Changes in the Macroinvertebrate Community of a Central Florida Herbaceous Wetland over a Twelve-Month Period

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Abstract

Monthly collections of aquatic macroinvertebrates were made at a depressional wetland in eastern Seminole County, FL for a one-year period, using D-frame dipnets to sample in the major vegetation types present. Samples were sorted and macroinvertebrates identified to lowest practical taxonomic level. A total of 22,432 invertebrates were identified, representing 275 distinct taxa. The greatest number of individuals was collected in February (4240), and the least in September (238). Greatest and least numbers of taxa were collected in January (150) and September (51), respectively. The major groups collected were Coleoptera, Diptera, and Odonata, together comprising >85% of individuals and >80% of taxa collected. In all but one month, the largest number of individuals was collected from *Utricularia*, though no particular aquatic macrophyte habitat consistently harbored more macroinvertebrate *taxa*. Predators were by far the most abundant functional feeding group, with lower numbers of collectors and shredders, and only a few filterers and scrapers. Drought conditions, which persisted throughout the study, appeared to have little negative effect on either richness or abundance of macroinvertebrates.

Site Description

Eastbrook Wetland (N 28.729171, W –81.100126) is an herbaceous marsh located in eastern Seminole County, Florida just east of the rural community of Geneva, within the Econlockhatchee River watershed. It is one of several hydrologically connected ponds and wetlands that lie within 475-acre Lake Proctor Wilderness Area (Figure 1), one unit of Seminole County's Natural Lands Program (http://www.seminolecountyfl.gov/pd/commres/natland/). From treeline to treeline, the wetland encompasses approximately 3.6 acres, though the inundated portion of this area varies dramatically with rainfall. Roughly circular in outline, Eastbrook Wetland (which was named in honor of a group of student volunteers from a local elementary school) is connected via surface water at its NW corner to a nearby wetland (and thence to Lake Proctor) only during extended periods of heavy rainfall or major storm events (Figure 2). The land in the immediate vicinity is completely undeveloped, although there is a cleared home site approximately 200m to the east, and State Road 46 lies about 275m to the south. Within a one-mile radius of the wetland, land use (based on St. Johns River Water Management District 2000 data) is approximately 55.3% natural, 24.3% agriculture and rangeland, and 20.4% urbanized (including communications, transportation, and utilities).

Vegetatively, the system is typical of other depressional marsh wetlands in central Florida, with specific plants occurring in fairly distinct concentric bands from the water outward (Gilbert *et al.* 1995). The deeper, consistently inundated portion of the wetland is dominated by *Nymphaea odorata* Aiton (fragrant water lilies) and several species of *Utricularia* spp. Linnaeus (bladderwort). Moving away from the center, one encounters a band made up largely of *Eleocharis baldwinii* (Torrey) Chapman (spikerush). Farther landward there is a relatively narrow ring comprised mainly of *Rhynchospora inundata*

(Oakes) Fernald (beaksedge), beyond which is a broad band dominated by *Hypericum* sp. Linnaeus (St. Johns wort) and *Eriocaulon* sp. Linnaeus (pipewort). This gradually gives rise to a zone dominated by grass species (*Panicum* Linnaeus and *Dicanthelium* Hitchcock and Chase) interspersed with various other herbaceous plants like *Lachnanthes caroliniana* (Lamarck) Dandy (redroot), *Rhexia* sp. Linnaeus (meadow beauties), *Sabatia grandiflora* (A. Gray) Small (largeflower rosegentian), *Xyris* sp. Linnaeus (yellow-eye grass), *Eupatorium capillifolium* Lamarck (dog fennel), and *Drosera capillaris* Poir (pink sundew). A small abruptly sloped area on the southeast shore of the wetland supports a thriving population of *Lycopodiella alopecuroides* (Linnaeus) Cranfill (foxtail club moss), and a sometimes-inundated small cove on the northeast corner of the wetland is surrounded by *Cephalanthus occidentalis* Linnaeus (button bush). A semi-floating island of vegetation in the center of the southern half of the wetland is home to several of the species mentioned above, as well as the orchid *Habenaria repens* Nuttall and *Galium tinctorium* Linnaeus (stiff marsh broomstraw), plus a small lone *Salix caroliniana* Michaux (Carolina willow). The herbaceous character of the wetland as a whole eventually yields to a more upland area dominated by *Pinus elliotti* Engelman (slash pine) with an understory made up predominately of *Myrica cerifera* Linnaeus (wax myrtle), *Acer rubrum* Linnaeus (red maple), *Gordonia lasianthus* (Linnaeus) J. Ellis (loblolly bay), and *Lyonia lucida* (Lamarck) K. Koch (fetterbush). Beyond this band is a truly upland zone characterized by xeric oaks (*Quercus* spp. Linnaeus), *Pinus clausa* (Chapman ex Englemen) Vasey ex Sargeant (sand pines), and *Serenoa repens* (W. Bartram) Small (saw palmetto), with a diverse understory of small shrubs and herbaceous plants, as well as *Cladonia* sp. Wiggins (reindeer moss).

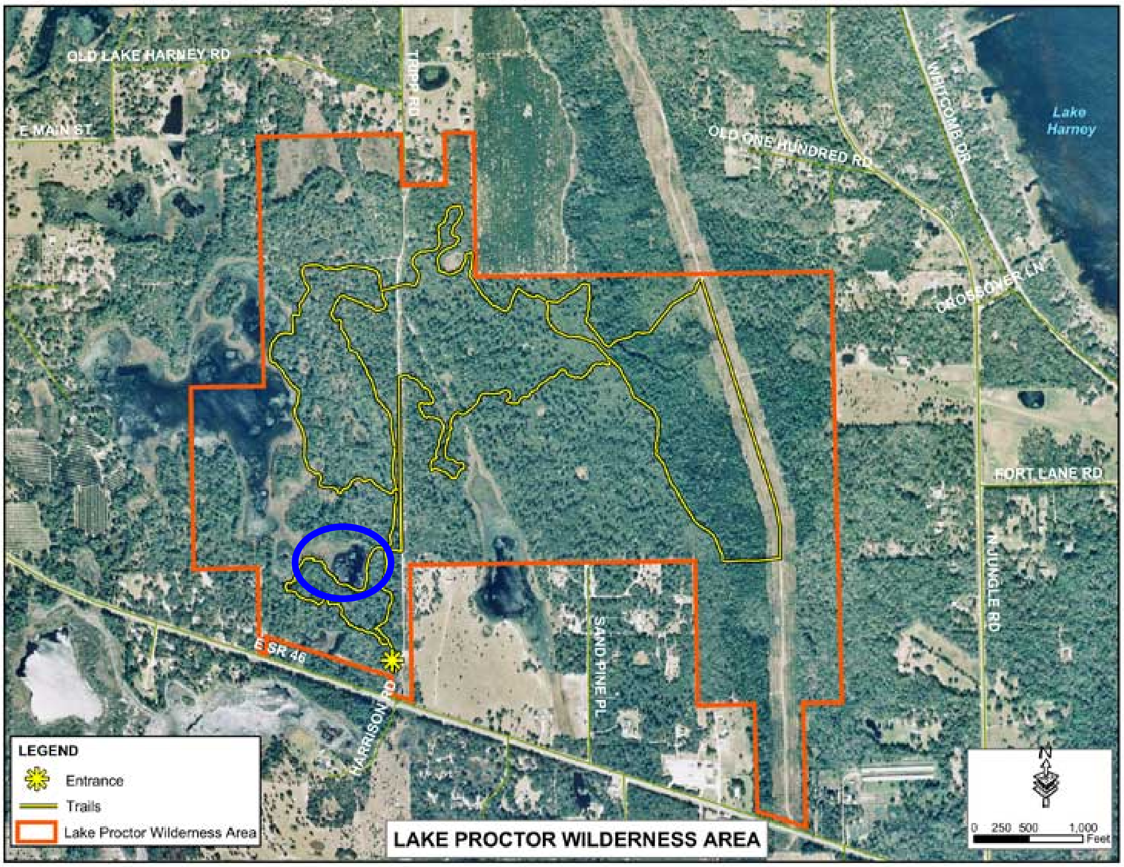

Figure 1. Lake Proctor Wilderness Area, eastern Seminole County, FL. Eastbrook Wetland is circled in blue. Image courtesy of Seminole County Natural Lands Program.

