Biscayne Bay Aquatic Preserve

SEACAR Habitat Analyses

Last compiled on 08 January, 2025

Contents

Funding & Acknowledgements

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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*
Dissolved Oxygen	mg/L	-0.000001	50
Dissolved Oxygen Saturation	%	-0.000001	500
Salinity	ppt	-0.000001	70
Turbidity	NTU	-0.000001	4000
Water Temperature	Degrees C	-5.000000	45
pH	None	2.000000	14

Table 2: Discrete Water Quality threshold values

Parameter Name	*Units*	*Low Threshold*	*High Threshold*
Ammonia, Un-ionized (NH3)	mg/L	-	-
Ammonium, Filtered (NH4)	mg/L	-	-
Chlorophyll a, Corrected for Pheophytin	ug/L	-	-
Chlorophyll a, Uncorrected for Pheophytin	ug/L	-	-
Colored Dissolved Organic Matter	PCU	-	-

Parameter Name	*Units*	*Low Threshold*	*High Threshold*
Dissolved Oxygen	mg/L	-0.000001	25
Dissolved Oxygen Saturation	%	-0.000001	310
Fluorescent Dissolved Organic Matter	QSE	-	-
Light Extinction Coefficient	m^-1	-	-
NO2+3, Filtered	mg/L	-	-
Nitrate (NO3)	mg/L	-	-
Nitrite (NO2)	mg/L	-	-
Nitrogen, organic	mg/L	-	-
Phosphate, Filtered (PO4)	mg/L	-	-
Salinity	ppt	-0.000001	70
Secchi Depth	m	0.000001	50
Specific Conductivity	mS/cm	0.005000	100
Total Kjeldahl Nitrogen	mg/L	-	-
Total Nitrogen	mg/L	-	-
Total Nitrogen	mg/L	-	-
Total Phosphorus	mg/L	-	-
Total Suspended Solids	mg/L	-	-
Turbidity	NTU	-	-
Water Temperature	Degrees C	3.000000	40
pH	None	2.000000	13

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

SEACAR QAQC Description	*Include*	*SEACAR QAQCFlagCode*
Exceeds maximum threshold	0	2Q
Below minimum threshold	0	4Q
Within threshold tolerance	1	6Q
No defined thresholds for this parameter	1	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	0	0	Value based on field kit determination; results may not be accurate
STORET-WIN	J	0	0	Estimated value
STORET-WIN	V	0	0	Analyte was detected at or above method detection limit
STORET-WIN	Y	0	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 determiniation; 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

Qualifier Source	*Value Qualifier*	*Include*	*Description*
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 water's surface to the bottom sediments, and it's where fish, dolphins, crabs and people swim! So much life makes its home in the water column that the health of marine and coastal ecosystems, as well as human economies, depend on the condition of this vulnerable habitat. Local patterns of rainfall, temperature, winds and currents can rapidly change the condition of the water column, while global influences such as El Niño/La Niña, large-scale fluctuation in sea temperatures and climate change can have long-term effects. Inputs from the prosperity of our day-to-day lives including farming, mining and forestry, and emissions from power generation, automobiles and water treatment can also alter the health of the water column. Acting alone or together, each input can have complex and lasting effects on habitats and ecosystems.

SEACAR evaluates water column health with several essential parameters. These include nutrient surveys of nitrogen and phosphorus, andwater quality assessments of salinity, dissolved oxygen, pH, and water temperature. Water clarity is evaluated with Secchi depth, turbidity, levels of chlorophyll a, total suspended solids, and colored dissolved organic matter. Additionally, the richness of nekton is indicated by the abundance of free-swimming fishes and macroinvertebrates like crabs and shrimps.

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**. The points for all Water Column plots displayed in this section are monthly averages. Trend significance will be denoted as "Significant Trend" (when $p < 0.05$), or "Non-significant Trend" (when $p >= 0.05$). Any parameters with insufficient data to perform Seasonal Kendall-Tau test will have their monthly averages plotted without a corresponding trend line.

Water Quality - Discrete

The following files were used in the discrete analysis:

- *Combined_WQ_WC_NUT_Chlorophyll_a_corrected_for_pheophytin-2024-Dec-08.txt*
- *Combined_WQ_WC_NUT_Chlorophyll_a_uncorrected_for_pheophytin-2024-Dec-08.txt*
- *Combined_WQ_WC_NUT_Colored_dissolved_organic_matter_CDOM-2024-Dec-08.txt*
- *Combined_WQ_WC_NUT_Dissolved_Oxygen-2024-Dec-08.txt*
- *Combined_WQ_WC_NUT_Dissolved_Oxygen_Saturation-2024-Dec-08.txt*
- *Combined_WQ_WC_NUT_pH-2024-Dec-08.txt*
- *Combined_WQ_WC_NUT_Salinity-2024-Dec-08.txt*
- *Combined_WQ_WC_NUT_Secchi_Depth-2024-Dec-08.txt*
- *Combined_WQ_WC_NUT_Total_Nitrogen-2024-Dec-08.txt*
- *Combined_WQ_WC_NUT_Total_Phosphorus-2024-Dec-08.txt*
- *Combined_WQ_WC_NUT_Total_Suspended_Solids_TSS-2024-Dec-08.txt*
- *Combined_WQ_WC_NUT_Turbidity-2024-Dec-08.txt*
- *Combined_WQ_WC_NUT_Water_Temperature-2024-Dec-08.txt*

Chlorophyll a, Corrected for Pheophytin - Discrete Water Quality

Seasonal Kendall-Tau Trend Analysis

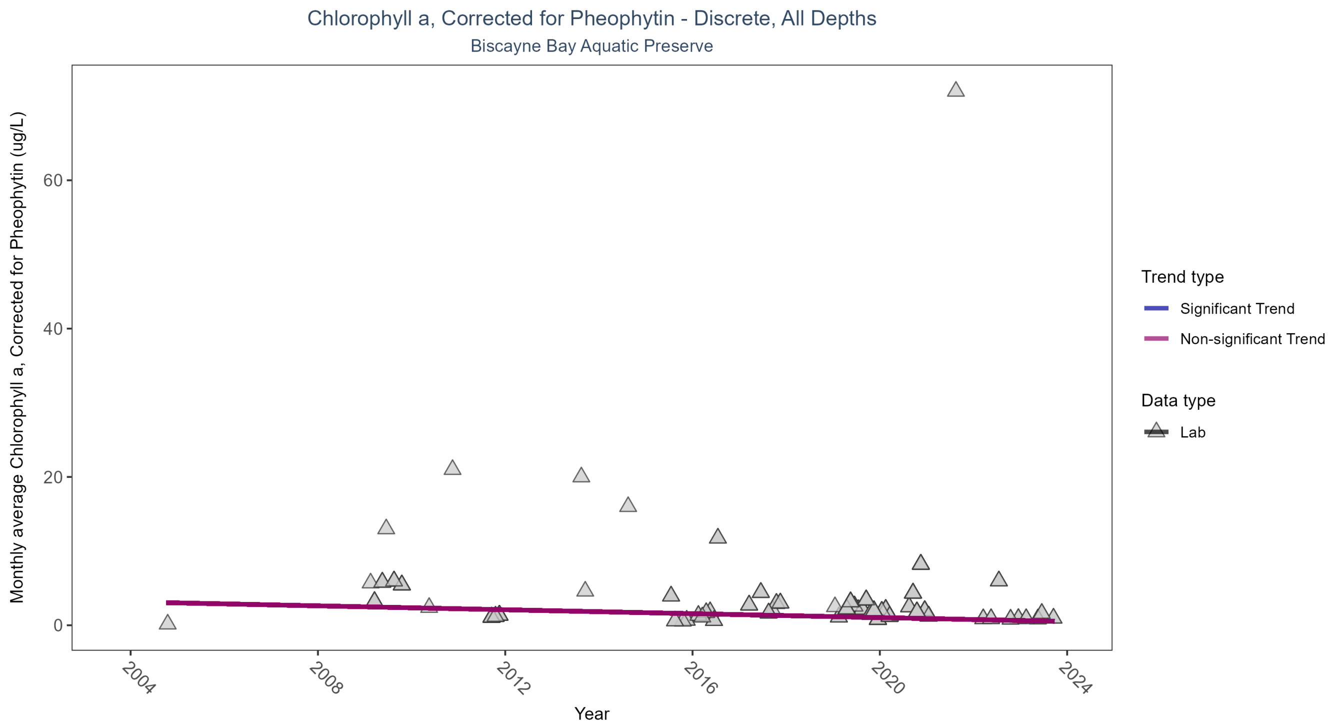

Figure 1: Seasonal Kendall-Tau Results for Chlorophyll a, Corrected for Pheophytin - Discrete

Table 6: Seasonal Kendall-Tau Trend Analysis for Chlorophyll a, Corrected for Pheophytin

RelativeDepth	N-Data	N-Years	Median	Independent	tau	p	SennSlope	SennIntercept	ChiSquared	pChiSquared	Trend
All	470	14	1.4	TRUE	-0.1845	0.1713	-0.1318	3.148	10.9176	0.4502	0

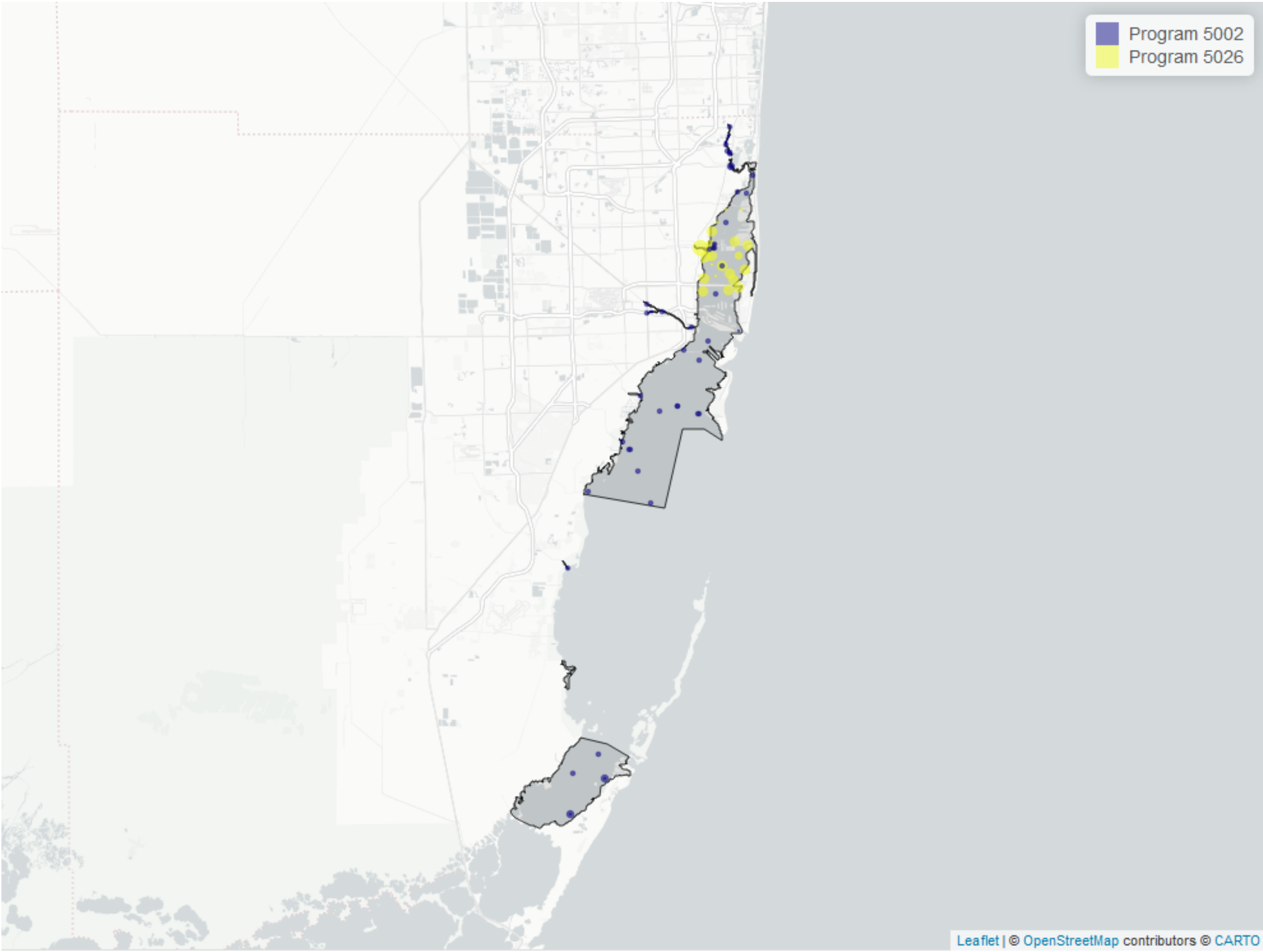

Figure 2: Map showing location of Discrete sampling sites for Chlorophyll a, Corrected for Pheophytin. The bubble size on the maps below reflect the amount of data available at each sampling site.

Table 7: Programs contributing data for Chlorophyll a, Corrected for Pheophytin

ProgramID	*N_Data*	*YearMin*	*YearMax*
5026	287	2019	2021
5002	184	2004	2023

Program names:

5002 - Florida STORET / WIN[1]
5026 - North Biscayne Bay Seagrass Loss Water Quality Program[2]

Chlorophyll a, Uncorrected for Pheophytin - Discrete Water Quality

Seasonal Kendall-Tau Trend Analysis

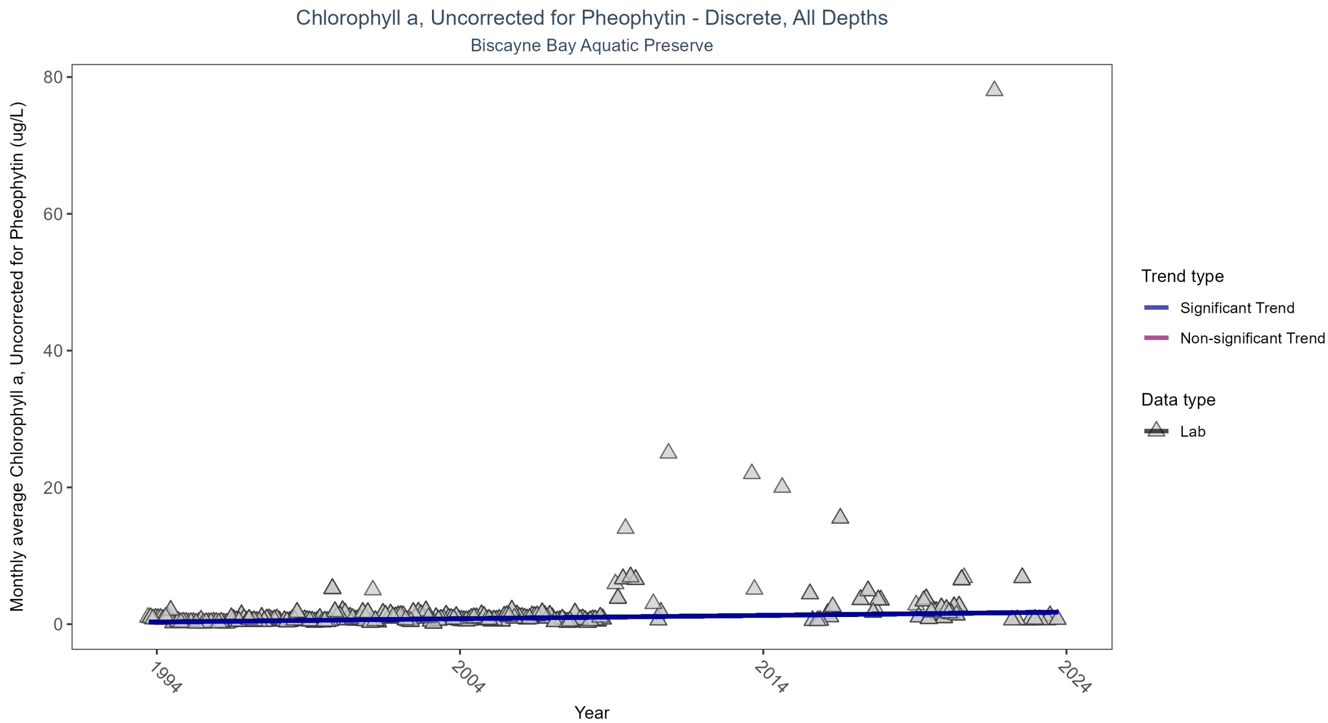

Figure 3: Seasonal Kendall-Tau Results for Chlorophyll a, Uncorrected for Pheophytin - Discrete

Table 8: Seasonal Kendall-Tau Trend Analysis for Chlorophyll a, Uncorrected for Pheophytin

RelativeDepth	N-Data	N-Years	Median	Independent	tau	p	SennSlope	SennIntercept	ChiSquared	pChiSquared	Trend
All	2254	28	0.6666	TRUE	0.3904	0	0.0484	0.2649	6.8459	0.8114	1

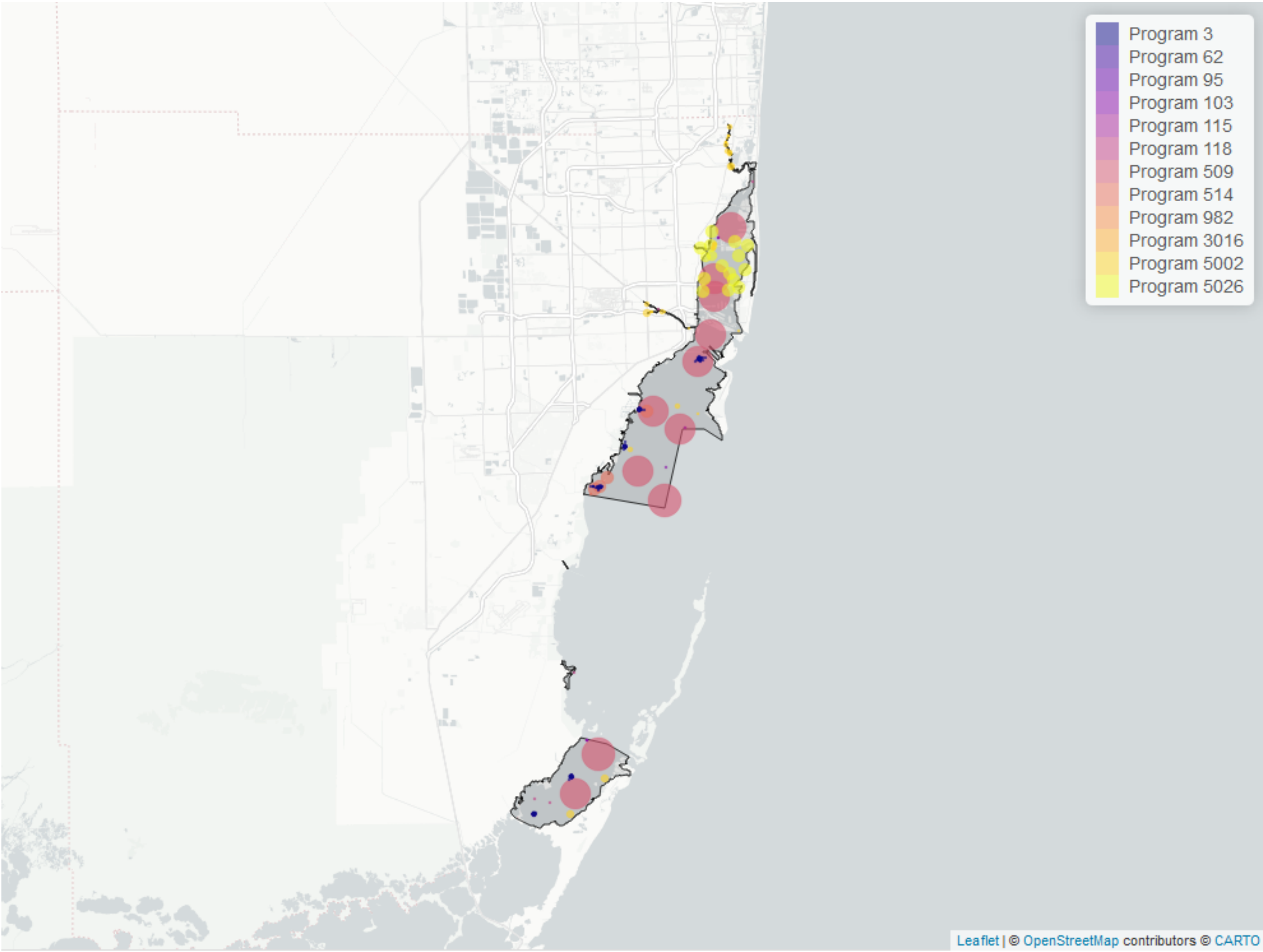

Figure 4: Map showing location of Discrete sampling sites for Chlorophyll a, Uncorrected for Pheophytin. The bubble size on the maps below reflect the amount of data available at each sampling site.

