Executive Summary



Department staff sampled 16 stations within the Blackwater River drainage basin. The primary objective of this investigation was to assess the habitat quality of various stream segments to determine the extent of degradation. A secondary objective was to assess the ecological integrity of selected waterbodies on the 303(d) list by conducting habitat, biological, and chemical sampling. Several of the waterbodies within the Blackwater River basin have been placed on the 303(d) list, requiring FDEP to conduct a Total Maximum Daily Load (TMDL) study on them. We sampled these stream segments to determine if they were placed on the 303(d) list appropriately.

Human activities within the river basin, such as recreation and land clearing, combined with the area's highly erodable soils, have resulted in substantial erosion problems. Habitat smothering (with sand) was the most significant parameter of concern throughout the basin, scoring in the poor or marginal range at 10 of the 16 sites, as determined by habitat assessment techniques. Observed sources of sediment loading included unpaved roads, unstable stream banks (*e.g.*, caused by inadequate riparian buffer zones at sites such as Riley's Bluff), and immense gullies caused by land clearing (*e.g.*, Hutton Gully).

Bio-Recon results indicated that 2 of the 5 sites sampled (Big Juniper Creek near Springhill, Florida and Big Juniper Creek at Indian Ford Road) were considered "healthy". East Fork Big Coldwater is "suspected to be impaired", while the remaining two sites (Layfayette Creek at Highway 20 and Ates Creek at Bud Bass Rd) failed to meet any of these parameters, indicating "impairment". Further definitive sampling using the Stream Condition Index methods should be performed on these three sites.

Based on the data collected, it is recommended that Mare Creek and Big Juniper Creek be taken off of the 303(d) list. Due to high levels of nitrite-nitrate and coliforms, it is suggested that Manning Creek and both the East and West Forks of the Big Coldwater Creek remain on the 303(d) list.



Figures 1 & 2:

Pictures of Sand Smothering
At two sites on the Blackwater River

Introduction

The Blackwater River State Forest, located in Santa Rosa and Okaloosa counties, consists of 189,374 acres of mainly mixed forest with extensive silviculture. The forest is drained by rivers and streams into Pensacola Bay, and ultimately into the Gulf of Mexico. Recreational and silvicultural activities within the river basin have resulted in significant erosion problems. Heavy vehicular traffic on unpaved roads within the forest combined with the area's highly erodable soils have led to intense turbidity and habitat smothering problems within the river system. In some cases, vegetation that normally serves to stabilize stream banks has been destroyed due to the public driving their vehicles to the river's edge (*e.g.*, Riley's Bluff). Public access to the system has also led to an increase in trash deposition along and within the river system. The Blackwater Forest River Restoration project has recently been implemented to restore the highly sloped and eroded entrance roads on the south side of the river in an effort to impede the soils' progress into the aquatic system (Compton, 1998).

The primary objective of this investigation was to assess the habitat of various segments of waterbodies within the basin to determine the extent of degradation.

A secondary objective of this study was to assess the ecological integrity of selected waterbodies on the 303(d) list by conducting biological and chemical sampling. Several of the waterbodies within the Blackwater River Basin have been placed on the 303(d) list, including the West and East Forks of Big Coldwater Creek, Manning, Mare, and Big Juniper 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.

