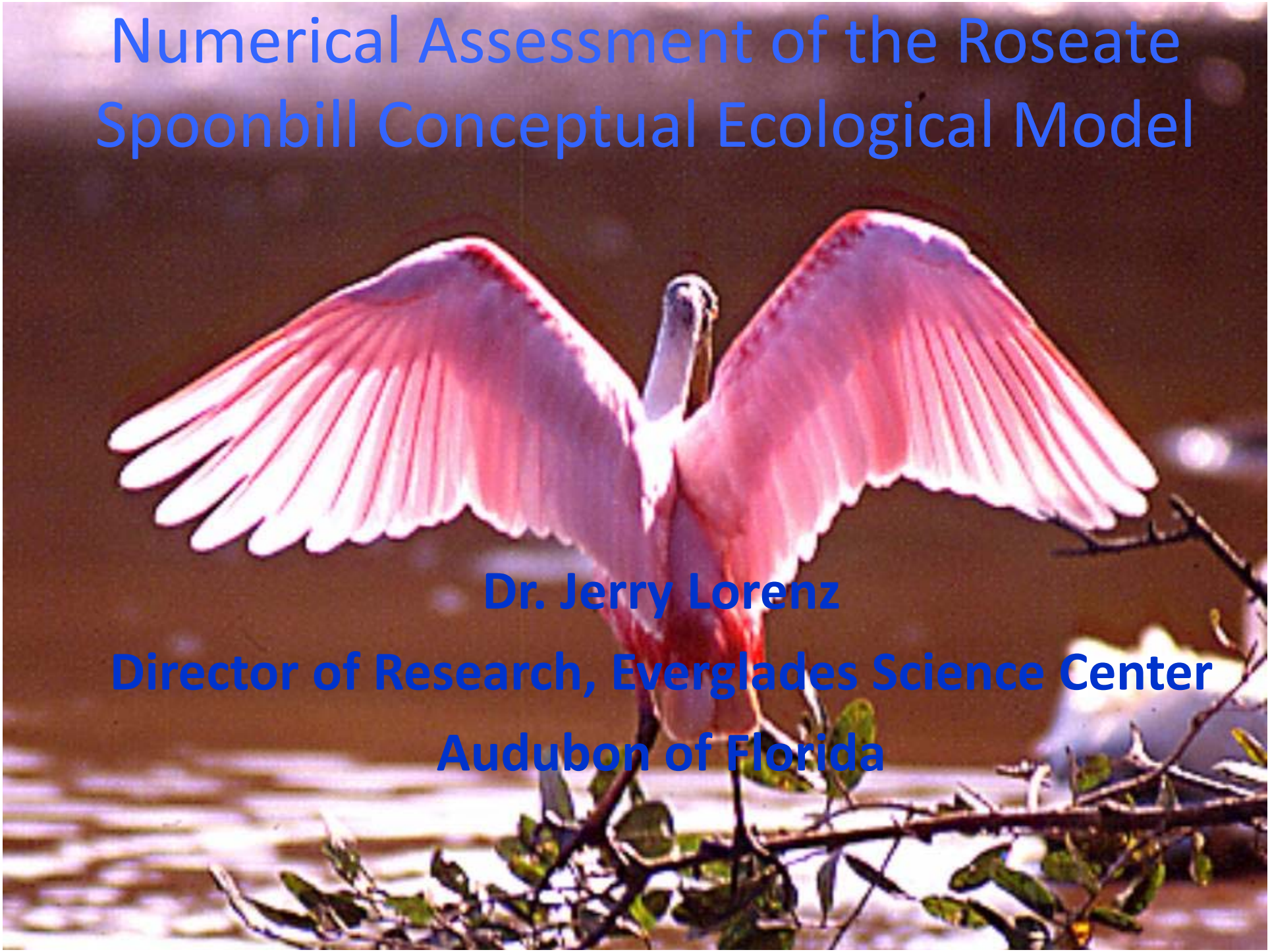
Numerical Assessment of the Roseate Spoonbill Conceptual Ecological Model



Dr. Jerry Lorenz

Director of Research, Everglades Science Center

Audubon of Florida

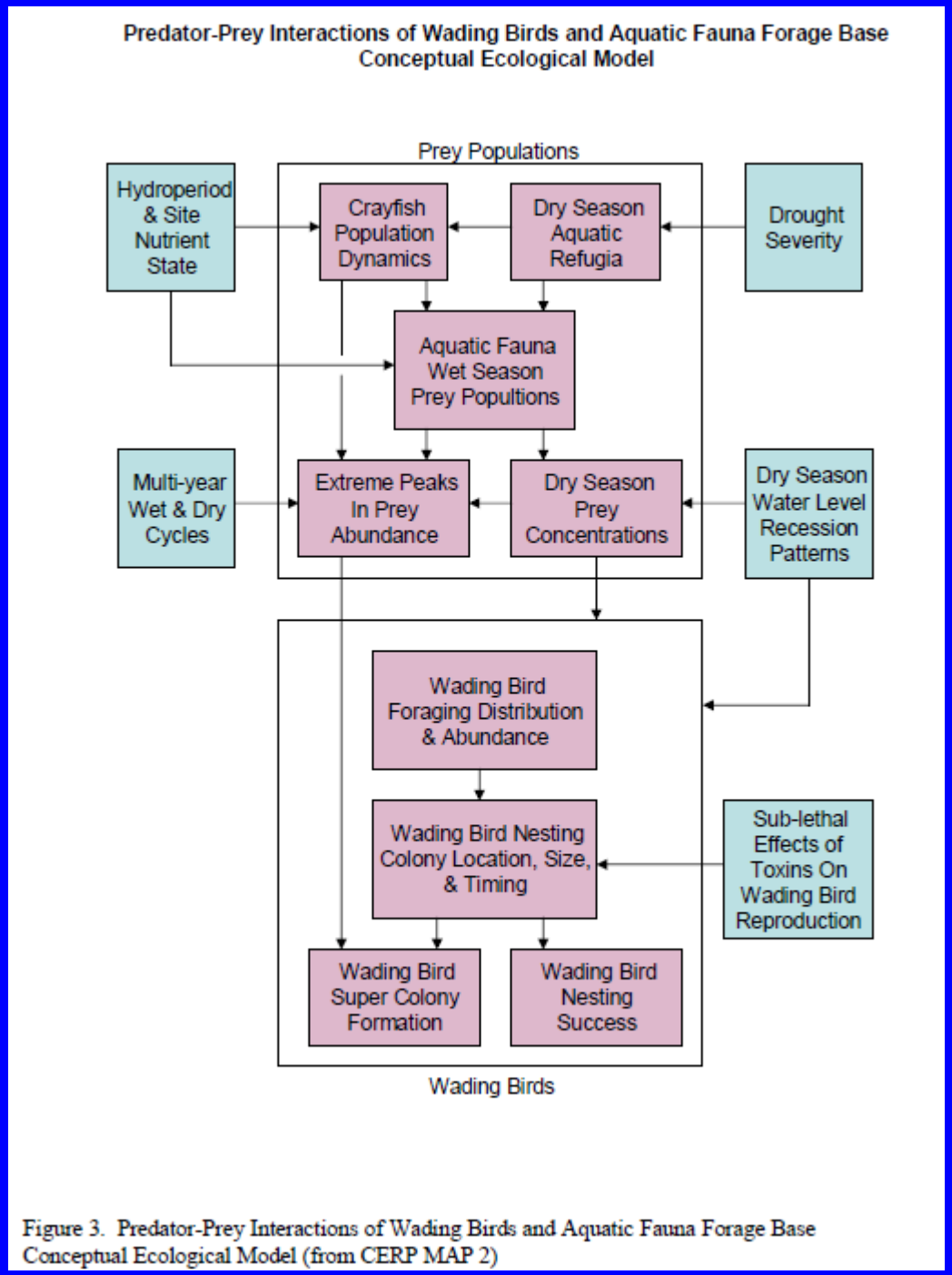
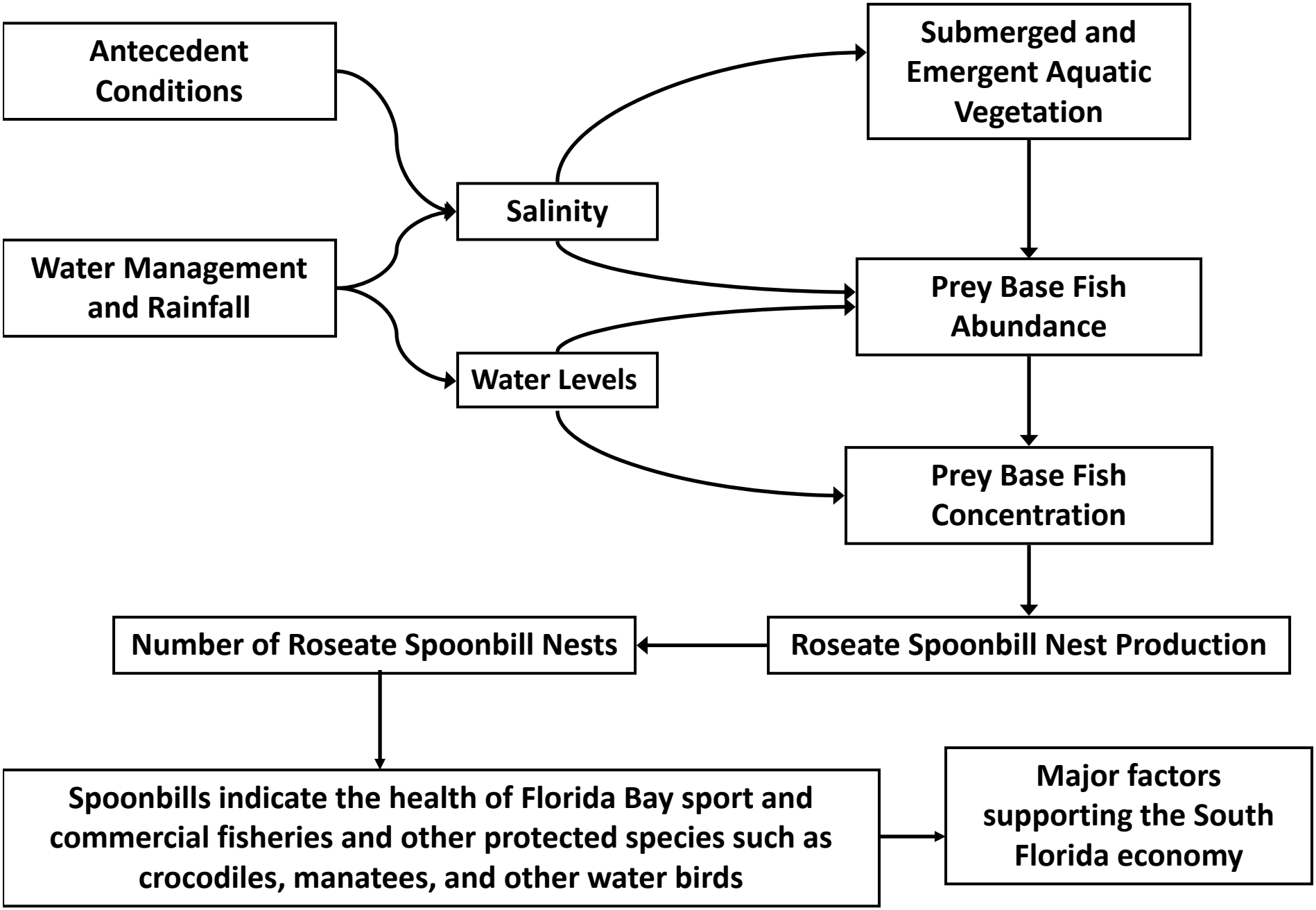


Figure 3. Predator-Prey Interactions of Wading Birds and Aquatic Fauna Forage Base Conceptual Ecological Model (from CERP MAP 2)


Antecedent Conditions
Water Management and Rainfall
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Water Levels
Submerged and Emergent Aquatic Vegetation
Prey Base Fish Abundance
Prey Base Fish Concentration
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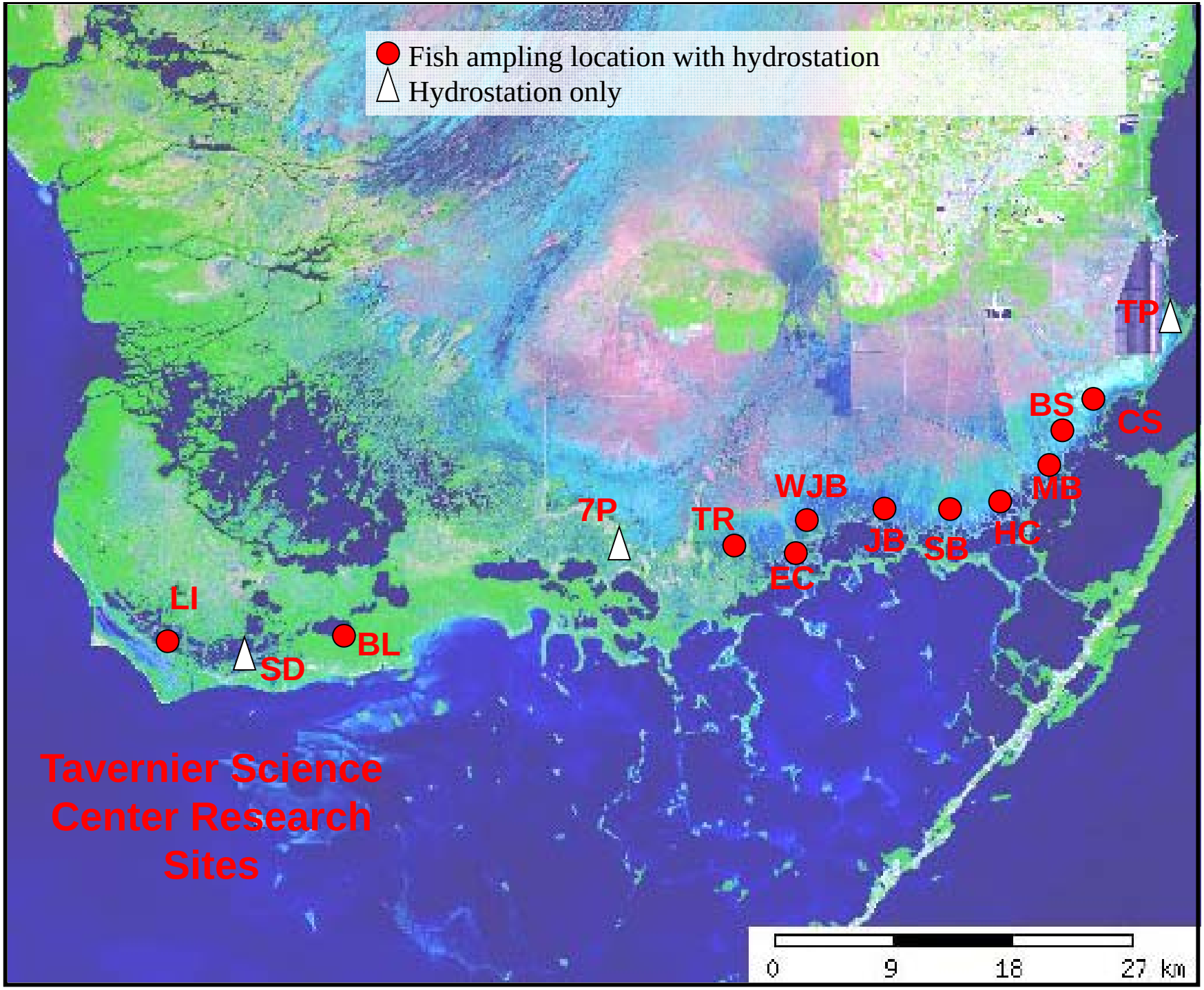
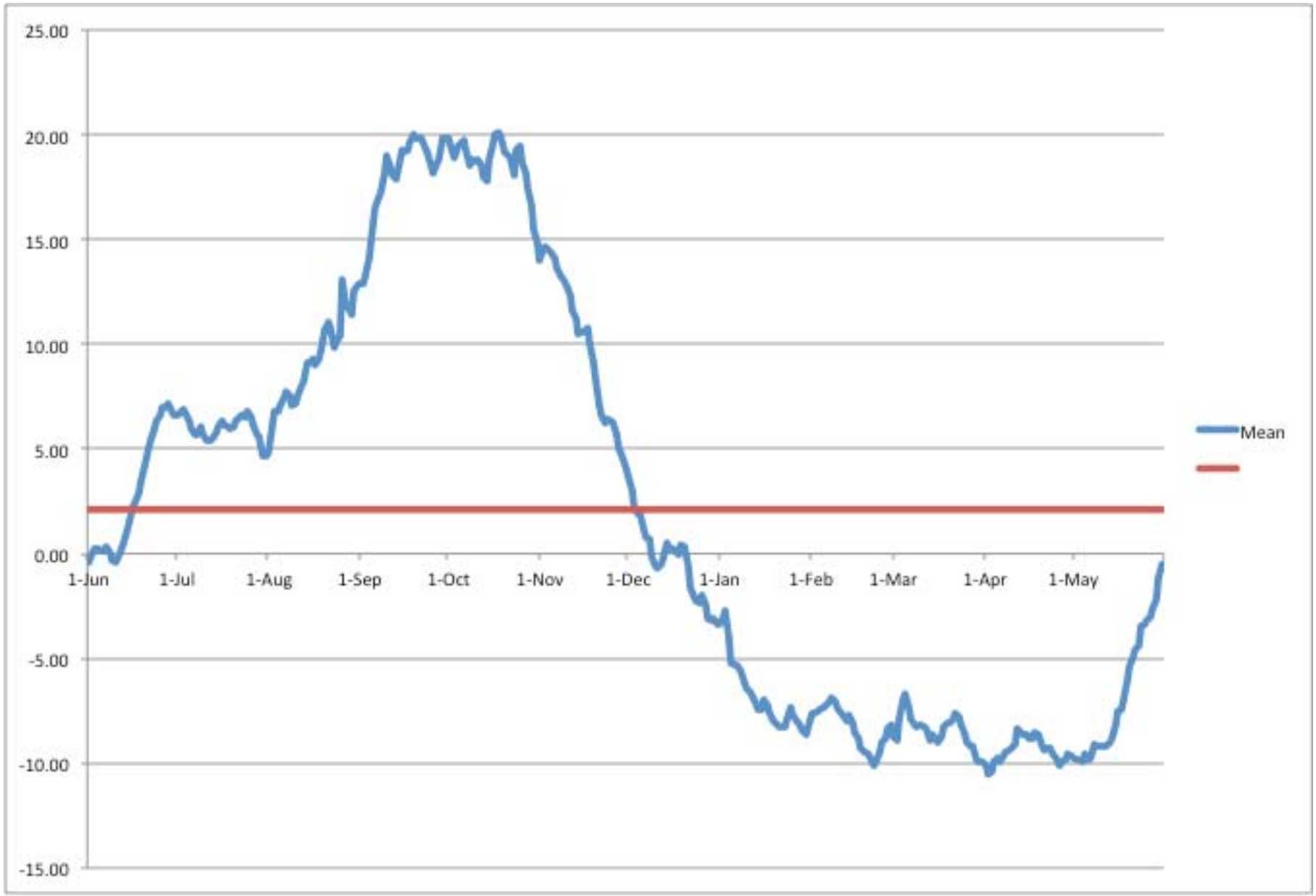
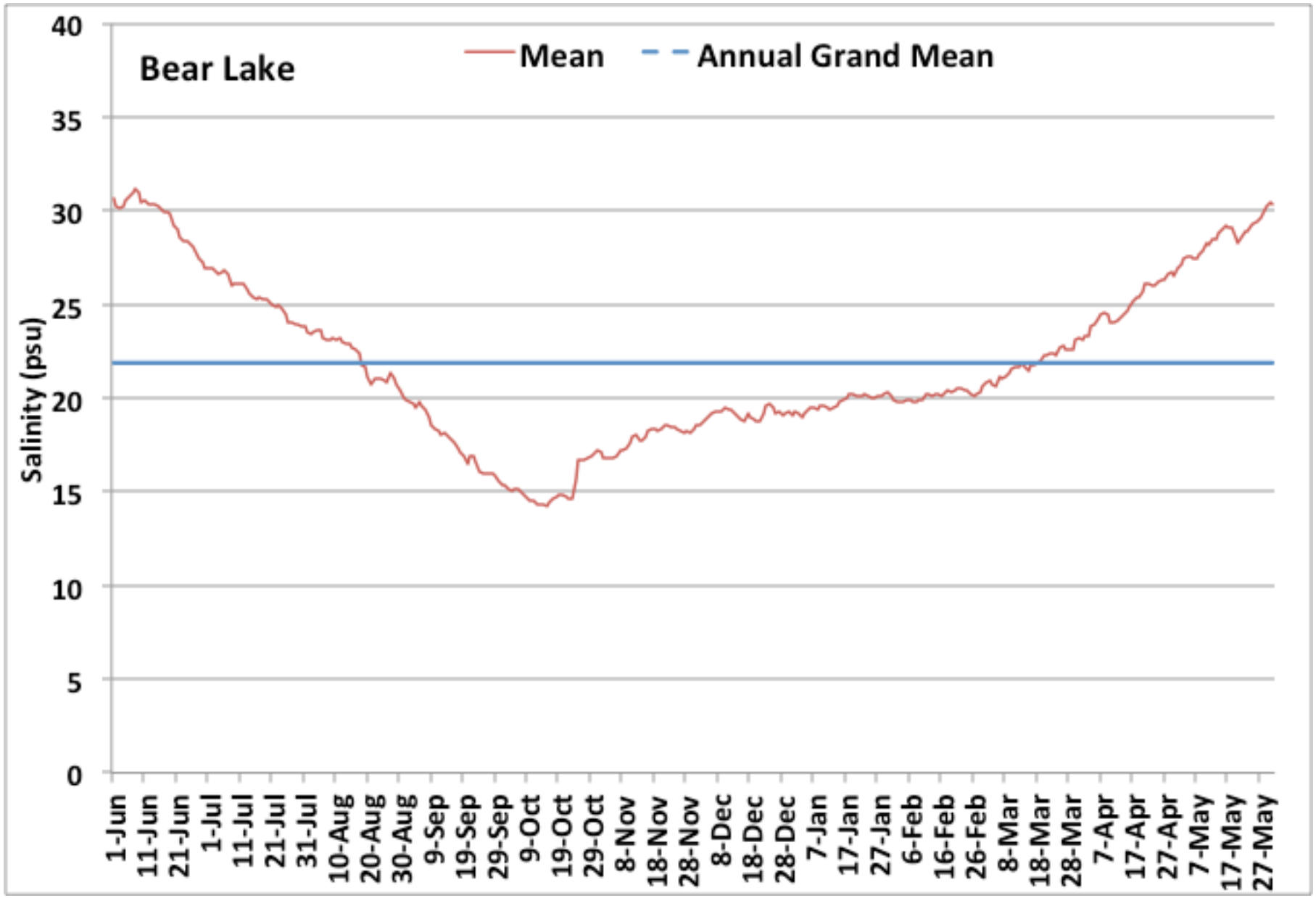
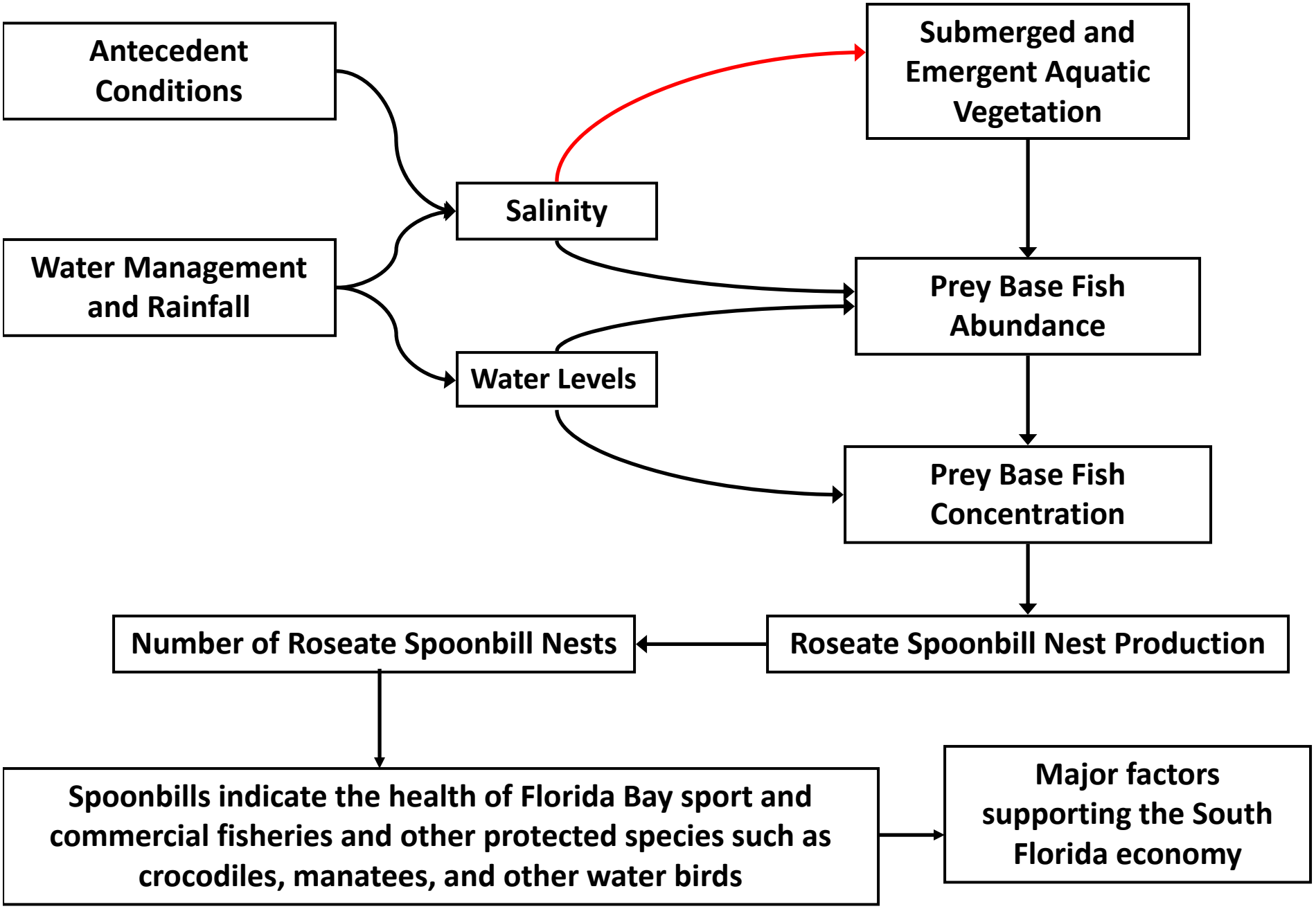