Table 9: 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
5002	103	2001	2023
514	92	2000	2005
103	7	2002	2006
118	6	2006	2010
115	1	2004	2004

Program names:

3 - Atlantic Oceanographic and Meteorological Laboratory (AOML) South Florida Program Synoptic Shipboard Surveys[3]
103 - EPA STOrage and RETrieval Data Warehouse (STORET)/WQX[4]
115 - Environmental Monitoring Assessment Program[5]

118 - National Aquatic Resource Surveys, National Coastal Condition Assessment[6]
509 - SERC Water Quality Monitoring Network[7]
514 - Florida LAKEWATCH Program[8]
5002 - Florida STORET / WIN[1]
5026 - North Biscayne Bay Seagrass Loss Water Quality Program[2]

Dissolved Oxygen - Discrete Water Quality

Seasonal Kendall-Tau Trend Analysis

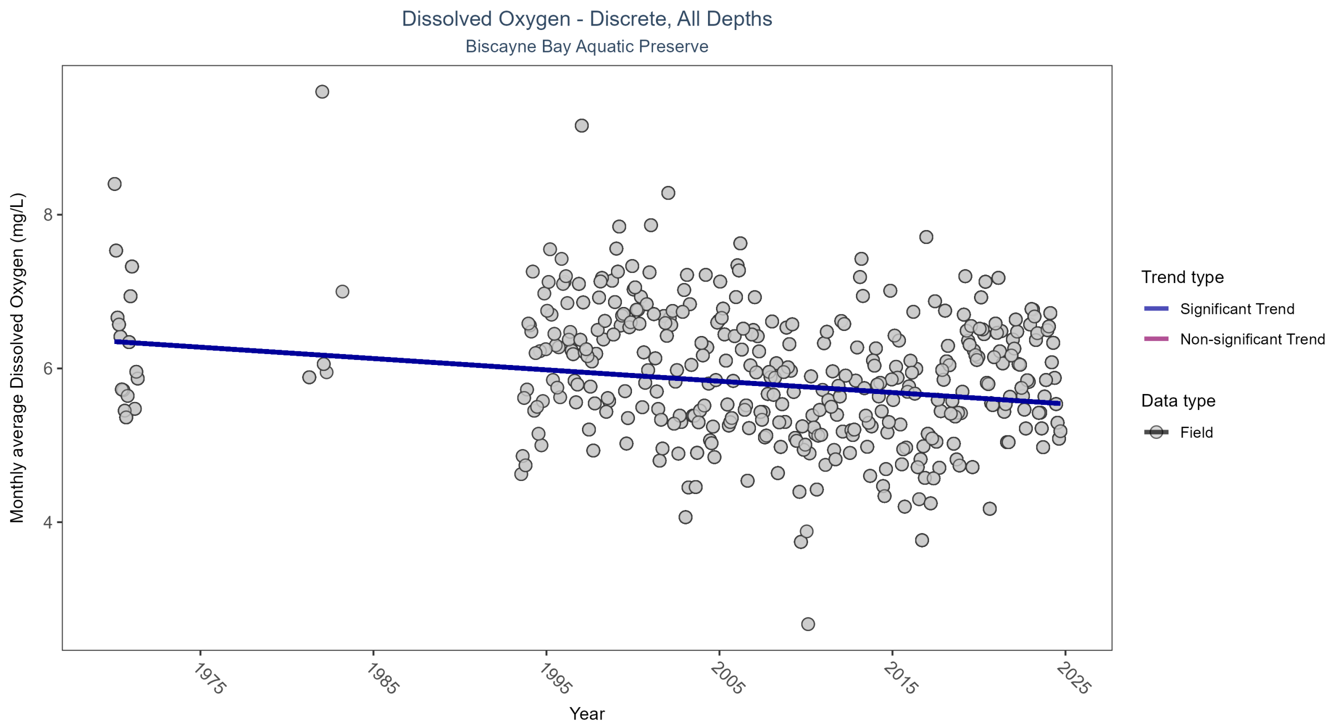

Figure 5: Seasonal Kendall-Tau Results for Dissolved Oxygen - Discrete

Table 10: Seasonal Kendall-Tau Trend Analysis for Dissolved Oxygen

RelativeDepth	N-Data	N-Years	Median	Independent	tau	p	SennSlope	SennIntercept	ChiSquared	pChiSquared	Trend
All	21842	37	6.01	TRUE	-0.2043	0	-0.0147	6.35	6.2301	0.8576	-1

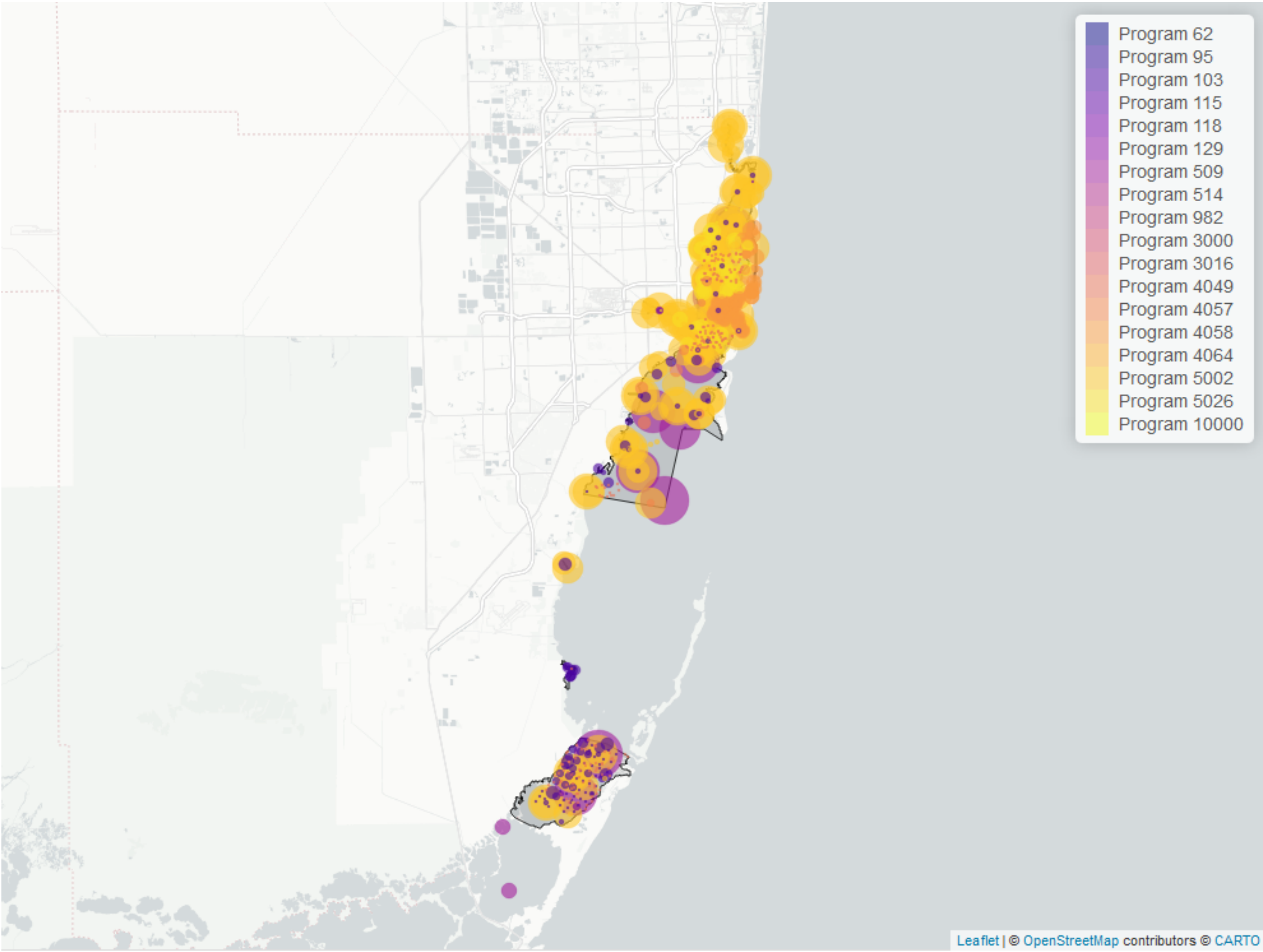

Figure 6: Map showing location of Discrete sampling sites for Dissolved Oxygen. The bubble size on the maps below reflect the amount of data available at each sampling site.

Table 11: Programs contributing data for Dissolved Oxygen

ProgramID	*N_Data*	*YearMin*	*YearMax*
5002	13987	2001	2024
509	3316	1993	2008
4058	2269	2016	2023
5026	1442	2019	2024
103	775	1970	2020
4049	192	2006	2008
4057	166	2015	2019
118	28	2006	2020
115	3	2004	2004

Program names:

103 - EPA STOrage and RETrieval Data Warehouse (STORET)/WQX[4]
115 - Environmental Monitoring Assessment Program[5]
118 - National Aquatic Resource Surveys, National Coastal Condition Assessment[6]
509 - SERC Water Quality Monitoring Network[7]

4049 - The South Florida Fisheries Habitat Assessment Program (FHAP)[9]
4057 - Biscayne Bay Water Watch[10]
4058 - City of Miami Beach Water Monitoring[11]
5002 - Florida STORET / WIN[1]
5026 - North Biscayne Bay Seagrass Loss Water Quality Program[2]

Dissolved Oxygen Saturation - Discrete Water Quality

Seasonal Kendall-Tau Trend Analysis

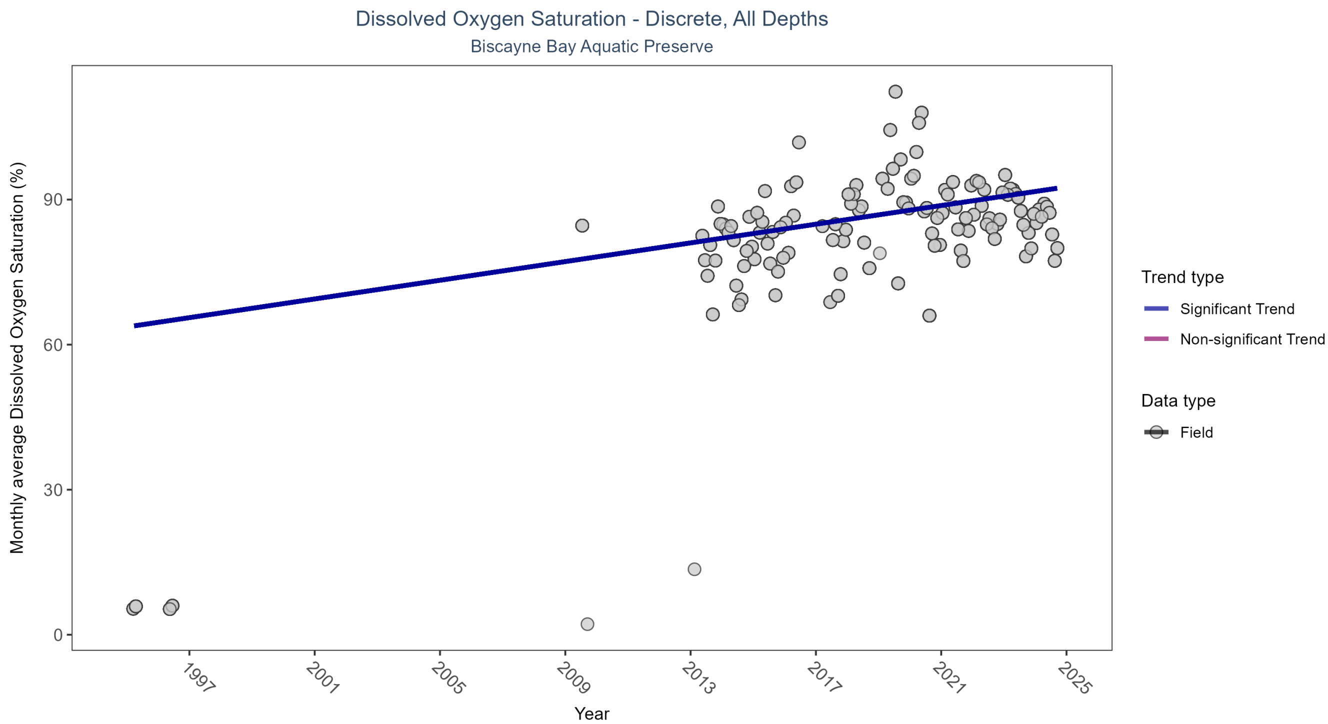

Figure 7: Seasonal Kendall-Tau Results for Dissolved Oxygen Saturation - Discrete

Table 12: Seasonal Kendall-Tau Trend Analysis for Dissolved Oxygen Saturation

RelativeDepth	N-Data	N-Years	Median	Independent	tau	p	SennSlope	SennIntercept	ChiSquared	pChiSquared	Trend
All	9941	15	90.3	TRUE	0.3164	0	0.9663	63.6506	12.2313	0.3465	1

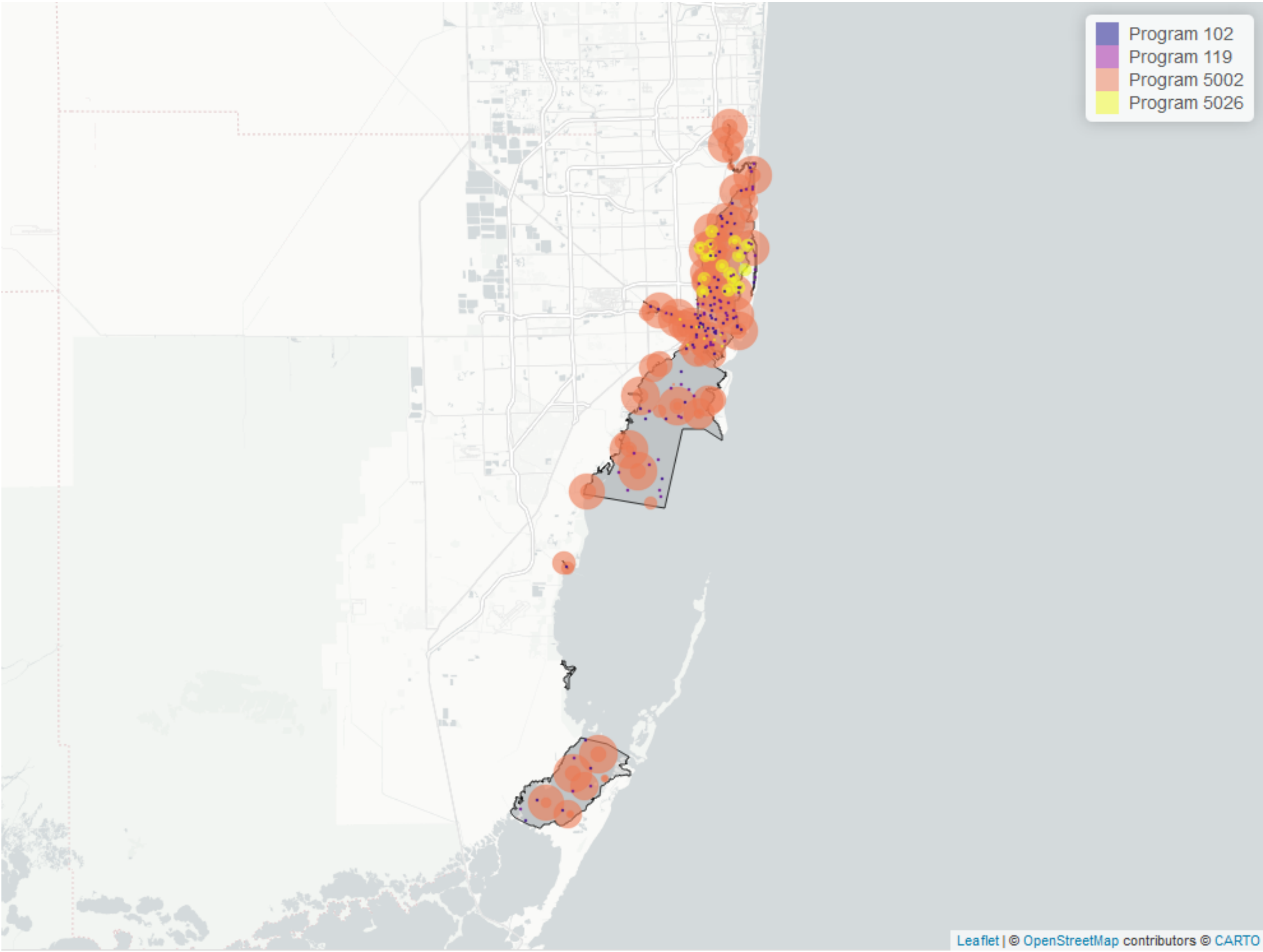

Figure 8: Map showing location of Discrete sampling sites for Dissolved Oxygen Saturation. The bubble size on the maps below reflect the amount of data available at each sampling site.

