

Lake Worth Lagoon Habitat Working Group
March 13, 2014

Lake Worth Lagoon Seagrass Mapping Project-
Preliminary Results



Coastal Eco-Group Inc.



Overview of 2013 mapping project

- Water clarity conditions in 2012 did not allow for aerial photography of sufficient quality for aerial seagrass mapping.
- 1,000 ground-truthing sites along or within 2007 bed edge- each site consisted of a 1 m² quadrat.
 - If a sampling site was located on a 2007 bed edge, a 30-m transect was surveyed to evaluate seagrass bed expansion or recession at the location.
 - 508 new sites to document expansion or retreat
 - 10-m radius swim conducted for interior bed points to verify seagrass cover
- 1,350 sites were sampled within the north, central and south segments of LWL
- - 85 sites in Jupiter Sound,
 - 73 sites in Lake Boca and Lake Wyman

In situ data collection

- 1.0 m² quadrat- Braun-Blanquet cover score and species composition
- Sediment type/depth (sand, silty sand, shell, muck)
- Water depth, temperature, salinity, Secchi depth, horizontal visibility
- Braun-Blanquet cover score, species composition, percent cover, sediment type, and water depth recorded at second quadrat (new bed edge or 30-m distance)
- Qualitative descriptions of cover along 30-m transect- species composition, general cover, sediment type

Breakdown of 2013 sampling locations

	Total # of Sites						
	North Segment	Central Segment	South Segment	Jupiter Sound	Lake Wyman	Lake Boca Raton	Total
Total Original Sites	485	198	218	56	26	17	1000
30 m Line Survey	414 (85%)	168 (85%)	196 (90%)	52 (93%)	22 (85%)	15 (88%)	867 (87%)
10 m Radius Survey	71 (15%)	30 (15%)	22 (10%)	4 (7%)	4 (15%)	2 (12%)	133 (13%)
Total New Sites	303	20	126	29	20	10	508
Bed Retreat "a"	71 (23%)	17 (85%)	50 (40%)	6 (21%)	7 (35%)	7 (70%)	158 (31%)
Bed Expansion "b"	203 (67%)	3 (15%)	76 (60%)	23 (79%)	13 (65%)	3 (30%)	321 (63%)
Bed Confirmation "c"	29 (10%)						29 (6%)
Total	788	218	344	85	46	27	1508

2013 seagrass mapping project

- Similar to the 2007 maps, highest seagrass cover was found in the northern segment and the lowest cover in the central segment.
- Central segment: ~93% of the original sites along or within the 2007 seagrass bed did not have seagrass.
- Southern segment: seagrass was not found at 51% of the original sites.
- Northern segment: only 30% of the original sites in the northern segment did not have seagrass.
- 2007 seagrass bed edge receded
 - 85% of the central sites
 - 38% of the southern sites
 - 23% of the northern sites.

2007 mapped seagrass acreages vs. 2013 seagrass polygons and unvegetated seagrass habitat

	Sum of Acres						
	North Segment	Central Segment	South Segment	Jupiter Sound	Lake Wyman	Lake Boca Raton	Grand Total
2007 CONTINUOUS SG	1069.3	183.3	382.9	81.4	51.4	17.5	1785.8
2007 PATCHY SG	20.9	20.9	10.4				52.2
2007 TOTAL SG	1090.2	204.3	393.3	81.4	51.4	17.5	1838.0
2013 SG POLYGONS	1211.1	29.4	351.0	83.9	58.1	21.9	1755.4
2013 Unvegetated Potential SG Habitat	71.6	175.8	88.3		1.8	2.4	339.8

Year	North Segment	Central Segment	South Segment	Total Acres
2007	65%	12%	23%	1688
2013	76%	2%	22%	1592

Note: 2013 total acreages includes zone of seagrass occurrence (average BB scores of 0.01 to 0.5)

2013 seagrass polygons by segment

BB Score Index	Sum of Acres (Percent of Total Acres)						
	North Segment	Central Segment	South Segment	Jupiter Sound	Lake Wyman	Lake Boca Raton	Grand Total
Unvegetated Potential SG Habitat	71.6 (5.6%)	175.8 (85.7%)	88.3 (20.1%)		1.8 (3.1%)	2.4 (10.9%)	339.8 (16.3%)
Zone of SG Occurrence	92.0 (7.2%)	11.6 (5.7%)	81.5 (18.5%)			19.5 (89.1%)	204.6 (9.8%)
Low Density / Patchy SG Habitat	528.0 (41.2%)	15.5 (7.5%)	265.5 (60.4%)	3.9 (4.7%)	56.3 (96.9%)		869.1 (41.6%)
Moderate to High Density SG Habitat	588.1 (45.8%)		1.7 (0.4%)	80.0 (95.3%)			669.8 (32.0%)
Not Surveyed	3.1 (0.2%)	2.3 (1.1%)	2.4 (0.5%)				7.8 (0.4%)
Grand Total	1282.7	205.2	439.3	83.9	58.1	21.9	2091.0