Fish ampling location with hydrostation
Hydrostation only
TP
BS
CS
MB
WJB
7P
TR
JB
SB
HC
EC
LI
SD
BL
Tavernier Science Center Research Sites
0
9
18
27 km


25.00
20.00
15.00
10.00
5.00
0.00
-5.00
-10.00
-15.00
1-Jun
1-Jul
1-Aug
1-Sep
1-Oct
1-Nov
1-Dec
1-Jan
1-Feb
1-Mar
1-Apr
1-May
Mean


Bear Lake
Mean
Annual Grand Mean
Salinity (psu)
40
35
30
25
20
15
10
5
0
1-Jun
11-Jun
21-Jun
1-Jul
11-Jul
21-Jul
31-Jul
10-Aug
20-Aug
30-Aug
9-Sep
19-Sep
29-Sep
9-Oct
19-Oct
29-Oct
8-Nov
18-Nov
28-Nov
8-Dec
18-Dec
28-Dec
7-Jan
17-Jan
27-Jan
6-Feb
16-Feb
26-Feb
8-Mar
18-Mar
28-Mar
7-Apr
17-Apr
27-Apr
7-May
17-May
27-May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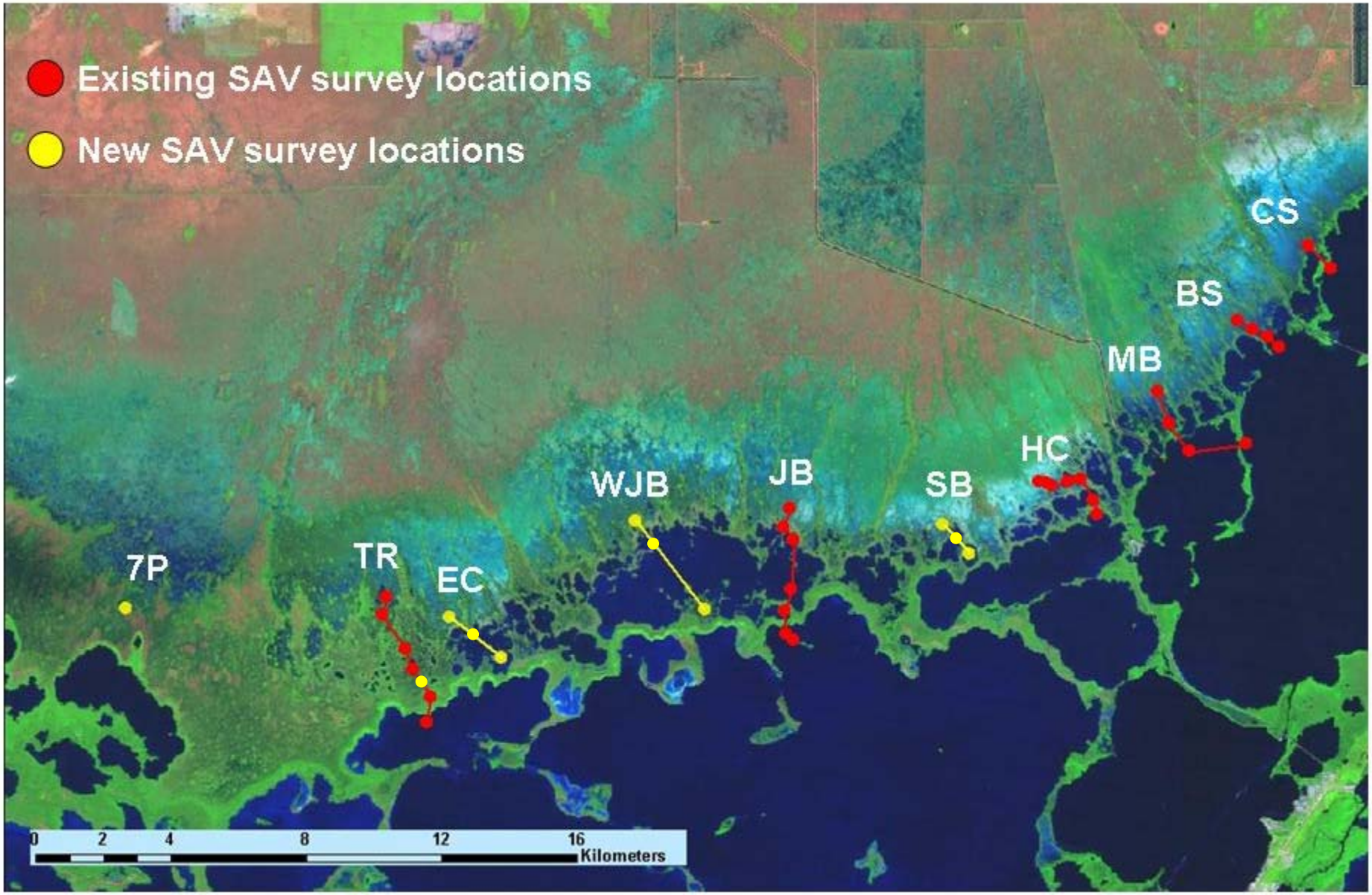
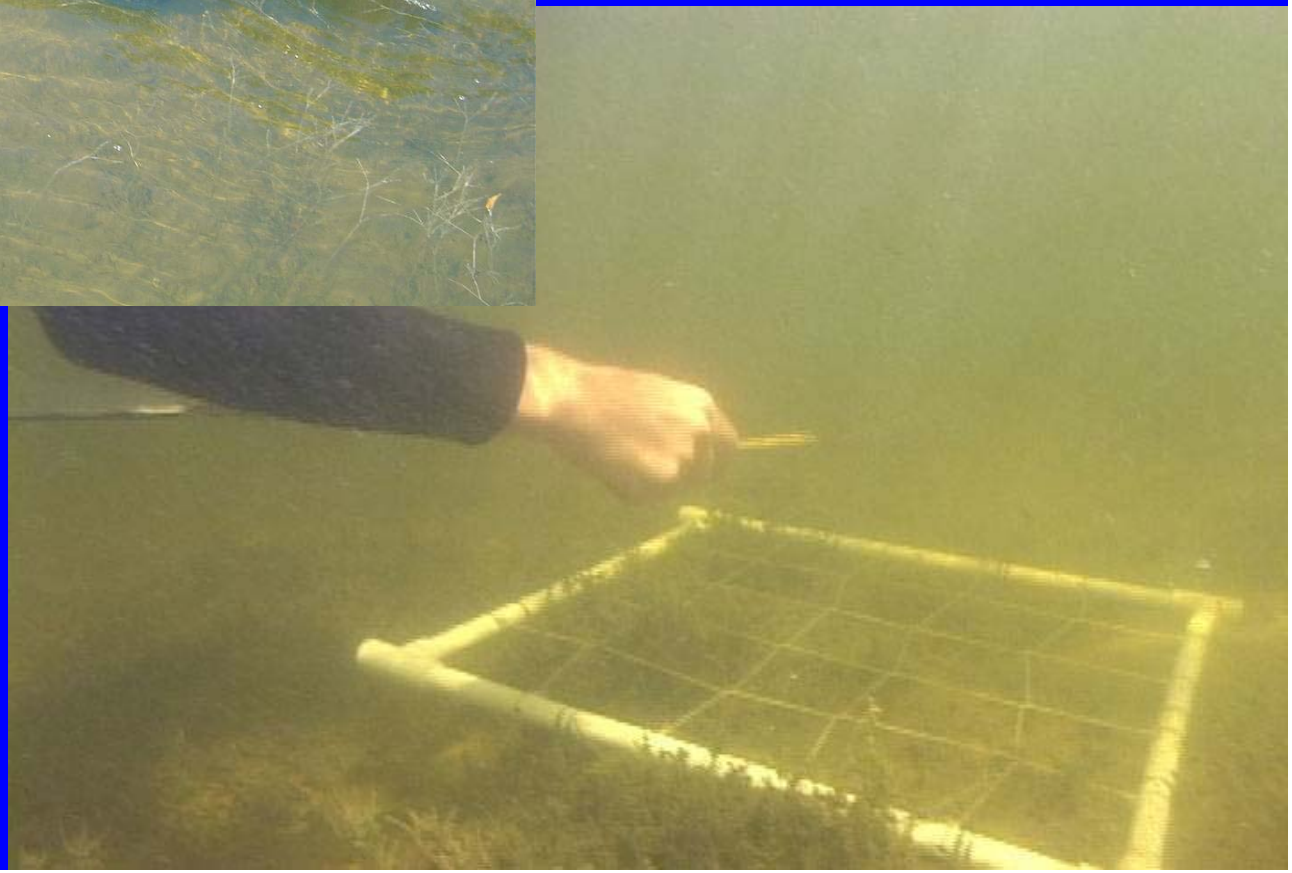
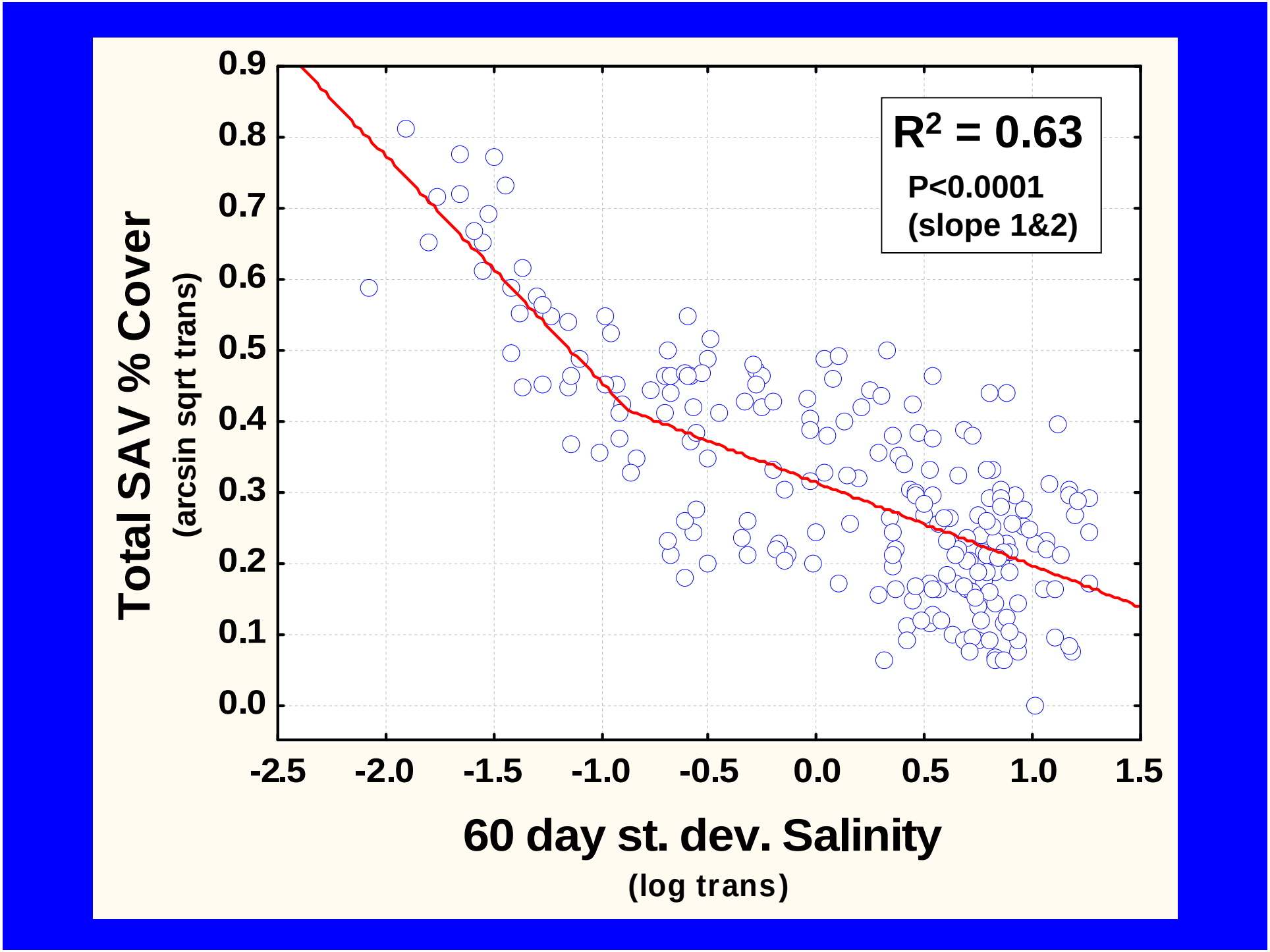
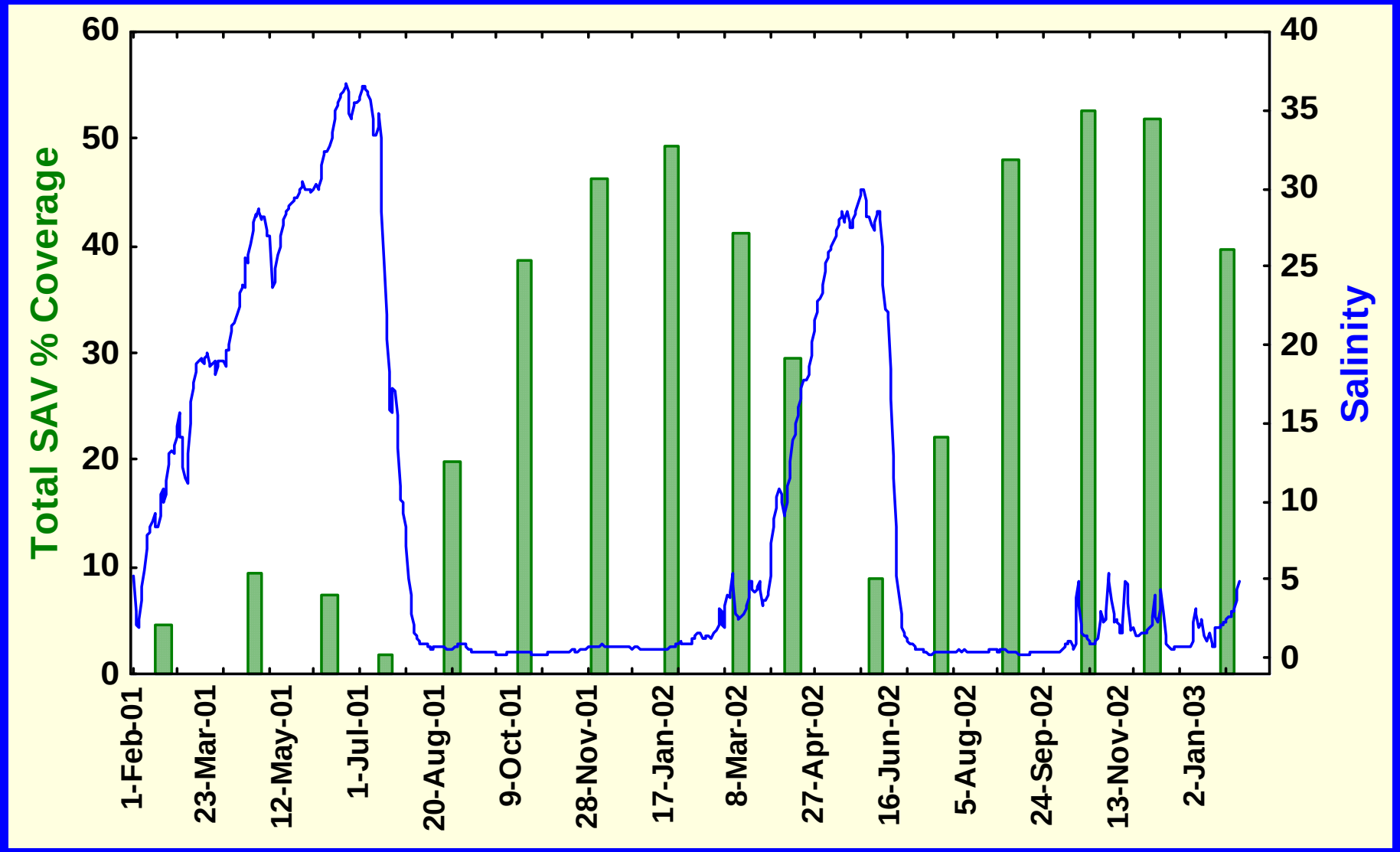
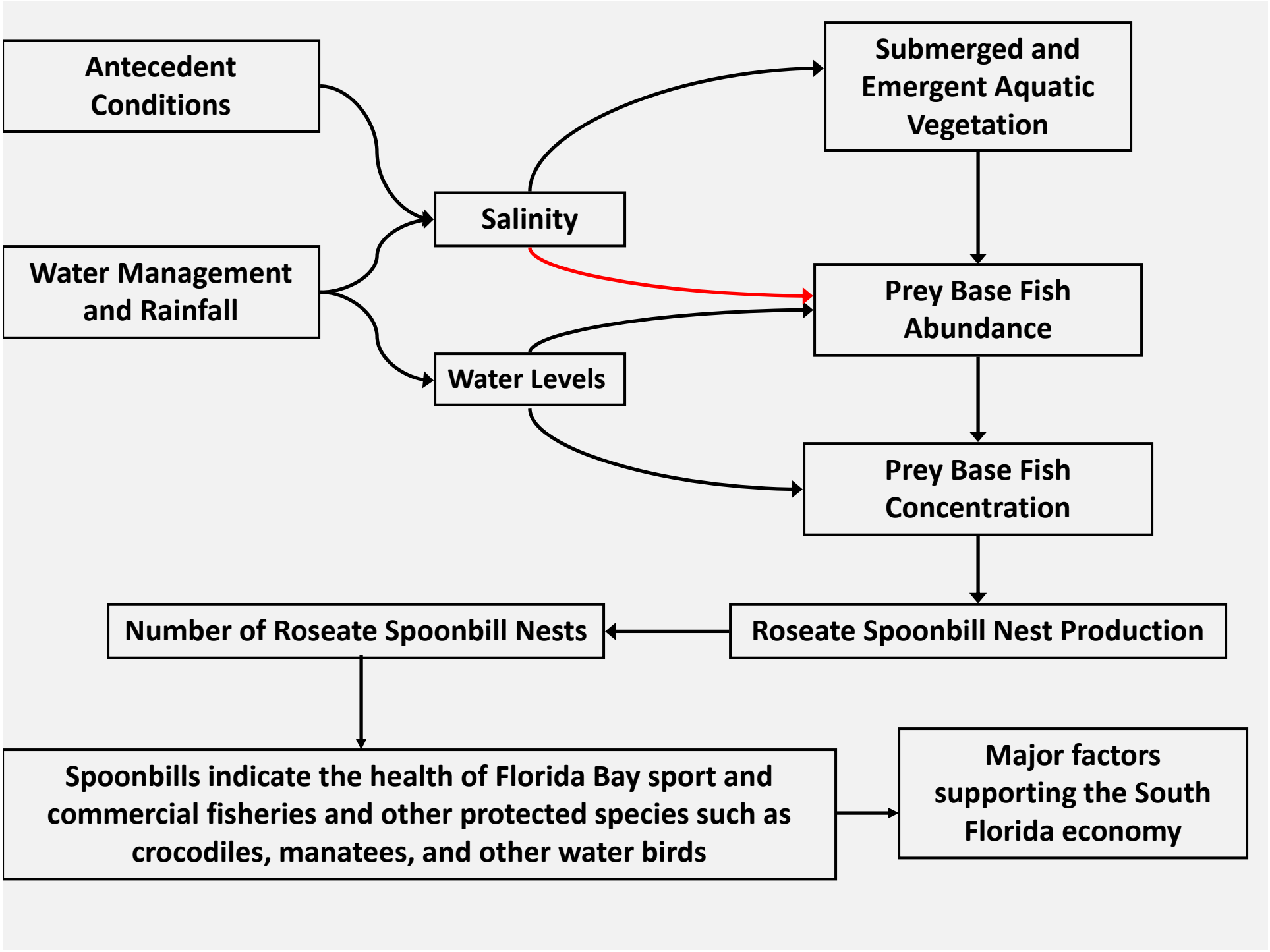
Audubon of Florida SAV monitoring transects






Total SAV % Cover
(arcsin sqrt trans)
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
R² = 0.63
P<0.0001
(slope 1&2)
-2.5
-2.0
-1.5
-1.0
-0.5
0.0
0.5
1.0
1.5
60 day st. dev. Salinity
(log trans)


