THE STATE UNIVERSITY OF NEW JERSEY
RUTGERS

Compendium of New Jersey Pine Barrens Literature

Dr. Kenneth Buchholz
Dr. Ralph E. Good

Center for coastal and environmental studies
Division of Pinelands Research

COMPENDIUM OF NEW JERSEY PINE BARRENS LITERATURE

Compiled By

Dr. Kenneth Buchholz

and

Dr. Ralph E. Good

Division of Pinelands Research, CCES

July 1982

Dr. Norbert P. Psuty, Director
Center for Coastal and Environmental Studies
Doolittle Hall - Busch Campus
Rutgers, The State University
New Brunswick, New Jersey 08903

COMPENDIUM OF NEW JERSEY PINE BARRENS LITERATURE

Compiled By

Dr. Kenneth Buchholz

and

Dr. Ralph E. Good

This compendium was prepared in the Division of Pinelands Research, Center for Coastal and Environmental Studies, with support from the Victoria Foundation and the Rutgers University Office of Community Affairs, and in cooperation with the New Jersey Pinelands Commission.

July 1982

81-5720 Victoria Foundation, Inc.
Pinelands Scientific Research Program (Good)

PREFACE

The New Jersey Pine Barrens is the single largest tract of relatively undeveloped land in the northeast urban corridor. Covering more than 1 million acres in southern New Jersey's Outer Coastal Plain, the Pine Barrens represents one of the most extensive land resources of the region. The close proximity of the Pine Barrens to adjacent urban centers, especially the greater New York City and Philadelphia urban areas, has placed severe developmental pressures upon this land resource.

Biologically, the Pine Barrens is a mosaic of various upland and wetland communities supporting more than 500 species of animals and 800 species and varieties of plants. Some species are endemic to the Pine Barrens while other species attain either their northernmost or southernmost distribution in the Pine Barrens. This large, diverse assemblage of species makes the Pine Barrens one of the most unique biological systems in North America. Land use and concomitant problems associated with urbanization threaten the continued existence of this very valuable biological resource.

The Pine Barrens also represents an important water resource. Distinct from the glaciated region of northern New Jersey, the Pine Barrens has developed on unglaciated, unconsolidated marine quartzose sediments of Tertiary age. These sands contain the largest unpolluted, freshwater aquifer (17 trillion gallons) in the northeastern United States. The relationship between aquifer and biota is so intimate that even the slightest change in water quality or quantity may have severe impacts on the biological communities comprising the Pine Barrens. Yet the ever-increasing land and water resource demands of the adjacent urban centers jeopardize the continued existence and maintenance of this aquifer and the biota dependent on it.

Recognition of the importance of the Pine Barrens as a valuable and very limited natural resource, and the jeopardy with which its future is faced, has resulted in recent public efforts on the national, state and local levels to preserve the Pine Barrens. The National Parks and Recreation Act of 1978 created our Nation's first national reserve - The Pinelands National Reserve - within the New Jersey Pine Barrens. In compliance with the federal statute, the Pinelands Protection Act, enacted by the New Jersey State Legislature in June 1979, created the Pinelands Commission as the regional planning and management entity for the Pinelands National Reserve. The Comprehensive Management Plan developed by the Pinelands Commission recognizes that the Pine Barrens contains a multitude of unique natural, physical and cultural qualities, that these qualities are threatened by increasing residential, industrial and cultural developmental pressures, and that it is in the public interest to preserve all of these qualities. The Comprehensive Management Plan delineates the strategy to be employed for preservation of all Pine Barrens resources, including assessment of natural, cultural, commercial and industrial resources within the context of maximum public utilization.

Successful preservation of the Pine Barrens requires an active participation by a variety of interest groups including the scientific community. Rutgers University established a Division of Pinelands Research within its Center for Coastal and Environmental Studies with the encouragement of the New Jersey Pinelands Commission. One of the major functions of the Division of Pinelands Research will be to facilitate the flow of information between the scientific community and the Pinelands Commission, offering scientists an opportunity to significantly contribute to regional management of the Pinelands National Reserve by making their expertise available. The Pinelands Commission is very much cognizant that successful implementation of its management plan depends in large part on thoughtful application of scientific principles and knowledge. Some information is available from earlier studies but some of this will need re-analysis and/or elaboration for application to management objectives; other information is currently unavailable or incomplete and requires additional research.

One of the initial objectives of the Division of Pinelands Research was to provide a readily-accessable data base of New Jersey Pine Barrens literature as a tool to aid both the Pinelands Commission in its management policy-making decisions and the scientific community by providing a data base illustrating areas which identify where new or further research is warranted. This Compendium of New Jersey Pine Barrens Literature represents this data base.

ACKNOWLEDGEMENTS

Numerous individuals contributed to the production of this compendium. Robert Hastings, Leland Merrill Jr., Mark Morgan, Norbert Psuty and Beryl Robichaud reviewed and commented throughout the project, and Robert Zampella and Arvind Vyas aided in the literature search. Many others assisted in the literature search by providing information on many of the more obscure citations and their help is gratefully acknowledged. Norma Good contributed comments and suggestions during composition of the compendium and aided in editing the final manuscript. The Center for Computer and Information Services, Rutgers University, provided computer time and support facilities.

TABLE OF CONTENTS

INTRODUCTION

The Compendium of New Jersey Pine Barrens Literature was developed with two specific purposes in mind: (1) to provide an easy-access reference system as a tool for policy-makers as well as scientific researchers, and (2) to provide a means for identifying current research needs and thus directions for future scientific investigations.

The Compendium is an annotated bibliography of literature on the New Jersey Pine Barrens. The primary source of information was an extensive literature search, using available bibliographies and reference citations from the literature. Many individuals contributed by providing information on more obscure literature. This information was compiled and edited using the DEC-20 computer network and support facilities of Rutgers University. Use of this computer system greatly facilitated compilation and continuous editing, and affords the capability for computer searches of the entire Compendium.

The Compendium contains information under six topic sections: 1) Botany, including agriculture, forestry, microflora and paleobotany; 2) Geology and Soils; 3) Hydrology, including surface water, ground water and water chemistry; 4) Meteorology, including microclimate; 5) Zoology, including soil microfauna and paleozoology; and 6) General References. The abundance of older and minor literature (e.g., notes on species occurrences, narrative magazine articles of general public interest, etc.) dictated limitations on the scope of the Compendium. The Compendium contains a complete bibliography of literature citations but is limited in annotations to more recent and major, substantive literature.

Each topic section is presented in standard scientific format: alphabetically by author's last name and chronologically by publication date. Each periodical citation contains:

> Author(s) name(s). Publication date. Title of article. Publication vehicle name. Volume number:inclusive pages.

Each book citation contains:

> Author(s) or editor(s) name(s). Publication date. Title of book. Publishers name and city address. Number of pages.

Citations for chapters in books are given as:

> Author(s) name(s). Publication date. Chapter title. Book author(s) or editor(s) name(s). Publisher's name and city address. Chapter pages.

Citations for reports published by various agencies contain:

> Author(s) name(s). Publication date. Title of article. Agency name and city address. Number of pages.

Following each citation is a parenthetical annotation indicating whether the article is a presentation of original scientific research (D), an abstract of an oral presentation (A), a review article (R), or a narrative of general public interest (N). Annotated citations contain information on research site location(s), keywords, and an abstract summary of the article. Author and Keyword indices follow the bibliographic sections.

The Keyword annotation contains key words in addition to those in the article title. The Location annotation indicates the research site location by name (e.g., Lebanon State Forest) and by an index number(s) (e.g., 8,9) referring to numerically-coded U.S.G.S. 7.5 minute topographic map quadrats in which the research site(s) is(are) located. A numerical key to the U.S.G.S. topographic maps is presented after the Keyword Index, followed by a location name - map number crossindex. The Abstract annotation contains the abstract or summary presented by the author(s); when an abstract or summary was not presented by the author(s), an abstract was prepared by the compiler from appropriate statements made by the author(s) in their text. To preserve accuracy, every effort was made to quote the author(s), where possible, verbatim.

Citations for literature containing information on two or more topics are presented in full in the most appropriate topic section and cross-referenced in other topic sections by author, date and topic section in which the full citation is given.

The General References section contains citations which cover all five topics (e.g., Forman, R.T.T. (ed). 1979. Pine Barrens: ecosystem and landscape. Academic Press, New York. 601p.) or miscellaneous subjects.

During the year of compilation, approximately 900 Pine Barrens literature citations were encountered. The majority of citations were reviewed by the compiler and the citations presented are complete. Some citations were unavailable for review by the compiler, and the information presented is as complete as possible. The computerized Compendium will be continuously edited and updated and may be expanded to included other subject bibliographies (e.g., archeology and cultural history); future editions of the Compendium will reflect these additions.

BIBLIOGRAPHIES

GENERAL REFERENCES

ABBOTT, C. C. 1885. A naturalist's rambles about home. D. Appleton and Co., New York. (N)

ABBOTT, C. C. 1889. Days out of doors. D. Appleton and Co., New York. (N)

ABBOTT, C. C. 1890. Upland and meadow. Harper Bros., New York. (N)

ABBOTT, C. C. 1891. Outings at odd times. D. Appleton and Co., New York. (N)

BOLTON, F. E. 1963. Browns Mill Pond (Mirror Lake), Burlington County. N. J. Outdoors 14:16-17. (N)

BOUCHER, B. P. and H. C. BROOKS. 1962. Field trips in New Jersey. Phillips-Campbell Publ. Co., Cedar Grove, N.J. 180p. (N)

BRANDER, R. 1968. Wilderness island in megalopolis: the pine barrens of New Jersey. Anim. Kingdom 71:2-7. (N)

Location: General

Keywords: Flora; Fauna; Conservation

BREISKY, W. 1955. New Jersey's unknown wilderness. Sat. Evening Post 6 August 1955:228. (N)

BUCKLEY, P. A., J. J. FLORIO, E. B. FORSYTHE, R. PATRICK, J. McCORMICK, S. LITTLE and R. W. HASTINGS. 1978. The preservation of the New Jersey Pine Barrens. Frontiers 42:12. (N)

BUELL, M. F. 1955. Origin and development of the pine region hydrological research project. Proc. 85th Ann. Meet., Amer. Cranberry Growers Assoc. 3p. (N)

BUTLER, M. G. 1953. A field trip to the New Jersey Pine Barrens. Bartonia 27:59-61. (N)

BUYUKMIHCI, H. S. and H. FANTEL. 1968. Unexpected treasure. M. Evans Co., New York. (N)

CAWLEY, J. and M CAWLEY. 1942. Exploring the little rivers of New Jersey. Rutgers Univ. Press, New Brunswick, N.J. (N)

CENTER FOR ECOLOGICAL RESEARCH IN PLANNING AND DESIGN. 1973. An ecological planning study of Medford Township. Tech. Rept. 3, Dept. Landscape Arch. Regional Planning, Univ. Penn., Philadelphia, Pa. (D)

CRANMER, C. B. 1952. Future of the Pine Barrens. Bartonia 26:53-60.

DEPARTMENT OF CONSERVATION AND ECONOMIC DEVELOPMENT. 1966. New Jersey's shore: an inventory and analysis of land use. Div. State Regional Plan., Trenton, N.J. (R)

EVERT, D. S. 1962. The Pine Barrens Conservationists. Bartonia 32:6. (N)

FISKLIN, R. J. and J. D. MONTGOMERY. 1971. An ecological survey of a stream in the New Jersey Pine Barrens. Bull. N. J. Acad. Sci. 16:8-13. (D)

Location: Oswego River

Keywords: Physical Parameters; Algae; Angiosperms; Invetebrates; Vertebrates

Abstract: The relationships between physical parameters and macrobiota were studied on the Oswego River in the Pine Barrens of southern New Jersey. The major limiting factor in the stream was the low pH of 3.5. Small numbers of species and of individuals were correlated with this condition. Communities are delineated based on biota, and physical factors such as current velocity and stream bottom composition.

FORMAN, R. T. T. (ed.). 1979. Pine Barrens: ecosystem and landscape. Academic Press, New York. 601p. (R)

Location: General

Keywords: History; Industry; Geology; Soils; Hydrology; Climate; Aquatic Ecosystems; Nutrients; Flora; Fauna; Genetics

Abstract: Complete state-of-the-knowledge review of the Pine Barrens utilizing an intergrated ecosystems approach.

McCORMICK, J. 1970. The Pine Barrens: a preliminary ecological inventory. N. J. State Museum Res. Rept. 2:1-103, Trenton, N. J. (D) (Originally issued as: McCormick, J. 1968. A study of significance of the Pine Barrens of New Jersey. Nat. Parks Serv., U. S. Dept. Interior, Washington, D. C.)

Location: Wading River Ecosystem (8,9,10,11,15,16,17, 18,24,25,26,27,32,33,34)

Keywords: Flora; Fauna; Hydrology; Geology; Soils

Abstract: This report summarizes results of an initial ecological inventory of the Wading River Ecosystem in the central portion of the New Jersey Pine Barrens.

McPHEE, J. A. 1968. The Pine Barrens. B. Farrar, Straus and Giroux Publ., New York. (N)

McPHEE, J. A. 1977. Pine Barrens. Horticulture 55:59. (N)

PARNES, R. 1977. Canoeing the Jersey Pine Barrens. East Woods Press, New York. 49p. (N)

P.B.C. CONSERVATION COMMITTEE. 1963. More orchid vandalism in New Jersey. Bartonia 33:12-13. (N)

PEEL, B. A. 1980. The Pine Barrens, a bibliography. Rept. 4:1-23, New Jersey State Museum, Trenton, N.J. (R)

Pierson, G. 1977. N.J.'s Renewable Resources. N.J. Outdoors 4:6-7, 30-31.

PINELANDS COMMISSION. 1980. New Jersey Pinelands Comprehensive Management Plan for the Pinelands National Reserve (National Parks and Recreation Act, 1978) and Pinelands Area (New Jersey Pinelands Protection Act, 1979). New Jersey Pinelands Commission, P.O. Box 7, New Lisbon, N.J. 446pp. (D)

PINELANDS ENVIRONMENTAL COUNCIL. 1974a. Project review. Conserv. Environ. Studies Center, RD7, Box 2230, Browns Mills, N.J. 21p. (R)

PINELANDS ENVIRONMENTAL COUNCIL. 1974b. The West Plains and Oswego River Extension Tracts of the New Jersey Pinelands. Conserv. Environ. Studies Center, RD7, Box 2230, Browns Mills, N.J. 89p. (D)

Location: West Plains (17); Oswego River (25,26)

Keywords: Physiography; Climate; Regional Geology; Soils; Hydrology; Fauna; Flora; Historical Significance; Land Use

Abstract: An ecological inventory of the West Plains dwarf pine-oak forest and the Oswego River Extension Tract to the Wharton and Bass River State Forests is presented, including maps, various environmental data, and floral and faunal species lists.

PINELANDS ENVIRONMENTAL COUNCIL. 1974c. Bulltown and Friendship Bogs - non-public lands within Wharton State Forest. Conserv. Environ. Studies Center, RD7, Box 2230, Browns Mills, N.J. 59p. (D)

Location: Wharton State Forest (16,25,33)

Keywords: Physiography; Climate; Geology; Hydrology; Soils; Fauna; Flora; History; Land Use

Abstract: An ecological inventory of the Bulltown Bog and Friendship Bog, two privately owned tracts within the confines of Wharton State Forest, is presented, including maps, various environmental data, and floral and faunal species lists.

PINELANDS ENVIRONMENTAL COUNCIL. 1975. Plan for the Pinelands. Conserv. Environ. Studies Center, RD7, Box 2230, Browns Mills, N.J. 69p. (R)

Location: General

Keywords: Resources Description; Resources Evaluation; Cultural Resources; Land Uses; Political Considerations

Abstract: New Jersey's Pinelands represent a nationally and internationally significant cultural and natural resource. This study has investigated this statement thoroughly and offers evidence to substantiate the truth of that basic premise. Further, the study recommends that in the public interest, the United States Government, the State of New Jersey, county and municipal governments should move cooperatively and immediately to create a Pinelands National Preserve consisting geographically of an Outer Protection Zone and an Inner Preservation Zone. The Outer or Protection Zone is congruent with the Cohansey aquifer (approximately 1.5 million acres including the Preservation Zone). In the Protection Zone, emphasis should rest on protecting existing, or improving, any degraded quality in ground water, as its purity and volume are essential to the maintenance of ecosystems within the Preservation Zone. This quality control should be performed at the state and local level, working with a Pinelands Commission to be established, so that ground water quality degradation does not occur anywhere in the Cohansey Formation. The Inner or Preservation Zone is where essential preservation must be accomplished. In the Preservation Zone, coordinated land use must be achieved to see that both existing water quality and subecosystems are preserved. Planned and future development must not be resource-degrading nor resource-destructive. The present mix of private, public, state, federal, developed, agricultural, silvicultural, recreational and residential land uses are desirable so that the very essence of the Pinelands may be preserved.

ROBICHAUD, B. and M. F. BUELL. 1973. Vegetation of New Jersey: a study of landscape diversity. Rutgers Univ. Press, New Brunswick, N.J. 340p. (R)

SMALL, J. A. 1952. The Pine Barrens of New Jersey, Introduction. Bartonia 26:19. (R)

THOMAS, L. S. 1967 (Revised 1977). The Pine Barrens of New Jersey. Div. Parks, Forestry Recreation, Dept. Conserv. Econ. Develop., Trenton, N.J. 32p. (R)

Location: General; Batsto (24); Quaker Bridge (24); Martha Furnace (25); Atsion (24); Hampton Furnace (15); Forge Pond (24); Sims Place (26); Plains (17,26,27); Goose Ponds (32); MacDonalds Branch (8)

Keywords: Soils; Forests; Plains; Berry Culture; Waters; Industry; Settlements; Wildlife; Cedar Swamps; Flora; Fauna; Species Lists

TILDEN, P. M. 1971. Planning in the Pine Barrens. Nat. Parks Conserv. Mag. 45:22. (N)

U. S. DEPARTMENT OF INTERIOR. 1978. Planning Aid Report: Existing fish and wildlife resources related to the Southern New Jersey Water Resources Study, Burlington, Camden and Gloucester Counties, New Jersey. Fish and Wildlife Serv., Ecol. Serv., Absecon, N.J. 265pp. (D).

Location: General

Keywords: Geomorphology; Topography; Soils; Climate;

Land Use; Habitat Types; Vegetation; Fish; Wildlife

WHERRY, E. T. 1956. Bennett Bog now a nature sanctuary. Bartonia 28:36-37. (N)

WHERRY, E. T. 1958. Goose Pond saved. Bartonia 29:2. (N)

BOTANY, AGRICULTURE AND FORESTRY

ANDRESEN, J. W. 1957. Precocity of Pinus rigida Mill. Castanea 22:130-134. (D)

Location: Lebanon State Forest (8,9)

Keywords: Flowering; Reproduction

Abstract: Flower production at very early ages by 55 species and varieties of nursery grown Pinus has been reported by Righter (1939). He observed ovulate and staminate flower formation on pitch pine (Pinus rigida) at a minimum of 4 years. Examples of precocious cone and seed production have also been cited by several other authorities. Data reported in the present paper demonstrate that the ages of initial flowering and fruiting in pitch pine occur several years earlier than previously reported.

ANDRESEN, J. W. 1959. A study of pseudo-nanism in Pinus rigida Mill. Ecol. Monog. 29:309-322. (D)

Location: Lebanon State Forest (9); Coyle Airfield (17)

Keywords: Growth; Sprouting; Phytometer; Soil; Aluminum; Plains; Plains-Barrens Transition

Abstract: Evidence of frequent fires and a study of the soils supporting stunted coppice-forests of Pinus rigida in the Plains indicated that the primary cause of the dwarfing is repeated burning and not toxic quantities of soluble aluminum in the soil. This assumption is made because similar soil conditions, even higher concentrations of soluble aluminum, and a lower frequency of fires were found in contiguous areas supporting Pinus rigida 30 to 40 ft. tall. Survival (89%) and growth rates of Pinus rigida seedlings planted on a Plains site were much higher than in a similar Barrens planting where survival was only 63.5%. Soluble aluminum in quantities of 200 ppm, which was five times the amount found in Barrens soil, exhibited no depressing effect upon the Plains seedlings. The poor growth and survival rates in the Barrens were attributed to droughty soil conditions due to a lack of sufficient soil colloids. Cutting and subsequent sprouting of 25 single-stemmed Pinus rigida trees ranging in age from 5 to 95 years indicated that greatest ultimate vigor and best form developed in the younger trees. Although the initial number of collar sprouts was as high as 330 on a stump 32 years old, this number was reduced to 195 within a year. Three years later sprouts of trees 8 to 11 years old exhibited the best form. A sowing of Pinus rigida and Avena sativa in crocks containing B horizon soils collected from

12 Plains and 12 Barrens stations revealed no marked growth differences between the two soils. Wide differences were exhibited within areas indicating a mosaic of soil types. Soluble aluminum played no consistent role in depressing growth of either species. Fertilizer tests with Avena sativa showed no significant differences in yield between Plains or Barrens soils. There were marked increases in oven dry weight and number of seed with increasing quantities of fertilizer and lime regardless of soil source. Pinus rigida is also classed as an aluminum accumulator.

ANDRESEN, J. W. 1963. Germination characteristics of Pinus rigida seed borne in serotinous cones. Broteria, Ser. Cienc. Nat. 32:151-178. (D)

ANDRESEN, J. W. and J. MCCORMICK. 1956. The root system of pitch pine sprouts. Bull. Ecol. Soc. Amer. 37:95. (A)

ANONYMOUS. 1874. Forest fires. First Annual Report Appendix:60-62, N. J. State Bd. Agr., Trenton, N. J. (N)

ANONYMOUS. 1907. The Pine Barrens of New Jersey. Amer. Bot. 12:103-108. (N)

ANONYMOUS. 1930. Fighting forest fires. N. J. Dept. Conserv. Develop., Trenton, N. J. 41p. (N)

ANONYMOUS. 1966. Wharton Tract plants. N. J. Dept. Conserv. Develop., Trenton, N. J. 22p. (D)

Location: Wharton State Forest (14,15,26,27)

Keywords: Flora

ARCHARD, H. O. and M. F. BUELL. 1954. Life-form spectra of four New Jersey pitch pine communities. Bull. Torrey Bot. Club 81:169-175. (D)

Location: Lebanon State Forest (8,9)

Keywords: Fire; Floristic Relationships

Abstract: The life-form spectra of four New Jersey communities in which pitch pine is important are compared and found to be in agreement with Raunkiaer's hypothesis that a correlation exists between the predominance of protected life-forms and the degree of climatic severity.

The phanerophytes predominate in each of these pitch pine communities, but an increasing proportion of hemicryptophytes and cryptophytes, the more protected life-forms, are found in the more severe climatic area. The successional changes from pine to oak dominance have a minor effect on the life form spectra.

AURISANO, R. W. 1980. Upper Cretaceous subsurface dinoflagellate stratigraphy and paleoecology of the Atlantic Coastal Plain of New Jersey. Ph.D. Thesis, Rutgers Univ., New Brunswick, New Jersey. 204pp. (D)

Location: Toms River (11); Transcontinential Gas Pipeline Wells (14,15,23)

Keywords: Plankton; Dinoflagellate Zonation; Palynology; Sediment Deposition Phases

Abstract: Upper Cretaceous sediment from seven wells were examined for palynomorphs. Four species of dinoflagellates are described as new. Twenty-four stratigraphically important species are systematically described. A list of all dinoflagellate species recognized is presented; more common sporomorphs and acritarchs are illustrated. Biostratigraphic control is provided by the planktonic foraminiferal zonation recognized by Petters. A dinoflagellate zonation is proposed based upon boundaries defined by first and last appearances of stratigraphically significant species whose stratigraphic ranges are consistently correlated with foraminiferal zones. Seven zones and three subzones are distinguished. Data from this study show changes in the dinoflagellate cyst assemblages which correspond to alternations of transgressive and regressive depositional phases. In addition, comparison of coeval cyst assemblages from well to well show differences which correspond to different conditions of deposition such as proximity to source and paleobathymetric differences. Paleoecologic factors are considered to be a prime control of the dinocyst distributions which may have been modified more or less by sedimentologic factors. The dinoflagellate data suggest more open marine conditions or deeper water conditions in the Raritan Embayment than in the South Jersey High. This is considered to be the first evidence of paleobathymetric contrast between the South Jersey High and the Raritan Embayment. Fluctuations in palynofacies corresponds to fluctuations in transgressive and regressive phases of deposition. It appears that there is a direct relationship between palynofacies and distance from terrigenous source of sediments.

BAILEY, J. S. and A. P. FRENCH. 1946. Identification of blueberry varieties by plant characteristics. Mass. Agr. Expt.

Sta. Bull. 431. (D)

BAKER, W. M. 1921. One cord and acre per year. Forestry 19:754-758. (N)

BAKER, W. M. 1922. Forestry for profit. N.J. Dept. Conserv. Develop., Trenton, N.J. (N)

BALLARD, J. and M. F. BUELL. 1975. The role of lowland vegetation communities in the evapotranspiration budget of the New Jersey Pine Barrens. Bull. N. J. Acad. Sci. 20:26-28. (D)

Location: Lebanon State Forest (8,9)

Keywords: Shrub Community; Cedar Swamp Community; Water Table; Hardwood Swamp Community

Abstract: Evapotranspiration from three lowland vegetation communities (shrub, hardwood swamp, cedar swamp) of the New Jersey Pine Barrens was measured by volumetric lysimeters in the shrub community, and water table fluctuation analysis in the swamp communities. Potential evaporation estimates were obtained for the shrub community from meteorological data collected at the site. Shrub community evapotranspiration averaged 31 cm/yr. Tree swamp community evapotranspiration was 75 cm/yr. Analysis of the total pine barrens evapotranspiration budget showed that the lowland communities account for about 12% of the area's evapotranspiration.

BAMFORD, G. T. and S. LITTLE. 1960. Effects of low thinning in Atlantic white-cedar stands. For. Res. Notes 104:1-4, N.E. For. Expt. Sta., U.S.D.A. For. Serv., Upper Darby, Pa. (D)

Location: Lebanon State Forest (8,9)

Keywords: Selective Harvest

Abstract: Low thinning (21-49% total basal area removed) of Atlantic white-cedar was conducted in pure stands. Mortality was much less in thinned than in unthinned plots, and basal area growth, with one exception, was substantially greater in thinned plots. However, growth of larger "crop" trees was not markedly or consistently increased by thinning. Trees in thinned plots did not suffer greater wind-throw damage than unthinned plots. Since low thinning did not appreciably increase production of merchantable timber, but did have the undesirable effect of stimulating the growth of hardwood understories, such thinnings are not

recommended in white-cedar management.

BANKS, W. G. and S. LITTLE. 1964. The forest fires of April 1963 in New Jersey can point the way to better protection and management. Proc. Soc. Amer. For. 1963:140-144. (N)

Location: General

Keywords: Weather Conditions; Fire Behavior; Fire Suppression; Prescribed Burning

Abstract: Emphasis should be placed on preventing the occurrence of fires during periods of critical weather. Restrictions on burning and camping permits - accompanied by newspaper, television and radio warnings of the potentially dangerous fire conditions - should help. Reduction of fuel, for instance through prescribed burning in types where it is silviculturally desirable, and other presuppression measures are recommended, both to facilitate the control of fires under more normal conditions and to help in reducing suppression problems and damage in extreme periods like 1963.

BASSETT, F. L. 1897. Some rare New Jersey plants. Garden and Forest 10:68. (N)

BATES, M. E. and M. F. BUELL. 1969. Measurement of evapotranspiration in lowland vegetation. Bull. N. J. Acad. Sci. 14:6-7. (D)

Location: General; MacDonald's Branch, Lebanon State Forest (8,9)

Keywords: Instrumentation; Water; Bog Vegetation

Abstract: Instrumentation is described whereby the evapotranspiration from bog vegetation can be measured under natural conditions. The instrumentation is automatic, measuring the input and output of water of a system necessary to maintain the same water table within as that prevailing outside the system. The system consists of a six foot square tank containing a unit of vegetation sunk into a bog of the same vegetation and monitored by a pumping and measuring station. The latter is connected through an underground pipe to an irrigation system in the bottom of the tank. The specific environment in the New Jersey Pine Barrens for which it is designed is described. The questions concerned with the Pine Barrens vegetation water relations which it is expected to answer are discussed.

BECKWITH, C. S. 1922. Cranberry growing in New Jersey. Circular 144:1-39, N. J. Agr. Expt. Sta., New Brunswick, N. J. (N)

BECKWITH, C. S. 1940. See ZOOLOGY citation.

BECKWITH, C. S. 1943. See ZOOLOGY citation.

BECKWITH, C. S. and J. G. FISHE. 1925. Weeds of cranberry bogs. Circular 171:1-22, N. J. Agr. Expt. Sta., New Brunswick, N. J. (D)

BELLING, A. J. 1977. Postglacial migration of *Chamaecyparis thyoides* (L.)B.S.P. (southern white cedar) in the northeastern United States. Ph.D. Thesis, New York Univ., New York. (D)

BENEDICT, R. C. 1913. *Schizaea pusilla* in its natural surroundings. Amer. Fern Jour. 3:11-13. (D)

Location: Tom's River (11)

Keywords: Species Location

BERNARD, J. M. 1960. The forest floor of the New Jersey pine barrens and its role in the hydrologic cycle. M.S. Thesis, Rutgers Univ., New Brunswick, N. J. (D)

Location: Middle Branch and McDonalds Branch, Lebanon State Forest (8,9)

Keywords: Litter; Soil Moisture Holding Capacity

Abstract: Differences in the litter of different forest types are not significant, varying in depth from 0.5 to 0.9 in, and the water retention of the litter is equivalent to approximately 0.05 in and of the 1 in layer of soil immediately below the surface 0.44 in. Thus the forest floor can hold approximately 0.5 in water based on overdry condition. These relationships hold true for litter accumulated in stands control-burned as recently as 10 years previously as well as in stands unburned for several decades. Lichen ground cover develops as a result of a persistent control-burn program that keeps litter cover at a minimum. The litter layer of the forest floor may be 2-3 times as effective in intercepting moisture in unburned forest than in control-burned areas.

BERNARD, J. M. 1963a. Forest floor moisture capacity of the New

Jersey pine barrens. Ecology 44:574-576. (D)

Location: MacDonalds Branch/Middle Branch, Lebanon State Forest (8,9)

Keywords: Soils; Litter; Mosses

Abstract: The significant facts that emerge from this study are that the differences in the litter of different forest types of the area are not significant, that the depth of the litter varies from 0.5 to 0.9 inches, and that the water retention of the litter is equivalent to approximately 0.05 inch and of the 1-inch layer immediately below it to 0.44 inch. Thus the forest floor can hold approximately 0.5 inch of water, based on its ovendry condition. These relationships hold true for litter accumulated in stands control-burned as recently as 10 years previously as well as in stands unburned for several decades. Of some interest is the comparative influence of the litter in interception relative to moss and lichen ground cover. The latter develops as a result of a persistent control-burn program that keeps the litter cover at a minimum. Moul and Buell (1955) have shown that moss mats that develop under such circumstances can intercept as much as 0.62 inch of precipitation and lichen mats as much as 0.22 inch. Since the mosses and lichens were found to cover only 33% of the ground in the burned areas while the litter in unburned areas usually covers from 90 to 100% of the ground, it would seem that the litter layer of the forest floor may be from 2 to 3 times as effective in intercepting moisture in unburned forest than in control-burned areas.

BERNARD, J. M. 1963b. Lowland forests of the Cape May Formation in southern New Jersey. Bull. N. J. Acad. Sci. 8:1-12. (D)

Location: Cape May County (42,43,44,45,47,48,49,50); Lower Cumberland County (36,37,42,43,46,47)

Keywords: Soils; Geology; Meteorology; Vegetation

Abstract: A vegetation study was conducted in the lowland forests on the Cape May Formation of southern New Jersey. The primary objective of the study was to describe the vegetation of these forests. The vegetation was sampled in 10 stands using nested quadrats. The hydroperiod was determined by making periodic trips to the sampled stands. Soils were collected and analyzed. There appeared to be three distinct types of forest communities based on the important trees found in the stands. They were the *Acer rubrum* type, the *Chamaecyparis thyoides* - *Acer rubrum*, and the mixed forest type. The former two stands were found on peat deposits which had a high water table and were wet throughout the year. The latter forest type was found on mineral soil which dried out to at least two feet below the soil surface by mid-July.

BERNARD, J. M. 1965. The status of <u>Taxodium distichum</u> L. Richard (Bald Cypress) in New Jersey. Bull. Torrey Bot. Club 92:305-307. (R)

Location: Cape May County

Keywords: Distribution

BERNARD, J. M and F. A. BERNARD. 1971. Mature upland forests of Cape May County, New Jersey. Bull. Torrey Bot. Club 98:167-171. (D)

Location: Cape May County (43,48,50)

Keywords: Floristic Diversity; Southern Hardwoods

Abstract: The mature upland forests of Cape May County, the most southerly county in New Jersey, show a decided southern affinity. The floristic diversity is not as great as areas to the south but the major species on a vegetational basis are clearly important members of the southern mixed hardwood forest. These mature stands have little in common with the vegetation of the New Jersey Pine Barrens. The Cape May forest are here considered to be outliers of the southern mixed hardwood forests.

BERRY, E. W. 1897. The Pine Barren plants of New Jersey. Asa Gray Bull. 5:71-75. (D)

BERRY, E. W. 1902. Notes on the local flora. Torreya 2:103-105. (D)

BLATT, R. 1964. Nutritional studies with pitch pine (<u>Pinus rigida</u> Mill.). Bull. N. J. Acad. Sci. 9:42. (A)

Location: General

Keywords: Nitrogen

Abstract: Growth did not increase significantly on pitch pine seedlings in the Pine Barrens following fertilization with N, P, K (rate 0.05 lb/tr.), Ca, Mg (1.0 lb. dolomitic limestone/tr.) and trace elements (19 g/tr.). The treatments, in a fractional factorial, were replicated once; the seedlings were growing in a loamy sand of low fertility.

It is suggested that a balance exists between the nutrient requirements of the species and the fertility level of the soil. Fertilization with N in the field resulted in significantly high mortality except when combined with superphosphate. Greenhouse experiments have shown that increased growth attributable to N only can be achieved at levels of N lower than that used in the field. Experiments are being continued to explore the N-superphosphate interaction.

BOERNER, R. 1981. Forest structure dynamics following wildfire and prescribed burning in the New Jersey Pine Barrens. Amer. Midl. Natur. 105:321-333. (D)

Location: Mays Landing (38); Lebanon State Forest (8,9)

Keywords: Pinus rigida; Quercus; Upland Forest; Fire; Community Structure

Abstract: The New Jersey Pine Barrens mosaic is made up of species exhibiting numerous adaptations to wildfire, including the dominants Pinus rigida and several species of Quercus. To evaluate community change and recovery from two disturbance intensities (wildfire and prescribed burning), a site unburned for 53 yrs., two sites burned by wildfire in 1977 and 1978 and two sites burned by prescription in 1977 and 1979 were examined for species composition, horizontal and vertical structure and biomass relations. Wildfire killed the aboveground portions of oaks and removed needle and branch tissue from pines, but almost all individuals of trees and shrubs resprouted to form a dense canopy ca. 1 m high after one growing season. While biomass and canopy height recovered slowly, total cover > 100% was established in 1.5 growing seasons, effectively eliminating gaps for pioneering tree species. Prescribed burning had little effect on community structure other than opening areas in the dense heath-shrub layer, where herbaceous species could establish themselves for one to two growing seasons before the resprouting heath cover eliminated light gaps. Few tree seedlings were observed. Adaptations to a regime of frequent disturbance have resulted in a species assemblage that minimizes both species turnover and the period of time necessary to reestablish the predisturbance community structure.

BOERNER, R. 1982. An inexpensive, tension-free lysimeter for use in sandy soils. Bull. Torrey Bot. Club 108:80-83. (D)

Location: Lebanon State Forest (8,9)

Keywords: Method; Water Flux

BONES, J. T. 1973. The timber industries of New Jersey and Delaware. U.S.D.A. For. Serv. Res. Bull. NE-28:1-17, Upper Darby, Pa. (D)

BOYD, H. P. and P. E. MARUCCI. 1979. See ZOOLOGY citation.

BOYD, W. M. 1953. See ZOOLOGY citation.

BOUCHER, B. P. and H. C. BROOKS. 1962. See GENERAL REFERENCES citation.

BRITTON, N. L. 1880. On the northward extension of the N. J. Pine Barren flora on Long and Staten Islands. Bull. Torrey Bot. Club 7:81-83. (N)

Location: General

Keywords: Soils

BRITTON, N. L. 1881a. A preliminary catalogue of the flora of New Jersey. [publisher unknown] New Brunswick, N.J. 233p. (D)

BRITTON, N. L. 1881b. List of New Jersey flora and lists. Bull. Torrey Bot. Club 8:81. (D)

BRITTON, N. L. 1884. The range of Phoradendron (in New Jersey). Bull. Torrey Bot. Club 11:76. (D)

Location: Lakewood (4a)

Keywords: Nyssa; Distribution

BRITTON, N. L. 1887. Proceedings of the Club. Bull. Torrey Bot. Club 14:153-154. (N)

Location: Cedar Bridge (18)

Keywords: Corema conradii

BRITTON, N. L. 1889. Catalogue of plants found in New Jersey. N.J. Geol. Surv. 2:27-642. (D)

BROWN, A. 1880. Notes on the New Jersey flora. Bull. Torrey Bot. Club 7:115. (D)

BROWN, H. P. 1912. Growth studies in forest trees. I. Pinus rigida. Bot. Gaz. 54:386-401. (D)

BROWN, O. H. and E. T. WHERRY. 1970. Checklist of the vascular flora of Cape May County, New Jersey. Bartonia 40:1-18. (D)

BROWN, S. 1910. Helonias bullata Linnaeus. Bartonia 3:1-6. (D)

BROWN, S. 1912. Lophiola aurea (Ker.). Bartonia 5:1-5. (D)

Location: Atco (13); Hammonton (23); Atsion (24); Batsto (24); Egg Harbor (45); Chatsworth (16); Speedwell (16)

Keywords: Bogs

BROWN, S. 1914. Corema conradii Torrey. Bartonia 6(1913):1-7. (D)

Location: Plains (17,26,27); Pemberton (8); Cedar Bridge (18)

Keywords: Quercus marilandica; Quercus ilicifolia; Arctostaphylos uva-ursi; Pinus rigida; Empetrum conradii (?)

BUCHHOLZ, K. 1979. The effects of fire-associated high temperatures on the germination of seeds from serotinous cones of Pinus rigida Mill. from the New Jersey Pine Barrens Pitch Pine Plains. Bulletin of the New Jersey Academy of Science 24:91. (A)

Location: Plains (17)

Keywords: Seasonal Simulations; Seedling Competitive Ability

Abstract: The effects on seed germination of fire-associated high temperature in cone opening were examined on serotinous Pinus rigida from the Plains of the New Jersey Pine Barrens under simulated seasonal conditions. Germination was unaffected by cone-opening high temperature in autumn and winter conditions, enhanced in spring conditions and inhibited in summer conditions. The hypothesis presented is that Plains P. rigida may use fire-associated high temperature as an indication of probability of seedling success, which may be a function of: (1) the competitive ability of the seedlings relative to that of root crown sprouts, and (2) the probability that the

seedlings will not be subjected to fire. The probability of seedling success appears to shift during the growing season.

BUCHHOLZ, K. 1980. Mineral nutrient accumulations in Plains and Barrens populations of _Pinus_ _rigida_ Mill., and an analysis of density, standing biomass and net annual aboveground productivity of Plains _P._ _rigida_. Ph.D. Thesis, Rutgers Univ., New Brunswick, N. J. 185p. (D)

Location: Plains (17,26,27); Barrens (17)

Keywords: Vegetative Reproduction; Nitrogen; Phosphorus; Potassium; Calcium; Magnesium; Iron; Zinc; Sodium; Copper; Soil Composition

Abstract: Density, aboveground standing biomass and net annual aboveground productivity of New Jersey Pine Barren Plains populations of _Pinus_ _rigida_ Mill. (pitch pine) were characterized and observed to be highly variable on a quadrat (25 m-sq) level. The mean stem density of Plains _P._ _rigida_ of 24,900 ± 12,000 stems/ha supported a mean standing aboveground biomass of 9020 ± 3240 kg/ha and had a mean net annual aboveground productivity of 1780 ± 533 kg/ha/yr. Plains _P._ _rigida_ had a high proportion of total standing biomass allocated to needles and current twigs (20.7%) and reproductive structures (6.8%), indicative of both the juvenility of the stems and precociousness of reproduction. Bolebark, bolewood, rootwood, current twigs, branches, needles, cones and seeds of Plains dwarfed and Barrens normal-growth _P._ _rigida_ were analyzed for tissue concentrations of Ca, Cu, Fe, Mg, N, Na, P and Zn. Plains _P._ _rigida_ rootwood had significantly higher tissue Fe and Na concentrations and significantly lower tissue Ca, K, Mg, N, P and Zn concentrations than Barrens _P._ _rigida_ suggesting that an Fe:P:K interference interaction exists in Plains _P._ _rigida_ rootwood. Such an elemental interference interaction in Plains rootwood may reduce nutrient uptake and/or translocation of nutrients from roots to shoots and thereby reduce shoot growth. Plains _P._ _rigida_ aboveground vegetative tissues had significantly higher tissue K and Na concentrations than Barrens _P._ _rigida_ aboveground vegetative tissues. This suggests that some other factor(s) is(are) limiting growth of Plains _P._ _rigida_. Such limiting factors may include other nutrients or water. Analysis of relative nutrient abundances in Plains _P._ _rigida_ suggests that Ca may be limiting for Plains _P._ _rigida_. Comparison of nutrient standing crops of Plains _P._ _rigida_ to Long Island Barrens _P._ _rigida_ and other _Pinus_ spp. further suggests that Ca may be limiting for Plains _P._ _rigida_.

BUCHHOLZ, K. and M. GALLAGHER. 1982. Initial mycorrhizal density responses to wildfire in the New Jersey Pine Barren

Plains. Bull. Torrey Bot. Club 109:(in press).

Location: West Plains (17)

Keywords: Fire; Nutrient Stress; *Pinus rigida*

Abstract: The New Jersey Pine Barren Plains are three distinct, dwarfed, upland pine-oak forests characterized by very high tree population and sprouts/genet densities and canopy height typically less than 3 m. Recent investigations suggest that nutrients may be more limiting for growth in the Plains than in non-dwarfed upland Pine Barrens pine-oak forests. We have initiated a long-term investigation of ectomycorrhizal density responses to fire in recently-burned Plains areas to determine fire effects on ectomycorrhizal communities and therefore on nutrient dynamics. Our initial data suggest that, following a short lag period, ectomycorrhizal hyphal densities decrease following fire in the Plains in contrast to the expected increase.

BUCHHOLZ, K. and R. E. GOOD. 1980. Productivity and nutrient analysis of Plains populations of *Pinus rigida* from southern New Jersey. Bull. Ecol. Soc. Amer. 61(2):93. (A)

Location: Plains (17,26,27)

Keywords: Tissue Elements; Fire Frequency; Biomass Allocations

Abstract: Three areas of dwarfed pitch pine (*Pinus rigida*) known as the Plains from the New Jersey Pine Barrens were sampled for density and productivity. Tissues of pitch pine from the Plains and normal Barrens trees (and soils from the sites) were analyzed for elemental content of Ca, Cu, Fe, K, Na, N, Mg, P and Zn. Density is locally high variable and negatively correlated with stand age. The East Plains has the greatest mean stand stem density (29,400/ha), the lowest mean age (7.7 yr), lowest mean standing biomass (6973 kg/ha) and the lowest mean net annual aboveground productivity (1507 kg/ha/yr) of the three Plains areas. Differences in these parameters are attributed to differences in fire frequency. Plains *P. rigida* have a greater proportion of their biomass distributed in reproductive structures, current needles and current twigs than Barrens pitch pine.

BUCHHOLZ, K. and R. E. GOOD. 1982. Density, age structure, standing biomass and net annual aboveground productivity of *Pinus rigida* Mill. from the New Jersey Pine Barren Plains. Bull. Torrey Bot. Club 109(1):24-34. (D)

Location: Plains (17,26,27)

Keywords: Fire; Vegetative Reproduction

Abstract: The New Jersey Pine Barren Plains are three distinct areas of dwarfed (3 m tall) Pinus rigida-dominated forests. In addition to differing from normal-growth Pine Barrens P. rigida in stature, Plains P. rigida is characterized as having predominantly serotinous cones, precociousness in reproduction and a predominance of vegetative reproduction. The density, age structure, aboveground biomass and net annual aboveground productivity of Plains P. rigida stems were determined. The mean stem density of 24,900 stems/ha supported a mean aboveground biomass of 9020 kg/ha and had a mean net annual aboveground productivity of 1780 kg/ha/yr. Plains P. rigida had a high proportion of biomass allocated to foliage and current twigs (20.7%) and reproductive structures (6.8%), indicative of stem juvenility and precociousness of reproduction. Age structure of stems indicated that following fire there was an immediate burst of sprout production and that sprout production continued at a relatively high though reduced rate for at least 15 years following the fire. The biomass accumulation ratio of Plains P. rigida indicated that the proportion of standing biomass which is new production each year is approximately twice that reported for normal-growth P. rigida. We feel that the density, age structure, biomass and net annual aboveground productivity characteristic of Plains P. rigida increase their flammability and thereby increase fire frequency and severity of the Plains communities of which they are members.

BUCHHOLZ, K. and H. MOTTO. 1981. Abundance and vertical distributions of mycorrhizae in Plains and Barrens forest soils from the New Jersey Pine Barrens. Bull. Torrey Bot. Club 108(2):268-271. (D)

Location: Plains (17); Barrens (17)

Keywords: Fire; Charcoal; Fungi; Nutrient Cycling

Abstract: Soil cores were extracted from Plains and Barrens forest soils, divided into top, middle and lower 7.0 cm subsamples, and examined for total numbers of active mycorrhizal hyphal tips. Plains soils had active mycorrhizal hyphal densities approximately five times greater than Barrens soils. Active hyphal tips were more evenly distributed throughout the soil profile in Plains soils than in Barrens soils. More than 70% of the active hyphae in Barrens soils were found in the top 7.0 cm soil. The observed differences in density and vertical distribution of soil mycorrhizal hyphae between Plains and Barrens forest soils may indicate differences in numbers and distribution of active sites (litter and charcoal) between

the sites, and suggest that differences in mineral cycling may exist between Plains and Barrens communities.

BUELL, M. F. 1955. New botanical problems in the New Jersey Pine Barrens. Bull. Torrey Bot. Club 82:237-241. (R)

Location: General

Keywords: Fire Management; Fire Effects

BUELL, M. F. 1970. Time of origin of the New Jersey Pine Barrens bogs. Bull. Torrey Bot. Club 97:105-108. (N)

Location: McDonald's Branch, Lebanon State Forest (8); Oswego River, Penn State Forest (17)

Keywords: Radiocarbon Dating; Cedar Swamp Forests; Vegetation History

Abstract: The radiocarbon dates of bottom samples from McDonald's Branch bog and a bog in a meander scar of the Oswego River are given. The former was determined as 9125 ± 195 B.P. and the latter as 10,485 ± 240 B.P. The impact of these dates on the interpretation of the published pollen diagrams for the area is discussed.

BUELL, M. F. and J. T. BALLARD. 1972. Evaporation from lowland vegetation in the New Jersey pine barrens. Water Resources Research Institute, Rutgers Univ., New Brunswick, N. J. 84p. (D)

BUELL, M. F. and J. E. CANTLON. 1950. A study of two communities of the New Jersey Pine Barrens and a comparison of methods. Ecology 31:567-586. (D)

Location: Lebanon State Forest (8,9)

Keywords: Upland Forest Vegetation; *Pinus rigida*; *Quercus*

Abstract: The structure of the vegetation of two upland forest communities occurring near the center of the Pine Region is compared. Frequency, basal area and cover data are presented. The two communities occur in the same general area and on similar soil types. The major causal factor in determining the difference in community composition seems to be age as influenced by fire history. The younger community is composed primarily of *Pinus rigida* and *P. echinata* with smaller amounts of *Quercus velutina*, *Q. stellata* and *Q. marilandica*. The understory is a mixture of ericaceous shrubs and scrub oaks. The older community is composed primarily of Q. montana and Q. velutina with smaller amounts of P. rigida, Q. stellata and Q. marilandica. The understory is composed primarily of ericaceous shrubs. The two communities seem to represent two stages in the succession toward the climax vegetation of the light Coastal Plain soils of the region. Their present status is probably a result of differential disturbance due to fire.

BUELL, M. F. and J. E. CANTLON. 1953. Effects of prescribed burning on ground cover in the New Jersey Pine Region. Ecology 34:520-528. (D)

Location: Lebanon State Forest (8,9)

Keywords: Gaylussacia; Herb Cover; Mosses; Lichens

Abstract: The effect of prescribed burning on shrub cover is to greatly reduce it. The practice affects all species but not all to the same extent. Gaylussacia species show the most pronounced changes. The herbs and mosses in general increase in cover with increased frequency of burning. Cutting the trees results in an increase in cover for the shrub, herb and moss layers whether the areas have been burned or not, but the effects are greatest where the burning has been most frequent. In the moss layer, it is the lichens rather than the mosses that increase with the increased light. Cutting the trees causes a decrease in litter cover and cover of Gaylussacia baccata. The importance of the changes in the lower layers of vegetation resulting from prescribed burning lies in their effect on: tree reproduction (pine being favored); rainfall interception; animal populations; changed habitat for insect fauna; plant disease reservoir; and the problem of fire control.

BURNS, P. Y. 1952. Effect of fire on forest soils in the Pine Barren Region of New Jersey. Yale Univ. School For. Bull. 57:1-80. (D)

Location: Mt. Misery and Lebanon Experimental Forest, Lebanon State Forest (8)

Keywords: Soil Productivity

Abstract: Controlled burning is used as a silvicultural measure in several forest types. In the New Jersey Pine Barrens light winter fires have been recommended because they furnish protection from wildfires, produce favorable seedbeds for pines, and retard hardwood reproduction. The purpose of this investigation was to study effects of such controlled burns on the soil in oak-pine stands of the

region. Two experimental areas in the Pine Barrens were available for study. Both were characterized by flat topography, temperate climate, small trees, and well-drained, sandy, acid soil. One area, located on soil of the Lakewood series, showed the effect of periodicities of burning varying from every year to every fifteen years. The other area, located on soil of the Evesboro series, exhibited the effects of annual burning for periods ranging from one to fifteen years. The data indicated that moderate burning treatments, that is, burning every four years or two annual burns, had much less effect on the soil than did annual burning for long periods. Moderate burning had the following effects on unincorporated organic matter: (1) the weight per unit area was slightly decreased, (2) the total thickness of the L layer was substantially reduced, (3) the thickness of the F and H layers was slightly decreased, (4) the proportion of area covered with forest-Floor material was appreciably reduced, and (5) the percentage of nitrogen and weight of nitrogen per unit of area were slightly reduced. The chemical and physical preperties of the mineral soil were not appreciably modified by moderate burning treatments. Annual burning for long periods caused: (1) almost complete destruction of the forest floor, with consequent exposure of mineral soil and loss of nitrogen contained in the unincorporated organic matter, (2) increases in pH, organic matter, nitrogen, exchangeable calcium, and exchangeable potassium in the A horizon, (3) a substantial decrease in rate of inflitration, (4) slight increases in field capacity and pore volume of the mineral soil, and (5) slight decreases in volume weight and air capacity of mineral soil. No appreciable change in phosphorus content as a result of this treatment could be detected. A consideration of the results leads to the following conclusions as to the effect of controlled burning on the soil characteristics investigated: (1) Moderate burning treatments benefit the mineral soil chemically and probably have favorable effects on the forest floor; (2) Annual burning for long periods has unfavorable effects on the forest floor but benefits the mineral soil chemically; and (3) Controlled burning is of little or no importance from the standpoint of the physical properties of the mineral soil.

BUTLER, G. G. 1956. The blueberry and cranberry industries in New Jersey. Circular 400:1-27, N. J. Dept. Agr., Trenton, N. J. (N)

CAMP, W. H. 1945. The North American Blueberries with notes on the other groups of Vacciniaceae. Brittonia 5:203-275. (R)

CANTLON, J. E. 1951. A preliminary investigation of the influence of prescribed burning on soil water supplies in South Jersey. Amer. Cranberry Growers Assoc. Proc., pp.18-26. (D)

CANTLON, J. E. and M. F. BUELL. 1952. Controlled burning: its broader aspects. Bartonia 26:48-52. (N)

Location: General

Keywords: Vegetation; Hydrology; Soils; Animals

CHAPMAN, H. H. 1952. The place of fire in the ecology of pines. Bartonia 26:39-40. (R)

Location: General

Keywords: Pinus Reproduction

CHRYSLER, M. A. and J. T. EDWARDS. 1947. The ferns of New Jersey, including fern allies. Rutgers Univ. Press, New Brunswick, N. J. 201p. (D)

CLAUSEN, R. T. 1939. Contributions to the flora of New Jersey. Torreya 39:125-132. (D)

Location: General

Keywords: Pinus rigida serotina

CLEMENTS, F. E. 1934. The relict method of dynamic ecology. Jour. Ecology 22:39-68. (R)

CLUTE, W. N. 1914. An elfin wood. Amer. Bot. 20:14-15. (N)

COGGINS, H. L. 1902. The heart of the New Jersey Pine Barrens Cassinia 6:26-31. (N)

COMAN, C. W. 1892. Oak-land and pine-land belts and their relation to agriculture. Ann. Rept. State Geol. 1891:111-140, N.J. Geol. Surv., Trenton, N.J. (R)

COMANOR, P. L. 1968. Forest vegetation and the pollen spectrum: an examination of the usefulness of the R-value. Bull. N. J. Acad. Sci. 13(1):7-19. (D)

Location: Middle Branch Watershed, Lebanon State Forest

(8,9)

Keywords: Cedar Swamp; Pollen Profiles

Abstract: The recent pollen spectrum from Middle Branch Watershed and the profile resulting from the application of R values to his forest genera pollen spectrum do not support Potzger's (1952) hypothesis that the Pine Barrens area was a refugium for northern species during the time above the Picea - Abies levels of his profiles.

