Florida Keys National Marine Sanctuary

SEACAR Habitat Analyses

Last compiled on 02 July, 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	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 $p >= 0.05$). 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

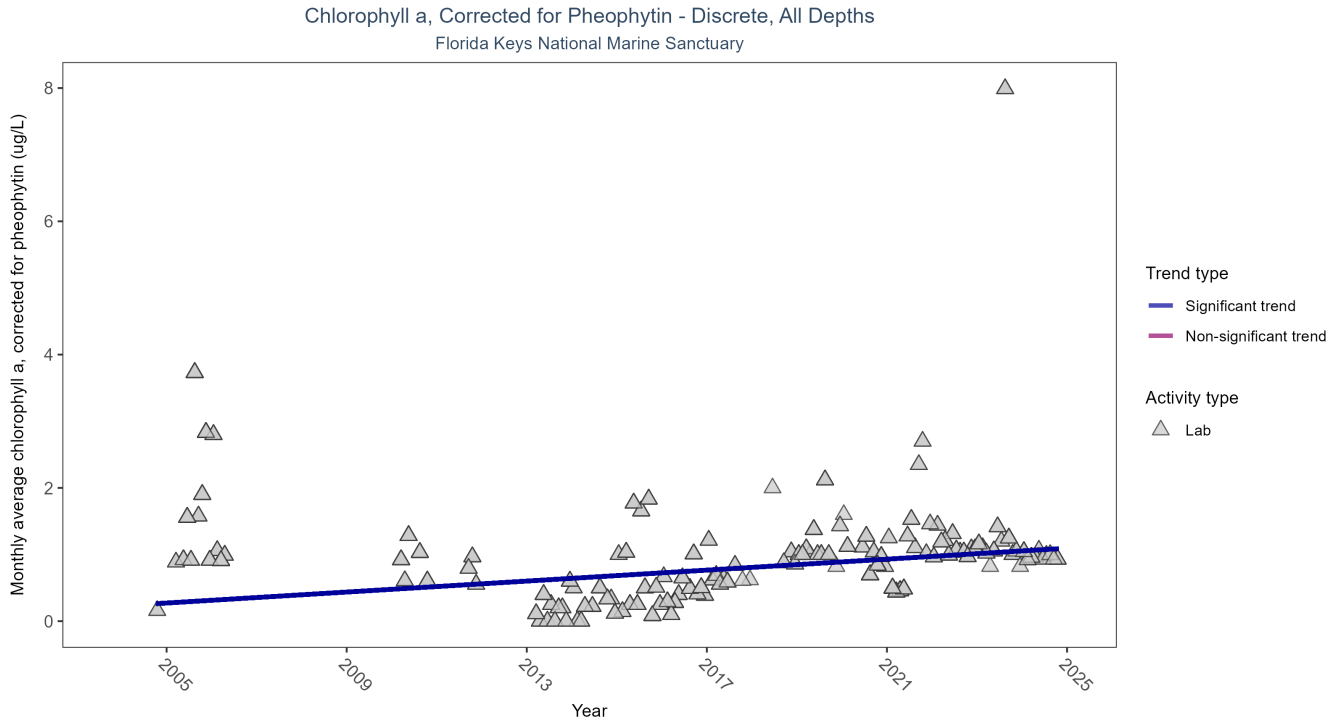

Figure 1: Scatter plot of monthly average levels of chlorophyll a, corrected for pheophytin, over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only laboratory-analyzed chlorophyll a (triangles) 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	2048	17	2004 - 2024	0.62	0.2827	0.2309	0.0411	0

Monthly average chlorophyll a, corrected for pheophytin, increased by 0.04 µg/L per year, indicating a decrease in water clarity.

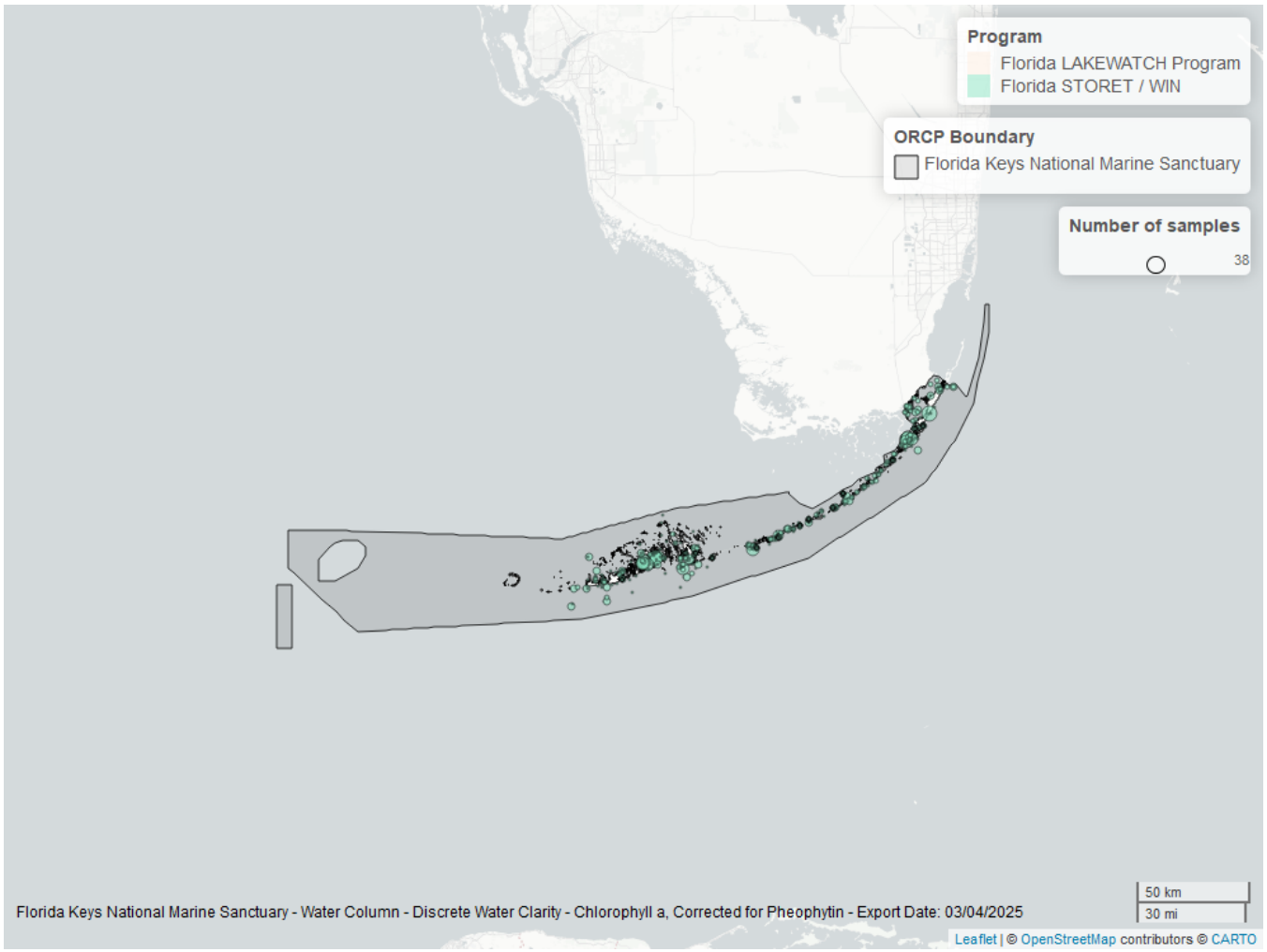

Figure 2: Map showing location of discrete water quality sampling locations within the boundaries of *Florida Keys National Marine Sanctuary*. The bubble size on the maps above reflect the amount of data available at each sampling site.

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

ProgramID	*N_Data*	*YearMin*	*YearMax*
5002	1943	2004	2024
514	198	2018	2024

Program names:

514 - Florida LAKEWATCH Program[1]
5002 - Florida STORET / WIN[2]

Chlorophyll a, Uncorrected for Pheophytin - Discrete

Seasonal Kendall-Tau Trend Analysis

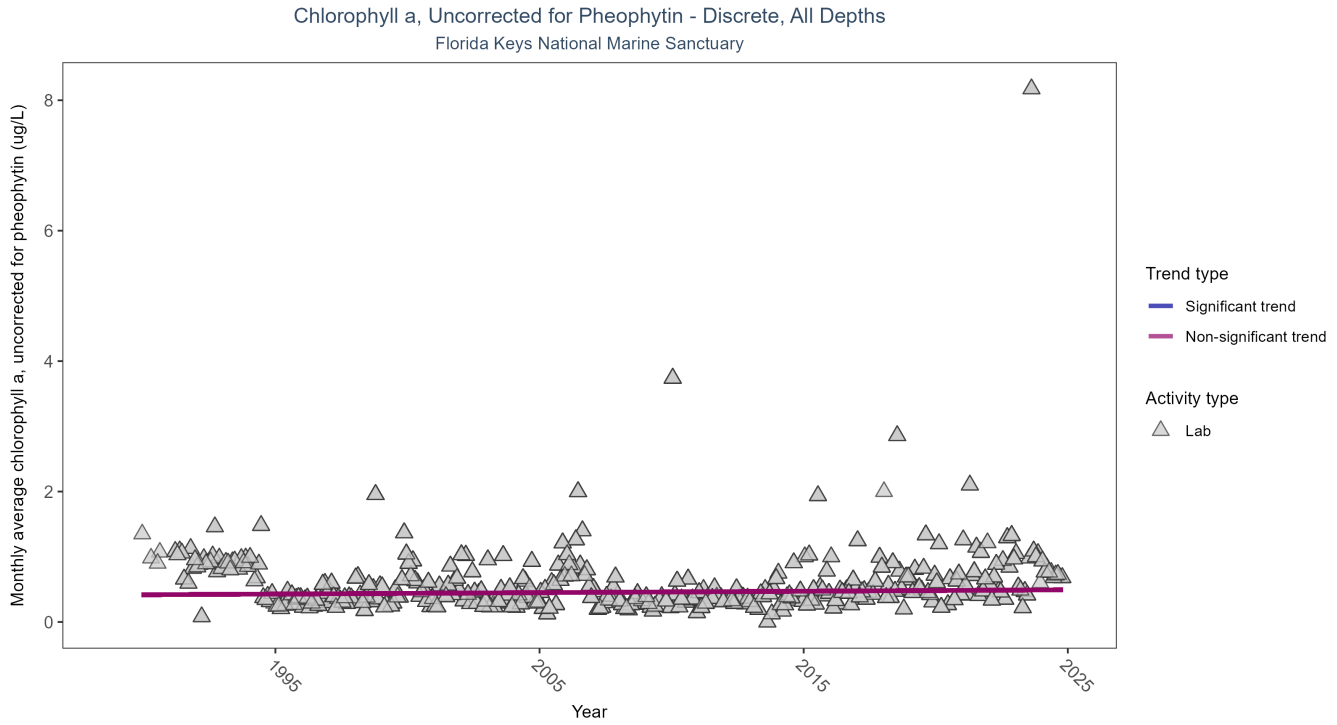

Figure 3: Scatter plot of monthly average levels of chlorophyll a, uncorrected for pheophytin, over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only laboratory-analyzed chlorophyll a (triangles) 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	No significant trend	21249	36	1989 - 2024	0.2973	0.0554	0.4152	0.0022	0.1261

Chlorophyll a, uncorrected for pheophytin, showed no detectable trend between 1989 and 2024.

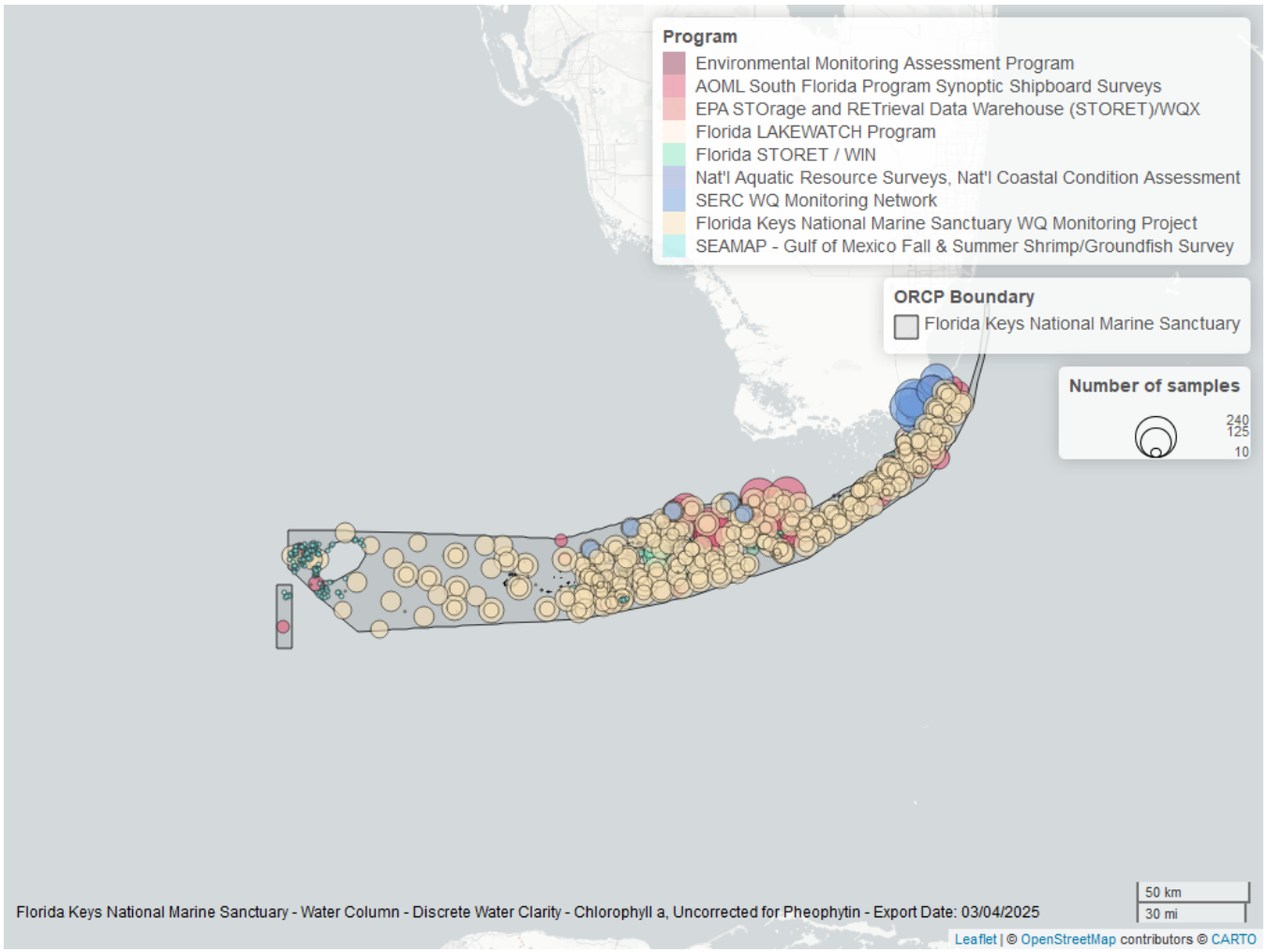

Figure 4: Map showing location of discrete water quality sampling locations within the boundaries of *Florida Keys National Marine Sanctuary*. The bubble size on the maps above reflect the amount of data available at each sampling site.

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

ProgramID	*N_Data*	*YearMin*	*YearMax*
297	16110	1995	2023
3	4011	1998	2024
514	2819	1998	2024
509	1418	1989	2008
5002	987	2001	2024
60	345	1993	2016
103	154	2000	2021
118	28	2000	2010
115	28	2000	2004

Program names:

3 - Atlantic Oceanographic and Meteorological Laboratory (AOML) South Florida Program Synoptic Shipboard Surveys[3]
60 - Southeast Area Monitoring and Assessment Program (SEAMAP) - Gulf of Mexico Fall & Summer

Shrimp/Groundfish Survey[4]
103 - EPA STOrage and RETrieval Data Warehouse (STORET)/WQX[5]
115 - Environmental Monitoring Assessment Program[6]
118 - National Aquatic Resource Surveys, National Coastal Condition Assessment[7]
297 - Florida Keys National Marine Sanctuary Water Quality Monitoring Project[8]
509 - SERC Water Quality Monitoring Network[9]
514 - Florida LAKEWATCH Program[1]
5002 - Florida STORET / WIN[2]

Colored Dissolved Organic Matter - Discrete

Seasonal Kendall-Tau Trend Analysis

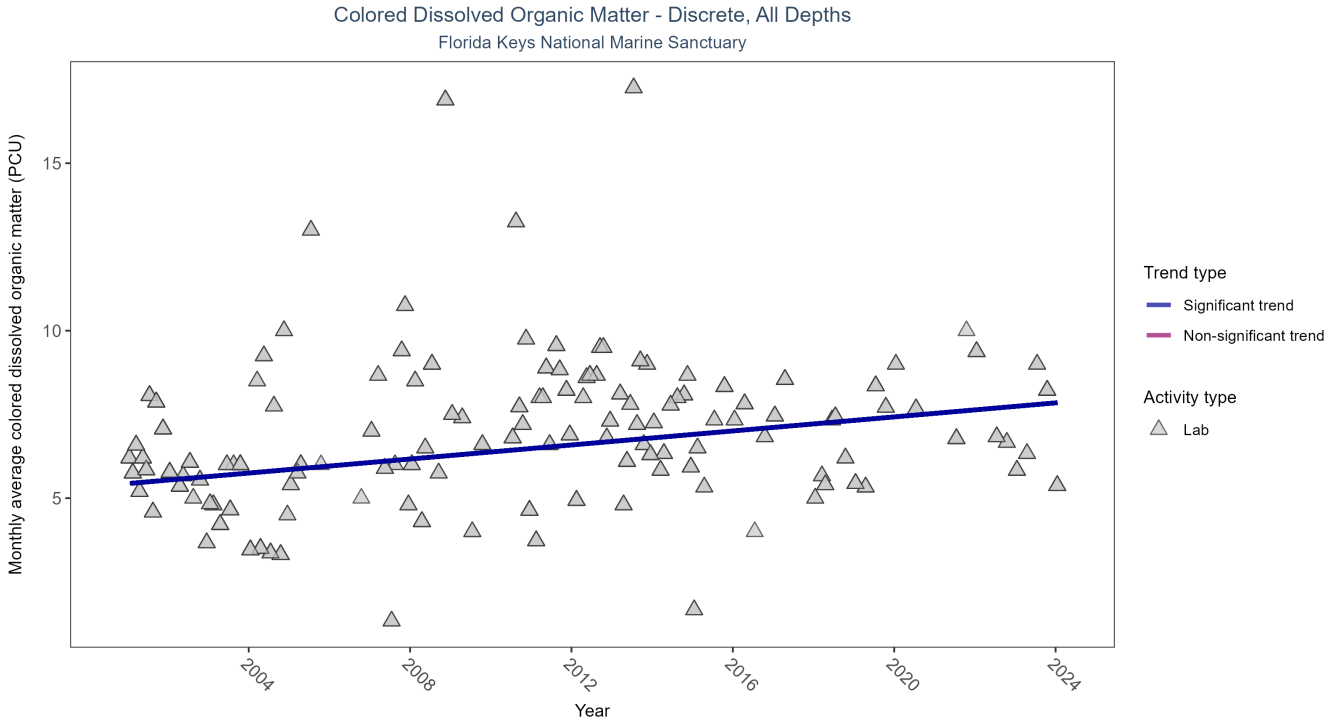

Figure 5: Scatter plot of monthly average colored dissolved organic matter (CDOM) over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only laboratory-analyzed CDOM (triangles) is included in the 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	1025	24	2001 - 2024	6	0.2457	5.4354	0.1048	0.0003

Monthly average colored dissolved organic matter increased by 0.1 PCU per year, indicating a decrease in water clarity.

