

Banana River Aquatic Preserve

SEACAR Habitat Analyses

Last compiled on 03 September, 2024

Contents

Threshold Filtering	2
Value Qualifiers	3
Water Column	5
Seasonal Kendall-Tau Analysis	5
Water Quality - Discrete	5
Chlorophyll a, Corrected for Pheophytin - Discrete Water Quality	6
Chlorophyll a, Uncorrected for Pheophytin - Discrete Water Quality	9
Dissolved Oxygen - Discrete Water Quality	11
Dissolved Oxygen Saturation - Discrete Water Quality	14
pH - Discrete Water Quality	16
Salinity - Discrete Water Quality	18
Secchi Depth - Discrete Water Quality	20
Total Nitrogen - Discrete Water Quality	22
Total Phosphorus - Discrete Water Quality	25
Total Suspended Solids - Discrete Water Quality	27
Turbidity - Discrete Water Quality	30
Water Temperature - Discrete Water Quality	33
Water Quality - Continuous	37
Dissolved Oxygen - Continuous Water Quality	39
IRLB04	39
Dissolved Oxygen Saturation - Continuous Water Quality	40
IRLB04	40
pH - Continuous Water Quality	41
IRLB04	41
Salinity - Continuous Water Quality	42
IRLB04	42
Turbidity - Continuous Water Quality	43
IRLB04	43
Water Temperature - Continuous Water Quality	44
IRLB04	44
Submerged Aquatic Vegetation	45
Parameters	45
Species	45
Notes	45

Threshold Filtering

Threshold filters, following the guidance of Florida Department of Environmental Protection's (*FDEP*) Division of Environmental Assessment and Restoration (*DEAR*) are used to exclude specific results values from the SEACAR Analysis. Based on the threshold filters, Quality Assurance / Quality Control (*QAQC*) Flags are inserted into the *SEACAR_QAQCFlagCode* and *SEACAR_QAQC_Description* columns of the export data. The *Include* column indicates whether the *QAQC* Flag will also indicate that data are excluded from analysis. No data are excluded from the data export, but the analysis scripts can use the *Include* column to exclude data (1 to include, 0 to exclude).

Table 1: Continuous Water Quality threshold values

<i>Parameter Name</i>	<i>Units</i>	<i>Low Threshold</i>	<i>High Threshold</i>	<i>Sensor Type</i>
Dissolved Oxygen	mg/L	0	50	YSI EXOs
Dissolved Oxygen	mg/L	0	50	Analysis Only - 2022-04-04
Dissolved Oxygen	mg/L	0	50	6600 Series
Salinity	ppt	0	70	6600 Series
Salinity	ppt	0	70	YSI EXOs
Salinity	ppt	0	70	Analysis Only - 2022-04-04
Water Temperature	Degrees C	-5	45	YSI EXOs
Water Temperature	Degrees C	-5	45	Analysis Only - 2022-04-04
Water Temperature	Degrees C	-5	45	6600 Series
pH	pH	2	14	Analysis Only - 2022-04-04
pH	pH	2	14	6600 Series
pH	pH	2	14	YSI EXOs
Dissolved Oxygen Saturation	%	0	500	YSI EXOs
Dissolved Oxygen Saturation	%	0	500	6600 Series
Dissolved Oxygen Saturation	%	0	500	Analysis Only - 2022-04-04
Specific Conductivity	mS/cm	0	100	6600 Series
Specific Conductivity	mS/cm	0	200	YSI EXOs
Turbidity	NTU	0	4000	YSI EXOs
Turbidity	NTU	0	1000	6600 Series
Turbidity	NTU	0	4000	Analysis Only - 2022-04-04

Table 2: Discrete Water Quality threshold values

<i>Parameter Name</i>	<i>Units</i>	<i>Low Threshold</i>	<i>High Threshold</i>
Dissolved Oxygen	mg/L	0.000001	22
Salinity	ppt	0	70
Water Temperature	Degrees C	3	40
pH		2	13
Dissolved Oxygen Saturation	%	0.000001	310
Specific Conductivity	mS/cm	0.005000001	100
Turbidity	NTU	0	-
Total Suspended Solids (TSS)	mg/L	0	-
Chlorophyll a uncorrected for pheophytin	ug/L	0	-
Chlorophyll a corrected for pheophytin	ug/L	0	-
Secchi Depth	m	0.000001	50
Light Extinction Coefficient	m^{-1}	0	-
Colored dissolved organic matter, CDOM	PCU	0	-
Fluorescent dissolved organic matter, FDOM	QSE	0	-
Total Nitrogen	mg/L	0	-
Total Kjeldahl Nitrogen TKN	mg/L	0	-
NO ₂ +3 Filtered	mg/L	0	-
NH ₄ Filtered	mg/L	0	-
Total Phosphorus	mg/L	0	-

Parameter Name	Units	Low Threshold	High Threshold
PO4 Filtered	mg/L	0	-
Ammonia- Un-ionized (NH3)	mg/L	0	-
Nitrate (N)	mg/L	0	-
Nitrite (N)	mg/L	0	-
Nitrogen, organic	mg/L	0	-

Table 3: Quality Assurance Flags inserted based on threshold checks listed in Table 1 & 2

SEACAR QAQC Description	Include	SEACAR QAQCFlagCode
Exceeds Maximum threshold. Not verified in raw data	No	2Q
Exceeds Maximum threshold. Verified in raw data	No	3Q
Below Minimum threshold. Not verified in raw data	No	4Q
Below Minimum threshold. Verified in raw data	No	5Q
Within threshold tolerance	Yes	6Q
No defined thresholds for this parameter	Yes	7Q

Value Qualifiers

Value qualifier codes included within the data are used to exclude certain results from the analysis. The data are retained in the data export files, but the analysis uses the *Include* column to filter the results.

STORET and WIN value qualifier codes

Value qualifier codes from *STORET* and *WIN* data are examined with the database and used to populate the *Include* column in data exports.

Table 4: Value Qualifier codes excluded from analysis

Qualifier Source	Value Qualifier	Include	MDL	Description
STORET-WIN	H	No	0	Value based on field kit determination; results may not be accurate
STORET-WIN	J	No	0	Estimated value
STORET-WIN	V	No	0	Analyte was detected at or above method detection limit
STORET-WIN	Y	No	0	Lab analysis from an improperly preserved sample; data may be inaccurate

Discrete Water Quality Value Qualifiers

The following value qualifiers are highlighted in the Discrete Water Quality section of this report. An exception is made for **Program 476 - Charlotte Harbor Estuaries Volunteer Water Quality Monitoring Network** and data flagged with Value Qualifier **H** are included for this program only.

H - Value based on field kit determination; results may not be accurate. This code shall be used if a field screening test (e.g., field gas chromatograph data, immunoassay, or vendor-supplied field kit) was used to generate the value and the field kit or method has not been recognized by the Department as equivalent to laboratory methods.

I - The reported value is greater than or equal to the laboratory method detection limit but less than the laboratory practical quantitation limit.

Q - Sample held beyond the accepted holding time. This code shall be used if the value is derived from a sample that was prepared or analyzed after the approved holding time restrictions for sample preparation or analysis.

S - Secchi disk visible to bottom of waterbody. The value reported is the depth of the waterbody at the location of the Secchi disk measurement.

U - Indicates that the compound was analyzed for but not detected. This symbol shall be used to indicate that the specified component was not detected. The value associated with the qualifier shall be the laboratory method detection limit. Unless requested by the client, less than the method detection limit values shall not be reported.

Systemwide Monitoring Program (SWMP) value qualifier codes

Value qualifier codes from the *SWMP* continuous program are examined with the database and used to populate the *Include* column in data exports. *SWMP* Qualifier Codes are indicated by *QualifierSource=SWMP*.

Table 5: SWMP Value Qualifier codes

<i>Qualifier Source</i>	<i>Value Qualifier</i>	<i>Include</i>	<i>Description</i>
SWMP	-1	Yes	Optional parameter not collected
SWMP	-2	No	Missing data
SWMP	-3	No	Data rejected due to QA/QC
SWMP	-4	No	Outside low sensor range
SWMP	-5	No	Outside high sensor range
SWMP	0	Yes	Passed initial QA/QC checks
SWMP	1	No	Suspect data
SWMP	2	Yes	Reserved for future use
SWMP	3	Yes	Calculated data: non-vented depth/level sensor correction for changes in barometric pressure
SWMP	4	Yes	Historical: Pre-auto QA/QC
SWMP	5	Yes	Corrected data

Water Column

The water column habitat extends from the surface of all water bodies to the bottom sediments and encompasses the different features found in the water at different depths (National Oceanographic Center, 2016). The water column habitat must be viewed in relation to its interconnectedness with other habitats. A healthy water column is an integral component in ensuring a healthy marine and coastal ecosystem. Having a flourishing marine and coastal ecosystem in Florida is necessary to support a strong economy. The health of the water column is dependent upon factors as diverse as land use (e.g., agriculture, mining, forestry practices); human population growth; emissions, (e.g., power plants, automobiles, wastewater); climate (e.g., rainfall, temperature, winds and currents); and decadal trends (e.g., El Niño/La Niña, Atlantic Multidecadal Oscillation, climate change).

The water column is composed of various physical, chemical and biological features, and only a small number of them are adequately monitored. Features of the water column that are monitored are used as indicators of the water column health and help assess the status of other habitats. These indicators include nutrient concentrations (nitrogen and phosphorus); water quality (dissolved oxygen, temperature, salinity and pH); water clarity (Secchi depth, turbidity, chlorophyll-a and colored dissolved organic matter); and nekton (fish, macroinvertebrates and megafauna).

Seasonal Kendall-Tau Analysis

Indicators must have a minimum of five to ten years, depending on the habitat, of data within the geographic range of the analysis to be included in the analysis. Ten years of data are required for discrete parameters, and five years of data are required for continuous parameters. If there are insufficient years of data, the number of years of data available will be noted and labeled as “insufficient data to conduct analysis”. Further, for the preferred Seasonal Kendall-Tau test, there must be data from at least two months in common across at least two consecutive years within the RCP managed area being analyzed. Values that pass both of these tests will be included in the analysis and be labeled as *Use_In_Analysis* = **TRUE**. Any that fail either test will be excluded from the analyses and labeled as *Use_In_Analysis* = **FALSE**.

Water Quality - Discrete

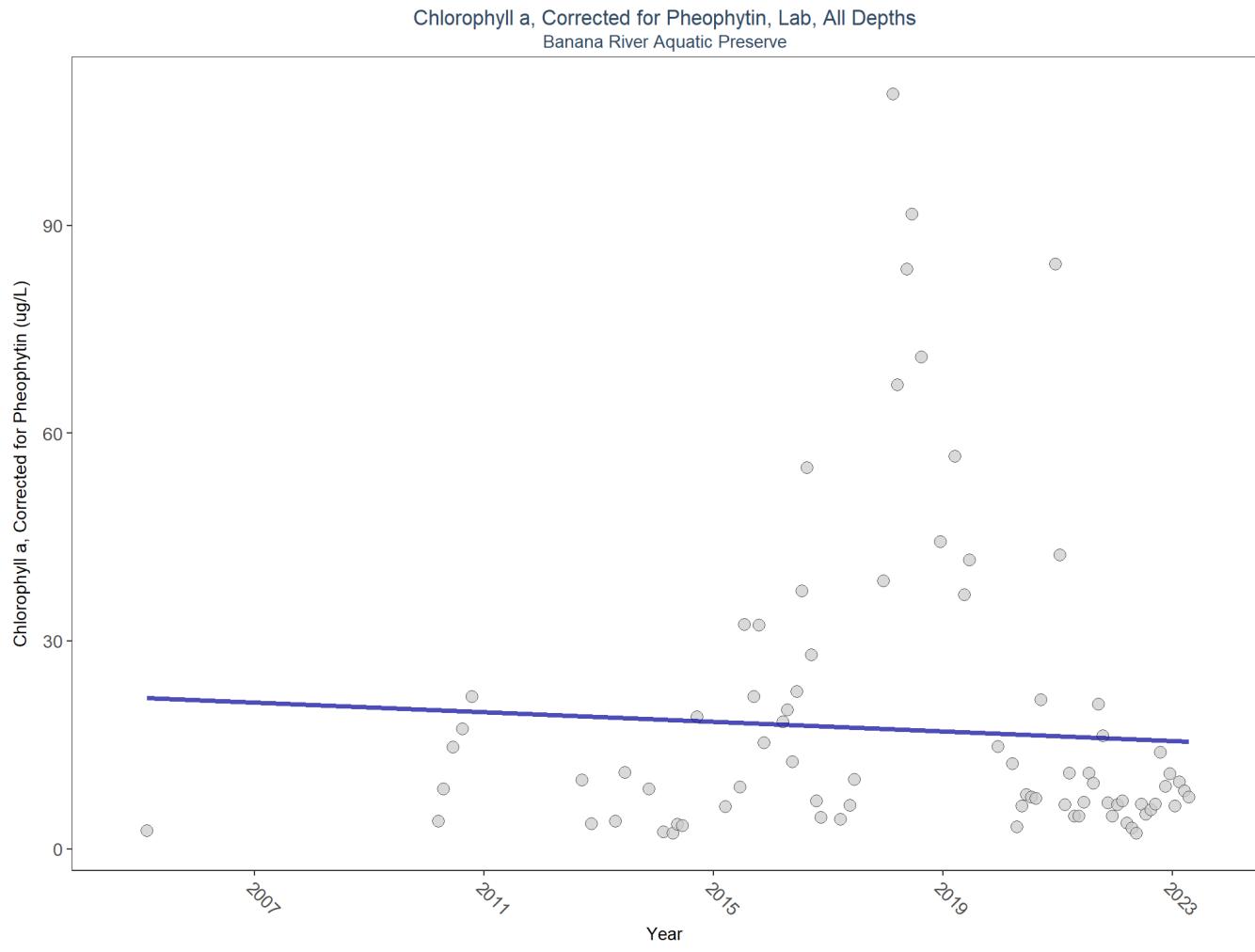
The following files were used in the discrete analysis:

- *Combined_WQ_WC_NUT_Chlorophyll_a_corrected_for_pheophytin-2024-Jul-11.txt*
- *Combined_WQ_WC_NUT_Chlorophyll_a_uncorrected_for_pheophytin-2024-Jul-11.txt*
- *Combined_WQ_WC_NUT_Colored_dissolved_organic_matter_CDOM-2024-Jul-11.txt*
- *Combined_WQ_WC_NUT_Dissolved_Oxygen-2024-Jul-11.txt*
- *Combined_WQ_WC_NUT_Dissolved_Oxygen_Saturation-2024-Jul-11.txt*
- *Combined_WQ_WC_NUT_pH-2024-Jul-11.txt*
- *Combined_WQ_WC_NUT_Salinity-2024-Jul-11.txt*
- *Combined_WQ_WC_NUT_Secchi_Depth-2024-Jul-11.txt*
- *Combined_WQ_WC_NUT_Total_Nitrogen-2024-Jul-11.txt*
- *Combined_WQ_WC_NUT_Total_Phosphorus-2024-Jul-11.txt*
- *Combined_WQ_WC_NUT_Total_Suspended_Solids_TSS-2024-Jul-11.txt*
- *Combined_WQ_WC_NUT_Turbidity-2024-Jul-11.txt*
- *Combined_WQ_WC_NUT_Water_Temperature-2024-Jul-11.txt*

Chlorophyll a, Corrected for Pheophytin - Discrete Water Quality

Chlorophyll-a is monitored as a measure of microalgae growing in the water. Algae are a natural part of coastal and aquatic ecosystems but in excess can cause poor water quality and clarity, and decreased levels of dissolved oxygen.

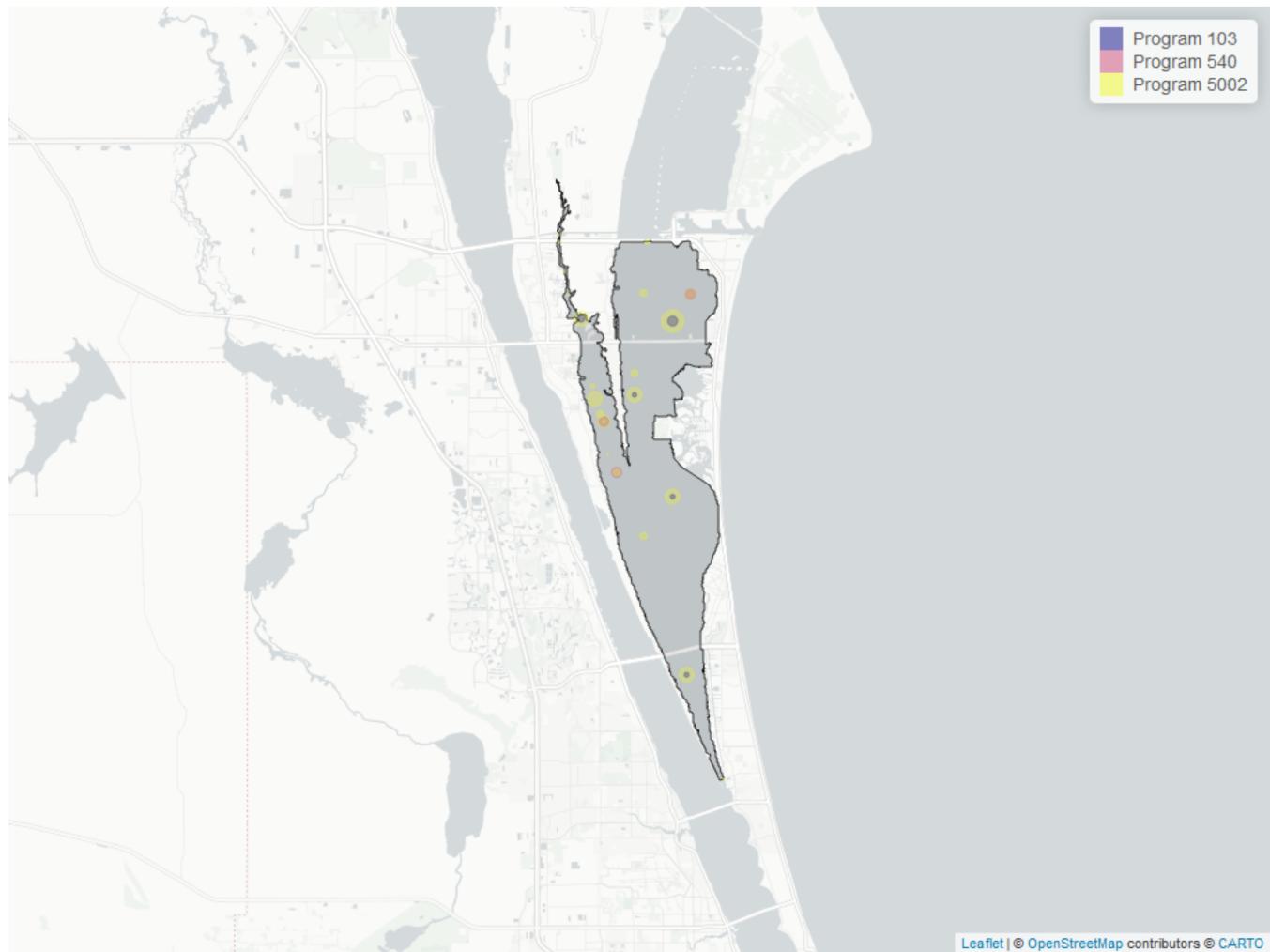
Seasonal Kendall-Tau Trend Analysis



p < 0.00005 appear as 0 due to rounding.

SennIntercept is intercept value at beginning of record for monitoring location

Map showing location of Discrete sampling sites for Chlorophyll a, Corrected for Pheophytin



The bubble size on the above plots reflects the amount of data available at each sampling site

Table 6: Programs contributing data for Chlorophyll a, Corrected for Pheophytin

ProgramID	N_Data	YearMin	YearMax
5002	358	2005	2023
103	43	2020	2021
540	42	2016	2020

Program names:

5002 - Florida STORET / WIN

103 - EPA STOrage and RETrieval Data Warehouse (STORET)

540 - Shellfish Harvest Area Classification Program

Value Qualifiers

- N_{Total} is total amount of data for a given year
- $N_{_}$ is the total amount of values flagged with the respective value qualifier in a given year
- $perc_{_}$ is the percent of data flagged with the respective value qualifier as a proportion of N_{Total}

Table 7: Value Qualifiers for Chlorophyll a, Corrected for Pheophytin

<i>Year</i>	<i>N_Total</i>	<i>N_I</i>	<i>perc_I</i>	<i>N_U</i>	<i>perc_U</i>
2005	10	9	90.0	1	10.0
2012	8	2	25.0		
2014	20	3	15.0		
2020	70	9	12.9		
2021	125	13	10.4	2	1.6
2022	87	16	18.4	2	2.3

Note: ¹**I** - Reported value is greater than or equal to lab method detection limit, but less than quantitation limit ²**U**
 - Compound was analyzed for but not detected

Programs containing Value Qualified data:

