Apalachicola National Estuarine Research Reserve

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	mˆ-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

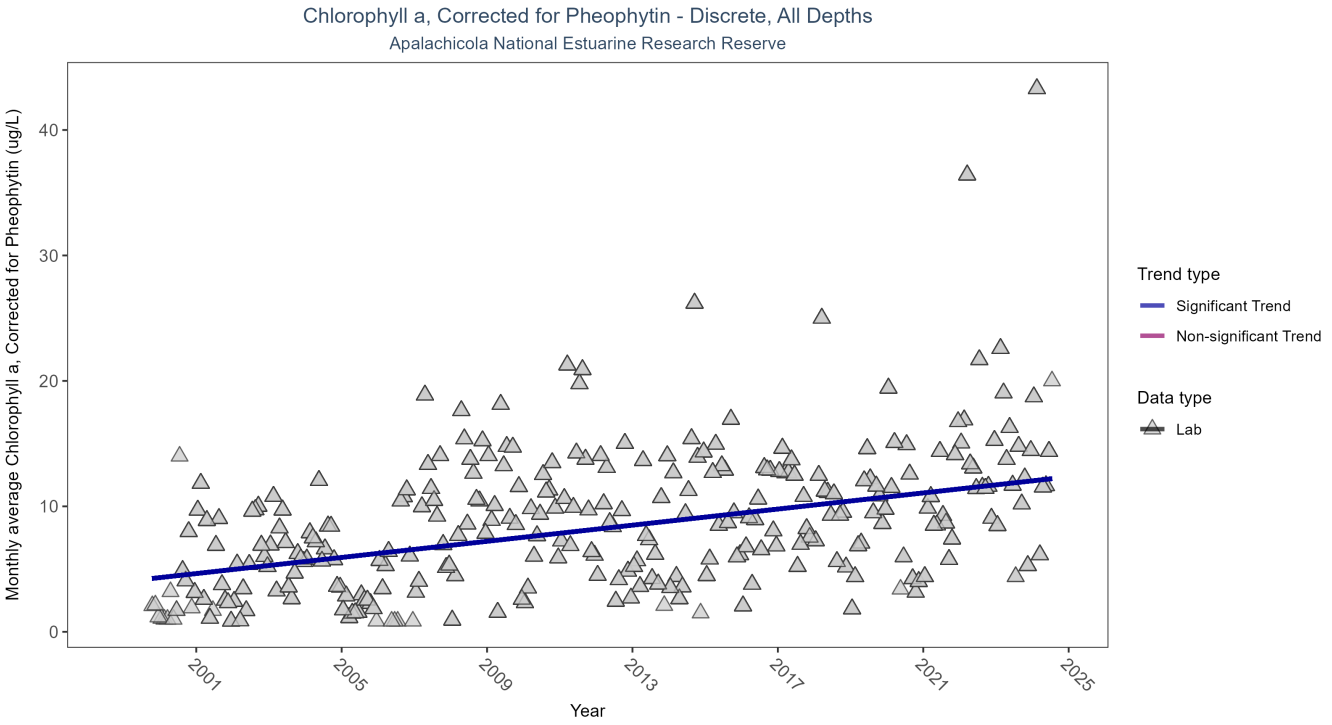

Figure 1: Seasonal Kendall-Tau Results for Chlorophyll a, Corrected for Pheophytin - Discrete

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	8985	26	7.6	TRUE	0.3411	0	0.3214	4.0006	10.5334	0.4831	1

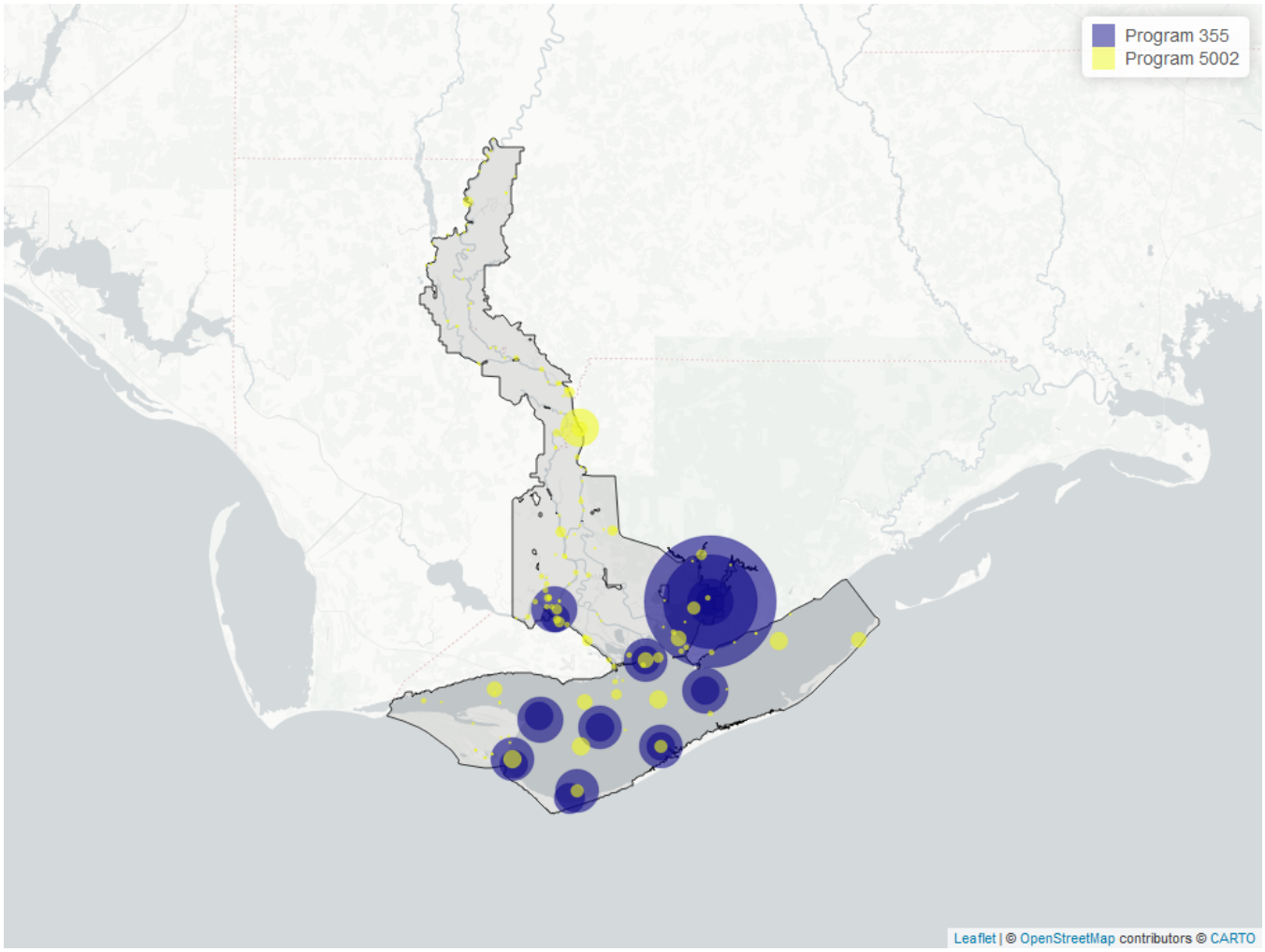

Figure 2: Map showing location of Discrete sampling sites for Chlorophyll a, Corrected for Pheophytin. The bubble size on the maps below reflect the amount of data available at each sampling site.

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

ProgramID	*N_Data*	*YearMin*	*YearMax*
355	7954	2002	2024
5002	1147	1999	2024

Program names:

355 - Apalachicola National Estuarine Research Reserve System-Wide Monitoring Program[1]
5002 - Florida STORET / WIN[2]

Chlorophyll a, Uncorrected for Pheophytin - Discrete Water Quality

Seasonal Kendall-Tau Trend Analysis

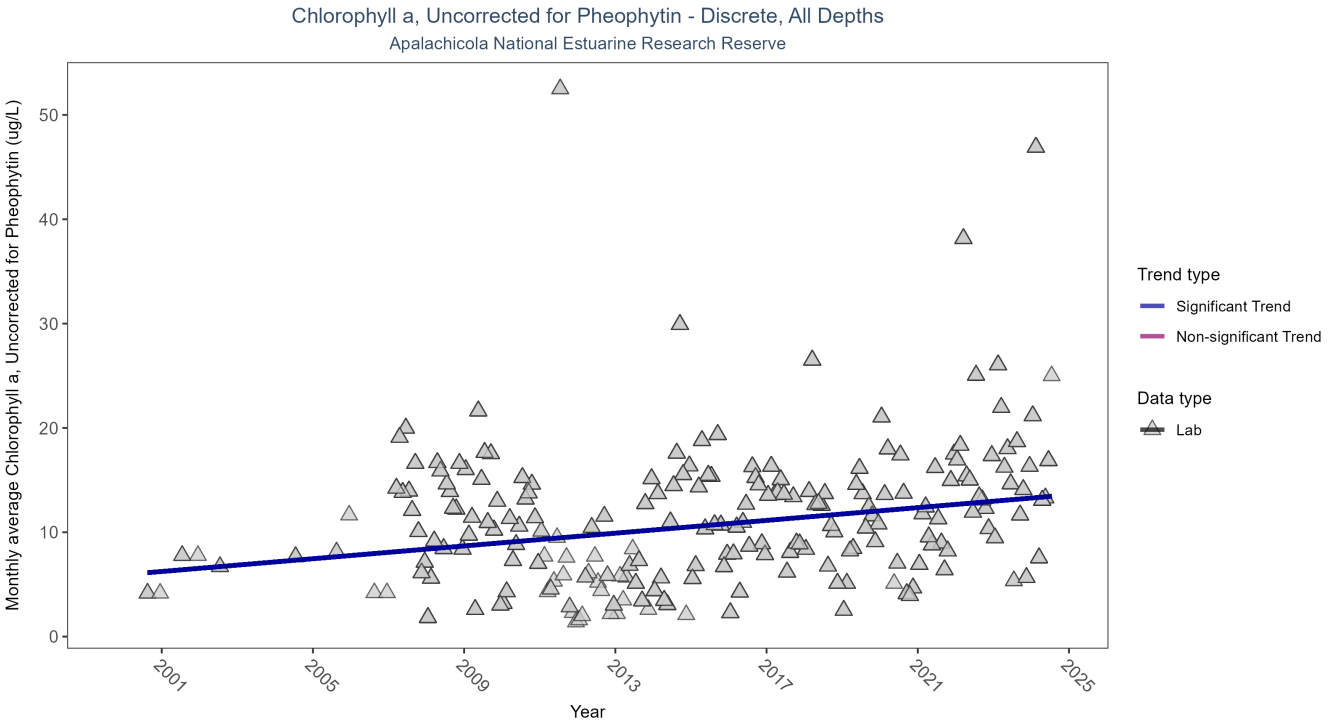

Figure 3: Seasonal Kendall-Tau Results for Chlorophyll a, Uncorrected for Pheophytin - Discrete

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	4711	24	10	TRUE	0.1868	0.0002	0.306	5.9327	16.0918	0.1378	1

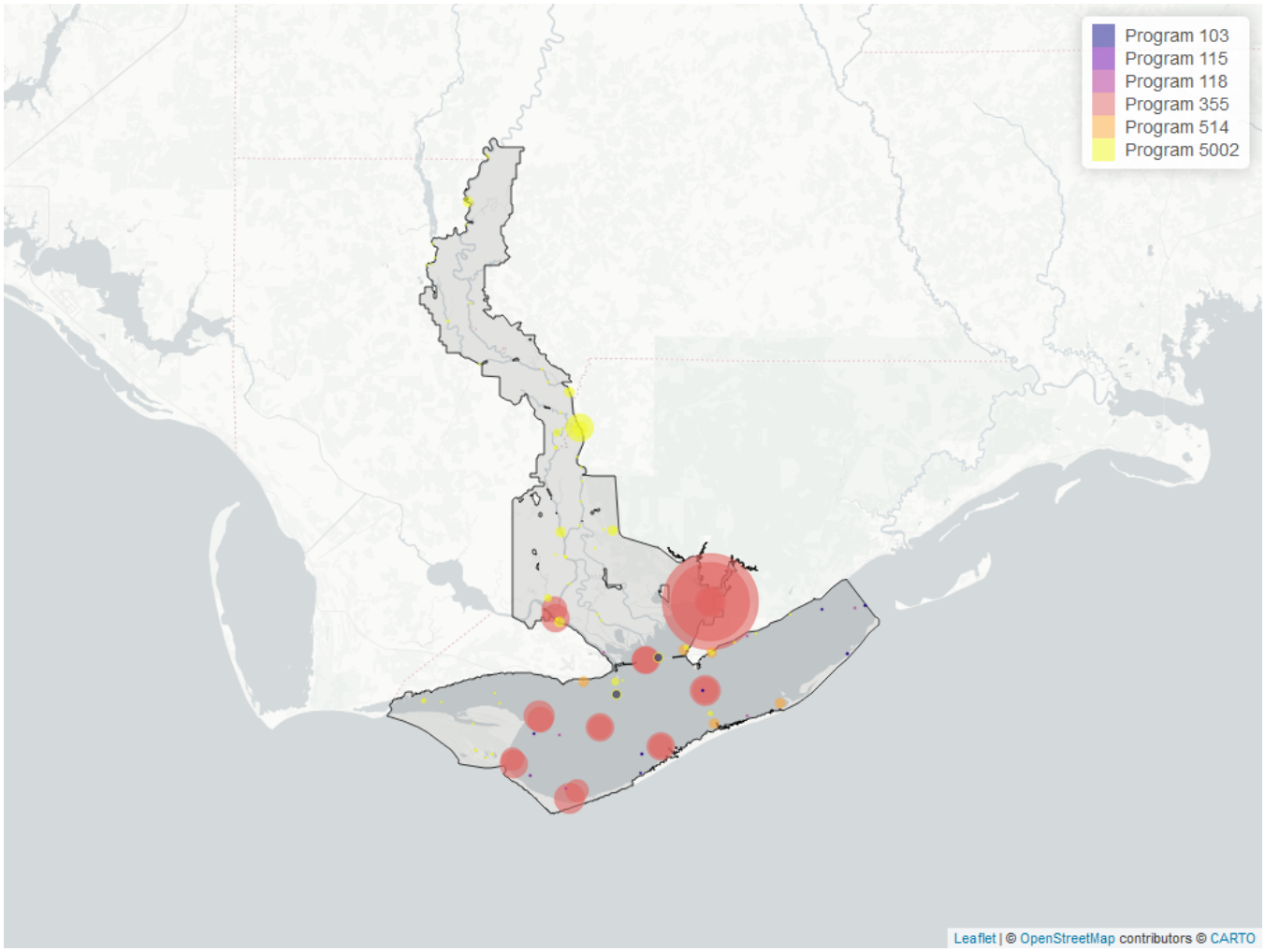

Figure 4: Map showing location of Discrete sampling sites for Chlorophyll a, Uncorrected for Pheophytin. The bubble size on the maps below reflect the amount of data available at each sampling site.

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

ProgramID	*N_Data*	*YearMin*	*YearMax*
355	4393	2007	2024
5002	370	2007	2024
514	85	2007	2008
103	33	2000	2021
118	10	2000	2010
115	6	2000	2004

Program names:

103 - EPA STOrage and RETrieval Data Warehouse (STORET)/WQX[3]
115 - Environmental Monitoring Assessment Program[4]
118 - National Aquatic Resource Surveys, National Coastal Condition Assessment[5]
355 - Apalachicola National Estuarine Research Reserve System-Wide Monitoring Program[1]
514 - Florida LAKEWATCH Program[6]
5002 - Florida STORET / WIN[2]

Colored Dissolved Organic Matter - Discrete Water Quality

Seasonal Kendall-Tau Trend Analysis

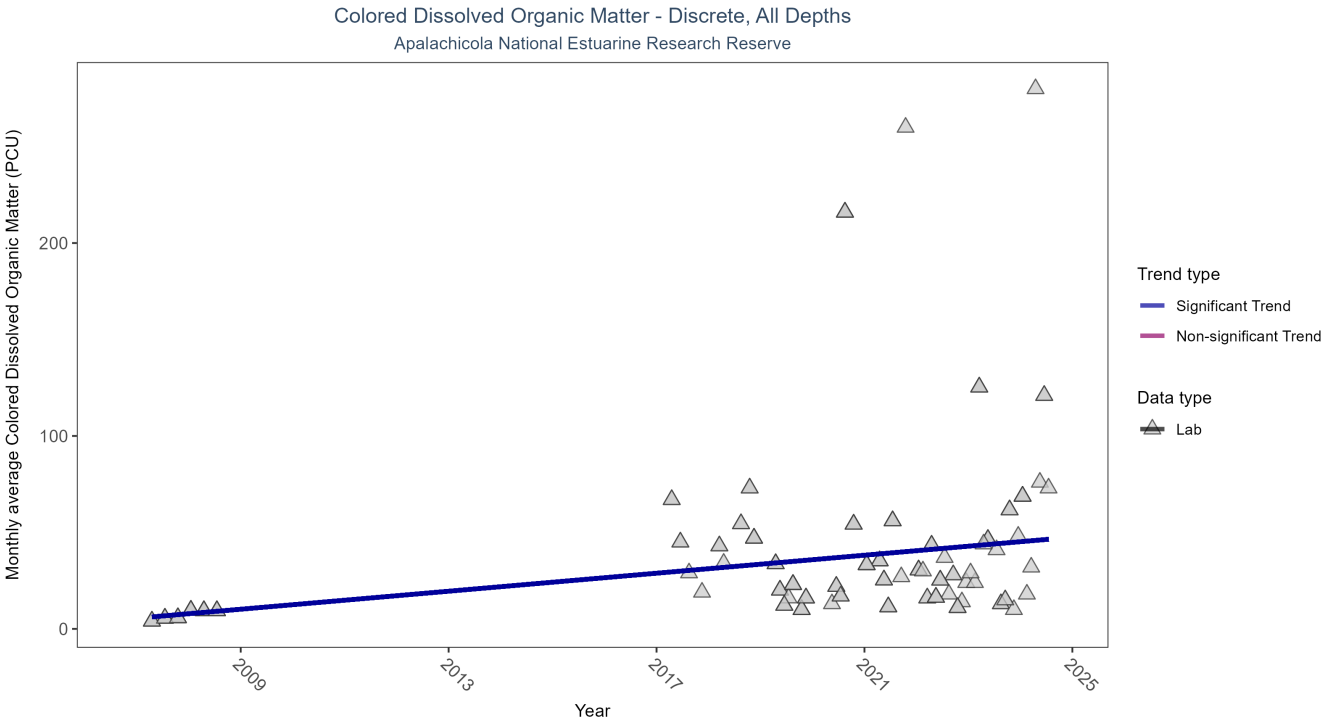

Figure 5: Seasonal Kendall-Tau Results for Colored Dissolved Organic Matter - Discrete

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	160	10	21.5	TRUE	0.2061	0.0046	2.3333	5.5172	27.1916	0.0043	2

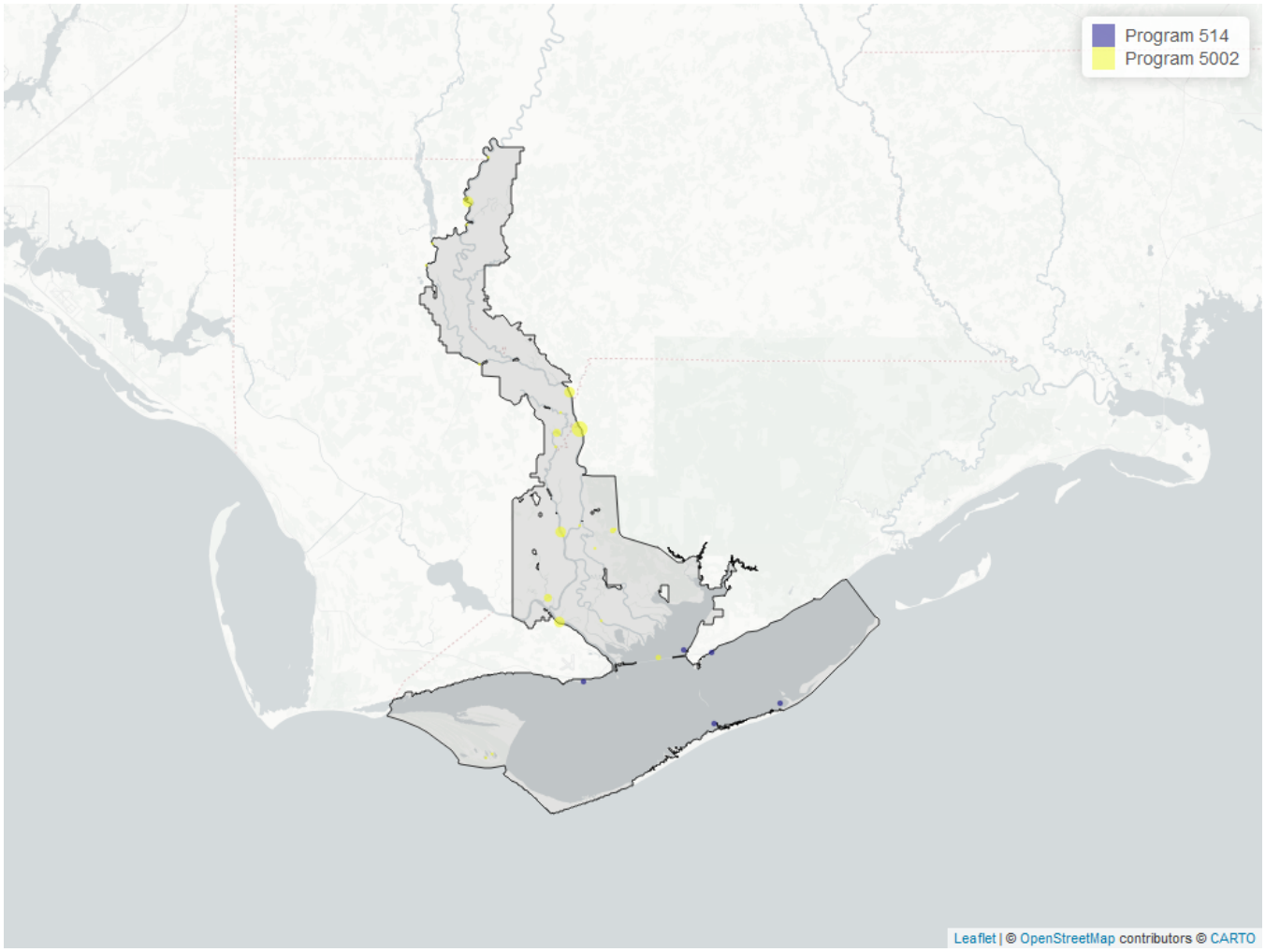

Figure 6: Map showing location of Discrete sampling sites for Colored Dissolved Organic Matter. The bubble size on the maps below reflect the amount of data available at each sampling site.