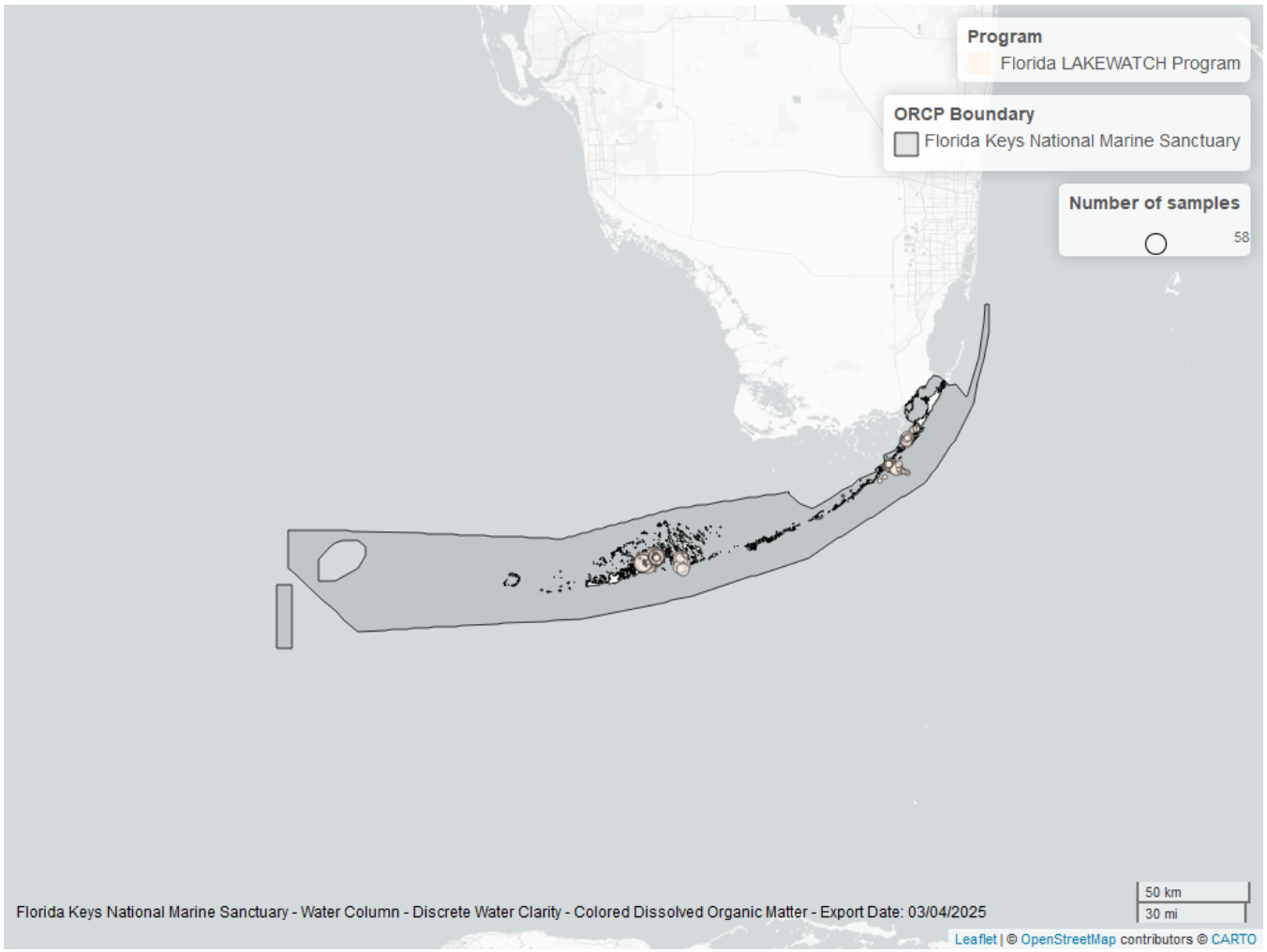

Figure 6: Map showing location of discrete water quality sampling locations within the boundaries of *Florida Keys National Marine Sanctuary*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Table 11: Programs contributing data for Colored Dissolved Organic Matter

ProgramID	*N_Data*	*YearMin*	*YearMax*
514	1025	2001	2024

Program names:

514 - Florida LAKEWATCH Program[1]

Dissolved Oxygen - Discrete

Seasonal Kendall-Tau Trend Analysis

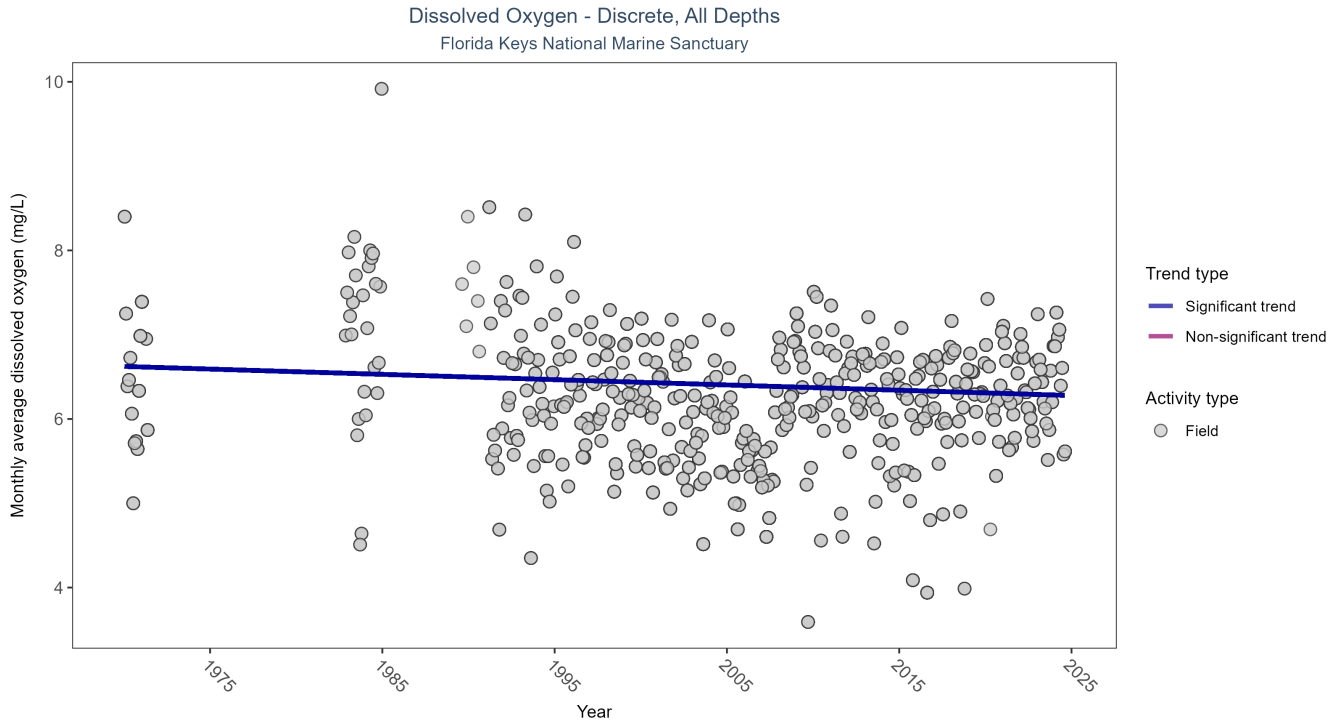

Figure 7: Scatter plot of monthly average dissolved oxygen over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only dissolved oxygen values measured in the field (circles) are included in the plot.

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	Significantly decreasing trend	47232	41	1970 - 2024	6.3	-0.0912	6.6235	-0.0063	0.0051

Monthly average dissolved oxygen decreased by 0.01 mg/L per year.

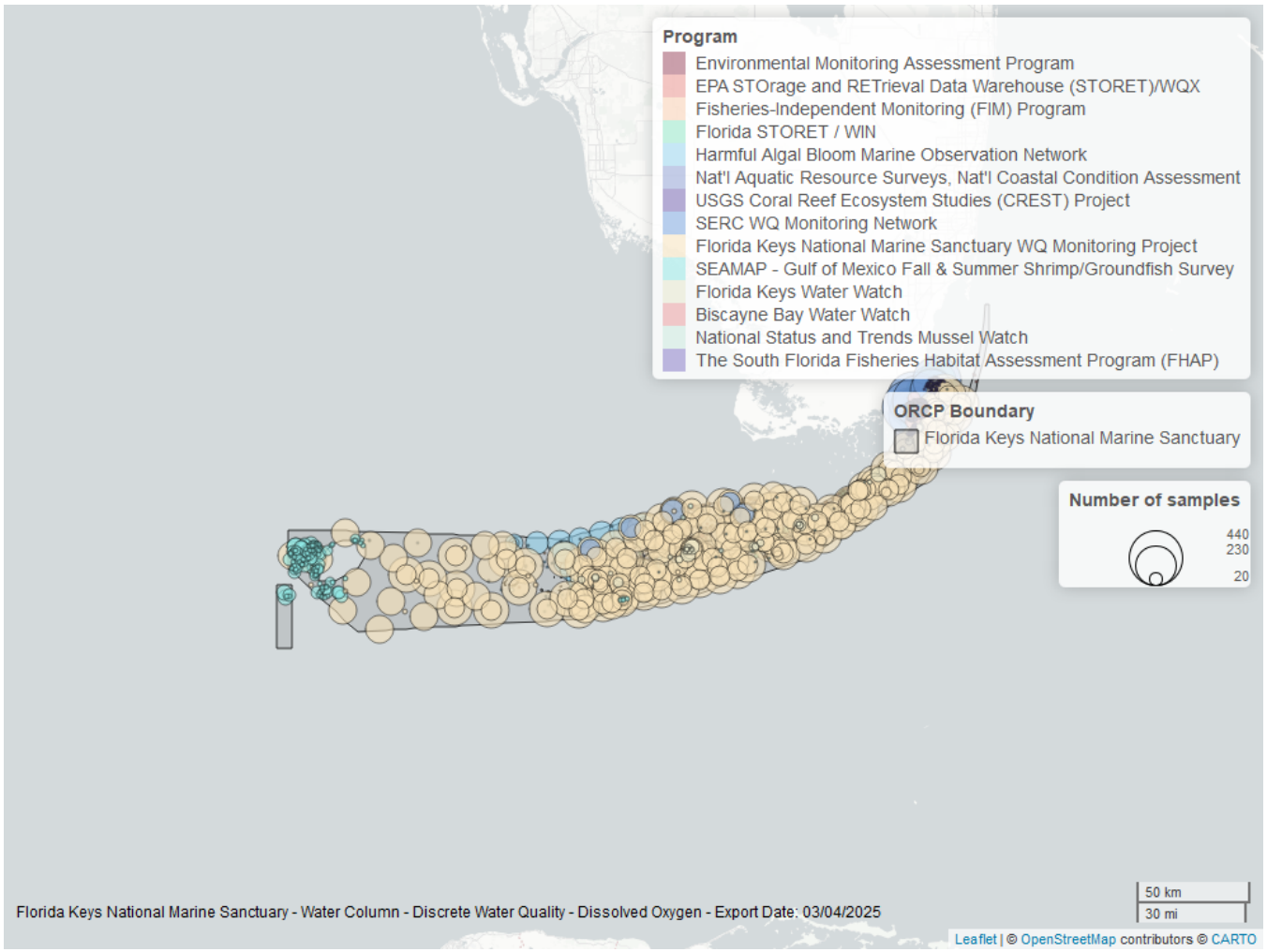

Figure 8: Map showing location of discrete water quality sampling locations within the boundaries of *Florida Keys National Marine Sanctuary*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Table 13: Programs contributing data for Dissolved Oxygen

ProgramID	*N_Data*	*YearMin*	*YearMax*
297	32169	1995	2023
5002	5155	2003	2024
509	2701	1989	2008
69	1743	1997	2022
60	1592	1993	2016
95	1560	1994	2018
4049	1024	2006	2023
103	601	1970	2021
3000	377	2015	2018
118	104	2000	2021
899	93	2014	2015
115	89	2000	2004
4057	59	2015	2018
102	42	1996	2000

Program names:

60 - Southeast Area Monitoring and Assessment Program (SEAMAP) - Gulf of Mexico Fall & Summer Shrimp/Groundfish Survey[4]
69 - Fisheries-Independent Monitoring (FIM) Program[10]
95 - Harmful Algal Bloom Marine Observation Network[11]
102 - National Status and Trends Mussel Watch[12]
103 - EPA STOrage and RETrieval Data Warehouse (STORET)/WQX[5]
115 - Environmental Monitoring Assessment Program[6]
118 - National Aquatic Resource Surveys, National Coastal Condition Assessment[7]
297 - Florida Keys National Marine Sanctuary Water Quality Monitoring Project[8]
509 - SERC Water Quality Monitoring Network[9]
899 - USGS Coral Reef Ecosystem Studies (CREST) Project[13]
3000 - Florida Keys Water Watch[14]
4049 - The South Florida Fisheries Habitat Assessment Program (FHAP)[15]
4057 - Biscayne Bay Water Watch[16]
5002 - Florida STORET / WIN[2]

Dissolved Oxygen Saturation - Discrete

Seasonal Kendall-Tau Trend Analysis

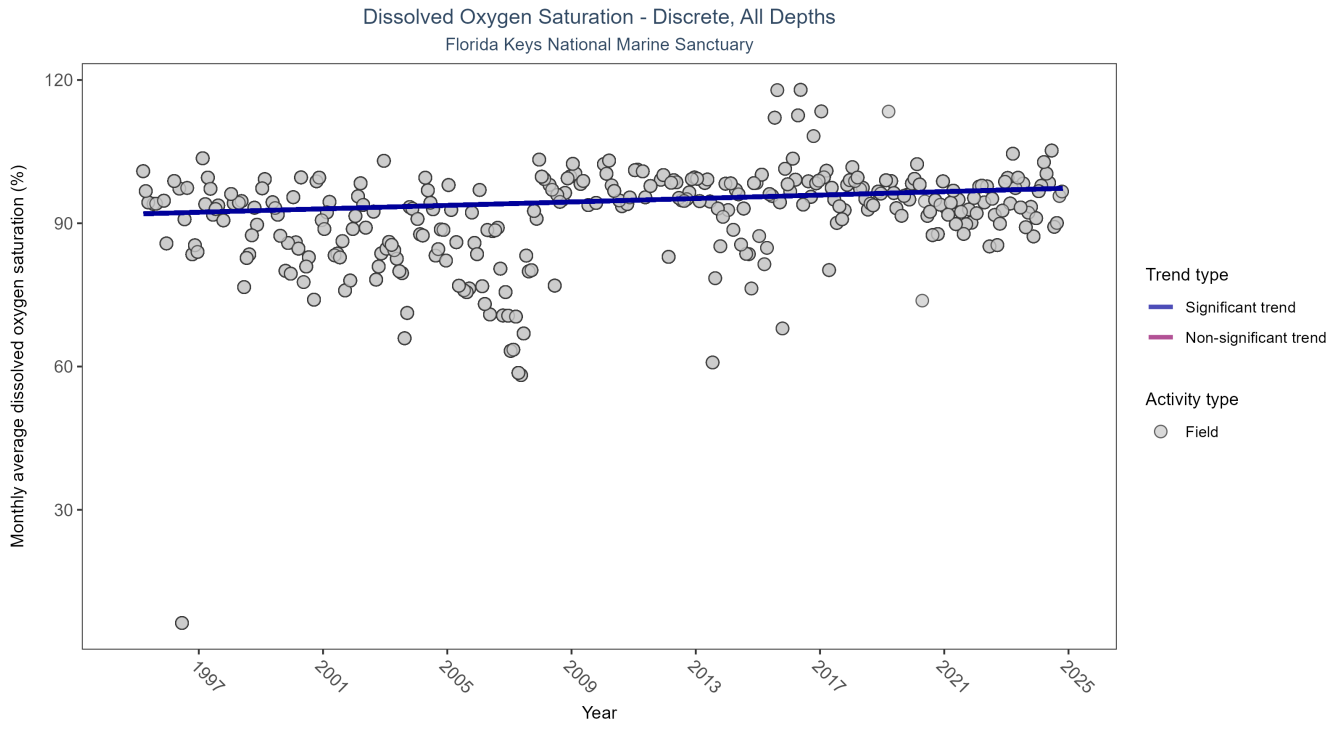

Figure 9: Scatter plot of monthly average dissolved oxygen saturation over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only dissolved oxygen saturation values measured in the field (circles) 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	Significantly increasing trend	29283	30	1995 - 2024	94.7731	0.1922	91.9441	0.18	0

Monthly average dissolved oxygen saturation increased by 0.18% per year.

