

Indian River-Malabar to Vero Beach Aquatic Preserve

SEACAR Habitat Analyses

Last compiled on 03 September, 2024

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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

Parameter Name	Units	Low Threshold	High Threshold	Sensor Type
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

Parameter Name	Units	Low Threshold	High Threshold
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	-
NO2+3 Filtered	mg/L	0	-
NH4 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:

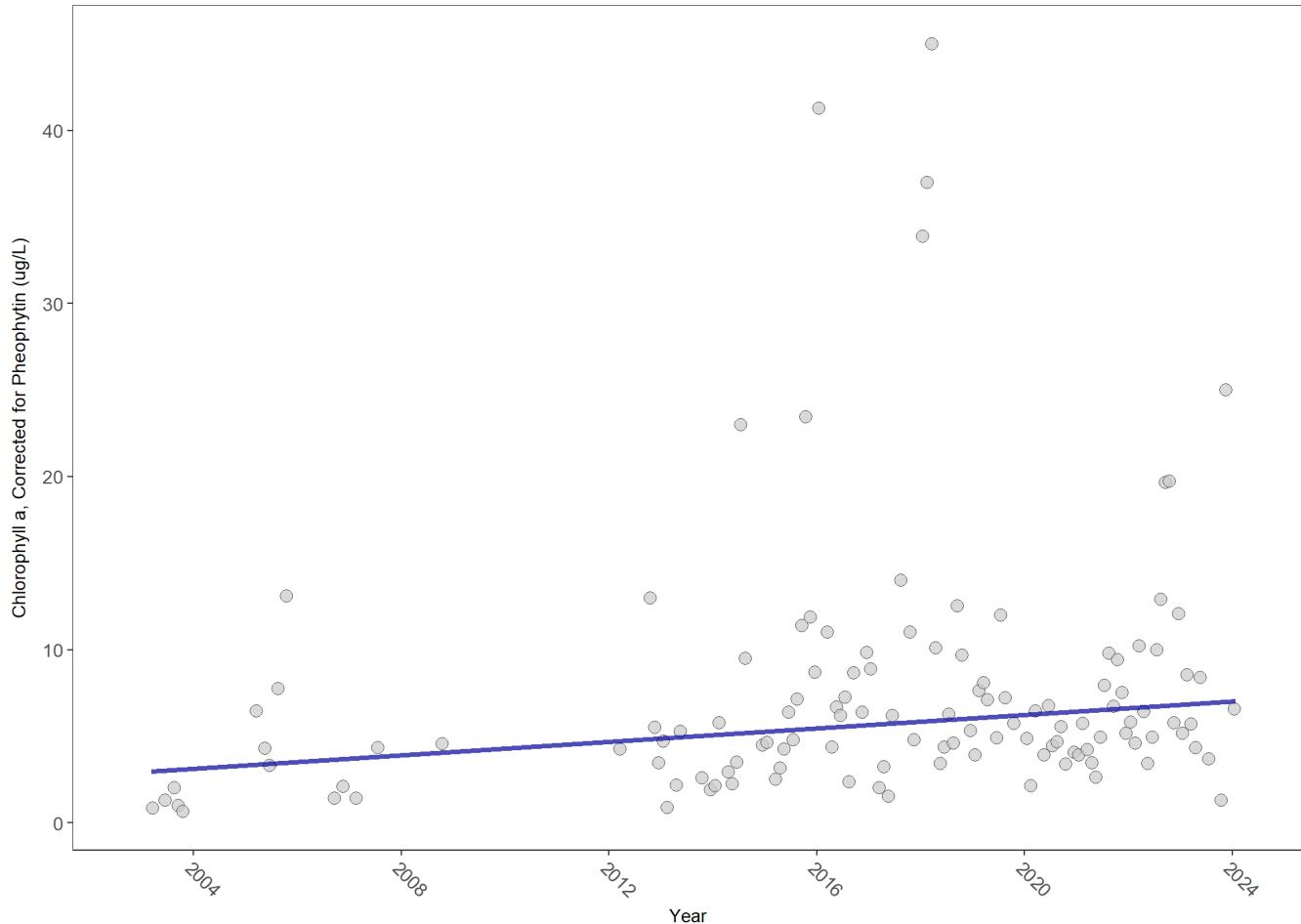
- *Combined_WQ_WC_NUT_Chlorophyll_a_corrected_for_pheophytin-2024-Jul-11.txt*
- *Combined_WQ_WC_NUT_Chlorophyll_a_uncorrected_for_pheophytin-2024-Jul-11.txt*
- *Combined_WQ_WC_NUT_Colored_dissolved_organic_matter_CDOM-2024-Jul-11.txt*
- *Combined_WQ_WC_NUT_Dissolved_Oxygen-2024-Jul-11.txt*
- *Combined_WQ_WC_NUT_Dissolved_Oxygen_Saturation-2024-Jul-11.txt*
- *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

Chlorophyll a, Corrected for Pheophytin, Lab, All Depths
Indian River-Malabar to Vero Beach Aquatic Preserve

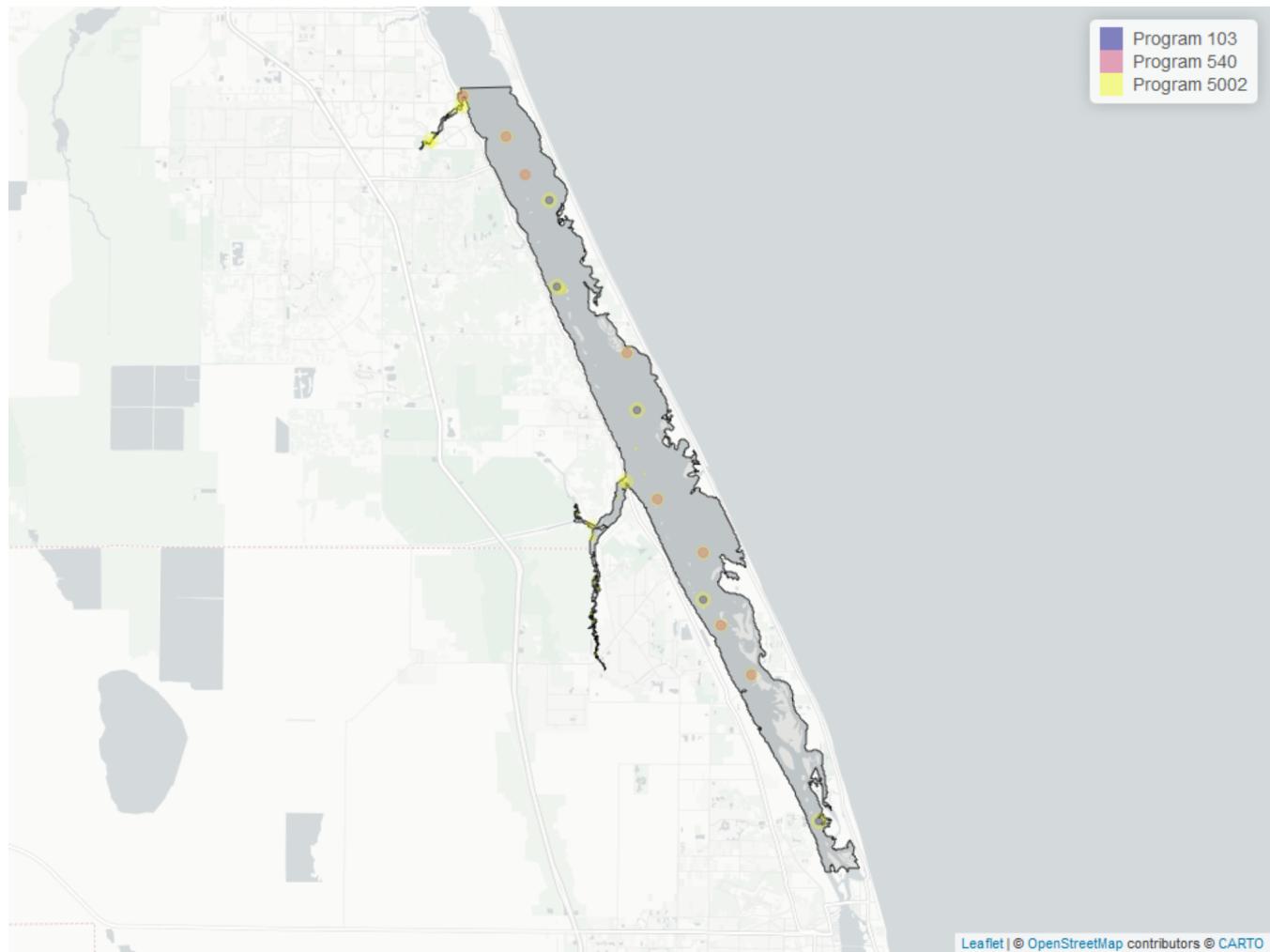


RelativeDepth	N_Data	N_Years	Median	Independent	tau	p	SennSlope	SennIntercept	ChiSquared	pChiSquared	Trend
All	668	18	4.45	TRUE	0.2322	0.0031	0.1953261	2.917901	6.7969	0.8153	1

$p < 0.00005$ 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 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	532	2003	2024
540	127	2016	2020
103	35	2020	2021

Program names:

5002 - Florida STORET / WIN

540 - Shellfish Harvest Area Classification Program

103 - EPA STOrage and RETrieval Data Warehouse (STORET)

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

Year	N_{Total}	N_I	$perc_I$	N_Q	$perc_Q$	N_U	$perc_U$
2003	6					1	16.7
2005	12	7	58.3				
2006	3	2	66.7			1	33.3
2007	4	2	50.0			2	50.0
2012	14	1	7.1				
2013	26	9	34.6				
2014	50	14	28.0			1	2.0
2015	59	2	3.4				
2016	46	1	2.2				
2017	35	9	25.7				
2018	58	1	1.7				
2019	30	1	3.3	2	6.7		
2020	84	30	35.7			5	6.0
2021	134	25	18.7			1	0.8
2022	93	30	32.3				
2023	35	12	34.3				
2024	3	2	66.7				

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:

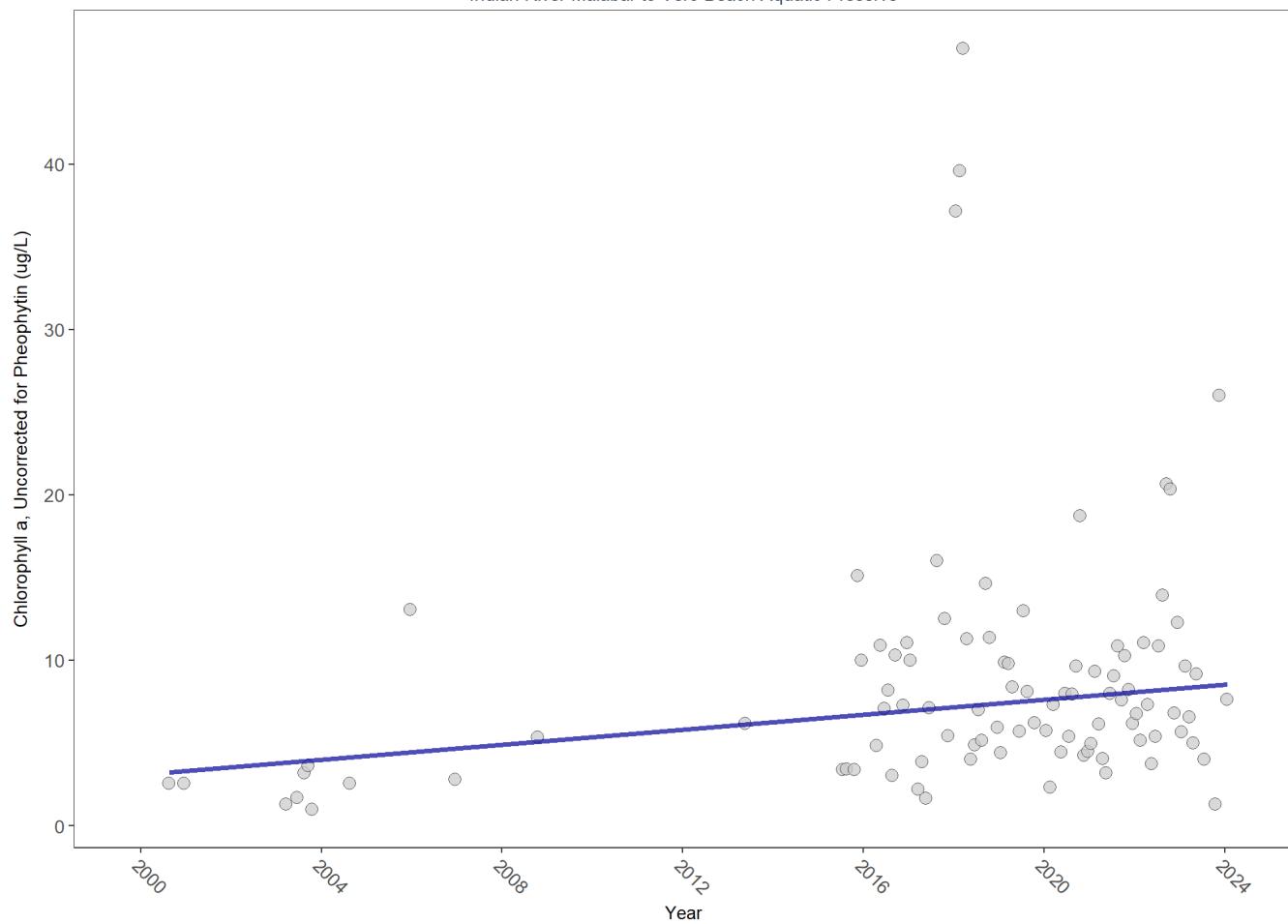
5002 - Florida STORET / WIN

540 - Shellfish Harvest Area Classification Program

Chlorophyll a, Uncorrected for Pheophytin - Discrete Water Quality

Seasonal Kendall-Tau Trend Analysis

Chlorophyll a, Uncorrected for Pheophytin, Lab, All Depths
Indian River-Malabar to Vero Beach Aquatic Preserve

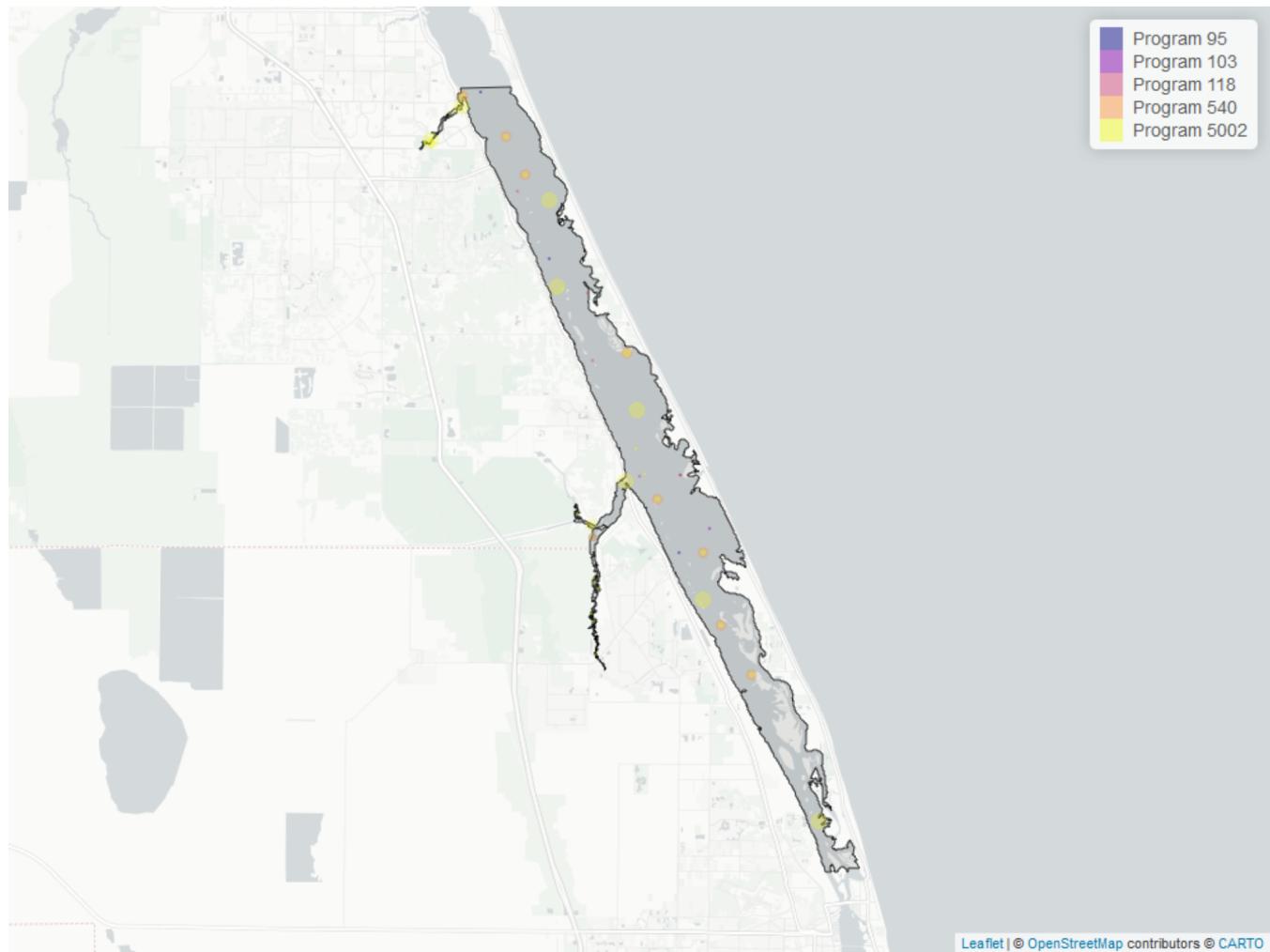


RelativeDepth	N_Data	N_Years	Median	Independent	tau	p	SennSlope	SennIntercept	ChiSquared	pChiSquared	Trend
All	507	17	5.90523	TRUE	0.183	0.0103	0.2275041	3.07214	9.8823	0.541	1

$p < 0.00005$ 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 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	371	2003	2024
540	131	2016	2020
103	14	2000	2021
118	5	2000	2010
95	3	2018	2018

Program names:

5002 - Florida STORET / WIN

540 - Shellfish Harvest Area Classification Program

103 - EPA STOrage and RETrieval Data Warehouse (STORET)

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 Pheophytin

Year	N_{Total}	N_I	$perc_I$	N_Q	$perc_Q$	N_U	$perc_U$
2017	34	3	8.8				
2019	30	1	3.3	2	6.7		
2020	81	13	16.0			1	1.2
2021	114	22	19.3				
2022	93	20	21.5				
2023	35	10	28.6				

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:

