Executive Summary

Submerged woody debris is extremely important to healthy river systems, providing habitat and enhancing channel stability and riverine energy cycling. Deadhead logging is the process of recovering submerged, pre-cut timbers from aquatic systems. The Board of Trustees allowed deadhead logging for 50 years prior to 1974. At that time the policy was changed to deny the removal of any deadhead logs. The Trustees changed this policy again in December 1998 due to their concern that this activity, which was occurring illegally, needed to be better regulated through an FDEP permitting process.

To make informed decisions regarding permitting issues, FDEP's Bureau of Submerged Lands and Environmental Resources (SLER) needed quantification of the amount of woody debris (snags) currently available in selected north Florida rivers, to determine if removal of deadheads would significantly reduce the total snag habitat.

During low water conditions, the Environmental Assessment Section mapped the snag habitat at 64 segments of the Apalachicola and Choctawhatchee Rivers. The mean percent visible snags in the Apalachicola River was 1.15% ± 0.14%. The mean percent visible woody debris in the Choctawhatchee River was 0.90% ± 0.34. . Compared to other southeastern U.S. rivers (which may be composed of up to 43% snags, depending upon water level), this is an extremely low availability of woody debris (Wallace and Benke 1984).

Since woody debris is such an important ecological resource, it is reasonable to recommend that steps be taken to enhance the amount of woody debris in Florida streams. These steps may include:

- A cooperative agreement with the Division of Forestry to place the appropriate size and type of woody material in rivers and streams which are shown to be deficient of snags. Such material may be available from logging operations in nearby watersheds.
- A cooperative agreement with the Fish and Wildlife Conservation Commission to design habitat restoration strategies for critical river reaches where threatened or endangered species reside.
- Replacement of deadheads with fresh snags to offset the habitat loss and potential channel de-stabilizing effects of deadhead removal.

Introduction

Throughout the 1800's and up until the early 1900's, large tracts of virgin Florida forest were harvested, fueling the State's early economy. The resulting logs, predominantly longleaf pine and cypress, were chained together in rafts and floated down river to mills, where they were prepared for shipment around the globe. An estimated 10% of these timbers were lost on their way to the mills and

sank to bottoms of various rivers. Deadhead logging is the process of recovering these submerged pre-cut pieces of timber from aquatic systems.

Deadhead logs are extremely valuable commercially. Timber of that size and quality is no longer available in Florida due to the absence of virgin or old growth forests. It has been estimated that 300,000 board feet of high-grade lumber rests at the bottom of the Blackwater and Yellow rivers alone.

For over 50 years, the Board of Trustees (the governor and his cabinet) authorized the removal of deadhead logs from sovereign submerged and other state-owned lands. In 1974 the trustees denied a request to remove deadheads from the Suwannee River, which became their policy until recently. They were concerned that removal of deadhead logs from rivers disrupted fish habitat and de-stabilized river channels, leading to increased erosion. The DEP brought this issue to the Trustees in December 1998 for several reasons

- an opinion from the Attorney General's office that "brand" owners could make a claim of title to the logs,
- a tremendous interest in the recovery of deadheads due to their value, and interest in recovery operations by persons displaced by the "net ban", and
- a need to address the illegal harvesting that was occurring by creating a formal process through which recovery could be managed to minimize environmental impacts.

In December, 1998, the Board of Trustees (Governor Lawton Chiles and his cabinet) approved a deadhead log recovery process that required both a use agreement and ERP or wetland resource permits. The use agreement addressed the state's proprietary and fiduciary interests while the permits addressed environmental impacts. The Board of Trustees asked DEP to come back in a year with an evaluation of how well the process was working. At that time they would decide whether or not to continue to allow recovery activities.

FDEP's Bureau of Submerged Lands and Environmental Resources (SLER) is responsible for permitting deadhead logging. They have worked with federal and state resource management agencies to develop a list of environmental guidelines that minimize habitat impacts. These guidelines are used by district permitting staff to assist in the review of ERP and wetland resource permits. SLER is considering potential mitigation activities (*e.g.*, replacement of deadhead logs with fresh snags) to accompany deadhead logging. To make an informed decision, SLER needed quantification of the amount of snag habitat currently available in selected north Florida rivers, to determine if removal of deadheads would significantly reduce the total snag habitat.