CONNOR, P. 1957. See ZOOLOGY citation.

COOPERATIVE EXTENSION SERVICE. 1969. List of New Jersey's biggest trees. Leaflet 440:1-7, N. J. Agr. Expt. Sta., New Brunswick, N. J. (D)

COTTRELL, A. T. 1930. Thinning white cedar in New Jersey. Jour. For. 28:1157-1162. (D)

COTTRELL, A. T. 1937. Unused South Jersey: its vast latent possibilities. Jour. Industry Finance 11(9):7-12. (N)

DIX, W. L. 1938. Trip of April 10 to the Pine Barrens of New Jersey. Torreya 38:99-100. (N)

Location: Cedar Bridge (18)

Keywords: Corema; Pyxidanthera; Arctostaphylos; Hudsonia ericoides; Dendrium buxifolium (Leiophyllum)

DOYLE, J. A. 1969a. Cretaceous angiosperm pollen of the Atlantic Coastal Plain and its evolutionary significance. Arnold Arbor. Jour. 50:1-35. (D)

DOYLE, J. A. 1969b. Angiosperm pollen evolution and biostratigraphy of the basal Cretaceous formations of Maryland, Delaware and New Jersey. Geol. Soc. Amer. Abstr. Program 1:51. (A)

ECK, P. and N. F. CHILDERS (eds.). 1968. Blueberry culture. Rutgers Univ. Press, New Brunswick, N. J. (N)

EHRENFELD, J. G. and M. GULICK. 1981. Structure and dynamics of hardwood swamps in the New Jersey Pine Barrens: contrasting patterns in trees and shrubs. American Journal of Botany 68(4):471-481. (D)

Location: Muskingum Brook (15); Clark Branch (14); Wesickaman (15); Friendship Creek (7); Hampton (24)

Keywords: Biomass; Density; Age Structure; Dominance Patterns; Flooding Gradients

Abstract: The biomass, density, age structure and dominance patterns of the tree and shrub populations in hardwood swamps of the New Jersey Pine Barrens are described and contrasted with each other. The total biomass of individual swamps ranges from 92,000 kg/ha to 194,000 kg/ha, depending on the age of the stand. These biomass values are similar to those reported for southern hardwood swamps. The Pine Barrens swamps are distinguished by very large populations of ericaceous and other shrubs, which range up to 13% of the total aboveground biomass. The tree populations, composed principally of Acer rubrum, Nyssa sylvatica and Magnolia virginiana, are even-aged: Acer is strongly dominating, with a minimum of 73% of the biomass, and species richness is associated with the availability of different microhabitats. The shrub populations, by contrast, are all-aged, with the dominance patterns among the species and the stand biomasses varying with the degree of flooding of the stand. Differences in size and growth rate among the shrub species parallel their evident response to the flooding gradient. The shrub stratum has lower species richness than the comparable southern swamps and floodplains, but ranges up to the higher biomass values.

ELMER, C. E. 1874. Forest fires and the means for diminishing or preventing them. Appendix, First Ann. Rept.:62-64, N. J. State Bd. Agr., Trenton, N. J. (N)

EPSTEIN, C. M. and G. SAWHILL. 1977. Changes in the ground cover of a New Jersey Pine Barrens woodland resulting from spray irrigation of sewage effluent. Bull. N. J. Acad. Sci. 22:6-11. (D)

Location: Pomona (39)

Keywords: Oak-Pine Forest; Pitch Pine Lowland Forest; Biomass Response

Abstract: The construction of a 150,000 GPD aerobic-treatment plant and effluent sprayfield followed by three years of effluent irrigation has greatly altered the ground cover composition of a New Jersey Pine Barrens oak-pine forest and pitch pine lowland forest. The original canopy, ground cover and forest soil were removed from nine

6 by 207 m areas, and chlorinated effluent sprayed into these areas and adjoining woodlands. The volume of effluent increased from 25 to 369 mm/month. The original ground cover plants were replaced by sedges (Carex sp., Scirpus rubricosus), grasses (Digitaria sp., Panicum sp., Andropogon virginicus, Phragmites communis), rushes (Juncus effusus), reeds (Typha latifolia) and various forbs (Phytolacca americana, Erechtites hieracifolia, Solanum nigrum, Solidago spp., Viola lanceolata, and Rumex acetosella). These varieties replaced most of the commonly occurring native ground cover species present prior to construction and spray irrigation (Pteridium aquilinum, Kalmia angustifolia, Gaultheria procumbens, Gaylussacia baccata, G. frondosa, and Vaccinium vacillans). The ground cover became lusher and larger with effluent irrigation than in non-irrigated woodlands.

EPSTEIN, C. M., M. L. WEEKS and G. SAWHILL. 1976. The effects of land application of effluent on woodland communities of the New Jersey Pine Barrens. Bull. N. J. Acad. Sci. 21:21. (A)

Location: Pomona (39)

Keywords: Sewerage; Species Compositions; Oak-Pine Forest; Pitch Pine Lowland Forest

Abstract: The composition and structure of "Pine Barrens" woodland communities has, over a four year period, been altered due to the excessive application of sewerage effluent and to the faulty construction of the effluent sprayfield. The sprayfield is located in an Oak-Pine Forest on the Downer loamy sand only in its higher elevations. Most of the sprayfield is either in an Oak-Pine Forest on the Hammonton loamy sand at intermediate elevations or in a Pitch Pine Lowlands Forest on the Atsion sand at lower elevations. Greater, deeper sunlight penetration resulted from removal of vegetation and upper soil horizons during the installment of the nine, parallel 10 X 700 foot, rectangular plots which make up the sprayfield and from subsequent moving of these plots. Non-woodland species, typical of lake margins and early old field succession, "invaded" the sprayfield and spread into the surrounding Oak-Pine Forest, and, to a lesser extent, Pitch Pine Lowland forming five zones following the change from high sunlight, high dosage conditions to "normal" woodland conditions: 1) Typha latifolia, Phragmites australis, Scirpus eriophorum, and Juncus effusus dominate the standing water where dosage and sunlight are greatest; 2) Several grass genera (Panicum, Digitaria, Andropogon) and the sedge Carex scoparia dominate the nearby drier areas; 3) Erechites hieraicifolia, Phytolacca americana, Solanum nigrum and Scirpus eriophorum dominate drier, shadier areas adjacent to

the woodland margins; 4) Vegetation characteristic of Oak-Pine Forests and Pitch Pine Lowlands occurs with comparable numbers of Erechites hieraicifolia, Phytolacca americana and Solanum nigrum; 5) Characteristic Oak-Pine and Pitch Pine Lowland Forests occur undisturbed beyond the spray radius.

EVANS, A. W. 1935. The Cladoniae of New Jersey. Torreya 35:81-109. (D)

EVANS, A. W. 1938. The Cladoniae of New Jersey - supplement. Torreya 38:137-149. (D)

EVANS, A. W. 1940. The Cladoniae of New Jersey - second supplement. Torreya 40:141-165. (D)

EVERT, D. S. 1957. Dionaea transplants in the New Jersey pine barrens. Bartonia 29:3-4. (D)

Location: Oceanville Bog (40); Webbs Mill (9,10)

Keywords: Chamaecyparis thyoides; Schizaea pusilla; Lycopodium carolinianum; Pinus rigida; Sarracenia flava; Bog Forests

EVERT, D. S. 1969. Ferns of the Pine Barrens. Plants Garden 25:29-30. (N)

FABLES, D. G. 1948. Field trip reports. April 4, 1948. Pine Barrens. Bull. Torrey Bot. Club 75:582. (N)

Location: Sim Place (26); West Plains (17)

Keywords: Corema conradii; Pinus echinata; Carex umbellata; Pyxidanthera barbulata; Chamaedaphne calyculata; Epigaea repens

FABLES, D. 1960. Plant succession in the New Jersey Pine Barren wetlands. Bull. N. J. Acad. Sci. 5(1):9. (A)

Location: General

Keywords: Flora

Abstract: The ponds are universally shallow with almost uniform depth of 15 in. to 20 in. At first they are invaded by green algae, subsequently by Floating Heart,

White Water Lily and Yellow Pond Lily. Following this sedges of several species appear: Dulichium arundinaceum, Rhynchospora inundata, Eleocharis trichostata and Cladium mariscoides. Subsequently, in some instances, Willow-herb occurs. Crowding out from shore at a later time are Vaccinium corymbosum and V. atrococcum as well as Kalmia angustifolia. With the gradual filling in of the ponds by decaying leaves, the Pitch Pine becomes an important invader rather than Red Maple or Coast White Cedar as one might expect. The savanah-like areas are fading rapidly from the New Jersey scene. Witmer Stone (1910) describes extensive stands of sedge-grass bordering the river courses. Destruction of many of these is traceable to cranberry culture. Prolonged summer drought during the past decade seems to have favored elimination of the savanah-like areas. They are characterized by Abama, Tofieldia and Lophiola, but as the land becomes drier invasion by Red Maple, Coast White Cedar and Tall Blueberry occurs. Considerable time was spent in search of evidence to support the generally accepted idea that hardwood forests (namely Red Maple) supplant Coast White Cedar. Thus far, no direct evidence has been found which substantiate this claim. Where Coast White Cedar remains uncut the dark stands seem to preclude the dominance of hardwoods.

FABLES, D. 1961. Caesarian flora and fauna: 20 "lost" plants. Bartonia 31:7-10. (D)

FABLES, D. 1962. Caesarian flora and fauna. Bartonia 32:7-14. (D)

FAIRBROTHERS, D. E. 1979. Endangered, threatened and rare vascular plants of the Pine Barrens and their biogeography. Chapter 22 In Forman, R. T. T.(ed.). Pine Barrens: ecosystem and landscape. Academic Press, New York. pp.395-405. (R)

Location: General

Keywords: Flora

Abstract: Botanical explorations made over the course of 230 years in New Jersey and the Pine Barrens provide an excellent opportunity to trace floristic changes, including introductions, rare species, and species threatened with extinction. Species have become rare in the Pine Barrens as a result of both natural events and human activities. Approximately 580 native species and 270 introduced species grow within the region; thus, one-third of the present flora has been introduced. Five species are endemic to the Pine Barrens. Seventy-one of the 580 native species are classified as rare, endangered, threatened or undetermined.

Thus, 12% are in jeopardy, in contrast to 10% for the United States and 8% for all of New Jersey. Of the species in jeopardy, 55% have southern geographical affinities. Thus, the Pine Barrens is a significant region within both the state and the nation, with respect to the number of species in danger of extinction.

FAIRBROTHERS, D. E. and M. Y. HOUGH. 1973. Rare or endangered vascular plants of New Jersey. N. J. State Museum Sci. Note 14:1-53, Trenton, N. J. (D)

Location: General

Keywords: Flora

FAIRBROTHERS, D. E., E. T. MOUL, A. R. EFFBACH, D. N. RIEMER and D. A. SCHALLOCK. 1965. Aquatic vegetation of New Jersey. Extension Bull. 382:1-107, N. J. Agr. Expt. Sta., New Brunswick, N. J. (D)

Location: General

Keywords: Species Keys; Ecology; Management Methods

FENTON, R. H. 1962. Forest Service research in New Jersey. Bull. N.J. Acad. Sci. 7:23. (A)

FENTON, R. H. 1964. Production and distribution of sweetgum seed in 1962 by four New Jersey stands. USDA For. Ser. Res. Note NE-18:1-6, Upper Darby, Pa. (D)

Location: Burlington County

Keywords: Reproduction; Seed Dispersal; Liquidambar styraciflua

FERGUSON, R. E. and C. E. MAYER. 1974. The timber resources of New Jersey. U.S.D.A. For. Serv. Res. Bull. NE-34:1-58, Upper Darby, Pa. (R)

FERREN, W. R., J. W. BRAXTON and L. HAND. 1979. Common vascular plants of the Pine Barrens. Chapter 21 In Forman, R. T. T. (ed.). Pine Barrens: ecosystem and landscape. Academic Press, New York. pp.373-393. (R)

Location: General

Keywords: Species Keys

Abstract: The common trees (19 species), shrubs (53 species) and some herbaceous plants (44 genera) of the Pine Barrens of New Jersey have been identified with the aid of keys. Additional descriptive information was provided for trees and shrubs in the form of illustrative figures.

FERREN, W. R., R. E. GOOD, R. WALKER and J. ARSENAULT. 1981. Vegetation and flora of Hog Island, a brackish wetland in the Mullica River, New Jersey. Bartonia 48:1-10. (D)

Location: Hog Island (33)

Keywords: Salinity; Spartina patens; Spartina alterniflora; Distichlis spicata; Peltandra virginica; Phragmites australis; Typha angustifolia; Eleocharis parvula; Floristic Transitions

Abstract: The vegetation and vascular flora of river and estuary systems of the Outer Coastal Plain of New Jersey have not been investigated extensively. In these systems three types of tidal wetlands occur: saltwater, brackish and freshwater. An unusual convergence of these three wetland types takes place in the Mullica River - Great Bay Estuary system of southern New Jersey. Saltwater species extend far upriver and freshwater species extend far downriver, converging in the narrow brackish water zone. The area of convergence is at Hog Island, an island of about 52 ha, located approximately 17 km upriver from the mouth of the estuary. Hog Island displays vegetational characteristics of each marsh type and supports narrowly restricted plants and plant associations. The floristic diversity is accompanied by floristic instability because the transition zone is subjected to periodic drastic changes in salinity which eliminate some species but provide suitable habitats for others. in contrast to the almost annual change in the flora because of the presence or absence of some species of peripheral occurrence, other changes occur gradually and represent a change in the relative frequency of various species. In example, an emergent, nonpersistent estuarine wetland dominated by a species with freshwater affinities is being replaced by an emergent, persistent estuarine wetland dominated by a species with saltwater affinities.

FISKLIN, T. J. and J. D. MONTGOMERY. 1971. See GENERAL REFERENCES citation.

FLORER, L. E. 1972. Palynology of a postglacial bog in the New Jersey Pine Barrens. Bull. Torrey Bot. Club 99:135-138. (D)

Location: Oswego River (25)

Keywords: Pollen Records

Abstract: Pollen analysis of a section of peat from a bog in a meander sear in the Oswego River, New Jersey, indicates that pine-oak communities have dominated the vegetation of the Pine Barrens since 10,000 B.P. With the exception of minor amounts of spruce pollen, evidence of boreal or southern broadleaf communities in the Pine Barrens was not found in the pollen record of the Oswego River site.

FOGG, J. M. 1934. Lilaeopsis chinensis in southern New Jersey. Bartonia 16:51-56. (D)

FOGG, J. M. 1935. Lophotocarpus spongiosus in Salem County, New Jersey. Bartonia 17:21-22. (D)

FOREST PARKS RESERVATION COMMISSION. 1906-1915. Annual Reports for years 1905-1914. Trenton, N. J. (R)

Location: General

Keywords: Forest Management; Forest Inventories; Forest Types; Fire; Maps.

FORMAN, R. T. T. 1979. Common bryophytes and lichens of the New Jersey Pine Barrens. Chapter 23 In Forman, R. T. T. (ed.). Pine Barrens: ecosystem and landscape. Academic Press, New York. pp.407-424. (R)

Location: General

Keywords: Fire; Soil Moisture

Abstract: Bryophytes and lichens are exceptionally prominent in Pine Barrens ecosystems, yet ecologically are little known, with even dominant species rarely recognized. Eight of the most common mosses, three liverworts, and six lichens are illustrated and briefly described to aid in field recognition. Common species in cedar and hardwood swamps are several Sphagnum species, Odontoschisma prostratum, Leucobryum spp., Dicranum flagellare, D. scoparium, Pallavicinia lyellii, Cladonia calycantha, C. bacillaris, C. incrassata, C. santensis, C. squamosa, C. cristalatella, and C. coniocraea. In the pine and oak uplands, common species are: Polytrichum juniperinum, Dicranum scoparium, D. flagellare, Leucobryum albidum, Ceratodon purpureus, Cladonia squamosa, C. cristatella, C. grayi, C. uncialis, C. subtenuis, C. atlantica, C. sylvatica, C. chlorophaea, C. clavulifera, C. caroliniana, Parmelia rudecta, and other foliose and crustose lichens. With increasing fire frequency, bryophyte communities increased in cover and in diversity of common species, but decreased in total diversity. With increasing soil moisture, the same patterns were observed, although with a spectacular increase in cover and more variability in diversity. Species composition changes also were marked, and overall bryophyte and vascular plant communities appear to change differently but equivalently along environmental gradients. The bryophyte community of the dwarf Pine Plains woodland is the most depauperate, although the dominant species, Dicranum condensatum, is the species most favored by fire.

FORMAN, R. T. and R. BOERNER. 1981. Fire frequency and the Pine Barrens of New Jersey. Bull. Torrey Bot. Club 108:34-50. (D)

Location: General

Keywords: Meteorology; Fire - Human Effects

Abstract: State fire records and literature citations were examined to estimate both regional fire frequency and point fire frequency. The number of annual wildfires in the 550,000 hectare Pine Barrens has remained at approximately 1100 since 1940 when fire control became effective. The total area burned annually dropped sharply from about 22,000 ha during 1906 - 1939 to 8,000 ha in the past four decades. Extensive wildfires of 8,000 - 16,000 ha each are common. Since 1838, about every two decades on the average, ten percent or more of the predominant pine and oak forest burns in a single year (50,000 ha). An average point in the pine and oak forest burns currently at about 65 year intervals, compared with 20 year intervals earlier this century. The number of wildfires in the region correlates linearly with the number of dry months in a year. However, the area burned annually is constant with up to four dry months during the January - September period; both average and variability of area burned increases with five or more dry months. The results suggest the upland Pine Barrens are a mosaic of fire-caused patches at two levels of scale: a fine-grained scale of small (averaging 6 ha) young patches imprinted on a coarse-grained scale of large (several tens of ha), variable-sized patches more than four decades old. The drop in point fire frequency favors (a) non fire-adapted populations, (b) hardwoods swamp replacing cedar swamp, and (c) loss of the coarse-grained landscape mosaic.

FOX, H. 1949. On the occurrence of Franklinia in Cape May County, New Jersey. Bartonia 25:69. (D)

FRASCO, B. and R. E. GOOD. 1976a. Cone, seed and germination characteristics of several pitch pine populations. Bull. N. J. Acad. Sci. 21:18. (A)

Location: General

Keywords: Pinus rigida; Cone Opening Temperatures

Abstract: Cone, seed and germination characteristics were studied in several pitch pine (Pinus rigida Mill.) populations from the Pine Barrens of New Jersey. Trees were divided into four populations based on growth form and cone serotiny: Plains closed cone, Barrens open cone, Barrens closed cone, and Barrens intermediate cone. Approximately 10 ripe first year cones were collected from each of 10 trees from each population. Length, width and weight measurements were made for each cone as well as temperature and time requirements for cone opening. There appears to be significant differences in cone size and weight, as well as differences in temperature requirements for cone opening among the four populations with the Plains requiring the greatest time and temperature. The number of seeds per cone, seed size and weight, and seed germination percentage from each population have also been determined.

FRASCO, B. and R. E. GOOD. 1976b. Cone, seed and germination characteristics of pitch pine (Pinus rigida Mill.). Bartonia 44:50-57. (D)

Location: West Plains (17); Lebanon State Forest (8,9)

Keywords: Serotiny; Fire

Abstract: Cone and seed characteristics of the four visually distinctive pitch pine groups (Barrens open cone, Barrens intermediate cone, Barrens closed cone, Plains closed cone) were significantly different for most characters studied. The groups differed mainly in regard to cone weight but also differed in cone length and width. Cone size and weight were not correlated with number of seeds per cone. Each of the three populations with closed cones had a different minimum temperature for maximum cone opening. Plains closed cones required more heat to induce opening than Barrens closed cones. Plains seeds did not germinate as quickly as Barrens seeds. It is concluded that significant variation in cone and seed characters exist in these Plains and Barrens populations. Fire is generally regarded as the major selective force favoring serotinous populations.

FRAZEE, V. L. 1935. Trip of April 7. Torreya 35:72. (N)

Location: Warren Grove (26)

Keywords: Pyxidanthera; Dendrium (Leiophyllum); Leucothoe; Orontium

FRAZEE, V. L. 1949. Field trip reports. Bull. Torrey Bot. Club 76:367-369. (N)

Location: Sim Place (26); West Plains (17)

Keywords: Corema conradii; Pyxidanthera barbulata; Hudsonia ericoides; Dendrium buxifolium (Leiophyllum); Epigaea repens

FURGESON, R. H. and C. F. MAYER. 1974. The timber resources of New Jersey. U.S.D.A. For. Serv. Res. Bull. NE-34:1-58, Upper Darby, Pa. (R)

GASKILL, A. 1906. Why prairies are treeless. Proc. Soc. Amer. For. 1:158-178. (N)

GASKILL, A. 1911. Forest fires of 1910. For. Park Reserv. Comm. N. J. Sixth Ann. Rept.:16-50, Trenton, N. J. (R) SEE Forest Parks Reservation Commission 1906-1915.

GASKILL, A. 1913. Forest planting in New Jersey. Dispatch Printing Co., Union Hall, N. J. 31p. (N) See FOREST PARKS RESERVATION COMMISSION 1906-1915, BOTANY Citation.

GASKILL, A. 1921. Report of the state forester. The Plains. N. J. Dept. Conserv. Develop. Ann. Rept. 1921:53-70, Trenton, N. J. (R)

GIFFORD, J. 1895a. A preliminary report on the forest conditions of South Jersey. Ann. Rept. State Geol. 1894:245-286, N. J. Geol. Surv., Trenton, N. J. (R)

GIFFORD, J. 1895b. Autumn meeting of the N. J. Forestry Association. Forest Leaves 5:92-93. (N)

GIFFORD, J. 1896. Report on forest fires for the season 1895. Ann. Rept. State Geol. 1895:157-182, N. J. Geol. Surv., Trenton, N. J. (R)

GIFFORD, J. 1900. Forestral conditions and silvicultural prospects of the coastal plain of New Jersey. Ann. Rept. State Geol. 1899:233-318, N. J. Geol. Surv., Trenton, N. J. (R)

GILL, D. E. 1975. Spatial patterning of pines and oaks in the New Jersey Pine Barrens. Jour. Ecology 63:291-298. (D)

Location: Plains (17); Wharton State Forest (24)

Keywords: Pinus rigida; Quercus marilandica; Quercus prinus; Pinus echinata; Plains; Upland Forest; Soil Gradients

Abstract: Pitch pine has strikingly different spatial patterns in the two localities. In the Plains, pitch pine exhibits uniform spacing within clumps. In contrast, Wharton Tract pitch pines were clumped significantly. Shortleaf pines in the Wharton Tract were as strongly clumped as the pitch pines; however, the clumps of the two pine species were significantly overlapping. The dispersion patterns of blackjack oak in the two sites were similar: very large clumps (400 m-sq.) with random patterns within clumps. The fact that patterns of clumping of pitch pine in the two sites are very different suggests that soil heterogeneity probably underlies the gross structure of the two forests. Certainly the large-scale gradient in density of pitch pines in the Plains is best explained by a gradient in soil conditions because no correlated change in the species compositions across the grid was observed. Although previous empirical and experimental efforts to demonstrate chemical differences in the soils of the Plains and neighboring tall forest which would explain the stunted growth of the Plains vegetation have failed or remain controversial; unfortunately, none of the previous investigations documented the microgeographical variation in soil chemistry on the scale of the quadrats, gradients or clump sizes measured in this investigation.

GIVNISH, T. 1971. A study of the New Jersey Pine Barrens Cedar Swamps. Princeton Univ., Princeton, N. J. 82p. (D)

Location: General

Keywords: Hydrology; Geology; Water Chemistry; Vegetation; Chamaecyparis thyoides

Abstract: We studied seventeen transect lines at nine sites. Along each transect the team mapped plant species as a function of such environmental gradients as water table depth, light intensity, peat depth, pH and chemical groundwater makeup. Cation concentrations determined included sodium, potassium, calcium, magnesium and iron.

Samples were also analyzed for chloride and silicia content. We also studied plant banding on hummocks. Rising as much as three feet above the generally low relief of the swamp floor, these convex mounds of sphagnum moss and peat represent the sharpest gradients of groundwater depth, evaporative potential and chemical composition to be found within the swamp. Water table depth stongly controls the dissolved oxygen gradient in partially saturated peat. Below the water table, the metabolic processes of bacteria involved in peat decomposition and humification rapidly exhaust oxygen reserves. While the principal re-oxygenating process is diffusion toward wetted surfaces, diffusion transport is far exceeded by biological demand. Atlantic white cedar does not possess air channels in its root system. Root cell metabolism, and hence tree growth and survival, are controlled by water table levels through its effect on soil oxygen content. As a result, water table level is a sere-maintaining factor for savannas, sphagnum bogs, and other treeless lowlands. We found chemical concentrations in the peat waters of sites in the Pine Barrens proper to have seemingly little effect on species distributions. Swamp species were found to be differentially adapted to low and moderate salinities induced by salt water intrusion. Cedar growth was stunted by relatively low salt concentrations; all swamp plants perished following an intrusion by bay water (11,000 ppm chloride).

GIVNISH, T. 1981. Serotiny, geography and fire in the Pine Barrens of New Jersey. Evolution 35:101-123. (D)

Location: General; Plains (17,26,27)

Keywords: _Pinus rigida_; Gene Flow Hypothesis; Clinal Variation; Selection Hypothesis

Abstract: Evidence from 274 vegetation samples of pitch pine in the central Pine Barrens of New Jersey suggests that local fire frequency plays a predominant role in setting local levels of serotiny, contrary to an earlier suggestion by Ledig and Fryer (1972). Data from transect studies show that gene flow from the Pine Plains, an area of fire-swept pygmy forests with a high incidence of serotiny, is not important in setting the frequency of serotiny in other Barrens areas more than 3-5 km away. Significant differentiation occurs between frequently burnt upland sites and rarely burnt lowland sites less than 100 m apart. I analyzed the relation between serotiny and fire frequency in upland forests by constructing of inferred fire frequency from an ordination of 168 vegetation samples and 14 tree species. Serotiny correlates in a highly significant manner with the inferred fire frequency. After using this relation to remove the effects of differential fire history across

sites at various distances from the Plains, I found gene flow to have a significant effect on the frequency of serotiny only within 2.5-3.0 km of the Plains. These data are related to a model that predicts fire frequency should increase from the edge to the center of the Pine Barrens, based on the premise that the sands underlying the Barrens are the ultimate cause of frequent fires there. This model is validated by an analysis of the geographic distribution of oak- and pine-dominated forests in the Pine Barrens, using the fact that arborescent oaks are less fire-tolerant than pitch pine. As expected, the inferred frequency of fires is greatest in the broadest gap between the firebreaks caused by large rivers and swamps in the Barrens. The Pine Plains occur in the largest area free of major barriers to fire. The rarity of serotiny on the northern Coastal Plain and in the hybrid zone between pitch pine and pond pine may also result from physiographic constraints on fire frequency, and appears to be a consequence of the low incidence of fires expected near the geographic limits of Coastal Plain soils. In light of data suggesting a selective advantage of serotinous trees following wildfires, I propose a model whereby serotinous and non-serotinous forms can be maintained in a population. This analysis relates fire frequency to the fraction of seeds dispersed to a burnt patch by trees within that patch; the lower the frequency of fires, the fewer are the number of patches with enough pitch pine to saturate the seedbed available after a fire within that patch, and the greater the reproduction within the patch by non-serotinous trees outside the patch. Highly similar patterns of seedling establishment may partly explain the high degree of non-overlap in the ranges of serotinous species or geographic variants of Pinus. The association of serotinous Pinus and Cupressus with highly infertile soils suggests that soil infertility may favor serotiny by dwarfing the vegetation and making it more arid, thus favoring fires, and by increasing the advantages of seeding into an ashen, fertilized seedbed. Throughout, the synergistic effects of fire, soil and physiography on serotiny are emphasized.

GOLDSTEIN, R. F. 1973. See GEOLOGY AND SOILS citation.

GOLDSTEIN, R. F. and H. L. COUSMINER. 1973. See GEOLOGY AND SOILS citation.

GOOD, R. E. and N. F. GOOD. 1975. Growth characteristics of two populations of Pinus rigida Mill. from the Pine Barrens of New Jersey. Ecology 56:1215-1220. (D)

Location: West Plains (17); Lebanon State Forest (8,9)

Keywords: Germination; Seedlings; Temperature Responses;

Biomass; Population Differences

Abstract: The Outer Coastal Plain of New Jersey is largely dominated by pitch pine (Pinus rigida) forests. Most of the area supports trees of normal stature (Barrens) but fairly extensive areas of pygmy forest (Plains) also are present. We compared germination and growth characteristics of two populations representing these types. Seeds derived from trees of the contrasting forms were grown under greenhouse-nursery and phytotron conditions for periods up to 5.5 years. Height, growth form and biomass comparisons were made. Significant height differences were found in both studies while significant biomass differences were found primarily in the greenhouse-nursery study. Where significant differences existed, Plains progeny were shorter and lighter than their Barrens counterparts. Height and biomass differences were greater in older plants but statistical differences were present in seedlings less than 1 year old. Plains progeny also included a larger percentage of poor, shrubby growth forms and were markedly more precocious in regard to cone production. We conclude that inherent characteristics of Plains trees, whether physiological or genetic, contribute in part to the stunted nature of the Plains.

GOOD, R. E. and N. F. GOOD. 1976. Growth analysis of pitch pine seedlings under three temperature regimes. For. Sci. 22:445-448. (D)

Location: Lebanon State Forest (8,9)

Keywords: Pinus rigida; Allometry; Biomass Distribution

Abstract: Pinus rigida seedlings were grown under three temperature regimes (17/11 C, 26/23 C, 32/29 C) in a phytotron for 14.5 months. Heights of the three groups were virtually identical at the end of this period although cool temperatures initially retarded seedling development. Biomass of both the cool and warm temperature regime plants was approximately one-half that of the moderate temperature regime plants at 14.5 months. Cool temperatures depressed needle biomass most while warm temperatures depressed root biomass most. Allometric analysis indicated similar relative growth rates of organs at the warm and cool temperatures but dissimilar proportions of stem, root and needle. Despite biomass depression at warm and cool temperatures, pitch pine grew relatively well at unfavorable temperatures compared to other conifers.

GOOD, R. E., N. F. GOOD and J. W. ANDRESEN. 1979. The Pine Barren Plains. Chapter 16 In Forman, R. T. T. (ed.). Pine Barrens: ecosystem and landscape. Academic Press, New York.

pp.283-295. (R)

Location: Plains (17,26,27)

Keywords: Pinus rigida; Fire; Pyxidanthera barbulata; Adaptive Hypothesis

Abstract: Three areas totalling approximately 4950 hectares (12,400 acres) of pygmy pine forest or "Plains" occur within the Pine Barrens of New Jersey and are dominated by pitch pine (Pinus rigida) 3 m (10 ft) high and shrubby oaks (Quercus marilandica, Q. ilicifolia). No plants are endemic to the Plains, but several species, such as pyxie moss (Pyxidanthera barbulata), broom crowberry (Corema conradii), and bearberry (Arctostaphylos uva-ursi), are more abundant than in the Barrens. Lengthy seed viability, asynchronous germination, and frequent habitat disturbance are suggested as important in the success of pyxie moss. Pitch pine has few seedlings but has many old root crowns, producing numerous young stems; sprouting from root crowns is important in recovery following fire. High fire frequency is considered the most significant factor in the development of the Plains vegetation. However, the roles of genetic and physiological factors also are considered important in its perpetuation. Plains pitch pine has almost only serotinous cones, appears to be slower growing, and is more precocious in seed production than typical Barrens pitch pine. The Plains, along with other pygmy conifer forests, are regarded as a product of selection for characters enhancing survival under severely limiting environmental conditions, such as frequent fires and (or) unfavorable soil. These conditions prevent the successful establishment of both normal-sized forests and other vegetation types such as low shrubland or grassland. Thus, the Plains trees will remain dwarf even if fire is eliminated.

GURIES, R. P. and F. T. LEDIG. 1982. Genetic diversity and population structure in pitch pine (Pinus rigida Mill.). Evolution 36:387-402.

Location: Lebanon State Forest (8,9); West Plains (17); East Plains (26)

Keywords: Allozymes; Genetic Distance; Population Differentiation

Abstract: Genic diversity and the organization of genetic variability in pitch pine were examined in 11 populations across the species range. Pitch pine is genetically variable; 76.2% of the loci studied were polymorphic and the average individual heterozygosity was 14.6%, but this is less than that exhibited by several other woody species.

The contrast may reflect differences among species in their evolutionary history, or may be an artifact relating to the choice of enzyme systems analyzed. Only a small percent of the observed genic diversity in pitch pine appears to be interpopulation, the remainder is due to differences between individuals within populations, in agreement with results for other tree species. Central populations seem to be more variable than those near the species border. An isolated population at the northern extreme of the species range has a heterozygosity of 13.8% and an average of 15.0% for central populations. The dwarf forest populations of the New Jersey Pine Plains are essentially identical in genic constitution to tall forest of the New Jersey Pine Barrens, at least for the allozyme loci we sampled. Whatever factors are responsible for the dwarf stature of these populations, they have not resulted in detectable changes in allozyme frequencies among populations. In general, results of allozyme analysis are not in agreement with previously reported patterns for morphological and growth traits, emphasizing the need to sample several types of loci to adequately understand the genetic structure of populations.

GRAY, T. C. and J. J. GROOT. 1966. Pollen and spores from the marine Upper Cretaceous formations of Delaware and New Jersey. Palaeontographica B117:114-134. (D)

GROOT, J. J. et al. 1961. See GEOLOGY AND SOILS citation.

HANKS, J. P. 1971. Secondary succession on the inner coastal plain of New Jersey. Bull. Torrey Bot. Club 98:315-321. (D)

Location: Bordentown (all sites within 24 miles)

Keywords: Floristics; Life-form; Vegetation Dominance; Vegetation Cover; Soils

Abstract: Old field succession on the inner coastal plain of New Jersey was investigated in one- to two-year-old fields and through the forest stage. The number of introduced species decreases through older age-groups. The number of native species shows a reciprocal increase through older age-groups. One- to two-year-old fields are dominated by Conzya canadensis and Anthemis arvensis. Ten- to 15-year-old fields are dominated by Solidago juncea and Andropogon virginicus. Rubus spp. are the most important shrubs in the 10- to 15-year-old fields. The 25- to 40-year-old fields are young forests, dominated by Liquidambar styraciflua and Acer rubrum. The forest stands are dominated by Fagus grandifolia, Liriodendron tulipifera and Acer rubrum. The area will probably support a mixed beech-oak forest given a suitable period of time for stabilization. Selected soil characteristics including pH, organic matter, magnesium, phosphorus, calcium, and potassium content differed among successional age-groups. These differences are almost certainly the result of agricultural practices on the inner coastal plain. A considerable interrelationship among land use history, soil parameters, and old field succession exists on the area.

HANKS, S. L. and D. E. FAIRBROTHERS. 1969. Habitats and associations of _Opuntia_ _compressa_ (Salisb.) Macbr. in New Jersey. Bull. Torrey Bot. Club 96:592-596. (D)

Location: Atsion (24); Mays Landing (38); Pleasant Mills (24)

Keywords: Ecological Variability; Soil Nutrients; Importance Value Index

Abstract: The study describes ecological variation found in eleven New Jersey populations of _Opuntia_ _compressa_ (Salisb.) Macbr. Ecological and pedological parameters are evaluated and an Importance Value Index was determined for the ecological data. Ecological data indicate that the occurrence of _O_. _compressa_ is not associated with the presence of any one species or group of species. The soil data indicate no positive correlation between amounts of minerals and the presence of _O_. _compressa_.

HARKNESS, B. 1932. Plant notes from the New Jersey Pine Barrens. Nat. Hort. Mag. 11:34-36,50. (R)

HARPER, R. M. 1918. A sketch of the forest geography of New Jersey. Bull. Geogr. Soc. Philadelphia 16:107-125. (D)

HARSHBERGER, J. W. 1913. The excursion of the international phytogeographers about New York City. Amer. Geogr. Soc. Bull. 45:847-848. (N)

HARSHBERGER, J. W. 1914. Plant life seen between Philadelphia and Atlantic City. Old Penn Weekly Rev. (Univ. Pa.), April 25.

HARSHBERGER, J. W. 1916. The vegetation of the New Jersey Pine Barrens: an ecological investigation. Christopher Sower Co., Philadelphia, Pa. (D)

Location: General

Keywords: Physiography; Soils; Geography; Plains; _Pinus_

rigida Reproduction; Community Types

HARSHBERGER, J. W. 1917. The New Jersey Pine Barrens. Jour. Amer. Museum Nat. Hist. 17:244-252. (D)

HARSHBERGER, J. W. Undated. American heaths and pine heaths. Brooklyn Bot. Gardens Memoirs 1:175-186. (R)

HARSHBERGER, J. W. 1925. The differentials effective in the distribution of plants in the coastal plain. Science 61:529-531. (R)

HART, R. 1976. Revegetation of a 70 year old sandpit in southern New Jersey. Bartonia 44:37-43. (D)

Location: Downer (21)

Keywords: Succession; Soil Development; Water Table; Pinus rigida; Acer rubrum; Hypericum canadense; Andropogon scoparius; Panicum virgatum; Soil Chemistry

Abstract: Notably absent from the pit are the introduced ruderals usually present in recently disturbed sites. The necessary seed source is not lacking because these weeds are abundant in adjacent roadsides and fields. The sandpit does not differ in pH or nutrient content from these adjacent sites, and it seems most likely that establishment of these plants can not occur in the shifting dry sands of the newly abandoned pit. However, most species in the pit do not establish until the sand is stabilized by the roots of Panicum virgatum and various trees. Yet even in these stabilized areas, introduced weeds are absent. Almost all plants present are typical native Coastal Plain species. It is encouraging that sandpit operations, unlike much other commercial mining, do not permanently scar the landscape. In less than half a century the regional vegetation has moved in and completely covered the area.

HASTINGS, G. T. 1931. Week end of September 25-27. Torreya 31:179-182. (N)

Location: West Plains (17)

Keywords: Flora; Soils; Corema; Pinus rigida; Hudsonia ericoides; Leiophyllum; Schizaea; Drosera

HAZEN, J. F. and O. M. WOOD. 1935. Animal damage in relation to size of planting stock. Allegheny For. Expt. Sta. Tech.

Note 4:1-4, USDA For. Serv., Upper Darby, Pa. (D)

HEUSSER, C. J. 1979. Vegetational history of the Pine Barrens. Chapter 12 In Forman, R. T. T. (ed.). Pine Barrens: ecosystem and landscape. Academic Press, New York. pp.215-227. (R)

Location: General

Keywords: Palynology; Geology; Quaternary Vegetation; Vegetation Origin; Chronosequence

Abstract: Some taxa in the vegetation of the Pine Barrens occupied the Coastal Plain during Cretaceous time, while the remainder are Tertiary or younger in age. The development of the Coastal Plain by marine and fluvial processes during and since the Cretaceous has influenced the past vegetation greatly. The major changes influencing the plant communities occurred during Quaternary time. Boreal forest species appear to have been prevalent in the region in late galcial time. Oaks and pines reinvaded subsequently, although the time of establishment of the present species is speculative. Atlantic white cedar appears to be a relatively recent arrival. The plant record shows many gaps in time, and future investigations should include Quaternary fossils of continental plants in marine sediments.

HICKMAN, J. C. and J. A. NEUHAUSER. 1978. Growth patterns and relative distribution of Chamaecyparis thyoides and Acer rubrum in Lebanon State Forest, New Jersey. Bartonia 45:30-36. (D)

Location: Lebanon State Forest (8,9)

Keywords: Ecology; Logging; Slash Burning; Seedling Establishment

HOLLICK, A. 1892. Paleobotany of the yellow gravel at Bridgeton, New Jersey. Bull. Torrey Bot. Club 19:330-333. (D)

Location: Bridgeton

Keywords: Magnolia; Ilex; Liquidambar; Asiminia; Amelanchier; Nyssa; Viburnum; Quercus

HOLLICK, A. 1899. The relation between forestry and geology in New Jersey. I. Present conditions. Amer. Nat. 33:1-14. (D)

HOLLICK, A. 1900. The relation between forestry and geology in

New Jersey. Ann. Rept. State Geol. 1899:173-201, N. J. Geol. Surv., Trenton, N. J. (R)

HOLLINSHEAD, M. H. 1938. Ferns of the New Jersey Pine Barrens. Torreya 38:63-66. (D)

Location: Quaker Bridge (24)

Keywords: Pteris; Woodwardia

JOHNSON, A. H., T. G. SICCAMA, D. WANG, R. S. TURNER and T. H. BARRINGER. 1981. Recent changes in patterns of tree growth rate in the New Jersey Pinelands: a possible effect of acid rain. Jour. Environ. Quality 10:427-430. (D)

Location: General

Keywords: Forest Productivity; Acid Precipitation; Pinus rigida; Pinus echinata; Pinus taeda

Abstract: Increment cores from pitch pine (Pinus rigida), shortleaf pine (P. echinata) and loblolly pine (P. taeda) indicate an abnormal decrease in growth rates over the past 25 years. Stream pH, a reliable index of precipitation pH, and a strong statistical relationship between stream pH and growth rates suggests that acid precipitation may have been a growth-limiting factor for the past two decades. Other factors such as drought, fire, pests and atmospheric oxidants do not appear to be responsible for the two decades of abnormally slow growth.

KELLER, I. A. and S. BROWN. 1905. Hand book of the flora of Philadelphia and vicinity. Philadelphia Bot. Club, Philadelphia, Pa. 360p. (D)

KIMYAI, A. 1966. New plant microfossils from the Raritan Formation (Cretaceous) in New Jersey. Micropaleontology 12:461-476. (D)

Location: General

Keywords: Paleoecological Factors; Botanical Affinities; Geology

Abstract: In an investigation of plant microfossils from the Raritan Formation of New Jersey, U.S.A., two new genera and thirty-six new species are described. The climate during the Raritan time ranged from subtropical to temperate. The age of the Raritan Formation is considered

to be the earliest Late Cretaceous. The presence of marine microfossils suggests a shallow-water marine environment for this formation.

KNIESKERN, P. D. 1856. A catalogue of plants growing without cultivation in the counties of Monmouth and Ocean. Ann. Rept., N. J. State Geol., N. J. Geol. Surv., Trenton, N. J. (D)

KOCH, R. C. 1975. See GEOLOGY AND SOILS citation.

KOCH, R. C. and R. K. OLSSON. 1977. See GEOLOGY AND SOILS citation.

KODAMA, D. R. and R. T. T. FORMAN. 1977. Bryophyte community changes along fire frequency and moisture gradients in the New Jersey Pine Barrens. Bull. N. J. Acad. Sci. 22:41. (A)

Location: Lebanon State Forest (8,9)

Keywords: Sphagnum; Hardwood Swamps; Cedar Swamps; Pitch Pine Swamps; Plains; Prescribed Burn

Abstract: Twenty-one sites representing seven major vegetation conditions in the Lebanon State Forest area were sampled with transects and reconnaissance. Annual burn sites had greater than 4X the bryophyte cover of old burn sites, reflecting a small increase in number of common species but a decrease in number of uncommon species. Six patchily-distributed acrocarpous mosses shared dominance in the annual aburns, while no dominants emerged in the old burns. Along the soil moisture gradient cedar swamps dominated by Sphagnum and two leafy hepatics had greater than 15X the cover of old burn sites, but with little change in diversity. Hardwood swamps were dominated by Sphagnum and other mosses, but pine plains and pitch pine swamps had negligible bryophyte cover. Bryophyte patterns, thus, are very distinct, and in some respects opposite, from patterns of vascular plant communities along the two environmental gradients.

KOSTER, H. 1948. Field trip report of August 30 - September 1. Mullica River valley, New Jersey. Bull. Torrey Bot. Club 75:234-235. (N)

Location: Greenbank (33); Weekstown (33); Bulltown (25); Batsto (24); Pleasant Mills (24)

Keywords: Telaranea; Flora

KUMMEL, H. B. 1902. Forestry. Ann. Rept. State Geol. 1901:xx-xxii, N. J. Geol. Surv., Trenton, N. J. (N)

KUMMEL, H. B. 1903. Forestry. Ann. Rept. State Geol. 1902:12-21, N. J. Geol. Surv., Trenton, N. J. (N)

KUMMEL, H. B. 1904. Forestry work. Ann. Rept. State Geol. 1903:xxvii-xxxii, N. J. Geol. Surv., Trenton, N. J. (N)

KUMMEL, H. B. 1910. Forest fires for 1909. Fifth Ann. Rept. For. Park Reserv. Comm. 1909:11-39, For. Park Reserv. Comm., Trenton, N. J. (D)

LAYCOCK, W. A. 1967. Distribution of roots and rhizomes in different soil types in the pine barrens of New Jersey. Prof. Paper 563-C:C1-C29, U.S. Geol. Surv., Washington, D. C. (D)

Location: Lebanon State Forest (8,9)

Keywords: Soil Profiles; Shrubs; Water Table; Fire Effects

Abstract: The Pine Barrens, which consist of upland forests and lowland swamps, covers approximately 2,000 square miles of the Coastal Plain of New Jersey. The root and rhizome systems of selected shrubs of this region were studied as part of the New Jersey Pine Barrens Hydrologic research project to determine the effects on the present and future ground-water supplies of changes in forest composition caused by controlled burning. The form, depth and lateral extent of the root and rhizome systems of 20 species of shrubs which grow in the upland forest and in the transition zone between the upland and lowland areas of the region are described. Two species of shrubs (Kalmia angustifolia and Lyonia mariana) in the transition zone have phreatophytic characteristics. The roots of these two species penetrate as deep as 40-58 inches to reach the underlying water table. Roots of the other species of shrubs may or may not extend to the water table. The A-0 soil horizon contains the highest number of tree and shrub roots per square foot, and the A-1 horizon contains the next highest number. In upland soils, numbers of roots decrease sharply from the A-1 to the A-2 horizon, increase slightly in the B-1 horizon, and then decrease with depth below the B-1 horizon. The increase in the B-1 horizon does not occur in the poorly drained soils. The highest total numbers of roots in the entire profile were found in soils having thin, imperfectly leached A-2 horizons. Sites with shrubs had significantly more roots, especially in the A-0 and A-1 horizons, than similar sites having no shrubs. A decrease in shrub cover caused by

controlled burning, and the resultant decrease in roots, might permit more water to reach the water table.

LEDIG, F. T. and J. H. FRYER. 1972. A pocket of variability in *Pinus rigida*. Evolution 26:259-266. (D)

Location: General

Keywords: Serotiny; Genetics; Fire

Abstract: The frequency of serotinous-coned pitch pine is highest in the New Jersey Pine Plains, an area of dwarf vegetation, and the immediately surrounding area in the Pine Barrens. There is evidence to suggest that serotinous-coned trees are homozygotes for a single gene controlling the trait. Under this assumption, gene frequency declines rapidly to zero within at least 200 miles in all directions, decreasing logarithmically as the distance from the Pine Plains increases ($r = -0.86$). The distribution suggests a very high selective advantage for serotinous-coned trees in the vicinity of the Pine Plains and a selective disadvantage for the trait away from this area, creating a pocket of variability. A steady state pocket-of-variability is considered more likely than a transitory pocket. The factors important in the establishment and maintenance of the cline are probably 1) an environmental pattern of fire occurrence and severity and 2) gene flow through pollen and seed dispersal. The alternative hypothesis that the occurrence of serotinous cones is pitch pine is directly related to active intergradation from the serotinous-coned pond pine taxon is rejected because the frequency of serotinous-coned trees is low in the transition area between the two taxa.

LEDIG, F. T. and J. H. FRYER. 1974. Genetics of pitch pine. NE. For. Expt. Sta. Res. Paper WO-27:1-14, U.S.D.A. For. Serv., Upper Darby, Pa. (R)

Location: General

Keywords: *Pinus rigida*; Tree Improvement; Geographic Variation; Racial Variation; Hybridization

Abstract: Although the relative importance of genetic and environmental effects has scarcely been tested, pitch pine, *Pinus rigida* Mill., appears to be an extremely variable species. In colonial times, intensive utilization may have resulted in dysgenic selection. Natural hybrids with pond, loblolly and shortleaf pines are suspected, and controlled crosses have been successful with these and several other species. The major role of pitch pine in tree improvement has been as a source of cold resistance in crosses with less

hardy pines.

LEDIG, F. T. and S. LITTLE. 1979. Pitch Pine (<u>Pinus rigida</u> Mill.): ecology, physiology and genetics. Chapter 20 <u>In</u> Forman, R. T. T. (ed.). Pine Barrens: ecosystem and landscape. Academic Press, New York. pp.347-371. (R)

Location: General; Plains (17,26,27)

Keywords: Habitat; Associated Flora; Associated Fauna; Seed Viability; Vegetative Reproduction; Growth; Root Development; Nanism; Reproductive Strategy; Photosynthesis; Serotiny; Cytogenetics

Abstract: Pitch pine is a hardy species which is adapted to poor soils with a severe fire history. Its adaptations to fire are its most striking characteristics, namely, the production of dormant buds that permit sprouting from the root crown, trunk and branches, the development of a basal crook and of thick bark to protect buds from fire, and the production of serotinous cones. Other characteristics make it a common invader of cleared sites and enable it to thrive on both droughty and wet sites. Its physiology, however, is not well understood. Although its seedlings are capable of the highest photosynthetic rates on record for conifers, its photosynthesis and productivity in the forest are not outstanding. Geographical variation is slight for both physiological characteristics and gene frequency in several enzyme systems. However, perhaps in relation to photoperiodic response, populations differ substantially in growth in uniform garden culture. There also are geographical trends in wood properties and other characteristics, but the only distinct ecotype is the dwarf tree pyrotype of the Pine Plains, a tree which may reach only one-half the height of "normal" pitch pine at 50 years. Pitch pine readily hybridizes with related species. Based on the presence of nine polymorphic genes and eight others with rare variants, plus knowledge of its Mendelian genetics and the demostration of linkage, pitch pine is suggested as an incipient "<u>Drosophila</u> tree" for forest genetics research.

LEE, L. L. and F. H. MILLEN. 1920. The New Jersey Plains boundard (sic) survey and preliminary report. Unpubl. typescript dated 14 February 1920, Div. Parks Forests Recreation, N. J. Dept. Conserv. Econ. Develop., Trenton, N. J. 4p. (D)

LEIPZIG. 1911. The vegetation of the New Jersey pine barrens: an ecological investigation. (Publ. unknown), Philadelphia, Pa. 329p. (D) (Manuscript cited in McCormick and Buell 1968)

LEVIN, M. H. 1962. A comparative floristic study of early succession on the Outer Coastal Plain of New Jersey. Bull. N. J. Acad. Sci. 7:22. (A)

Location: Batsto (24); Atsion (24); New Lisbon (7); Plains (17,26); Millville (35); Tuckahoe (43); Manahawkin (27)

Keywords: Vascular Plants; Bryophytes

Abstract: Sites for studying secondary succession of fields 1 and 2 years of age have been established in the following areas of the New Jersey coastal plain: 1) Pine Barrens at Batsto, Atsion and New Lisbon, 2) Pine Plains at Warren Grove, 3) Gravel Section at Millville, 4) Cape May Terrace at Tuckahoe and Manahawkin. The general characteristics of each site are: approximately one acre, well-drained soil, prior cultivation at some previous time; exceptions are New Lisbon and Warren Grove. One half of each site is being denuded and the vegetation which returns will be analyzed and compared with the unplowed half of the same field, and with plowed portions of the other fields. Methods of quantitative plant·analysis, and total survey are being employed to study the selected fields. Emphasis is being placed on identification of vascular plants and bryophytes. The goals of the project are to describe early secondary succession on the outer coastal plain, obtain data which indicate diversity or uniformity in the flora of the fields, determine geographic affinities of the flora, and to investigate the role of climate, disseminules, geological substrate and soil. The results of the study will have application in at least three ways: 1) add to floristic and ecological knowledge of coastal plain vegetation, 2) desirability of early successional vegetation to wildlife, 3) agriculture.

LEVIN, M. H. 1966. Early stages of secondary succession on the coastal plain, New Jersey. Amer. Midl. Nat. 75:101-131. (D)

Location: Manahawkin (27); Tuckahoe (43); Millville (35); Warren Grove (26,27); New Lisbon (7); Atsion (24); Batsto (24)

Keywords: Life Form Spectra; Environmental Effects; Geology; Native Species; Naturalized Species

Abstract: A study of the flora and vegetation associated with early secondary succession was initiated in March 1961, and concluded in October 1963. The year prior to site clearing was devoted to reconnaissance of selected sites, collection of flora, and examination of soil morphology. First and second years after clearing were devoted to floristic survey, and quadrat studies of vegetation of the

seven cleared sites. Four of the sites (Warren Grove, New Lisbon, Atsion and Batsto) lie in the vegetation region known as the Pine Region or Pine Barrens. The remaining three sites (Manahawkin, Tuckahoe and Millville) are on the Pine Region fringe. A total of 198 species of vascular plants were found during the first year and 127 during the second year. Of these, 24% of the first year and 23% of the second year flora were naturalized species. Hemicryptophyte (45, 48%) was the leading life form category and the therophytes (30, 24%) were of second importance. Herbaceous vegetation of the cleared sites was separable into five categories: (1) dominance by annuals during the first and second year (Tuckahoe), (2) dominance by annuals first year and by perennials the second year (Manahawkin), (3) dominance by perennials first year and by annuals the second year (Millville and Batsto), (4) dominance by perennials first and second year (New Lisbon and Atsion), and (5) no dominance (Warren Grove). No first year field in the Pine Region supported an annual "weed" stage; two of the three Pine Region fringe sites on heavier soils with better moisture relations and recent agriculture history did have an annual "weed" stage during the first year. It appeared that land use was the factor primarily responsible for the vegetation patterns. Since all but three woody species had developed from residual vegetative parts, no generalization could be made regarding the importance of woody species that invade by seed. Each community appeared to represent a special example made possible by the species present prior to clearing and the degree of clearing disturbance to the vegetation.

