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Sawgrass Density, Biomass, and Leaf Area Index: A Flume Study in Support of Research on Wind Sheltering Effects in the Florida Everglades

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By Nancy B. Rybicki, Justin T. Reel, Henry A. Ruhl, Patricia T. Gammon, Virginia Carter, and Jonathan K. Lee

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ABSTRACT

The U.S. Geological Survey is studying the wind sheltering effects of vegetation in the Florida Everglades. In order to test both the flow resistance and wind sheltering effects of sawgrass, uniform dense stands of sawgrass were grown in a tilting flume at Stennis Space Center, Mississippi. In June, 1997, one end of the flume was covered with a wind cowling with a removable top, and a series of experiments were conducted between June, 1997 and July, 1998. During each set of experiments, the sawgrass was sampled for vegetative characteristics, biomass, and leaf area index. The results of the analyses of the vegetation samples are summarized in a series of appendixes.

INTRODUCTION

The U.S. Geological Survey (USGS) is studying vegetative resistance to flow and the wind sheltering effects of vegetation in the South Florida Everglades as part of the USGS South Florida Ecosystem study. Living and dead vegetation in the water column can be expected to retard the flow of water, depending upon its density. In order to test the flow resistance of sawgrass under controlled conditions, uniform dense stands of sawgrass were grown in pans that were fit tightly into the USGS tilting flume at Stennis Space Center, Mississippi, to form a 61-m long, 1.8-m wide artificial sawgrass ecosystem (Lee and Carter, 1996). The depth of water in the flume was controlled by adding or removing metal plates (stop logs) at the downstream end. An initial series of experiments were conducted at various flow depths, and vegetative resistance was calculated from velocity, flow depth, and surface-water slope. This report describes the flume experiments and presents results of analyses of the vegetation samples.

STUDY METHODS

Flume/Wind Experiments

In June of 1997, one end of the flume was covered with a wind cowling with a removable top to determine the wind sheltering effect of sawgrass. The wind cowling was a rectangular channel made of plywood with structural modifications to ensure a nearly uniform, steady wind field with minimal secondary circulation patterns (Jenter, 1999; Jenter and Duff, 1999). Wind was generated by a portable band of four fans arranged in

a two-by-two array with a portable expansion section inserted between the fan bank and the wind cowling. The fan bank and expansion section could be moved to either end of the cowling to create winds that either opposed or were in the same direction as water flow in the flume. The removable top was intended to allow the plants to receive light from a band of mercury halide lamps when experiments were not being conducted. A series of wind sheltering experiments were conducted between June, 1997 and July, 1998.

During each experimental wind series, the vegetation in the flume was sampled to determine biomass per unit area, the number of live and dead standing culms and leaves per unit area, and leaf and culm width as a function of distance from the bed or the sediment/water interface. Other characteristics of the vegetation were also measured during these experiments. The general methods for measuring biomass and plant characteristics are outlined below. Measurements were made in June, 1997, October, 1997, April, 1998, and July, 1998. Measurement dates, type of measurements, condition of plants, and activity between measurements are summarized in Table 1.

Quadrat Biomass Measurements

Sawgrass biomass was measured in 37x55 cm quadrats; eight to twelve quadrats were characterized on each date (see table 1**).** In June, 1997, three quadrats were randomly selected from each quarter of the entire flume. Six of these (1A-C and 2A-C) were located in the area where the wind cowling would be placed. After June, 1997, the wind cowling was constructed, and the flume beneath the wind cowling was divided into an upstream (1) and a downstream (2) half. Four quadrats (A-D) were randomly selected in each half. For each quadrat and on all sample dates, leaves, culms, and dead material were cut and removed in 20-cm layers between 0 and 60 cm from the sediment/water interface and at 30-cm layers above 60 cm, starting at the top. The plant material from each layer was sorted (see plant descriptions below), dried at 105 °C for about 12 hours, and weighed, with weight expressed as grams dry weight per square meter (gdw/m^2). All vegetative components, live leaves, live culms, dead standing leaves, dead standing culms, and dead litter were separated, and their biomass was measured separately. Biomass data for individual quadrats were averaged to give layer-by-layer biomass data for the flume for each date.

Plant Descriptions

For each quadrat and on all sample dates, all leaves and culms in each layer were counted. Live leaves and dead leaves were separated into small, medium, and large classes; six widths were measured for each live size class (when possible). Likewise, live and dead standing culms were divided into small and large classes, and six live diameters were measured for each class, except in April, 1998, and July, 1998, when no widths were obtained for dead culms. Descriptive data were summarized for each date. Leaf area index (LAI) in $m^2\ m^{-2}$ was calculated for each layer using the equation:

$$LAI = LL \times AW_{LL} + ML \times AW_{ML} + SL \times AW_{SL} + LC \times AW_{LC} + SC \times AW_{SC} \times DL,$$

where LL = number of large live plus dead leaves, AW = average width of live leaves or culms, ML = number of medium live plus dead leaves, SL = number of small live plus dead leaves, LC = number of large live plus dead culms, SC = number of small live plus dead culms, and DL = depth of the layer in meters. LAI includes only standing plant material; however, dead litter accumulates in the flume over time, and this also provides resistance to flow. To account for the resistance of the dead litter, the ratio of dead litter biomass to standing plant biomass was calculated, the LAI was multiplied by this ratio, and the result was added to the LAI to provide a corrected LAI.

RESULTS OF SAMPLE MEASUREMENTS AND ANALYSES

Appendixes A, B, C, and D summarize biomass, vegetative characteristics, and leaf area index for June, 1997, October, 1997, April, 1998, and July, 1998, respectively. In general, as the experiment continued, more and more of the sawgrass plants in the flume died, primarily because the structural elements of the wind tunnel interfered with the amount of light reaching the plants.

REFERENCES CITED

Jenter, H. L., 1999, Laboratory experiments for evaluating the effects of wind forcing on shallow waters with emergent vegetation: Proceedings of the Coastal Ocean Symposium, a tribute to William D. Grant, Woods Hole Oceanographic Institution Technical Report 99-04.

Jenter, H. L. and Duff, M. P., 1999, Locally-forced wind effects on shallow waters with emergent vegetation: CD ROM in Proceedings of the 3rd International Symposium on Ecohydraulics, July 13-16, 1999, Salt Lake City, Utah.

Lee, J. K. and Carter, Virginia, 1996, Vegetation affects water movement in the Florida Everglades: U.S. Geological Survey Fact Sheet FS-147-96, 2 p.

Table 1. Procedures used on each sampling date and treatment between and during sampling dates

Dates	Sampling procedure		Treatment between sampling dates/comments
June 1997	Biomass: live leaves and culms, dead standing leaves and culms, dead litter, total Description Leaf area index	12 quadrats 12 quadrats all layers	Wind tunnel installed Front and back sections cleared Tops of plants not cut since March, 1997
October 1997	Biomass: live, dead, total Description Leaf area index	8 quadrats 8 quadrats all layers	Many plants were leaning over on this date.
April 1998	Biomass: live, dead, total Description Leaf area index	8 quadrats 8 quadrats all layers	Much of the plant material was lying down. 4 samples were taken where plants were down and mostly dead; 4 samples were taken in a healthier section.
July, 1998	Biomass: live, dead, total Description Leaf area index	8 quadrats 8 quadrats all layers	Plants mostly dead and many were lying down on this date. They had apparently not received sufficient light to maintain growth. 4 samples taken in area with plants standing and 4 were taken in an area where plants were lying down.

Appendix A: Biomass, Vegetative Characteristics, and Leaf Area Index of Flume Sawgrass in June, 1997

Table A-1. Sawgrass biomass in the flume, June, 1997
[Plants were 30 months old; layer in centimeters above the sediment/water interface; sample biomass in grams dry weight per square meter (gdw/m^2); dead includes all dead material.]

Layer	Sample biomass (gdw/m^2) 1A			1B			1C		
	Live	Dead	Total	Live	Dead	Total	Live	Dead	Total
>210	0.29		0.29						
180-210	2.58		2.58	0.14		0.14	0.43		0.43
150-180	15.50		15.50	1.94		1.94	5.17		5.17
120-150	36.60		36.60	6.10		6.10	13.56		13.56
90-120	62.72		62.72	16.65		16.65	32.08		32.08
60-90	117.11	20.88	137.99	37.39	4.95	42.34	80.16	77.43	157.58
40-60	77.07	55.69	132.76	30.71	7.25	37.96	60.42	65.30	125.72
20-40	91.21	84.10	175.31	19.09	23.47	42.55	64.37	88.91	153.28
0-20	108.21	168.85	277.07	35.38	90.92	126.30	88.55	216.36	304.91
Total	511.29	329.52	840.81	147.40	126.58	273.98	344.74	448.00	792.73
Layer	2A			2B			2C		
	Live	Dead	Total	Live	Dead	Total	Live	Dead	Total
>210									
180-210	0.07		0.07	0.57		0.57	1.58		1.58
150-180	11.27		11.27	5.17		5.17	25.33		25.33
120-150	27.77	0.72	28.49	11.63		11.63	49.87		49.87
90-120	60.06		60.06	19.81		19.81	76.57		76.57
60-90	105.06	24.83	129.89	72.33	8.32	80.66	264.08	63.44	327.51
40-60	77.93	56.83	134.77	46.86	56.62	103.48	199.42	125.22	324.64
20-40	98.96	107.78	206.74	35.38	106.20	141.58	176.53	110.94	287.47
0-20	177.61	169.35	346.96	76.21	160.02	236.23	382.55	155.65	538.20
Total	558.72	359.52	918.24	267.95	331.17	599.12	1175.93	455.25	1631.18
Layer	3A			3B			3C		
	Live	Dead	Total	Live	Dead	Total	Live	Dead	Total
>210									
180-210	0.43		0.43				1.44		1.44
150-180	7.46		7.46	9.69		9.69	4.74		4.74
120-150	31.43		31.43	17.51		17.51	11.84		11.84
90-120	56.48		56.48	31.07		31.07	16.36		16.36
60-90	140.15	13.56	153.71	75.42	4.09	79.51	42.19		42.19
40-60	94.87	35.23	130.10	44.20	12.06	56.26	69.32	10.26	79.58
20-40	89.63	50.38	140.00	52.82	15.79	68.60	34.01	22.39	56.40
0-20	133.76	151.20	284.96	53.03	106.92	159.95	40.47	120.13	160.60
Total	554.20	250.37	804.57	283.74	138.86	422.59	220.37	152.78	373.15

Table A-1. Sawgrass biomass in the flume, June, 1997, continued
[Plants were 30 months old; layer in centimeters above the sediment/water interface; sample biomass in grams dry weight per square meter (gdw/m^2); dead includes all dead material.]