Table 13: Programs contributing data for Dissolved Oxygen Saturation

ProgramID	*N_Data*	*YearMin*	*YearMax*
5002	9231	2009	2024
5026	491	2019	2023
102	259	1995	1996

Program names:

102 - National Status and Trends Mussel Watch[12]
5002 - Florida STORET / WIN[1]
5026 - North Biscayne Bay Seagrass Loss Water Quality Program[2]

pH - Discrete Water Quality

Seasonal Kendall-Tau Trend Analysis

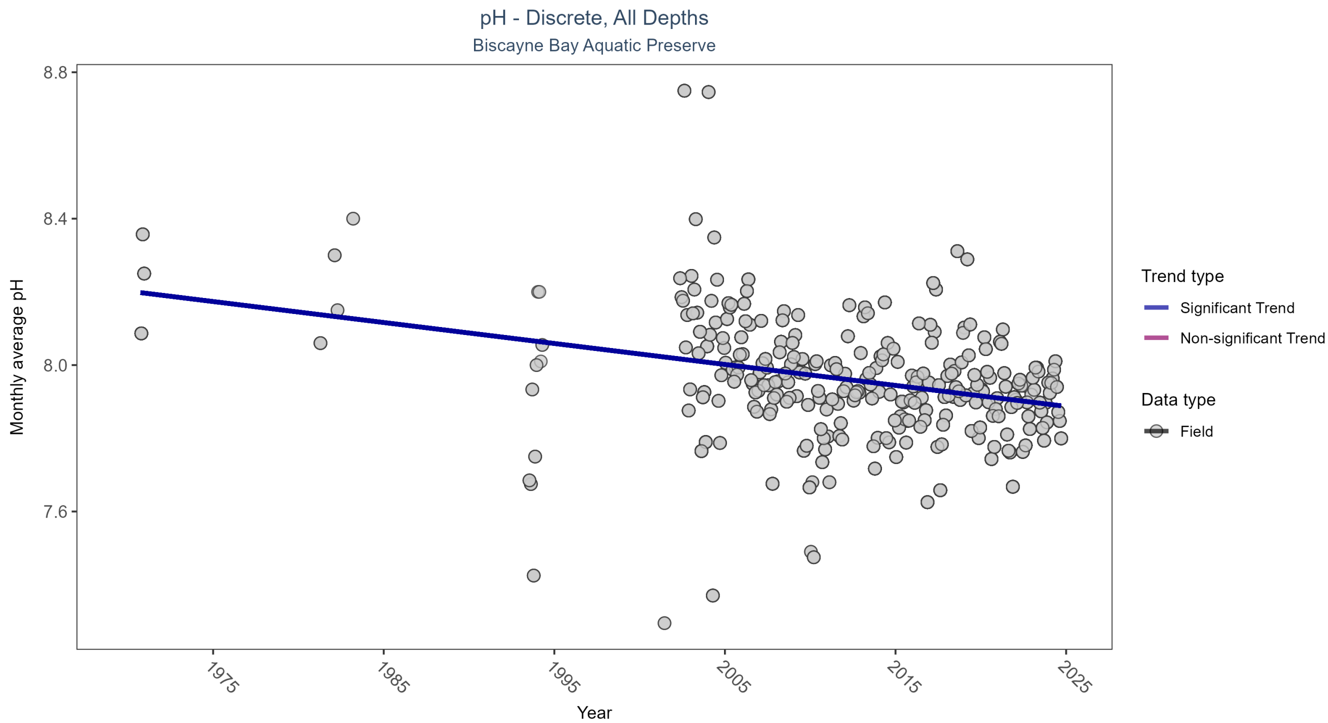

Figure 9: Seasonal Kendall-Tau Results for pH - Discrete

Table 14: Seasonal Kendall-Tau Trend Analysis for pH

RelativeDepth	N-Data	N-Years	Median	Independent	tau	p	SennSlope	SennIntercept	ChiSquared	pChiSquared	Trend
All	18131	30	7.96	TRUE	-0.2897	0	-0.0057	8.2023	6.516	0.8368	-1

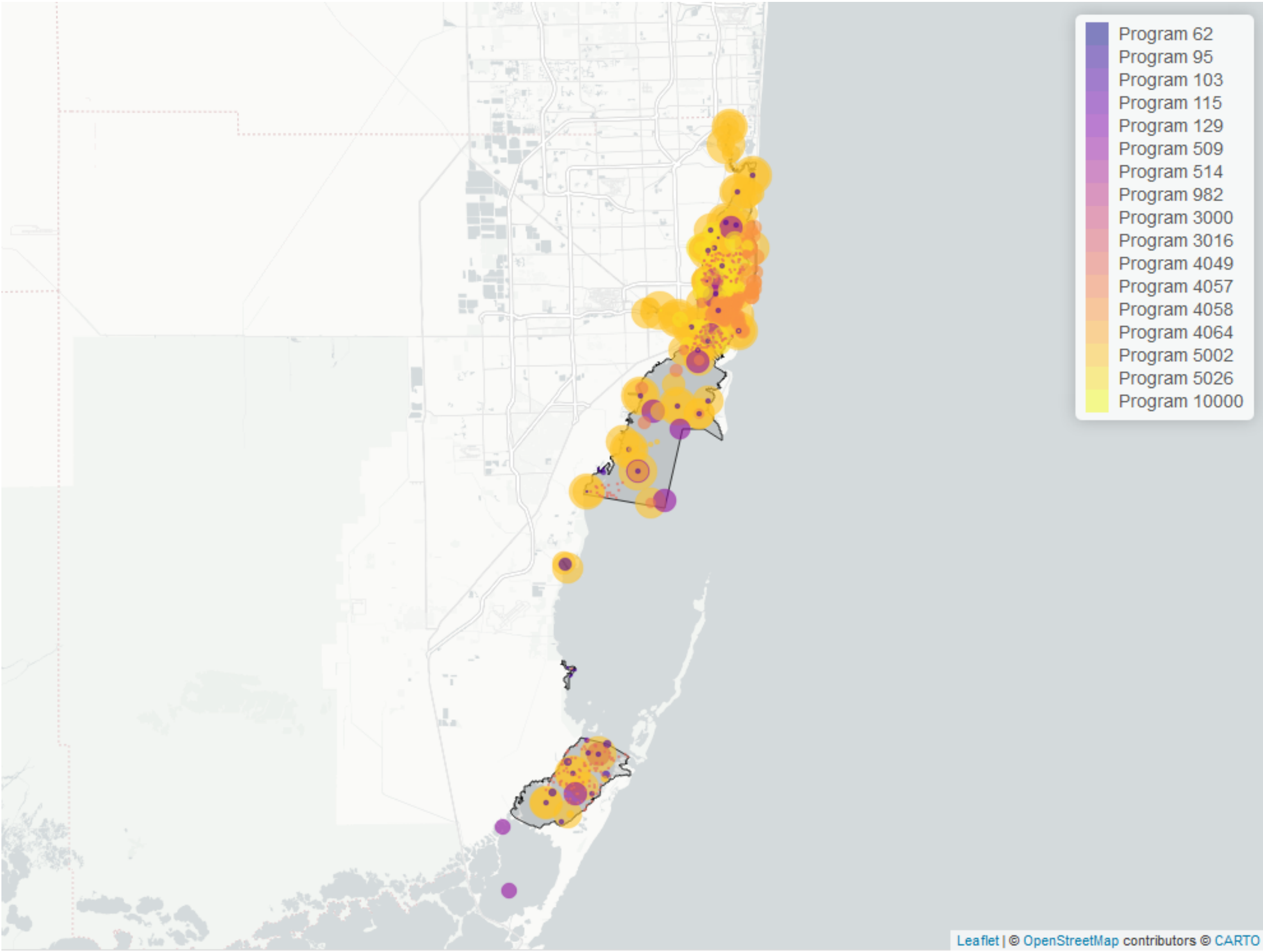

Figure 10: Map showing location of Discrete sampling sites for pH. The bubble size on the maps below reflect the amount of data available at each sampling site.

Table 15: Programs contributing data for pH

ProgramID	*N_Data*	*YearMin*	*YearMax*
5002	13061	2001	2024
4058	2312	2016	2023
5026	1528	2019	2024
509	822	2002	2008
4049	247	2005	2008
4057	169	2015	2019
103	166	1970	2020
115	3	2004	2004

Program names:

103 - EPA STOrage and RETrieval Data Warehouse (STORET)/WQX[4]
115 - Environmental Monitoring Assessment Program[5]
509 - SERC Water Quality Monitoring Network[7]
4049 - The South Florida Fisheries Habitat Assessment Program (FHAP)[9]
4057 - Biscayne Bay Water Watch[10]

4058 - City of Miami Beach Water Monitoring[11]
5002 - Florida STORET / WIN[1]
5026 - North Biscayne Bay Seagrass Loss Water Quality Program[2]

Salinity - Discrete Water Quality

Seasonal Kendall-Tau Trend Analysis

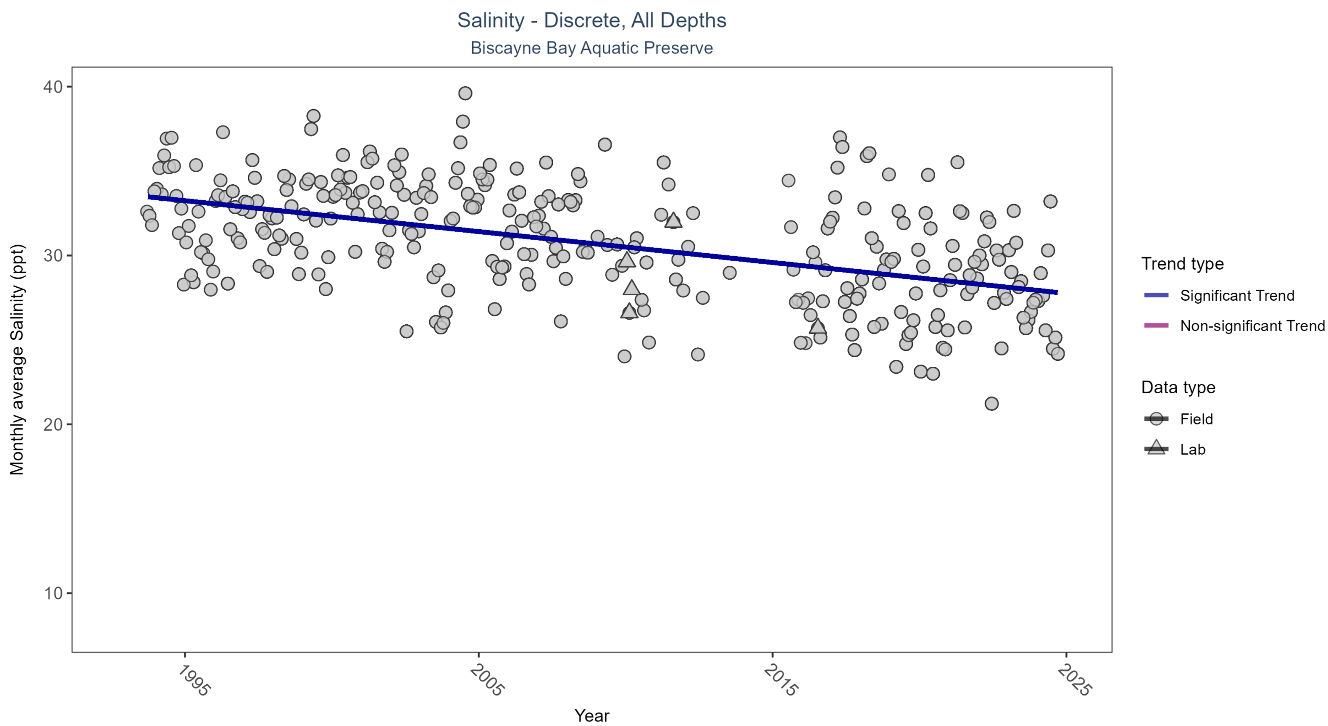

Figure 11: Seasonal Kendall-Tau Results for Salinity - Discrete

Table 16: Seasonal Kendall-Tau Trend Analysis for Salinity

RelativeDepth	N-Data	N-Years	Median	Independent	tau	p	SennSlope	SennIntercept	ChiSquared	pChiSquared	Trend
All	23942	32	32	TRUE	-0.4146	0	-0.183	33.6113	6.9745	0.8011	-1

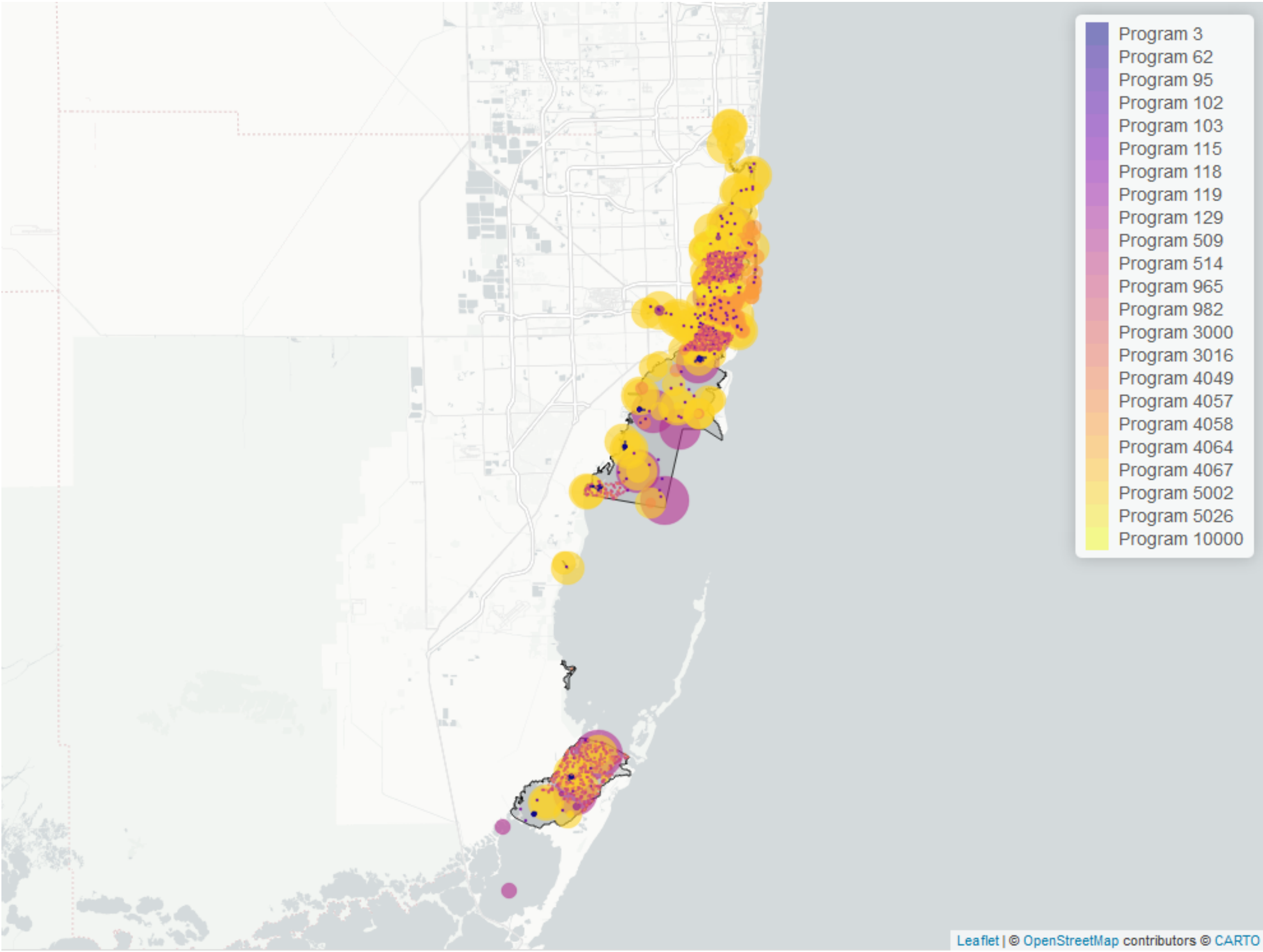

Figure 12: Map showing location of Discrete sampling sites for Salinity. The bubble size on the maps below reflect the amount of data available at each sampling site.

Table 17: Programs contributing data for Salinity

ProgramID	*N_Data*	*YearMin*	*YearMax*
5002	14251	2003	2024
509	3316	1993	2008
965	2512	2005	2011
4058	2309	2016	2023
5026	436	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
103	3	2003	2003
115	3	2004	2004

Program names:

3 - Atlantic Oceanographic and Meteorological Laboratory (AOML) South Florida Program Synoptic Shipboard Surveys[3]
95 - Harmful Algal Bloom Marine Observation Network[13]
102 - National Status and Trends Mussel Watch[12]
103 - EPA STOrage and RETrieval Data Warehouse (STORET)/WQX[4]
115 - Environmental Monitoring Assessment Program[5]
118 - National Aquatic Resource Surveys, National Coastal Condition Assessment[6]
509 - SERC Water Quality Monitoring Network[7]
965 - South Florida Seagrass Fish and Invertebrate Assessment Network[14]
4049 - The South Florida Fisheries Habitat Assessment Program (FHAP)[9]
4057 - Biscayne Bay Water Watch[10]
4058 - City of Miami Beach Water Monitoring[11]
5002 - Florida STORET / WIN[1]
5026 - North Biscayne Bay Seagrass Loss Water Quality Program[2]

Secchi Depth - Discrete Water Quality

Seasonal Kendall-Tau Trend Analysis

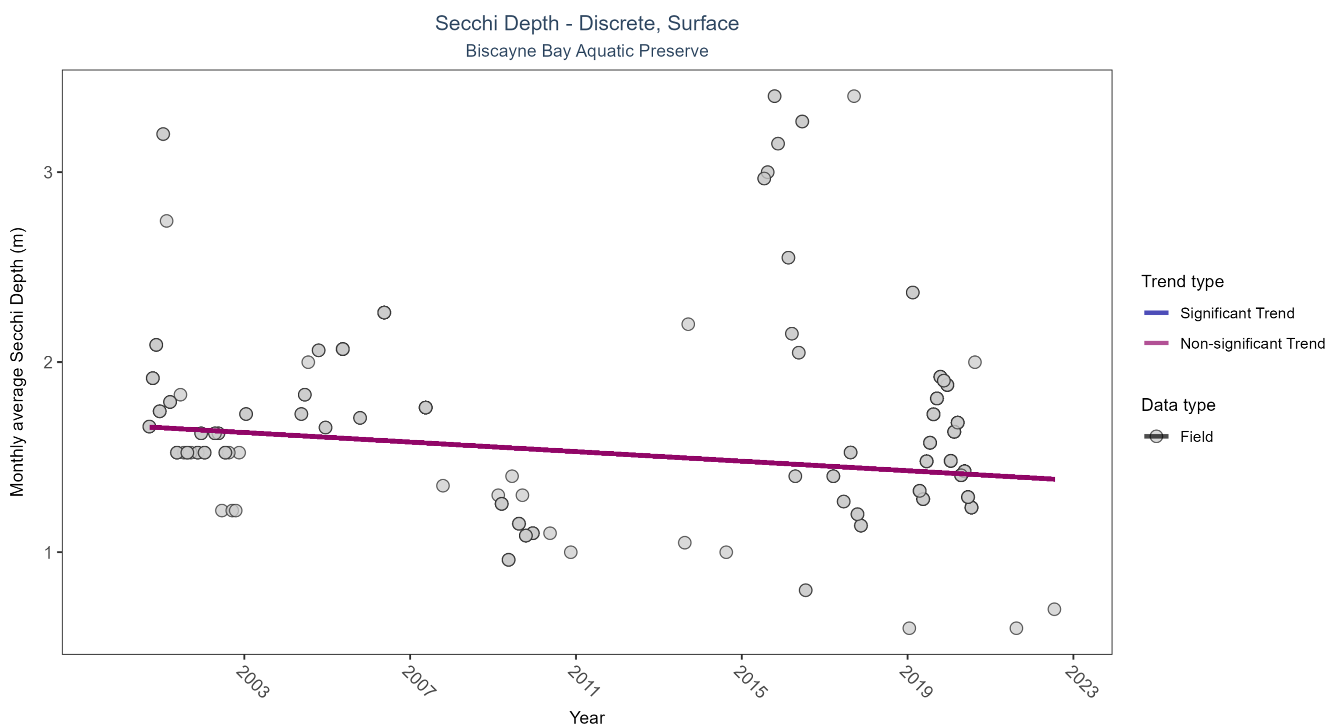

Figure 13: Seasonal Kendall-Tau Results for Secchi Depth - Discrete

Table 18: Seasonal Kendall-Tau Trend Analysis for Secchi Depth

RelativeDepth	N-Data	N-Years	Median	Independent	tau	p	SennSlope	SennIntercept	ChiSquared	pChiSquared	Trend
Surface	686	19	1.524	TRUE	-0.1156	0.3365	-0.0126	1.6676	4.614	0.9484	0

