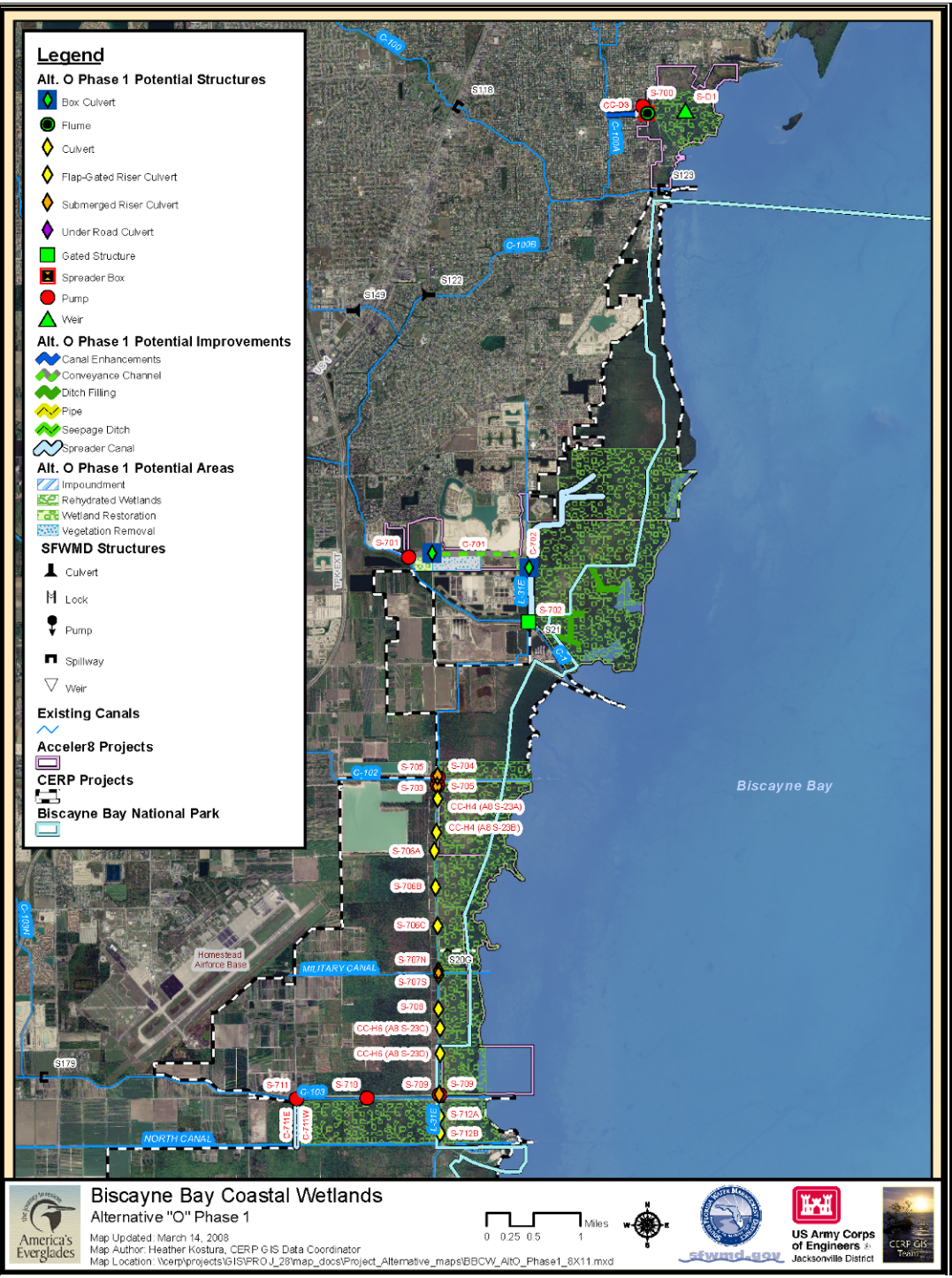
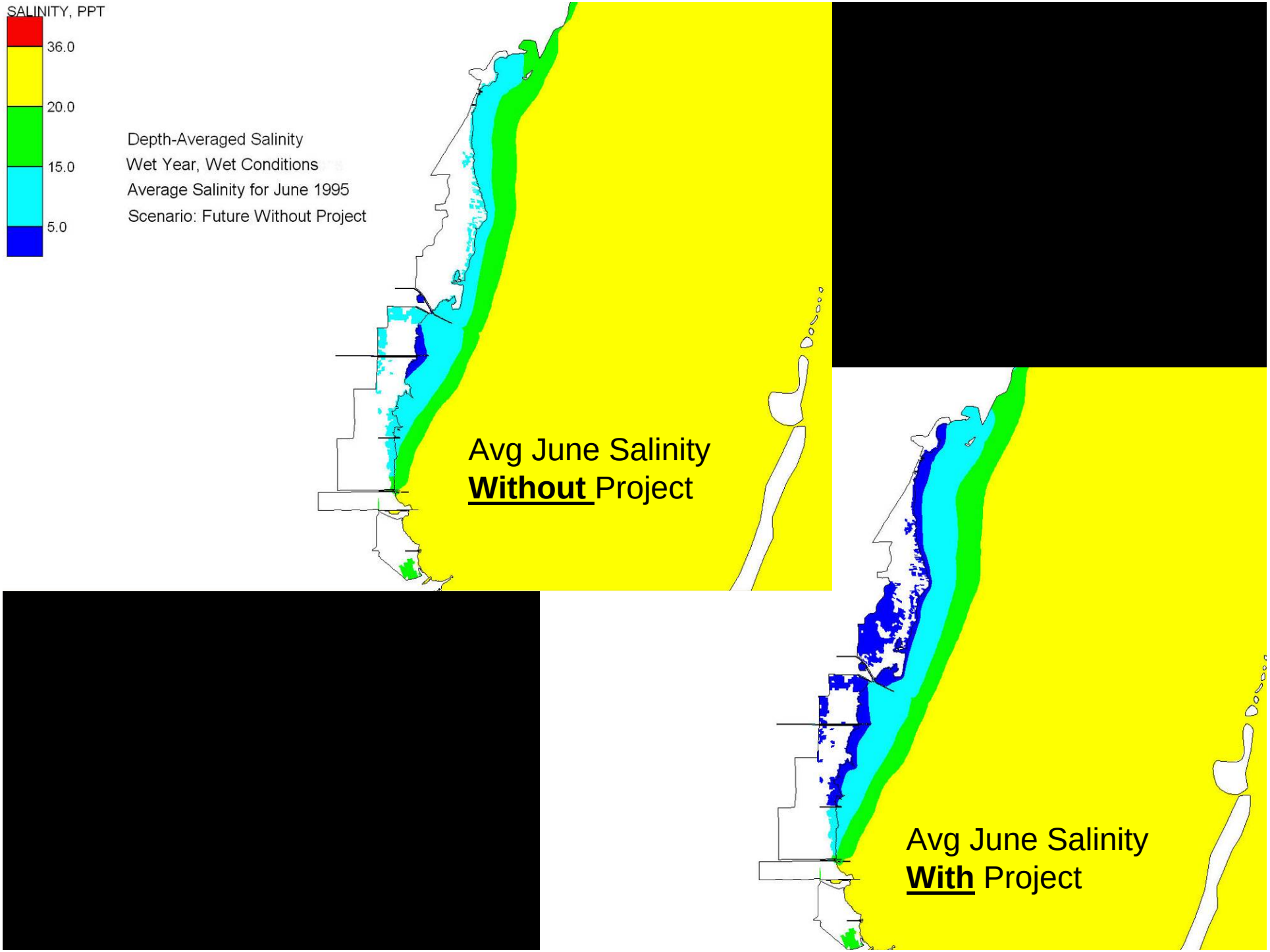
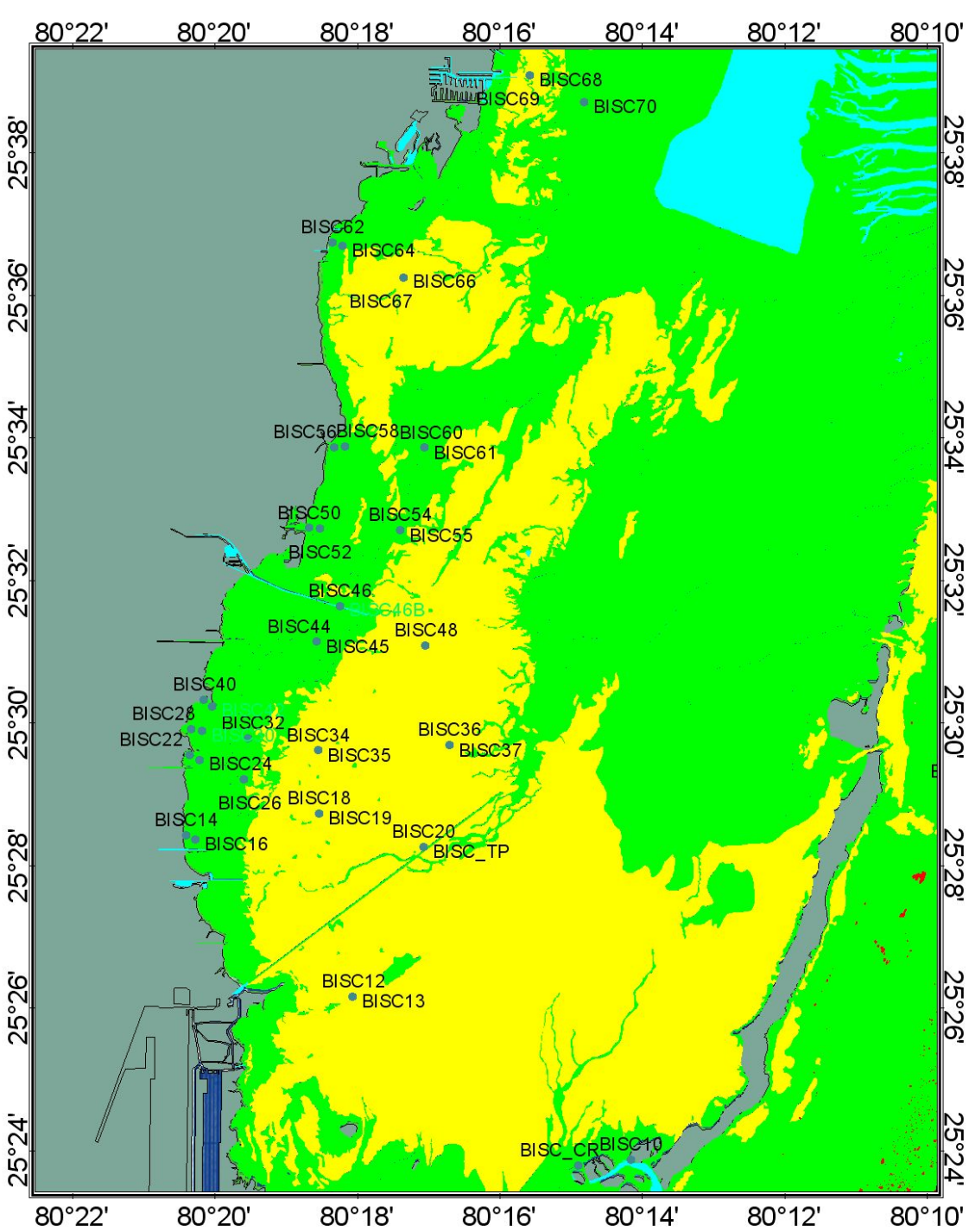
Biscayne Bay:
Nearshore Continuous Salinity Monitoring

Greg Graves, RECOVER Division, SFWMD
Sarah Bellmund, Biscayne National Park

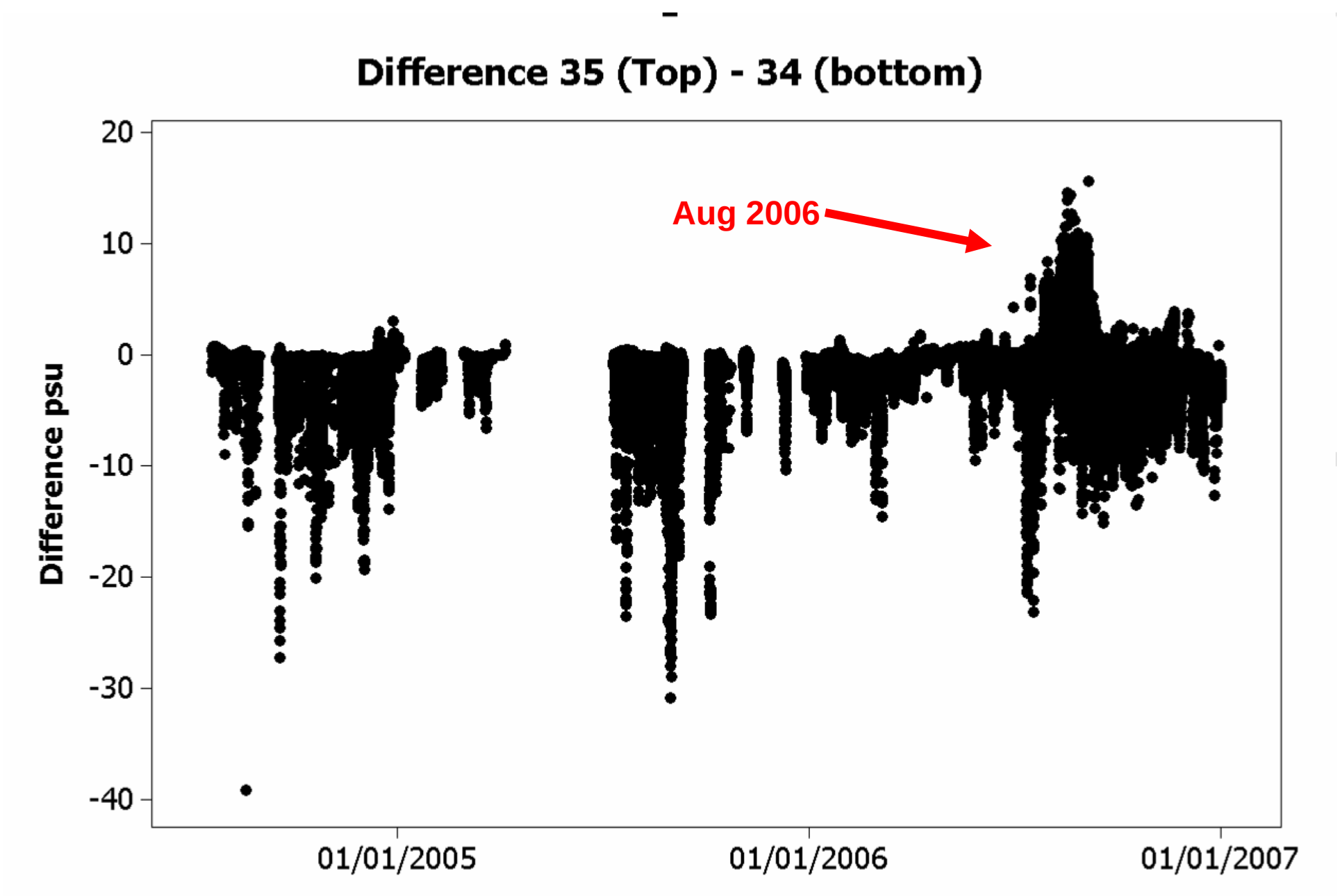


BBCW "Alt O" Phase I Restoration Plan

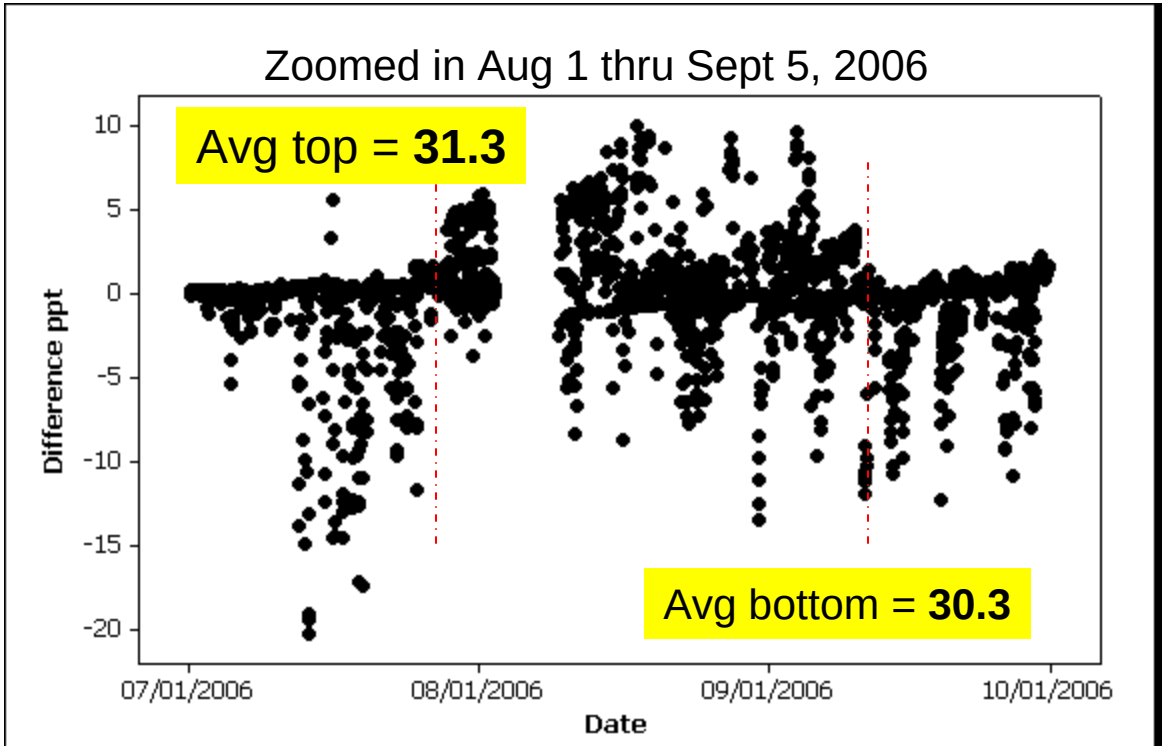

SALINITY, PPT
36.0
20.0
15.0
5.0
Depth-Averaged Salinity
Wet Year, Wet Conditions
Average Salinity for June 1995
Scenario: Future Without Project
Avg June Salinity
Without Project
Avg June Salinity
With Project



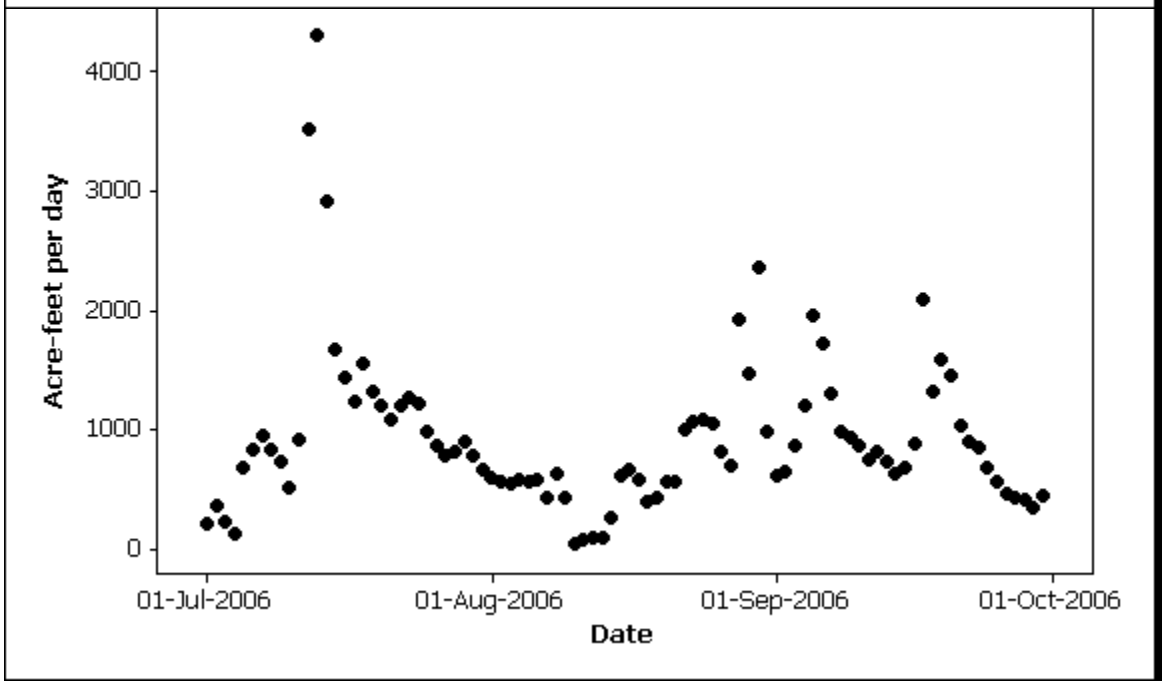
Biscayne Bay Continuous Salinity Monitoring Network