LITTLE, S. 1937. Deer damage to pine reproduction in southern New Jersey. Allegheny For. Expt. Sta. Tech. Note 19, U.S.D.A. For. Serv., Upper Darby, Pa. (D)

LITTLE, S. 1940a. Seed fall of Atlantic white cedar. Allegheny For. Expt. Sta. Tech. Note 26, U.S.D.A. For. Serv., Upper Darby, Pa. (D)

LITTLE, S. 1940b. Seed fall of shortleaf pine. Allegheny For. Expt. Sta. Tech. Note 27, U.S.D.A. For. Serv., Upper Darby, Pa. (D)

LITTLE, S. 1941. Calender of seasonal aspects for New Jersey forest trees. Penn. For. Leaves 31(4):1-2,13-14. (D)

LITTLE, S. 1942. Progress report on thinning plots in a south Jersey oak-pine stand. Unpubl. ms., U.S.D.A. For. Serv. NE. For. Expt. Sta., Upper Darby, Pa. (D)

LITTLE, S. 1945. Influence of fuel types on fire danger. Jour. For. 43:744-749. (D)

Location: General

Keywords: Fuel Moisture; Wind; Oak-Pine; Pine-Oak; White Cedar; Hardwood Swamps

LITTLE, S. 1946. The effects of forest fires on the stand history of New Jersey's Pine Region. NE. For. Expt. Sta. Management Paper 2:1-43, U.S.D.A. For. Serv., Upper Darby, Pa. (D)

LITTLE, S. 1947. Ecology and silviculture of whitecedar and associated hardwoods in southern New Jersey. Ph.D. Thesis, Yale Univ., New Haven, Conn. (D)

Location: Lebanon State Forest (8,9)

Keywords: _Chamaecyparis thyoides_; Distribution; Associated Species; Silvical Habits; Ecological Relations; Succession; Fire; Management

LITTLE, S. 1950. Ecology and silviculture of white cedar and associated hardwoods in southern New Jersey. Yale Univ. School Forestry Bull. 56:1-103. (D)

Location: Lebanon State Forest (8,9)

Keywords: _Chamaecyparis thyoides_; Distribution; Associated Species; Silvical Habits; Ecological Relations; Succession; Fire; Management

Abstract: Although it occupies only a small proportion of the forest area, white cedar is one of the most important timber trees of southern New Jersey and of certain other sections along the Atlantic Coast. It occurs on poorly drained peat or sandy soils in which the organic matter may range in depth from only a few inches to over 30 feet. The soils are acid, the pH ranging from 2.0 to 5.5. Associated hardwoods in southern New Jersey are principally maple, blackgum and sweetbay; all are common associates in many parts of the range of white cedar. The hardwoods are of little or no value. White cedar has several characteristics favoring successful management. Seed is first borne at an early age and later fair crops are produced annually, with heavy crops at intervals of 2 to 3 years. Viability of the seed varies greatly, but a large amount of seed may remain viable in the forest floor for at least 1 to 2 years. Although the seed falls throughout the year, 60% is disseminated between October 15 and December 15, and 93% by

March 1. White cedar seed is distributed by the wind, and the distance to which it is carried depends greatly on the extent of obstructions by surrounding vegetation. As a result of the influence of weather conditions, 80-85% of the seeds borne by isolated trees fall on the east side of the source. The establishment of natural reproduction is greatly affected by moisture and light relations. Excessive water prevents germination or kills seedlings; too little moisture also has unfavorable effects. White cedar, pitch pine, gray birch and red maple are all common invaders of open areas. White cedar is subclimax to the hardwoods other than gray birch. In southeastern New Jersey the physiographic climax on swamp sites is an all-aged stand composed predominantly of red maple and sweetbay, but locally containing a high proportion of blackgum and occasional trees of holly and sassafras. Clear-cuttings have tended to favor the perpetuation of white cedar stands, but partial cuttings of white cedar alone and the lack of slash disposal have aided the succession to hardwoods. Fires in recent years have had a dual role, favoring in some places the perpetuation of white cedar, although more usually conversion to hardwoods.

LITTLE, S. 1951. Observations on the minor vegetation of the Pine Barren swamps in southern New Jersey. Bull. Torrey Bot. Club 78:153:160. (D)

Location: Lebanon State Forest (8,9)

Keywords: Lichens; <u>Sphagnum</u>; Liverworts; <u>Chamaecyparis thyoides</u>; <u>Acer rubrum</u>; Nonarborescent Vegetation; Cedar Swamp Forests

Abstract: The purpose of this paper is to record observations on the occurrence of nonarborescent species in some swamps in southern New Jersey and to describe the conditions under which they were found. Information about these species was collected during a study of the successional trends in stands of white cedar and associated hardwoods (see Little 1947, 1950).

LITTLE, S. 1952a. Effects of forest fires on upland sites in the pine region of southern New Jersey. Leaflet 100:1-8, N. J. Coll. Agr. Ext. Serv., New Brunswick, N. J. (R)

Location: General

Keywords: Fire Frequency; Fire Intensity; Productivity; Succession

LITTLE, S. 1952b. Silvicultural objectives and methods on

upland sites in the New Jersey Pine Region. Bartonia 26:44-47. (N)

Location: General

Keywords: Growth Potential; Management; Prescribed Burning

LITTLE, S. 1953. Prescribed burning as a tool of forest management in the Northeast States. Jour. For. 51:496-500. (N)

Location: General

Keywords: Forest Composition; Forest Succession; Species Characteristics; Fire Effects

Abstract: One advantage in using prescribed burning is its low cost compared to other methods for accomplishing the same amount of seedbed preparation and hardwood control. A second advantage from periodically prescribed burning is in fuel reduction. This not only facilitates the suppression of wild fires, but greatly reduces their damage. Already these highly important benefits have been observed on a few areas in New Jersey. Disadvantages in using prescribed burning are chiefly (1) in educating people to understand the varying results from fires and (2) in accomplishing the job correctly. Experience has been that the good and bad effects of fire form no more difficult and complex problem in education than similar effects from cutting. Problems in accomplishing the job of prescribed burning are (1) organizing and training crews, (2) developing experienced, qualified leaders, and (3) selecting proper conditions. Unfortunately the fire-danger meter is not a sufficiently accurate guide and the selection of proper conditions is still a matter of experience and judgement, aided by actually setting a small test fire. But experience has been that the job of prescribed burning can be done properly if adequately organized.

LITTLE, S. 1954. Coastal Oak-Pine Research Center Quartnary Report, Oct. - Dec. 1953. Lebanon Expt. For. (New Lisbon, N. J.), NE. For. Expt. Sta., U.S.D.A. For. Serv., Upper Darby, Pa. (R)

LITTLE, S. 1958. Forests and deer in the pine region of New Jersey. U.S.D.A. For. Serv., Upper Darby, Pa. (R)

LITTLE, S. 1964. Fire ecology and forest management in the New Jersey Pine Region. pp. 34-59 In Proc. Third Ann. Tall

Timbers Fire Ecology Conf., Tallahassee, Fla., April 9-10, 1964. U.S.D.A. For. Serv., Washington, D. C. (R)

LITTLE, S. 1965. Direct seeding in southern New Jersey and the Pennsylvania Poconos. Proc. Direct Seeding in the Northeast Symposium, Univ. Mass. Expt. Sta. Bull. pp.64-68. (R)

Location: General

Keywords: Soils; Germination; Growth; Pinus

Abstract: The Northeastern Forest Experiment Station has made several trials of direct seeding in southern New Jersey and the Pennsylvania Poconos in the last 24 years. In southern New Jersey some of the trials with shortleaf pine and Atlantic white cedar were made in 1941 and 1942, while those with pitch pine were mostly between 1955 and 1961. Tests of direct-seeding red and jack pines in the Pennsylvania Poconos have extended over a four-year period, beginning in 1961. Even though the trials have been on a small scale, they have shown, in my opinion, the techniques that will or will not give success, and the importance of weather conditions during seed germination and early establishment of seedlings. From the direct-seeding tests we have also gained appreciable knowledge on the role of this method in establishing desired coniferous reproduction in these two sections. This paper will describe briefly what we have learned. The discussion will deal first with Atlantic white cedar on swamp sites in the New Jersey Pine Region, then with pitch and shortleaf pine on upland sites in that section, and finally with red and jack pines in the Pennsylvania Poconos.

LITTLE, S. 1967. Treatments needed to regenerate yellow-poplar in New Jersey and Maryland. N.E. For. Expt. Sta. Res. Note NE-58:1-8, U.S.D.A. For. Serv., Upper Darby, Pa. (D)

Location: General

Keywords: Liriodendron tulipifera; Prescribed Fire; Seedbed Treatments

Abstract: In 17 areas, mostly in the Coastal Plain and Piedmont sections of New Jersey and Maryland, treatments were made to favor the establishment and growth of yellow-poplar reproduction. Results emphasize the importance of fairly large overstory openings (preferably 1 acre or more) and of reductions in understories by mistblowing, burning or disking, but show that seedbed preparation is needed only in areas borderline because of deep litter, scant seed supply, or dense herbaceous growth.

LITTLE, S. 1969. Local seed sources recommended for Loblolly Pine in Maryland and Shortleaf Pine in New Jersey and Pennsylvania. For. Serv. Res. Paper NE-134, N.E. For. Expt. Sta., U.S.D.A. For. Serv., Upper Darby, Pa. 16p. (D)

Location: Green Bank State Forest (33)

Keywords: *Pinus echinata*; Management; *Pinus taeda*

Abstract: Local seed should be used in establishing shortleaf pine stands in southern New Jersey or southeastern Pennsylvania. Local sources provide trees adapted to the local climates, and these trees usually grow much faster in the Northeast than stems that originate from seed collected farther south.

LITTLE, S. 1972a. Eighteen-year changes in the composition of a shortleaf - pitch pine stand of southern New Jersey. Bull. N. J. Acad. Sci. 17:2. (A)

Location: Not given

Keywords: Pine Mortality; Seedlings; Fire

Abstract: In 1953, the stand overstory was composed of shortleaf and pitch pines about 22 yrs old. Understory trees were inconspicuous: 2 to 24 hardwood stems per acre larger than 0.5 in dbh, although there were about 3,000 smaller hardwoods per acre. In the following 18 yrs many of the yellow pines died, so the number larger than 0.5 in dbh fell from about 700 to 300-350 stems per acre. Understory hardwoods grew to 600 to 1,000 stems larger than 0.5 in dbh per acre. Many more became established, so the number of smaller hardwoods increased by 2,600 to 6,200 per acre. White pines also became established, seed coming from a nearby plantation. Oaks were the most common members of the understory, with black and southern red oaks being far more numerous than post or white oaks. Black cherry and sassafras were also common, but only occasional stems were hickory, red maple, holly or blackgum. A light thinning of the pine overstory in 1954 increased the number of hardwoods larger than 0.5 in dbh in 1971, while three winter fires between 1954 and 1962 decreased that number. However, the burns favored the subsequent establishment of oaks, black cherry and sassafras. Changes described herein and observed in similar stands indicate the successional trend toward a hardwood climax, if not interrupted by severe disturbances.

LITTLE, S. 1972b. Growth of planted white pines and pitch seedlings in a south Jersey Plains area. Bull. N. J. Acad. Sci. 17(2):18-23. (D)

Location: West Plains (17)

Keywords: Productivity; Pinus rigida; Pinus strobus

Abstract: In 1954 a study was started to determine the productivity of Plains sites in southern New Jersey for tree growth. The initial treatments were designed to favor 400 selected pitch pine sprouts per acre or to convert to pitch pine stands of seedling origin. After 6 years some of the treatments were disrupted by cutting of the selected sprouts by cone collectors, but the results obtained by then indicated that such sprouts cannot be expected to develop into normal-sized trees. In 1960, white pine seedlings were planted in the plots of the disrupted treatments. Although parts of some of these plots were damaged by a wildfire in 1963, the white pines by 1971 had grown markedly more than pitch pine seedlings of Plains origin. The slow height growth, crooked stems and appearance of early maturity seemed to indicate a genetically different race of pitch pines than found in some other sections of the Barrens. In contrast, white pines 11 years after planting had growth rates that would produce trees 18 to 24 meters tall in 50 years. Thus, the 1971 results indicate that Plains sites are potentially as productive as other upland sites in the Pine Barrens, but that the fire history may have favored a special race of pitch pine in the Plains vegetation.

LITTLE, S. 1972c. Eighteen-year changes in the composition of a shortleaf - pitch pine stand of Southern New Jersey. Bull. N. J. Acad. Sci. 17:41. (A)

Location: Greenbank State Forest (25)

Keywords: Forest Succession; Prescribed Burning; Selective Harvest; Reproduction

Abstract: In 1953 the stand overstory was composed of shortleaf and pitch pines about 22 years old. Understory trees were inconspicuous: 2 to 24 hardwood stems per acre larger than 0.5 inch d.b.h., although there were about 3,000 smaller hardwoods per acre. In the following 18 years many of the "yellow pines" died, so the number larger than 0.5 inch d.b.h. fell from about 700 to 300-350 stems per acre. Understory hardwoods grew to 600 to 1,000 stems larger than 0.5 inch d.b.h. per acre. Many more became established, so the number of smaller hardwoods increased by 2,600 to 6,200 per acre. White pines also became established, seed coming from a nearby plantation. Oaks were the most common members of the understory, with black and southern red oaks being far more numerous than post or white oaks. Black cherry and sassafras were also common, but only occasional stems were hickory, red maple, holly or blackgum. A light thinning of the pine overstory in 1954 increased the number of hardwoods

larger than 0.5 inch d.b.h. in 1971, while three winter fires between 1954 and 1962 decreased that number. However, the burns favored the subsequent establishment of oaks, black cherry and sassafras. Changes described herein and observed in similar stands indicate the successional trend toward a hardwood climax, if not interrupted by severe disturbances.

LITTLE, S. 1973a. Eighteen-year changes in the composition of a stand of _Pinus echinata_ and _P. rigida_ in southern New Jersey. Bull. Torrey Bot. Club 100:94-102. (D)

Location: Green Bank State Forest (25)

Keywords: Forest Succession; Prescribed Burning; Selective Harvest

Abstract: In recent years, some ecologists have questioned the applicability of the succession concept to the New Jersey Pine Barrens. The data presented in this paper cover the 18-year changes in composition of one old-field pine stand and changes in three other pine stands monitored for 7 to 21 years. Reported changes validate the concept of directional and predictable succession in the Pine Barrens.

LITTLE, S. 1973b. Establishment of selected clones of pitch and loblolly pines in an orchard, controlled breeding and early results from field tests of clonal crosses between species. Bull. N. J. Acad. Sci. 18:17. (A)

Location: Lebanon State Forest (8)

Keywords: Pine Hybrids; Growth; _Pinus rigida_; _Pinus taeda_

Abstract: In 1964 apparently superior trees of pitch pine and of loblolly pine were selected, and that fall the Station began establishment of a 5-acre orchard of grafted pines in New Jersey. Today the orchard has 31 clones of loblolly pines from trees selected mostly in Maryland and 32 clones of pitch pines (from eight geographic sources in Virginia, West Virginia and northeastward). By 1968 there was sufficient flowering so 109 pollination bags were mounted, and the number has increased each year, up to 719 in 1972. Field tests of interspecific hybrids have started. Progeny of certain crosses are growing slower than regular pitch pines; some other progenies slower than loblolly pines; but certain progenies have seedlings 50 percent taller than loblolly at 2 years from seed in some tests. In West Virginia the maximum individual height of hybrids is 4.8 feet at 3 years.

LITTLE, S. 1973c. Fire in wildland management. Use of fire: comments from the northeast. Jour. For. 71:378-379. (R)

Location: General

Keywords: Prescribed Burn; Fuel Reduction; Succession

LITTLE, S. 1973d. Survival, growth of loblolly, pitch, shortleaf pines established by different methods in New Jersey. Tree Planters Notes 23:1-5. (D)

Location: Wharton State Forest (14,15,23,24); Lebanon State Forest (8,9)

Keywords: Root Systems; Direct Seeding; Stock Planting; Management

Abstract: Direct seeding in the New Jersey Pine Barrens can provide good stocking of pine seedlings in years with favorable soil moisture for germination, for initial establishment, and for survival through the second growing season. Under unfavorable moisture conditions, and especially on sites where competing sedges or other plants have not been eliminated, direct seeding will not provide as good stocking of pine seedlings as planting.

LITTLE, S. 1974a. Effects of fire on temperatate forests: northeastern United States. pp. 225-250 In T. T. Kozlowski and C. E. Ahlgren (eds.). Fire and Ecosystems. Academic Press, New York. (R)

LITTLE, S. 1974b. Wildflowers of the Pine Barrens and their niche requirements. N. J. Outdoors May/June:16-18. (R)

Location: General

Keywords: Flora; Disturbances; Wildfire

Abstract: Many of the interesting flowering plants of the New Jersey Pine Barrens have niches determined not only by soil and moisture, but also by the amount of overhead light, and in some cases, the type of forest floor. Certain kinds of disturbances, sometimes severe ones, are needed to provide the light and forest-floor conditions that these plants require. While further ecological studies are necessary to determine what the proper conditions are for each of these interesting plants, it is apparent that exclusion of fires (wild or prescribed), cessation of timber cutting, and prevention of other disturbances associated with moderate use of the Barrens would favor shade tolerant shrubs and not the herbs and subshrubs (such as

golden-heather) that have aroused so much interest in the Pine Barren flora.

LITTLE, S. 1978. Fire effects in New Jersey's Pine Barrens. Frontiers 42:29-32. (R)

Location: General

Keywords: Succession; Species Susceptibility; Fire Frequency; Fire Intensity

Abstract: On upland sites, all of the various combinations of species occur on a wide variety of soils, so fire history has been more important in shaping the present-day forest than soil differences. Though the organic content and drainage has created differences in the vegetation of the pinelands and swamps here, too, fire has been the overriding factor in shaping both the lowlands and swamps.

LITTLE, S. 1979. The Pine Barrens of New Jersey. In R. L. Specht (ed.). Heathlands and related shrublands. Elsevier Press, Amsterdam. (In press). (R)

Location: General

Keywords: Fire History; Vegetative Composition; Upland Succession; Lowland Succession; Reproduction; Wood Production

Abstract: The present Pine Barrens vegetation has been shaped in large part by extensive wildfires and heavy cuttings, and locally by disturbance. Abandoned upland fields progress, in order of dominance, from grass to pine to oak, but the shrub layer develops slowly. Abandoned swamp sites, invaded by shrubs, Atlantic white cedar, or hardwoods, also tend toward hardwoods. Cutting may hasten succession toward hardwoods is both uplands and lowlands. Successional rates vary enormously: whereas an upland field may become a thicket of pine saplings in 15 years, leatherleaf shrubs may dominate a lowland spot for 50 years before trees begin to dominate. Different fire frequencies and intensities interrupt succession, thus accounting for most of the current variations in forest composition, and largely obscuring the effects of soil differences. In swamps, fire may favor the reproduction of white cedar or hardwoods; if fire consumes enough of the organic soil, quaking bogs, meadows, or leatherleaf areas may be favored. On uplands and lowlands, many pines are sprouts from old root crowns, or have recovered from the last fire by trunk sprouts. Fire kills oak stems more readily than pines, but most oaks sprout. Periodic wildfires at possibly forty-year intervals have produced oak-pine mixtures over extensive

areas of upland, while more frequent fires have created mixtures of pitch pine and shrub oaks, and the most frequent fires created the Pine Plains.

LITTLE, S. 1981. Implications from the growth of Pinus rigida and planted P. strobus in the Pine Plains of southern New Jersey. Bull. Torrey Bot. Club 108:85-94. (D)

Location: West Plains (17)

Keywords: Fire; Growth; Plains Development; Plains Maintenance; Soils

Abstract: In the Pine Plains of southern New Jersey, dominant P. rigida sprouts reached heights of 5 to 6 m at 50 years of age; in plots cleared of existing trees, P. rigida seedlings reached about the same height in 22 years, and planted P. strobus seedlings 5 to 9 m in 17 years. Results substantiate other studies that repeated wildfires, not soils, are the primary cause of the low stature of P. rigida in Plains areas, and that genetic composition of the P. rigida is a contributing factor. To maintain typical Plains sprouts less than 2 m tall, as well as many of the associated non-arborescent species, fires that kill back woody stems are needed at about 10-year intervals.

LITTLE, S. and J. P. ALLEN. 1952. Choosing suitable times for prescribed burning in southern New Jersey. U.S.D.A. For. Serv. N.E. For. Expt. Sta. Paper 51:1-7. (D)

LITTLE, S., J. P. ALLEN and E. B. MOORE. 1948. Controlled burning as a dual-purpose tool of forest management in New Jersey's Pine Region. Jour. For. 46:810-819. (R)

Location: General

Keywords: Applicable Sites; Methods; Management Practices

LITTLE, S., J. P. ALLEN and H. A. SOMES. 1948. More about the technique of prescribed burning. NE. For. Expt. Sta., U.S.D.A. For. Serv., Upper Darby, Pa. 4p. (R)

LITTLE, S., C. B. CRANMER and H. A. SOMES. 1958. Direct seeding of pitch pine in southern New Jersey. NE. For. Expt. Sta. Paper 111:1-14, U.S.D.A. For. Serv., Upper Darby, Pa. (D)

Location: Chatsworth (16); Penn State Forest (17); Speedwell (16)

Keywords: Pinus rigida; Germination; Seedbed Treatment

LITTLE, S. and A. N. LENTZ. 1952. Effects of forest fires on upland sites in the Pine Region of southern New Jersey. Rutgers Univ. Coll. Agr. Ext. Serv. Leaflet 100:1-8, New Brunswick, N. J. (R)

Location: General

Keywords: Growth; Fire Intensity; Fire Frequency; Pine Plains; Vegetative Composition

LITTLE, S., J. McCORMICK and J. W. ANDRESEN. 1970. A selected and annotated bibliography of pitch pine (Pinus rigida Mill.). NE. For. Expt. Sta., U.S.D.A. For. Serv., Upper Darby, Pa. 103p. (R)

LITTLE, S. and F. MERGEN. 1966. External and internal changes associated with basal-crook formation in pitch and shortleaf pines. For. Sci. 12:268-275.

Location: Burlington County

Keywords: Pinus rigida; Pinus echinata; Seedling Growth

Abstract: Successive sketches show changes in basal form of 10 Pinus rigida Mill. and 22 P. echinata Mill. seedlings through their first 6 years, or until the seedling died. Only two of the 21 seedlings surviving 6 years (one of each species) did not form a typical basal crook. Many seedlings formed incipient crooks during the first summer; others a year or more later. Shortleaf pines usually formed shorter crooks and in less time than pitch pines. Open-grown seedlings formed crooks in less time than shade-grown ones. Stem form continues to change for a period of 2 to 10 years. Changes in stem form can be explained on the basis of (1) weak stems, (2) usually upright direction of apical growth, and (3) formation of compression wood and eccentric growth rings. These wood features were clearly evident in stem sections. Sections also showed heterogeneous alignment of the wood fibers, but revealed no ruptures in cell walls or between growth rings.

LITTLE, S. and E. B. MOORE. 1945. Controlled burning in South Jersey's oak-pine stands. Forestry 43:499-506. (D)

Location: Lebanon State Forest (8,9)

Keywords: Fire; Pine Reproduction

Abstract: Data obtained in this study, combined with more extensive observations of controlled burning made throughout this section, suggest that prescribed burning in the form of light winter fires may be used advantageously in the oak-pine stands of New Jersey's pine region. The role of these fires seems to be partly in preparation of the seedbed for pine reproduction and later, when the seedling pines have reached 3 inches in diameter, in control of the hardwood element. This latter function appears to have a definite further value of so reducing the fuel accumulations as to lessen the danger of severe spring fires.

LITTLE, S. and E. B. MOORE. 1949. The ecological role of prescribed burns in the pine-oak forests of southern New Jersey. Ecology 30:223-233. (R)

Location: General

Keywords: Fire; Management; Reproduction; Succession

LITTLE, S. and E. B. MOORE. 1950. Effects of prescribed burns and shelterwood cutting on reproduction of shortleaf and pitch pine. NE. For. Expt. Sta. Paper 35, U.S.D.A. For. Serv., Upper Darby, Pa. (D)

LITTLE, S. and E. B. MOORE. 1952. Mechanical preparation of seedbeds for converting oak-pine stands to pine. Jour. For. 50:840-844. (D)

Location: Lebanon State Forest (8,9)

Keywords: Cutting Treatments; Slash Disposal; Mechanical Treatments; Seed Production; Seedbed Conditions; <u>Pinus rigida</u>; <u>Quercus</u>

LITTLE, S. and E. B. MOORE. 1953. Severe burning tested on lowland pine sites. NE. For. Expt. Sta. Paper 64:1-11, U.S.D.A. For. Serv., Upper Darby, Pa. (D)

Location: Not Given

Keywords: Prescribed Burning; Reproduction; Productivity

LITTLE, S., G. R. MOOREHEAD and H. A. SOMES. 1958. Forestry and deer in the pine region of New Jersey. NE. For. Expt. Sta. Paper 109:1-4, U.S.D.A. For. Serv., Upper Darby, Pa. (R)

LITTLE, S. and H. A. SOMES. 1949. Slash disposal in oak-pine

stands of southern New Jersey. NE. For. Expt. Sta. Paper 31:1-12, U.S.D.A. For. Serv., Upper Darby, Pa. (D)

Location: General

Keywords: Pine Reproduction; Prescribed Burn

LITTLE, S. and H. A. SOMES. 1951a. Deer browsing in New Jersey handicaps pine seedlings. NE. For. Expt. Sta. Res. Note 2:3-4, U.S.D.A. For. Serv., Upper Darby, Pa. (D)

LITTLE, S. and H. A. SOMES. 1951b. Age, origin and crown injuries effect growth of South Jersey pines. NE. For. Expt. Sta. Res. Note 8:1-4, U.S.D.A. For. Serv., Upper Darby, Pa. (D)

LITTLE, S. and H. A. SOMES. 1951c. No exceptional vigor found in hybrid pines tested. NE. For. Expt. Sta. Res. Note 10, U.S.D.A. For. Serv., Upper Darby, Pa. (D)

LITTLE, S. and H. A. SOMES. 1952. Poisoning hardwoods in southern New Jersey. NE. For. Expt. Sta. Res. Note 16:1-4, U.S.D.A. For. Serv., Upper Darby, Pa. (D)

LITTLE, S. and H. A. SOMES. 1956. Buds enable pitch and shortleaf pines to recover from injury. NE. For. Expt. Sta. Paper 81:1-14, U.S.D.A. For. Serv., Upper Darby, Pa. (D)

Location: General

Keywords: _Pinus rigida_; _Pinus echinata_

LITTLE, S. and H. A. SOMES. 1961. Prescribed burning in the Pine Regions of southern New Jersey and Eastern Shore Maryland - a summary of present knowledge. NE. For. Expt. Sta. Paper 151:1-21, U.S.D.A. For. Serv., Upper Darby, Pa. (R)

LITTLE, S. and H. A. SOMES. 1964a. Releasing pitch pine sprouts from old stools ineffective. Jour. For. 62:23-26. (D)

LITTLE, S. and H. A. SOMES. 1964b. Root systems of direct-seeded and variously planted loblolly, shortleaf and pitch pines. U.S.D.A. For. Serv. Res. Paper NE-26:1-13, N.E. For. Expt. Sta., Upper Darby, Pa. (D)

Location: Lebanon State Forest (8,9); Wharton State Forest (14,15,23,24)

Keywords: Pinus rigida; Pinus echinata; Pinus taeda; Root Growth

Abstract: A study was started in 1960 to compare the development of direct-seeded and planted pitch, shortleaf and loblolly pines in southern New Jersey. The planting included 1-0 and 2-0 stock; and center-hole, good-slit, and poor-slit planting. All seeds and seedlings of each species came from one lot of seed. The direct seeding and planting 1-0 stock were done in the spring of 1961; and 2-0 stock was put in 1 year later. In November 1962, one seedling from each plot (four for each species-treatment combination) was excavated to determine the early effects of establishment methods on root systems. Seedlings starting in place from direct seeding had normal root systems; taproots usually penetrated vertically; laterals grew away from taproots almost at right angles and on all sides. Seedlings planted in slits usually had one-plane root systems. Those in poor slits, which had been planted with J- , L- or U-shaped taproots, had reacted either by the new growth of the taproot turning abruptly downward, or by another root developing to replace the taproot. Seedlings planted in good slits exhibited much less distortion of root systems, but this method did not provide the spreading root systems of center-hole planting. In all planting methods, intertwined roots were found near the soil surface. This condition was especially conspicuous on stock planted in poor slits. Presumably some of these intertwined root will strangle each other to death and thus provide entry for wood-decaying fungi. Root systems of 1-0 stock showed much greater recovery from planting distortions than did those of 2-0 stock. In establishing plantations by planting, carefully planted 1-0 stock would seem to offer the most promise of developing into stands that would be relatively safe from root-rot damage. Whether they would be as resistant as stands from direct seeding is still an unresolved question.

LITTLE, S. and H. A. SOMES. 1965. Atlantic White-Cedar being eliminated by excessive animal damage in south Jersey. U.S.D.A. For. Serv. Res. Note NE-33:1-3, Upper Darby, Pa. (D)

Location: General

Keywords: Deer

LITTLE, S., H. A. SOMES and J. P. ALLEN. 1952. Choosing suitable times for prescribed burning in southern New Jersey. NE. For. Expt. Sta. Paper 51:1-7, U.S.D.A. For. Serv., Upper Darby, Pa. (D)

Location: General

Keywords: Weather

LLOYD, H. C. 1955. A preliminary report, the New Jersey Plains. Unpubl. ms. dated 28 Jan. 1955. Div. Parks Forests Recreation, N. J. Dept. Conserv. Econ. Develop., Trenton, N. J. (D)

LONG, B. 1909. Pinus serotina Michx. in southern New Jersey and other local notes. Bartonia 2:17-21. (D)

Location: Gloucester County; Salem County

Keywords: Pinus rigida; Pinus taeda; Andropogon elliottii; Psilocarya nitens; Scirpus spp.; Carex harpeii

LONG, B. 1911. Some results of recent field work in the Cape May Peninsula. Bartonia 4:14-19. (N)

LONG, B. 1928. Some noteworthy indigenous species new to the Philadelphia area. Bartonia 10:30-52. (D)

LULL, H. W. and J. H. AXLEY. 1958. Forest soil-moisture relations in the Coastal Plain sands of southern New Jersey. For. Sci. 4(1):2-19. (D)

Location: Lebanon State Forest (8,9)

Keywords: Evapotranspiration

Abstract: Soil moisture measurements during the growing season on upland sites in the New Jersey Pine Barrens indicated that stands of shortleaf pine and oak scrub used about the same amount of water at about the same rate from the upper five feet of soil. Both removed moisture to a depth of at least 12 feet, the lowest depth sampled. Evapotranspiration from 7 year old pine seedling - oak sprout stands was governed largly by the sprouts, which removed moisture as rapidly and from the same depth as older oak stands. A 15 year old stand of shortleaf pine saplings utilized moisture to a depth of 8 feet; this was about 4 feet less than depths utilized by the pine-pole and oak stands, indicating withdrawal of a smaller amount of moisture. Soil moisture evaporated from the bare area to a depth of 6 feet, the smallest depletion of soil moisture. In respect to water supply, this is of little practical

importance because bare areas do not occur naturally in this region. Within the 0- to 5-foot depth, soil moisture depletion proceeded simultaneously within each foot-depth and tended toward the same rate. During the period of record, 30% of moisutre removed came from the upper foot, 22% from the second foot, and 16% from each of the next three feet.

LUTZ, H. J. 1934a. Concerning a geologic explanation of the origin and present distribution of the New Jersey pine barren vegetation. Ecology 15:399-406. (R)

LUTZ, H. J. 1934b. Ecological relations in the pitch pine plains of southern New Jersey. Yale Univ. School Forestry Bull. 38:1-80. (D)

Location: General

Keywords: Geology; Soils; Fire; Nutrients

LYON, G. E. 1910. New Jersey forests and forestry. Forest Quarterly 8:450-461. (R)

MARTIN, G. W. 1929. Dinoflagellates from marine and brackish waters of New Jersey. Univ. Iowa Studies 12. (D)

MARUCCI, P. E. 1947. See ZOOLOGY citation.

MARUCCI, P. E. 1966. See ZOOLOGY citation.

MAY, F. E. 1976. Dinoflagellates: fossil motile - stage tests from the Upper Cretaceous of the northern New Jersey Coastal Plain. Science 193:1128-1130.

McCLENNEN, F. H. 1939. Further notes on seed productivity of chestnut oak in southern New Jersey. Allegheny For. Expt. Sta. Tech. Note 24:1-2, U.S.D.A. For. Serv., Upper Darby, Pa. (D)

McCORMICK, J. 1955. A vegetation inventory of two watersheds in the New Jersey Pine Barrens. Ph.D. Thesis, Rutgers Univ., New Brunswick, N. J. 126p. (D)

Location: MacDonalds Branch (8)

Keywords: Vegetation Complexes; Fire History

Abstract: The vegetation of two watersheds in the New Jersey Pine Barrens was found to be separable into at least 9 lowland and 8 upland communities. The lowland areas are occupied by 4 forest and 5 non-forest communities. The forest communities recognized are the cedar swamp, the hardwood swamp, the pine-transition, and the pine lowland types. Their canopies are comprised of various combinations of *Chamaecyparis thyoides*, *Pinus rigida*, *Acer rubrum var. trilobum*, *Nyssa sylvatica*, *Betula populifolia* and *Magnolia virginiana*. The most widespread of the eight upland forest communities are the pine - black oak - scrub oak and the oak - pine types. *Pinus rigida*, *P. echinata* and several arboreal species of oaks comprise the canopies of the upland forests. A comparison of the vegetation complexes of the two watersheds indicated a pronounced difference between them, especially in the upland portions of the areas. Approximately 76% of one watershed is occupied by predominantly pine communities. Over 60% of the other watershed is occupied by predominantly oak communities. Many features of the vegetation of the watersheds are related to the intensive exploitation and to the fire histories of the areas. It is suggested that the differences between the vegetation complexes of the watersheds are, at least in part, a reflection of differences in the fire histories of the watersheds.

McCORMICK, J. 1968a. A study of signifance of the Pine Barrens of New Jersey. Nat. Parks Serv., U. S. Dept. Interior, Washington, D. C. 75p. (D) (SEE McCormick, J. 1970 GENERAL REFERENCES Citation.)

McCORMICK, J. 1968b. Vegetation of the Wading River Ecosystem complex and adjacent areas, New Jersey Pine Barrens. Bull. N. J. Acad. Sci. 13:98. (A)

Location: Burlington County; Ocean County

Keywords: Vegetation Types; Areal Coverage

Abstract: A vegetation type survey was made on an area in Burlington and Ocean Counties, which included the region occupied by the 250 square mile Wading River Ecosystem complex. The WRE complex consists of the Wading River basin and those parts of Bass River, Tuckerton Creek, Westecunk Creek and Cedar Run basins situated west of the Garden State Parkway. Elevations in this Coastal Plain area range from 0 to 215 feet above mean sea level. Nine cover types were recognized. Brackish marsh, fresh marsh, swamp shrubs, southern white cedar swamp forests, red maple - black gum - sweetbay magnolia (hardwood) swamp forests, and pitch pine lowland forest were considered in low ground. In upland

areas, pine - blackjack oak, pine - oak, and oak - pine forest types were mapped. Survey traverses along roads and trails were made from March through August 1967. Typing for the Wharton Tract State Forest and Park was adapted from a map by James Cummins. Pine - blackjack oak vegetation, including the East and West Plains, formed 46% of the WRE complex. Pine - oak forests composed 7% and oak - pine forests composed 5% of the complex. The most extensive lowland ground type, the pitch pine lowland forest, covered 3% of the WRE area. White cedar forests and brackish marshes each occupied 1.5% of the area. Other low ground types have not been mapped in sufficient detail to permit estimation of their areas. Approximately 35% of the WRE area has not yet been typed owing to difficulty of access and to human activities. Air photographs and additional ground checks will be used to complete this study.

McCORMICK, J. 1970. See GENERAL REFERENCES citation.

McCORMICK, J. 1978. Vegetation of the Pine Barrens. Frontiers 42:22-28. (R)

Location: General

Keywords: Pine-Oak Forest; Oak-Pine Forest; Wetland Herb Communities; Wetland Shrub Communities; Wetland Forests; Species List; Vegetation Map

Abstract: Regardless of the inordinate cutting and largely because of the frequent fires, the vegetation of the New Jersey Pine Pine Barrens is unique in the world. Owing to this vegetation and to the area's sparse settlement, the Pine Barrens is of formidable significance as a natural open space and recreation source to the people of New Jersey, of the Eastern Seaboard's megapopulation and of the Nation.

McCORMICK, J. 1979a. The vegetation of the New Jersey Pine Barrens. Chapter 13 In R. T. T. Forman (ed.). Pine Barrens: ecosystem and landscape. Academic Press, New York. pp.229-243. (R)

Location: General

Keywords: Floristic Complexes; Fire; Lowlands; Uplands

Abstract: The vegetation of the Pine Barrens is composed of two relatively distinct floristic complexes, namely, lowlands on soil saturated for prolonged periods, and uplands with a water table generally >0.7 m (2 ft) below the soil surface. Lowland vegetation includes swamp forests and relatively small freshwater marshes. Although southern

white cedar forests are considered characteristic of the region, broadleaf swamp forests of trident red maple, blackgum, and sweetbay now are more widespread than white cedar forest. Upland vegetation includes two shrub types, i.e., the heath type, in which lowbush blueberry and black huckleberry are predominant, form a nearly continuous cover throughout the uplands, and the scrub oak type, in which scrub oak projects above the heaths. The upland canopy layer is divided into two broad groupings, depending on the relative abunadnce of pitch pine and several oak species (particularly chestnut, scarlet, white, black to the north, and southern red to the south). The (a) Pine-oak forest types are pine-blackjack oak, pine-post oak and pine-black oak; (b) the Oak-pine forest types are oak-pine, chestnut oak, and scarlet oak-shortleaf pine. Except for the chestnut oak forest with a depauperate heath undergrowth, the shrub and canopy layers appear to be distributed independently, producing at least eight combinations in the changing mosaic of the upland Pine Barrens vegetation.

McCORMICK, J. 1979b. Water, vegetation, fire and man in the Pine Barrens: vegetation of two watersheds in Lebanon State Forest, New Jersey, and a consideration of the origin and nature of the Pine Barrens. Prof. Paper 563-b, U. S. Geol. Surv., Washington, D. C. (D)

McCORMICK, J. and J. W. ANDRESEN. 1960a. Some effects of animals on the vegetation of the New Jersey Pine Barrens. Bull. Torrey Bot. Club 87:375-385. (D)

Location: Middle Branch and McDonald's Branch, Lebanon State Forest (8,9)

Keywords: Insects; Defoliation; Mammals

Abstract: Numerous examples of the direct influences exerted by animals on the vegetation of the Pine Barrens were noted during the course of studies in the West Plains (Andresen, 1959) and on Middle Branch and McDonald's Branch watersheds in Lebanon State Forest, Burlington and Ocean Counties, New Jersey. This paper contains data on each type of animal influence that was observed, but no attempt is made to list influences which have been cited by other authors. Neither is there any suggestion that the effects chronicled here are of equal importance. Some have a very minor impact on the regional vegetation; others have widespread and enduring impacts and may contribute significantly to the faunal control of vegetation.

McCORMICK, J. and J. W. ANDRESEN. 1960b. Infestations of pitch and shortleaf pines by the red pine sawfly in southern New Jersey. Amer. Museum Novitates 2032:1-6. (D)

McCORMICK, J. and J. W. ANDRESEN. 1963. The role of *Pinus virginiana* Mill. in the vegetation of southern New Jersey. N. J. Nature News 18:27-38. (D)

Location: Millville (35)

Keywords: Secondary Succession

Abstract: *Pinus virginiana*, the Virginia or scrub pine, is the potential old field forest tree on some 50,000 acres of the New Jersey Coastal Plain. Small, scattered stands occur from New Brunswick, Middlesex County, southwestardly in a narrow belt along the western margin of the Pine Barrens to Delaware Bay. In Cumberland County, between the cities of Bridgeton and Millville, the Virginia pine occupies several hundred acres of old farmland and is a conspicuous component of the vegetation of the region.

McCORMICK, J. and J. W. ANDRESEN. 1975. New Jersey Pine Barrens shrub cover: stable for 42 years. Bull. N. J. Acad. Sci. 20:18-19. (D)

Location: Lebanon State Forest (8,16)

Keywords: Wildfire; Species Composition; Upland Pine-Oak Forest

McCORMICK, J. and M. F. BUELL. 1957. Natural revegetation of a plowed field in the New Jersey pine barrens. Bot. Gaz. 118:261-264. (D)

Location: Mount Misery (8)

Keywords: Secondary Succession; Flora

Abstract: The vegetation on a formerly cultivated field in the New Jersey Pine Barrens was surveyed 5 and 13 months after abandonment. Both surveys indicated that *Panicum virgatum*, *P. capillare* and *Cyperus filiculmis* var. *macilentus* were the most important components of the vegetation. The second survey revealed 53 species not encountered in the first survey. The total vascular flora of the 1-acre field was found to consist of 113 species. This is an extremely diverse flora for an area of this size in the Pine Barrens.

McCORMICK, J. and M. F. BUELL. 1968. The Plains: pigmy forest of the New Jersey Pine Barrens, a review and annotated bibliography. Bull. N. J. Acad. Sci. 13:20-34. (R)

Location: Plains (17,26,27)

Keywords: Locations; Topography; Land Use; Geology; Map; Plains Vegetation Defined; Plains Development Hypotheses; Fire

Abstract: The loction, size, topography, land use, geology and soils and definition of Plains forest communities is presented, including a map of the Plains areas as mapped by Harshberger, and Lee and Millen. A historical review of proposed explanations for Plains vegetation development is presented along with an annotated bibliography of Plains literature.

McCORMICK, J. and L. JONES. 1973. The Pine Barrens vegetation geography. N. J. State Museum Res. Rept. 3:1-71, Trenton, N. J. (D)

Location: General

Keywords: Vegetation Maps

McCORMICK, J. et al. 1957. Resurveys of permanently marked quadrats following a severe wildfire in the New Jersey pine barrens. Ecol. Soc. Amer. Bull. 38:98. (A)

McNAMARA, J. H. 1976. Population biology of <u>Amphicarpum purshii</u> in the New Jersey Pine Barrens. M.S. Thesis, Rutgers University, New Brunswick, N.J. 32pp. (D)

Location: Atsion (24); Hampton Furnace (15); Cedar Bridge (17,18); Lacey Road (8,9)

Keywords: Peanutgrass; Soils; pH; Reproduction

Abstract: Five New Jersey populations of <u>Amphicarpum purshii</u> (an annual panicoid grass) were investigated as to total allocation of biomass to reproduction and its distribution between aerial chasmogamous and subterranean cleistogamous inflorescences. Germination of both types of seed was documented, for the first time, in not only the field but under three laboratory temperature regimes. Overall, approximately 29% of the biomass was allocated to reproduction. On a population basis, subterranean inflorescences accounted for 37 to 100% of the reproductive basis, and these seed (five times heavier but fewer in number) were the source of most surviving seedlings. Cleistogamous spikelets contained caryopses significantly more frequently than chasmogamous spikelets. The ratio of the number of viable aerial seed to the number of viable subterranean seed increased from 0/4 to 4/2 with recentness and/or frequency of disturbance. As the pioneer species in secondary succession, Amphicarpum purshii thus produces a larger subterranean propagule, with greater seedling vigor and a higher probability of local reproductive success, and also a smaller aerial propagule in larger numbers with potentially greater genetic variability.

McQUILKEN, W. E. 1935. Root development of pitch pine, with some comparative observations on shortleaf pine. Jour. Agr. Res. 51:983-1016. (D)

Location: Lebanon State Forest (8,9); Ockanickon Forest, Medford (6)

Keywords: Seedlings; Saplings; Secondary Branches; Lateral System; Mature Root Systems; Branch Origin; Heavy Soils; Absorption; Pinus rigida; Pinus echinata

Abstract: The root system of Pinus rigida was studied by the direct, dry method in the pine-barren section of New Jersey. It attains a moderately extensive development both vertically and horizontally. The basic plan consists of a taproot from which 15 to 30 horizontal branches originate and extend radially in the surface layers of soil. From these primary branches horizontal and vertical secondary branches develop; these in turn give off tertiary branches, and so on. Normally the root system occupies a roughly circular area of topsoil; in all of this area except the marginal parts it has extensive contacts with the subsoil through the development of vertical, or sinker, roots. Seedlings are predominantly taprooted. They reach depths varying from 3-12 inches during the first season of growth. The taproots of seedlings 4-5 years old reach depths of 15-24 inches, and the strongest laterals approximate the same length. Plants of this age are semidecumbent; a permanent crook persists at the ground line long after they have become rigidly erect. The taproots of plants 8-9 years old reach depths of 1.5-2.5 feet, and the strongest laterals approximate the same length. Plants of this age usually are erect. Saplings 12 years of age are beginning to display regular whorls of stem branches, and are assuming the aspect of a tree. Taproots reach depths of 3-4 feet, and the strongest laterals extend 6-8 feet. (In mature trees) lateral roots function mechanically as props or braces, and only incidentally as guy wires. Thickening is stimulated by compression, and not by tensile strain. This is conclusively demonstrated by the eccentric development of the root systems of leaning trees. Poor development of tops is associated with inferior root systems. Replacement tips develop following the death of the terminal portion of a

root only when death has not extended back into the region where secondary wood completely encircles the primary xylem. Pitch pine is capable of extensive root growth below the water table in saturated soils. The descending branches of taproots under water sometimes are arranged in a peculiar and characteristic fan-shaped mass, the explanation of which is obscure. Trees growing on saturated soils appear to be in full health and vigor. On sloping sites, the primary lateral branches generally parallel the soil surface, both uphill and downhill. On heavier soils, root development tends to be less extensive, both horizontally and vertically, than it is in the sandy soils of the Coastal Plain. Root fusions occur occasionally, on both _Pinus rigida_ and _P. echinata_, between roots of the same or of different systems. The fine roots of the higher orders, through which most absorption presumably occurs, are most profusely developed in the upper soil layers, and frequently extend into the raw surface humus. The ultimate branches of vertical roots are generally coarser and are produced in much less profusion. Nearly all root tips become dormant, and many die, during the dry periods of midsummer. Growth takes place mostly in spring and fall. Mycorrhizae are a conspicuous feature of pitch pine roots. Their period of growth coincides with that of nonmycorrhizal tips. They are found at all depths on both drained and saturated soils, but attain their greatest profusion in the surface organic layer. With respect to adaptations to xeric sites, the root systems of pitch pine show no apparent superiority over those of many other species of trees.

McQUILKEN, W. E. and S. LITTLE. 1952. Deer repellent fails to protect pine seedlings. NE. For. Expt. Sta. Res. Note 15:1-4, U.S.D.A. For. Serv., Upper Darby, Pa. (D)

MEIER, F. R. 1903. Forest fires in New Jersey during 1902. Ann. Rept. State Geol. 1902:99-107, N. J. Geol. Serv., Trenton, N. J. (D)

MEIER, F. R. 1904. Forest fires in New Jersey during 1903. Ann. Rept. State Geol. 1903:47-71, N. J. Geol. Surv., Trenton, N. J. (D)

MEIER, F. R. 1905. Forest fires in New Jersey during 1904. Ann. Rept. State Geol. 1904:275-289, N. J. Geol. Surv., Trenton, N. J. (D)

MIRICK, S. M. and J. A. QUINN. 1976. Pollination in _Gaultheria procumbens_. Bull. N. J. Acad. Sci. 21:21. (A)

Location: Not given

Keywords: _Bombus_; Seed Production

Abstract: Pollination mechanisms in _Gaultheria procumbens_ were studied at three sites in the New Jersey Pine Barrens. Pollinator exclusion methods produced no appreciable difference in seed set between experimental plants and controls at all three sites, indicating that _G. procumbens_ is autogamous. However, insect visitors were common. Captured individuals belong almost exclusively to the genus _Bombus_. Bee species identification will be presented as well as an analysis of pollen loads. In general, at least under prevailing conditions at the study sites, the number of fruits produced in the fall comprise a small percentage of buds set in the spring.

MITCHELL, J. G. 1977. Its not so barren in the pines. Sierra Club Bull. 62(7):4-5,26-27. (N)

MOLDENKE, H. N. 1935. A list of plants observed at and near The Pines, Branchville, N. J., during the Branchville Nature Conference, May 24-26, 1935. (Privately printed, no address given) (N)

MONTGOMERY, J. 1961. Comparative floristic study of two New Jersey bogs. Bull. N. J. Acad. Sci. 6:13. (A)

Location: Bennett Bog (43,44)

Keywords: Ericads; Vegetative Distribution

Abstract: A comparative floristic study of two bogs in the state of New Jersey was made with the emphasis on the geographical affinities of the bog flora. Bennett Bog, in Cape May County, is an example of a southern type bog; Uttertown Bog, in Passaic County, is an example of a northern type bog. The two bogs differ as to geology, glacial history and soils. The flora of the two bogs was found to be nearly distinct. Bennett Bog is a bog of grasses and sedges and composites, while Uttertown Bog is a bog of ericaceous plants and sedges. Several plants reach their northern limit at Bennett Bog, other species of the bog reach their northern limit of the New Jersey Pine Barrens. Several northern species approach their southern geographical limit in the latitude of northern New Jersey. Thus we have in two bogs, located 150 miles from each other, southern plants reaching their northern limit in bogs in southern New Jersey and northern plants reaching their southern limit in bogs in northern New Jersey.

MONTGOMERY, J. D. 1963. Flora of the Bennett Bog Wildlife Sanctuary, N.J. N.J. Nature News 18:111-124. (D)

Location: Bennett Bog (43,44)

MOORE, E. B. 1936. Seedling-sprout growth of shortleaf and pitch pine in New Jersey. Jour. For. 34:879-882. (D)

Location: (Inferred) Lebanon State Forest (8,9); Wharton State Forest (14,15,16,17,23,24,25,26)

Keywords: Reproduction; Fire; Clear-cutting; Management

MOORE, E. B. 1939. Forest management in New Jersey. N. J. Dept. Conserv. Develop., Trenton, N. J. (N)

MOORE, E. B. 1940. Forest and wildlife management in South Jersey Pine Barrens. Jour. For. 38:27-30. (D)

MOORE, E. B. 1943. Practical forestry in New Jersey. N. J. Dept. Conserv. Develop., Trenton, N. J. (N)

MOORE, E. B. and A. F. WALDRON. 1938. Southern white cedar. Div. Forests Parks, N. J. Dept. Conserv. Develop., Trenton, N. J. 4p. (R)

MOORE, E. B. and A. F. WALDRON. 1940a. A comparison of the growth of oak and pine in southern New Jersey. Tech. Note 10:1-6, Div. Parks Forests, N. J. Dept. Conserv. Develop., Trenton, N. J. (D)

MOORE, E. B. and A. F. WALDRON. 1940b. Growth studies of southern white cedar in New Jersey. Jour. For. 38:568-572. (D)

Location: Lebanon State Forest (8,9)

Keywords: Site Quality; Thinning; Mortality; Economic Aspects; Chamaecyparis thyoides

MOORE, E. B., G. E. SMITH and S. LITTLE. 1955. Wildfire damage reduced on prescribe-burned areas in New Jersey. Jour. For. 53:339-341. (D)

MOORE, E. B. et al. 1942. Forest fuel types of New Jersey.

Allegheny For. Expt. Sta., U.S.D.A. For. Serv., Upper Darby, Pa. 56p. (D)

MOUL, E. T. and H. F. BUELL. 1979. Algae of the Pine Barrens. Chapter 24 _In_ Forman, R. T. T. (ed.). Pine Barrens: ecosystem and landscape. Academic Press, New York. pp.425-440. (R)

Location: General

Keywords: Habitats; Ecology; Flora; Species Key; Chlorophyta; Euglenophyta; Chrysophyta; _Sphagnum_

Abstract: The composition of the algal flora is strongly linked to the acid waters of three major habitat types present in the New Jersey Pine Barrens, i.e., slowly moving streams, ponds and lakes with dams, and poorly drained lowlands with _Sphagnum_ moss present. Green algae are common and well represented by an abundance of desmids, plus other members of the Zygnematales. Yellow-green algae, particularly diatoms, are abundant. Euglenoids are common, and of the red algae, _Batrachospermum_ species and _Audouinella_ are present. In species number and biomass, blue-green are unimportant. A list of all of the 360 known algal taxa is given, together with available information on sites of collections, habitats, seasonality and abundance of each species.

MOUL, E. T. and M. F. BUELL. 1955. Moss cover and rainfall interception in frequently burned sites in the New Jersey Pine Barrens. Bull. Torrey Bot. Club 82:155-162. (D)

Location: Mt. Misery, Lebanon State Forest (8)

Keywords: Prescribed Burning; Bryophytes; Lichens; Water Relations

Abstract: Prescribed burning, while removing the litter layer, favors development of a bryophyte-lichen layer. This layer may cover as much as 48% of the ground. Three species of turf type represent 98% of the moss cover, one species of cushion type little over 1%, and three species of mat type cover about 0.5%. Lichens cover nearly as much area as bryophytes. Under laboratory conditions, well developed moss mats of the kind studied when air dried may absorb an average of 0.62 inches of rainfall, ranging from 0.52 (_Dicranum_) to 0.68 (_Ceratodon_ and _Leucobryum_). Well developed lichen mats may absorb from 0.15 inches to 0.28 inches depending on the species. Assuming the mosses dry out completely between storms, they may intercept as much as 50% of the throughfall where they occur. Lichens may intercept about half as much as the mosses. As an

interceptor of precipitation, the bryophyte layer, even at its maximum, is, on an area basis, probably never as important as the thick, continuous litter layer of areas not subjected to prescribed burning.

