Status and Trends of Salinity, Water Clarity, and Nutrients, in Perdido and Pensacola Bay

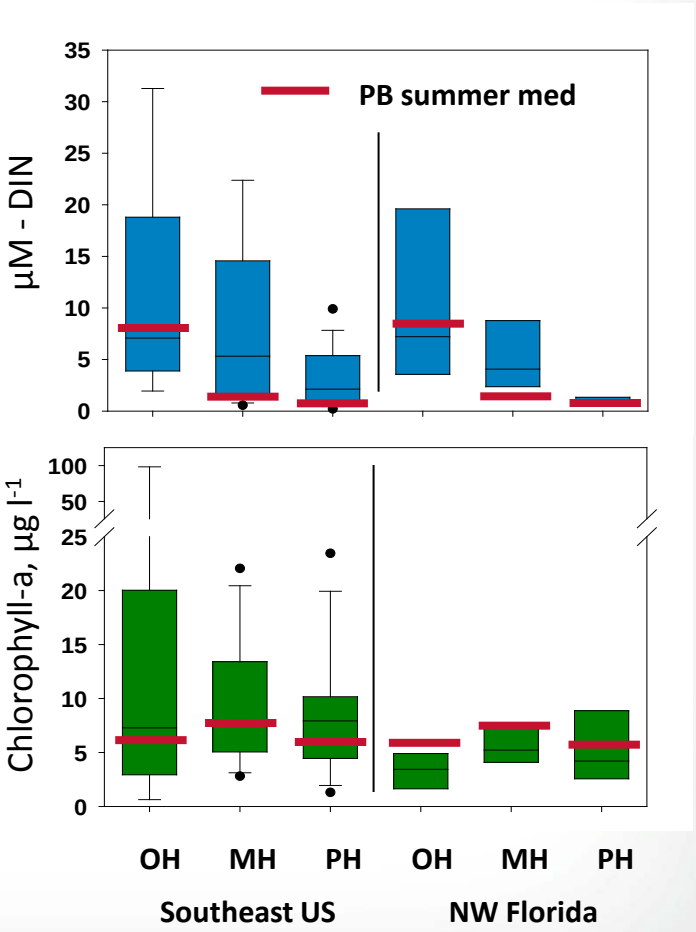
James D. Hagy III, Michael C. Murrell[1]
[1]U.S. EPA Office of Research and Development, Gulf Breeze, FL

Overview

- Pensacola Bay general status
- Long term trends in river flows
- Changes in nutrient loading
- Status of chlorophyll-a, nutrients and water clarity.
- Relationship between water clarity today and historical seagrass depth distribution

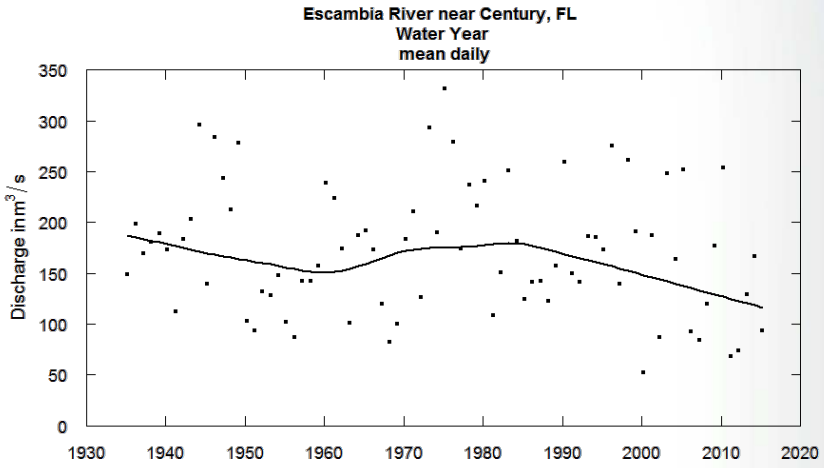
Pensacola Bay Nutrients Regime

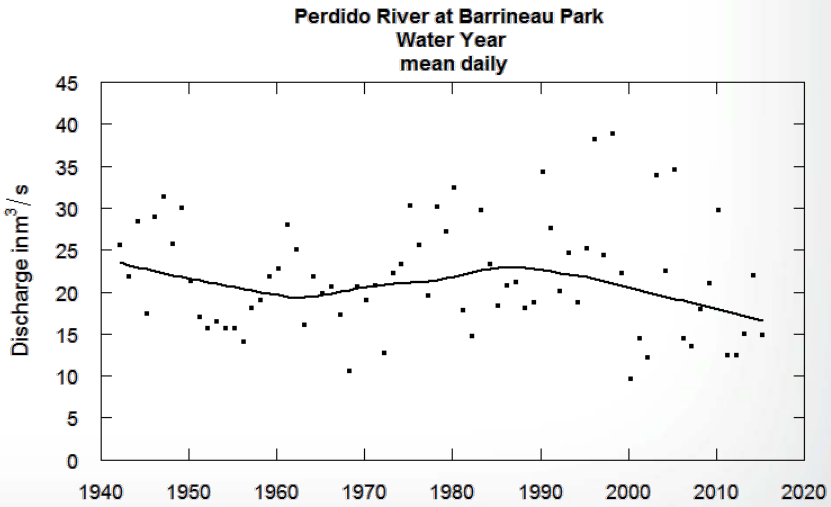
- N and P yield from the upper watershed is "relatively low": N yield=262 kg km^{-2} y^{-1}; P yield=22 kg km^{-2} y^{-1}
- N & P loading is "moderate" due to large watershed: 12 g N m^{-2} y^{-1}, 1 g P m^{-2} y^{-1}
- Inorganic N and P concentrations in the Bay are "usually low," especially in mesohaline (MH) and polyhaline (PH) reaches.
- Phytoplankton usually nutrient limited due to high water clarity; both N limitation and P limitation have been demonstrated.
- Microphytobenthos is important
- Summer phytoplankton assemblage dominated by cyanobacteria … consistent with nutrient limitation.



