

# Big Bend Seagrasses Aquatic Preserve

## SEACAR Habitat Analyses

Last compiled on 22 May, 2025

### Contents

<b>Funding &amp; Acknowledgements</b>	<b>2</b>
<b>Threshold Filtering</b>	<b>2</b>
<b>Value Qualifiers</b>	<b>3</b>
<b>Water Column</b>	<b>5</b>
<b>Seasonal Kendall-Tau Analysis</b>	<b>5</b>
<b>Water Quality - Discrete</b>	<b>5</b>
Chlorophyll a, Corrected for Pheophytin - Discrete . . . . .	6
Chlorophyll a, Uncorrected for Pheophytin - Discrete . . . . .	8
Colored Dissolved Organic Matter - Discrete . . . . .	10
Dissolved Oxygen - Discrete . . . . .	12
Dissolved Oxygen Saturation - Discrete . . . . .	14
pH - Discrete . . . . .	15
Salinity - Discrete . . . . .	18
Secchi Depth - Discrete . . . . .	20
Total Nitrogen - Discrete . . . . .	22
Total Phosphorus - Discrete . . . . .	25
Total Suspended Solids - Discrete . . . . .	27
Turbidity - Discrete . . . . .	28
Water Temperature - Discrete . . . . .	30
<b>Water Quality - Continuous</b>	<b>34</b>
Dissolved Oxygen - Continuous . . . . .	36
Dissolved Oxygen Saturation - Continuous . . . . .	38
pH - Continuous . . . . .	40
Salinity - Continuous . . . . .	42
Turbidity - Continuous . . . . .	44
Water Temperature - Continuous - Program 7 . . . . .	46
Water Temperature - Continuous - Program 471 . . . . .	47
<b>Submerged Aquatic Vegetation</b>	<b>49</b>
Parameters . . . . .	49
Species . . . . .	49
Notes . . . . .	49
<b>Coastal Wetlands</b>	<b>55</b>
<b>References</b>	<b>57</b>

## 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:** 2025-05-22



## 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

<i>Qualifier Source</i>	<i>Value Qualifier</i>	<i>Include</i>	<i>Description</i>
SWMP	-1	1	Optional parameter not collected
SWMP	-2	0	Missing data
SWMP	-3	0	Data rejected due to QA/QC
SWMP	-4	0	Outside low sensor range
SWMP	-5	0	Outside high sensor range
SWMP	0	1	Passed initial QA/QC checks
SWMP	1	0	Suspect data
SWMP	2	1	Reserved for future use
SWMP	3	1	Calculated data: non-vented depth/level sensor correction for changes in barometric pressure
SWMP	4	1	Historical: Pre-auto QA/QC
SWMP	5	1	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, and water 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  $p \geq 0.05$ ). 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-2025-Mar-06.txt*
- *Combined\_WQ\_WC\_NUT\_Chlorophyll\_a\_uncorrected\_for\_pheophytin-2025-Mar-06.txt*
- *Combined\_WQ\_WC\_NUT\_Colored\_dissolved\_organic\_matter\_CDOM-2025-Mar-06.txt*
- *Combined\_WQ\_WC\_NUT\_Dissolved\_Oxygen-2025-Mar-06.txt*
- *Combined\_WQ\_WC\_NUT\_Dissolved\_Oxygen\_Saturation-2025-Mar-06.txt*
- *Combined\_WQ\_WC\_NUT\_pH-2025-Mar-06.txt*
- *Combined\_WQ\_WC\_NUT\_Salinity-2025-Mar-06.txt*
- *Combined\_WQ\_WC\_NUT\_Secchi\_Depth-2025-Mar-06.txt*
- *Combined\_WQ\_WC\_NUT\_Total\_Nitrogen-2025-Mar-06.txt*
- *Combined\_WQ\_WC\_NUT\_Total\_Phosphorus-2025-Mar-06.txt*
- *Combined\_WQ\_WC\_NUT\_Total\_Suspended\_Solids\_TSS-2025-Mar-06.txt*
- *Combined\_WQ\_WC\_NUT\_Turbidity-2025-Mar-06.txt*
- *Combined\_WQ\_WC\_NUT\_Water\_Temperature-2025-Mar-06.txt*

## Chlorophyll a, Corrected for Pheophytin - Discrete

### Seasonal Kendall-Tau Trend Analysis

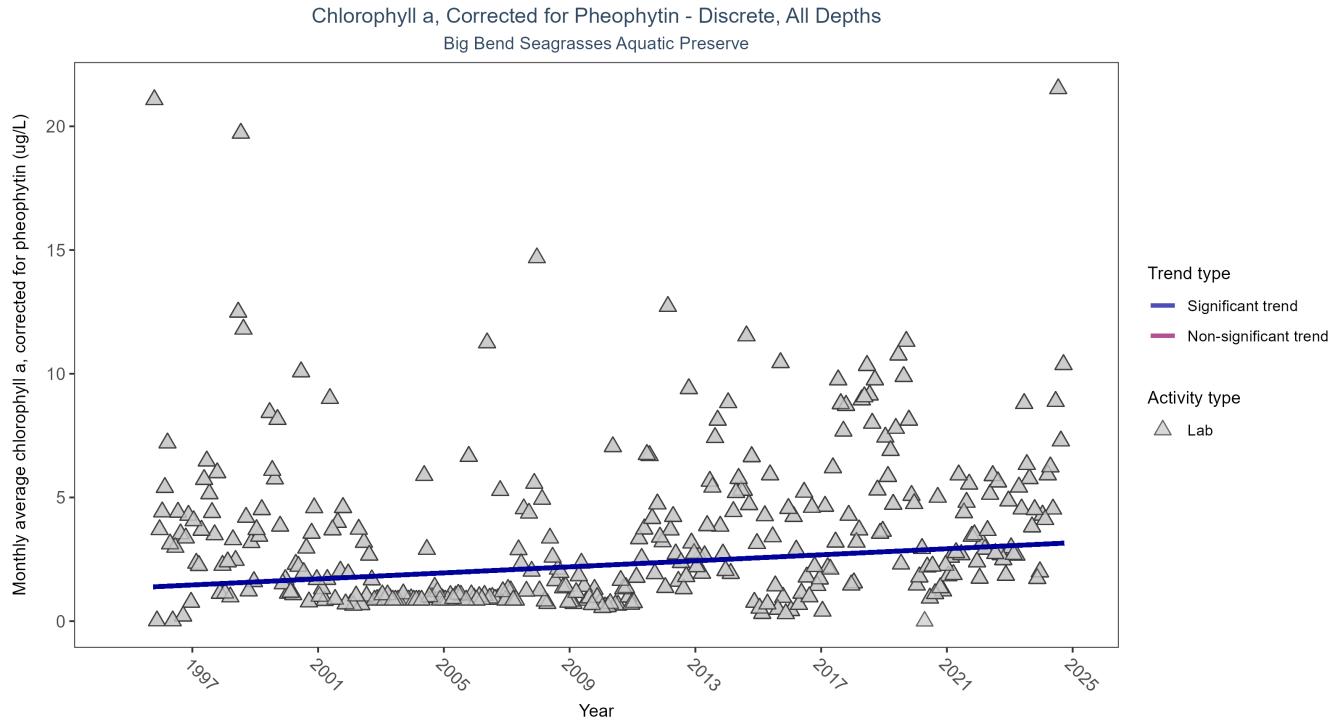


Figure 1: Scatter plot of monthly average levels of chlorophyll a, corrected for pheophytin, over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only laboratory-analyzed chlorophyll a (triangles) is included in the plot.

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

Activity Type	Statistical Trend	Sample Count	Years with Data	Period of Record	Median	tau	Sen Intercept	Sen Slope	p
Lab	Significantly increasing trend	4771	30	1995 - 2024	1.1	0.1745	1.3409	0.061	0

Monthly average chlorophyll a, corrected for pheophytin, increased by 0.06 µg/L per year, indicating a decrease in water clarity.

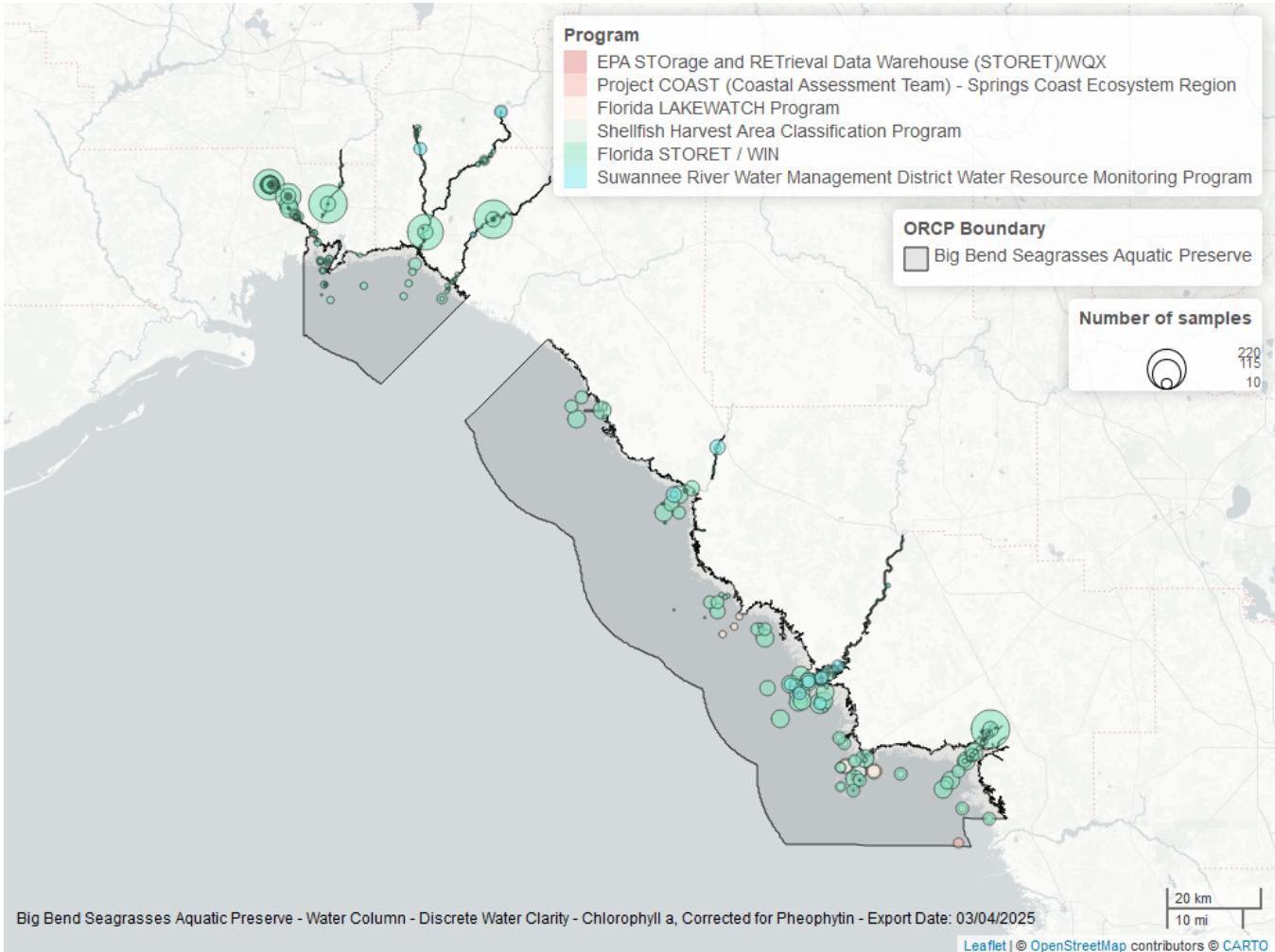


Figure 2: Map showing location of discrete water quality sampling locations within the boundaries of *Big Bend Seagrasses Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

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

<i>ProgramID</i>	<i>N_Data</i>	<i>YearMin</i>	<i>YearMax</i>
5002	4090	1995	2024
514	300	2013	2024
477	299	2016	2024
540	131	2017	2022
5008	17	2023	2024
103	10	2020	2021

#### Program names:

- 103 - EPA STOrage and RETrieval Data Warehouse (STORET)/WQX<sup>1</sup>
- 477 - Suwannee River Water Management District Water Resource Monitoring Program<sup>2</sup>
- 514 - Florida LAKEWATCH Program<sup>3</sup>
- 540 - Shellfish Harvest Area Classification Program<sup>4</sup>
- 5002 - Florida STORET / WIN<sup>5</sup>
- 5008 - Project COAST (Coastal Assessment Team) - Springs Coast Ecosystem Region<sup>6</sup>

## Chlorophyll a, Uncorrected for Pheophytin - Discrete

### Seasonal Kendall-Tau Trend Analysis

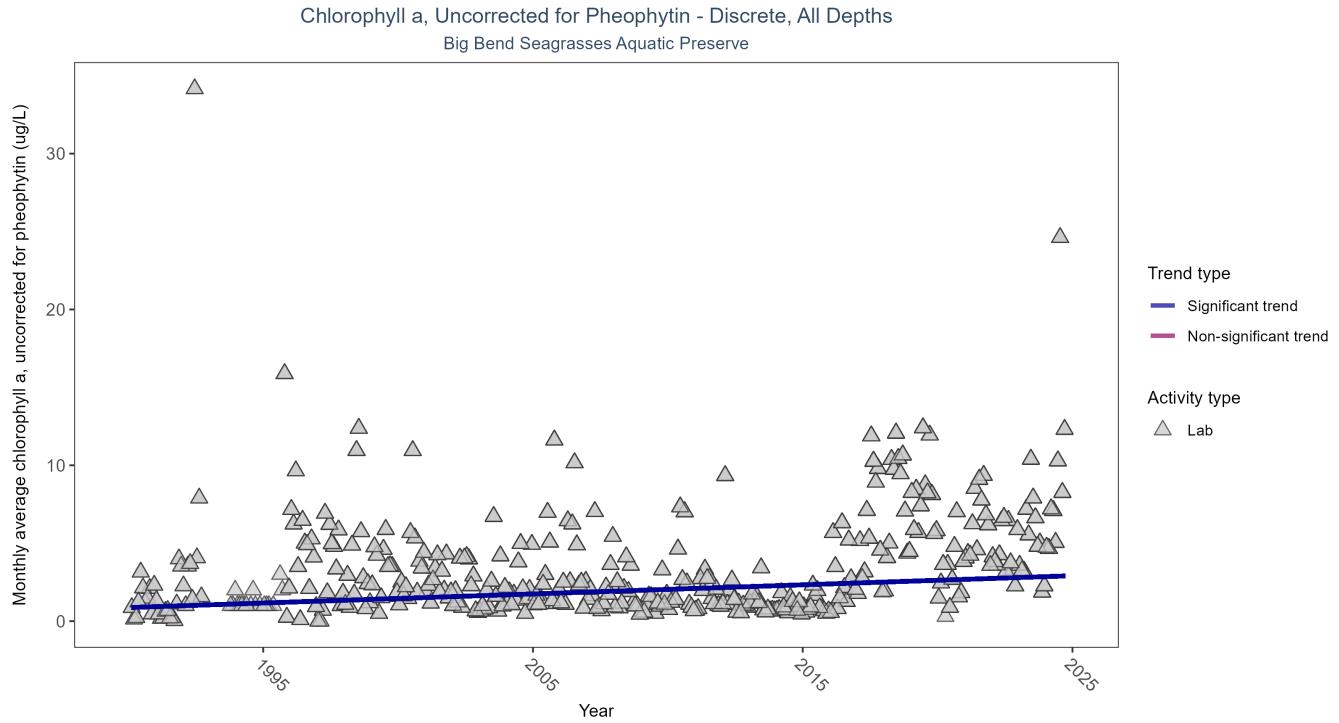


Figure 3: Scatter plot of monthly average levels of chlorophyll a, uncorrected for pheophytin, over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only laboratory-analyzed chlorophyll a (triangles) is included in the plot.

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

Activity Type	Statistical Trend	Sample Count	Years with Data	Period of Record	Median	tau	Sen Intercept	Sen Slope	p
Lab	Significantly increasing trend	6375	35	1990 - 2024	1.2	0.2072	0.8724	0.0584	0

Monthly average chlorophyll a, uncorrected for pheophytin, increased by 0.06 µg/L per year, indicating a decrease in water clarity.

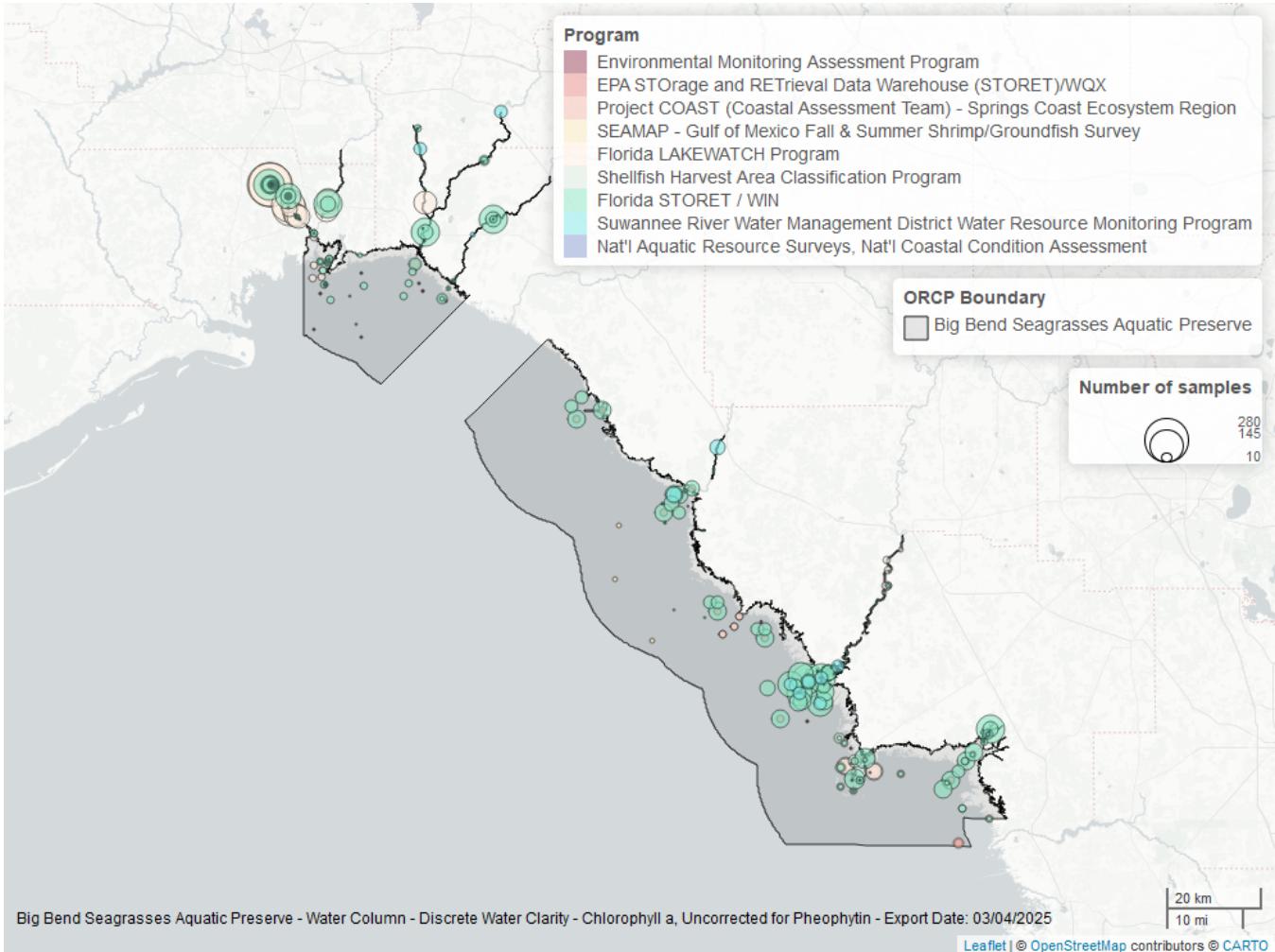


Figure 4: Map showing location of discrete water quality sampling locations within the boundaries of *Big Bend Seagrasses Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

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

<i>ProgramID</i>	<i>N_Data</i>	<i>YearMin</i>	<i>YearMax</i>
5002	3506	1990	2024
514	2229	1993	2024
477	302	2016	2024
103	270	2000	2021
540	142	2017	2022
5008	18	2021	2024
118	12	2000	2010
60	9	2014	2015
115	7	2000	2004

#### Program names:

60 - Southeast Area Monitoring and Assessment Program (SEAMAP) - Gulf of Mexico Fall & Summer Shrimp/Groundfish Survey<sup>7</sup>

103 - EPA STOrage and RETrieval Data Warehouse (STORET)/WQX<sup>1</sup>

115 - Environmental Monitoring Assessment Program<sup>8</sup>

118 - National Aquatic Resource Surveys, National Coastal Condition Assessment<sup>9</sup>

477 - Suwannee River Water Management District Water Resource Monitoring Program<sup>2</sup>

514 - Florida LAKEWATCH Program<sup>3</sup>

540 - Shellfish Harvest Area Classification Program<sup>4</sup>

5002 - Florida STORET / WIN<sup>5</sup>

5008 - Project COAST (Coastal Assessment Team) - Springs Coast Ecosystem Region<sup>6</sup>

## Colored Dissolved Organic Matter - Discrete

### Seasonal Kendall-Tau Trend Analysis

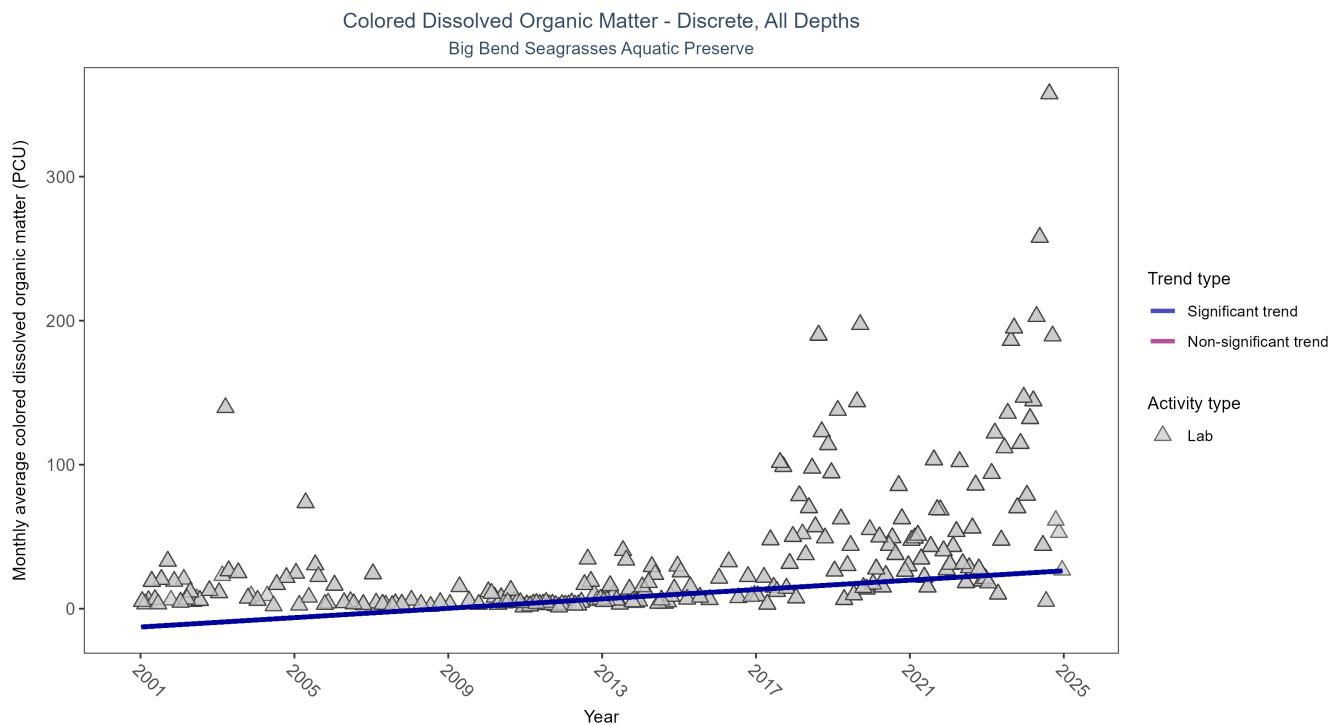


Figure 5: Scatter plot of monthly average colored dissolved organic matter (CDOM) over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only laboratory-analyzed CDOM (triangles) is included in the plot.

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

Activity Type	Statistical Trend	Sample Count	Years with Data	Period of Record	Median	tau	Sen Intercept	Sen Slope	p
Lab	Significantly increasing trend	2790	24	2001 - 2024	17.2	0.4573	-12.715	1.6267	0

Monthly average colored dissolved organic matter increased by 1.63 PCU per year, indicating a decrease in water clarity.