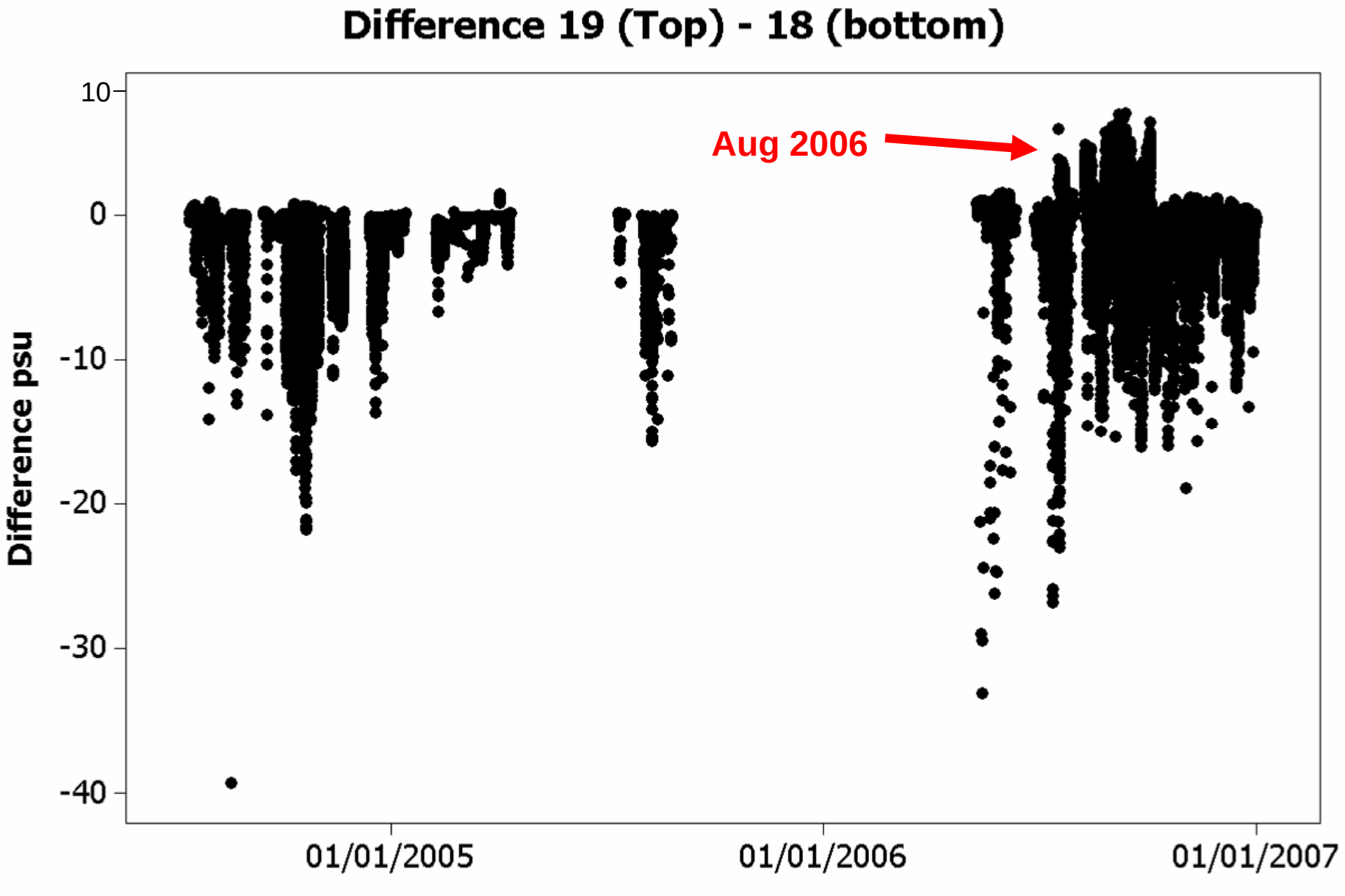
Phenomenon of “fresher on bottom”



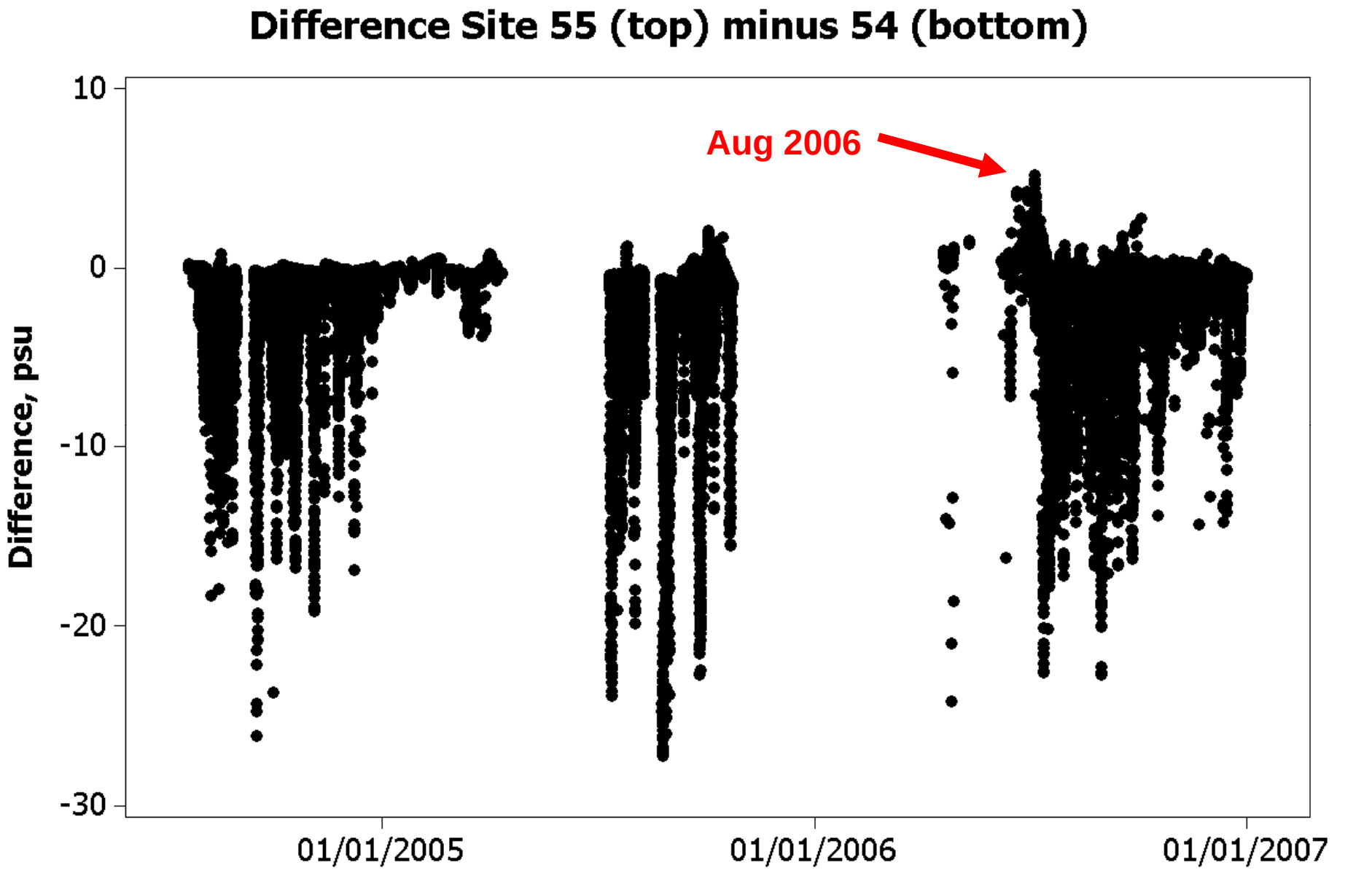
Difference 35 – 34 (top – bottom) Salinity



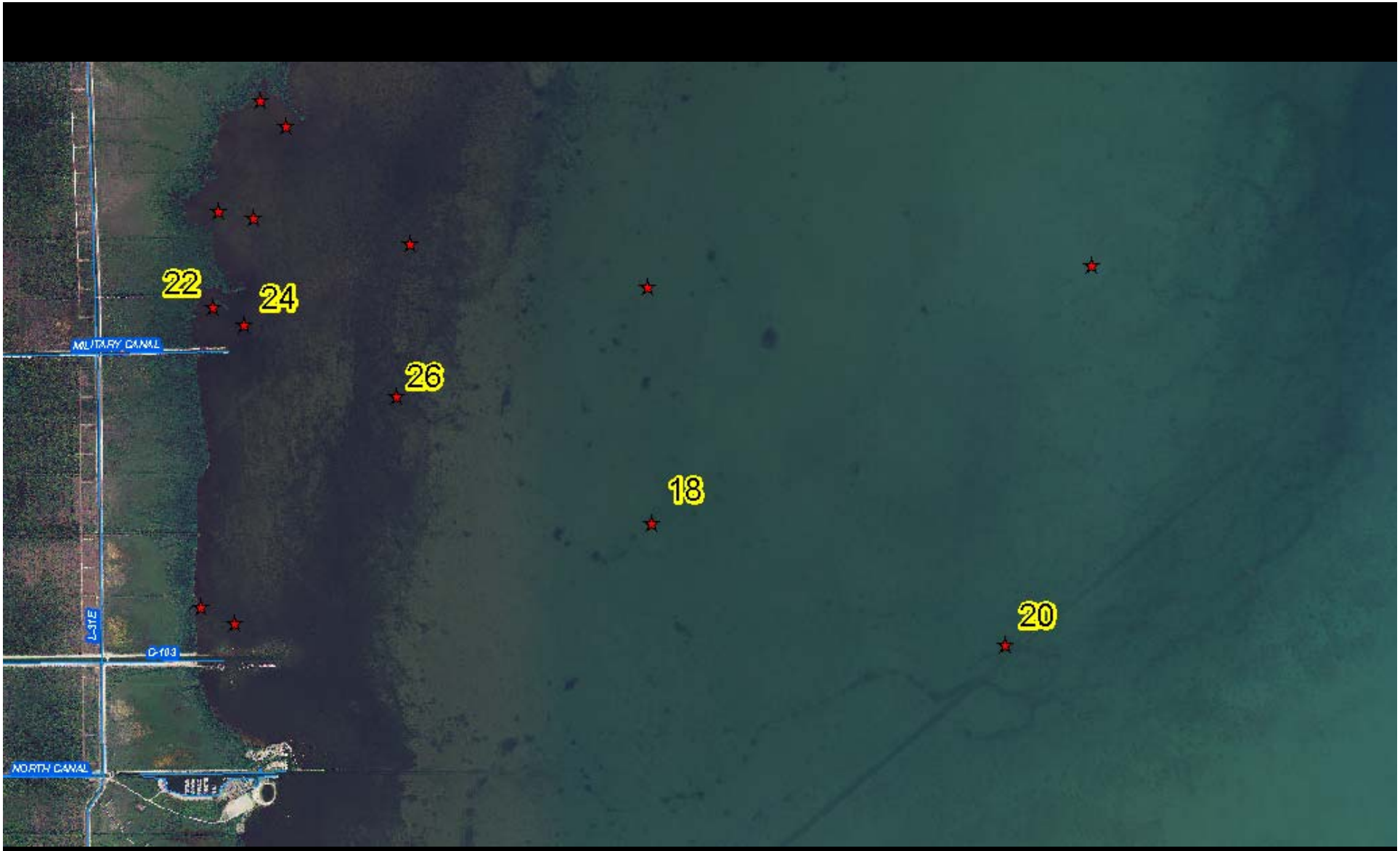
Daily Canal Discharge Volume



Phenomenon of “fresher on bottom” occurs elsewhere in Bay



Phenomenon of “fresher on bottom” occurs elsewhere in Bay

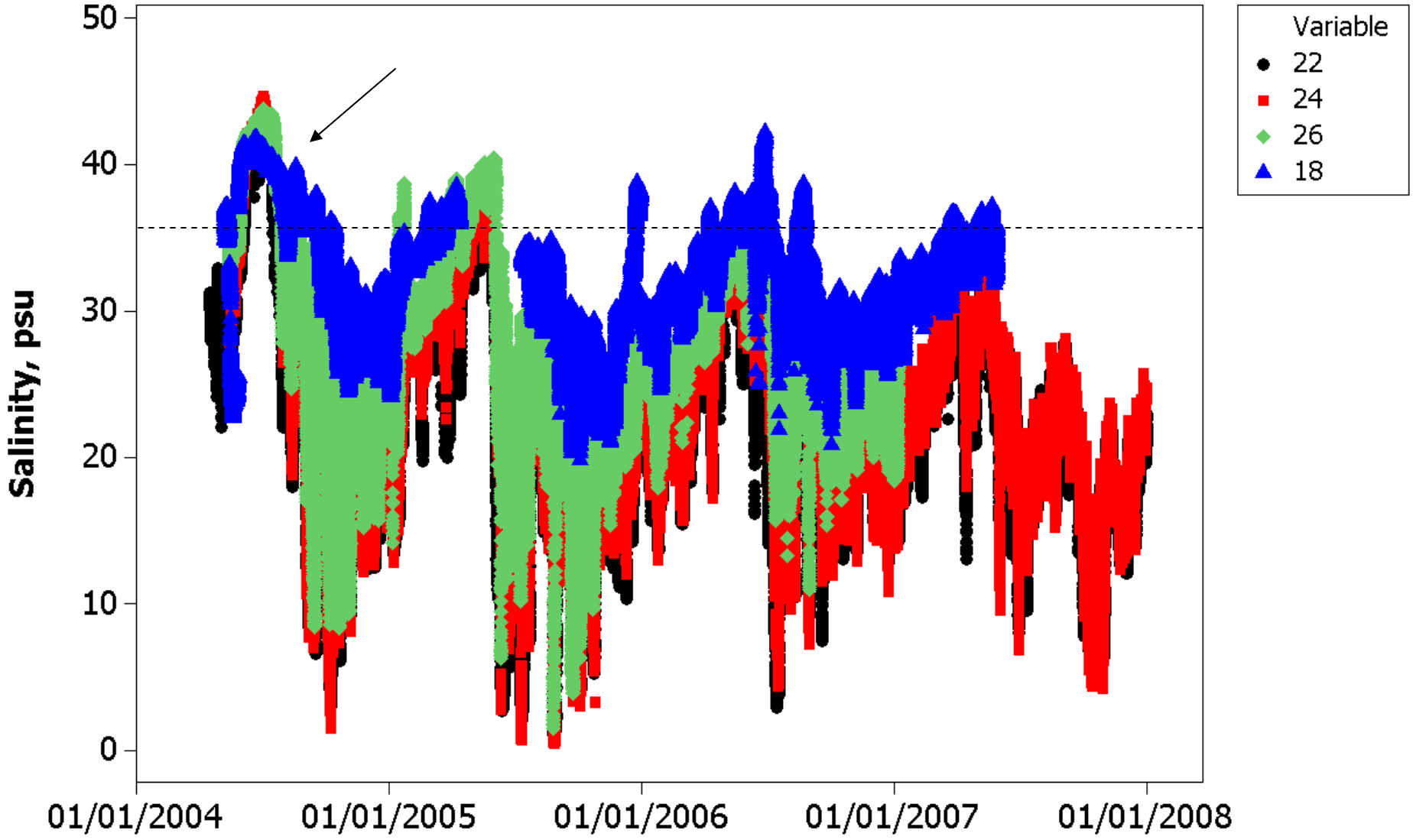


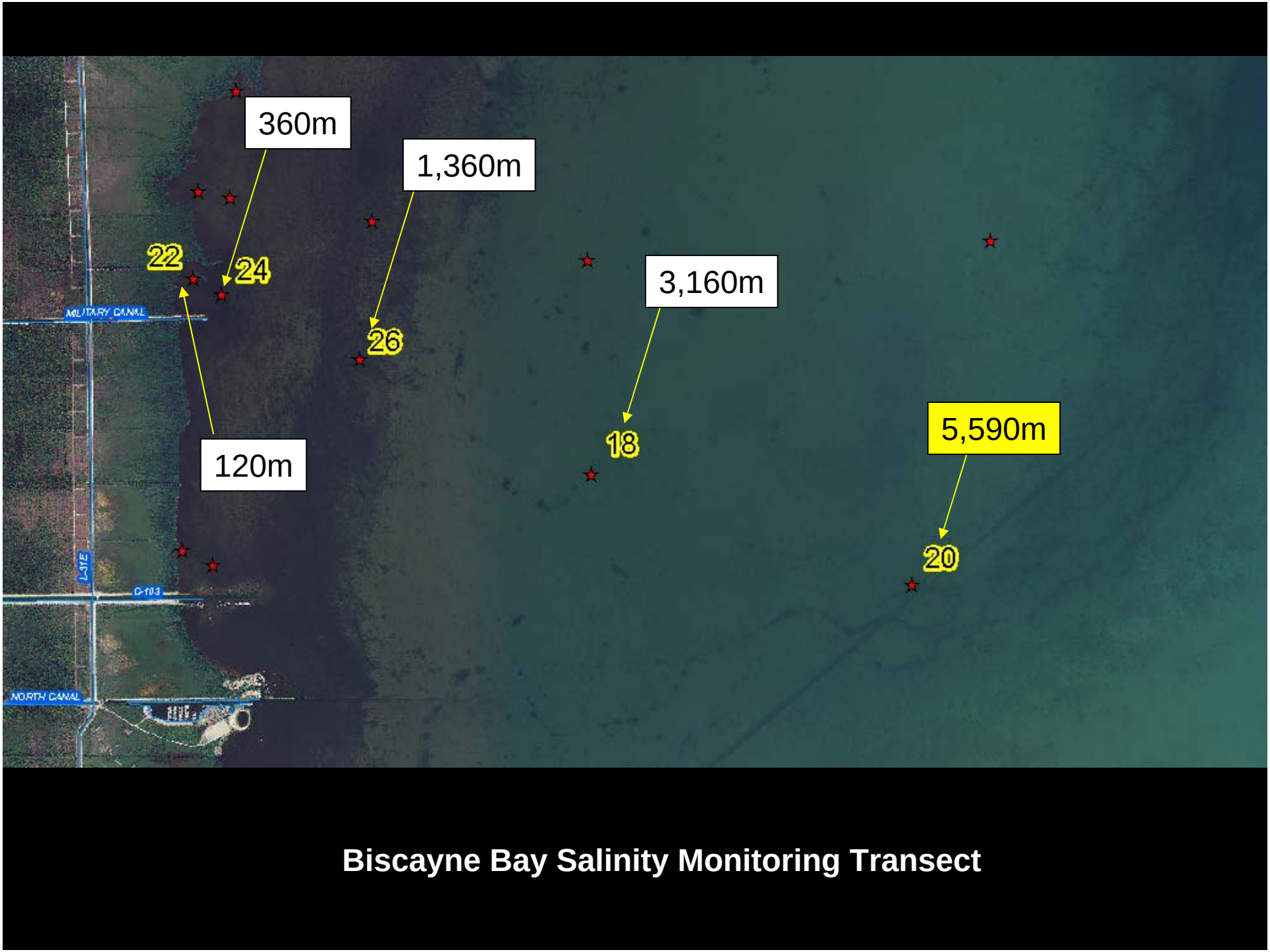
Biscayne Bay Salinity Monitoring Transect