MUNTZ, J. P. 1959. The changing geography of the New Jersey woodlands, 1600-1900. Ph.D. Thesis, Rutgers Univ., New Brunswick, N. J. 287p. (D) OLSSON, H. 1976. A phytosociological classification of the New Jersey Pine Barrens. Bull. N. J. Acad. Sci. 21:18. (A)

Location: New Lisbon (7); Browns Mills (8); Whiting (9); East Plains (26,27)

Keywords: Floristic Composition; Habitats

Abstract: Within the area defined by New Lisbon, Browns Mills, Whiting and East Plains the vegetation has been classified into plant communities with respect to floristic composition and habitat, e.g. microclimate, soil and nutrients. Forests occupy a main part of the area studied, 26 stands. Pine- and oak forests occur in drier sites with distinct podzols or disturbed soil profiles due to fire effects and fluctuations in the water table. In a Pinus rigida - Quercus ilicifolia community temperature, light and humidity can be 90F, 800 ft-c and 75% respectively on the ground in summer. The heliophilous Cladonia caroliniana - Breweria pickeringii community shows 110F, 12,000 ft-c and 40% respectively. Cedar swamps, red maple swamps with Nyssa sylvatica and sweet gum stands growing on richer soils are found in wet and moist habitats. In contrast to the closed cedar swamps poor in species, lumbered sites, wood edges and seep, adjacent to thickets, include a large number of species. In periodically inundated places Sphagnum pulibrum and S. tenellum are reported. The natural bogs often with a homogeneous vegetation of Chamaedaphne calyculata differ from the artifical cranberry bogs containing several plant communities due to water gradients and stages of succession in the abandoned fields. The vegetation of the dikes is favored by regular cutting. A Polygala lutea - Habenaria blephariglottis community occurs in disturbed sites, where Sphagnum compactum and S. strictum are preserving the soil moisture. Old fields, wheel-tracks and roadsides are examples of very unstable habitats, often rich in species. Diodea teres and Aristida spp. are found in the driest places.

OLSSON, H. 1979. Vegetation of the New Jersey Pine Barrens: a phytosociological classification. Chapter 14 In Forman, R. T. T. (ed.). Pine Barrens: ecosystem and landscape. Academic Press, New York. pp.245-263. (R)

Location: General

Keywords: Forests; Thicket-bogs; Marsh-sod; Stream-pond; Floristics; Releves

Abstract: The vegetation of the New Jersey Pine Barrens was analyzed using European phytosociological methods to show the floristic diversity of, and the relationships within, the vegetational pattern. Trees, shrubs, herbs, bryophytes, and lichens sampled in 247 releves formed the basis of a hierarchial classification. Six major vegetation types, (1) pine-oak forest, (2) white cedar-red maple swamp, (3) thicket-bog, (4) marsh-sod, (5) stream-pond, and (6) old field (including roadsides), comprised 19 distinct vegetational entities. Fifty-one finer subdivisions of the vegetational entities were delineated. Human activities, including drainage and the development of lakes, roads, sand and turf removal, abandoned agriculture, and cranberry bog development, are responsible mainly or entirely for a third of the types of vegetation at all three levels of classification. Human-caused fires, fire control, and cutting are significant in several additional types. The number of plant species in most open unstable environments exceeds that in closed shady sites.

OLSVIG, L. S. 1980. A comparative study of northeastern Pine Barrens vegetation. Ph.D. Thesis, Cornell Univ., Ithaca, N.Y. 479p. (D)

Location: General

Keywords: Ordination; Productivity Analysis; Nutrients; Fire; Genetics; Drought

OLSVIG, L. S., J. F. CRYAN and R. H. WHITTAKER. 1979. Vegetational gradients of the Pine Plains and Barrens of Long Island, New York. Chapter 15 <u>In</u> Forman, R. T. T. (ed.). Pine Barrens: ecosystem and landscape. Academic Press, New York. p.265-282. (R)

Location: Westhampton, Long Island, New York

Keywords: Ordination; Soils; Vegetative Compositions; Disturbances; Plains; Uplands; Lowlands

Abstract: The relationship of the Long Island pine plains, a forest of dwarf pitch pine (<u>Pinus rigida</u>), to surrounding pine barrens communities and to the New Jersey Pine Plains is examined. Three ordination techniques were applied to vegetation samples from 42 Long Island and three New Jersey stands. Soil texture and nutrients were measured, and degree of disturbance was estimated. The sample Long Island

communities relate to one another along a primary vegetational gradient from oak-pine forests through pine barrens (pine forests with shrub oak and heath undergrowth) and transitional scrub (dominated by scrub oak <u>Quercus ilicifolia</u>) to pine plains. Along this primary gradient, soil nutrient content and the percentage of silt and clay decrease. A secondary vegetational gradient leads from the pine plains to heaths (dominated by vaccinioid heath shrubs about 0.5 m tall) and is correlated with increasing disturbance. The New Jersey Pine Plains appear more mesic and less disturbed than the Long Island Pine Plains. The Long Island pine plains are interpreted as a distinctive plant community adapted to a combination of interrelated environmental factors, including soil texture, drought stress, low soil fertility and frequent fire.

PATRICK, R., B. MATSON and L. ANDERSON. 1979. See HYDROLOGY citation.

PEEL, B. A. 1980. See GENERAL REFERENCES citation.

PETERS, J. E. 1893. Notes on the flora of southern New Jersey. Bull. Torrey Bot. Club 20:294-295. (D)

Location: Atlantic County (23,24,30,31,32,33,34,36,37, 38,39,40,41,43,44,45)

PETERSON, G. A. 1949. Keys to the herbaceous dicotyledons of New Jersey: based on vegetation structure. Ph.D. Thesis, Rutgers Univ., New Brunswick, N. J. p. (D)

PHILLIPS, J. J. 1963. Advance reproduction under mature oak stands of the New Jersey coastal plain. U.S.D.A. For. Serv. Res. Note NE-4:1-5. (D)

PINCHOT, G. 1899a. A study of forest fires and wood production in southern New Jersey. Ann. Rept. State Geol. 1898:1-102 (Appendix), N.J. Geol. Surv., Trenton, N.J. (D)

PINCHOT, G. 1899b. The relation between forestry and geology in New Jersey. Ann. Rept. State Geol. 1899: Rept. on Forests pp.103-172, Trenton, N.J. (D)

PINCHOT, G. 1900. The Plains. Ann. Rept. State Geol. 1899:125-130, N.J. Geol. Surv., Trenton, N.J. (R)

PINELANDS COMMISSION. 1980. See GENERAL REFERENCES citation.

PINELANDS ENVIRONMENTAL COUNCIL. 1974. See GENERAL REFERENCES citation.

PINELANDS ENVIRONMENTAL COUNCIL. 1975. See GENERAL REFERENCES citation.

PITT, D. T., C. S. BECKWITH and C. J. GRANT. 1933. A survey of the cranberry and blueberry industries in New Jersey. Circ. 232:1-34, N.J. Dept. Agr., Trenton, N.J. (R)

POTZGER, J. E. 1945. The Pine Barrens of New Jersey, a refugium during Pleistocene times. Butler Univ. Bot. Studies 7:1-15. (D)

POTZGER, J. E. 1952. What can be inferred from pollen profiles in the New Jersey Pine Barrens. Bartonia 26:20-27. (D)

Location: Bidwell Marsh (42); North Branch Bog (8); Tuckerton (35);

Keywords: Peat; Bog Forests; Succession; Plant Distributions; Geologic History

PRICE, T. P. 1895. Short sketch of a forest fire. Forester 1:60-61. (N)

PRICE, T. P. 1907. Report of state fire warden. 2nd Ann. Rept. 1906:19-21, Forest Park Reservation Commission, Trenton, N.J. (R)

PRICE, T. P. 1908. Report of state fire warden. 3rd Ann. Rept. 1907:49-74, Forest Park Reservation Commission, Trenton, N.J. (R)

PRICE, T. P. 1909. Report of forest fire service. 4th Ann. Rept. 1908:42-54, Forest Parks Reservation Commission, Trenton, N.J. (R)

PURVIS, E. R. 1964. Crop production on high water table soils of the New Jersey Pine Barrens. N.J. Agr. Expt. Sta. Bull. 806:1-15, New Brunswick, N.J. (D)

RACHELE, J. D. 1976. Palynology of the Legler lignite: a deposit in the Tertiary Cohansey Formation of New Jersey, U.S.A. Rev. Palaeobot. Palynol. 22:225-252. (D)

Location: Legler (4)

Keywords: Kirkwood Formation; Beacon Hill Formation; Bridgeton Formation; Pensauken Formation; Cape May Formation; Vegetation; Climate; Physiography; Lithology

Abstract: Six measured sections of lignite and related sediments of the Cohansey formation were studied palynologically reconstructing the vegetation and environment of the time of deposition and ascertaining the age of the deposit. Sections were exposed in a pit located at Legler, New Jersey, approximately 3.2 km north of Lakehurst. This is the first reported study of pollen of this formation. Pollen and spores of 40 taxa, consisting of 5 cryptograms, 4 gymnosperms and 31 angiosperms were encountered in the lignite. Quercus and associates, Gordonia, Rosaceae, Ilex and Clethra, form the lowermost stratigraphic assemblage. A middle assemblage consists of Quercus-Nyssa in association with the Ericaceae and Polypodiaceae; Quercus-Pinus makes up the uppermost assemblage. Several, now predominantly warm-temperate to tropical genera, for example, Cyrilla, Jussiaea, Englehardia, Gordonia and Cyathea, are also represented. Dinoflagellates in the upper portions of the sections indicate a transitory estuarine setting. The dominant vegetation of Quercus, Pinus, Carya and the warm-temperate genera, depict a climate generally warmer and wetter than at present. Pollen assemblages reflect a local environment that was subject to marine transgression and subsequent regression. The age of the deposit is believed to be late Miocene or early Pliocene.

REASONER, A. 1940. Jersey bogs yield sphagnum moss. Penn Farmer (November 16). 5p. (N)

REDFIELD, J. H. 1869a. On the occurrence of Corema conradii in New Jersey. Proc. Acad. Nat. Sci. Philadelphia 21:91-92. (D)

Location: Cedar Bridge (18)

REDFIELD, J. H. 1869b. Corema conradii (Torrey). Amer. Nat. 3:327-328. (D)

Location: Cedar Bridge (18); Pemberton (7)

REDFIELD, J. H. 1869c. Note on the first discovery of Schizaea pusilla. Proc. Acad. Philadelphia 21:13. (D)

Location: Quaker Bridge (24)

REDFIELD, J. H. 1876. Dr. Torrey's first trip to the Pines. Bull. Torrey Bot. Club 6:82-84. (N)

Location: Quaker Bridge (24)

Keywords: Schizaea

REDFIELD, J. H. 1884. Corema conradii and its localities. Bull. Torrey Bot. Club 11:97-101. (D)

Location: Pemberton Mills (7); Cedar Bridge (18); Plains (17,26,27)

Keywords: Empetrum; Pinus rigida

REDFIELD, J. H. 1889a. Notes on Corema conradii. Proc. Acad. Nat. Sci. Philadelphia 41:135-136. (D)

Location: General; Plains (17,26,27)

Keywords: Pinus rigida

REDFIELD, J. H. 1889b. Corema in New Jersey. Bull. Torrey Bot. Club 16:193-195. (D).

Location: West Plains (17)

Keywords: Corema conradii; Pinus rigida; Quercus ilicifolia; Arctostaphylos uva-ursi; Pyxidanthera

REDFIELD, R. W. 1961. Flowering plants of New Jersey: Pyxie (Pyxidanthera barbulata). N. J. Nature News 16:29. (N)

REDFIELD, R. W. 1962. The ferns of New Jersey: Curly Grass Fern (Schizaea pusilla). N. J. Nature News 17:120. (N)

REDFIELD, R. W. 1963. Flowering plants of New Jersey: Arethusa (Arethusa bulbosa). N. J. Nature News 18:158. (N)

REDFIELD, R. W. 1964. Flowering plants of New Jersey: Swamp Pink (Helonias bullata). N. J. Nature News 19:145. (N)

REDFIELD, R. W. 1965. Flowering plants of New Jersey: Spreading Pogonia (*Cleistes divaricata*). N. J. Nature News 20:20. (N)

REIFSNYDER, W. E. and J. W. LULL. 1965. Radiant energy in relation to forests. U.S.D.A. Tech. Bull. 1344, Washington, D.C. (D)

RENLUND, R. N. 1950. Aquatic vegetation of some New Jersey freshwater lakes. Lakes and Ponds:165-171, N.J. Fisheries Surv. Rept. 1, Trenton, N.J. (D)

Location: Colliers Mills (3)

Keywords: Flora

REYNOLDS, P. A., K. A. GIGLIELLO, T. W. FROMM, K. G. CARLSON, R. J. KAMINSKI and M. K. REYNOLDS. 1978. Nutrient biomass for the tree stratum of New Jersey Pine Barrens hardwood swamp. Plant Physiol. 61(Supplement 4):79.

Location: Pomona (39)

Keywords: *Acer rubrum*; *Chamaecyparis thyoides*; Minerals

RIEMER, D. N. and S. J. TOTH. 1968. A survey of the chemical composition of aquatic plants in New Jersey. N.J. Agr. Expt. Sta. Bull. 820:1-14, New Brunswick, N.J. (D)

Location: Tom's River (11); Chatsworth (16); Cape May (51)

Keywords: Water Chemistry

RIGGS, G. B. 1940a. The development of sphagnum bogs in North America. Bot. Rev. 6:666-693. (R)

Location: Buckingham (9); Ong's Hat (8); Forked River (18,19)

Keywords: pH; Flora; Peat; Convex Bogs; Flat Bogs

RIGGS, G. B. 1940b. Comparisons of the development of some sphagnum bogs of the Atlantic Coast, the interior, and the Pacific Coast. Amer. Jour. Bot. 27:1-14. (D)

Location: Buckingham (9); Ong's Hat (8); Forked River

(18,19)

Keywords: Chamaecyparis; Vaccinium; Kalmia; Peat Cores

RIGGS, G. B. 1951. The development of sphagnum bogs in North America. II. Bot. Rev. 17:109-132. (R)

Location: General

Keywords: pH; Flora; Peat; Habitats; Convex Bogs; Flat Bogs; Chamaecyparis

ROBICHAUD, B. 1971. Diversity in vegetation of New Jersey. Ph.D. Thesis, Rutgers Univ., New Brunswick, N.J. (D)

ROBICHAUD, B. and M. F. BUELL. 1973. See GENERAL REFERENCES citation.

RUE, L. L. 1964. New Jersey out-of-doors: a history of its flora and fauna. Hicks Printing, N.J. (N)

SAUNDERS, C. F. 1898. Some Pine Barrens Carices. Asa Gray Bull. 6. (R)

SAUNDERS, C. F. 1900a. New Jersey Pine Barrens in July. Plant World 3:1-4. (N)

SAUNDERS, C. F. 1900b. The Pine Barrens of New Jersey. Proc. Acad. Nat. Sci. Philadelphia 52:544-549. (R)

Location: General

Keywords: Flora; Plains; Species Distributions

SAWHILL, G. S. 1977. The effect of the spray irrigation of secondary treated effluent on the vegetation, soils and groundwater quality in a New Jersey Pine Barrens habitat. Ph.D. Dissertation, Rutgers University, New Brunswick, N.J. 182pp. (D)

Location: Stockton State College, Pomona (39)

Keywords: Pine-Oak Forest; Soil Chemistry; Vegetation Composition

Abstract: The chemical and physiochemical characteristics of effluent, groundwater, soils and vegetation of the Stockton State College spray disposal system and control area at Pomona, New Jersey were monitored to evaluate the physical and chemical capabilities of the sandy soils of the pine barrens region to renovate secondary treated effluent. The area is characterized by a pine-oak ecosystem, continential climate with prevailing land and sea breezes, and acid, sandy soils. Initial construction errors resulted in the removal of vegetation in the irrigation area and the application of a portion of the effluent to an area with a seasonally high water table approaching the surface. Seasonal samples of effluent and groundwater were collected from October 1973 to June 1975. Monthly effluent applications averaged 21.3 ha-cm/ha (8.3 ac-in/A). With the exception of Si and Ni, the monitored chemical constituents in the effluent showed significant seasonal variations. The electrical conductivity, pH and the concentrations of Ca, Mg, K, Na, NH4(N), NO3(N), Cl, and SO4 were significantly higher in the renovated groundwater than in the groundwater of the control area. Average NO3(N) concentrations of the renovated water showed dramatic increases over those of the groundwater in the control areas and exceeded EPA standards for potable water. Vegetation samples were collected during the winter and summer of 1974. The developing flora of the laterals was primarily composed of species not normally associated with the previously undisturbed pine-oak, oak-pine woodland communities. Significant increases, as the result of treatment, in the percentage of total N, crude protein, Ca, Mg, Na, K, P, Cl and Cu were noted in both the winter and summer vegetation. Soil samples analyzed for physical and chemical properties showed an increase in the base saturation, a significant increase in sand at a profile depth of 0 to 8 cm (0-3.2 in) and clay at a profile depth of 12 to 25 cm (4.7 to 9.8 in), and a significant decrease in the hydraulic conductivity at a profile depth of 12 to 25 cm (4.7 to 9.8 in). Cations principally responsible for the increased base saturation of the treated soils were Na and Ca. Groundwater levels were not significantly affected by effluent applications.

SCHWEITZER, D. F., T. M. PELCZAR and R. W. FREDRICKSON. 1972. Post-fire recovery in the New Jersey Pine Barrens. Amer. Jour. Bot. 59:677. (A)

Location: Not Given

Keywords: <u>Vaccinium vacillans</u>; <u>Gaylussacia frondosa</u>; <u>Pinus rigida</u>; <u>Quercus coccinea</u>; <u>Quercus velutina</u>

Abstract: First-season recovery after a fire was studied in a pine-oak association in the Pine Barrens of New Jersey. This stand has a known fire history. Quadrats and transects were used to determine survival rates for various plants and

the manner in which survival occurred. Analysis of shrubs shows that the blueberry (Vaccinium vacillans) sprouts relatively more vigorously than the huckleberry (Gaylussacia baccata) or dangleberry (Gaylussacia frondosa), the only other major understory species. Data in the literature indicate that blueberry declines in importance more rapidly than the others as the New Jersey Pine Barren forests mature. Thus, blueberry seems to be essentially an early successional species in the region. Among the trees, virtually all hardwoods had been killed to the ground and had sprouted back from the base or root. Most pines were damaged but sprouting anew either from the base, trunk, or limbs, or two or all three sources. However, a considerable number escaped injury althogether, and others were completely killed. Pitch pine (Pinus rigida) was the only woody plant found reproducing by seed. It is believed to be largely fire dependent in this area, as it does not seem to persist well in more mature stands. It has been suggested in the literature that the potential climax species for the region would be scarlet oak (Quercus coccinea) or black oak (Quercus velutina). However, frequent fires maintain a perpetual disclimax. Nonwoody plants were not important on the study area.

SEIFRITZ, W. 1953. The oecology of thicket formation. Vegetatio 4:155-164. (N)

Location: Plains (17,26,27)

Keywords: Wind; Krumholtz

Abstract: Descriptions and discussion of nine dwarfed plant communities, including the New Jersey Pine Plains. Concluded that there is one climatic factor common to all nine of these communities, and that that factor, dessicating wind, is responsible for the development and continued maintenance of these krumholtz communities by the repeated killing back of new growing tips of shoots.

SMALL, J. A. 1937. Joint trip of the Southern Appalachian Botanical Club and the Torrey Botanical Club in southern New Jersey, June 17-20, 1937. Castanea 2:88-93. (N)

SMALL, J. A. 1952. The Pine Barrens of New Jersey. Bartonia 26:19. (N)

SMALL, J. A. 1959. Guest editorial: The New Jersey Pine Region. Bull. N. J. Acad. Sci. 4:1. (N)

SMITH, A. P. 1972. Survival and seed production of transplants of _Dionaea muscipula_ in the New Jersey Pine Barrens. Bull. Torrey Bot. Club 99:145-146. (D)

Location: Oceanville (40)

Keywords: _Sarracenia purpurea_; _Vaccinium macrocarpon_

Abstract: Transplants (and/or their descendants) of _Dionaea muscipula_ (Venus fly trap) have survived for at least 22 years and have produced viable seed in the New Jersey Pine Barrens in a bog approximately 528 km north of the species' natural northern limit.

SNYDER, D. B. and V. E. VIVIAN. 1981. Rare and endangered vascular plant species in New Jersey. Conserv. Environ. Studies Center, Browns Mills, N. J. 98pp. (D)

SOMES, H. A. 1951. Cost of prescribed burning continues to go down. NE. For. Expt. Sta. Res. Note 2:1-4, U.S.D.A. For. Serv., Upper Darby, Pa. (D)

SOMES, H. A. and G. R. MOOREHEAD. 1950. Prescribed burning does not reduce yield from oak-pine stands of southern New Jersey. NE. For. Expt. Sta. Paper 36:1-19, U.S.D.A. For. Serv., Upper Darby, Pa. (D)

SOMES, H. A. and G. R. MOOREHEAD. 1954. Do thinning and prescribed burning affect the growth of shortleaf pine? NE. For. Expt. Sta. For. Res. Note 34:1-2, U.S.D.A. For. Serv., Upper Darby, Pa. (D)

STEBBINS, G. L., E. B. MATZKE and C. EPLING. 1947. Hybridization in a population of _Quercus marilandica_ and _Quercus ilicifolia_. Evolution 1:79-88. (D)

Location: Plains (17,26,27); Lakehurst (4)

Keywords: Morphology; Population Differentiation

Abstract: Population samples of _Quercus marilandica_ and _Q. ilicifolia_, gathered at Lakehurst, N.J., were compared with herbarium sheets of these two species collected for most part outside of the region of their geographical and ecological overlap. The following characters especially were studied: leaf width, number of veins on lower part of leaf, character of leaf base, pubescence of under surface of leaves, length of mature terminal buds of adult twigs, and depth of acorn cups. Hybrid indices were computed; the

Cliffwood material had the same general range of scores as the standard of Q. marilandica; in the Lakehurst population approximately 37% of the individuals collected were Q. marilandica, approximately 28% were Q. ilicifolia, and the remainder showed varying degrees of intermediacy, the gene flow in this particular sampling being predominantly from Q. ilicifolia into Q. marilandica.

STEPHENSON, S. N. 1963. Vegetation change on upland sites in the Pine Barrens of New Jersey. Bull. N. J. Acad. Sci. 8:30-31. (A)

Location: Lebanon State Forest (8,9)

Keywords: Shrub; Community Compositions

Abstract: Permanent vegetation sampling units have been established in Lebanon State Forest, New Jersey. The sample sites were established in 1951 and a vegetation survey finished in 1953. A resurvey of the upland sites was conducted in 1962 with the purpose of comparing data derived from the two surveys. Before valid comparisons could be made, however, comparability of the two independently conducted surveys had to be demonstrated. Accordingly, replicate sampling was conducted during the resurvey, with results illustrating the method of sampling repeatable. Comparisons of data from the two surveys indicate the major vegetation change as taking place in the shrub stratum.

STEPHENSON, S. N. 1965a. Structure and development of the New Jersey Pine Barrens heath synusia. Bull. N. J. Acad. Sci. 10:33. (A)

Location: Not given

Keywords: Shrubs; Post-fire Revegetation; Gaylussacia baccata; Vaccinium vacillans

Abstract: Past studies in the New Jersey pine barrens have raised a number of questions dealing with the distribution and development of the low shrub stratum. This stratum or synusia which is composed primarily of members of the heath family (Ericaceae) is dominated by one or two major species, Vaccinium vacillans and Gaylussacia baccata, which are similar in form and ecological disribution. A conspicuous feature of the synusia is its highly clumped or patterned nature during early stages of development. Pattern decreases with age, usually accompanying a concurrent closure of the canopy. The ultimate or climax stage of development which is probably seldom reached in this region, appears to result in a marked reduction in synusial density and reduction of pattern. The subject of this paper is an

investigation into the causes and development of pattern with particular reference to post-fire revegetation.

STEPHENSON, S. N. 1965b. Vegetation change in the Pine Barrens of New Jersey. Bull. Torrey Bot. Club 92:102-114. (D)

Location: McDonalds Branch and Middle Branch, Lebanon State Forest (8,9)

Keywords: Succession; Oak-Pine Forest

Abstract: A resurvey of the vegetation on 104 permanent sample units was conducted during the summer of 1962 in Lebanon State Forest, New Jersey. Replicate sampling was conducted to determine if the sample method used was reproducable. Comparisons of replicate sample data indicate close agreement among values derived by two independent observers for tree and shrub cover, basal area and stem numbers. Disagreement was found when comparing seedling data. Comparisons of results of the 1954 and 1962 surveys indicate a number of changes have taken place in the vegetation of the sample sites. No detectable change occurred in the canopy cover, and with one exception none in canopy space, that was statistically significant. A general increase in basal area was found, with greatest increases being found in early successional communities and insignificant increase or decrease noted in older Oak-Pine communities. Changes of stem size classes indicate a shift toward the larger size classes and an overall decrease in total stems. Comparisons of shrub cover values indicate a marked reduction of total shrub cover, apparently due to decreased shrub density. Indications are that a change in shrub population structure has occurred resulting in reduced relative importance of _Vaccinium_ _vacillans_ and increased relative importance of other major shrub species. Drought is offered as a possible explanation for the observed decrease in shrub cover and total stem number of tree species.

STEPHENSON, S. N. 1965c. Structure and development of upland heath synusia in the New Jersey Pine Barrens. Ph.D. Thesis, Rutgers Univ., New Brunswick, N.J. (D)

Location: McDonalds Branch and Middle Branch, Lebanon State Forest (8,9)

Keywords: Succession; Oak-Pine Forest

Abstract: Considering dispersal first, post-disturbance composition of the heath synusia is apparently dependent entirely upon residual plant parts, and in the case of denuded areas, invasion is primarily through lateral growth

of rhizomes. The potential for propagation by seed is known to exist, yet it remains to be demonstrated in the field following fire. Consequently, after fire the heath dominants are already established and their distribution is altered only through differential survival within the areas previously occupied. Post-disturbance pattern is established as the result of differential response to the changed and changing environmental conditions. During the initial stages of post-fire revegetation, both species exhibit similar growth responses to the new set of environmental conditions. Initial sprout production and growth appears to be largely independent of environmental factors. Rather, it depends on the condition of the rhizome prior to disturbance. Subsequently mortality may occur among those plants situated in unfavorable sites or those which may have been most damaged by the fire, and may lead to extensive decreases in density. As canopy development proceeds, resulting in modification of the micro-environment, such as localized sites of shade and litter accumulation, conditions become increasingly favorable for rhizome proliferation and thus increased aerial stem density. At this stage, pattern is often most pronounced. With increasing stand age and canopy closure micro-environmental conditions become more uniform, resulting in larger scales of pattern in the heath synusia. Once the heath synusia is removed, reinvasion is effectively prevented by unfavorable soil conditions in the disturbed area. These conditions result from a greater degree of podzolization beneath dense growth of heaths. Extreme development of the Ao-A1 and greatest leaching occur as the result of increased litter capture where the shrub densities are greatest. Under these conditions, the rhizome systems of both species are located chiefly or entirely within the Ao-A1 horizon, and in the case of Gaylussacia, the entire root system may be restricted to this horizon. Rhizomes growing into the disturbed conditions from the original level of proliferation are subject to extremes of drying and soil temperatures, and as a result, soon produce an aerial sprout, thus ending invasion in the case of that rhizome axis. Consequently the spread and reinvasion into a disturbed site is effectively blocked until litter accumulation again becomes suitable for rapid rhizome elongation. The apparent lack of inhibitory effects between the two dominant heaths might be explained on the basis of the vertical separation of the two species in the soil. The superficial habit of Gaylussacia wherein the root systems are localized in the organic soil horizons contrasts sharply with Vaccinium which possesses roots penetrating into the B horizon. Thus the two species are drawing upon different nutrient and moisture reserves. This niche separation is apparently sufficient to allow their close association at maximum densities. The greater root depth of Vaccinium may favor the species during short term droughts when only surface moisture becomes depleted. However, during seasons such as were experienced in 1963 and 1964 in which moisture depletion is more extensive, litter-humus interception may have prevented soil moisture recharge to the B horizon depth. Consequently, under severe drought conditions Gaylussacia may be favored by its superficial habit. Such a mechanism may have been operative in the observed Vaccinium decline between the years 1953 and 1962.

STERN, W. L. and M. F. BUELL. 1951. Life-form spectra of New Jersey pine barrens forest and Minnesota jack pine forest. Bull. Torrey Bot. Club 78:61-65. (D)

Location: Lebanon State Forest (8,9)

Keywords: Flora; Pinus rigida; Pinus echinata; Fire

Abstract: Raunkiaer (1934) has shown that the life-form spectrum of the plants in an area is indicative of the prevailing climate. Life-form spectra have usually been based upon the flora (species list) of an area as a whole. The study reported here is limited to a comparison of the life-form spectra of two apparently comparable pine communities in two different climatic regions. Not only are the species lists of the communities used as a basis, but an attempt is also made to base the spectra on quantitative vegetational data. The two communities chosen are the pitch pine - shortleaf pine (Pinus rigida - P. echinata) of the pine barrens area of New Jersey's coastal plain, and the jack pine (P. banksiana) of northern Minnesota. Both communities are restricted to coarse, sandy soils of low pH. Shrubs of the Ericaceae are conspicuous members of both communities, a few species being common to both. Fire has been a common factor in the recent history of a large part of the area occupied by them (Hansen 1937; Sterrett 1920; Little 1946). If fire were prevented, communities of quite different composition would be established.

STEVENS, T. D. 1940. Forest succession on upland soils in the New Jersey Pine Barrens. Ph.D. Thesis, Yale Univ. School Forestry. 268p. (D)

STONE, E. L. and M. H. STONE. 1943. Dormant buds in certain species of Pinus. Amer. Jour. Bot. 30:346-351. (D)

Location: General

Keywords: Fire; Sprouting; Pinus rigida

STONE, E. L. and M. H. STONE. 1954. Root collar sprouts in pine. Jour. For. 52:487-491. (D)

STONE, H. E. and J. M. FOGG. 1933. _Leptoloma cognatum_ in southern New Jersey - two notes. Bartonia 15:36-37. (D)

STONE, W. 1907a. Some new plants of southern New Jersey. Torreya 7:39-40. (D)

STONE, W. 1907b. The life-areas of southern New Jersey. Proc. Acad. Nat. Sci. Philadelphia 59:452-459. (D)

STONE, W. 1908a. The coastal strip of New Jersey and the rediscovery of _Lilaeopsis_. Bartonia 1:20-24. (N)

STONE, W. 1908b. Recent additions to our knowledge of the flora of southern New Jersey. Proc. Acad. Nat. Sci. Philadelphia 60:457-459. (D)

STONE, W. 1910. _Corema conradii_ in Ocean County, New Jersey, east of the Plains. Bartonia 3:26. (D)

Location: West Creek (27)

Keywords: _Arctostaphylos_; _Hudsonia ericoides_; _Dendrium_ (=_Leiophyllum_)

STONE, W. 1911. The plants of southern New Jersey, with especial reference to the flora of the Pine Barrens and the geographical distribution of the species. N.J. State Museum Ann. Rept. 1910:23-828, Trenton, N.J. (D)

STREET, J. F. 1909. Cruising through the New Jersey Pine Barrens. Cassina 13:19-24. (N)

STREET, J. F. 1929. The orchids of the New Jersey Pine Barrens. Yearbook Acad. Nat. Sci. Philadelphia 1928:20-25. (R)

SWIFT, E. and P. WELLS. 1960. The pitcher plant. Wild Flower 36(4):53-60. (N)

Location: General

Keywords: _Sarracenia purshii_

TAYLOR, N. 1912. On the origin and present distribution of the Pine Barrens of New Jersey. Torreya 12:229-242. (D)

Location: General

Keywords: Beacon Hill Formation; Geologic History

TAYLOR, N. 1915. Flora of the vicinity of New York: contribution to plant geography. Memoirs N.Y. Bot. Gardens Vol. 5. (D)

TAYLOR, W. G. 1931. Field trip of Sunday, March 29. Torreya 31:87-88. (N)

Location: West Plains (17)

TAYLOR, W. G. 1932. Brown's Mills, N.J., outing, September 25 to 27, 1931. Amer. Fern Jour. 22:28-30. (N)

Location: West Plains (17); Batsto (24); Atsion (24); Hanover Furnace (8)

TEALE, E. W. 1951. Chapter 28. The Pine Barrens. In North with the spring. Dodd, Mead and Co., New York. pp.272-281. (R)

TEMPEL, A. S. 1976. Racial differences in cone characteristics in *Pinus rigida* in relation to seed predation by the red squirrel (*Tamiasciurus hudsonicus*). M. S. Thesis, Rutgers Univ., New Brunswick, N.J. (D)

Location: West Plains (17); Lebanon State Forest (8,9); Chatsworth (16); Wharton State Forest (14,15,23,24)

Keywords: Cone Serotiny

Abstract: The seed - seed predator interaction between *Pinus rigida* and *Tamiasciurus hudsonicus* in the New Jersey Pine Barrens was investigated. Cones of serotinous and of non-serotinous pitch pine were collected in six sites where red squirrels are the major coniferous seed predators. Several cone characteristics were examined for evidence of evolutionary divergence between the two races as a result of squirrel foraging behavior, among them the number of seeds per cone, the number of scales per cone, and seed density (the number of seeds per cone scale). The mean number of seeds per cone did not differ significantly between non-serotinous and serotinous cones, but the mean number of scales per cone was significantly higher in serotinous cones, resulting in a lower seed density in that race. Serotinous cones collected from the Pine Plains dwarf forests, and pond pine cones collected in Maryland, areas in which there was little or no squirrel predation on pine cones, contained seed densities equal to non-serotinous pitch pine cones. A model is presented which demonstrates that seed predation may cause divergence between two cone races in the absence of predator discrimination between them. The possible effects of predator release are discussed.

TEPPER, H. B. 1963. Leader growth of young pitch pine and shortleaf pines. For. Sci. 9(3):344-353. (D)

Location: Lebanon State Forest (8,9)

Keywords: Pinus rigida; Pinus echinata; Morphology

Abstract: Seedlings of Pinus rigida Mill. and P. echinata Mill. in New Jersey display highly synchronized leader elongation, often involving the formation and elongation of several buds. Winter buds of these two species are often multinodal. Initially, leader elongation is due to the extension of the basal internode of the winter bud. Subsequently, the succeeding higher internodes elongate. Each internode displays a sigmoid growth curve achieving its peak growth rate after the internode below it. As the winter bud extends, its apical meristem is reactivated, and a new terminal bud formed. In P. rigida seedlings this bud occasionally elongates to form a summer shoot. Open-grown P. echinata seedlings almost always develop one summer shoot, and many produce two.

TEPPER, H. B. and G. T. BAMFORD. 1959. Natural regeneration in bottomland hardwoods of southern New Jersey. NE. For. Expt. Sta. For. Res. Note 93:1-4, U.S.D.A. For. Serv., Upper Darby, Pa. (D)

TEPPER, H. B. and G. T. BAMFORD. 1960. Thinning sweetgum stands in southern New Jersey. NE. For. Expt. Sta. For. Res. Note 95:1-3, U.S.D.A. For. Serv., Upper Darby, Pa. (D)

THOMAS, L. S. 1967. See GENERAL REFERENCES citation.

TILLOTSON, H. S. 1952. Pine Barrens plants. Frontiers 16(4):112-113. (R)

TOBOROWSKY, P. G. 1968. Geographic distribution of 60 species of the Pine Barrens of New Jersey. Bull. N. J. Acad. Sci. 13:98. (A)

Location: General

Keywords: Species Maps

Abstract: Distribution maps were drawn to show the specific localities for each of 60 plants collected from Middlesex, Monmouth, Ocean, Atlantic, Burlington, Camden, Gloucester, Salem, Cumberland and Cape May Counties. Each map represents a qualitative survey of a particular species, regardless of the number of individuals collected. Data were collected from herbaria of The Academy of Natural Sciences in Philadelphia, The University of Pennsylvania and Rutgers University. A composite map, compiled from locations appearing on individual maps was also prepared. It is intended to serve as a botanical outline of The Pine Barrens of New Jersey.

TOMLINSON, W. E. 1941. See ZOOLOGY citation.

TOMLINSON, W. E. 1961. See ZOOLOGY citation.

TOMLINSON, W. E. 1968. See ZOOLOGY citation.

TORREY, J. 1833. An account of several new genera and species of North American plants. Ann. N.Y. Lyceum Nat. Hist. 4:80-94. (D)

TORREY, R. H. 1931. The relation of the flora of the New Jersey Pine Barrens to the geological history of the region. Torreya 31:169-173. (D)

Location: General

Keywords: Pleistocene Epoch; Beacon Hill Formation

TRANSEAU, E. N. 1903. On the geographic distribution and ecological relations of the bog plant societies of northern North America. Bot. Gaz. 36(6):401-420. (D)

TREAT, M. 1873. Observations of the sundew. Amer. Nat. 7:705-708. (D)

Location: General

Keywords: <u>Drosera</u> <u>filiformis</u>

TREAT, M. 1882. In the Pines. Harper's New Monthly Mag. 65(June):65-71. (N)

TREAT, M. 1888a. April in the Pine Barrens. Garden Forest 1:124. (N)

TREAT, M. 1888b. The Pine Barrens in May. Garden Forest 1:182. (N)

TREAT, M. 1888c. Among the Pines in June. Garden Forest 1:243. (N)

TREAT, M. 1888d. The Pines in July. Garden Forest 1:290-291. (N)

TREAT, M. 1888e. August in the Pines. Garden Forest 1:362-363. (N)

TREAT, M. 1888f. The Pines in October. Garden Forest 1:435. (N)

TREAT, M. 1888g. The Pines in mid-November. Garden Forest 1:494-495. (N)

TREAT, M. 1888h. Christmas in the Pines. Garden Forest 1:518-519. (N)

TREAT, M. 1889. Winter in the Pines. Garden Forest 2:87-88. (N)

TREAT, M. 1890a. October in the Pines. Garden Forest 3:524. (N)

TREAT, M. 1890b. Ornamental fruits in the Pines. Garden Forest 3:534-535. (N)

TREAT. M. 1890c. The wild garden. Garden Forest 3:442-444. (N)

TREAT. M. 1890d. September in the Pines. Garden Forest 3:463. (N)

TREAT, M. 1890e. Evergreens in the New Jersey Pine Region. Garden Forest 3:546-547. (N)

TREAT, M. 1891a. The Pines at Christmas-time. Garden Forest 4:14. (N)

TREAT, M. 1891b. See ZOOLOGY citation.

TREAT, M. 1892a. Spring in the New Jersey Pines. Garden Forest 5:220. (N)

TREAT, M. 1892b. Weeds in southern New Jersey. Garden Forest 5:292. (N)

TREAT, M. 1892c. Water-plants in southern New Jersey. Garden Forest 5:363. (N)

TREAT, M. 1892d. Climbing plants in the Pines. Garden Forest 5:400. (N)

TREAT, M. 1892e. Edible plants in the Pines. Garden Forest 5:435-436. (N)

TREAT, M. 1892f. Late autumn in the Pines. Garden Forest 5:567-568. (N)

TREAT, M. 1893a. Native plants for winter decoration. Garden Forest 6:141. (N)

TREAT, M. 1893b. Summer in the Pines. Garden Forest 6:314. (N)

TREAT, M. 1894a. Winter-blooming plants in the Pines. Garden Forest 7:102. (N)

TREAT, M. 1894b. March in the Pines. Garden Forest 7:142. (N)

TREAT, M. 1894c. Early June in the Pines. Garden Forest 7:243-244. (N)

TREAT, M. 1894d. Wayside plants in the Pines. Garden Forest 7:302-303. (N)

TREAT, M. 1894e. Late autumn in the Pines. Garden Forest 7:482-483. (N)

TREAT, M. 1895a. Christmas in the Pines. Garden Forest 8:3. (N)

TREAT, M. 1895b. Troublesome grasses in southern New Jersey. Garden Forest 8:103-104. (N)

TREAT, M. 1895c. The heaths among the Pines in early winter. Garden Forest 8:492-493. (N)

TREAT, M. 1897a. Weeds in southern New Jersey. Garden Forest 10:313. (N)

TREAT, M. 1897b. Autumn flowers in the Pines. Garden Forest 10:411-412. (N)

TREAT, M. 1897c. Autumn fruits in the Pines. Garden Forest 10:471-472. (N)

U. S. DEPARTMENT OF INTERIOR. 1978. See GENERAL REFERENCES citation.

VERMEULE, C. C. and G. PINCHOT. 1900. The forests of New Jersey. Report on forests. Ann. Rept. State Geol. 1899:13-172, N.J. Geol. Surv., Trenton, N.J. (D)

VERMEULE, C. C. et al. 1900. Report on forests. Ann. Rept. State Geol. 1899:1-327, N.J. Geol. Surv., Trenton, N.J. (D)

VOIGT, G. K., B. N. RICHARDS and E. C. MANNION. 1964. Nutrient utilization by young pitch pine. Soil Sci. Soc. Amer. Proc. 28:707-709. (D)

Location: Bass River State Forest (26)

Keywords: Pinus rigida; Calcium; Potassium; Growth

Abstract: Ten pitch pines (Pinus rigida Mill.) ranging in age from 5 to 9 years were excavated from an abandoned gravel pit in southern New Jersey. Lateral and vertical distribution of the root systems were recorded and total soil volume occupied by roots was calculated (root system

sorption zone). In addition, the volume of soil within 1 cm of any root surface was calculated (root surface sorption zone). Contents of total and exchangeable Ca and K in these zones were related to contents of Ca and K in the trees. Exchangeable Ca and K contents in the root system sorption zone were generally higher than the total content of these nutrients in the trees while the reverse was true for the relationship between the root surface sorption zone and the tree. Annual uptake of K by the trees was approximately equal to exchangeable K content of the root surface sorption zone. Annual uptake of Ca by the trees was only about one-third of the exchangeable Ca in the root surface sorption zone indicating that average distance of movement of Ca from soil to root surface was less than that for K. Less than 10% of the total soil volume occupied by roots was utilized in absorption of Ca and K.

WAANDERS, G. L. 1974. Palynology of the Monmouth Group (Maastrichtian) from Monmouth Co., New Jersey, U.S.A. Ph.D. Thesis, Michigan State Univ., East Lansing, Mich. (D)

WAKSMAN, S. A., H. SCHULHOFF, C. A. HICKMAN, T. C. CORDON and S. C. STEVENS. 1943. The peats of New Jersey and their utilization. Geol. Serv. Bull. 55(B):9-278, N.J. Dept. Conserv. Develop., Trenton, N.J. (R)

WATTS, W. A. 1979. Late Quaternary vegetation of central Appalachia and the New Jersey Coastal Plain. Ecol. Monogr. 49(4):427-469. (D)

WEBSTER, H. H. and C. H. STOLTENBERG. 1958. The timber resources of New Jersey. NE. For. Expt. Sta., U.S.D.A. For. Serv., Upper Darby, Pa. 41p. (R)

Location: General

Keywords: Timber Inventory; Major Forest Types (Map)

WEISS, H. B. and E. WEST. 1924. Insects and plants of a dry woods in the Pine Barrens of New Jersey. Ecology 5:241-253. (D)

Location: Lakehurst (4)

Keywords: Insect Food Habits; Herbaceous Flora

WHARTON SUBCOMMITTEE. 1956. Management policies of the Wharton Tract. Trenton, N.J. 18p. (D)

Location: Wharton State Forest (14,15,23,24,25)

WHERRY, E. T. 1920. Correlation between vegetation and soil acidity in southern New Jersey. Proc. Acad. Nat. Sci. Philadelphia 72:113-119. (D)

WHERRY, E. T. 1922. Soil acidity preferences of some eastern conifers. Jour. For. 20:488-496. (D)

Location: General

Keywords: _Pinus rigida_; _Chamaecyparis thyoides_; _Pinus taeda_; _Pinus echinata_

WHERRY, E. T. 1924. Notes on some local plants and their soil acidity. Bartonia 8:33-34. (D)

Location: Whitesbog (8)

Keywords: _Ophioglossum vulgatum_ Varieties

WHERRY, E. T. 1932. Ecological studies of serpentine-barren plants. I. Ash composition. Penn. Acad. Sci. Proc. 6:32-38. (D)

WHITTAKER, R. H. 1979. Vegetational relationships of the Pine Barrens. _In_ Forman, R. T. T. (ed.). Pine Barrens: ecosystem and landscape. Academic Press, New York. pp.315-331. (R)

Location: New Jersey; New York (Long Island)

Keywords: Vegetational Pattern; Soil Moisture Gradient; Soil Texture Gradient; Disturbance; Climate; Fire

Abstract: The vegetation of the Pine Barrens is distinguished by its strong differentiation of plant communities in an area of low relief and by the widespread occurrence of dry pine and heath communities in a humid, forest climate. Major features of the pattern relate to three groups of environmental factors, i.e., a soil moisture gradient (swamp forest to dry pine-oak forest), soil texture and nutrient relations (oak forest through oak-pine and pine-oak to the dwarf Pine Plains), and disturbance. Occurrence of pine-oak forests and dwarf pine plains in a deciduous forest climate probably results from: (a) sandy soils with low water- and nutrient-holding capacity that (b) subject the vegetation to periodic drought, and consequently to frequent fire; and (c) permit nutrient loss from the soil to low levels that support regrowth of (d) pine and

shrub communities susceptible to another fire. The dwarf Pine Plains are interpreted as a soil-determined climax representing these interactions at their extreme for the area. Because of the importance of heaths, the prevalent communities of the Pine Barrens are pine and pine-oak heaths, and the dwarf pine plains are heathlands. Some relationships to other heathlands and heath forests are summarized; these communities mostly occur on infertile soils in relatively humid climates, are dominated by pines and/or heaths (and other groups of the southern hemisphere), and are subject to fire.

WILBER, C. P. 1912. The forest fire service. Ann. Rept. 1911:19-67, For. Park Reserv. Comm. N.J., Trenton, N.J. (N)

WILBER, C. P. 1913. The forest fire service. Ann. Rept. 1912:15-56, For. Parks Reserv. Comm., Trenton, N.J. (N)

WILBER, C. P. 1914. The forest fire service. Ann. Rept. 1913:43-80, For Parks Reserv. Comm., Trenton, N.J. (N)

WILBER, C. P. 1915. Report of the state fire warden. Ann. Rept. 1914:47-79, N.J. Dept. Conserv. Develop., Trenton, N.J. (N)

WILBER, C. P. 1916. Report of the state fire warden. Ann. Rept. 1915:45-77, N.J. Dept. Conserv. Develop., Trenton, N.J. (N)

WILBER, C. P. 1917. Report of the state fire warden. Ann. Rept. 1916:57-84, N.J. Dept. Conserv. Develop., Trenton, N.J. (N)

WILBER, C. P. 1918. Report of the state fire warden. Ann. Rept. 1917:103-135, N.J. Dept. Conserv. Develop., Trenton, N.J. (n)

WILBER, C. P. 1920. Report of the state fire warden. Ann. Rept. 1919:65-97, N.J. Dept. Conserv. Develop., Trenton, N.J. (N)

WILBER, C. P. 1921. Report of the state fire warden. Ann. Rept. 1920:91-111, N.J. Dept. Conserv. Develop., Trenton, N.J. (N)

WILBER, C. P. 1923. Report of the state fire warden. Ann. Rept. 1922:90-115, N.J. Dept. Conserv. Develop., Trenton, N.J. (N)

WILDER, L. B. 1937. Pine Barren beauty. House Garden 72:74-75,88. (N)

WILLIAMS, C. R. 1929. The Pine Barrens "island" of New Jersey. Amer. Bot. 35:49-55. (R)

WILLIAMS, C. R. 1930. Corema in the Pine Barrens. Amer. Bot. 36:77-80. (D)

WILLIS, O. R. 1874. Catalogue of plants growing without cultivation in the state of New Jersey. (Publ. unknown). New York. 71p. (D)

WILLIS, O. R. 1878. Flora of New Jersey. Bull. Torrey Bot. Club 6:252. (D)

Location: Egg Harbor (32)

Keywords: Calluna vulgaris

WILSON, W. C. 1939. Pine Barrens, home of the pyxie. Nature Mag. 32:469. (N)

Location: General

Keywords: Plains; Pyxidanthera barbulata

WOLGAST, L. J. 1973. Mast production in scrub oak on the coastal plain in New Jersey. Ph.D. Thesis, Rutgers Univ., New Brunswick, N. J. 137pp. (D)

Location: Not Given

Keywords: Humidity; Age Effects; Fertilization; Browse; Herbicides; Site Quality Effects; Genetics; Quercus ilicifolia

Abstract: Studies were conducted to determine the genetic and ecological factors which influence acron yields in scrub oak. Variability in acorn yields from site to site, among stands within sites, among clumps within stands within sites and among stems within clumps within stands within sites was estimated. This information was then utilized in designing

experiments to evaluate the effects of age, fertilizer application, stand density and herbicide application on acorn production. Acorn yields were shown to decrease with age between the ages of five and 13 years. However, the late March addition of 800 pounds per acre of 5-10-5 fertilizer to scrub oak older than eight years of age increased the production of acorns. Higher quanitites of browse were also produced by fertilized scrub oak. Manipulation of stand densities within the range of 920 to 2640 trees per acre had relaitvely little effect on acorn yields. The use of 2,4,5-T to manipulate stand density did not cause mortality of the remaining crop trees, and had little effect on acorn production. Growth chambers were used to determine that high relative humidity at the time of flowering is detrimental to fruit set. An experiment in which excellent, good and poor acorn producing trees were transplanted from a heterogeneous environment to a common site coupled with the chemical and physical analysis of the soils under the trees of varying productivity indicates that genetics plays a major role in determining acorn yields.

WOLGAST, L. J. 1974. Bear Oak - Quercus ilicifolia. U.S.D.A. For. Serv. Gen. Tech. Note 9:108-110. (D)

WOLGAST, L. J. 1978a. A study of variability in the production of immature acorns in bear oak. Bull. N.J. Acad. Sci. 23(1):21-25. (D)

Location: Collier's Mills (3), Greenwood Forest (17,18), Manchester (10)

Keywords: Quercus ilicifolia; Reproduction

Abstract: Acorns are significant components of the diets of many species of wildlife. In order to characterize variability in the production of immature acorns by bear oak so that experimental effort could be allocated efficiently in future studies, the hierarchial design was utilized. Tree to tree variability is much greater than stand to stand variability, which in turn is much greater than site to site variability in the production of immature acorns by bear oak. Estimates of these components of variability are presented.

WOLGAST, L. J. 1978b. Effects of site quality and genetics on bear oak mast production. Amer. Jour. Bot. 65:487-489. (D)

Location: Manchester Wildlife Management Area (4,10); Greenwood Forest Wildlife Management Area (10,11)

Keywords: Quercus ilicifolia; Soils; Water Table

Abstract: From a total sample of 1,350 bear oak (Quercus ilicifolia) trees on which all acorns had been counted, the 10 highest, 10 lowest and 10 intermediate acorn producers were selected. Fifty-four additional trees were transplanted onto a common site. One-third of these were high acorn producers, one-third were medium and one-third were poor acorn producers. These trees failed to converge in productivity, indicating that genetics plays a major role in determining acorn yields in bear oak.

WOOD, O. M. 1933. Litter cover and soil surface temperatures, oak-pine type. Allegheny For. Expt. Sta. Tech. Note 3:1-3, U.S.D.A. For. Serv., Upper Darby, Pa. (D)

WOOD, O. M. 1934. A brief record of seed productivity for chestnut oak in southern New Jersey. Jour. For. 32:1014-1016. (D)

Location: Northeastern Edge of Pine Barrens (No specific location given)

Keywords: Quercus prinus (Q. montana)

WOOD, O. M. 1936a. Early survival of some pine interplantings in southern New Jersey. Jour. For. 34(9):873-878. (D)

Location: Camp Ockanickon Experimental Forest (6)

Keywords: Pinus rigida; Quercus montana (Q. prinus); Quercus alba; Quercus velutina

WOOD, O. M. 1936b. First year losses after a fire may not represent total mortality. Allegheny For. Expt. Sta. Tech. Note 13, U.S.D.A. For. Serv., Upper Darby, Pa. 1p. (D)

WOOD, O. M. 1937a. The fall of shortleaf pine seed in southern New Jersey. Allegheny For. Expt. Sta. Tech. Note 18, U.S.D.A. For. Serv., Upper Darby, Pa. 1p. (D)

WOOD, O. M. 1937b. The interception of precipitation in an oak-pine forest. Ecology 18:251-254. (D)

Location: Camp Ockanickon Experimental Forest (6)

Keywords: Quercus prinus (Q. montana); Pinus rigida; Quercus alba; Nyssa sylvatica; Canopy Throughfall

WOOD, O. M. 1938a. Seed dispersal of southern white cedar. Allegheny For. Expt. Sta. Tech. Note 21, U.S.D.A. For. Serv., Upper Darby, Pa. 1p. (D)

WOOD, O. M. 1938b. Seedling reproduction of oak in southern New Jersey. Ecology 19:276-293. (D)

Location: Camp Ockanickon (6), Lebanon State Forest (8,9)

Keywords: _Quercus montana_ (_Q. prinus_); Seed Productivity; Predation; Seedbed Conditions; Soils

WOOD, O. M. 1939. Reproduction of shortleaf pine following mechanical treatment of the seed bed. Jour. For. 37(10):813-814. (D)

Location: Lebanon State Forest (8,9)

Keywords: Seedbed Disturbance

WOODFORD, E. M. 1968. Summer in the New Jersey Pine Barrens. Horticulture 46:28-30,44. (N)

WOODWELL, G. M. 1979. Leaky ecosystems: nutrient fluxes and succession in the Pine Barrens vegetation. Chapter 19 _In_ Forman, R. T. T. (ed.). Pine Barrens: ecosystem and landscape. Academic Press, New York. pp. 333-343. (R)

Location: General

Keywords: Nutrient Budget; Groundwater; Net Ecosystem Productivity

Abstract: Evolution and succession are the core of the theory of ecology. Data from a study of an agriculture-to-forest sequence of central Long Island, New York have shown that the theory of succession as progressive, developmental change is correct and useful. We must avoid, however, the circularity of thinking that all changes along succession are biotic changes; some may be simply responses to leaching over time. During the earlier stages of succession nutrients were shown to be lost at a high rate; during the later stages nutrients also are released, but at a lower rate. The quality of the groundwater follows this pattern, i.e., higher nutrient content under leakier ecosystems. Fire deflects the succession toward various stages of impoverishment that probably also are leaky, as are the earlier stages of the agriculture-to-forest sequence.

