Initial Monitoring Results of Ecosystem Response to the C-111 Spreader Canal Western Phase in Northeastern Florida Bay

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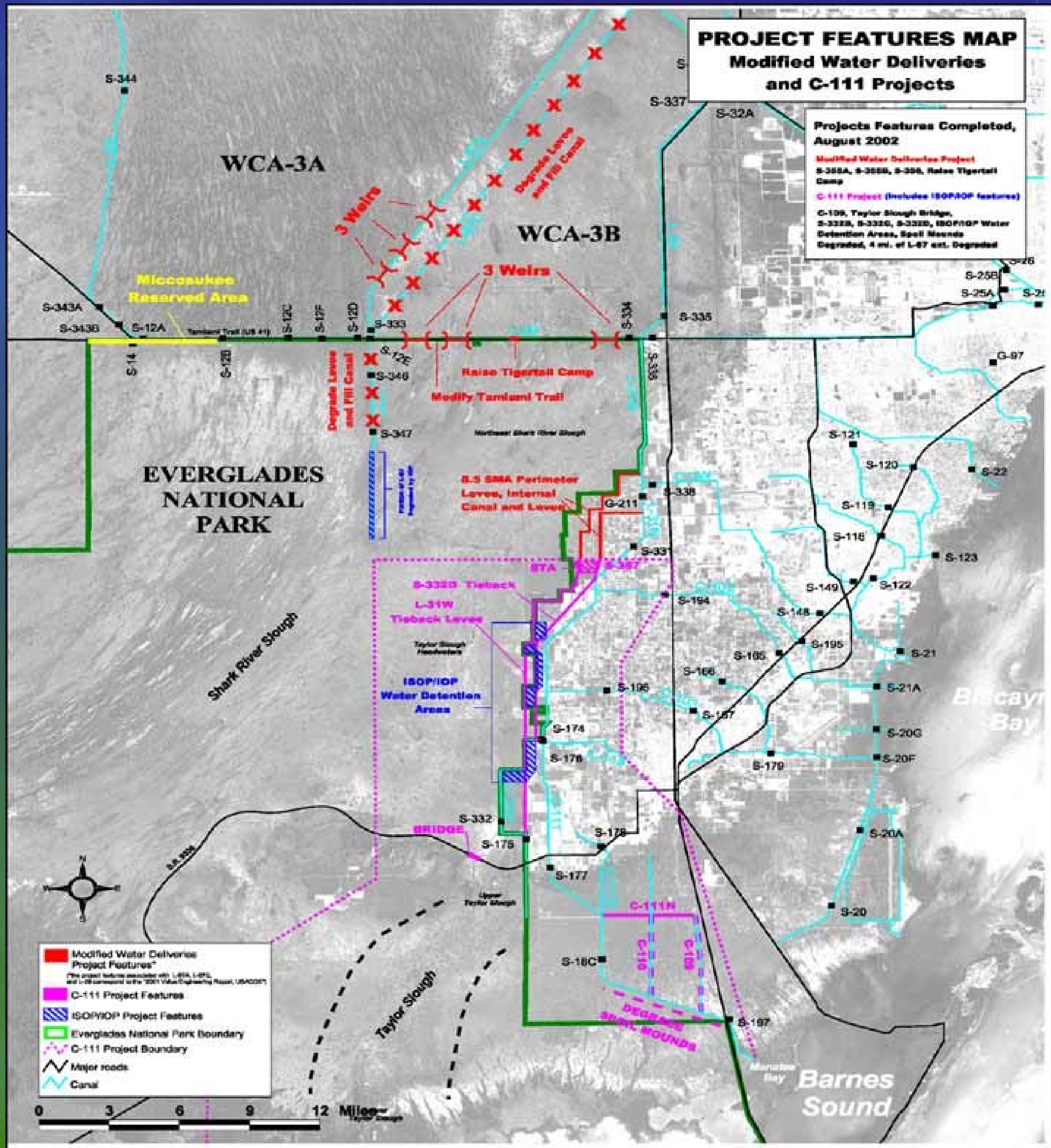
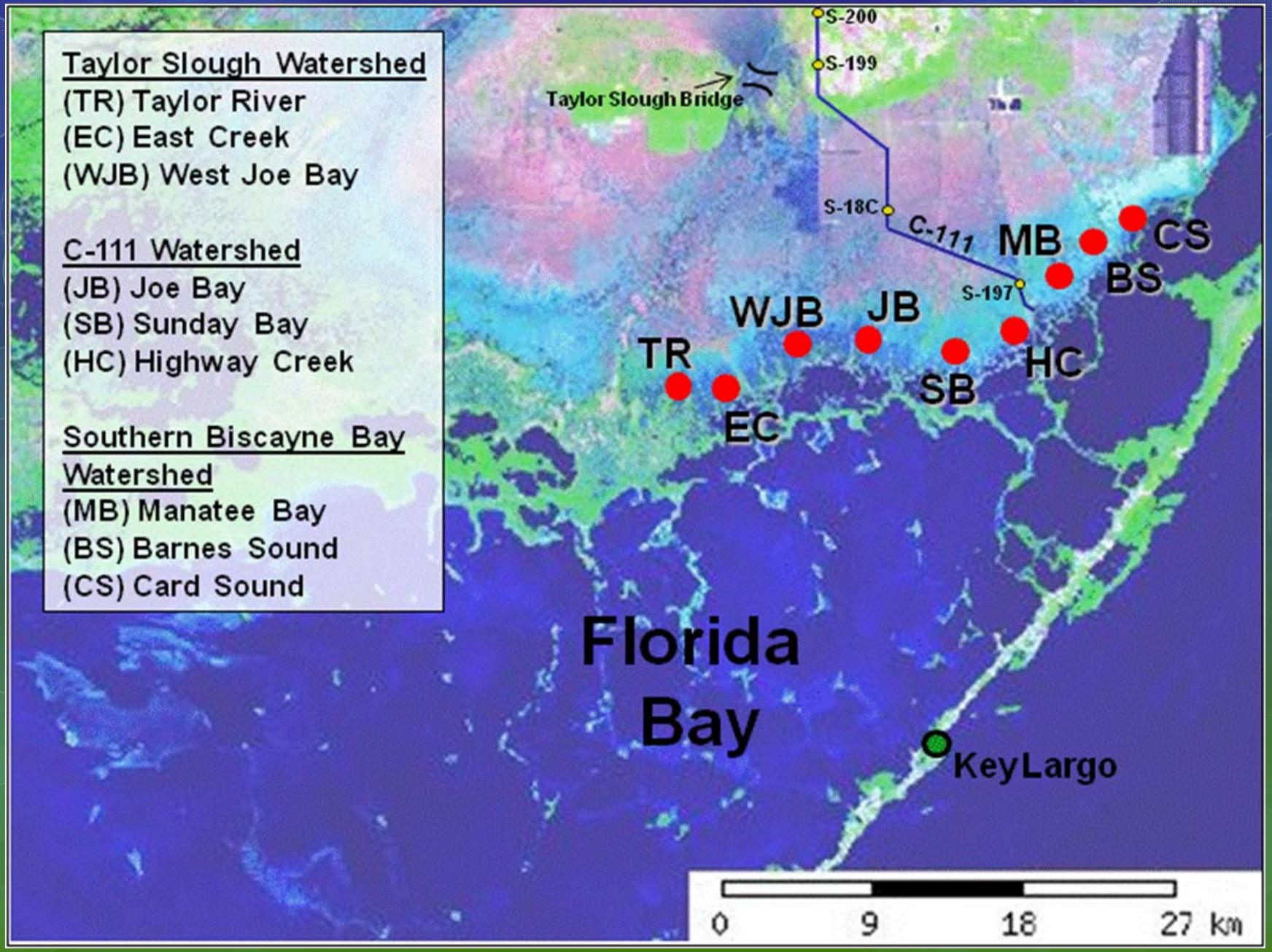
Audubon FLORIDA


PROJECT FEATURES MAP
Modified Water Deliveries
and C-111 Projects
Projects Features Completed,
August 2002
C-111 Project (Includes ISOP/IOP features)
WCA-3A
WCA-3B
3 Weirs
Degrade Levee and Fill Canal
Miccosukee Reserved Area
Raise Tigertail Camp
Modify Tamiami Trail
Degrade Levee and Fill Canal
EVERGLADES NATIONAL PARK
8.5 SMA Perimeter Levee, Internal Canal and Levee
STA
S-332D Tieback
L-31W Tieback Levee
ISOP/IOP Water Detention Areas
Shark River Slough
BRIDGE
C-111N
DEGRADE SPOIL MOUNDS
Taylor Slough
Biscayne Bay
Barnes Sound
S-344
S-343A
S-343B
S-12A
S-14
S-12B
S-12C
S-12F
S-12D
S-333
S-12E
S-346
S-347
S-334
S-335
S-336
S-337
S-32A
S-338
G-211
S-331
S-194
S-196
S-174
S-176
S-332
S-175
S-178
S-177
S-18C
S-197
S-121
S-120
S-22
S-119
S-118
S-123
S-149
S-122
S-148
S-195
S-165
S-21
S-166
S-21A
S-167
S-20G
S-179
S-20F
S-20A
S-20
S-25B
S-25A
G-97
Modified Water Deliveries Project Features*
C-111 Project Features
ISOP/IOP Project Features
Everglades National Park Boundary
C-111 Project Boundary
Major roads
Canal
0
3
6
9
12 Miles

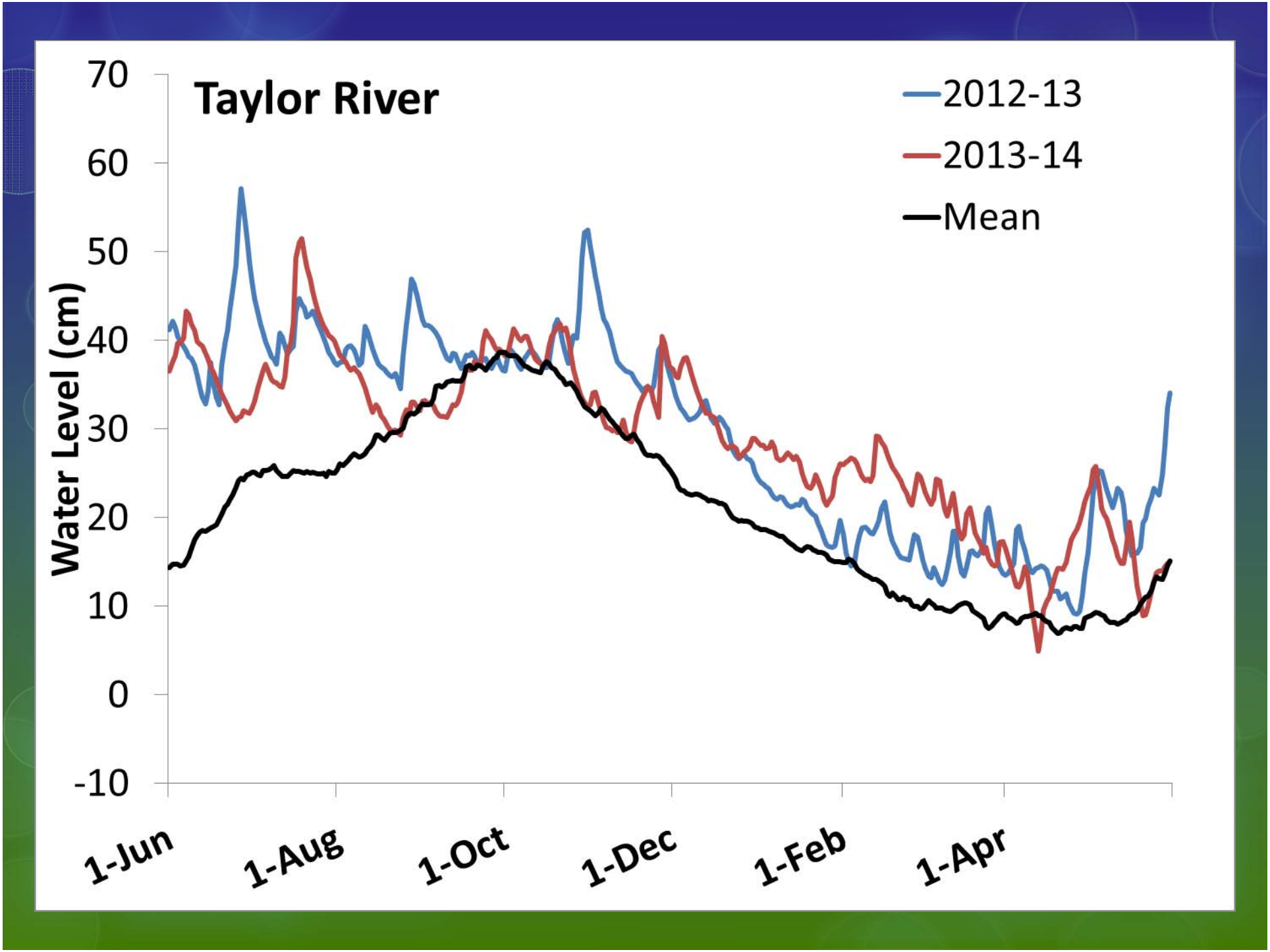
Goals of the C-111SCWP

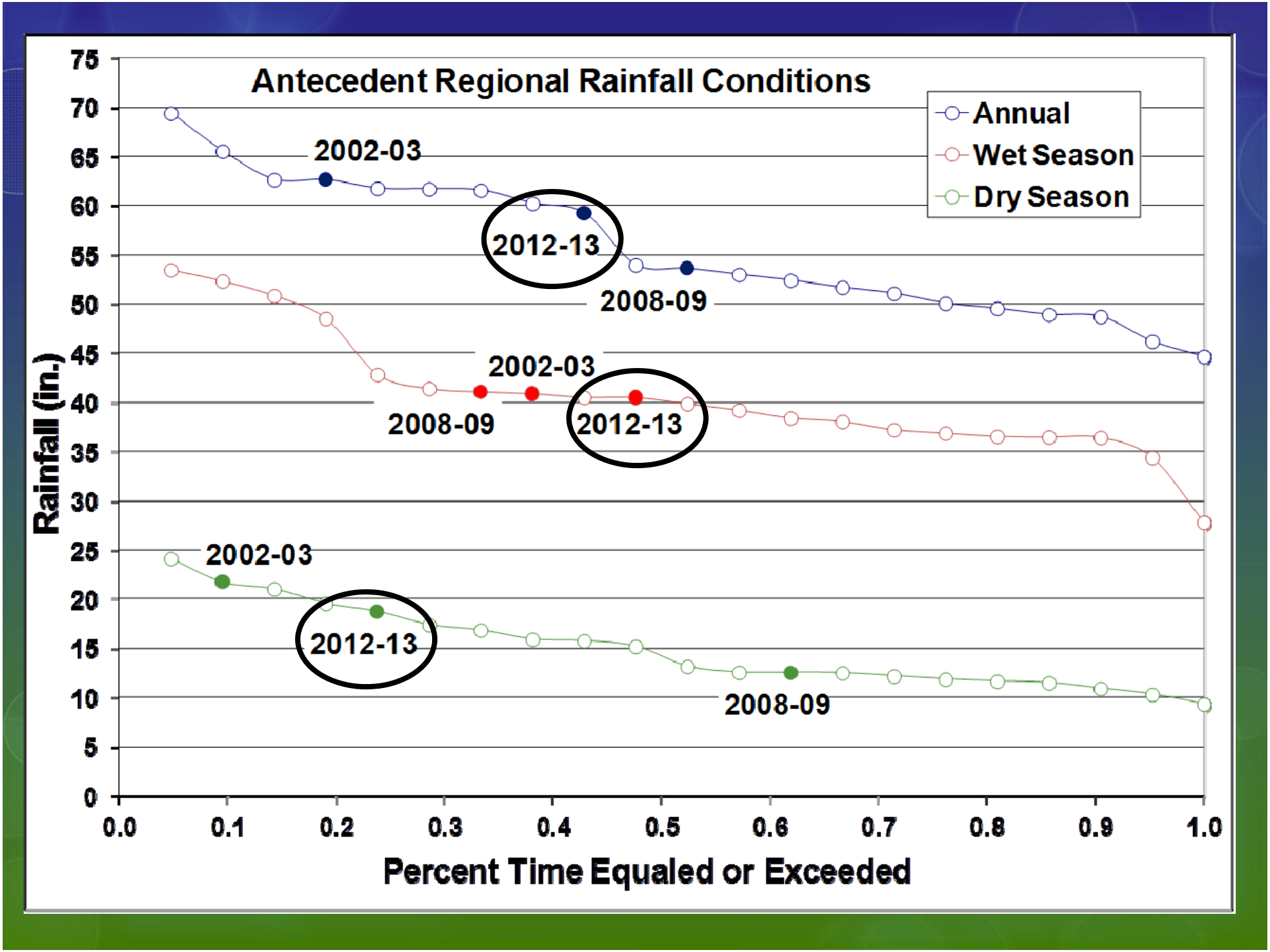
1. Increase the hydroperiod
2. Increase freshwater conditions
3. Increase abundance of SAV
4. Increase the abundance of freshwater fish