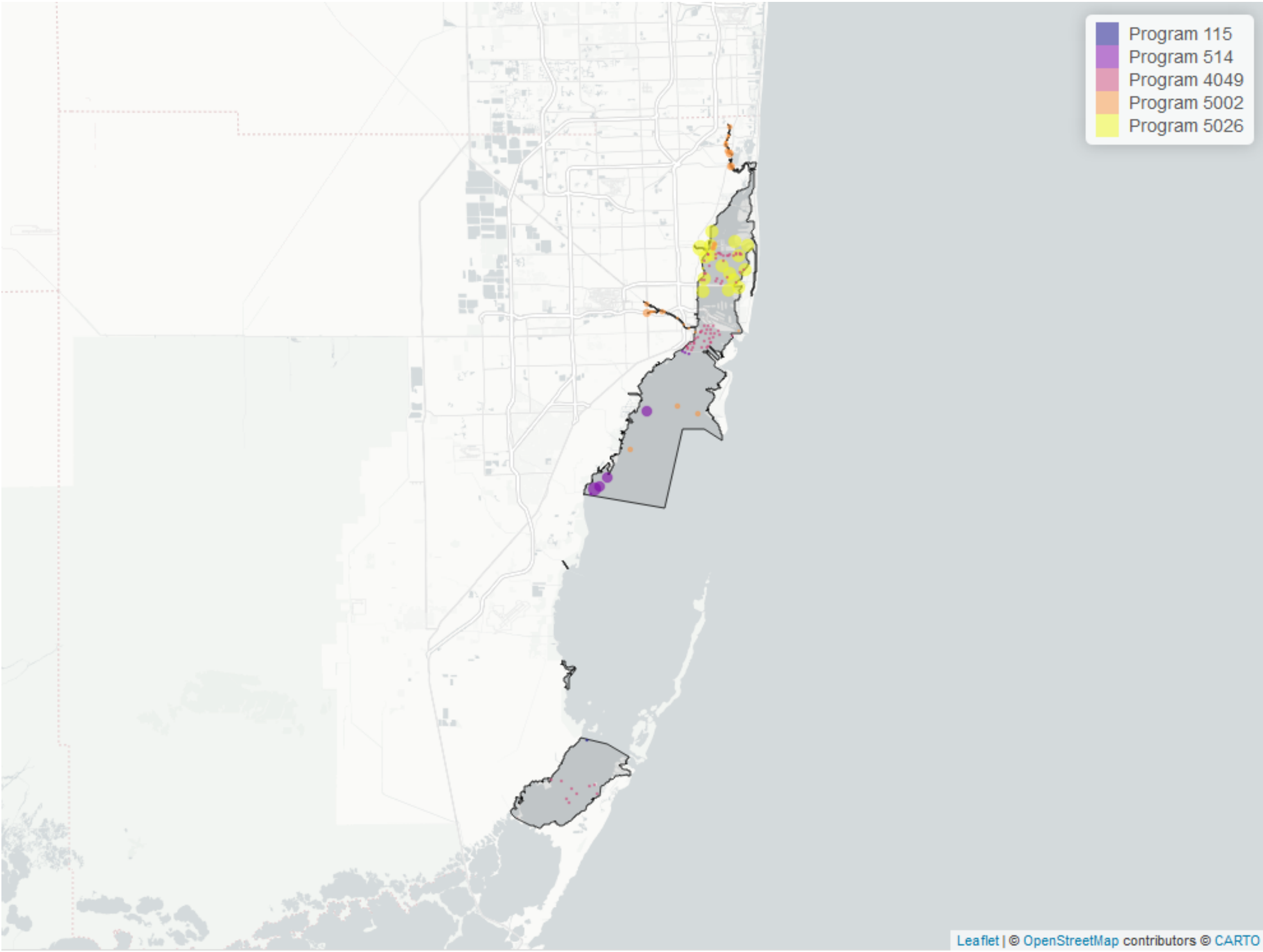

Figure 14: Map showing location of Discrete sampling sites for Secchi Depth. The bubble size on the maps below reflect the amount of data available at each sampling site.

Table 19: Programs contributing data for Secchi Depth

ProgramID	*N_Data*	*YearMin*	*YearMax*
5026	426	2019	2020
5002	101	2007	2022
514	86	2000	2005
4049	73	2005	2007
115	1	2004	2004

Program names:

115 - Environmental Monitoring Assessment Program[5]
514 - Florida LAKEWATCH Program[8]
4049 - The South Florida Fisheries Habitat Assessment Program (FHAP)[9]
5002 - Florida STORET / WIN[1]
5026 - North Biscayne Bay Seagrass Loss Water Quality Program[2]

Total Nitrogen - Discrete Water Quality

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 + NO3O2;
2) TN = TKN + NO3 + NO2;
3) TN = ORGN + NH4 + NO3O2;
4) TN = ORGN + NH4 + NO2 + NO3;
5) TN = TKN + NO3;
6) TN = ORGN + NH4 + NO3;

Additional Information:

- Rules for use of sample fraction:
  - Florida Department of Environmental Protection (FDEP) report that if both "Total" and "Dissolved" components are reported, only "Total" is used. If the total is not reported, then the dissolved components are used as a best available replacement.
  - Total nitrogen calculations are done using nitrogen components with the same sample fraction, nitrogen components with mixed total/dissolved sample fractions are not used. In other words, total nitrogen can be calculated when TKN and NO3O2 are both total sample fractions, or when both are dissolved sample fractions. *Future calculations of total nitrogen values may be 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

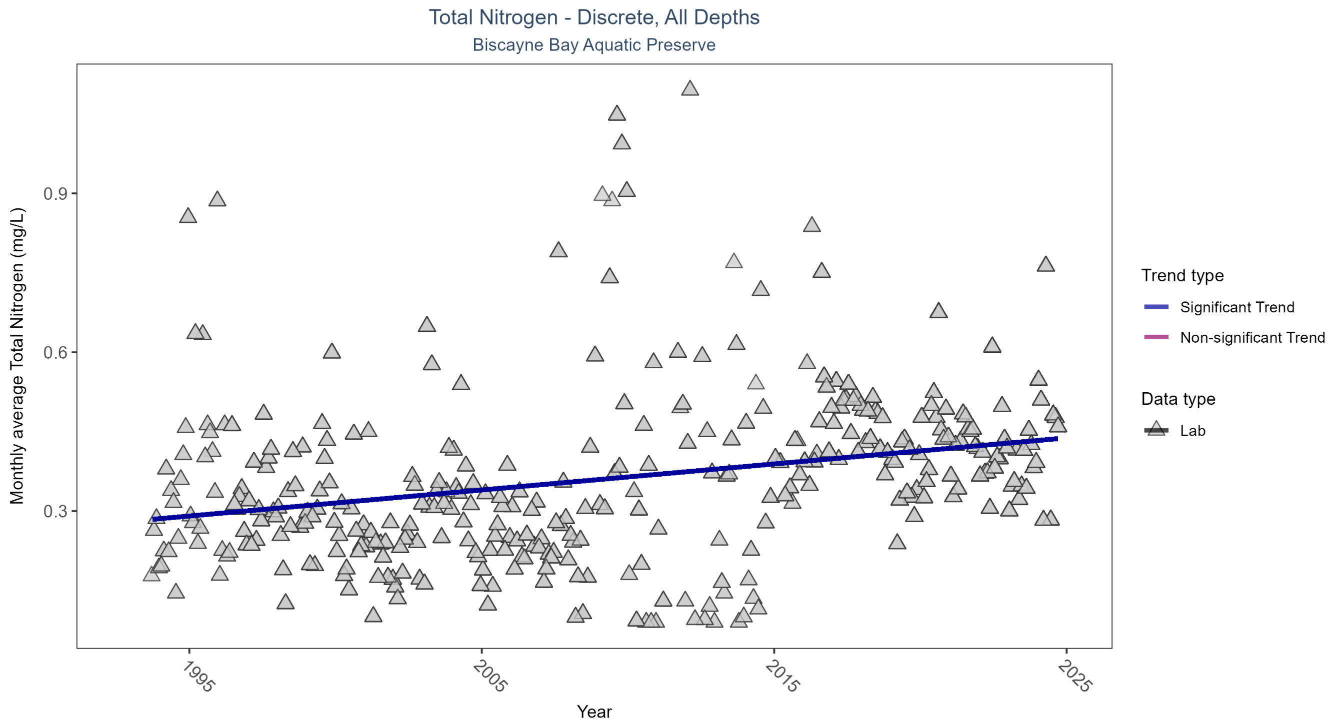

Figure 15: Seasonal Kendall-Tau Results for Total Nitrogen - Discrete

Table 20: Seasonal Kendall-Tau Trend Analysis for Total Nitrogen

RelativeDepth	N-Data	N-Years	Median	Independent	tau	p	SennSlope	SennIntercept	ChiSquared	pChiSquared	Trend
All	7878	32	0.334	TRUE	0.2323	0	0.0049	0.2808	10.77	0.4627	1

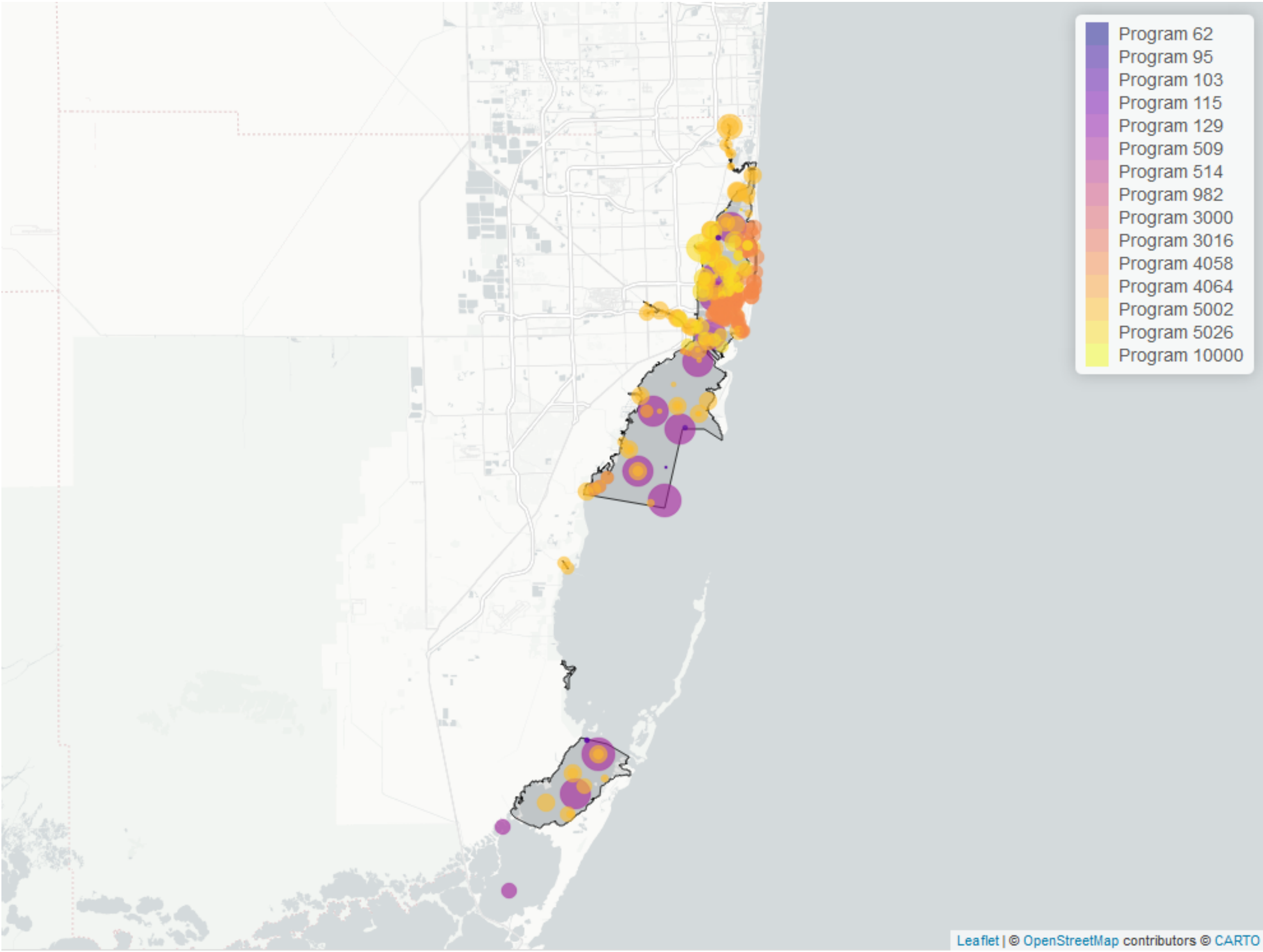

Figure 16: Map showing location of Discrete sampling sites for Total Nitrogen. The bubble size on the maps below reflect the amount of data available at each sampling site.

Table 21: Programs contributing data for Total Nitrogen

ProgramID	*N_Data*	*YearMin*	*YearMax*
5002	2613	1994	2024
4058	2125	2016	2023
509	1654	1993	2008
5026	1417	2019	2024
514	104	2000	2005
103	20	2002	2006
115	1	2004	2004

Program names:

103 - EPA STOrage and RETrieval Data Warehouse (STORET)/WQX[4]
115 - Environmental Monitoring Assessment Program[5]
509 - SERC Water Quality Monitoring Network[7]
514 - Florida LAKEWATCH Program[8]
4058 - City of Miami Beach Water Monitoring[11]

5002 - Florida STORET / WIN[1]
5026 - North Biscayne Bay Seagrass Loss Water Quality Program[2]

Total Phosphorus - Discrete Water Quality

Seasonal Kendall-Tau Trend Analysis

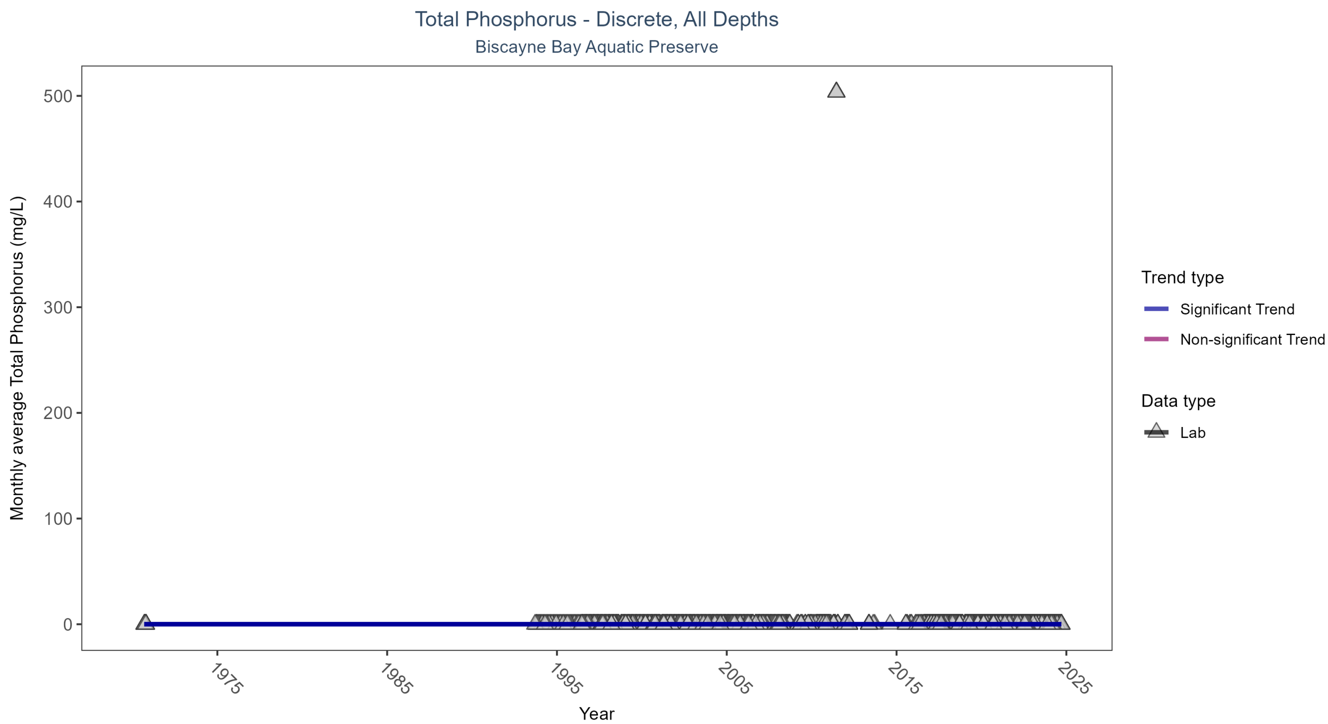

Figure 17: Seasonal Kendall-Tau Results for Total Phosphorus - Discrete

Table 22: Seasonal Kendall-Tau Trend Analysis for Total Phosphorus

RelativeDepth	N-Data	N-Years	Median	Independent	tau	p	SennSlope	SennIntercept	ChiSquared	pChiSquared	Trend
All	7984	33	0.0091	TRUE	0.3644	0	0.0003	-0.0019	1.6149	0.9995	1

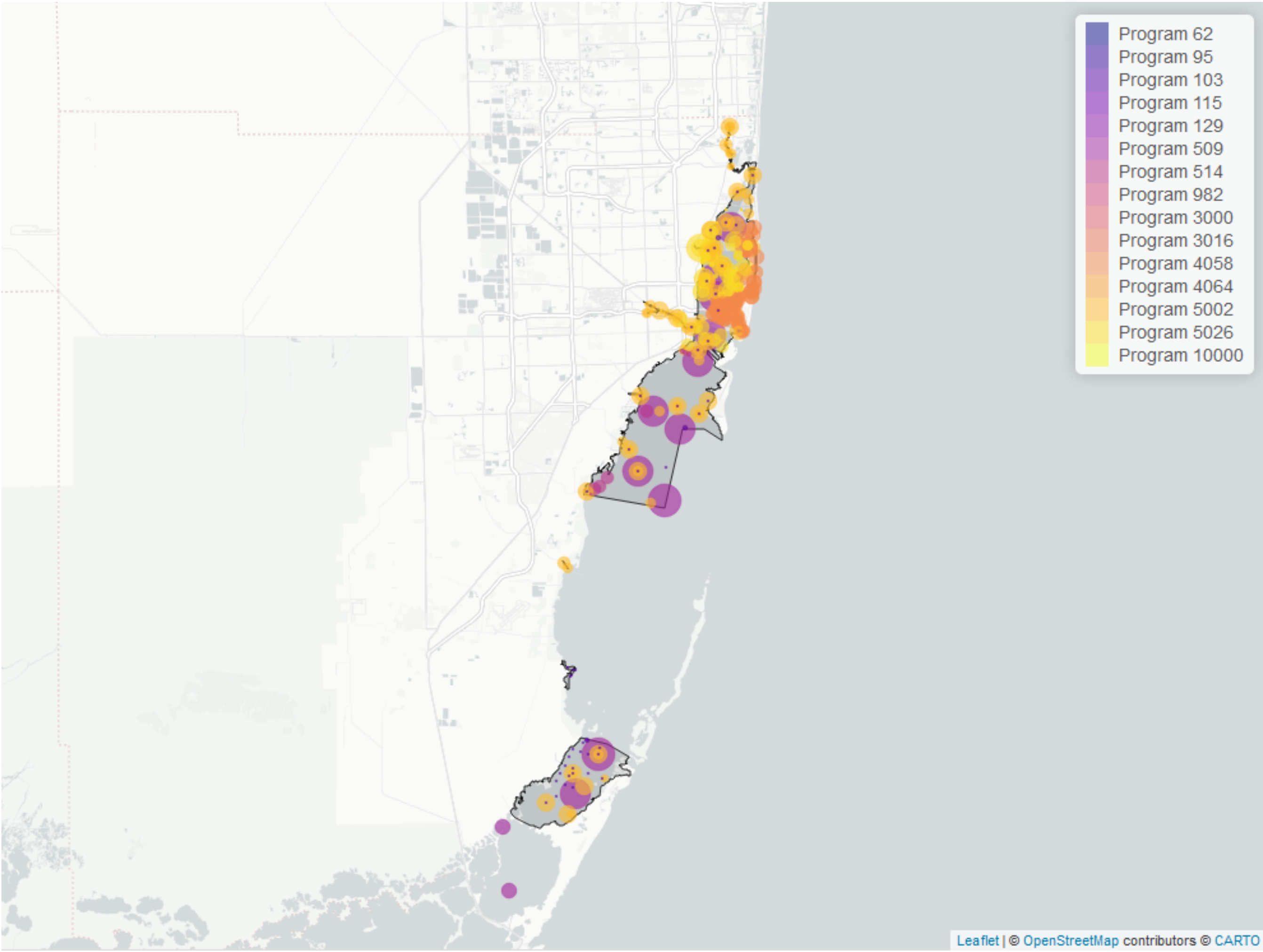

Figure 18: Map showing location of Discrete sampling sites for Total Phosphorus. The bubble size on the maps below reflect the amount of data available at each sampling site.

