

# Biscayne Bay 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

<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 <sub>2</sub> +3 Filtered	mg/L	0	-
NH <sub>4</sub> 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

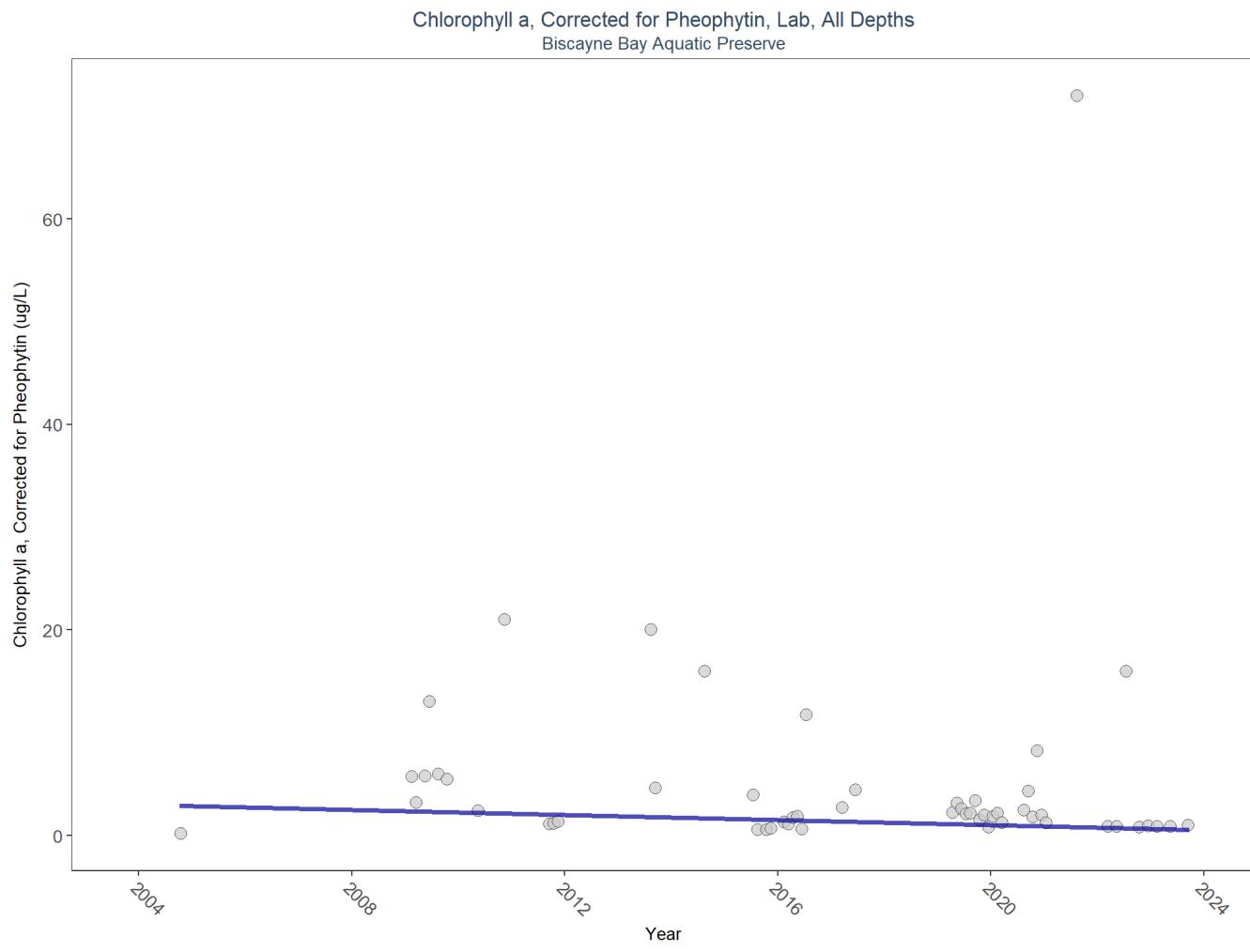
The following files were used in the discrete analysis:

- *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.

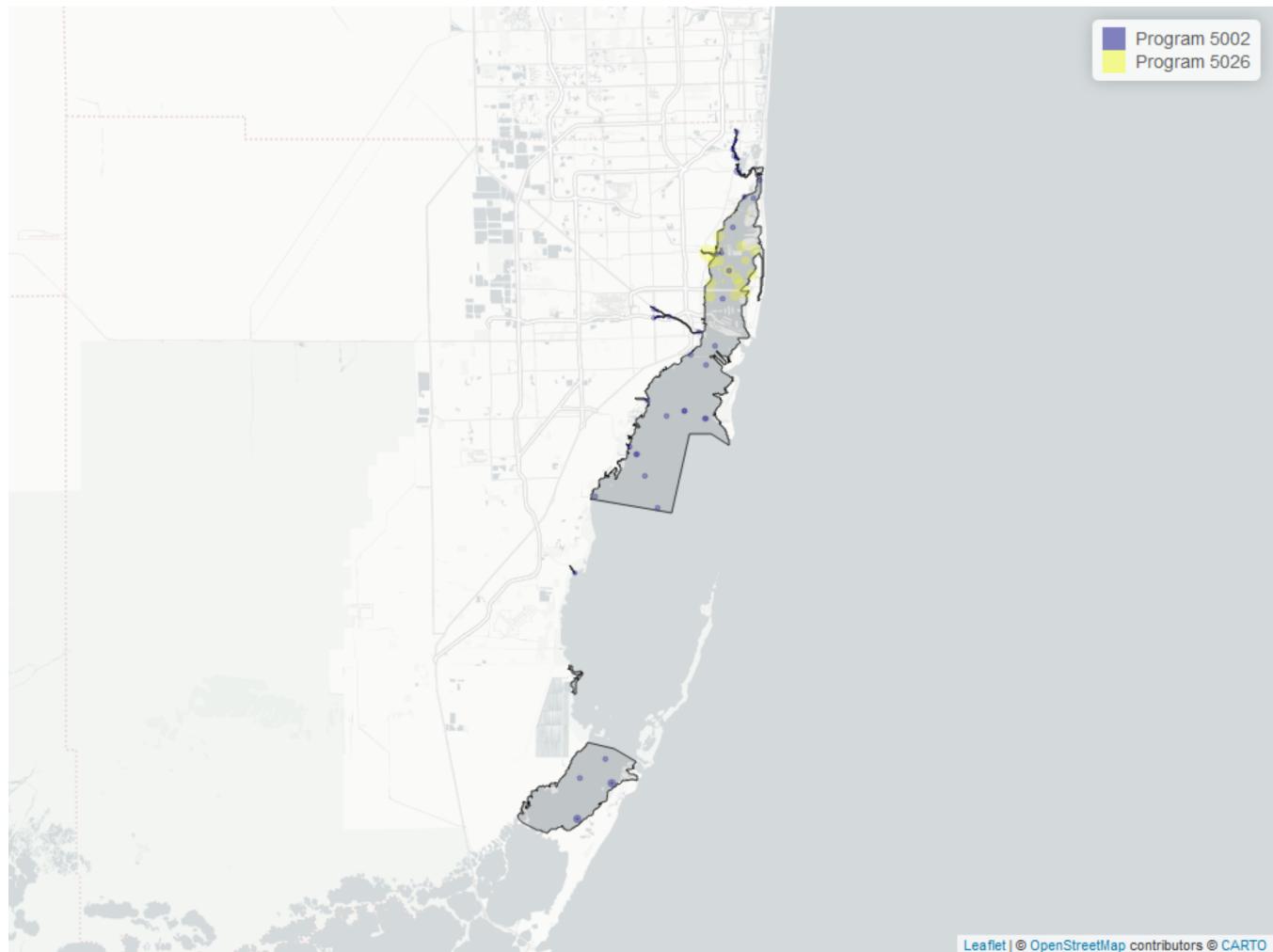
### Seasonal Kendall-Tau Trend Analysis



*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
5026	287	2019	2021
5002	163	2004	2023

#### Program names:

5026 - North Biscayne Bay Seagrass Loss Water Quality Program

5002 - Florida STORET / WIN

#### 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 Pheo-phytin

<i>Year</i>	<i>N_Total</i>	<i>N_I</i>	<i>perc_I</i>	<i>N_U</i>	<i>perc_U</i>
2004	1			1	100.0
2009	34	5	14.7		
2011	72	24	33.3		
2015	9	3	33.3	3	33.3
2016	13	6	46.1	2	15.4
2017	8	2	25.0		
2020	117	1	0.8		
2022	9	2	22.2	6	66.7
2023	6			6	100.0

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

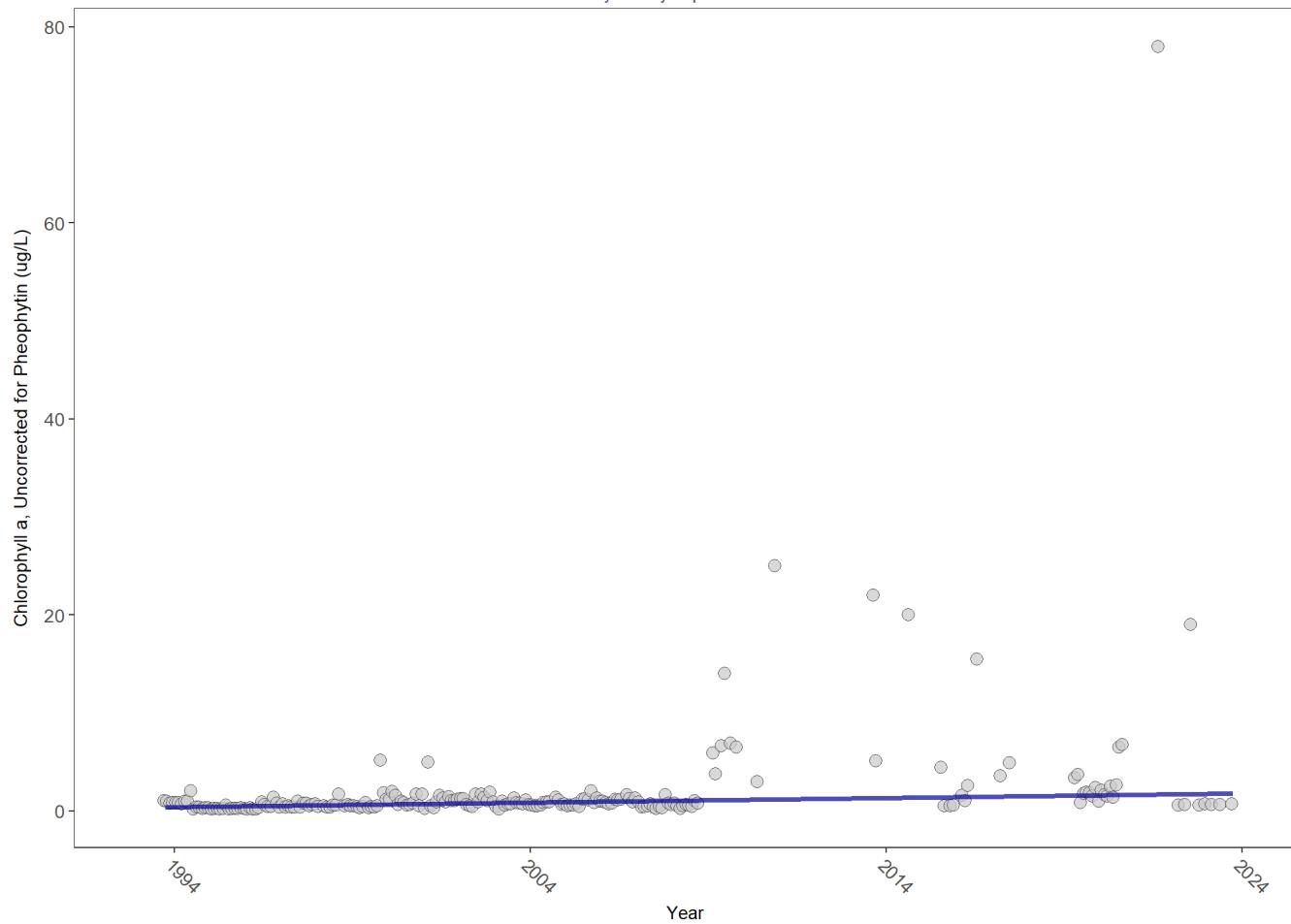
**Programs containing Value Qualified data:**

5002 - Florida STORET / WIN

# Chlorophyll a, Uncorrected for Pheophytin - Discrete Water Quality

## Seasonal Kendall-Tau Trend Analysis

Chlorophyll a, Uncorrected for Pheophytin, Lab, All Depths  
Biscayne Bay Aquatic Preserve

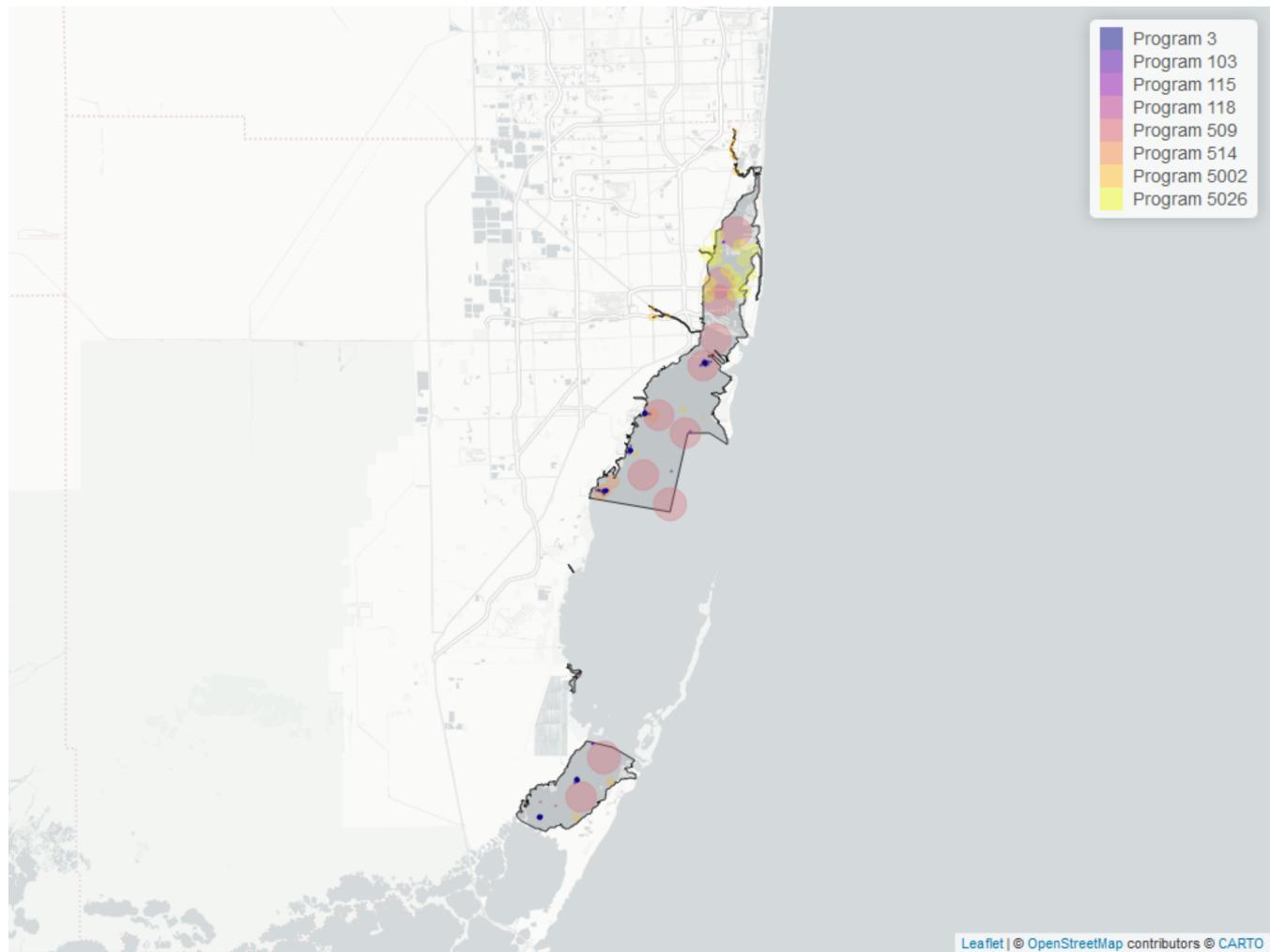


RelativeDepth	N_Data	N_Years	Median	Independent	tau	p	SennSlope	SennIntercept	ChiSquared	pChiSquared	Trend
All	2229	28	0.6591	TRUE	0.3765	0.0000	0.04698206	0.3386111	7.1623	0.7858	1

*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
509	1636	1993	2008
5026	410	2019	2020
3	384	2002	2012
514	92	2000	2005
5002	82	2001	2023
103	7	2002	2006
118	6	2006	2010
115	1	2004	2004

**Program names:**

509 - SERC Water Quality Monitoring Network

5026 - North Biscayne Bay Seagrass Loss Water Quality Program

3 - Atlantic Oceanographic and Meteorological Laboratory (AOML) South Florida Program Synoptic Shipboard Surveys

514 - Florida LAKEWATCH Program

5002 - Florida STORET / WIN

103 - EPA STOrage and RETrieval Data Warehouse (STORET)

118 - National Aquatic Resource Surveys, National Coastal Condition Assessment

115 - Environmental Monitoring Assessment 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 9: Value Qualifiers for Chlorophyll a, Uncorrected for Pheo-phytin

Year	$N_{Total}$	$N_I$	$perc_I$	$N_U$	$perc_U$
2009	34	1	2.9		
2015	9	6	66.7		
2016	8			2	25.0
2017	8	1	12.5		
2022	9	2	22.2	6	66.7
2023	6			6	100.0

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

### Programs containing Value Qualified data:

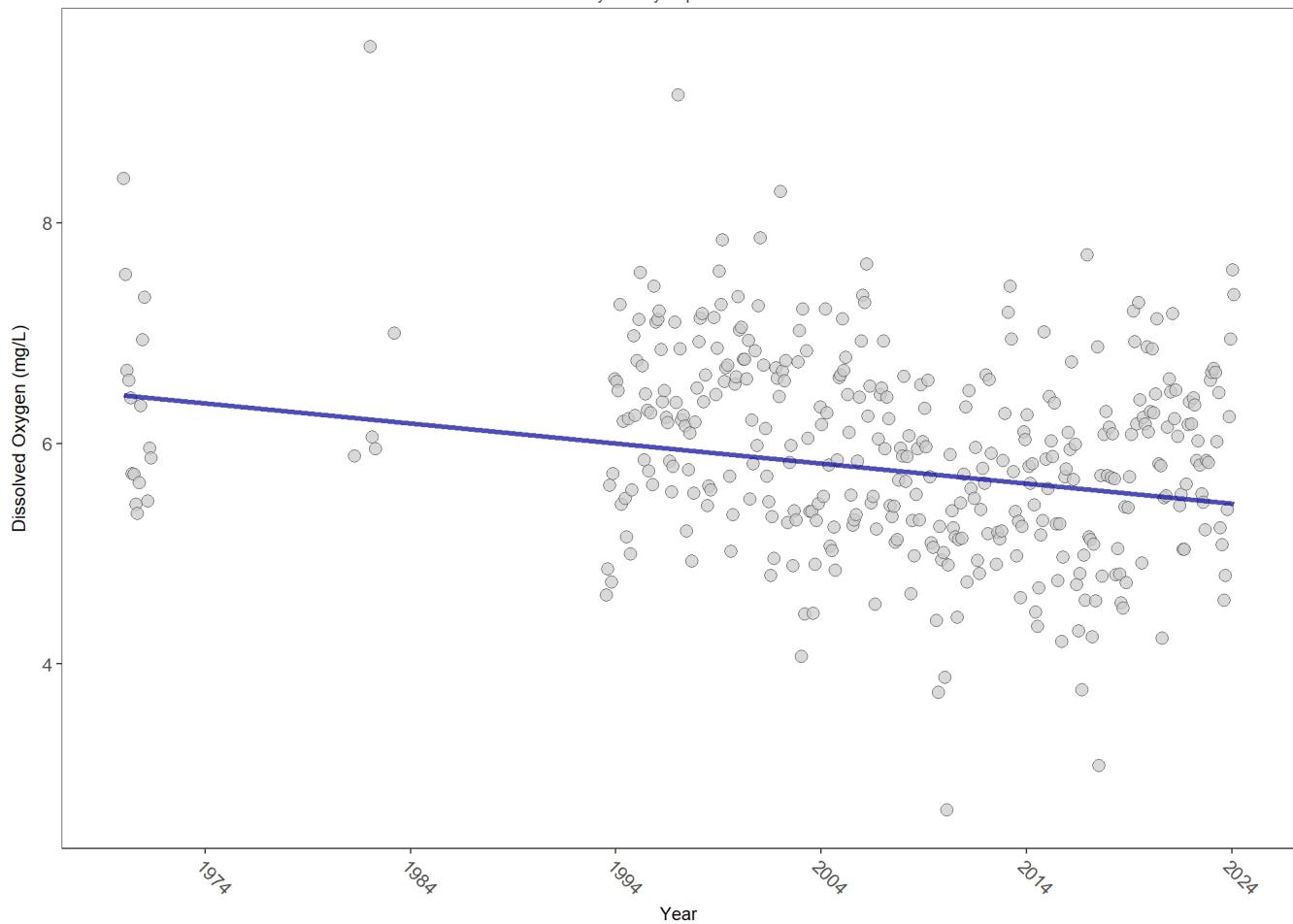
5002 - Florida STORET / WIN

## 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  
Biscayne Bay Aquatic Preserve



RelativeDepth	N_Data	N_Years	Median	Independent	tau	p	SennSlope	SennIntercept	ChiSquared	pChiSquared	Trend
All	17587	37	6.01	TRUE	-0.2259	0.0000	-0.01807487	6.433833	3.8483	0.9741	-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

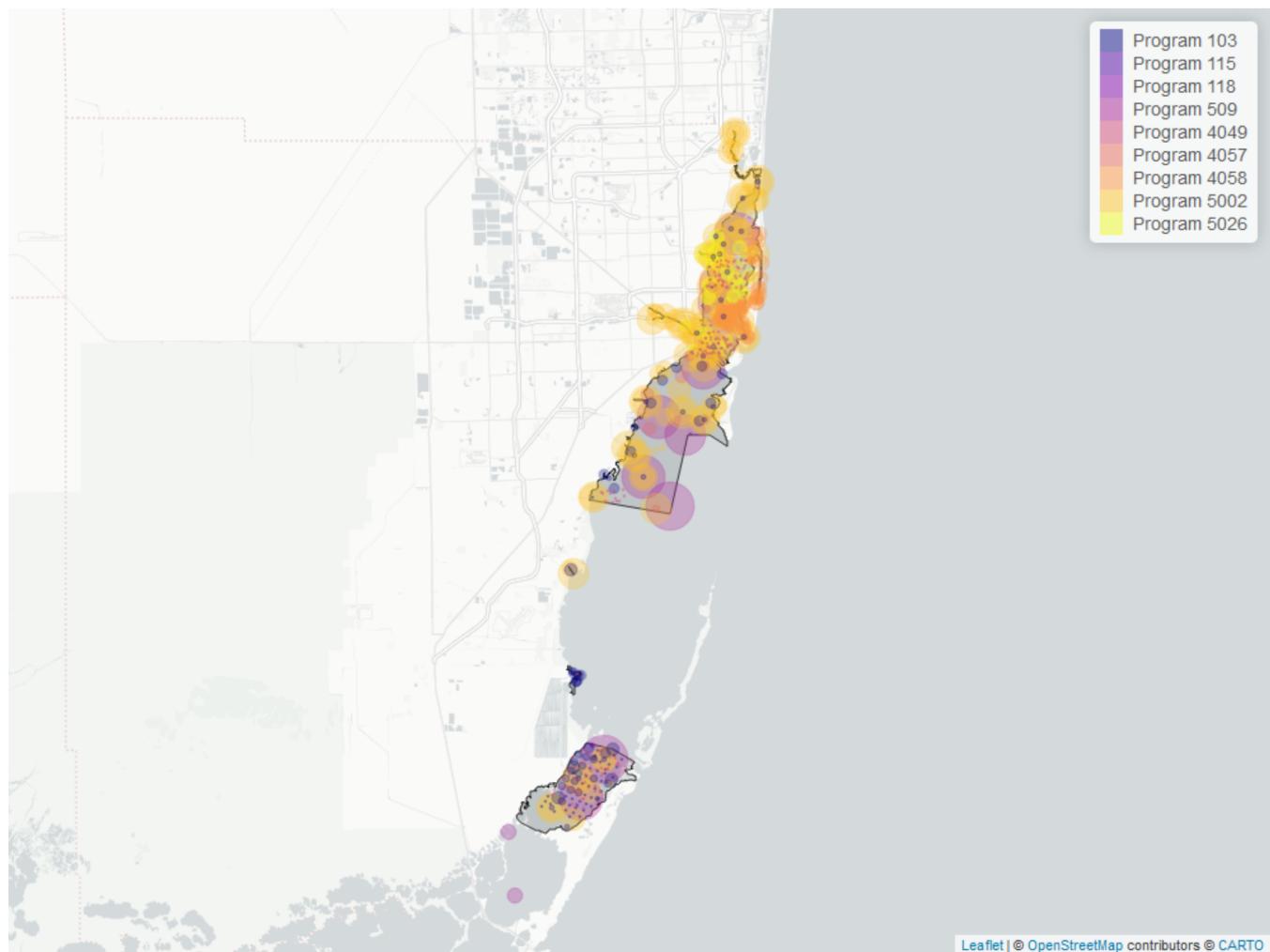


Table 10: Programs contributing data for Dissolved Oxygen

ProgramID	N_Data	YearMin	YearMax
5002	10048	2001	2023
509	3316	1993	2008
4058	2269	2016	2023
5026	1135	2019	2024
103	775	1970	2020
4049	192	2006	2008
4057	166	2015	2019
115	3	2004	2004
118	2	2006	2006

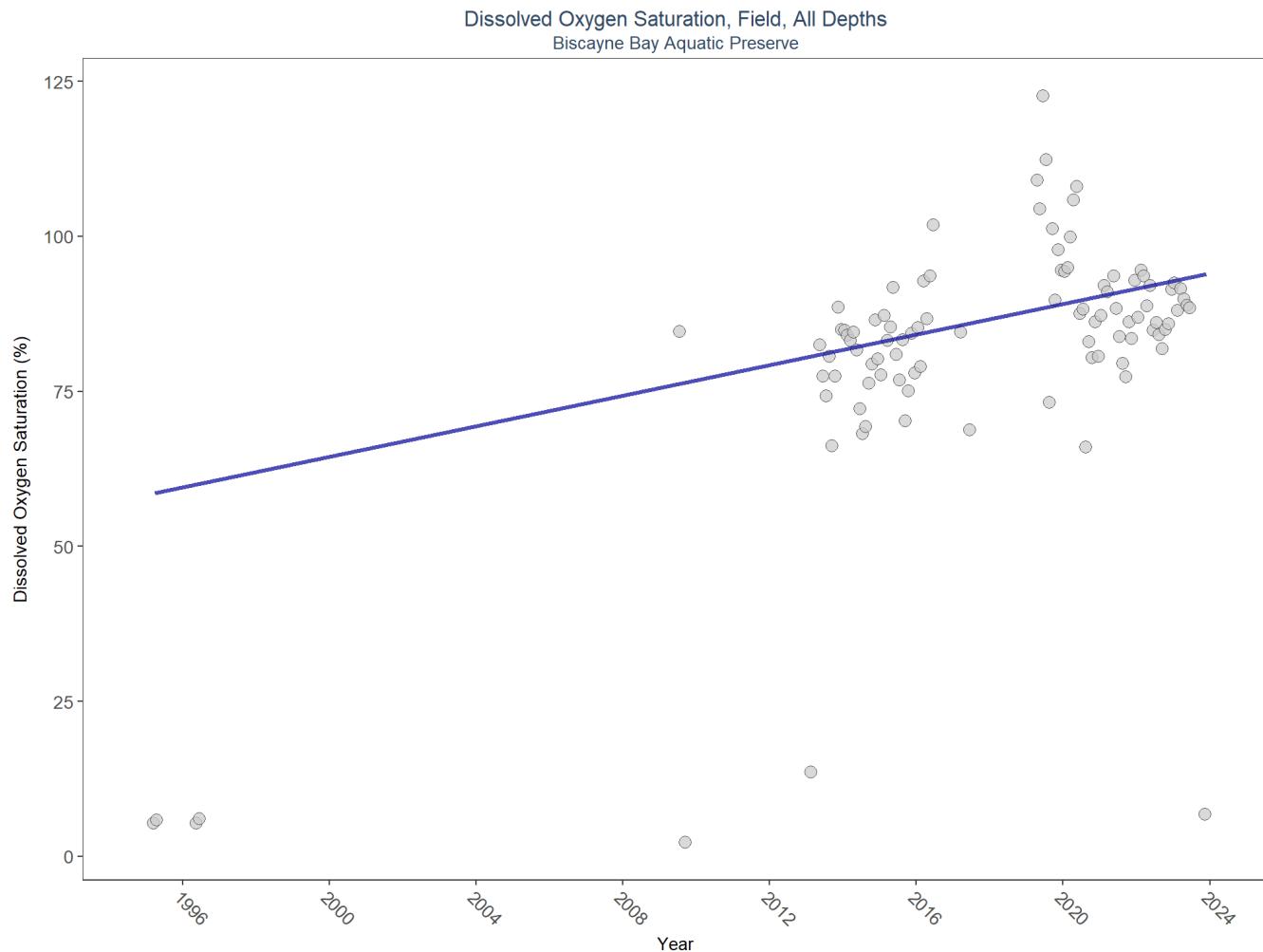
**Program names:**

5002 - Florida STORET / WIN  
 509 - SERC Water Quality Monitoring Network  
 4058 - City of Miami Beach Water Monitoring  
 5026 - North Biscayne Bay Seagrass Loss Water Quality Program  
 103 - EPA STOrage and RETrieval Data Warehouse (STORET)  
 4049 - The South Florida Fisheries Habitat Assessment Program (FHAP)  
 4057 - Biscayne Bay Water Watch  
 115 - Environmental Monitoring Assessment Program  
 118 - National Aquatic Resource Surveys, National Coastal Condition Assessment