The Environmental Assessment Section carried out this investigation to address this concern.

Methods

This study took place after of period of deficit rainfall, resulting in low river stage, so that habitat normally below the water line would be visible. Total available visible habitat was determined at two sampling sites (noted as A and B) on each river, for a total of four sites. At each site, sixteen 100 meter stretches were mapped for habitat availability, eight on both the left and right banks (for a total of 64

sites in this study). Percent habitat represented by woody debris (snags), roots, and aquatic vegetation was also determined for each of the 64 sites. Standard Operation Procedures for habitat mapping, physical chemical characterization, and habitat assessment are available at http://www.dep.state.fl.us/labs/sops.htm.

This sampling method did not quantify the total amount of deadhead logs at each site, although deadheads were observed. These results represent the habitat that could be seen and accessed from a boat, therefore, logs in deeper water were not included. In the Choctawhatchee, field observations suggested that the vast majority most of the snags were visible. Due to the somewhat greater depth at the Apalachicola site studied, we were less certain as to how many snags were situated too deep to be visible. We will attempt to use side scan sonar at a future date to determine the amount of snag habitat available in these deeper areas.

Habitat quality was determined for two sites on the left and right banks of each river (for a total of 4 sites per river) during an *in situ* assessment. Eight attributes known to have potential effects on the stream biota, including habitat diversity, habitat abundance, water velocity, bank stability, habitat smothering, degree of artificial channelization, riparian zone buffer width, and riparian zone buffer vegetation quality, were evaluated and scored, with 20 possible points 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).

Results and Discussion

Submerged logs, or snags, are environmentally important in Florida rivers, since they provide habitat to invertebrates and fish, improve stream bank stability, serve as aquatic refugia during flooding, and enhance a stream's ability to process and conserve nutrient and energy inputs. FDEP's Northwest district staff determined that macroinvertebrate assemblages from deadhead logs in selected north Florida rivers were of extremely high quality, validating the deadheads' importance as habitat (FDEP 1999).

The percent of snags, roots, vegetation, and the number of individual snags were calculated for each site. These data and their summary statistics are presented in Appendix 1 and Appendix 2, respectively. Boxplots were done for the percent (Figure 1) and number of snags (Figure 2) by site and bank.

The mean percent visible snags in the Apalachicola River was 1.15% ± 0.14%. The mean percent visible woody debris in the Choctawhatchee River was 0.90% ± 0.34%. Considering both systems together, there was approximately 1% snag habitat available. Compared to other southeastern U.S. rivers (which may be composed of up to 43% snags), this is an extremely low availability of woody debris (Wallace and Benke 1984). The boxplots show that while there is more variability in the percent and number of snags in the Choctawhatchee River than in the Apalachicola, there is a paucity of snag habitat in both. Furthermore, the left and right banks at the same site are not homogeneous (which is not surprising, given the dynamics of hydrologic processes).

The results of the habitat assessment are displayed in Figures 3 and 4. All four sites fell into the suboptimal range. Parameters of concern included low habitat availability, bank instability, and habitat smothering (with sediment).

Conclusions

Woody debris (snag) habitat was extremely limiting in the north Florida rivers studied, accounting for only approximately 1% of the substrate. Although this study did not quantify the amount of deadhead logs at the sampled sites, it demonstrated that the amount of visible snag habitat is very small (approximately 1% in both rivers). Since woody debris is such an important ecological resource, it is reasonable to recommend that steps be taken to enhance the amount of woody debris in Florida streams.

These steps may include:

- A cooperative agreement with the Division of Forestry to place the appropriate size and type of woody material in rivers and streams which are shown to be deficient of snags. Such material may be available from logging operations in nearby watersheds.
- A cooperative agreement with the Fish and Wildlife Conservation Commission to design habitat restoration strategies for critical river reaches where threatened or endangered species reside.
- Replacement of deadheads with fresh snags to offset the habitat loss and potential channel de-stabilizing effects of deadhead removal.

Additional study, which involves quantifying the amount of woody debris in deepwater areas via side-scanning sonar, has been proposed.

Literature Cited

Ray, D. 1999. Ecological and morphological significance of old growth deadhead logs in the Apalachicola River. Fl. Dept. Environ. Prot. N.W. Dist. 6 p.

