RESEARCH ON THE HOFMANN FOREST - 1936 to 2000
Project Abstracts and Publication List

Prepared for the North Carolina Forestry Foundation

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Research Projects

RESEARCH PROJECTS

DRAINAGE, WATER MANAGEMENT, AND WATER QUALITY

Some Interrelationships of Drainage, Water Table, and Soil on the Hofmann Forest in Eastern North Carolina

Description and Location: Leslie E. Gallup, under the direction of Dr. T. E. Maki, conducted a study on three selected areas on Deppe Trail and Roper Road to determine the interrelationships of soil, drainage, and water table. Four lines of wells were installed in each area with wells at 30, 60, 120, 180, 300, 420, 660, and 900 feet from the canal. The study areas and lines of wells were established under the direction of Dr. C.M. Kaufman in 1950.

Gallup found that drainage effects were measurable up to 900 feet from the canal. He also found that roads create a barrier effect to drainage and therefor should be located on the downslope side of the canal. He measured drawdown rates in all areas and observed that the effect of evapotranspiration during the growing season was three to four times that due to drainage.

Publication:

Gallup, Leslie Edward. 1954. Some interrelationships of drainage, water table, and soil on the Hofmann Forest in Eastern North Carolina. Master's thesis. North Carolina State College. 67 pp.

The Effect of Field Drainage on Groundwater Recharge

Description and Location: The study was conducted by Abdolkarim Behnia as an M.S. thesis project in the Department of Biological and Agricultural Engineering under the direction of Dr. R.W. Skaggs. The thesis does not specifically identify the Hofmann as a study area. However, it is known that the investigator did reclear some of the 1950 lines of wells and monitor water levels. Some portions of the study were carried out elsewhere as stated in the thesis. A computer model was developed to characterize the response of percolation to various combinations of surface and subsurface water management.

Publication:

Behnia, Abdolkarim. 1975. The effect of field drainage on groundwater recharge. Master's Thesis. NC State University. 72 pp.

Water Quality Monitoring of Outfalls on the Hofmann Forest

Description and Location: In 1994, outfalls in each of the three major watersheds on the Hofmann Forest were selected for a water quality study: 21 in the New River watershed, 10 in the Trent River watershed, and 9 in the White Oak River watershed. Two sites on Croatan National Forest were chosen as controls; these sites are comprised of natural channels exiting undisturbed pocosin. Sampling sites were selected in order to provide a representation of water exiting the forest and traveling through adjacent property. The first complete set of samples was collected in March of 1995. Until June of 2000, all 42 points were sampled during the first week of each month. Effective as of June of 2000, 23 medium and major outfalls and the 2 reference sites on the Croatan National Forest are sampled monthly, and 9 major outfalls, three in each watershed, are sampled weekly. the Hydrolab TM Water Multiprobe and the accompanying Surveyor 3 data recorder are used to perform water temperature, pH, dissolved oxygen, specific conductance, and turbidity measurements at the site. Two 500ml bottles of water are collected at each site for analysis. Total suspended solid analysis is completed in house at the Woodlot Forestry Hydrology laboratory. Fecal coloform analysis, which began in October of 1996, is completed by the Onslow County Waste Water Treatment Center. Other analyses are conducted in the EPA certified lab of Dr. Wayne Robarge of the NCSU Soil science department. All methods and procedures for collection and analysis of the samples follow strict EPA and North Carolina State standards and protocol.

Publication: Hazel D. in preparation

Water Management Modeling

Description and Location: The DRAINWAT hydrolic model was employed to simulate the Crooked Run subwatershed in the northeast part of the Hofmann forest to determine whether it was an adequate tool for use in a water management plan. In order to set up the model, the area in question was surveyed, culverts and roadside ditches were measured, precipitation was measured, and soil samples were taken. Construction of the model involved dividing the watershed into fields, noting all drainage canals and their outlets from each field. Twenty six nodes corresponding to the outlets, a point down- stream from each outlet, each field outlet, and each drainage canal intersection were entered into the model. All inputs to the model were broken down into operational files, field files and weather files each with parameters. Twenty different model simulations were run to test the sensitivity of the model to parameter changes and to explore different management situations. Difficulties such as a dry summer and beaver activities corrupted flow data and made it impossible to calibrate the model, therefore, the base data simulation (corresponding to normal conditions) was used as real life data. Flow data from 1997 was compared to the predictions of the model. It was found that the DRAINWAT model could be effective in accomplishing some of the water management objectives for a given stand on the Hofmann Forest. It can predict drainage and simulate weir heights, storage situations and depth of ditches. It can also simulate peak events to manage water quality.

Publication:

Jurek, Jeffery Scott. 2001. Use of the DRAINMOD-based, watershed-scale model DRAINWAT in accomplishing water management objectives in the Hofmann Forest. Master's Thesis. NC State University. 70 pp.

LOBLOLLY AND SLASH PINE

Deppe Spacing Study

Description and Location: Eleven one-acre plots of loblolly and slash pine were planted in by the C.C.C. under the supervision of Mr. G.E. Jackson in Spring, 1936 at the following spacings: 4' X 4'; 6' X 6'; and 8' X 8'. Six loblolly plots were located southwest of the headquarters and five slash pine plots were located northeast of the fire tower. In 1937, six more one-acre plots were planted just across US-17 from the headquarters with four, six, and eight-foot spacings of slash pine and cypress. Height and diameters were measured in 1944, 1948, 1951, 1955, 1959, 1963, 1967, and 1972 on six loblolly and two slash pine plots based on located files. All trees on the interior 0.25 acres were measured. The data seemed to have last been compiled by Dr. T.E. Maki based on measurements through 1959.

Publications:

Miller, William D., and T. E. Maki. 1957. Planting pines in pocosins. Jour. For. 55(9):559-663.

