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FUNGI OF THE SAND PRAIRIE-SCRUB OAK NATURE PRESERVE

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Introduction

The vegetation found in the Sand Prairie-Scrub Oak Nature Preserve (nine miles south of Havana, between Bath and Kilbourne, Sec. 23 and parts of Secs. 14 and 26, T20N, R9W, 3PM, Mason Co) is a mosaic of three unique vascular plant communities - sand prairie, savanna, and closed forest. The closed forests in the preserve are dominated by stable community of shade intolerant trees including black oak (*Quercus velutina*), blackjack oak (*Quercus marilandica*), black hickory, (*Carya texana*), and mockernut hickory (*Carya tomentosa*), which thrive under xeric conditions in acidic, sandy soils. Despite the number of floristic and ecological studies completed to date on these closed forests, there has been little effort to catalog the fungi which occur in these habitats and assess their ecological role in the maintenance and preservation of the forest. Although the importance of saprobic fungi as agents of decomposition and nutrient recycling is well-established, the role of fungi as mycorrhizal associates with vascular plants has only recently begun to be assessed and understood. Mycorrhizae are unique symbiotic associations which form between fungal hyphae and the roots of vascular plants. Since the fungal hyphae penetrate the soil to a much greater extent than roots, they have a greater surface area in contact with soil moisture and nutrients than vascular plants. As such, the fungal hyphae facilitate the uptake of water and nutrients from the soil and transport to the plant host. This is of particular importance to trees in the closed forests which are subjected to periodic drought and acidic, sandy soils which do not readily retain nutrients and water. In exchange for nutrients and water hyphae supply the plant host, the fungus receives a supply of organic and nitrogenous compounds necessary for its metabolic processes. This project represents the first to attempt to inventory the fungi of the closed forests of the Sand Prairie-Scrub Oak Nature Preserve and assess the ecological role of these organisms in the maintenance and preservation of the preserve. The specific objectives of the study were as follows:

Objectives

1. Prepare an inventory of fungi associated with black oak, black jack oak, black hickory, and mockernut hickory in the closed forests of the Sand Prairie-Scrub Oak Nature Preserve.

2. Assess the edaphic factors (ie., precipitation, vascular plant associates, etc.) which influence the occurrence and distribution of fungi in these closed forests.

3. Assess the ecological role of fungi in the maintenance and preservation of oak savannas through recorded observations of the location of specimens and their spatial relationship with presumed mycorrhizal and non-mycorrhizal associates.

4. Publish an annotated list of fungi collected in the closed forests along with a summary of their ecological role.

5. Serve as a model for future studies on fungi in other Illinois Nature Preserves, Conservation Areas, and State Parks and forests.

Materials and Methods

The preserve was visited eleven times during the study period at intervals determined by precipitation and overnight temperature, specifically, September 20, October 4, and October 25, 1992 and April 16, May 7, May 21, June 4, June 18, July 2, July 15, and July 29, 1993. Representative sporocarps of fungi encountered were collected with minimal disruption of the soil and vegetation. The occurrence of a fungus on a particular vascular plant host was recorded when the host could be determined (ie., the log was not decorticated or lacking bark). Color slides were taken of individual taxa in the field to demonstrate a particular substrate or upon return to the laboratory.

After returning to the laboratory, notes on macroscopic features were recorded where pertinent and fungi identified using relevant mycological references. Tissue isolates were prepared of a number of taxa and incorporated into the mycological culture collection in the Botany Department at Eastern Illinois University. These isolates are being maintained for future projects designed to assess the ecological role of fungi in the maintenance and preservation of the closed oak-hickory forests. Following identification and preparation of tissue isolates, the specimens were dried, boxed or placed in plastic Ziplock bags, and stored in the mycological herbarium at Eastern Illinois University.

Results and Discussion

A total of 250 specimens were collected during the study. More than 165 different kinds of fungi (Ascomycota and Basidiomycota) were identified and from these specimens and are included in the enclosed list. The fungi are listed alphabetically using a classification system utilized in the field mycology course taught at Eastern Illinois University. In some instances, specimens have been sent to colleagues with expertise with a particular group of fungi for authentication of preliminary identifications.