- o – Unvegetated potential SG Habitat
- o.01-0.5 – Zone of Seagrass Occurrence
- o.51-2 – Low density/Patchy SG Habitat
- 2.1-5 – Moderate to High Density SG Habitat

Total number of sample sites and average BB score of original and new sites in the three LWL segments during the 2013 ground-truthing survey

	North Segment		Central Segment		South Segment	
	Total # of Sites	Total Average (\pm SE) BB	Total # of Sites	Total Average (\pm SE) BB	Total # of Sites	Total Average (\pm SE) BB
Original Site	483	1.2 \pm 0.1	198	0 \pm 0	218	0.4 \pm 0.1
New Site	303	1.4 \pm 0.1	20	0.5 \pm 0.2	126	0.8 \pm 0.1
Total Sites	786	1.3 \pm 0	218	0.1 \pm 0	344	0.6 \pm 0

Total number of sample sites which document bed expansion or recession from the 2007 bed edge in the three LWL segments during the 2013 ground-truthing survey.

	North Segment	Central Segment	South Segment
Total New Sites	303	20	126
Bed Retreated	71	17	48
Bed Expanded	203	3	78
Undetermined	29		

Percent of original sample sites in the 2007 mapped seagrass beds for each BB cover score

Percent of Total Original Sites for each BB Score			
BB Score	North Segment	Central Segment	South Segment
0	29.9%	93.4%	50.5%
0.1	1.5%	2.5%	15.1%
0.5	7.6%	2.5%	11.5%
1	14.2%	1.5%	10.6%
2	22.1%	0.0%	10.6%
3	8.9%	0.0%	1.4%
4	4.7%	0.0%	0.5%
5	2.1%	0.0%	0.0%

Seagrass occurrence by species at the original sample sites and new bed edge sites in the three segments

		Total # of Sites where species was present					
		<i>Halophilla declipens</i>	<i>Halophilla johnsonii</i>	<i>Halodule wrightii</i>	<i>Halophilla engelmannii</i>	<i>Syringodium filiforme</i>	<i>Thalassia testudinum</i>
Original Sites	North Segment	217	64	101	5	31	24
	Central Segment	0	9	4	0	0	0
	South Segment	61	21	48	0	0	0
	TOTAL	278	94	153	5	31	24
New Sites	North Segment	189	70	70	6	14	14
	Central Segment	0	19	3	0	0	0
	South Segment	67	26	46	0	0	0
	TOTAL	256	115	119	6	14	14
Grand Total		534	209	272	11	45	38

LWL Fixed Transect Program Overview

- PBCERM initiated a long-term seagrass monitoring program in 2000 with 5 permanent transects
- 9 transects surveyed annually since 2001 except for 2006. Transects selected by proximity to LWL Partnership Grant projects or habitat improvement projects
- *H. decipiens* and *H. johnsonii* are dominant species
- Document annual changes in seagrass abundance and distribution as an indicator of lagoon-wide seagrass health

