Estero 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

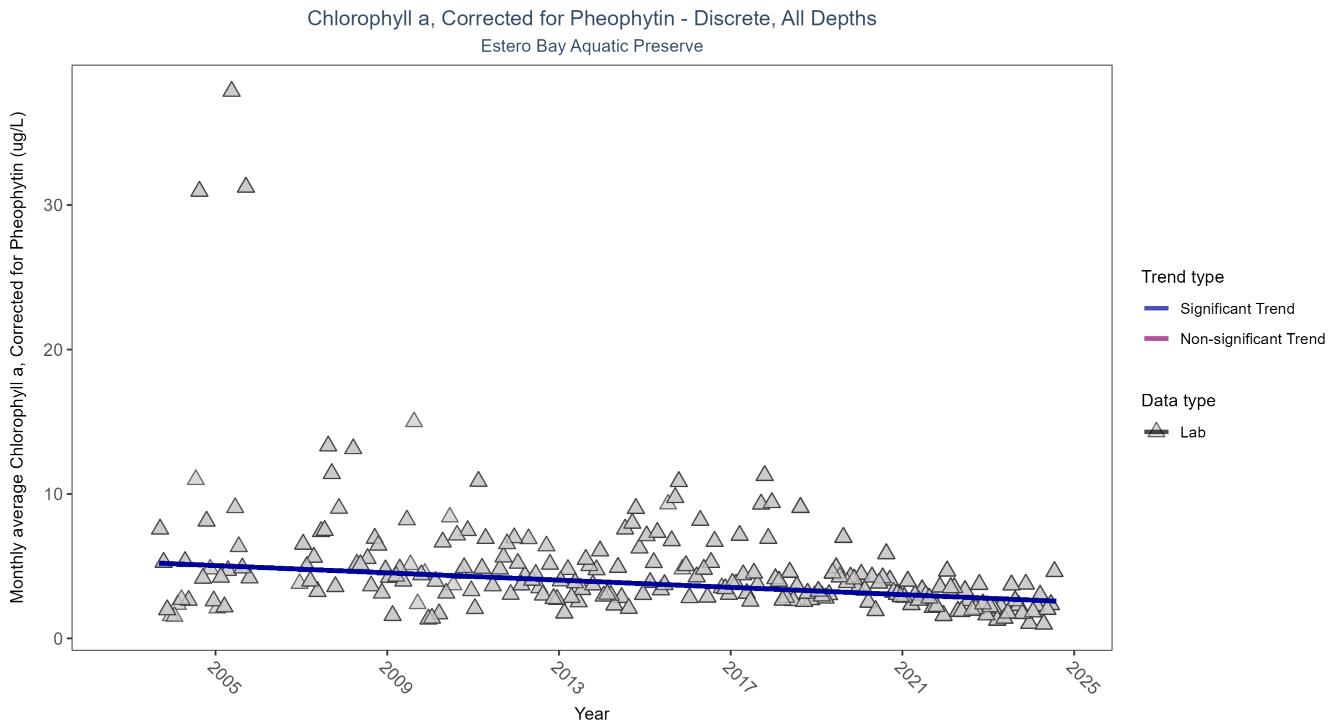

Figure 1: Seasonal Kendall-Tau Results for Chlorophyll a, Corrected for Pheophytin - Discrete

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	2480	22	2.73	TRUE	-0.2805	0	-0.1259	5.2939	9.7939	0.549	-1

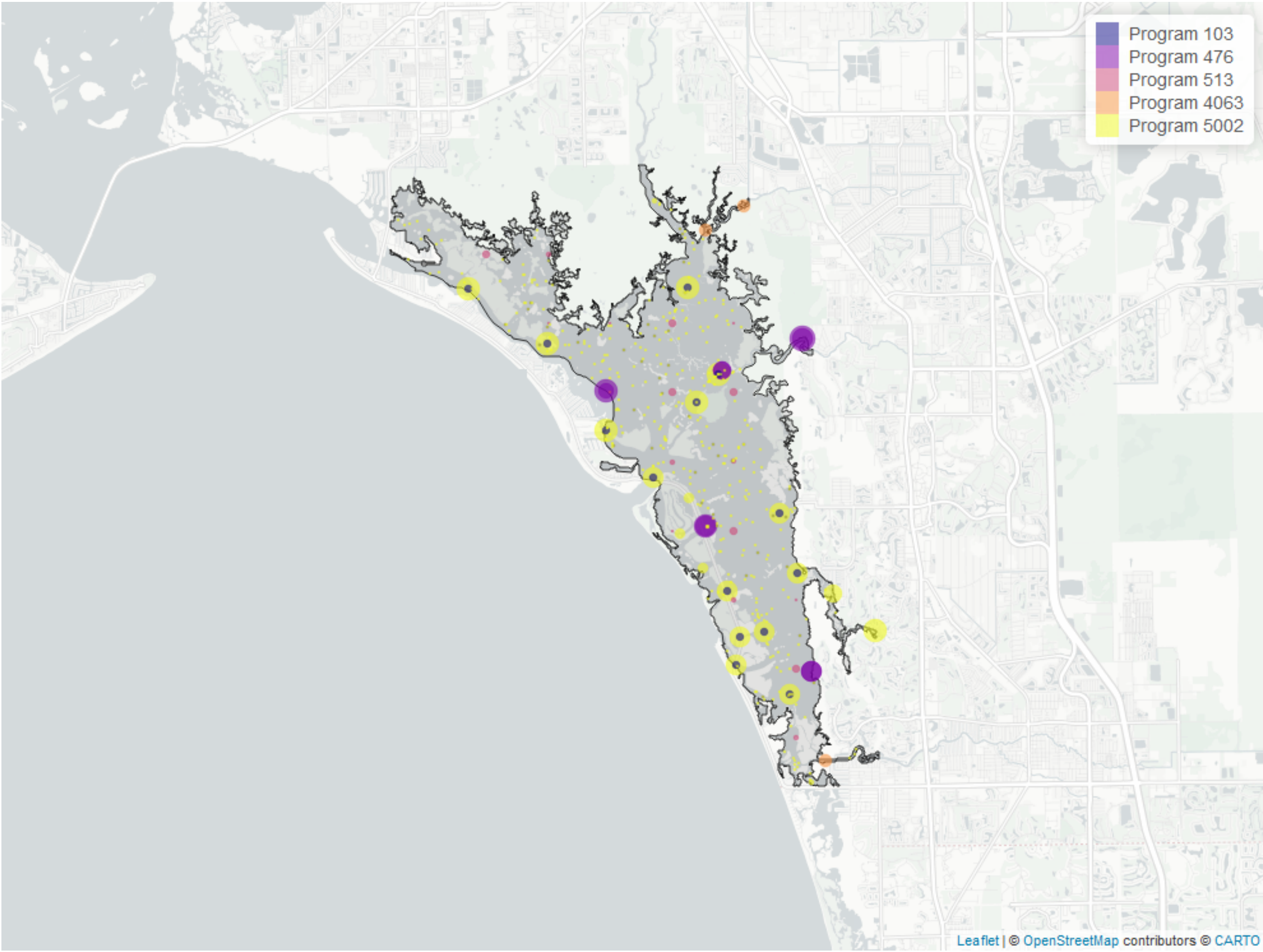

Figure 2: Map showing location of Discrete sampling sites for Chlorophyll a, Corrected for Pheophytin. The bubble size on the maps below reflect the amount of data available at each sampling site.

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

ProgramID	*N_Data*	*YearMin*	*YearMax*
5002	1563	2006	2024
476	647	2008	2024
103	170	2020	2021
513	80	2003	2005
4063	76	2018	2024

Program names:

103 - EPA STOrage and RETrieval Data Warehouse (STORET)/WQX[1]
476 - Charlotte Harbor Estuaries Volunteer Water Quality Monitoring Network[2]
513 - Coastal Charlotte Harbor Monitoring Network[3]
4063 - Estero Bay Tributary Monitoring[4]
5002 - Florida STORET / WIN[5]

Chlorophyll a, Uncorrected for Pheophytin - Discrete Water Quality

Seasonal Kendall-Tau Trend Analysis

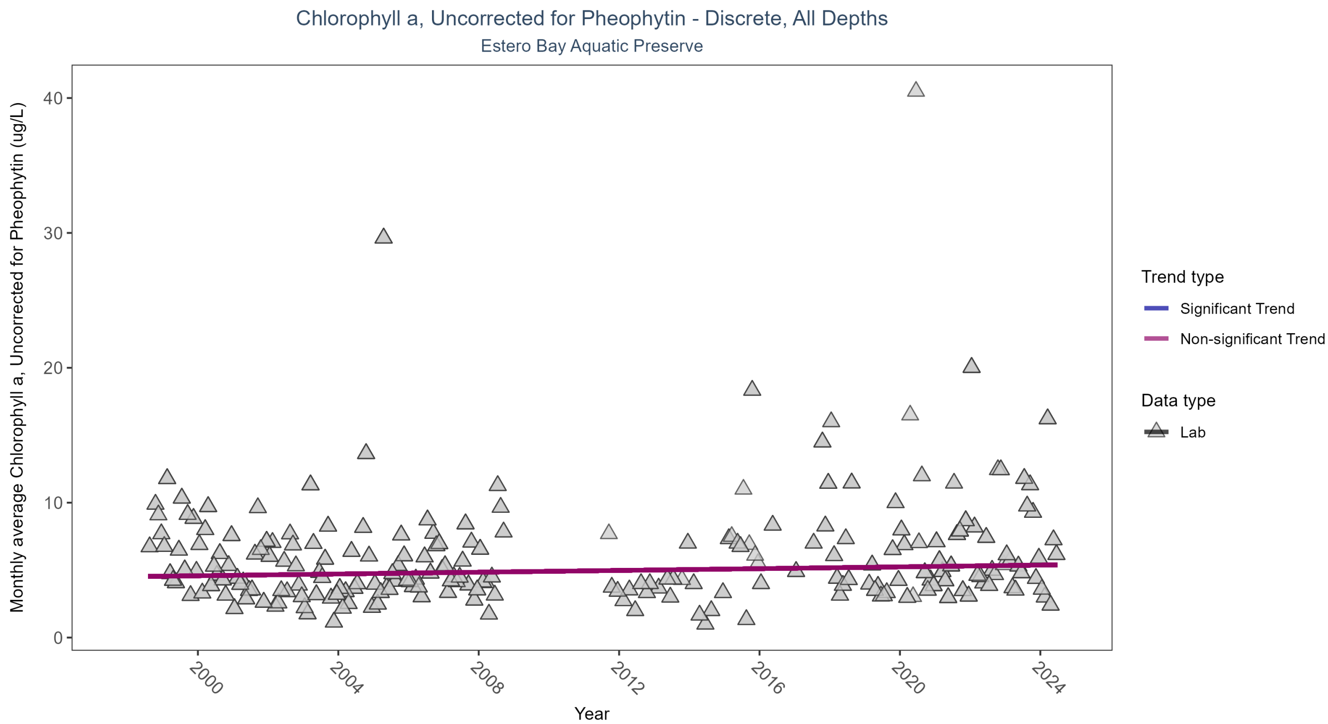

Figure 3: Seasonal Kendall-Tau Results for Chlorophyll a, Uncorrected for Pheophytin - Discrete

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	1228	25	4.32	TRUE	0.0898	0.0571	0.033	4.5147	7.5419	0.7537	0

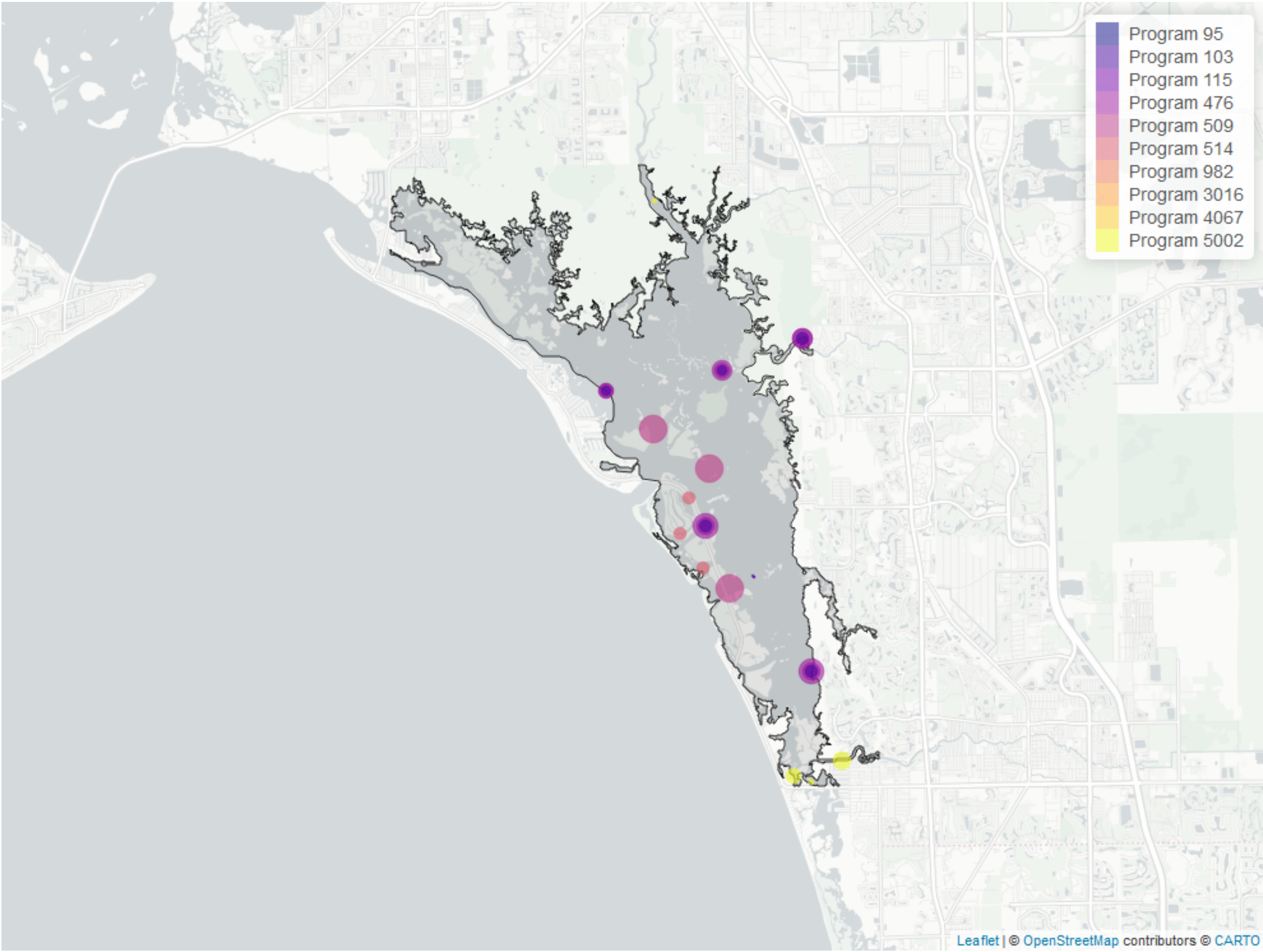

Figure 4: Map showing location of Discrete sampling sites for Chlorophyll a, Uncorrected for Pheophytin. The bubble size on the maps below reflect the amount of data available at each sampling site.

Table 9: Programs contributing data for Chlorophyll a, Uncorrected for Pheophytin

ProgramID	*N_Data*	*YearMin*	*YearMax*
476	614	1998	2024
509	347	1999	2008
103	111	2003	2022
5002	99	2011	2024
514	82	2011	2018
115	1	2003	2003

Program names:

103 - EPA STOrage and RETrieval Data Warehouse (STORET)/WQX[1]
115 - Environmental Monitoring Assessment Program[6]
476 - Charlotte Harbor Estuaries Volunteer Water Quality Monitoring Network[2]
509 - SERC Water Quality Monitoring Network[7]
514 - Florida LAKEWATCH Program[8]
5002 - Florida STORET / WIN[5]

Colored Dissolved Organic Matter - Discrete Water Quality

Seasonal Kendall-Tau Trend Analysis

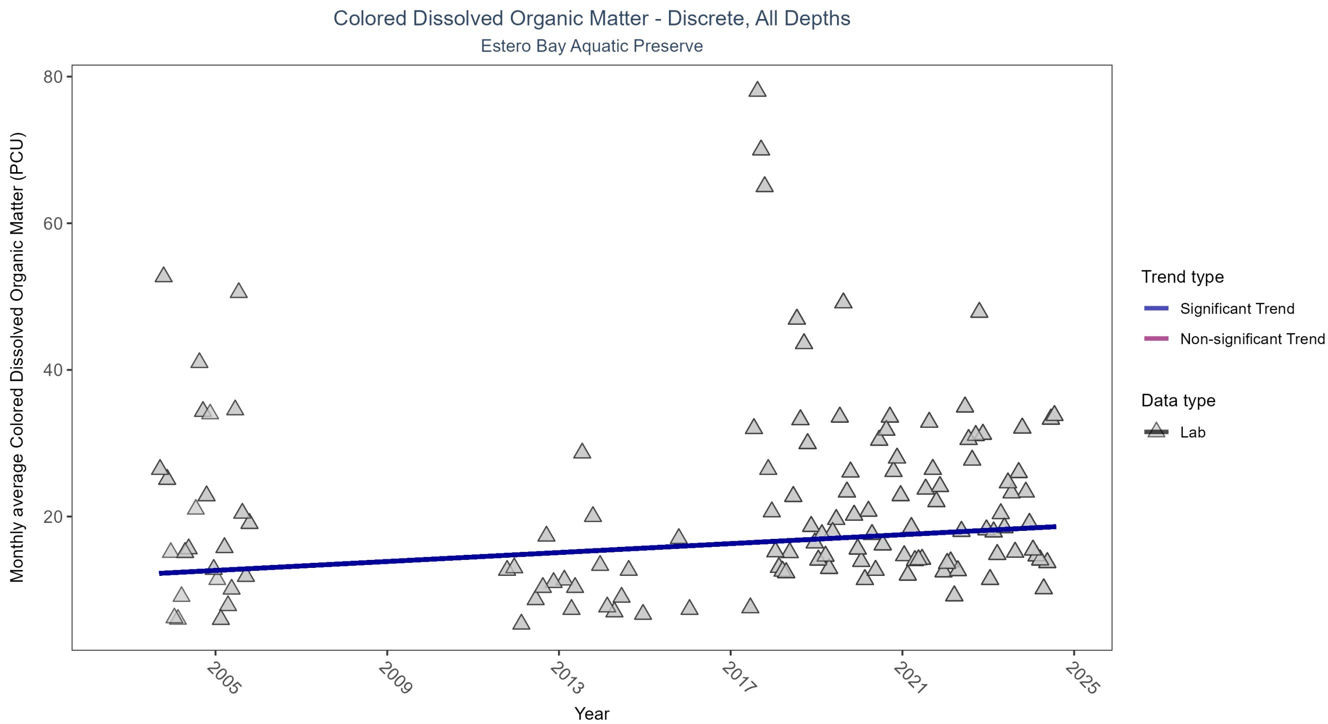

Figure 5: Seasonal Kendall-Tau Results for Colored Dissolved Organic Matter - Discrete

Table 10: Seasonal Kendall-Tau Trend Analysis for Colored Dissolved Organic Matter

RelativeDepth	N-Data	N-Years	Median	Independent	tau	p	SennSlope	SennIntercept	ChiSquared	pChiSquared	Trend
All	1919	17	14	TRUE	0.2171	0.0011	0.3049	12.0394	10.0389	0.5269	1