Wallace, J. B. and A. C. Benke. 1984. Quantification of wood habitat in subtropical coastal plain streams. Can. J. Fish. Aquat. Sci. 41:1643-1652.

Figure 1. Percent of snags by site and bank.

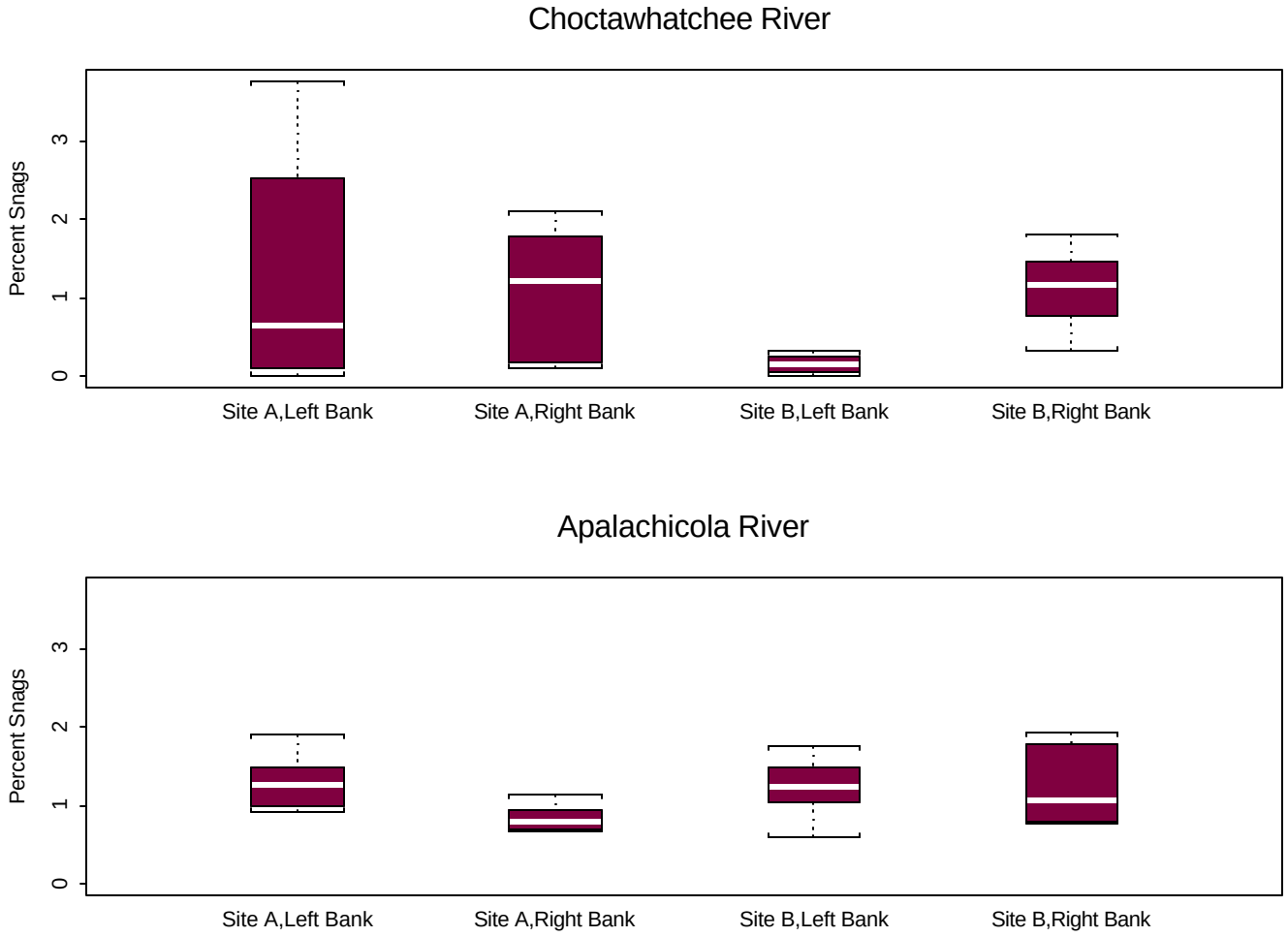
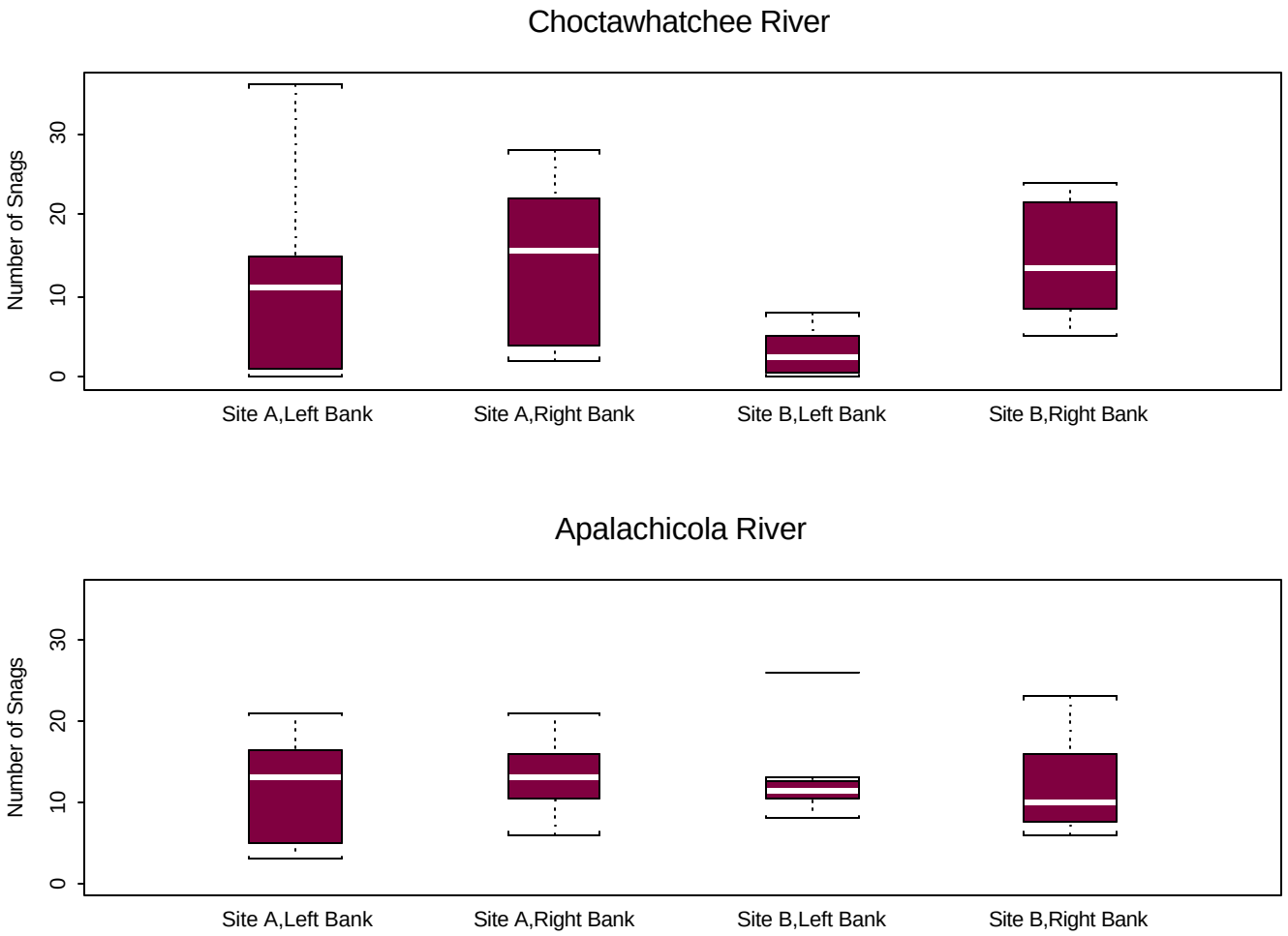


Figure 2. Number of snags by site and bank.