Biscayne Bay Salinity Monitoring Transect

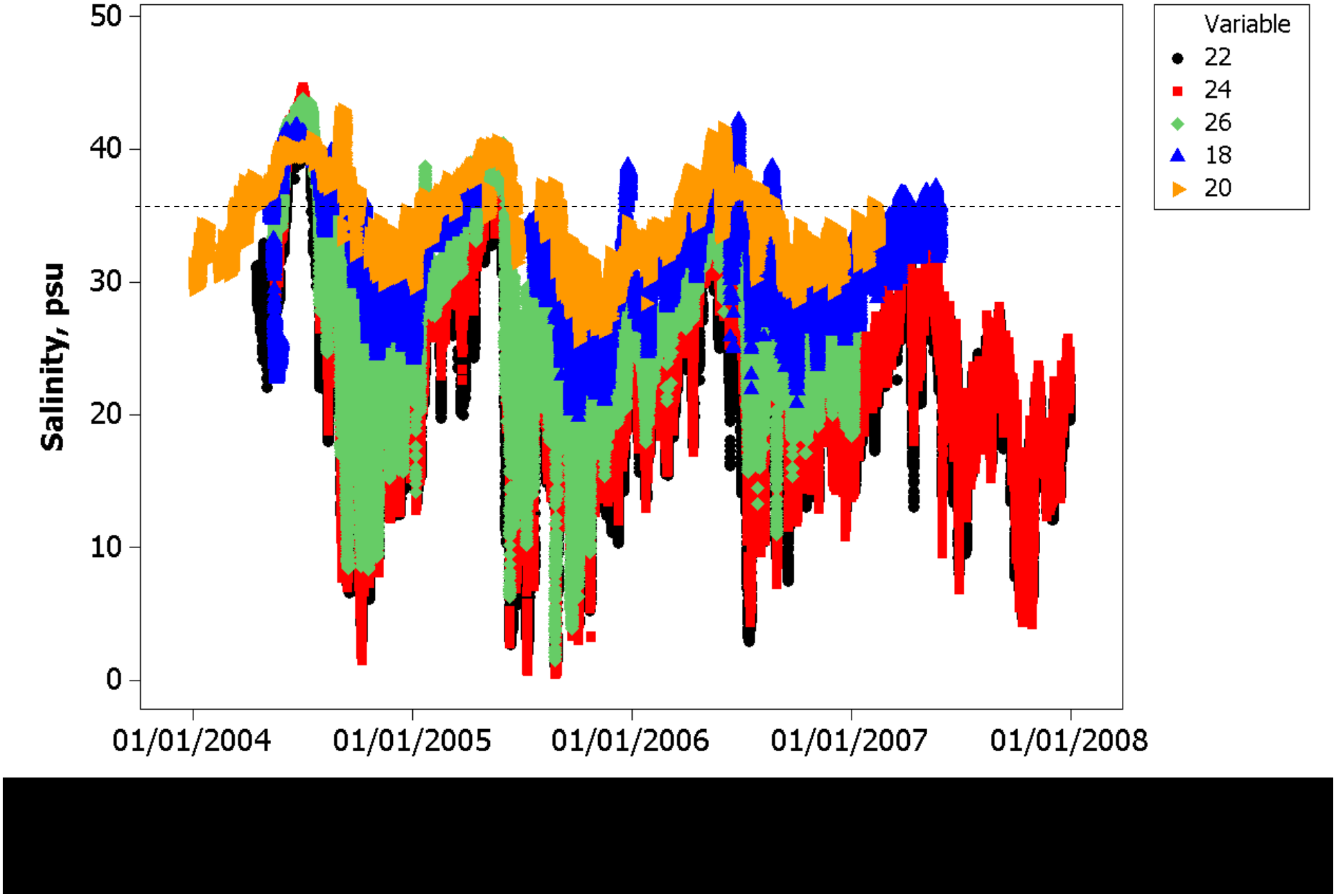
-

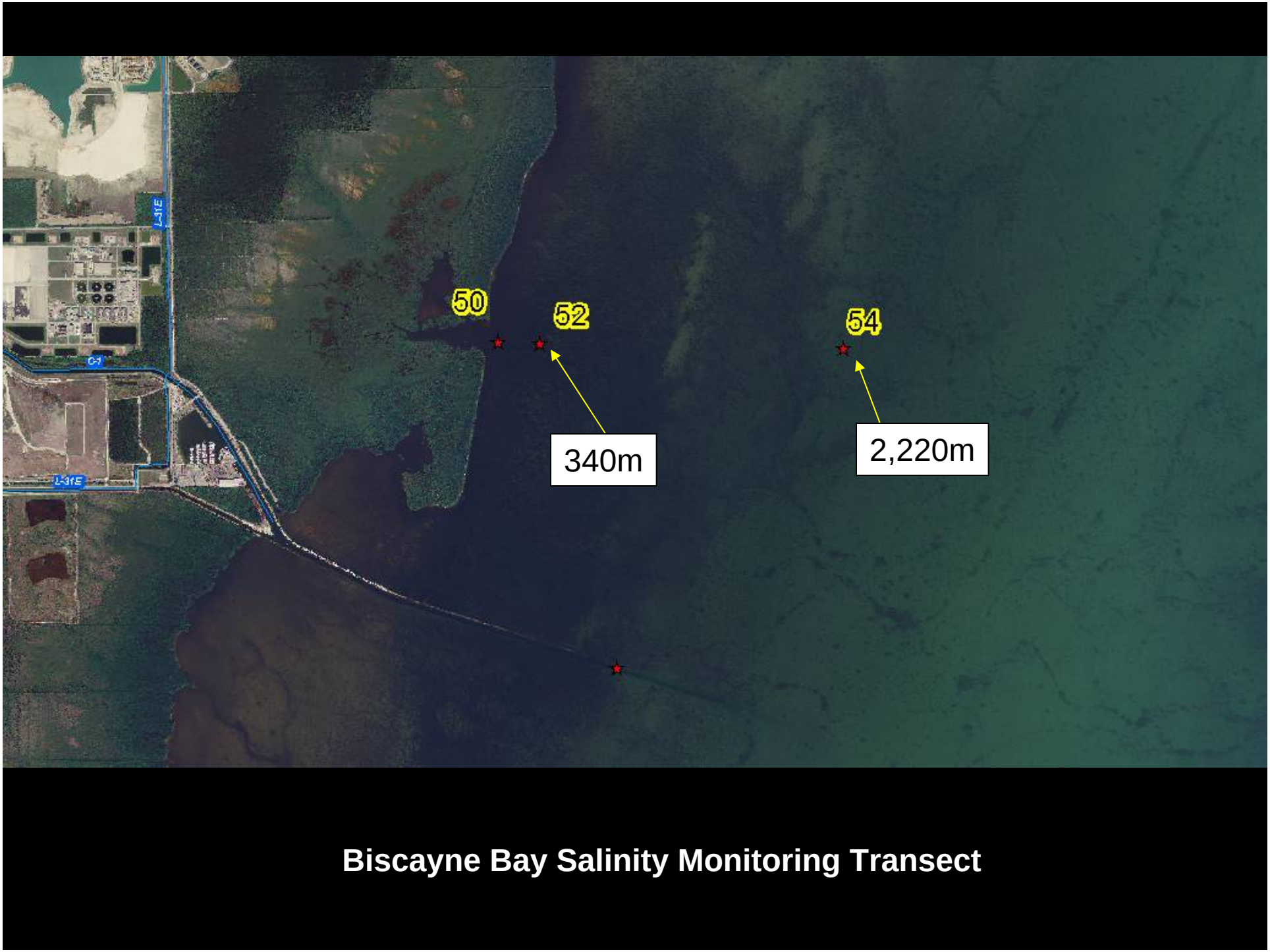
Sites 22, 24, 26, 18



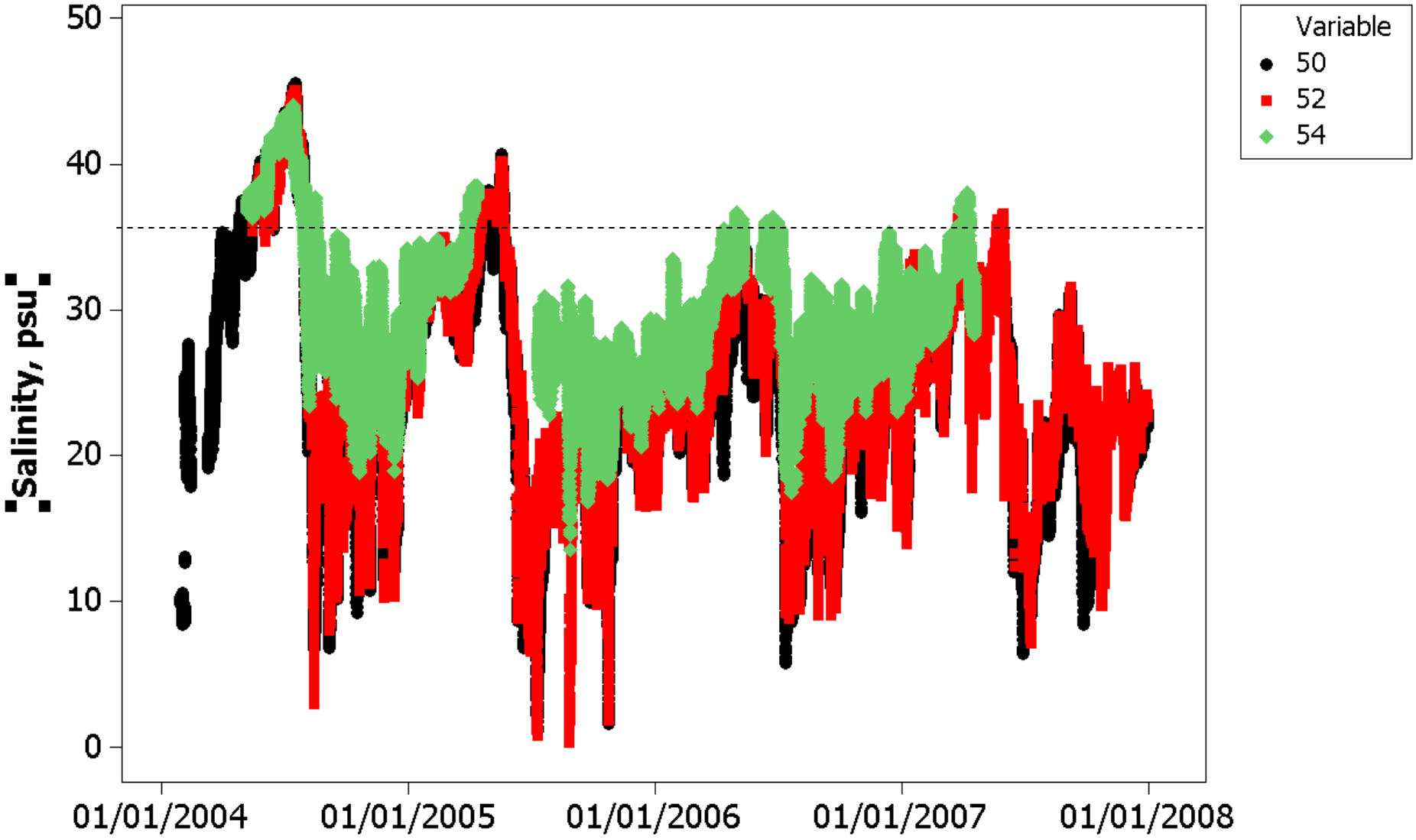


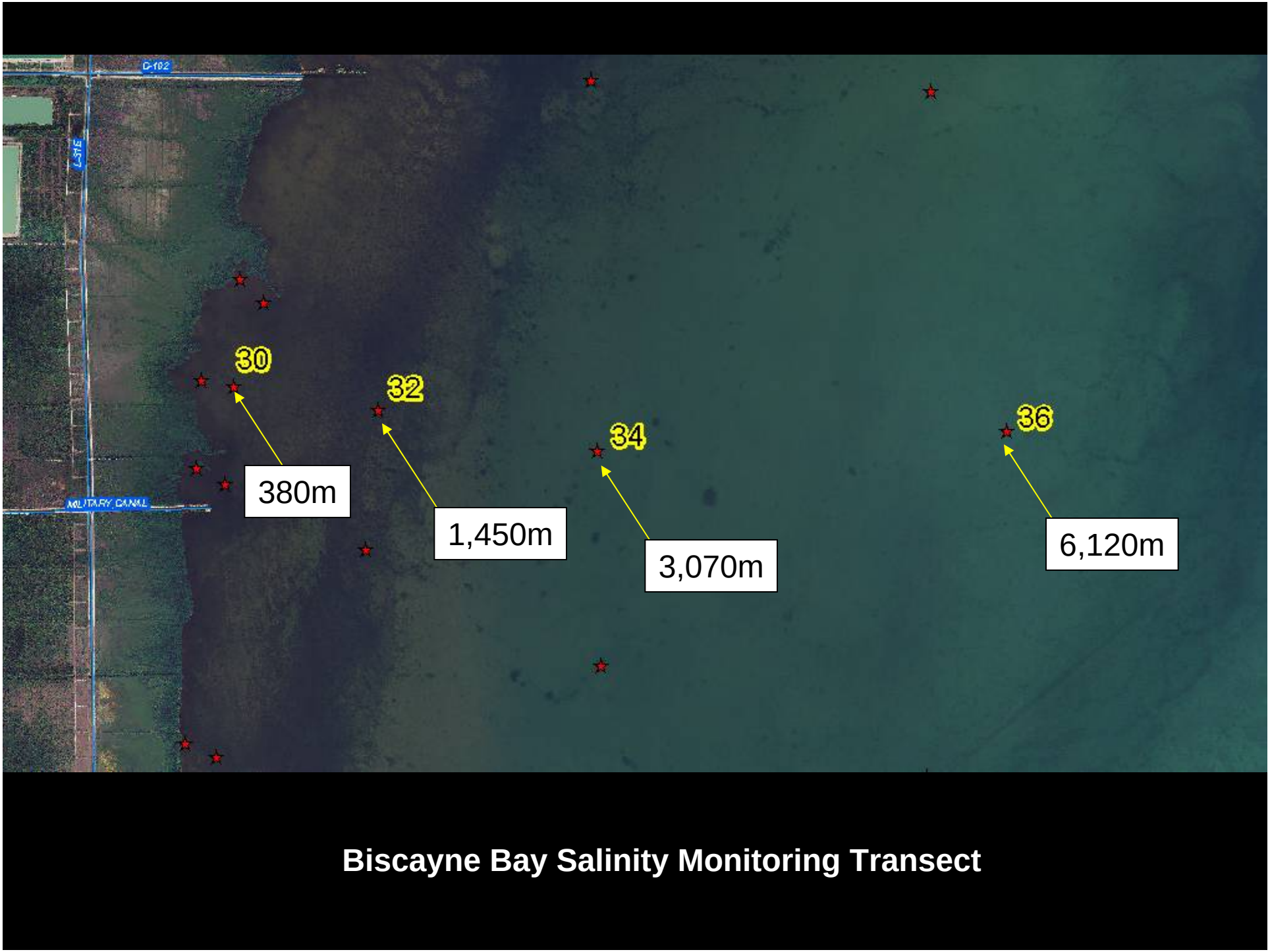
Biscayne Bay Salinity Monitoring Transect


Sites 22, 24, 26, 18, 20
Salinity, psu
50
40
30
20
10
0
01/01/2004
01/01/2005
01/01/2006
01/01/2007
01/01/2008
Variable
22
24
26
18
20

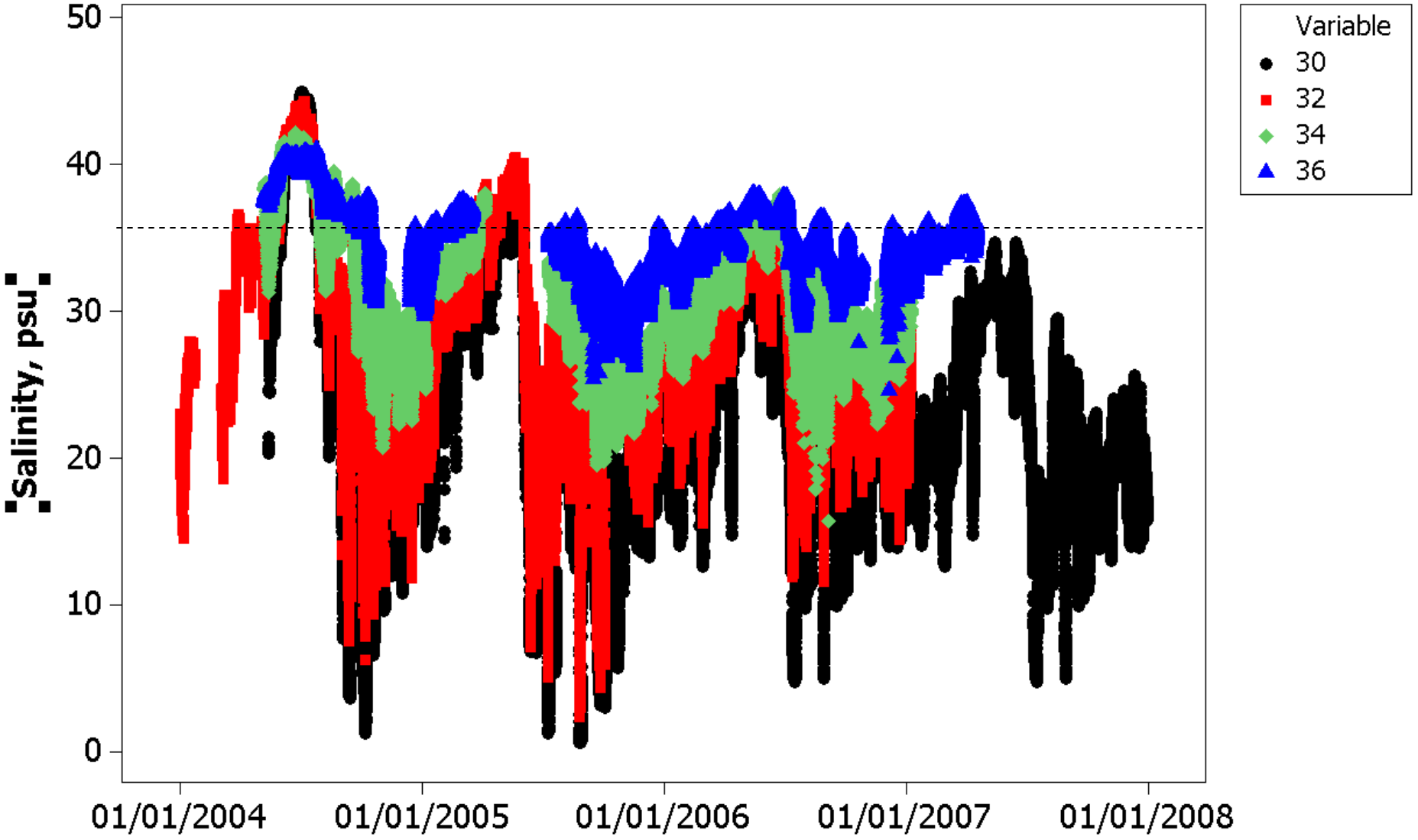


Biscayne Bay Salinity Monitoring Transect

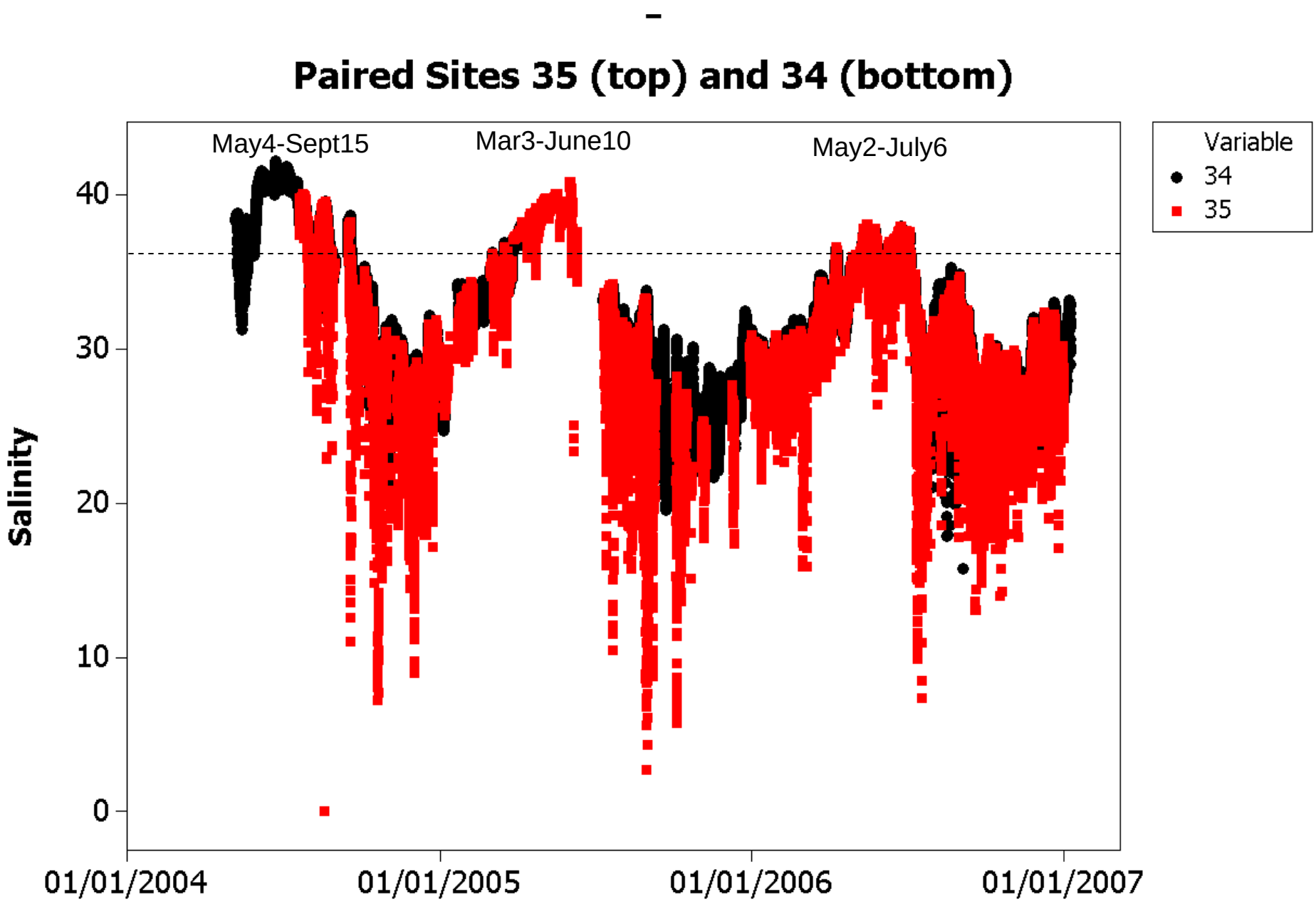

Sites 50, 52, 54
'Salinity, psu'
50
40
30
20
10
0
01/01/2004
01/01/2005
01/01/2006
01/01/2007
01/01/2008
Variable
50
52
54



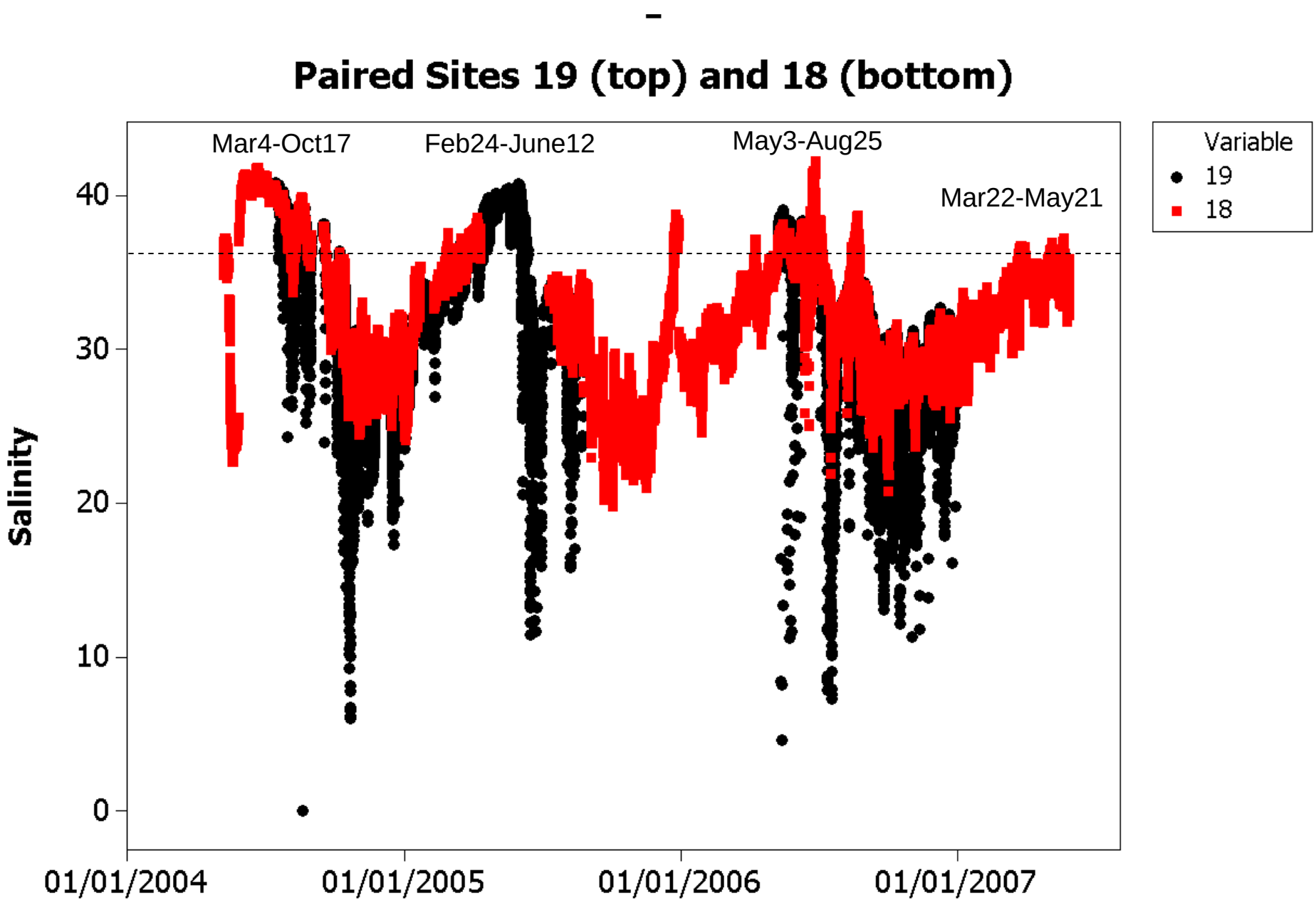
Biscayne Bay Salinity Monitoring Transect