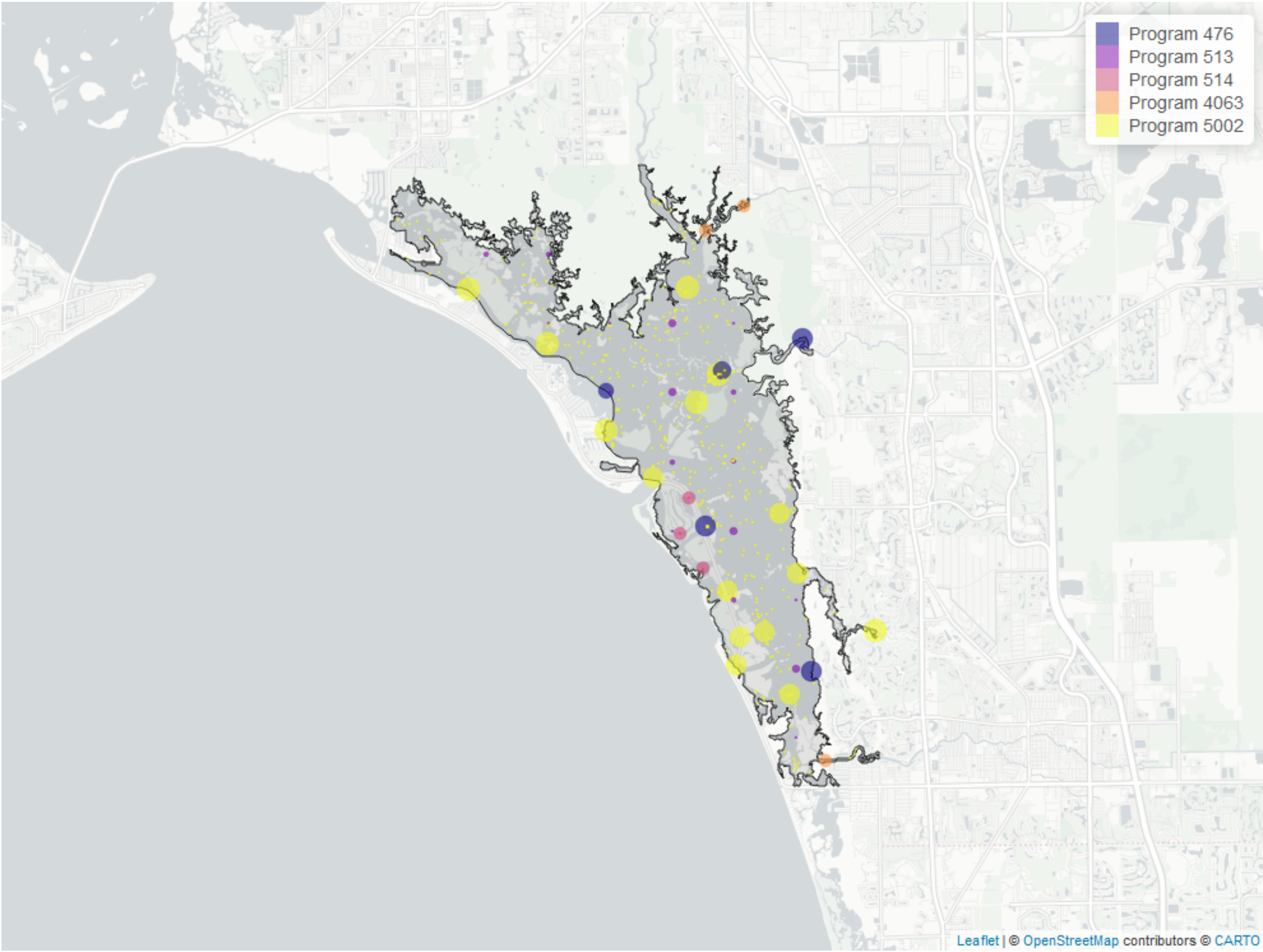

Figure 6: Map showing location of Discrete sampling sites for Colored Dissolved Organic Matter. The bubble size on the maps below reflect the amount of data available at each sampling site.

Table 11: Programs contributing data for Colored Dissolved Organic Matter

ProgramID	*N_Data*	*YearMin*	*YearMax*
5002	1454	2018	2024
476	261	2017	2024
4063	76	2018	2024
513	68	2003	2005
514	66	2011	2019

Program names:

476 - Charlotte Harbor Estuaries Volunteer Water Quality Monitoring Network[2]
513 - Coastal Charlotte Harbor Monitoring Network[3]
514 - Florida LAKEWATCH Program[8]
4063 - Estero Bay Tributary Monitoring[4]
5002 - Florida STORET / WIN[5]

Dissolved Oxygen - Discrete Water Quality

Seasonal Kendall-Tau Trend Analysis

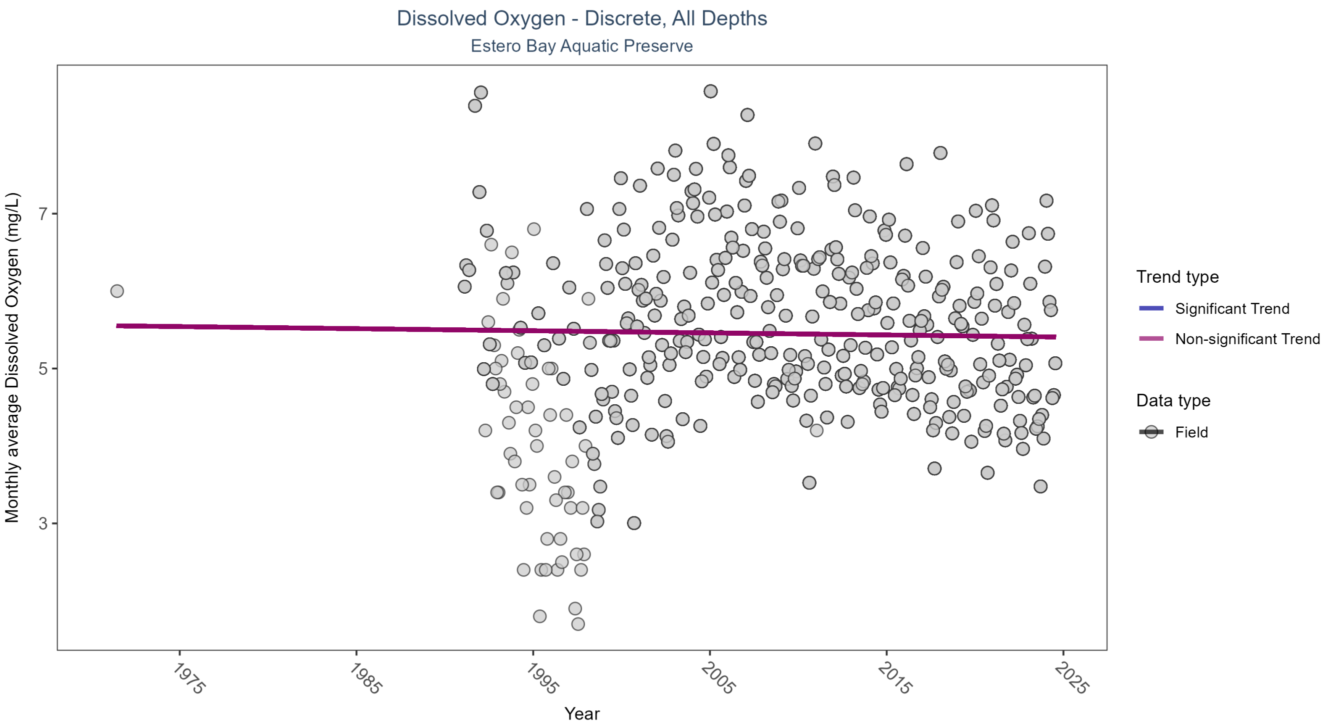

Figure 7: Seasonal Kendall-Tau Results for Dissolved Oxygen - Discrete

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

RelativeDepth	N-Data	N-Years	Median	Independent	tau	p	SennSlope	SennIntercept	ChiSquared	pChiSquared	Trend
All	11569	35	5.8	TRUE	-0.024	0.5125	-0.0027	5.5525	9.9735	0.5328	0

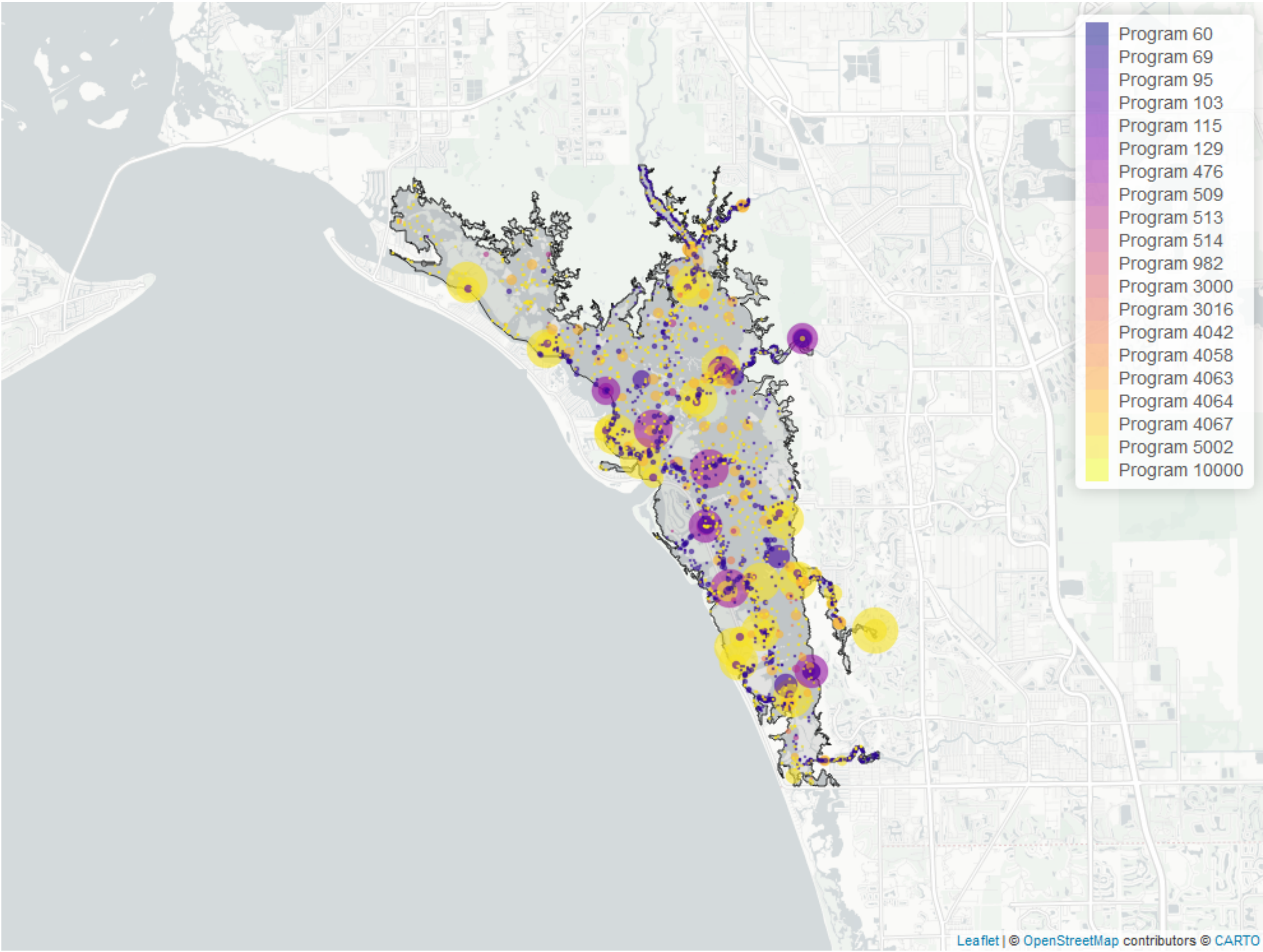

Figure 8: Map showing location of Discrete sampling sites for Dissolved Oxygen. The bubble size on the maps below reflect the amount of data available at each sampling site.

Table 13: Programs contributing data for Dissolved Oxygen

ProgramID	*N_Data*	*YearMin*	*YearMax*
5002	6370	1991	2024
69	2263	2001	2007
476	979	1998	2024
509	696	1999	2008
4064	619	2011	2012
95	443	1971	2018
103	252	2003	2022
513	69	2003	2005
4042	62	2016	2024
115	3	2003	2003

Program names:

69 - Fisheries-Independent Monitoring (FIM) Program[9]
95 - Harmful Algal Bloom Marine Observation Network[10]
103 - EPA STOrage and RETrieval Data Warehouse (STORET)/WQX[1]

115 - Environmental Monitoring Assessment Program[6]
476 - Charlotte Harbor Estuaries Volunteer Water Quality Monitoring Network[2]
509 - SERC Water Quality Monitoring Network[7]
513 - Coastal Charlotte Harbor Monitoring Network[3]
4042 - Estero Bay Oyster Monitoring[11]
4064 - A spatial model to improve site selection for seagrass restoration in shallow boating environments[12]
5002 - Florida STORET / WIN[5]

Dissolved Oxygen Saturation - Discrete Water Quality

Seasonal Kendall-Tau Trend Analysis

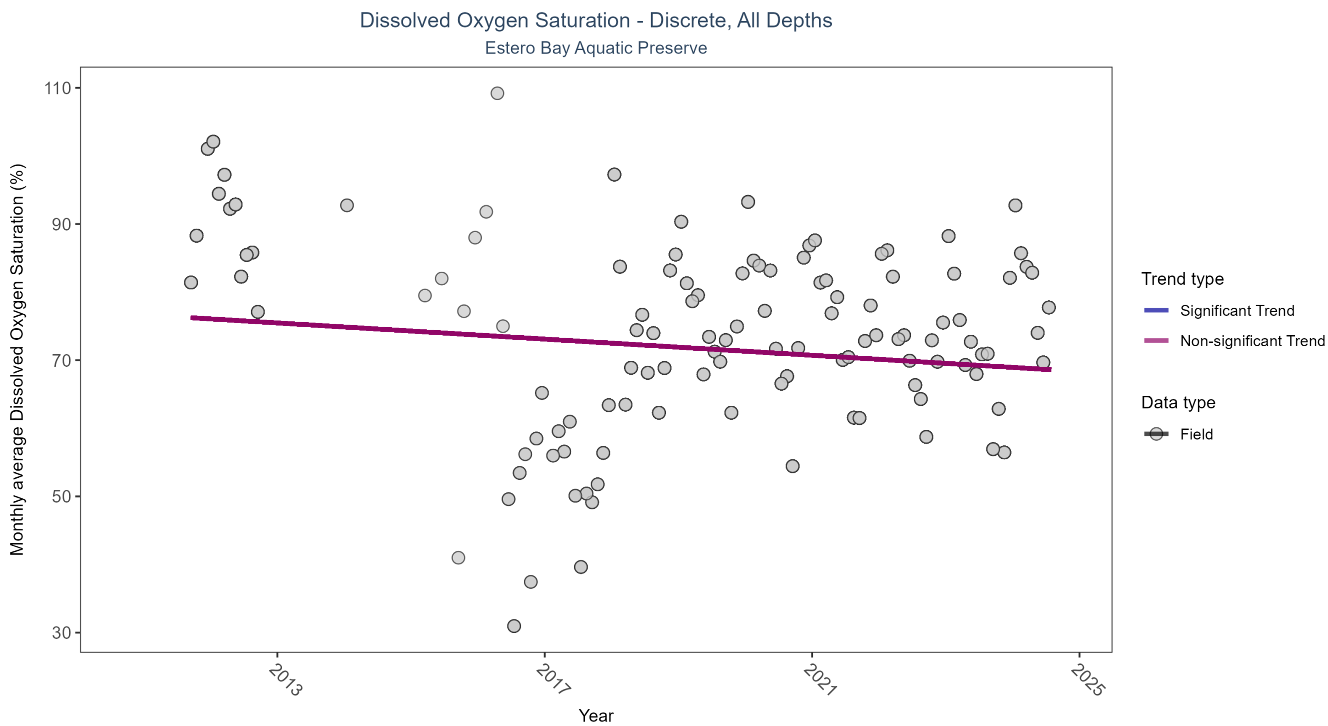

Figure 9: Seasonal Kendall-Tau Results for Dissolved Oxygen Saturation - Discrete

Table 14: Seasonal Kendall-Tau Trend Analysis for Dissolved Oxygen Saturation

RelativeDepth	N-Data	N-Years	Median	Independent	tau	p	SennSlope	SennIntercept	ChiSquared	pChiSquared	Trend
All	2669	13	82.2014	TRUE	-0.1211	0.0933	-0.5936	76.6637	7.7734	0.7334	0

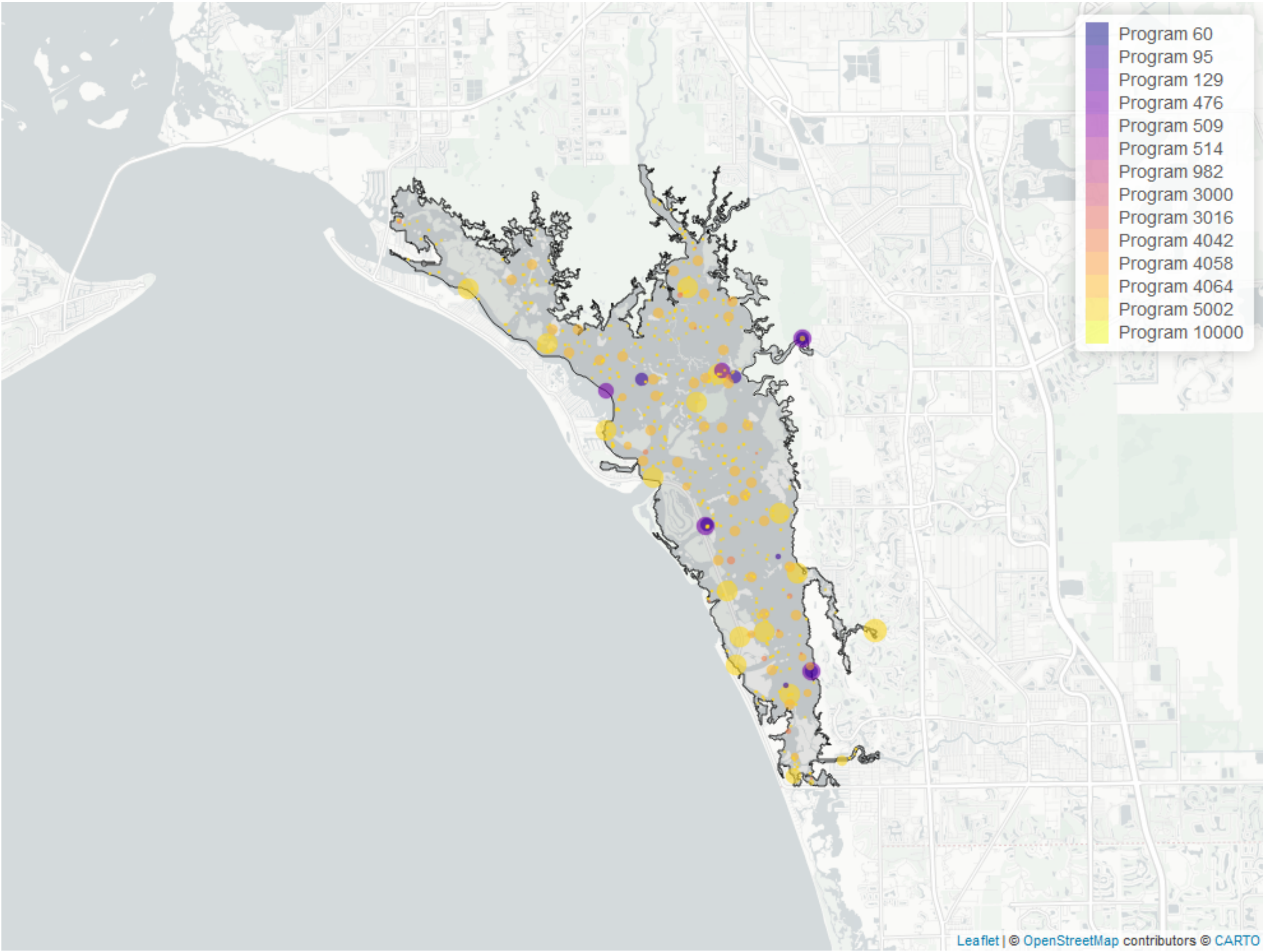

Figure 10: Map showing location of Discrete sampling sites for Dissolved Oxygen Saturation. The bubble size on the maps below reflect the amount of data available at each sampling site.

