# Banana River Aquatic Preserve

SEACAR Habitat Analyses

Last compiled on 08 January, 2025

## Contents

## Funding & Acknowledgements

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## Threshold Filtering

Threshold filters, following the guidance of Florida Department of Environmental Protection's (*FDEP*) Division of Environmental Assessment and Restoration (*DEAR*) are used to exclude specific results values from the SEACAR Analysis. Based on the threshold filters, Quality Assurance / Quality Control (*QAQC*) Flags are inserted into the *SEACAR_QAQCFlagCode* and *SEACAR_QAQC_Description* columns of the export data. The *Include* column indicates whether the *QAQC* Flag will also indicate that data are excluded from analysis. No data are excluded from the data export, but the analysis scripts can use the *Include* column to exclude data (1 to include, 0 to exclude).

Table 1: Continuous Water Quality threshold values

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

Table 2: Discrete Water Quality threshold values

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

| *Parameter Name* | *Units* | *Low Threshold* | *High Threshold* |
|---|---|---|---|
| Dissolved Oxygen | mg/L | -0.000001 | 25 |
| Dissolved Oxygen Saturation | % | -0.000001 | 310 |
| Fluorescent Dissolved Organic Matter | QSE | - | - |
| Light Extinction Coefficient | 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

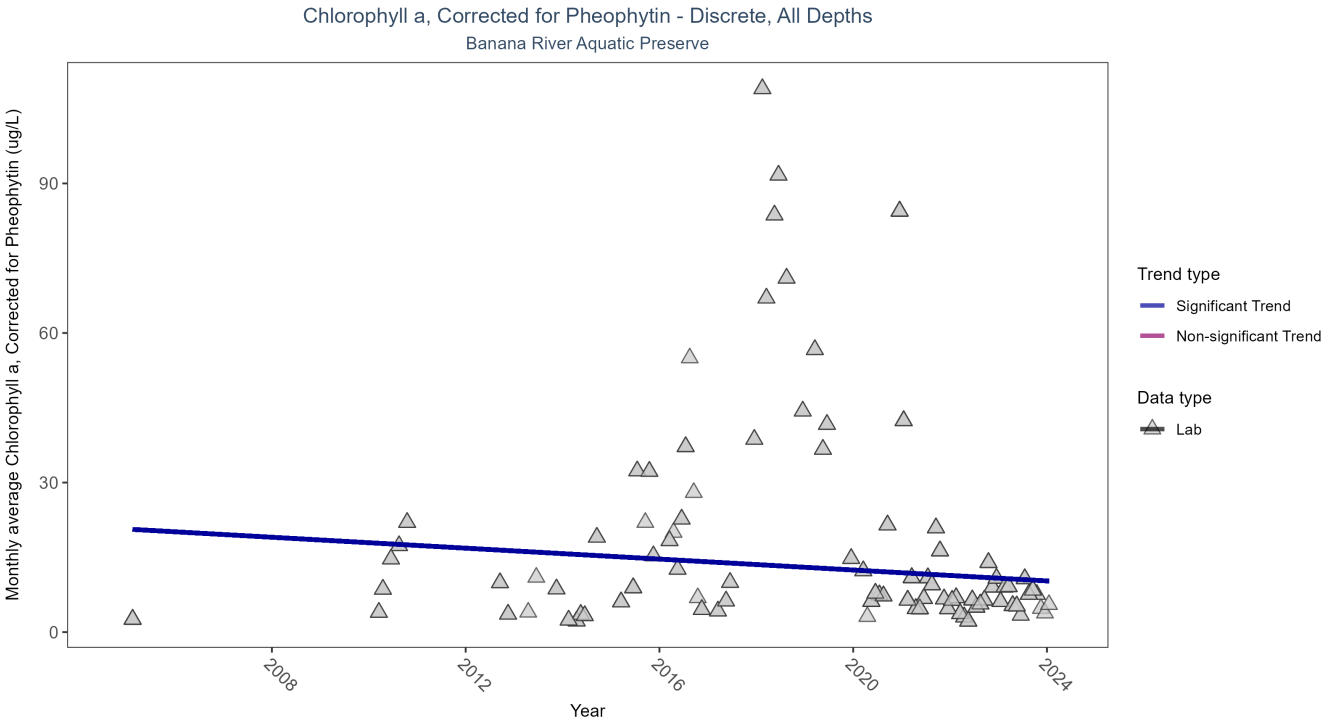


Figure 1: Seasonal Kendall-Tau Results for Chlorophyll a, Corrected for Pheophytin - Discrete

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 | 475 | 15 | 7.0221 | TRUE | -0.2346 | 0.0154 | -0.5476 | 20.6703 | 10.3269 | 0.5012 | -1 |

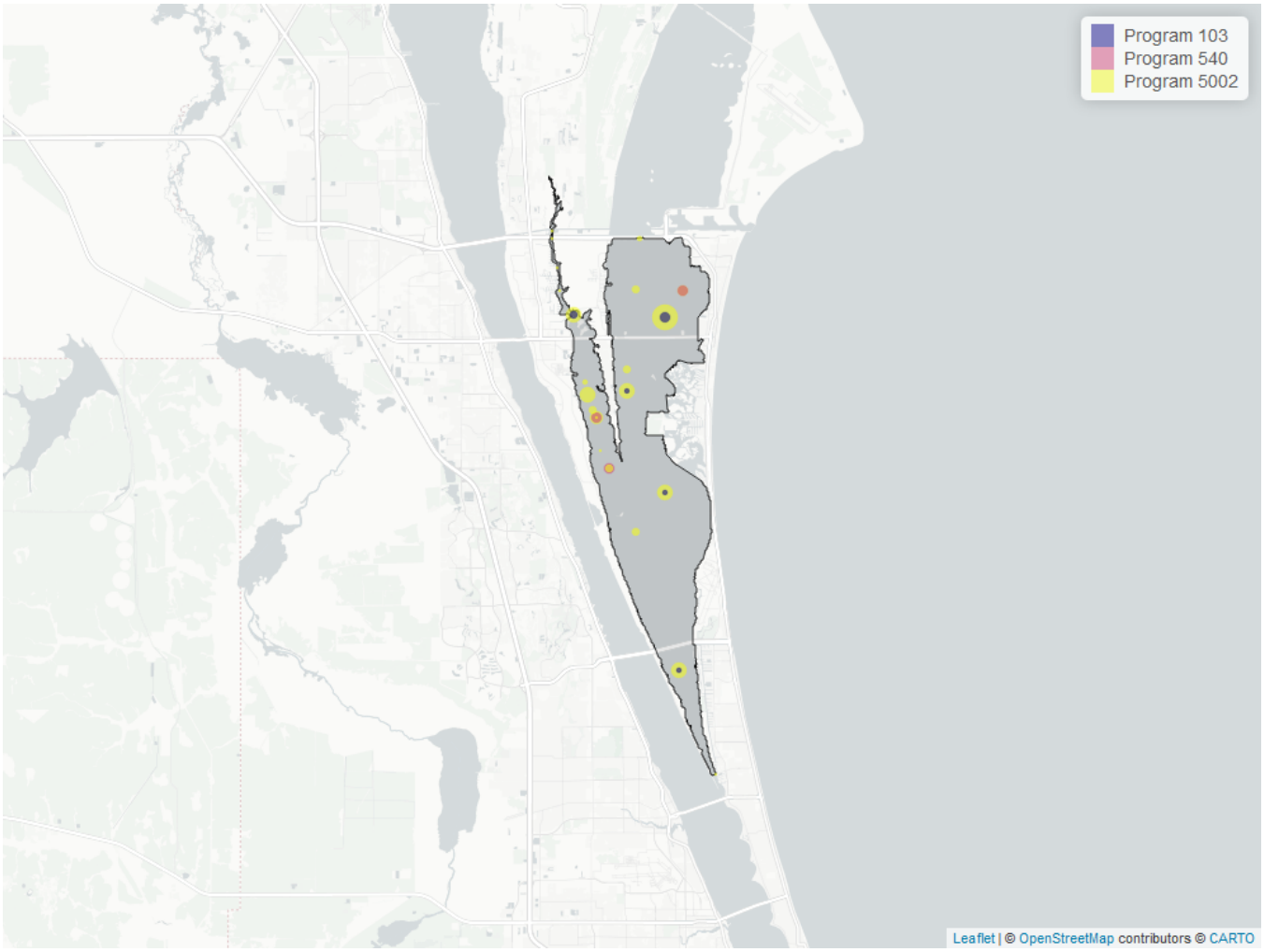


Figure 2: Map showing location of Discrete sampling sites for Chlorophyll a, Corrected for Pheophytin. The bubble size on the maps below reflect the amount of data available at each sampling site.

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

| *ProgramID* | *N_Data* | *YearMin* | *YearMax* |
|---|---|---|---|
| 5002 | 410 | 2005 | 2024 |
| 103 | 43 | 2020 | 2021 |
| 540 | 42 | 2016 | 2020 |

**Program names:**

*103* - EPA STOrage and RETrieval Data Warehouse (STORET)/WQX[1]
*540* - Shellfish Harvest Area Classification Program[2]
*5002* - Florida STORET / WIN[3]

## Chlorophyll a, Uncorrected for Pheophytin - Discrete Water Quality

### Seasonal Kendall-Tau Trend Analysis

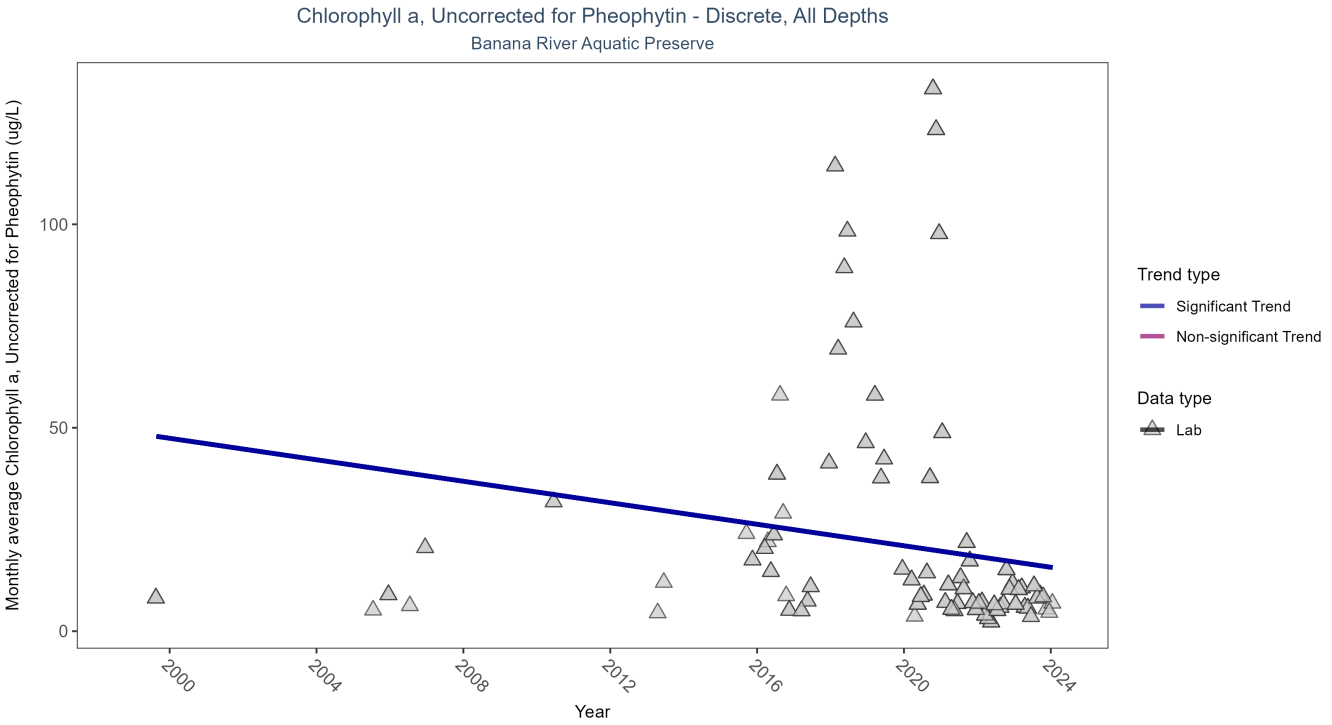


Figure 3: Seasonal Kendall-Tau Results for Chlorophyll a, Uncorrected for Pheophytin - Discrete

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 | 386 | 15 | 8.4779 | TRUE | -0.3217 | 0.0003 | -1.321 | 48.7348 | 7.4679 | 0.76 | -2 |

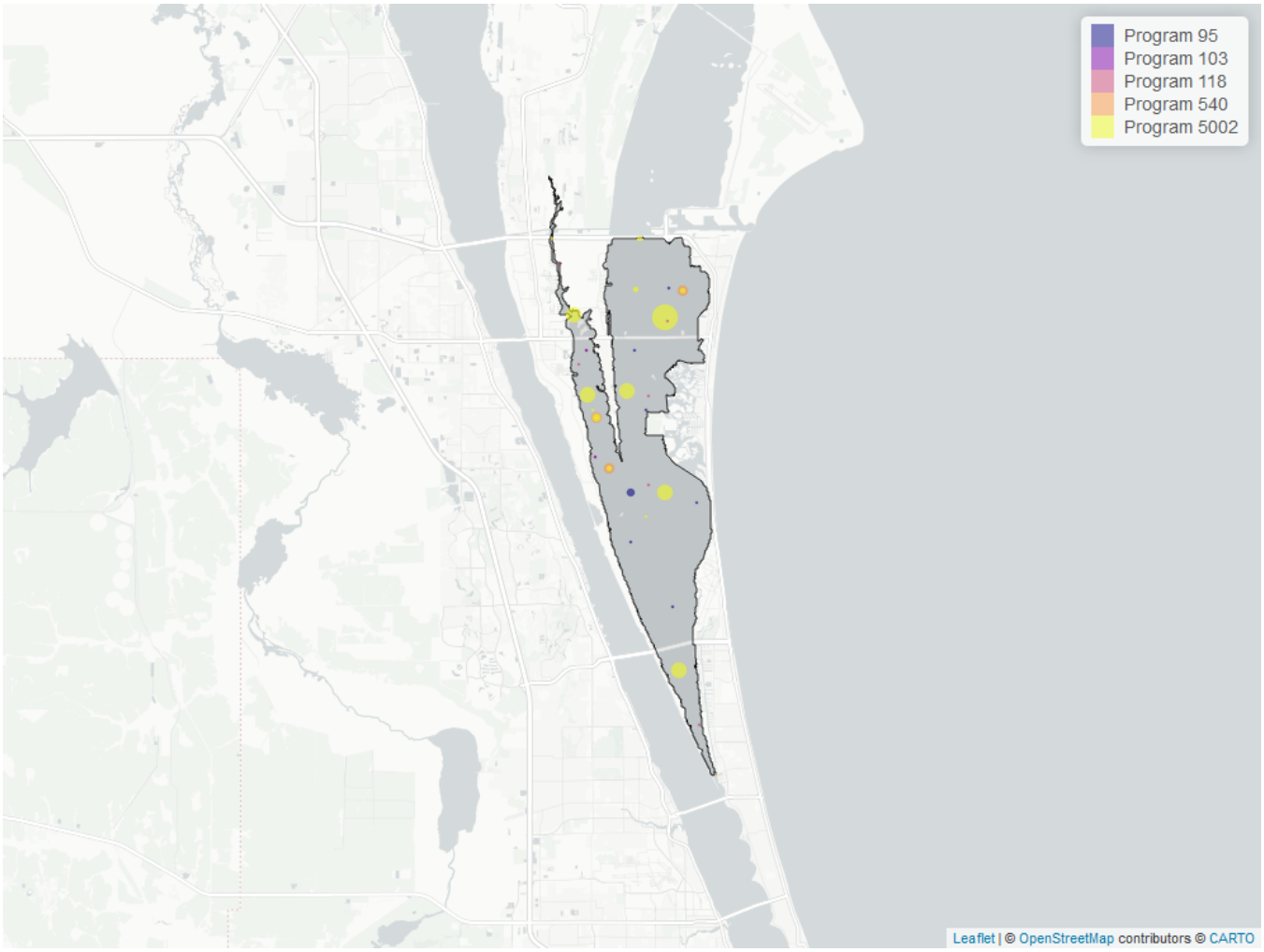


Figure 4: Map showing location of Discrete sampling sites for Chlorophyll a, Uncorrected for Pheophytin. The bubble size on the maps below reflect the amount of data available at each sampling site.