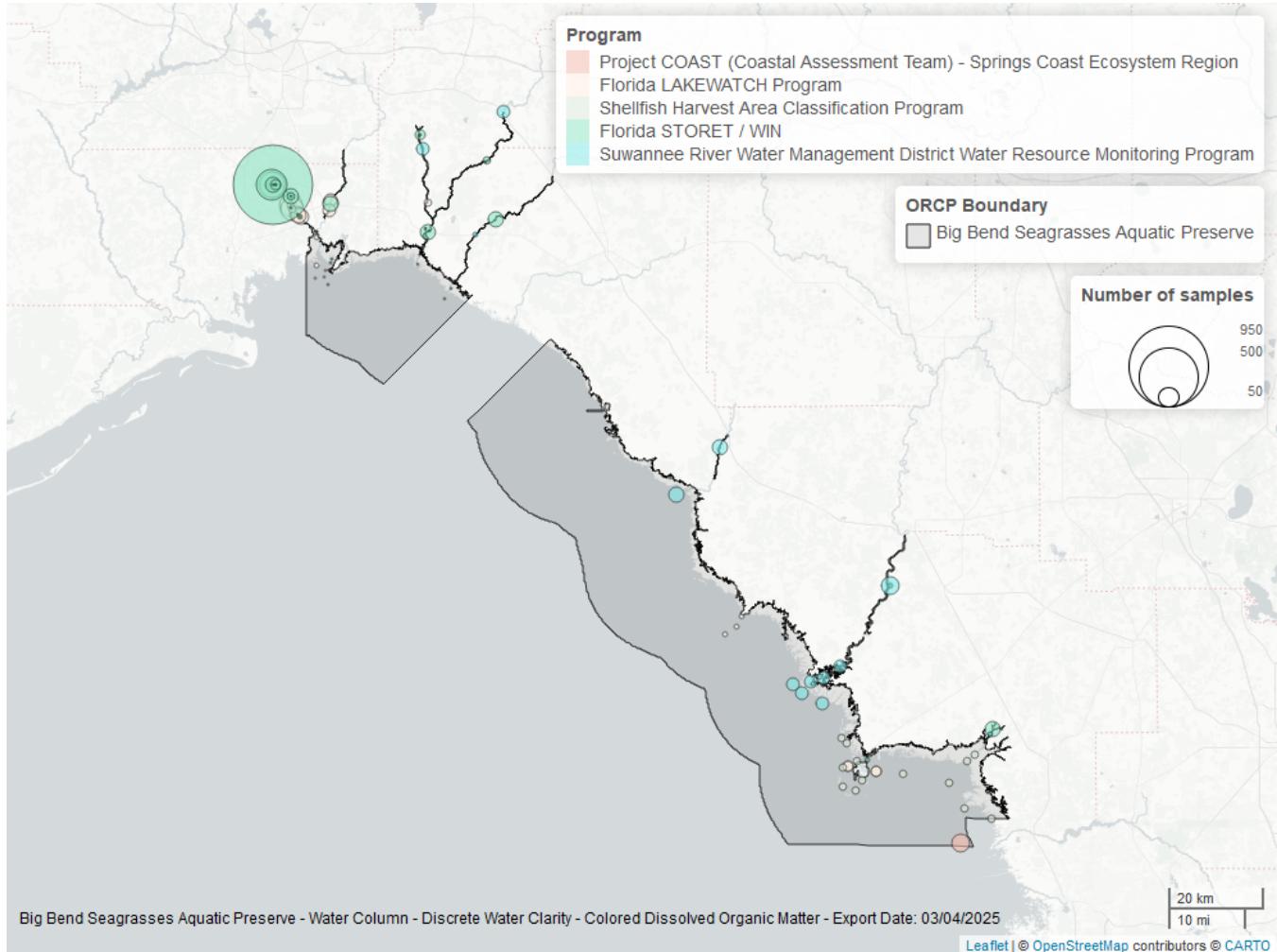


Figure 6: Map showing location of discrete water quality sampling locations within the boundaries of *Big Bend Seagrasses Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Table 11: Programs contributing data for Colored Dissolved Organic Matter

<i>ProgramID</i>	<i>N_Data</i>	<i>YearMin</i>	<i>YearMax</i>
5002	1417	2014	2024
514	893	2001	2024
477	358	2016	2024
540	99	2017	2019
5008	44	2021	2024

#### Program names:

477 - Suwannee River Water Management District Water Resource Monitoring Program<sup>2</sup>

514 - Florida LAKEWATCH Program<sup>3</sup>

540 - Shellfish Harvest Area Classification Program<sup>4</sup>

5002 - Florida STORET / WIN<sup>5</sup>

5008 - Project COAST (Coastal Assessment Team) - Springs Coast Ecosystem Region<sup>6</sup>

## Dissolved Oxygen - Discrete

### Seasonal Kendall-Tau Trend Analysis

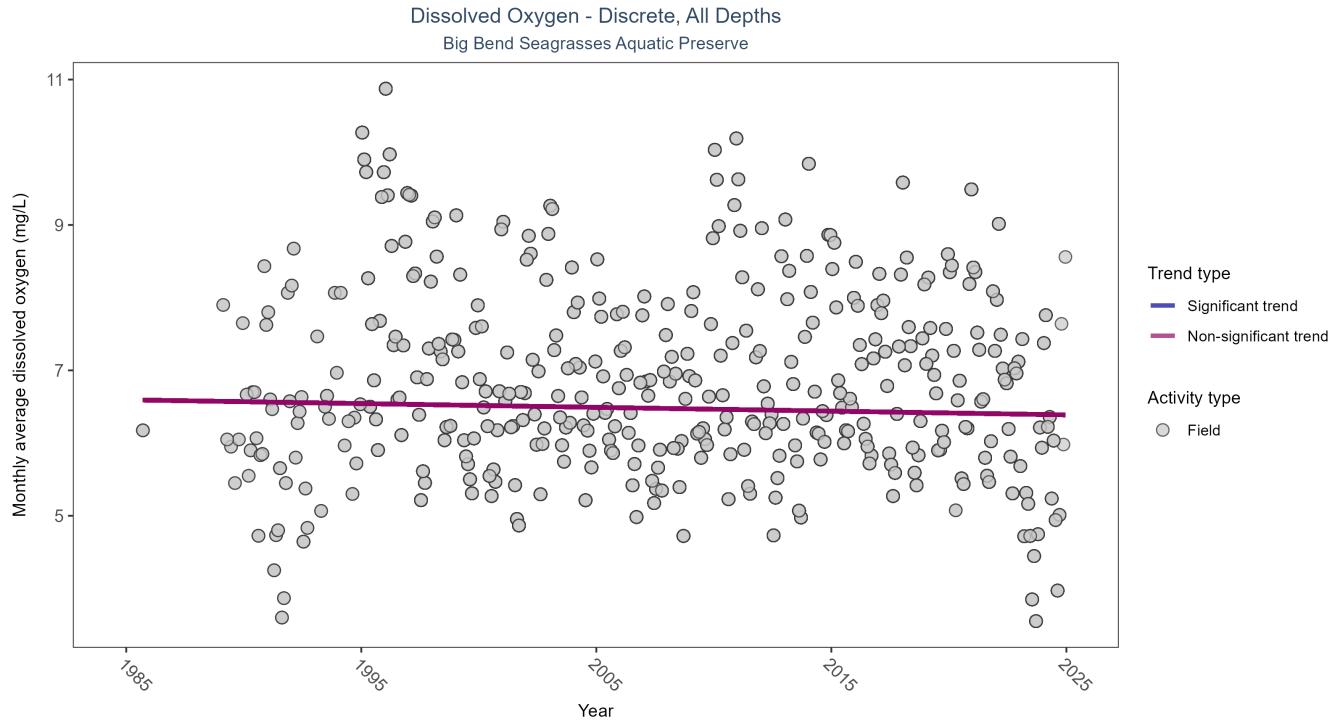


Figure 7: Scatter plot of monthly average dissolved oxygen over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only dissolved oxygen values measured in the field (circles) are included in the plot.

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

Activity Type	Statistical Trend	Sample Count	Years with Data	Period of Record	Median	tau	Sen Intercept	Sen Slope	p
Field	No significant trend	149190	37	1985 - 2024	6.7	-0.046	6.5951	-0.0052	0.2024

Dissolved oxygen showed no detectable trend between 1985 and 2024.

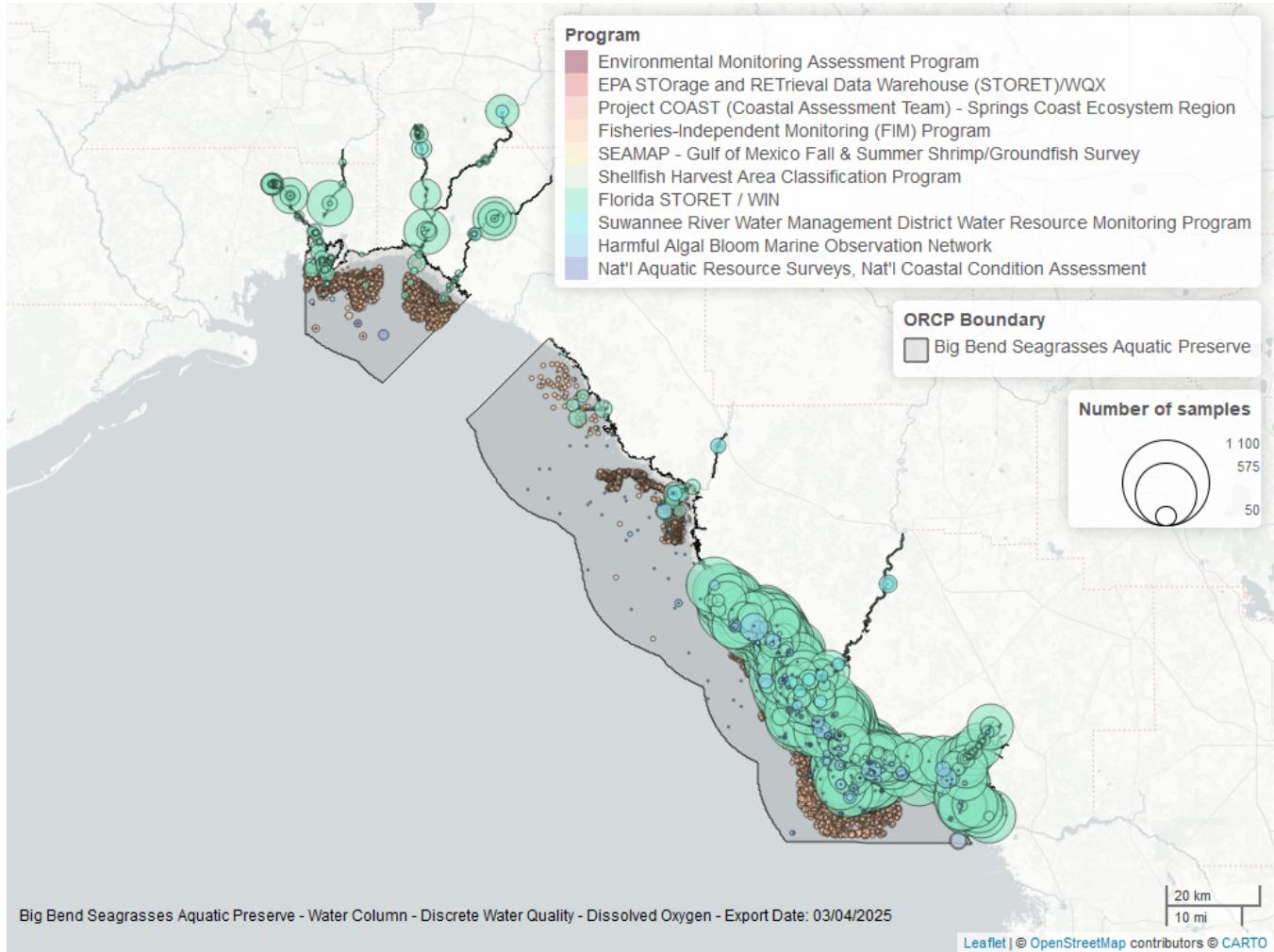


Figure 8: Map showing location of discrete water quality sampling locations within the boundaries of *Big Bend Seagrasses Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Table 13: Programs contributing data for Dissolved Oxygen

<i>ProgramID</i>	<i>N_Data</i>	<i>YearMin</i>	<i>YearMax</i>
5002	93875	1989	2024
69	53488	1996	2022
95	1163	1985	2018
477	358	2016	2024
103	158	2004	2021
540	121	2017	2022
118	53	2000	2021
5008	44	2021	2024
115	43	1991	2004
60	18	2014	2015

#### Program names:

60 - Southeast Area Monitoring and Assessment Program (SEAMAP) - Gulf of Mexico Fall & Summer Shrimp/Groundfish Survey<sup>7</sup>

- 69 - Fisheries-Independent Monitoring (FIM) Program<sup>10</sup>  
 95 - Harmful Algal Bloom Marine Observation Network<sup>11</sup>  
 103 - EPA STOrage and RETrieval Data Warehouse (STORET)/WQX<sup>1</sup>  
 115 - Environmental Monitoring Assessment Program<sup>8</sup>  
 118 - National Aquatic Resource Surveys, National Coastal Condition Assessment<sup>9</sup>  
 477 - Suwannee River Water Management District Water Resource Monitoring Program<sup>2</sup>  
 540 - Shellfish Harvest Area Classification Program<sup>4</sup>  
 5002 - Florida STORET / WIN<sup>5</sup>  
 5008 - Project COAST (Coastal Assessment Team) - Springs Coast Ecosystem Region<sup>6</sup>

## Dissolved Oxygen Saturation - Discrete

### Seasonal Kendall-Tau Trend Analysis

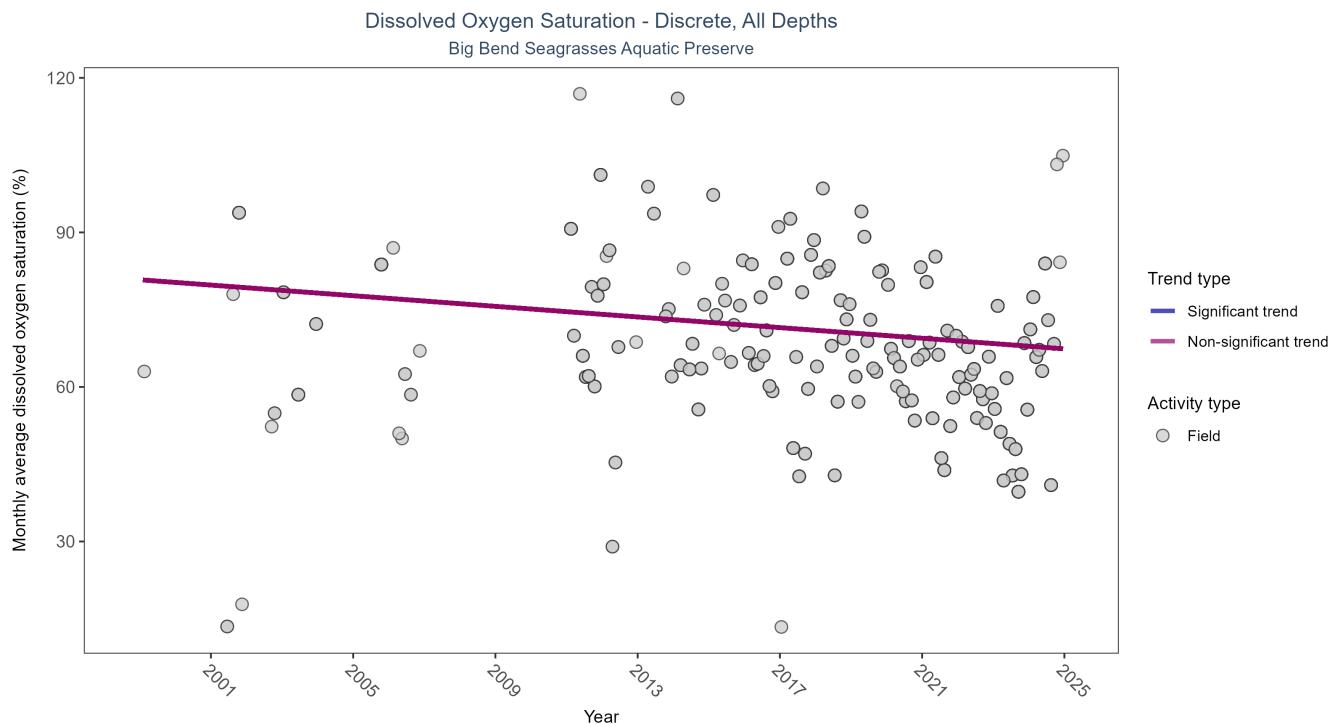


Figure 9: Scatter plot of monthly average dissolved oxygen saturation over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only dissolved oxygen saturation values measured in the field (circles) are included in the plot.

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

Activity Type	Statistical Trend	Sample Count	Years with Data	Period of Record	Median	tau	Sen Intercept	Sen Slope	p
Field	No significant trend	1669	20	1999 - 2024	69.2	-0.1201	80.8069	-0.516	0.0683

Dissolved oxygen saturation showed no detectable trend between 1999 and 2024.

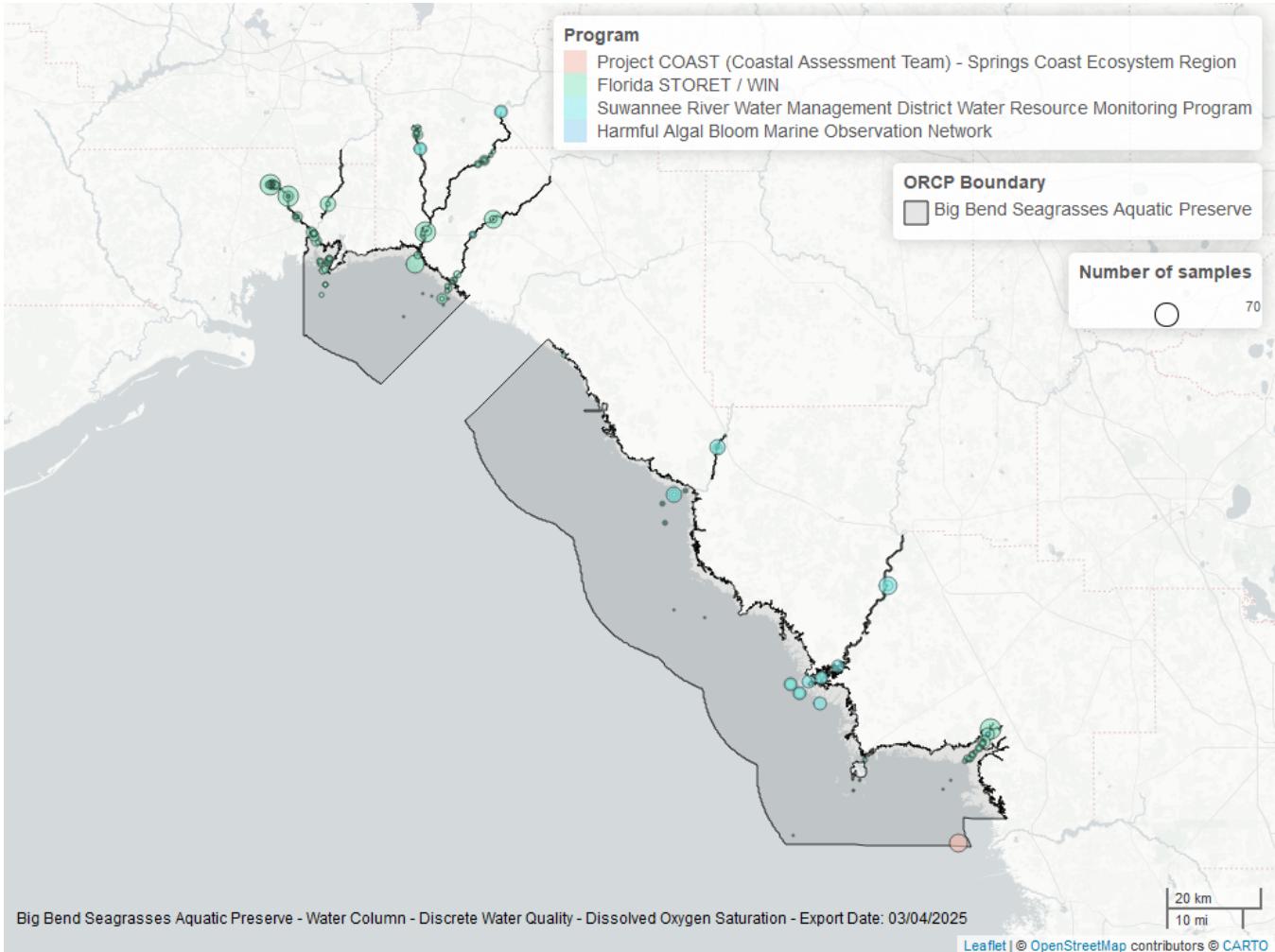


Figure 10: Map showing location of discrete water quality sampling locations within the boundaries of *Big Bend Seagrasses Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Table 15: Programs contributing data for Dissolved Oxygen Saturation

<i>ProgramID</i>	<i>N_Data</i>	<i>YearMin</i>	<i>YearMax</i>
5002	1300	1999	2024
477	358	2016	2024
5008	44	2021	2024
95	3	2016	2018

#### Program names:

95 - Harmful Algal Bloom Marine Observation Network<sup>11</sup>

477 - Suwannee River Water Management District Water Resource Monitoring Program<sup>2</sup>

5002 - Florida STORET / WIN<sup>5</sup>

5008 - Project COAST (Coastal Assessment Team) - Springs Coast Ecosystem Region<sup>6</sup>

#### pH - Discrete

#### Seasonal Kendall-Tau Trend Analysis

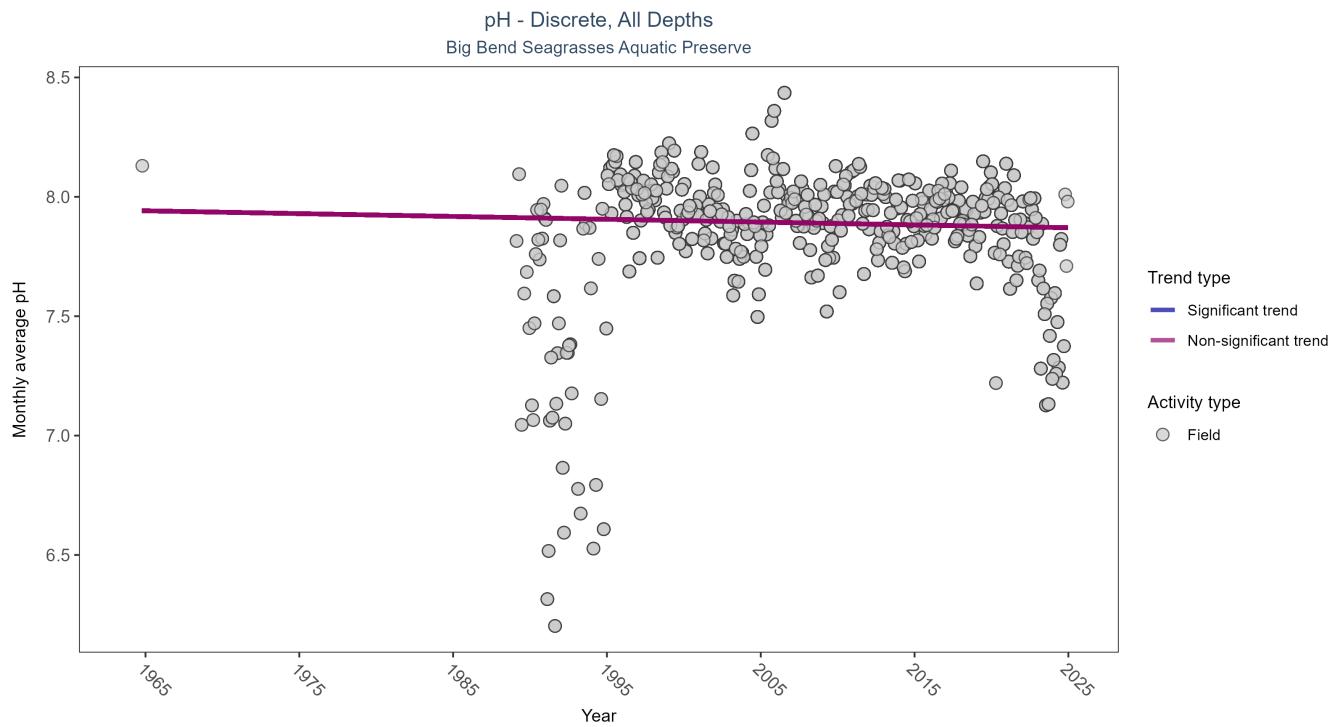


Figure 11: Scatter plot of monthly average pH over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only pH values measured in the field (circles) are included in the plot.

Table 16: Seasonal Kendall-Tau Trend Analysis for pH

Activity Type	Statistical Trend	Sample Count	Years with Data	Period of Record	Median	tau	Sen Intercept	Sen Slope	p
Field	No significant trend	106775	37	1964 - 2024	8	-0.0476	7.9426	-0.0012	0.213

pH showed no detectable trend between 1964 and 2024.