Table 11: Programs contributing data for Colored Dissolved Organic Matter

ProgramID	*N_Data*	*YearMin*	*YearMax*
5002	145	2017	2024
514	26	2007	2008

Program names:

514 - Florida LAKEWATCH Program[6]
5002 - Florida STORET / WIN[2]

Dissolved Oxygen - Discrete Water Quality

Seasonal Kendall-Tau Trend Analysis

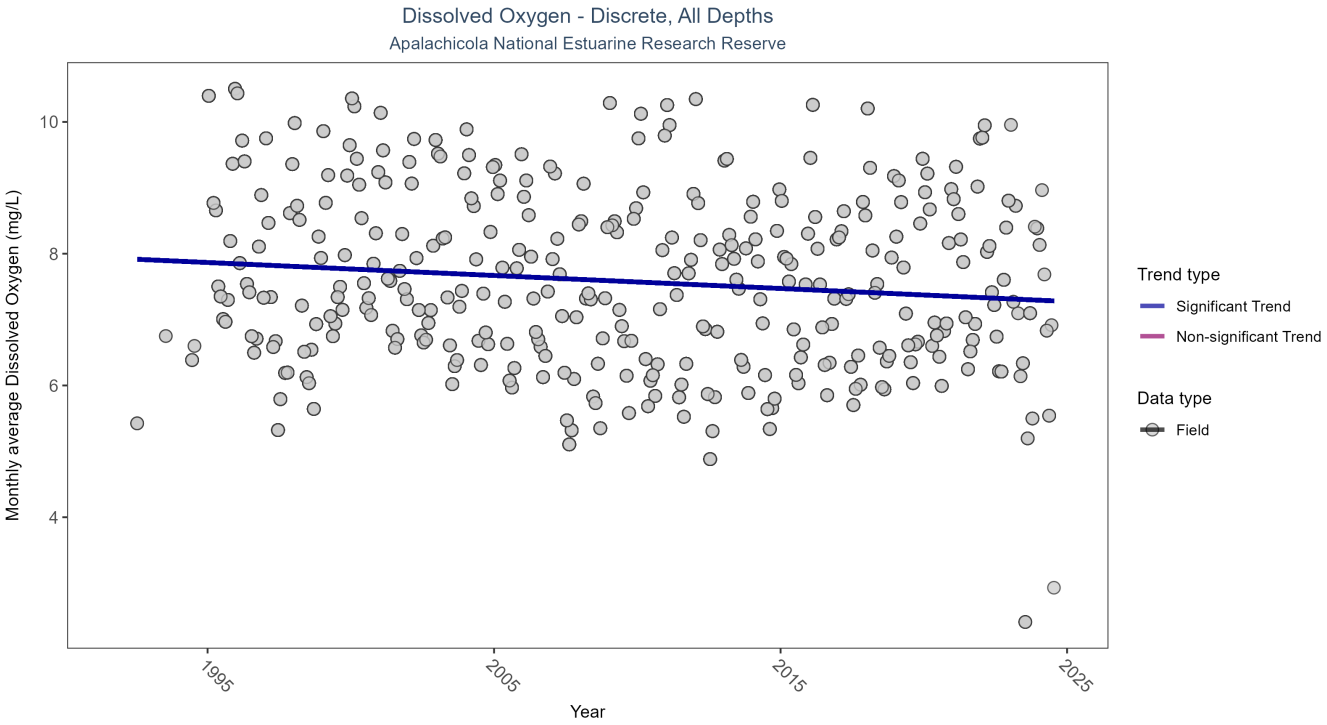

Figure 7: Seasonal Kendall-Tau Results for Dissolved Oxygen - Discrete

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	80793	33	7.5	TRUE	-0.1569	0	-0.0197	7.9255	13.3698	0.2698	-1

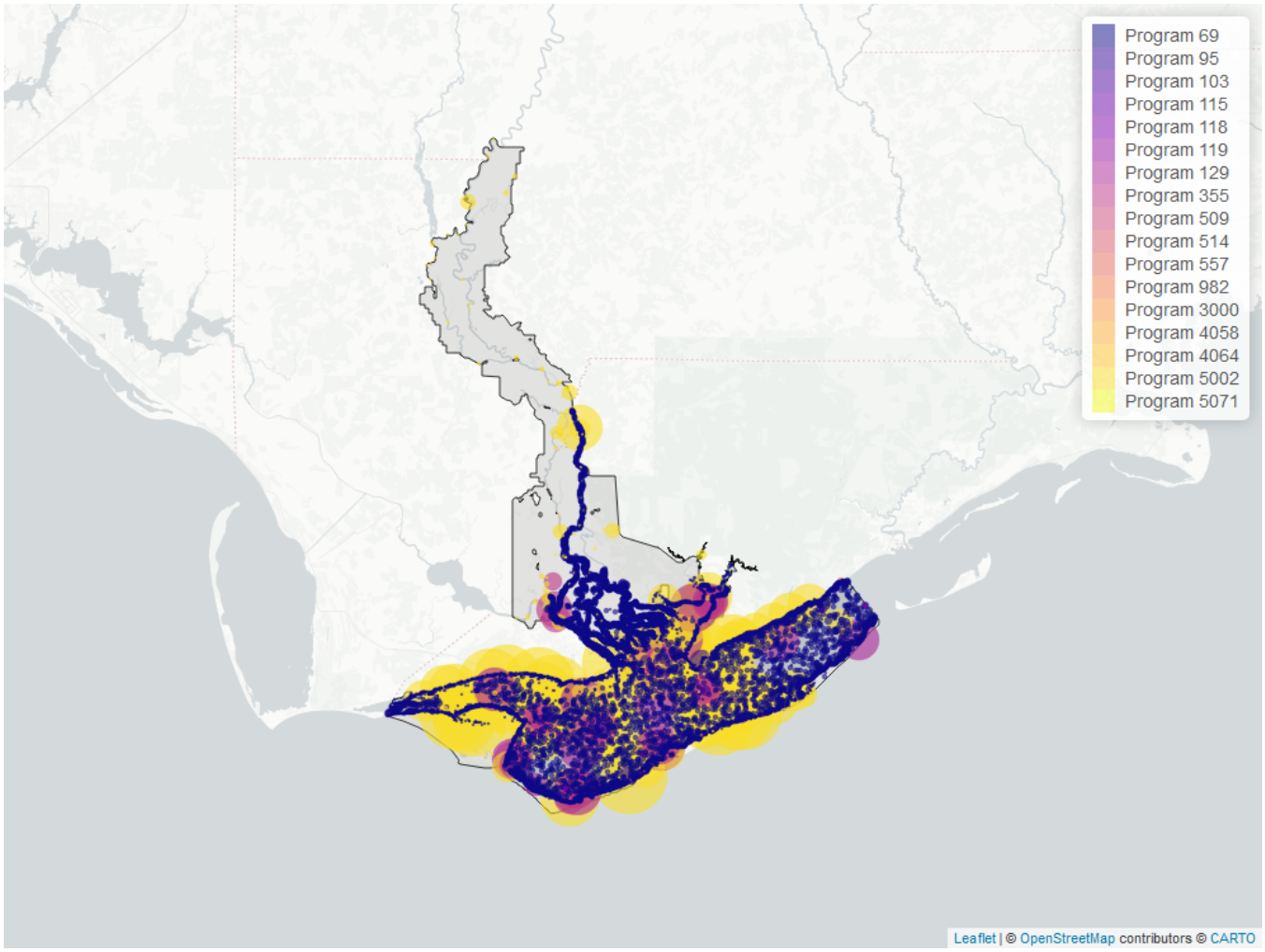

Figure 8: Map showing location of Discrete sampling sites for Dissolved Oxygen. The bubble size on the maps below reflect the amount of data available at each sampling site.

Table 13: Programs contributing data for Dissolved Oxygen

ProgramID	*N_Data*	*YearMin*	*YearMax*
69	41529	1998	2022
5002	32085	1995	2024
129	3956	2000	2023
355	3744	2003	2024
95	410	1995	2018
557	222	2006	2023
118	78	2000	2020
115	28	1992	2004
103	24	2004	2021
119	14	1994	1994
5071	4	2017	2017

Program names:

69 - Fisheries-Independent Monitoring (FIM) Program[7]
95 - Harmful Algal Bloom Marine Observation Network[8]

103 - EPA STOrage and RETrieval Data Warehouse (STORET)/WQX[3]
115 - Environmental Monitoring Assessment Program[4]
118 - National Aquatic Resource Surveys, National Coastal Condition Assessment[5]
119 - National Status and Trends Bioeffects program[9]
129 - Apalachicola National Estuarine Research Reserve Juvenile Fish and Benthic Macroinvertebrate Monitoring[10]
355 - Apalachicola National Estuarine Research Reserve System-Wide Monitoring Program[1]
557 - Central Panhandle Aquatic Preserves Seagrass Monitoring[11]
5002 - Florida STORET / WIN[2]
5071 - Oyster shell heights and taxonomic diversity in 2015-2017 among previously documented oiled and non-oiled reefs in Louisiana, Alabama, and the Florida panhandle[12]

Dissolved Oxygen Saturation - Discrete Water Quality

Seasonal Kendall-Tau Trend Analysis

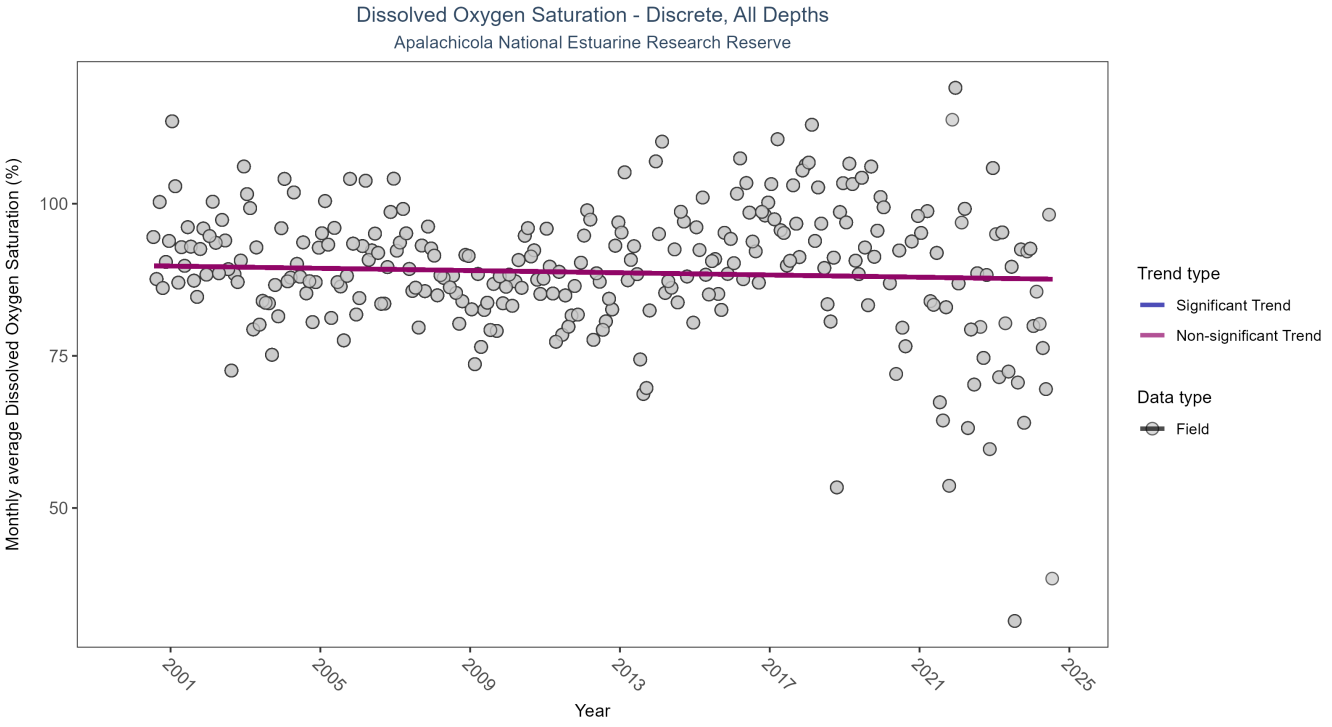

Figure 9: Seasonal Kendall-Tau Results for Dissolved Oxygen Saturation - Discrete

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	6939	25	91.4	TRUE	-0.0546	0.1801	-0.0914	89.8416	20.902	0.0344	0

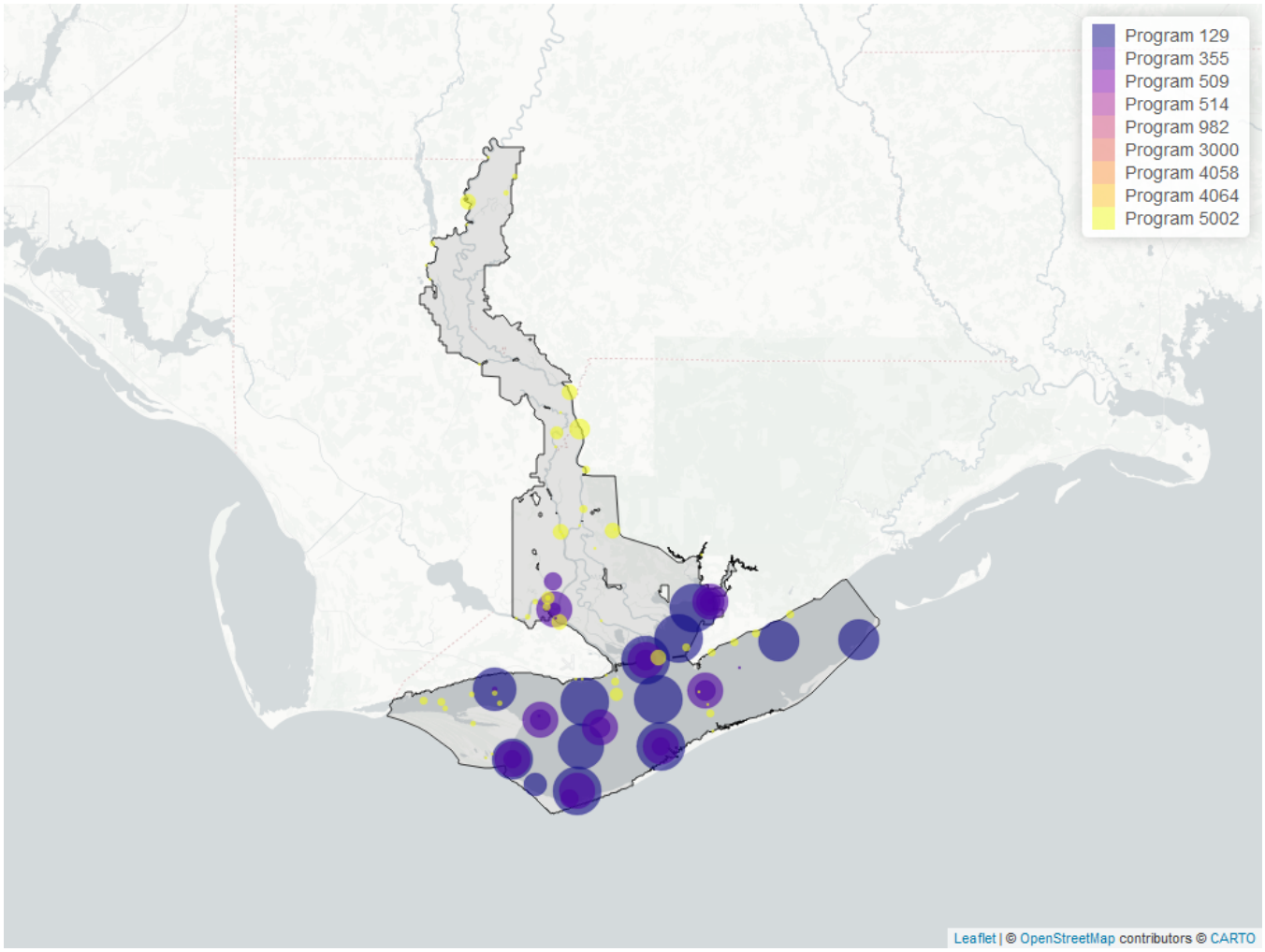

Figure 10: Map showing location of Discrete sampling sites for Dissolved Oxygen Saturation. The bubble size on the maps below reflect the amount of data available at each sampling site.