Total SAV % Coverage
Salinity
60
50
40
30
20
10
0
40
35
30
25
20
15
10
5
0
1-Feb-01
23-Mar-01
12-May-01
1-Jul-01
20-Aug-01
9-Oct-01
28-Nov-01
17-Jan-02
8-Mar-02
27-Apr-02
16-Jun-02
5-Aug-02
24-Sep-02
13-Nov-02
2-Jan-03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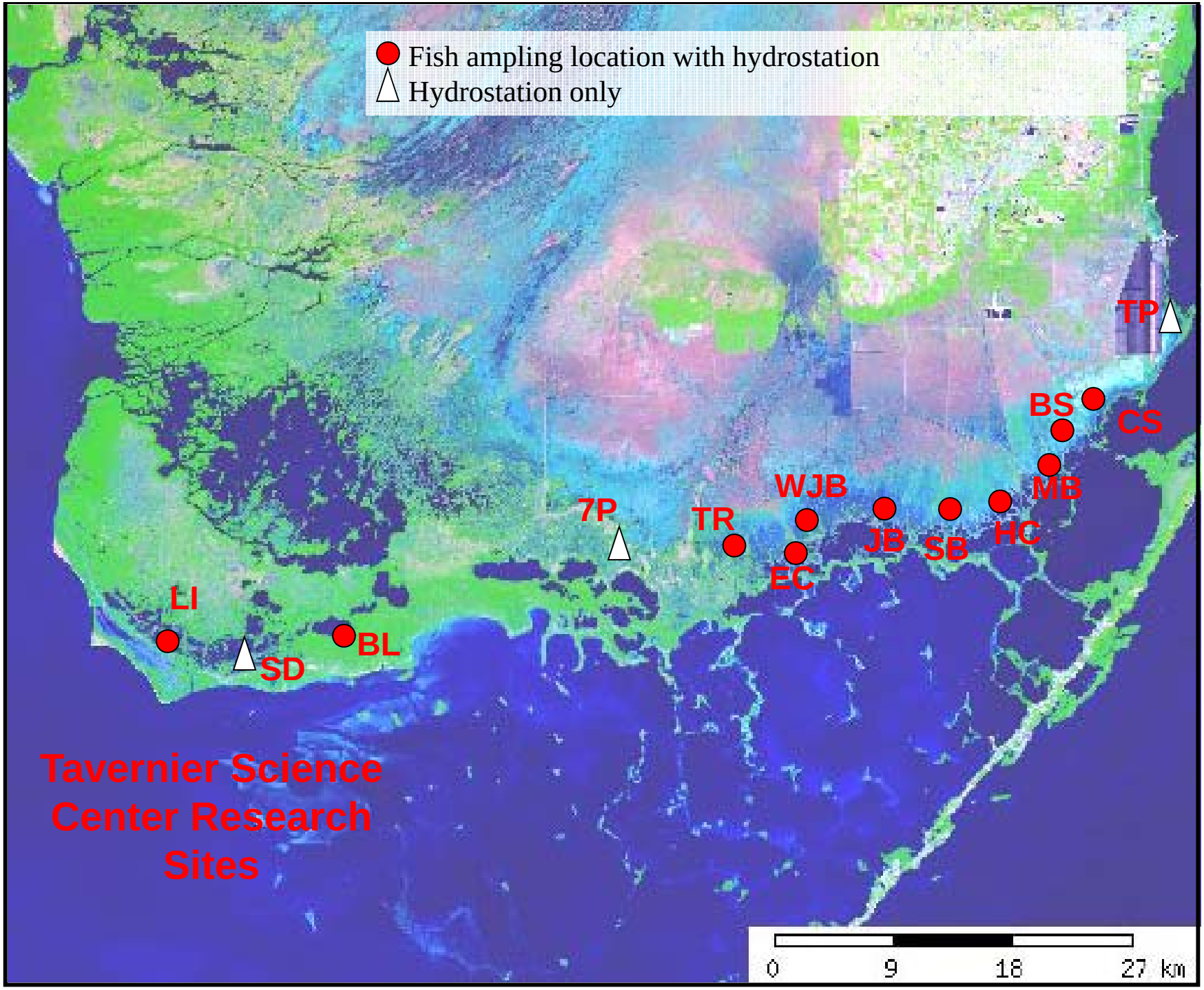
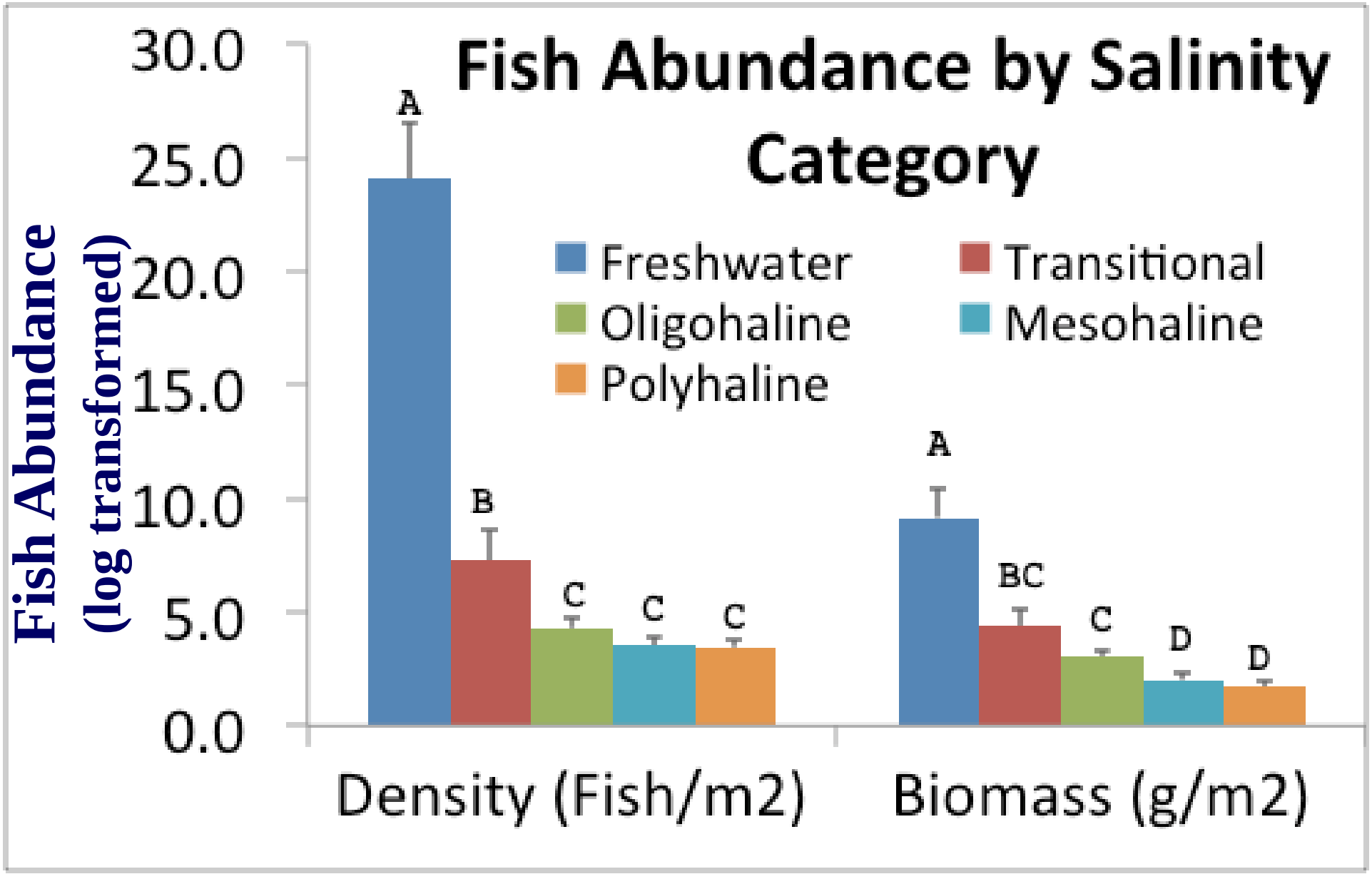
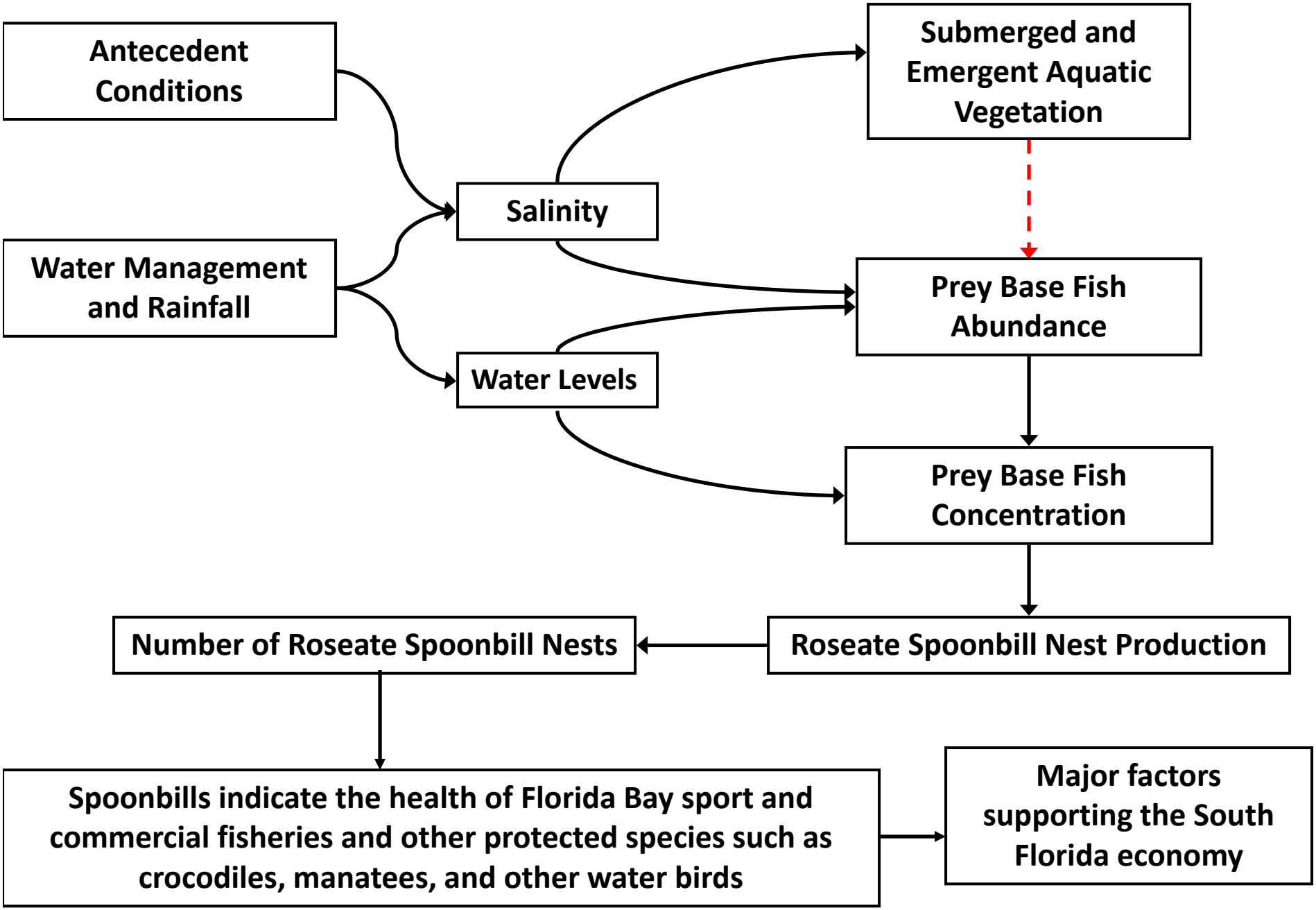

Fish ampling location with hydrostation
Hydrostation only
TP
BS
CS
MB
WJB
7P
TR
JB
SB
HC
EC
LI
SD
BL
Tavernier Science Center Research Sites
0
9
18
27 km


Fish Abundance by Salinity Category
Fish Abundance (log transformed)
30.0
25.0
20.0
15.0
10.0
5.0
0.0
Freshwater
Transitional
Oligohaline
Mesohaline
Polyhaline
A
B
C
C
C
A
BC
C
D
D
Density (Fish/m2)
Biomass (g/m2)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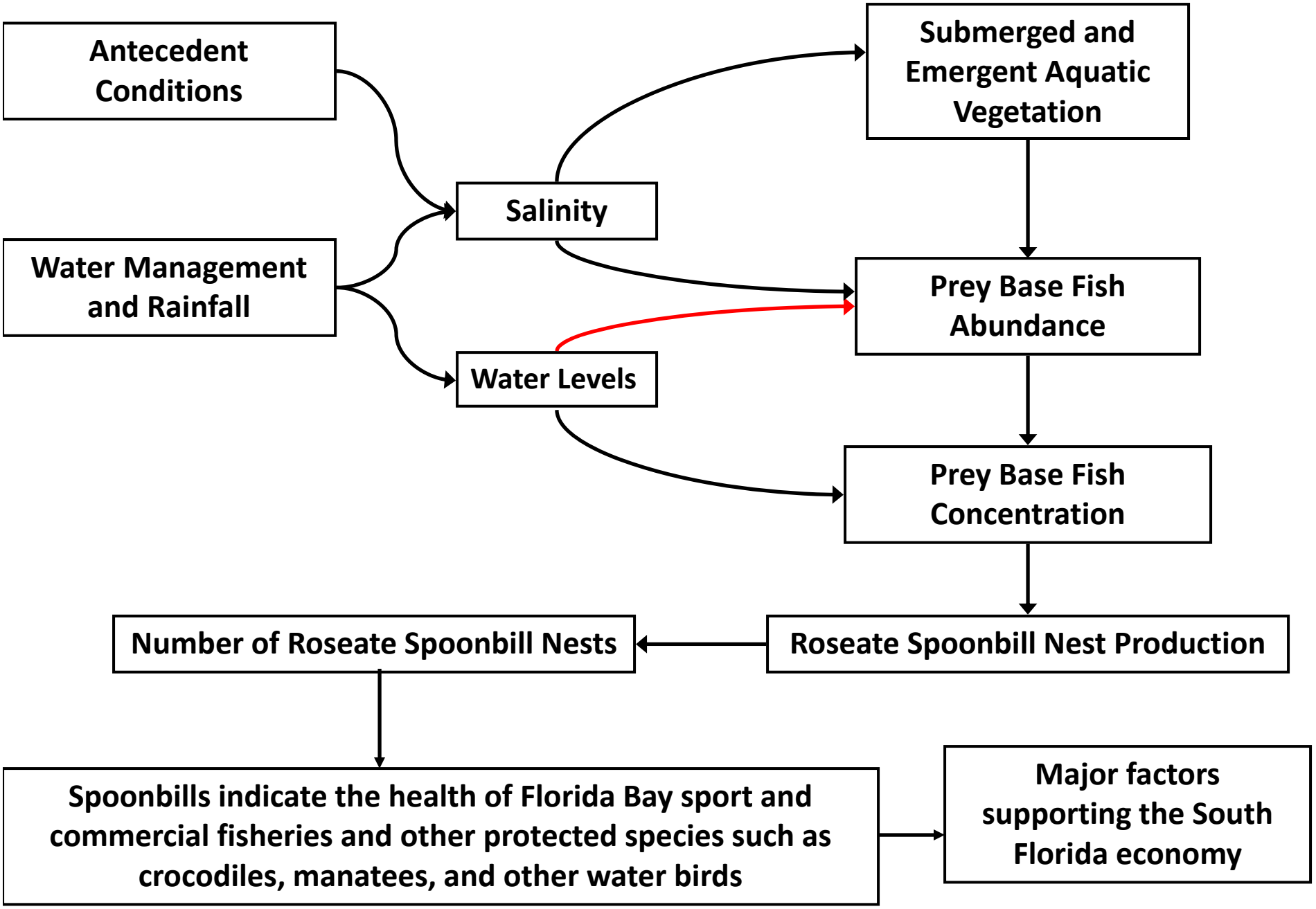
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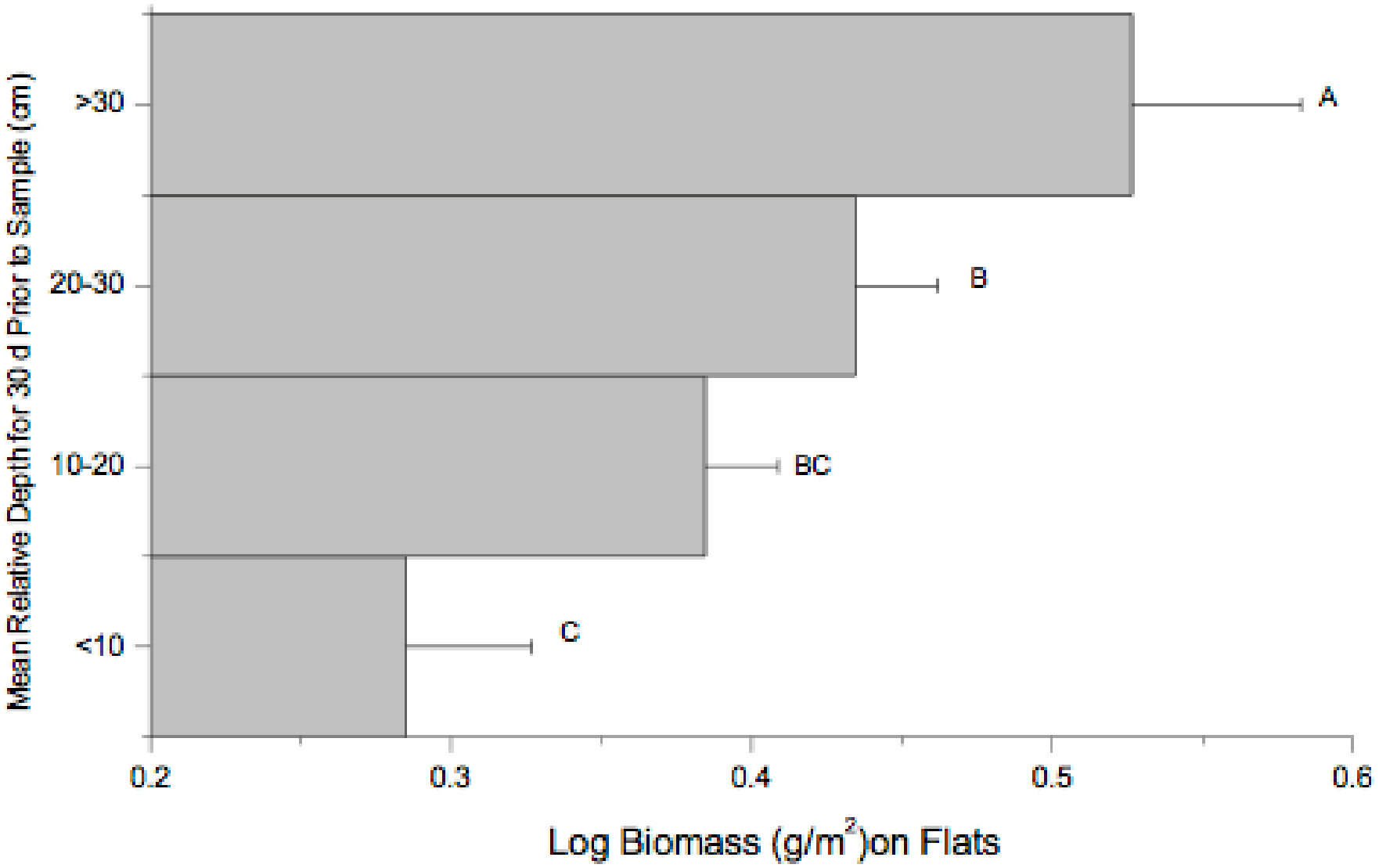
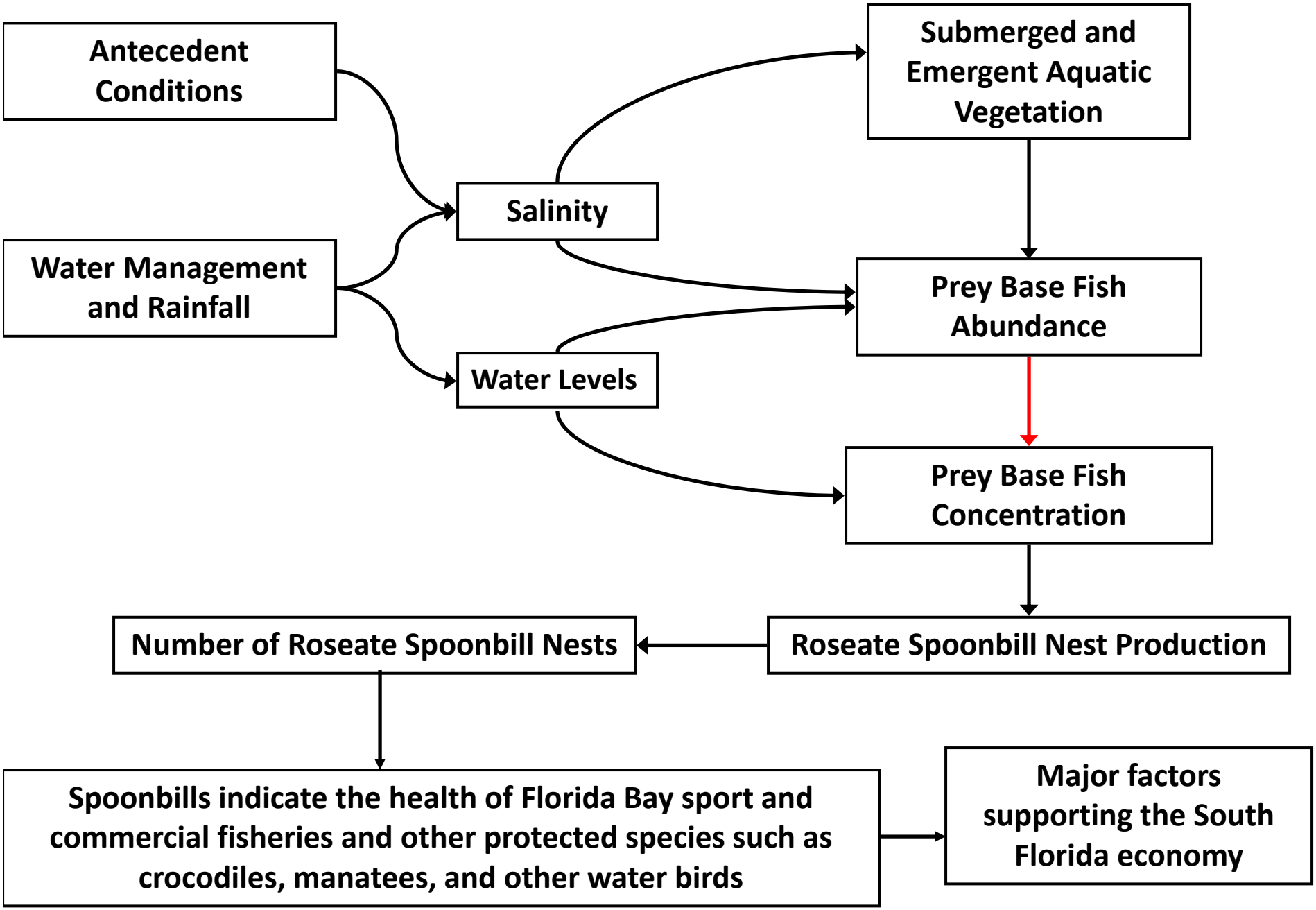

Mean Relative Depth for 30 d Prior to Sample (cm)
>30
20-30
10-20
<10
A
B
BC
C
0.2
0.3
0.4
0.5
0.6
Log Biomass (g/m2)on Flats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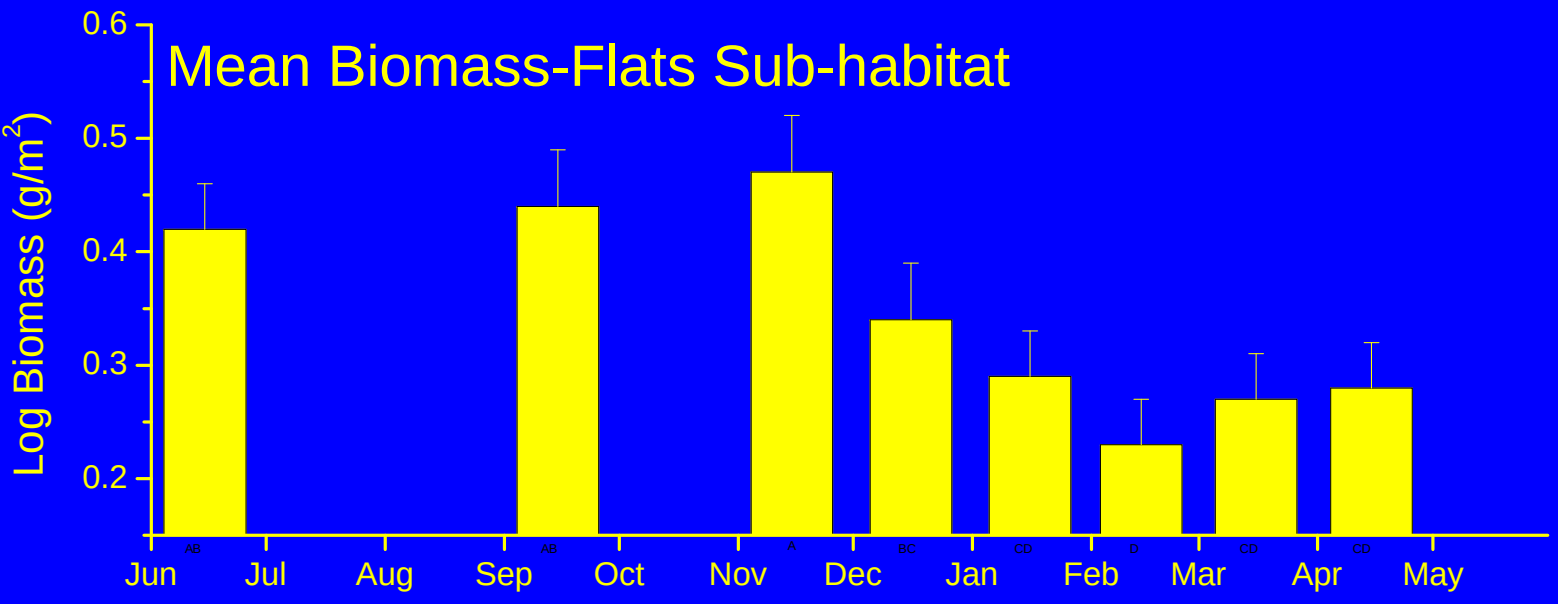