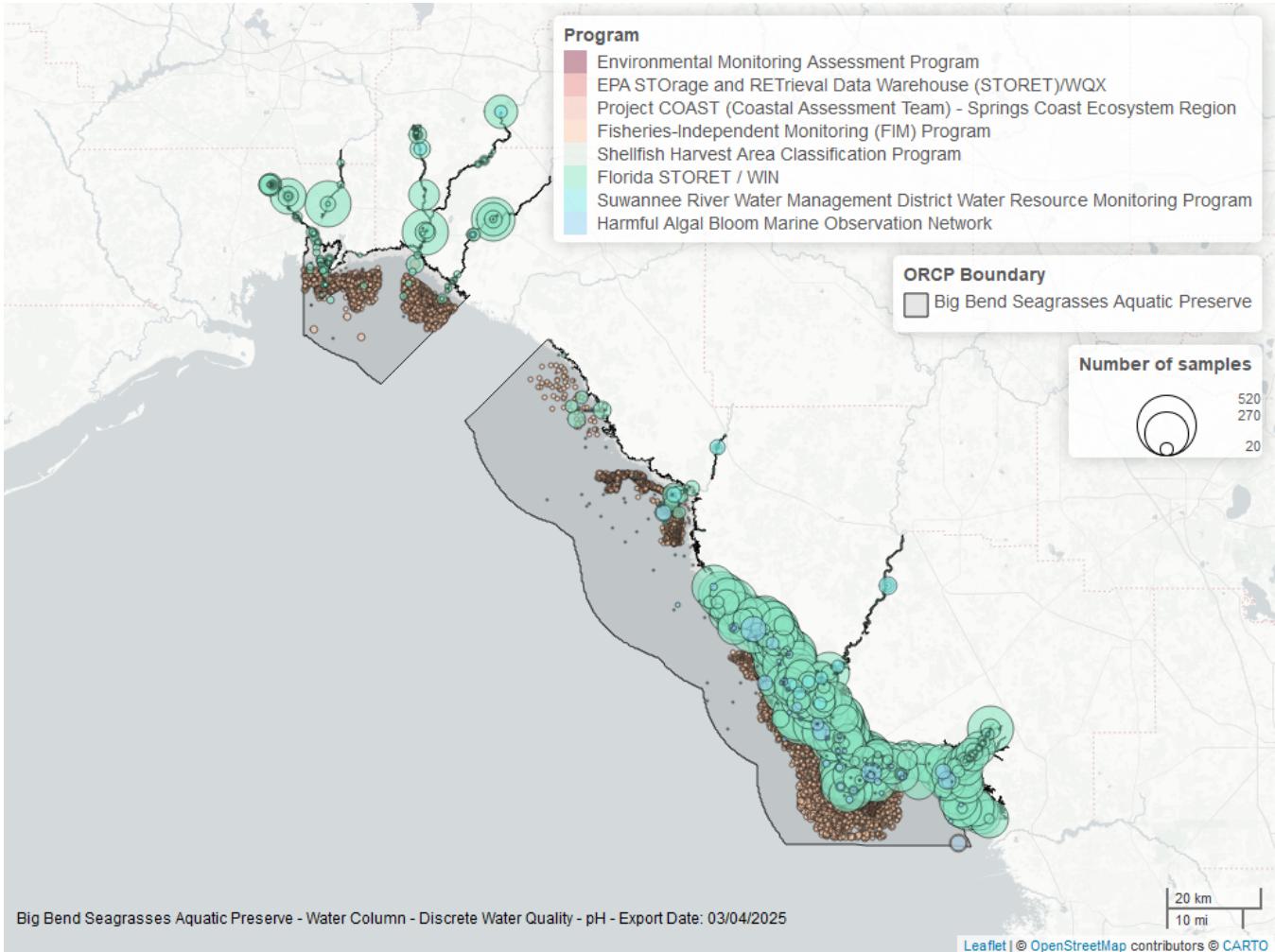


Figure 12: Map showing location of discrete water quality sampling locations within the boundaries of *Big Bend Seagrasses Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Table 17: Programs contributing data for pH

<i>ProgramID</i>	<i>N_Data</i>	<i>YearMin</i>	<i>YearMax</i>
69	53420	1996	2022
5002	51978	1989	2024
95	776	1964	2018
477	358	2016	2024
103	154	2004	2021
540	85	2017	2022
5008	44	2021	2024
115	43	1991	2004

#### Program names:

69 - Fisheries-Independent Monitoring (FIM) Program<sup>10</sup>

95 - Harmful Algal Bloom Marine Observation Network<sup>11</sup>

103 - EPA STOrage and RETrieval Data Warehouse (STORET)/WQX<sup>1</sup>

115 - Environmental Monitoring Assessment Program<sup>8</sup>

477 - Suwannee River Water Management District Water Resource Monitoring Program<sup>2</sup>

540 - Shellfish Harvest Area Classification Program<sup>4</sup>

5002 - Florida STORET / WIN<sup>5</sup>

5008 - Project COAST (Coastal Assessment Team) - Springs Coast Ecosystem Region<sup>6</sup>

## Salinity - Discrete

### Seasonal Kendall-Tau Trend Analysis

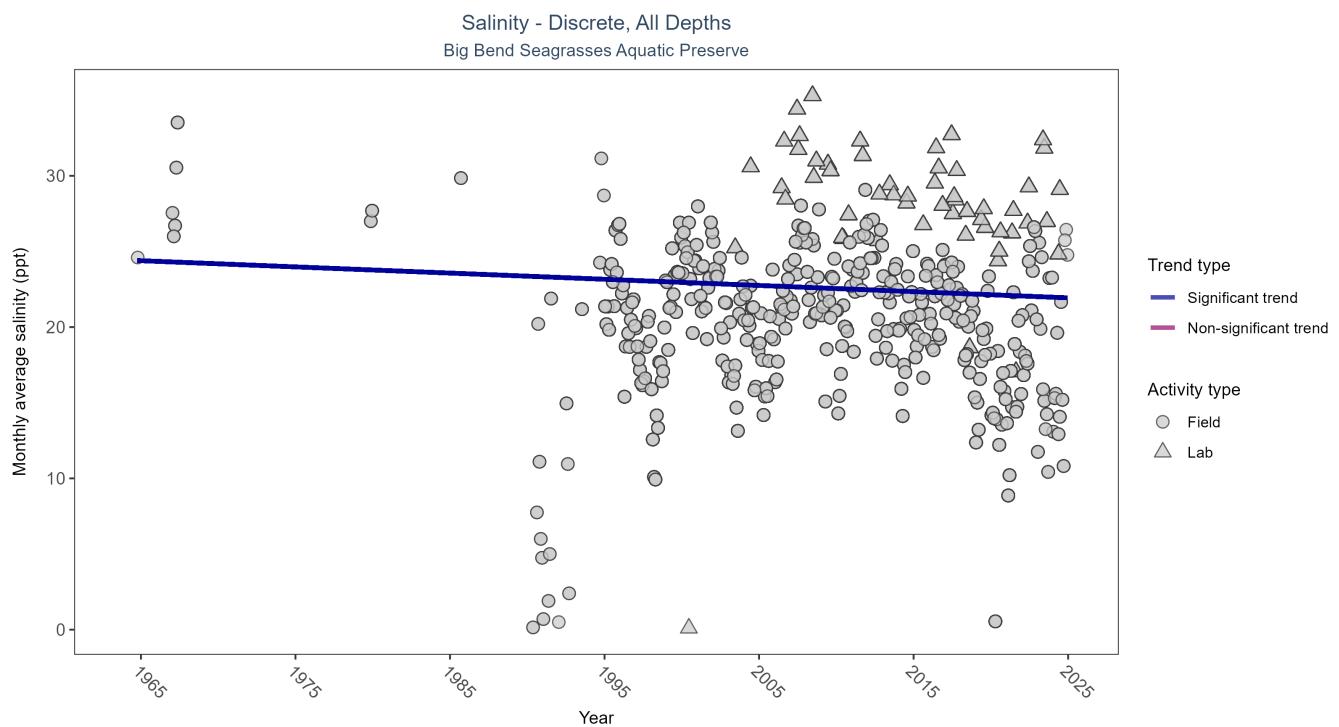


Figure 13: Scatter plot of monthly average salinity over time. If the time series included ten or more years of discrete observations, significant (blue) or non-significant (magenta) trend lines are also shown. Discrete salinity values derived from grab samples analyzed in the field (circles) or the laboratory (triangles) are both included in the plot.

Table 18: Seasonal Kendall-Tau Trend Analysis for Salinity

Activity Type	Statistical Trend	Sample Count	Years with Data	Period of Record	Median	tau	Sen Intercept	Sen Slope	p
All	Significantly decreasing trend	154440	39	1964 - 2024	23.2	-0.0743	24.4299	-0.0409	0.0376

Monthly average salinity decreased by 0.04 ppt per year.

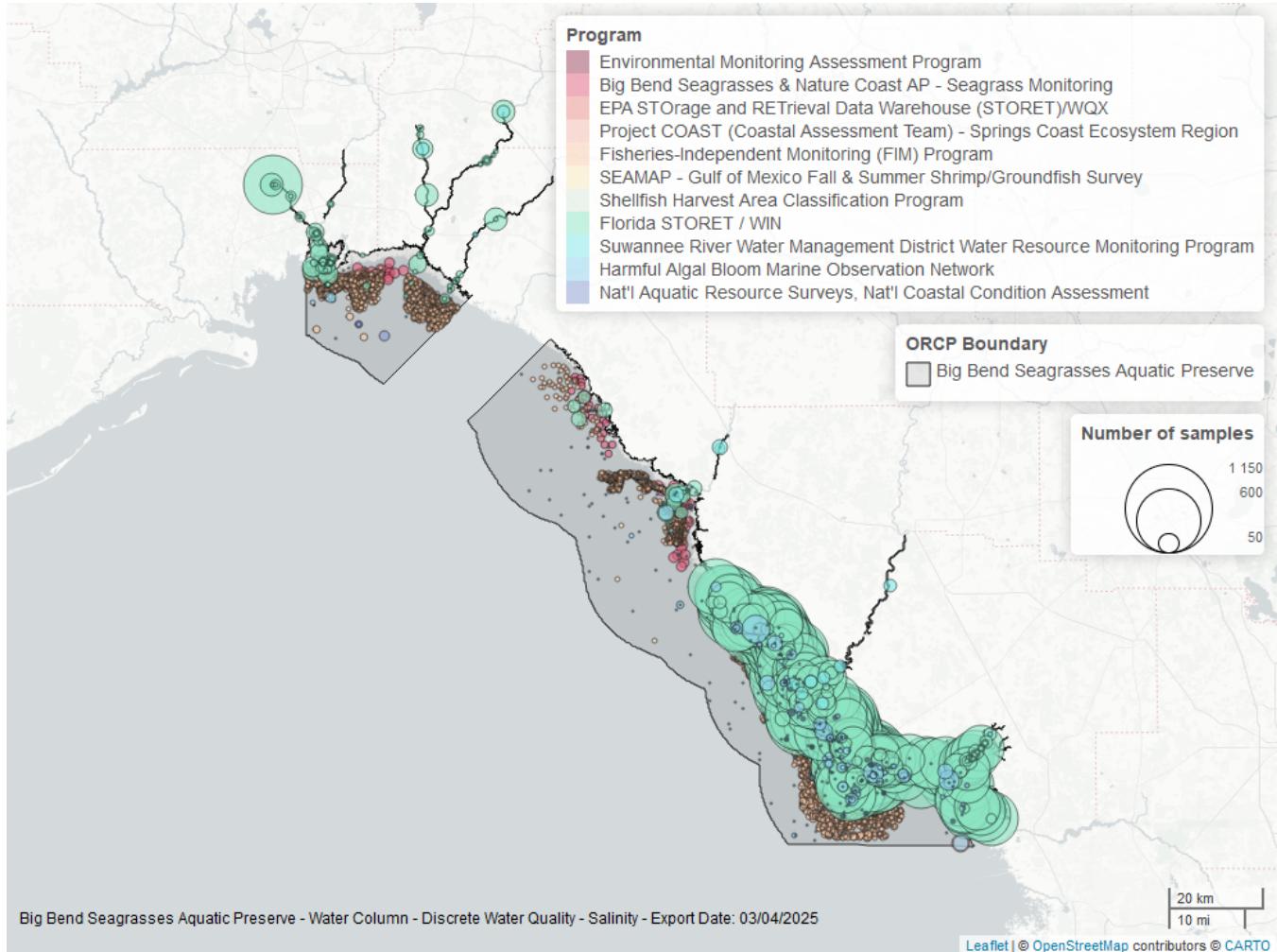


Figure 14: Map showing location of discrete water quality sampling locations within the boundaries of *Big Bend Seagrasses Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Table 19: Programs contributing data for Salinity

<i>ProgramID</i>	<i>N_Data</i>	<i>YearMin</i>	<i>YearMax</i>
5002	97500	1990	2024
69	53641	1996	2022
560	1474	2003	2024
95	1289	1964	2018
477	329	2016	2024
540	132	2017	2022
118	51	2015	2021
5008	46	2021	2024
115	43	1991	2004
60	18	2014	2015
103	4	2004	2004

#### Program names:

60 - Southeast Area Monitoring and Assessment Program (SEAMAP) - Gulf of Mexico Fall & Summer

Shrimp/Groundfish Survey<sup>7</sup>

69 - Fisheries-Independent Monitoring (FIM) Program<sup>10</sup>

95 - Harmful Algal Bloom Marine Observation Network<sup>11</sup>

103 - EPA STOrage and RETrieval Data Warehouse (STORET)/WQX<sup>1</sup>

115 - Environmental Monitoring Assessment Program<sup>8</sup>

118 - National Aquatic Resource Surveys, National Coastal Condition Assessment<sup>9</sup>

477 - Suwannee River Water Management District Water Resource Monitoring Program<sup>2</sup>

540 - Shellfish Harvest Area Classification Program<sup>4</sup>

560 - Big Bend Seagrasses & Nature Coast Aquatic Preserves - Seagrass Monitoring<sup>12</sup>

5002 - Florida STORET / WIN<sup>5</sup>

5008 - Project COAST (Coastal Assessment Team) - Springs Coast Ecosystem Region<sup>6</sup>

## Secchi Depth - Discrete

### Seasonal Kendall-Tau Trend Analysis

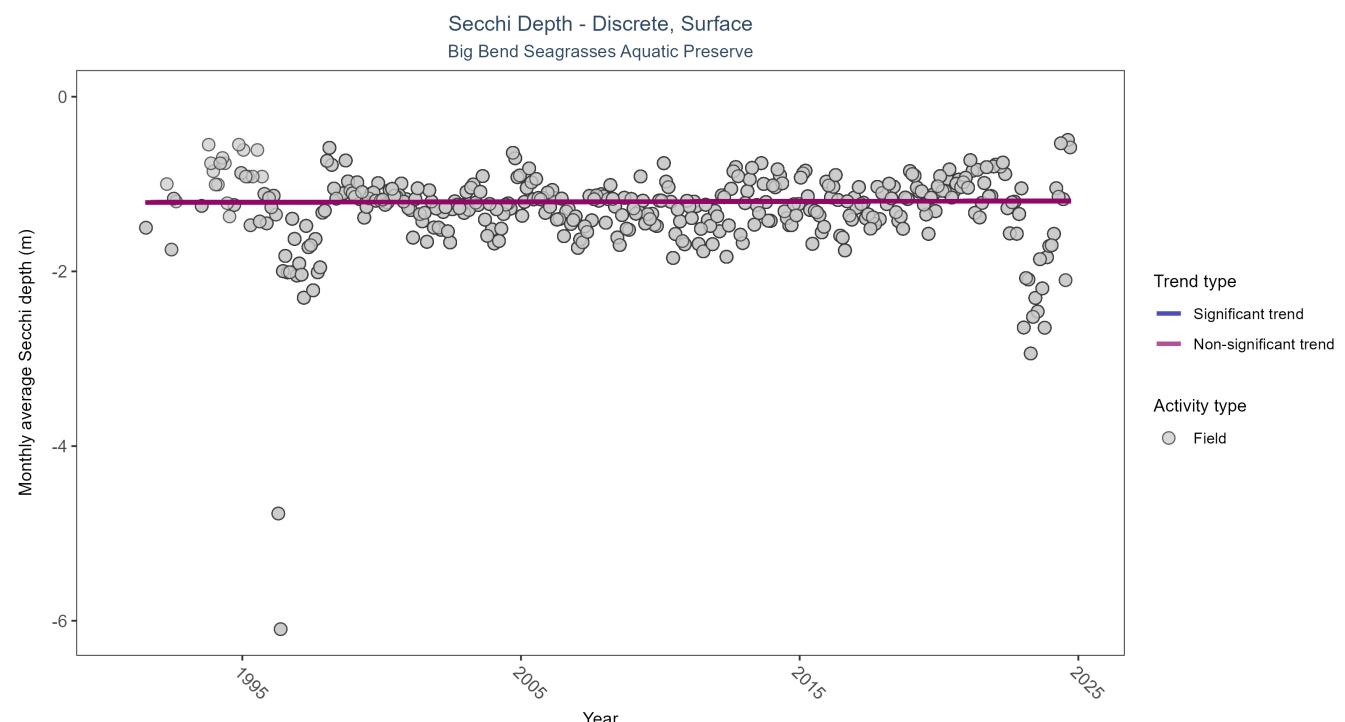


Figure 15: Scatter plot of monthly average Secchi depth over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Secchi depth is only measured in the field (circles).

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

Activity Type	Statistical Trend	Sample Count	Years with Data	Period of Record	Median	tau	Sen Intercept	Sen Slope	p
Field	No significant trend	58852	34	1991 - 2024	-0.9	0.0107	-1.2106	0.0005	0.8012

Secchi depth showed no detectable trend between 1991 and 2024.

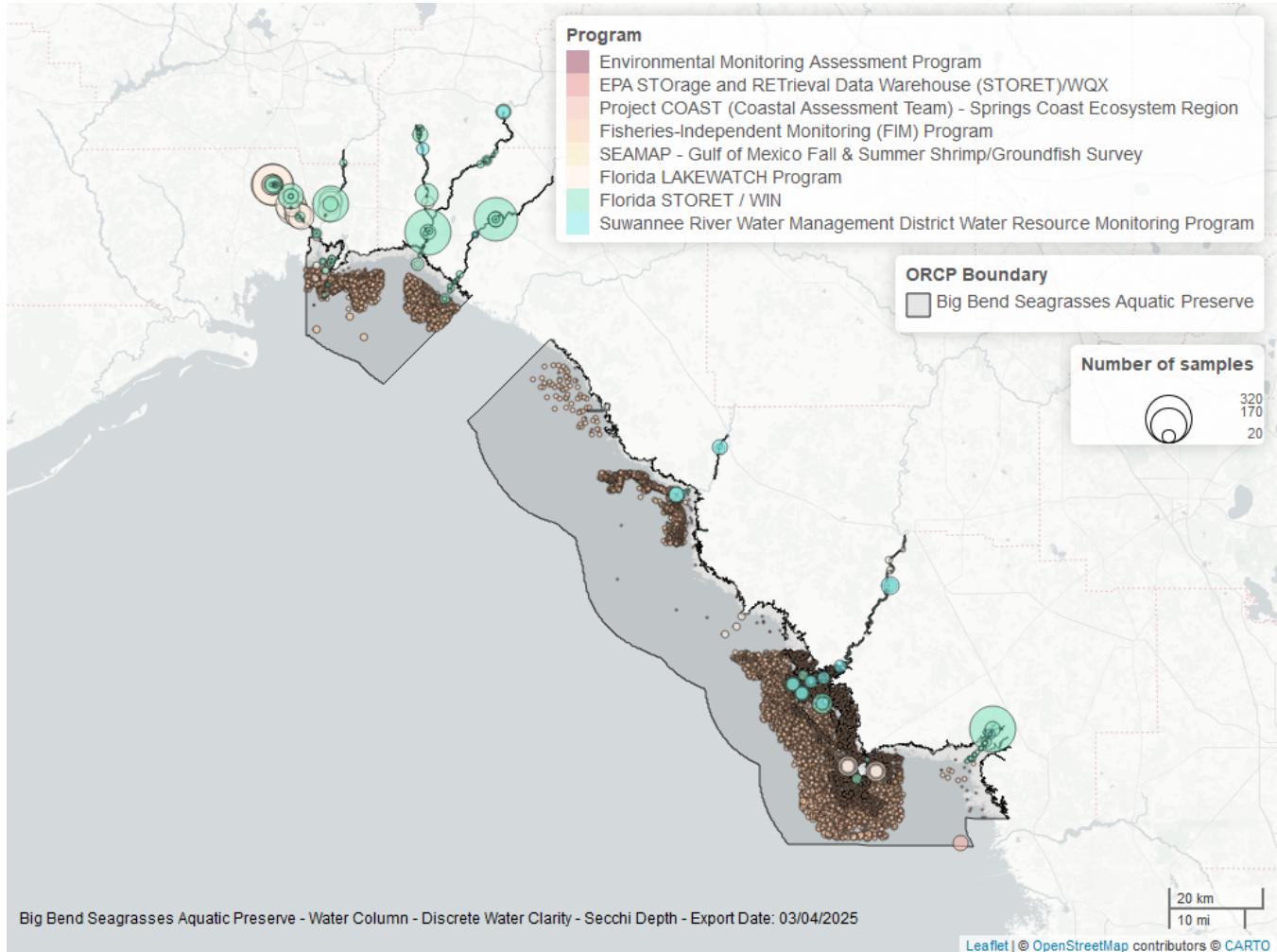


Figure 16: Map showing location of discrete water quality sampling locations within the boundaries of *Big Bend Seagrasses Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Table 21: Programs contributing data for Secchi Depth

ProgramID	N_Data	YearMin	YearMax
69	53622	1996	2022
5002	2525	1992	2024
514	2256	1993	2024
477	355	2016	2024
103	47	2020	2021
5008	32	2021	2024
115	21	1991	2004
60	2	2014	2014

#### Program names:

60 - Southeast Area Monitoring and Assessment Program (SEAMAP) - Gulf of Mexico Fall & Summer Shrimp/Groundfish Survey<sup>7</sup>

69 - Fisheries-Independent Monitoring (FIM) Program<sup>10</sup>

103 - EPA STOrage and RETrieval Data Warehouse (STORET)/WQX<sup>1</sup>

115 - Environmental Monitoring Assessment Program<sup>8</sup>

477 - Suwannee River Water Management District Water Resource Monitoring Program<sup>2</sup>

514 - Florida LAKEWATCH Program<sup>3</sup>

5002 - Florida STORET / WIN<sup>5</sup>

5008 - Project COAST (Coastal Assessment Team) - Springs Coast Ecosystem Region<sup>6</sup>

## Total Nitrogen - Discrete

### 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)  $TN = TKN + NO_3O_2;$
- 2)  $TN = TKN + NO_3 + NO_2;$
- 3)  $TN = ORGN + NH_4 + NO_3O_2;$
- 4)  $TN = ORGN + NH_4 + NO_2 + NO_3;$
- 5)  $TN = TKN + NO_3;$
- 6)  $TN = ORGN + NH_4 + NO_3;$

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 NO<sub>3</sub>O<sub>2</sub> 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\_QAACFlagCode = “1Q”
  - SEACAR\_QAAC>Description = “SEACAR Calculated”

## Seasonal Kendall-Tau Trend Analysis

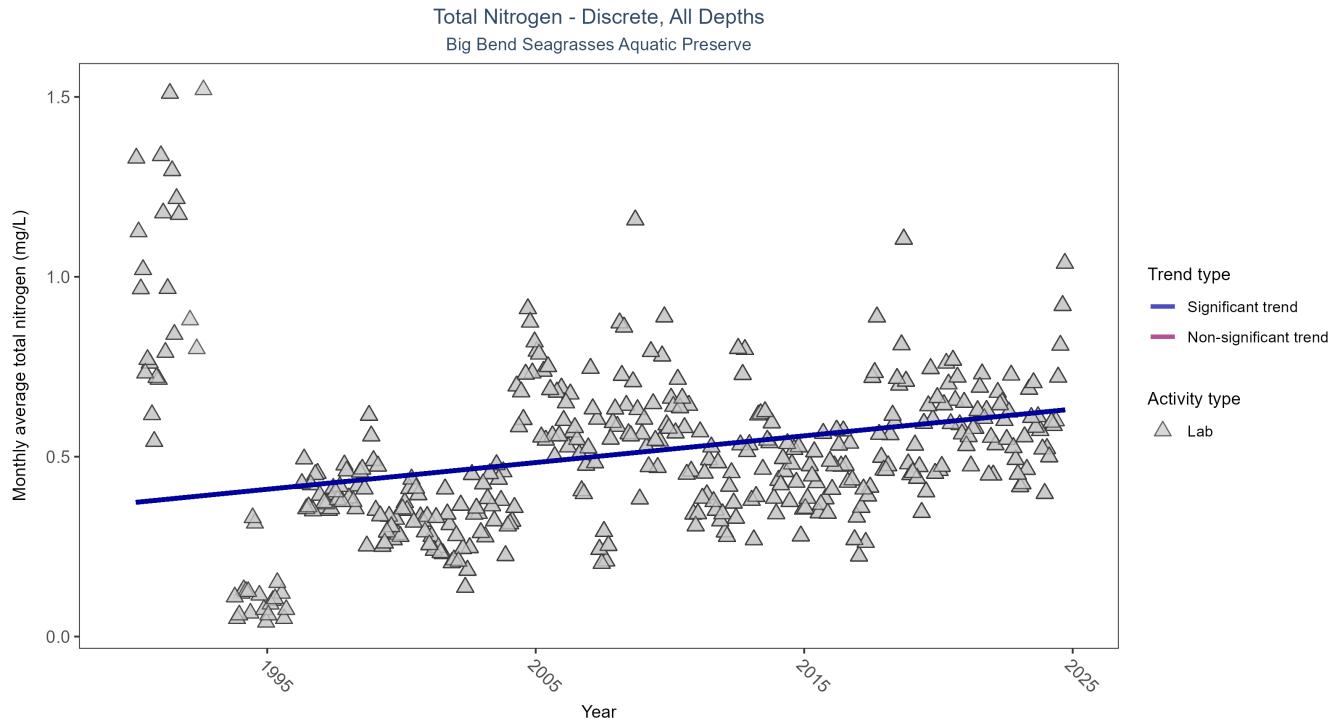


Figure 17: Scatter plot of monthly average total nitrogen over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only nitrogen values obtained from laboratory analyses (triangles) are included in the plot.

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

Activity Type	Statistical Trend	Sample Count	Years with Data	Period of Record	Median	tau	Sen Intercept	Sen Slope	p
Lab	Significantly increasing trend	8092	35	1990 - 2024	0.464	0.23	0.3723	0.0074	0

Monthly average total nitrogen increased by 0.01 mg/L per year.

