Executive Summary

Department staff conducted a study of the lower Ocklawaha basin, including eight tributary streams and two sites in the Ocklawaha River, located upstream and downstream of the Rodman Reservoir. The objectives were to gather baseline habitat, water quality, and biological information on the system prior to the proposed restoration activities, and to assess the status of TMDL waterbodies in the watershed.

Habitat quality was in the "optimal" or "suboptimal" range for all assessed stations. Habitat parameters of concern at selected study sites included substrate availability (Daisy Creek), water velocity (Sweetwater and Daisy Creeks), and habitat smothering (Sweetwater Creek, Deep Creek, and Camp Branch).

Of the ten Ocklawaha basin sites evaluated with the Stream Condition Index (SCI), six scored in the "excellent" category (Orange Creek, Ocklawaha River upstream of Eureka Dam, Ocklawaha River downstream of Rodman Dam, Deep Creek, Camp Branch, and Mill Creek). Two sites (Brunt Bridge Brook and Unnamed Creek @ 315) scored in the "good" category. Macroinvertebrate communities at the remaining two sites, Sweetwater and Daisy Creeks, were judged to be "poor".

The Shannon-Weaver Diversity Index decreased by 40% between the Ocklawaha River sites located upstream and downstream of the Rodman Reservoir. This represents a violation of the Class III surface water quality standard for biological integrity, which prohibits a diversity decrease of greater than 25% (Rule 62-302.530 FAC). The low diversity at the site below the Rodman Reservoir was due to the large numbers of an organism known to be favored by the export of algae from impoundments (the caddisfly, *Hydropsyche* sp.). Therefore, the presence of the Rodman Dam (and resulting impoundment) may be thought of as contributing to the lowered diversity. Note however, that the overall community health at this site was excellent, as reflected by the SCI score.

Bio-Recon (a rapid method) and SCI (more comprehensive) methods were performed concurrently at eight sites to continue to evaluate the relationship between these techniques. The two different methods yielded results consistent with their intended use at all eight sites.

Total phosphorus enrichment was observed in Orange Creek (0.19 mg/L) and Daisy Creek (0.33 mg/L). Elevated levels of nitrite-nitrate (0.52 mg/L) were found at the Ocklawaha River upstream of Eureka Dam, probably due to groundwater inputs from Silver Springs. Dissolved oxygen was well below the Class III surface water quality standard of 5.0 mg/L at Unnamed Creek @ SR 315 (2.9 mg/L), Sweetwater Creek (0.5 mg/L) and Mill Creek (3.8 mg/L) with zero-flow conditions contributing heavily to the low dissolved oxygen concentrations at Sweetwater Creek. Dissolved oxygen at three other the sites (Bruntbridge Brook, Camp Branch, and Daisy Creek) were slightly below the state standard.

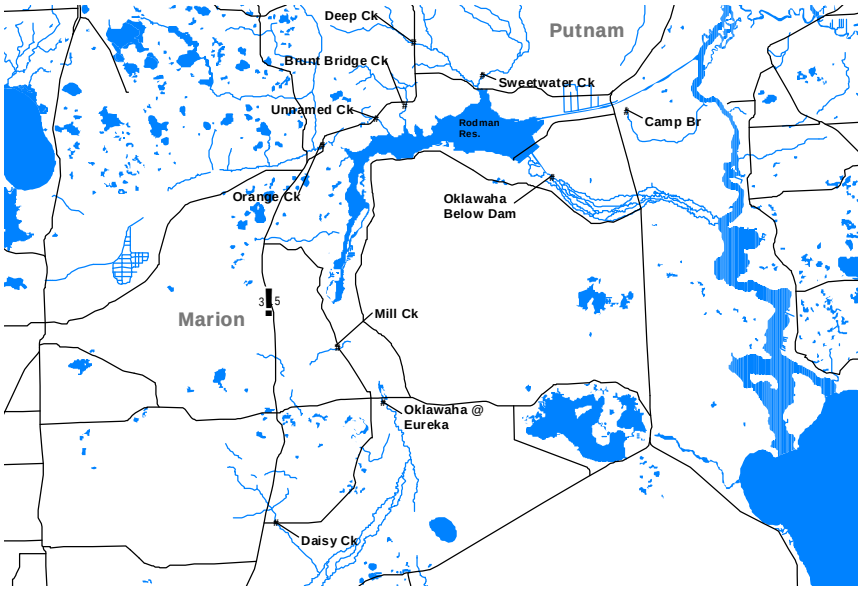
It is recommended Daisy Creek (SCI results in the "poor" range, phosphorus enrichment, low dissolved oxygen) and Sweetwater (SCI results in the "poor" range, low dissolved oxygen) remain on the 303(d) list. Biological health was excellent at Orange Creek, but total phosphorus was moderately elevated. It is recommended that Orange Creek also remain on the 303d list for the purpose of addressing the phosphorus enrichment from that watershed.