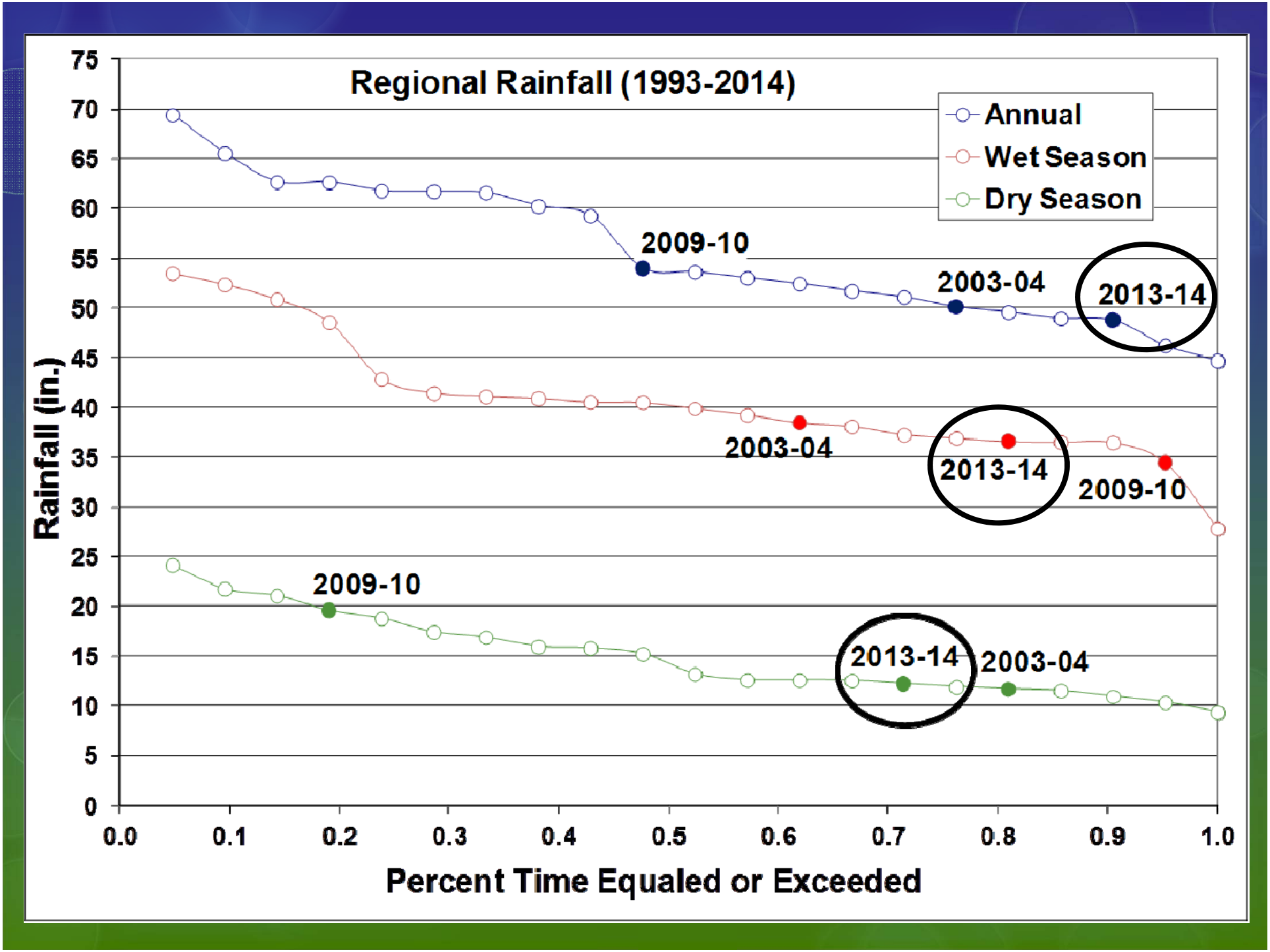

Taylor Slough Watershed
(TR) Taylor River
(EC) East Creek
(WJB) West Joe Bay
C-111 Watershed
(JB) Joe Bay
(SB) Sunday Bay
(HC) Highway Creek
Southern Biscayne Bay Watershed
(MB) Manatee Bay
(BS) Barnes Sound
(CS) Card Sound
S-200
S-199
Taylor Slough Bridge
S-18C
C-111
S-197
MB
CS
BS
WJB
JB
TR
EC
SB
HC
Florida Bay
KeyLargo
0
9
18
27 km

High water levels and high salinity at these sites can be caused by 3 things

1. Water Management Practices
2. High rainfall and the accompanying sheet flow
3. High water conditions in the marine environment

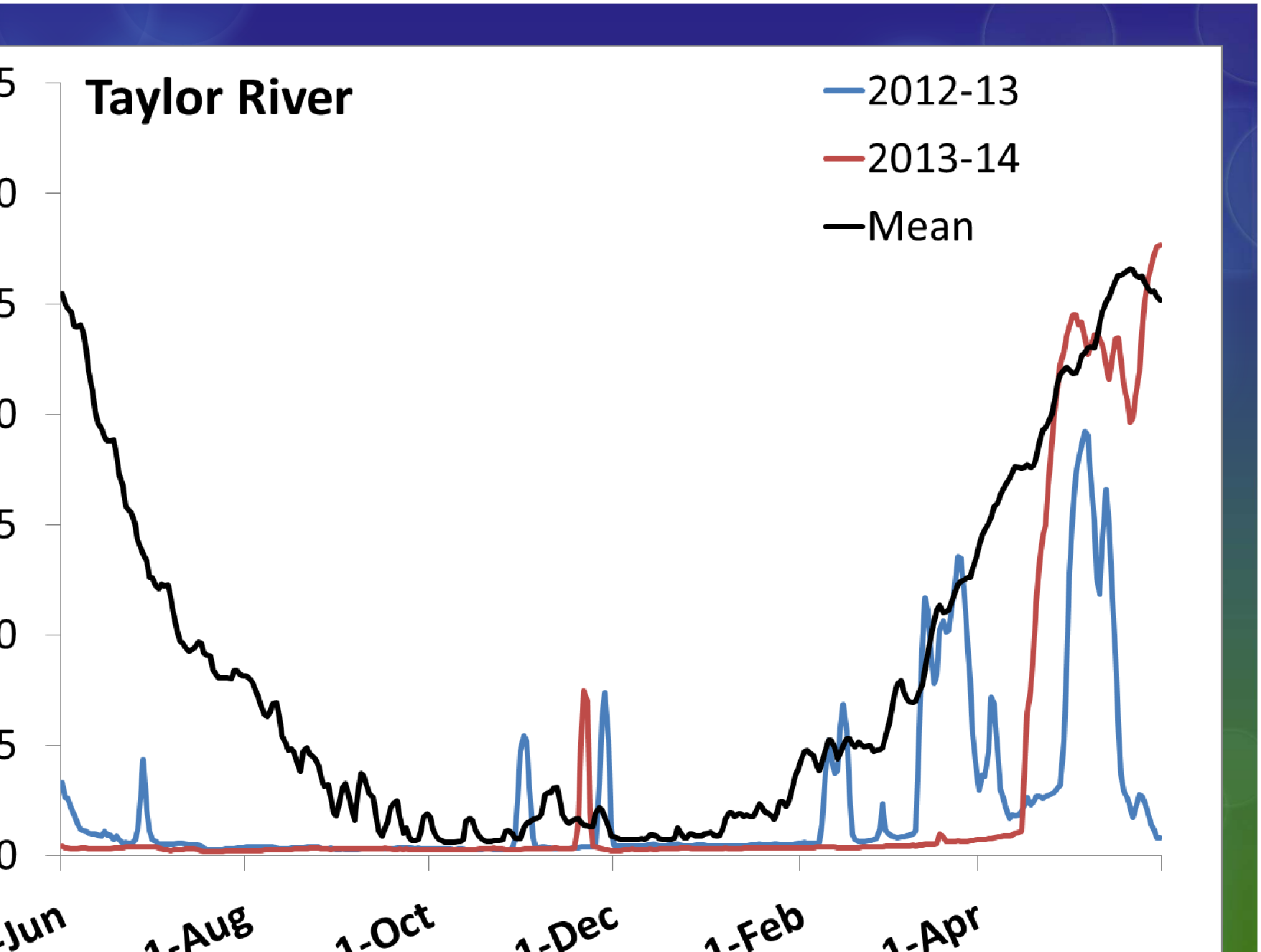

Taylor River
2012-13
2013-14
Mean
Water Level (cm)
70
60
50
40
30
20
10
0
-10
1-Jun
1-Aug
1-Oct
1-Dec
1-Feb
1-Apr


Antecedent Regional Rainfall Conditions
Annual
Wet Season
Dry Season
Rainfall (in.)
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
0
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
Percent Time Equaled or Exceeded
2002-03
2012-13
2008-09
2002-03
2008-09
2012-13
2002-03
2012-13
2008-09


Regional Rainfall (1993-2014)
Annual
Wet Season
Dry Season
Rainfall (in.)
Percent Time Equaled or Exceeded
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
0
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
2009-10
2003-04
2013-14
2003-04
2013-14
2009-10
2009-10
2013-14
2003-04

High water levels and high salinity at these sites can be caused by 3 things

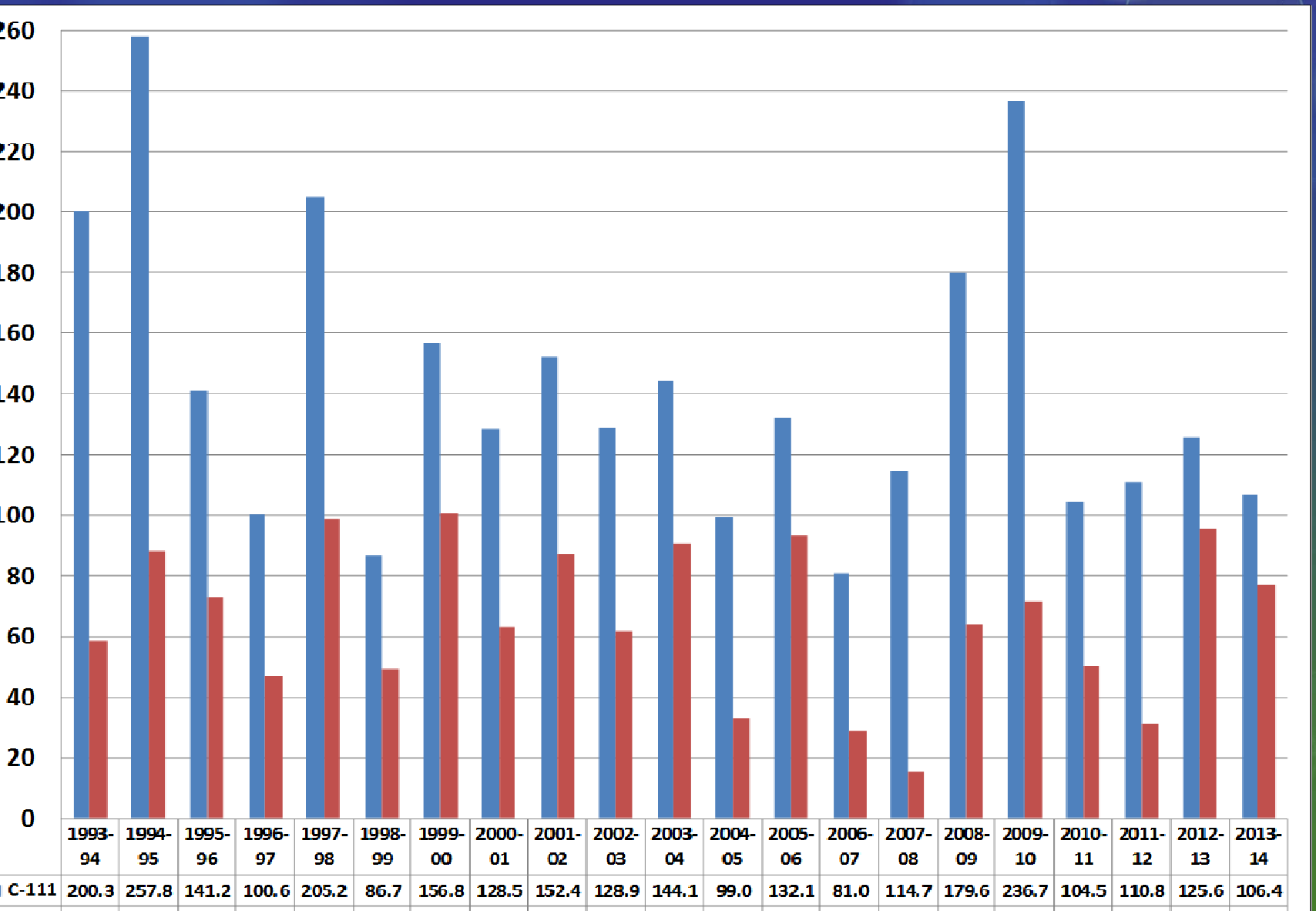
1. Water Management Practices
2. ~~High rainfall and accompanying sheet flow~~
3. High water conditions in the marine environment


Taylor River
2012-13
2013-14
Mean
1-Aug
1-Oct
1-Dec
1-Feb
1-Apr

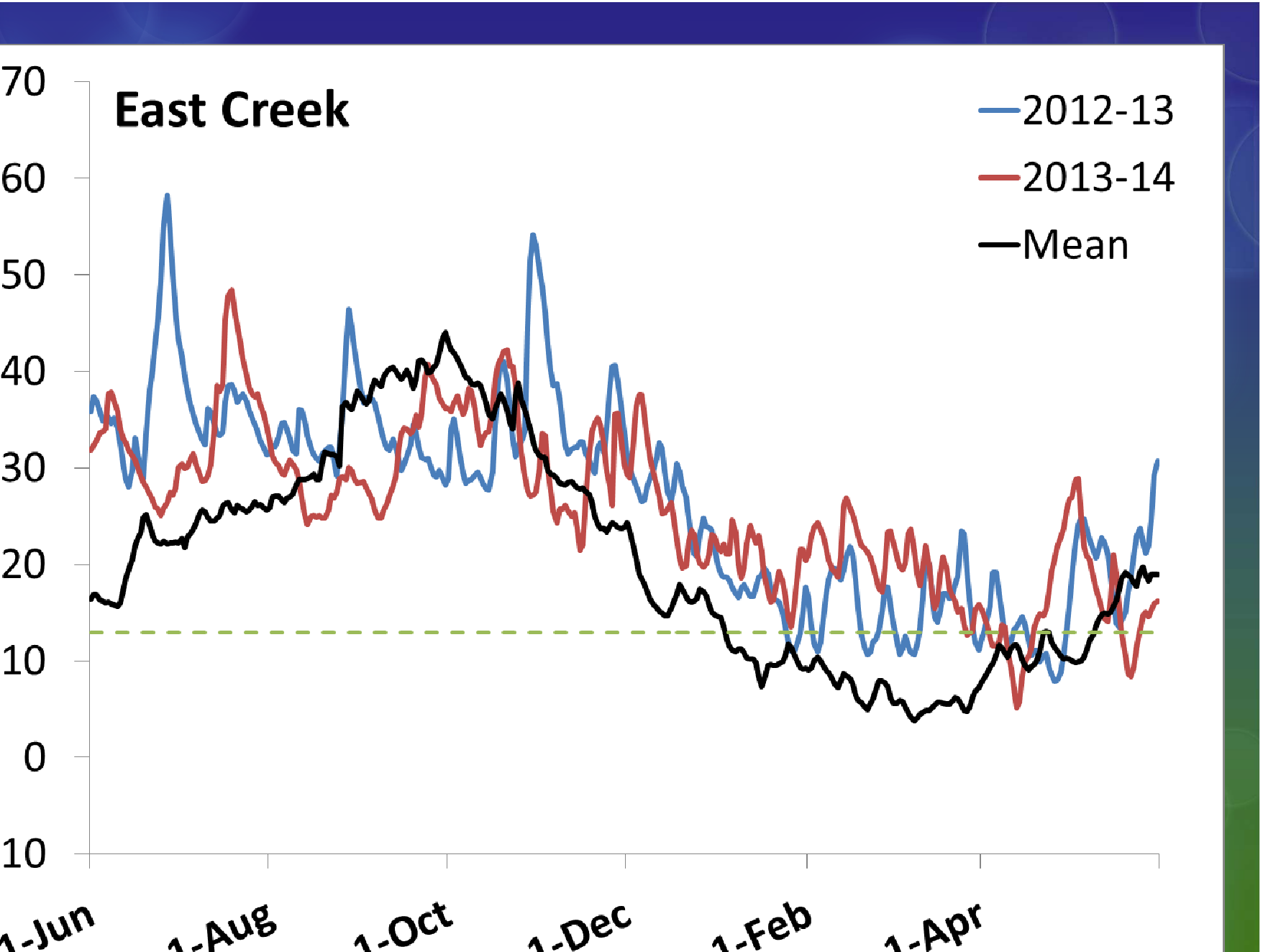
High water levels and high salinity at these sites can be caused by 3 things

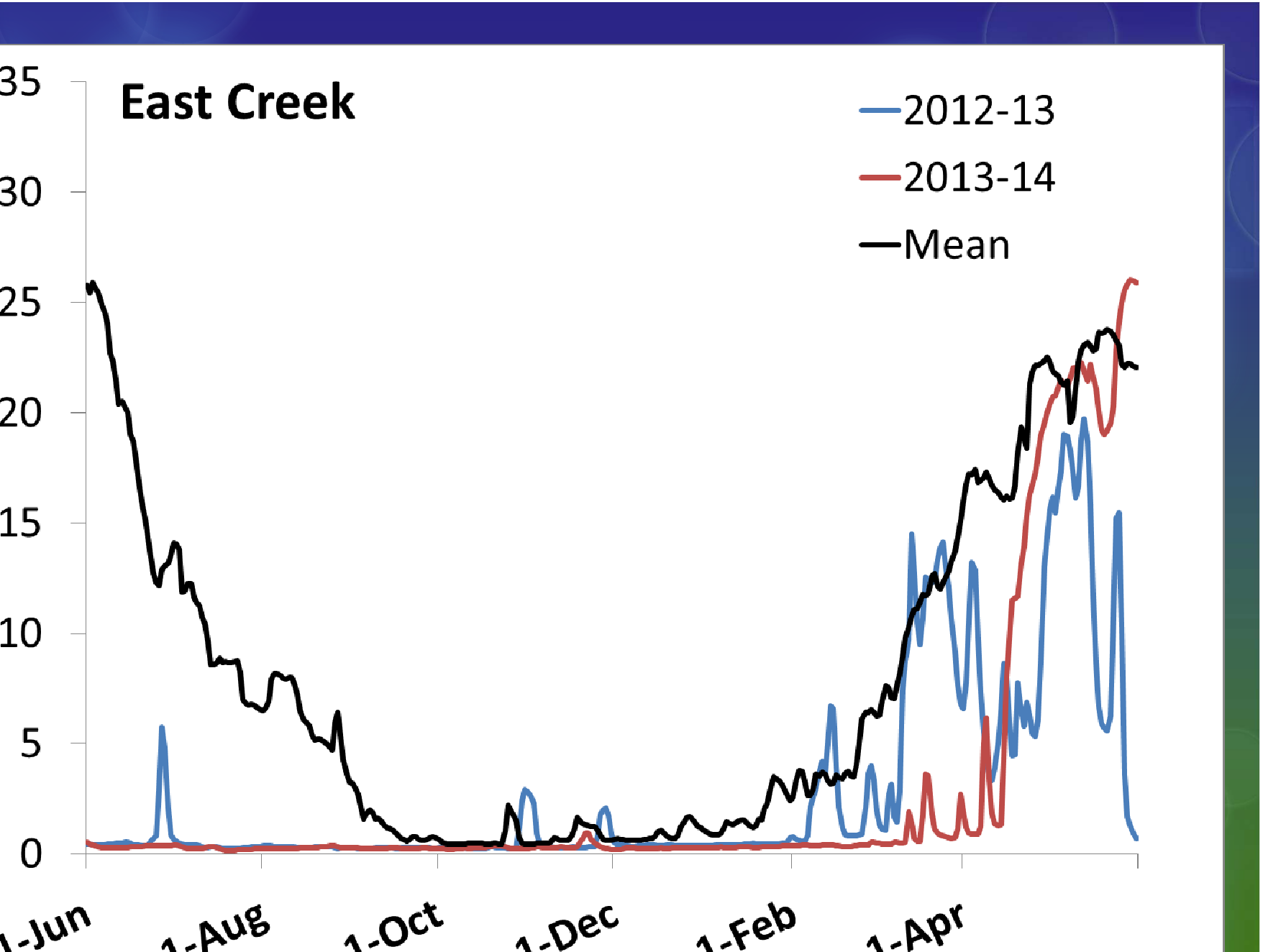
1. Water Management Practices
2. ~~High rainfall and accompanying sheet flow~~
3. ~~High water conditions in the marine environment~~