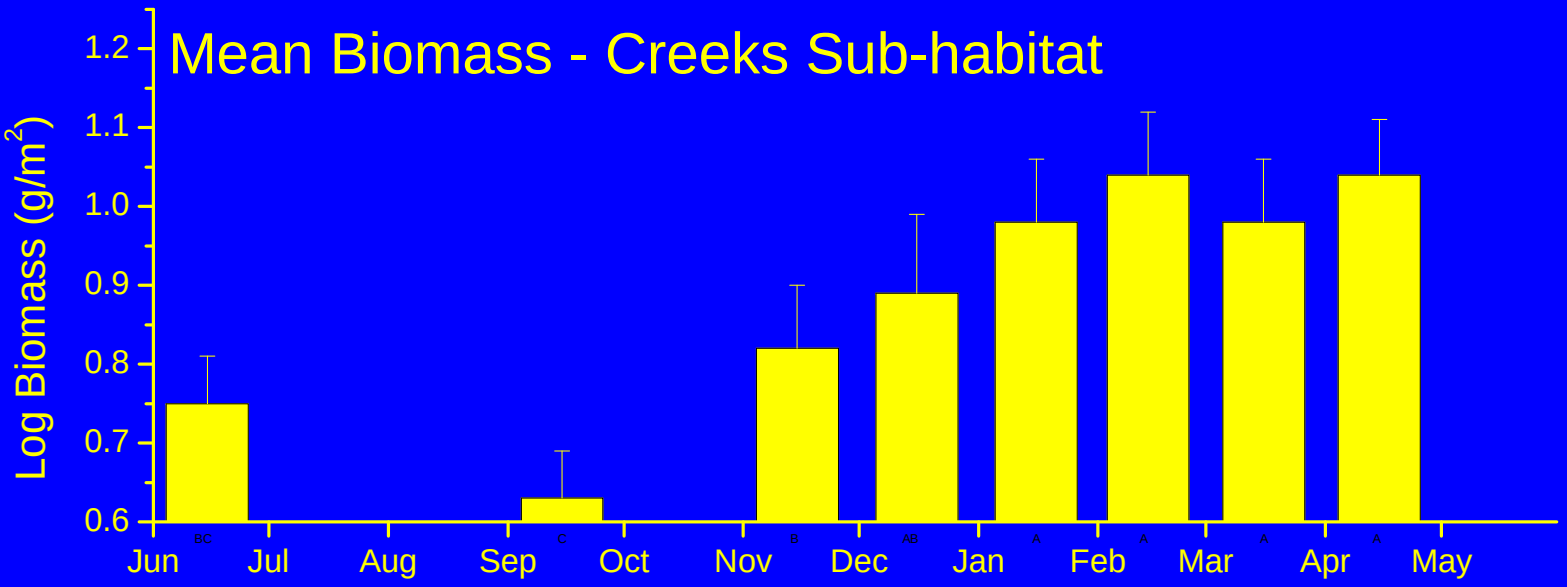

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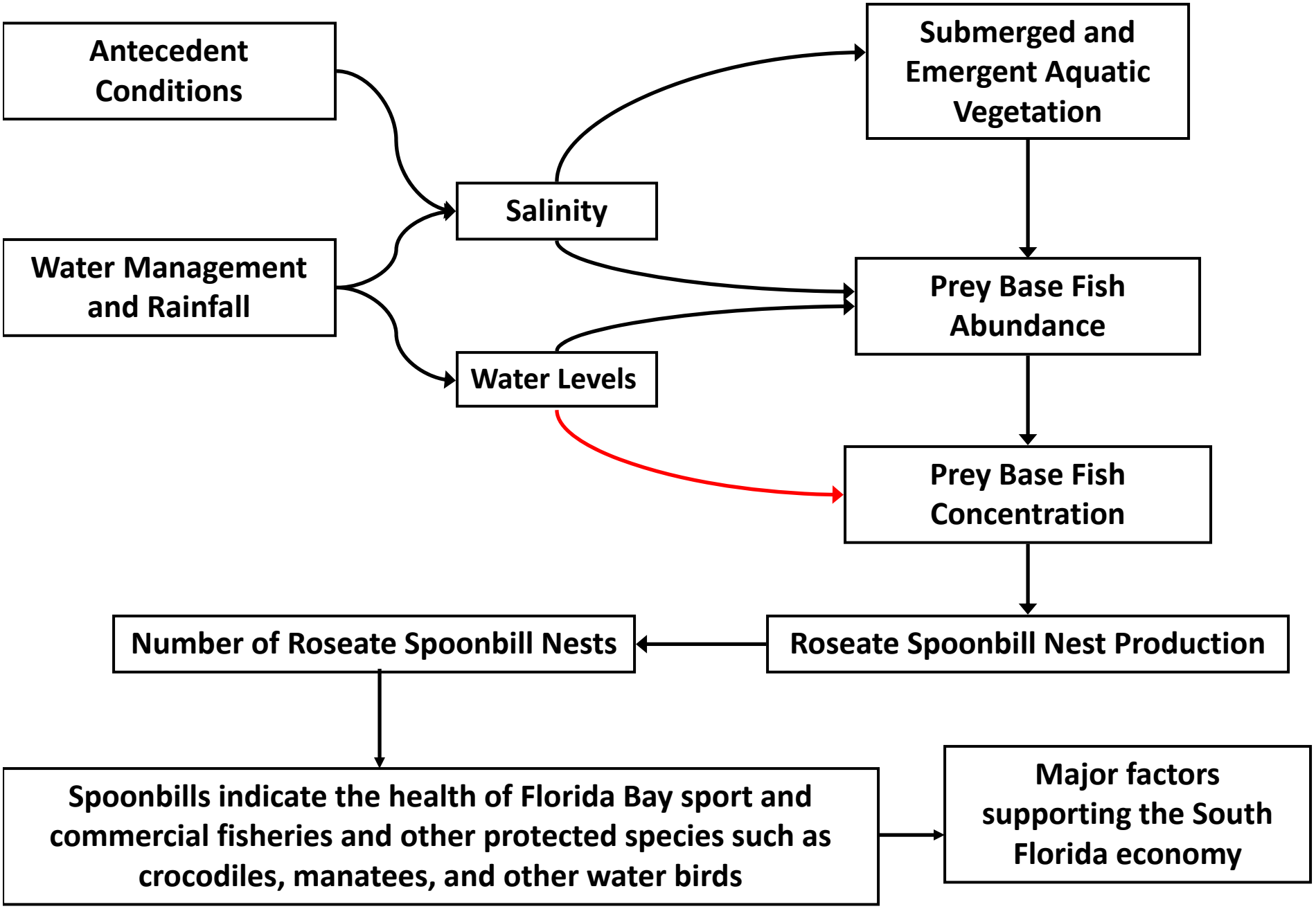
Lorenz and Heath, In prep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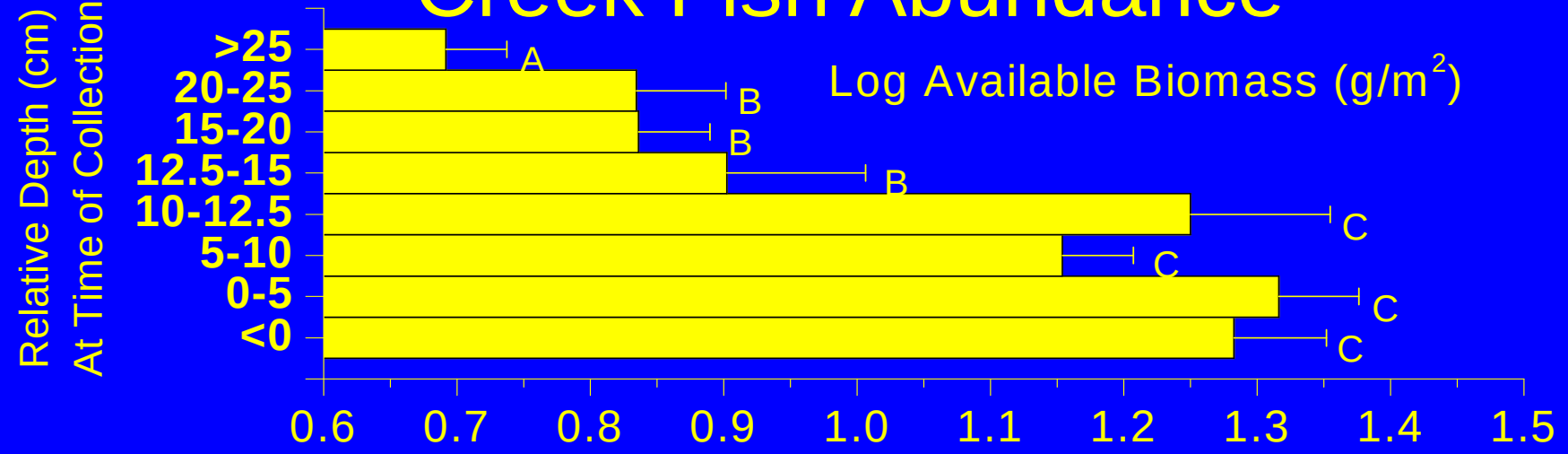
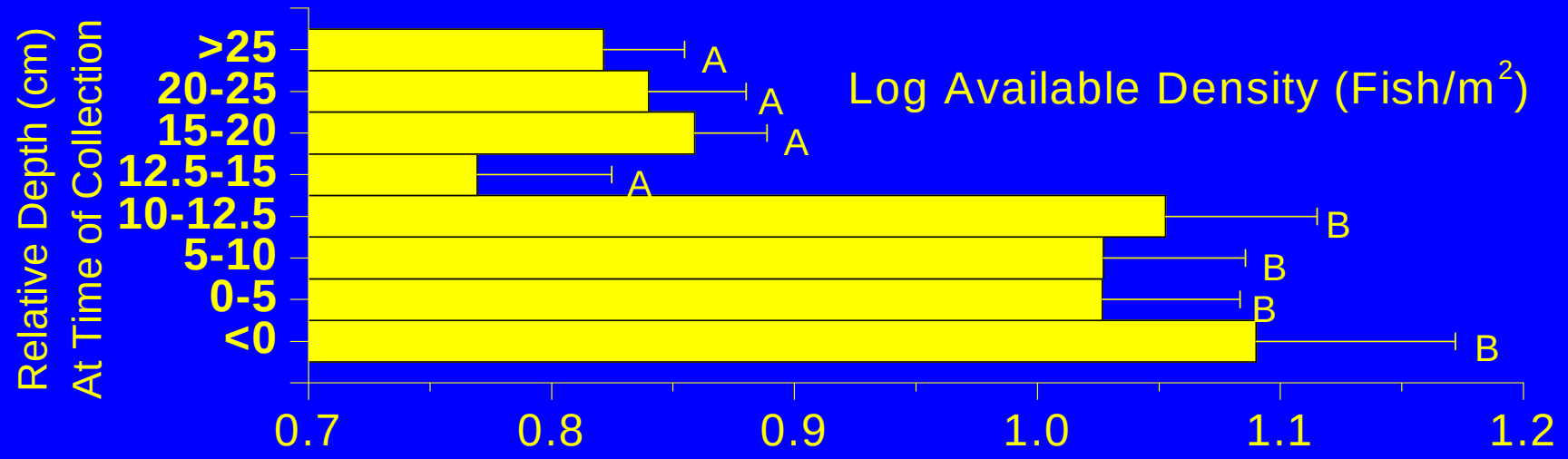
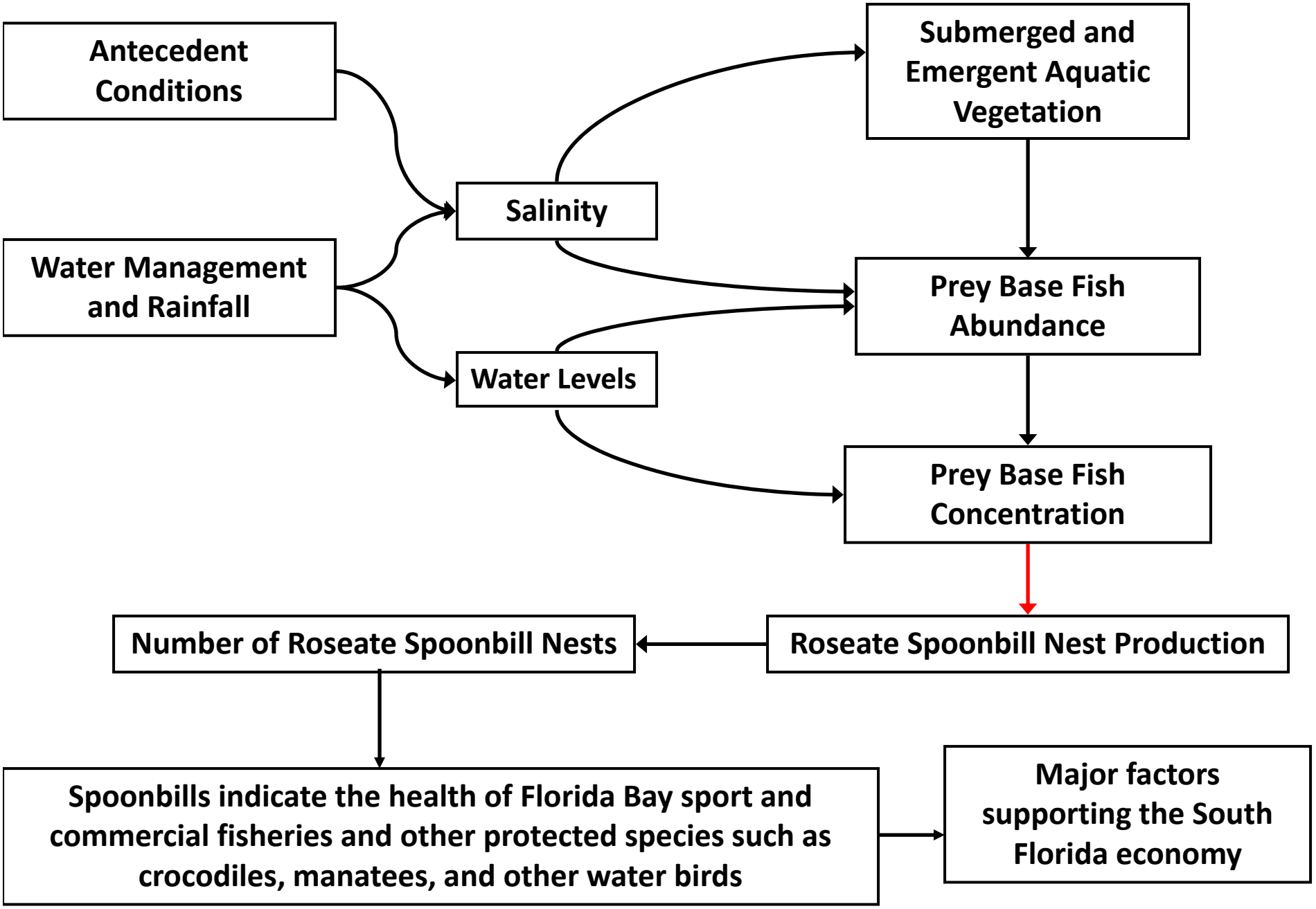
Creek Fish Abundance





Lorenz 2000, Ph.D. Dissertation RSMAS, U of Miami

Lorenz, Heath and Bennetts, In Prep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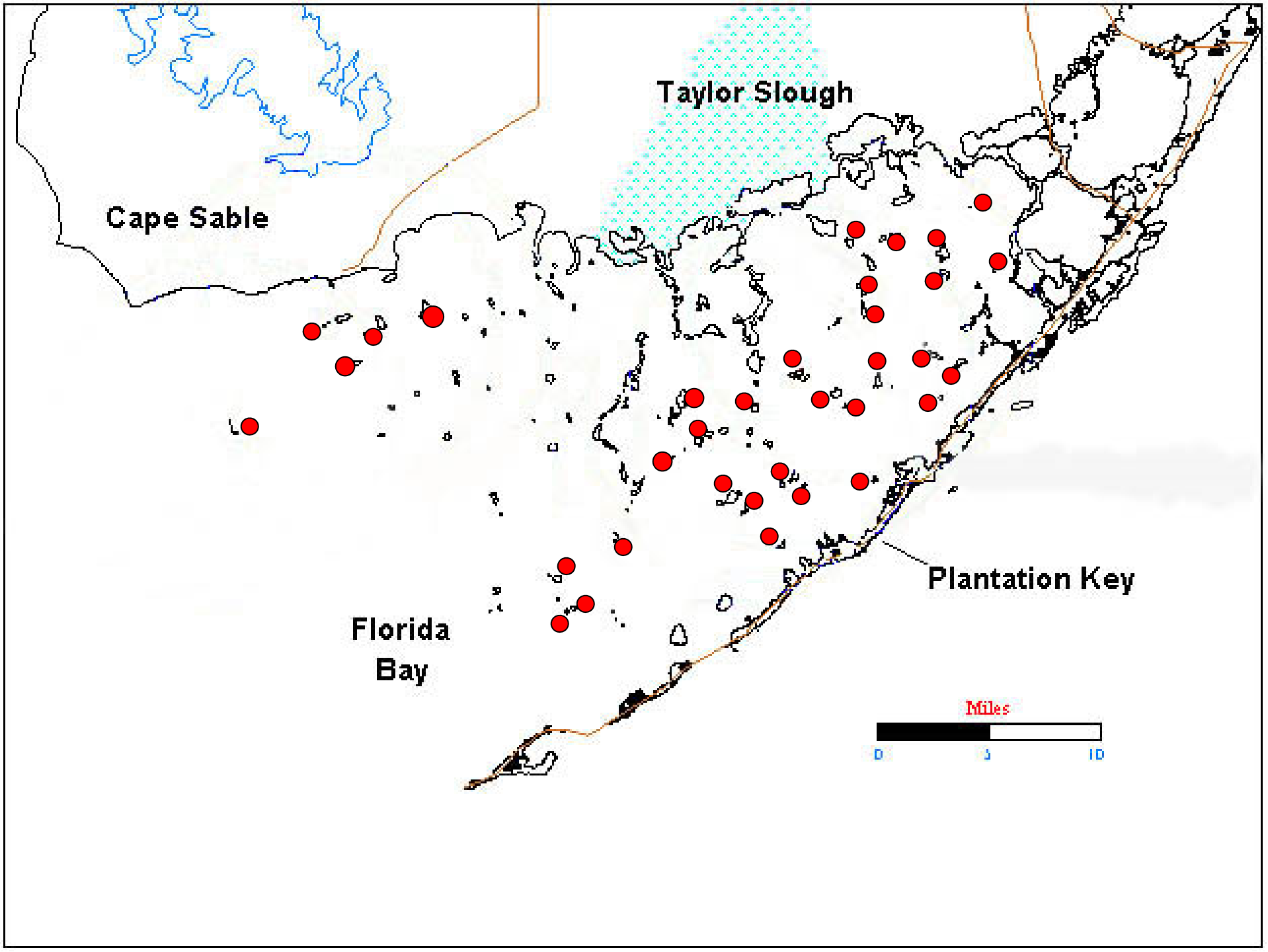
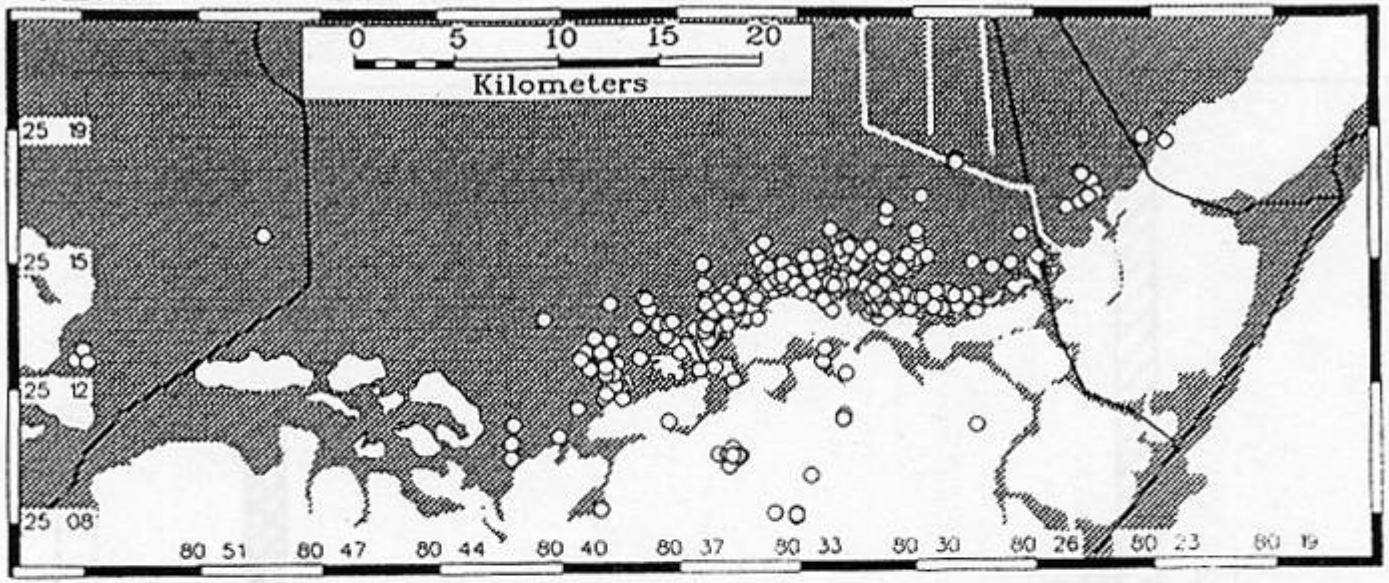
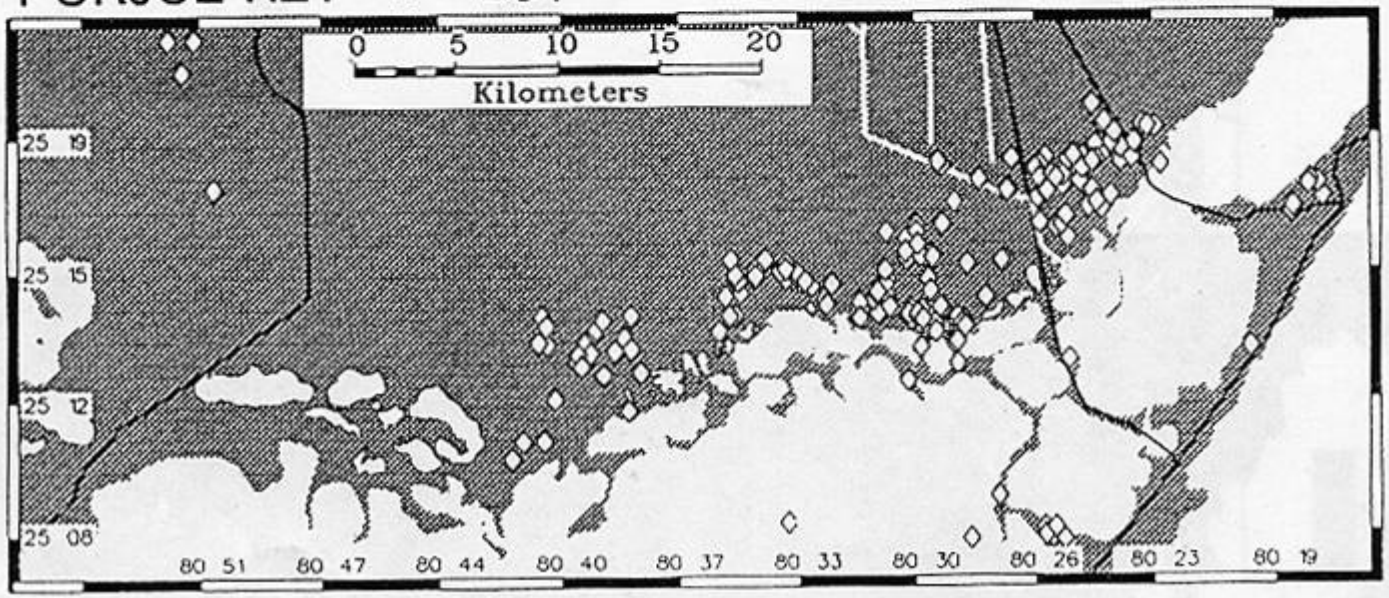

