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St. Johns River Water Management District

Aquatic Community, Hydrologic, and Water-Quality Data for Apopka, Bugg, Rock, and Wekiva Springs, Central Florida, 1931-2006

By Stephen J. Walsh and Sharon E. Kroening

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Conversion Factors

Multiply	By	To obtain
Length		
inch (in.)	2.54	centimeter (cm)
inch (in.)	25.4	millimeter (mm)
foot (ft)	0.3048	meter (m)
mile (mi)	1.609	kilometer (km)
Area		
square inch (in^2)	6.452	square centimeter (cm^2)
square foot (ft^2)	0.0929	square meter (m^2)
square mile (mi^2)	259.0	hectare (ha)
square mile (mi^2)	2.590	square kilometer (km^2)
Flow rate		
cubic foot per second (ft^3/s)	0.02832	cubic meter per second (m^3/s)
million gallons per day (Mgal/d)	0.04381	cubic meter per second (m^3/s)

Temperature in degrees Celsius (°C) may be converted to degrees Fahrenheit (°F) as follows:
°F=(1.8×°C)+32
Temperature in degrees Fahrenheit (°F) may be converted to degrees Celsius (°C) as follows:
°C=(°F-32)/1.8

Acronymns and Abbreviations

LPIL	lowest practicable identification level
µm	micron
MFL's	minimum flows and levels
mm	millimeter
SCI	stream condition index
SJRWMD	St. Johns River Water Management District
USGS	U.S. Geological Survey
WAR	Water and Air Research

Aquatic Community, Hydrologic, and Water Quality Data for Apopka, Bugg, Rock, and Wekiva Springs, Central Florida, 1931-2006

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Abstract

This report summarizes aquatic community, hydrologic, and water-quality data collected or compiled by the U.S. Geological Survey (USGS) for Apopka, Bugg, Rock, and Wekiva springs from October 1, 2005 to September 30, 2006. Aquatic community data are summarized for quarterly collections of benthic macroinvertebrates, and fishes collected during one sampling event per spring. Hydrologic data for each spring were compiled from the USGS, St. Johns River Water Management District, and a private landowner. Water-quality data collected by the USGS consisted of quarterly physicochemical, chlorophyll-*a*, and pheophytin-*a* measurements; water-quality data were collected on the same days that benthic macroinvertebrates were sampled.

Introduction

Florida's springs and spring runs are renowned for their intrinsic beauty, importance as ground-water resources, and their cultural, recreational, and ecological significance (Rosenau and others 1977; Scott and others 2002, 2004). Threats to springs, in particular declining flow rates and increased nutrient and contaminant concentrations, have escalated over time as the human population of Florida expands and land-use patterns change. All of the ground water that discharges from the springs comes from the Floridan aquifer system that is the main source of water supply in central Florida. Projections by water managers of the St. Johns River Water Management District (SJRWMD) and ground-water flow models developed by the SJRWMD and U.S. Geological Survey (USGS) indicate that increased pumping of ground water likely will result in decreased discharge from many of Florida's springs. Nitrate concentrations have increased in many springs in central Florida over time (Spechler and Halford 2001; Phelps and others 2006), and pesticides and other organic compounds used by humans have been detected in the spring water (Phelps and others 2006). The ecological effects of decreased discharge and the presence of nutrients and contaminants are largely unknown because the aquatic ecosystems of many of the springs have received little study.

This study was initiated to provide baseline data on the hydrology, water quality, and benthic macroinvertebrate and fish communities of selected springs in the SJRWMD. The primary objective of this study is to compile and collect comparative data that may be of value in evaluating interactions of flow, water quality, and ecological conditions, especially as they relate to the establishment and/or assessment of Minimum Flows and Levels (MFL's). The study was initiated in 2004 with the collection of physicochemical and biological data for De Leon, Gemini, Green, and Silver springs; results of those data-collection efforts were summarized by Phelps and others (2006). In 2006, data on physicochemical parameters, benthic macroinvertebrates, fishes, and chlorophyll-*a* and pheophytin-*a* concentrations were collected for Apopka, Bugg, Rock, and Wekiva Springs.

Purpose and Scope

This report summarizes data on aquatic communities (benthic macroinvertebrates and fishes) and water quality collected by the USGS at Apopka, Bugg, Rock, and Wekiva Springs from October 1, 2005 to September 30, 2006. Hydrologic data were compiled for these springs from the USGS, SJRWMD, and a private landowner. This report is not intended to provide detailed analysis or interpretation of results; a more in-depth synopsis and scientific review is planned for a final project report (2008) that will summarize data for all springs included in the study.

Description of the Study Area

Apopka, Bugg, Rock, and Wekiva springs are located in Lake County and northwest Orange County, Florida (fig. 1). Water from these springs discharges from the Floridan aquifer system. The climate in this area is subtropical and is characterized by warm, humid, rainy summers and temperate dry winters. The average annual rainfall in the study area is about 50 inches that primarily falls from June through September. Springs are classified on the basis of the amount of water which discharges from them. A second magnitude spring discharges from 10 to 100 cubic feet per second (6.5 to 65 million gallons per day).

Apopka Spring is a second magnitude spring (median discharge: 27 ft^3/s) located at the southwest corner of Lake Apopka in an area referred to as the Gourd Neck, a narrow arm of Lake Apopka that curves northwesterly from the main body of the lake. The spring is accessible only by boat. The spring discharges from a bowl-shaped depression about 5 to 6 feet in diameter, and the vent opening is about 45 feet below the water surface of the lake. The spring emerges from an underground cave system; the vent opening narrows vertically downward into the limestone for 16 feet, and then it slopes northward at about 45° to a depth of 90 feet as determined by cave divers.

Bugg Spring is a second magnitude spring (median discharge: 12 ft^3/s) located about 0.4 miles northwest of Okahumpka on private property and is not accessible to the public. The spring is leased to the U.S. Naval Research Laboratory for underwater calibration of sonar systems. The spring has a deep, circular pool about 400 feet in diameter. Water discharges from a cave at the bottom of the spring pool at a depth of approximately 170 feet. The limestone walls of the spring pool are almost vertical and also reach a depth of about 170 feet on all sides except the western shoreline. No boil is evident on the pool surface due to the substantial depth of the spring vent. The discharge from Bugg Spring flows into a spring run that flows into Lake Denham.

Rock Springs is a second magnitude spring (median discharge: 58 ft^3/s) located in a county park approximately 6 miles north of Apopka. Spring water discharges from two partly submerged caves at the base of a 20-foot-high limestone and sand bluff. In contrast to most large springs in peninsular Florida, Rock Springs has no well-defined spring pool. Clear, blue water discharges from the caves with considerable velocity, which results in the initial part of the spring run being characterized by eroded limestone. Rock ledges jut out from the banks of the run for about 100 feet below the cavern opening. About 10 feet downstream from the cavern opening, additional water is discharged through a submerged opening in the channel bottom. Several hundred feet downstream of the spring cavern, part of the springflow is diverted from the spring run to a large swimming area mostly surrounded by concrete retaining walls. Overflow from the swimming area rejoins the run after passing through a concrete weir. Rock Springs and Rock Springs Run are within the boundaries of the Wekiva River Aquatic Preserve.

Wekiva Springs is a second magnitude spring (median discharge: 68 ft^3/s) located about 4 miles northeast of Apopka. Wekiva Springs is also commonly referred to as Wekiwa Spring or Wekiwa Springs. Wekiva Springs is used herein in accordance with the Geographic Names Information System, U.S. Board on Geographic Names (*http://geonames.usgs.gov/domestic/index.html*). The spring pool and run are located within Wekiwa Springs State Park. Two areas of discharge in Wekiva Springs produce surface boils near the edge in the southeast half of the pool. The strongest boil is over a large irregular-shaped vent about 35 feet long by 5 feet wide in the limestone bottom about 15 feet below the surface. The other boil is above a rock ledge in the extreme southeast edge of the pool. Except for the limestone rock bottom in the southeast part of the pool, the pool bottom is mostly sand. The spring pool is kidney-shaped, about 200 feet long and 100 feet wide, elongated southeast. A sidewalk surrounds the pool and a wooden footbridge crosses the run immediately downstream of the pool. A 2 to 3-foot high retaining wall encloses the pool and extends a short distance down the run. The clear, bluish-green water flows northeasterly in a spring run that joins Rock Springs Run. The combined discharge from Rock and Wekiva springs forms the headwaters of the Wekiva River, a National Wild and Scenic River (Kroening 2004) and designated an Outstanding Florida Water by the Florida Department of Environmental Protection.

Methods

The following sections describe the methods used to compile and collect the discharge, water-chemistry, and aquatic community data from the four springs.

Hydrologic Data Compilation

Periodic discharge data from each of the four springs were compiled from databases maintained by the USGS, SJRWMD, and a private citizen. Daily-mean discharge data from Wekiva Springs were compiled from the SJRWMD database. The longest period of record of data was available for Rock and Wekiva springs. At these two springs, data collection began in the 1930's, although most of the data were collected after 1970. Continuous monitoring of the discharge from Wekiva Springs was done by the SJRWMD since 2003. The period of record of data from Apopka and Bugg springs was shorter compared to Rock and Wekiva springs. Discharge measurements from Apopka Spring began in 1971, although most of the data were collected after 1990. Weekly measurements of discharge from Bugg Spring have been made since 1990.

Water-Chemistry Data Collection and Analysis

Basic physicochemical data (water temperature, specific conductance, pH, dissolved oxygen concentration, and turbidity) were collected with a YSI 6920™, YSI 600R™, or Hydrolab Quanta™ submersible water-quality monitoring sonde, calibrated according to standard USGS protocol (U.S. Geological Survey 1997-2006) each day that measurements were made. Grab samples for chlorophyll-*a* and pheophytin-*a* analyses were collected quarterly from near the center of the Wekiva Springs and Bugg Spring runs immediately downstream of the vents. Water samples for chlorophyll-*a* and pheophytin-*a* analyses from Apopka Spring and Rock Springs Run were collected in the vicinity of the spring pool and swimming area, respectively. Samples were collected on 47 mm glass-fiber filters, wrapped in aluminum foil to prevent exposure to light, and kept frozen until analysis. Chlorophyll-*a* and pheophytin-*a* concentrations were determined by fluorescence at the USGS National Water-Quality Laboratory in Denver, Colorado according to Arar and Collins (1997).

Aquatic Community Data Collection and Analysis

Benthic macroinvertebrates were collected with a D-frame dip net (500 µm mesh, 0.3 m width) and Wildco™ petite ponar dredge. Sampling at Apopka Spring was limited to petite ponar dredge. Dip net sampling was based on a multihabitat approach as described by Barbour and others (1999); collections were made with this method to determine richness and diversity metrics and to calculate the Stream Condition Index (SCI: Barbour and others 1996b; Fore 2004; see below). Collections made with the petite ponar dredge were done to estimate abundance (density as organisms per square meter). Dip net collections and those using the petite ponar dredge followed standard operating procedures by the Florida Department of

Environmental Protection (FDEP 2004). Sampling was done downstream of main spring vents in those systems with a prominent spring run (Bugg, Rock, and Wekiva) or in close proximity to the boil (Apopka), in areas inferred to provide suitable conditions and habitats to support benthic macroinvertebrate communities based on substrate and prior studies (e.g., Barbour and others 1999). A dip net sample consisted of 20 sweeps taken from leaf packs, aquatic macrophytes (submersed and emergent), roots or undercut banks, sediment (muck or sand), rock, and woody snag habitats in proportion to the approximate percent coverage of each habitat type estimated visually. Each sweep consisted of collecting a 0.5 m section of substrate by scraping or jabbing the dip net, or the substrate was agitated manually or brushed in a manner to allow benthic macroinvertebrates and organic matter to flow into the net held stationary downstream. Material was rinsed through a series of sieves to remove coarse debris, vegetation, detritus and sediment. At each site and on individual sampling dates three replicate samples were taken with the petite ponar dredge. Rinsed dip net samples and the entire contents of each ponar grab (including substrate and benthic macroinvertebrates) were preserved in a 10 percent solution of formalin containing Rose Bengal dye.

Freshly preserved samples were transferred to the USGS laboratory in Gainesville, Florida, soaked and rinsed in water for 24-48 hours (following a fixation period of at least 2 days), and placed in a solution of 70 percent ethanol. Samples were delivered to Water and Air Research, Inc. (WAR) for identification and enumeration. Subsampling procedures were applied to randomly select a minimum target number of 100-110 organisms per collection (Florida Department of Environmental Protection 2004). Taxonomic identifications were made to the lowest practicable identification level (LPIL). A voucher collection of representative taxa is maintained by WAR.

Standard community metrics for benthic macroinvertebrates were calculated using proprietary statistical software (“Warstat”), PRIMER™ (version 6.1.6; Clarke and Warwick 2001; Clarke and Gorley 2006), and PC-ORD™ (version 5.0; McCune and Grace 2002; McCune and Mefford 2006). For individual dip net samples, data were collapsed for those organisms not identified to species level by apportioning their numbers to the next higher LPIL of similar taxa (for example, known genera or species) that were represented in the sample. Data from ponar samples were pooled for each set of replicates taken at an individual spring on the same date.

The Stream Condition Index (SCI) is a multimetric index used to evaluate the relative condition of water quality in a water body based on characteristics of the benthic invertebrate community (Barbour and others 1996a, b). It is a summation of macroinvertebrate metrics that are responsive to environmental disturbance. The SCI has been slightly modified since established and currently includes the following core metrics: taxonomic richness; numbers of Ephemeroptera, Trichoptera, Tanytarsini, clinger taxa, long-lived taxa, sensitive taxa; and, percentages of filter feeders, dominant taxa, and very tolerant taxa (Fore 2004). The index is calibrated for ecoregions of

Florida and is normalized to a scale of 0 to 100 by multiplication by 0.9. Values for scores based on a single sample are: "good"=73-100; "fair"=46-73; "poor"=19-46; "very poor"=0-19. Details on the calculation of the SCI are provided in Florida Department of Environmental Protection Standard Operating Procedure LT7200, Stream Condition Index Determination (available online at: *http://www.dep.state.fl.us/labs/qa/sops.htm*).

The Shannon diversity index, *H*' (Shannon 1948), was calculated as:

$$H' = \frac{n \log n - \sum_{i=1}^{k} f_i \log f_i}{n}$$

where k is the number of categories, f_i is the number of observations in category i, and n is sample size. For tabular purposes, *H*' was calculated using both logarithmic bases 10 and 2. The magnitude of *H*' is affected by distribution of data and number of categories; thus, the maximum possible diversity for a set of data consisting of k categories is:

$$H'_{\max} = \log k$$

Evenness (Pielou1966) was calculated as:

$$J' = \frac{H'}{H'_{\max}}$$

The measure *J*' is unaffected by change in logarithmic base. Calculation of *H*' using logarithmic base 2 was used for graphical presentation. Multiplication factors for converting among diversity measures using different logarithmic bases are provided in Zar (1999; table 4.1).

Fishes were collected using an electroshocking boat equipped with a Smith-Root™ GPP 9.0 controller. Frequency and voltage settings on the controller were adjusted in the range of 60-120 Hz and 100-680 volts to produce about 2-14 amps. Two netters at the front of the boat retrieved fish with dip nets and placed them in a live well. Large fish were identified, measured (total length, TL, in mm), and released near the site of capture. Small fish (less than about 75 mm) were fixed in a 10 percent formalin solution and returned to the laboratory for identification and enumeration. Accessibility was limited in Bugg and Rock springs to the extent that electrofishing was conducted in downstream reaches of each spring run (downstream of the U.S. Navy fence at Bugg Spring, and downstream of the county park in Rock Springs Run). Voucher specimens of representative fishes were deposited at the Florida Museum of Natural History in Gainesville, Florida.

Acknowledgments

Dr. Joseph and Margaret Branham provided access and canoes to sample at Bugg Spring and generously contributed considerable historical information about the spring. Mr. Joseph A. Rotarius assisted with transporting equipment and personnel in Kelly Park (Rock Spring), and provided access to private residences in the downstream section of the spring run and assisted with electrofishing efforts. Mr. Dane Huge and Mr. J. Travis Smith assisted with electrofishing at all of the springs. Mr. Douglas A. Strom and Ms. Laura Linne provided expertise with taxonomic identification of invertebrates and data summation and analysis. Ms. Christine Fadeley contributed administrative assistance.