Layer	4A			4B			4C		
	Live	Dead	Total	Live	Dead	Total	Live	Dead	Total
>210				0.79		0.79			
180-210	2.87		2.87	11.12		11.12	2.51		2.51
150-180	39.54		39.54	14.78		14.78	30.00		30.00
120-150	79.44		79.44	40.04		40.04	60.42		60.42
90-120	134.62	1.87	136.49	50.09		50.09	90.27		90.27
60-90	405.52	102.40	507.92	102.69	6.67	109.36	279.65	49.01	328.66
40-60	219.80	136.49	356.29	119.27	27.27	146.53	191.89	93.43	285.32
20-40	204.87	138.28	343.16	93.93	60.28	154.21	183.63	108.93	292.57
0-20	283.67	260.78	544.44	118.62	134.05	252.67	278.86	170.21	449.07
Total	1370.33	639.81	2010.14	551.33	228.27	779.60	1117.23	421.59	1538.82

Table A-2. Summary of sawgrass biomass, June, 1997
[Plants were 30 months old; layer in centimeters above the sediment/water interface; sample biomass in grams dry weight per square meter (gdw/m^2); SD = standard deviation; N = number of samples; dead includes all dead material.]

Layer	Average live biomass	SD	N	Average dead biomass	SD	Average total biomass	SD
>210	0.09	0.24	16			0.09	0.24
180-210	1.98	3.06	16			1.98	3.06
150-180	14.21	11.66	16			14.21	11.66
120-150	32.18	22.41	16	0.06	0.21	32.24	22.40
90-120	53.90	34.96	16	0.16	0.54	54.05	35.36
60-90	143.48	113.14	16	31.30	33.77	174.78	141.24
40-60	102.65	65.54	16	56.80	43.07	159.45	104.57
20-40	95.37	62.08	16	76.45	41.01	171.82	96.20
0-20	148.08	111.20	16	158.70	46.25	306.78	140.35
Total	591.94	407.91	16	323.48	153.85	915.41	539.29

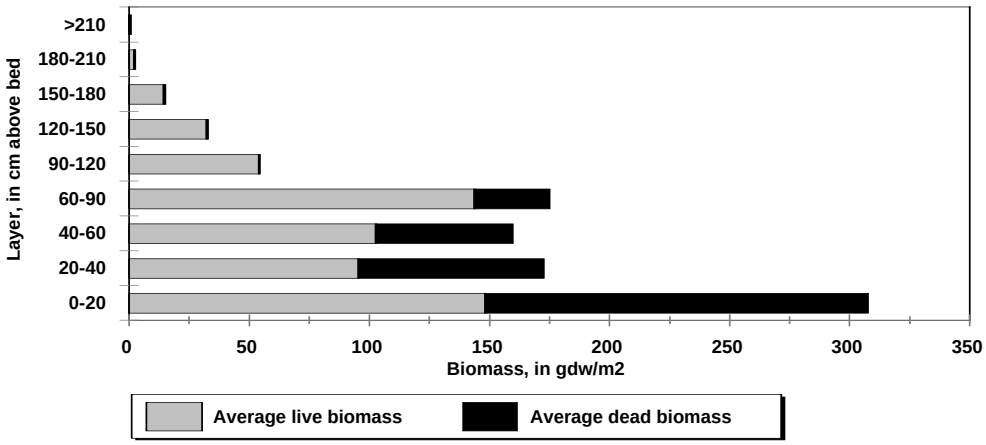

>210
180-210
150-180
120-150
90-120
60-90
40-60
20-40
0-20
Layer, in cm above bed
0
50
100
150
200
250
300
350
Biomass, in gdw/m2
Average live biomass
Average dead biomass

Table A-3. Sawgrass biomass (live and dead leaves and culms and dead litter) in the flume, June, 1997

[Plants were 30 months old; sample biomass in grams dry weight per square meter (gdw/m^2); dead refers to dead standing leaves and culms--dead litter was tabulated separately.]

Layer	Sample biomass (gdw/m^2)									
	1A					1B				
	Live leaves	Dead leaves	Live culms	Dead culms	Dead litter	Live leaves	Dead leaves	Live culms	Dead culms	Dead litter
>210	0.29									
180-210	2.58					0.14				
150-180	15.50					1.94				
120-150	36.60					6.10				
90-120	57.26		5.45			16.65				
60-90	94.51	20.88	22.60			33.44	3.95	3.95		1.00
40-60	39.11	28.49	37.96		27.20	23.25	7.25	7.46		
20-40	16.07	33.01	75.13	4.45	46.64	0.00	11.19	19.09		12.27
0-20	3.80	11.63	104.41	29.42	127.80	2.08	8.61	33.30	36.17	46.14
Total	265.73	94.01	245.56	33.87	201.65	83.60	31.00	63.79	36.17	59.42
Layer	1C					2A				
	Live leaves	Dead leaves	Live culms	Dead culms	Dead litter	Live leaves	Dead leaves	Live culms	Dead culms	Dead litter
>210										
180-210	0.43					0.07				
150-180	5.17					11.27				
120-150	13.56					27.77	0.72			
90-120	30.28		1.79			60.06				
60-90	71.83	34.88	8.32		42.55	95.23	5.67	9.83		19.16
40-60	45.28	52.89	15.14		12.41	55.54	20.38	22.39		36.45
20-40	4.81	66.02	59.56	6.75	16.15	21.10	38.25	77.86	3.23	66.31
0-20	0.00	25.47	88.55	13.28	177.61	0.00	9.83	177.61	19.16	140.36
Total	171.36	179.26	173.37	20.02	248.72	271.04	74.85	287.69	22.39	262.28
Layer	2B					2C				
	Live leaves	Dead leaves	Live culms	Dead culms	Dead litter	Live leaves	Dead leaves	Live culms	Dead culms	Dead litter
>210										
180-210	0.57					1.58				
150-180	5.17					25.33				
120-150	11.63					49.87				
90-120	14.50		5.31			76.57				
60-90	68.89	8.32	3.44			216.28	55.97	47.79		7.46
40-60	33.22	55.04	13.63		1.58	119.48	60.06	79.94		65.16
20-40	5.53	48.58	29.85		57.62	19.16	61.07	157.37	4.95	44.92
0-20	0.00	33.51	76.21	22.82	103.69	0.00	24.61	382.55	16.00	115.03
Total	139.50	145.46	128.45	22.82	162.90	508.28	201.72	667.66	20.95	232.57

Table A-3. Sawgrass biomass (live and dead leaves and culms and dead litter) in the flume, June, 1997, continued

[Plants were 30 months old; sample biomass in grams dry weight per square meter (gdw/m^2); dead refers to dead standing leaves and culms--dead litter was tabulated separately.]

Layer	Sample biomass (gdw/m^2)									
	3A					3B				
	Live leaves	Dead leaves	Live culms	Dead culms	Dead litter	Live leaves	Dead leaves	Live culms	Dead culms	Dead litter
>210										
180-210	0.43									
150-180	7.46					9.69				
120-150	31.43					16.72		0.79		
90-120	56.48					26.19		4.88		
60-90	123.00	13.56	17.15			67.96	4.09	7.46		
40-60	69.39	32.22	25.47		3.01	37.32	10.26	6.89		1.79
20-40	4.81	45.35	84.82		5.02	10.05	15.14	42.77		0.65
0-20	1.00	16.58	132.76	1.22	133.40	0.00	22.75	53.03	3.01	81.16
Total	294.00	107.71	260.20	1.22	141.44	167.92	52.24	115.82	3.01	83.60
Layer	3C					4A				
	Live leaves	Dead leaves	Live culms	Dead culms	Dead litter	Live leaves	Dead leaves	Live culms	Dead culms	Dead litter
>210										
180-210	1.44					2.87				
150-180	4.74					39.54				
120-150	11.84					79.01		0.43		
90-120	16.36					107.42	1.87	27.20		
60-90	39.32		2.87			339.28	93.07	66.23		9.33
40-60	62.07	10.26	7.25			128.31	119.34	91.49		17.15
20-40	10.98	15.36	23.03		7.03	6.31	123.79	198.56	2.51	11.98
0-20	0.00	8.47	40.47	12.92	98.74	0.00	34.80	283.67	3.88	222.10
Total	146.75	34.09	73.63	12.92	105.77	702.75	372.86	667.58	6.39	260.56
Layer	4B					4C				
	Live leaves	Dead leaves	Live culms	Dead culms	Dead litter	Live leaves	Dead leaves	Live culms	Dead culms	Dead litter
>210	0.79									
180-210	11.12					2.51				
150-180	14.78					30.00				
120-150	40.04					60.42				
90-120	41.91		8.18			66.02		24.25		
60-90	93.72	4.02	8.97		2.66	223.75	49.01	55.90		
40-60	76.64	16.65	42.63		10.62	111.01	91.64	80.87		1.79
20-40	13.63	36.17	80.30	4.81	19.30	26.12	77.50	157.51	4.23	27.20
0-20	0.00	9.83	118.62	3.59	120.63	0.00	13.63	278.86	4.31	152.27
Total	292.64	66.67	258.69	8.40	153.21	519.83	231.78	597.40	8.54	181.27

Table A-4. Summary of biomass (live and dead leaves and culms and dead litter) in the flume, June, 1997

[Plants were 30 months old; biomass in grams dry weight per square meter (gdw/m^2); SD = standard deviation; N = number of samples; avg = average.]