Taylor Slough
Cape Sable
Plantation Key
Florida
Bay
Miles
0
5
10

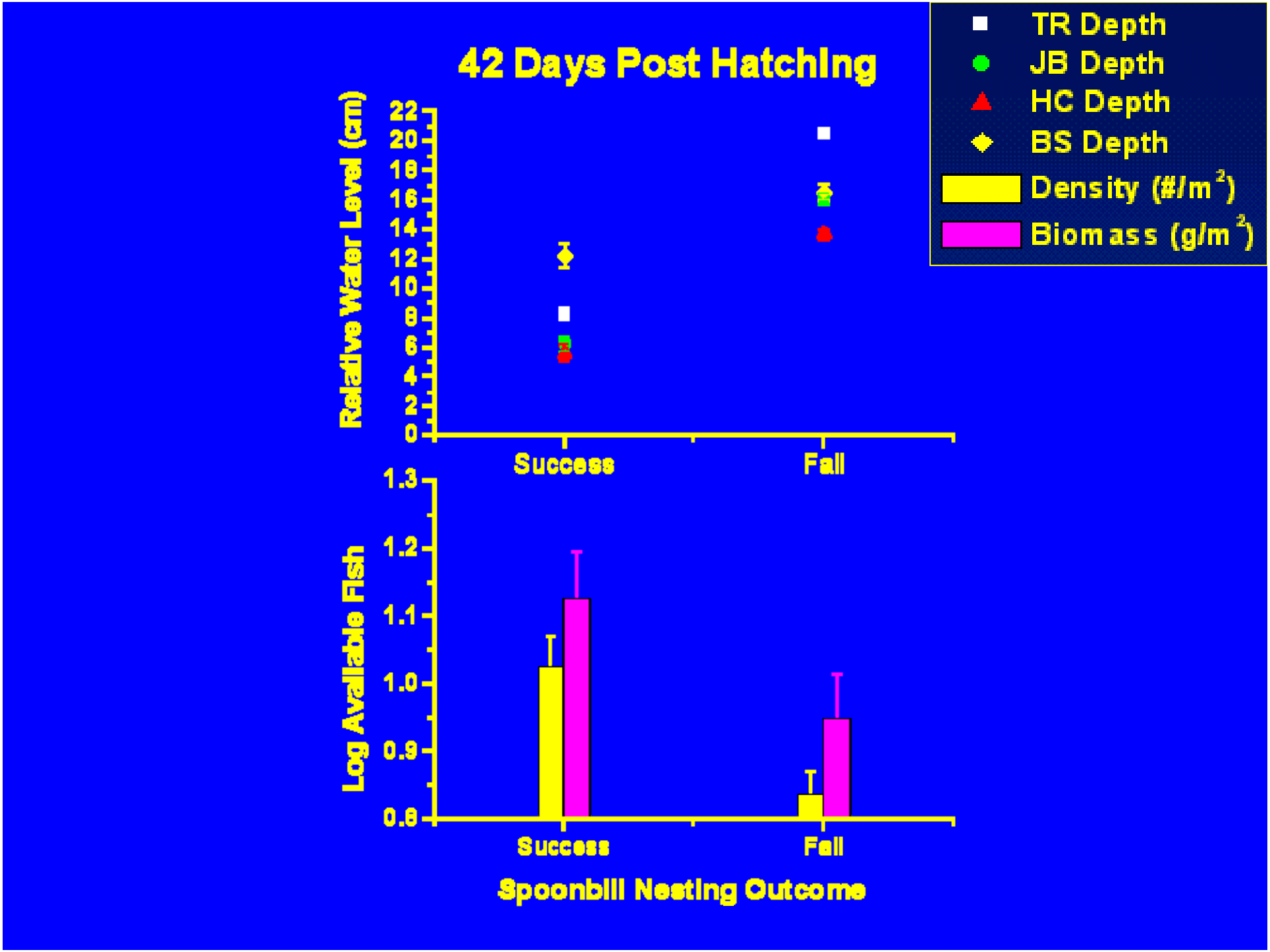
1990-91

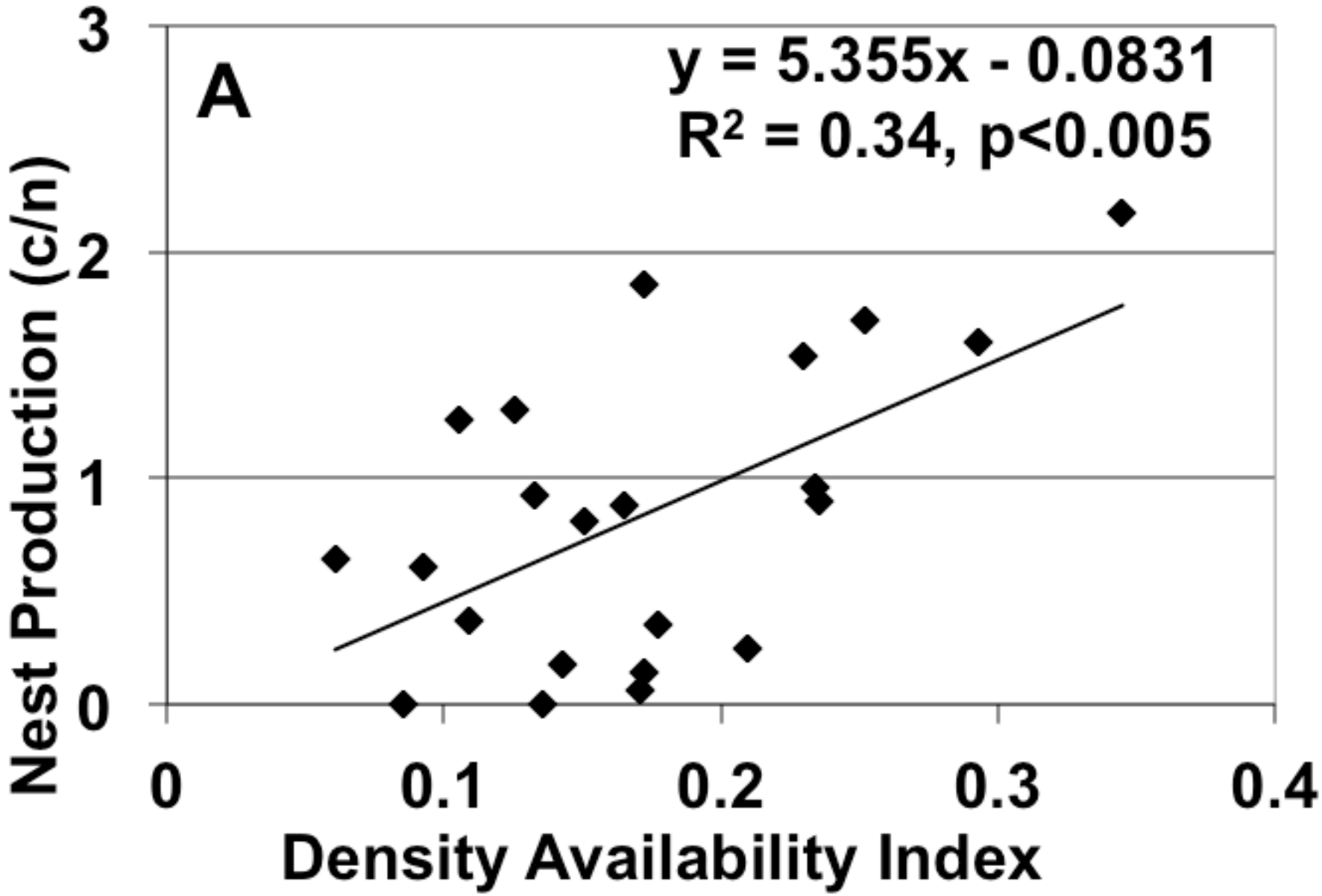
TERN KEY n = 438

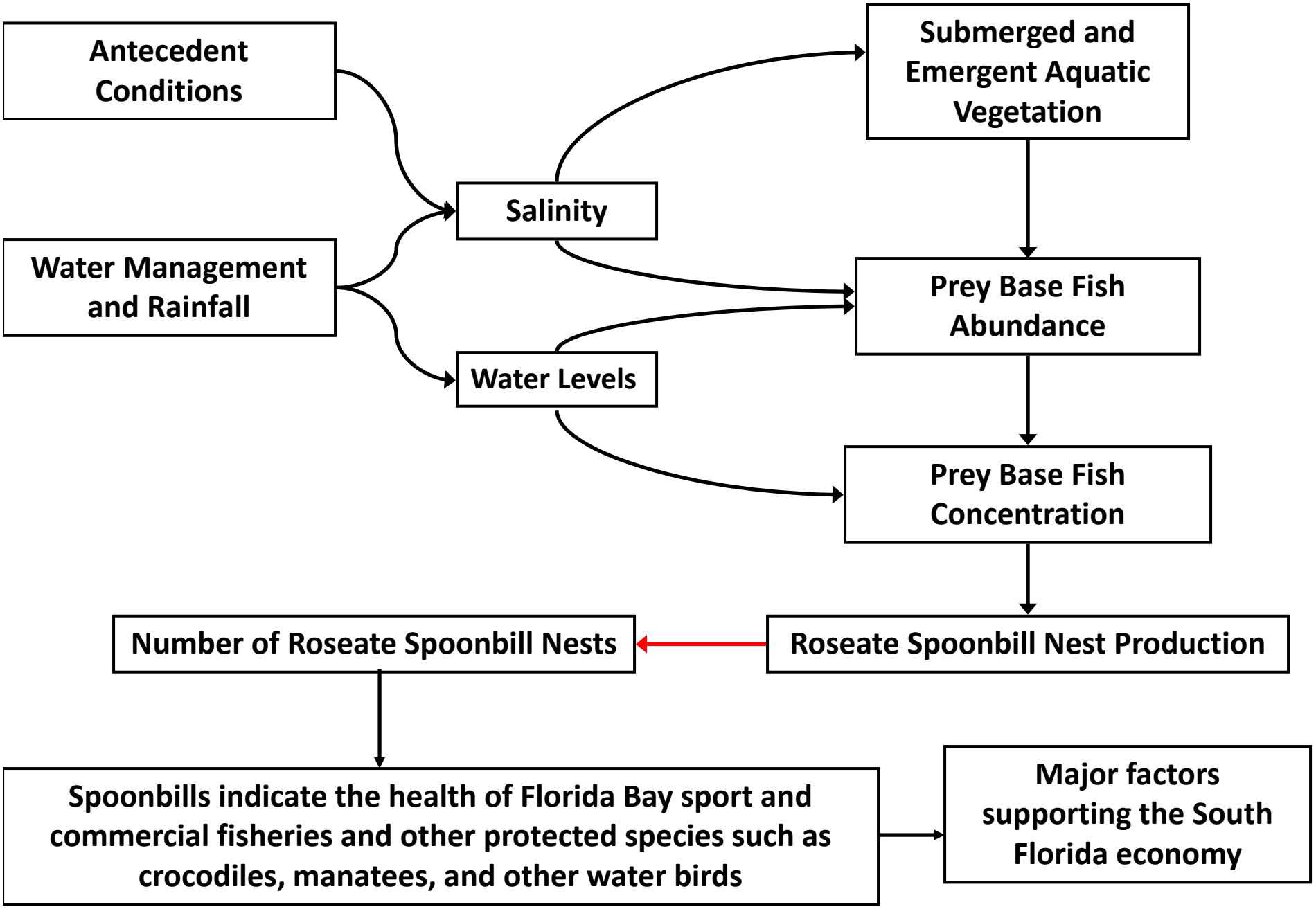


PORJOE KEY n = 264




42 Days Post Hatching
TR Depth
JB Depth
HC Depth
BS Depth
Density (#/m²)
Biomass (g/m²)
Relative Water Level (cm)
22
20
18
16
14
12
10
8
6
4
2
0
Success
Fail
Log Available Fish
1.3
1.2
1.1
1.0
0.9
0.8
Success
Fail
Spoonbill Nesting Outcome


A
y = 5.355x - 0.0831
R² = 0.34, p<0.005
Nest Production (c/n)
3
2
1
0
0
0.1
0.2
0.3
0.4
Density Availability Index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USGS

Colored with
Alpha/Numeric code

Colored without
Alpha/Numeric code

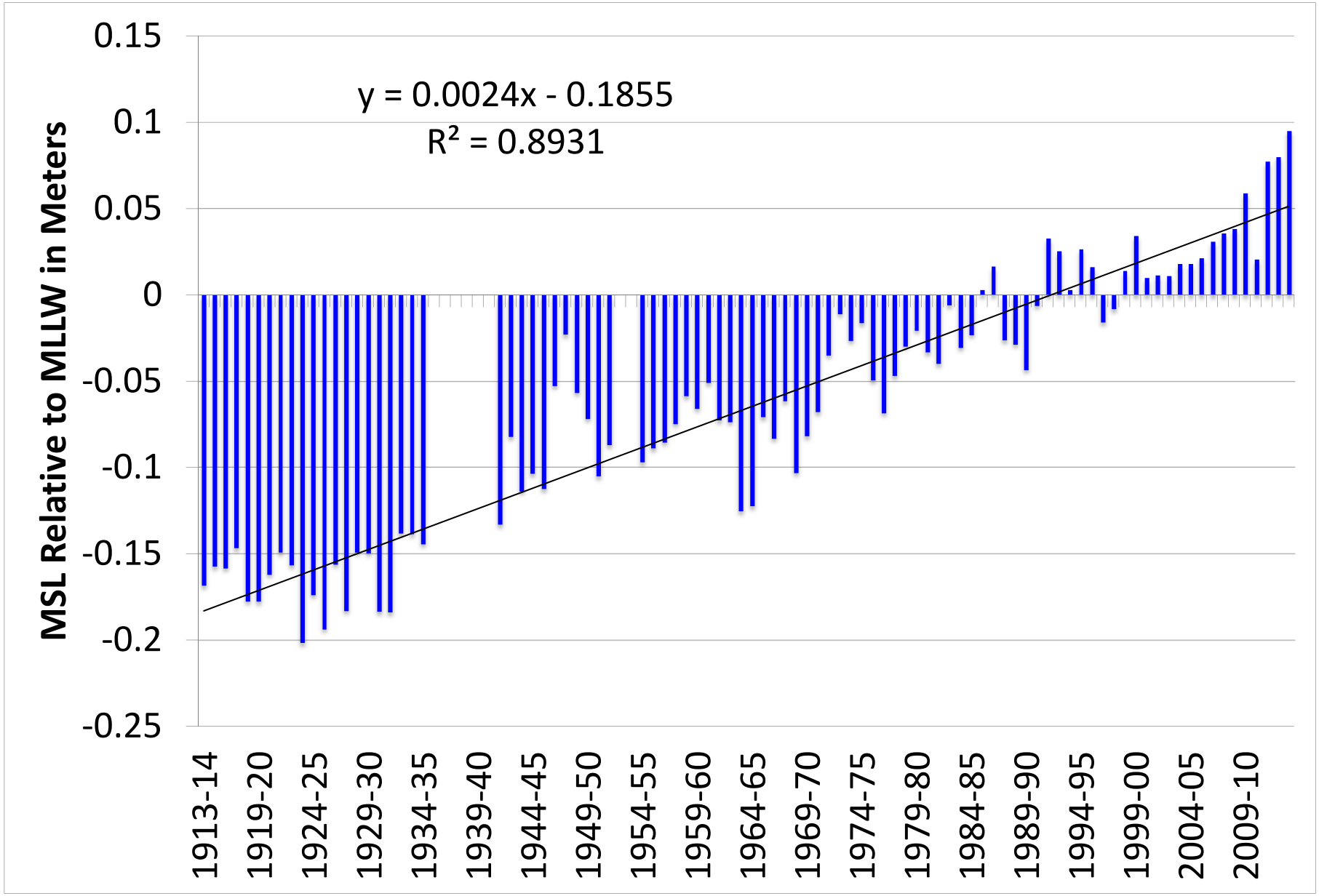
Location of Resights of Birds in Breeding Plumage (23 total resights) During Breeding Season

- In breeding colony
- In adjacent colony
- In colony of same bay
- On colony foraging ground
- Not in natal bay
- Disperser

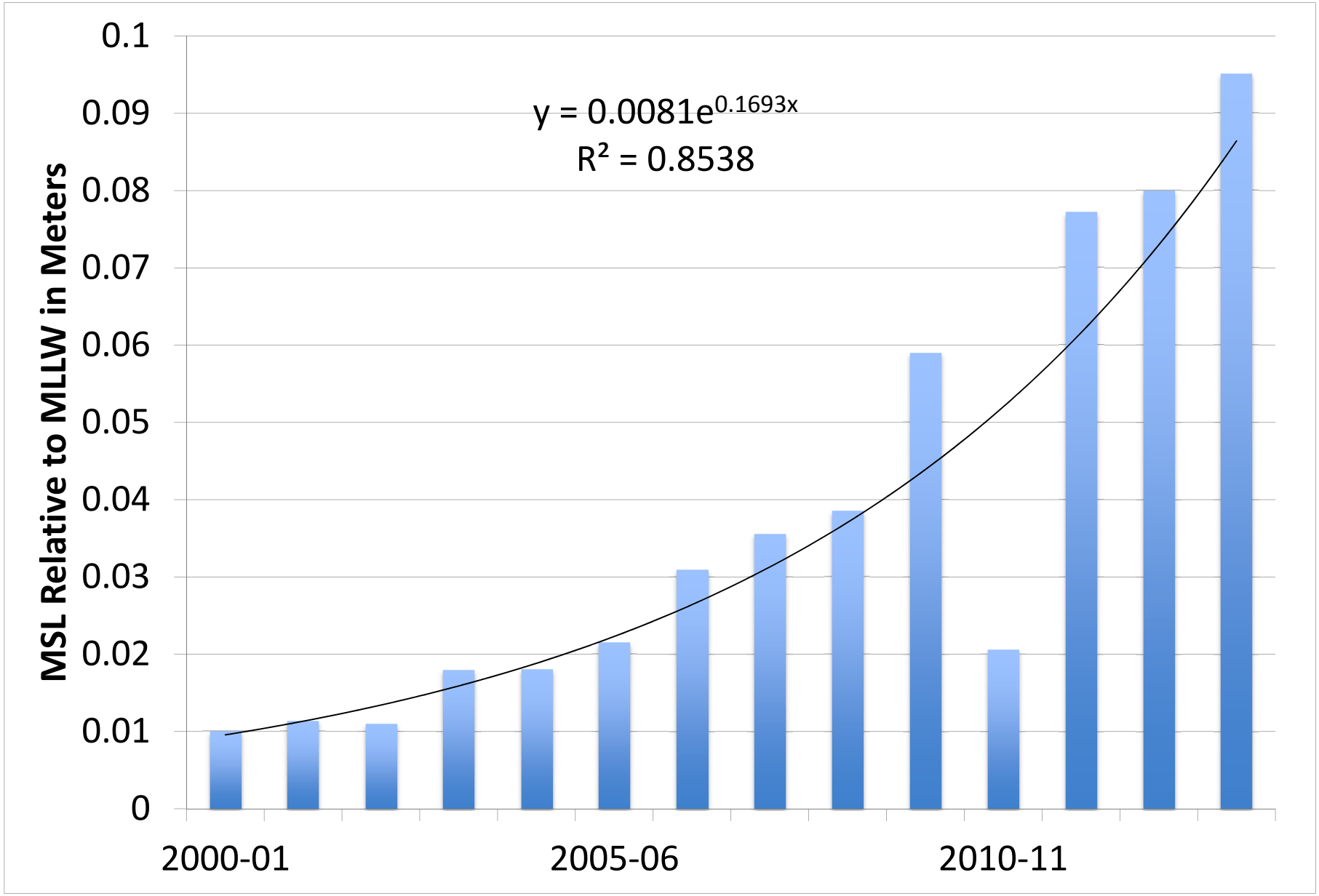
Sea Level Rise

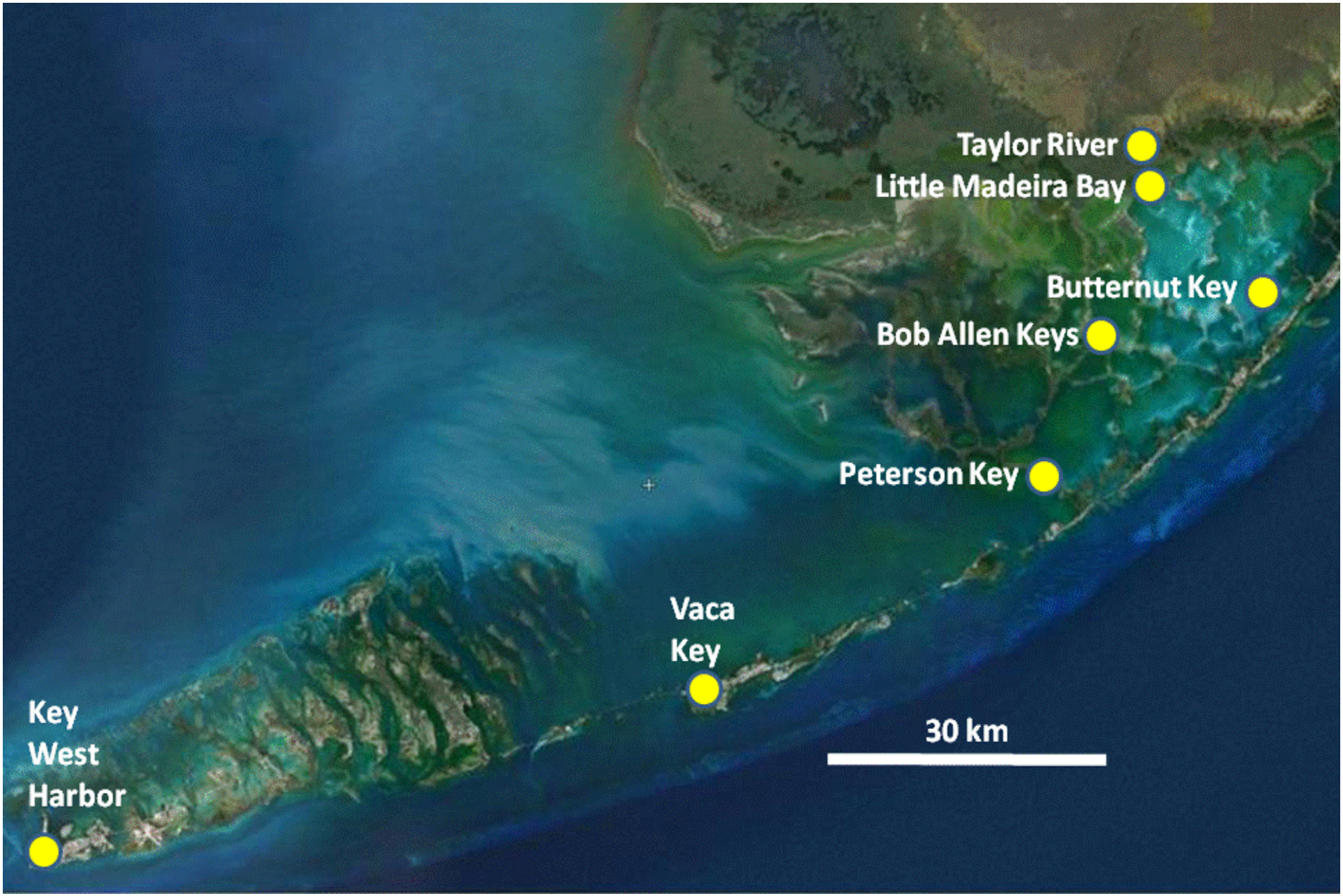
- A developing factor that adds a new parameter to the model

