Apalachicola Bay Aquatic Preserve

SEACAR Habitat Analyses

Last compiled on 08 January, 2025

Contents

Funding & Acknowledgements

The data used in this analysis is from the Export Standardized Tables in the SEACAR Data Discovery Interface (DDI). Documents and information available through the SEACAR DDI are owned by the data provider(s) and users are expected to provide appropriate credit following accepted citation formats. Users are encouraged to access data to maximize utilization of gained knowledge, reducing redundant research and facilitating partnerships and scientific innovation.

With respect to documents and information available from SEACAR DDI, neither the State of Florida nor the Florida Department of Environmental Protection makes any warranty, expressed or implied, including the warranties of merchantability and fitness for a particular purpose arising out of the use or inability to use the data, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights.

This report was funded in part, through a grant agreement from the Florida Department of Environmental Protection, Florida Coastal Management Program, by a grant provided by the Office for Coastal Management under the Coastal Zone Management Act of 1972, as amended, National Oceanic and Atmospheric Administration. The views, statements, findings, conclusions and recommendations expressed herein are those of the author(s) and do not necessarily reflect the views of the State of Florida, NOAA or any of their sub agencies.

Published: 2025-01-08

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

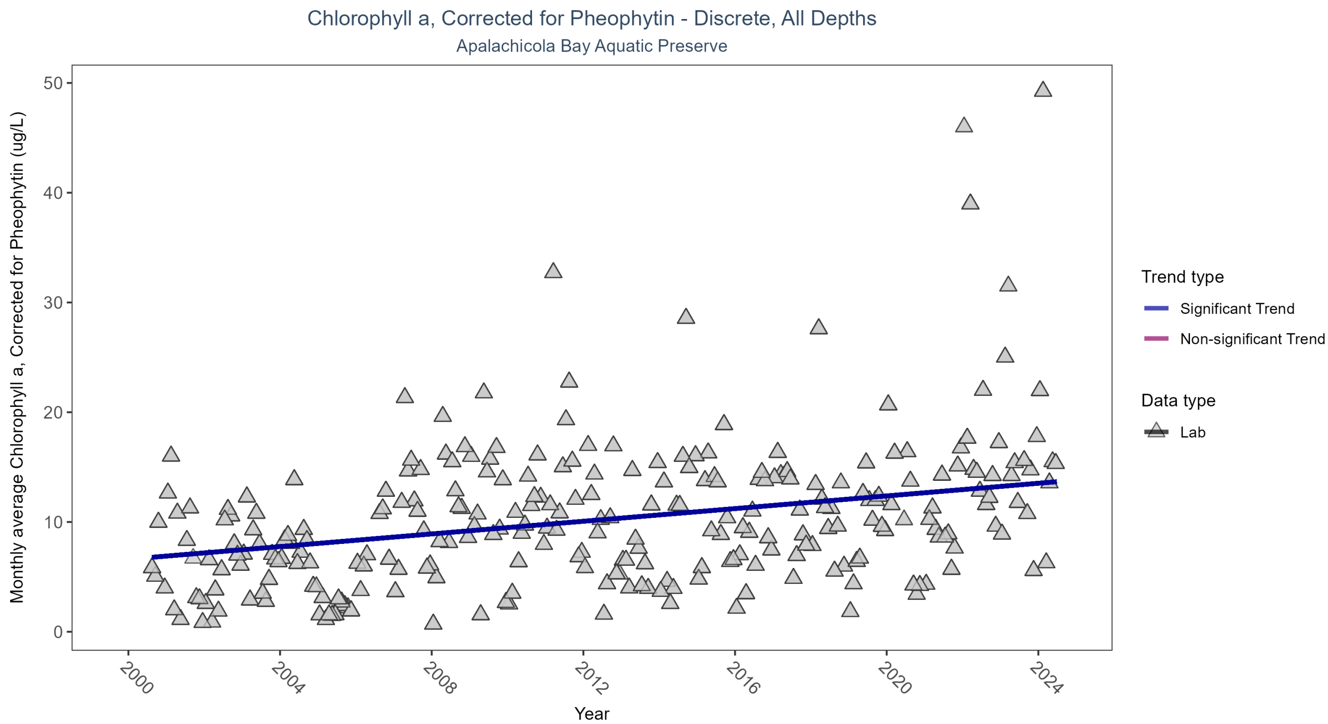

Figure 1: Seasonal Kendall-Tau Results for Chlorophyll a, Corrected for Pheophytin - Discrete

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	7438	25	8.6	TRUE	0.2842	0	0.2885	6.6053	9.2716	0.5968	1

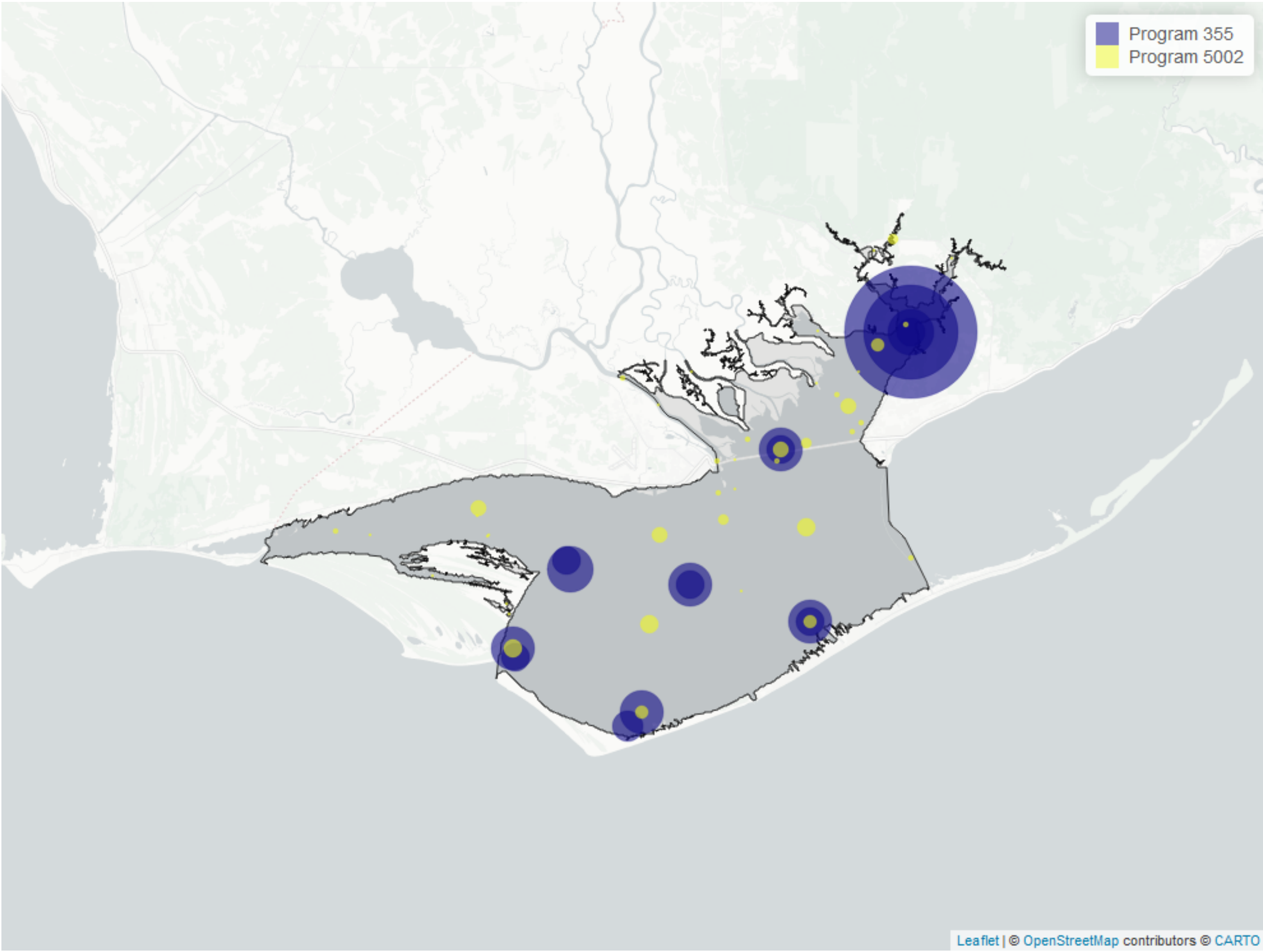

Figure 2: Map showing location of Discrete sampling sites for Chlorophyll a, Corrected for Pheophytin. The bubble size on the maps below reflect the amount of data available at each sampling site.

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

ProgramID	*N_Data*	*YearMin*	*YearMax*
355	7047	2002	2024
5002	497	2000	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

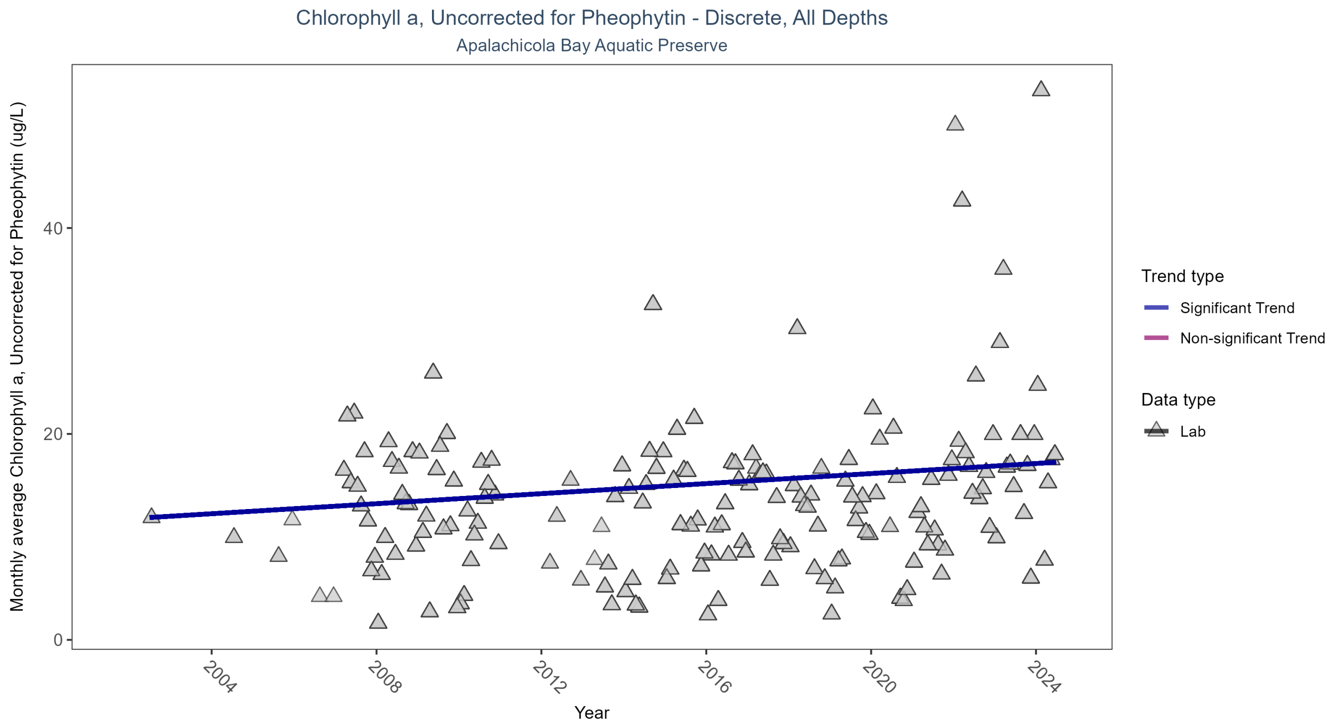

Figure 3: Seasonal Kendall-Tau Results for Chlorophyll a, Uncorrected for Pheophytin - Discrete

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	3913	21	11.6	TRUE	0.164	0.0035	0.2439	11.7621	20.019	0.0451	1

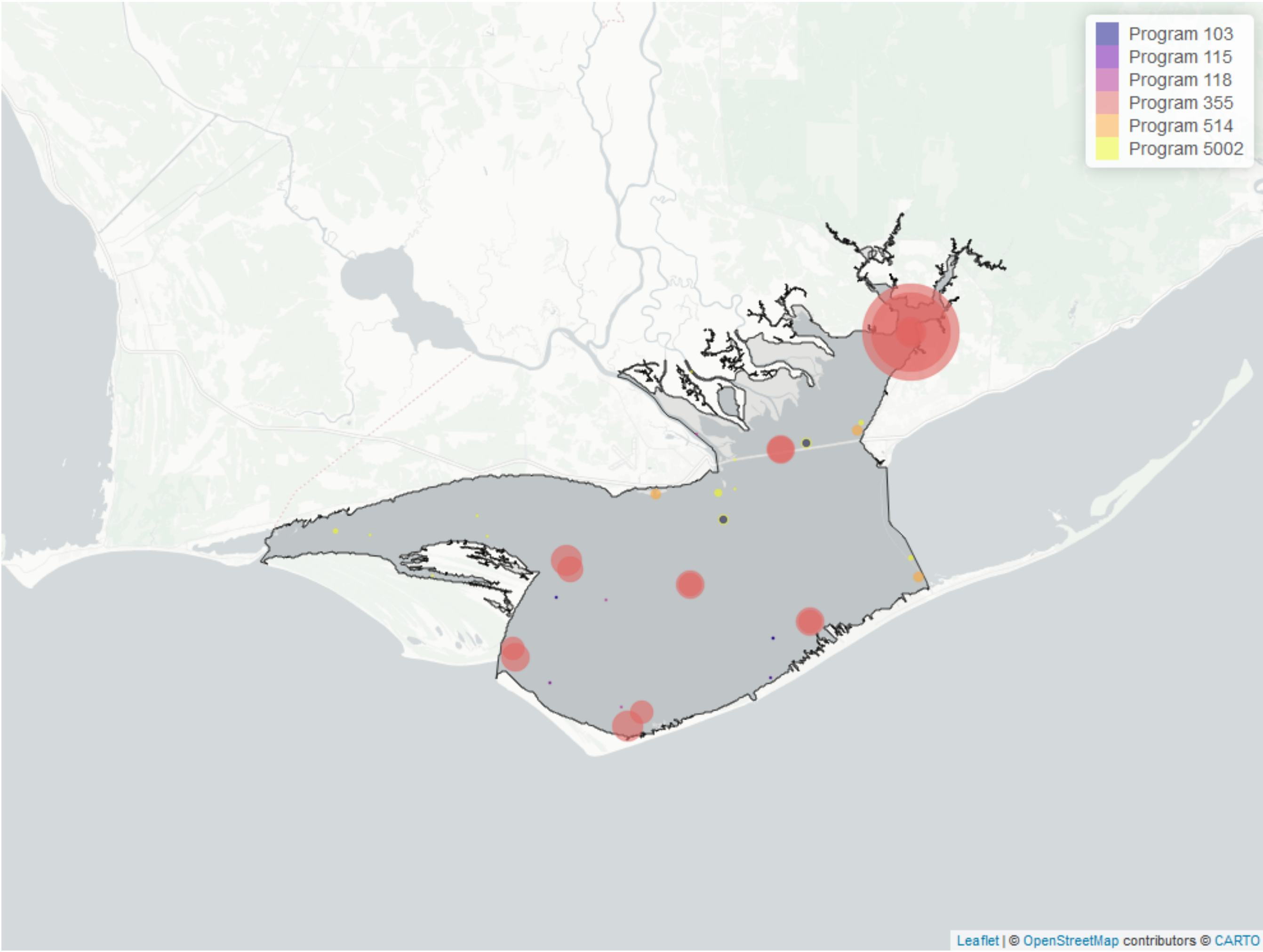

Figure 4: Map showing location of Discrete sampling sites for Chlorophyll a, Uncorrected for Pheophytin. The bubble size on the maps below reflect the amount of data available at each sampling site.

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

ProgramID	*N_Data*	*YearMin*	*YearMax*
355	3919	2007	2024
5002	61	2012	2024
514	51	2007	2008
103	26	2002	2021
118	5	2005	2010
115	2	2002	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]

Dissolved Oxygen - Discrete Water Quality

Seasonal Kendall-Tau Trend Analysis

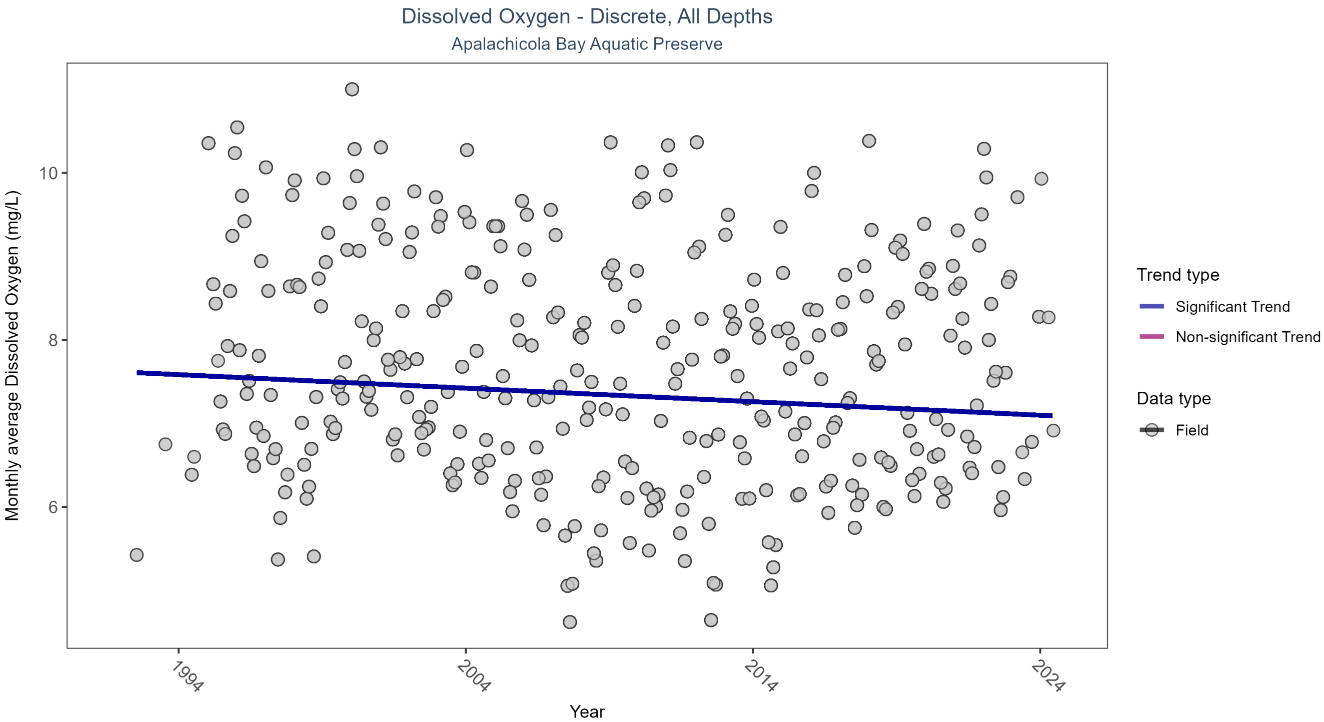

Figure 5: Seasonal Kendall-Tau Results for Dissolved Oxygen - Discrete

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

RelativeDepth	N-Data	N-Years	Median	Independent	tau	p	SennSlope	SennIntercept	ChiSquared	pChiSquared	Trend
All	52352	33	7.5	TRUE	-0.1327	0.0006	-0.0162	7.6166	12.4298	0.3322	-1