Table 15: Programs contributing data for Dissolved Oxygen Saturation

ProgramID	*N_Data*	*YearMin*	*YearMax*
129	3938	2000	2023
355	2492	2003	2023
5002	548	2003	2024

Program names:

129 - Apalachicola National Estuarine Research Reserve Juvenile Fish and Benthic Macroinvertebrate Monitoring[10]
355 - Apalachicola National Estuarine Research Reserve System-Wide Monitoring Program[1]
5002 - Florida STORET / WIN[2]

pH - Discrete Water Quality

Seasonal Kendall-Tau Trend Analysis

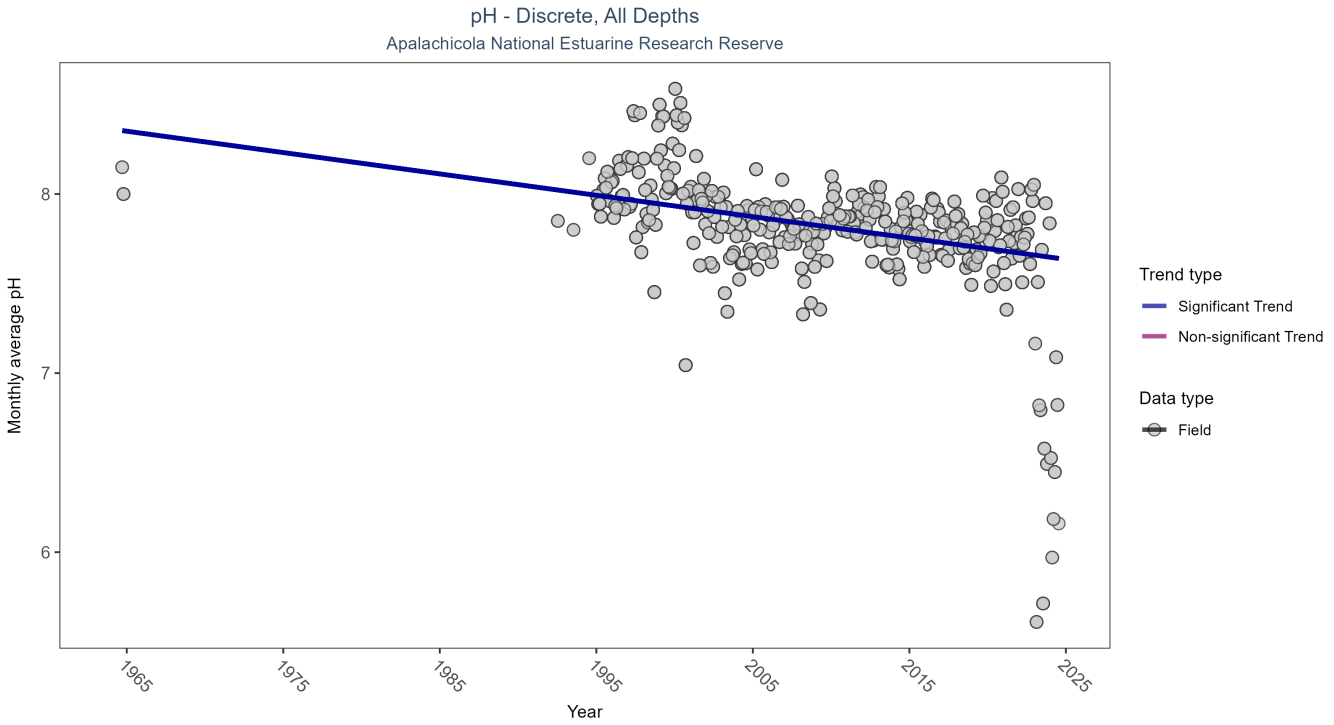

Figure 11: Seasonal Kendall-Tau Results for pH - Discrete

Table 16: Seasonal Kendall-Tau Trend Analysis for pH

RelativeDepth	N-Data	N-Years	Median	Independent	tau	p	SennSlope	SennIntercept	ChiSquared	pChiSquared	Trend
All	65060	34	7.95	TRUE	-0.3699	0	-0.0119	8.363	12.7925	0.3071	-1

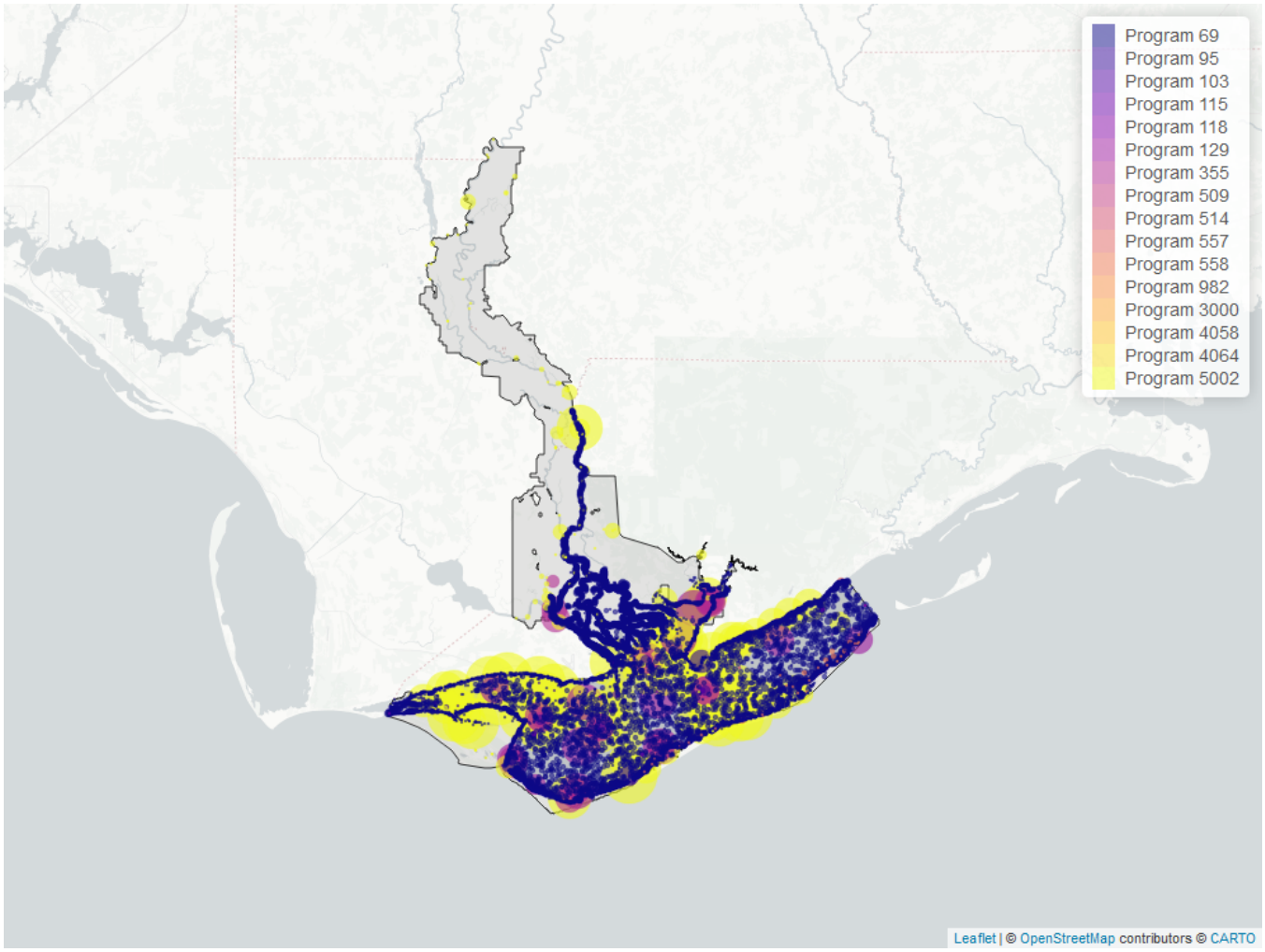

Figure 12: Map showing location of Discrete sampling sites for pH. The bubble size on the maps below reflect the amount of data available at each sampling site.

Table 17: Programs contributing data for pH

ProgramID	*N_Data*	*YearMin*	*YearMax*
69	41711	1998	2022
5002	19222	1995	2024
355	2519	2011	2024
129	2249	2000	2023
95	305	1964	2018
557	209	2006	2023
558	38	2008	2013
115	28	1992	2004
103	19	2004	2021

Program names:

69 - Fisheries-Independent Monitoring (FIM) Program[7]
95 - Harmful Algal Bloom Marine Observation Network[8]
103 - EPA STOrage and RETrieval Data Warehouse (STORET)/WQX[3]
115 - Environmental Monitoring Assessment Program[4]

129 - Apalachicola National Estuarine Research Reserve Juvenile Fish and Benthic Macroinvertebrate Monitoring[10]
355 - Apalachicola National Estuarine Research Reserve System-Wide Monitoring Program[1]
557 - Central Panhandle Aquatic Preserves Seagrass Monitoring[11]
558 - Franklin County Coastal Waters Seagrass Monitoring[13]
5002 - Florida STORET / WIN[2]

Salinity - Discrete Water Quality

Seasonal Kendall-Tau Trend Analysis

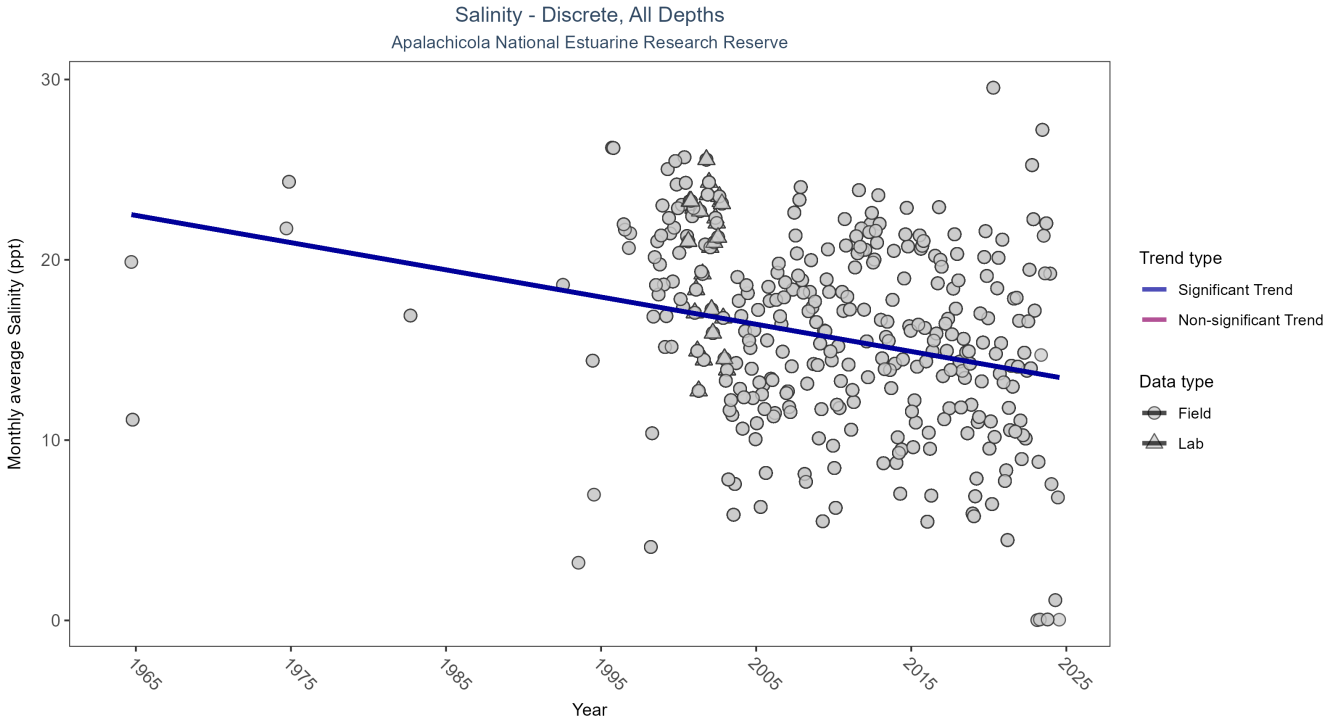

Figure 13: Seasonal Kendall-Tau Results for Salinity - Discrete

Table 18: Seasonal Kendall-Tau Trend Analysis for Salinity

RelativeDepth	N-Data	N-Years	Median	Independent	tau	p	SennSlope	SennIntercept	ChiSquared	pChiSquared	Trend
All	93589	36	16.79	TRUE	-0.2144	0	-0.1509	22.6131	8.9526	0.6263	-1

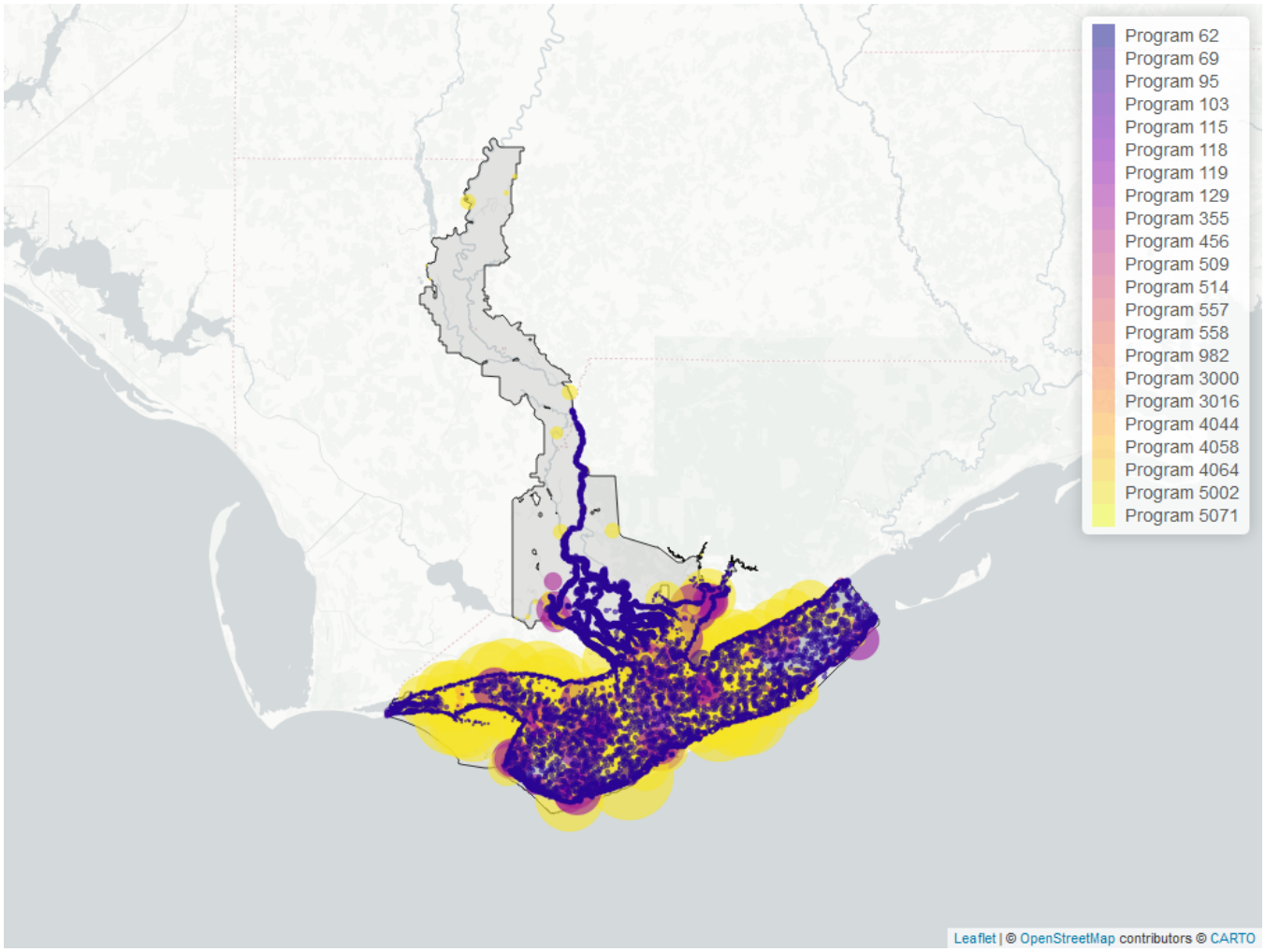

Figure 14: Map showing location of Discrete sampling sites for Salinity. The bubble size on the maps below reflect the amount of data available at each sampling site.

Table 19: Programs contributing data for Salinity

ProgramID	*N_Data*	*YearMin*	*YearMax*
5002	43865	1995	2024
69	41833	1998	2022
129	3968	2000	2023
355	3721	2003	2024
95	586	1964	2018
4044	280	2007	2023
557	222	2006	2023
558	132	2008	2014
118	79	2015	2020
456	63	2005	2015
115	28	1992	2004
119	14	1994	1994
5071	4	2017	2017
103	3	2004	2004

Program names:

69 - Fisheries-Independent Monitoring (FIM) Program[7]
95 - Harmful Algal Bloom Marine Observation Network[8]
103 - EPA STOrage and RETrieval Data Warehouse (STORET)/WQX[3]
115 - Environmental Monitoring Assessment Program[4]
118 - National Aquatic Resource Surveys, National Coastal Condition Assessment[5]
119 - National Status and Trends Bioeffects program[9]
129 - Apalachicola National Estuarine Research Reserve Juvenile Fish and Benthic Macroinvertebrate Monitoring[10]
355 - Apalachicola National Estuarine Research Reserve System-Wide Monitoring Program[1]
456 - Oyster Sentinel[14]
557 - Central Panhandle Aquatic Preserves Seagrass Monitoring[11]
558 - Franklin County Coastal Waters Seagrass Monitoring[13]
4044 - NRDA Oyster Cultch Recovery Project[15]
5002 - Florida STORET / WIN[2]
5071 - Oyster shell heights and taxonomic diversity in 2015-2017 among previously documented oiled and non-oiled reefs in Louisiana, Alabama, and the Florida panhandle[12]

Secchi Depth - Discrete Water Quality

Seasonal Kendall-Tau Trend Analysis

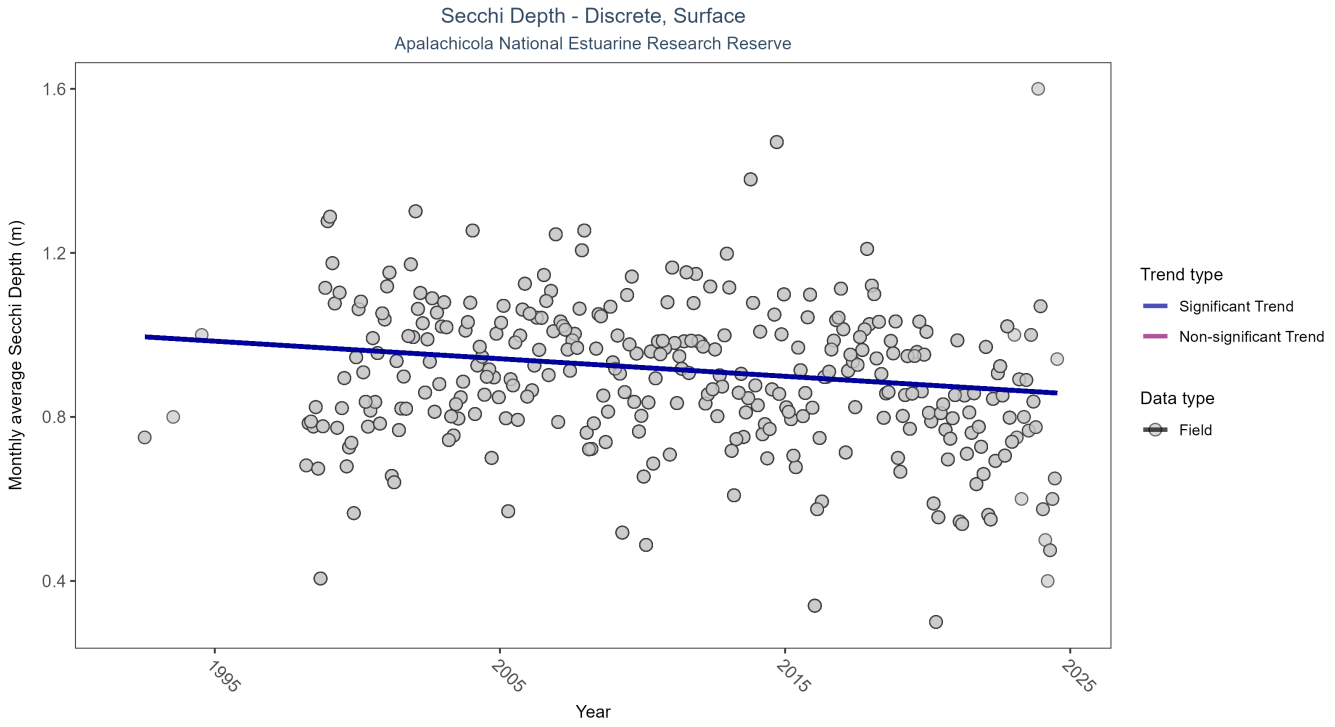

Figure 15: Seasonal Kendall-Tau Results for Secchi Depth - Discrete

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	45158	30	0.8	TRUE	-0.1556	0.0001	-0.0043	0.9975	23.1926	0.0166	-1

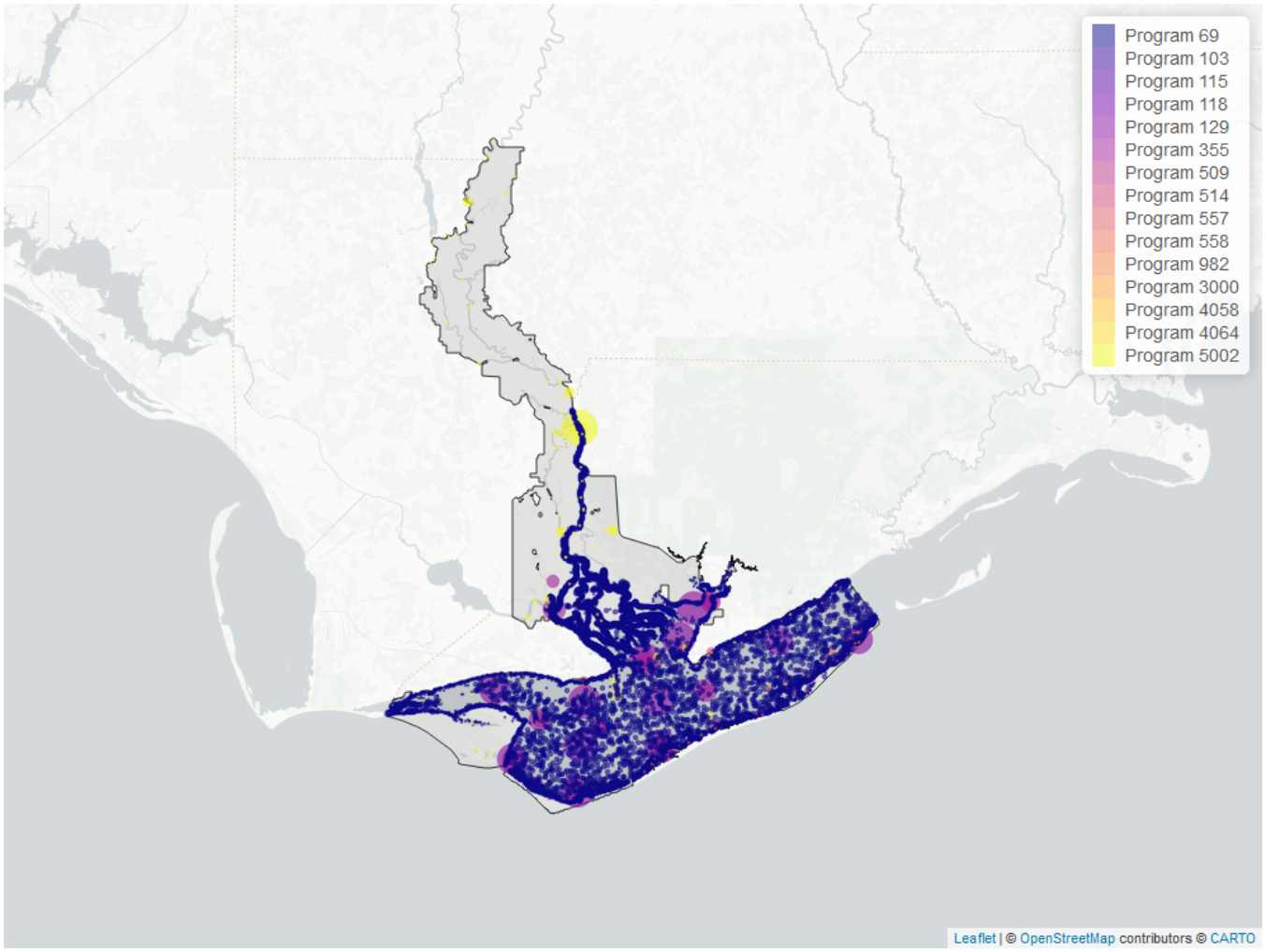

Figure 16: Map showing location of Discrete sampling sites for Secchi Depth. The bubble size on the maps below reflect the amount of data available at each sampling site.