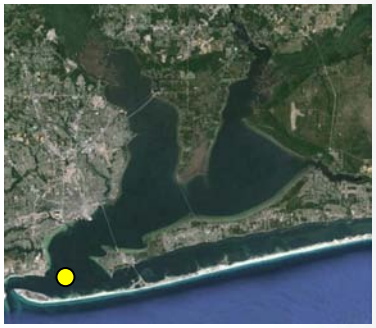
Freshwater Inflows from Rivers

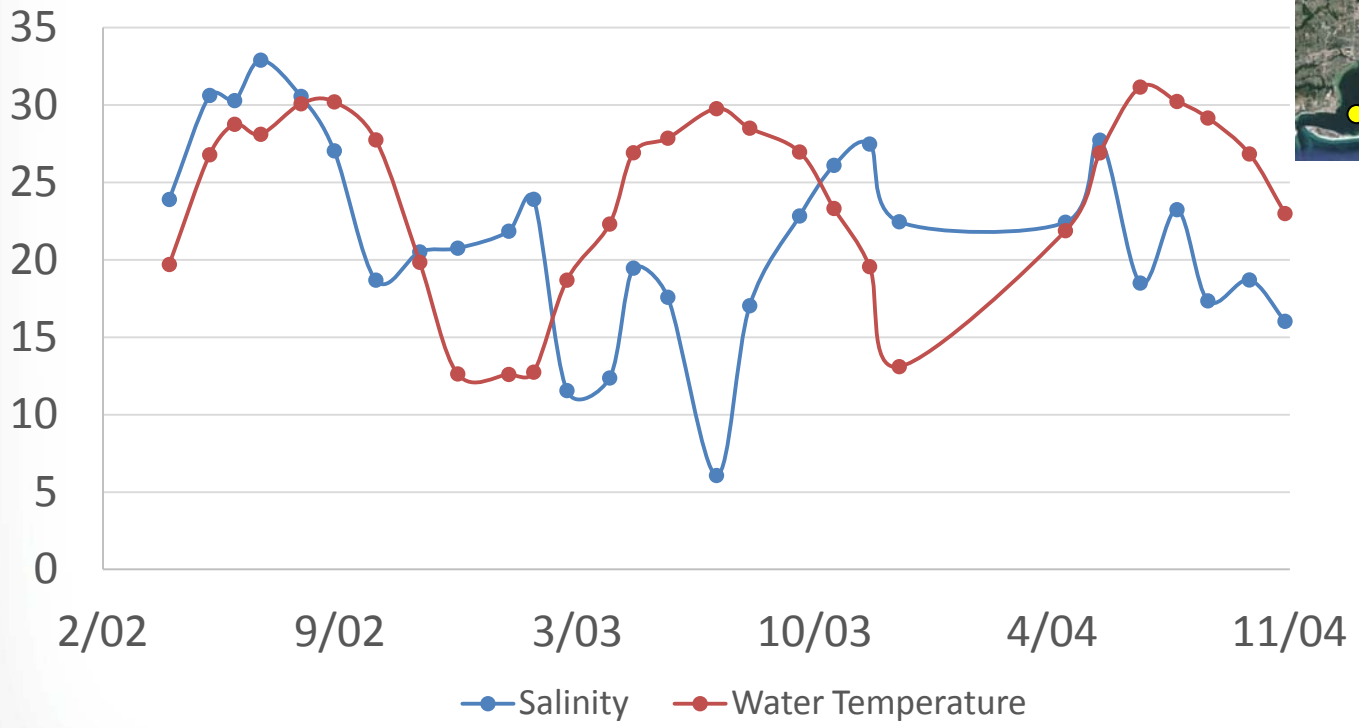
- Analysis of Flows using USGS EGRET tools in R.
- Perdido River flow decreased 16% in past 30 years
- Escambia River (largest FW source to Pensacola Bay decreased 29% since 1980.
- Drivers are either parallel in both watersheds, or climatic.