Layer	Avg live leaves	SD	Avg dead leaves	SD	Avg live culms	SD	Avg dead culms	SD	Avg dead litter	SD	N
>210	0.03	0.24									12
180-210	1.01	3.04									12
150-180	12.58	11.93									12
120-150	28.45	22.99	0.06	0.21	0.10	0.25					12
90-120	46.18	28.55	0.16	0.54	6.42	9.46					12
60-90	114.97	92.16	24.45	28.62	21.21	22.44			6.85	12.67	12
40-60	61.30	35.95	42.04	35.25	35.93	31.32			14.76	19.72	12
20-40	9.88	7.44	47.62	31.73	83.82	58.15	2.58	2.48	26.26	22.11	12
0-20	0.69	1.20	18.31	9.62	147.50	111.53	13.81	11.39	126.58	45.35	12
Total	275.09	190.75	132.64	100.44	294.99	223.86	16.39	11.50	174.45	69.21	12

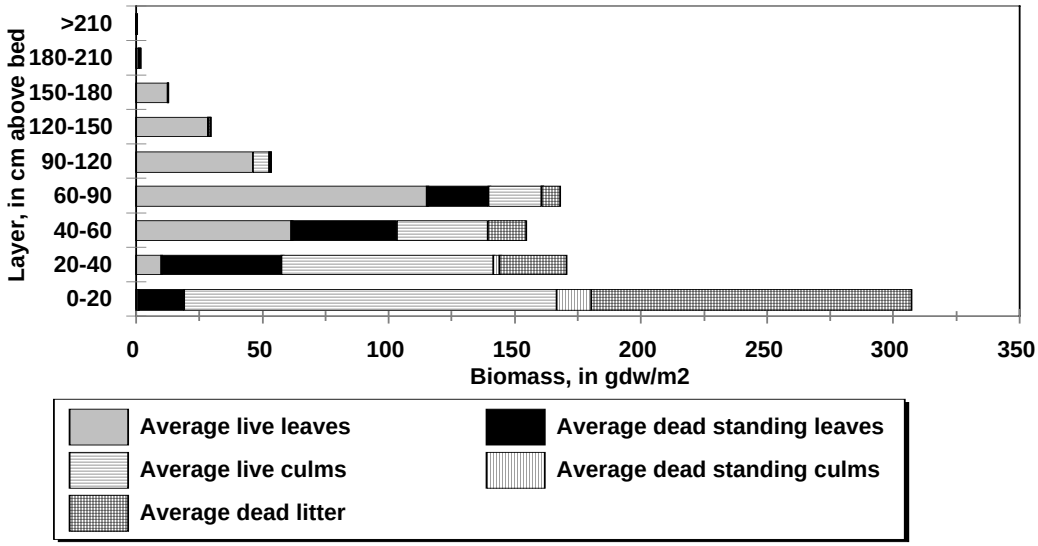


Table A-5. Descriptive information on flume vegetation, June, 1997
Plants were 30 months old; dead leaves and culms were erect and standing--dead litter was not counted; layer in centimeters above sediment/water interface; average width in mm; lvs = leaves; avg = average.]

LIVE	Large leaves		Medium leaves		Small leaves		Large culms		Small culms	
Layer	Avg # lvs/m^2	Avg width	Avg # lvs/m^2	Avg width	Avg # lvs/m^2	Avg width	Avg # culms/m^2	Avg width	Avg # culms/m^2	Avg width
>210	0.6	10.0	1.8	5.3	1.8	1.7				
180-210	3.0	10.1	20.9	6.4	23.3	2.1				
150-180	10.8	11.8	52.0	7.1	44.3	2.3				
120-150	16.7	11.5	94.5	7.2	43.1	2.3			1.2	3.5
90-120	14.4	11.0	115.4	6.6	42.5	2.4			15.0	5.4
60-90	26.9	11.3	218.3	7.2	38.3	3.3	1.2	13.5	32.9	5.3
40-60	31.1	13.8	125	7.5	35.3	3.9	11.4	13.2	29.9	5.8
20-40	19.5	13.8	10.2	7.3	9.0	2.9	30.5	14.5	15.0	7.4
0-20	0.6	11.0	0.6	6.0	0.6	5.0	40.7	21.2	9.0	6.3

DEAD	Large leaves		Medium leaves		Small leaves		Large culms		Small culms	
Layer	Avg # lvs/m^2	Avg width	Avg # lvs/m^2	Avg width	Avg # lvs/m^2	Avg width	Avg # culms/m^2	Avg width	Avg # culms/m^2	Avg width
>210										
180-210										
150-180										
120-150					1.2	2.5				
90-120			0.6	8.0						
60-90	1.2	12.0	65.8	6.5	17.3	3.8				
40-60	21.5	14.8	107.0	6.8	22.7	4.3				
20-40	61.0	16.1	102.3	7.7	12.0	4.3	0.6	15.0	4.8	7.7
0-20	37.7	14.9	20.9	6.9	7.8	3.7	7.2	15.0	6.6	8.5

Table A-6. Summary of leaves and culms in the flume, June, 1997
[Plants were 30 months old; dead leaves and culms were erect and standing--dead litter was not counted; layer in centimeters above the sediment/water interface; SD = standard deviation; N = number of samples.]

LIVE Layer	Total leaves/m^2	SD	N	Total culms/m^2	SD
>210	4.2	8.90	12		
180-210	47.2	33.16	12		
150-180	107.0	67.70	12		
120-150	154.3	87.54	12	1.2	2.79
90-120	172.2	83.12	12	15.0	15.44
60-90	283.5	154.77	12	34.1	21.45
40-60	191.4	75.59	12	41.3	24.12
20-40	38.7	22.40	12	45.4	23.77
0-20	1.8	3.25	12	49.6	28.45
DEAD Layer	Total leaves/m^2	SD	N	Total culms/m^2	SD
>210			12		
180-210			12		
150-180			12		
120-150	1.2	4.14	12		
90-120	0.6	2.07	12		
60-90	77.1	89.48	12		
40-60	139.3	130.02	12		
20-40	165.0	117.14	12	4.8	6.21
0-20	66.4	35.83	12	13.8	9.41

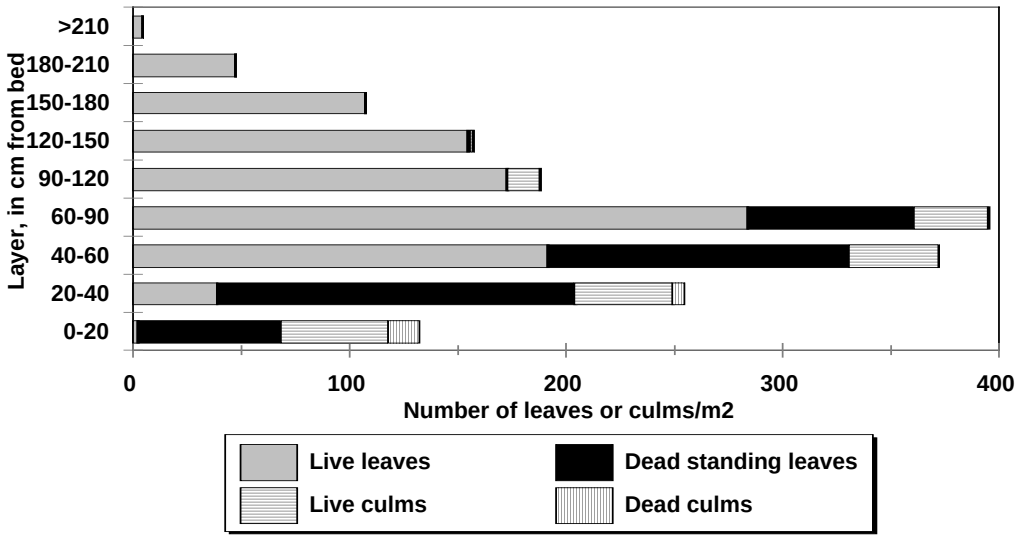
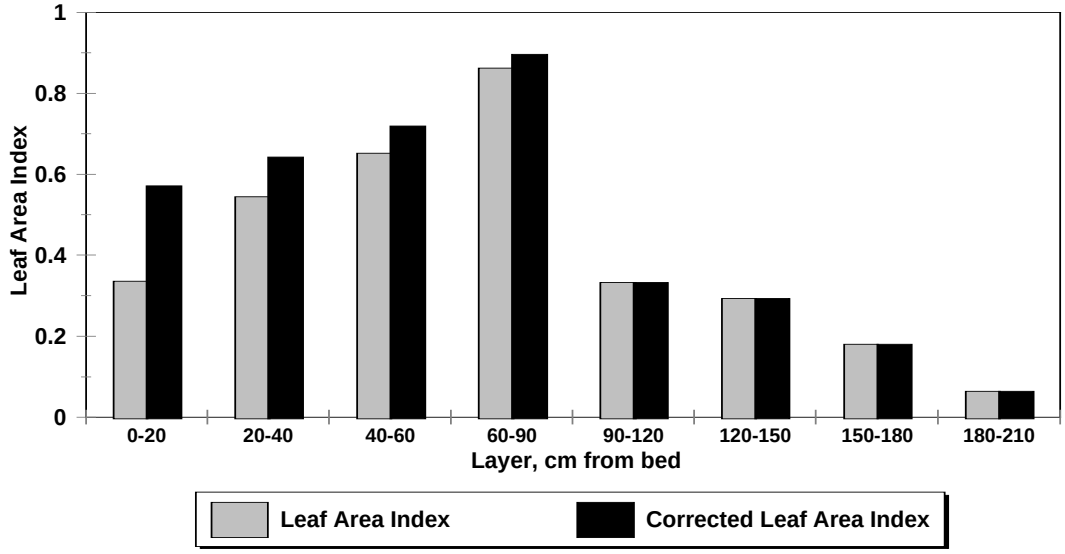