Table 21: Programs contributing data for Secchi Depth

ProgramID	*N_Data*	*YearMin*	*YearMax*
69	41353	1998	2022
129	1966	2000	2023
355	952	2011	2019
5002	473	2003	2024
558	188	2008	2017
557	128	2006	2023
514	80	2007	2008
115	10	1992	2004
103	10	2021	2021

Program names:

69 - Fisheries-Independent Monitoring (FIM) Program[7]
103 - EPA STOrage and RETrieval Data Warehouse (STORET)/WQX[3]
115 - Environmental Monitoring Assessment Program[4]
129 - Apalachicola National Estuarine Research Reserve Juvenile Fish and Benthic Macroinvertebrate Monitoring[10]

355 - Apalachicola National Estuarine Research Reserve System-Wide Monitoring Program[1]
514 - Florida LAKEWATCH Program[6]
557 - Central Panhandle Aquatic Preserves Seagrass Monitoring[11]
558 - Franklin County Coastal Waters Seagrass Monitoring[13]
5002 - Florida STORET / WIN[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

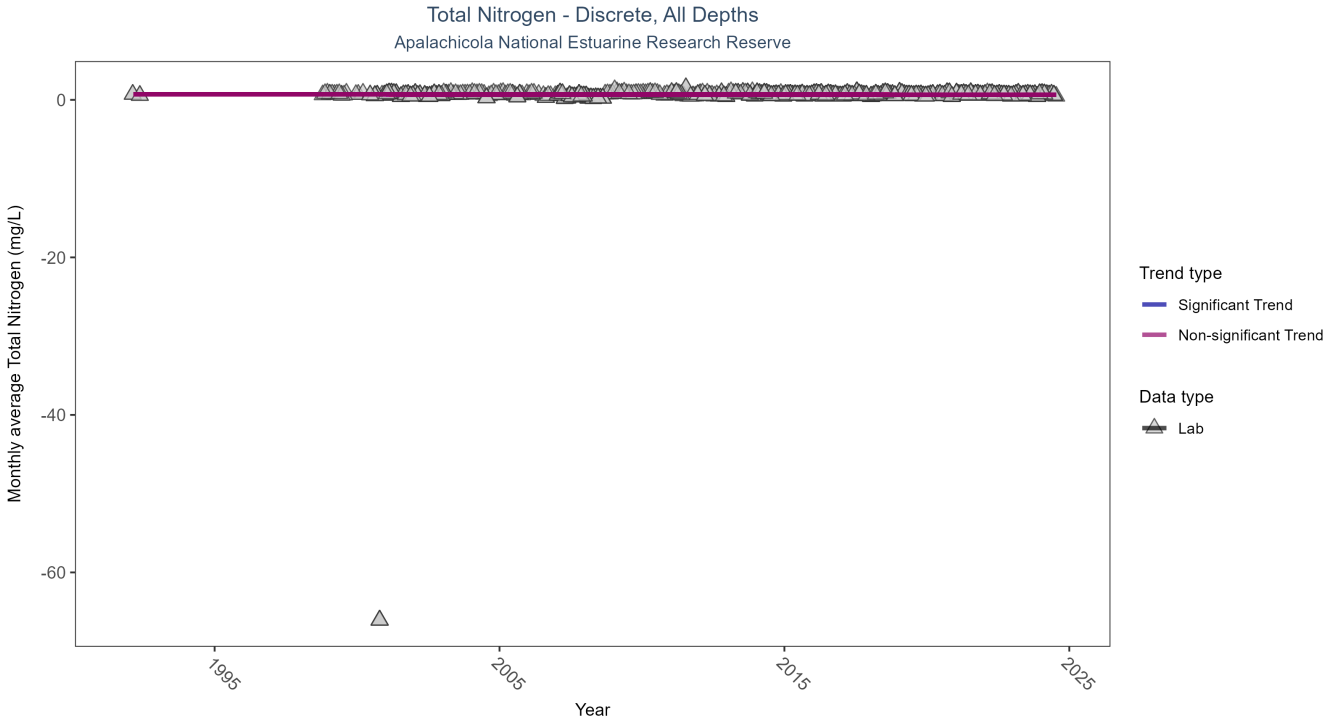

Figure 17: Seasonal Kendall-Tau Results for Total Nitrogen - Discrete

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	4164	28	0.63	TRUE	-0.0658	0.1371	-0.0019	0.7144	13.1454	0.2839	0

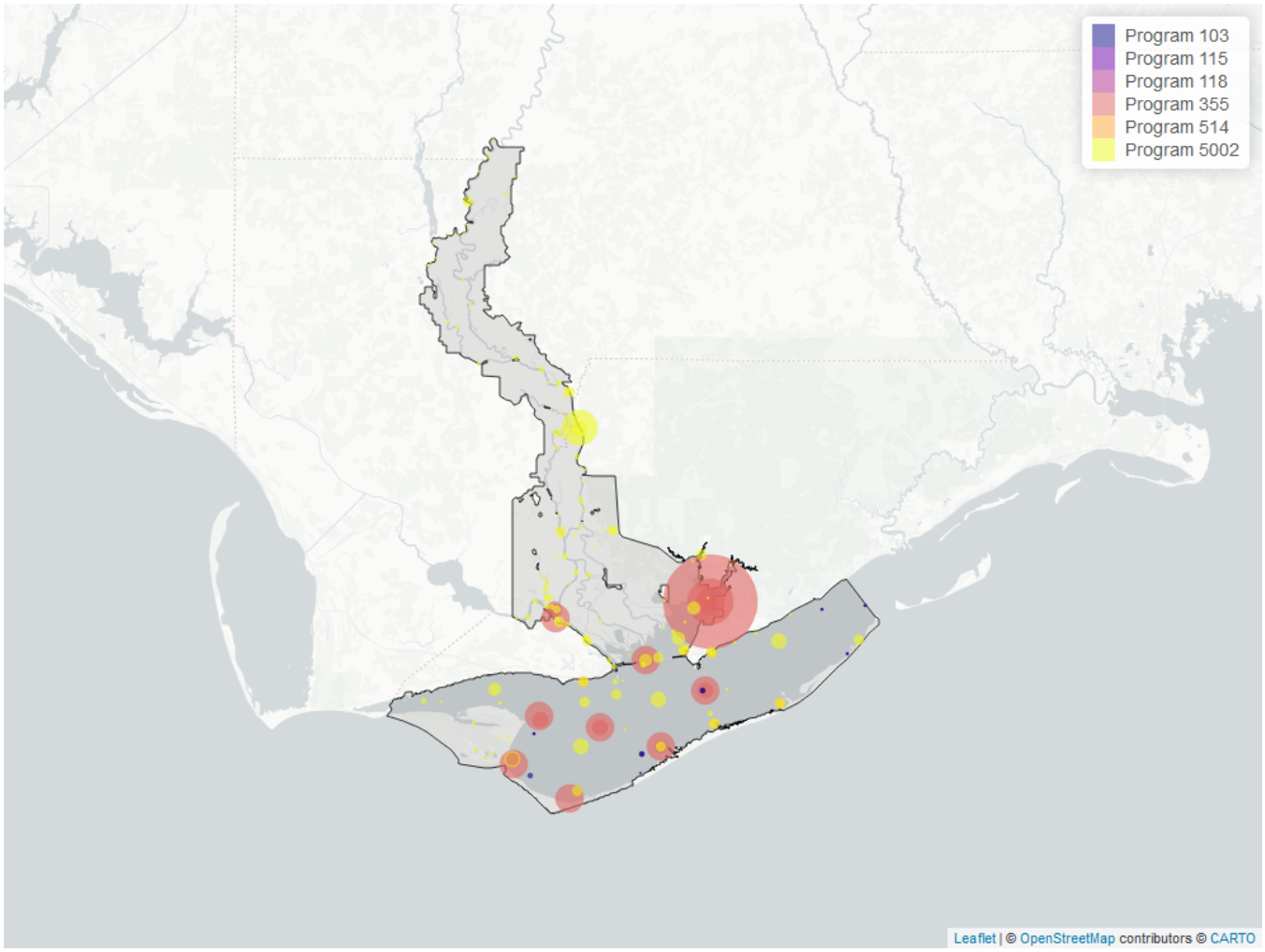

Figure 18: Map showing location of Discrete sampling sites for Total Nitrogen. The bubble size on the maps below reflect the amount of data available at each sampling site.

Table 23: Programs contributing data for Total Nitrogen

ProgramID	*N_Data*	*YearMin*	*YearMax*
355	3032	2013	2024
5002	1033	1992	2024
514	83	2007	2008
103	28	2000	2006
115	6	2000	2004

Program names:

103 - EPA STOrage and RETrieval Data Warehouse (STORET)/WQX[3]
115 - Environmental Monitoring Assessment Program[4]
355 - Apalachicola National Estuarine Research Reserve System-Wide Monitoring Program[1]
514 - Florida LAKEWATCH Program[6]
5002 - Florida STORET / WIN[2]

Total Phosphorus - Discrete Water Quality

Seasonal Kendall-Tau Trend Analysis

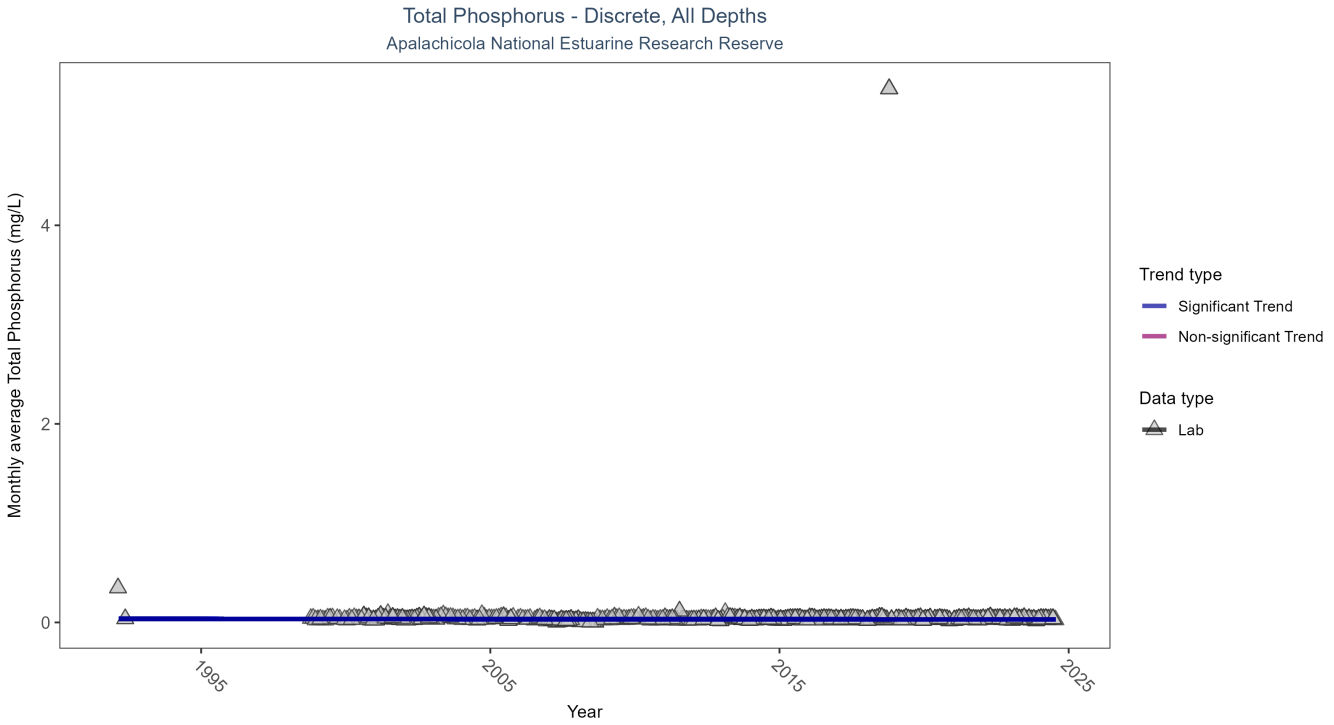

Figure 19: Seasonal Kendall-Tau Results for Total Phosphorus - Discrete

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	4504	28	0.031	TRUE	-0.1188	0.0041	-0.0002	0.036	8.2549	0.6903	-1

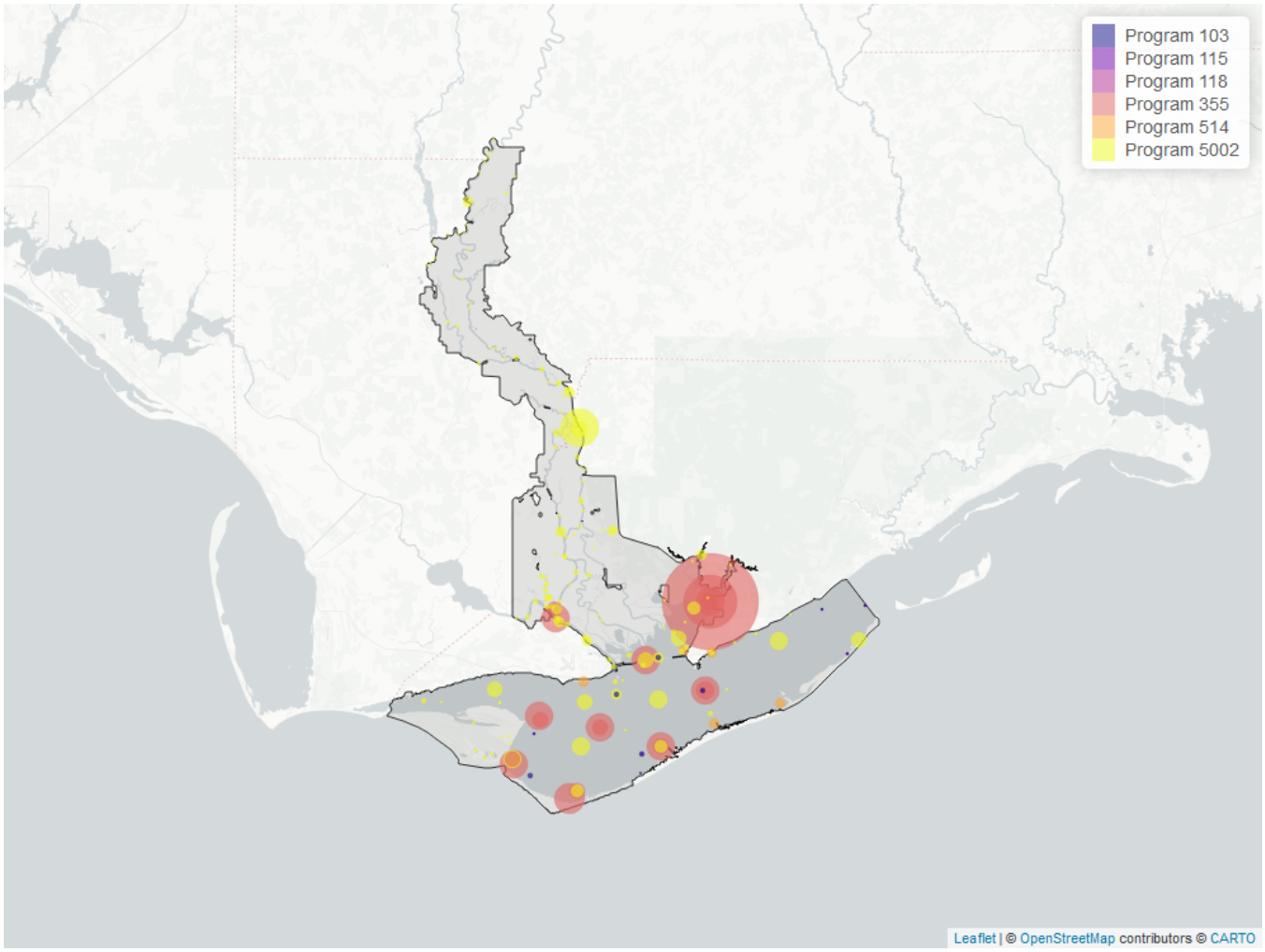

Figure 20: Map showing location of Discrete sampling sites for Total Phosphorus. The bubble size on the maps below reflect the amount of data available at each sampling site.

Table 25: Programs contributing data for Total Phosphorus

ProgramID	*N_Data*	*YearMin*	*YearMax*
355	3324	2013	2024
5002	1165	1992	2024
514	83	2007	2008
103	26	2000	2021
115	6	2000	2004

Program names:

103 - EPA STOrage and RETrieval Data Warehouse (STORET)/WQX[3]
115 - Environmental Monitoring Assessment Program[4]
355 - Apalachicola National Estuarine Research Reserve System-Wide Monitoring Program[1]
514 - Florida LAKEWATCH Program[6]
5002 - Florida STORET / WIN[2]

Total Suspended Solids - Discrete Water Quality

Seasonal Kendall-Tau Trend Analysis

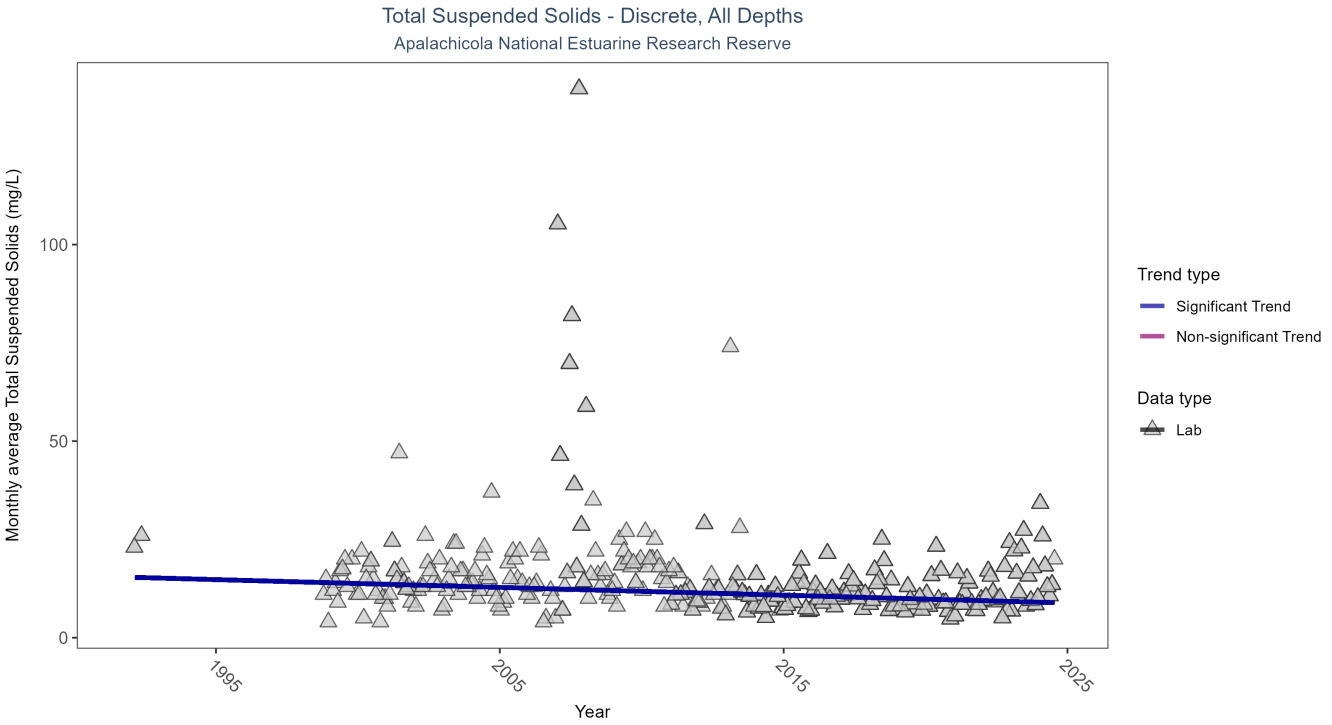

Figure 21: Seasonal Kendall-Tau Results for Total Suspended Solids - Discrete

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	3976	28	10	TRUE	-0.2109	0	-0.1983	15.3723	16.5535	0.1218	-1