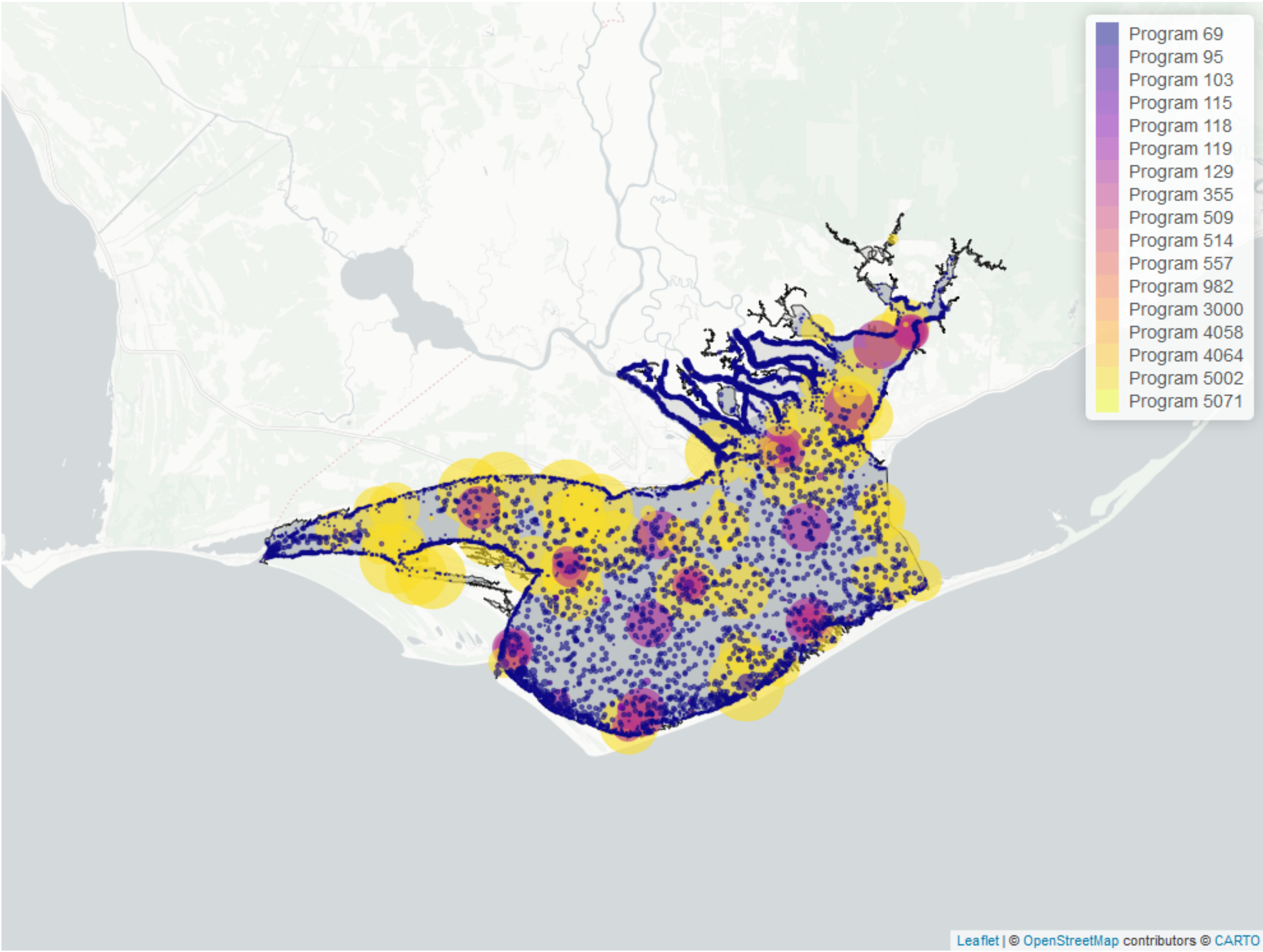

Figure 6: Map showing location of Discrete sampling sites for Dissolved Oxygen. The bubble size on the maps below reflect the amount of data available at each sampling site.

Table 11: Programs contributing data for Dissolved Oxygen

ProgramID	*N_Data*	*YearMin*	*YearMax*
69	24593	1998	2022
5002	21942	1995	2024
129	3433	2000	2023
355	2942	2003	2024
95	256	1995	2018
557	121	2006	2023
118	52	2005	2020
103	22	2004	2021
115	16	1992	2004
119	14	1994	1994
5071	3	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

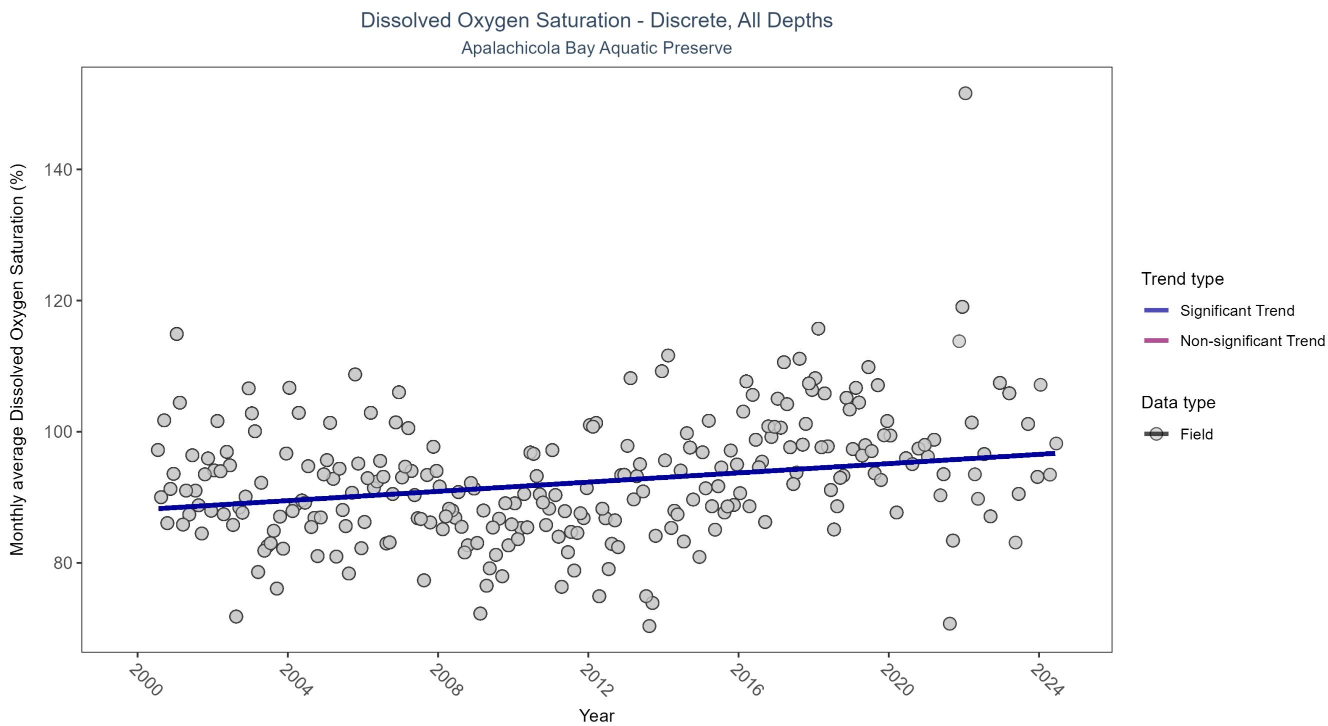

Figure 7: Seasonal Kendall-Tau Results for Dissolved Oxygen Saturation - Discrete

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

RelativeDepth	N-Data	N-Years	Median	Independent	tau	p	SennSlope	SennIntercept	ChiSquared	pChiSquared	Trend
All	5468	25	92.7	TRUE	0.2116	0	0.3528	88.0779	3.7456	0.9768	1

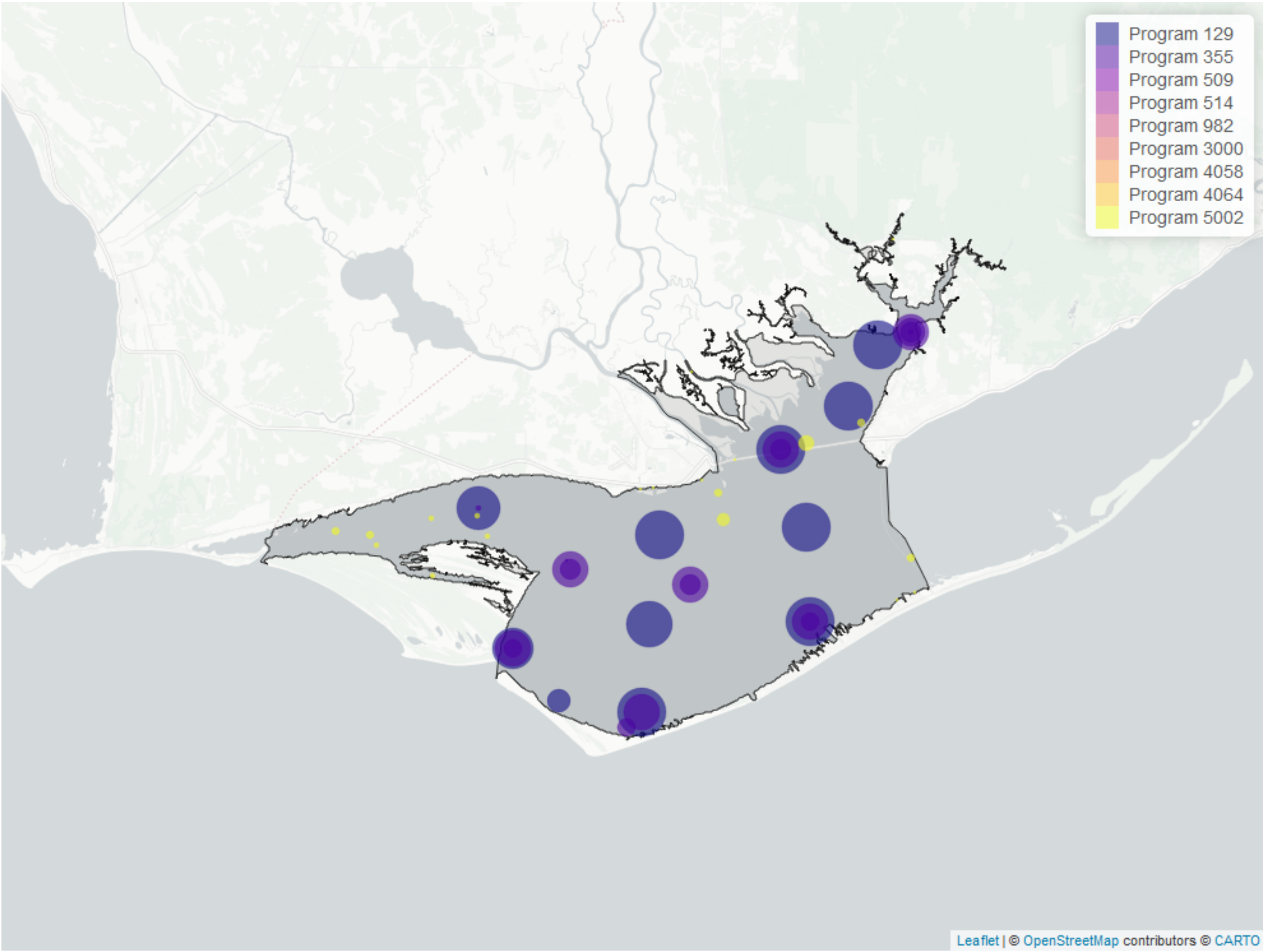

Figure 8: Map showing location of Discrete sampling sites for Dissolved Oxygen Saturation. The bubble size on the maps below reflect the amount of data available at each sampling site.

Table 13: Programs contributing data for Dissolved Oxygen Saturation

ProgramID	*N_Data*	*YearMin*	*YearMax*
129	3419	2000	2023
355	1935	2003	2023
5002	141	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

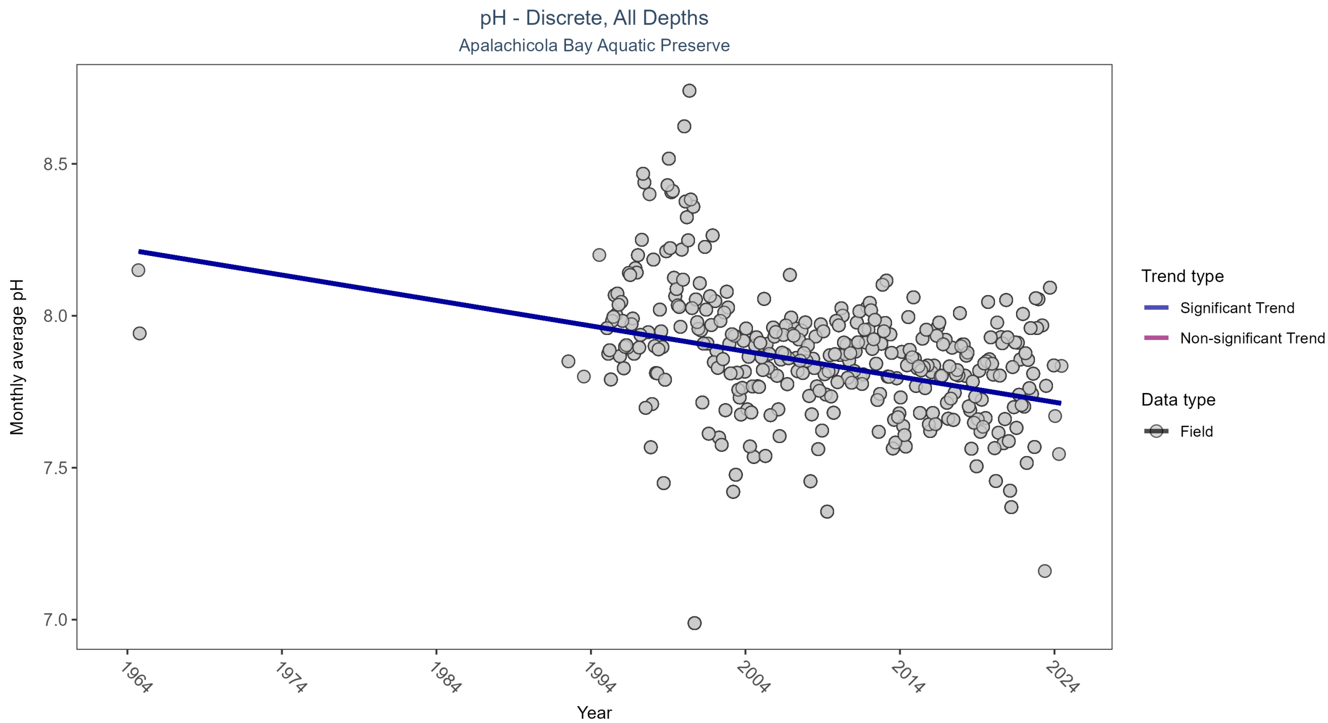

Figure 9: Seasonal Kendall-Tau Results for pH - Discrete

Table 14: Seasonal Kendall-Tau Trend Analysis for pH

RelativeDepth	N-Data	N-Years	Median	Independent	tau	p	SennSlope	SennIntercept	ChiSquared	pChiSquared	Trend
All	40866	34	8	TRUE	-0.2806	0	-0.0084	8.2178	9.4824	0.5775	-1

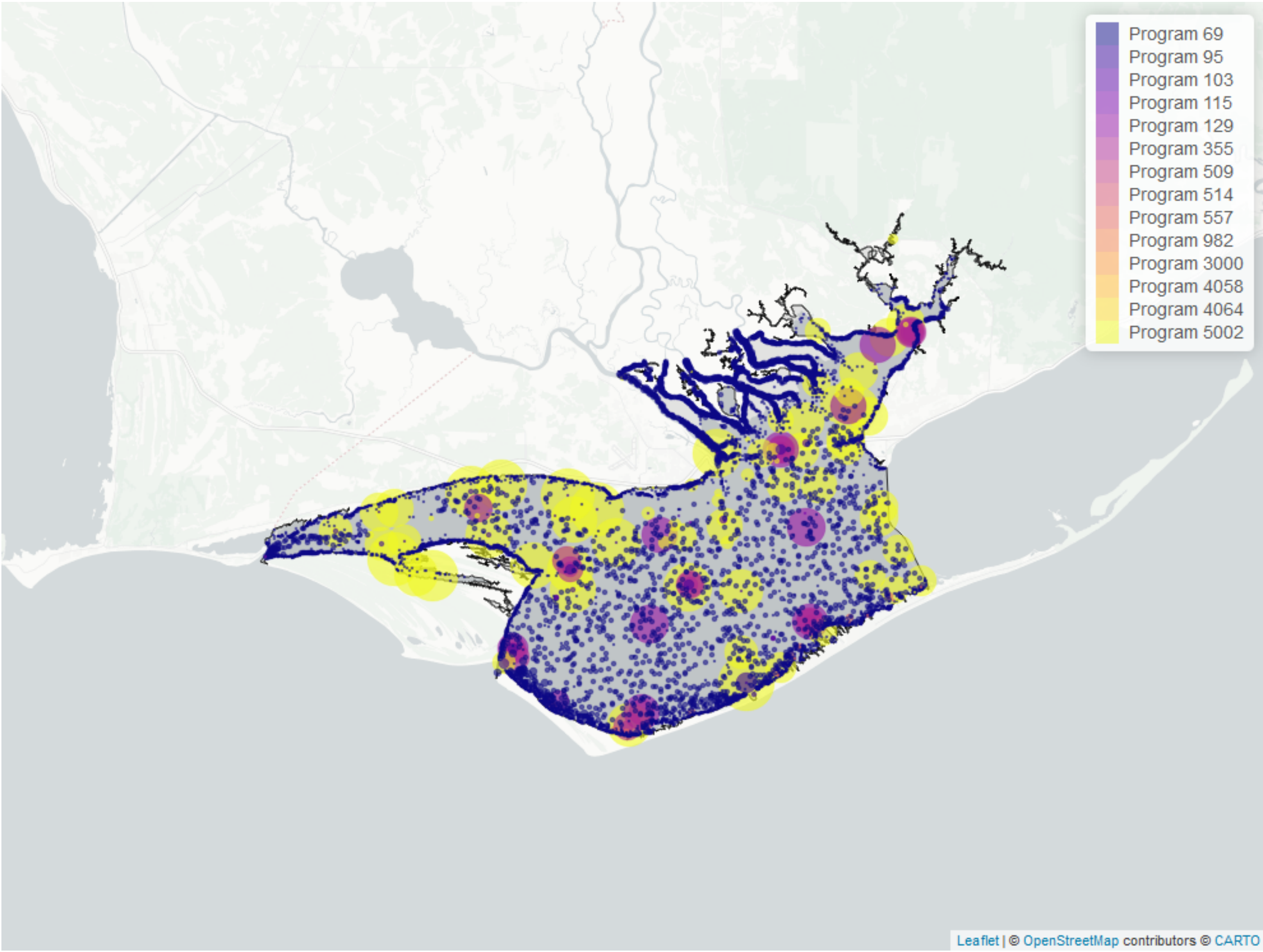

Figure 10: Map showing location of Discrete sampling sites for pH. The bubble size on the maps below reflect the amount of data available at each sampling site.