Table A-7. Leaf area index by layer for the flume, June, 1997
[Leaf area index is calculated for live leaves and culms plus dead standing leaves and culms; layer in centimeters above the sediment-water interface; biomass in grams dry weight/m^2; formula for calculations is in text.]

Layer	Leaf area index	Corrected leaf area index
180-210	0.064	0.064
150-180	0.180	0.180
120-150	0.293	0.293
90-120	0.335	0.333
60-90	0.862	0.897
40-60	0.653	0.719
20-40	0.545	0.643
0-20	0.336	0.572
Total	3.265	4.033



Appendix B: Biomass, Vegetative Characteristics, and Leaf Area Index of Flume Sawgrass in October, 1997

Table B-1. Sawgrass biomass in the flume, October, 1997
[Plants were 34 months old; layer in centimeters above the sediment/water interface; sample biomass in grams dry weight per square meter (gdw/m^2); dead includes all dead material.]

Layer	1A			1B		
	Live	Dead	Total	Live	Dead	Total
>180						
150-180						
120-150	12.92		12.92	5.02		5.02
90-120	21.67		21.67	3.88		3.88
60-90	90.70	11.27	101.97	96.52		96.52
40-60	87.48	58.13	145.60	186.07	8.90	194.97
20-40	158.95	48.44	207.39	85.97	10.69	96.66
0-20	168.35	117.26	285.60	102.47	122.42	224.90
Total	540.07	235.09	775.15	479.93	142.01	621.94

Layer	1C			1D		
	Live	Dead	Total	Live	Dead	Total
>180				1.87		1.87
150-180				2.66		2.66
120-150				10.91		10.91
90-120	2.51		2.51	41.98		41.98
60-90	136.27	11.27	147.54	94.51		94.51
40-60	130.67	58.13	188.80	192.17	15.57	207.75
20-40	70.18	48.44	118.62	233.36	125.72	359.09
0-20	54.11	117.26	171.36	145.39	201.29	346.67
Total	393.75	235.09	628.83	722.84	342.58	1065.42

Layer	2A			2B		
	Live	Dead	Total	Live	Dead	Total
>180						
150-180						
120-150						
90-120						
60-90	52.10	14.64	66.74	2.51	7.18	9.69
40-60	120.49	100.75	221.24	76.35	37.46	113.81
20-40	181.27	124.14	305.41	65.01	82.31	147.32
0-20	321.92	168.28	490.19	99.75	84.89	184.64
Total	675.76	407.81	1083.58	243.63	211.84	455.46

Layer	2C			2D		
	Live	Dead	Total	Live	Dead	Total
>180						
150-180						
120-150				33.58		33.58
90-120				2.15		2.15
60-90	30.64		30.64	269.67	21.82	291.49
40-60	314.38	96.52	410.90	160.60	188.01	348.61
20-40	216.93	92.50	309.43	199.42	205.81	405.23
0-20	175.17	103.33	278.50	309.50	164.55	474.05
Total	737.12	292.35	1029.47	974.93	580.18	1555.11

Table B-2. Summary of sawgrass biomass, October, 1997
[Plants were 34 months old; layer in centimeters above the sediment/water interface; sample biomass in grams dry weight per square meter (gdw/m^2); SD = standard deviation; N = number of samples); dead includes all dead material.]

Layer	Average live biomass	SD	N	Average dead biomass	SD	Average total biomass	SD
>180	0.23	0.66	8			0.23	0.66
150-180	0.33	0.94	8			0.33	0.94
120-150	7.80	11.66	8			7.80	11.66
90-120	9.02	15.15	8			9.02	15.15
60-90	96.62	81.72	8	8.27	8.00	104.89	86.90
40-60	158.53	75.79	8	70.43	58.08	228.96	100.64
20-40	151.39	68.25	8	92.26	60.50	243.64	116.75
0-20	172.08	97.15	8	134.91	39.05	306.99	122.14
Total	596.00	305.87	8	305.87	137.78	901.87	352.75

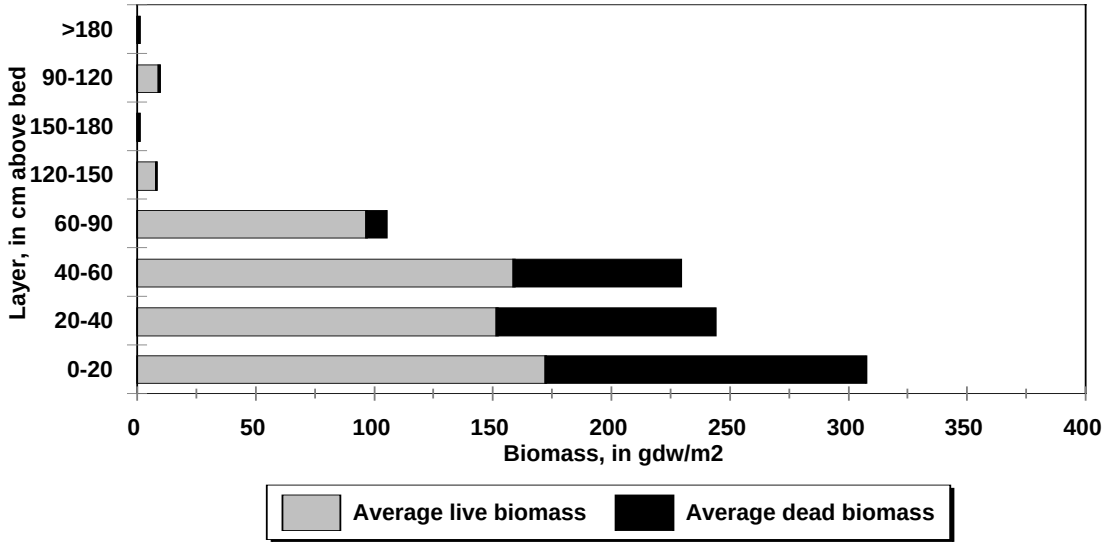


Table B-3. Sawgrass biomass (live and dead leaves and culms and dead litter) in the flume, October, 1997

[Plants were 34 months old; sample biomass in grams dry weight per square meter (gdw/m^2); dead refers to dead standing leaves and culms--dead litter was tabulated separately.]

Layer	1A					1B				
	Live leaves	Dead leaves	Live culms	Dead culms	Dead litter	Live leaves	Dead leaves	Live culms	Dead culms	Dead litter
>180										
150-180										
120-150	12.92					5.02				
90-120	21.17		0.50			3.88				
60-90	87.76	14.14	2.94			85.82		10.69		
40-60	66.95	53.25	20.52			176.03	8.90	10.05		
20-40	80.66	138.93	78.29			82.09	10.69	3.88		
0-20	5.17	153.49	163.18	9.11	73.48	36.38	81.73	66.09		40.69
Total	274.63	359.80	265.44	9.11	73.48	389.23	101.33	90.70	0.00	40.69

Layer	1C					1D				
	Live leaves	Dead leaves	Live culms	Dead culms	Dead litter	Live leaves	Dead leaves	Live culms	Dead culms	Dead litter
>180						1.87				
150-180						2.66				
120-150						10.91				
90-120	2.51					41.98				
60-90	118.76	11.27	17.51			76.35		18.16		
40-60	110.22	56.33	20.45	1.79		158.95	15.57	33.22		
20-40	51.16	40.76	19.02	0.00	7.68	145.60	125.72	87.76		
0-20	5.31	61.50	48.80	18.23	37.53	0.50	149.91	144.88	10.48	40.90
Total	287.97	169.86	105.77	20.02	45.21	438.81	291.20	284.03	10.48	40.90

Layer	2A					2B				
	Live leaves	Dead leaves	Live culms	Dead culms	Dead litter	Live leaves	Dead leaves	Live culms	Dead culms	Dead litter
>180										
150-180										
120-150										
90-120										
60-90	48.08	14.64	4.02			2.51	7.18			
40-60	84.82	100.75	35.66			53.75	35.59	22.60		1.87
20-40	5.24	112.66	176.03	11.48		35.38	69.75	29.64		12.56
0-20			321.92	16.79	151.49		20.74	99.75	4.02	60.13
Total	138.14	228.05	537.63	28.27	151.49	91.64	133.26	151.99	4.02	74.56

Table B-3. Sawgrass biomass (live and dead leaves and culms and dead litter) in the flume, October, 1997, continued

[Plants were 34 months old; sample biomass in grams dry weight per square meter (gdw/m^2); dead refers to dead standing leaves and culms--dead litter was tabulated separately.]