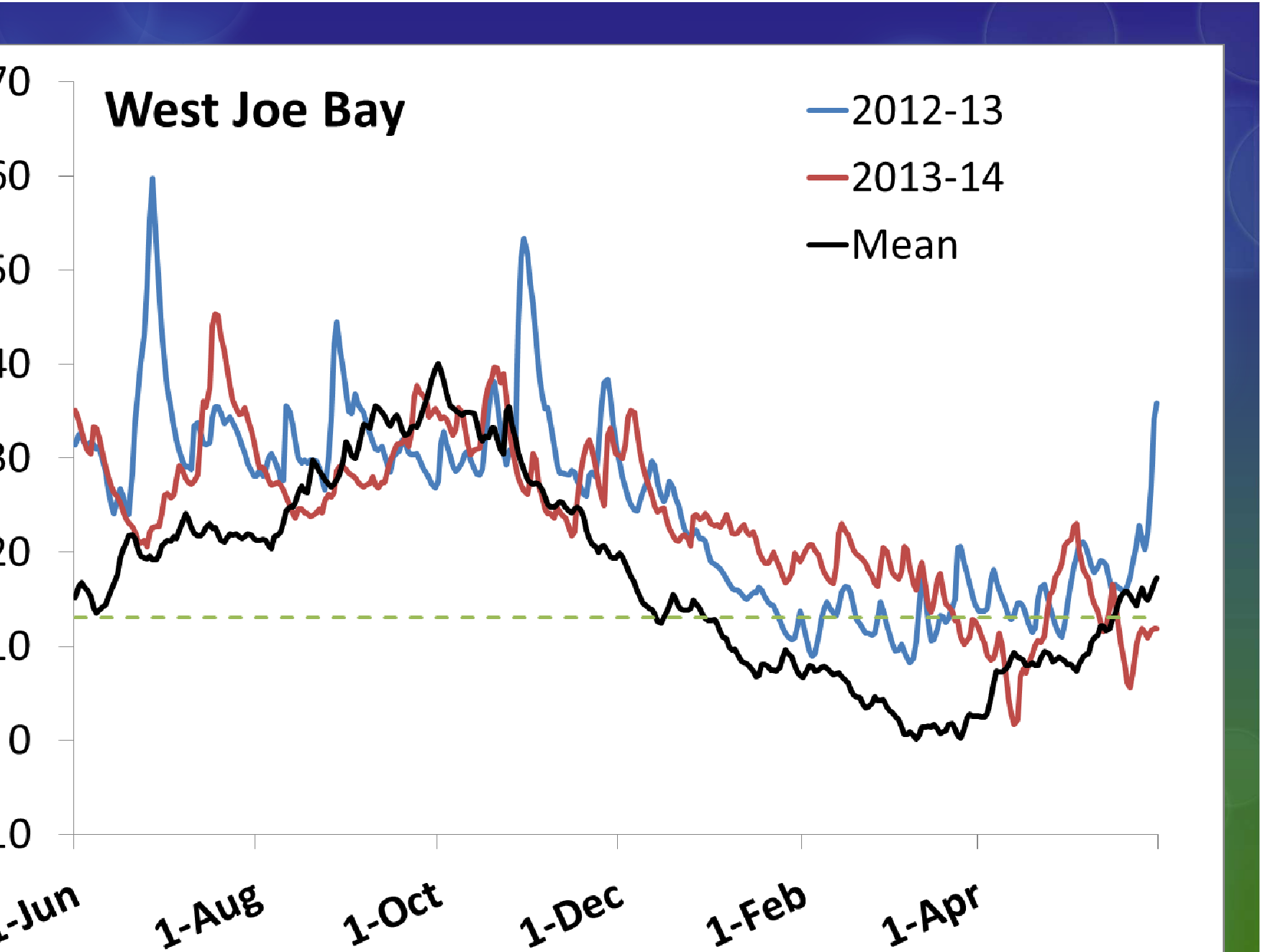
Annual Flow Rates For C-111 and TSB

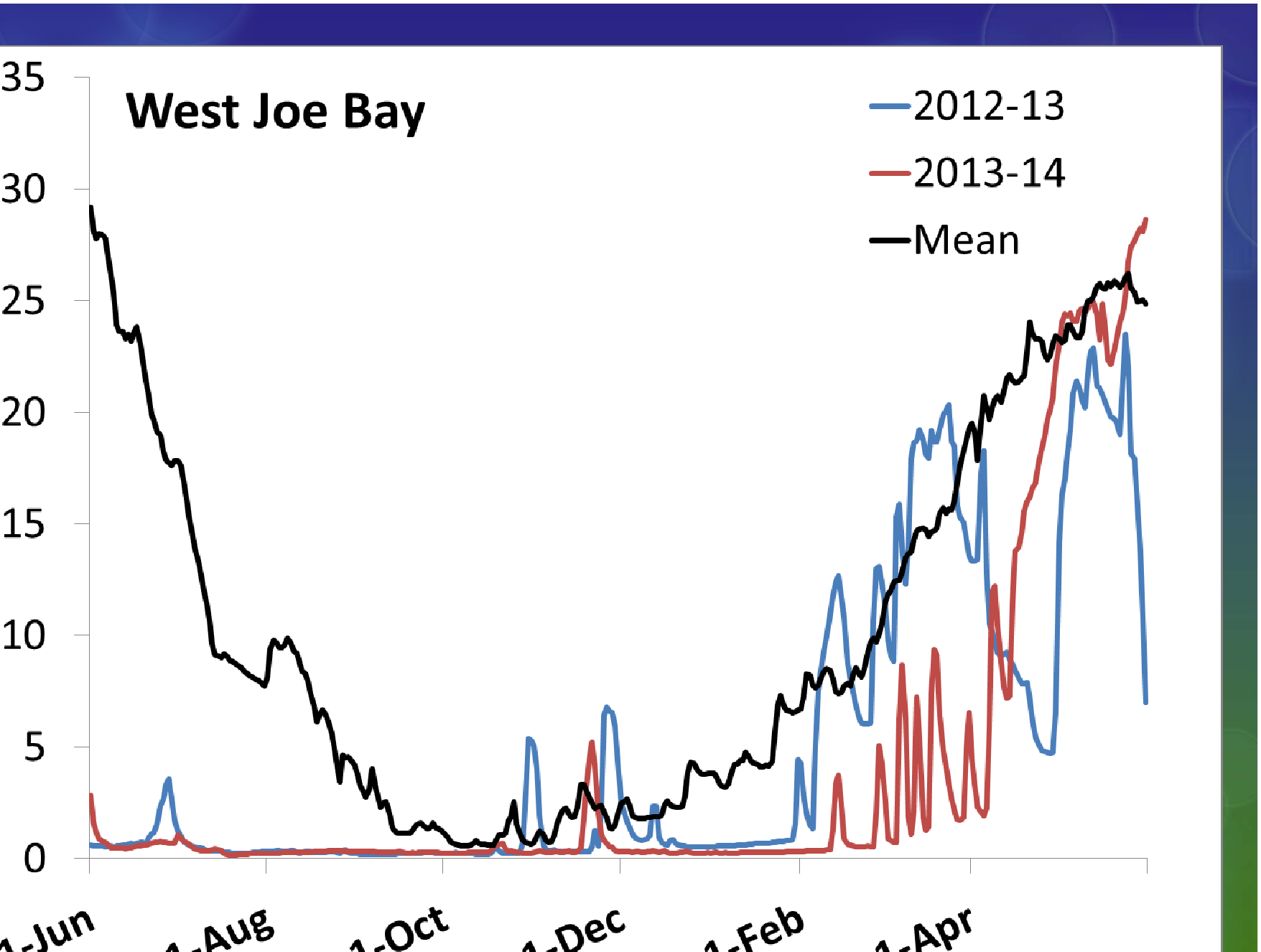


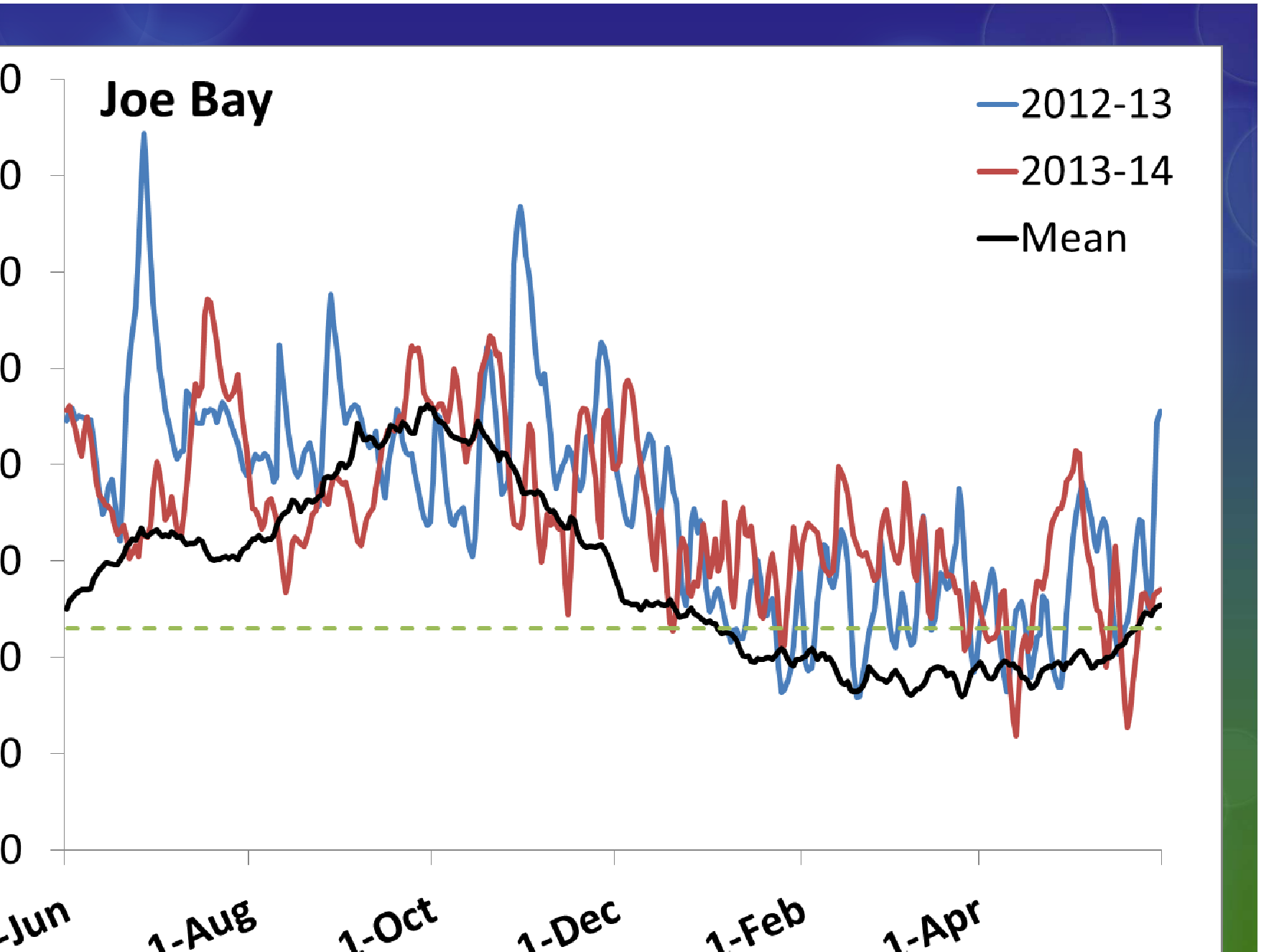
	1993-94	1994-95	1995-96	1996-97	1997-98	1998-99	1999-00	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14
C-111	200.3	257.8	141.2	100.6	205.2	86.7	156.8	128.5	152.4	128.9	144.1	99.0	132.1	81.0	114.7	179.6	236.7	104.5	110.8	125.6	106.4

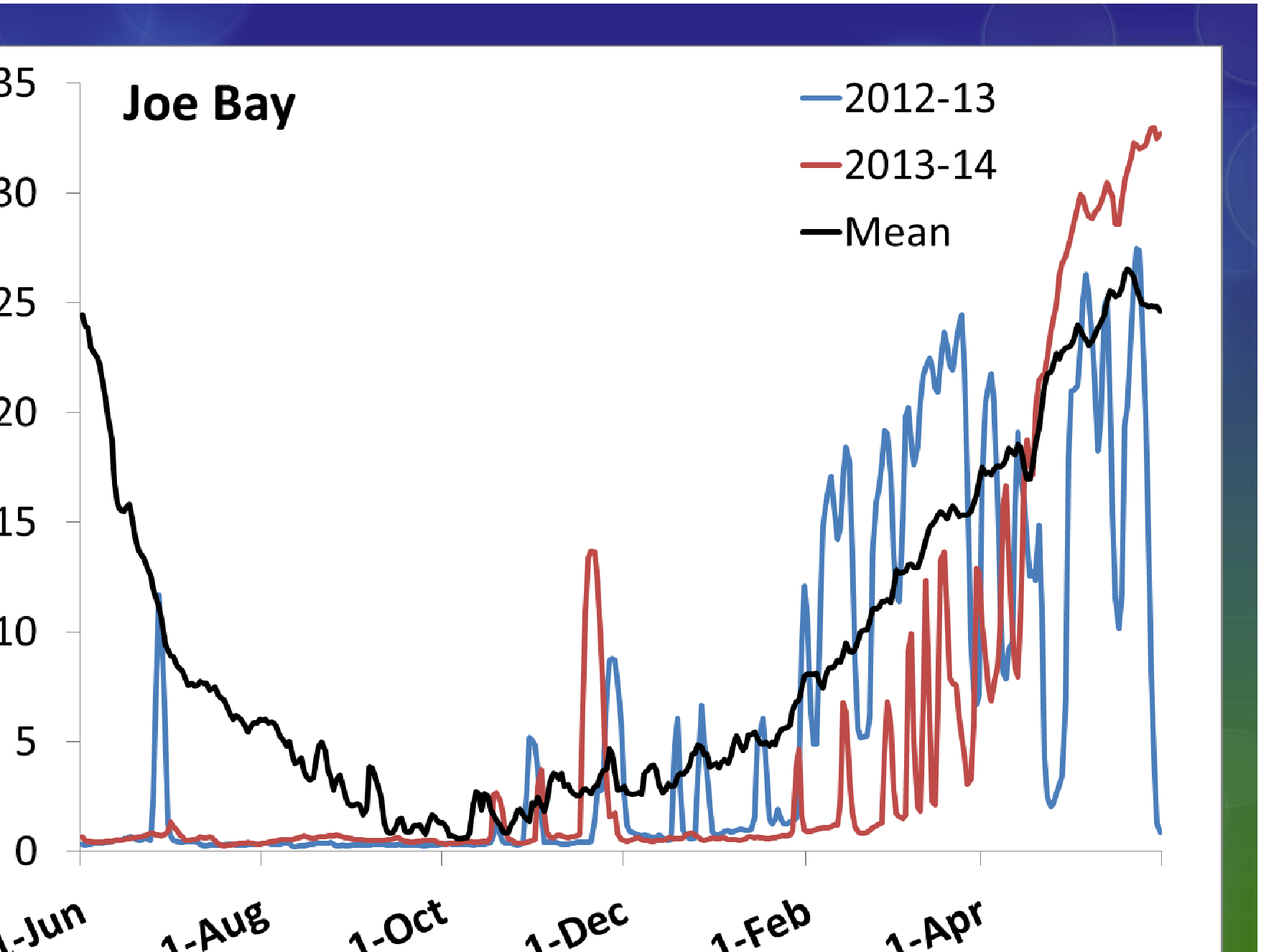

East Creek
2012-13
2013-14
Mean
70
60
50
40
30
20
10
0
10
1-Jun
1-Aug
1-Oct
1-Dec
1-Feb
1-Apr


East Creek
2012-13
2013-14
Mean
35
30
25
20
15
10
5
0
1-Jun
1-Aug
1-Oct
1-Dec
1-Feb
1-Apr


West Joe Bay
2012-13
2013-14
Mean
70
60
50
40
30
20
10
0
10
1-Jun
1-Aug
1-Oct
1-Dec
1-Feb
1-Apr


West Joe Bay
2012-13
2013-14
Mean
35
30
25
20
15
10
5
0
1-Jun
1-Aug
1-Oct
1-Dec
1-Feb
1-Apr


Joe Bay
2012-13
2013-14
Mean
0
0
0
0
0
0
0
-Jun
1-Aug
1-Oct
1-Dec
1-Feb
1-Apr


Joe Bay
2012-13
2013-14
Mean
35
30
25
20
15
10
5
0
1-Jun
1-Aug
1-Oct
1-Dec
1-Feb
1-Apr