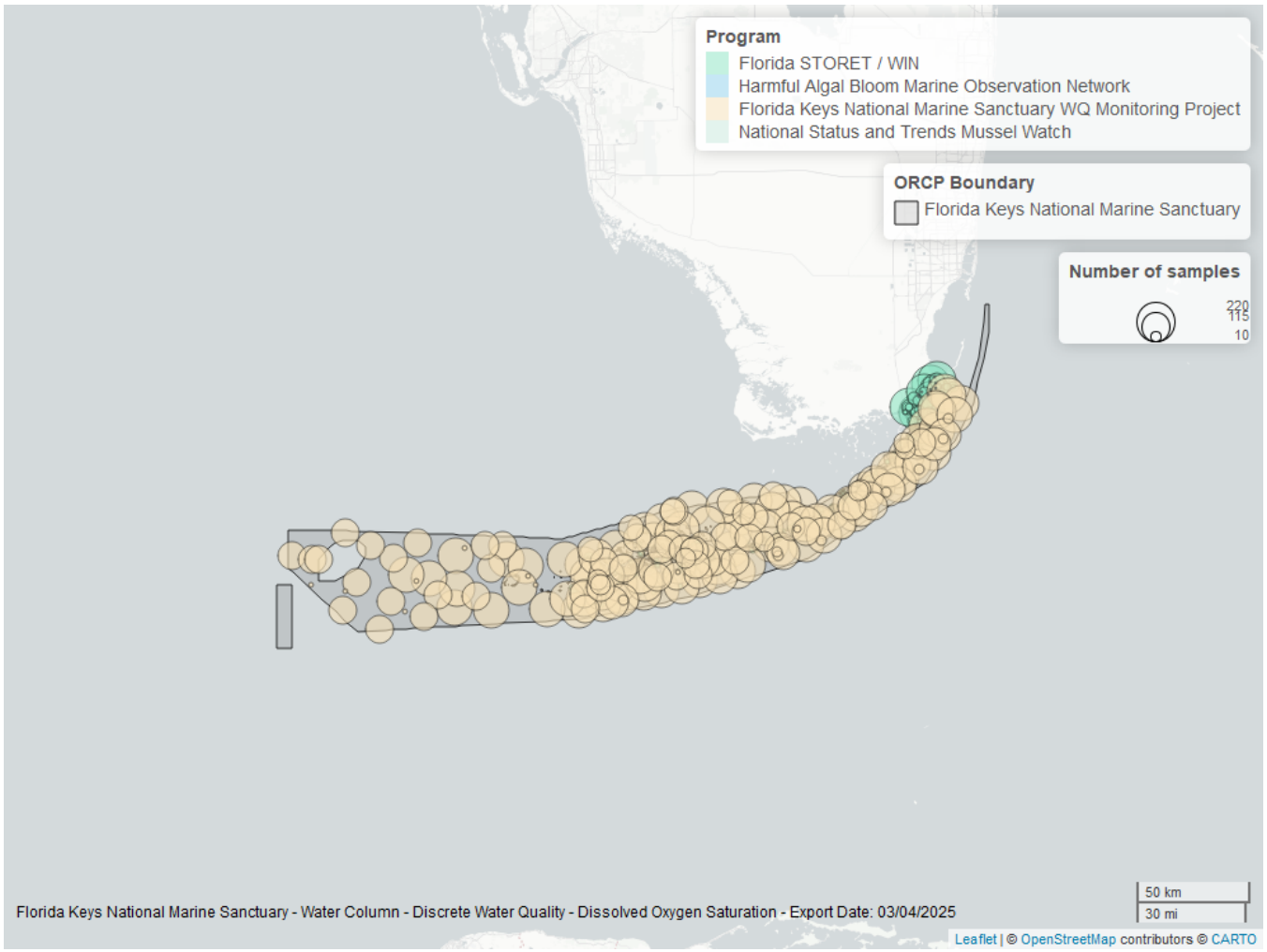

Figure 10: Map showing location of discrete water quality sampling locations within the boundaries of *Florida Keys National Marine Sanctuary*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Table 15: Programs contributing data for Dissolved Oxygen Saturation

ProgramID	*N_Data*	*YearMin*	*YearMax*
297	25419	1995	2020
5002	3907	2009	2024
102	18	1996	1996
95	1	2017	2017

Program names:

95 - Harmful Algal Bloom Marine Observation Network[11]
102 - National Status and Trends Mussel Watch[12]
297 - Florida Keys National Marine Sanctuary Water Quality Monitoring Project[8]
5002 - Florida STORET / WIN[2]

pH - Discrete

Seasonal Kendall-Tau Trend Analysis

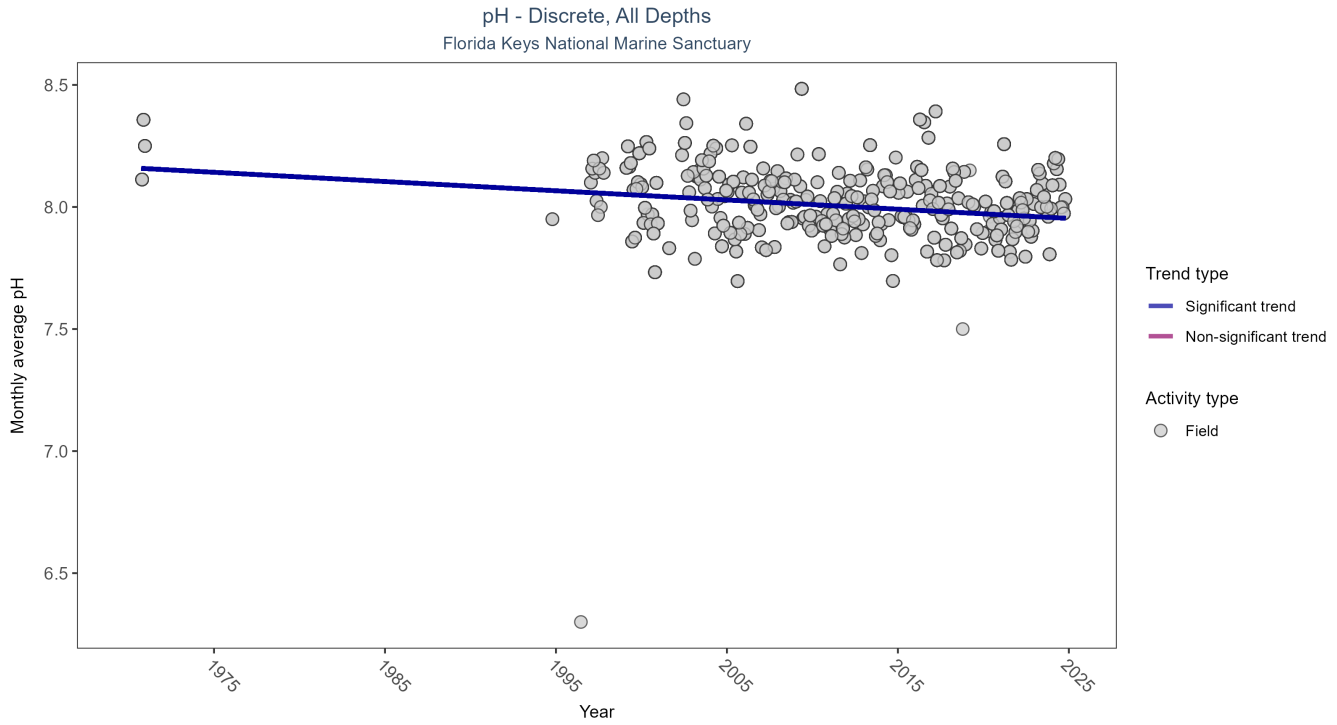

Figure 11: Scatter plot of monthly average pH over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only pH values measured in the field (circles) are included in the plot.

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	Significantly decreasing trend	9785	30	1970 - 2024	8.04	-0.167	8.1609	-0.0038	0

Monthly average pH decreased by less than 0.01 pH units per year.

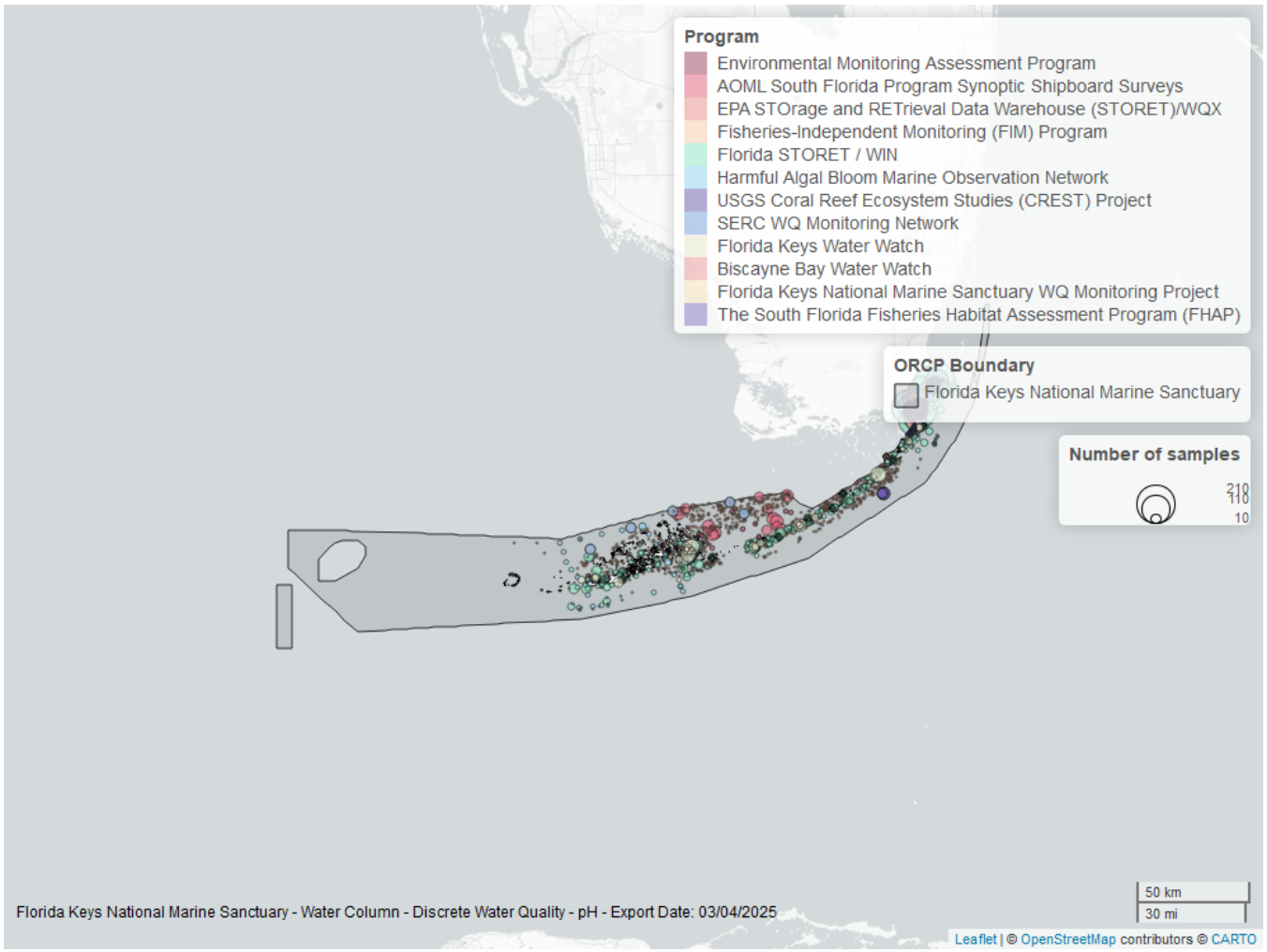

Figure 12: Map showing location of discrete water quality sampling locations within the boundaries of *Florida Keys National Marine Sanctuary*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Table 17: Programs contributing data for pH

ProgramID	*N_Data*	*YearMin*	*YearMax*
5002	5287	2003	2024
69	1733	1997	2022
4049	1103	2005	2023
509	545	2002	2008
3000	377	2015	2018
3	287	2009	2012
95	142	1994	2018
297	114	2003	2011
115	89	2000	2004
899	88	2014	2015
103	86	1970	2021
4057	59	2015	2018

Program names:

3 - Atlantic Oceanographic and Meteorological Laboratory (AOML) South Florida Program Synoptic Shipboard Surveys[3]
69 - Fisheries-Independent Monitoring (FIM) Program[10]
95 - Harmful Algal Bloom Marine Observation Network[11]
103 - EPA STOrage and RETrieval Data Warehouse (STORET)/WQX[5]
115 - Environmental Monitoring Assessment Program[6]
297 - Florida Keys National Marine Sanctuary Water Quality Monitoring Project[8]
509 - SERC Water Quality Monitoring Network[9]
899 - USGS Coral Reef Ecosystem Studies (CREST) Project[13]
3000 - Florida Keys Water Watch[14]
4049 - The South Florida Fisheries Habitat Assessment Program (FHAP)[15]
4057 - Biscayne Bay Water Watch[16]
5002 - Florida STORET / WIN[2]

Salinity - Discrete

Seasonal Kendall-Tau Trend Analysis

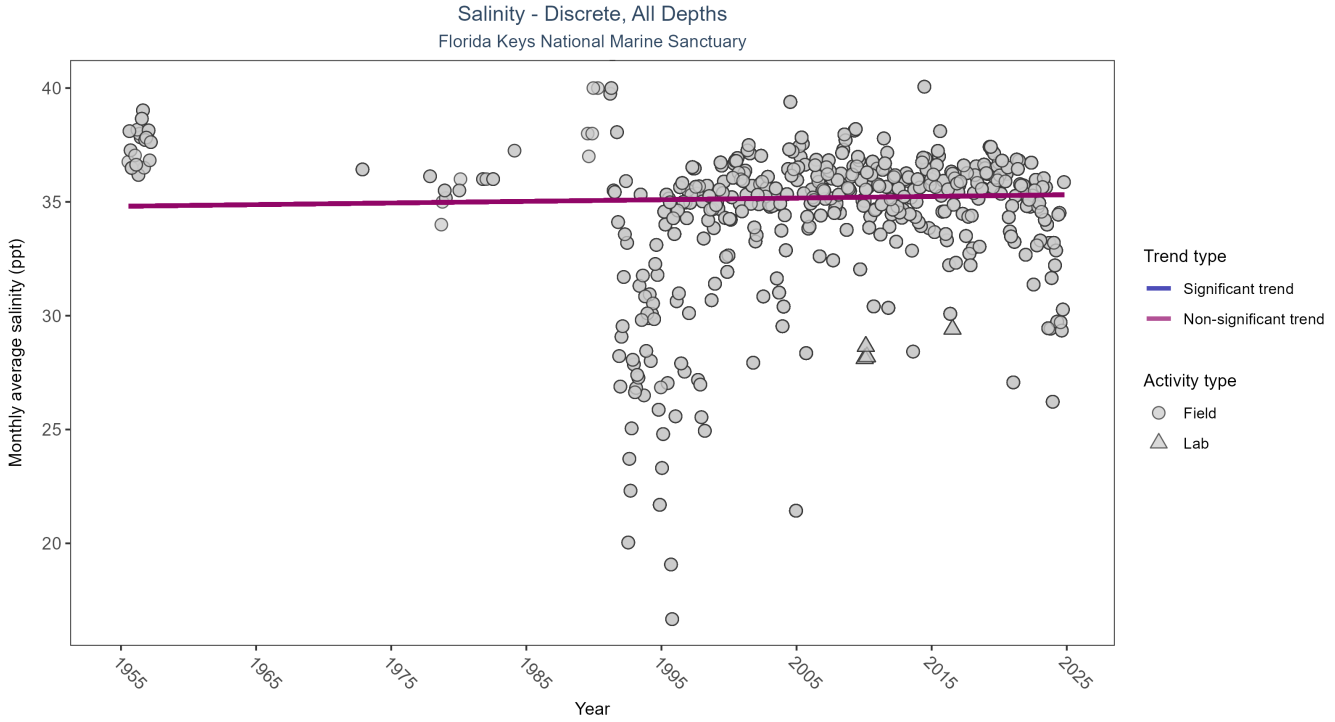

Figure 13: Scatter plot of monthly average salinity over time. If the time series included ten or more years of discrete observations, significant (blue) or non-significant (magenta) trend lines are also shown. Discrete salinity values derived from grab samples analyzed in the field (circles) or the 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	No significant trend	54590	47	1955 - 2024	36.19	0.0275	34.8062	0.0072	0.4344

Salinity showed no detectable trend between 1955 and 2024.