Hydrologic, Water-Quality, and Aquatic Community Data

Discharge data for Apopka, Bugg, Rock, and Wekiva springs are shown in Figures 2-5. Raw data are provided electronically as Appendix 1. Physicochemical data for each of the springs sampled on given dates are listed in Table 1. Chlorophyll-*a* and pheophytin-*a* measurements are listed in Table 2. A cumulative taxonomic list of benthic macroinvertebrates collected during this phase of the study is provided in Table 3. Summaries of invertebrate taxa as raw numbers per subsample and percent composition collected by dip net per spring and date are tabulated in Tables 4-6. Metrics used to calculate the SCI are provided in Tables 7-9 and Figures 6-8. Diversity indices for dip net samples are provided in Table 10 and Figure 9. Taxon richness for samples collected by petite ponar dredge are illustrated by spring and season in Figure 10. Abundance metrics for organisms collected by petite ponar dredge are presented in Tables 11-14, with diversity indices for these samples provided in Table 15 and Figure 11. Total density of all organisms by pooled replicate ponar samples per spring and by season is illustrated in Figure 12. A comparison of all benthic macroinvertebrate collections based on fourth-root transformed Bray-Curtis similarity values is summarized as a hierarchical cluster dendrogram in Figure 13 and a non-metric multi-dimensional scaling (MDS) plot in Figure 14. Number of specimens and percent composition of fish species collected from each spring or spring run are summarized in Table 16. Taxonomic richness of fishes is presented in Figures 15-16.

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Table 1. Physicochemical data for Apopka, Bugg, Rock, and Wekiva springs on dates that benthic macroinvertebrate samples were collected. [DS, downstream; RB, right bank; LB, left bank].

Spring	Location	Date	Time	Depth (ft)	Temp (°C)	Specific Conductance (µS/cm)	DO (mg/L)	pH	Turbidity (NTU)
Apopka	boil	12/30/2005	1530	27.9	18.6	297	6.8	8.0	---
Apopka	boil	3/28/2006	---	18.5	22.0	288	5.0	8.5	---
Apopka	boil	3/28/2006	---	14.9	22.1	288	5.0	8.5	---
Apopka	boil	3/28/2006	---	9.9	22.1	287	5.0	8.4	---
Apopka	boil	3/28/2006	1237	4.9	22.4	285	4.8	8.4	---
Apopka	boil	3/28/2006	1239	1.1	22.4	286	4.9	8.3	---
Apopka	boil	7/13/2006	1013	22	23.9	266	2.7	7.9	0
Apopka	boil	7/13/2006	1017	20	24.2	267	3.2	8.0	0
Apopka	boil	7/13/2006	1019	15	24.4	271	3.4	8.0	0
Apopka	boil	7/13/2006	1020	10	24.4	271	3.4	8.0	0.1
Apopka	boil	7/13/2006	1022	5	24.7	283	4.3	8.2	1.2
Apopka	boil	7/13/2006	1027	1	24.0	263	4.0	8.1	0
Apopka	boil	9/21/2006	1440	22	24.4	265	2.5	8.0	0.2
Apopka	boil	9/21/2006	1444	20	24.2	261	2.3	8.0	0
Apopka	boil	9/21/2006	1446	15	24.2	262	2.3	8.0	0
Apopka	boil	9/21/2006	1448	10	24.2	261	2.2	8.0	0
Apopka	boil	9/21/2006	1450	5	24.4	262	2.5	8.0	0
Apopka	boil	9/21/2006	1451	1	24.4	261	2.8	8.3	0
Bugg	head of run	12/30/2005	1210	1.6	22.0	283	2.6	7.6	0
Bugg	head of run	3/17/2006	1250	1	23.9	312	5.3	7.4	---
Bugg	boil	7/12/2006	1040	25	23.2	311	0.6	7.3	0
Bugg	boil	7/12/2006	1041	20	23.2	311	0.7	7.3	0
Bugg	boil	7/12/2006	1043	15	23.2	311	0.8	7.3	0
Bugg	boil	7/12/2006	1044	10	23.2	311	1.1	7.4	0
Bugg	boil	7/12/2006	1046	5	23.6	310	4.8	7.7	0
Bugg	boil	7/12/2006	1048	1	24.1	308	7.8	8.1	0.4
Bugg	head of run	7/12/2006	1000	1	24.0	308	7.0	7.9	0.4
Bugg	150 ft DS	7/12/2006	0945	1	24.1	307	7.7	8.0	2
Bugg	300 ft DS	7/12/2006	0930	1	24.3	307	7.4	7.8	3.4
Bugg	boil	9/21/2006	0926	24	23.4	315	1.4	7.4	0
Bugg	boil	9/21/2006	0931	20	23.4	315	1.3	7.4	0

Table 1. Physicochemical data for Apopka, Bugg, Rock, and Wekiva springs on dates that benthic macroinvertebrate samples were collected. [DS, downstream; RB, right bank; LB, left bank].

Spring	Location	Date	Time	Depth (ft)	Temp (°C)	Specific Conductance (µS/cm)	DO (mg/L)	pH	Turbidity (NTU)
Bugg	boil	9/21/2006	0933	15	23.4	314	2.0	7.5	0
Bugg	boil	9/21/2006	0935	10	23.4	314	2.2	7.5	0
Bugg	boil	9/21/2006	0937	5	23.5	314	2.4	7.5	0
Bugg	boil	9/21/2006	0938	1	23.6	314	2.7	7.6	0
Bugg	300 ft DS	9/21/2006	1000	1	23.8	312	3.6	7.6	0.2
Bugg	450 ft DS	9/21/2006	1015	1	24.1	312	3.7	7.6	0.2
Bugg	600 ft DS	9/21/2006	1020	1	24.0	313	3.5	7.7	0.3
Rock	boil	12/6/2005	1310	0.6	23.7	236	1.1	7.6	0
Rock	swimming area	12/6/2005	1500	0.4	23.6	237	2.1	7.7	0
Rock	lower section (end tube run)	12/6/2005	1615	0.4	23.4	237	2.8	7.7	0
Rock	boil; 5 ft from RB	3/17/2006	1147	1.6	23.6	258	1.1	7.5	---
Rock	boil; 10 ft from RB	3/17/2006	1149	1.7	23.7	258	1.0	7.6	---
Rock	boil; 15 ft from RB	3/17/2006	1150	1.6	23.7	258	1.0	7.6	---
Rock	boil; 20 ft from RB	3/17/2006	1152	1.5	23.7	258	1.0	7.6	---
Rock	midreach; 3 ft from RB	3/17/2006	1242	2	23.8	257	2.1	7.8	---
Rock	midreach; 6 ft from RB	3/17/2006	1244	2.1	23.8	257	2.2	7.8	---
Rock	midreach; 10 ft from RB	3/17/2006	.	0.98	23.8	258	3.0	7.8	---
Rock	lower section; 5 ft from RB	3/17/2006	1335	1.5	24.0	250	4.1	8.0	---
Rock	lower section; 10 ft from RB	3/17/2006	1337	1.5	24.1	257	4.1	8.0	---
Rock	lower section; 15 ft from RB	3/17/2006	1339	1.7	24.1	258	3.7	8.0	---
Rock	lower section; 20 ft from RB	3/17/2006	1341	1.7	24.1	258	3.6	8.0	---
Rock	lower section; 25 ft from RB	3/17/2006	1342	1.3	24.1	258	3.7	8.0	---
Rock	lower section; 30 ft from RB	3/17/2006	1344	0.4	24.1	258	3.7	8.0	---
Rock	boil	6/21/2006	1117	0.4	23.7	265	0.9	7.5	6.5
Rock	swimming area; RB footbridge	6/21/2006	1238	0.5	23.9	265	2.0	7.9	16.5
Rock	swimming area; LB footbridge	6/21/2006	1242	0.5	23.9	265	2.1	8.0	6.7
Rock	lower section (end tube run)	6/21/2006	1347	0.3	24.3	265	3.0	7.9	30.3
Rock	boil	9/27/2006	0940	1.5	23.8	262	1.3	7.6	0
Rock	swimming area; RB footbridge	9/27/2006	1100	1	23.9	262	2.4	7. 8	0
Rock	swimming area; LB footbridge	9/27/2006	1105	1	23.9	262	2.3	7.8	0
Rock	swimming area; steps	9/27/2006	1130	1	24.1	262	2.9	7.9	0

Table 1. Physicochemical data for Apopka, Bugg, Rock, and Wekiva springs on dates that benthic macroinvertebrate samples were collected. [DS, downstream; RB, right bank; LB, left bank].

Spring	Location	Date	Time	Depth (ft)	Temp (°C)	Specific Conductance (µS/cm)	DO (mg/L)	pH	Turbidity (NTU)
Rock	lower section (end tube run)	9/27/2006	1210	1	24.2	262	3.5	8.0	0
Wekiva	foot bridge	12/7/2005	1100	0.4	23.7	317	0.7	7.3	0
Wekiva	foot bridge; 5 ft from RB	3/27/2006	1540	0.3	23.8	342	0.8	7.3	---
Wekiva	foot bridge; 10 ft from RB	3/27/2006	1541	0.8	23.8	344	0.6	7.3	---
Wekiva	foot bridge; 15 ft from RB	3/27/2006	1542	0.79	23.7	344	0.6	7.3	---
Wekiva	foot bridge; 20 ft from RB	3/27/2006	1543	0.86	23.7	344	0.5	7.3	---
Wekiva	foot bridge; 25 ft from RB	3/27/2006	1544	0.78	23.7	339	0.6	7.3	---
Wekiva	foot bridge; RB	6/22/2006	1021	0.2	23.9	355	0.7	6.7	12.6
Wekiva	foot bridge; middle	6/22/2006	1023	0.2	23.8	354	0.7	7.0	5.7
Wekiva	foot bridge; LB	6/22/2006	1029	0.2	23.8	355	0.5	7.2	5.9
Wekiva	foot bridge; 40 ft from LB	9/27/2006	1310	0.5	23.9	344	1.2	7.3	0
Wekiva	foot bridge; center	9/27/2006	1312	1	23.9	344	1.2	7.3	0
Wekiva	foot bridge; 60 ft from LB	9/27/2006	1315	1	23.9	344	1.1	7.3	0

Table 2. Physicochemical measurements, chlorophyll-*a*, and pheophytin-*a* concentrations at Apopka, Bugg, Rock, and Wekiva springs, December 2005-September 2006 [Sp Cond, specific conductance in microsiemens per centimeter at 25 degrees Celsius; NTU, nephelometric turbidity unit; mg/L, milligrams per liter; µg/L, micrograms per liter].

Spring	Date	Time	Turb (NTU)	DO (mg/L)	pH	Sp Cond	Temp (°C)	Chlorophyll-*a*, phytoplankton (µg/L)	Pheophytin-*a*, phytoplankton (µg/L)
Apopka Spring	12/30/2005	1530						18.4	5.8
Apopka Spring	3/28/2006	1200		4.9	8.3	286	22.4	13.9	3.2
Apopka Spring	7/13/2006	1030	0	4	7.9	263	24.0	5.9	1.3
Apopka Spring	9/21/2006	1430	0.2	2.5	8	265	24.4	0.6	0.2
Bugg Spring	12/30/2005	1210						0.7	0.4
Bugg Spring	3/17/2006	1250		5.3	7.4	312	23.9	2.2	1.4
Bugg Spring	7/12/2006	1000	2	7.4	7.9	307	24.1	41.2	24.9
Bugg Spring	9/21/2006	1000	0.2	3.6	7.6	312	23.8	24.8	13.4
Rock Springs	12/6/2005	1615						0.2	0.2
Rock Springs	3/27/2006	1318		2.2	7.8	257	23.8	0.6	0.7
Rock Springs	6/28/2006	1015		1.7	7.6	259	23.7	0.2	0.4
Rock Springs	9/27/2006	1140	0	2.9	7.9	262	24.1	0.4	0.7
Wekiva Springs	12/7/2005	1100						<0.1	<0.1
Wekiva Springs	3/27/2006	1605		0.6	7.3	344	23.8	<0.3	<0.3
Wekiva Spring	6/28/2006	0840		1.8	7.2	342	23.7	<0.1	<0.1
Wekiva Springs	9/27/2006	1345	0	1.1	7.3	344	23.9	0.1	0.1

Table 3. Benthic macroinvertebrates collected by dip net and petite ponar dredge from Apopka, Bugg, Rock, and Wekiva springs, December 2005-September 2006. [Authorities are listed for lowest practicable identification level (LPIL) indicated. Taxa listed in approximate phylogenetic order by higher categories and alphabetically at genus and species level].

Class	Order	Family	Taxa	Authority
			Porifera (LPIL)	Grant 1836
Demospongiae	Haplosclerida	Spongillidae	*Ephydatia* sp.	Lamouroux 1816
Demospongiae	Haplosclerida	Spongillidae	*Spongilla* sp.	Lamarck 1816
Hydrozoa	Hydroida	Hydridae	*Hydra* sp.	
Oligochaeta	Haplotaxida	Naididae	*Allonais inaequalis*	Stephenson 1911
Oligochaeta	Haplotaxida	Tubificidae	*Aulodrilus pigueti*	Kowalewski 1914
Oligochaeta	Haplotaxida	Naididae	*Bratislavia unidentata*	(Harman 1973)
Oligochaeta	Haplotaxida	Naididae	*Dero botrytis*	Marcus 1943
Oligochaeta	Haplotaxida	Naididae	*Dero digitata*	(Müller 1773)
Oligochaeta	Haplotaxida	Naididae	*Dero digitata* complex	(Müller 1773)
Oligochaeta	Haplotaxida	Naididae	*Dero flabelliger*	(Stephenson 1931)
Oligochaeta	Haplotaxida	Naididae	*Dero furcata*	(Müller 1773)
Oligochaeta	Haplotaxida	Naididae	*Dero pectinata*	Aiyer 1930
Oligochaeta	Haplotaxida	Naididae	*Dero* sp.	Okem 1815
Oligochaeta	Haplotaxida	Naididae	*Dero trifida*	Loden 1979
Oligochaeta	Rhynchobdellida	Glossiphoniidae	*Desserobdella phalera*	(Graf 1899)
Oligochaeta	Lumbriculida	Lumbriculidae	*Eclipidrilus palustris*	(Smith 1900)
Oligochaeta	Lumbriculida	Lumbriculidae	*Eclipidrilus* sp.	Eisen 1881
Oligochaeta	Rhynchobdellida	Glossiphoniidae	Glossiphoniidae (LPIL)	Vaillant 1890
Oligochaeta	Haplotaxida	Tubificidae	*Haber speciosus*	(Hrabe 1931)
Oligochaeta	Rhynchobdellida	Glossiphoniidae	*Helobdella stagnalis*	Linnaeus 1758
Oligochaeta	Rhynchobdellida	Glossiphoniidae	*Helobdella triserialis*	(Blanchard 1849)
Oligochaeta	Haplotaxida	Tubificidae	*Ilyodrilus templetoni*	(Southern 1909)
Oligochaeta	Haplotaxida	Tubificidae	*Limnodrilus hoffmeisteri*	Claparède 1862
Oligochaeta	Lumbriculida	Lumbriculidae	*Lumbriculus* sp.	Grube 1844
Oligochaeta	Lumbriculida	Lumbriculidae	*Lumbriculus variegatus*	(Müller 1774)
Oligochaeta	Rhynchobdellida	Piscicolidae	*Myzobdella lugubris*	Leidy 1851
Oligochaeta	Haplotaxida	Naididae	Naidinae (LPIL)	
Oligochaeta	Haplotaxida	Naididae	*Nais communis* complex	Piquet 1906
Oligochaeta	Haplotaxida	Naididae	*Nais elinguis*	Müller 1773
Oligochaeta	Haplotaxida	Naididae	*Nais* sp.	Müller 1773
Oligochaeta	Haplotaxida	Naididae	*Nais variabilis*	Piquet 1906
Oligochaeta	Haplotaxida	Naididae	*Pristina leidyi*	Smith 1896
Oligochaeta	Haplotaxida	Naididae	*Pristina* sp.	Ehrenberg 1828
Oligochaeta	Haplotaxida	Tubificidae	*Psammoryctides convolutus*	Loden 1978
Oligochaeta	Haplotaxida	Naididae	*Slavina appendiculata*	(D'udekem 1855)
Oligochaeta	Haplotaxida	Tubificidae	*Spirosperma ferox*	Eisen 1879
Oligochaeta	Haplotaxida	Tubificidae	*Spirosperma* sp.	Eisen 1879
Oligochaeta	Haplotaxida	Tubificidae	*Tubificidae* immature sp. A (LPIL)	
Oligochaeta	Haplotaxida	Tubificidae	*Tubificidae* immature sp. B (LPIL)	
Oligochaeta	Haplotaxida	Tubificidae	*Varichaetadrilus angustipenis*	(Brinkhurst & Cook 1966)
Hirudinea	Arhynchobdellida	Erpobdellidae	Erpobdellidae (LPIL)	Blanchard 1894
Hirudinea	Arhynchobdellida	Erpobdellidae	*Erpobdella punctata*	(Leidy 1870)
Hirudinea	Arhynchobdellida	Erpobdellidae	*Mooreobdella tetragon*	Sawyer and Shelley 1976

Table 3. Benthic macroinvertebrates collected by dip net and petite ponar dredge from Apopka, Bugg, Rock, and Wekiva springs, December 2005-September 2006. [Authorities are listed for lowest practicable identification level (LPIL) indicated. Taxa listed in approximate phylogenetic order by higher categories and alphabetically at genus and species level].