5002 - Florida STORET / WIN

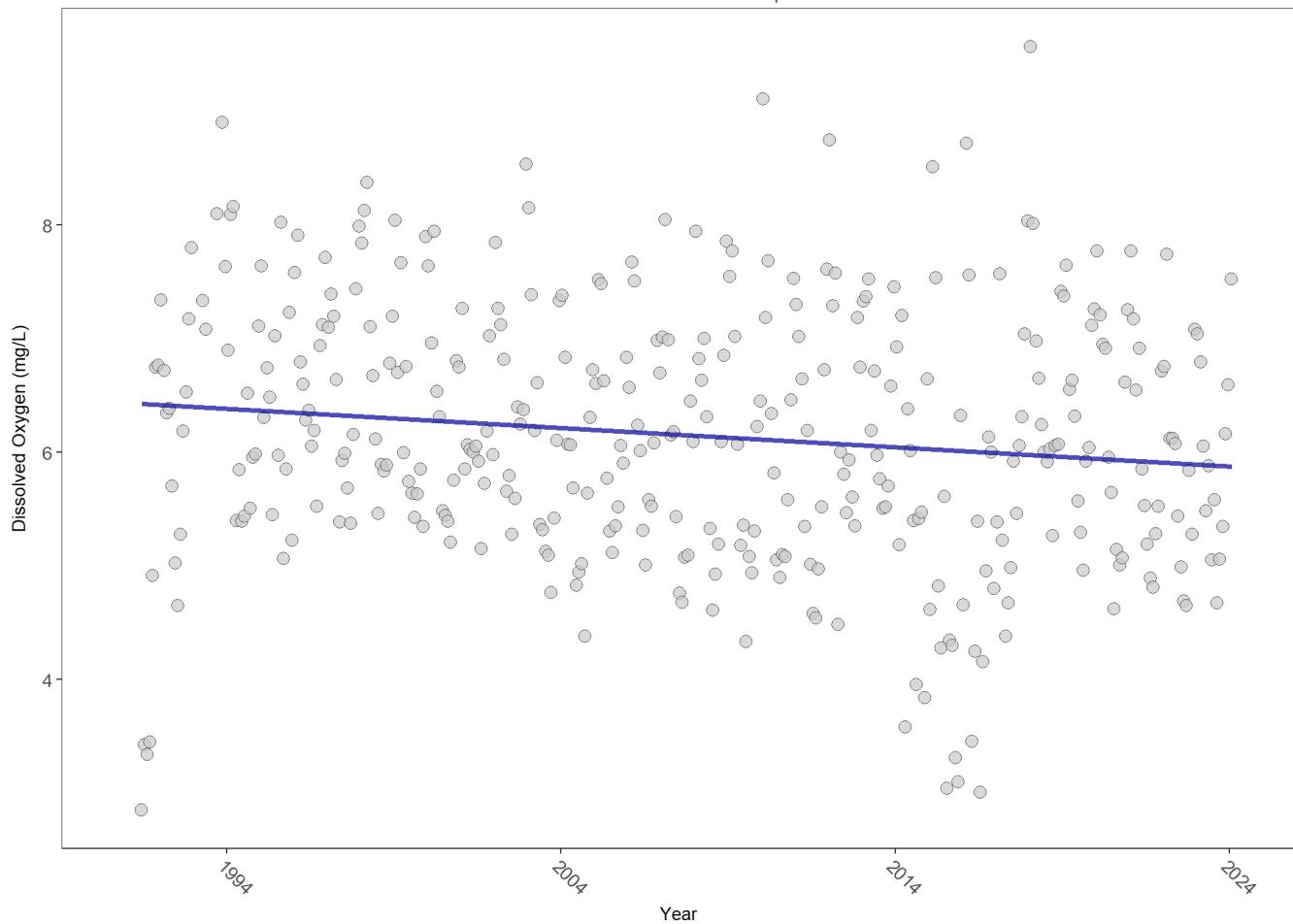
540 - Shellfish Harvest Area Classification Program

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
Indian River-Malabar to Vero Beach Aquatic Preserve



RelativeDepth	N_Data	N_Years	Median	Independent	tau	p	SennSlope	SennIntercept	ChiSquared	pChiSquared	Trend
All	56673	34	6.2	TRUE	-0.1586	0.0000	-0.01689332	6.431804	10.2913	0.5044	-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

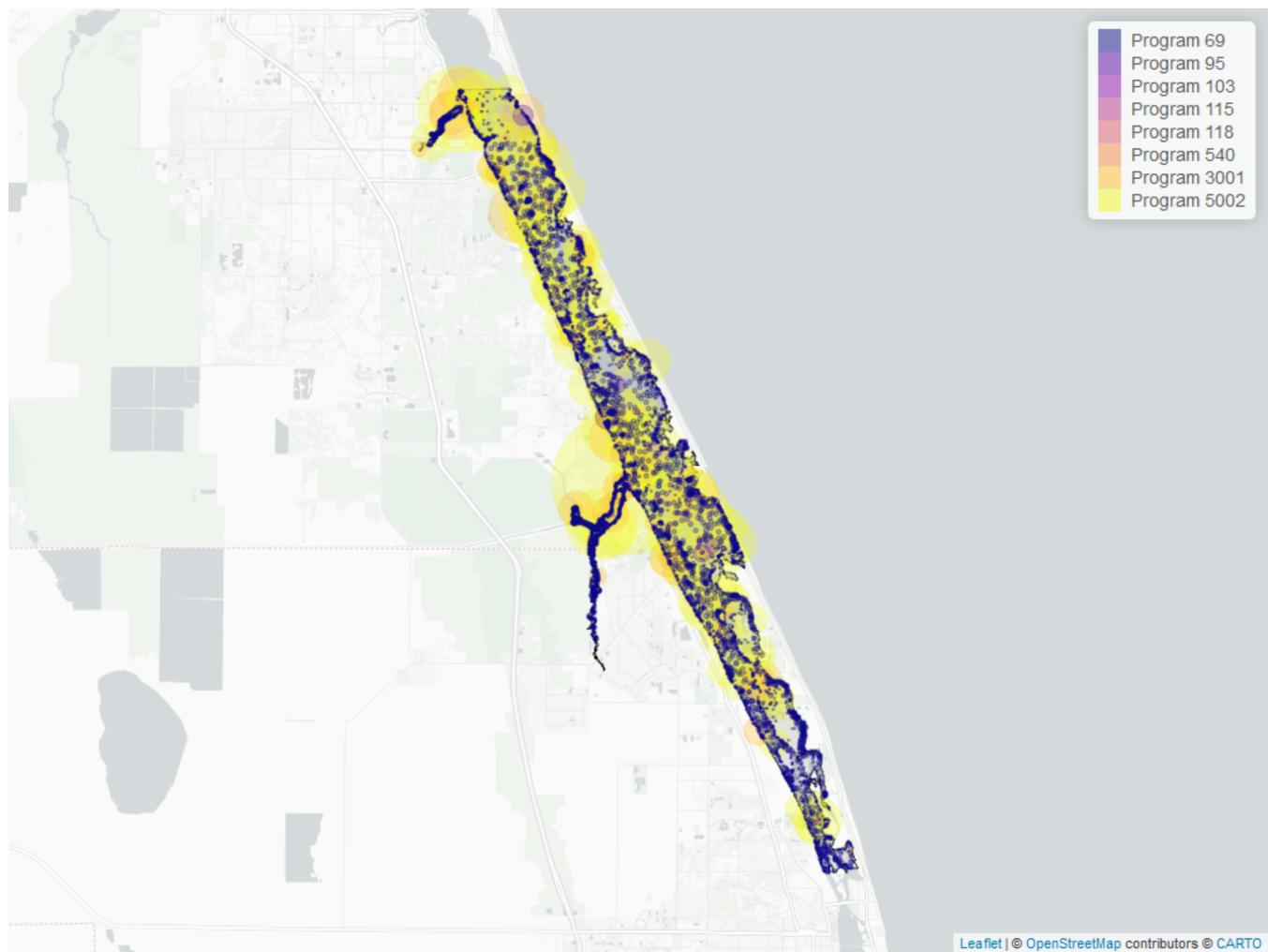


Table 10: Programs contributing data for Dissolved Oxygen

ProgramID	N_Data	YearMin	YearMax
5002	29453	1991	2024
69	19362	1991	2022
3001	6309	1991	2023
3013	1107	2003	2023
95	488	1996	2018
540	127	2016	2020
103	63	2004	2021
115	28	1994	1995
118	4	2000	2006

Program names:

5002 - Florida STORET / WIN

69 - Fisheries-Independent Monitoring (FIM) Program

3001 - Lagoon Watch (Formerly Marine Discovery Center)

3013 - Seagrass (SJRWMD)

95 - Harmful Algal Bloom Marine Observation Network

540 - Shellfish Harvest Area Classification Program

103 - EPA STOrage and RETrieval Data Warehouse (STORET)

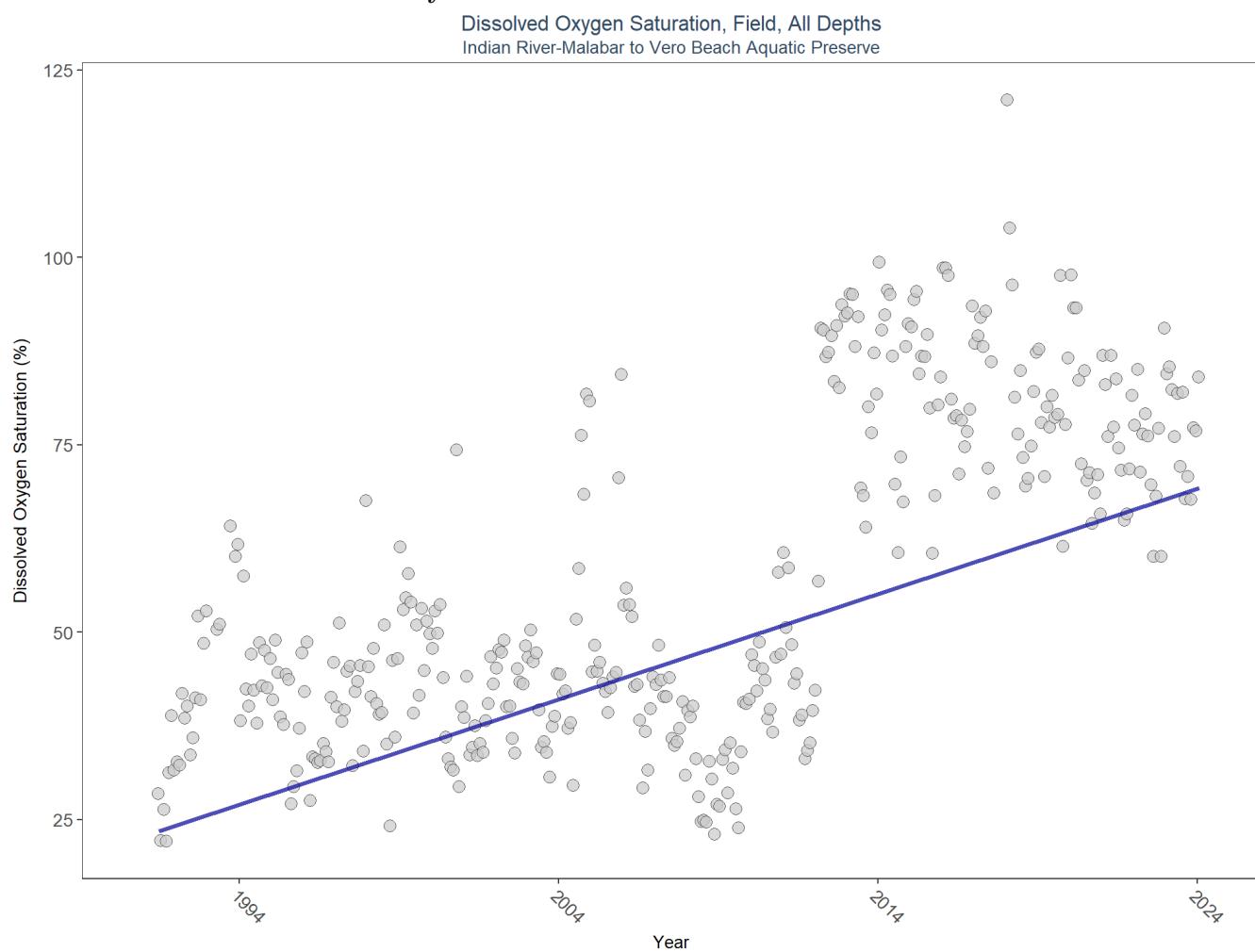
115 - Environmental Monitoring Assessment Program

118 - National Aquatic Resource Surveys, National Coastal Condition Assessment

There are no qualifying Value Qualifiers for Dissolved Oxygen in Indian River-Malabar to Vero Beach Aquatic Preserve

Dissolved Oxygen Saturation - Discrete Water Quality

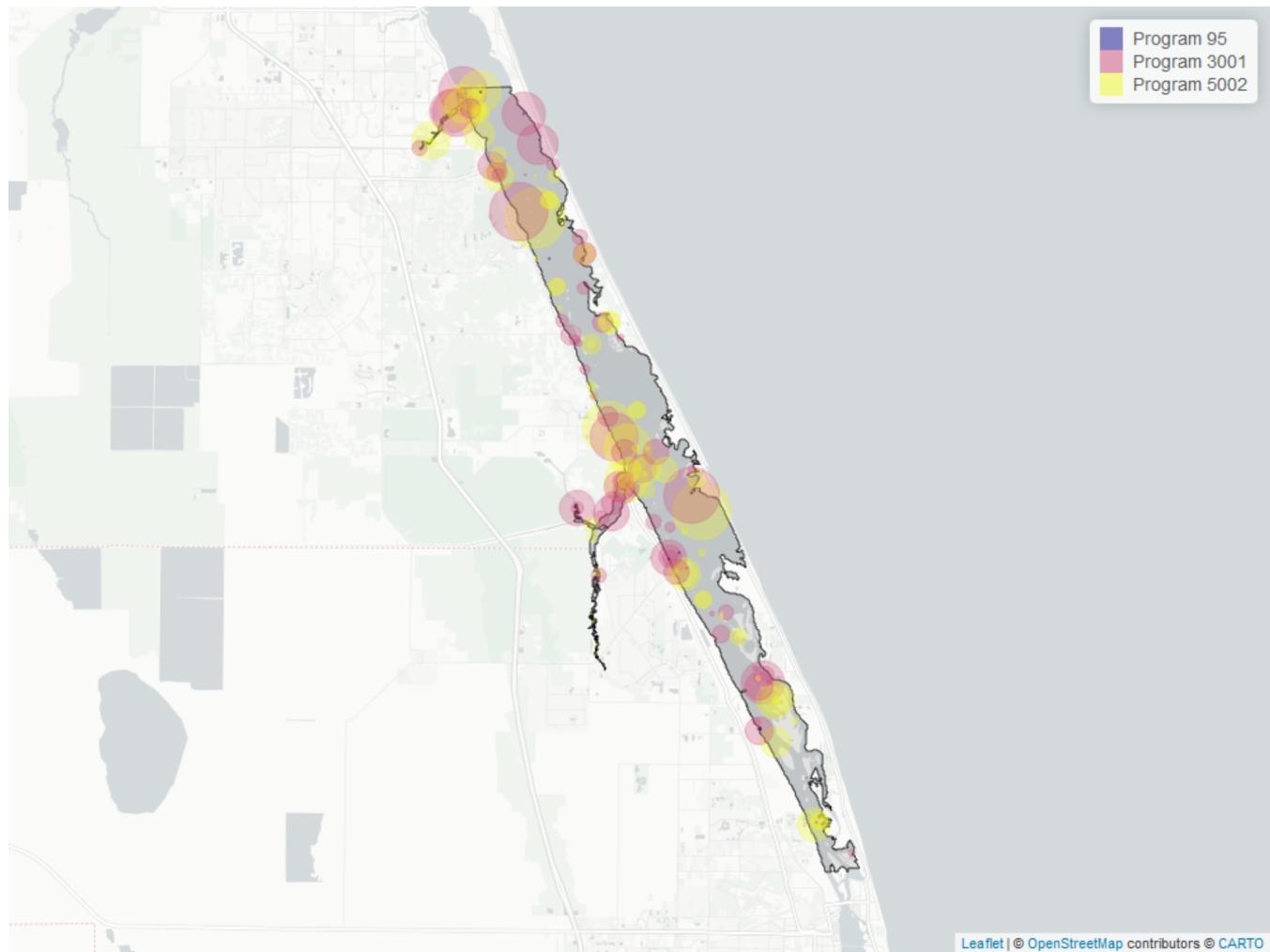
Seasonal Kendall-Tau Trend Analysis



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 Dissolved Oxygen Saturation



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

Table 11: Programs contributing data for Dissolved Oxygen Saturation

ProgramID	N_Data	YearMin	YearMax
3001	6321	1991	2023
5002	6172	1991	2024
3013	570	2012	2023
95	5	2016	2018

Program names:

3001 - Lagoon Watch (Formerly Marine Discovery Center)

5002 - Florida STORET / WIN

3013 - Seagrass (SJRWMD)

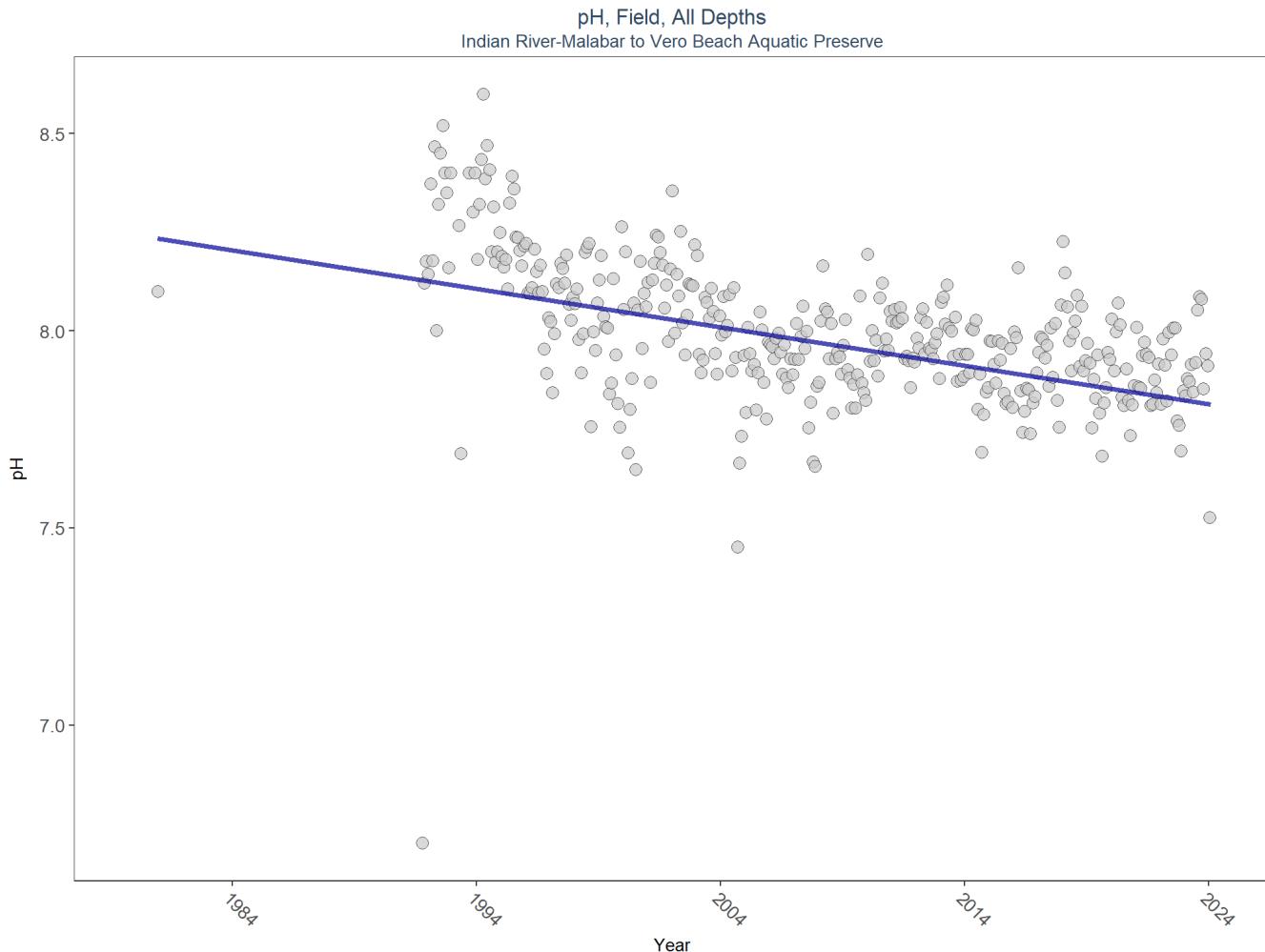
95 - Harmful Algal Bloom Marine Observation Network