Layer	2C					2D				
	Live leaves	Dead leaves	Live culms	Dead culms	Dead litter	Live leaves	Dead leaves	Live culms	Dead culms	Dead litter
>180										
150-180										
120-150						33.58				
90-120						2.15				
60-90	30.64					238.60	21.82	31.07		
40-60	284.67	96.52	29.71			130.89	188.01	29.71		
20-40	50.73	76.14	166.20		16.36	31.07	204.80	168.35	1.00	
0-20	3.16	45.78	172.01	1.44	56.12		80.95	309.50	8.32	75.28
Total	369.21	218.44	367.91	1.44	72.48	436.30	495.57	538.63	9.33	75.28

Table B-4. Summary of biomass (live and dead leaves and culms and dead litter) in the flume, October, 1997

[Plants were 34 months old; biomass in grams dry weight per square meter (gdw/m^2); SD = standard deviation; N = number of samples.]

Layer	Average live leaves	SD	Average dead leaves	SD	Average live culms	SD	Average dead culms	SD	Average dead litter	SD	N
>180	0.23	0.66									8
150-180	0.33	0.94									8
120-150	7.80	11.66									8
90-120	8.96	15.09			0.06	0.18					8
60-90	86.07	71.64	8.63	8.22	10.55	11.02					8
40-60	133.29	74.66	69.37	58.46	25.24	8.41	0.22	0.63	0.23	0.66	8
20-40	60.24	42.84	97.43	61.22	91.14	71.29	1.56	4.02	4.57	6.73	8
0-20	6.31	12.36	74.26	55.36	165.77	102.47	8.55	6.65	66.95	37.14	8
Total	303.24	229.85	249.69	183.26	292.76	193.37	10.33	11.31	71.76	44.53	8

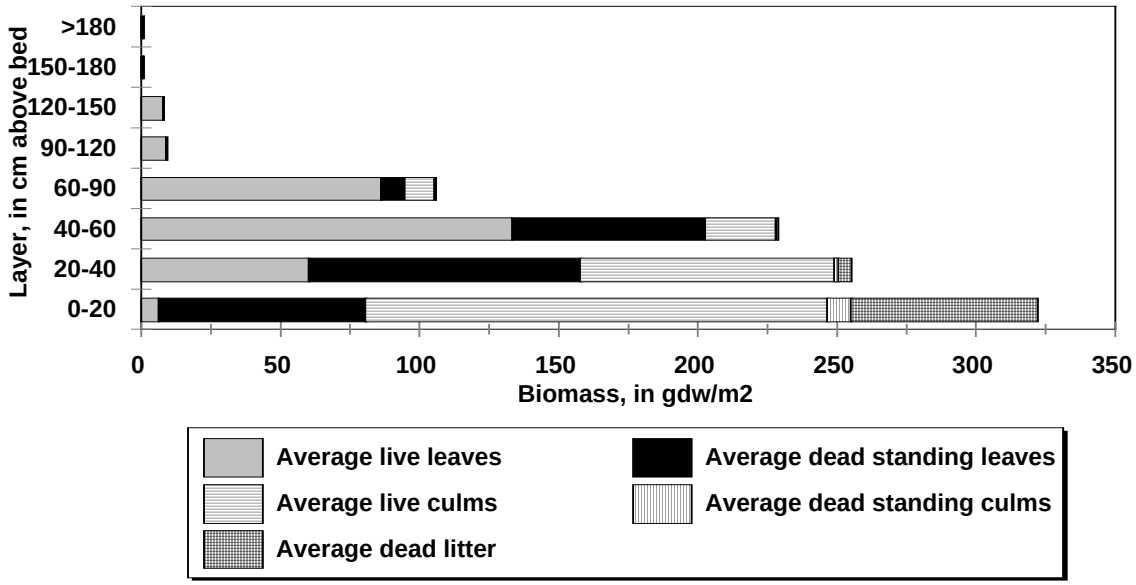


Table B-5. Descriptive information on flume vegetation, October 1997
[Plants were 34 months old; dead leaves and culms were erect and standing—dead litter was not counted; layer in centimeters above sediment/water interface; average width in mm; lvs = leaves; avg = average.]

LIVE	Large leaves		Medium leaves		Small leaves		Large culms		Small culms	
Layer	Avg # lvs/m^2	Avg width	Avg # lvs/m^2	Avg width	Avg # lvs/m^2	Avg width	Avg # lvs/m^2	Avg width	Avg # lvs/m^2	Avg width
>180					3.6	1.5				
150-180			1.8	5.5	2.7	2.3				
120-150	0.9	15.0	21.5	7.2	22.4	2.5				
90-120	4.5	12.6	22.4	7.2	20.6	2.4			0.9	4.0
60-90	28.7	12.0	186.6	7.3	104.1	3.0	0.9	10.0	19.7	5.1
40-60	61.9	12.1	227.8	7.4	154.3	3.2	9.0	13.3	28.7	5.4
20-40	26.0	14.5	98.7	7.4	96.0	3.7	18.8	18.8	26.9	5.3
0-20			16.1	7.5	5.4	3.3	29.6	23.3	17.0	8.2

DEAD	Large leaves		Medium leaves		Small leaves		Large culms		Small culms	
Layer	Avg # lvs/ m^2	Avg width	Avg # lvs/ m^2	Avg width	Avg # lvs/ m^2	Avg width	Avg # lvs/ m^2	Avg width	Avg # lvs/ m^2	Avg width
>180										
150-180										
120-150										
90-120										
60-90	3.6	11.7	21.5	7.4	9.9	4.2				
40-60	41.3	13.6	82.5	7.6	58.3	4.2			0.9	4.0
20-40	81.6	18.9	92.4	7.8	63.7	3.8			2.7	8.5
0-20	74.5	18.5	52.9	7.0	30.5	4.3	4.5	11.8	5.4	7.3

Table B-6. Summary of leaves and culms in the flume, October 1997
[Plants were 34 months old; dead leaves and culms were erect and standing—dead litter was not counted; layer in centimeters above the sediment/water interface; SD = standard deviation; N = number of samples.]

LIVE					
Layer	Total leaves/ m^2	SD	N	Total culms/ m^2	SD
>180	3.6	10.1	8		
150-180	4.5	12.7	8		
120-150	44.9	66.1	8		
90-120	47.5	72.7	8	0.9	2.5
60-90	319.3	249.4	8	20.6	18.6
40-60	444.0	256.6	8	37.7	20.6
20-40	220.7	131.4	8	45.7	17.1
0-20	21.5	33.2	8	46.6	17.6
DEAD					
Layer	Total leaves/ m^2	SD	N	Total culms/ m^2	SD
>180			8		
150-180			8		
120-150			8		
90-120			8		
60-90	35.0	33.5	8		
40-60	182.1	153.3	8	0.9	2.5
20-40	237.7	118.7	8	2.7	5.3
0-20	157.9	54.8	8	9.9	6.6

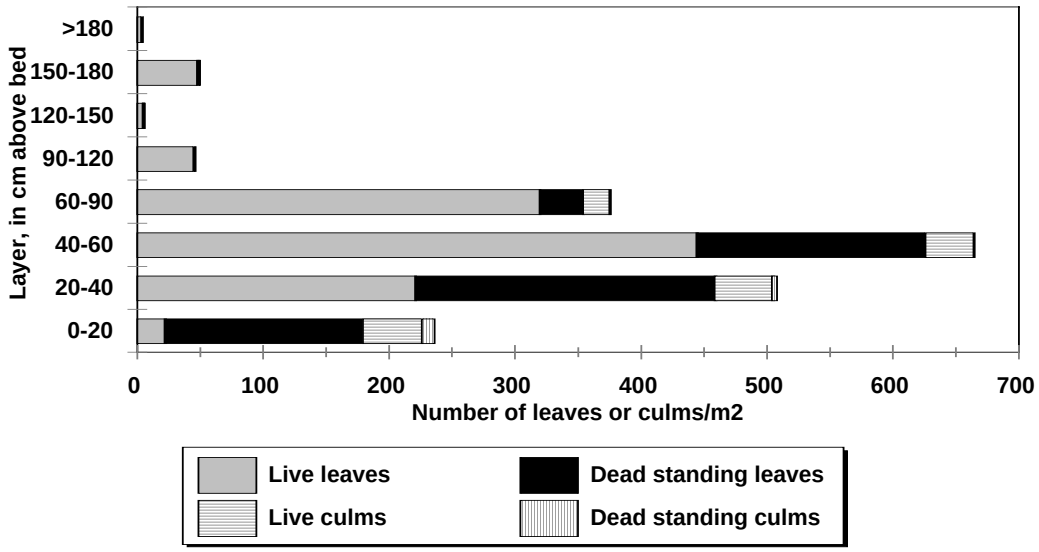
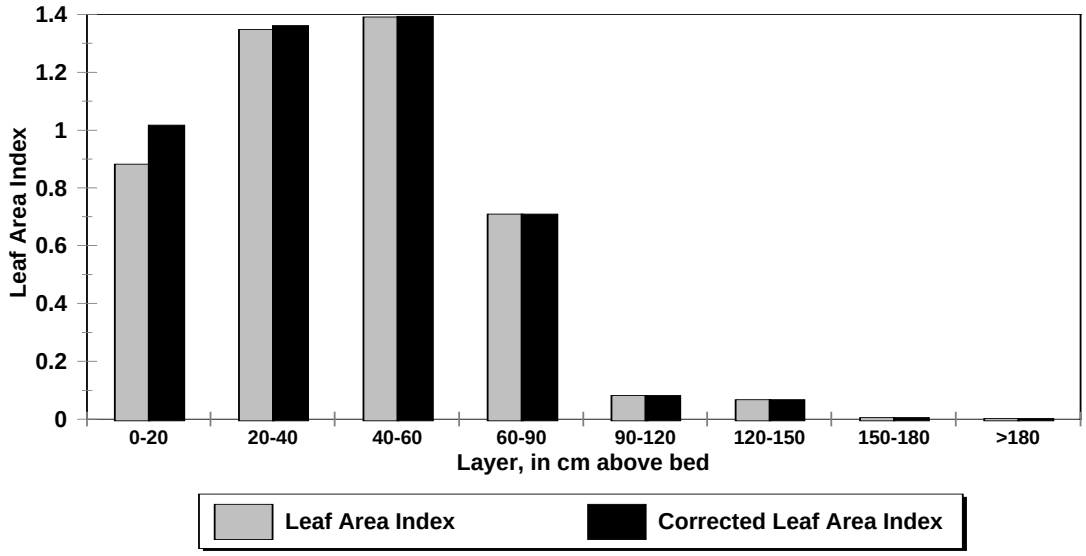