Sites 30, 32, 34, 36
'Salinity, psu'
50
40
30
20
10
0
01/01/2004
01/01/2005
01/01/2006
01/01/2007
01/01/2008
Variable
30
32
34
36

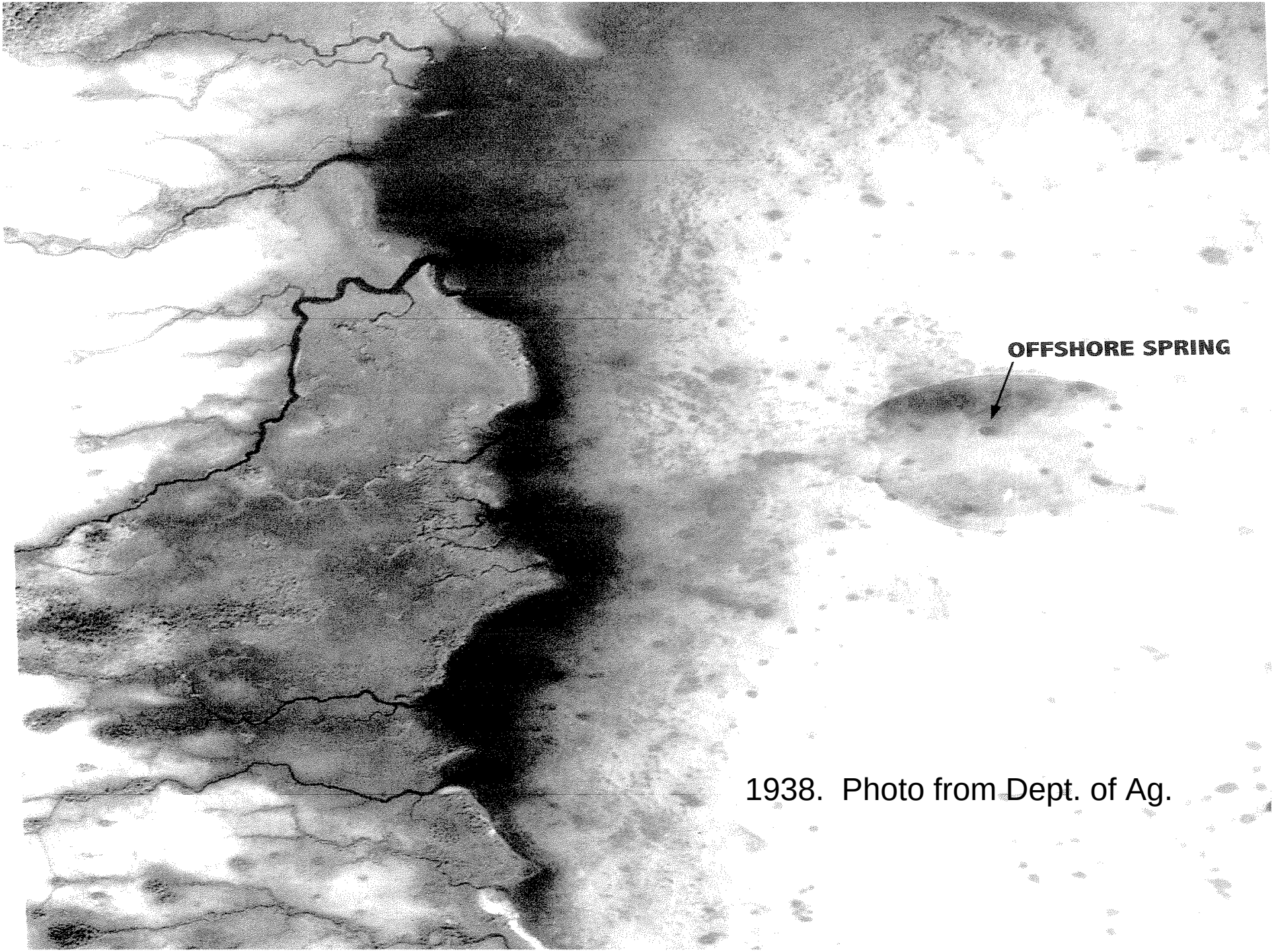
Top and Bottom Paired Sites



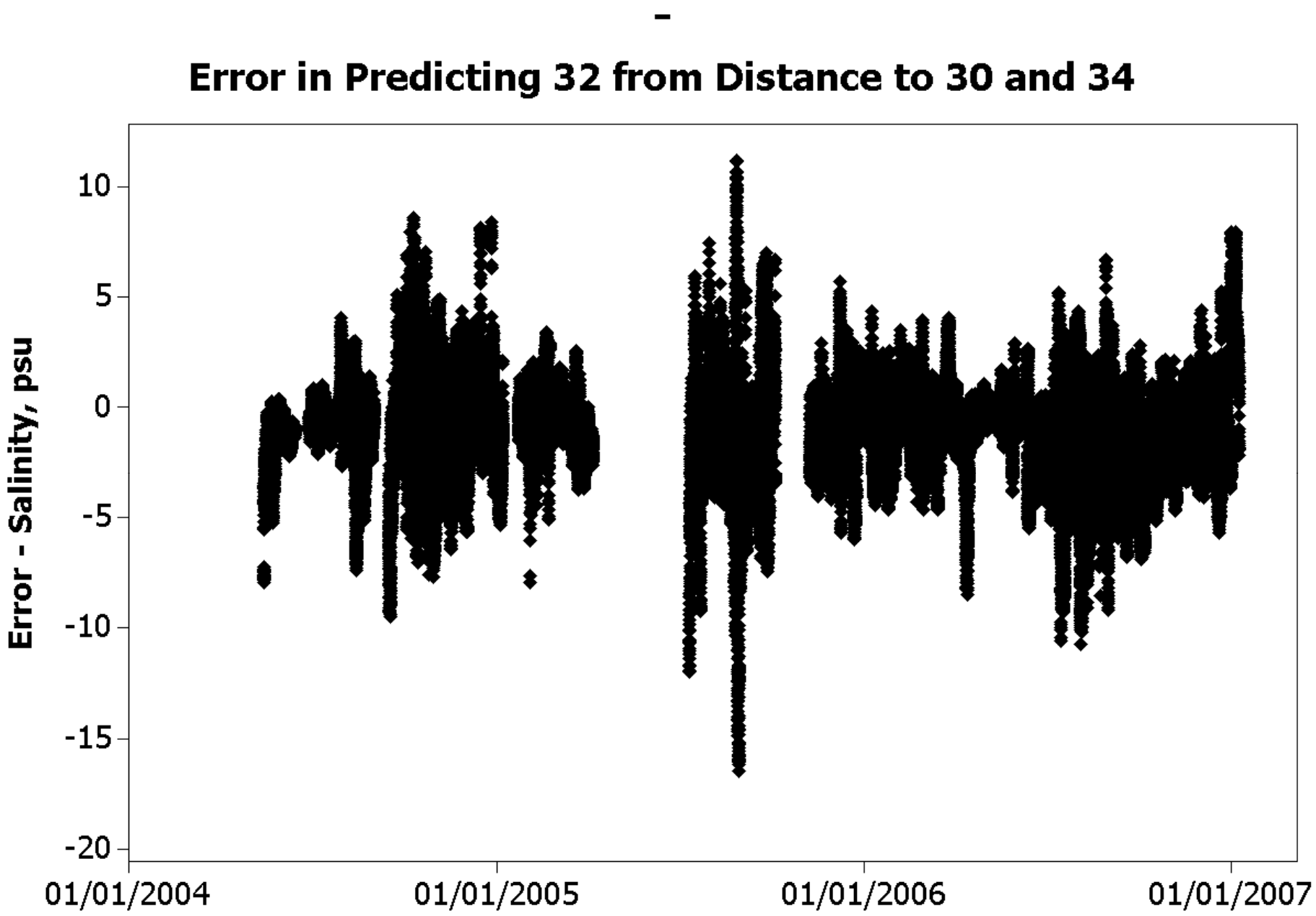
Hypersalinity Events – Top to Bottom



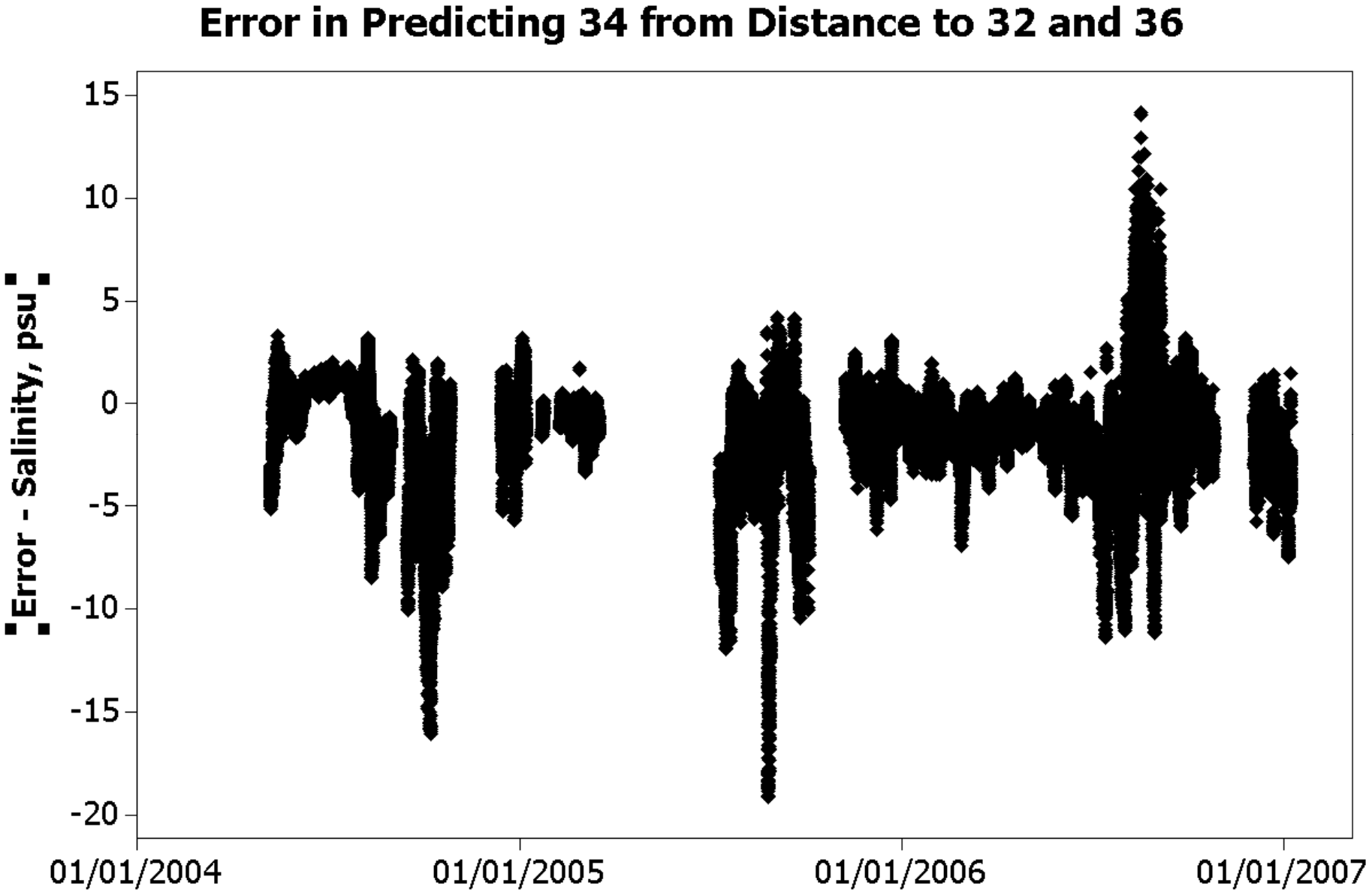
Hypersalinity Events – Top to Bottom



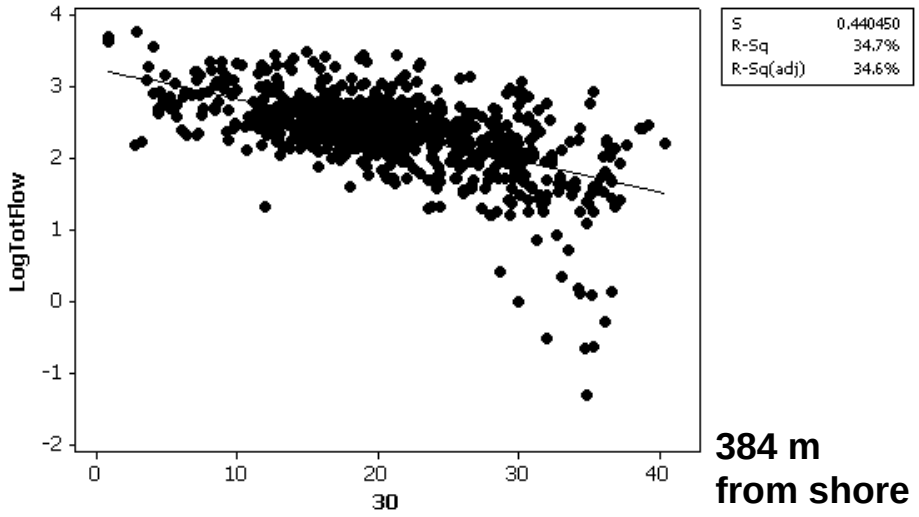
1938. Photo from Dept. of Ag.



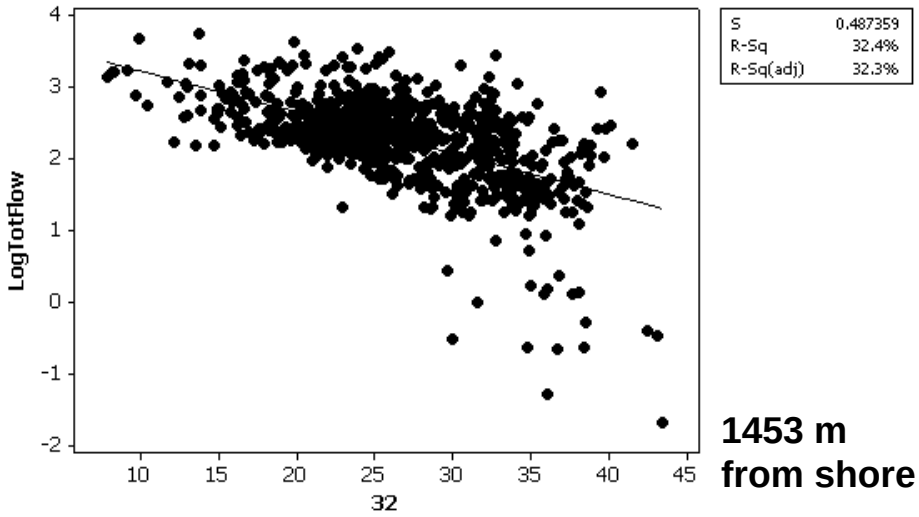
Accuracy of Predicted Salinity from Salinity at Bracketing Sites along Transect



Accuracy of Predicted Salinity from Salinity at Bracketing Sites along Transect

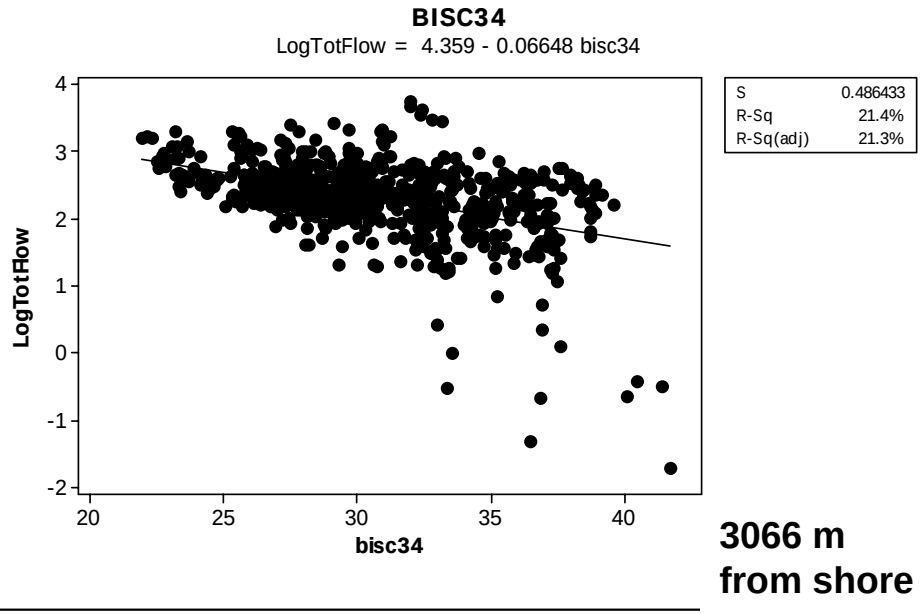


384 m from shore

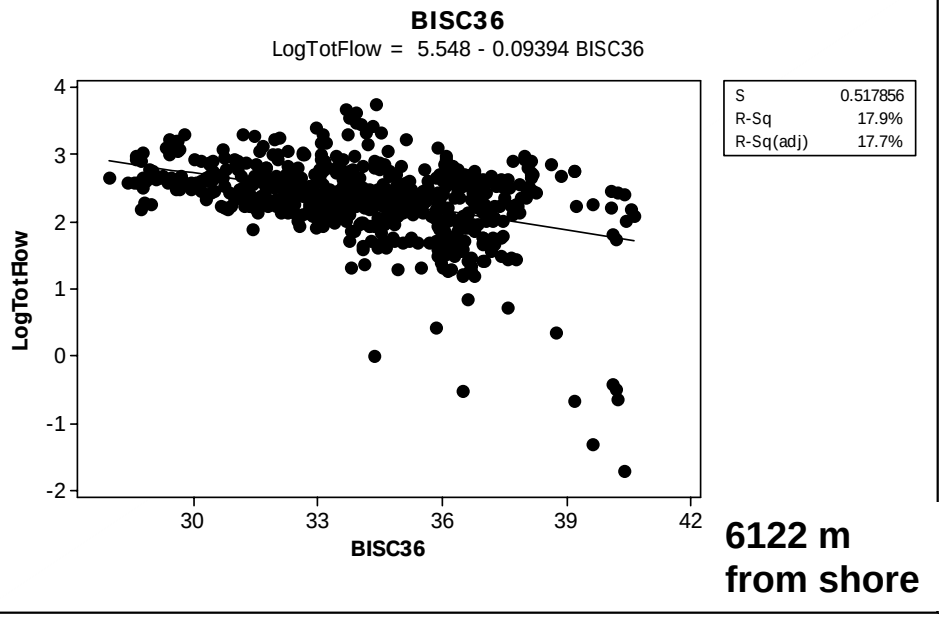


1453 m from shore

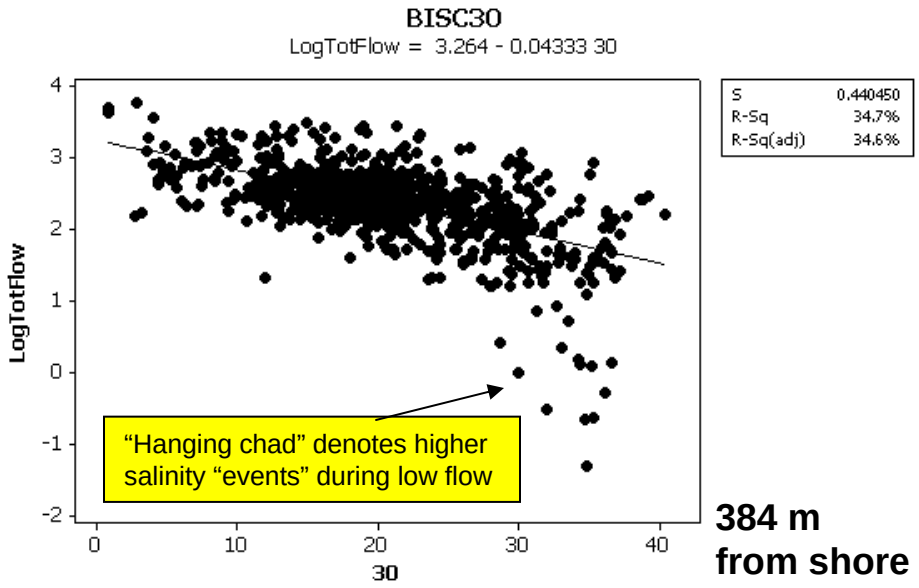
Salinity along 30-32-34-36 transect as function of Canal Discharge