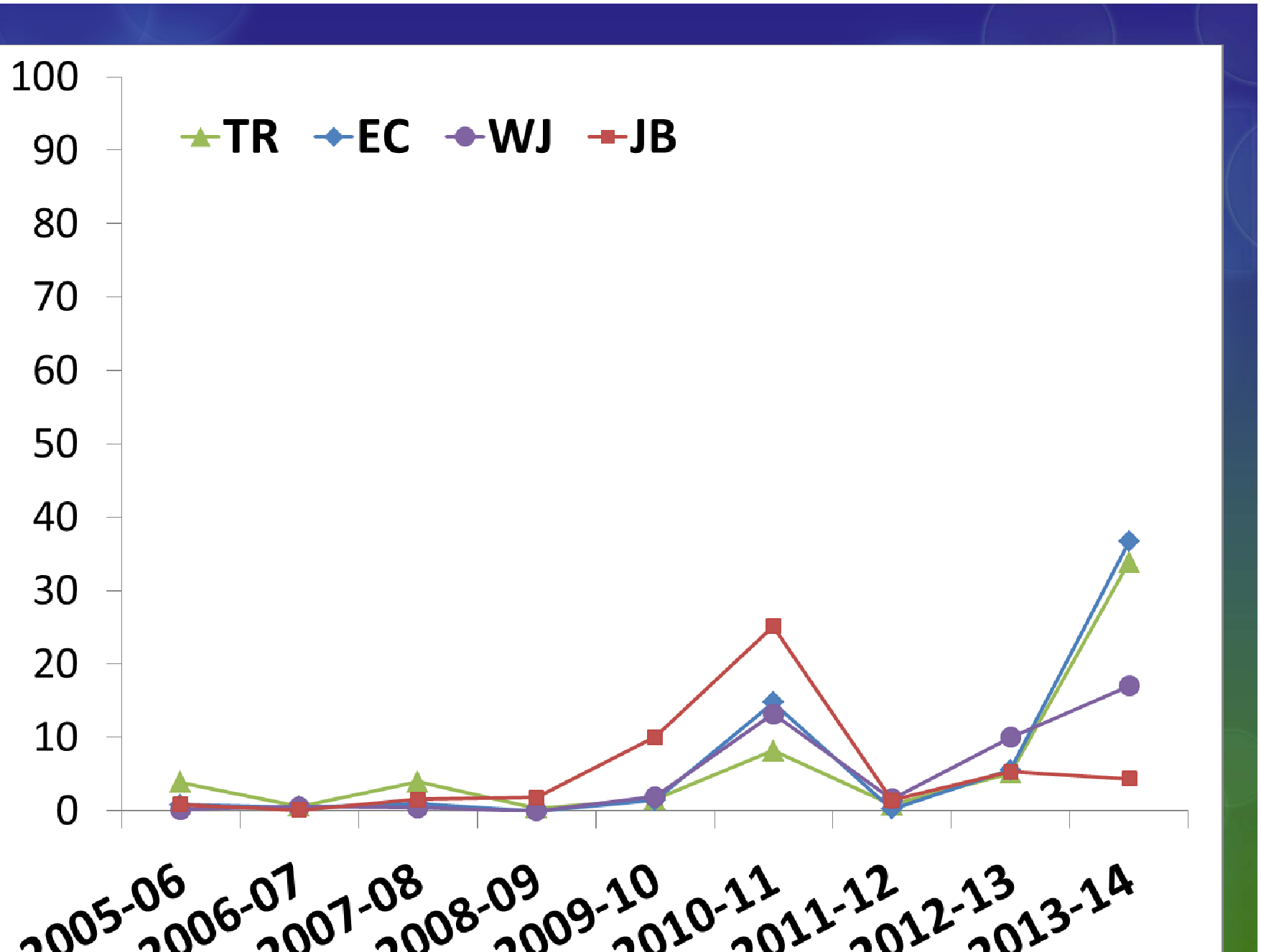
2012-2014 Post C-11SCWP

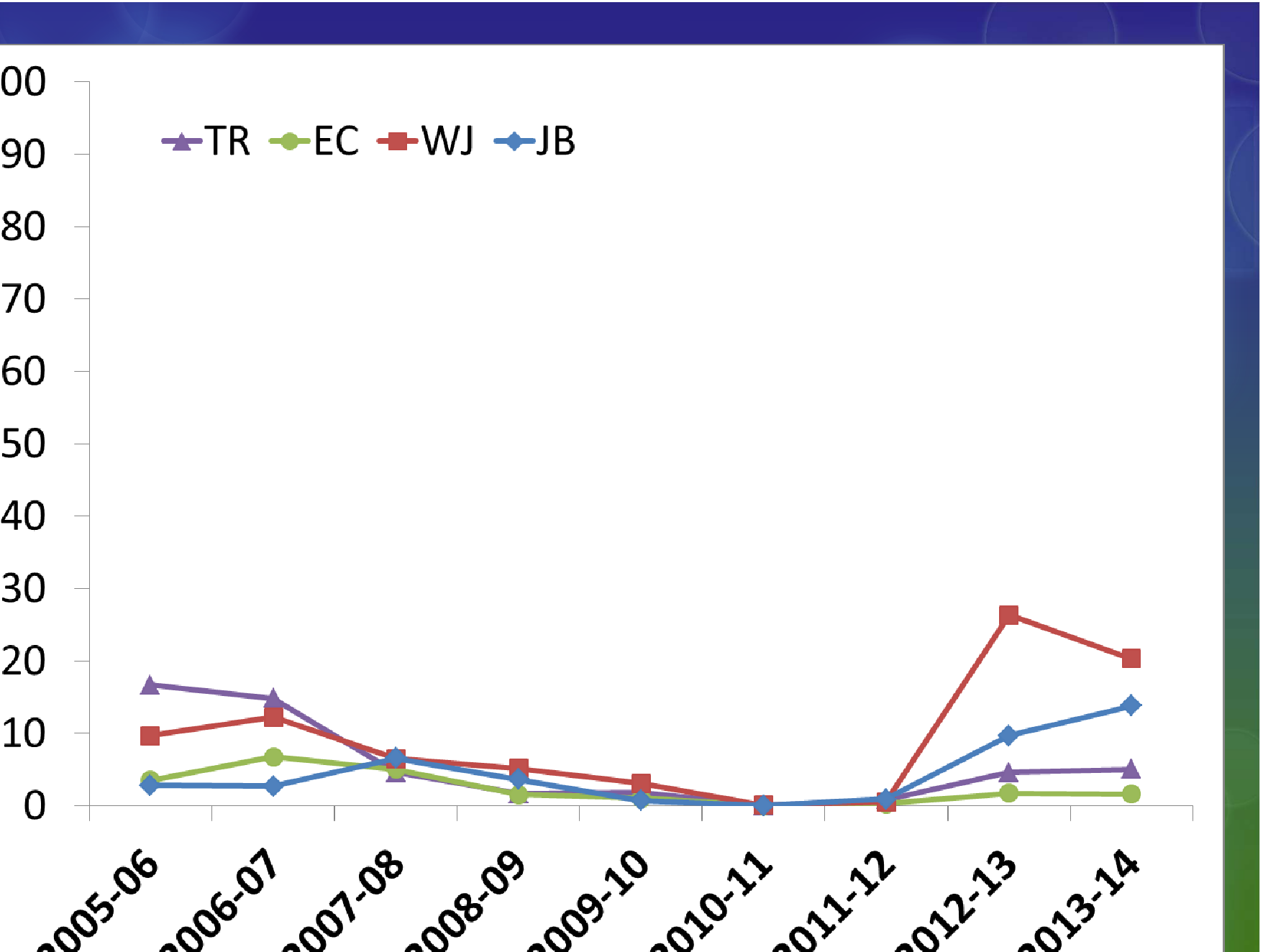
- Increased flow through TSB
- Record high water levels
- Longer hydroperiods
- Lower salinity levels

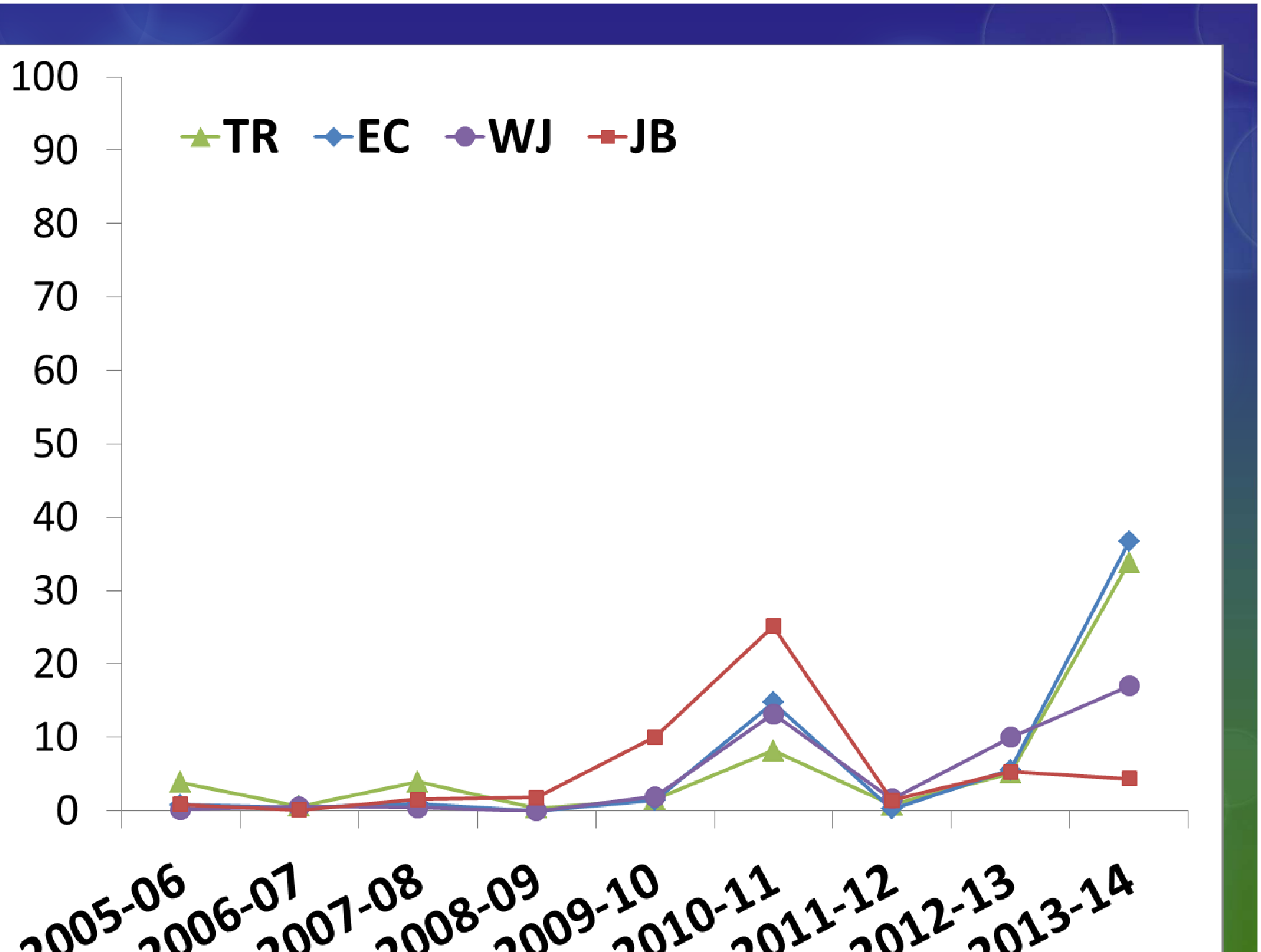
Fish Populations in Mangrove Ecosystems Response to Increased Fresh Water

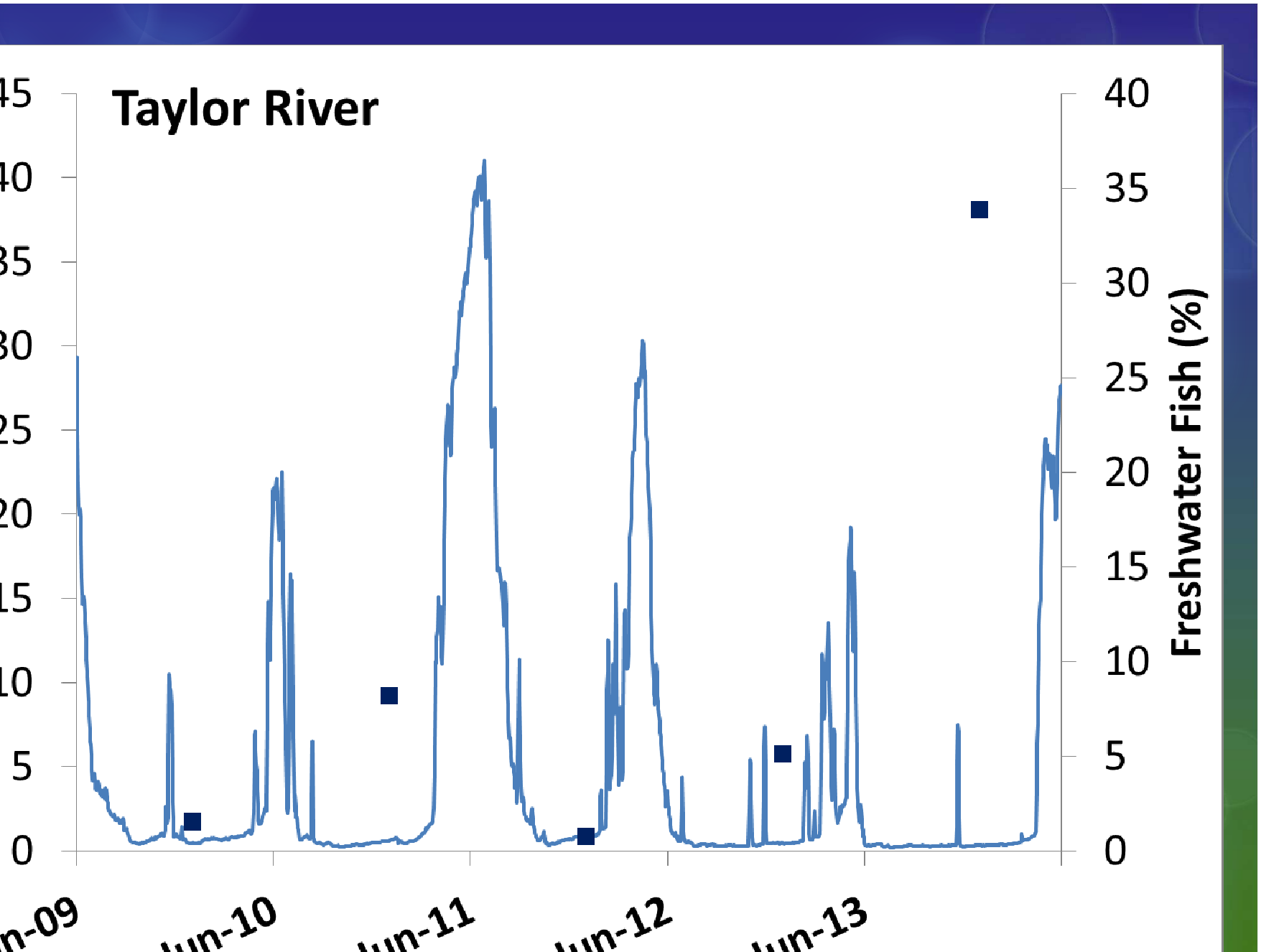
- Higher percentage of freshwater fish species
- This results in higher fish densities and higher fish biomass

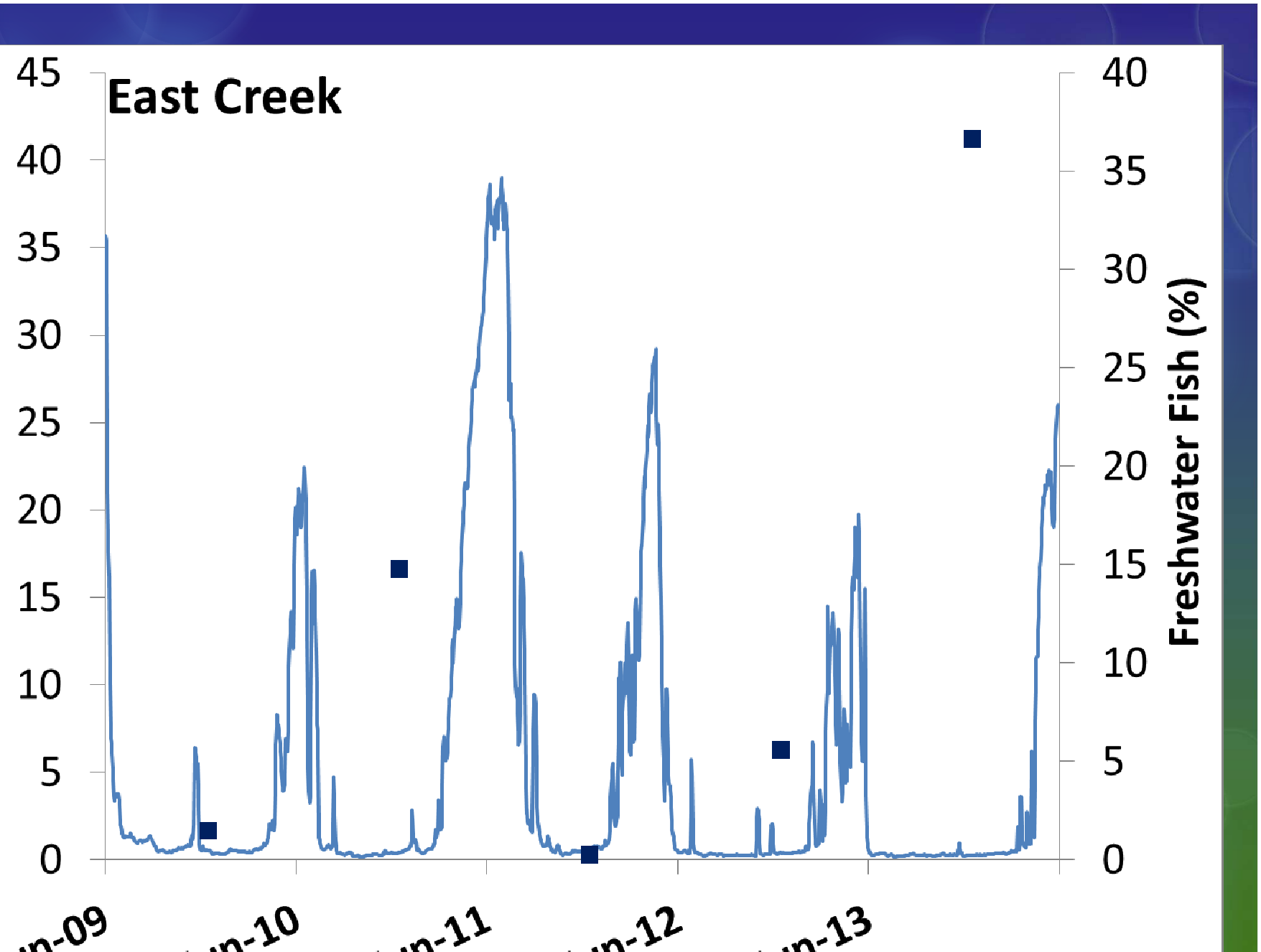
Lorenz, J.J., Serafy J.E., 2006. Subtropical wetland fish assemblages and changing Salinity regimes: implications of Everglades Restoration. Hydrobiologia 569, 401-422.