Table 15: Programs contributing data for Dissolved Oxygen Saturation

ProgramID	*N_Data*	*YearMin*	*YearMax*
5002	1662	2015	2024
4064	619	2011	2012
476	222	2017	2024
95	120	2011	2018
4042	53	2016	2024

Program names:

95 - Harmful Algal Bloom Marine Observation Network[10]
476 - Charlotte Harbor Estuaries Volunteer Water Quality Monitoring Network[2]
4042 - Estero Bay Oyster Monitoring[11]
4064 - A spatial model to improve site selection for seagrass restoration in shallow boating environments[12]
5002 - Florida STORET / WIN[5]

pH - Discrete Water Quality

Seasonal Kendall-Tau Trend Analysis

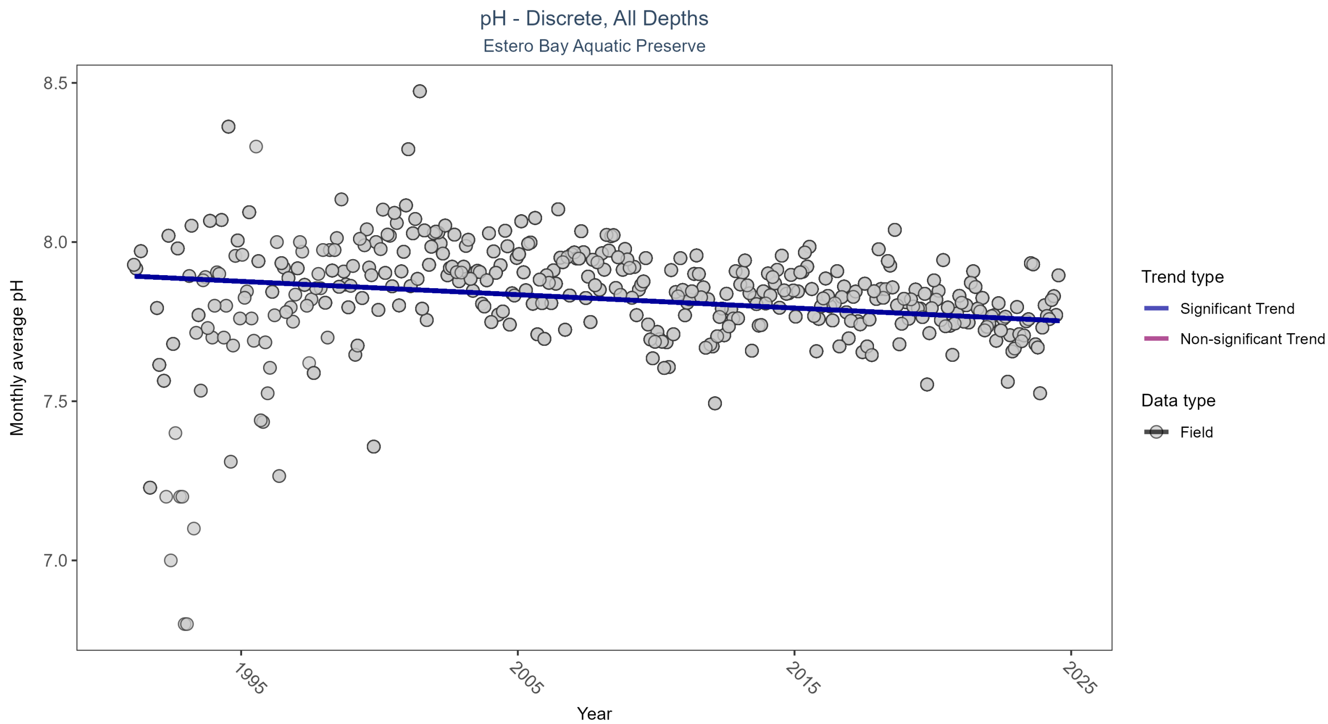

Figure 11: Seasonal Kendall-Tau Results for pH - Discrete

Table 16: Seasonal Kendall-Tau Trend Analysis for pH

RelativeDepth	N-Data	N-Years	Median	Independent	tau	p	SennSlope	SennIntercept	ChiSquared	pChiSquared	Trend
All	10934	34	7.9	TRUE	-0.1934	0	-0.0042	7.8933	8.8073	0.6397	-1

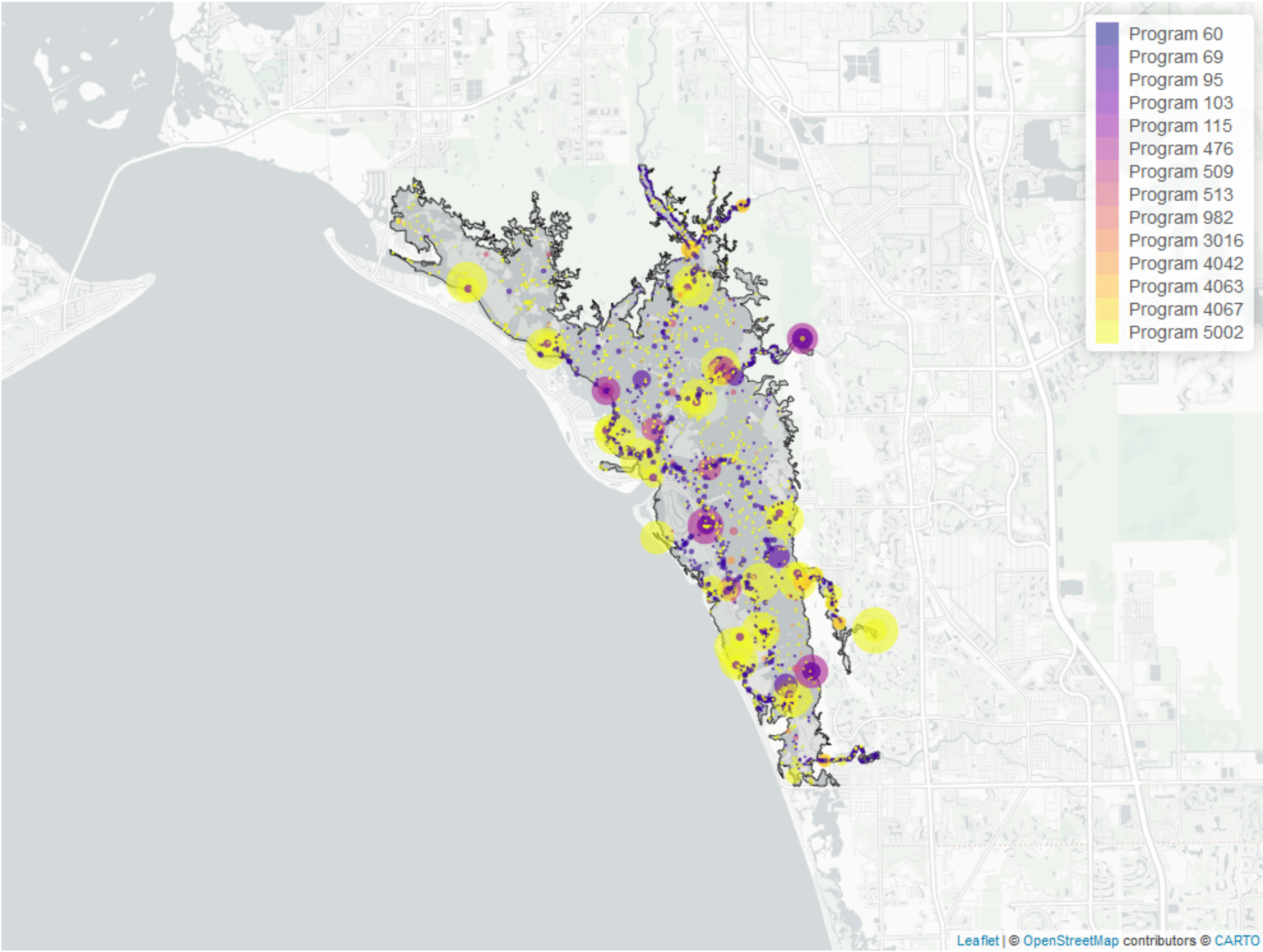

Figure 12: Map showing location of Discrete sampling sites for pH. The bubble size on the maps below reflect the amount of data available at each sampling site.

Table 17: Programs contributing data for pH

ProgramID	*N_Data*	*YearMin*	*YearMax*
5002	6659	1991	2024
69	2264	2001	2007
476	981	1998	2024
95	445	2005	2018
509	270	2001	2008
103	253	2003	2022
513	67	2003	2005
4042	56	2016	2024
115	3	2003	2003

Program names:

69 - Fisheries-Independent Monitoring (FIM) Program[9]
95 - Harmful Algal Bloom Marine Observation Network[10]
103 - EPA STOrage and RETrieval Data Warehouse (STORET)/WQX[1]
115 - Environmental Monitoring Assessment Program[6]

476 - Charlotte Harbor Estuaries Volunteer Water Quality Monitoring Network[2]
509 - SERC Water Quality Monitoring Network[7]
513 - Coastal Charlotte Harbor Monitoring Network[3]
4042 - Estero Bay Oyster Monitoring[11]
5002 - Florida STORET / WIN[5]

Salinity - Discrete Water Quality

Seasonal Kendall-Tau Trend Analysis

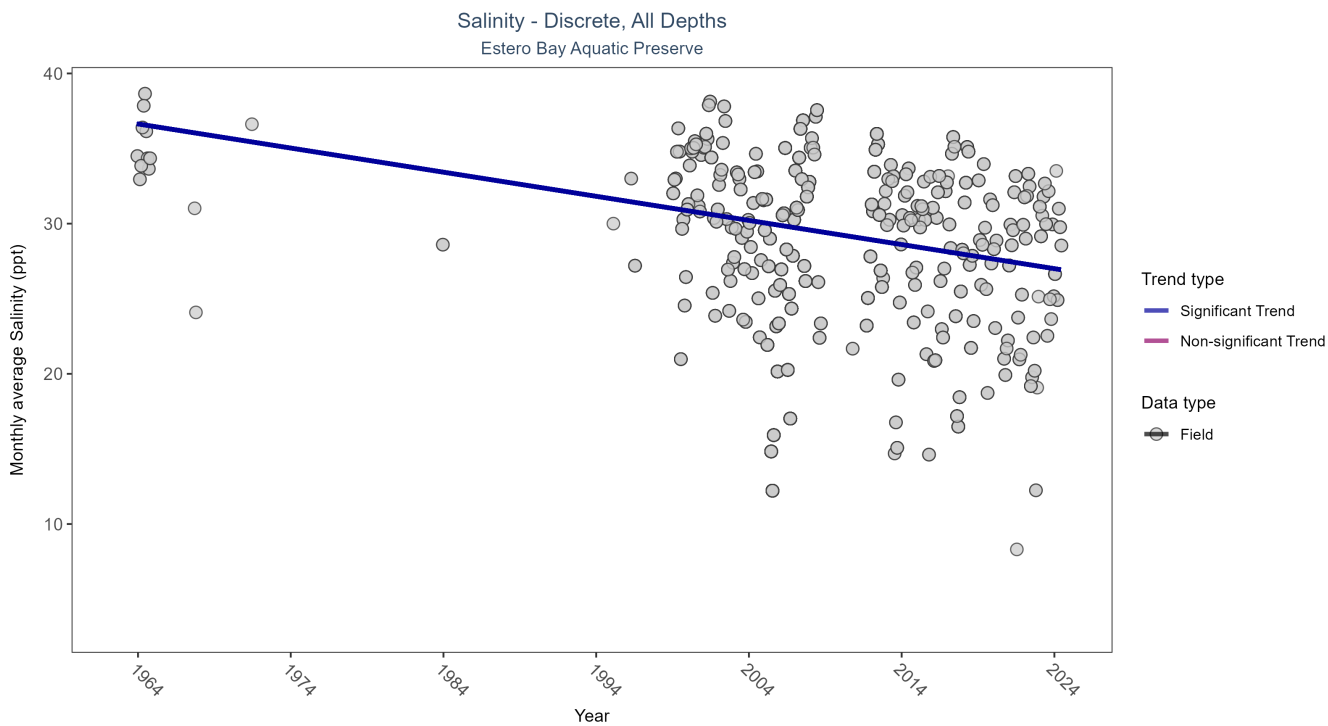

Figure 13: Seasonal Kendall-Tau Results for Salinity - Discrete

Table 18: Seasonal Kendall-Tau Trend Analysis for Salinity

RelativeDepth	N-Data	N-Years	Median	Independent	tau	p	SennSlope	SennIntercept	ChiSquared	pChiSquared	Trend
All	5338	34	32.2	TRUE	-0.2895	0	-0.1606	36.7988	4.212	0.9633	-1

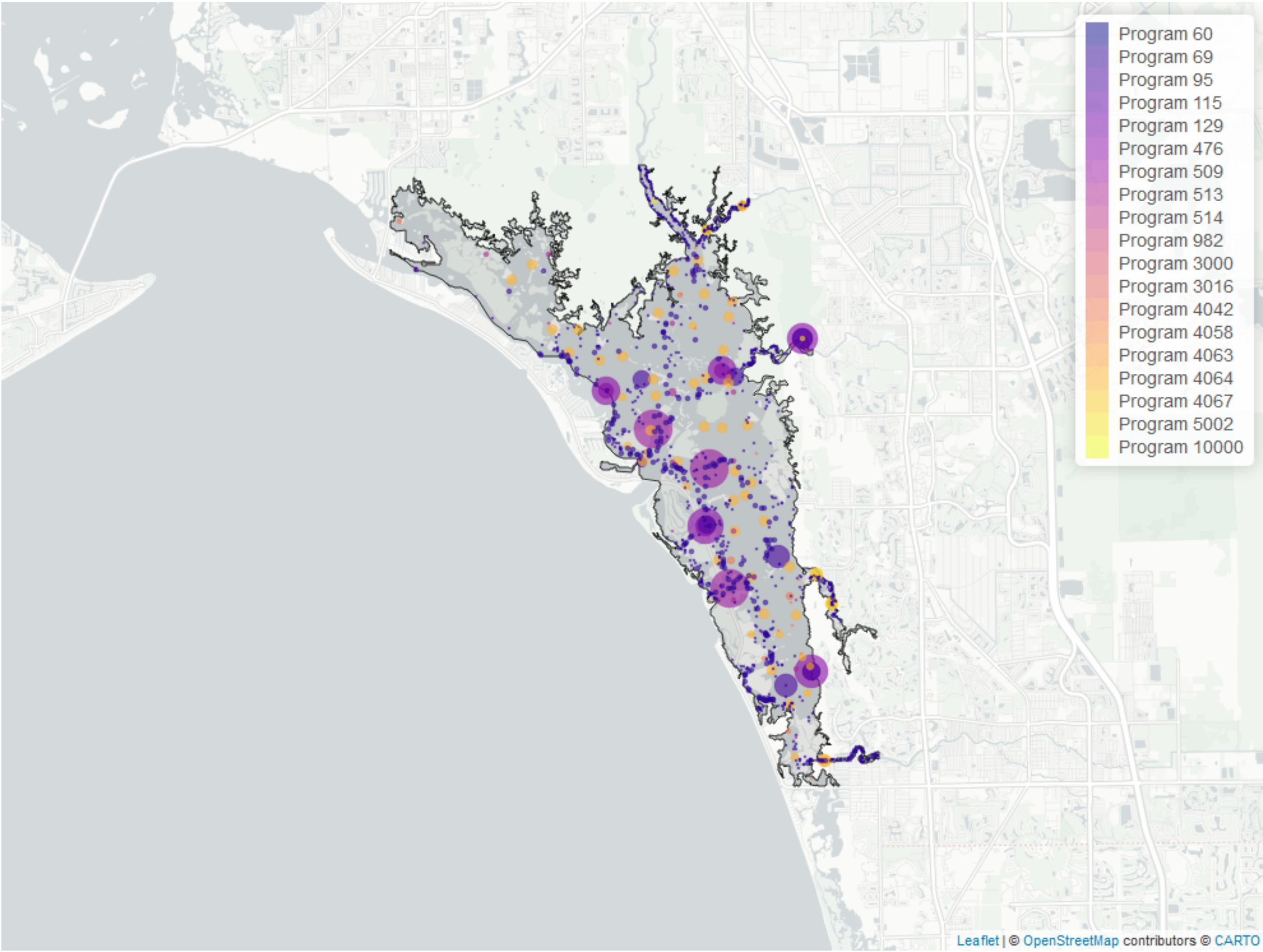

Figure 14: Map showing location of Discrete sampling sites for Salinity. The bubble size on the maps below reflect the amount of data available at each sampling site.

Table 19: Programs contributing data for Salinity

ProgramID	*N_Data*	*YearMin*	*YearMax*
69	2261	2001	2007
476	998	1998	2024
509	702	1999	2008
4064	619	2011	2012
95	528	1963	2018
5002	114	2009	2023
4042	62	2016	2024
513	60	2003	2005
115	3	2003	2003

Program names:

69 - Fisheries-Independent Monitoring (FIM) Program[9]
95 - Harmful Algal Bloom Marine Observation Network[10]
115 - Environmental Monitoring Assessment Program[6]
476 - Charlotte Harbor Estuaries Volunteer Water Quality Monitoring Network[2]

509 - SERC Water Quality Monitoring Network[7]
513 - Coastal Charlotte Harbor Monitoring Network[3]
4042 - Estero Bay Oyster Monitoring[11]
4064 - A spatial model to improve site selection for seagrass restoration in shallow boating environments[12]
5002 - Florida STORET / WIN[5]

Secchi Depth - Discrete Water Quality

Seasonal Kendall-Tau Trend Analysis

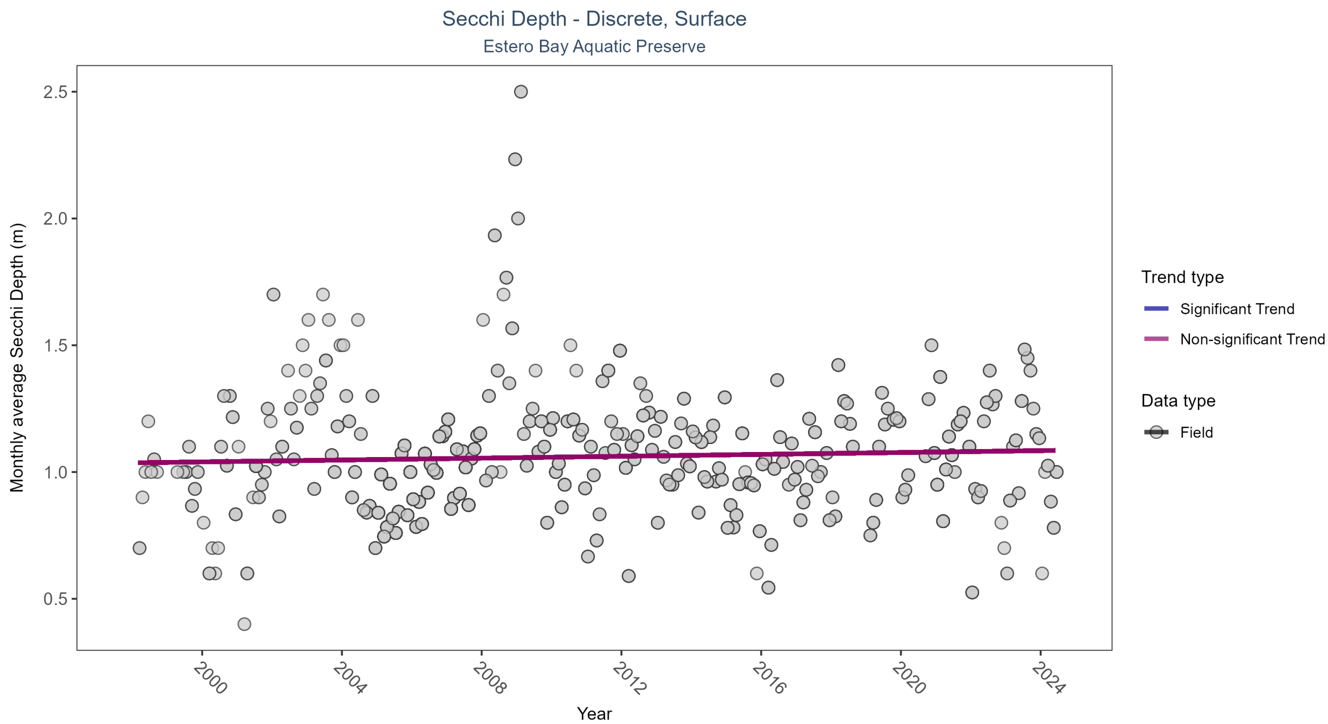

Figure 15: Seasonal Kendall-Tau Results for Secchi Depth - Discrete

Table 20: Seasonal Kendall-Tau Trend Analysis for Secchi Depth

RelativeDepth	N-Data	N-Years	Median	Independent	tau	p	SennSlope	SennIntercept	ChiSquared	pChiSquared	Trend
Surface	3379	27	0.9	TRUE	0.0398	0.3033	0.0019	1.0362	23.9949	0.0128	0

