ILLINOIS WILDLIFE PRESERVATION FUND
SMALL PROJECT REPORT

TO ILLINOIS DEPARTMENT OF NATURAL RESOURCES,
DIVISION OF NATURAL HERITAGE

AQUATIC INVERTEBRATE INVENTORY OF BLUFF SPRINGS SAND PONDS

PREPARED BY

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PROJECT OVERVIEW

The purpose of this project was to inventory the aquatic invertebrate species living in a set of woodland temporary ponds (Bluff Springs Sand Ponds; BSSP). This project also collected other data on the ponds (size, hydroperiod, water chemistry). The provided funding enabled travel to Bluff Springs Sand Ponds (Cass County, Arenzville Quadrangle, Section 34, T18 N - R11 W) from the campus of University of Illinois at Springfield and purchase of miscellaneous materials for sample collection and processing.

The Bluff Springs Sand Ponds are vernal (springtime), but to document the possibility of an additional autumnal wet period, several reconnaissance trips were made to the ponds during fall and winter of 1996-1997. The ponds did not develop during that interval, although it is possible the ponds develop in fall/winter during other, wetter years.

Travel to the ponds occurred weekly from March 7 through June 27 1997 for sampling. Thirteen ponds were sampled weekly during this study, or until a pond dried out. The project proposal listed 5 objectives:

1. Sample all of the Bluff Springs temporary ponds for invertebrates and basic water chemistry (pH, DO, temperature), weekly during each pond's hydroperiod, for one year.
2. Sample and analyze water from each pond biweekly for the following variables: hardness, alkalinity, conductivity, color, chlorophyll a (algal biomass).
3. Identify all collected invertebrates to lowest practicable taxonomic level (usually to species).
4. Summarize collected species data as diversity over time for each pond (seasonal successions) and as annual diversity for each pond.
5. Identify potential relationships between species composition and environmental variables (e.g., pond location, nutrient levels, hydroperiod, etc.).

Objectives 1 and 2 were completed within the project period. Data are summarized below. Objective 3 was partially completed; full completion depends on hand-processing of numerous detritus-laden samples to extract and then microscopically identify invertebrates. In addition, sampling continued through June 27: all samples have not yet been processed. Objectives 4 & 5 depend on completion of Objective 3. Objectives 3-5 are being addressed in the next several months: what can be provided at this time is a list of invertebrate species identified to date among all ponds. Lists of species per pond, seasonal successions, diversity calculations, and environment-composition relationships will be developed upon completion of sample processing and identifications.

The DNR proposal instructions also stated that photographs and two local newspaper articles were required to be submitted. Photographs of organisms are included with this report (see attached). A receipt of funding for the project was announced in a UIS campus newsletter, and a newspaper article (Illinois Times) is pending, dependent on the journalist's and newspaper's schedules.

Results are organized below as an annotated taxonomic list of species identified to date and a summary of physical-chemical data.

ANNOTATED TAXONOMIC LIST: BLUFF SPRINGS SAND PONDS

(Higher level taxonomy follows Barnes, Calow and Olive, 1993; Annotations per Pennak 1978 and Wiggins et al. 1980).

Dactylbiotus (Phylum Tardigrada):

Tardigrades are well suited to temporary ponds, though little studied. Tardigrades can withstand dessication by encysting, and are often found in wet mosses and shallow waters. Though fascinating animals (they can withstand utter dessication and freezing), little is known about their ecology or distributions.

Daphnia obtusa/pulex (Phylum Crustacea, Class Branchiopoda, Order Cladocera):

Daphnia are commonly studied and well-known from temporary ponds as well as permanent ponds. *Daphnia* from the Bluff Springs Sand Ponds are not clearly species *obtusa* or *pulex*: those species are closely related, and distinguishing traits are intermediate in pond specimens. I sent specimens to Dr. Paul Hebert, University of Guelph, Ontario, for electrophoretic analysis. Dr. Hebert is the leading *Daphnia* taxonomist in North America: I requested his assistance because *Daphnia* are of wide interest, identifications were uncertain, and because it is possible that the Bluff Springs Sand Ponds are a hybridization site for the two species - a possibility unobserved to date. His analyses should be completed within the next few months.

Simocephalus serratus and *Simocephalus vetulus* (Phylum Crustacea, Class Branchiopoda, Order Cladocera): *Simocephalus* are also well-known from ponds, both permanent and temporary. *Simocephalus* are often observed in shallow waters, among weeds or filamentous algae. I have observed *Simocephalus* in the Bluff Springs Sand Ponds to develop populations later in the year than *Daphnia*, perhaps indicating some temporal segregation of resources.

Scapholeberis mucronata (Phylum Crustacea, Class Branchiopoda, Order Cladocera):

A very small cladoceran, *S. mucronata* is "common and widely distributed" in the U.S., often found in shallow waters and weedy zones. *S. mucronata* is not described as restricted to temporary waters, but has adaptations for temporary waters common to all Cladocera.

Lynceus brachyurus (Phylum Crustacea, Class Branchiopoda, Order Conchostraca):

Lynceus brachyurus is a typical resident of temporary ponds, and is described as the most common species of the genus in North America. *L. brachyurus* are also found in permanent ponds, but are vulnerable to fish predators. A second species of uncertain identity is also present; a definitive literature search for recent taxonomic monographs needs to be conducted because the specimens do not match a standard taxonomic key (Pennak 1989).

Eubranchipus serratus (Phylum Crustacea, Class Branchiopoda, Order Anostraca):

This species of fairy shrimp is common to temporary ponds of the Midwest, but is apparently restricted to temporary pond habitats alone, as is true for most anostracans, probably because they are vulnerable to fish predation.