There are no qualifying Value Qualifiers for Dissolved Oxygen Saturation in Indian River-Malabar to Vero Beach 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

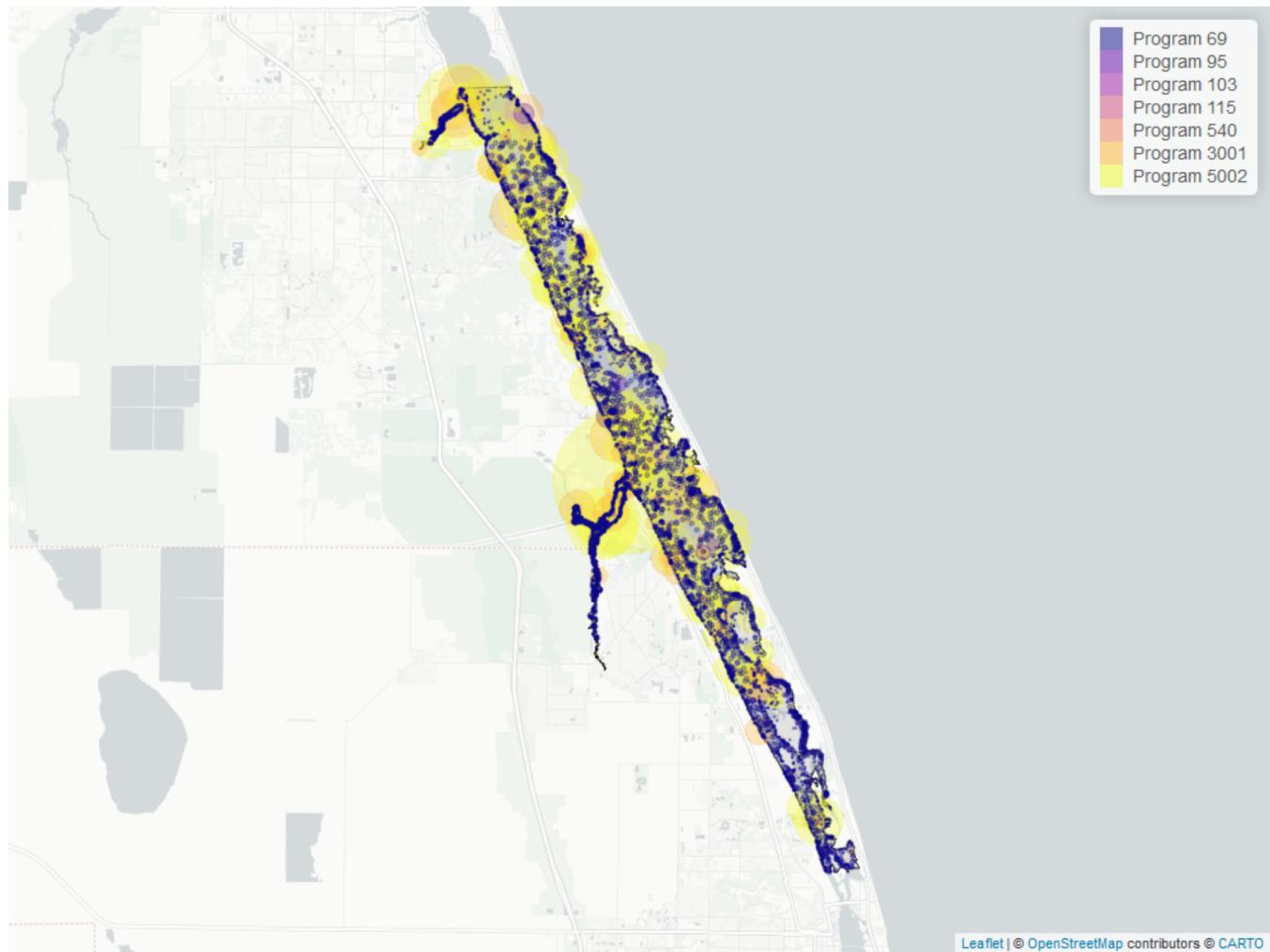


RelativeDepth	N_Data	N_Years	Median	Independent	tau	p	SennSlope	SennIntercept	ChiSquared	pChiSquared	Trend
All	47691	35	8	TRUE	-0.4125	0.0000	-0.009746373	8.243364	4.4632	0.9544	-1

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 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	21887	1995	2024
69	19360	1991	2022
3001	5913	1991	2023
3013	1119	2003	2023
95	454	1980	2018
540	119	2016	2020
103	62	2004	2021
115	22	1994	1995

Program names:

5002 - Florida STORET / WIN

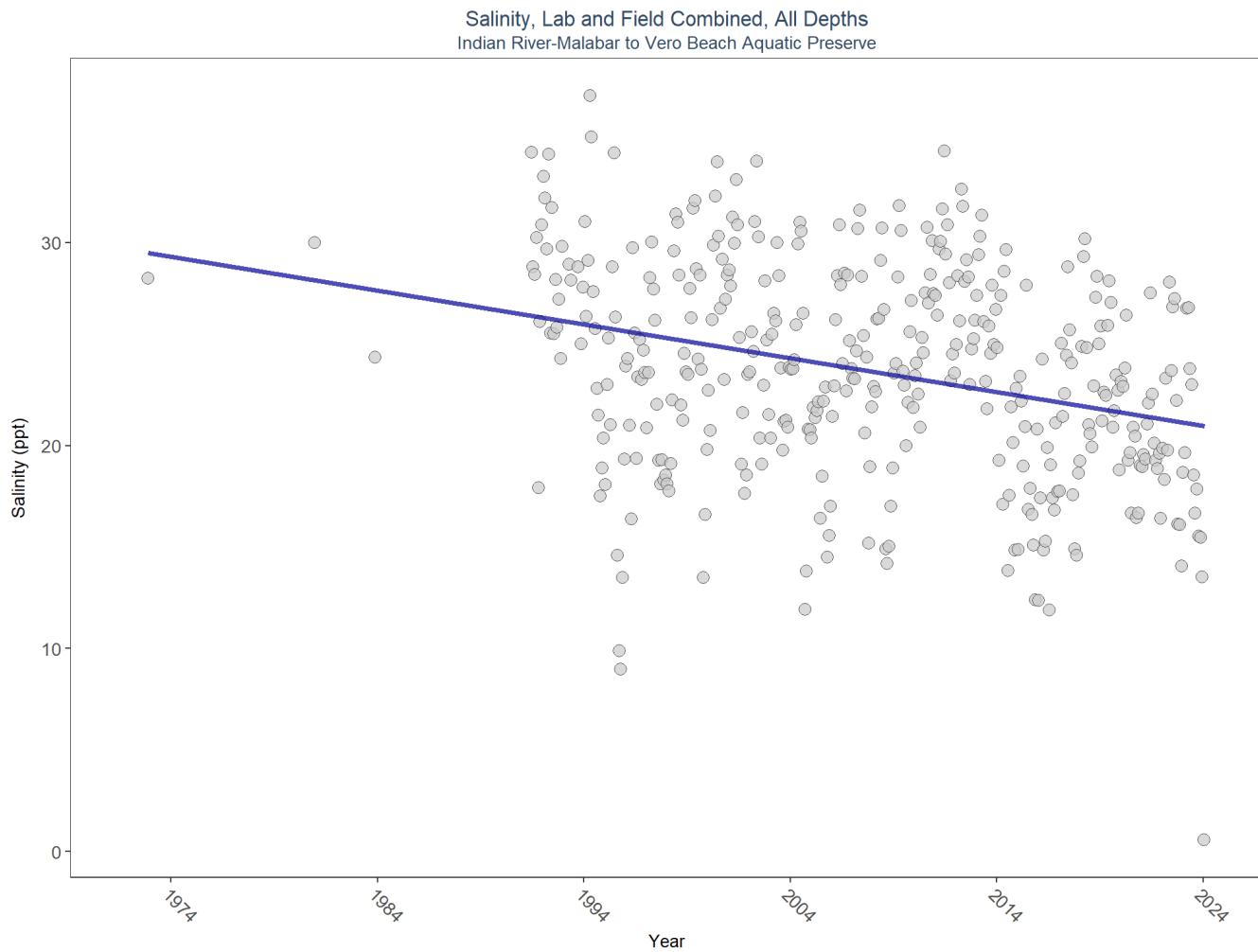
- 69 - Fisheries-Independent Monitoring (FIM) Program
 3001 - Lagoon Watch (Formerly Marine Discovery Center)
 3013 - Seagrass (SJRWM)
 95 - Harmful Algal Bloom Marine Observation Network
 540 - Shellfish Harvest Area Classification Program
 103 - EPA STOrage and RETrieval Data Warehouse (STORET)
 115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

There are no qualifying Value Qualifiers for pH in Indian River-Malabar to Vero Beach 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

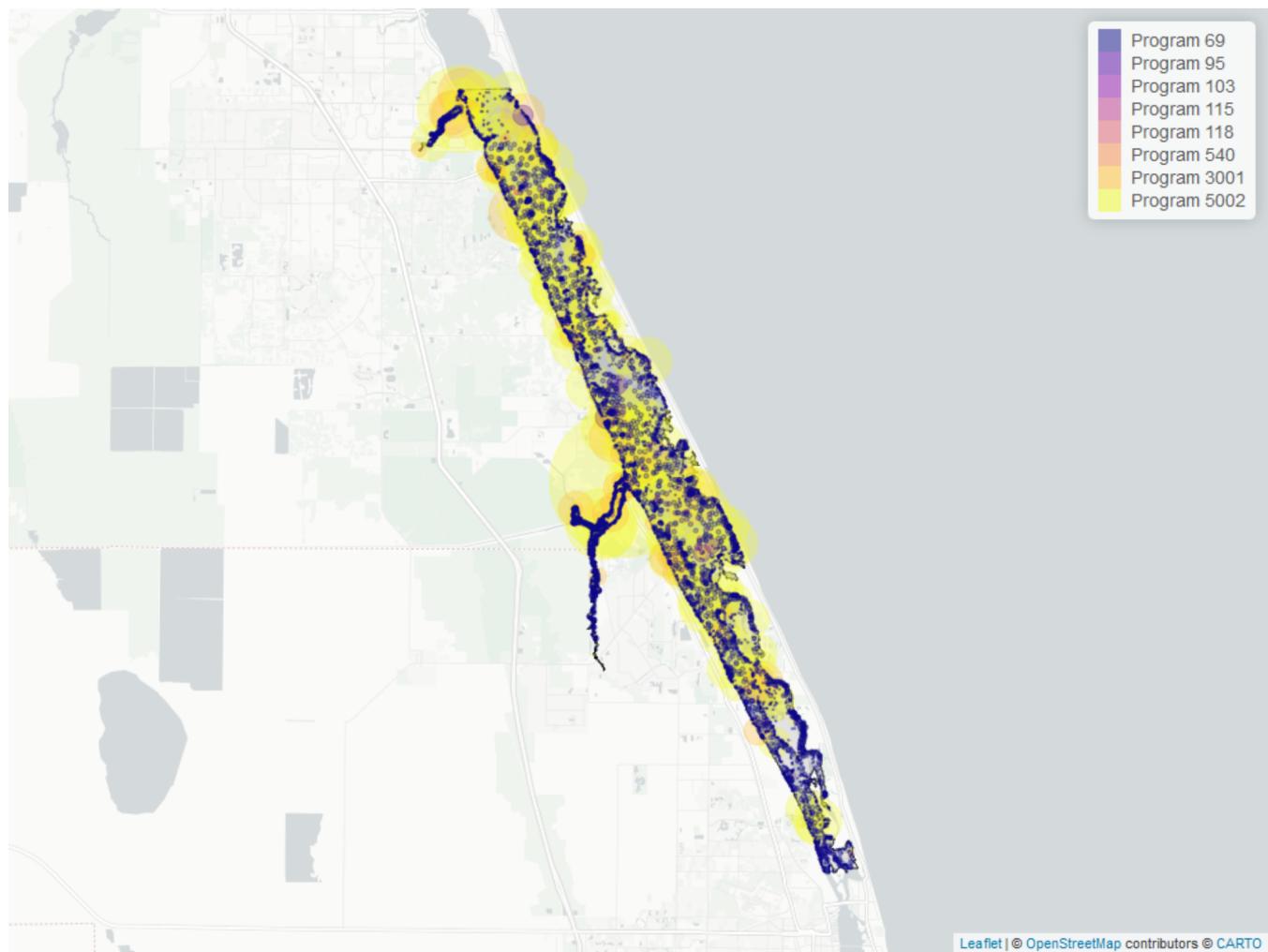


RelativeDepth	N_Data	N_Years	Median	Independent	tau	p	SennSlope	SennIntercept	ChiSquared	pChiSquared	Trend
All	59612	37	26.1	TRUE	-0.2293	0.0000	-0.1665138	29.63202	8.9113	0.6301	-1

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 Salinity



Leaflet | © OpenStreetMap contributors © CARTO

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	32204	1991	2024
69	19433	1991	2022
3001	6272	1991	2023
3013	1123	2003	2023
95	519	1972	2018
540	127	2016	2020
115	25	1994	1995
118	10	2015	2021
103	2	2004	2004

Program names:

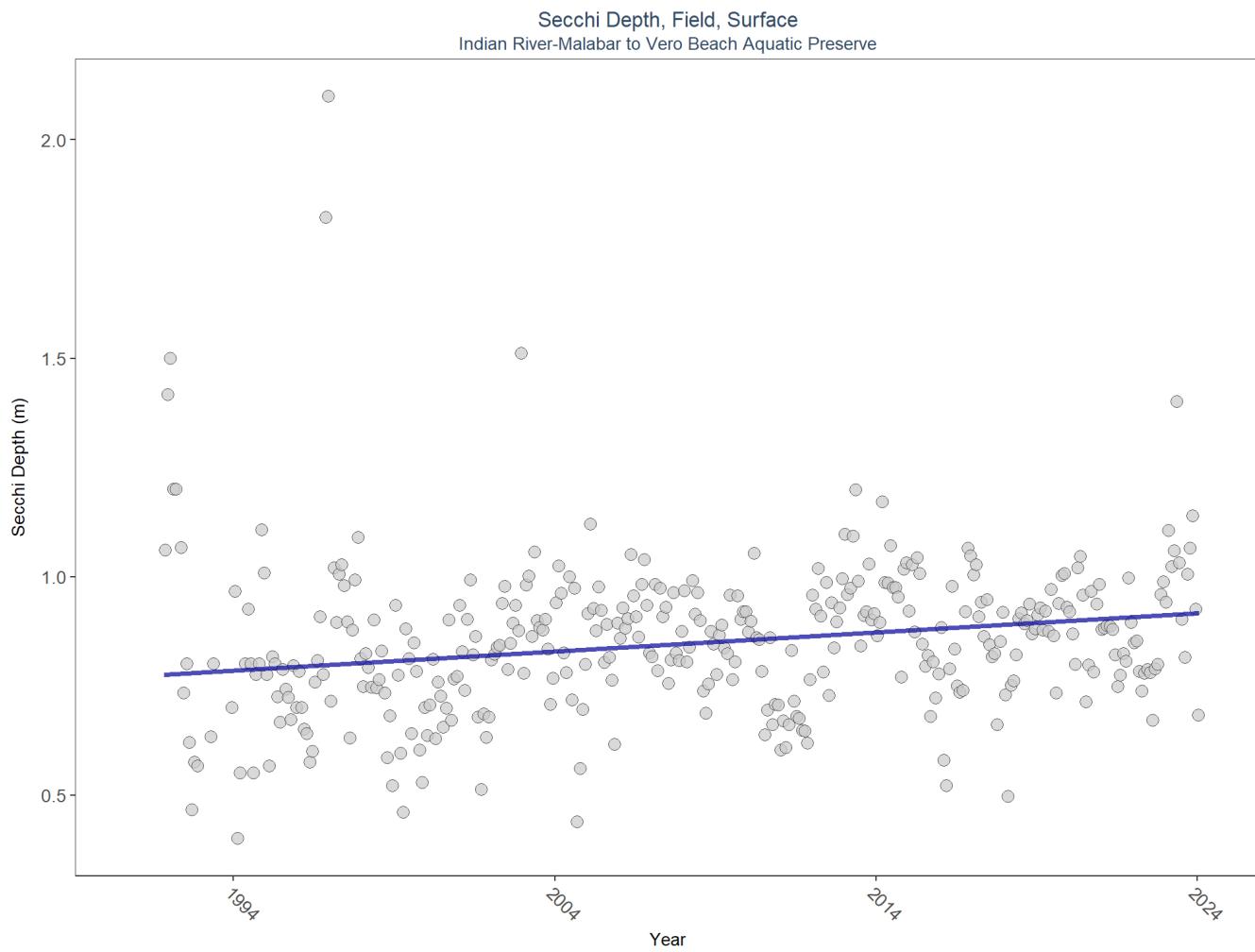
5002 - Florida STORET / WIN
 69 - Fisheries-Independent Monitoring (FIM) Program
 3001 - Lagoon Watch (Formerly Marine Discovery Center)
 3013 - Seagrass (SJRWMD)
 95 - Harmful Algal Bloom Marine Observation Network
 540 - Shellfish Harvest Area Classification Program
 115 - Environmental Monitoring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

There are no qualifying Value Qualifiers for Salinity in Indian River-Malabar to Vero Beach 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.