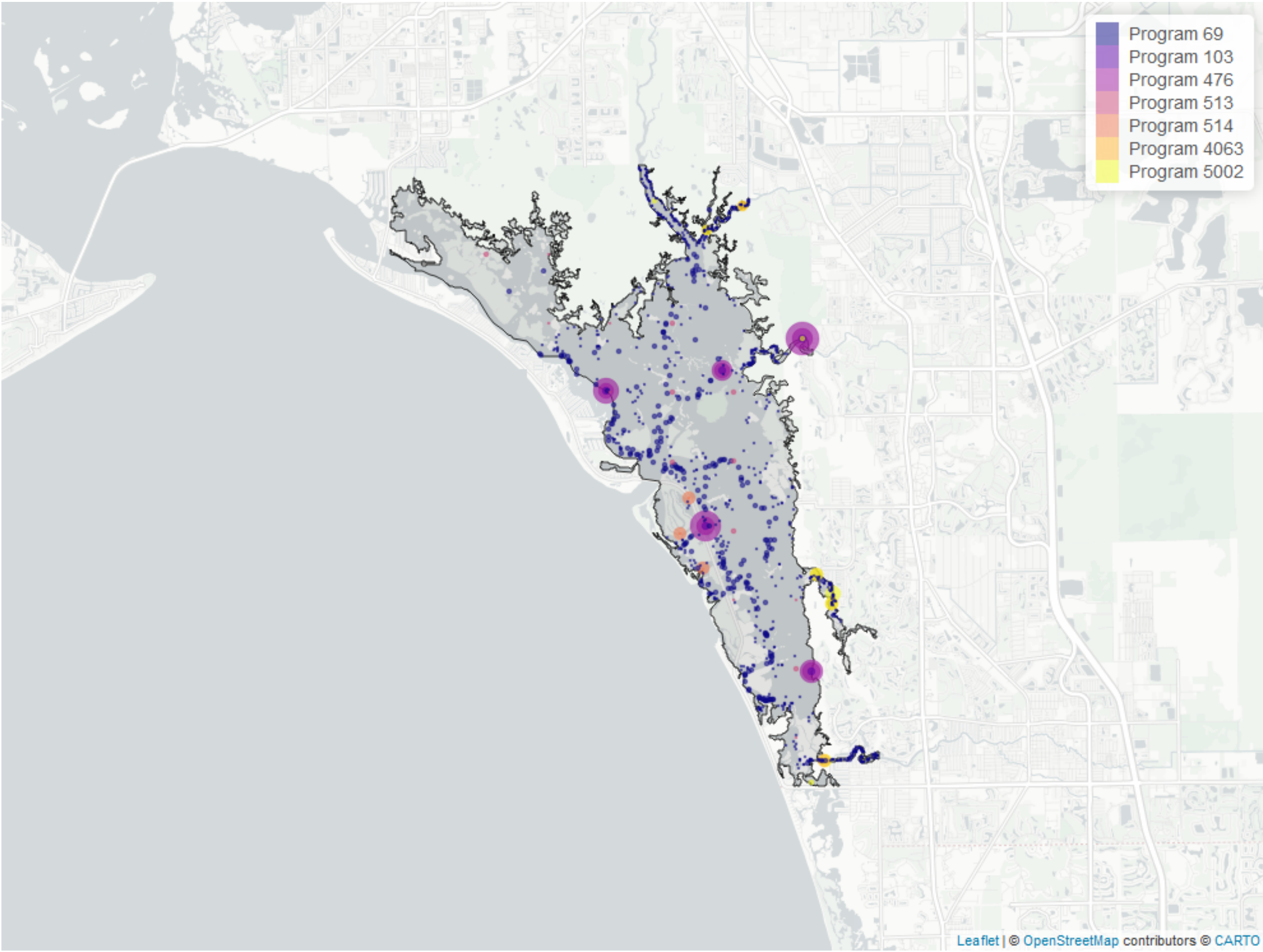

Figure 16: Map showing location of Discrete sampling sites for Secchi Depth. The bubble size on the maps below reflect the amount of data available at each sampling site.

Table 21: Programs contributing data for Secchi Depth

ProgramID	*N_Data*	*YearMin*	*YearMax*
69	2264	2001	2007
476	795	1998	2024
5002	150	2006	2023
514	79	2011	2019
103	53	2020	2022
513	40	2003	2005

Program names:

69 - Fisheries-Independent Monitoring (FIM) Program[9]
103 - EPA STOrage and RETrieval Data Warehouse (STORET)/WQX[1]
476 - Charlotte Harbor Estuaries Volunteer Water Quality Monitoring Network[2]
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514 - Florida LAKEWATCH Program[8]
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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

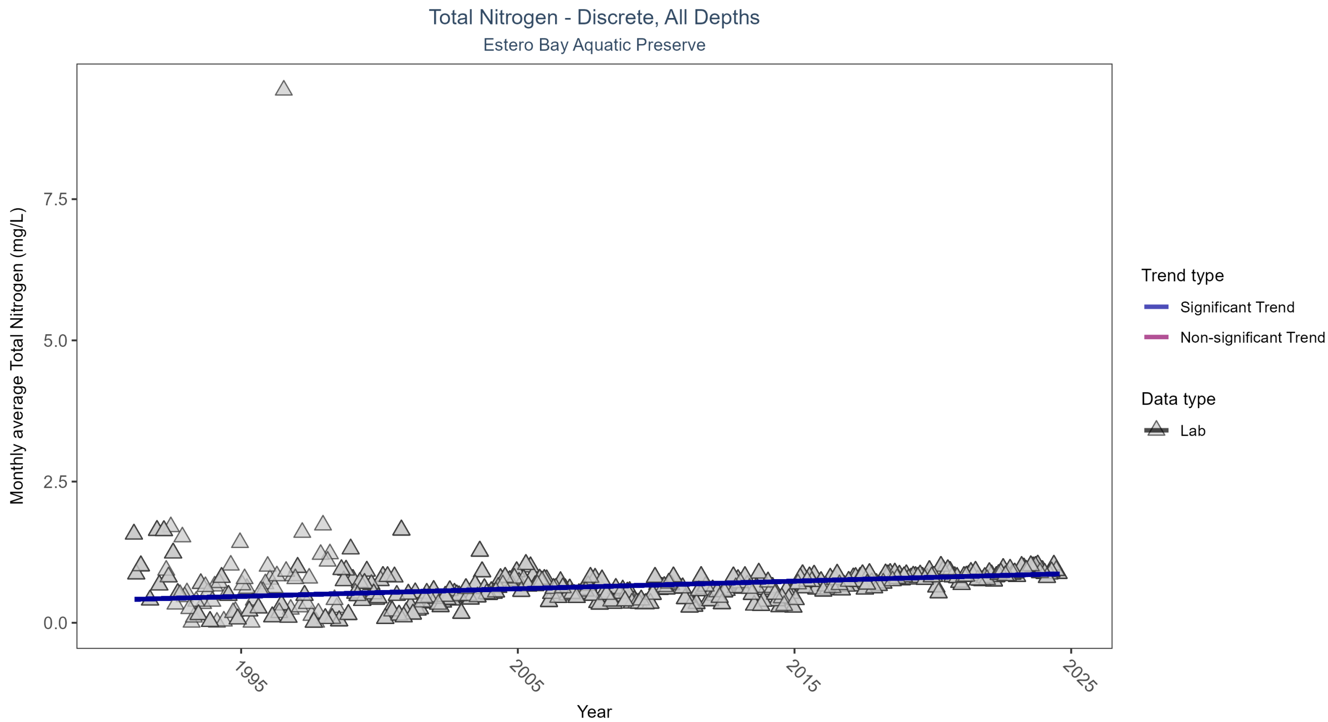

Figure 17: Seasonal Kendall-Tau Results for Total Nitrogen - Discrete

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

RelativeDepth	N-Data	N-Years	Median	Independent	tau	p	SennSlope	SennIntercept	ChiSquared	pChiSquared	Trend
All	7880	34	0.64	TRUE	0.3193	0	0.0135	0.4134	11.9407	0.3681	1

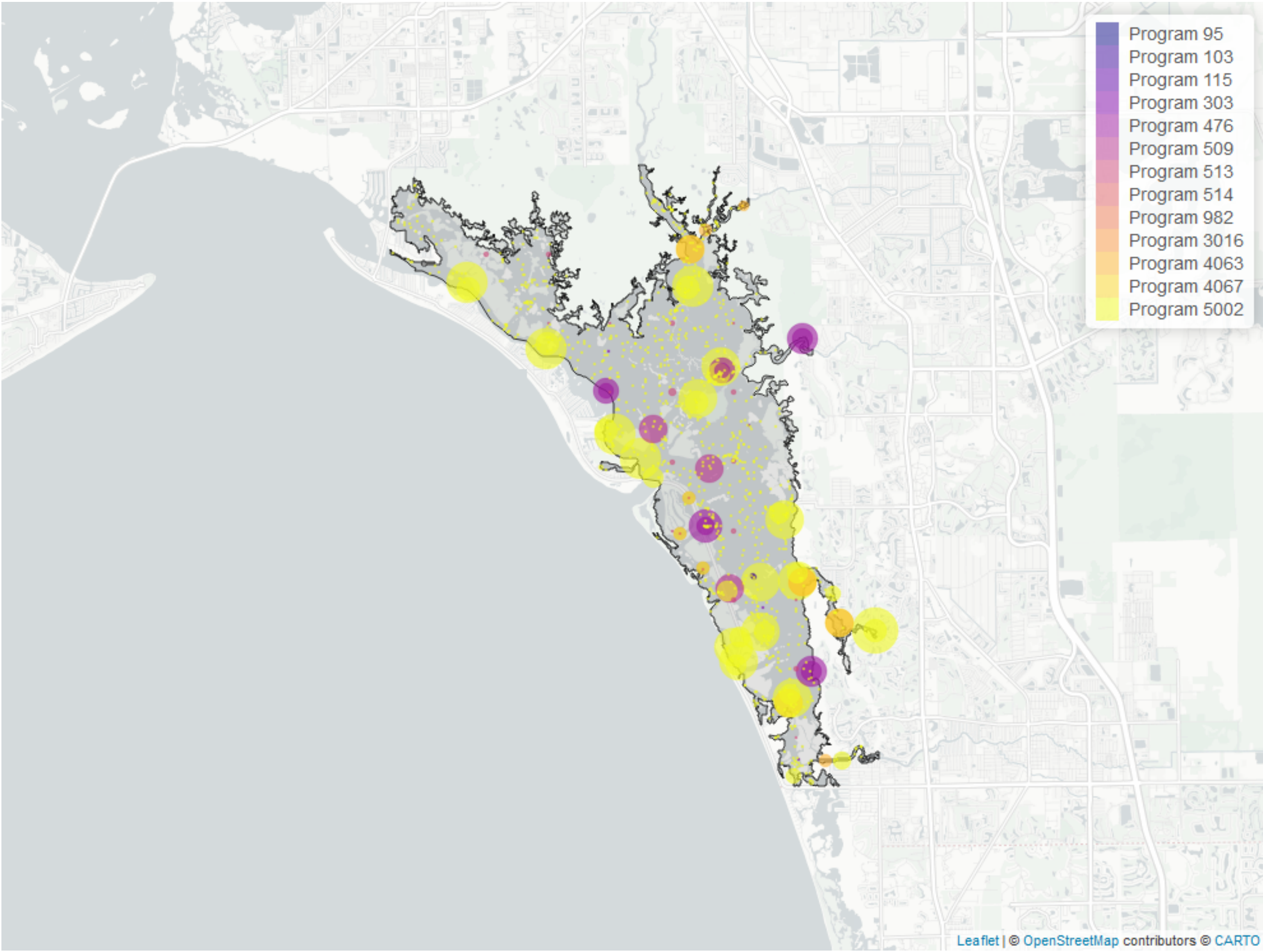

Figure 18: Map showing location of Discrete sampling sites for Total Nitrogen. The bubble size on the maps below reflect the amount of data available at each sampling site.

Table 23: Programs contributing data for Total Nitrogen

ProgramID	*N_Data*	*YearMin*	*YearMax*
5002	6417	1991	2024
476	918	1998	2024
509	351	1999	2008
514	84	2011	2019
4063	67	2018	2024
513	59	2003	2005
303	8	2020	2021
103	7	2003	2003
115	1	2003	2003

Program names:

103 - EPA STOrage and RETrieval Data Warehouse (STORET)/WQX[1]
115 - Environmental Monitoring Assessment Program[6]
303 - River, Estuary and Coastal Observing Network[13]
476 - Charlotte Harbor Estuaries Volunteer Water Quality Monitoring Network[2]

509 - SERC Water Quality Monitoring Network[7]
513 - Coastal Charlotte Harbor Monitoring Network[3]
514 - Florida LAKEWATCH Program[8]
4063 - Estero Bay Tributary Monitoring[4]
5002 - Florida STORET / WIN[5]

Total Phosphorus - Discrete Water Quality

Seasonal Kendall-Tau Trend Analysis

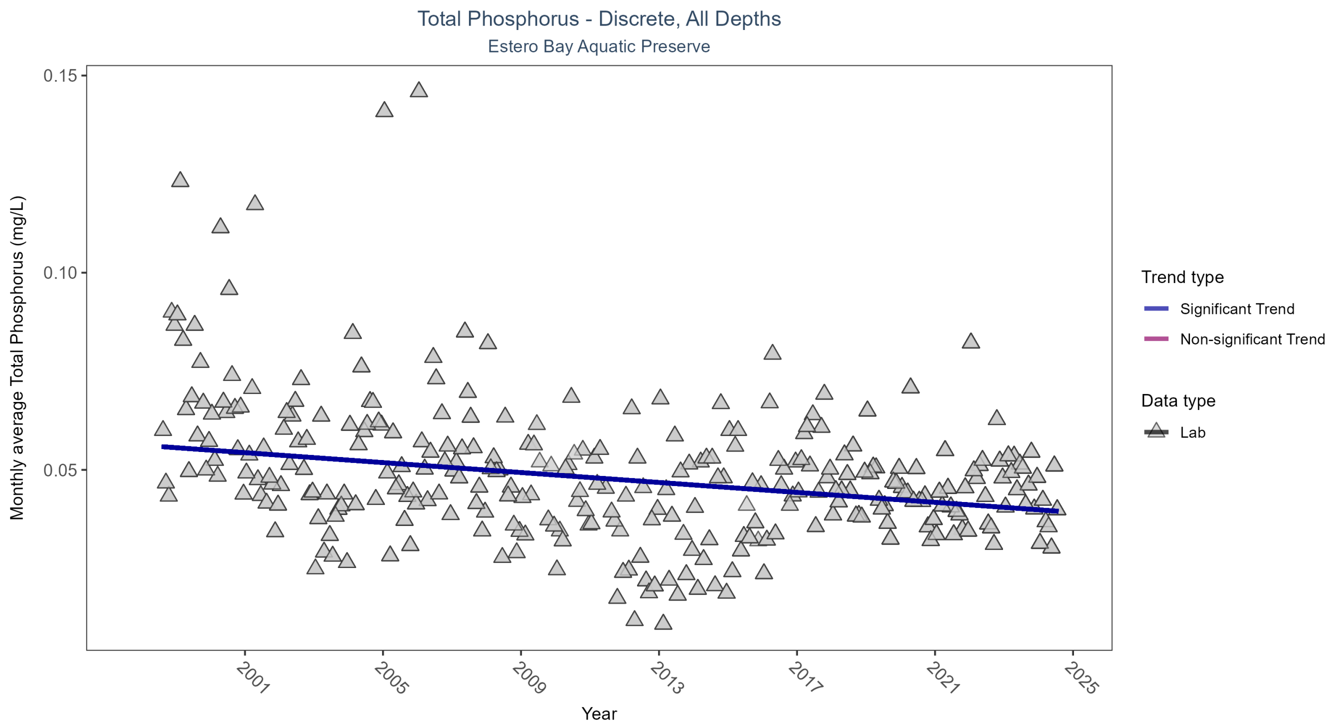

Figure 19: Seasonal Kendall-Tau Results for Total Phosphorus - Discrete

Table 24: Seasonal Kendall-Tau Trend Analysis for Total Phosphorus

RelativeDepth	N-Data	N-Years	Median	Independent	tau	p	SennSlope	SennIntercept	ChiSquared	pChiSquared	Trend
All	3392	27	0.043	TRUE	-0.2495	0	-0.0006	0.0563	7.6419	0.745	-1

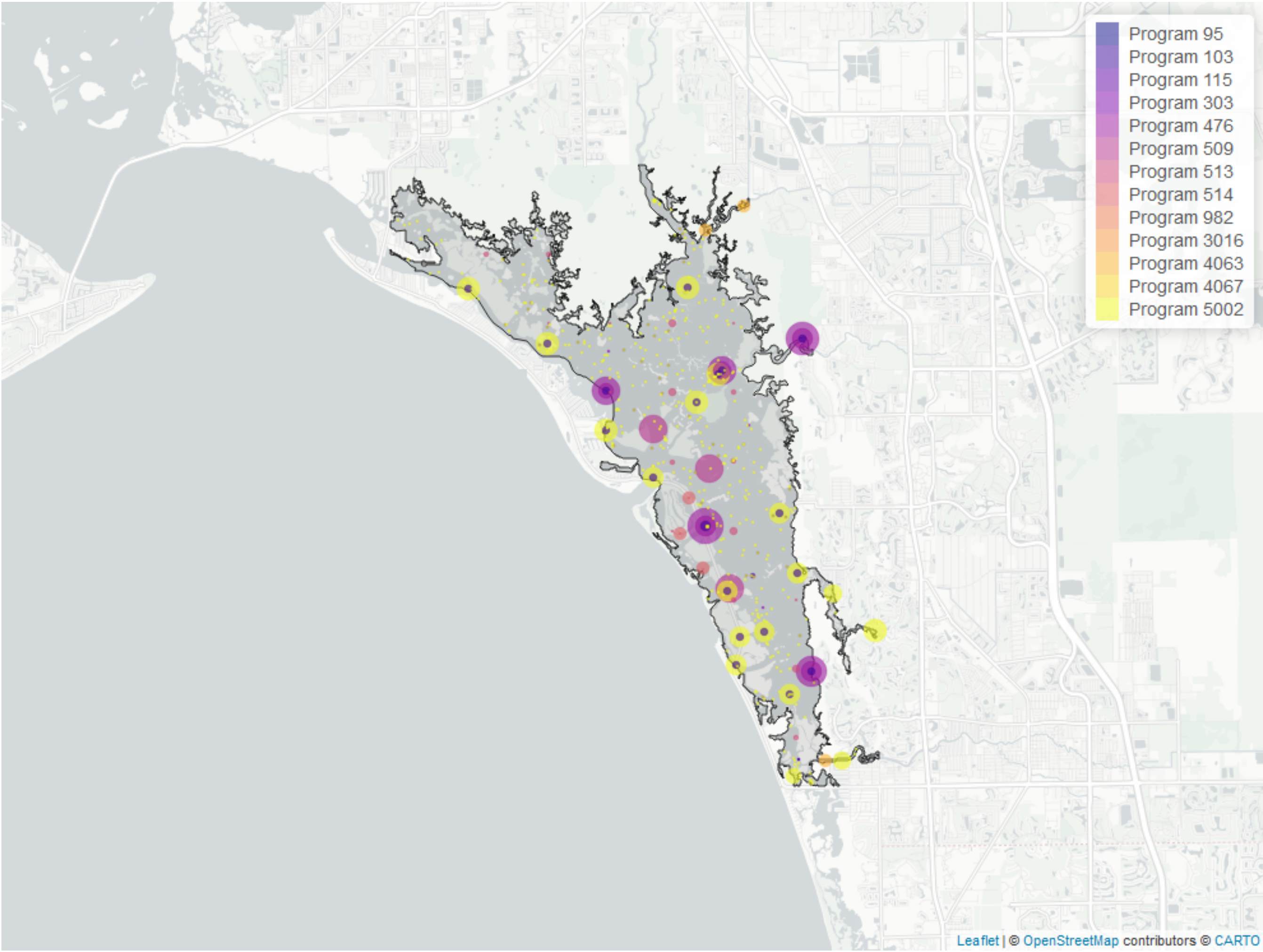

Figure 20: Map showing location of Discrete sampling sites for Total Phosphorus. The bubble size on the maps below reflect the amount of data available at each sampling site.