Table B-7. Leaf area index by layer for the flume, October, 1997
[Leaf area index is calculated for live leaves and culms plus dead standing leaves and culms; layer in centimeters above the sediment-water interface; biomass in grams dry weight/m^2; formula for calculations is in text.]

Layer	Leaf area index	Corrected leaf area index
>180	0.002	0.002
150-180	0.005	0.005
120-150	0.067	0.067
90-120	0.081	0.081
60-90	0.709	0.709
40-60	1.392	1.394
20-40	1.347	1.361
0-20	0.882	1.018
Total	4.486	4.637



Appendix C: Biomass, Vegetative Characteristics, and Leaf Area Index of Flume Sawgrass in April, 1998

Table C-1. Sawgrass biomass in the flume, April, 1998
[Plants were 40 months old; layer in centimeters above the sediment/water interface; sample biomass in grams dry weight per square meter (gdw/m^2); dead includes all dead material.]

Layer	Sample biomass (gdw/m^2) 1A Live	1A Dead	1A Total	1B Live	1B Dead	1B Total
>150						
120-150						
90-120				10.48		10.48
60-90	3.91	3.35	7.26	112.15		112.15
40-60	88.76	47.82	136.58	61.27	59.68	120.95
20-40	107.12	223.25	330.36	150.27	95.26	245.53
0-20	125.00	201.93	326.93	96.44	114.18	210.62
Total	324.79	476.35	801.14	430.60	269.12	699.72

Layer	1C Live	1C Dead	1C Total	1D Live	1D Dead	1D Total
>150						
120-150	5.51		5.51	10.78		10.78
90-120	36.05		36.05	41.25	2.02	43.27
60-90	137.37	65.91	203.28	137.38	98.32	235.70
40-60	129.40	156.42	285.81	86.87	96.68	183.55
20-40	124.48	122.26	246.74	57.28	77.52	134.79
0-20	255.87	147.98	403.84	164.88	73.16	238.04
Total	688.67	492.56	1181.23	498.44	347.69	846.14

Layer	2A Live	2A Dead	2A Total	2B Live	2B Dead	2B Total
>150	0.14		0.14	0.10		0.10
120-150	5.94		5.94	1.27		1.27
90-120	19.11		19.11	5.45		5.45
60-90	198.95	102.47	301.42	26.80	6.92	33.73
40-60	139.44	86.43	225.88	0.90	17.24	18.14
20-40	204.54	155.39	359.93	29.82	56.64	86.46
0-20	518.48	172.07	690.55	139.06	184.15	323.21
Total	1086.61	516.36	1602.97	203.41	264.95	468.36

Layer	2C Live	2C Dead	2C Total	2D Live	2D Dead	2D Total
>150						
120-150	0.94		0.94	0.43		0.43
90-120	7.61		7.61	4.88		4.88
60-90	41.94	9.90	51.83	102.72	71.14	173.86
40-60	89.48	82.97	172.45	157.92	320.42	478.33
20-40	98.37	133.56	231.93	145.35	155.02	300.37
0-20	117.28	49.35	166.63	205.31	103.59	308.90
Total	355.61	275.77	631.39	616.60	650.16	1266.76

Table C-2. Summary of sawgrass biomass, April, 1998
[Plants were 40 months old; layer in centimeters above the sediment/water interface; sample biomass in grams dry weight per square meter (gdw/m^2); SD = standard deviation; N = number of samples); dead includes all dead material.]

Layer	Average live biomass	SD	N	Average dead biomass	SD	Average total biomass	SD
>150	0.03	0.06	8			0.03	0.06
120-150	3.11	3.91	8			3.11	3.91
90-120	15.60	14.32	8	0.25	0.72	15.86	15.80
60-90	95.15	66.03	8	44.75	44.25	139.90	105.44
40-60	94.25	49.63	8	108.46	94.78	202.71	136.18
20-40	114.65	55.03	8	127.36	52.54	242.01	93.31
0-20	202.79	137.66	8	130.80	54.61	638.97	469.26
Total	525.59	326.64	8	411.62	246.90	1242.60	823.96

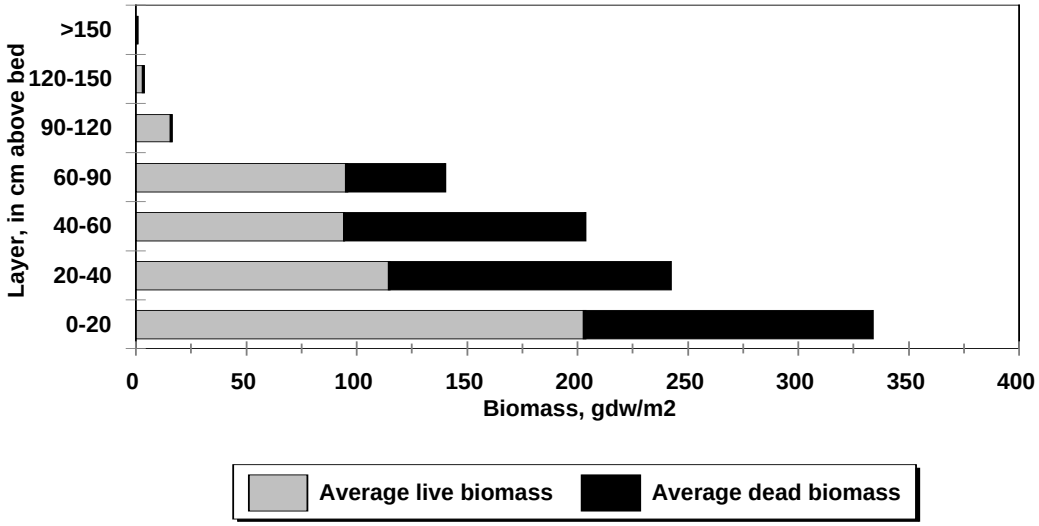


Table C-3. Sawgrass biomass (live and dead leaves and culms and dead litter) in the flume, April, 1998

[Plants were 40 months old; sample biomass in grams dry weight per square meter (gdw/m^2); dead refers to dead standing leaves and culms--dead litter was tabulated separately.]

Layer			1A					1B		
	Live leaves	Dead leaves	Live culms	Dead culms	Dead litter	Live leaves	Dead leaves	Live culms	Dead culms	Dead litter
>150										
120-150										
90-120						10.48				
60-90	3.91	3.35				104.35		7.80		
40-60	87.82	47.82	0.94			61.27	59.68			
20-40	101.69	183.10	5.43	7.47	32.68	65.54	95.26	84.73		
0-20	24.79	53.68	100.21	12.15	136.11	11.71	68.06	84.73	2.78	43.33
Total	218.21	287.94	106.58	19.62	168.79	253.35	223.01	177.25	2.78	43.33

Layer			1C					1D		
	Live leaves	Dead leaves	Live culms	Dead culms	Dead litter	Live leaves	Dead leaves	Live culms	Dead culms	Dead litter
>150										
120-150	5.51					10.78				
90-120	36.05					41.25	2.02			
60-90	130.56	65.91	6.81			136.57	98.32	0.81		
40-60	108.68	156.42	20.72			75.11	96.68	11.76		
20-40	38.35	122.26	86.13			18.32	69.57	38.96	7.94	
0-20	5.58	86.11	250.29		61.86	7.74	27.94	157.15	8.88	36.35
Total	324.72	430.70	363.95	0.00	61.86	289.77	294.52	208.68	16.82	36.35

Layer			2A					2B		
	Live leaves	Dead leaves	Live culms	Dead culms	Dead litter	Live leaves	Dead leaves	Live culms	Dead culms	Dead litter
>150	0.14					0.10				
120-150	5.94					1.27				
90-120	19.11					5.45				
60-90	193.60	102.47	5.35			21.86	6.92	4.94		
40-60	107.07	86.43	32.38				17.24	0.90		
20-40	55.44	135.40	149.10	19.99		29.82	56.64			
0-20	23.64	46.47	494.84	34.19	91.41		149.96	139.06	11.52	22.66
Total	404.94	370.78	681.67	54.17	91.41	58.50	230.77	144.91	11.52	22.66

Table C-3. Sawgrass biomass (live and dead leaves and culms and dead litter) in the flume, April, 1998, continued

[Plants were 40 months old; sample biomass in grams dry weight per square meter (gdw/m^2); dead refers to dead standing leaves and culms--dead litter was tabulated separately.]