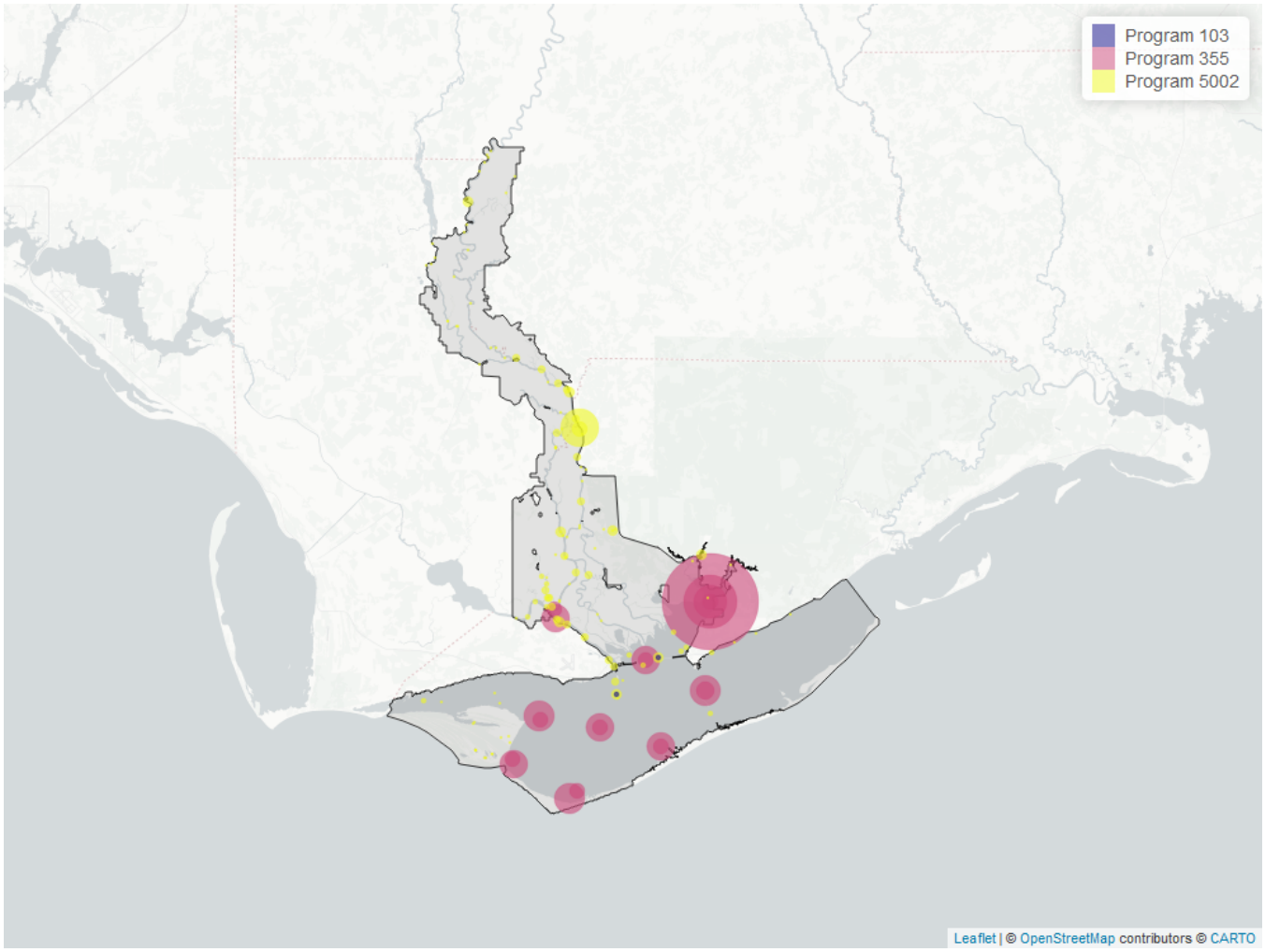

Figure 22: Map showing location of Discrete sampling sites for Total Suspended Solids. The bubble size on the maps below reflect the amount of data available at each sampling site.

Table 27: Programs contributing data for Total Suspended Solids

ProgramID	*N_Data*	*YearMin*	*YearMax*
355	3442	2013	2024
5002	725	1992	2024
103	10	2021	2021

Program names:

103 - EPA STOrage and RETrieval Data Warehouse (STORET)/WQX[3]
355 - Apalachicola National Estuarine Research Reserve System-Wide Monitoring Program[1]
5002 - Florida STORET / WIN[2]

Turbidity - Discrete Water Quality

Seasonal Kendall-Tau Trend Analysis

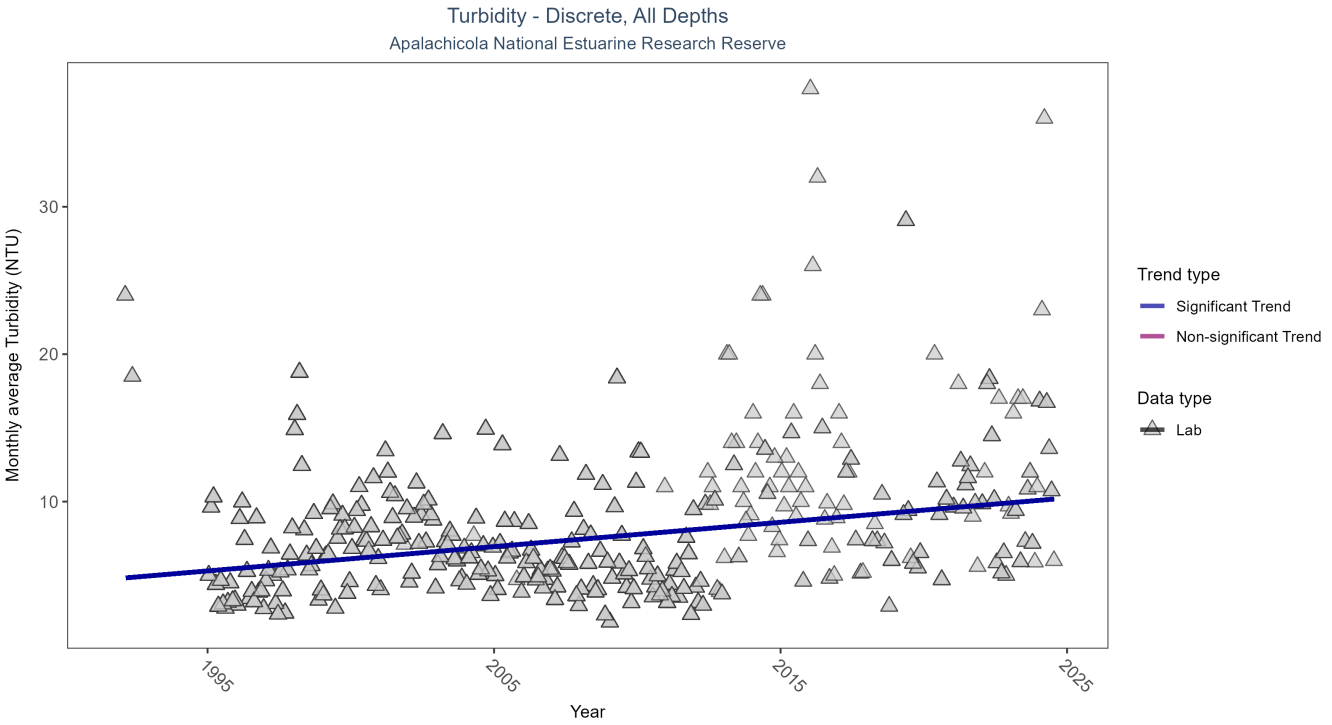

Figure 23: Seasonal Kendall-Tau Results for Turbidity - Discrete

Table 28: Seasonal Kendall-Tau Trend Analysis for Turbidity

RelativeDepth	N-Data	N-Years	Median	Independent	tau	p	SennSlope	SennIntercept	ChiSquared	pChiSquared	Trend
All	22963	31	5.1	TRUE	0.2567	0	0.165	4.8013	9.4782	0.5778	1

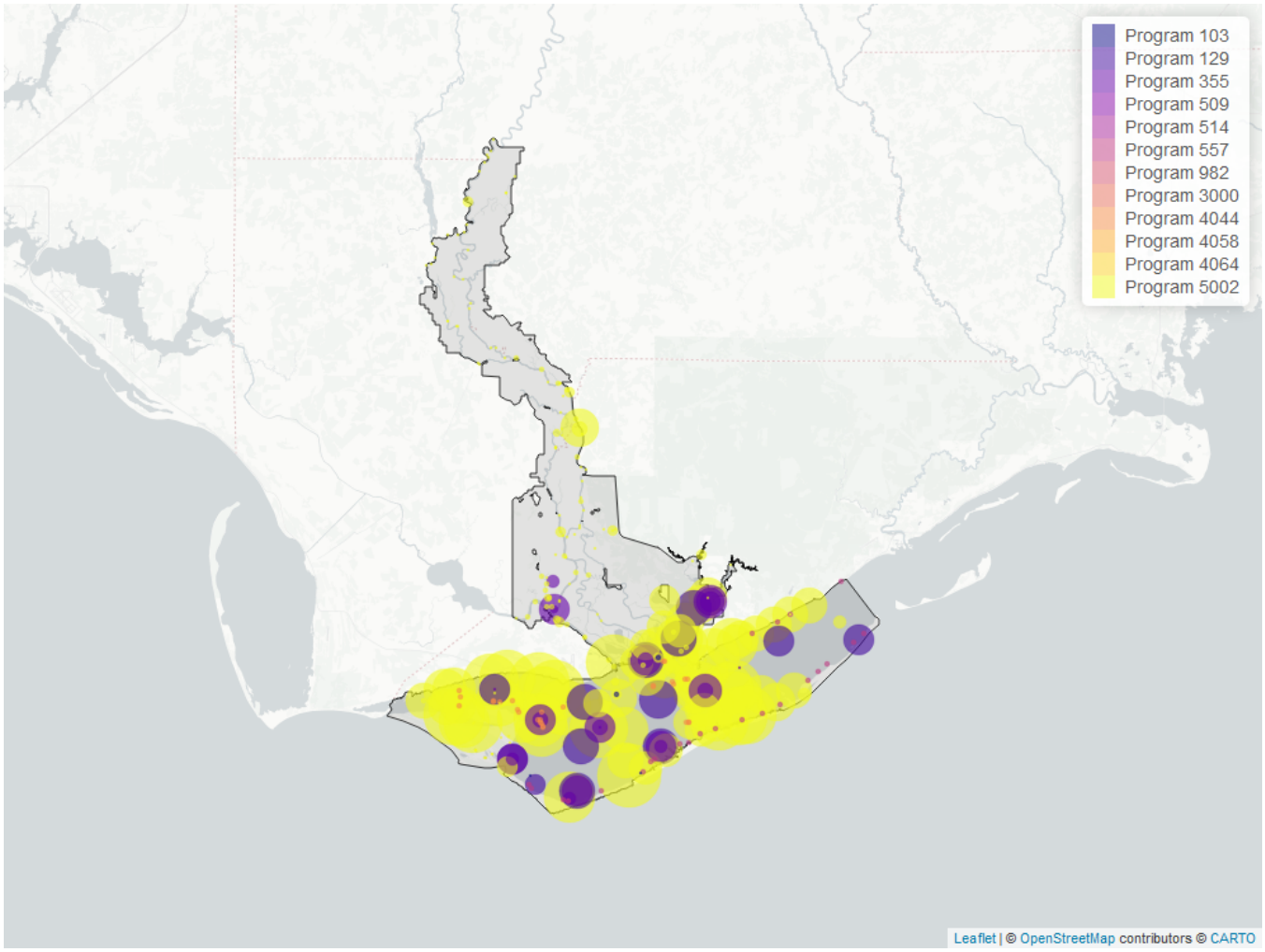

Figure 24: Map showing location of Discrete sampling sites for Turbidity. The bubble size on the maps below reflect the amount of data available at each sampling site.

Table 29: Programs contributing data for Turbidity

ProgramID	*N_Data*	*YearMin*	*YearMax*
5002	22968	1992	2024
129	2253	2000	2023
355	1833	2004	2019
4044	112	2021	2023
557	78	2022	2023
103	13	2005	2021

Program names:

103 - EPA STOrage and RETrieval Data Warehouse (STORET)/WQX[3]
129 - Apalachicola National Estuarine Research Reserve Juvenile Fish and Benthic Macroinvertebrate Monitoring[10]
355 - Apalachicola National Estuarine Research Reserve System-Wide Monitoring Program[1]
557 - Central Panhandle Aquatic Preserves Seagrass Monitoring[11]
4044 - NRDA Oyster Cultch Recovery Project[15]
5002 - Florida STORET / WIN[2]

Water Temperature - Discrete Water Quality

Seasonal Kendall-Tau Trend Analysis

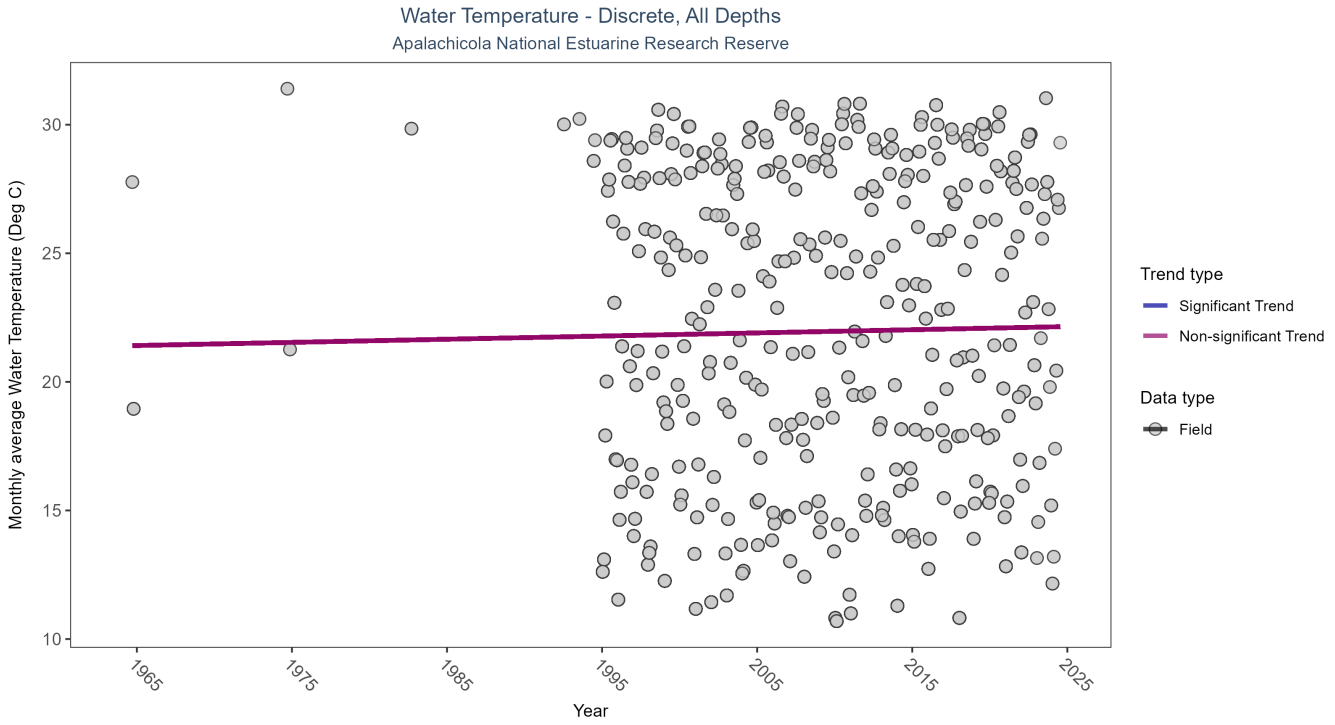

Figure 25: Seasonal Kendall-Tau Results for Water Temperature - Discrete

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	93793	36	23.4	TRUE	0.0683	0.0732	0.0123	21.4004	3.486	0.9826	0

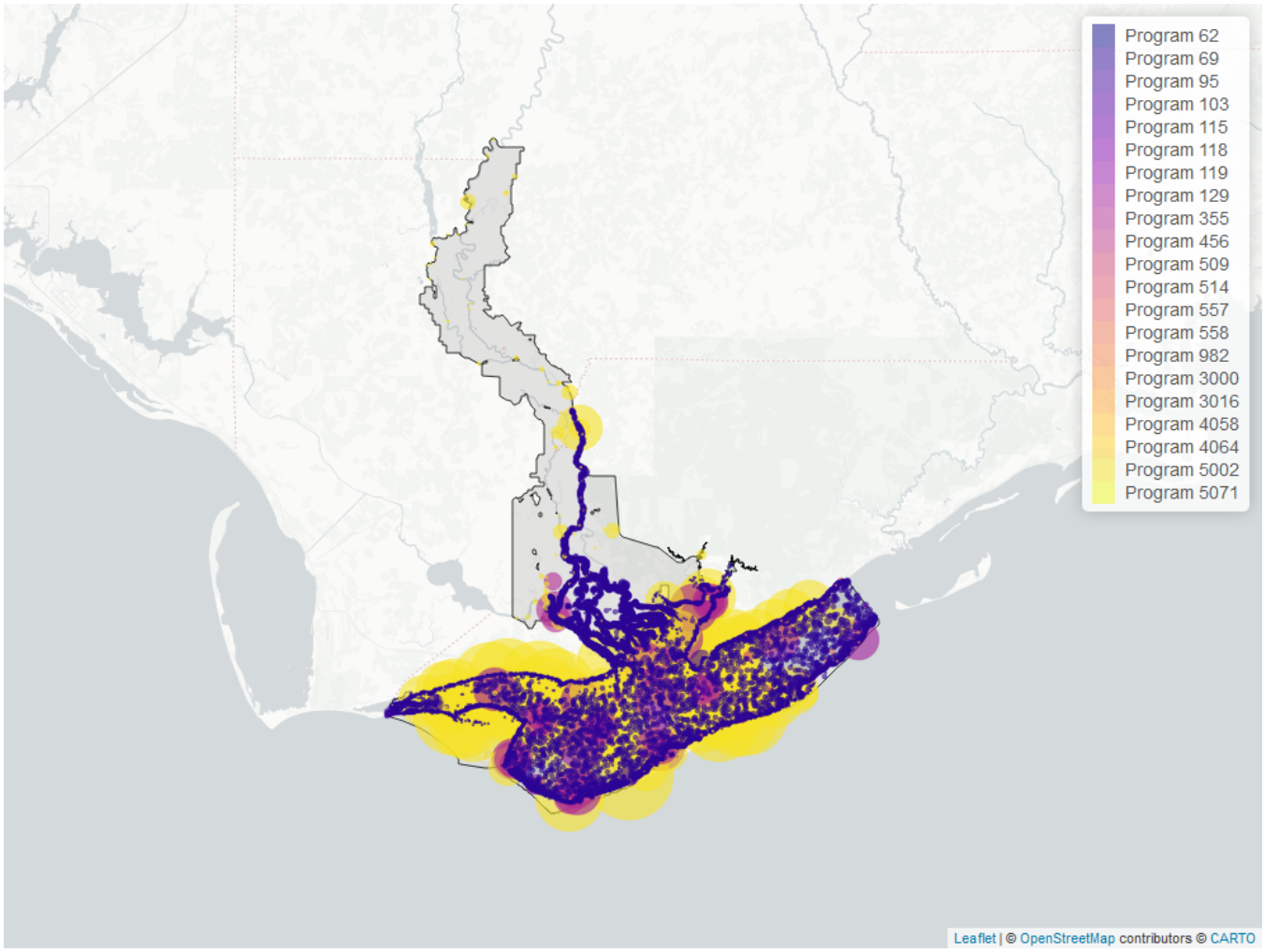

Figure 26: Map showing location of Discrete sampling sites for Water Temperature. The bubble size on the maps below reflect the amount of data available at each sampling site.