WRIGHT, E. 1895. Forest fires in South Jersey. Forester 1:81-82. (N)

GEOLOGY AND SOILS (INCLUDING MICROFLORA AND MICROFAUNA)

ANDRESEN, J. W. 1959. See BOTANY citation.

ANDERSON, H. R. and C. A. APPEL. 1969. See HYDROLOGY citation.

AURISANO, R. W. 1980. See BOTANY citation.

BAGG, R. M. 1898. See ZOOLOGY citation.

BAILEY, J. W. 1841. See ZOOLOGY citation.

BAIRD, D. 1964. See ZOOLOGY citation.

BAIRD, D. and G. R. CASE. 1966. See ZOOLOGY citation.

BALDWIN, M., C. E. KELLOGG and J. THORP. 1938. Soil classification. U. S. D. A. Yearbook Agric. 1938:979-1001, Washington, D. C. (D)

BEAR, F. E., A. L. PRINCE and J. L. MALCOLM. 1945. Potassium needs of New Jersey soils. N.J. Agric. Expt. Sta. Bull. 721, Rutgers Univ., New Brunswick, N.J. (D)

BERNARD, J. M. 1960. See BOTANY citation.

BERNARD, J. M. 1963. See BOTANY citation.

BLAIR, A. W. and A. L. PRINCE. 1925. The chemical composition of the soils of the Chatsworth area in New Jersey. N.J. Agr. Expt. Sta. Bull. 414:1-15, New Brunswick, N.J. (D)

Location: Chatsworth (16)

Keywords: Sassafras Soil; Collington Soil; St. Johns Soil; Norfolk Soil; Keansburg Soil; Shrewsbury Soil; Portsmouth Soil; Scranton Soil; Beach Sand Soil; Soil Nutrients; Soil pH; Soil Descriptions

BOERNER, R. 1982. See BOTANY citation.

BOWMAN, J. F. 1966a. Lateritic weathering in the Pensauken Formation. Geol. Soc. Amer. First Ann. Meet. N.E. Sect., Philadelphia, Pa. pp. (A)

BOWMAN, J. F. 1966b. Petrology of the Pensauken Formation. Ph.D. Thesis, Rutgers Univ., New Brunswick, N.J. 155pp. (D)

Location: General (1,5,6,13,14,21,22)

Keywords: Pensauken Facies; Classification; Paleology; Heavy Metals; Well Log Data

Abstract: The Pensauken Formation was deposited in a fluvial environment. The main Pensauken trough was the probable locus of the ancestral Hudson River. The Pensauken dispersal pattern reflects the lenticular nature of Pensauken bedding and the activity of tributary streams draining into the main through. The Pensauken is texturally and minerologically immature. Maturity may be a function of reworking of earlier Coastal Plain sediments that have undergone at least one previous cycle of sedimentation. The Pensauken formation was deposited during a relatively warm interglacial period. The Pensauken, although not important as an aquifer, influences ground-water infiltration and recharge of aquifers that it overlies. Permeability of Pensauken sands may be lower than average in zones of maximum weathering.

BOWMAN, J. F. and W. LODDING. 1969. The Pensauken Formation - a Pleistocene fluvial deposit in New Jersey. In Subitzky, S. (ed.). Geology of selected areas in New Jersey and eastern Pennsylvania, and a guidebook of excursions. Rutgers Univ. Press, New Brunswick, N.J. pp.3-6. (R)

Location: General

Keywords: Texture; Structural Composition; Weathering

Abstract: A detailed study of the texture, mineralogy and structure of the Pensauken Formation strongly indicates a fluvial environment of deposition with paleoslope toward the southwest. A bauxitic laterite-type of weathering is revealed by X-ray diffraction analysis. This weathering, in conjunction with other evidence, suggests that the Pensauken was deposited during a relatively warm, interglacial period.

BROWN, K. W. and Associates. 1980. An assessment of the impact of septic leach fields, home lawn fertilization and agricultural activities on groundwater quality. Report perpared for the N. J. Pinelands Commission by K. W. Brown and Associates, College Station, Texas. 104p. (D)

Location: General

Keywords: Soil Chemistry; Bacteria; Viruses; Organics

Abstract: The high permeabilities, low pH and low phosphorus adsorption capabilities of the soils minimize their ability to prevent migration of inorganic pollutants to the groundwater. Additionally, many of the soils have high water tables which would allow pathogenic organisms to enter the aquifer and are thus unsuitable for septic fields. For septic leach fields, the soils with rapid infiltration belonging to hydrological group A cannot be used because of the potential for pathogen migration to the groundwater. In the New Jersey Pinelands, the soils belonging to hydrological groups C and D cannot be used because of seasonally high water tables, and thus only soils in hydrological group B with groundwater tables greater than 6 ft. from the surface may be acceptable. The potential for denitrification is low in these soils and only small amounts of nitrogen may be taken up by vegetation. Therefore, much of the nitrogen is likely to eventually move to the groundwater. For drinking water use, the U.S. Public Health Service requires that nitrate nitrogen be less than 10 ppm, while the New Jersey State Department of Environmental Protection has set an acceptable limit for the Pinelands area of 2 ppm. The average nitrate content of the existing groundwater is 0.17 ppm. To prevent the average annual nitrate nitrogen concentration in the groundwater from rising more than 2.0 ppm, septic field spacing for a typical family would require lot sizes of 3.0 acres. The 0.17 ppm leachate nitrogen limit would require 37.0 acres. Phosphorus will likely break through the soils in group B which have permeabilities of between 2 and 6 inches per hour within a year after septic systems are put into use. For soils in group B with permeabilities of 0.2 to 2 inches per hour, the breakthrough may require several years. In either case, procedures need to be employed, including perhaps the use of alum to precipitate the phosphorus. Home lawn fertilization would be expected to add large amounts of nitrogen to the groundwater, and even larger acreages than are required for septic fields would need to be set aside to allow dilution of the leach water to acceptable levels. It may be necessary to consider a prohibition on home lawns and instead encourage the use of native vegetation which would not require fertilization. Irrigation with secondary treated sewage effluent could provide effective disposal without elevating the groundwater concentration above 2.0 ppm only if large acreages were set aside for the purpose. Fertilization of the limited number of acres used for agricultural production is expected to contribute only small amounts of nitrogen to the groundwater if fertilizers are applied in split applications and if management practices are designed to meet, but not exceed, the crop needs. Information is lacking and needed on (1) the groundwater recharge volumes under soils in the different hydrological groups, (2) the phosphorus adsorption capacity of the subsoil materials in soils in hydrological group B, (3) the influence of septic effluent on the soil pH and that of the

water entering the groundwater, and (4) the concentrations and mobilities of biocides found in septic effluent.

BROWN, P. M., J. A. MILLER and F. M. SWAIN. 1972. Structural and stratigraphic framework, spatial distribution and permeability of the Atlantic Coastal Plain, North Carolina to New York. U.S. Geol. Surv. Prof. Paper 796:1-79, Washington, D.C. (D)

BUCHHOLZ, K. 1980. See BOTANY citation.

BUCHHOLZ, K. and H. MOTTO. 1981. See BOTANY citation.

BUELL, M. F. 1970. See BOTANY citation.

BURNS, P. Y. 1952. See BOTANY citation.

CAMPBELL, M. R. and F. BASCOM. 1933. Origin and structure of the Pensauken gravel. Amer. Jour. Sci. 26:300-318. (D)

Location: Mt. Holly (6)

Keywords: Pensauken Gravel Distribution; Pensauken Plain

CANFIELD, F. A. 1889. Catalogue of minerals found in New Jersey. Final Rept. State Geol. 1889 Vol. 2:3-24, N. J. Geol. Surv., Trenton, N. J. (D)

CANTLON, J. E. 1951. See BOTANY citation.

CANTLON, J. E. and M. F. BUELL. 1952. See BOTANY citation.

CARTER, C. 1975. Miocene-Pliocene beach and tidal deposits, southern New Jersey. In Ginsburg, R. N. (ed.). Tidal deposits - a casebook of recent examples and fossil counterparts. Springer-Verlag, New York. pp.109-116. (R)

CARTER, C. R. 1972. Miocene-Pliocene beach and tidal flat sedimentation, southern New Jersey. Ph.D. Thesis, John Hopkins Univ., Baltimore, Maryland. (D)

CLARK, G. H. 1898. Report upon the Upper Cretaceous formations, 1897. Final Rept. State Geol. 1897:161-210, N.J. Geol. Surv., Trenton, N.J. (R)

CLARK, W. B. 1892. A preliminary report of the Cretaceous and Tertiary Formations of New Jersey. Ann. Rept. State Geol., N.J. Geol. Surv., Trenton, N.J. (R)

CLARK, W. B. 1893. Cretaceous and Tertiary geology. Ann. Rept. State Geol. for 1892:339, N. J. Geol. Surv., Trenton, N.J. (R)

CLARK, W. B. 1894. Origin and classification of the greensands of New Jersey. Jour. Geol. 2:161-177. (D)

Location: General

Keywords: Stratigraphy; Genesis; Greensand Distribution; Taxonomy

CLARK, W. B. 1904. The Matawan formation of Maryland, Delaware and New Jersey. Amer. Jour. Sci. (4)18:435-440. (R)

COLONY, R. J. 1932. Source of the sands of the south shore of Long Island and the coast of New Jersey. Jour. Sed. Petro. 2:150-159. (D)

COOK, G. H. 1856. Geology of the County of Cape May, State of New Jersey. N. J. Geol. Surv., Trenton, N. J. 211pp. (D)

COOK, G. H. 1864. Geologic survey of New Jersey. N. J. Geol. Surv., Trenton, N. J. 13pp. (R)

COOK, G. H. 1865. Geologic survey of New Jersey. N. J. Geol. Surv., Trenton, N. J. 24pp. (R)

COOK, G. H. 1866. Geologic survey of New Jersey. N. J. Geol. Surv., Trenton, N. J. 12pp. (R)

COOK, G. H. 1867. Geologic survey of New Jersey. N. J. Geol. Surv., Trenton, N. J. 27pp. (R)

COOK, G. H. 1868a. Geologic survey of New Jersey. N. J. Geol. Surv., Trenton, N. J. 28pp. (R)

COOK, G. H. 1868b. Geology of New Jersey. Daily Advertiser, N.J. 900p. (D)

COOK, G. H. 1870. Annual report of the State Geologist for 1869. N. J. Geol. Surv., Trenton, N. J. 57pp. (R)

COOK, G. H. 1871. Annual report of the State Geologist for 1870. N. J. Geol. Surv., Trenton, N. J. 75pp. (R)

COOK, G. H. 1872a. Annual report of the State Geologist for 1871. N. J. Geol. Surv., Trenton, N. J. 46pp. (R)

COOK, G. H. 1872b. Annual report of the State Geologist for 1872. N. J. Geol. Surv., Trenton, N. J. 44pp. (R)

COOK, G. H. 1873. Annual report of the State Geologist for 1873. N. J. Geol. Surv., Trenton, N. J. 128pp. (R)

COOK, G. H. 1874a. Annual report of the State Geologist for 1874. N. J. Geol. Surv., Trenton, N. J. 115pp. (R)

COOK, G. H. 1874b. Soils of New Jersey; their origin and distribution. N.J. State Bd. Agr. Ann. Rept. 1:11-30, Trenton, N.J. (D)

COOK, G. H. 1878a. Preliminary description and classification of the soils of New Jersey. Ann. Rept. State Geol. 1878:24-47,N.J. Geol. Surv., Trenton, N.J. (D)

COOK, G. H. 1878b. Miscellaneous clay deposits. Ann. Rept. State Geol. 1878:49-69, N.J. Geol. Surv., Trenton, N.J. (D)

COOK, G. H. 1882. Agricultural development in southern New Jersey. Ann. Rept. State Geol. 1882:90-94, N.J. Geol. Surv., Trenton, N.J. (R)

COOKE, C. W. and L. W. STEPHENSON. 1928. The Eocene age of the supposed Upper Cretaceous greensand marls of New Jersey. Jour. Geol. 36:139-148. (D)

Location: General

Keywords: Hornerstown Marl; Vincentown Sand; Manasquan Marl; Fauna

COX, H. R. 1948. Monmouth County soils. N. J. Agric. Expt.

Sta. Bull. 738. (D)

Location: Monmouth County

Keywords: Land Use; Farm Product Values; Soil Quality; Soil Profiles; Soil Erosion; Conservation Practices

CRERAR, D. A., G. W. KNOX and J. L. MEANS. 1979. Biogeochemistry of bog iron in the New Jersey Pine Barrens. Chem. Geol. 24:111-135. (D)

Location: Batsto (24)

Keywords: Geology; Surface Water; Ground Water; Water Chemistry; Bacteriology

Abstract: Rivers and swamps of the southern New Jersey Coastal Plain contain sporadic but quantitatively important deposits of bog iron. This consists of unconsolidated to massive limonite impregnating sands and silts, the only X-ray identifable Fe mineral being goethite. The chemistry and hydrology of river, swamp and ground waters suggest that Fe supplied by lateral and vertical migration of corrosive, acidic ground waters up through Fe-rich sediments toward aerated surfaces. Here oxidation of Fe is catalyzed by Fe-fixing bacteria including Thiobacillus ferrooxidans, Leptothrix ochracea, Crenothrix polyspora, Siderocapsa geminata, and Metallogenium sp. These bacteria are essential to the precipitation of Fe, which would not otherwise oxidize at significant rates given the acid pH and chemical composition of surface waters.

DADDARIO, J. J. 1961. A lagoon deposit profile near Atlantic City, New Jersey. Bull. N.J. Acad. Sci. 6:7-14. (D)

Location: Leed's Point (40)

Keywords: Peat; Silt; Salt Marsh Vegetation

Abstract: A study was conducted of the lagoon deposits along a transect directed down the slope of the coastal plain. The objectives were to describe the basic lagoon profile and establish some relationship between this profile and the developmental history of this barrier beach-lagoon system. Submergence of the coast was responsible for the deposition of all the deposits of the 4525-yard profile. During this change in the location of the shoreline, processes operated to form four distinct profile layers. Submergence, the slope of the mainland being submerged, and the dynamics of the barrier beach operated to determine the lagoon size. Coastal submergence may have been directly involved in the initial formation of the barrier

beach-lagoon system.

DAHLGREN, P. B. 1977. Geology of Monmouth County in brief. Bureau Geol. Topogr., Trenton, N. J. 22pp. (R)

Location: Monmouth County

Keywords: Physiography; Formation Descriptions; Mineral Resources

DINDAL, D. E. 1979. See ZOOLOGY citation.

DOUGLAS, L. A. 1981. Smectites in highly acidic soils. Proc. 7th. International Clay Conf., Bologna, Italy. (In press).

DOUGLAS, L. A. and J. J. TRELA. 1979. Mineralogy of Pine Barrens soils. Chapter 6 In Forman, R. T. T. (ed.). Pine Barrens: ecosystem and landscape. Academic Press, New York. pp.95-109. (R)

Location: General

Keywords: Soils; Minerals; Podzols; Topography Effects; Drainage Effects; Soil Properties

Abstract: The clay mineralogy of most Pine Barrens soils (highly developed podzols) is partially the result of the alteration sequences. The end product is present as a mixed-layer mineral. Soil kaolinite and gibbsite are assumed to be the result of the weathering of feldspars, although kaolinite can be formed by the decomposition of aluminum-interlayered vermiculite. The soil mineral alteration evident in younger soils is the production of a small amount of aluminum-interlayered vermiculite-smectite mixed-layer material in A and C1 horizons. On older parent materials (mid- to early Quaternary) the amount of smectite increases, and in early Quaternary materials some smectite has aluminum interlayers. Kaolinite is dominant in older B3 and C1 horizons. In soils developed on Pliocene-Miocene (?) sediments, an aluminum-interlayered smectite-aluminum-interlayered vermiculite often is present. Kaolinite, which exhibits a high degree of crystallinity, and gibbsite may be major components in B and C1 horizons. It is thought that some of the characteristics of the aluminum interlayers are related to the very low pH of these soils.

DORF, E. and S. K. FOX. 1957. Cretaceous and Cenozoic of the New Jersey Coastal Plain. In E. Dorf (ed.). Guide for field trips, Atlantic City Meeting. Geol. Soc. Amer. pp.1-13. (R)

DOYLE, J. A. 1969. See BOTANY citation.

DRYDEN, A. L. and C. DRYDEN. 1960. Atlantic Coastal Plain heavy minerals - a speculative summary. Internat. Geol. Congress 1956. (N)

ENRIGHT, R. 1969a. The stratigraphy, micropaleontology and paleoenvironmental analysis of the Eocene sediments of the New Jersey Coastal Plain. Ph.D. Thesis, Rutgers Univ., New Brunswick, N.J. 242pp. (D)

Location: Toms River (11); Butler Place, Lebanon State Forest (16)

Keywords: Manasquan Formation; Shark River Formation; Globorotalia; Subbotina; Pseudohastigerina; Deposition

Abstract: A stratigraphic, micropaleontologic and paleoenvironmental analysis of the Eocene sediments of the northeastern half of the New Jersey Coastal Plain has resulted in the redefinement of the Eocene stratigraphy of this area. The Manasquan Formation consists of two members which are named the Farmingdale and Deal Members. In the subsurface, the upper Deal Member is a major lithologic unit and its unique montmorillonite - clinoptilolite clay mineral assemblage makes it an important marker bed in the Tertiary stratigraphy of the study area. The Shark River Formation is redefined to include a lower glauconitic member which occurs in outcrop, and an upper quartz sand which is entirely subsurface. These members are named the Squankum and Toms River Members, respectively. In the subsurface, the Toms River Member also assumes major importance as it thickens rapidly down dip. Deposition of the Manasquan and Shark River Formations spanned at least the interval from the uppermost Paleocene (Olsson 1967) to the middle part of the middle Eocene. The following planktonic foraminiferal zones are recognized within the Eocene section. Lower Eocene: (1) Globorotalia subbotinae - G. aequa zone; (2) Globorotalia formosa formosa zone; (3) Subbotina inaequispira zone; (4) Pseudohastigerina sharkriverensis zone. Middle Eocene: (5) Subbotina frontosa zone; (6) Turbonotalia centralis zone. The New Jersey zonation is basically similar to Bolli's zonation (1957) but modified to include elements which are more common to the mid-latitudes and as a result more applicable to New Jersey. Paleoenvironmental analysis indicates that the slight shoalling during deposition of the uppermost Paleocene sediments was followed by the deposition of the Farmingdale Member in water depths characteristics of today's middle to outer shelf. Water depths decreased gradually during deposition of the remainder of the Farmingdale, Deal and Squankum Members after which shoalling rapidly occurred as

the Toms River clastic wedge was deposited in shoal inner neritic waters.

ENRIGHT, R. 1969b. The stratigraphy and clay mineralogy of the Eocene sediments of the northern New Jersey Coastal Plain. In Subitzky, S. (ed.) Geology of selected areas in New Jersey and eastern Pennsylvania and guidebook of excursions. Rutgers Univ. Press, New Brunswick, N.J. pp.14-20. (D)

Location: Toms River (11); Butler Place, Lebanon State Forest (16)

Keywords: Manasquan Formation; Shark River Formation

Abstract: Examination of well samples and outcrops of the Eocene sediments of the northeastern New Jersey Coastal Plain indicate that sedimentation was continuous from the latest Paleocene to at least the middle Eocene. These Eocene sediments are divided into two formations - the Manasquan Formation and Shark River Formation. The Manasquan Formation consists of the newly named Farmingdale and Deal Members. Along strike to the southwest, the Farmingdale persists as far as Medford. In the subsurface it appears to wedge out at distances of 20 miles downdip. On the other hand the Deal Member thickens downdip and is an important unit in the subsurface. Its unique clay mineral assemblage substantiates its lithologic continuity in the subsurface and also indicates that volcanic sources contributed significant amounts of volcanic ash to this member. The Shark River Formation as redefined includes the Squankum Member and the overlying Toms River Member, which is restricted to the subsurface. The quartzose Toms River Member rapidly thickens downdip where it too becomes a major unit in the subsurface.

EPSTEIN, C., M. L. WEEKS and G. SAWHILL. 1976. See BOTANY citation.

FLORER, L. E. 1972. See BOTANY citation.

FORMAN, R. T. T. 1979. See GENERAL REFERENCES citation.

GAMBEL, J. F. 1963. A study of strontium, barium and calcium relationships in soils and vegetation. AEC Final Report NYO-10581, Rutgers Univ., New Brunswick, N. J.

GILL, D. E. 1975. See BOTANY citation.

GILL, H. 1956. A stratigraphic analysis of the Matawan Group.

M.S. Thesis, Rutgers Univ., New Brunswick, N.J. pp. (D)

GIVNISH, T. 1971. See BOTANY citation.

GIVNISH, T. 1981. See BOTANY citation.

GOLDSTEIN, R. F. 1973. Paleoenvironmental analysis of the Kirkwood Formation. Ph.D. Thesis, Rutgers Univ., New Brunswick, N.J. 70pp. (D)

Locations: Cape May (50); Newfield (29); Milmay (37); Atlantic City (45)

Keywords: Palynology; Dinoflagellates; Diatoms; Radiolarians; Climate; Microfloras

Abstract: Palynological analyses were made on 200 samples of the Kirkwood Formation from 7 wells and 3 outcrop localities to determine the environments of deposition and climatic conditions that prevailed during its deposition. The Kirkwood Formation consists of three surface members: the Asbury Park, Grenloch Sand and Alloway Clay. Five subsurface phases, identified and described in this study, are correlated with the Early Miocene Tampa and Hawthorn Formations of South Carolina, Georgia and Florida, and the Middle Miocene Calvert, Choptank and St. Marys Formations of Maryland, Delaware and Virginia. The Asbury Park, Grenloch Sand and Alloway Clay Members are correlated with the subsurface Calvert Phase on the basis of their palynological assemblages. Paleobathymetric interpretations of the surface and subsurface facies of the Kirkwood Formation are made on the basis of their pollen, spore, dinoflagellate, diatom, silicoflagellate and radiolarian assemblages. These assemblages indicate nearshore environments of deposition for the Asbury Park, Grenloch Sand and Alloway Clay Members and transgressive and regressive sequences in the Tampa, Hawthorn, Calvert and St. Marys Phases. Paleoclimatic interpretations, made on the basis of <u>Pinus</u>/<u>Picea</u> ratios and changes in the regional microfloras indicate that the Asbury Park, Grenloch Sand and Alloway Clay were deposited during a period of climatic deterioration from subtropical to temperate conditions. A period of climatic deterioration from subtropical to temperate conditions is indicated to have taken place during the deposition of the Tampa, Hawthorn and lower portion of the Calvert Phase. A period of climatic amelioration is indicated during the deposition of the upper part of the Calvert Phase. A second period of climatic deterioration is indicated to have taken place during the deposition of the St. Marys Phase.

GOLDSTEIN, R. F. and H. L. COUSMINER. 1973. The palynology of the Kirkwood Formation in New Jersey. Proc. Geol. Soc. Amer. 5:168. (A)

Location: Not Given

Keywords: Fossil Invertebrates; Quercus; Carya; Paleofloristics

Abstract: Palynologic study of the Kirkwood Formation was initiated in order to determine if use of these techniques can provide new data bearing on the stratigraphy, geologic age and environmental setting of these sediments. These are broadly exposed from Asbury Park southwest to Salem. Subsurface equivalents thicken to over 800′ at Atlantic City. Fossil invertebrates indicate close correlation of the upper part of the Kirkwood Formation with the Chesapeake Group formations in Delaware, Maryland, Virginia and North Carolina. The formaniniferal assemblage in the lower part of the Kirkwood Formation indicates that continuous depostion had taken place from at least the lowermost Miocene. Sample intervals are placed in three depositional environments based on abundance and character of the organic residues: (a) subaerial or littoral, barren of organic detritus or containing highly oxidized and fragmented macerals; (b) restricted marine, abundant organic detritus including terrestrial plant macerals and fungal spores, and (c) open marine, moderate to low frequency organic detritus including dinoflagellates, diatoms, silico-flagellates, Radiolaria and Foraminifera. Palynomorph associates are dominated by pollen of the Quercus-Carya forest climax. Subordinates include forms of potential value for paleofloristic interpretation.

GRAMETBAUR, A. B. 1946. Bibliography and index of the geology of New Jersey. Geol. Bull. 59, Dept. Conserv., Trenton, N.J. pp. (R)

GRAY, T. C. and J. J. GROOT. 1966. See BOTANY citation.

GREACEN, K. F. 1941. The stratigraphy, fauna and correlation of the Vincentown formation. Bull. N.J. Geol. Surv. 52. (D)

GROOT, J. J. et al. 1961. Plant microfossils and the age of the Raritan, Tuscaloosa and Magothy formations of the eastern U.S.A. Palaeontographica B108:121-140. (D)

HANKS, J. P. 1971. See BOTANY citation.

HANKS, J. P. and D. E. FAIRBROTHERS. 1969. See BOTANY citation.

HARSHBERGER, J. W. 1916. See BOTANY citation.

HASTINGS, G. T. 1931. See BOTANY citation.

HEUSSER, C. J. 1979. See BOTANY citation.

HOLLICK, H. A. 1892. See BOTANY citation.

HOLLICK, A. 1899. See BOTANY citation.

HOLLICK, A. 1900. See BOTANY citation.

ISPHORDING, W. C. 1966. Petrology and stratigraphy of the Kirkwood Formation. Ph.D. Thesis, Rutgers University, New Brunswick, N. J. 181pp. (D)

Location: Specific Locations Not Given

Keywords: Minerological Descriptions; Cohansey Formation; Hydrometer Analyses; Textural Analysis

Abstract: The Kirkwood Formation of middle Miocene age was deposited under humid subtropical or warm-temperate climatic conditions. Deposition occurred adjacent to a highly weathered, low landmass on which the Schooley peneplane had developed. Initial deposition consisted of marine clays in the southern part of the state and organic-rich silts and clayey sands in the vicinity of Asbury Park, representing lagoonal conditions. The southern marine clays have been designated the Alloway clay member whereas the lagoonal phase has been termed the Asbury Park member. Basal sediments in the intervening area consist chiefly of dark grey sands and silts and represent the basal portion of the Sand facies of the Kirkwood formation. No unconformity is indicated between these Calvert age sediments and the higher Choptank and St. Mary's sands. Several locations can be seen where the silty, clayey, organic-rich sands of the Asbury Park member interfinger with the lower pale orange and white silts and sands of the Sand facies. No outcrops were seen where the Alloway clay member interfingers with the Sand facies in southern New Jersey but well logs indicate a similarity of conditions. The micaceous talc-like clay, found within the Alloway clay member, contains no talc and a relatively small amount of mica. The soft texture results from the presence of large flakes of kaolinite which appear to be the result of initial deposition in a fresh-water environment followed by diagenetic alteration, chiefly by dialysis. The latter is also thought to be responsible for the increase in kaolinite at the expense of montmorillonite which is found locally in

the Alloway clay. No evidence was found to indicate that the so-called "fluffy" sands lie below the micaceous talc-like clay of Ries and Kummel, and, on the contrary, they appear to represent uppermost Kirkwood. Heavy minerals in the Kirkwood formation are limited in variety and generally only the more resistant species are found. Prolonged weathering during the Oligocene and early Miocene undoubtedly removed most unstable minerals in the source lands; thus, they were never available for deposition. No major trends were noted in heavy mineral variation which could be used for correlative purposes. Feldspar is present in small quantities throughout the Kirkwood formation but is chiefly restricted, in abundance, to the lower portion of the Sand facies. A gradual depletion occurs vertically in the section and may reflect an increase in severity of weathering in the source area. Indications are that weathering of this type continued through middle Miocene and possibly throughout most of Cohansey time. Glauconite is scarce in the Kirkwood formation and testifies to a minimum of reworking of older Coastal Plain sediments. The general angularity of both light and heavy minerals suggests a first-cycle origin, predominantly from sources in the Piedmont and New Jersey Highlands. The relationship of the overlying Cohansey formation to the Kirkwood formation could not be absolutely determined but, though local unconformities do exist in outcrop, no evidence was found to indicate such a relationship downdip. The Cohansey formation probably represents a shoreward phase of the Kirkwood formation with initial deposition occurring during the withdrawal of the St. Mary's sea. Deposition continued throughout upper Miocene time, chiefly in deltas and lagoons, accompanied by an eastward migration of the shoreline. The mineralogy of the Cohansey formation would indicate a continuation, and possibly intensification, of climatic conditions which characterized the source area during Kirkwood deposition.

ISPHORDING, W. C. 1970. Petrology, stratigraphy and re-definition of the Kirkwood Formation (Miocene) of New Jersey. Jour. Sediment Petrol. 40:986-997. (D)

Location: General

Keywords: Alloway Clay Member; Asbury Park Member; Grenloch Sand Member; Texture; Heavy Minerals

Abstract: The late Tertiary Kirkwood Formation is exposed over an area of nearly 600 square miles in the Coastal Plain Province of New Jersey and is made up of sands, silts and clays deposited in marine and transitional marine environments. Detailed investigation and sediment analysis revealed that the Kirkwood Formation can be subdivided into three members: (1) The Alloway Clay Member, exposed in the

southern part of the state; (2) The Asbury Park Member, found in the northeastern portion of the Coastal Plain, in Monmouth County, and (3) the Grenloch Sand Member, which grades laterally into both of the other members and also overlies them and is best exposed in the central and northern portion of the Coastal Plain. The Alloway Clay Member consists of marine clays, with some interbedded sands and sandy silts that were deposited chiefly in the middle neritic (sub-litoral) zone. Fossil evidence indicated that deposition may have been initiated as early as the late Oligocene and continued, uninterrupted, through the lower middle Miocene. Diagenetic changes resulting from the upward leaching of groundwaters have caused part of the Alloway Clay to become greatly enriched in kaolinite and have also resulted in the formation of a bed of exceptionally large kaolinite grains, some of which exceed 0.2 mm in size. In addition, a highly fossiliferous portion of the Alloway Clay, known locally as the "Shiloh Marl", has been transformed into an opal-cemented orthoquartzite by precipitation of dissolved silica ain groundwaters. The Asbury Park Member is the smallest of the three members that make up the Kirkwood Formation and is, for the most part, non-marine in origin. The finely laminated, organic-rich, silty sands are thought to be the product of deposition in swamps, lagoons, and estuaries that were open to the sea and reflect this origin both in texture and mineralogy. The pale yellow, orange, and pink silts and fine sands of the Grenloch Sand Member are found cropping out from Delaware Bay to Raritan Bay and form the largest member of the Kirkwood Formation. Sediments in the lower portion of this unit were deposited in the middle-neritic environment during the final transgressions of the late Tertiary seas and grade upward into coarser grained sediments. These coarser sediments were deposited in shallow marine and transitional marine environments during the late middle Miocene when the seas began to withdraw from the present Coastal Plain. Deposition and withdrawal of the sea is thought to have continued throughout the upper Miocene with the result that an essentially conformable relationship exists between the Kirkwood Formation and overlying Cohansey Sand. Heavy minerals were not found to be useful for stratigraphic correlation within the formation but the extremely limited suite coupled with the light minerals and clay minerals present furnished strong evidence for humid, sub-tropical climatic conditions in northeastern United States during the middle Miocene.

ISPHORDING, W. C. and W. LODDING. 1968. Origin of the Woodstown, New Jersey, macro-kaolinite. Clays and Clay Minerals 16:257-264. (D)

Location: Woodstown

Keywords: Kirkwood Formation; Vincentown Sand; Clay; Sedimentation

Abstract: A kaolin bed in which many of the individual platelets exceed 0.2 mm in size occurs in the immediate vicinity of the base of the middle Miocene Kirkwood Formation, near Woodstown N.J. These platelets appear to have resulted from breakdown of pre-existing illite and montmorillonite coupled with concurrent epitaxial growth and diagenetic growth of primary kaolinite. The alteration of the clay minerals is thought to be a product of upward leaching (dialysis) by groundwaters in the underlying Vincentown Sand. This is further evidenced by abnormally high percentages of clay-size kaolinite in the clays that lie above the Vincentown Sand but beneath the macro-kaolinite horizon. Growth of the macro-kaolinite was facilitated by face-to-edge sedimentation and the resultant high permeability of the stratum.

ISPHORDING, W. C. and W. LODDING. 1969. Facies changes in sediments of Miocene age in New Jersey. In Subitzky, S. (ed.). Geology of selected areas in New Jersey and eastern Pennsylvania and guidebook of excursions. Rutgers Univ. Press, New Brunswick, N.J. pp.7-13. (R)

Location: General

Keywords: Kirkwood Formation; Alloway Clay; Cohansey Formation; Grenloch Sand

ISPHORDING, W. C. and W. LODDING. 1973. Geochemistry and diagenesis of macrokaolinite. Geol. Soc. Amer. Bull. 84:2319-2326. (D)

Location: Newfield (29); Fairton

Keywords: Kirkwood Formation; Alloway Clay Member; Calcium; Iron; Groundwater; Siderite; Muscovite

Abstract: Three stages of diagenesis can be identified in the sediments that form the Alloway Clay Member of the Miocene Kirkwood Formation in New Jersey. Clay- and sand-size muscovite, mixed with woody debris, formed the original sediment. These materials were deposited in restricted lagoons receiving a high amount of fresh water runoff. Transgression of the sea then resulted in the deposition of marine clays above the lagoonal sediments. Following regression, the muscovite was altered to sand-size kaolinite by the action of acidic ground water. This highly permeable unit was locally cemented by deposition of siderite, forming large concretions. Later, all calcereous fossils in the macrokaolinite bed were removed by

dissolution, while those inside the siderite concretions were preserved. These diagenetic episodes are controlled by changes in Ca+2 and Fe+2 concentration of the ground water and, significantly, by permeability.

JAWORSKI, A. Z. 1980. A pedologic study of some tidal marsh soils in New Jersey. Ph.D. Thesis, Rutgers Univ., New Brunswick, N.J. 154pp. (D)

Location: Silverton (4a); Cedar Run (27); Parkertown (35); Stone Harbor (49); New Gretna (34); Reeds Beach (50); Port Norris (47)

Keywords: Organic Material; C/N Ratios; Cation Exchange Capacity; Salinity; Texture

Abstract: Field and laboratory investigations were conducted to characterize the tidal marsh soils of New Jersey and to classify them according to their genesis. An attempt was made to correlate the distribution of vegetation with soil conditions and to observe soil erosion in the tidal marshes. Organic matter content is variable in these soils, however, it generally decreases with soil depth. Conversely, the degree of humification increases with depth. Organic matter tends to accumulate in larger amounts in less frequently flooded areas of the tidal marsh. Since the organic matter content is generally less than 20%, the soils are not considered to be, in general, organic. C/N ratios range from 17.4 to 20.9 in these inundated soils and gleization occurs extensively throughout the frofile in many cases. The CEC was found to be 32,6 me/100 g in one study, and the exchangeable sodium occupied 13 percent of the exchange sites. The conductivity of this site was 28 mmhos/cm. Generally, the salinity is higher in the protected coastal marshes than the estuarine marshes, but it is usually 4 mmhos/cm. Generally, the depth of the soil increases with closer proximity to the sea, river or bay while the texture of the underlying sediment grades from sand to silt. Identifable plant remains in the soil profile suggest that presentday salt marsh vegetation has covered freshwater plants, indicating that the marshes are encroaching landward as a result of coastal submergence. Particle size distribution studies suggest that the estuarine marshes have formed in a much higher energy environment, overall, than the protected coastal marshes. Sand grain morphology studies indicate that grains occurring in the tidal marsh are more rounded and chemically weathered suggesting the movement of these particles from upland conditions into the marsh by streams and water during the formation of the tidal marshes. Non-expanding clay-size minerals such as chlorite, illite, kaolinite and quartz were found associated with the saline, protected coastal marshes. In the freshwater estuarine marsh, expanding clay-size

minerals such as 2:1 smectite interstratified with mica, and hydroxy-Al-interlayered vermiculite were found. Illite, kaolinite and quartz were found also in the freshwater estuary. Chlorite and halloysite were not detected in this estuary site. Aerial photographs indicate that erosion has occurred along the edge of the tidal marsh at Parkertown between the years 1940 and 1974. Soil texture, as well as salinity and other factors may influence the distribution of salt marsh vegetation. Soils have been classified according to their physiographic position and their depth. Four soil series were named. A map of the survey sites is presented along with profile descriptions of some tidal marsh soils.

JENNINGS, P. H. 1936. See ZOOLOGY citation.

JOFFE, J. S. 1931. Soil profile studies: III. The process of podzolization. Soil Sci. 32:303-323. (D)

JOFFE, J. S. and C. W. WATSON. 1933. Soil profile studies: V. Mature podzols. Soil Sci. 35:313-331. (D)

JOGAN, B. 1978. Geology of Atlantic County in brief. Bur. Geol. Topogr., Dept. Environ. Protect., Trenton, N. J. 20pp. (D)

Location: Atlantic County

Keywords: Physiography; Formations Descriptions; Natural Resources

JOHNSON, M. E. 1950. Geologic map of New Jersey, atlas sheet 40. Dept. Conserv. Econ. Develop., Trenton, N.J. 1p. (D)

JOHNSON, M. E. and H. G. RICHARDS. 1952. Stratigraphy of the Coastal Plain of New Jersey. Amer. Assoc. Petro. Geol. Bull. 36:2150-2160. (D)

JORDAN, C. F. 1968. A simple tension-free lysimeter. Soil Sci. 105:81-86. (D)

Location: Not Given

Keywords: Lakewood Soil; pH; Iron; Calcium; Potassium; Organic Material

KASABACH, H. F. and R. J. SCUDDER. 1961. See HYDROLOGY citation.

KIMYAI, A. 1966. See BOTANY citation.

KOCH, R. C. 1975. Dinoflagellate biostratigraphy of Maestrichian formations of the New Jersey Coastal Plain. Ph.D. Thesis, Rutgers Univ., New Brunswick, N.J. 110pp. (D)

Location: Leggette Well (29); Contact Creek Well (2)

Keywords: Cretaceous; Hornerstown Formation; Plankton; Foraminifera

Abstract: The Cretaceous strata that lie along the line of outcrop below the Hornerstown Formation have been interpreted either as angularly truncated beds or as sedimentary facies of equivalent age. This problem has remained unresolved because of the lack of definitive biostratigraphic control due to the absence of calcareous skeletal fossils wwhich apparently were lost to solution. The presence of organic-walled planktonic microfossils in these beds and their occurrence in the subsurface where they are associated with calcareous planktonic microfossils now enables clarification of this Cretaceous problem. The vertical distribution of dinoflagellate species permits a biostratigraphic zonation of the Maestrichtian formations of the New Jersey Coastal Plain and comparison to well established biostratigraphic zones based on planktonic foraminifera. The basal Maestrichtian is marked by the Paleohystrichophaera infusorioides Zone and is equivalent to the Rugotruncana subcircumnodifera Zone based on planktonic foraminifers. The mid to upper Maestrichtian is defined by the Paleoperidinium basilium Zone which has been subdivided into a lower Deflandrea magnifica - Svalbardella australiana subzone and an upper Deflandrea cretacea subzone. The lower and upper subzones are equivalent to the planktonic foraminiferal Globotruncana gansseri and Abathomphalus mayaroensis Zones respectively. The presence of the latest Maestrichtian zonal indicators in the basal beds of the Hornerstown Formation in southern New Jersey in conjunction with other Cretaceous invertebrates and vertebrates indicates that the so-called "bone bed" within the lower part of the Hornerstown marks the top of the Cretaceous System in New Jersey. The analysis of the dinoflagellate and acritarch assemblages has revealed the presence of 46 species distributed among 29 genera. Eight species are described as new.

KOCH, R. C. and R. K. OLSSON. 1977. Dinoflagellate and planktonic foraminiferal biostratigraphy of the Uppermost Cretaceous of New Jersey. Jour. Paleo. 51:480-491. (D)

Location: Leggette Well (29); Contact Creek Well (2)

Keywords: Hornerstown Formation; Deposition; Foraminifera

Abstract: The association of dinoflagellate-acritarch and planktonic foraminiferal assemblages in the Maestrichtian strata of the New Jersey Coastal Plain indicates that the formations upon which the Hornerstown Formation rests represent equivalent sedimentary facies. Furthermore the top of the Cretaceous System falls within the basal part of the Hornerstown Formation, a formation within which lies the Cretaceous-Tertiary boundary.

KODAMA, D. R. and R. T. T. FORMAN. 1977. See BOTANY Citation.

KUMMEL, H. B. 1940. The geology of New Jersey. N.J. Dept. Conserv. Develop. Bull. 50:1-203, Trenton, N.J. (D)

KUMMEL, H. B. and G. N. KNAPP. 1904. The stratigraphy of New Jersey clays. In Ries, H. and H. B. Kummell (eds.). The clays and clay industry of New Jersey. Final Rept. State Geol. 6:117-203, N.J. Geol. Surv., Trenton, N.J. (R)

KUMMEL, H. B. and J. V. LEWIS. 1940. The geology of New Jersey. Geol. Ser. Bull. 50, N.J. Dept. Conserv. Develop., Trenton, N.J. (R)

LAYCOCK, W. A. 1967. See BOTANY citation.

LEWIS, J. V. and H. B. KUMMEL. 1910. Geologic map of New Jersey. N. J. Geol. Surv., Trenton, N.J. 1p. (D)

LEWIS, J. V. and H. B. KUMMEL. 1940. The geology of New Jersey. Bull. 50, Dept. Conserv. Econ. Develop., Div. Geol. Topogr., Trenton, N.J. (D)

LIGHT, M. A. 1950. Glauconite of the New Jersey Coastal Plain. Ph.D. Thesis, Rutgers Univ., New Brunswick, N.J. 244pp. (D)

Location: Hornerstown (2); Georgetown (1); Birmingham (7)

Keywords: Thermal Analysis; Petrographic Analysis; Chemical Analysis; Sedimentation; Upper Magothy Formation

Abstract: Authigenic and detrital glauconites are described. Authigenic glauconite predominates in the Upper

Cretaceous clays and is typically developed in the Merchantville formation. Detrital glauconite predominates in the formations above the Marshalltown. It is typically developed in the Hornerstown formation. Authigenic glauconite is found intimately associated with clay which is predominately illitic. Sedimentary deposits which are composed of predominately detrital glauconite do not contain significant amounts of clay. The clays which are predominantly kaolinitic do not contain authigenic glauconite (e.g., Raritan, Lower and Middle Magothy and the Marshalltown as developed in Monmouth County). Chemical analyses of authigenic and detrital glauconite show a similarity in much of the composition but the detrital shows that some of the iron has been replaced by other bases. Conditions which are necessary for the formation of glauconite: illitic source material, availability of replaceable ions, a neutral salt solution (sea water), presence of $CaCO_3$ for precipitation of ferric iron and reducing conditions (presence of organic matter) for the formation of ferrous iron and facilitation of potassium absorption.

LITTLE, S. 1945. See BOTANY citation.

LITTLE, S. 1981. See BOTANY citation.

LODDING, W. 1961. Gibbsite vermiforms in the Pensauken Formation of New Jersey. Amer. Minerol. 46:394-401. (D)

Location: Columbus (1)

Keywords: Chemistry; Distribution; Genesis

Abstract: Vermiform aggregrates found in seven localities in the coarse sands of the Pensauken formation were identified as composed mostly of gibbsite. Although their appearance is very similar to kaolinite vermiforms and knaeuel described in the literature, all indications are that they are authigenic and formed by direct weathering of feldspar and other silicates to gibbsite, suggesting a near-laterite type of weathering during an interglacial period of the Pleistocene in this area.

LULL, H. W. and J. H. AXLEY. 1958. See BOTANY citation.

LUTZ, H. J. 1934. See BOTANY citation.

LYELL, C. 1844. Notes on the Cretaceous of New Jersey and the Atlantic border states. Amer. Jour. Sci. 47:213-214. (R)

LYELL, C. 1845. The Cretaceous strata of New Jersey. Quart. Jour. Geol. Soc. London 1:55-60. (R)

LYFORD, W. H. and G. A. QUAKENBUSH. 1956. Developments in the classification of the Sassafras soil series. Soil Sci. Soc. Amer. Proc. 20:397-399. (D)

Location: General

Keywords: Distribution; Description

Abstract: Drastic modifications have taken place in the classification of the Sassafras soil series since it was first named in 1900. Until about 1936 the range of the series was very broad and texture of the B horizon varied from sand to silty clay loam. During the period 1936 to 1943 more than 30 new series were proposed to cover the same range. These sites and the reasons for the new separations are listed. A representative description of the present day Sassafras is given.

MacCLINTOCK, P. and H. G. RICHARDS. 1936. Correlation of late Pleistocene marine and glacial deposits of New Jersey and New York. Geol. Soc. Amer. Bull. 47:289-338. (D)

MANSFIELD, G. R. 1919. General features of the New Jersey glauconite beds. Econ. Geol. 14:555-567. (D)

MANSFIELD, G. R. 1920. The physical and chemical character of the New Jersey Greensand. Econ. Geol. 15:547-566. (D)

MANSFIELD, G. R. 1922. Potash in the greensands of New Jersey. U.S. Geol. Surv. Bull. 727. (D)

MARKEWICZ, F. J. 1969. Ilmenite deposits of the New Jersey Coastal Plain. In Subitzky, S. (ed.). Geology of selected areas of New Jersey and eastern Pennsylvania and guidebook of excursions. Rutgers Univ. Press, New Brunswick, N.J. pp.363-382. (R)

Location: Lakehurst (3,4); Browns Mills (8); Medford Lakes (14)

Keywords: Cohansey Formation Deposition; Distribution; Kirkwood Formation; Cape May Formation; Heavy Metals; Mineralogy; Ore Characterization

MARKEWICZ, F. J. and D. G. PARILLO. 1957. Preliminary reports on Ileminite-bearing sands from the Coastal Plain of New Jersey. Geol. Soc. Amer. Ann. Meet.:92. (A)

MARKEWICZ, F. J., D. G. PARILLO and M. E. JOHNSON. 1958. The titanium sands of southern New Jersey. Meet. Ann. Inst. Min. Eng., New York . prepr. No. 5818A5. p. (R)

Location: Lakewood (4A); Lakehurst (3,4); Colliers Mill (3); Browns Mills (8); Medford Lakes (14)

Keywords: Geography; Geology; Kirkwood Formation; Cohansey Formation; Ilemenite

MARKLEY, M. L. 1979. Soil series of the Pine Barrens. Chapter 5 <u>In</u> Forman, R. T. T. (ed.). Pine Barrens: ecosystem and landscape. Academic Press, New York. pp.81-93. (R)

Location: General

Keywords: Soils Distributions; Soil Properties

Abstract: A map of the general distribution of soils in the Pine Barrens is presented, along with detailed descriptions of ecologically important characteristics of the 13 major soil series. In order, the most extensive soils are Downer, Atsion, Lakewood, Lakehurst, Muck, and Evesboro. Information on the three additional soils of limited distribution is included. Northern and southern portions of the Pine Barrens generally have different soils, and eastern and western portions differ similarly. Seven soils are well-to-excessively drained, whereas eight soils exhibit impeded drainage,i.e., three moderately well or somewhat poor, and five poor to very poor. Only one uncommon soil is classified as moderately well-drained. All unlimed surface soils are extremely acid (pH 3.6 - 4.0), with subsurface and substratum horizons about pH 4.2 - 5.0. Except for the upper horizons of Muck soil, all soils range from sandy clay loam to sand and have low fertility (cation exchange capacity generally well under 10). Crops currently are grown on almost all soils.

MARTENS, J. H. 1948. Heavy mineral tailings from New Jersey glass sands. Info. Circ. 2, Bur. Min. Res., Rutgers Univ., New Brunswick, N.J.

MARTENS, J. H. 1956. Industrial sands of New Jersey. Rutgers Univ. Bureau Mineral Research Bull. 6, New Brunswick, N. J. (R)

MAY, F. E. 1976. See BOTANY citation.

McCORMACK, R. K. 1955. Quaternary and Tertiary geology of the Millville area in southern New Jersey. M.S. Thesis, Rutgers Univ., New Brunswick, N.J. 121pp. (D)

Location: Millville (36)

Keywords: Soils; Bridgeton Formation; Cohansey Formation; Cape May Formation; Deposition

Abstract: There is no significant change in the mineral suite of the Cohansey formation in the approximately one-hundred foot vertical section examined. Some thin beds may occur which have a different composition, but their presence is doubted. The differences which exist between the Cohansey formation and the Bridgeton and Cape May formations in the proportion of black opaques and brown opaques are significant and may be used for stratigraphic purposes. Deposition was not continuous throughout the time interval represented by the Cohansey formation. Fairly large local unconformities are indicated by the distribution of the clay strata and the presence of intraformational conglomerates. The differences noted in both the heavy and light mineral constituents of the Bridgeton formation as compared to those of the Cohansey formation amplify Salisbury and Knapp's (1917) conclusions that the Glassboro phase of the Bridgeton is largely derived from northern sources. The composition and physical characteristics of the Cape May materials can be readily explained if it is considered to be entirely derived from a combined Bridgeton and Cohansey source. This particular part of the Cohansey formation was deposited in a deltaic environment. For this reason the divisions made in the formation in this particular area can not be expected to be developed continuously over a wide extent of the Coastal Plain. Other clay deposits may or may not have a similar mode of deposition and stratigraphic position.

McCORMICK, J. 1970. See GENERAL REFERENCES citation.

McCORMICK, J. and M. F. BUELL. 1968. See BOTANY citation.

MELLO, J. F., J. P. MINARD and J. P. OWENS. 1964. See ZOOLOGY citation.

MILLER, H. W. 1955. See ZOOLOGY citation.

MILLER, H. W. 1956. Paleocene and Eocene, and Cretaceous-Paleocene boundary in New Jersey. Amer. Assoc.

Petro. Geol. Bull. 40:722-736. (D)

MINARD, J. P., J. P. OWENS and T. C. NICHOLS. 1964. Pre-Quaternary geology of the Mount Holly Quadrangle, New Jersey. Geol. Quad. Map GQ-272, U.S. Geol. Surv., Washington, D.C. 1p. (D)

MINARD, J. P., J. P. OWENS, N. F. SOHL, H. E. GILL and J. P. MELLO. 1969. Cretaceous - Tertiary boundary in New Jersey, Delaware and eastern Maryland. U.S. Geol. Surv. Bull. 1274-H:1-33, Washington, D.C. (R)

MINARD, J. P., J. P. OWENS and R. TODD. 1961. Redefinition of the Mount Laurel Sand (Upper Cretaceous) in New Jersey. Article 173, U.S. Geol. Surv. Prof. Paper 424-C, Washington, D.C. pp.61-63. (D)

NEW JERSEY GEODETIC CONTROL SURVEY. 1944. Bench marks in Cumberland and Salem Counties. Geol. Ser. 58, Dept. Conserv. Develop., Trenton, N.J. (D)

NEW JERSEY GEOLOGIC SURVEY. 1868. Geological Survey of New Jersey Maps. Trenton, N. J. 13pp. (D)

NEW JERSEY GEOLOGIC SURVEY. 1854-1908. Annual Reports of the State Geologist. Trenton, N. J.

NINE, O. W. 1954. See ZOOLOGY citation.

O'GRADY, M. D. 1976. Paleobathymetry of the Bass River Formation and its implications. Ph.D. Thesis, Rutgers Univ., New Brunswick, N.J. 105pp. (D)

Location: Lakehurst (4); Toms River (11); Island Beach (20); Transco Well 17 (18); Transco Well 16 (26)

Keywords: Foraminifera; Structural Features; Salisbury Embayment; Systematic Descriptions

Abstract: A major transgression encroached upon New Jersey in Early Cenomanian times which lasted until nearly Middle Turonian times. An extensive subsurface marine lithologic unit, the Bass River Formation, was thus deposited. Using foraminifera as a primary tool, three distinct paleobathymetric zones can be recognized within the Bass River Formation. Zone 1 represents a shallow water

environment, Zone 2 a mid to outer shelf environment, and Zone 3 represents a bathyal environment. The existence of these widely differing bathymetric realms during Bass River times lends support to the proposed existence of major structural features in New Jersey at this time. In this regard, a structural high, termed the South Jersey High, located in south-central Jersey, can be recognized and contrasted with a structural, termed the Salisbury Embayment, located in southern New Jersey. This depression also extends into Delaware and Maryland.

OLSSON, R. K. 1960. See ZOOLOGY citation.

OLSSON, R. K. 1963. Latest Cretaceous and earliest Tertiary stratigraphy of New Jersey coastal plain. Bull. Amer. Assoc. Petro. Geol. 47:643-665. (D)

Location: General

Keywords: Biostratigraphy; Lithostratigraphy; Navesink Formation; Tinton Formation; Hornerstown Formation; New Egypt Formation; Foraminifera; Globotruncana; Globorotalia; Hedbergella; Deposition Cycle; Redbank Formation

Abstract: Biostratigraphic and lithostratigraphic analyses of surface and subsurface sediment samples from latest Cretaceous and earliest Tertiary formations of the New Jersey Coastal Plain have resulted in a new interpretation of the stratigraphy of this sequence. Five formations are recognized and one of these, the New Egypt Formation, is newly described. The Navesink, Tinton, Hornerstown and New Egypt Formations lithologically are characterized by a great abundance of the mineral glauconite, which occurs principally as sand-size grains. In contrast, the Redbank Formation is a quartz sand. Two new members of the Redbank Formation are recognized, a lower Sandy Hook Member and an upper Shrewsbury Member. Four planktonic foraminiferal assemblage zones are established in this stratigraphic sequence. The Navesink Formation is of late Early or Middle Maestrichtian age and contains the Globotruncana fornicata - Globotruncana tricarinata Assemblage Zone. The Late Maestrichtian Redbank Formation contains the Globotruncana contusa - Hedbergella monmouthensis Assemblage Zone. The Globorotalia compressa - Globigerinoides daubjergensis (Early Paleocene or Danian) and the Globorotalia angulata (Late Paleocene to Early Eocene) Assemblage Zones are present in the Hornerstown Formation. The occurrence of all of these zones in the New Egypt Formation demonstrates the facies relationship which exists between this formation and the other formations considered in this paper. A single cycle of glauconite deposition occurred throughout latest

Cretaceous and earliest Tertiary time. The cycle was interrupted locally by influx of the Redbank quartz clastics but adjacent to the site of quartz sand deposition glauconite accumulated continuously. Paleoecological data indicate deposition of this sequence in shallow mid-neritic depths of water. There is no convincing evidence of a Cretaceous - Tertiary unconformity, but in contrast most of the evidence suggests continuous deposition from Cretaceous into Tertiary time. The New Egypt Formation is interpreted as a seaward facies of the more varied nearer-shore facies represented by the Navesink, Redbank, Tinton and Hornerstown Formations.