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

| *ProgramID* | *N_Data* | *YearMin* | *YearMax* |
|---|---|---|---|
| 5002 | 334 | 1999 | 2024 |
| 540 | 44 | 2016 | 2020 |
| 95 | 17 | 2010 | 2018 |
| 118 | 8 | 2005 | 2010 |
| 103 | 4 | 2005 | 2021 |

**Program names:**

*95* - Harmful Algal Bloom Marine Observation Network[4]
*103* - EPA STOrage and RETrieval Data Warehouse (STORET)/WQX[1]
*118* - National Aquatic Resource Surveys, National Coastal Condition Assessment[5]
*540* - Shellfish Harvest Area Classification Program[2]
*5002* - Florida STORET / WIN[3]

## Dissolved Oxygen - Discrete Water Quality

### Seasonal Kendall-Tau Trend Analysis

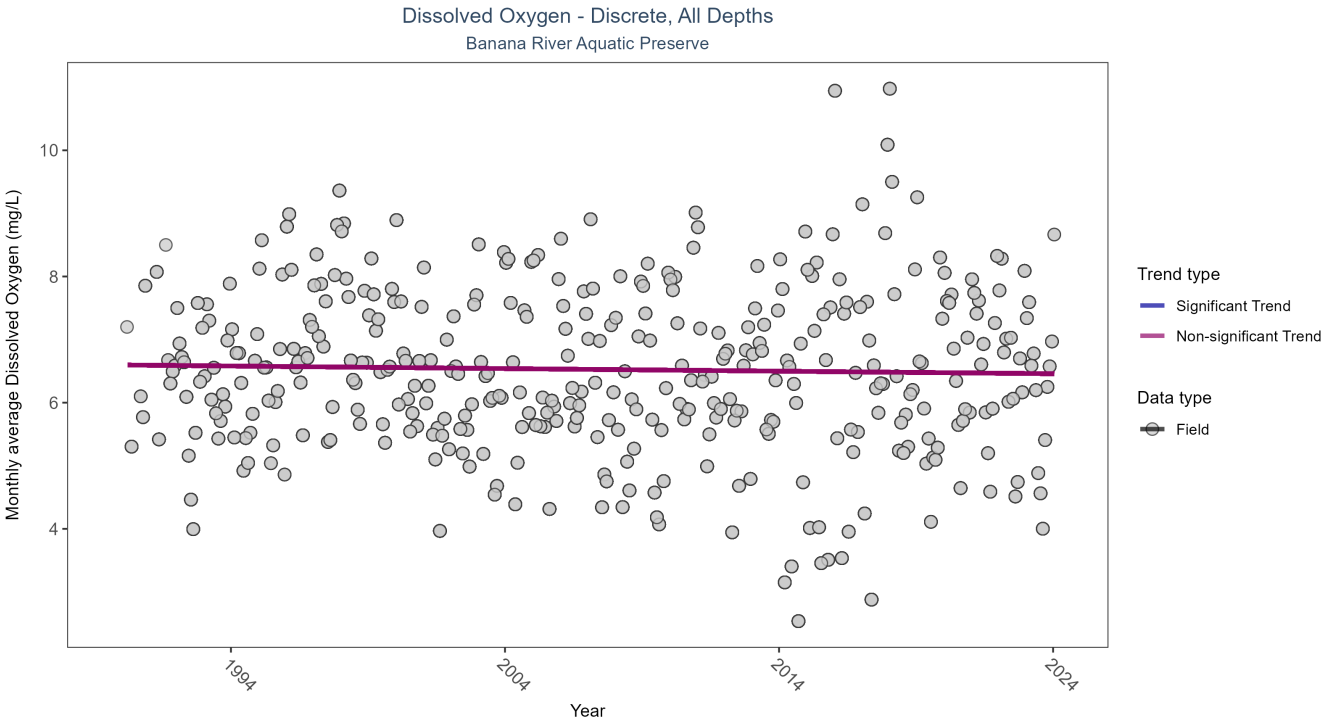


Figure 5: Seasonal Kendall-Tau Results for Dissolved Oxygen - Discrete

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 | 29828 | 35 | 6.48 | TRUE | -0.0308 | 0.366 | -0.0041 | 6.5973 | 11.3836 | 0.4117 | 0 |

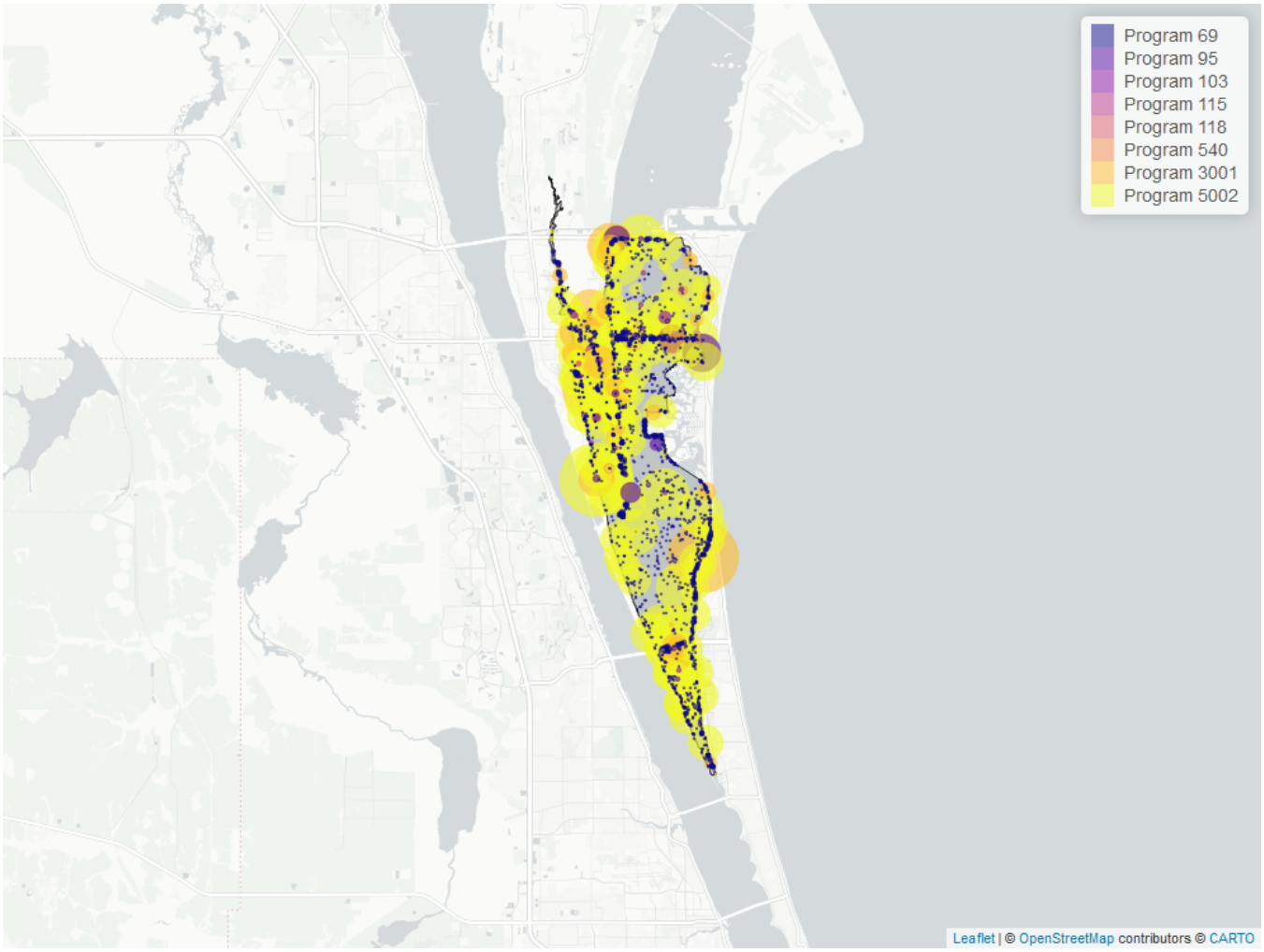


Figure 6: Map showing location of Discrete sampling sites for Dissolved Oxygen. The bubble size on the maps below reflect the amount of data available at each sampling site.

Table 11: Programs contributing data for Dissolved Oxygen

| *ProgramID* | *N_Data* | *YearMin* | *YearMax* |
|---|---|---|---|
| 5002 | 20256 | 1991 | 2024 |
| 69 | 4315 | 1990 | 2022 |
| 3001 | 4249 | 1991 | 2023 |
| 95 | 668 | 2006 | 2018 |
| 3013 | 328 | 2003 | 2023 |
| 103 | 111 | 2020 | 2021 |
| 540 | 42 | 2016 | 2020 |
| 118 | 17 | 2005 | 2020 |
| 115 | 8 | 1995 | 1995 |

**Program names:**

*69* - Fisheries-Independent Monitoring (FIM) Program[6]
*95* - Harmful Algal Bloom Marine Observation Network[4]
*103* - EPA STOrage and RETrieval Data Warehouse (STORET)/WQX[1]
*115* - Environmental Monitoring Assessment Program[7]

*118* - National Aquatic Resource Surveys, National Coastal Condition Assessment[5]
*540* - Shellfish Harvest Area Classification Program[2]
*3001* - Lagoon Watch (Formerly Marine Discovery Center)[8]
*3013* - Seagrass (SJRWMD)[9]
*5002* - Florida STORET / WIN[3]

## Dissolved Oxygen Saturation - Discrete Water Quality

### Seasonal Kendall-Tau Trend Analysis

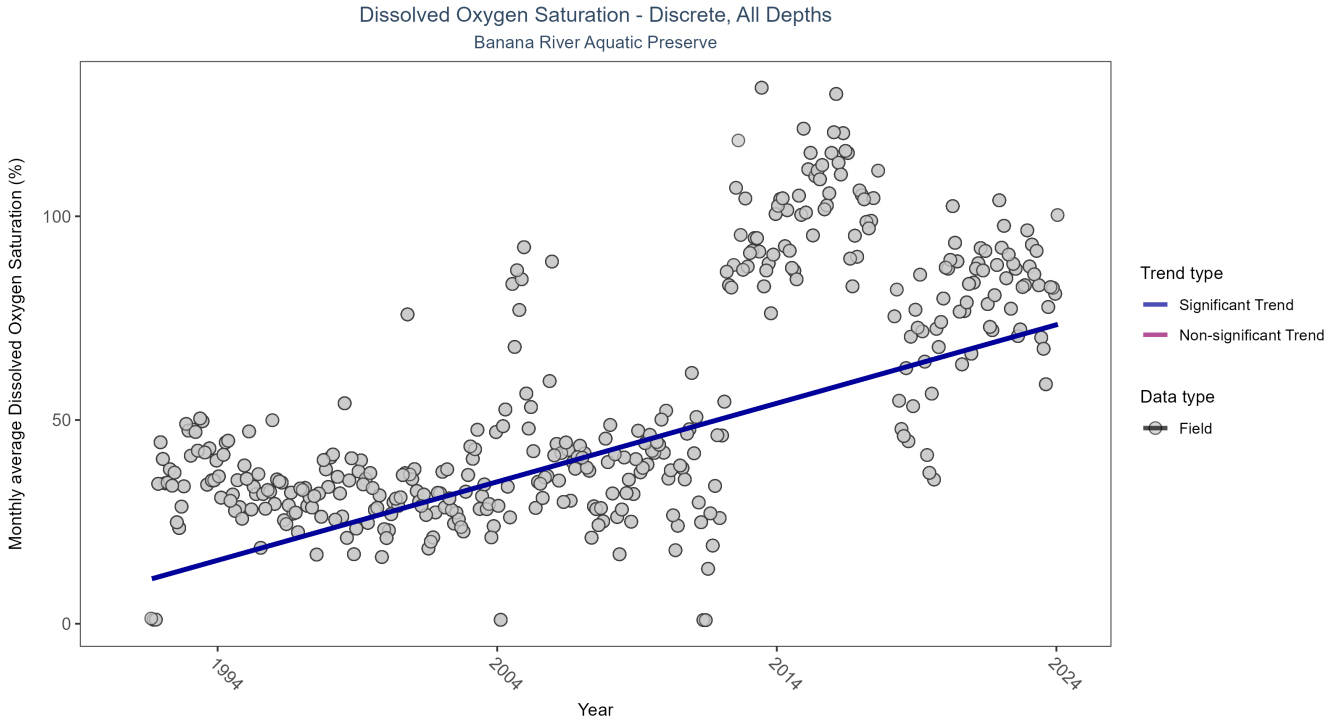


Figure 7: Seasonal Kendall-Tau Results for Dissolved Oxygen Saturation - Discrete

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 | 7455 | 34 | 58 | TRUE | 0.449 | 0 | 1.9268 | 9.7875 | 5.6017 | 0.8986 | 1 |

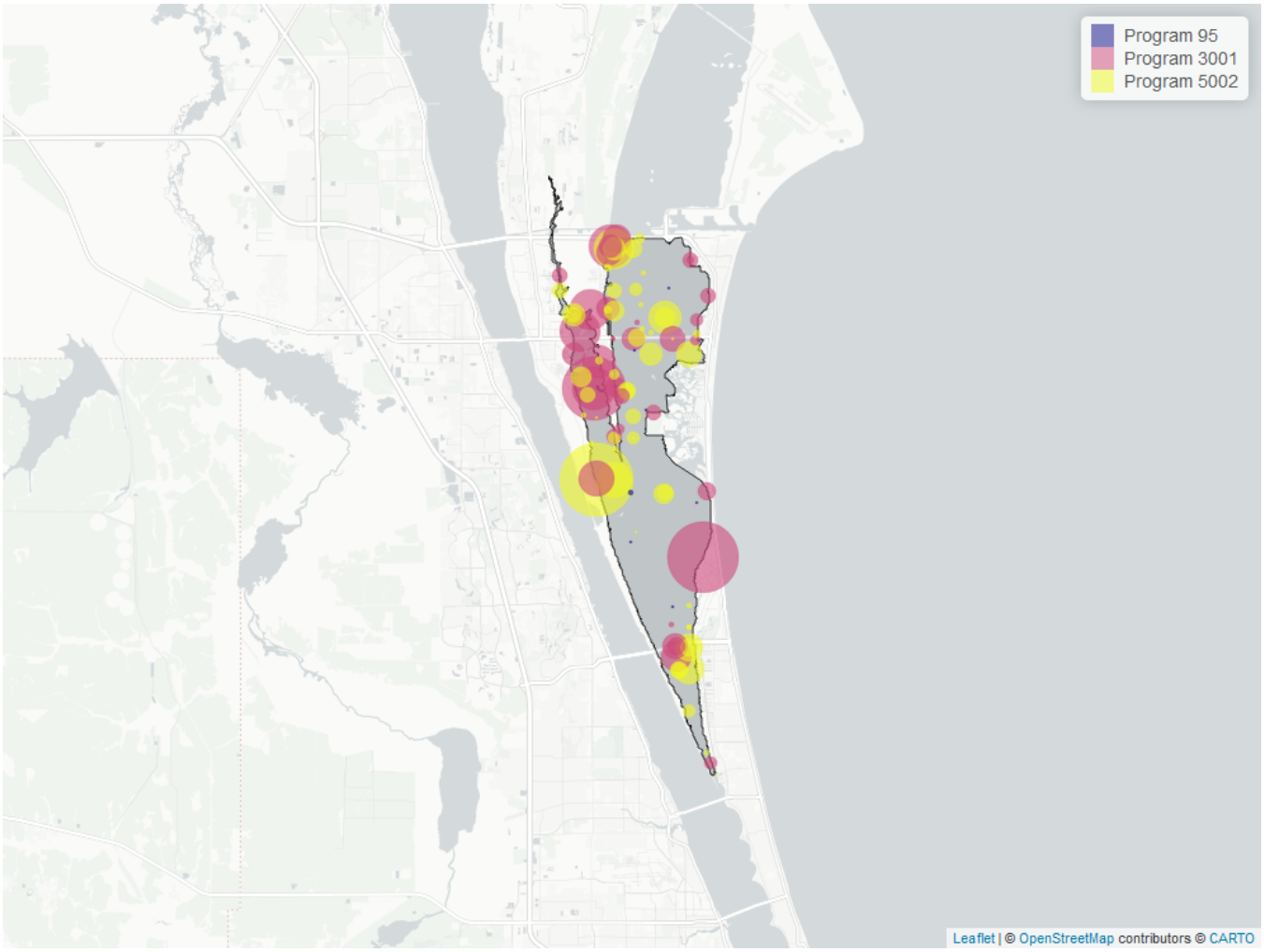


Figure 8: Map showing location of Discrete sampling sites for Dissolved Oxygen Saturation. The bubble size on the maps below reflect the amount of data available at each sampling site.

Table 13: Programs contributing data for Dissolved Oxygen Saturation

| *ProgramID* | *N_Data* | *YearMin* | *YearMax* |
|---|---|---|---|
| 3001 | 4178 | 1991 | 2023 |
| 5002 | 3120 | 1991 | 2024 |
| 3013 | 162 | 2012 | 2023 |
| 95 | 11 | 2014 | 2018 |

**Program names:**

*95* - Harmful Algal Bloom Marine Observation Network[4]
*3001* - Lagoon Watch (Formerly Marine Discovery Center)[8]
*3013* - Seagrass (SJRWMD)[9]
*5002* - Florida STORET / WIN[3]

## pH - Discrete Water Quality

### Seasonal Kendall-Tau Trend Analysis

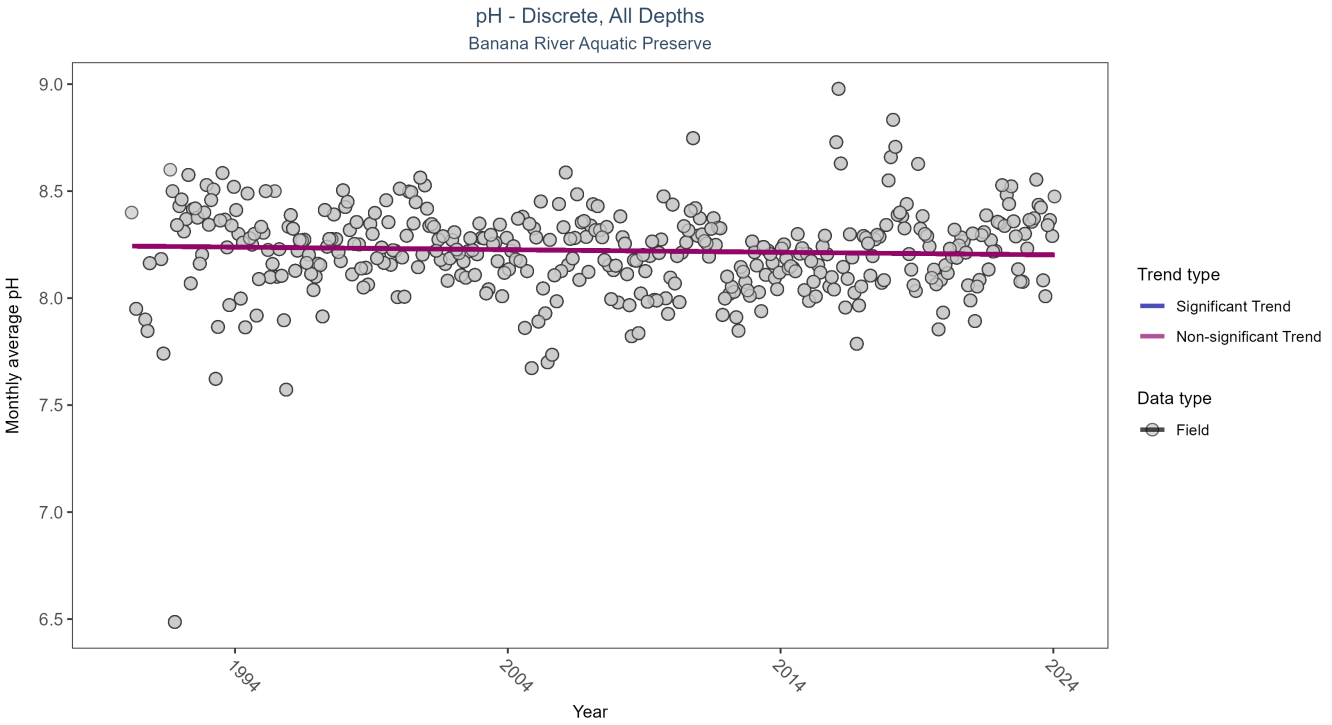


Figure 9: Seasonal Kendall-Tau Results for pH - Discrete

Table 14: Seasonal Kendall-Tau Trend Analysis for pH

| RelativeDepth | N-Data | N-Years | Median | Independent | tau | p | SennSlope | SennIntercept | ChiSquared | pChiSquared | Trend |
|---|---|---|---|---|---|---|---|---|---|---|---|
| All | 22717 | 35 | 8.2 | TRUE | -0.0414 | 0.2599 | -0.0012 | 8.2433 | 21.0272 | 0.0331 | 0 |

