

Ecological Assessment of

1st Order Reference Streams

Manatee & Hardee Counties

Sampled November 1999

July 2000

Bureau of Laboratories

Division of Resource Assessment and Management

Comprehensive Quality Assurance Plan No's:

Laboratories- 870346G & 870688G

Field- 980028

Introduction

This investigation is an ongoing, cooperative study between FDEP's Bureau of Mine Reclamation and Bureau of Laboratories to determine success of stream reclamation activities. For this report, three sites were selected as 1st order reference streams and sampled for macroinvertebrates using DEP's 4 dipnet sweep biological reconnaissance (Bio-Recon) sampling technique. Sites were selected based on local knowledge of land use conditions surrounding the systems. The sampling was conducted to determine if regional thresholds for the Bio-Recon are applicable to 1st order streams in this geographic area. Previous studies used the same assessment procedures.

Habitat assessment data and water quality samples were collected along with surveys of aquatic biological communities (Bio-Recon). A Bio-Recon is used primarily as a screening technique, designed to determine which systems are biologically healthy. A stream that fails the Bio-Recon is only suspected to be impaired, and further definitive sampling is suggested.

Methods

Benthic macroinvertebrate communities were evaluated using Bio-Recon techniques. Invertebrates were collected from multiple substrates (e.g., roots, snags, leaf packs, vegetation) using 4 discrete dip net sweeps (FDEP 2000a, Biology Section Standard Operating Procedure #IZ-31), field picked, and finally brought back to the laboratory for identification under the dissecting microscope. Bio-Recon results were then compared to existing criteria for three categories: total taxa richness, total Florida Index, and total EPT (Ephemeroptera/Trichoptera/Plecoptera). If two or more of the metrics are greater than or equal to the target values, the site is considered "healthy." If less than two of the metrics are within target range, the site is "suspected to be impaired." A physical/chemical characterization (FDEP 2000c, IZ-20) and habitat assessment (FDEP 2000b, IZ-21) were also performed at each study site.