Annual Mean Water Level Key West Harbor 1913-2014

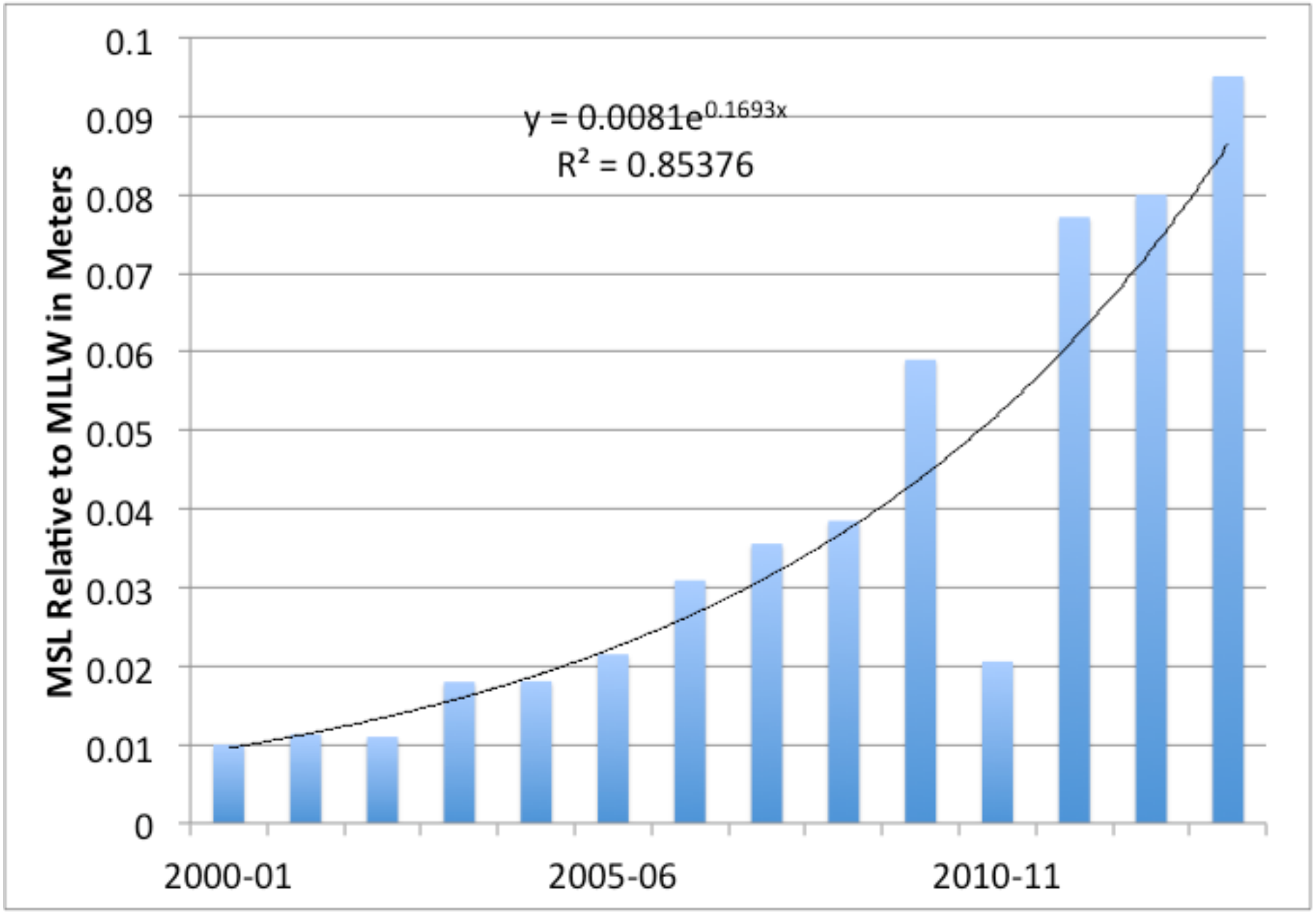


Annual Mean Water Level Key West Harbor 2000-2014

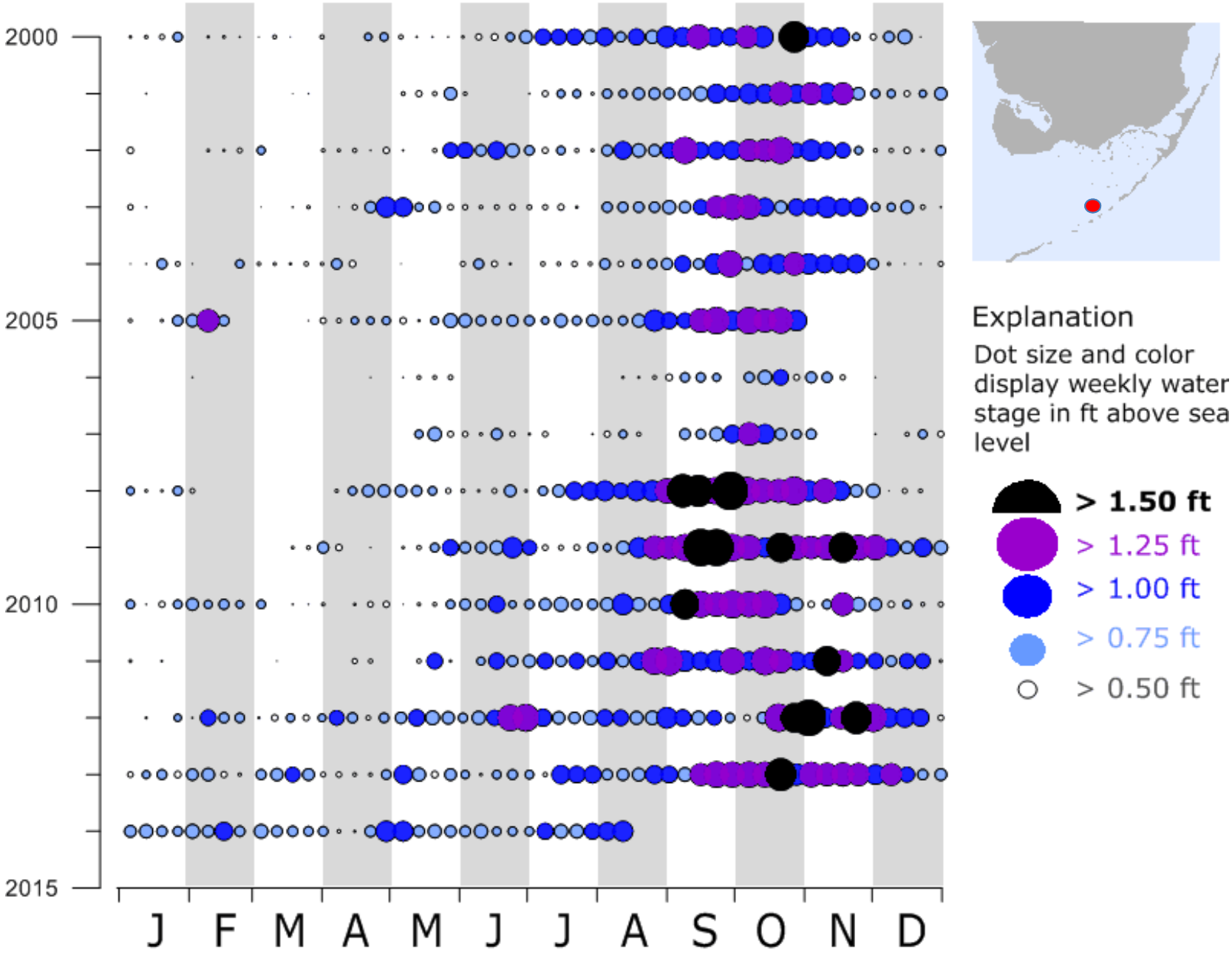



Taylor River
Little Madeira Bay
Butternut Key
Bob Allen Keys
Peterson Key
Vaca
Key
Key
West
Harbor
30 km

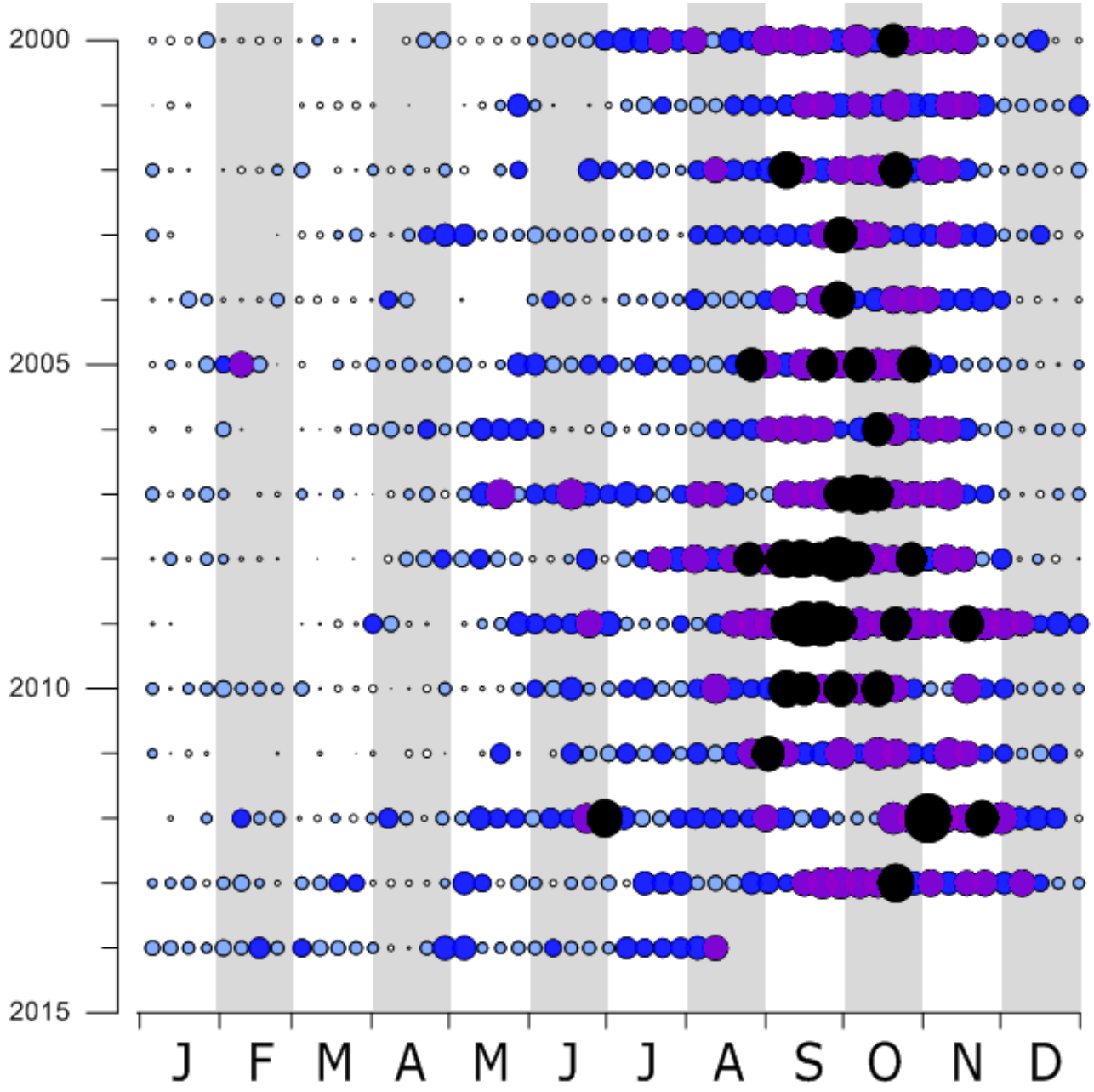
Annual Mean Water Level Vaca Key 2000-2014



Average Weekly Water Stage at Peterson Key



Average Weekly Water Stage at Bob Allen

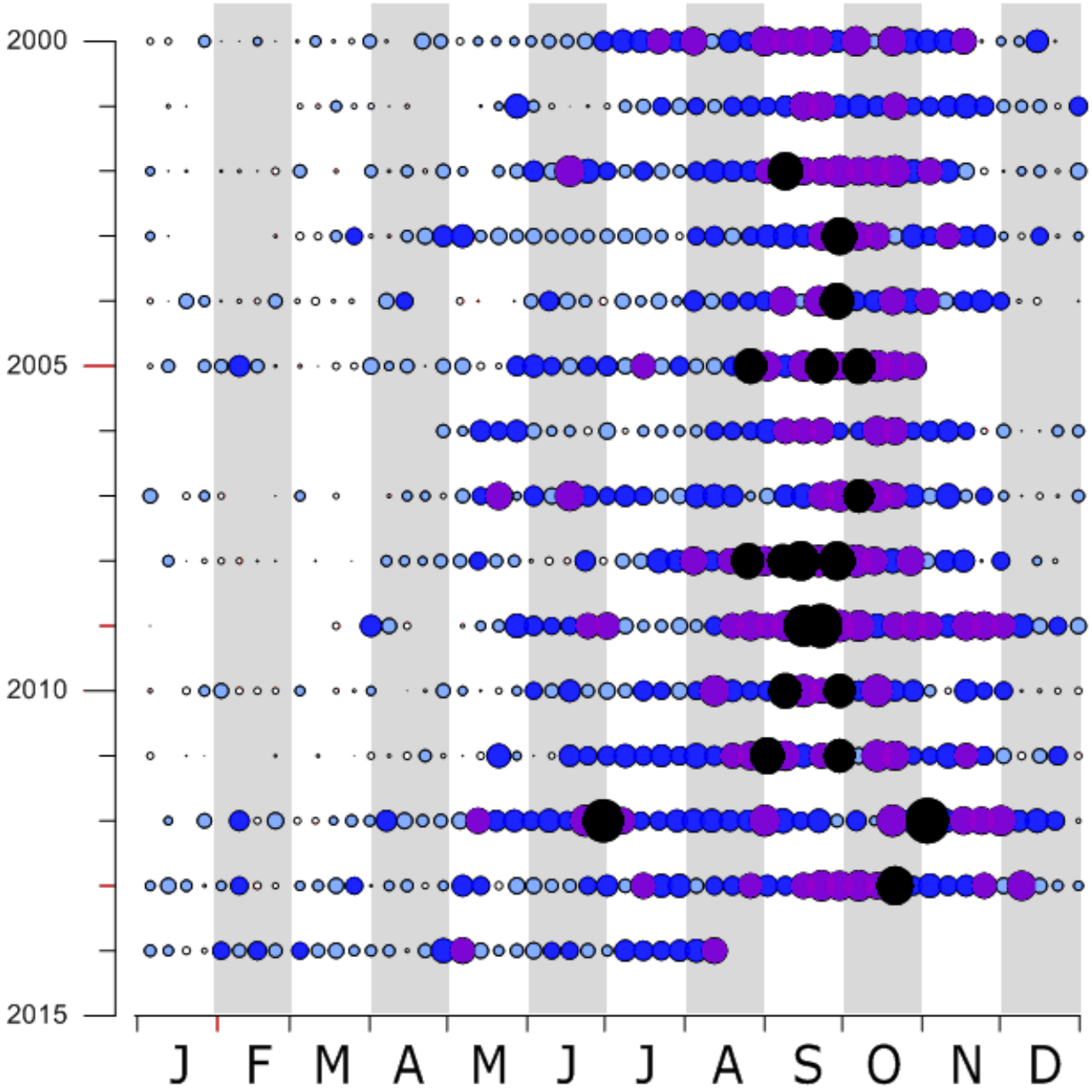


Explanation

Dot size and color display weekly water stage in ft above sea level

- **> 1.50 ft**
- > 1.25 ft
- > 1.00 ft
- > 0.75 ft
- > 0.50 ft

Average Weekly Water Stage at Butternut Key



Explanation

Dot size and color display weekly water stage in ft above sea level

> 1.50 ft

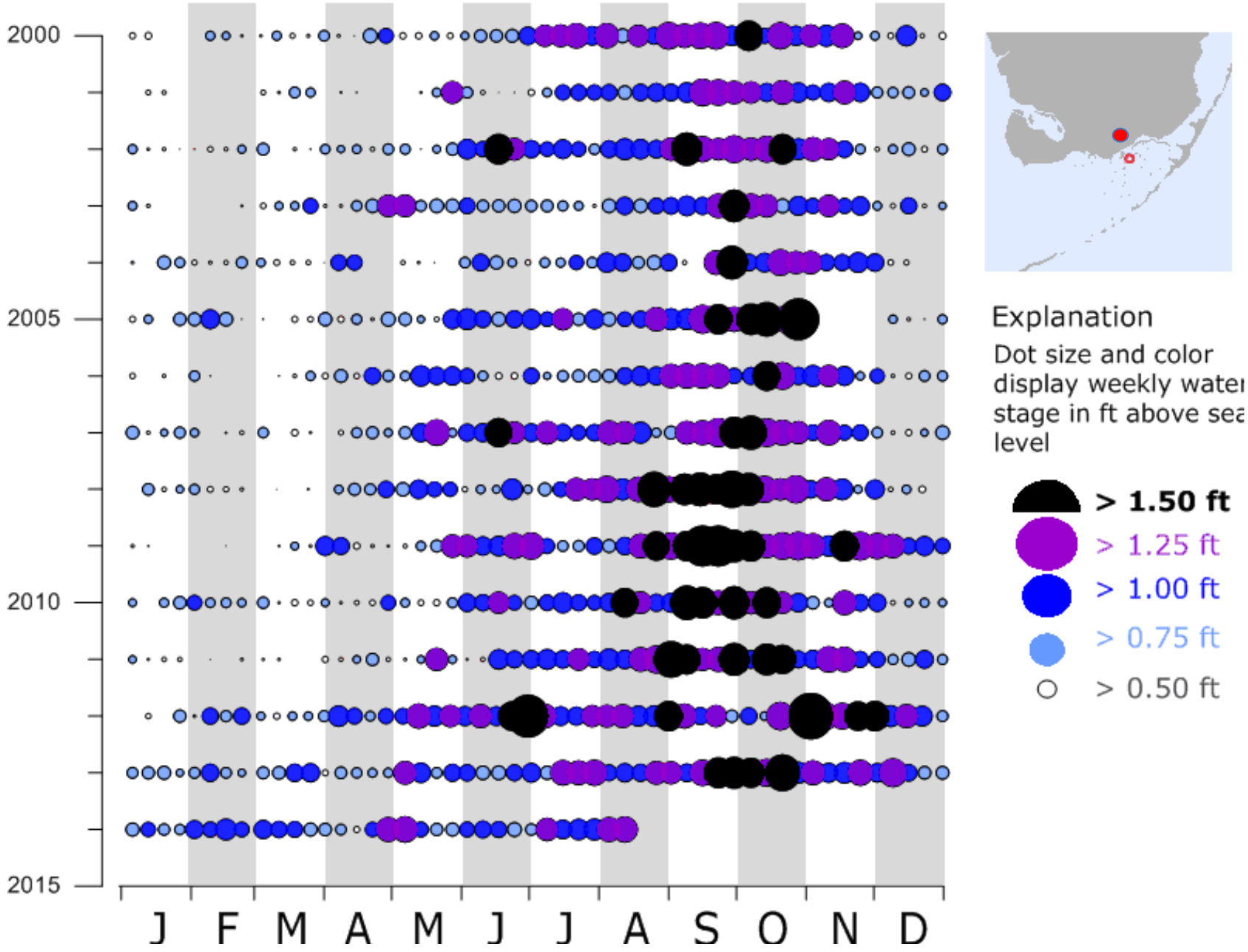
> 1.25 ft

> 1.00 ft

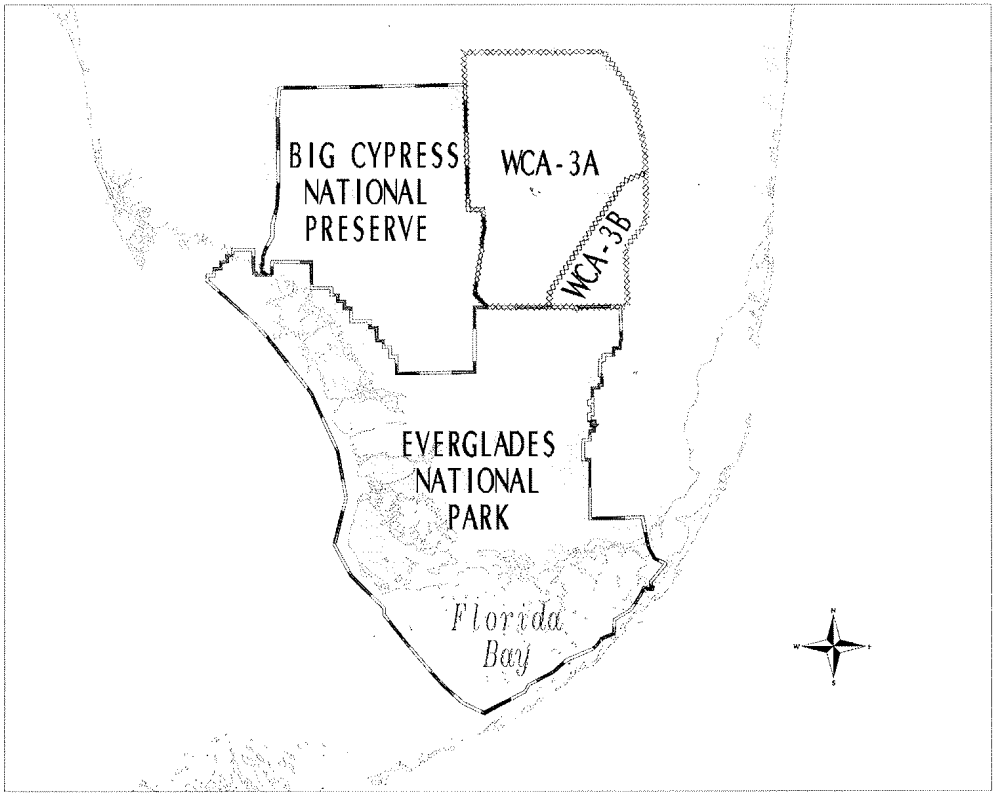
> 0.75 ft

> 0.50 ft

Average Weekly Water Stage at Little Madeira Key



Ecological Assessment of the 1994 -1995 High Water Conditions in the Southern Everglades

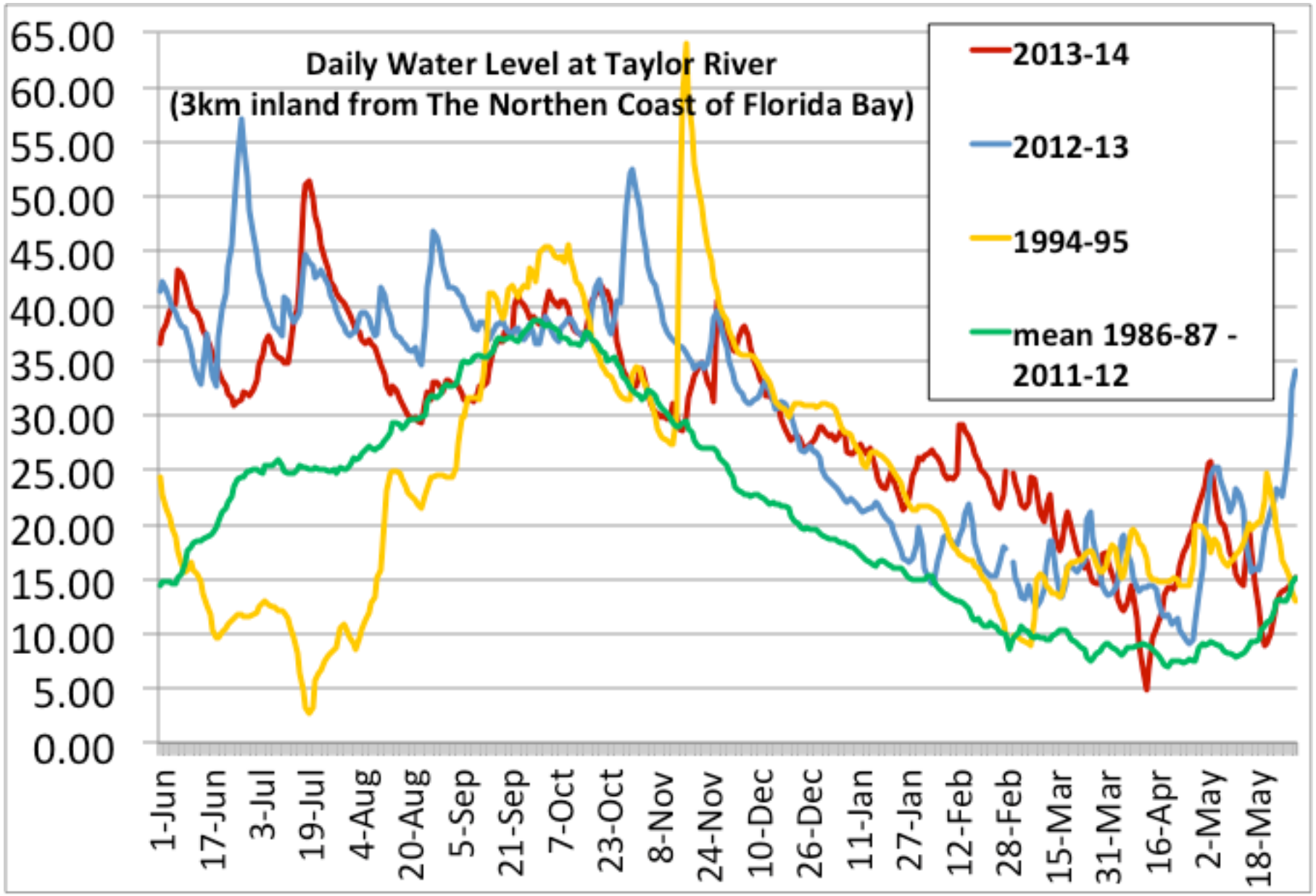


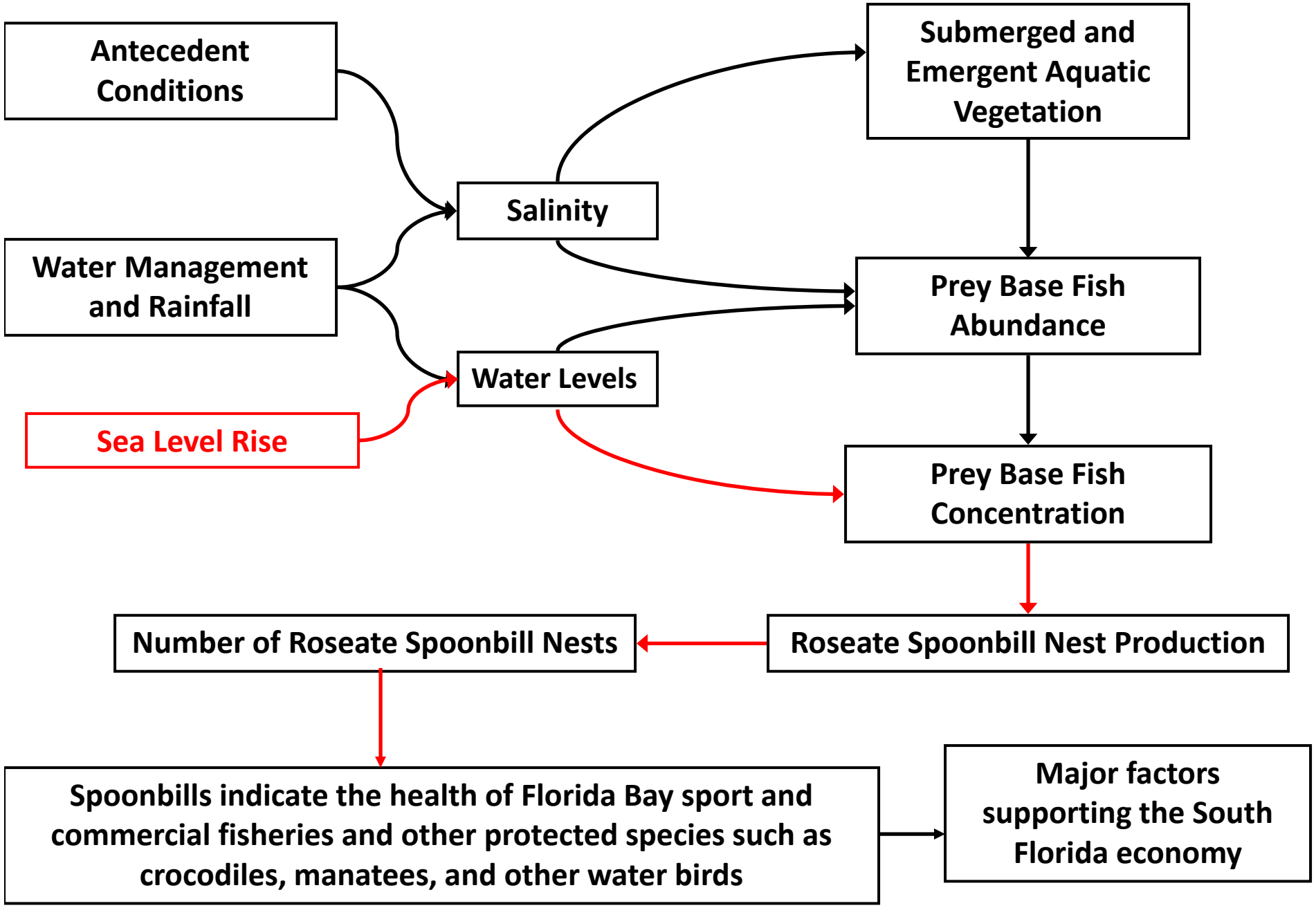
Proceedings

of the conference held at Florida International University, August 22 -23, 1996 in Miami, Florida