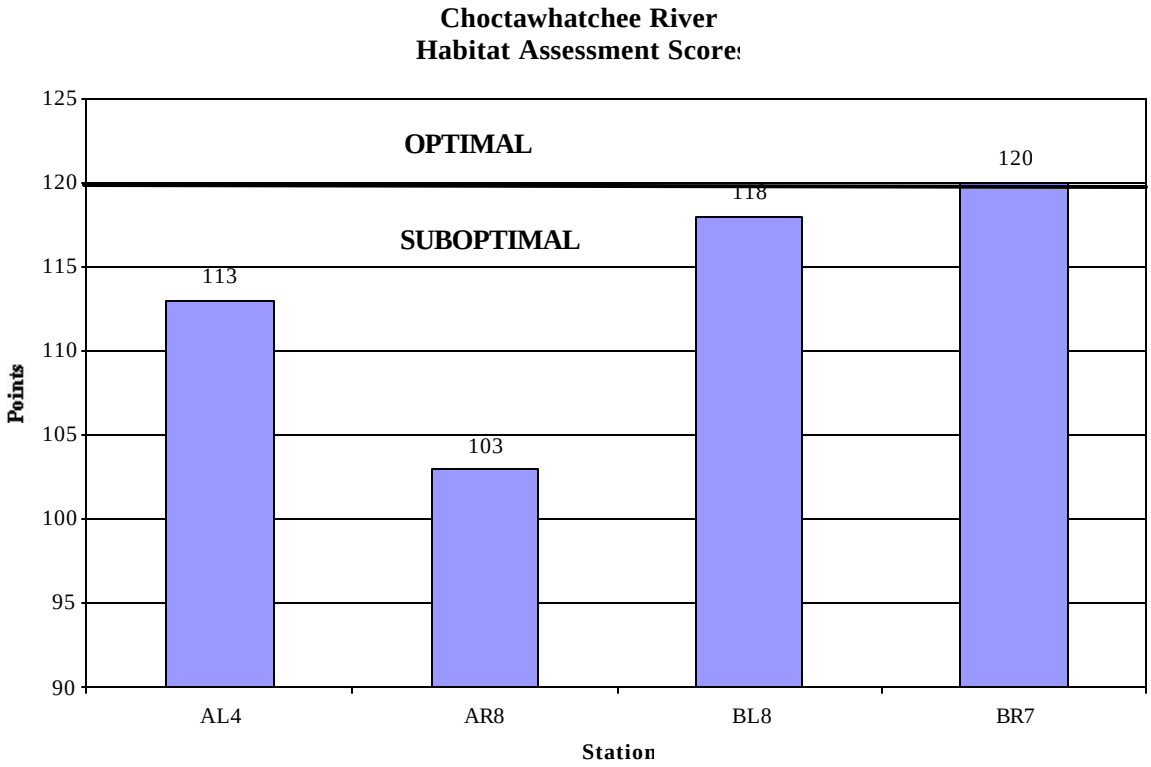


Figure 3. Choctawhatchee River Habitat Assessment Scores.