Class	Order	Family	Taxa	Authority
Turbellaria	Tricladida		Tricladida (LPIL)	
Turbellaria			Turbellaria (LPIL)	
Gastropoda	Architaenioglossa	Ampullariidae	*Pomacea paludosa*	(Say 1829)
Gastropoda	Basommatophora	Ancylidae	Ancylidae (LPIL)	
Gastropoda	Basommatophora	Ancylidae	*Hebetancylus excentricus*	(Morelet 1851)
Gastropoda	Basommatophora	Ancylidae	*Laevapex peninsulae*	(Pilsbry 1903)
Gastropoda	Basommatophora	Ancylidae	*Laevapex* sp.	Walker 1903
Gastropoda	Neotaenioglossa	Hydrobiidae	Hydrobiidae (LPIL)	Simpson 1865
Gastropoda	Neotaenioglossa	Hydrobiidae	*Amnicola dalli*	(Pilsbry and Beecher 1892)
Gastropoda	Neotaenioglossa	Hydrobiidae	*Aphaostracon monas*	(Pilsbry 1899)
Gastropoda	Neotaenioglossa	Hydrobiidae	cf. *Floridobia* sp.	Thompson and Hershler 2002
Gastropoda	Neotaenioglossa	Hydrobiidae	*Floridobia wekiwae*	(Thompson 1968)
Gastropoda	Neotaenioglossa	Hydrobiidae	cf. *Notogillia wetherbyi*	(Dall 1885)
Gastropoda	Neotaenioglossa	Hydrobiidae	*Pyrgophorus platyrachis*	Thompson 1968
Gastropoda	Neotaenioglossa	Hydrobiidae	Rissoidea (LPIL)	
Gastropoda	Basommatophora	Planorbidae	*Planorbella scalaris*	(Jay 1839)
Gastropoda	Neotaenioglossa	Pleuroceridae	*Elimia floridensis*	(Reeve 1860)
Gastropoda	Neotaenioglossa	Thiaridae	*Melanoides tuberculata*	(Müller 1774)
Gastropoda	Neotaenioglossa	Thiaridae	*Melanoides turricula*	(Lea 1862)
Gastropoda	Neotaenioglossa	Thiaridae	*Melanoides* sp. (immature)	Olivier 1804
Gastropoda	Neotaenioglossa	Thiaridae	cf. *Tarebia* sp.	Adams and Adams 1854
Gastropoda	Neotaenioglossa	Thiaridae	cf. Thiaridae (LPIL)	
Gastropoda	Architaenioglossa	Viviparidae	*Campeloma floridense*	Call 1886
Gastropoda	Architaenioglossa	Viviparidae	*Viviparus georgianus*	(Lea 1834)
Bivalvia			Bivalvia (LPIL)	Linnaeus 1758
Bivalvia	Veneroida	Corbiculidae	*Corbicula fluminea*	Müller 1774
Bivalvia	Veneroida	Pisidiidae	Pisidiidae (LPIL)	Gray 1857
Bivalvia	Veneroida	Pisidiidae	cf. *Musculium* sp.	Link 1807
Bivalvia	Veneroida	Pisidiidae	*Sphaerium striatinum*	(Lamarck 1818)
Bivalvia	Unionoida	Unionidae	*Utterbackia imbecilis*	(Say 1829)
Arachnida	Acariformes		Acariformes (LPIL)	
Arachnida	Acariformes	Hydrodromidae	*Hydrodroma* sp.	Koch 1837
Arachnida	Acariformes	Lebertiidae	*Lebertia* sp.	Neumann 1880
Arachnida	Acariformes	Limnesiidae	*Limnesia* sp.	Koch 1835
Arachnida	Acariformes	Pionidae	*Piona* sp.	Koch 1842
Insecta	Ephemeroptera	Baetidae	*Callibaetis floridanus*	Banks 1900
Insecta	Ephemeroptera	Caenidae	*Caenis diminuta*	Walker 1853
Insecta	Ephemeroptera	Caenidae	*Caenis* sp.	Stephens 1835
Insecta	Ephemeroptera	Leptohyphidae	*Tricorythodes albilineatus*	Berner 1946
Insecta	Odonata	Coenagrionidae	*Argia* sp.	Rambur 1842
Insecta	Odonata	Coenagrionidae	Coenagrionidae (LPIL)	
Insecta	Odonata	Coenagrionidae	*Enallagma* sp.	Charpentier 1840
Insecta	Odonata	Corduliidae	*Macromia* sp.	Rambur 1842
Insecta	Odonata	Libellulidae	*Perithemis tenera seminole*	(Say 1839)

Table 3. Benthic macroinvertebrates collected by dip net and petite ponar dredge from Apopka, Bugg, Rock, and Wekiva springs, December 2005-September 2006. [Authorities are listed for lowest practicable identification level (LPIL) indicated. Taxa listed in approximate phylogenetic order by higher categories and alphabetically at genus and species level].

Class	Order	Family	Taxa	Authority
Insecta	Hemiptera	Hebridae	*Merragata* sp.	White 1877
Insecta	Hemiptera	Mesoveliidae	*Mesovelia mulsanti*	White 1879
Insecta	Hemiptera	Mesoveliidae	*Mesovelia* sp. (immature)	Mulsant and Rey 1852
Insecta	Trichoptera	Hydropsychidae	Hydropsychidae (LPIL)	Curtis 1835
Insecta	Trichoptera	Hydropsychidae	*Cheumatopsyche* sp.	Wallengren 1891
Insecta	Trichoptera	Leptoceridae	*Nectopsyche pavida*	(Hagen 1861)
Insecta	Trichoptera	Polycentropodidae	*Cernotina* sp.	Ross 1938
Insecta	Diptera	Ceratopogonidae	Ceratopogonidae (LPIL)	
Insecta	Diptera	Ceratopogonidae	*Bezzia-Palpomyia* complex Brigham	Kieffer 1899 (Bezzia); Meigen 1818 (Palpomyia)
Insecta	Diptera	Ceratopogonidae	*Palpomyia-Sphaeromias* group Brigham	Meigen 1818 (Palpomyia); Curtis 1829 (Sphaeromias)
Insecta	Diptera	Chironomidae	Chironomidae (LPIL)	
Insecta	Diptera	Chironomidae	Chironomini (LPIL)	
Insecta	Diptera	Chironomidae	*Beardius truncatus*	Reiss and Sublette 1985
Insecta	Diptera	Chironomidae	*Chironomus* sp.	Meigen 1803
Insecta	Diptera	Chironomidae	*Cladopelma* sp.	Kieffer 1921
Insecta	Diptera	Chironomidae	*Cladotanytarsus* cf. *daviesi* Epler	Kieffer 1921 for genus
Insecta	Diptera	Chironomidae	*Cladotanytarsus* sp. A Epler	Kieffer 1921 for genus
Insecta	Diptera	Chironomidae	*Cryptochironomus* sp.	Kieffer 1918
Insecta	Diptera	Chironomidae	*Dicrotendipes modestus*	(Say 1823)
Insecta	Diptera	Chironomidae	*Dicrotendipes neomodestus*	(Malloch 1915)
Insecta	Diptera	Chironomidae	*Dicrotendipes* sp.	Kieffer 1913
Insecta	Diptera	Chironomidae	*Dicrotendipes* sp. (immature)	Kieffer 1913
Insecta	Diptera	Chironomidae	*Einfeldia natchitocheae*	(Sublette 1964)
Insecta	Diptera	Chironomidae	*Glyptotendipes meridionalis* group	Dendy and Sublette 1959
Insecta	Diptera	Chironomidae	*Glyptotendipes paripes*	(Edwards 1929)
Insecta	Diptera	Chironomidae	*Glyptotendipes* sp.	Kieffer 1913
Insecta	Diptera	Chironomidae	*Goeldichironomus amazonicus*	(Fittkau 1965)
Insecta	Diptera	Chironomidae	*Goeldichironomus carus*	(Townes 1945)
Insecta	Diptera	Chironomidae	*Goeldichironomus* sp.	Fittkau 1965
Insecta	Diptera	Chironomidae	*Parachironomus supparilis*	(Edwards date unknown)
Insecta	Diptera	Chironomidae	*Paralauterborniella nigrohalteralis*	(Malloch 1915)
Insecta	Diptera	Chironomidae	*Polypedilum flavum*	(Johannsen 1905)
Insecta	Diptera	Chironomidae	*Polypedilum halterale* group Epler	(Coquillett 1901)
Insecta	Diptera	Chironomidae	*Polypedilum illinoense* group Epler	(Malloch 1915)
Insecta	Diptera	Chironomidae	*Polypedilum scalaenum* group Epler	(Schrank 1803)
Insecta	Diptera	Chironomidae	*Polypedilum tritum*	(Walker 1856)
Insecta	Diptera	Chironomidae	*Pseudochironomus* sp.	Malloch 1915
Insecta	Diptera	Chironomidae	*Rheotanytarsus* sp.	Bause and Thienemann 1913
Insecta	Diptera	Chironomidae	*Stempellinella* sp. *A* Epler	Brundin 1947
Insecta	Diptera	Chironomidae	*Stenochironomus* sp.	Kieffer 1919
Insecta	Diptera	Chironomidae	*Tanytarsus* sp.	Wulp 1874
Insecta	Diptera	Chironomidae	*Tanytarsus* sp. C Epler	Wulp 1874
Insecta	Diptera	Chironomidae	*Tanytarsus* sp. G Epler	Wulp 1874

Table 3. Benthic macroinvertebrates collected by dip net and petite ponar dredge from Apopka, Bugg, Rock, and Wekiva springs, December 2005-September 2006. [Authorities are listed for lowest practicable identification level (LPIL) indicated. Taxa listed in approximate phylogenetic order by higher categories and alphabetically at genus and species level].

Class	Order	Family	Taxa	Authority
Insecta	Diptera	Chironomidae	*Tanytarsus* sp. L Epler	Wulp 1874
Insecta	Diptera	Chironomidae	*Tanytarsus* sp. T Epler	Wulp 1874
Insecta	Diptera	Chironomidae	*Tanytarsus* sp. V Epler	Wulp 1874
Insecta	Diptera	Chironomidae	*Tribelos jucundum*	(Walker 1848)
Insecta	Diptera	Chironomidae	*Tribelos* sp.	Townes 1945
Insecta	Diptera	Chironomidae	*Zavreliella marmorata*	Kieffer 1920
Insecta	Diptera	Chironomidae	Orthocladiinae (LPIL)	Lenz 1921
Insecta	Diptera	Chironomidae	*Cricotopus bicinctus*	(Meigen 1818)
Insecta	Diptera	Chironomidae	*Cricotopus politus*	(Coquillett 1902)
Insecta	Diptera	Chironomidae	*Pseudosmittia* sp.	Goetghebuer 1932
Insecta	Diptera	Chironomidae	*Thienemanniella* sp.	Kieffer 1911
Insecta	Diptera	Chironomidae	*Ablabesmyia rhamphe* group Epler	Sublette 1964
Insecta	Diptera	Chironomidae	*Clinotanypus* sp.	Kieffer 1913
Insecta	Diptera	Chironomidae	*Larsia decolorata*	(Malloch 1915)
Insecta	Diptera	Chironomidae	*Larsia* sp.	Wiedemann 1824
Insecta	Diptera	Chironomidae	*Monopelopia boliekae*	Beck and Beck 1966
Insecta	Diptera	Chironomidae	*Pentaneura inconspicua*	(Malloch 1915)
Insecta	Diptera	Chironomidae	*Tanypus carinatus*	Sublette 1964
Insecta	Diptera	Chironomidae	*Tanypus* sp.	Meigen 1803
Insecta	Diptera	Tipulidae	Tipulidae (LPIL)	
Malacostraca	Isopoda	Asellidae	*Caecidotea racovitzai australis*	(W.D. Williams 1970)
Malacostraca	Isopoda	Asellidae	*Caecidotea* sp.	Packard 1871
Malacostraca	Isopoda	Sphaeromatidae	*Cassidinidea ovalis*	(Say 1818)
Malacostraca	Amphipoda		Gammarida (LPIL)	Latreille 1802
Malacostraca	Amphipoda	Gammaridae	*Gammarus* cf. *tigrinus* LeCroy	Sexton 1939
Malacostraca	Amphipoda	Gammaridae	*Gammarus* sp.	Fabricius 1775
Malacostraca	Amphipoda	Hyalellidae	*Hyalella azteca*	Saussure 1858
Malacostraca	Decapoda	Cambaridae	Cambaridae (LPIL)	Hobbs 1942
Malacostraca	Decapoda	Palaemonidae	*Palaemonetes paludosus*	(Gibbes 1850)
Malacostraca	Decapoda	Palaemonidae	*Palaemonetes* sp.	Heller 1869
Malacostraca	Decapoda	Cambaridae	*Procambarus* sp. (immature)	Ortmann 1905

Table 4. Number of specimens (n) and percent composition (%) of benthic macroinvertebrate taxa collected by dip net from Bugg Spring, December 2005-September 2006. [Values represent material as subsampled by FDEP protocols for calculating the Stream Condition Index].

Taxon	30 Dec 2005		17 Mar 2006		12 Jul 2006		21 Sep 2006	
	n	%	n	%	n	%	N	%
Aulodrilus pigueti			3	3.1	3	2.8	5	4.5
Bratislavia unidentata					1	0.9	3	2.7
Dero flabelliger			3	3.1				
Dero pectinata			2	2.1				
Glossiphoniidae (LPIL)			1	1.0				
Helobdella stagnalis							1	0.9
Ilyodrilus templetoni			1	1.0			5	4.5
Limnodrilus hoffmeisteri	3	6.7	8	8.2	8	7.4	10	9.1
Nais communis complex					1	0.9		
Nais elinguis							1	0.9
Pristina leidyi					1	0.9		
Spirosperma ferox					1	0.9		
Spirosperma sp.							5	4.5
Tubificidae immature sp. A (LPIL)	2	4.4						
Erpobdellidae (LPIL)	1	2.2						
Mooreobdella tetragon							1	0.9
Hebetancylus excentricus					1	0.9		
Laevapex sp.	1	2.2						
Planorbella scalaris					4	3.7		
Melanoides tuberculata	21	46.7					2	1.8
Melanoides turricula	5	11.1					15	13.6
Melanoides sp. (immature)					1	0.9		
Viviparus georgianus	3	6.7					2	1.8
Bivalvia (LPIL)					3	2.8		
Corbicula fluminea							1	0.9
Sphaerium striatinum	3	6.7	2	2.1			6	5.5
Utterbackia imbecilis	1	2.2						
Acariformes (LPIL)	3	6.7						
Limnesia sp.							1	0.9
Callibaetis floridanus			4	4.1				
Caenis diminuta			7	7.2	1	0.9		
Caenis sp.							2	1.8
Coenagrionidae (LPIL)							1	0.9
Mesovelia sp. (immature)			3	3.1				
Bezzia-Palpomyia group					3	2.8		
Palpomyia-Sphaeromias group			1	1.0				
Beardius truncatus					1	0.9		
Chironomus sp	1	2.2	5	5.2	3	2.8	7	6.4
Cladotanytarsus sp. A Epler			1	1.0	1	0.9		
Cryptochironomus sp.			1	1.0				
Dicrotendipes modestus			9	9.3				
Dicrotendipes sp.					1	0.9		
Einfeldia natchitocheae			7	7.2			2	1.8
Glyptotendipes sp.	1	2.2						
Parachironomus supparilis			1	1.0				

Table 4. Number of specimens (n) and percent composition (%) of benthic macroinvertebrate taxa collected by dip net from Bugg Spring, December 2005-September 2006. [Values represent material as subsampled by FDEP protocols for calculating the Stream Condition Index].

Taxon	30 Dec 2005		17 Mar 2006		12 Jul 2006		21 Sep 2006	
	n	%	n	%	n	%	N	%
Polypedilum illinoense group			1	1.0				
Polypedilum tritum			1	1.0				
Pseudochironomus sp.					1	0.9		
Tanytarsus sp.							2	1.8
Tanytarsus sp. G Epler			20	20.6	1	0.9		
Tanytarsus sp. L Epler			2	2.1				
Zavreliella marmorata			2	2.1				
Clinotanypus sp.			1	1.0				
Larsia decolorata					5	4.6		
Monopelopia boliekae			1	1.0				
Tanypus carinatus			6	6.2				
Tanypus sp.					1	0.9	1	0.9
Hyalella azteca			4	4.1	65	60.2	35	31.8
Palaemonetes sp.					1	0.9		
Procambarus sp. (juvenile)							2	1.8
Total	45*	100	97*	100	108	100	110	100
Number of Taxa	12		26		22		22	

*failed to obtain target number of subsampled organisms (100-110) due to time constraints during sorting process.

Table 5. Number of specimens (n) and percent composition (%) of benthic macroinvertebrate taxa collected by dip net from Rock Springs, December 2005-September 2006. [Values represent material as subsampled by FDEP protocols for calculating the Stream Condition Index].