The 534 hectare Sand Prairie-Scrub Oak Nature Preserve is a mosaic of dry sand prairie, dry sand savanna, and dry, closed, oak-hickory forest. For the purposes of this study collections of fungi were made from three areas: dry sand savanna, "blowouts" or areas of actively moving sand at the edge of the savanna, and dry, closed sand forests dominated by black oak, blackjack oak, black hickory, and mockernut hickory. The presumed ecological role of the fungi in each of these areas are discussed separately.

Savanna

The dry sand savanna which extends throughout large portions of the preserve is dominated by a variety of grasses and herbaceous prairie plants. The majority of the fungi which were collected in this area are saprobic in nature, including a number of puffballs and a variety of mushrooms and cup fungi. The hyphae of these fungi permeate the soil, elongating rapidly after periods of precipitation and producing sporocarps in profusion when adequate moisture accumulates in the summer and fall. The presumed role of these organisms includes the decomposition of roots, leaves, and stems of herbaceous plants. These activities are significant in that the recycling of nutrient material for subsequent uptake by other organisms is critical for the maintenance and preservation of the savanna. Although VAM fungi are frequently associated with grasses and other herbaceous plants, VAM fungi are outside the investigators area of expertise and were excluded from this study.

Results and Discussion

Blowouts

The blowouts at the edge of the savannas represent areas of actively moving sand and disrupted vegetation. In this area, the most common fungi collected were puffballs (Class Gasteromycetes). The basidiospores of puffballs are presumed to require little moisture for germination. The depth to which the hyphae penetrate the soil may explain why the hyphae are capable of growth even during periodic drought. The extent to which the hyphae develop in the soil explains, in part, the role of puffballs in the "blowouts." Preliminary observations indicate that the hyphae may help bind the soil in place and slow the movement of sand in and around the "blowout." Puffballs produce sporocarps in profusion when adequate moisture accumulates in the summer. Puffballs apparently function as saprobes in the soil, decomposing the roots of uprooted vegetation and recycling nutrient material for subsequent uptake by other organisms. Although vesicular-arbuscular mycorrhizal fungi (VAM fungi) are often associated with grasses and other herbaceous vegetation in "blowouts," VAM fungi are outside the principal investigator's area of expertise and scope of this study. As such, VAM fungi were excluded from this study.

Oak-Hickory Forest

The largest and most diverse assemblage of fungi collected during the study were found in the closed oak-hickory forests which occur along the edge of the savannas. In general, these habitats were found to be considerably more mesic than the sand prairies and savannas in the remainder of the preserve. The shading effect of the canopy and the accumulation of humus and leaf litter ensure that the soil in this habitat remains moist for relatively long periods of time following precipitation. Preliminary observations in this habitat indicate that the fungi appear to be carrying out one or more of the following roles in the preservation and maintenance of the preserve: parasitic interactions on woody vascular plants, saprobic functions of debris, leaf litter, and humus, and ectomycorrhizal associations with the black and blackjack oaks. Prevailing knowledge in mycorrhizal biology indicates that the mockernut and black hickory are endomycorrhizal but not ectomycorrhizal. Endomycorrhizal fungi are outside of the investigators area of expertise and thus excluded from this study.

A number of the polypores (Order Polyporales) and mushrooms (Order Agaricales) in the forest act as facultative parasites which attack, kill, and often destroy oaks and hickorys. Despite this activity, preliminary evidence would suggest that these organisms are actually playing an important role in the maintenance and preservation of the oak-hickory forests. These organisms appear to eliminate weaker or older trees and open new "niches" for seedling establishment. Once dead trees fall, facultative parasites often shift to saprobic nutritional modes, aiding in the decomposition of organic matter remaining in the wood and helping to replenish the soil's nutrient supply.

