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A Survey of Oomycetes in the Pease Creek-Des Moines River Drainage, Ledges State Park, Iowa

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A Survey of Oomycetes in the Pease Creek-Des Moines River Drainage, Ledges State Park, Iowa[1]

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Water, bank soil, and sediment samples were collected from various sites in the Pease Creek-Des Moines River drainage during November, 1976, and March, April, and May, 1977. Oomycetes isolated from the samples included species of *Achlya, Saprolegnia, Thraustotheca,* and unidentified Pythiaceous and Saprolegniaceous species. Sorensen's (1948) index of similarity was used to compare the species composition among sites. Members of the Saprolegniales were compared to Beneke's (1948) study of Illinois Saprolegniaceous species.
INDEX DESCRIPTORS: Oomycetes, Lotic, Pythiales, Saprolegniales.

The Saprolegniales, Lagenidales, Leptomitales, Peronosporales, and Pythiales comprise the Oomycetes. Members of this group of lower fungi are highly diverse in habitat yet are bound together by their characteristic abilities to produce non-motile "eggs" or oospheres and to produce motile zoospores which function in asexual reproduction. Although they are found in such diverse habitats as fresh and brackish water, moist soil, or as parasites of aquatic or land vascular plants, they require water as a medium in which the zoospores can swim.

The Saprolegniales, or "water molds," is the largest group of aquatic Oomycetes. Some species of the Lagenidales, Pythiales, and Leptomitales are also aquatic. The aquatic species are cosmopolitan in their distribution (Alexopoulos and Bold, 1967). A summary of aquatic Oomycetes isolated from water, soil, and sediment samples taken during a 6 month period from sites along Pease Creek and its confluence with the Des Moines River at Ledges State Park, Boone County, Iowa is presented in this paper.

METHODS

Triplicate water, soil, and sediment samples were taken from each of 6 sites along Pease Creek and the Des Moines River on November 11, 1976; March 15, 1977; April 29, 1977; and May 23, 1977 (Fig. 1). The sites were selected because each represented a change in habitat along the longitudinal course of Pease Creek.

Sediment samples were collected 30.5 cm inward from the bank-river interface. Soil samples from the lower bank were taken at points within 10.0 cm of the water's edge, which were permanently waterlogged. Upper bank samples were taken outside the 10.0 cm distance from the bank-water interface, in an intermittently waterlogged zone. Because of dry weather, the water level was frequently low enough to expose islands and sand spits, from which samples were also taken. Both soil and sediment samples were taken at a depth of 5 to 16 cm below the ground surface. They were put in sterile 1 liter plastic collection bags. Water samples were collected in sterile 100 ml screw cap glass bottles.

Isolations of aquatic Oomycetes were made in sterile petri plates baited with 2 or 3 split and boiled hemp seeds. Water samples were added directly to isolation plates. Approximately 1 to 2 cm^3 of soil or sediment and 15 to 20 ml of sterile, glass-distilled water (SGDW) were used for each soil or water sediment sample. The cultures were incubated at 18-20C. When an aquatic fungus grew on a bait, it was transferred to a second sterile petri plate to which new bait and SGDW were added. The cultures were rinsed with SGDW and transferred to new sterile petri plates to limit bacterial growth until unifungal and then pure fungus cultures could be made.

Following a procedure which is a modification of the second method discussed by Seymour (1970), unifungal cultures were obtained. Zoospores were collected with a micropipette from newly developed sporangia of young cultures. The spore suspension was placed within a plexiglass ring which was partially submerged in corn meal agar (CMA). After incubation at 18°C, bacteria-free hyphae grew outside the ring. A small block of agar bearing fungal filaments was then transferred to a petri plate and covered with SGDW.

The agar-block colonies were transferred onto fresh bait. When sporangiospores developed, single spore isolates were made by streaking the suspension of asexual spores onto CMA and transferring an agar plug bearing a germinating spore to a fresh CMA plate.

A sterile hemp seed was placed on the margin of the advancing colony. After 2 or 3 days incubation at 20°C, the infested bait was transferred to a petri plate containing SGDW. Reproductive structures were studied as they developed.