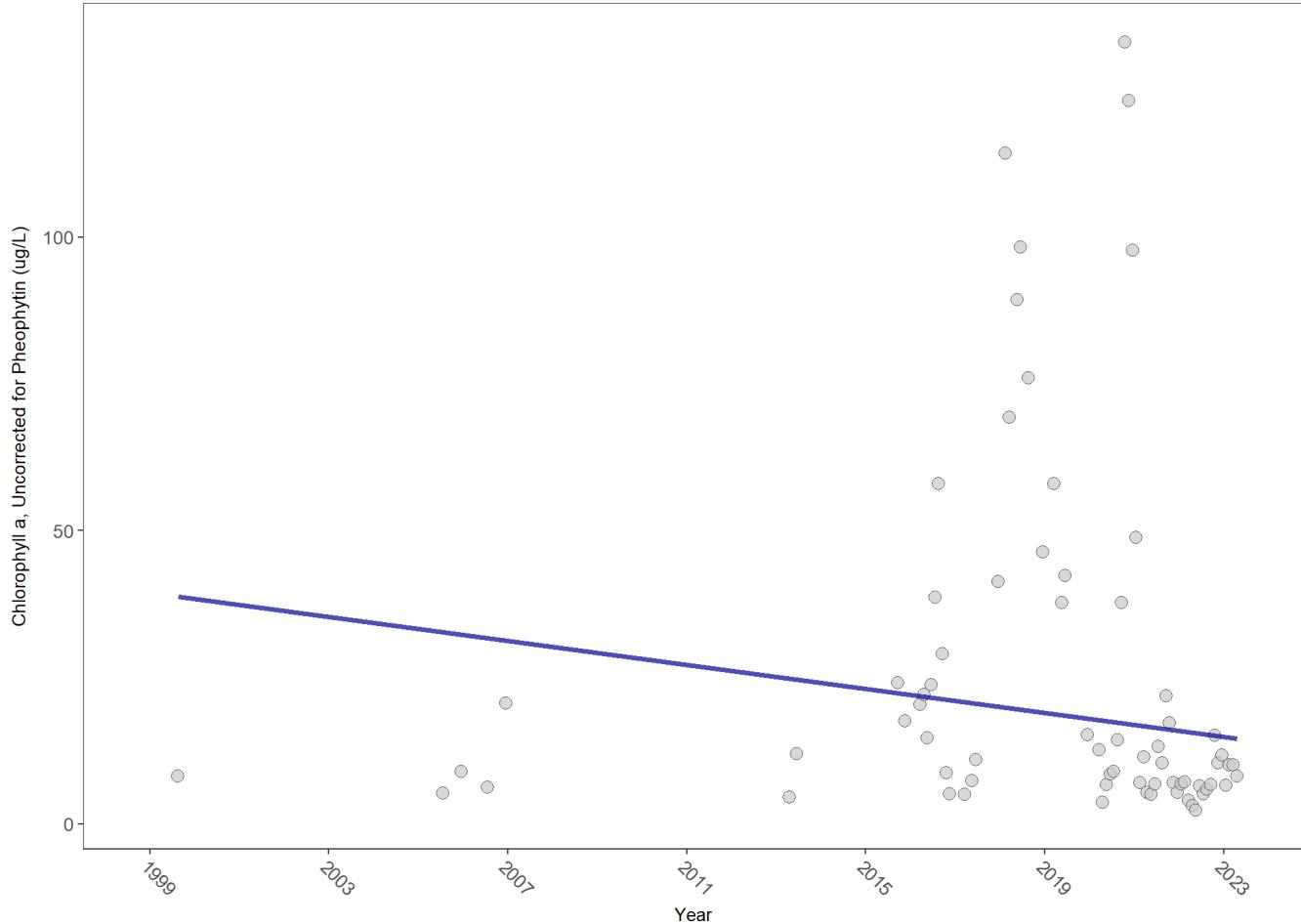
5002 - Florida STORET / WIN

540 - Shellfish Harvest Area Classification Program

Chlorophyll a, Uncorrected for Pheophytin - Discrete Water Quality

Seasonal Kendall-Tau Trend Analysis

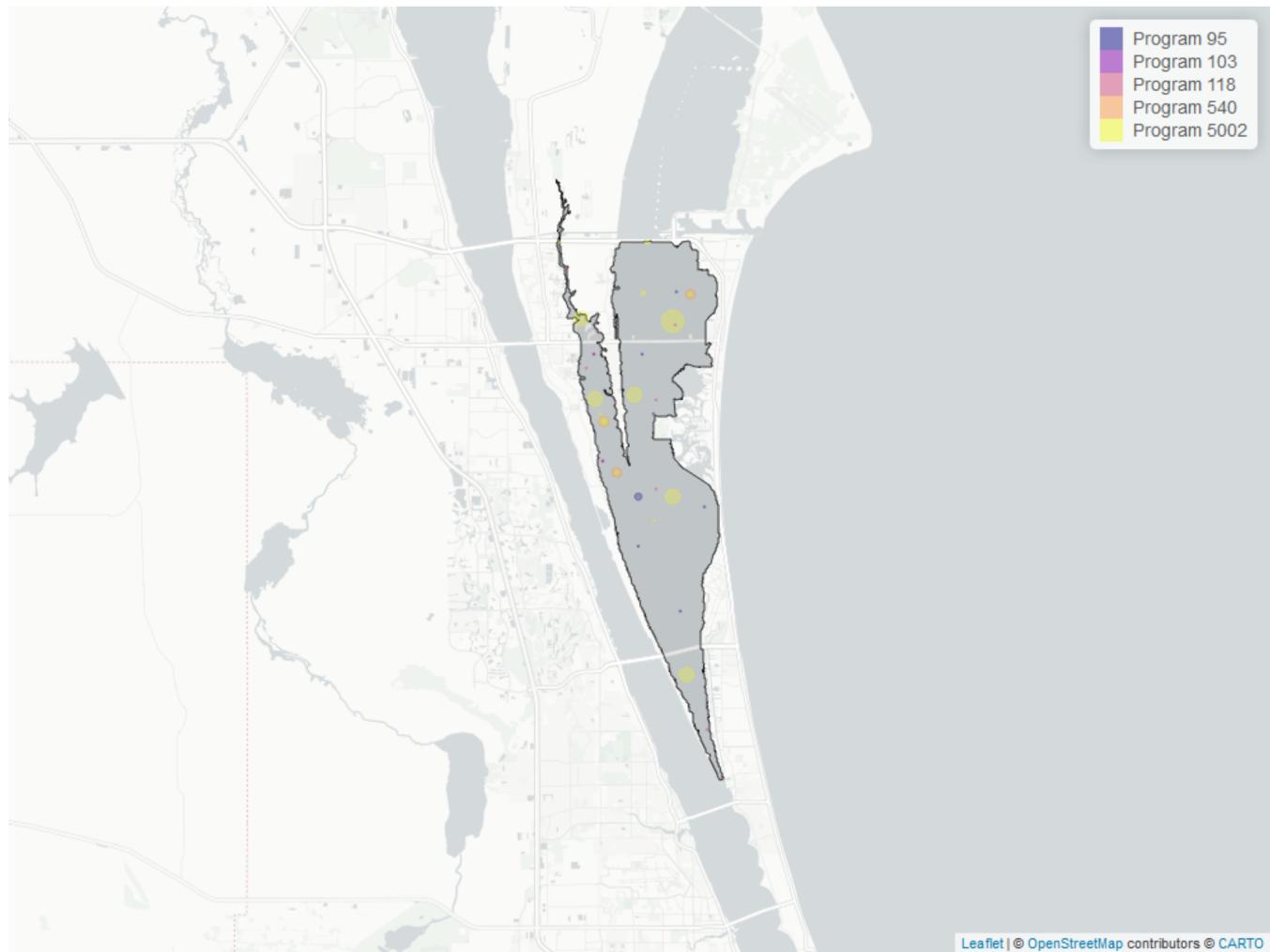
Chlorophyll a, Uncorrected for Pheophytin, Lab, All Depths
Banana River Aquatic Preserve



$p < 0.00005$ appear as 0 due to rounding.

SennIntercept is intercept value at beginning of record for monitoring location

Map showing location of Discrete sampling sites for Chlorophyll a, Uncorrected for Pheophytin



The bubble size on the above plots reflects the amount of data available at each sampling site

Table 8: Programs contributing data for Chlorophyll a, Uncorrected for Pheophytin

ProgramID	N_Data	YearMin	YearMax
5002	282	1999	2023
540	44	2016	2020
95	17	2010	2018
118	8	2005	2010
103	4	2005	2021

Program names:

5002 - Florida STORET / WIN

540 - Shellfish Harvest Area Classification Program

95 - Harmful Algal Bloom Marine Observation Network

Value Qualifiers

- N_{Total} is total amount of data for a given year
- $N_{}$ is the total amount of values flagged with the respective value qualifier in a given year
- $perc_{}$ is the percent of data flagged with the respective value qualifier as a proportion of N_{Total}

Table 9: Value Qualifiers for Chlorophyll a, Uncorrected for Pheo-phytin

Year	N_{Total}	N_I	$perc_I$	N_U	$perc_U$
2020	64	2	3.1		
2021	90	14	15.6		
2022	87	13	14.9	4	4.6

Note: ¹I - Reported value is greater than or equal to lab method detection limit, but less than quantitation limit ²U
- Compound was analyzed for but not detected

Programs containing Value Qualified data:

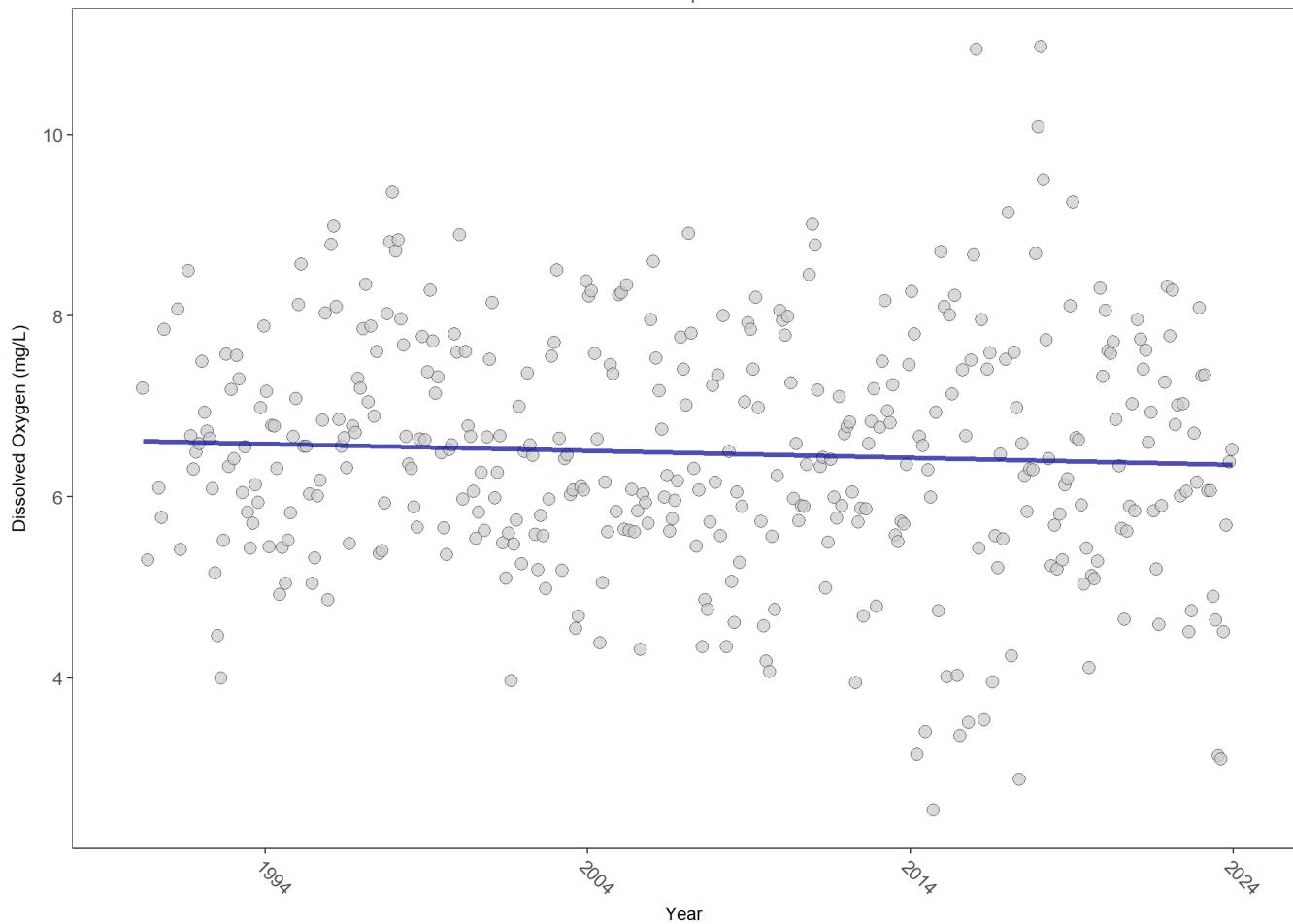
540 - Shellfish Harvest Area Classification Program
5002 - Florida STORET / WIN

Dissolved Oxygen - Discrete Water Quality

Dissolved Oxygen (DO) is a key indicator of water quality. Oxygen enters surface waters by air-sea gas exchange, by wind action, or as a byproduct of aquatic plant photosynthesis. The actual quantity of DO in aquatic environments is dependent on the above processes as well as water temperature and salinity.

Seasonal Kendall-Tau Trend Analysis

Dissolved Oxygen, Field, All Depths
Banana River Aquatic Preserve

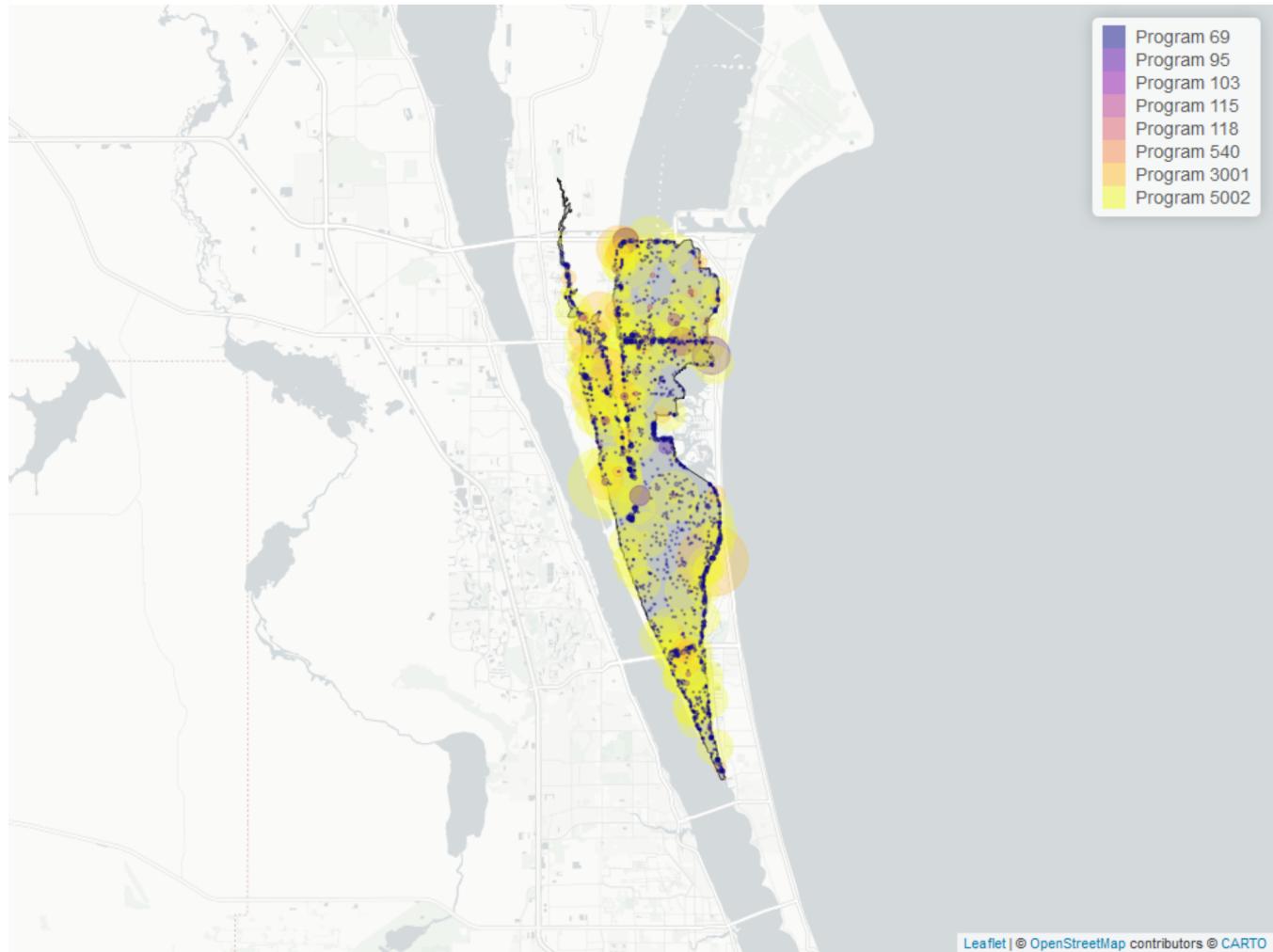


RelativeDepth	N_Data	N_Years	Median	Independent	tau	p	SennSlope	SennIntercept	ChiSquared	pChiSquared	Trend
All	29748	34	6.47	TRUE	-0.0559	0.1029	-0.00753152	6.616149	12.5605	0.323	0

p < 0.00005 appear as 0 due to rounding.

SennIntercept is intercept value at beginning of record for monitoring location

Map showing location of Discrete sampling sites for Dissolved Oxygen



The bubble size on the above plots reflects the amount of data available at each sampling site

Table 10: Programs contributing data for Dissolved Oxygen

ProgramID	N_Data	YearMin	YearMax
5002	20192	1991	2023
69	4325	1990	2022
3001	4249	1991	2023
95	658	2006	2018
3013	328	2003	2023
103	111	2020	2021
540	39	2016	2020
115	8	1995	1995
118	6	2005	2006

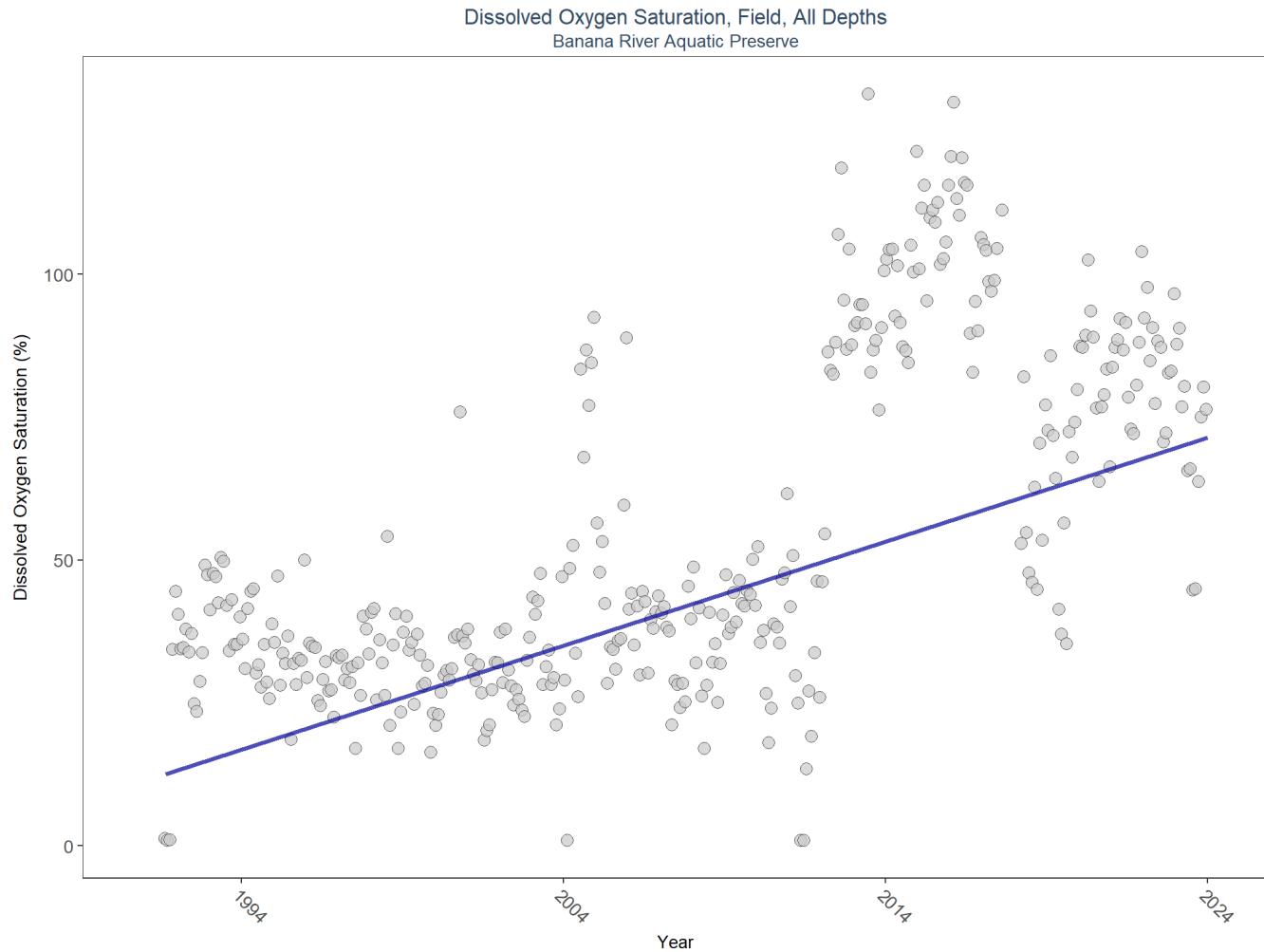
Program names:

- 5002 - Florida STORET / WIN
 69 - Fisheries-Independent Monitoring (FIM) Program
 3001 - Lagoon Watch (Formerly Marine Discovery Center)
 95 - Harmful Algal Bloom Marine Observation Network
 3013 - Seagrass (SJRWMD)
 103 - EPA STOrage and RETrieval Data Warehouse (STORET)
 540 - Shellfish Harvest Area Classification Program
 115 - Environmental Monitoring Assessment Program
 118 - National Aquatic Resource Surveys, National Coastal Condition Assessment

There are no qualifying Value Qualifiers for Dissolved Oxygen in Banana River Aquatic Preserve

Dissolved Oxygen Saturation - Discrete Water Quality

Seasonal Kendall-Tau Trend Analysis



RelativeDepth	N_Data	N_Years	Median	Independent	tau	p	SennSlope	SennIntercept	ChiSquared	pChiSquared	Trend
All	7394	33	57	TRUE	0.4407	0.0000	1.820376	11.41543	5.3406	0.9136	1

p < 0.00005 appear as 0 due to rounding.