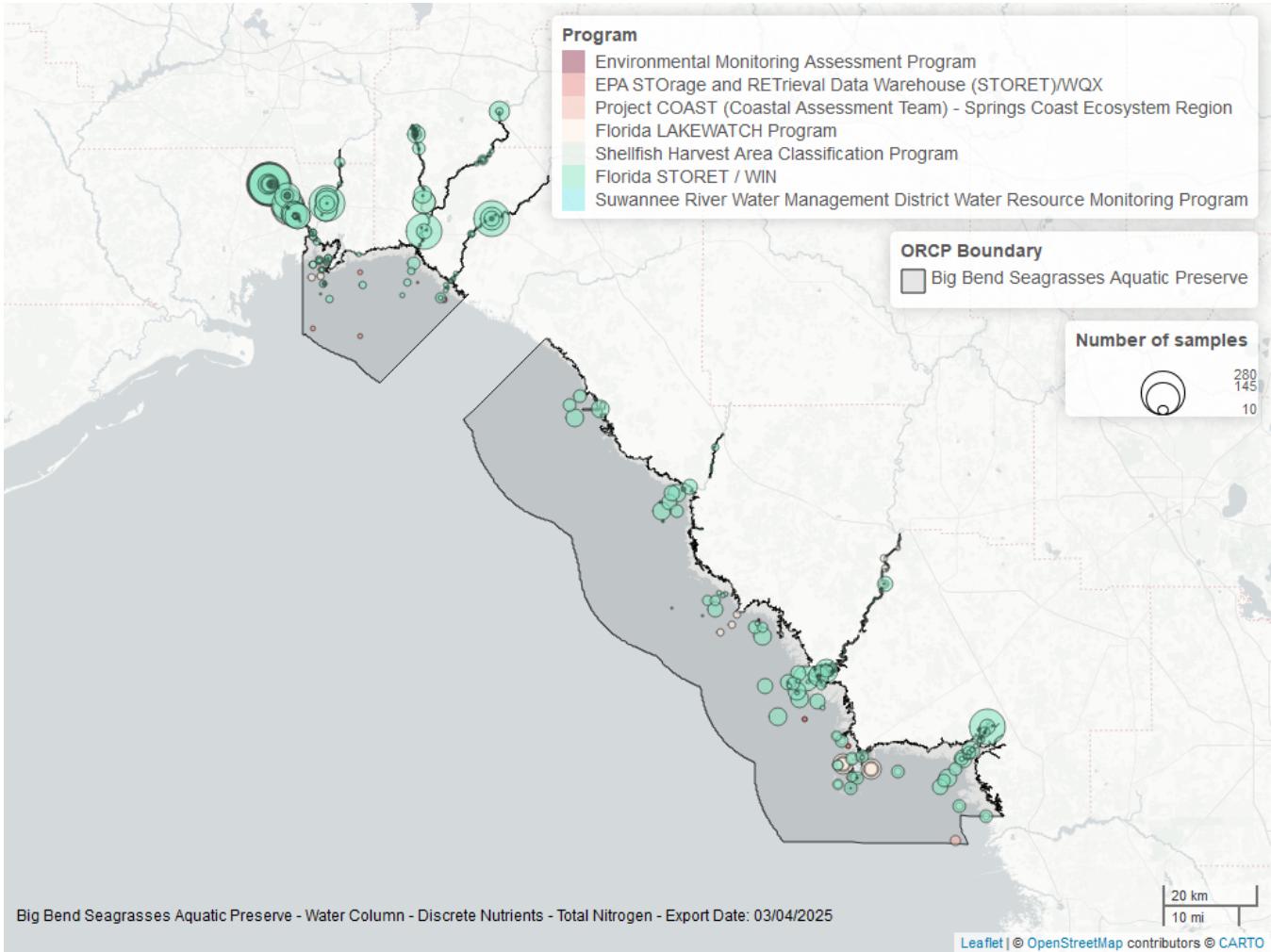


Figure 18: Map showing location of discrete water quality sampling locations within the boundaries of *Big Bend Seagrasses Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Table 23: Programs contributing data for Total Nitrogen

<i>ProgramID</i>	<i>N_Data</i>	<i>YearMin</i>	<i>YearMax</i>
5002	5514	1990	2024
514	2379	1993	2024
540	131	2017	2022
103	47	2000	2006
5008	17	2021	2024
115	5	2000	2004
477	3	2017	2017

#### Program names:

103 - EPA STOrage and RETrieval Data Warehouse (STORET)/WQX<sup>1</sup>

115 - Environmental Monitoring Assessment Program<sup>8</sup>

477 - Suwannee River Water Management District Water Resource Monitoring Program<sup>2</sup>

514 - Florida LAKEWATCH Program<sup>3</sup>

540 - Shellfish Harvest Area Classification Program<sup>4</sup>

5002 - Florida STORET / WIN<sup>5</sup>

5008 - Project COAST (Coastal Assessment Team) - Springs Coast Ecosystem Region<sup>6</sup>

## Total Phosphorus - Discrete

### Seasonal Kendall-Tau Trend Analysis

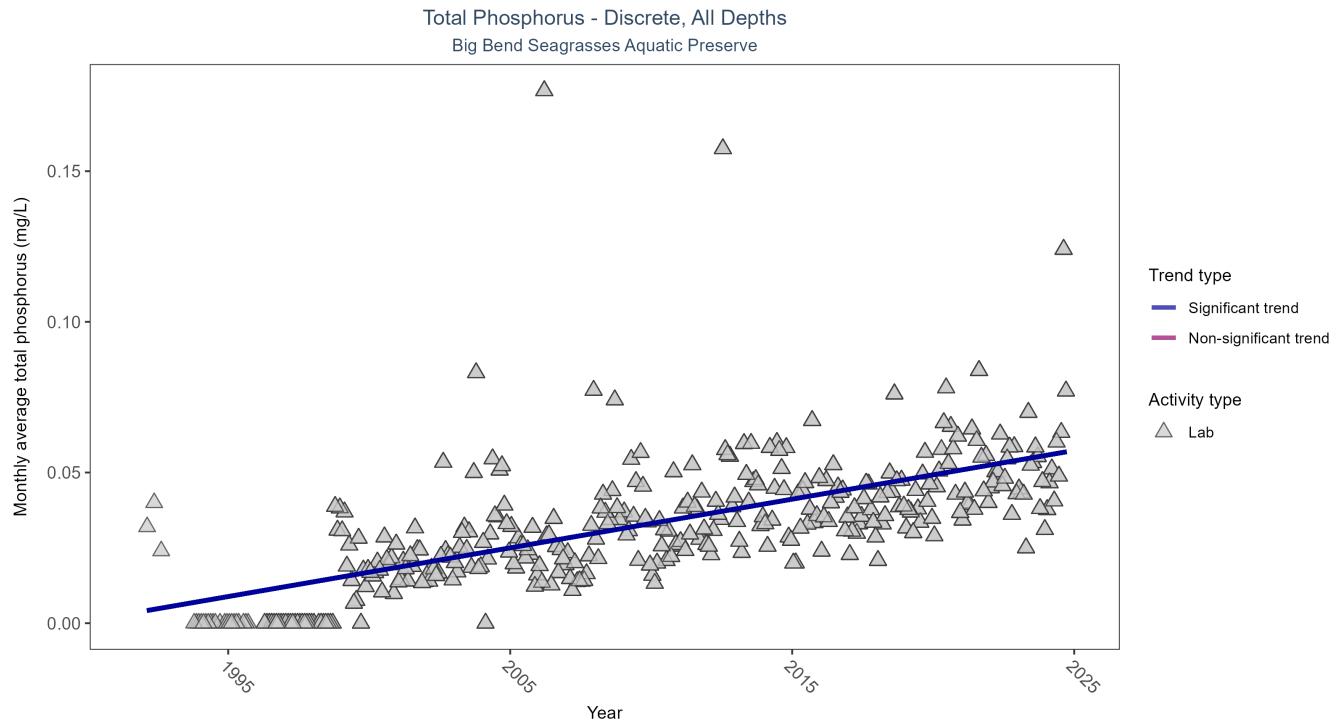


Figure 19: Scatter plot of monthly average total phosphorus over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only phosphorus values obtained from laboratory analyses (triangles) are included in the plot.

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

Activity Type	Statistical Trend	Sample Count	Years with Data	Period of Record	Median	tau	Sen Intercept	Sen Slope	p
Lab	Significantly increasing trend	6485	33	1992 - 2024	0.032	0.601	0.004	0.0016	0

Monthly average total phosphorus increased by less than 0.01 mg/L per year.

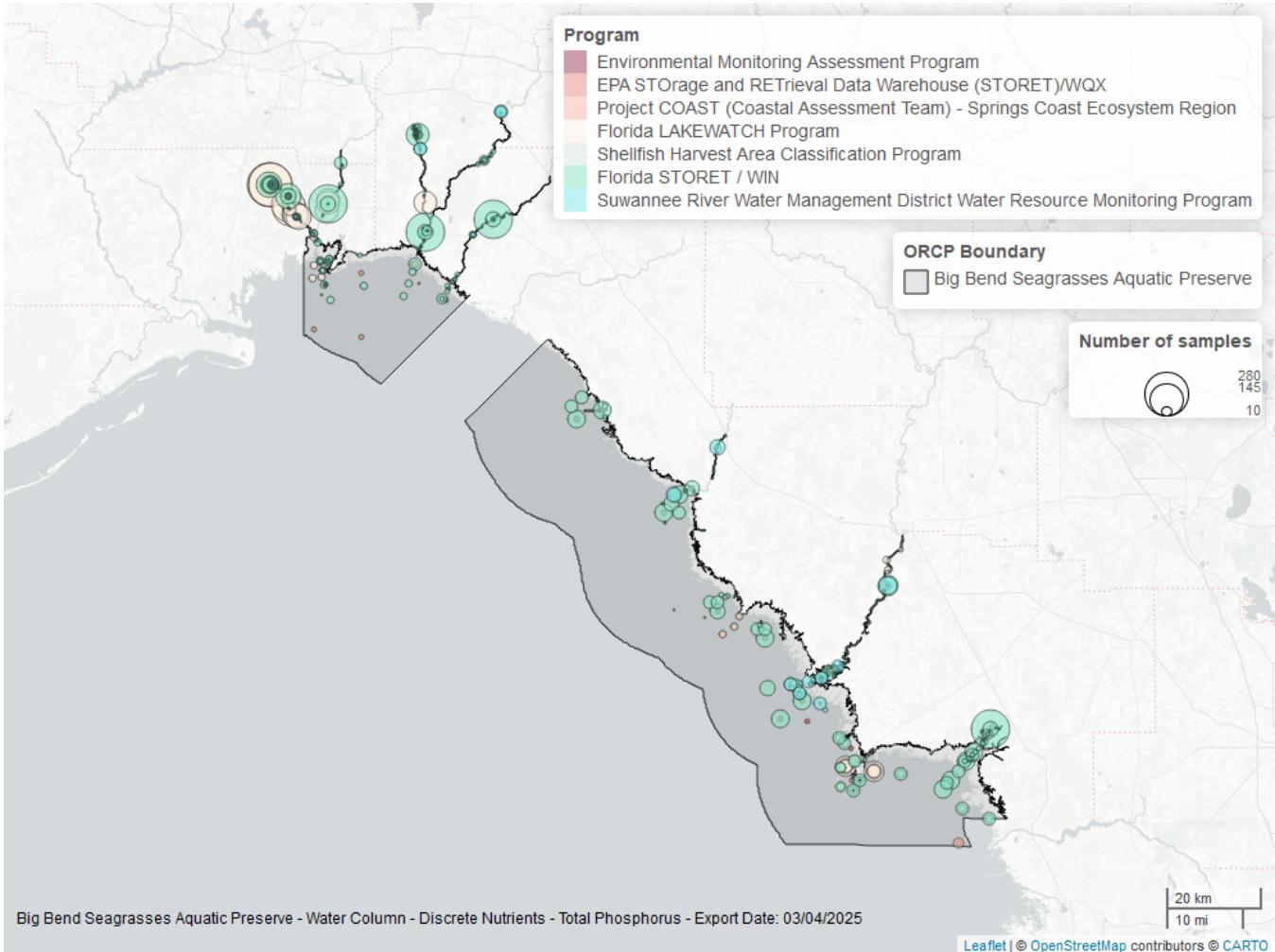


Figure 20: Map showing location of discrete water quality sampling locations within the boundaries of *Big Bend Seagrasses Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Table 25: Programs contributing data for Total Phosphorus

<i>ProgramID</i>	<i>N_Data</i>	<i>YearMin</i>	<i>YearMax</i>
5002	3599	1992	2024
514	2356	1993	2024
477	358	2016	2024
103	169	2000	2021
540	131	2017	2022
5008	17	2021	2024
115	5	2000	2004

#### Program names:

103 - EPA STOrage and RETriev Data Warehouse (STORET)/WQX<sup>1</sup>

115 - Environmental Monitoring Assessment Program<sup>8</sup>

477 - Suwannee River Water Management District Water Resource Monitoring Program<sup>2</sup>

514 - Florida LAKEWATCH Program<sup>3</sup>

540 - Shellfish Harvest Area Classification Program<sup>4</sup>

5002 - Florida STORET / WIN<sup>5</sup>

5008 - Project COAST (Coastal Assessment Team) - Springs Coast Ecosystem Region<sup>6</sup>

## Total Suspended Solids - Discrete

### Seasonal Kendall-Tau Trend Analysis

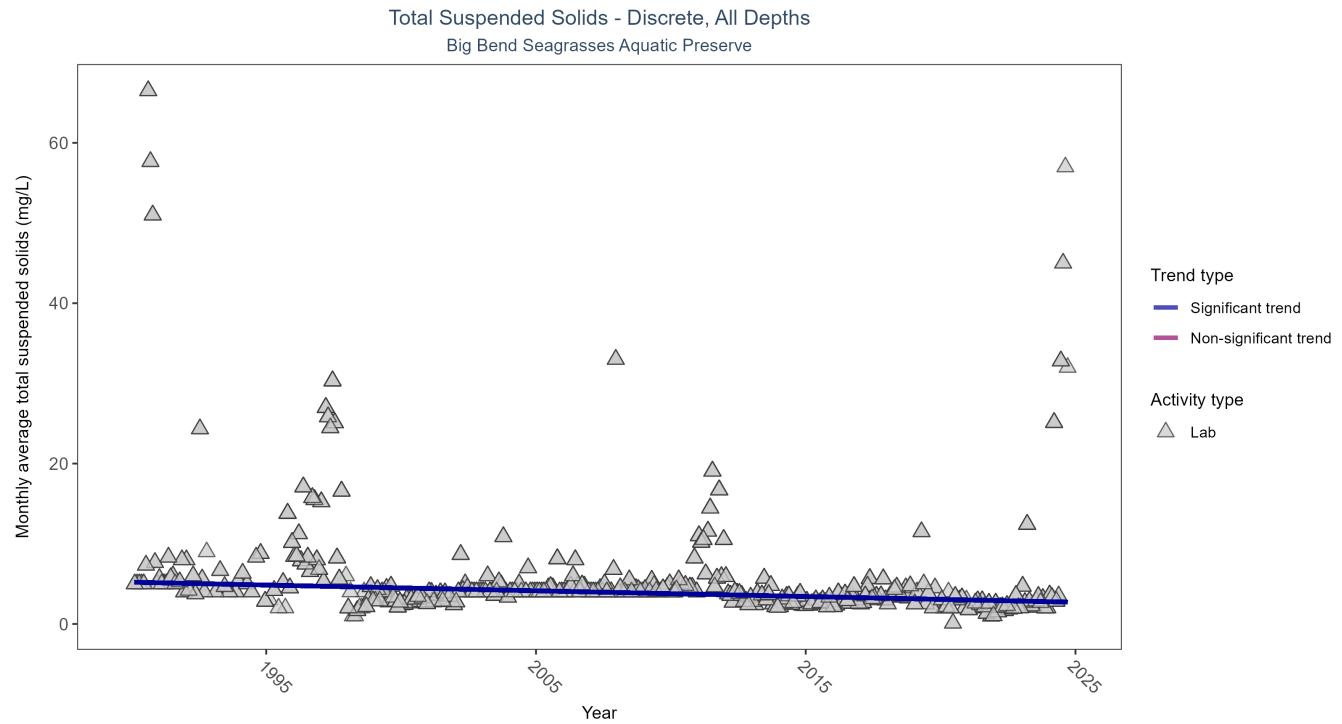


Figure 21: Scatter plot of monthly average total suspended solids (TSS) over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only TSS values obtained from laboratory analyses (triangles) are included in the plot.

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

Activity Type	Statistical Trend	Sample Count	Years with Data	Period of Record	Median	tau	Sen Intercept	Sen Slope	p
Lab	Significantly decreasing trend	2933	35	1990 - 2024	4	-0.3256	5.2083	-0.0714	0

Monthly average total suspended solids decreased by 0.07 mg/L per year, indicating an increase in water clarity.

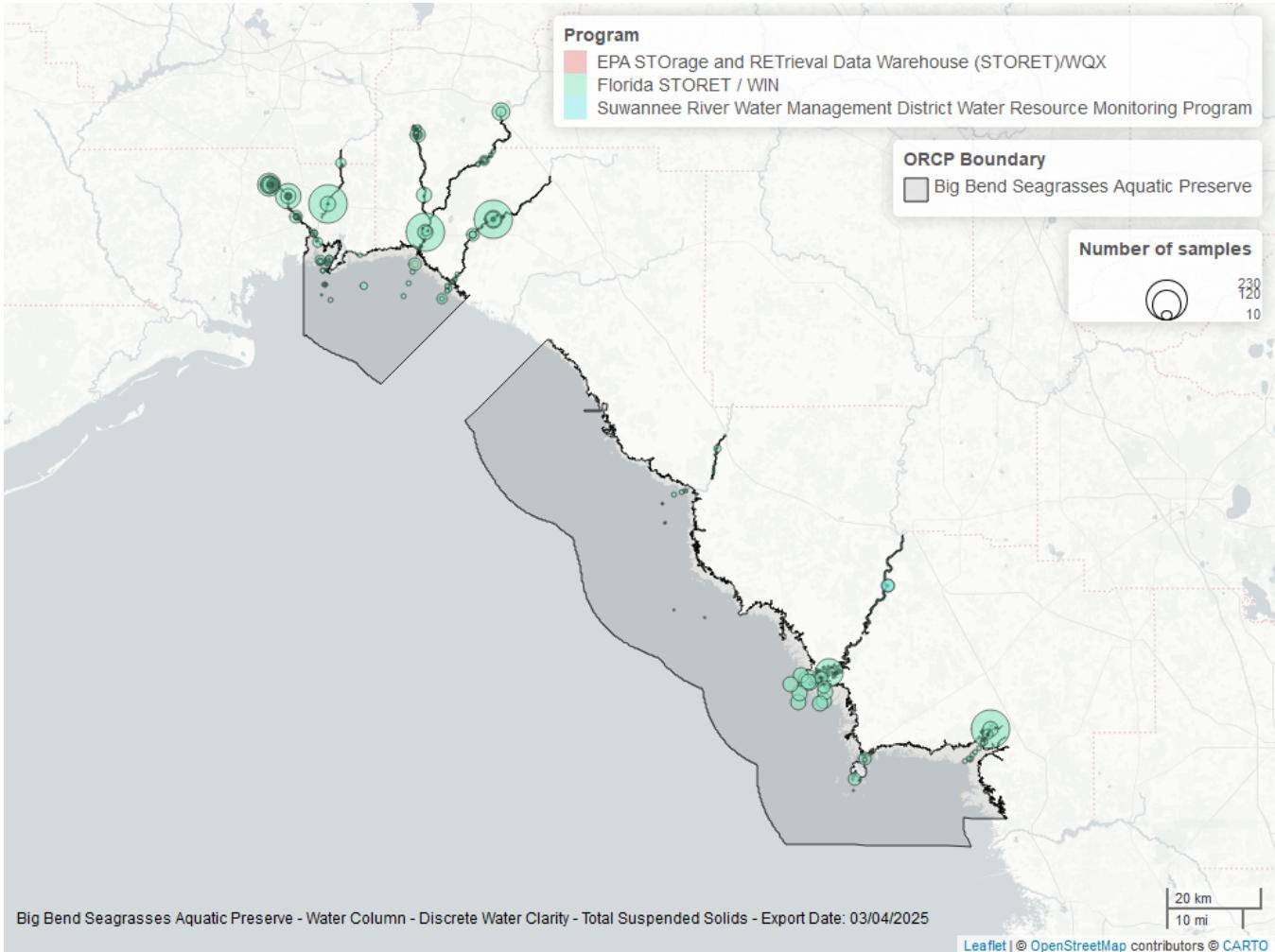


Figure 22: Map showing location of discrete water quality sampling locations within the boundaries of *Big Bend Seagrasses Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Table 27: Programs contributing data for Total Suspended Solids

<i>ProgramID</i>	<i>N_Data</i>	<i>YearMin</i>	<i>YearMax</i>
5002	2925	1990	2024
477	28	2021	2023
103	12	2020	2021

#### Program names:

103 - EPA STOrage and RETrieval Data Warehouse (STORET)/WQX<sup>1</sup>

477 - Suwannee River Water Management District Water Resource Monitoring Program<sup>2</sup>

5002 - Florida STORET / WIN<sup>5</sup>

#### Turbidity - Discrete

#### Seasonal Kendall-Tau Trend Analysis

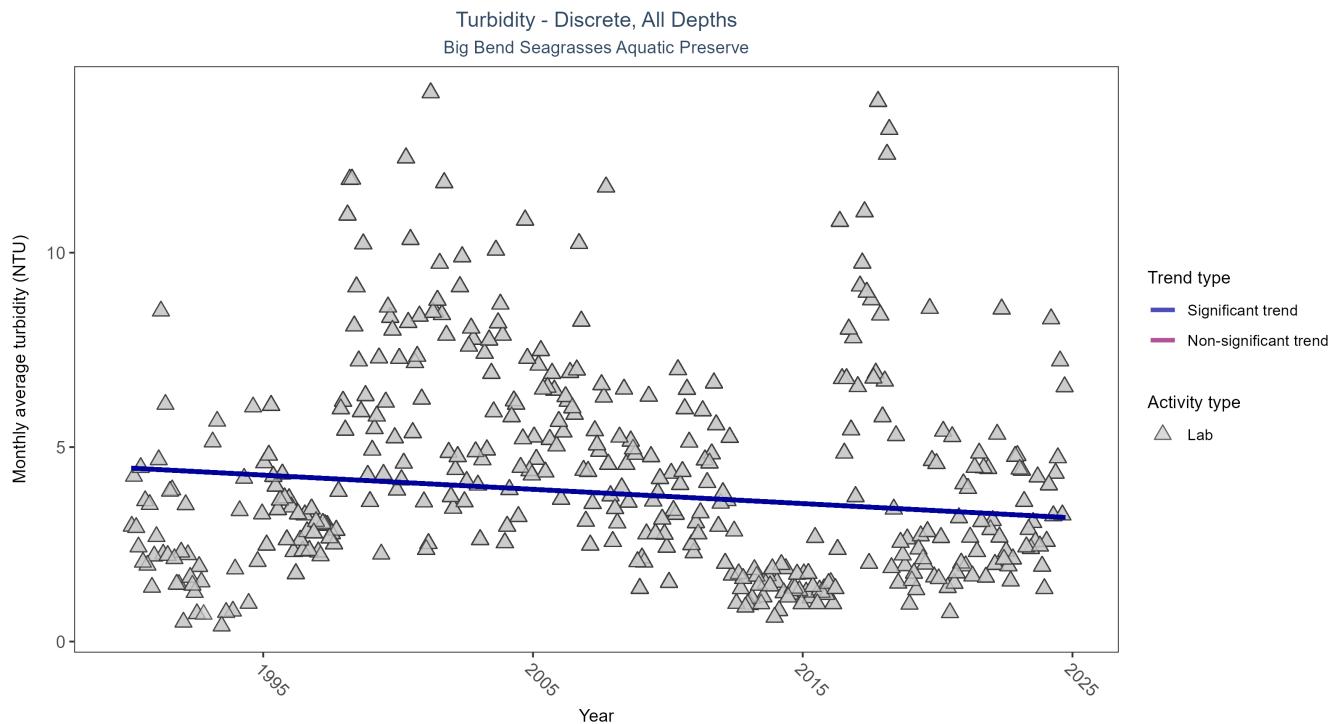


Figure 23: Scatter plot of monthly average turbidity over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only turbidity values measured in the laboratory (triangles) are included in the plot.

Table 28: Seasonal Kendall-Tau Trend Analysis for Turbidity

Activity Type	Statistical Trend	Sample Count	Years with Data	Period of Record	Median	tau	Sen Intercept	Sen Slope	p
Lab	Significantly decreasing trend	42811	35	1990 - 2024	3.4	-0.1048	4.4636	-0.0366	0.0026

Monthly average turbidity decreased by 0.04 NTU per year, indicating an increase in water clarity.