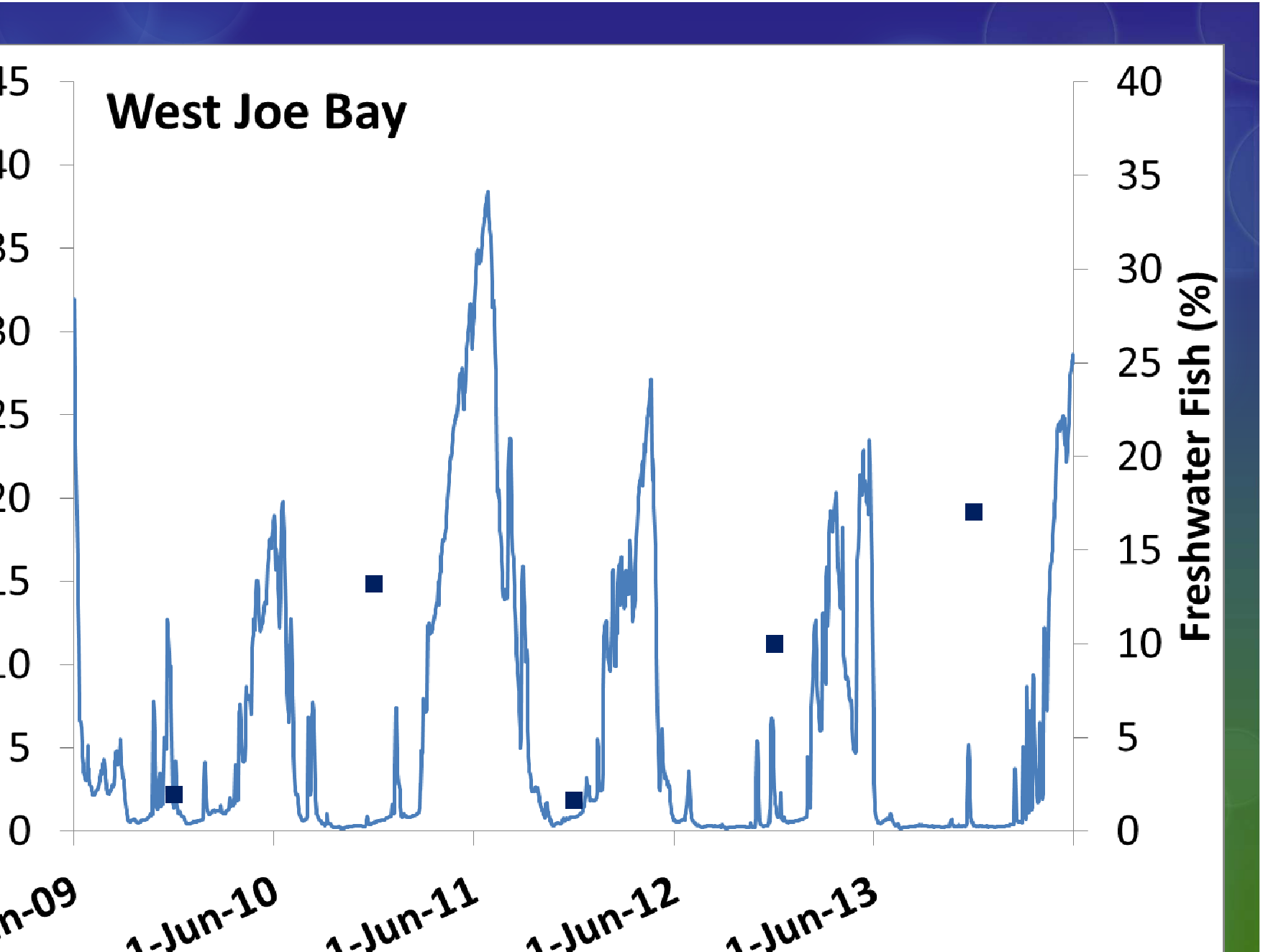

100
90
80
70
60
50
40
30
20
10
0
TR
EC
WJ
JB
2005-06
2006-07
2007-08
2008-09
2009-10
2010-11
2011-12
2012-13
2013-14

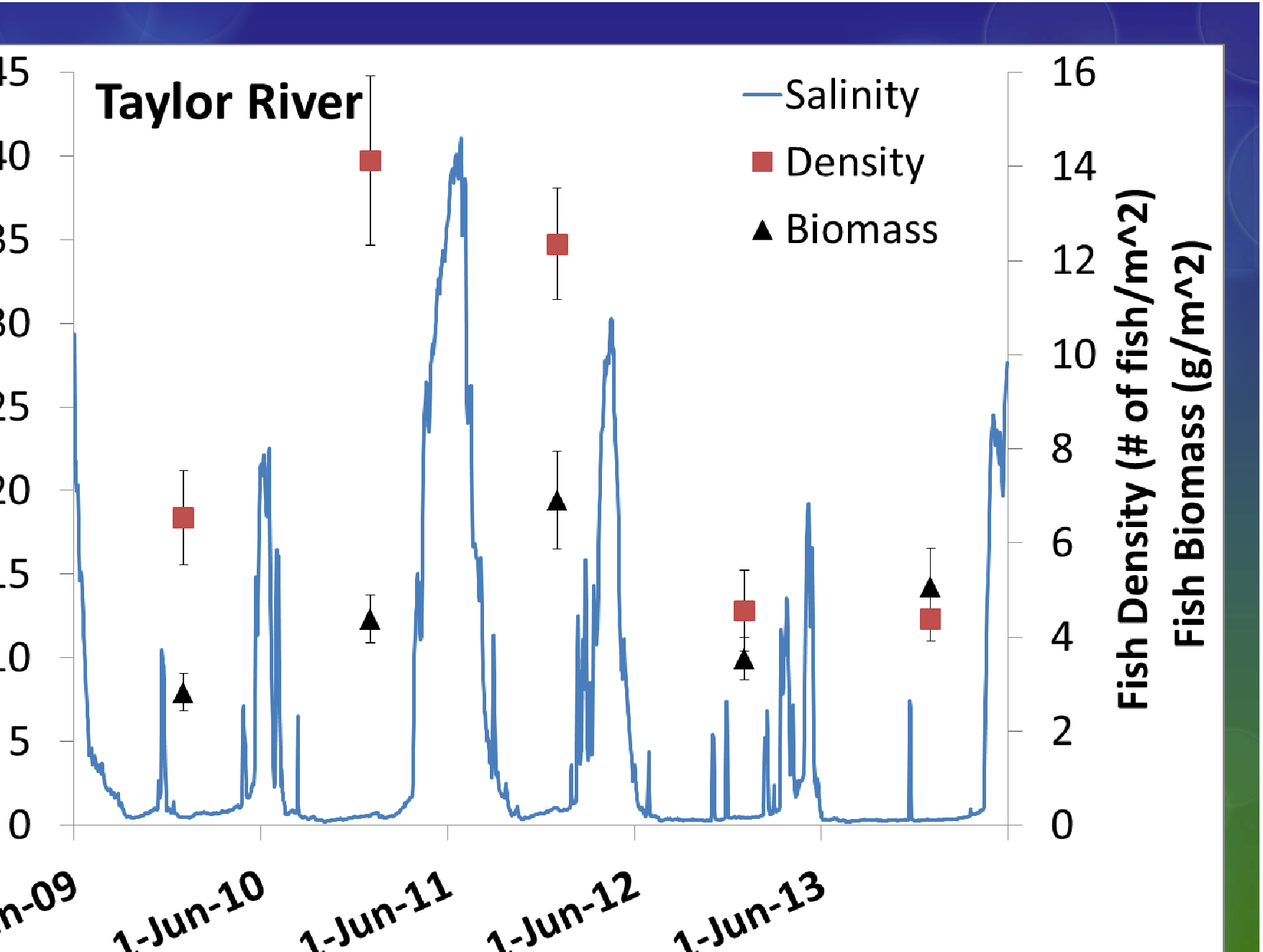

00
90
80
70
60
50
40
30
20
10
0
TR
EC
WJ
JB
2005-06
2006-07
2007-08
2008-09
2009-10
2010-11
2011-12
2012-13
2013-14

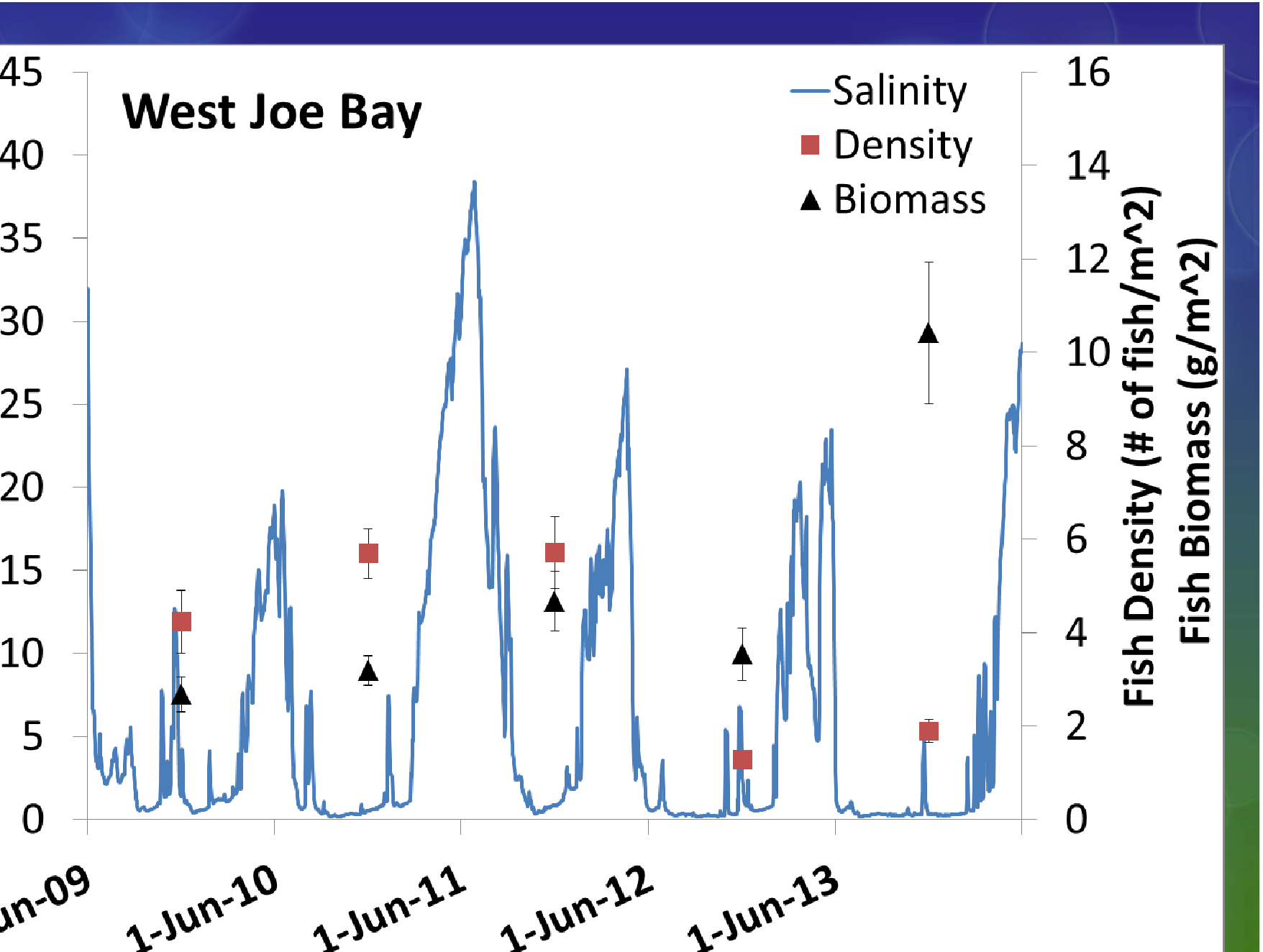

100
90
80
70
60
50
40
30
20
10
0
TR
EC
WJ
JB
2005-06
2006-07
2007-08
2008-09
2009-10
2010-11
2011-12
2012-13
2013-14

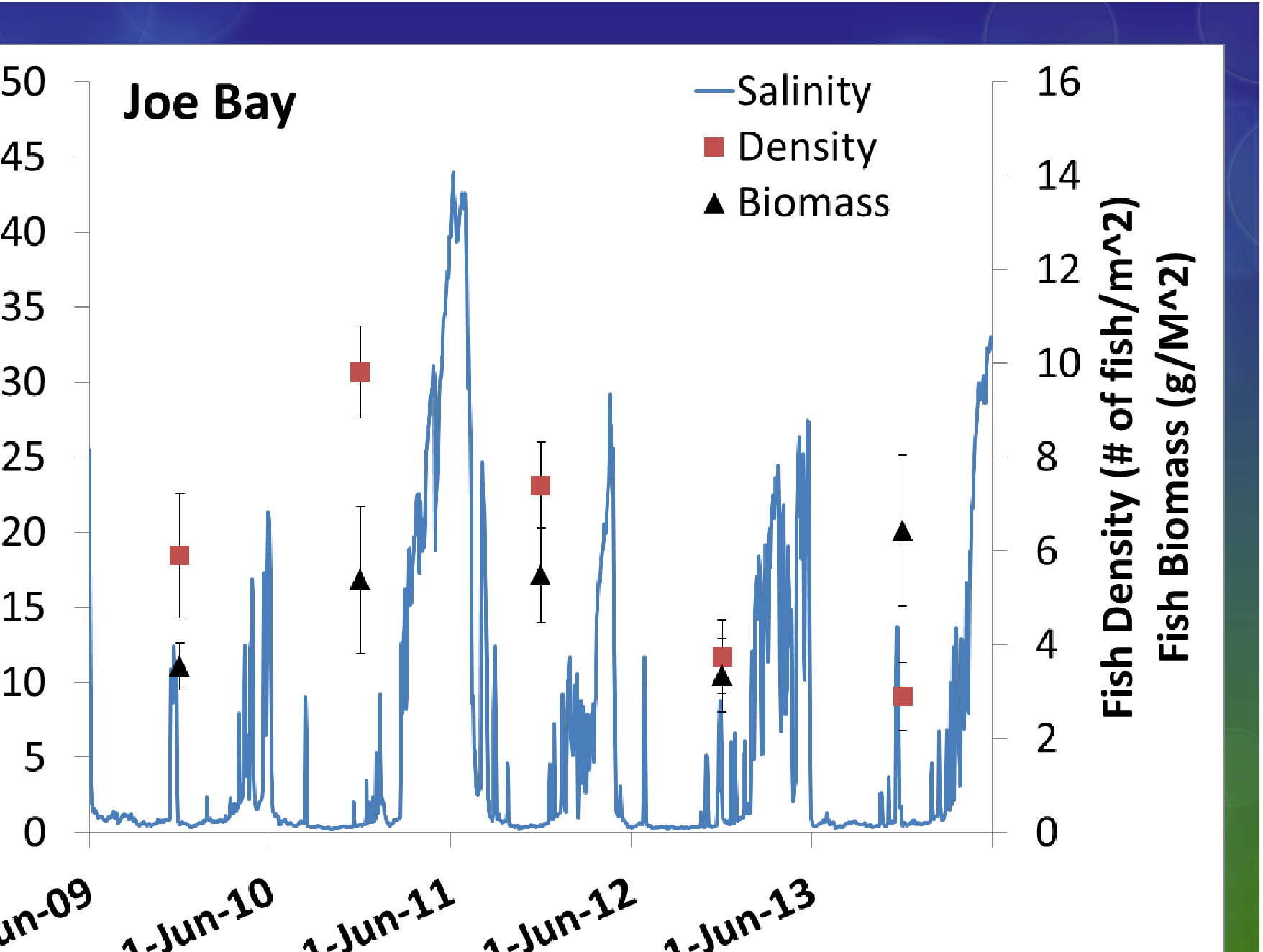

Taylor River
45
40
35
30
25
20
15
10
5
0
40
35
30
25
20
15
10
5
0
Freshwater Fish (%)
n-09
un-10
un-11
un-12
un-13


East Creek
45
40
35
30
25
20
15
10
5
0
40
35
30
25
20
15
10
5
0
Freshwater Fish (%)
n-09
n-10
n-11
n-12
n-13


West Joe Bay
45
40
35
30
25
20
15
10
5
0
40
35
30
25
20
15
10
5
0
Freshwater Fish (%)
n-09
1-Jun-10
1-Jun-11
1-Jun-12
1-Jun-13


Taylor River
Salinity
Density
Biomass
45
40
35
30
25
20
15
10
5
0
16
14
12
10
8
6
4
2
0
Fish Density (# of fish/m^2)
Fish Biomass (g/m^2)
n-09
1-Jun-10
1-Jun-11
1-Jun-12
1-Jun-13


West Joe Bay
Salinity
Density
Biomass
45
40
35
30
25
20
15
10
5
0
16
14
12
10
8
6
4
2
0
Fish Density (# of fish/m^2)
Fish Biomass (g/m^2)
un-09
1-Jun-10
1-Jun-11
1-Jun-12
1-Jun-13


Joe Bay
Salinity
Density
Biomass
50
45
40
35
30
25
20
15
10
5
0
16
14
12
10
8
6
4
2
0
Fish Density (# of fish/m^2)
Fish Biomass (g/M^2)
un-09
1-Jun-10
1-Jun-11
1-Jun-12
1-Jun-13