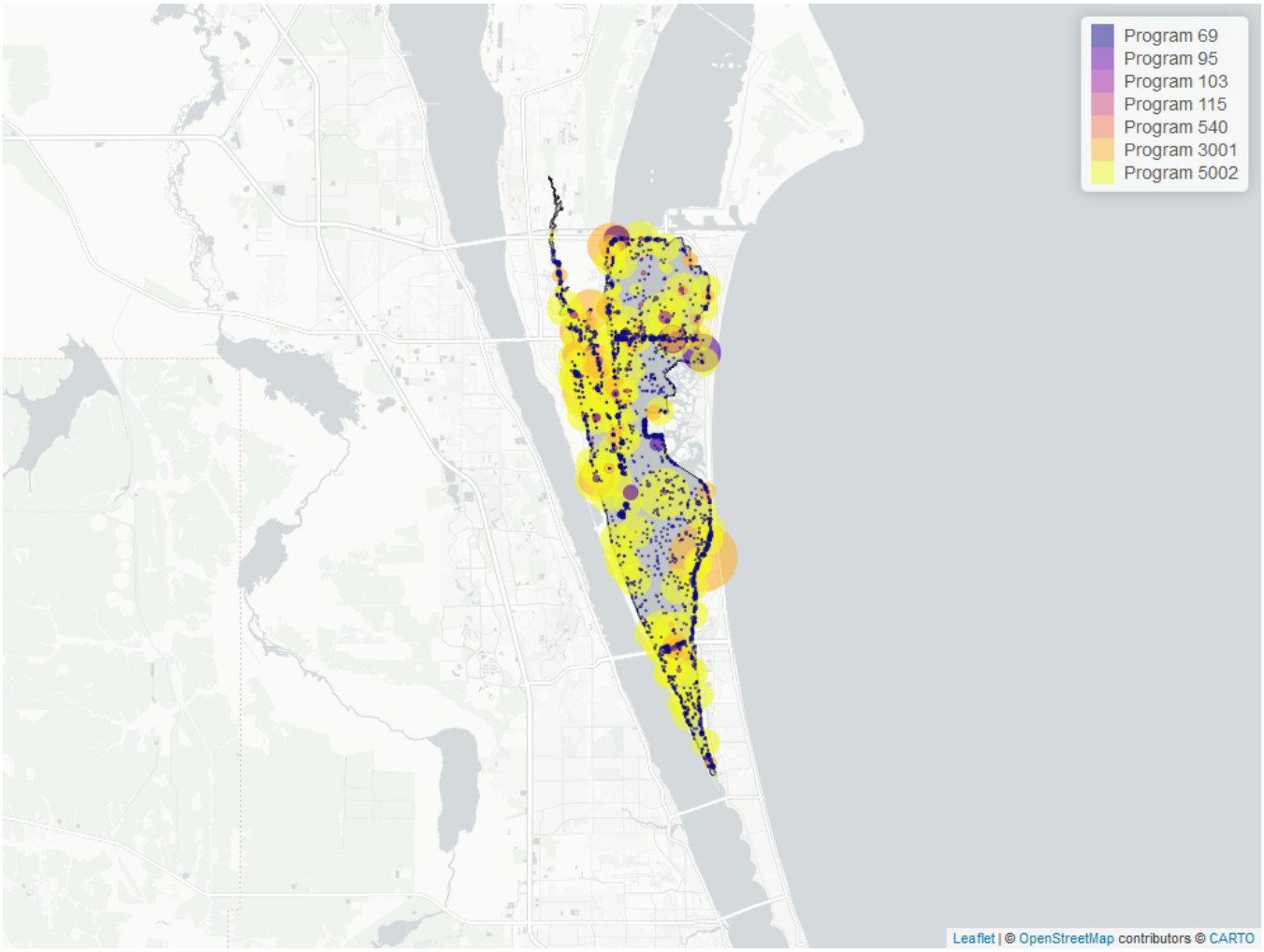


Figure 10: Map showing location of Discrete sampling sites for pH. The bubble size on the maps below reflect the amount of data available at each sampling site.

Table 15: Programs contributing data for pH

| *ProgramID* | *N_Data* | *YearMin* | *YearMax* |
|---|---|---|---|
| 5002 | 13748 | 1996 | 2024 |
| 69 | 4279 | 1990 | 2022 |
| 3001 | 4109 | 1991 | 2023 |
| 95 | 624 | 2006 | 2018 |
| 3013 | 327 | 2003 | 2023 |
| 103 | 111 | 2020 | 2021 |
| 540 | 42 | 2016 | 2020 |
| 115 | 7 | 1995 | 1995 |

**Program names:**

*69* - Fisheries-Independent Monitoring (FIM) Program[6]
*95* - Harmful Algal Bloom Marine Observation Network[4]
*103* - EPA STOrage and RETrieval Data Warehouse (STORET)/WQX[1]
*115* - Environmental Monitoring Assessment Program[7]
*540* - Shellfish Harvest Area Classification Program[2]

*3001* - Lagoon Watch (Formerly Marine Discovery Center)[8]
*3013* - Seagrass (SJRWMD)[9]
*5002* - Florida STORET / WIN[3]

## Salinity - Discrete Water Quality

### Seasonal Kendall-Tau Trend Analysis

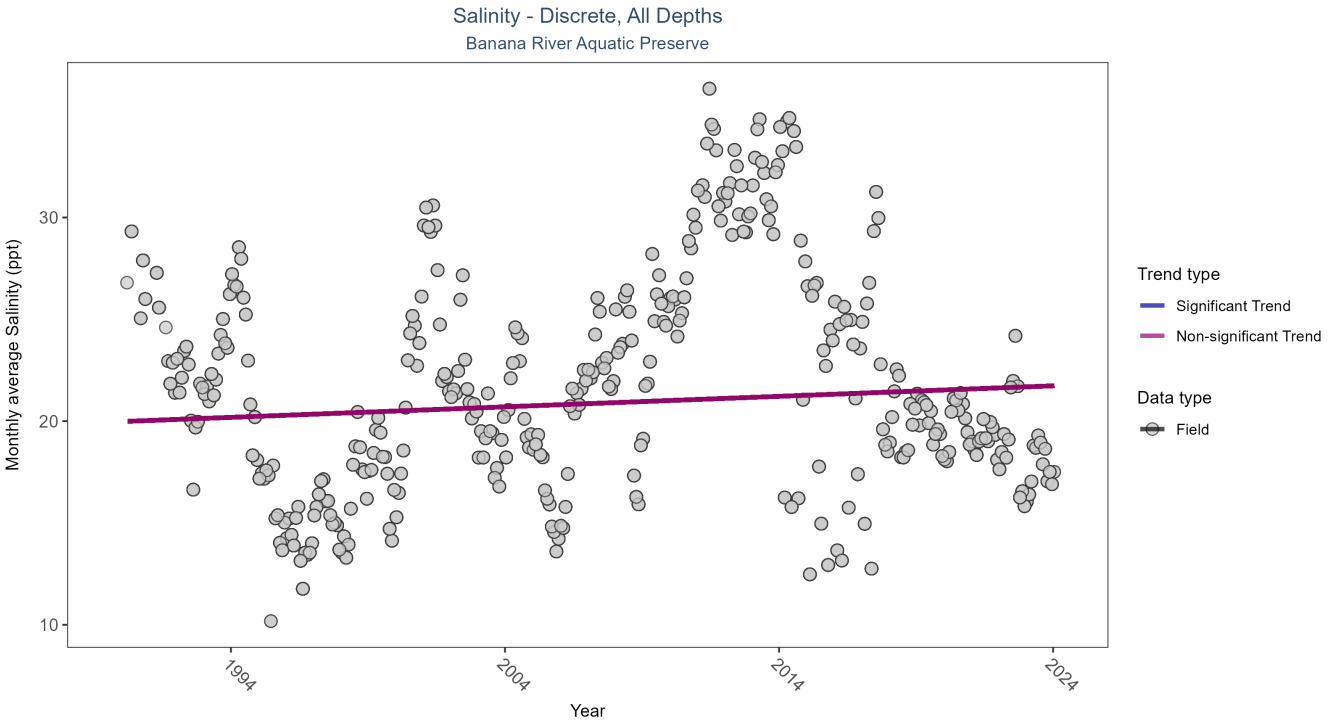


Figure 11: Seasonal Kendall-Tau Results for Salinity - Discrete

Table 16: Seasonal Kendall-Tau Trend Analysis for Salinity

| RelativeDepth | N-Data | N-Years | Median | Independent | tau | p | SennSlope | SennIntercept | ChiSquared | pChiSquared | Trend |
|---|---|---|---|---|---|---|---|---|---|---|---|
| All | 31351 | 35 | 19.8 | TRUE | 0.0652 | 0.0672 | 0.0516 | 19.9798 | 2.2224 | 0.9975 | 0 |

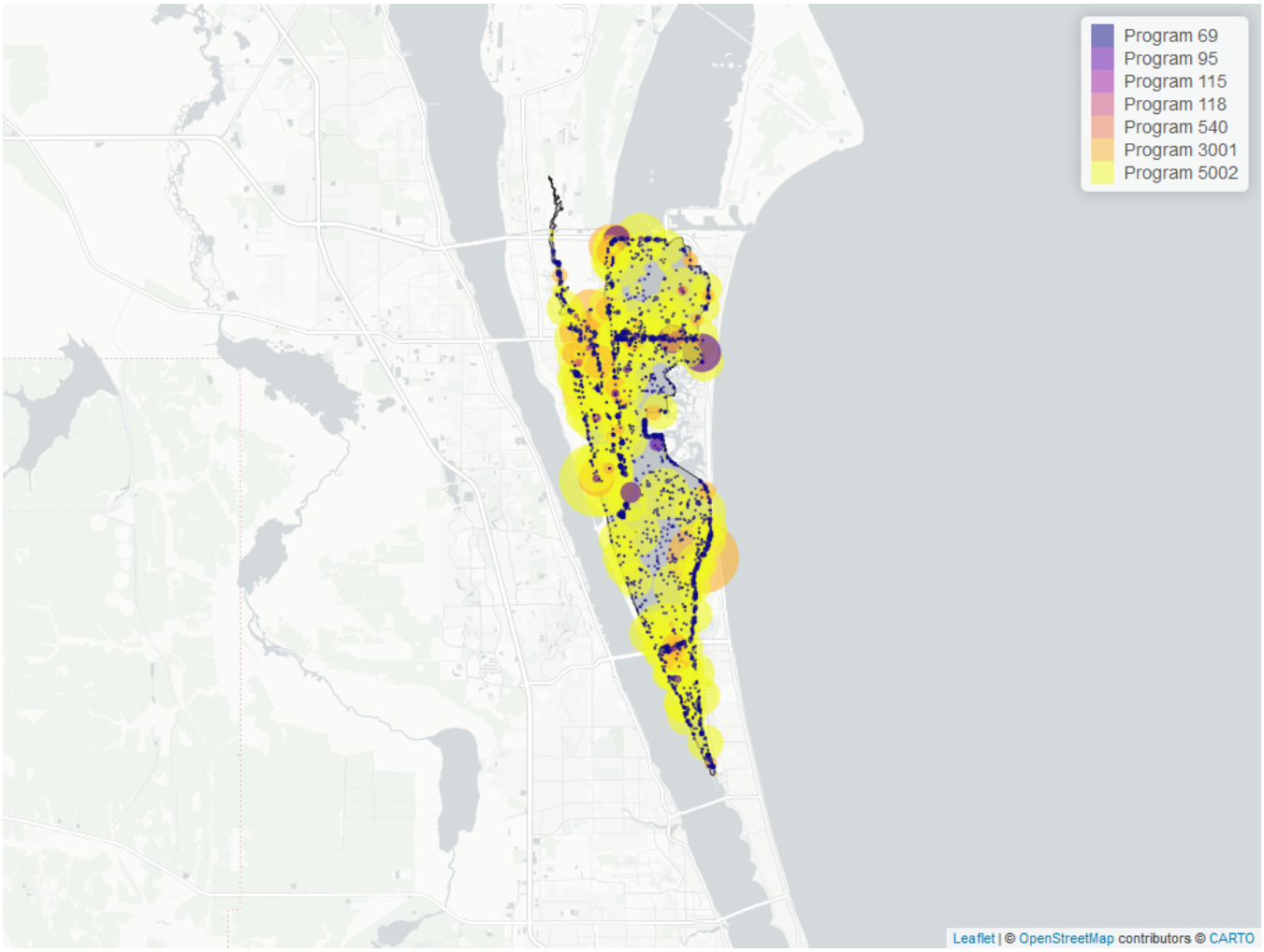


Figure 12: Map showing location of Discrete sampling sites for Salinity. The bubble size on the maps below reflect the amount of data available at each sampling site.

Table 17: Programs contributing data for Salinity

| *ProgramID* | *N_Data* | *YearMin* | *YearMax* |
|---|---|---|---|
| 5002 | 21718 | 1991 | 2024 |
| 69 | 4320 | 1990 | 2022 |
| 3001 | 4257 | 1991 | 2023 |
| 95 | 681 | 2006 | 2018 |
| 3013 | 329 | 2003 | 2023 |
| 540 | 42 | 2016 | 2020 |
| 118 | 11 | 2015 | 2020 |
| 115 | 6 | 1995 | 1995 |

**Program names:**

*69* - Fisheries-Independent Monitoring (FIM) Program[6]
*95* - Harmful Algal Bloom Marine Observation Network[4]
*115* - Environmental Monitoring Assessment Program[7]
*118* - National Aquatic Resource Surveys, National Coastal Condition Assessment[5]
*540* - Shellfish Harvest Area Classification Program[2]

*3001* - Lagoon Watch (Formerly Marine Discovery Center)[8]
*3013* - Seagrass (SJRWMD)[9]
*5002* - Florida STORET / WIN[3]

## Secchi Depth - Discrete Water Quality

### Seasonal Kendall-Tau Trend Analysis

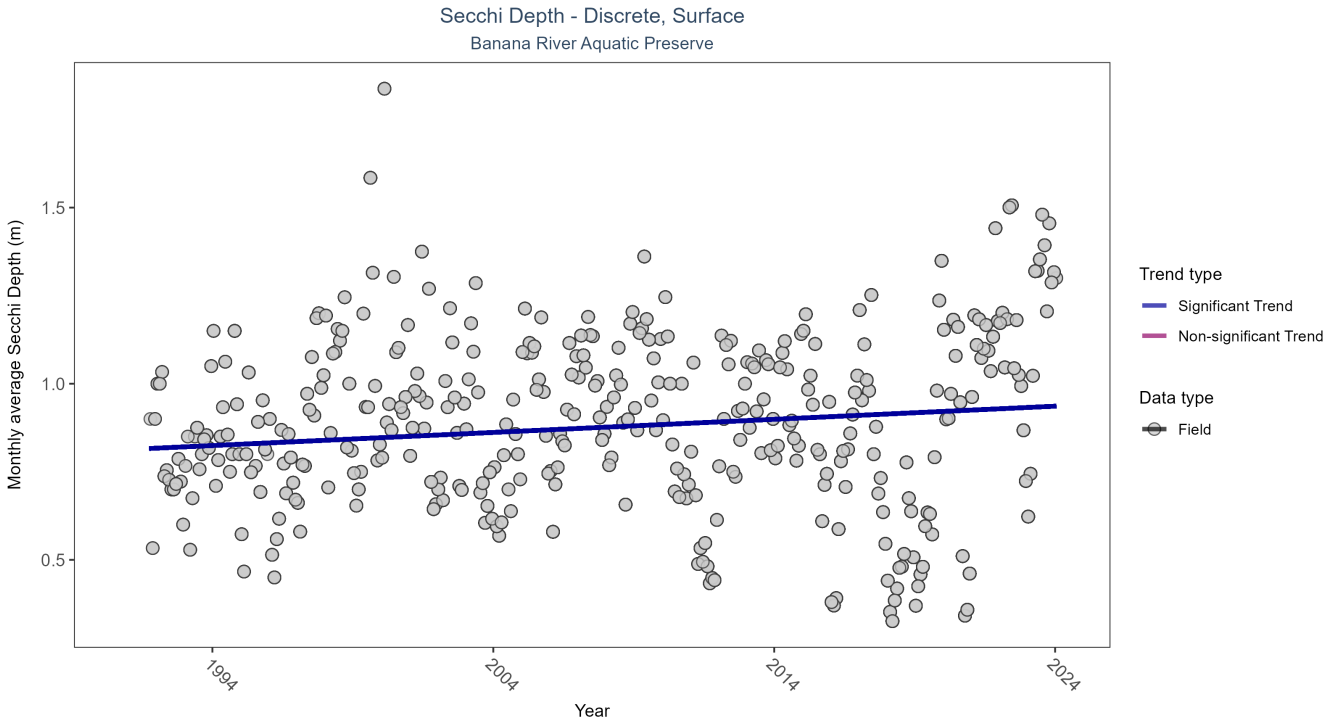


Figure 13: Seasonal Kendall-Tau Results for Secchi Depth - Discrete

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 | 8795 | 34 | 0.85 | TRUE | 0.091 | 0.0112 | 0.0037 | 0.8133 | 4.4763 | 0.9539 | 1 |