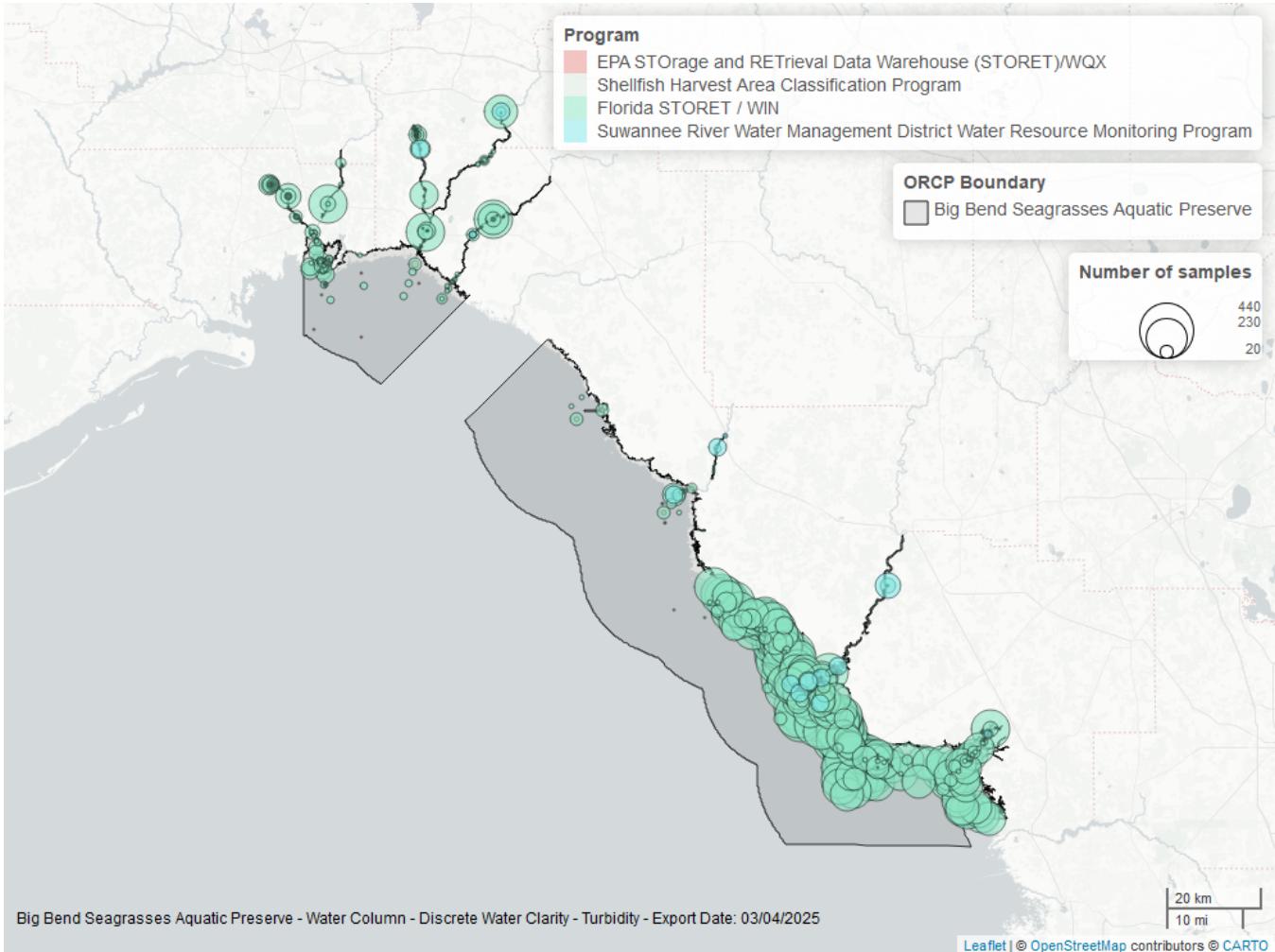


Figure 24: Map showing location of discrete water quality sampling locations within the boundaries of *Big Bend Seagrasses Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Table 29: Programs contributing data for Turbidity

<i>ProgramID</i>	<i>N_Data</i>	<i>YearMin</i>	<i>YearMax</i>
5002	42576	1990	2024
477	624	2016	2024
103	116	2005	2021
540	35	2019	2022

#### Program names:

103 - EPA STOrage and RETrieval Data Warehouse (STORET)/WQX<sup>1</sup>

477 - Suwannee River Water Management District Water Resource Monitoring Program<sup>2</sup>

540 - Shellfish Harvest Area Classification Program<sup>4</sup>

5002 - Florida STORET / WIN<sup>5</sup>

#### Water Temperature - Discrete

#### Seasonal Kendall-Tau Trend Analysis

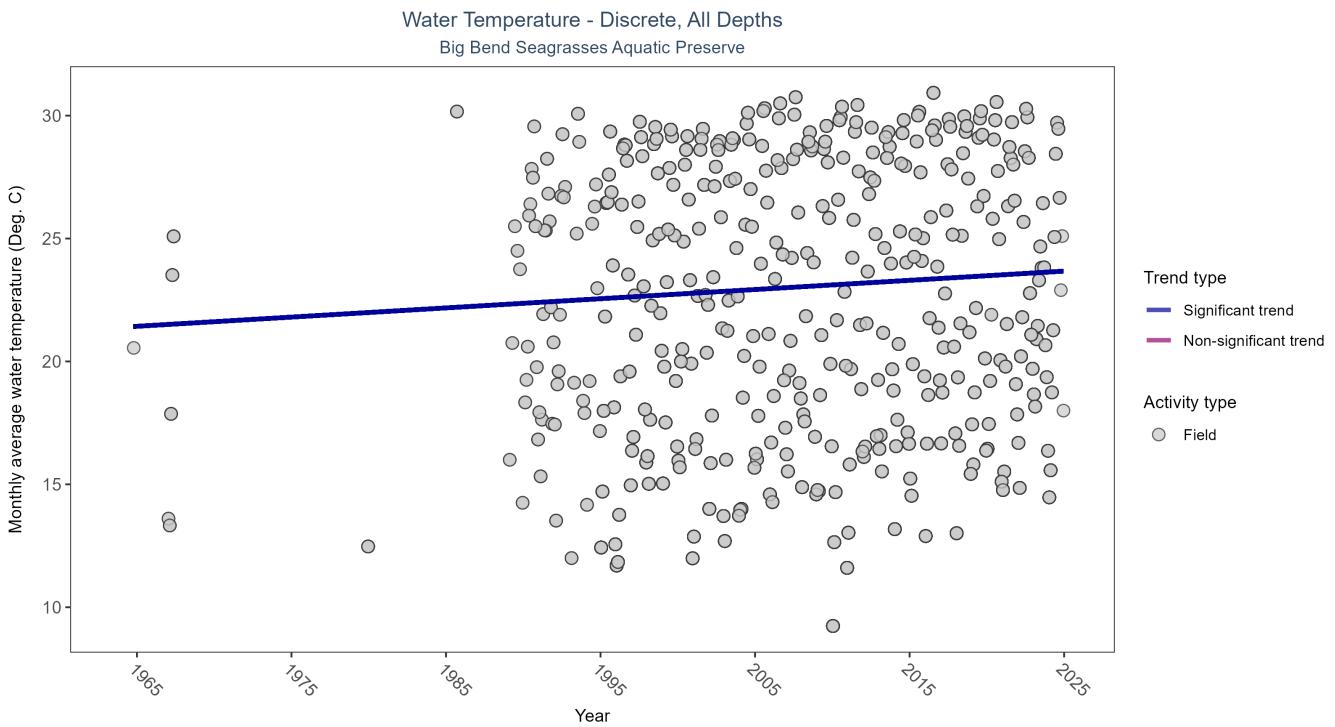


Figure 25: Scatter plot of monthly average water temperature over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only water temperature measurements taken in the field (circles) are included in the plot.

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

Activity Type	Statistical Trend	Sample Count	Years with Data	Period of Record	Median	tau	Sen Intercept	Sen Slope	p
Field	Significantly increasing trend	155972	40	1964 - 2024	24.1	0.1882	21.3919	0.0374	0

Monthly average water temperature increased by 0.04°C per year.

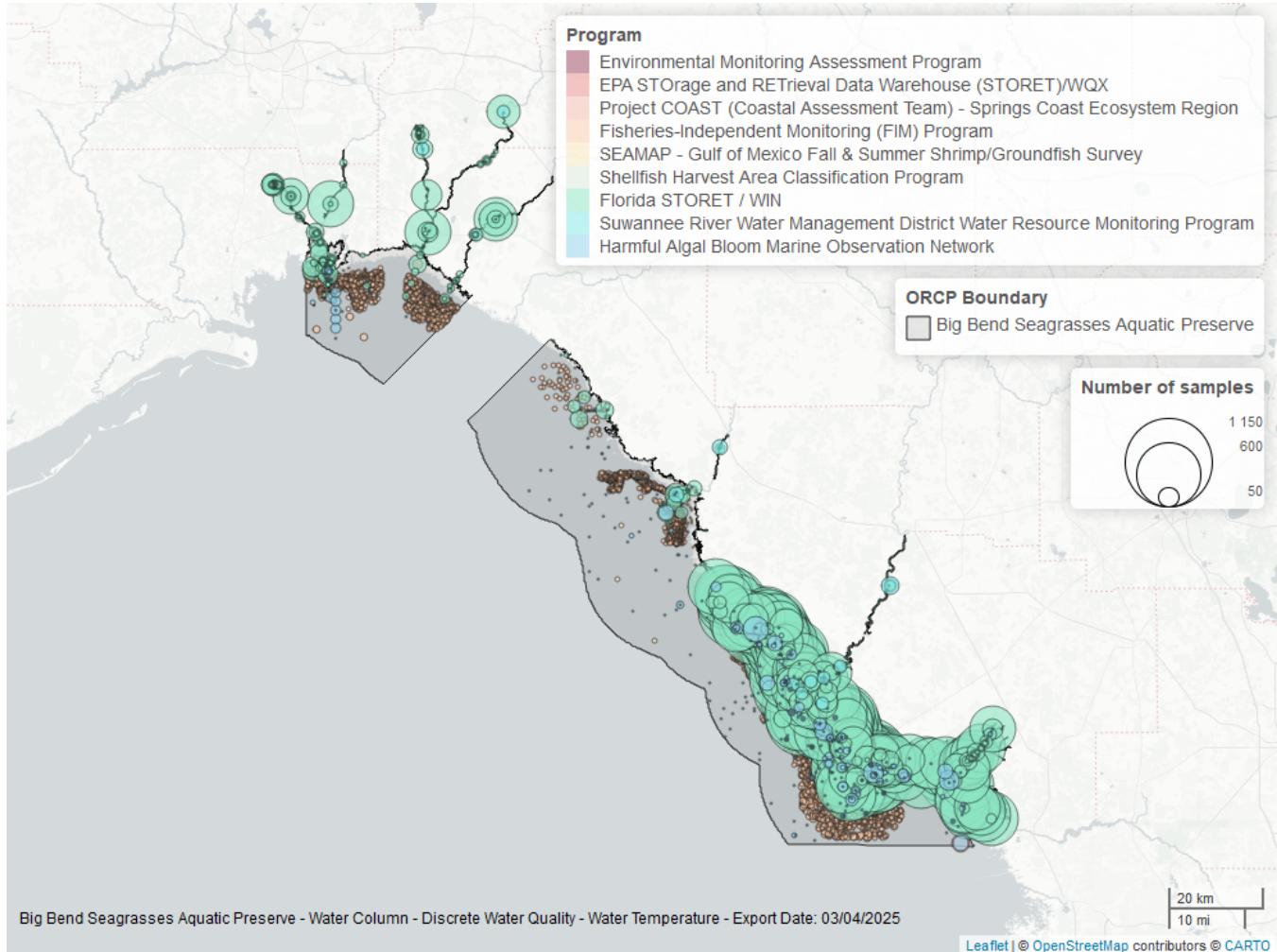


Figure 26: Map showing location of discrete water quality sampling locations within the boundaries of *Big Bend Seagrasses Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Table 31: Programs contributing data for Water Temperature

ProgramID	N_Data	YearMin	YearMax
5002	100282	1989	2024
69	53664	1996	2022
95	1377	1964	2018
477	358	2016	2024
103	158	2004	2021
540	133	2017	2022
5008	44	2021	2024
115	43	1991	2004
60	17	2014	2015

#### Program names:

60 - Southeast Area Monitoring and Assessment Program (SEAMAP) - Gulf of Mexico Fall & Summer Shrimp/Groundfish Survey<sup>7</sup>

69 - Fisheries-Independent Monitoring (FIM) Program<sup>10</sup>

- 95 - Harmful Algal Bloom Marine Observation Network<sup>11</sup>  
103 - EPA STOrage and RETrieval Data Warehouse (STORET)/WQX<sup>1</sup>  
115 - Environmental Monitoring Assessment Program<sup>8</sup>  
477 - Suwannee River Water Management District Water Resource Monitoring Program<sup>2</sup>  
540 - Shellfish Harvest Area Classification Program<sup>4</sup>  
5002 - Florida STORET / WIN<sup>5</sup>  
5008 - Project COAST (Coastal Assessment Team) - Springs Coast Ecosystem Region<sup>6</sup>

## Water Quality - Continuous

The following files were used in the continuous analysis:

- *Combined\_WQ\_WC\_NUT\_cont\_Dissolved\_Oxygen\_NW-2025-Mar-06.txt*
- *Combined\_WQ\_WC\_NUT\_cont\_Dissolved\_Oxygen\_Saturation\_NW-2025-Mar-06.txt*
- *Combined\_WQ\_WC\_NUT\_cont\_pH\_NW-2025-Mar-06.txt*
- *Combined\_WQ\_WC\_NUT\_cont\_Salinity\_NW-2025-Mar-06.txt*
- *Combined\_WQ\_WC\_NUT\_cont\_Turbidity\_NW-2025-Mar-06.txt*
- *Combined\_WQ\_WC\_NUT\_cont\_Water\_Temperature\_NW-2025-Mar-06.txt*

### Continuous monitoring locations in Big Bend Seagrasses Aquatic Preserve

Table 32: Station overview for Continuous parameters by Program

ProgramID	ProgramLocationID	Years of Data	Use in Analysis	Parameters
7	02313700	8	TRUE	DO , pH , Sal
7	02313700	24	TRUE	TempW
7	02323566	12	TRUE	DO , pH , TempW
7	02323592	16	TRUE	Sal
7	02323592	26	TRUE	TempW
7	02326050	5	TRUE	TempW
7	02326516	6	TRUE	DO , pH , TempW
7	02326526	10	TRUE	DO , pH , TempW
7	02326550	8	TRUE	Sal
7	02326550	24	TRUE	TempW
7	02327022	3	FALSE	TempW
7	291652083064100	1	FALSE	Sal , TempW
7	291842083085100	1	FALSE	Sal , TempW
471	BBSCK	1	FALSE	DO , DOS , pH , Sal , Turb , TempW
471	BBSDB	10	TRUE	DO , DOS , pH , Sal , Turb , TempW
471	BBSSK	12	TRUE	DO , DOS , pH , Sal , Turb , TempW
471	BBSST	6	TRUE	DO , DOS , pH , Sal , Turb , TempW
471	BBSSW	8	TRUE	DO , DOS , pH , Sal , Turb , TempW

### Program names:

7 - National Water Information System<sup>13</sup>

471 - Big Bend Seagrasses Aquatic Preserves Continuous Water Quality Monitoring<sup>14</sup>

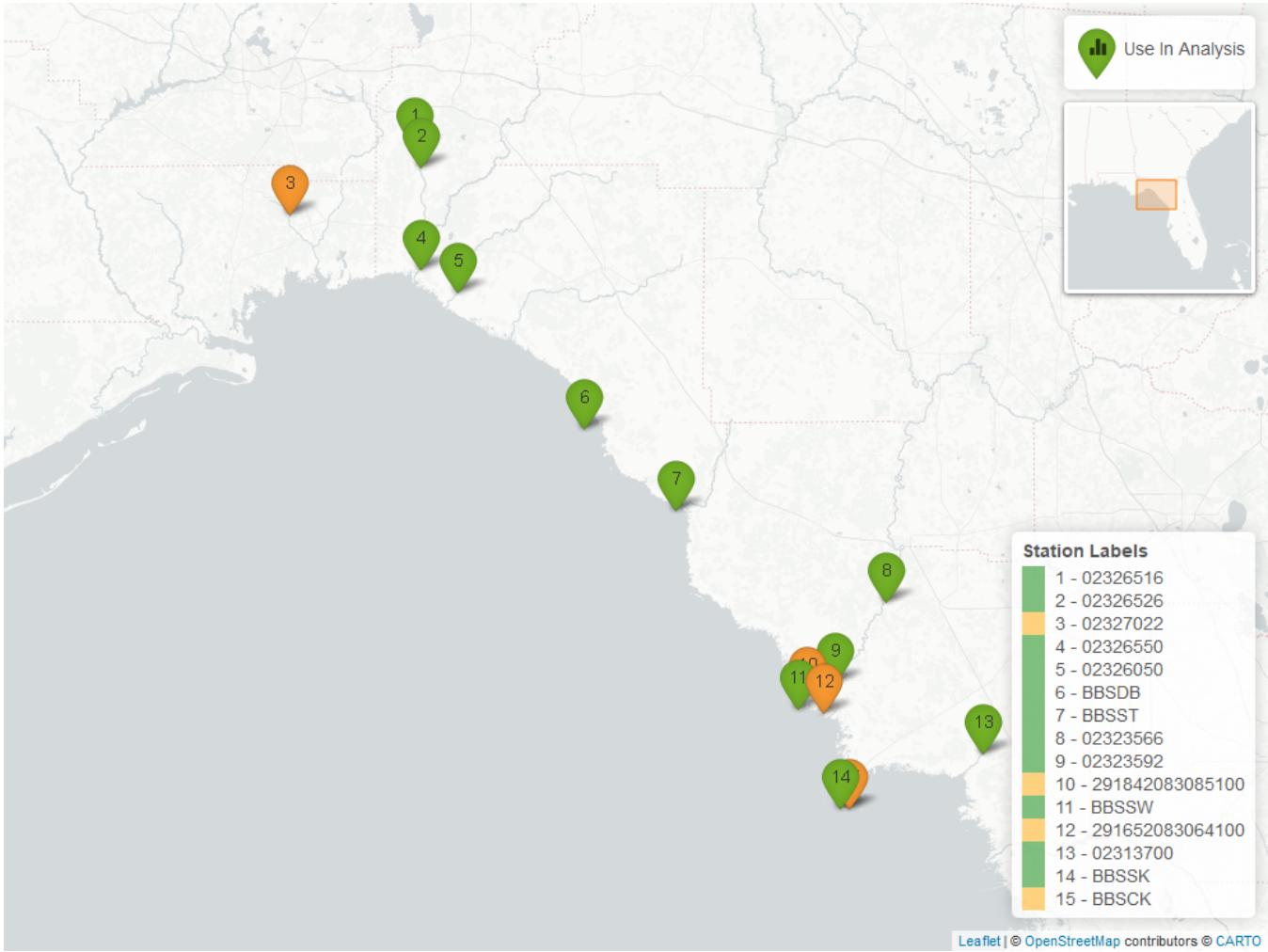


Figure 27: Map showing continuous water quality sampling locations within the boundaries of *Big Bend Seagrasses Aquatic Preserve*. Sites marked as *Use In Analysis* (green) are featured in this report.

## Dissolved Oxygen - Continuous

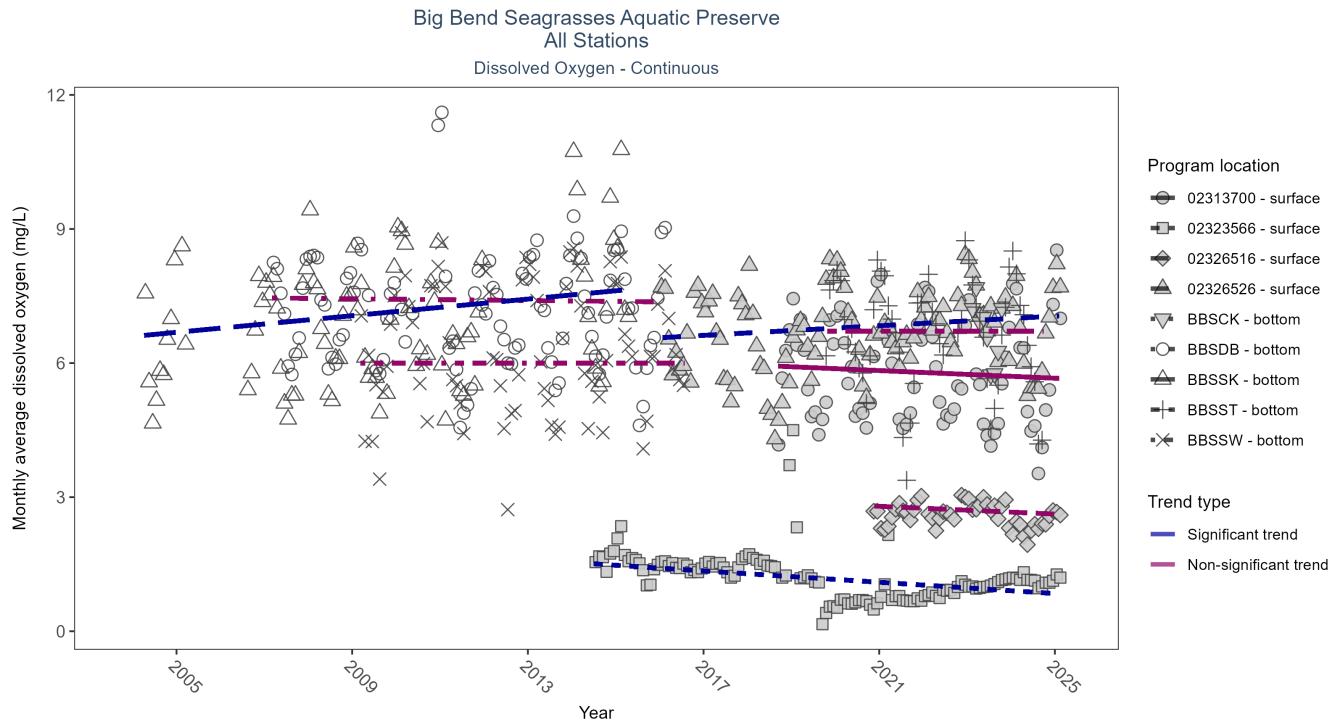


Figure 28: Scatter plot of monthly average dissolved oxygen over time at continuously monitored program locations. Each location is analyzed separately, with significant (blue) or non-significant (magenta) trend lines shown for time series that included five or more years of observations.

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

Station	Statistical Trend	Sample Count	Years with Data	Period of Record	Median	tau	Sen Intercept	Sen Slope	p
02326526	Significantly increasing trend	3141	10	2016 - 2025	6.7	0.16	6.57	0.05	0.03
02326516	No significant trend	1388	6	2020 - 2025	2.6	-0.15	2.84	-0.04	0.37
02313700	No significant trend	2224	8	2018 - 2025	5.5	-0.16	5.96	-0.04	0.16
02323566	Significantly decreasing trend	3680	12	2014 - 2025	1.2	-0.4	1.54	-0.06	0
BBSDB	No significant trend	184327	10	2007 - 2016	7.3	-0.05	7.46	-0.01	0.61
BBSCK	Insufficient data to calculate trend	14788	1	2023 - 2023	6.7	-	-	-	-
BBSSK	Significantly increasing trend	134287	10	2004 - 2015	7.1	0.28	6.6	0.09	0
BBSST	No significant trend	146149	6	2019 - 2024	6.9	-0.01	6.71	0	1
BBSSW	No significant trend	182327	8	2009 - 2016	6.2	0	6	0	1

At two program locations, monthly average dissolved oxygen increased by 0.05 mg/L per year at one site and by 0.09 mg/L per year at the other. At one program location, monthly average dissolved oxygen decreased by 0.06 mg/L per year. No detectable change in monthly average dissolved oxygen was observed at five locations. There was insufficient data to fit a model for one location.

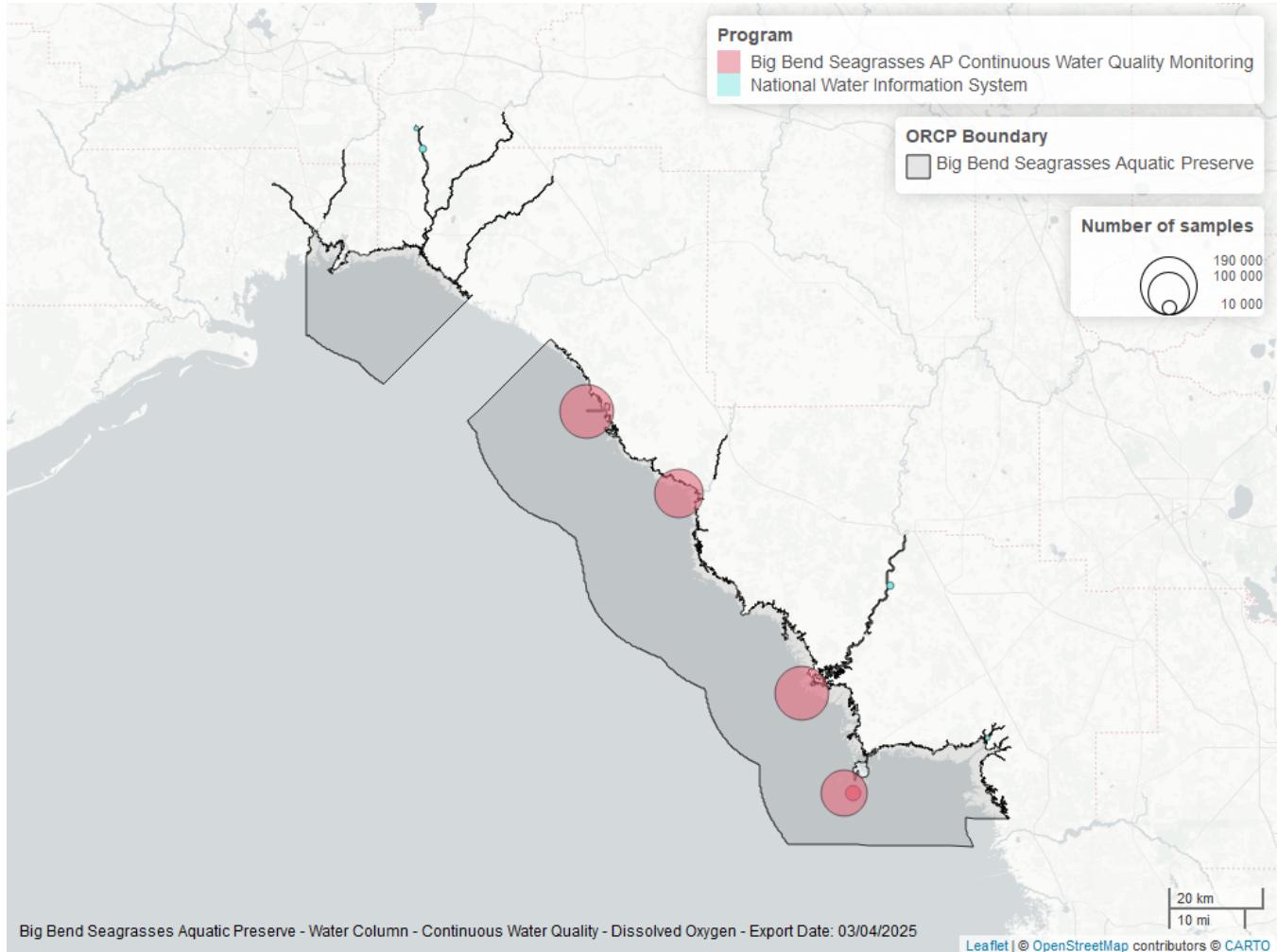


Figure 29: Map showing location of dissolved oxygen continuous water quality sampling locations within the boundaries of *Big Bend Seagrasses Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

## Dissolved Oxygen Saturation - Continuous

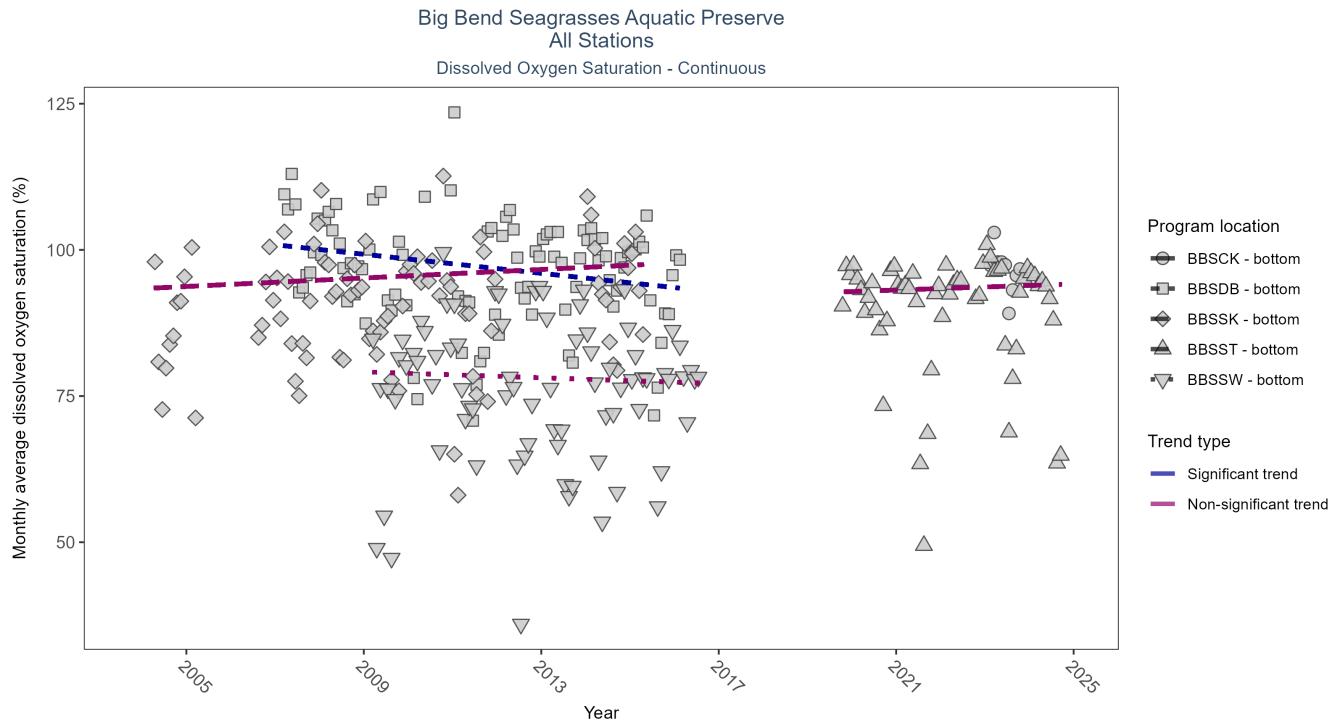


Figure 30: Scatter plot of monthly average dissolved oxygen saturation over time at continuously monitored program locations. Each location is analyzed separately, with significant (blue) or non-significant (magenta) trend lines shown for time series that included five or more years of observations.