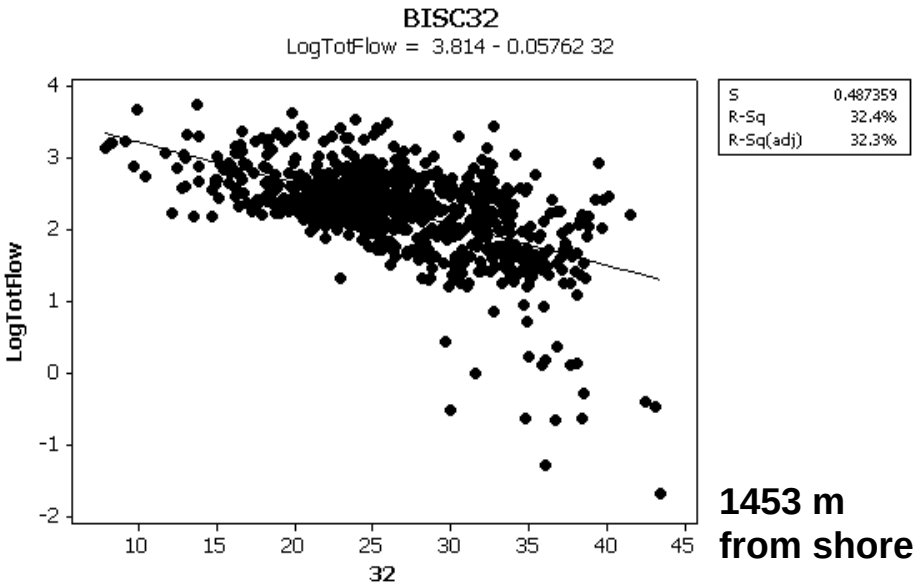
3066 m from shore



6122 m from shore

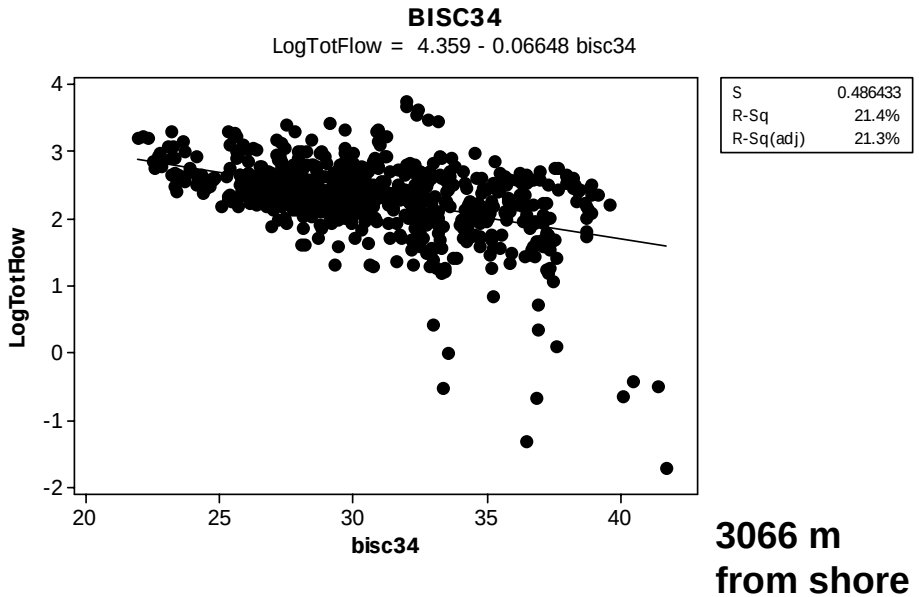


384 m from shore

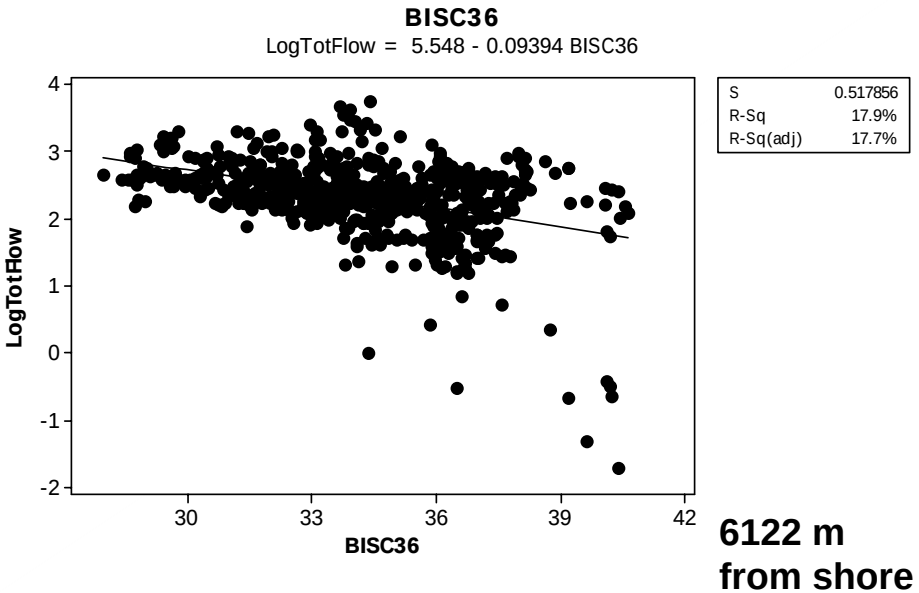


1453 m from shore

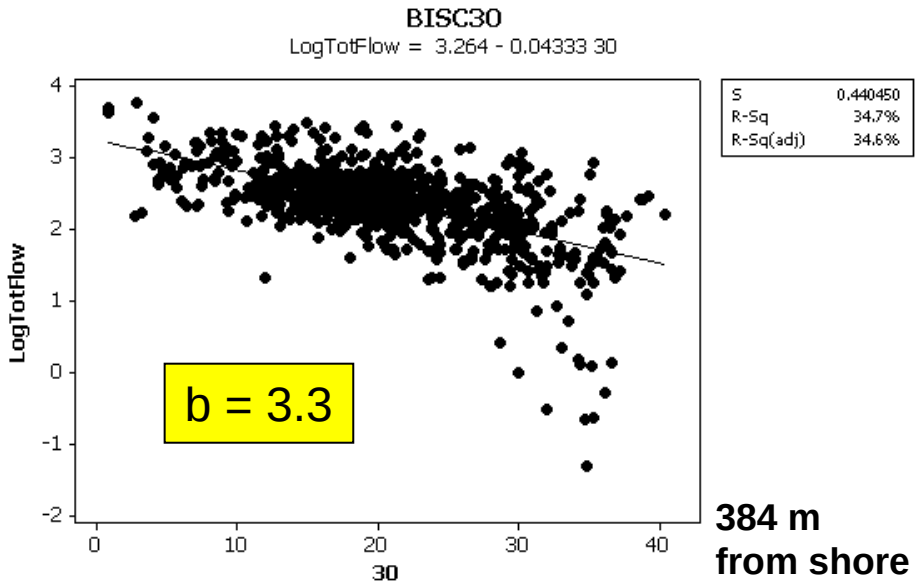
Salinity along 30-32-34-36 transect as function of Canal Discharge



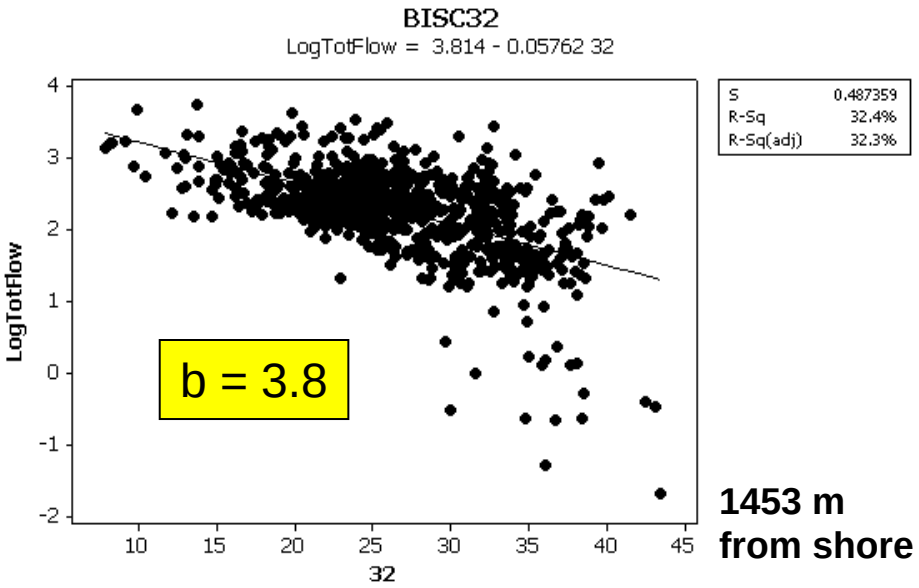
3066 m from shore



6122 m from shore

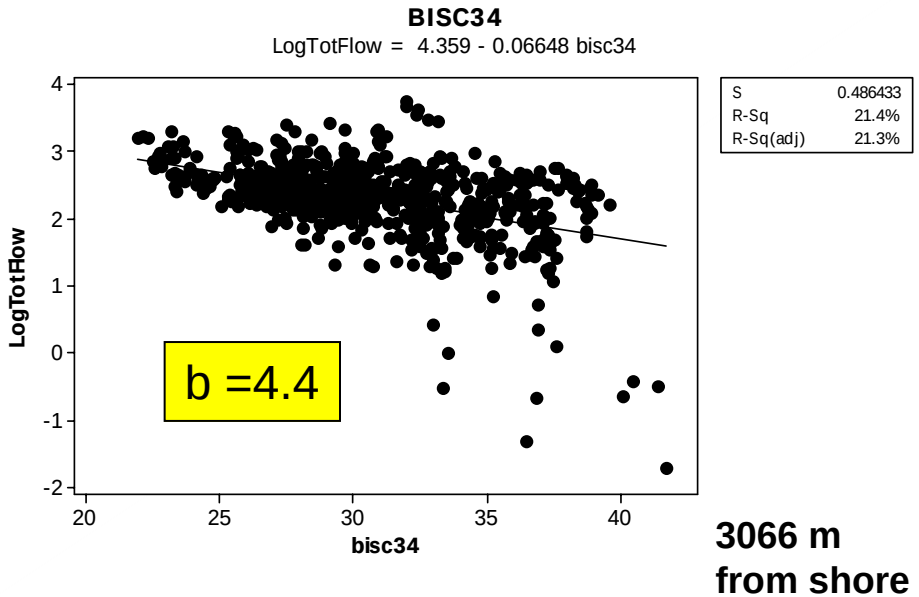


384 m from shore

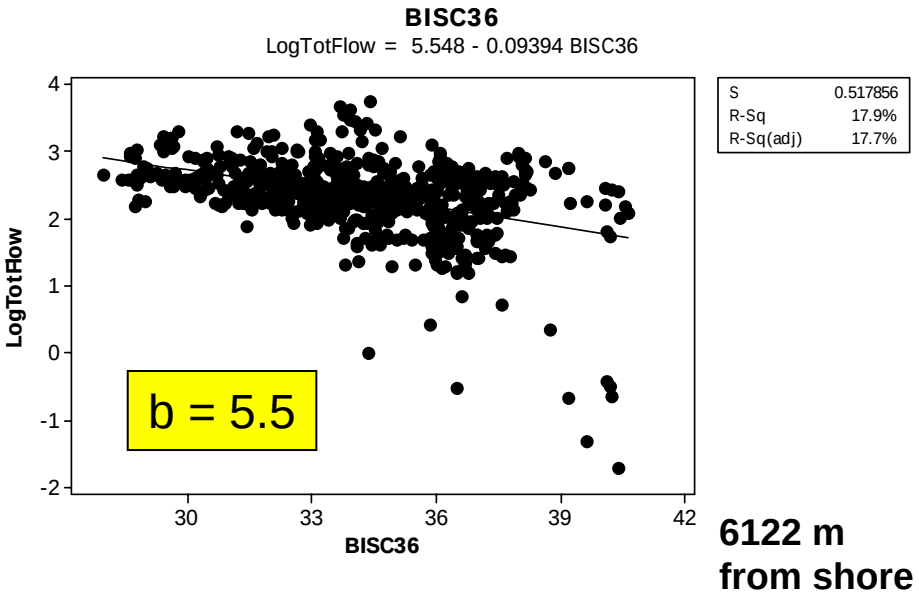


1453 m from shore

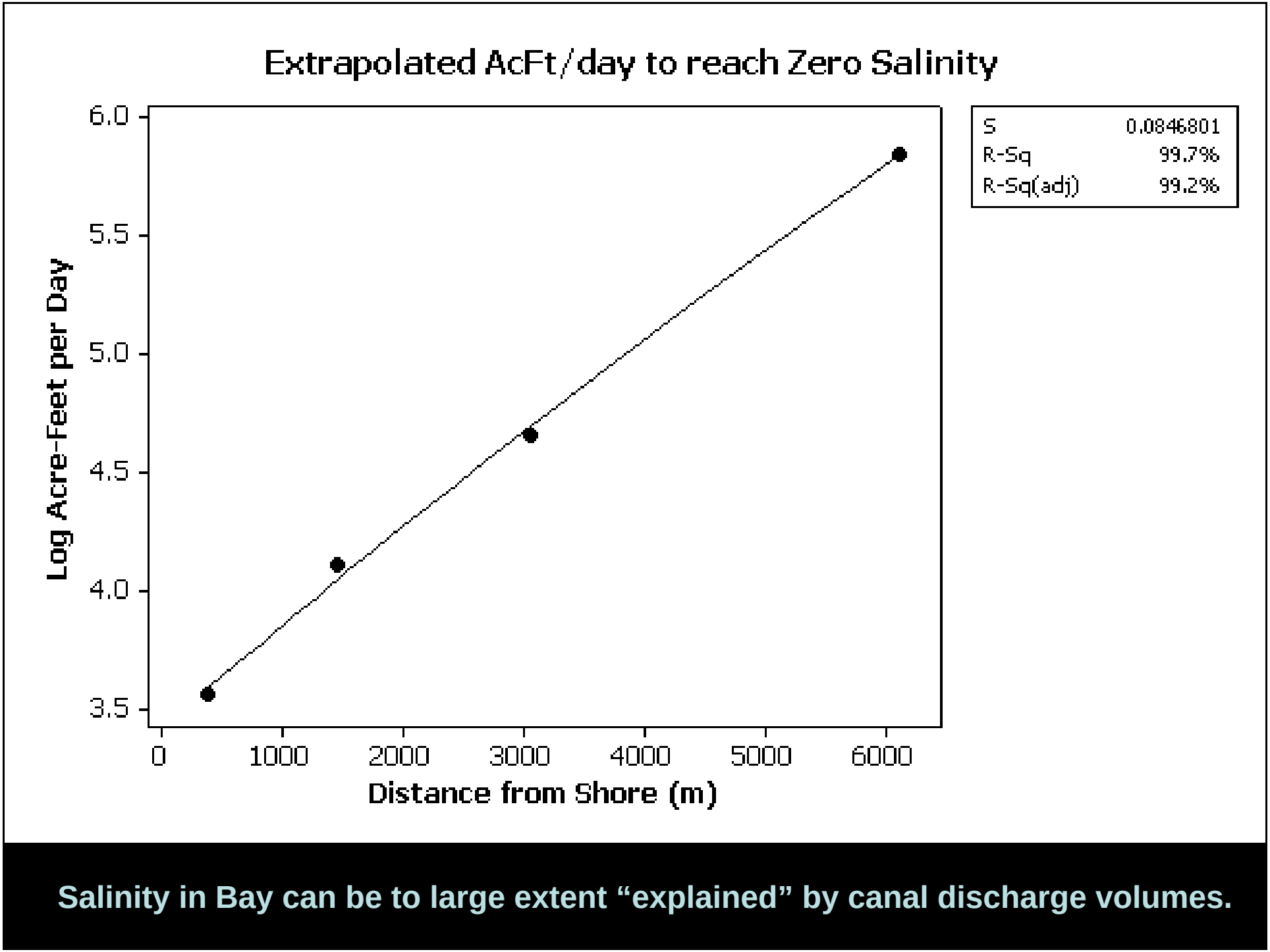
Salinity along 30-32-34-36 transect as function of Canal Discharge



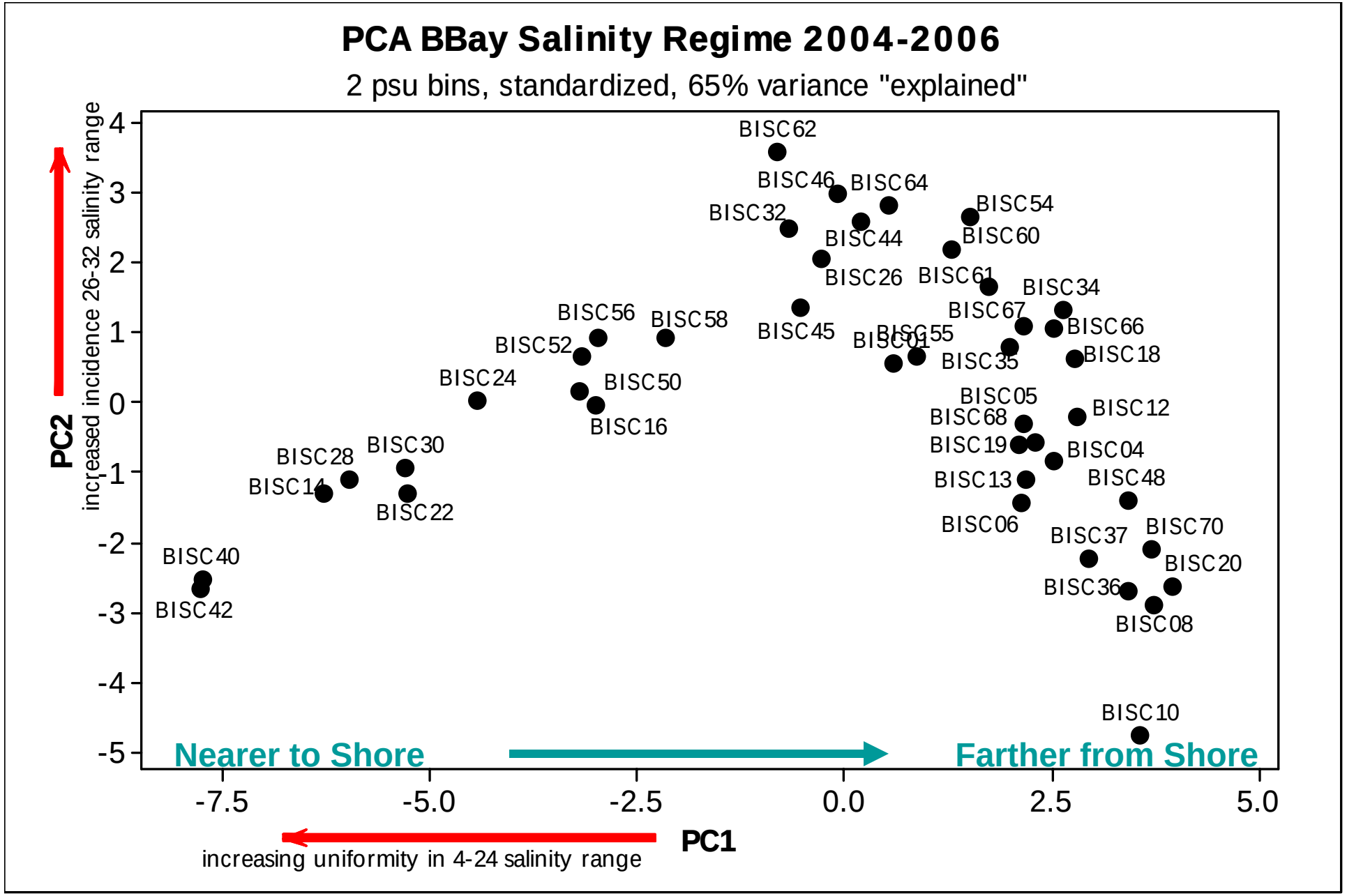
3066 m from shore

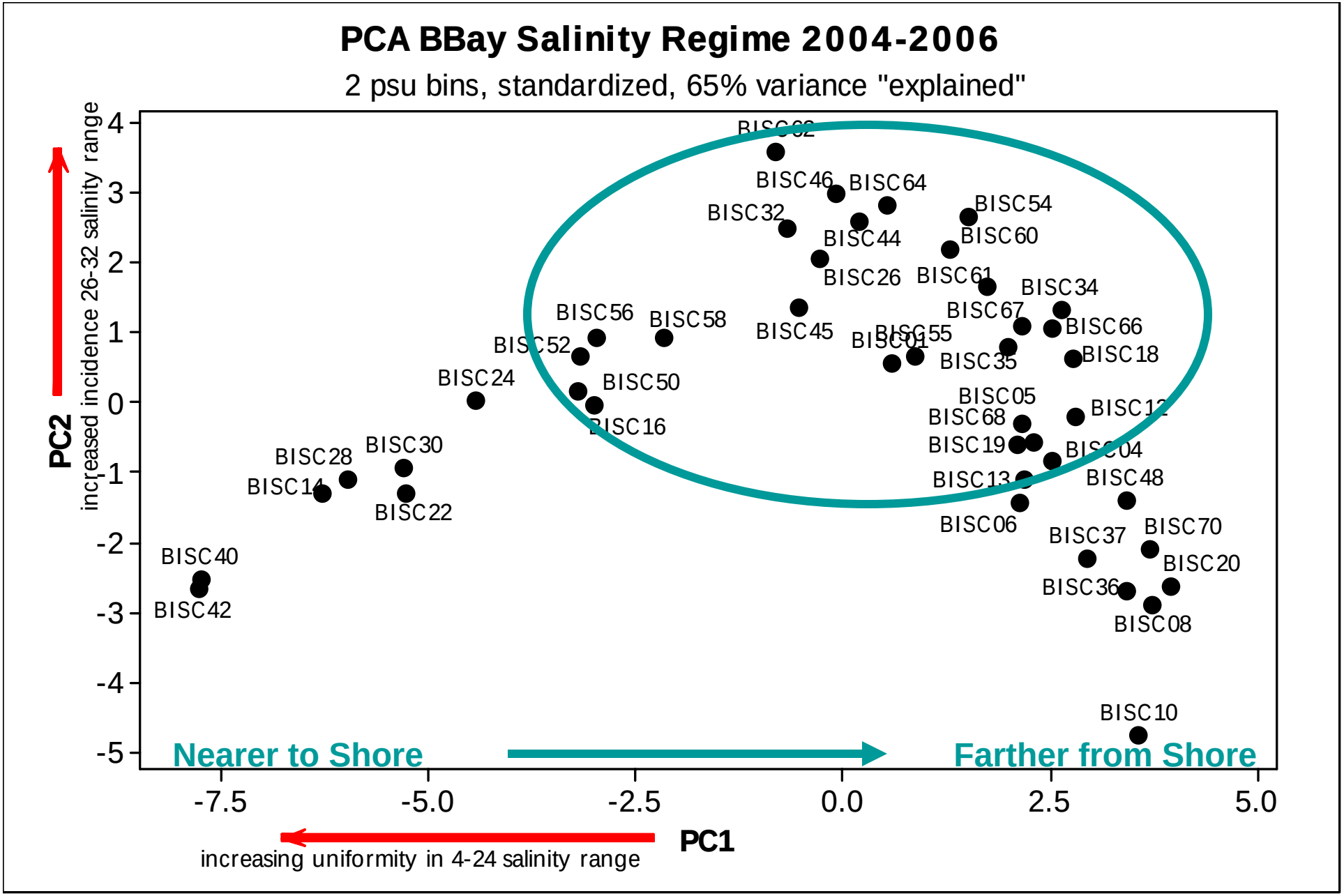


6122 m from shore



Salinity in Bay can be to large extent “explained” by canal discharge volumes.