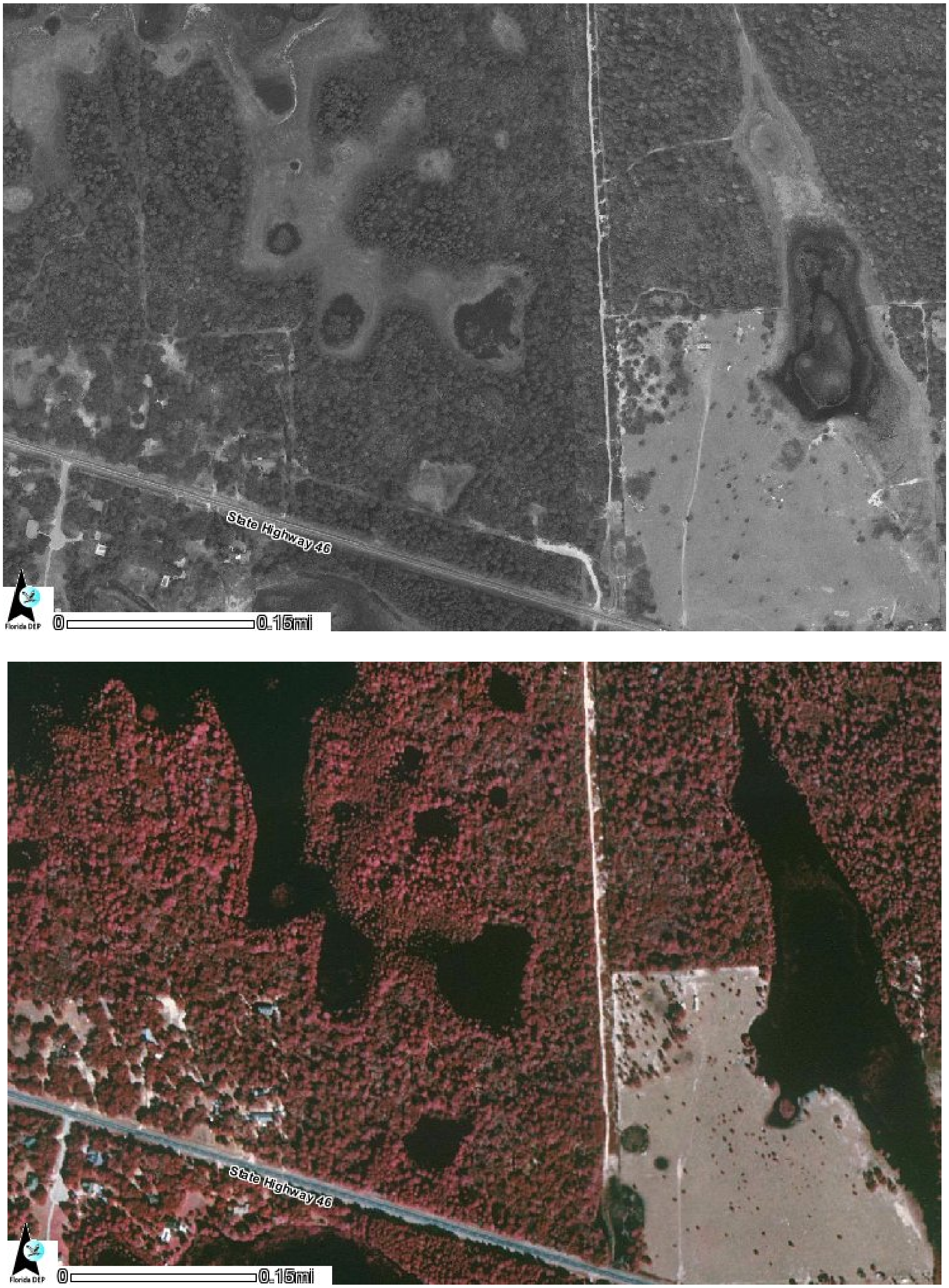

Figure 2. Eastbrook Wetland and vicinity during extremes of water level. Aerial photographs of low water at top (photo taken prior to 1997) and high water at bottom (photo taken 2002).

Soil types at Eastbrook Wetland include Basinger series fine sands within the wetland proper, Immokalee sandy soils farther landward, and Astatula sand in the uplands (Gilbert *et al*. 1995, SSURGO soils data). Throughout a large part of the wetland proper, the sand is covered by a one- to several inches thick layer of peaty organic material that dries and cracks into fragments during dry weather.

The water in this wetland is darkly tannic, with pH measurements ranging from 4.6 to 7.02 su during the study period. Temperature and dissolved oxygen levels varied drastically, as well. The highest water temperature recorded was 37.2°C (98.9°F), measured in May, and the lowest was 5.3°C (41.5°F), recorded on an unusually frigid morning in late December when the shallow wetland had frozen over completely the night before with a sheet of ice roughly 5 mm thick.

Dissolved oxygen measurements ranged from a maximum of 6.53 mg/L in November to a minimum of 0.55 mg/L in April, when the water level was lowest. Specific conductance ranged from 103 to 266 μmhos/cm. The Secchi disk was visible on the bottom each time it was deployed.

Introduction

Relatively few studies have been carried out exploring seasonal changes in the macroinvertebrate community of wetland systems in Florida and the southeast. Leslie *et al.* (1997) examined macroinvertebrates communities of three Florida cypress swamps over a 17-month period. Rader (1994) looked at the macroin-vertebrate species composition and trophic structure of sloughs in the northern Everglades. Macroinvertebrate community structure and seasonal variation in a titi swamp in north Florida was studied by Haack *et al.* (1989). Stagliano *et al.* (1998) examined the seasonal emergence of adult aquatic insects from a small wetland within the Talladega Wetland Ecosystem in west-central Alabama. Temporal changes in the invertebrate communities of periphyton mats in Shark River Slough in the northern Everglades were evaluated by Liston and Trexler (2005), and monthly determinations of invertebrate abundance and biomass were made by Duffy and LaBar (1994) in three wetlands in Noxubee Wildlife Refuge, Mississippi.

The aims of this study were to determine what macroinvertebrates inhabit a minimally-impacted central Florida wetland of this type, what invertebrate community changes take place over the span of a year given the large degree of environmental variation occurring in these systems as the seasons change, and the degree of fidelity various macroinvertebrate taxa have to specific vegetation habitat types. In addition, it is hoped that the information learned in this study will be useful in the ongoing development of wetland biocriteria in Florida and elsewhere, and will represent a substantial addition to Seminole County Natural Lands Program's continuing biological inventory effort. Because a record drought took place during the sampling period, this data might also be useful in evaluating the effects of drought on wetland macroinvertebrate communities.

Materials and Methods

Monthly samples were collected at Eastbrook Wetland from May 2000 until April 2001, each sample being taken at approximately the same time each month. Macroinvertebrates were collected using a D-frame dipnet with a 28.5 cm wide opening and a bag with 590 μm diameter mesh. Five sweeps were collected on each date, one from each of four main aquatic vegetation habitat types present at the wetland (*Eleocharis baldwinii*, *Nymphaea odorata*, *Rhynchospora inundata*, and *Utricularia* spp.), and a fifth mixed sweep taken in a spot where all of the four habitat types were represented. Each sweep was 1 meter in length, the net being swept over the same spot several times to ensure collection of most or all of the macroinvertebrates present in that area. Dipnet sampling was employed because of its simplicity of use and its demonstrated effectiveness when employed in wetland sampling. Turner and Trexler (1997), for instance, concluded that more individuals, more taxa, and a more even distribution were found when macro-invertebrate samples were collected in the Everglades using D-frame dipnets as the main sampling gear (augmented by other devices used to catch larger and more elusive taxa). The standard wetland sampling method used by FDEP biologists is dipnet sweeps (FDEP 1994, Graves *et al.* 1998). In this study, all five sweeps were initially combined into one composite sample, but it became apparent that valuable habitat-related data was being lost using this method. Consequently, the sweeps were kept separate from October 2000 through the end of the study period. The samples were preserved using buffered formalin. Sweeps were later sorted in their entirety to remove all macroinvertebrates present, with the exception of naidid oligochaetes, which were present in enormous numbers, making removal of every individual present impractical. In the case of these, a representative sample of approximately 40 individuals was removed from each sweep and later identified. Sorted specimens were preserved in 95% ethanol until identifications were made. Taxonomic identifications were made to the lowest practical level (in most cases species). Chironomid midges and smaller oligochaetes were mounted on slides in CMC-10 (available from the Masters Company, Wood Dale, IL) and covered with glass coverslips. Ident-ification of these was made using an Olympus Model BX51 microscope equipped with Nomarski DIC optics. All other taxa were identified in ethanol or dry using an Olympus Model SZ11 dissecting microscope illuminated by a ring light. A variety of taxonomic keys were used in the identification of the specimens, most of which have been developed by the Florida Department of Environmental Protection. A list of taxonomic references used is given in Appendix 1.

On each sampling date, dissolved oxygen level, pH, water temperature, and specific conductance were measured using a Hydrolab multimeter, and water clarity was examined using a standard Secchi disk. Appendix 2 shows these water quality measurements. Additional observations of weather, aquatic plants present, vertebrates (or signs thereof) observed, and adult odonates noted were also taken.

RESULTS

Overall observations

In all, 22,432 macroinvertebrates were identified during this study. The largest group of individuals examined was dipterans. There were 12,897 dipterans identified (including 10,089 Chironomidae), or 57.5% of all the individuals examined. Coleoptera accounted for 13.7% of the invertebrates identified, with 3069 individuals. Odonates were also quite abundant, with 3261 individuals, or 14.5% of the total number. The total number of individuals and distinct taxa within each major taxonomic group collected is shown below, in Table 1.

Table 1. Numbers and percentages of macroinvertebrate individuals and distinct taxa by major taxonomic group.

TAXON	INDIVIDUALS	% INDIVIDUALS	DISTINCT TAXA	% TAXA
Coleoptera	3069	13.68	83	30.18
Collembola	33	0.15	1	0.36
Crustacea	173	0.77	4	1.45
Diptera	12897	57.49	82	29.82
Ephemeroptera	271	1.21	2	0.73
Hemiptera	248	1.11	19	6.91
Lepidoptera	120	0.53	5	1.82
Mollusca	463	2.06	2	0.73
Odonata	3261	14.54	36	13.09
Oligochaeta	149*	0.66*	8	2.91
Trichoptera	358	1.60	5	1.82
Trombidiformes	1382	6.16	27	9.82
Turbellaria	8	0.04	1	0.36
TOTAL	22432	100.00	275	100.00

* Exclusive of *Dero digitata* complex, which were not enumerated.

The largest number of taxa collected was among the beetles, with 83 distinct species identified. This accounts for about 30% of all the taxa found in this study. The dipteran community had almost the same degree of richness as the Coleoptera, with 82 different taxa, also roughly 30% of the total taxa. Approximately 75% of the remaining taxa were made up of odonates, water mites, and true bugs. A master list showing all taxa identified, the dates and locations, and the number of individuals collected, is shown in Appendix 3.

Individual taxon abundance was highest in the larval Ceratopogonidae. There were 2552 larval ceratopogonids counted in this study, or 11.5% of all individuals enumerated. The chironomid *Guttipelopia guttipennis* Wulp was the next most abundant taxon, with 1575 individuals, or 7.1% of the whole, followed by the tanypod midge *Ablabesmyia peleensis* (Walley), which was represented by 1263 individuals (5.7%). Table 2 shows the 25 most abundant taxa found in the study.

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Table 2. Most abundant macroinvertebrate taxa collected - Eastbrook Wetland study.
Total number of individuals/ taxon and percentage of all macroinvertebrates found is shown.