Introduction

In 1933, legislation was passed creating the Canal Authority of the State of Florida. This act gave the State the power to construct a canal across the state, from one Florida coast to the other. Construction on the canal began in 1964 by the Army Corp of Engineers. One of the major components of the canal was the construction of tow dams on the lower Ocklawaha River creating a navigable waterway from the St. Johns River to Silver Run, due east of Ocala. These two dams created the impoundment, the Rodman Reservoir. In 1969, the Environmental Defense Fund filed suit in federal court to seek a permanent injunction against further construction of the canal. In 1976, Governor Askew stopped the construction of the canal and established a task force to make recommendations about the best use of the canal lands. After 15 years of study, the Cross-Florida Barge Canal was officially deauthorized in early 1991. Since that time many have argued the best way to "restore" the land with much of the controversy surrounding the Rodman Reservoir. After a 2 year intensive study on the different alternatives for restoration, Governor Chiles directed the Department of Environmental Protection to begin restoring the Ocklawaha River back to its normal flow by controlled drawdowns of the Rodman Reservoir.

The main objective of this study was to gather baseline data on tributary streams to the Ocklawaha River. This sampling event represents conditions before the proposed restoration, and these data may be compared to determine changes in biological community health after restoration is complete. A secondary objective of this study was to assess the status of selected waterbodies on the TMDL list by conducting biological sampling of instream biota. Three of the waterbodies within the Ocklawaha River Basin have been placed on the 303(d) list, Sweetwater, Orange, and Daisy Creeks. Water bodies on this list are required by EPA to have a Total Maximum Daily Load (TMDL) study performed on them. The purpose of the TMDL is to determine the amount of pollution reduction needed to restore the system to a condition suitable for its designated use. In this case, the designated use is for recreation and the maintenance of a healthy, well-balanced aquatic community.

Figure 1: Overview Map



Methods

To fulfill the above objectives, we collected biological, habitat, and physical/chemical information from selected streams in the drainage basin.

Habitat quality (FDEP 1996, Biology Section Standard Operating Procedure #BA-18), physical/chemical data (FDEP 1996, Biology Section Standard Operating Procedure #BA-17) and benthic macroinvertebrate communities were evaluated at all ten study sites. The department's 20 dip net methodology (FDEP 1996, Biology Section Standard Operating Procedure #BA-7) was used to determine biological health of the systems. Invertebrates were collected from the most productive habitats (*e.g.*, snags, leaf packs, root mats, vegetation) at each site using 20 discrete dip net sweeps. The samples were then identified under dissecting and compound microscopes to the lowest practical taxonomic unit. The Stream Condition Index is calculated on the resulting data. Points are assigned to a variety of parameters, depending on how closely each parameter approaches an expected reference condition. The parameters involved in the Stream Condition Index (SCI) are taxa richness, % contribution of the dominant taxon, the Florida Index, the EPT Index, number of chironomid taxa, % Diptera, and % filter feeders. The SCI rates a site as excellent, good, poor, or severely degraded, based upon a slightly variable point scale for geographic region (Panhandle, Peninsula, or Northeast) and season (summer vs. winter).

Eight of the ten sites (Orange Creek, Mill Creek, Brunt Bridge Brook, Unnamed Creek at SR 315 and Daisy Creek) were also evaluated using DEP's technique for rapid biological reconnaissance, Bio-Recon (FDEP 1996, Biology Section Standard Operating Procedure #BA-29). Invertebrates were collected from the most productive habitats (*e.g.*, snags, leaf packs, root mats, vegetation) at each site using 4 discrete dip net sweeps. The samples were then field picked, and brought back to the laboratory for identification under a dissecting microscope. Bio-Recon is a screening tool, designed to determine which systems are biologically healthy. Thresholds, specific to this method, have been established for taxa richness, the EPT Index, and the Florida Index. These thresholds vary slightly with geographic region. If two of the three thresholds are exceeded, the site is considered healthy. Streams that fail the Bio-Recon are suspected to be impaired, and it is suggested that follow-up, definitive sampling (using Stream Condition Index methods) be performed for further evaluation. Additional invertebrate collections, using Hester-Dendy samplers (FDEP 1996, Biology Section Standard Operating Procedure #BA-13) were taken at two of the ten stations (Ocklawaha River near State Route 316 bridge in Eureka & Ocklawaha River 1.1 miles downstream of Rodman Dam).

Explanation of Measurements of Community Health

Selected measurements of macroinvertebrate community health were employed to assess a site. These are briefly discussed here.

Habitat Assessment: Eight attributes known to have potential effects on the stream biota were evaluated and scored, with 20 points possible for each factor. Based on the sum of these individual scores, overall habitat quality is assigned to one of four categories: Optimal (121-160 points); Suboptimal (81-120 points); Marginal (41-80 points); and Poor (0-40 points).