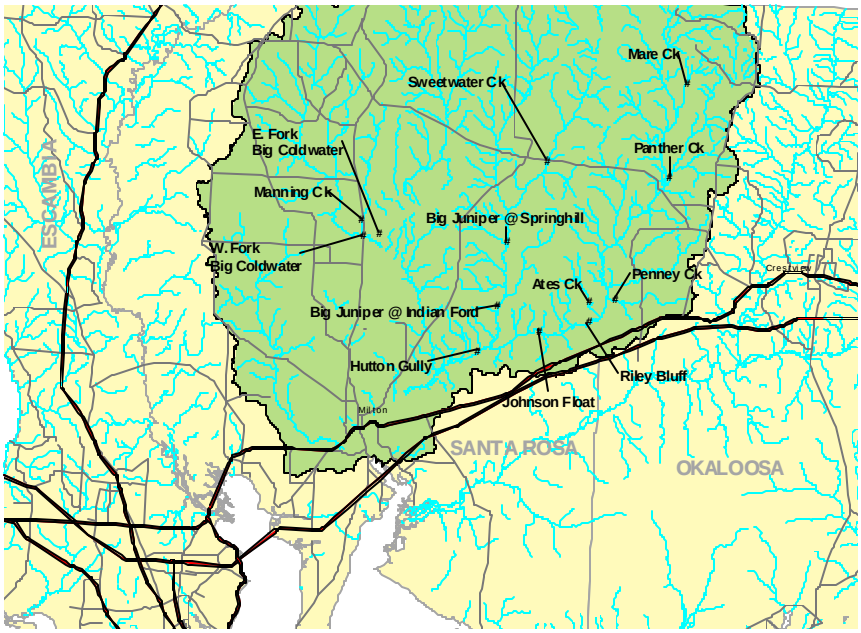


Figure 3: Overview Map

Methods

The focus of this investigation was to determine if human activities within the Blackwater River basin were affecting the health of receiving waters by collecting habitat, physical/chemical and biological information from selected streams in the drainage basin.

Habitat quality (FDEP 1999c, #IZ-21) and physical/chemical data (FDEP 1999b, #IZ-20) were evaluated at all 16 study sites (with the exception of Blackwater River upstream of Hutton Gully where only habitat was assessed). Water samples from all sites (with the exception of Ates Creek at Bud Bass Road and Big Juniper Creek at Indian Ford Road) were analyzed for nutrients, turbidity, fecal and total coliforms, total suspended solids (TSS), and total organic carbon (TOC).

Habitat quality was determined for each station during an *in situ* assessment. Eight attributes (substrate diversity, substrate availability, water velocity, artificial channelization, bank stability, habitat smothering, riparian zone buffer width, and riparian vegetation quality) known to have potential effects on the stream biota were evaluated and scored, with a total of 20 points possible for each parameter. 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).

Benthic macroinvertebrate communities were evaluated at five of the study sites (Layfayette Creek, East Fork Big Coldwater, Ates Creek at Bud Bass Road and Big Juniper Creek at Indian Ford Road and near Springhill, FL) using DEP's technique for rapid biological assessment, Bio-Recon (FDEP 1999a, #IZ-31). A Bio-Recon is a screening tool, designed to determine which systems are biologically healthy. Invertebrates were collected at each site from the most productive habitats (*e.g.*, snags, leaf packs, root mats, vegetation) using 4 discrete dip net sweeps. The samples were then field picked and brought back to the laboratory for identification under a dissecting microscope. 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 a site passes all three of the thresholds, the site is considered healthy. Streams that fail one or two metrics of the Bio-Recon are suspected to be impaired, while systems that fail all three metrics are considered impaired, and it is suggested that follow-up, definitive sampling using the more rigorous Stream Condition Index method (SCI) be performed for further evaluation.

Explanation of Measurements of Community Health

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

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.

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.

Description of Sampling Sites

All of the sites sampled for this investigation lie within the Southern Pine Plains and Hills Subregion (65f) of Florida. Most of this subregion is woodland and evergreen and mixed forest with some cropland and pasture (Omernick, 1994).

TMDL Study Sites:

Five of the sixteen sites sampled during this investigation were placed on the 1998 State of Florida 303(d) list. Two of these five sites, East Fork of the Big Coldwater and Big Juniper creek, were sampled for biological parameters using the Bio-Recon methodology.

East Fork of the Big Coldwater, located in Santa Rosa County, near Springhill, Florida, was placed on the 1998 303(d) list for high levels of coliforms and total suspended solids.



West Fork of the Big Coldwater, located in Santa Rosa County, was sampled below state road 87. Coliforms and nutrients were the parameters of concern on the 1998 303(d) list.

Mare Creek, located in Okaloosa County, was placed on the 303(d) list for dissolved oxygen and turbidity violations. This site was sampled on Kennedy Road.

Manning Creek is located in Santa Rosa County and is a tributary of Big Coldwater Creek. Coliforms, turbidity and total suspended solids levels placed Manning Creek on the list. The site was sampled above highway 87.

Big Juniper Creek is located in Santa Rosa County and was sampled near Springhill, Florida. Coliforms and turbidity levels were the parameters of concern listed on the 303(d) list.

Habitat Assessment Study Sites:

During this investigation eleven sites were sampled to determine the impact human activity has had on the aquatic habitat within the basin. Three of these eleven sites were also sampled for biological parameters using the Bio-Recon methodology (Layfayette Creek, Ates Creek at Bud Bass Road and Big Juniper Creek at Indian Ford Rd).