TAXON	**GROUP**	**TOTAL #**	**PERCENTAGE**
Ceratopogoninae larvae	Diptera	2552	11.53
Guttepelopia guttipennis Wulp	Diptera	1575	7.11
*Ablabesmyia peleensis (*Walley)	Diptera	1263	5.70
Tanytarsus sp. Wulp	Diptera	1140	5.15
Chironomus sp. Meigen	Diptera	1107	5.00
Procladius sp. Skuse	Diptera	1056	4.77
Erythemis simplicicollis Say	Odonata	1011	4.57
Larsia berneri Beck and Beck	Diptera	920	4.16
Pachydiplax longipennis (Burmeister)	Odonata	513	2.32
Libellulidae unid. (very small)	Odonata	475	2.15
Paratendipes subaequalis (Malloch)	Diptera	462	2.09
Ancylidae	Mollusca	462	2.09
Berosus infuscatus LeConte	Coleoptera	444	2.01
Berosus sp. (larva) Leach	Coleoptera	434	1.96
Arrenurus melemus Cook	Trombidiformes	369	1.65
Ischnura sp. Charpentier	Odonata	349	1.58
Oribatei unid.	Trombidiformes	332	1.50
Polypedilum illinoense group (Malloch)	Diptera	257	1.16
Suphisellus gibbulus (Aubé)	Coleoptera	245	1.11
Ablabesmyia rhamphe group Sublette	Diptera	244	1.10
Polypedilum fallax group (Johannsen)	Diptera	242	1.09
Polypedilum tritum (Walker)	Diptera	239	1.08
Peltodytes oppositus Roberts	Coleoptera	219	0.99
Oxyethira sp. (larva) Eaton	Trichoptera	209	0.94
Caenis diminuta Stephens	Ephemeroptera	204	0.92

The highest concentration by area of individual macroinvertebrate taxa was found in January, when Ceratopogonidae larvae were present at a density of 3053 individuals/m^2, mainly within *Utricularia* beds. The next month they were also very abundant, occupying bladderwort habitat in a density of 1246 individuals/m^2. The twenty-five highest densities of individuals of specific taxa are shown in Table 3 below.

Table 3. Twenty-five highest densities of specific taxa found in Eastbrook Wetland study.

TAXON	DATE	HABITAT	INDIVIDUALS/m^2
Ceratopogonidae larvae	1/23/2001	*Utricularia*	3053
Ceratopogonidae larvae	2/26/2001	*Utricularia*	1246
Larsia berneri	2/26/2001	*Utricularia*	1046
Oribatei	3/26/2001	*Utricularia*	877
Ceratopogonidae larvae	3/26/2001	*Utricularia*	825
Chironomus	1/23/2001	*Eleocharis*	768
Ablabesmyia peleensis	2/26/2001	*Utricularia*	730
Ceratopogonidae larvae	3/26/2001	mixed	726
Paratendipes subaequalis	11/22/2006	*Rhynchospora*	723
Ablabesmyia peleensis	1/23/2001	*Utricularia*	663
Ancylidae	3/26/2001	*Rhynchospora*	663
Tanytarsus	1/23/2001	*Rhynchospora*	642
Guttipelopia guttipennis	1/23/2001	*Eleocharis*	600
Ceratopogonidae larvae	1/23/2001	mixed	596
Erythemis simplicicollis	11/22/2006	*Utricularia*	551
Guttipelopia guttipennis	3/26/2001	mixed	540
Tanytarsus	11/22/2006	mixed	523
Tanytarsus	11/22/2006	*Utricularia*	512
Erythemis simplicicollis	10/26/2000	*Utricularia*	477
Ceratopogonidae larvae	1/23/2001	*Rhynchospora*	467
Ablabesmyia peleensis	3/26/2001	mixed	467
Tanytarsus	1/23/2001	mixed	435
Chironomus	1/23/2001	*Rhynchospora*	425
Guttipelopia guttipennis	12/20/2000	mixed	418
Guttipelopia guttipennis	4/25/2001	*Eleocharis*	400

Macroinvertebrates were present in all of the aquatic plant habitats sampled on each date, although they were not evenly distributed among those habitat types (see Figure 3). In each case except one (the last sampling date in April 2001), more macroinvertebrates were collected from *Utricularia* than any other habitat type. The greatest density of macroinvertebrates found in the study was in January, when the *Utricularia* sweep yielded 1806 individuals, for a density of 6337 individuals/m^2. At the severest point of the drought in April, however, there were almost twice as many macroinvertebrates found in the *Eleocharis* than in the *Utricularia*.

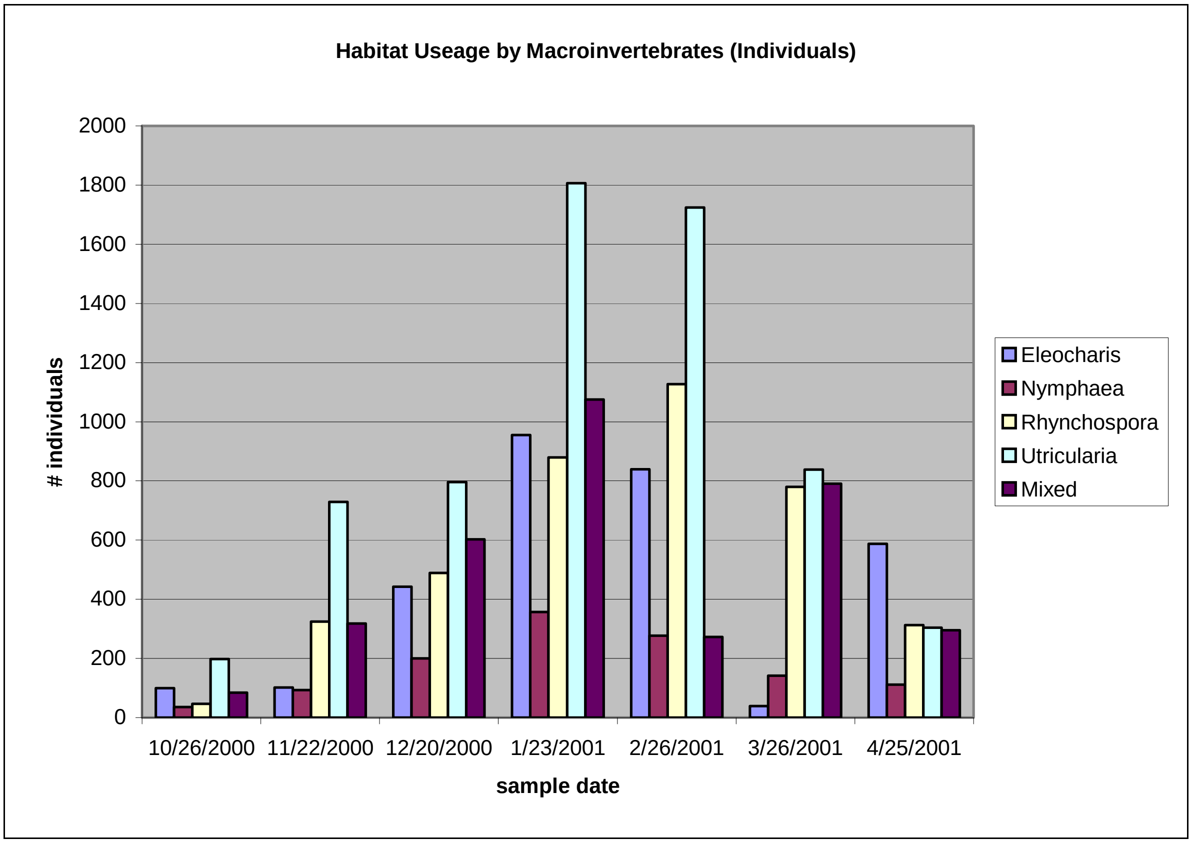


Figure 3. Numbers of individual macroinvertebrates collected from major aquatic plant habitats. *(Note: Dipnet sweeps were not kept separate until October. Thus, no specific habitat data is available for the period May through September 2000.)*

Although *Utricularia* was found to be the most productive of the macrophyte habitats sampled in terms of abundance, this did not hold true in terms of taxa richness. There was no apparent pattern of taxa richness in regard to the different habitat types. As shown in Figure 4, no single habitat type consistently produced more types of macroinvertebrates than any other. In no case, however, did *Nymphaea* harbor the largest numbers of either taxa or individuals.

Figure 4. Numbers of macroinvertebrate taxa collected from major aquatic plant habitats. *(Note: Dipnet sweeps were not kept separate until October. Thus, no specific habitat data is available for the period May through September 2000.)*

When numbers of invertebrate taxa collected from the various habitats are combined over the entire sample period, a roughly even distribution is seen (Figure 5).

Figure 5. Percentages of all macroinvertebrate taxa identified in Eastbrook Wetland study inhabiting various aquatic plant habitats May 2000 - April 2001.

Seasonal changes of abundance were largely consistent among the taxonomic groups. In almost all of the main groups of macroinvertebrates, there was a peak of abundance in the late winter/early spring and a period of greatly reduced abundance in late summer (Figure 6). All groups showed a decline in numbers during the last month of the study, possibly due to the extremely low water level resulting from the persisting drought.