Taxa richness: This measurement is based on the total number of taxa found at a site. Stress tends to reduce the number of different types of organisms present in a system, although moderate nutrient enrichment may sometimes be correlated with increased algal taxa richness.

The Shannon-Weaver diversity index (D Bar): Based upon a combination of the taxa richness at a site and how equitably distributed the abundance of individuals are between each taxon. This index is specified in the Florida Administrative Code as a measure of biological integrity. Low diversity scores are undesirable. They represent conditions where a few organisms are very abundant, to the exclusion of other taxa. Excessive numerical dominance of a single type of organism (a high % contribution of the dominant taxon) is a related measure also associated with disturbance.

Numbers of pollution sensitive taxa: Some organisms become rare or absent as the intensity or duration of disturbance increases. For example, the Florida Index assigns points to stream-dwelling macroinvertebrates based on their sensitivity to pollution (see Ross 1990). A site with a high Florida Index score is considered healthy.

Ephemeroptera/Plecoptera/Trichoptera (EPT) Index: This index is the sum of the number of larval Mayfly, Stonefly and Caddisfly taxa present. Higher EPT values are associated with healthier systems.

Community Structure: Substantial shifts in the proportions of major groups of organisms, compared to reference conditions, may indicate degradation.

Trophic composition/feeding guilds: Disturbance can shift the feeding strategies of invertebrates. In Florida, for example, pollution may be responsible for reducing the number of filter - feeders (Barbour et al. 1996).

Description of Sampling Sites

All ten sites sampled for this investigation lie within the Eastern Florida flatwoods Subregion (75d). The land is predominantly a combination of sandy, natural flatwoods with some wetland areas. Urban areas and agriculture make up a much smaller percentage of the landuse in the area.

The Ocklawaha River upstream of State Route 316 bridge near Eureka, FL is the farthest site upstream of Eureka Dam and the Rodman Reservoir. The drainage basin upstream of this site is nearly 1400 square miles, too large to accurately assess non-point source pollution. Silver River contributes the largest flow to the Ocklawaha River in this area. Therefore, landuse can be best summarized from the confluence of the Silver River. This encompasses approximately 97.3 square miles, consisting mainly of natural upland forest and wetlands (80% of the drainage basin). Urban and agriculture area's make up only approximately 11% of the basin.

Agricultural uses make up over 25% of Orange Creek at State Road 315's approximate 40 square mile drainage basin. Natural uplands and wetlands comprise about 65% of the landuse with only slightly over 6% being urban.

Unnamed Creek and Bruntbridge Brook, both at State Road 315, have smaller drainage basins (2.4 and 5.7 square miles, respectively). Both basins have similar landuse: over 90% natural, less than 5% agriculture and less than 1% urban. Unnamed Creek @ SR 315 is a small 2nd order stream that probably goes dry during drought conditions.

Seventy-five percent of the landuse in the Deep Creek at State Road 315 drainage basin is natural upland forest or wetlands. Approximately, 19% of the 12.3 square miles is urban and agriculture.

Sweetwater Creek, located approximately 0.5 miles north of State Road 310, has nearly 19% urban landuse in its basin. The majority of the land use (72%) is natural. Dissolved oxygen, coliforms, un-ionized ammonia, and nutrients were parameters of concern on the 1998 303(d) list.

Land use in the Camp Branch drainage basin (at Rodman Dam Road) is nearly 30% agricultural. Sixty-two percent of this basin is natural. The stream was divided when the barge canal was constructed.

Land use impacts at the Ocklawaha River site located 1.1 miles downstream of Rodman Dam are integrated affects from the entire upstream basin.

Mill Creek at Daisy Road was placed on the 1998 state of Florida 303(d) list for high levels of coliforms, nutrients, and iron. The site was recently dry.

Dissolved oxygen, nutrients, turbidity, coliforms, and iron were parameters of concern on the 1998 303(d) list for Daisy Creek at Daisy Road. Daisy Creek is an intermittent stream that drains a local sod farm.

Sampling for this investigation was performed on August 10th and 11th, 1998 jointly by FDEP's Bureau of Laboratories and Central District staffs. The FDEP Central Laboratories performed the Biological and Chemical analysis.