Explanation of Measurements of Community Health

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

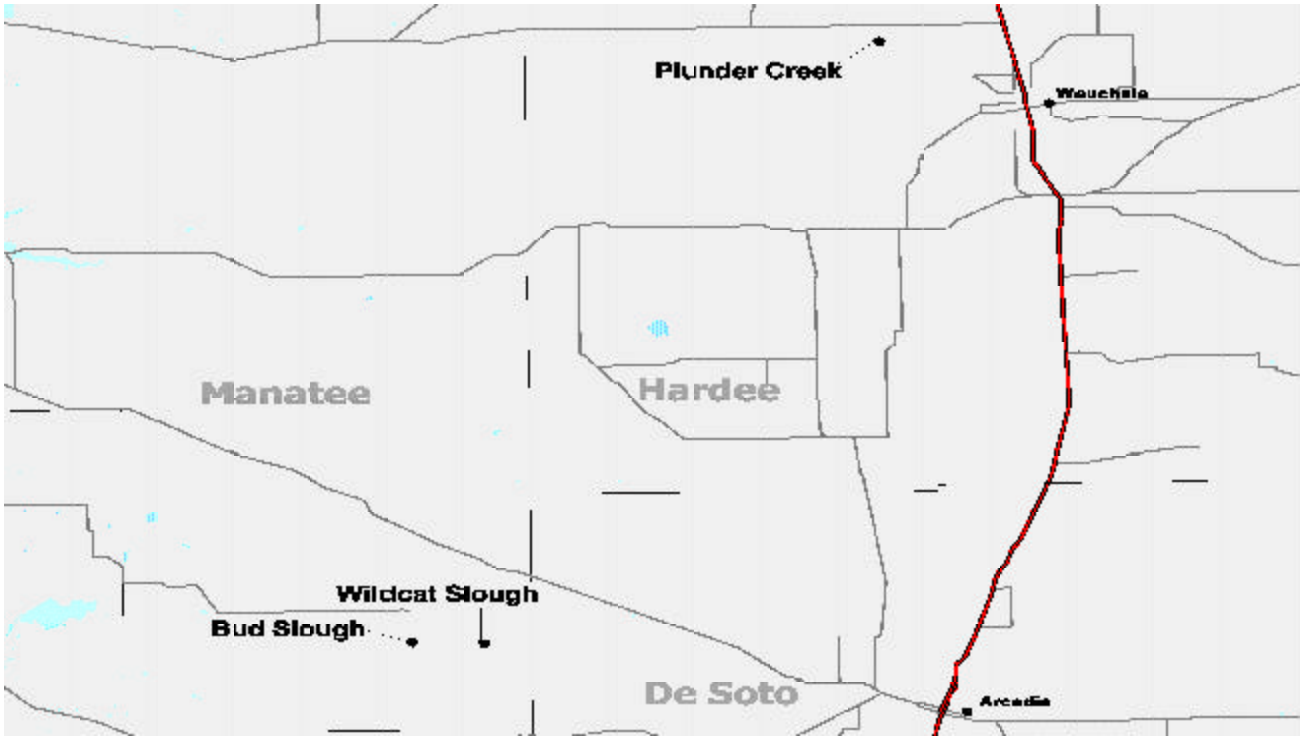


Figure 1: Overview Map

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.

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 EPT taxa present. Higher EPT values are associated with healthier systems.

Personnel from the FDEP Central Laboratories and Bureau of Mine Reclamation performed sampling for this investigation on November 22 and 23, 1999. The FDEP Bureau of Laboratories performed the biological and chemical analyses.

Study Area

The sites in this study are all located in the Southwestern Florida Flatwoods Subregion of the Southern Coastal Plain Ecoregion (see Figure 1). This subregion is characterized by forest, pasture and rangeland, spreading urbanization, lands disturbed by phosphate mining, and citrus groves (EPA Florida Regionalization Project, unpublished report). Wildcat Slough and Bud Slough are in Manatee County, and Plunder Creek is in Hardee County.

Results and Discussion

Habitat Assessment Parameters

Stream-dwelling invertebrate populations respond to habitat as well as water quality. Eight parameters are measured in the habitat assessment procedure: substrate diversity, substrate availability, water velocity, artificial channelization, bank stability, habitat smothering, riparian zone buffer width, and riparian vegetation quality (see habitat assessment sheets in Appendix). Total Habitat Assessment scores for the three study streams were in the "optimal" category (125 at Wildcat Slough, 123 at Bud Slough, and 135 at Plunder Creek). Water velocity was the only parameter scoring below the "suboptimal" category. See Figure 2 and Table 1 for a summary of the total habitat assessment scores.

Wildcat Slough and Bud Slough both scored in the "poor" range for water velocity (0.03 m/s and <0.01 m/s, respectively); Plunder Creek scored in the marginal range for this category (0.07 m/s). The velocity of water flowing through the system influences the amount of dissolved oxygen in the water and the movement of materials and food particles through the system. Velocities lower than 0.1 m/sec will support progressively fewer taxa as dissolved oxygen and food movement is reduced.

Water Chemistry Parameters

Dissolved oxygen concentrations were below the Class III Surface Water Quality Standard of 5.0 mg/L at Wild-

Table 1: Summary of Data

Station	WILDCAT SLOUGH	BUD SLOUGH	PLUNDER CREEK
Sampling Date	11/23/99	11/23/99	11/22/99
Habitat Assessment	125	123	135
Taxa Richness	21	18	19
Florida Index	4	4	7
EPT Index	5	3	4
Conductivity (umhos/cm2)	703	272	101
DO (mg/l)	4.9	3.6	5.8
BOD	3.1	1.6	1.6
pH (SU)	5.68	6.62	6.6
Temperature (oC)	19.2	19.7	21.1
Turbidity (NTU)	2.8	1.7	15
TNH3 (mg/L)	0.028	0.033	0.032
TNOx (mg/L)	0.01	0.04	0.01
TKN (mg/L)	0.68	0.79	1.7
TP (mg/L)	0.069	0.37	0.72
TSS (mg/L)	6	4	6
Color (PCU)	80	100	500