Location of Data: All data are located in files found in 3136 Jordan Hall.

Deppe Plantation Thinnings

Description and Location: In the spring of 1957, a set of ten one-acre plots were laid out in the 1936 plantations of loblolly and slash pine. The slash pine was located on the left side of Deppe Trail and the loblolly pine on the right side when approaching Deppe from Roper Road. Five treatments were assigned at random to five plots per block, and replicated twice per species for a total of ten blocks per species.

Treatments were described as: shelterwood, seed tree, "Hofmann" (evidently Dr. Hofmann's prescription), "Bryant's best silviculture", and control where only anticipated five-year mortality was removed. No precise description of treatments was found such as before- and after-treatment basal areas. Thus only a compilation of the data would

yield such descriptions. It appears the objective was to follow changes in overstory structure. No data on regeneration were found. All plots were measured in 1957 and 1967. Some were additionally remeasured in 1972. On some plots, overwood was still standing in the 1972 measurement. Data from one loblolly shelterwood plot was summarized in a 1967 "memorandum to files" from Dr. T.E. Maki. Basal areas of 58, 66, and 109 ft.2/acre were shown for 1957, 1960, and 1967 respectively.

Publications: None found.

Location of Data: 3136 Jordan Hall

Effects of Soils, Water Table, and Drainage on the Height Growth of Slash and Loblolly Pine Plantations

Description and Location: Over 400 acres of loblolly and slash pine were planted north of US-17 on either side of Deppe Trail in 1936. Acreage of the plantation is given as 400 acres of operational planting and 22 acres of spacing study (Miller, W.D., and T.E. Maki, 1957). Planting pines in pocosins. J. Forestry, 55(9):659-653. , 419 acres total (Pruitt thesis below), and elsewhere as 440 acres total. The plantation was dissected by widely-spaced drainage ditches and included a spacing study described below. Preparation of the planting site consisted of cutting the scattered pond pine and broadcast burning the slash and brush. Pines were planted at a six-foot spacing except for the spacing study. In 1946-47, A. A. Pruitt (under the direction of Dr. W.D. Miller) conducted a study to determine how drainage of pocosin soils affected height growth of loblolly and slash pine. A line of shallow groundwater wells was installed at a right angle to the drainage ditch in each of four compartments. Daily well measurements were made for a fourteen-day period in February, 1947. Tree heights were measured along the transect. No inferential statistics were used nor did the design permit such analyses.

Based on the limited data, the following observations were made: (1) the water table was affected by ditching up to 1000 feet from the ditch; (2) effects on height growth was improved by drainage up to 500 to 600 feet from the ditch; (3) drainage did not affect chemical soil properties but improved physical properties; (4) height growth of both species was greater nearer the ditch.

Publications:

Pruitt, Austin A. 1947. A study of the effects of soils, water table, and drainage on the height growth of slash and loblolly pine plantations on the Hofmann Forest. Master's thesis. NC State College.

Maki, T. E. 1971. Forest management technology - drainage: effect on productivity. 50th Annual Meeting Proc., Appalachian Section, SAF, pp. 16-23.

Location of Data: The only data available are in the thesis located in the Natural Resources Library, Jordan Hall, NC State University.

Status of the Study: No evidence has been found of subsequent water table measurements.

Role of Bark Characteristics in Fire Hardiness for Loblolly Pine

Location and Description: J. F. Renfro conducted a study to determine some of the physical characteristics of bark and cambium of loblolly pines as they relate to observed differences in fire tolerance. He found that pond pine has slightly thicker bark, lower thermal conductivity, and less cambial kill for any given temperature. It was also noted that pond pine sprout and form epicormic branches after fire.

Publication:

Renfro, James Francis. 1956. Bark and cambium characteristics of pond pine (Pinus serotina Mich.) and loblolly pine (Pinus taeda L.) with special reference to fire hardiness. Master's thesis. North Carolina State College. 46 pp.

Location of Data: Some notes and progress reports are found in 3136 Jordan Hall.

Gum Swamp Road Demonstration Plots

Location: In 1961, seven loblolly pine plots, each approximately an acre in size were established along the north side of Gum Swamp Road just west of the boundary line. Treatments included: burning only, burn and direct seed; burn and hand plant; double disk and direct seed; double disk and hand plant; no burn, single disk, and hand plant; no burn, single disk, and direct seed. The plots are mostly standing as of January 2001. The plots may have importance for late-rotation measurement for evaluation of these site preparation and establishment treatments. Although only a hand-written establishment report exists, it appears the plots were established by Dr. T.E. Maki.

Data and Publications: No publications nor measurement data are known to exist.

Drainage, Site Preparation, and Site Improvement in Relation to Reforestation of Pocosin Lands (Stilley Hill Plantation study)

Location and Description: A large-scale (700+ acres) pilot plantation was installed in 1966 under the direction of Dr. T. E. Maki employing findings of earlier studies. The area was logged in 1958, but failed to reproduce a vigorous stand. The area was ditched, chopped, and burned in 1965, bedded and planted with loblolly pine in February and March 1958 at spacings of 8' x 8', 8' x 9', and 8' x 10'. Part of the plantation was remeasured in 1973 after seven growing seasons.

Publication:

Maki, T. Ewald. 1972. Factors affecting forest production on organic soils. Proc. on Organic Soils. Div 5 of the Soil Sci. Soc. Amer., Miami, FL.

Location of Data: Data and records are located in a file located in 3136 Jordan Hall.