Layfayette Creek, located in Freeport, Walton County and flows to Choctawhatchee Bay was sampled on August 17, 1998 by the Northwest District staff.

Big Juniper Creek is located in Santa Rosa County and was sampled below Indian Ford Rd.

Ates Creek, located in Santa Rosa County, was sampled at Bud Bass Road and at Bryants Bridge below the fish hatchery.

Panther Creek located in Okaloosa County was sampled at Kennedy Road.

Penney Creek located in Santa Rosa County was sampled below a large gully.

Habitat Assessment Scores

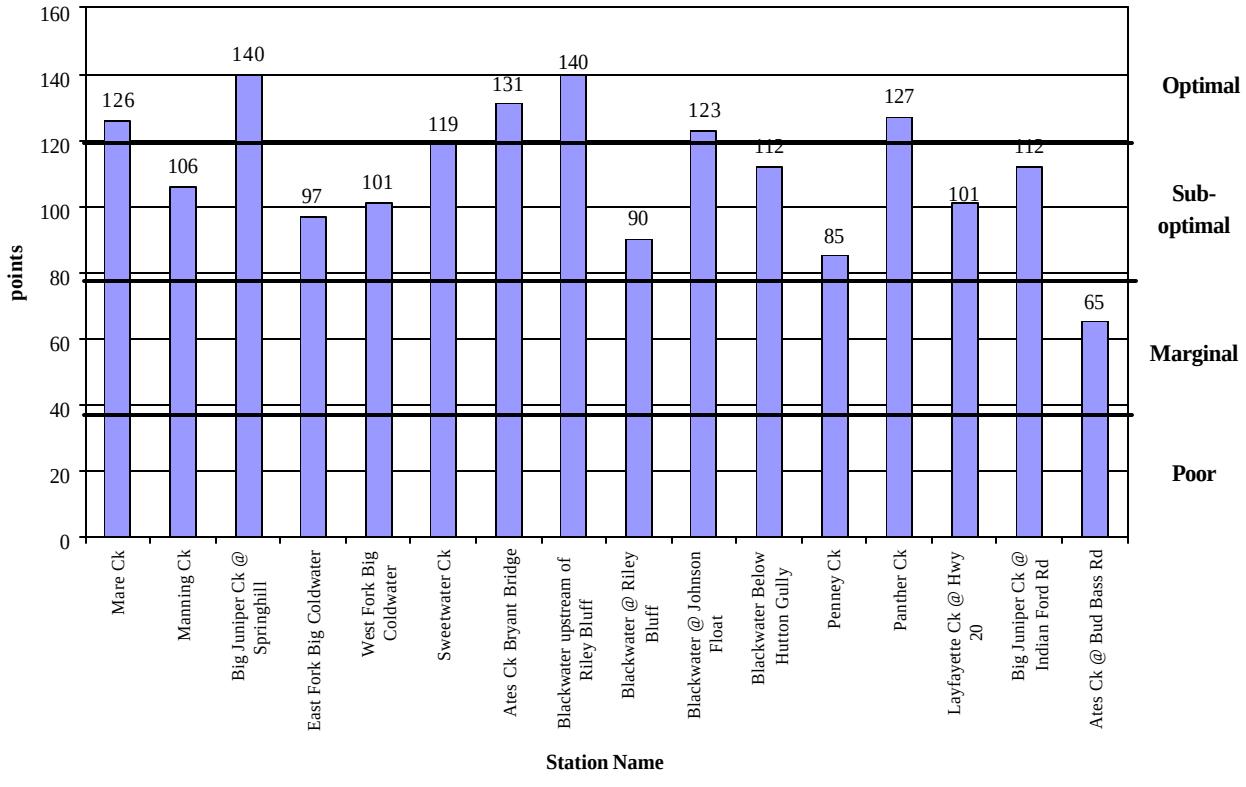


Figure 4: Habitat Assessment Data

The Blackwater River located in Santa Rosa County was sampled in four locations, below Hutton Gully, at Johnson Float Road, upstream of Riley's Bluff and at Riley's Bluff.

Sweetwater Creek, located in Santa Rosa County, was sampled four miles upstream of Highway 4.

Sampling for this investigation was performed on December 9th and 10th, 1998 jointly by FDEP's Bureau of Laboratories and Northwest District staffs. FDEP Central Laboratories performed the Biological and Chemical analyses.