Results and Discussion

Oak-Hickory Forest

The activities of the facultative parasites converges with those of strictly saprobic fungi which function in the decomposition of organic material and nutrient recycling. The saprobic fungi in the oak-hickory forests comprise the largest and most diverse group of fungi throughout in the preserve. Preliminary evidence suggests that rather than competing for limited organic resources on the forest floor these organisms have actually evolved an elaborate successional cooperative which caters to each group of fungi. Once a particular group of fungi has utilized a particular substrate or type of organic matter, they are replaced by a second group of fungi which degrade a different set of matter and are subsequently replaced by a third group of fungi, etc. This process is continued until the available organic material has been converted into soluble forms which are recycled throughout the ecosystem. Based on the relative paucity of certain kinds of debris on the forest floor this process is presumed to be a rather efficient one.

Although the hickorys in the forest are presumed to be endomycorrhizal, the oaks are clearly ectomycorrhizal. In fact, following sufficient precipitation, an abundance of sporocarps presumed to be the products of ectomycorrhizal fungi appear. The presence of these sporocarps and subsequent dispersal of their spores appears to ensure that the roots of oak seedlings in the preserve are likely to come in contact with suitable ectomycorrhizal hosts and readily form these unique symbiotic associations. Although we have little evidence of it, we presume that the endomycorrhizal fungi associated with the hickorys must be equally effective at dispersal and colonization of the rootlets of hickory seedlings.

Summary

The presence of mycorrhizal fungi, facultative parasites, and saprobic fungi in the Sand Prairie-Scrub Oak Nature Preserve suggests that the preserve exhibits a normal progression of vegetational displacement and renewal which ensures its maintenance and survival so long as the preserve is protected from human intrusion and the savannas and sand prairies are burned periodically. Environmental conditions during the spring and summer of 1993 were far conducive to the growth and development of fungi. As such, a significant number of additional records were added to the list of fungi from the preserve. After the completion of a second sampling season, it is apparent that a minimum of one additional field season is necessary before the true range of fungal taxa present in the closed forests of the Sand Prairie-Scrub Oak Nature Preserve can be determined.

FUNGI COLLECTED IN SAND PRAIRIE-SCRUB OAK NATURE PRESERVE

Division Ascomycota

Class Hymenoascomycetes

Order Sphaeriales (Pyrenomycetes)

Daldinia concentrica (Bolt.: Fr.) Cesati & de Notaris
Hypocrea citrina (Pers.: Fr.) Fr.
Hypomyces latizonata (Fr.) Tul.
Hypoxylon atropunctatum (Schw.) Ellis & Everhart
Xylaria longiana Rehm
Xylaria polymorpha (Pers.: Fr.) Grev.

Order Pezizales (Operculate Cup Fungi)

Aleuria aurantia (Fr.) Fuckel
Ascocoryne sarcoides (Jacq.: S. F. Gray) Groves and Wilson
Bisporella citrina (Batsch.: Fr.) Korf and Carpenter
Galiella rufa (Schw.) Nannf. & Korf
Gyromitra fastigiata (Kromb.) Rehm
Helvella crispa Scop.: Fr.
Humaria hemispherica (Wiggers.: Fr.) Fuckel
Microstoma floccosum (Schw.) Raitv.
Pachyella clypeata (Schw.) Le Gaul
Sarcoschypha coccinea (Jacq.: Fr.) Lambotte
Sarcoscypha occidentalis (Schw.) Sacc.
Scutellinia scutellata (L.) Lambotte
Tarzetta cupularis (L.: Fr.) Lambotte
Urnula craterium (Schw.) Fr.

Order Helotiales (Inoperculate Cup Fungi)

Leotia lubrica Pers.: Fr.
Leotia viscosa Fr.

FUNGI COLLECTED IN SAND PRAIRIE-SCRUB OAK NATURE PRESERVE

Division Basidiomycota

Class Hymenomycetes

Order Agaricales (Mushrooms)