Table 25: Programs contributing data for Total Phosphorus

ProgramID	*N_Data*	*YearMin*	*YearMax*
5002	1598	2006	2024
476	1015	1998	2024
509	351	1999	2008
103	230	2003	2022
514	84	2011	2019
4063	76	2018	2024
513	69	2003	2005
303	8	2020	2021
115	1	2003	2003

Program names:

103 - EPA STOrage and RETrieval Data Warehouse (STORET)/WQX[1]
115 - Environmental Monitoring Assessment Program[6]
303 - River, Estuary and Coastal Observing Network[13]
476 - Charlotte Harbor Estuaries Volunteer Water Quality Monitoring Network[2]

509 - SERC Water Quality Monitoring Network[7]
513 - Coastal Charlotte Harbor Monitoring Network[3]
514 - Florida LAKEWATCH Program[8]
4063 - Estero Bay Tributary Monitoring[4]
5002 - Florida STORET / WIN[5]

Total Suspended Solids - Discrete Water Quality

Seasonal Kendall-Tau Trend Analysis

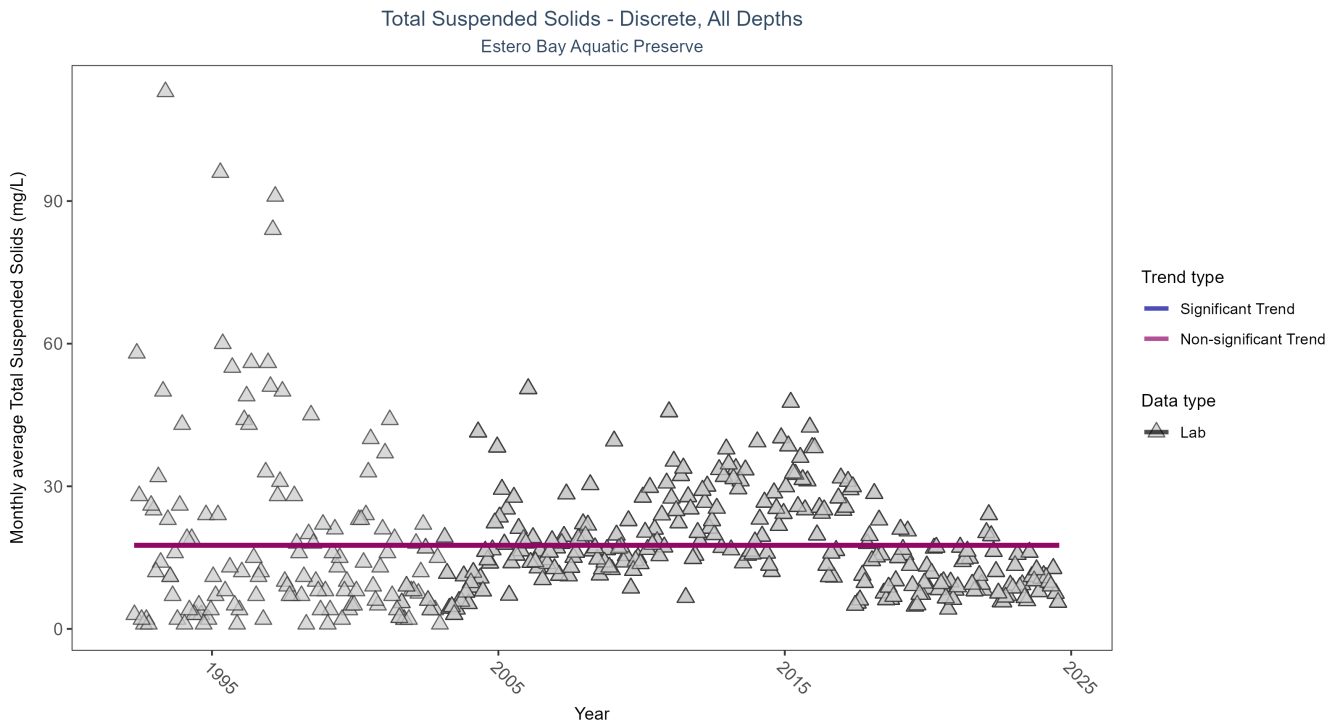

Figure 21: Seasonal Kendall-Tau Results for Total Suspended Solids - Discrete

Table 26: Seasonal Kendall-Tau Trend Analysis for Total Suspended Solids

RelativeDepth	N-Data	N-Years	Median	Independent	tau	p	SennSlope	SennIntercept	ChiSquared	pChiSquared	Trend
All	5412	33	14	TRUE	-0.0004	0.9517	0	17.5722	16.9693	0.1088	0

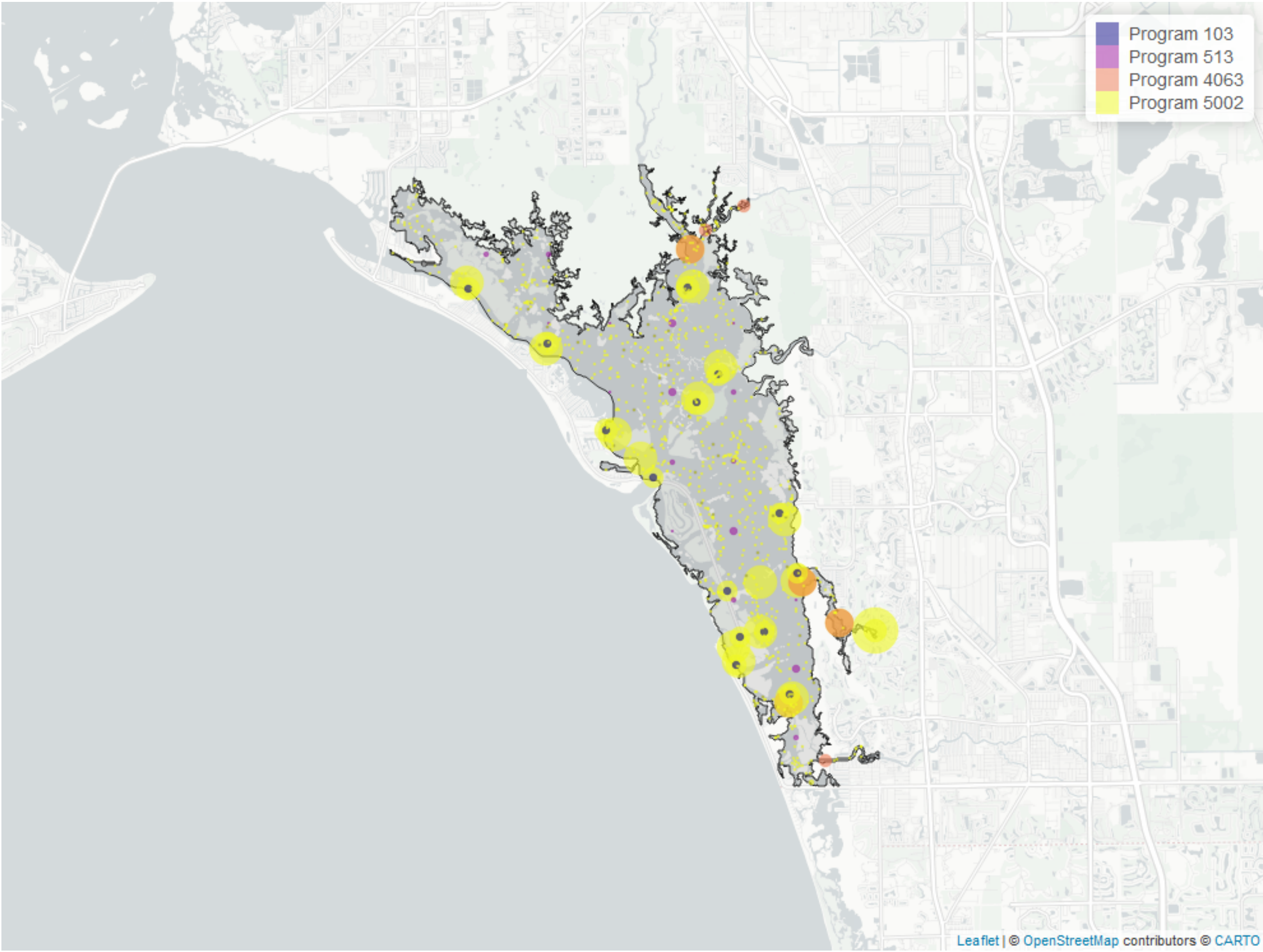

Figure 22: Map showing location of Discrete sampling sites for Total Suspended Solids. The bubble size on the maps below reflect the amount of data available at each sampling site.

Table 27: Programs contributing data for Total Suspended Solids

ProgramID	*N_Data*	*YearMin*	*YearMax*
5002	5340	1992	2024
103	170	2020	2021
4063	76	2018	2024
513	69	2003	2005

Program names:

103 - EPA STOrage and RETrieval Data Warehouse (STORET)/WQX[1]
513 - Coastal Charlotte Harbor Monitoring Network[3]
4063 - Estero Bay Tributary Monitoring[4]
5002 - Florida STORET / WIN[5]

Turbidity - Discrete Water Quality

Seasonal Kendall-Tau Trend Analysis

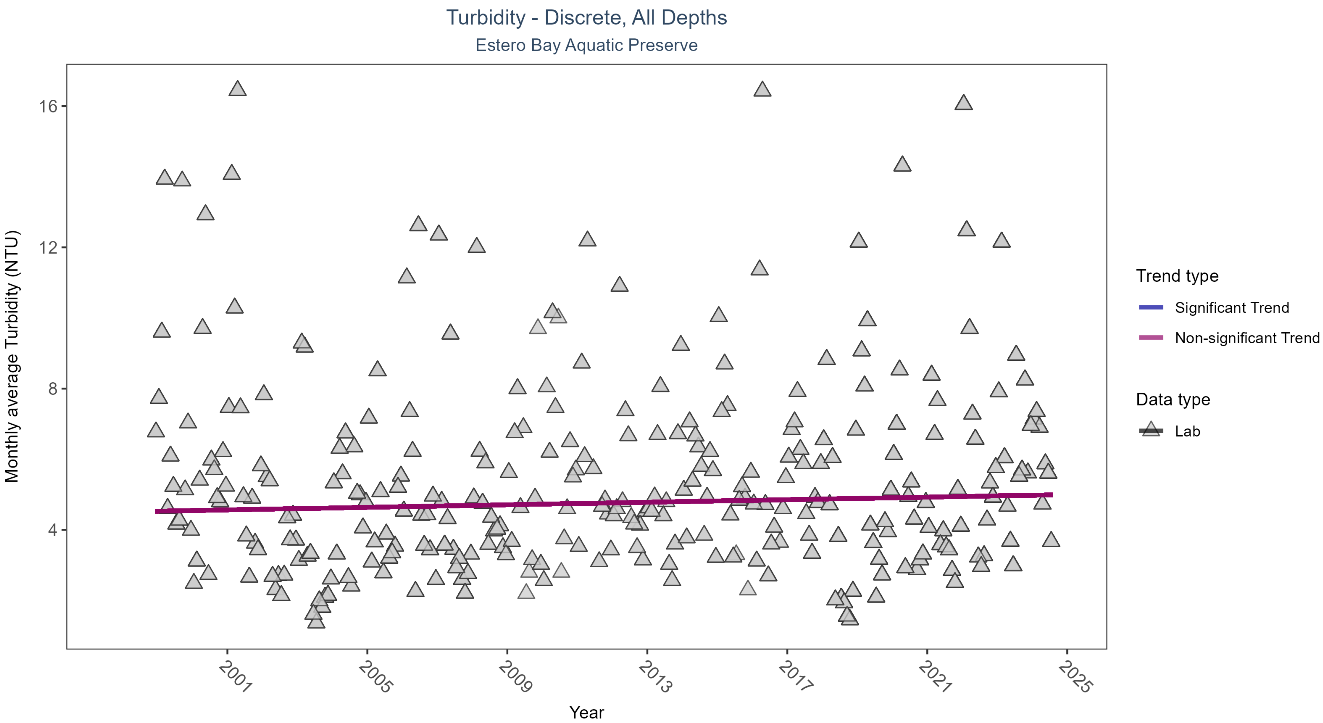

Figure 23: Seasonal Kendall-Tau Results for Turbidity - Discrete

Table 28: Seasonal Kendall-Tau Trend Analysis for Turbidity

RelativeDepth	N-Data	N-Years	Median	Independent	tau	p	SennSlope	SennIntercept	ChiSquared	pChiSquared	Trend
All	2977	27	4	TRUE	0.0456	0.2446	0.018	4.512	8.5726	0.6613	0

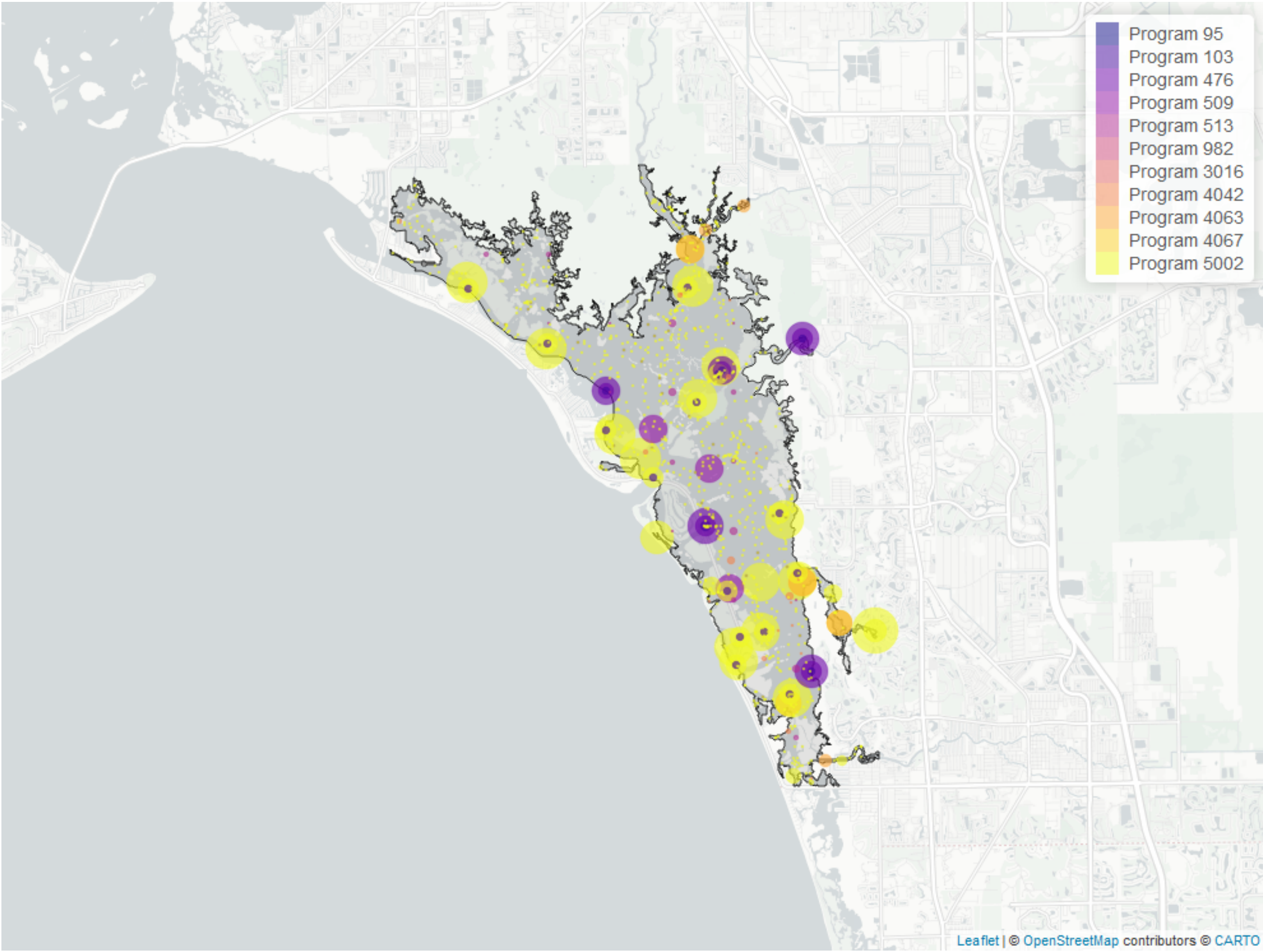

Figure 24: Map showing location of Discrete sampling sites for Turbidity. The bubble size on the maps below reflect the amount of data available at each sampling site.