PCA BBay Salinity Regime 2004-2006
2 psu bins, standardized, 65% variance "explained"
PC2
increased incidence 26-32 salinity range
PC1
increasing uniformity in 4-24 salinity range
Nearer to Shore
Farther from Shore
BISC62
BISC46
BISC64
BISC32
BISC54
BISC44
BISC60
BISC26
BISC61
BISC34
BISC56
BISC58
BISC45
BISC67
BISC66
BISC52
BISC55
BISC01
BISC35
BISC18
BISC24
BISC50
BISC05
BISC68
BISC12
BISC16
BISC19
BISC04
BISC30
BISC28
BISC14
BISC13
BISC48
BISC22
BISC06
BISC37
BISC70
BISC40
BISC20
BISC36
BISC42
BISC08
BISC10
4
3
2
1
0
-1
-2
-3
-4
-5
-7.5
-5.0
-2.5
0.0
2.5
5.0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Nearer to Shore
Farther from Shore
BISC62
BISC46
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BISC44
BISC60
BISC26
BISC61
BISC34
BISC56
BISC58
BISC45
BISC67
BISC66
BISC52
BISC55
BISC01
BISC18
BISC35
BISC24
BISC50
BISC05
BISC16
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BISC13
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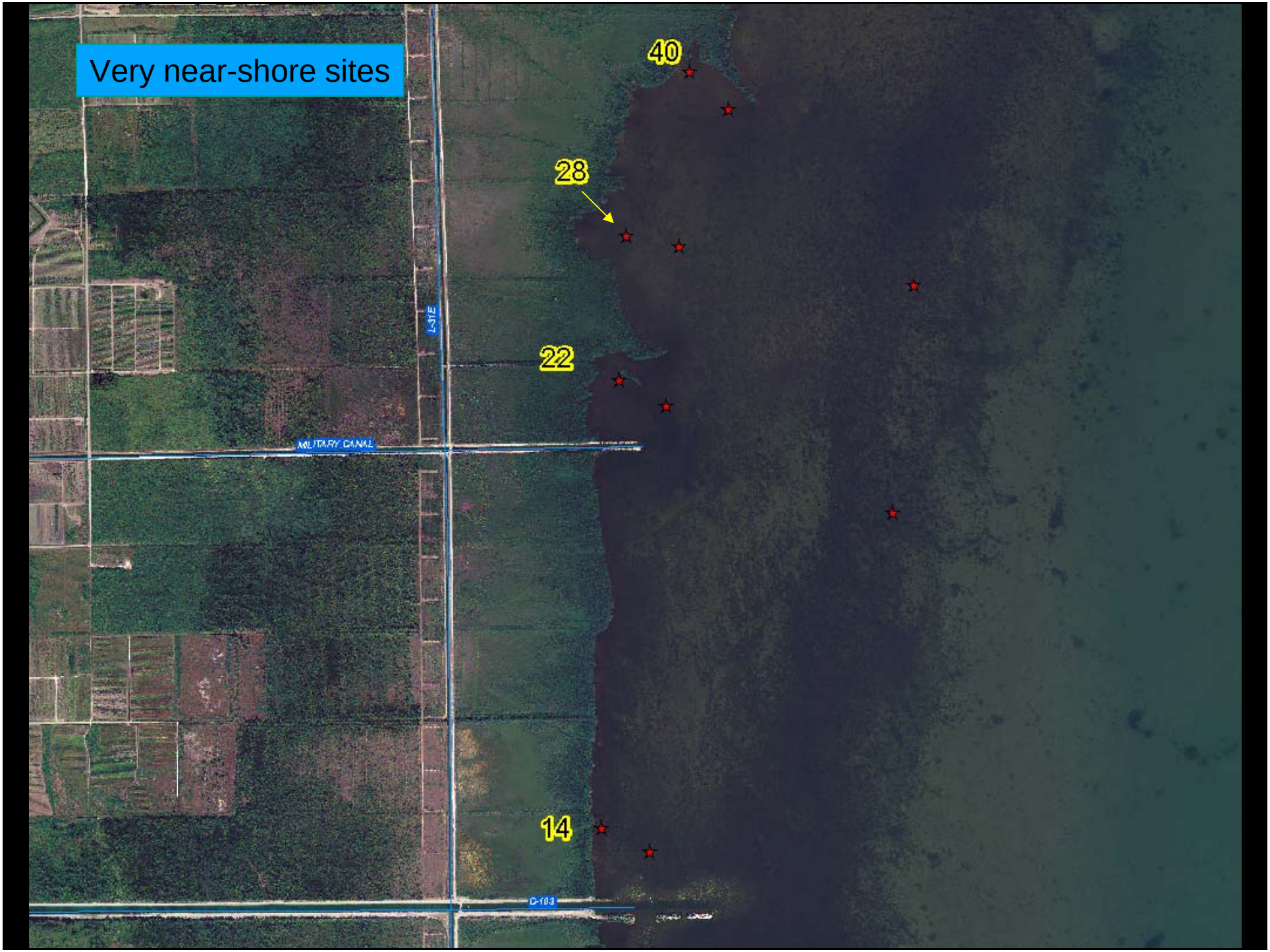
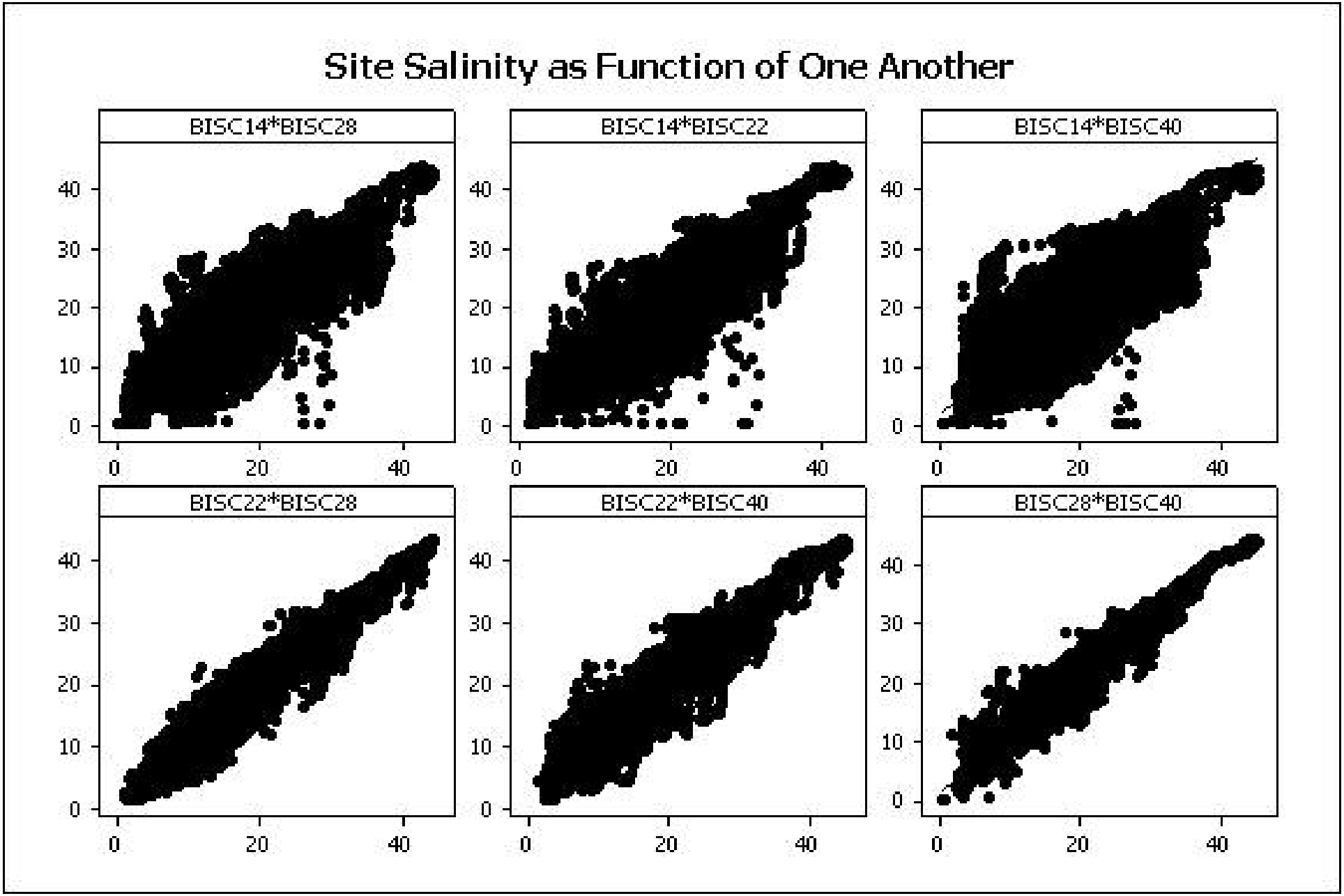
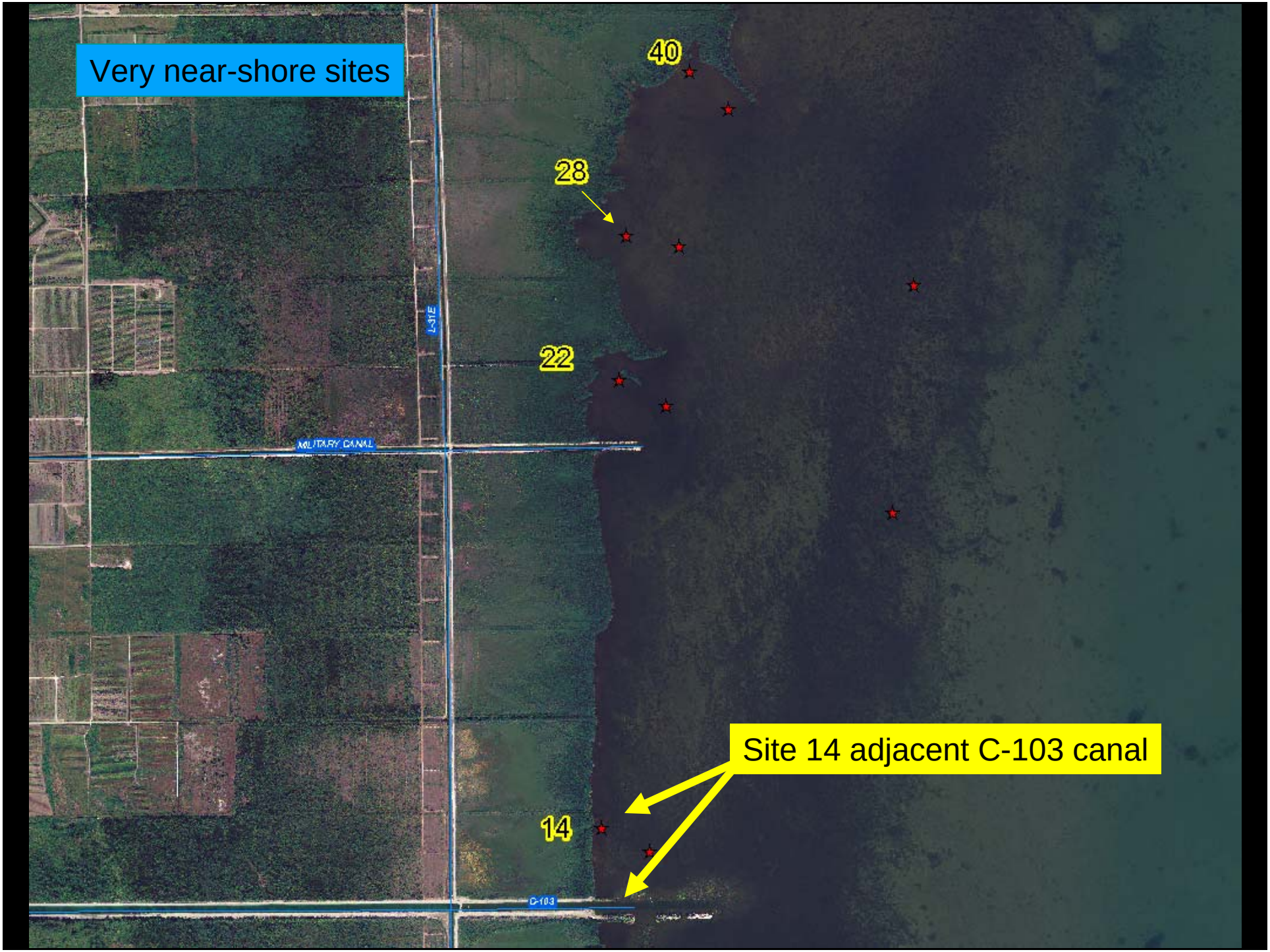
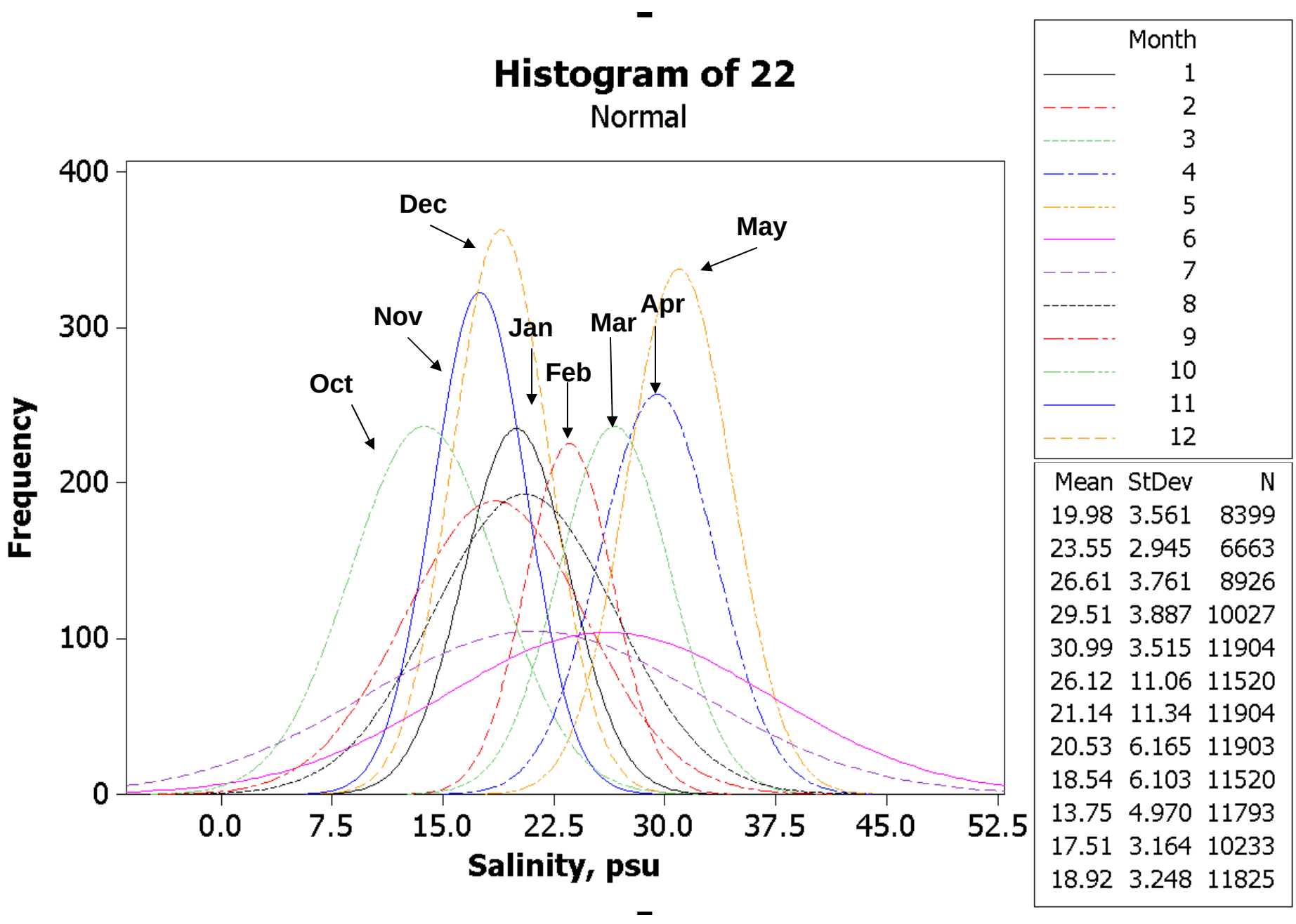
BISC22
BISC06
BISC37
BISC70
BISC40
BISC20
BISC36
BISC42
BISC08
BISC10
4
3
2
1
0
-1
-2
-3
-4
-5
-7.5
-5.0
-2.5
0.0
2.5
5.0


Very near-shore sites
40
28
22
14
L-31E
MILITARY CANAL
C-103



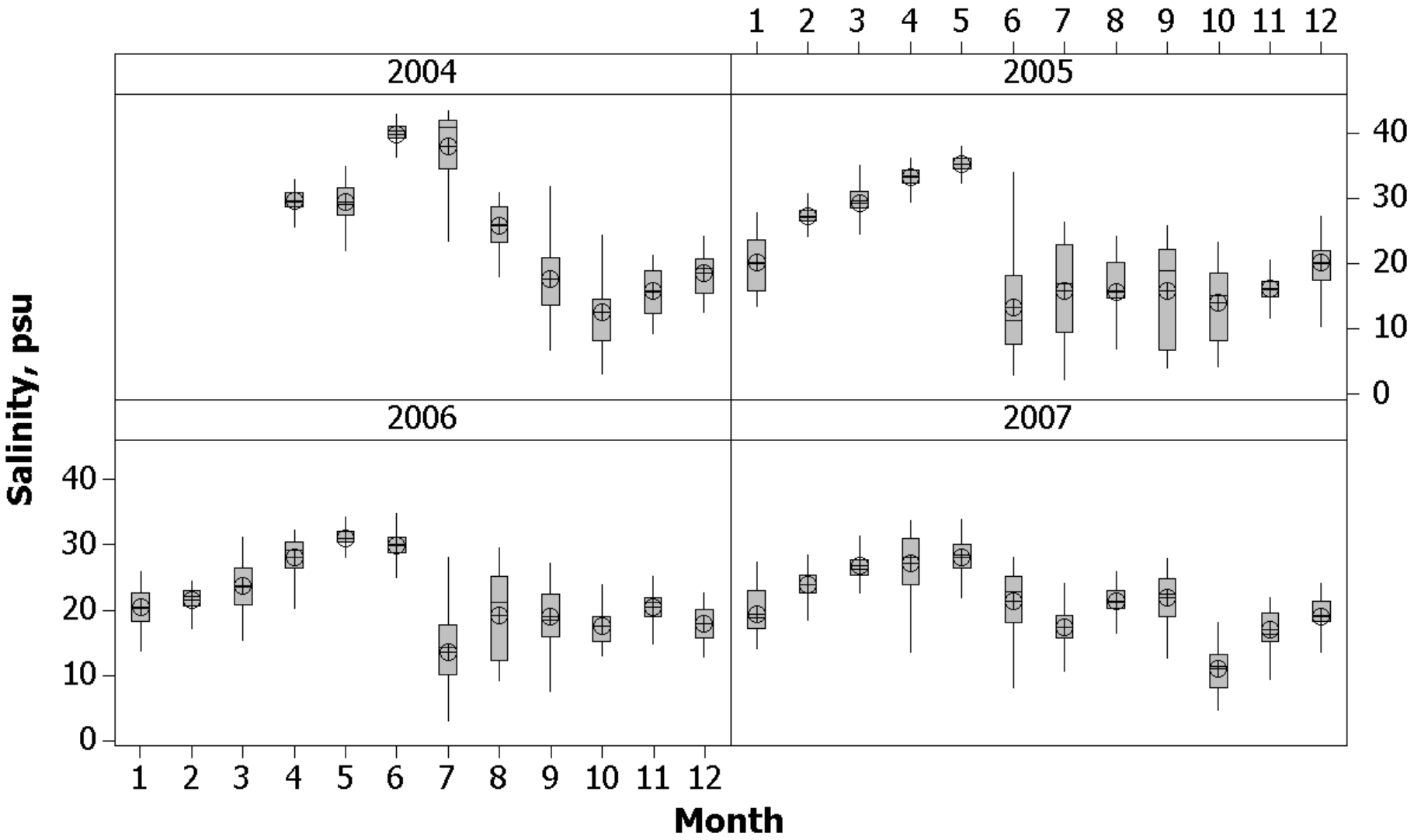
Very near-shore sites (<150m)