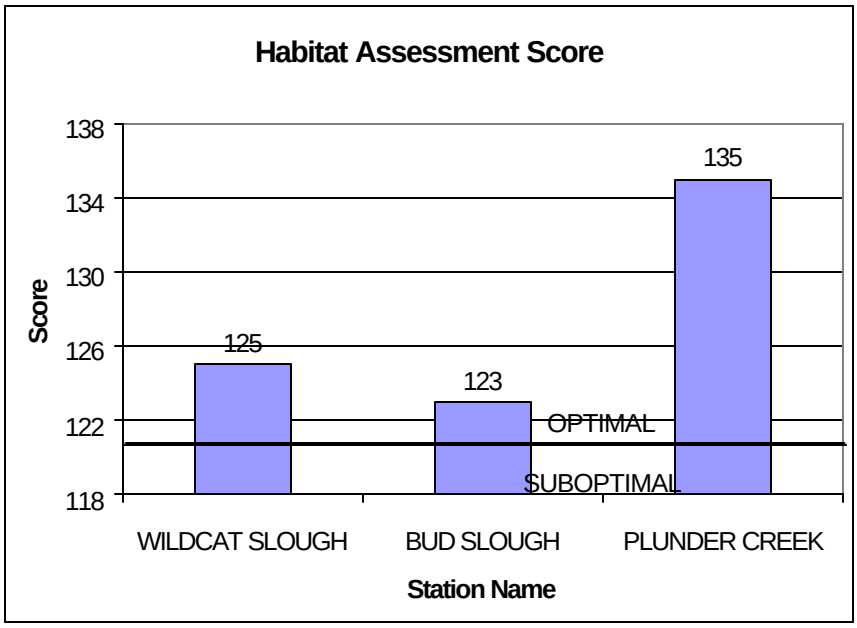


Figure 2: Habitat Assessment Score

cat Slough (4.9 mg/L) and Bud Slough (3.6 mg/L). Diversity of organisms found at a site can be limited by dissolved oxygen levels in this range. Dissolved oxygen at Plunder Creek was 5.8 mg/L. Specific conductance values ranged from 101 µmhos/cm at Plunder Creek to 703 µmhos/cm at Wildcat Slough.

Turbidity values were acceptable at all sites, with Plunder Creek having the highest turbidity of the three sites at 15 NTU. The turbidity values are all within Class III water quality standards, which prohibit turbidity from exceeding 29 NTU above background. Turbidity at Wildcat Slough (2.8 NTU) and Bud Slough (1.7 NTU) were near the average turbidity for Florida streams (2.8 NTU). Total suspended solids (TSS) were also present in relatively low concentrations in these study streams (Wildcat Slough at 6 mg/L, Bud Slough at 4 mg/L, and Plunder Creek at 6 mg/L).

Nitrite-nitrate (NOx) values were relatively low at all three sites, with a concentration of 0.04 mg/L at Bud Slough and less than 0.01 mg/L at both Wildcat Slough and Plunder Creek. These levels are lower than 80% of Florida Streams. Similarly, ammonia (TNH3) and total Kjeldahl nitrogen (TKN) levels were low at all three sites, except for the elevated TKN concentration at Plunder Creek (1.7 mg/L) most likely due to the break down of leaf matter (color, 500 PCU). Phosphorus enrichment was observed at Bud Slough (0.37 mg/L) and Plunder Creek (1.7 mg/L). Wildcat Slough had a relatively low total phosphorus value of 0.069 mg/L. See Table 1 for a summary of the water chemistry parameters. High phosphorus levels are expected in this region.

Macroinvertebrate Parameters

The Bio-Recon thresholds for a "healthy" peninsular stream are: total taxa (18), Florida Index (10), and EPT Index (4) (see Bio-Recon forms in Appendix). Wildcat Slough and Plunder Creek passed two of the three Bio-Recon metrics. Total taxa (21) and the EPT Index (5) at Wildcat Slough exceeded the minimum expectations for these metrics. Total taxa (19) and EPT Index (4) values at Plunder Creek also met expectations. However, the Florida Index scores (Wildcat Slough, 4, Bud Slough,