Nutritional Problems of Pinus taeda L. (Loblolly Pine) Growing on Pocosin Soil

Description and Location: The purpose of this study was to identify factors contributing to the infertility of pocosins and to find a non-tree indicator species of site quality. Four 6.48 ha blocks in the Big Opening of the Hofmann Forest were divided into 1.62-ha plots with the following randomly assigned treatments:1) control, 2) burning, 3) disking, and 4) burning and disking. The plots were subdivided into four 0.40-ha subplots that were randomly assigned the following treatments: 1) control, 2) lime, 3) Calphos (P), 4) lime plus Calphos. Fertilization occurred in 1962 and loblolly and pond pine were planted in March of 1963. Soil and foliage samples were collected and tree heights were measured in December of 1969. Lyonia lucida was chosen as the subordinate vegetation to be sampled. Where P was applied alone, heights were about two times that of the control. When P and limestone were applied in combination, the heights were about two and one half that of the control. There was a significant linear correlation between tree height and available P in the soil. The critical level of P was determined to be 16 ppm. P content of Lyonia was significantly correlated with the P content and height of Loblolly pine supporting its use as an indicator species.

Publication:

MacCarthy, R. And C.B. Davey. 1976. Nutritional problems of Pinus taeda L. (Loblolly Pine) growing on pocosin soil. Soil. Sci. Soc. Am. J. 40:582-585.

Manipulating Loblolly Pine Productivity with Early Cultural Treatment

Description and Location: Fourteen field trials, one of which is on the Hofmann Forest, were established during the late 1970's in the SE US to examine the effects of site preparation, early fertilization, and weed control on loblolly pine growth and nutrition. Various treatments were applied solely and in combination to determine the optimum productivity. After eight years, significant growth gains indicated that current regeneration practices were not fulfilling potential productivity. Intensive site preparation, application of fertilizer, and the addition of herbicide

all increased height growth and generally increased stand growth. When combined, their effects were additive. The largest effects were seen within the first few years where cultural treatments accelerated the early growth of individual trees and periodic height increment responses to cultural treatments peaked. Also, this study has identified large areas of well-drained upper Coastal Plain soils that are P deficient. Additional incremental responses after age 8 are expected to be small unless treatments provide long term improvement in resource availability. It is unknown whether early growth gains will increase, be maintained or diminish in the future.

Publication:

Allen, H. L. 1990. Manipulating loblolly pine productivity with early cultural treatment. In: S.P. Gessel et. al. (editor). Sustained productivity of forest soils: 7th North American Forest Soils Conference. Vancouver: Forestry Publications, Faculty of Forestry, University of British Columbia. pp 301-317.

POND PINE

Pond Pine Stocking Study

Description and Location: In 1946, nine plots of principally pond pine were located and measured by Dr. W.D. Miller with assistance from J.V. Hofmann, J.G. Hofmann, and others. No project description or report has been found. The objective seems to have been to compare actual stocking of pond pine on pocosin sites to "normal" stocking as determined by a formula specified only as "Matthews - p.26." Perhaps this refers to D.M. Matthews Management of American Forests (1935, McGraw-Hill Book Company, New York). Stand ages ranged from 11 to 85 years. Plots were variously located on the forest. A stocking table was prepared to summarize results.

Publications: None found.

Location of Data: 3136 Jordan Hall

Effect of Soil Characteristics on Height Growth of Pond Pine

Description and Location: Dr. J. G. Hofmann examined 41 plots on Hofmann Forest and 90 additional plots in South Carolina, Georgia, and Florida to determine the relationship between height growth of pond pine and soils. Height growth on mineral soils was significantly affected by the reciprocal of age, the moisture equivalent, the product of the depth of the A1 layer times the organic matter content of the A1 layer, the depth to mottling, and the length of the growing season. On inorganic soils, height growth was significantly affected by reciprocal of age, organic matter content, product of depth of A1 layer times organic matter content, and stand density.

Publication:

Hofmann, Julian George. 1949. The effect of certain soil characteristics on the height growth and site index of pond pine in the Coastal Plain of the Carolinas, Georgia, and Florida. Doctoral dissertation. Duke University.

Status of Study: No data other than those presented in the dissertation have been located.

Growth Characteristics of Pond Pine

Location and Description: In 1950, J.B. White completed a thesis entitled "A Study of Some of the Growth Characteristics of Pond Pine as Found on the Hofmann Forest" under the direction of Dr. C.M. Kaufman. The following variables were each regressed with age: height, DBH, rate of basal area increase, bark thickness, and Girard form class. Average site index was 49 feet at 50 years with a maximum average was 66 feet at 100 years. The rate of basal area increase suggested a "natural" rotation of about 60 years for natural stands.

Publications:

White, John Benjamin. 1950. A study of some of the growth characteristics of pond pine as found in the Hofmann Forest. Master's thesis. North Carolina State College. 50 pp.

Kaufman, Clemons M., John B. White, and Robert J. Monroe. 1954. Growth of pond pine in a pocosin area. Jour. For. 52(4):275-279.

The Influence of Certain Properties of Organic Soils on the Height Growth of Pond Pine in North Carolina

Soil samples collected from 20 plots and used by Hofmann in his study of site quality for pond pine on organic soils were tested for new variables. Analysis was concentrated on the surface soil, especially the A2 horizon, and determined the moisture equivalent, imbibitional water value, percent total sands, and hydronium-ion concentration. These variables, in addition to four which had previously been tested by Hofmann, were subjected to statistical analysis to determine their significance to the height growth of pond pine. Only percent organic matter of the surface soil was found to be significant. As percent organic matter of the A1 horizon increases, site index decreases. An indication of the degree of drainage is given indirectly by the organic matter content, as litter decomposition is slow during the anarobic conditions caused by flooding. The depth of the A1 horizon had no significant effect on the site quality as may have been implied by Hofmann's treatment of that variable in conjunction with percent organic matter. The substantial effects of flooding on pond pine height growth mask any effects of soil characteristics rendering them insignificant. If the organic matter content of the A1 horizon is less than 35%, a height growth of 50 foot or more can be accomplished in 50 years. A site with organic matter content over 50% is extremely poor for pond pine growth and would not be economically profitable to manage.