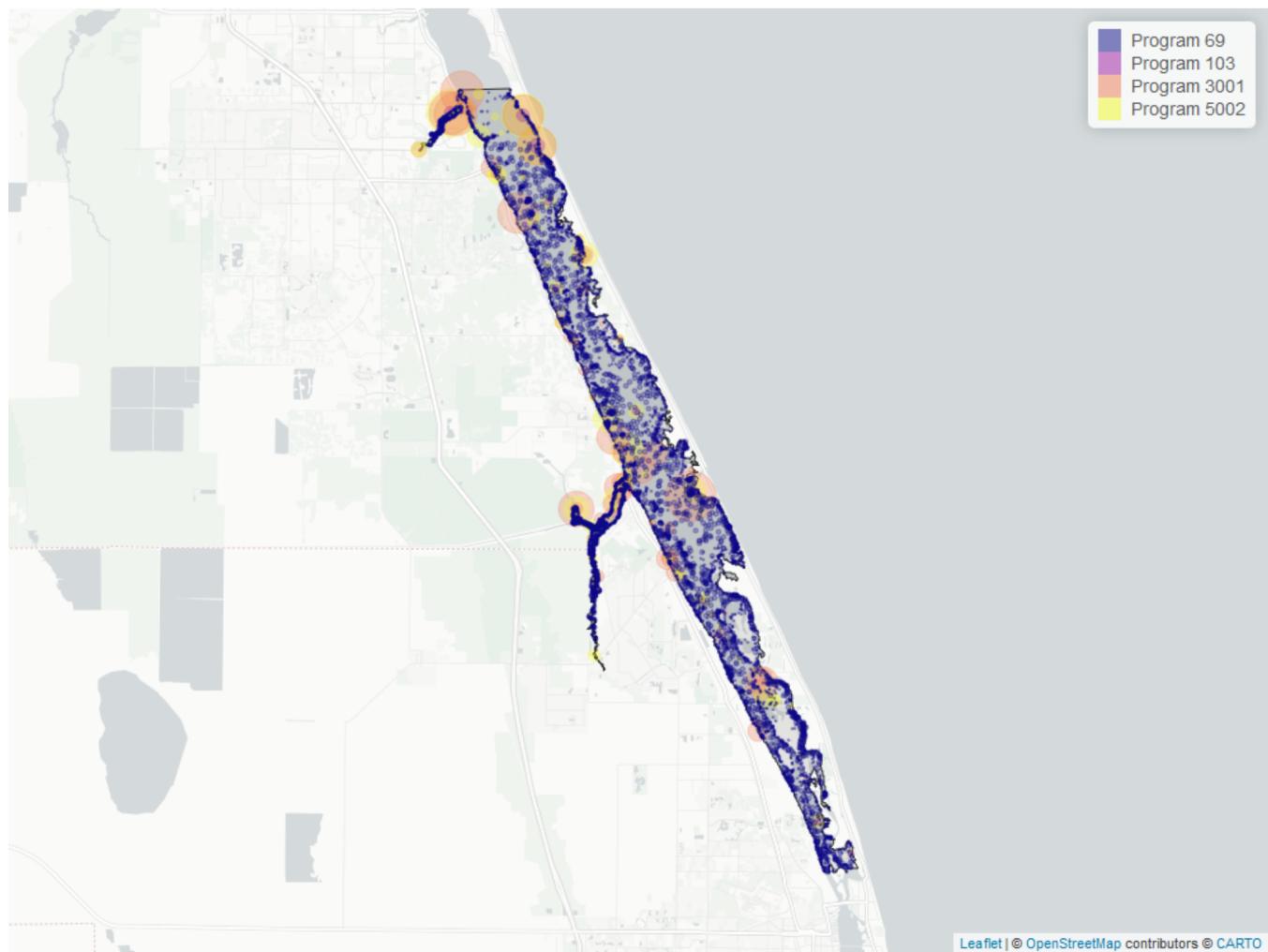
Seasonal Kendall-Tau Trend Analysis



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	19263	1995	2022
3001	4033	1991	2023
5002	2586	2005	2024
3013	1129	2003	2023
103	148	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
- $N_{_}$ 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 15: Value Qualifiers for Secchi Depth

Year	$N_{_Total}$	$N_{_S}$	$perc_{_S}$
2015	1082	12	1.1
2016	1071	26	2.4
2017	1216	188	15.5
2018	1403	167	11.9
2019	1275	130	10.2
2020	1082	87	8.0
2021	1222	128	10.5
2022	951	80	8.4
2023	394	73	18.5

Note: 1S - 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) $TN = TKN + NO_3O_2;$
- 2) $TN = TKN + NO_3 + NO_2;$
- 3) $TN = ORGN + NH_4 + NO_3O_2;$
- 4) $TN = ORGN + NH_4 + NO_2 + NO_3;$
- 5) $TN = TKN + NO_3;$
- 6) $TN = ORGN + NH_4 + NO_3;$

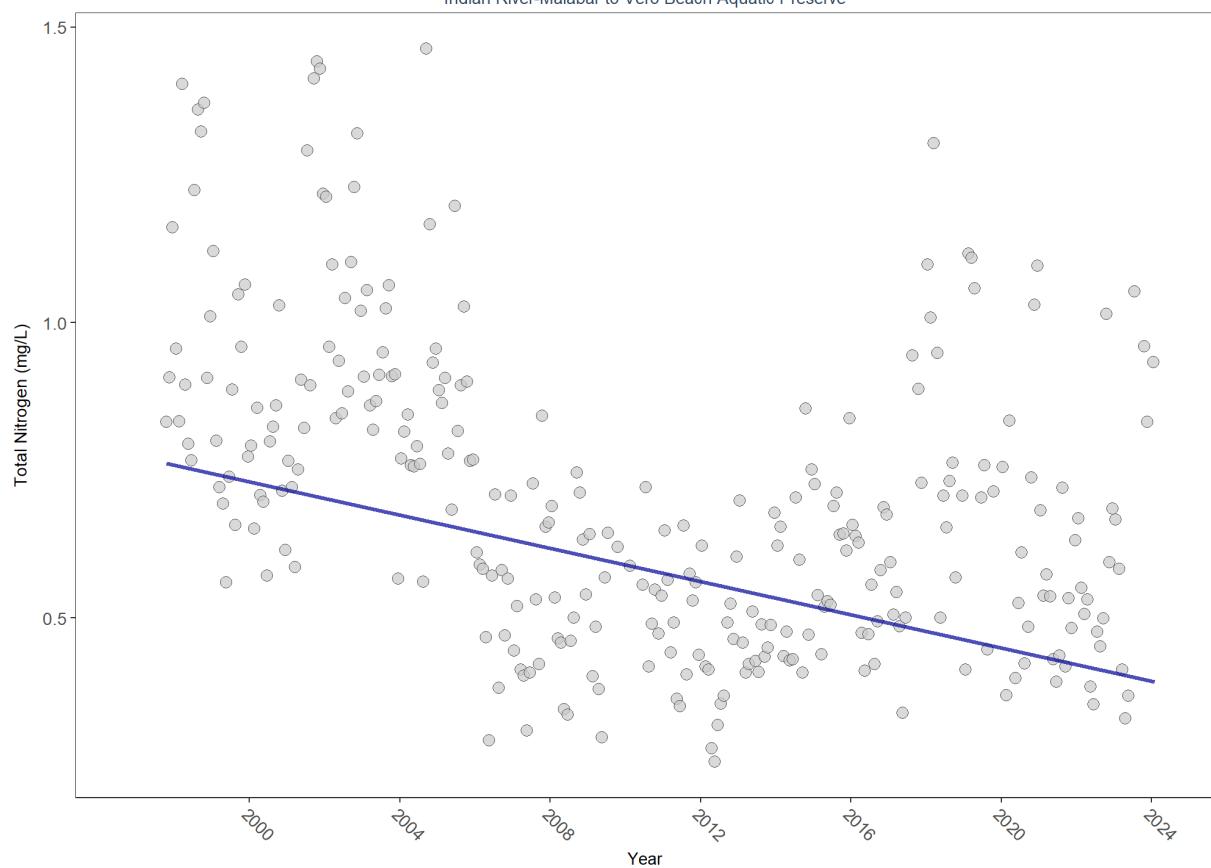
Additional Information:

- 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
Indian River-Malabar to Vero Beach Aquatic Preserve

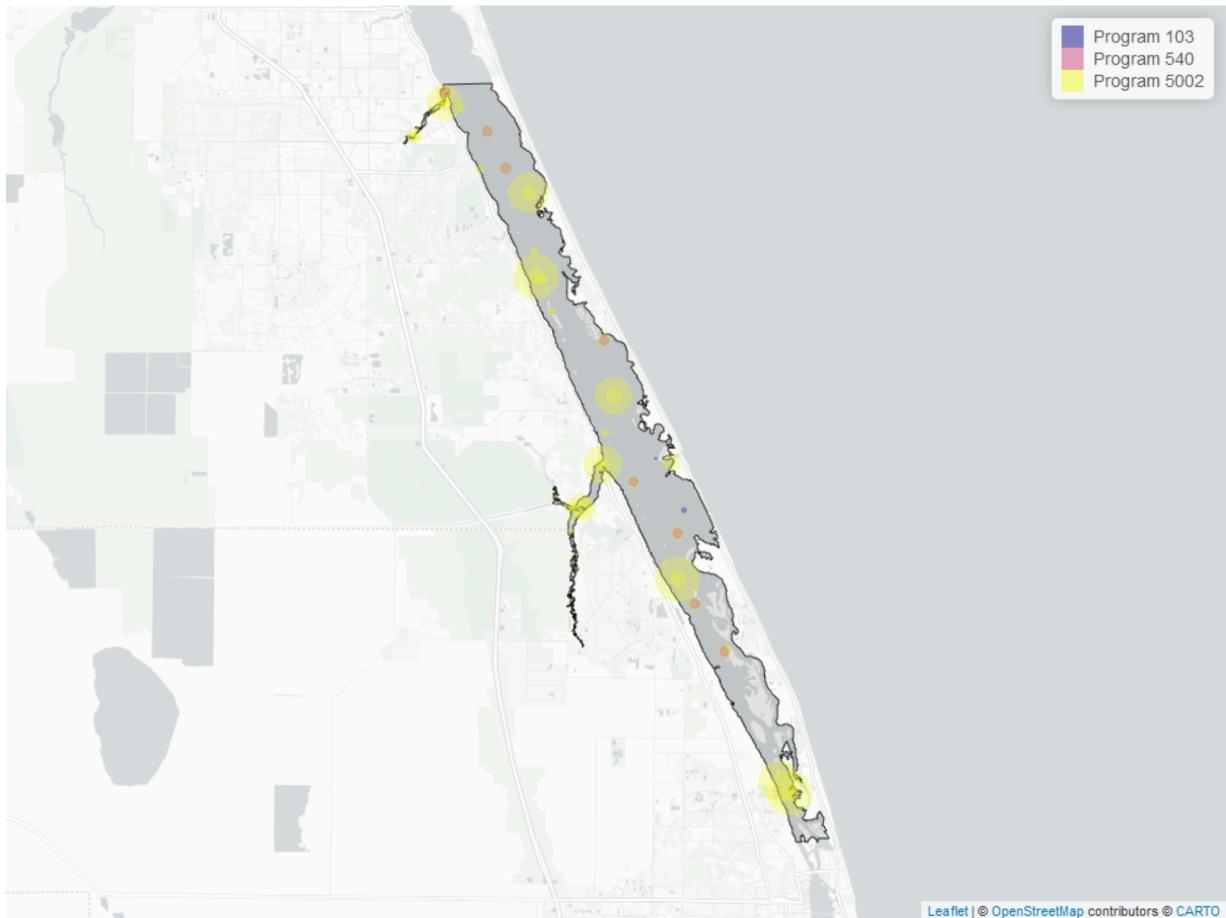


RelativeDepth	N_Data	N_Years	Median	Independent	tau	p	SennSlope	SennIntercept	ChiSquared	pChiSquared	Trend
All	3080	28	0.6581	TRUE	-0.3074	0.0000	-0.0140858	0.7729597	4.812	0.9399	-1

$p < 0.00005$ 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	2954	1997	2024
540	122	2016	2020
103	4	2000	2004

Program names:

5002 - Florida STORET / WIN

540 - Shellfish Harvest Area Classification Program

103 - EPA STOrage and RETrieval Data Warehouse (STORET)

Value Qualifiers

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

Table 17: Value Qualifiers for Total Nitrogen

Year	N_Total	N_I	perc_I
2009	90	1	1.1

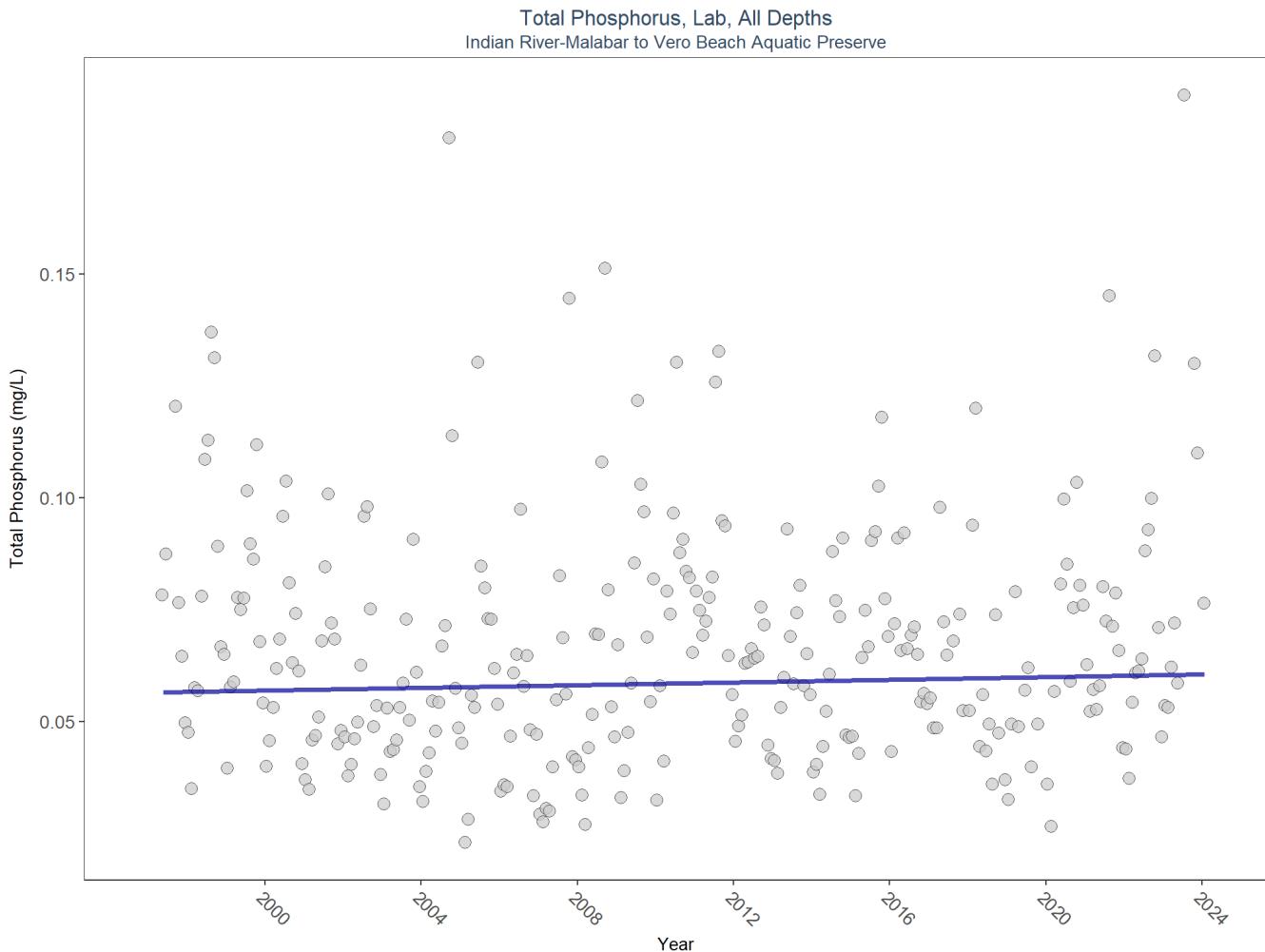
Note: ¹I - Reported value is greater than or equal to lab method detection limit, but less than quantitation limit

Programs containing Value Qualified data:

5002 - Florida STORET / WIN

Total Phosphorus - Discrete Water Quality

Seasonal Kendall-Tau Trend Analysis

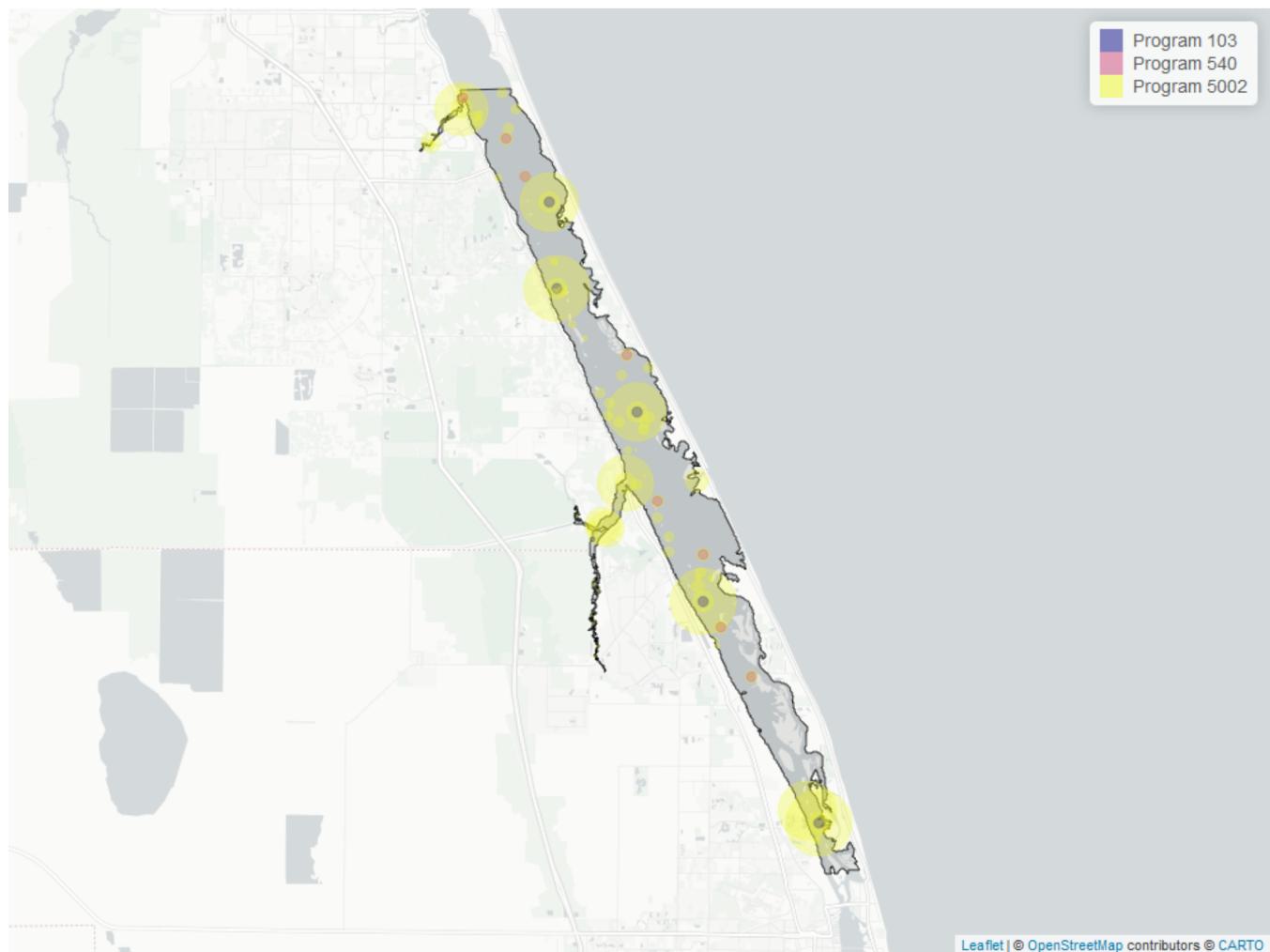


RelativeDepth	N_Data	N_Years	Median	Independent	tau	p	SennSlope	SennIntercept	ChiSquared	pChiSquared	Trend
All	6320	28	0.05307	TRUE	0.048	0.2217	0.0001509858	0.05643282	14.4016	0.2116	0

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 Total Phosphorus



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

Table 18: Programs contributing data for Total Phosphorus

ProgramID	N_Data	YearMin	YearMax
5002	6225	1997	2024
540	126	2016	2020
103	76	2020	2021

Program names:

5002 - Florida STORET / WIN

540 - Shellfish Harvest Area Classification Program

103 - EPA STOrage and RETrieval Data Warehouse (STORET)

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 19: Value Qualifiers for Total Phosphorus