Table 15: Programs contributing data for pH

ProgramID	*N_Data*	*YearMin*	*YearMax*
69	24644	1998	2022
5002	12904	1995	2024
129	1991	2000	2023
355	1988	2011	2024
95	184	1964	2018
557	110	2006	2023
103	19	2004	2021
115	16	1992	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]
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]

Salinity - Discrete Water Quality

Seasonal Kendall-Tau Trend Analysis

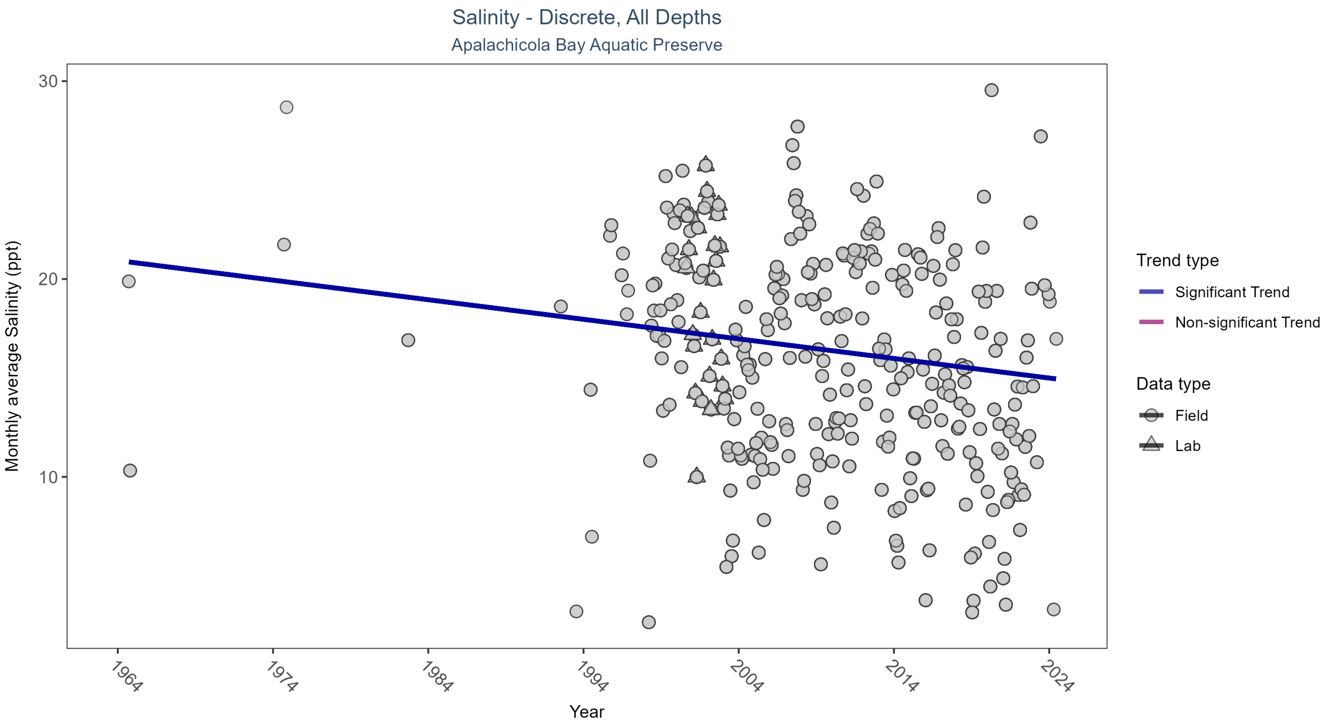

Figure 11: Seasonal Kendall-Tau Results for Salinity - Discrete

Table 16: Seasonal Kendall-Tau Trend Analysis for Salinity

RelativeDepth	N-Data	N-Years	Median	Independent	tau	p	SennSlope	SennIntercept	ChiSquared	pChiSquared	Trend
All	61377	36	15.8	TRUE	-0.1255	0.001	-0.099	20.933	9.8195	0.5467	-1

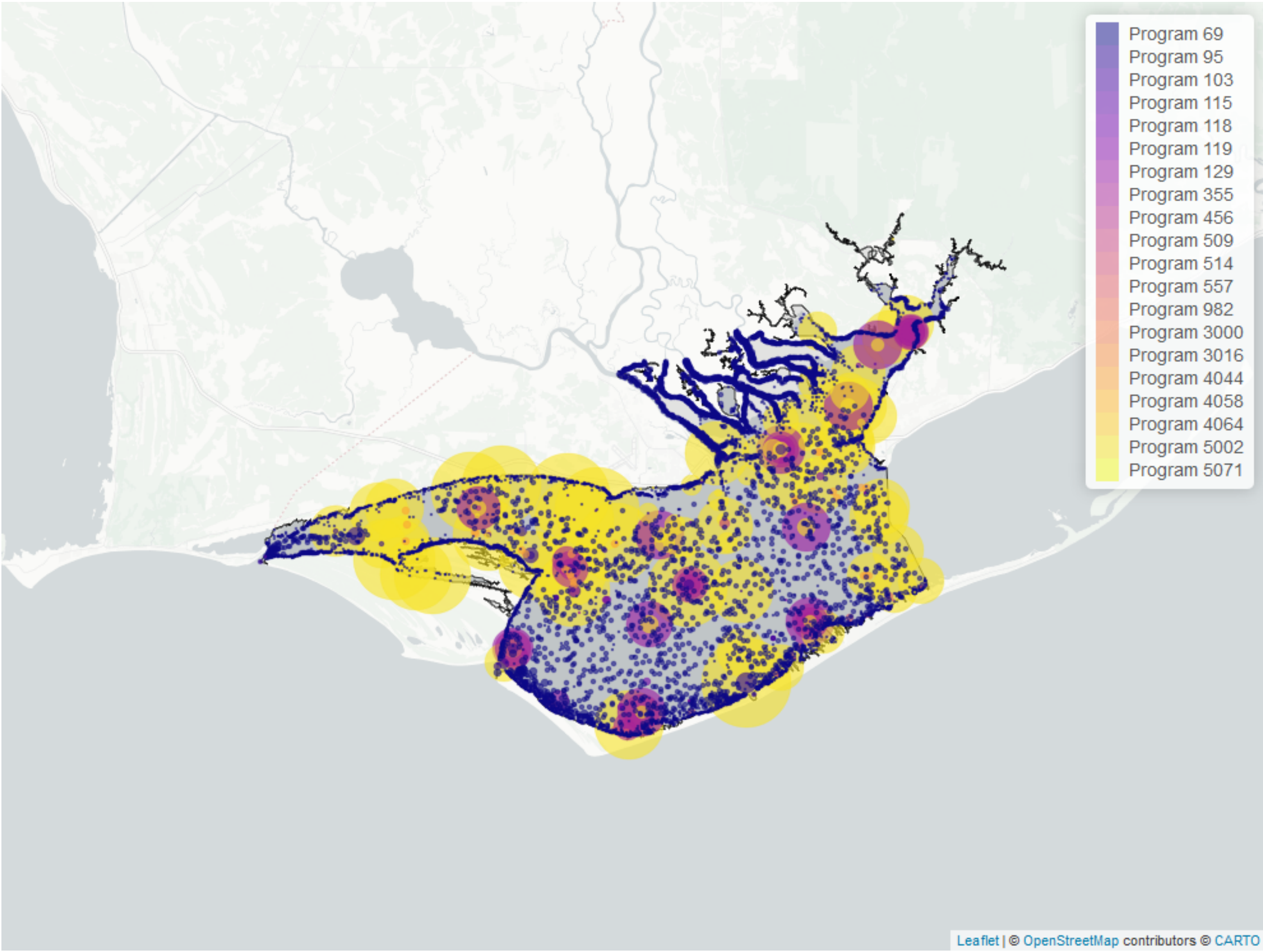

Figure 12: Map showing location of Discrete sampling sites for Salinity. The bubble size on the maps below reflect the amount of data available at each sampling site.

Table 17: Programs contributing data for Salinity

ProgramID	*N_Data*	*YearMin*	*YearMax*
5002	30348	1995	2024
69	24742	1998	2022
129	3438	2000	2023
355	2923	2003	2024
95	373	1964	2018
4044	280	2007	2023
557	121	2006	2023
118	57	2015	2020
456	33	2005	2013
115	16	1992	2004
119	14	1994	1994
5071	3	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[13]
557 - Central Panhandle Aquatic Preserves Seagrass Monitoring[11]
4044 - NRDA Oyster Cultch Recovery Project[14]
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

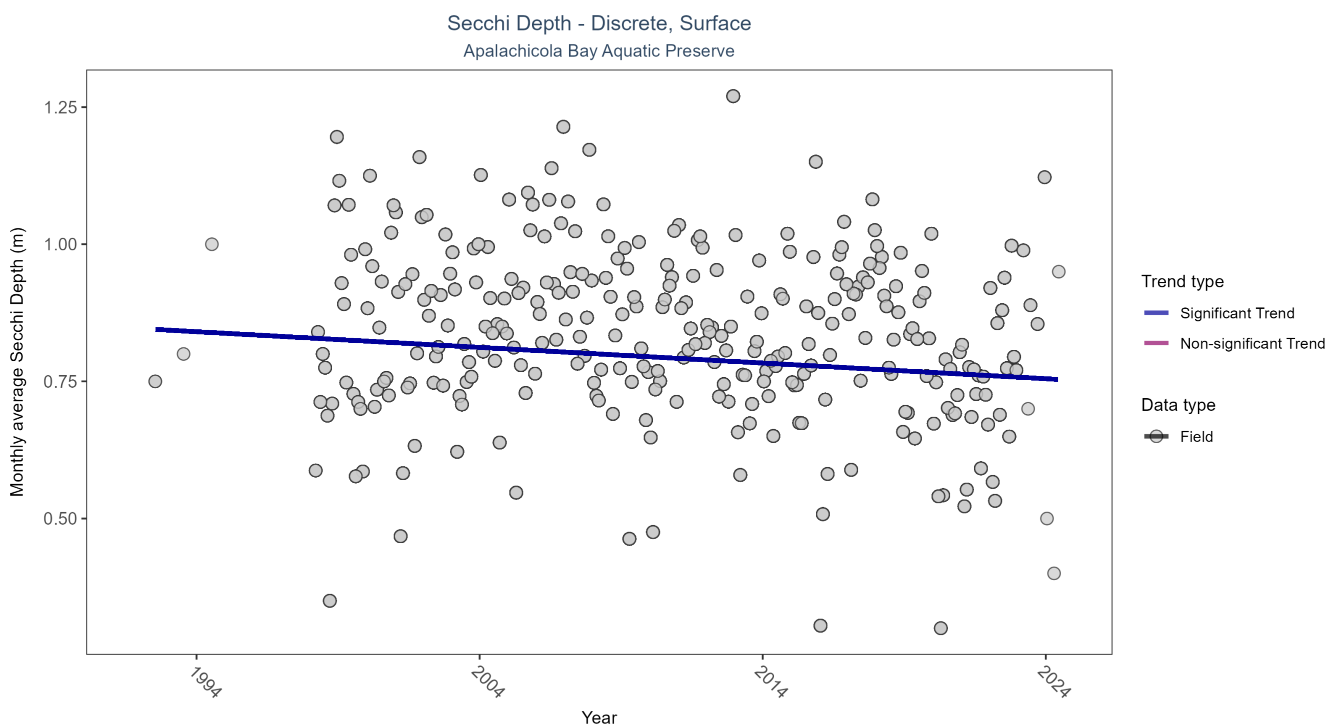

Figure 13: Seasonal Kendall-Tau Results for Secchi Depth - Discrete

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

RelativeDepth	N-Data	N-Years	Median	Independent	tau	p	SennSlope	SennIntercept	ChiSquared	pChiSquared	Trend
Surface	27081	30	0.8	TRUE	-0.1073	0.011	-0.0029	0.8463	23.0846	0.0172	-1

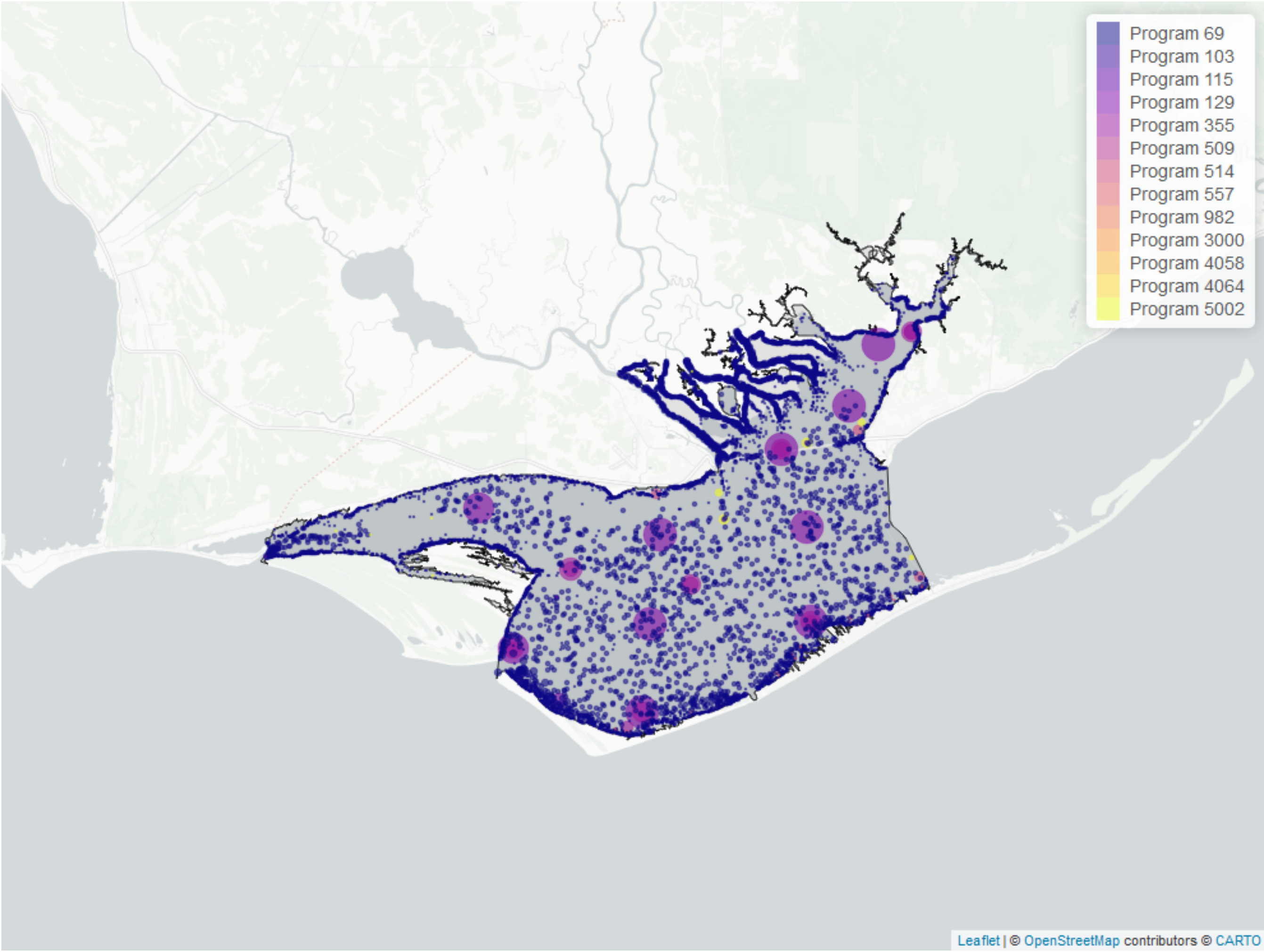

Figure 14: Map showing location of Discrete sampling sites for Secchi Depth. The bubble size on the maps below reflect the amount of data available at each sampling site.

Table 19: Programs contributing data for Secchi Depth

ProgramID	*N_Data*	*YearMin*	*YearMax*
69	24458	1998	2022
129	1703	2000	2023
355	731	2011	2019
557	67	2006	2023
5002	58	2012	2024
514	48	2007	2008
103	10	2021	2021
115	6	1992	2004

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]
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

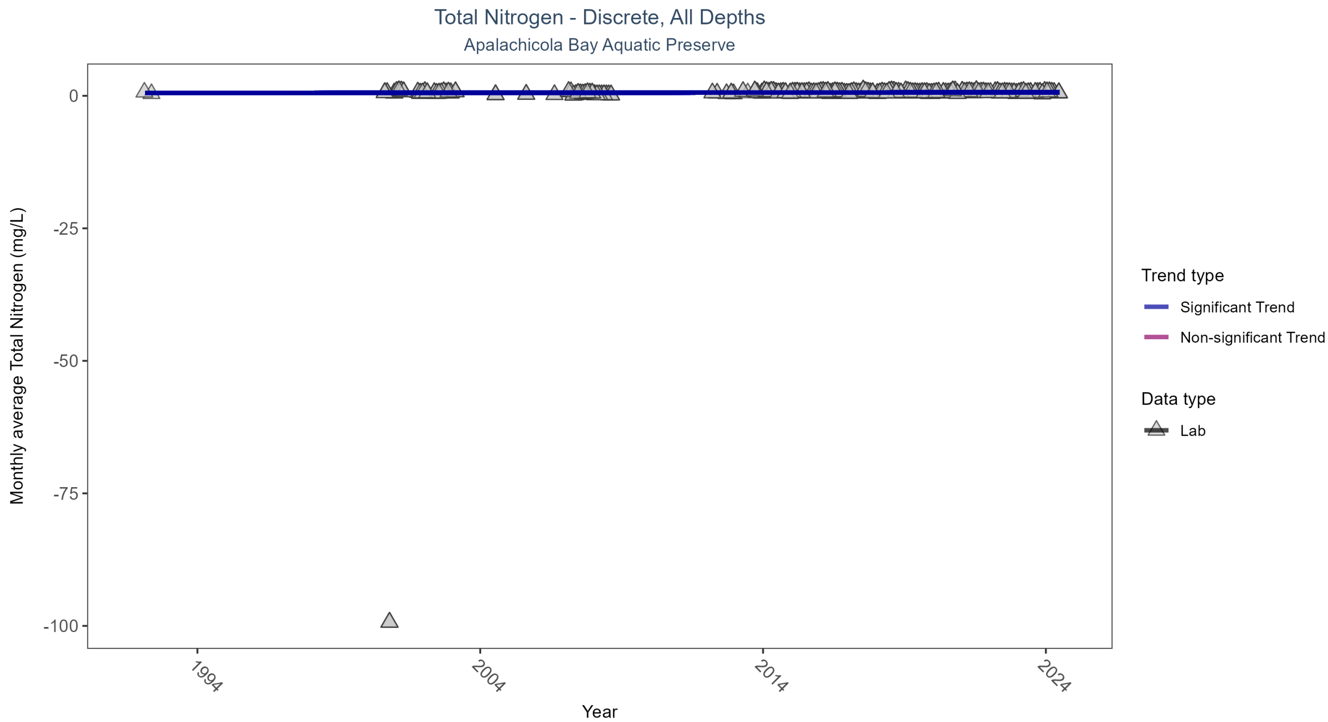

Figure 15: Seasonal Kendall-Tau Results for Total Nitrogen - Discrete

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

RelativeDepth	N-Data	N-Years	Median	Independent	tau	p	SennSlope	SennIntercept	ChiSquared	pChiSquared	Trend
All	3187	23	0.62	TRUE	0.1409	0.0113	0.0039	0.5272	13.2377	0.2781	1

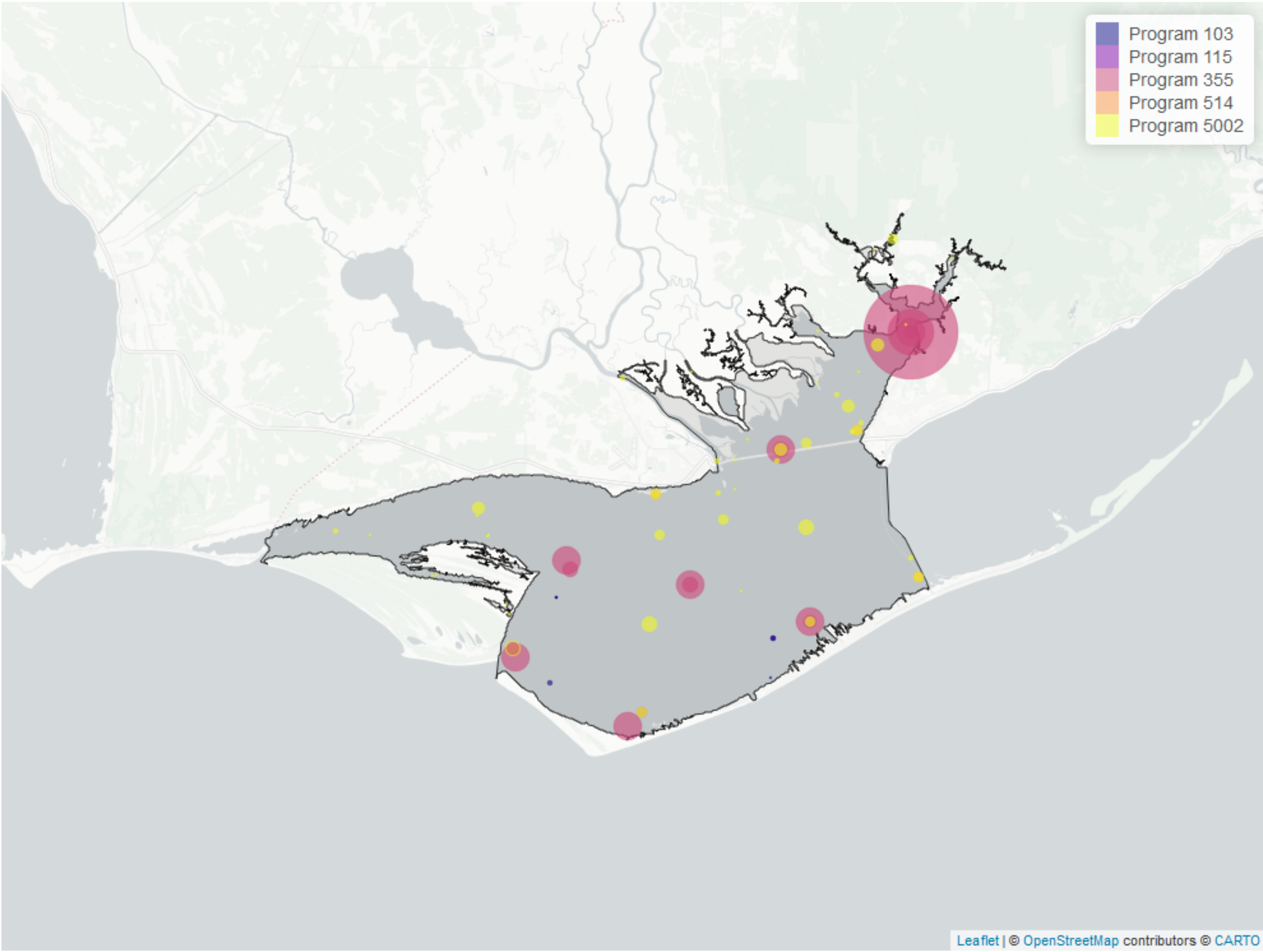

Figure 16: Map showing location of Discrete sampling sites for Total Nitrogen. The bubble size on the maps below reflect the amount of data available at each sampling site.