Sponsored by : U.S. National Park Service, U.S. Army Corps of Engineers, South Florida Water Management District, Natural Resources Defense Council, Florida International University, and National Audubon Society

Held under the Auspices of : The Science Sub-Group of the South Florida Management and Coordination Working Group

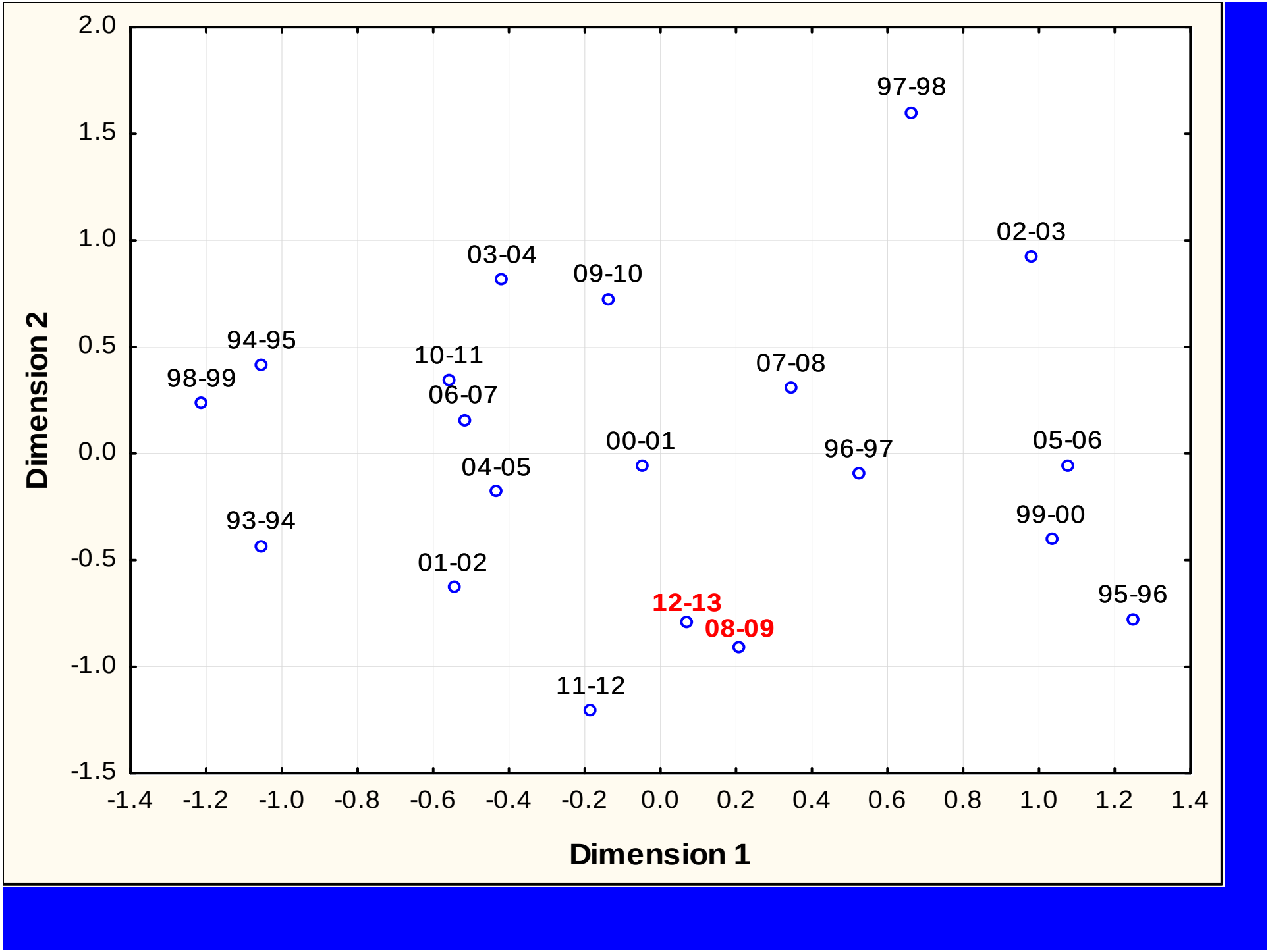

Daily Water Level at Taylor River
(3km inland from The Northen Coast of Florida Bay)
2013-14
2012-13
1994-95
mean 1986-87 - 2011-12
65.00
60.00
55.00
50.00
45.00
40.00
35.00
30.00
25.00
20.00
15.00
10.00
5.00
0.00
1-Jun
17-Jun
3-Jul
19-Jul
4-Aug
20-Aug
5-Sep
21-Sep
7-Oct
23-Oct
8-Nov
24-Nov
10-Dec
26-Dec
11-Jan
27-Jan
12-Feb
28-Feb
15-Mar
31-Mar
16-Apr
2-May
18-May

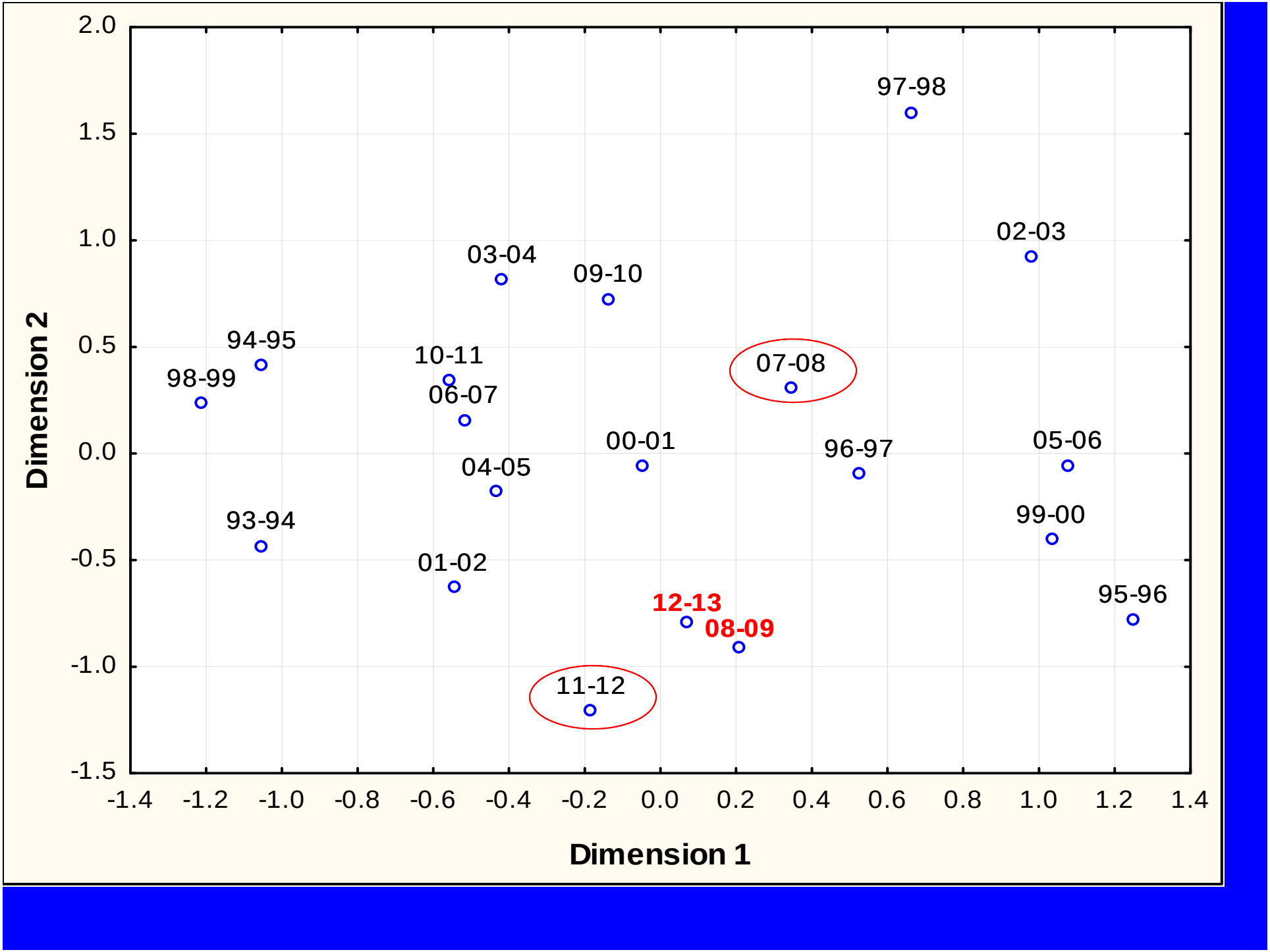

Antecedent Conditions
Water Management and Rainfall
Sea Level Rise
Salinity
Water Levels
Submerged and Emergent Aquatic Vegetation
Prey Base Fish Abundance
Prey Base Fish Concentration
Roseate Spoonbill Nest Production
Number of Roseate Spoonbill Nests
Spoonbills indicate the health of Florida Bay sport and commercial fisheries and other protected species such as crocodiles, manatees, and other water birds
Major factors supporting the South Florida economy


Paurotis Pond
Madeira Hammock
Key Larg
Tavernier
Plantation Key

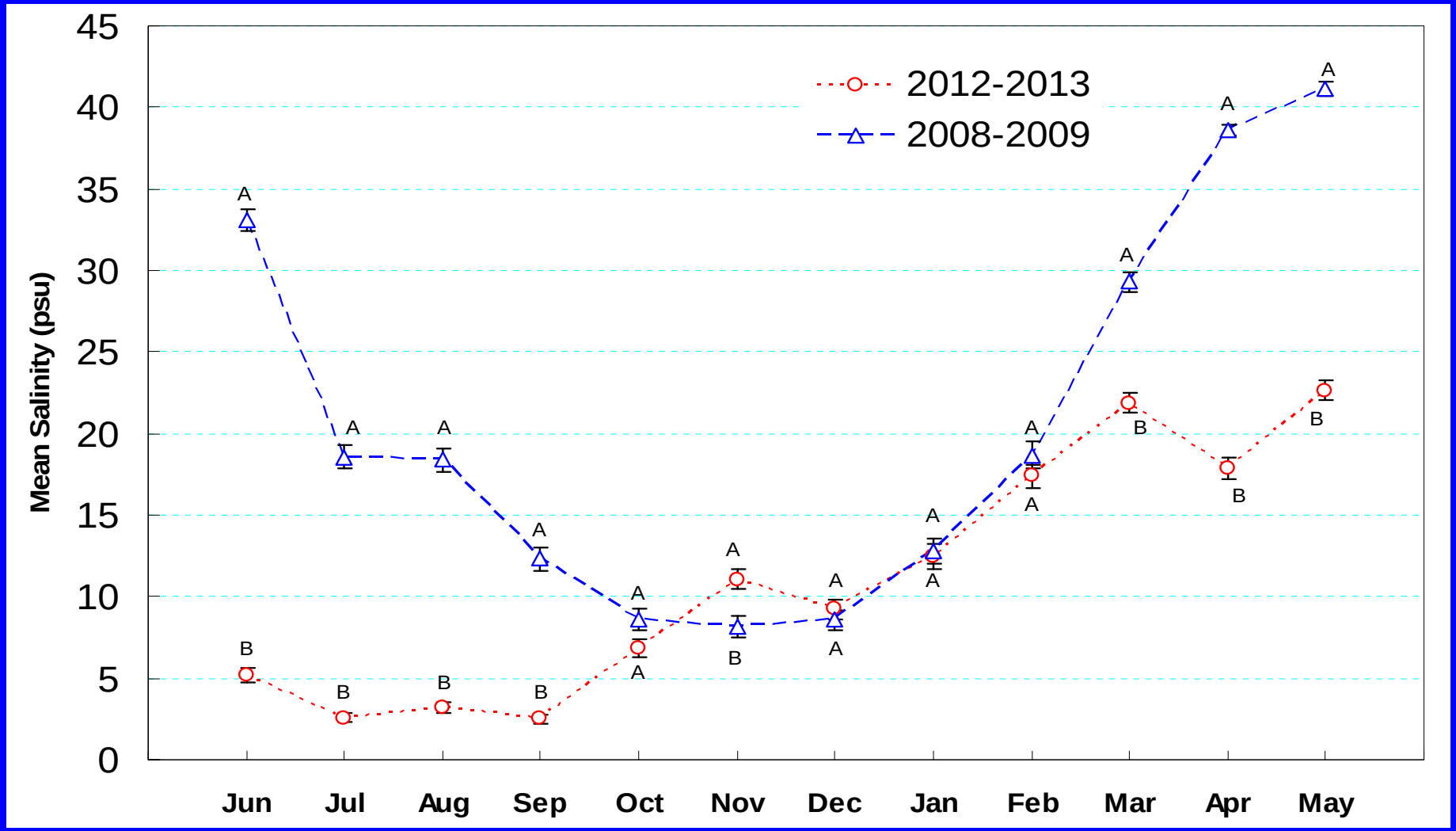
Project can be used to detect changes

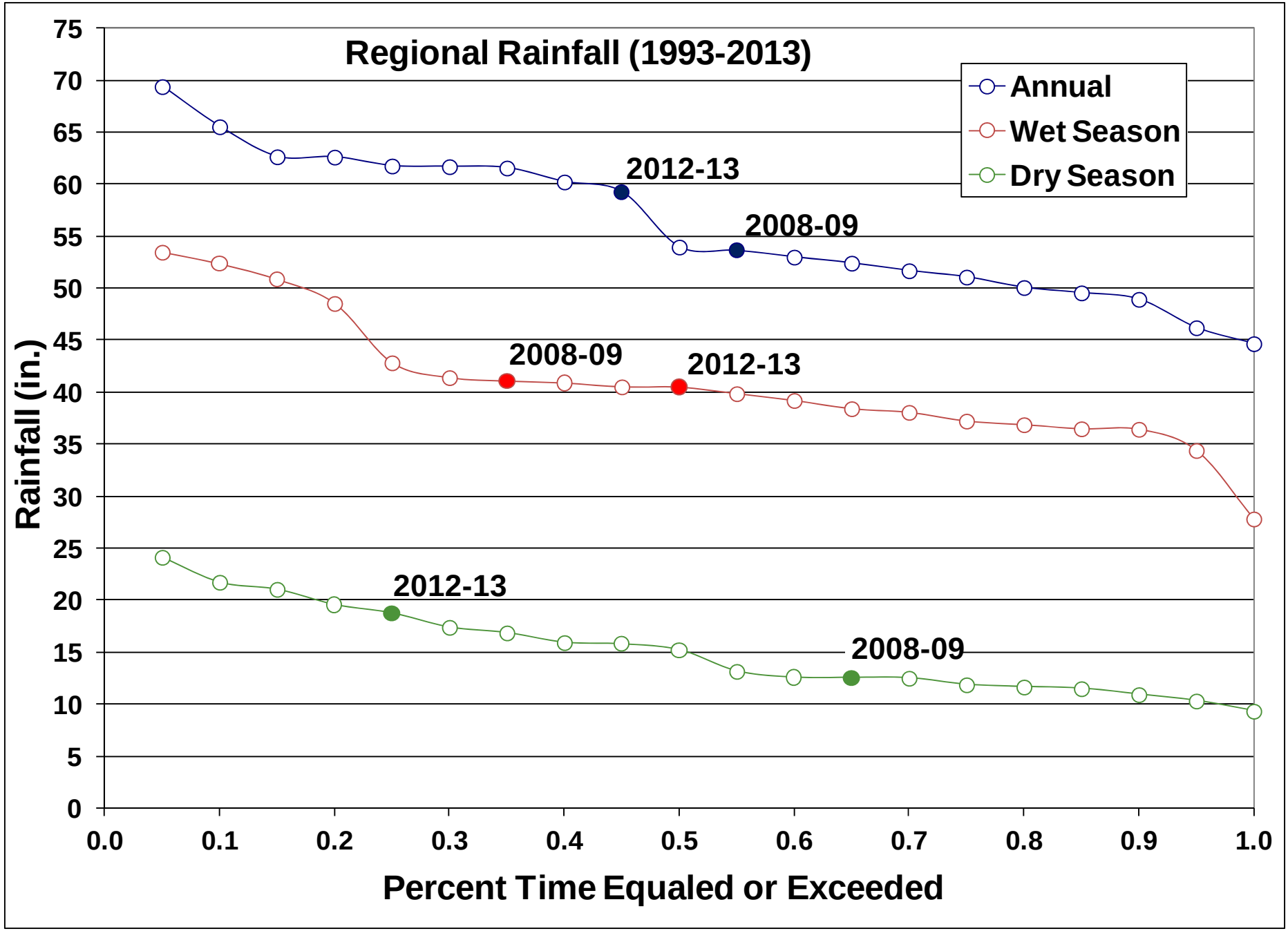
- Case Study: Year 1 of C-111 SC Operations

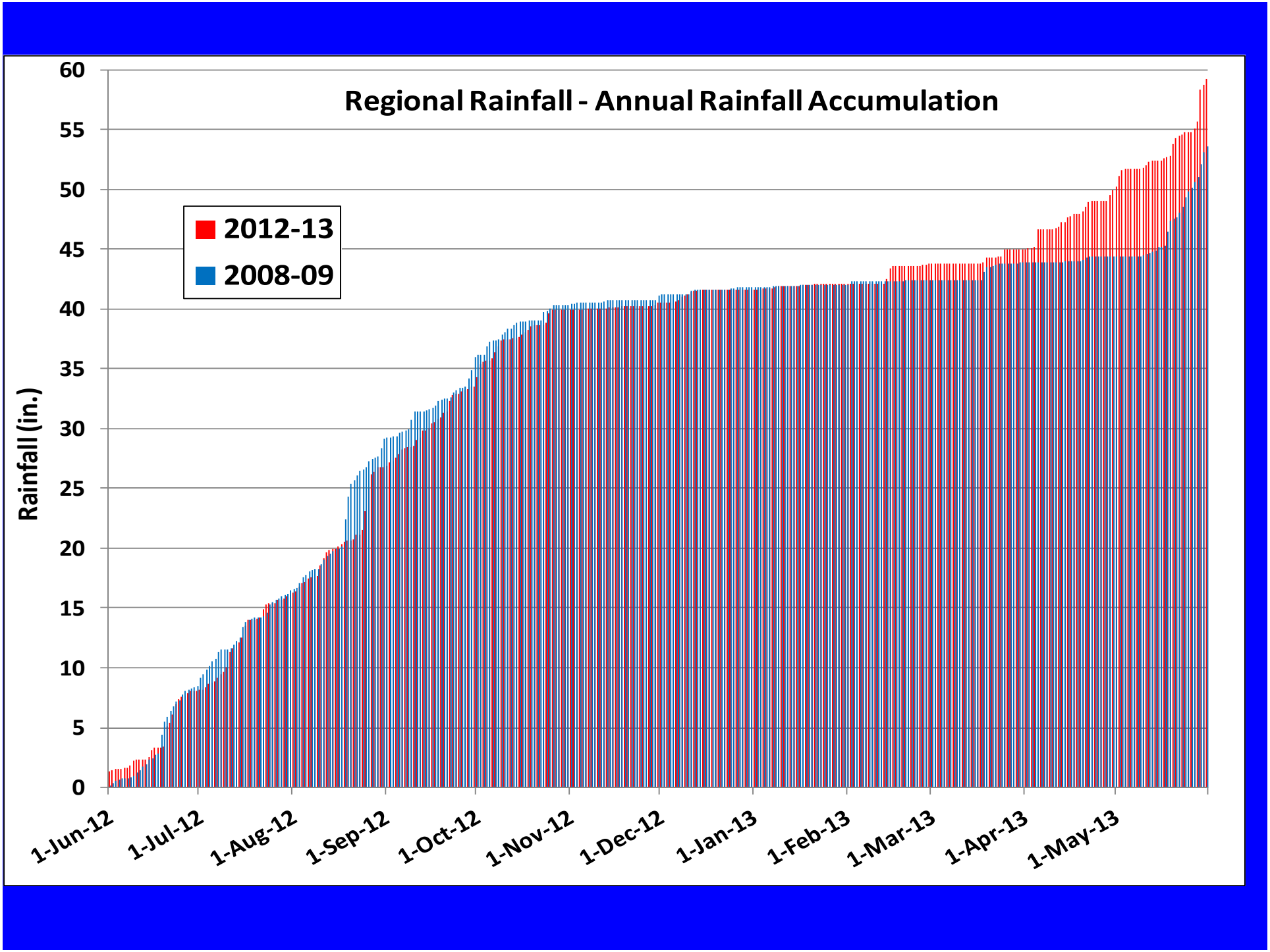

2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
-1.4
-1.2
-1.0
-0.8
-0.6
-0.4
-0.2
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
Dimension 2
Dimension 1
97-98
02-03
03-04
09-10
94-95
10-11
98-99
06-07
07-08
00-01
96-97
05-06
04-05
93-94
99-00
01-02
95-96
12-13
08-09
11-12

