant color measured by visual indexing and by comparisons to color charts ranged from chlorotic yellow to green as the level of nutrition increased. Nitrogen concentrations in the leaves increased as the level of nutrition increased, but several months were required for this effect to occur. Plants from this experiment will be planted into containers with soil-based media to simulate outplanting. Growth responses in the outplanting environment without further fertilization or with uniform fertilization of all plants will be measured by mass and heights of the pines. Better nutrition should lead to better growth of forest trees. The research on production of well-nourished liners or transplants should lead to plants that perform better than transplants that have lesser levels of nutrition. Well-nourished plants will perform well in stressful environments such as conditions that contain weeds or that are low in soil fertility.

Chapter 6 : Details - Growth studies in forest trees. - Biodiversity Heritage Library

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Search Share Thinning young western larch forests can boost their climate change resilience without reducing their ability to capture carbon. In places like the American West, rising temperatures and drought mean less water for trees, sometimes shriveling swaths of woodland. Now, scientists have found that thinning early in forest growth creates tougher trees that can endure climate change. But if trees get too crowded, they compete for light and waterâ€”and stressed trees are more susceptible to drought and insect attacks. Removing some trees can ease the competition, letting the remaining trees grow big and healthy. But scientists worry that removing trees can reduce forest carbon storage. These worries, however, are based mostly on models and short-term studies. To see if the climate trade-off truly exists, scientists tapped into a long-term experiment in northwestern Montana. Forest Service officials started the experiment in a young forest of western larchâ€”a conifer common in the Inland Northwest. The forest was broken up into plots. In some plots, the 8-year-old trees were thinned from tens of thousands per hectare down to per hectare 2. These trees grew thick trunks and broad canopies. Other plots were left alone, and the teeming trees grew tall and skinny as they competed for sunlight. The original study was rooted in an interest in growing timber rapidly. But the scientists at the University of Montana sprouted a new question: How did tree density affect carbon storage? To find out, they measured tree height, diameter, and width of branches to estimate the amount of carbon stored. They also calculated the carbon contained in other plants, dead wood, and forest floor debris. Total carbon was nearly the same in both forests. The un-thinned forest had more trees, but the thinned forest compensated with bigger trees , the team reports this month in Forest Ecology and Management. Larson was surprised by how quickly the thinned trees had caught up. Long-term studies like this are useful to validate climate models, he says. The remaining trees grow rapidly. Climate change may bring more severe droughts to the West. Big trees are more drought-resilient, and their thick bark can resist fire better than can young trees. Also, they are healthier and can fight off disease and insects. When the large larches do die, they become homes for woodpeckers and lynx. The results can be applied to forests that have been clear cut, boosting the recovery of trees, says forest ecologist Michael Schaedel, lead author of the study. In Montana, snowshoe haresâ€”preyed on by the threatened Canada lynxâ€”inhabit young western larch forests. Thinning in these forests could reduce hare habitat and in turn food for lynx. Still, Larson thinks thinning could become a useful tool for addressing climate change.

Chapter 7 : Study forecasts growth rates of loblolly pine trees

Tree Growth Study Introduction. Forest trees grow in both height and diameter. The growth of a tree is influenced by it environment. By working with the cross section of a tree, a view of a tree round can reveal how outside influences have affected the tree's quality of life. The cross section can also provide information about the tree's age.

Chapter 8 : To save forests, cut some trees down, scientists say | Science | AAAS

Data on the diameter of trees, the number of leaves produced in a given year, and how much water is evaporated from the forest are all fed into a model representing the process of forest growth.