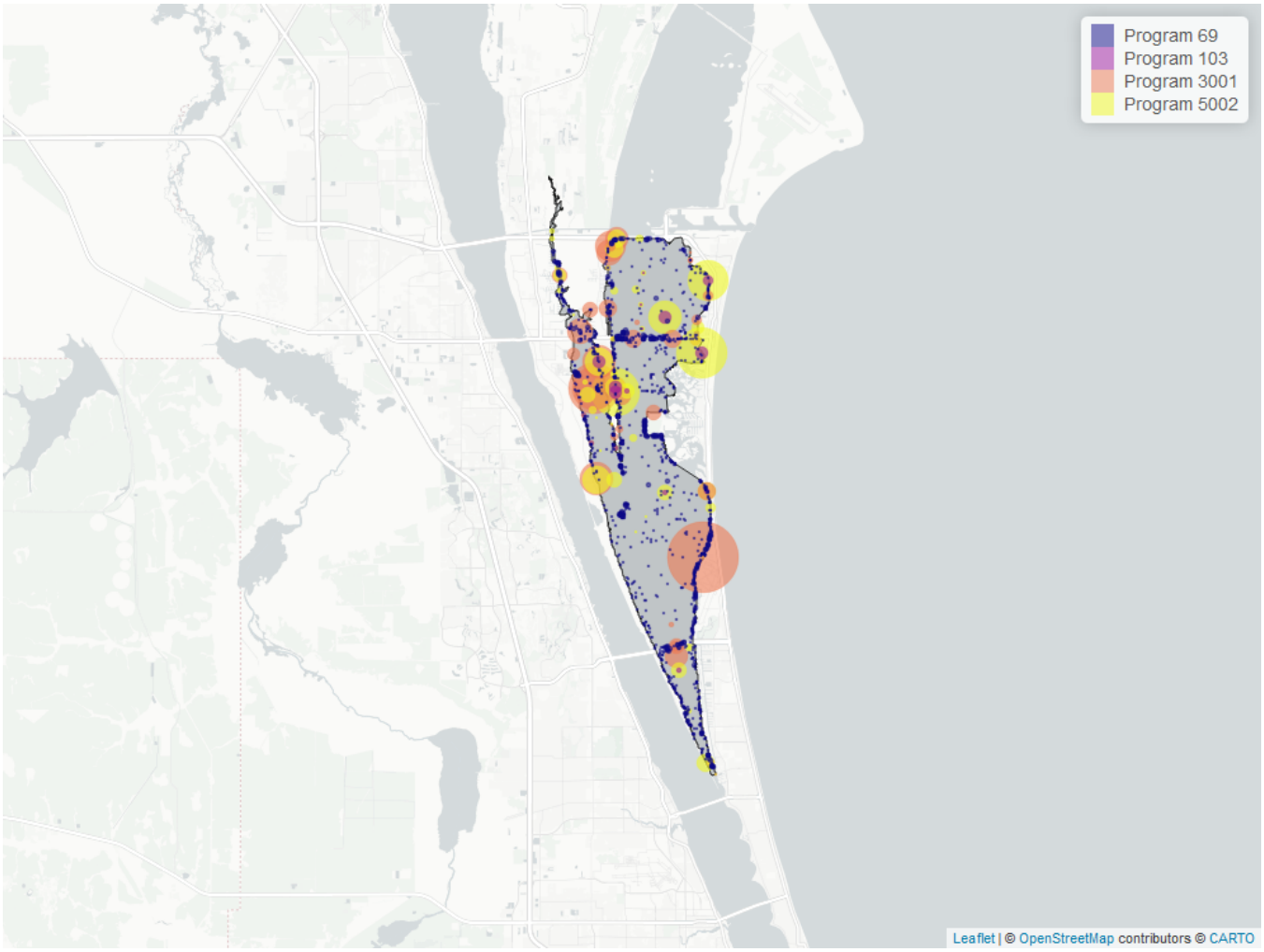


Figure 14: Map showing location of Discrete sampling sites for Secchi Depth. The bubble size on the maps below reflect the amount of data available at each sampling site.

Table 19: Programs contributing data for Secchi Depth

| *ProgramID* | *N_Data* | *YearMin* | *YearMax* |
|---|---|---|---|
| 69 | 3276 | 1994 | 2022 |
| 3001 | 2922 | 1991 | 2023 |
| 5002 | 2149 | 1999 | 2024 |
| 3013 | 322 | 2003 | 2023 |
| 103 | 197 | 2020 | 2021 |

**Program names:**

*69* - Fisheries-Independent Monitoring (FIM) Program[6]
*103* - EPA STOrage and RETrieval Data Warehouse (STORET)/WQX[1]
*3001* - Lagoon Watch (Formerly Marine Discovery Center)[8]
*3013* - Seagrass (SJRWMD)[9]
*5002* - Florida STORET / WIN[3]

## 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

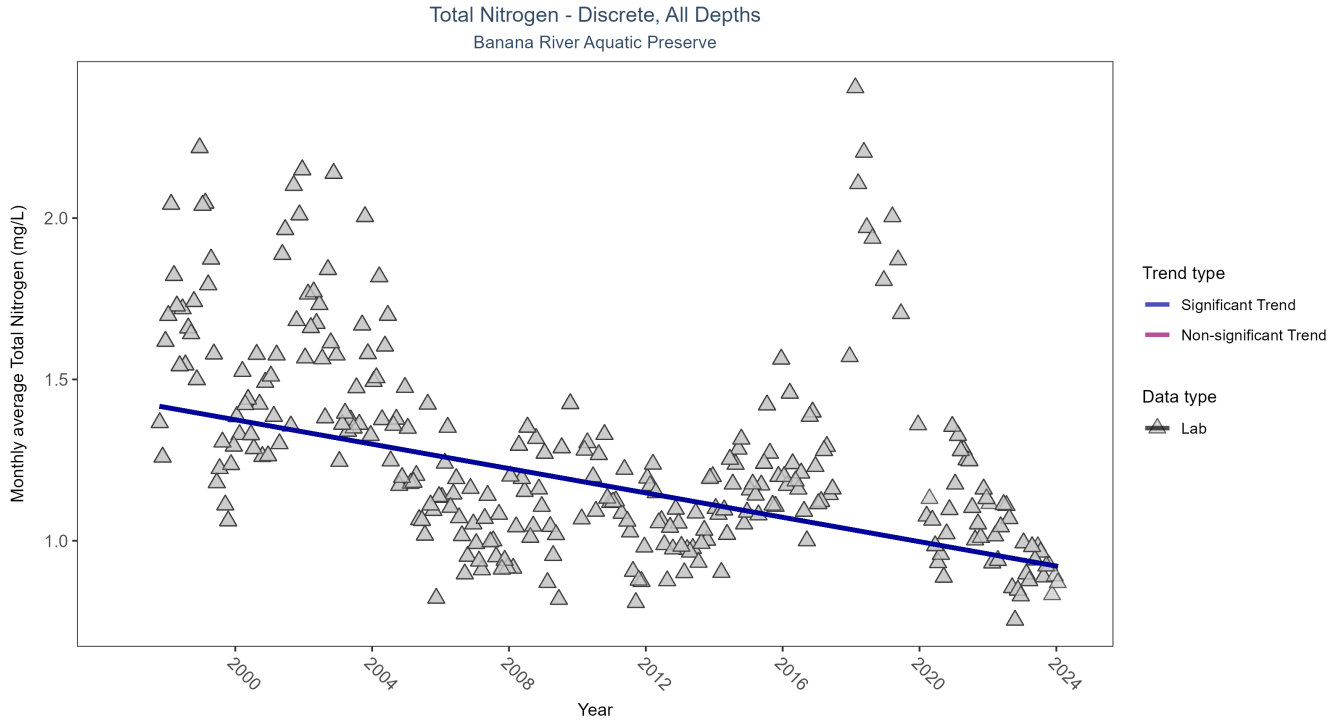


Figure 15: Seasonal Kendall-Tau Results for Total Nitrogen - Discrete

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 | 2186 | 28 | 1.2354 | TRUE | -0.3929 | 0 | -0.0189 | 1.4316 | 6.0415 | 0.8706 | -1 |

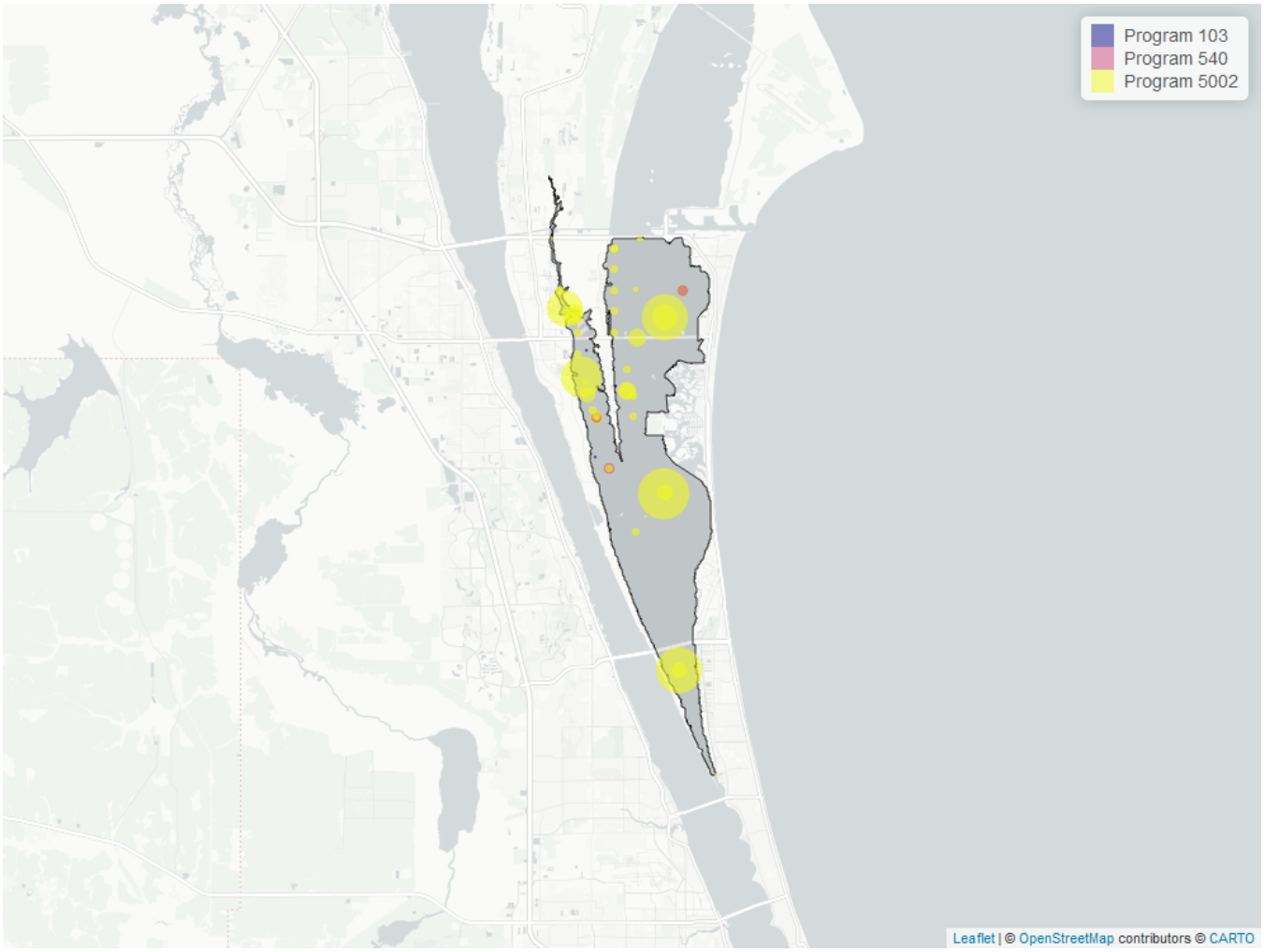


Figure 16: Map showing location of Discrete sampling sites for Total Nitrogen. The bubble size on the maps below reflect the amount of data available at each sampling site.

Table 21: Programs contributing data for Total Nitrogen

| *ProgramID* | *N_Data* | *YearMin* | *YearMax* |
|---|---|---|---|
| 5002 | 2141 | 1997 | 2024 |
| 540 | 41 | 2016 | 2020 |
| 103 | 4 | 2005 | 2006 |

**Program names:**

*103* - EPA STOrage and RETrieval Data Warehouse (STORET)/WQX[1]
*540* - Shellfish Harvest Area Classification Program[2]
*5002* - Florida STORET / WIN[3]

## Total Phosphorus - Discrete Water Quality

### Seasonal Kendall-Tau Trend Analysis

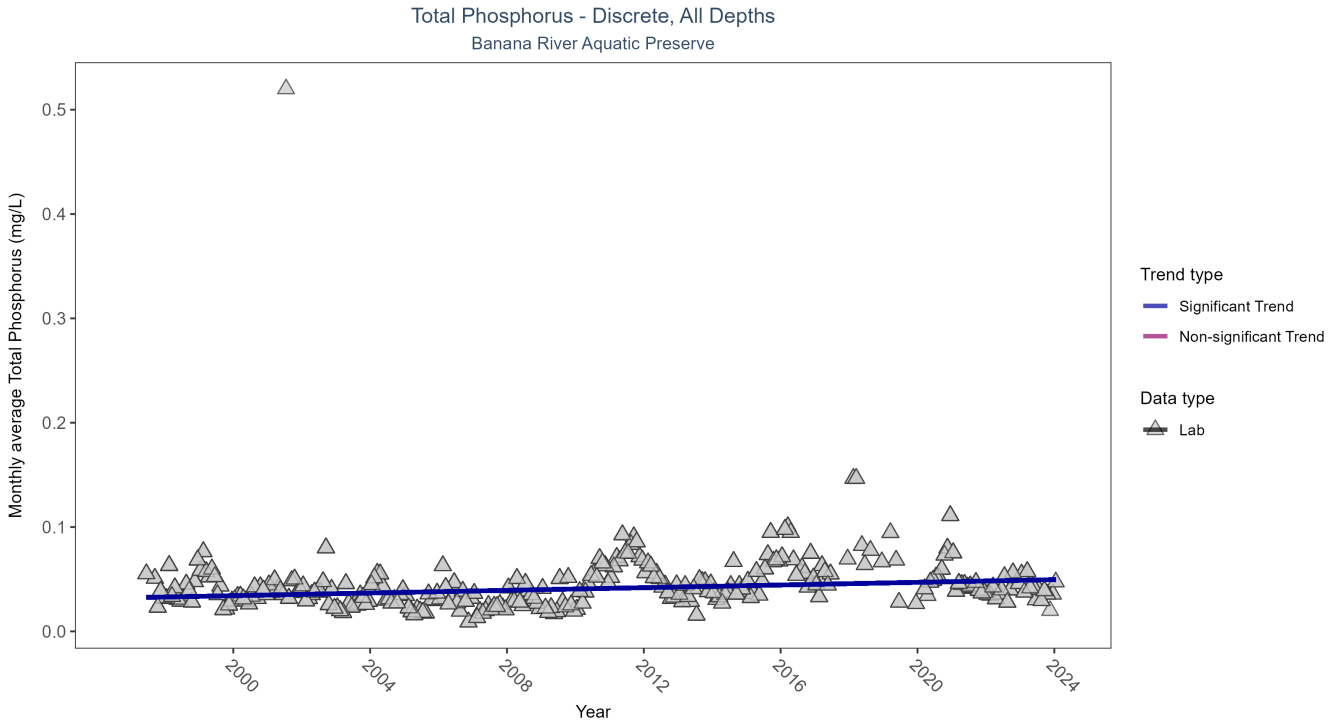


Figure 17: Seasonal Kendall-Tau Results for Total Phosphorus - Discrete

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 | 4657 | 28 | 0.0355 | TRUE | 0.2162 | 0 | 0.0006 | 0.0323 | 4.2479 | 0.9621 | 1 |

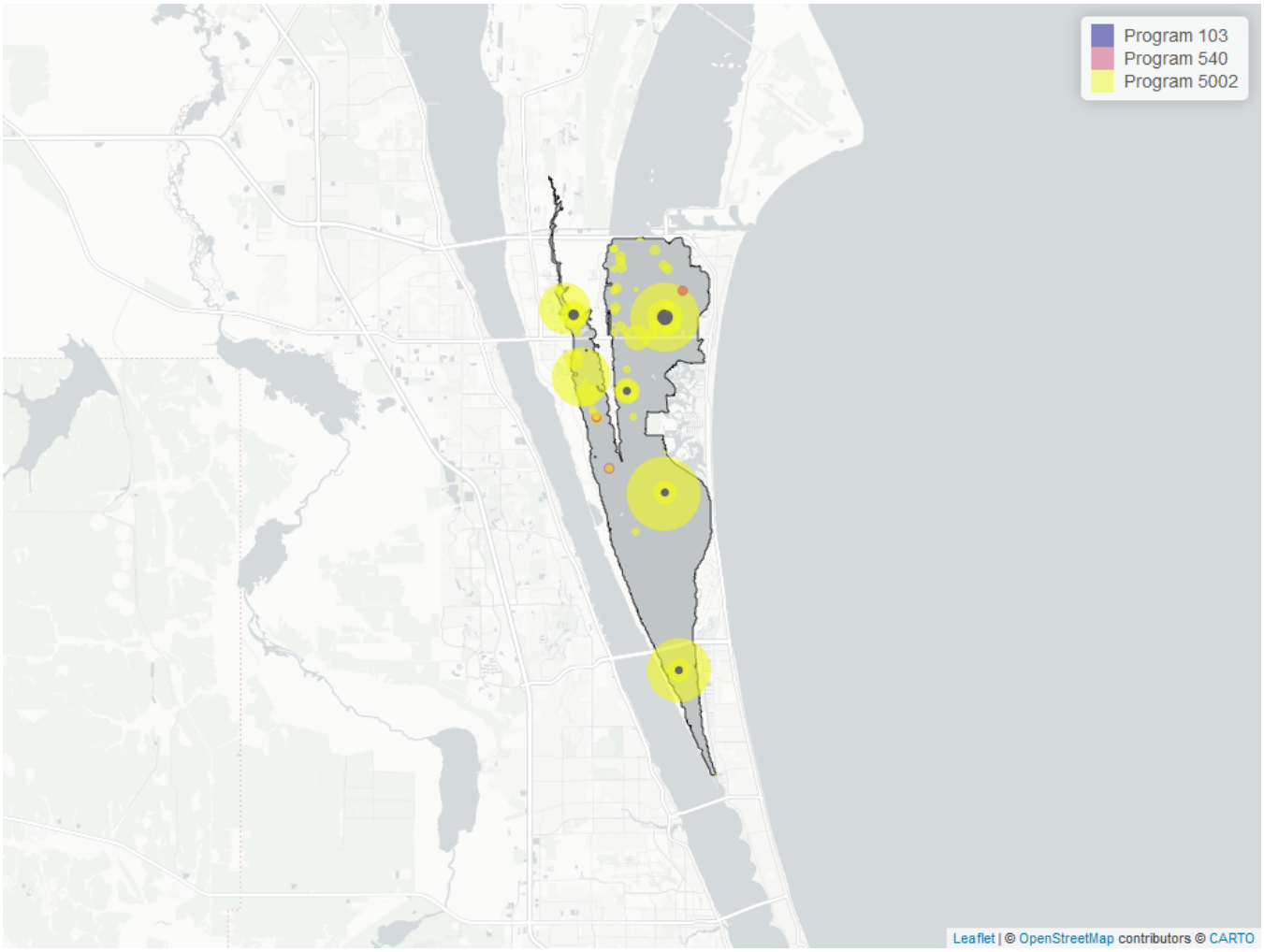


Figure 18: Map showing location of Discrete sampling sites for Total Phosphorus. The bubble size on the maps below reflect the amount of data available at each sampling site.