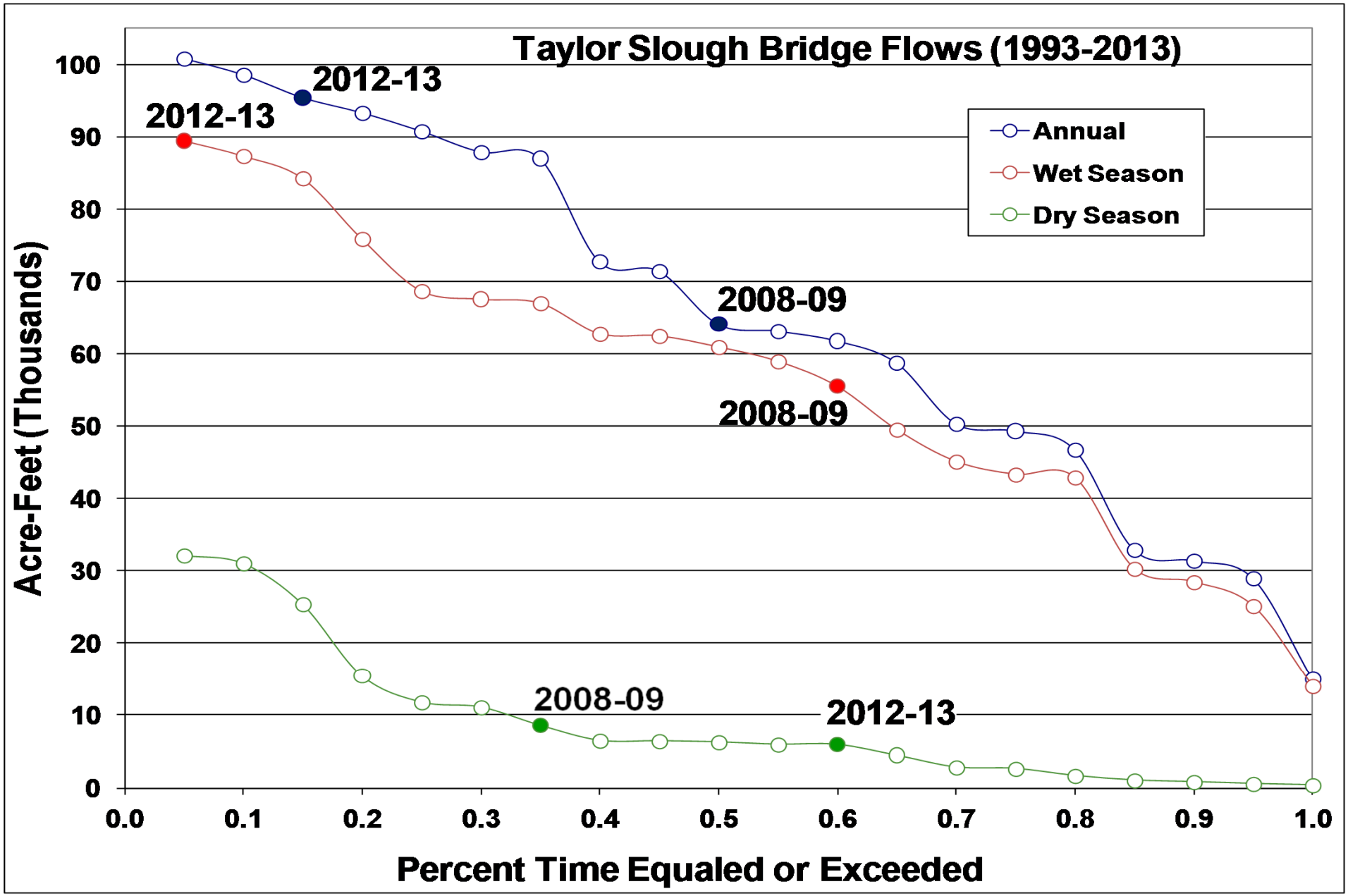

2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
-1.4
-1.2
-1.0
-0.8
-0.6
-0.4
-0.2
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
Dimension 2
Dimension 1
97-98
02-03
03-04
09-10
94-95
10-11
98-99
06-07
07-08
00-01
96-97
05-06
04-05
93-94
99-00
01-02
95-96
12-13
08-09
11-12

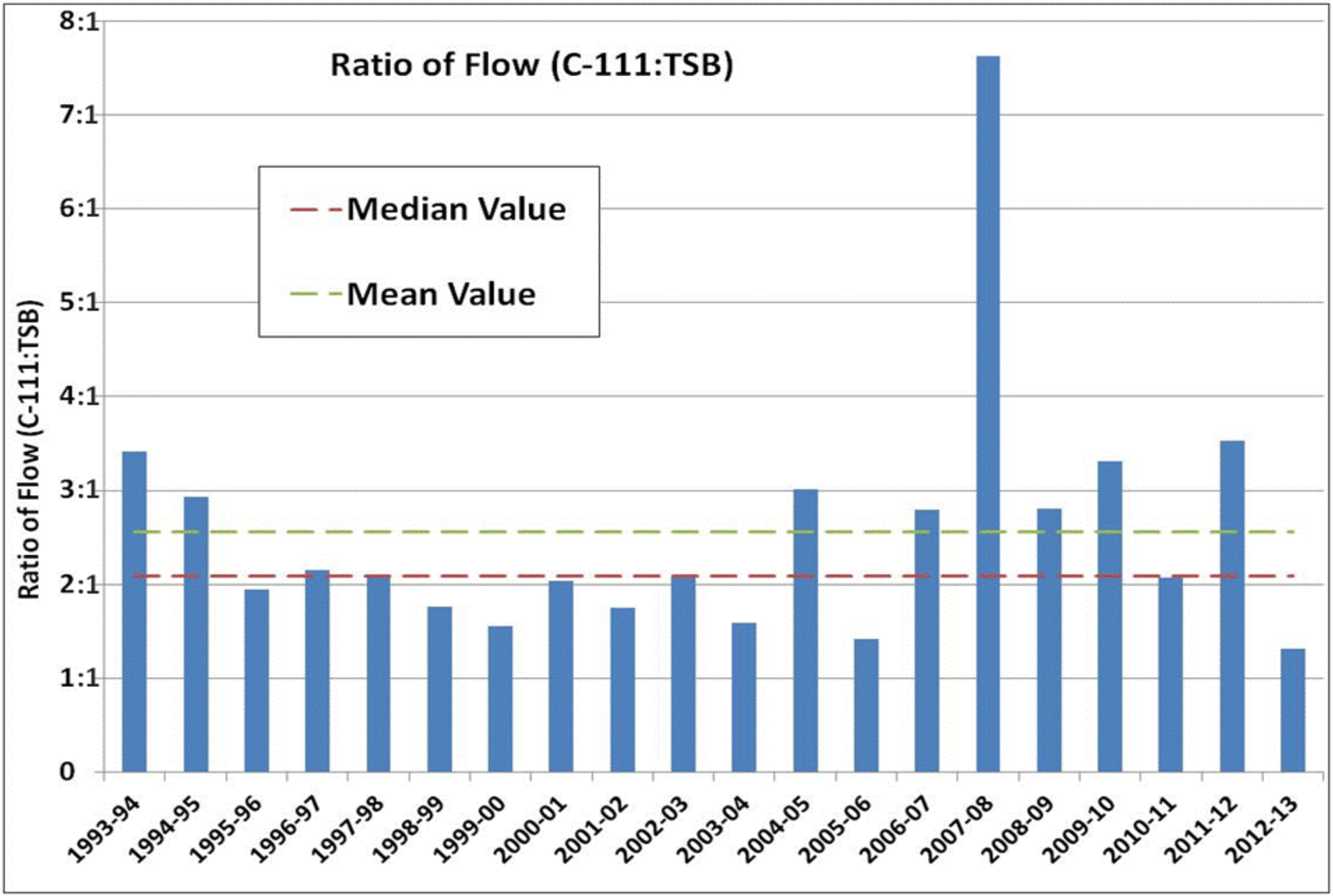
Antecedent Conditions More Favorable in 2012-13 than 2008-09



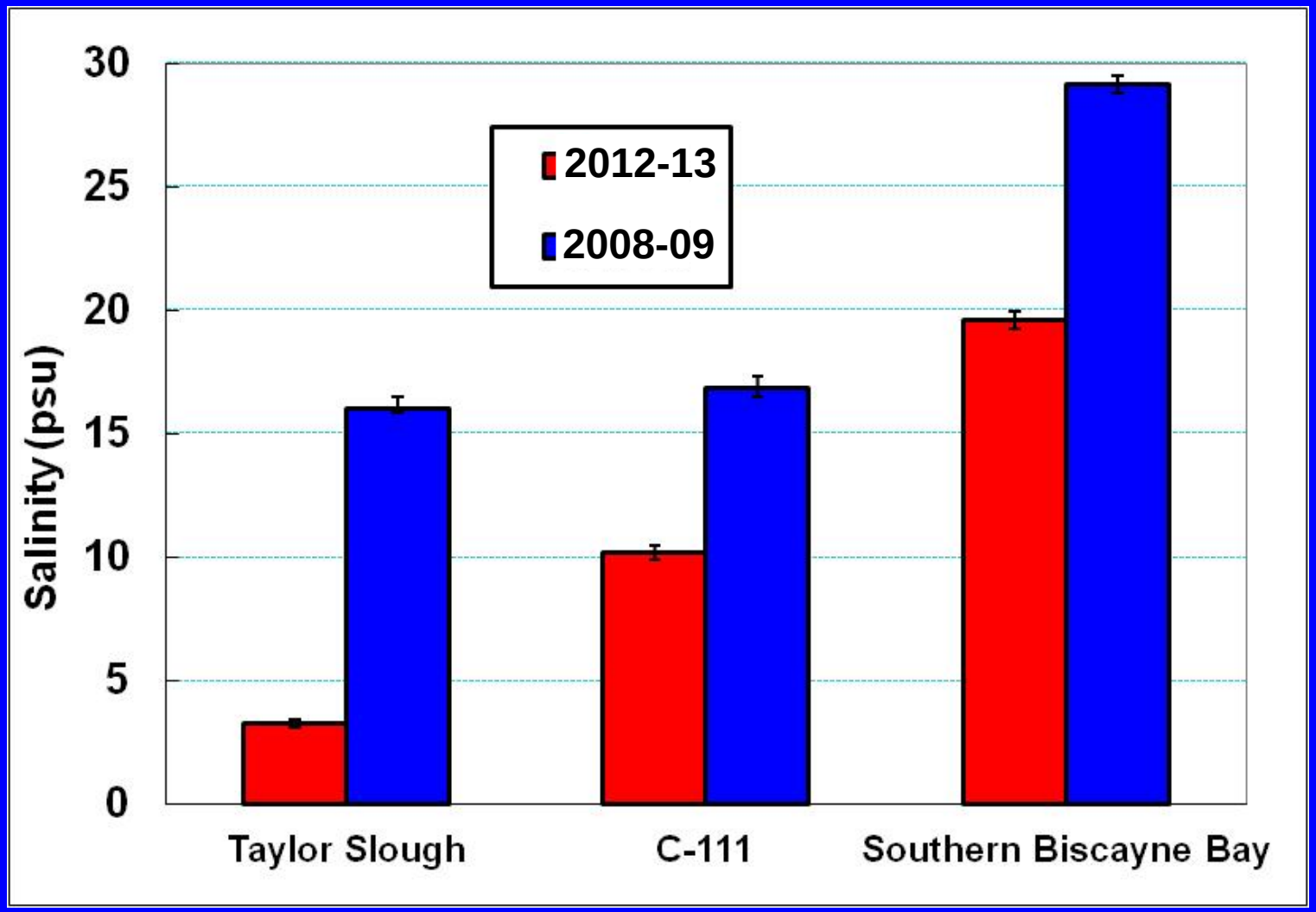

Regional Rainfall (1993-2013)
Annual
Wet Season
Dry Season
2012-13
2008-09
2008-09
2012-13
2012-13
2008-09
Rainfall (in.)
Percent Time Equaled or Exceeded
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
0
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0

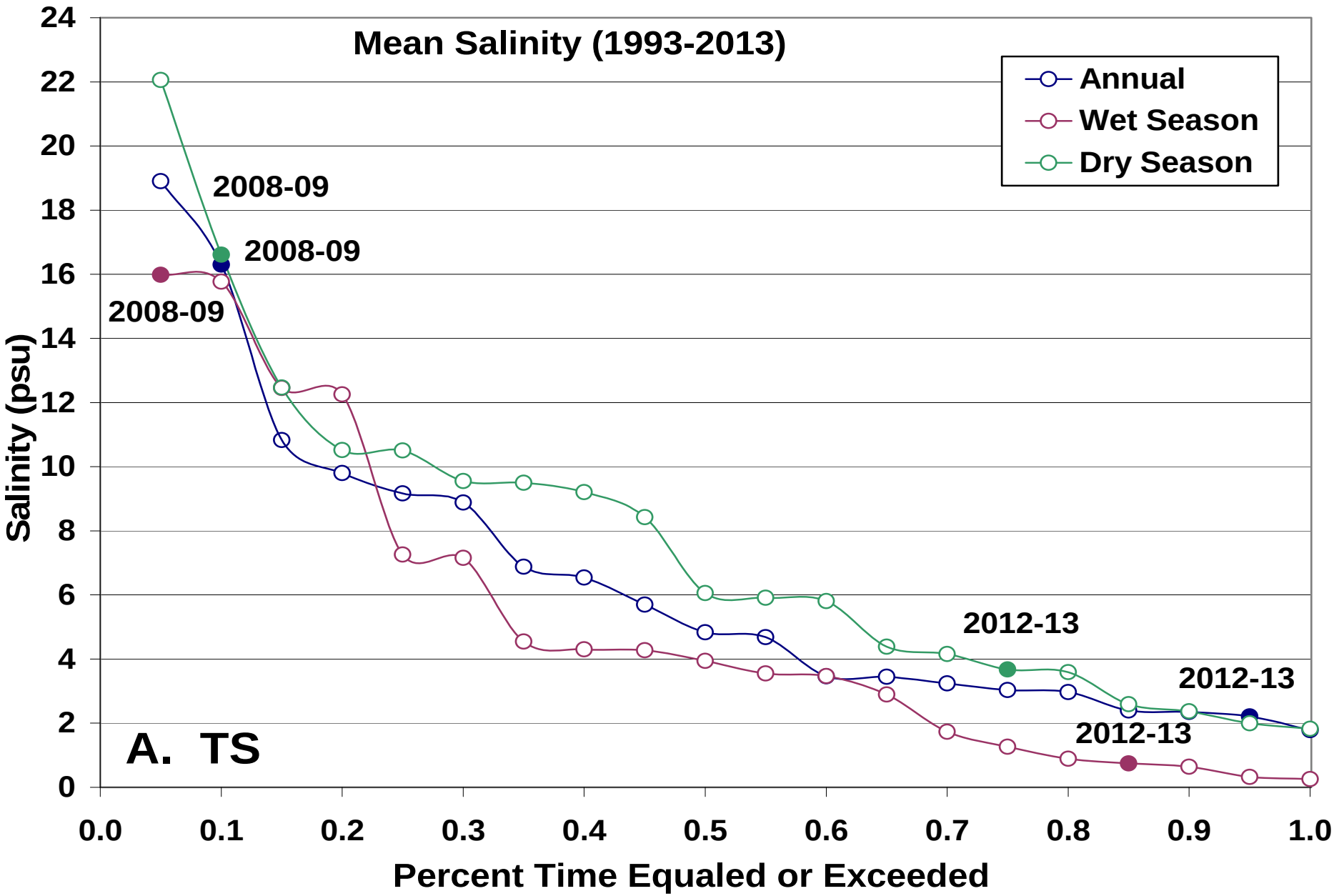

Regional Rainfall - Annual Rainfall Accumulation
2012-13
2008-09
Rainfall (in.)
60
55
50
45
40
35
30
25
20
15
10
5
0
1-Jun-12
1-Jul-12
1-Aug-12
1-Sep-12
1-Oct-12
1-Nov-12
1-Dec-12
1-Jan-13
1-Feb-13
1-Mar-13
1-Apr-13
1-May-13


Taylor Slough Bridge Flows (1993-2013)
Acre-Feet (Thousands)
Percent Time Equaled or Exceeded
Annual
Wet Season
Dry Season
2012-13
2012-13
2008-09
2008-09
2008-09
2012-13
100
90
80
70
60
50
40
30
20
10
0
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0

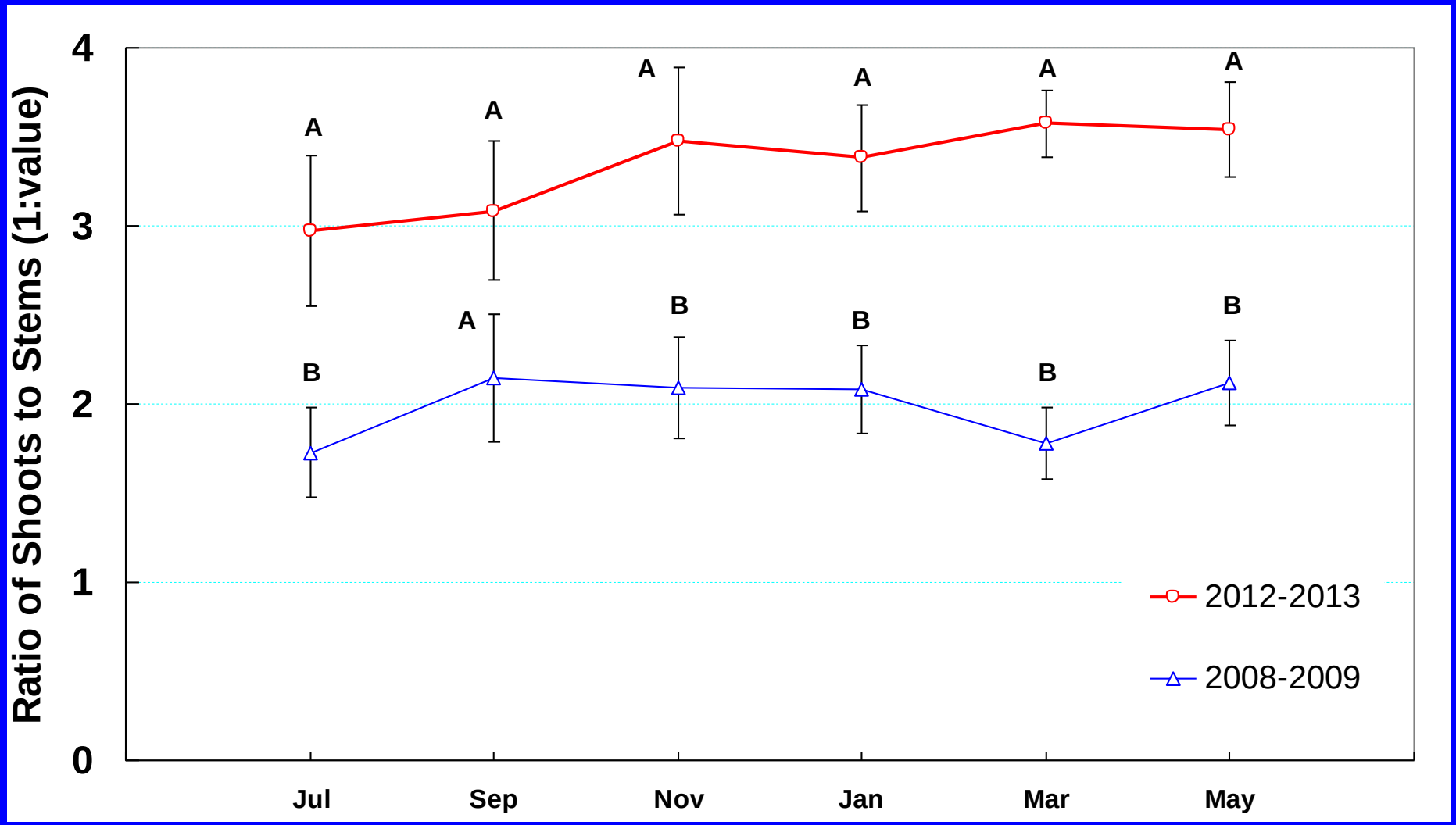

Ratio of Flow (C-111:TSB)
Median Value
Mean Value
Ratio of Flow (C-111:TSB)
8:1
7:1
6:1
5:1
4:1
3:1
2:1
1:1
0
1993-94
1994-95
1995-96
1996-97
1997-98
1998-99
1999-00
2000-01
2001-02
2002-03
2003-04
2004-05
2005-06
2006-07
2007-08
2008-09
2009-10
2010-11
2011-12
2012-13

Annual Mean Salinity at 3 Watersheds in Mangrove Zone

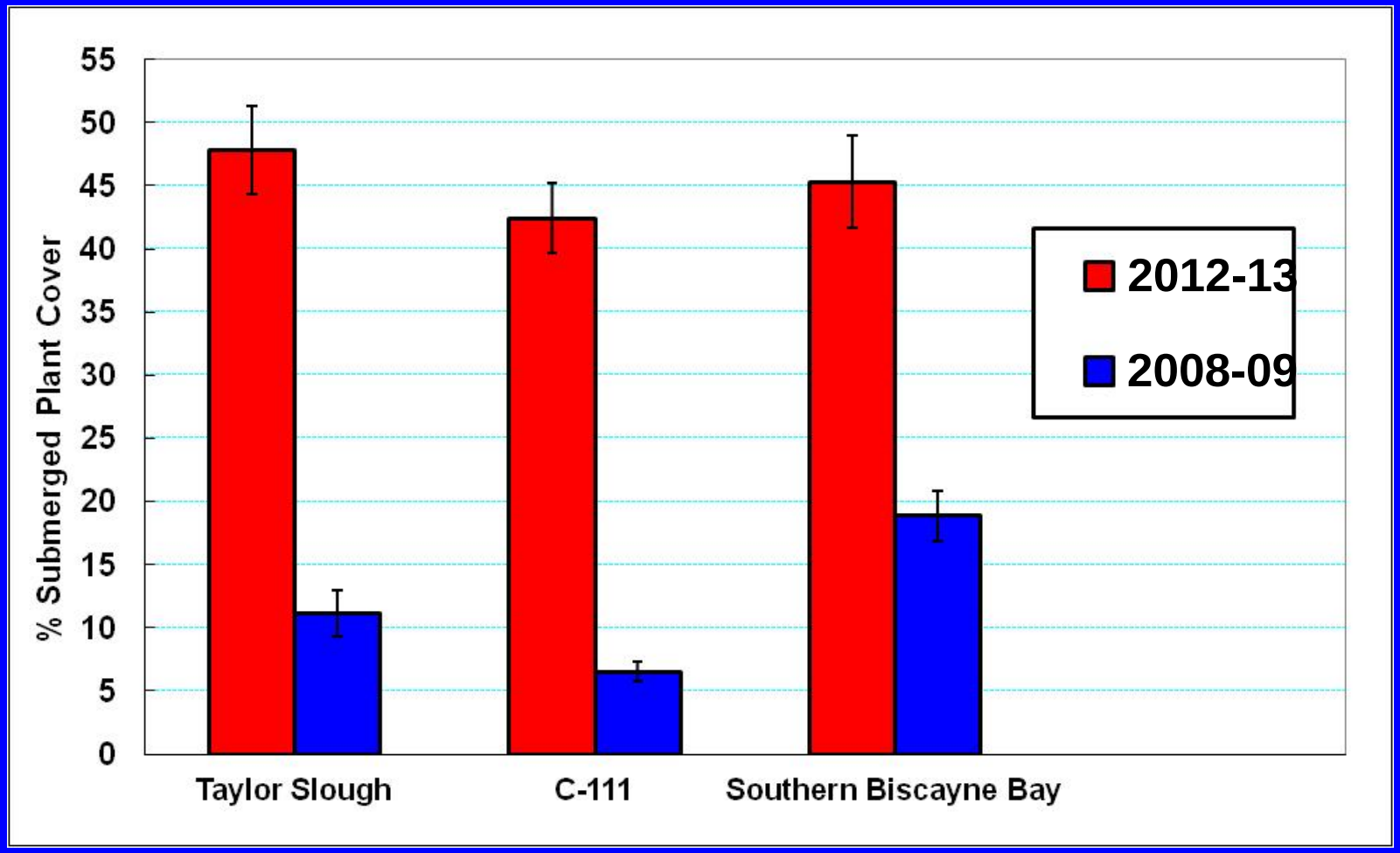



Mean Salinity (1993-2013)
Annual
Wet Season
Dry Season
2008-09
2008-09
2008-09
2012-13
2012-13
2012-13
A. TS
Salinity (psu)
Percent Time Equaled or Exceeded
0
2
4
6
8
10
12
14
16
18
20
22
24
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0

Emergent Vegetation



Annual Mean % Plant Cover (SAV) at 3 Watersheds in Mangrove Zone



Audubon FLORIDA

The Southern Everglades and Florida Bay

C-111 Project Frees Flows for Increased Wildlife Abundance

Southern Everglades Restoration Goals

Short-term Ecosystem Goals:

•Increase freshwater conditions across the southern mangrove zone

•Increase in coverage by brackish and freshwater submerged grass and algae species in the southern mangrove zone

Mid-term Ecosystem Goals:

•Increase in freshwater prey fish populations in the southern mangrove zone

•Increase in the productivity of the southern mangrove zone and northeastern Florida Bay, i.e. improved ability of the region to support more wildlife

Long-term Ecosystem Goals:

•Increase in nesting Roseate Spoonbills in northeast Florida Bay

•Increase in wintering waterfowl usage of the lakes imbedded in the southern mangrove zone

Fish and Spoonbills

- The fish community between the 2 years was about the same
  - Lorenz and Serafy (2006) indicated that the community would take about 3 years to become dominated by low salinity species
- Spoonbill's nested successfully in both years

Problems with this Comparison

- Antecedent conditions don't support your wet season conclusions
- Rainfall explains the lower salinity in the late dry season

Rebuttal

- Flow through TS was record high
- C-111 discharge (S-18C-S-197) was record low
- SBB salinity (control sites) was lower than comparison year salinity but not to the exaggerated degree of TS

Bottom Line

- One year of data is clearly inconclusive
- Multi year analysis will be much stronger
- Regardless, the point is that this monitoring program has the ability to detect change in water management practices

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