The fungi isolated were identified using the taxonomic treatments of Beneke (1948), Chaudhuri, Kochhar, Lotus, Banerjee, and Khan (1947), Dick (1973), Gilman (1957), Johnson (1956), Scott (1961), Seymour (1970), and Waterhouse (1963, 1964, 1968, 1970a, 1970b). Determinations were supplemented by comparisons with the original descriptions.

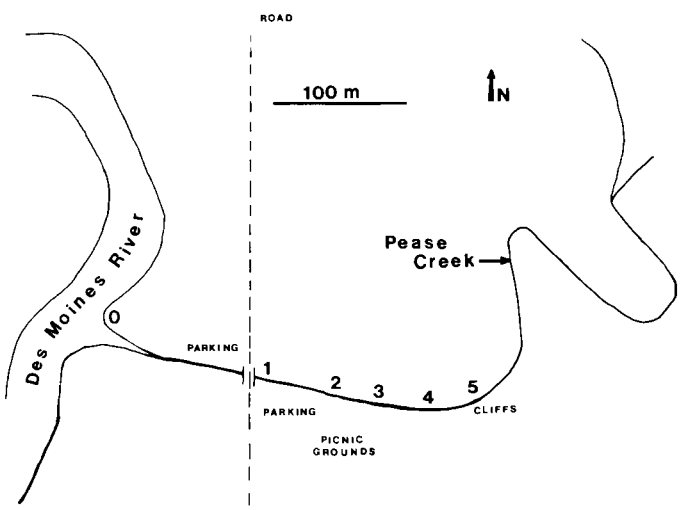

Figure 1. *Map of Pease Creek showing collection sites in Ledges State Park, Boone County, Iowa.*

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RESULTS AND DISCUSSION

The water velocity of Pease Creek varied from motionless to swift, depending on the water level. At the junction of the creek and river, Site 0, the creek was slow moving to trickling; the river current was swift. Samples were taken on the downstream side of the confluence. At site 1 the creek bed was dry except for a trickle approximately 20 cm wide and for occasional puddles. Similarly, at site 2, only a small stream of water flowed through the creek bed. Further upstream, at site 3, the creek flowed more swiftly and was marked by riffles because of rocks, up to 13 cm diameter, below the water surface. The stream of water at this site filled approximately one-half of the creek bed. At site 4, the water was swift in the center but pooled near the banks. The creek bed at this site consisted largely of a fallen cement slab. Site 5 was located beneath cliffs and had the fastest water flow of the 6 study sites. However, there were no rapids. The sediment profile of the creek showed that the larger rocks were deposited upstream while sand was more prevalent near the mouth.

The aquatic fungi isolated in this study may reflect drought tolerant Oomycetes (Table 1). Since the creek bed was more dry than during a normal year, the fungi which could compete best could maintain their niches as the aquatic environment decreased. *Saprolegnia ferax, S. diclina* and species of the Pythiales were the fungi most frequently isolated. Isolates that could not be identified failed to form both the sexual and asexual reproductive structures used in the keys to designate species. Hyphal characteristics, and asexual reproductive structures in some isolates were sufficient to place the isolates at least in the appropriate order (Sparrow, 1973).

Species isolated are listed below according to site, date, and habitat. Numbers in front of isolates equal the number of times that organism was isolated.

Site 0 November
Sediment: *Saprolegnia diclina, S. ferax,* member of the Pythiales (MP)
Water: *Achlya flagellata, S. ferax,* MP
Lower bank: *S. ferax, S. diclina,* MP
Upper bank: *S. ferax,* 2 MP

Site 0 March
Sediment: *S. ferax,* 2 MP
Water: 2 *S. diclina,* MP
Lower bank: *S. diclina,* 2 MP
Upper bank: *S. ferax,* 2 MP

Site 0 April
Sediment: *S. hypogyna, S. terrestris, S. ferax*
Water: S. australis, 2 *S. ferax*
Lower bank: *S. ferax, S. diclina,* MP
Upper bank: 3 MP

Site 0 May
Sediment: *S. diclina,* 2 *S. ferax*
Water: *S. diclina,* 2 *S. ferax*
Lower bank: 3 MP
Upper bank: S. ferax, 2 MP

Site 1 November
Sediment: *Thraustotheca clavata,* 2 *S. diclina*
Water: 3 *S. ferax*
Lower bank: 2 *S. diclina,* MP
Upper bank: 3 *S. ferax*