Table 23: Programs contributing data for Total Phosphorus

ProgramID	*N_Data*	*YearMin*	*YearMax*
5002	2600	2001	2024
4058	2196	2016	2023
509	1655	1993	2008
5026	1462	2019	2024
514	103	2000	2005
103	75	1970	2020
115	1	2004	2004

Program names:

103 - EPA STOrage and RETrieval Data Warehouse (STORET)/WQX[4]
115 - Environmental Monitoring Assessment Program[5]
509 - SERC Water Quality Monitoring Network[7]
514 - Florida LAKEWATCH Program[8]
4058 - City of Miami Beach Water Monitoring[11]

5002 - Florida STORET / WIN[1]
5026 - North Biscayne Bay Seagrass Loss Water Quality Program[2]

Total Suspended Solids - Discrete Water Quality

Seasonal Kendall-Tau Trend Analysis

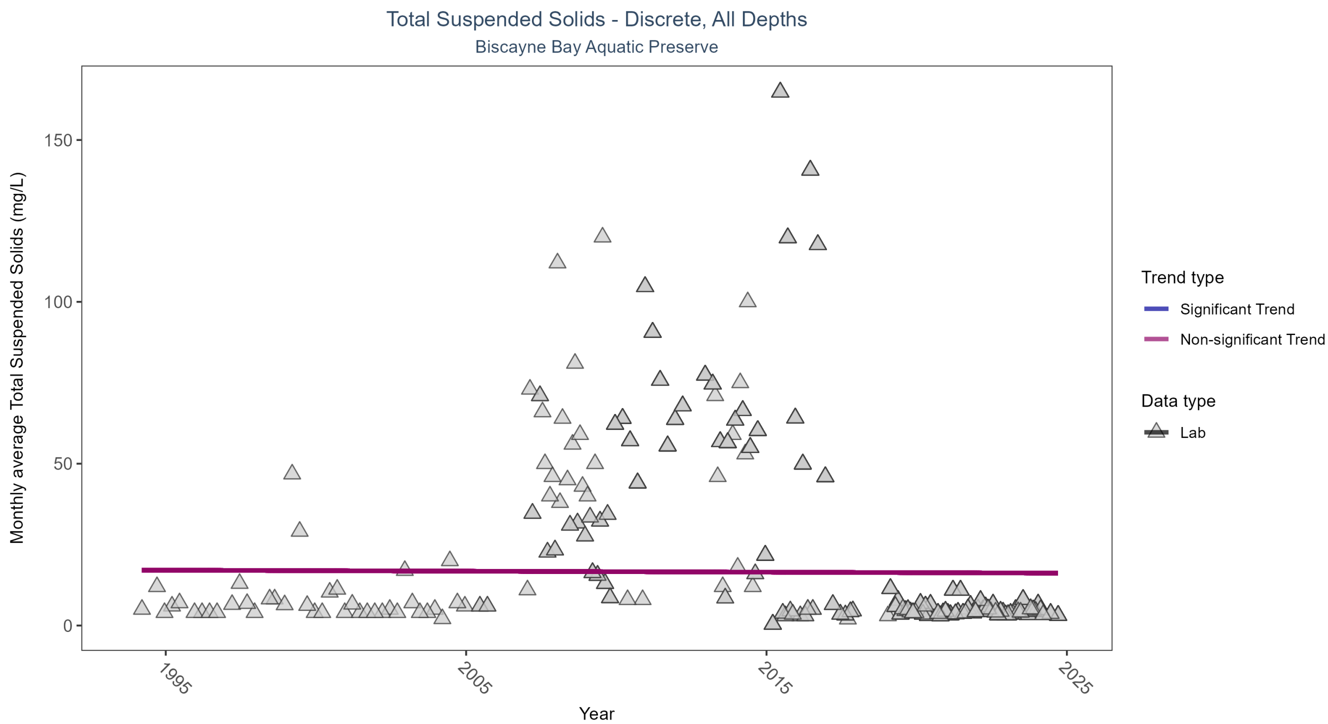

Figure 19: Seasonal Kendall-Tau Results for Total Suspended Solids - Discrete

Table 24: Seasonal Kendall-Tau Trend Analysis for Total Suspended Solids

RelativeDepth	N-Data	N-Years	Median	Independent	tau	p	SennSlope	SennIntercept	ChiSquared	pChiSquared	Trend
All	2221	29	4.9	TRUE	-0.1596	0.2724	-0.0308	17.1354	15.1965	0.1737	0

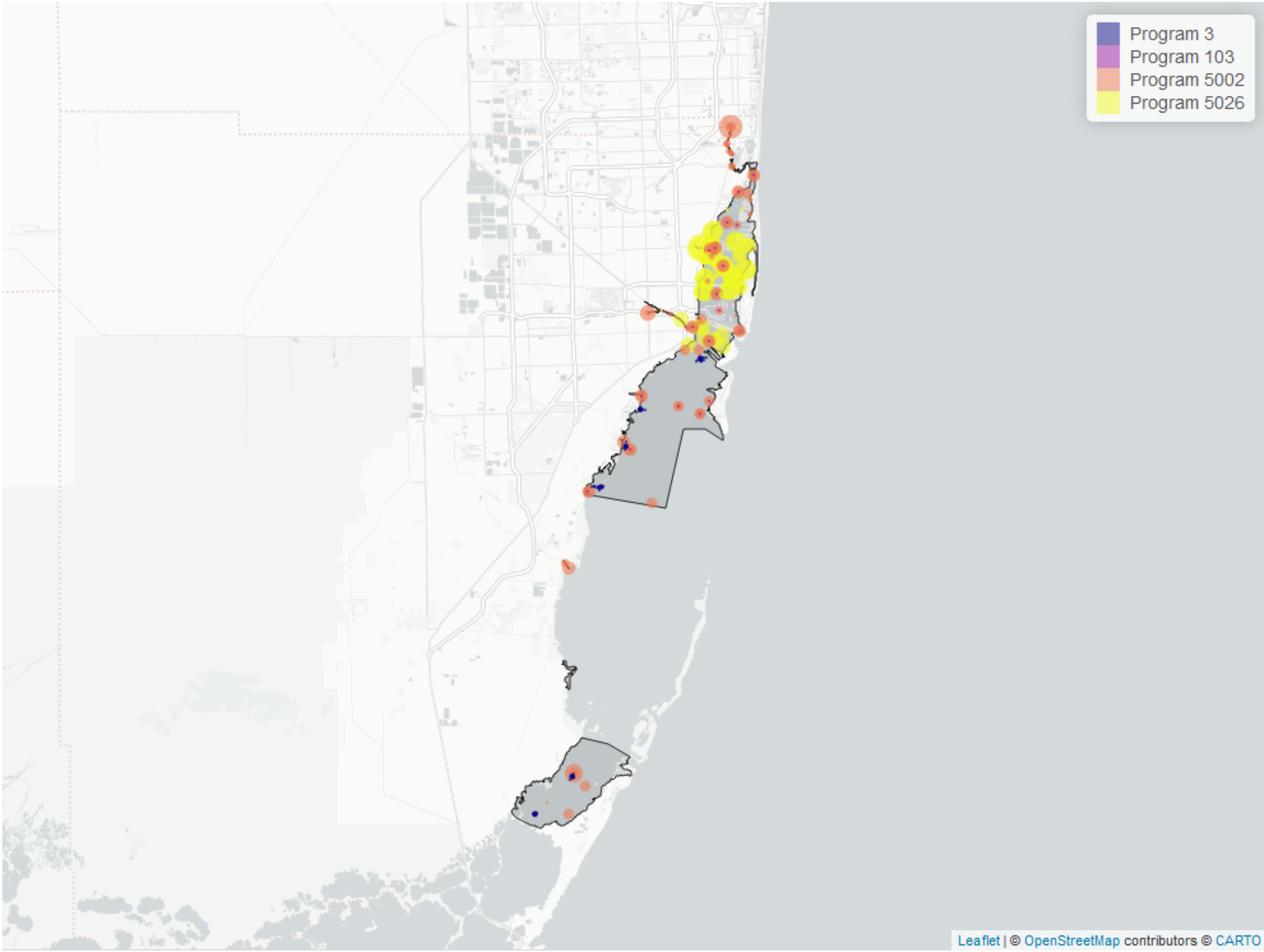

Figure 20: Map showing location of Discrete sampling sites for Total Suspended Solids. The bubble size on the maps below reflect the amount of data available at each sampling site.

Table 25: Programs contributing data for Total Suspended Solids

ProgramID	*N_Data*	*YearMin*	*YearMax*
5026	1917	2019	2024
5002	1193	1994	2024
3	369	2002	2012
103	19	2020	2020

Program names:

3 - Atlantic Oceanographic and Meteorological Laboratory (AOML) South Florida Program Synoptic Shipboard Surveys[3]
103 - EPA STOrage and RETrieval Data Warehouse (STORET)/WQX[4]
5002 - Florida STORET / WIN[1]
5026 - North Biscayne Bay Seagrass Loss Water Quality Program[2]

Turbidity - Discrete Water Quality

Seasonal Kendall-Tau Trend Analysis

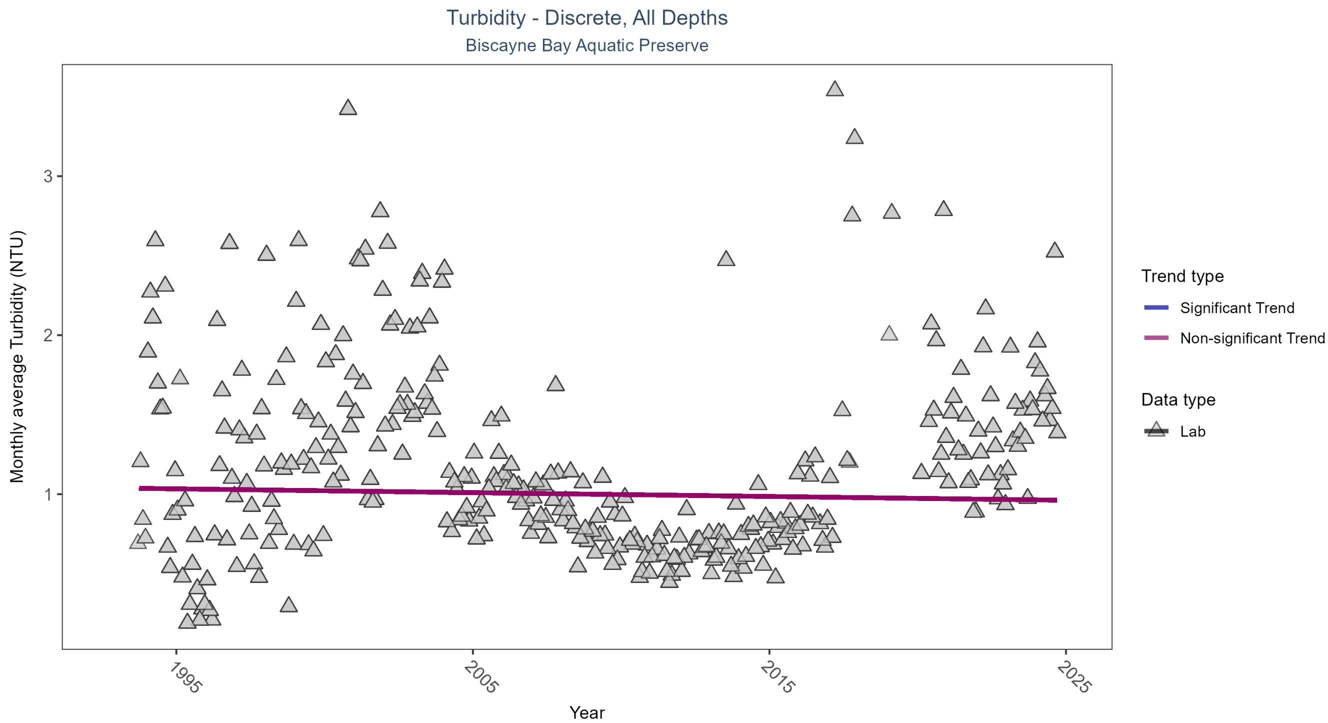

Figure 21: Seasonal Kendall-Tau Results for Turbidity - Discrete

Table 26: Seasonal Kendall-Tau Trend Analysis for Turbidity

RelativeDepth	N-Data	N-Years	Median	Independent	tau	p	SennSlope	SennIntercept	ChiSquared	pChiSquared	Trend
All	11884	31	0.8	TRUE	-0.027	0.4931	-0.0024	1.0383	4.2044	0.9636	0

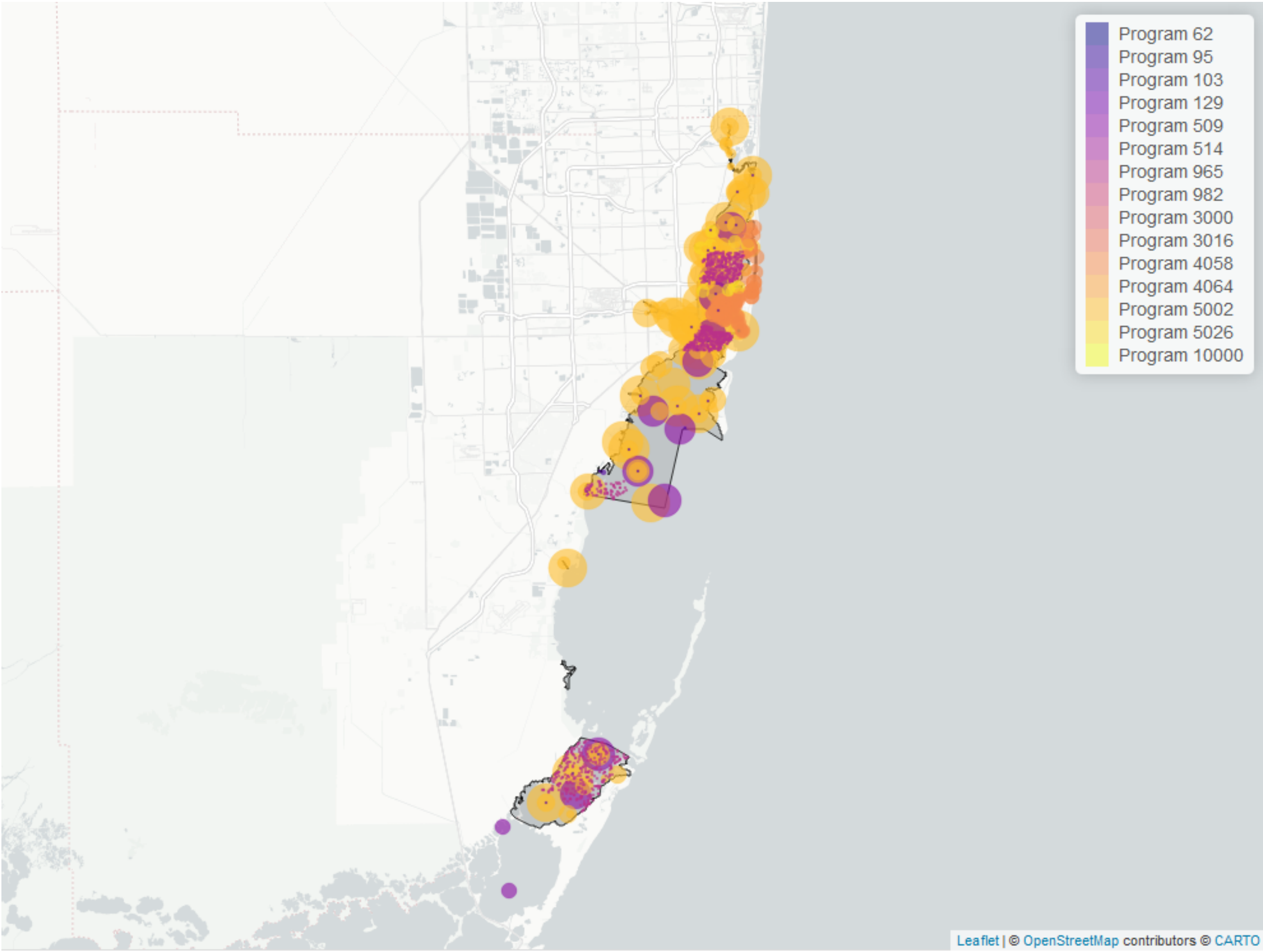

Figure 22: Map showing location of Discrete sampling sites for Turbidity. The bubble size on the maps below reflect the amount of data available at each sampling site.

Table 27: Programs contributing data for Turbidity

ProgramID	*N_Data*	*YearMin*	*YearMax*
5002	11080	1994	2024
4058	2316	2016	2023
509	1658	1993	2008
965	1254	2005	2011
5026	410	2019	2020
103	32	1982	2020

Program names:

103 - EPA STOrage and RETrieval Data Warehouse (STORET)/WQX[4]
509 - SERC Water Quality Monitoring Network[7]
965 - South Florida Seagrass Fish and Invertebrate Assessment Network[14]
4058 - City of Miami Beach Water Monitoring[11]
5002 - Florida STORET / WIN[1]
5026 - North Biscayne Bay Seagrass Loss Water Quality Program[2]

Water Temperature - Discrete Water Quality

Seasonal Kendall-Tau Trend Analysis

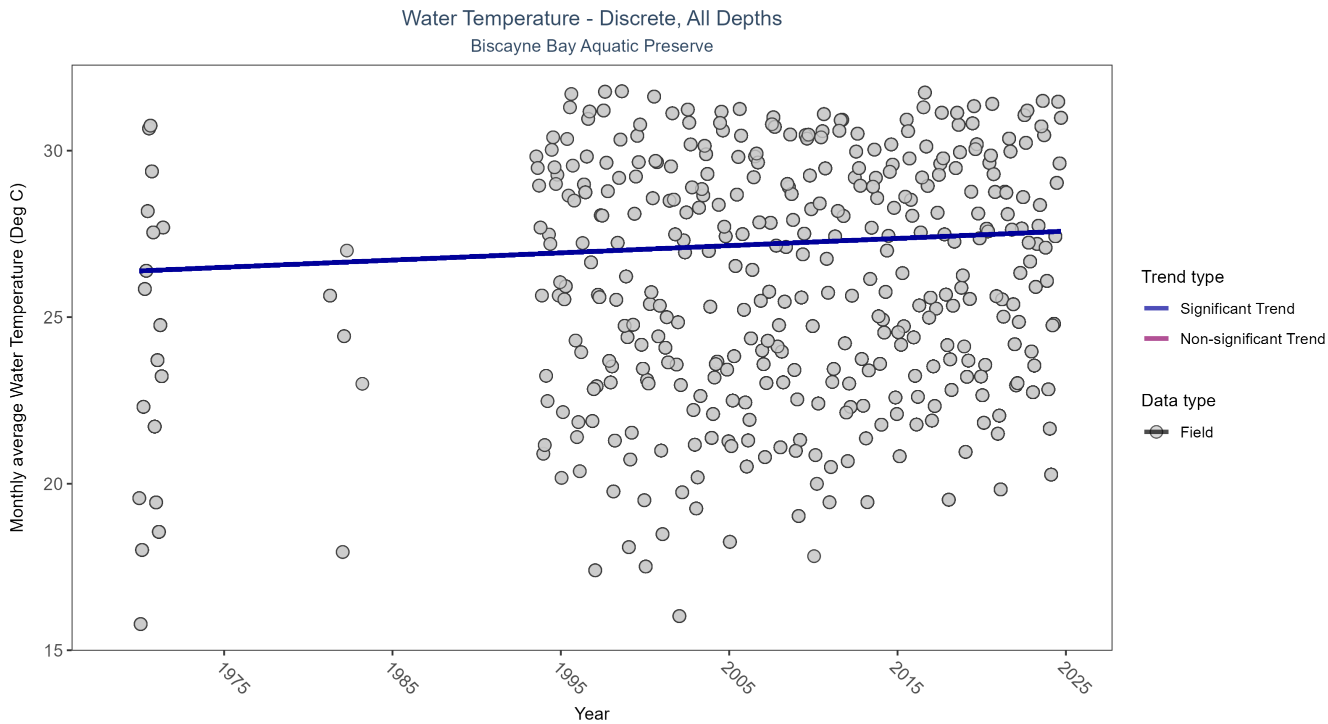

Figure 23: Seasonal Kendall-Tau Results for Water Temperature - Discrete

Table 28: Seasonal Kendall-Tau Trend Analysis for Water Temperature

RelativeDepth	N-Data	N-Years	Median	Independent	tau	p	SennSlope	SennIntercept	ChiSquared	pChiSquared	Trend
All	25790	38	27	TRUE	0.1371	0.0001	0.0217	26.3665	10.0478	0.5261	1