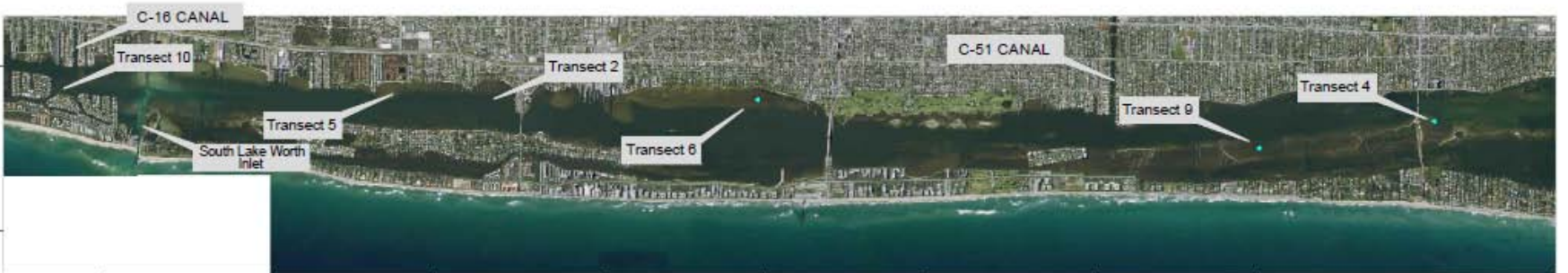
Drawing Updated JANUARY 9, 2014

N 862500 N 868500 N 874500 N 880500 N 886500 N 892500 N 898500 N 904500 N 910500



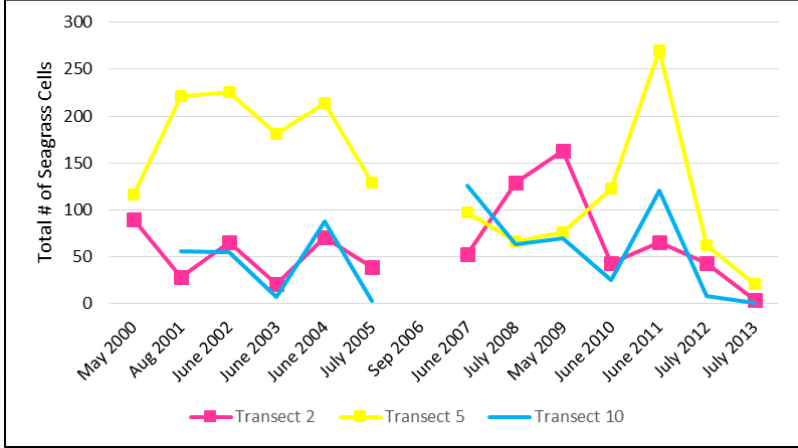
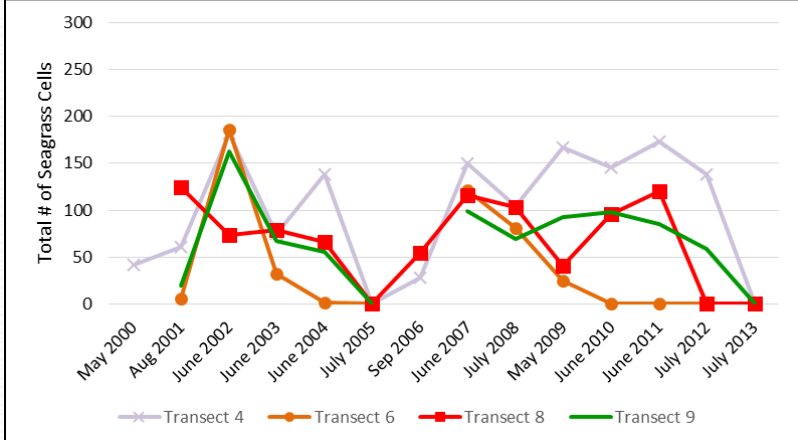
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N 804500 N 810500 N 816500 N 822500 N 828500 N 834500 N 840500 N 846500 N 852500

- July 2013 fixed transect survey was indicative of lagoon-wide trends in seagrass cover in 2013
- 2 northern transects - substantial declines in cover and bed edge recession.
- Transect 3 - edge receded from 12.2 ft. MLLW in 2012 to 6.4 ft. MLLW in July 2013.
- Seagrass was not observed at the 4 transects in the central segment in 2013.
- Seagrass cover was the lowest of the monitoring program at all 3 southern transects.



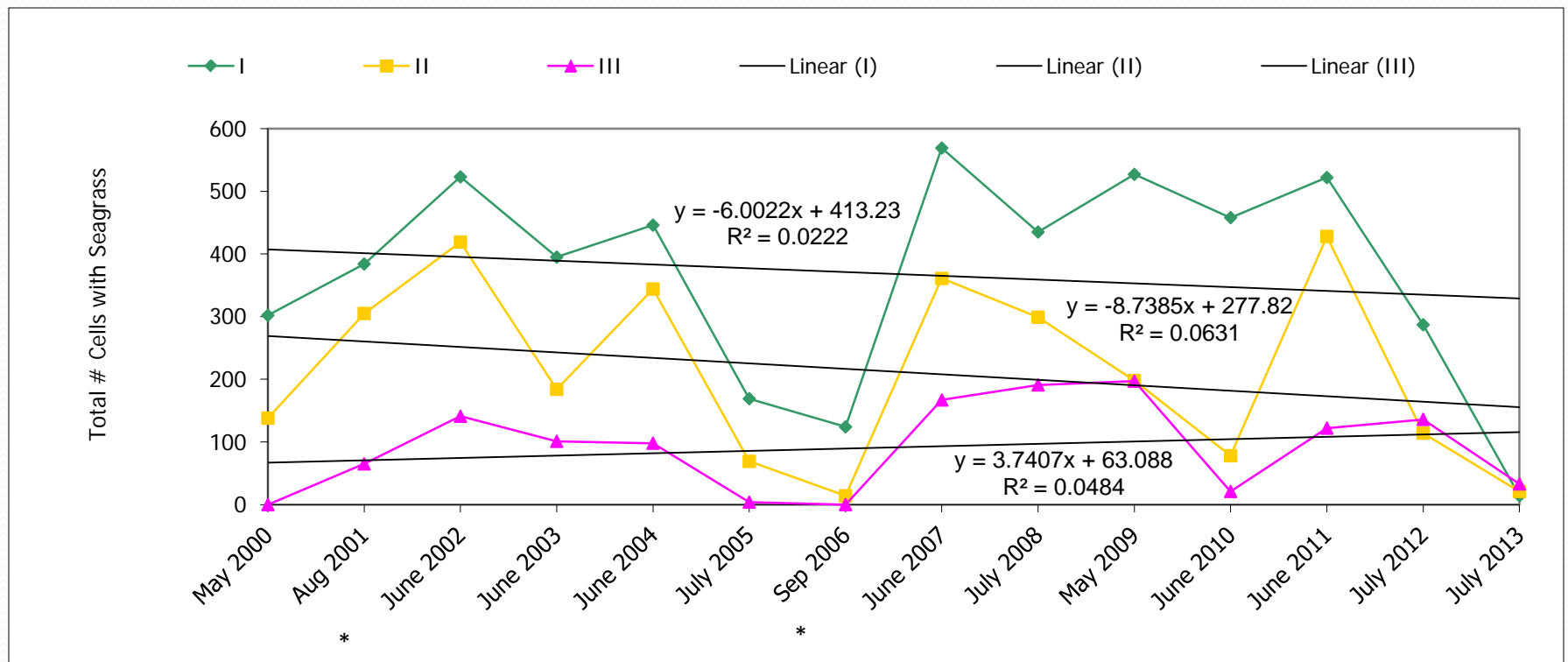
Overall seagrass frequency of occurrence at the transect level, 2000-2013