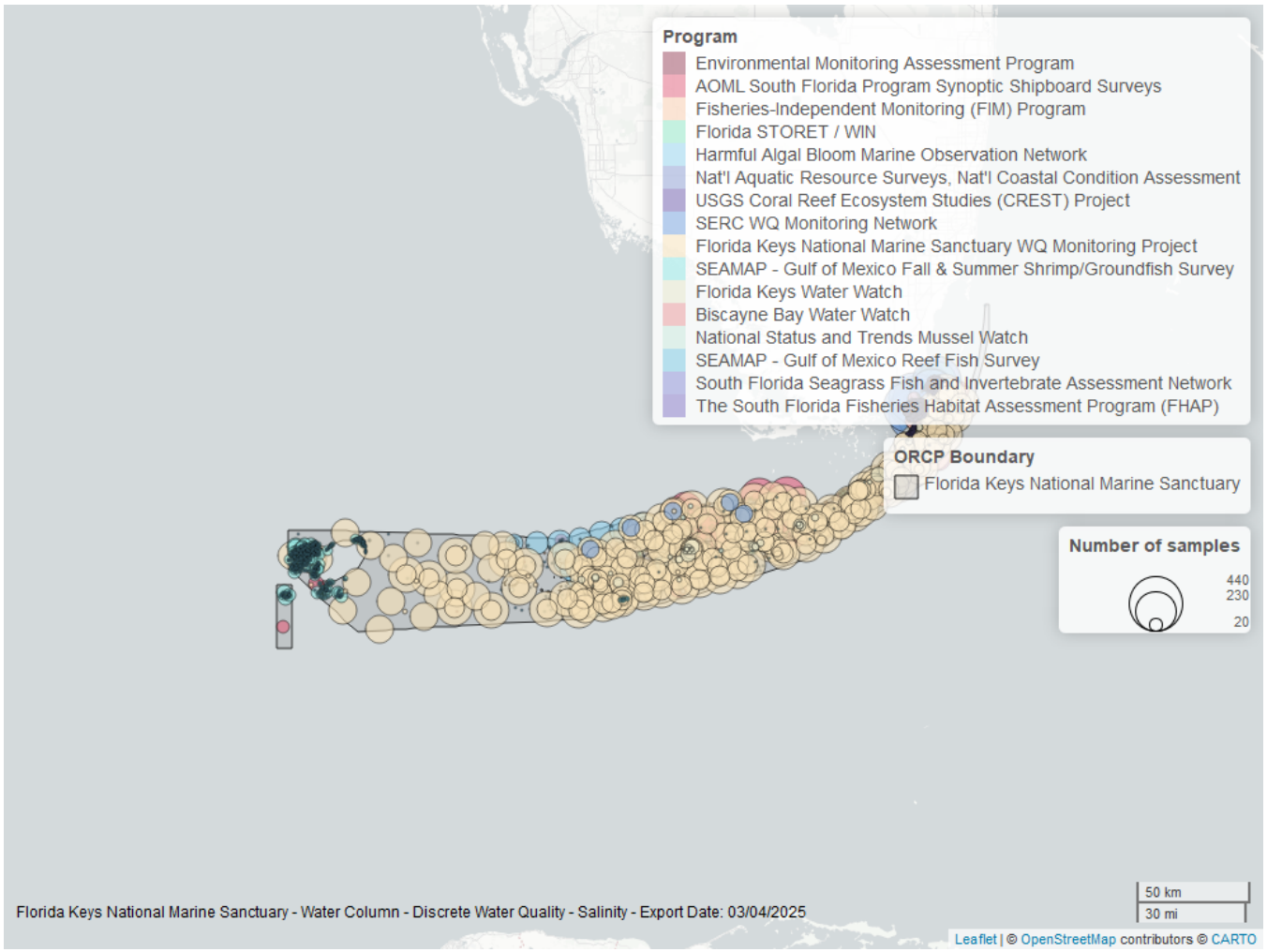

Figure 14: Map showing location of discrete water quality sampling locations within the boundaries of *Florida Keys National Marine Sanctuary*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Table 19: Programs contributing data for Salinity

ProgramID	*N_Data*	*YearMin*	*YearMax*
297	31841	1995	2023
5002	5291	2003	2024
3	4343	1998	2024
509	2581	1989	2008
965	2317	2005	2011
95	1889	1955	2018
69	1741	1997	2022
60	1524	1993	2016
4049	1168	2005	2023
62	1142	1993	2019
3000	379	2015	2018
118	109	2015	2021
115	89	2000	2004
899	82	2014	2015
102	60	1996	2000

ProgramID	*N_Data*	*YearMin*	*YearMax*
4057	59	2015	2018

Program names:

3 - Atlantic Oceanographic and Meteorological Laboratory (AOML) South Florida Program Synoptic Shipboard Surveys[3]
60 - Southeast Area Monitoring and Assessment Program (SEAMAP) - Gulf of Mexico Fall & Summer Shrimp/Groundfish Survey[4]
62 - Southeast Area Monitoring and Assessment Program (SEAMAP) - Gulf of Mexico Reef Fish Survey[17]
69 - Fisheries-Independent Monitoring (FIM) Program[10]
95 - Harmful Algal Bloom Marine Observation Network[11]
102 - National Status and Trends Mussel Watch[12]
115 - Environmental Monitoring Assessment Program[6]
118 - National Aquatic Resource Surveys, National Coastal Condition Assessment[7]
297 - Florida Keys National Marine Sanctuary Water Quality Monitoring Project[8]
509 - SERC Water Quality Monitoring Network[9]
899 - USGS Coral Reef Ecosystem Studies (CREST) Project[13]
965 - South Florida Seagrass Fish and Invertebrate Assessment Network[18]
3000 - Florida Keys Water Watch[14]
4049 - The South Florida Fisheries Habitat Assessment Program (FHAP)[15]
4057 - Biscayne Bay Water Watch[16]
5002 - Florida STORET / WIN[2]

Secchi Depth - Discrete

Seasonal Kendall-Tau Trend Analysis

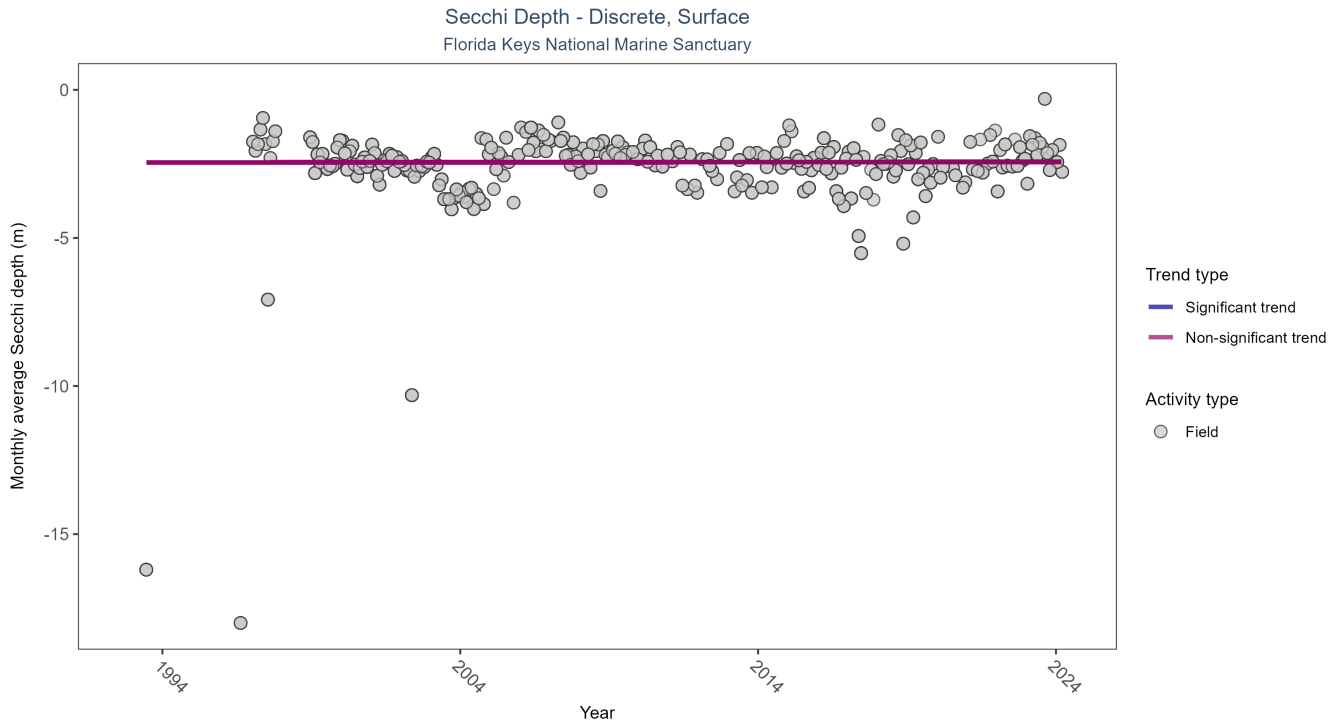

Figure 15: Scatter plot of monthly average Secchi depth over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Secchi depth is only measured in the field (circles).

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	5051	30	1993 - 2024	-2.1336	0.0036	-2.4543	0.0007	0.8805

Secchi depth showed no detectable trend between 1993 and 2024.

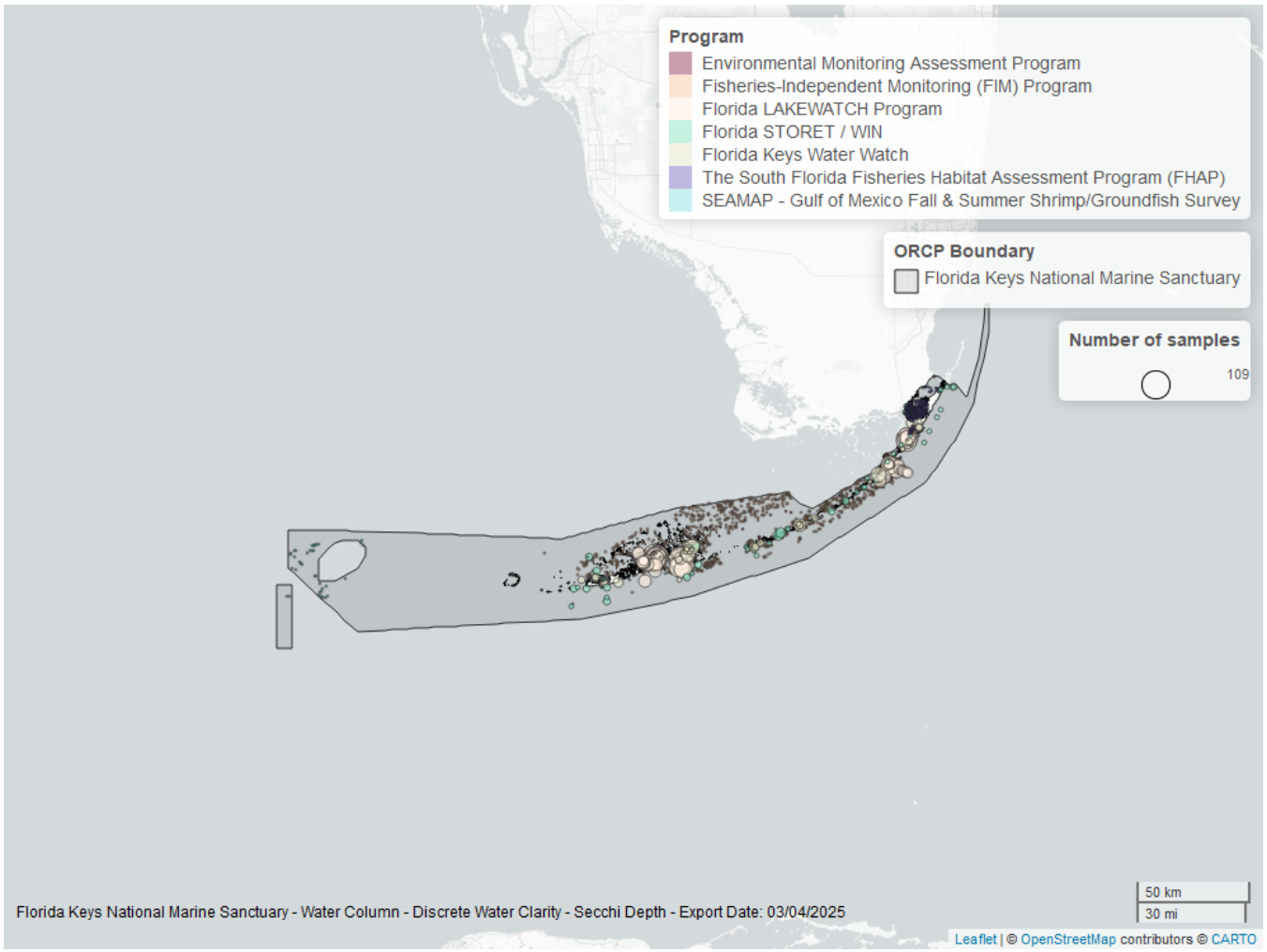

Figure 16: Map showing location of discrete water quality sampling locations within the boundaries of *Florida Keys National Marine Sanctuary*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Table 21: Programs contributing data for Secchi Depth

ProgramID	*N_Data*	*YearMin*	*YearMax*
514	2500	1998	2024
69	1750	1997	2022
3000	373	2015	2018
5002	352	2005	2022
4049	252	2005	2023
60	37	1993	2002
115	21	2000	2004

Program names:

60 - Southeast Area Monitoring and Assessment Program (SEAMAP) - Gulf of Mexico Fall & Summer Shrimp/Groundfish Survey[4]
69 - Fisheries-Independent Monitoring (FIM) Program[10]
115 - Environmental Monitoring Assessment Program[6]
514 - Florida LAKEWATCH Program[1]

3000 - Florida Keys Water Watch[14]
4049 - The South Florida Fisheries Habitat Assessment Program (FHAP)[15]
5002 - Florida STORET / WIN[2]

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 + NO3O2;
2) TN = TKN + NO3 + NO2;
3) TN = ORGN + NH4 + NO3O2;
4) TN = ORGN + NH4 + NO2 + NO3;
5) TN = TKN + NO3;
6) TN = ORGN + NH4 + NO3;

Additional Information:

- Rules for use of sample fraction:
  - Florida Department of Environmental Protection (FDEP) report that if both "Total" and "Dissolved" components are reported, only "Total" is used. If the total is not reported, then the dissolved components are used as a best available replacement.
  - Total nitrogen calculations are done using nitrogen components with the same sample fraction, nitrogen components with mixed total/dissolved sample fractions are not used. In other words, total nitrogen can be calculated when TKN and NO3O2 are both total sample fractions, or when both are dissolved sample fractions. *Future calculations of total nitrogen values may be based on components with mixed sample fractions.*
- Values inserted into data:
  - ParameterName = "Total Nitrogen"
  - SEACAR_QAQCFlagCode = "1Q"
  - SEACAR_QAQC_Description = "SEACAR Calculated"

Seasonal Kendall-Tau Trend Analysis

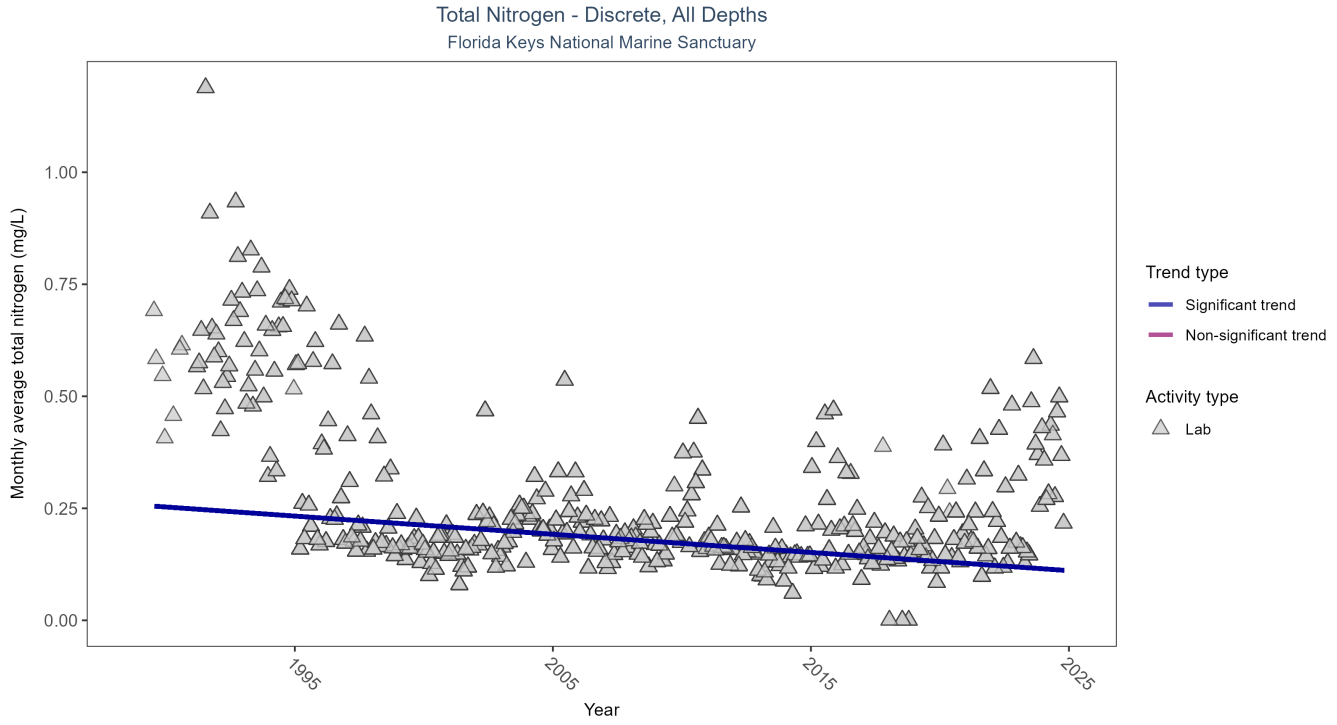

Figure 17: Scatter plot of monthly average total nitrogen over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only nitrogen values obtained from laboratory analyses (triangles) are included in the 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 decreasing trend	34570	36	1989 - 2024	0.146	-0.2631	0.257	-0.0041	0

Monthly average total nitrogen decreased by less than 0.01 mg/L per year.