Year	$N_{_Total}$	$N_{_I}$	$perc_{_I}$	$N_{_Q}$	$perc_{_Q}$	$N_{_U}$	$perc_{_U}$
1997	138	26	18.8				
1998	410	93	22.7	6	1.5		
1999	303	30	9.9	1	0.3		
2001	288			24	8.3		
2002	479	128	26.7	8	1.7		
2003	318	112	35.2	12	3.8		
2004	382	134	35.1	1	0.3		
2005	303	114	37.6				
2006	297	130	43.8				
2007	288	133	46.2				
2008	276	107	38.8			4	1.4
2009	259	76	29.3			2	0.8
2010	238	113	47.5	20	8.4		
2011	222	109	49.1	12	5.4		
2012	182	132	72.5				
2013	202	119	58.9				
2014	241	122	50.6	7	2.9		
2015	251	142	56.6	34	13.6		
2016	240	132	55.0	16	6.7		
2017	120	64	53.3				
2020	151	20	13.2	1	0.7	1	0.7
2021	266	43	16.2	1	0.4	1	0.4
2022	179	43	24.0	3	1.7	4	2.2
2023	63	19	30.2				

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:

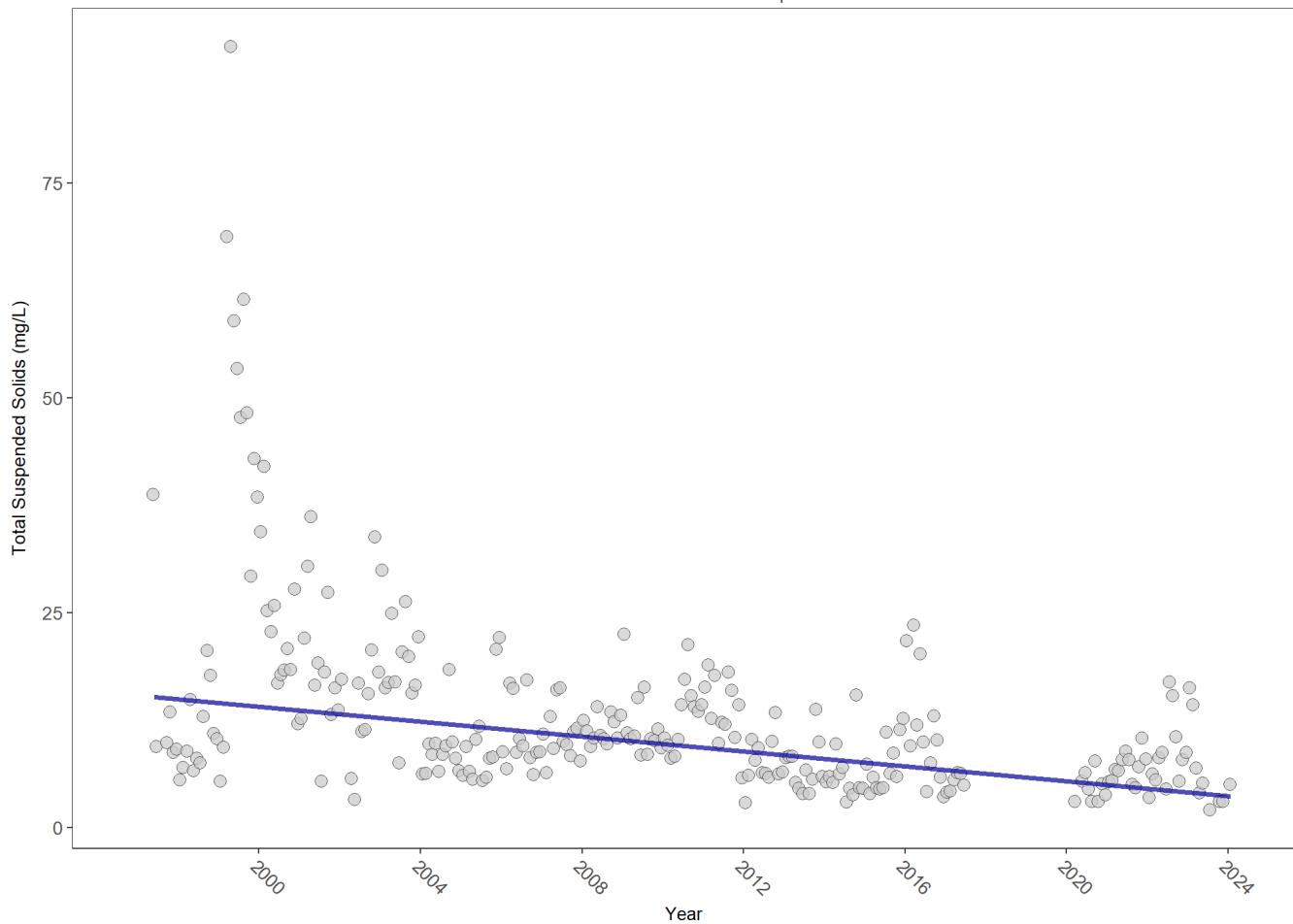
5002 - Florida STORET / WIN

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

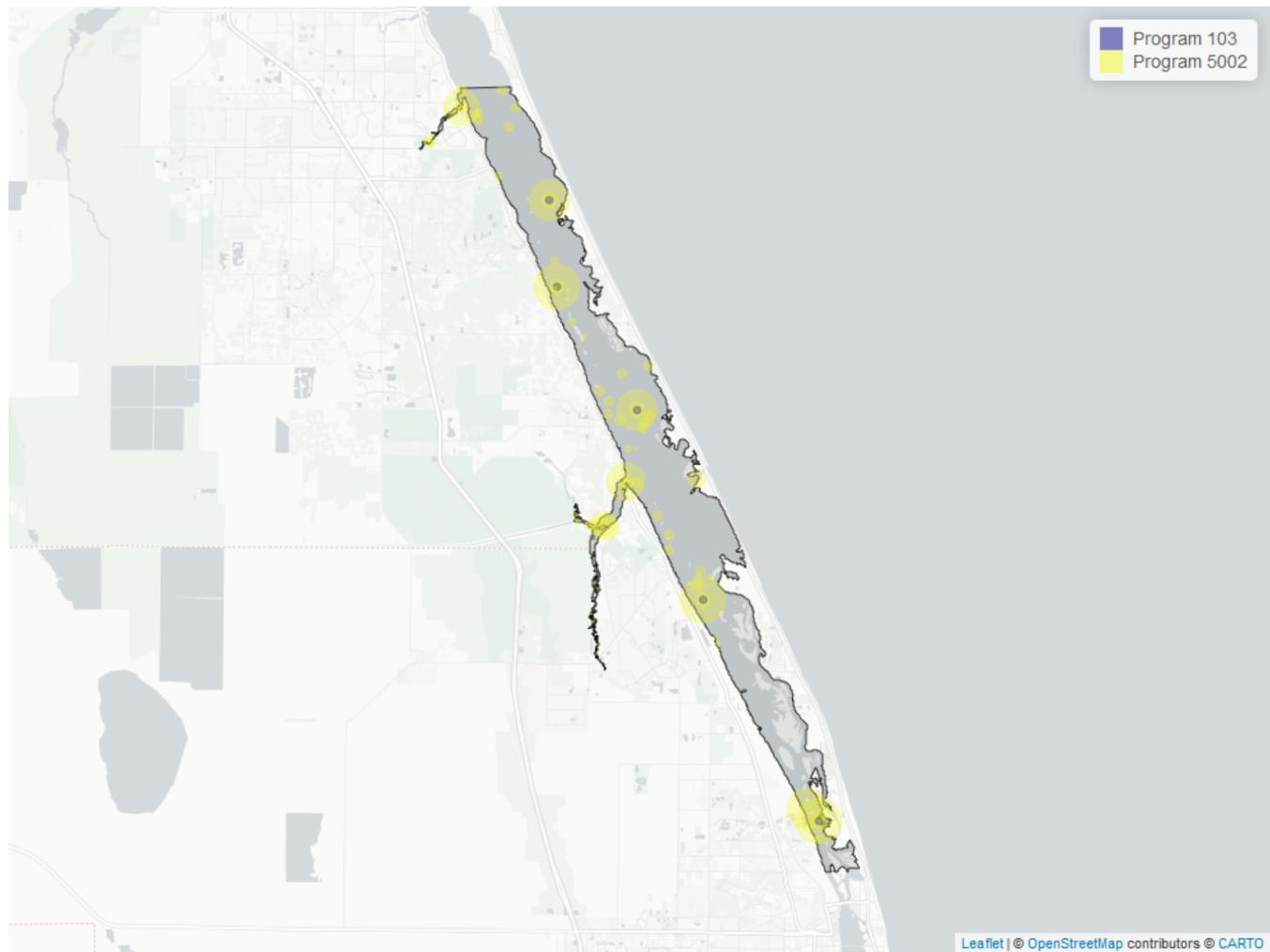
Total Suspended Solids, Lab and Field Combined, All Depths
Indian River-Malabar to Vero Beach Aquatic Preserve



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 Total Suspended Solids



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

Table 20: Programs contributing data for Total Suspended Solids

ProgramID	N_Data	YearMin	YearMax
5002	3246	1997	2024
103	41	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
- $N_{\text{Qualifier}}$ is the total amount of values flagged with the respective value qualifier in a given year
- $\text{perc}_{\text{Qualifier}}$ is the percent of data flagged with the respective value qualifier as a proportion of N_{Total}

Table 21: Value Qualifiers for Total Suspended Solids

Year	N_Total	N_I	perc_I	N_Q	perc_Q	N_U	perc_U
1997	87	47	54.0				
1998	205	153	74.6				
1999	151	23	15.2			2	1.3
2000	120					9	7.5
2001	172			22	12.8	6	3.5
2002	260	86	33.1	14	5.4	3	1.1
2003	176	82	46.6	18	10.2		
2004	252	139	55.2	5	2.0		
2005	198	103	52.0			1	0.5
2006	155	55	35.5	3	1.9		
2007	144	57	39.6				
2008	145	32	22.1			8	5.5
2009	140	24	17.1			2	1.4
2010	119	13	10.9				
2011	111	13	11.7	2	1.8		
2012	84	43	51.2				
2013	89	64	71.9				
2014	96	75	78.1	1	1.0		
2015	106	72	67.9	1	0.9	1	0.9
2016	106	54	50.9	3	2.8	1	0.9
2017	43	40	93.0				
2020	57	38	66.7	2	3.5	5	8.8
2021	140	66	47.1	11	7.9	12	8.6
2022	93	58	62.4			10	10.8
2023	35	19	54.3	4	11.4	3	8.6
2024	3	3	100.0				

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:

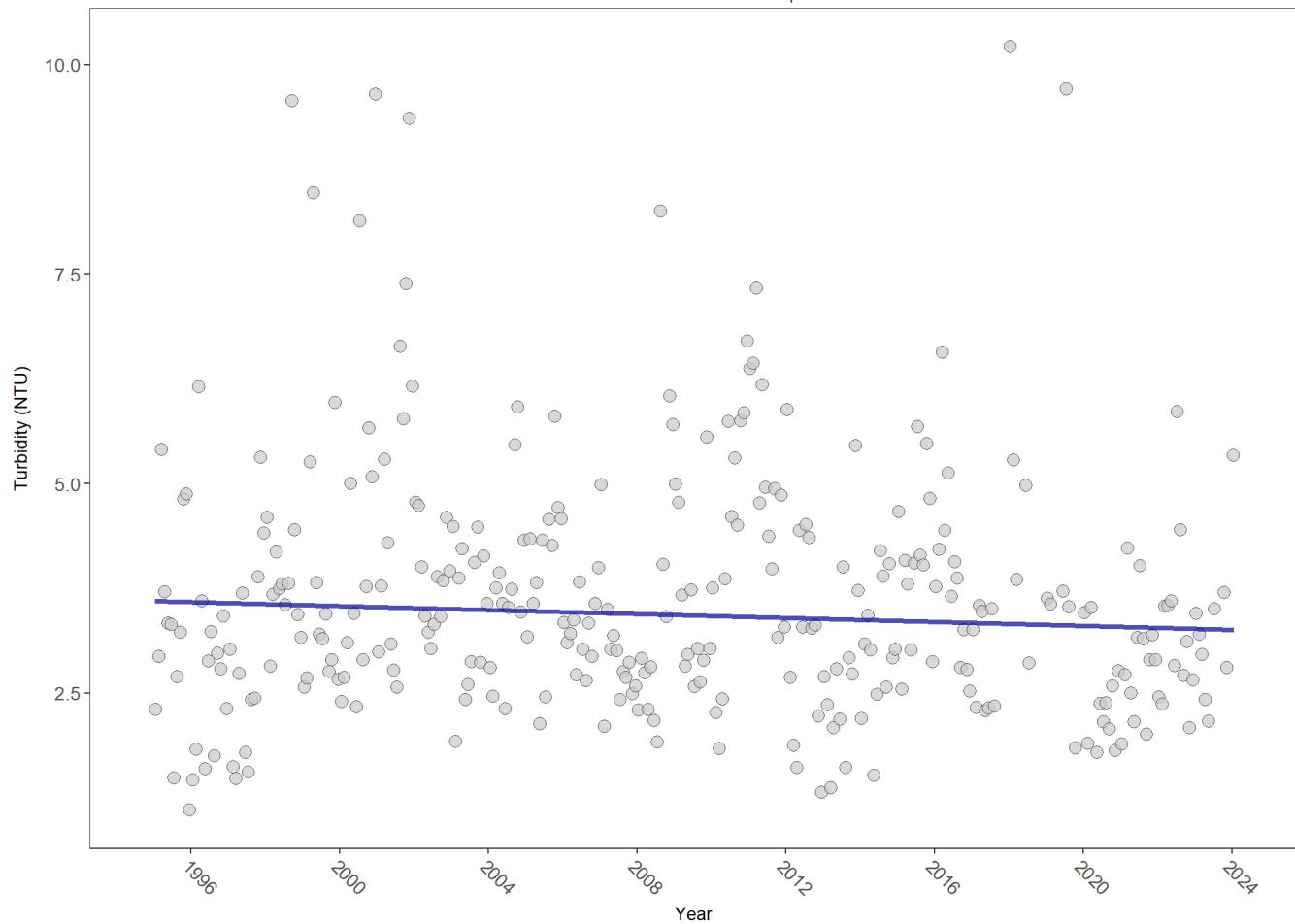
5002 - Florida STORET / WIN

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
Indian River-Malabar to Vero Beach Aquatic Preserve

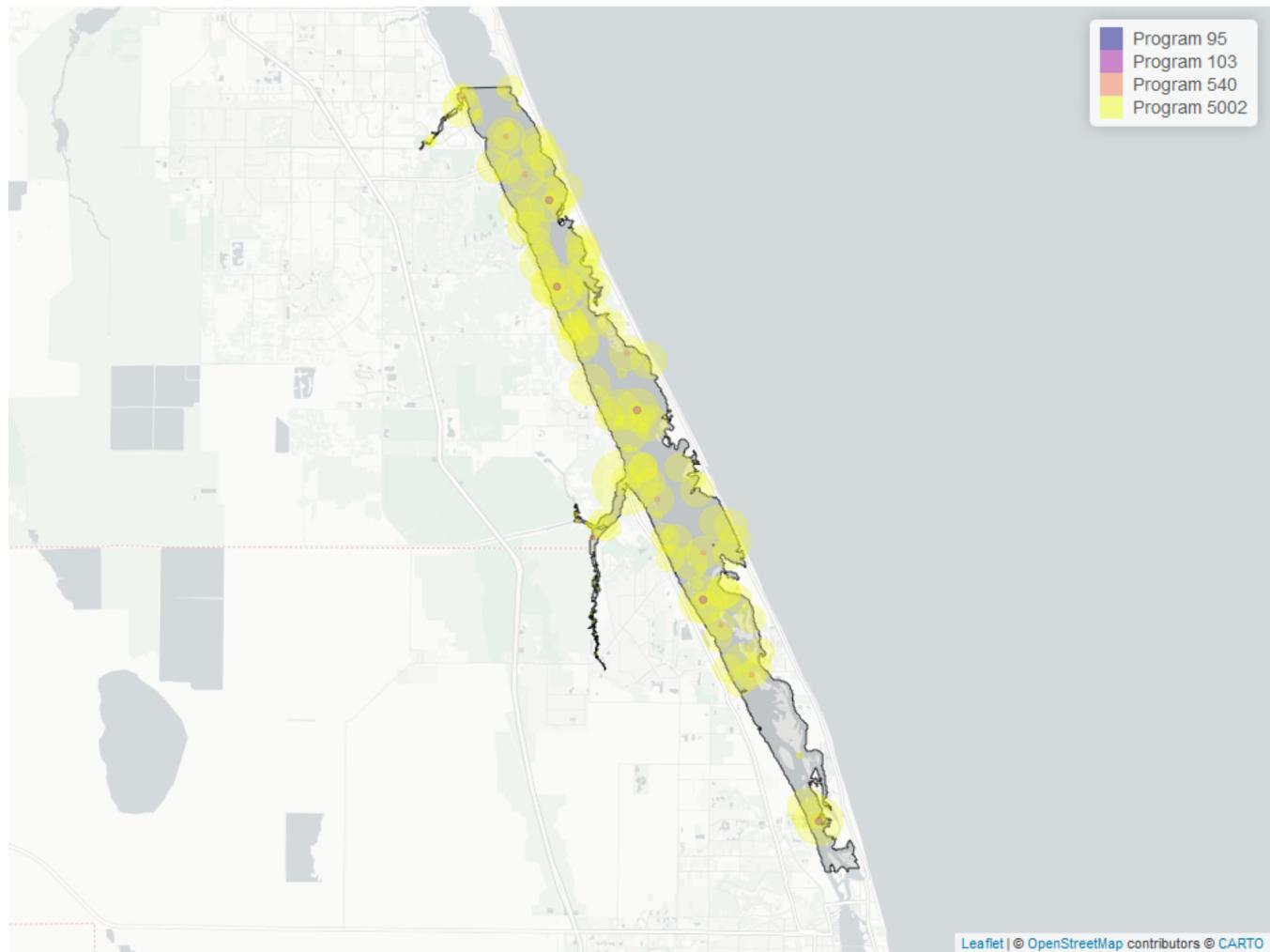


RelativeDepth	N_Data	N_Years	Median	Independent	tau	p	SennSlope	SennIntercept	ChiSquared	pChiSquared	Trend
All	15884	30	2.9	TRUE	-0.0641	0.1649	-0.01181786	3.600258	23.4213	0.0154	0

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 22: Programs contributing data for Turbidity

ProgramID	N_Data	YearMin	YearMax
5002	14908	1995	2024
3013	938	2004	2019
103	40	2020	2021
540	29	2019	2020
95	1	2008	2008

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

Table 23: Value Qualifiers for Turbidity

Year	N_{Total}	N_I	perc_I	N_Q	perc_Q	N_U	perc_U
1998	1131	21	1.9				
1999	877	7	0.8				
2001	976			18	1.8		
2002	907	25	2.8	2	0.2		
2003	725	27	3.7				
2004	870	32	3.7				
2005	739	28	3.8	3	0.4		
2006	637	17	2.7	3	0.5		
2007	660	58	8.8	4	0.6		
2008	652	30	4.6	7	1.1		
2009	632	6	0.9	10	1.6		
2012	264	20	7.6	8	3.0		
2013	150	26	17.3	3	2.0		
2014	163	31	19.0	1	0.6		
2015	189	7	3.7	9	4.8		
2016	186	22	11.8				
2017	88	5	5.7	2	2.3		
2020	84	18	21.4			1	1.2
2021	138	20	14.5	4	2.9	1	0.7
2022	93	15	16.1				
2023	35	9	25.7				