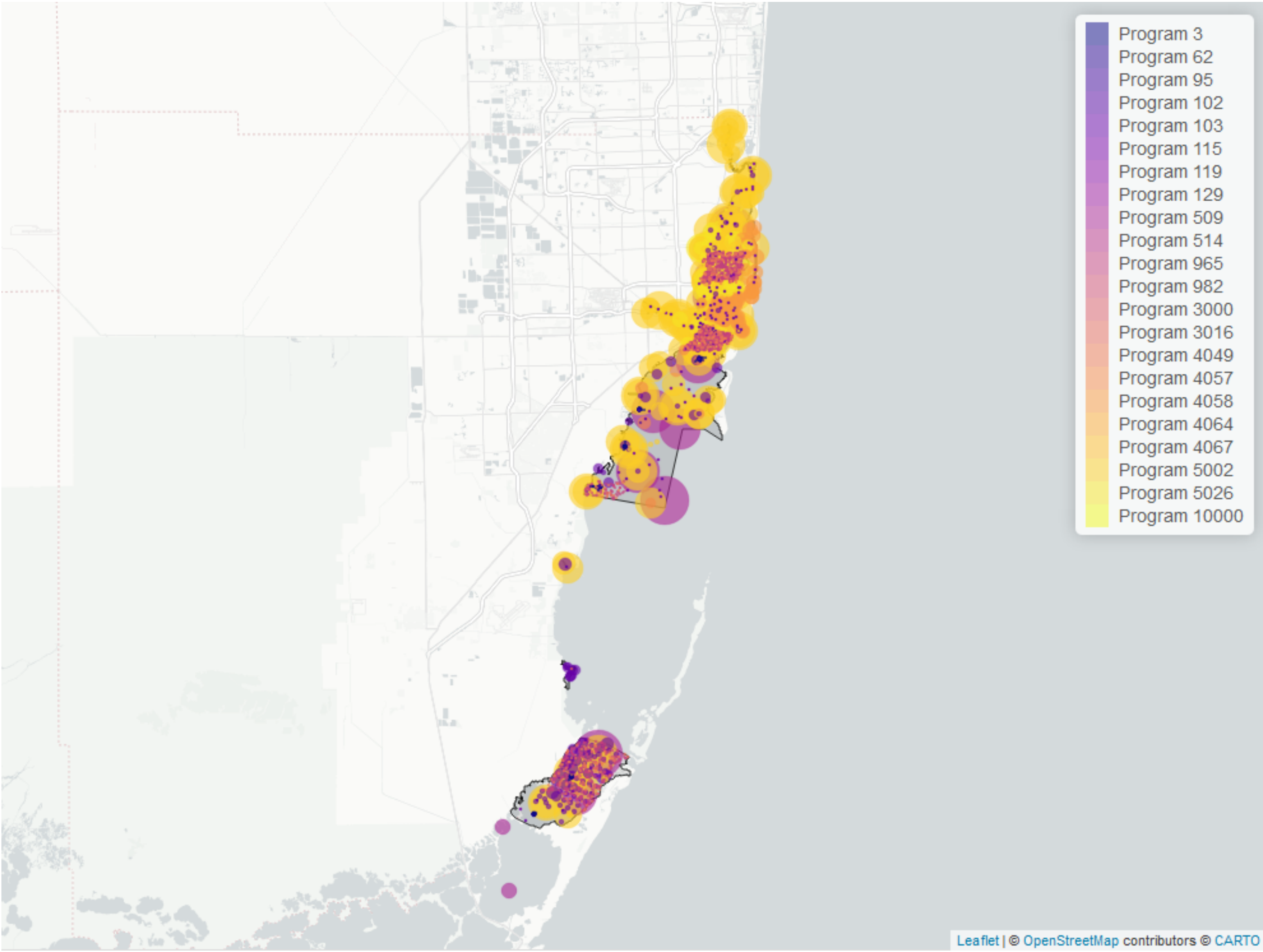

Figure 24: Map showing location of Discrete sampling sites for Water Temperature. The bubble size on the maps below reflect the amount of data available at each sampling site.

Table 29: Programs contributing data for Water Temperature

ProgramID	*N_Data*	*YearMin*	*YearMax*
5002	13945	2001	2024
509	3316	1993	2008
965	2512	2005	2011
4058	2299	2016	2023
5026	1535	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	2004

Program names:

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

Surveys[3]
95 - Harmful Algal Bloom Marine Observation Network[13]
102 - National Status and Trends Mussel Watch[12]
103 - EPA STOrage and RETrieval Data Warehouse (STORET)/WQX[4]
115 - Environmental Monitoring Assessment Program[5]
509 - SERC Water Quality Monitoring Network[7]
965 - South Florida Seagrass Fish and Invertebrate Assessment Network[14]
4049 - The South Florida Fisheries Habitat Assessment Program (FHAP)[9]
4057 - Biscayne Bay Water Watch[10]
4058 - City of Miami Beach Water Monitoring[11]
5002 - Florida STORET / WIN[1]
5026 - North Biscayne Bay Seagrass Loss Water Quality Program[2]

Water Quality - Continuous

The following files were used in the continuous analysis:

- *Combined_WQ_WC_NUT_cont_Dissolved_Oxygen_SE-2024-Dec-08.txt*
- *Combined_WQ_WC_NUT_cont_Dissolved_Oxygen_Saturation_SE-2024-Dec-08.txt*
- *Combined_WQ_WC_NUT_cont_pH_SE-2024-Dec-08.txt*
- *Combined_WQ_WC_NUT_cont_Salinity_SE-2024-Dec-08.txt*
- *Combined_WQ_WC_NUT_cont_Turbidity_SE-2024-Dec-08.txt*
- *Combined_WQ_WC_NUT_cont_Water_Temperature_SE-2024-Dec-08.txt*

Continuous monitoring locations in Biscayne Bay Aquatic Preserve

Table 30: Biscayne Bay Aquatic Preserves Continuous Water Quality Monitoring (5077)

ProgramLocationID	*Years of Data*	*Use in Analysis*	*Parameters*
BBBB14	6	TRUE	DO , DOS , pH , Sal , Turb , TempW
BBCWA4	3	FALSE	DO , DOS , pH , Sal , Turb , TempW
BBJT71	6	TRUE	DO , DOS , pH , Sal , Turb , TempW
BBLR03	5	TRUE	DO , DOS
BBLR03	6	TRUE	pH , Sal , Turb , TempW
BBMRDW	4	FALSE	DO , DOS , pH , Sal , Turb , TempW
BBMRRB	3	FALSE	DO , DOS , pH , Sal , Turb , TempW

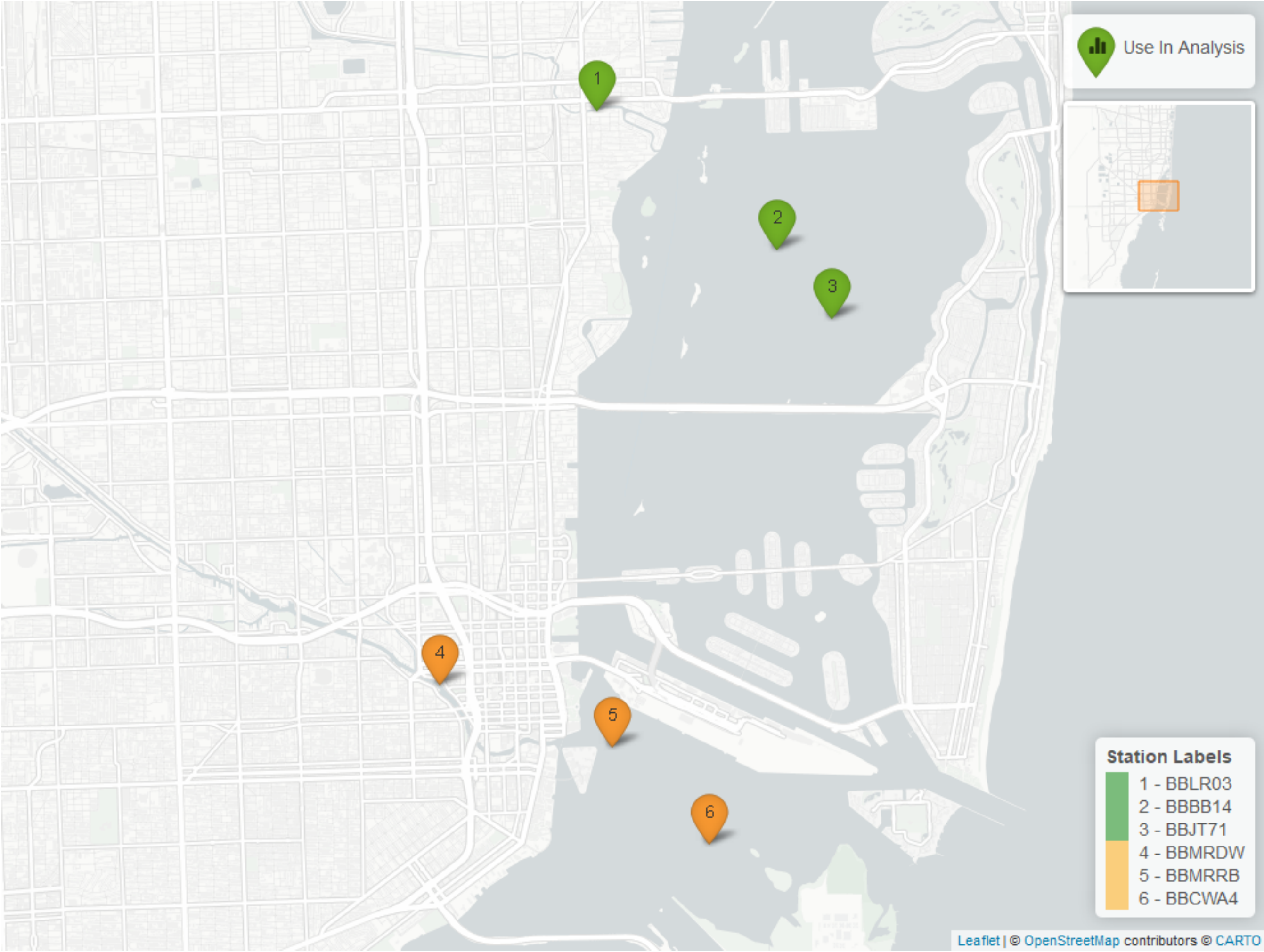

Figure 25: Map showing Continuous Water Quality Monitoring sampling locations within the boundaries of Biscayne Bay Aquatic Preserve. Sites marked as *Use In Analysis* are featured in this report.

Dissolved Oxygen - All Stations Combined

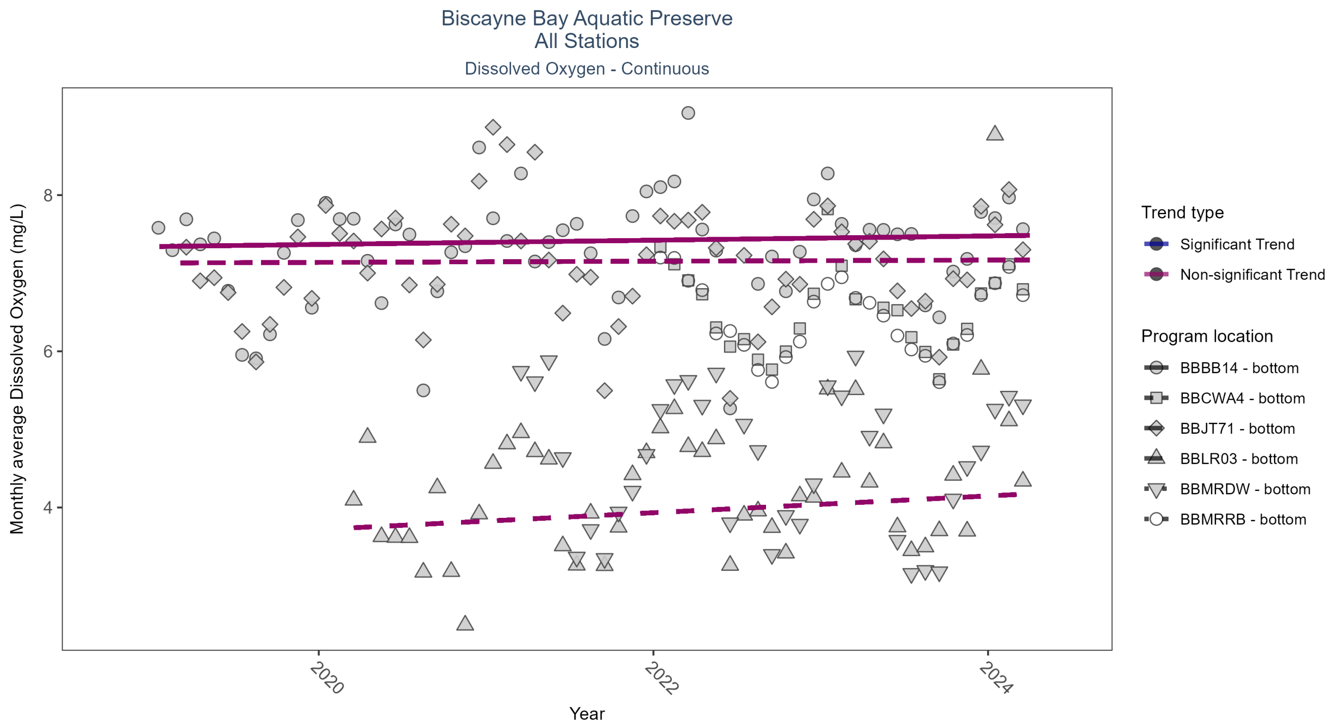

Figure 26: Figure for Dissolved Oxygen - Continuous - All stations combined

Table 31: Seasonal Kendall-Tau Results for All Stations - Dissolved Oxygen

Station	N_Data	N_Years	Period of Record	Median	tau	SennIntercept	SennSlope	p
BBCWA4	71466	3	2022 - 2024	6.5	-	-	-	-
BBBB14	158232	6	2019 - 2024	7.3	0.09	7.34	0.03	0.4258
BBJT71	175347	6	2019 - 2024	7.0	0.08	7.13	0.01	0.5824
BBLR03	130447	5	2020 - 2024	4.2	0.21	3.72	0.11	0.1564
BBMRDW	98760	4	2021 - 2024	4.6	-	-	-	-
BBMRRB	76975	3	2022 - 2024	6.4	-	-	-	-

Dissolved Oxygen Saturation - All Stations Combined

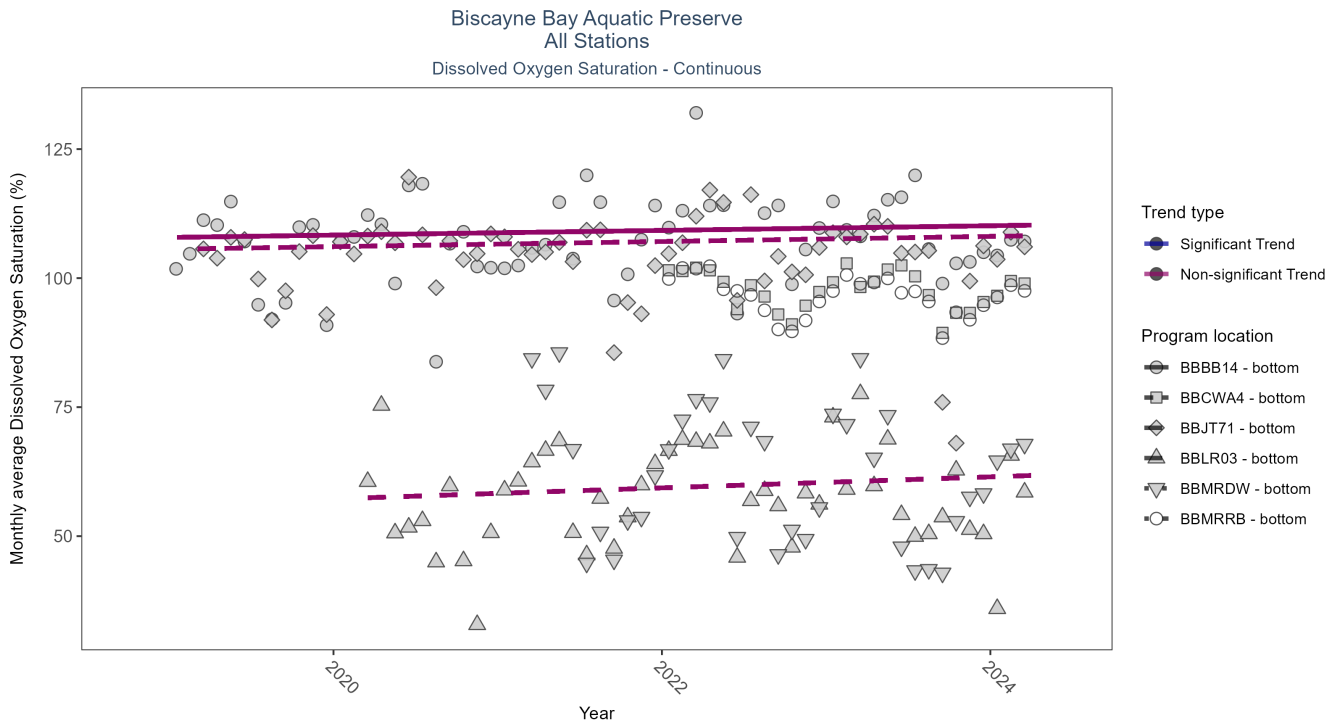

Figure 27: Figure for Dissolved Oxygen Saturation - Continuous - All stations combined

Table 32: Seasonal Kendall-Tau Results for All Stations - Dissolved Oxygen Saturation