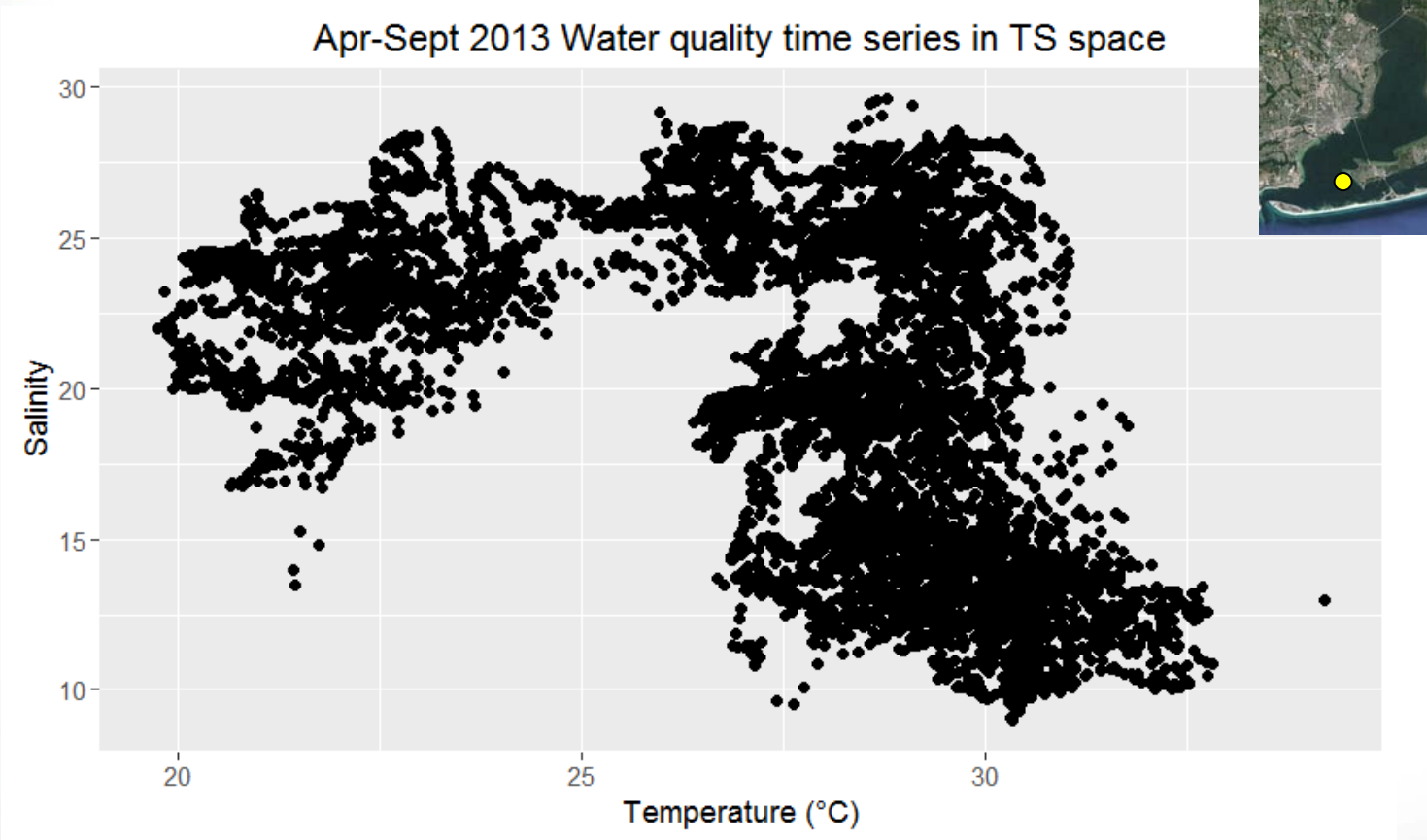


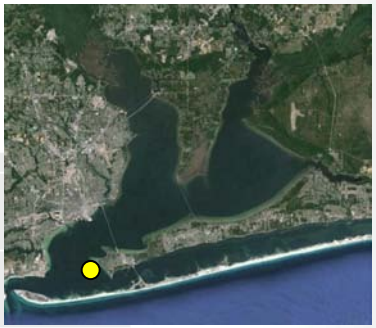
Salinity, Temp in Lower Pens Bay



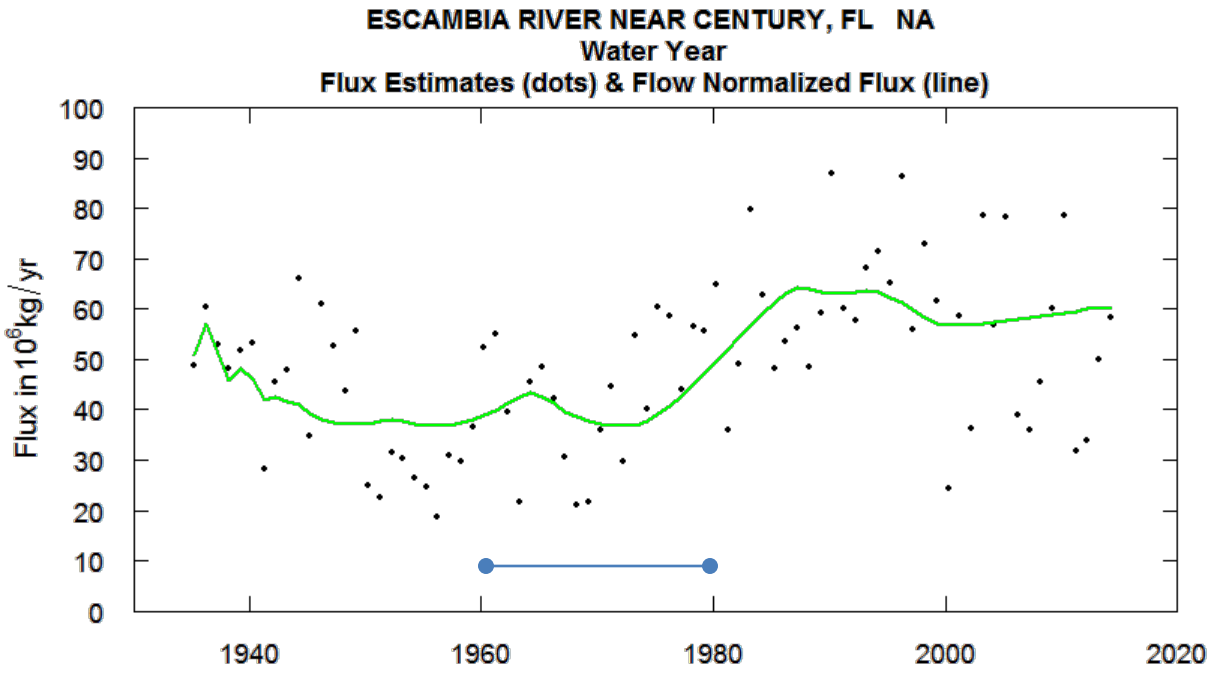


Continuous T, S in Lower Pens Bay



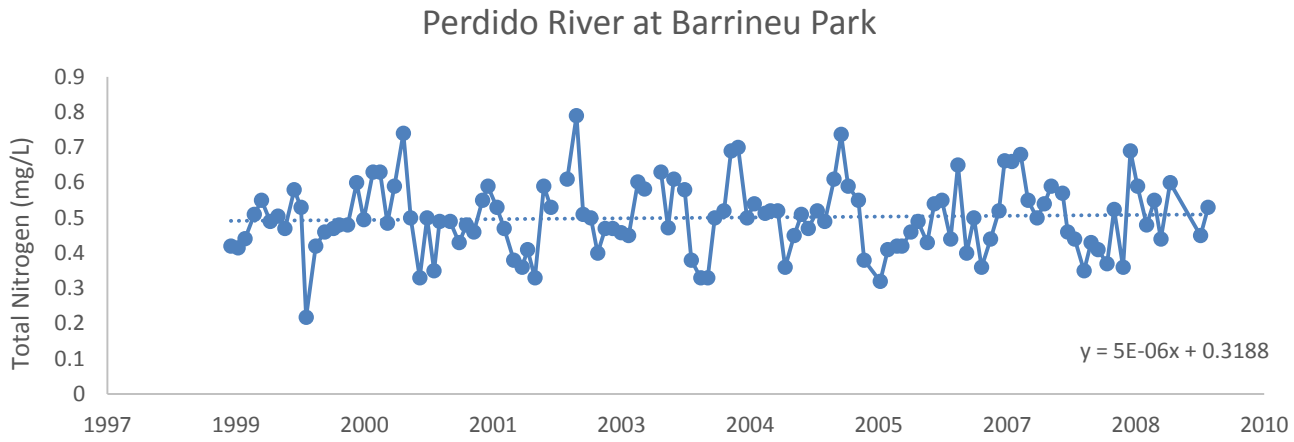