Station	Layfayette Ck @ Hwy 20	East Fork Big Coldwater	Big Juniper Creek near Springhill FL.	Ates Ck @ Bud Bass Rd	Big Juniper Ck @ Indian Ford Rd
Date	08/17/98	12/09/98	12/09/98	12/10/98	12/09/98
Number of Taxa (24)	20	**25**	**36**	20	**39**
Florida Index (22)	6	21	**30**	0	**37**
EPT (17)	7	12	**17**	3	**22**
# Ephemeroptera	5	4	6	3	8
# Trichoptera	1	5	7	0	8
# Plecoptera	1	3	4	0	6
Rating	Impaired	Suspect	Healthy	Impaired	Healthy

Figure 5: BioRecon Data (West Panhandle Thresholds in Parentheses)

Results and Discussion

Summary of Results by Site

TMDL Sites

East Fork of the Big Coldwater had an overall habitat assessment in the "suboptimal" category (61%, 97 points out of 160). Habitat smothering caused "poor" substrate availability (5%). Habitat was close to 90% smothered, also falling in the "poor" category. A canoe landing area on the right bank of the river was one of the sources of smothering. It decreased the riparian buffer width to less than 6 meters, giving this parameter a "marginal" rating. Dissolved oxygen (8.56 mg/L) complied with the Class III surface water quality standard of 5.0 mg/L. Conductivity was 31 µmhos/cm. Ammonia and total phosphorus levels were below the analytical detection limit. Total Kjehldahl nitrogen was also low, in the lowest 5 percentile of Florida streams (See *Typical Values for Selected Parameters in Florida Waters* in Appendix). Nitrate-nitrite concentrations were slightly elevated, however, above the 60th percentile. Total suspended solids were well within the acceptable range at 7 mg/L. Turbidity levels (8.8 NTU's) were above 85% of other Florida streams, but were not in violation of the Class III standard. Both fecal and total coliform

Station	Mare Ck	Manning Ck	Big Juniper Ck @ Springhill	East Fork Big Coldwater	West Fork Big Coldwater	Sweetwater Ck	Ates Ck Bryant Bridge	Blackwater upstream of Riley Bluff	Blackwater @ Riley Bluff	Blackwater @ Johnson Float
Date	12/10/98	12/9/98	12/9/98	12/9/98	12/9/98	12/10/98	12/10/98	12/9/98	12/9/98	12/9/98
Habitat Assessment	126	106	140	97	101	119	131	140	90	123
SampleDepth (*m*)	0	0.5	0.9	0.1	0.8	0	0	No Data	1.3	1.7
Conductivity (*umhos/cm*^{2})	20	45	No Data	31	48	12	40	No Data	6	5
DO (*mg/L*)	7.4	7.69	8.8	8.56	7.97	8.7	7.5	No Data	8.6	8.2
pH (*SU*)	5.1	5.71	5	5.07	5.71	5.1	6.5	No Data	5	5
Temperature (*C*)	14.4	17.93	18.2	18.4	18.96	15.2	16.4	No Data	18.7	18.8
Turbidity (*NTU*)	4.3	3.4	3.5	8.8	5	4.1	4.5	No Data	5.3	6.4
Color (*PCU*)	60	60	60	80	40	60	40	No Data	60	80
Total Ammonia (*mg/L*)	.010 BDL	.010 BDL	.010 BDL	.010 BDL	.010 BDL	.010 BDL	.010 BDL	No Data	.010 BDL	0.029
Nitrite-Nitrate (*mg/L*)	0.012	0.84	0.069	0.16	1.2	0.064	0.033	No Data	0.21	0.17
TKN (*mg/L*)	0.21	0.17	0.16	0.19	0.21	0.18	0.17	No Data	0.2	0.21
Total Phosphorus (*mg/L*)	0.025	0.015 BDL	0.019	.015 BDL	0.016	.015 BDL	0.02	No Data	.015 BDL	0.015
BOD-5 (*mg/L*)	0.4	0.7	0.6	0.7	0.7	0.5	0.6	No Data	0.5	0.6
Fecal Coliforms (*col/100 mL*)	56	80	86	**1100**	370	50	72	No Data	174	150
Total Coliforms (*col/100 mL*)	390	400	480	**4000**	**2200**	350	350	No Data	600	770
Total Organic Carbon (*mg/L*)	4.3	4.2	3.9	4.9	3.8	4.9	2.2	No Data	4.9	4.8
Total Suspended Solids (*mg/L*)	4 BDL	4 BDL	4 BDL	7	4 BDL	4 BDL	4 BDL	No Data	7	12

Figure 6: Chemistry & Habitat Assessment Data





Figure 6: Photos of Hutton Gully

levels (1100 and 4000 colonies/100mL, respectively) were in violation of state surface water standards (800 colonies/100 mL for fecal coliforms and 2400 colonies/100 mL for total coliform counts). Biological communities were considered "suspect for impairment" according to the Bio-Recon, failing to meet the Florida Index and EPT index thresholds for the western panhandle.