Results and Discussion

Summary of Results by Site

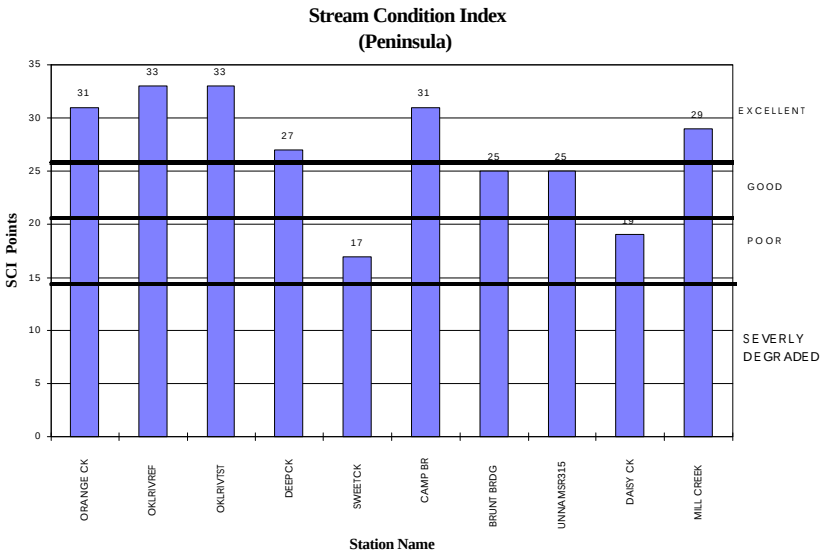
The Ocklawaha River near Eureka, FL had "optimal" habitat (96%, 139 points out of 145). Nitrogen as nitrite-nitrate (0.52 mg/L) was elevated above 85% of other Florida streams. Elevated nitrite-nitrate levels can be explained by the large spring input carried into the Ocklawaha River by Silver River from Silver Springs. Many Florida springs have elevated nitrite-nitrate levels due to nitrogen loading in their respective recharge areas. The source of the nitrate-nitrate is predominantly from inorganic fertilizers or animal and human wastes. Other nutrient species were found at acceptable limits within the river. Total Kjeldahl nitrogen (0.32 mg/L) and ammonia (0.02 mg/L) were near background levels. Total phosphorus (0.086 mg/L) was also below the majority of streams in Florida. Conductivity (386 µmhos/cm) and pH (7.6 SU) values were indicative of a spring-fed stream. Dissolved oxygen (5.5 mg/L) complied with the Class III surface water standard of 5.0 mg/L. Biological communities were healthy, as indicated by an SCI score (33 points) in the "excellent" category. Taxa richness (38), EPT (10) and Florida Index (20) were all well above the expected threshold for healthy streams. Six replicate Hester-Dendy samplers produced 47 total taxa, 14 EPT and 34 Florida Index points. The Shannon-Weaver Diversity was 3.7, a better than average value.

Habitat was "optimal" at Orange Creek (86%, 138 points out of 160). Total Kjeldahl nitrogen (1.4 mg/L) and total phosphorus (0.19 mg/L) levels indicated anthropogenic inputs into the system (greater than 75% and 60%, respectively, of streams in Florida). Nitrite-nitrate (0.08 mg/L) concentrations were slightly elevated compared to other Florida streams. Ammonia (0.029 mg/L) was near background levels. The pH (6.2 SU) was slightly acidic. Con-

	ORANGE CK	MILL CK	BRUNT BRDG	UNNAMED @ 315	Camp Branch	Sweetwater Ck	Deep Ck	DAISY CK
StoretCode	20020006		20020142	20020143	20020141	20020145	20020144	20020118
Total Taxa	***29***	***28***	***21***	17	***34***	***28***	***38***	***19***
FL Index	***15***	***12***	***10***	8	***18***	3	***30***	4
EPT	***10***	***9***	***4***	2	***9***	2	***13***	2

Figure 2: BioRecon Data (Scores that exceeded regional thresholds are italicized)

ductivity (84 µmhos/cm) was typical of peninsular blackwater streams. The dissolved oxygen (5.9 mg/L) was adequate to support aquatic life. Both the 20 dip net (SCI) and 4 dip net (Bio-Recon) biological assessment methods were performed on Orange Creek. Both assessments indicated the stream was healthy. The SCI (31 points) scored in the "excellent" category with taxa richness (40), EPT (6) and Florida Index (8) all indicative of healthy biological communities. Taxa richness (29), EPT (10) and Florida Index (15) exceeded all three Bio-Recon thresholds for peninsular streams (18, 10 and 4, respectively).