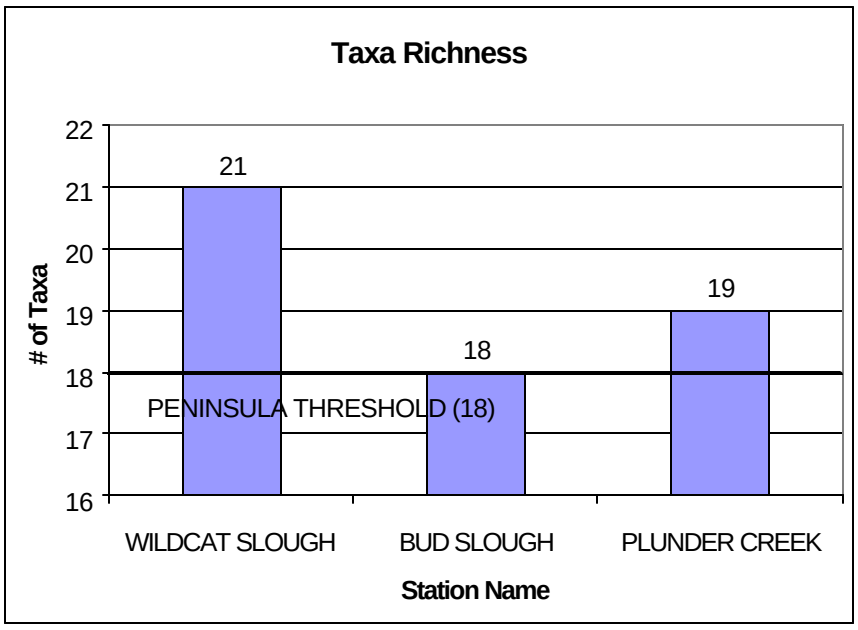


Figure 3: Taxa Richness Score

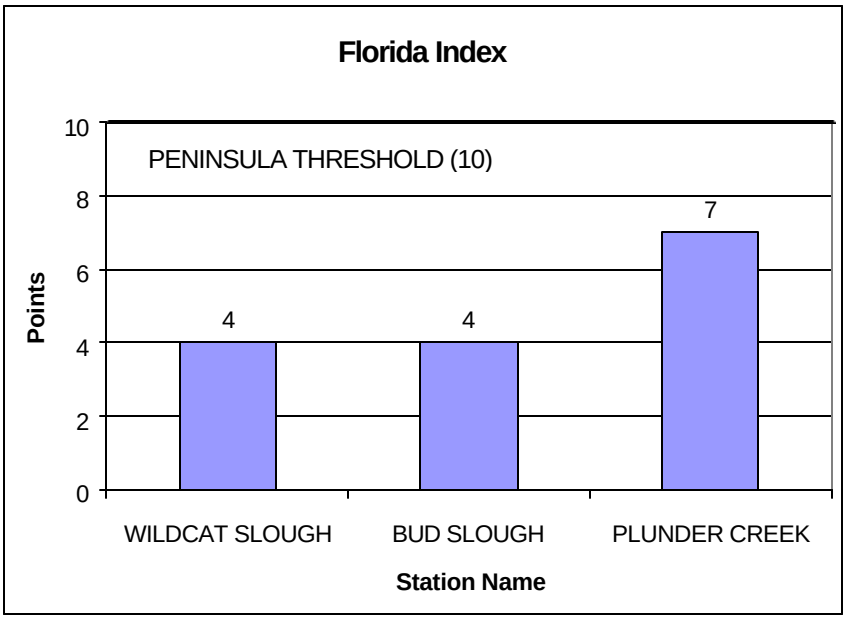


Figure 4: Florida Index Score

4, and Plunder Creek, 7) did not meet the Peninsular threshold of 10 for any of the three sites.

Bud Slough met or exceeded only the total taxa richness threshold (18). The Florida Index (4) at Bud Slough was well below the threshold value of 10, while the EPT Index (3) was only one short of the threshold (4). See Figures 3, 4, and 5 and Table 1 for summaries of the macroinvertebrate parameters.

The low-flow conditions could be a possible explanation for the suppressed number of sensitive organisms. Many of the sensitive organisms on the Florida Index are rheophilic (flow-loving; see discussion on water velocity in the Habitat Parameters section).

Conclusions

Water quality samples at all three sites showed typical levels of phosphorus for this area of the state with Wildcat Slough (0.069 mg/L) having the lowest concentrations of the three (Bud Slough, 0.37 mg/L and Plunder Creek, 0.72 mg/L). Nitrogen species (nitrate-nitrite, Kjeldahl nitrogen and ammonia) were low except for TKN at Plunder Creek (1.7 mg/L) which may be due to break down of organic material (color, 500 PCU). Bud and Wildcat Slough (3.6 & 4.9 mg/L, respectively) did not meet the Class III Water Quality Standard of 5.0 mg/L for dissolved oxygen.