The West Fork of the Big Coldwater also received an overall "suboptimal" rating on the habitat assessment (63%, 101 points out of 160). Both habitat availability (3%) and smothering (80%) scored in the "poor" category. This area is used heavily as a local swimming hole and degradation of the quality of the right bank was observed. Bank stability, riparian buffer zone width and riparian zone quality in this area were all in the "marginal" category. Dissolved oxygen levels (7.97 mg/L) complied with state criteria. Conductivity was 48 µmhos/cm. Ammonia (undetected), Total Kjehldahl nitrogen (0.21 mg/L), and total phosphorus levels (0.016 mg/L) were all in the lower 5th percentile of Florida streams. Fecal (370 colonies/100mL) and total coliform (2200 colonies/100 mL) levels were elevated, but did not exceed surface water standards. Measured nitrite-nitrate levels (1.2 mg/L) were quite high, exceeding 95% of other state streams. Turbidity (5 NTU's) was not in violation of state criteria, but was slightly elevated compared to other Florida streams.

Mare Creek had "optimal" habitat (79%, 126 points). Substrate availability (7%) was "marginal" with some slight habitat smothering from sand. Dissolved oxygen levels (7.4 mg/L) were in compliance with Class III water quality standards. Conductivity was 20 µmhos/cm. Ammonia (undetected), nitrite-nitrate (0.012 mg/L), total Kjehldahl nitrogen (0.21 mg/L) and total phosphorus (0.025 mg/L) were all near background, falling in the top 10% or better of Florida streams. Turbidity (4.3 NTU's) was slightly elevated. Fecal and total coliform counts were low (56 and 390 colonies/100 mL, respectively).

Manning Creek had "suboptimal" habitat (66%, 106 points). Habitat availability (7%) and habitat smothering (70%) were in the lower part of the "marginal" category. Riparian buffer zone width on the left bank was less than 6 meters, and therefore rated a "poor" score. Dissolved oxygen levels (7.69 mg/L) were above acceptable limits. Conductivity was 45 µmhos/cm. Ammonia (undetected), TKN (0.17 mg/L), and total phosphorus (undetected) levels were better than 95% of other streams in the state. Nitrate-nitrite levels were high, however, 0.84 mg/L. Fecal and total coliform levels were low (80 and 400 colonies/100 mL). Total suspended solid load was at the detection limit (4 mg/L). This is better than 95% of Florida streams. Turbidity measurements were just below the 60th percentile (3.5 NTU's).

Big Juniper Creek @ Spring Hill, Florida had "optimal" habitat (88%, 140 points). Points were lost due to an adjacent camping area lowering the width and quality of the riparian buffer zone. Dissolved oxygen was 8.8 mg/L, capable of supporting aquatic life. Ammonia (undetected), TKN (0.16 mg/L), and total phosphorus (0.019 mg/L) were all below the 5th percentile of Florida streams. Nitrite-nitrate levels (0.069 mg/L) were also acceptable, in the lower 40th percentile. Fecal (86 colonies/100 mL) and total coliforms (480 colonies/100 mL) complied with Class III standards. The turbidity (3.5 NTU's) level of the stream was just below the 60th percentile. Bio-Recon results indicate the creek has "healthy" biological communities, far surpassing thresholds for all three metrics (Total Taxa-36; FL Index-30; EPT-17).

Habitat Assessment Sites

Figure 7: Chemistry and Habitat Assessment Data (Cont.)