Station	N_Data	N_Years	Period of Record	Median	tau	SennIntercept	SennSlope	p
BBCWA4	75189	3	2022 - 2024	97.5	-	-	-	-
BBBB14	157972	6	2019 - 2024	105.1	0.12	107.88	0.45	0.3528
BBLR03	130446	5	2020 - 2024	56.9	0.05	57.22	1.07	0.7768
BBJT71	176498	6	2019 - 2024	102.0	0.1	105.6	0.5	0.4095
BBMRRB	76983	3	2022 - 2024	95.8	-	-	-	-
BBMRDW	98761	4	2021 - 2024	60.6	-	-	-	-

pH - All Stations Combined

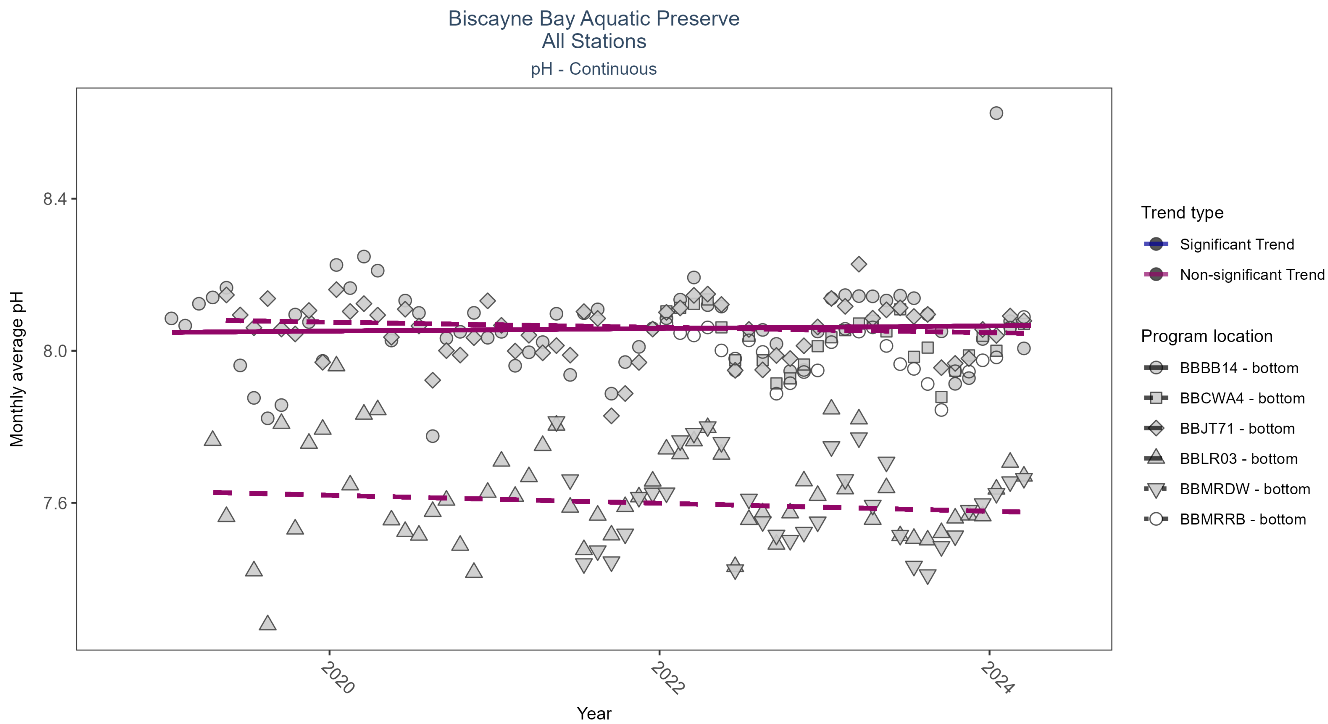

Figure 28: Figure for pH - Continuous - All stations combined

Table 33: Seasonal Kendall-Tau Results for All Stations - pH

Station	N_Data	N_Years	Period of Record	Median	tau	SennIntercept	SennSlope	p
BBCWA4	75371	3	2022 - 2024	8.0	-	-	-	-
BBBB14	154159	6	2019 - 2024	8.1	0.06	8.05	0	0.6905
BBJT71	163759	6	2019 - 2024	8.1	-0.15	8.08	-0.01	0.2199
BBLR03	145957	6	2019 - 2024	7.6	-0.16	7.63	-0.01	0.2199
BBMRDW	95215	4	2021 - 2024	7.6	-	-	-	-
BBMRRB	77027	3	2022 - 2024	8.0	-	-	-	-

Salinity - All Stations Combined

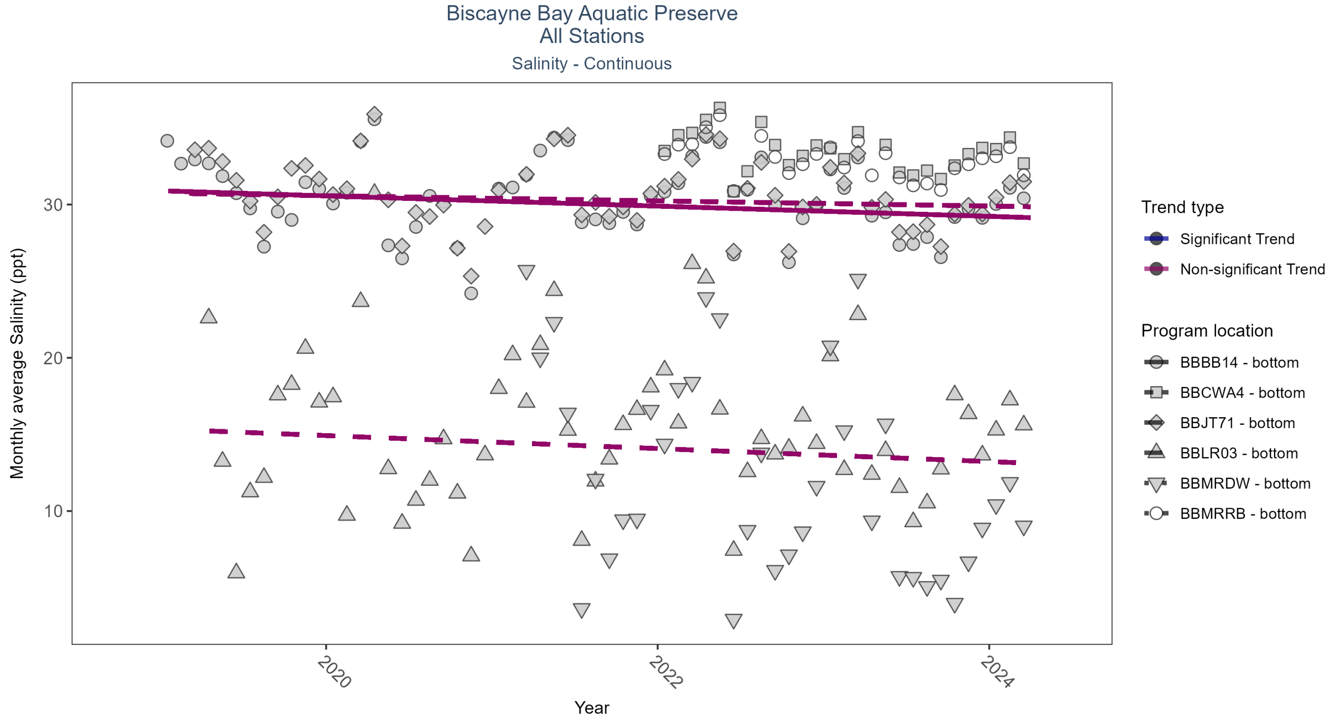

Figure 29: Figure for Salinity - Continuous - All stations combined

Table 34: Seasonal Kendall-Tau Results for All Stations - Salinity

Station	N_Data	N_Years	Period of Record	Median	tau	SennIntercept	SennSlope	p
BBBB14	147846	6	2019 - 2024	30.2	-0.21	30.9	-0.33	0.1049
BBCWA4	69581	3	2022 - 2024	33.6	-	-	-	-
BBLR03	150444	6	2019 - 2024	16.2	-0.15	15.35	-0.42	0.2293
BBJT71	161583	6	2019 - 2024	30.9	-0.12	30.75	-0.17	0.3169
BBMRDW	96889	4	2021 - 2024	10.1	-	-	-	-
BBMRRB	76983	3	2022 - 2024	33.1	-	-	-	-

Turbidity - All Stations Combined

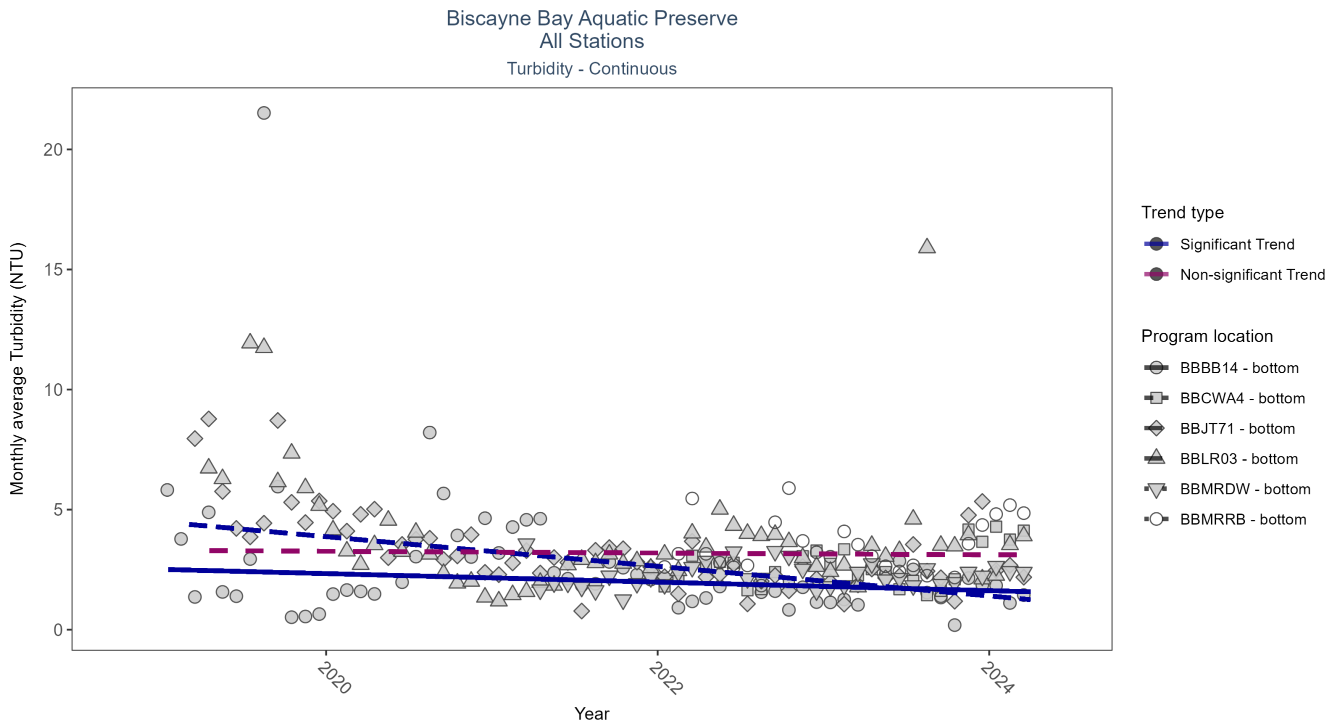

Figure 30: Figure for Turbidity - Continuous - All stations combined

Table 35: Seasonal Kendall-Tau Results for All Stations - Turbidity

Station	N_Data	N_Years	Period of Record	Median	tau	SennIntercept	SennSlope	p
BBBB14	147344	6	2019 - 2024	2	-0.26	2.51	-0.18	0.0216
BBCWA4	72769	3	2022 - 2024	2	-	-	-	-
BBJT71	169453	6	2019 - 2024	3	-0.61	4.49	-0.62	0.0000
BBLR03	152908	6	2019 - 2024	3	-0.03	3.3	-0.04	0.8286
BBMRDW	98484	4	2021 - 2024	2	-	-	-	-
BBMRRB	76043	3	2022 - 2024	3	-	-	-	-

Water Temperature - All Stations Combined

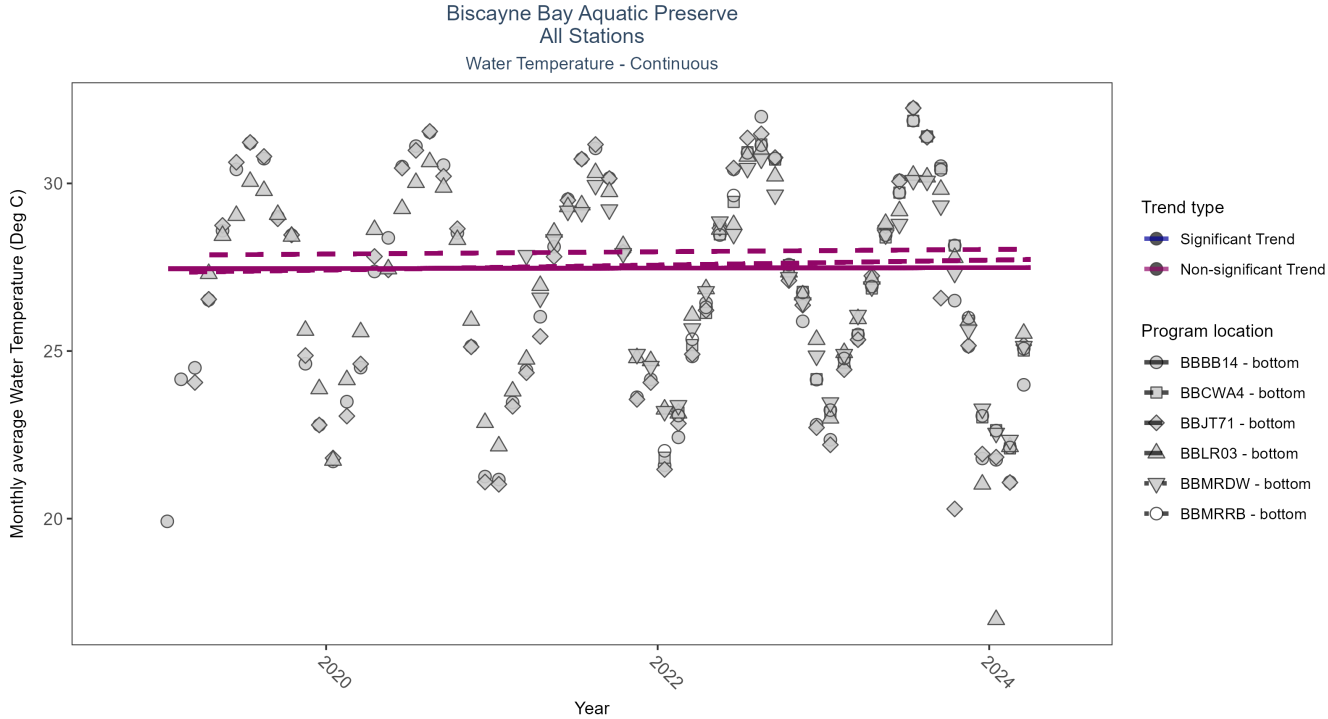

Figure 31: Figure for Water Temperature - Continuous - All stations combined

Table 36: Seasonal Kendall-Tau Results for All Stations - Water Temperature

Station	N_Data	N_Years	Period of Record	Median	tau	SennIntercept	SennSlope	p
BBBB14	158344	6	2019 - 2024	26.9	0.04	27.45	0.01	0.7906
BBCWA4	75372	3	2022 - 2024	26.7	-	-	-	-
BBJT71	176850	6	2019 - 2024	27.1	0.06	27.34	0.07	0.5824
BBLR03	156713	6	2019 - 2024	27.7	0.02	27.86	0.03	0.9436
BBMRDW	98772	4	2021 - 2024	27.4	-	-	-	-
BBMRRB	77027	3	2022 - 2024	26.9	-	-	-	-

Submerged Aquatic Vegetation

The data file used is: **All__SAV__Parameters-2024-Dec-08.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

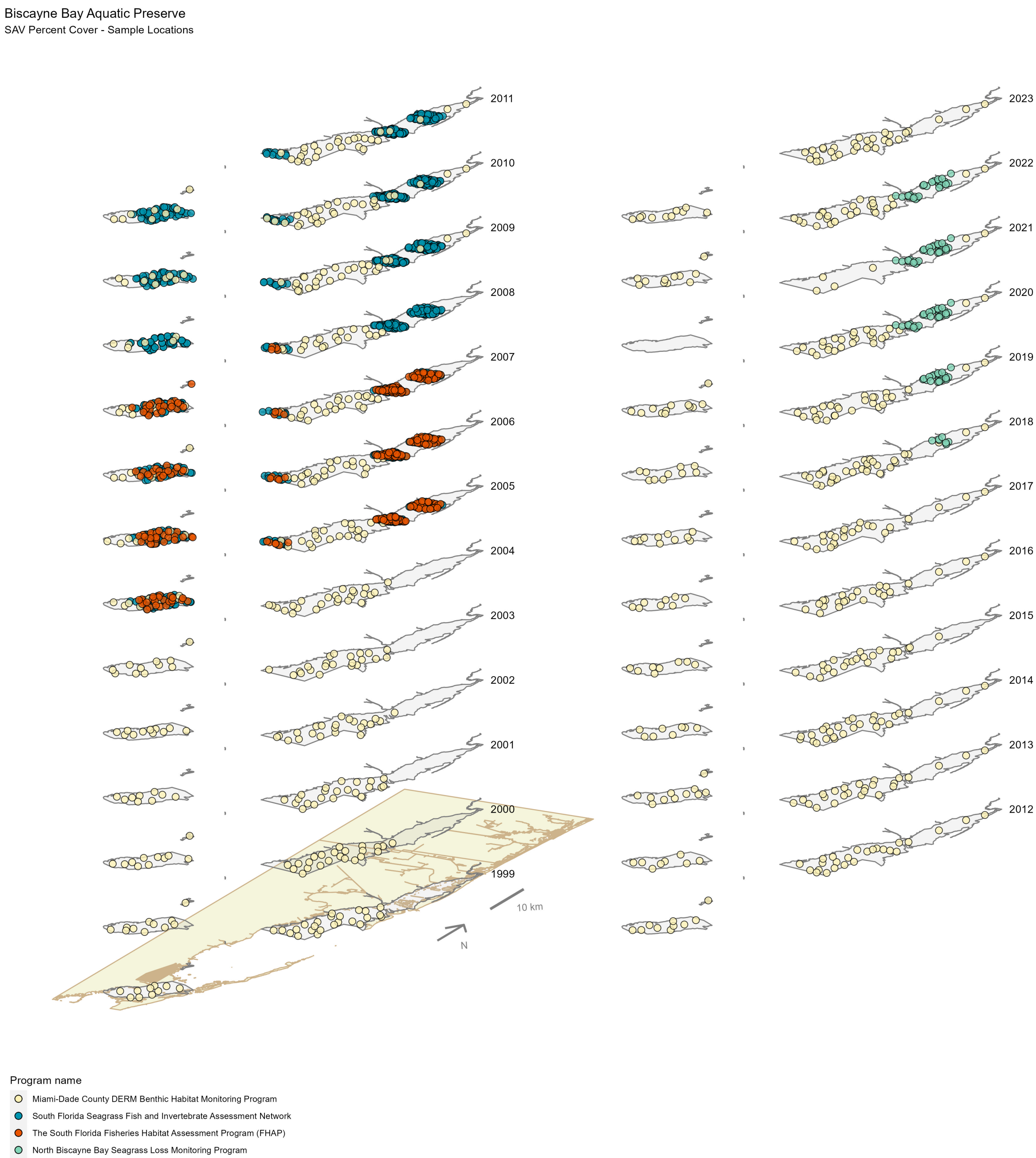

Figure 32: Maps showing the temporal scope of SAV sampling sites within the boundaries of *Biscayne Bay Aquatic Preserve* by Program name.