Table 23: Programs contributing data for Total Phosphorus

| *ProgramID* | *N_Data* | *YearMin* | *YearMax* |
|---|---|---|---|
| 5002 | 4557 | 1997 | 2024 |
| 103 | 91 | 2005 | 2021 |
| 540 | 42 | 2016 | 2020 |

**Program names:**

*103* - EPA STOrage and RETrieval Data Warehouse (STORET)/WQX[1]
*540* - Shellfish Harvest Area Classification Program[2]
*5002* - Florida STORET / WIN[3]

## Total Suspended Solids - Discrete Water Quality

### Seasonal Kendall-Tau Trend Analysis

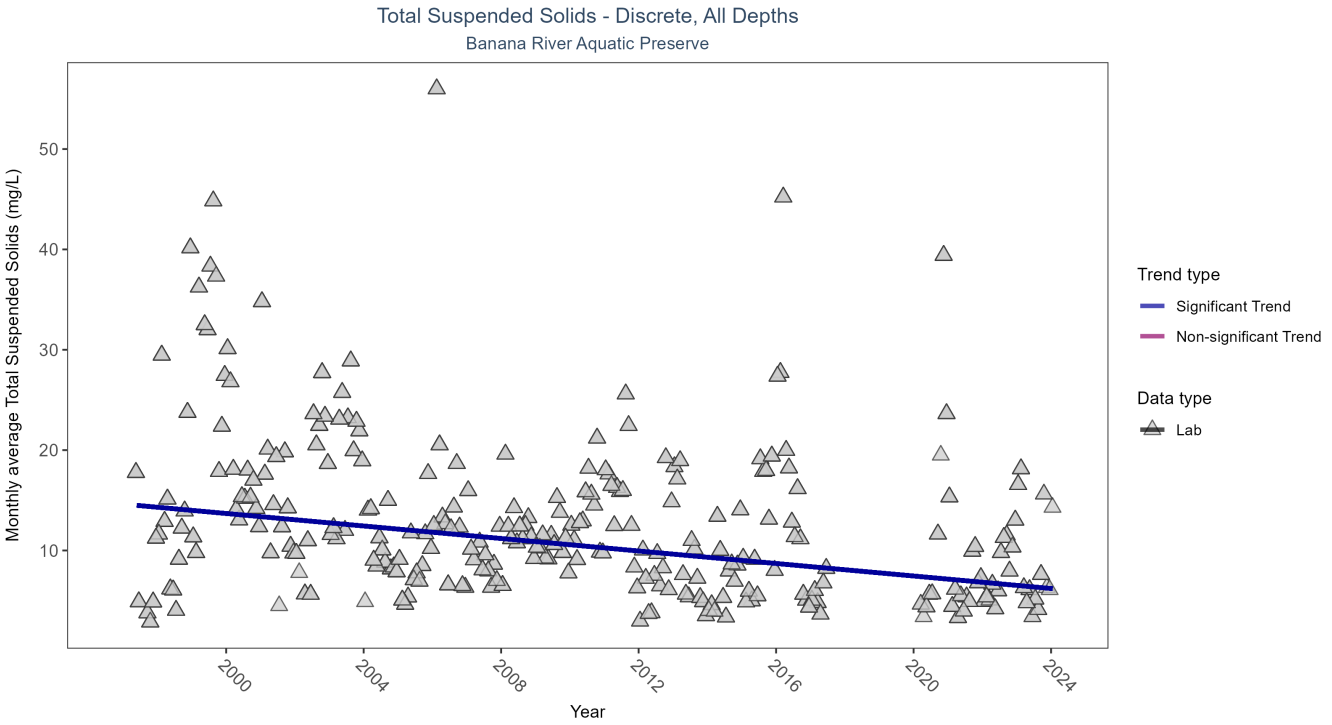


Figure 19: Seasonal Kendall-Tau Results for Total Suspended Solids - Discrete

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 | 2416 | 26 | 10 | TRUE | -0.2639 | 0 | -0.3114 | 14.6199 | 5.9146 | 0.879 | -1 |

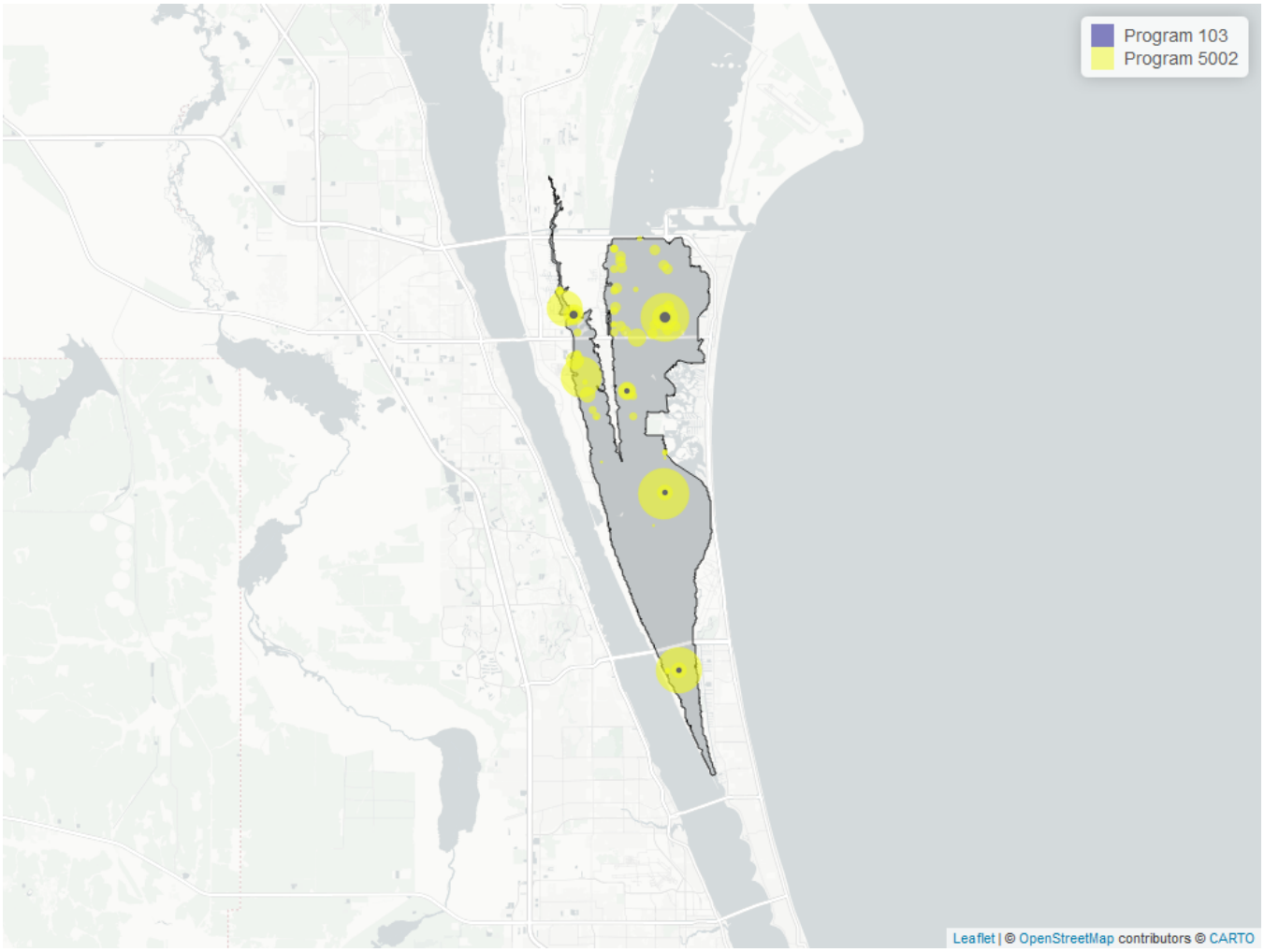


Figure 20: Map showing location of Discrete sampling sites for Total Suspended Solids. The bubble size on the maps below reflect the amount of data available at each sampling site.

Table 25: Programs contributing data for Total Suspended Solids

| *ProgramID* | *N_Data* | *YearMin* | *YearMax* |
|---|---|---|---|
| 5002 | 2442 | 1997 | 2024 |
| 103 | 43 | 2020 | 2021 |

**Program names:**

*103* - EPA STOrage and RETrieval Data Warehouse (STORET)/WQX[1]
*5002* - Florida STORET / WIN[3]

## Turbidity - Discrete Water Quality

### Seasonal Kendall-Tau Trend Analysis

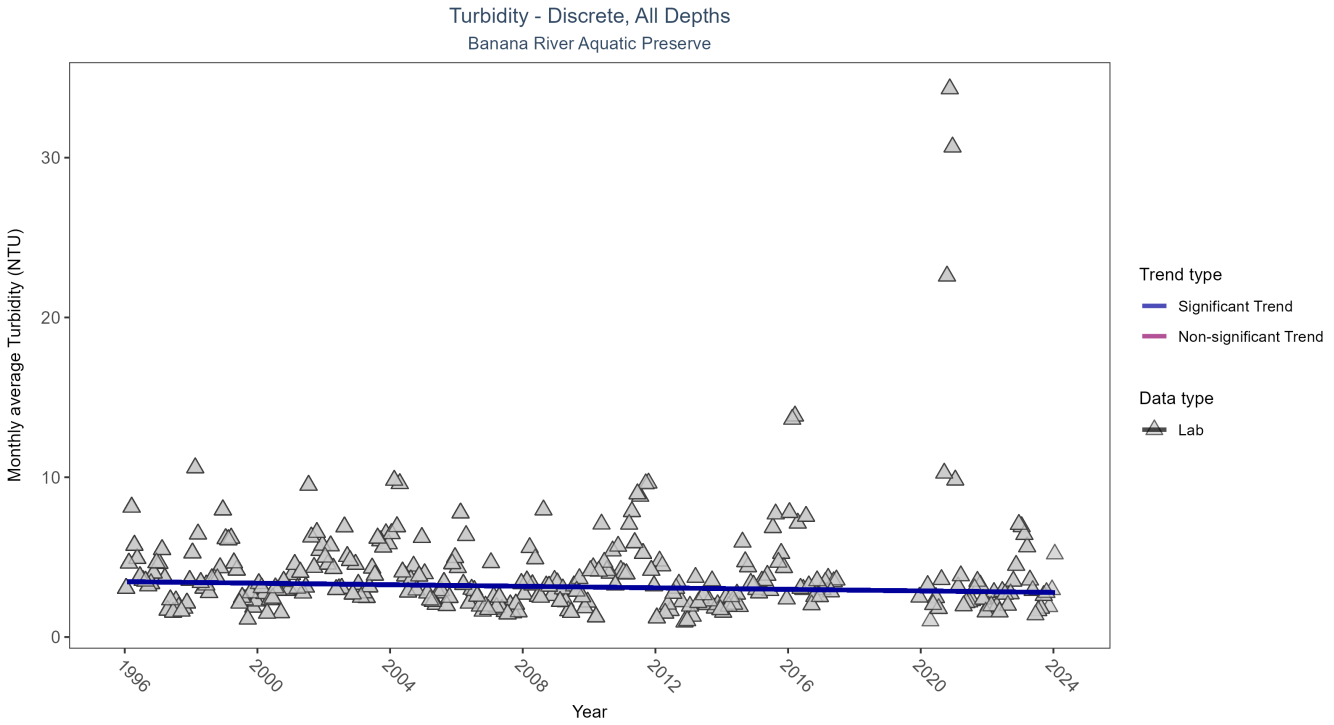


Figure 21: Seasonal Kendall-Tau Results for Turbidity - Discrete

Table 26: Seasonal Kendall-Tau Trend Analysis for Turbidity

| RelativeDepth | N-Data | N-Years | Median | Independent | tau | p | SennSlope | SennIntercept | ChiSquared | pChiSquared | Trend |
|---|---|---|---|---|---|---|---|---|---|---|---|
| All | 13427 | 28 | 3.2 | TRUE | -0.0902 | 0.0256 | -0.0241 | 3.4663 | 7.1071 | 0.7903 | -1 |

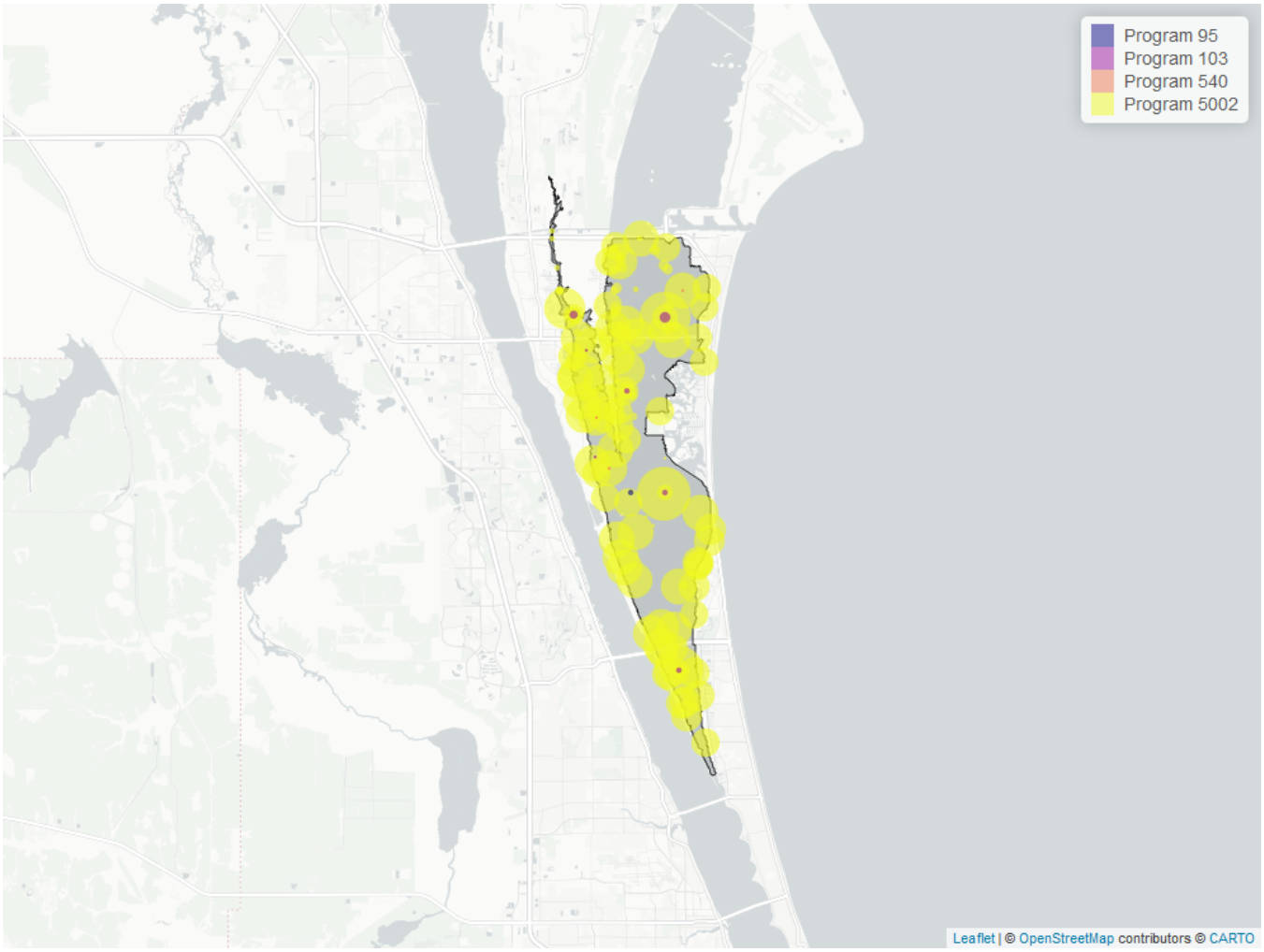


Figure 22: Map showing location of Discrete sampling sites for Turbidity. The bubble size on the maps below reflect the amount of data available at each sampling site.