Station	Below Hutton Gully	Penney Ck	Panther Ck	Layfayette Ck @ Hwy 20	Big Juniper Ck @ Indian Ford Rd	Ates Ck @ Bud Bass Rd
Date	12/9/98	12/9/98	12/10/98	8/17/98	12/9/98	12/10/98
Habitat Assessment	112	85	127	101	112	65
SampleDepth (*m*)	0.8	0	0.5	1	0.4	0.5
Conductivity (*umhos/cm*^{2})	10	5	7	75	28	15
DO (*mg/L*)	7.5	9.8	8.8	7.13	8.44	5.7
pH (*SU*)	4.3	5.3	5.4	5.51	5.28	5.66
Temperature (*C*)	18.8	18.6	15.3	23.7	18.64	17.8
Turbidity (*NTU*)	4.2	9	4.6	3	No Data	No Data
Color (*PCU*)	60	40	60	60	No Data	No Data
Total Ammonia (*mg/L*)	.010 BDL	.010 BDL	.010 BDL	.010 BDL	No Data	No Data
Nitrite-Nitrate (*mg/L*)	0.12	0.66	0.19	0.4	No Data	No Data
TKN (*mg/L*)	0.16	0.061	0.18	0.29	No Data	No Data
Total Phosphorus (*mg/L*)	.015 BDL	.015 BDL	0.018	0.015	No Data	No Data
BOD-5 (*mg/L*)	0.5	0.3	0.5	1.4	No Data	No Data
Fecal Coliforms (*col/100 mL*)	122	52	72	600	No Data	No Data
Total Coliforms (*col/100 mL*)	480	330	350	**4900**	No Data	No Data
Total Organic Carbon (*mg/L*)	4.2	1.7	3.7	5.5	No Data	No Data
Total Suspended Solids (*mg/L*)	4 BDL	4 BDL	4 BDL	5	No Data	No Data

Layfayette Creek scored in the "suboptimal" category (63%, 101 points out of 160) for total habitat score. Artificial channelization and habitat smothering from silt were the lowest scored parameters at the site. Greater than 90% of habitat was smothered with silt, resulting in a score in the "poor" category (2 points) for this parameter. The creek had been artificially channelized in the past and is still greater than 80% affected. It was noted on the assessment sheet that the channel was much wider than seen during previous monitoring. Dissolved oxygen (7.13 mg/L) complied with state standards. Conductivity was 75 µmhos/cm. Ammonia (undetected), TKN (0.29 mg/L), and total phosphorus (0.015 mg/L) were below the 25th percentile. Nitrite-nitrate (0.40 mg/L) levels, however, showed enrichment exceeding 80% of other streams. Turbidity (3 NTU's) was in the 55th percentile. Fecal coliform counts of 600 colonies/100 mL were moderately elevated, but complied with Class III standards. Total coliform counts (4900 colonies/100 mL), however, were in violation of the Class III surface water standard of 2400 colonies/100 mL. Bio-Recon results indicated "impairment" with the creek failing to meet any of the three biological parameters (Total Taxa- 20; FL Index- 6; EPT- 7).

Big Juniper Creek below Indian Ford Road received a "suboptimal" habitat rating (70%, 112 points). Over 90% of the habitat was covered with sand, leaving only "marginal" amounts available for refugia for macroinvertebrates. Dissolved oxygen was above the Class III threshold, at 8.44 mg/L. Conductivity was 28 µmhos/cm. The creek exceeded all expectations for healthy systems, with 39 total taxa, 22 EPT taxa, and 37 points on the Florida Index. No water chemistry was sampled for this site.

Ates Creek at Bud Bass Road had "marginal" overall habitat (41%, 65 points) for a variety of reasons. The site was artificially channelized and impounded by the road. Severe habitat smothering (>90%) and zero flow conditions were also found at the time of sampling. The riparian buffer width on the left bank was less than 6 meters, and riparian vegetation quality on both banks was also clearly affected. Cattle were present upstream in areas formerly serving as riparian zone. Dissolved oxygen (5.7 mg/L) was above the Class III standard of 5.0 mg/L. Conductivity was 15 µmhos/cm. Ates Creek failed to meet any of the three biological parameters measured by the Bio-Recon (Total Taxa- 20; FL Index- 0; EPT- 3), probably due to hydrologic effects. The site is considered "impaired". No water chemistry was sampled for this site.

Ates Creek was sampled for water chemistry at Bryant's Bridge, below the fish hatchery. Habitat at this site scored an 81% (131 points) and therefore fell in the "optimal" category. Dissolved oxygen was 7.5 mg/L. Conductivity was 40 µmhos/cm. Ammonia was below the detection limit. TKN (0.17 mg/L) and total phosphorus (0.02 mg/L) were in the lowest 5% of Florida streams. Nitrite-nitrate (0.033 mg/L) was also low, in the 20th percentile. Turbidity (4.5 NTU's) was below the Class III standard, but was still somewhat elevated. Fecal coliforms (72 colonies/100 mL) and total coliforms (350 colonies/100 mL) were also present in acceptable levels.