Table 31: Programs contributing data for Water Temperature

ProgramID	*N_Data*	*YearMin*	*YearMax*
5002	44353	1995	2024
69	41971	1998	2022
129	3961	2000	2023
355	3748	2003	2024
95	537	1964	2018
557	222	2006	2023
558	146	2008	2017
456	63	2005	2015
115	28	1992	2004
103	20	2004	2021
119	14	1994	1994
5071	4	2017	2017

Program names:

69 - Fisheries-Independent Monitoring (FIM) Program[7]

95 - Harmful Algal Bloom Marine Observation Network[8]
103 - EPA STOrage and RETrieval Data Warehouse (STORET)/WQX[3]
115 - Environmental Monitoring Assessment Program[4]
119 - National Status and Trends Bioeffects program[9]
129 - Apalachicola National Estuarine Research Reserve Juvenile Fish and Benthic Macroinvertebrate Monitoring[10]
355 - Apalachicola National Estuarine Research Reserve System-Wide Monitoring Program[1]
456 - Oyster Sentinel[14]
557 - Central Panhandle Aquatic Preserves Seagrass Monitoring[11]
558 - Franklin County Coastal Waters Seagrass Monitoring[13]
5002 - Florida STORET / WIN[2]
5071 - Oyster shell heights and taxonomic diversity in 2015-2017 among previously documented oiled and non-oiled reefs in Louisiana, Alabama, and the Florida panhandle[12]

Water Quality - Continuous

The following files were used in the continuous analysis:

- *Combined_WQ_WC_NUT_cont_Dissolved_Oxygen_NW-2024-Dec-08.txt*
- *Combined_WQ_WC_NUT_cont_Dissolved_Oxygen_Saturation_NW-2024-Dec-08.txt*
- *Combined_WQ_WC_NUT_cont_pH_NW-2024-Dec-08.txt*
- *Combined_WQ_WC_NUT_cont_Salinity_NW-2024-Dec-08.txt*
- *Combined_WQ_WC_NUT_cont_Turbidity_NW-2024-Dec-08.txt*
- *Combined_WQ_WC_NUT_cont_Water_Temperature_NW-2024-Dec-08.txt*

Continuous monitoring locations in Apalachicola National Estuarine Research Reserve

Table 32: Apalachicola National Estuarine Research Reserve System-Wide Monitoring Program (355)

ProgramLocationID	*Years of Data*	*Use in Analysis*	*Parameters*
apabpwq	5	TRUE	DO , DOS , pH , Sal , Turb , TempW
apacpwq	23	TRUE	DO , DOS , pH , Sal , Turb , TempW
apadbwq	23	TRUE	DO , DOS , pH , Sal , Turb , TempW
apaebwq	28	TRUE	Turb
apaebwq	30	TRUE	DO , DOS , pH , Sal , TempW
apaeswq	29	TRUE	Turb
apaeswq	30	TRUE	DO , DOS , pH , Sal , TempW
apalmwq	9	TRUE	DO , DOS , pH , Sal , Turb , TempW
apapcwq	9	TRUE	DO , DOS , pH , Sal , Turb , TempW

Table 33: National Data Buoy Center (5)

ProgramLocationID	*Years of Data*	*Use in Analysis*	*Parameters*
APCF1	20	TRUE	TempW

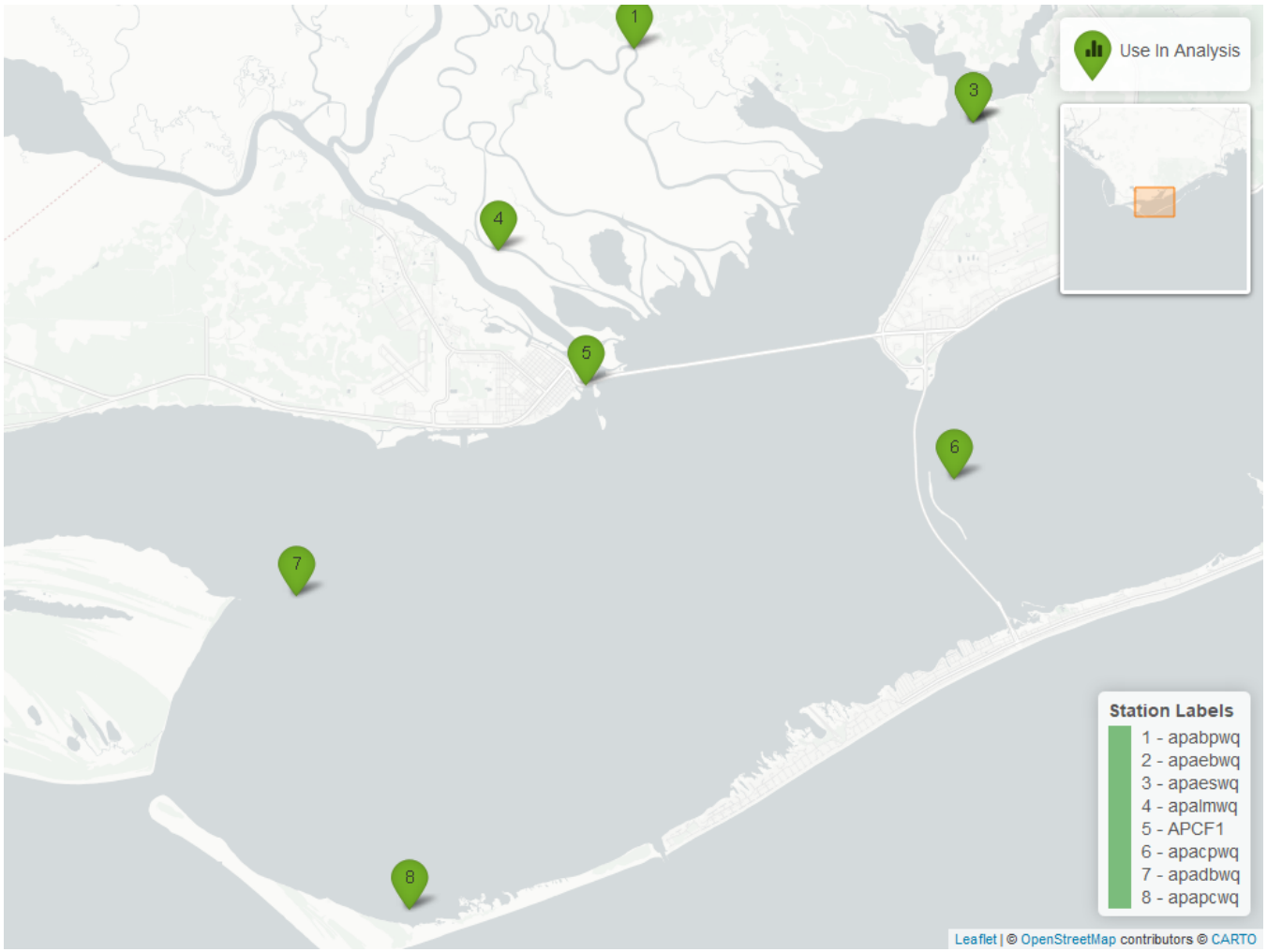

Figure 27: Map showing Continuous Water Quality Monitoring sampling locations within the boundaries of Apalachicola National Estuarine Research Reserve. Sites marked as *Use In Analysis* are featured in this report.

Dissolved Oxygen - All Stations Combined

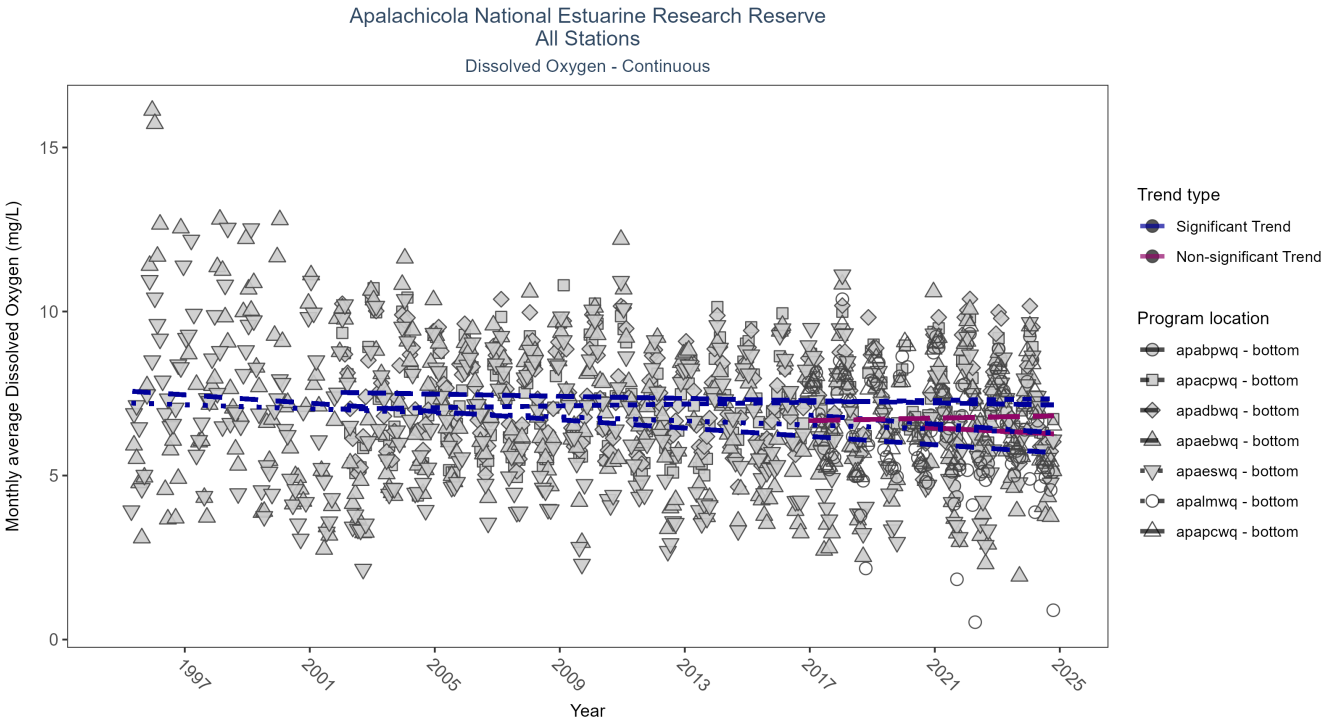

Figure 28: Figure for Dissolved Oxygen - Continuous - All stations combined

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

Station	N_Data	N_Years	Period of Record	Median	tau	SennIntercept	SennSlope	p
apaebwq	655847	30	1995 - 2024	6.8	-0.30	7.59	-0.06	0.0000
apadbwq	611956	23	2002 - 2024	7.2	-0.16	7.53	-0.02	0.0004
apacpwq	607585	23	2002 - 2024	7.1	0.12	7.03	0.01	0.0052
apalmwq	247064	9	2016 - 2024	6.3	-0.24	6.91	-0.07	0.0038
apapcwq	258495	9	2016 - 2024	6.9	0.06	6.66	0.02	0.4258
apaeswq	705901	30	1995 - 2024	6.8	-0.16	7.22	-0.03	0.0000
apabpwq	139625	5	2020 - 2024	6.4	-0.12	6.50	-0.05	0.5361

Dissolved Oxygen Saturation - All Stations Combined

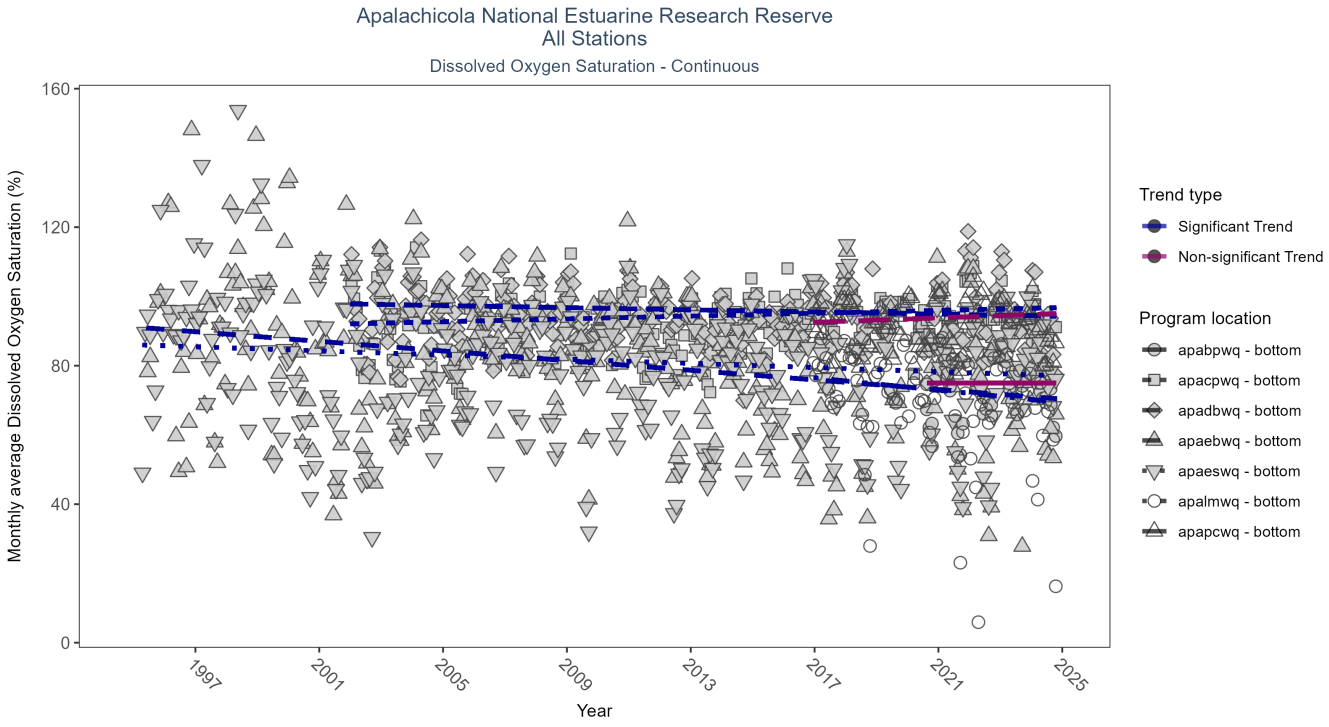

Figure 29: Figure for Dissolved Oxygen Saturation - Continuous - All stations combined

Table 35: Seasonal Kendall-Tau Results for All Stations - Dissolved Oxygen Saturation

Station	N_Data	N_Years	Period of Record	Median	tau	SennIntercept	SennSlope	p
apaeswq	707065	30	1995 - 2024	83.9	-0.12	86.07	-0.30	0.0010
apadbwq	615405	23	2002 - 2024	94.6	-0.11	97.83	-0.16	0.0180
apabpwq	139625	5	2020 - 2024	75.8	0.00	74.97	0.00	0.9296
apapcwq	261951	9	2016 - 2024	94.0	0.10	92.20	0.32	0.2467
apacpwq	609113	23	2002 - 2024	94.0	0.15	92.07	0.21	0.0003
apaebwq	651672	30	1995 - 2024	84.5	-0.27	91.20	-0.70	0.0000
apalmwq	247600	9	2016 - 2024	74.4	-0.25	77.37	-0.89	0.0030

pH - All Stations Combined

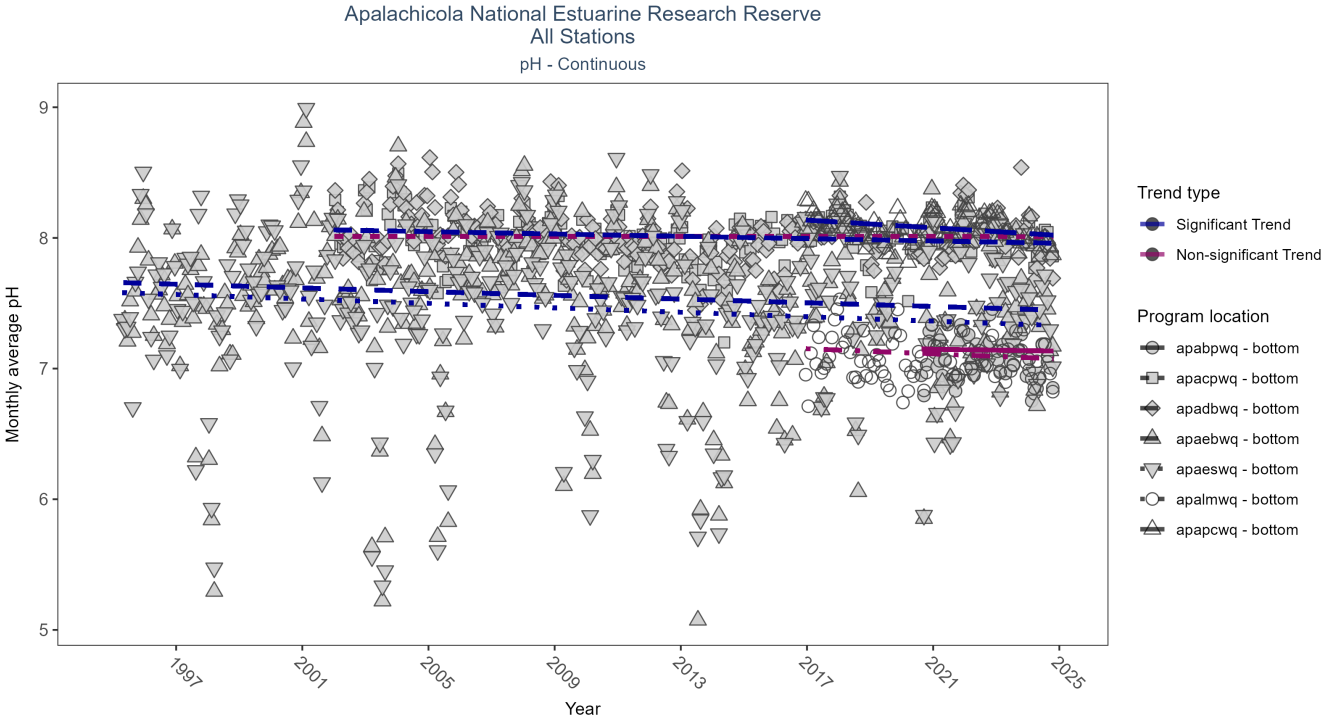

Figure 30: Figure for pH - Continuous - All stations combined

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

Station	N_Data	N_Years	Period of Record	Median	tau	SennIntercept	SennSlope	p
apadbwq	593014	23	2002 - 2024	8.0	-0.14	8.06	0.00	0.0015
apaeswq	710133	30	1995 - 2024	7.5	-0.13	7.58	-0.01	0.0005
apapcwq	258424	9	2016 - 2024	8.1	-0.29	8.15	-0.01	0.0007
apacpwq	606691	23	2002 - 2024	8.0	-0.01	8.01	0.00	0.9435
apaebwq	708442	30	1995 - 2024	7.6	-0.12	7.66	-0.01	0.0010
apalmwq	255201	9	2016 - 2024	7.1	-0.07	7.16	-0.01	0.4258
apabpwq	140938	5	2020 - 2024	7.1	-0.03	7.15	0.00	1.0000

Salinity - All Stations Combined

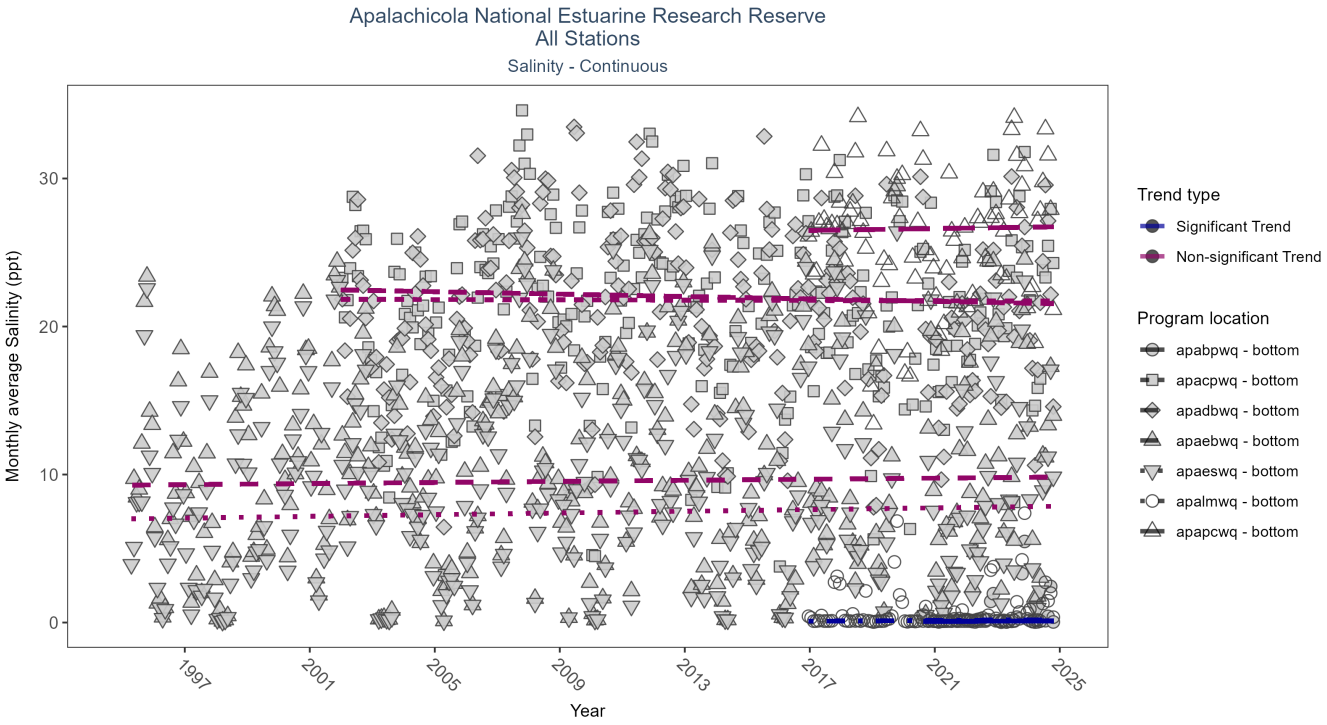

Figure 31: Figure for Salinity - Continuous - All stations combined

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

Station	N_Data	N_Years	Period of Record	Median	tau	SennIntercept	SennSlope	p
apalmwq	262776	9	2016 - 2024	0.1	0.22	0.08	0.01	0.0091
apacpwq	621811	23	2002 - 2024	22.4	0.00	21.84	-0.01	0.8998
apapcwq	260825	9	2016 - 2024	26.7	0.02	26.46	0.03	0.8849
apaeswq	750078	30	1995 - 2024	7.4	0.05	7.00	0.03	0.2183
apadbwq	610043	23	2002 - 2024	22.1	-0.05	22.47	-0.04	0.2984
apaebwq	737639	30	1995 - 2024	9.8	0.03	9.28	0.02	0.4301
apabpwq	142177	5	2020 - 2024	0.1	0.33	0.07	0.01	0.0142