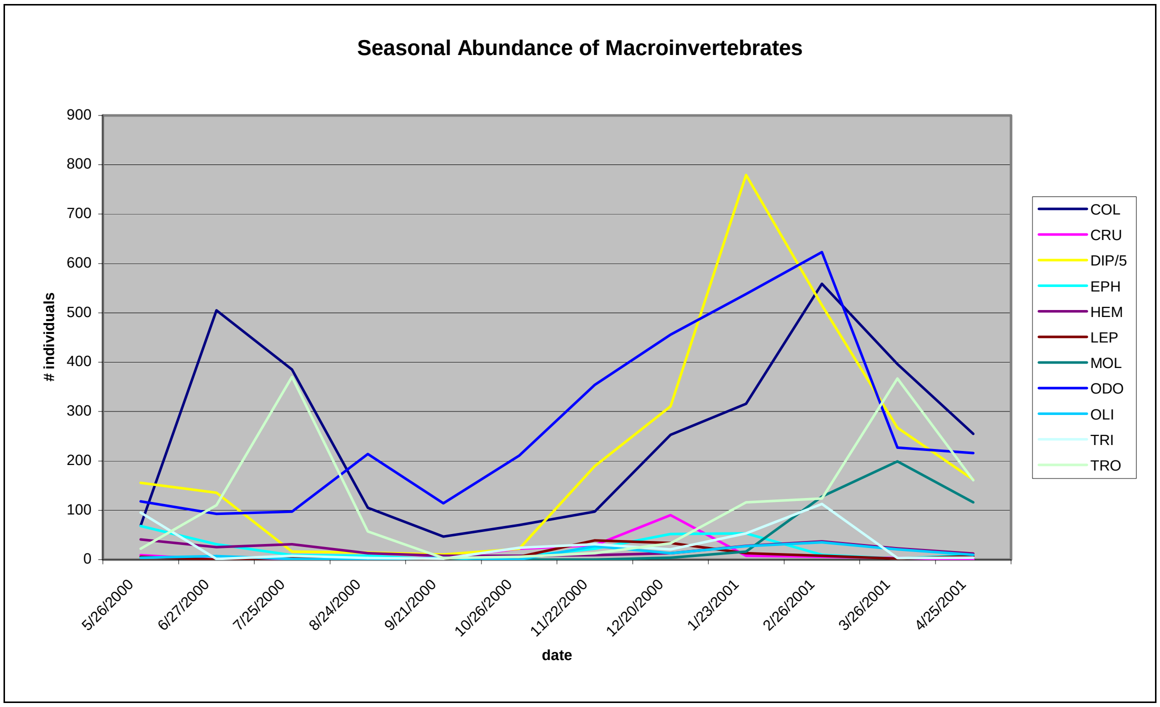


Figure 6. Changes in abundance of major macroinvertebrate taxonomic groups May 2000-April 2001. *(Note: Abundance of dipterans is represented at 1/5th of actual value to make graph more readable.)*

Observations within taxonomic groups

Coleoptera

The water beetles were the most diverse group of macroinvertebrates examined in this project. The 83 different beetle taxa collected included 11 different families and 48 different genera. Hydrophilidae, Dytiscidae, and Noteridae were the three most abundant families of Coleoptera, with 31, 29, and 9 different taxa, respectively, together accounting for >83% of the beetle taxa collected. Although many beetle taxa were very common, some were not. There were 18 species in which only one individual was collected, on only one date.

Among the Hydrophilidae, the genera *Berosus*, *Enochrus* Thomson, and *Tropisternus* Solier were very well represented, with 18 of the 31 hydrophilid beetle taxa. The most abundant hydrophilid (and most abundant beetle) was *Berosus infuscatus*, 444 adults having been collected throughout the study period. They were particularly abundant in the months of June and July, but quite scarce during the cooler months of the year. Larval *Berosus*, however, were abundant during the cooler months (when they were particularly common among *Utricularia*), but infrequent during the warm months. These trends probably reflect life cycle changes among the population.

The most abundant members of the family Dytiscidae collected at Eastbrook Wetland were the tiny *Anodocheilus exiguus* Aubé, *Neoporus* sp. Guignot, *Coptotomus interrogatus* (Fabricius), and *Bidessonotus pulicarius* (Aubé). These four taxa comprised about 62% of the 642 dytiscids identified.

The genus *Suphisellus* Crotch was the most common and diverse in the Noteridae. Four of the five Florida species were found at the wetland, and one of those species, *S. gibbulus* (Aubé), accounted for almost 67% of all of the noterids. *Hydrocanthus regius* Young was the next most abundant noterid.

Water beetles in the family Haliplidae were fairly common in the samples, but most (219 out of 240) were a single taxon – *Peltodytes oppositus* Roberts. Two species in the other Florida genus, *Haliplus* Latrielle, were also present, but were comparatively rare.

Diptera

True flies were also a large portion of the macroinvertebrates collected in this study, in terms of both taxa and numbers of individuals. Eight families of dipterans were collected, including 43 different genera, 35 of these being chironomids. Among the Chironomidae, 24 of the genera were in the subfamily Chironominae, accounting for 7064 individuals. The other 11 genera included seven Tanypodinae (2974 individuals) and 4 Orthocladiinae (51 individuals).

The most abundant chironomid was the tanypod *Guttipelopia guttipennis*. There were 1575 of these distinctive larval midges identified in the study. The next most abundant chironomid was also a member of the Tanypodinae, *Ablabesmyia peleensis*, with 1263 individuals counted. Other very abundant midges included *Tanytarsus* sp. (1140), *Chironomus* sp. (1112), and *Procladius* sp. (1056). Orthoclads were not very well represented in the samples in general, although *Psectrocladius* (*Monopsectrocladius*) sp. Keiffer was not uncommon in samples collected in February, March, and April.

Several chironomids showed a distinct seasonal pattern of abundance. Among the more numerous midges, *Guttipelopia guttipennis*, *Ablabesmyia peleensis*, *Tanytarsus* sp., and *Larsia berneri* were all much more abundant during the cooler months of the year than during warmer weather. *Chironomus* was present in greatest numbers in January, but no definite pattern was evident through the year. Unlike many of the other midges, *Procladius* sp. was more abundant during warm weather, in May and June. The chironomid *Paratendipes subaequalis* showed a very interesting pattern of distribution. Like many of the other midges, it was most abundant during cooler weather (November through February), but it was collected only in *Rhynchospora*, or in mixed sweeps that contained *Rhynchospora*. Not a single specimen was found in *Eleocharis*, *Utricularia*, or *Nymphaea* sweeps.

Other Diptera were occasional in the dipnet sweeps, and did not constitute a substantial component of the macroinvertebrate community.

Heteroptera

The water bugs were substantially less abundant than the aforementioned groups, but there was fairly good taxa richness given the relatively low numbers of individuals collected. Of the 248 individuals identified, there were 19 different taxa occupying 13 genera, within 8 different families. The most abundant heteropteran found in the samples was the naucorid *Pelocoris carolinensis* Torre-Bueno, with 113 individuals, or about 45% of all the heteropterans. The mesoveliid *Mesovelia mulsanti* White was the next most numerous true bug collected, with 59 individuals, or approximately 24% of all Heteroptera found in the study. Unlike most of the beetles and dipterans, *Pelocoris* and *Mesovelia* were present in the lowest numbers during the coldest months of the year.

Mollusca

There were only two molluscan taxa found in the study. One of these, a hydrobiid snail, was found on only one occasion, and only one individual was found. Freshwater limpets (Ancylidae) were quite common in the later months of the study, however, ranging from only 4 in December to almost 200 in March. It is likely that the paucity of mollusk taxa and individuals is due to the characteristic low pH of the wetland (mean 5.77 during the study period), which is not conducive to shell growth.

Odonates

Dragonflies and damselflies were a common and diverse group in this study. Thirty-six different taxa were found, accounting for 3261 individuals. Of this number, there were 2581 dragonfly larvae (22 taxa) and 680 damselfly larvae (14 taxa). Among the Anisoptera, there were 11 different genera, but only 4 zygopteran genera were collected. Most of the dragonflies were members of the family Libellulidae (including subfamilies Libellulinae and Corduliinae), although 2 genera within the Aeshnidae and 1 within the Gomphidae were also represented. Three of the 4 damselfly genera were members of the family Coenagrionidae. At least one species of *Lestes* Leach (Lestidae) was also present.

The most abundant odonate was *Erythemis simplicicollis*, with 1011 individuals identified (4.5% of all macroinvertebrates identified in the study). This dragonfly larva, which was common throughout the year, was very strongly associated with *Utricularia* (see Figure 7), but was normally collected in all of the other macrophyte habitats sampled as well. Adults of this species were commonly noted during the warmer months of the year, but were rare or absent from November through March. Nymphs, however, were most common during those same months.

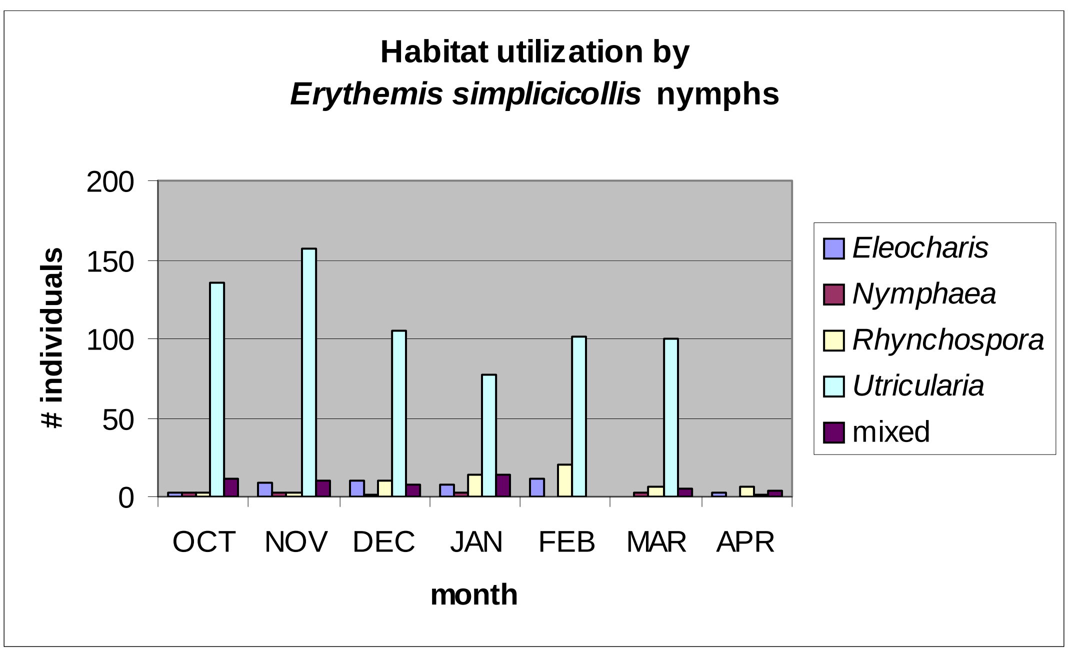


Figure 7. Macrophyte habitat utilization by *Erythemis simplicicollis* nymphs.
(Note: Dipnet sweeps were not kept separate until October. Thus, no specific habitat data is available for the period May through September 2000.)