Agrocybe dura (Bolt.: Fr.) Singer
Agrocybe pediades (Pers.: Fr.) Fayod
Agrocybe praecox (Fr.) Fayod
Amanita bisporigera Atkinson
Amanita brunnescens Atkinson
Amanita citrina Scaeff.: Fr.
Amanita flavorubescens Atkinson
Amanita rubescens (Fr.) S. F. Gray
Armillaria mellea sensu lato
Clitocybe gibba (Fr.) Kummer
Clitocybe odora (Bull.: Fr.) Kummer
Collybia biformis (Pk.) Singer
Collybia dryophila (Bull.: Fr.) Kummer
Collybia spongiosa(B & C) Singer
Collybia subnuda (Ellis: Pk.) Gilliam
Coprinus atramentarius (Bull.: Fr.) Fr.
Coprinus micaceus (Bull.: Fr.) Fr.
Crepidotus pubescens Bres. sensu Kuhner & Romagnesi
Crinipellis setipes (Pk.) Singer
Crinipellis zonata (Pk.) Pat.
Entoloma abortivum (B & C) Donk
Flammulina velutipes (Fr.) Karsten
Galerina autumnalis (Pk.) Smith & Singer
Galerina marginata (Batsch: Secr.) Kuhner
Hygrophorus pratensis (Fr.) Fr.
Hygrophorus russula (Fr.) Quel.
Hygrophorus sordidus Peck
Inocybe geophylla (Sow.: Fr.) Kummer
Laccaria ochropurpurea (Berk.) Pk.
Lactarius argillaceifolius Hesler & Smith
Lactarius camphoratus (Fr.) Fr.
Lactarius deceptivus Peck
Lactarius piperatus (Scop.: Fr.) S. F. Gray
Lactarius volemus (Fr.) Fr.
Lentinellus cochleatus (Fr.) Karsten
Lentinellus ursinus (Fr.) Kuhner
Lepiota acutaesquamosa (Weinm.) Karsten
Marasmiellus candidus Bolt.: Singer
Marasmiellus opacus (B & C) Singer
Marasmius cohaerens var. lachnophyllus (Berk. in Lea) Gilliam
Marasmius delectans Morgan
Marasmius pyrrocephalus Berk.
Marasmius rotula (Fr.) Fr.
Marasmius scorodonius (Fr.) Fr.
Marasmius strictipes (Pk.) Singer
Marasmius sullivantii Montagne

FUNGI COLLECTED IN SAND PRAIRIE-SCRUB OAK NATURE PRESERVE

Division Basidiomycota

Class Hymenomycetes

Order Agaricales (Mushrooms)

Mycena galericulata (Fr.) Quel.
Mycena haematopus (Fr.) Kummer
Mycena leaiana (Berk.) Saccardo
Mycena luteopallens (Pk.) Saccardo
Panellus stypticus (Fr.) Karsten
Pluteus cervinus (Schaeff.: Fr.) Kummer
Pluteus lutescens (Fr.) Bres.
Pluteus petasatus (Fr.) Gill.
Psathyrella velutina (Pers.: Fr.) Singer
Russula compacta Frost
Russula delica Fr.
Russula variata Benning *apud* Peck
Russula virescens (Scaeff.: Zand) Fr.
Stropharia hardii Atkinson
Tricholoma resplendens (Fr.) Quel.
Tricholoma sejunctum (Fr.) Quel.

Order Boletales (Boletes)

Boletus affinis Peck
Boletus campestris Smith and Thiers
Boletus griseus Peck
Boletus pallidus Frost
Boletus variipes Peck
Gyroporus castaneus (Bull.: Fr.) Quel.
Leccinum rugosiceps (Pk.) Singer
Strobilomyces confusus Singer
Strobilomyces floccopus (Vahl.: Fr.) Karst.
Tylopilus felleus (Bull.: Fr.) Karst.
Tylopilus rubrobrunneus Masser and Smith

Order Cantharellales (Chanterelles)

Cantharellus lateritius (Berk.) Singer

Order Clavariales (Coral Fungi)

Clavicorona pyxidata (Fr.) Doty
Clavulina cinerea (Fr.) Schroet.
Ramaria concolor (Fr.) Quel.
Ramaria stricta (Fr.) Quel.
Ramariopsis fusiformis (Sow.: Fr.) Petersen

FUNGI COLLECTED IN SAND PRAIRIE-SCRUB OAK NATURE PRESERVE

Division Basidiomycota

Class Hymenomycetes

Order Hydnales (Teeth Fungi)