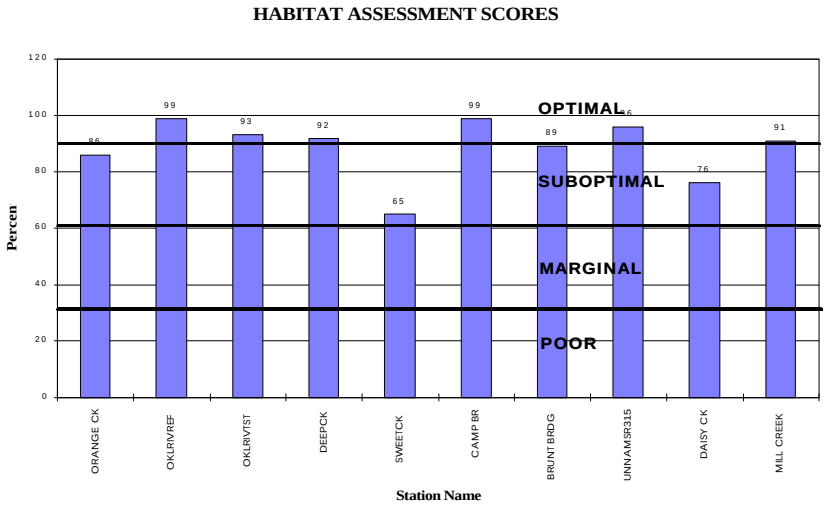


Unnamed Creek @ SR 315 had "optimal" habitat (96%, 154 points out of 160). Total Kjeldahl nitrogen (0.89 mg/L) was the only chemical parameter above ambient levels. Ammonia (0.021 mg/L) nitrite-nitrate (undetected), and total phosphorus (0.015 mg/L) were all within the lowest 5 percentile of Florida streams. Conductivity (63 µmhos/cm) was low and pH (3.9 SU) was the most acidic of any of the sites in this study. The dissolved oxygen (2.9 mg/L) was below the state water quality standard of 5.0 mg/L. Biological communities were evaluated using both SCI and Bio-Recon methodologies. The Bio-Recon indicated "suspected impairment" at this site. While none of the three metrics met or exceeded their thresholds, total taxa (17), EPT (2), and Florida Index (8) were all within 2 points of their respective thresholds (18, 4 and 18). The more intensive Stream Condition Index (25 points) ranked Unnamed Creek @ SR 315 in the "good" category. In fact, the SCI score at this location was only 1 point shy of being in the "excellent" category. Taxa richness (23) and EPT (3) were slightly below expected values for healthy streams. Conversely, the Florida Index (16) far exceeded the expected threshold.

Habitat scored in the "optimal" category at Bruntbridge Brook (89%, 143 points out of 160). Total Kjeldahl nitrogen (1.0 mg/L) and total phosphorus (0.07 mg/L) were slightly elevated above ambient levels. Ammonia (0.027 mg/L) and nitrite-nitrate (undetected) were both within the lowest 5 percent of Florida streams. Conductivity was 99 µmhos/cm and the pH was 5.3. Dissolved oxygen (4.3 mg/L) was below the

	ORANGE CK	OKLAWAHA @ EUREKA	OKLAWAHA @ BELOW DAM	DEEP CK	CAMP BR	BRUNT BRDG	UNNAMED @ 315	DAISY CK	MILL CK	SWTWTR CK
StoretCode	20020006	20020012	20020068	20020144	20020141	20020142	20020143	20020118		20020145
Ammonia (mg/l)	0.029	0.02	Undetected	0.02	0.04	0.027	0.021	N/A	N/A	0.048
Nitrite-Nitrate (mg/l)	0.08	0.52	Undetected	0.01	0.05	Undetected	Undetected	0.03	Undetected	0.004
TKN (mg/l)	1.4	0.32	0.48	0.69	0.37	1	0.89	1.2	1.6	0.52
TP (mg/l)	0.19	0.086	0.055	0.029	0.074	0.07	0.015	0.33	0.041	0.074
Conductivity (umho/cm^2)	84	386	446	120	407	99	63	92	59	120
DO (mg/l)	5.9	5.5	7.5	5.9	4.7	4.3	2.9	4.5	3.8	0.5
pH (SU)	6.22	7.57	7.92	6.85	7.38	5.33	3.93	6.1	5.04	6.72
Temp (C)	24.6	24.5	29.1	24.2	28.6	24.2	25.6	24.7	24.8	25.1
SCI (score)	31	33	33	27	31	25	25	19	29	17
SCI (Category)	Excellent	Excellent	Excellent	Excellent	Excellent	Good	Good	Poor	Excellent	Poor
Total Taxa	40	38	41	30	33	24	23	22	35	33
FL Index	8	20	15	17	14	7	16	1	15	2
EPT	6	10	8	10	10	2	3	0	4	1
Chironomidae	12	10	14	2	5	6	7	5	14	8
% Diptera	36.84	25.83	28.76	7.14	6.01	31.71	37.34	16.48	53.62	25.81
% Filterers	19.74	33.44	30.9	12.76	18.58	22.36	20.54	8.24	46.38	0.32
% Dominat Taxa	10.53	14.57	16.31	24.49	15.85	19.51	35.27	28.57	34.78	39.35

Figure 3: Chemistry & Stream Condition Index Data



state standard of 5.0 mg/L. The SCI (25 points) scored this site near the top of the "good" category. Taxa richness (24), EPT (2) and Florida Index (7) were either slightly below or just met expected values for healthy streams. Brunt Bridge Brook met or exceeded all three metrics for the Bio-Recon (taxa richness-21, EPT-4, Florida Index-10).