Transect	May 2000	Aug 2001	June 2002	June 2003	June 2004	July 2005	Sep 2006	June 2007	July 2008	May 2009	June 2010	June 2011	July 2012	July 2013
Transect 1	62	181	96	7	132	71	37	100	73	100	2	46	133	36
Transect 2	90	28	66	21	71	39		53	129	163	43	65	43	4
Transect 3	130	58	36	211	121	0	19	235	236	187	24	192	94	6
Transect 4	42	61	182	75	138	0	28	150	104	167	146	173	138	0
Transect 5	116	221	226	181	214	129		97	67	76	123	270	62	21
Transect 6		6	186	32	2	0		121	81	25	0	0	0	0
Transect 8		124	73	79	66	0	54	116	103	41	96	120	0	0
Transect 9		19	163	67	56	0		99	69	93	98	85	59	0
Transect 10		56	55	7	88	3		126	63	70	25	121	8	1
Total	440	754	1083	680	888	242	138	1097	925	922	557	1072	537	68

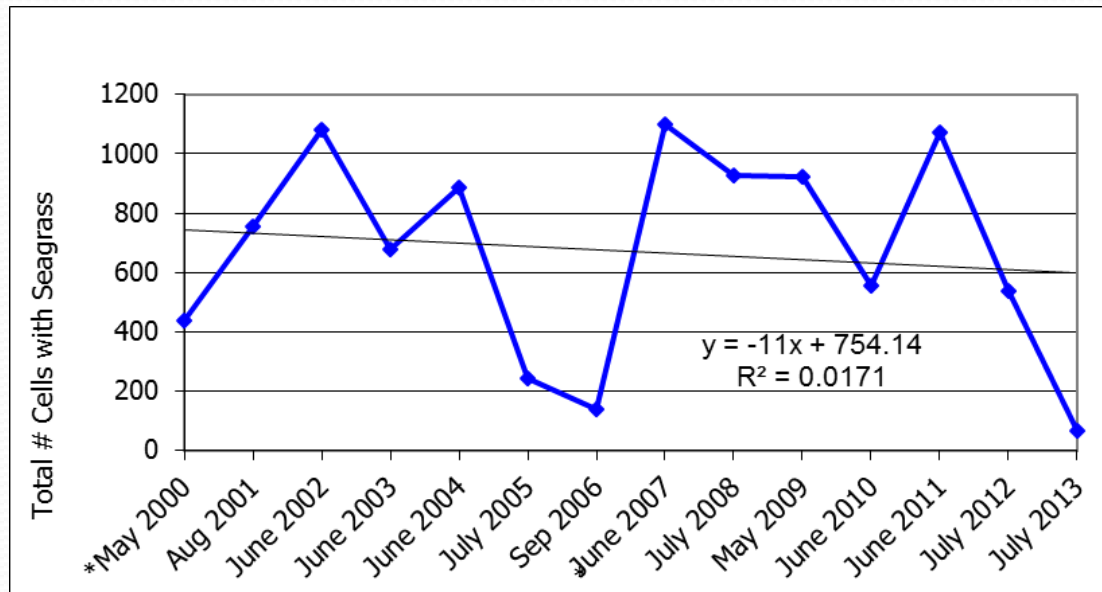
Red- annual record lows; blue-annual record highs

Total frequency of occurrence of seagrasses at the station level, 2000-2013

	May 2000	Aug 2001	June 2002	June 2003	June 2004	July 2005	Sep 2006	June 2007	July 2008	May 2009	June 2010	June 2011	July 2012	July 2013
I	302	384	523	395	446	169	124	569	435	527	458	522	287	14
II	138	305	419	184	344	69	14	361	299	198	78	428	114	21
III	0	65	141	101	98	4	0	167	191	197	21	122	136	33
Total	440	754	1083	680	888	242	138	1097	925	922	557	1072	537	68