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

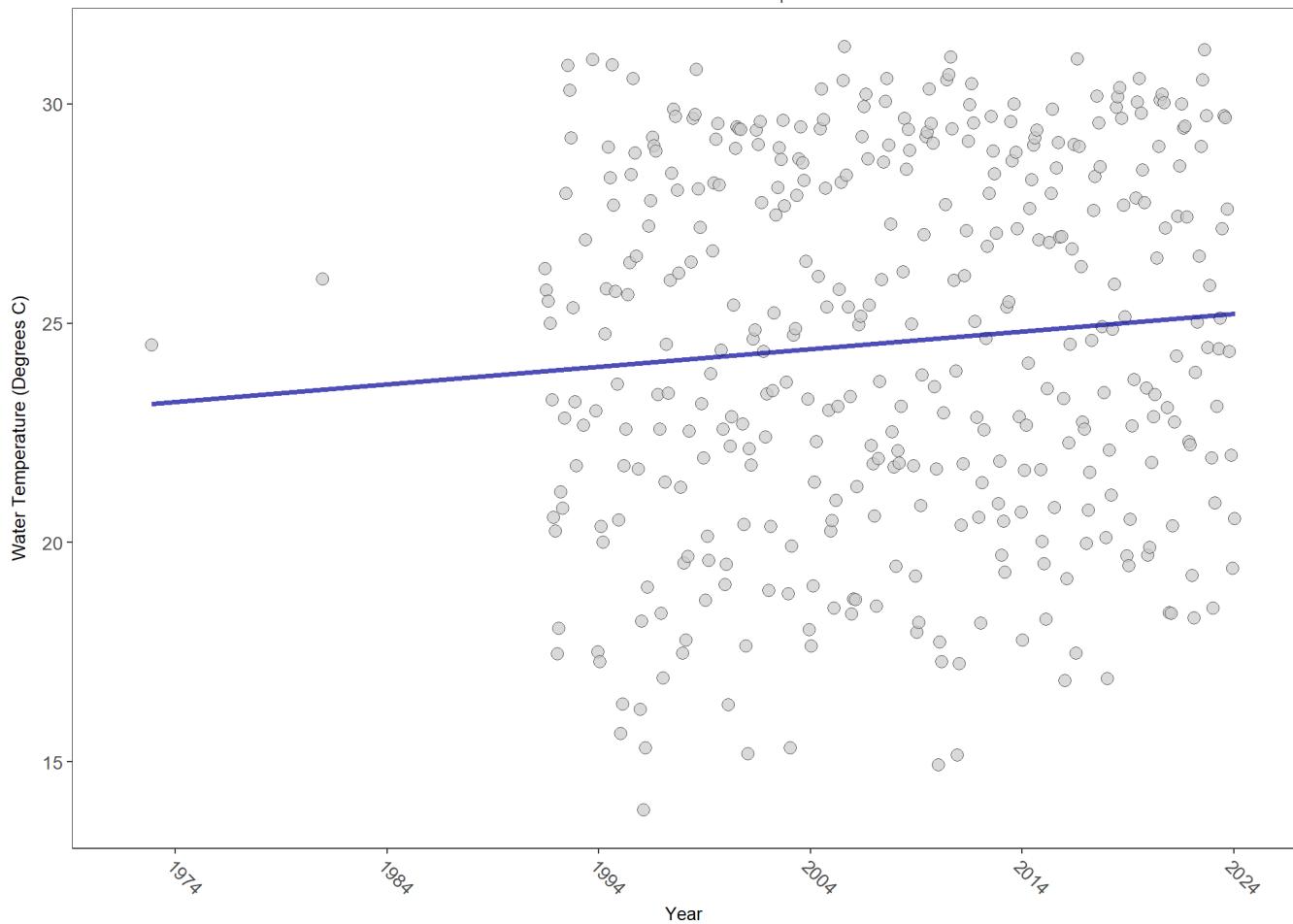
540 - Shellfish Harvest Area Classification Program

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
Indian River-Malabar to Vero Beach Aquatic Preserve

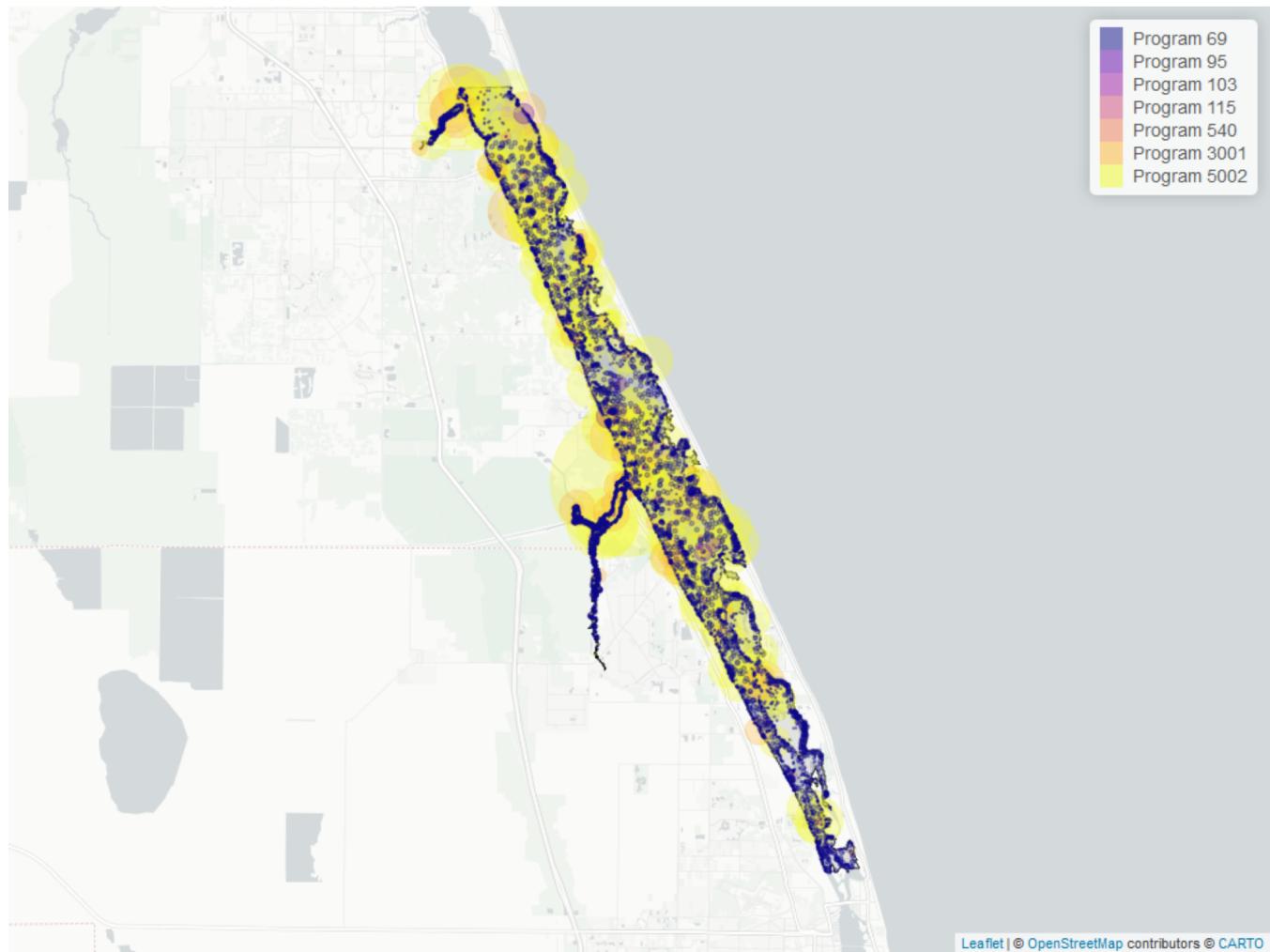


RelativeDepth	N_Data	N_Years	Median	Independent	tau	p	SennSlope	SennIntercept	ChiSquared	pChiSquared	Trend
All	58759	36	25.5	TRUE	0.2092	0.0000	0.03993498	23.13436	4.6567	0.9466	1

$p < 0.00005$ 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 24: Programs contributing data for Water Temperature

ProgramID	N_Data	YearMin	YearMax
5002	32677	1991	2024
69	19435	1991	2022
3001	6298	1991	2023
3013	1115	2003	2023
95	502	1972	2018
540	127	2016	2020
103	62	2004	2021
115	25	1994	1995

Program names:

5002 - Florida STORET / WIN

69 - Fisheries-Independent Monitoring (FIM) Program

3001 - Lagoon Watch (Formerly Marine Discovery Center)

3013 - Seagrass (SJRWMD)

95 - Harmful Algal Bloom Marine Observation Network

540 - Shellfish Harvest Area Classification Program

103 - EPA STOrage and RETrieval Data Warehouse (STORET)

115 - Environmental Monitoring Assessment Program

There are no qualifying Value Qualifiers for Water Temperature in Indian River-Malabar to Vero Beach Aquatic Preserve

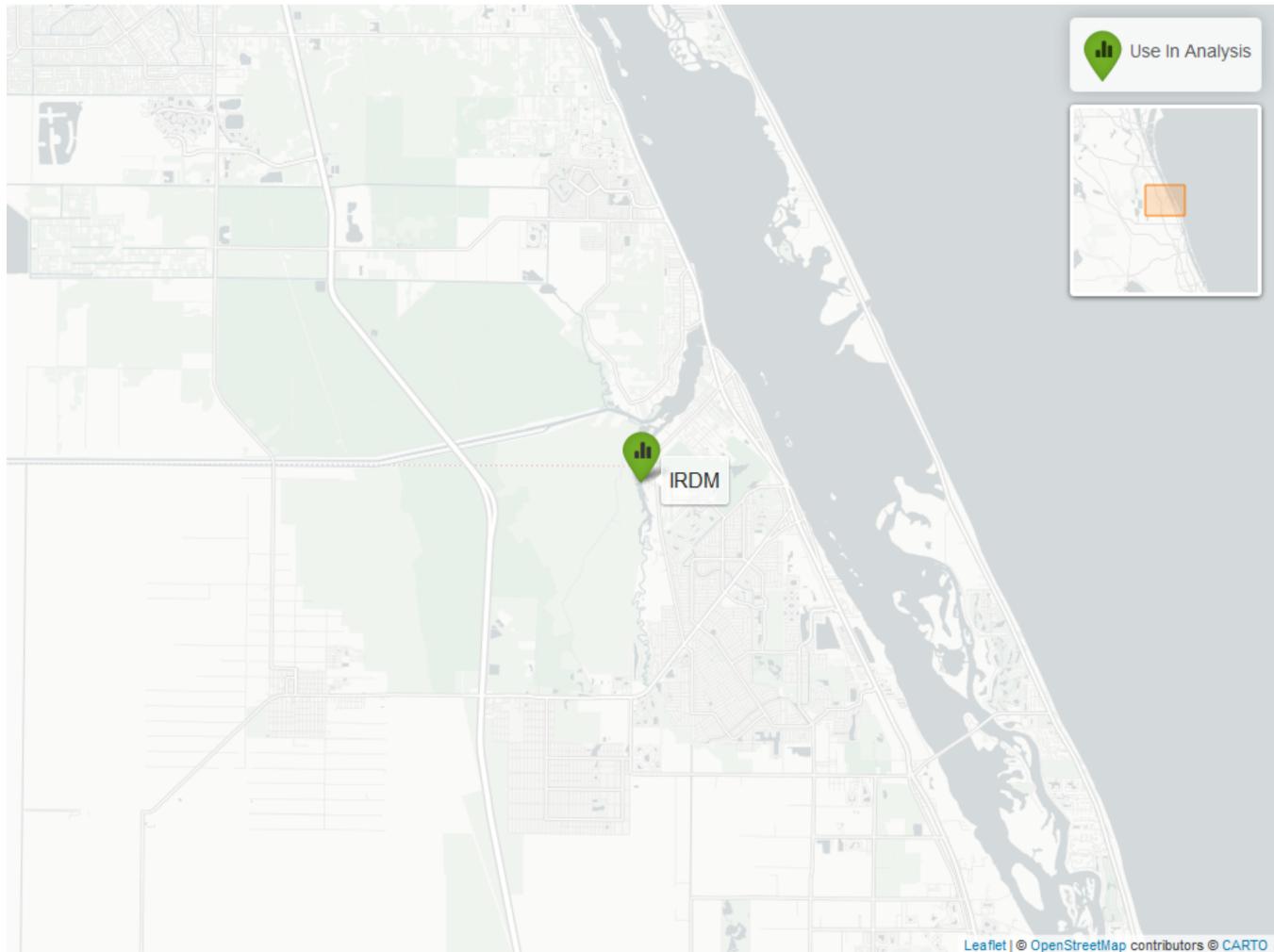
Water Quality - Continuous

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 25: Indian River Lagoon Aquatic Preserves Continuous Water Quality Monitoring (5005)

<i>Program</i>	<i>LocationID</i>	<i>Years of Data</i>	<i>Use in Analysis</i>	<i>Parameters</i>
IRDM		5	TRUE	DO , DOS , pH , Sal , Turb , TempW



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

Dissolved Oxygen - Continuous Water Quality

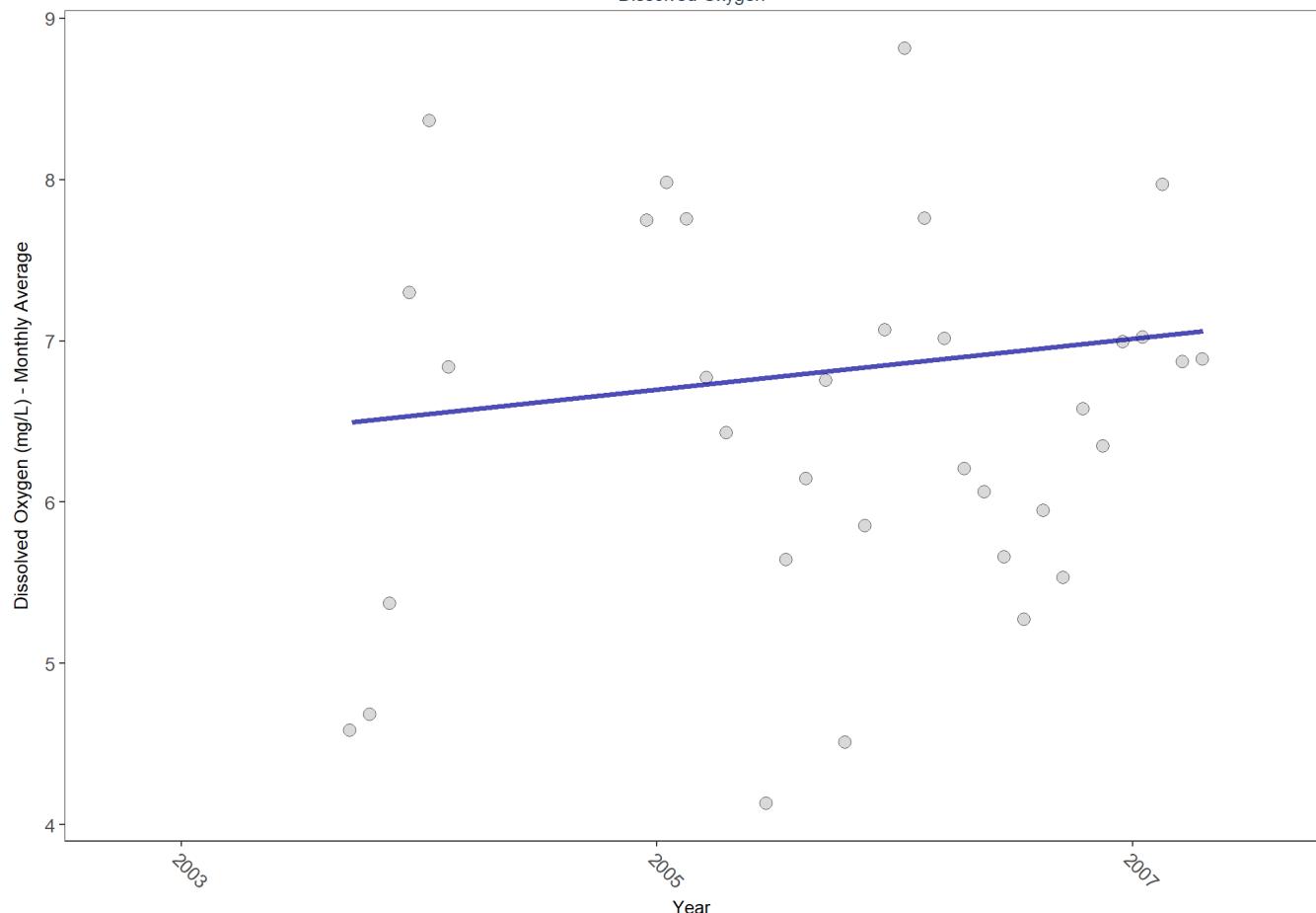
IRDM

Indian River Lagoon Aquatic Preserves Continuous Water Quality Monitoring (5005)

Indian River-Malabar to Vero Beach Aquatic Preserve

IRDM

Dissolved Oxygen



RelativeDepth	N_Data	N_Years	Median	Independent	tau	p	SennSlope	SennIntercept	ChiSquared	pChiSquared	Trend
bottom	39746	5	6.5	TRUE	0.1515	0.4674	0.1586875	6.380433	12.3659	0.2613	0

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

SennIntercept is intercept value at beginning of record for monitoring location

Dissolved Oxygen Saturation - Continuous Water Quality

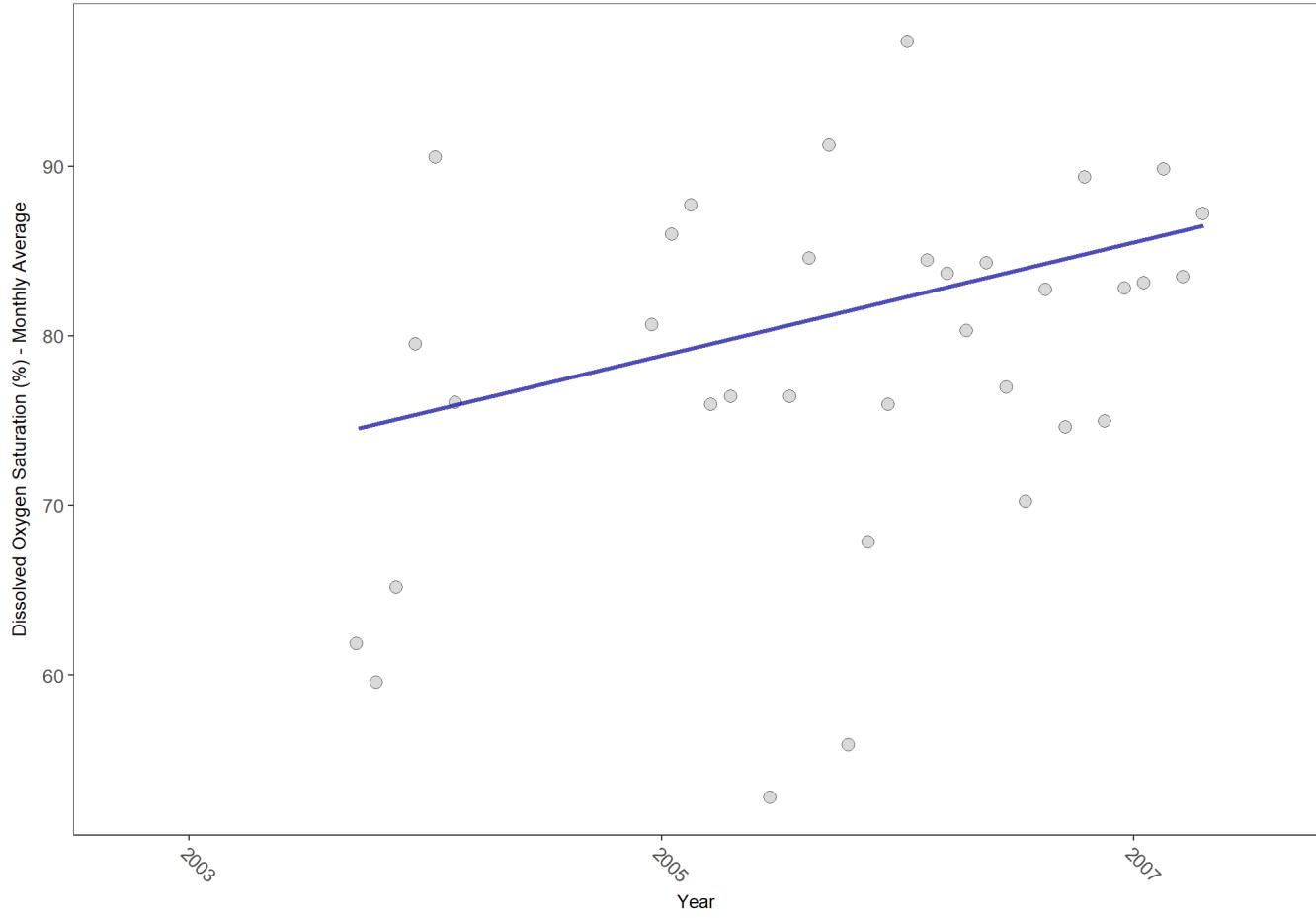
IRDM

Indian River Lagoon Aquatic Preserves Continuous Water Quality Monitoring (5005)