There are no qualifying Value Qualifiers for Dissolved Oxygen in Biscayne Bay Aquatic Preserve

## Dissolved Oxygen Saturation - Discrete Water Quality

### Seasonal Kendall-Tau Trend Analysis

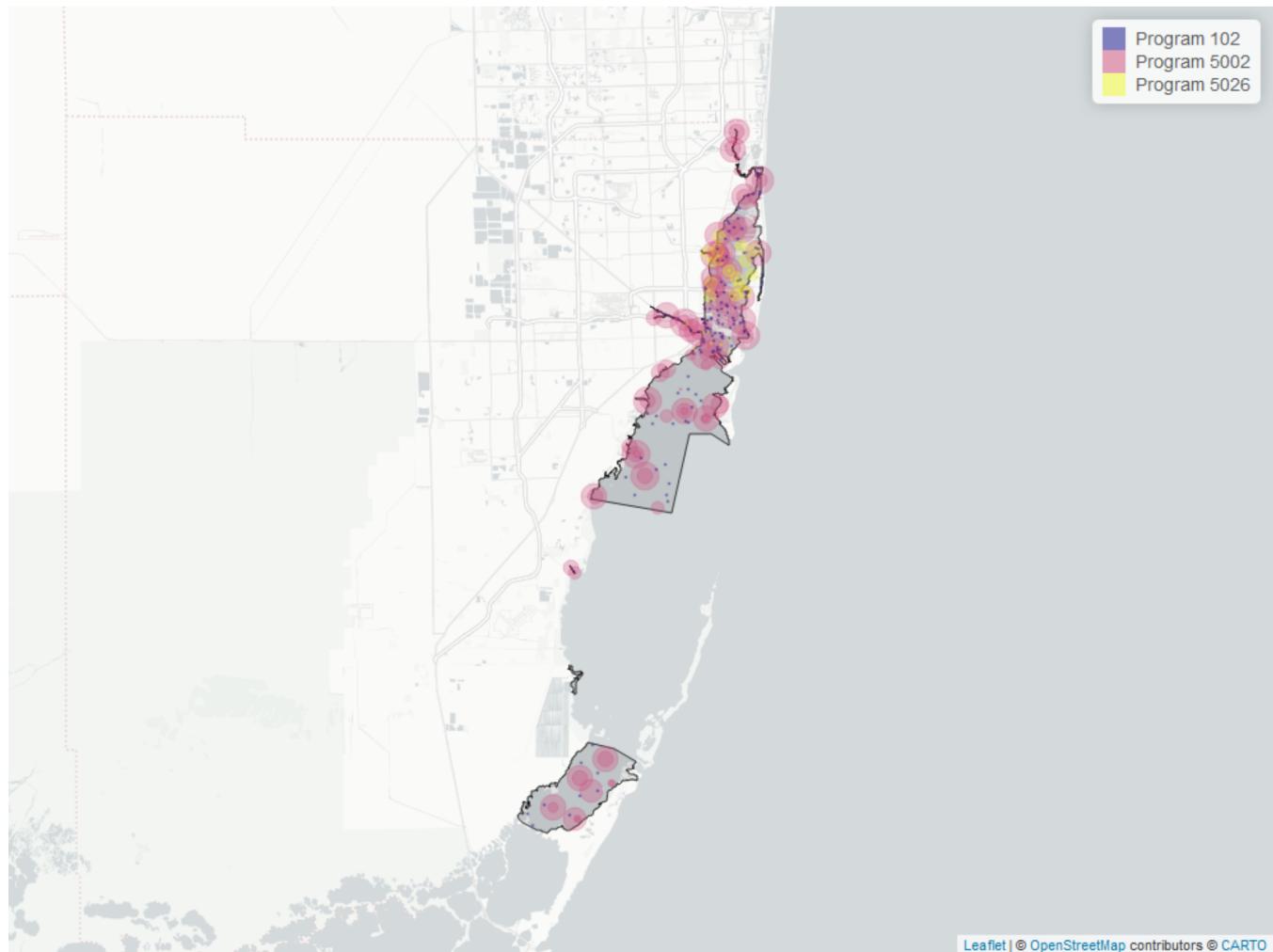


RelativeDepth	N_Data	N_Years	Median	Independent	tau	p	SennSlope	SennIntercept	ChiSquared	pChiSquared	Trend
All	6020	13	90.3	TRUE	0.357	0.0000	1.230361	58.30559	14.6595	0.1986	1

*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



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
5002	5360	2009	2023
5026	426	2019	2023
102	259	1995	1996

#### Program names:

5002 - Florida STORET / WIN

5026 - North Biscayne Bay Seagrass Loss Water Quality Program

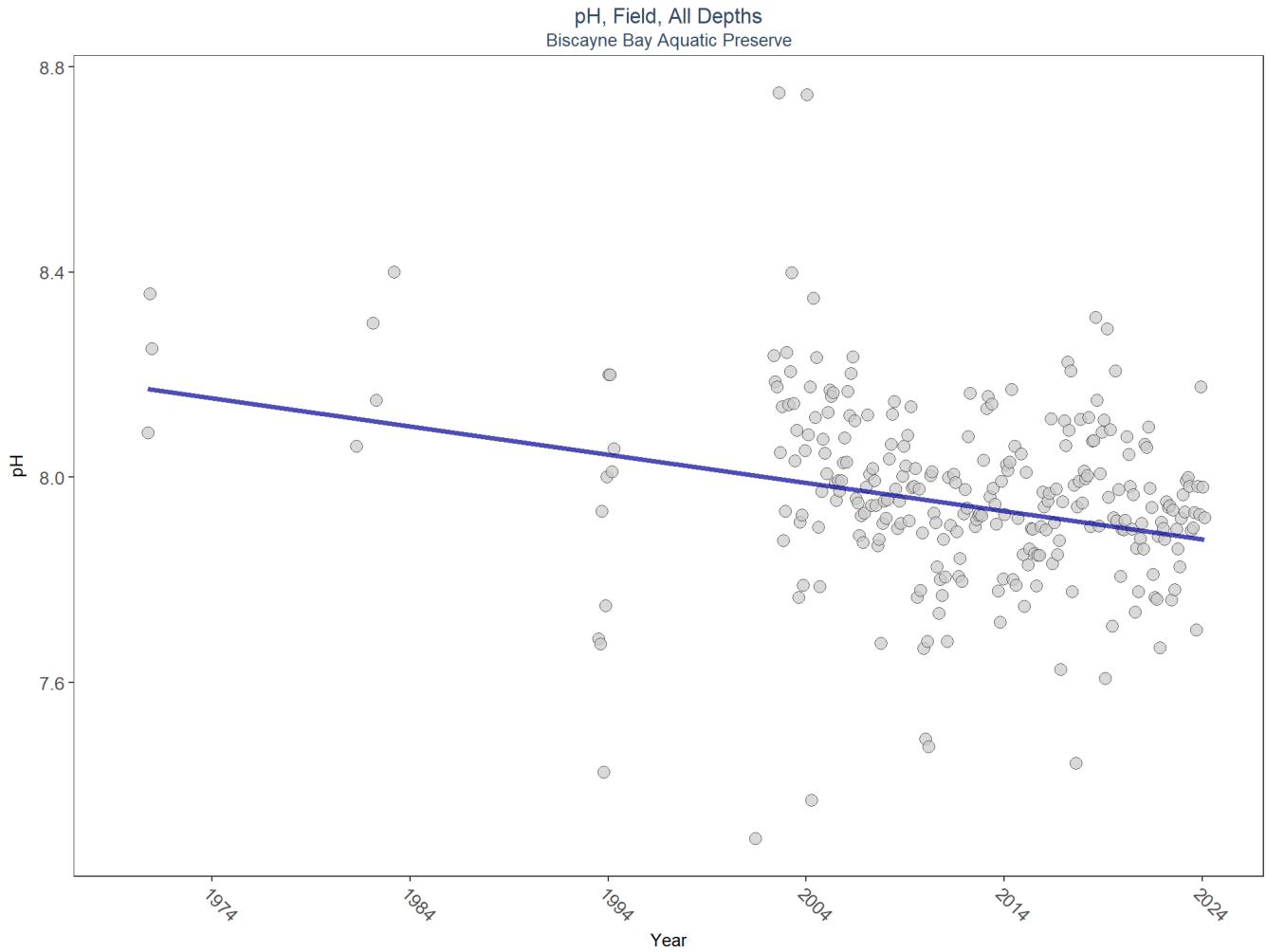
102 - National Status and Trends Mussel Watch

There are no qualifying Value Qualifiers for Dissolved Oxygen Saturation in Biscayne Bay 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

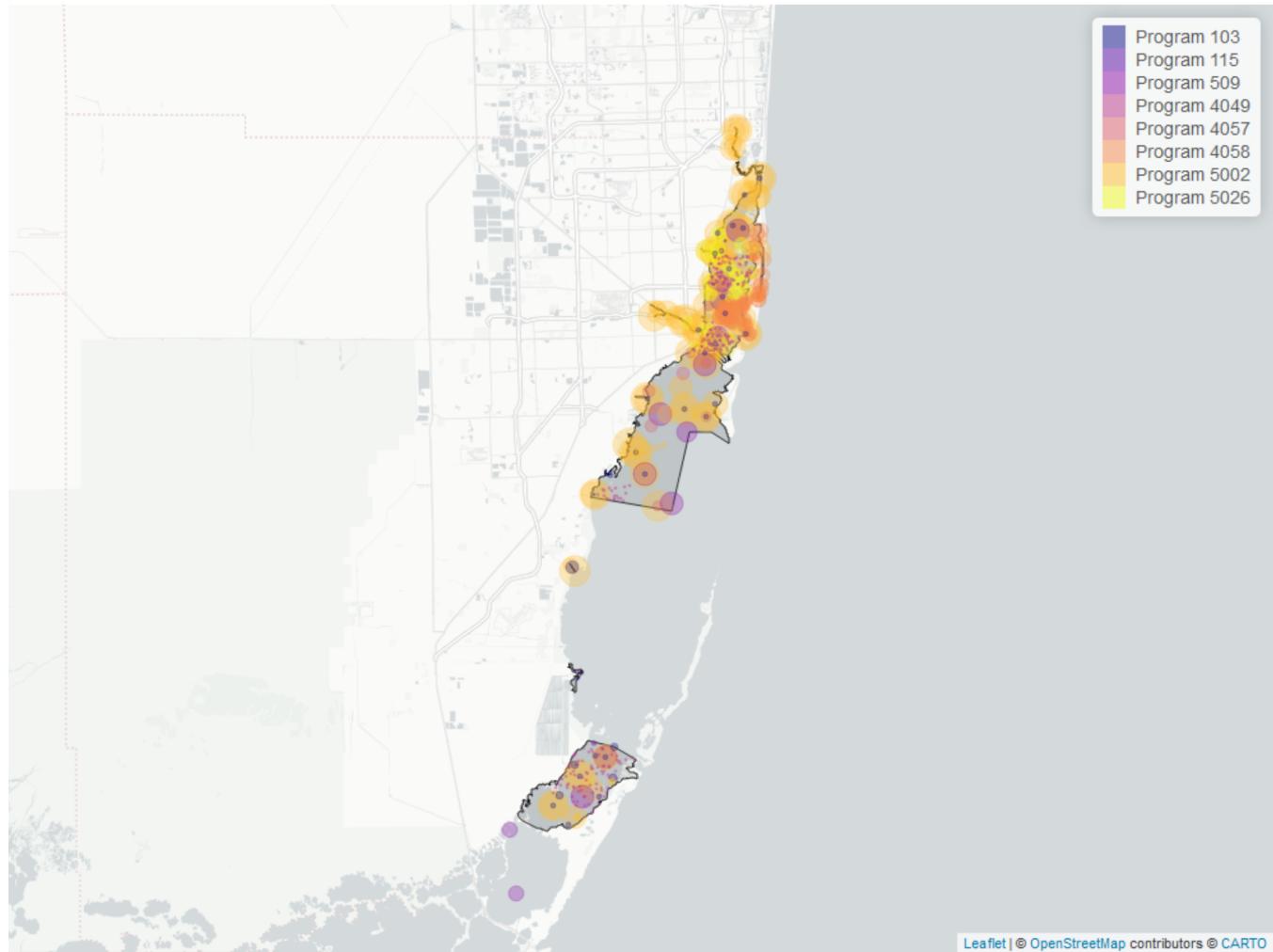


RelativeDepth	N_Data	N_Years	Median	Independent	tau	p	SennSlope	SennIntercept	ChiSquared	pChiSquared	Trend
All	14308	30	7.98	TRUE	-0.2426	0.0000	-0.005508021	8.176375	10.6025	0.4771	-1

*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	9607	2001	2023
4058	2312	2016	2023
5026	1151	2019	2024
509	822	2002	2008
4049	247	2005	2008
4057	169	2015	2019
103	166	1970	2020
115	3	2004	2004

**Program names:**

5002 - Florida STORET / WIN

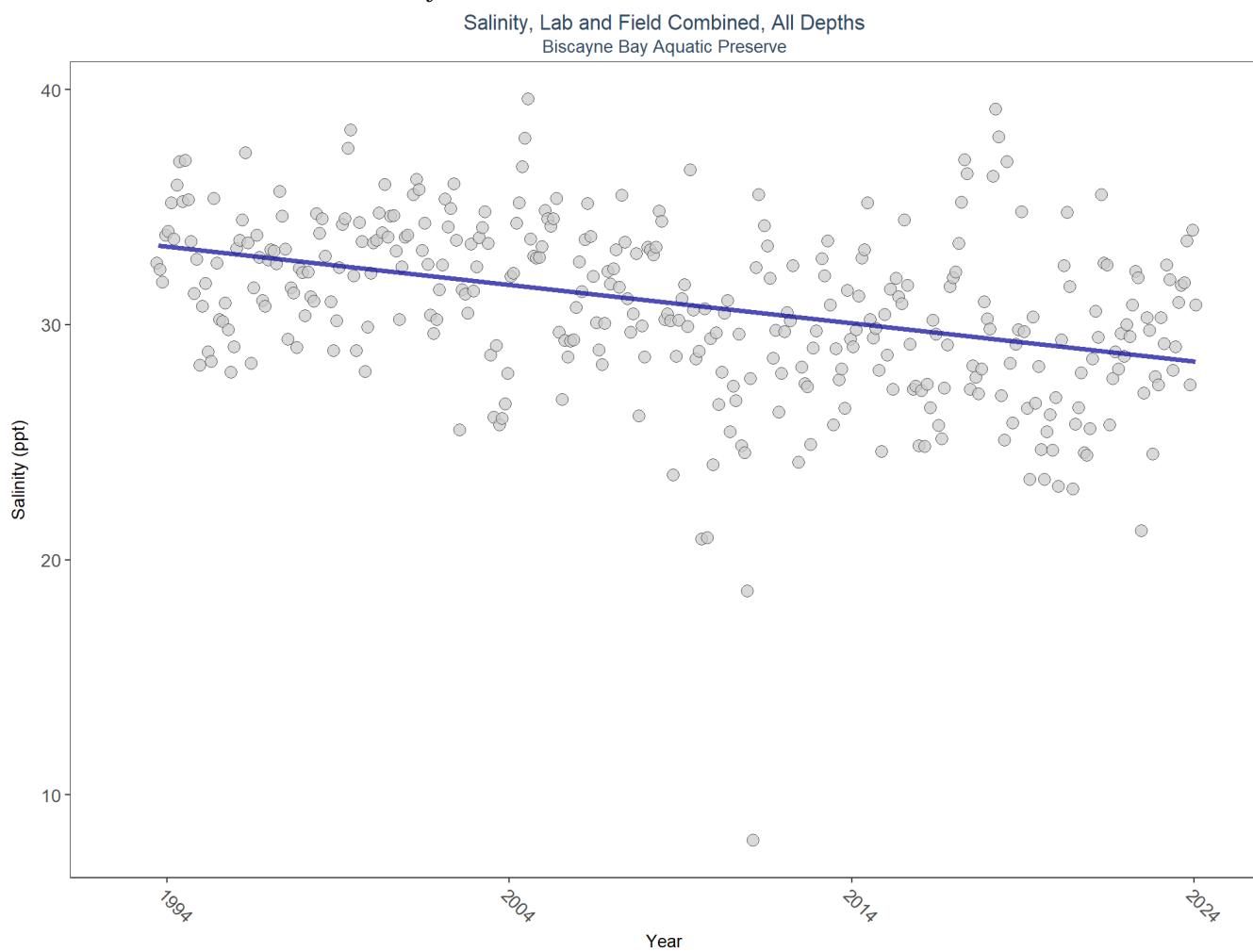
- 4058 - City of Miami Beach Water Monitoring  
 5026 - North Biscayne Bay Seagrass Loss Water Quality Program  
 509 - SERC Water Quality Monitoring Network  
 4049 - The South Florida Fisheries Habitat Assessment Program (FHAP)  
 4057 - Biscayne Bay Water Watch  
 103 - EPA STOrage and RETrieval Data Warehouse (STORET)  
 115 - Environmental Monitoring Assessment Program

There are no qualifying Value Qualifiers for pH in Biscayne Bay 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

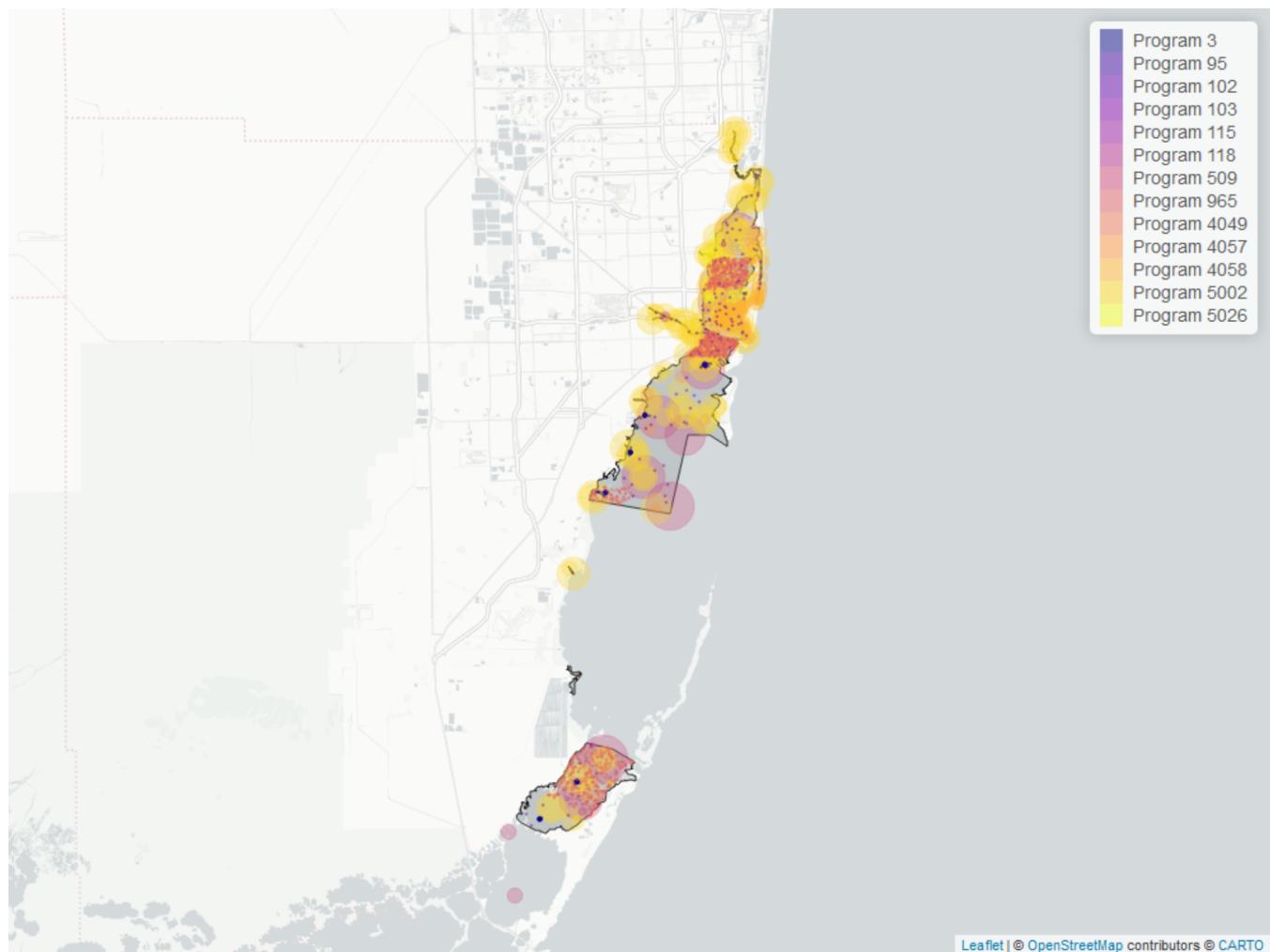


RelativeDepth	N_Data	N_Years	Median	Independent	tau	p	SennSlope	SennIntercept	ChiSquared	pChiSquared	Trend
All	20049	32	32.2	TRUE	-0.3494	0.0000	-0.163032	33.4877	6.1091	0.866	-1

*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



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	10359	2003	2023
509	3316	1993	2008
965	2512	2005	2011
4058	2309	2016	2023
5026	435	2019	2024
3	391	2002	2012
4049	271	2005	2008
102	263	1995	1996
4057	171	2015	2019
118	29	2015	2020
95	7	2013	2013
115	3	2004	2004

<i>ProgramID</i>	<i>N_Data</i>	<i>YearMin</i>	<i>YearMax</i>
103	3	2003	2003

**Program names:**

5002 - Florida STORET / WIN  
 509 - SERC Water Quality Monitoring Network  
 965 - South Florida Seagrass Fish and Invertebrate Assessment Network  
 4058 - City of Miami Beach Water Monitoring  
 5026 - North Biscayne Bay Seagrass Loss Water Quality Program  
 3 - Atlantic Oceanographic and Meteorological Laboratory (AOML) South Florida Program Synoptic Shipboard Surveys  
 4049 - The South Florida Fisheries Habitat Assessment Program (FHAP)  
 102 - National Status and Trends Mussel Watch  
 4057 - Biscayne Bay Water Watch  
 118 - National Aquatic Resource Surveys, National Coastal Condition Assessment  
 95 - Harmful Algal Bloom Marine Observation Network  
 115 - Environmental Monitoring Assessment Program  
 103 - EPA STOrage and RETrieval Data Warehouse (STORET)

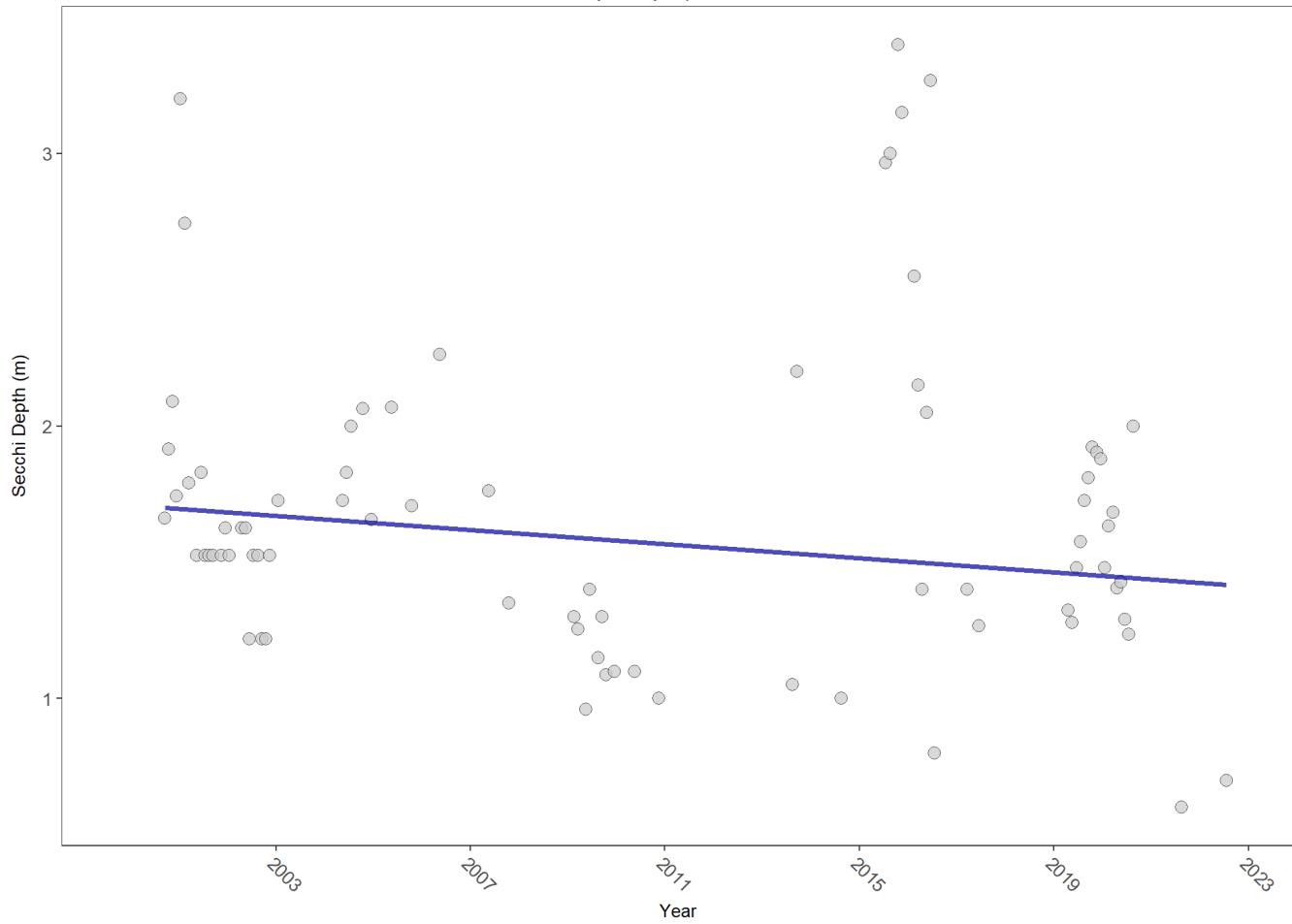
There are no qualifying Value Qualifiers for Salinity in Biscayne Bay Aquatic Preserve