SennIntercept is intercept value at beginning of record for monitoring location

Map showing location of Discrete sampling sites for Dissolved Oxygen Saturation

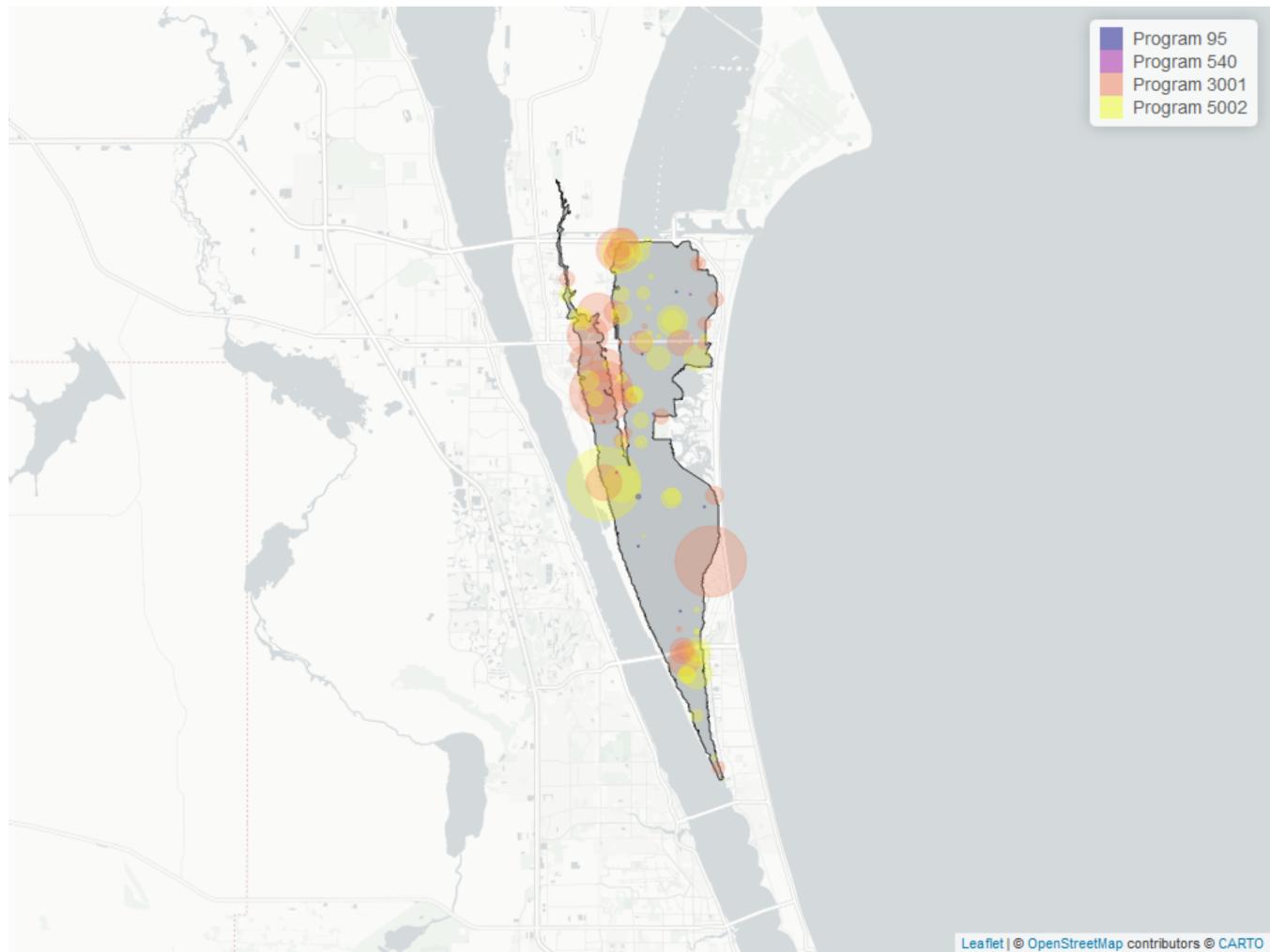


Table 11: Programs contributing data for Dissolved Oxygen Saturation

ProgramID	N_Data	YearMin	YearMax
3001	4178	1991	2023
5002	3056	1991	2023
3013	162	2012	2023
95	11	2014	2018
540	3	2018	2018

Program names:

- 3001 - Lagoon Watch (Formerly Marine Discovery Center)
- 5002 - Florida STORET / WIN
- 3013 - Seagrass (SJRWMD)

95 - Harmful Algal Bloom Marine Observation Network

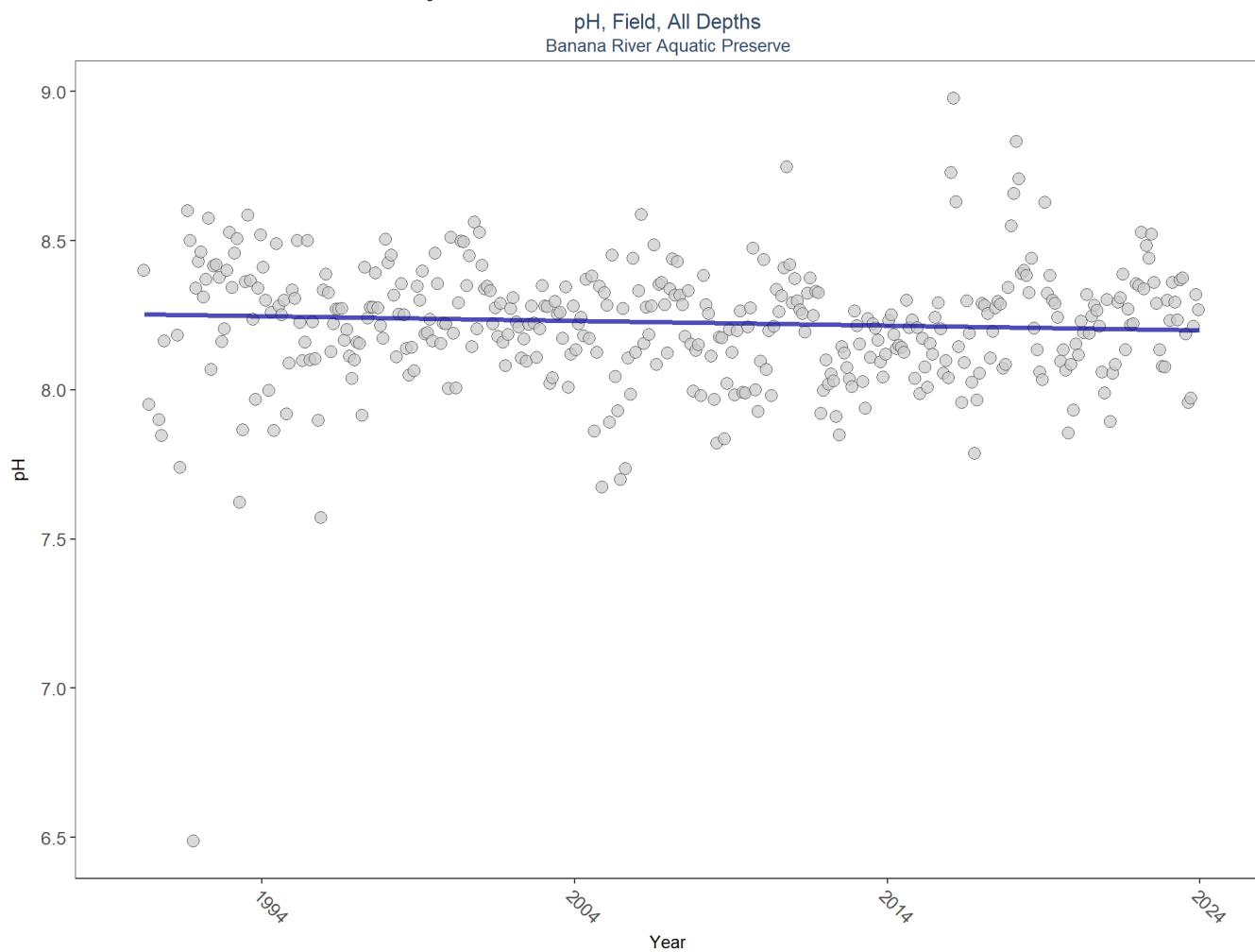
540 - Shellfish Harvest Area Classification Program

There are no qualifying Value Qualifiers for Dissolved Oxygen Saturation in Banana River Aquatic Preserve

pH - Discrete Water Quality

The **pH** of water is the measure of how acidic or basic the water body is on a scale of 0-14, with lower readings indicating acidic and higher readings indicating basic, and a pH of 7 being neutral. Florida's natural waters fall between 6.5 and 8.5 on this scale. A water body's pH can change due to precipitation, geology, vegetation, water pollution and air pollution.

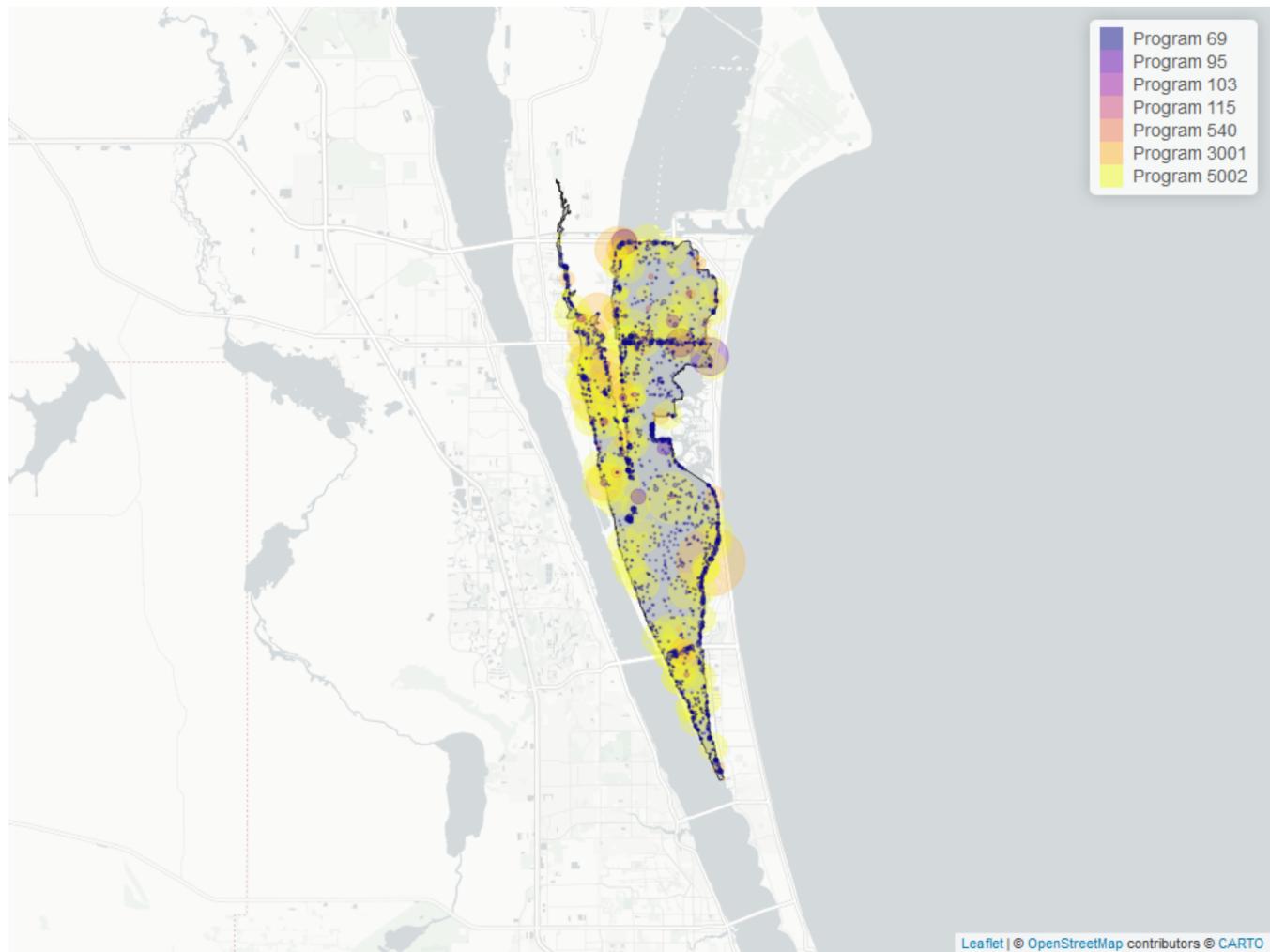
Seasonal Kendall-Tau Trend Analysis



p < 0.00005 appear as 0 due to rounding.

SennIntercept is intercept value at beginning of record for monitoring location

Map showing location of Discrete sampling sites for pH



The bubble size on the above plots reflects the amount of data available at each sampling site

Table 12: Programs contributing data for pH

ProgramID	N_Data	YearMin	YearMax
5002	13684	1996	2023
69	4279	1990	2022
3001	4109	1991	2023
95	624	2006	2018
3013	327	2003	2023
103	111	2020	2021
540	42	2016	2020
115	7	1995	1995

Program names:

5002 - Florida STORET / WIN

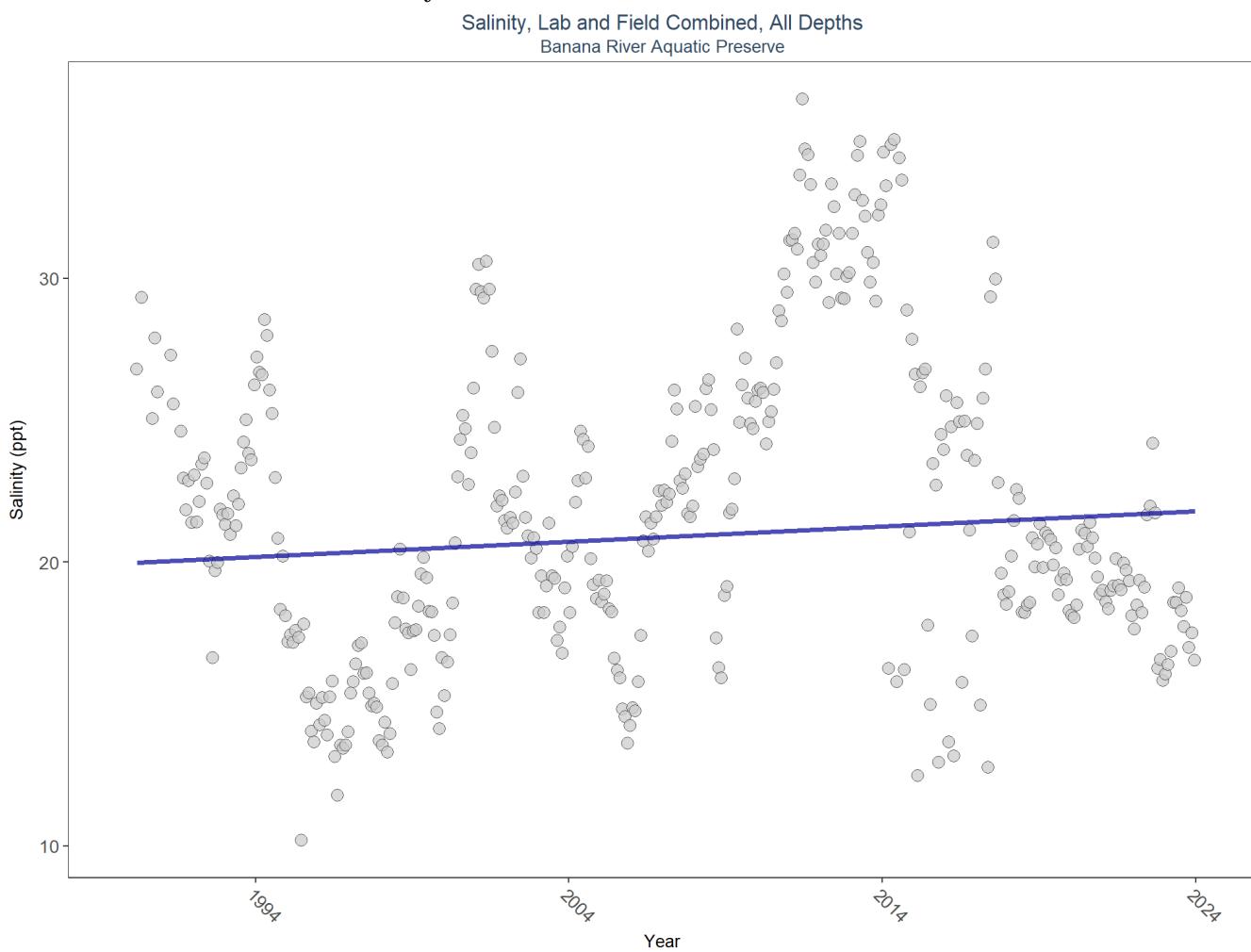
- 69 - Fisheries-Independent Monitoring (FIM) Program
- 3001 - Lagoon Watch (Formerly Marine Discovery Center)
- 95 - Harmful Algal Bloom Marine Observation Network
- 3013 - Seagrass (SJRWMD)
- 103 - EPA STOrage and RETrieval Data Warehouse (STORET)
- 540 - Shellfish Harvest Area Classification Program
- 115 - Environmental Monitoring Assessment Program

There are no qualifying Value Qualifiers for pH in Banana River Aquatic Preserve

Salinity - Discrete Water Quality

Salinity is a measure of the amount of salt in the water. In estuarine ecosystems, salinity is influenced by precipitation, evaporation, surface-water inputs, and exchange with coastal waters.

Seasonal Kendall-Tau Trend Analysis

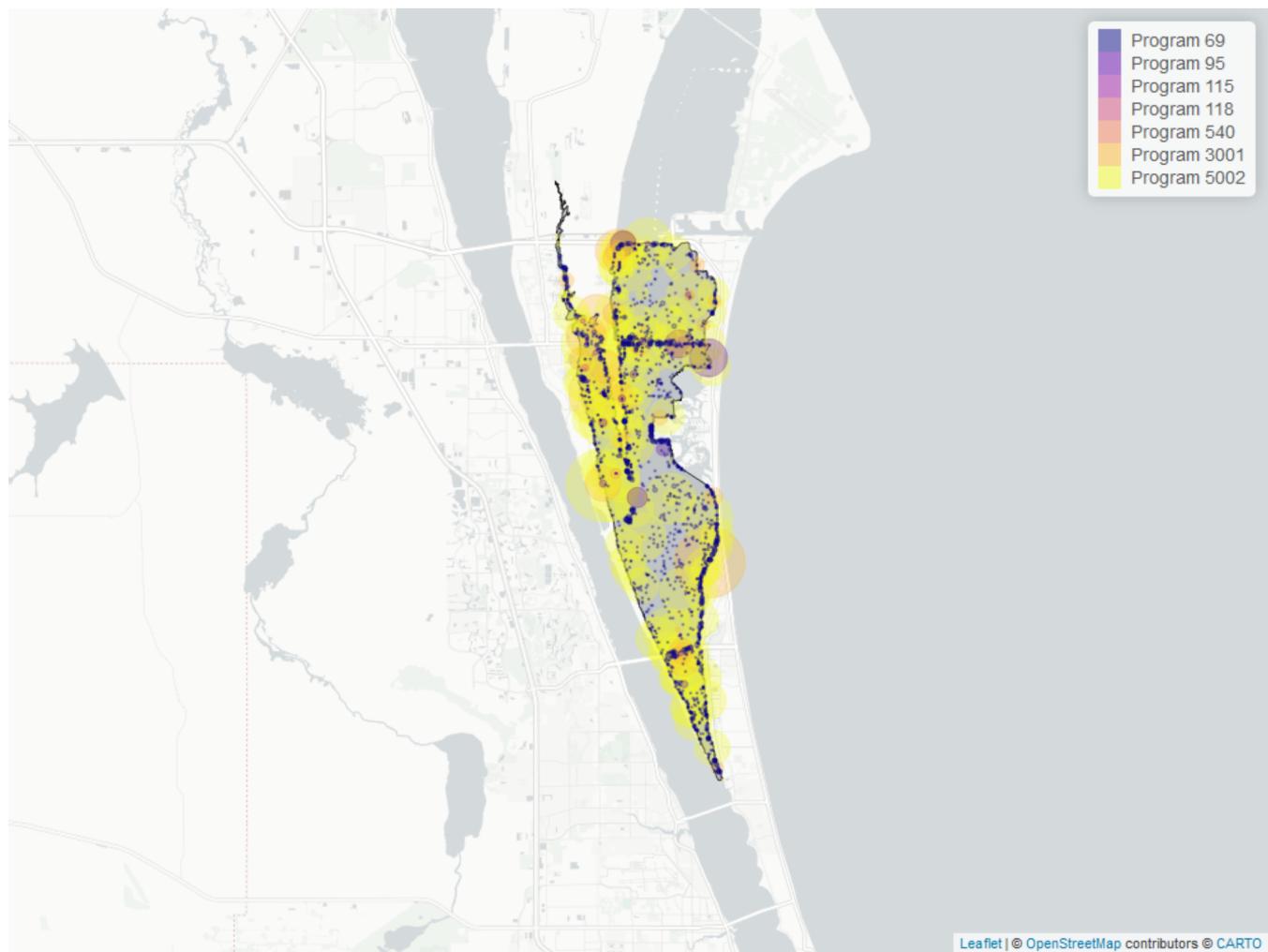


RelativeDepth	N_Data	N_Years	Median	Independent	tau	p	SennSlope	SennIntercept	ChiSquared	pChiSquared	Trend
All	31287	34	19.8	TRUE	0.0681	0.0569	0.05348404	19.96851	2.4977	0.9958	0

p < 0.00005 appear as 0 due to rounding.

SennIntercept is intercept value at beginning of record for monitoring location

Map showing location of Discrete sampling sites for Salinity



The bubble size on the above plots reflects the amount of data available at each sampling site

Table 13: Programs contributing data for Salinity

ProgramID	N_Data	YearMin	YearMax
5002	21654	1991	2023
69	4331	1990	2022
3001	4257	1991	2023
95	670	2006	2018
3013	329	2003	2023
540	42	2016	2020
118	11	2015	2020
115	6	1995	1995

Program names:

5002 - Florida STORET / WIN

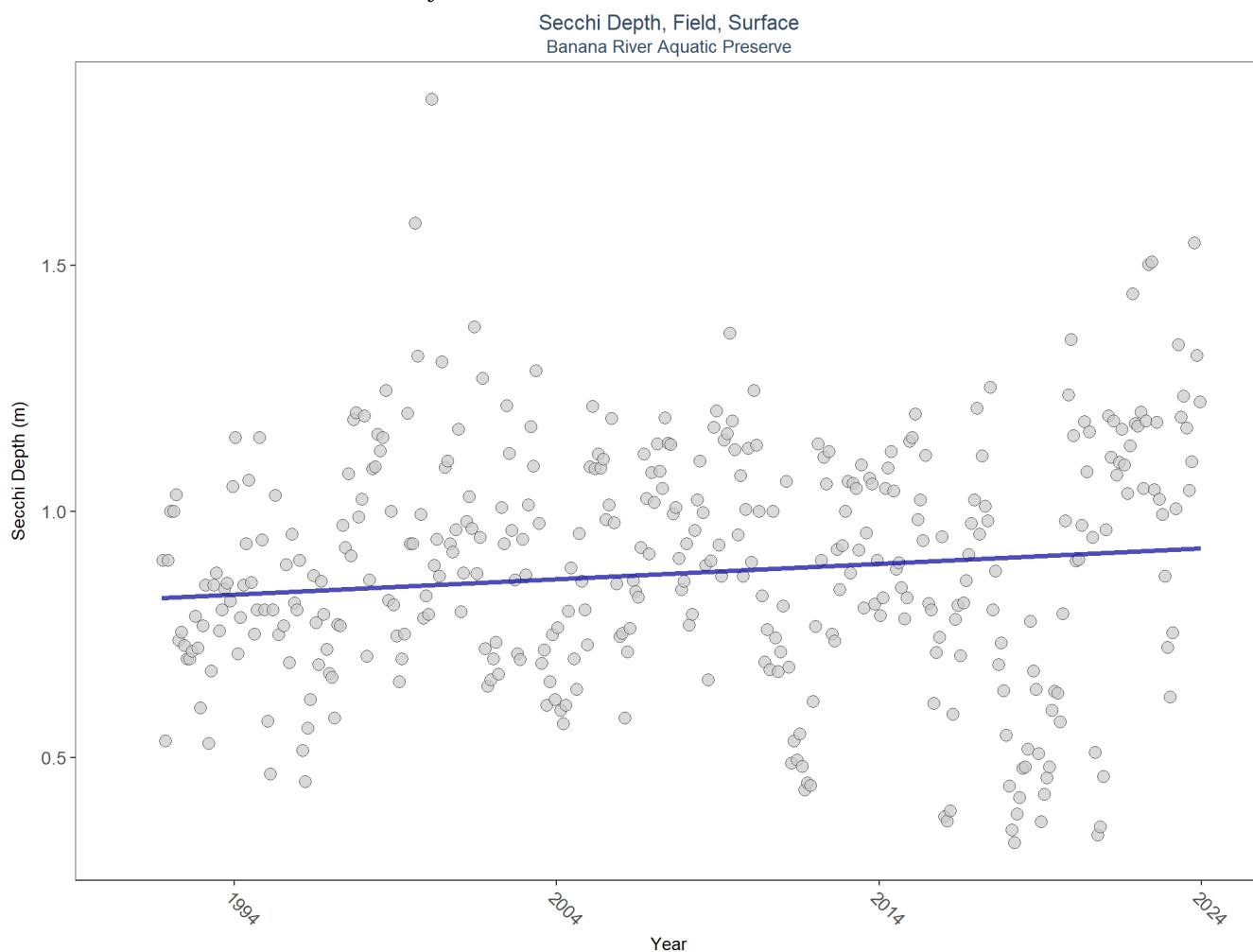
- 69 - Fisheries-Independent Monitoring (FIM) Program
- 3001 - Lagoon Watch (Formerly Marine Discovery Center)
- 95 - Harmful Algal Bloom Marine Observation Network
- 3013 - Seagrass (SJRWMD)
- 540 - Shellfish Harvest Area Classification Program
- 118 - National Aquatic Resource Surveys, National Coastal Condition Assessment
- 115 - Environmental Monitoring Assessment Program

There are no qualifying Value Qualifiers for Salinity in Banana River Aquatic Preserve

Secchi Depth - Discrete Water Quality

Secchi depth is a measure of the transparency or clarity of the water by a device called a Secchi disk. A Secchi disk is a black and white disk that is lowered into the water on a cord. The Secchi depth is the depth at which the disk can no longer be seen. The deeper the Secchi depth, the greater the water clarity.