Table 21: Programs contributing data for Total Nitrogen

ProgramID	*N_Data*	*YearMin*	*YearMax*
355	2719	2013	2024
5002	418	1992	2024
514	50	2007	2008
103	15	2002	2006
115	2	2002	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

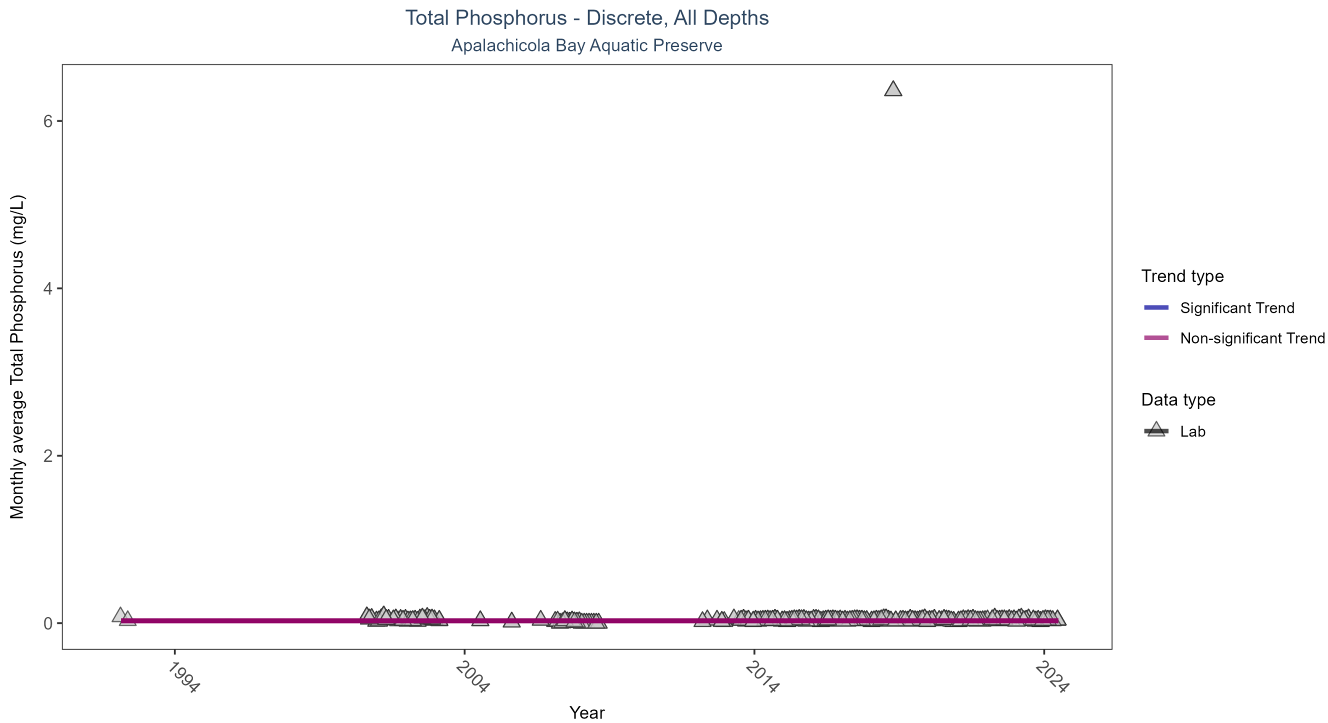

Figure 17: Seasonal Kendall-Tau Results for Total Phosphorus - Discrete

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

RelativeDepth	N-Data	N-Years	Median	Independent	tau	p	SennSlope	SennIntercept	ChiSquared	pChiSquared	Trend
All	3477	23	0.031	TRUE	0.0408	0.5316	0.0001	0.027	13.956	0.2354	0

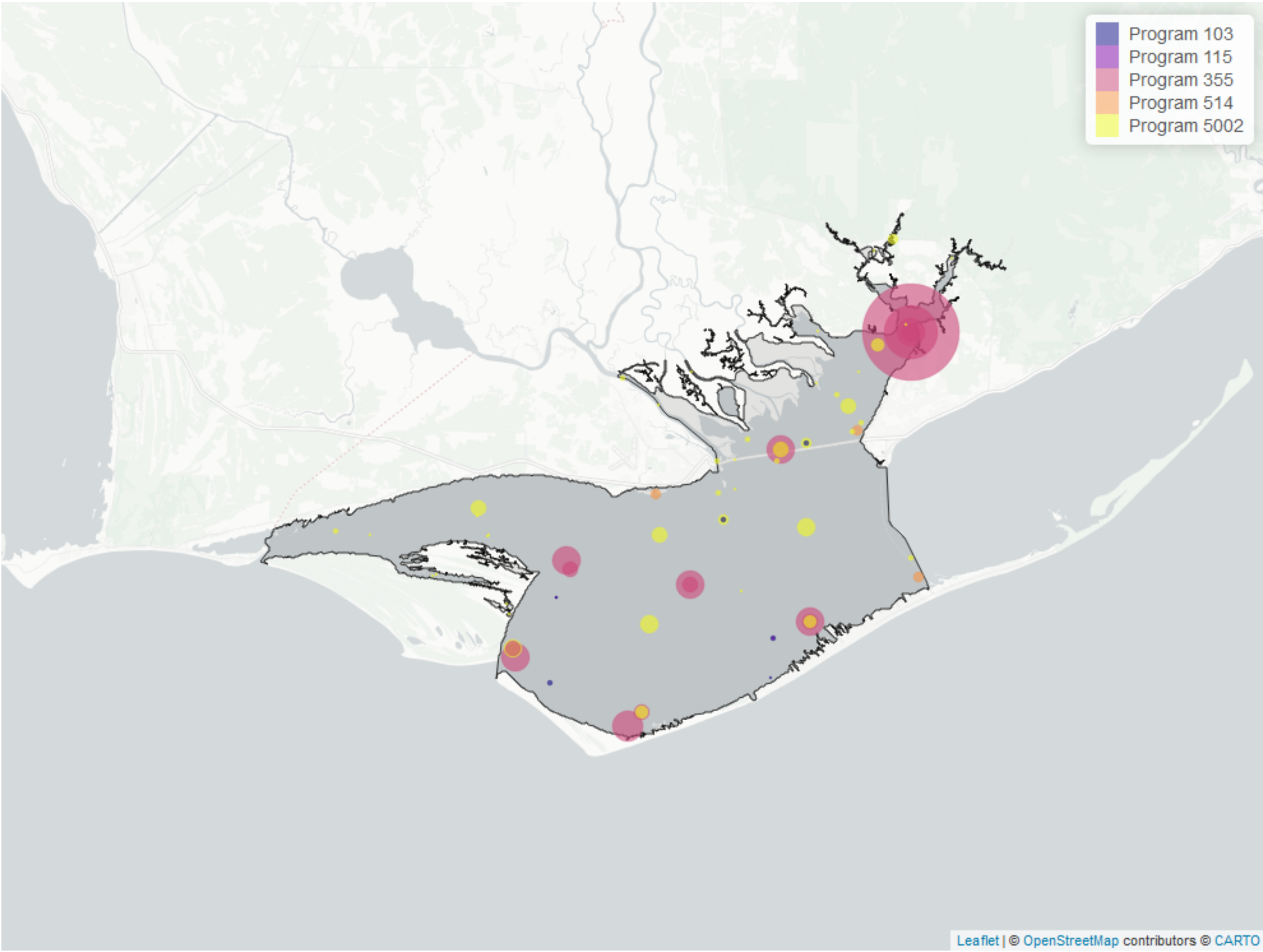

Figure 18: Map showing location of Discrete sampling sites for Total Phosphorus. The bubble size on the maps below reflect the amount of data available at each sampling site.

Table 23: Programs contributing data for Total Phosphorus

ProgramID	*N_Data*	*YearMin*	*YearMax*
355	2992	2013	2024
5002	494	1992	2024
514	50	2007	2008
103	20	2002	2021
115	2	2002	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

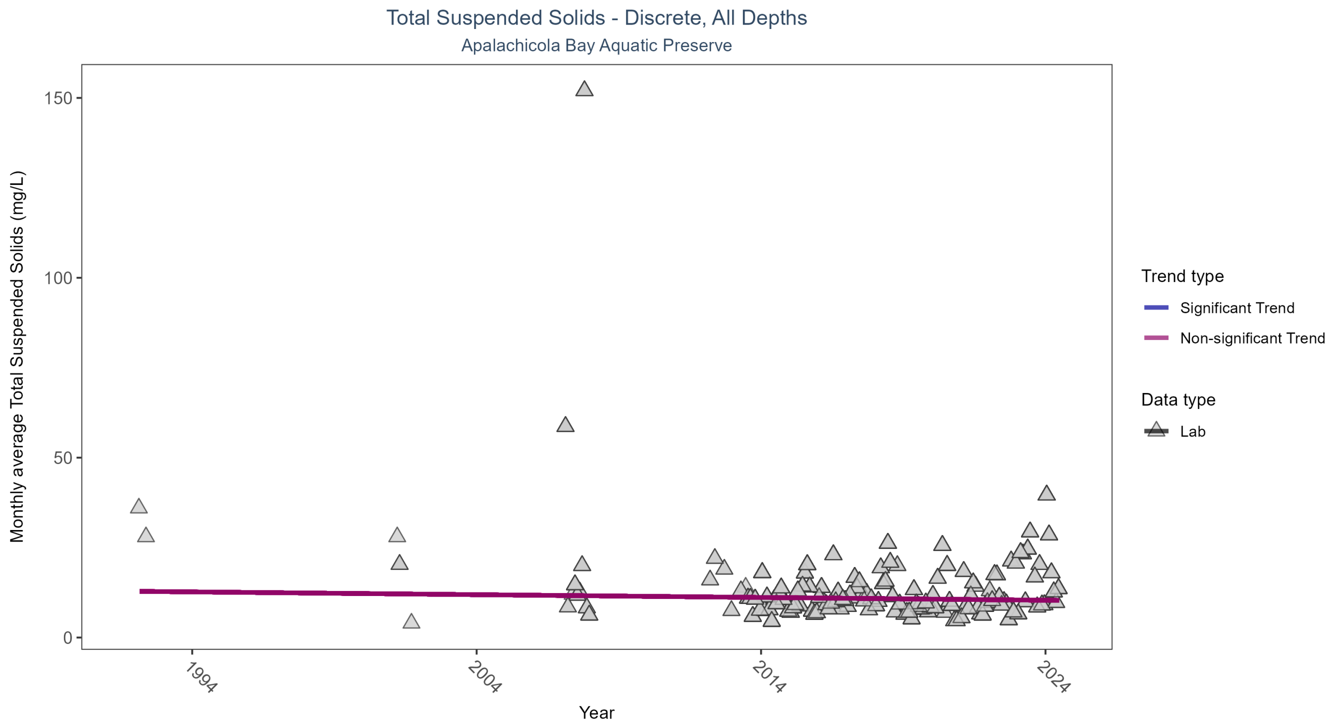

Figure 19: Seasonal Kendall-Tau Results for Total Suspended Solids - Discrete

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

RelativeDepth	N-Data	N-Years	Median	Independent	tau	p	SennSlope	SennIntercept	ChiSquared	pChiSquared	Trend
All	3048	16	9	TRUE	-0.0326	0.5296	-0.0774	12.8461	11.2606	0.4217	0

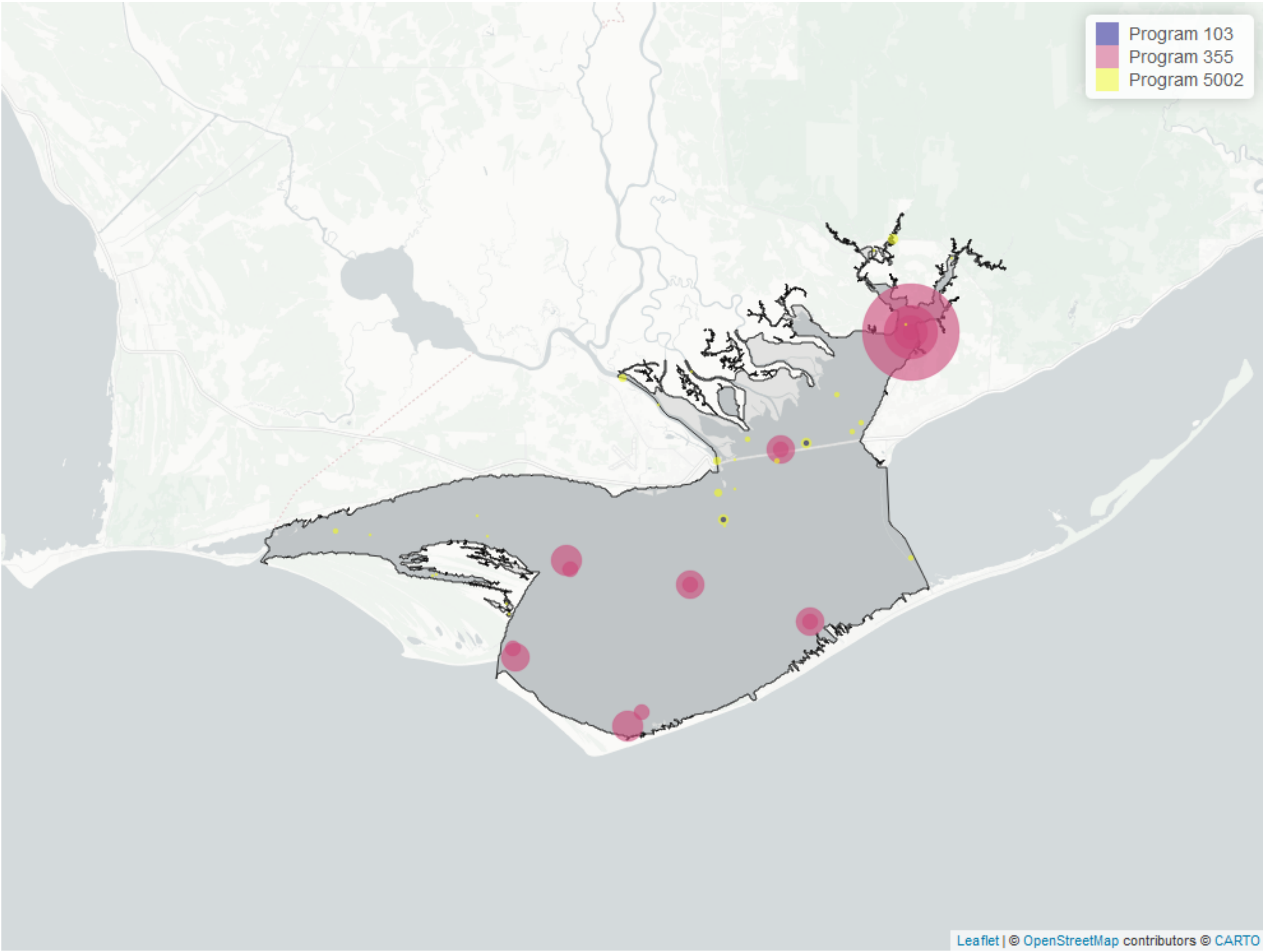

Figure 20: Map showing location of Discrete sampling sites for Total Suspended Solids. The bubble size on the maps below reflect the amount of data available at each sampling site.