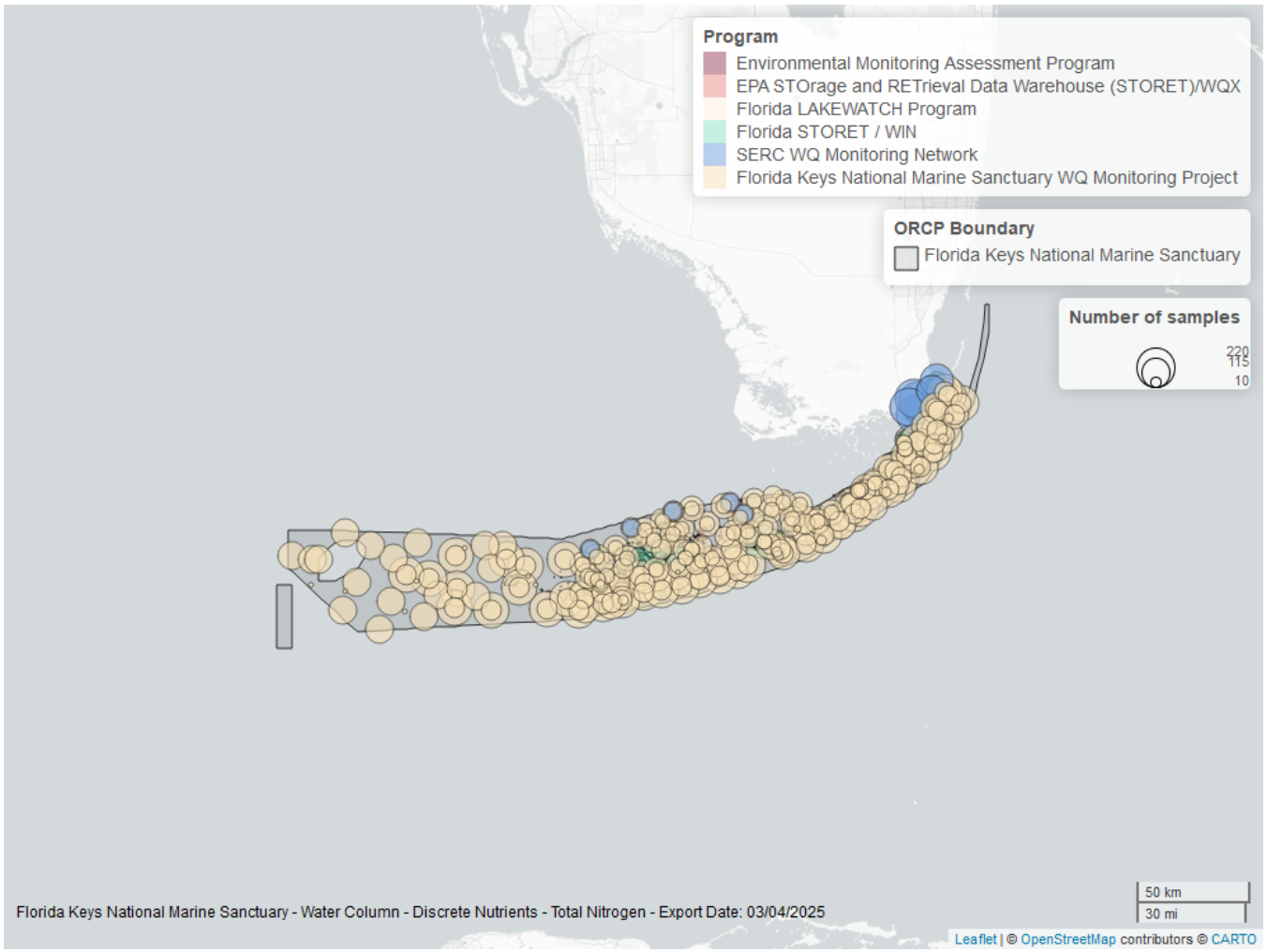

Figure 18: Map showing location of discrete water quality sampling locations within the boundaries of *Florida Keys National Marine Sanctuary*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Table 23: Programs contributing data for Total Nitrogen

ProgramID	*N_Data*	*YearMin*	*YearMax*
297	26153	1995	2023
5002	4797	1998	2024
514	2907	1998	2024
509	1424	1989	2008
103	149	2000	2006
115	28	2000	2004

Program names:

103 - EPA STOrage and RETrieval Data Warehouse (STORET)/WQX[5]
115 - Environmental Monitoring Assessment Program[6]
297 - Florida Keys National Marine Sanctuary Water Quality Monitoring Project[8]
509 - SERC Water Quality Monitoring Network[9]
514 - Florida LAKEWATCH Program[1]
5002 - Florida STORET / WIN[2]

Total Phosphorus - Discrete

Seasonal Kendall-Tau Trend Analysis

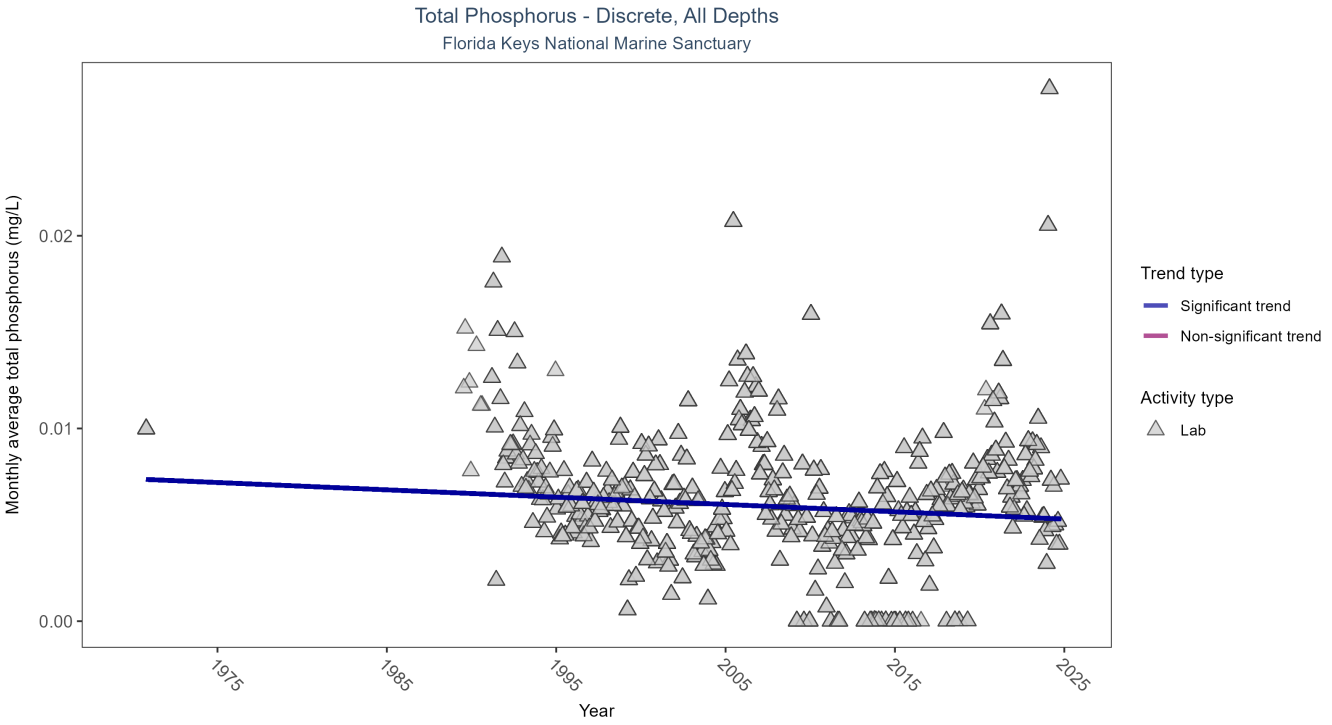

Figure 19: Scatter plot of monthly average total phosphorus over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only phosphorus values obtained from laboratory analyses (triangles) are included 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 decreasing trend	32282	37	1970 - 2024	0.0059	-0.0865	0.0074	0	0.0125

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

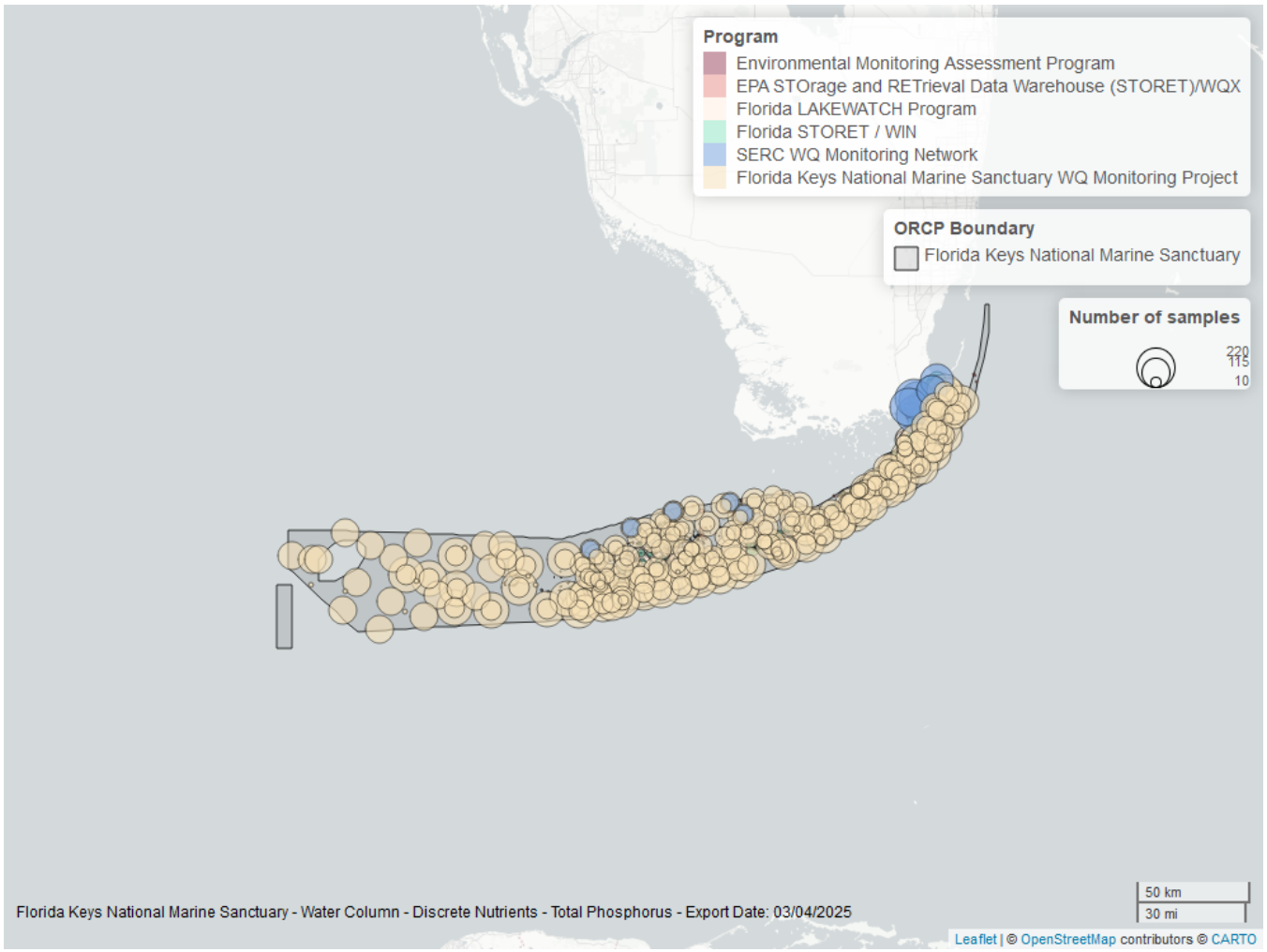

Figure 20: Map showing location of discrete water quality sampling locations within the boundaries of *Florida Keys National Marine Sanctuary*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Table 25: Programs contributing data for Total Phosphorus

ProgramID	*N_Data*	*YearMin*	*YearMax*
297	26170	1995	2023
514	2914	1998	2024
5002	2121	2005	2024
509	1425	1989	2008
103	182	1970	2021
115	28	2000	2004

Program names:

103 - EPA STOrage and RETrieval Data Warehouse (STORET)/WQX[5]
115 - Environmental Monitoring Assessment Program[6]
297 - Florida Keys National Marine Sanctuary Water Quality Monitoring Project[8]
509 - SERC Water Quality Monitoring Network[9]
514 - Florida LAKEWATCH Program[1]
5002 - Florida STORET / WIN[2]

Total Suspended Solids - Discrete

Seasonal Kendall-Tau Trend Analysis

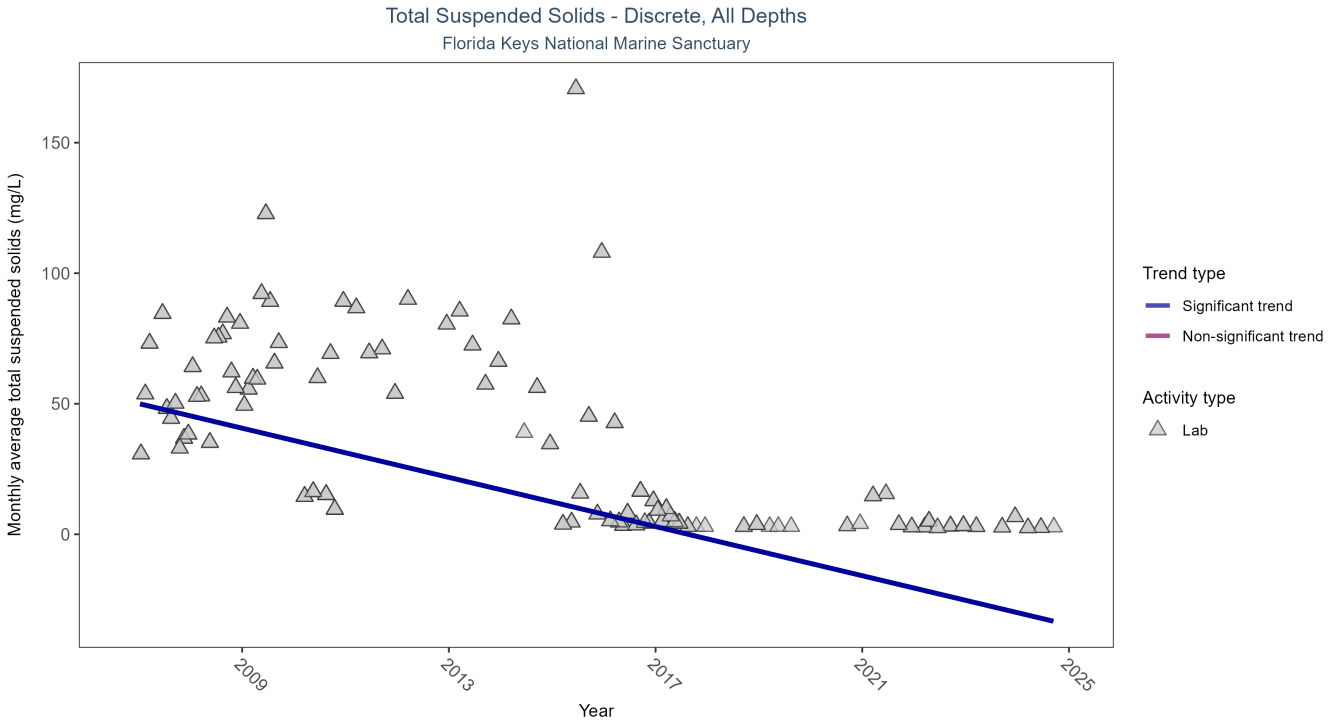

Figure 21: Scatter plot of monthly average total suspended solids (TSS) over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only TSS values obtained from laboratory analyses (triangles) are included 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	536	18	2007 - 2024	12	-0.5976	50.053	-4.7089	0

Monthly average total suspended solids decreased by 4.71 mg/L per year, indicating an increase in water clarity.

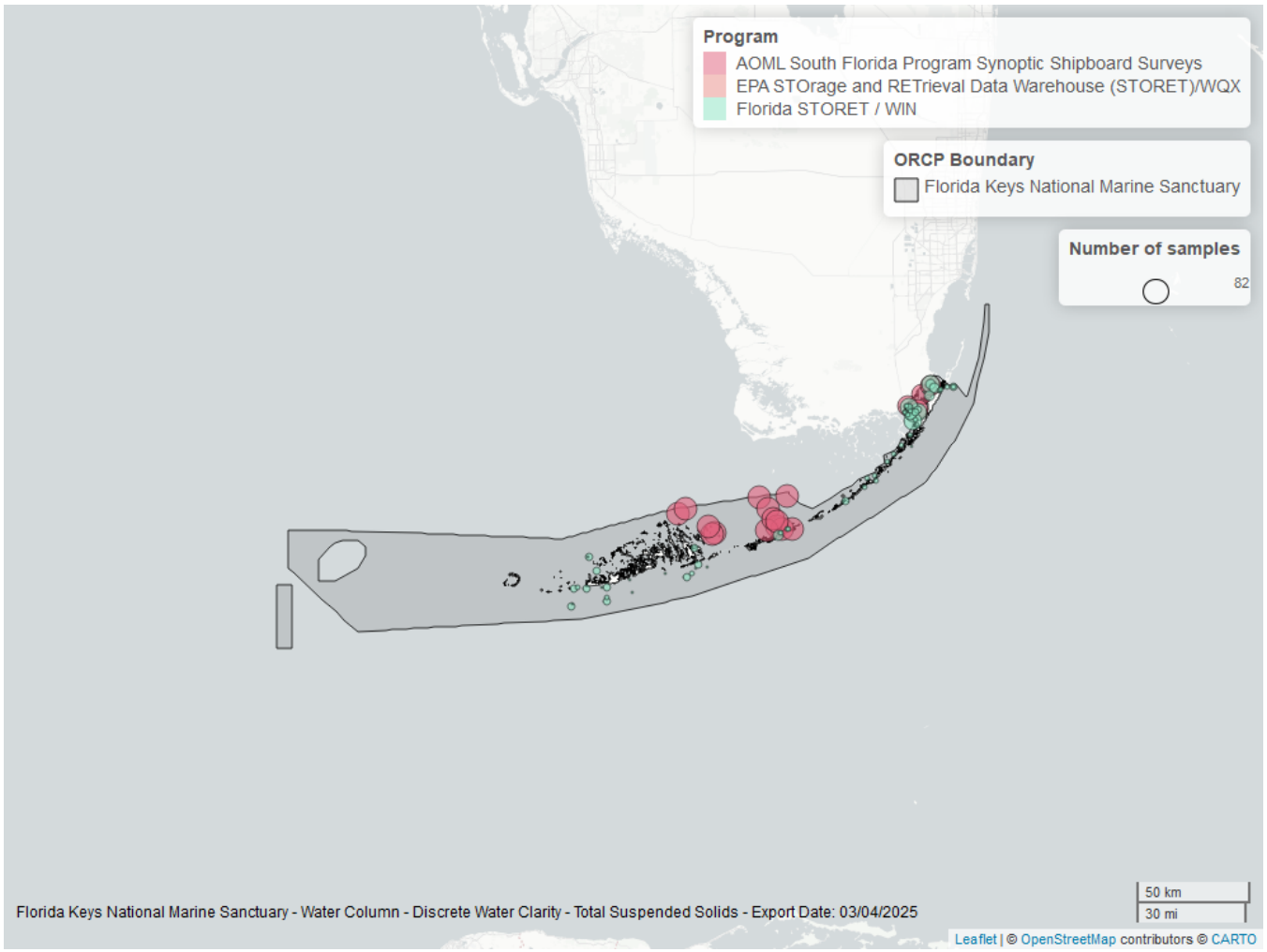

Figure 22: Map showing location of discrete water quality sampling locations within the boundaries of *Florida Keys National Marine Sanctuary*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Table 27: Programs contributing data for Total Suspended Solids

ProgramID	*N_Data*	*YearMin*	*YearMax*
3	1391	2001	2012
5002	548	2007	2024
103	1	2020	2020

Program names:

3 - Atlantic Oceanographic and Meteorological Laboratory (AOML) South Florida Program Synoptic Shipboard Surveys[3]
103 - EPA STOrage and RETrieval Data Warehouse (STORET)/WQX[5]
5002 - Florida STORET / WIN[2]