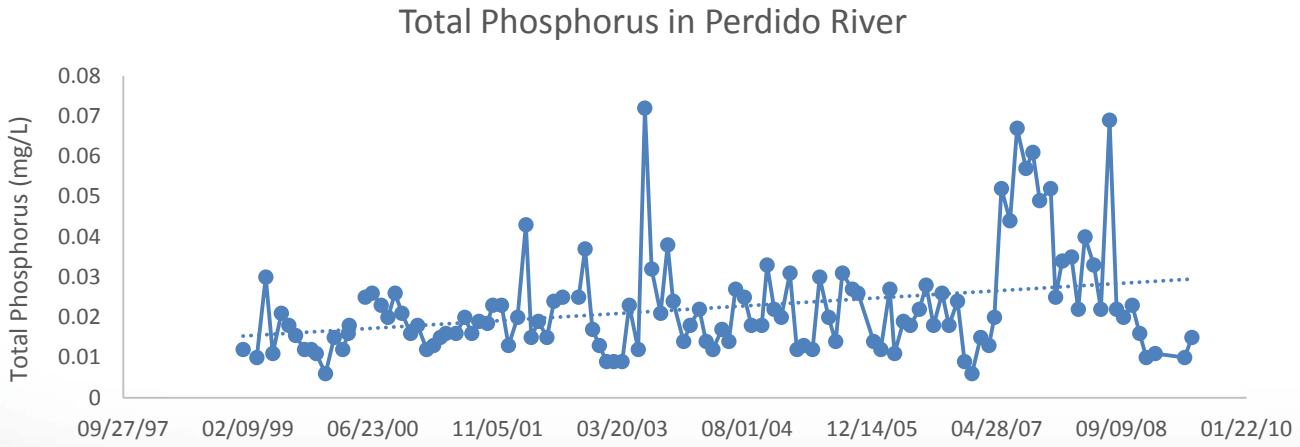
Nitrate Flux – Escambia River



Data assembled by J. Caffrey

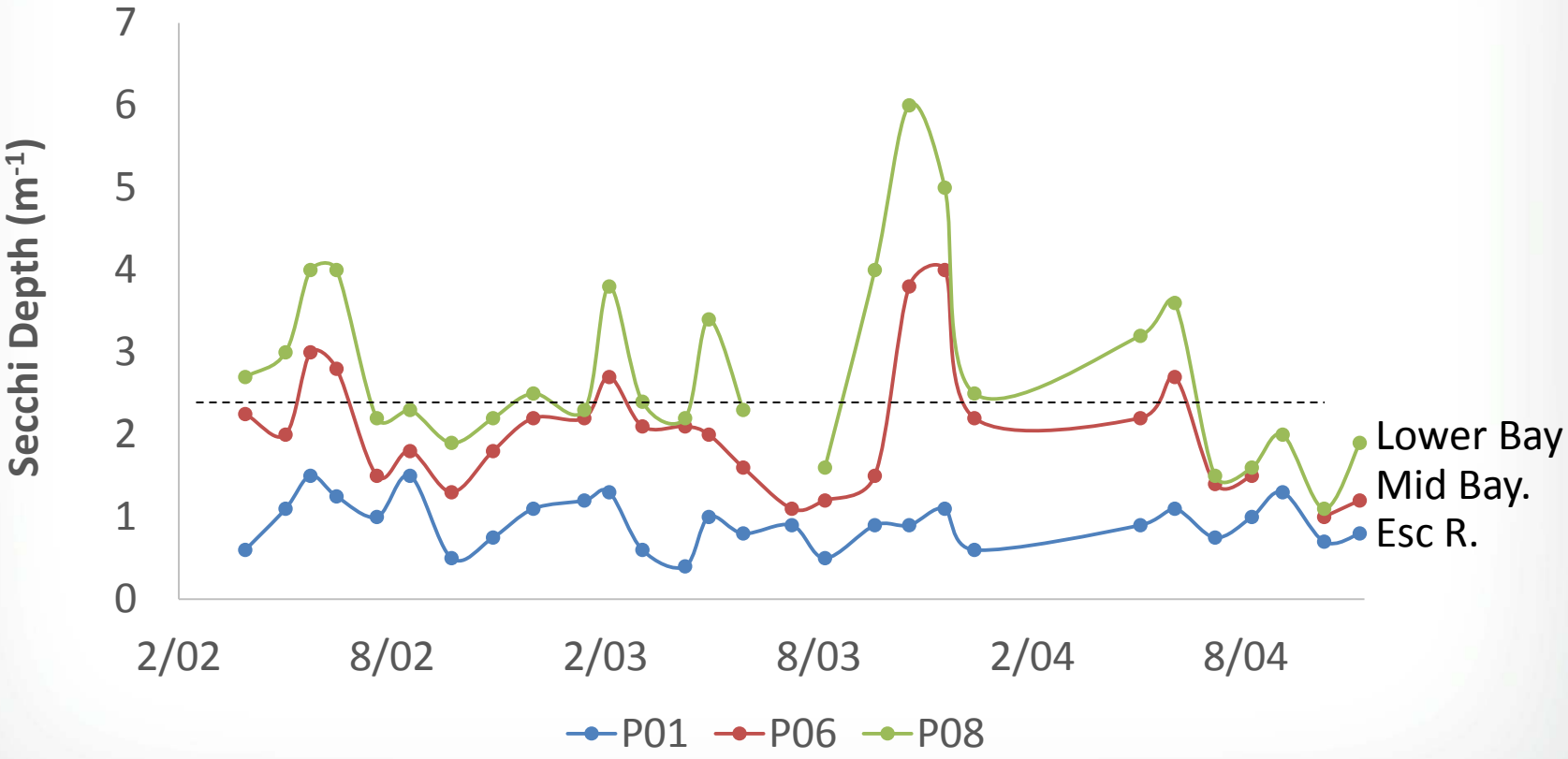
Nutrients in Perdido River





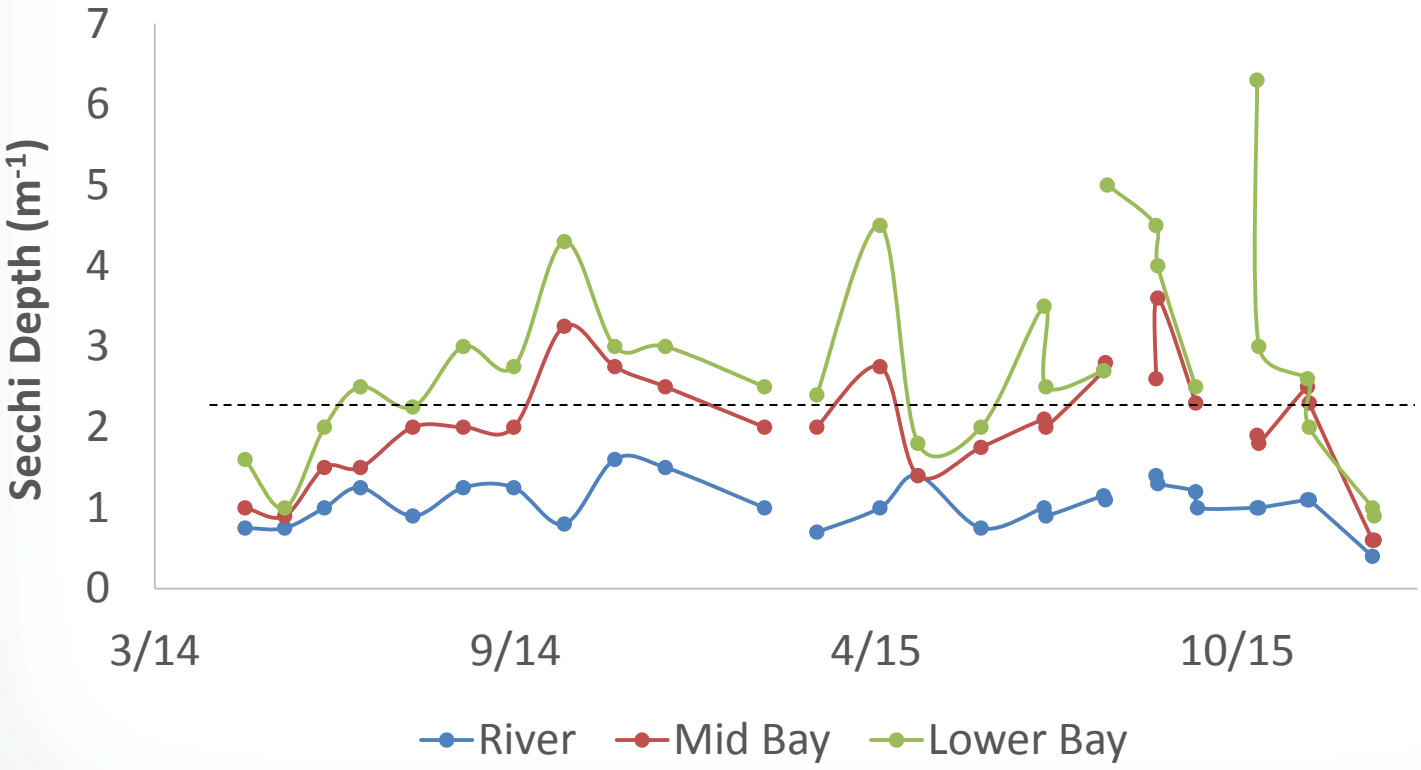