Publication:

Zahner, Robert. 1951 The influence of certain properties of organic soils on the height growth of pond pine in North Carolina. Master's thesis. Duke University. 21 pp.

Influence of Fire on Pond Pine Regeneration

Description and Location: An April 1950 wildfire which burned 69,000 acres of mostly pocosin provided an opportunity to study pond pine reproduction after fire. J. D. Besse under the direction of Dr. T. E. Maki selected the following categories for study from aerial photographs:

Unburned - unlogged
Burned - unlogged
Burned shortly before logging
Burned shortly after logging

The combination of burning after logging provided good germination and survival and superior height growth. Results indicated that adequate regeneration is only obtained through the use of fire.

Publication:

Besse, John David. 1952. Initial influence of fire on the regeneration of pond pine. Master's thesis. North Carolina State College. 53 pp.

Cone and Seed Production of Pond Pine

Description and Location: In 1950, H. G. Posey completed a thesis entitled "Cone and Seed Production of Pond Pine (Pinus rigida var. serotina Loud.) in Eastern North Carolina at Various Ages" under the direction of Dr. C. M. Kaufman. Data were collected in 1948 and 1949 from the Hofmann and adjacent areas. Data on cone and seed production, seed weight, and problem insects were collected for seven age classes.

It was concluded that pond pine seed trees should be 9-10 inches DBH or larger and 25 to 30 years old. Such trees will produce 175 to 200 closed sound cones each bearing 75 to 80 seeds. Average germination was 44 percent in 60

days. Pond pine averaged 50,817 seed per pound. Although summertime logging appeared to provide conditions which caused opening of cones on felled trees, it was concluded that proper timed use of fire was the best means of obtaining satisfactory seed dispersal.

Publications:

Posey, Henry Gerhart. 1950. Cone and seed production of pond pine (Pinus rigida var. serotina Loud.) in Eastern North Carolina. Master's thesis. North Carolina State College. 45 pp.

Kaufman, Clemens M., and Henry G. Posey. 1953. Production and quality of pond pine seed in a pocosin area of North Carolina. Jour. For. 51(4):280-282.

Location of Data: No data exist except those presented in the thesis located in the Natural Resources Library.

Sprouting of Pond Pine After Burning

Description and Location: W. L. Hafley attempted determine how sprout initiation and growth of pond pine are influenced by tree size and age and by logging. The study was directed by Dr. T. E. Maki. He found that sprout vigor was not related to parent tree diameter, however, sprouts originating from trees larger than 4 inches did not survive and grow to tree size. He also found that by about age nine only one sprout remained per tree and sprout height was about equal to seedling height growth. Stumps from cut trees were observed to sprout, however, it did not appear that sprouts survived long enough to produce a tree.

Publication:

Hafley, William Leroy. 1957. Some factors affecting the initiation and growth of pond pine sprouts in a pocosin area of Eastern North Carolina. Master's thesis. North Carolina State College. 51 pp.

Location of Data: Some notes and progress reports are found in 3136 Jordan Hall.

Some Interrelationships of Drainage, Stand Development, and Growth of Pond Pine on the Hofmann Forest

Description and Location: W. C. Asher, under the direction of Dr. T.E. Maki, measured tree heights and diameters and soil characteristics along the lines of wells established in 1950 (see Gallup thesis above). The objectives of the study included characterizing the water table profile under differing soil types and distances from the canal; observing water table changes since 1951 when the lines of wells were established; and relating drainage to regeneration, overstory growth, understory development, and soil chemistry.

Asher documented overall improvement in drainage due to canals and suggested that continued extension of the canal system would be effective. However, data failed to conclusively show changes in overstory structure or growth, understory development, or soil chemistry (with the possible exception of pH) due to improved drainage. He felt the April 1950 fire may have "masked" effects of drainage on vegetation. He noted that the stands had recovered from the fire to pre-fire growth rates within three years.

The study was followed for several years through remeasurement of CFI plots under the direction of T. E. Maki, Ralph Bryant, and James Huff. Local volume tables were developed.

Publications:

Asher, William Curtis. 1957. Some interrelationships of drainage, stand development, and growth of pond pine (Pinus serotina Mich.) on the Hofmann Forest. Master's thesis. North Carolina State College. 66 pp.

Maki. T. E. 1957. Drain a forest? Res. and Farming XV(3):14.

Maki, T. E. 1959. Improving site quality by wetland drainage. Proc. 8th Annual Symp. LSU Press. 106-114.

Maki, T. E. 1968. Drainage & soil moisture control in forest production. Proc. 17th Annual For. Symp. LSU Press. 139-157.

Location of Data: Some summaries and annual project reports are located in 3136 Jordan Hall.

Pond Pine Seed Extraction Study

Description and Location: Leslie Gallup conducted a study to find a rapid and efficient method of artificial extraction of pond pine seed. One and two year-old cones were gathered trees felled in the spring on the Hofmann Forest. Treatments included: mechanical; water soaking for 24 hours; boiling for five seconds; flame contact for 5 seconds; and air dried (control). The flame and boiling treatments were superior for seed extraction. However, when results from germination tests were considered, the flame treatment was the best .

Publication: No publication has been located. However, a draft publication was prepared in 1956 or 1957.

Location of Data: All data, statistical analyses, and a report are located in a file in 3136 Jordan Hall.