Seasonal Kendall-Tau Trend Analysis

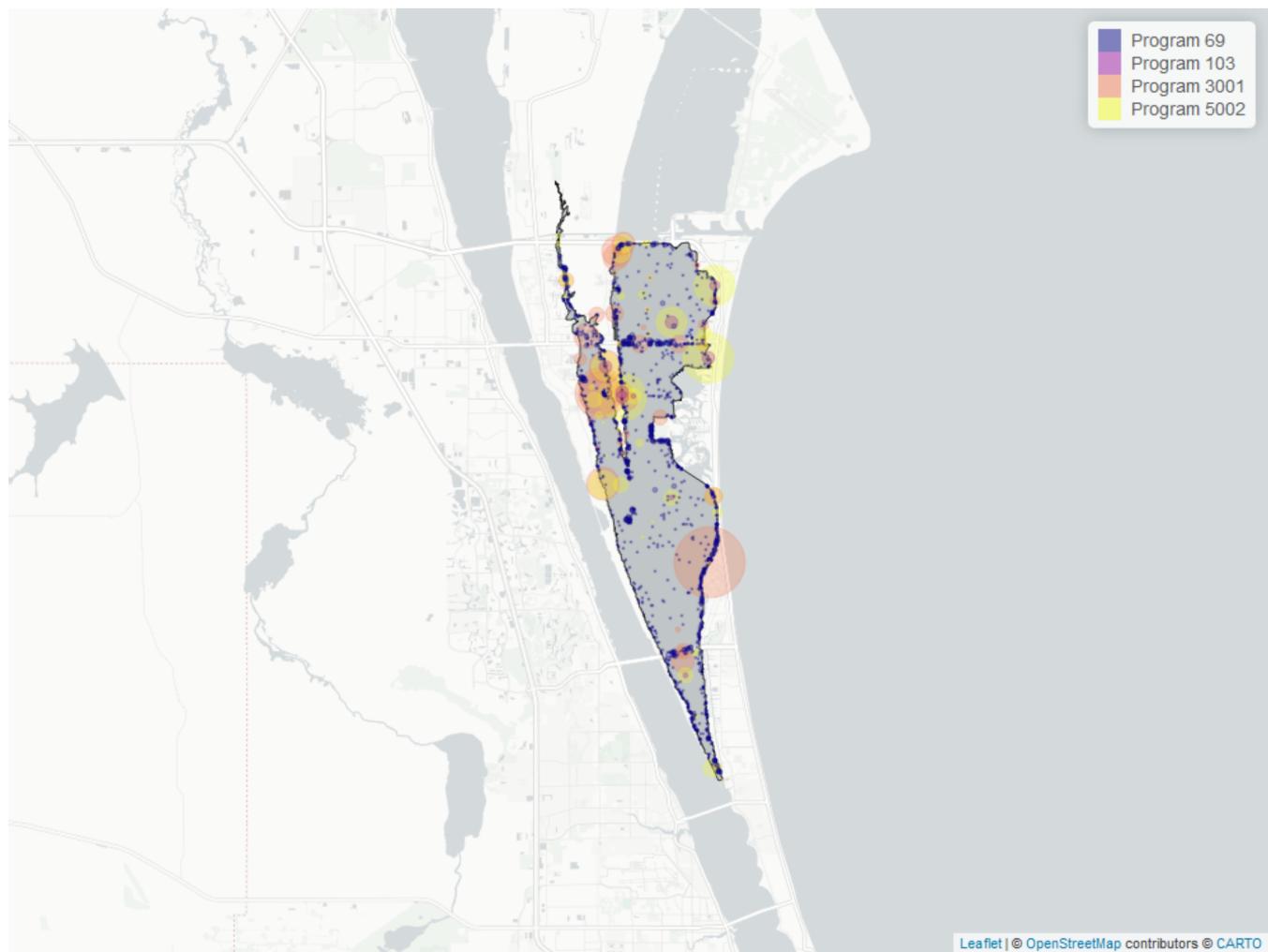


RelativeDepth	N_Data	N_Years	Median	Independent	tau	p	SennSlope	SennIntercept	ChiSquared	pChiSquared	Trend
Surface	8736	33	0.8	TRUE	0.0825	0.0218	0.003157895	0.8212044	4.7855	0.9411	1

p < 0.00005 appear as 0 due to rounding.

SennIntercept is intercept value at beginning of record for monitoring location

Map showing location of Discrete sampling sites for Secchi Depth



The bubble size on the above plots reflects the amount of data available at each sampling site

Table 14: Programs contributing data for Secchi Depth

ProgramID	N_Data	YearMin	YearMax
69	3276	1994	2022
3001	2922	1991	2023
5002	2090	1999	2023
3013	322	2003	2023
103	197	2020	2021

Program names:

- 69 - Fisheries-Independent Monitoring (FIM) Program
- 3001 - Lagoon Watch (Formerly Marine Discovery Center)
- 5002 - Florida STORET / WIN
- 3013 - Seagrass (SJRWMD)

Value Qualifiers

- N_{Total} is total amount of data for a given year
- N_{S} is the total amount of values flagged with the respective value qualifier in a given year
- perc_{S} is the percent of data flagged with the respective value qualifier as a proportion of N_{Total}

Table 15: Value Qualifiers for Secchi Depth

Year	N_{Total}	N_{S}	perc_{S}
2015	400	53	13.2
2016	389	24	6.2
2017	295	80	27.1
2019	395	13	3.3
2020	685	56	8.2
2021	698	147	21.1
2022	493	93	18.9
2023	178	24	13.5

Note: $^1\mathbf{S}$ - Secchi disk visible to bottom of waterbody

Programs containing Value Qualified data:

5002 - Florida STORET / WIN

Total Nitrogen - Discrete Water Quality

Nitrogen and **Phosphorous** are key nutrients that provide nourishment essential for the growth and maintenance of aquatic plants and animals; however, excess nutrients can cause harmful algal blooms and other water quality concerns. Nutrients enter water bodies several ways, including runoff from rain events and atmospheric deposition from natural and industrial sources.

Total Nitrogen Calculation:

The logic for calculated Total Nitrogen was provided by Kevin O'Donnell and colleagues at FDEP (with the help of Jay Silvanima, Watershed Monitoring Section). The following logic is used, in this order, based on the availability of specific nitrogen components.

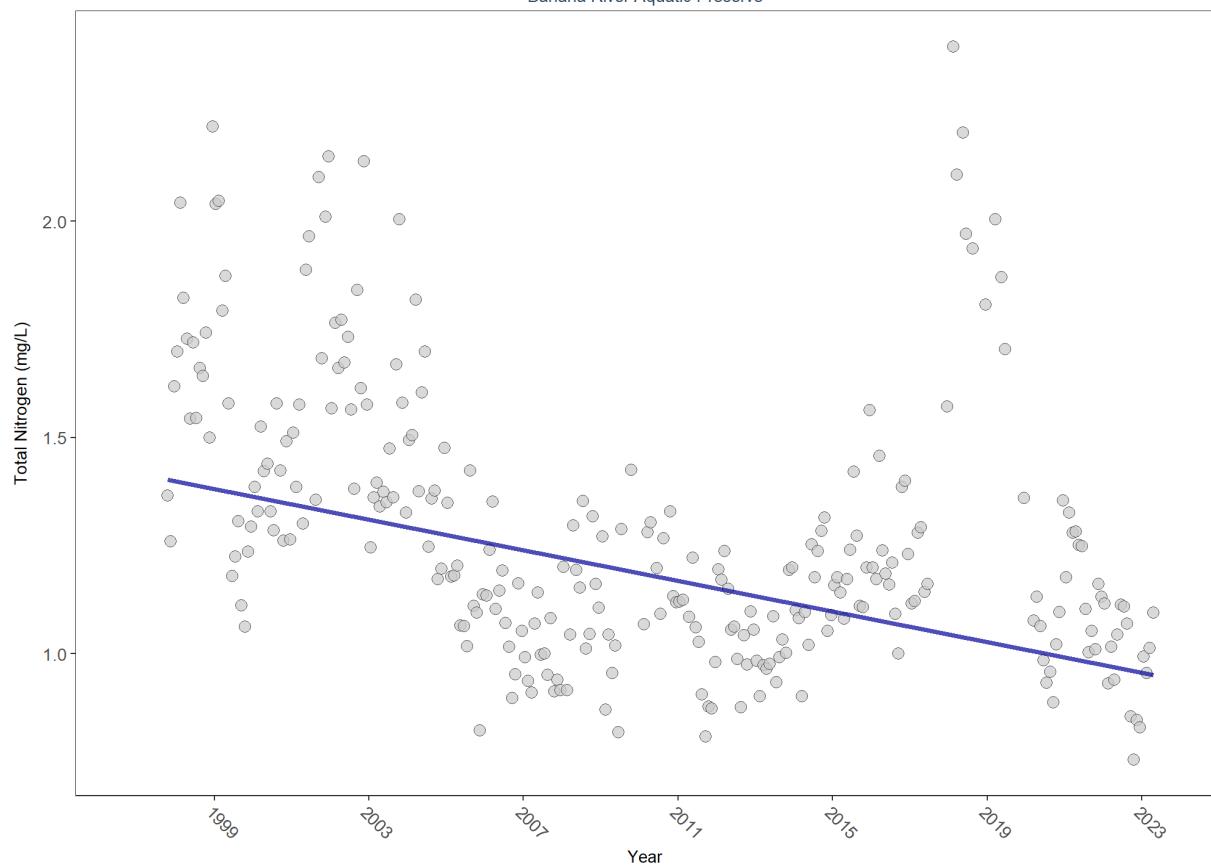
- 1) $\text{TN} = \text{TKN} + \text{NO}_3\text{O}_2;$
- 2) $\text{TN} = \text{TKN} + \text{NO}_3 + \text{NO}_2;$
- 3) $\text{TN} = \text{ORG}_N + \text{NH}_4 + \text{NO}_3\text{O}_2;$
- 4) $\text{TN} = \text{ORG}_N + \text{NH}_4 + \text{NO}_2 + \text{NO}_3;$
- 5) $\text{TN} = \text{TKN} + \text{NO}_3;$
- 6) $\text{TN} = \text{ORG}_N + \text{NH}_4 + \text{NO}_3;$

Additional Information:

- Rules for use of sample fraction:
 - FDEP report that if both “Total” and “Dissolved” are reported, only “Total” is used. If the total is not reported, they do use dissolved as a best available replacement.
 - An analysis of all SEACAR data shows that 90% of all possible TN calculations can be done using nitrogen components with the same sample fraction, rather than use nitrogen components with mixed total/dissolved sample fractions. In other words, TN can be calculated when TKN and NO_3O_2 are both total sample fraction, or when both are dissolved sample fraction. This is important, because then the calculated TN value is not based on components with mixed sample fractions.
- Values inserted into data:
 - ParameterName = “Total Nitrogen”
 - SEACAR_QAQCFlagCode = “1Q”
 - SEACAR_QAQC_Description = “SEACAR Calculated”

Seasonal Kendall-Tau Trend Analysis

Total Nitrogen, Lab, All Depths
Banana River Aquatic Preserve

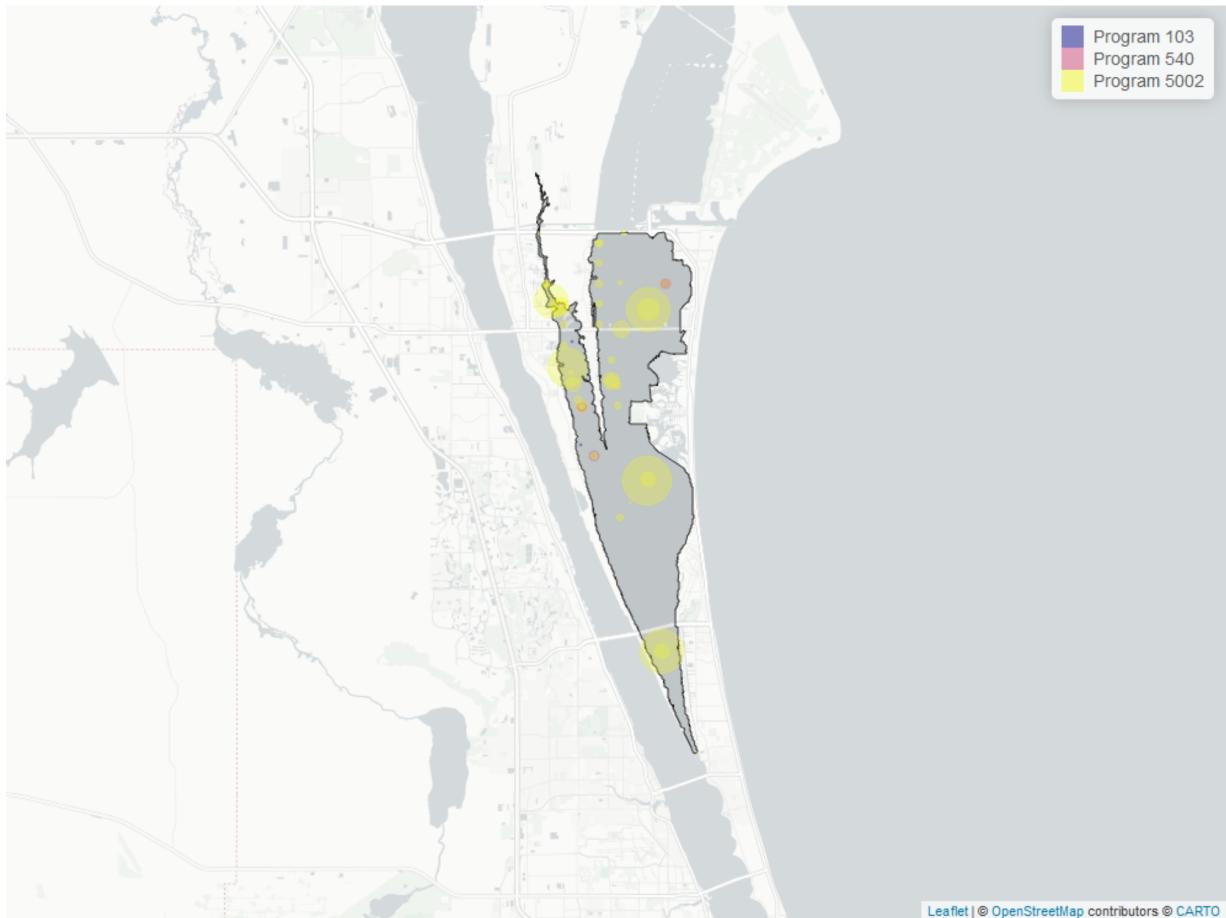


RelativeDepth	N_Data	N_Years	Median	Independent	tau	p	SennSlope	SennIntercept	ChiSquared	pChiSquared	Trend
All	2137	27	1.2414	TRUE	-0.3546	0.0000	-0.01770013	1.415622	7.1408	0.7876	-1

p < 0.00005 appear as 0 due to rounding.

SennIntercept is intercept value at beginning of record for monitoring location

Map showing location of Discrete sampling sites for Total Nitrogen



The bubble size on the above plots reflects the amount of data available at each sampling site

Table 16: Programs contributing data for Total Nitrogen

ProgramID	N_Data	YearMin	YearMax
5002	2092	1997	2023
540	41	2016	2020
103	4	2005	2006

Program names:

5002 - Florida STORET / WIN

540 - Shellfish Harvest Area Classification Program

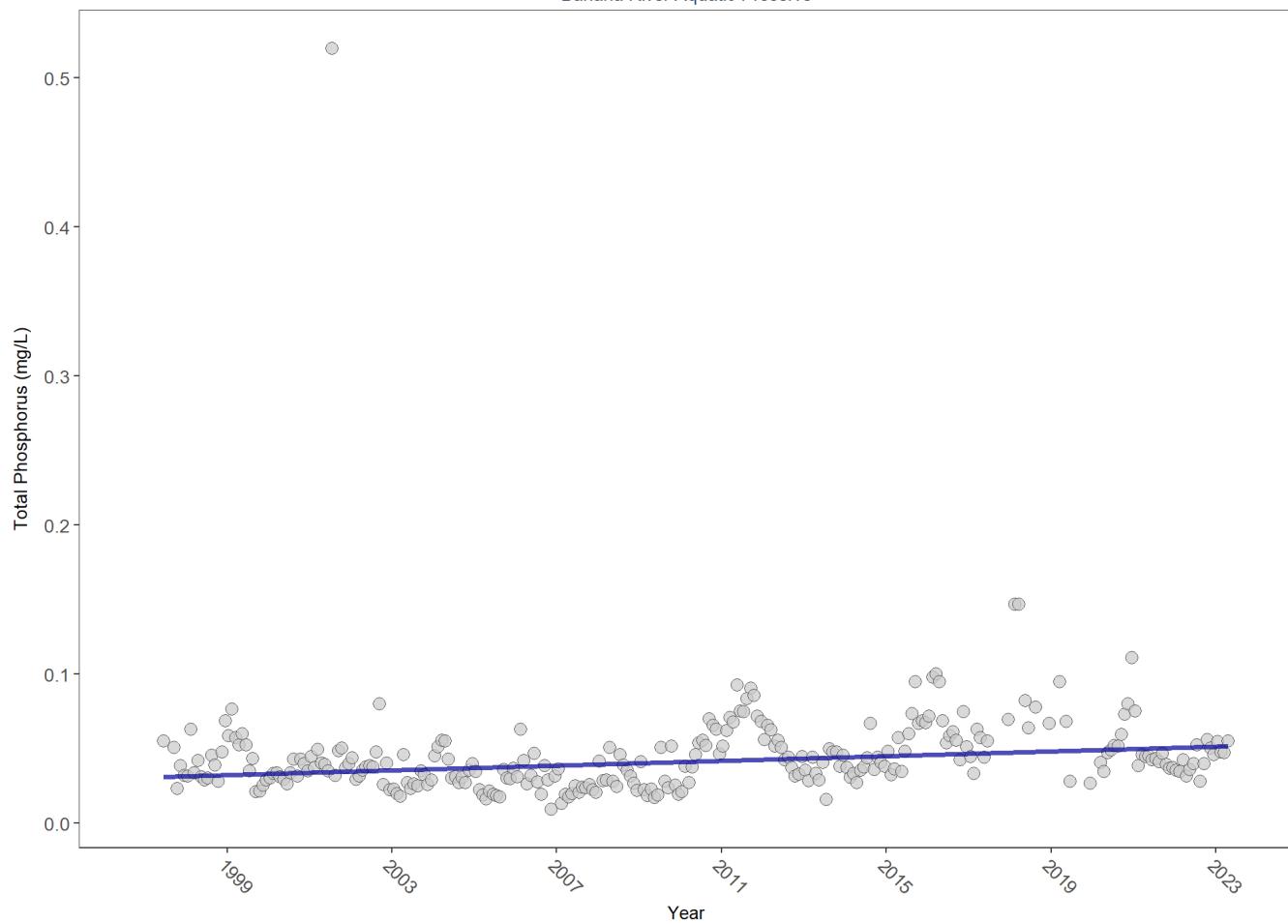
103 - EPA STOrage and RETrieval Data Warehouse (STORET)

There are no qualifying Value Qualifiers for Total Nitrogen in Banana River Aquatic Preserve

Total Phosphorus - Discrete Water Quality

Seasonal Kendall-Tau Trend Analysis

Total Phosphorus, Lab, All Depths
Banana River Aquatic Preserve

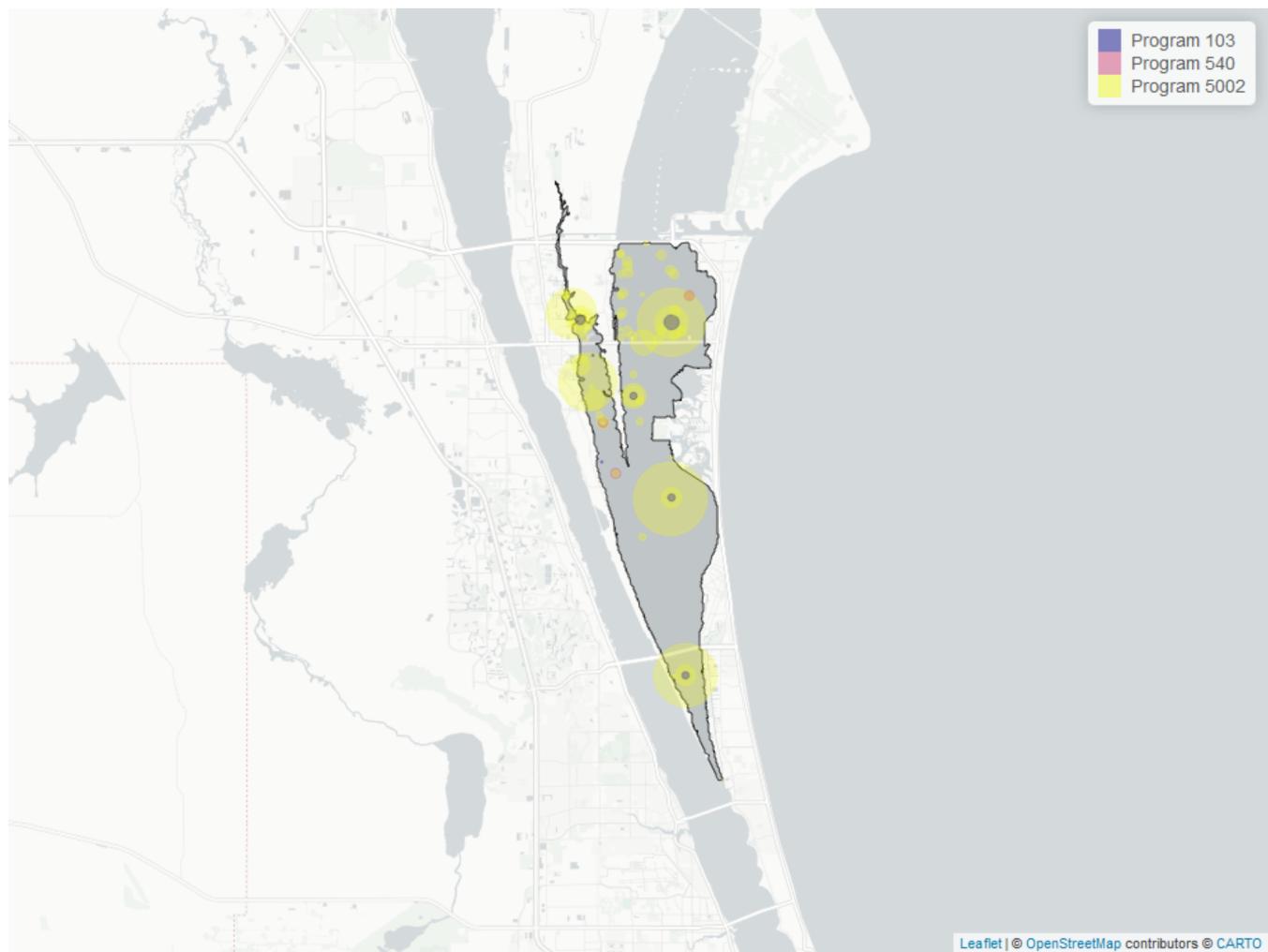


RelativeDepth	N_Data	N_Years	Median	Independent	tau	p	SennSlope	SennIntercept	ChiSquared	pChiSquared	Trend
All	4563	27	0.0356	TRUE	0.2447	0.0000	0.0007977444	0.0306678	3.7544	0.9766	1

$p < 0.00005$ appear as 0 due to rounding.