Deep Creek had "optimal" habitat (89%, 129 points out of 145) with only slight to moderate habitat smothering. Ammonia (0.02 mg/L), nitrite-nitrate (0.01 mg/L), total Kjeldahl nitrogen (0.69 mg/L) and total phosphorus (0.029 mg/L) were all near background levels. Conductivity at this site was 120 µmhos/cm and the pH was 6.8 SU. The dissolved oxygen (5.9 mg/L) complied with Class III surface water standards. The SCI indicated the biological communities were in the "excellent" category (with 27 points). Taxa richness (30), EPT (10) and Florida Index (17) all exceeded expectations for healthy systems. Biorecon results also indicated healthy conditions (Taxa richness-38, FL Index-30, EPT-13).

Sweetwater Creek had habitat (63%, 91 points out of 145) in the "sub-optimal" category. The site had severe habitat smothering and almost no flow at the time of sampling. Ammonia (0.048 mg/L), nitrite-nitrate (0.004 mg/L), total Kjeldahl nitrogen (0.52 mg/L) and total phosphorus (0.074 mg/L) were all at acceptable levels (in the lower 40% of Florida streams). Conductivity was 120 µmhos/cm and the pH was 6.7 SU. Dissolved oxygen (0.5 mg/L) was too low to support a healthy aquatic community, potentially due to the lack of flow in the stream and the presence of oxygen demanding organic matter. Biological communities in Sweetwater Creek showed suspected impairment using the Biorecon protocal. Only Taxa Richness (28) met or exceeded its threshold level (FL Index-3, EPT-2). More intensive investigation using the Stream Condition Index (17 points, "poor") confirmed the Biorecon results. Measures of sensitive organisms, EPT (1) and Florida Index (2), for the SCI were well below expected values for healthy streams.

Habitat was "optimal" at Camp Branch (95%, 138 points out of 145) with slight silt smothering of productive habitat. Ammonia (0.04 mg/L), nitrite-nitrate (0.05 mg/L), total Kjeldahl nitrogen (0.37 mg/L) and total phosphorus (0.074 mg/L) were all at acceptable levels (in the lower 40% of Florida streams). High conductivity (407 µmhos/cm) and pH (7.4 SU) are probably due to calcareous inputs. The dissolved oxygen (4.7 mg/L) was slightly below the state standard but did not seem to be adversely affecting aquatic life. Biological communities were in the "excellent" category of the SCI (31 points). Taxa richness (33), EPT (10) and Florida Index (14) all indicated healthy biological communities. Biorecon results agreed with the SCI. All three metrics exceeded thresholds for the Biorecon (Taxa Richness-34, FL Index- 18, EPT- 9).

The Ocklawaha River downstream of Rodman Dam had "optimal" habitat (90%, 130 points out of 145) only losing a few points for smothering and artificial channelization. Ammonia (undetected), nitrite-nitrate (undetected), total Kjeldahl nitrogen (0.48 mg/L) and total phosphorus (0.055 mg/L) were in the lower 30th percentile of Florida streams. Conductivity (446 µmhos/cm) and pH (7.9 SU) at this site indicate calcareous spring inputs (mainly the Silver River). Dissolved oxygen levels (7.5 mg/L) complied with Class III water quality standards. Biological communities were healthy, as indicated by an SCI score (33 points) in the "excellent" category. Taxa richness (41), EPT (8) and Florida Index (15) were all well above the expected threshold for healthy streams. Macroinvertebrate sampling using Hester-Dendy samplers produced 44 total taxa, 15 EPT and 31 Florida Index points. The Shannon-Weaver Diversity was 2.2, which is below average for a Florida stream.

Habitat was "optimal" at Mill Creek (91%, 146 points out of 160). Total Kjeldahl nitrogen (1.6 mg/L) was elevated above 85% of streams in Florida.

Nitrite-nitrate (undetected) and total phosphorus (0.041 mg/L) were near ambient levels. Conductivity was 59 µmhos/cm and the pH was 5.0 SU. The dissolved oxygen (3.8 mg/L) was below the Class III water quality standard of 5.0 mg/L. The SCI indicated the biota of Mill Creek was in the "excellent" category (29 points) and all three of the Bio-Recon metrics exceeded expected thresholds (28 taxa, 9 EPT and 12 Florida Index).