### **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**

Secchi Depth, Field, Surface  
Biscayne Bay Aquatic Preserve

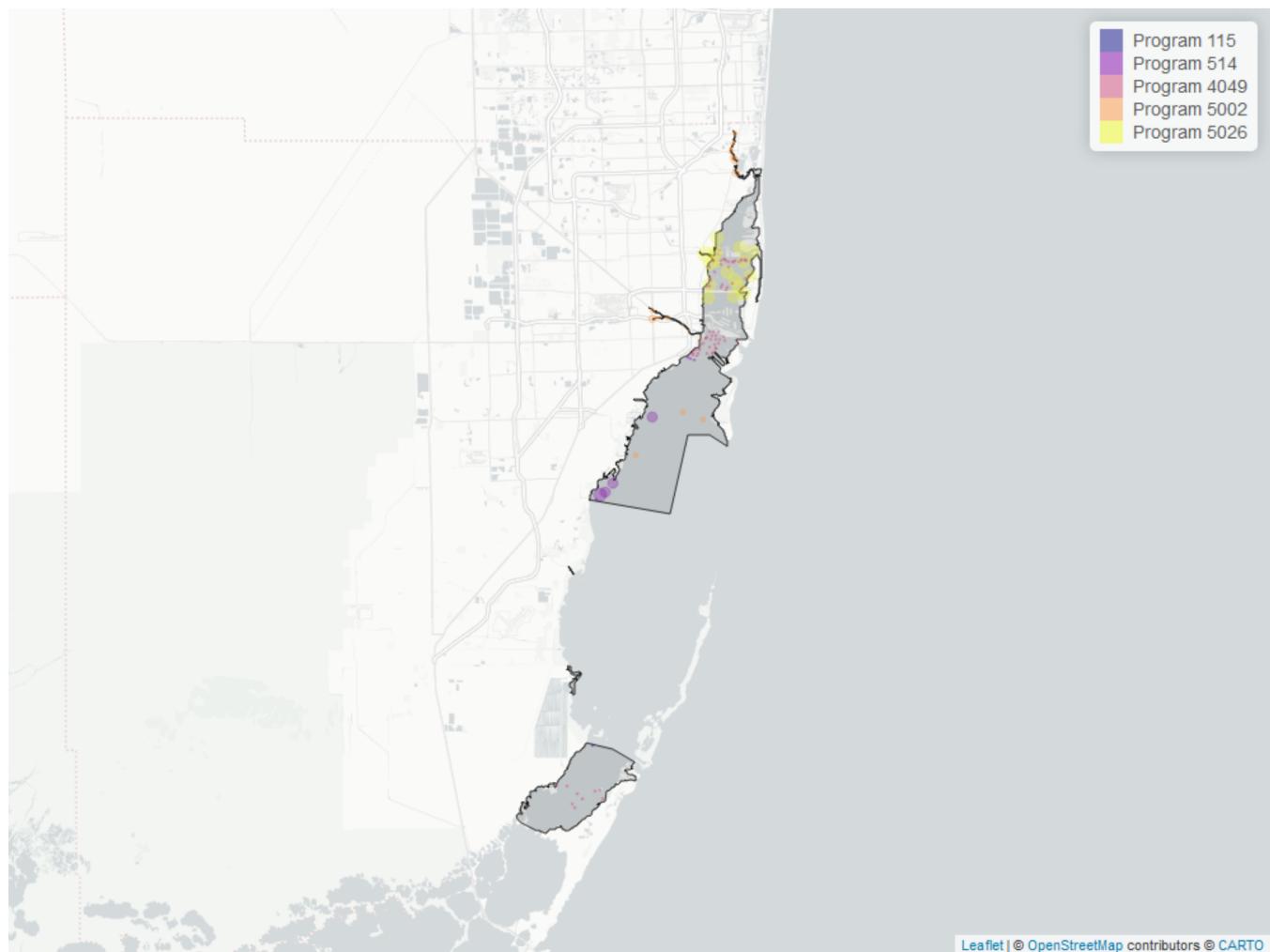


RelativeDepth	N_Data	N_Years	Median	Independent	tau	p	SennSlope	SennIntercept	ChiSquared	pChiSquared	Trend
Surface	668	19	1.524019	TRUE	-0.1204	0.3144	-0.01288222	1.70837	3.1308	0.9889	0

$p < 0.00005$  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 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
5026	426	2019	2020
514	86	2000	2005
5002	83	2007	2022
4049	73	2005	2007
115	1	2004	2004

#### Program names:

5026 - North Biscayne Bay Seagrass Loss Water Quality Program

514 - Florida LAKEWATCH Program

5002 - Florida STORET / WIN

4049 - The South Florida Fisheries Habitat Assessment Program (FHAP)

### 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	$N_{\_Total}$	$N_{\_S}$	$perc_{\_S}$
2014	1	1	100.0
2015	9	7	77.8
2016	13	9	69.2
2017	7	4	57.1
2022	1	1	100.0

**Note:** <sup>1</sup>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.

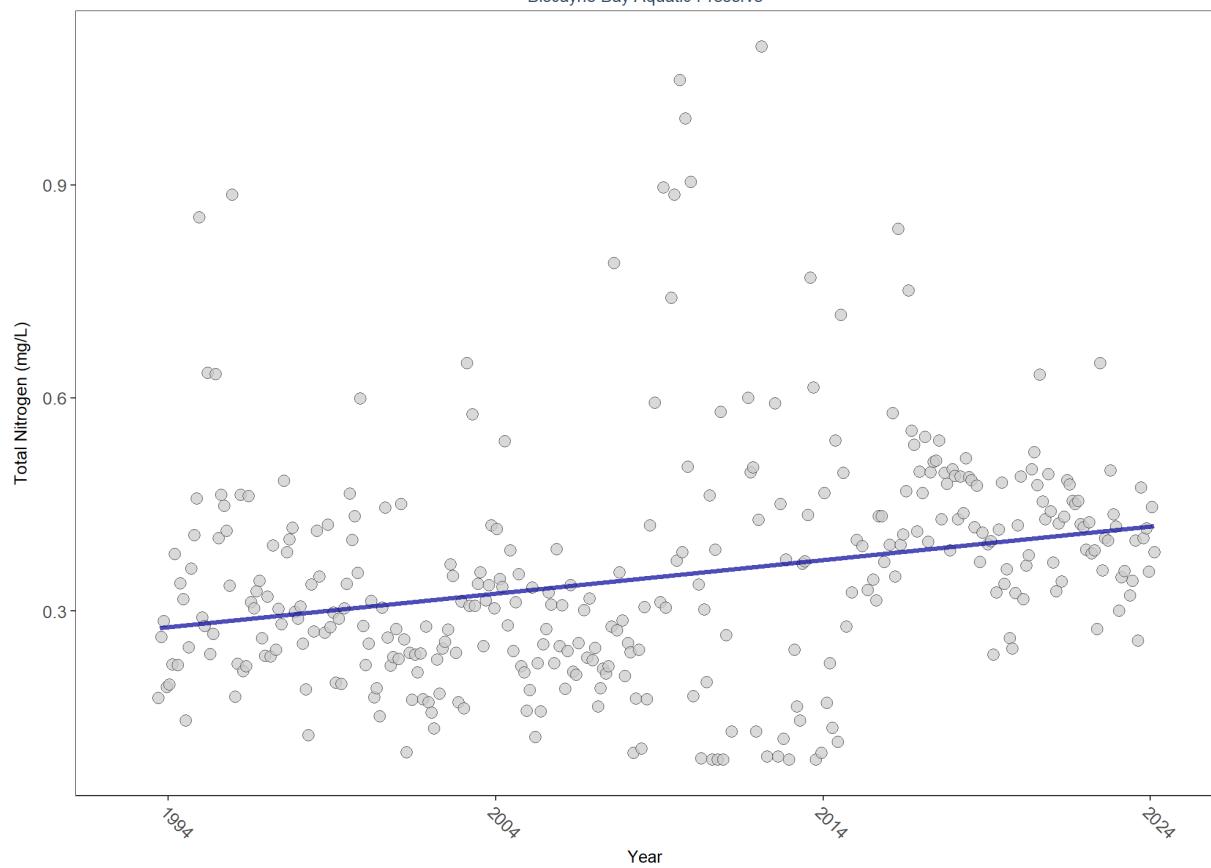
- 1)  $TN = TKN + NO_3O_2;$
- 2)  $TN = TKN + NO_3 + NO_2;$
- 3)  $TN = ORGN + NH_4 + NO_3O_2;$
- 4)  $TN = ORGN + NH_4 + NO_2 + NO_3;$
- 5)  $TN = TKN + NO_3;$
- 6)  $TN = ORGN + NH_4 + NO_3;$

### 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  
Biscayne Bay Aquatic Preserve

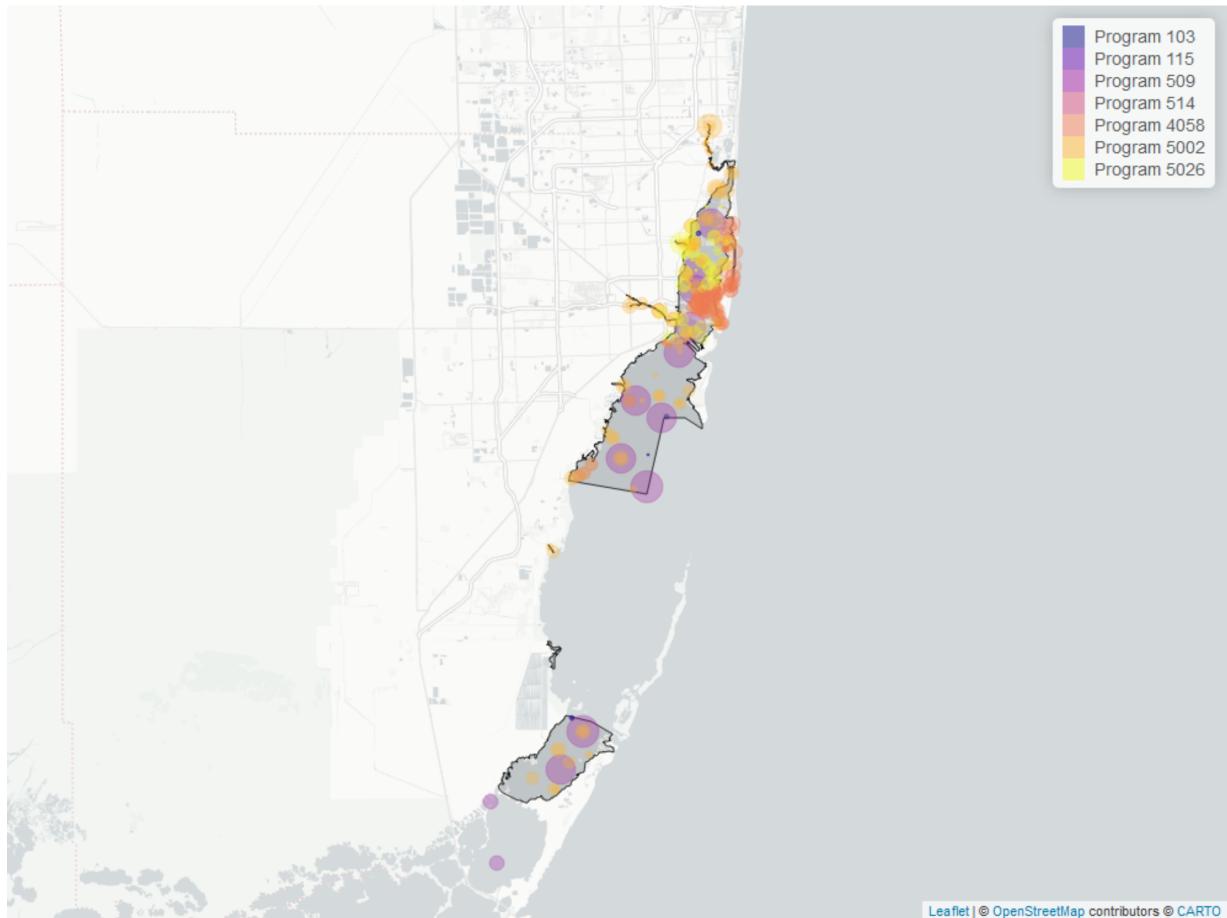


RelativeDepth	N_Data	N_Years	Median	Independent	tau	p	SennSlope	SennIntercept	ChiSquared	pChiSquared	Trend
All	6940	32	0.331	TRUE	0.2112	0.0000	0.004719102	0.2728316	9.3908	0.5859	1

*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
4058	2125	2016	2023
5002	1993	1994	2023
509	1654	1993	2008
5026	1043	2019	2024
514	104	2000	2005
103	20	2002	2006
115	1	2004	2004

#### Program names:

4058 - City of Miami Beach Water Monitoring

5002 - Florida STORET / WIN

509 - SERC Water Quality Monitoring Network

5026 - North Biscayne Bay Seagrass Loss Water Quality Program

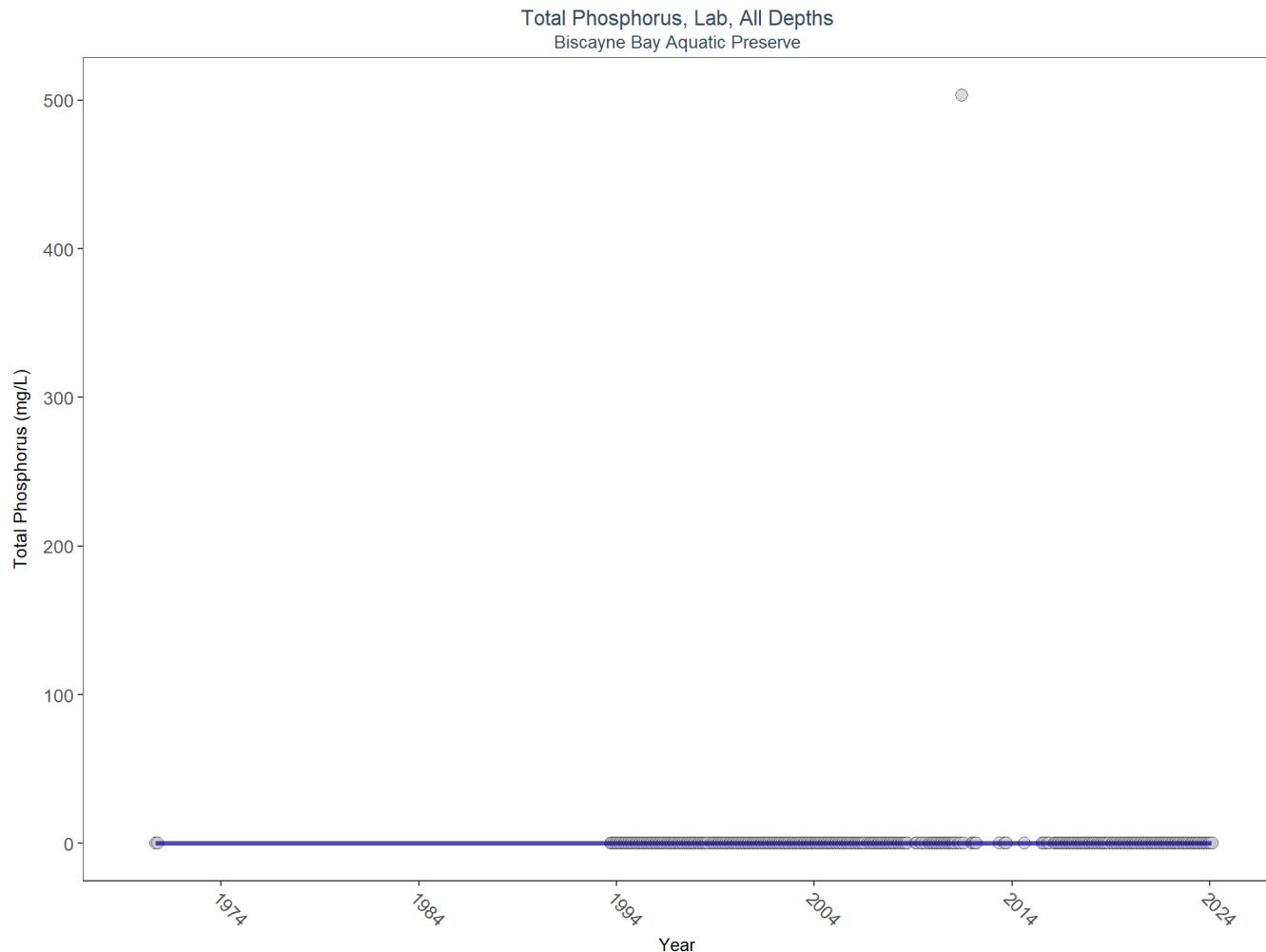
514 - Florida LAKEWATCH Program

103 - EPA STOrage and RETrieval Data Warehouse (STORET)  
115 - Environmental Monitoring Assessment Program

There are no qualifying Value Qualifiers for Total Nitrogen in Biscayne Bay Aquatic Preserve

## Total Phosphorus - Discrete Water Quality

### Seasonal Kendall-Tau Trend Analysis

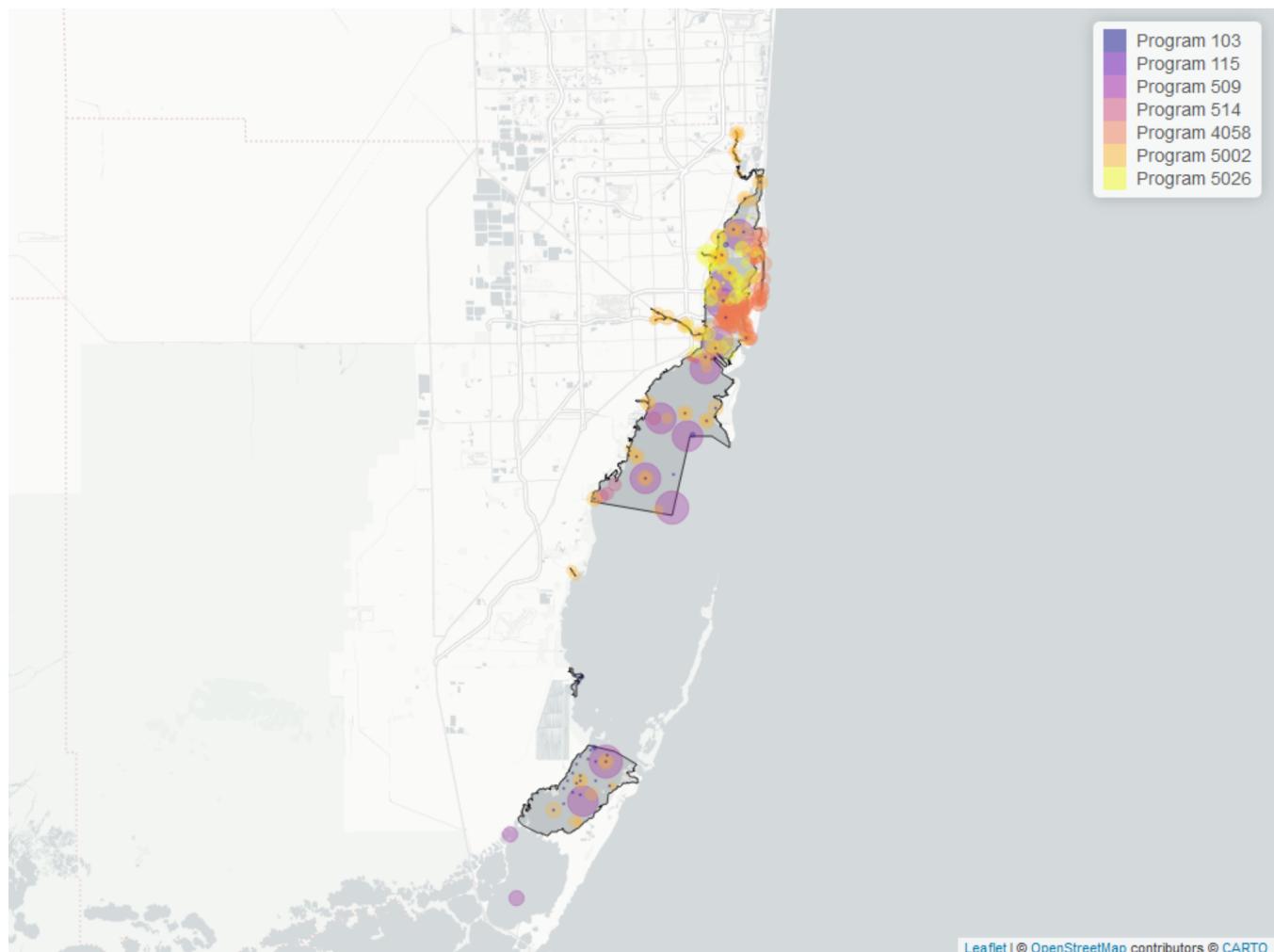


RelativeDepth	N_Data	N_Years	Median	Independent	tau	p	SennSlope	SennIntercept	ChiSquared	pChiSquared	Trend
All	7000	33	0.00997	TRUE	0.3967	0.0000	0.00036239	-0.003915918	1.4861	0.9996	1

*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
4058	2196	2016	2023
5002	1931	2001	2023
509	1655	1993	2008
5026	1080	2019	2024
514	103	2000	2005
103	75	1970	2020
115	1	2004	2004

**Program names:**

4058 - City of Miami Beach Water Monitoring  
5002 - Florida STORET / WIN

509 - SERC Water Quality Monitoring Network  
 5026 - North Biscayne Bay Seagrass Loss Water Quality Program  
 514 - Florida LAKEWATCH Program  
 103 - EPA STOrage and RETrieval Data Warehouse (STORET)  
 115 - Environmental Monitoring Assessment 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	$N_{Total}$	$N_I$	$perc_I$	$N_Q$	$perc_Q$	$N_U$	$perc_U$
2009	49	15	30.6				
2010	293	187	63.8			22	7.5
2011	166	80	48.2			23	13.9
2012	51	8	15.7	4	7.8	39	76.5
2013	33	15	45.5			7	21.2
2015	9	6	66.7				
2016	173	3	1.7				
2020	867	166	19.1			37	4.3
2021	850	330	38.8			33	3.9
2022	674	327	48.5			45	6.7
2023	657	225	34.2			103	15.7
2024	36	23	63.9				

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

### Programs containing Value Qualified data:

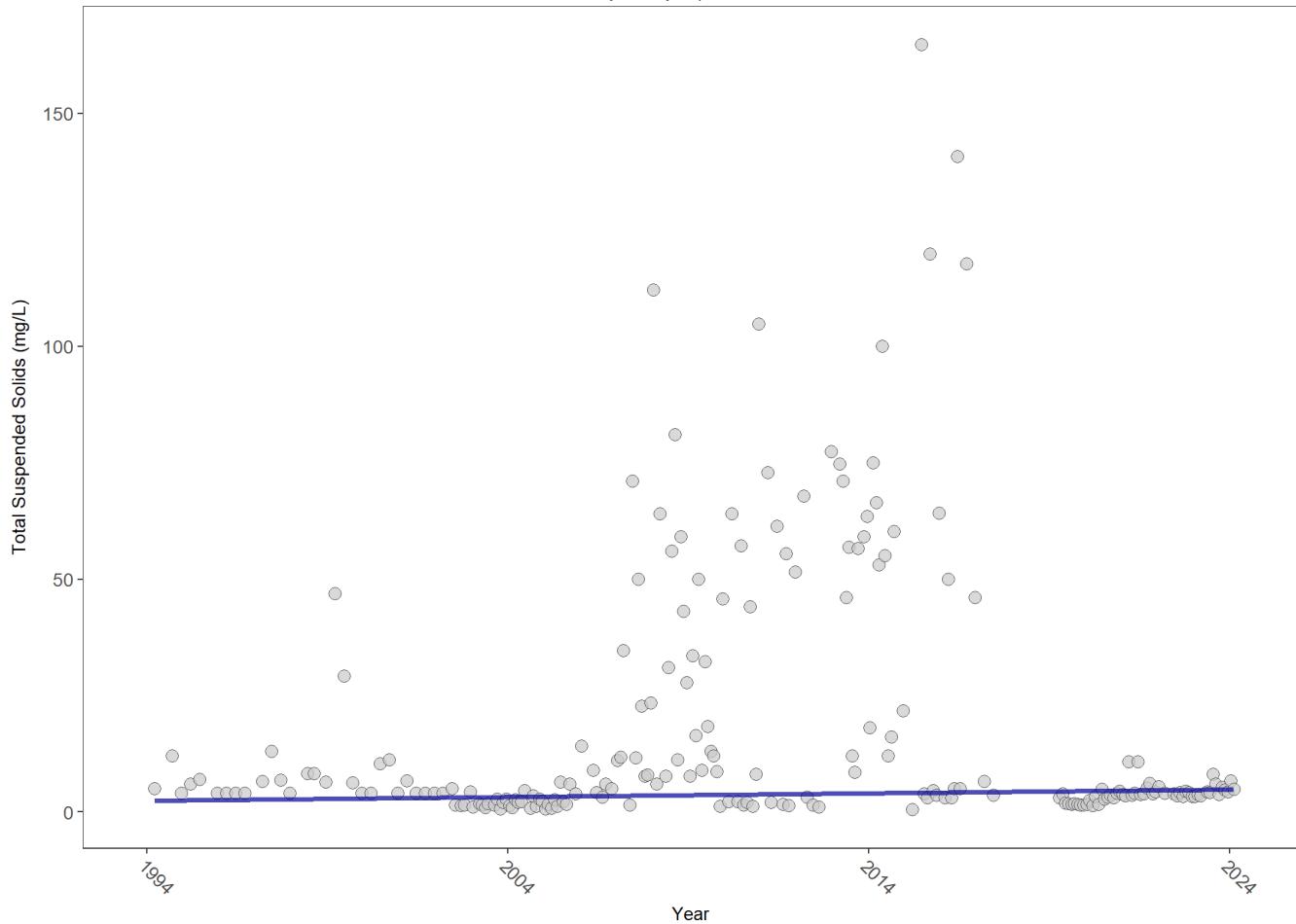
5026 - North Biscayne Bay Seagrass Loss Water Quality Program  
 5002 - Florida STORET / WIN

### 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  
Biscayne Bay Aquatic Preserve



RelativeDepth	N_Data	N_Years	Median	Independent	tau	p	SennSlope	SennIntercept	ChiSquared	pChiSquared	Trend
All	2887	30	3	TRUE	0.1448	0.0124	0.08304212	2.393015	3.5068	0.9822	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

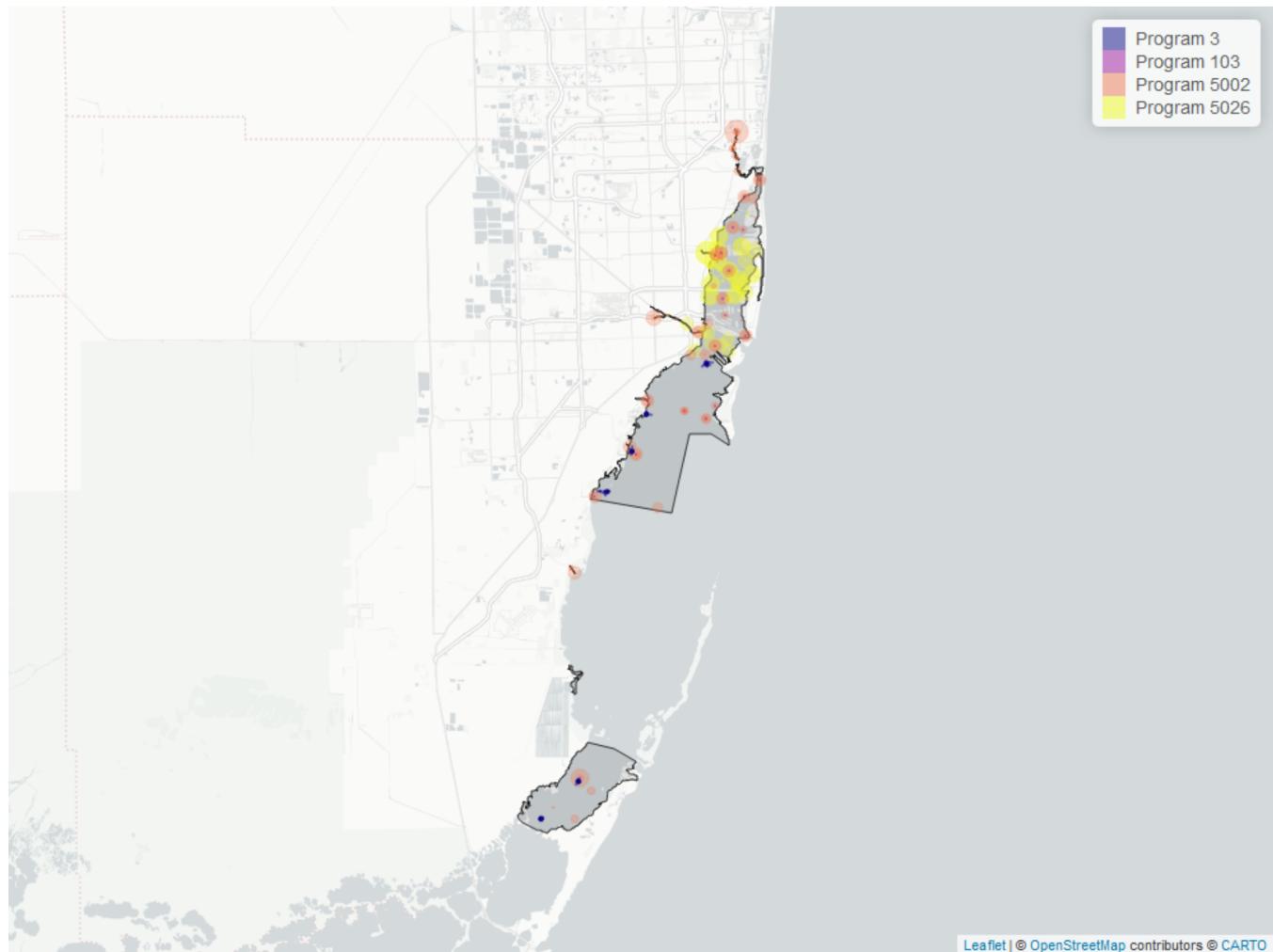


Table 19: Programs contributing data for Total Suspended Solids

ProgramID	N_Data	YearMin	YearMax
5026	1517	2019	2024
5002	1040	1994	2023
3	369	2002	2012
103	19	2020	2020