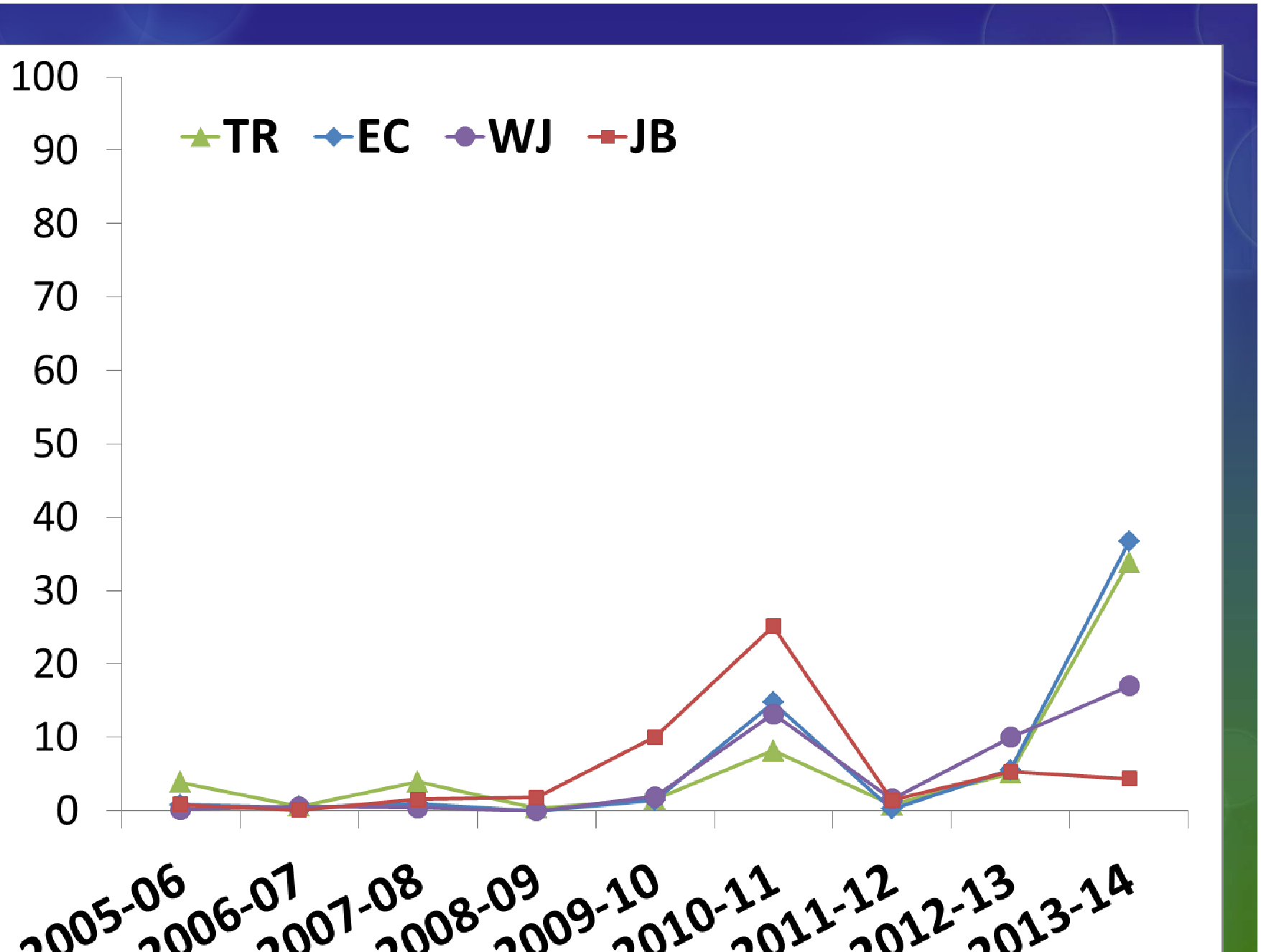
012-2014 Post C-111SCWP

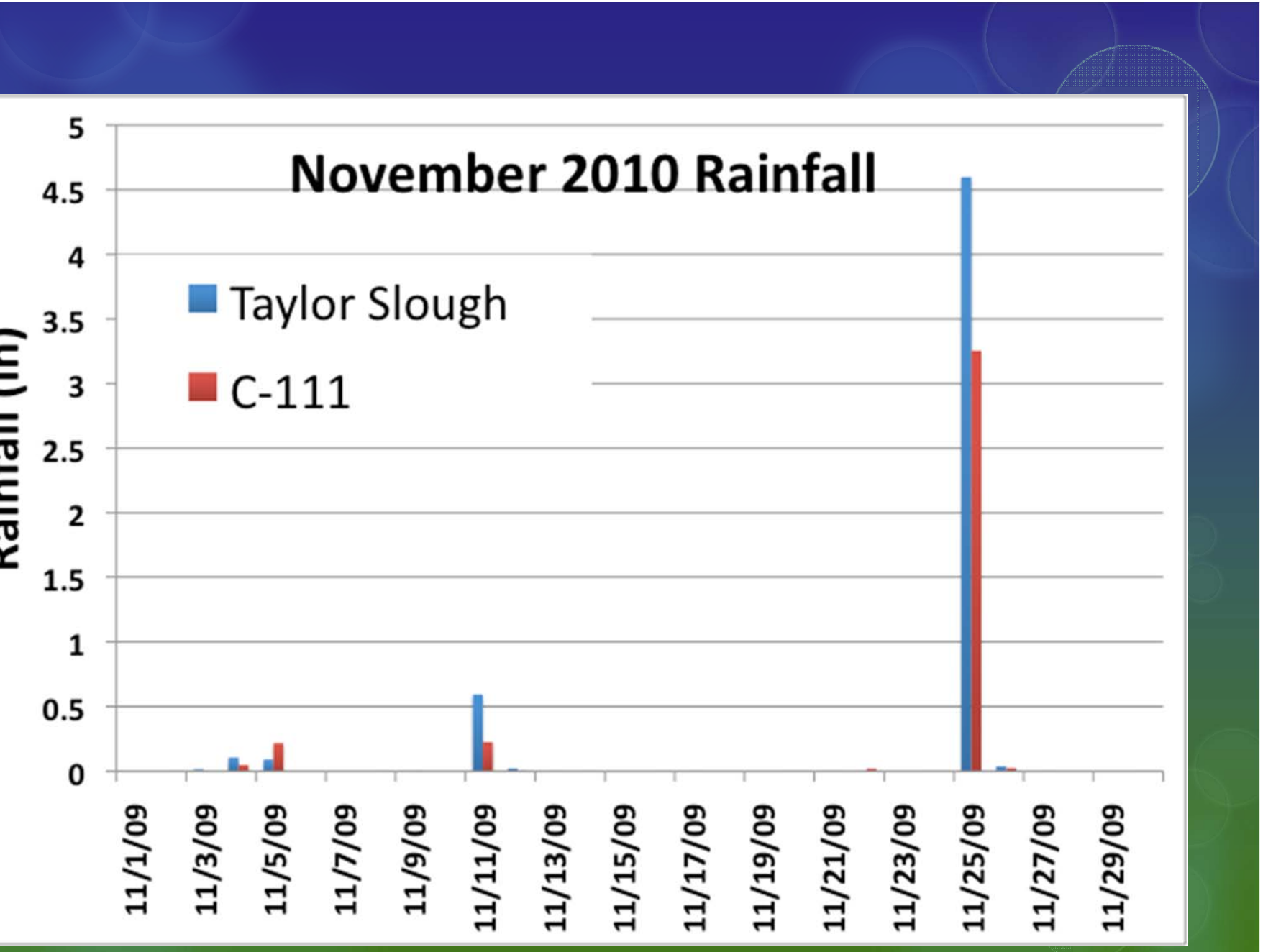
- Increased flow through TSB
- Record high water levels
- Longer hydroperiods
- Lower salinity levels

012-2014 Post C-111SCWP

- Increased flow through TSB
- Record high water levels
- Longer hydroperiods
- Lower salinity levels

- Increase in the % coverage of SAV
- Increase in the % of freshwater fish
- Increase in the amount of larger fish


100
90
80
70
60
50
40
30
20
10
0
TR
EC
WJ
JB
2005-06
2006-07
2007-08
2008-09
2009-10
2010-11
2011-12
2012-13
2013-14


November 2010 Rainfall
Taylor Slough
C-111
Rainfall (in)
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
11/1/09
11/3/09
11/5/09
11/7/09
11/9/09
11/11/09
11/13/09
11/15/09
11/17/09
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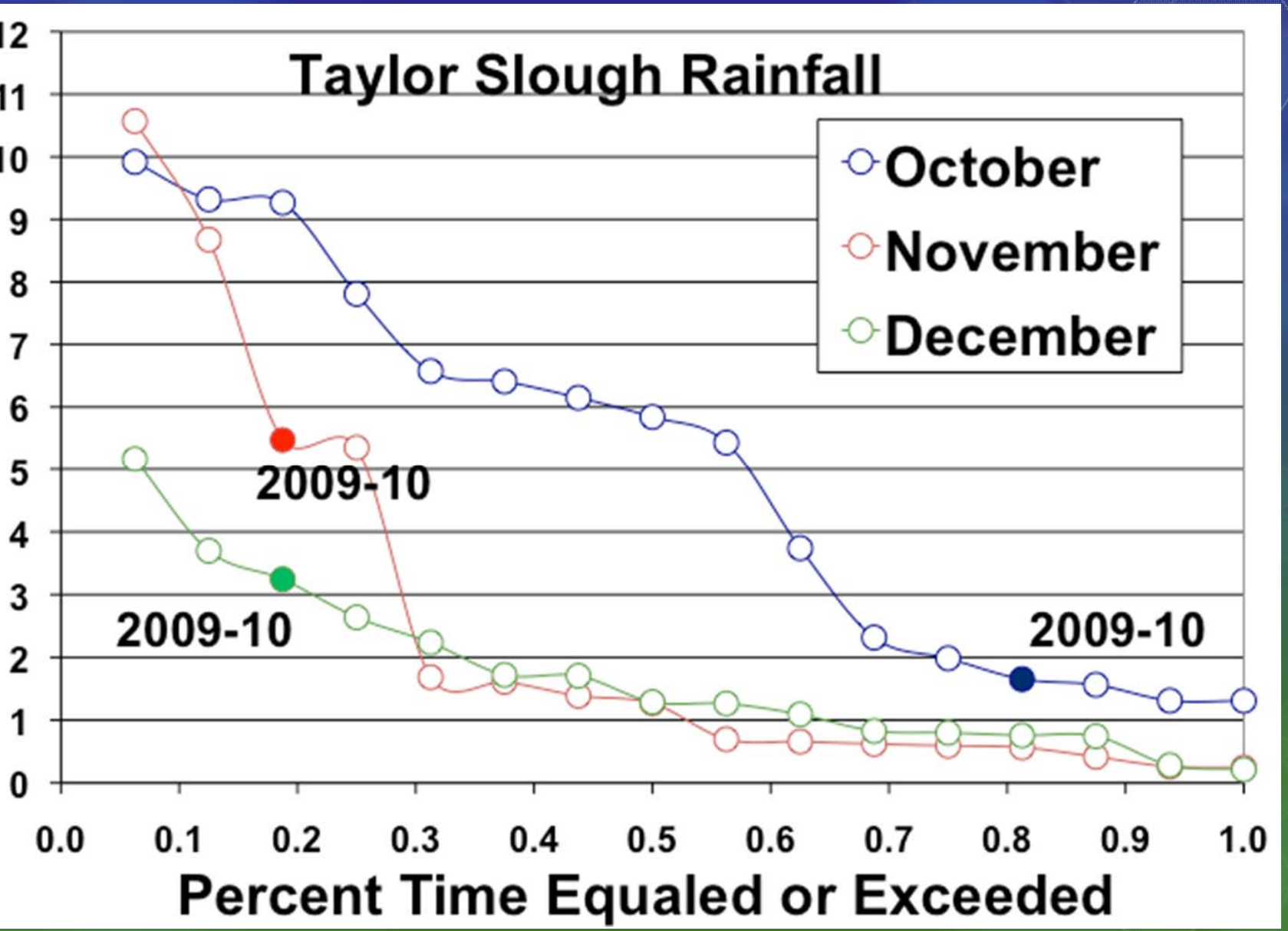
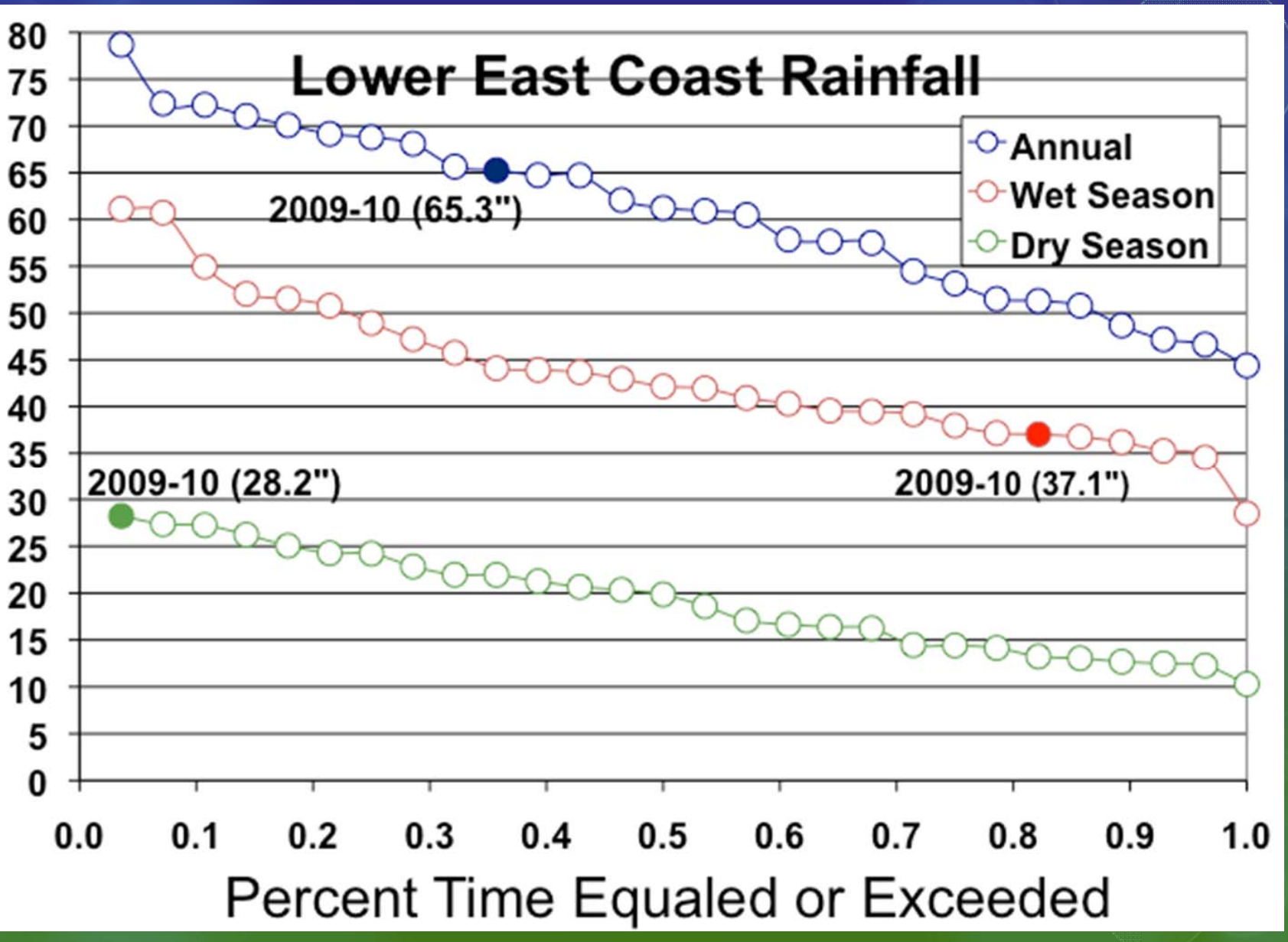
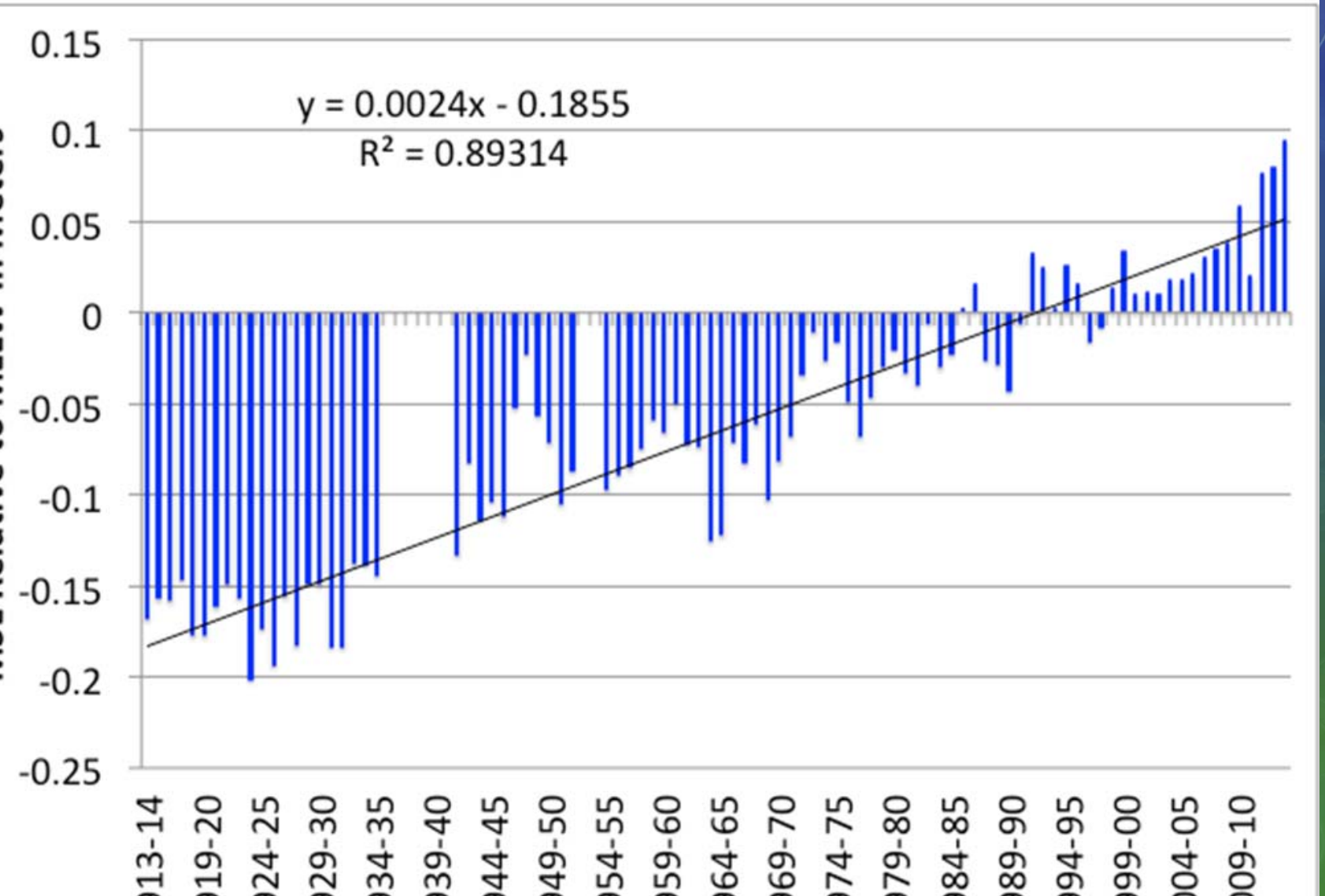
11/21/09
11/23/09
11/25/09
11/27/09
11/29/09