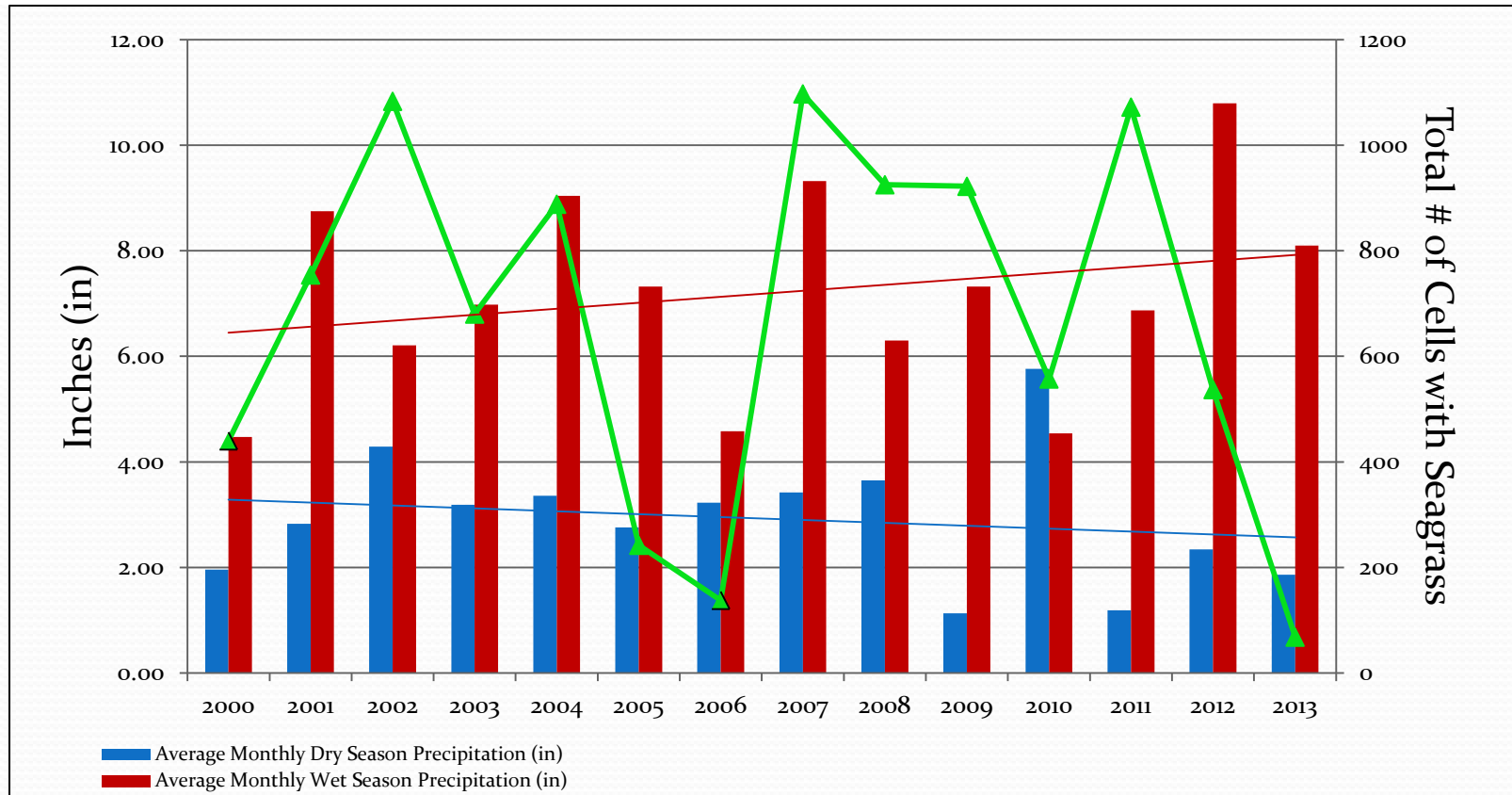


Overall seagrass frequency of occurrence 2000-2013



Large-scale events, such as the extreme freshwater discharges associated with tropical storms and hurricanes, may be the largest contributor to overall seagrass trends in the LWL.

Total seagrass frequency of occurrence vs. average wet /dry season precipitation



2007 survey followed a very dry “wet season”