TIMBER SPECIES OTHER THAT PINE

Sweetgum Plantation

Description and Location: Located about 3.5 km northeast of Deppe Trail at the intersection of Roper Road and Gramp Slocum Road, the 15 hectare sweetgum plantation was planted in February of 1986 under the direction of Russ Lea. A year prior to planting, drainage ditches were dug at 180m intervals, and site preparation included shearing and piling, bedding, and fertilization with 280 kg/ha of triple super phosphate; this was done by Champion before the responsibility of forest management was returned to the Forestry Foundation. Seedlings were planted at 1.8m intervals using modified shovels in beds 2.7m apart resulting in approximately 2,000 seedlings per hectare. Initial survival in December of 1986 was 84% with the mean seedling height of 1.45m. No further measurements have been made.

Plantability of Atlantic White Cedar

Description and Location: Several objectives concerning the artificial regeneration of Atlantic white-cedar were tested : (1) the notion that white-cedar cannot be successfully planted, (2) the performance on a wide range of site conditions; (3) methods of preventing browsing; and (4) white cedar response to competition and subsequent release. The study involved six sites exhibiting a range of soil types and previous land use history, two of which were on the Hofmann Forest. One year bare root seedlings and containerized root cuttings were planted in alternate rows in April and May of 1989, respectively, at a spacing of 5 to 6 feet within rows and 8 to 12 feet between rows. Physical barriers were installed to prevent browsing. Three of the sites (not including the Hofmann) were treated with herbicides. Height and survival were measured after the first three growing seasons. Second and third cycles of planting were done in 1990 and 1991. It was found that white-cedar can be successfully planted on sites with acidic organic soils that are properly prepared for planting. The Hofmann sites, especially the bedded site, presented the best performing trees with the highest mean seedling height, the highest mean cutting height, and the highest percent survival. Seedling performance was found to be slightly better than cutting performance, though both show potential for artificial regeneration. Damage from deer browsing was not as extensive as first thought and may not be a serious threat. Herbicide treatment did not appear to affect white-cedar growth or mortality and was effective in controlling competition.

Publications:

Phillips, Ronald W.; W.E. Gardner, F.M. White, J.H. Hughes. 1991. Forestation with Atlantic white cedar (Chamaecyparis thyoides) rooted cuttings and bare-root seedlings: Conference on Coastal Forests and Forested Wetlands, New Haven, Connecticut April 18-21.

Phillips, R.W.; Gardner, William; Summerville, K.O. 1992. Plantability of Atlantic white cedar rooted cuttings and bare-root seedlings: 7th Biennial Southern Silvicultural Research Conference.

Phillips, Ronald W. 1992. Forestation with Atlantic white cedar (Chamaecyparis thyoides) rooted cuttings and bare-root seedlings. Work project for master's degree. North Carolina State University. 26 pp.

FOREST FUELS

Forest Fuels on Organic and Associated Soils in the Coastal Plain of North Carolina

Description and Location: The objectives of this study were to 1) identify types of pocosin fuels based on the species composition, height and density and 2) to determine the total weight per unit area of each type, group them into height classes and rank them in terms of blowup potential. The majority of sampling was done on the Hofmann Forest; some sampling was done on Croatan National Forest and in Tyrell County. Fourteen types of fuels were identified, described and photographed. Each type was categorized as brush, switch cane, or grass depending on composition. Understory vegetation and litter were sampled for fuel weight and overstory vegetation was sampled to estimate the contribution of pine crowns to total fuel weights. Total fuel weight and blowup potential were defined for each fuel type.

Publication:

Wendel, G. W., T. G. Storey, and G. M. Byram. 1962. Forest fuels on organic and associated soils in the Coastal Plain of North Carolina. SE For. Exp. St. Paper No. 144, 46 pp.

Seasonal Moisture Fluctuations in Four Species of Pocosin Vegetation

Description and Location: Yearly extremes in moisture content and patterns of seasonal change were determined for common gallberry, redbay, swamp cyrilla, and switch cane. For common gallberry, difference between moisture content of plants growing on mineral soil versus organic soil was determined. All sampling was conducted on the Hofmann at an unknown location presumably in a pine pond stand. Five whole plant samples were taken weekly for nine months and then intermittently at intervals between 1-3 weeks for 3 months. Moisture content was determined for the whole plant and for plant components using oven dried weight. Moisture content for all species (excluding gallberry) increased from the end of March reaching a maximum in late May and early June before gradually decreasing for the rest of the year. Gallberry moisture began increasing in early may and peaked in June on the dry site and July on the wet site before decreasing. Differences in moisture content over time were highly statistically significant for all species. There was a statistically significant difference in moisture between gallberry sites and over time with the plants from the organic site having the most moisture. Lowest vegetation moisture coincided with seasons of greatest fire occurrence.

Publication:

Wendel, G.W. and Storey, T.G. 1962. Seasonal Moisture fluctuations in four species of pocosin vegetation. U.S. Forest Serv. Southern. Forest Expt. Sta. Paper No. 147, 9pp.

Seasonal and Diurnal Variation in Moisture Content of Six Species of Pocosin Shrubs

Description and Location: Seasonal variation in moisture content of gallberry, swamp cyrilla, redbay, switch cane, fetterbush, and honeycup was observed from March through December 1965 on the Hofmann Forest. Foliage and stem moisture were separately measured and compared with the average for the whole plant. Diurnal moisture was observed for gallberry, swamp cyrilla, honeycup, and fetterbush.

Publication:

Blackmarr, W. H., and William B. Flanner. 1968. Seasonal and diurnal variation in moisture content of six species of pocosin shrubs. USDA Forest Service. Res. Pap. SE-33. 11 pp.

WILDLIFE STUDIES

Threatened Furbearers in Eastern North Carolina

Description and Location: Principal investigators were Dick Lancia and Jay Hair. The study was conducted from 1979-1981. Bobcats and River Otter were captured, radio-marked, and released in the White Oak River and southwestern Croatan National Forest. However, some of each species traveled to or through the Hofmann after release. Study personnel from NCSU Forestry and Zoology refurbished and stayed in the guest house at the Hofmann headquarters.