Daisy Creek's habitat was in the low end of the "optimal" category (76%, 122 points out of 160). Substrate availability and flow were the biggest problems. Total Kjeldahl nitrogen (1.2 mg/L) and total phosphorus (0.33 mg/L) were elevated above 65% and 75%, respectively, of other streams in Florida. Nitrite-nitrate (0.03 mg/L) was near ambient levels. Conductivity was 92 µmhos/cm. The pH was 6.1 SU. Dissolved oxygen (4.5 mg/L) was below the state standard of 5.0 mg/L. The SCI (19 points) was in the "poor" category with only 22 total taxa, 0 EPT and 1 Florida Index point. A Bio-Recon of the site (19 taxa, 2 EPT and 4 Florida Index points) also indicated suspected impairment.

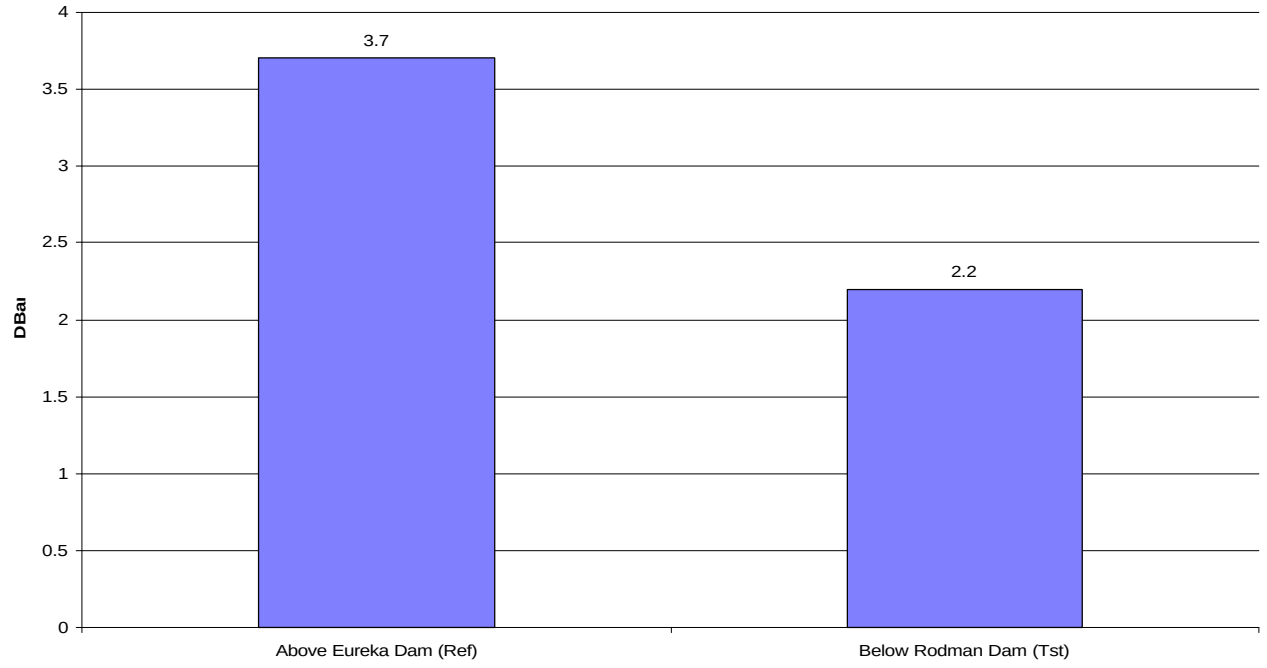
Hester-Dendy Data

Station	Above Eureka Dam (Ref)	Below Rodman Dam (Tst)
StoretCode	20020012	20020068
Date	8/10/98	8/10/98
#Taxa	47	44
DBar	3.7	2.2
FI	34	31
EPT	14	15
%Col-fltr/susp fdr	50.33	83.12
Dominant Taxa	Rheotanytarsus exiguus grp.	Hydropsyche
% Dominant Taxa	23.41	65.56
% Diptera	81.79	10.49
Total Chironomidae	20	20

Discussion

Both of the Ocklawaha River sites, one located upstream of the Rodman Reservoir (near Eureka Dam) and the other located downstream of the Rodman Reservoir, accommodated healthy macroinvertebrate communities (based on the SCI scores). However, the Shannon-Weaver Diversity Index decreased by 40% between the upstream site and the downstream site. This represents a violation of the Class III surface water quality standard for biological integrity, which prohibits a diversity decrease of greater than 25% (Rule 62-302.530 FAC). The Shannon-Weaver diversity was depressed at the site

Shannon-Weaver Diversity



below the Rodman Reservoir due to the large numbers of the caddisfly, *Hydropsyche* sp., found on the Hester-Dendy samplers there. Net spinning caddisflies (such as *Hydropsyche* sp.) may be found in large densities below impoundments, predominantly related to growth and export of algae from the impoundment. Therefore, the presence of the Rodman Dam (and resulting impoundment) may be thought of as contributing to the lowered diversity. Note however, that the overall community health at this site was excellent, as reflected by the SCI score. Furthermore, Hester-Dendy data from samples taken in January of 1998 showed no decrease in diversity (Dbar 3.8 at the test site and 3.2 at the reference site).