Table 27: Programs contributing data for Turbidity

| *ProgramID* | *N_Data* | *YearMin* | *YearMax* |
|---|---|---|---|
| 5002 | 13664 | 1996 | 2024 |
| 3013 | 271 | 2004 | 2019 |
| 103 | 45 | 2005 | 2021 |
| 540 | 6 | 2019 | 2020 |
| 95 | 4 | 2009 | 2010 |

**Program names:**

*95* - Harmful Algal Bloom Marine Observation Network[4]
*103* - EPA STOrage and RETrieval Data Warehouse (STORET)/WQX[1]
*540* - Shellfish Harvest Area Classification Program[2]
*3013* - Seagrass (SJRWMD)[9]
*5002* - Florida STORET / WIN[3]

## Water Temperature - Discrete Water Quality

### Seasonal Kendall-Tau Trend Analysis

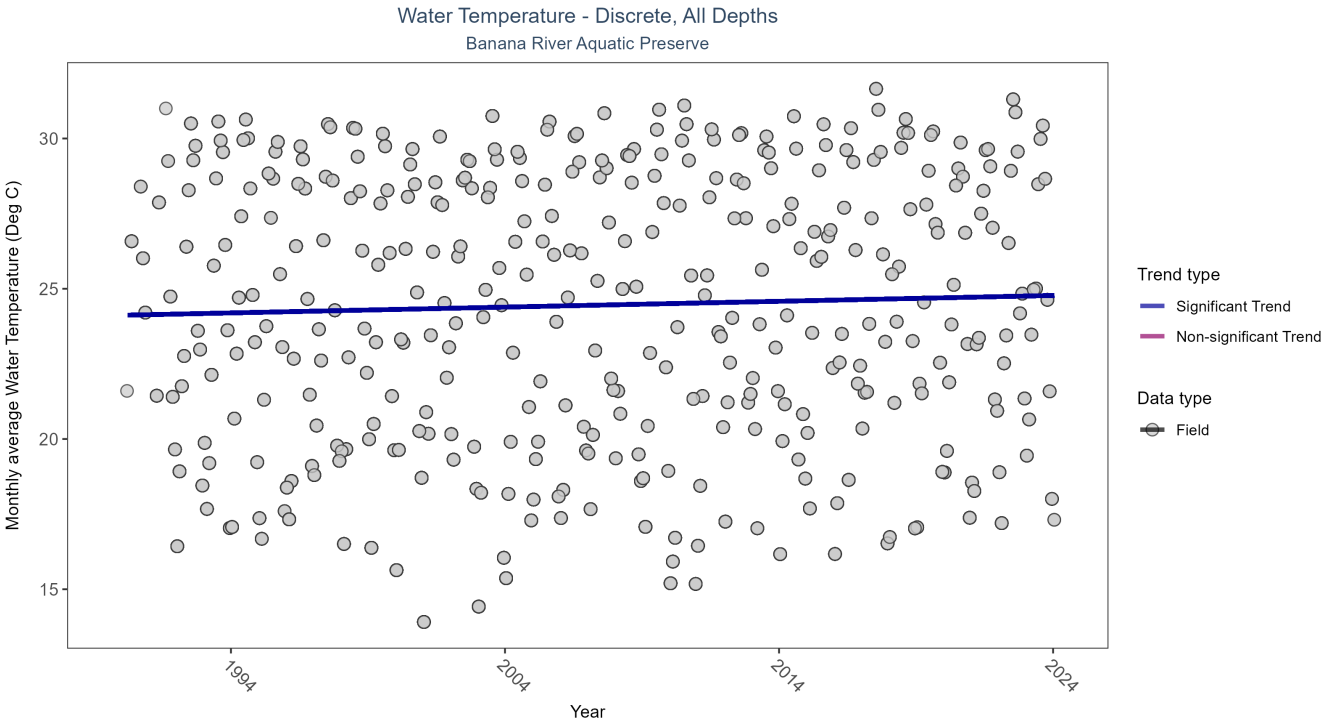


Figure 23: Seasonal Kendall-Tau Results for Water Temperature - Discrete

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 | 31300 | 35 | 25.5 | TRUE | 0.108 | 0.0023 | 0.0194 | 24.1177 | 10.9427 | 0.4481 | 1 |

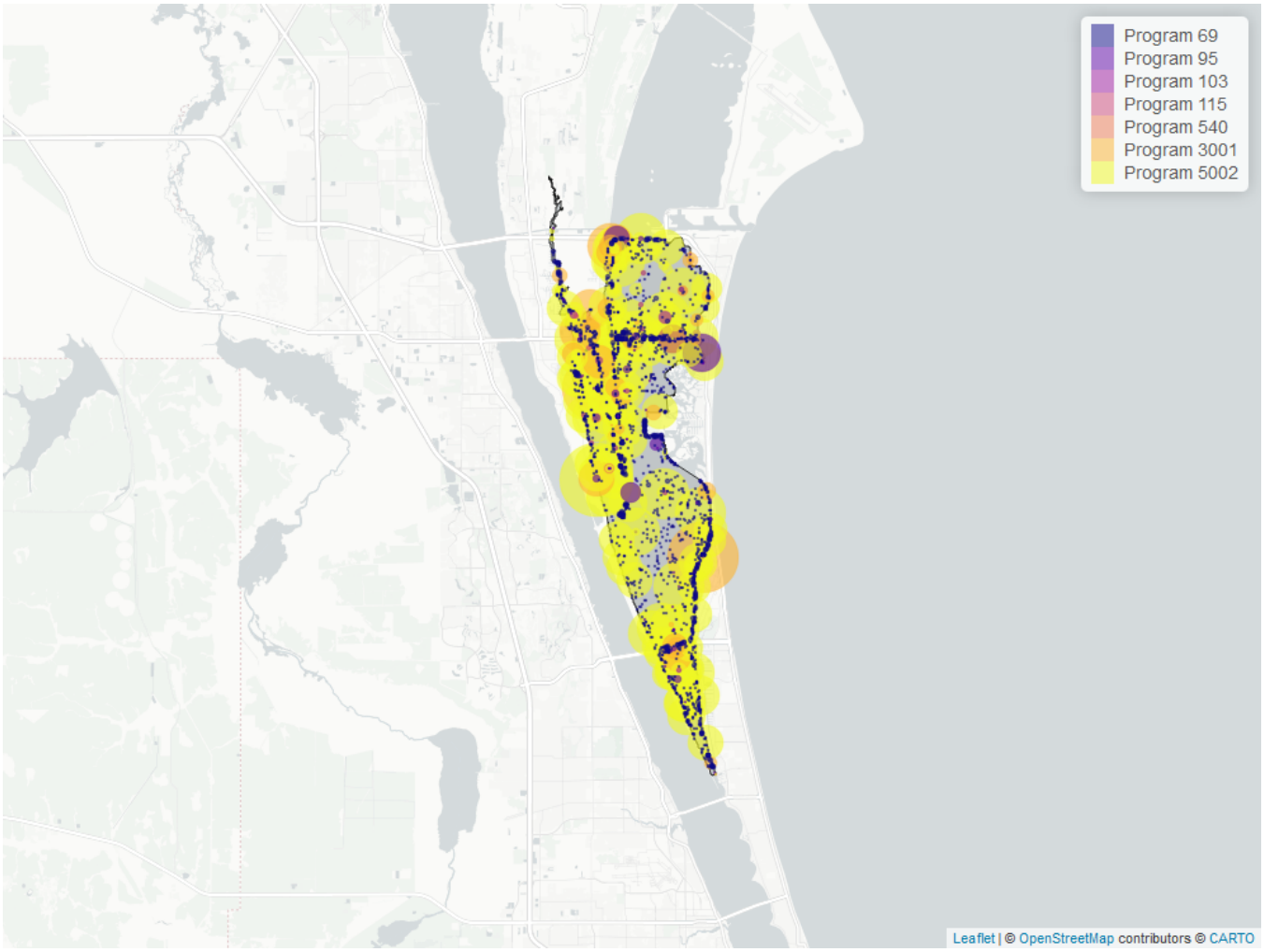


Figure 24: Map showing location of Discrete sampling sites for Water Temperature. The bubble size on the maps below reflect the amount of data available at each sampling site.

Table 29: Programs contributing data for Water Temperature

| *ProgramID* | *N_Data* | *YearMin* | *YearMax* |
|---|---|---|---|
| 5002 | 22075 | 1991 | 2024 |
| 69 | 4343 | 1990 | 2022 |
| 3001 | 4286 | 1991 | 2023 |
| 95 | 680 | 2006 | 2018 |
| 3013 | 329 | 2003 | 2023 |
| 103 | 111 | 2020 | 2021 |
| 540 | 42 | 2016 | 2020 |
| 115 | 7 | 1995 | 1995 |

**Program names:**

*69* - Fisheries-Independent Monitoring (FIM) Program[6]
*95* - Harmful Algal Bloom Marine Observation Network[4]
*103* - EPA STOrage and RETrieval Data Warehouse (STORET)/WQX[1]
*115* - Environmental Monitoring Assessment Program[7]
*540* - Shellfish Harvest Area Classification Program[2]

*3001* - Lagoon Watch (Formerly Marine Discovery Center)[8]
*3013* - Seagrass (SJRWMD)[9]
*5002* - Florida STORET / WIN[3]

## Water Quality - Continuous

The following files were used in the continuous analysis:

- *Combined_WQ_WC_NUT_cont_Dissolved_Oxygen_NE-2024-Dec-08.txt*
- *Combined_WQ_WC_NUT_cont_Dissolved_Oxygen_Saturation_NE-2024-Dec-08.txt*
- *Combined_WQ_WC_NUT_cont_pH_NE-2024-Dec-08.txt*
- *Combined_WQ_WC_NUT_cont_Salinity_NE-2024-Dec-08.txt*
- *Combined_WQ_WC_NUT_cont_Turbidity_NE-2024-Dec-08.txt*
- *Combined_WQ_WC_NUT_cont_Water_Temperature_NE-2024-Dec-08.txt*

**Continuous monitoring locations in Banana River Aquatic Preserve**

Table 30: St. Johns River Water Management District Continuous Water Quality Programs (5061)

| *ProgramLocationID* | *Years of Data* | *Use in Analysis* | *Parameters* |
|---|---|---|---|
| CMMerritt | 3 | FALSE | Turb |
| CMMerritt | 4 | FALSE | DO , DOS , pH , Sal , TempW |
| IRLB04 | 8 | TRUE | DO , DOS , pH , Sal , Turb , TempW |

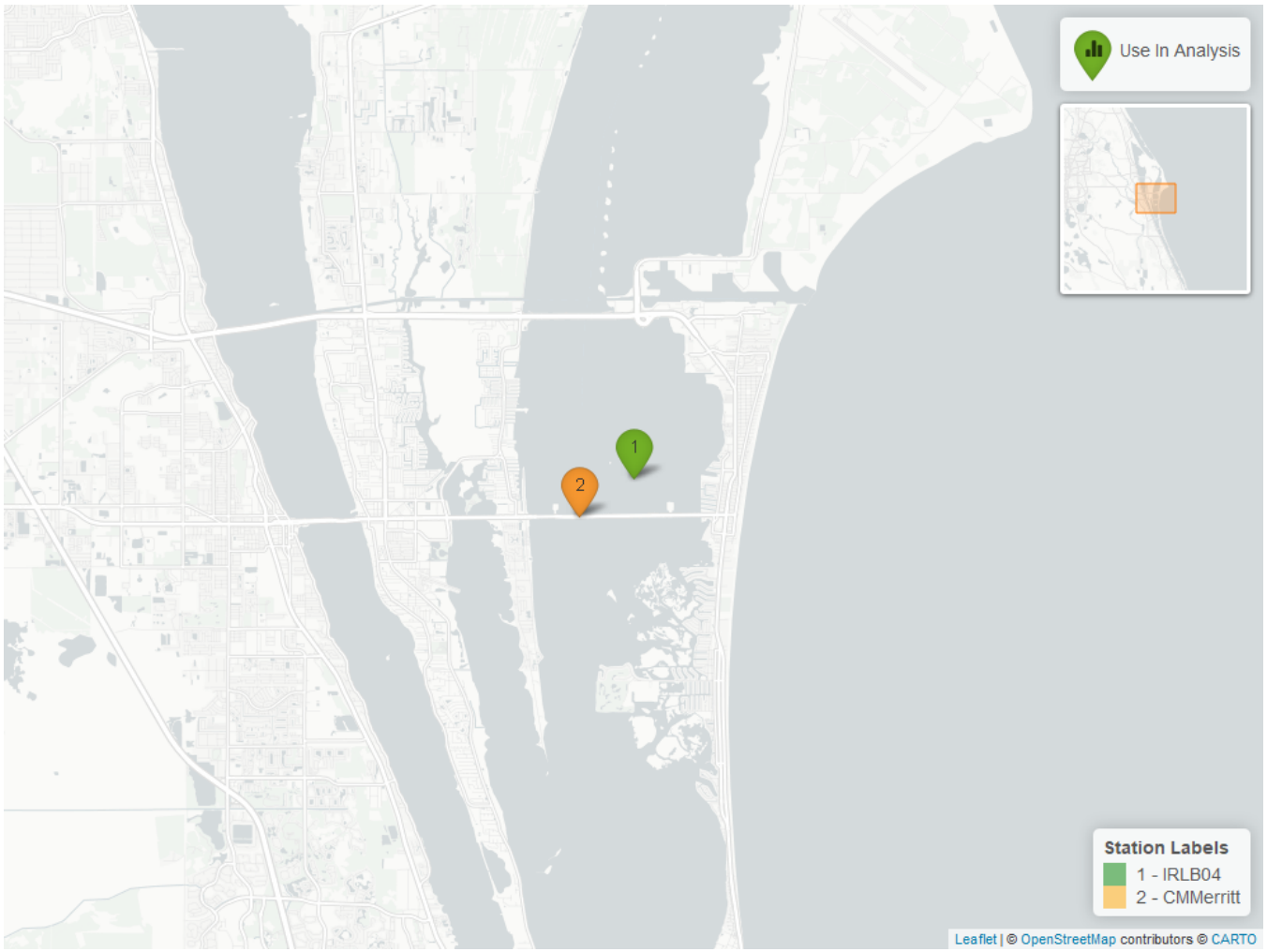


Figure 25: Map showing Continuous Water Quality Monitoring sampling locations within the boundaries of Banana River Aquatic Preserve. Sites marked as *Use In Analysis* are featured in this report.

### Dissolved Oxygen - All Stations Combined

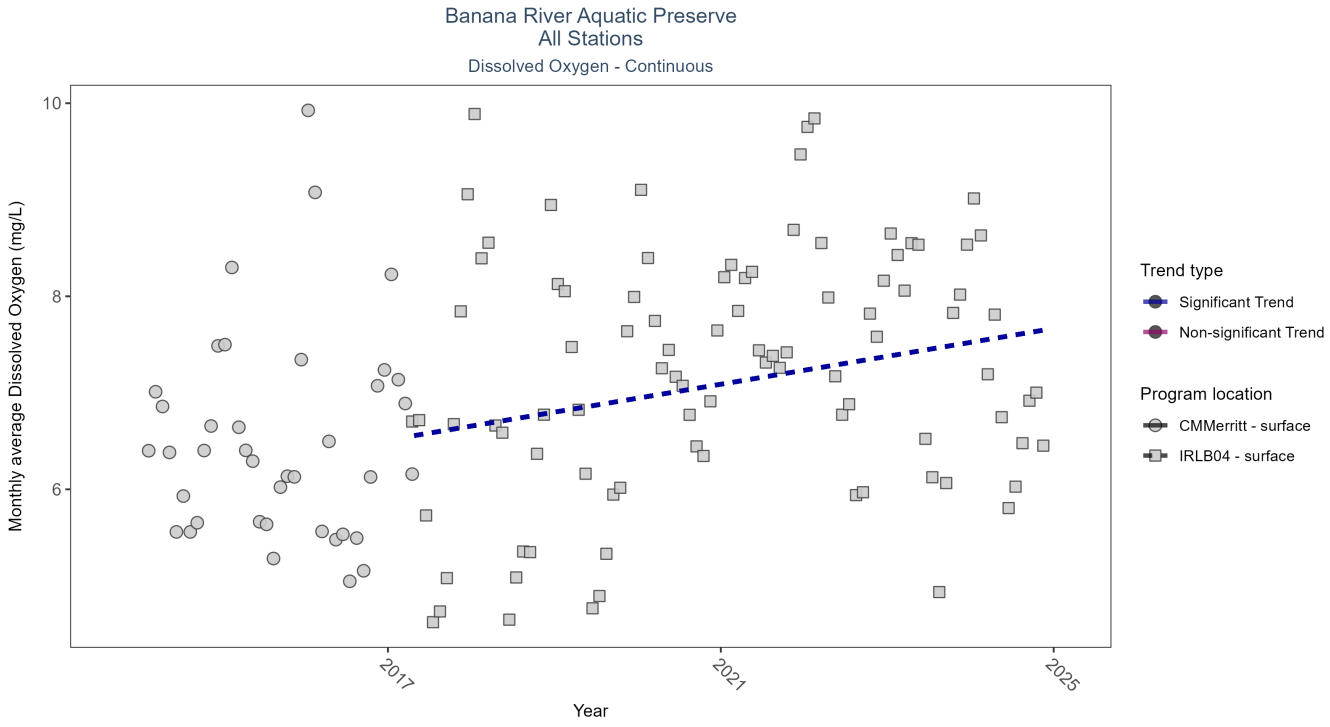


Figure 26: Figure for Dissolved Oxygen - Continuous - All stations combined

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

| Station | N_Data | N_Years | Period of Record | Median | tau | SennIntercept | SennSlope | p |
|---|---|---|---|---|---|---|---|---|
| CMMerritt | 27378 | 4 | 2014 - 2017 | 6.51 | - | - | - | - |
| IRLB04 | 65727 | 8 | 2017 - 2024 | 7.29 | 0.26 | 6.51 | 0.14 | 0.0022 |

### Dissolved Oxygen Saturation - All Stations Combined

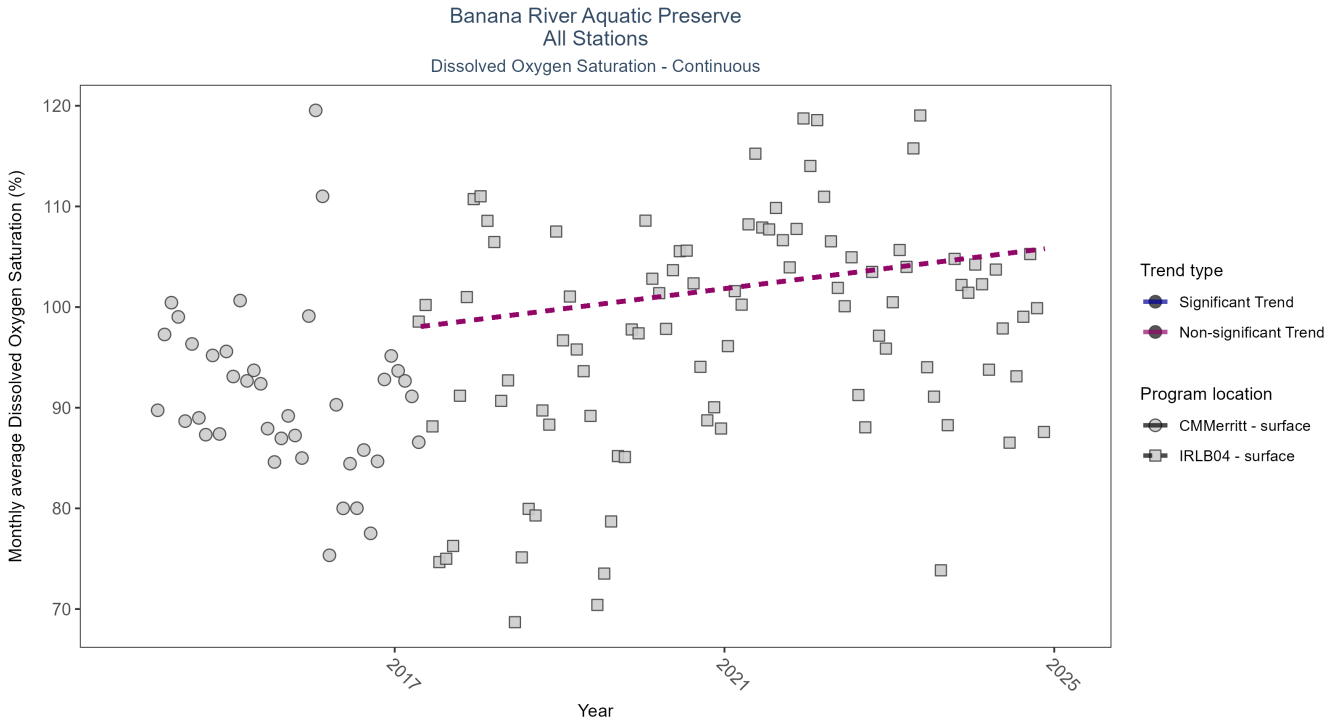


Figure 27: Figure for Dissolved Oxygen Saturation - Continuous - All stations combined