Site 1 March
Sediment: 3 *S. ferax*
Water: 2 *S. ferax, S. diclina*
Lower bank: MP, 2 members of the Saprolegniales (MS)
Upper bank: 3 MP

Site 1 April
Sediment: *A. flagellata,* 2 *S. ferax*
Water: 2 *S. diclina, S. ferax*
Lower bank: *A. flagellata,* 2 *S. ferax*
Upper bank: *S. diclina,* 2 *S. ferax*

Site 1 May
Sediment: 2 *S. ferax, S. diclina*
Water: 2 *S. ferax, S. diclina*
Lower bank: *S. ferax, S. diclina,* MP
Upper bank: 3 MP

Site 2 November
Sediment: 3 *S. ferax*
Water: *A. flagellata,* 2 *S. diclina*
Lower bank: *S. ferax, S. diclina,* MP
Upper bank: *S. ferax* 2 MS

Site 2 March
Sediment: 2 MP, MS
Water: 2 *S. diclina, S. ferax*
Lower bank: *S. ferax,* 2 MP
Upper bank: 3 MP

Site 2 April
Sediment: 3 *S. ferax*
Water: *S. australis, S. ferax,* MP
Lower bank: 3 *S. ferax*
Upper bank: *S. ferax,* 2 MP

Site 2 May
Sediment: *Achlya* sp., *S. ferax, S. diclina*
Water: 2 *S. ferax,* MP
Lower bank: 3 MP
Upper bank: *S. ferax,* 2 MP

Site 3 November
Sediment: *S. hypogyna, S. ferax,* MP
Water: 2 *S. diclina, S. ferax*
Lower bank: *S. ferax,* 2 MP
Upper bank: 3 MP

Site 3 March
Sediment: 3 *S. ferax*
Water: 2 *S. ferax,* MP
Lower bank: 3 MP
Upper bank: 3 MP

Site 3 April
Sediment: *S. diclina, S. terrestris, A.* sp
Water: 3 MP
Lower bank: 2 *S. diclina,* MP
Upper bank: *S. ferax,* 2 MP

Site 3 May
Sediment: 2 *S. ferax, S. diclina*
Water: *S. australis,* 2 *S. ferax*
Lower bank: *S. ferax,* 2 MP
Upper bank: *S. ferax,* 2 MP

Site 4 November
Sediment: 2 *S. ferax, S. diclina*
Water: 3 *S. ferax*
Lower bank: *S. ferax,* 2 MP
Upper bank: *S. ferax,* 2 MP
Isle: MP
Spit: *S. diclina, S. ferax,* MP

Site 4 March
Sediment: 3 MP
Water: 3 *S. ferax*
Lower bank: 3 MP
Upper bank: *S. ferax,* 2 MP
Isle: *S. diclina,* 2 *S. ferax*
Stagnant Water: 3 MP

Site 4 April
Sediment: 2 *S. hypogyna, S. ferax*

Water: 2 *S. ferax, S. hypogyna*
Lower bank: *S. ferax, S. australis, A. flagellata*
Upper bank: 3 *S. ferax*
Isle: 2 MP, MS

Site 4 May
Sediment: 2 *S. ferax, S. hypogyna*
Water: *S. ferax, S. diclina,* MP
Lower bank: 3 *S. ferax*
Upper bank: 3 MP

Site 5 November
Sediment: *S. hypogyna, S. diclina,* MP
Water: *S. diclina,* 2 MP
Lower bank: *S. ferax,* 2 MP
Upper bank: 3 MP

Site 5 March
Sediment: *S. diclina,* 2 MP
Water: *S. diclina, S. ferax,* MP
Lower bank: *S. ferax,* 2 MP
Upper bank: 3 MP

Site 5 April
Sediment: 2 *S. hypogyna,* MS
Water: *S. ferax,* 2 MP
Lower bank: 3 *S. ferax*
Upper bank: 3 MP
Isle: 3 MP

Site 5 May
Sediment: 3 *S. ferax*
Water: *S. hypogyna, S. diclina, S. ferax*
Lower bank: 2 *S. ferax,* MP
Upper bank: *S. ferax,* 2 MP

Longitudinal differences among the aquatic fungal communities were compared (Table 2) using Sorensen's (1948) index of similarity. Sites 0 and 4 were most similar in species composition. Sites 1 and 3 differed the most in species composition. Site 0 occupied the central position — the position of the site most similar to all other sites. Site 3 was least like any other site. Sites 0 and 4 represented relatively swift moving parts of the stream. Site 1 had only a trickling water-flow, and the water-flow in site 3 was disturbed by riffles. Since site 0 was downstream to the other sites, it is reasonable to expect that it would have the highest average similarity to the other sites in species composition because of its central position in Sorensen's Index.