Data from WQP/STORET

Secchi Depth in Pensacola Bay



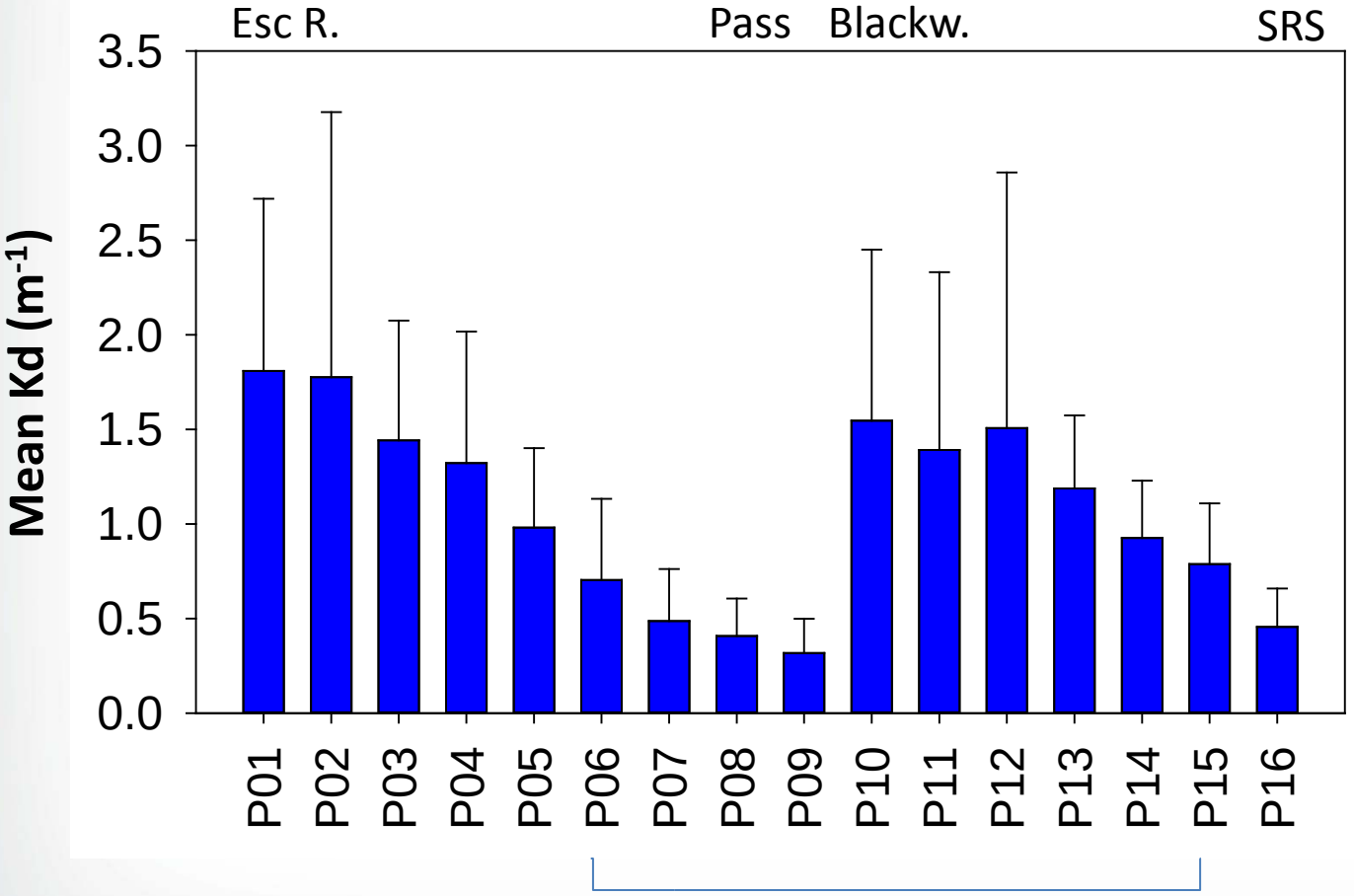
---------- Approximate Seagrass Depth of Colonization in lower Bay

Secchi Depth in Pensacola Bay



---------- Approximate Seagrass Depth of Colonization in lower Bay