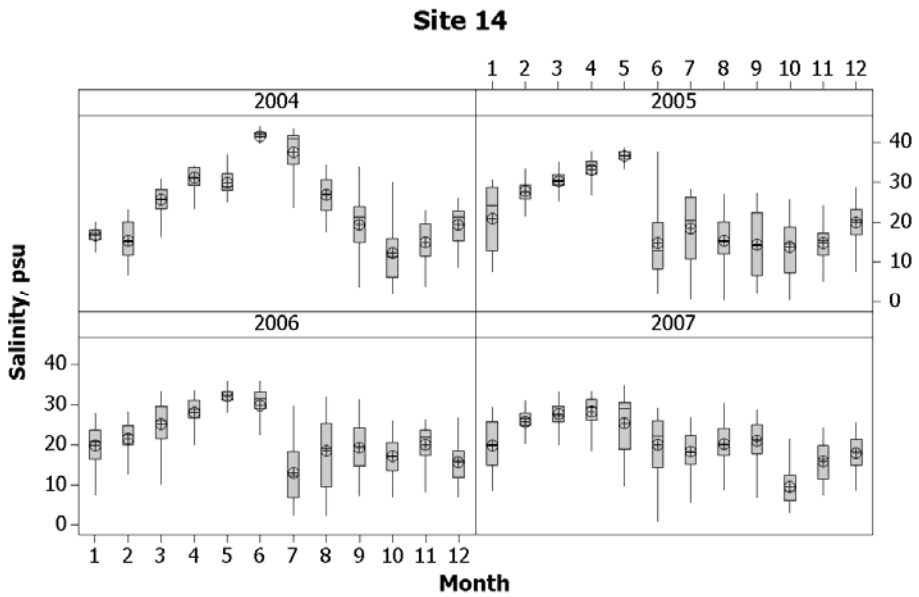

Very near-shore sites
40
28
22
14
L-31E
MILITARY CANAL
C-103
Site 14 adjacent C-103 canal

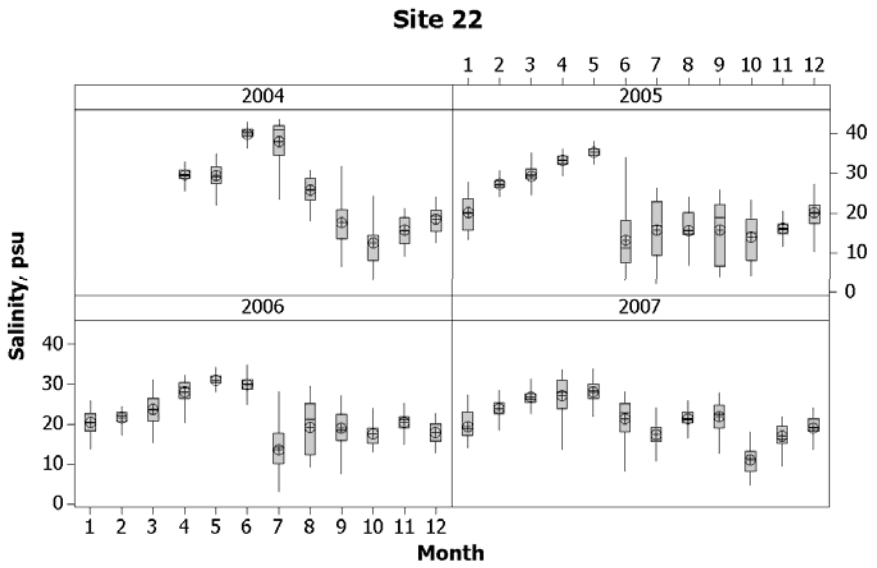


Mean	StDev	N
19.98	3.561	8399
23.55	2.945	6663
26.61	3.761	8926
29.51	3.887	10027
30.99	3.515	11904
26.12	11.06	11520
21.14	11.34	11904
20.53	6.165	11903
18.54	6.103	11520
13.75	4.970	11793
17.51	3.164	10233
18.92	3.248	11825

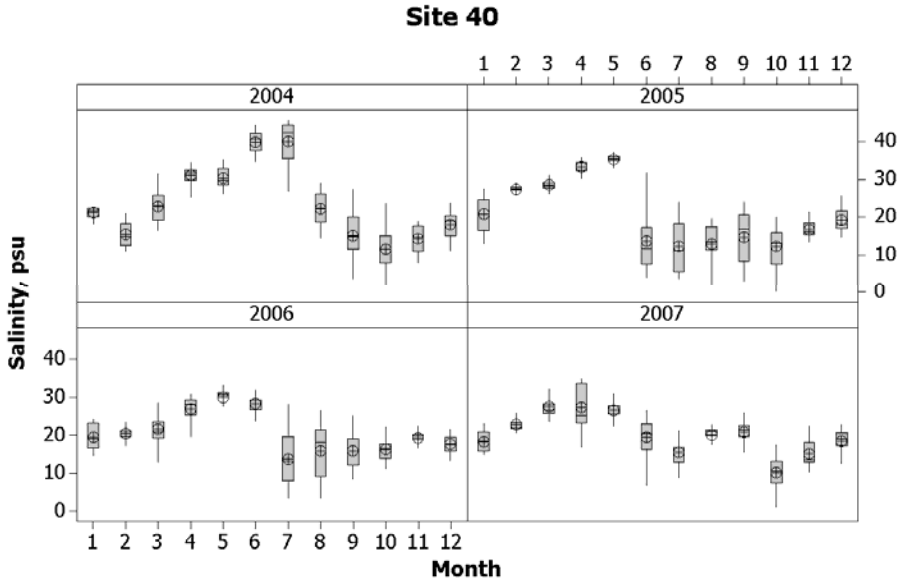
Site 22

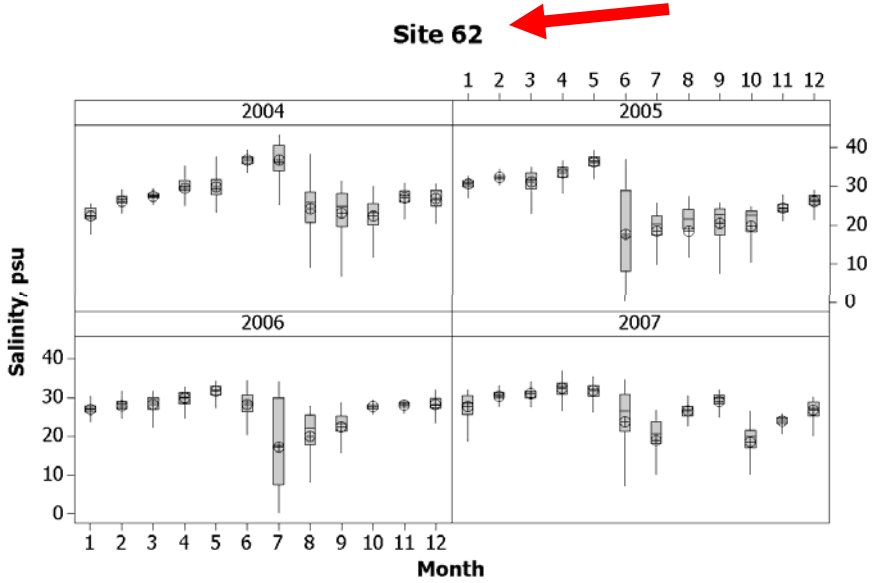

2004
2005
2006
2007
Salinity, psu
Month
0
10
20
30
40
1
2
3
4
5
6
7
8
9
10
11
12



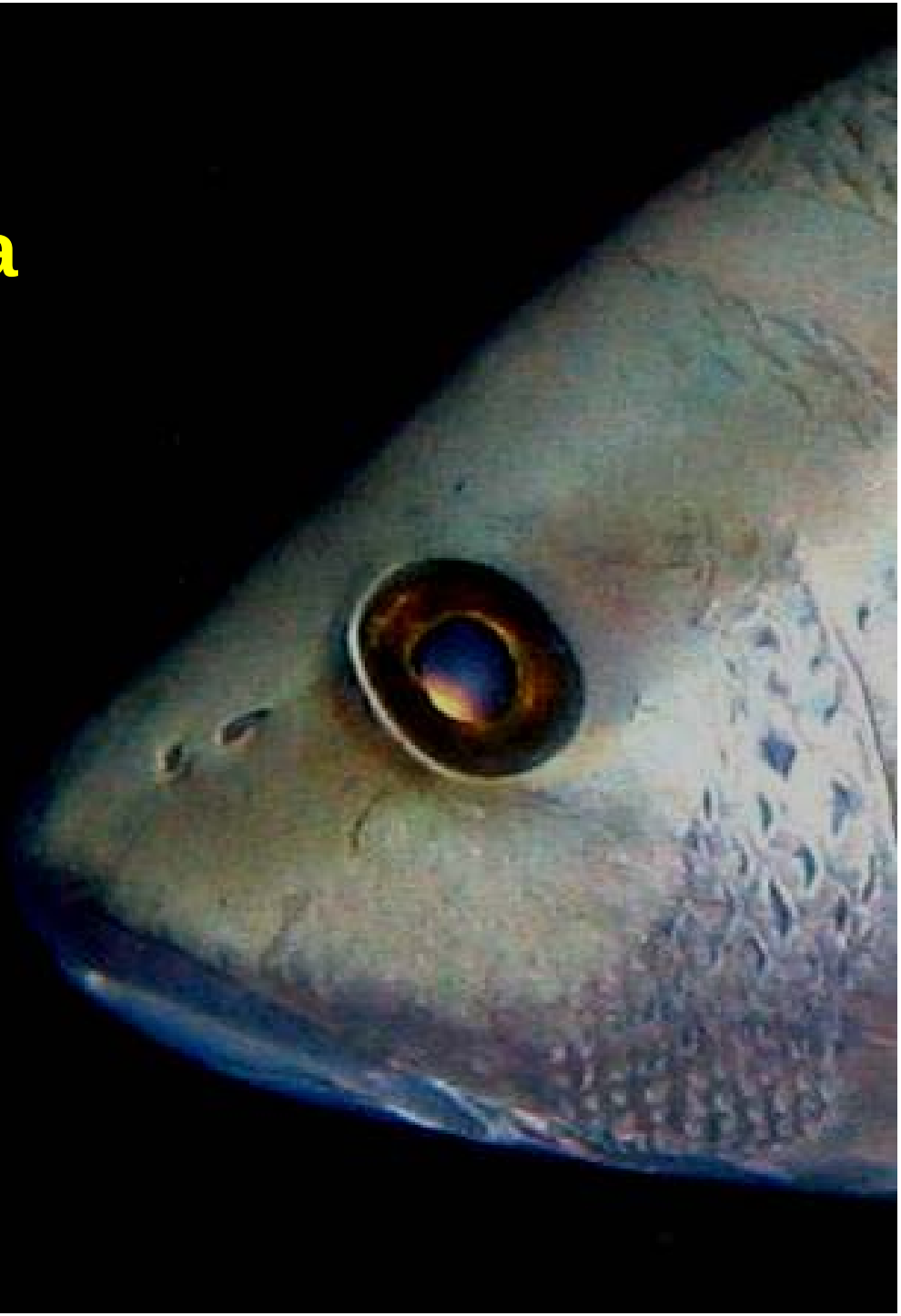


Salinity at 4 Nearshore sites, by year, by month

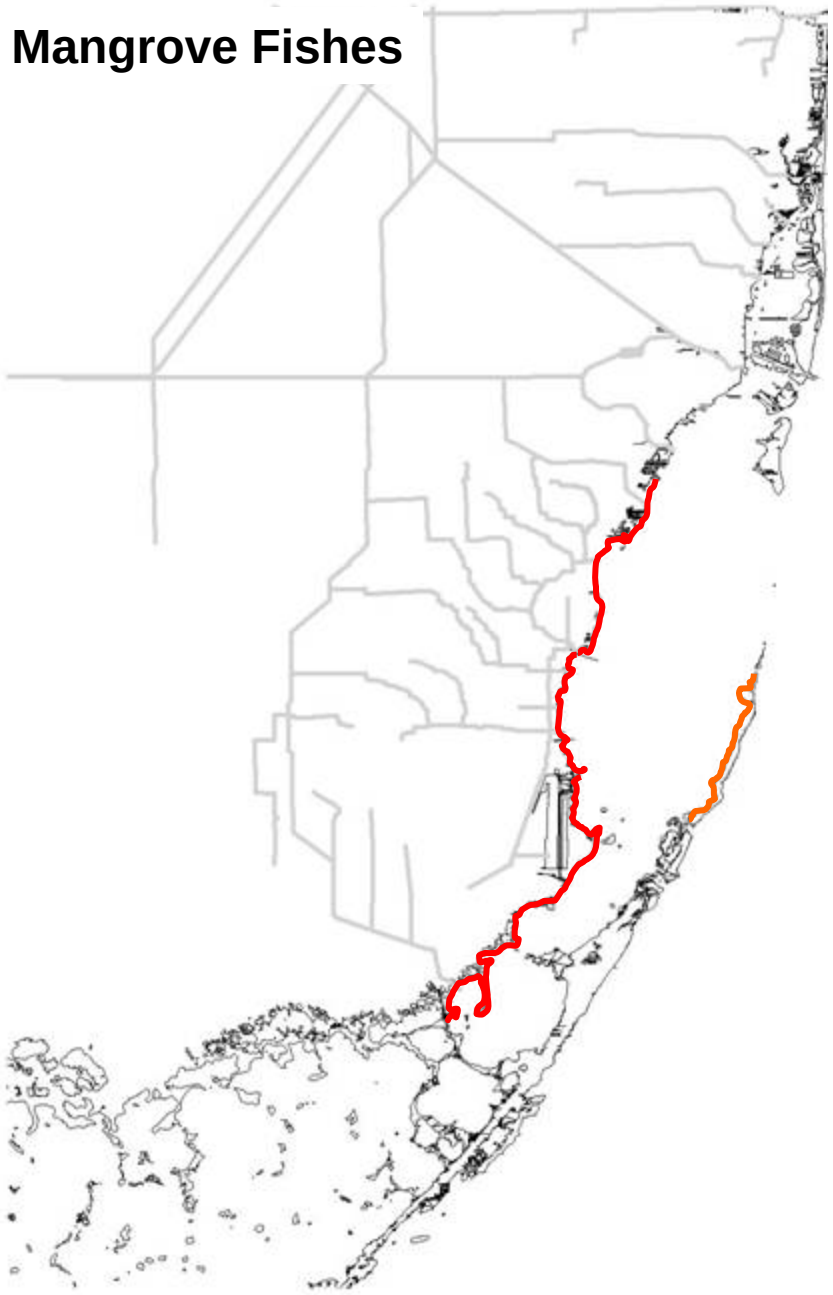


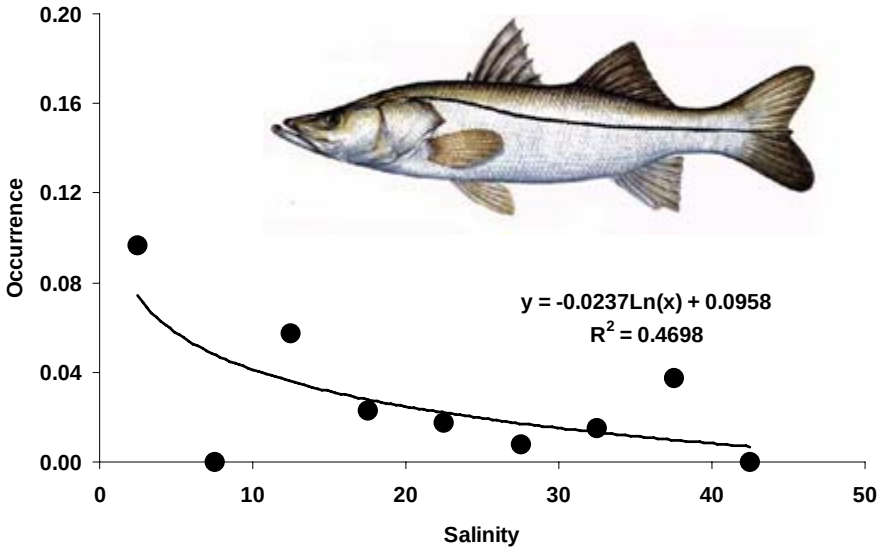


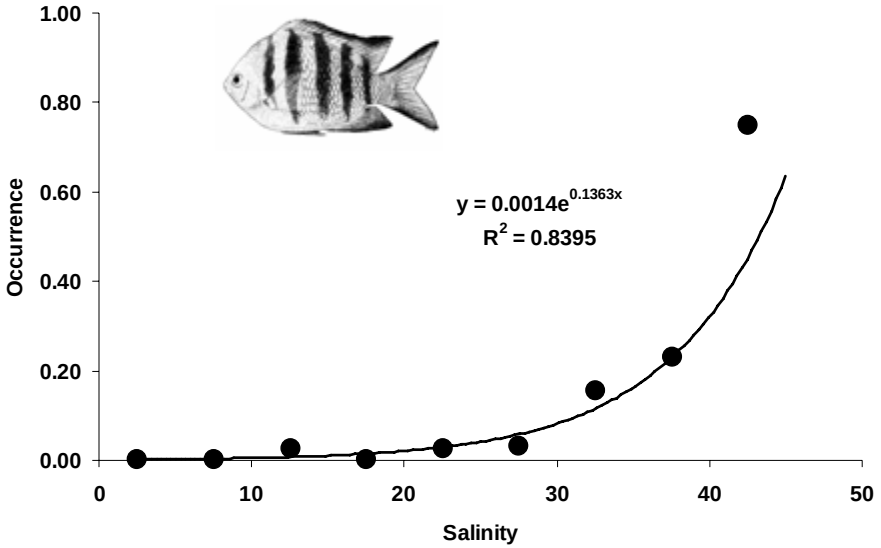
Linking Salinity Data to Ecological Response