**Program names:**

5026 - North Biscayne Bay Seagrass Loss Water Quality Program

5002 - Florida STORET / WIN

3 - Atlantic Oceanographic and Meteorological Laboratory (AOML) South Florida Program Synoptic Shipboard Surveys

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 20: Value Qualifiers for Total Suspended Solids

Year	$N_{Total}$	$N_I$	$perc_I$	$N_U$	$perc_U$
1994	3			1	33.3
1995	3			1	33.3
1996	3			3	100.0
1997	4			1	25.0
2000	4			1	25.0
2001	4			4	100.0
2002	21			2	9.5
2003	51	1	2.0	2	3.9
2004	58			2	3.5
2005	60			4	6.7
2007	48	4	8.3	5	10.4
2008	35	2	5.7	4	11.4
2009	86	20	23.3	8	9.3
2010	116	10	8.6	6	5.2
2011	130	5	3.9	4	3.1
2012	66	3	4.6	2	3.0
2013	107	14	13.1	6	5.6
2014	100	16	16.0	3	3.0
2015	81	14	17.3	7	8.6
2016	84	26	31.0	10	11.9
2017	8	6	75.0	1	12.5
2020	565	102	18.0	78	13.8
2021	337	156	46.3	115	34.1
2022	209	122	58.4	82	39.2
2023	291	171	58.8	106	36.4
2024	36	31	86.1	2	5.6

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

### Programs containing Value Qualified data:

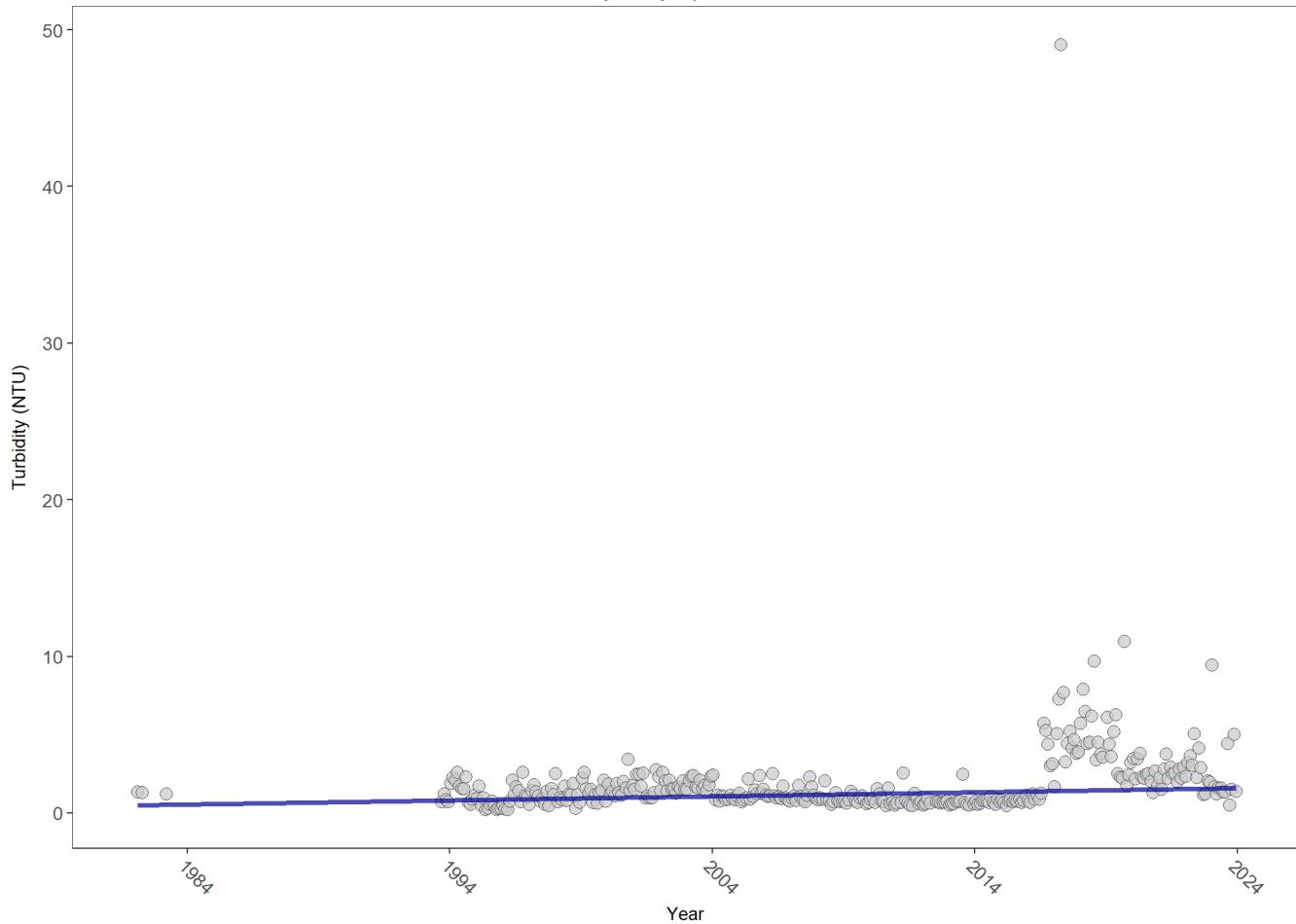
5026 - North Biscayne Bay Seagrass Loss Water Quality Program  
5002 - Florida STORET / WIN

## 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  
Biscayne Bay Aquatic Preserve



RelativeDepth	N_Data	N_Years	Median	Independent	tau	p	SennSlope	SennIntercept	ChiSquared	pChiSquared	Trend
All	15624	33	1.07	TRUE	0.1623	0.0000	0.02621859	0.4934565	3.3127	0.9859	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 Turbidity

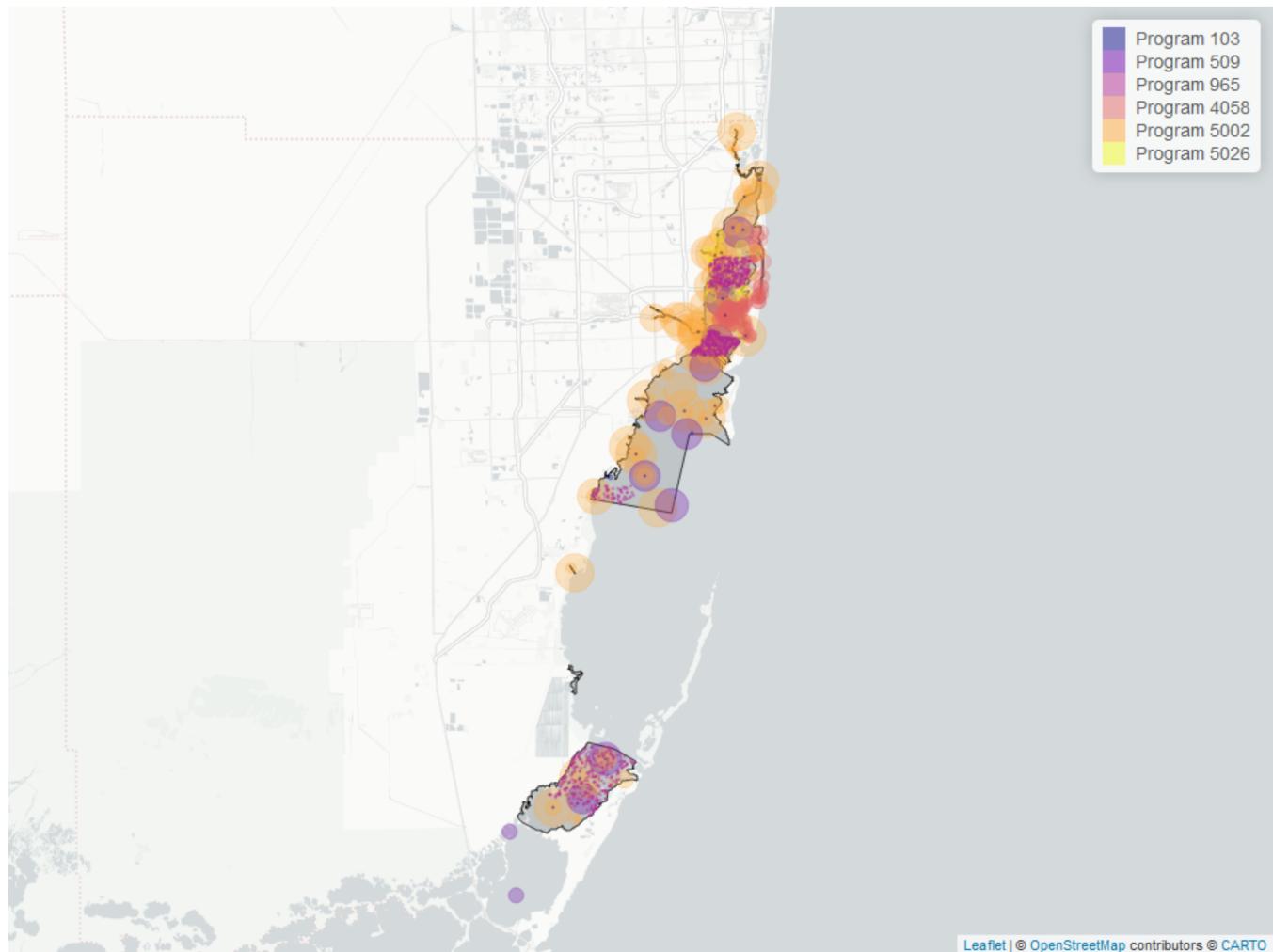


Table 21: Programs contributing data for Turbidity

ProgramID	N_Data	YearMin	YearMax
5002	10010	1994	2023
4058	2316	2016	2023
509	1658	1993	2008
965	1254	2005	2011
5026	410	2019	2020
103	32	1982	2020

**Program names:**

5002 - Florida STORET / WIN

4058 - City of Miami Beach Water Monitoring

509 - SERC Water Quality Monitoring Network

965 - South Florida Seagrass Fish and Invertebrate Assessment Network  
 5026 - North Biscayne Bay Seagrass Loss Water Quality 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 22: Value Qualifiers for Turbidity

Year	$N_{Total}$	$N_I$	$perc_I$	$N_Q$	$perc_Q$	$N_U$	$perc_U$
1995	395					60	15.2
1996	507					17	3.4
2003	564	21	3.7				
2004	562	99	17.6				
2005	715	225	31.5			3	0.4
2006	756	154	20.4				
2007	745	71	9.5			1	0.1
2008	663	63	9.5				
2009	591	91	15.4			1	0.2
2010	535	97	18.1			1	0.2
2011	521	91	17.5				
2012	333	79	23.7				
2013	375	82	21.9				
2014	378	79	20.9				
2015	265	48	18.1				
2016	422	37	8.8				
2017	512	5	1.0				
2020	736	4	0.5	2	0.3		
2021	674	14	2.1			7	1.0
2022	939	31	3.3				
2023	479	18	3.8			2	0.4

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

### Programs containing Value Qualified data:

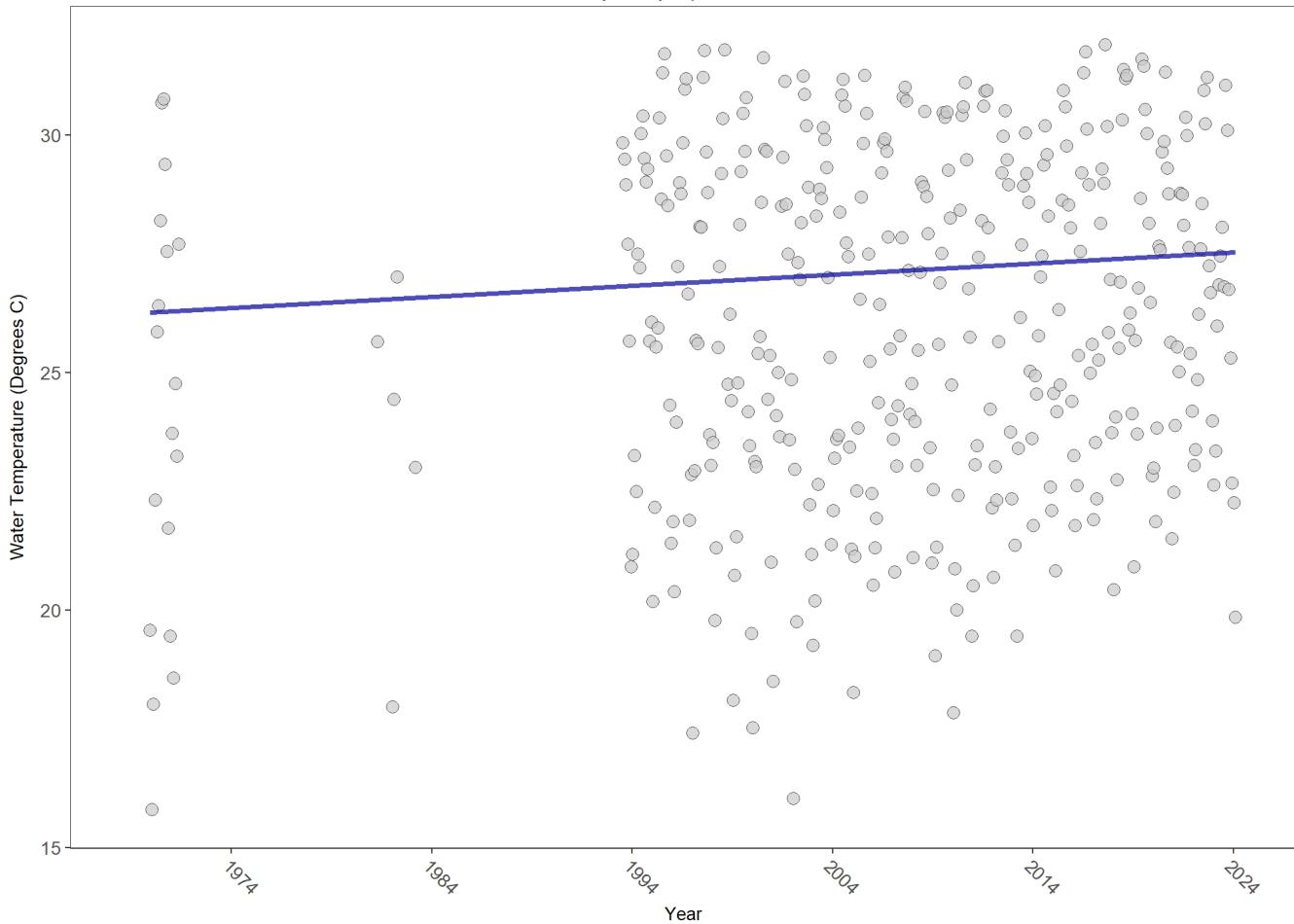
5002 - Florida STORET / WIN

## 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  
Biscayne Bay Aquatic Preserve

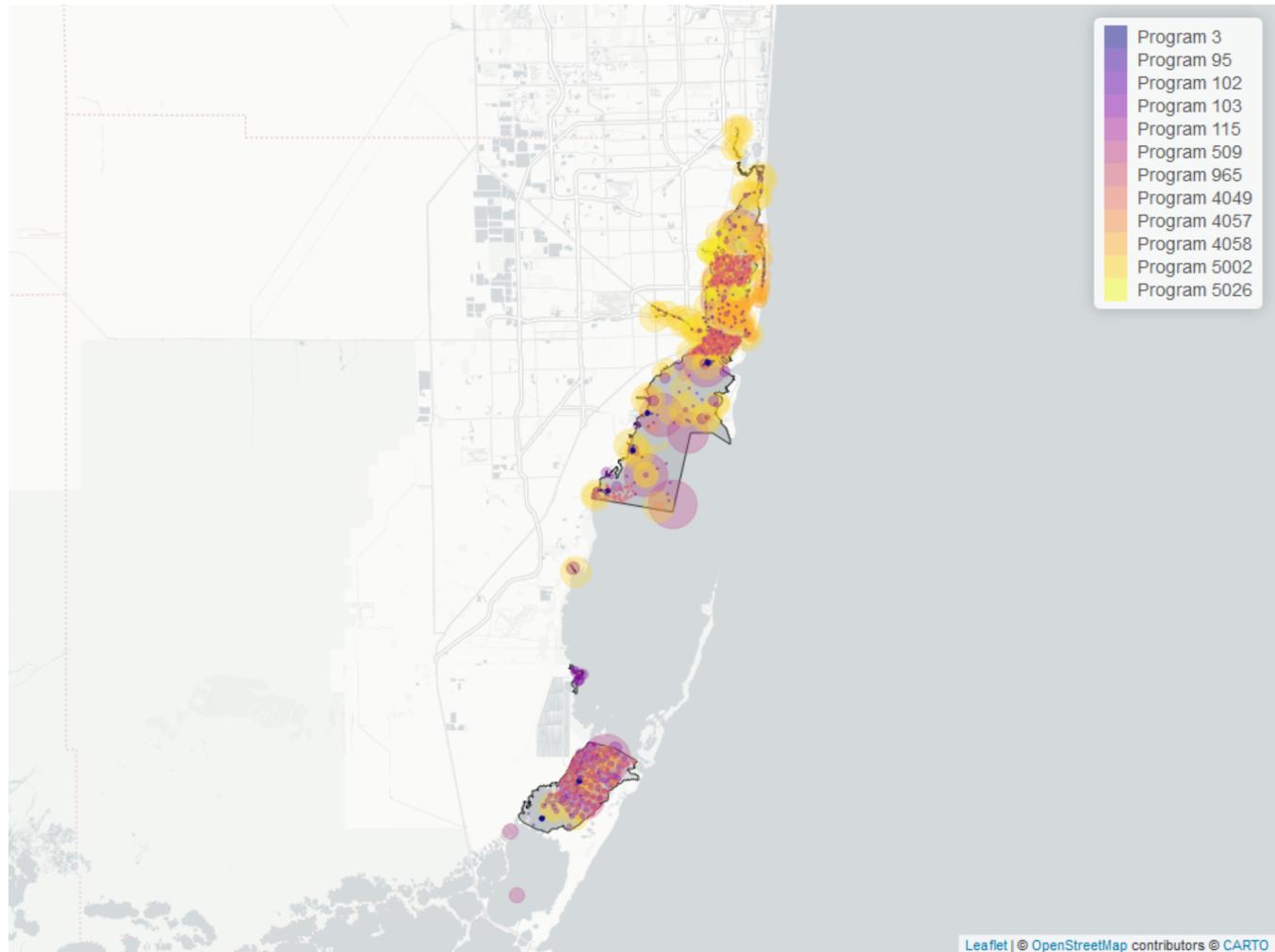


RelativeDepth	N_Data	N_Years	Median	Independent	tau	p	SennSlope	SennIntercept	ChiSquared	pChiSquared	Trend
All	21301	38	26.94	TRUE	0.1329	0.0002	0.02354122	26.23472	12.1614	0.3516	1

$p < 0.00005$  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	9838	2001	2023
509	3316	1993	2008
965	2512	2005	2011
4058	2299	2016	2023
5026	1152	2019	2024
103	1089	1969	2020
3	391	2002	2012
4049	271	2005	2008
102	263	1995	1996
4057	168	2015	2019
95	9	2012	2015
115	3	2004	

**Program names:**

- 5002 - Florida STORET / WIN
- 509 - SERC Water Quality Monitoring Network
- 965 - South Florida Seagrass Fish and Invertebrate Assessment Network
- 4058 - City of Miami Beach Water Monitoring
- 5026 - North Biscayne Bay Seagrass Loss Water Quality Program
- 103 - EPA STOrage and RETrieval Data Warehouse (STORET)
- 3 - Atlantic Oceanographic and Meteorological Laboratory (AOML) South Florida Program Synoptic Shipboard Surveys
- 4049 - The South Florida Fisheries Habitat Assessment Program (FHAP)
- 102 - National Status and Trends Mussel Watch
- 4057 - Biscayne Bay Water Watch
- 95 - Harmful Algal Bloom Marine Observation Network
- 115 - Environmental Monitoring Assessment Program

There are no qualifying Value Qualifiers for Water Temperature in Biscayne Bay Aquatic Preserve

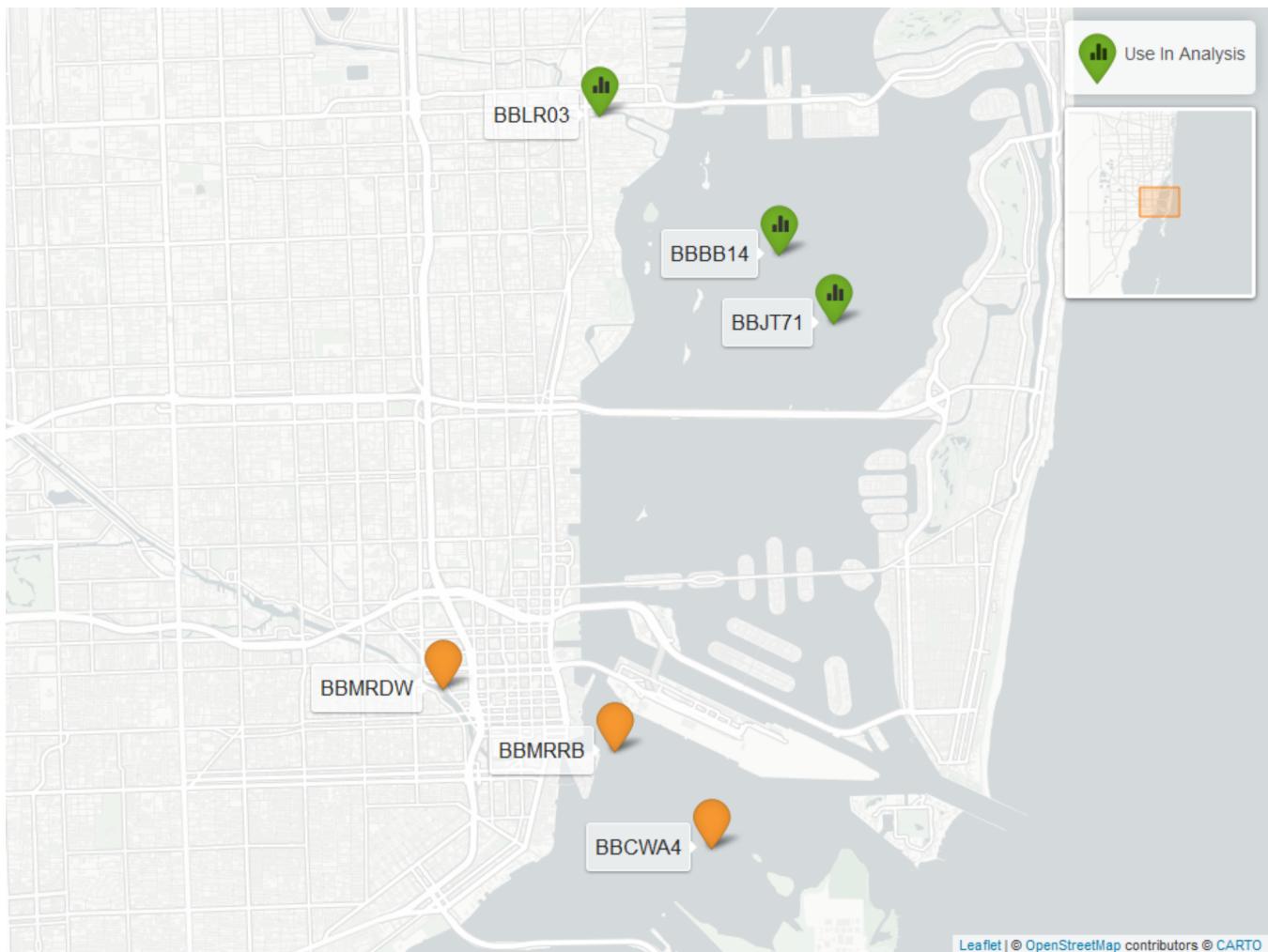
## Water Quality - Continuous

The following files were used in the continuous analysis:

- *Combined\_WQ\_WC\_NUT\_cont\_Dissolved\_Oxygen\_SE-2024-Jul-02.txt*
- *Combined\_WQ\_WC\_NUT\_cont\_Dissolved\_Oxygen\_Saturation\_SE-2024-Jul-02.txt*
- *Combined\_WQ\_WC\_NUT\_cont\_pH\_SE-2024-Jul-02.txt*
- *Combined\_WQ\_WC\_NUT\_cont\_Salinity\_SE-2024-Jul-02.txt*
- *Combined\_WQ\_WC\_NUT\_cont\_Turbidity\_SE-2024-Jul-02.txt*
- *Combined\_WQ\_WC\_NUT\_cont\_Water\_Temperature\_SE-2024-Jul-02.txt*

Table 24: Biscayne Bay Aquatic Preserves Continuous Water Quality Monitoring (5077)

<i>ProgramLocationID</i>	<i>Years of Data</i>	<i>Use in Analysis</i>	<i>Parameters</i>
BBBB14	5	TRUE	DO , DOS , pH , Sal , Turb , TempW
BBCWA4	2	FALSE	DO , DOS , pH , Sal , Turb , TempW
BBJT71	5	TRUE	DO , DOS , pH , Sal , Turb , TempW
BBLR03	4	FALSE	DO , DOS
BBLR03	5	TRUE	pH , Sal , Turb , TempW
BBMRDW	3	FALSE	DO , DOS , pH , Sal , Turb , TempW
BBMRRB	2	FALSE	DO , DOS , pH , Sal , Turb , TempW



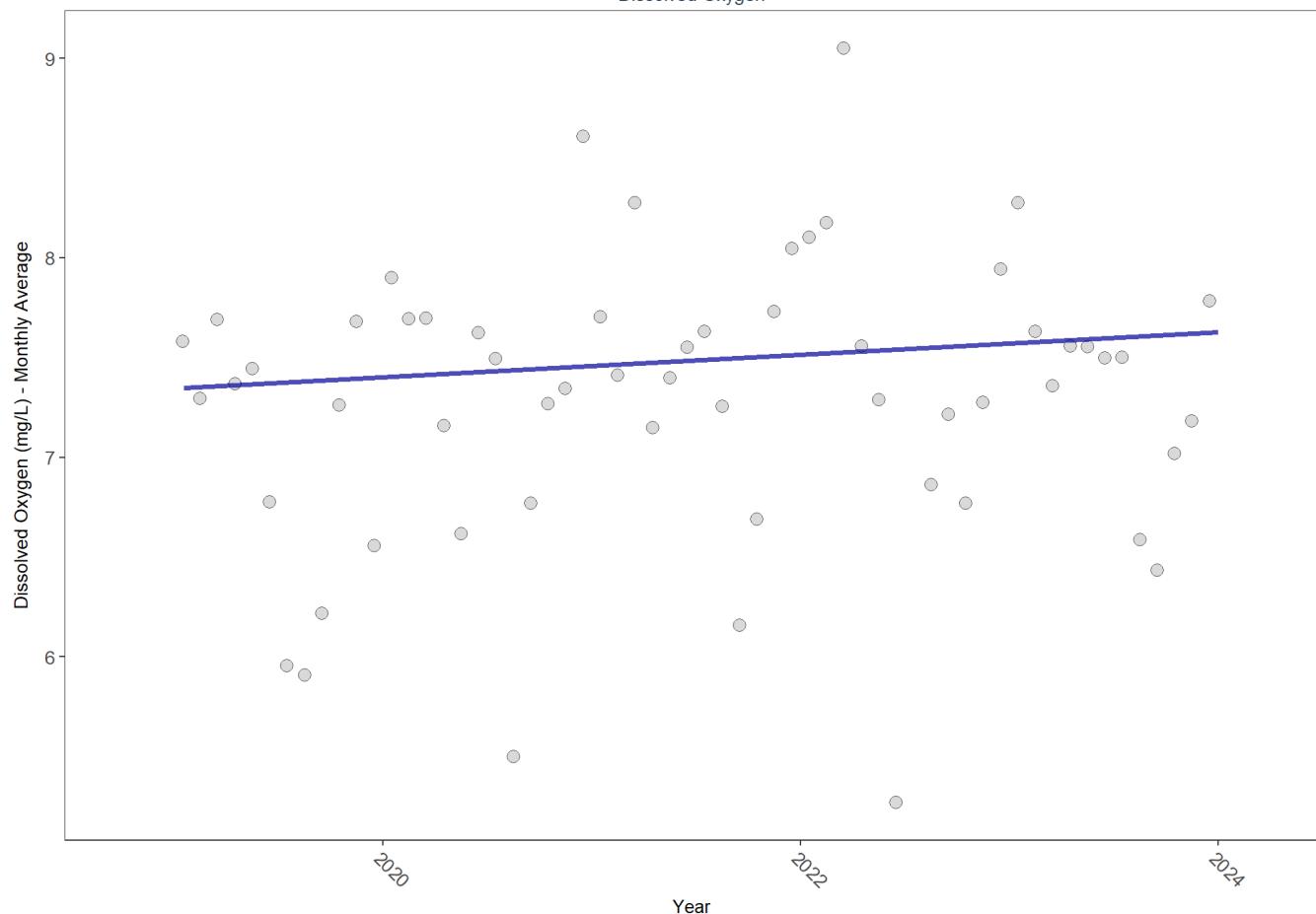
Map showing Continuous Water Quality Monitoring sampling locations within the boundaries of Biscayne Bay Aquatic Preserve. Sites marked as *Use In Analysis* are featured in this report.