Pachydiplax longipennis was also quite common in the samples, with 513 individuals noted. Unlike *Erythemis simplicicollis*, *P. longipennis* did not show any particular preference for *Utricularia*, but was found in all of the various aquatic plant habitats, showing no consistent pattern of habitat affinity or of seasonal abundance. Adults of this species were commonly noted in all but the coldest months of the year. Both *P. longipennis* and *E. simplicicollis*, however, are known to fly throughout the year in Florida (Needham *et al.* 2000).

The third most common dragonfly nymph identified was *Erythrodiplax minuscula* (Rambur). One hundred ninety of these small larvae were found. They occurred in each of the various habitats sampled, and in most months of the year. The larvae showed no particular seasonal pattern of abundance. The adults, however, were not observed during December and January, although Needham *et al.* (2000) listed these as year-round fliers in Florida, as well.

More than 70% of all the zygopterans identified were members of the genus *Ischnura*. Many of the individuals were too immature or damaged to identify to species, but at least 4 species (*Ischnura hastata* (Say), *I. kellicotti* Williamson, *I. posita* (Hagen), and *I. ramburii* (Selys)) were identifiable. None showed a particular affinity for specific macrophyte habitat types, although Dunkle (1990) suggests that both adults and larvae of *Ischnura kellicotti* are normally limited to water lily habitats. *Ischnura* larvae were present in all months except March, and showed no overall pattern of seasonal abundance.
Five of the adults odonates observed flying at the wetland were not found in the larval state. These included *Anax junius* Drury (all *Anax* nymphs identified were *A. longipes* Hagen), *Erythemis vesciculosa* (Fabricius) (outside its normal range), the introduced *Orthemis ferruginea* (Fabricius), *Pantala flavescens* (Fabricius), and *Tramea* cf. *lacerata* Hagen. All but the first of these were seen on only one occasion. *Anax junius*, however, was commonly seen - often observed flying in tandem - but the larva of this species was not collected from Eastbrook Wetland during the study period.

OLIGOCHAETA

Although certain dipterans are identified above as being the most abundant macroinvertebrates enumerated in this study, in terms of actual abundance, they were far exceeded by naidid worms of the genus *Dero* Oken. As mentioned above, these were not specifically counted because of the impracticality of sorting out, mounting, and identifying such huge numbers of individuals. Most dipnet sweep samples easily contained several thousand individuals. Identification of representative subsamples of about 40 individuals from each sweep revealed that the large majority were members of the *Dero digitata* Müller complex (Milligan 1997). A small number (32 were counted during the entire study) were identified as *Dero flabelliger* (Stephenson). Most of the *Dero* collected were free-living, but a few were found in hyaline tubes that they secrete (Wetzel *et al.* 2006), and one was found inhabiting an empty *Oxyethira* caddisfly case.

Unlike the *Dero*, tubificid and lumbriculid worms were infrequently found in the samples. Two species of oligochaetes, *Spirosperma ferox* Eisen and *Pristina breviseta* Bourne, were found on only one occasion, and only one individual of each was found.

TRICHOPTERA

Caddisfly larvae were not a very diverse group in this study. Only five different taxa were identified, including three Hydroptilidae, one Polycentropodidae, and one Hydropsychidae.

Certainly the most abundant trichopterans found at the wetland were microcaddisflies of the genus *Oxyethira*. Identifications of late stage pupae (pharate adults) showed that there were at least two species present: *Oxyethira glasa* (Ross) and *O. zeronia* Ross. These microcaddisflies were common in most months, but both larvae and pupae were most abundant in March. Ultraviolet light trap samples were collected at Eastbrook Wetland on May 12, 2001 and March 22, 2002, in part to compare the adult caddisflies collected with what was found in the aquatic dipnet samples. Hydroptilids collected using this method included 3 species of *Oxyethira* (*O. glasa, O. janella* Denning, and *O. zeronia*) and two species of *Orthotrichia* Eaton (*O. aegerfasciella* (Chambers) and *O. curta* Kingsolver and Ross). Of these, *Oxyethira glasa* was by far the most abundant. (Complete light trap results are shown below in Table 4.)

Table 4. Ultraviolet light trap data - caddisflies - Eastbrook Wetland, 5/2001 and 3/2002.

family	Species	date	count
Hydropsychidae			
	Cheumatopsyche	5/12/2001	1F
Hydroptilidae			
	Orthotrichia aegerfasciella	5/12/2001	1
	Orthotrichia aegerfasciella	3/22/2002	1
	Orthotrichia curta	3/22/2002	38
	Oxyethira glasa	3/22/2002	235
	Oxyethira janella	3/22/2002	1
	Oxyethira zeronia	5/12/2001	1
	Oxyethira zeronia	3/22/2002	1
Leptoceridae			
	Nectopsyche tavara	3/22/2002	1M
	Oecetis inconspicua complex	5/12/2001	70M, 53F
	Oecetis inconspicua complex	3/22/2002	3M
	Oecetis osteni	5/12/2001	2M, 5F
	Oecetis osteni	3/22/2002	1M
Polycentropodidae			
	Cernotina truncona	3/22/2002	5M

The polycentropodid caddisfly *Cernotina* Ross was found in sweep samples within a very restricted time frame. In May, 22 specimens were identified. Only one was found in the next month, and no more were found throughout the study. The reason for the strong seasonality shown in *Cernotina* is not known, as Florida Department of Environmental Protection biologists have collected this taxon in many locations throughout the state during every month of the year (FDEP 2006). Perhaps a lack of availability of suitable habitats for construction of its silken tube retreats might be a factor.

Somewhat surprisingly, one larval specimen of the hydropsychid caddisfly *Cheumatopsyche* Wallengren was collected from *Eleocharis* in December. Hydropsychids are generally considered stream dwellers, and are not normally found in lentic systems. However, the light trap data in Table 4 shows that an adult female *Cheumatopsyche* was also collected at the wetland using a light trap in May 2001.

Despite the fact that numerous adult leptocerid caddisflies were subsequently collected at Eastbrook Wetland, none were found in the dipnet samples.

TROMBIDIFORMES

One of the macroinvertebrate groups most characteristic of freshwater marsh habitats is the water mites. This holds true for Eastbrook Wetland. Twenty-seven distinct water mite taxa were identified in this study, accounting for 1382 individuals, or 6.16% of all macroinvertebrates identified, and nearly 10% of all the different macroinvertebrate taxa. There were 9 different water mite families represented, including 12 different genera. The most abundant and speciose genus by far was *Arrenurus*, with 12 different species identified. Large numbers of different *Arrenurus* species inhabiting a single water body is not an uncommon occurrence (Smith and Cook 1991). In fact, Smit and Pesic (2006) note that *Arrenurus* is the most speciose genus of water mites worldwide. The most abundant of these in Eastbrook Wetland was *A. melemus*, with 407 individuals counted, ranking it 15th in abundance of all macroinvertebrate taxa found.

The 9 families of water mites collected are all known from temporary or permanent lentic systems, and all utilize adult Diptera, Trichoptera, Hemiptera, and Odonata as larval hosts (Smith and Cook 1991). Adults of each of these groups of insects are common at Eastbrook Wetland.

Because of their often-strong sexual dimorphism, many of the *Arrenurus* mites were enumerated by sex as well as species. In all cases, substantially more female mites were found than males. Overall, there were roughly 3 times as many female *Arrenurus* as there were male *Arrenurus*. This is consistent with the findings of Smith and Florentino (2004), who noted that there was a profound bias toward females in a population of *Arrenurus manubriator* Marshall from New York.

DISCUSSION

As previously noted, macroinvertebrate abundance and taxa richness varied widely between taxonomic groups. Of the four most abundant and diverse taxonomic groups seen in this study (Coleoptera, Diptera, Odonata, and Trombidiformes), many or all members are predators. Using the functional feeding groups outlined by Merritt and Cummins (1984), 175 of the taxa found in the present study (nearly 60%) are classified as predators. Based on numbers of individuals, nearly 70% of the invertebrates identified were predators. Similarly, Haugerud (2003) found that predators represented 33.3% (the largest fraction) of the macroinvertebrate taxa found in his study of seasonal floodplain wetlands along the Missouri River. Schneider and Frost (1996) found that predators showed greater diversity and abundance in long-duration water bodies (like Eastbrook Wetland) than in short-duration ones, and that they fed primarily on those species that were usually dominate in short-duration systems. At Eastbrook Wetland, the extremely abundant *Dero* oligochaetes likely serve as important food source for predators, along with members of other feeding guilds, as well as smaller predators.

Barren sediments have been shown to be very depauperate in terms of macroinvertebrate colonization (Beckett et al. 1992a, Beckett et al. 1992b). Aquatic plants, then, are essentially the only habitat type present in this wetland. Thus, substantial populations of gatherers and shredders (which directly use the plants or parts thereof for food) such as midges in the subfamily Chironominae, hydroptilid caddisflies, oligochaetes, and lepidopterans, are also to be expected. However, since Eastbrook Wetland is a non-flowing system, small populations of filterers like hydropsychid caddisflies and scrapers such as the mollusks and certain beetles would be anticipated. At Eastbrook Wetland, gathering collectors and shredders each accounted for about 17% of the taxa identified, and about 6% was made up of filtering collector and shredder taxa. When numbers of individuals are taken into account, gathering collectors and shredders accounted for 11% and 15%, respectively, of individuals, and the small remainder was made up of filtering collectors and scrapers.

The success of certain groups of macroinvertebrates at this and similar marsh wetlands is probably due to a combination of factors. As is typical for marsh systems, the dissolved oxygen level at Eastbrook Wetland is generally low. During the study period, the average value was 2.86 mg/L, with a minimum of 0.55 mg/L and a maximum of 6.53 mg/L. Consequently, those groups of macroinvertebrates which can utilize atmospheric air, or which require very little oxygen, have an advantage. Thus, air breathers like beetles and true bugs, and those that require very little oxygen, such as the water mites and many midges, are abundant. Also, due to the very dynamic patterns of inundation in these systems, organisms that have short life cycles tend to do well. Such is the case with many of the abundant odonate, dipterans, and hydroptilid caddisflies collected.