Table 1. *Oomycetes isolated from Pease Creek; November, 1976 to May, 1977.*

Fungus	Percent of total isolates
Achlya flagellata Coker	1.6%
A. sp.	0.7%
Members of the Pythiales	39.8%
Saprolegnia australis Elliot	1.3%
S. diclina Humphrey	13.2%
S. ferax (Gruith.) Thuret	36.8%
S. hypogyna (Pringsheim) de Bary	3.3%
S. terrestris Cookson ex Seymour	0.7%
S. spp.	2.3%
Thraustotheca clavata (de bary) Humphrey	0.3%

Table 2. *Comparisons of Species Composition at sites along Pease Creek from November 1976 through May 1977. Values are Sorensen's (1948) index of similarity.*

Numbers	0	1	2	3	4	5	Site Average
		0Site					
0		48	44	47	62	53	51
1			50	19	35	37	38
2				36	40	21	38
3					31	22	31
4						50	44
5							37
Total Average							40

Table 3. *Numbers of Pythiales and Saprolegniales isolated from various habitats in Pease Creek, Boone County, Iowa, from November, 1976 to May, 1977.*

Habitat	Number of Saprolegniales	Number of Pythiales	x^2
sediment	60 [a]	12	A [c]
water	58	14	A
lower bank	38	34	B
upper bank	22	50	C
isle	4/10 [b]	6/10	
spit	2/3	1/3	
stagnant water	0/3	3/3	

[a] times isolated per 72 isolations
[b] times isolated/total isolations at the indicated site
[c] A letter followed by a different letter indicates significant differences between habitats (chi square, = 0.05) in relation to both orders.

Since several species of the Pythiales are pathogens of land vascular plants, the dry upper banks of Pease Creek were predicted to be a better habitat for members of this order. Isolates of Pythiales were found in sediment, water, lower bank, upper bank, isle, spit, and stagnant water locations. Similarly, members of the Saprolegniales were found in all habitats (Table 3). Techniques used in this study yielded isolates from any propagules that could initiate colonies, rather than from one type such as only from resting spores. These techniques could also have favored the isolation of the more aggressive fungi and some slower growing Oomycetes may have been eliminated. Even though the data presented may not be a complete fungal flora, they suggest that the drier habitats do favor isolation of members of the Pythiales over isolation of members of the Saprolegniales.

Since the Pease Creek watershed is within a state park, the Oomycete flora might profitably be compared to the fungal flora of similar Iowa streams with farmland watersheds.

Alabi (as cited by Hunter, 1975) compared Nigerian all-season, dry-season, and rainy-season species of Saprolegniaceae and found species with centric oospores only in the rainy season. Dick (1966) states that *Achlya americana, A. flagellata, A megasperma, A. racemosa, A. radiosa* and *Isoachlya monilifera* show a habitat prefer-

ence for damp as opposed to permanently waterlogged sites. Similarly, environmental variables, such as severe drought conditions, may have influenced the number and types of species isolated during the Pease Creek study. Species which might be expected during a year of normal precipitation (Beneke, 1948) but not found in this study include *Achlya americana, Brevilegnia diclina, B. megasperma, B. unisperma, B. unisperma* var. *delica, B. unisperma* var. *litoralis, B. unisperma* var. *montana, Dictyuchus achlyoides, D. missouriensis, D. monosporus, D. pseudoachlyoides, D. pseudodictyon, Geolegnia inflata, Isoachlya turuloides, Saprolegnia delica, S. lapponica, S. mixta, S. monoica, S. monica* var. *glomerata, S. turfosa, Thraustotheca primoachlya.* Species found under the drought conditions of the present study, but not reported by Beneke (1948) include *Achlya flagellata, Saprolegnia australis, S. hypogyna* and *S. terrestris.*

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