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 |
|---|---|---|---|---|---|---|---|---|
| CMMerritt | 25864 | 4 | 2014 - 2017 | 91.03 | - | - | - | - |
| IRLB04 | 78329 | 8 | 2017 - 2024 | 101.46 | 0.13 | 97.74 | 1.02 | 0.1041 |

### pH - All Stations Combined

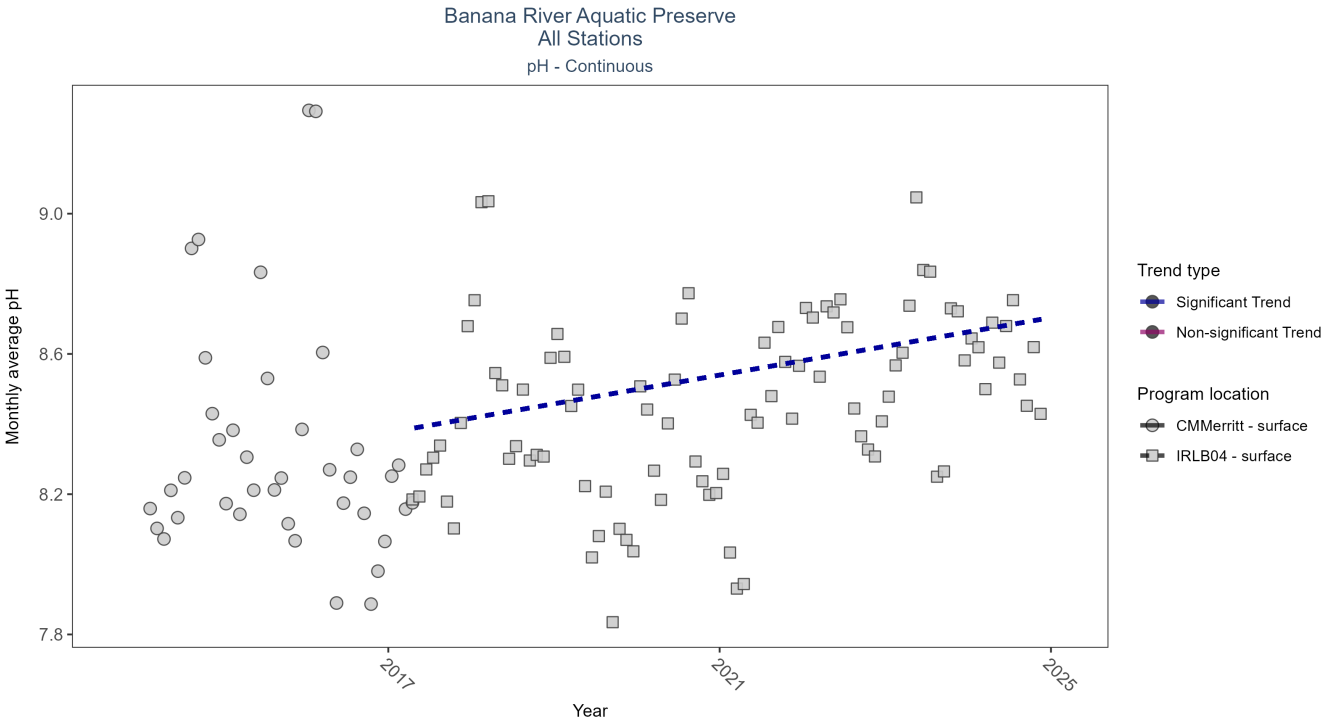


Figure 28: Figure for pH - Continuous - All stations combined

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

| Station | N_Data | N_Years | Period of Record | Median | tau | SennIntercept | SennSlope | p |
|---|---|---|---|---|---|---|---|---|
| CMMerritt | 27417 | 4 | 2014 - 2017 | 8.22 | - | - | - | - |
| IRLB04 | 65643 | 8 | 2017 - 2024 | 8.48 | 0.27 | 8.38 | 0.04 | 0.0008 |

### Salinity - All Stations Combined

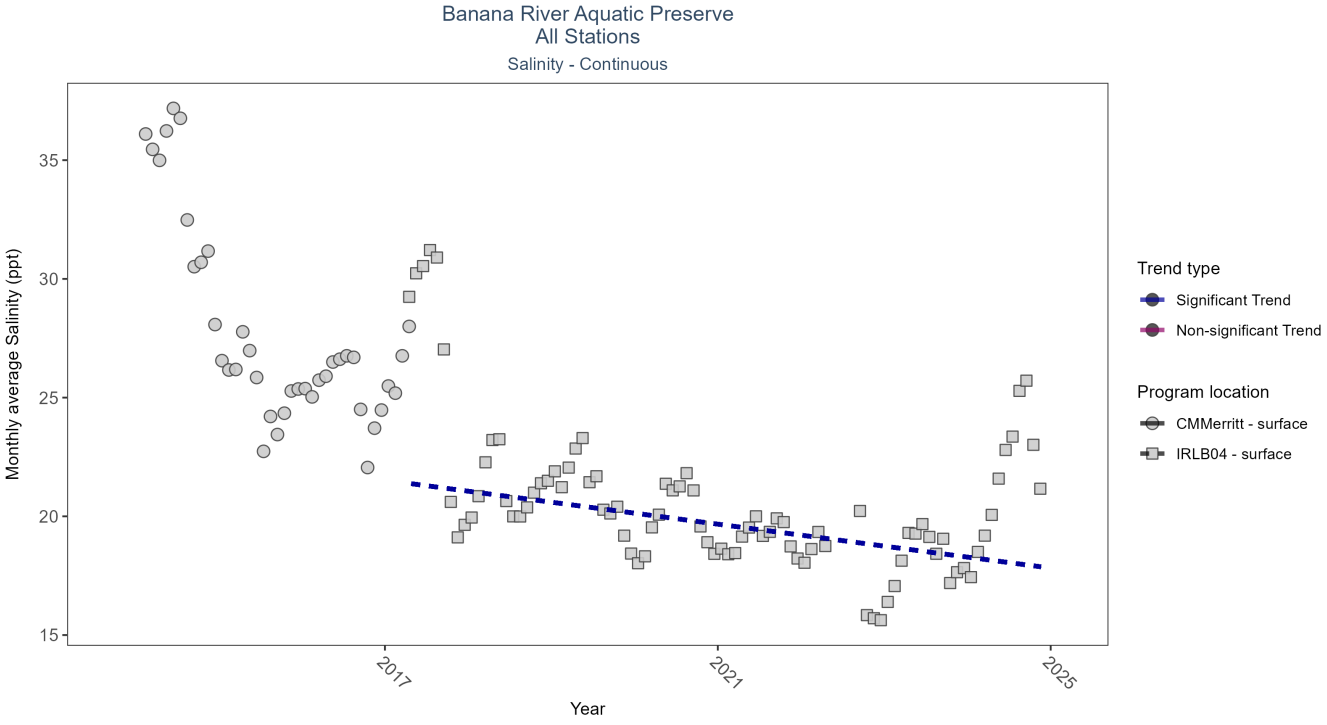


Figure 29: Figure for Salinity - Continuous - All stations combined

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

| Station | N_Data | N_Years | Period of Record | Median | tau | SennIntercept | SennSlope | p |
|---|---|---|---|---|---|---|---|---|
| IRLB04 | 61864 | 8 | 2017 - 2024 | 19.82 | -0.46 | 21.52 | -0.46 | 0.0000 |
| CMMerritt | 25902 | 4 | 2014 - 2017 | 26.40 | - | - | - | - |

### Turbidity - All Stations Combined

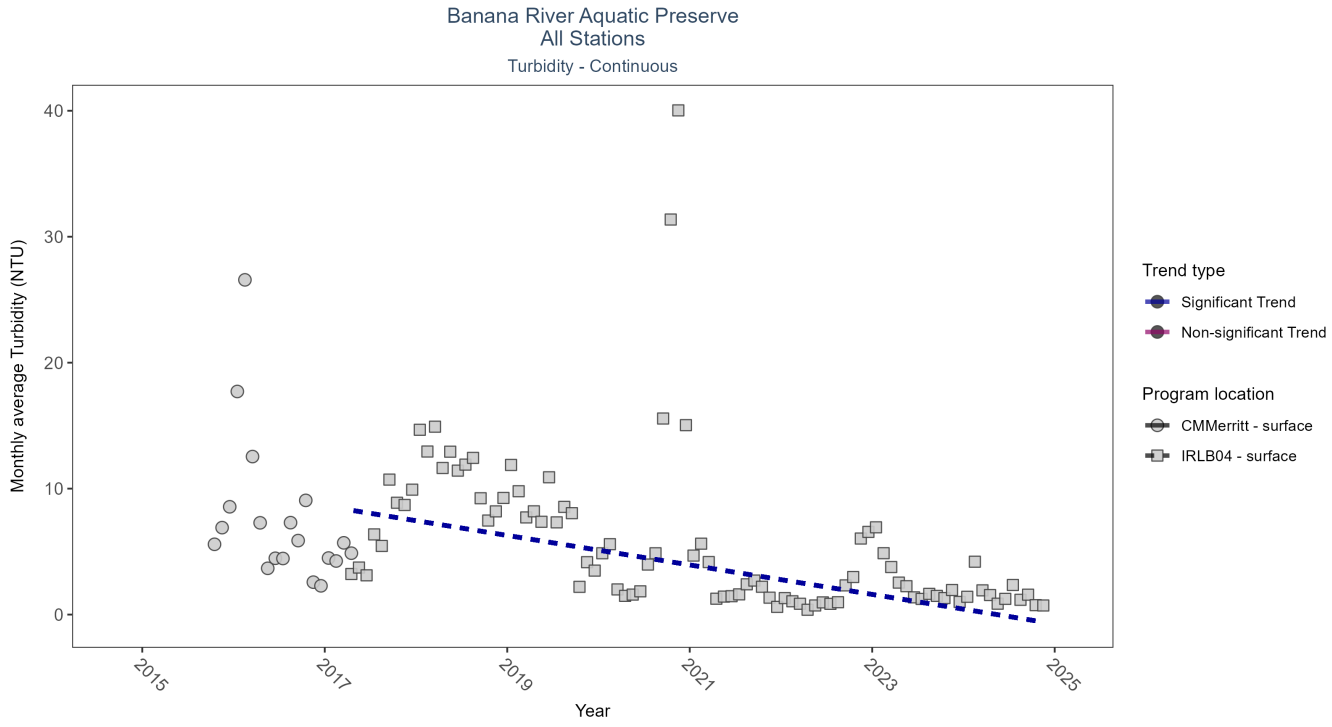


Figure 30: Figure for Turbidity - Continuous - All stations combined

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

| Station | N_Data | N_Years | Period of Record | Median | tau | SennIntercept | SennSlope | p |
|---|---|---|---|---|---|---|---|---|
| IRLB04 | 62930 | 8 | 2017 - 2024 | 3.18 | -0.6 | 8.62 | -1.17 | 0.0000 |
| CMMerritt | 12912 | 3 | 2015 - 2017 | 5.29 | - | - | - | - |

### Water Temperature - All Stations Combined

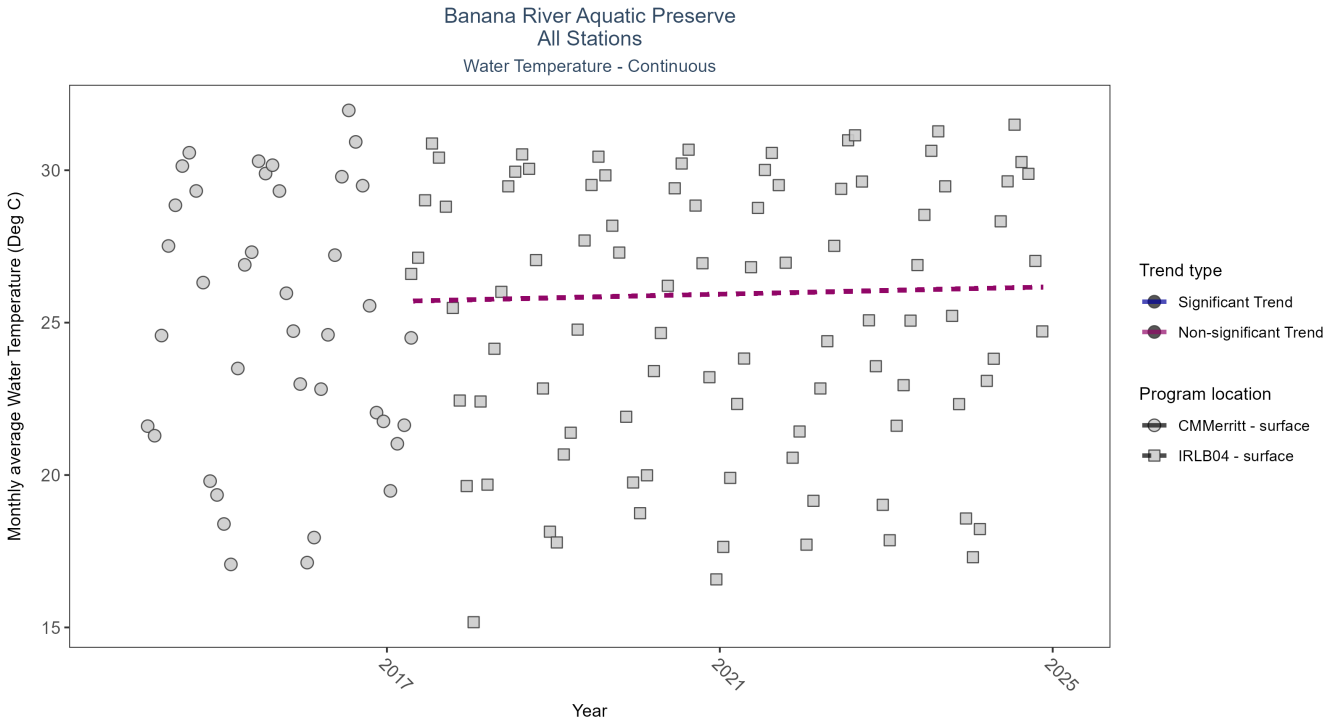


Figure 31: Figure for Water Temperature - Continuous - All stations combined

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

| Station | N_Data | N_Years | Period of Record | Median | tau | SennIntercept | SennSlope | p |
|---|---|---|---|---|---|---|---|---|
| CMMerritt | 27484 | 4 | 2014 - 2017 | 25.43 | - | - | - | - |
| IRLB04 | 65731 | 8 | 2017 - 2024 | 25.90 | 0.1 | 25.69 | 0.06 | 0.2413 |

# 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

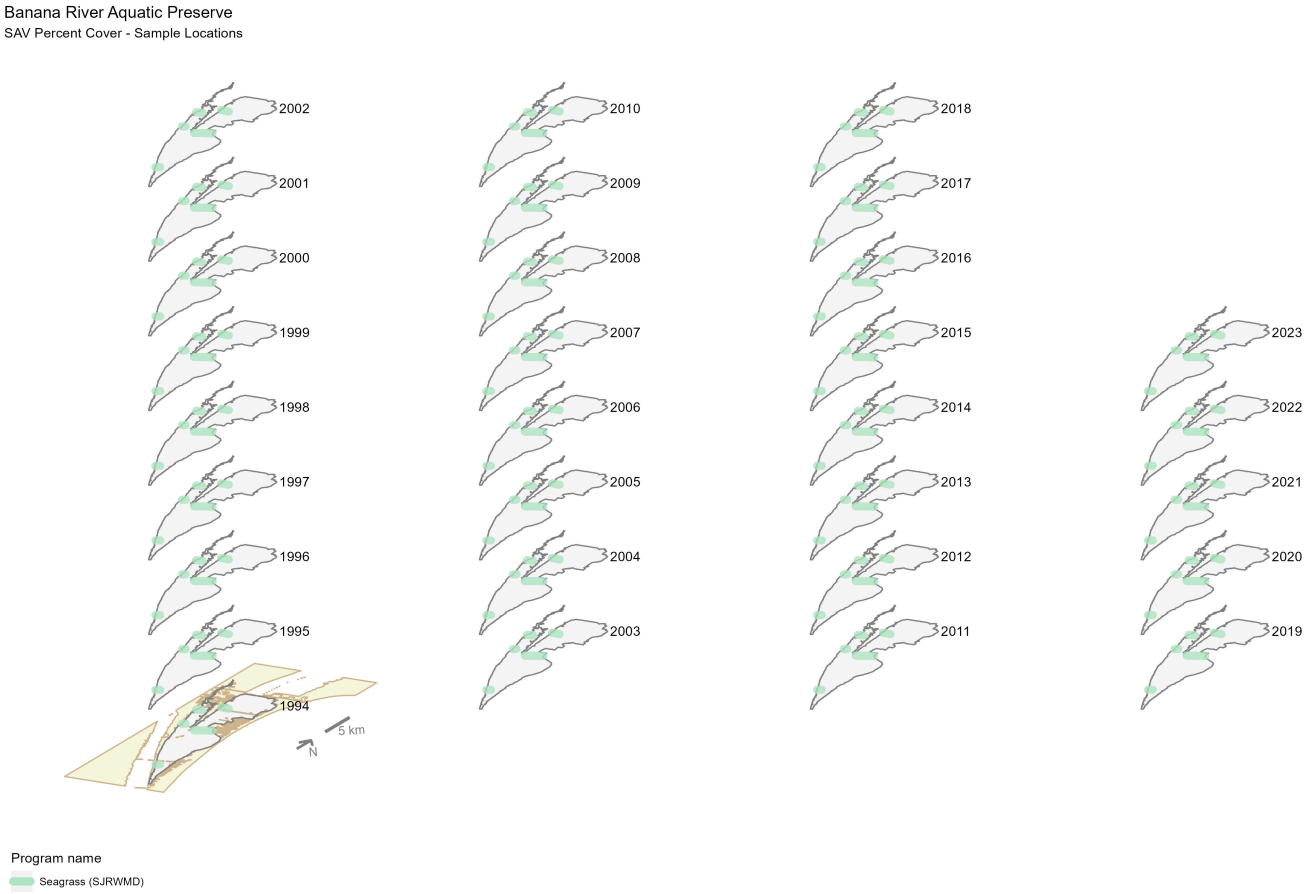


Figure 32: Maps showing the temporal scope of SAV sampling sites within the boundaries of *Banana River Aquatic Preserve* by Program name.