OLSSON, R. K. 1964. See ZOOLOGY citation.

OLSSON, R. K. 1967. See ZOOLOGY citation.

OLSSON, R. K. 1970. See ZOOLOGY citation.

OLSSON, R. K. 1975. Upper Cretaceous and Lower Tertiary Stratigraphy, New Jersey Coastal Plain. Petro. Explor. Soc. N. Y. Second Ann. Field Guide Book. 49pp. (R)

OLSSON, R. K. and E. S. GAFFNEY. 1970. The Cretaceous - Tertiary datum in New Jersey. NE Sect. Meet., Pittsburg, Geol Soc. Amer. Abstracts. (A)

OLSVIG, L. S., J. F. CRYAN and R. H. WHITTAKER. 1979. See BOTANY citation.

OWENS, J. P. and J. P. MINARD. 1975. Geologic map of the surficial deposits in the Trenton area, New Jersey and Pennsylvania. U.S. Geol. Surv. Misc. Invest. Map Ser. I:1-884, Reston, Virginia. (D)

OWENS, J. P., J. P. MINARD and P. D. BLACKMON. 1961. Distribution of clay-sized sediments in the coastal plain sediments near Trenton, New Jersey. U.S. Geol. Surv. Prof. Paper 424-C:c317-c319. (D)

OWENS, J. P., J. P. MINARD and N. F. SOHL. 1968. Cretaceous deltas in the northern New Jersey Coastal Plain. In R. L. Fink (ed.). Guidebook to field excursions. N.Y. State Geol. Assoc. 40th Ann. Meet., Flushing, N.Y. Dept. Geol., Brockport Univ. Coll., Brockport, N.Y. pp.33-48. (R)

OWENS, J. P., J. P. MINARD and N. F. SOHL. 1970. Stratigraphy of the outcropping post-Magothy Upper Cretaceous formations in southern New Jersey and northern Delmarva Peninsula. U.S. Geol. Surv. Prof. Paper 674:1-60, Washington, D.C. (D)

OWENS, J. P. and N. F. SOHL. 1969. Shelf and deltaic paleo-environments in the Cretaceous-Tertiary formations of the New Jersey Coastal Plain. In S. Subitsky (ed.). Geology of selected areas in New Jersey and Pennsylvania, and guidebook of excursions. Rutgers Univ. Press, New Brunswick, N.J. pp.235-278. (R)

Location: General; Mount Holly (6)

Keywords: Formation Descriptions; Sedimentation; Petrology; Texture; Heavy Metals; Mineralogy

Abstract: The northern Atlantic Coastal Plain consists of sediments deposited in a wide variety of continential, transitional and marine environments. Pleistocene erosion of the emerged Coastal Plain has exposed nearly a complete stratigraphic sequence of formations ranging in age from Late Cretaceous (Cenomanian) through Pliocene (?). The Coastal Plain or continential terrace can be separated into four natural rock sequences; these are, in ascending order: (1) largely fluviatile-deltaic deposits of early Late Cretaceous age, represented by the Raritan Formation; (2) chiefly interstratified deltaic and shelf deposits of Late Cretaceous and early Tertiary age; (3) sediments of middle Miocene-Pliocene (?) age; and (4) sediments of Quaternary age. Deposits of the first three sequences are discussed and demonstrate the contrast between the deposits formed in deltaic and shelf environments. These three sequences are compared with modern analogs from the Gulf of Mexico.

OWENS, J. P. and N. F. SOHL. 1973. Glauconites from the New Jersey - Maryland Coastal Plain. Geol. Soc. Amer. Bull. 84:2811-2838. (D)

PARRIS, D. C. 1974. See ZOOLOGY citation.

PEEL, B. A. 1980. See GENERAL REFERENCES citation.

PETTERS, S. W. 1975. Subsurface Upper Cretaceous stratigraphy and foraminiferal biostratigraphy of the Atlantic Coastal Plain of New Jersey. Ph.D. Thesis, Rutgers Univ., New Brunswick, N.J. (D)

Location: Lakehurst (4); Fort Dix (2,3,8,9); Toms River (11); Transcontinential Pipeline Wells

(8,9,10,16,17,18,26,27)

Keywords: Depositional Phases; Bass River Formation; plankton; Salisbury Embayment; Merchantville Formation; Magothy Formation; Greensands; Bolivinoides

Abstract: A time Stratigraphic framework is presented by means of which the relationship between the various lithic units in the Cretaceous section of the New Jersey Coastal Plain can be appraised, in order to gain a three-dimensional view. This has been done by collating available biostratigraphic data from outcrop with detailed foraminiferal zonation of the subsurface section. The stratigraphic history of the Upper Cretaceous of the Coastal Plain is considered in terms of four main depositional phases which in turn reflect major transgressive-regressive cycles. A new stratigraphic unit, the Bass River Formation, is proposed for the calcareous clayey silts deposited during the initial encroachment of the sea into the region. The Bass River Formation ranges in age from earliest Cenomanian (Washitian) to early Turonian (Eaglefordian). The Bass River Formation is restricted to the subsurface with only marginal marine facies in the Woodbridge Clay member of the Raritan. It would appear as if this transgression reached its climax in the lower Turonian during which the Woodbridge Clay Member was deposited.

PETTERS, S. W. 1976. Upper Cretaceous subsurface stratigraphy of Atlantic Coastal Plain of New Jersey. Amer. Assoc. Petro. Geol. Bull. 60:87-107. (D)

PETTERS, S. W. 1977a. Upper Cretaceous planktonic foraminifera from the subsurface of the Atlantic Coastal Plain of New Jersey. Jour. Foraminiferal Res. 7:165-187. (D)

Location: Transcontinential Gas Pipeline Wells (4,6,7,8,9,10,11,12 14,15,16,17,18,19,20,26,50)

Keywords: Planktonic Zonation; Whiteinella; Globotruncanella; Globigerinelloides; Hedbergella

Abstract: Foraminiferal analysis of the subsurface Cretaceous section of the New Jersey Coastal Plain has provided a complete planktonic zonation of Washitan (Cenomanian) to Navarroan (Maastrichtian) age, thus expanding the previous zonation. Fourteen zones are recognized and used to correlate with the standard European and North American sections. In the Santonian a remarkable evolutionary outburst took place among the globigerine taxa so that new short-lived forms of Whiteinella appeared in rapid evolutionary succession from the early Santonian to late Campanian. This produced a Whiteinella bioseries which

led to Globotruncanella. In the Santonian, transitional stages occur among the hedbergellids which show a high, asymmetric, equatorial position of the primary aperature and a very low to slightly depressed spiral side. This was the evolutionary pathway which led to the planispiral morphology of Globigerinelloides. Two new species exhibit this transition, namely, Hedbergella lata n. sp. which led to Globigerinelloides prairiehillensis, and Hedbergella atlantica n. sp. which gave rise to Globigerinelloides praevolutus n. sp., the ancestor of Globigerinelloides volutus.

PETTERS, S. W. 1977b. Bolivinoides evolution and Upper Cretaceous biostratigraphy of the Atlantic Coastal Plain of New Jersey. Jour. Paleo. 51:1023-1036. (D)

Location: Lakehurst (4); Lavellette (12); Island Beach State Park (20); Fort Dix (2); Lebanon State Forest (8,9); Warren Grove (26,27)

Keywords: Evolutionary Trend; Pore Density; Size Changes

Abstract: Analysis of subsurface samples from the Atlantic Coastal Plain of New Jersey shows that the following Bolivinoides zones are present in the region: B. strigillatus Zone, B. culverensis Zone, B. decoratus Zone, B. miliaris Zone, and B. draco Zone. Bolivinoides species show an evolutionary trend affecting pore density and morphology from the simple rounded sparsely distributed pores of B. strigillatus to the dense slit-like pores of B. culverensis which culminated in the highest pore density of B. draco. The rate of size change (darwins) was computed for the Bolivinoides lineages; a fast rate of change occurred during the Campanian, the greatest acceleration taking place between B. culverensis and B. decoratus leading to an increase in test size in a lineage which was apparently favored by strong selective pressures during the Campanian temperature optimum.

PIKE, C. M. 1971. See HYDROLOGY citation.

PINELANDS COMMISSION. 1980. See GENERAL REFERENCES citation.

PINELANDS ENVIRONMENTAL COUNCIL. 1974. See BOTANY citation.

PINELANDS ENVIRONMENTAL COUNCIL. 1975. See BOTANY citation.

PLATT, D. W. 1979. Mineralogy as an indicator of weathering in the Downer series. M.S. Thesis, Rutgers Univ., New Brunswick, N. J. (D)

POTZGER, J. E. 1952. See BOTANY citation.

PURVIS, E. R. 1964. See BOTANY citation.

RACHELE, J. D. 1976. See BOTANY citation.

RHODEHAMEL, E. C. 1973. See HYDROLOGY citation.

RHODEHAMEL, E. C. 1979. Geology of the Pine Barrens of New Jersey. Chapter 3 In Forman, R. T. T. (ed.). Pine Barrens: ecosystem and landscape. Academic Press, New York. pp.39-60. (R)

Location: General

Keywords: Physiography; Geologic History; Stratigraphy; Tertiary Deposits; Quaternary Deposits

Abstract: Underlying the Pine Barrens of New Jersey is a 200 - 170 million-year-old Atlantic Coastal Plain ranging in thickness from 400 to 1830 m (1300-6000 ft), with a gentle southeastward dip. Lower Cretaceous age continential deposits are overlain by Upper Cretaceous and Tertiary age strata deposited first in transitional and nearshore-marine environments, followed by open marine shelf, nearshore-marine, transitional (deltaic and interdeltaic), and finally, in fluvial environments. During the middle or late Miocene time 18-5 million years ago, the Coastal Plain emerged >100 m, exposing thick deposits of marine quartzose sand and clay (Kirkwood Formation), overlain by deltaic, beach and tidal flat quartz-arenite deposits interspersed with carbonaceous silt and clay (Cohansey Sand). Upon this predominantly sandy plain, a quartzose and cherty sand and gravel (Beacon Hill Gravel) was laid down, most probably by an ancient Hudson River. This was the last deposit introduced into the northern and central upland Pine Barrens area and today caps many of the highest hills, attesting to the enormous amount of erosion which followed. Fluvial deposits, Arkose 2 and Arkose 1, were introduced into the southwestern portion of the Pine Barrens in late Tertiary. The so-called "valley-terrace phase" of the Cape May Formation in the Pine Barrens is a misnomer. Quartz Sand 2 and Quartz Sand 1 of a Quaternary interglacial (Sangamonian age) represent redeposition of some of these older deposits. Because of the tundra and arctic climate that likely existed in the region during the late Pleistocene (Wisconsin Glaciation), the present Pine Barrens flora subsequently entered the region along either a widely exposed Coastal Plain corridor prior to sea level rise, or by an eastern migration from higher ground to the west, and perhaps by both routes. Sand, chiefly from the Cohansey Sand, with patches of younger deposits as a discontinuous veneer on

hilltops and elsewhere, suggesting a "reversal of topography", is the primary geological characteristic of the Pine Barrens region. Thus, eight geologic deposits underpinning the characteristic sandy droughty soil of the Pine Barrens region are the result of many major geologic episodes of deposition and erosion spanning the last 20 or more million years. Of these, the Cohansey Sand is paramount. However, the last 5 million years of continuous erosion and redeposition, i.e., that time since the deposition of the Beacon Hill Gravel, are the most important. This encompasses several critical Pleistocene events in the Pine Barrens and surrounding regions.

RICHARDS, H. G. 1945a. Correlation of Atlantic Coastal Plain Cenozoic formations. Geol. Soc. Amer. Bull. 56:401-408. (D)

RICHARDS, H. G. 1945b. Subsurface stratigraphy of the Atlantic Coastal Plain between New Jersey and Georgia. Amer. Assoc. Petro. Geol. Bull. 29:885-995. (D)

RICHARDS, H. G. 1960. The geologic history of the New Jersey Pine Barrens. N.J. Nat. News 15:146-151. (R)

RICHARDS, H. G. 1967. Stratigraphy of the Atlantic Coastal Plain between Long Island and Georgia - Review. Amer. Assoc. Petro. Geol. Bull. 51:2400-2429. (R)

RICHARDS, H. G. and W. GALLAGHER. 1974. The problem of the Cretaceous - Tertiary boundary in New Jersey. Notulae Naturae 449:1-6. (R)

RICHARDS, H. G., J. J. GROOT and R. M. GERMOUTH. 1957. Cretaceous and Tertiary geology of New Jersey, Delaware and Maryland. In Geological Society of America. Guidebook for field trips 1957:183-230. (R)

RICHARDS, H. G. and A. HARBISON. 1942. See ZOOLOGY citation.

RICHARDS, H. G., F. H. OLMSTED and J. L. RUHLE. 1969. Generalized structure contour maps of the New Jersey Coastal Plain. N.J. Geol. Surv. Geol. Rept. Series 4:1-38. (D)

Location: General

Keywords: Geologic Formations Descriptions

Abstract: Twelve generalized structural contour maps were prepared from a study of 169 well logs or sample logs of drill cuttings from the Coastal Plain of New Jersey, Delaware and the Eastern Shore of Maryland. The configuration of the tops of the nonmarine Cretaceous deposits (Patuxent, Patapsco, Raritan and Magothy formations) and the Piney Point Formation (Eocene) show the known subsurface extent of these formations in both New Jersey and Delaware. The structural contour maps show the tops of the Merchantville Formation and Woodbury Clay, the Englishtown Formation, the Marshalltown Formation, the Wenonah Formation and Mount Laurel Sand, the Navesink Formation and the Red Bank Sand which are all of Late Cretaceous age. The maps of the Hornerstown Sand, the Vincentown Formation, and the Manasquan Formation and Shark River Marl of early Tertiary age show the subsurface extent of these formations only in New Jersey. Also included is an outline map showing the locations of wells and seismic stations and a structural contour map showing the configuration of the bedrock surface of the report area. Structural contours on top of the Magothy Formation, or on top of the Raritan Formation where the Magothy formation is absent, show the configuration of the nonmarine deposits of Cretaceous age. Isopachs of the nonmarine deposits are derived by interpolation between contours on top of the bedrock and the top of either the Magothy Formation or the Raritan Formation where the Magothy is absent. The Merchantville Formation and Woodbury Clay are difficult to separate in the subsurface, and therefore the contours are drawn on top of the Woodbury Clay. In New Jersey, the thickness of the combined Merchantville Formation and Woodbury Clay ranges from about 100 to 140 feet near the outcrop, but exceeds 250 feet in the subsurface along the coast in Ocean County. The top of the Englishtown Formation is easy to recognize because it generally consists of a micaceous white and yellow sand, although it is locally a silty clay. The formation thins toward the southwest from about 160 feet in central Ocean County to less than 20 feet in Salem County. It has not been recognized in Delaware. The Marshalltown Formation varies from black clay to a glauconite sand. It usually ranges in thickness from 20 to 60 feet. It is very thin or absent in Delaware. The Wenonah Formation and Mount Laruel Sand are difficult to separate in New Jersey, and therefore are shown as a unit. The combined thickness ranges from 60 to 100 feet. In Delaware the two formations are easily separated. The Navesink Formation is generally highly glauconitic and it is difficult to determine the upper limit where overlain by the Hornerstown Sand which is also glauconitic. The contour map on the top of the Navesink is based upon relatively little control. The Red Bank Sand reaches a thickness of about 160 feet in Monmouth County. It thins southwestward and is absent in outcrop in the southern part of the Coastal Plain of New Jersey. A probable equivalent of the Red Bank has

been recognized in Delaware. The Tinton Sand Member is the topmost unit of the Red Bank Sand in Monmouth County. The Hornerstown Sand is mostly glauconitic and is about 30 feet thick in outcrop. This is overlain by the Vincentown Formation which consists of two facies, (1) calcareous sand facies and (2) quartz sand facies. These are overlain by the Manasquan Formation and Shark River Marl which are here treated as a unit. In outcrop the combined thickness of the Manasquan Formation and Shark River Marl is about 40 feet, but in the subsurface they thicken to about 200 feet. The Piney Point Formation of Jackson age occurs in the subsurface in Cape May and Atlantic Counties, N. J., and in southern Delaware but is not exposed in these states. Brief notes are given on formations of later Tertiary and Pleistocene age, but no contour maps were constructed.

RICHARDS, H. G., G. R. WHITE and K. MADDEN. 1973. Upper Cretaceous geology and paleontology at Sewell, New Jersey. Abstr., Geol. Soc. Amer. NE Sect. Meet., Allentown, Pa. (A)

RIES, H., H. B. KUMMEL and G. N. KNAPP. 1904. The clays and clay industry of New Jersey. Final Rept. State Geol. 6:117-208, N. J. Geol. Surv., Trenton, N.J. (R)

RIGGS, G. B. 1940. See BOTANY citation.

RIGGS, G. B. 1951. See BOTANY citation.

ROGERS, H. D. 1865. Description of the geology of the State of New Jersey. Final Rept. State Geol. 1865:1-227, N. J. Geol. Surv., Trenton, N. J. (D)

ROSENAU, J. C., S. M. LANG, G. S. HILTON and J. G. ROONEY. 1969. See HYDROLOGY citation.

RUSH, F. E. 1968. See HYDROLOGY citation.

SALISBURY, R. D. 1898. The physical geography of New Jersey. N. J. Geol. Surv. Final Rept. 4, Trenton, N. J. (R)

SALISBURY, R. D. and G. N. KNAPP. 1917. The Quaternary formations of southern New Jersey. Final Rept. State Geol. 8:1-128, N.J. Geol. Surv., Trenton, N.J. (R)

SMOCK, J. C. 1892. Geologic work in the southern part of the state. Ann. Rept. State Geol. 1891:4-10, N.J. Geol. Surv., Trenton., N.J. (N)

SOHL, N. F. and J. E. MELLO. 1970. Stratigraphy of the outcropping post-Magothy Upper Cretaceous formations in southern New Jersey and northern Delmarva peninsula, Delaware and Maryland. U.S. Geol. Surv. Prof. Paper 674:28-60, Washington, D.C. (D)

SPANGLER, W. B. and J. J. PETERSON. 1950. Geology of the Atlantic Coastal Plain in New Jersey, Delaware, Maryland and Virginia. Amer. Assoc. Petro. Geol. Bull. 34:1-98. (D)

STEPHENSON, L. B. 1954. See ZOOLOGY citation.

STEVENS, T. D. 1940. See BOTANY citation.

TEDROW, J. C. F. 1952. Soil conditions in the Pine Barrens of New Jersey. Bartonia 26:28-52. (D)

Location: General

Keywords: Cape May Formation; Bridgeton Formation; Cohansey Formation; Kirkwood Formation; Soil Genesis; Geologic Map

Abstract: The pine-barren area in New Jersey owes its existence primarily to the character of the geologic materials from which the soil was derived. Soil type, poor moisture conditions, lack of nutrients, acidity, aluminum toxicity and repeated fires appear to be traceable to the nature of these materials.

TEDROW, J. C. F. 1961. New Jersey soils. N. J. Agric. Expt. Sta. Circ. 601:1-6, New Brunswick, N.J. (R)

TEDROW, J. C. F. 1979. Development of Pine Barrens soils. Chapter 4 In Forman, R. T. T. (ed.). Pine Barrens: ecosystem and landscape. Academic Press, New York. pp.61-79. (R)

Location: General

Keywords: Vegetation; Topography; Climate; Soil Conditions; Aeolian Activity; Podzol; Drainage Catena; Disturbance Effects

Abstract: Soils of the Pine Barrens are formed on sandy, siliceous, acid materials which are highly leached and strikingly depauperate in plant nutrients. The most highly

leached soil is the Lakewood, which is a podzol. Where a little more silt and clay are present in the soil matrix, the Sassafras and other soil series are present. This latter group of soils is not so highly podzolized. On some of the Tertiary hilltops the podzol soils contain lateritic affinities. Very acid mineral gley soils are present in the low positions within the Pine Barrens, and a few bogs are found in cedar swamps and contiguous areas.

THOMAS, L. S. 1967. See GENERAL REFERENCES citation.

TORREY, R. H. 1931. See BOTANY citation.

TOTH, S. J. and R. F. SMITH. 1960. See HYDROLOGY citation.

ULRICH, B. C. 1976. The Eocene foraminiferal biostratigraphy of the Atlantic Coastal Plain of New Jersey. M.S. Thesis, Rutgers Univ., New Brunswick, N.J. 72pp. (D)

Location: Bricktownship (4a); Island Beach (20)

Keywords: Lithostratigraphy; Phylogenetic Trends; Paleogeography; Systematic Paleontology; Manasquan Formation

Abstract: Biostratigraphic analysis of the Deal Member of the Manasquan Formation, a transgressive deeper water marine facies of nearer shore shallow facies, indicates that it ranges in age from Early Eocene to Middle Eocene. The planktonic foraminiferal content of this member in three wells indicates that is spans the entire Lower and Middle Eocene. The foraminiferal zonal scheme established in New Jersey for the Lower Bocene correlates reasonably well with Bolli's zonation for Trinidad. However, the alternative zonation based on the evolution of <u>Globorotalia cerroazulensis</u> (Cole) described in Possagno, Italy, by Toumarkine and Bolli is more applicable to the Middle Eocene section of New Jersey than is the lower latitude zonation of Bolli.

U. S. DEPARTMENT OF AGRICULTURE. 1966a. Soil survey, Gloucester County (MARKLEY, M. L.). U. S. D. A. Soil Conserv. Serv., Somerset, N. J. 84p. (D)

U. S. DEPARTMENT OF AGRICULTURE. 1966b. Soil survey of Camden County, New Jersey (MARKLEY, M. L.). U. S. D. A. Soil Conserv. Serv., Somerset, N. J. 94p. (D)

U. S. DEPARTMENT OF AGRICULTURE. 1969. Soil survey, Salem County (POWLEY, V. R.). U.S.D.A. Soil Conserv. Serv., Somerset, N. J. 87p. (D)

U. S. DEPARTMENT OF AGRICULTURE. 1971. Soil survey, Burlington County (MARKLEY, M. L.). U. S. D. A. Soil Conserv. Serv., Somerset, N. J. 120p. (D)

U. S. DEPARTMENT OF AGRICULTURE. 1974. Soil survey laboratory data and descriptions for some soils of New Jersey. Soil Surv. Invest. Rept. 26, Washington, D. C. (D)

U. S. DEPARTMENT OF AGRICULTURE. 1976. Soil survey investigations for Lakewood, Lakehurst and Woodmansie soils. Soil Conserv. Serv., Somerset, N. J. (D)

U. S. DEPARTMENT OF AGRICULTURE. 1977. Soil survey, Cape May County (MARKLEY, M. L.). U. S. D. A. Soil Conserv. Serv., Somerset, N. J. (D)

U. S. DEPARTMENT OF AGRICULTURE. 1978a. Soil survey, Atlantic County (JOHNSON, J.). U. S. D. A. Soil Conserv. Serv., Somerset, N. J. 61p. (D)

U. S. DEPARTMENT OF AGRICULTURE. 1978b. Soil survey, Cumberland County (POWLEY, V. R.). U. S. D. A. Soil Conserv. Serv., Somerset, N. J. 69p. (D)

U. S. DEPARTMENT OF AGRICULTURE. 1980. Soil survey of Ocean County, New Jersey (HOLE, T. and H. C. SMITH). U.S.D.A. Soil Conserv. Serv., Somerset, N.J. 102p. (D)

U. S. DEPARTMENT OF INTERIOR. 1978. See GENERAL REFERENCES citation.

VOIGT, G. K., B. N. RICHARDS and E. C. MANNION. 1964. See BOTANY citation.

WAANDERS, G. L. 1974. See BOTANY citation.

WAKSMAN, S. A., H. SCHULHOFF, C. A. HICKMAN, T. C. CORDON and S. C. STEVENS. 1943. See BOTANY citation.

WELLER, S. 1907. A report on the Cretaceous paleontology of New

Jersey. Paleontology Series 4:1-871, N. J. Geol. Surv., Trenton, N.J. (R)

WHERRY, E. T. 1920. See BOTANY citation.

WHERRY, E. T. 1922. See BOTANY citation.

WHITFIELD, R. P. 1894. See ZOOLOGY citation.

WHITTAKER, R. H. 1979. See BOTANY citation.

WIDMER, K. 1964. The geology and geography of New Jersey. N. J. History Series 19, D. Van Nostrand Co., Princeton, N. J. 193pp. (R)

WOLFE, P. E. 1974. The geology and landscapes of New Jersey. Crane Russak, New York. 351pp. (R)

WOOD, O. M. 1933. See BOTANY citation.

WOODWELL, G. M. 1979. See BOTANY citation.

HYDROLOGY AND WATER CHEMISTRY

ACADEMY OF NATURAL SCIENCES OF PHILADELPHIA. 1973. Chemical and biological studies of the surface waters of Medford Township, New Jersey, 1971-1972. Cent. Ecol. Res. Plan. Des., Dept. Landscape Archit. Reg. Plan., Univ. Pennsylvania, Philadelphia, Pa. (D)

ANDERSON, H. R. and C. A. APPEL. 1969. Geology and ground water resources of Ocean County, New Jersey. Div. Water Policy Supply Spec. Rept. 29:1-93, N. J. Dept. Conserv. Econ. Develop., Trenton, N. J. (D)

Location: Ocean County

Keywords: Water Quality; Surface Water

Abstract: Ocean County is in east-central New Jersey in the Atlantic Coastal Plain physiographic province. The Coastal Plain sediments dip gently seaward (southeast), increasing in total thickness downdip from 1000 to 4000 feet in Ocean County. The aquifers are continental, near-shore marine, beach or deltaic deposits of porous sand and gravel; the confining beds are chiefly deeper water marine deposits of clay and glauconite. Generally the Coastal Plain formations are more permeable near their outcrop, where shallow-water deposits occur, than downdip where marine clays and glauconites occur. Ground water is obtained principally from four artesian aquifer systems and a water-table aquifer. The artesian aquifers in ascending stratigraphic order are: the Raritan and Magothy Formations, the Englishtown Formation, the Wenonah Formation and Mount Laurel Sand, and the Kirkwood Formation. The Raritan and Magothy Formations of Cretaceous age form an artesian aquifer system 600 to 2000 feet thick. Well yields of 500 to 1000 gpm (gallons per minute) can be expected, but yields as high as 1850 gpm have been obtained. Potable water in the aquifer system is soft (28 to 51 ppm hardness) and is generally high in iron content (0.66 to 3.2 ppm). Temperatures of 70-90 degrees F make the water less desirable than shallow water for cooling purposes. In southern Ocean County, the Raritan and Magothy Formations generally contain brackish water below a depth of 2500 feet below land surface. The aquifer in the Englishtown Formation is heavily pumped in northeastern Ocean County and in the coastal part of Monmouth County. In this area, water levels in wells have declined from above sea level to more than 75 feet below sea level since 1900. Maximum well yields are less than 500 gpm and the average is 260 gpm. Water from the Englishtown Formation is soft to moderately hard (30 to 82 ppm hardness) and the pH ranges from 7.5 to 8.3. The aquifer thins to the southeast and is absent in

southern Ocean County. The aquifer of the Wenonah Formation and Mount Laurel Sand yields small quantities of water to wells (less than 100 gpm) and is relatively undeveloped in northern Ocean County. The water is generally soft. It contains high iron concentrations locally. Downdip, the Wenonah Formation and Mount Laurel Sand becomes a confining bed. The Atlantic City 800-foot sand of the Kirkwood Formation is the most heavily pumped (average 12 mgd) aquifer on the New Jersey coast south of Monmouth County. Since 1900, water levels in wells tapping this aquifer have declined to as much as 30 feet below sea level on Long Beach Island. Well yields as much as 1225 gpm have been obtained from the Kirkwood Formation, but the average is about 420 gpm. The coefficient of transmissibility of the aquifer determined from an aquifer test at Ocean Gate is 11000 gpd per ft. At Atlantic City in Atlantic County, calculated coefficients of transmissibility range from 66,000 to 99,000 gpd per ft. Recharge to the Kirkwood Formation occurs in the topographic high areas of the inner Coastal Plain by vertical leakage from the overlying water-table aquifer. Water from the aquifer in the Kirkwood Formation is suitable for most uses but may require treatment for iron removal. It is generally soft to moderately hard (2.9 to 105 ppm hardness) and generally low in dissolved solids content (4 to 180 ppm). The water-table aquifer is pumped heavily in the Toms River and Lakehurst areas where the average well yield is 320 gpm and the maximum reported is 665 gpm. About 6.5 mgd is the maximum amount pumped for domestic, industrial and public supply use. An estimated 0.8 mgd per sq mi or 100 mgd, equal to the ground-water flow to the Toms River, may be pumped from the water-table aquifer in the Toms River basin without seriously depleting ground water storage. Such pumpage will, however, substantially diminish the flow of Toms River. The coefficient of transmissibility of the water-table aquifer ranges from 30,000 (at Toms River) to 100,000 gpd per ft (at Batsto, Burlington County). Water from the water-table aquifer has a low pH (4.4 to 6.7), high iron content (0.09 to 22 ppm) and an unpleasant odor. Near Barnegat Bay and on the barrier beach, the aquifer contains brackish water.

ANDERSON, P. W. 1970. Occurrence and distribution of trace elements in New Jersey streams. Div. Water Policy Supply, Dept. Environ. Protect., Trenton, N. J. 24pp. (D)

Location: General

Keywords: Heavy Metals; Pollution; pH

Abstract: The concentration of trace elements was measured in water samples collected at 37 stream-sampling sites in New Jersey. The data presented indicate the prevalence of higher concentrations than normal in some streams. Such

concentrations generally are found only in streams where water quality is known to be greatly influenced by man's activities, primarily the discharge of industrial and municipal waste waters. However, high concentrations of iron and manganese relate better to vegetal decomposition or to ground-water inflow to streams. In general, the magnitude of concentration of the individual elements, in descending order, is as follows: iron, aluminum, strontium, manganese, boron, barium, chronium, copper, nickel, zinc, lead, cobalt, lithium, titanium, rubidium, vanadium, molybdenum, and silver. In addition, the following are sought, but were not observed: beryllium, bismuth, cadmium, germanium and tin.

AUSTIN, C. R. 1960. Earthquake fluctuations in wells in New Jersey. Water Resources Circ. 5:1-13, Div. Water Policy Supply, Dept. Conserv. Econ. Develop., Trenton, N. J. (D)

Location: Pleasantville (39); Cape May (50); Atlantic City (40);

Keywords: Magnitude; Water Level

BACK, W. 1960. Origin of hydrochemical facies of ground water in the Atlantic Coastal Plain. Internat. Geol. Congress, 21st. Rept. Sess. Norden, Part 1, Copenhagen. pp.87-95. (D)

BALLARD, J. T. 1979. Fluxes of water and energy through the Pine Barrens ecosystems. Chapter 8 In R. T. T. Forman (ed.). Pine Barrens: ecosystem and landscape. Academic Press, New York. pp.133-145. (R)

Location: General

Keywords: Evapotranspiration; Vegetative Communities; Ecosystem Interactions

Abstract: We are becoming increasingly aware that the surface of the earth is a mosaic of interacting ecosystems, and that this mosaic is becoming more fine grained as human activities dissect ecosystems and destroy the homogeneity of large tracts. The encroachment of human activities upon the Pine Barrens serves to illustrate how the destruction of an ecosystem's homogeneity may force us to adopt new investigative tactics when dealing with energy- and water-related questions. It is not adequate to speak of watershed yield of a certain number of gallons per day - not when the salient problems are caused by salt water intrusion due to excessive pumping of the groundwater in a certain locality, or by contaminants introduced into the groundwater aquifer that force us to determine the future trajectory of

these pollutants in the aquifer. Data for a watershed or even a region may be pertinent for certain managerial purposes, but different approaches are needed to answer questions and develop policies pertaining to the water and energy of increasingly prevalent smaller units of landscape.

BALLARD, J. and M. F. BUELL. 1975. See BOTANY citation.

BARKSDALE, H. C. 1952a. Ground water in the New Jersey Pine Barrens. In The Pine Barrens of New Jersey, Ecol. Soc. Amer. Symposium, Philadelphia, Pa. (R)

BARKSDALE, H. C. 1952b. Ground water in the New Jersey Pine Barrens. Bartonia 26:36-38. (R)

BARKSDALE, H. C., D. W. GREENMAN, S. M. LANG, G. S. HILTON and D. E. OUTLAW. 1958. Ground-water resources in the Tri-state region adjacent to the lower Delaware River. N. J. Div. Water Policy Supply Special Rept. 13, Trenton, N. J. (D)

Location: General

Keywords: Climate; Drainage; Discharge; Geologic Formations; Hydrologic Characteristics

Abstract: The purpose of this report is to appraise and evaluate the ground-water resources of a tri-state region adjacent to the lower Delaware River that is centered around Philadelphia, Pa., and Camden, N. J., and includes Wilmington, Del., and Trenton, N. J. Specifically, the region includes New Castle County, Del.; Burlington, Camden, Gloucester, Mercer and Salem Counties in New Jersey; and Bucks, Chester, Delaware, Montgomery and Philadelphia Counties in Pennsylvania. The peculiar advantages of ground water, such as its availability in many places without the necessity for expensive pipelines and its relatively uniform temperature and quality, make it an especially valuable resource in an industrial area. Large, readily available supplies of good, fresh water have contributed substantially to the recent rapid industrial growth of the lower Delaware River basin and will be vital to its continued prosperity. The major part of these supplies is drawn from the streams passing through the region, but very large quantities of ground water are also used. The region is divided almost equally by the Fall Line, which extends in a southwesterly direction along the general course of the Delaware River from Trenton, N. J., to Wilmington, Del., and beyond. Northwest of the Fall Line is a region of consolidated rocks in which ground water occurs mainly in cracks, crevices and openings created or enlarged by weathering. The capacity of

the various geologic formations to yield water depends largely upon the degree to which they have been fractured and weathered. The yield of individual wells in this part of the region is generally small to moderate and not readily predictable. Ground water in this part of the region is generally low in dissolved minerals and suitable for many uses without treatment. Southeast of the Fall Line lie the unconsolidated rocks of the Coastal Plain. Ground water occurs in these rocks largely in the pore spaces between the individual mineral grains. The major formations and the principal aquifers are rather uniform in their water-bearing characteristics over large areas. The yield of individual wells is moderate to very large and may be predicted with a reasonable degree of assurance. Sufficient quantities of ground water are available in most places for all ordinary purposes. The chemical quality of the ground water from the Coastal Plain aquifers is generally acceptable for most uses, but objectionable quantities of iron or other minerals are found in some places, and some waters have a low pH and are corrosive. More than 40 distinct geologic formations occur in the region. They range in age from Precambrian to Recent. Nearly all will yield some water to wells. However, only about a dozen yield water freely enough to be considered major aquifers. Of these, the sands of the Raritan and Magothy formations have been developed most intensively, and the Cohansey sand appears to have the greatest capacity for additional development.

BARKSDALE, H. C., R. W. SUNDSTROM and M. S. BRUNSTEIN. 1936. Supplementary report on the ground water supplies of the Atlantic County region. Spec. Rept. 6:1-139, State Water Policy Commission, Trenton, N. J. (D)

BATES, M. E. and M. F. BUELL. 1969. See BOTANY citation.

BERNARD, J. M. 1960. See BOTANY citation.

BERNARD, J. M. 1963. See BOTANY citation.

BOERNER, R. 1982. See BOTANY citation.

BUELL, M. F. and J. BALLARD. 1972. See BOTANY citation.

BURNS, P. Y. 1952. See BOTANY citation.

CANTLON, J. 1951. See BOTANY citation.

CANTLON, J. E. and M. F. BUELL. 1952. See BOTANY citation.

CLARK, G. A., H. MEISLER, E. C. RHODEHAMEL and H. E. GILL. 1968. Summary of ground-water resources of Atlantic County, New Jersey.

N.J. Div. Water Policy Supply Water Resources Circ. 18:1-53, Trenton, N.J. (D)

Location: Atlantic County

Keywords: Kirkwood Formation; Cohansey Sands; Water Quality

Abstract: Atlantic County is located in southeastern New Jersey in the Coastal Plain physiographic province. The county is underlain by unconsolidated sediments consisting of gravel, sand, silt and clay of Quaternary, Tertiary and Cretaceous age. The principal fresh-water aquifers are in the Kirkwood Formation of Miocene age and the Cohansey Sand of Miocene (?) and Pliocene (?) age. In Atlantic County, aquifers below the Kirkwood generally contain brackish or saline water. The Kirkwood Formation is tapped primarily by industrial and public-supply wells. Reported yields of such wells range from 250 to 1,200 gpm (gallons per minute). The median yield is 700 gpm. Specific capacities of these wells range from 2.5 to 34 gpm per foot drawdown and the median is 15 gpm per foot drawdown. The Cohansey Sand is tapped widely by wells for domestic and poultry-farm use as well as for industrial use, public supply, air conditioning and irrigation. Reported yields of industrial, public supply and air conditioning wells range from 30 to 1,440 gpm and the median yield is 720 gpm. Specific capacities of these wells range from 2.4 to 43 gpm per foot drawdown and the median is 22 gpm per foot drawdown. Water from both the Kirkwood and Cohansey is generally low is dissolved solids and in total hardness. The pH of water from the Cohansey sand is generally acidic. In the Kirkwood Formation, the pH of the water is generally alkaline along the coast and acidic in the northern part of the county. Water from some Cohansey wells along the coast is very high in dissolved solids, chlorides and other constituents, indicating salt-water encroachment. Ten public water-supply systems in Atlantic County pumped an average of 16.2 mgd (million gallons per day) of ground water in 1964. Because of a summer influx of tourists, water use is considerably higher during the summer months. In 1964, pumpage during July, the peak month, was more than twice that during February, the lowest month.

CRERAR, D. A., J. L. MEANS, R. F. YURETICH, M. P. BORCSIK, J. L. AMSTER, D. W. HASTINGS, G. W. KNOX, K. E. LYON and R. F. QUIETT. 1981. Hydrogeochemistry of the New Jersey Coastal Plain: 2. Transport and decomposition of iron, aluminum, dissolved organic matter and selected trace elements in stream, ground- and estuary water. Chem. Geol. 33:23-44. (D)

Location: Cedar Creek (10,11); Mullica River (14,15,24,33,34); West Branch, Wading River (25); Oswego

River (25,26)

Abstract: The geochemical controls on the transport and deposition of iron, organic carbon, and certain trace elements have been examined in bogs, streams, groundwater and estuaries of the New Jersey Coastal Plain. Surface waters are unusually dilute (total dissolved solids about 25 ppm) and acidic (pH 4-5) and contain relatively high concentrations of organic C and Fe. Liquid chromatographic analyses show that from 10 to 70% of total "dissolved" Fe (0.2 um) in river water is associated with dissolved organic carbon (DOC), which is primarily humic and fulvic acid, presumably as organo-metallic complexes. A significant proportion of the stream-borne Fe and Al is colloidal or particulate (>0.2 um) Fe-oxyhydroxide or -oxyhydroxides admixed with insoluble organic material. The proportion of organically-complexed Fe present varies seasonally with the DOC content of the water. These stream waters are near saturation with respect to amorphorous Fe(OH3). Both stream and groundwaters are near saturation with respect to halloysite, slightly supersaturated with respect to gibbsite, and highly supersaturated with respect to kaolinite. Bog iron deposits are common in streams and swamps where Fe precipitation is catalyzed by iron-oxidizing bacteria. Fe and Al precipitate rapidly within both estuaries, with ionic strength rather than increased pH exerting the prime control on estuarine deposition. Estuarine floccules contain very little or no organic matter, suggesting that inorganic Fe- and Al-oxyhydroxides are the primary precipitates. The high contents of "dissolved" (0.2 um) Fe and Al suggest that both are either organically complexed or in the form of small (0.2 um) oxyhydroxide colloids in the estuaries.

DOUGHERTY, D. F. and A. C. LENDO. 1959. Surface water supply of New Jersey: streamflow records 1 October 1945 - 30 September 1950. Spec. Rept. 14:1-362, Water Policy Commission, Trenton, N. J. (D)

Location: Cedar Creek at Lanoka Harbor (19); Toms River at Toms River (11); Batsto River at Batsto (24); East Branch, Wading River at Harrisville (26); Absecon Creek at Absecon (39); Great Egg River at Folsom (31); Maurice River at Norma (29); Loper Run at Bridgeton; Manantico River at Norma

Keywords: Daily Discharge

DONSKY, E. 1963. Records of wells and ground-water quality in Camden County, N.J., with special reference to public water supplies. N.J. Div. Water Policy Supply Water Resources Circ. 10:1-70, Trenton, N.J. (D)

Location: Camden County

Keywords: Management; pH; Elemental Composition; Specific Conductance

DURAND, J. B. 1979. Nutrient and hydrological effects of the Pne Barrens on neighboring estuaries. Chapter 11 In R. T. T. Forman (ed.). Pine Barrens: ecosystem and landscape. Academic Press, New York. pp.195-211. (D)

Location: General

Keywords: Nitrogen; Productivity; Salinity; Nutrient Load; Riverflow

Abstract: Primary production by the phytoplankton community in the Great Bay estuary was controlled by the supply of nitrogen derived from the Mullica River drainage basin in the Pine Barrens. Low nitrate-nitrogen concentrations were found in streams of relatively undisturbed areas of the drainage basin, while high nitrate-nitrogen concentrations were characteristic of streams draining the agricultural and urban areas of the Pine Barrens. Low nitrogen levels often limited primary production, especially in the well-lighted bay. Primary production in the bay increased in response to nitrogen supplied by the river, even when the nitrogen was supplied in minute quantities. Salinity gradients in the estuary, maintained by the volume of the river water flow, are critical to many estuarine animals. Thus, the relatively low nutrient levels and the amount and relative constancy of water flow in Pine Barrens streams have a major controlling and stabilizing effect on the ecosystems of the coastal estuaries.

DURAND, J. B., M. L. GRANSTROM and G. H. NIESWAND. 1969. Water resource development of Mullica River Basin, New Jersey. Amer. Soc. Mech. Eng., United Engineering Center, 345 E. 47th St., New York, N.Y. 5pp. (D)

Location: Mullica River (33,34)

Keywords: Nitrogen; River Flow; Primary Production

Abstract: In 1961 an extensive survey of the nitrogen concentrations was initiated on a year-round basis. In addition, chlorophyll a concentrations were determined. In all but three instances of nutrient limitation, nitrate proved to be limiting. Phosphate and trace metals were limiting only once. Vitamins, sulfur and silicate apparently were present in sufficient amounts. Data from subsequent years show that nitrate continued to be the principal limiting nutrient. Upriver nitrate concentrations

are higher than the downriver nitrate concentrations; this is particularly noticeable during the winter months when biological activity is reduced by low temperature both in the river and on the surrounding land. It is clear that the river serves as a source of nitrate-N for the downriver areas and bay. On a seasonal basis the importance of the river as a nitrogen source will vary because of the seasonal variation in primary productivity.

DURAND, J. B., N. L. GRANDSTROM and N. S. RUDOLPH. 1974. Water resources development in the Mullica River basin. Water Resources Bull. 10:272-282. (D)

Location: Mullica River (33,34)

Keywords: Great Bay Estuary; Conjunctive Use; Salinity; Streamflow; Environmental Effects

Abstract: The potential withdrawal of water from the Mullica River - Great Bay Estuary in southern New Jersey prompted a joint study by biologists and engineers to determine the maximum supply of water that could be diverted from the basin without causing undue environmental impacts. The effect of removal of water from the basin over long periods of time was simulated by review of records of a severe drought. Based on analysis of streamflows and salinities during these drought conditions, minimum mean monthly streamflows were determined corresponding to the maximum salinities tolerable by the fish and shellfish communities, important sources of revenue and recreation in the region. A physically optimized, chance constrained linear programming model was developed for the conjunctive use of ground and surface waters. Adjusting water withdrawal from streamflow and groundwater sources according to physical and seasonal criteria would permit maximum use of the basin's resources with no additional burden on the ecology of the estuary.

DURAND, J. B. and R. J. NADEAU. 1972. Water resources development in the Mullica River Basin. Part I. Biological evaluation of the Mullica River - Great Bay Estuary. Water Resources Instit., Rutgers Univ., New Brunswick, N.J. 138pp. (D)

Location: Mullica River (33,34); Great Bay (34,35)

Keywords: Phytoplankton; Primary Productivity; Fish; Shellfish; Oysters; Detritus; Benthic Community

Abstract: In this study, particular attention has been given to an overall evaluation of the ecology of the estuary. The original assignment called for recommendations concerning a salinity regime to be established for the estuary such that a minimal disturbance of the estuary would result. The goal was to develop such a regime to preserve the ecological values of the area, not to develop a regime that would press the limits of tolerance of the area. We have focused our attention on the communities within the system. A number of key communities have been described: benthic invertebrates, zooplankton and nekton. It should be realized that these communities interact to varying degrees; some interdependence of communities can be demonstrated. In general, each of the invertebrate communities appears to be characterized by the presence of a relatively few dominant organisms associated with a rather large number of other species present in smaller numbers.

DURAND, J. B. and B. ZIMMER. 1981. Pinelands surface water quality. Center for Coastal and Environ. Studies, Rutgers Univ., New Brunswick, N.J. 262p. (D)

Location: Mullica River Watershed

Keywords: Discharge; Nutrients; Nitrogen; Groundwater; Sedimentation

Abstract: Eight aspects of nitrogen dynamics were investigated in disturbed and undisturbed watersheds in the Mullica River drainage basin in the Pine Barrens during 1978-1980. These included nutrient concentrations in the surface water, discharge rates, concentrations of nutrients in the ground water at streamside, organic content of the sediments, rate of ammonification in the water column, rate of nitrification in the water column, and rate of nitrate-N and ammonium-N loss from the water in sediment/water microcosms. Concentrations of organic carbon and ortho-phosphate were generally low at all sites. Organic carbon concentrations were slightly elevated at pristine sites during the summer months at the peak of the warm weather cedar stain in the water. Organic carbon concentrations ranged from 3-20 ppm; ortho-phosphate concentrations ranged from 0-5 ugat PO4-P/l. Nitrate-N showed a distinct seasonal increase in the disturbed watersheds. Summer concentrations ranged from 20-60 ugat NO3-N/l, while winter concentrations ranged from 80-150 ugat NO3-N/l. Nitrate-N concentrations at undisturbed sites ranged from 0-10 ugat NO3-N/l. Ammonium-N concentrations in the stream water were generally below 20 ugat NH4-N/l, with no seasonal variation. Ammonium-N concentrations at Great Swamp ranged from 0-175 ugat NH4-N/l, with a distinct wintertime peak. This peak was due to upstream inputs of ammonium-N. Organic-N concentrations ranged from 0-225 ugat N/l. High values were measured at Great Swamp Branch which corresponded with the high wintertime ammonium-N values. High values were measured at undisturbed sites which

correspond with the high summer organic carbon. A significant shift of more than 1 pH unit was consistently measured at disturbed sites compared to undisturbed sites. The pH at undisturbed sites ranged from 2.7 - 5.1, and from 4.1 - 6.4 at dfisturbed sites. The increase in pH at disturbed sites was due to application of lime for agricultural use.

EPSTEIN, C. M. and G. SAWHILL. 1977. See BOTANY citation.

EPSTEIN, C. M., M. L. WEEKS and G. SAWHILL. 1976. See BOTANY citation.

FABLES, D. 1960. See BOTANY citation.

FARLESKAS, G. M., B. NEMICKAS and H. E. GILL. 1976. Geology and ground-water resources of Camden County, New Jersey. Water Resources Invest. 76-76:1-146, U.S. Geol. Surv., Reston, Virginia. (D)

FISKLIN, T. J. and J. D. MONTGOMERY. 1971. See GENERAL REFERENCES citation.

FORMAN, R. T. T. 1979. See GENERAL REFERENCES citation.

GILL, H. E. 1962a. Ground-water resources of Cape May County, New Jersey: Salt-water invasion of principal aquifers. Special Rept. 18:1-171, Dept. Conserv. Econ. Develop., Trenton, N. J.

Location: Cape May County

Keywords: Geologic History; Stratigraphy; Hydrology; Water Quality; Kirkwood Formation; Cohansey Sand

Abstract: Cape May County, largely a peninsula extending into the ocean at the southernmost tip of New Jersey, is a leading recreational area of the State. Because of this, a considerable drain is placed on the county's water resources during the summer. The permanent population according to the 1960 census is 47,452, and the summer only, population is estimated to be close to 1,000,000. This influx of summer residents is concentrated in a coastal area where ground water is susceptible to salt-water encroachment. Cape May County is part of the coastal plain of New Jersey. It is underlain by unconsolidated sediments of Quaternary, Tertiary and Cretaceous age, mostly alternating sand and clay beds. The top of the basement complex ranges in depth from 4,000 feet below sea level in the northwestern part of the county to 6,000 feet near the southern tip. The ponds

and streams of Cape May County intersect the water table and receive water from ground-water discharge. A source of serious contamination of the fresh surface waters of the county on the Cape May peninsula is the natural encroachment of salt water from the Atlantic Ocean and Delaware Bay. All the streams of the county are tidal in their lower reaches, and at time of low flow salt water advances several miles upstream. Salt-water flooding during severe storms has resulted in deterioration in the quality of water in low-level ponds and lakes on the Cape May peninsula. The ages of the geologic formations that contain fresh ground water range from Miocene to Recent; these formations occur at depths to 1,000 feet below mean sea level. In most areas of the county, yields of 500 gallons per minute from large-diameter wells can be obtained. The chemical quality of the water is generally acceptable for most uses, but objectionable concentrations of iron and chloride (salt water) are found in some areas. Some of the water has a low pH and is corrosive. Five aquifers presently yield fresh water in Cape May County; they are the unconfined Holly Beach water-bearing zone and the confined aquifers in the estuarine sand facies of the Cape May Formation, the Cohansey Sand, and two aquifers in the Kirkwood Formation. The greatest quantity of water is being withdrawn from the Cohansey Sand; substantial quantities of water also are being withdrawn from the two aquifers in the Kirkwood Formation.

GILL, H. E. 1962b. Records of wells, well logs and summary stratigraphy of Cape May County, New Jersey. Water Resources Circ. 8:1-54, Div. Water Policy Supply, Dept. Conserv. Econ. Develop., Trenton, N. J. (D)

Location: Cape May County

Keywords: Water Level Data

Abstract: Cape May County, a peninsular area at the southernmost tip of New Jersey, is part of the Coastal Plain physiographic province. The county is underlain by unconsolidated sediments of Quaternary, Tertiary and Cretaceous age. These sediments are composed of interbedded sand and clay and reach a thickness of about 4000 to 6000 feet. Five fresh water aquifers underlie Cape May County. These are included in the upper 1100 feet of the Coastal Plain sediments and they reange in age from Miocene to Recent. These aquifers, in the order of their present development, are the Cohansey Sand of Pliocene (?) age, two sands in the Kirkwood Formation of Pleistocene age, the estuarine sand facies of the Cape May Formation of Pleistocene age, and the Holly Beach water-bearing zone of Pleistocene and Recent age. The sediments of pre-Tertiary age have not been studied in detail, owing to the scarcity of wells drilled to deeper strata in the county. Information on deeper water-bearing beds, obtained from test holes in Atlantic, Cumberland and Camden Counties, suggests that wells tapping these strata in Cape May County would yield salt water.

GILL, H. E., J. VECCHIOLI and H. R.ANDERSON. 1963. Evaluation of geologic and hydrologic data from the test-drilling program at Island Beach State Park, New Jersey. Water Resources Circ. 12:1-25, Div. Water Policy Supply, Dept. Conserv. Econ. Develop., Trenton, N. J. (D)

Location: Island Beach State Park (12)

Keywords: Regional Geology; Geohydrology; Water Chemistry

Abstract: The test-drilling program at Island Beach State Park, N. J. was undertaken to provide geologic and hydrologic information necessary for proper evaluation of the ground-water resources of southern New Jersey. An exploratory borehole was drilled through the entire unconsolidated Coastal Plain sequence. Electric and radioactivity logs were made of the hole, core samples of the materials penetrated were taken and described, and water samples obtained at several horizons were analyzed. These data and the interpretations based on them are presented in this report. Most of the Coastal Plain formations at Island Beach differ significantly from their updip outcrop counterparts. In general, the sequence at Island Beach reflects a deeper water environment of deposition. The finer grained nature of several of the formations that function as important aquifers updip renders them unfit for development in the Island Beach test-well area. The aquifer system in the Raritan Formation is the only one capable of furnishing large supplies of fresh water to wells in this area. However, the water becomes increasingly saline toward the base of the formation and extreme care should be taken in the development of water supplies from the upper part of the system to prevent salt-water contamination. The data presented in this report should be augmented with similar data in other areas before definite conclusions can be reached regarding the geohydrologic framework of the aquifers in the Coastal Plain of New Jersey.

GIVNISH, T. 1971. See BOTANY citation.