Turbidity - All Stations Combined

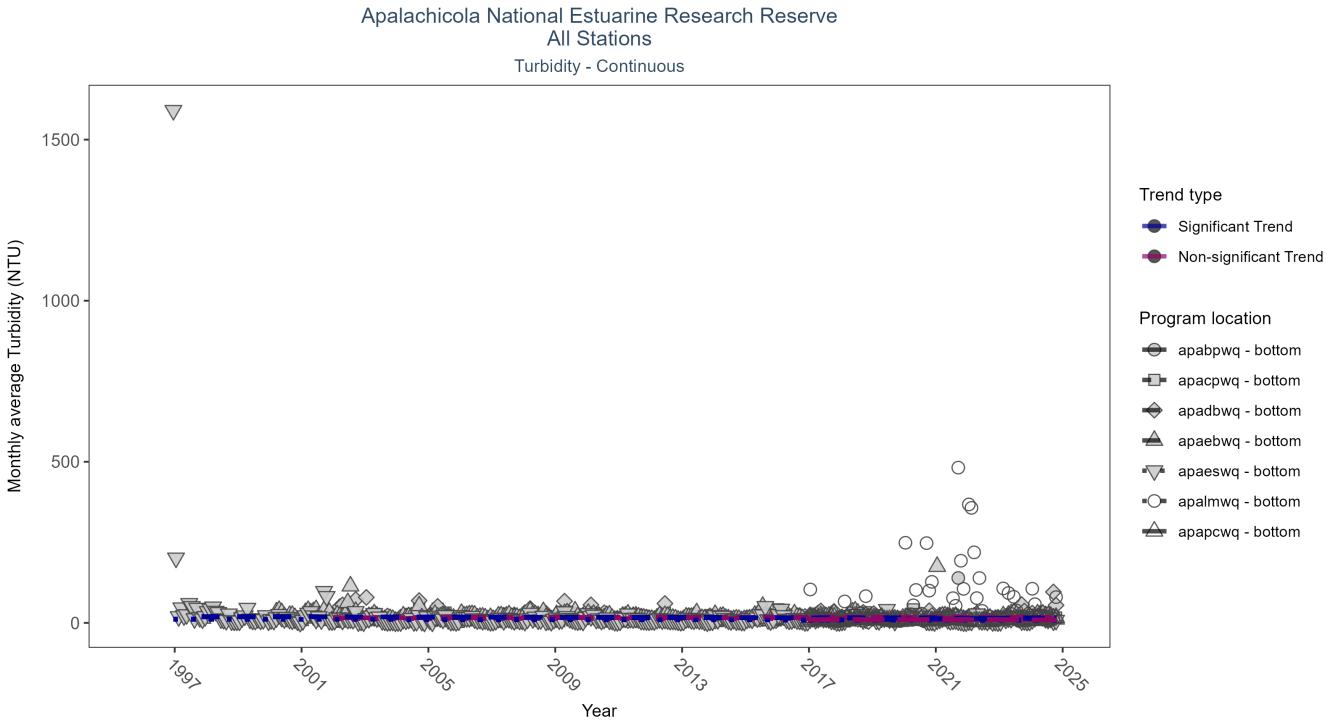

Figure 32: Figure for Turbidity - Continuous - All stations combined

Table 38: Seasonal Kendall-Tau Results for All Stations - Turbidity

Station	N_Data	N_Years	Period of Record	Median	tau	SennIntercept	SennSlope	p
apaebwq	626180	26	1997 - 2024	13	-0.19	19.68	-0.20	0.0000
apacpwq	618864	23	2002 - 2024	8	0.00	13.20	0.00	0.9938
apapcwq	249363	9	2016 - 2024	7	-0.06	10.47	-0.11	0.4855
apalmwq	235869	9	2016 - 2024	12	0.24	7.63	0.93	0.0047
apabpwq	142173	5	2020 - 2024	11	0.08	10.09	0.19	0.6585
apaeswq	693953	29	1996 - 2024	9	-0.15	11.37	-0.11	0.0003
apadbwq	597217	23	2002 - 2024	10	0.02	16.11	0.03	0.6196

Water Temperature - All Stations Combined

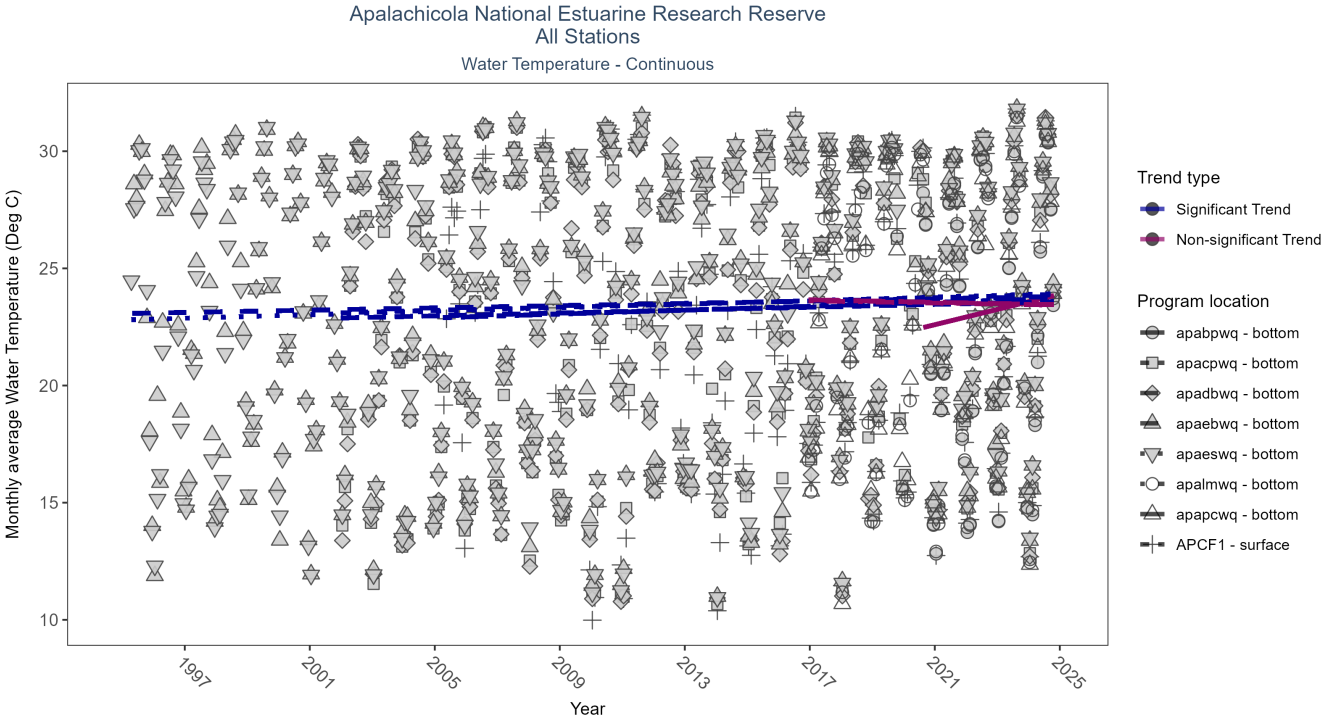

Figure 33: Figure for Water Temperature - Continuous - All stations combined

Table 39: Seasonal Kendall-Tau Results for All Stations - Water Temperature

Station	N_Data	N_Years	Period of Record	Median	tau	SennIntercept	SennSlope	p
APCF1	1317092	20	2005 - 2024	23.3	0.12	22.89	0.04	0.0324
apaebwq	752681	30	1995 - 2024	24.3	0.14	23.07	0.02	0.0002
apadbwq	635215	23	2002 - 2024	23.4	0.15	22.88	0.03	0.0010
apapcwq	264293	9	2016 - 2024	23.3	-0.05	23.68	-0.03	0.5624
apacpwq	660804	23	2002 - 2024	23.6	0.16	23.10	0.03	0.0004
apaeswq	759336	30	1995 - 2024	24.2	0.19	22.80	0.04	0.0000
apabpwq	142177	5	2020 - 2024	22.9	0.20	22.27	0.33	0.1329
apalmwq	265036	9	2016 - 2024	22.8	-0.03	23.64	-0.02	0.7721

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

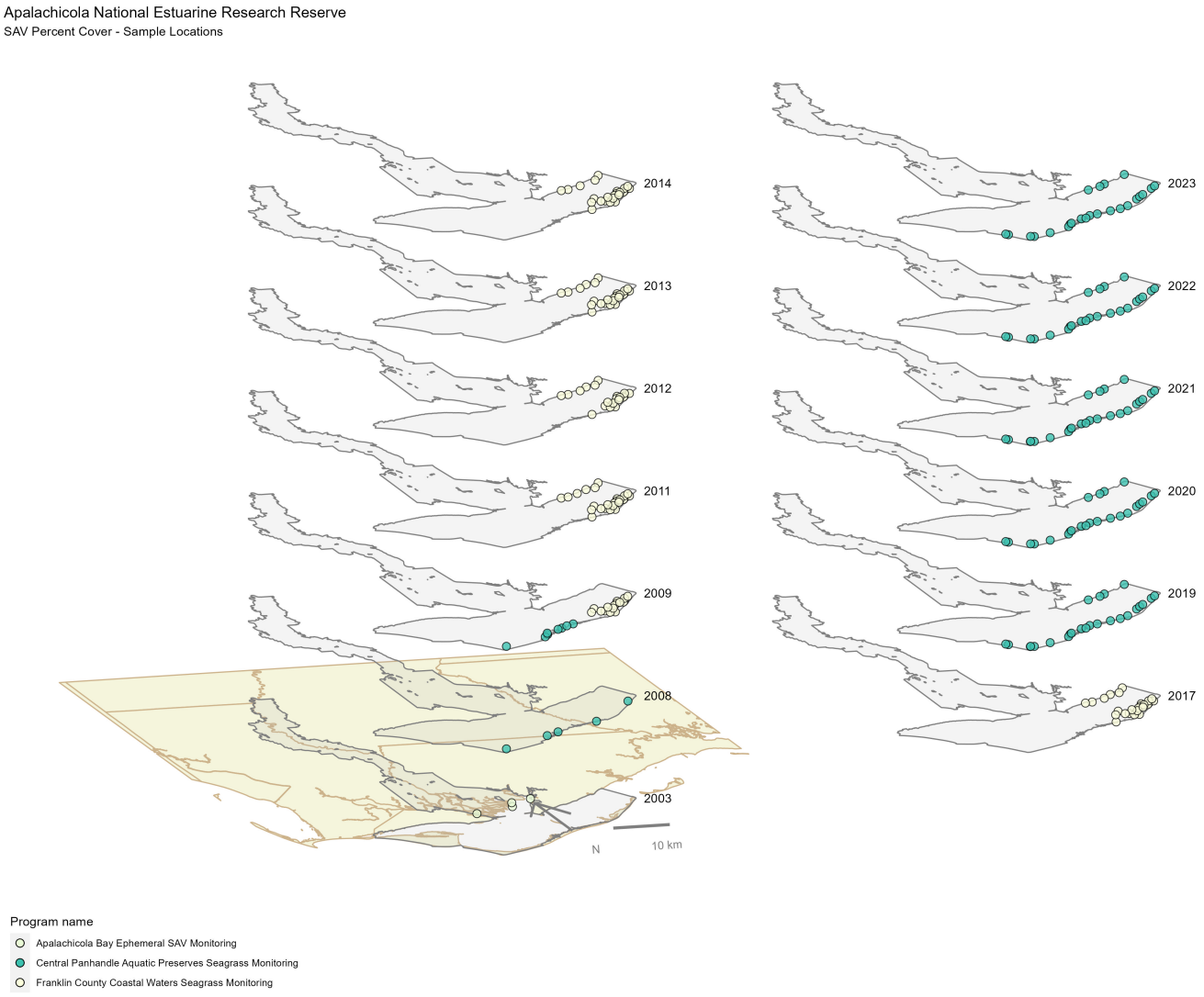

Figure 34: Maps showing the temporal scope of SAV sampling sites within the boundaries of *Apalachicola National Estuarine Research Reserve* by Program name.

Sampling locations by Program:

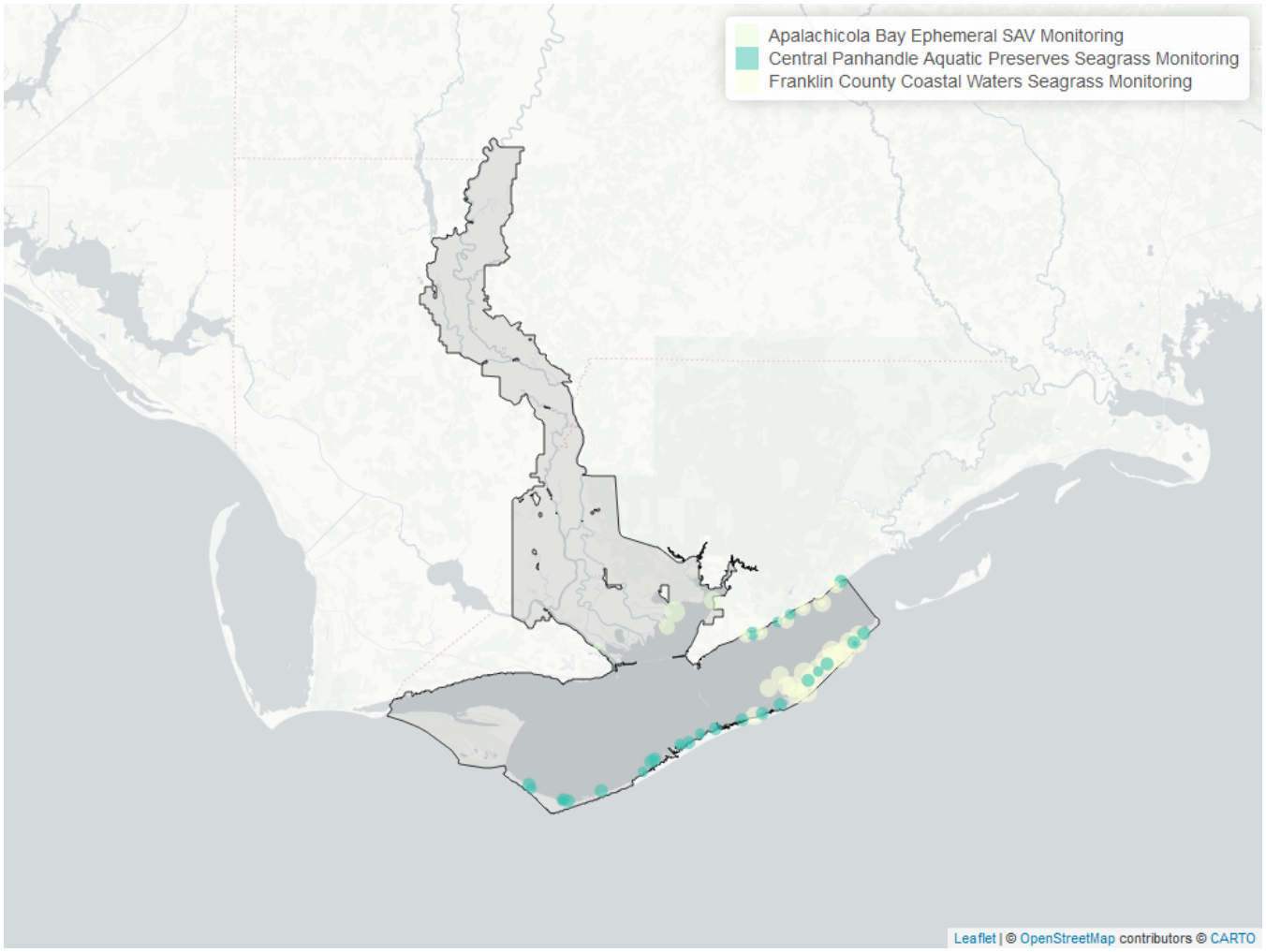

Figure 35: Map showing SAV sampling sites within the boundaries of *Apalachicola National Estuarine Research Reserve*. The point size reflects the number of samples at a given sampling site.

Table 40: Franklin County Coastal Waters Seagrass Monitoring - Program 558

N-Data	*YearMin*	*YearMax*	*method*	*Sample Locations*
1402	2009	2017	Percent Cover	32

Table 41: Central Panhandle Aquatic Preserves Seagrass Monitoring - Program 557

N-Data	*YearMin*	*YearMax*	*method*	*Sample Locations*
590	2008	2023	Braun Blanquet	35

Table 42: Apalachicola Bay Ephemeral SAV Monitoring - Program 997

N-Data	*YearMin*	*YearMax*	*method*	*Sample Locations*
79	2003	2003	Braun Blanquet	4
81	2003	2003	Percent Cover	4

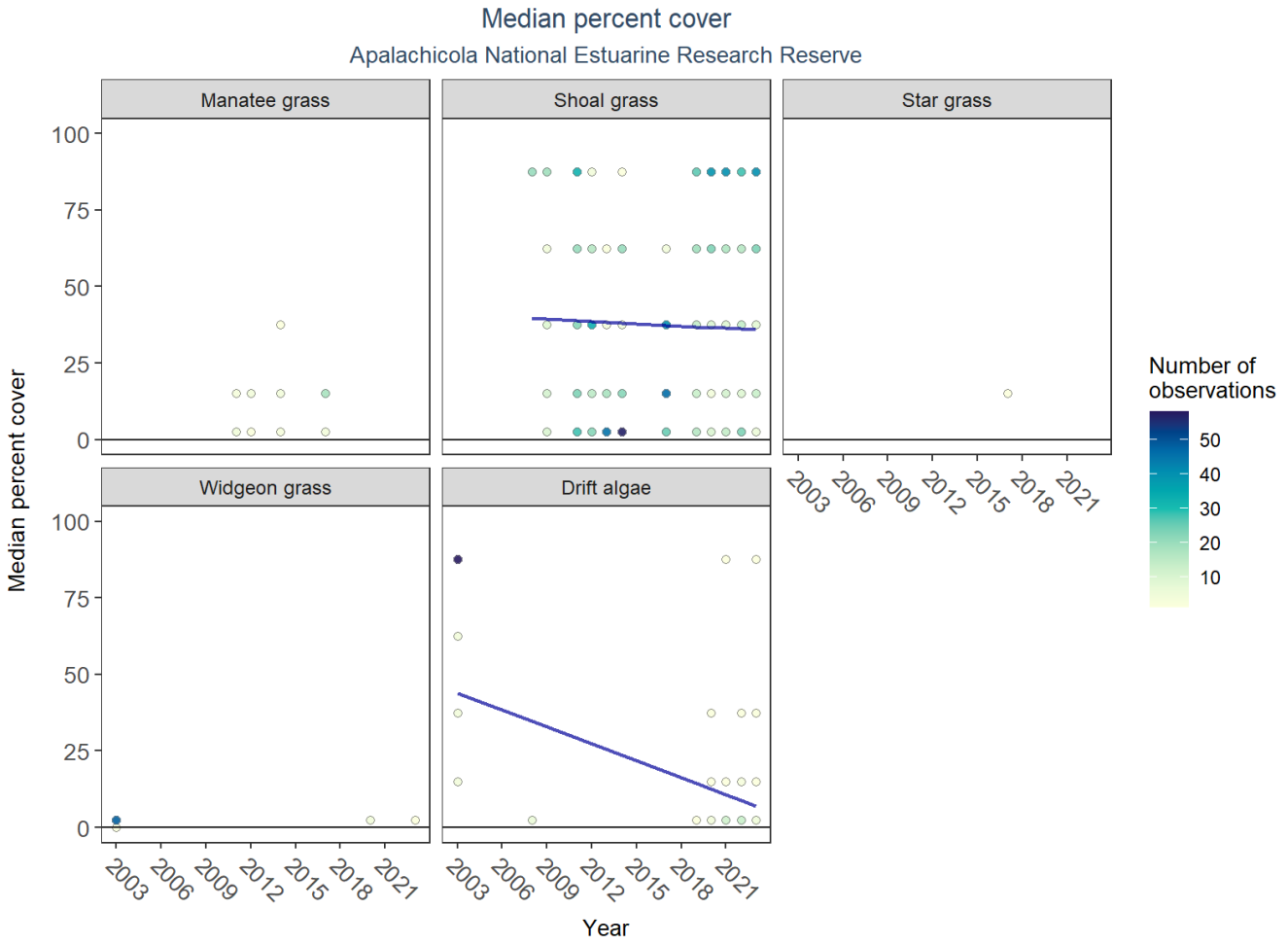

Figure 36: Trends in median percent cover for various seagrass species in Apalachicola National Estuarine Research Reserve