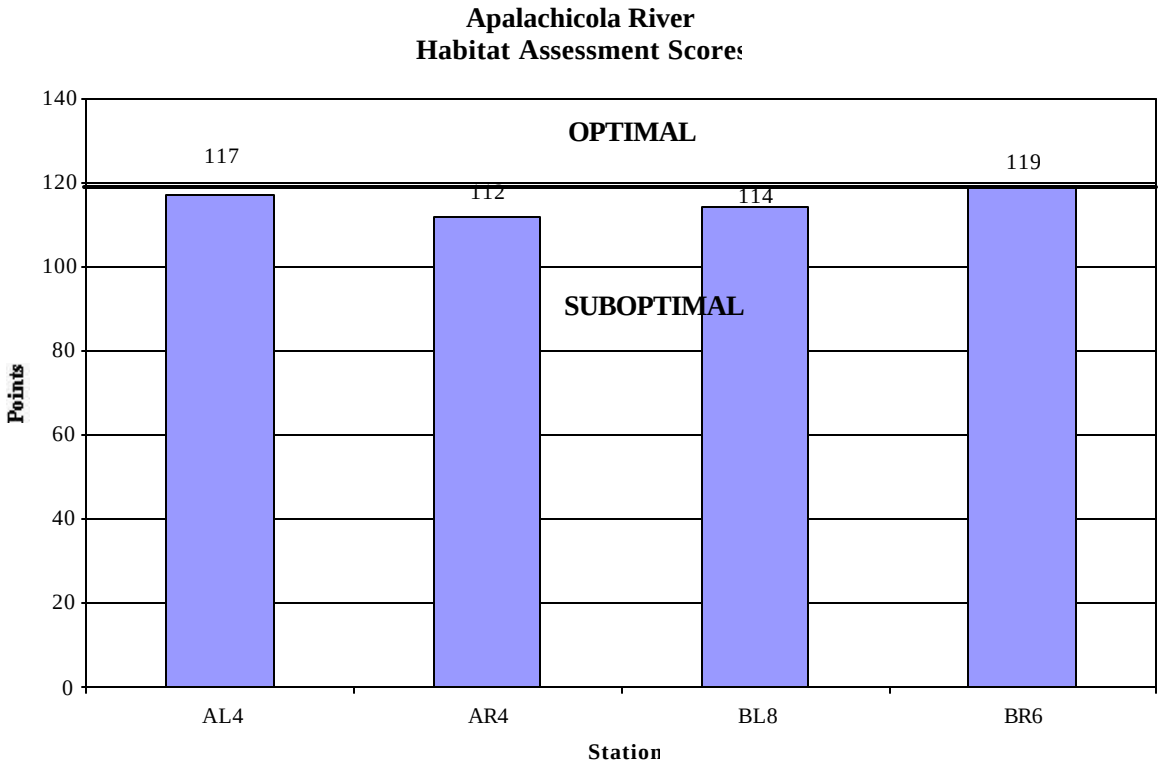


Figure 4. Apalachicola River Habitat Assessment Scores.

Appendix 1. Raw Data.

River	Site	Bank	Rep	% Snags	% Roots	% Veg	% Cover	Number of Snags
Apalachicola	A	L	1	1.9	0.23	0.7	2.8	13
Apalachicola	A	L	2	1.5	0.36	0	1.85	4
Apalachicola	A	L	3	0.93	0.28	0	1.2	6
Apalachicola	A	L	4	0.92	0.14	0	1.06	3
Apalachicola	A	L	5	1.34	0.27	0	1.6	17
Apalachicola	A	L	6	1.2	0.09	0.13	1.42	21
Apalachicola	A	L	7	1.48	0.22	0	1.7	16
Apalachicola	A	L	8	1.06	0.04	0.62	1.72	13
Apalachicola	A	R	1	0.7	0	0.37	1.07	16
Apalachicola	A	R	2	0.76	0	0.4	1.17	16
Apalachicola	A	R	3	1.05	0.07	0	1.12	13
Apalachicola	A	R	4	1.13	0.16	0	1.28	21
Apalachicola	A	R	5	0.67	0.31	0	0.98	6
Apalachicola	A	R	6	0.7	0.37	0	1.07	9
Apalachicola	A	R	7	0.83	0.3	0	1.13	12
Apalachicola	A	R	8	0.84	0.09	0	0.93	13
Apalachicola	B	L	1	1.75	0	0.09	1.84	26
Apalachicola	B	L	2	1.12	0.28	0	1.4	8
Apalachicola	B	L	3	1.62	0.09	0	1.7	11
Apalachicola	B	L	4	1.34	0.09	0.22	1.65	12

River	Site	Bank	Rep	% Snags	% Roots	% Veg	% Cover	Number of Snags
Apalachicola	B	L	5	0.59	0.18	0.54	1.31	12
Apalachicola	B	L	6	1.34	0.27	0	1.61	13
Apalachicola	B	L	7	0.93	0.21	0.46	1.61	11
Apalachicola	B	L	8	1.15	0.05	0.69	1.88	10
Apalachicola	B	R	1	1.26	0	2.29	3.55	6
Apalachicola	B	R	2	0.77	0.05	0.9	1.71	6
Apalachicola	B	R	3	0.8	0	2.06	2.86	10
Apalachicola	B	R	4	0.79	0	1.25	2.04	9
Apalachicola	B	R	5	0.86	0	1.29	2.16	10
Apalachicola	B	R	6	1.92	0	0	1.92	18
Apalachicola	B	R	7	1.86	0.23	0	2.09	14
Apalachicola	B	R	8	1.68	0.16	0.37	2.21	23
Choctawhatchee	A	L	1	3.75	0.4	0	4.15	36
Choctawhatchee	A	L	2	2.88	0	0	2.88	15
Choctawhatchee	A	L	3	2.17	0.29	0	2.47	15
Choctawhatchee	A	L	4	0.71	0.5	0	1.21	13
Choctawhatchee	A	L	5	0.15	0	0	0.15	1
Choctawhatchee	A	L	6	0	0	0	0	0
Choctawhatchee	A	L	7	0.05	0	0	0.05	1
Choctawhatchee	A	L	8	0.55	0	0	0.55	9
Choctawhatchee	A	R	1	1.06	0.06	0	1.12	28