Habitat quality was in the "optimal" or "suboptimal" range for all assessed stations. Substrate availability (Daisy Creek), water velocity (Sweetwater and Daisy Creeks), and habitat smothering (Sweetwater Creek, Deep Creek, and Camp Branch) were the biggest concerns at the study sites. Reduced water velocity at Sweetwater and Daisy Creeks (where velocity was negligible) was associated with the poor quality macroinvertebrate populations found at these sites. It was noted on the field sheets that Daisy Creek was probably dry within a few months of sampling. All other sites had healthy macroinvertebrate communities.

Total phosphorus enrichment, indicating anthropogenic inputs, was observed in Orange Creek (0.19 mg/L) and Daisy Creek (0.33 mg/L). Dissolved oxygen was depressed below the Class III surface water quality standard of 5.0 mg/L at Unnamed Creek @ SR 315 (2.9 mg/L), Sweetwater Creek (0.5 mg/L), and Mill Creek (3.8 mg/L) with zero-flow conditions contributing heavily to the low dissolved oxygen concentrations at Sweetwater Creek. Dissolved oxygen at Brunt Bridge Brook (4.3 mg/L), Camp Branch (4.7 mg/L), and Daisy Creek (4.5 mg/L) was slightly below the state standard at the time of sampling, but this did not appear to be adversely affecting the macroinvertebrates.

Conclusions

Habitat quality was in the "optimal" or "suboptimal" range for all assessed stations. Habitat parameters of concern at selected study sites included substrate availability (Daisy Creek), water velocity (Sweetwater and Daisy Creeks), and habitat smothering (Sweetwater Creek, Deep Creek, and Camp Branch).

Of the ten Oklawaha basin sites evaluated with the Stream Condition Index, six scored in the "excellent" category (Orange Creek, Oklawaha River upstream of Eureka Dam, Oklawaha River downstream of Rodman Dam, Deep Creek, Camp Branch, and Mill Creek). Two sites (Brunt Bridge Brook and Unnamed Creek @ 315) scored in the "good" category. Macroinvertebrate communities at the remaining two sites, Sweetwater and Daisy Creeks, were judged to be "poor".

The Shannon-Weaver Diversity Index decreased by 40% between the Oklawaha River sites located upstream and downstream of the impoundment. This represents a violation of the Class III surface water quality standard for biological integrity, which prohibits a diversity decrease of greater than 25% (Rule 62-302.530 FAC). The low diversity at the site below the Rodman Reservoir was due to the large numbers of an organism known to be favored by the export of algae from impoundments (the caddisfly, *Hydropsyche* sp.). Therefore, the presence of the Rodman Dam (and resulting impoundment) may be thought of as contributing to the lowered diversity. Note however, that the overall community health at this site was excellent, as reflected by the SCI score.

The Bio-Recon and SCI methods were performed concurrently at eight sites to continue to evaluate the relationship between these techniques. Both methods produced the same rating of biological health at seven sites, including Orange Creek (unimpaired), Mill Creek (unimpaired), Brunt Bridge Brook (unimpaired), Camp Branch (unimpaired), Deep Creek (unimpaired), Sweetwater Creek (impaired) and Daisy Creek (impaired). At the eighth site (Unnamed Creek @ 315), the Bio-Recon determined the site to be "suspected impaired", which operationally means that Stream Condition Index methods should be performed for further evaluation. The corresponding SCI at Unnamed Creek @ 315 indicated the site to be in the "good" range. Therefore, the two different methods yielded results consistent with their intended use at all eight sites.

Total phosphorus enrichment was observed in Orange Creek (0.19 mg/L) and Daisy Creek (0.33 mg/L). Elevated levels of nitrite-nitrate (0.52 mg/L) were found at the Oklawaha River upstream of Eureka Dam, probably due to groundwater inputs from Silver Springs. Dissolved oxygen was well below the Class III surface water quality standard of 5.0 mg/L at Unnamed Creek @ SR 315 (2.9 mg/L), Sweetwater Creek (0.5 mg/L) and Mill Creek (3.8 mg/L) with zero-flow conditions contributing heavily to the low dissolved oxygen concentrations at Sweetwater Creek. Dissolved oxygen at three other the sites (Brunt Bridge Brook, Camp

Branch, and Daisy Creek) were slightly below the state standard.

It is recommended Daisy Creek (poor SCI, phosphorus enrichment, low dissolved oxygen) and Sweetwater (poor SCI, low dissolved oxygen) remain on the 303(d) list. Biological health was excellent at Orange Creek, but total phosphorus was moderately elevated. It is recommended that Orange Creek also remain on the 303d list for the purpose of addressing the phosphorus enrichment from the watershed.

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