HARDISON, C. H. and R. MARTIN. 1963. Water-supply characteristics of streams in the Delaware River Basin and in southern New Jersey. U.S. Geol. Surv. Water-Supply Paper 1669:1-45, Washington, D. C. (D)

HARDT, W. F. 1963. Public water supplies in Gloucester County, New Jersey. Water Resources Circ. 9:1-55, Div. Water Policy Supply, Dept. Conserv. Econ. Develop., Trenton, N. J. (D)

Location: Gloucester County

keywords: Water Quality; pH

Abstract: Gloucester County is in the southwestern part of New Jersey, below Camden, and is part of the Lower Delaware River Valley. This area is attracting new industry and has shown a population increase of about 47% from 1950 to 1960, mostly urban. With the economic growth of the county, the availability and quality of water become increasingly important. The county is in the Coastal Plain of New Jersey. It is underlain by unconsolidated sands and clays of Quaternary, Tertiary and Cretaceous age. The Raritan and Magothy Formations contstitute the most important aquifers and yield more than 95% of the water pumped by the public water systems in the county. These formations are capable of yielding 1,400 gpm (gallons per minute) or more to large diameter wells. High yielding wells generally can be drilled anywhere in the county, although the formations are deeper toward the Atlantic Ocean. The Cohansey Sand, second most important aquifer, yields up to 800 gpm or more from large diameter wells. This aquifer is present only in the sparsely populated southeastern half of the county. The Wenonah Formation and Mount Laurel Sand are capable of yielding 100 to 200 gpm in certain areas. The overall chemical quality of the naturally occurring ground water is good. The water generally meets U.S. Public Health Service's (1962) suggested limit for dissolved solids; however, in some areas, the water carries objectionable amounts of iron and nitrate in solution and has a low pH. Contamination of ground water by salt-water encroachment or by pollution from industrial activity or organic waste in densely populated areas should be prevented. The quality rather than the quantity of water may be the important factor in future ground-water developments. The 21 public water systems in Gloucester County pumped about 1.3 billion gallons of water during 1948 and some 2.7 billion gallons during 1959. This is slightly more than a hundred percent increase in pumpage in 12 years. The average per capita public water supply consumption in 1959 was approximately 75 gallons per day. This report includes a summary of the history of the present installations, ground-water conditions, quality and availability of water, and potential future yield for the 21 public water systems in Gloucester County.

HARDT, W. F. and G. S. HILTON. 1969. Water resources and geology of Gloucester County, New Jersey. N.J. Div. Water Policy Supply Special Rept. 30:1-130, Trenton, N.J. (D)

Location: Gloucester County

Keywords: Water Quality; Geologic Descriptions; Hydrologic Budgets; Ground Water Use

Abstract: Gloucester County, in the southwestern part of New Jersey adjacent to Philadelphia, Pa., Camden, N. J. and Wilmington, Del. in the lower Delaware River valley, has an area of 339 square miles. It is in the Coastal Plain physiographic province and is underlain by unconsolidated sand and clay of Quaternary, Tertiary and Cretaceous age. These sediments overlie bedrock which consists of metamorphic and igneous rocks of upper Precambrian (?) age. The unconsolidated formations dip to the southeast and generally thicken oceanward. The older formations are at or near the surface in the vicinity of the Delaware River and are progressively deeper toward the Atlantic Ocean. Water sufficient for domestic and farm supplies is available anywhere in the county, usually from wells less than 200 feet deep. However, moderate to large amounts of water can be pumped economically only from the Raritan and Magothy Formations, the Cohansey Sand, and the Wenonah Formation and Mount Laurel Sand. The most important and productive aquifer is the undifferentiated Raritan and Magothy Formations of Late Cretaceous age. The aquifer yields about 75% of the ground water used in the county. Wells tapping this aquifer yield up to 1400 gpm (gallons per minute) and large capacity wells usually can be drilled almost anywhere in the county, however high chlorides may be present in the southeastern parts of the county. Pumping tests indicate that the coefficients of transmissibility range from 30,000 to 68,000 gpd (gallons per day) per foot in the Raritan and Magothy Formations. The aquifer is more permeable in the northwestern part of the county. The Cohansey Sand of Tertiary age is the second most important aquifer in the county and has the greatest potential for future development. The formation crops out in the sparsely populated southern half of the county and yields of 800 gpm are possible from wells less than 200 feet deep. Pumping tests at Clayton and Williamstown indicate a coefficient of transmissibility of about 60,000 gpd per foot. The undifferentiated Wenonah Formation and Mount Laurel Sand are capable of yielding 100 to 200 gpm to wells in the area between Pitman and Turnersville. In the county this aquifer is an important source of water for domestic supplies in and near the outcrop area of the formation. Total ground water pumpage in the county (1966) was estimated at about 40 mgd (million gallons per day) which consisted of 15.5 mgd for industrial use; 11 mgd for public supplies; 10 mgd for irrigation; and 3.5 mgd for rural domestic supplies. Precipitation in the county contributed about 2 mgd of water per square mile. This is far more than is needed to recharge water pumped from the ground water reservoir. Therefore, most of the water that does not return directly

to the atmosphere as evapotranspiration enters the streams. Past records indicate that on the average about half the precipitation is evapotranspired and the other half is discharged by streams. Low-flow stream measurements in July 1957 indicate that the minimum total base flow from the county to be 50 or 60 mgd whereas annual average discharge is about 300 mgd. The chemical quality of ground water is generally acceptable for most uses, although in some areas objectionable amounts of iron, nitrate and fluoride are found. Near the Delaware River and in the southeastern part of the county, chloride in the water from the Raritan and Magothy Formations may be a future problem.

HARTWELL, O. W. 1936. Surface water supply of New Jersey: stream flow records 1 October 1928 - 30 September 1934. Spec. Rept. 5:1-253, Water Policy Commission, Trenton, N. J. (D)

Location: Toms River at Toms River (11); Cedar Creek at Lanoka Harbor (19); Batsto River at Batsto (24); East Branch, Wading River at Harrisville (26); Absecon Creek at Absecon (39); Great Egg River at Folson (31); Maurice River at Norma (29); Manantico River at Millville; Loper Run at Bridgeton

Keywords: Daily Discharge

HARTWELL, O. W. and O. LAUTERHAHN. 1952. Surface water supply of New Jersey: stream flow records 1 October 1940 - 30 September 1945. Spec. Rept. 12:1-379, Water Policy Commission, Trenton, N. J. (D)

Location: Toms River at Toms River (11); Cedar Creek at Lanoka Harbor (19); Batsto River at Batsto (24); East Branch, Wading River at Harrisville (26); Absecon Creek at Absecon (39); Great Egg River at Folsom (31); Maurice River at Norma (29); Manantico River at Millville; Loper Run at Bridgeton

Keywords: Daily Discharge

ISPHORDING, W. C. and W. LODDING. 1969. See GEOLOGY AND SOILS citation.

JABLONSKI, L. A. 1959. Records of wells and ground-water quality in Monmouth County, New Jersey. Dept. Conserv. Econ. Develop., Trenton, N. J. 47pp. (D)

Location: Monmouth County

Keywords: Elemental Composition

JABLONSKI, L. A. 1960. Factual data for public-supply wells and selected irrigation wells in Monmouth County, New Jersey. Dept. Conserv. Econ. Develop., Trenton, N. J. 28pp. (D)

Location: Monmouth County

Keywords: Elemental Composition; Water Level Data

JOHNSON, A. H. 1979a. Acidification of headwater streams in the New Jersey Pine Barrens. Jour. Environ. Qual. 8:383-386. (D)

Location: MacDonalds Branch (8,9); Oyster Creek (19); Toms River (11); Mill Creek (27); Four Mile Branch (18); Springers Brook (15); Greenwood Branch (8); Batsto River (24); Great Egg Harbor River (31); Oswego (Wading) River (25); North Branch Rancocas Creek (7)

Keywords: Water Chemistry; Surface Water; Acid Precipitation; pH

Abstract: Sixteen years of stream pH data indicate acidification of two relatively undisturbed headwater streams of the New Jersey Pine Barrens. Average yearly stream pH decreased approximately 0.2 to 0.5 units in the two small streams that have long-term records. Hydronium ion concentration is correlated with SO4 in the two headwater streams in approximately a 1:1 ratio by equivalents, suggesting that H2SO4 is an important source of the acidity. A decrease in precipitation pH over the period is suggested in the literature and may be responsible for the decreasing stream pH.

JOHNSON, A. H. 1979b. Evidence of acidification of headwater streams in the New Jersey Pinelands. Science 206:834-836. (D)

Location: MacDonalds Branch (8,9); Oyster Creek (19)

Keywords: Acid Precipitation; Stream Chemistry; _Chamaecyparis thyoides_; _Sphagnum_ sp.

Abstract: Seventeen years of stream pH data indicate a trend of acidification in two small streams in the New Jersey Pine Barrens which drain relatively undisturbed areas. The decline in pH has amounted to approximately 0.4 units, with an estimated increase in H+ concentration of about 50 microequivalents per liter. The data collected to date are consistent with the postulation of an atmospheric source for the increased H+.

JOFFE, J. S. 1931. See GEOLOGY AND SOILS citation.

JORDAN, C. F. 1968. See GEOLOGY AND SOILS citation.

KASABACH, H. F. and R. J. SCUDDER. 1961. Deep wells of the New Jersey Coastal Plain. Bureau Geol. Topogr., Dept. Conserv. Econ. Develop., Trenton, N. J. 60pp. (D)

Location: General

Keywords: Geologic Formations; Lithology; Water Level Data

KELSEY, H. M. 1971. A hydrologic and geochemical study of the New Jersey Pine Barrens. B.A. Thesis, Princeton Univ., Princetown, N. J. 128pp. (D)

LANG, S. M. 1961. Natural movement of ground water at a site on the Mullica River in the Wharton Tract, southern New Jersey. U.S. Geol. Surv. Prof. Paper 424-D:D52-D54, Washington, D.C. (D)

LANG, S. M. and E. C. RHODEHAMEL. 1962. Movement of ground water beneath the bed of the Mullica River in the Wharton Tract, southern New Jersey. U.S. Geol. Surv. Prof. Paper 450-B:B90-B91, Washington, D.C. (D)

LANG, S. M. and E. C. RHODEHAMEL. 1963. Aquifer test at a site on the Mullica River in the Wharton Tract, southern New Jersey. Internat. Assoc. Sci. Hydrol. Bull. 8:31-38. (D)

LANGMUIR, D. 1969. Geochemistry of iron in a coastal plain aquifer of the Camden, N. J., area. U.S. Geol. Surv. Prof. Paper 650-C:C224-C235, Washington, D. C. (D)

LASKOWSKI, S. L. 1970. Statistical summaries of New Jersey streamflow records. N.J. Div. Water Policy Supply Water Resources Circ. 23:1-264. (D)

Location: Toms River at Toms River (11); Cedar Creek at Lanoka Harbor (19); Batsto River at Batsto (24); East Branch, Wading River at Harrisville (26); Absecon Creek at Absecon (39); Great Egg River at Folsom (31); Maurice River at Norma (29); Manantico River at Millville; Loper Run at Bridgeton

Keywords: Daily Discharge

LAYCOCK, W. A. 1967. See BOTANY citation.

LULL, J. W. and J. H. AXLEY. 1958. See BOTANY citation.

MARTIN, G. W. 1929. See BOTANY citation.

McCALL, J. E. and A. C. LENDO. 1960. Surface water supply of New Jersey: stream flow records 1 October 1950 - 30 September 1955. Spec. Rept. 16:1-405, Water Policy Commission, Trenton, N. J. (D)

Location: Toms River at Toms River (11); Cedar Creek at Lanoka Harbor (19); Batsto River at Batsto (24); East Branch, Wading River at Harrisville (26); Absecon Creek at Absecon (39); Great Egg River at Folsom (31); Maurice River at Norma (29); Manantico River at Millville; Loper Run at Bridgeton

Keywords: Daily Discharge

McCALL, J. E. and A. C. LENDO. 1963. Surface water supply of New Jersey: stream flow records 1 October 1955 - 30 September 1960. Spec. Rept. 20:1-425, Water Policy Commission, Trenton, N. J. (D)

Location: Toms River at Toms River (11); Cedar Creek at Lanoka Harbor (19); Batsto River at Batsto (24); East Branch, Wading River at Harrisville (26); Absecon Creek at Absecon (39); Great Egg River at Folsom (31); Maurice River at Norma (29); Manantico River at Millville; Loper Run at Bridgeton

Keywords: Daily Discharge

McCORMICK, J. 1970. See GENERAL REFERENCES citation.

McCORMICK, J. 1979. See BOTANY citation.

MEANS, J. L., R. F. YURETICH, D. A. CRERAR, D. J. KINSMAN and M. P. BORCSIK. 1981. Hydrogeochemistry of the New Jersey Pine Barrens. N.J. Dept. Environ. Protect. Bull. 76, Trenton, N.J. 107p. (D)

Location: General

Keywords: Groundwater; Stream Water; Precipitation; Mass Balances; Trace Metals; Iron; Aluminum; Bacteriology; Bog Iron

Abstract: This report has outlined the chemistry of the major aqueous systems of the New Jersey Pine Barrens. Most phases of the hydrologic cycle have been studied, including precipitation, surface waters, groundwaters and the estuarine environment. The results may be used as a data base for comparison with the hydrochemistry of the entire Atlantic Coastal Plain. The Pine Barrens rivers are unique in many respects. The pH of Pine Barrens rivers is considerably lower while dissolved Fe and organic carbon are significantly higher than values reported for most rivers. The ionic strength of Pine Barrens waters is unusually low, reflecting low total dissolved solids, about 20% of the average river water. Concomittantly, the ratios of dissolved Fe, Al and organic carbon to total dissolved solids are exceptionally high.

MEYERSON, A. L., J. GRYTA and A. A. WHALEN. 1974. Effects of sewage abatement on water and sediment chemistry, Navesink River, New Jersey. Bull. N. J. Acad. Sci. 19:34-38. (D)

Location: Red Bank

Keywords: Water Chemistry; Dissolved Oxygen; pH; Phosphate

Abstract: A primary sewage treatment plant on the Navesink River at Red Bank, New Jersey, ceased operation after December 1971. Inorganic phosphate and dissolved oxygen analyses were run on water samples before and after sewage abatement, as were analyses for calcium-, iron- and aluminum phosphate in the sediment. The water chemistry returned to normal within 1 month of abatement, while sedimentary phosphate values increased. The sediment appears to be a phosphate sink rather than a reservoir.

MILLER, E. G. 1966. Flow probability of New Jersey streams. N.J. Div. Water Policy Supply Water Resources Circ. 15:1-61, Trenton, N.J. (D)

Location: Toms River at Toms River (11); Cedar Creek at Lanoka Harbor (19); Batsto River at Batsto (24); East Branch, Wading River at Harrisville (26); Absecon Creek at Absecon (39); Great Egg River at Folsom (31); Maurice River at Norma (29); Manantico River at Millville; Loper Run at Bridgeton

Keywords: Daily Discharge

MILLER, E. G. and J. E. McCALL. 1961. New Jersey streamflow records analyzed with electronic computer. N.J. Div. Water Policy Supply Water Resources Circ. 6:1-89, Trenton, N.J. (D)

Location: Toms River at Toms River (11); Cedar Creek at Lanoka Harbor (19); Batsto River at Batsto (24); East Branch, Wading River at Harrisville (26); Absecon Creek at Absecon (39); Great Egg River at Folsom (31); Maurice River at Norma (29); Manantico River at Millville; Loper Run at Bridgeton

Keywords: Daily Discharge

MONROE, W. H. and M. A. PENTZ. 1936. Availability of shallow ground water supplies in parts of the Atlantic Coastal Plain, with special reference to their use in forest fires. Unpubl. ms.,U.S. Geol. Surv., Reston Virginia. (D)

MOUL, E. T. and H. F. BUELL. 1979. See BOTANY citation.

MOUL, E. T. and M. F. BUELL. 1955. See BOTANY citation.

NEW JERSEY DEPARTMENT OF CONSERVATION AND DEVELOPMENT. 1922. Report on water resources of the State and their development. Hazen, Whipple and Fuller Civil Engineers, New York. 76pp. (D)

NEWMAN, F. 1967. A study of water quality on the Rancocas Creek, North Branch. Bull. N. J. Acad. Sci. 12:28-30. (D)

Location: Smithville (6); Pemberton (7); Browns Mills (8)

Keywords: Conductivity; pH; Pollution; Temperature

Abstract: Most streams in Burlington County begin in the Pine Barrens or marginal areas with similar types of soil, move through Cedar Swamps and empty into the Delaware Bay. The Rancocas Creek is a typical stream of this area with a drainage basin showing increased human and industrial pressure as it moves downstream from its source. Many tests can be used as indicators of pollution in fresh water streams. Conductivity and pH tests are particularly sensitive to changes in the level of stream pollutants. In addition to these, other tests conducted on a regular basis were Alkyl Benzene Sulfonate, Orthophosphate and Color. The results of the Orthophosphate and color tests indicated faulty technique and consequently no evaluation of these test results are included. Few studies of water quality have been conducted in Burlington County streams to date. Surveys of scattered sites, compiled as part of "Water Resources Records for New Jersey - 1964" and "Water Resources Data for New Jersey - 1965" by the United States Geological Survey constitute the major portion of the data currently available. Additional studies are planned to give a more complete picture of water quality of the Rancocas.

NIESWAND, G. H. and M. L. GRANSTROM. 1971. A chance-contrained approach to the conjunctive use of surface waters and groundwaters. Water Resources Research 7:1425-1436. (D)

Location: Mullica River Basin (33,34)

Keywords: Streamflow; Pollution Abatement; Recreation; Wildlife

Abstract: A set of chance-constrained linear programming models for the conjunctive use of surface waters and groundwaters was developed for the Mullica River basin in New Jersey. A zero order decision was used to obtain deterministic equivalents for the chance-constrained models. The resulting linear programming models were solved for a variety of constraint situations. The results indicated the maximum total withdrawals that could be expected from the basin for the assumed conjunctive use operation. The satisfaction of specified target outputs for the basin by alternative feasible combinations of surface water and groundwater withdrawals was also demonstrated.

OWENS, J. P. and J. P. MINARD. 1975. See GEOLOGY AND SOILS citation.

PARKER, G. G. et al. 1964. Water resources of the Delaware River basin. U.S. Geol. Surv. Prof. Paper 381:1-200, Wasington, D. C. (D)

PATRICK, R., B. MATSON and L. ANDERSON. 1979. Streams and lakes in the Pine Barrens. Chapter 10 In R. T. T. Forman (ed.). Pine Barrens: ecosystem and landscape. Academic Press, New York. pp.169-193. (R)

Location: General

Keywords: Species Lists; Water Characteristics

Abstract: Most river basins are confined to the Pine Barrens, although a few originate there and flow into adjacent terrain. Records of fish, insects, diatoms and other algae, plus chemical and bacteriological data, are summarized for each river basin. Chemical data indicate that the streams and lakes are low in hardness, alkalinity and pH, and that most are high in humic compounds. Typical acid water conditions are indicated by nine fish species widespread throughout the Pine Barrens, and by an insect fauna with abundant dragonflies and damselflies (Odonata) and abundant whirligig beetles (Gyrinidae), but with no mayflies (Ephemeroptera), indicating an acid condition, and few caddisflies (Trichoptera) and other insect groups.

Algae are characteristic of acid water streams, as witnessed by the prevalence of genera such as _Eunotia_, _Actinella_, _Anomoeoneis_, _Pinnularia_ and _Batrachospermum_. Stream temperatures are relatively cool and constant. Changes in stream chemistry and/or biology indicate scattered sources of pollution (fertilizers, farm and sanitary wastes) in the Pine Barrens.

PEEL, B. A. 1980. See GENERAL REFERENCES citation.

PIKE, C. M. 1971. Ground water resources, Cumberland County, New Jersey. Spec. Rept. 34:1-83, Div. Water Resources, Dept. Environ. Protection, Trenton, N. J. (D)

Location: Cumberland County

Keywords: Geography; Hydrologic Budget; Water-level Fluctuations; Salt-water Intrusion; Geologic Descriptions; Ground-water Use

Abstract: Cumberland County is located in the Atlantic Coastal Plain physiographic province along the northeastern shore of Delaware Bay in southwestern New Jersey. An average annual hydrologic budget was computed for Cumberland County. Water gains are: precipitation, 1050 mgd (million gallons per day); surface-water inflow, 142 mgd; ground-water inflow negligible. Water losses are: evapotranspiration, 685 mgd; surface-water outflow, 370 mgd; ground-water outflow, 137 mgd. Unconsolidated and semiconsolidated Coastal Plain sediments, 2500 to 4500 feet thick, and ranging in age from Cretaceous to Holocene, consist of layers of clay, silt, sand and gravel. Aquifers composed mainly of sand and gravel occur in the Potomac Group and Raritan and Magothy Formation, the Wenonah Formation and Mount Laurel Sand, the Piney Point Formation, and the Kirkwood Formation and Cohansey Sand. Aquifers in the Potomac-Raritan-Magothy sequence contain saline water and are not currently utilized in Cumberland County. However, they may be utilized in the future for underground storage of fresh water, or possibly other uses when more is known about this aquifer system. The aquifer in the Wenonah Formation and Mount Laurel Sand is not presently utilized in Cumberland County. It is probably suitable for future development, however, of wells yielding as much as 300 gpm of good quality water in the northern part of the county. The Piney Point Formation is tapped in Cumberland County by only a few wells; each of these generally yield less than 100 gpm. Additional small supplies can be developed from this aquifer. Water from this aquifer requires little or no treatment for domestic use. The two principal aquifers in the Kirkwood Formation and Cohansey Sand: (1) the lower Kirkwood aquifer and (2) the Cohansey-Kirkwood aquifer.

Most wells tapping the lower Kirkwood aquifer yield less than 50 gpm but are capable of yielding as much as 400 gpm. Wells in the lower Kirkwood range in depth from 200 to 370 feet. The Cohansey-Kirkwood aquifer is the shallowest and most important source of ground water in the county but is highly susceptible to surface contamination. This aquifer is highly permeable; analysis of data from two pumping tests indicate permeabilities of 1200 and 2700 gpm per square foot. It generally yields large supplies of water (300 to 1200 gpm) to wells from depths of less than 180 feet. Water in the Cohansey-Kirkwood aquifer is characterized by low dissolved solids content (63 mg/l, median), low hardness (21 mg/l, median), and low pH values (5.5 pH units, median). Water use in Cumberland County varies and is highly seasonal, mainly because of increasing requirements for irrigation and the food processing industries in the county. In 1964 seasonal use ranged from 27 mgd in March to 145 mgd in August. This is much higher than withdrawals in neighboring Salem and Cape May Counties. In 1964 withdrawals in Cumberland County averaged about 51 mgd; almost all of this, 49.4 mgd, was from ground-water supplies. The total annual water use in 1964 according to type of use was: for public supply, 10.6 mgd; for industrial use, 19.0 mgd; irrigation, 15.4 mgd; suburban, rural, residential, institutional, farm and commercial, 5.9 mgd.

PINELANDS COMMISSION. 1980. See GENERAL REFERENCES citation.

PINELANDS ENVIRONMENTAL COUNCIL. 1974. See GENERAL REFERENCES citation.

PINELANDS ENVIRONMENTAL COUNCIL. 1975. See GENERAL REFERENCES citation.

PURVIS, E. R. 1964. See BOTANY citation.

RHODEHAMEL, E. C. 1970. A hydrologic analysis of the New Jersey Pine Barrens region. N.J. Div. Water Policy Supply Water Resources Circ. 22:1-35, Trenton, N.J. (D)

Location: General

Keywords: Hydrologic Budget; Precipitation; Water Yield; Evapotranspiration; Water Table Fluctuations; Water Quality; Water Availability

Abstract: Water is one of the outstanding resources of the Pine Barrens region of south-central New Jersey - a 2250 square-mile region in the Atlantic Coastal Plain underlain by the Cohansey Sand. The long-term hydrologic budget in the Pine Barrens region can be stated as P = R + ET where:

P, the average annual precipitation is 45 inches; R, the average annual stream runoff is 22.5 inches; and ET, the average annual evapotranspiration is 22.5 inches. Average annual evapotranspiration losses which total 2.41 bgd (billion gallons per day) for the Pine Barrens region can be divided into: (1) interception loesses - 0.63 bgd, (2) evapotranspiration for undrained depressions - 0.09 bgd, and (3) evapotranspiration from soil and ground water - 1.69 bgd. Average annual stream runoff which totals 2.41 bgd for the Pine Barrens region can be divided into (1) direct runoff - 0.27 bgd and (2) base runoff or ground-water runoff - 2.14 bgd. Areal variations in ground-water runoff per square mile of drainage basin are accounted for by variation in distribution of precipitation and evapotranspiration and by movement of some ground water in a regional flow system bypassing local streams and discharging into more distant, lower lying systems. The flow of water within the regional flow system in the Pine Barrens region is calculated to be 70 mgd (million gallons per day), or about 0.7 inch of water per year. Both ground and surface waters of the Barrens area contain objectionable amounts of iron and at times color, and the pH values are in the acidic range. However, because of the low concentrations of total dissolved solids (25-50 mg/l) treatment of the water for iron and pH adjustments will provide a water supply suitable for most purposes. Development of the water resources could be achieved by locating high-yielding wells adjacent to the downstream reaches of major streams thus allowing streamflow, which is largely composed of ground-water discharge, to reenter the ground. Additional wells should be located further from the streams for use during prolonged low flow periods. Development by the use of surface reservoirs is not as suitable in the Pine Barrens region because surface reservoirs would cause inundation of large areas, would permit excessive evaporation and would create subsurface leakage toward areas of lower hydrologic head.

RHODEHAMEL, E. C. 1973. Geology and water resources of the Wharton Tract and the Mullica River Basin in southern New Jersey. N.J. Div. Water Resources Special Rept. 36:1-58, Trenton, N.J. (D)

RHODEHAMEL, E. C. 1979. Hydrology of the New Jersey Pine Barrens. Chapter 9 <u>In</u> R. T. T. Forman (ed.). Pine Barrens: ecosystem and landscape. Academic Press, New York. pp.147-167. (R)

Location: General

Keywords: Surface Water; Oswego River; Mullica River; Batsto River; Stream Flow; Ground Water; Geologic Formations; Hydrological Budget; Precipitation;

Evapotranspiration; Stream Runoff; Ground Water Quality

Abstract: The source of all water in the Pine Barrens is 114 cm of average annual precipitation. One-half of this water is lost by evapotranspiration. The remaining half enters the ground-water reservoir and may discharge directly to local streams or may move long distances at average rates as great as 40 to 50 m/yr to discharge many years later into the lower reaches of major Pine Barrens drainages. Thus, Pine Barrens streams vary widely in average annual runoff, from 36 to 84 cm of water (depth per unit area), and averaging about 57 cm. The water-table configuration is a subdued image of the land surface and slopes toward major rivers, varying in upland areas from 18.3 m deep to within centimeters of the surface. At a given site, it may fluctuate between extreme wet and dry periods by as much as 4 m, or 3 m from spring to fall; average annual fluctuation is upland areas is 1.5 m. The principal aquifer in the Pine Barrens is essentially a water-table reservoir lying in the upper Kirkwood-Cohansey Sand strata of of Miocene age, with younger overlying deposits generally hydraulically connected. Lesser, poorly defined, deeper aquifers extend to a few kilometers inland from the present coast. Because there is practically no overland flow, most streamflow is ground-water discharge from the principal aquifer. A long term hydrological budget for the Pine Barrens relating water input to water yield plus water loss is: precipitation (114.3 cm) = interception (15.0 cm) + evapotranspiration from undrained depressions (2.3 cm) + evapotranspiration from soil and ground water (39.9 cm) + direct runoff (6.3 cm) + ground-water runoff (50.8 cm).

RHODEHAMEL, E. C. and S. M. LANG. 1962. Winter ground-water temperatures along the Mullica River, Wharton Tract, New Jersey. U.S. Geol. Surv. Prof. Paper 450-D:D165-D168, Washington, D.C. (D)

RIEMER, D. N. and J. S. TOTH. 1968. See BOTANY citation.

RIGGS, G. B. 1940. See BOTANY citation.

RIGGS, G. B. 1951. See BOTANY citation.

ROSENAU, J. C., S. M. LANG, G. S. HILTON and J. G. ROONEY. 1969. Geology and ground-water resources of Salem County, New Jersey. Div. Water Policy Supply Spec. Rept. 33:1-142, Dept. Conserv. Econ. Develop., Trenton, N. J. (D)

Location: Salem County

Keywords: Hydrology; Geologic Formations Descriptions;

Water Quality

Abstract: Salem County is in southwestern New Jersey in the Atlantic Coastal Plain physiographic province. The county is underlain by coastal plain deposits of Quaternary, Tertiary and Cretaceous age which are composed of alternating clay, silt, sand and gravel. These deposits are underlain by crystalline rocks of Early Paleozoic or Precambrian age. The Coastal Plain deposits in Salem County range in thickness from about 200 feet in the northwestern part of the county to about 2400 feet in the extreme southeastern part of the county. The pre-Quaternary deposits dip gently to the southeast. The important aquifers in Salem County occur in the Potomac Group and Raritan and Magothy Formations, Wenonah Formation and Mount Laurel Sand, Vincentown Formation, Cohansey Sand, and Cape May Formation. Separating these aquifers are aquicludes composed of clayey materials. The Potomac Group and Raritan and Magothy Formations contain the most productive aquifers in Salem County. These aquifers are hydrodraulically connected in places and may be considered to form a single hydrologic unit or aquifer system. Reported yields of wells tapping this system range up to 860 gpm (gallons per minute). The highest yields commonly occur where the system has direct hydraulic connection with the overlying Cape May Formation near the Delaware River. A decline in water levels in the aquifer system of the Potomac, Raritan and Magothy has resulted from heavy pumpage. Movement of water towards centers of pumpage has created the danger of salt-water encroachment into the aquifer from downdip areas where the aquifer already contains saline water. The occurrence of saline water in the aquifer is indicated by local chloride concentrations of up to 2057 ppm. The aquifer in the Wenonah Formation and Mount Laurel Sand is the second most highly used aquifer in Salem County and is an important source of water for future development. Reported yields of wells tapping this aquifer range up to 507 gpm. Water from this aquifer ranges from soft to very hard (12 to 345 ppm, median 127 ppm) and is commonly high in iron (0.1 to 6.3 ppm). Salt-water intrusion into the aquifer, probably from the overlying Vincentown Formation, in the vicinity of the City of Salem is indicated by chloride concentrations of up to 396 ppm. The aquifer in the Vincentown Formation is an important aquifer in part of Salem County. It is capable of supplying considerably more water than is now being pumped and hence is important for future ground-water development. Reported yields of wells tapping this aquifer range up to 270 gpm. The water is hard (134 to 270 ppm) and moderate to high in iron content (0.15 to 10 ppm). Salt-water intrusion in the Salem area is indicated by chloride concentrations of up to 2850 ppm. The Cohansey Sand is capable of transmitting large quantities of water and is an important source for future ground-water development. Coefficients of transmissibility and storage

calculated from a pumping test in Salem County are 30,000 gallons per day per foot and 0.0003, respectively. Water in the aquifer is generally soft (average 47 ppm) and slightly mineralized. Iron (average 0.3 ppm) and dissolved carbon dioxide are commonly present in objectionable quantities. The Cape May Formation of Pleistocene age is an important aquifer in the Penns Grove-Deepwater area where it yields up to 1500 gpm to Ranney (horizontal) collector wells. Where Pleistocene deposits are not thick enough to function as an aquifer, their chief hydrologic function is to absorb precipitation and transmit it to underlying formations. Use of ground water in Salem County in 1964 averaged 12.28 mgd or nearly 200 gpd per person. Industrial use was 5.33 mgd and use for public supply was 2.74 mgd. Irrigation, which has become increasingly important in recent years, accounted for 2.14 mgd. Average total summer use of ground water - approximately 17.7 mgd - was considerably higher than the yearly average.

RUSH, F. E. 1962. Records of wells and ground-water quality in Burlington County, New Jersey. Water Resources Circ. 7:1-104, Div. Water Policy Supply, Dept. Conserv. Econ. Develop., Trenton, N. J. (D)

Location: Burlington County

Keywords: Water Chemistry; Water Level Data

RUSH, F. E. 1968. Geology and ground-water resources of Burlington County, New Jersey. Div. Water Policy Supply Spec. Rept. 26:1-65, Dept. Conserv. Econ. Develop., Trenton, N. J. (D)

SEABER, P. R. 1963. Chloride concentrations of water from wells in the Atlantic Coastal Plain of New Jersey, 1923-1961. Spec. Rept. 22:1-250, Div. Water Policy Supply, Dept. Conserv. Econ. Develop., Trenton, N. J. (D)

STANKOWSKI, S. J. 1972. Floods of August and September 1971 in New Jersey. Spec. Rept. 37:1-329, Div. Water Research, Dept. Environ. Protection, Trenton, N. J. (D)

Location: Toms River at Toms River (11); Great Egg River at Berlin (13); Tuckahoe River (43); Crosswicks Creek at New Egypt (2); South Branch, Rancocas Creek at Vincentown (6); North Branch, Rancocas Creek at Pemberton (7); Parkers Creek at Mt. Laurel (5)

Keywords: Flood Descriptions; Storage Regulator; Damage; Frequency; Discharge; Flood Elevations Data

Abstract: Floods of unprecendented magnitude in August 1971 created havoc in south-central, central and northeastern New Jersey. Recordbreaking floods in September 1971 occurred in the highly urbanized basins of northeastern New Jersey. The August flood resulted from heavy antecedent rainfall in the morning and afternoon of August 27 followed by precipitation associated with the passage of tropical storm Doria across New Jersey in the evening of August 27 and early morning hours of August 28. Total storm rainfall amounts during the 32-hour period ranged from about 3 to over 11 inches across New Jersey. Flooding was widespread throughout most of New Jersey and river levels reached stages greater than any previously known in many areas of the state. The September flood resulted from heavy intermittent thunderstorm activity on September 11-14, 1971 which average about 7 inches in northeastern New Jersey and caused recordbreaking peak flows in many streams in that part of the state and moderate flooding in many other areas of the state. These two outstanding flood events caused the loss of at least 7 lives and direct property damage estimated at more than 140 million dollars. This report provides hydrologic data needed for planning and design to control or lessen damages from future floods. It includes discussions on the antecedent hydrology and meteorology of the storms; a description of the floods, comparison to previous floods, effects on ground-water levels, sedimentation, and flood frequency; a summary of flood stages and discharges; and detailed information on stage and discharge for August and September 1971. Flood-crest elevations are tabulated for more than 700 sites for the August flood and flood profiles are presented for 36 streams.

STANKOWSKI, S. J. 1974. Magnitude and frequency of floods in New Jersey with effects of urbanization. Spec. Rept. 38:1-46, Div. Water Research, Dept. Environ. Protection, Trenton, N. J. (D)

Location: Toms River at Toms River (11); Great Egg River at Berlin (13); Tuckahoe River (43); Crosswicks Creek at New Egypt (2); South Branch, Rancocas River at Vincentown (6); North Branch, Rancocas River at Pemberton (7); Parkers Creek at Mt. Laurel (5)

Keywords: Hydrologic Characteristics

Abstract: Mathematical and graphical relations are presented to estimate flood-peak magnitudes having selected recurrence intervals ranging from 2 to 100 years for drainage basins larger than one square mile with various degrees of existing or projected urban and suburban development. Four parameters are required for use of the relations. Three of these may be measured from topographic maps; namely, basin size, channel slope, and surface

storage within the basin. The fourth is an index of manmade impervious cover which can be determined for existing and future development conditions from census data and population projections that are readily available from regional, state and local planning agencies. Developed from an analysis of flood information for 103 sites in New Jersey, the relations should be useful for design of bridge waterway openings, selection of optimum size for drainage structures, evaluation of flood hazards for alternative land-use plans, and for definition of floodway and flood-hazard-area limits. Urban and suburban development are shown to increase flood peaks up to 3 times the 2-year recurrence interval and up to 1.8 times at the 100-year recurrence interval as statewide averages.

STEPHENSON, S. N. 1965. See BOTANY citation.

TEDROW, J. C. F. 1979. See GEOLOGY AND SOILS citation.

THOMAS, D. M. 1964. Floods in New Jersey: magnitude and frequency. N.J. Div. Water Resources Circ. 13:1-145, Trenton, N.J. (D)

TOTH, S. J. and A. OTT. 1972. Composition of surface waters of New Jersey in relation to soil series: III. Waters of the Inner and Outer Coastal Plain. Bull. N. J. Acad. Sci. 17:23-34. (D)

Location: Oyster Creek, Waretown (19); Cedar Creek (10); Mullica River, Batsto (24); West Creek (27)

Keywords: Water Chemistry; pH; Fertilization; Heavy Metals; Water Flow

Abstract: The composition of waters of the Inner Coastal Plains regions of New Jersey is strongly influenced by land fertilization and liming. The composition of these waters no longer reflects the influence of variations in soil series composition, based on comparisons of waters that flow through woodlands and cultivated areas. The waters of the Inner Coastal Plains were lower in Ca and Mg and generally higher in K than waters of the Central and Northern regions of New Jersey. The heavy metal contents of waters of the Inner Coastal Plains area were higher than those noted in waters of northern and central regions of New Jersey. The heavy metal content of waters of the Manasquan River were related to the presence of marl beds in the stream channel. The waters of the Outer Coastal Plains area had the lowest Na, K, Ca and Mg concentrations of all waters examined in New Jersey. The low base content of waters of the Outer Coastal Plains was related to the highly weathered nature of soil parent material. Waters of the Outer Coastal Plain did not exhibit any increase in base content during low flow periods as did the waters of the northern region. With an increase in intensity of color of cedar waters in the Outer Coastal Plain, the Fe contents of these waters tended to increase because of chelation.

TOTH, S. J. and R. F. SMITH. 1960. Soil over which water flows affects ability to grow fish. N.J. Agric. 42:5-11. (D)

Location: Oyster Creek (18,19); Cedar Creek (10,11); West Creek (47); Mullica River (33,34)

Keywords: pH; Water Chemistry; Conductance

Abstract: Four stream waters of the Inner Coastal Plain Area, Yellow Brook, Manasquan River, and Rancocas and Raccoon Creeks, were sampled during the spring and summer flow periods and analyzed. Simultaneously, four streams of the Outer Coastal Plains Areas, Oyster, Cedar and West Creeks and the upper reaches of the Mullica River were studied. The most important findings were: (1) the composition of waters of the Inner Coastal Plains regions of New Jersey is strongly influenced by land fertilization and liming. The composition of these waters no longer reflects the influence of variations in soil series composition, based on comparisons of waters that flow through woodlands and cultivated areas; (2) the waters of the Inner Coastal Plains were lower in Ca and Mg and generally higher in K than waters of the Central and Northern regions of New Jersey; (3) the heavy metal contents of waters of the Inner Coastal Plains area were higher than those notes in waters of the northern and central regions of New Jersey; (4) the heavy metal content of waters of the Manasquan River were related to the presence of marl beds in the stream channel; (5) the waters of the Outer Coastal Plains area had the lowest Na, K, Ca and Mg concentrations of all waters examined in New Jersey; (6) the low base content of waters of the Outer Coastal Plains was related to the highly weathered nature of soil parent material; (7) waters of the Outer Coastal Plain did not exhibit any increase in base content during low flow periods, as did waters of the northern region; (8) with an increase in intensity of color of cedar waters in the Outer Coastal Plain, the Fe contents of these waters tended to increase because of chelation.

U. S. DEPARTMENT OF INTERIOR. 1978. See GENERAL REFERENCES citation.

U. S. GEOLOGICAL SURVEY. 1964-1966. Water resources data for New Jersey. Part 2. Water Quality Records. (Issued annually).

N.J. Div. Water Resources, Trenton, N.J. (D)

Location: General

Keywords: Hydrological Conditions; Water Quality; Sediments; Water Temperature; Surface Water; Water-discharge

U. S. GEOLOGICAL SURVEY. 1981. Water resources data for New Jersey, vol. 1: Atlantic Slope Basins, Hudson River to Cape May. Water-data Rept. NJ-80-1, Washington, D. D. 362pp. (D)

Location: General

Keywords: Hydrological Conditions; Water-discharge; Water Quality; Water Temperature; Sediments; Surface Water

VERMEULE, C. C. 1892. Water supply and water power. N.J. Geol. Surv. Ann. Rept. State Geol. 1891:141-215, Trenton, N.J. (N)

VERMEULE, C. C. 1893. Water supply and water power. N.J. Geol. Surv. Ann. Rept. State Geol. 1892:247-272, Trenton, N.J. (N)

VERMEULE, C. C. 1894a. Water supply and water power. N.J. Geol. Surv. Ann. Rept. State Geol. 1893:371-385, Trenton, N.J. (N)

VERMEULE, C. C. 1894b. Report on water supply, water power, the flow of streams and attendant phenomena. Final Rept. Ser. 3:1-352 and appendix:1-96, N.J. Geol. Surv., Trenton, N.J. (R)

VERMEULE, C. C. 1899. The pine belt of southern New Jersey and water supply. N.J. Geol. Surv. Ann. Rept. State Geol. 1898:183-193, Trenton, N.J. (N)

VICKERS, A. A. and J. E. McCALL. 1968. Surface water supply of New Jersey: streamflow records 1 October 1960 - 30 September 1965. Spec. Rept. 31:1-351, Div. Water Policy Supply, Dept. Conserv. Econ. Develop., Trenton, N. J. (D)

Location: Toms River at Toms River (11); Cedar Creek at Lanoka Harbor (19); Batsto River at Batsto (24); East Branch, Wading River at Harrisville (26); Absecon Creek at Absecon (39); Great Egg River at Folsom (31); Maurice River at Norma (29); Manatico River at Millville; Loper

Run at Bridgeton

Keywords: Daily Discharge

WOOD, O. M. 1937. See BOTANY citation.

WOODWELL, G. M. 1979. See BOTANY citation.

WOOLMAN, L. 1889-1902. (Annual reports on artesian wells and water-bearing horizons of New Jersey.) N.J. Geol. Surv. Ann. Repts. State Geol. for 1889-1902, Trenton, N.J. (D)

YURETICH, R. F., D. A. CRERAR, D. J. KINSMAN, J. L.MEANS and M. P. BORCSIK. 1981. Hydrogeochemistry of the New Jersey Coastal Plain: 1. Major-element cycles in precipitation and river water. Chem. Geol. 33:1-21. (D)

Location: Toms River (4); Wrangle Branch (4); Cedar Creek (10,11); Forked River (19); Oyster Creek (18); Batsto River (15,24); Mullica River (24); Hammonton Creek (24); West Branch, Wading River (25); Oswego River (26); Bass River (26); Tuckerton Creek (35); Mill Creek (27,28); Cedar Run (27); Westecunk Creek (27)

Keywords: Transport Mechanisms; Ionic Budgets; Mass Balance

Abstract: The New Jersey Coastal Plain (Pine Barrens) is an extensive region where inorganic interactions between the soils and shallow groundwater are at a minimum. This study compares the geochemistry of precipitation and surface water to analyze transport mechanisms of major elements and to evaluate hydrogeochemical balances in this relatively unusual system. Precipitation composition is controlled by proximity to the ocean and seasonal variability of storm movements. Total dissolved solids in precipitation are high (11.5 ppm) but decrease inland; Na+ and Cl- are more abundant in winter precipitation whereas K+, SO4--, Ca++ and NO3- exhibit greater concentrations during the summer months. Na+ and Cl- are derived from marine aerosols; SO4-- is a product of SO2 pollution in the atmosphere; other ions have significant contributions from continential aerosols. Dissolved solids in rivers are low (20 ppm) compared with average river water and pH is acidic (4.5). Both reflect paucity of mineral - water reactions in the uppermost aquifer (Cohansey Formation - quartz sand and gravel). However, regional variations in river-water geochemistry suggest cross-aquifer migration of deep groundwaters into the Mullica River basin. Mass balances confirm that river-water composition is controlled principally by precipitation. However, Ca++, PO4--- and

SO_4^{--} are depleted in river waters, probably as a result of removal by biota or cedar swamp processes. Mg^{++} shows an excess in the rivers, suggesting a contribution from deep groundwater. The poor chemical buffering in the waters of this region render them highly susceptible to contamination.

METEOROLOGY, INCLUDING MICROCLIMATE

BARKSDALE, H. C., D. W. GREENMAN, S. M. LAND, G. S. HILTON and D. E. OUTLAW. 1958. See HYDROLOGY Citation.

BROTAK, E. A. and M. D. SCHULMAN. 1971. Tropical cyclone precipitation in New Jersey. Bull. N. J. Acad. Sci. 16:2-7. (D)

BROTAK, E. A. and M. D. SCHULMAN. 1973. A study of temperature trends (1900-1969) in New Jersey. Bull. N. J. Acad. Sci. 18:39-46. (D)

GAY, S. F. 1976. Precipitation chemistry and its relation to the river chemistry of the New Jersey Pine Barrens. B.A. Thesis, Princeton Univ., Princeton, N.J. 86p. (D)

FORMAN, R. T. T. 1979. See GENERAL REFERENCES citation.

FORMAN, R. T. T. and R. BOERNER. 1981. See BOTANY Citation.

FRIEDMAN, S. and M. D. SCHULMAN. 1977. New Jersey seasonal snowfall as estimated by the incomplete gamma distribution. Bull. N. J. Acad. Sci. 22:22-26. (D)

GOLDSTEIN, R. F. 1973. See GEOLOGY AND SOILS citation.

HAVENS, A. V. 1979. Climate and microclimate of the New Jersey Pine Barrens. Chapter 7 In Forman, R. T. T. (ed.). Pine Barrens: ecosystem and landscape. Academic Press, New York. pp.113-131. (R)

Location: General

Keywords: Temperature; Precipitation; Snowfall; Wind; Humidity; Solar Radiation; Human Impacts

Abstract: In winter a strong northwesterly flow of cold dry air masses from Canada predominates in the Pine Barrens, and temperatures average 0-2 degrees C (32-36 degrees F). In summer a southwesterly flow of warm humid air around the Bermuda high-pressure area dominates the Pine Barrens, with temperatures averaging 22-24 C (72-75 F). From year to year, however, both summer and winter temperatures are highly variable. A coastal sea breeze in spring and summer lowers afternoon temperatures and increases relative

humidity over the extreme eastern portions of the Pine Barrens. Average annual precipitation throughout the Pine Barrens is 1067-1168 mm (42-46 in), but again annual variability is high, e.g. 642-1706 mm (25-67 in) at Atlantic City Airport. Drought occurs relatively frequently and influences the entire region; flooding is occasional and of localized importance. Temperature, humidity, wind, solar radiation and precipitation before and during fire outbreaks, particularly in spring, are important in determining the spread of major forest fires. At least five weather situations produce strong winds and heavy precipitation in different seasons. Stationary or slow-moving high pressure areas, 87% of which occur during August-November, cause extended periods of atmospheric stagnation with haze and pollution buildup. Although the climate of the Pine Barrens generally is similar to that of surrounding regions, the microclimate is unique in several respects. Since human use of the land often has profound effects upon microclimate, any further development in the Pine Barrens must be evaluated carefully for potential microclimate changes.

ISPHORDING, W. C. 1970. Late Tertiary paleoclimate of eastern United States. Amer. Assoc. Petro. Geol. Bull. 54:334-343. (R)

JOHNSON, A. H., T. G. SICCAMA, D. WANG, R. S. TURNER and T. H. BARRINGER. 1981. See BOTANY citation.

LITTLE, S., H. A. SOMES and J. P. ALLEN. 1952. See BOTANY citation.

McCARTHY, E. F. and M. D. SCHULMAN. 1976. A statistical analysis of trends and cycles in New Jersey precipitation. Bull. N. J. Acad. Sci. 21:6-10. (D)

McCORMICK, J. 1970. See GENERAL REFERENCES citation.

MOUL, E. T. and M. F. BUELL. 1955. See BOTANY citation.

PEEL, B. A. 1980. See GENERAL REFERENCES citation.

PINELANDS COMMISSION. 1980. See GENERAL REFERENCES citation.

RHODEHAMEL, E. C. 1970. See HYDROLOGY citation.

RHODEHAMEL, E. C. 1979. See HYDROLOGY citation.

SCOTT, C. M. and M. D. SCHULMAN. 1976. An extreme value analysis of heavy precipitation in New Jersey. Bull. N. J. Acad. Sci. 21:1-5. (D)

SCHULMAN, M. D. and E. F. McCARTHY. 1976. A rain-snow climatology of New Jersey. Bull. N. J. Acad. Sci. 21:6-9. (D)

U. S. DEPARTMENT OF INTERIOR. 1978. See GENERAL REFERENCES citation.

ZOOLOGY, INCLUDING MICROFAUNA

ABBOTT, C. C. 1868. Appendix E: catalogue of vertebrate animals of New Jersey. _In_ G. H. Cook. Geology of New Jersey, Newark, N.J. (D)

ABBOTT, C. C. 1890. Voice of _Hyla_ _andersoni_. Amer. Natur. 24:189. (N)

AKERS, J. F. 1980. Summer Evening Grosbeak in Atlantic County, New Jersey. Cassinia 52:35. (D)

APGAR, A. C. 1904. The birds of New Jersey. N. J. State Museum Ann. Rept. 1903:29-118. Trenton, N. J. (D)

APPLEGATE, J. E. 1974. The wildlife resources of New Jersey. pp243-266 _In_ T. P. Norman (ed.). New Jersey Trends. Institute Environ. Studies, Rutgers Univ., New Brunswick, N. J. (R)

BAGG, R. M. 1898. The Cretaceous Foraminifera of New Jersey. U. S. Geol. Surv. Bull. 88:4-89, Washington, D.C. (D)

BAILEY, J. W. 1841. Notes on the discovery of fossil foraminifera in New Jersey. Amer. Jour. Sci. First Ser. 16:213-214. (D)

BAIRD, D. 1964. A fossil sea-turtle from New Jersey. N.J. State Mus. Investigation 1:1-26, Trenton, N.J. (D)

BAIRD, D. and G. R. CASE. 1966. Rare marine reptiles from the Cretaceous of New Jersey. Jour. Paleo. 40:1211-1215. (D)

Location: General

Keywords: Navesink Formation; _Halisaurus_ _platspondylus_; _Monasaurus_ _conodon_

Abstract: New finds from the Navesink greensand (Maestrichtian) of Burlington County, New Jersey, include the first-known frontal bone of the mosasaurine lizard _Halisaurus_ _platyspondylus_ and a vertebra of _Monasaurus_ [_Clidastes_] _conodon_. A peripheral bone of the toxochelyid saw-turtle _Prionochelys_ demostrates the survival of this genus into Maestrichtian time on the Atlantic seaboard.

BARBOUR, T. 1916. A note on two interesting New Jersey amphibians. Copeia 26:5-7. (N)

Location: Lakehurst (4)

Keywords: <u>Rana virgatipes</u>; <u>Hyla andersoni</u>

BECKWITH, C. S. 1940. Insects of the cultivated blueberry. N. J. Agr. Expt. Sta. Circ. 311:17-23. New Brunswick, N. J. (D)

BECKWITH, C. S. 1943. Insects attacking the blueberry fruit. N. J. Agr. Expt. Sta. Circ. 472, New Brunswick, N. J. (R)

BLACK, I. H. and K. L. GOSNER. 1957. The barking treefrog, <u>Hyla gratiosa</u> in New Jersey. Herpetologica 13:254-255. (D)

Location: Bennett (50)

Keywords: Description

BOYD, H. P. 1973. Collecting tiger beetles in the Pine Barrens of New Jersey. Cicindela 5:1-12. (N)

BOYD, H. P. and P. E. MARUCCI. 1979 . Arthropods of the Pine Barrens. Chapter 29 <u>In</u> Forman, R.T.T. (ed.). Pine Barrens: ecosystem and landscape. Academic Press, N. Y. pp.505-525. (R)

Location: General

Keywords: Diversity; Habitats; Pine-Oak Forests; Shrub Vegetation; Aquatic Habitats

Abstract: Over 125 arthropods found in the Pine Barrens of New Jersey are presented and briefly described. These are considered to be either the most common and representative of each major habitat type, or the most significant ecologically, economically or aesthetically. Notes on ecological relationships and behavioral patterns often are included. The Diptera (flies, etc.) probably are present in the greatest numbers; the Coleoptera (beetles) and Hymenoptera (bees, wasps, ants, etc.) have the greatest diversity; and the Lepidoptera (moths and butterflies) include many characteristic Pine Barrens species.

BOYD, W. M. 1953. Insects of importance in New Jersey nurseries. N. J. Dept. Agr. Circ. 390, Trenton, N. J. (D)

BRANDER, R. L. 1971. An additional specimen of the scarlet snake Cemophora coccinea from the New Jersey Pine Barrens. Bull. Maryland Herpetol. Soc. 7:38-39. (D)

BRYAN, T. M. 1879. Large rattlesnakes. Amer. Natur. 13:322. (N)

BUFFINGTON, J. D. 1967. Soil arthropod populations of the New Jersey pine barrens as affected by fire. Annals Entomol. Soc. Amer. 60:530-535. (D)

BULL, J. 1964. Birds of the New York area. Harper and Row Publ., New York. (D)

BUMP, G. 1936. From scruboak and pitch pine to quail. Proc. First N. Amer. Wildlife Conf. 1:599-603. (N)

BURBUTIS, P. P. 1956. The Siphonaptera of New Jersey. N. J. Agr. Expt. Sta. Bull 782:1-36, New Brunswick, N. J. (D)

BURGER, J. W. 1934. The hibernation habits of the rattlesnake in New Jersey Pine Barrens. Copeia 3:142. (D)

Location: Mt. Misery (8)

Keywords: Crotalus horridus

BURLINGTON, H. J. 1939. Land-clearing for wildlife in southern New Jersey. Trans. N. Amer. Wildlife Conf. 4:546-548. (D)

CANTLON, J. E. and M. F. BUELL. 1952. See BOTANY citation.