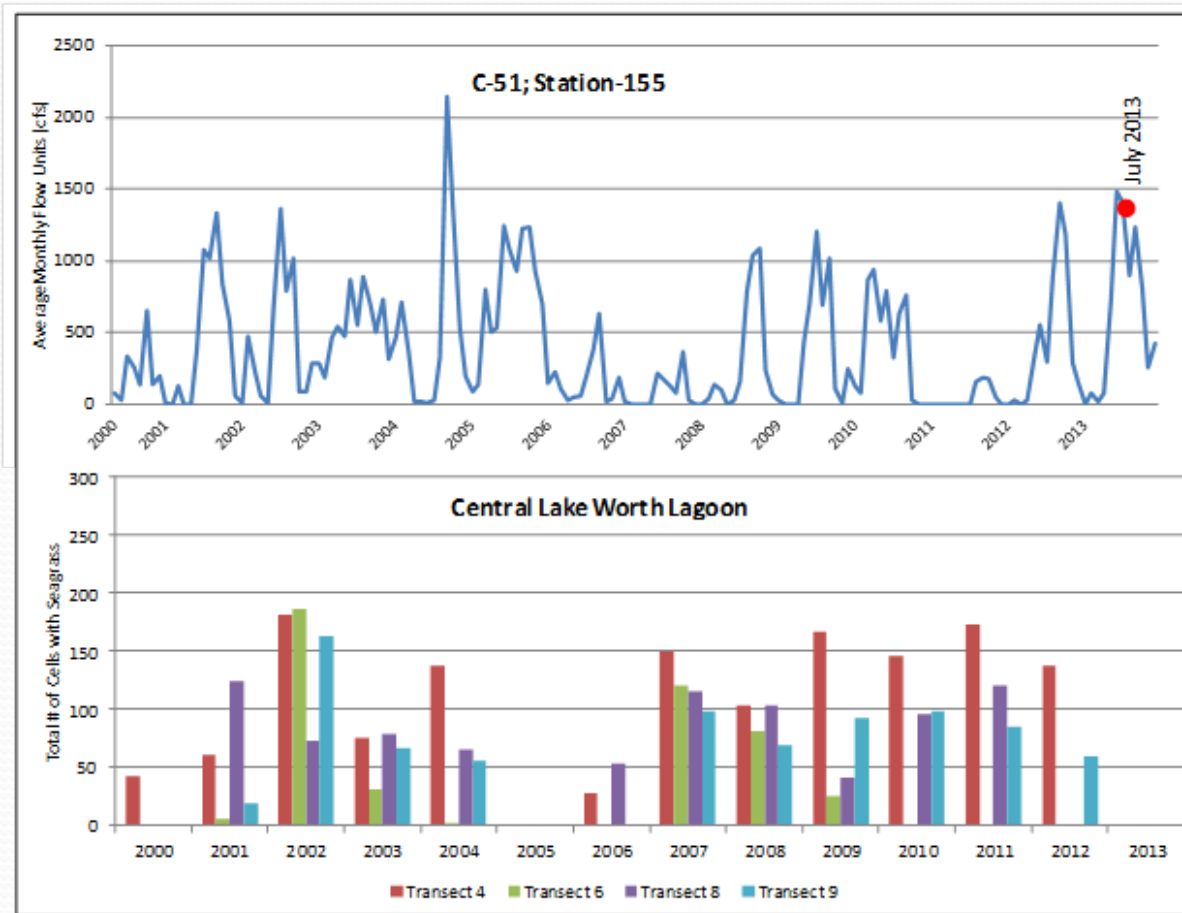
2009- more normal rainy season, ~44 inches of rain between May & October

2009/2010- wetter dry season,

2011 survey preceded by a very dry “dry season”

2012 wettest season was highest on record for monitoring program, ~ 65 inches

Average annual flow units at C-51 Canal vs, total number of cells with seagrass pooled across transects for each survey



Tropical Storm Isaac in August 2012, producing a 1-in-100 year rainfall event in the C-51 Basin with nearly 15 inches of rain over a 72-hour period.

Record flow of 10,300 cfs was measured at the C-51 control structure.

Average annual flow from the C-51 was the second highest recorded flow for the entire monitoring period

Seagrass target depth in LWL

- Action Plan HE -4: development of a seagrass restoration target, an average maximum extent at which seagrasses will recruit and grow in the LWL.
- Prediction of where seagrass will be based on water depth and substrate type

North Segment	Central Segment	South Segment	Grand Total
1282.7	205.2	439.3	1932.2

LWL Segment	2001 Seagrass (Acres)	Potential Seagrass by Depth (Acres)	Potential Seagrass by Depth and Substrate	Potential Seagrass Target (Acres)
North	1,134	321	197	1,331
Central	192	537	204	396
South	300	236	65	365
Totals	1,626	1,094	466	2,092