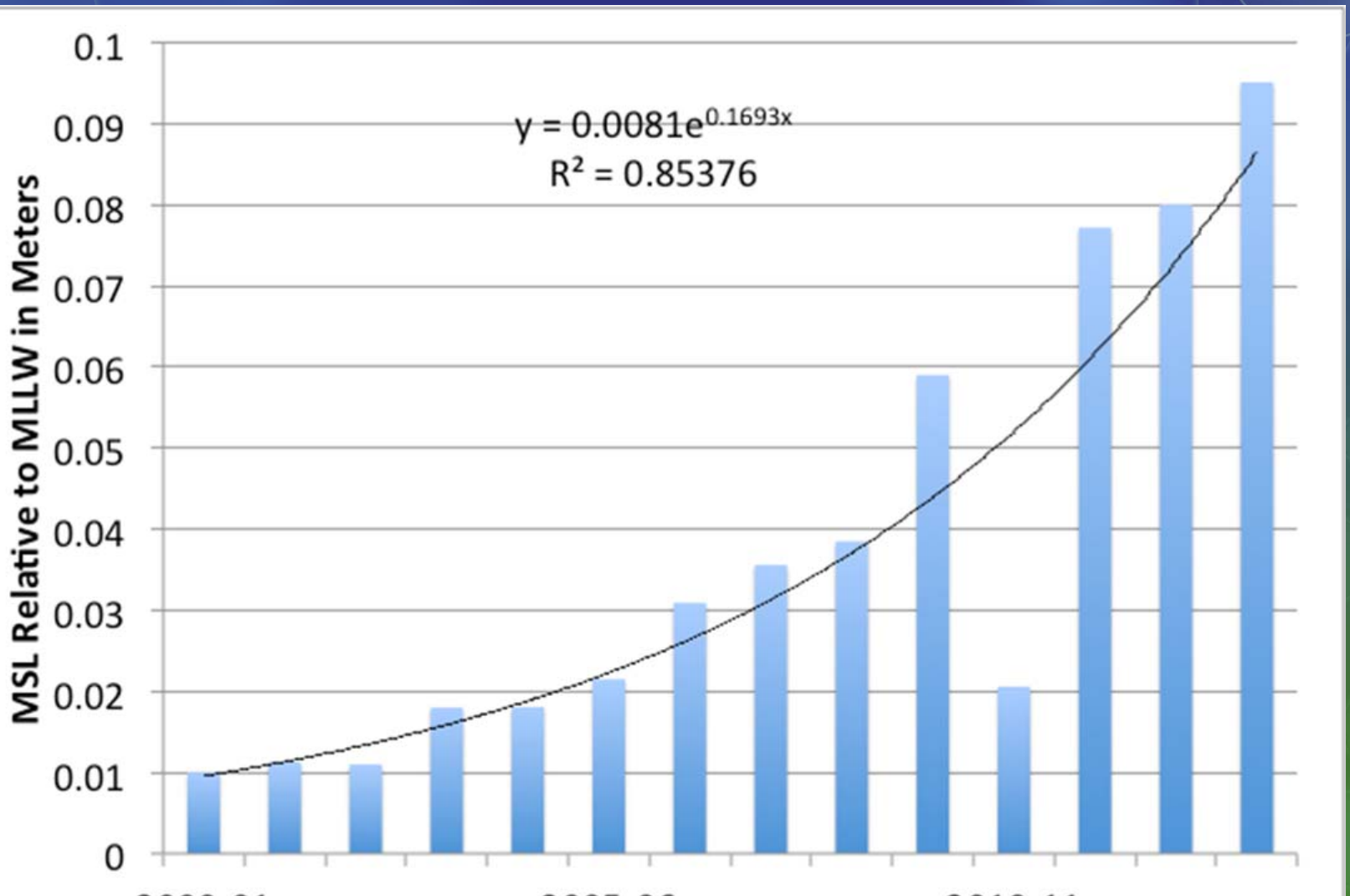

Taylor Slough Rainfall
October
November
December
2009-10
2009-10
2009-10
12
11
10
9
8
7
6
5
4
3
2
1
0
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
Percent Time Equaled or Exceeded

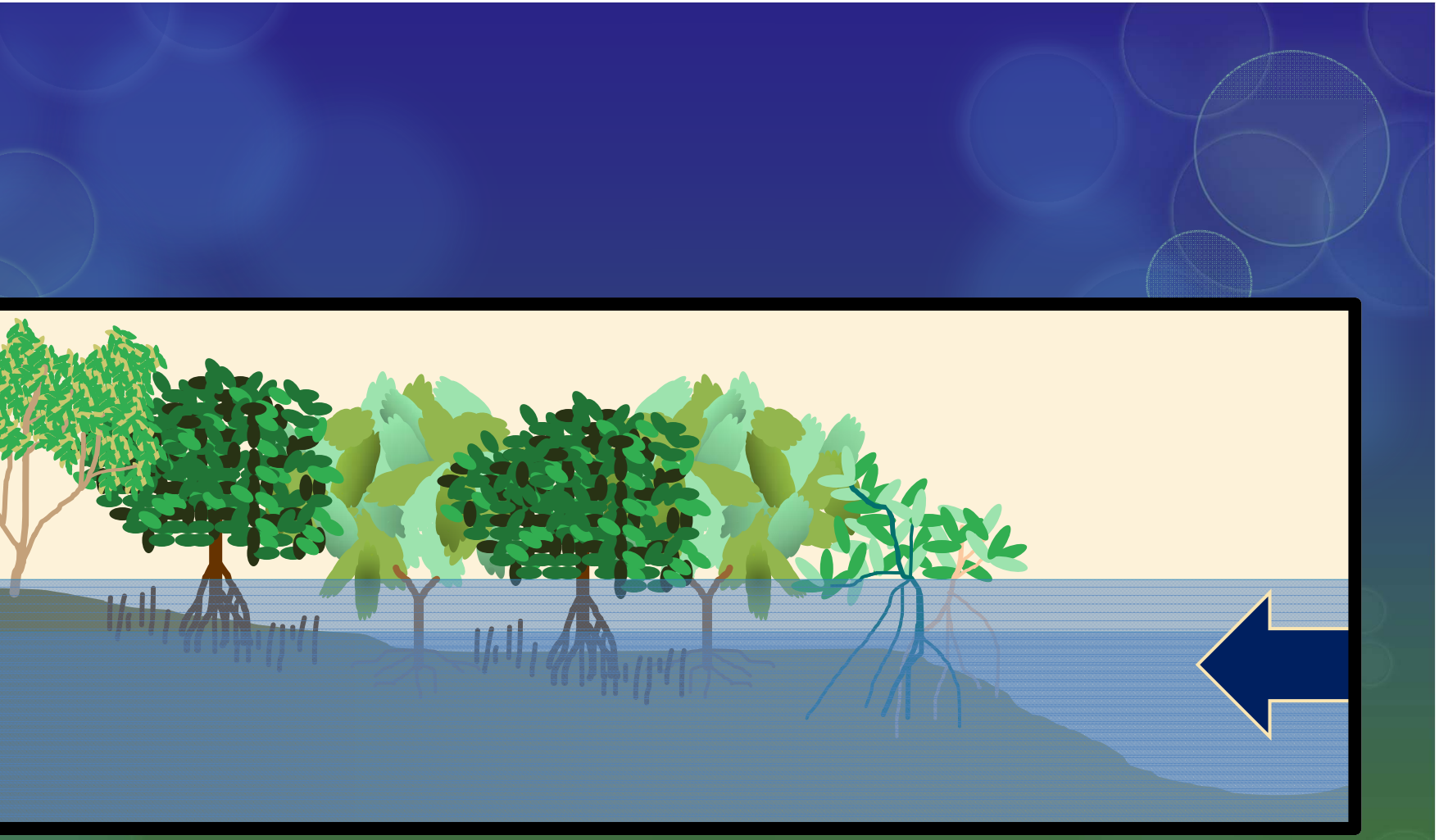

Lower East Coast Rainfall
Annual
Wet Season
Dry Season
2009-10 (65.3")
2009-10 (28.2")
2009-10 (37.1")
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
0
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
Percent Time Equaled or Exceeded

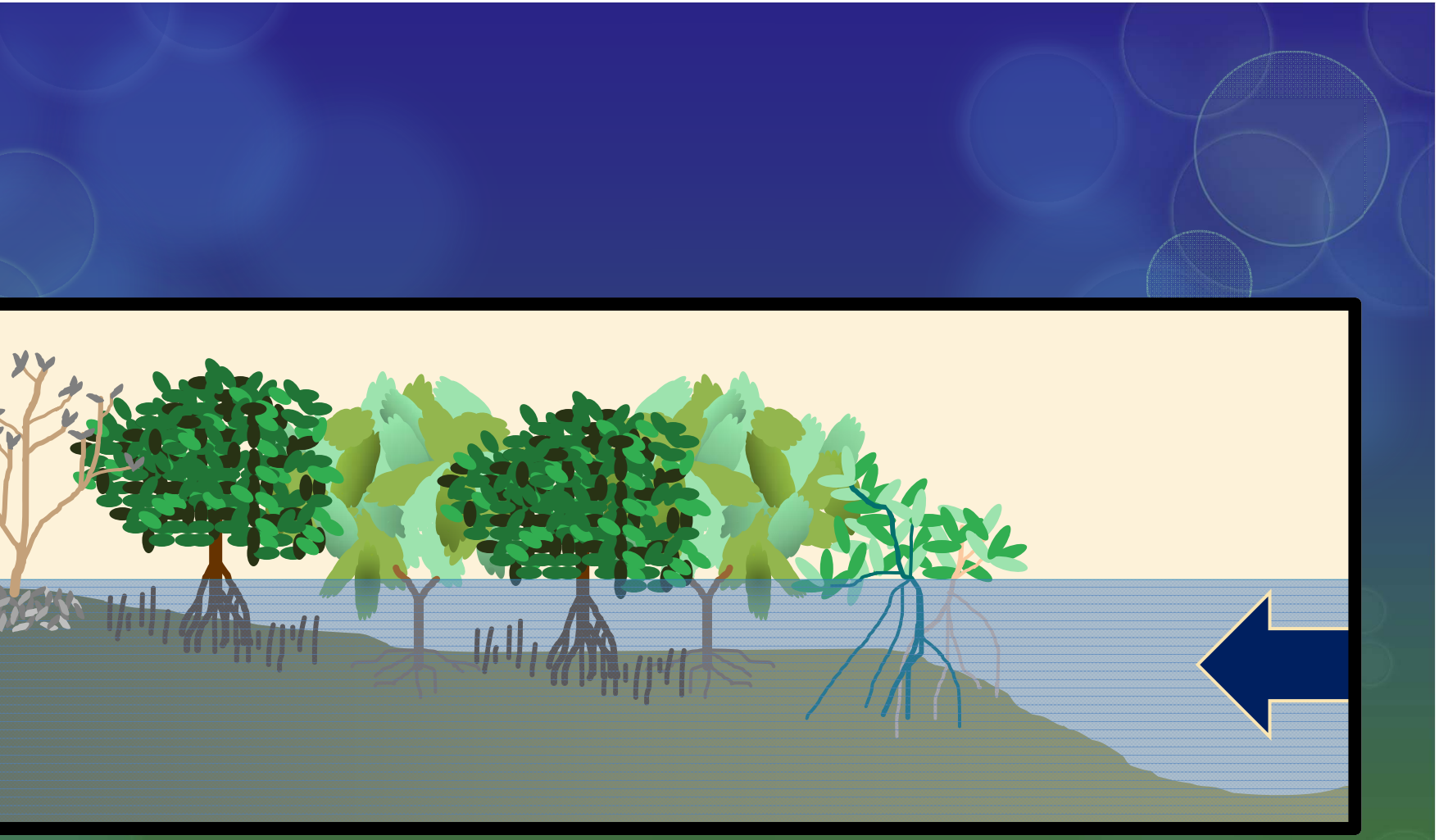
Annual Mean Water Level Key West Harbor 1913-2014

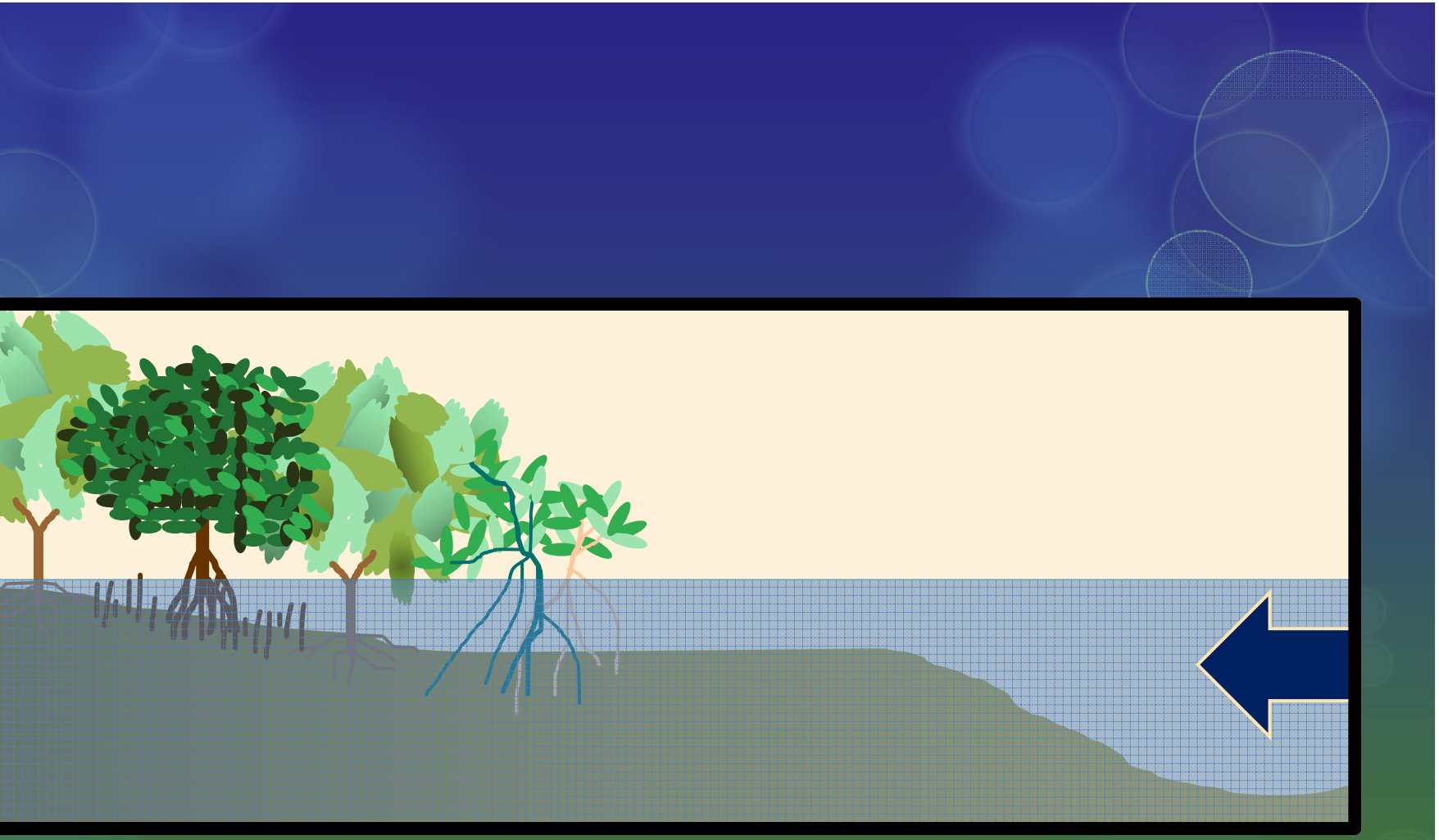


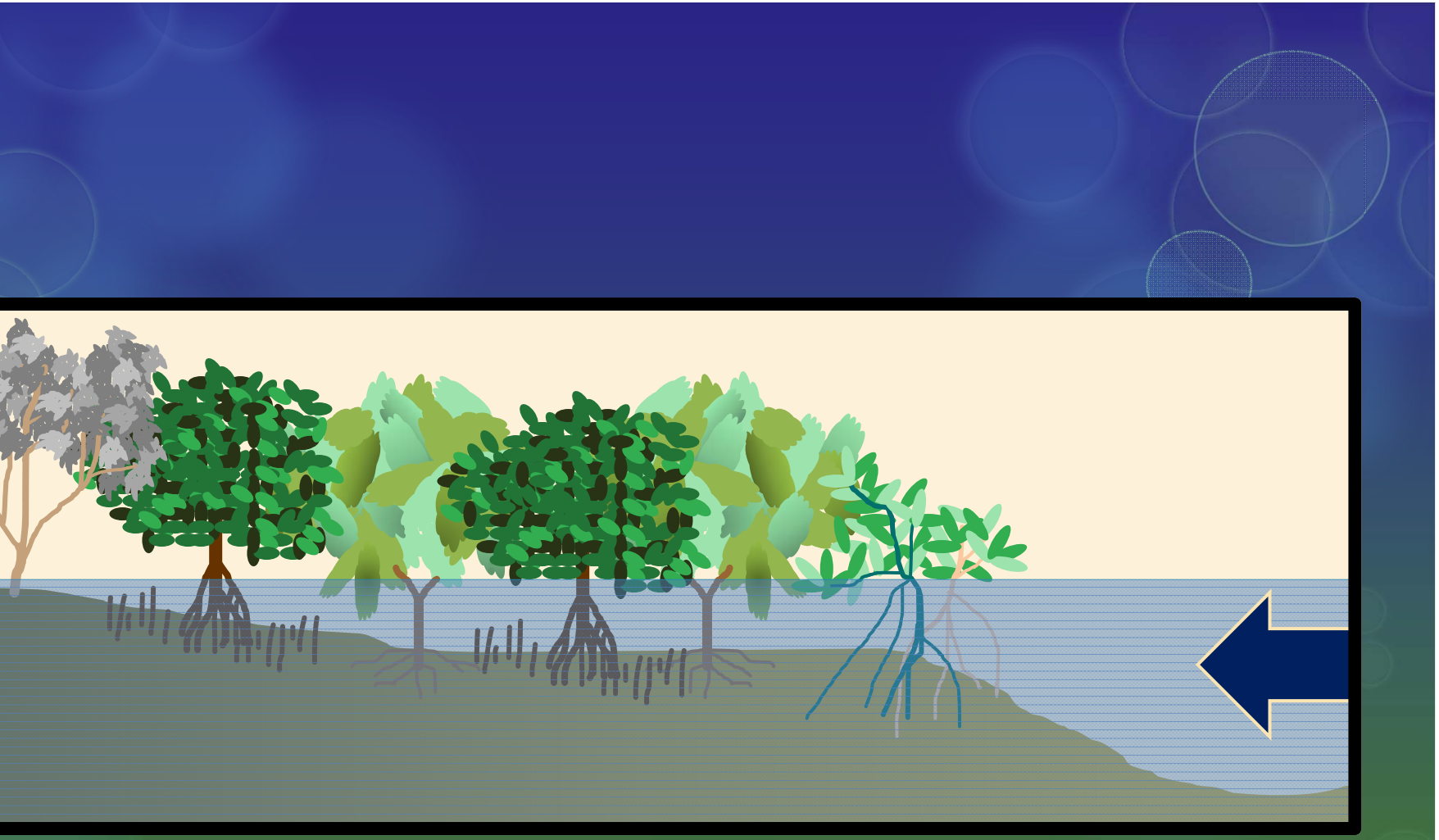
Annual Low Mean Water Level Key West Harbor 2000-2014