SennIntercept is intercept value at beginning of record for monitoring location

Map showing location of Discrete sampling sites for Total Phosphorus



The bubble size on the above plots reflects the amount of data available at each sampling site

Table 17: Programs contributing data for Total Phosphorus

ProgramID	N_Data	YearMin	YearMax
5002	4460	1997	2023
103	91	2005	2021
540	42	2016	2020

Program names:

5002 - Florida STORET / WIN

103 - EPA STOrage and RETrieval Data Warehouse (STORET)

540 - Shellfish Harvest Area Classification Program

Value Qualifiers

- N_{Total} is total amount of data for a given year

- $N_{_}$ is the total amount of values flagged with the respective value qualifier in a given year
- $perc_{_}$ is the percent of data flagged with the respective value qualifier as a proportion of $N_{_Total}$

Table 18: Value Qualifiers for Total Phosphorus

Year	$N_{_Total}$	$N_{_I}$	$perc_{_I}$	$N_{_Q}$	$perc_{_Q}$	$N_{_U}$	$perc_{_U}$
1997	90	46	51.1				
1998	284	142	50.0				
1999	217	13	6.0				
2000	241					11	4.6
2001	254			20	7.9	10	3.9
2002	335	155	46.3	22	6.6	3	0.9
2003	238	109	45.8				
2004	297	110	37.0	1	0.3		
2005	226	114	50.4			1	0.4
2006	172	103	59.9	1	0.6		
2007	144	86	59.7				
2008	177	107	60.5			7	4.0
2009	159	80	50.3			8	5.0
2010	135	86	63.7	10	7.4		
2011	112	59	52.7	10	8.9		
2012	102	85	83.3				
2013	118	90	76.3	2	1.7		
2014	191	118	61.8	12	6.3		
2015	201	129	64.2	24	11.9		
2016	193	110	57.0	14	7.2		
2017	92	52	56.5				
2018	18					1	5.6
2020	137	52	38.0				
2021	252	91	36.1				
2022	174	101	58.0	2	1.1	6	3.5
2023	22	10	45.5			1	4.6

Note: ¹I - Reported value is greater than or equal to lab method detection limit, but less than quantitation limit ²Q
 - Sample held beyond the accepted holding time ³U - Compound was analyzed for but not detected

Programs containing Value Qualified data:

540 - Shellfish Harvest Area Classification Program

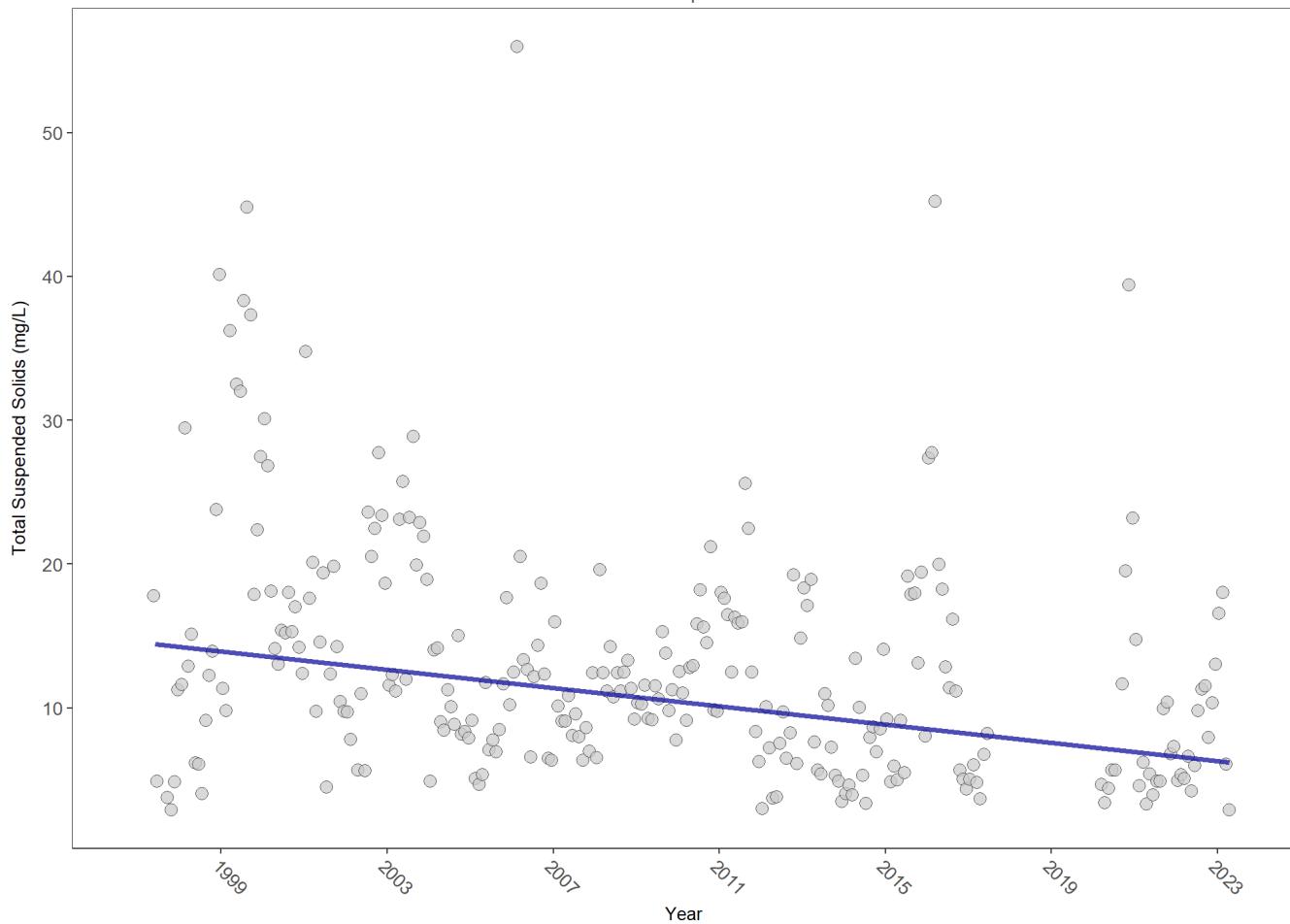
5002 - Florida STORET / WIN

Total Suspended Solids - Discrete Water Quality

Total Suspended Solids (TSS) are solid particles suspended in water that exceed 2 microns in size and can be trapped by a filter.

Seasonal Kendall-Tau Trend Analysis

Total Suspended Solids, Lab and Field Combined, All Depths
Banana River Aquatic Preserve

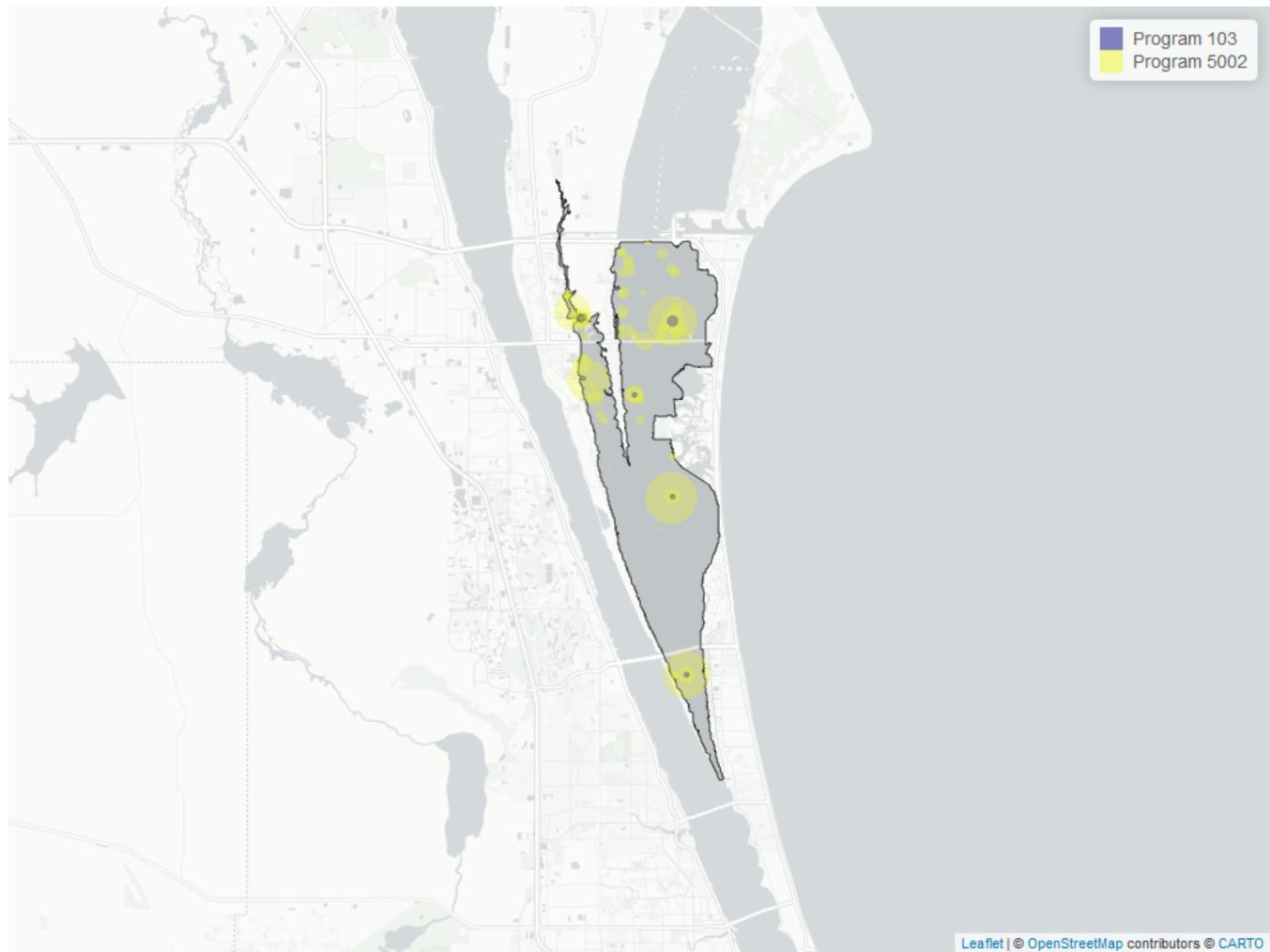


RelativeDepth	N_Data	N_Years	Median	Independent	tau	p	SennSlope	SennIntercept	ChiSquared	pChiSquared	Trend
All	2407	25	10	TRUE	-0.2477	0.0000	-0.3160173	14.53831	5.6377	0.8964	-1

p < 0.00005 appear as 0 due to rounding.

SennIntercept is intercept value at beginning of record for monitoring location

Map showing location of Discrete sampling sites for Total Suspended Solids



The bubble size on the above plots reflects the amount of data available at each sampling site

Table 19: Programs contributing data for Total Suspended Solids

ProgramID	N_Data	YearMin	YearMax
5002	2390	1997	2023
103	43	2020	2021

Program names:

5002 - Florida STORET / WIN

103 - EPA STOrage and RETrieval Data Warehouse (STORET)

Value Qualifiers

- N_{Total} is total amount of data for a given year
- N_{Qual} is the total amount of values flagged with the respective value qualifier in a given year
- $\text{perc}_{\text{Qual}}$ is the percent of data flagged with the respective value qualifier as a proportion of N_{Total}

Table 20: Value Qualifiers for Total Suspended Solids

Year	N_Total	N_I	perc_I	N_Q	perc_Q	N_U	perc_U
1997	63	17	27.0				
1998	142	99	69.7				
1999	98	21	21.4			1	1.0
2000	126			10	7.9	7	5.6
2001	149			4	2.7	13	8.7
2002	182	47	25.8	8	4.4	5	2.8
2003	139	66	47.5	18	12.9		
2004	202	55	27.2	1	0.5		
2005	134	67	50.0	1	0.8		
2006	98	29	29.6				
2007	72	30	41.7				
2008	108	7	6.5			16	14.8
2009	98	4	4.1	1	1.0	6	6.1
2010	75	9	12.0				
2011	56	4	7.1				
2012	47	28	59.6				
2013	58	38	65.5				
2014	86	59	68.6				
2015	91	45	49.5				
2016	91	33	36.3	6	6.6		
2017	40	32	80.0				
2020	55	23	41.8	1	1.8		
2021	125	72	57.6	15	12.0	5	4.0
2022	87	67	77.0			6	6.9
2023	11	6	54.5	1	9.1		

Note: ¹I - Reported value is greater than or equal to lab method detection limit, but less than quantitation limit ²Q
 - Sample held beyond the accepted holding time ³U - Compound was analyzed for but not detected

Programs containing Value Qualified data:

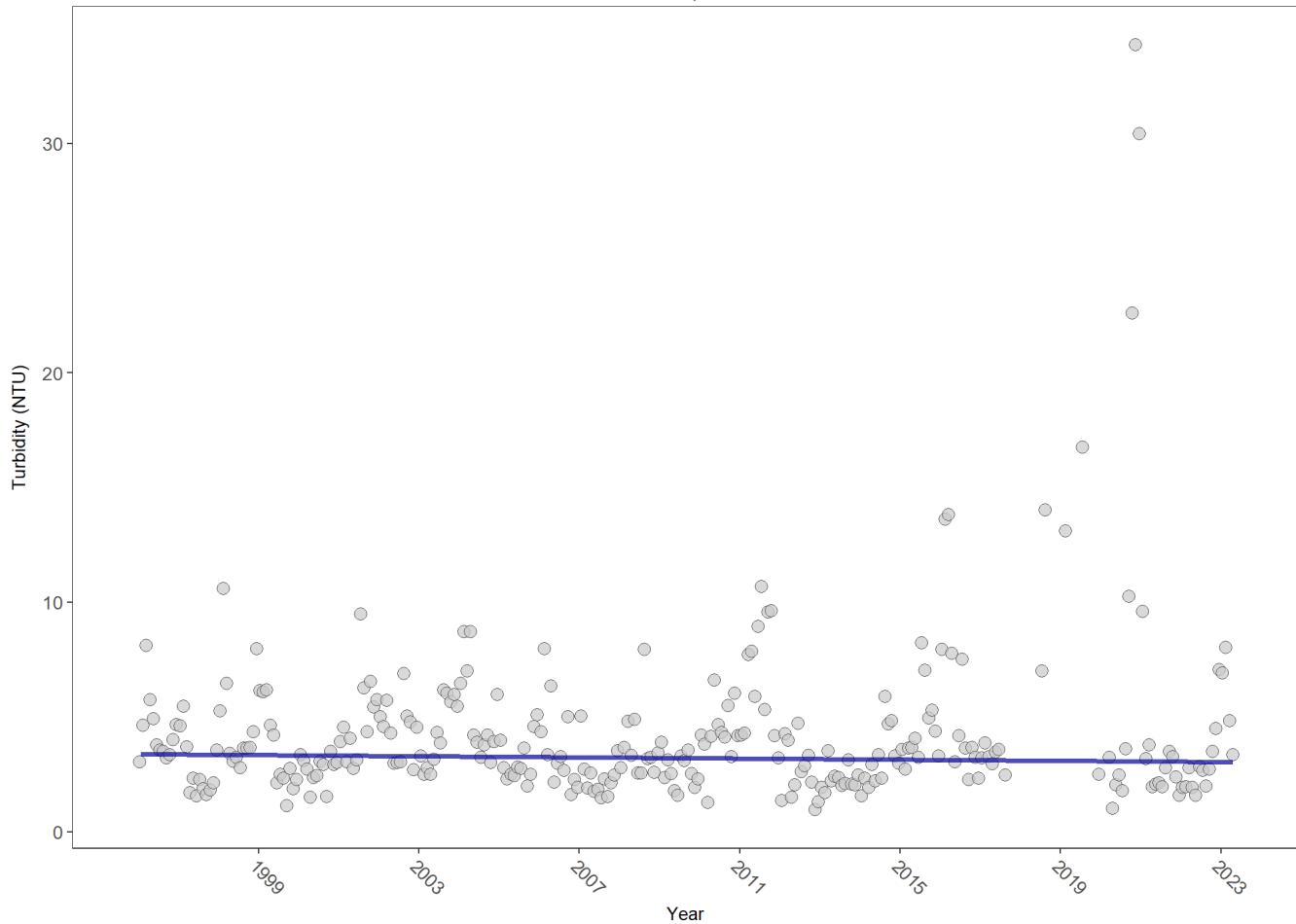
5002 - Florida STORET / WIN

Turbidity - Discrete Water Quality

Turbidity results from suspended solids in the water, including silts, clays, tannins, industrial wastes, sewage and plankton, which are all factors that contribute to how clouded or murky a water column is. Turbidity is caused by soil erosion, excess nutrients, pollutants, and physical forces such as winds, currents and bottom feeders.

Seasonal Kendall-Tau Trend Analysis

Turbidity, Lab and Field Combined, All Depths
Banana River Aquatic Preserve

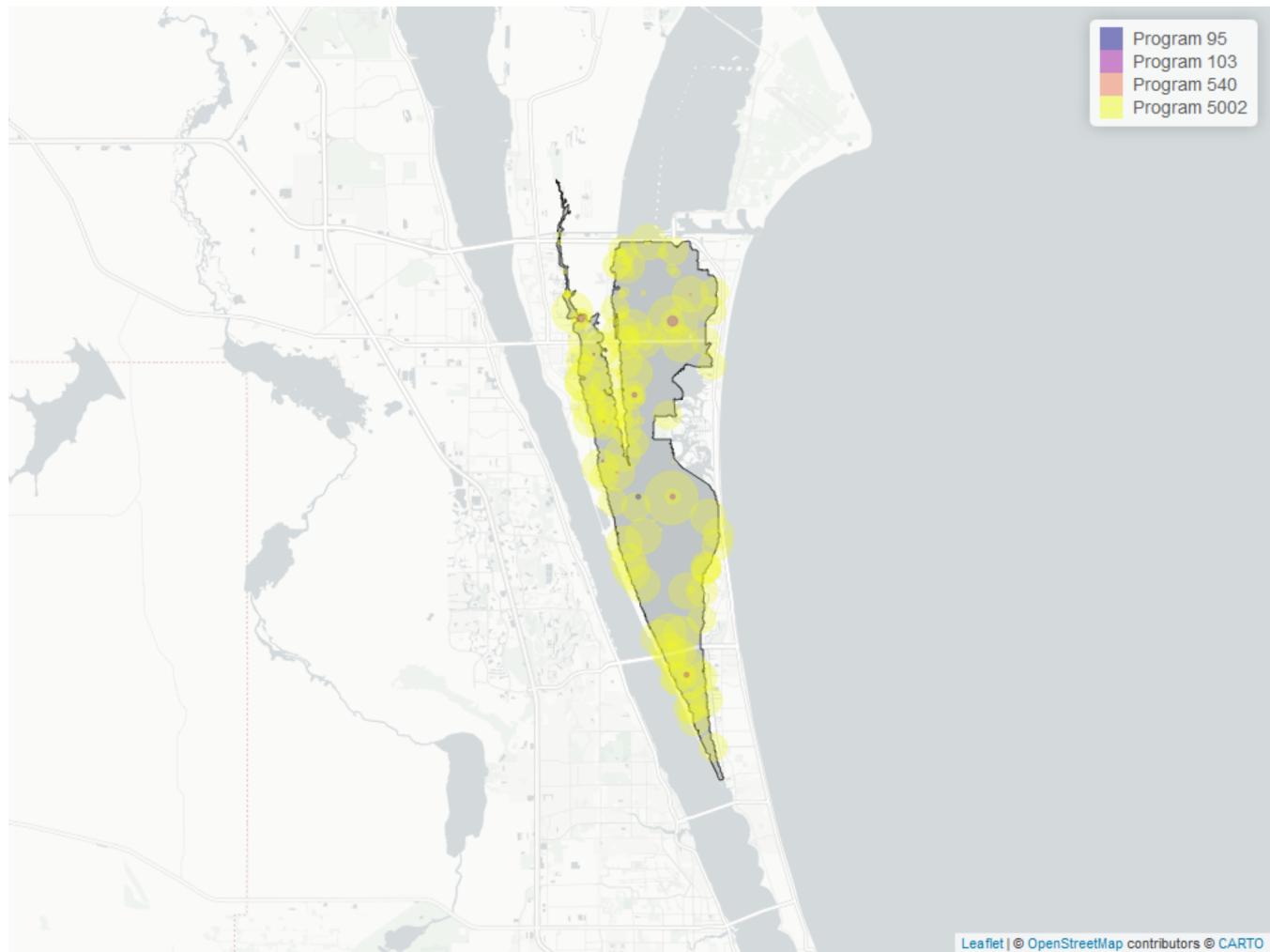


RelativeDepth	N_Data	N_Years	Median	Independent	tau	p	SennSlope	SennIntercept	ChiSquared	pChiSquared	Trend
All	13933	28	3.2	TRUE	-0.0414	0.2922	-0.0127313	3.393975	8.5101	0.667	0

p < 0.00005 appear as 0 due to rounding.