As part of the effort to install a digital satellite image processing system for habitat mapping, a land use/cover map was developed for the Hofmann using a 1973 digital LANDSAT image.

Publications:

Lancia, R. A., D. W. Hazel, S. D. Miller, and J. D. Hair. 1982. Computer mapping of potential habitat quality for bobcat based on digital LANDSAT imagery. Proc. of Inplace Resour. Invent. Nat. Workshop, Orono, Maine.

Lancia, R. A., S. D. Miller, D. A. Adams, and D. W. Hazel. 1982. Validating habitat quality assessment: an example. Trans. N. Amer. Wild. and Natur. Resour. Conf. 47:96-110.

Lancia , Richard A., David K. Woodward, and S. Douglas Miller. Summer movement patterns and habitat use by bobcats on Croatan National Forest, North Carolina.
Location of Data: Dave Woodward of the Zoology Department has additional data on otter food habits not yet published.

Hofmann Forest Black Bear Population Status

Description and Location: The feasibility of using remote camera re-sights to generate population size estimates of black bears on the Hofmann Forest was assessed. Bears were trapped and tagged for visual re-identification from 12 May to 25 July 1999. Camera re-sightings were conducted from 1 August through 31 October. The effective study area (ESA) of 181km2 was divided into 36 equal grids each with a remote camera that was activated by a baited tripwire. Cameras were repositioned within the grid once a month. Trapping and camera results were analyzed using Bailey's binomial model to estimate the bear population as 266 bears or 0.80 bears/km2 on 332 km2. Problems included equipment vandalism, interference from non target species, and hurricane damage. Factors such as the vastness of the ESA and the inaccessibility of some areas also decreased the effectiveness of the camera use. The results are not accurate enough to be used alone when developing a black bear management plan for the Hofmann , but should be considered in conjunction with Bear Management Unit data (the Hofmann lies within two BMU's), and the judgment of NCWRC and HF personnel.

Publication:

Jones, Mark D. 2000. Hofmann Forest black bear population status. North Carolina Wildlife Resources Commission Report. 13 pp.

MISCELLANEOUS

Experimental Pastures

Description and Location: In 1937 through 1946, a cooperative grazing experiment was conducted by the Foundation and the NC State College Animal Husbandry Department. The objective of the study apparently focused on the suitability or not of cane and associated plants as forage. About 300 cattle were grazed on the forest year-round near Deppe and Comfort. An intensive beef cattle and forest grazing experiment was set up in Block One on the northwest corner of the forest in 1942. The intensive study also involved the USDA Forest Service and the United States Bureau of Animal Husbandry. Eight 48-acre pastures were set up with the following treatments:

-Logged and heavily stocked
-Logged and moderately stocked
-Unlogged and heavily stocked
-Unlogged and moderately stocked

After four years of grazing, cane and other palatable browse had been reduced 50 to 60 percent while other plants were relatively unaffected. Sustained grazing capacity was estimated to be between one-third and one-half cow month of grazing per acre during the summer season. Growth and establishment of pond pine seedlings was improved by grazing.

Publication:

Shephard, W.O., E.U. Dillard, and H.L. Lucas. 1951. Grazing and fire influences in pond pine forests. Tech. Bull. 32, NC Agricul. Exp. Sta.

Status of Study: The study has been discontinued. No data other than those in the publication have been located.

Seed Tree Study - Experimental Pasture Area

Description and Location: A "regeneration study" was installed along Gasperson Road west of Quaker Bridge Road in the vicinity of the experimental pasture area in the winter of 1959 - 1960. Four replications of the following treatments were installed: burn before logging, burn and disk before logging, disc before logging, disk before logging, and control. Burning was done in May of 1959. Plots were each 5 by 5 chains. Only a hand-written sketch with notes has been found. It is assumed the study was installed by Dr. T.E. Maki. Because no records have been found other than a hand-written map with notes, it is not clear whether the "study" was fully installed. Because the location has not been verified, it is not clear whether the seed trees were pond pine or loblolly pine.

Data and Publications: No publications nor measurement data are known to exist.

Effects of Environmental Modification on Vegetation and Tree Growth

Description and Location: This study was carried out by J. Lamar Teate as a Ph.D dissertation study under the direction of Dr. T. E. Maki. The study was installed in a 80-acre area near the intersection of Quaker Bridge and Pocosin Roads. Objectives of the study were to observe the effects of drainage, burning, disking, and fertilization on planted loblolly seedlings and native vegetation. Documentation of methods in the dissertation is excellent.

Publications:

Teate, J. Lamar. 1967. Some effects of environmental modification on vegetation and tree growth in a North Carolina Pocosin. Ph.D Dissertation. North Carolina State University. 108 pp.

Teate, J. Lamar, and T.E. Maki. 1970. The effect of drainage and evapo-transpiration on water table behavior in an organic soil. SSS Proceedings. 11 pp. (further documentation needed)

Location of Data: Additional data beyond what is in the dissertation are located in files in 3136 Jordan Hall.

Progeny Tests
Description and Location: During the 1970s, numerous progeny tests were established on the Hofmann for loblolly and pond pine. Both Piedmont and Coastal Plain source loblolly pine were tested. Seedling sources included state nurseries, Federal Paper, and WestVaco. Although many test plots have not had final harvest, no plots are any longer considered to be important for research. An internal Champion memo had determined that by 1989 only a couple of tests were still "active."