Table 25: Programs contributing data for Total Suspended Solids

ProgramID	*N_Data*	*YearMin*	*YearMax*
355	3080	2013	2024
5002	117	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

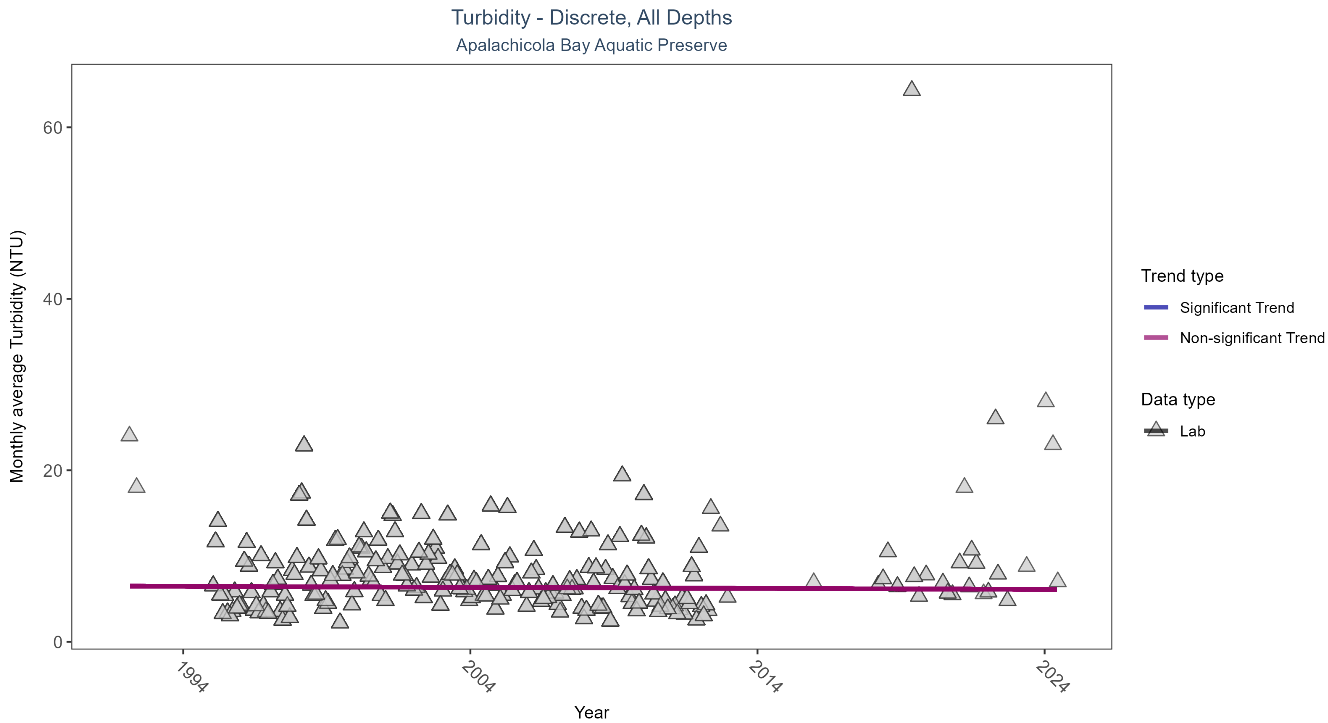

Figure 21: Seasonal Kendall-Tau Results for Turbidity - Discrete

Table 26: Seasonal Kendall-Tau Trend Analysis for Turbidity

RelativeDepth	N-Data	N-Years	Median	Independent	tau	p	SennSlope	SennIntercept	ChiSquared	pChiSquared	Trend
All	15518	27	5.6	TRUE	-0.0259	0.6339	-0.0119	6.4878	12.7783	0.3081	0

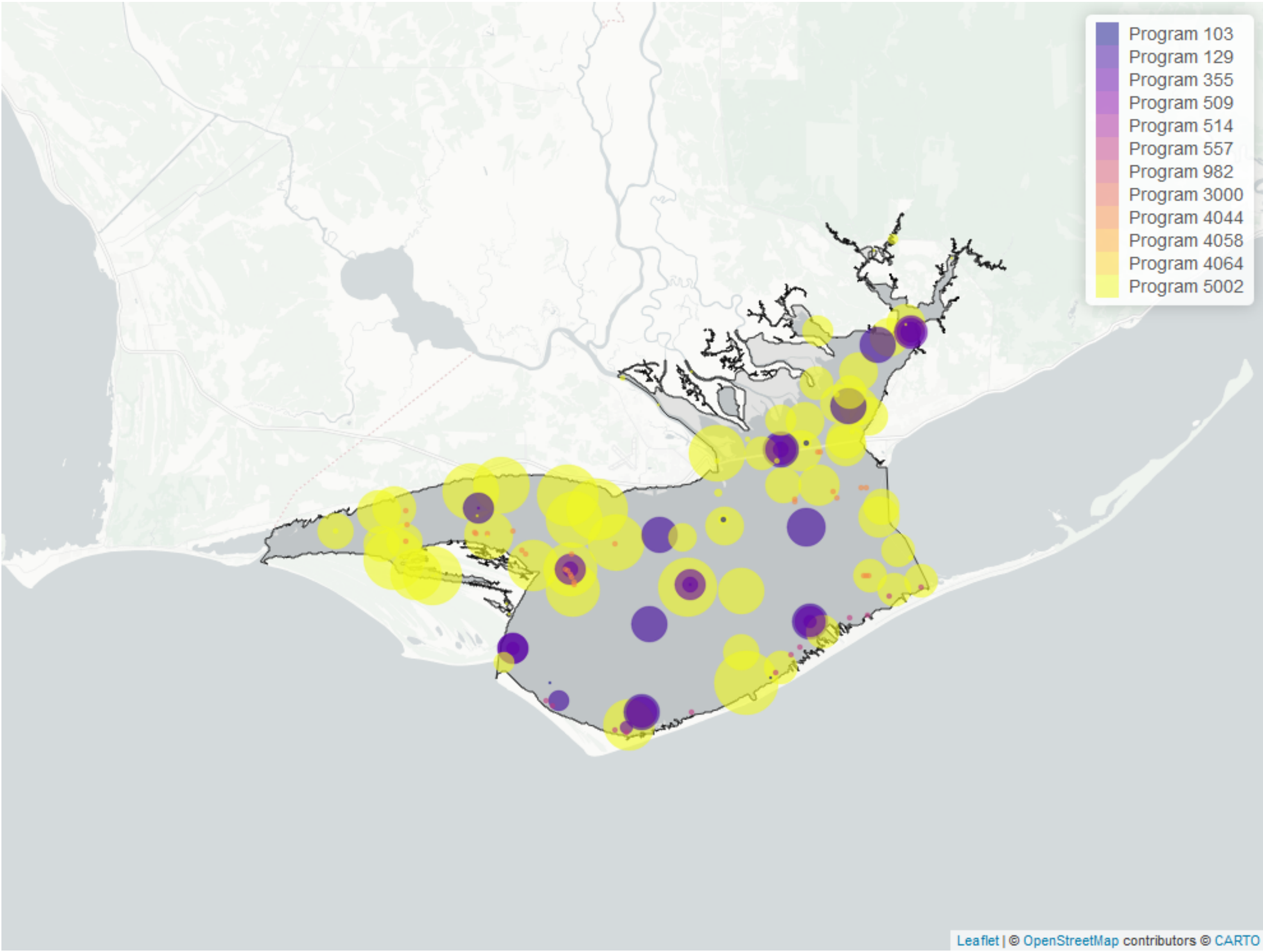

Figure 22: Map showing location of Discrete sampling sites for Turbidity. The bubble size on the maps below reflect the amount of data available at each sampling site.

Table 27: Programs contributing data for Turbidity

ProgramID	*N_Data*	*YearMin*	*YearMax*
5002	15520	1992	2024
129	1970	2000	2023
355	1446	2004	2019
4044	112	2021	2023
557	41	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[14]
5002 - Florida STORET / WIN[2]

Water Temperature - Discrete Water Quality

Seasonal Kendall-Tau Trend Analysis

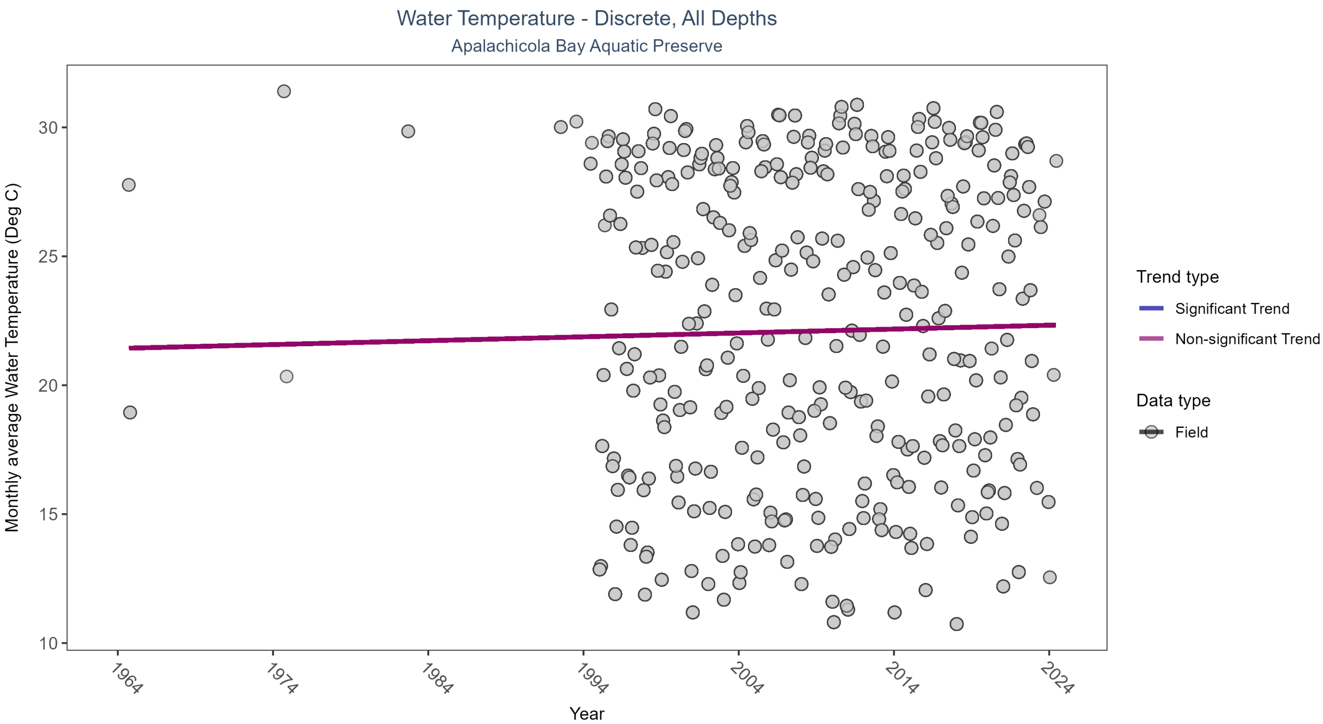

Figure 23: Seasonal Kendall-Tau Results for Water Temperature - Discrete

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

RelativeDepth	N-Data	N-Years	Median	Independent	tau	p	SennSlope	SennIntercept	ChiSquared	pChiSquared	Trend
All	61222	36	24	TRUE	0.073	0.0617	0.015	21.4264	7.0412	0.7957	0

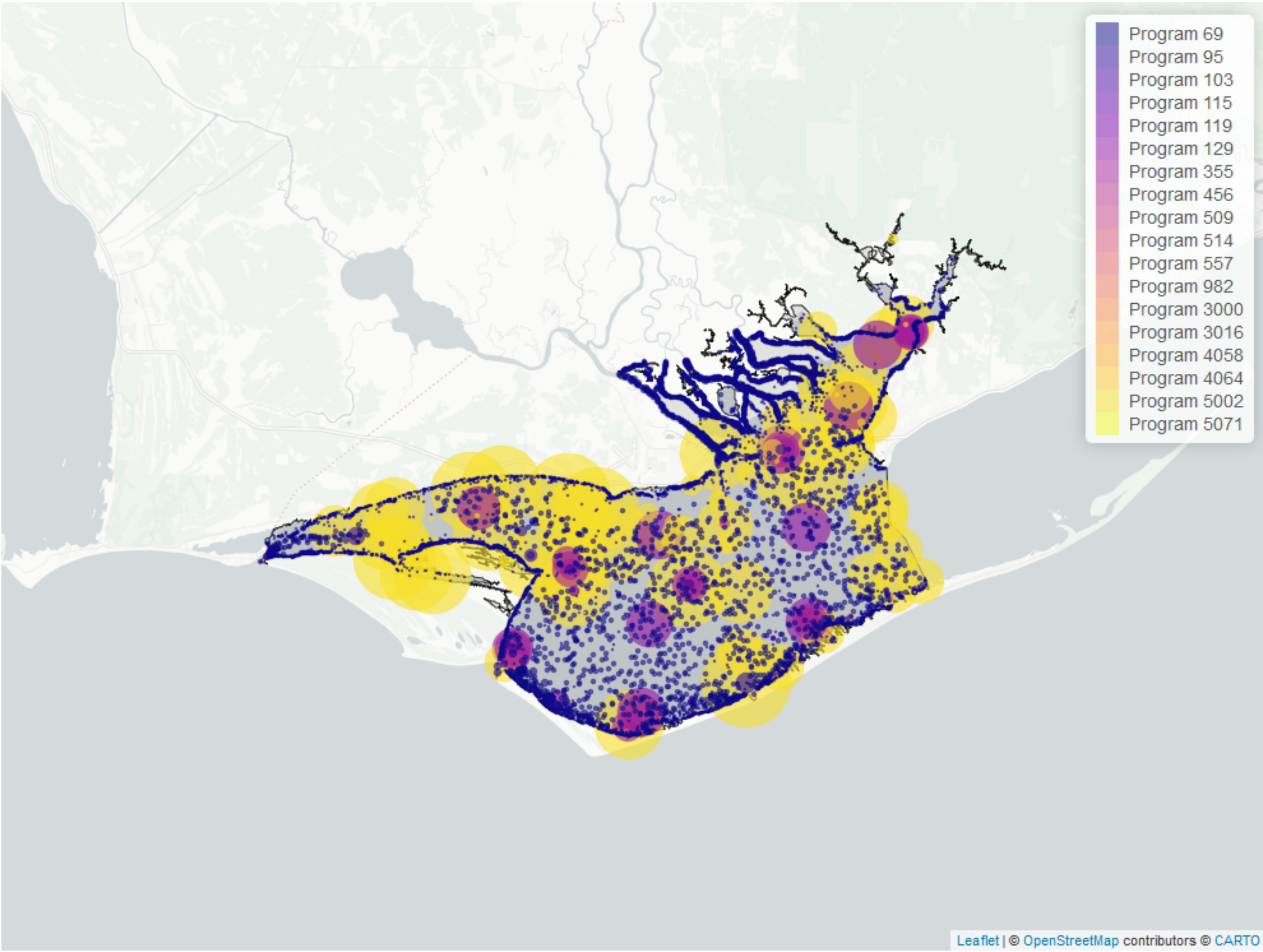

Figure 24: Map showing location of Discrete sampling sites for Water Temperature. The bubble size on the maps below reflect the amount of data available at each sampling site.

Table 29: Programs contributing data for Water Temperature

ProgramID	*N_Data*	*YearMin*	*YearMax*
5002	30496	1995	2024
69	24833	1998	2022
129	3432	2000	2023
355	2944	2003	2024
95	332	1964	2018
557	121	2006	2023
456	33	2005	2013
103	20	2004	2021
115	16	1992	2004
119	14	1994	1994
5071	3	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[13]
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]

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 Bay Aquatic Preserve

Table 30: Apalachicola National Estuarine Research Reserve System-Wide Monitoring Program (355)

ProgramLocationID	*Years of Data*	*Use in Analysis*	*Parameters*
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

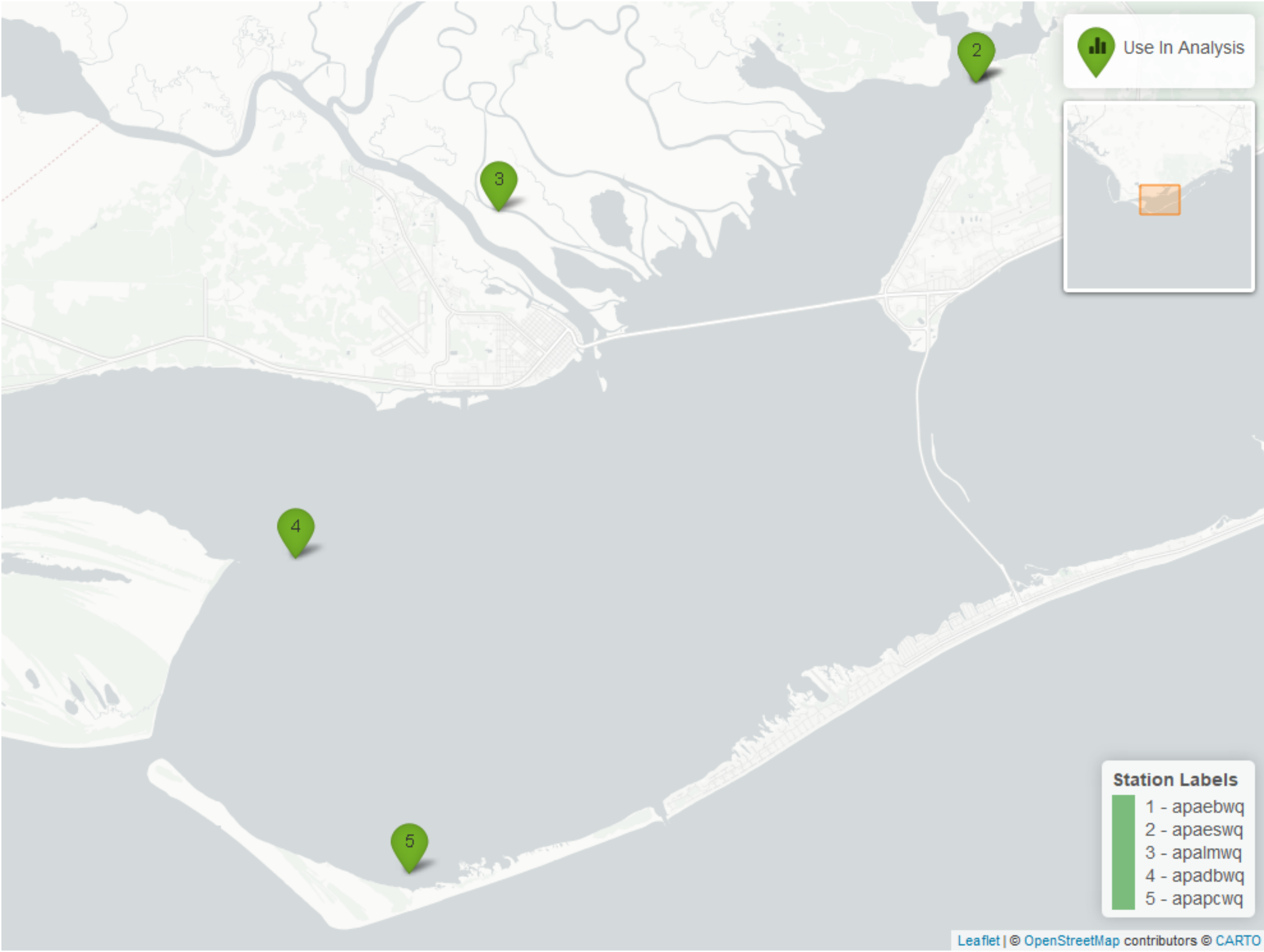

Figure 25: Map showing Continuous Water Quality Monitoring sampling locations within the boundaries of Apalachicola Bay Aquatic Preserve. Sites marked as *Use In Analysis* are featured in this report.