CARRICK, M. R., A. N. LENTZ and J. R. WESTMAN. 1955. Bibliography on snakes, lizards, turtles, frogs and salamanders of New Jersey. Leaflet 127:1-8, Rutgers Univ., New Brunswick, N. J. (R)

CARTER, W. C. 1971. Nine years of bird banding at four areas in New Jersey: III. Tyrannidae, Hirundinidae and Sittidae. EBBA News 34:223-229. (D)

CHOATE, E. A. and F. TILLY. 1973. The 1970 autumn hawk count at Cape May Point, New Jersey. Science Note 11:1-7, N. J. State Museum, Trenton, N. J. (D)

Location: Cape May Point (50)

Keywords: Migration; Abundances

COLLETTE, B. B. 1962. The swamp darters of the subgenus Hololepis (Pisces, Percidae). Tulane Studies Zoology 9:115-211. (D)

COMEGYS, G. R. and J. B. SCHMITT. 1966. A list of the Thysanoptera or thrips of New Jersey. Jour. N. Y. Entmolo. Soc. 73:195-222. (D)

COMSTOCK, W. P. 1940. Butterflies of New Jersey; a list of the Lepidoptera suborder Rhopalocera occurring in the state of New Jersey, giving time of flight, food plants, records of capture with locality and date. Jour. N. Y. Entomol. Soc. 48:47-84. (D)

CONANT, R. 1946. Intergradation among the ring-necked snakes from southern New Jersey and the Del-Mar-Va peninsula. Bull. Chicago Acad. Sci. 7:473-482. (D)

CONANT, R. 1957. The eastern mud salamander (Pseudotriton montanus montanus): a new state record for New Jersey. Copeia 2:152-153. (N)

Location: Webbs Mills (9,10)

Keywords: Pseudotriton ruber

CONANT, R. 1961. The softshell turtle, Trionyx spinifer, introduced and established in New Jersey. Copeia 3:355-356. (D)

Location: Kean's Lake, Elmer (29)

Keywords: Species Status

CONANT, R. 1962. Notes on the distribution of reptiles and amphibians in the Pine Barrens of New Jersey. N. J. Nature News 17:16-21. (D)

CONANT, R. 1979. A zoogeographical review of the amphibians and reptiles of southern New Jersey, with emphasis on the Pine Barrens. Chapter 27 In Forman, R.T.T. (ed.). Pine Barrens: ecosystem and landscape. Academic Press, New York. pp.467-488. (R)

Location: General

Keywords: Habitat Destruction; Geographical Distributions; Introduced Species; Geographical Origin

Abstract: Distribution patterns of the 58 native and two introduced species of amphibians and reptiles known to occur in southern New Jersey are analyzed, and comments are presented on the probable geographical origins of and human impacts upon this fauna. Six categories of species are recognized, those which are: (a) confined to the Pine Barrens; (b) wide ranging across southern New Jersey; (c) known from a relatively few localities within the borders of the Pine Barrens; (d) relict in the Pine Barrens; (e) restricted to areas outside the Pine Barrens; and (f) present because of introductions by people. Species that range broadly across eastern North America may have invaded the region shortly after the last glacial period, whereas many Coastal Plain species at or near the northern extremes of their ranges may have arrived at the onset of a more recent warm period. Major injurious effects on the herptological fauna are evident as a result of intensive agriculture, urbanization, and industrialization and the activities of amateur and commercial collectors. In the midst of the region, however, the Pine Barrens serve as a huge, immensely valuable refugium for amphibians and reptiles.

CONANT, R. and R. M. BAILEY. 1936. Some herpetological records from Monmouth and Ocean Counties, New Jersey. Occas. Papers Museum Zoology 328:1-10, Univ. Michigan, E. Lansing. (D)

CONNOR, P. 1953. Notes on the mammals of a New Jersey Pine Barrens area. Jour. Mammol. 34:227-235. (D)

Location: Burlington County; Ocean County

Keywords: Habitats; Species List

CONNOR, P. 1957. A method of plant dispersal by a mammal. Ecology 38:151-152. (D)

Location: Oswego Lake (26)

Keywords: _Juncus pelocarpus_; _Synaptomys cooperi_

CONNOR, P. F. 1959. The bog lemming, _Synaptomys cooperi_, in southern New Jersey. Publ. Mus. Mich. State Univ., Biol. Ser. 1:165-248. (N)

Location: Oswego Lake (26)

Keywords: Juncus pelocarpus

COOKE, C. W. and L. W. STEPHENSON. 1928. See GEOLOGY AND SOILS citation.

COPE, E. D. 1862. On some new and little-known American Anura. Proc. Acad. Nat. Sci. Phila. 14:151-159. (D)

Location: Jackson (4)

Keywords: Hyla andersoni; Description

COPE, E. D. 1883. The fishes of the Batsto River, N. J. Proc. Acad. Nat. Sci. Phila. 35:132-133. (R)

COPE, E. D. 1891. A new species of frog (Rana virgatipes) from New Jersey. Amer. Natur. 25:1017-1019. (D)

Location: Great Egg Harbor River Tributary

Keywords: Type Specimen Description

COPE, E. D. 1896. Fishes from isolated pools. Amer. Natur. 30:943-944. (D)

Location: Winslow (23)

Keywords: Species List

DARLINGTON, E. T. 1952. Notes on blueberry lepidoptera in New Jersey. Amer. Entomol. Soc. Trans. 78:33-57. (D)

DAVIS, W. T. 1904a. Note on Hyla andersoni Baird. Proc. Nat. Sci. Assoc. Staten Island 9:26. (D)

DAVIS, W. T. 1904b. Hyla andersoni and Rana virgatipes at Lakehurst, New Jersey. Amer. Nat. 38:893. (N)

DAVIS, W. T. 1905. Further note on Hyla andersoni and Rana virgatipes in New Jersey. Amer. Nat. 39:795-796. (N)

DAVIS, W. T. 1907. Additional observations on Hyla andersoni and <u>Rana</u> <u>virgatipes</u> in New Jersey. Amer. Nat. 41:49-51. (N)

DAVIS, W. T. 1912. An injurious grasshopper at Ridgeway, New Jersey. Entomol. News 23:2-3. (D)

DINDAL, D. E. 1979. Soil arthropod microcommunities of the Pine Barrens. Chapter 30 <u>In</u> Forman, R.T.T. (ed.). Pine Barrens: ecosystem and landscape. Academic Press, New York. pp.527-539. (R)

Location: General

Keywords: Community Structure; Macroarthropods; Fire

Abstract: The community structure of soil microarthropods is compared under six vegetative conditions of the New Jersey Pine Barrens. Microarthropod density ranged from 900/m in the Pine Plains to 69,000/m in upland old-burn sites. The decomposer food web was well developed in microsites with abundant organic matter. Microarthropod richness was highest in pine lowlands and lowest in annually burned soils. Oribatid mites, the major decomposer organisms, dominated the microarthropod community on all sites, whereas predatory arthropods were diverse. The microarthropod community in pine lowland soil appeared exceedingly stable, based on high richness and low spatial variability. published data on larger soil arthropods indicate that predatory litter-dwelling spiders and ants are prevalent. Many species of scarab beetles, mostly decomposers, are reported in the Pine Barrens. Periodic burns have enhanced the richness of microarthropods, and oribatid mites have been affected less than springtail (Collembola) decomposers by fires. Periodic burns selected against spiders and most ants. However, two new ant species colonized, and two others increased in abundance after periodic fires. Annual burning was very detrimental to the richness and population dynamics of all soil arthropod groups.

EDWARD, J. L. 1939. General observations of hawk migration in New Jersey. Urner Ornithol. Club Bull. 1. (D)

ENGLEHARDT, G. P. 1916. An unusually large pine snake from New Jersey. Copeia 26:7-8. (D)

Location: Hornerstown (2)

Keywords: <u>Pituophis</u> <u>melanoleucus</u>

FABLES, D. G. 1950. Fourteenth breeding bird census. Pine Barrens and cedar bog. Audubon Field Notes 4:301. (D)

FABLES, D. G. 1955. Annotated list of New Jersey birds. Urner Ornithol. Club, Newark, N. J. (R)

FABLES, D. G. 1962. Breeding birds of the New Jersey Pine Barrens. N. J. Nature News 17:60-64. (D)

Location: General

Keywords: Species List

FABLES, D. G. 1962. See BOTANY citation.

FISKLIN, T. J. and J. D. MONTGOMERY. 1971. See GENERAL REFERENCES citation.

FORMAN, R. T. T. 1979. See GENERAL REFERENCES citation.

FOWLER, H. W. 1904. Description of a new race of <u>Notropis chalybaeus</u> from New Jersey. Proc. Phila. Aca. Nat. Sci. 56:239-240. (D)

FOWLER, H. W. 1905a. The fishes of New Jersey. N. J. State Museum Ann. Rept. 1905 part 2:35-477, Trenton, N. J. (D)

FOWLER, H. W. 1905b. The sphagnum frog of New Jersey - <u>Rana virgatipes</u> Cope. Proc. Acad. Nat. Sci. Phila. 57:662-664. (R)

Location: Wading River, Speedwell (16); Batsto River, White Horse (24)

Keywords: Species Descriptions

FOWLER, H. W. 1906. The fishes of New Jersey. N. J. State Museum Ann. Rept. 1905:34-477. (D)

FOWLER, H. W. 1907a. The amphibians and reptiles of New Jersey. N. J. State Museum Ann. Rept. 1906:23-250, Trenton, N. J. (D)

FOWLER, H. W. 1907b. A supplementary account of the fishes of New Jersey. N. J. State Museum Ann. Rept. 1906:251-350, Trenton, N. J. (D)

FOWLER, H. W. 1908. Further notes on New Jersey fishes. N. J. State Museum Ann. Rept. 1907:120-189, Trenton, N. J. (D)

FOWLER, H. W. 1909a. Notes on New Jersey fishes. N. J. State Museum Ann. Rept. 1908:351-392, Trenton, N. J. (D)

FOWLER, H. W. 1909b. Notes on New Jersey amphibians and reptiles. N. J. State Museum Ann. Rept. 1908:393-408, Trenton, N. J. (D)

FOWLER, H. W. 1912. The Crustacea of New Jersey. N. J. State Museum Ann. Rept. 1911:29-651, Trenton, N. J. (D)

FOWLER, H. W. 1920. A list of the fishes of New Jersey. Proc. Biol. Soc. Washington 33:139-170. (D)

FOWLER, H. W. 1952. A list of the fishes of New Jersey, with off-shore species. Proc. Acad. Nat. Sci. Phila. 104:89-151. (D)

FRANCOIS, D. D. 1959. The crayfishes of New Jersey. Ohio Jour. Sci. 59:108-127. (D)

GOLDSTEIN, R. F. 1973. See GEOLOGY AND SOILS citation.

GOLDSTEIN, R. F. and H. L. COUSMINER. 1973. See GEOLOGY AND SOILS citation.

GOSNER, K. L. and I. H. BLACK. 1957. The effects of acidity on the development and hatching of New Jersey frogs. Ecology 38:256-262. (D)

Location: Speedwell (16)

Keywords: _Rana_ spp.; _Bufo woodhousei melanota_; _Hyla andersonii_; Water pH

Abstract: The anuran populations of the New Jersey pine barrens are restricted in variety of species in comparison with those of adjacent areas. _Rana virgapites_ and _Hyla andersoni_ are two characteristic species found in typical sphagnaceous barren habitats; _Rana pipiens sphenocephala_, _R. clamitans melanota_ and _Bufo w. fowleri_ are their normal

associates. Other New Jersey anurans breed in the barrens in intrusive, usually non-sphagnaceous, situations such as grassy pools and gravel pits. Rana palustris, R. catesbeiana and Acris c. crepitans are generally absent from the barrens. The water in typical sphagnaceous breeding habitats in the pine barrens is clear but strongly "tea" colored, weakly buffered, and with low dissolved mineral content. It is acid with an average pH between 4.0 and 4.3. The observed pH range was 3.6 - 5.2. The pH range of grassy pools and gravel pits in intrusive areas was 5.5 - 6.6. Embryonic tolerances for acid water varied in the eleven species tested. A pH of 3.8 or lower in bog water or hydrochloric acid-tap water solutions results in some abnormal development in Rana virgatipes while a pH of 4.2 - 4.6 has a similar effect on Acris. Deleterious effects on embryonic development are characterized by a failure of the perivitelline space to absorb normal quantities of water following the completion of embryonic Stage 12. This restriction apparently subjects the embryo to mechanical pressure resulting in morphological and behavioral abnormalities. Exposure to salt concentrations of 0.150 - 0.350 grams per 100 cc results in similar abnormalities. It is possible that deleterious effects associated with exposure to the acid solutions employed may have been due to alterations in the properties of the egg coats, interferring with normal osmotic control and responses to hatching enzymes. The acidity of bog water in the New Jersey pine barrens may be a limiting factor in the distribution of anurans. Rana virgapites and Hyla andersoni embryos tolerate more strongly acid solutions than any of the other species tested. Rana palustris and Acris c. crepitans have the least tolerance to such conditions and these species are practically absent from unaltered pine barrens habitats. Seven of the eleven species tested require bog water or tap water acidified with hydrochloric acid at a pH of 4.1 or higher for normal development. Hyla c. crucifer is capable of spawning successfully in bog water at a pH of 4.2 - 4.5. Pseudoacris is able to spawn in bog water at pH 4.7, or perhaps even lower.

GOSNER, K. L. and I. H. BLACK. 1967. Hyla andersoni. Amer. Soc. Icthyol. Herpteol. Catalog Amer. Amphibians and Reptiles 54.1-54.2. (R)

GOSNER, K. L. and I. H. BLACK. 1968. Rana virgatipes. Amer. Soc. Icthyol. Herpetol. Catalog Amer. Amphibians and Reptiles 67.1-67.2 (R)

GRAHAM, J. H. 1978. Factors affecting the distribution of sunfishes (Centrarchidae) in southern New Jersey. M.S. Thesis, Rutgers Univ., New Brunswick, N.J. 119p. (D)

Location: General

Keywords: Enneacanthus; Lepomis; Dietary Analysis; Food Habits; Functional Morphology

Abstract: At least three factors are at work limiting the distribution of species of Ennaecanthus and Lepomis in southern New Jersey. These are: (1) the chemical characteristics of the aquatic habitat, especially pH, calcium, dissolved carbon dioxide, and toxic heavy metals; (2) interspecific competition; and (3) the productivity and trophic structure of the respective habitat types. L. gibbosus and L. macrochirus are absent from most acid, dystrophic waters, while E. chaetodon and E. obseus are characteristic of these habitats. E. gloriosus is widely distributed in both dystrophic and eutrophic waters. Ennaecanthus species are morphologically and behaviorally suited for nutrient poor dystrophic habitats where almost all production is associated with iron floc covering both aquatic macrophytes and substrate. L. gibbosus and L. macrochirus are at a disadvantage in these habitats. Very young Lepomis are primarily open water planktivores, a feeding niche that is conspicuously absent in dystrophic waters. Water chemistry gives the illusion of having a direct effect on distribution, but is probably more important because of the way it effects habitat structure.

GREACEN, K. F. 1941. See GEOLOGY AND SOILS citation.

GREEN, H. A. 1881. Some reptiles of southern New Jersey. Sci. Advocate 2:28-29. (R)

GREENLAW, J. S. 1978. The relation of breeding and clutch size to food supply in the rufous-sided towhees. Condor 80:24-33. (D)

Location: General

Keywords: Pipilo erythrophthalamus

GULA, T. M. 1977. Foraging patterns of the Carolina chickadee (Parus carolinensis) compared in oak and pine forests of the New Jersey Pine Barrens. M.S. Thesis, Rutgers Univ., New Brunswick, N. J. pp. (D)

HALL, R. B. 1976. A study of controlled burning and its effects on south Jersey game habitat. Job V-B, Pittman-Robertson Rep. Proj. No. W-52-R-4. N. J. D. E. P., Trenton, N. J. (D)

HASTINGS, R. W. 1978. Vertebrates of the Pine Barrens. Frontiers 42:33-36. (R)

Location: General

Keywords: Species List; Habitats

HASTINGS, R. W. 1979. Fish of the Pine Barrens. Chapter 28 In Forman, R. T. T. (ed.). Pine Barrens: ecosystem and landscape. Academic Press, New York. pp.489-504. (R)

Location: General

Keywords: Characteristic Species; Peripheral Species; Anadromous Species; Introduced Species; Zoogeography

Abstract: The Pine Barrens fish fauna is depauperate, with four major groups containing approximately 36 species, and only 16 species indigenous to the typical acid waters. These 16 species are either (a) characteristic of sluggish lowland Coastal Plain streams or (b) widely distributed in many habitats in eastern North America. These fish are noted for their tolerance to high acidities; however, slow-moving water, food availability, and reduced competition also may be important factors. About ten other species common in southern New Jersey occur in less acid, peripheral Pine Barrens locations. Six introduced species are established in peripheral Pine Barrens locations. Four anadromous marine fish spawn in Pine Barrens streams. The Pine Barrens fish fauna is primarily a northward extension of the warm temperate Coastal Plain fish fauna of southeastern North America.

HAZEN, J. F. and O. M. WOOD. 1935. See BOTANY citation.

HEINTZELMAN, D. S. (ed.). 1971. Rare or endangered fish and wildlife of New Jersey. N. J. State Museum Sci. Note 4, Trenton, N. J. (D)

Location: General

Keywords: Amphibians; Reptiles; Birds; Mammals

HENRY, T. J. 1978. Description of a new Polymerus with notes on two other little known mirids from the New Jersey Pine Barrens. Proc. Entomol. Soc. Wash. 80:543-547. (D)

HOFF, H. K. 1974. Migration, food habits and age composition of striped bass. pp.132-139 In Ichthyological Associates, Inc.

Ecological studies in the bays and other waterways near Little Egg Inlet and in the ocean in the vicinity of the proposed site for the Atlantic Generating Station, New Jersey. Progress Rept. 1973. 709pp. (D)

HOFF, H. K. 1976. The life history of striped bass, <u>Morone saxatilis</u> (Walbaum) in the Great Bay - Mullica River estuary and the vicinity of Little Egg Inlet. pp.43-53 <u>In</u> Ichthological Associates, Inc. Ecological studies in the bays and other waterways near Little Egg Inlet and in the ocean in the vicinity of the proposed site for the Atlantic Generating Station, New Jersey. Progress Rept. 1975. 572pp. (D)

HOPE, J. G. 1943. An investigation of the litter fauna of two types of pine forest. Bull. Wagner Free Inst. Sci. 18:1-7. (D)

HUNT, C. J. 1905. A-birding among the New Jersey pines. Wilson Bull. 17:105-107. (N)

HUNT, C. J. 1908. The Kentucky Warbler in southern New Jersey. Auk 25:87. (D)

Location: Pensauken Creek (5)

Keywords: Species Distribution

HUTCHINSON, M. T. 1961. Plant parasitic nematodes of New Jersey. N. J. Agr. Expt. Sta. Bull 796:1-33, New Brunswick, N. J. (D)

JACOBSEN, F. L. 1965. A review of the fish and wildlife resources in Ocean County. N.J. Nat. News 20:156-163. (R)

Location: Ocean County

Keywords: Species List

JENNINGS, P. H. 1936. A microfauna from the Monmouth and basal Rancocas groups of New Jersey. Bull. Amer. Paleo. 23:3-76. (D)

KAUFFELD, C. F. 1935. The scarlet snake, <u>Cemophora</u> <u>coccinea</u>, in southern New Jersey. Copeia 1935:191. (D)

Location: Whitesbog (8)

Keywords: Species Distribution

KAUFFELD, C. F. 1966. The history of the corn snake, _Elaphe guttata guttata_ in southern New Jersey. Herpetologica 3:6-9. (D)

KAUFFELD, C. F. 1967. The history of the scarlet snake, _Cemophora coccinea_ in southern New Jersey. Herpetologica 3:7-9. (D)

KAUFFELD, C. F. and H. TRAPIDA. 1944. Additional records of the scarlet snake in New Jersey. Copeia 1944:62-63. (D)

Location: Whitesbog (8); Greenbank (33); Vineland (35); Pleasant Mills (24); Mt. Misery (8)

Keywords: _Cemophora coccinea_; Distribution; Description

KLOTS, A. B. 1930. Notes on Amphibia and Lacertilia collected at Weymouth, New Jersey. Copiea 173:107-111. (D)

Location: Weymouth (31)

Keywords: Species Descriptions

LECK, C. F. 1975. The birds of New Jersey. Rutgers Univ. Press, New Brunswick, N. J. 190pp. (D)

LECK, C. F. 1979. Birds of the Pine Barrens. Chapter 26 _In_ R. T. T. Forman (ed.). Pine Barrens: ecosystem and landscape. Academic Press, New York. pp.457-466. (R)

Location: General

Keywords: Breeding Birds; Fire Effects

Abstract: Throughout the year the avifauna of the New Jersey Pine Barrens is remarkably simple. Common breeding birds are present with some diet and habitat preferences, the rufous-sided towhee being overwhelmingly the most abundant nesting species in the uplands. In wetter areas, the catbird and other scrub species increase in importance. In winter, flocking species, such as junco, mourning dove, Carolina chickadee, starling and house sparrow, are most common. Severe winters usually mean fewer waterfowl but more horned larks and "northern finches". Fires appear to favor the eastern bluebird and common nighthawk, but over recent decades these two species have declined markedly.

Rare species of both southern and northern affinities breed in the Pine Barrens, and two species, the bald eagle and eastern bluebird, are endangered in the state. The native turkey, which became extinct in the region, has been reintroduced with uncertain success. Large cedar and hardwood swamps, which may be centers of rarer species, warrant study and protection.

LEDIG, F. T. and S. LITTLE. 1979. See BOTANY citation.

LENG, C. W. 1902. Notes on the Cicindelidae of the Pine Barrens of New Jersey. Jour. N. Y. Entomol. Soc. 10:236-240. (D)

LEONARD, M. D. 1956. A preliminary list of the aphids of New Jersey. Jour. N. Y. Entomol. Soc. 64:99-124. (D)

LEONARD, M. D. 1972. Aphids of New Jersey, a few more records. Jour. N. Y. Entomol. Soc. 80:182-194. (D)

LEONARD, M. D. 1974. Aphids in the Pine Barrens of New Jersey. Cooperative Econ. Insect Rept. 24:530-534, U. S. Dept. Agr., Washington, D. C. (D)

LITTLE, S., G. R. MOOREHEAD and H. A. SOMES. 1958. See BOTANY citation.

LITTLE, S. and H. A. SOMES. 1951. See BOTANY citation.

LOCKWOOD, S. 1875a. The pine snake of New Jersey. Amer. Nat. 9:1-14. (N)

Location: General

Keywords: Pituophis melanoleucus

LOCKWOOD, S. 1875b. Some habits of the pine snake. Amer. Nat. 9:424-425. (N)

Location: General

Keywords: Pituophis melanoleucus

LOCKWOOD, S. 1880. The pine snake. Amer. Nat. 14:528. (N)

Location: General

Keywords: Pituophis melanoleucus

LUND, R. C. 1972. Deer biology and habitat relationships. N. J. Outdoors October:1-8. (R)

MARUCCI, P. E. 1947. A leaf hopper survey in blueberry fields. Proc. Ann. Blueberry Open House 16:3-5. (D)

MARUCCI, P. E. 1966. Blueberry insects and their control. In P. Eck and N. Childers (eds.). Blueberry culture. Rutgers Univ. Press, New Brunswick, N. J. pp.199-235. (R)

McCLAIN, J. F. 1972. Fish studies. In N. J. Dept. Environ. Protection Div. Fish, Game Shellfish Misc. Rept. 8M:1-54, Trenton, N. J. (D)

McCOOK, H. C. 1880. Note on a new northern cutting ant, Atta septentrionalis. Proc. Acad. Nat. Sci. Phila. 32:359-363. (N)

Location: Toms River (11)

Keywords: Habits; Distributions

McCORMICK, J. 1970. See GENERAL REFERENCES citation.

McCORMICK, J. and J. W. ANDRESEN. 1960. See BOTANY citation.

McQUILKEN, W. E. and S. LITTLE. 1952. See BOTANY citation.

MELLO, J. F., J. P. MINARD and J. P. OWENS. 1964. Foraminifera from the Exogyra ponderosa zone of the Marshalltown Formation at Auburn, N.J. U.S. Geol. Surv. Prof. Paper 501-B:61-63, Washington, D.C. (D)

MILLER, H. W. 1955. A check-list of the Cretaceous and Tertiary vertebrates of New Jersey. Jour. Paleo. 29:903-914. (D)

MOORE, J. P. 1893. The eggs of Pituophis melanoleucus. Amer. Nat. 27:878-885. (D)

Location: Formosa Bog (48)

Keywords: Description

MOORE, J. P. 1894. Note on the occurrence of <u>Hyla</u> <u>andersoni</u> in New Jersey. Amer. Nat. 28:1045-1046. (N)

Location: Pleasant Mills (24)

MOORE, J. P. 1896. <u>Lygosoma</u> (<u>Liolepsima</u>) <u>laterale</u> in New Jersey. Amer. Nat. 30:752-753. (N)

Location: Batsto (24)

NELSON, J. 1890. Descriptive catalogue of the vertebrates of New Jersey. Final Rept. State Zool. Vol. 2 Part 2, Trenton, N. J. (D)

NEW JERSEY DEPARTMENT CONSERVATION ECONOMIC DEVELOPMENT. 1951. Lakes and ponds. Fish Surv. Rept. 1, N. J. Div. Fish, Game, Trenton, N. J. (D)

NEW JERSEY DEPARTMENT ENVIRONMENTAL PROTECTION. 1972. Studies of the Great Egg Harbor River and Bay. Div. Fish, Game, Shellfish Misc. Rept. 8M, Trenton, N. J. (D)

NEW JERSEY DEPARTMENT ENVIRONMENTAL PROTECTION. 1976. List of waters stocked. N. J. Div. Fish, Game, Shellfishes, Trenton, N. J. (D)

NEW JERSEY DEPARTMENT ENVIRONMENTAL PROECTION. 1980. Endangered and threatened species of New Jersey. Endangered Nongame Species Project, Div. Fish Game Wildlife, Trenton, N. J. 44pp. (D)

Location: General

Keywords: Fish; Amphibians; Reptiles; Birds; Mammals; Marine

Abstract: List of endangered and threatened species, including sections on distinguishing characteristics, distribution and habitat, status, management techniques and protective measures, and recommendations for each of the 52 species classified.

NEW JERSEY REGISTER. 1975. Endangered, threatened, peripheral and undetermined wildlife species in New Jersey. N. J. State Museum, Trenton, N. J. 7(10 April 1975):1-146. (D)

NINE, O. W. 1954. A microfauna from the Upper Cretaceous

Navesink Formation in New Jersey. Ph.D. Thesis, Rutgers Univ., New Brunswick, N.J. 259pp. (D)

Location: New Egypt (2)

Keywords: Lithology; Systematic Paleontology; Ostracodes

Abstract: Microfossils were first recorded from the New Jersey Coastal Plain over a century ago and have been reported subsequently from time to time. The present work is a detailed study of the Foraminifera and Ostracoda from the Upper Cretaceous Navesink formation in New Jersey. Fossiliferous samples were collected from the formation at four localities. They have yielded an unusually large fauna consisting of 128 species of Foraminifera and 36 species of Ostracodes. The Foraminifera are distributed throughout 52 genera and 14 families; the Ostracodes throughout 18 genera and 3 families. A correlation of the Navesink formation with upper Navarro beds in the Gulf Coast region was made possible by the large number of species common to both sediments. Current investigation has revealed the presence of a much larger microfauna than had previously been reported from the Navesink marl. Many of the species also occur in Upper Cretaceous sediments from the Gulf Coastal Plain. It is concluded that the Navesink is a typical neritic deposit probably formed in depths of water between 100-600 feet.

NOBLE, G. K. and R. C. NOBLE. 1923. The Anderson treefrog (Hyla andersoni Baird.), observations on its habits and life history. Zoologica 2:413-455. (D)

OLSSON, R. K. 1960. Foraminifera of latest Cretaceous and earliest Tertiary age in the New Jersey Coastal Plain. Jour. Paleont. 34:1-58. (D)

Location: New Egypt (2); Birmingham (7); Sewell (21); Browns Mills (8)

Keywords: Systematic Descriptions; Distributions; Stratigraphy

OLSSON, R. K. 1964. Late Cretaceous planktonic foraminifera from New Jersey and Delaware. Micropaleontology 10:157-188. (D)

Location: General

Keywords: Globotruncana spp.; Hedbergella spp.; Biostratigraphic Zonation

Abstract: Upper Campanian and Maestrichtian Atlantic

Coastal Plain sediments of New Jersey contain abundant delicately preserved planktonic foraminifera, and well-preserved late Campanian planktonic foraminifera have been recognized from Delaware Coastal Plain sediments. Twenty-eight species of planktonic foraminifera have been identified from the New Jersey and Delaware samples. One new species of Hedbergella is described and illustrated. Apparently, the Maestrichtian Boreal planktonic foraminiferal faunas differed somewhat from those of the Tethys.

OLSSON, R. K. 1967. Early Tertiary planktonic forminiferal zonation of New Jersey. Proc. Internat. Planktonic Conf., Geneva. (D)

OLSSON, R. K. 1970. Paleocene planktonic foraminiferal biostratigraphy and paleozoogeography of New Jersey. Jour. Paleo. 44:589-597. (D)

Location: General

Keywords: Globorotalia; Pseudohastigerina; Paleocene Strata

Abstract: The Paleocene strata of New Jersey seem to contain all of the planktonic foraminiferal assemblages used in intercontinential biostratigraphy. Seven such assemblages can be recognized and assigned to the standard biostratigraphic zones of southern Europe and the Carribean. The Paleocene biostratigraphic zones from lowest to highest include: Globigerina edita Zone, Globorotalia trinidadensis Zone, Globorotalia uncinata Zone, Globorotalia angulata Zone, Globorotalia pusilla Zone, Globorotalia pseudomenardii Zone, and Globorotalia velascoensis Zone. The G. velascoensis Zone seems to be only partially developed because of a possible disconformable relationship between the Vincentown Formation and the Manasquan Formation. The lowest Eocene zone, the Globorotalia subbotinae Zone, begins in the basal beds of the Manasquan which also contain the Pseudohastigerina datum. Comparison of the New Jersey Paleocene faunas with the faunas of other sections in the north Atlantic province indicates: 1) widespread uniformity of faunal assemblages in the early Paleocene, 2) distinctive latitudinal faunal differentiation in the mid-Paleocene, 3) evidence of a cool climatic shift in the late Paleocene. The mid and late Paleocene faunas of New Jersey indicate a distinct temperate paleogeographic faunal province.

PANCOAST, J. M. 1937. Muskrat industry in southern New Jersey. Trans. N. Amer. Wildlife Conf. 2:527-530. (N)

PARRIS, D. C. 1974. Additional records of Pleisiesaurs from K N.J. Jour. Paleo. 48:32-38. (D)

PATRICK, R., B. MATSON and L. ANDERSON. 1979. See HYDROLOGY citation.

PEEL, B. A. 1980. See GENERAL REFERENCES citation.

PETERS, J. E. 1889. Another specimen of <u>Hyla andersoni</u>. Amer. Nat. 23:58-59. (N)

Location: Mays Landing (38)

PETTERS, S. W. 1975. See GEOLOGY AND SOILS citation.

PINELANDS COMMISSION. 1980. See GENERAL REFERENCES citation.

PINELANDS ENVIRONMENTAL CENTER. 1974. See BOTANY citation.

POOLE, E. L. 1949. The extinct heath hen. Frontiers 13:68-70. (N)

PYLE, A. B. 1957. Preliminary report of studies on the ability of trout to withstand various acidities in New Jersey streams. N. J. Dept. Environ. Protection Misc. Rept. 20, Div. Fish Game Shellfish, Trenton, N. J. (D)

PYLE, A. B. 1971. Annual report. Freshwater Res. Devel., Bureau Fish, Div. Gish Game Shellfish, N. J. Dept. Environ. Protection, Trenton, N. J. (D)

QUINN, J. P. 1967a. The strange and beautiful fishes of the Pine Barrens. Tropical Fish Hobbyist 16:26-27,29,37,41,45. (N)

QUINN, J. P. 1967b. The chaetodon. The Aquarium December Issue. (N)

REED, C. F. 1957. <u>Rana virgatipes</u> in southern Maryland, with notes upon its home range from New Jersey to Georgia. Herpteologica 13:137-138. (D)

REHN, J. A. 1946. The post-oak locust at Mt. Misery, N. J., in 1944. Entomol. News 57:147-148. (N)

RHOADS, S. N. 1893. A new <u>Synaptomys</u> from New Jersey. Amer. Nat. 25:53-54. (D)

Location: Mays Landing (38)

Keywords: <u>Synaptomys</u> <u>stonei</u> Type Specimen Description

RHOADS, S. N. 1903. The mammals of Pennsylvania and New Jersey. Privately published, Philadelphia, Pa. 266pp. (D)

RICHARDS, H. G. and A. HARBISON. 1942. Miocene invertebrate fauna of New Jersey. Phila. Acad. Nat. Sci. Proc. 94:167-250. (D)

Location: General

Keywords: Kirkwood Formation; Cohansey Formation; Stratigraphy; Fossils; Species List

ROBACK, S. S. 1957. The immature Tendipedids of the Philadelphia area. Acad. Nat. Sci. Phila. Monogr. 9:1-152. (D)

Location: General

Keywords: Water Chemistry; Species Keys; Species Descriptions

SHOEMAKER, L. M. 1963. Mammals of New Jersey. N. J. State Museum Bull. 8, Trenton, N. J. (R)

SHRINER, C. A. 1897. The birds of New Jersey. N. J. Fish Game Commission, Trenton, N. J. (R)

SIM, R. J. 1930. Scarabidae, Coleoptera; Observations on species unrecorded or little-known in New Jersey. Jour. N. Y. Entomol. Soc. 38:139-147. (D)

SMITH, J. B. 1910. The insects of New Jersey. N. J. State Museum Ann. Rept. 1909:15-888, Trenton, N. J. (D)

SMITH, R. F. 1950. Fisheries. Report 1, Dept. Conserv. Econ. Develop., Trenton, N.J. (D)

SMITH, R. F. 1951. Fisheries. Report 2, Dept. Conserv. Econ.

Develop., Trenton, N.J. (D)

SMITH, R. F. 1952. Neutralization experiments in certain acid ponds in New Jersey. Proc. Ann. Conf. Nat. Lime Assoc. 50:89-95. (D)

Location: General

Keywords: Fish Reproduction; Water pH

SMITH, R. F. 1953. Some observations on the distribution of fishes in New Jersey. In N. J. Dept. Conserv. Econ. Devel. Div. Fish Game Fish Surv. Rept. 2:165-174, Trenton, N. J. (D)

SMITH, R. F. 1957. Lakes and ponds. N. J. Dept. Conserv. Econ. Devel. Div. Fish Game Fish Surv. Rept. 3, Trenton, N. J. (N)

SMITH, R. F. 1960. An ecological survey of an acid pond in the New Jersey Coastal Plain. Ph.D. Thesis, Rutgers Univ., New Brunswick, N. J. 190pp. (D)

Location: Turkey Lake

Keywords: Water Chemistry; Iron Floc; Biotic Communities; Productivity

Spinks, R. 1976. Beaver-otter investigations. Pittman-Robertson Rept. Proj. W-53-R-4, NJDEP, Trenton, NJ.

STANDAERT, W. F. 1967. Growth, maturation and population ecology of the carpenter frog (Rana virgatipes Cope.). Ph.D. Thesis, Rutgers Univ., New Brunswick, N. J. 202pp. (D)

Location: Colliers Mills (3)

Keywords: Sex Ratio; Age; Seasonal Activities; Drought; Vegetational Zones

Abstract: A population of Rana virgatipes was observed for three years at a pond and slough area in the pine barrens of New Jersey. More than 900 frogs were marked by toe-clipping and yielded many recaptures - 101 were taken 6 or more times. Ecological information on their metamorphosis, growth, maturation, seasonal activities, sex ratio, age-class structure, and population dynamics is reported, and several new statistical techniques are proposed for the handling of such data. The peak of the metamorphic season was in early September, and the mean metamorphic size was 32 cm. Tadpoles from the spawn of the normal breeding season apparently do not overwinter. Previous authors have

presumed spring metamorphosis, at 23-28 mm, after an overwintering larval period. Sexual dimorphism was investigated biometrically, and a procedure is described for bias-free assessment of the sex and maturity of amphibians by superfacial characteristics. Maturation (development of ear dimorphism) was found to be normally distributed with respect to body size. A tolerance interval and probit analysis were used to determine the mean maturation size (43 mm) and to obtain a size-maturation curve for evaluating the reproductive status of various size classes. While some early transformed frogs developed sexual dimorphism and breeding behavior as early as August of their year of metamorphosis (0 season), typical animals did not reach reproductive size until June of their I year. Population size-frequency histograms were analyzed into age-classes, and seasonal changes in population composition were interpreted. The 0 and I year-class peaks were distinct, and the age of many study animals could be estimated. Natality and mortality were low. The sex ratio showed seasonal, diurnal, and zonal fluctuations. Females were less nocturnal, more shore-oriented, less active in the spring, but were significantly more numerous than males by midsummer. There was some evidence for differential mortality and dispersal. Growth-sampling methods were reviewed, and statistical improvements are suggested. The form of the anuran growth curve and characteristics of amphibian growth are discussed. Evidence indicated that von Bertalanffy's growth model and decaying exponential function apply very well to postmetamorphic length increase. Useful growth quantifications are summarized. A computer method was used to fit the asymptotic regression to recapture measurements of marked, known-age frogs. Males had a lower arithmetic, but slightly higher asymptotic, growth rate than females and reached a 4.4 mm lower asymptotic size. Seventy-eight percent of their growth was completed by one year of age. Seasonal as well as annual, season-free curves are presented. An instantaneous growth rate was derived for following short-term fluctuations in an animal's growth performance. The formulation estimates asymptotic growth and has the advantage of being unaffected by the age or size of the animal or variability of the recapture interval. Its statistical properties are examined, and a computer program is given for obtaining rate estimates from routine recapture data. Growth rates were then used as a physio-ecological index of the frogs' response to environmental variables, such as temperature, drought and habitat differences. The analysis revealed a seasonal cycle, with a midsummer maximum, and moderate year-to-year differences in growing conditions. Drought-induced habitat changes were accompanied by a sharp drop in growth rates. Only slight, nonsignificant differences were found among vegetational zones and adjacent ponds, however. The toe-clipping procedure was similarly evaluated and found to have only a slight, temporary effect of the animals.

STEPHENSON, L. B. 1954. Additions to the fauna of the Raritan Formation. U.S. Geol. Surv. Prof. Paper 264-B:b25-b43, Washington, D.C. (D)

STEWART, R. W. 1971. Studies on the standing crops of fish in New Jersey lakes and ponds. N. J. Dept. Environ. Protection Div. Fish Game Shellfish Misc. Rept. 34, Trenton, N. J. (D)

STEWART, R. W. 1972. Neutralization experiments. N. J. Dept. Environ. Protection Div. Fish Game Shellfish Misc. Rept. 35, Trenton, N. J. (D)

STILES, E. W. 1979. Animal communities of the New Jersey Pine Barrens. Chapter 31 In Forman, R.T.T. (ed.). Pine Barrens: ecosystem and landscape. Academic Press, New York. pp.541-553. (R)

Location: General

Keywords: Water; Fire; Plant-Herbivore Interactions; Seasonality; Resource Distribution; Resource Predictability

Abstract: A rich literature on animal species in the Pine Barrens contrasts with the few, but useful, studies of animal communities. Water, fire, seasonality, plant-herbivore interaction, resource distribution, and resource predictability are suggested as the major controls on the nature of the animal communities. Fire brings about increases, decreases, or constancy in bird species, depending on foraging habits, while the absence of fire results in variations among foliage insect communities as tree species change. Temporal differences are illustrated by the late spring peak in caterpillars in oak forest not evident in pine forest. Spatial differences are seen as avian communities change vertically in the forest, and small mammal communities change horizontally with habitat differences. The relatively simple and homogeneous vegetation structure in the Pine Barrens is particularly useful for the study of animal communities.

STONE, W. 1890. Pennsylvania and New Jersey spiders of the family Lycosidae. Proc. Phila. Acad. Nat. Sci. 42:420-434. (D)

STONE, W. 1894. Summer birds of the Pine Barrens of New Jersey. Auk 11:133-140. (D)

STONE, W. 1907. See BOTANY citation.

STONE, W. S. 1908. The mammals of New Jersey. N. J. State Museum Ann. Rept. 190, Trenton, N. J. (D)

STONE, W. 1909. The birds of New Jersey. N. J. State Museum Ann. Rept. 1908:11-347. (D)

STONE, W. 1937. Bird studies at Old Cape May, an ornithology of coastal New Jersey. Reprinted 1965 by Dover Publishers, New York. (D)

STORER, R. W. 1940. The hoary bat in New Jersey. Jour. Mammology 21:354-355. (N)

Location: Cape May (50); Tuckerton (35)

Keywords: Species Location

SWINEBROAD, J. 1963. Edge effects and bird populations in southern New Jersey. N.J. Nat. News 18:66-72. (N)

Sweet, J.C. and C.W. Wright, 1954. A population evaluation of White-Tailed deer. Pittman-Robertson Rept. Project W-25-R. NJDep, Trenton, NJ.

SWINEBROAD, J. and O. SUSSMAN. 1964. Breeding bird populations in New Jersey. N. J. Nature News 19:102-110. (D)

SWINEBROAD, J. and O. SUSSMAN. 1965. Breeding bird populations in New Jersey. N.J. Nat. News 20:102-111. (D)

TEMPEL, A. S. 1976. See BOTANY citation.

THOMAS, L. S. 1967. See BOTANY citation.

TOMLINSON, W. E. 1948. Seven important blueberry insects. Proc. Ann. Blueberry Open House 17:10-13. (D)

TOMLINSON, W. E. 1961. Berry fruitworm (<u>Acrobusis vaccinnii</u>) and its control. Cranberries 25:12-13. (R)

TOMLINSON, W. E. 1968. A new cranberry cutworm and other insects of 1967. Cranberries 32:15-16. (D)

TRAPIDA, H. 1937. The snakes of New Jersey: a guide. Newark Museum Publ., pp.1-60, Newark, N. J. (D)

TREAT, M. 1891. Insect enemies of the Pitch Pine. Garden Forest 4:62-63. (N)

ULRICH, B. C. 1976. See GEOLOGY AND SOILS citation.

URNER, C. A. 1926. Effects of fires on Pine Barrens bird life. Auk 43:558-559. (D)

Location: Ocean County

Keywords: Breeding Birds

U. S. DEPARTMENT OF INTERIOR. 1978. See GENERAL REFERENCES citation.

WALLACE, H. K. 1942. A revision for the burrowing spiders of the genus <u>Geolycosa</u> (Araneae, Lycosidae). Amer. Midl. Nat. 27:1-62. (D)

WEISS, H. B. and E. WEST. 1924. See BOTANY citation.

WEYGANDT, C. 1907. Some birds of Brown's Mill, New Jersey. Cassinia 11:7-16. (D)

WHITE, J. E. 1961. The effect of controlled burning on small mammal populations of the Pine Barrens. Ph.D. Thesis, Rutgers Univ., New Brunswick, N. J. 90pp. (D)

Location: Lebanon State Forest (8)

Keywords: Oak-Pine Forest; Cedar Swamp Forest; <u>Peromyscus leucopus</u>; <u>Blarina brevicauda</u>; <u>Pitymys pinetorum</u>; <u>Glaucomys volans</u>; <u>Clethrionomys gapperi</u>; <u>Sorex cinereus</u>; Wildfire

Abstract: Control burning as a silvicultural tool in the New Jersey Pine Barrens presented the question of its effect on the small mammal populations. Controlled burned and unburned plots in an upland oak-pine community in Lebanon State Forest were studied intensively during the summers of 1957, 1958 and 1959 to determine the effects control burning would have on the population of small mammals. Some examination was made of the upland study area during 1960.

Subsidiary studies on control burning were conducted in low pine and cedar swamp communities of Lebanon State Forest. A wildfire area near Whiting, New Jersey served as another subsidiary study plot. The white-footed mouse, _Peromyscus leucopus_, was numerically the dominant small mammal captured on the upland study areas. The majority of animals captured in the low pine-cedar swamp region were red-backed voles, _Clethrionomys gapperi_. Three methods of obtaining an index of the small mammal population were examined to see if they gave similar results when estimating the same population. The adjusted count, the Hayne modification of the Lincoln Index, and capture success or the percentage of traps that captured animals on any one night proved to give estimates of the population level that had a high degree of correlation. Thus it mattered little which method was used for comparison purposes. The range of activity of small mammals was determined by the method of Harrison (1958). This method employs the concept of a zone of more intensive activity around the center of activity. The ranges of activity were large at low population levels and small at high population levels. A correlation coefficient examining the intensity of this relationship showed the correlation to be highly significant. The ranges of male activity were larger than the ranges of female activity. During the summer season, there were no increases or decreases in population that could be associated with control burning. However, examination of nest boxes indicated that the breeding season of _P. leucopus_ in New Jersey started in April and in some cases this species breeds throughout the winter. There was no association of reproductive condition with control burned or unburned plots during the summer season. The overall sex ratio of _P. leucopus_ captured in this study was significantly skewed toward lower numbers of females. This skewness was not associated with any control burning treatment or with any particular year of study. Examination of the stomach contents shows the animals were feeding on insects, fungi, green vegetation, seeds, berries and an unidentifiable mast. The total weight of shrub vegetation showed extreme variation from plots of various control burning treatments. The weight of succulent shrub vegetation, however, was similar for all plots except one. Analysis of the nitrogen content of the succulent shrub vegetation denotes no differences in the nitrogen content of the vegetation from burned and unburned plots existed. There was a difference in nitrogen content of the soils from burned and unburned plots. The unburned plots had higher concentrations of nitrogen than the unburned plots. The population density, capture success, adjusted count population estimates, and Hayne population estimates all show that burned plots at times had higher, lower, and the same population levels as unburned plots. Thus, there is no consistent association of population levels and control burning treatment. If control burning does effect the population of small mammals, it must have its effect in very subtile ways.

WHITFIELD, R. P. 1894. Mollusca and Crustacea of the Miocene formations of New Jersey. U. S. Geol. Surv. Monogr. 24. (D)

WILDE, M. L. 1905. Breeding habits of the parula warbler (Composothylpis americana usneae) in New Jersey. Wilson Bull. 17:4-8. (D)

WOLGAST, L. J. 1979. Mammals of the New Jersey Pine Barrens. Chapter 25 In Forman, R.T.T. (ed.). Pine Barrens: ecosystem and landscape. Academic Press, New York. pp.443-454. (R)

Location: General

Keywords: Marsupialia; Insectivora; Chiroptera; Lagomorpha; Rodentia; Carnivora; Artiodactyla

Abstract: Thirty-four species of mammals reside in the New Jersey Pine Barrens, and four additional species of bats are found during migration. The fauna includes the large mammal, the white-tailed deer, 11 intermediate-sized mammals ranging in size from the river otter to the muskrat, and 22 small mammals, the smallest of which is the masked shrew, measuring about 5 cm (2 in) in length. Two species are introduced and associated with human habitation, and all species range widely beyond the Pine Barrens. Several species are restricted to very specific Pine Barrens habitats, but none presently is considered to be threatened or endangered. In general, diets are relatively broad. A number of species are valuable game and/or furbearers. Deer browsing is the most important of several effects of mammals on Pine Barrens vegetation.

WRIGHT, C. W. 1949. A survey of white-tailed deer (Odocoileus virginianus subsp.) damage, damage control methods, and population characteristics in New Jersey. Federal Aid to Wildlife Project 21R, N. J. Div. Fish Game, Trenton, N. J. 208pp mimeographed. (D)

ZICH, H. E. 1977. The collection of existing information and field investigation of anadromous clupeid spawning in New Jersey. Misc. Rept. 41, Div. Fish, Game, Shellfisheries, N. J. Dept. Environ. Protect., Trenton, N.J. (D)

INDICES

AUTHOR INDEX

KEYWORD INDEX

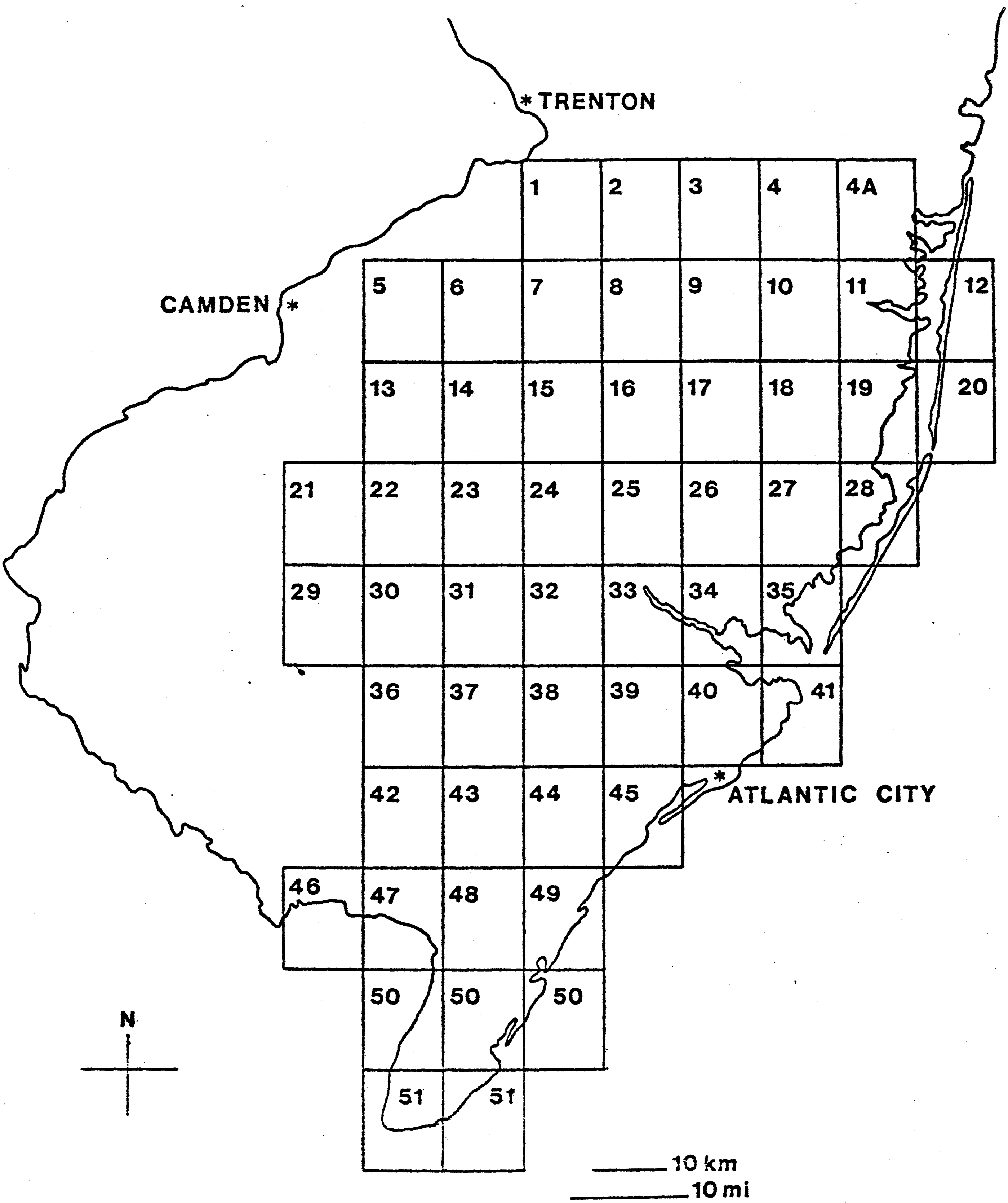
U.S.G.S. TOPOGRAPHIC MAP INDEX

Research site locations have been numerically indexed by U.S.G.S. 7.5 min. topographic quadrangle map(s) in which the site is located. For each location code, the map name and date of survey is given. Map locations are illustrated in Figure 1. Additional information regarding the maps may be obtained through The Eastern Mapping Unit, Topographic Division, U. S. Geological Survey, Reston, Virginia 22092.

NUMBER	MAP NAME (SURVEY DATE)
1	Columbus (1948-57)
2	New Egypt (1948)
3	Cassville (1948)
4	Lakehurst (1948-57)
4a	Lakewood (1947-54)
5	Moorestown (1953-66)
6	Mt. Holly (1953-67)
7	Pemberton (1949-57)
8	Browns Mills (1949)
9	Whiting (1949-57)
10	Keswick Grove (1949-57)
11	Toms River (1953)
12	Seaside Park (1953)
13	Clementon (1953-67)
14	Medford Lakes (1953-67)
15	Indian Mills (1949-57)
16	Chatsworth (1947-57)
17	Woodmansie (1949-57)
18	Brookville (1949-57)
19	Forked River (1953)
20	Barnegat Light (1953)
21	Pittman East (1953-66)
22	Williamstown (1953-66)
23	Hammonton (1953-66)
24	Atsion (1953)
25	Jenkins (1956)
26	Oswego Lake (1955)
27	West Creek (1951)
28	Ship Bottom (1952)
29	Newfield (1953)
30	Buena (1953)
31	Newtonville (1953)
32	Egg Harbor City (1956)
33	Green Bank (1956)
34	New Gretna (1951)
35	Tuckerton (1952)

NUMBER	MAP NAME (SURVEY DATE)
36	Five Points (1956)
37	Dorothy (1956)
38	Mays Landing (1955)
39	Pleasantville (1952)
40	Oceanville (1952)
41	Brigantine Inlet (1952)
42	Port Elizabeth (1956)
43	Tuckahoe (1956)
44	Marmora (1952)
45	Ocean City (1952)
46	Port Norris (1956)
47	Heislerville (1957)
48	Woodbine (1958)
49	Sea Isle City (1952)
50	Rio Grande (1956)
	Stone Harbor (1955)
	Avalon (1953)
51	Cape May (1954)
	Wildwood (1943)

Figure 1 (Facing page). Locations of the U.S.G.S. 7.5 minute topographic maps cited in this Compendium.


TRENTON
CAMDEN
ATLANTIC CITY
1
2
3
4
4A
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
50
50
51
51
N
10 km
10 mi

LOCATION NAME - MAP NUMBER CROSS INDEX

Research site locations cited in the text are listed alphabetically below and cross-indexed to the 7.5 minute U.S.G.S. Topographic Map in which the location is located. Map numbers correspond to those used in text and Map Index.

The preparation of this document was financed in part through a planning grant from the National Park Service, Department of Interior, under the provisions of the Land and Water Conservation Fund Act of 1965(Public Law 88-578, as amended).