## Dissolved Oxygen - Continuous Water Quality

**BBBB14**

Biscayne Bay Aquatic Preserves Continuous Water Quality Monitoring (5077)

Biscayne Bay Aquatic Preserve  
BBBB14  
Dissolved Oxygen



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

SennIntercept is intercept value at beginning of record for monitoring location

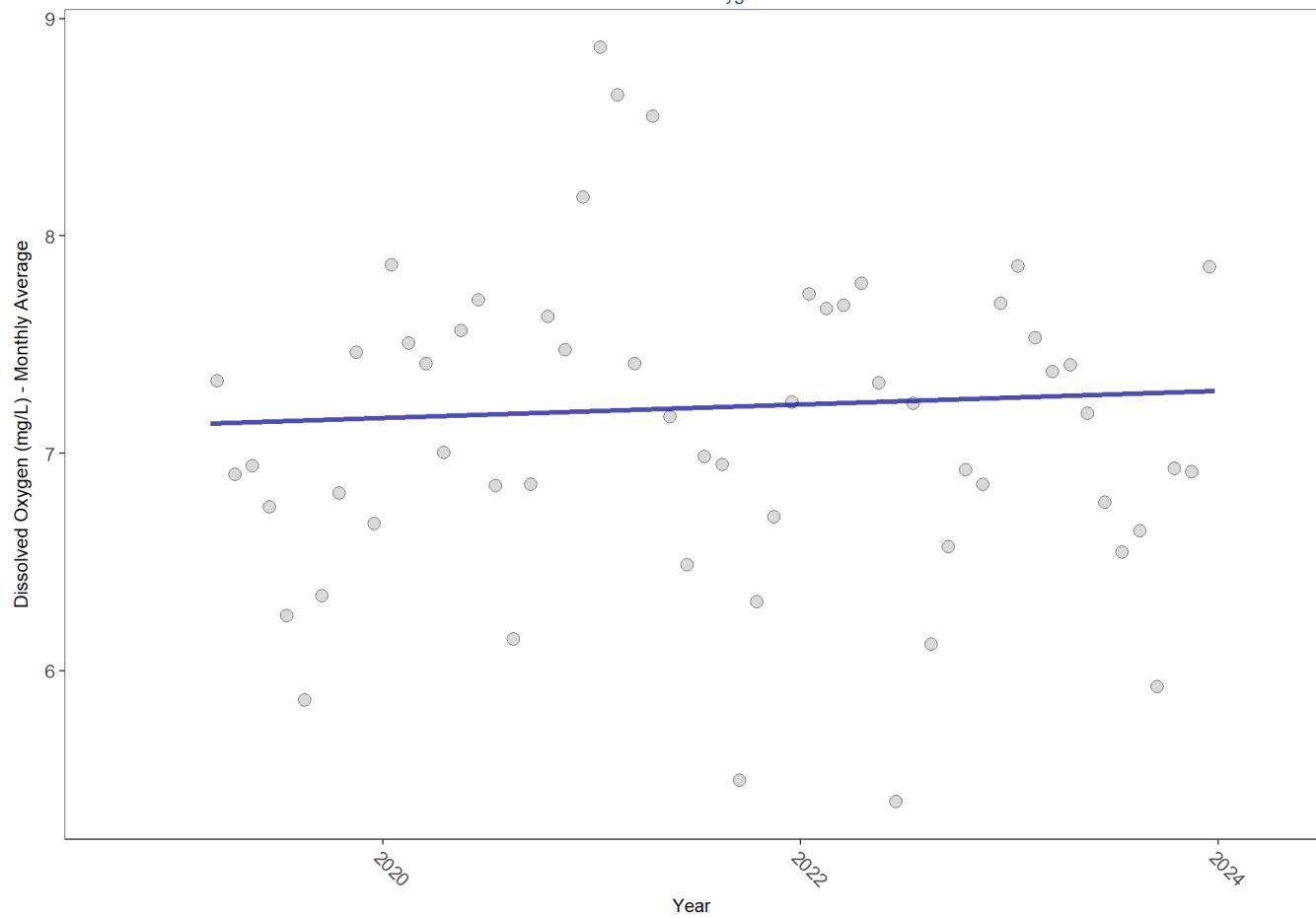
## BBJT71

Biscayne Bay Aquatic Preserves Continuous Water Quality Monitoring (5077)

Biscayne Bay Aquatic Preserve

BBJT71

Dissolved Oxygen



RelativeDepth	N_Data	N_Years	Median	Independent	tau	p	SennSlope	SennIntercept	ChiSquared	pChiSquared	Trend
bottom	166857	5	7	TRUE	0.1322	0.2688	0.03143211	7.131004	5.3023	0.9156	0

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

*SennIntercept is intercept value at beginning of record for monitoring location*

## All Stations Combined

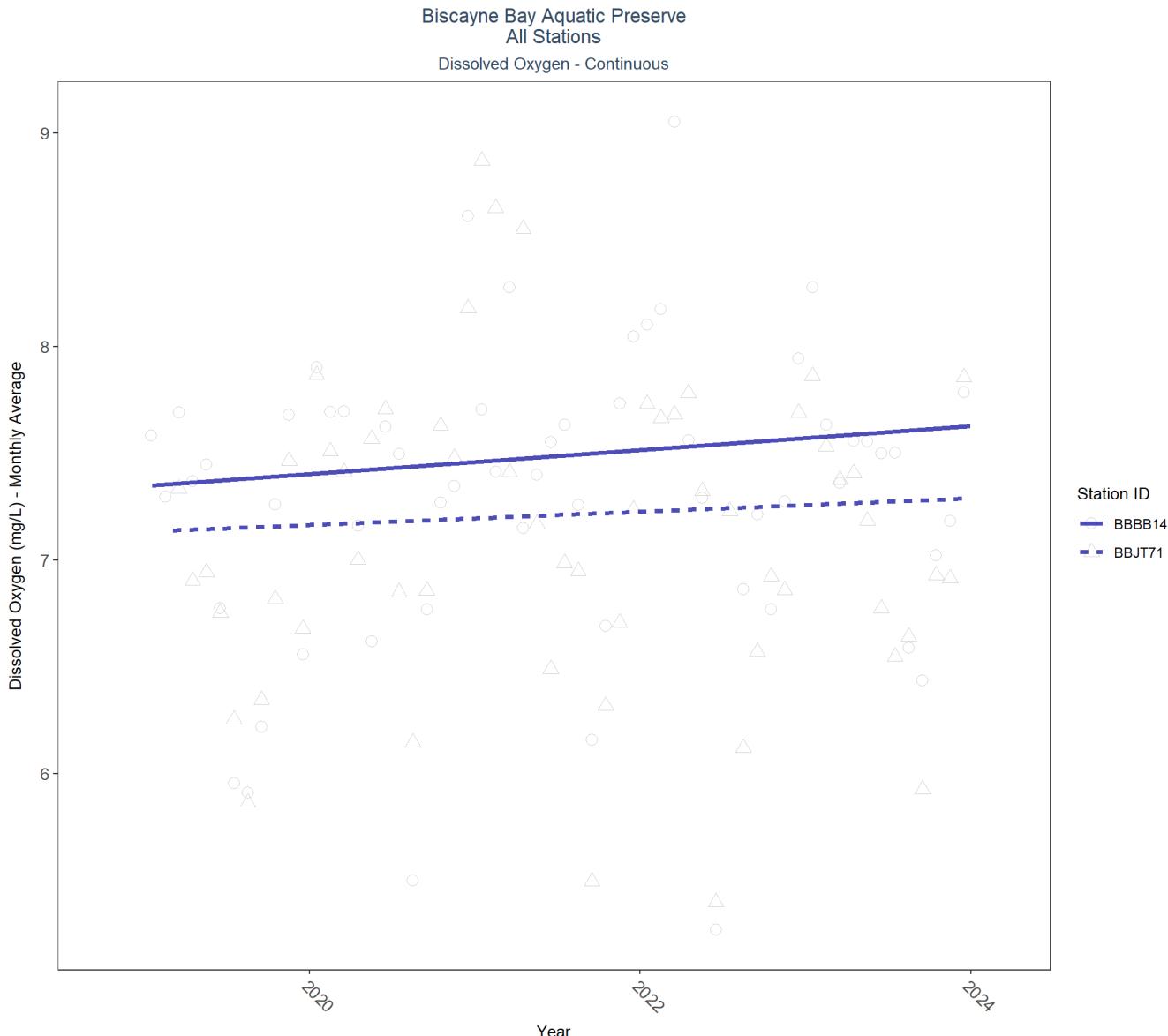


Table 25: Seasonal Kendall-Tau Results for All Stations - Dissolved Oxygen

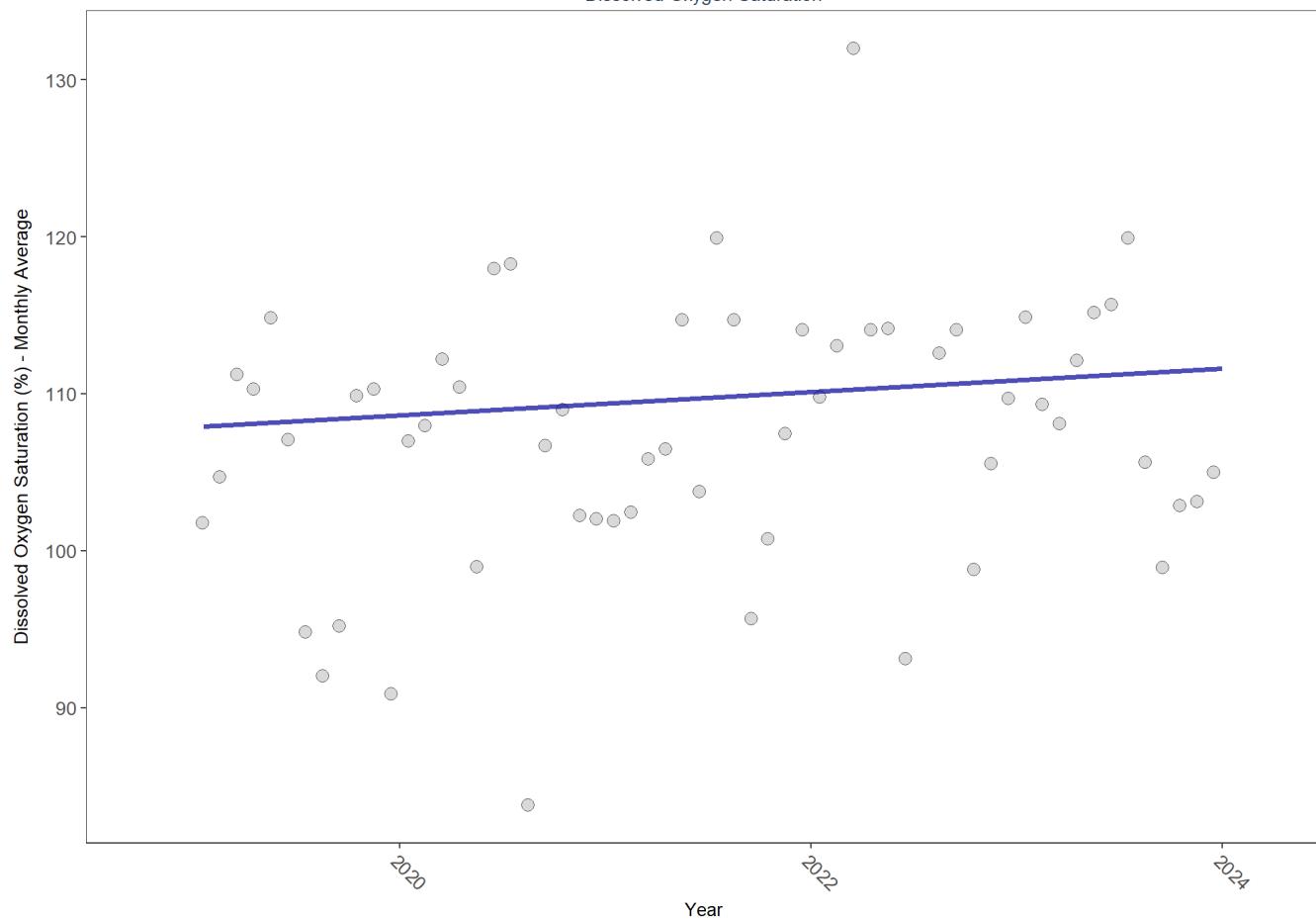
Station	N_Data	N_Years	Period of Record	Median	tau	SennIntercept	SennSlope	p
BBBB14	151799	5	2019 - 2023	7.3	0.13	7.34	0.06	0.3481
BBCWA4	62736	2	2022 - 2023	6.5	-	-	-	-
BBJT71	166857	5	2019 - 2023	7.0	0.13	7.13	0.03	0.2688
BBLR03	121719	4	2020 - 2023	4.1	-	-	-	-
BBMRDW	92968	3	2021 - 2023	4.5	-	-	-	-
BBMRRB	68245	2	2022 - 2023	6.4	-	-	-	-

## Dissolved Oxygen Saturation - Continuous Water Quality

**BBBB14**

Biscayne Bay Aquatic Preserves Continuous Water Quality Monitoring (5077)

Biscayne Bay Aquatic Preserve  
BBBB14  
Dissolved Oxygen Saturation



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

SennIntercept is intercept value at beginning of record for monitoring location

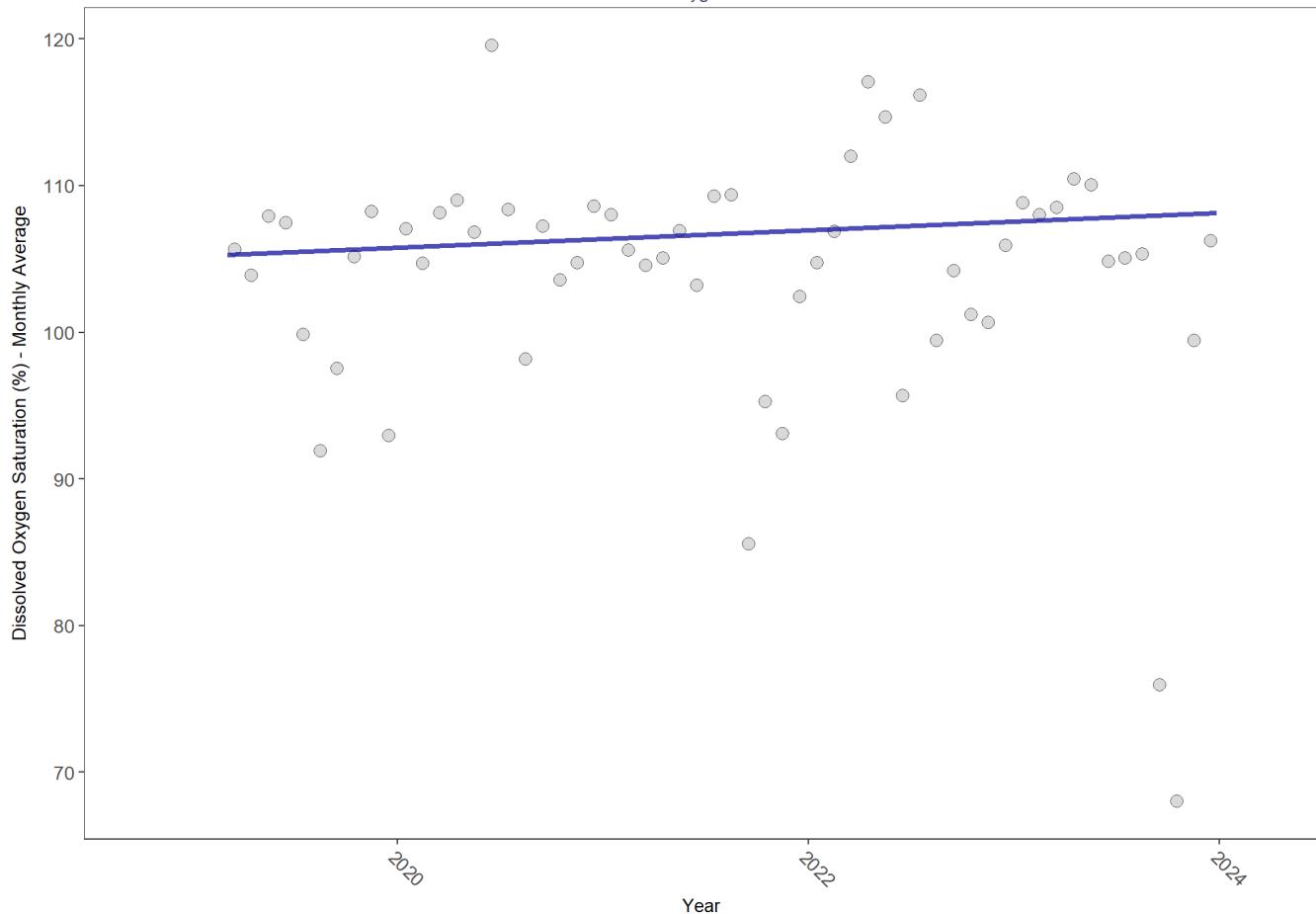
## BBJT71

Biscayne Bay Aquatic Preserves Continuous Water Quality Monitoring (5077)

Biscayne Bay Aquatic Preserve

BBJT71

Dissolved Oxygen Saturation



## All Stations Combined

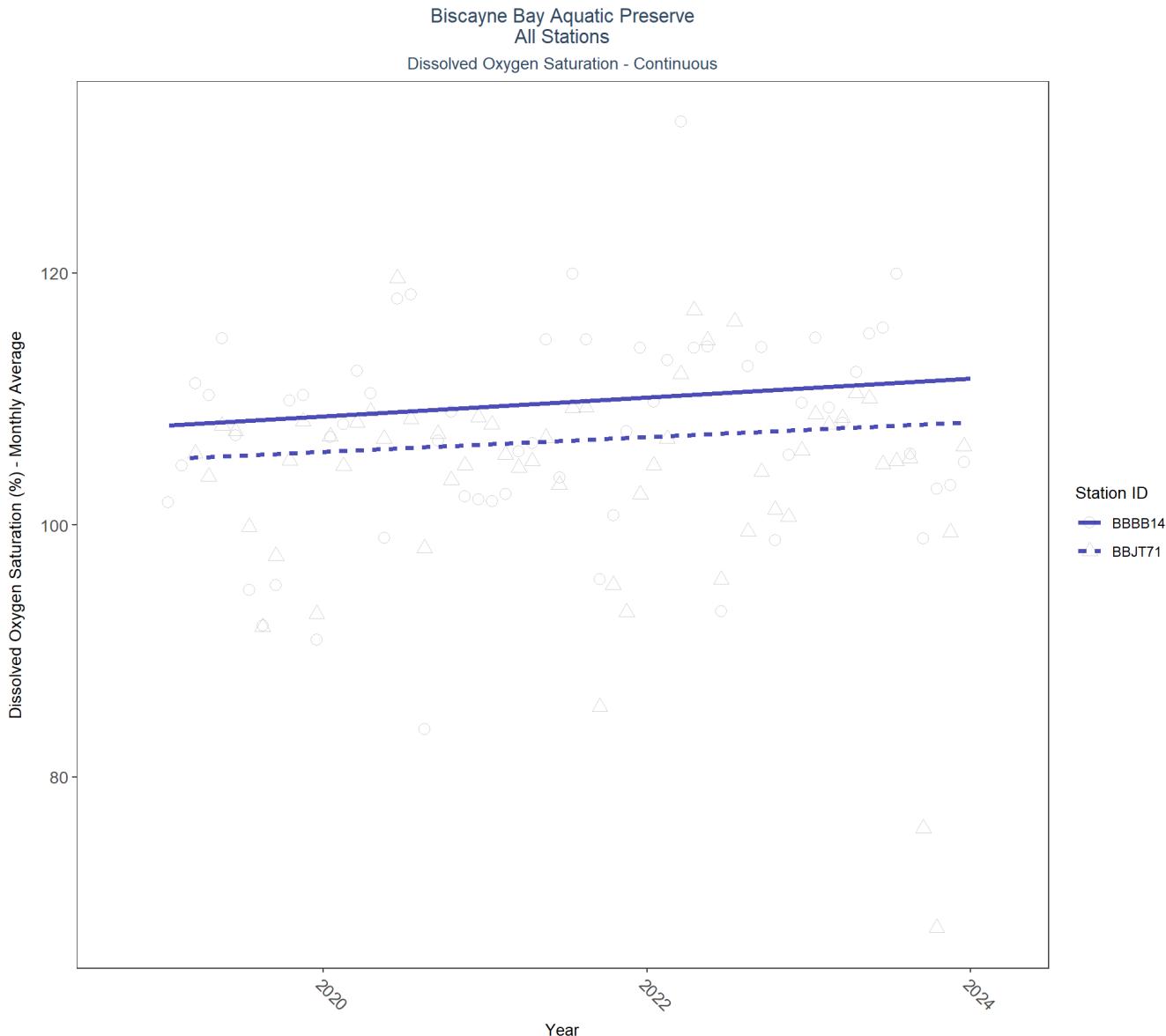


Table 26: Seasonal Kendall-Tau Results for All Stations - Dissolved Oxygen Saturation

Station	N_Data	N_Years	Period of Record	Median	tau	SennIntercept	SennSlope	p
BBBB14	151539	5	2019 - 2023	105.1	0.18	107.88	0.75	0.1703
BBCWA4	66459	2	2022 - 2023	97.3	-	-	-	-
BBJT71	168008	5	2019 - 2023	101.9	0.14	105.2	0.59	0.3379
BBLR03	121718	4	2020 - 2023	56.9	-	-	-	-
BBMRRB	68253	2	2022 - 2023	95.6	-	-	-	-
BBMRDW	92969	3	2021 - 2023	59.7	-	-	-	-

## pH - Continuous Water Quality

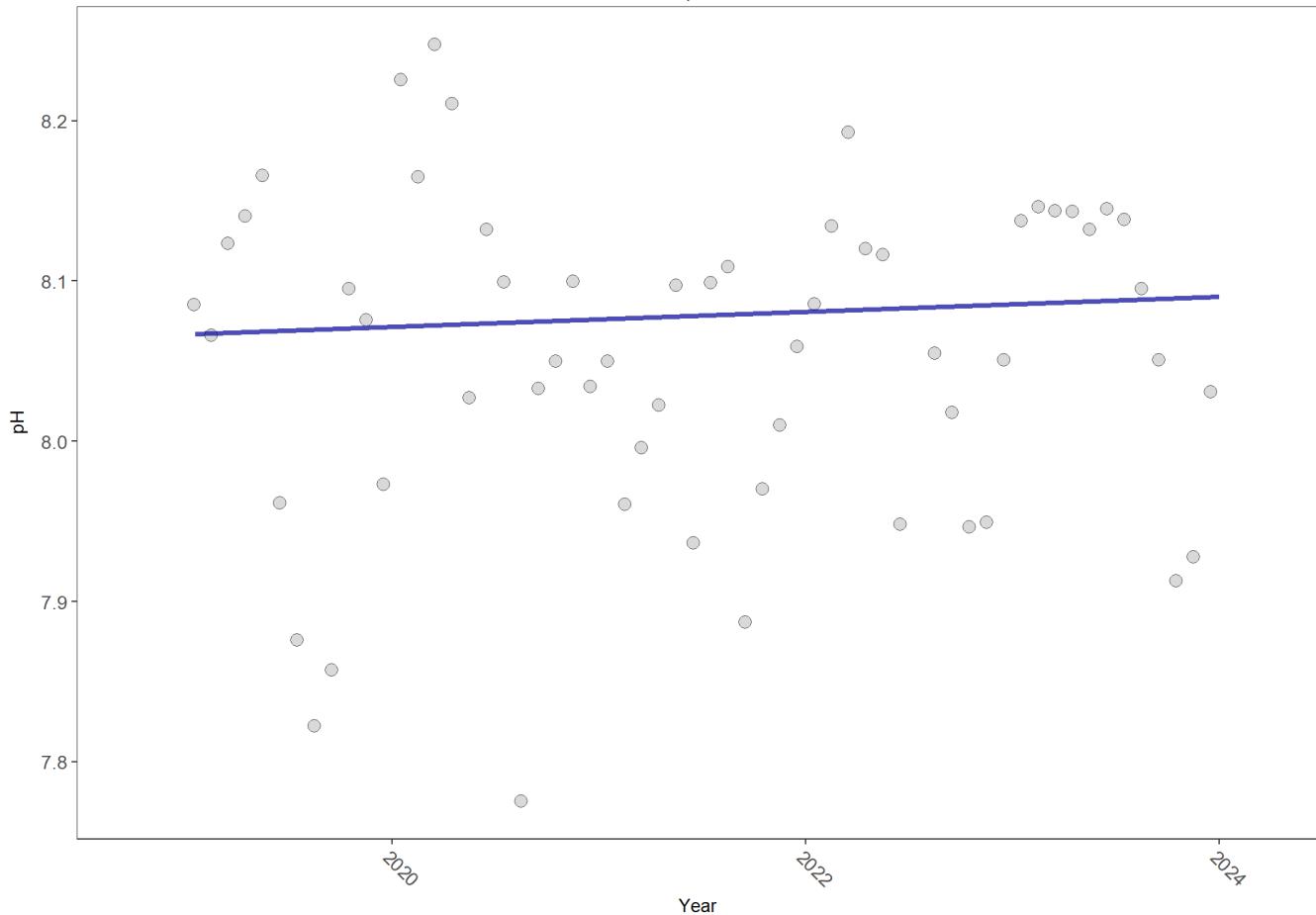
**BBBB14**

Biscayne Bay Aquatic Preserves Continuous Water Quality Monitoring (5077)

Biscayne Bay Aquatic Preserve

BBBB14

pH



RelativeDepth	N_Data	N_Years	Median	Independent	tau	p	SennSlope	SennIntercept	ChiSquared	pChiSquared	Trend
bottom	147726	5	8.1	TRUE	0.0621	0.7182	0.004688968	8.066817	15.7214	0.1518	0