Dissolved Oxygen - All Stations Combined

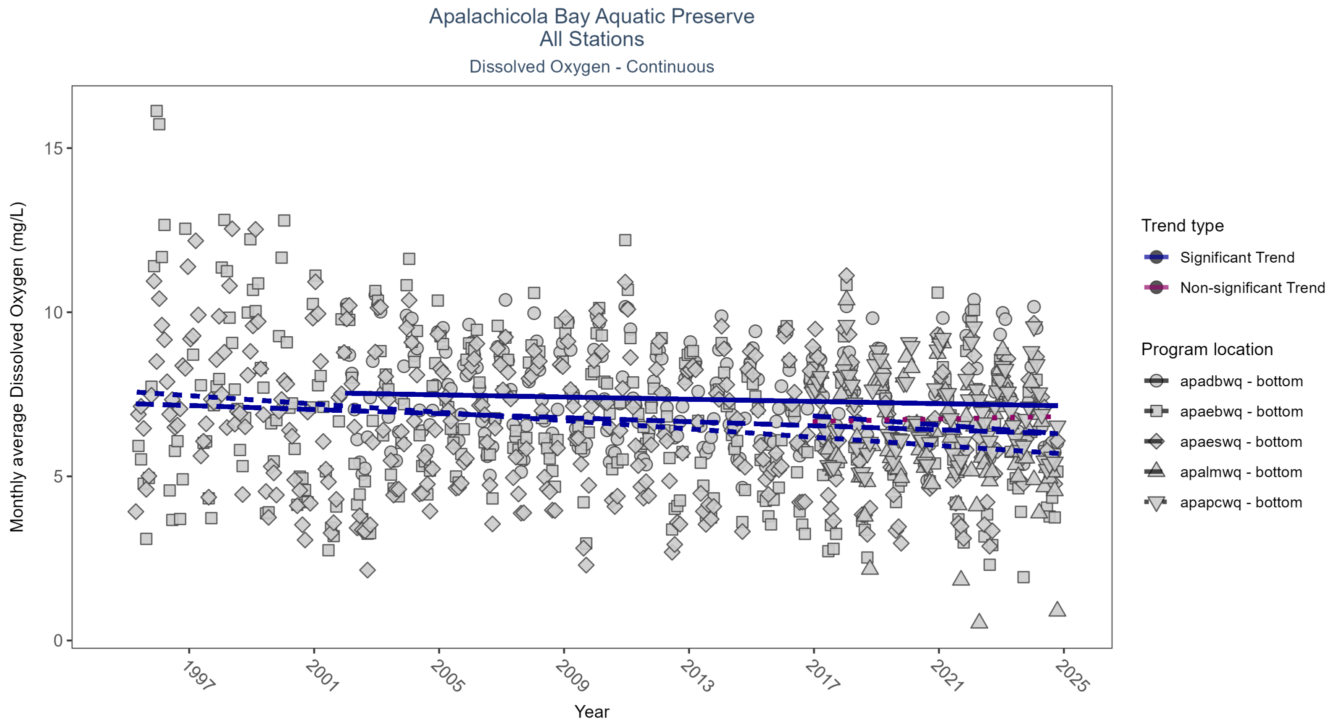

Figure 26: Figure for Dissolved Oxygen - Continuous - All stations combined

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

Station	N_Data	N_Years	Period of Record	Median	tau	SennIntercept	SennSlope	p
apaebwq	655847	30	1995 - 2024	6.8	-0.30	7.59	-0.06	0.0000
apaeswq	705901	30	1995 - 2024	6.8	-0.16	7.22	-0.03	0.0000
apapcwq	258495	9	2016 - 2024	6.9	0.06	6.66	0.02	0.4258
apadbwq	611956	23	2002 - 2024	7.2	-0.16	7.53	-0.02	0.0004
apalmwq	247064	9	2016 - 2024	6.3	-0.24	6.91	-0.07	0.0038

Dissolved Oxygen Saturation - All Stations Combined

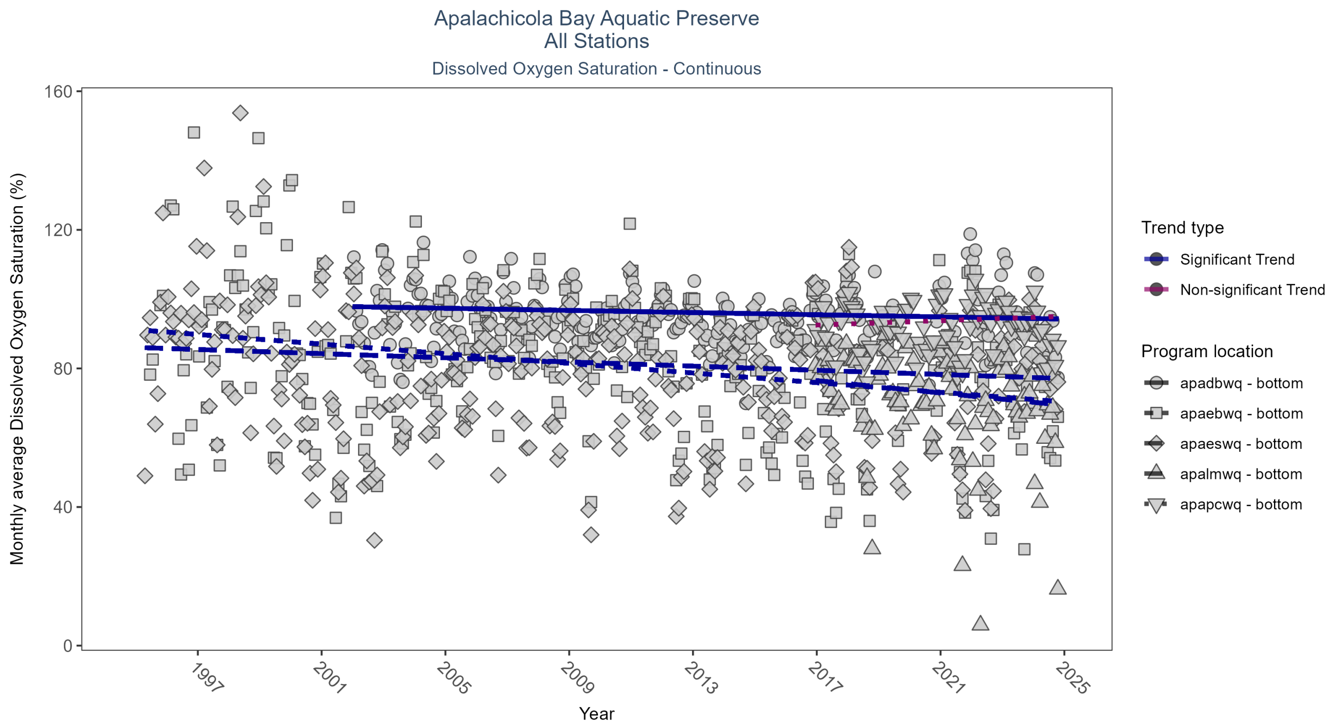

Figure 27: Figure for Dissolved Oxygen Saturation - Continuous - All stations combined

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

Station	N_Data	N_Years	Period of Record	Median	tau	SennIntercept	SennSlope	p
apalmwq	247600	9	2016 - 2024	74.4	-0.25	77.37	-0.89	0.0030
apaeswq	707065	30	1995 - 2024	83.9	-0.12	86.07	-0.30	0.0010
apaebwq	651672	30	1995 - 2024	84.5	-0.27	91.20	-0.70	0.0000
apadbwq	615405	23	2002 - 2024	94.6	-0.11	97.83	-0.16	0.0180
apapcwq	261951	9	2016 - 2024	94.0	0.10	92.20	0.32	0.2467

pH - All Stations Combined

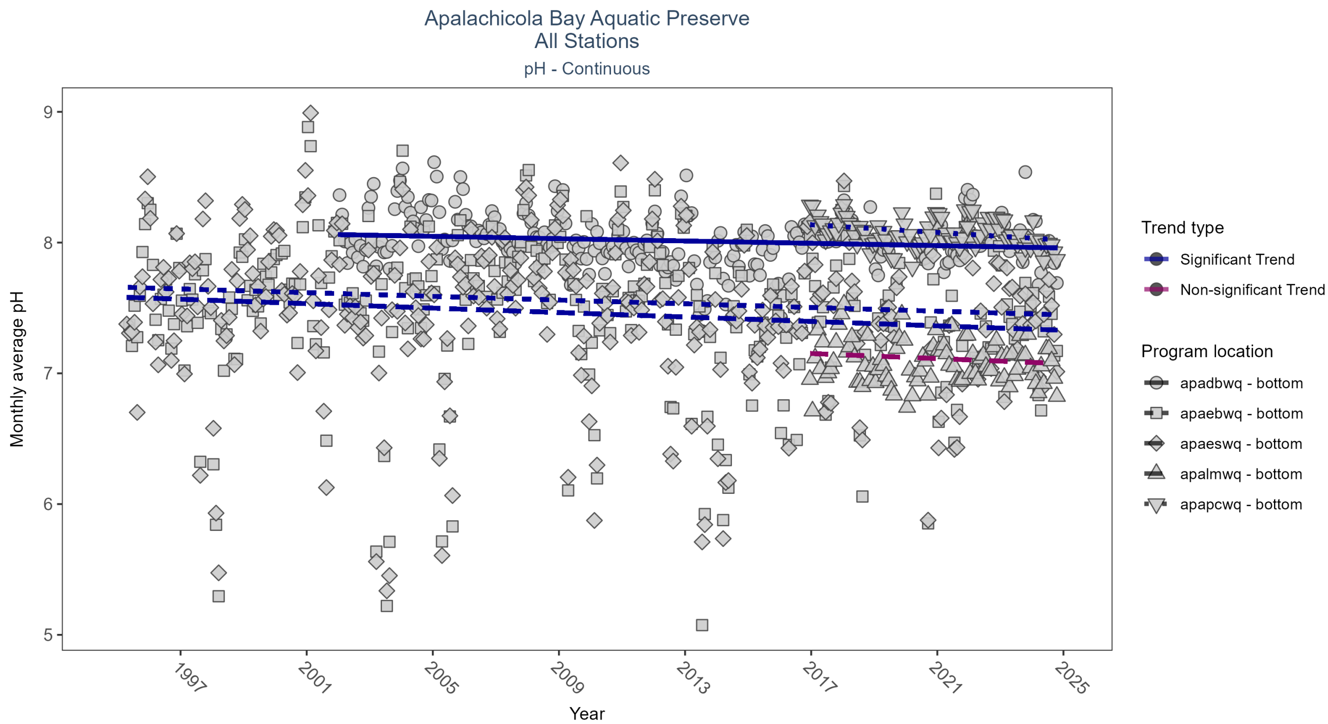

Figure 28: Figure for pH - Continuous - All stations combined

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

Station	N_Data	N_Years	Period of Record	Median	tau	SennIntercept	SennSlope	p
apaebwq	708442	30	1995 - 2024	7.6	-0.12	7.66	-0.01	0.0010
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
apalmwq	255201	9	2016 - 2024	7.1	-0.07	7.16	-0.01	0.4258

Salinity - All Stations Combined

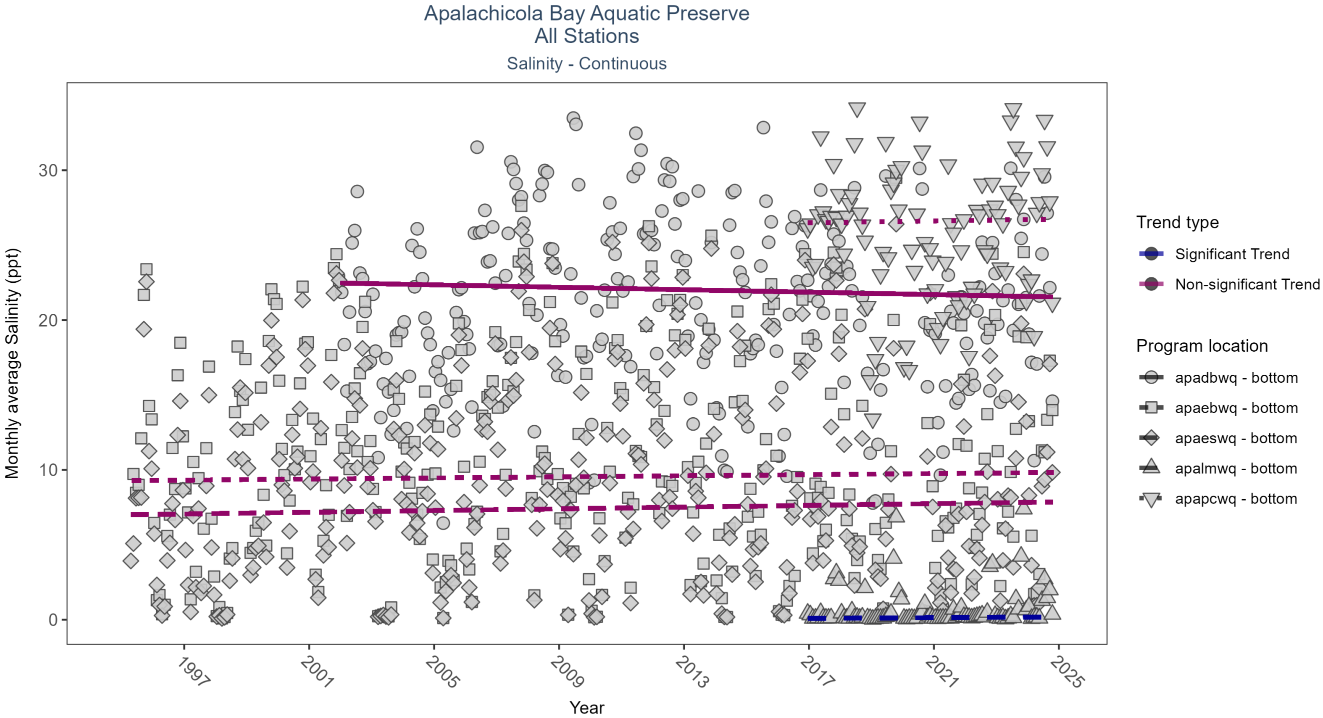

Figure 29: Figure for Salinity - Continuous - All stations combined

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

Station	N_Data	N_Years	Period of Record	Median	tau	SennIntercept	SennSlope	p
apadbwq	610043	23	2002 - 2024	22.1	-0.05	22.47	-0.04	0.2984
apaeswq	750078	30	1995 - 2024	7.4	0.05	7.00	0.03	0.2183
apapcwq	260825	9	2016 - 2024	26.7	0.02	26.46	0.03	0.8849
apaebwq	737639	30	1995 - 2024	9.8	0.03	9.28	0.02	0.4301
apalmwq	262776	9	2016 - 2024	0.1	0.22	0.08	0.01	0.0091

Turbidity - All Stations Combined

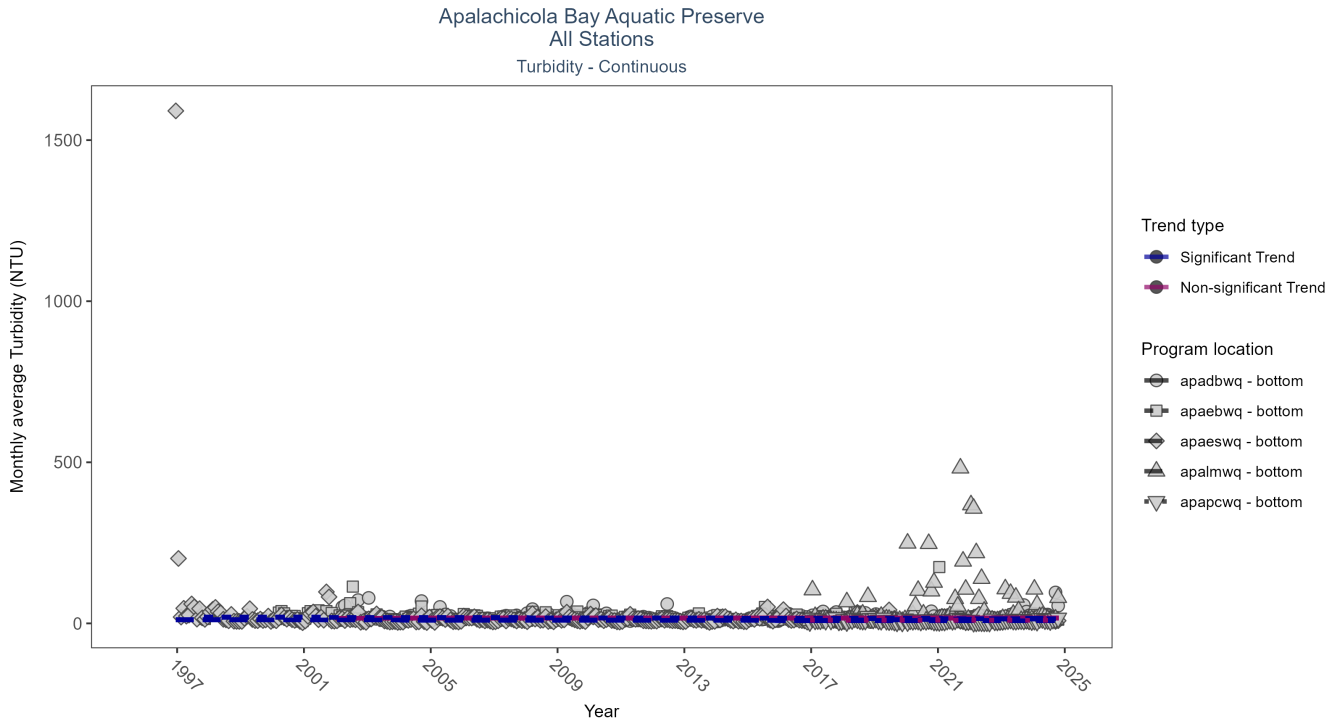

Figure 30: Figure for Turbidity - Continuous - All stations combined

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

Station	N_Data	N_Years	Period of Record	Median	tau	SennIntercept	SennSlope	p
apaeswq	693953	29	1996 - 2024	9	-0.15	11.37	-0.11	0.0003
apapcwq	249363	9	2016 - 2024	7	-0.06	10.47	-0.11	0.4855
apadbwq	597217	23	2002 - 2024	10	0.02	16.11	0.03	0.6196
apaebwq	626180	26	1997 - 2024	13	-0.19	19.68	-0.20	0.0000
apalmwq	235869	9	2016 - 2024	12	0.24	7.63	0.93	0.0047

Water Temperature - All Stations Combined

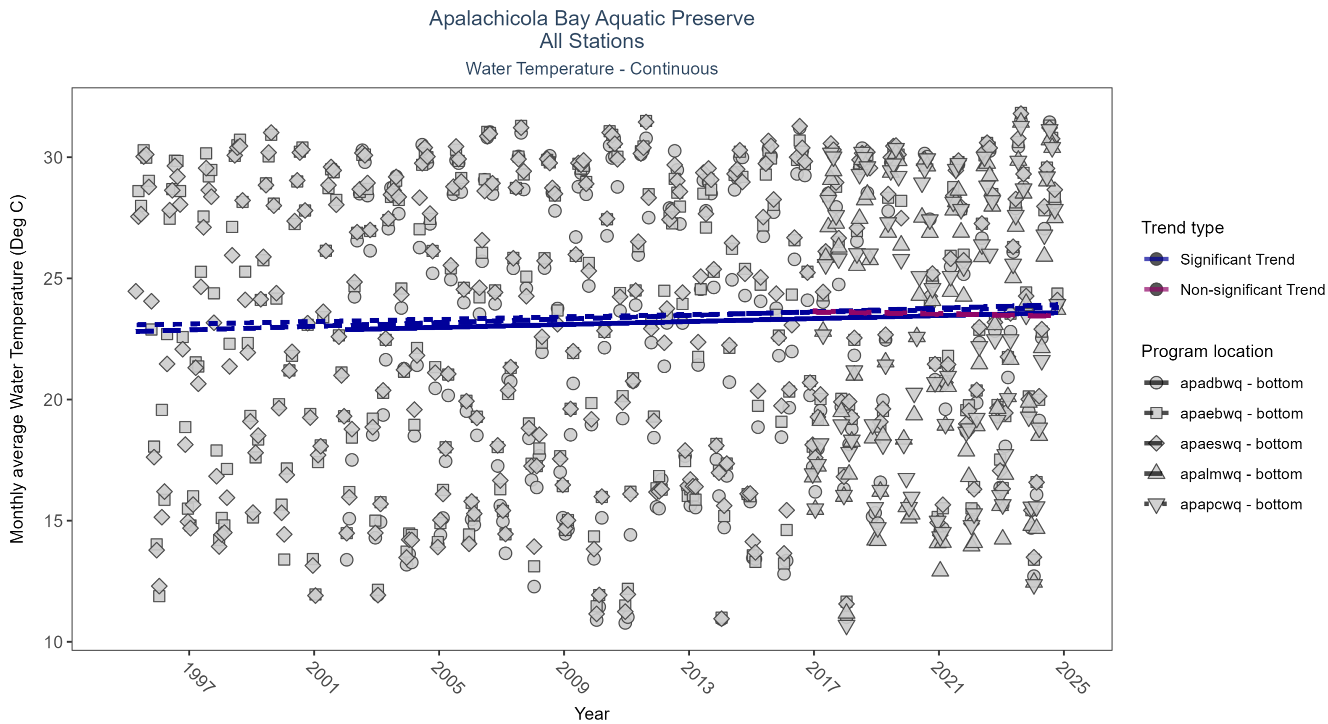

Figure 31: Figure for Water Temperature - Continuous - All stations combined

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

Station	N_Data	N_Years	Period of Record	Median	tau	SennIntercept	SennSlope	p
apalmwq	265036	9	2016 - 2024	22.8	-0.03	23.64	-0.02	0.7721
apaebwq	752681	30	1995 - 2024	24.3	0.14	23.07	0.02	0.0002
apaeswq	759336	30	1995 - 2024	24.2	0.19	22.80	0.04	0.0000
apapcwq	264293	9	2016 - 2024	23.3	-0.05	23.68	-0.03	0.5624
apadbwq	635215	23	2002 - 2024	23.4	0.15	22.88	0.03	0.0010

Submerged Aquatic Vegetation

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

Submerged aquatic vegetation (*SAV*) refers to plants and plant-like macroalgae species that live entirely underwater. The two primary categories of *SAV* inhabiting Florida estuaries are *benthic macroalgae* and *seagrasses*. They often grow together in dense beds or meadows that carpet the seafloor. *Macroalgae* include multicellular species of green, red and brown algae that often live attached to the substrate by a holdfast. They tend to grow quickly and can tolerate relatively high nutrient levels, making them a threat to seagrasses and other benthic habitats in areas with poor water quality. In contrast, *seagrasses* are grass-like, vascular, flowering plants that are attached to the seafloor by extensive root systems. *Seagrasses* occur throughout the coastal areas of Florida, including protected bays and lagoons as well as deeper offshore waters on the continental shelf. *Seagrasses* have taken advantage of the broad, shallow shelf and clear water to produce two of the most extensive seagrass beds anywhere in continental North America.