Taxon	6 Dec 2005		27 Mar 2006		21 Jun 2006		27 Sep 2006	
	n	%	n	%	n	%	n	%
Allonais inaequalis							2	1.8
Bratislavia unidentata					1	0.9	1	0.9
Dero digitata complex					3	2.7		
Helobdella stagnalis			1	0.9				
Limnodrilus hoffmeisteri			1	0.9				
Nais communis complex					6	5.5		
Pristina leidyi							1	0.9
Tubificidae immature sp. A (LPIL)	2	1.8			1	0.9		
Hydrobiidae (LPIL)	12	10.6						
Amnicola dalli	40	35.4	56	50.9	24	21.8	76	69.1
Pyrgophorus platyrachis			1	0.9				
Rissoidea (LPIL)					3	2.7		
Melanoides tuberculata	2	1.8						
Melanoides turricula			14	12.7			2	1.8
cf. *Tarebia* sp.							1	0.9
cf. Thiaridae (LPIL)			2	1.8				
Hydrodroma sp.					1	0.9		
Lebertia sp.					8	7.3	1	0.9
Limnesia sp.							1	0.9
Tricorythodes albilineatus			1	0.9	1	0.9		
Argia sp.	1	0.9						
Enallagma sp.					2	1.8		
Merragata sp.	1	0.9						
Mesovelia mulsanti	1	0.9						
Hydropsychidae (LPIL)					4	3.6		
Chironomidae (LPIL)	1	0.9						
Chironomus sp.			1	0.9	7	6.4		
Cryptochironomus sp.					1	0.9		
Dicrotendipes modestus					3	2.7		
Dicrotendipes neomodestus							9	8.2
Paralauterborniella nigrohalteralis	1	0.9						
Polypedilum flavum			6	5.5	1	0.9		
Polypedilum scalaenum group	2	1.8	6	5.5	7	6.4	2	1.8
Polypedilum tritum	2	1.8						
Pseudochironomus sp.					4	3.6	2	1.8
Stempellinella sp. A Epler	1	0.9						
Tanytarsus sp.			1	0.9				
Tanytarsus sp. C Epler	1	0.9			7	6.4	6	5.5
Tanytarsus sp. G Epler								
Tanytarsus sp. L Epler	2	1.8						
Cricotopus bicinctus					2	1.8		
Cricotopus politus							1	0.9
Thienemanniella sp.					1	0.9		
Pentaneura inconspicua							1	0.9
Tipulidae (LPIL)					1	0.9		

Table 5. Number of specimens (n) and percent composition (%) of benthic macroinvertebrate taxa collected by dip net from Rock Springs, December 2005-September 2006. [Values represent material as subsampled by FDEP protocols for calculating the Stream Condition Index].

Taxon	6 Dec 2005		27 Mar 2006		21 Jun 2006		27 Sep 2006	
	n	%	n	%	n	%	n	%
Cassidinidea ovalis					1	0.9		
Gammarus cf. *tigrinus* LeCroy	15	13.3	12	10.9	7	6.4	1	0.9
Gammarus sp.	6	5.3						
Hyalella azteca	17	15.0	7	6.4	11	10.0	3	2.7
Palaemonetes paludosus	6	5.3	1	0.9	3	2.7		
Total	113	100	110	100	110	100	110	100
Number of Taxa	18		14		25		16	

Table 6. Number of specimens (n) and percent composition (%) of benthic macroinvertebrate taxa collected by dip net from Wekiva Springs, December 2005-September 2006 [Values represent material as subsampled by FDEP protocols for calculating the Stream Condition Index].

Taxa	7 Dec 2005		27 Mar 2006		22 Jun 2006		27 Sep 2006	
	n	%	n	%	n	%	n	%
Dero digitata complex			3	2.7				
Helobdella stagnalis	3	2.2					1	0.9
Limnodrilus hoffmeisteri	2	1.5						
Naidinae (LPIL)	1	0.7						
Nais communis complex					4	3.6		
Nais elinguis							1	0.9
Nais variabilis			1	0.9				
Pristina sp.	1	0.7						
Tubificidae immature sp. A (LPIL)	4	3.0	1	0.9	4	3.6	3	2.7
Tricladida (LPIL)					2	1.8		
Turbellaria (LPIL)							3	2.7
Hydrobiidae (LPIL)	15	11.2						
Amnicola dalli	61	45.5	30	27.3			64	58.2
Aphaostracon monas	4	3.0	2	1.8	72	65.5		
Planorbella scalaris	1	0.7						
Melanoides turricula	3	2.2						
Melanoides sp. (immature)					1	0.9		
Caenis diminuta	9	6.7	30	27.3	11	10.0	1	0.9
Enallagma sp.			2	1.8				
Chironomus sp.	5	3.7	2	1.8			1	0.9
Cladopelma sp.	3	2.2					1	0.9
Cladotanytarsus cf. *daviesi* Epler					1	0.9		
Dicrotendipes sp. (immature)			4	3.6				
Polypedilum halterale group					1	0.9		
Stenochironomus sp.	1	0.7						
Tanytarsus sp.								
Tanytarsus sp. C Epler							1	0.9
Tanytarsus sp. T Epler	2	1.5	27	24.5	4	3.6	19	17.3
Tribelos sp.	1	0.7						
Pseudosmittia sp.			1	0.9				
Caecidotea racovitzai australis	2	1.5						
Caecidotea sp.	3	2.2	1	0.9	1	0.9		
Hyalella azteca	13	9.7	6	5.5	9	8.2	4	3.6
Total	134	100	110	100	110	100	110	100
Number of Taxa	19		13		11		12	

Table 7. Stream Condition Index (SCI) metrics for benthic macroinvertebrates collected by dip net from Bugg Spring, December 2005-September 2006 [Calculated scores are based on computations for the Florida peninsula; raw values <0 or >10 are adjusted to 0 or 10 to obtain the corrected score as per FDEP standard operating procedures. Total SCI scores are rounded to nearest integer].

SCI METRIC	6 DEC 05		17 MAR 06		12 JUL 06		21 SEP 06	
	Raw	Score	Raw	Score	Raw	Score	Raw	Score
Total taxa	11	-2.00	26	4.00	22	2.40	22	2.40
Corrected total taxa		0.00		4.00		2.40		2.40
Ephemeroptera taxa	0	0.00	2	4.00	1	2.00	1	2.00
Corrected Ephemeroptera taxa		0.00		4.00		2.00		2.00
Trichoptera taxa	0	0.00	0	0.00	0	0.00	0	0.00
Corrected Trichoptera taxa		0.00		0.00		0.00		0.00
% filterer	9.30	2.13	19.10	4.64	1.40	0.10	7.30	1.62
Corrected % filterer		2.13		4.64		0.10		1.62
Long-lived taxa	0	0.00	0	0.00	1	2.50	2	5.00
Corrected long-lived taxa		0.00		0.00		2.50		5.00
Clinger taxa	0	0.00	0	0.00	0	0.00	0	0.00
Corrected Clinger taxa		0.00		0.00		0.00		0.00
% dominance	46.70	1.66	20.60	7.59	60.20	-1.41	31.80	5.05
Corrected % dominance		1.66		7.59		0.00		5.05
% Tanytarsini	0.00	0.00	23.70	9.72	0.90	1.95	1.80	3.12
Corrected % Tanytarsini		0.00		9.72		1.95		3.12
Sensitive taxa	0	0.00	0	0.00	0	0.00	0	0.00
Corrected sensitive Taxa		0.00		0.00		0.00		0.00
% Very tolerant taxa (VTT)	75.50	-0.58	38.10	1.06	19.30	2.66	36.30	1.17
Corrected VTT		0.00		1.06		2.66		1.17
Subsampling Factor	0.02777		0.83330		0.04167		0.02546	
Total SCI Score	**4**		**34**		**13**		**23**	

Table 8. Stream Condition Index (SCI) metrics for benthic macroinvertebrates collected by dip net from Rock Springs, December 2005-September 2006 [Calculated scores are based on computations for the Florida peninsula; raw values <0 or >10 are adjusted to 0 or 10 to obtain the corrected score as per Florida FDEP standard operating procedures. Total SCI scores are rounded to nearest integer].

SCI METRIC	**6 DEC 05**		**27 MAR 06**		**21 JUN 06**		**27 SEP 06**	
	Raw	**Score**	**Raw**	**Score**	**Raw**	**Score**	**Raw**	**Score**
Total taxa	15	-0.40	14	-0.80	25	3.60	16	0.00
Corrected total taxa		0.00		0.00		3.60		0.00
Ephemeroptera taxa	0	0.00	1	2.00	1	2.00	0	0.00
Corrected Ephemeroptera taxa		0.00		2.00		2.00		0.00
Trichoptera taxa	0	0.00	0	0.00	1	1.43	0	0.00
Corrected Trichoptera taxa		0.00		0.00		1.43		0.00
% filterer	0.91	-0.02	0.00	-0.26	8.20	1.85	6.85	1.50
Corrected % filterer		0.00		0.00		1.85		1.50
Long-lived taxa	1	2.50	1	2.50	1	2.50	0	0.00
Corrected long-lived taxa		2.50		2.50		2.50		0.00
Clinger taxa	1	1.25	0	0.00	1	1.25	0	0.00
Corrected Clinger taxa		1.25		0.00		1.25		0.00
% dominance	46.00	1.82	50.90	0.70	21.80	7.32	69.10	-3.43
Corrected % dominance		1.82		0.70		7.32		0.00
% Tanytarsini	2.70	3.96	0.90	1.95	6.40	6.07	5.50	5.67
Corrected % Tanytarsini		3.96		1.95		6.07		5.67
Sensitive taxa	1	1.11	1	1.11	1	1.11	0	0.00
Corrected sensitive Taxa		1.11		1.11		1.11		0.00
% Very tolerant taxa (VTT)	2.70	6.81	16.30	3.05	22.90	2.26	11.80	3.78
Corrected VTT		6.81		3.05		2.26		3.78
Subsampling Factor	0.00694		0.27800		0.01389		0.00231	
Total SCI Score	**19**		**13**		**33**		**12**	

Table 9. Stream Condition Index (SCI) metrics for benthic macroinvertebrates collected by dip net from Wekiva Springs, December 2005-September 2006. [Calculated scores are based on computations for the Florida peninsula; raw values <0 or >10 are adjusted to 0 or 10 to obtain the corrected score as per FDEP standard operating procedures. Total SCI scores are rounded to nearest integer].

SCI METRIC	6 DEC 05		27 MAR 06		22 JUN 06		27 SEP 06	
	Raw	**Score**	**Raw**	**Score**	**Raw**	**Score**	**Raw**	**Score**
Total taxa	15	-0.40	13	-1.20	11	-2.00	12	-1.60
Corrected total taxa		0.00		0.00		0.00		0.00
Ephemeroptera taxa	1	2.00	1	2.00	1	2.00	1	2.00
Corrected Ephemeroptera taxa		2.00		2.00		2.00		2.00
Trichoptera taxa	0	0.00	0	0.00	0	0.00	0	0.00
Corrected Trichoptera taxa		0.00		0.00		0.00		0.00
% filterer	0.77	-0.06	13.76	3.27	2.30	0.33	9.10	2.08
Corrected % filterer		0.00		3.27		0.33		2.08
Long-lived taxa	0	0.00	0	0.00	0	0.00	0	0.00
Corrected long-lived taxa		0.00		0.00		0.00		0.00
Clinger taxa	0	0.00	0	0.00	0	0.00	0	0.00
Corrected Clinger taxa		0.00		0.00		0.00		0.00
% dominance	48.50	1.25	17.30	8.34	65.50	-2.61	58.20	-0.95
Corrected % dominance		1.25		8.34		0.00		0.00
% Tanytarsini	1.50	2.78	24.50	9.81	4.50	5.17	18.20	8.95
Corrected % Tanytarsini		2.78		9.81		5.17		8.95
Sensitive taxa	0	0.00	1	1.11	0	0.00	0	0.00
Corrected sensitive Taxa		0.00		1.11		0.00		0.00
% Very tolerant taxa (VTT)	17.50	2.88	9.90	4.17	4.50	5.84	2.70	6.81
Corrected VTT		2.88		4.17		5.84		6.81
Subsampling Factor	0.03009		0.45800		0.01389		0.00694	
Total SCI Score	**10**		**32**		**15**		**22**	

Table 10. Taxon richness (*S*), Shannon diversity index (H'_{log2}, H'_{log10}), evenness (J'), and Florida Index values for benthic macroinvertebrates collected by dip net in Bugg, Rock, and Wekiva springs, December 2005-September 2006 [Values based on subsampled, upward-collapsed data of dip net collections and thus not normalized to entire sample (see Tables 7-9 for subsampling factors)].

Spring	Date	S	H'_{log2}	H'_{log10}	J'	Florida Index
Bugg	12/30/2005	12	2.718	0.818	0.758	0
	3/17/2006	26	4.089	1.231	0.870	2
	7/12/2006	22	2.551	0.768	0.572	1
	9/21/2006	22	3.520	1.060	0.789	0
Rock	12/6/2005	18	3.060	0.921	0.734	5
	3/27/2006	14	2.471	0.744	0.649	3
	6/21/2006	25	4.006	1.206	0.863	8
	9/27/2006	16	1.948	0.586	0.487	0
Wekiva	12/7/2005	19	2.965	0.892	0.698	4
	3/27/2006	13	2.627	0.791	0.710	1
	6/22/2006	11	1.901	0.572	0.550	2
	9/27/2006	12	2.052	0.618	0.572	4

Table 11. Density (as number of organisms per taxon per square meter, n/m^2), and percent by density (%) of benthic macroinvertebrate taxa by pooled petite ponar grabs from Apopka Spring, December 2005-September 2006 [Results are based on 3 ponar grabs in December and 4 ponar grabs from March-September].

Taxon	30 Dec 2005		28 Mar 2006		13 Jul 2006		21 Sep 2006	
	n/m^2	%	n/m^2	%	n/m^2	%	n/m^2	%
Spongilla sp.			86	0.99				
Dero trifida			86	0.99				
Desserobdella phalera	57	0.41						
Eclipidrilus palustris					259	2.40		
Helobdella stagnalis	115	0.83						
Helobdella triserialis					517	4.80	776	5.70
Myzobdella lugubris	57	0.41						
Pristina leidyi							86	0.63
Psammoryctides convolutus					172	1.60		
Tubificidae immature sp. A (LPIL)			216	2.48				
Tricladida (LPIL)	345	2.50			1379	12.80		
Turbellaria (LPIL)							1034	7.59
Hydrobiidae (LPIL)							86	0.63
Amnicola dalli			86	0.99	431	4.00	431	3.16
cf. *Floridobia* sp.					172	1.60		
cf. *Notogillia wetherbyi*					86	0.80		
Planorbella scalaris					86	0.80		
Melanoides tuberculata					259	2.40		
Bivalvia (LPIL)					86	0.80		
Pisidiidae (LPIL)							86	0.63
cf. *Musculium* sp.					86	0.80		
Perithemis tenera seminole	57	0.41						
Chironomus sp.			86	0.99				
Glyptotendipes meridionalis group							172	1.26
Glyptotendipes paripes	402	2.91						
Goeldichironomus amazonicus	115	0.83						
Caecidotea racovitzai australis	14	0.10					948	6.96
Caecidotea sp.	72	0.52	86	0.99	690	6.40	1552	11.40
Hyalella azteca	12572	91.06	8060	92.58	6552	60.81	8448	62.03
Total	13806	100	8706	100	10775	100	13619	100
Number of Taxa	10		7		13		10	

Table 12. Density (as number of organisms per taxon per square meter, n/m^2), and percent by density (%) of benthic macroinvertebrate taxa by pooled petite ponar grabs from Bugg Spring, December 2005-September 2006 [Results are based on 3 ponar grabs per sampling event].

Taxon	30 Dec 2005		17 Mar 2006		12 Jul 2006		21 Sep 2006	
	n/m^2	%	n/m^2	%	n/m^2	%	n/m^2	%
Porifera (LPIL)							230	2.35
Ephydatia sp.							115	1.18
Dero digitata							805	8.24
Dero sp.							690	7.06
Dero trifida			29	0.88				
Helobdella stagnalis	172	5.81						
Helobdella triserialis							345	3.53
Ilyodrilus templetoni	402	13.59	431	13.14	86	0.82	690	7.06
Limnodrilus hoffmeisteri	718	24.26	101	3.08	402	3.85		
Naidinae (LPIL)							230	2.35
Spirosperma ferox					546	5.23		
Spirosperma sp.							230	2.35
Tubificidae immature sp. A (LPIL)	690	23.32	532	16.22	1494	14.31	2644	27.05
Tubificidae immature sp. B (LPIL)	144	4.87			172	1.65		
Erpobdella punctata	172	5.81						
Mooreobdella tetragon			29	0.88			115	1.18
Tricladida (LPIL)					115	1.10		
Ancylidae (LPIL)			144	4.39				
Hebetancylus excentricus	115	3.89			345	3.30		
Amnicola dalli							115	1.18
Melanoides tuberculata	29	0.98			575	5.51	1724	17.64
Melanoides sp. (immature)							805	8.24
Viviparus georgianus	316	10.68						
Bivalvia (LPIL)					129	1.24		
Pisidiidae (LPIL)			230	7.01				
Sphaerium striatinum	115	3.89	144	4.39				
Piona sp.			230	7.01				
Caenis diminuta			29	0.88				
Palpomyia-Sphaeromias group			259	7.90	172	1.65		
Chironomus sp.			144	4.39	86	0.82		

Table 12. Density (as number of organisms per taxon per square meter, n/m^2), and percent by density (%) of benthic macroinvertebrate taxa by pooled petite ponar grabs from Bugg Spring, December 2005-September 2006 [Results are based on 3 ponar grabs per sampling event].