Panther Creek had "optimal" habitat (79%, 127 points) with only moderate habitat smothering (50%). With only 7% available habitat, the site scored in the "marginal" range for this category. Dissolved oxygen (8.8 mg/L) was capable of supporting aquatic life.

Conductivity was 7 µmhos/cm. Ammonia (undetected), TKN (0.18 mg/L), and phosphorus (0.018 mg/L) were lower than 95% of other Florida streams. Nitrite-nitrate levels (0.19 mg/L) were elevated, however, ranking higher than 70% of other streams. Fecal and total coliforms were within the acceptable range (72 and 350 colonies/100 mL, respectively). Turbidity levels (4.6 NTU's) were in the 70th percentile, but were not in violation of Class III surface water standards.

Penney Creek had a total habitat score in the low "suboptimal" (53%, 85 points) category. The site was located directly below an immense gully. Therefore, bank stability, riparian buffer width, and riparian vegetation quality on the right bank were severely impacted and given the lowest possible score. Habitat availability (3%) and habitat smothering (90%) were also areas of concern. Substrate diversity was in the "marginal" range. Dissolved oxygen was high, 9.8 mg/L, far surpassing the state standard. Conductivity was 5 µmhos/cm. All nutrients were in the acceptable range (top 5th percentile), except nitrite-nitrate (0.66 mg/L), which was higher than 90% of streams in Florida. Turbidity (9 NTU's) was in the 87th percentile. Coliform counts were also in the acceptable range, 52 colonies/100 mL for fecal coliforms, 330 colonies/100 mL for total coliforms.

Blackwater River upstream of Riley's Bluff was assessed for habitat only, to be used as a comparison to a stretch of river at the Bluff. This upstream portion had "optimal" habitat (88%, 140 points), though substrate diversity was "suboptimal" and habitat availability was in the "marginal" range. In contrast, habitat at Riley's Bluff was in the low "suboptimal" range (56%, 90 points). Substrate diversity was "poor", consisting only of one type of habitat, snags. These snags represented only 1% of the total coverage of the stream, placing the habitat availability parameter in the "poor" category as well. Due to vehicular traffic and frequent campfires, the riparian buffer on the left bank had been decreased to approximately 6 meters. The bank was also extremely unstable, failing to meet even the lowest score on the scale (0 points). Dissolved oxygen was 8.6 mg/L. Conductivity was 6 µmhos/cm. Ammonia and phosphorus levels were below detection limits, and TKN was in the lowest 5% of Florida streams. Nitrite-nitrate levels (0.21 mg/L) were in the 70th percentile. Turbidity (5.3 NTU's)was greater than 75% of other state streams. Both fecal and total coliforms were well within the acceptable range.

Blackwater River at Johnson Float Road had "optimal" habitat (77%, 123 points), despite "poor" right bank stability and a riparian buffer width of less than 6 meters on the right bank. A canoe launch was adjacent to the site explaining the lessor quality of the right bank. Though habitat smothering was not a problem at this site, the launch may contribute to sand deposition farther downstream. Dissolved oxygen levels were high, 8.2 mg/L. Conductivity was 5 µmhos/cm. Ammonia (0.029 mg/L) was in the 12th percentile, while TKN (0.21 mg/L) and phosphorus (undetected) were in the lowest 5 percent of Florida streams. Nitrite-nitrate levels (0.17 mg/L) were in the 65th percentile. Turbidity was 6.4 NTU's, above 80% of other streams. Fecal (150 colonies/100 mL) and total coliforms (770 colonies/100mL) were well within the acceptable range.

Blackwater River below Hutton Gully had "suboptimal" habitat (70%, 112 points). Heavy erosion was noted in the areas adjacent to this stretch of the river. Consequently, habitat smothering was severe at this site (100%) due to the cumulative effect of the gullies upstream. As a result of this smothering, habitat availability was "poor" (< 5%), and habitat diversity also scored low, falling in the "marginal" range. Dissolved oxygen was in the acceptable range, 7.5 mg/L. Conductivity was 10 µmhos/cm. Ammonia (undetected), phosphorus (undetected), and TKN (0.16 mg/L) were all in the 5th percentile or better. Nitrite-nitrate levels (0.12 mg/L) were higher, in the 55th percentile of other state streams. While turbidity (4.2 NTU) was not in violation of state standards, it was in the 65th percentile. Fecal and total coliform counts were low, 122 colonies/100 mL and 480 colonies/100 mL, respectively.