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

Station	Statistical Trend	Sample Count	Years with Data	Period of Record	Median	tau	Sen Intercept	Sen Slope	p
BBSDB	Significantly decreasing trend	183530	10	2007 - 2016	97.6	-0.3	100.88	-0.81	0
BBSCK	Insufficient data to calculate trend	19834	1	2023 - 2023	95.7	-	-	-	-
BBSSK	No significant trend	134196	10	2004 - 2015	91.8	0.12	93.37	0.36	0.26
BBSST	No significant trend	149203	6	2019 - 2024	93.3	0.08	92.61	0.26	0.5
BBSSW	No significant trend	182158	8	2009 - 2016	75.8	-0.05	79.14	-0.25	0.68

At one program location, monthly average dissolved oxygen saturation decreased by 0.81% per year. No detectable change in monthly average dissolved oxygen saturation was observed at three locations. There was insufficient data to fit a model for one location.

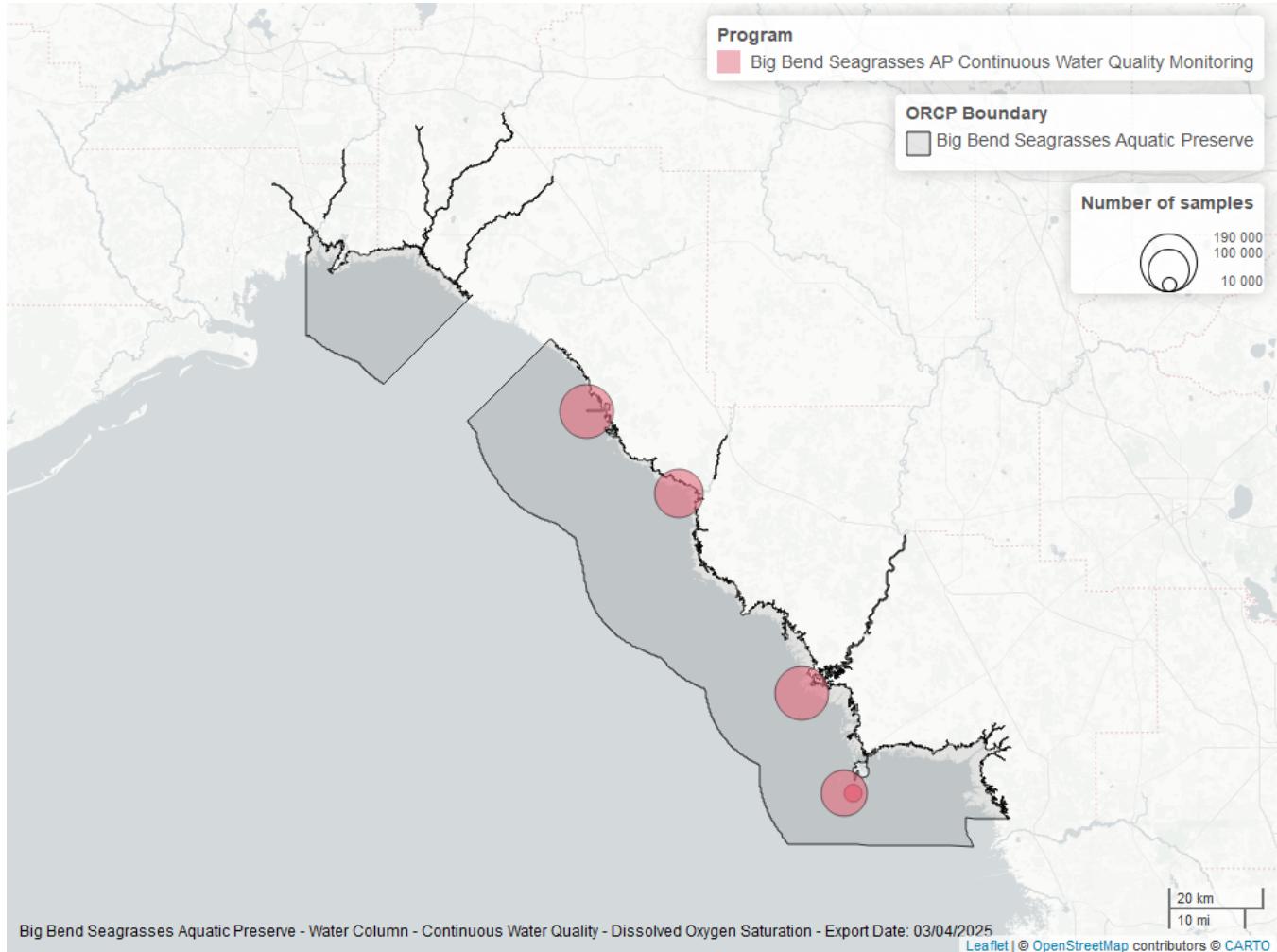


Figure 31: Map showing location of dissolved oxygen saturation continuous water quality sampling locations within the boundaries of *Big Bend Seagrasses Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

## pH - Continuous

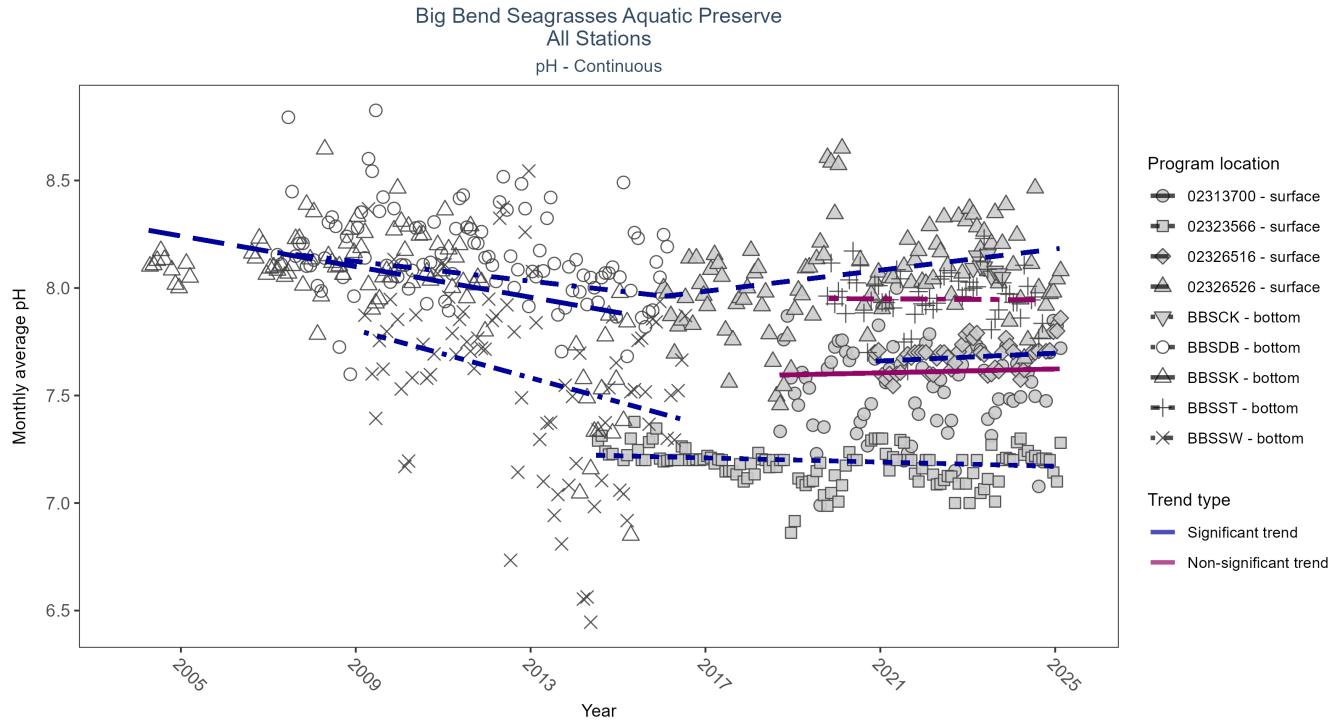


Figure 32: Scatter plot of monthly average pH over time at continuously monitored program locations. Each location is analyzed separately, with significant (blue) or non-significant (magenta) trend lines shown for time series that included five or more years of observations.

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

Station	Statistical Trend	Sample Count	Years with Data	Period of Record	Median	tau	Sen Intercept	Sen Slope	p
02326516	Significantly increasing trend	1348	6	2020 - 2025	7.7	0.3	7.65	0.01	0.01
02326526	Significantly increasing trend	2952	10	2016 - 2025	8.0	0.22	7.96	0.02	0.01
02323566	Significantly decreasing trend	3521	12	2014 - 2025	7.2	-0.16	7.22	0	0.03
02313700	No significant trend	2187	8	2018 - 2025	7.6	0.07	7.59	0	0.59
BBSDB	Significantly decreasing trend	250183	10	2007 - 2016	8.1	-0.28	8.17	-0.02	0
BBSCK	Insufficient data to calculate trend	18185	1	2023 - 2023	8.1	-	-	-	-
BBSSK	Significantly decreasing trend	168278	10	2004 - 2015	8.1	-0.37	8.28	-0.04	0
BBSST	No significant trend	153335	6	2019 - 2024	8.0	-0.01	7.95	0	0.94
BBSSW	Significantly decreasing trend	224733	8	2009 - 2016	7.6	-0.29	7.8	-0.06	0

At two program locations, monthly average pH increased by 0.01 pH units per year at one site and by 0.02 pH units per year at the other. At four program locations, monthly average pH decreased between less than 0.01 and 0.06 pH units per year. No detectable change in monthly average pH was observed at two locations. There was insufficient data to fit a model for one location.

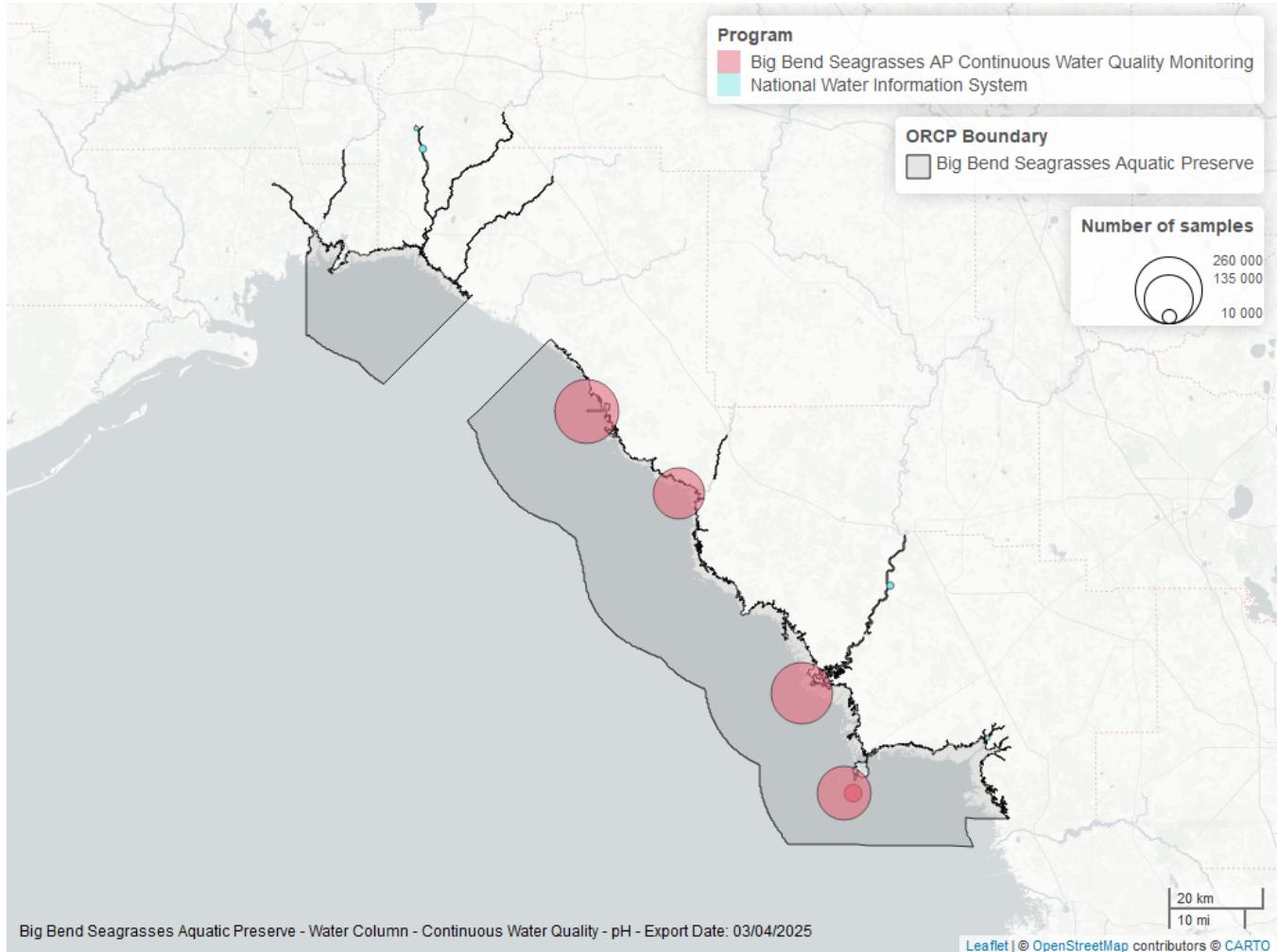


Figure 33: Map showing location of pH continuous water quality sampling locations within the boundaries of *Big Bend Seagrasses Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

## Salinity - Continuous

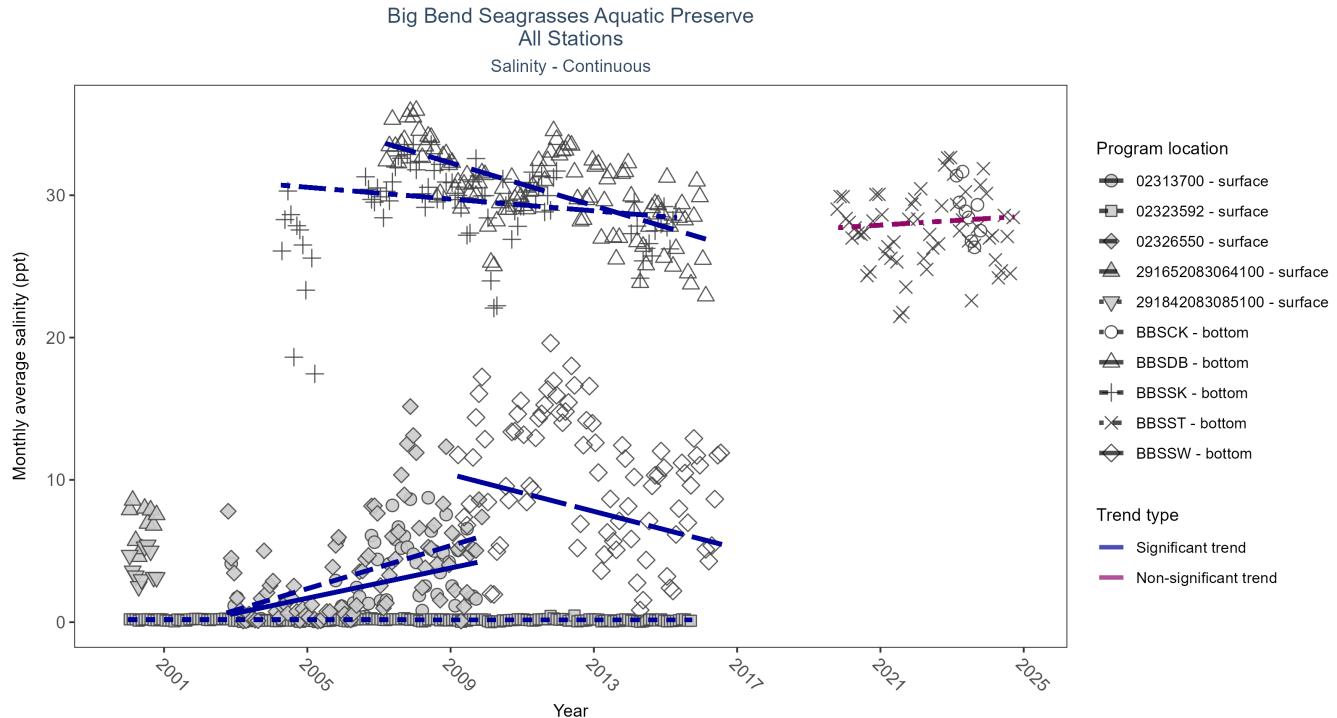


Figure 34: Scatter plot of monthly average salinity over time at continuously monitored program locations. Each location is analyzed separately, with significant (blue) or non-significant (magenta) trend lines shown for time series that included five or more years of observations.

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

Station	Statistical Trend	Sample Count	Years with Data	Period of Record	Median	tau	Sen Intercept	Sen Slope	p
291652083064100	Insufficient data to calculate trend	827	1	2000 - 2000	6.7	-	-	-	-
02326550	Significantly increasing trend	2507	8	2002 - 2009	1.7	0.48	0.09	0.76	0
02313700	Significantly increasing trend	1601	7	2002 - 2009	2.1	0.52	0.1	0.53	0
02323592	Significantly decreasing trend	6064	16	2000 - 2015	0.1	-0.13	0.18	0	0.02
291842083085100	Insufficient data to calculate trend	584	1	2000 - 2000	3.7	-	-	-	-
BBSDB	Significantly decreasing trend	265544	10	2007 - 2016	30.6	-0.53	33.78	-0.75	0
BBSCK	Insufficient data to calculate trend	14782	1	2023 - 2023	29.2	-	-	-	-
BBSSK	Significantly decreasing trend	178356	10	2004 - 2015	29.6	-0.22	30.77	-0.21	0.02
BBSST	No significant trend	156720	6	2019 - 2024	28.5	0.08	27.59	0.15	0.52
BBSSW	Significantly decreasing trend	221696	8	2009 - 2016	7.5	-0.23	10.39	-0.65	0.02

At two program locations, monthly average salinity increased by 0.53 ppt per year at one site and by 0.76 ppt per year at the other. At four program locations, monthly average salinity decreased between less than 0.01 and 0.75 ppt per year. No detectable change in monthly average salinity was observed at one location. There was insufficient data to fit a model for three locations.

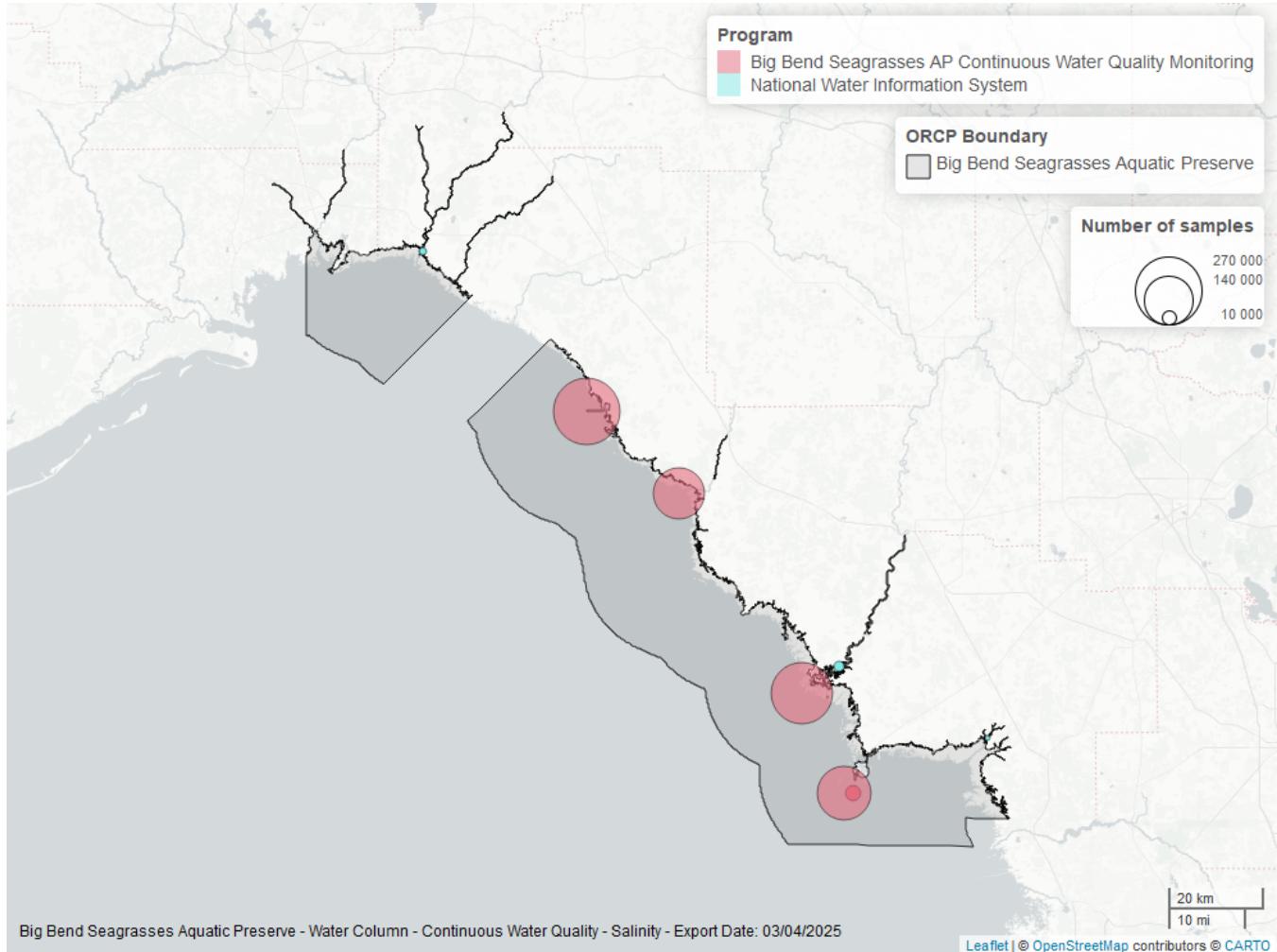


Figure 35: Map showing location of salinity continuous water quality sampling locations within the boundaries of *Big Bend Seagrasses Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

## Turbidity - Continuous

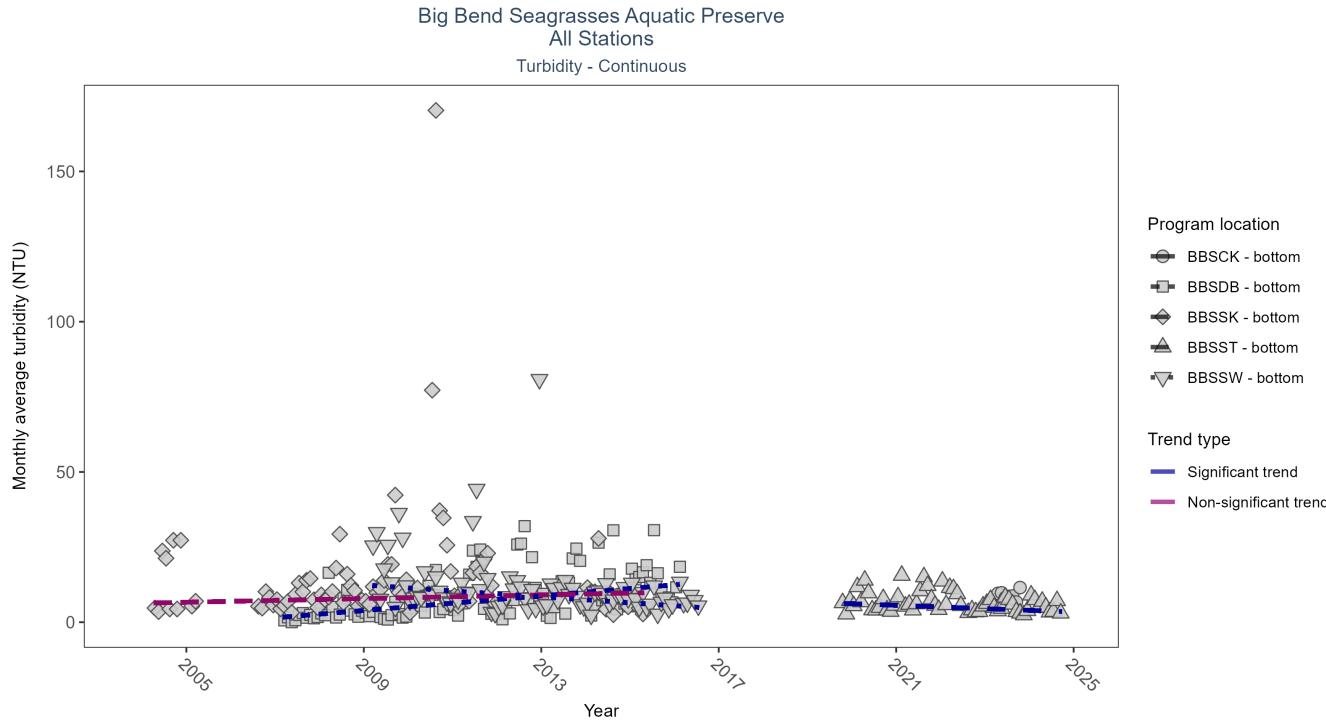


Figure 36: Scatter plot of monthly average turbidity over time at continuously monitored program locations. Each location is analyzed separately, with significant (blue) or non-significant (magenta) trend lines shown for time series that included five or more years of observations.