Parameters

Percent Cover measures the fraction of an area of seafloor that is covered by SAV, usually estimated by evaluating multiple small areas of seafloor. Percent cover is often estimated for total SAV, individual types of vegetation (seagrass, attached algae, drift algae) and individual species.

Frequency of Occurrence was calculated as the number of times a taxon was observed in a year divided by the number of sampling events, multiplied by 100. Analysis is conducted at the quadrat level and is inclusive of all quadrats (i.e., quadrats evaluated using Braun-Blanquet, modified Braun-Blanquet, and percent cover."

Species

Turtle grass (*Thalassia testudinum*) is the largest of the Florida seagrasses, with longer, thicker blades and deeper root structures than any of the other seagrasses. It is considered a climax seagrass species.

Shoal grass (*Halodule wrightii*) is an early colonizer of vegetated areas and usually grows in water too shallow for other species except *widgeon grass*. It can often tolerate larger salinity ranges than other seagrass species. *Shoal grass* is characterized by thin, flat blades, that are narrower than *turtle grass* blades.

Manatee grass (*Syringodium filiforme*) is easily recognizable because its leaves are thin and cylindrical instead of the flat, ribbon-like form shared by many other seagrass species. The leaves can grow up to half a meter in length. *Manatee grass* is usually found in mixed seagrass beds or small, dense monospecific patches.

Widgeon grass (*Ruppia maritima*) grows in both fresh and salt water and is widely distributed throughout Florida's estuaries in less saline areas, particularly in inlets along the east coast. This species resembles *shoal grass* in certain environments but can be identified by the pointed tips of its leaves.

Three species of *Halophila spp.* are found in Florida - **Star grass** (*Halophila engelmannii*), **Paddle grass** (*Halophila decipiens*), and **Johnson's seagrass** (*Halophila johnsonii*). These are smaller, more fragile seagrasses than other Florida species and are considered ephemeral. They grow along a single long rhizome, with short blades. These species are not well-studied, although surveys are underway to define their ecological roles.

Notes

Star grass, *Paddle grass*, and *Johnson's seagrass* will be grouped together and listed as **Halophila spp.** in the following managed areas. This is because several surveys did not specify to the species level:

- Banana River Aquatic Preserve
- Indian River-Malabar to Vero Beach Aquatic Preserve
- Indian River-Vero Beach to Ft. Pierce Aquatic Preserve
- Jensen Beach to Jupiter Inlet Aquatic Preserve
- Loxahatchee River-Lake Worth Creek Aquatic Preserve
- Mosquito Lagoon Aquatic Preserve

- Biscayne Bay Aquatic Preserve
- Florida Keys National Marine Sanctuary

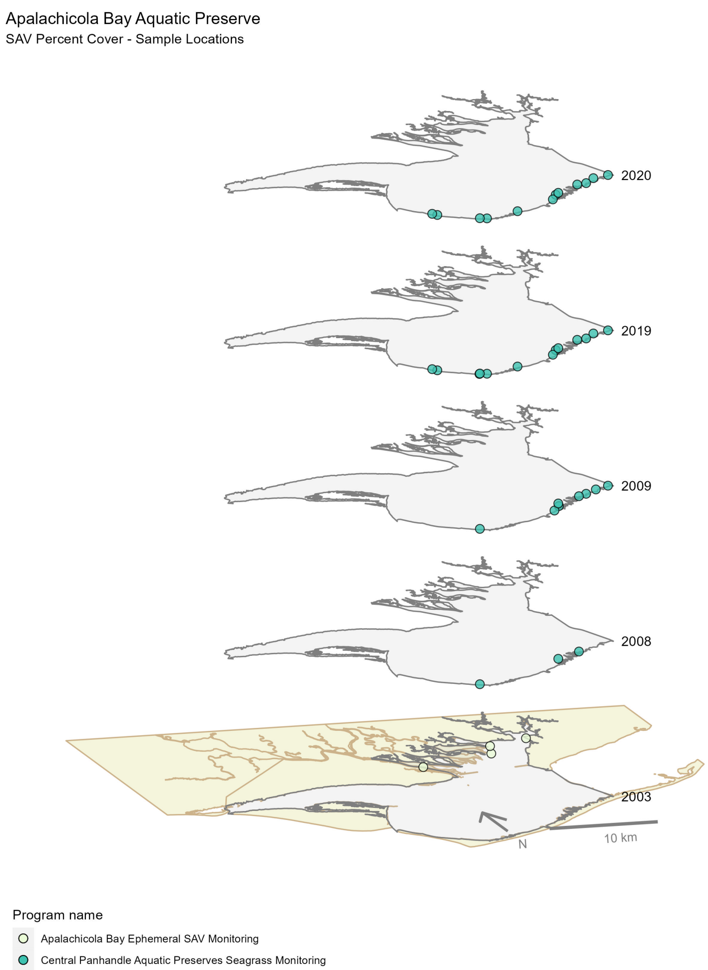

Figure 32: Maps showing the temporal scope of SAV sampling sites within the boundaries of *Apalachicola Bay Aquatic Preserve* by Program name.

Sampling locations by Program:

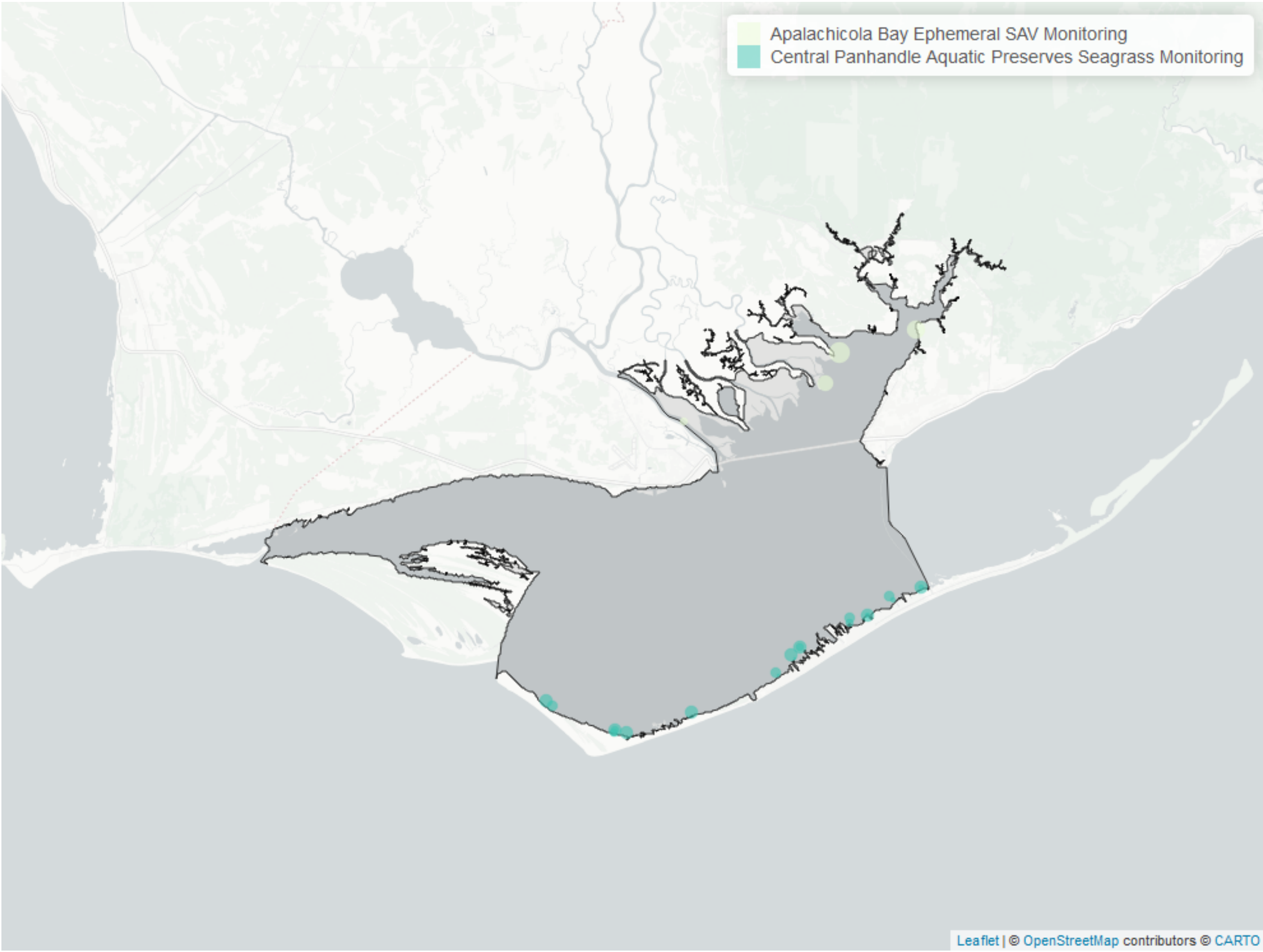

Figure 33: Map showing SAV sampling sites within the boundaries of *Apalachicola Bay Aquatic Preserve*. The point size reflects the number of samples at a given sampling site.

Table 37: Central Panhandle Aquatic Preserves Seagrass Monitoring - Program 557

N-Data	*YearMin*	*YearMax*	*method*	*Sample Locations*
308	2008	2023	Braun Blanquet	21

Table 38: 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

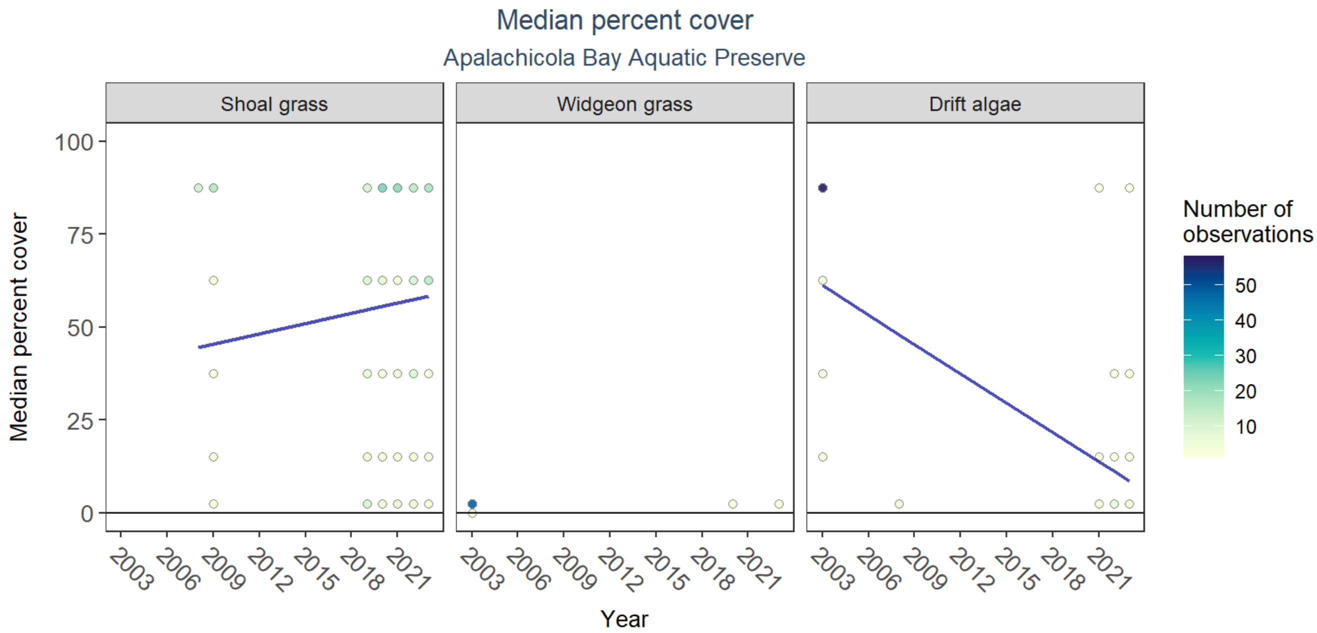

Figure 34: Trends in median percent cover for various seagrass species in Apalachicola Bay Aquatic Preserve

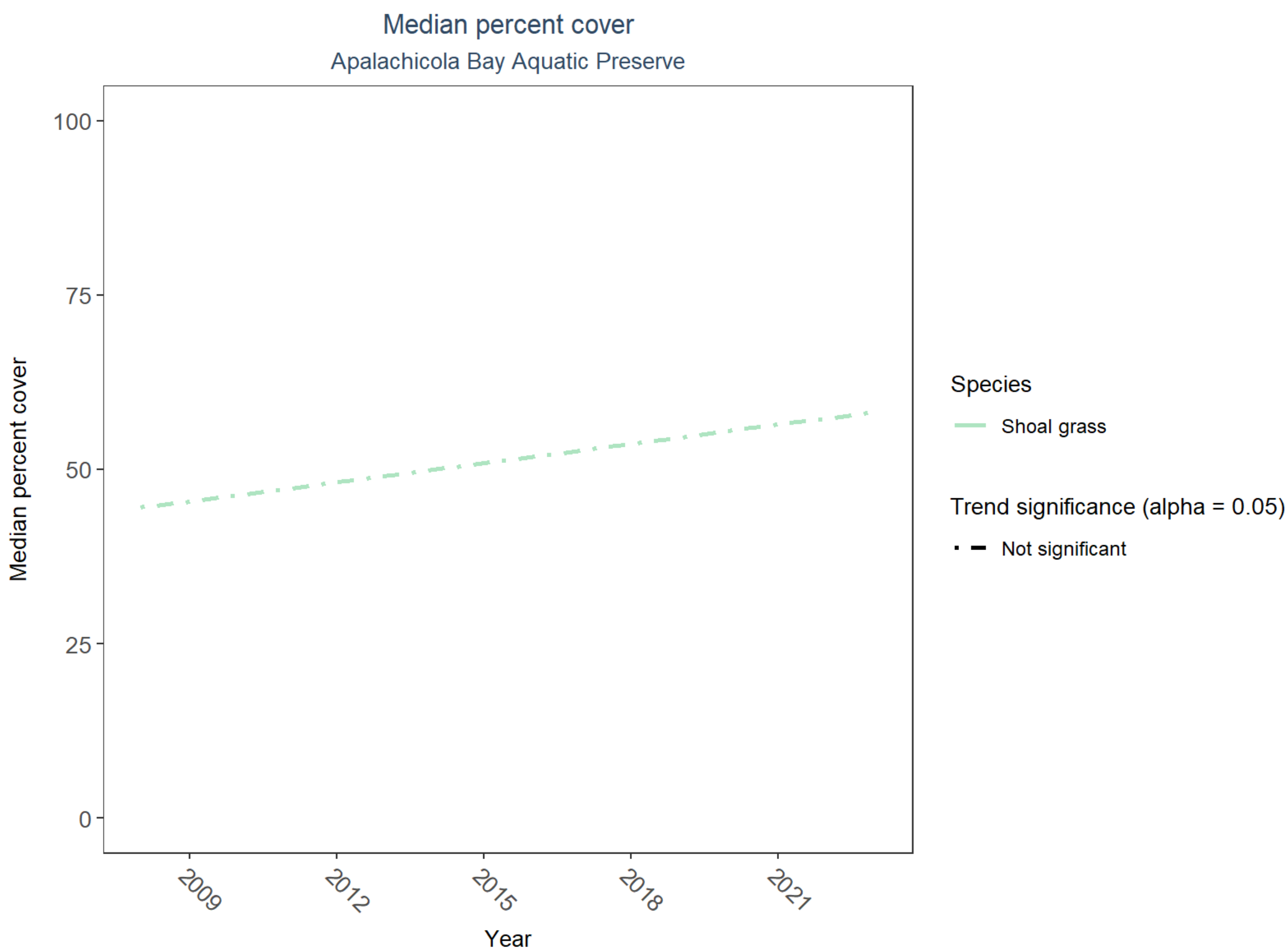

Figure 35: Trends in median percent cover for various seagrass species in Apalachicola Bay Aquatic Preserve - simplified

Table 39: Percent Cover Trend Analysis for Apalachicola Bay Aquatic Preserve

CommonName	*Trend Significance (0.05)*	*Period of Record*	*LME-Intercept*	*LME-Slope*	*p*
Drift algae	Significantly decreasing trend	2003 - 2023	84.82182	-2.6309481	0.0014344
Shoal grass	No significant trend	2008 - 2023	31.68993	0.9163934	0.4876111
No grass in quadrat	Model did not fit the available data	2003 - 2023	-	-	-
Widgeon grass	Insufficient data to calculate trend	-	-	-	-

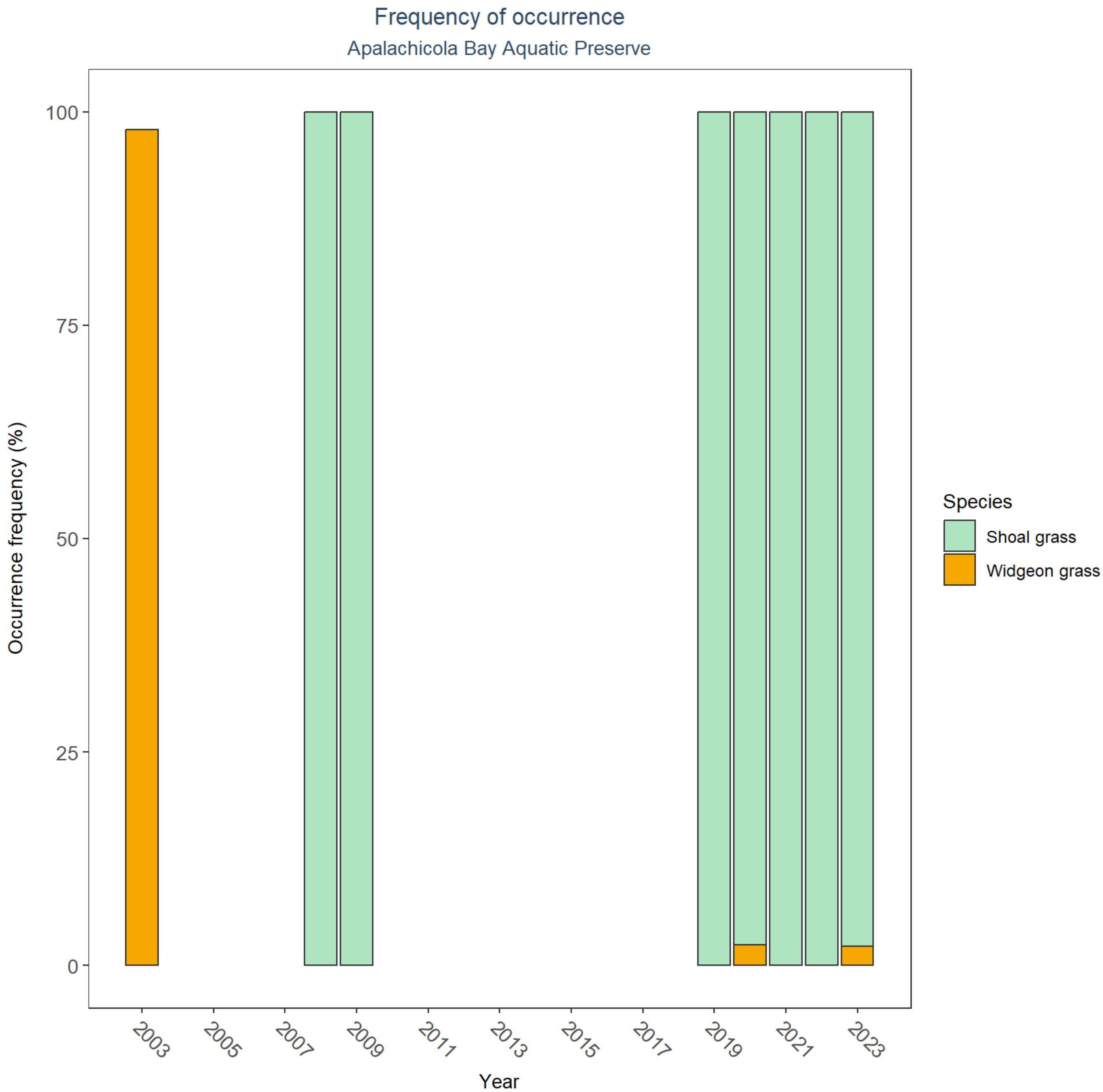

Figure 36: Frequency of occurrence for various seagrass species in Apalachicola Bay Aquatic Preserve