The strong preference shown by many of the wetland macroinvertebrates for *Utricularia* habitat is probably related to the more complex architecture of the plants themselves. Cheruvelil et al. (2002) noted that aquatic plants with a more complex overall physical structure often provide a better substrate for colonization by macroinvertebrates than simpler ones. Compared to the architecture of the other three types of macrophytes sampled, bladderwort offers a more physically diverse type of habitat. Structurally, a leaf of *Nymphaea* is little more than a single thin stem with a flat horizontal plate floating exposed near the surface, offering little refuge for most invertebrates. Clumps of *Eleocharis* have a simple architecture of numerous parallel stems lying in close proximity to one another. *Rhynchospora* has larger vertical stems in clumps surrounded by dead leaves at the base. The beds of *Utricularia* are similar to masses of complexly intertwined masses of thin green hairs (*U. gibba* Linnaeus) interspersed with occasional complex spindle-like formations (*U. purpurea* Walter). This arrangement provides excellent protection for macroinvertebrates (as sorters of these samples could testify!) and a diversity of surfaces for epiphytic attachment.

Central Florida experienced a record drought during the sampling period. After two years of lower than normal rainfall, the area received only 32.83 inches of rain in 2000, more than 18.5 inches less than the mean annual rainfall of 51.49 inches (Figure 8). During the specific period that the wetland was sampled (May 2000 through April 2001), a total of only 38.69 inches of precipitation fell on eastern Seminole County.

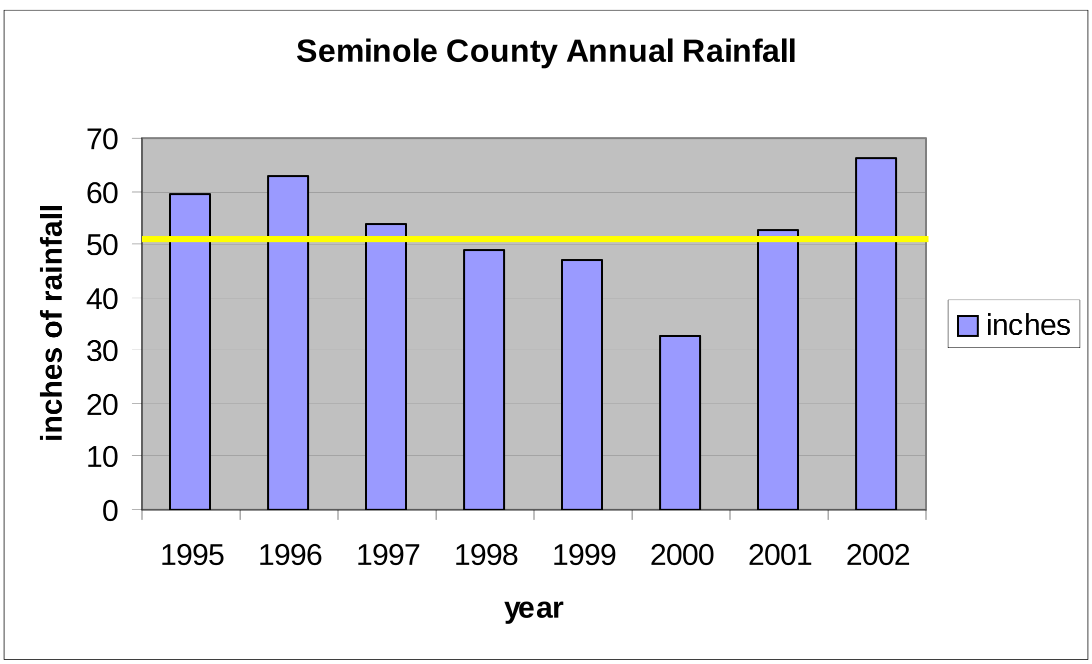
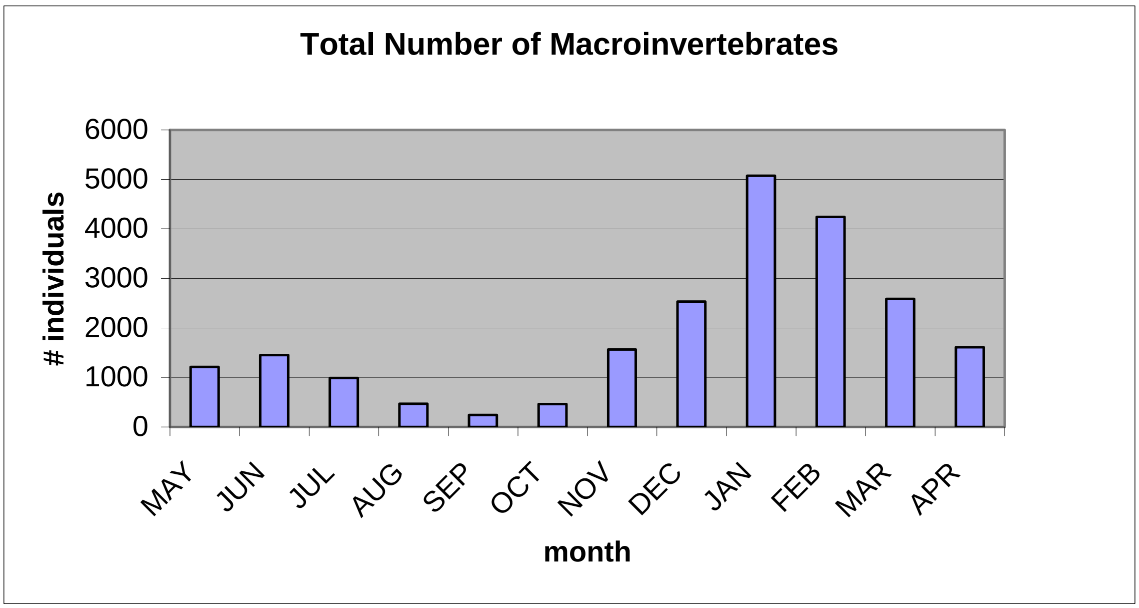
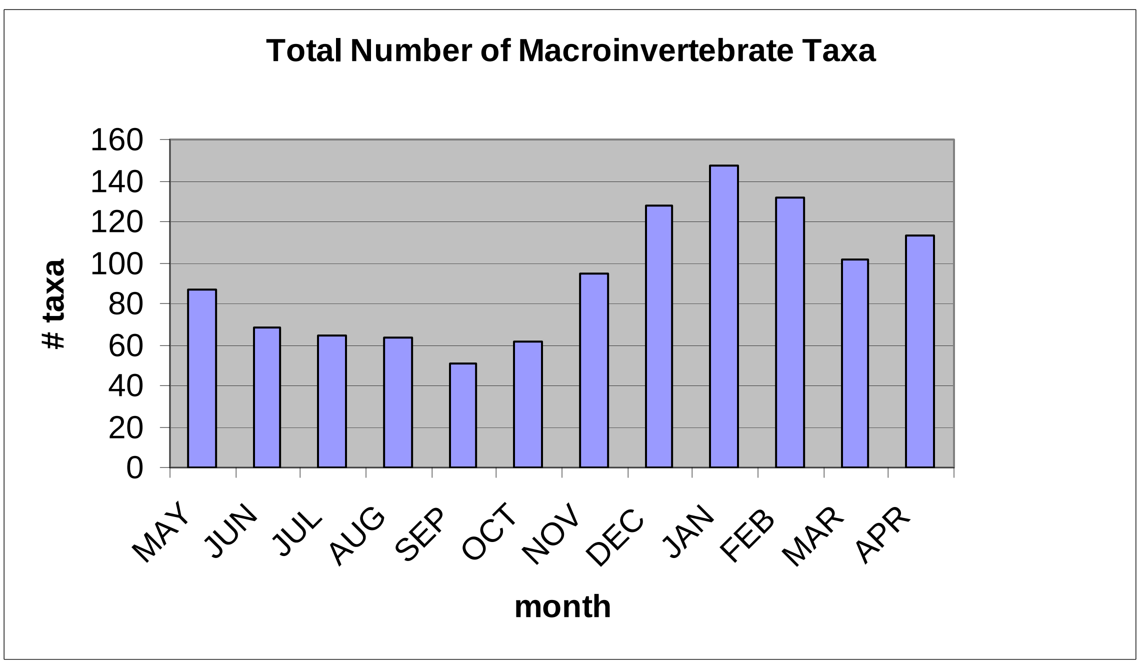


Figure 8. Annual rainfall measured at Sanford weather station, Sanford, FL. Average annual precipitation is 51.49 inches.

Consequently, the water level in Eastbrook Wetland receded steadily throughout the 12 months that sampling occurred. Occasional rains during the fall and early winter briefly brought the water level up somewhat, but beginning in January, the wetland began to dry up. By April, the inundated portion of the wetland was confined to a few mostly very shallow pools near the south end, and the dissolved oxygen level reached a low of 0.55 mg/L. Despite this, both abundance and taxa richness of macroinvertebrates did not appear to be affected. As shown below in Figures 9 and 10, the number of individual macroinvertebrates identified as well as the number of distinct taxa present appeared to follow a defined seasonal pattern. This suggests that the macroinvert-ebrates inhabiting marsh ponds like Eastbrook Wetland are well adapted to a very dynamic environment characterized by extremes of temperature, oxygen level, and inundation.





Summarily, this study paints a picture of a diverse and stable, yet very changeable, aquatic system characterized by seasonal patterns of abundance rooted in life cycle changes and cyclic environmental patterns. Aquatic plants (especially *Utricularia*) are the foundation of the system, providing habitat, as well as food (directly or indirectly) and oxygen for the animals inhabiting the wetland. The macroinvertebrate community is dominated by those groups best adapted to the harsh conditions of the marsh, most notably predatory water beetles, dipterans, and odonates, but also includes more transitory members like caddisflies and mayflies. As a typical and largely unimpacted depression marsh, the information gathered at Eastbrook Wetland should serve as an appropriate characterization of the biota of such systems, and will hopefully be helpful in the effort to protect these unique water bodies. Further study aimed at more clearly understanding the functional role of macroinvertebrates in marsh wetlands should be carried out in the future.

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Appendix 2. Water quality measurements – Eastbrook Wetland study.