River	Site	Bank	Rep	% Snags	% Roots	% Veg	% Cover	Number of Snags
Choctawhatchee	A	R	2	0.22	0	0	0.22	6
Choctawhatchee	A	R	3	0.1	0	0	0.1	2
Choctawhatchee	A	R	4	0.1	0.2	0	0.3	2
Choctawhatchee	A	R	5	2.09	0	0	2.09	27
Choctawhatchee	A	R	6	1.85	0.35	0	2.2	17
Choctawhatchee	A	R	7	1.73	0.22	0	1.95	14
Choctawhatchee	A	R	8	1.38	0.09	0	1.47	17
Choctawhatchee	B	L	1	0.22	0	0.77	0.98	6
Choctawhatchee	B	L	2	0	0	0	0	0
Choctawhatchee	B	L	3	0	0	0	0	0
Choctawhatchee	B	L	4	0.22	0	0	0.22	3
Choctawhatchee	B	L	5	0.32	0.23	0	0.54	8
Choctawhatchee	B	L	6	0.09	0.27	0	0.36	1
Choctawhatchee	B	L	7	0.26	0.18	0	0.44	4
Choctawhatchee	B	L	8	0.07	0	0	0.07	2
Choctawhatchee	B	R	1	1.05	0.14	0	1.2	12
Choctawhatchee	B	R	2	1.51	0.007	0	1.58	24
Choctawhatchee	B	R	3	1.26	0	0	1.26	22
Choctawhatchee	B	R	4	1.81	0.15	0	1.96	21
Choctawhatchee	B	R	5	1.4	0.23	0	1.63	15
Choctawhatchee	B	R	6	0.32	0.51	0	0.83	5

River	Site	Bank	Rep	% Snags	% Roots	% Veg	% Cover	Number of Snags
Choctawhatchee	B	R	7	0.81	0.26	0	1.06	10
Choctawhatchee	B	R	8	0.71	0.35	0	1.07	7

Appendix 2. Summary Statistics.

Summary Statistics for Apalachicola River (All Sites)					
Statistic	Percent Snags	Percent Roots	Percent Vegetation	Percent Cover	Number of Snags
Minimum	0.59	0.00	0.00	0.93	3.00
1st Quartile	0.82	0.03	0.00	1.19	9.00
Mean	1.15	0.14	0.39	1.68	12.44
Median	1.09	0.12	0.05	1.63	12.00
3rd Quartile	1.38	0.24	0.56	1.89	16.00
Maximum	1.92	0.37	2.29	3.55	26.00
Total N	32.00	32.00	32.00	32.00	32.00
Variance	0.16	0.01	0.36	0.35	29.93
Std Deviation	0.39	0.12	0.60	0.59	5.470964
Standard Error of the Mean	0.07	0.02	0.11	0.10	0.97
Lower 95% Confidence Limit	1.01	0.10	0.17	1.46	10.47
Upper 95% Confidence Limit	1.29	0.19	0.60	1.89	14.41

Apalachicola River Site A					
Statistic	Percent Snags	Percent Roots	Percent Vegetation	Percent Cover	Number of Snags
Minimum	0.67	0.00	0.00	0.93	3.00
1st Quartile	0.81	0.09	0.00	1.07	8.25
Mean	1.06	0.18	0.14	1.38	12.44
Median	0.99	0.19	0.00	1.19	13.00
3rd Quartile	1.24	0.29	0.19	1.63	16.00
Maximum	1.90	0.37	0.70	2.80	21.00
Total N	16.00	16.00	16.00	16.00	16.00
Variance	0.12	0.02	0.06	0.23	30.80
Std Deviation	0.35	0.13	0.24	0.47	5.55
Standard Error of the Mean	0.09	0.03	0.06	0.12	1.39
Lower 95% Confidence Limit	0.88	0.12	0.01	1.13	9.48
Upper 95% Confidence Limit	1.25	0.25	0.27	1.63	15.39