Indian River-Malabar to Vero Beach Aquatic Preserve

IRDM

Dissolved Oxygen Saturation



RelativeDepth	N_Data	N_Years	Median	Independent	tau	p	SennSlope	SennIntercept	ChiSquared	pChiSquared	Trend
bottom	39746	5	77.7	TRUE	0.2929	0.1099	3.336711	72.16269	9.17	0.5161	0

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

SennIntercept is intercept value at beginning of record for monitoring location

pH - Continuous Water Quality

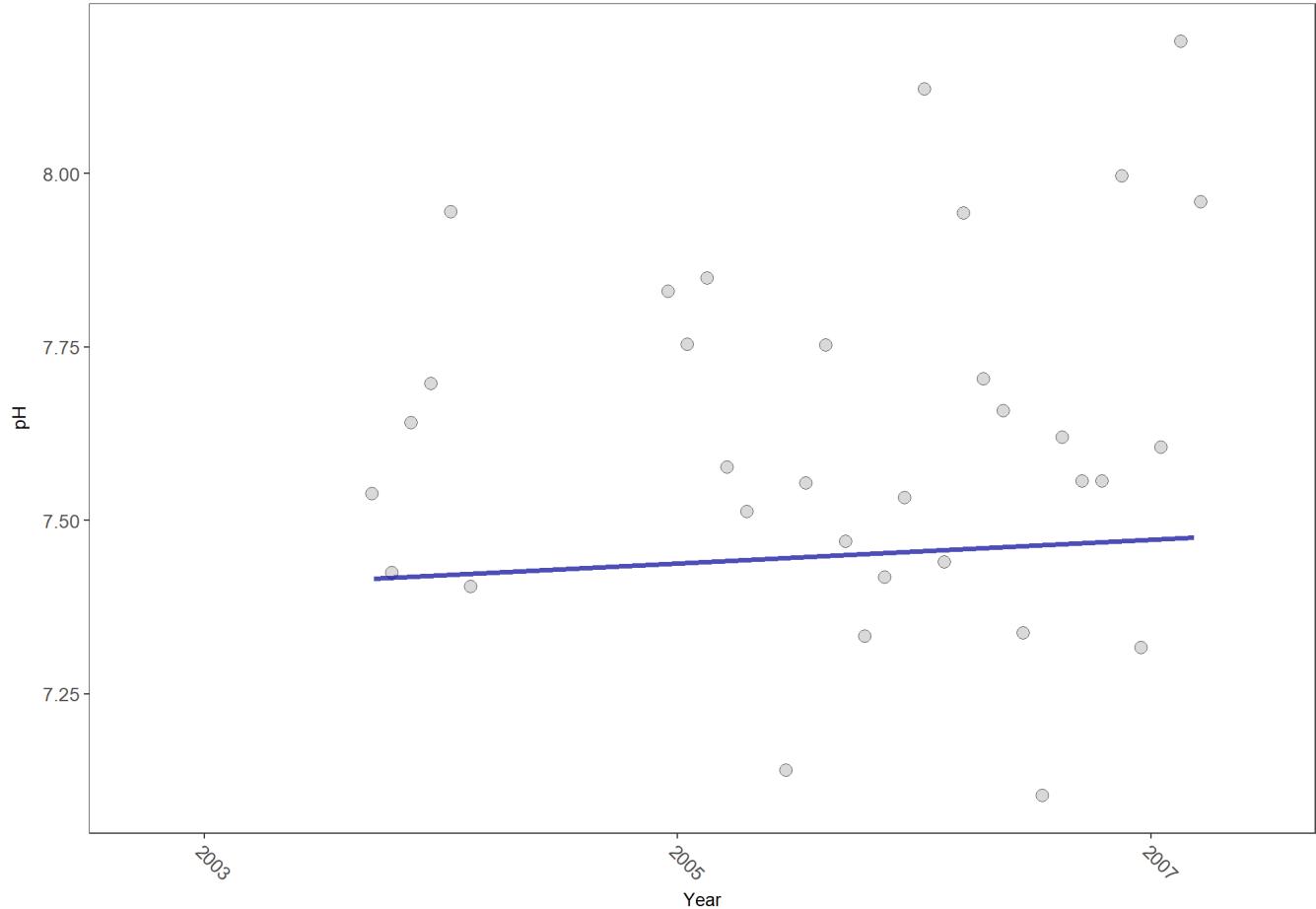
IRDM

Indian River Lagoon Aquatic Preserves Continuous Water Quality Monitoring (5005)

Indian River-Malabar to Vero Beach Aquatic Preserve

IRDM

pH



RelativeDepth	N_Data	N_Years	Median	Independent	tau	p	SennSlope	SennIntercept	ChiSquared	pChiSquared	Trend
bottom	38184	5	7.6	TRUE	0.1458	0.6535	0.01711302	7.403957	10.8791	0.367	0

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

SennIntercept is intercept value at beginning of record for monitoring location

Salinity - Continuous Water Quality

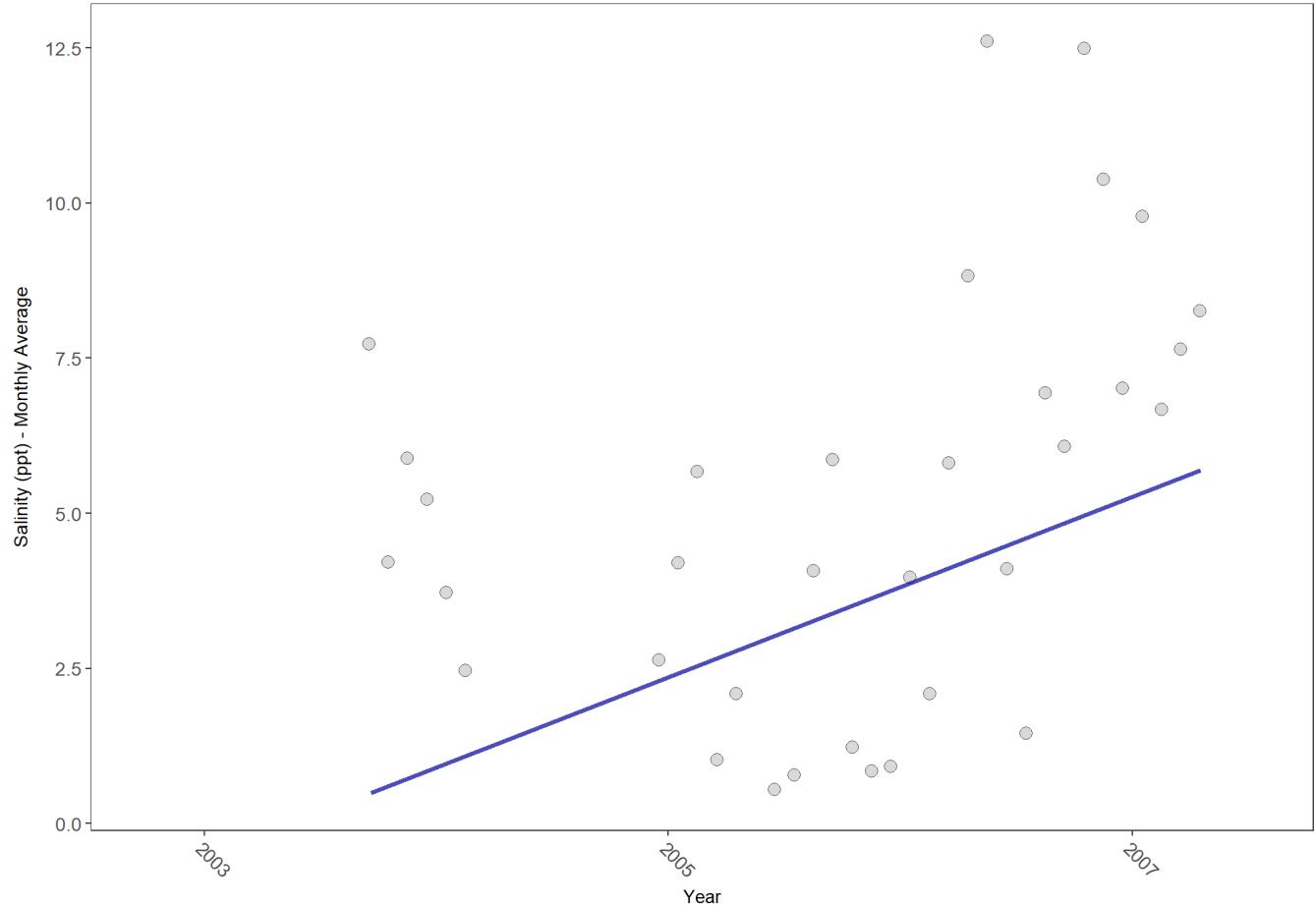
IRDM

Indian River Lagoon Aquatic Preserves Continuous Water Quality Monitoring (5005)

Indian River-Malabar to Vero Beach Aquatic Preserve

IRDM

Salinity



RelativeDepth	N_Data	N_Years	Median	Independent	tau	p	SennSlope	SennIntercept	ChiSquared	pChiSquared	Trend
bottom	43791	5	3.9	TRUE	0.4545	0.0588	1.452301	-0.5491935	3.5339	0.9659	0

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

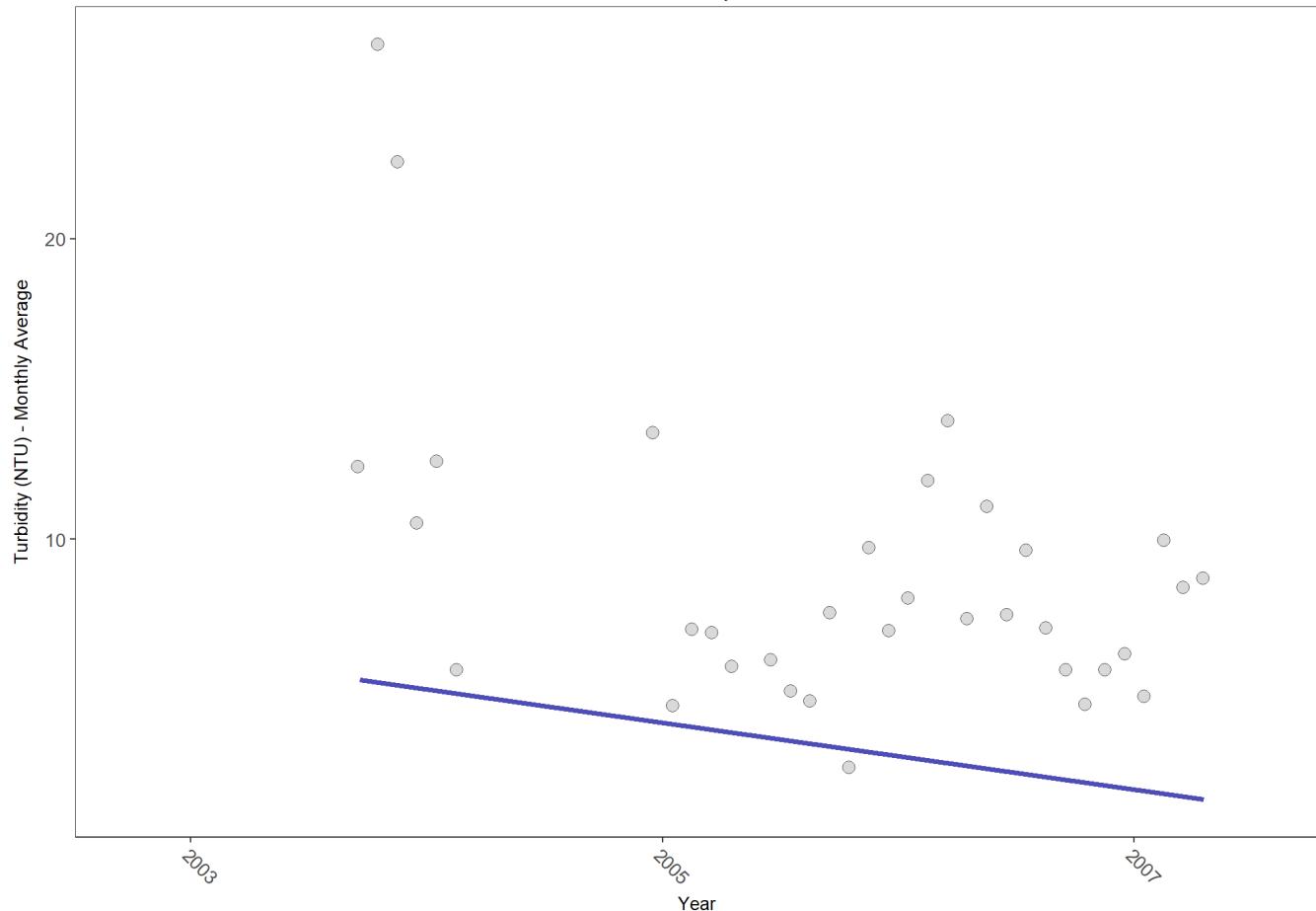
SennIntercept is intercept value at beginning of record for monitoring location

Turbidity - Continuous Water Quality

IRDM

Indian River Lagoon Aquatic Preserves Continuous Water Quality Monitoring (5005)

Indian River-Malabar to Vero Beach Aquatic Preserve
IRDM
Turbidity



RelativeDepth	N_Data	N_Years	Median	Independent	tau	p	SennSlope	SennIntercept	ChiSquared	pChiSquared	Trend
bottom	39124	5	5	TRUE	0.0505	0.8844	-1.112982	6.134734	15.0113	0.1317	0

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

SennIntercept is intercept value at beginning of record for monitoring location

Water Temperature - Continuous Water Quality

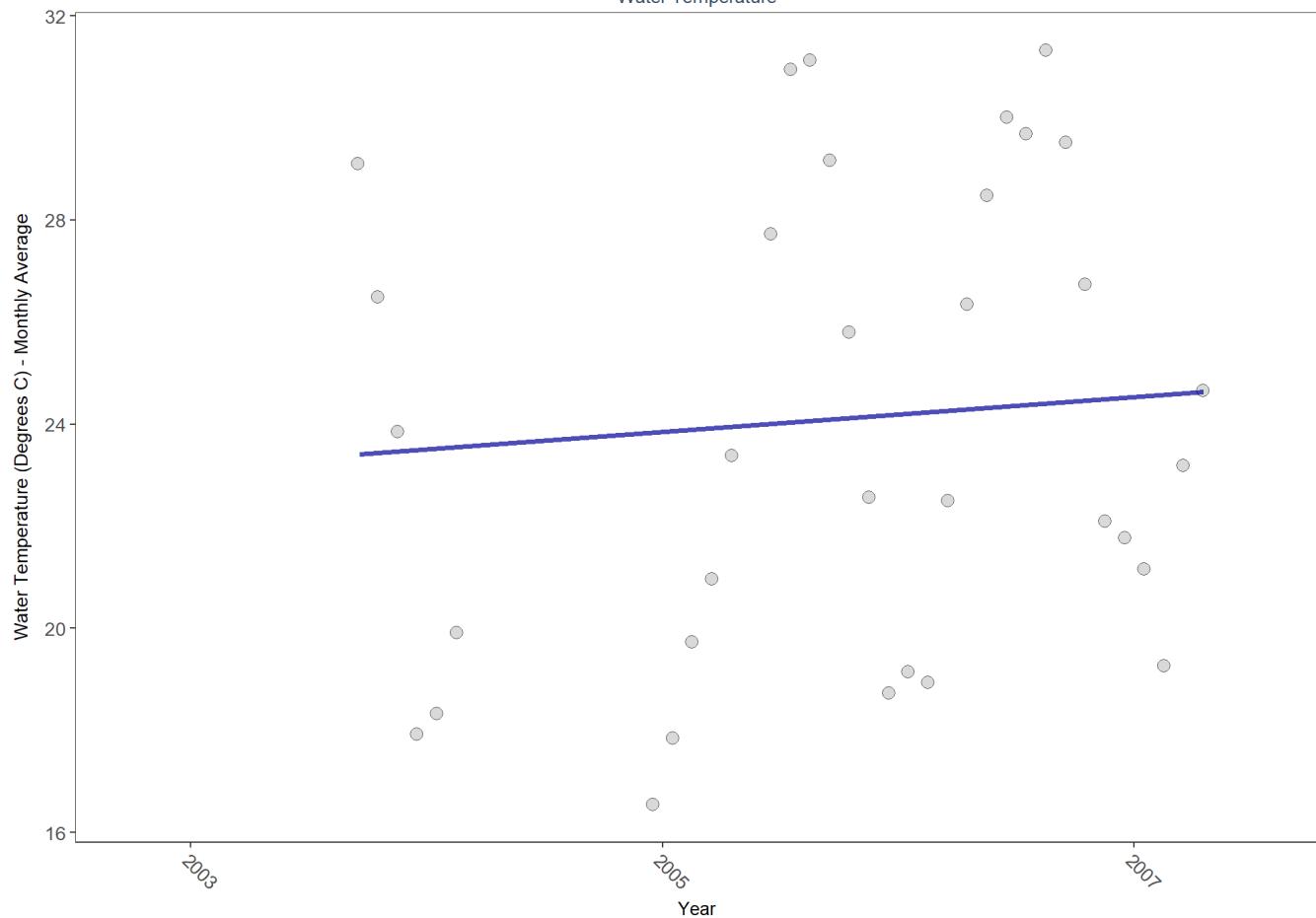
IRDM

Indian River Lagoon Aquatic Preserves Continuous Water Quality Monitoring (5005)

Indian River-Malabar to Vero Beach Aquatic Preserve

IRDM

Water Temperature



RelativeDepth	N_Data	N_Years	Median	Independent	tau	p	SennSlope	SennIntercept	ChiSquared	pChiSquared	Trend
bottom	43791	5	23.5	TRUE	0.2929	0.1908	0.3408025	23.16665	14.2021	0.164	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

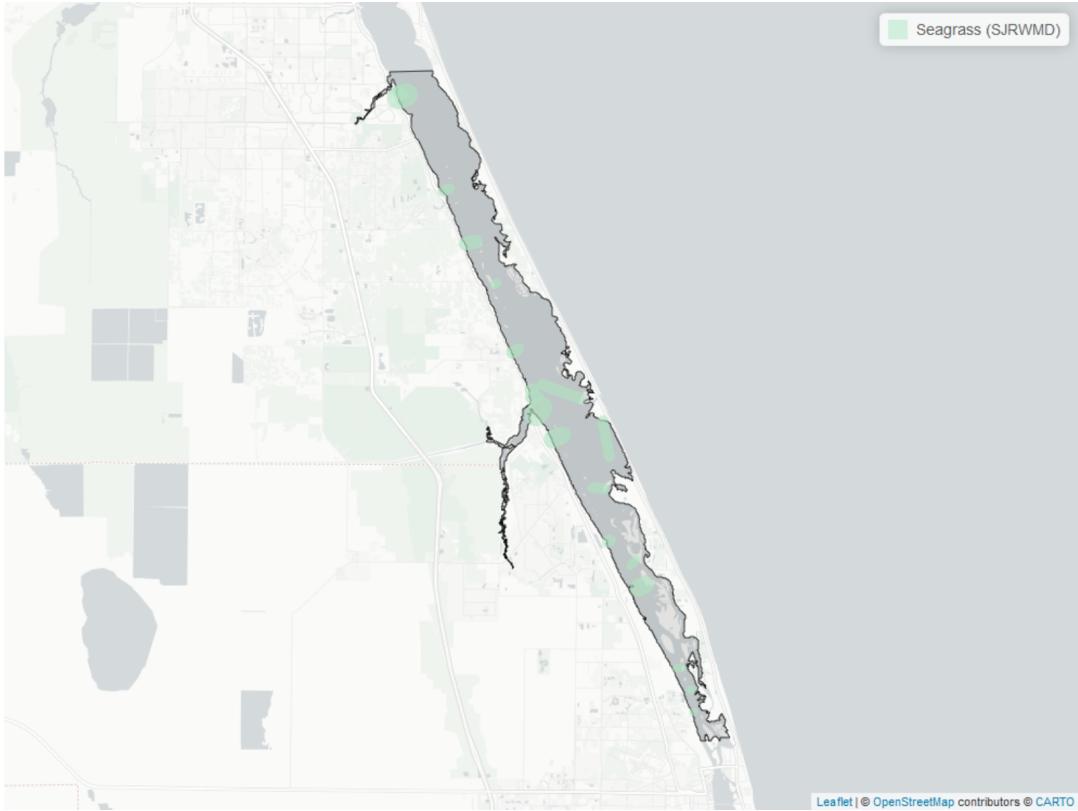
Indian River-Malabar to Vero Beach Aquatic Preserve
SAV Percent Cover - Sample Locations



Program name
Seagrass (SJRWMD)

Maps showing the temporal scope of SAV sampling sites within the boundaries of *Indian River-Malabar to Vero Beach Aquatic Preserve* by Program name.