Date	Time	Water temp.	Water temp.	pH	DO	Conductivity	Secchi
mm/dd/yyyy	24 hr	degrees C	degrees F	su	mg/L	µmhos/cm	m
5/26/2000	1424	37.17	98.91	6.71	5.41	103	>0.4
6/27/2000	934	26.53	79.75	6.00	2.36	200	>0.4
7/25/2000	849	25.71	78.28	5.27	1.08	112	>0.4
8/24/2000	900	26.28	79.30	5.10	1.08	175	>0.2
9/21/2000	730	25.54	77.97	5.05	1.81	231	>0.2
10/26/2000	820	20.76	69.37	4.60	1.68	184	>0.3
11/22/2000	1235	11.36	52.45	7.02	6.53	266	>0.3
12/20/2000	830	5.28	41.50	6.50	4.14	177	>0.1
1/23/2001	1345	14.75	58.55	6.21	4.79	152	>0.2
2/26/2001	1518	26.54	79.77	6.07	1.28	151	>0.3
3/31/2001	938	21.63	70.93	5.70	3.64	240	0.3
4/25/2001	820	20.61	69.10	4.97	0.55	266	>0.2

Appendix 3. Complete macroinvertebrate taxa list and monthly counts – Eastbrook Wetland study, May 2000 - April 2001.

		MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR
COLEOPTERA (overall diversity 3.35)													
Chrysomelidae													
	Chrysomelidae unid.	1											2
	Donacia sp.	1											
Curculionidae													
	Curculionidae unid.	3		1		1	4	1	1	1	5	5	2
Dryopidae													
	Pelonomus obscurus											1	
Dytiscidae													
	Anacaena suturalis (larva)								1				
	Anodocheilus exiguus	1							20	7	30	81	19
	Bidessonotus pulicarius			33	4					3	2	4	
	Bidessonotus inconspicuus											8	
	Bidessonotus longovalis								7	14	8	2	1
	Bidessonotus sp.										1		4
	Brachyvatus apicatus								1				2
	Celina angustata			1	1								1
	Celina contiger												1
	Celina slossoni												2
	Celina sp. (larva)	1	3	1		4		1	1	1	1	1	10
	Copelatus chevrolatus chevrolatus							1			1		
	Copelatus caelatipennis princeps					1	1				17	2	8
	Coptotomus interrogatus	2	10	24	7			3	1		1		
	Coptotomus venustus										1		
	Cybister fimbriolatus	1	1										
	Desmopachria sp.									1			2
	Dytiscidae larva												8
	Hydaticus bimarginatus							1			2		
	Hydrocolus sp.					4		2					

	Hydrovatus pustulatus										**1**		**7**
	Hydrovatus sp. (larva)					**1**							**2**
	Hygrotus margipennis							**2**					
	Hygrotus sp. (larva)							**2**	**1**				
	Laccodytes pumilio								**2**		**2**	**5**	**1**
	Laccophilus gentilis				**1**								
	Laccophilus proximus		**23**	**2**				**1**		**1**	**5**		**1**
	Liodessus (larva)										**1**		
	Neoporus sp.				**4**		**1**		**20**	**13**	**14**	**23**	**25**
	Neoporus sp. (larva)			**14**	**4**				**7**	**22**			
	Neoporus lobatus	**4**	**5**	**3**			**9**	**1**		**1**			
	Neoporus venustus								**1**				
	Thermonectus basillaris	**2**	**18**	**3**	**1**					**1**			
Gyrinidae													
	Gyrinus elevatus									**2**			
Haliplidae													
	Haliplus confluentus								**2**				
	Haliplus punctatus		**2**					**2**		**1**	**2**		**5**
	Peltodytes dietrichi								**4**				
	Peltodytes oppositus (adult)	**11**	**24**	**16**	**22**	**3**	**1**	**29**	**6**	**20**	**29**	**34**	**24**
	Peltodytes sp. (larva)									**3**			
Hydraenidae													
	Gymnochthebius fossatus									**1**	**5**		**8**
	Hydraena marginicollis			**1**	**1**				**8**	**2**	**9**	**2**	**1**
	Hydraena spangleri									**4**	**9**		
Hydrophilidae													
	Berosus aculeatus	**4**	**35**	**28**	**1**								
	Berosus corrini											**1**	
	Berosus exiguus				**18**	**3**						**1**	
	Berosus infuscatus	**2**	**265**	**150**	**3**	**3**		**4**	**3**		**5**	**7**	**2**
	Berosus ordinatus			**3**									
	Berosus peregrinus				**4**	**5**		**2**		**1**	**3**		**1**
	Berosus pugnax	**1**		**1**									

	Berosus sp. (larva)	**2**		**3**	**1**	**2**	**40**	**36**	**127**	**120**	**87**	**10**	**6**
	Cercyon sp. (larva)											**5**	
	Derallus altus									**1**			
	Enochrus blatchleyi									**1**			
	Enochrus concors									**1**			
	Enochrus consortus								**1**		**1**	**1**	
	Enochrus fimbriatus										**22**	**3**	
	Enochrus ochraceus			**1**					**3**	**4**	**21**	**3**	**4**
	Enochrus pygmaeus							**1**					
	Enochrus sublongus										**5**	**1**	
	Enochrus (larva)									**1**	**15**		**4**
	Helochares (larva)											**1**	
	Helocombus bifidus									**1**	**53**		**4**
	Hydrobiomorpha casta								**1**				
	Hydrobius sp. (larva)									**1**			
	Hydrochus minimus								**1**				
	Hydrochus rugosus				**3**				**1**	**19**	**15**	**9**	
	Hydrochus sp.	**1**	**1**	**8**	**3**				**7**	**8**	**65**	**22**	**10**
	Paracymus nr. confusus			**1**									
	Paracymus nanus			**2**	**1**								
	Phaenonotum minor										**1**	**1**	**31**
	Phaenonotum exstriatum										**7**		
	Phaenonotum sp. (larva)											**3**	**5**
	Sphaeridiinae						**1**			**1**			
	Tropisternus blatchleyi	**2**	**6**	**9**	**11**			**3**	**2**		**1**	**2**	**1**
	Tropisternus collaris		**1**	**8**	**1**				**3**				
	Tropisternus lateralis nimbatus	**13**	**78**	**35**	**4**			**1**	**3**	**3**	**4**	**3**	**6**
	Tropisternus natator	**5**	**3**	**4**	**1**			**1**	**4**	**1**		**3**	**2**
	Tropisternus sp. (larva)	**5**		**7**	**7**	**2**	**10**	**3**		**4**	**37**	**4**	**8**
Noteridae													
	Hydrocanthus oblongus	**6**	**4**	**5**	**2**	**2**				**8**	**4**	**18**	**1**
	Hydrocanthus regius					**2**			**1**	**1**	**5**	**3**	
	Hydrocanthus sp. (larva)	**1**	**3**				**3**						

	Notomicrus sp.		2										
	Suphis inflatus			1		1					1		
	Suphisellus bicolor								2	2			
	Suphisellus gibbulus		21	19					10	36	24	120	15
	Suphisellus insularis					2				1			
	Suphisellus parsoni					5					6		
	Suphisellus puncticollis					3					1		8
	Suphisellus sp. (larva)			1		3			1			1	11
Scirtidae													
	Cyphon sp. (larva)									2	16		
	Scirtes/Ora (larva)									1	14	6	
Staphylindae													
	unid.									5	5	2	
COLLEMBOLA (overall diversity 0)													
	Collembola unid.	1				1			8	1	15		7
CRUSTACEA (overall diversity 0.94)													
Amphipoda													
	Hyalella azteca									1			
Cladocera													
	Cladocera unid.	1		1		1	17	13	73			2	
Copepoda													
	Copepoda unid.						2	6	13	2	4		
Decapoda													
	Procambarus sp.	8			1	3	3	10	4	5	2	1	
DIPTERA (overall diversity 2.80)													
Ceratopogonidae													
	Ceratopogoninae larvae unid.	5	3	20	1	15	1	33	127	1292	486	493	76
	Ceratopogonidae pupae unid.									16	52	81	12
	Ceratopogonidae type c11 Rutter							16					

	Atrichopogon sp.										1	7	
	Dasyhelea sp.	1											
Chaoboridae													
	Chaoborus "albatus-type"	5	3					1		1			
	Chaoborus punctipennis							2					
	Chaoborus sp.				1								
Chironomidae													
	Ablabesmyia aspera									5			
	Ablabesmyia mallochi								10	10	1		
	Ablabesmyia peleensis	4	3	5			4	41	129	302	475	187	113
	Ablabesmyia rhamphe group	20					4	17	118	53	32		
	Ablabesmyia (Karelia) sp.	30			22	9			9				
	Chironomidae pupa unid.			7			5	4	6	30	51	10	14
	Chironominae unid.					1	1	8	6	5		1	1
	Chironomini genus III	6						17					
	Chironomus sp.	236	66				2	8	105	460	145	7	83
	Chironomus sp."florida" (Epler)	2											
	Cladopelma sp.	17	11	2	5			24	13	36	58		1
	Cladotanytarsus sp.	11	1						1	1			
	Clinotanypus sp.			2					1				
	Cryptotendipes						2	1	1	2			
	Dicrotendipes thanatogratus									6			
	Dicrotendipes sp.				5		1	3	3	3	1		1
	Glyptotendipes sp.							1	4	8	9	4	13
	Goeldichironomus holoprasinus								12	6	1		2
	Goeldichironomus cf. natans											6	
	Guttepelopia guttipennis	2	6	22	4	11	3	78	249	386	338	177	299
	Hyporhygma quadripunctatum	2	1							1			
	Labrundinia neopilosella	24			1				4	2			
	Labrundinia sp.	35					4	11	8	1	1		
	Larsia berneri	28		4	12	11	14	3	59	159	458	140	32
	Larsia decolorata	7								11		13	3
	Larsia sp.						4	1	12		9		