Apalachicola River Site B					
Statistic	Percent Snags	Percent Roots	Percent Vegetation	Percent Cover	Number of Snags
Minimum	0.59	0.00	0.00	1.31	6.00
1st Quartile	0.85	0.00	0.00	1.64	9.75
Mean	1.24	0.10	0.64	1.97	12.44
Median	1.21	0.07	0.42	1.86	11.00
3rd Quartile	1.64	0.19	0.99	2.11	13.25
Maximum	1.92	0.28	2.29	3.55	26.00
Total N	16.00	16.00	16.00	16.00	16.00
Variance	0.18	0.01	0.55	0.31	31.06
Std Deviation	0.43	0.11	0.74	0.56	5.57
Standard Error of the Mean	0.11	0.03	0.19	0.14	1.39
Lower 95% Confidence Limit	1.01	0.04	0.24	1.67	9.47
Upper 95% Confidence Limit	1.47	0.16	1.03	2.27	15.41

Summary Statistics for Choctawhatchee River (All Sites)					
Statistic	Percent Snags	Percent Roots	Percent Vegetation	Percent Cover	Number of Snags
Minimum	0.00	0.00	0.00	0.00	0.00
1st Quartile	0.14	0.00	0.00	0.22	2.00
Mean	0.90	0.14	0.02	1.07	10.72
Median	0.63	0.08	0.00	1.02	8.50
3rd Quartile	1.43	0.24	0.00	1.59	15.50
Maximum	3.75	0.51	0.77	4.15	36.00
Total N	32.00	32.00	32.00	32.00	32.00
Variance	0.89	0.03	0.02	0.98	91.18
Std Deviation	0.94	0.16	0.14	0.99	9.55
Standard Error of the Mean	0.17	0.03	0.02	0.17	1.69
Lower 95% Confidence Limit	0.56	0.08	-0.03	0.71	7.28
Upper 95% Confidence Limit	1.24	0.20	0.07	1.42	14.16

Choctawhatchee River Site A					
Statistic	Percent Snags	Percent Roots	Percent Vegetation	Percent Cover	Number of Snags
Minimum	0.00	0.00	0.00	0.00	0.00
1st Quartile	0.14	0.00	0.00	0.20	2.00
Mean	1.17	0.13	0.00	1.31	12.69
Median	0.89	0.03	0.00	1.17	13.50
3rd Quartile	1.91	0.24	0.00	2.12	17.00
Maximum	3.75	0.50	0.00	4.15	36.00
Total N	16.00	16.00	16.00	16.00	16.00
Variance	1.31	0.03	0.00	1.51	116.90
Std Deviation	1.15	0.17	0.00	1.23	10.81
Standard Error of the Mean	0.29	0.04	0.00	0.31	2.70
Lower 95% Confidence Limit	0.56	0.04	0.00	0.65	6.93
Upper 95% Confidence Limit	1.79	0.22	0.00	1.96	18.45

Choctawhatchee River Site B					
Statistic	Percent Snags	Percent Roots	Percent Vegetation	Percent Cover	Number of Snags
Minimum	0.00	0.00	0.00	0.00	0.00
1st Quartile	0.19	0.00	0.00	0.33	2.75
Mean	0.63	0.15	0.05	0.83	8.75
Median	0.32	0.15	0.00	0.91	6.50
3rd Quartile	1.10	0.24	0.00	1.22	12.75
Maximum	1.81	0.51	0.77	1.96	24.00
Total N	16.00	16.00	16.00	16.00	16.00
Variance	0.36	0.02	0.04	0.38	63.27
Std Deviation	0.60	0.16	0.19	0.62	7.95
Standard Error of the Mean	0.15	0.04	0.05	0.15	1.99
Lower 95% Confidence Limit	0.31	0.06	-0.05	0.50	4.51
Upper 95% Confidence Limit	0.95	0.23	0.15	1.15	12.99