Stratigraphy and Geomorphology of the Hofmann Forest Pocosin

Description and Location: The stratigraphy and geomorphology of the Hofmann Forest was examined to determine the factors responsible for the accumulation of organic materials. An auger drill rig was used to study sediments; mapping of histols was done using standard field techniques; hydraulic conductivity of sediment was determined by the piezometer method; and organic carbon content was determined by loss on ignition of oven dried samples. It was found that pre-Croatan formations and the Wicomico and Talbot non-stratigraphic units underlie the Hofmann Forest. Overlying the pre-Croatan units is a discontinuous layer of the Pliocene-Pleistocene Croatan formation. The surface sediments fit a morphostratigraphic unit consistent with the Wicomico and Talbot units. Saprists cover most of the Hofmann Forest and are highly decomposed except for localized Atlantic white cedar logs. Several factors such as the large distance between streams, a virtually flat landscape, the shallow depth to the pre-Croatan formation (aquiclude), and an excess of rainfall over evaporation are responsible for the organic layer. Stream dissection would only provide limited drainage. The organic mantle has no surface drainage and the water is controlled by rainfall, evaporation, and surface runoff. The forest is as well drained as anytime in geomorphologic history. Past history suggests Hofmann forest has always been a potential site for organic accumulation.

Publication:

Daniels, R.B., E.E. Gamble, W.H. Wheeler, and C.S. Holzhey. 1977. The stratigraphy and geomorphology of the Hofmann Forest pocosin. Soil. Sci. Soc. Am. Proc, 41:1175-1180.

Lithographic Characteristics and Diagenesis of Some Siliceous Coastal plain Rocks

Description and Location: "Silica- cemented sandstone and porcellanite rocks were excavated from the Hofmann Forest and analyzed by scanning electron microscopy, polarized light, and x-ray diffraction to determine their diagenetic history, age, and stratigraphic position. The rocks consist of sandy porcellanites and silica-cemented sandstones (quartz-arenites) that contain small lenses or pockets of porcellanite. The sandstones were cemented initially by opal-CT, which formed linings around the sand grains, and subsequently by fibrous chalcedony, which filled some of the remaining pore spaces. With the aid of the scanning electron microscope, small quantities of authigenic montorillonite, kaolinite, euhedral quartz and framboidal pyrite were observed along with fragmentary remains of siliceous micro-fossils. The original sediments ranged from quartzose sand to sandy diatomaceous mud or diatomite. The lithologies observed are commonly found in the upper Paleocene and Eocene sequences in the southeastern Coastal Plain of the United States." (From abstract)

Publication:

Wise, S.W. Jr., M.P. Ausburn, D.A. Textoris, W.H. Wheeler, R.B. Daniels, and E.E. Gamble, 1981. Lithographic characteristics and diagenesis of some siliceous coastal plain rocks. Scanning Electron Microscopy. 9pp.

A Time Series Study of Stumpage Prices in the Hofmann Forest Timber Market

Description and Location: The purpose of this study was to analyze past and current regional stumpage prices to anticipate future prices needed for efficient timber management. The objectives were: 1) to describe the Hofmann Forest timber market, 2) to compile a data set of historic stumpage prices in the Hofmann Forest vicinity, 3) to review methods of forecasting stumpage prices, and 4) to project prices that may be received for future Hofmann Forest timber. The Hofmann Forest is located in a region near three major paper and pulp mills, three major sawmills, and nine local mills. Other suppliers in the area include Croatan National Forest, Camp Lejeune Military base, industrial land, and non-industrial private forested land. Because a comprehensive price series from Hofmann Forest was not available, price data from the Timber-Mart South report was chosen, adjusted for inflation, and used for analysis. Among the time series techniques reviewed, exponential smoothing was chosen to model prices for saw timber, pulpwood, and chip-n-saw. It was found that forecasts for even short term planning were limited by prediction intervals and a time series analysis was not able to predict stumpage prices in the NC Coastal Plain region. Historic price behavior was not useful in predicting future stumpage prices. A model specific to the forest

could be constructed if timber sales, including the prices of sawtimber, chip-n-saw, and pulpwood are recorded, maintained, and updated in detail in a database. Only then can an accurate projection of future prices be made.

Publication:

Graham, Barbara Lynn. 1993. A time series study of stumpage prices in the Hofmann Forest timber market. Master's Thesis. North Carolina State University. 66p.

The Effect of Silvicultural Practices and Stand Development on Surface Water Storage in Forested Wetland Flats

Description and Location: Surface water storage properties in wet pine flats were examined in order to determine the effects of silvicultural practices. Four pine plantations of various ages located on the Hofmann Forest were compared to a 60 year old relatively natural pine flat. Microtopography, physical soil properties, litter properties, innundation, and leaf area were compared. Three methods were employed to measure microtopography; the most accurate method involved estimating the size of depressional areas using contour maps. Small and large diameter wells were installed to measure water table depths. Physical soil properties examined included organic matter content, porosity , and bulk density. Proportion, bulk density and porosity of litter were measured. On a microtopographical scale, the conversion of semi-natural flats to pine plantation increased the potential for surface water storage. Higher bulk density and removal of organic matter were relevant effects of silvicultural activities on soil properties affecting surface water storage. The leaf area index and the litter did not significantly contribute to the differences in surface water storage among the plots. This study did not consider microtopography or the relationship between surface storage and subsurface storage; further study should include these factors.

Publication:

Farley, Paul M. 1995. The effect of silvicultural practices and stand development on surface water storage in forested wetlands. Master's Thesis East Carolina University. 84pp.