Taxon	30 Dec 2005		17 Mar 2006		12 Jul 2006		21 Sep 2006	
	n/m^2	%	n/m^2	%	n/m^2	%	n/m^2	%
Dicrotendipes modestus					86	0.82		
Dicrotendipes sp. (immature)			259	7.90				
Einfeldia natchitocheae			230	7.01				
Goeldichironomus carus	57	1.93						
Goeldichironomus sp.							115	1.18
Tanytarsus sp. G Epler			101	3.08				
Zavreliella marmorata			230	7.01				
Hyalella azteca	29	0.98	158	4.82	6149	58.88	920	9.41
Cambaridae (LPIL)					86	0.82		
Total	2959	100	3280	100	10443	100	9773	100
Number of Taxa	12		17		14		15	

Table 13. Density (as number of organisms per taxon per square meter, n/m^2), and percent by density (%) of benthic macroinvertebrate taxa by pooled petite ponar grabs from Rock Springs, December 2005-September 2006 [Results are based on 3 ponar grabs per sampling event].

Taxon	6 Dec 2005		27 Mar 2006		21 Jun 2006		27 Sep 2006	
	n/m^2	%	n/m^2	%	n/m^2	%	n/m^2	%
Hydra sp.					57	1.07		
Allonais inaequalis							57	0.70
Dero digitata							57	0.70
Dero furcata							115	1.42
Dero sp.							57	0.70
Eclipidrilus palustris	14	0.56					115	1.42
Eclipidrilus sp.							57	0.70
Haber speciosus					43	0.81		
Helobdella stagnalis							115	1.42
Ilyodrilus templetoni							115	1.42
Limnodrilus hoffmeisteri	172	6.89	29	0.33	43	0.81	57	0.70
Lumbriculus sp.					129	2.42		
Lumbriculus variegatus	14	0.56	14	0.16				
Naidinae (LPIL)							57	0.70
Nais communis complex					43	0.81	57	0.70
Nais sp.			115	1.30				
Slavina appendiculata					43	0.81	57	0.70
Tubificidae immature sp. A (LPIL)	273	10.93	29	0.33	489	9.16	230	2.84
Tubificidae immature sp. B (LPIL)	690	27.63			129	2.42	57	0.70
Varichaetadrilus angustipenis	14	0.56						
Tricladida (LPIL)			920	10.41	115	2.15		
Turbellaria (LPIL)							57	0.70
Pomacea paludosa					43	0.81		
Ancylidae (LPIL)			14	0.16				
Laevapex peninsulae					57	1.07		
Hydrobiidae (LPIL)			14	0.16	790	14.80		
Amnicola dalli	747	29.92	115	1.30	129	2.42	1494	18.46
cf. *Floridobia* sp.							57	0.70
Elimia floridensis							57	0.70
Melanoides tuberculata					158	2.96		
Melanoides turricula							460	5.68

Table 13. Density (as number of organisms per taxon per square meter, n/m^2), and percent by density (%) of benthic macroinvertebrate taxa by pooled petite ponar grabs from Rock Springs, December 2005-September 2006 [Results are based on 3 ponar grabs per sampling event].

Taxon	6 Dec 2005		27 Mar 2006		21 Jun 2006		27 Sep 2006	
	n/m^2	%	n/m^2	%	n/m^2	%	n/m^2	%
Melanoides sp. (immature)					172	3.22		
cf. *Tarebia* sp.							575	7.10
Campeloma floridense					43	0.81		
Caenis diminuta							57	0.70
Tricorythodes albilineatus							115	1.42
Macromia sp.							57	0.70
Cheumatopsyche sp.							57	0.70
Nectopsyche pavida					14	0.26		
Cernotina sp.	172	6.89						
Bezzia-Palpomyia complex					43	0.81	57	0.70
Chironomidae (LPIL)					57	1.07		
Chironomus sp.			101	1.14	345	6.46	172	2.12
Cryptochironomus sp.					43	0.81	57	0.70
Dicrotendipes neomodestus					86	1.61		
Dicrotendipes sp.					129	2.42		
Dicrotendipes sp. (immature)							57	0.70
Paralauterborniella nigrohalteralis			115	1.30	86	1.61	115	1.42
Polypedilum flavum			230	2.60				
Polypedilum scalaenum group					388	7.27	1092	13.49
Pseudochironomus sp.			230	2.60	43	0.81	115	1.42
Stempellinella sp. A Epler							115	1.42
Stenochironomus sp.	14	0.56			57	1.07		
Tanytarsus sp.			230	2.60				
Tanytarsus sp. C Epler			115	1.30	129	2.42	460	5.68
Tanytarsus sp. G Epler			230	2.60				
Tanytarsus sp. L Epler					86	1.61		
Tanytarsus sp. V Epler	172	6.89						
Tribelos sp.			29	0.33				
Orthocladiinae (LPIL)			690	7.81				
Cricotopus bicinctus					302	5.66		
Cricotopus politus							115	1.42

Table 13. Density (as number of organisms per taxon per square meter, n/m^2), and percent by density (%) of benthic macroinvertebrate taxa by pooled petite ponar grabs from Rock Springs, December 2005-September 2006 [Results are based on 3 ponar grabs per sampling event].

Taxon	6 Dec 2005		27 Mar 2006		21 Jun 2006		27 Sep 2006	
	n/m^2	**%**	**n/m^2**	**%**	**n/m^2**	**%**	**n/m^2**	**%**
Cricotopus sp.					43	0.81		
Ablabesmyia rhamphe group					57	1.07	57	0.70
Larsia decolorata					43	0.81		
Pentaneura inconspicua							115	1.42
Caecidotea sp.					57	1.07		
Gammarus cf. *tigrinus*	187	7.49	2730	30.89	86	1.61	402	4.97
Gammarus sp.	14	0.56	2773	31.38	460	8.62	517	6.39
Hyalella azteca			115	1.30	302	5.66	460	5.68
Procambarus sp. (immature)	14	0.56						
Total	2497	100	8838	100	5339	100	8095	100
Number of Taxa	13		20		37		39	

Table 14. Density (as number of organisms per taxon per square meter, n/m^2), and percent by density (%) of benthic macroinvertebrate taxa by pooled petite ponar grabs from Wekiva Springs, December 2005-September 2006 [Results are based on 3 ponar grabs per sampling event].

Taxon	7 Dec 2005		27 Mar 2006		22 Jun 2006		27 Sep 2006	
	n/m^2	%	n/m^2	%	n/m^2	%	n/m^2	%
Dero botrytis							172	0.48
Dero digitata	57	0.24	575	4.27				
Dero digitata complex					345	5.36		
Dero pectinata					115	1.79		
Dero sp.							115	0.32
Desserobdella phalera	43	0.18						
Helobdella stagnalis	2644	11.15	1149	8.54	115	1.79		
Helobdella triserialis	43	0.18			115	1.79		
Limnodrilus hoffmeisteri	517	2.18	460	3.42	805	12.50	57	0.16
Naidinae (LPIL)	273	1.15			115	1.79	115	0.32
Nais communis complex					345	5.36		
Nais elinguis							402	1.12
Nais variabilis							230	0.64
Tubificidae immature sp. A (LPIL)	2974	12.55	690	5.13	2069	32.14	805	2.25
Tricladida (LPIL)	43	0.18	690	5.13	345	5.36		
Turbellaria (LPIL)							1379	3.85
Hydrobiidae (LPIL)	6207	26.18	230	1.71	1724	26.78		
Amnicola dalli			5977	44.44			24885	69.51
Aphaostracon monas							115	0.32
cf. *Floridobia* sp.							115	0.32
Floridobia wekiwae							1034	2.89
Melanoides turricula							345	0.96
Caenis diminuta	230	0.97	920	6.84			690	1.93
Caenis sp.							805	2.25
Chironomidae (LPIL)							57	0.16
Chironomini (LPIL)			230	1.71				
Chironomus sp.	244	1.03			230	3.57	1379	3.85
Cladopelma sp.					115	1.79	1149	3.21
Dicrotendipes modestus			460	3.42				
Dicrotendipes sp. (immature)			460	3.42			115	0.32
Polypedilum halterale group			115	0.85				

Table 14. Density (as number of organisms per taxon per square meter, n/m^2), and percent by density (%) of benthic macroinvertebrate taxa by pooled petite ponar grabs from Wekiva Springs, December 2005-September 2006 [Results are based on 3 ponar grabs per sampling event].

Taxon	7 Dec 2005		27 Mar 2006		22 Jun 2006		27 Sep 2006	
	n/m^2	%	n/m^2	%	n/m^2	%	n/m^2	%
Polypedilum scalaenum group			230	1.71				
Rheotanytarsus sp.			115	0.85				
Tanytarsus sp.			575	4.27			172	0.48
Tanytarsus sp. C Epler			115	0.85				
Tanytarsus sp. T Epler	9871	41.64	460	3.42			1494	4.17
Tribelos jucundum	43	0.18						
Caecidotea racovitzai australis	43	0.18						
Caecidotea sp.	72	0.30					115	0.32
Hyalella azteca	345	1.46					57	0.16
Procambarus sp. (immature)	57	0.24						
Total	23706	100	13451	100	6438	100	35802	100
Number of Taxa	17		17		12		23	

Table 15. Taxon richness (*S*), number of organisms per square meter (n/m^2), Shannon diversity index (H'_{log2}, H'_{log10}), evenness (J'), and Florida Index values for benthic macroinvertebrates collected by petite ponar grab in Apopka, Bugg, Rock, and Wekiva springs, December 2005-September 2006 [Values are based on subsampled, pooled data representing three replicates per spring per sampling date except for four replicates from Apopka Spring for March, July, and September].

Spring	Date	*S*	n/m^2	H'_{log2}	H'_{log10}	J'	Florida Index
Apopka	12/30/2005	10	13806	0.668	0.201	0.201	2
	3/28/2006	7	8706	0.565	0.170	0.201	1
	7/13/2006	13	10775	2.138	0.644	0.578	1
	9/21/2006	10	13619	1.947	1.060	0.586	2
Bugg	12/30/2005	12	2959	3.016	0.908	0.841	0
	3/17/2006	17	3280	3.759	1.131	0.919	0
	7/12/2006	14	10443	2.222	0.669	0.583	0
	9/21/2006	15	9773	3.26	0.586	0.834	0
Rock	12/6/2005	13	2497	2.717	0.818	0.734	4
	3/27/2006	20	8838	2.83	0.852	0.655	2
	6/21/2006	37	5339	4.551	1.370	0.873	11
	9/27/2006	39	8095	4.381	0.618	0.829	10
Wekiva	12/7/2005	17	23706	2.328	0.701	0.569	2
	3/27/2006	17	13451	3.06	0.921	0.748	1
	6/22/2006	12	6438	2.78	0.837	0.775	0
	9/27/2006	23	35802	2.044	1.060	0.452	1

Table 16. Fishes (total number of specimens, n; percent composition per sample, %) collected by boat electroshocker in vicinity of Apopka, Bugg, Wekiva, and Rock springs [The downstream spring run sections were sampled for Bugg, Wekiva, and Rock springs, and the Gourd Neck area of Lake Apopka was sampled. Dates of sampling: Apopka Spring, 25 May 2006; Bugg Spring, 7 June 2006; Rock Springs, 25 August 2006; and Wekiva Springs, 27 July 2006].

Family	Species	Apopka		Bugg		Wekiva		Rock	
		n	%	n	%	n	%	n	%
Lepisosteidae	*Lepisosteus osseus*	1	0.1	---	---	---	---	---	---
	Lepisosteus platyrinchus	7	0.8	2	0.6	5	5.5	5	1.6
Amiidae	*Amia calva*	2	0.2	9	2.5	7	7.7	13	4.1
Anguillidae	*Anguilla rostrata*	---	---	---	---	2	2.2	---	---
Clupeidae	*Dorosoma petenense*	1	0.1	---	---	---	---	---	---
Cyprinidae	*Notemigonus crysoleucas*	3	0.4	---	---	8	8.8	49	15.4
	Notropis maculatus	1	0.1	---	---	---	---	---	---
	Notropis petersoni	---	---	---	---	---	---	6	1.9
Catostomidae	*Erimyzon sucetta*	---	---	3	0.8	13	14.3	32	10.1
Ictaluridae	*Ameiurus catus*	1	0.1	---	---	1	1.1	---	---
	Ameiurus natalis	---	---	---	---	---	---	2	0.6
	Ameiurus nebulosus	4	0.5	---	---	2	2.2	---	---
Callichthyidae	*Hoplosternum littorale* [a]	---	---	---	---	1	1.1	---	---
Loricariidae	*Pterygoplichthys disjunctivus* [a]	---	---	---	---	2	2.2	16	5.0
Esocidae	*Esox americanus*	---	---	6	1.7	---	---	---	---
Atherinopsidae	*Labidesthes sicculus*	27	3.2	---	---	1	1.1	---	---
Fundulidae	*Fundulus seminolis*	3	0.4	7	2.0	3	3.3	---	---
	Lucania goodei	3	0.4	2	0.6	---	---	5	1.6
	Lucania parva	---	---	---	---	---	---	2	0.6
Poeciliidae	*Gambusia holbrooki*	35	4.2	156 [b]	43.8	1	1.1	1	0.3
	Heterandria formosa	1	0.1	5	1.4	---	---	---	---
	Poecilia latipinna	---	---	56	15.7	---	---	---	---
Centrarchidae	*Lepomis auritus*	34	4.0	4	1.1	16	17.6	45	14.2
	Lepomis gulosus	13	1.5	4	1.1	---	---	15	4.7
	Lepomis macrochirus	336	39.9	9	2.5	---	---	39	12.3
	Lepomis marginatus	2	0.2	---	---	---	---	---	---
	Lepomis microlophus	17	2.0	26	7.3	---	---	23	7.2
	Lepomis punctatus	---	---	52	14.6	18	19.8	36	11.3
	Micropterus salmoides	46	5.5	13	3.7	11	12.1	27	8.5
	Pomoxis nigromaculatus	9	1.1	---	---	---	---	---	---
Percidae	*Etheostoma fusiforme*	1	0.1	---	---	---	---	---	---
	Percina nigrofasciata	---	---	---	---	---	---	2	0.6
Cichlidae	*Oreochromis aureus* [a]	295 [c]	35.0	2	0.6	---	---	---	---
	Total	**842**	**100**	**356**	**100**	**91**	**100**	**318**	**100**

[a] Nonindigenous species.
[b] Disproportionately large number of specimens collected as schooling adults at the surface.
[c] Disproportionately large number of specimens collected as small fry disgorged from buccal cavities of adult mouthbrooding females.

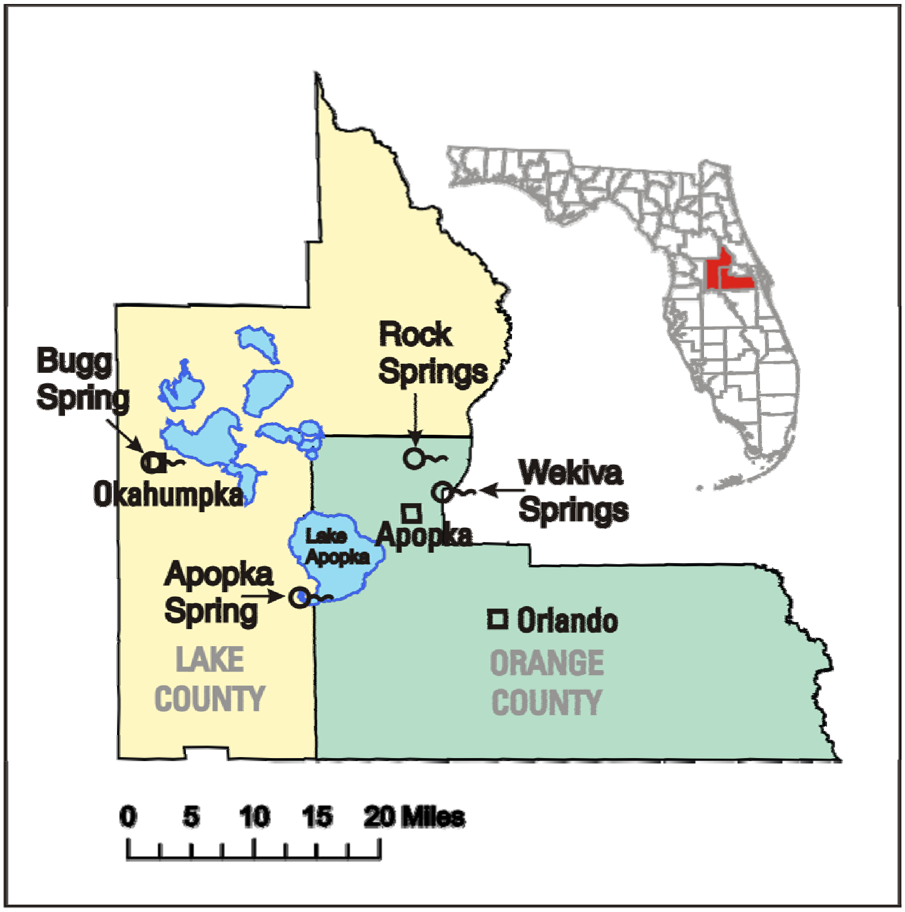

Figure 1. Location of Apopka, Bugg, Rock, and Wekiva springs, central Florida.