Table 29: Programs contributing data for Turbidity

ProgramID	*N_Data*	*YearMin*	*YearMax*
5002	6438	1991	2024
476	1069	1998	2024
509	348	1999	2008
103	221	2020	2022
4063	76	2018	2024
513	69	2003	2005
4042	61	2016	2024

Program names:

103 - EPA STOrage and RETrieval Data Warehouse (STORET)/WQX[1]
476 - Charlotte Harbor Estuaries Volunteer Water Quality Monitoring Network[2]
509 - SERC Water Quality Monitoring Network[7]
513 - Coastal Charlotte Harbor Monitoring Network[3]
4042 - Estero Bay Oyster Monitoring[11]

4063 - Estero Bay Tributary Monitoring[4]
5002 - Florida STORET / WIN[5]

Water Temperature - Discrete Water Quality

Seasonal Kendall-Tau Trend Analysis

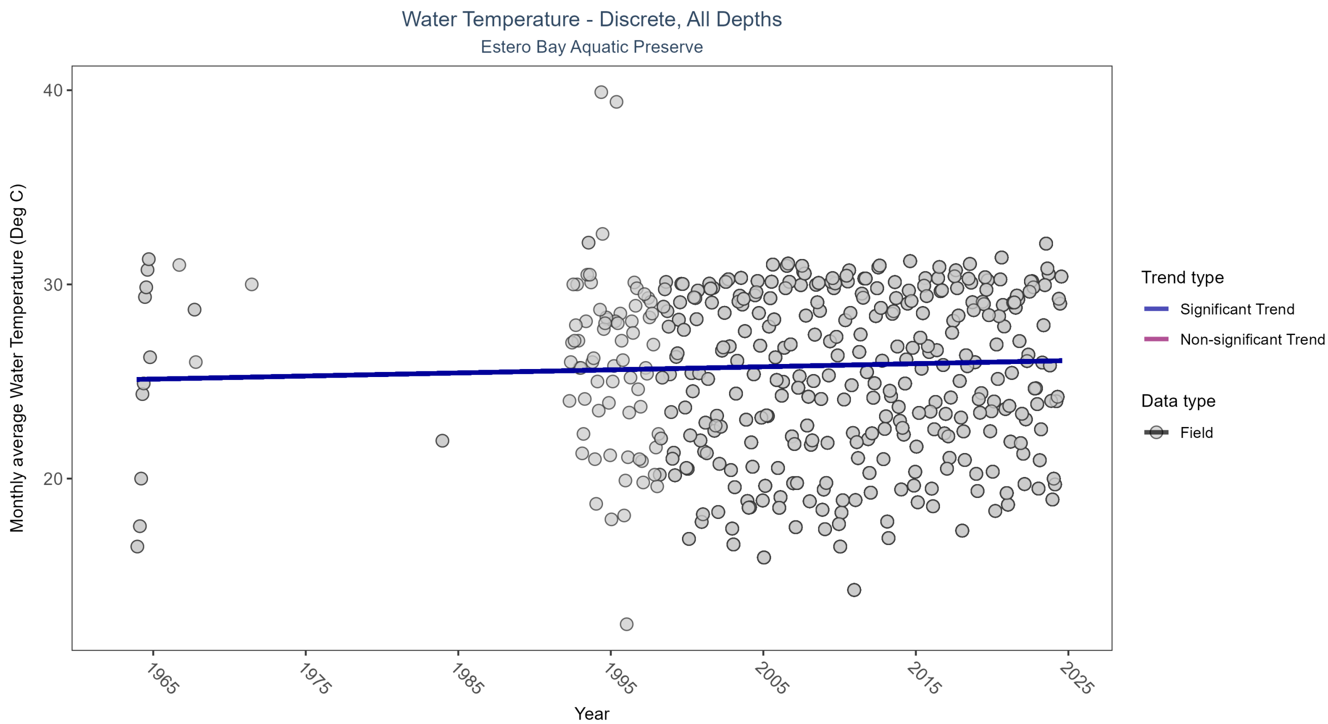

Figure 25: Seasonal Kendall-Tau Results for Water Temperature - Discrete

Table 30: Seasonal Kendall-Tau Trend Analysis for Water Temperature

RelativeDepth	N-Data	N-Years	Median	Independent	tau	p	SennSlope	SennIntercept	ChiSquared	pChiSquared	Trend
All	11200	39	25.9	TRUE	0.0919	0.0091	0.0159	25.0911	7.7068	0.7393	1

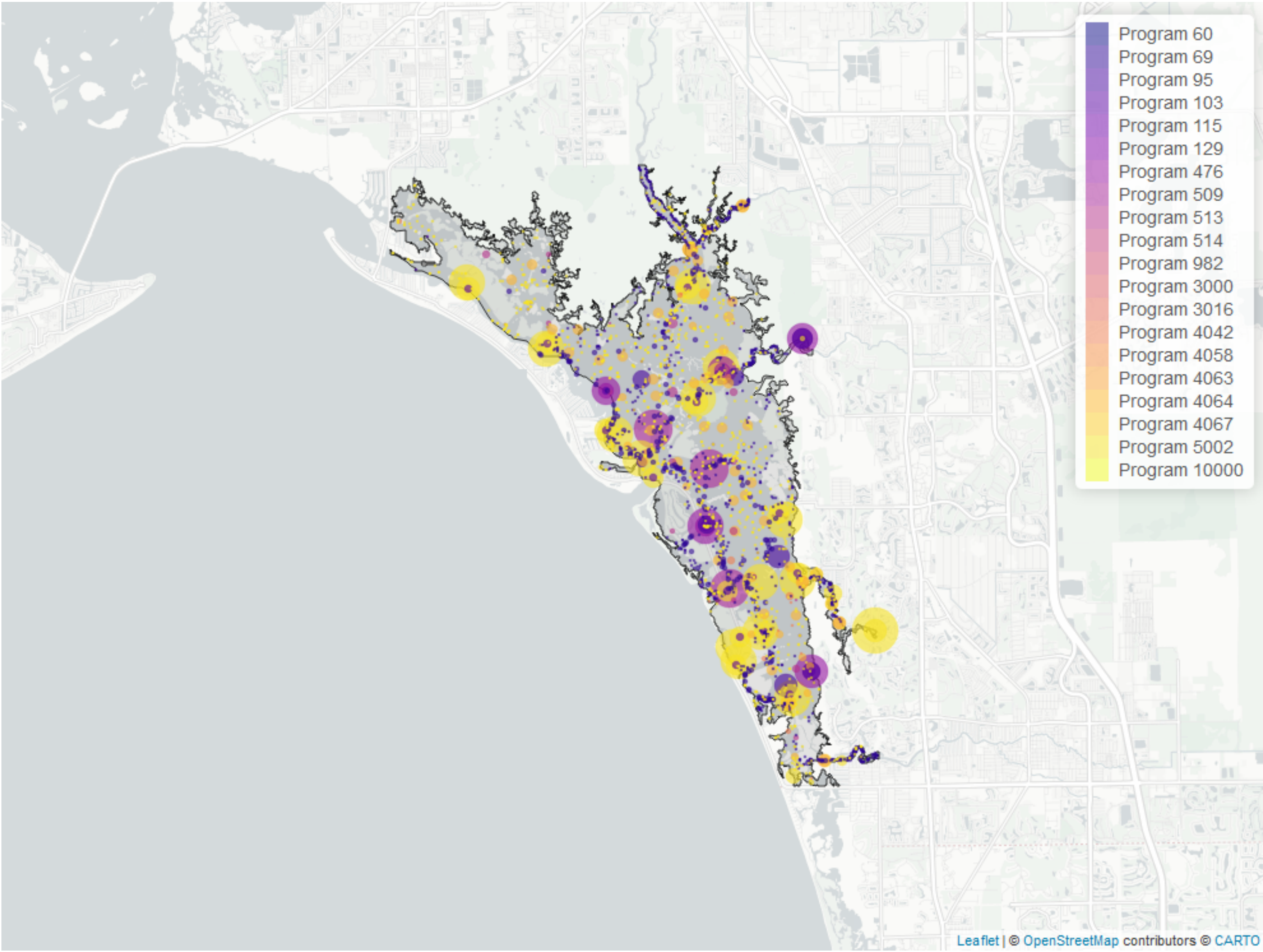

Figure 26: Map showing location of Discrete sampling sites for Water Temperature. The bubble size on the maps below reflect the amount of data available at each sampling site.

Table 31: Programs contributing data for Water Temperature

ProgramID	*N_Data*	*YearMin*	*YearMax*
5002	5678	1992	2024
69	2262	2001	2007
476	1002	1998	2024
509	702	1999	2008
4064	619	2011	2012
95	494	1963	2018
103	253	2020	2022
513	130	2003	2005
4042	62	2016	2024
115	3	2003	2003

Program names:

69 - Fisheries-Independent Monitoring (FIM) Program[9]
95 - Harmful Algal Bloom Marine Observation Network[10]
103 - EPA STOrage and RETrieval Data Warehouse (STORET)/WQX[1]

115 - Environmental Monitoring Assessment Program[6]
476 - Charlotte Harbor Estuaries Volunteer Water Quality Monitoring Network[2]
509 - SERC Water Quality Monitoring Network[7]
513 - Coastal Charlotte Harbor Monitoring Network[3]
4042 - Estero Bay Oyster Monitoring[11]
4064 - A spatial model to improve site selection for seagrass restoration in shallow boating environments[12]
5002 - Florida STORET / WIN[5]

Water Quality - Continuous

The following files were used in the continuous analysis:

- *Combined_WQ_WC_NUT_cont_Dissolved_Oxygen_SW-2024-Dec-08.txt*
- *Combined_WQ_WC_NUT_cont_Dissolved_Oxygen_Saturation_SW-2024-Dec-08.txt*
- *Combined_WQ_WC_NUT_cont_pH_SW-2024-Dec-08.txt*
- *Combined_WQ_WC_NUT_cont_Salinity_SW-2024-Dec-08.txt*
- *Combined_WQ_WC_NUT_cont_Turbidity_SW-2024-Dec-08.txt*
- *Combined_WQ_WC_NUT_cont_Water_Temperature_SW-2024-Dec-08.txt*

Continuous monitoring locations in Estero Bay Aquatic Preserve

Table 32: Estero Bay Aquatic Preserve Continuous Water Quality Monitoring (474)

ProgramLocationID	*Years of Data*	*Use in Analysis*	*Parameters*
EB01	19	TRUE	DO , DOS , pH , Sal , Turb , TempW
EB01b	1	FALSE	DO , DOS , pH , Sal , Turb , TempW
EB02	21	TRUE	DO , DOS , pH , Sal , Turb , TempW
EB03	21	TRUE	DO , DOS , pH , Sal , Turb , TempW
EB04	4	FALSE	DO , DOS , pH , Sal , Turb , TempW

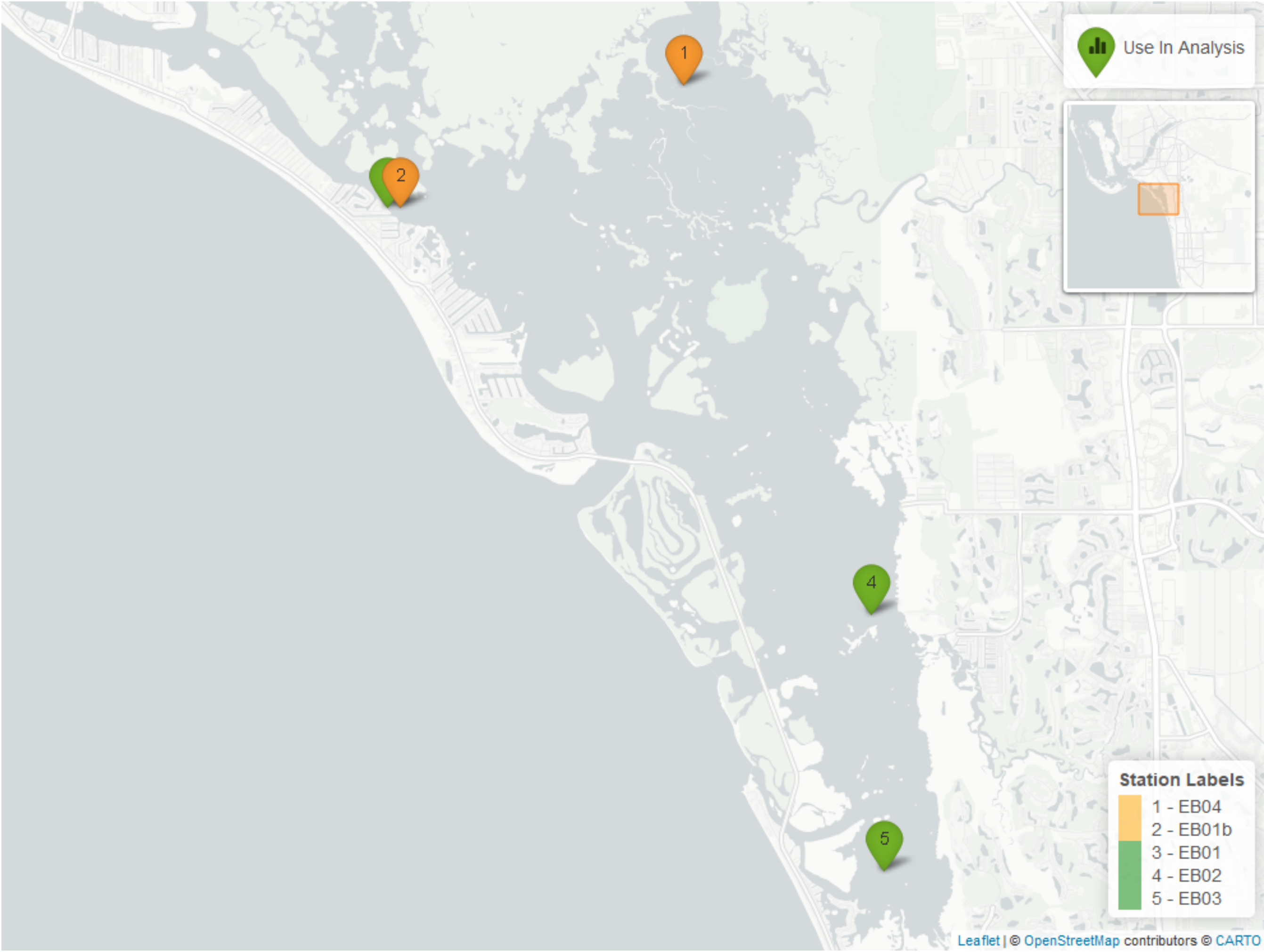

Figure 27: Map showing Continuous Water Quality Monitoring sampling locations within the boundaries of Estero Bay Aquatic Preserve. Sites marked as *Use In Analysis* are featured in this report.

Dissolved Oxygen - All Stations Combined

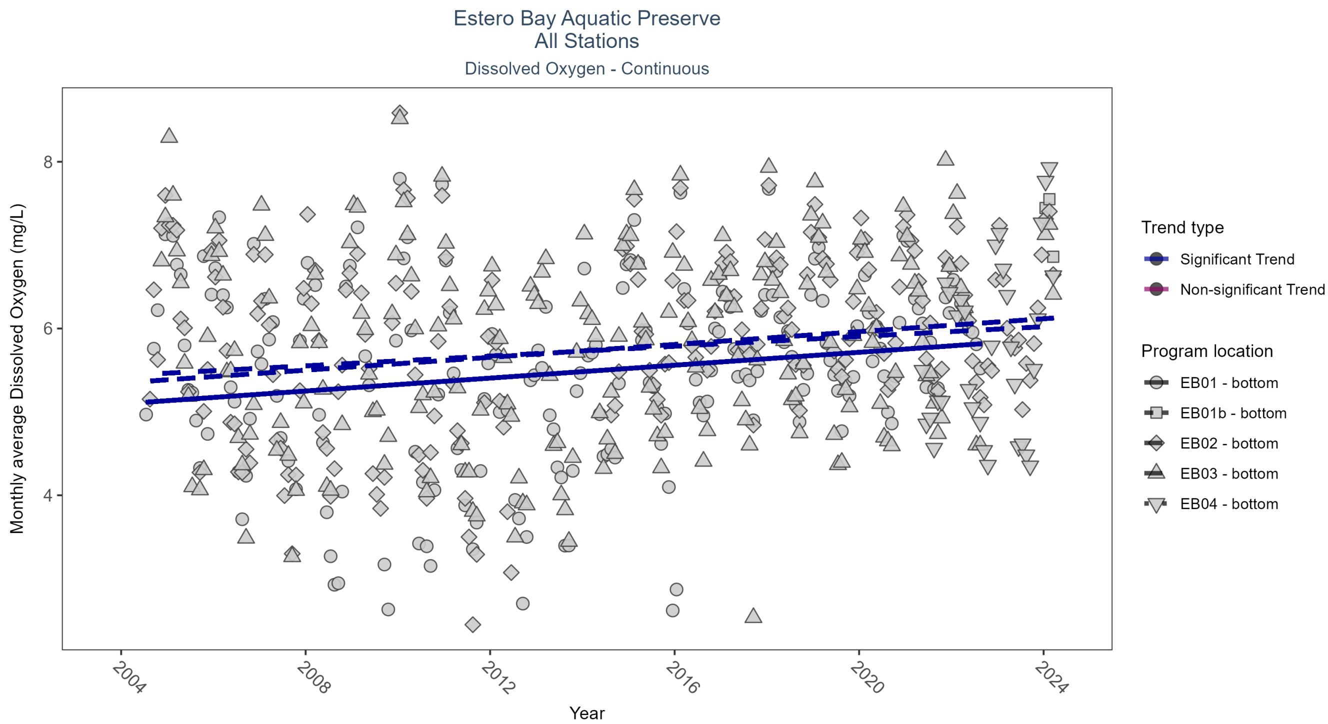

Figure 28: Figure for Dissolved Oxygen - Continuous - All stations combined

Table 33: Seasonal Kendall-Tau Results for All Stations - Dissolved Oxygen

Station	N_Data	N_Years	Period of Record	Median	tau	SennIntercept	SennSlope	p
EB01	478415	19	2004 - 2022	5.6	0.22	5.1	0.04	0.0000
EB02	460690	20	2004 - 2024	6.1	0.26	5.35	0.04	0.0000
EB01b	6000	1	2024 - 2024	7.4	-	-	-	-
EB03	447513	20	2004 - 2024	5.9	0.2	5.44	0.03	0.0002
EB04	83521	4	2021 - 2024	5.8	-	-	-	-

Dissolved Oxygen Saturation - All Stations Combined

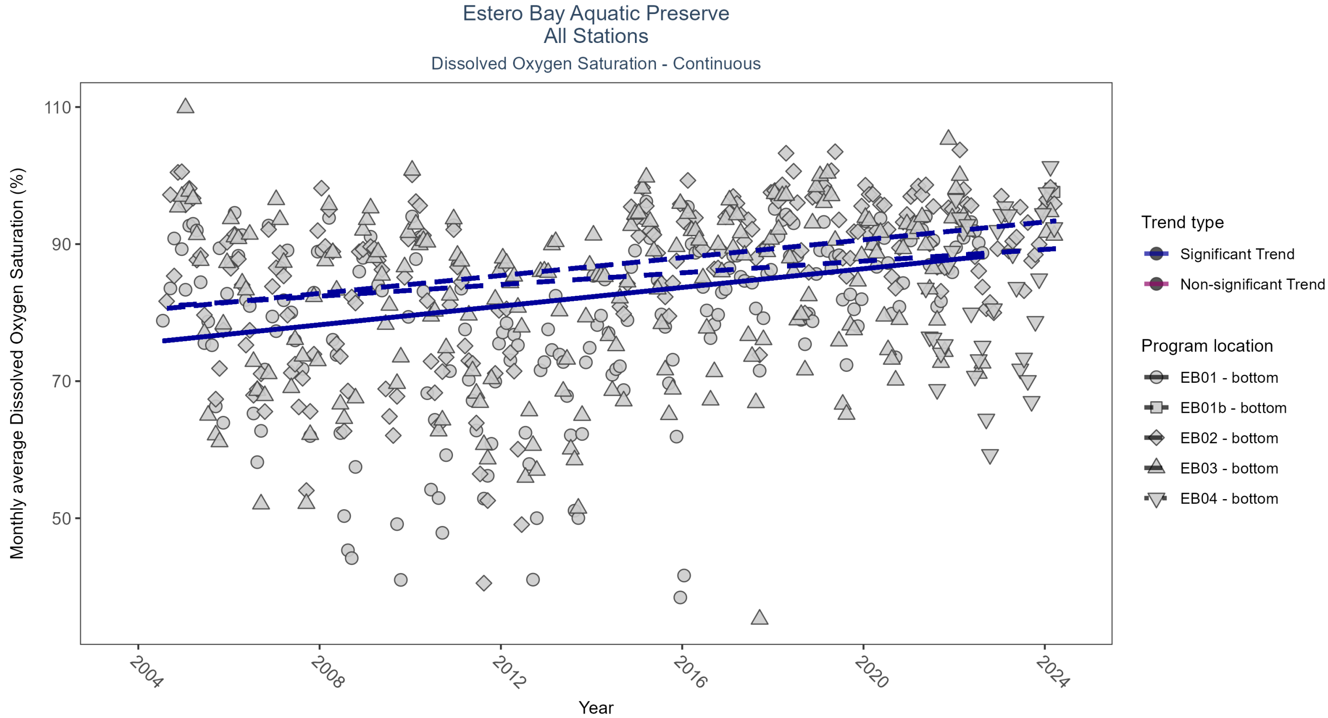

Figure 29: Figure for Dissolved Oxygen Saturation - Continuous - All stations combined

Table 34: Seasonal Kendall-Tau Results for All Stations - Dissolved Oxygen Saturation