Sweetwater Creek four miles upstream of Highway 4 was in the "suboptimal" range for habitat (74%, 119 points). Severe habitat smothering (80% on the area) was found here. Large sand islands were observed within the system at this site. Habitat availability was also low, in the low "marginal" range (8%). Dissolved oxygen was 8.7 mg/L, surpassing the state criteria. Conductivity was 12 µmhos/cm. Ammonia (undetected), nitrite-nitrate (0.064 mg/L), TKN (0.18 mg/L) and phosphorus (undetected) levels were all at acceptable levels (in the lower 40% of Florida streams). Turbidity was 4.1 NTU's, in the 48th percentile of Florida streams. Both fecal (50 colonies/100 mL) and total coliforms (350 colonies/100 mL) passed Class III criteria.

Discussion of Results

Two of the five sites sampled by Bio-Reconnaissance accommodate healthy macroinvertebrate communities (Big Juniper Creek near Springhill Florida and at Indian Ford Rd). East Fork Big Coldwater is "suspected to be impaired", while the remaining two sites, Layfayette Creek and Ates Creek at Bud Bass Road, were considered "impaired".

Overall habitat quality was in the "optimal' or "suboptimal" category for 15 of the 16 stations assessed. Ates Creek at Bud Bass Road was the exception, scoring only in the "marginal" category. Substrate availability was low at nearly every station, mostly due to smothering from sand or silt. A wide variety and abundance of submerged structures in the stream are necessary to provide macroinvertebrates with refugia or niches. The greater the variety and extent of available microhabitats or attachment sites, the greater the variety of invertebrates a stream can support. Snags and submerged logs, roots/ undercut banks, leaf packs, and aquatic vegetation are productive habitat structure in low-gradient streams. Severe substrate smothering limits habitat by burying structures otherwise available for use within the system. Greater than 80% of habitat was smothered at half of the 16 stations assessed. Much of the smothering was due to either human impacts (canoe landings, roads, people driving too close to the stream, etc.) or gullies located upstream of the sampling sites.

Over half of the sites tested for water quality had elevated levels of nitrite-nitrate, ranging from 0.16 mg/L at the East fork of the Big Coldwater River to 1.2 mg/L at the West fork of the Big Coldwater. All of these sites had concentrations placing them above 62-95% of other Florida streams. Corresponding low conductivity values at these sites suggest that these high levels of nutrients were due to nonpoint sources within the basin. Dissolved oxygen values complied with the Class III standard of 5.0 mg/L at all sites sampled. While there were no violations of the Class III surface water quality standard for turbidity, every site sampled-showed some elevation above background conditions. Two sites failed to meet state standards for coliforms, East Fork Big Coldwater and Layfayette Creek. The East Fork Big Coldwater failed both fecal (1100 colonies/100 mL) and total (4000 colonies/100 mL) coliform parameters. Layfayette Creek had a total coliform count of 4900 colonies /100 mL.

Conclusion

Human activities within the Blackwater River basin, such as recreation and land clearing, combined with the area's highly erodable soils, have resulted in substantial erosion problems. Habitat smothering (with sand) was the most significant parameter of concern throughout the basin, scoring in the poor or marginal range at 10 of the 16 sites, as determined by habitat assessment techniques. Observed sources of sediment loading included unpaved roads, unstable stream banks (*e.g.*, caused by inadequate riparian buffer zones at sites such as Riley's Bluff), and immense gullies caused by land clearing (*e.g.*, Hutton Gully).

Bio-Recon results indicated that 2 of the 5 sites sampled (Big Juniper Creek near Springhill, Florida and Big Juniper Creek at Indian Ford Road) were considered "healthy". East Fork Big Coldwater is "suspected to be impaired", while the remaining two sites (Layfayette Creek at Highway 20 and Ates Creek at Bud Bass Rd) failed to meet any of these parameters, indicating "impairment". Further definitive sampling using the Stream Condition Index methods should be performed on these three sites.

Based on the data collected, it is recommended that Mare Creek and Big Juniper Creek be taken off of the 303(d) list. Due to high levels of nitrite-nitrate and coliforms, it is suggested that Manning Creek and both the East and West Forks of the Big Coldwater Creek remain on the 303(d) list.

Literature Cited

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