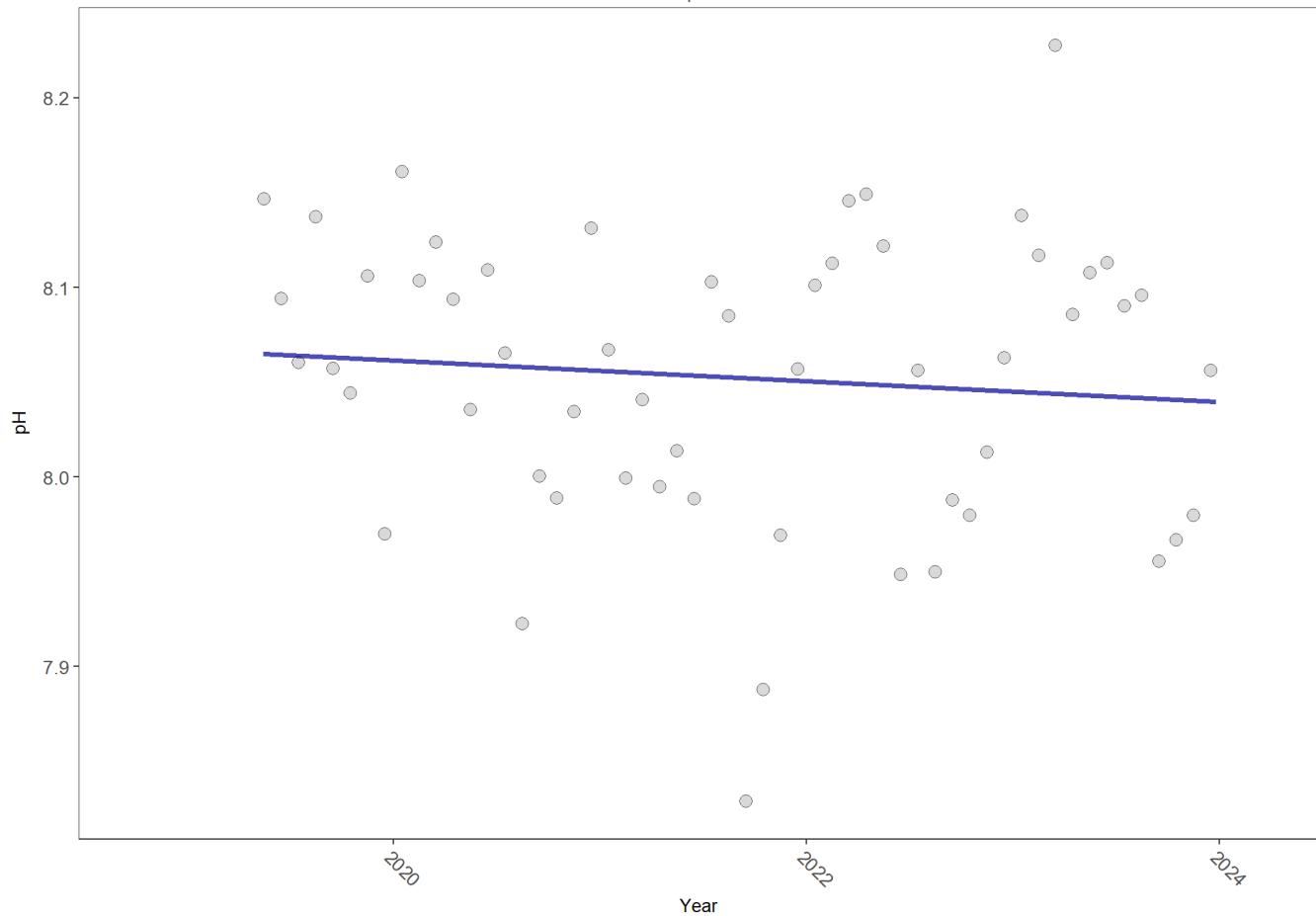
*p < 0.00005 appear as 0 due to rounding.*

*SennIntercept is intercept value at beginning of record for monitoring location*

## BBJT71

Biscayne Bay Aquatic Preserves Continuous Water Quality Monitoring (5077)

Biscayne Bay Aquatic Preserve  
BBJT71  
pH



RelativeDepth	N_Data	N_Years	Median	Independent	tau	p	SennSlope	SennIntercept	ChiSquared	pChiSquared	Trend
bottom	155269	5	8.1	TRUE	-0.0655	0.4875	-0.005454413	8.067019	10.4138	0.4936	0

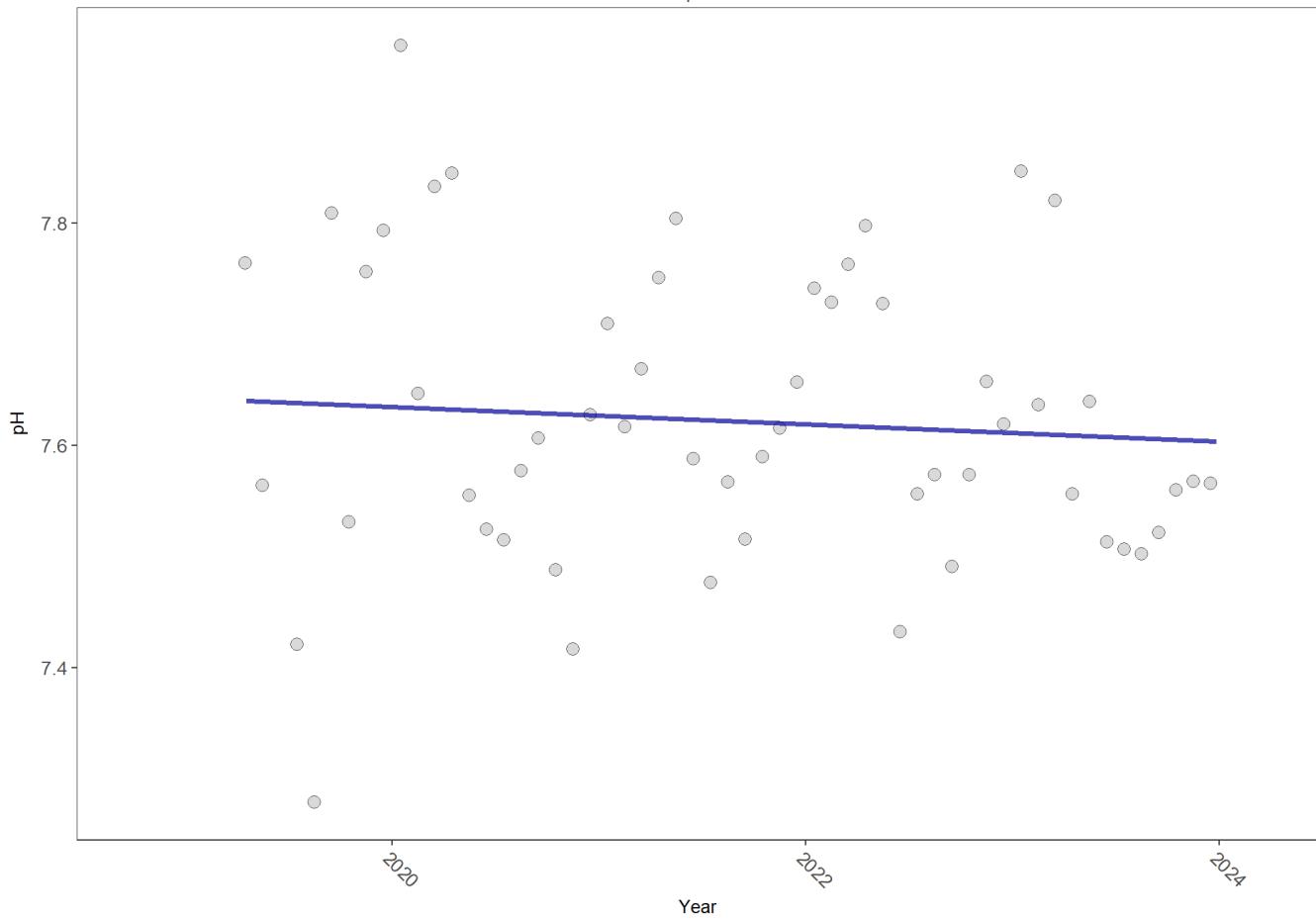
$p < 0.00005$  appear as 0 due to rounding.

*SennIntercept* is intercept value at beginning of record for monitoring location

## BBLR03

Biscayne Bay Aquatic Preserves Continuous Water Quality Monitoring (5077)

Biscayne Bay Aquatic Preserve  
BBLR03  
pH



## All Stations Combined

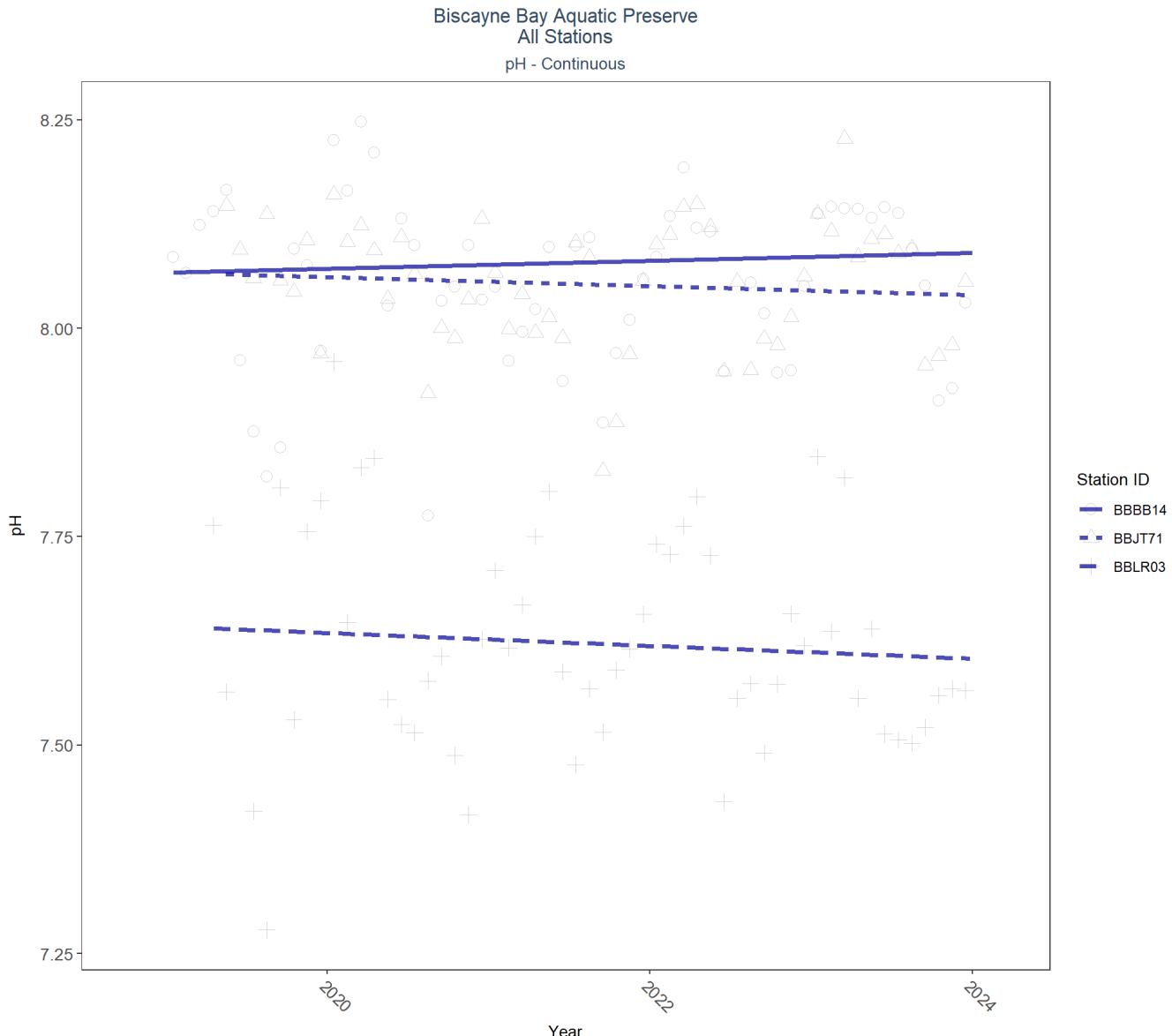


Table 27: Seasonal Kendall-Tau Results for All Stations - pH

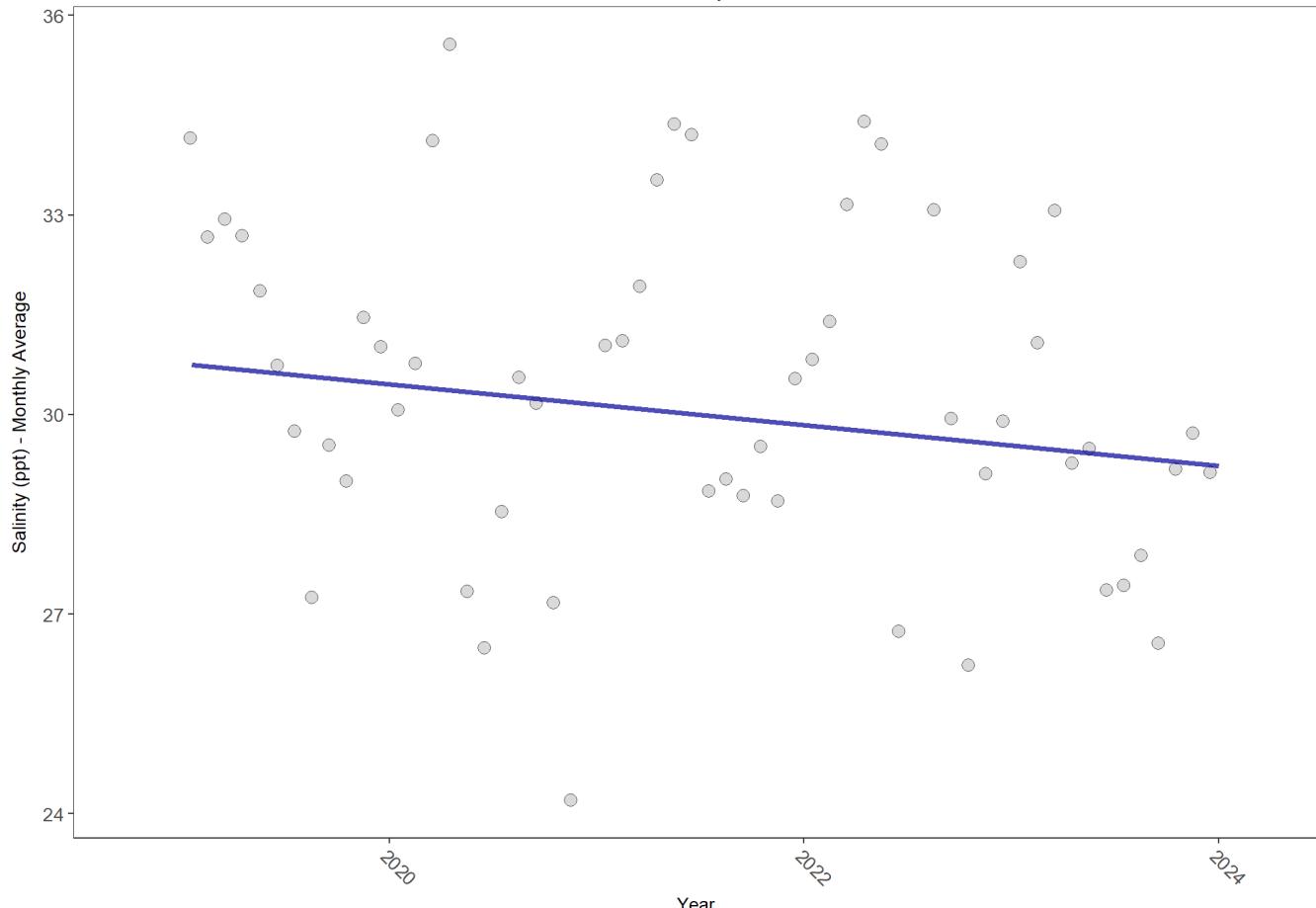
Station	N_Data	N_Years	Period of Record	Median	tau	SennIntercept	SennSlope	p
BBBB14	147726	5	2019 - 2023	8.1	0.06	8.07	0	0.7182
BBCWA4	66641	2	2022 - 2023	8.0	-	-	-	-
BBJT71	155269	5	2019 - 2023	8.1	-0.07	8.07	-0.01	0.4875
BBLR03	138608	5	2019 - 2023	7.6	-0.13	7.64	-0.01	0.3159
BBMRRB	68297	2	2022 - 2023	8.0	-	-	-	-
BBMRDW	89423	3	2021 - 2023	7.6	-	-	-	-

## Salinity - Continuous Water Quality

**BBBB14**

Biscayne Bay Aquatic Preserves Continuous Water Quality Monitoring (5077)

Biscayne Bay Aquatic Preserve  
BBBB14  
Salinity



RelativeDepth	N_Data	N_Years	Median	Independent	tau	p	SennSlope	SennIntercept	ChiSquared	pChiSquared	Trend
bottom	141413	5	30.2	TRUE	-0.1494	0.3379	-0.3061468	30.7611	6.3238	0.8509	0

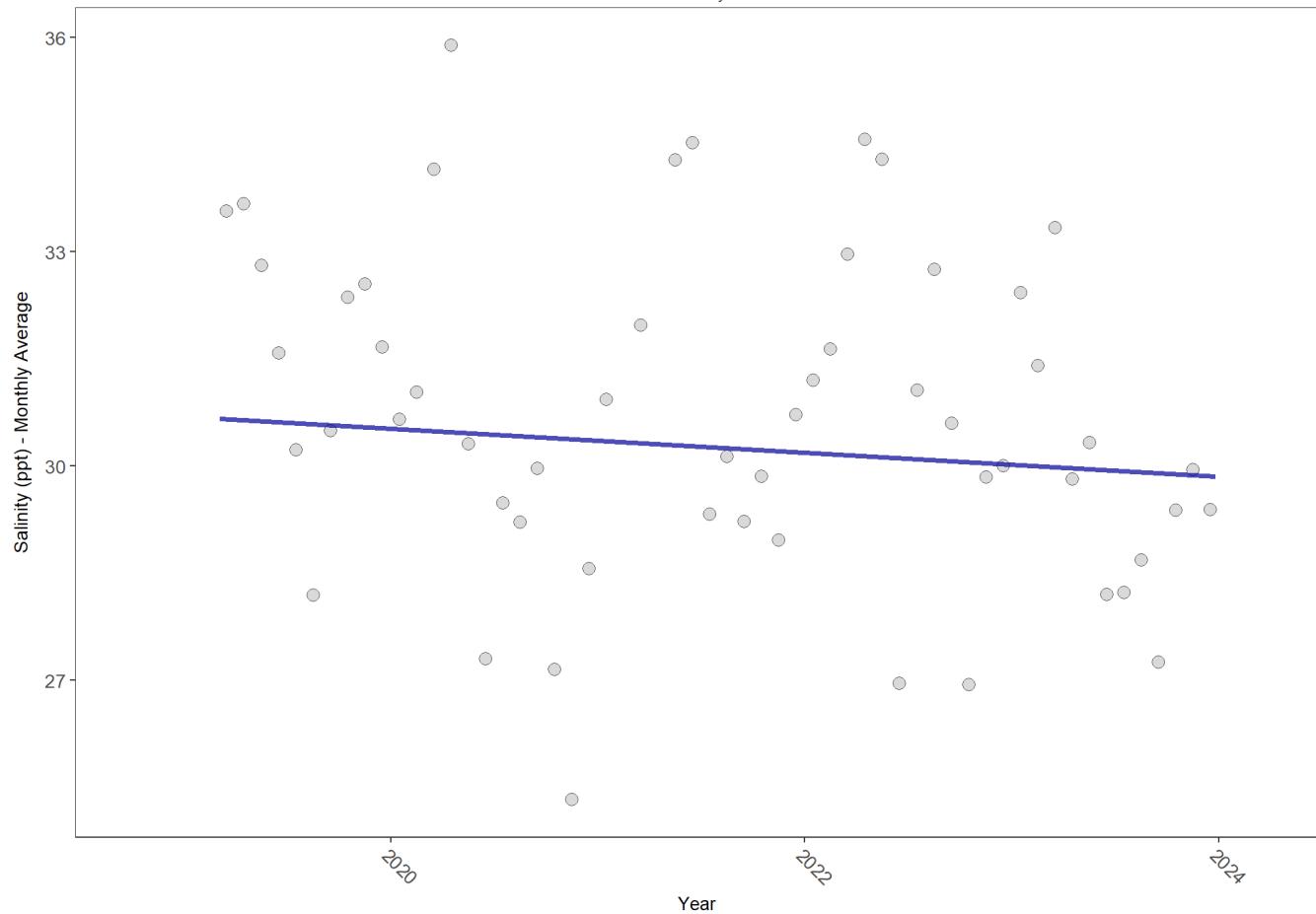
*p < 0.00005 appear as 0 due to rounding.*

*SennIntercept is intercept value at beginning of record for monitoring location*

## BBJT71

Biscayne Bay Aquatic Preserves Continuous Water Quality Monitoring (5077)

Biscayne Bay Aquatic Preserve  
BBJT71  
Salinity



RelativeDepth	N_Data	N_Years	Median	Independent	tau	p	SennSlope	SennIntercept	ChiSquared	pChiSquared	Trend
bottom	153093	5	30.9	TRUE	-0.0417	0.6464	-0.1687103	30.69589	10.5548	0.4813	0

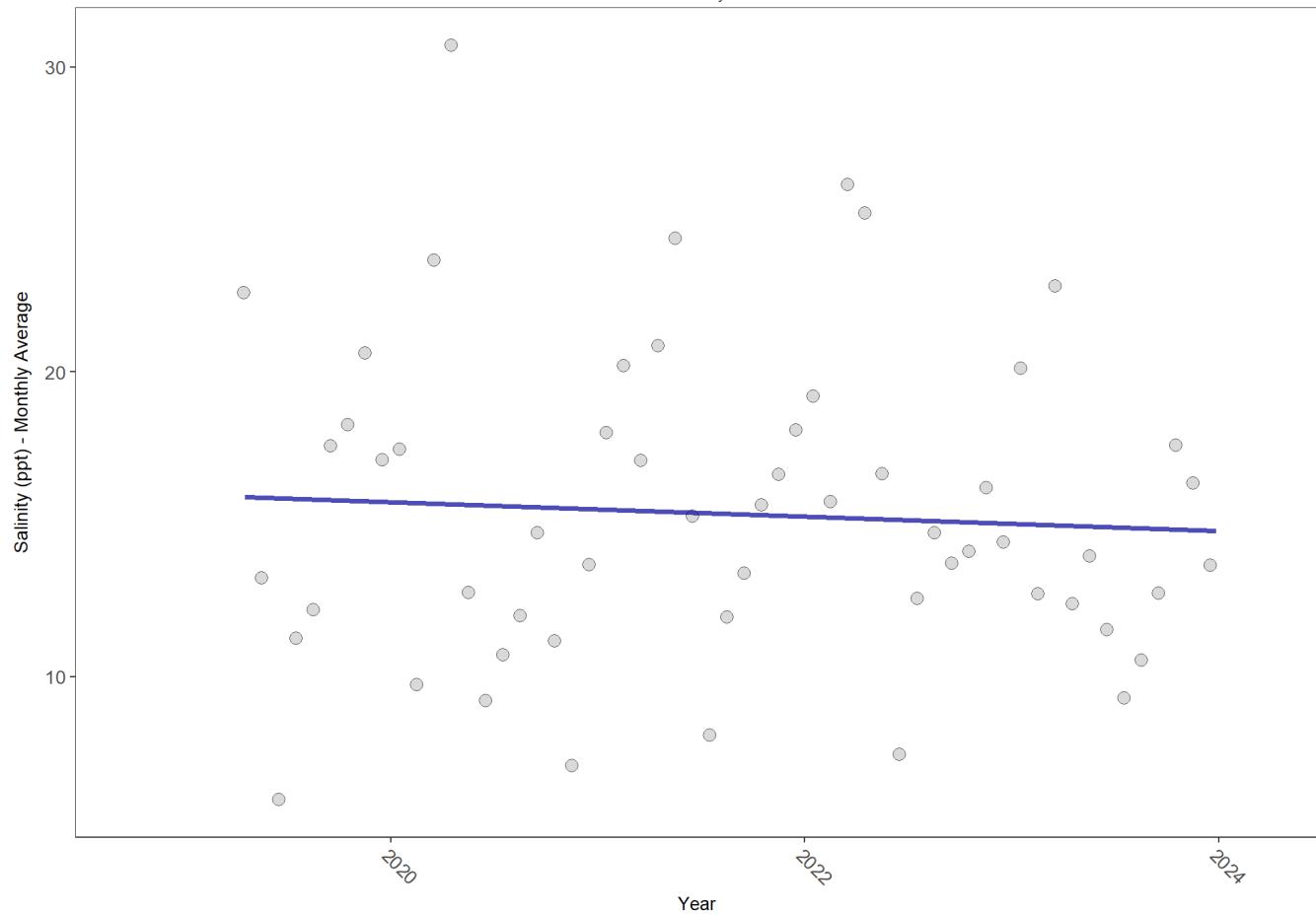
*p < 0.00005 appear as 0 due to rounding.*

*SennIntercept is intercept value at beginning of record for monitoring location*

## BBLR03

Biscayne Bay Aquatic Preserves Continuous Water Quality Monitoring (5077)

Biscayne Bay Aquatic Preserve  
BBLR03  
Salinity



RelativeDepth	N_Data	N_Years	Median	Independent	tau	p	SennSlope	SennIntercept	ChiSquared	pChiSquared	Trend
bottom	143095	5	15.9	TRUE	-0.0877	0.4070	-0.2359276	15.96057	12.0854	0.3573	0

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

*SennIntercept is intercept value at beginning of record for monitoring location*

## All Stations Combined

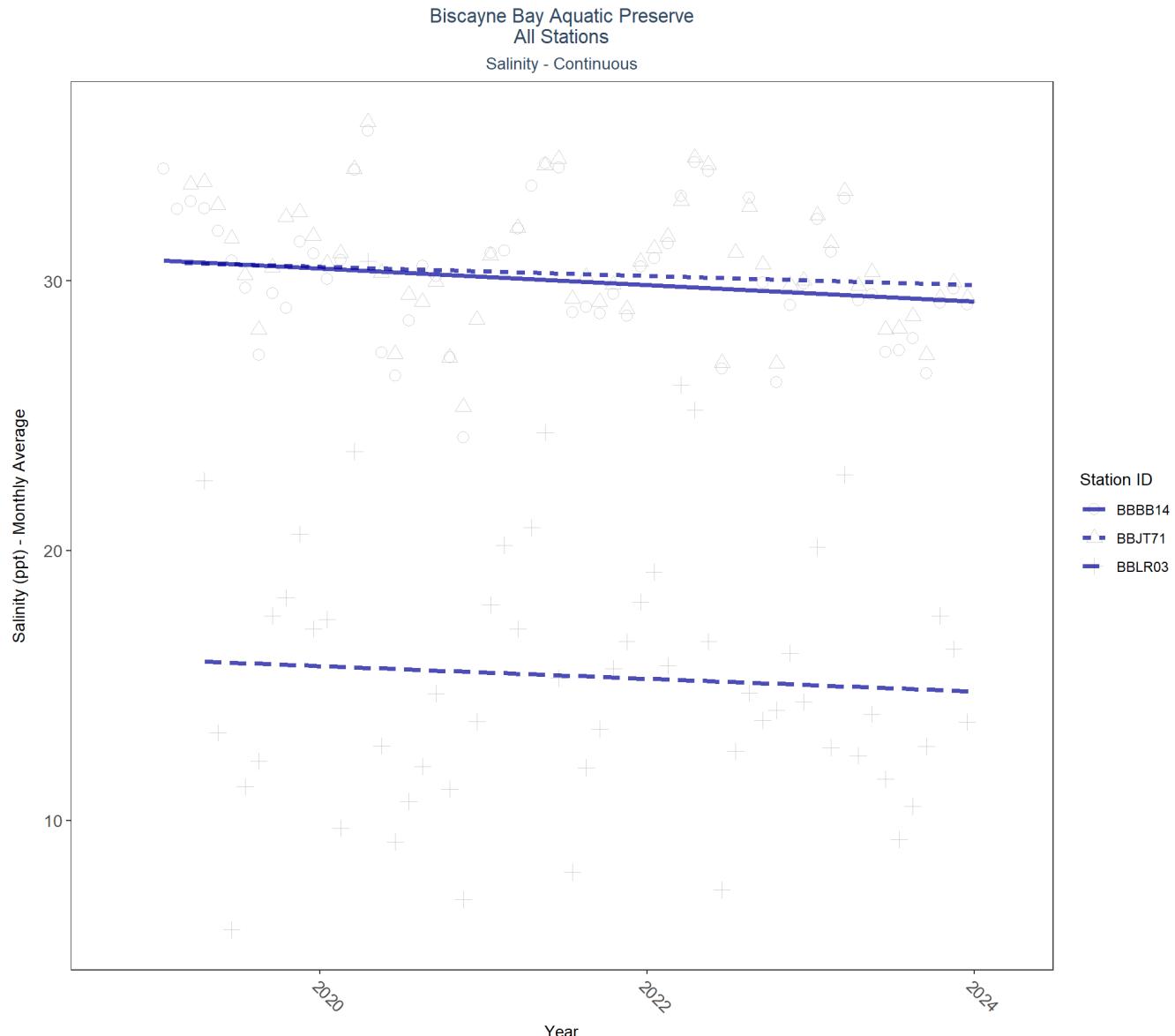


Table 28: Seasonal Kendall-Tau Results for All Stations - Salinity

Station	N_Data	N_Years	Period of Record	Median	tau	SennIntercept	SennSlope	p
BBBB14	141413	5	2019 - 2023	30.2	-0.15	30.76	-0.31	0.3379
BBCWA4	60851	2	2022 - 2023	33.6	-	-	-	-
BBJT71	153093	5	2019 - 2023	30.9	-0.04	30.7	-0.17	0.6464
BBLR03	143095	5	2019 - 2023	15.9	-0.09	15.96	-0.24	0.4070
BBMRRB	68253	2	2022 - 2023	33.1	-	-	-	-
BBMRDW	91097	3	2021 - 2023	10.1	-	-	-	-