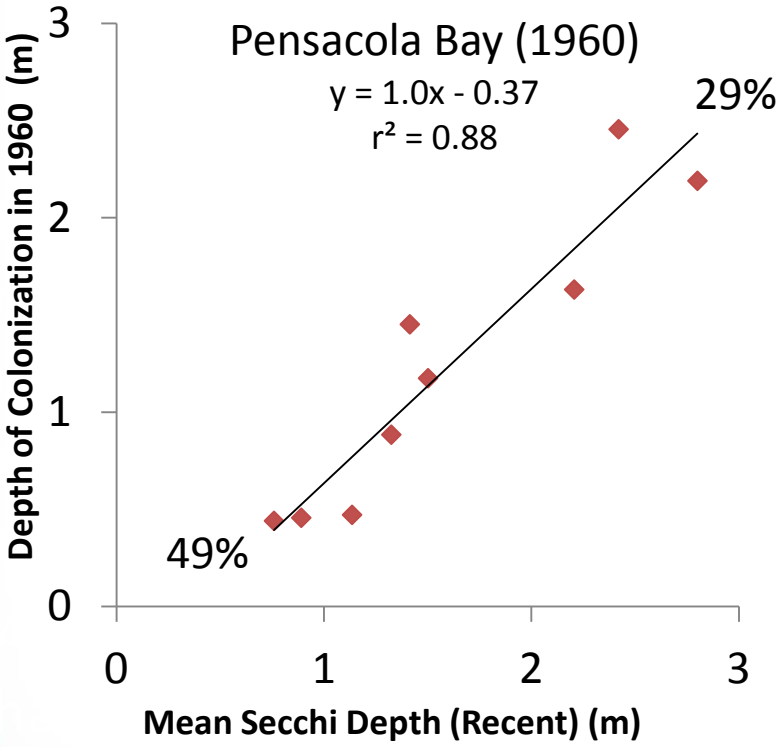
Light Attenuation in Pensacola Bay



The same data is available for ~ 2011 to present

2002-4 Data Based on regression of log PAR vs. depth (4pi sensor on CTD)