Sampling locations by Program:

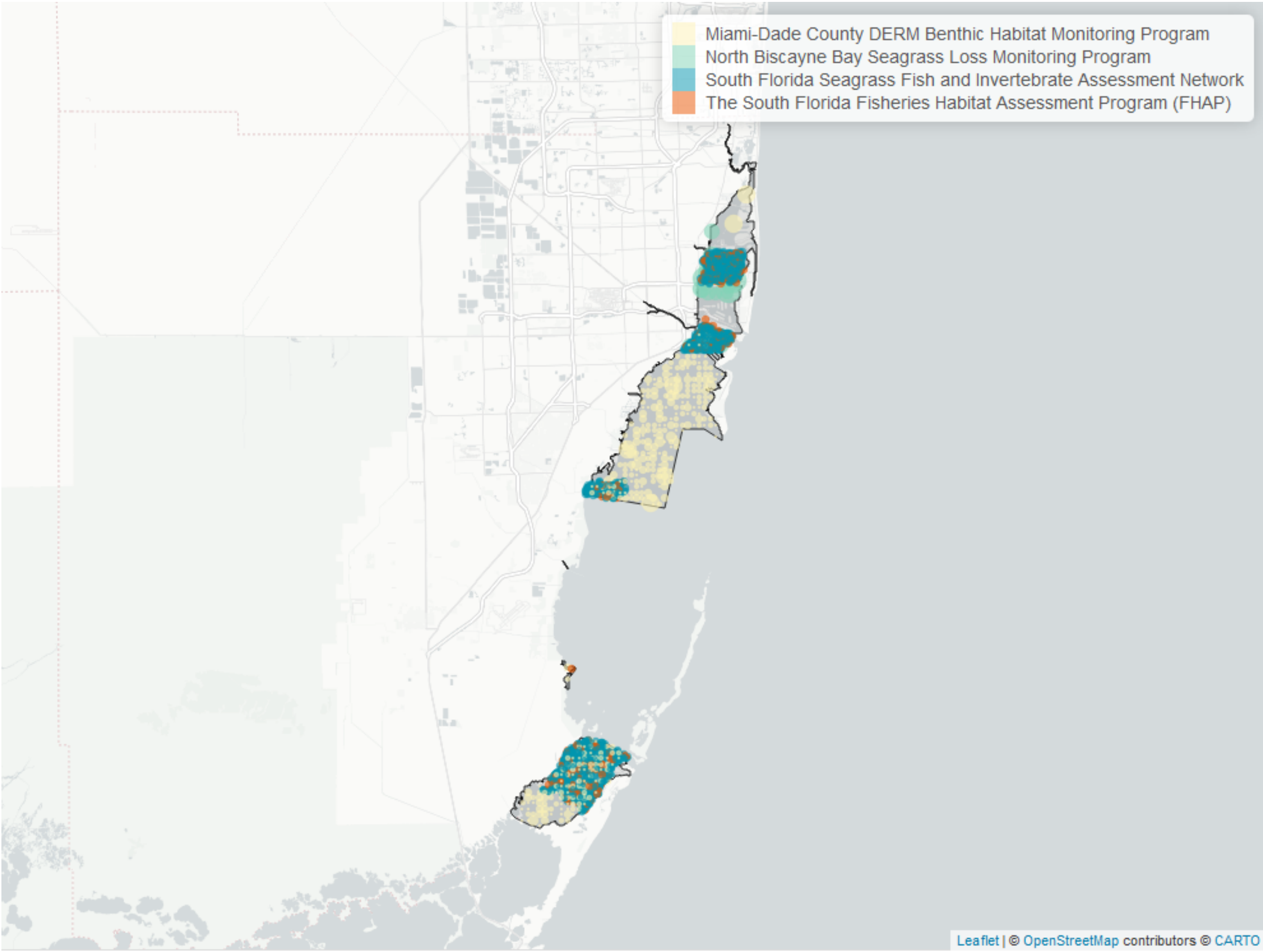

Figure 33: Map showing SAV sampling sites within the boundaries of *Biscayne Bay Aquatic Preserve*. The point size reflects the number of samples at a given sampling site.

Table 37: South Florida Seagrass Fish and Invertebrate Assessment Network - Program 965

N-Data	*YearMin*	*YearMax*	*method*	*Sample Locations*
71071	2005	2011	Braun Blanquet	94

Table 38: Miami-Dade County DERM Benthic Habitat Monitoring Program - Program 4018

N-Data	*YearMin*	*YearMax*	*method*	*Sample Locations*
17330	1999	2023	Braun Blanquet	365
966	1999	2007	Percent Cover	232

Table 39: The South Florida Fisheries Habitat Assessment Program (FHAP) - Program 4049

N-Data	*YearMin*	*YearMax*	*method*	*Sample Locations*
18891	2005	2008	Braun Blanquet	273

Table 40: North Biscayne Bay Seagrass Loss Monitoring Program - Program 5027

N-Data	*YearMin*	*YearMax*	*method*	*Sample Locations*
5414	2018	2022	Braun Blanquet	31
5457	2018	2022	Percent Cover	31

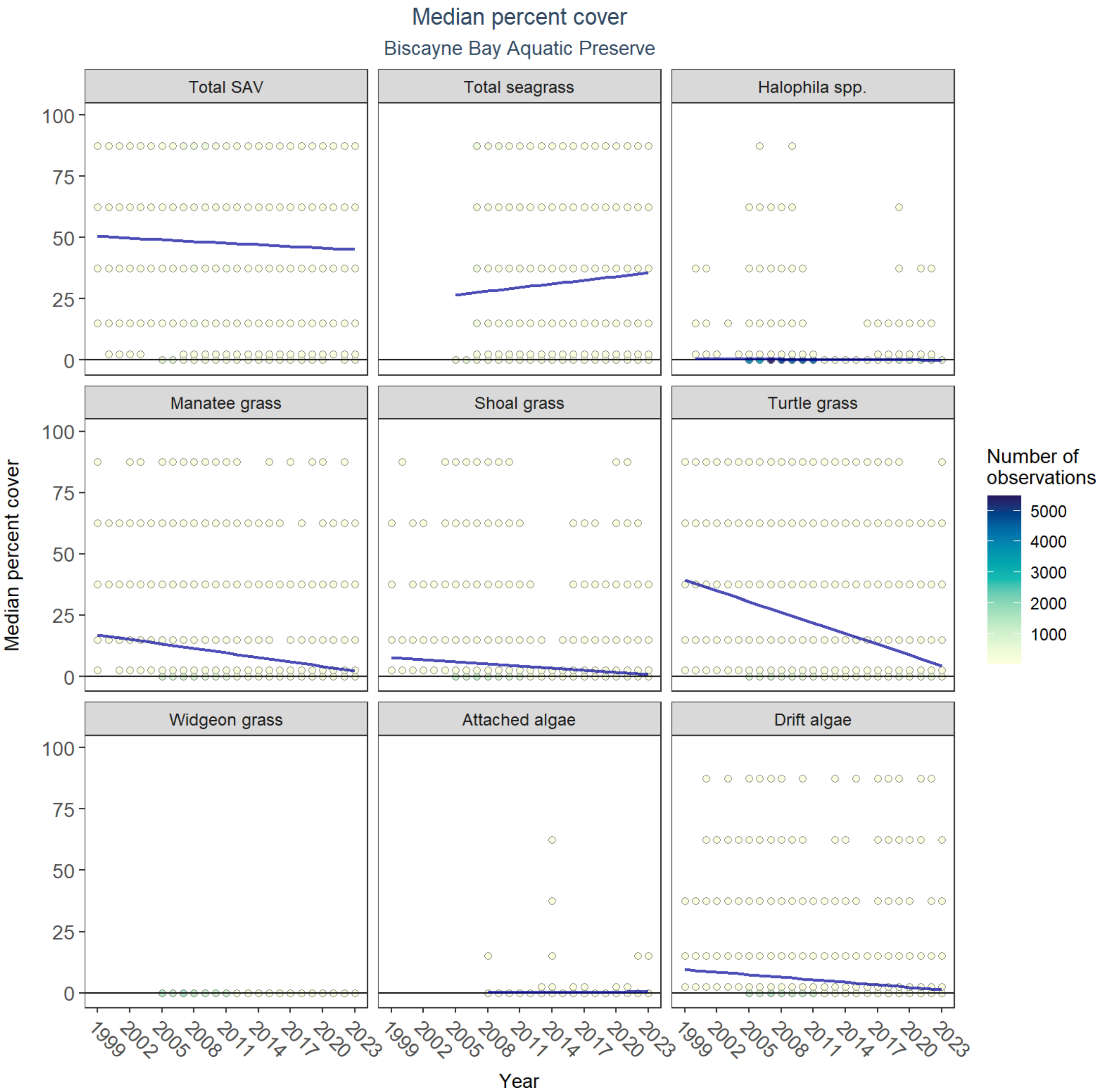

Figure 34: Trends in median percent cover for various seagrass species in Biscayne Bay Aquatic Preserve

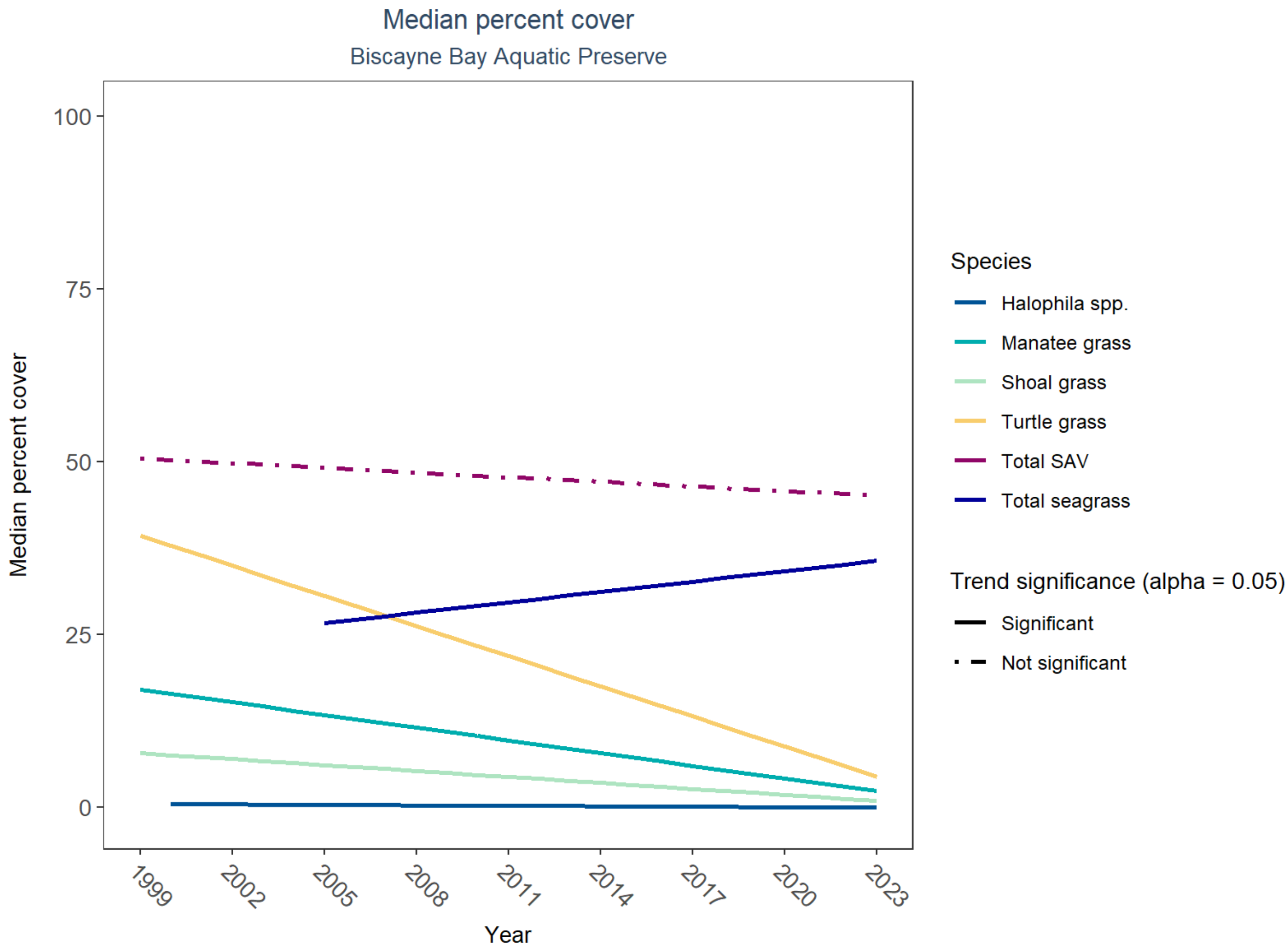

Figure 35: Trends in median percent cover for various seagrass species in Biscayne Bay Aquatic Preserve - simplified

Table 41: Percent Cover Trend Analysis for Biscayne Bay Aquatic Preserve

CommonName	*Trend Significance (0.05)*	*Period of Record*	*LME-Intercept*	*LME-Slope*	*p*
Attached algae	Significantly increasing trend	2008 - 2023	-0.2513798	0.0221077	0.0410380
Drift algae	Significantly decreasing trend	1999 - 2023	11.2382137	-0.3433918	0.0000002
Shoal grass	Significantly decreasing trend	1999 - 2023	9.2639104	-0.2869642	0.0000005
Halophila spp.	Significantly decreasing trend	2000 - 2023	0.5904383	-0.0219981	0.0249565
Widgeon grass	Model did not fit the available data	2005 - 2023	-	-	-
Manatee grass	Significantly decreasing trend	1999 - 2023	20.0834243	-0.6125839	0.0000000
Turtle grass	Significantly decreasing trend	1999 - 2023	46.5547420	-1.4527012	0.0000000
Total SAV	No significant trend	1999 - 2023	51.5762974	-0.2246879	0.2445087
Total seagrass	Significantly increasing trend	2005 - 2023	21.1535181	0.4993106	0.0107801

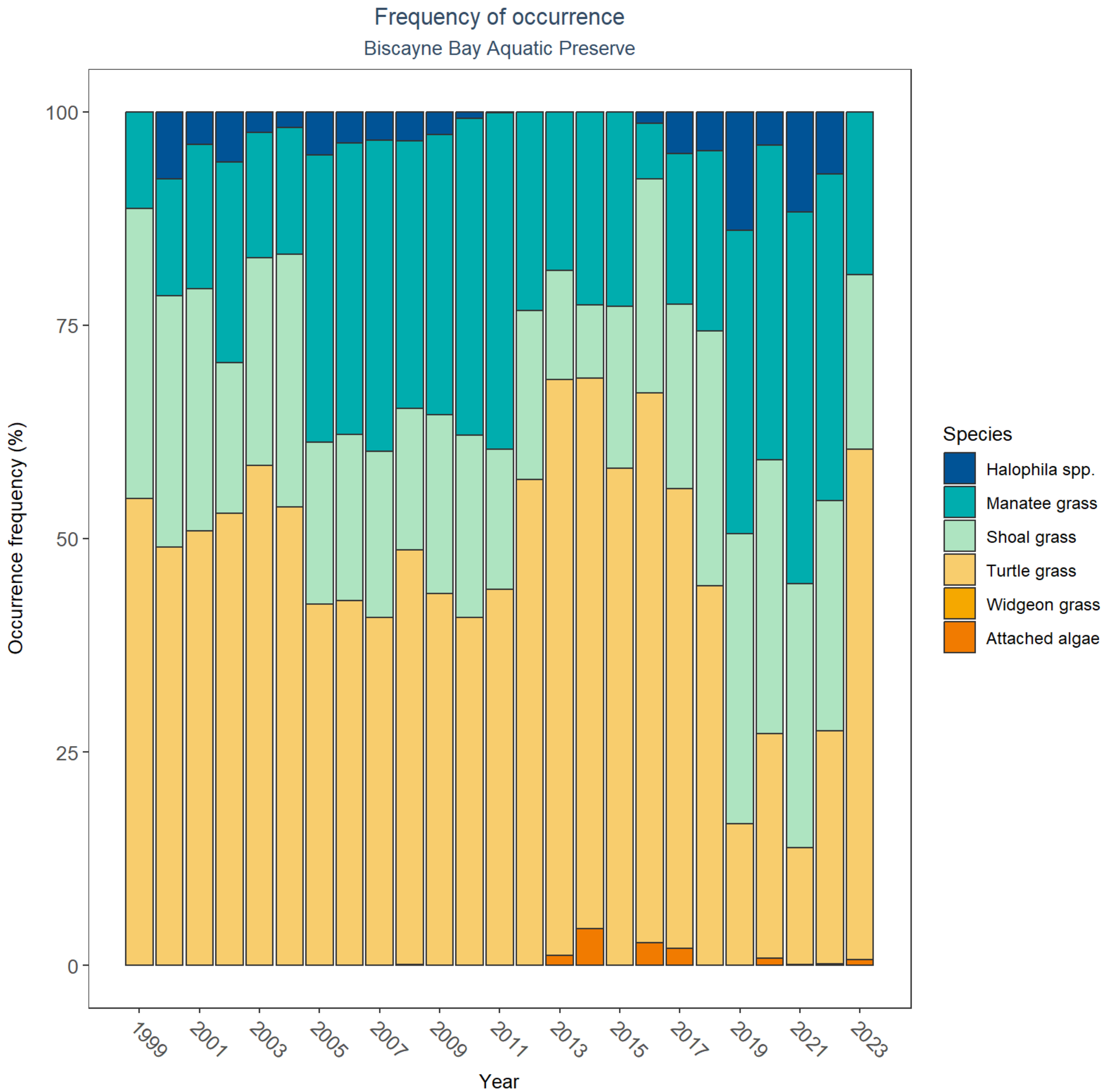

Figure 36: Frequency of occurrence for various seagrass species in Biscayne Bay Aquatic Preserve

Coral Reef

The data file used is: **All_CORAL_Parameters-2024-Dec-08.txt**
Species Richness

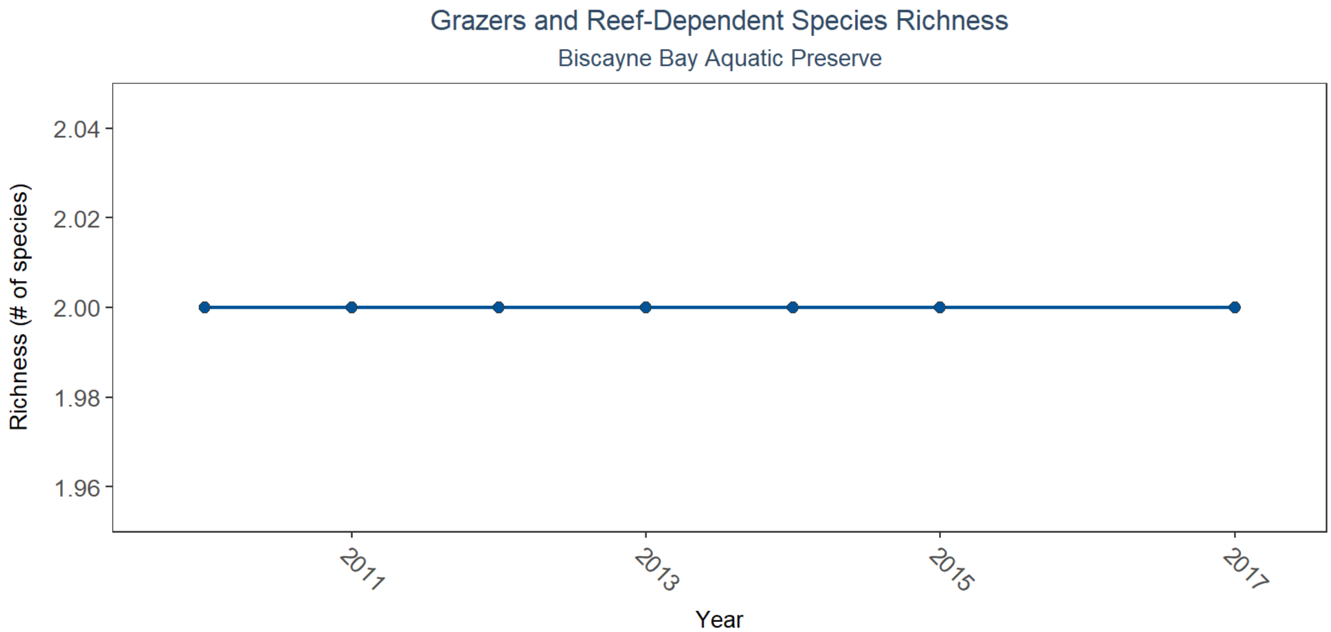

Figure 37: Figure for Coral Species Richness in Biscayne Bay Aquatic Preserve

Table 42: Coral Species Richness

N-Years	*EarliestYear*	*LatestYear*	*N-Data*	*Min*	*Max*	*Median*	*Mean*	*StDev*	*Year-MinRichness*	*Year-MaxRichness*
7	2010	2017	19	2	2	2	2	0	2010	2010

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