## Turbidity - Continuous Water Quality

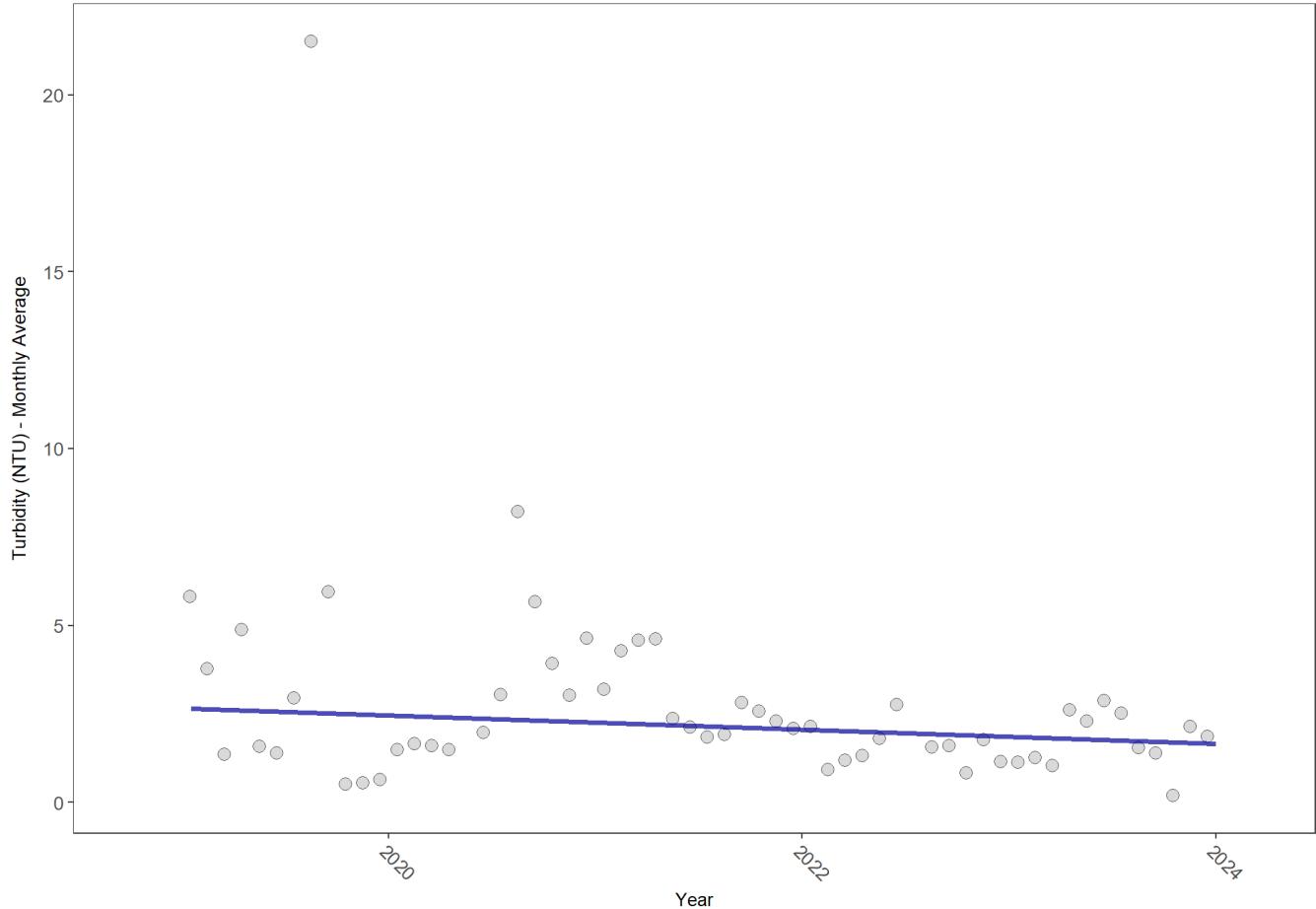
**BBBB14**

Biscayne Bay Aquatic Preserves Continuous Water Quality Monitoring (5077)

Biscayne Bay Aquatic Preserve

BBBB14

Turbidity



RelativeDepth	N_Data	N_Years	Median	Independent	tau	p	SennSlope	SennIntercept	ChiSquared	pChiSquared	Trend
bottom	140915	5	2	TRUE	-0.2759	0.0223	-0.1975344	2.650642	19.8031	0.0481	-1

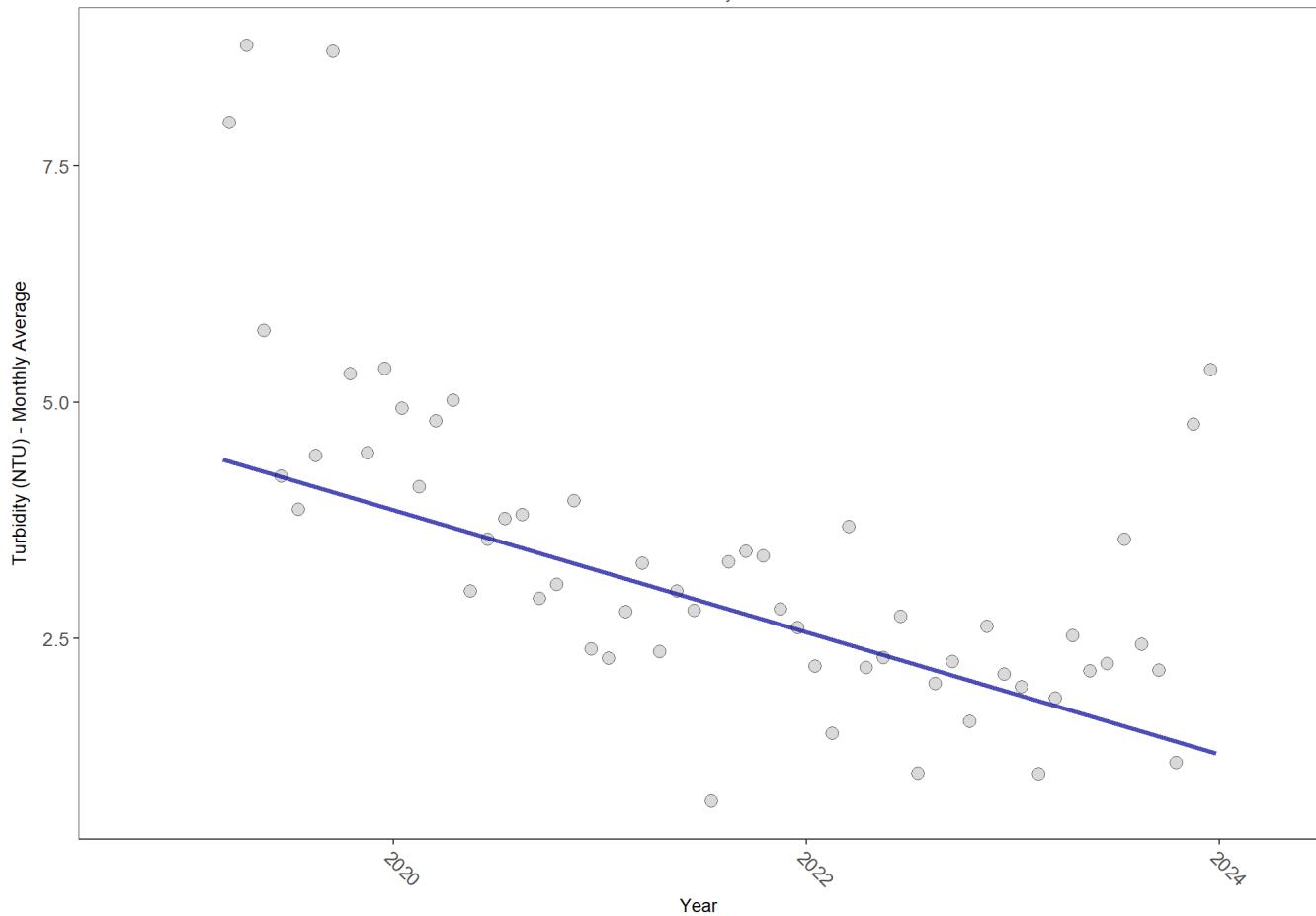
*p < 0.00005 appear as 0 due to rounding.*

*SennIntercept is intercept value at beginning of record for monitoring location*

## BBJT71

Biscayne Bay Aquatic Preserves Continuous Water Quality Monitoring (5077)

Biscayne Bay Aquatic Preserve  
BBJT71  
Turbidity



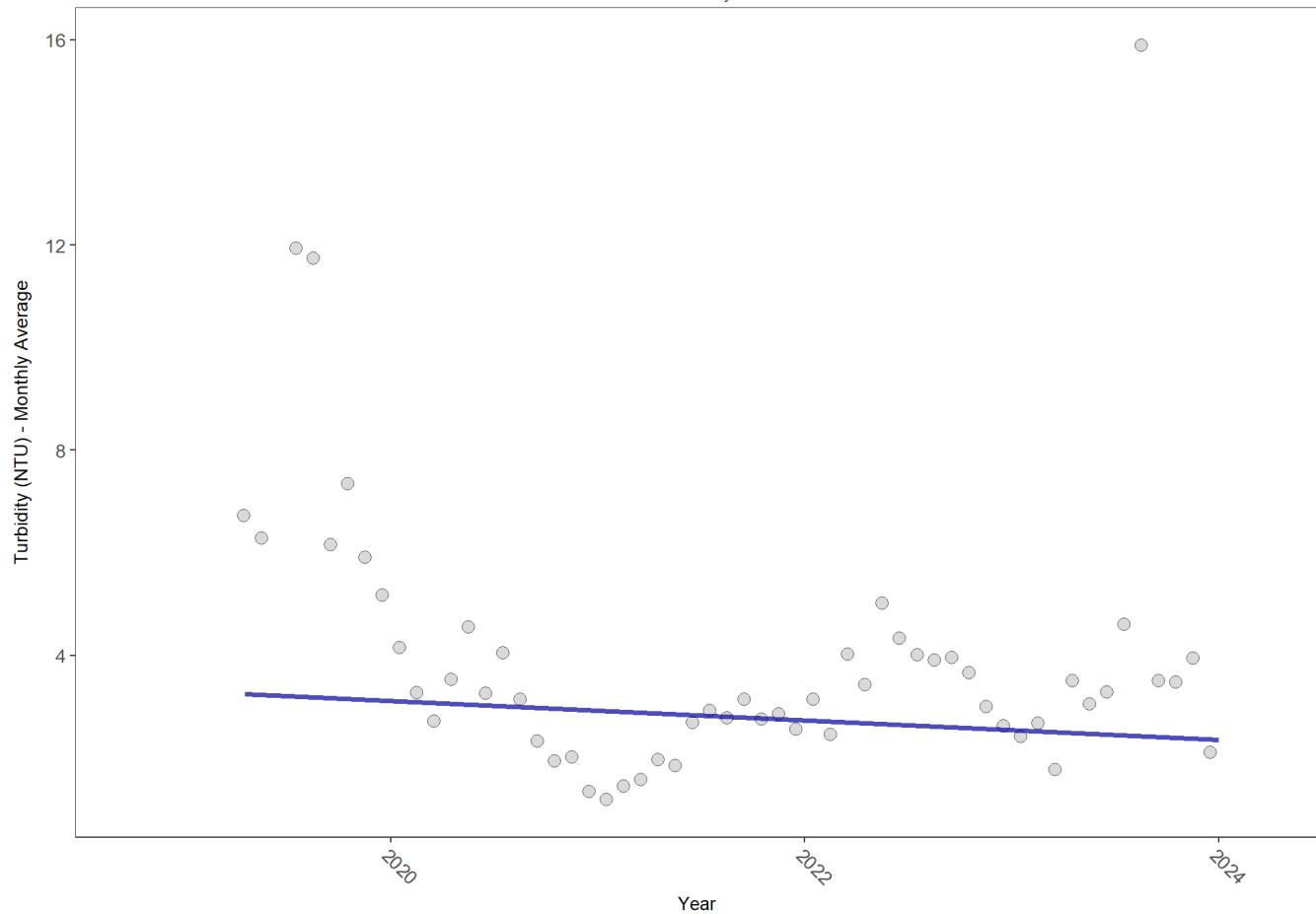
$p < 0.00005$  appear as 0 due to rounding.

*SennIntercept* is intercept value at beginning of record for monitoring location

## BBLR03

Biscayne Bay Aquatic Preserves Continuous Water Quality Monitoring (5077)

Biscayne Bay Aquatic Preserve  
BBLR03  
Turbidity



RelativeDepth	N_Data	N_Years	Median	Independent	tau	p	SennSlope	SennIntercept	ChiSquared	pChiSquared	Trend
bottom	144183	5	3	TRUE	-0.0714	0.5892	-0.1884805	3.303624	3.4831	0.9827	0

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

*SennIntercept is intercept value at beginning of record for monitoring location*

## All Stations Combined

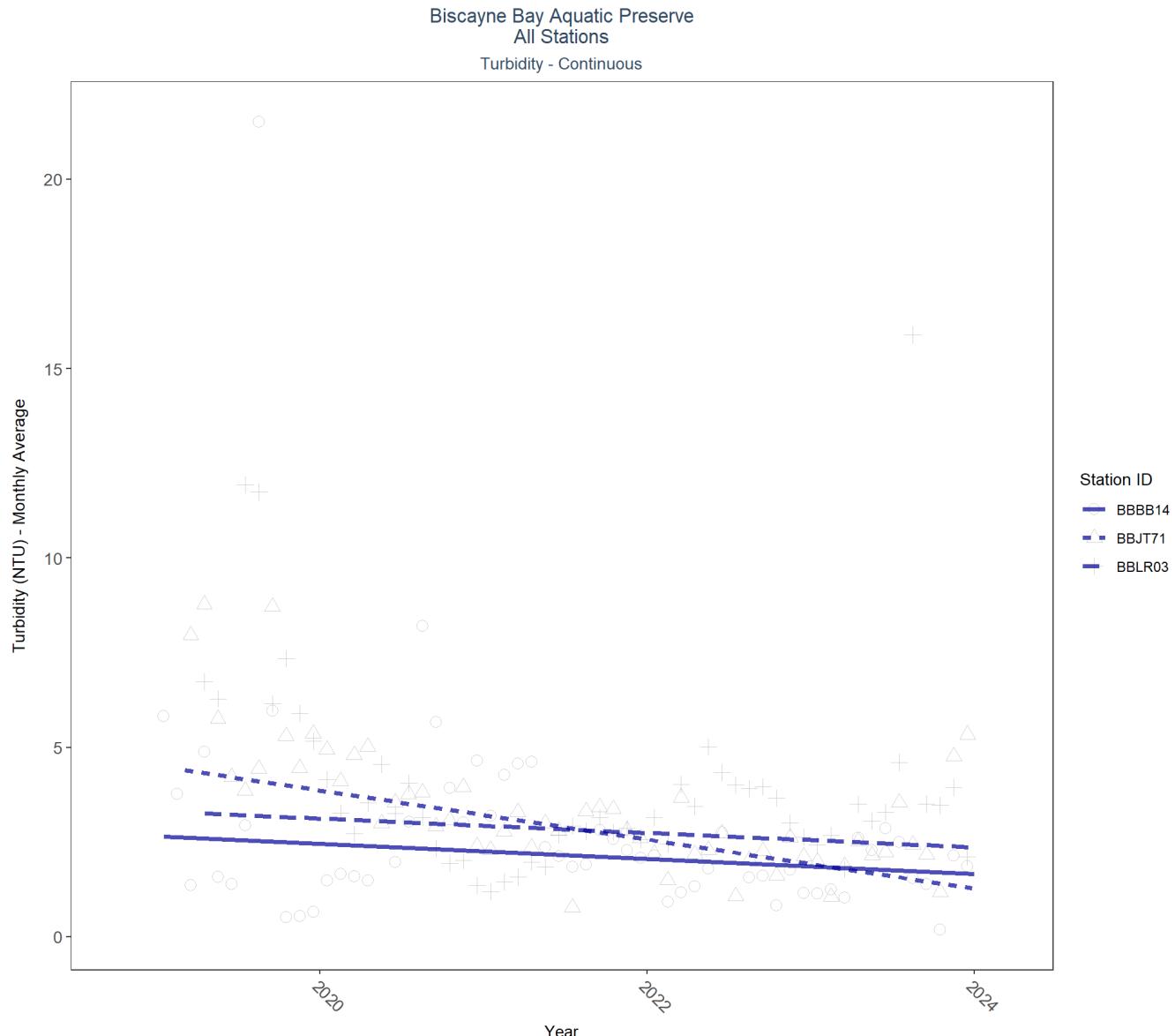


Table 29: Seasonal Kendall-Tau Results for All Stations - Turbidity

Station	N_Data	N_Years	Period of Record	Median	tau	SennIntercept	SennSlope	p
BBBB14	140915	5	2019 - 2023	2	-0.28	2.65	-0.2	0.0223
BBCWA4	64050	2	2022 - 2023	2	-	-	-	-
BBJT71	160970	5	2019 - 2023	3	-0.69	4.51	-0.65	0.0000
BBLR03	144183	5	2019 - 2023	3	-0.07	3.3	-0.19	0.5892
BBMRRB	67454	2	2022 - 2023	3	-	-	-	-
BBMRDW	92695	3	2021 - 2023	2	-	-	-	-

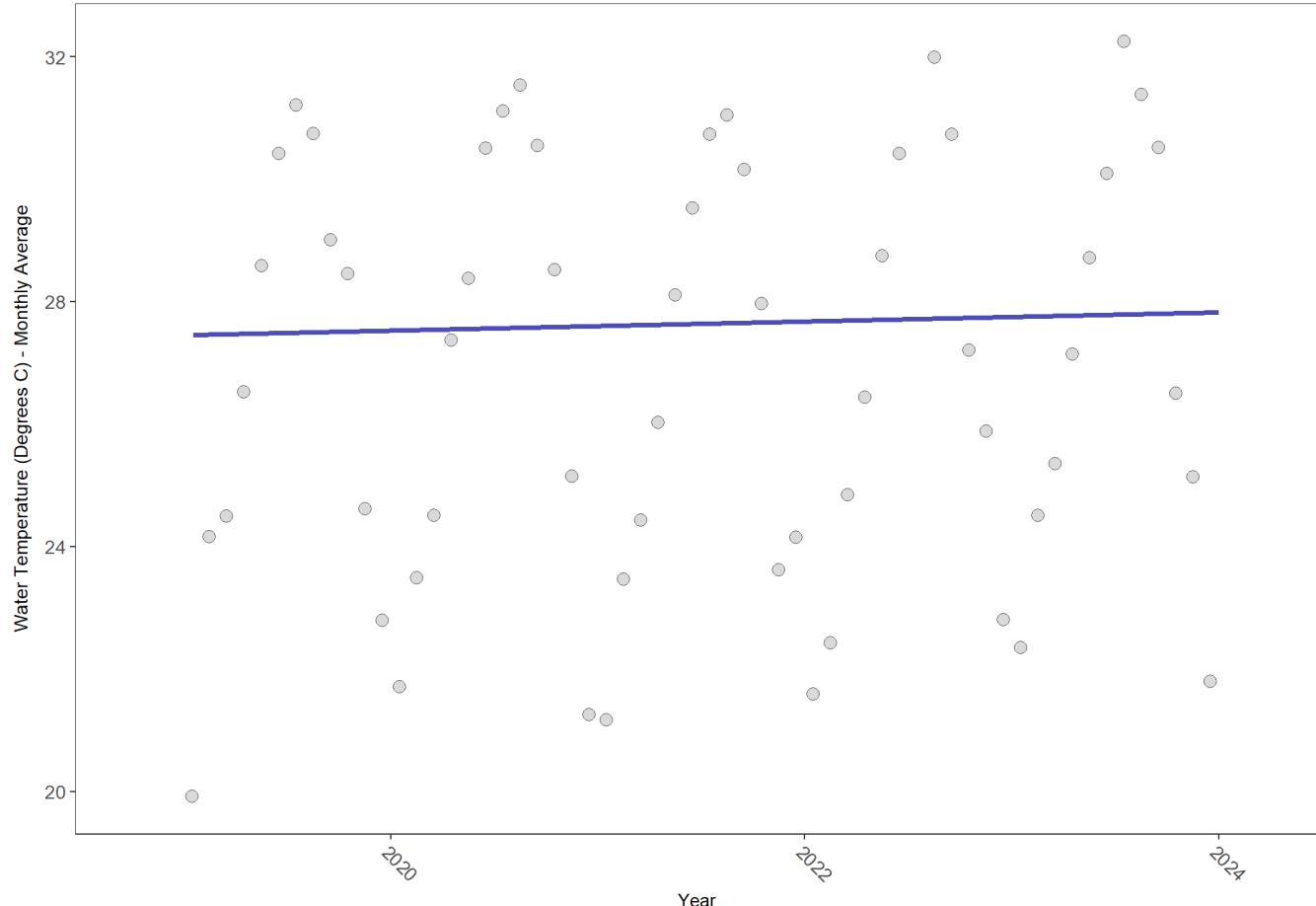
## Water Temperature - Continuous Water Quality

**BBBB14**

Biscayne Bay Aquatic Preserves Continuous Water Quality Monitoring (5077)

Biscayne Bay Aquatic Preserve  
BBBB14

Water Temperature



RelativeDepth	N_Data	N_Years	Median	Independent	tau	p	SennSlope	SennIntercept	ChiSquared	pChiSquared	Trend
bottom	151911	5	27.2	TRUE	0.1017	0.4273	0.07338344	27.45353	10.32	0.5019	0

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

*SennIntercept is intercept value at beginning of record for monitoring location*

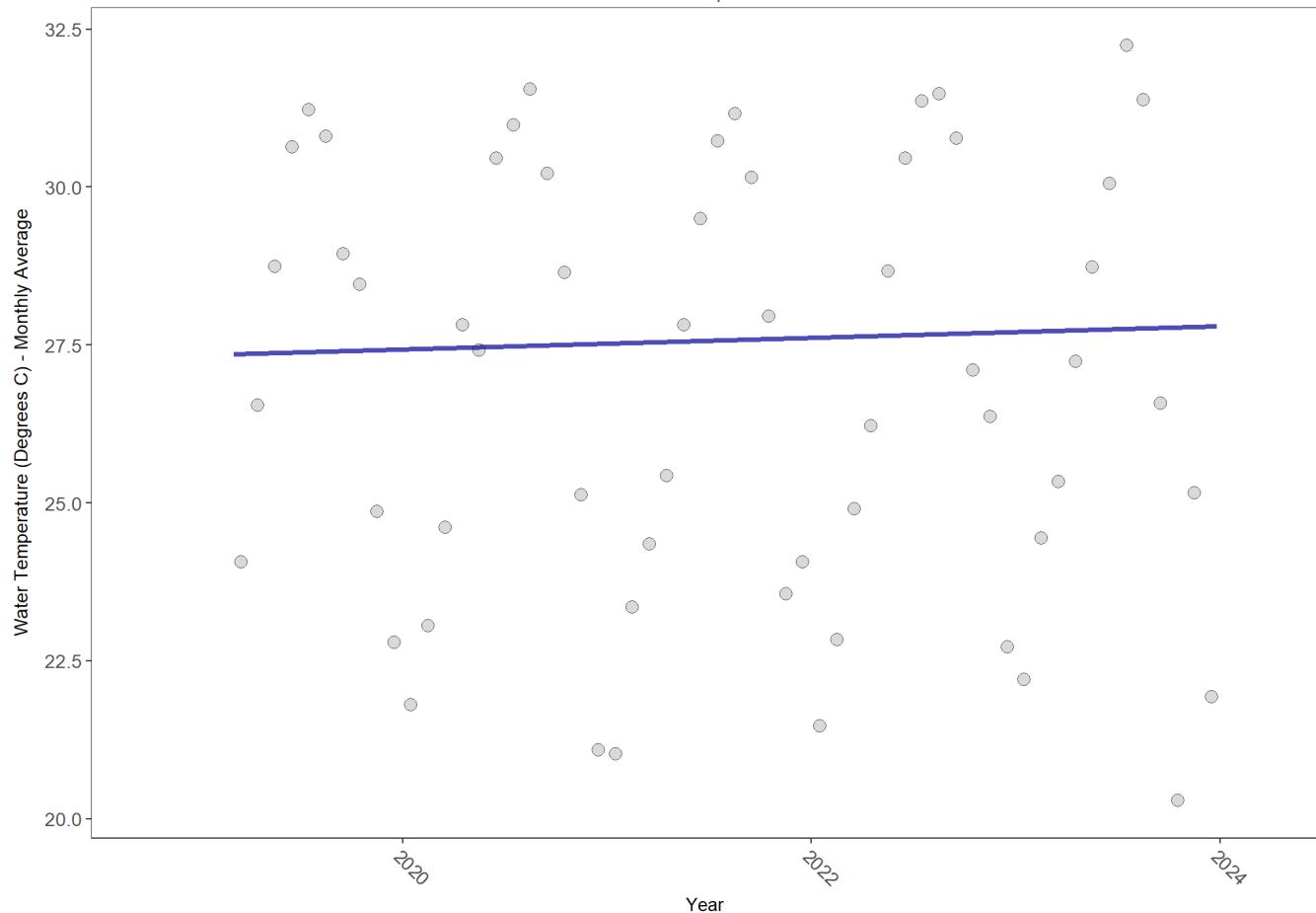
## BBJT71

Biscayne Bay Aquatic Preserves Continuous Water Quality Monitoring (5077)

Biscayne Bay Aquatic Preserve

BBJT71

Water Temperature



RelativeDepth	N_Data	N_Years	Median	Independent	tau	p	SennSlope	SennIntercept	ChiSquared	pChiSquared	Trend
bottom	168360	5	27.4	TRUE	0.0805	0.6058	0.0909294	27.34282	12.9474	0.2968	0

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

*SennIntercept is intercept value at beginning of record for monitoring location*