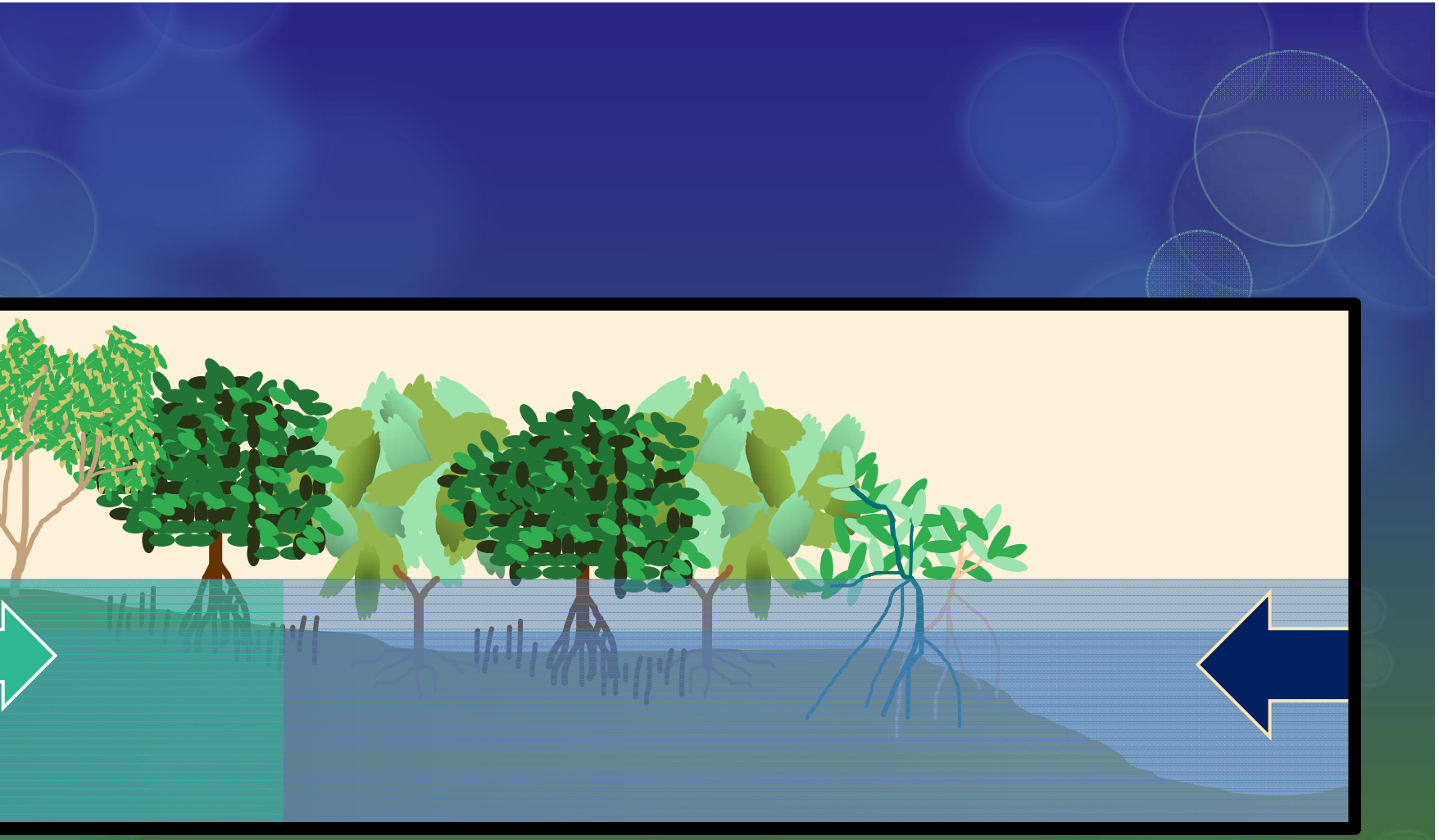


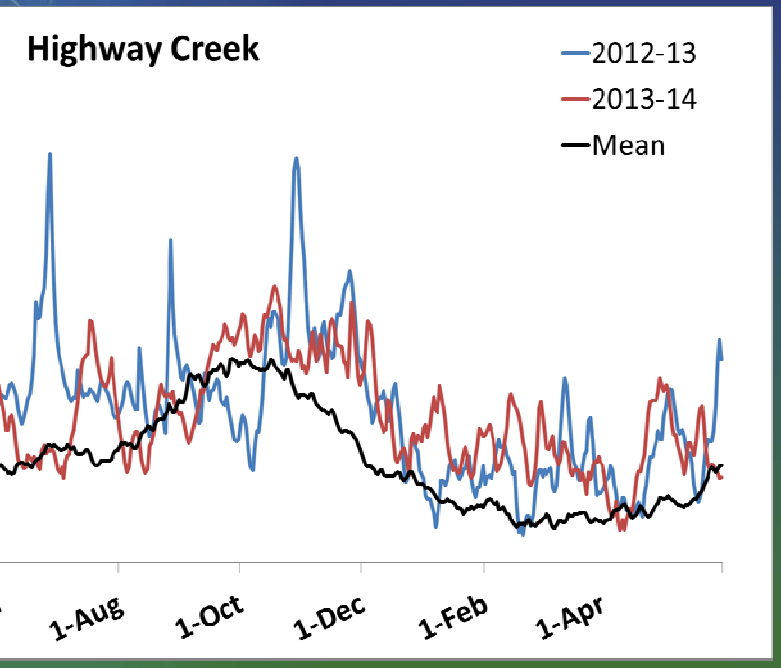


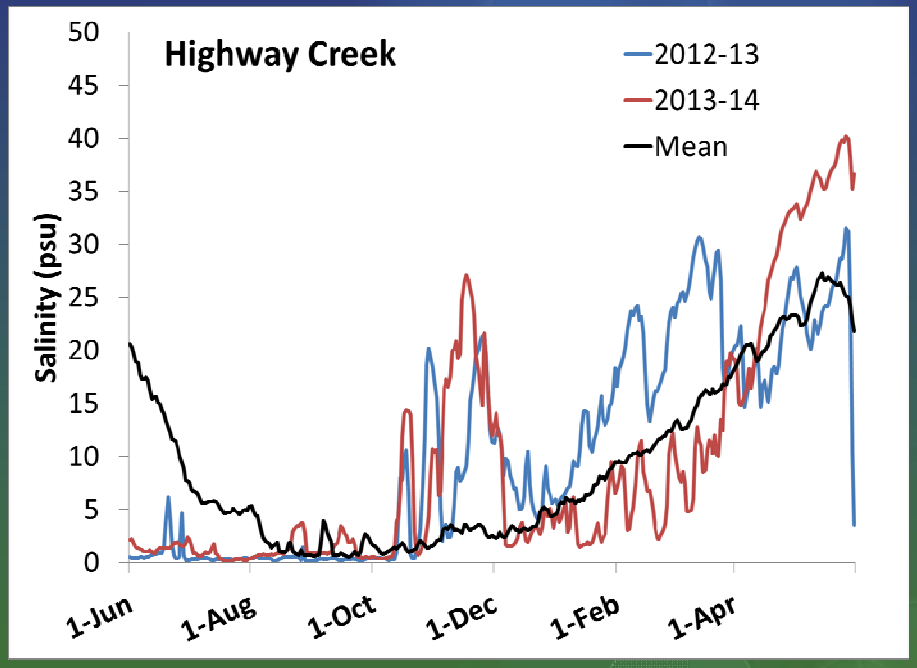


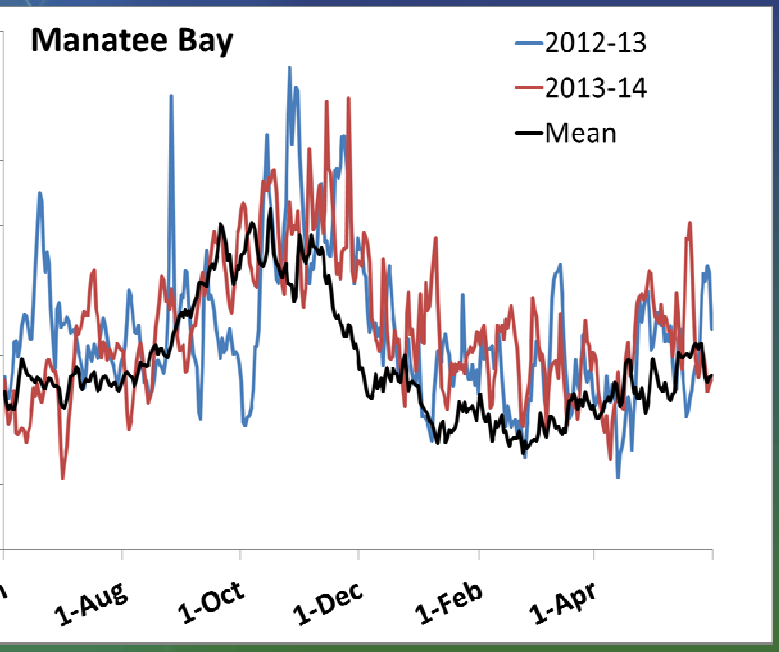


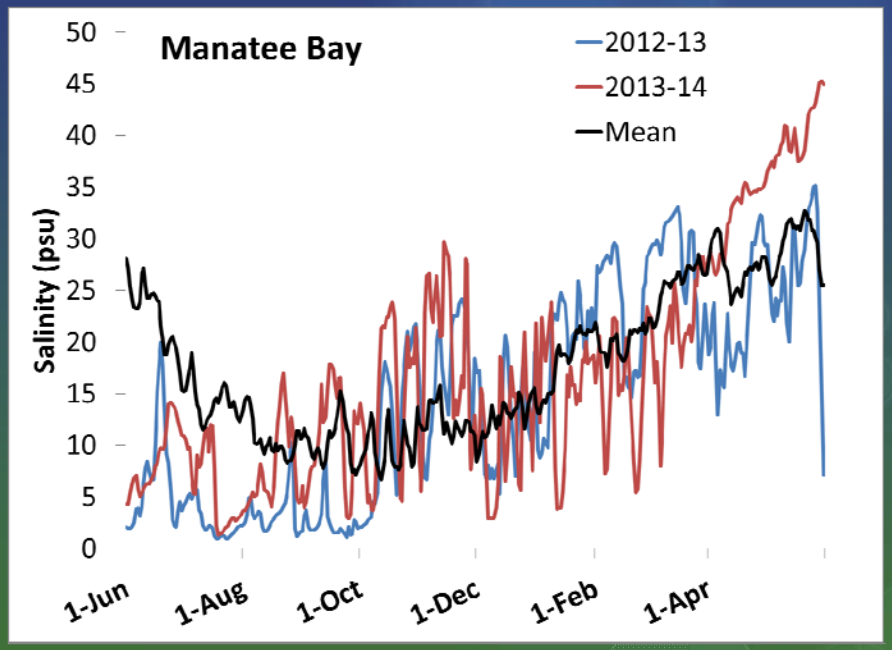


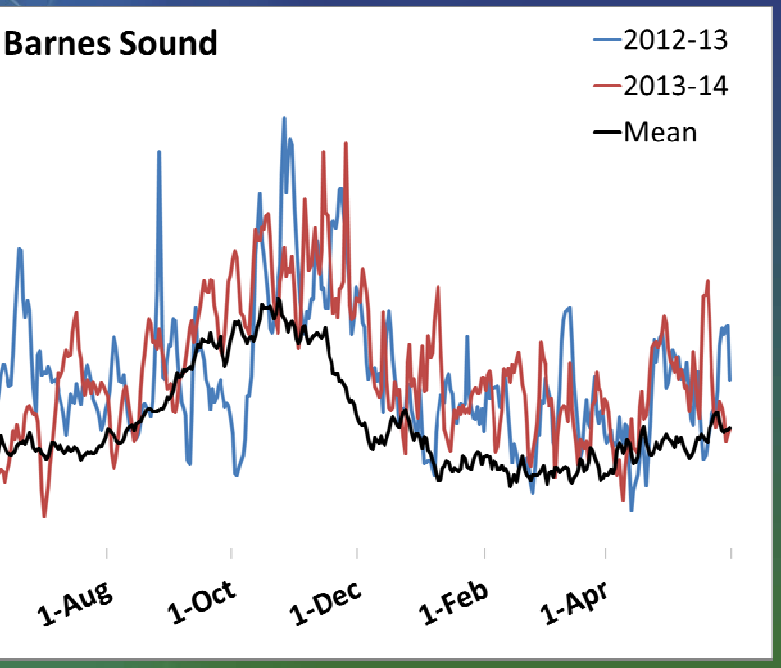


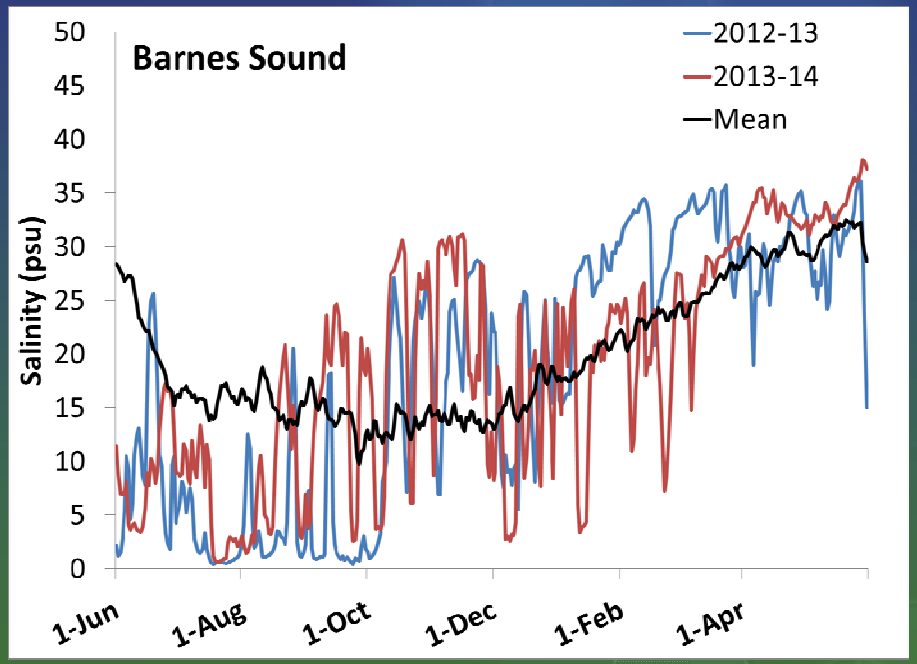

Highway Creek
2012-13
2013-14
Mean
1-Aug
1-Oct
1-Dec
1-Feb
1-Apr


Highway Creek
2012-13
2013-14
Mean
Salinity (psu)
50
45
40
35
30
25
20
15
10
5
0
1-Jun
1-Aug
1-Oct
1-Dec
1-Feb
1-Apr


Manatee Bay
2012-13
2013-14
Mean
1-Aug
1-Oct
1-Dec
1-Feb
1-Apr


Manatee Bay
2012-13
2013-14
Mean
Salinity (psu)
50
45
40
35
30
25
20
15
10
5
0
1-Jun
1-Aug
1-Oct
1-Dec
1-Feb
1-Apr


Barnes Sound
2012-13
2013-14
Mean
1-Aug
1-Oct
1-Dec
1-Feb
1-Apr


Barnes Sound
2012-13
2013-14
Mean
Salinity (psu)
50
45
40
35
30
25
20
15
10
5
0
1-Jun
1-Aug
1-Oct
1-Dec
1-Feb
1-Apr

Conclusions

1. The past 2 years have shown longer hydro periods, higher water levels, lower salinity levels and an increase in the percentage of freshwater fish at the TR, EC, WJ and JB.
   - Data suggests this is a result of the C-111SCWP
2. The increase in fresh water flow appears to be beneficial in preventing salt water intrusion