Hericium erinaceum (Bull.: Fr.) Persoon
Hydnellum spongiosipes (Pk.) Pouz.
Hydnochaete olivaceum (Schw.) Banker
Hydnum repandum L.: Fr.
Steccherinum ochraceum (Pers.: Fr.) S. F. Gray

Order Polyporales (Polypores)

Bjerkandera adusta (Willd.: Fr.) Karst.
Cerrena unicolor (Bull.: Fr.) Murrill
Daedalea quercina Fr.
Daedaleopsis confragosa (Bolt.: Fr.) Schroet.
Ganoderma applanatum (Pers.) Patouillard
Ganoderma lucidum (Leysser: Fr.) Karst.
Gloeoporus dichrous (Fr.) Bres.
Hapilopilus nidulans (Fr.) Karsten
Inonotus andersonii (Ellis & Everhart) Cerny
Inonotus cuticularis (Bull.: Fr.) Karsten
Irpex lacteus (Fr.: Fr.) Fr.
Lentodium squamosum Morgan
Lenzites betulina (Fr.) Fr.
Merulius incarnatus Schw.
Merulius tremellosus Fr.
Oxyporus latemarginatus (Mont. & Dur.: Mont.) Donk
Perenniporia ohiensis (Berk.) Ryvarden
Phanerochaete crassa
Phellinus gilvus (Schw.) Pat.
Phellinus johnsonianus (Murrill) Ryvarden
Polyporus arcularius Batsch: Fr.
Polyporus alveolaris (DC: Fr.) Bond. & Singer
Polyporus brumalis Pers.: Fr.
Polyporus squamosus Huds.: Fr.
Polyporus varius Fr.
Porodisculus pendulus (Schw.) Murrill
Pycnoporus cinnabarinus (Jacq.: Fr.) Karsten
Schizopora paradoxa (Fr.) Donk
Schizophyllum commune Fr.
Spongipellis pachydon (Pers.) Kotlaba & Pouzar
Spongipellis unicolor (Schw.) Murrill
Stereum hirsutum (Willd.: Fr.) S. F. Gray
Stereum ostrea (Blume & Nees: Fr.) Fr.

FUNGI COLLECTED IN SAND PRAIRIE-SCRUB OAK NATURE PRESERVE

Division Basidiomycota

Class Hymenomycetes

Order Polyporales (Polypores)

Trametes conchifer (Schw.: Fr.) Pilat
Trametes cervina (Schw.) Bres.
Trametes elegans (Spreng.: Fr.) Fr.
Trametes hirsuta (Wolf.: Fr.) Pilat
Trametes trogii Berk. in Trog.
Trametes versicolor (L.: Fr.) Pilat
Trichaptum biforme (Fr. in Kl.) Ryv.
Xylobolus frustulatus (Pers.: Fr.) Boid.

Order Lycoperdales (Puffballs)

Lycoperdon perlatum Pers.
Lycoperdon pyriforme Pers.
Lycoperdon umbrinum Pers.

Order Geastrales (Earth Stars)

Geastrum saccatum Fr.

Order Sclerodermatales

Astraeus hygrometricus (Pers.) Morgan
Scleroderma areolatum Ehrenberg
Scleroderma polyrhizon Pers.

Order Nidulariales (Bird Nest Fungi)

Crucibulum laeva (Huds.: Rehl.) Kambly
Cyathus striatus (Huds.) Willd. apud Pers.
Nidula candida Pk.

Class Phragmobasidiomycetes

Order Auriculariales

Auricularia auricula (Hooker) Underwood

Order Tremellales

Ductifera puhuluhuana (Pat.) Wells
Exidia glandulosa Bull.: Fr.
Tremella foliacea Pers.: Fr.
Tremella mesenterica Retzius: Fr.
Tremellodendron pallidum (Schw.) Burt

FUNGI COLLECTED IN SAND PRAIRIE-SCRUB OAK NATURE PRESERVE

Division Basidiomycota

Class Phragmobasidiomycetes

Order Dacrymycetales

Calocera cornea (Batsch: Fr.) Fr.
Dacrymyces deliquescens (Merat) Duby
Dacryopinax elegans (B & C) Martin