**Sampling locations by Program:**

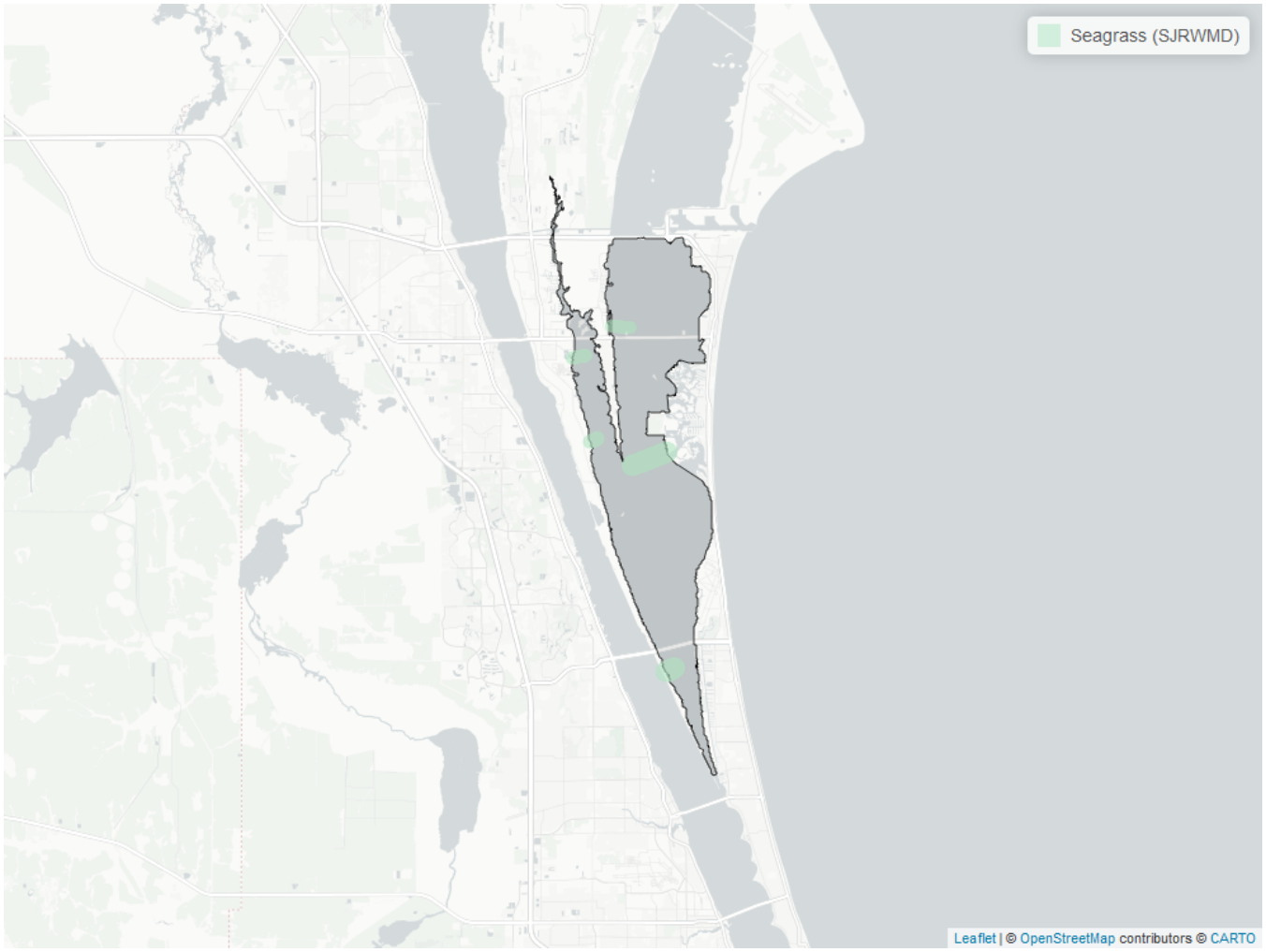


Figure 33: Map showing SAV sampling sites within the boundaries of *Banana River Aquatic Preserve*. The point size reflects the number of samples at a given sampling site.

Table 37: Seagrass (SJRWMD) - Program 3013

| *N-Data* | *YearMin* | *YearMax* | *method* | *Sample Locations* |
|---|---|---|---|---|
| 39569 | 1994 | 2023 | Percent Cover | 5 |
| 45895 | 1994 | 2023 | Percent Occurrence | 5 |

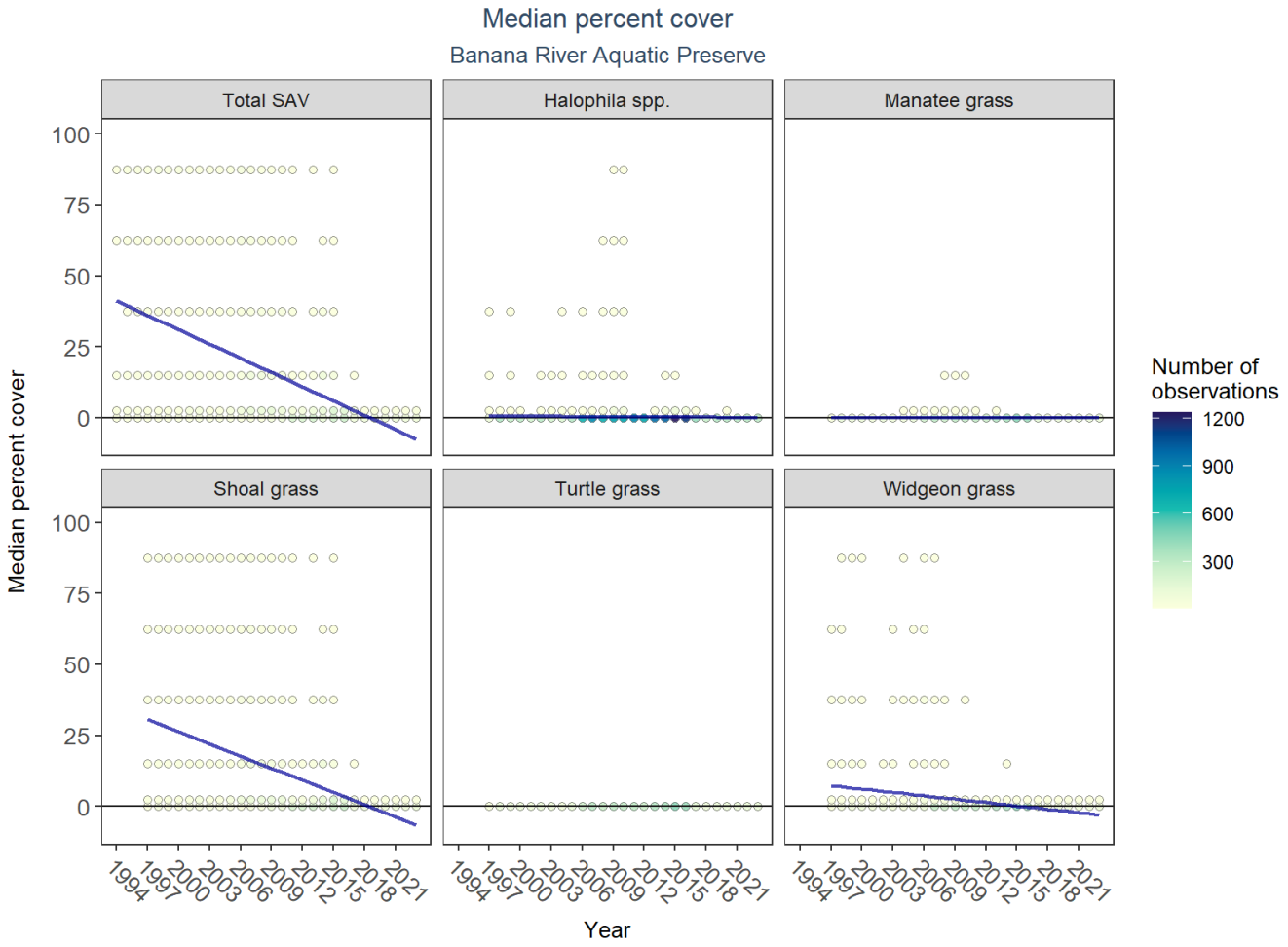


Figure 34: Trends in median percent cover for various seagrass species in Banana River Aquatic Preserve

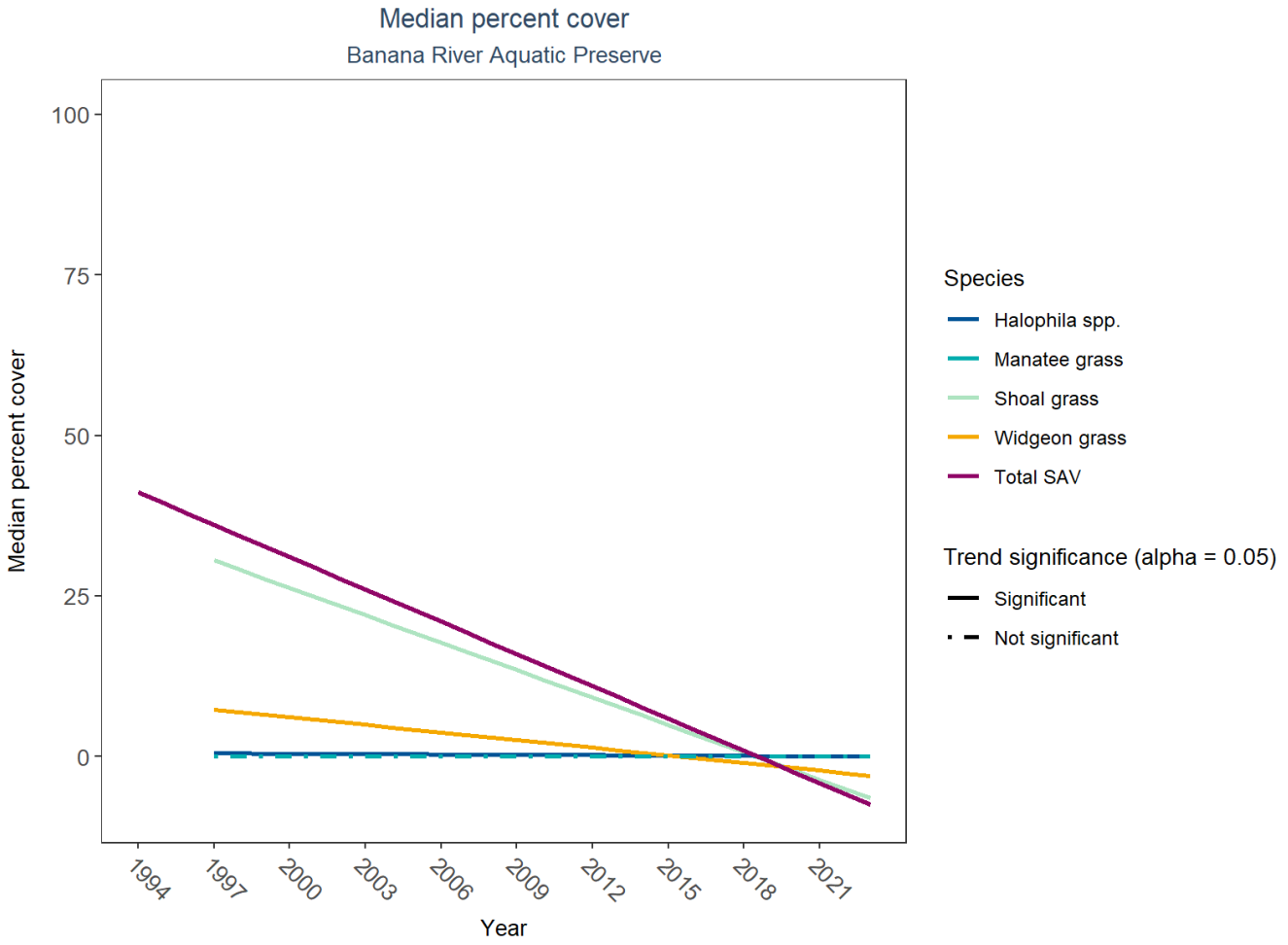


Figure 35: Trends in median percent cover for various seagrass species in Banana River Aquatic Preserve - simplified

Table 38: Percent Cover Trend Analysis for Banana River Aquatic Preserve

| *CommonName* | *Trend Significance (0.05)* | *Period of Record* | *LME-Intercept* | *LME-Slope* | *p* |
|---|---|---|---|---|---|
| Drift algae | Insufficient data to calculate trend | - | - | - | - |
| Shoal grass | Significantly decreasing trend | 1997 - 2023 | 34.8235790 | -1.4227787 | 0.0000000 |
| Halophila spp. | Significantly decreasing trend | 1997 - 2023 | 0.5890947 | -0.0189073 | 0.0044257 |
| Widgeon grass | Significantly decreasing trend | 1997 - 2023 | 8.5312731 | -0.3963701 | 0.0002338 |
| Manatee grass | No significant trend | 1997 - 2023 | 0.0910998 | -0.0027346 | 0.0853524 |
| Turtle grass | Model did not fit the available data | 1997 - 2023 | - | - | - |
| Total SAV | Significantly decreasing trend | 1994 - 2023 | 41.1181168 | -1.6748695 | 0.0000000 |
| Total seagrass | Insufficient data to calculate trend | - | - | - | - |

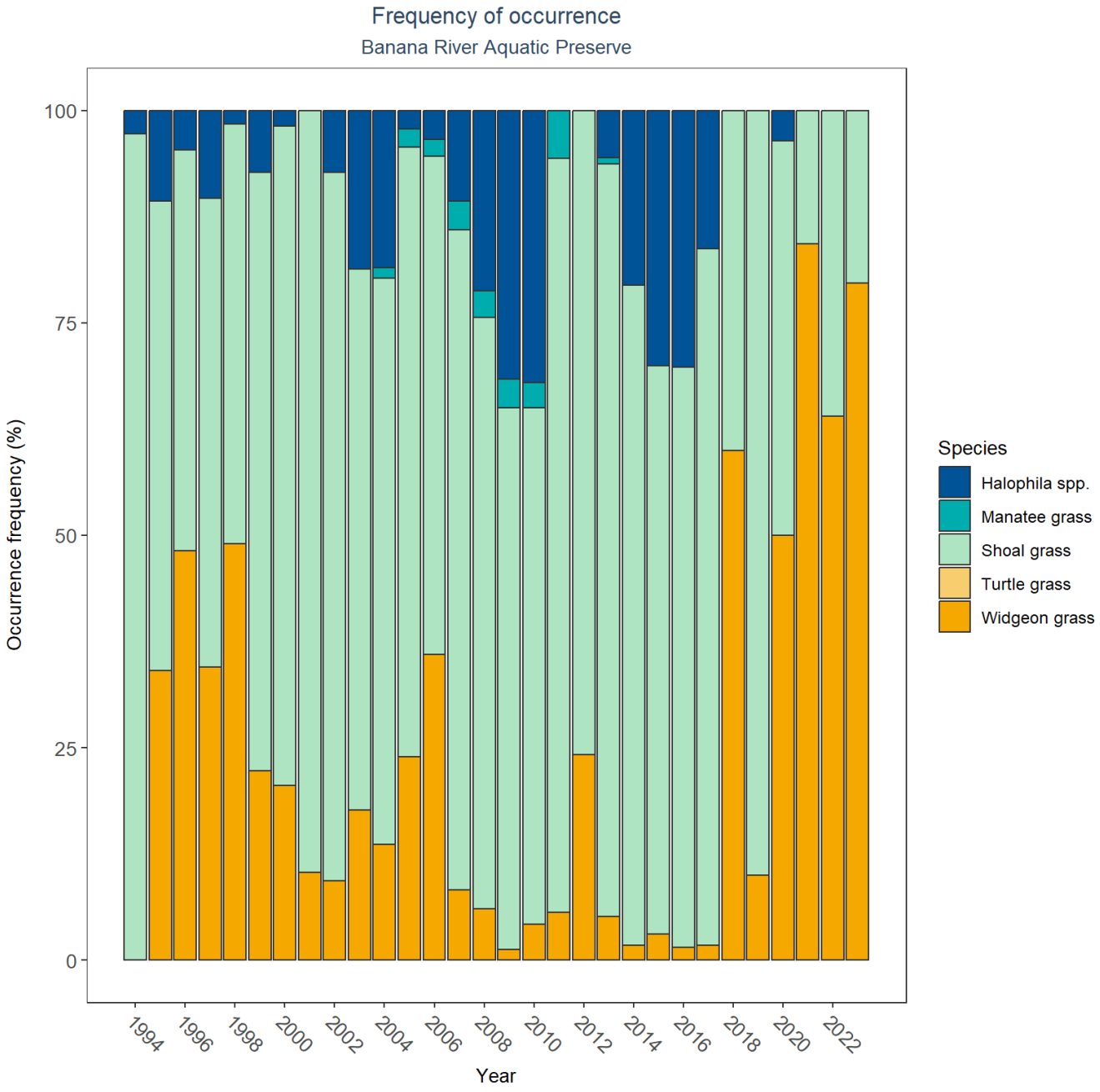


Figure 36: Frequency of occurrence for various seagrass species in Banana River Aquatic Preserve

# References


1. U.S. Environmental Protection Agency (EPA). EPA STOrage and RETrieval Data Warehouse (STORET)/WQX. (2023).
2. Florida Department of Agriculture and Consumer Services (FDACS) - Division of Aquaculture. Shellfish Harvest Area Classification Program. (2022).
3. Florida Department of Environmental Protection (DEP). Florida STORET / WIN. (2024).
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