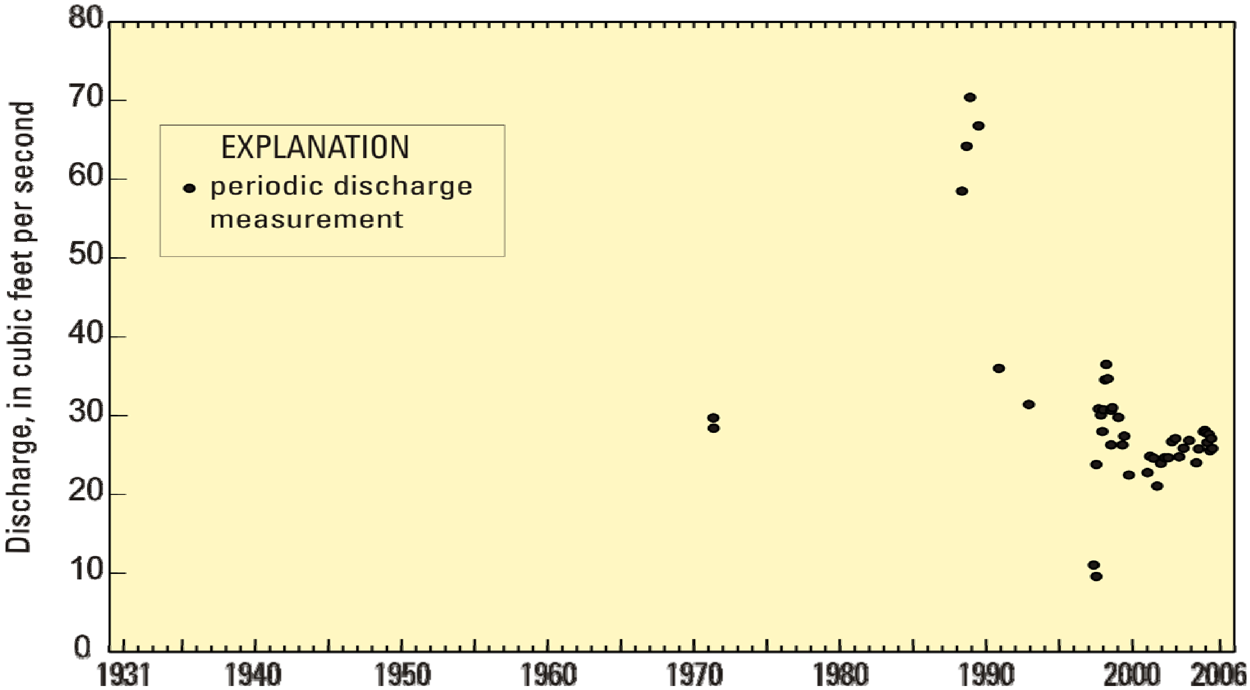

Figure 2. Periodic discharge measurements from Apopka Spring, 1971-2005 [Data from the St. Johns River Water Management District].

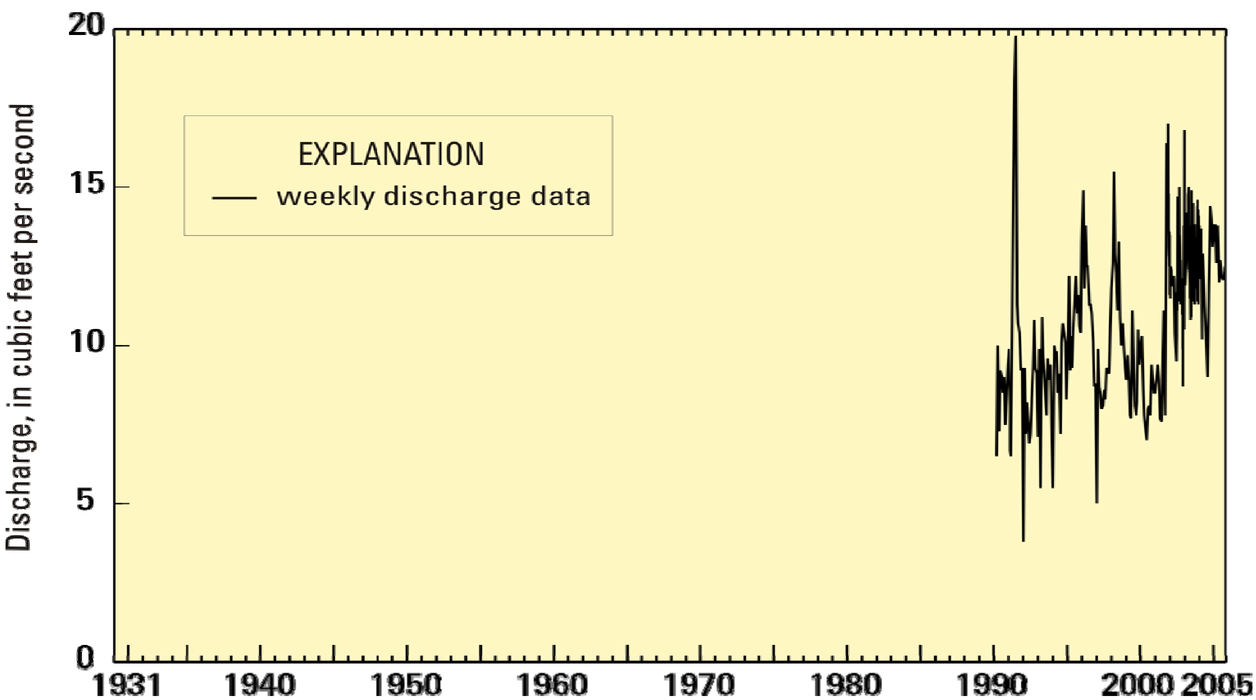

Figure 3. Weekly discharge data from Bugg Spring, 1990-2005 [Data from J. Branham].

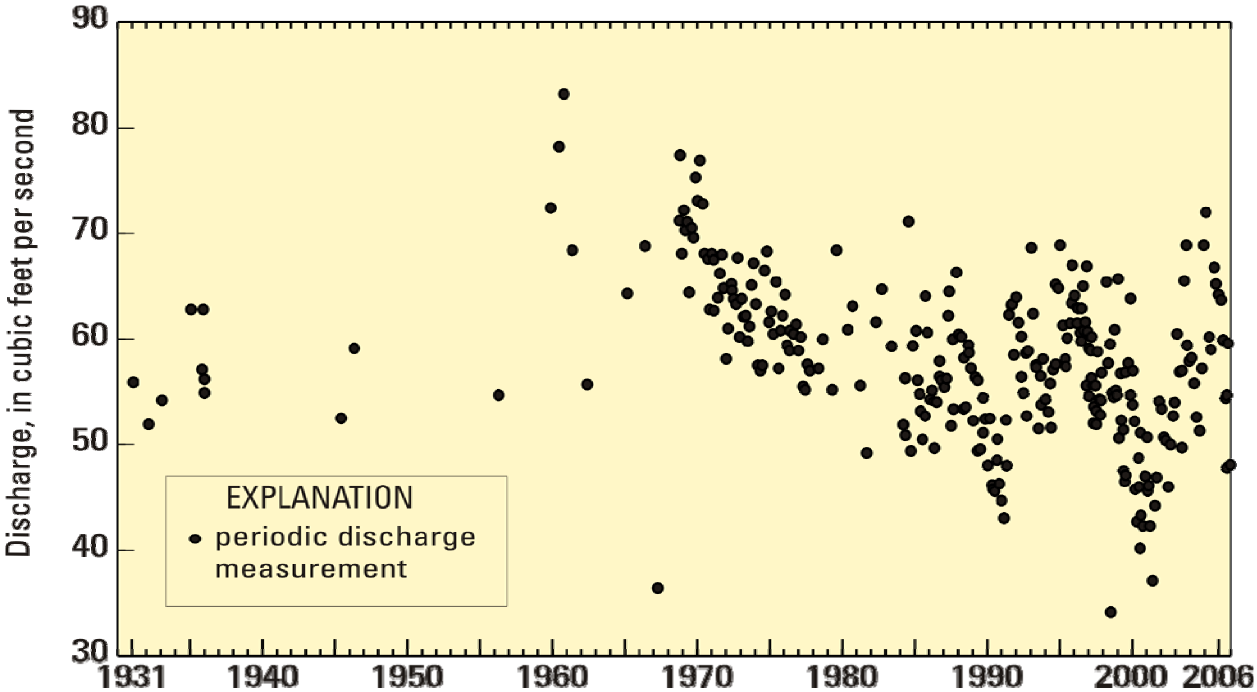

Figure 4. Periodic discharge measurements from Rock Springs, 1931-2006 [Data from the St. Johns River Water Management District and U.S. Geological Survey].

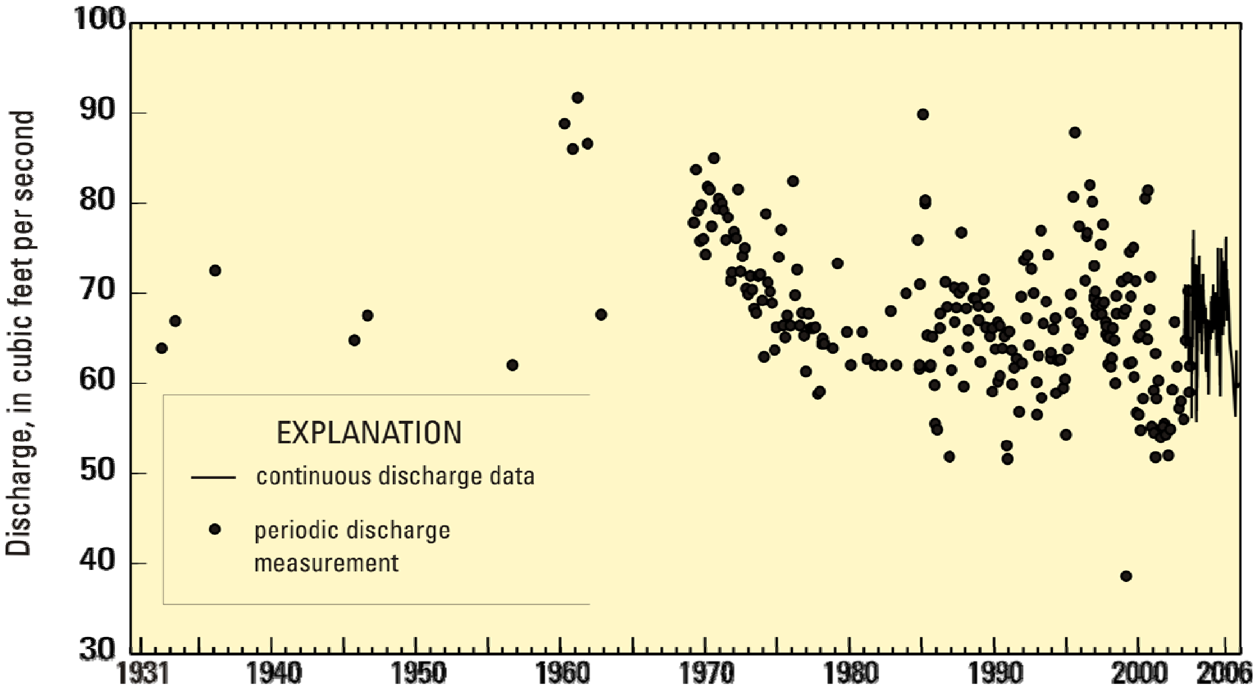

Figure 5. Continuous and periodic discharge data from Wekiva Springs, 1932-2006 [Data from the St. Johns River Water Management District and U.S. Geological Survey].

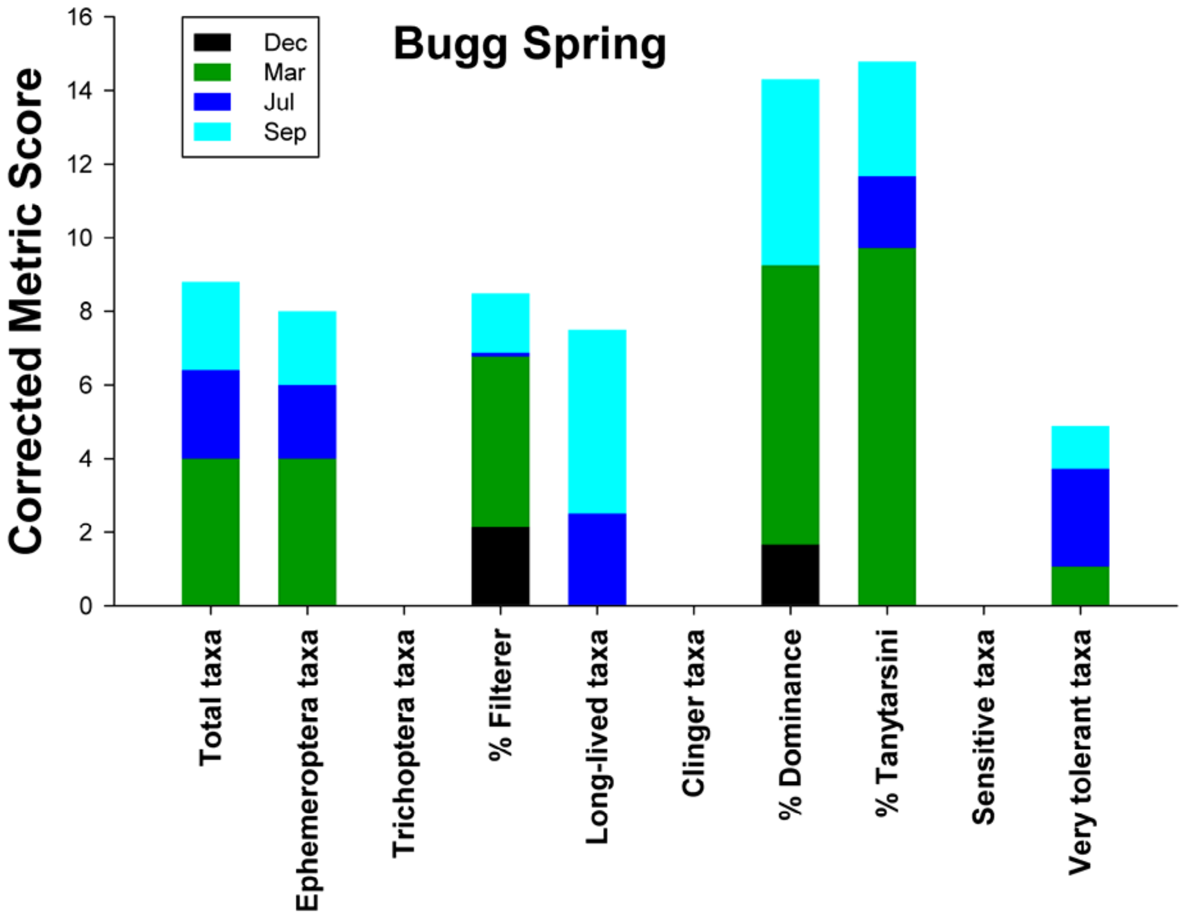

Figure 6. Metrics used to calculate the Stream Condition Index (SCI) for benthic macroinvertebrates collected by dip net from Bugg Spring, December 2005-September 2006 [For raw values <0 or >10, scores are corrected by adjusting to values of 0 or 10, respectively]