2001 Seagrass Acreage and Potential Seagrass (Braun, 2006)

Mean tide-corrected depth within each segment by cover class- 2013 survey

BB Score	Mean (\pm SE) Tide Corrected Depth (ft)						
	North Segment	Central Segment	South Segment	Jupiter Sound	Lake Wyman	Lake Boca Raton	Grand Total
0	5.1 \pm 0.2	2.8 \pm 0.1	4.0 \pm 0.2	4.1 \pm 1.1	5.7 \pm 0.7	5.1 \pm 0.8	3.9 \pm 0.1
0.1	5.9 \pm 0.3	1.0 \pm 0.2	3.7 \pm 0.2	9.2 \pm 1.8	8.7 \pm 0.7	5.8 \pm 0.3	5.0 \pm 0.2
0.5	4.9 \pm 0.3	1.3 \pm 0.2	4.0 \pm 0.2	5.8 \pm 2.4	6 \pm 0.6	6.8 \pm 0.5	4.6 \pm 0.2
1	5.1 \pm 0.3	0.5 \pm 0.3	3.4 \pm 0.2	2.7 \pm 0.7	6.6 \pm 1.1	4.2 \pm 1.0	4.5 \pm 0.2
2	4.7 \pm 0.2	2.0 \pm 0.7	3.6 \pm 0.3	4.0 \pm 0.6	5.5 \pm 0.6	4.3	4.5 \pm 0.2
3	4 \pm 0.4		3.6 \pm 0.7	4.7 \pm 0.5	5.8 \pm 1.6		4.2 \pm 0.3
4	2.5 \pm 0.3		6.3 \pm 1.5	3.4 \pm 0.4	4.0 \pm 1.0		2.9 \pm 0.3
5	1.5 \pm 0.6			3.1 \pm 0.5			2.2 \pm 0.4
Grand Total	4.8 \pm 0.1	2.6 \pm 0.1	3.8 \pm 0.1	4.1 \pm 0.3	6.3 \pm 0.3	5.4 \pm 0.3	4.3 \pm 0.1

Table 3. Average Seagrass Depth and Potential Target Depth by Segment in Lake Worth Lagoon

Zone	Average* Seagrass Depth Feet in NGVD	Target Depth
North	-5.0	-6.0
Central	-4.4	-5.0
South	-3.4	-4.0

*Weighted average

Source: Braun, 2006

Water depths at the permanent transect seagrass bed edges, 2009 through 2013.

Transect	2009	2010	2011	2012	2013
1	4.7 ft (1.4 m)	3.3 ft (1.0 m)	4.5 ft (1.4 m)	4.5 ft (1.4 m)	3.9 ft (1.2 m)
2	7.2 ft (2.2 m)	7.2 ft (2.2 m)	7.1 ft (2.2 m)	6.7 ft (2.0 m)	4.0 ft (1.2 m)
3	7.0 ft (2.1 m)	5.7 ft (1.7 m)	5.3 ft (1.6 m)	12.2 ft (3.7 m)	6.4 ft (2.0 m)
4	4.8 ft (1.5 m)	3.2 ft (1.0 m)	3.4 ft (1.0 m)	4.3 ft (1.3 m)	No Seagrass
5	7.5 ft (2.3 m)	2.8 ft (0.9 m)	7.7 ft (2.3 m)	3.1 ft (0.9 m)	2.2 ft (0.7 m)
6	5.7 ft (1.7 m)	No Seagrass	3.7 ft (1.1 m)	No Seagrass	No Seagrass
8	4.7 ft (1.4 m)	3.1 ft (0.9 m)	4.6 ft (1.4 m)	No Seagrass	No Seagrass
9	6.4 ft (2.0 m)	2.2 ft (0.7 m)	5.8 ft (1.8 m)	4.5 ft (1.4 m)	No Seagrass
10	7.0 ft (2.1 m)	7.4 ft (2.3 m)	8.5 ft (2.6 m)	6.7 ft (2.0 m)	5.8 ft (1.8 m)