SennIntercept is intercept value at beginning of record for monitoring location

Map showing location of Discrete sampling sites for Turbidity



The bubble size on the above plots reflects the amount of data available at each sampling site

Table 21: Programs contributing data for Turbidity

ProgramID	N_Data	YearMin	YearMax
5002	13612	1996	2023
3013	271	2004	2019
103	45	2005	2021
540	6	2019	2020
95	4	2009	2010

Program names:

5002 - Florida STORET / WIN

3013 - Seagrass (SJRWMD)

103 - EPA STOrage and RETrieval Data Warehouse (STORET)

540 - Shellfish Harvest Area Classification Program

Value Qualifiers

- N_{Total} is total amount of data for a given year
- $N_{}$ is the total amount of values flagged with the respective value qualifier in a given year
- $perc_{}$ is the percent of data flagged with the respective value qualifier as a proportion of N_{Total}

Table 22: Value Qualifiers for Turbidity

Year	N_{Total}	N_I	$perc_I$	N_Q	$perc_Q$	N_U	$perc_U$
1997	809	11	1.4				
1998	820	18	2.2	11	1.3		
1999	770					2	0.3
2002	859	6	0.7				
2003	789	10	1.3				
2004	636	11	1.7	5	0.8		
2005	765	33	4.3	4	0.5		
2006	431	15	3.5	2	0.5		
2007	577	45	7.8				
2008	527	4	0.8	13	2.5		
2009	618	8	1.3				
2012	171	12	7.0	6	3.5		
2013	75	11	14.7				
2014	105	16	15.2	4	3.8		
2015	118	9	7.6	8	6.8		
2016	115	6	5.2	1	0.9		
2017	54	2	3.7	1	1.9		
2020	69	11	15.9	1	1.4	1	1.4
2021	125	16	12.8	1	0.8	2	1.6
2022	87	23	26.4			1	1.1

Note: ¹I - Reported value is greater than or equal to lab method detection limit, but less than quantitation limit ²Q
 - Sample held beyond the accepted holding time ³U - Compound was analyzed for but not detected

Programs containing Value Qualified data:

5002 - Florida STORET / WIN

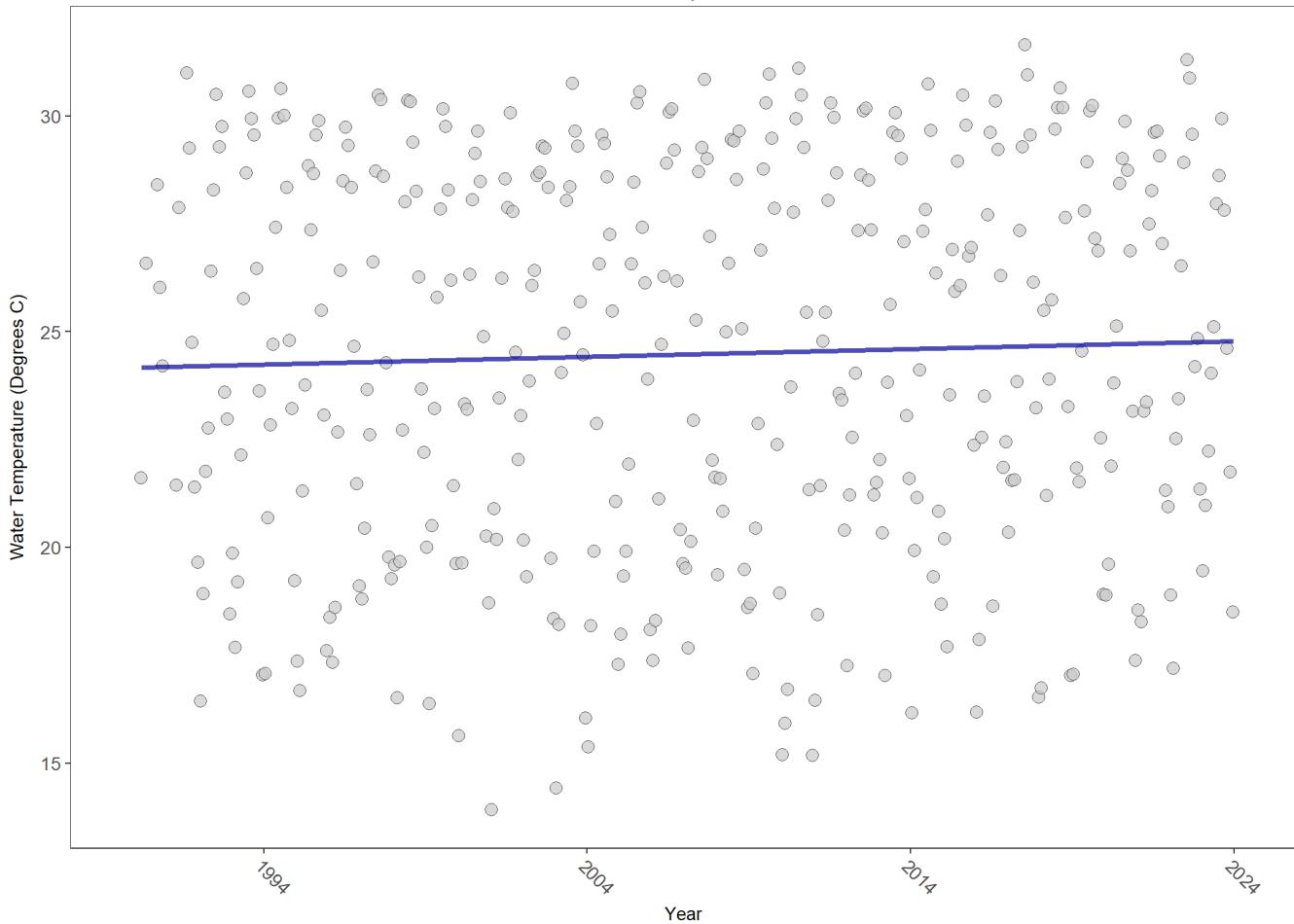
540 - Shellfish Harvest Area Classification Program

Water Temperature - Discrete Water Quality

Temperature determines the capacity of water to hold oxygen. Cooler water can hold more dissolved oxygen because water molecules are more tightly packed, making it harder for oxygen to escape. Additionally, as water temperature increases, fish and other aquatic organisms become more active and consume oxygen at a faster rate.

Seasonal Kendall-Tau Trend Analysis

Water Temperature, Field, All Depths
Banana River Aquatic Preserve

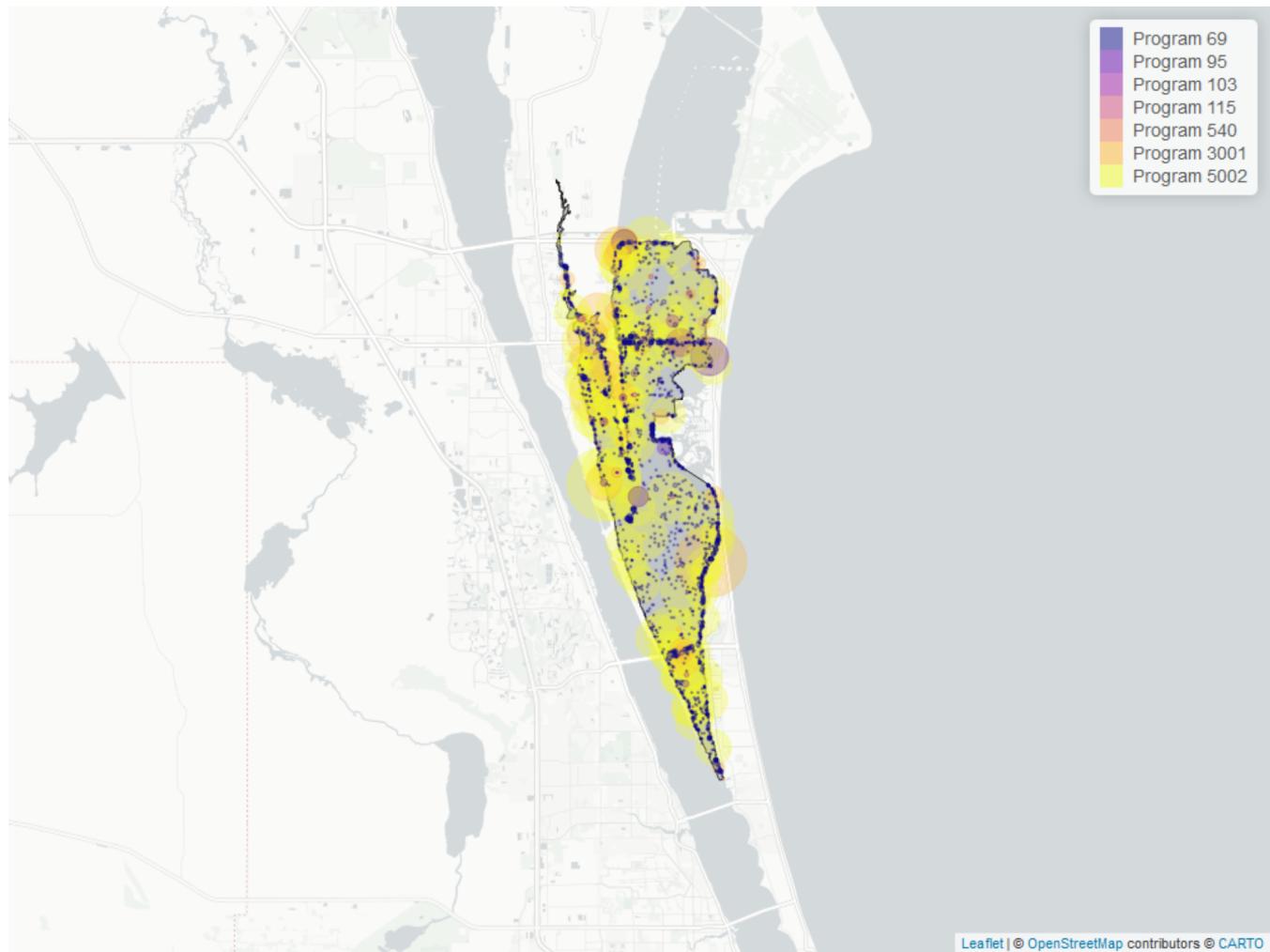


RelativeDepth	N_Data	N_Years	Median	Independent	tau	p	SennSlope	SennIntercept	ChiSquared	pChiSquared	Trend
All	31236	34	25.5	TRUE	0.0968	0.0063	0.01836598	24.15989	10.6669	0.4716	1

$p < 0.00005$ appear as 0 due to rounding.

SennIntercept is intercept value at beginning of record for monitoring location

Map showing location of Discrete sampling sites for Water Temperature



The bubble size on the above plots reflects the amount of data available at each sampling site

Table 23: Programs contributing data for Water Temperature

ProgramID	N_Data	YearMin	YearMax
5002	22011	1991	2023
69	4354	1990	2022
3001	4286	1991	2023
95	669	2006	2018
3013	329	2003	2023
103	111	2020	2021
540	42	2016	2020
115	7	1995	1995

Program names:

5002 - Florida STORET / WIN

69 - Fisheries-Independent Monitoring (FIM) Program
3001 - Lagoon Watch (Formerly Marine Discovery Center)
95 - Harmful Algal Bloom Marine Observation Network
3013 - Seagrass (SJRWMD)
103 - EPA STOrage and RETrieval Data Warehouse (STORET)
540 - Shellfish Harvest Area Classification Program
115 - Environmental Monitoring Assessment Program

There are no qualifying Value Qualifiers for Water Temperature in Banana River Aquatic Preserve

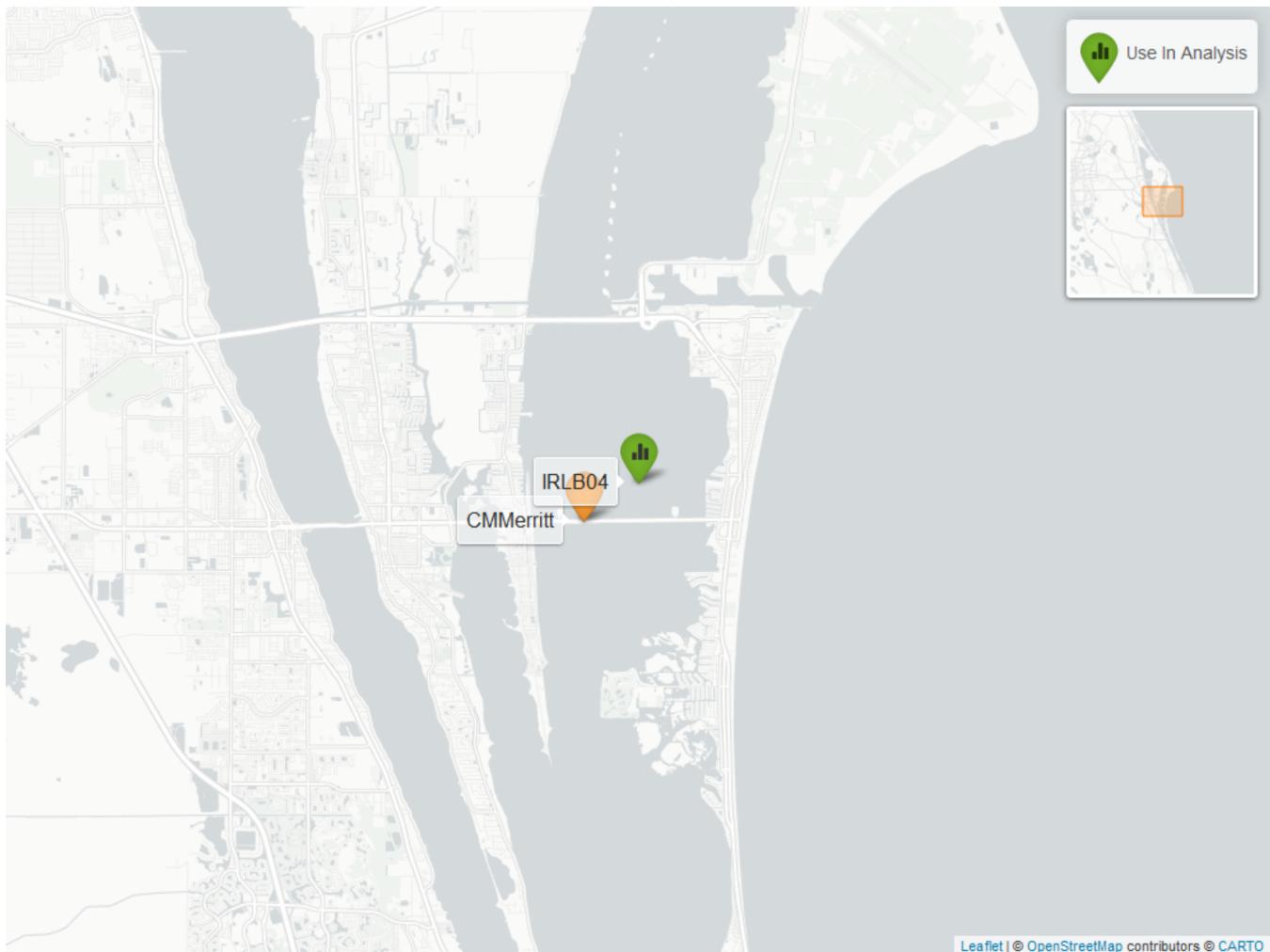
Water Quality - Continuous

The following files were used in the continuous analysis:

- *Combined_WQ_WC_NUT_cont_Dissolved_Oxygen_NE-2024-Jul-02.txt*
- *Combined_WQ_WC_NUT_cont_Dissolved_Oxygen_Saturation_NE-2024-Jul-02.txt*
- *Combined_WQ_WC_NUT_cont_pH_NE-2024-Jul-02.txt*
- *Combined_WQ_WC_NUT_cont_Salinity_NE-2024-Jul-02.txt*
- *Combined_WQ_WC_NUT_cont_Turbidity_NE-2024-Jul-02.txt*
- *Combined_WQ_WC_NUT_cont_Water_Temperature_NE-2024-Jul-02.txt*

Table 24: St. Johns River Water Management District Continuous Water Quality Programs (5061)

<i>ProgramLocationID</i>	<i>Years of Data</i>	<i>Use in Analysis</i>	<i>Parameters</i>
CMMerritt	3	FALSE	Turb
CMMerritt	4	FALSE	DO , DOS , pH , Sal , TempW
IRLB04	8	TRUE	DO , DOS , pH , Sal , Turb , TempW



Map showing Continuous Water Quality Monitoring sampling locations within the boundaries of Banana River Aquatic Preserve. Sites marked as *Use In Analysis* are featured in this report.

Dissolved Oxygen - Continuous Water Quality

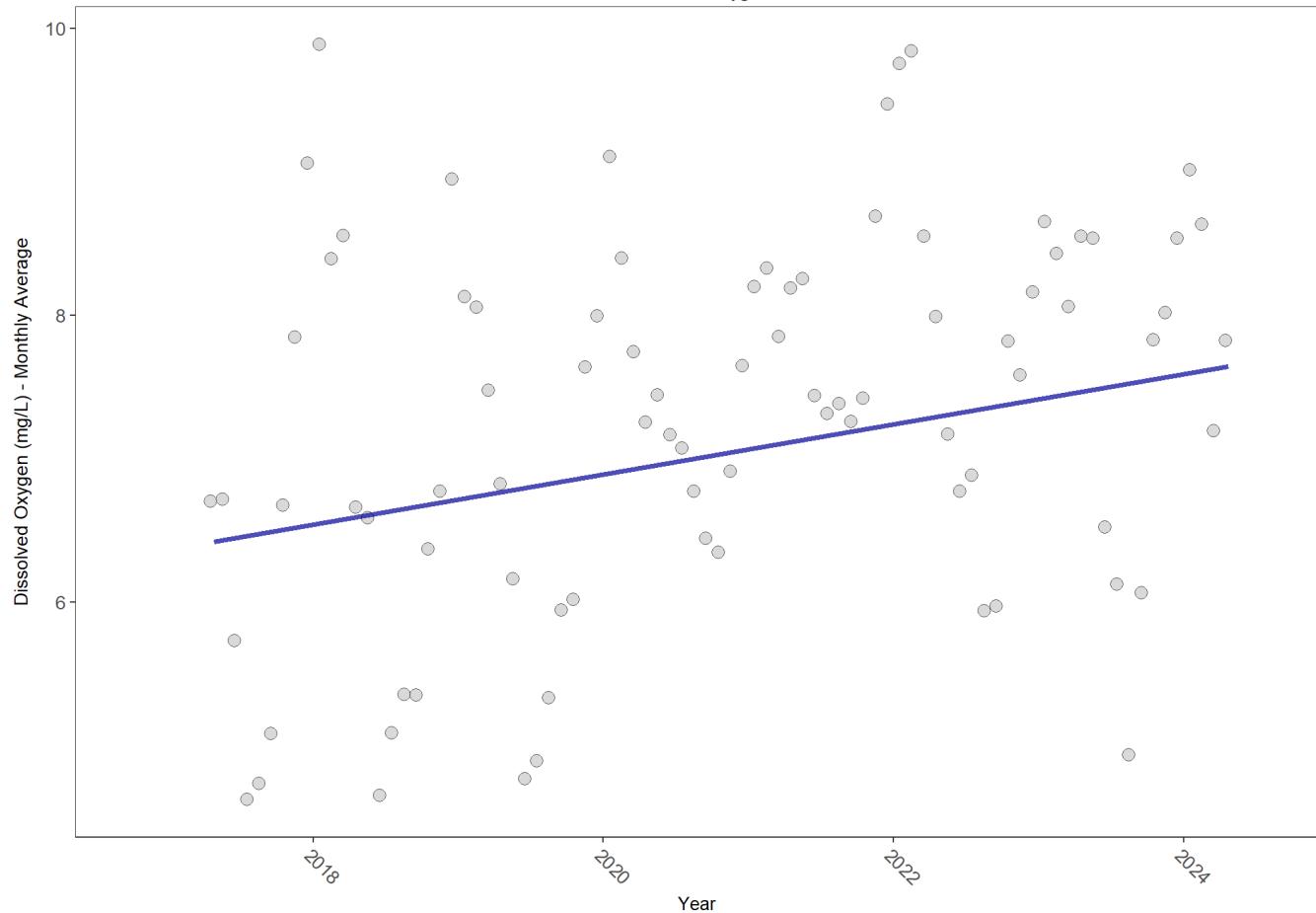
IRLB04

St. Johns River Water Management District Continuous Water Quality Programs (5061)

Banana River Aquatic Preserve

IRLB04

Dissolved Oxygen



RelativeDepth	N_Data	N_Years	Median	Independent	tau	p	SennSlope	SennIntercept	ChiSquared	pChiSquared	Trend
surface	61028	8	7.36	TRUE	0.3154	0.0005	0.1744281	6.36537	9.4696	0.5786	1

p < 0.00005 appear as 0 due to rounding.

SennIntercept is intercept value at beginning of record for monitoring location

Dissolved Oxygen Saturation - Continuous Water Quality

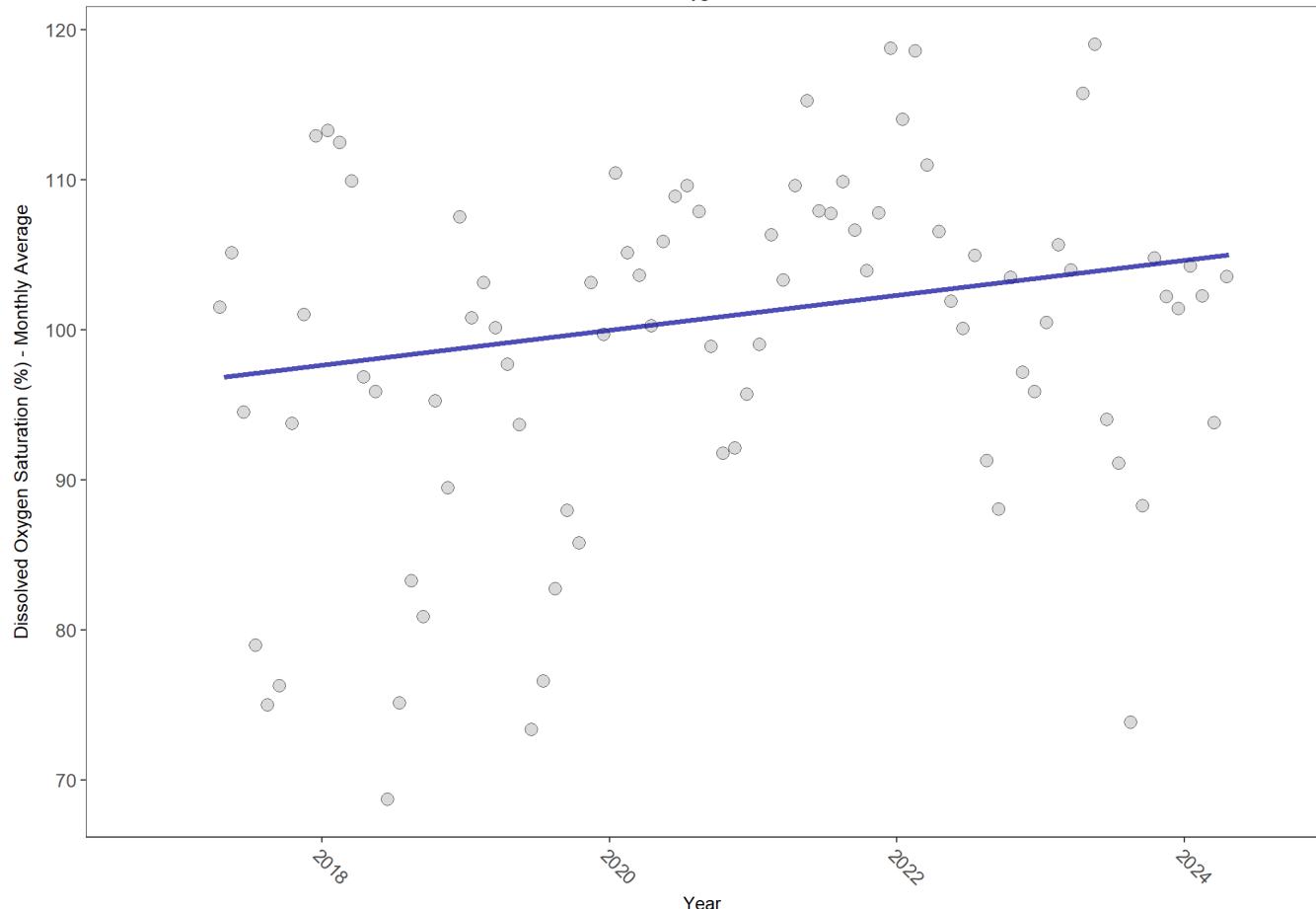
IRLB04

St. Johns River Water Management District Continuous Water Quality Programs (5061)

Banana River Aquatic Preserve

IRLB04

Dissolved Oxygen Saturation



RelativeDepth	N_Data	N_Years	Median	Independent	tau	p	SennSlope	SennIntercept	ChiSquared	pChiSquared	Trend
surface	70110	8	100.8444	TRUE	0.1843	0.0412	1.163036	96.49813	10.0051	0.5299	1

p < 0.00005 appear as 0 due to rounding.