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

Station	Statistical Trend	Sample Count	Years with Data	Period of Record	Median	tau	Sen Intercept	Sen Slope	p
BBSDB	Significantly increasing trend	224613	10	2007 - 2016	1	0.49	1.47	1.22	0
BBSCK	Insufficient data to calculate trend	23243	1	2023 - 2023	7	-	-	-	-
BBSSK	No significant trend	165043	10	2004 - 2015	5	0.11	6.35	0.3	0.19
BBSST	Significantly decreasing trend	157393	6	2019 - 2024	4	-0.31	6.73	-0.55	0.01
BBSSW	Significantly decreasing trend	202699	8	2009 - 2016	6	-0.35	12.41	-0.99	0

At one program location, monthly average turbidity increased by 1.22 NTU per year. At two program locations, monthly average turbidity decreased by 0.55 NTU per year at one site and by 0.99 NTU per year at the other. No detectable change in monthly average turbidity was observed at one location. There was insufficient data to fit a model for one location.

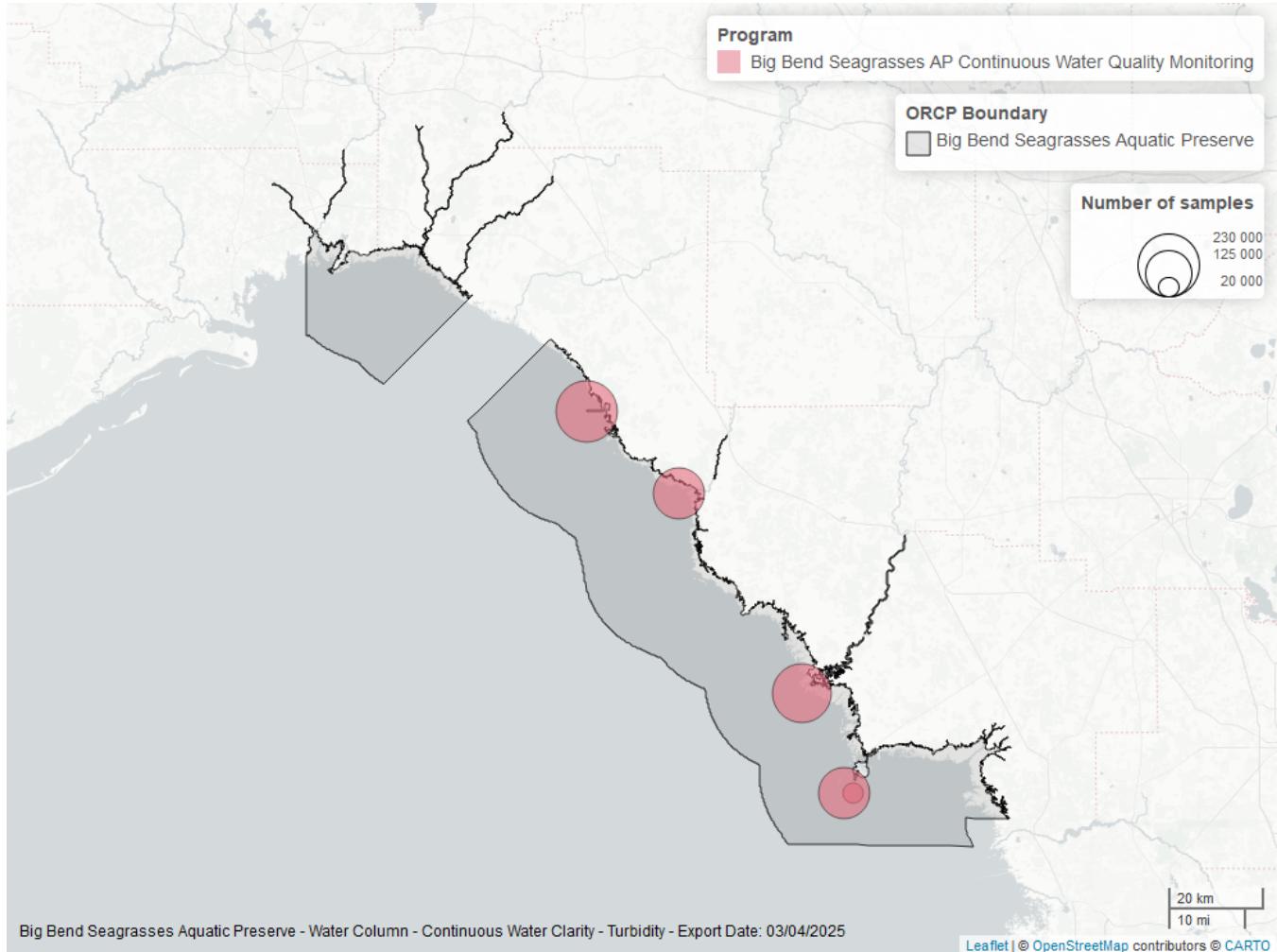


Figure 37: Map showing location of turbidity continuous water quality sampling locations within the boundaries of *Big Bend Seagrasses Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

## Water Temperature - Continuous - Program 7

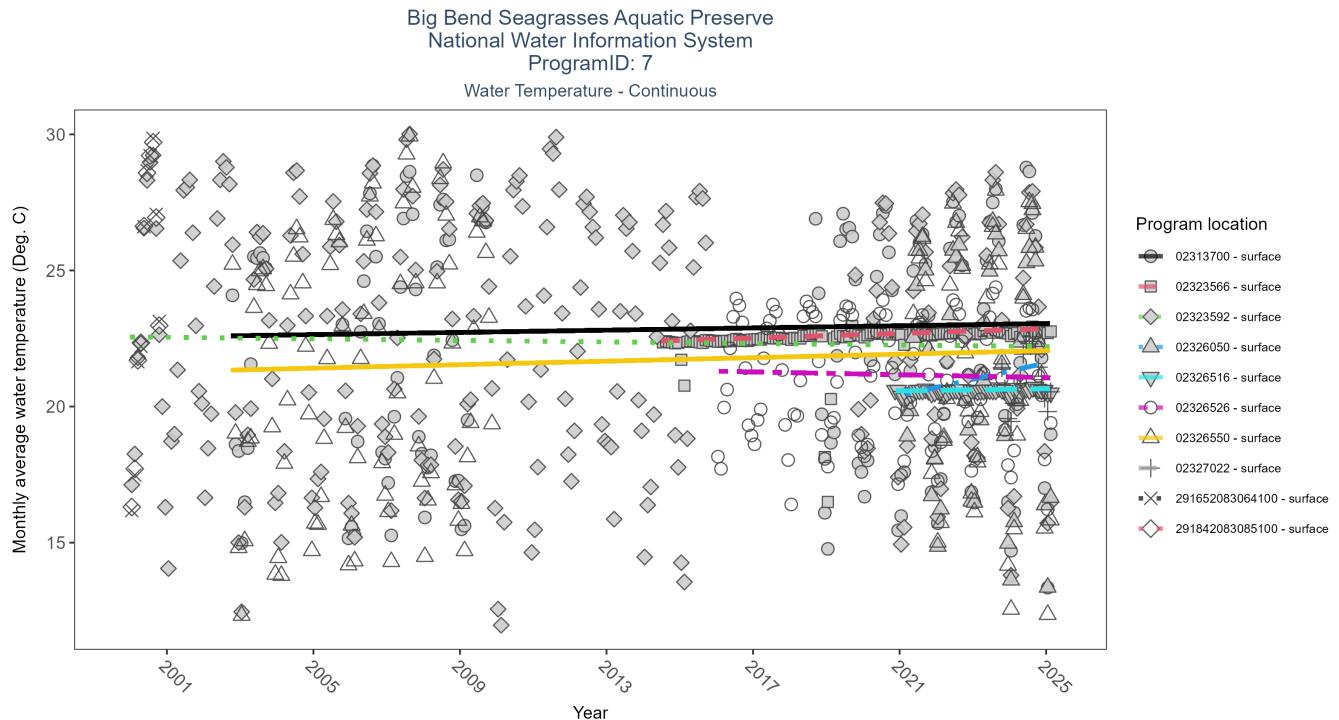


Figure 38: Scatter plot of monthly average water temperature over time at continuously monitored program locations. Each location is analyzed separately, with significant (blue) or non-significant (magenta) trend lines shown for time series that included five or more years of observations.

Table 38: Seasonal Kendall-Tau Results for Water Temperature - Program 7

Station	Statistical Trend	Sample Count	Years with Data	Period of Record	Median	tau	Sen Intercept	Sen Slope	p
02323592	No significant trend	12738	23	2000 - 2025	23.3	-0.05	22.56	-0.01	0.27
02327022	Insufficient data to calculate trend	462	3	2023 - 2025	21.0	-	-	-	-
02326526	No significant trend	3198	10	2016 - 2025	21.5	-0.1	21.3	-0.03	0.19
02326516	Significantly increasing trend	1425	6	2020 - 2025	20.6	0.36	20.56	0.02	0.02
02326050	Significantly increasing trend	1510	5	2021 - 2025	21.6	0.33	20.4	0.3	0.02
02326550	Significantly increasing trend	4604	13	2002 - 2025	22.2	0.18	21.31	0.03	0.01
02313700	No significant trend	3896	15	2002 - 2025	22.9	0.11	22.58	0.02	0.12
02323566	Significantly increasing trend	3820	12	2014 - 2025	22.6	0.76	22.39	0.04	0
291842083085100	Insufficient data to calculate trend	542	1	2000 - 2000	23.1	-	-	-	-
291652083064100	Insufficient data to calculate trend	473	1	2000 - 2000	26.1	-	-	-	-

At four program locations, monthly average water temperature increased between 0.02 and 0.3°C per year. At one program location, monthly average water temperature decreased by 0.37°C per year. No detectable change in monthly average water temperature was observed at six locations. There was insufficient data to fit a model for four locations.

## Water Temperature - Continuous - Program 471

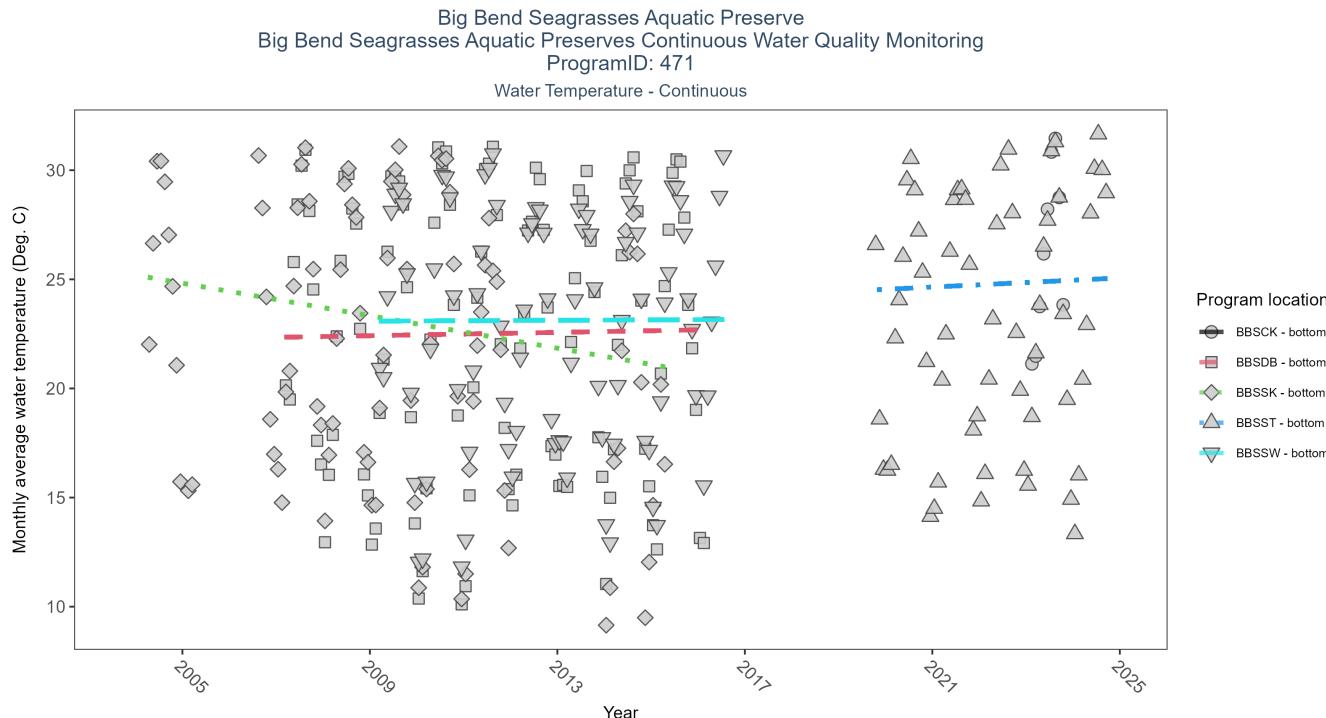


Figure 39: Scatter plot of monthly average water temperature over time at continuously monitored program locations. Each location is analyzed separately, with significant (blue) or non-significant (magenta) trend lines shown for time series that included five or more years of observations.

Table 39: Seasonal Kendall-Tau Results for Water Temperature - Program 471

Station	Statistical Trend	Sample Count	Years with Data	Period of Record	Median	tau	Sen Intercept	Sen Slope	p
BBSDB	No significant trend	265988	10	2007 - 2016	23.2	0.08	22.34	0.04	0.29
BBSCK	Insufficient data to calculate trend	22232	1	2023 - 2023	26.4	-	-	-	-
BBSSK	Significantly decreasing trend	179213	10	2004 - 2015	21.7	-0.33	25.19	-0.37	0
BBSST	No significant trend	163227	6	2019 - 2024	23.5	0.1	24.44	0.1	0.52
BBSSW	No significant trend	227996	8	2009 - 2016	23.7	0.02	23.09	0.01	0.9

At four program locations, monthly average water temperature increased between 0.02 and 0.3°C per year. At one program location, monthly average water temperature decreased by 0.37°C per year. No detectable change in monthly average water temperature was observed at six locations. There was insufficient data to fit a model for four locations.

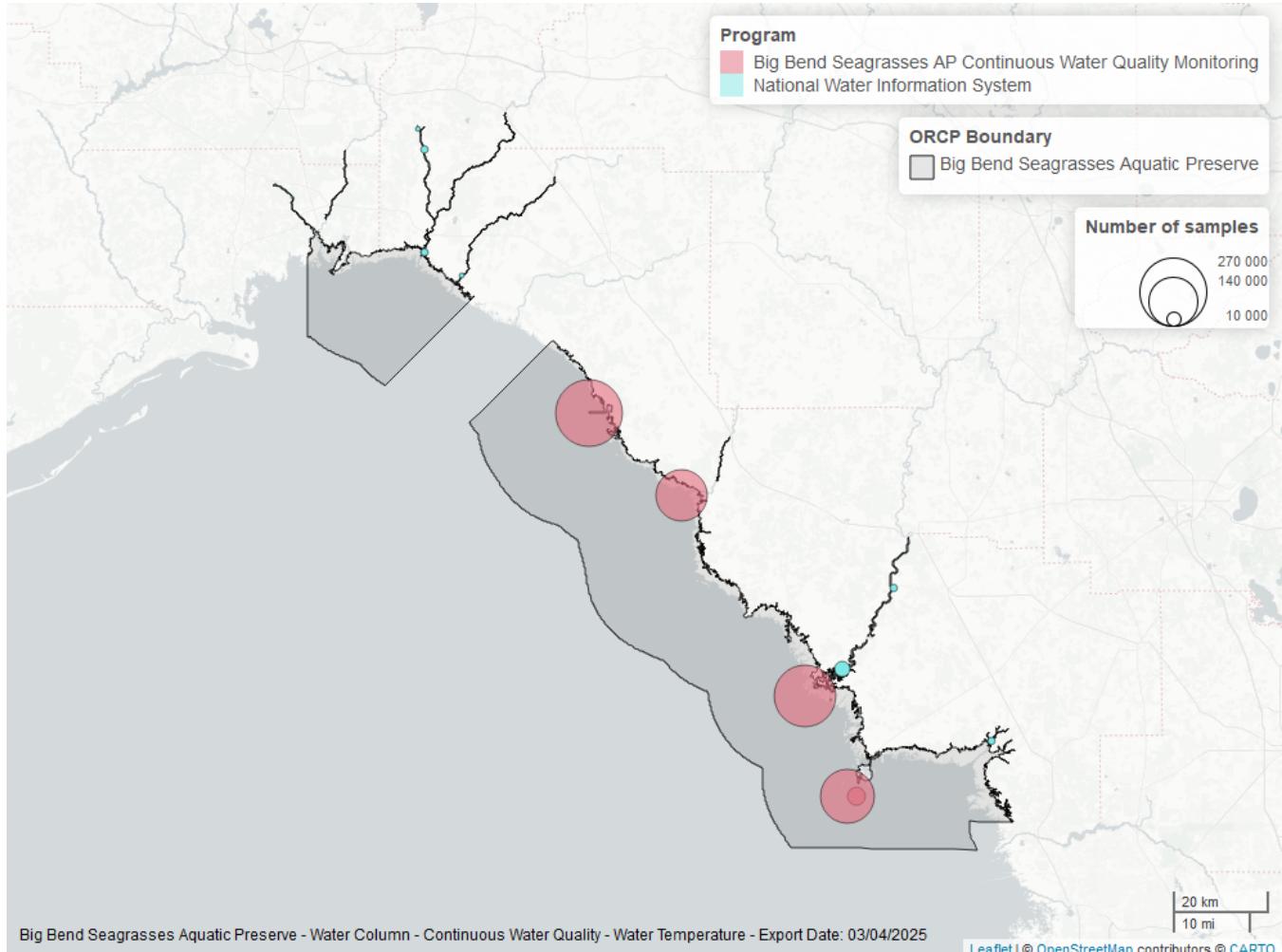


Figure 40: Map showing location of water temperature continuous water quality sampling locations within the boundaries of *Big Bend Seagrasses Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

# Submerged Aquatic Vegetation

The data file used is: All\_SAV\_Parameters-2025-Mar-06.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.

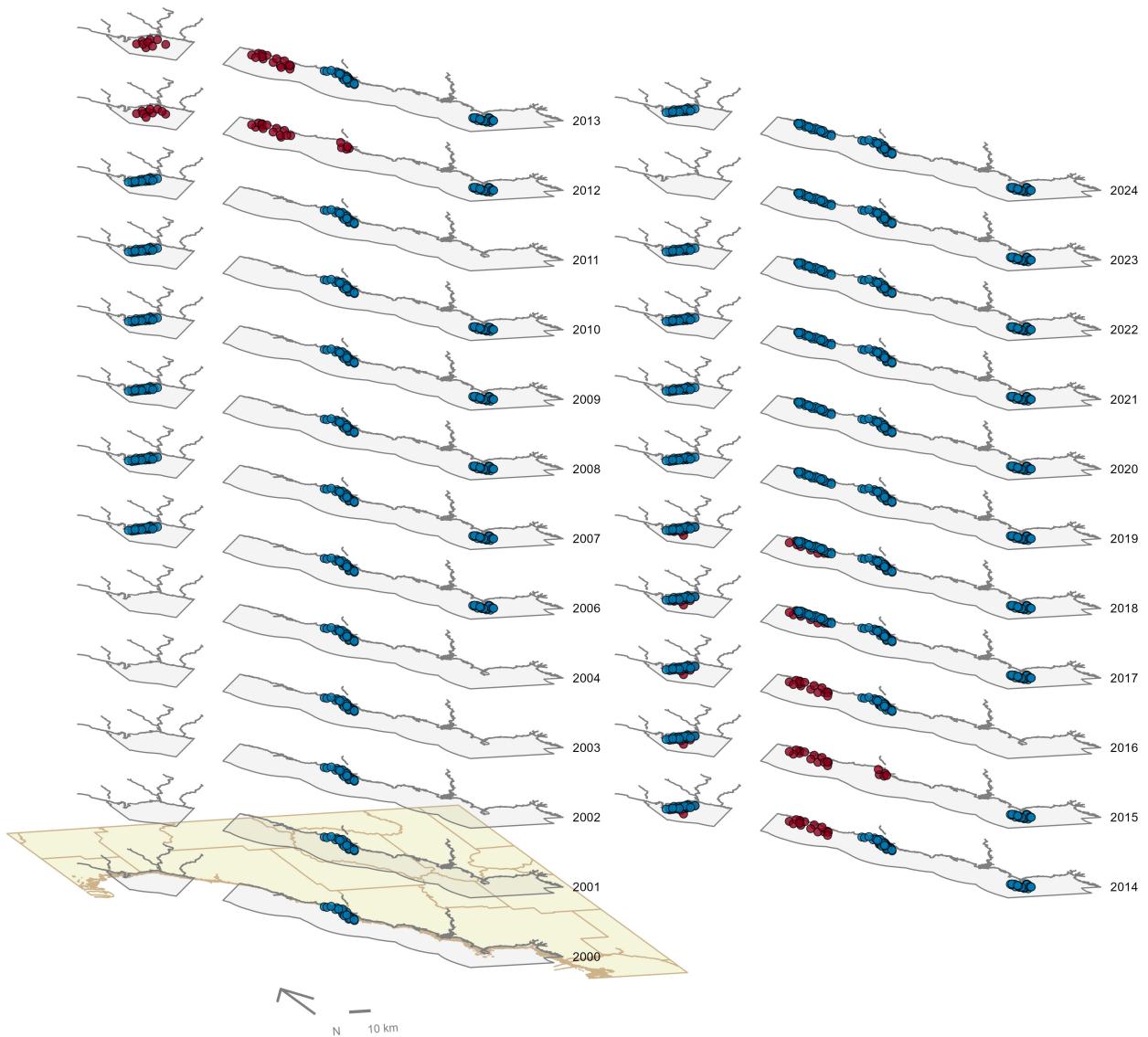
## Notes

*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

Big Bend Seagrasses Aquatic Preserve  
SAV Percent Cover - Sample Locations



Program name  
 ● Big Bend Seagrasses & Nature Coast Aquatic Preserves - Seagrass Monitoring  
 ● Northern Big Bend Seagrass Monitoring

Figure 41: Maps showing the temporal scope of SAV sampling sites within the boundaries of *Big Bend Seagrasses Aquatic Preserve* by Program name.

Click [here](#) to view spatio-temporal plots on GitHub.