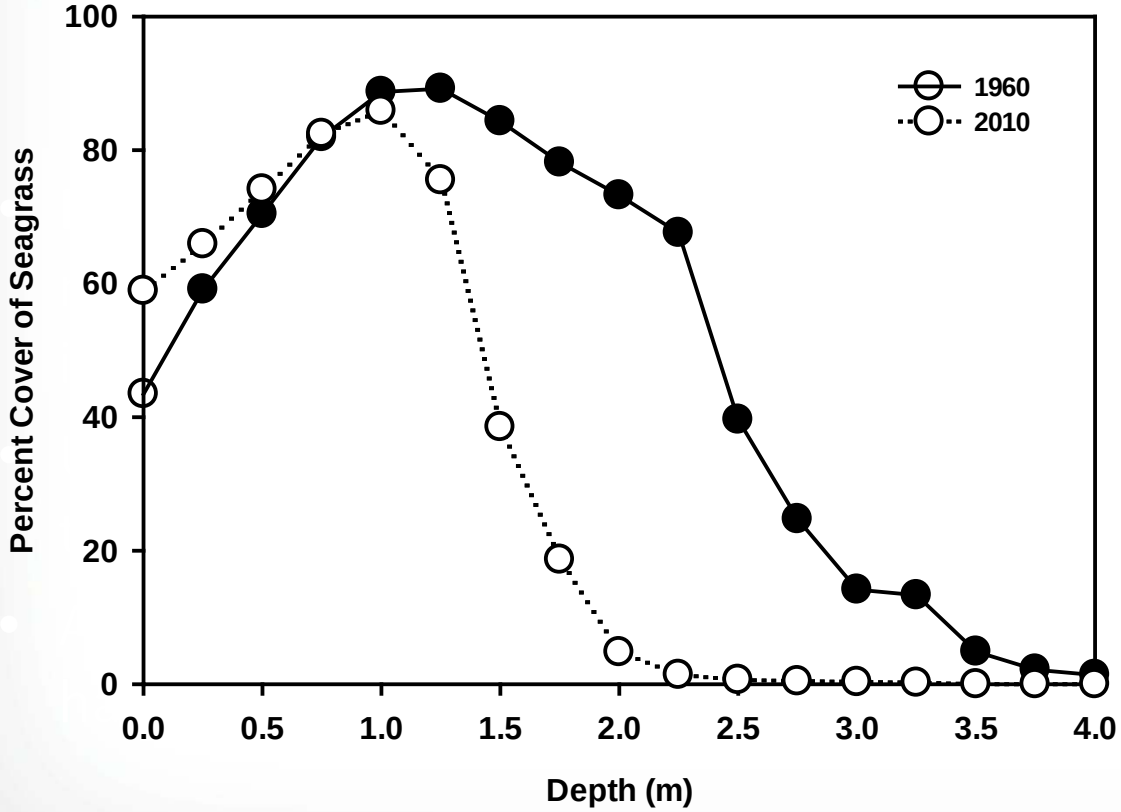
Seagrass Depth vs. Secchi Depth



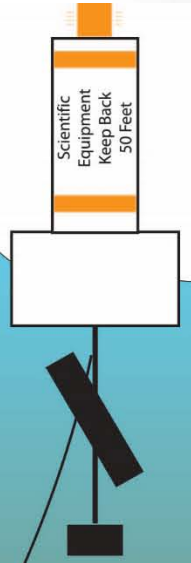
Santa Rosa Sound Seagrass ‘60 vs ‘10

Seagrass Depth Distribution

Santa Rosa Sound



Open Water Metabolism

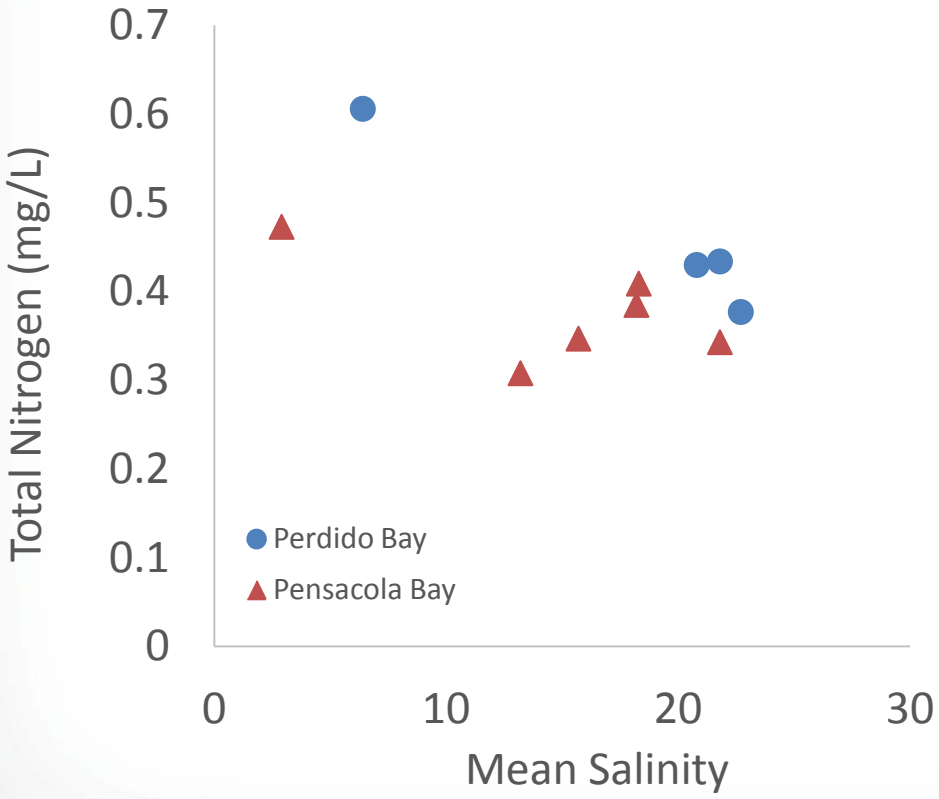


- **Ecosystem Metabolism** is a useful measure of trophic status; possible indicator of nutrient pollution effects
- Useful approach is to infer rates from DO time series using **Open Water Method**
- Analysis typically assumes that advection has minimal effect on DO.