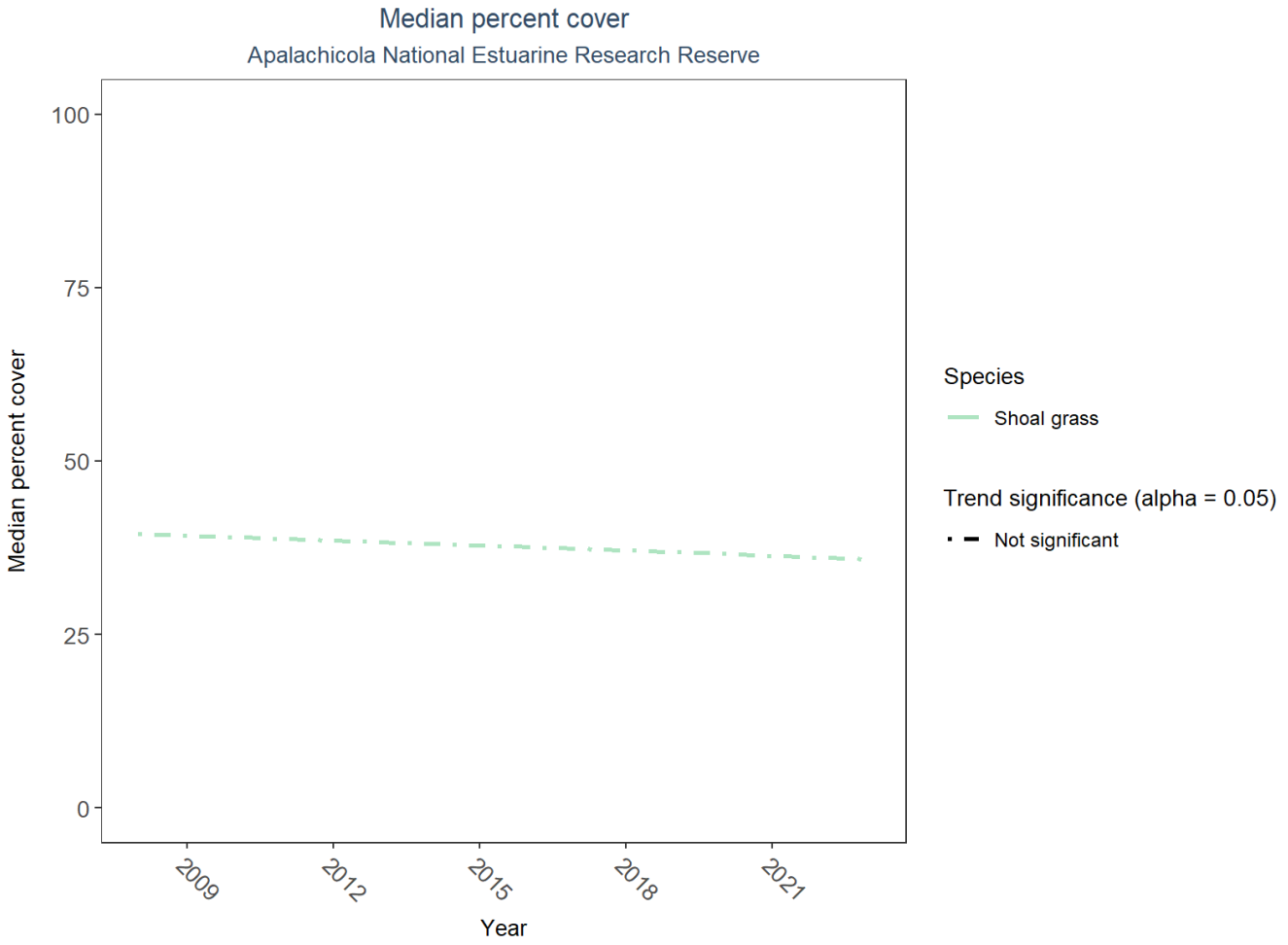

Figure 37: Trends in median percent cover for various seagrass species in Apalachicola National Estuarine Research Reserve - simplified

Table 43: Percent Cover Trend Analysis for Apalachicola National Estuarine Research Reserve

CommonName	*Trend Significance (0.05)*	*Period of Record*	*LME-Intercept*	*LME-Slope*	*p*
Drift algae	Significantly decreasing trend	2003 - 2023	60.30817	-1.8362756	0.0314660
Shoal grass	No significant trend	2008 - 2023	42.98086	-0.2444919	0.7268447
Star grass	Insufficient data to calculate trend	-	-	-	-
No grass in quadrat	Model did not fit the available data	2003 - 2023	-	-	-
Widgeon grass	Insufficient data to calculate trend	-	-	-	-
Manatee grass	Insufficient data to calculate trend	-	-	-	-

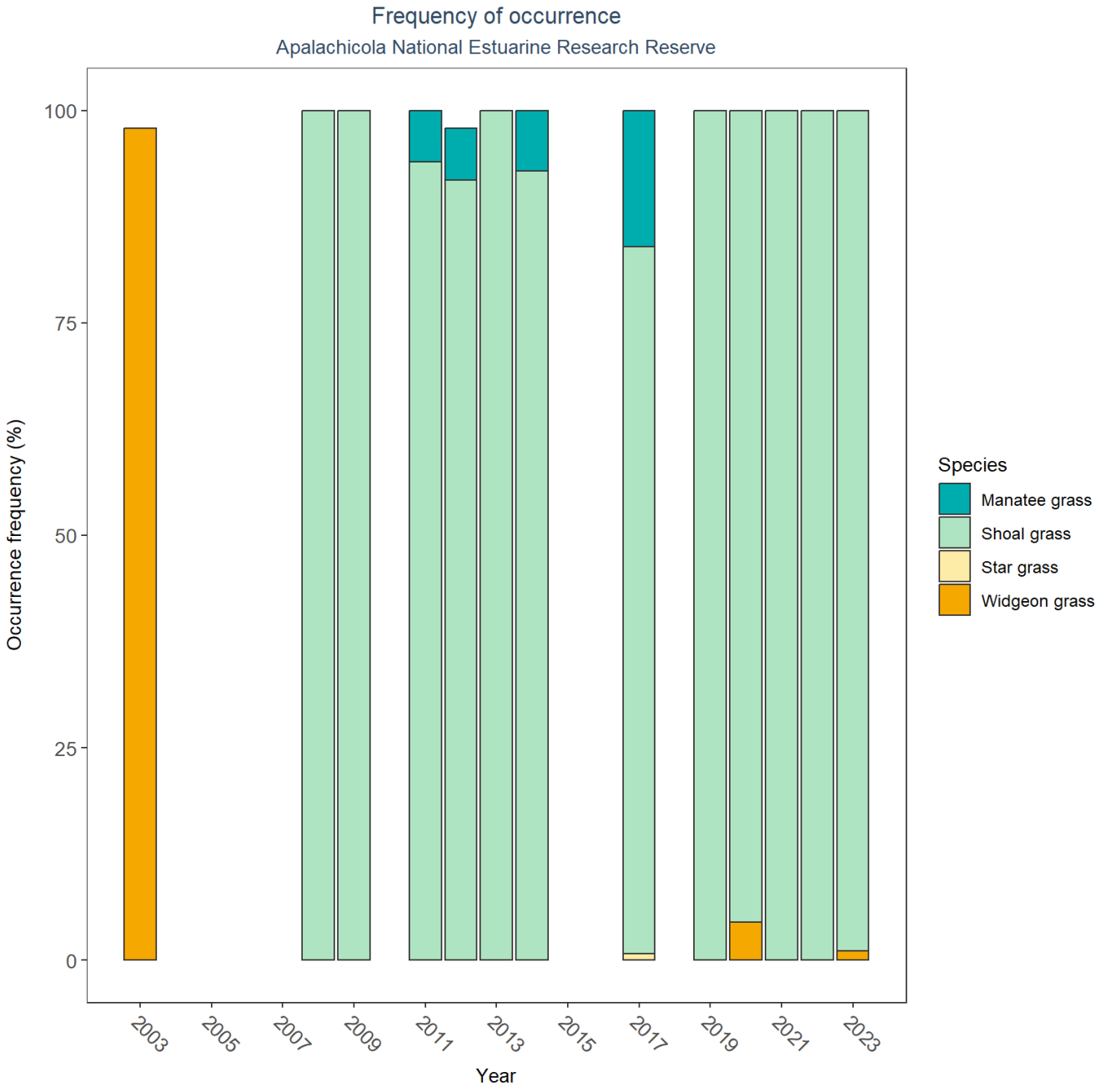

Figure 38: Frequency of occurrence for various seagrass species in Apalachicola National Estuarine Research Reserve

Nekton

The data file used is: **All_NEKTON_Parameters-2024-Dec-17.txt**

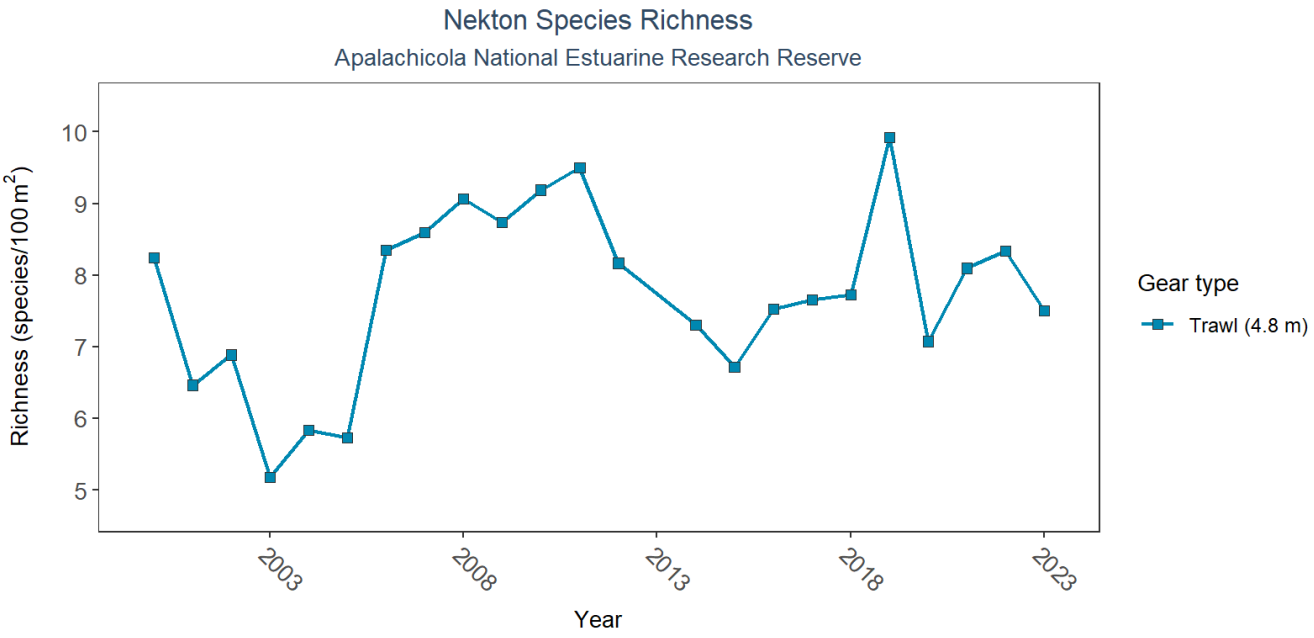

Figure 39: Figure for Nekton Species Richness in Apalachicola National Estuarine Research Reserve

Table 44: Nekton Species Richness

Gear Type	*Sample Count*	*Number of Years*	*Period of Record*	*Median N of Taxa*	*Mean N of Taxa*
Trawl (4.8)	2003	23	2000 - 2023	7.41	7.63

Oyster

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

Density

Natural

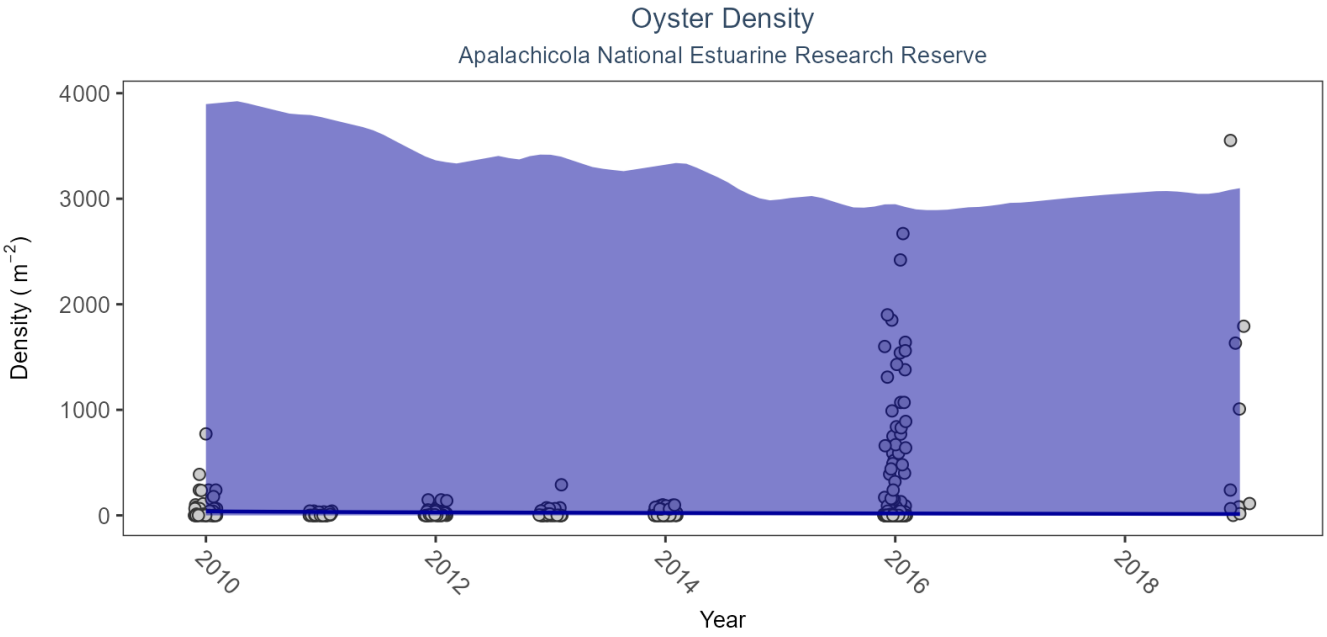

Figure 40: Figure for Oyster Density in Apalachicola National Estuarine Research Reserve

Table 45: Model results for Oyster Density - Natural

Shell Type	*Habitat Type*	*Trend Status*	*Estimate*	*Standard Error*	*Credible Interval*
Live Oyster Shells	Natural	No significant change	-0.1	0.08	-0.25 to 0.06

Percent Live

Natural

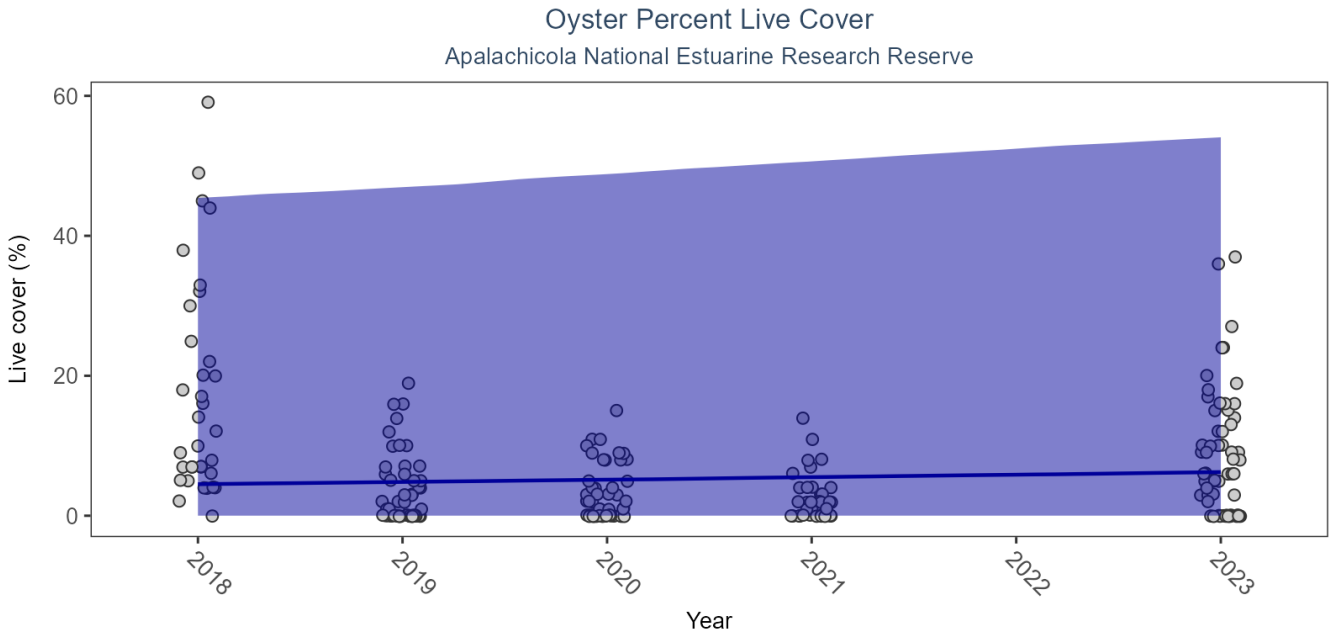

Figure 41: Figure for Oyster Percent Live in Apalachicola National Estuarine Research Reserve

Table 46: Model results for Oyster Percent Live - Natural

Shell Type	*Habitat Type*	*Trend Status*	*Estimate*	*Standard Error*	*Credible Interval*
Live Oyster Shells	Natural	Significantly increasing trend	0.05	0.02	0.02 to 0.09

Shell Height

Natural

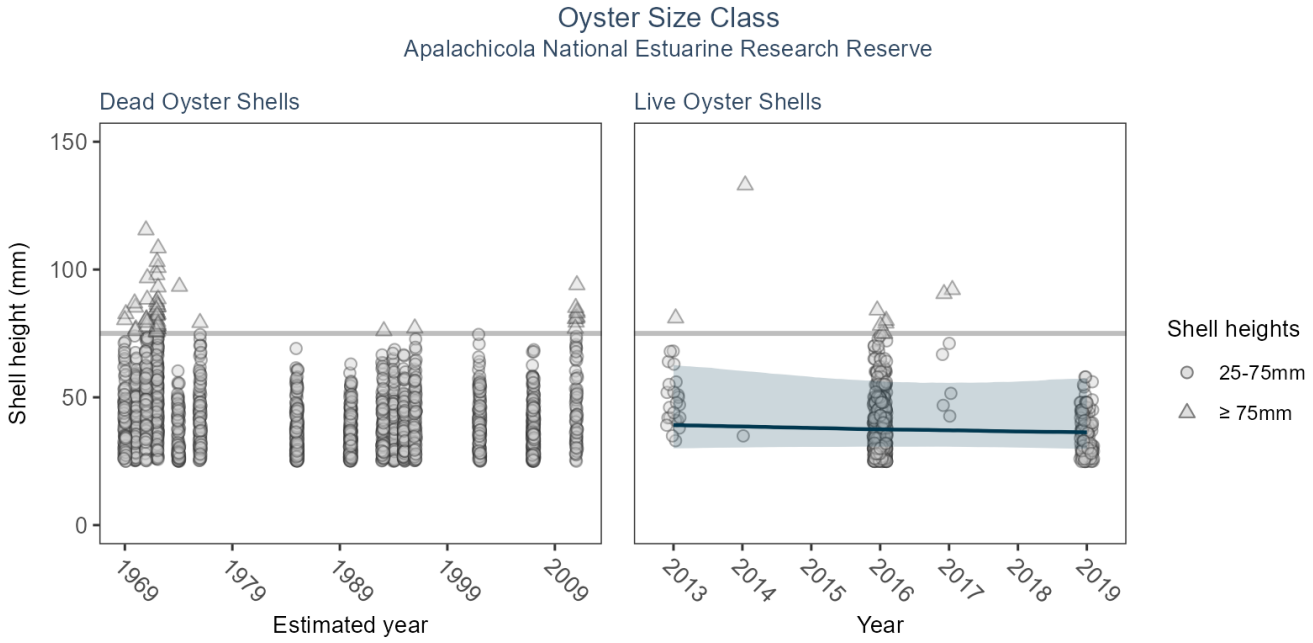

Figure 42: Figure for Oyster Shell Height in Apalachicola National Estuarine Research Reserve

Table 47: Model results for Oyster Shell Height - Natural

Shell Type	*Habitat Type*	*Trend Status*	*Estimate*	*Standard Error*	*Credible Interval*
Dead Oyster Shells	Natural	No significant change	-26.30	66.05	-245.8 to 0.3
Dead Oyster Shells	Natural	-	-	-	NA to NA
Dead Oyster Shells	Natural	-	-	-	NA to NA
Live Oyster Shells	Natural	No significant change	-7.42	7.20	-23.16 to 6.75
Live Oyster Shells	Natural	No significant change	-2.27	3.73	-9.8 to 4.9
Live Oyster Shells	Natural	-	-	-	NA to NA

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