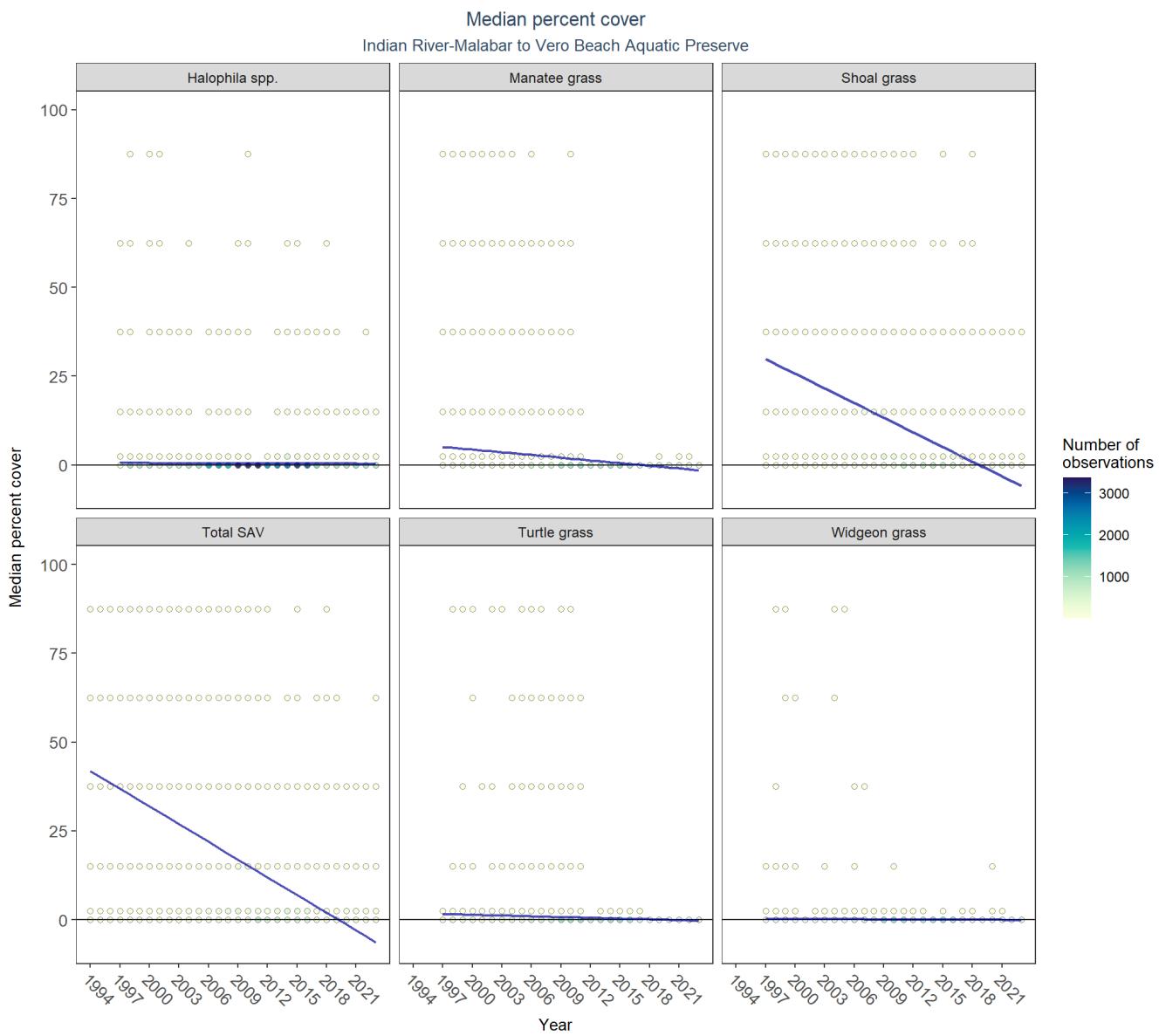
Sampling locations by Program:



Map showing SAV sampling sites within the boundaries of *Indian River-Malabar to Vero Beach Aquatic Preserve*. The point size reflects the number of samples at a given sampling site.

Table 26: Seagrass (SJRWM) - Program 3013

<i>N_Data</i>	<i>YearMin</i>	<i>YearMax</i>	<i>Collection Method</i>	<i>Sample Locations</i>
123999	1994	2023	Percent Cover	19
146527	1994	2023	Percent Occurrence	19



Median percent cover by species in *Indian River-Malabar to Vero Beach 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.

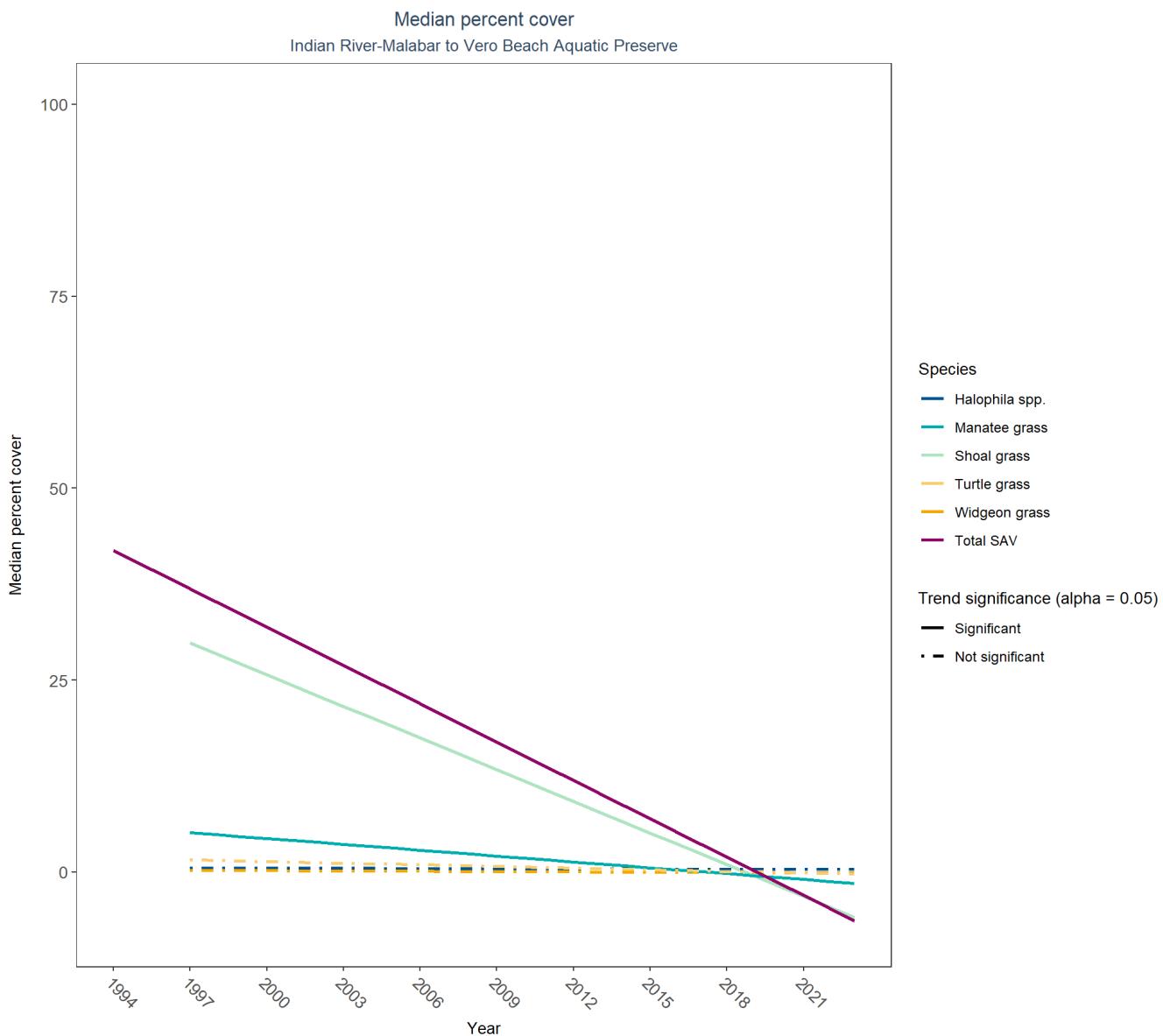
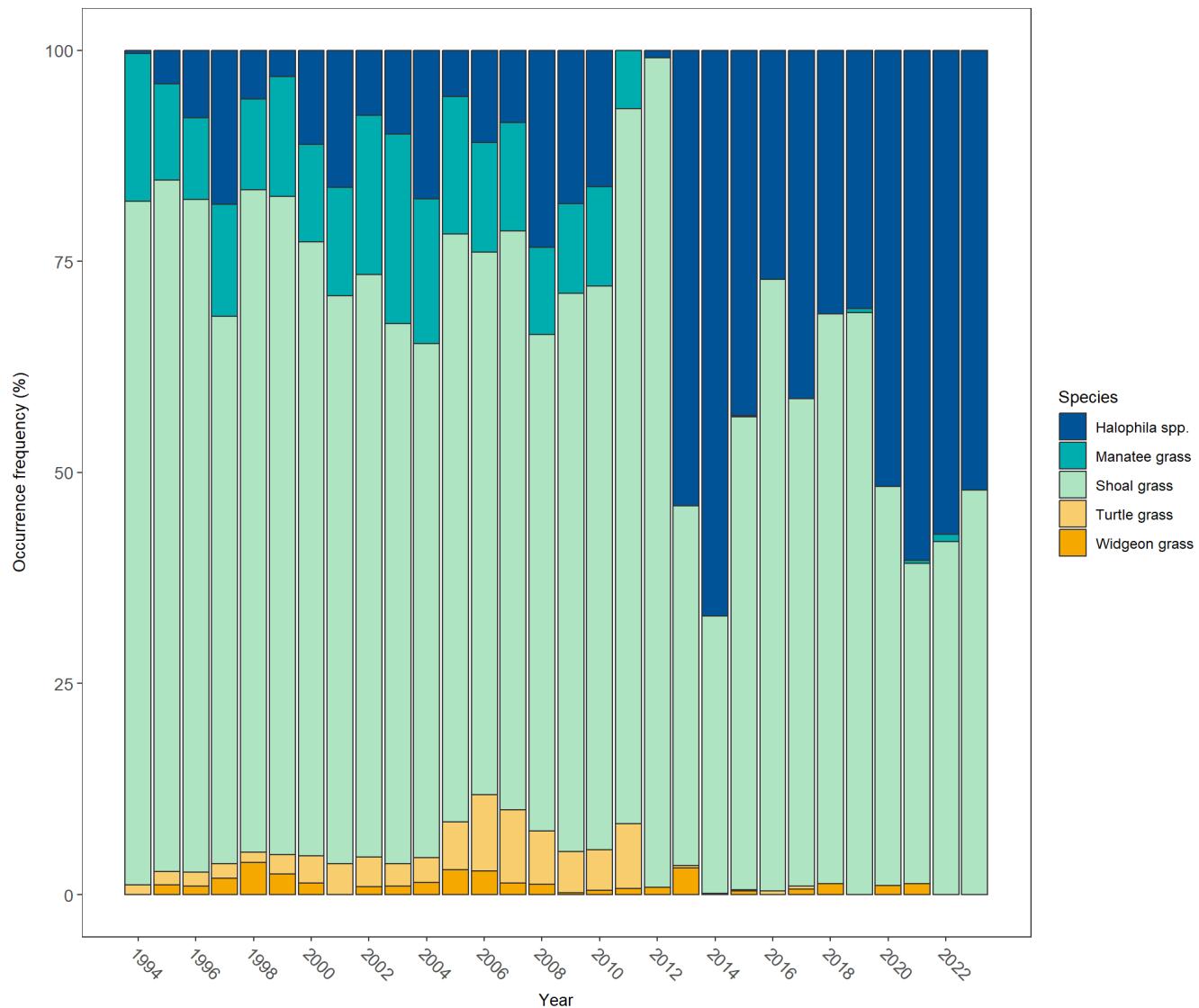


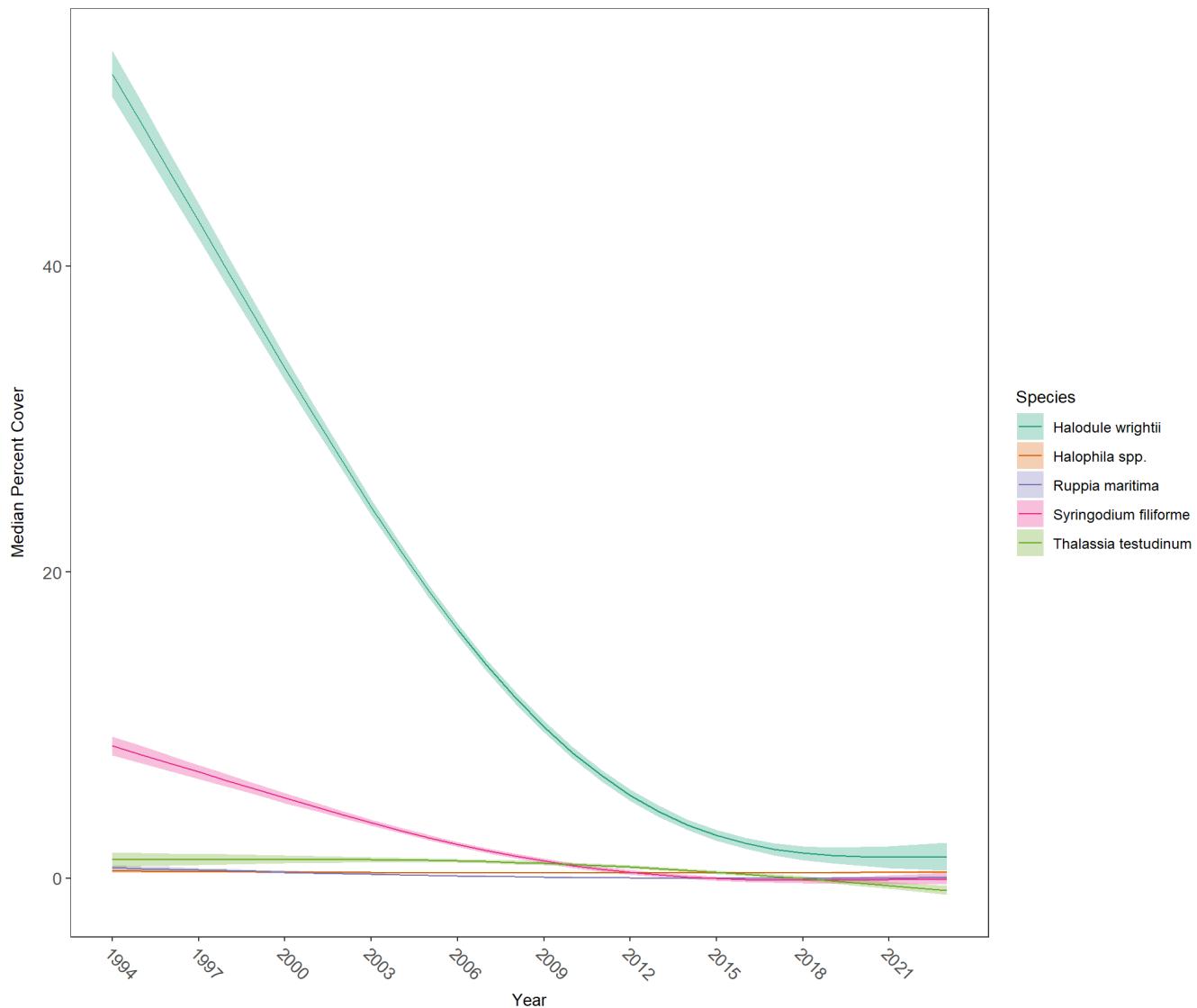
Table 27: Percent Cover Trend Analysis for Indian River-Malabar to Vero Beach Aquatic Preserve

Species	CommonName	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	33.9584	-1.3749	0.0000
Halophila spp.		No significant trend	1997 - 2023	0.5667	-0.0076	0.3586
Ruppia maritima	Widgeon grass	No significant trend	1997 - 2023	0.2582	-0.0123	0.1028
Syringodium filiforme	Manatee grass	Significantly decreasing trend	1997 - 2023	5.9004	-0.2544	0.0045
Thalassia testudinum	Turtle grass	No significant trend	1997 - 2023	1.8113	-0.0715	0.0979
Total SAV		Significantly decreasing trend	1994 - 2023	41.8892	-1.6639	0.0000
Total seagrass		Insufficient data to calculate trend				

Frequency of occurrence
Indian River-Malabar to Vero Beach Aquatic Preserve



Median Percent Cover for seagrass species
Indian River-Malabar to Vero Beach Aquatic Preserve



Generalized additive models for each species in Indian River-Malabar to Vero Beach 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.