Turbidity - Discrete

Seasonal Kendall-Tau Trend Analysis

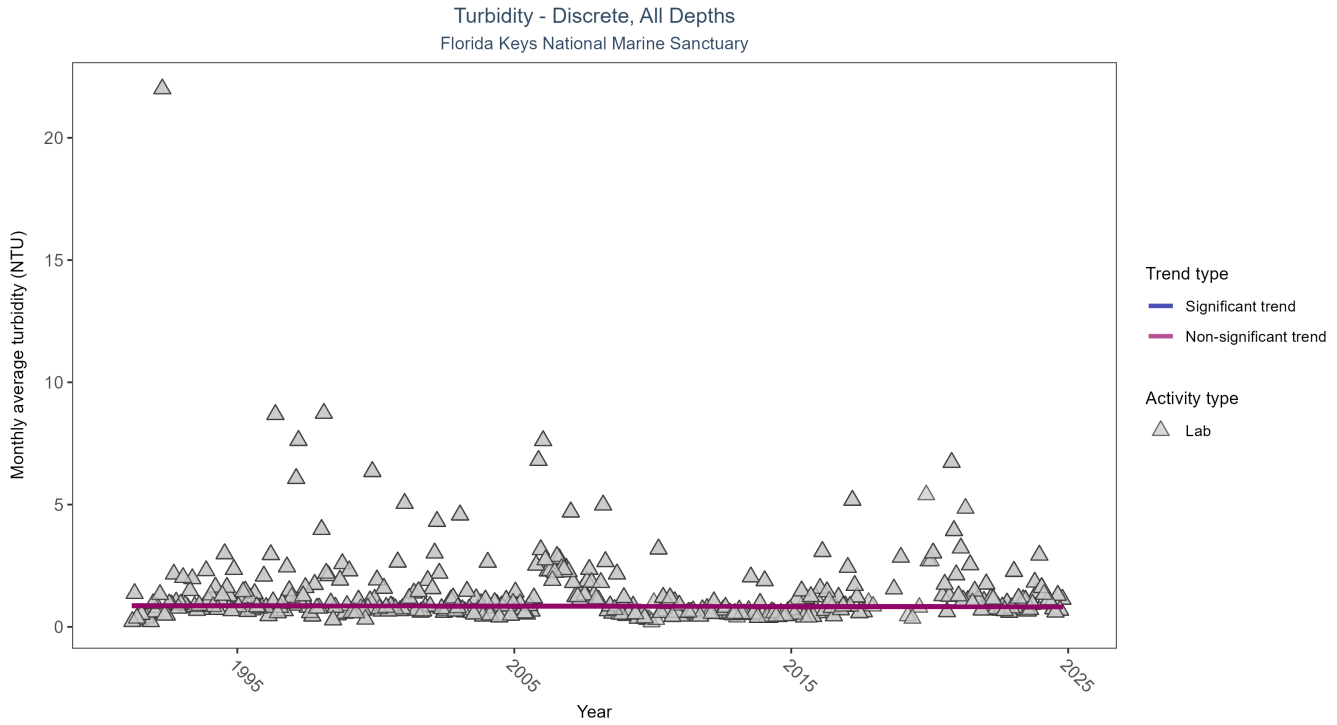

Figure 23: Scatter plot of monthly average turbidity over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only turbidity values measured in the laboratory (triangles) are included in the plot.

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	No significant trend	3529	34	1991 - 2024	0.705	-0.0203	0.8692	-0.0015	0.5837

Turbidity showed no detectable trend between 1991 and 2024.

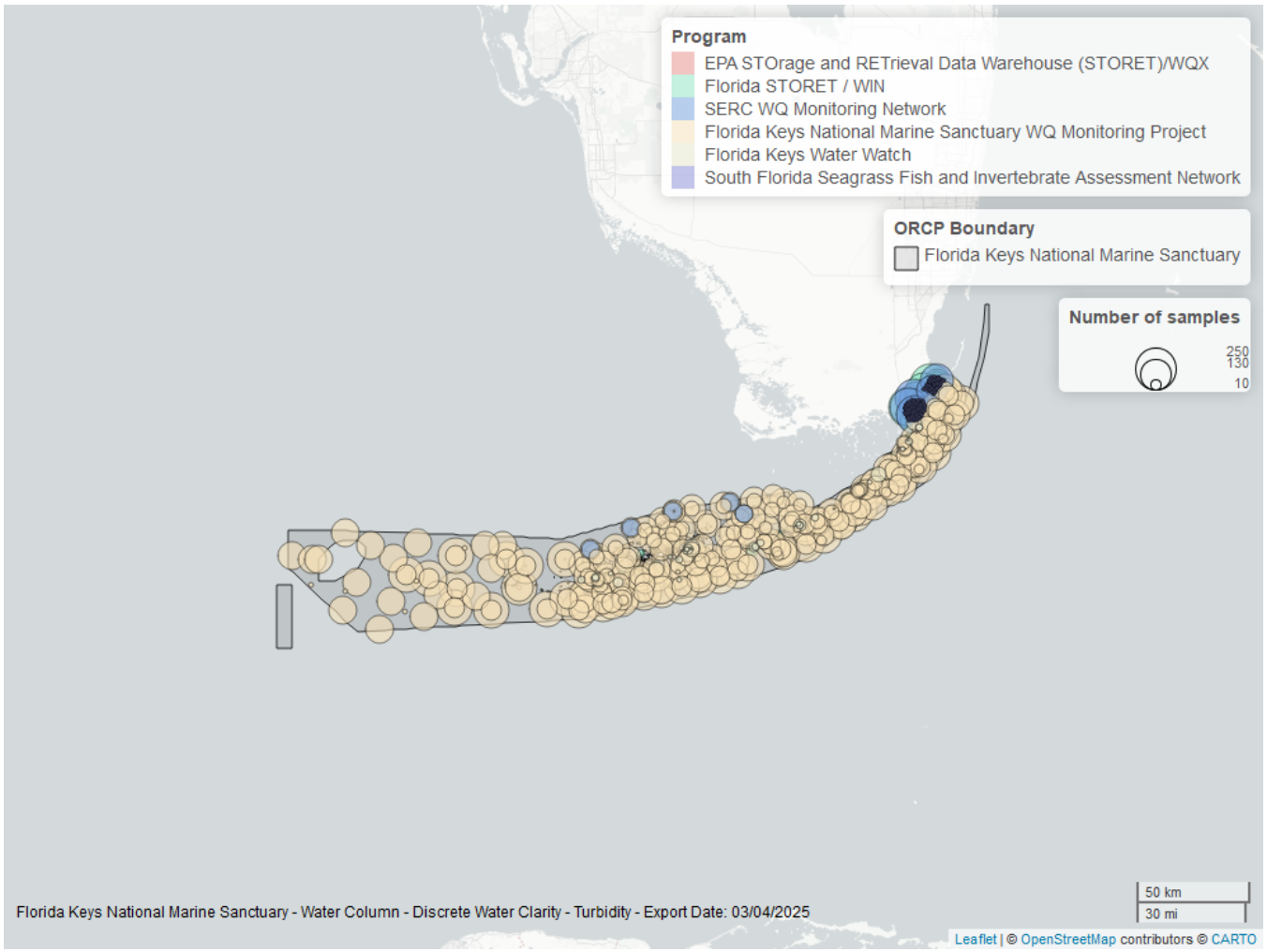

Figure 24: Map showing location of discrete water quality sampling locations within the boundaries of *Florida Keys National Marine Sanctuary*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Table 29: Programs contributing data for Turbidity

ProgramID	*N_Data*	*YearMin*	*YearMax*
297	26741	1995	2023
5002	2144	1994	2024
509	1404	1991	2008
965	1157	2005	2011
3000	370	2015	2018
103	117	2005	2021

Program names:

103 - EPA STOrage and RETrieval Data Warehouse (STORET)/WQX[5]
297 - Florida Keys National Marine Sanctuary Water Quality Monitoring Project[8]
509 - SERC Water Quality Monitoring Network[9]
965 - South Florida Seagrass Fish and Invertebrate Assessment Network[18]
3000 - Florida Keys Water Watch[14]
5002 - Florida STORET / WIN[2]

Water Temperature - Discrete

Seasonal Kendall-Tau Trend Analysis

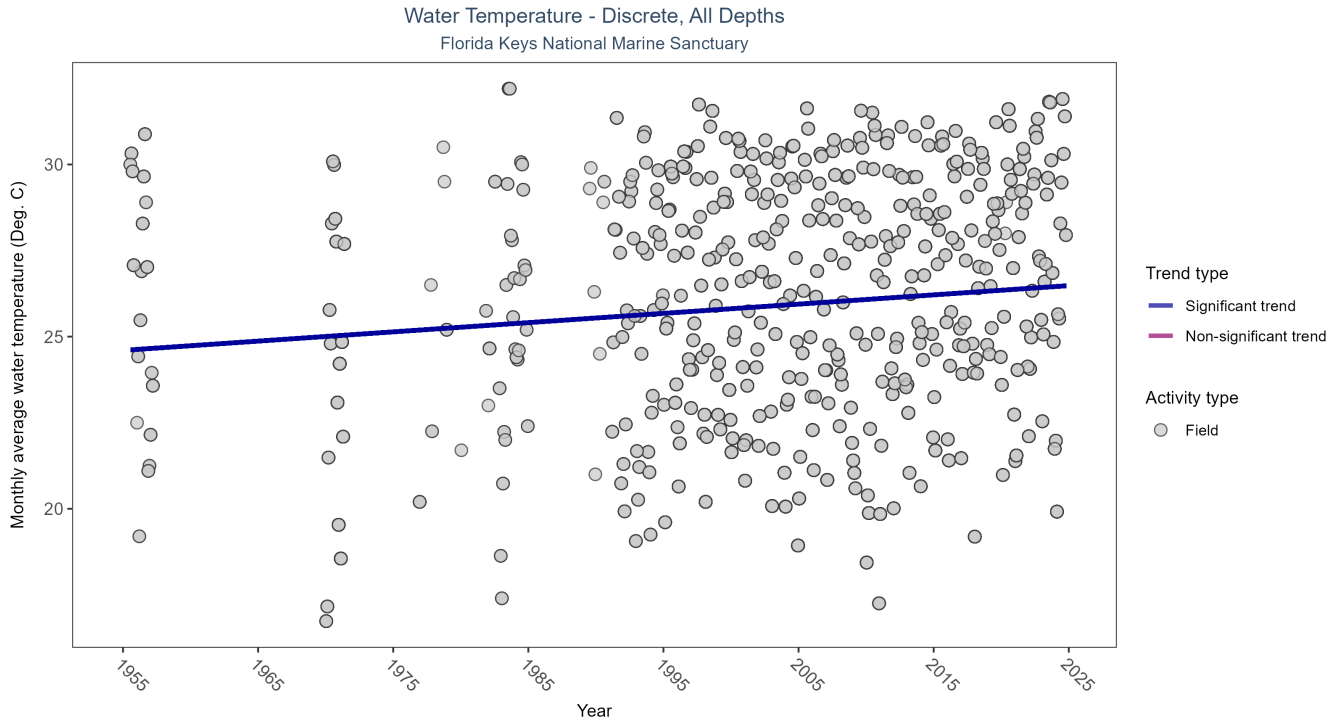

Figure 25: Scatter plot of monthly average water temperature over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only water temperature measurements taken in the field (circles) are included in 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	53391	49	1955 - 2024	27.1769	0.2247	24.6007	0.0269	0

Monthly average water temperature increased by 0.03°C per year.

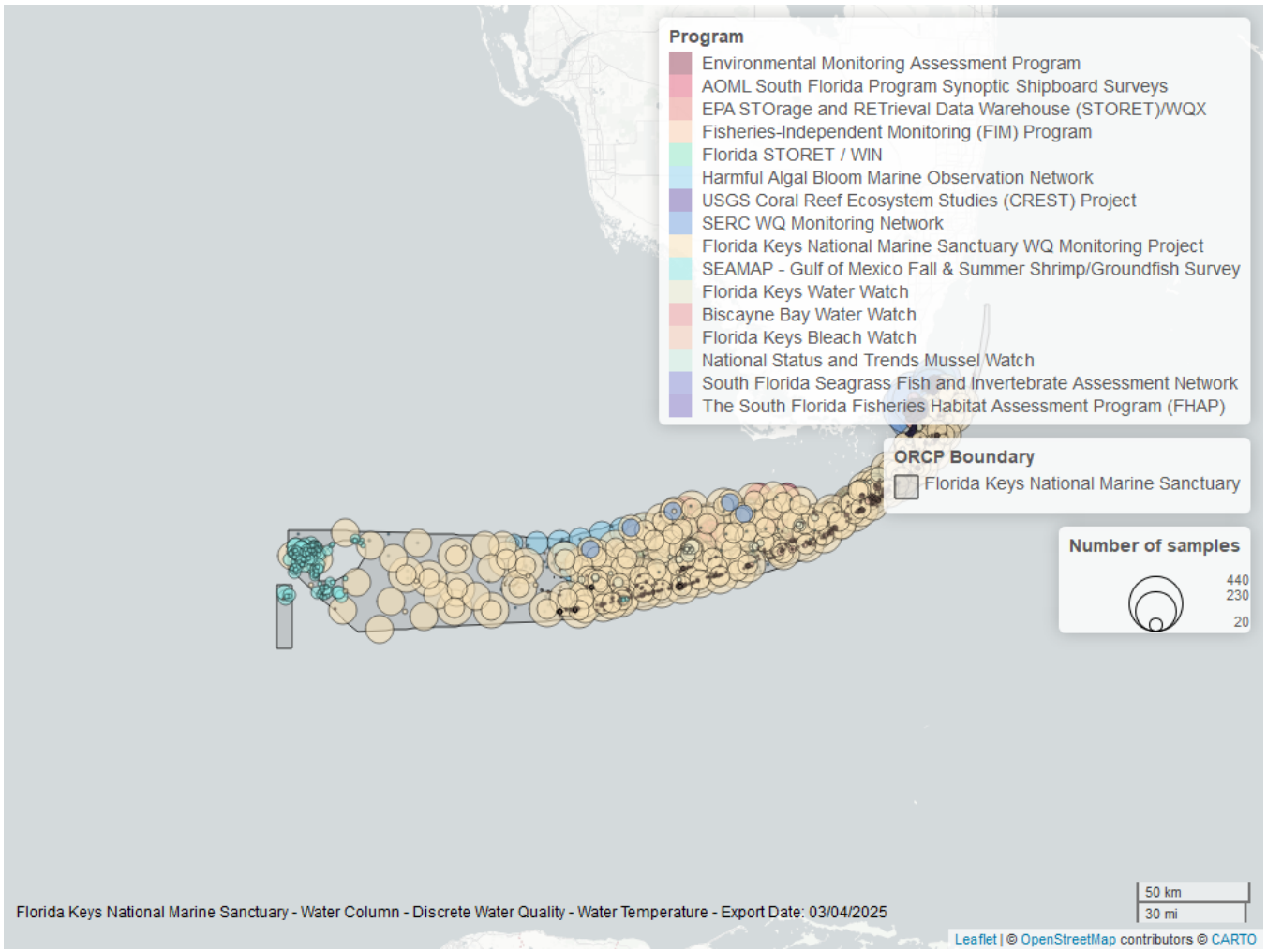

Figure 26: Map showing location of discrete water quality sampling locations within the boundaries of *Florida Keys National Marine Sanctuary*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Table 31: Programs contributing data for Water Temperature

ProgramID	*N_Data*	*YearMin*	*YearMax*
297	31793	1995	2023
5002	5723	2003	2024
509	2601	1989	2008
965	2317	2005	2011
95	1957	1955	2018
3	1853	1998	2012
69	1776	1997	2022
60	1582	1993	2016
4049	1168	2005	2023
982	1129	2014	2023
103	875	1970	2021
3000	374	2015	2018
115	89	2000	2004
899	85	2014	2015
4057	59	2015	2018

ProgramID	*N_Data*	*YearMin*	*YearMax*
102	43	1996	2000

Program names:

3 - Atlantic Oceanographic and Meteorological Laboratory (AOML) South Florida Program Synoptic Shipboard Surveys[3]
60 - Southeast Area Monitoring and Assessment Program (SEAMAP) - Gulf of Mexico Fall & Summer Shrimp/Groundfish Survey[4]
69 - Fisheries-Independent Monitoring (FIM) Program[10]
95 - Harmful Algal Bloom Marine Observation Network[11]
102 - National Status and Trends Mussel Watch[12]
103 - EPA STOrage and RETrieval Data Warehouse (STORET)/WQX[5]
115 - Environmental Monitoring Assessment Program[6]
297 - Florida Keys National Marine Sanctuary Water Quality Monitoring Project[8]
509 - SERC Water Quality Monitoring Network[9]
899 - USGS Coral Reef Ecosystem Studies (CREST) Project[13]
965 - South Florida Seagrass Fish and Invertebrate Assessment Network[18]
982 - Florida Keys Bleach Watch[19]
3000 - Florida Keys Water Watch[14]
4049 - The South Florida Fisheries Habitat Assessment Program (FHAP)[15]
4057 - Biscayne Bay Water Watch[16]
5002 - Florida STORET / WIN[2]

Water Quality - Continuous

The following files were used in the continuous analysis:

- *Combined_WQ_WC_NUT_cont_Dissolved_Oxygen_SE-2025-Mar-06.txt*
- *Combined_WQ_WC_NUT_cont_Dissolved_Oxygen_Saturation_SE-2025-Mar-06.txt*
- *Combined_WQ_WC_NUT_cont_pH_SE-2025-Mar-06.txt*
- *Combined_WQ_WC_NUT_cont_Salinity_SE-2025-Mar-06.txt*
- *Combined_WQ_WC_NUT_cont_Turbidity_SE-2025-Mar-06.txt*
- *Combined_WQ_WC_NUT_cont_Water_Temperature_SE-2025-Mar-06.txt*