The Ecological Changes in a Pocosin Site Following Intensive Site Preparation and Plantation Management Contrasted to the Ecological Conditions of a Natural Unaltered Pocosin Site: A Soil, Vegetation and Planted Pine Volume Analysis

Description and Location: The study area on the Hofmann was the Big Opening and the objectives were to address questions surrounding pocosin habitat conversion to artificial loblolly pine plantations. This project is a supplement to the pocosin amelioration study performed by Maki and Teate in 1963. Baseline data on pocosin vegetation and soil characteristics associated with habitat conversion and intensive timber management were sought. Treatments to optimize lesser vegetation species richness; stem count diversity and evenness index values; lesser vegetation biomass diversity and evenness index values; and pine fiber production were explored. Moisture and fertility gradients were measured to compare dominance values of the natural pocosin to the pine plantation. Drainage, soil nutrient values, planted pine productivity, and woody and herbaceous vegetation response to non-fertilized and fertilized treatments across four site preparation treatments, disk, burn, disk-burn, and control were examined. Four types of data were analyzed: lesser vegetation stem count; lesser vegetation biomass; planted pine volume, height, and diameter; and soil fertility. Treatment combinations which were significantly different for stem count are: fertilization, species, site preparation, site preparation x fertilization x species, site preparation x species, species x fertilization, distance x fertilization, and species x distance. Treatment combinations which were significantly different when lesser vegetation biomass was considered are: fertilization, species, and block x site preparation. The significant treatment combinations for the combined planted pine parameters were block, species and fertilization. It is recommended that, in order to achieve the greatest timber production and to maintain diverse native vegetative cover, the disk treatment should be used and pond pine should be planted using phosphate fertilizer.

Publication:

Bettis, Jerry Lamont. 1996. The ecological changes in a pocosin site following intensive site preparation and plantation management, contrasted to the ecological conditions of a natural unaltered pocosin: a soil, vegetation, and planted pine volume analysis. Doctoral Dissertation. North Carolina State University. 222 pp.

Restoration Potential of Disturbed Longleaf Pine Understory Plants

Description and Location: Through historical land use analysis and through the comparison of disturbed sites to "pristine" sites, the restoration potential of severely disturbed longleaf pine flatwood sites in the NC Coastal Plain was determined. The disturbed sites, named Tower, Margaret, and Ella, are located in Block ten of the Hofmann Forest, and the two pristine sites are located in Croatan National Forest (CNF) and Camp Lejeune. Land use history was compiled by examining archived documents and through interviews with employees. Conclusions of the land use history are:

1.All five study sites were forested with longleaf pine in presettlement times

2.Early land use by settlers was similar for all sites, and all were exploited heavily prior to the 1930's

3.The primary difference between the CNF and Lejeune sites and the Hofmann Forest sites is that the CNF and Lejeune sites have never been planted and the understory disturbance has been minimal.

4. Based on land use history, the Margaret site shows the greatest potential of the three Hofmann Forest sites for restoration to a longleaf pine ecosystem.

The current vegetation of the Ella, Margaret and CNF study sites was compared within and among sites, and seedbed viability was determined. The conclusions of the vegetation analysis are:

1. The disturbed sites share over 25% of their current species with the pristine CNF site, indicating high resiliency to disturbance by understory species,

2. Restoration potential is greatest when disturbed sites are under five years old, with an open canopy: and

3. A viable seedbed exists in disturbed sites, and it could be used to restore longleaf understory vegetation.

Because characteristic longleaf understory plants have survived, and the seed bed is viable, the longleaf pine ecosystem can be restored through burning on all sites, removal of loblolly pines (on the Ella site only), chopping of dense woody vegetation, and restoration of a species analogous to wiregrass.

Publication:

Cohen, Susan A. 1998. Restoration potential of disturbed longleaf pine understory plants. Master's thesis. North Carolina State University. 117pp.

Nutrient Deposition Monitoring Project

Description and location: Several factors together make the Hofmann Forest a near ideal laboratory in which to study landscape-scale nutrient cycling including atmospheric deposition. These factors include: (1) because the forest as a pocosin is a "swamp on a hill", the forest receives minimal nutrient inputs from surface water or subsurface-water pathways; (2) the forest has readily identifiable and reachable outfalls along the perimeter of the forest through which most drainage water with associated nutrients leaves the forest; and, (3) the forest may serve as an air-shed for airborne nutrients being generated at numerous swine facilities surrounding the forest, especially up-wind. In 2000, rainfall collectors were installed at nine locations to collect throughfall under pine plantation canopies and bulk rainfall in the open. Rainfall is being collected within 24 hours of precipitation events. Nine corresponding nearby surface water outfalls are being sampled weekly. Drs. Carlyle Franklin and James Gregory are the Principal Investigators.

Data and Publications: Rainfall has been collected and weekly samples have been taken at the corresponding outfall since September 2000. Publication of these data in conjunction with water quality data is in progress.

Hofmann Forest Wetland Mitigation Bank Forested Wetland Restoration and Monitoring Plan

Hofmann Forest Wetland Mitigation Bank Forested Wetland Restoration and Monitoring Plan

Description and Location: The Hofmann Forest Wetland Mitigation Bank (HFWMB) plan was designed to compensate for unavoidable impacts to the Wet Flat hydrogeomorphic type in the pine savanna and nonriverine wet hardwood forest vegetation types. Principal investigators are Drs. E. Carlyle Franklin and Doug Frederick. The goal is to incorporate a species trial, a test of alternative liming materials, a commercially forested firebreak managed for timber, and enhanced wildlife habitat. The plan calls for restoration and monitoring of 400 acres of uplands located at the intersection of Quaker Bridge and Sopp Hollow Roads consisting of 80 acres of prior converted agricultural land and 320 acres of excessively drained fields. Wetland hydrology will be maintained for the longest periods possible during the year. The bank was designed to provide, at the completion of restoration, 100 acres of pine savanna forest, 188 acres of nonriverine wet hardwood forest and 112 acres of nonriverine cypress forest.

PUBLICATION LIST

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