SennIntercept is intercept value at beginning of record for monitoring location

pH - Continuous Water Quality

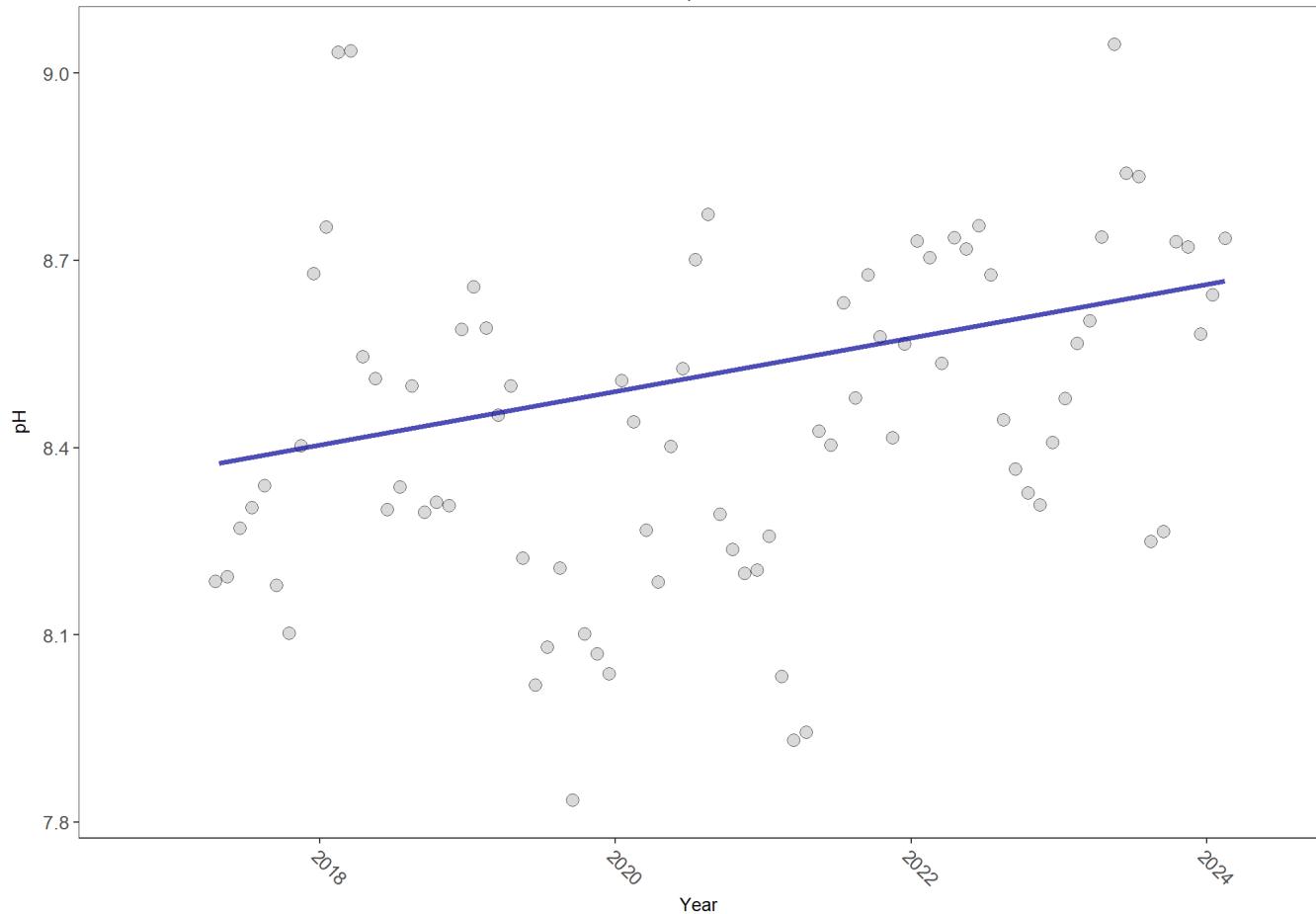
IRLB04

St. Johns River Water Management District Continuous Water Quality Programs (5061)

Banana River Aquatic Preserve

IRLB04

pH



RelativeDepth	N_Data	N_Years	Median	Independent	tau	p	SennSlope	SennIntercept	ChiSquared	pChiSquared	Trend
surface	59293	8	8.45	TRUE	0.2321	0.0121	0.04301433	8.361113	15.3079	0.1688	1

p < 0.00005 appear as 0 due to rounding.

SennIntercept is intercept value at beginning of record for monitoring location

Salinity - Continuous Water Quality

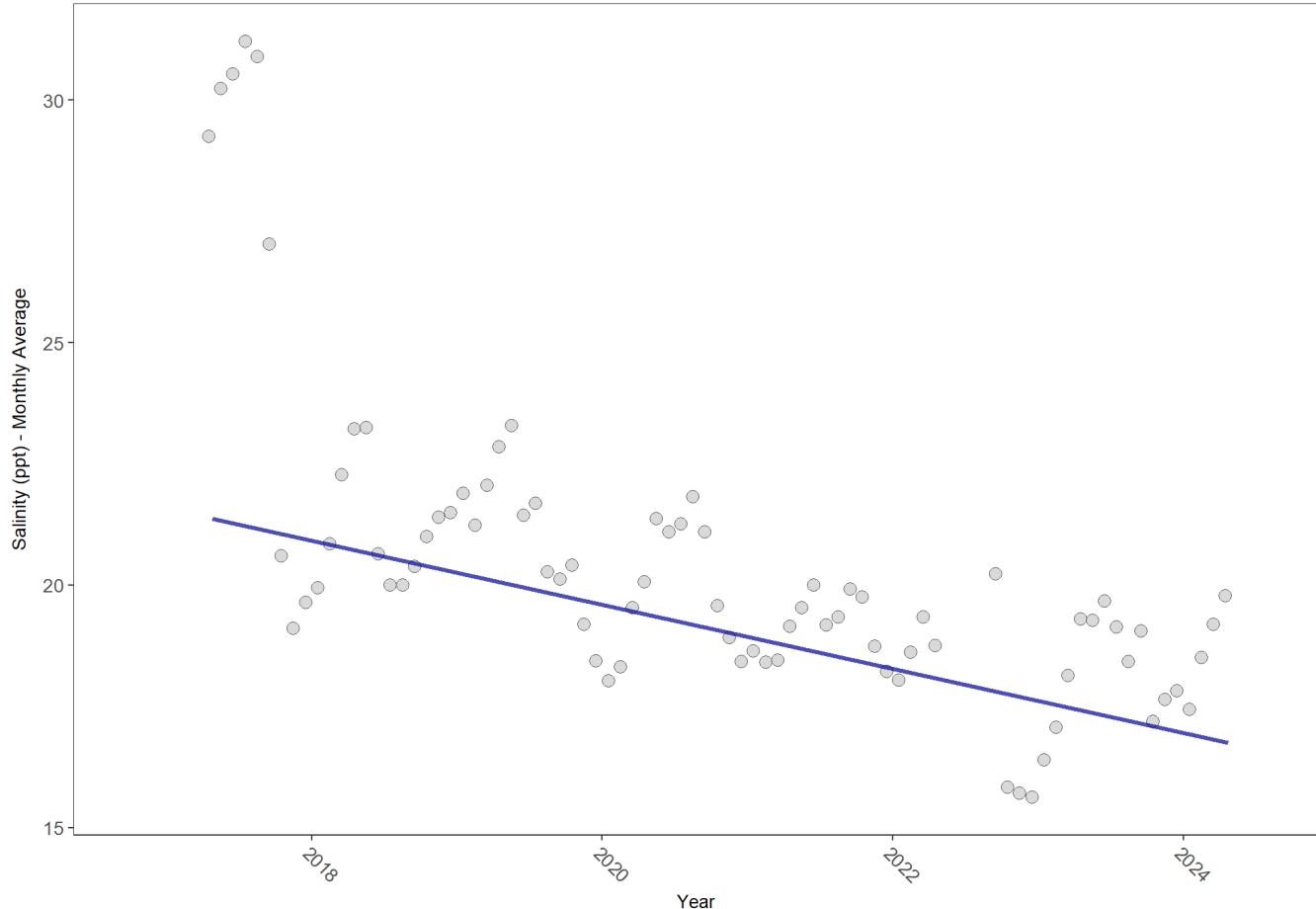
IRLB04

St. Johns River Water Management District Continuous Water Quality Programs (5061)

Banana River Aquatic Preserve

IRLB04

Salinity



RelativeDepth	N_Data	N_Years	Median	Independent	tau	p	SennSlope	SennIntercept	ChiSquared	pChiSquared	Trend
surface	57168	8	19.6728	TRUE	-0.6717	0.0000	-0.6601953	21.57513	1.7056	0.9993	-1

$p < 0.00005$ appear as 0 due to rounding.

SennIntercept is intercept value at beginning of record for monitoring location

Turbidity - Continuous Water Quality

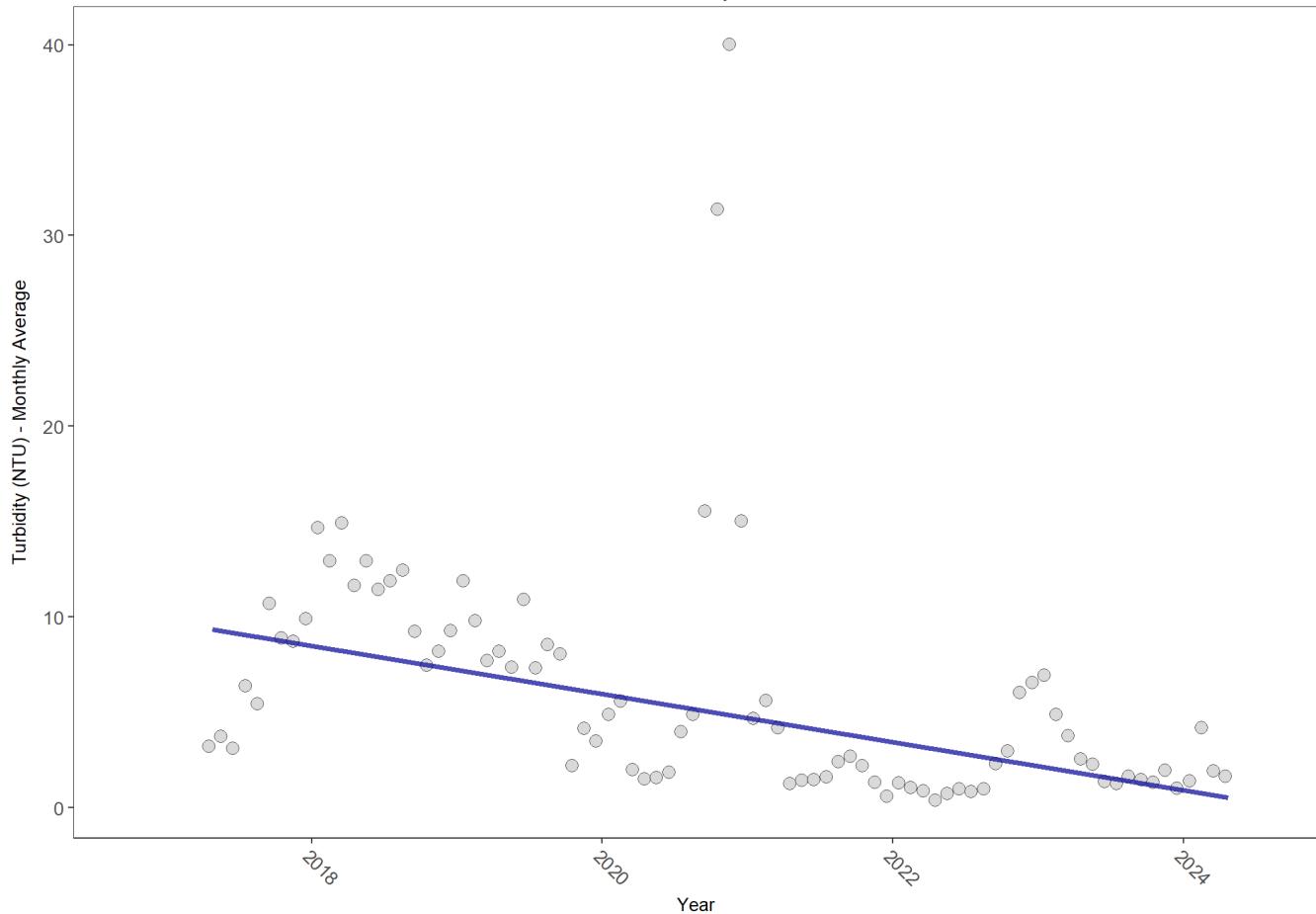
IRLB04

St. Johns River Water Management District Continuous Water Quality Programs (5061)

Banana River Aquatic Preserve

IRLB04

Turbidity



RelativeDepth	N_Data	N_Years	Median	Independent	tau	p	SennSlope	SennIntercept	ChiSquared	pChiSquared	Trend
surface	59010	8	3.55	TRUE	-0.5854	0.0000	-1.261383	9.731418	1.7478	0.9992	-2

p < 0.00005 appear as 0 due to rounding.

SennIntercept is intercept value at beginning of record for monitoring location

Water Temperature - Continuous Water Quality

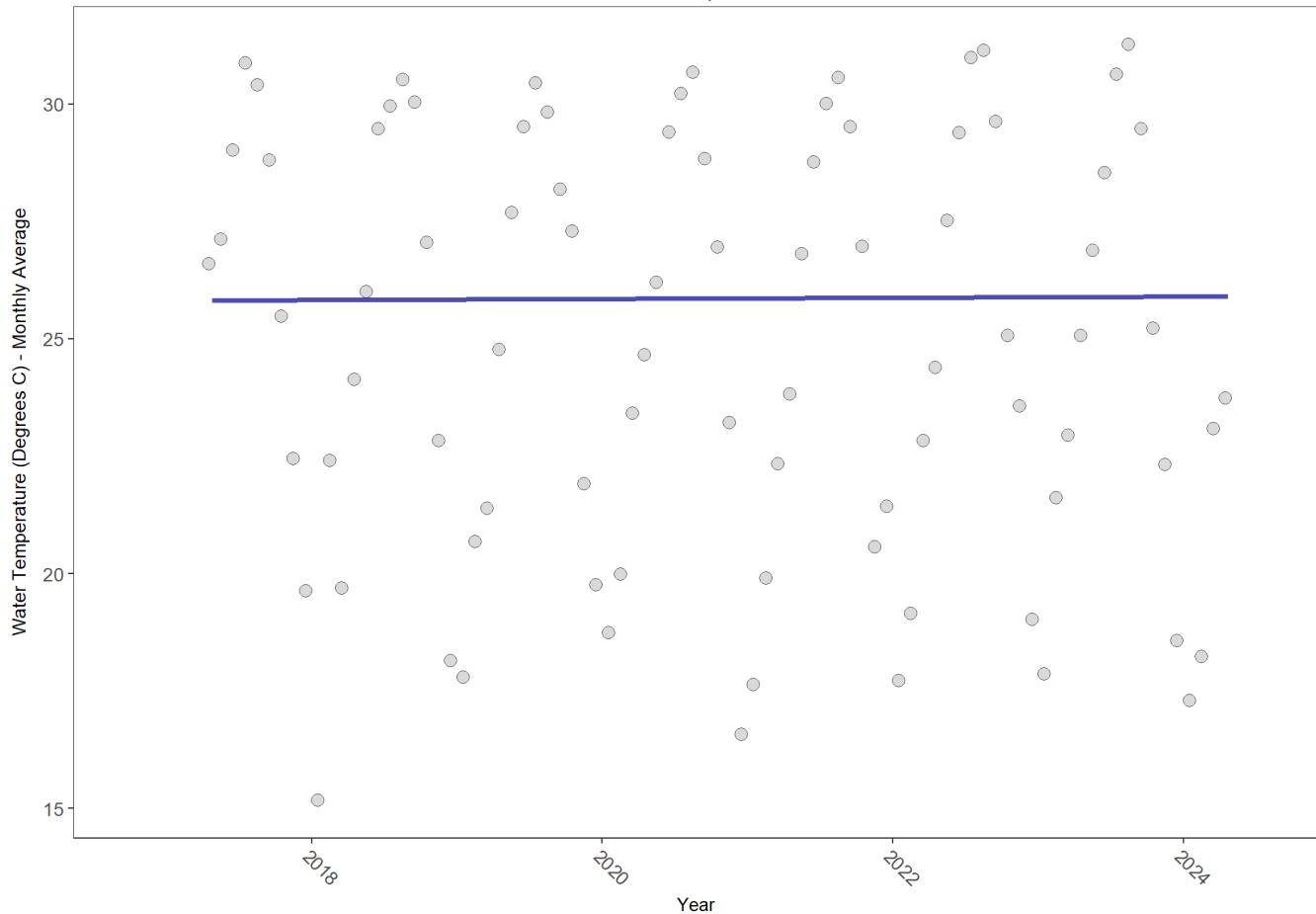
IRLB04

St. Johns River Water Management District Continuous Water Quality Programs (5061)

Banana River Aquatic Preserve

IRLB04

Water Temperature



RelativeDepth	N_Data	N_Years	Median	Independent	tau	p	SennSlope	SennIntercept	ChiSquared	pChiSquared	Trend
surface	61032	8	25.5	TRUE	0.0095	1.0000	0.01226852	25.81887	18.1854	0.0774	0

p < 0.00005 appear as 0 due to rounding.

SennIntercept is intercept value at beginning of record for monitoring location

Submerged Aquatic Vegetation

The data file used is: All_SAV_Parameters-2024-Jul-02.txt

Submerged aquatic vegetation (SAV) refers to plants and plant-like macroalgae species that live entirely underwater. The two primary categories of SAV inhabiting Florida estuaries are *benthic macroalgae* and *seagrasses*. They often grow together in dense beds or meadows that carpet the seafloor. *Macroalgae* include multicellular species of green, red and brown algae that often live attached to the substrate by a holdfast. They tend to grow quickly and can tolerate relatively high nutrient levels, making them a threat to seagrasses and other benthic habitats in areas with poor water quality. In contrast, *seagrasses* are grass-like, vascular, flowering plants that are attached to the seafloor by extensive root systems. *Seagrasses* occur throughout the coastal areas of Florida, including protected bays and lagoons as well as deeper offshore waters on the continental shelf. *Seagrasses* have taken advantage of the broad, shallow shelf and clear water to produce two of the most extensive seagrass beds anywhere in continental North America.

Parameters

Percent Cover measures the fraction of an area of seafloor that is covered by SAV, usually estimated by evaluating multiple small areas of seafloor. Percent cover is often estimated for total SAV, individual types of vegetation (seagrass, attached algae, drift algae) and individual species.

Frequency of Occurrence was calculated as the number of times a taxon was observed in a year divided by the number of sampling events, multiplied by 100. Analysis is conducted at the quadrat level and is inclusive of all quadrats (i.e., quadrats evaluated using Braun-Blanquet, modified Braun-Blanquet, and percent cover.)

Species

Turtle grass (*Thalassia testudinum*) is the largest of the Florida seagrasses, with longer, thicker blades and deeper root structures than any of the other seagrasses. It is considered a climax seagrass species.

Shoal grass (*Halodule wrightii*) is an early colonizer of vegetated areas and usually grows in water too shallow for other species except *widgeon grass*. It can often tolerate larger salinity ranges than other seagrass species. *Shoal grass* is characterized by thin, flat blades, that are narrower than *turtle grass* blades.

Manatee grass (*Syringodium filiforme*) is easily recognizable because its leaves are thin and cylindrical instead of the flat, ribbon-like form shared by many other seagrass species. The leaves can grow up to half a meter in length. *Manatee grass* is usually found in mixed seagrass beds or small, dense monospecific patches.

Widgeon grass (*Ruppia maritima*) grows in both fresh and salt water and is widely distributed throughout Florida's estuaries in less saline areas, particularly in inlets along the east coast. This species resembles *shoal grass* in certain environments but can be identified by the pointed tips of its leaves.

Three species of *Halophila spp.* are found in Florida - **Star grass** (*Halophila engelmannii*), **Paddle grass** (*Halophila decipiens*), and **Johnson's seagrass** (*Halophila johnsonii*). These are smaller, more fragile seagrasses than other Florida species and are considered ephemeral. They grow along a single long rhizome, with short blades. These species are not well-studied, although surveys are underway to define their ecological roles.