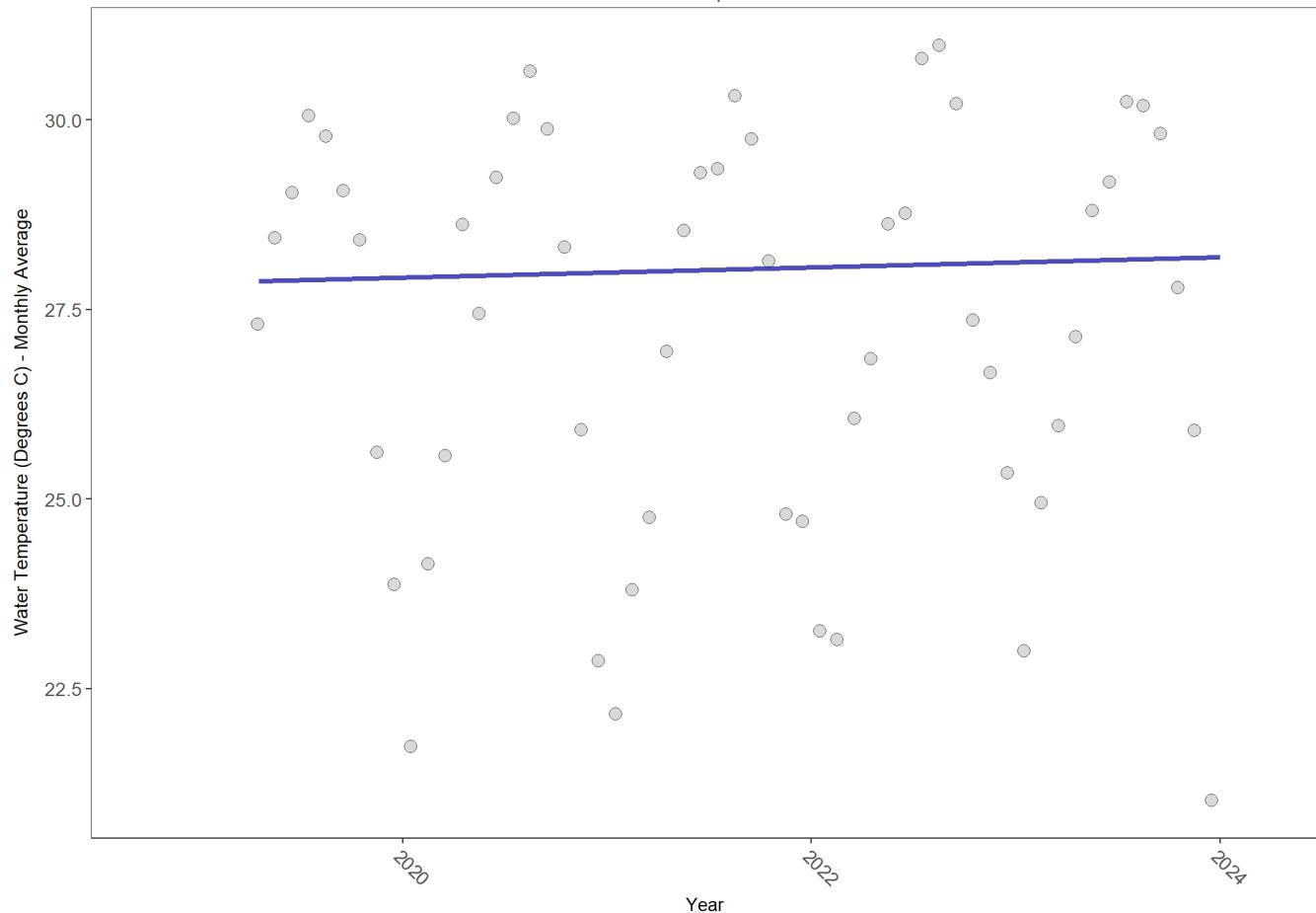
## BBLR03

Biscayne Bay Aquatic Preserves Continuous Water Quality Monitoring (5077)

Biscayne Bay Aquatic Preserve

BBLR03

Water Temperature



RelativeDepth	N_Data	N_Years	Median	Independent	tau	p	SennSlope	SennIntercept	ChiSquared	pChiSquared	Trend
bottom	147985	5	27.9	TRUE	0.1228	0.4070	0.06690071	27.85779	11.6023	0.3943	0

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

*SennIntercept is intercept value at beginning of record for monitoring location*

## All Stations Combined

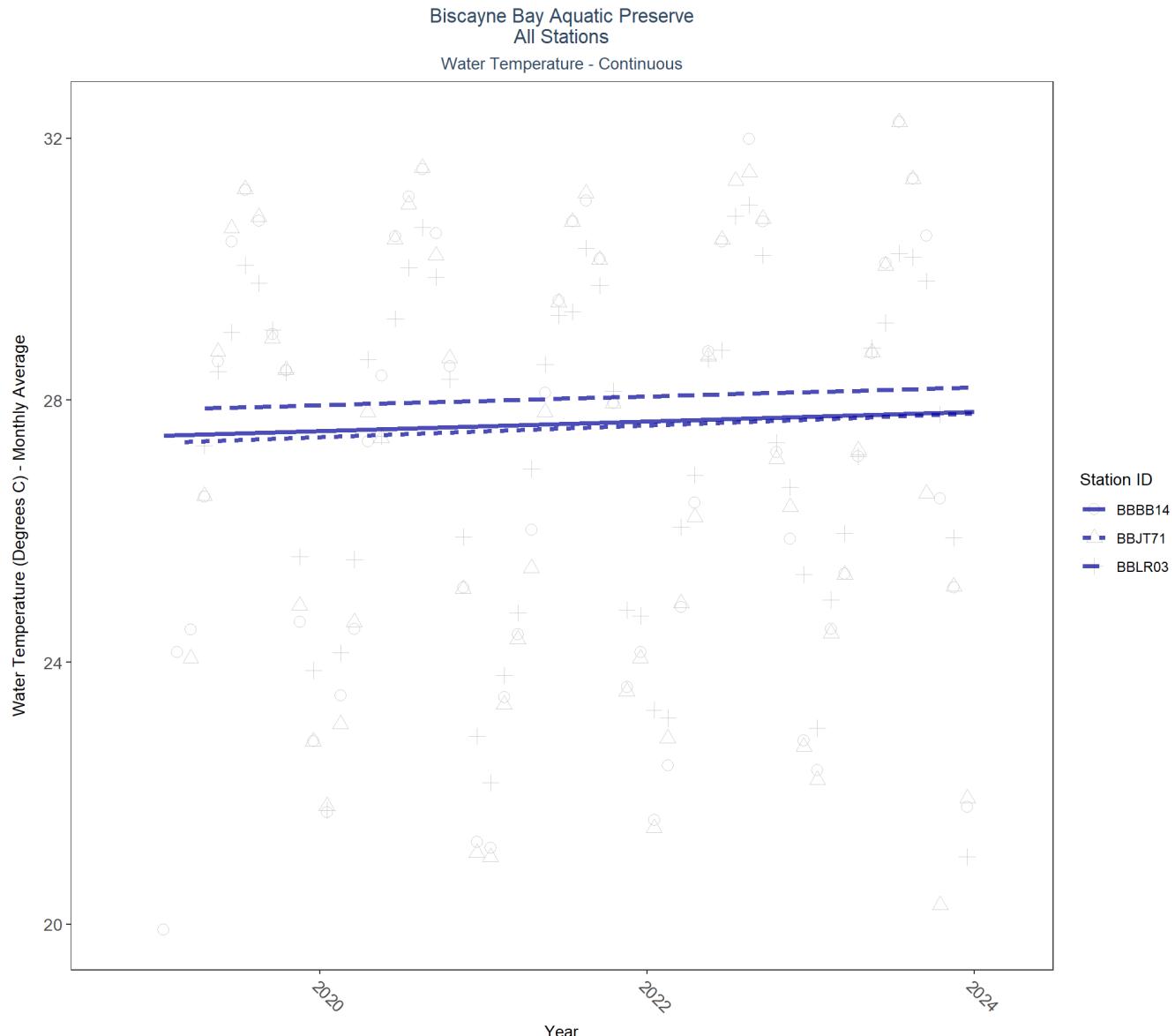


Table 30: Seasonal Kendall-Tau Results for All Stations - Water Temperature

Station	N_Data	N_Years	Period of Record	Median	tau	SennIntercept	SennSlope	p
BBBB14	151911	5	2019 - 2023	27.2	0.1	27.45	0.07	0.4273
BBCWA4	66642	2	2022 - 2023	27.2	-	-	-	-
BBJT71	168360	5	2019 - 2023	27.4	0.08	27.34	0.09	0.6058
BBLR03	147985	5	2019 - 2023	27.9	0.12	27.86	0.07	0.4070
BBMRRB	68297	2	2022 - 2023	27.4	-	-	-	-
BBMRDW	92980	3	2021 - 2023	27.7	-	-	-	-

# 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.

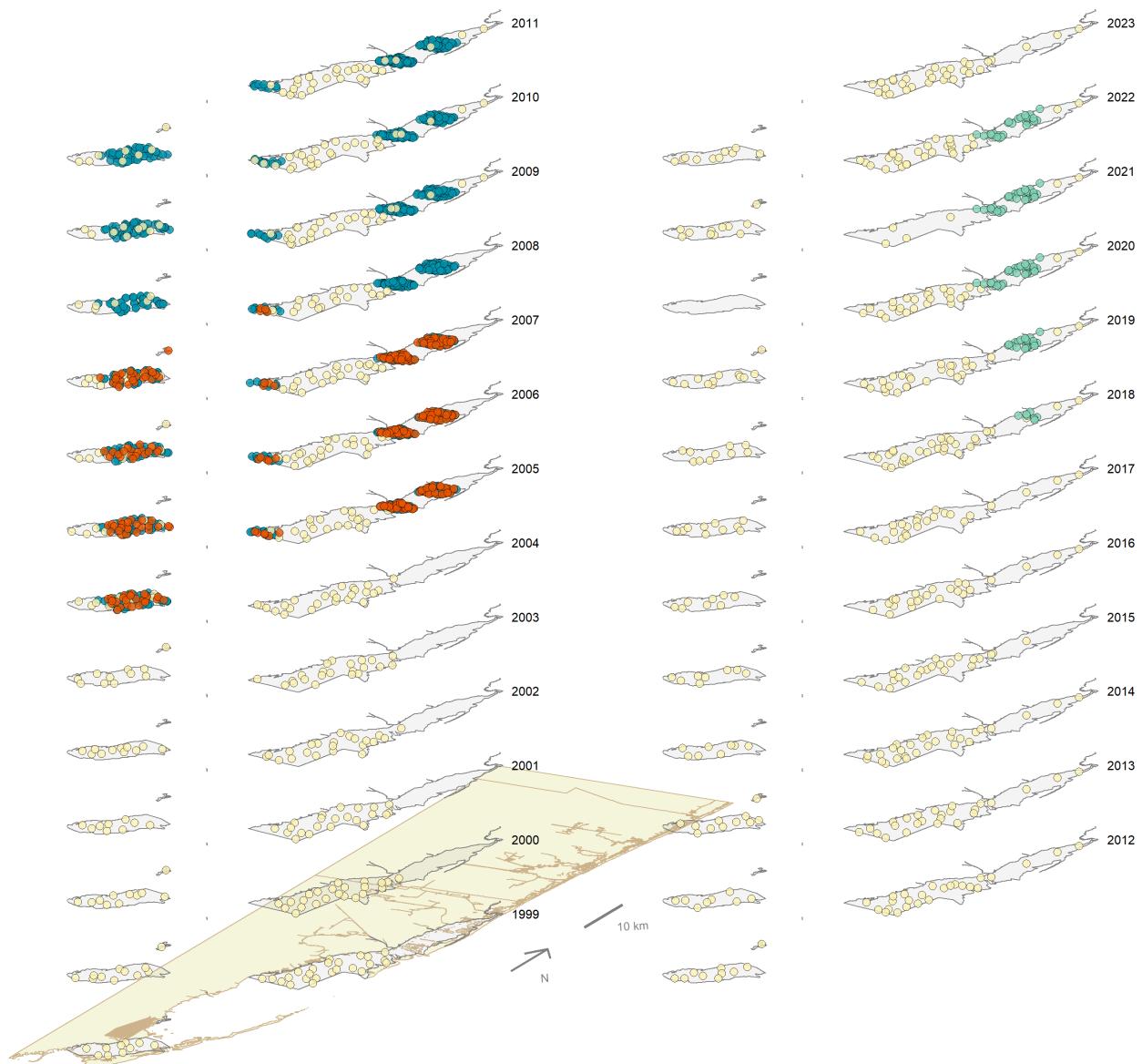
## Notes

*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

Biscayne Bay Aquatic Preserve  
SAV Percent Cover - Sample Locations

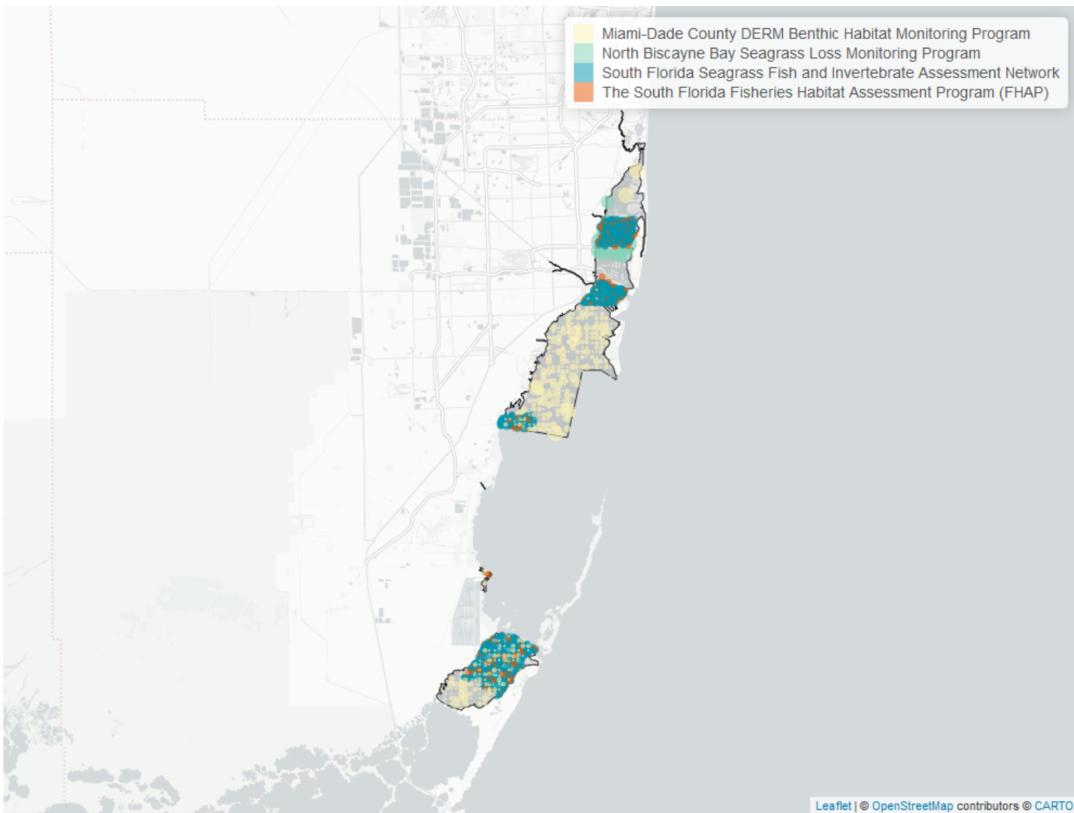


Program name

- Miami-Dade County DERM Benthic Habitat Monitoring Program
- South Florida Seagrass Fish and Invertebrate Assessment Network
- The South Florida Fisheries Habitat Assessment Program (FHAP)
- North Biscayne Bay Seagrass Loss Monitoring Program

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

**Sampling locations by Program:**



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

Table 31: South Florida Seagrass Fish and Invertebrate Assessment Network - *Program 965*

<i>N_Data</i>	<i>YearMin</i>	<i>YearMax</i>	<i>Collection Method</i>	<i>Sample Locations</i>
71071	2005	2011	Braun Blanquet	94

Table 32: Miami-Dade County DERM Benthic Habitat Monitoring Program - *Program 4018*

<i>N_Data</i>	<i>YearMin</i>	<i>YearMax</i>	<i>Collection Method</i>	<i>Sample Locations</i>
17330	1999	2023	Braun Blanquet	365
966	1999	2007	Percent Cover	232

Table 33: The South Florida Fisheries Habitat Assessment Program (FHAP) - *Program 4049*

<i>N_Data</i>	<i>YearMin</i>	<i>YearMax</i>	<i>Collection Method</i>	<i>Sample Locations</i>
18891	2005	2008	Braun Blanquet	273

Table 34: North Biscayne Bay Seagrass Loss Monitoring Program -  
Program 5027

<i>N_Data</i>	<i>YearMin</i>	<i>YearMax</i>	<i>Collection Method</i>	<i>Sample Locations</i>
5414	2018	2022	Braun Blanquet	31
5457	2018	2022	Percent Cover	31



Median percent cover by species in *Biscayne Bay 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.

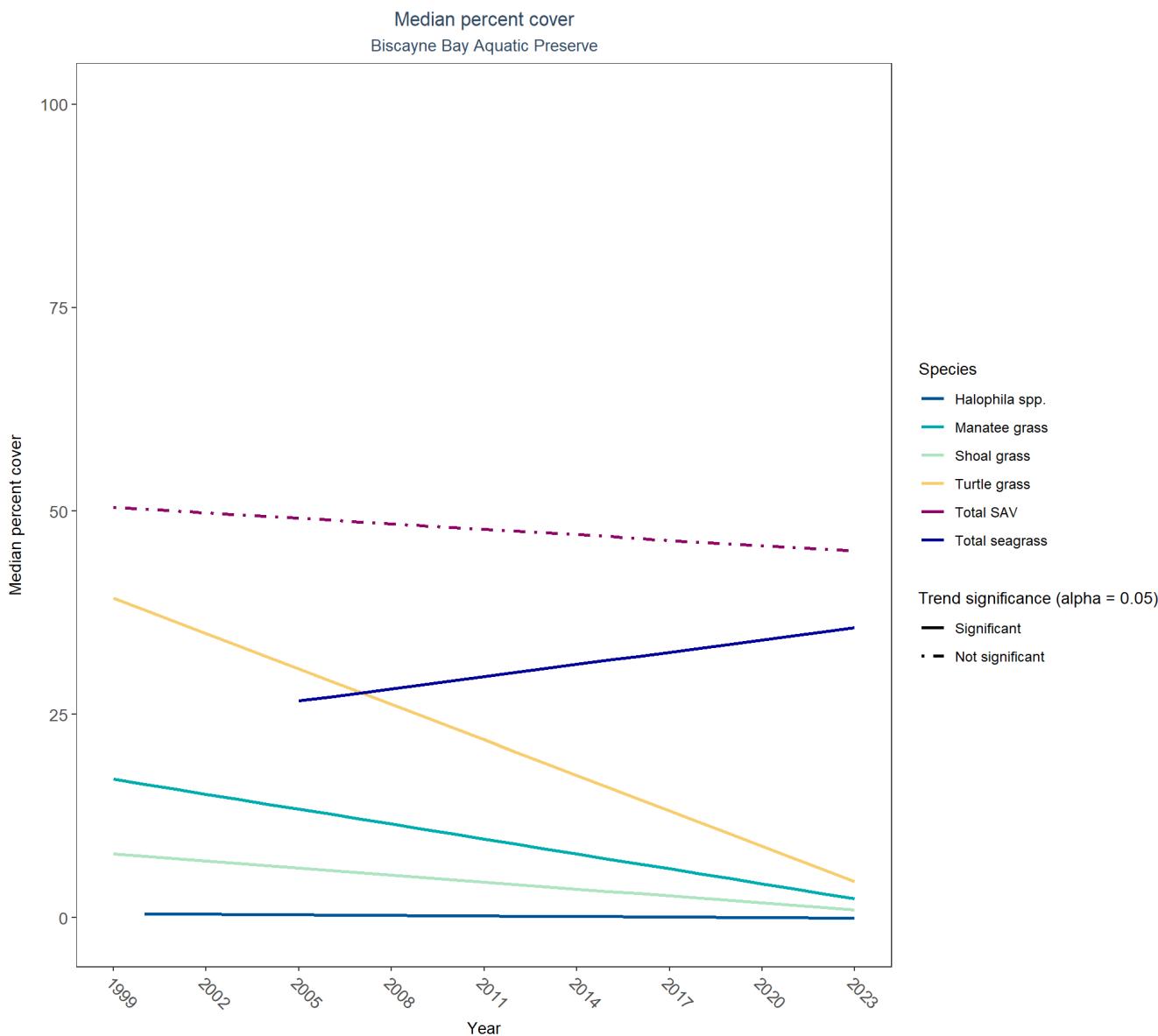
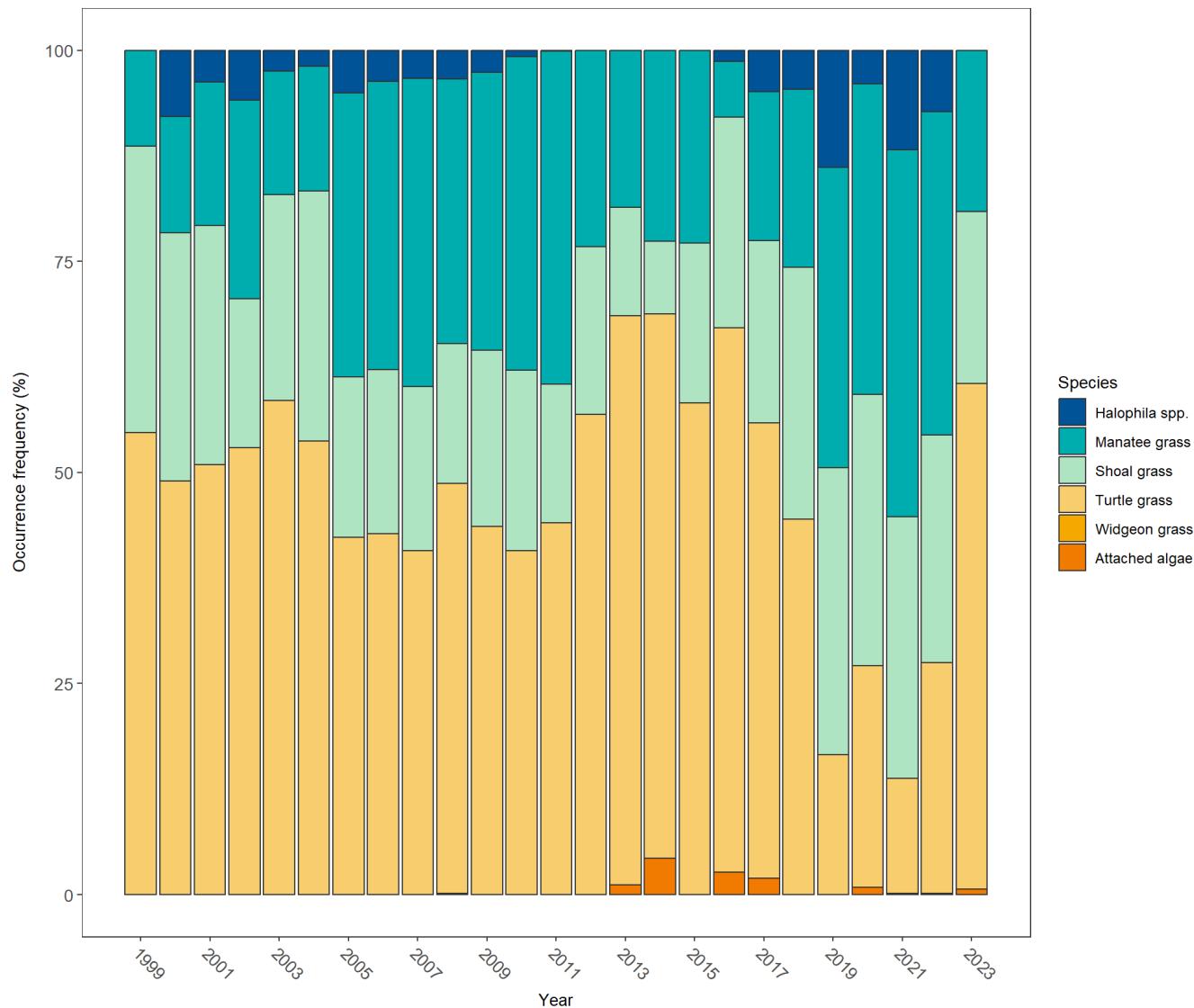


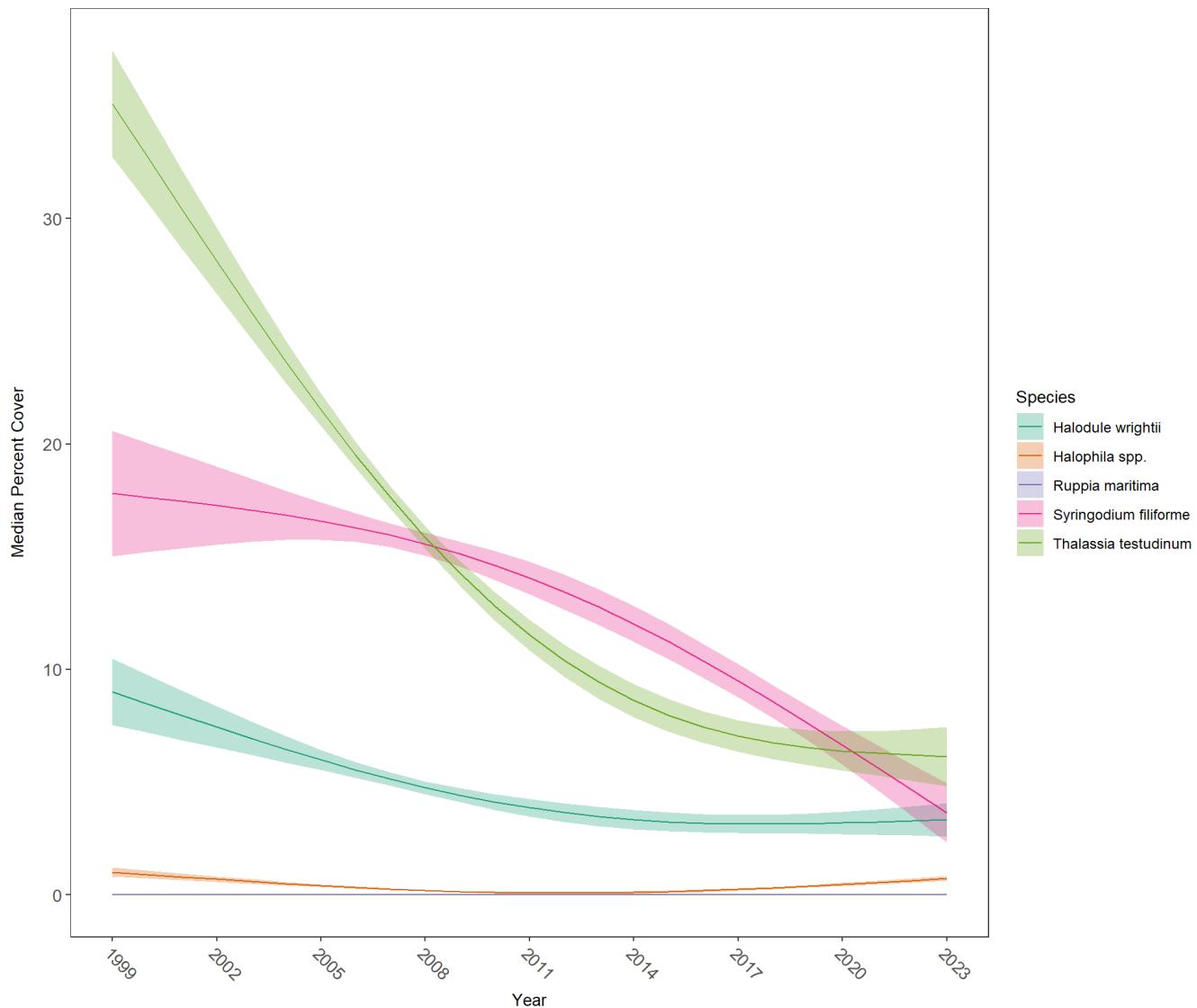
Table 35: Percent Cover Trend Analysis for Biscayne Bay Aquatic Preserve

Species	Common Name	Trend Significance ( $\alpha = 0.05$ )	Period of Record	LME-Intercept	LME-Slope	p
Attached algae		Significantly increasing trend	2008 - 2023	-0.2514	0.0221	0.0410
Drift algae		Significantly decreasing trend	1999 - 2023	11.2382	-0.3434	0.0000
Halodule wrightii	Shoal grass	Significantly decreasing trend	1999 - 2023	9.2639	-0.2870	0.0000
Halophila spp.		Significantly decreasing trend	2000 - 2023	0.5904	-0.0220	0.0250
Ruppia maritima	Widgeon grass	Model did not fit the available data	2005 - 2023			
Syringodium filiforme	Manatee grass	Significantly decreasing trend	1999 - 2023	20.0834	-0.6126	0.0000
Thalassia testudinum	Turtle grass	Significantly decreasing trend	1999 - 2023	46.5547	-1.4527	0.0000
Total SAV		No significant trend	1999 - 2023	51.5763	-0.2247	0.2445
Total seagrass		Significantly increasing trend	2005 - 2023	21.1541	0.4993	0.0108

Frequency of occurrence  
Biscayne Bay Aquatic Preserve



Median Percent Cover for seagrass species  
Biscayne Bay Aquatic Preserve



Generalized additive models for each species in Biscayne Bay 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.