Nekton

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

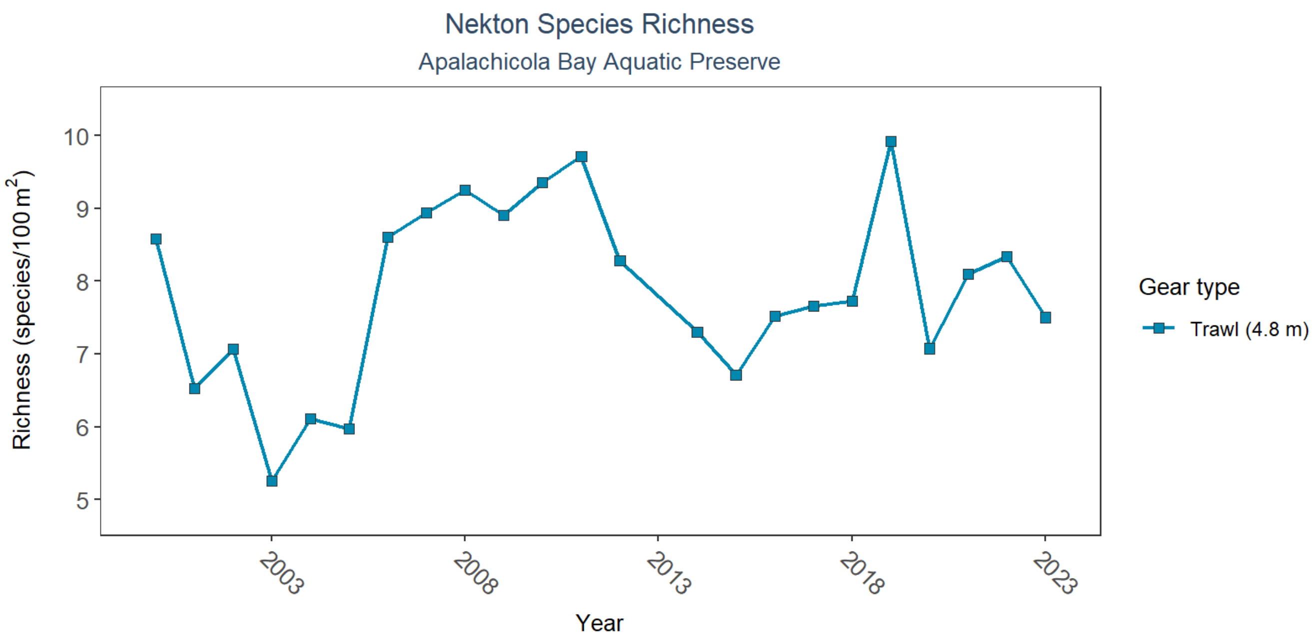

Figure 37: Figure for Nekton Species Richness in Apalachicola Bay Aquatic Preserve

Table 40: Nekton Species Richness

Gear Type	*Sample Count*	*Number of Years*	*Period of Record*	*Median N of Taxa*	*Mean N of Taxa*
Trawl (4.8)	1736	23	2000 - 2023	7.78	7.8

Coastal Wetlands

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

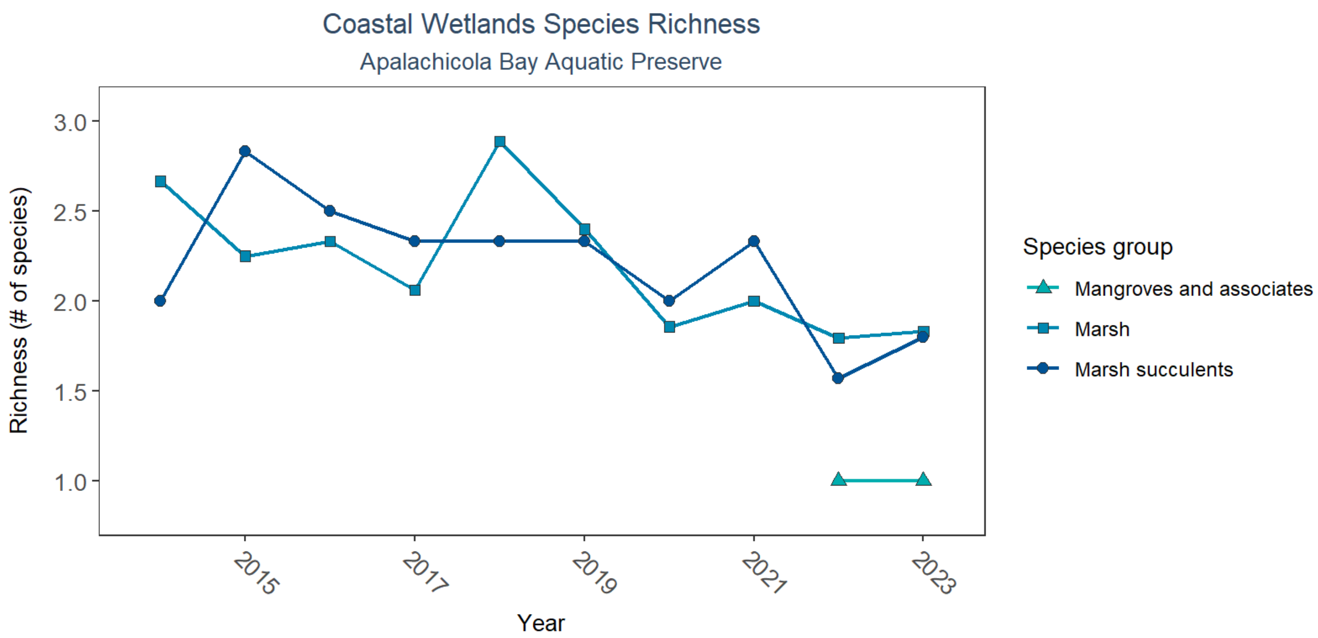

Figure 38: Figure for Coastal Wetlands Species Richness in Apalachicola Bay Aquatic Preserve

Table 41: Coastal Wetlands Species Richness

Species Group	*Sample Count*	*Number of Years*	*Period of Record*	*Median N of Taxa*	*Mean N of Taxa*
Mangroves and associates	4	2	2022 - 2023	1.0	1.00
Marsh	144	10	2014 - 2023	1.5	2.08
Marsh succulents	56	10	2014 - 2023	3.0	2.20

Oyster

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

Density

Natural

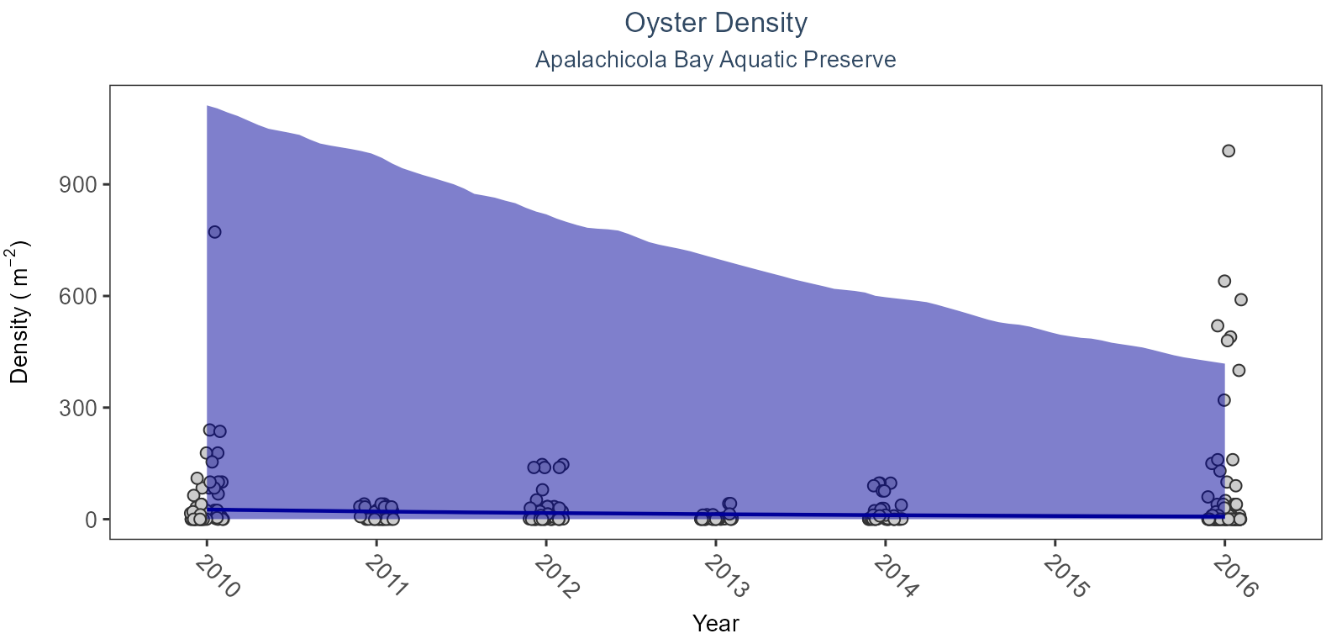

Figure 39: Figure for Oyster Density in Apalachicola Bay Aquatic Preserve

Table 42: Model results for Oyster Density - Natural

Shell Type	*Habitat Type*	*Trend Status*	*Estimate*	*Standard Error*	*Credible Interval*
Live Oyster Shells	Natural	Significantly decreasing trend	-0.17	0.09	-0.34 to -0.01

Percent Live

Natural

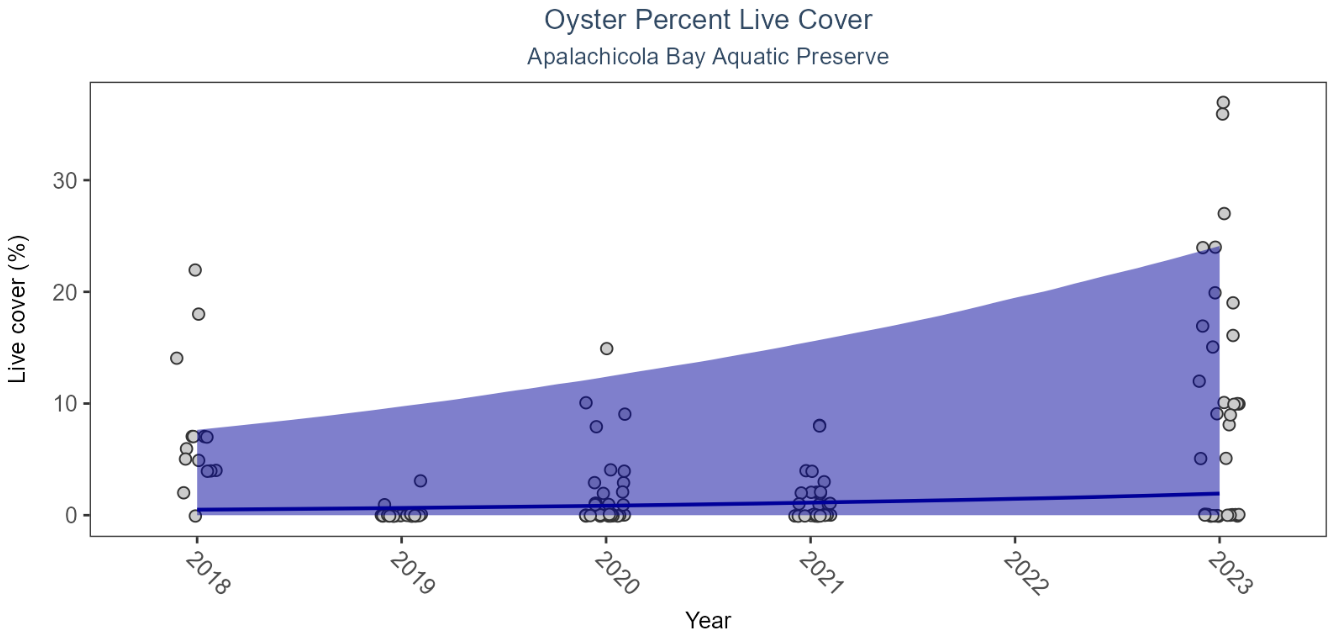

Figure 40: Figure for Oyster Percent Live in Apalachicola Bay Aquatic Preserve

Table 43: 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	0.27	0.03	0.22 to 0.33

Shell Height

Natural

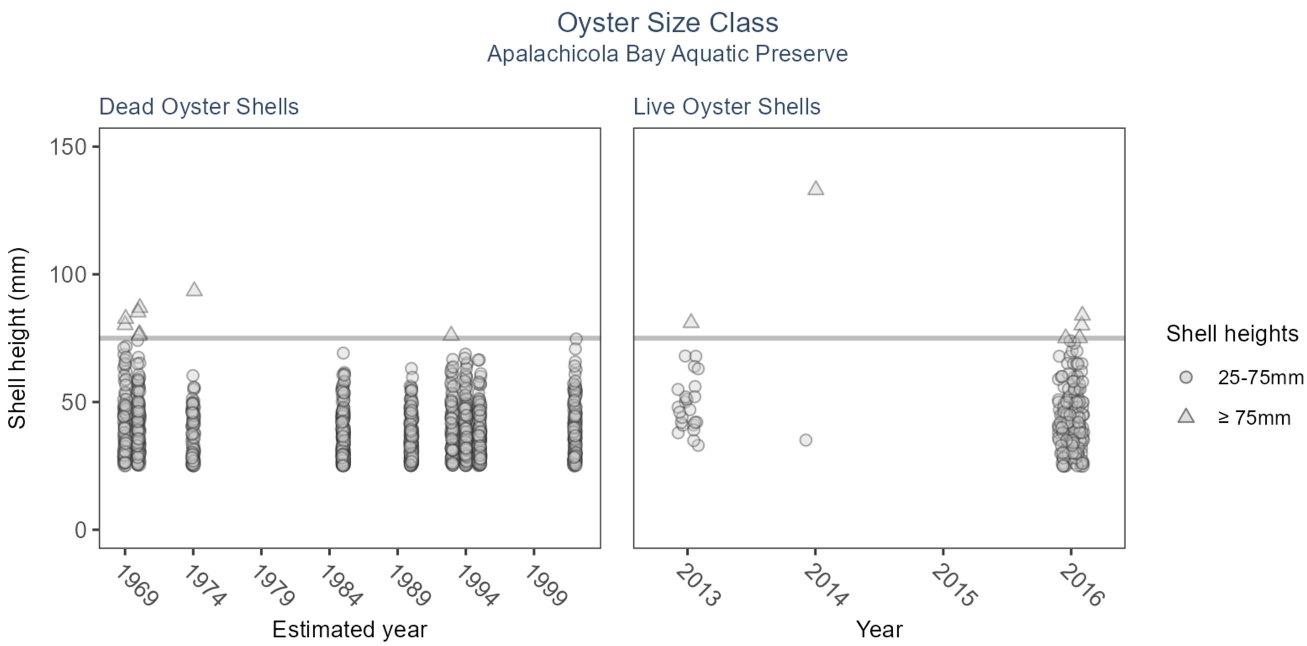

Figure 41: Figure for Oyster Shell Height in Apalachicola Bay Aquatic Preserve

Table 44: 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	-27.34	88.92	-400.01 to 10.1
Dead Oyster Shells	Natural	-	-	-	NA to NA
Dead Oyster Shells	Natural	-	-	-	NA to NA
Live Oyster Shells	Natural	-	-	-	NA to NA
Live Oyster Shells	Natural	-	-	-	NA to NA
Live Oyster Shells	Natural	-	-	-	NA to NA

References

1. Florida Department of Environmental Protection (DEP); Office of Resilience and Coastal Protection (RCP); Apalachicola National Estuarine Research Reserve. Apalachicola National Estuarine Research Reserve System-Wide Monitoring Program. (2024).

2. Florida Department of Environmental Protection (DEP). Florida STORET / WIN. (2024).

3. U.S. Environmental Protection Agency (EPA). EPA STOrage and RETrieval Data Warehouse (STORET)/WQX. (2023).

4. U.S. Environmental Protection Agency (EPA); Office of Research and Development. Environmental Monitoring Assessment Program. (2004).

5. U.S. Environmental Protection Agency (EPA); Office of Water; National Oceanic and Atmospheric Administration (NOAA); U.S. Geological Survey (USGS); U.S. Fish and Wildlife Service (USFWS); National Estuary Program (NEP); coastal states. National Aquatic Resource Surveys, National Coastal Condition Assessment. (2021).

6. University of Florida (UF); Institute of Food and Agricultural Sciences. Florida LAKEWATCH Program. (2024).

7. Florida Fish and Wildlife Conservation Commission (FWC). Fisheries-Independent Monitoring (FIM) Program. (2022).

8. Florida Fish and Wildlife Conservation Commission (FWC); Florida Fish and Wildlife Research Institute (FWRI). Harmful Algal Bloom Marine Observation Network. (2018).

9. National Oceanic and Atmospheric Administration (NOAA); National Centers for Coastal Ocean Science's Center for Coastal Monitoring and Assessment. National Status and Trends Bioeffects program. (1994).

10. Florida Department of Environmental Protection (DEP); Office of Resilience and Coastal Protection (RCP); Apalachicola National Estuarine Research Reserve. Apalachicola National Estuarine Research Reserve Juvenile Fish and Benthic Macroinvertebrate Monitoring. (2023).

11. Florida Department of Environmental Protection (DEP); Office of Resilience and Coastal Protection (RCP); Central Panhandle Aquatic Preserves. Central Panhandle Aquatic Preserves Seagrass Monitoring. (2023).

12. Alabama Center for Ecological Resilience (ACER). Oyster shell heights and taxonomic diversity in 2015-2017 among previously documented oiled and non-oiled reefs in Louisiana, Alabama, and the Florida panhandle. (2017).

13. Oyster Sentinel. Oyster Sentinel . (2016).

14. Florida Department of Environmental Protection (DEP); Office of Resilience and Coastal Protection (RCP); Central Panhandle Aquatic Preserves. NRDA Oyster Cultch Recovery Project. (2024).