Layer	2C					2D				
	Live leaves	Dead leaves	Live culms	Dead culms	Dead litter	Live leaves	Dead leaves	Live culms	Dead culms	Dead litter
>150										
120-150	0.94					0.43				
90-120	7.61					4.88				
60-90	41.94	9.90				102.72	71.14			
40-60	87.97	82.97	1.51			140.33	320.42	17.59		
20-40	70.69	117.72	27.68	15.84		32.03	125.56	113.32	13.10	16.36
0-20	13.09	32.34	104.20	13.93	3.08	7.73	34.59	197.58	2.96	66.05
Total	222.23	242.93	133.38	15.84	3.08	288.12	551.70	328.48	16.05	82.41

Table C-4. Summary of biomass (live and dead leaves and culms and dead litter) in the flume, April, 1998
[Plants were 40 months old; biomass in grams dry weight per square meter (gdw/m^2); SD = standard deviation; N = number of samples.]

Layer	Average live leaves	SD	Average dead leaves	SD	Average live culms	SD	Average dead culms	SD	Average dead litter	SD	N
>150	0.03	0.06									8
120-150	3.11	3.91									8
90-120	15.60	15.30	0.64	1.21							8
60-90	91.94	64.64	12.29	34.76	3.21	3.34	41.17	40.28			8
40-60	83.53	41.39	108.46	94.78	10.72	12.01					8
20-40	51.49	27.32	113.19	39.75	55.34	54.50	8.04	7.78	6.51	11.99	8
0-20	11.78	8.63	62.39	40.46	191.01	134.59	10.80	10.72	57.22	42.41	8
Total	257.48	161.26	296.97	210.95	260.29	204.43	60.01	58.78	63.74	54.39	8

Table C-5. Descriptive information on live flume vegetation, April, 1998
[Plants were 40 months old; layer in centimeters above sediment/water interface; average width in mm; lvs = leaves; avg = average.]

LIVE	Large leaves		Medium leaves		Small leaves		Large culms		Small culms	
Layer	Avg # lvs/m^2	Avg width	Avg # lvs/m^2	Avg width	Avg # lvs/m^2	Avg width	Avg # culms/m^2	Avg width	Avg # culms/m^2	Avg width
>150					3.6	2.0				
120-150	4.5	12.7	11.2	6.5	22.4	2.9				
90-120	8.1	13.5	69.5	7.2	58.3	3.3				
60-90	33.2	10.8	203.6	7.3	150.7	3.3			10.8	4.6
40-60	25.1	10.7	167.7	7.3	162.4	3.4	1.8	11.0	17.0	4.9
20-40	26.9	11.3	115.7	7.1	103.2	3.5	19.5	16.1	19.7	6.8
0-20			34.1	7.0	17.0	3.8	35.9	21.1	29.6	7.8

Table C-6. Descriptive information on dead flume vegetation, April, 1998
[Plants were 40 months old; dead leaves and culms were erect and standing--dead litter was not counted; layer in centimeters above sediment/water interface; average width in mm; avg = average.]

DEAD Layer	Large leaves Avg # leaves/ m^2	Medium leaves Avg # leaves/ m^2	Small leaves Avg # leaves/ m^2	Large culms Avg # culms/ m^2	Small culms Avg # culms/ m^2
>150					
120-150					
90-120	0.9	1.8			
60-90	15.3	101.4	43.1		
40-60	59.2	164.2	72.7		
20-40	97.8	146.2	71.8	2.7	1.8
0-20	51.1	69.1	35.9	3.6	3.6

Table C-7. Summary of leaves and culms in the flume, April, 1998
[Plants were 40 months old; dead leaves and culms were erect and standing--dead litter was not counted; layer in centimeters above the sediment/water interface; SD = standard deviation; N = number of samples.]

LIVE Layer	Total leaves/m^2	SD	N	Total culms m^2	SD
>150	3.6	6.6	8		
120-150	38.1	37.2	8		
90-120	135.9	143.0	8		
60-90	387.5	197.3	8	10.8	12.1
40-60	355.2	144.0	8	18.8	16.7
20-40	245.8	124.3	8	36.8	28.0
0-20	51.1	43.6	8	65.5	25.3
DEAD Layer	Total leaves/m^2	SD	N	Total culms/ m^2	SD
>150			8		
120-150			8		
90-120	2.7	5.3	8		
60-90	159.7	112.9	8		
40-60	296.0	233.4	8		
20-40	315.7	124.2	8	4.5	3.7
0-20	156.1	81.0	8	7.2	3.8

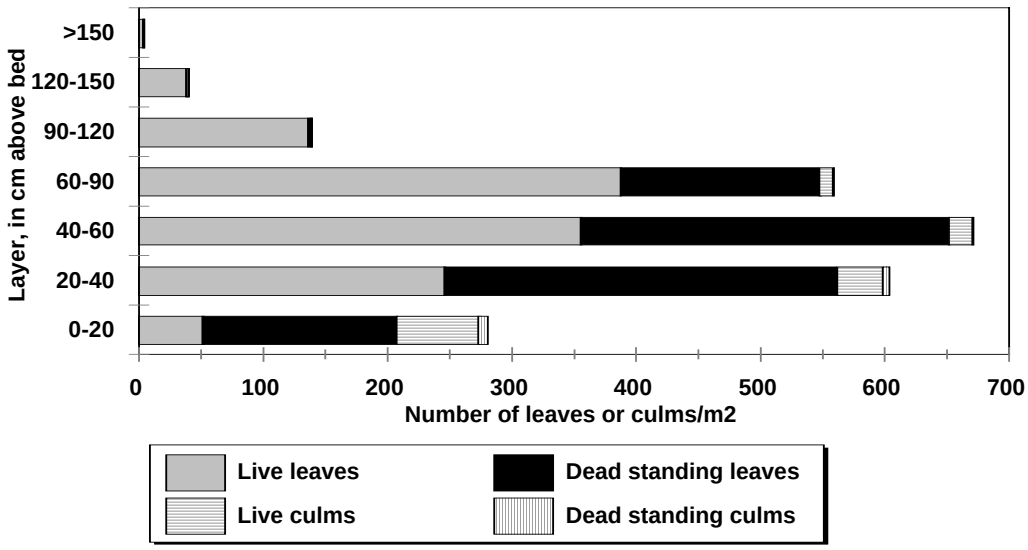
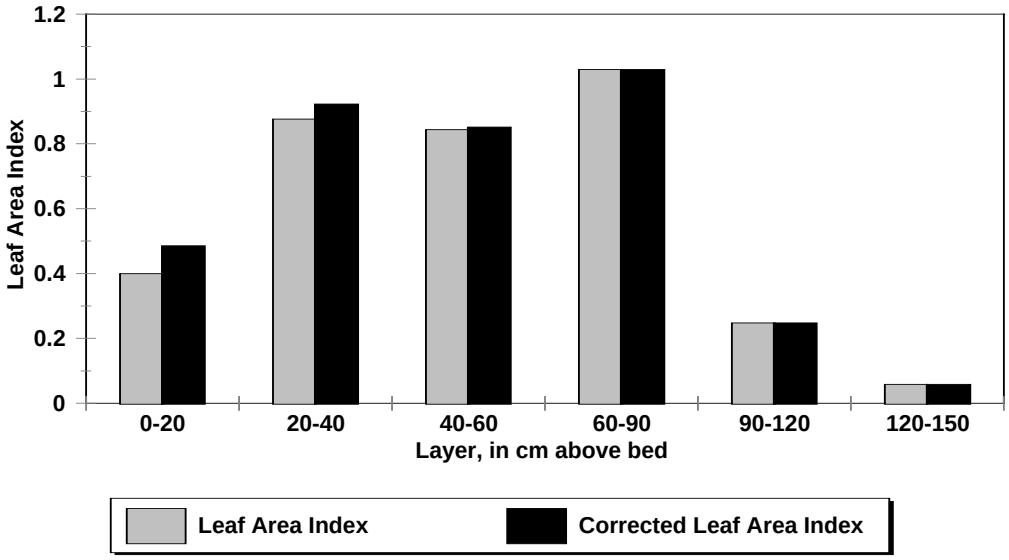


Table C-8. Leaf area index by layer for the flume, April, 1998
[Leaf area index is calculated for live leaves and culms plus dead standing leaves and culms; layer in centimeters above the sediment-water interface; biomass in grams dry weight/m^2; formula for calculations is in text.]

Layer	Leaf area index	Corrected leaf area index
120-150	0.058	0.058
90-120	0.248	0.248
60-90	1.029	1.029
40-60	0.843	0.851
20-40	0.877	0.924
0-20	0.404	0.491
total	3.459	3.602



Appendix D: Biomass, Vegetative Characteristics, and Leaf Area Index of Flume Sawgrass in July, 1998

Table D-1. Sawgrass biomass in the flume, July, 1998
[Plants were 43 months old; layer in centimeters above the sediment/water interface; sample biomass in grams dry weight per square meter (gdw/m^2); dead includes all dead material.]