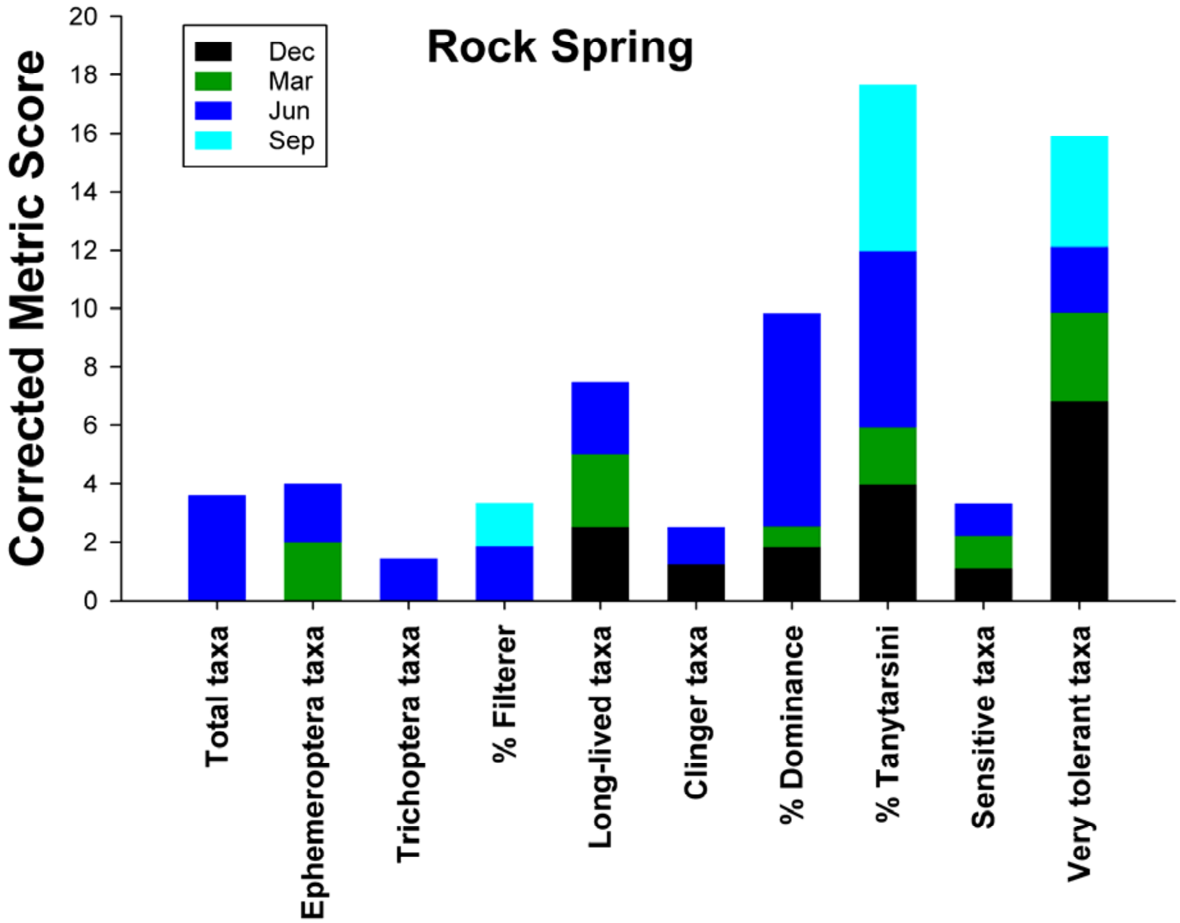

Figure 7. Metrics used to calculate the Stream Condition Index (SCI) for benthic macroinvertebrates collected by dip net from Rock Springs, December 2005-September 2006 [For raw values <0 or >10, scores are corrected by adjusting to values of 0 or 10, respectively].

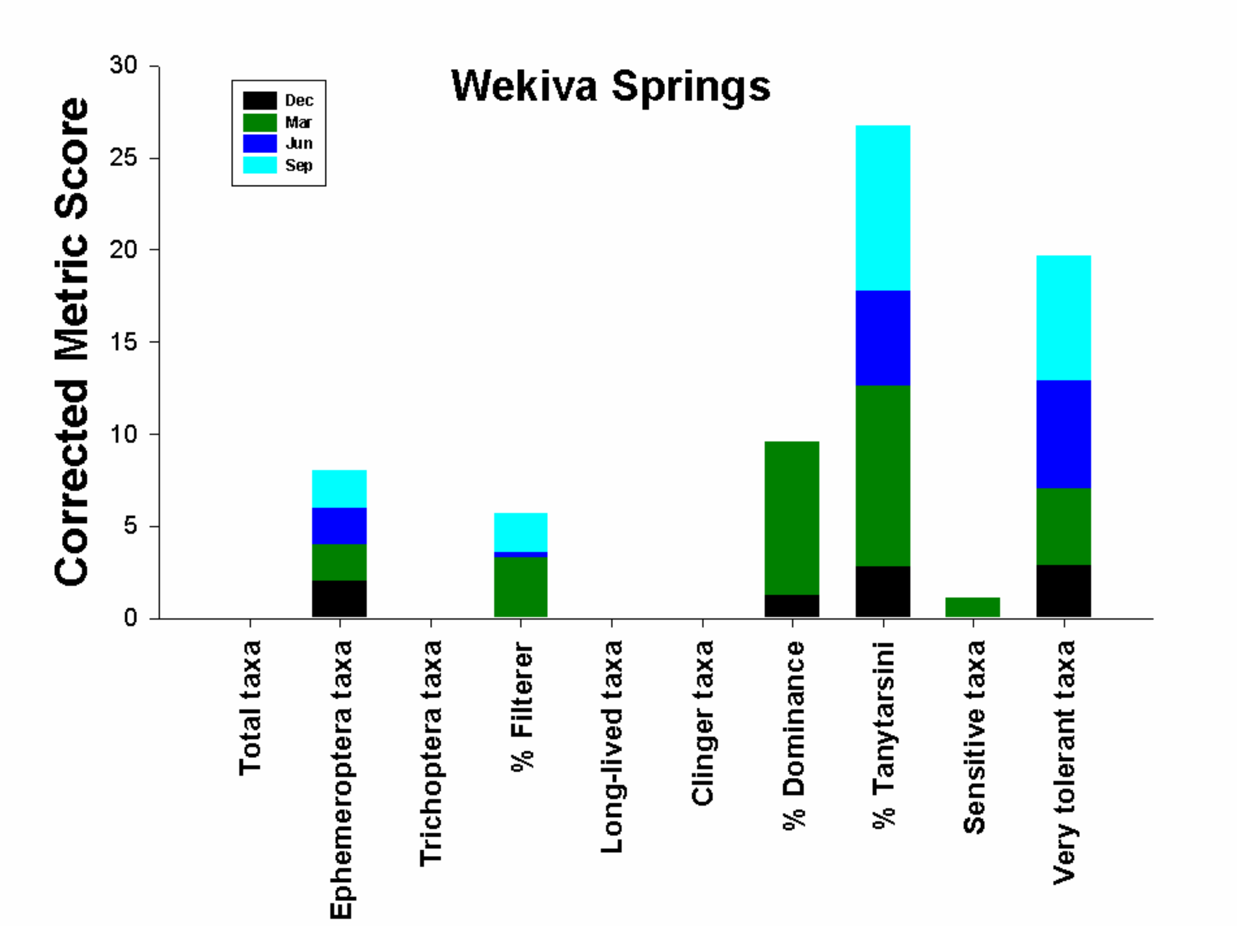

Figure 8. Metrics used to calculate the Stream Condition Index (SCI) for benthic macroinvertebrates collected by dip net from Wekiva Springs, December 2005-September 2006 [For raw values <0 or >10, scores are corrected by adjusting to values of 0 or 10, respectively].

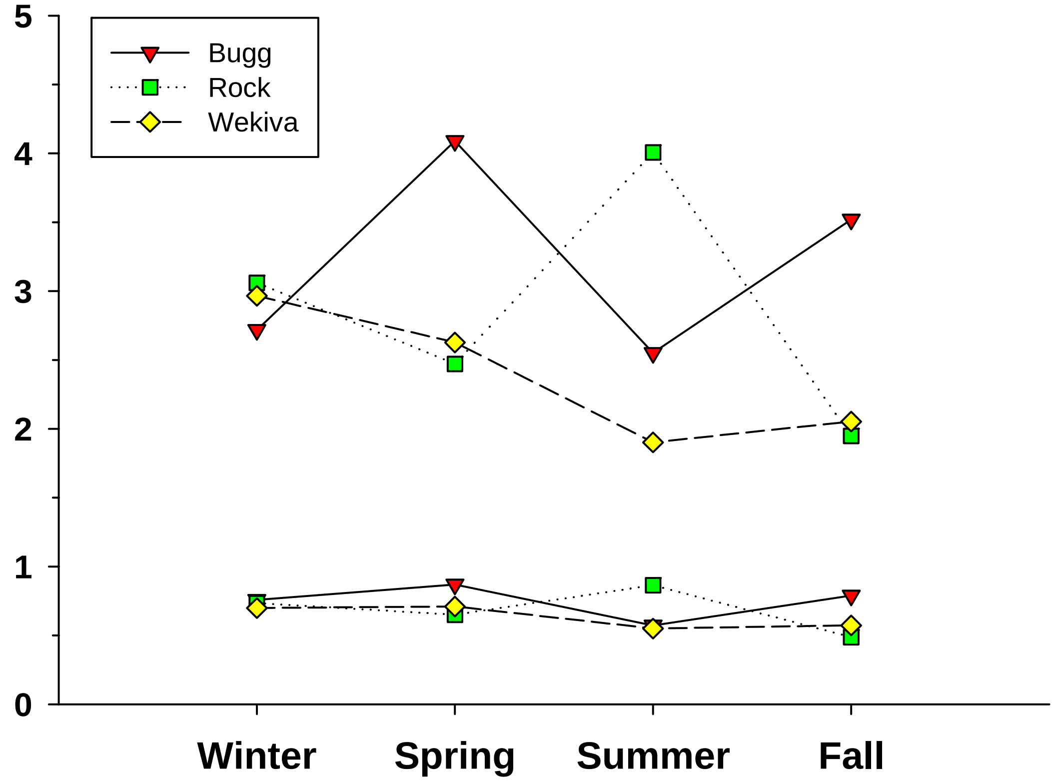

Figure 9. Shannon diversity index (*H´*, log base 2) and evenness (*J´*) by season for benthic macroinvertebrate assemblages collected by dip net from Bugg, Rock, and Wekiva springs, December 2005-September 2006.

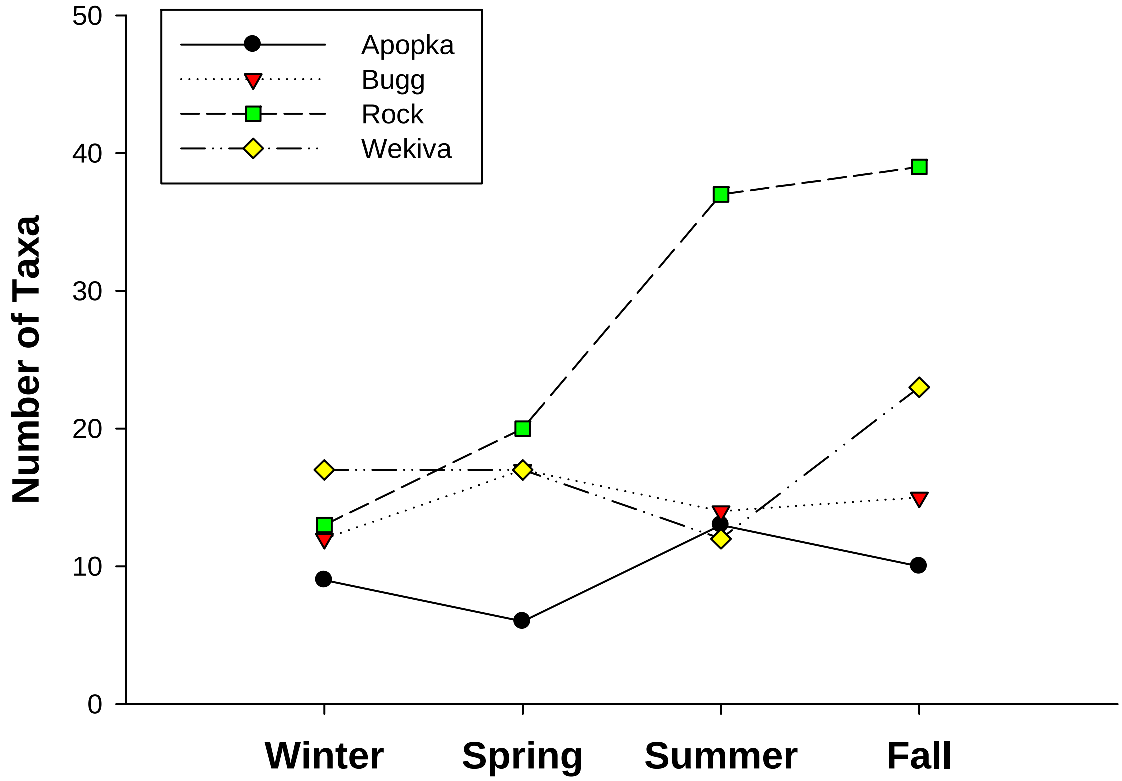

Figure 10. Richness of benthic macroinvertebrate taxa collected by pooled replicate ponar grabs (n = 3-4) by season for Apopka, Bugg, Rock, and Wekiva springs.

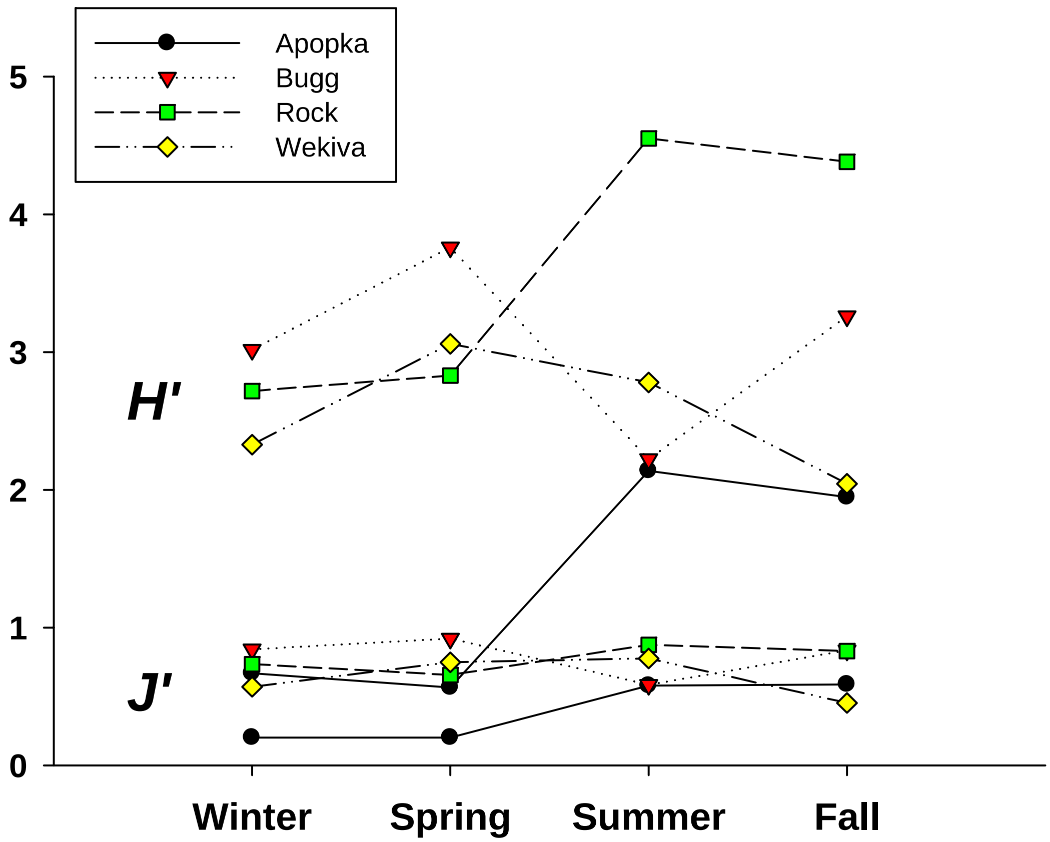

Figure 11. Shannon diversity index (*H´*, log base 2) and evenness (*J´*) by season for benthic macroinvertebrate assemblages collected by pooled ponar grabs (n = 3-4) from Apopka, Bugg, Rock, and Wekiva springs, December 2005-September 2006.