#### Sampling locations by Program:

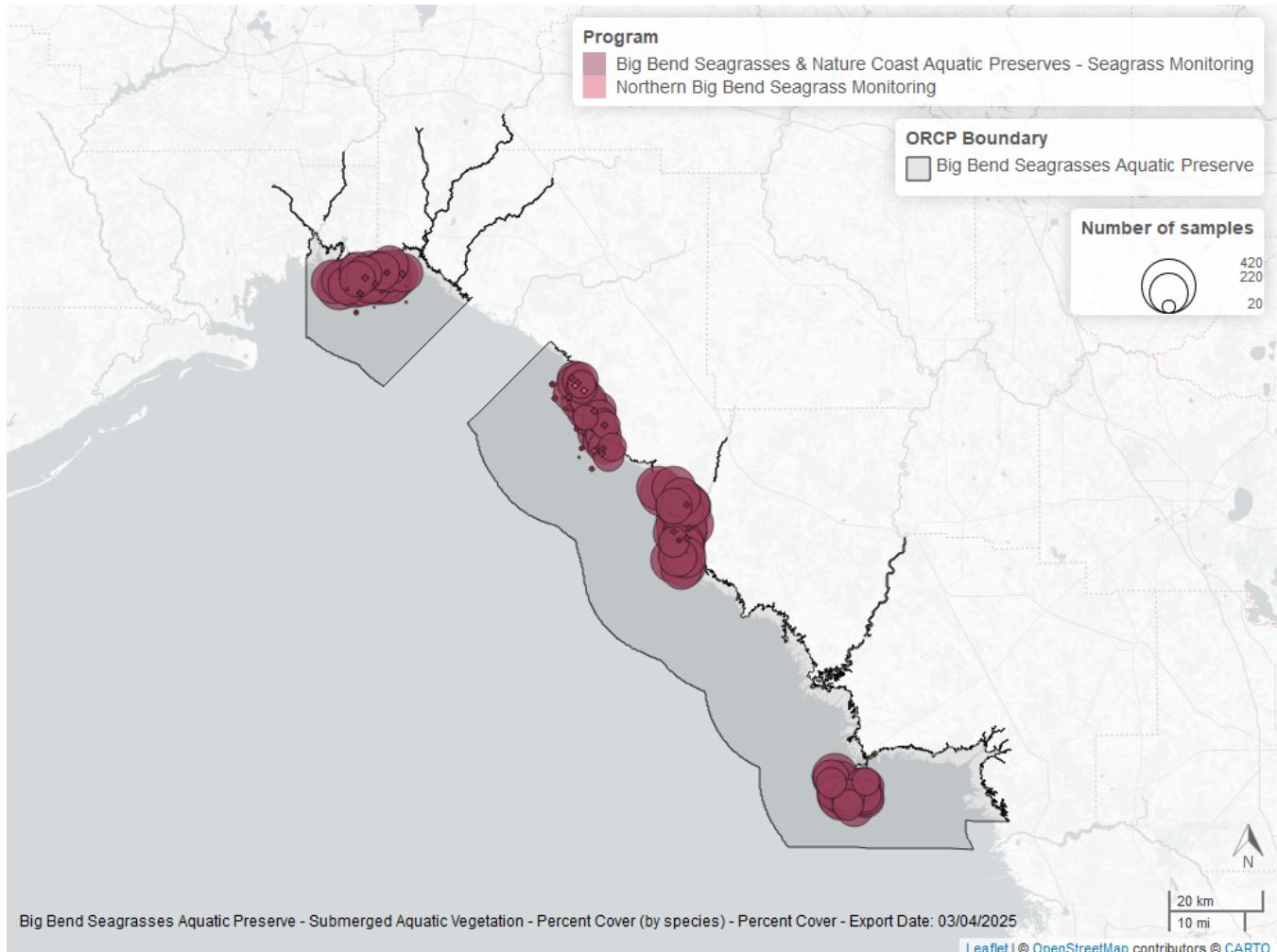


Figure 42: Map showing SAV sampling sites within the boundaries of *Big Bend Seagrasses Aquatic Preserve*. The point size reflects the number of samples at a given sampling site.

Table 40: Program Information for Submerged Aquatic Vegetation

ProgramID	N-Data	YearMin	YearMax	method	Sample Locations
559	537	2012	2018	Modified Braun Blanquet	195
560	19753	2000	2024	Modified Braun Blanquet	100
560	4271	2022	2024	Percent Cover	100

#### Program names:

559 - Northern Big Bend Seagrass Monitoring<sup>15</sup>

560 - Big Bend Seagrasses & Nature Coast Aquatic Preserves - Seagrass Monitoring<sup>12</sup>

560 - Big Bend Seagrasses & Nature Coast Aquatic Preserves - Seagrass Monitoring<sup>12</sup>

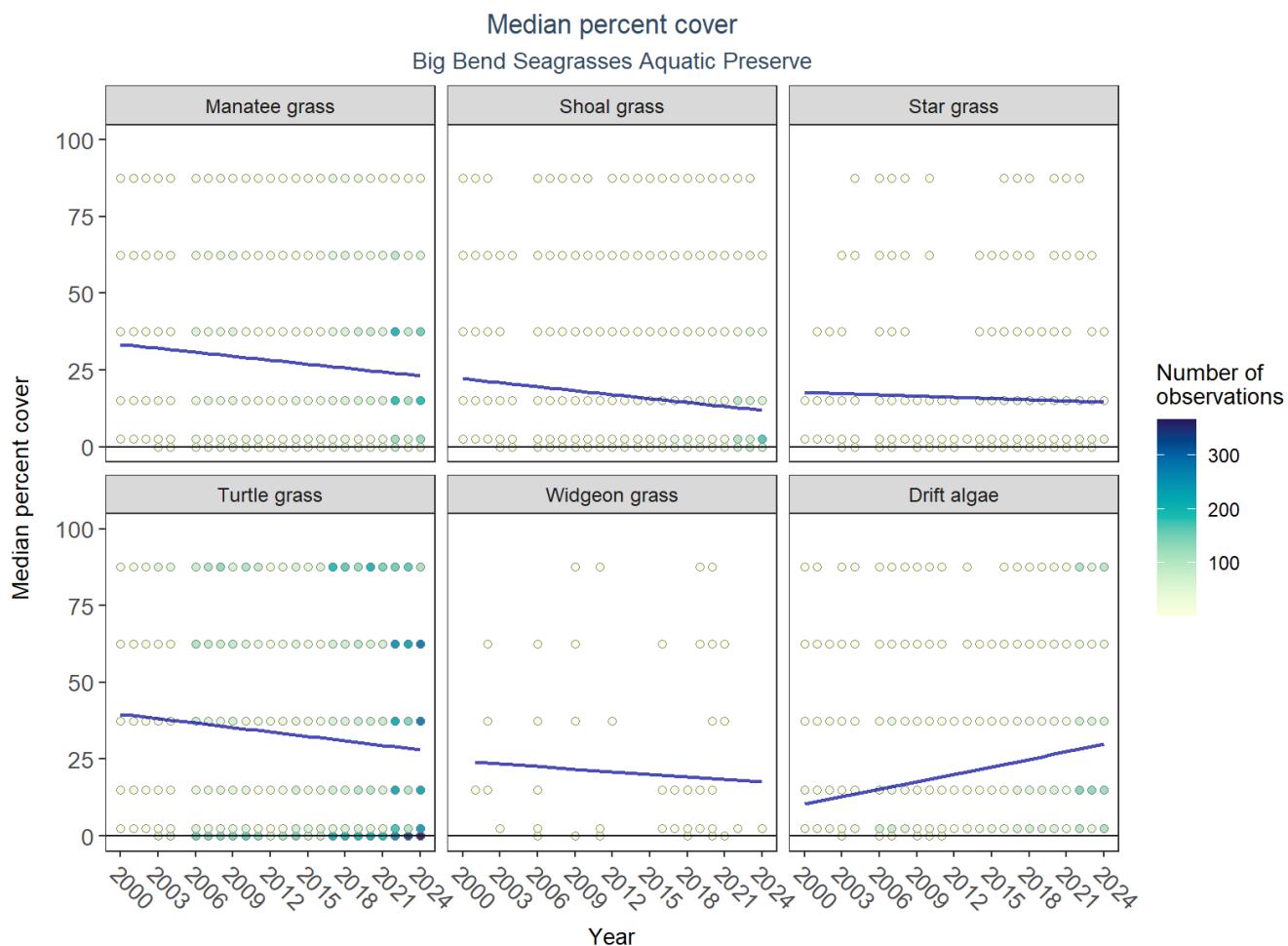


Figure 43: Scatter plots of median percent cover of submerged aquatic vegetation over time by group. Plots for time series that included five or more years of observations show the estimated trend as a blue line.

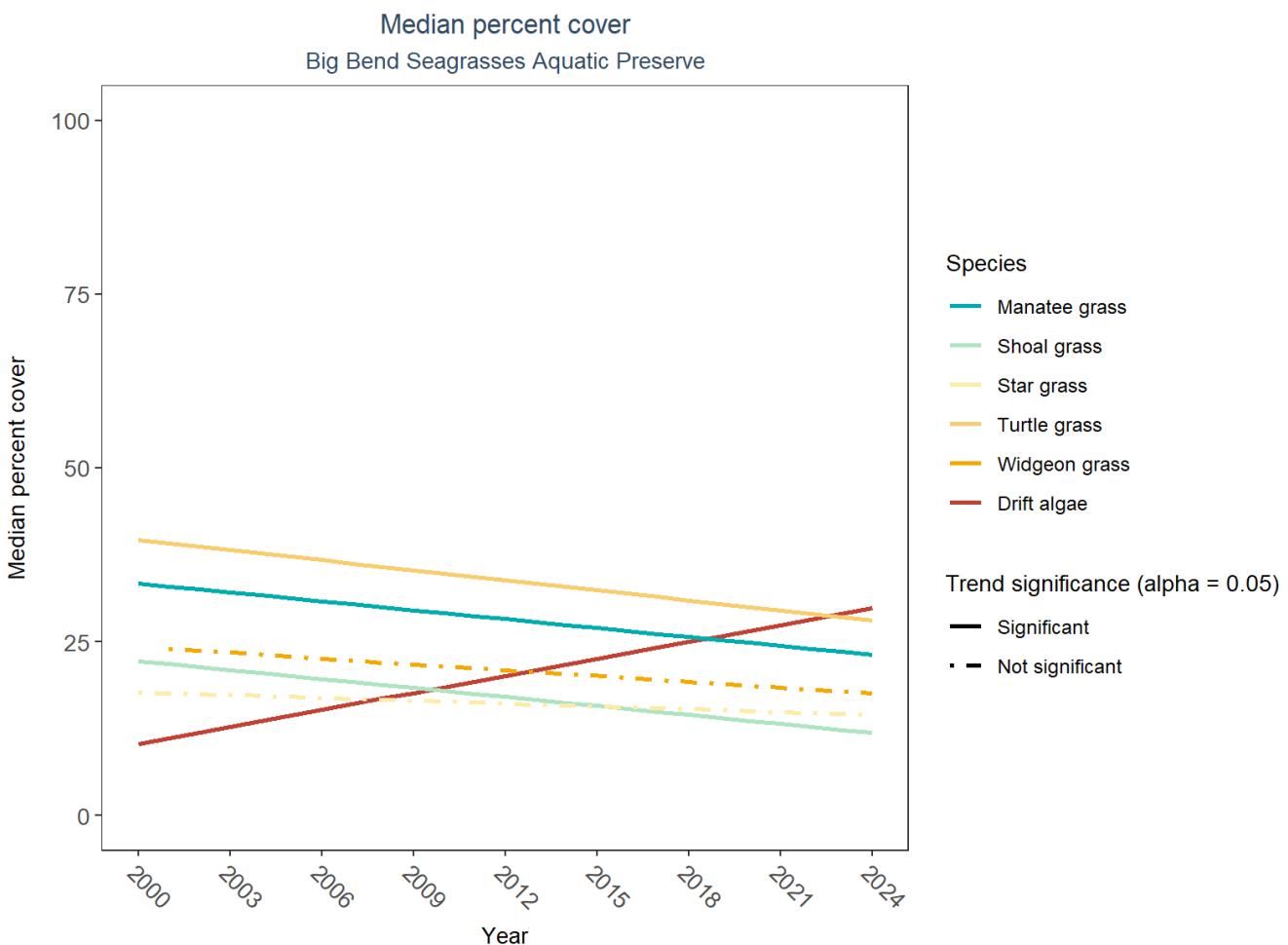


Figure 44: Trends in median percent cover for various seagrass species in Big Bend Seagrasses Aquatic Preserve - simplified

Table 41: Percent Cover Trend Analysis for Big Bend Seagrasses Aquatic Preserve

Common Name	Trend Significance (0.05)	Period of Record	LME-Intercept	LME-Slope	p
Drift algae	Significantly increasing trend	2000 - 2024	5.453921	0.8127326	0.0000009
Shoal grass	Significantly decreasing trend	2000 - 2024	24.829747	-0.4314551	0.0001280
Star grass	No significant trend	2000 - 2024	18.552789	-0.1347727	0.3089913
No grass in quadrat	Model did not fit the available data	2004 - 2024	-	-	-
Widgeon grass	No significant trend	2001 - 2024	25.939902	-0.2793375	0.5982282
Manatee grass	Significantly decreasing trend	2000 - 2024	35.945396	-0.4271771	0.0000536
Turtle grass	Significantly decreasing trend	2000 - 2024	42.516006	-0.4815112	0.0000000

An annual increase in percent cover was observed for drift algae (0.8%). Annual decreases in percent cover were observed for manatee grass (-0.4%), shoal grass (-0.4%), and turtle grass (-0.5%). No detectable change in percent cover was observed for star grass and widgeon grass.

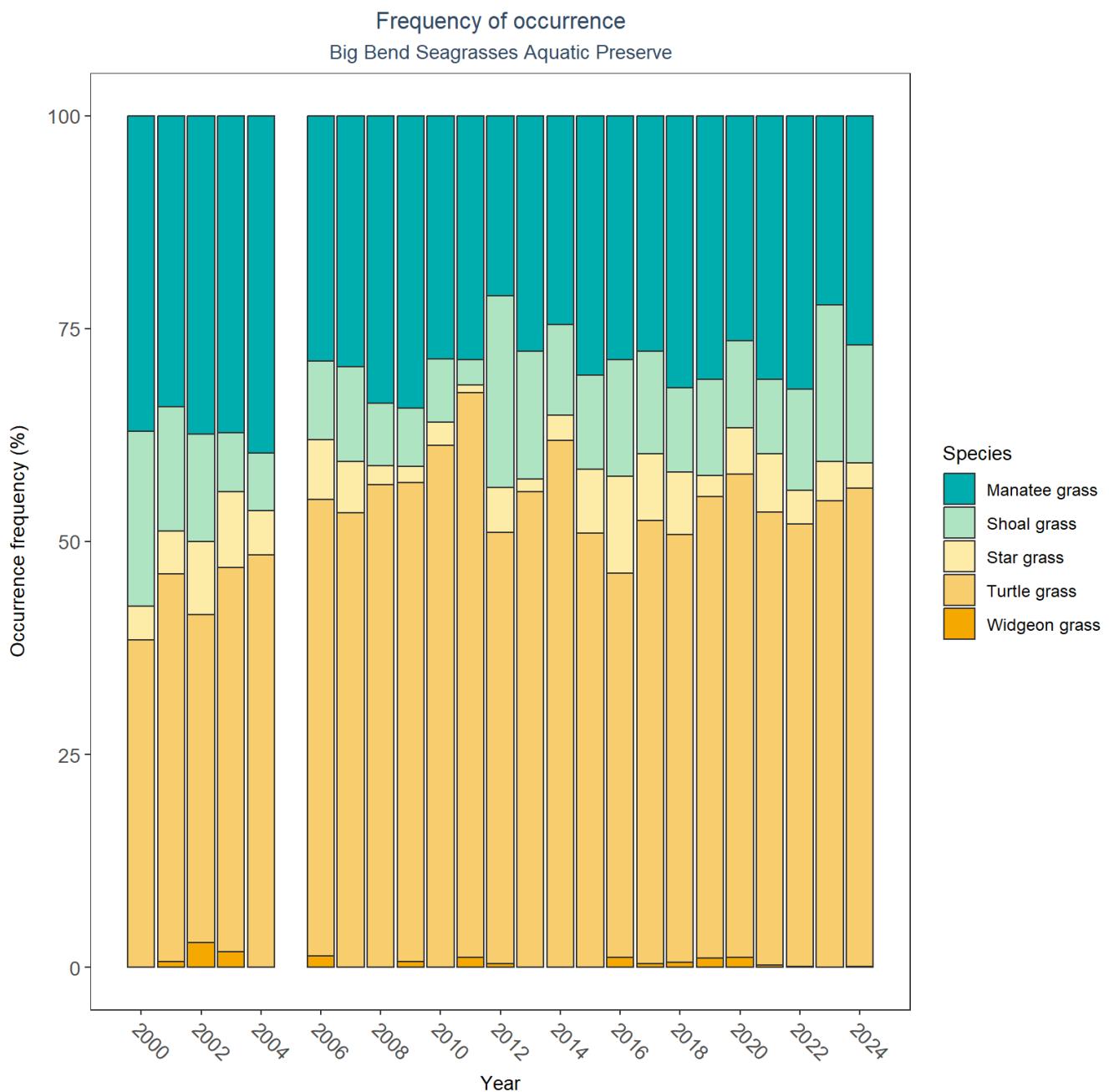


Figure 45: Frequency of occurrence for various seagrass species in Big Bend Seagrasses Aquatic Preserve

## Coastal Wetlands

The data file used is: All\_CW\_Parameters-2025-Mar-06.txt

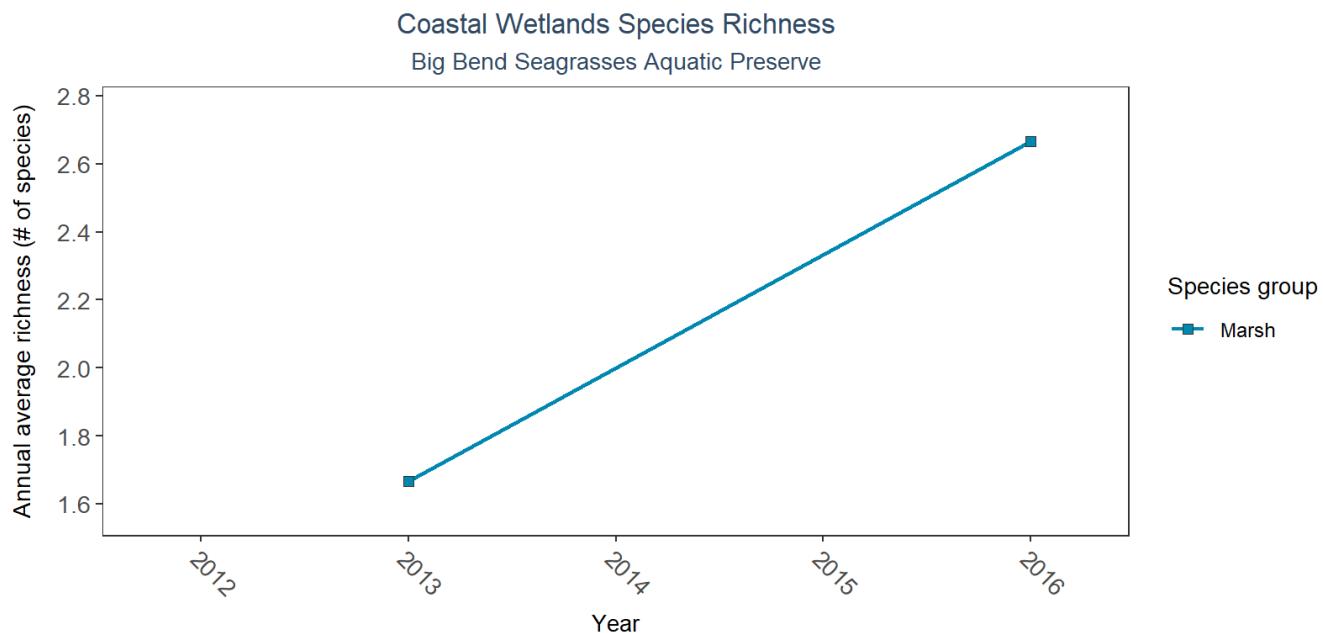


Figure 46: Line graph of annual average coastal wetlands species richness over time for mangroves and associates (triangles), marsh (squares), and marsh succulents (circles). If the time series by species group included more than one year of observations, a line connects data points for visualization.

Table 42: Coastal Wetlands Species Richness

Species Group	Sample Count	Number of Years	Period of Record	Median N of Taxa	Mean N of Taxa
Marsh	6	2	2013 - 2016	2	2.17

Between 2013 and 2016, the median annual number of species for *marsh* was 2 based on 6 observations.

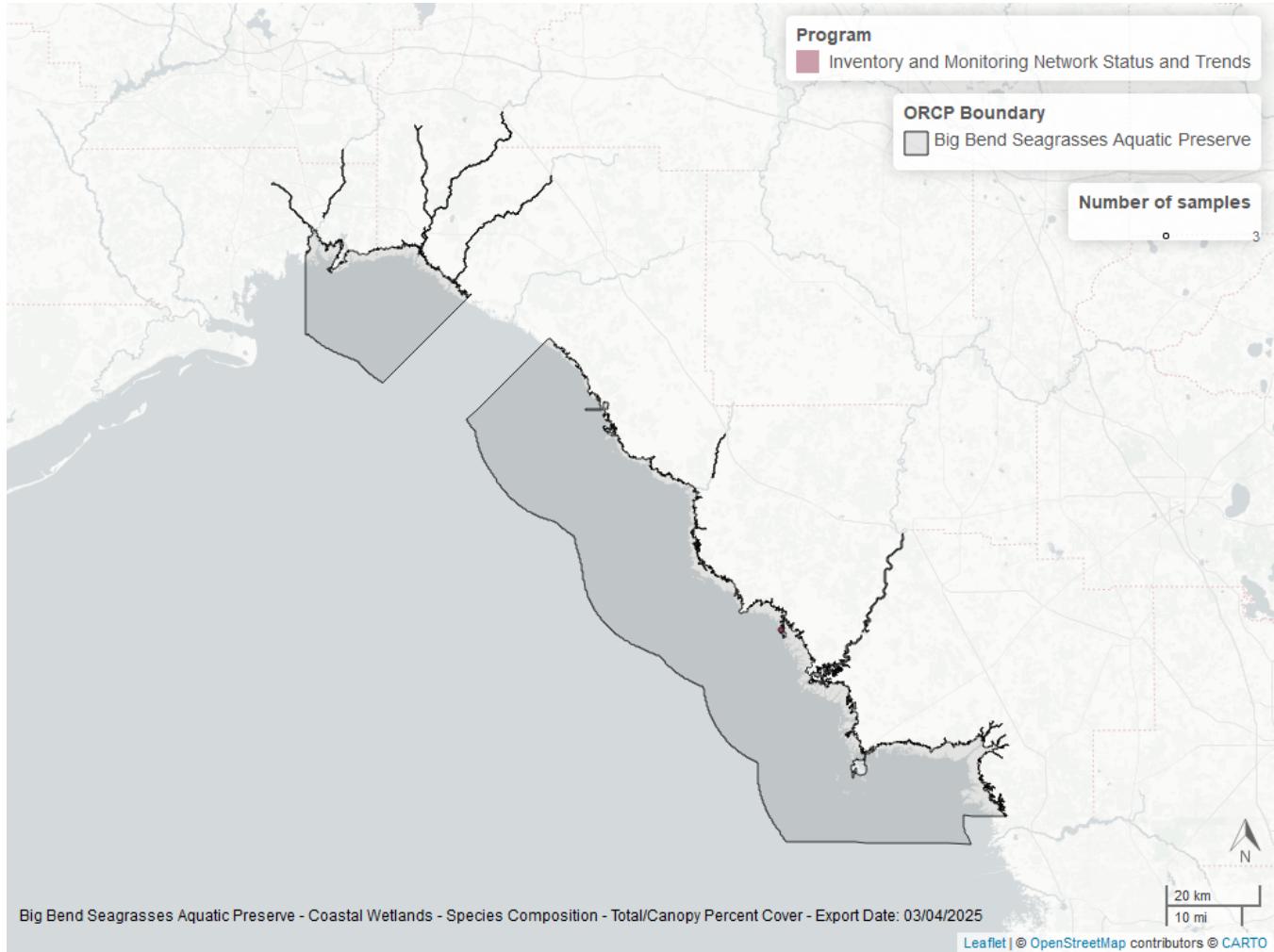


Figure 47: Map showing location of coastal wetlands sampling locations within the boundaries of *Big Bend Seagrasses Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

## References

1. U.S. Environmental Protection Agency (EPA). [EPA STORET and RETrieval Data Warehouse \(STORET\)/WQX](#). (2023).
2. Suwannee River Water Management District (SRWMD). [Suwannee River Water Management District Water Resource Monitoring Program](#). (2024).
3. University of Florida (UF); Institute of Food and Agricultural Sciences. [Florida LAKEWATCH Program](#). (2024).
4. Florida Department of Agriculture and Consumer Services (FDACS) - Division of Aquaculture. [Shellfish Harvest Area Classification Program](#). (2022).
5. Florida Department of Environmental Protection (DEP). [Florida STORET / WIN](#). (2024).
6. University of Florida (UF); Florida Department of Environmental Protection (DEP); Office of Resilience and Coastal Protection (RCP); Big Bend Seagrasses Aquatic Preserves / Nature Coast Aquatic Preserve. [Project COAST \(Coastal Assessment Team\) - Springs Coast Ecosystem Region](#). (2024).
7. Gulf States Marine Fisheries Commission. [Southeast Area Monitoring and Assessment Program \(SEAMAP\) - Gulf of Mexico Fall & Summer Shrimp/Groundfish Survey](#). (2016).
8. U.S. Environmental Protection Agency (EPA); Office of Research and Development. [Environmental Monitoring Assessment Program](#). (2004).
9. 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).
10. Florida Fish and Wildlife Conservation Commission (FWC). [Fisheries-Independent Monitoring \(FIM\) Program](#). (2022).
11. Florida Fish and Wildlife Conservation Commission (FWC); Florida Fish and Wildlife Research Institute (FWRI). [Harmful Algal Bloom Marine Observation Network](#). (2018).
12. Florida Department of Environmental Protection (DEP); Office of Resilience and Coastal Protection (RCP); Big Bend Seagrasses Aquatic Preserves; University of Florida - Nature Coast Aquatic Preserve. [Big Bend Seagrasses & Nature Coast Aquatic Preserves - Seagrass Monitoring](#). (2024).
13. U.S. Geological Survey (USGS). [National Water Information System](#). (2024).
14. Florida Department of Environmental Protection (DEP); Office of Resilience and Coastal Protection (RCP); Big Bend Seagrasses Aquatic Preserves. [Big Bend Seagrasses Aquatic Preserves Continuous Water Quality Monitoring](#). (2024).
15. Florida Fish and Wildlife Conservation Commission (FWC); Florida Fish and Wildlife Research Institute (FWRI). [Northern Big Bend Seagrass Monitoring](#). (2018).