This study shows the thresholds for the Bio-Recon methodology may be applied to small, 1st order streams. Two (Wildcat Slough and Plunder Creek) of the three reference sites "passed" the Bio-Recon (they met or surpassed the thresholds for taxa richness and the EPT index) indicating the systems are considered "healthy."

All three sites sampled scored in the "optimal" category for habitat assessment (125 at Wildcat Slough, 123 at Bud Slough, and 135 at Plunder Creek), with water velocity being the only parameter of concern (<0.01 m/s to 0.07 m/s). Wildcat Slough and Plunder Creek passed two of the three metrics (taxa richness; 21 & 19, respectively and EPT Index; 5 & 4, respectively for both sites), indicating a "healthy" system. Bud Slough, however, passed only the taxa richness (18) portion of the Bio-Recon, falling one taxa short from achieving the threshold for the

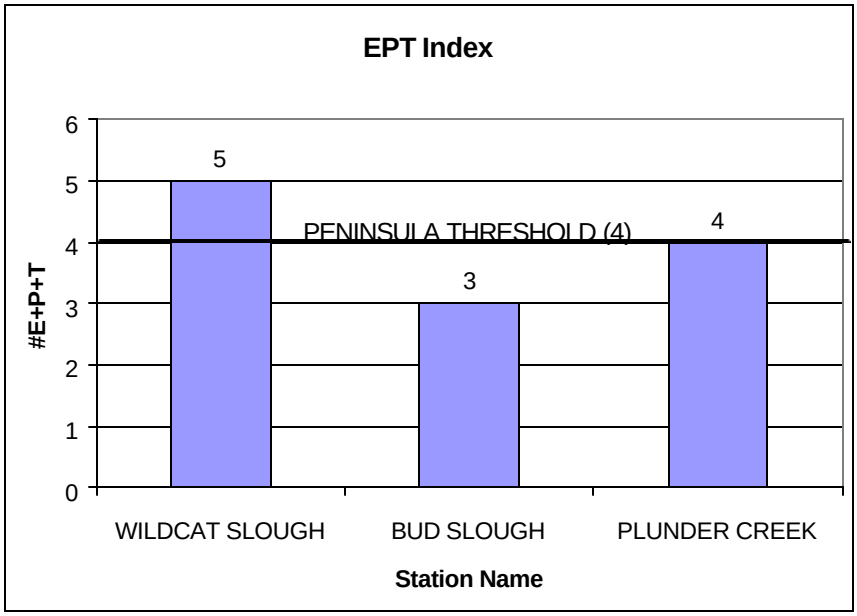


Figure 5: EPT Index Score

EPT Index (3). The site would be "suspected to be impaired" until more definitive sampling such as the Stream Condition Index (SCI) could be performed. The Bio-Recon is designed such that sites that are considered "healthy" by the Bio-Recon are guaranteed to pass the SCI (score in the "good" or "excellent" range). Sites that fail the Bio-Recon are only considered "suspected impaired" and may or may not pass the SCI. All three sites did not meet the threshold for the Florida Index. One possible explanation for the low Florida Index scores may be the very low velocities observed at all three sites.

Literature Cited

FDEP. 1999. Ecological Assessment of Reclaimed Streams. Fla. Dept. Environ. Prot., Bureau of Laboratories. Unpaginated.

FDEP. 2000a. Standard Operating Procedures IZ-31, Bio-Recon. Fla. Dept. Environ. Prot. Bureau of Laboratories. Unpaginated.

FDEP. 2000b. Standard Operating Procedures IZ-21, Stream Habitat Assessment. Fla. Dept. Environ. Prot., Bureau of Laboratories. Unpaginated.

FDEP. 2000c. Standard Operating Procedures IZ-20, Physical/Chemical Characterization. Fla. Dept. Environ. Prot., Bureau of Laboratories. Unpaginated.

Ross, L. T. 1990. Methods for aquatic biology. Fla. Dept. Environ. Reg. Tech. Ser. 10(1): 1-47.