Station	N_Data	N_Years	Period of Record	Median	tau	SennIntercept	SennSlope	p
EB01	480233	19	2004 - 2022	81.6	0.31	75.5	0.68	0.0000
EB02	460927	20	2004 - 2024	87.9	0.38	80.21	0.65	0.0000
EB01b	6001	1	2024 - 2024	96.8	-	-	-	-
EB03	449039	20	2004 - 2024	83.9	0.25	80.69	0.43	0.0000
EB04	93785	4	2021 - 2024	83.5	-	-	-	-

pH - All Stations Combined

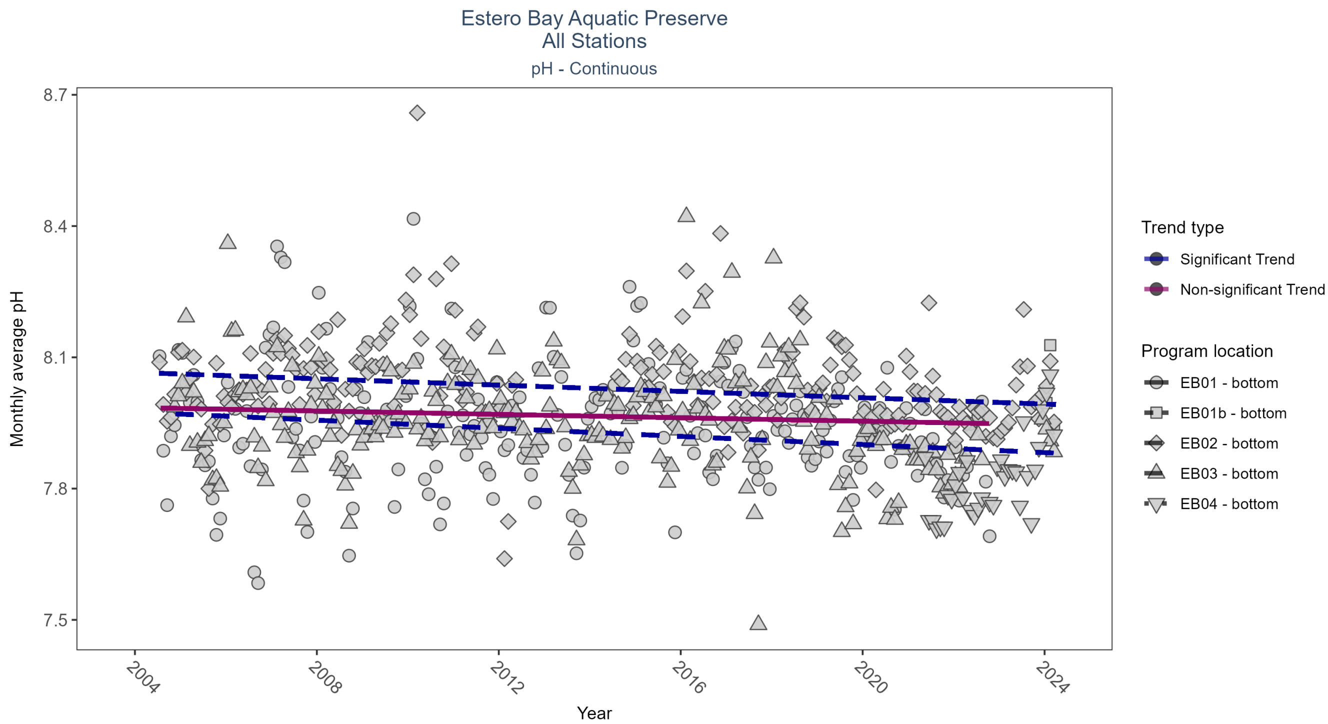

Figure 30: Figure for pH - Continuous - All stations combined

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

Station	N_Data	N_Years	Period of Record	Median	tau	SennIntercept	SennSlope	p
EB01	562188	19	2004 - 2022	7.9	-0.08	7.99	0	0.1157
EB02	529626	20	2004 - 2024	8.0	-0.17	8.07	0	0.0009
EB01b	6001	1	2024 - 2024	8.0	-	-	-	-
EB03	535767	21	2004 - 2024	8.0	-0.18	7.97	0	0.0002
EB04	96283	4	2021 - 2024	7.8	-	-	-	-

Salinity - All Stations Combined

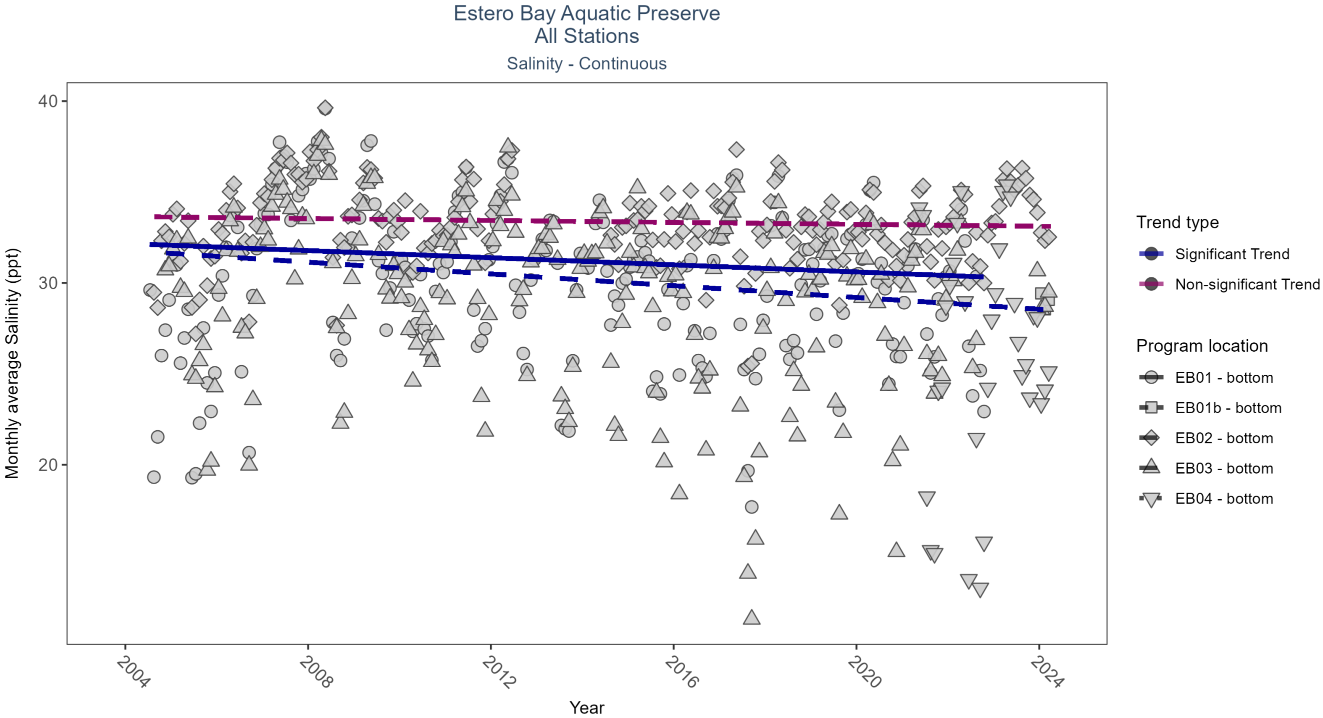

Figure 31: Figure for Salinity - Continuous - All stations combined

Table 36: Seasonal Kendall-Tau Results for All Stations - Salinity

Station	N_Data	N_Years	Period of Record	Median	tau	SennIntercept	SennSlope	p
EB01	567163	19	2004 - 2022	30.7	-0.13	32.17	-0.1	0.0110
EB02	548588	20	2004 - 2024	33.6	-0.06	33.65	-0.03	0.1963
EB01b	6000	1	2024 - 2024	29.3	-	-	-	-
EB03	543765	21	2004 - 2024	30.8	-0.22	31.79	-0.16	0.0000
EB04	93215	4	2021 - 2024	27.7	-	-	-	-

Turbidity - All Stations Combined

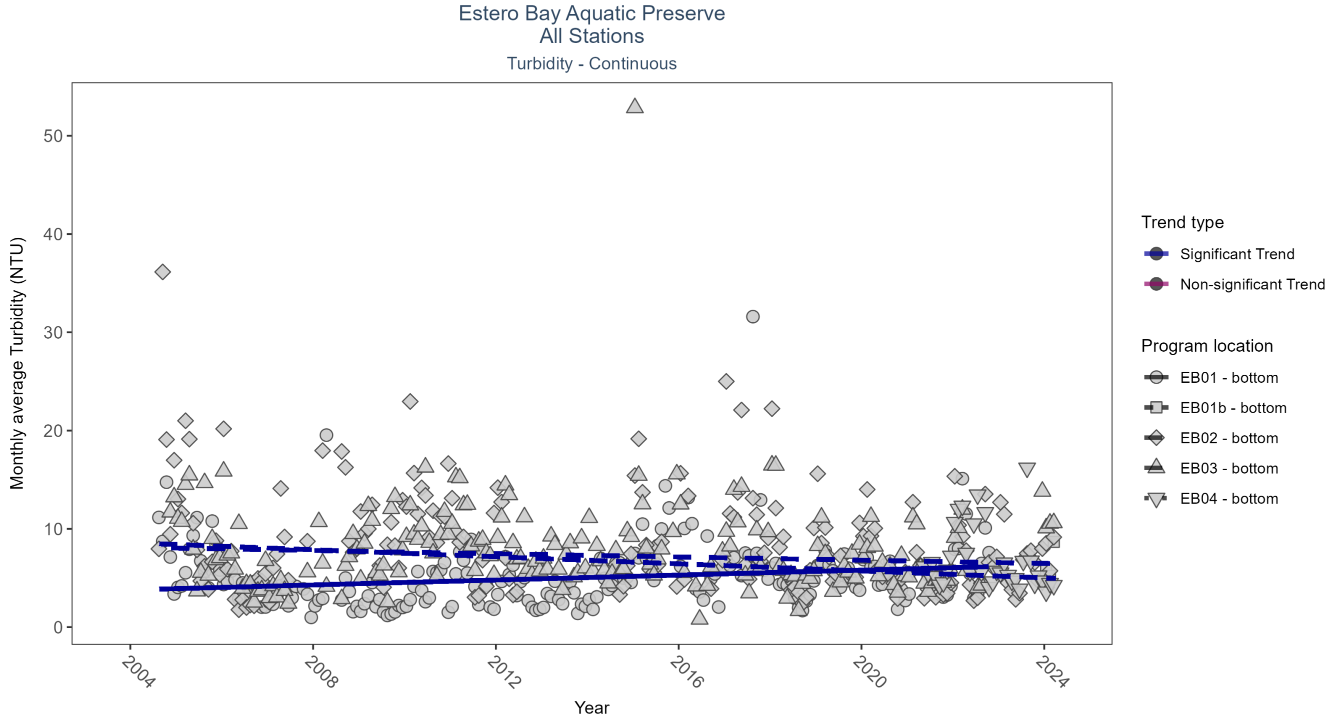

Figure 32: Figure for Turbidity - Continuous - All stations combined

Table 37: Seasonal Kendall-Tau Results for All Stations - Turbidity

Station	N_Data	N_Years	Period of Record	Median	tau	SennIntercept	SennSlope	p
EB01	510965	19	2004 - 2022	4	0.18	3.79	0.13	0.0005
EB02	443455	20	2004 - 2024	5	-0.21	8.59	-0.18	0.0002
EB01b	8672	1	2024 - 2024	6	-	-	-	-
EB03	424195	21	2004 - 2024	5	-0.12	8.13	-0.08	0.0426
EB04	90939	4	2021 - 2024	5	-	-	-	-

Water Temperature - All Stations Combined

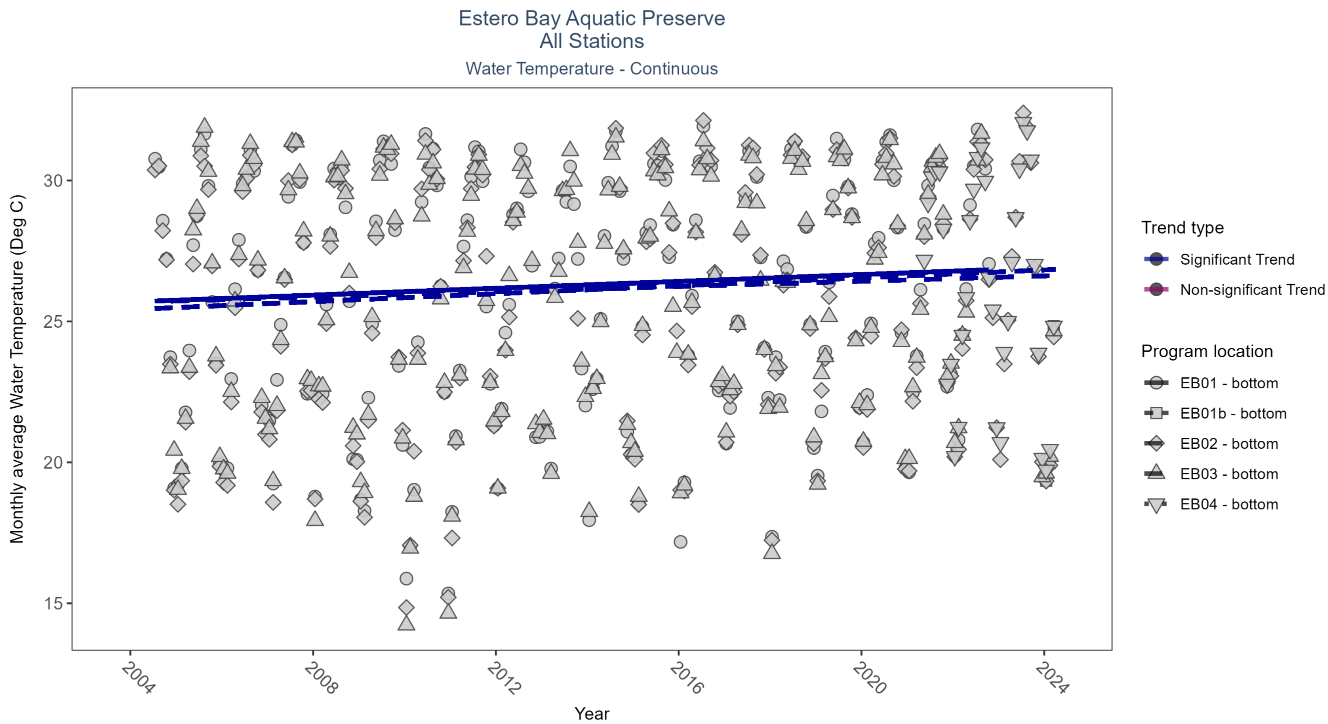

Figure 33: Figure for Water Temperature - Continuous - All stations combined

Table 38: Seasonal Kendall-Tau Results for All Stations - Water Temperature

Station	N_Data	N_Years	Period of Record	Median	tau	SennIntercept	SennSlope	p
EB01	617636	19	2004 - 2022	26.8	0.25	25.69	0.06	0.0000
EB02	592277	21	2004 - 2024	26.4	0.33	25.42	0.07	0.0000
EB01b	5999	1	2024 - 2024	19.5	-	-	-	-
EB03	582680	21	2004 - 2024	26.3	0.16	25.68	0.05	0.0010
EB04	101277	4	2021 - 2024	27.0	-	-	-	-

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

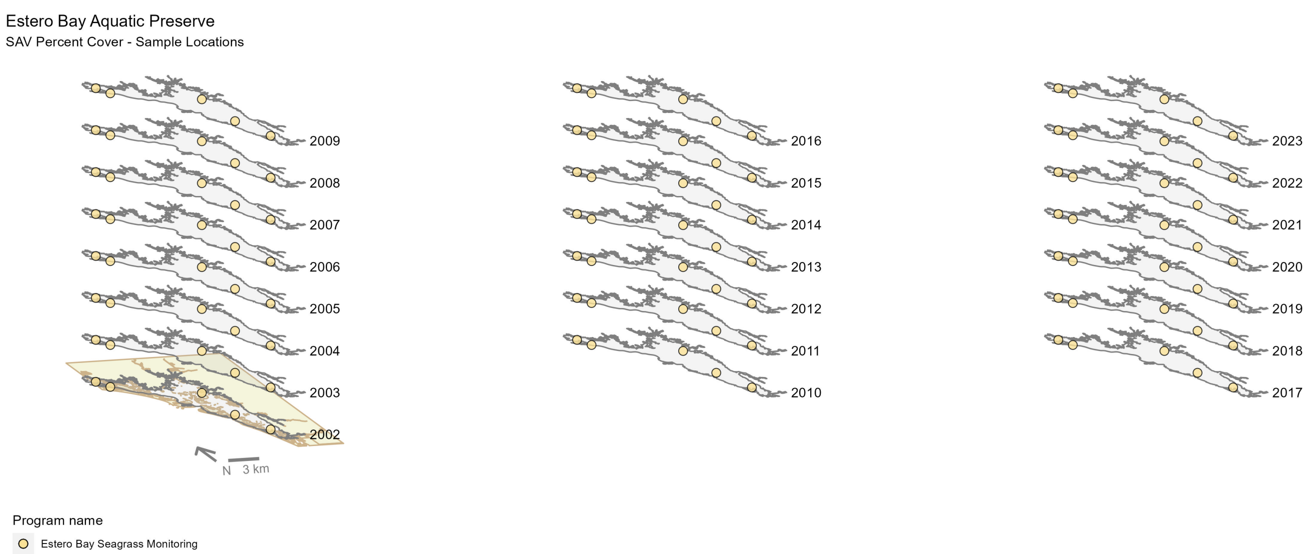

Figure 34: Maps showing the temporal scope of SAV sampling sites within the boundaries of *Estero Bay Aquatic Preserve* by Program name.

Sampling locations by Program:

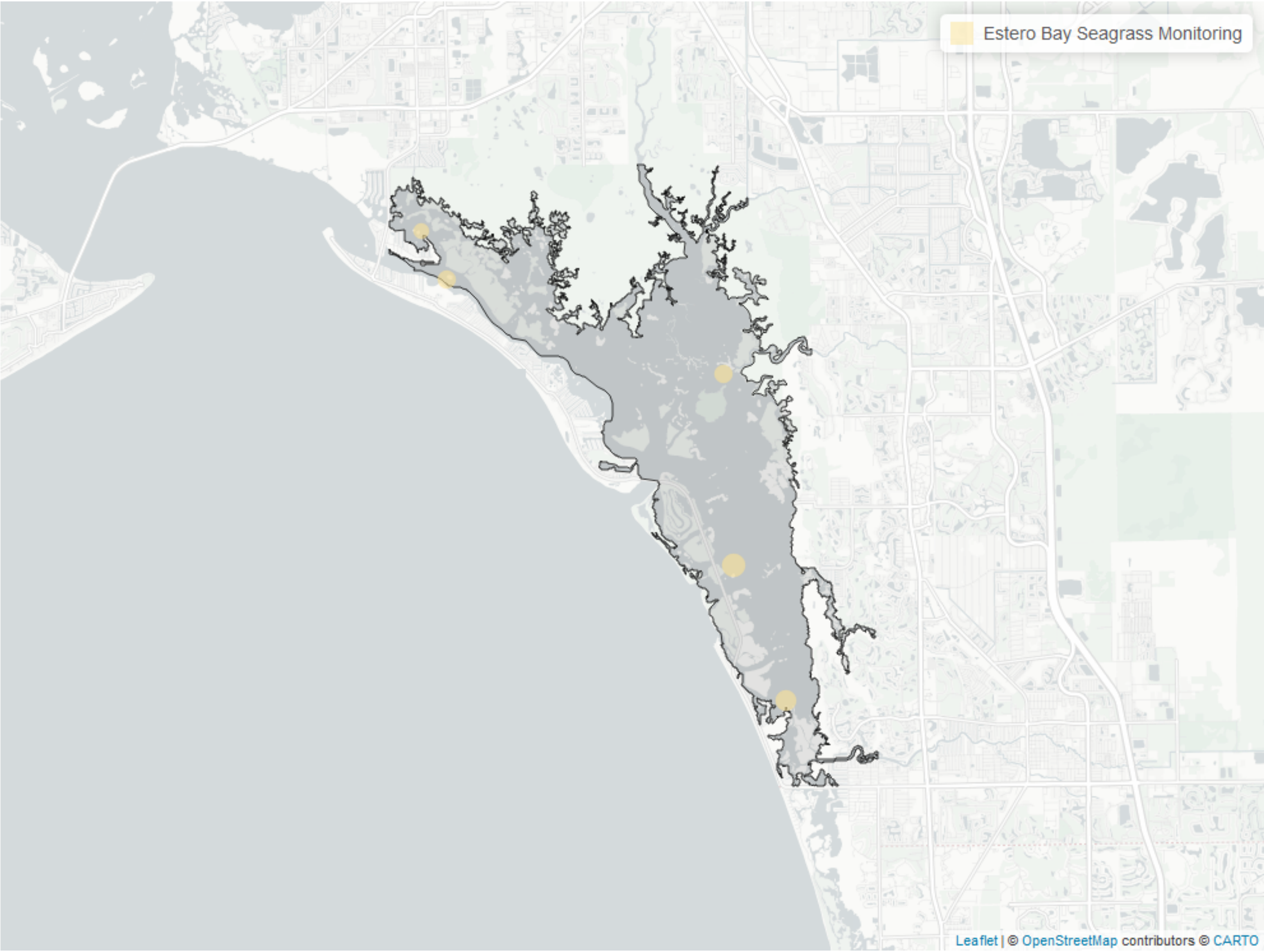

Figure 35: Map showing SAV sampling sites within the boundaries of *Estero Bay Aquatic Preserve*. The point size reflects the number of samples at a given sampling site.