Continuous monitoring locations in Florida Keys National Marine Sanctuary

Table 32: Station overview for Continuous parameters by Program

ProgramID	*ProgramLocationID*	*Years of Data*	*Use in Analysis*	*Parameters*
2	1B	6	TRUE	Sal , TempW
5	KYWF1	20	TRUE	TempW
5	LONF1	28	TRUE	TempW
5	MLRF1	33	TRUE	TempW
5	SANF1	15	TRUE	TempW
5	SMKF1	21	TRUE	TempW
7	245323080410100	3	FALSE	Sal , TempW
7	245622080364200	3	FALSE	Sal , TempW
296	214	18	TRUE	TempW
296	215	16	TRUE	TempW
296	216	17	TRUE	TempW
296	220	17	TRUE	TempW
296	223	18	TRUE	TempW
296	225	18	TRUE	TempW
296	227	17	TRUE	TempW
296	235	18	TRUE	TempW
296	237	18	TRUE	TempW
296	239	17	TRUE	TempW
296	241	18	TRUE	TempW
296	243	18	TRUE	TempW
296	248	18	TRUE	TempW
296	255	18	TRUE	TempW
296	260	18	TRUE	TempW
296	267	18	TRUE	TempW
296	269	18	TRUE	TempW
296	271	18	TRUE	TempW
296	273	18	TRUE	TempW
296	276	18	TRUE	TempW
296	284	18	TRUE	TempW
296	285	18	TRUE	TempW
296	287	18	TRUE	TempW
296	291	18	TRUE	TempW
296	294	18	TRUE	TempW
296	296	18	TRUE	TempW
296	305	18	TRUE	TempW
296	307	18	TRUE	TempW
296	309	18	TRUE	TempW
296	314	18	TRUE	TempW
296	500	8	TRUE	TempW
296	501	7	TRUE	TempW
296	502	4	FALSE	TempW
296	503	1	FALSE	TempW
296	504	1	FALSE	TempW
296	506	8	TRUE	TempW
296	507	8	TRUE	TempW
296	508	8	TRUE	TempW
296	509	8	TRUE	TempW
296	SB	19	TRUE	TempW
899	Crocker	10	TRUE	TempW
899	Molasses	5	TRUE	TempW
899	Sombrero	14	TRUE	TempW
986	10	3	FALSE	TempW
986	11	20	TRUE	TempW
986	12	15	TRUE	TempW
986	14	21	TRUE	TempW
986	15	17	TRUE	TempW
986	18	7	TRUE	TempW
986	21	7	TRUE	TempW
986	22	14	TRUE	TempW
986	23	11	TRUE	TempW

Program names:

2 - Atlantic Oceanographic and Meteorological Laboratory (AOML) South Florida Program Moored Instrument Array[20]
5 - National Data Buoy Center[21]
7 - National Water Information System[22]
296 - Florida Keys National Marine Sanctuary Seagrass Monitoring Project[23]
899 - USGS Coral Reef Ecosystem Studies (CREST) Project[13]
986 - Water Temperature on Coral Reefs in the Florida Keys[24]
989 - Continuous Bottom Temperature Measurements along the Florida Reef Tract[25]
10004 - Florida Keys Aquatic Preserves Continuous Water Quality Monitoring[26]

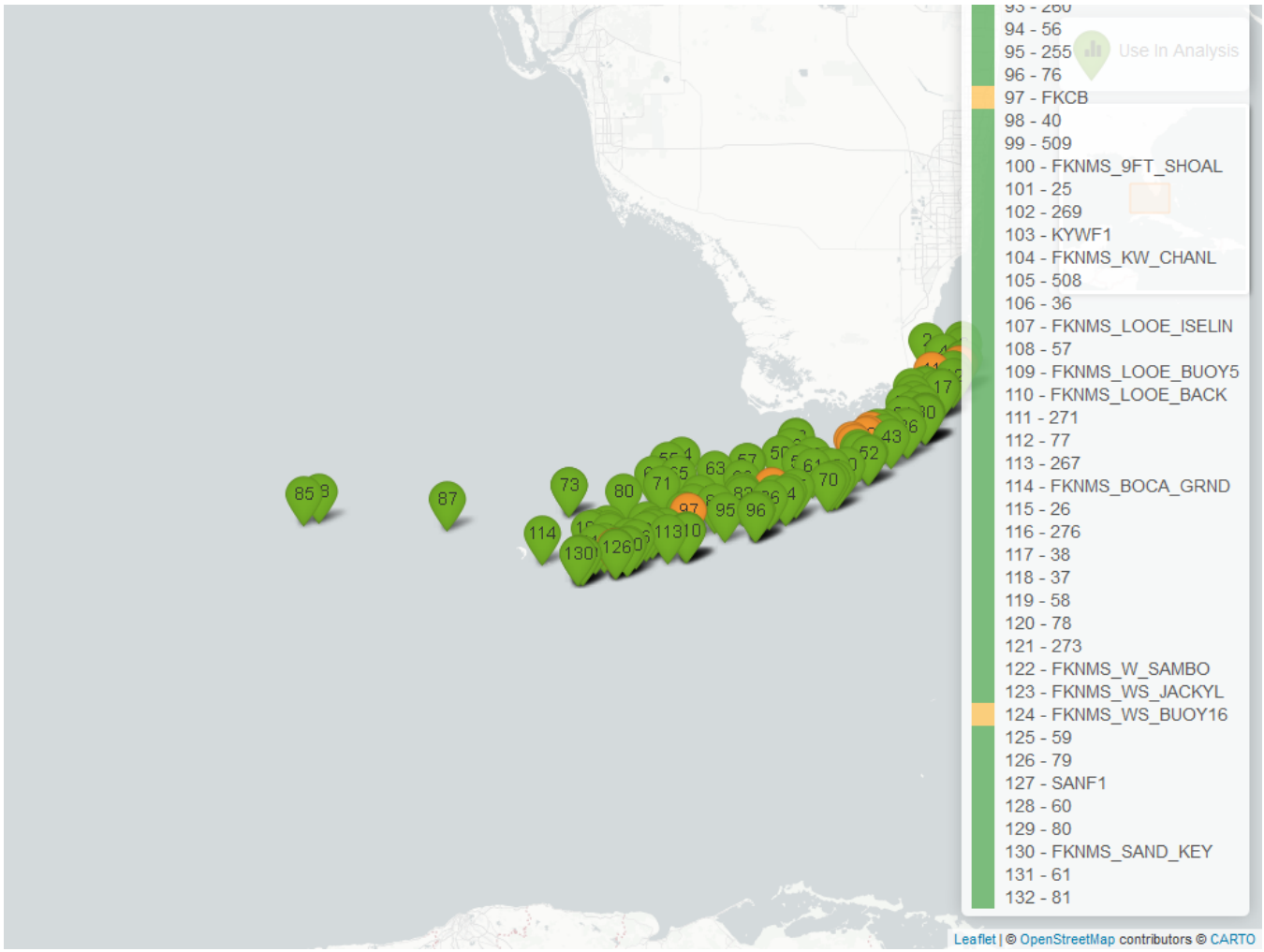

Figure 27: Map showing continuous water quality sampling locations within the boundaries of *Florida Keys National Marine Sanctuary*. Sites marked as *Use In Analysis* (green) are featured in this report.

Dissolved Oxygen - Continuous

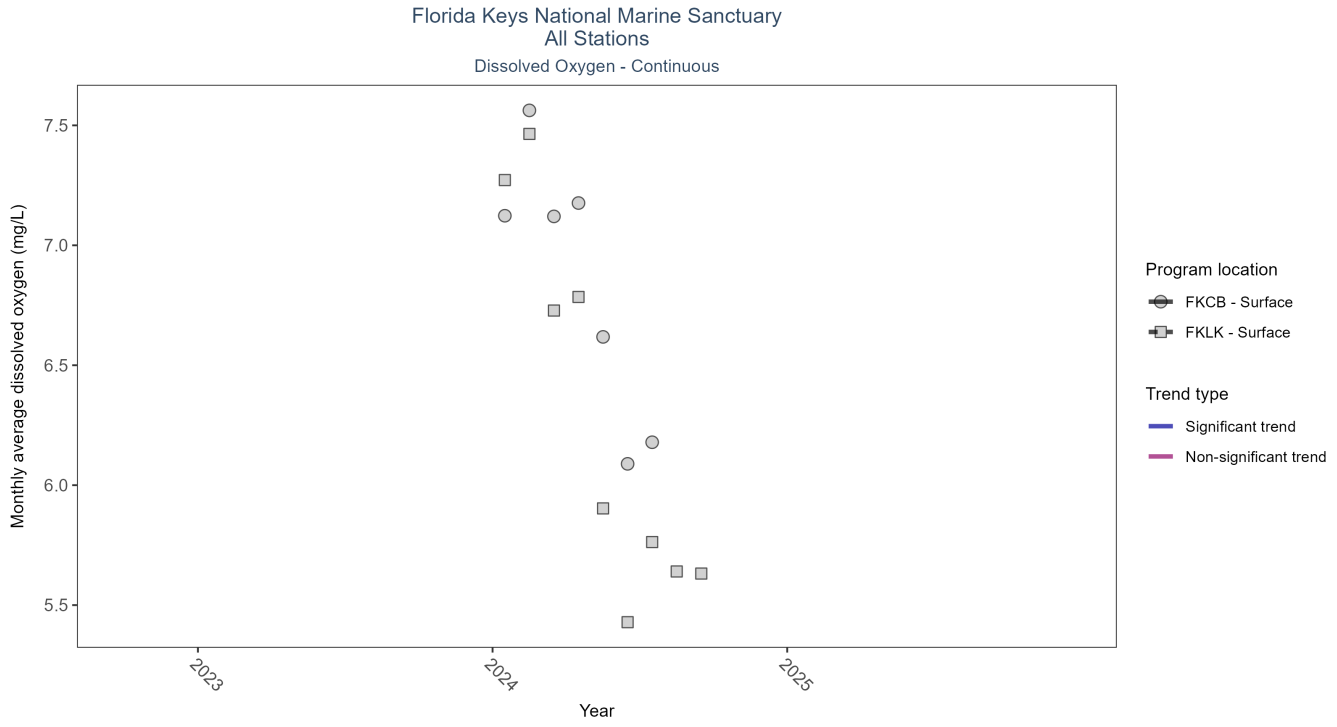

Figure 28: Scatter plot of monthly average dissolved oxygen over time at continuously monitored program locations. Each location is analyzed separately, with significant (blue) or non-significant (magenta) trend lines shown for time series that included five or more years of observations.

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
FKLK	Insufficient data to calculate trend	21525	1	2024 - 2024	6.2	-	-	-	-
FKCB	Insufficient data to calculate trend	16262	1	2024 - 2024	6.8	-	-	-	-

There was insufficient data to fit a model for two locations.

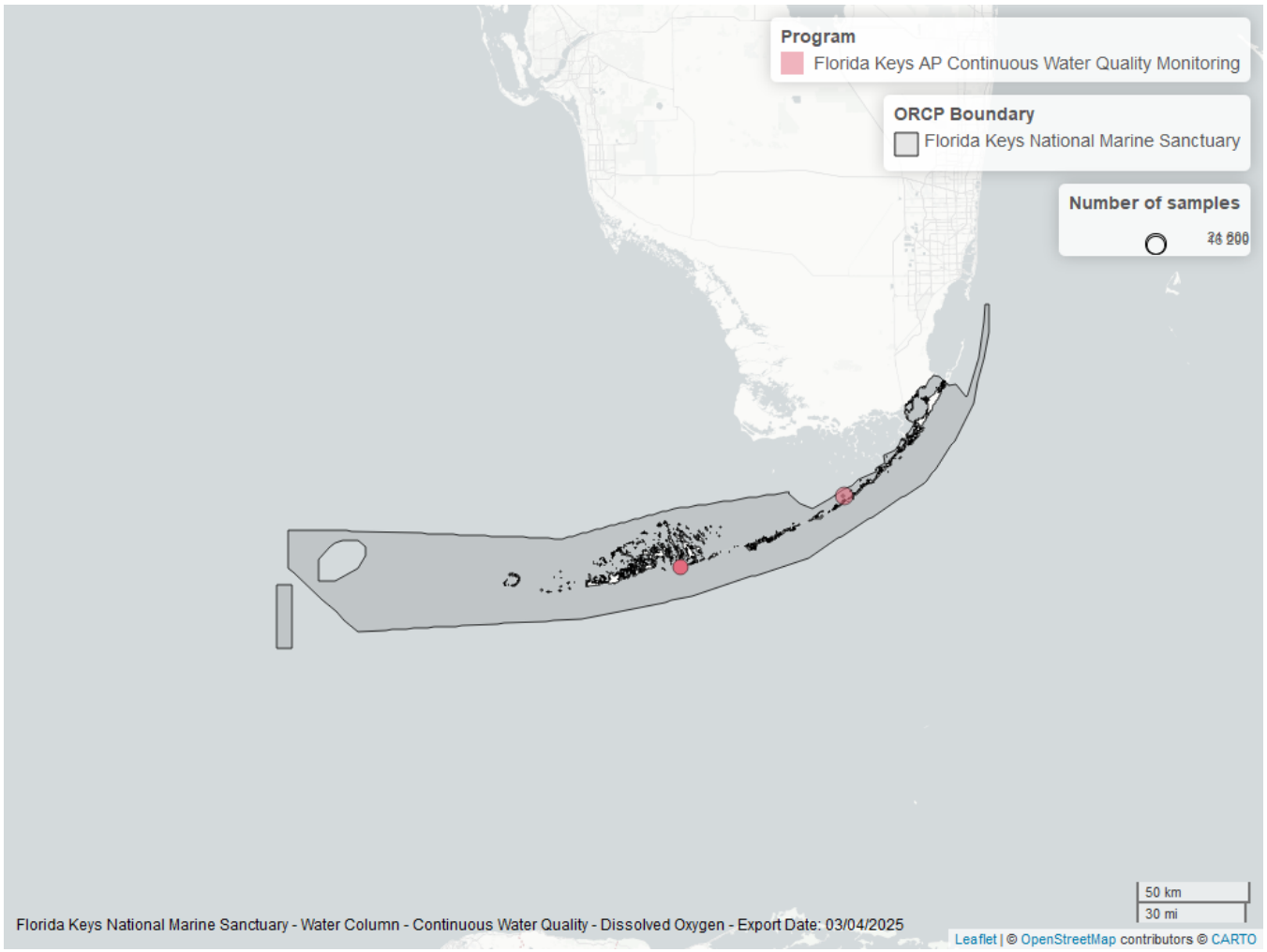

Figure 29: Map showing location of dissolved oxygen continuous water quality sampling locations within the boundaries of *Florida Keys National Marine Sanctuary*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Dissolved Oxygen Saturation - Continuous

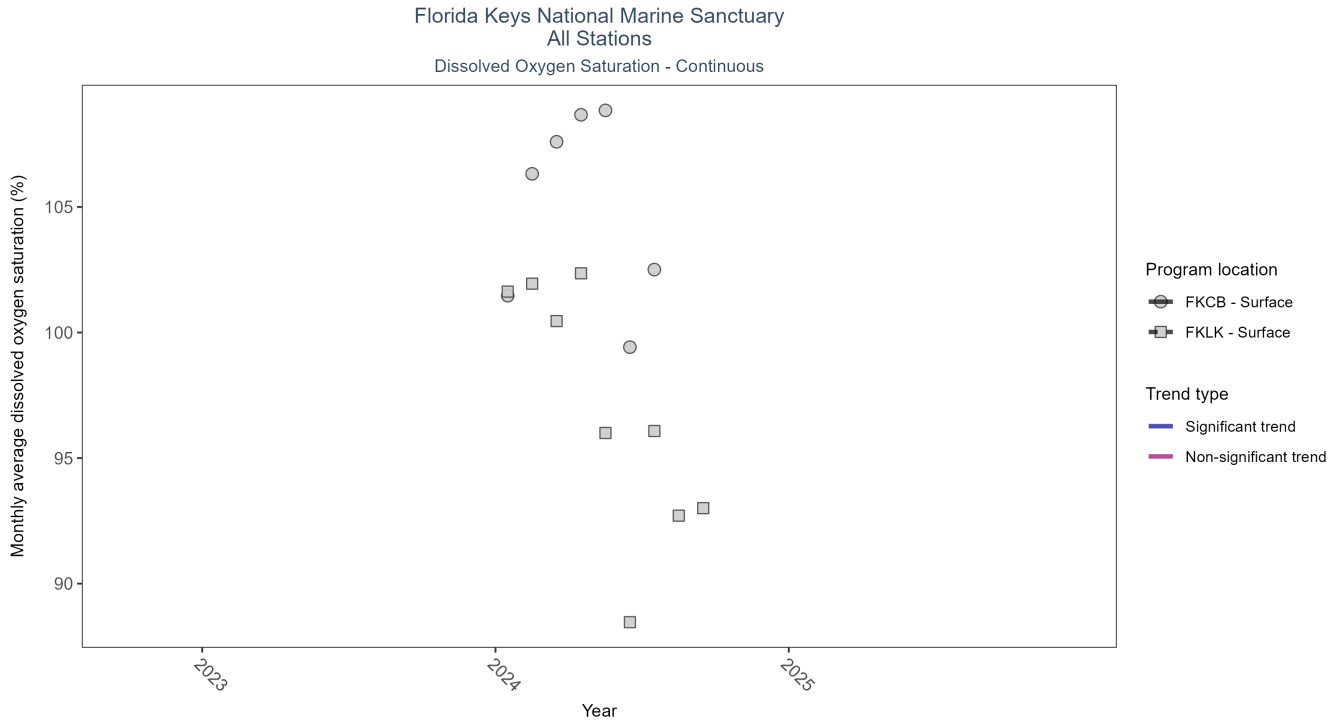

Figure 30: Scatter plot of monthly average dissolved oxygen saturation over time at continuously monitored program locations. Each location is analyzed separately, with significant (blue) or non-significant (magenta) trend lines shown for time series that included five or more years of observations.

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
FKLK	Insufficient data to calculate trend	21525	1	2024 - 2024	91.9	-	-	-	-
FKCB	Insufficient data to calculate trend	16263	1	2024 - 2024	103.3	-	-	-	-

There was insufficient data to fit a model for two locations.