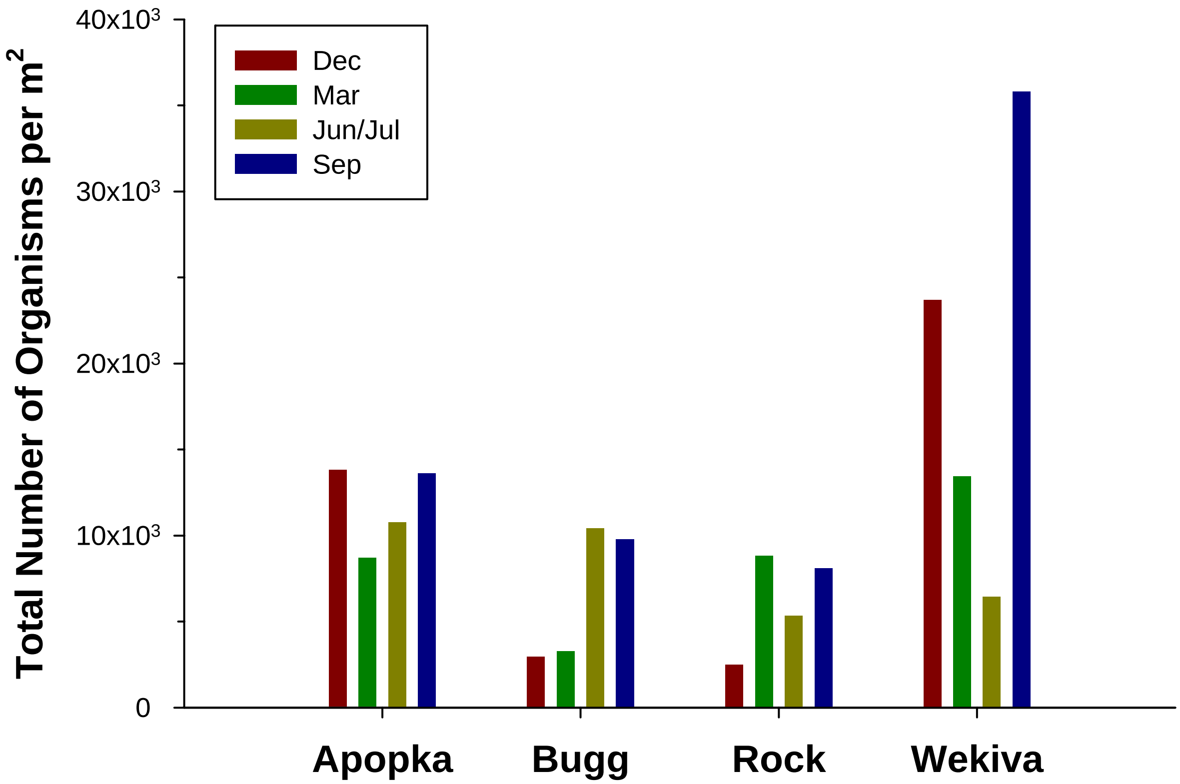

Figure 12. Abundance of benthic macroinvertebrates (all taxa combined) collected by pooled replicate ponar grabs by month for Apopka, Bugg, Rock, and Wekiva springs [n = 3-4 ponar grabs].

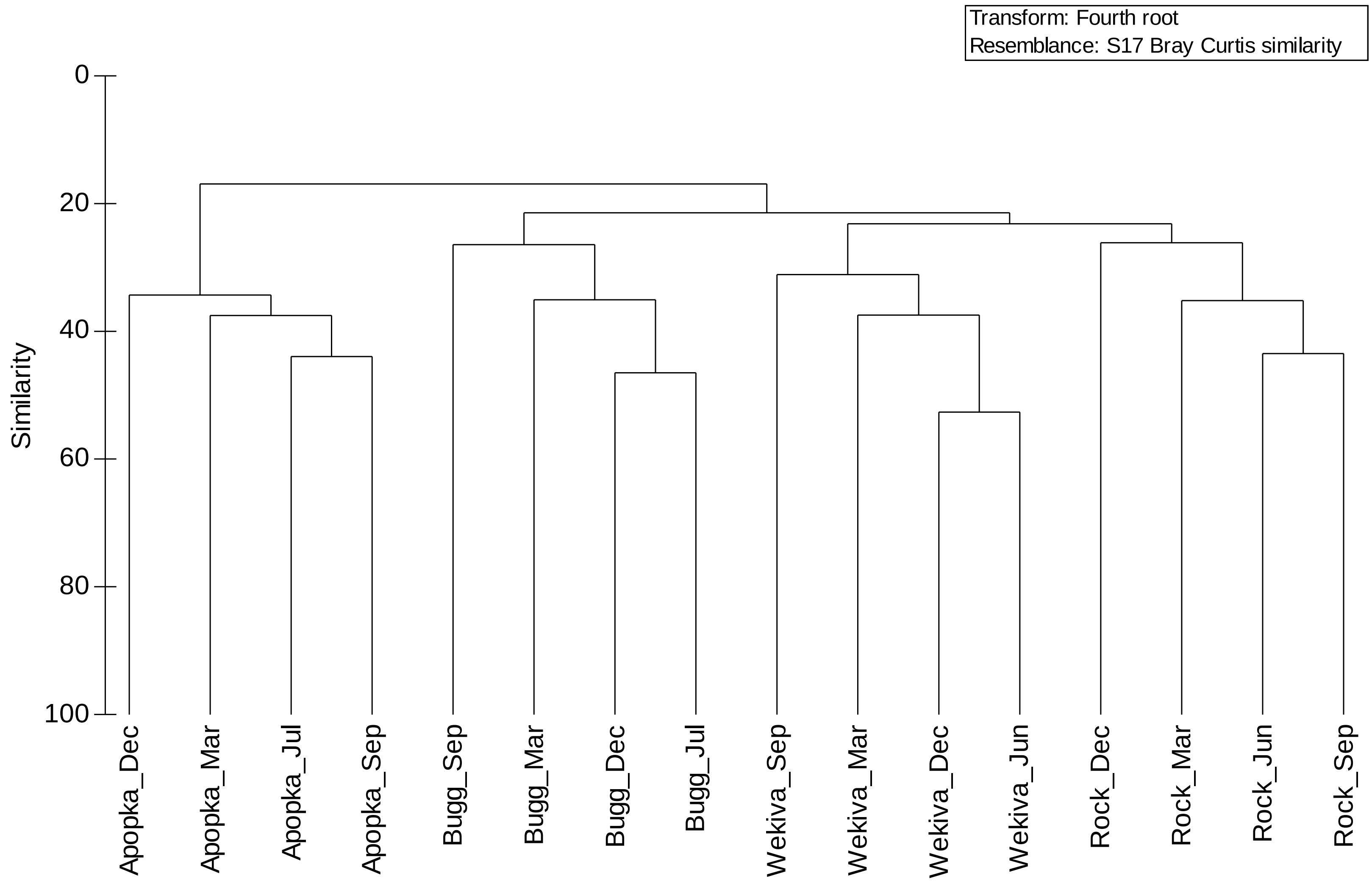

Figure 13. Hierarchical clustering dendrogram of benthic macroinvertebrate assemblages by pooled replicate ponar samples per date and spring [Calculated using group average of 4th-root transformed Bray-Curtis similarity].

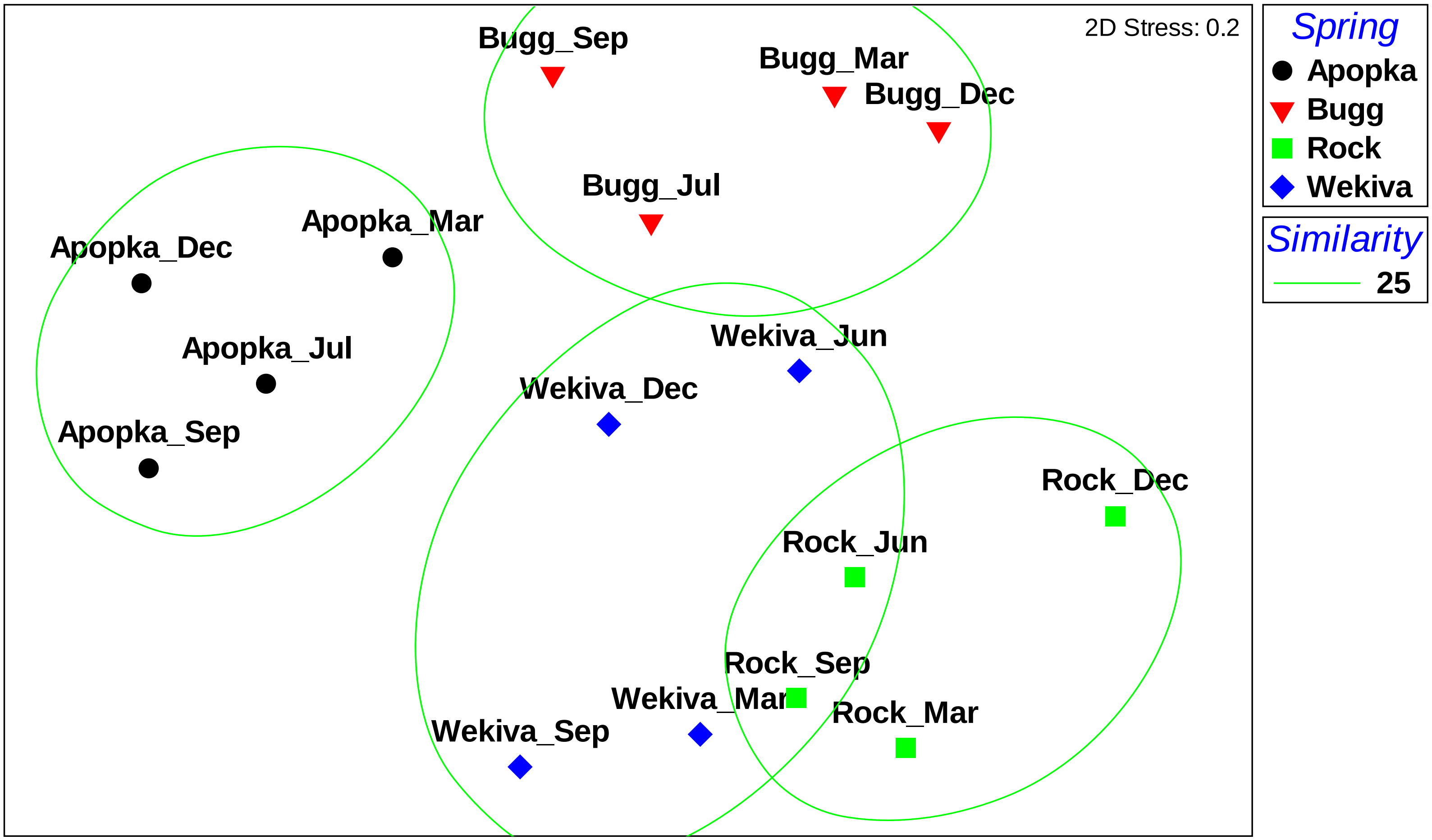

Figure 14. Non-metric multi-dimensional scaling (MDS) plot of benthic macroinvertebrate assemblages collected by petite ponar dredge at Apopka, Bugg, Rock, and Wekiva springs, December 2005-September 2006 [Plot generated using Primer (ver. 6.16). Plot generated from Bray-Curtis similarities of 4th-root transformed data representing pooled samples (n=3 for all except n=4 for spring, summer, and fall samples at Apopka Spring). Grouped clusters based on 25% similarity].

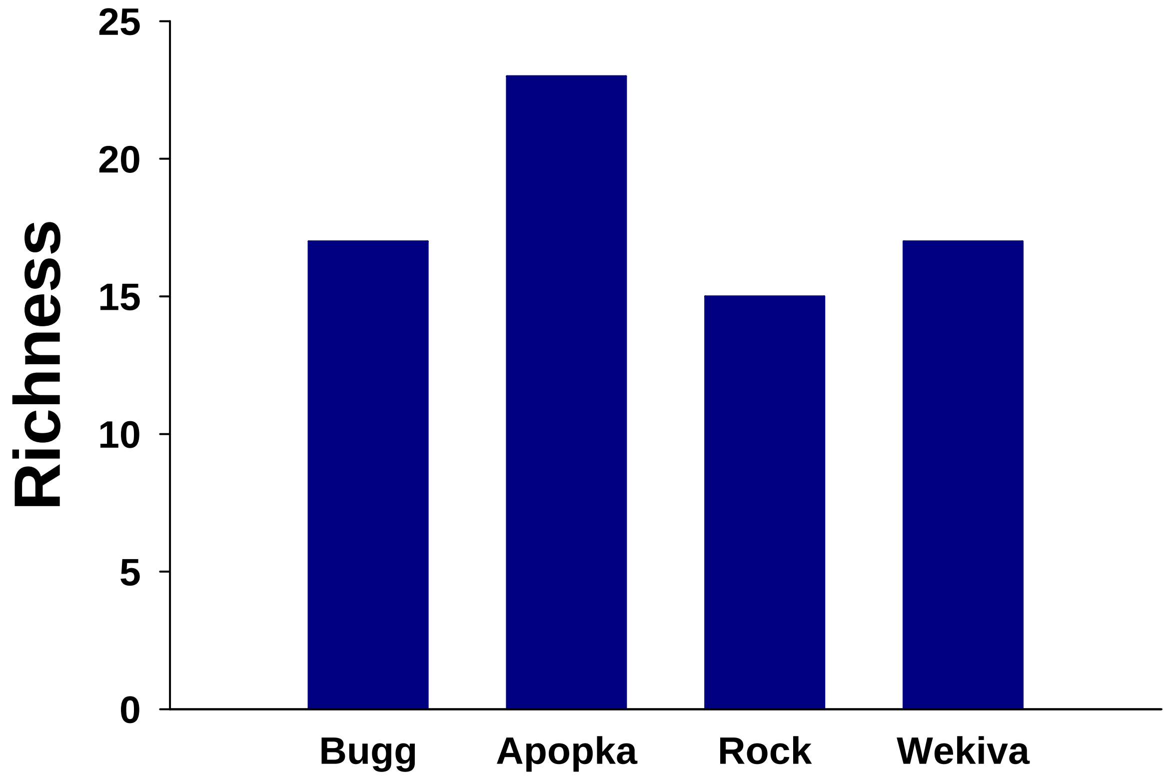

Figure 15. Total number of fish species collected at Apopka, Bugg, Rock, and Wekiva springs [Collection dates are listed in Table 16 legend].

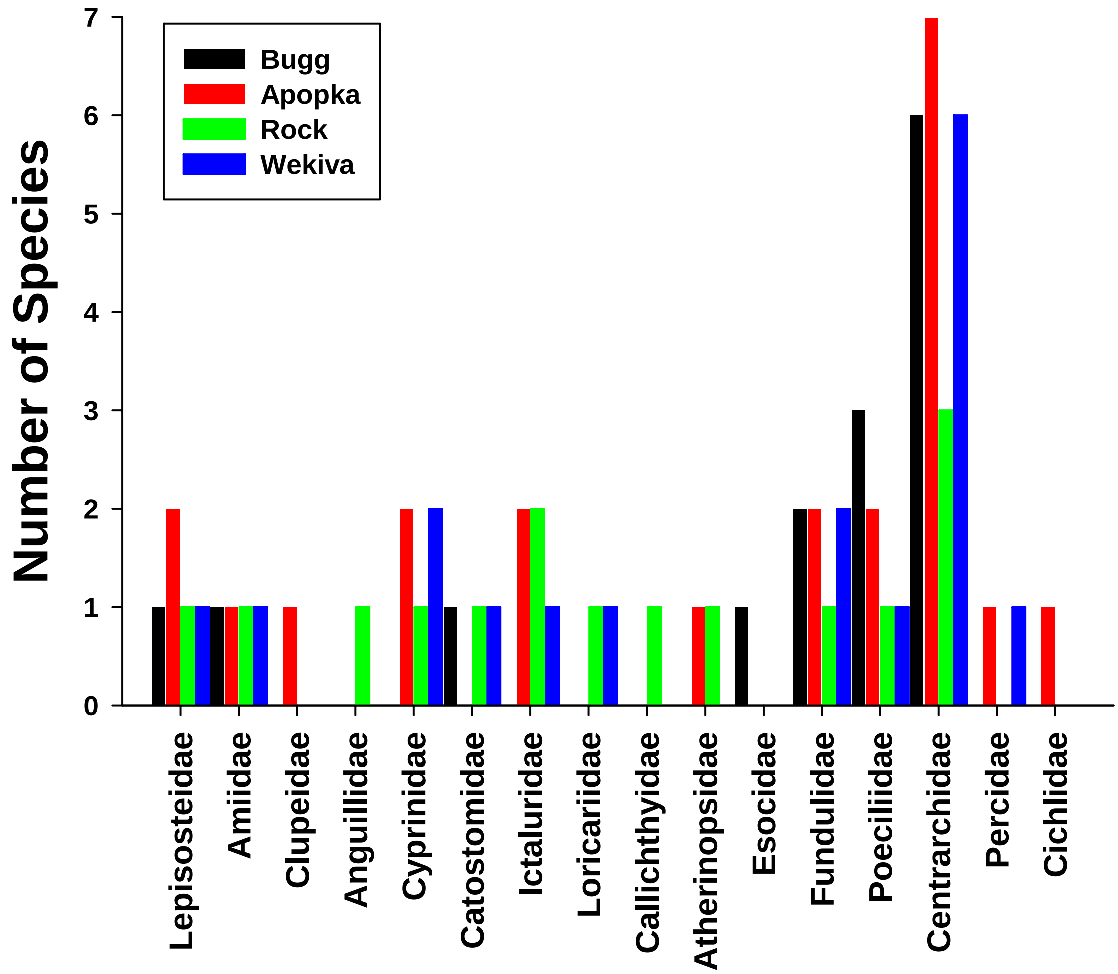

Figure 16. Number of species by family of fishes collected at Apopka, Bugg, Rock, and Wekiva springs [Collection dates are listed in Table 16 legend].