Mangrove Fishes

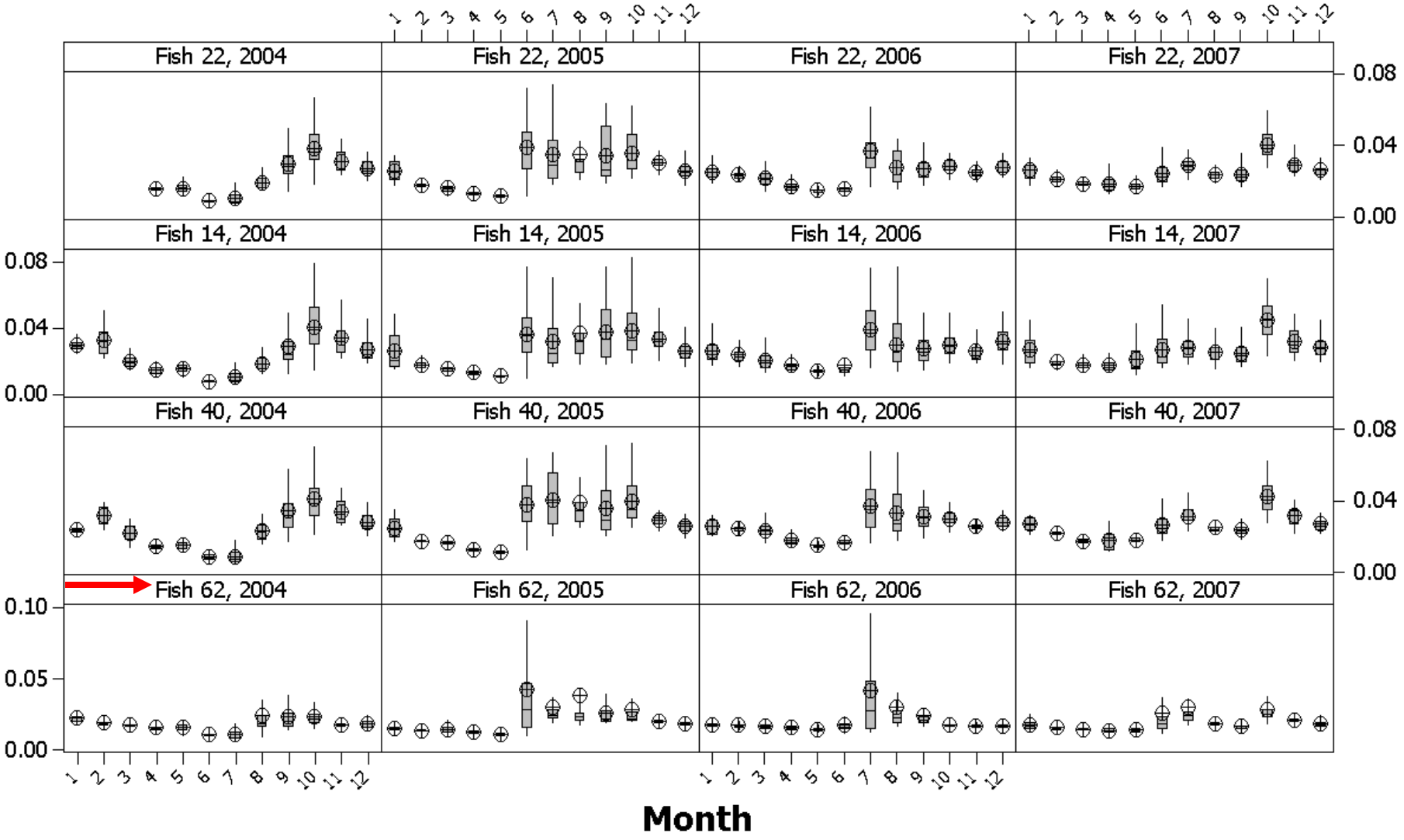


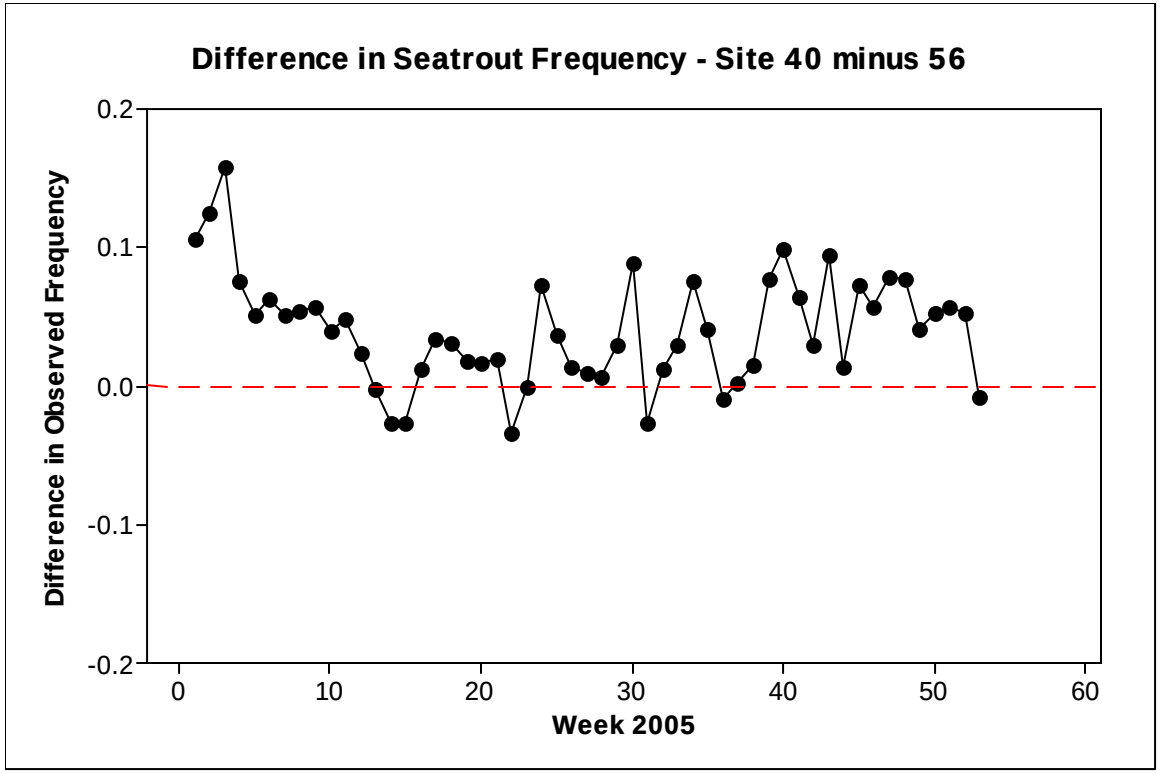


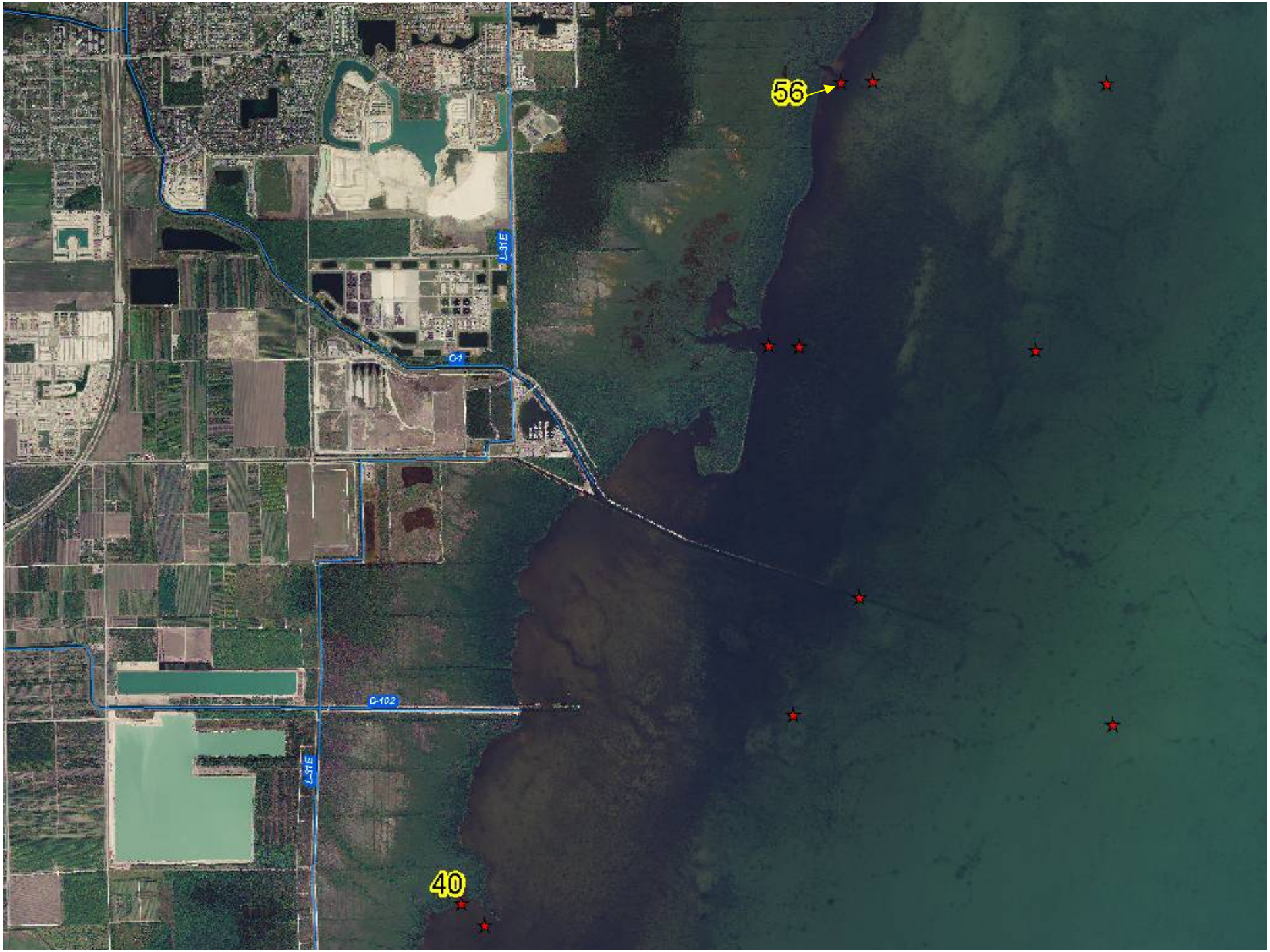


Courtesy J.Serafy 2008

Juvenile Seatrout Occurence as function of Salinity




Difference in Seatrout Frequency - Site 40 minus 56
Difference in Observed Frequency
0.2
0.1
0.0
-0.1
-0.2
0
10
20
30
40
50
60
Week 2005


56
L-31E
C-1
C-102
L-31E
40

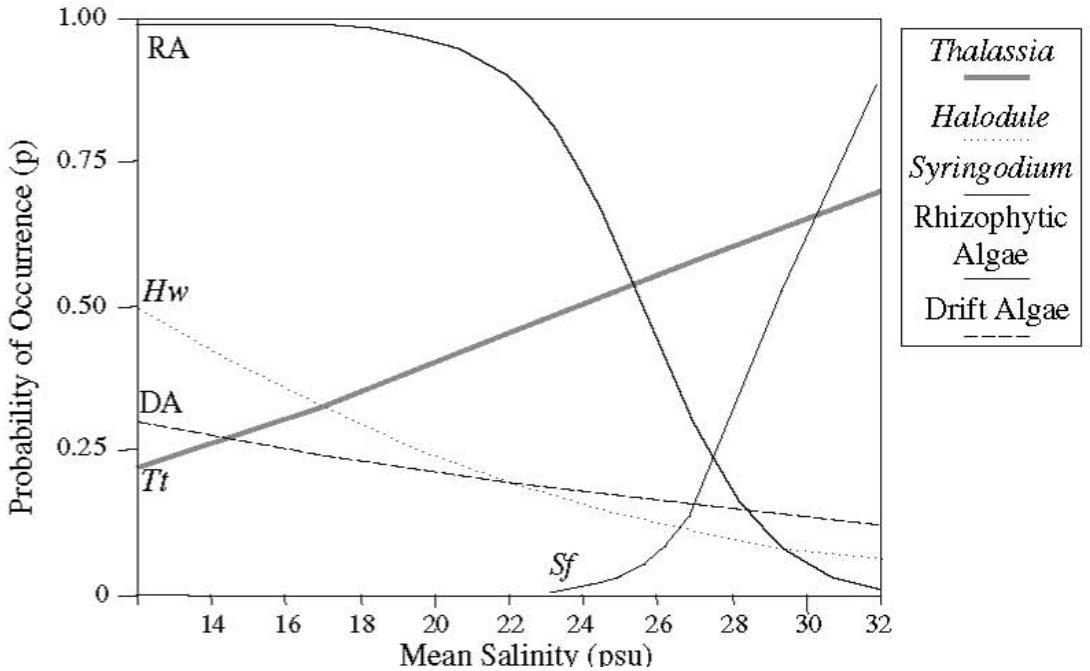


Fig. 6 Probability of occurrence of SAV taxa in relation to mean salinity during the wet season fitted with logistic regression. The low abundance of *Ruppia* precluded this species from being included in this analysis

Salinity – SAV relationships also being developed

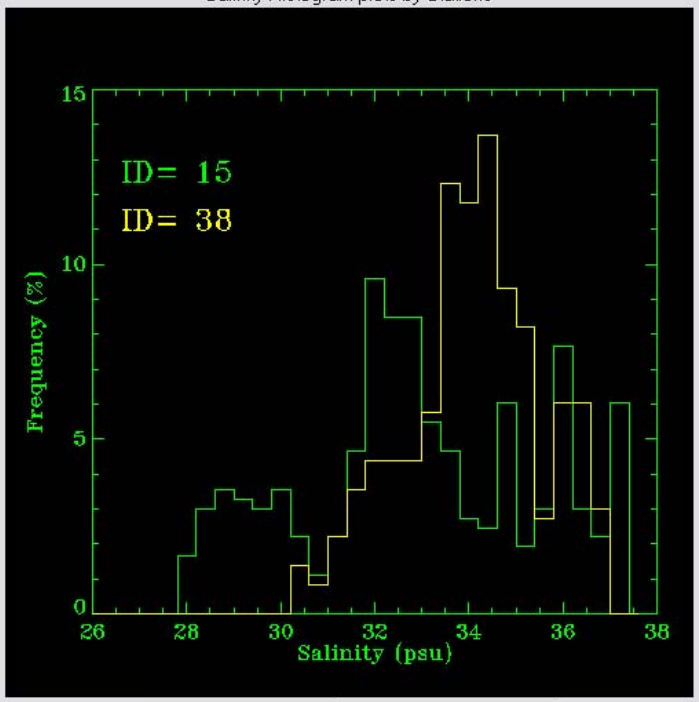
Sample Station Salinity Statistics from Model

File

Station Salinity Statistics from Biscayne Bay Hydrodynamic Model output

Site	ID	N	Days	Mean	stdev	MinS	MaxS	Median	Mode	Skewnes	Kurtosis	Absdev	-%<10	%>36
0	365.00	365.00	34.2653	1.0700	31.5495	36.7053	34.4574	34.5000	-0.3916	-0.1131	0.8406	0.0000	3.5616
1	365.00	365.00	34.3137	1.1607	31.0243	36.7550	34.5328	34.5000	-0.5704	0.3041	0.8972	0.0000	6.5753
2	365.00	365.00	34.3889	1.2100	31.1282	36.7954	34.5896	34.5000	-0.5218	0.1671	0.9257	0.0000	11.5068
3	365.00	365.00	34.3249	1.3117	30.7613	36.8260	34.5703	34.5000	-0.5454	0.1616	1.0028	0.0000	12.0548
4	365.00	365.00	33.8651	1.8106	28.6886	36.8656	34.1246	34.5000	-0.6981	0.0864	1.4135	0.0000	12.0548
5	365.00	365.00	34.0901	1.8012	27.4330	37.1149	34.3233	34.5000	-1.1315	1.9259	1.3127	0.0000	12.8767
6	365.00	365.00	33.6932	2.4799	22.8863	37.1678	34.1632	34.5000	-1.8779	5.0129	1.6942	0.0000	13.6986
7	365.00	365.00	33.4235	2.3888	26.1284	37.2978	33.5947	33.5000	-0.7941	0.5335	1.8304	0.0000	14.5205
8	365.00	365.00	31.6969	3.5971	22.2563	37.3089	31.8443	31.5000	-0.5255	-0.3817	2.9453	0.0000	12.8767
9	365.00	365.00	23.9439	9.2523	5.2737	37.4244	25.6834	31.5000	-0.3990	-1.1684	8.0224	10.1370	3.5616
10	365.00	365.00	27.2645	6.6443	7.2634	37.4349	27.7452	35.5000	-0.4981	-0.4062	5.5851	1.6438	5.2055
11	365.00	365.00	28.4901	5.9200	7.8914	37.4200	28.6821	35.5000	-0.6409	0.3564	4.8210	1.0959	8.2192
12	365.00	365.00	26.9727	6.5157	5.6044	37.4195	26.9195	35.5000	-0.3970	-0.1108	5.2456	1.0959	7.3973
13	365.00	365.00	31.4365	3.5853	21.6434	37.3613	31.1210	30.5000	-0.2122	-0.5819	2.9409	0.0000	12.8767
14	365.00	365.00	32.4889	2.8775	25.8401	37.4472	32.2889	31.5000	-0.1155	-0.7946	2.3605	0.0000	15.8904
15	365.00	365.00	33.1373	2.5090	28.1183	37.5426	32.9849	32.5000	-0.0788	-0.8489	2.0376	0.0000	18.9041
16	365.00	365.00	33.4229	2.3790	28.6816	37.5996	33.3003	33.5000	-0.0791	-0.8541	1.9220	0.0000	19.7260
17	365.00	365.00	33.6064	2.2862	28.9783	37.6282	33.5290	33.5000	-0.0836	-0.8462	1.8418	0.0000	20.0000
18	365.00	365.00	34.0667	2.0085	29.5714	37.4285	34.0627	33.5000	-0.2295	-0.7534	1.6249	0.0000	20.5479
19	365.00	365.00	33.9856	2.1747	28.8745	37.5131	33.9817	33.5000	-0.2752	-0.7580	1.7802	0.0000	22.7397
20	365.00	365.00	33.7599	2.5664	27.8312	37.8413	33.7272	33.5000	-0.3320	-0.7653	2.1349	0.0000	24.3836
21	365.00	365.00	32.9561	3.8105	23.4615	38.5419	32.8430	37.5000	-0.3947	-0.7419	3.2247	0.0000	29.5890
22	365.00	365.00	32.7595	4.1424	23.0598	38.6953	32.4915	38.5000	-0.2653	-0.9789	3.5694	0.0000	29.8630
23	365.00	365.00	32.7516	4.2181	23.9836	38.9206	32.4692	38.5000	-0.1727	-1.1248	3.6656	0.0000	30.1370
24	365.00	365.00	32.0676	5.4541	10.0741	39.4631	32.0543	39.5000	-0.8240	1.1525	4.4346	0.0000	29.8630
25	365.00	365.00	32.6968	4.3124	24.0538	39.0448	32.3888	38.5000	-0.1376	-1.1747	3.7609	0.0000	30.4110
26	365.00	365.00	32.7386	4.2710	24.0389	39.0158	32.4477	38.5000	-0.1501	-1.1546	3.7210	0.0000	30.4110
27	365.00	365.00	32.7679	4.2272	24.0468	38.9575	32.4965	38.5000	-0.1665	-1.1336	3.6770	0.0000	30.4110
28	365.00	365.00	32.7925	4.1972	24.0184	38.9253	32.5302	38.5000	-0.1790	-1.1183	3.6471	0.0000	30.4110
29	365.00	365.00	32.8169	4.1524	23.9600	38.8672	32.5654	38.5000	-0.1960	-1.0957	3.6027	0.0000	30.4110
30	365.00	365.00	32.8291	4.1166	23.9314	38.8102	32.5762	38.5000	-0.2072	-1.0791	3.5672	0.0000	30.4110
31	365.00	365.00	33.4114	3.1263	26.1504	38.1700	33.3812	37.5000	-0.3608	-0.7848	2.6343	0.0000	27.3973
32	365.00	365.00	33.7081	2.6439	27.2724	37.7940	33.6870	33.5000	-0.3284	-0.7845	2.2076	0.0000	24.3836
33	365.00	365.00	33.8789	2.3638	28.2315	37.6146	33.8526	33.5000	-0.3022	-0.7719	1.9553	0.0000	23.2877
34	365.00	365.00	34.3926	1.5921	30.2961	37.3663	34.4859	34.5000	-0.2523	-0.4413	1.2556	0.0000	18.0822
35	365.00	365.00	34.2005	1.6059	30.8592	37.2425	34.2772	34.5000	-0.0558	-0.7025	1.2639	0.0000	16.7123
36	365.00	365.00	33.9160	1.7975	30.0722	37.2611	33.9486	33.5000	-0.1314	-0.6581	1.4162	0.0000	16.1644
37	365.00	365.00	34.1380	1.5758	30.4915	37.1234	34.2434	34.5000	-0.1769	-0.5126	1.2387	0.0000	15.3425
38	365.00	365.00	34.2978	1.4457	30.6714	37.0676	34.3740	34.5000	-0.2276	-0.3545	1.1347	0.0000	15.0685
39	365.00	365.00	35.0375	0.8687	32.8930	36.8171	35.0466	35.5000	-0.1170	-0.4247	0.6896	0.0000	14.5205

Salinity Histogram plots by Stations



Overlay plot

Select 1st plot: 15

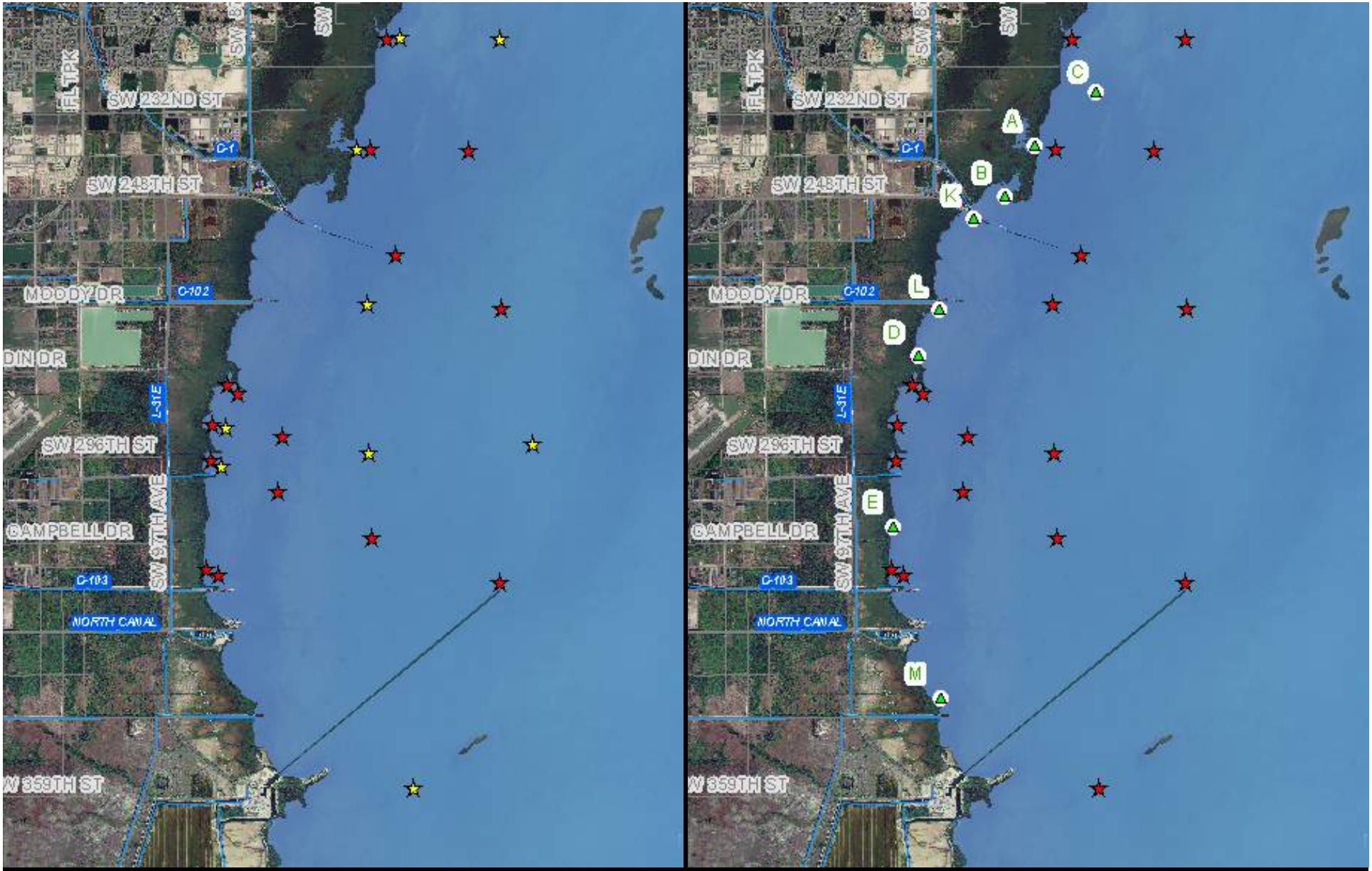
Select 2nd plot: 38

Customizing Histogram

Select min salinity: 26

Select max salinity: 38

Select histogram bin: 0.500000



Optimized network

Biscayne Bay:
Nearshore Continuous Salinity Monitoring

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Sarah Bellmund, Biscayne National Park