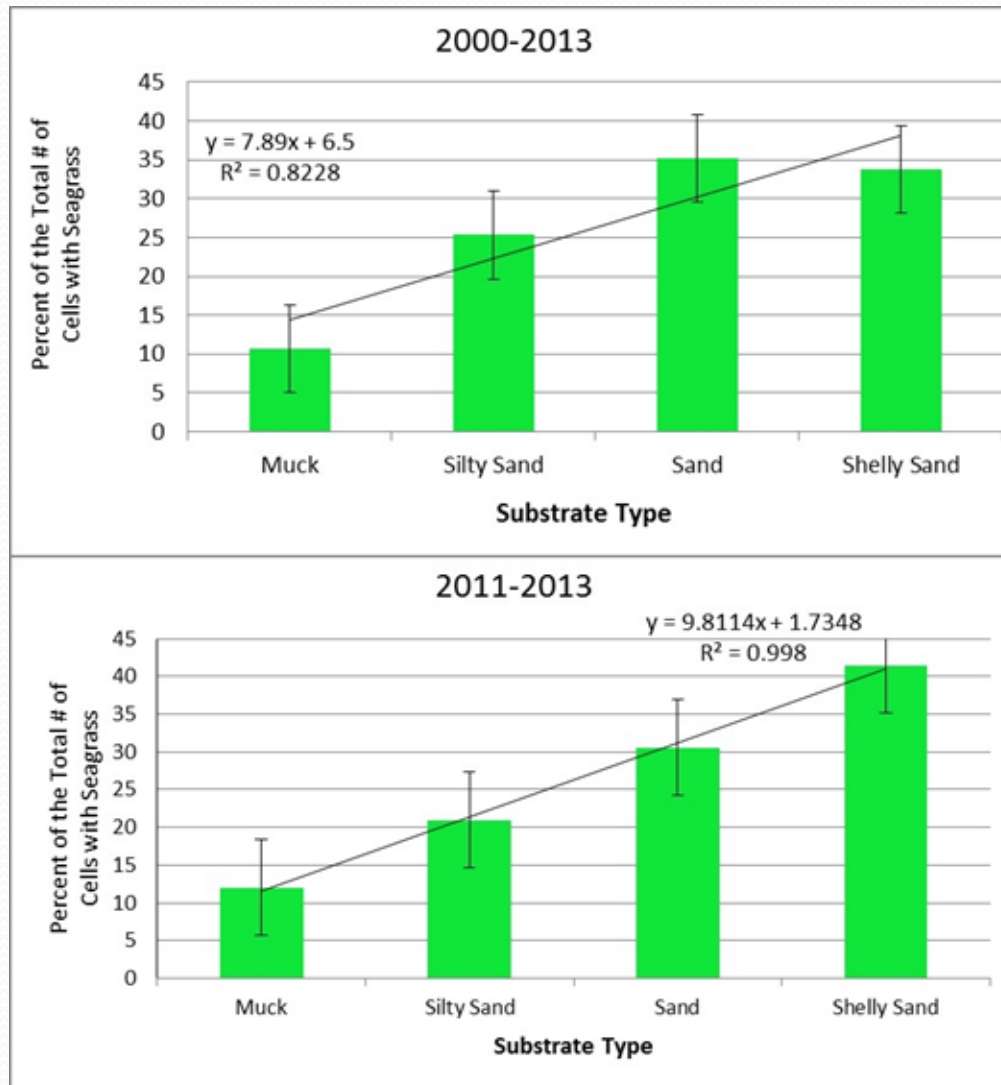
Mean Secchi depth within each segment by cover class

BB Score	Mean (\pm SE) Secchi Depth (m)						
	North Segment	Central Segment	South Segment	Jupiter Sound	Lake Wyman	Lake Boca Raton	Grand Total
0	1.8 \pm 0.1	0.8 \pm 0.0	1.0 \pm 0.0	1.5 \pm 0.2	2.0 \pm 0.1	1.5 \pm 0.1	1.3 \pm 0.0
0.1	2.0 \pm 0.1	0.6 \pm 0.1	0.9 \pm 0.0	2.0	3.0 \pm 0.1	1.7 \pm 0.1	1.6 \pm 0.1
0.5	1.7 \pm 0.1	1.0 \pm 0.1	1.1 \pm 0.0	3.0	2.0 \pm 0.1	1.5	1.6 \pm 0.0
1	1.9 \pm 0.1	0.6 \pm 0.1	1.1 \pm 0.0	1.5 \pm 0.4	No msmt	1.1	1.7 \pm 0.1
2	2.0 \pm 0.1	No msmt	1.6 \pm 0.1	1.5 \pm 0.2	1.7 \pm 0.1	No msmt	2.0 \pm 0.1
3	1.8 \pm 0.1		0.9	2.0 \pm 0.1	1.8 \pm 0.2		1.8 \pm 0.1
4	1.2 \pm 0.1		No msmt	1.5 \pm 0.1	No msmt		1.3 \pm 0.1
5	0.9 \pm 0.1			1.5 \pm 0.2			1.1 \pm 0.1
Grand Total	1.8 \pm 0.0	0.8 \pm 0.0	1.1 \pm 0.0	1.7 \pm 0.1	2.0 \pm 0.1	1.5 \pm 0.1	1.5 \pm 0.0

		(SD _{target}) (in meters)
Northern Lake Worth Lagoon	0.95 (2007 aerial)	0.85
Central Lake Worth Lagoon	1.17 (2001 aerial)	1.05
Southern Lake Worth Lagoon	0.78 (2001 aerial)	0.7

Source: FDEP, 2013

Relationship between substrate and seagrass frequency of occurrence- 2000 -2013



Sediment inventory 2013

Substrate	Total # of Sites						Grand Total
	North Segment	Central Segment	South Segment	Jupiter Sound	Lake Wyman	Lake Boca Raton	
Shell	3						3
Shelly Sand	69	7	22		12		110
Sand	383	71	154	74	16	24	722
Sandy Silt	11	5	10	1	3		30
Silty Sand	206	76	86	9	7	3	387
Shelly Sand/Muck			2				2
Sand Muck Mix			5				5
Sandy Silt/Muck	4	5	3		2		14
Silty Sand/Muck	25	6	15		4		50
Muck	68 (8.6%)	48 (22.0%)	45 (13.1%)	1	2		164
No Data	19		2				21
Grand Total	788	218	344	85	46	27	1508

Sites with muck or muck component (% of total sites)			
Segment	North	Central	South
Original sites	53(10.9%)	59 (29.8%)	46 (21.1%)
New sites	55 (14.5%)	0 (0.0%)	24 (19.0%)