Diaptomus sp. & *Osphrancticum labronectum* (Phylum Crustacea, Class Copepoda, Order Calanoida): These calanoid copepods are noted as being found in temporary waters, although *O. labronectum* is considered uncommon. This may be due to few studies of copepods in temporary waters, rather than limited distributions.

Cyclops nearcticus, Cyclops haueri, Cyclops navus (Phylum Crustacea, Class Copepoda, Order Cyclopoida): These tiny cyclopoid copepods are descried as being temporary pond residents. Cyclopoids are difficult to identify, so these identifications should be considered tentative: further work is needed on additional specimens for more definitive identifications.

Atheyella sp., *Canthocamptus* sp. (Phylum Crustacea, Class Copepoda, Order Cyclopoida, Order Harpacticoida): These harpacticoid copepods are described as being found in temporary ponds, but so little is known about harpacticoids (taxonomy and ecology) that little more can be stated, and identifications will not be possible to species.

Other invertebrate taxa observed:

Oligochaete annelid worms
Turbellaria (flatworms)
Bdelloid rotifers: samples are being sent to a taxonomic expert for identification
Nematodes
Planorbid gastropods (snails)
Sphaerium clams
Aquatic mites
Dytiscid beetles (larvae & adults)
Notonectids (diving bugs)
Gerrids (water striders)
Odonates (dragonfly and damselfly nymphs)
Chironomids (midge larvae and adults)
mosquito larvae and adults

PHYSICAL-CHEMICAL DATA SUMMARY:

The Bluff Springs Sand Ponds are so named because they are located in the Illinois River Sand Area, and are completely enclosed by a ridge of sandy soil. The lack of surface inflow and sandy soils combine to produce unique aquatic habitat in central Illinois; acidic, soft-water ponds, low in primary production, and dominated by decomposition of detritus.

Hydroperiod and Size: Average hydroperiod of the Bluff Springs Sand Ponds was 62 days, although hydroperiods ranged from approximately 1 month to over 4 months, depending on pond size. Each pond varies in size through the wet season: most ponds reach maximum size quickly, and pond size reduces thereafter, especially after trees

leaf out (and presumably, evapotranspiration removes water). Ponds range in maximum size from 200 m^2 to over 7000 m^2.

Temperature and Dissolved Oxygen: Water temperatures closely track air temperatures because ponds are small and shallow. Dissolved oxygen averaged 4.2 $\pm$ 0.7 mg/L (mean $\pm$ std. deviation) in April, and reduced to 1.4 $\pm$ 0.9 mg/L by mid June. This reduction in dissolved oxygen to levels that may be considered anoxic appears to be due to decomposition of detritus in the ponds. Low oxygen content may limit species composition of some ponds, especially for slow-developing species (e.g., some insects).

pH, Alkalinity, Conductivity and Hardness: Mean pH increased slightly during the wet season, from 5.4 $\pm$ 0.1 to 6.1 $\pm$ 0.3. This slight increase may be due to ion exchange with sediments, but does not seem to be due to carbonate buffering, because alkalinity decreased from 237 mg/L as $CaCO_3$ in April to 112 mg/L as $CaCO_3$ in June. Ponds can be described as having very soft water, with mean hardness ranging from 63 to 31 mg/L as $CaCO_3$.

Total Phosphorus: Phosphorus is usually the limiting nutrient in freshwaters, and phosphorus concentrations are predictive of overall productivity and biomass. Phosphorus levels are relatively high in the Bluff Springs Sand Ponds, starting at a mean of 0.21 mg/L in March and rising through the spring months to a mean of 0.85 mg/l in late spring. Some of this phosphate may not be available to phytoplankton because it is bound to dissolved and particulate organic substances. The low phytoplankton densities (see below), high P levels, and rapid depletion of dissolved oxygen suggest that the food web in the ponds is probably based on detritus and associated bacterial production.

Chlorophyll a and Phaeophytin: Chlorophyll a is commonly measured as an indication of active phytoplankton biomass. Pheophytin is a degraded form of chorophyll, and can be used to indicate health of phytoplankton or other residual plant products in the water.The ponds can be considered to very low in phytoplankton biomass, having an overall mean value of 6 µg/m3 of chlorophyll a. This is consistent with low oxygen content, stained waters (tannic and humic acids), and shaded conditions, especially after trees leaf out. However, pheophytin is moderate, with an overall mean value of 10 mg/m^3. This probably reflects the decomposition of leaves in the ponds rather than phytoplankton biomass.

CONCLUSIONS:

The Bluff Springs Sand Ponds are unique to Central Illinois, as a concentrated set of ephemeral habitats with specially-adapted aquatic invertebrates. The species present are not considered endangered or even endemic to Central Illinois, but in my opinion, the habitat is rare. Numerous temporary ponds probably once dotted the prairie, and may have contained fauna similar to those in the Bluff Springs Sand Ponds. Temporary ponds have been filled and/or drained throughout our highly-managed landscape,

leaving relatively few sites such as those studied for this project. In addition, the few temporary ponds that can be found todya occur in isolation: I know of no sites with multiple, separate ponds such as those at the Bluff Springs Sand Ponds site. Given the rarity of such ponds today, I think the Bluff Springs Sand Ponds may be considered relic habitats in Central Illinois. The current conditions of the ponds (shaded, woodland ponds) reflects a natural succession of vegetation following the cessation of cattle grazing on the site in the 1950's: the site owner remembers wet prairie on the site when grazed.

The high density and variety of ponds on the site provide a rich natural laboratory for investigating the patterns among and within the temporary ponds and the processes responsible for those patterns. This funding enabled that research to begin, for which I am very grateful. I hope I can provide information on this jewel of a site for years to come, and help form a basis for the protection of the site and others like it.