Layer	1A			1B		
	Live	Dead	Total	Live	Dead	Total
>90		5.61	5.61			
60-90	17.82	76.14	93.96	14.45	55.20	69.65
40-60	26.87	212.01	238.88	20.54	177.17	197.71
20-40	69.35	235.72	305.07	16.30	196.46	212.77
0-20	88.20	329.49	417.69	80.13	456.36	536.49
Total	202.23	858.98	1061.22	131.44	885.19	1016.62

Layer		1C			1D	
	Live	Dead	Total	Live	Dead	Total
>90						
60-90				2.99		12.16
40-60				3.90	5.27	37.89
20-40				2.35	26.36	28.71
0-20	6.00	511.97	517.97	0.00	258.67	258.67
Total	6.00	511.97	517.97	9.24	290.30	299.54

Layer		2A			2B	
	Live	Dead	Total	Live	Dead	Total
>90						
60-90						
40-60						
20-40						
0-20	16.79	805.00	821.79		630.12	630.12
Total	16.79	805.00	821.79		630.12	630.12

Layer		2C			2D	
	Live	Dead	Total	Live	Dead	Total
>90						
60-90					20.47	20.47
40-60					73.01	73.01
20-40				7.41	99.31	106.72
0-20		654.64	654.64	8.32	364.71	373.03
Total		654.64	654.64	15.74	557.50	573.23

Table D-2. Summary of sawgrass biomass, July, 1998
[Plants were 43 months old; layer in centimeters above the sediment/water interface; sample biomass in grams dry weight per square meter (gdw/m^2); SD = standard deviation; N = number of samples); dead includes all dead material.]

Layer	Average live biomass	SD	N	Average dead biomass	SD	Average total biomass	SD
>90			8	0.70	1.98	0.70	1.98
60-90	4.41	7.37	8	18.98	30.20	24.53	34.50
40-60	6.41	10.89	8	58.43	88.14	68.44	90.76
20-40	11.93	23.90	8	69.73	96.97	81.66	117.84
0-20	24.93	37.06	8	501.37	185.75	526.30	177.95
Total	47.68	79.22	8	649.21	403.04	701.63	423.03

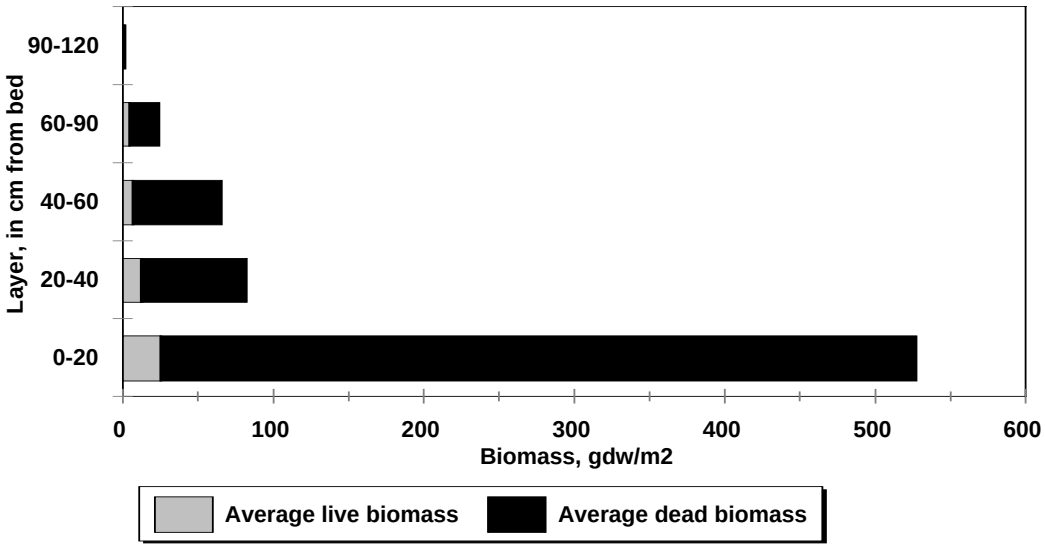


Table D-3. Sawgrass biomass (live and dead leaves and culms and dead litter) in the flume, July, 1998

[Plants were 43 months old; sample biomass in grams dry weight per square meter (gdw/m^2); dead refers to dead standing leaves and culms--dead litter was tabulated separately.]

Layer	1A					1B				
	Live leaves	Dead leaves	Live culms	Dead culms	Dead litter	Live leaves	Dead leaves	Live culms	Dead culms	Dead litter
>90		5.61								
60-90	17.82	76.14				14.45	55.20			
40-60	26.87	212.01				19.17	162.51	1.37	7.86	6.80
20-40	3.32	130.08	66.03	61.21	44.43	0.27	143.63	16.03	20.59	32.25
0-20		112.66	88.20	36.10	180.72		252.70	80.13	69.64	134.03
Total	48.01	536.51	154.23	97.31	225.15	33.90	614.04	97.54	98.08	173.07

Layer	1C					1D				
	Live leaves	Dead leaves	Live culms	Dead culms	Dead litter	Live leaves	Dead leaves	Live culms	Dead culms	Dead litter
>90										
60-90						2.99				
40-60						3.90	5.27			
20-40						1.90	26.36	0.45		
0-20	6.00	273.67		28.97	209.33		72.39		158.44	27.84
Total	6.00	273.67		28.97	209.33	8.79	104.02	0.45	158.44	27.84

Layer	2A					2B				
	Live leaves	Dead leaves	Live culms	Dead culms	Dead litter	Live leaves	Dead leaves	Live culms	Dead culms	Dead litter
>90										
60-90										
40-60										
20-40										
0-20	16.79	216.61		273.59	314.80		173.00		104.41	352.71
Total	16.79	216.61		273.59	314.80		173.00		104.41	352.71

Table D-3. Sawgrass biomass (live and dead leaves and culms and dead litter) in the flume, July 1998, continued

[Plants were 43 months old; sample biomass in grams dry weight per square meter (gdw/m^2); dead refers to dead standing leaves and culms--dead litter was tabulated separately.]

Layer	2C					2D				
	Live leaves	Dead leaves	Live culms	Dead culms	Dead litter	Live leaves	Dead leaves	Live culms	Dead culms	Dead litter
>90										
60-90									20.47	
40-60							71.26		1.75	
20-40						7.41	45.63		43.07	10.61
0-20		183.84		251.05	219.76	7.86	72.40	0.46	94.44	197.87
Total		183.84		251.05	219.76	15.28	189.28	0.46	159.73	208.48

Table D-4. Summary of biomass (live and dead leaves and culms and dead litter) in the flume, July, 1998

[Plants were 43 months old; biomass in grams dry weight per square meter (gdw/m^2); SD = standard deviation; N = number of samples.]

Layer	Average live leaves	SD	Average dead leaves	SD	Average live culms	SD	Average dead culms	SD	Average dead litter	SD	N
>90			0.70	1.98							8
60-90	5.33	7.20	16.42	30.91			2.56	7.24			8
40-60	7.23	10.34	56.38	85.39	0.17	0.48	1.20	2.76	0.85	2.40	8
20-40	0.69	1.25	43.21	60.22	10.31	23.19	15.61	24.13	10.91	17.62	8
0-20	2.85	6.01	169.66	77.74	21.10	38.99	127.08	93.04	204.63	100.83	8
Total	16.10	24.80	286.37	256.24	31.58	62.66	146.45	127.17	216.39	120.86	

Table D-5. Descriptive information on live flume vegetation, July, 1998
[Plants were 43 months old; layer in centimeters above sediment/water interface; average width in mm; lvs = leaves; avg = average.]

LIVE	Large leaves		Medium leaves		Small leaves		Large culms		Small culms	
Layer	Avg # lvs/m^2	Avg width	Avg # lvs/ m^2	Avg width	Avg # lvs/ m^2	Avg width	Avg # culms/ m^2	Avg width	Avg # culms/ m^2	Avg width
>90										
60-90	6.3	12.5	8.1	7.1	5.4	2.7				
40-60	6.3	11.4	8.1	7.3	2.7	3.0			0.9	5.0
20-40			1.8	7.0	1.8	3.5	2.7	17.3	0.9	3.0
0-20			5.4	7.0	1.8	3.0	5.4	20.3	2.7	4.3

Table D-6. Descriptive information on dead flume vegetation, July, 1998
[Plants were 43 months old; dead leaves and culms were erect and standing--dead litter was not counted; layer in centimeters above sediment/water interface; average width in mm; avg = average.]

DEAD	Large leaves	Medium leaves	Small leaves	Large culms	Small culms
Layer	Avg # leaves/m^2	Avg # leaves/ m^2	Avg # leaves/ m^2	Avg # culms/ m^2	Avg # culms/ m^2
>90		4.5			
60-90	7.2	23.3	26.0		
40-60	23.3	104.1	47.5		2.7
20-40	21.5	86.1	39.5	5.4	5.4
0-20	109.4	163.3	110.3	26.0	17.9

Table D-7. Summary of leaves and culms in the flume, July, 1998
[Plants were 43 months old; dead leaves and culms were erect and standing--dead litter was not counted; layer in centimeters above the sediment/water interface; SD = standard deviation; N = number of samples.]

LIVE Layer	Total leaves/m^2	SD	N	Total culms/ m^2	SD
>90					
60-90	19.7	26.8	8		
40-60	17.0	21.0	8	0.9	2.5
20-40	3.6	5.4	8	3.6	5.4
0-20	7.2	13.8	8	8.1	15.1
DEAD Layer	Total leaves/ m^2	SD	N	Total culms/ m^2	SD
>90					
60-90	56.5	86.9	8		
40-60	174.9	262.4	8	2.7	5.3
20-40	147.1	197.3	8	10.8	15.3
0-20	383.0	168.0	8	44.0	19.0

Table D-8. Leaf area index by layer for the flume, July, 1998
[Leaf area index is calculated for live leaves and culms plus dead standing leaves and culms; layer in centimeters above the sediment-water interface; biomass in grams dry weight/m^2; formula for calculations is in text.]

Layer	Leaf area index	Corrected leaf area index
60-90	0.134	0.134
40-60	0.260	0.264
20-40	0.184	0.212
0-20	0.448	0.733
Total	1.026	1.343