Table 39: Estero Bay Seagrass Monitoring - Program 571

N-Data	*YearMin*	*YearMax*	*method*	*Sample Locations*
2582	2002	2023	Braun Blanquet	5

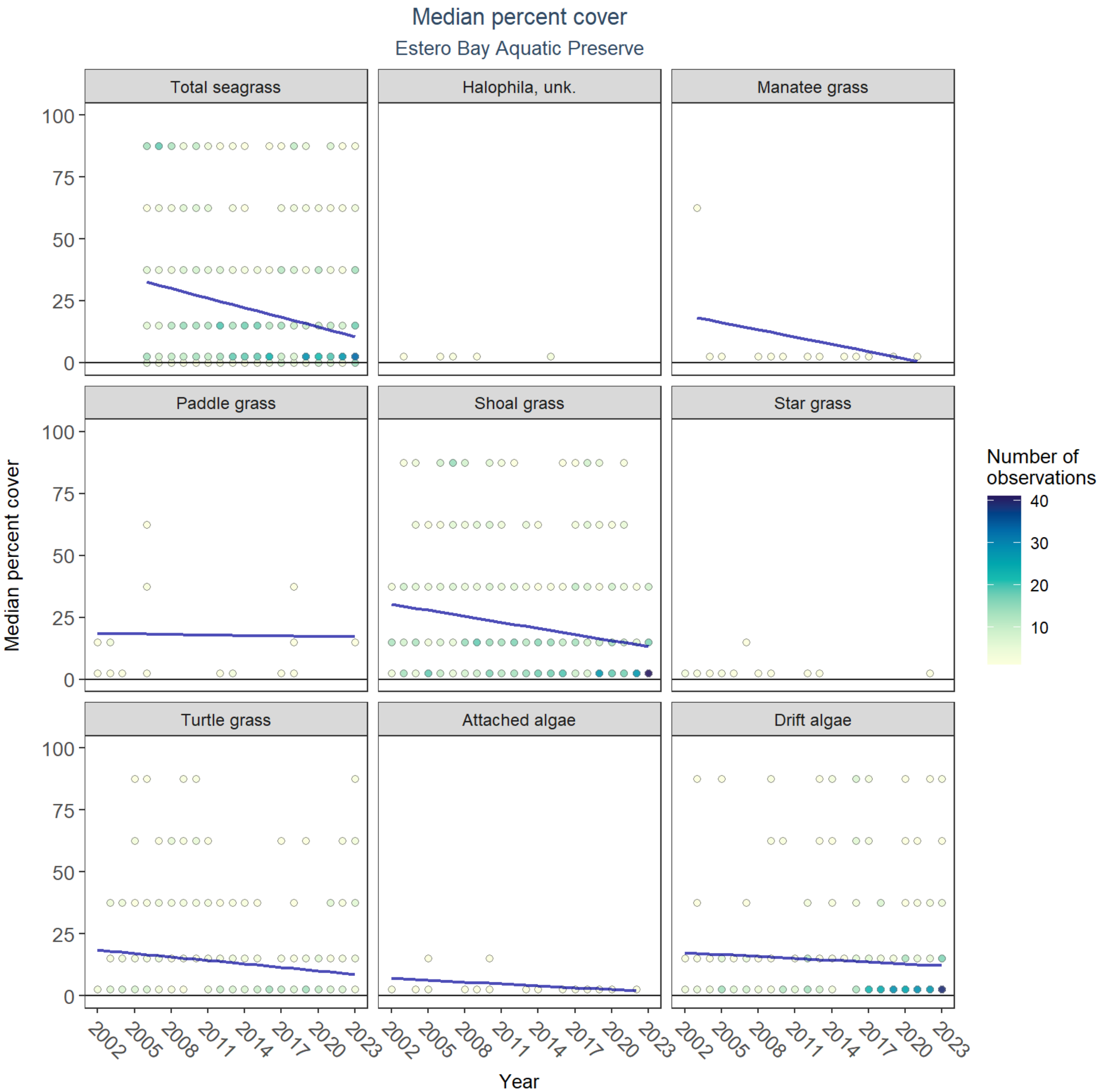

Figure 36: Trends in median percent cover for various seagrass species in Estero Bay Aquatic Preserve

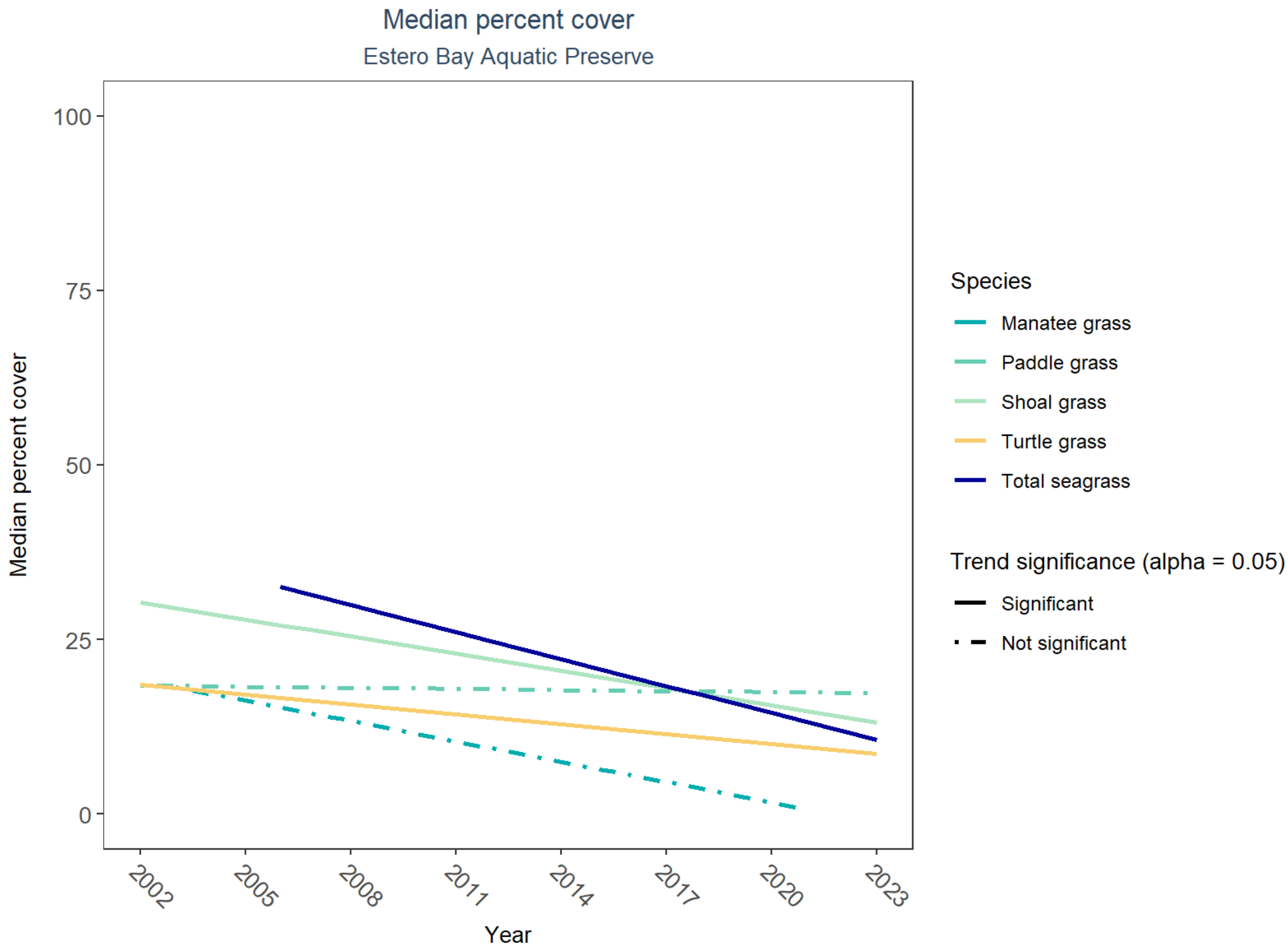

Figure 37: Trends in median percent cover for various seagrass species in Estero Bay Aquatic Preserve - simplified

Table 40: Percent Cover Trend Analysis for Estero Bay Aquatic Preserve

CommonName	*Trend Significance (0.05)*	*Period of Record*	*LME-Intercept*	*LME-Slope*	*p*
Attached algae	No significant trend	2002 - 2022	9.035419	-0.2506769	0.3842801
Drift algae	No significant trend	2002 - 2023	19.399922	-0.2506230	0.3787135
Shoal grass	Significantly decreasing trend	2002 - 2023	36.883378	-0.8178698	0.0016888
Paddle grass	No significant trend	2002 - 2023	18.899337	-0.0551538	0.9221973
Star grass	Model did not fit the available data	2002 - 2022	-	-	-
No grass in quadrat	Model did not fit the available data	2002 - 2023	-	-	-
Manatee grass	No significant trend	2003 - 2021	26.939075	-0.9721088	0.3517504
Turtle grass	Significantly decreasing trend	2002 - 2023	22.273355	-0.4692596	0.0173599
Total seagrass	Significantly decreasing trend	2006 - 2023	48.098611	-1.2932390	0.0236360
Halophila, unk.	Model did not fit the available data	2003 - 2015	-	-	-

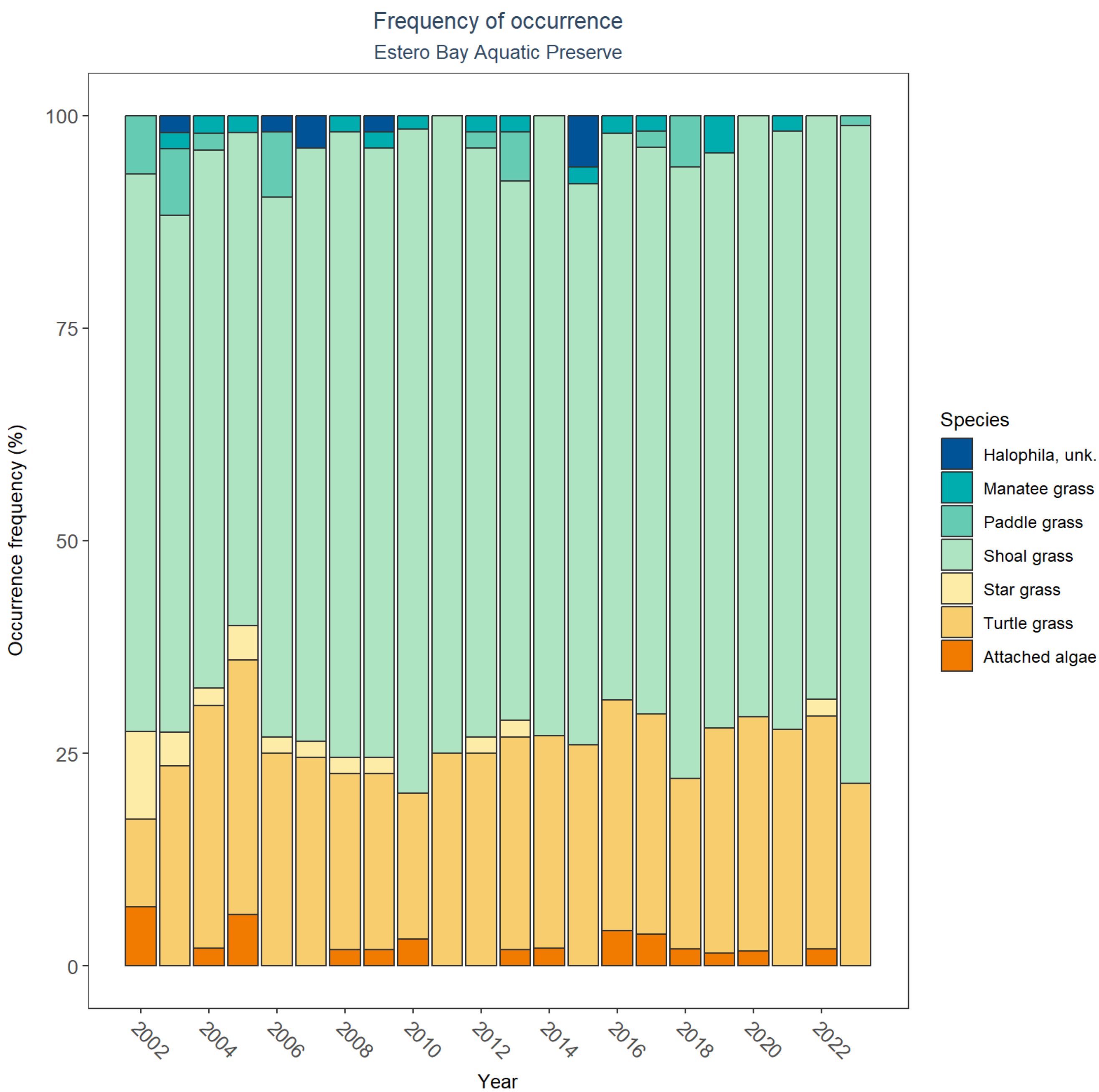

Figure 38: Frequency of occurrence for various seagrass species in Estero Bay Aquatic Preserve

Oyster

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

Density

Natural

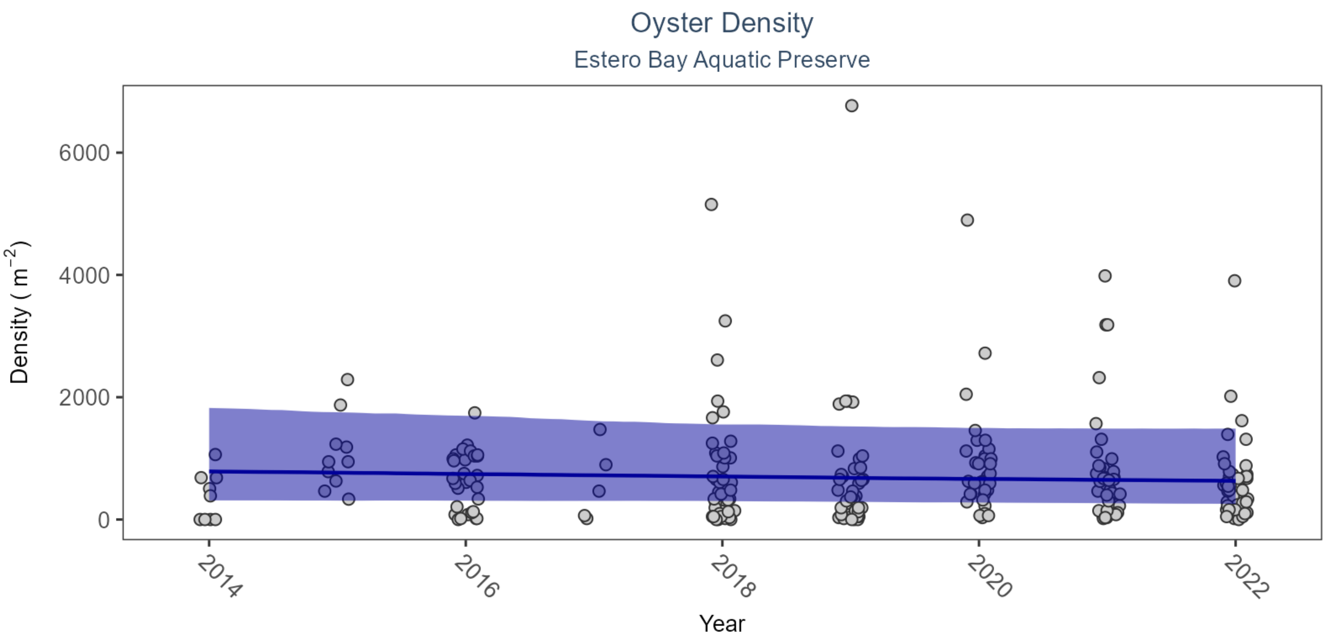

Figure 39: Figure for Oyster Density in Estero Bay Aquatic Preserve

Table 41: Model results for Oyster Density - Natural

Shell Type	*Habitat Type*	*Trend Status*	*Estimate*	*Standard Error*	*Credible Interval*
Live Oyster Shells	Natural	No significant change	-0.02	0.03	-0.09 to 0.04

Shell Height

Natural

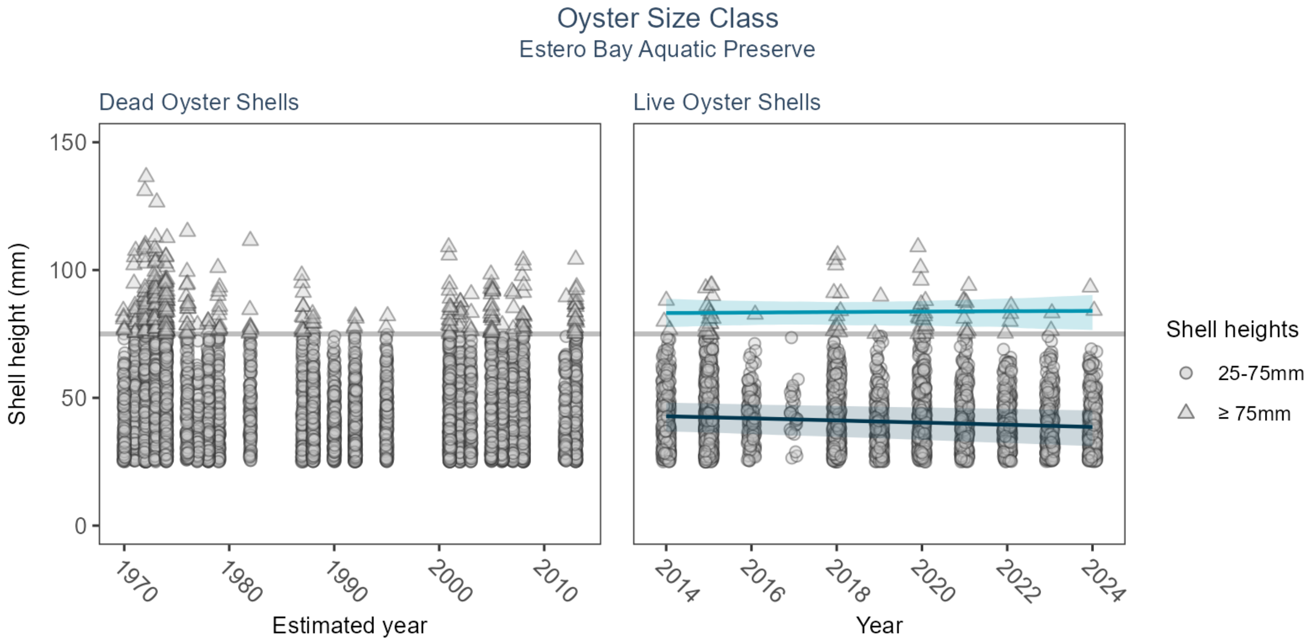

Figure 40: Figure for Oyster Shell Height in Estero Bay Aquatic Preserve

Table 42: Model results for Oyster Shell Height - Natural

Shell Type	*Habitat Type*	*Trend Status*	*Estimate*	*Standard Error*	*Credible Interval*
Dead Oyster Shells	Natural	Significantly decreasing trend	-1.66	1.35	-4.84 to -0.21
Dead Oyster Shells	Natural	No significant change	-0.35	2.68	-3.21 to 2.36
Dead Oyster Shells	Natural	-	-	-	NA to NA
Live Oyster Shells	Natural	No significant change	0.01	0.49	-1.01 to 0.9
Live Oyster Shells	Natural	No significant change	0.26	0.22	-0.17 to 0.69
Live Oyster Shells	Natural	-	-	-	NA to NA

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