Conclusions

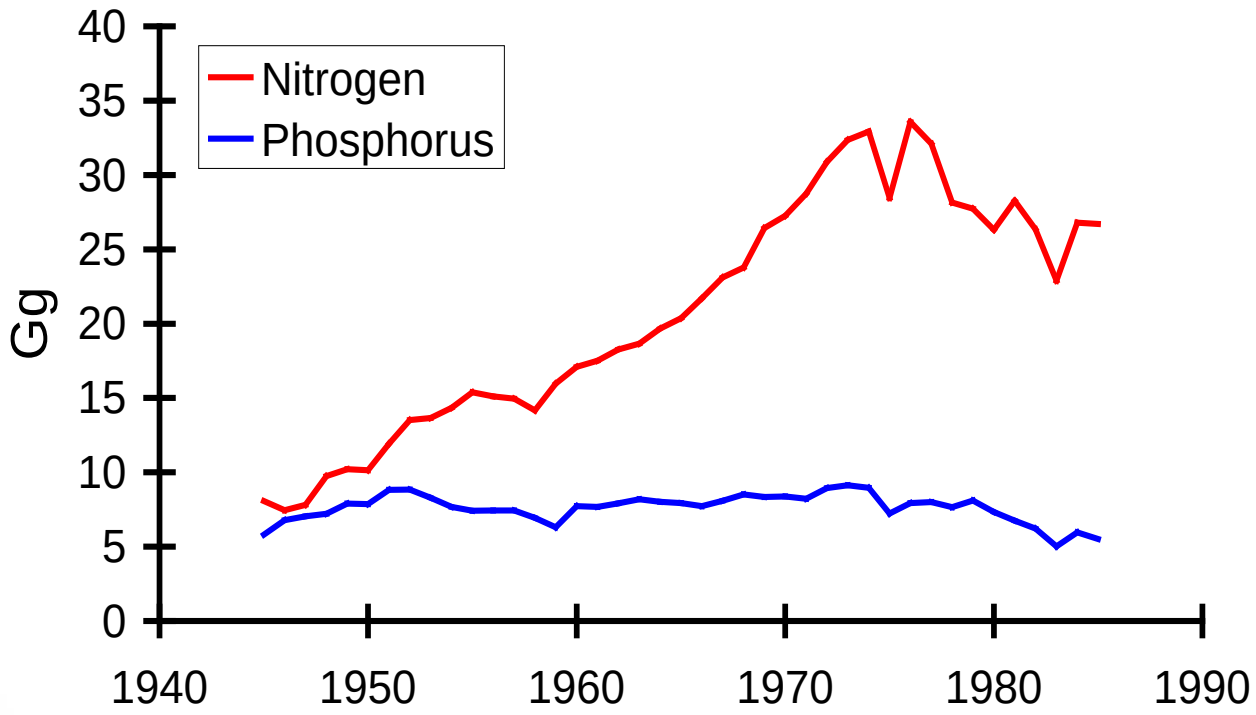
- Salinity is variable in Pensacola Bay. Declining river flow be important, but effects not documented at this point.
- Similar trends in freshwater flow present in Perdido River … likely climate driven
- Water clarity in Pensacola Bay is consistent with light expectations for seagrass at historical distribution … but seagrass isn't there after many years.
- And, seagrass depth of colonization may still be declining in lower Bay and Santa Rosa Sound.

Total Nitrogen vs. Salinity



Long-Term Mean Total NItrogen vs. Salinity (from FDEP)

Fertilizer use in Pensacola Bay Watershed

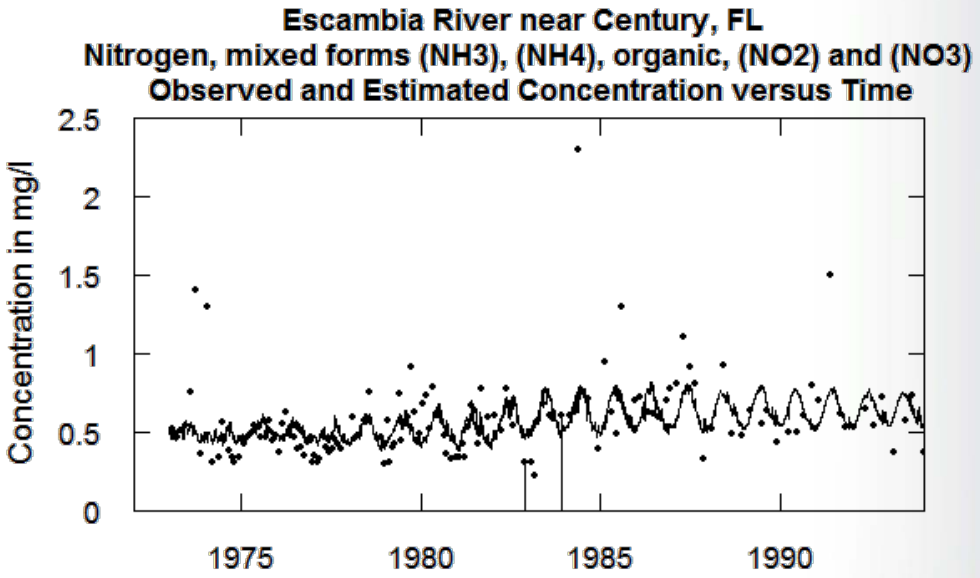


Alexander and Smith 1990; USGS OFR 90-130

Compiled by J. Caffrey

Total Nitrogen in Escambia River

- Analysis of TN loading using WRTDS in EGRET tools



Group	Chl-a ($\mu g\ l^{-1}$)	Secchi Depth (m)	DIN (µM)	PO_4^{3-} (µM)	TN (µM)	TP (µM)
Oligohaline (Salinity < 5)						
Ecoregion 75	3.8 (16)	0.93 (12)	2.9 (15)	0.11 (15)	nd	nd
Ecoregion 75a	2.1 (6)	1.6 (4)	2.6 (6)	0.023 (6)	23.4 (6)	0.67 (6)
Pensacola Bay	5.6 (103)	0.9 (93)	8.7 (102)	0.18 (86)	29.2 (49)	0.88 (32)
Mesohaline (Salinity 5-18)						
Ecoregion 75	5.1 (21)	1.0 (21)	1.3 (20)	0.13 (21)	nd	nd
Ecoregion 75a	4.1 (7)	1.0 (7)	0.81 (7)	0.065 (7)	26.5 (7)	0.56 (7)
Pensacola Bay	7.3 (233)	1.2 (198)	0.97 (210)	0.11 (122)	31.7 (59)	0.55 (47)
Polyhaline (Salinity > 18)						
Ecoregion 75	4.3 (28)	1.3 (28)	0.59 (27)	0.11 (28)	nd	nd
Ecoregion 75a	3.5 (6)	1.4 (5)	0.47 (6)	0.052 (6)	20.5 (6)	0.73 (6)
Pensacola Bay	5.8 (107)	2.0 (100)	0.44 (102)	0.048 (82)	32.7 (57)	0.43 (56)

nd = No data