	Micropsectra sp.		**1**										
	Monopelopia boliekae									**1**			
	Nanocladius sp.									**5**			
	Natarsia sp. A	**1**											
	Orthocladiinae												**1**
	Orthocladius sp.								**1**		**1**		
	Parachironomus alatus	**3**						**27**	**24**	**62**	**10**	**5**	**6**
	Parachironomus chaetoalus complex					**1**	**3**	**5**	**2**			**3**	**11**
	Parachironomus hirtalatus	**13**	**3**										
	Parachironomus sp.								**14**	**4**			
	Parakiefferiella sp.								**1**				
	Paratanytarsus dissimilis								**1**				
	Paratendipes subaequalis							**207**	**79**	**140**	**2**	**34**	
	Polypedilum (Asheum) beckae				**4**								
	Polypedilum fallax group						**8**		**83**	**74**	**76**		**1**
	Polypedilum flavum							**1**		**7**	**5**	**2**	**1**
	Polypedilum halterale group				**1**				**1**	**2**	**1**		
	Polypedilum illinoense group	**2**	**3**		**2**		**1**	**6**	**61**	**31**	**79**	**46**	**26**
	Polypedilum laetum									**3**	**4**		**1**
	Polypedilum trigonus						**4**	**2**	**25**	**67**	**17**	**11**	**6**
	Polypedilum tritum	**3**				**1**			**44**	**33**	**127**	**29**	**2**
	Polypedilum sp. A (Epler)			**2**				**4**	**32**	**43**	**17**	**20**	**20**
	Polypedilum sp.				**2**	**2**	**1**	**1**	**3**		**1**	**1**	
	Procladius sp.	**301**	**545**	**15**	**5**	**2**	**4**	**43**	**61**	**55**	**17**	**1**	**7**
	Psectrocladius (Monopsectrocladius) sp.									**2**	**19**	**11**	**11**
	Pseudochironomus sp.			**1**					**1**	**2**		**2**	**24**
	Tanypodinae						**1**	**1**	**1**	**4**			
	Tanypus sp.				**2**			**1**	**11**				
	Tanypus carinatus						**1**	**51**	**28**	**80**	**14**		**5**
	Tanypus punctipennis							**17**					**1**
	Tanypus stellatus								**2**				
	Tanytarsus sp.	**3**	**5**		**2**		**40**	**306**	**199**	**471**	**59**	**20**	**35**
	Tanytarsus sp. C (Epler)	**4**											

	Tanytarsus sp. D (Epler)	1											
	Tanytarsus sp. F. (Epler) -- distinct									1		1	
	Tanytarsus sp. G (Epler)		2	1									
	Tanytarsus sp. P (Epler)	1											
	Tribelos fuscicorne							2					
	Zavreliella marmorata	11	25	1				1		3	3	1	
Dolichopodidae													
	unid.										1	17	1
Empididae													1
	unid.									4			
Ephydridae													
	unid. Larva									4	1		
	Hydrellia sp. (?) - pupae						2				2		
Tabanidae													
	Chrysops sp.		1		2		1	1		3			
	Tabanidae unid.								1		1	1	1
	Tabanus sp.							1					1
Tipulidae													
	unid. (Pilaria?)										1	6	
unidentified Diptera									1	1	1		
EPHEMEROPTERA (overall diversity 0.66)													
Caenidae													
	Caenis diminuta	68	31	9	1		2	7	43	35	5	2	1
Baetidae													
	Callibaetis pretiosus				7		2						
	Callibaetis sp.						2	15	9	18	5		9
HEMIPTERA (HETEROPTERA) (overall diversity 1.80)													
	Belostoma lutarium	1									1		
	Hydrometra australis				1						1		
	Lethocerus uhleri				1			1					
	Lethocerus sp. (nymph)				1								

	Mesovelia mulsanti	**3**	**1**	**1**	**3**			**2**	**5**	**4**	**28**	**6**	**6**
	Mesovelia cryptophila			**1**									
	Neogerris hesione	**1**											
	Neoplea sp.									**1**			
	Paraplea sp.								**1**				
	Pelocoris carolinensis	**22**	**18**	**21**	**7**	**7**	**4**	**3**	**1**	**9**	**5**	**16**	
	Ranatra australis	**2**							**1**	**1**	**2**		**1**
	Ranatra kirkaldyi	**1**	**1**	**3**						**5**		**1**	
	Ranatra nigra		**1**							**1**			
	Ranatra sp.							**1**		**1**			
	Rheumobates sp.						**1**						
	Sigara bradleyi	**11**	**4**	**5**									
	Sigara sp.					**1**			**1**				
	Trepobates sp.							**2**					
	Trichorixa louisianae												**1**
	unidentified very young									**6**			
	terrestrial forms						**3**		**4**				**4**
LEPIDOPTERA (overall diversity 0.88)													
	Lepidoptera unid.					**1**		**1**	**27**	**12**	**8**	**1**	**6**
Pyralidae													
	Paraponyx sp.	**6**		**3**		**1**	**6**	**38**	**2**	**1**		**1**	**1**
	Neargyractis slossonalis								**1**				
	Petrophila sp.								**1**				
	Synclita obliteralis								**3**				
MOLLUSCA (overall diversity 0.015)													
Gastropoda													
	Ancylidae								**4**	**15**	**128**	**199**	**116**
	Hydrobiidae									**1**			

ODONATA (overall diversity 2.34)													
Anisoptera													
	Aeshnidae unid.			2									
	Anax longipes				2	2		6		5			
	Anax sp.						1						
	Arigomphus pallidus		1										
	Celithemis amanda	35	3										
	Celithemis elisa									1	1	1	
	Celithemis eponina			2						1			
	Celithemis fasciata	7	7	1									
	Celithemis ornata		11										
	Celithemis sp.									1			
	Coryphaeschna adnexa			2	3		1						
	Coryphaeschna ingens							1					
	Epitheca princeps regina	4	25										
	Epitheca sepia					1							
	Erythemis simplicicollis	8	7	34	59	57	155	181	134	115	133	114	14
	Erythrodiplax minuscula		1		11		5	5	68		69	21	10
	Erythrodiplax umbrata								5	12	1		3
	Ladona (=Libellula exusta) deplanata	13	9	2	6	2		1	1				
	Libellula auripennis					1		6	3	6	3	1	1
	Libellula axilena		1										
	Libellula incesta					1		13	9	17	2		
	Libellula sp.				45	5	1		2	8		1	
	Libellulidae unid. (tiny)	9		28	21				61	93	146	11	106
	Pachydiplax longipennis	16	15	10	19	28	4	56	76	147	70	32	40
	Tramea carolina	5		8	26	11	13	11	7		2		1
Zygoptera													
	Coenagrionidae									56		1	
	Enallagma concisum	2						8	2				
	Enallagma doubledayi	11											
	Enallagma dubium				4								
	Enallagma pollutum		5				11	5	8	1	1	2	

	Enallagma sp.			1		3	1	8	19	9	12	2	
	Ischnura hastata	7			5		3		2	34	23		
	Ischnura kellicotti	1	5	7	1			15					
	Ischnura posita								3	2	2		
	Ischnura ramburii		3		5	2	5	6	3				5
	Ischnura sp.				7	1	10	22	49	27	158	41	34
	Lestes sp.						1		1	1			
	Lestes vigilax							10	3				
	Nehallenia integricollis									2			2
OLIGOCHAETA													
Naididae													
	Dero trifida (Dero digitata complex)	TNTC	TNTC	TNTC	TNTC	TNTC	TNTC	4	TNTC	TNTC	TNTC	6	2
	Dero flabelliger								2		23	2	5
	Pristina breviseta										1		
Tubificidae													
	Spirosperma ferox											1	
	Tubificidae unid.with hair setae	2	7					17	10				
	Tubificidae unid.without hair setae	2		1		1		6	1	4			1
Lumbriculidae													
	Lumbriculidae unid.									3	1	1	
	Eclipidrilus palustris					3				20	10	11	2
TRICHOPTERA (overall diversity 0.88)													
Hydropsychidae													
	Cheumatopsyche sp.								1				
Hydroptilidae													
	Orthotrichia sp.	1						2	1	4	2		
	Oxyethira sp. (larva)	19					18	26	9	43	90	3	1
	Oxyethira sp. (pupae)	54		8	3	2	6	3	10	6	21		3
Polycentropodidae													
	Cernotina sp.	21	1										

TROMBIDIFORMES2 (overall diversity 2.35)													
	unid. larva	1											
	Oribatei unid.	1								37	1	298	19
	Arrenurus c.f. pandarus		11							1			1
	Arrenurus cf. facetopsis									1			
	Arrenurus cf. rumulus male			1							7		1
	Arrenurus facetus female			5						5	8	2	1
	Arrenurus facetus male			1							1	2	7
	Arrenurus manateensis												1
	Arrenurus melemus female	5	54	112	23		3	7	4	8	15	2	37
	Arrenurus melemus male	1	19	64	22			2	5	1	9	2	12
	Arrenurus newelli									1			1
	Arrenurus odatus female			18									
	Arrenurus odatus male			4									
	Arrenurus cf. pandarus female		10										
	Arrenurus cf. pandarus male		1										
	Arrenurus parasuperior				1								
	Arrenurus problecornis female		2	29	1		1		1	2	5	11	6
	Arrenurus problecornis male			43	1					3			4
	Arrenurus sp. (females)		1	36	6	3	2	2	10	32	62	18	49
	Arrenurus sp. (males)											6	2
	Arrenurus sp. (nymphs)											2	15
	Arrenurus ziseri								1				
	Arrenurus zorus									1	2		
	Frontipoda sp.												
	Hydrodroma sp.	2							1	4	1	3	
	Hydryphantes sp.	1											
	Koenikea (s.s.) angulata	1								5			
	Koenikea sp.			16	1			2	4	4	10	16	2
	Limnesia (s.s.) sp.	7	4	20						1		1	
	Mideopsis sp.			1									
	Neumania (Tetraneumania) distincta	1	3	9						7	1		
	Oxus sp.		2	11	1				7	2	1	2	2

	Piona sp.				**1**					**1**	**1**	**2**	**1**
	Unionicola sp.	**2**	**3**										
TURBELLARIA (overall diversity 0)													
	unid.											**8**	
	TOTAL INDIVIDUALS	**1211**	**1451**	**987**	**472**	**238**	**464**	**1567**	**2530**	**5072**	**4240**	**2590**	**1610**
	TOTAL TAXA	**87**	**68**	**64**	**63**	**51**	**105**	**181**	**245**	**288**	**260**	**184**	**210**