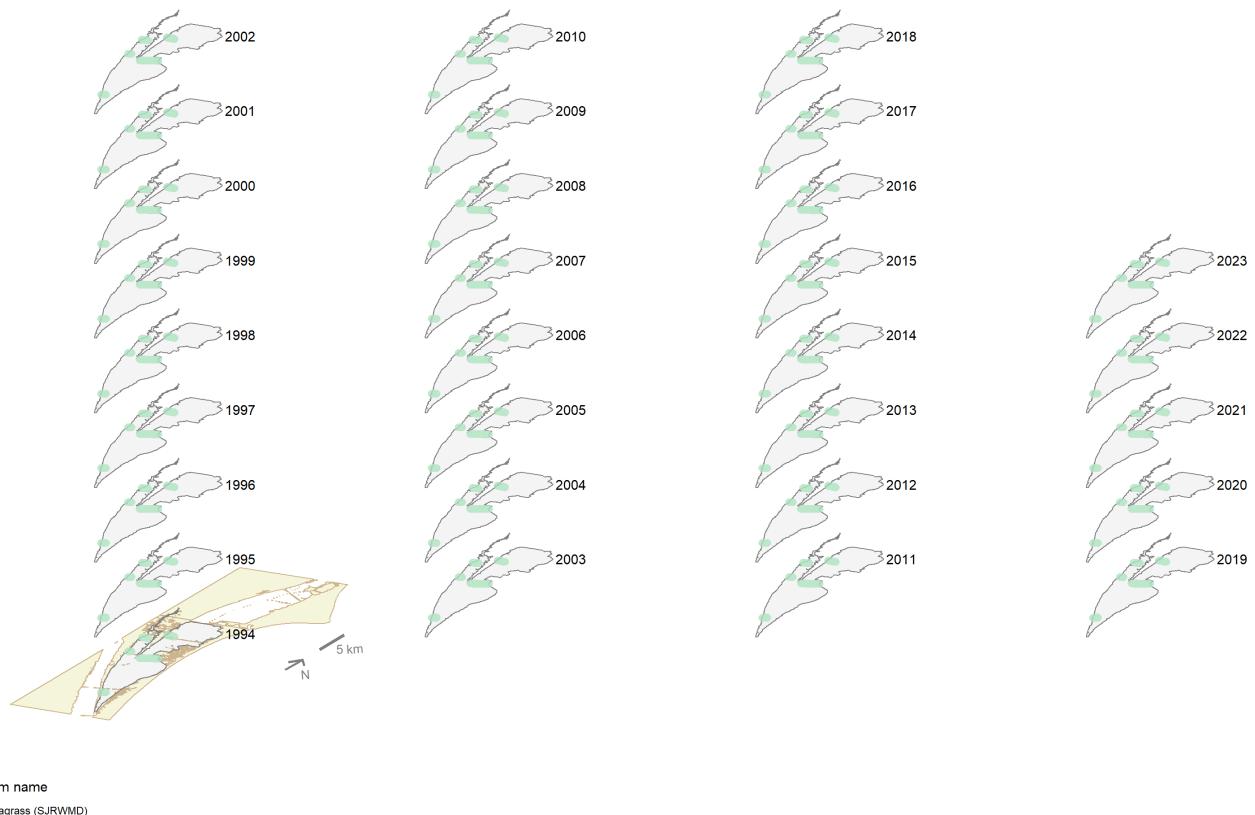
Notes

Star grass, *Paddle grass*, and *Johnson's seagrass* will be grouped together and listed as **Halophila spp.** in the following managed areas. This is because several surveys did not specify to the species level:

- Banana River Aquatic Preserve
- Indian River-Malabar to Vero Beach Aquatic Preserve
- Indian River-Vero Beach to Ft. Pierce Aquatic Preserve
- Jensen Beach to Jupiter Inlet Aquatic Preserve
- Loxahatchee River-Lake Worth Creek Aquatic Preserve
- Mosquito Lagoon Aquatic Preserve

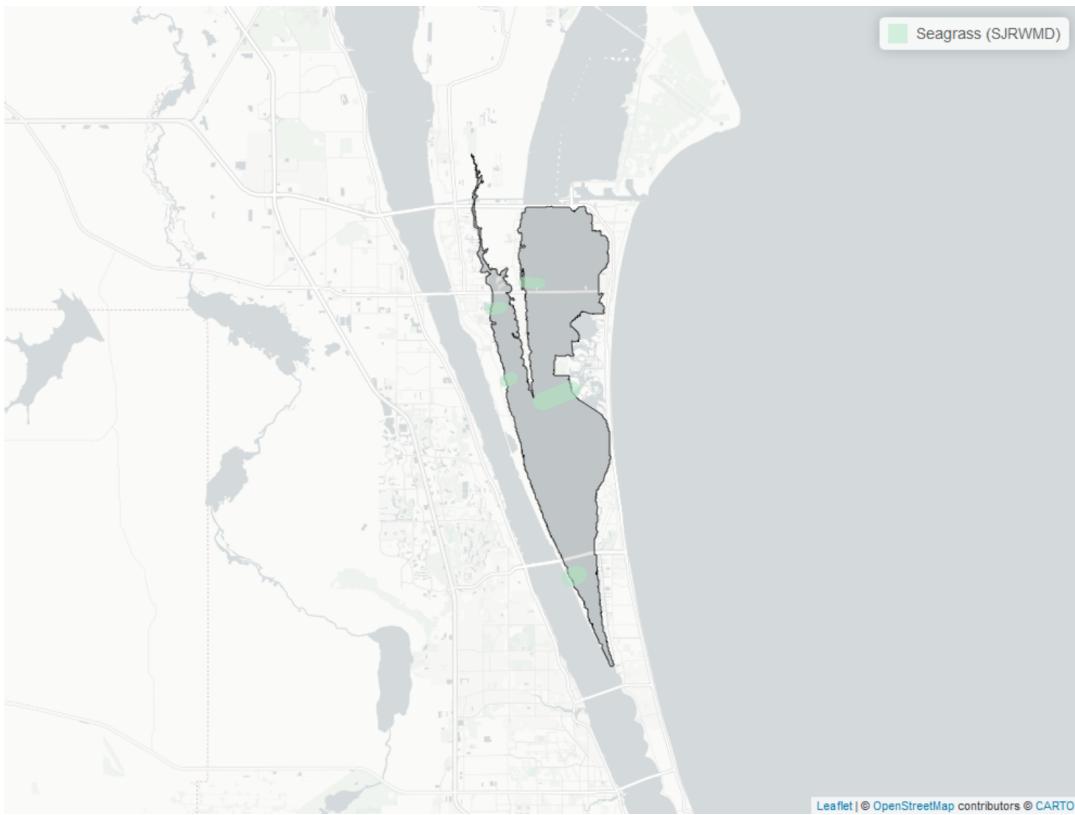
- Biscayne Bay Aquatic Preserve
- Florida Keys National Marine Sanctuary

Banana River Aquatic Preserve
SAV Percent Cover - Sample Locations



Maps showing the temporal scope of SAV sampling sites within the boundaries of *Banana River Aquatic Preserve* by Program name.

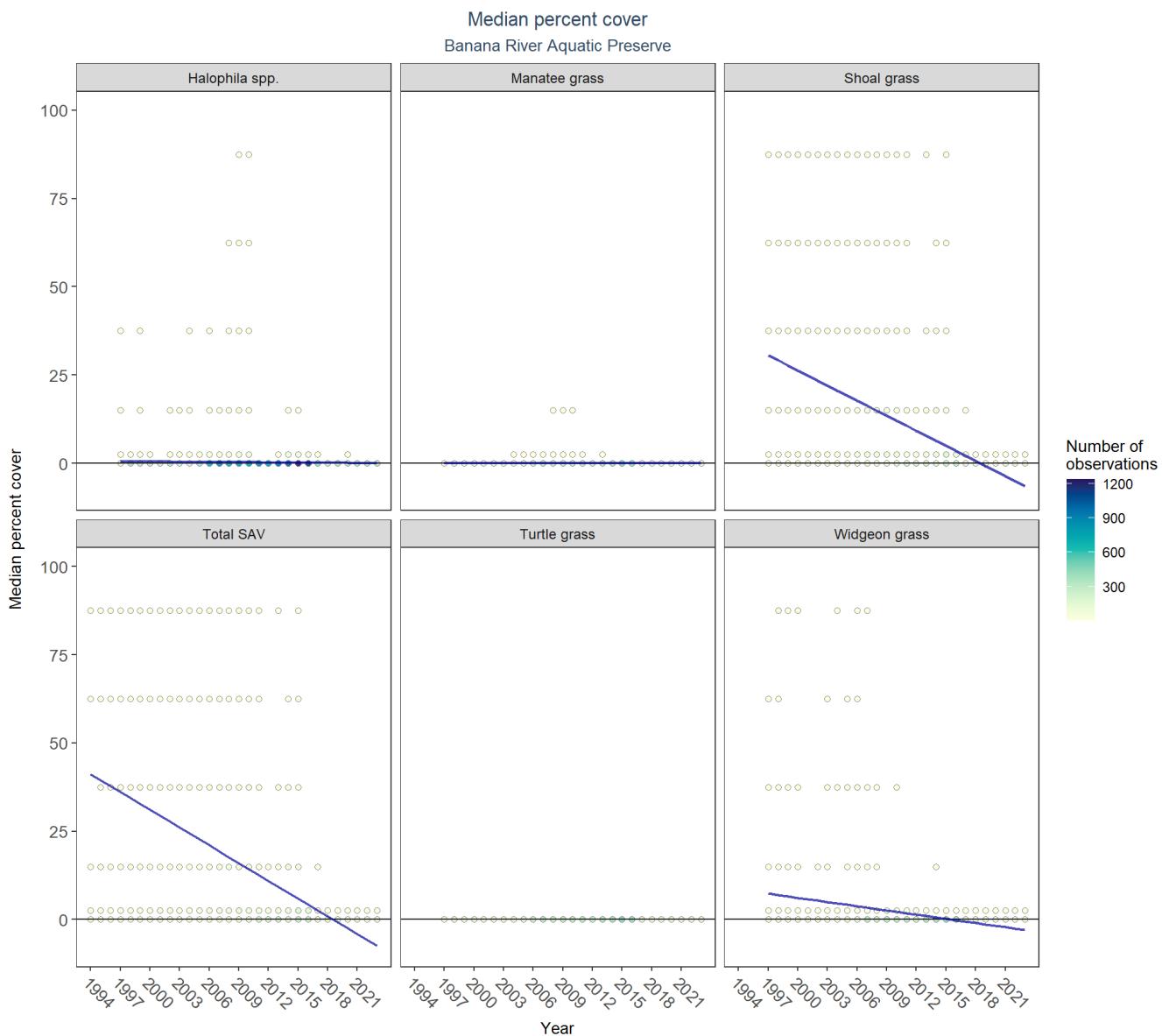
Sampling locations by Program:



Map showing SAV sampling sites within the boundaries of *Banana River Aquatic Preserve*. The point size reflects the number of samples at a given sampling site.

Table 25: Seagrass (SJRWMD) - Program 3013

<i>N_Data</i>	<i>YearMin</i>	<i>YearMax</i>	<i>Collection Method</i>	<i>Sample Locations</i>
39569	1994	2023	Percent Cover	5
45895	1994	2023	Percent Occurrence	5



Median percent cover by species in *Banana River Aquatic Preserve*. Linear mixed-effects models are applied to each species to produce species trends. The trendlines are then isolated and reproduced below for ease of viewing. The LME results are available in table form beneath the supplemental trendplot below.

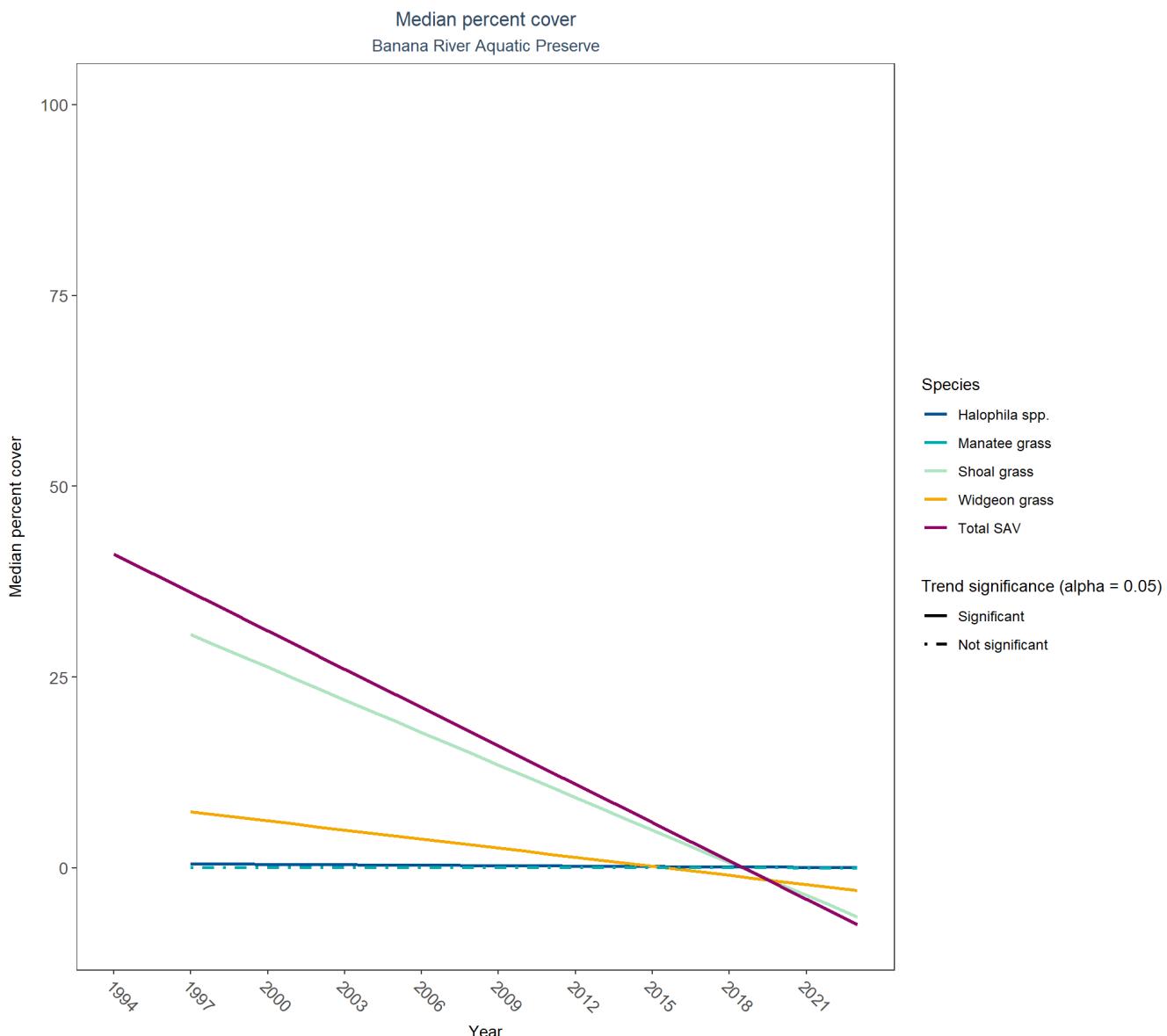
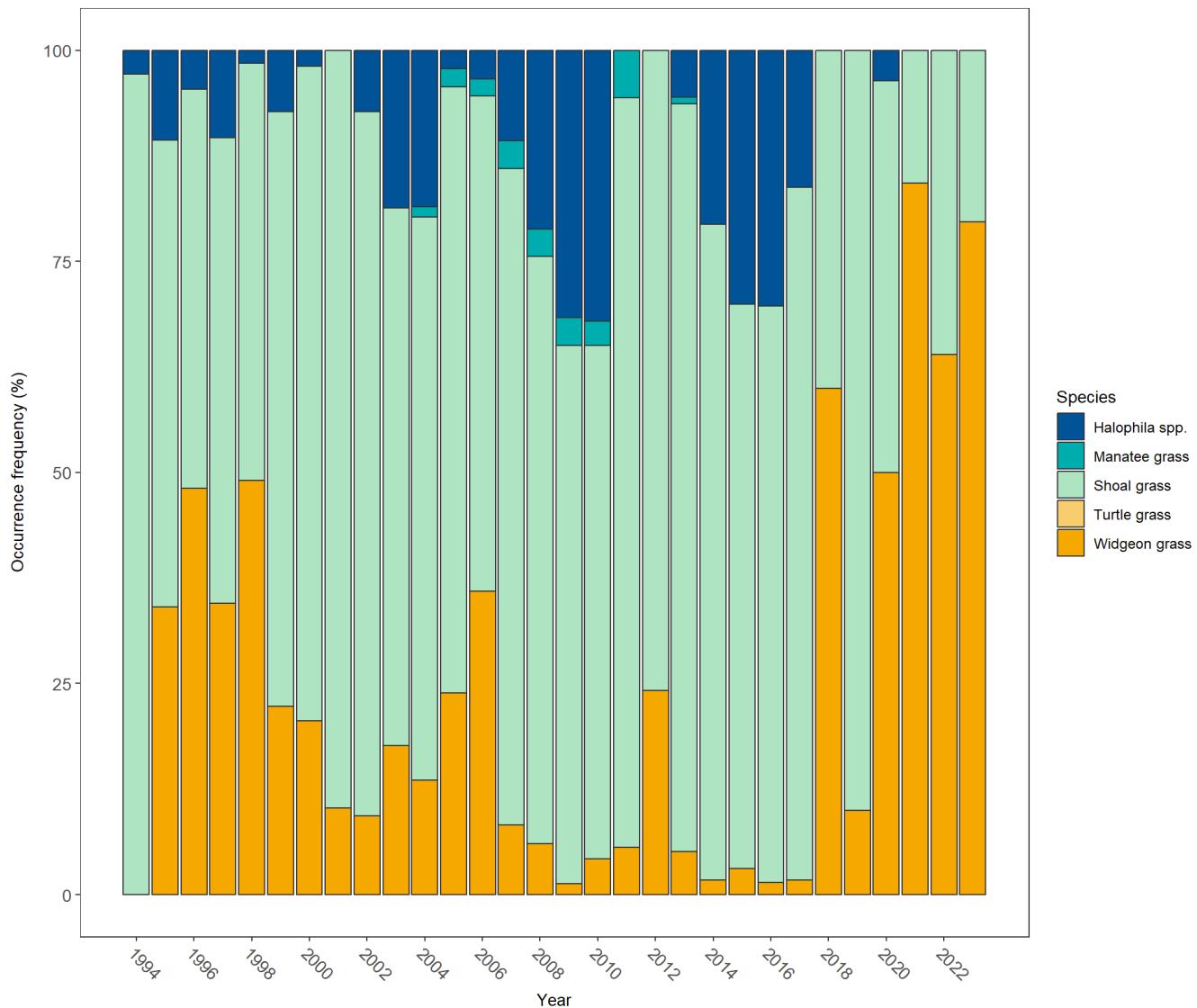
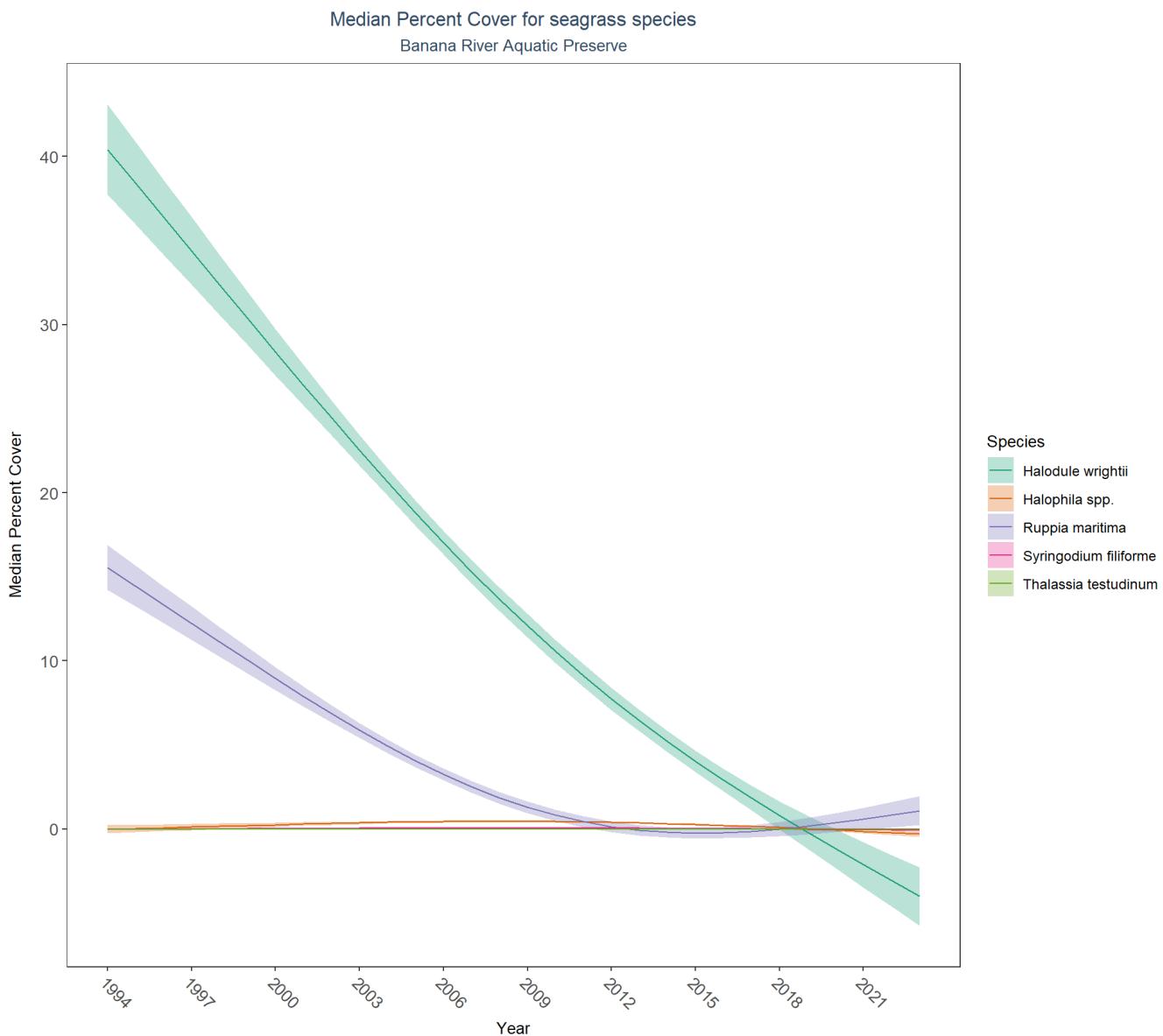


Table 26: Percent Cover Trend Analysis for Banana River Aquatic Preserve

Species	Common Name	Trend Significance (0.05)	Period of Record	LME-Intercept	LME-Slope	p
Drift algae		Insufficient data to calculate trend				
Halodule wrightii	Shoal grass	Significantly decreasing trend	1997 - 2023	34.8236	-1.4228	0.0000
Halophila spp.		Significantly decreasing trend	1997 - 2023	0.5891	-0.0189	0.0044
Ruppia maritima	Widgeon grass	Significantly decreasing trend	1997 - 2023	8.5313	-0.3964	0.0002
Syringodium filiforme	Manatee grass	No significant trend	1997 - 2023	0.0911	-0.0027	0.0854
Thalassia testudinum	Turtle grass	Model did not fit the available data	1997 - 2023			
Total SAV		Significantly decreasing trend	1994 - 2023	41.1181	-1.6749	0.0000
Total seagrass		Insufficient data to calculate trend				

Frequency of occurrence
Banana River Aquatic Preserve





Generalized additive models for each species in Banana River Aquatic Preserve. Species must have at least 10 years of data to be evaluated.

Drift algae, Total seagrass, Attached algae, No grass in Quadrat, and Total SAV are excluded from the analyses.