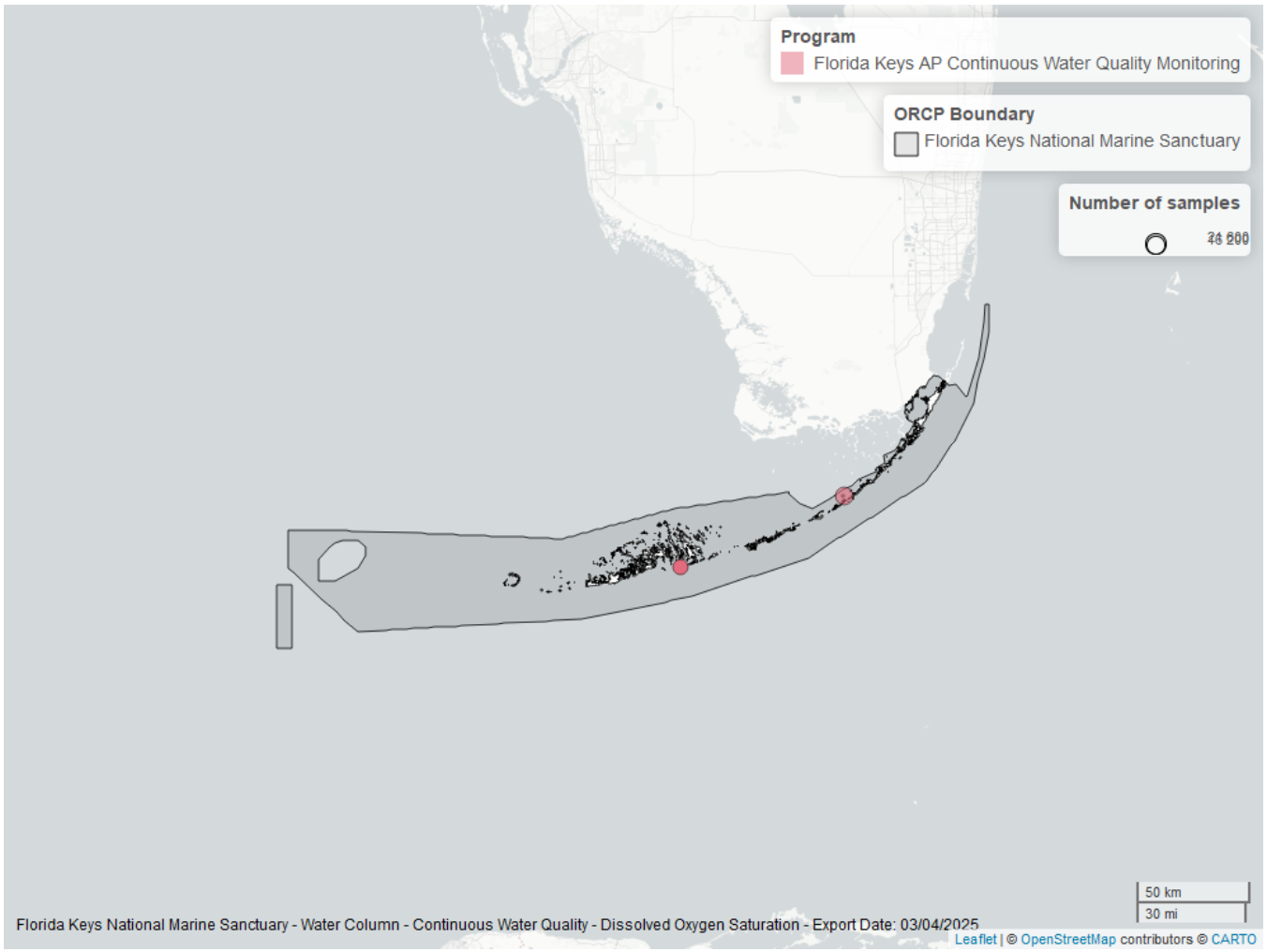

Figure 31: Map showing location of dissolved oxygen saturation continuous water quality sampling locations within the boundaries of *Florida Keys National Marine Sanctuary*. The bubble size on the maps above reflect the amount of data available at each sampling site.

pH - Continuous

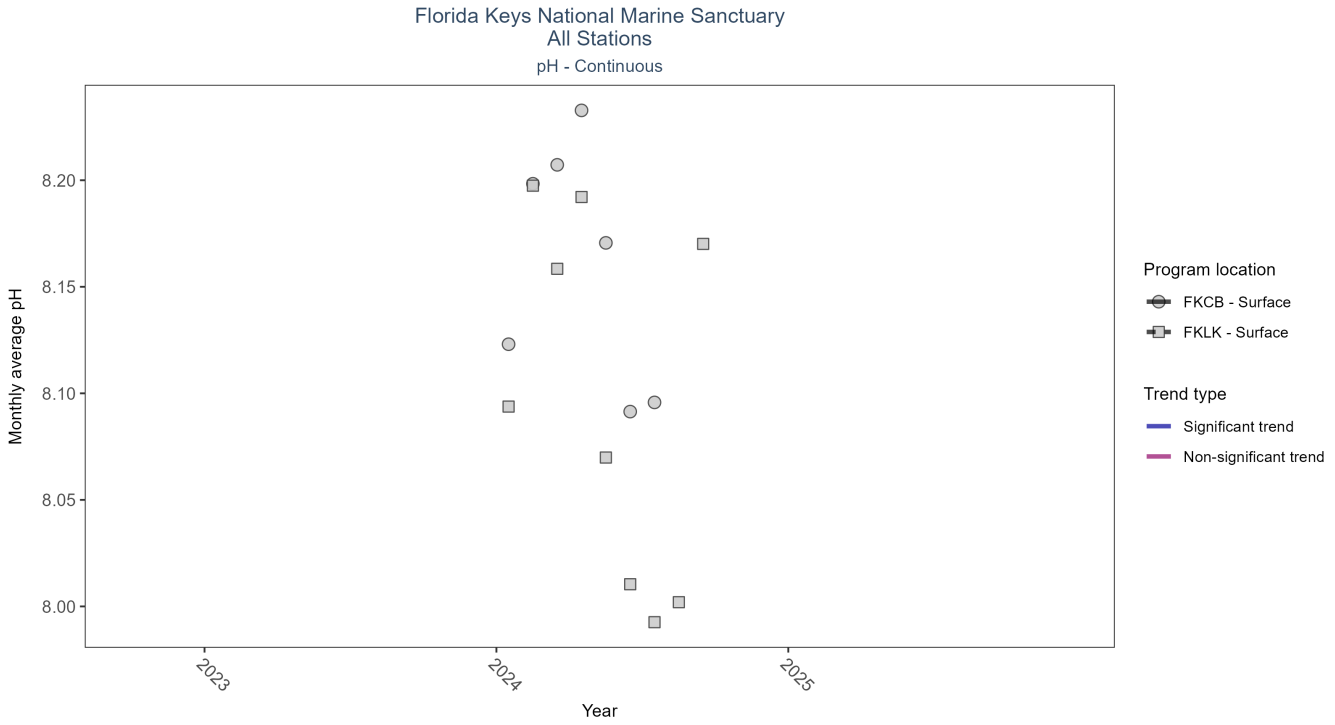

Figure 32: Scatter plot of monthly average pH over time at continuously monitored program locations. Each location is analyzed separately, with significant (blue) or non-significant (magenta) trend lines shown for time series that included five or more years of observations.

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
FKLK	Insufficient data to calculate trend	21517	1	2024 - 2024	8.1	-	-	-	-
FKCB	Insufficient data to calculate trend	16263	1	2024 - 2024	8.2	-	-	-	-

There was insufficient data to fit a model for two locations.

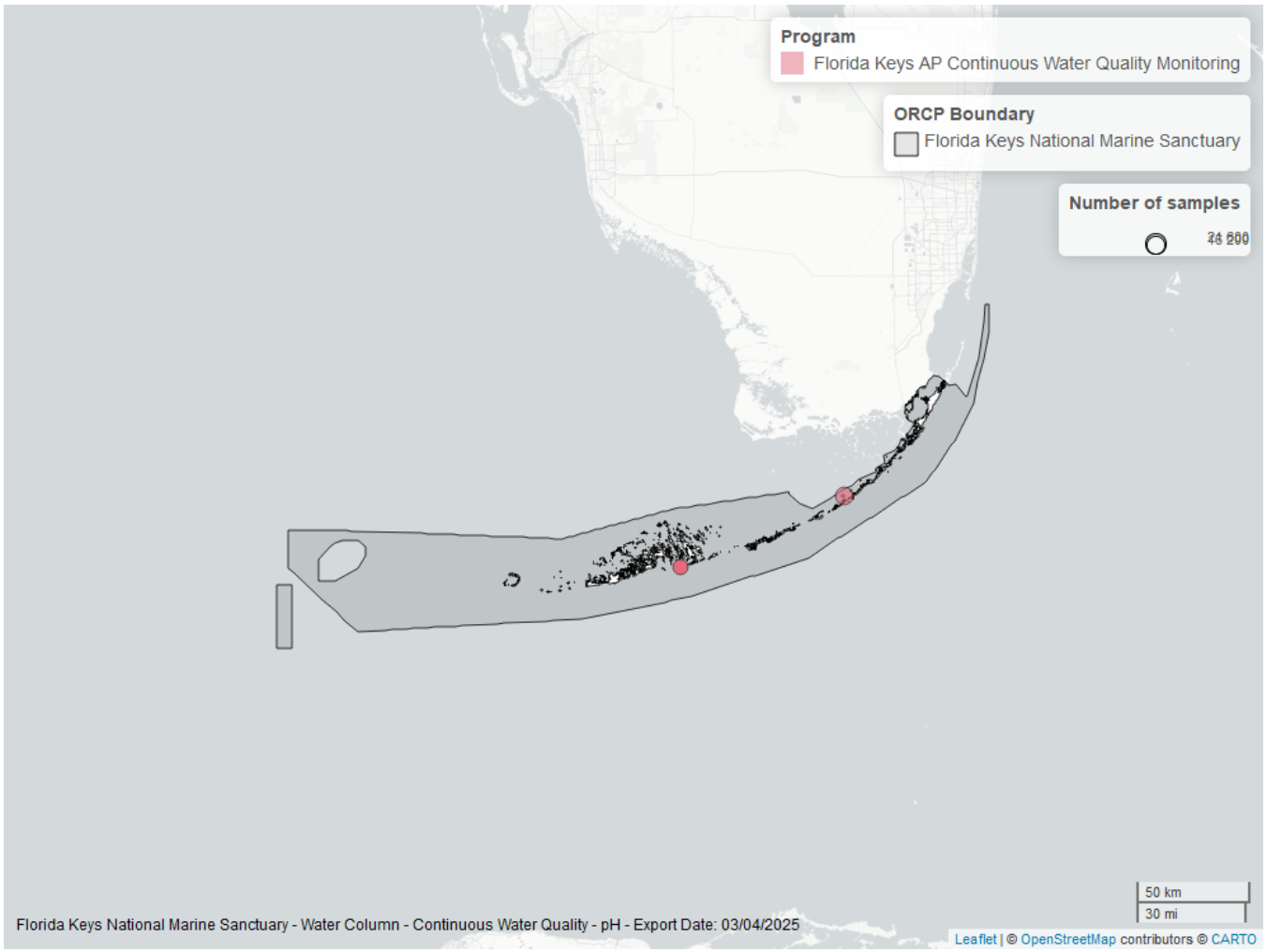

Figure 33: Map showing location of ph continuous water quality sampling locations within the boundaries of *Florida Keys National Marine Sanctuary*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Salinity - Continuous

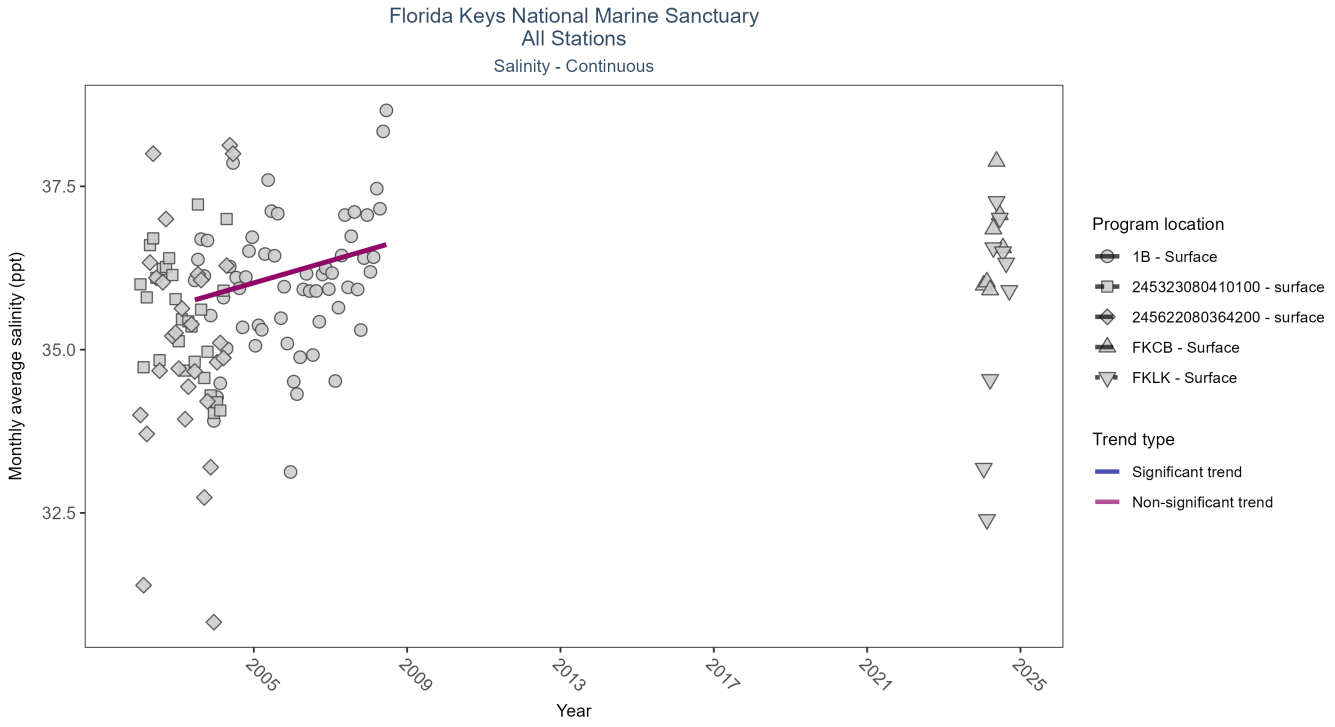

Figure 34: Scatter plot of monthly average salinity over time at continuously monitored program locations. Each location is analyzed separately, with significant (blue) or non-significant (magenta) trend lines shown for time series that included five or more years of observations.

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
1B	No significant trend	86204	6	2003 - 2008	36.07	0.24	35.68	0.17	0.05
245323080410100	Insufficient data to calculate trend	746	3	2002 - 2004	35.00	-	-	-	-
245622080364200	Insufficient data to calculate trend	764	3	2002 - 2004	35.00	-	-	-	-
FKLK	Insufficient data to calculate trend	21517	1	2024 - 2024	36.10	-	-	-	-
FKCB	Insufficient data to calculate trend	16258	1	2024 - 2024	36.50	-	-	-	-

No detectable change in monthly average salinity was observed at one location. There was insufficient data to fit a model for four locations.

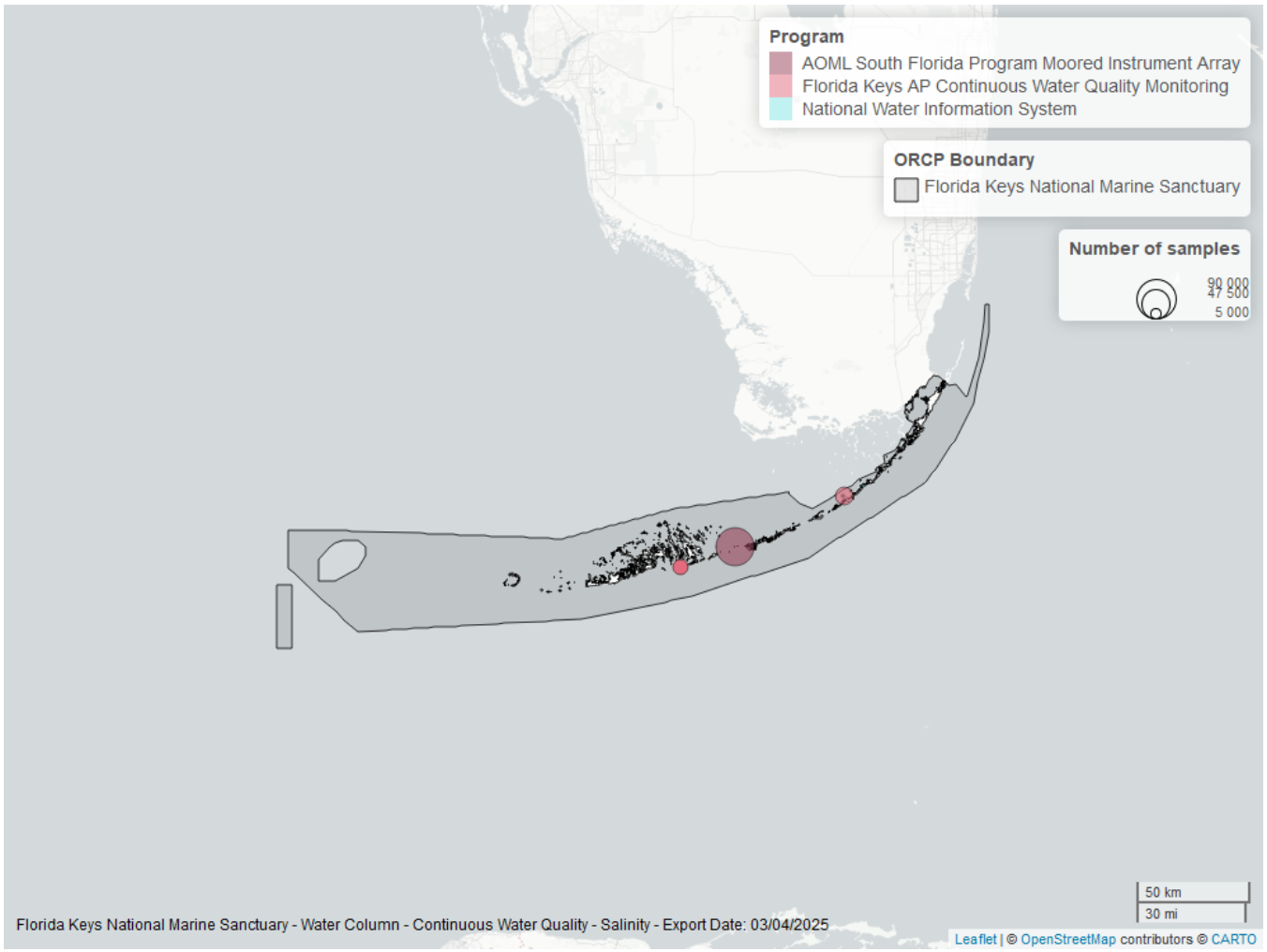

Figure 35: Map showing location of salinity continuous water quality sampling locations within the boundaries of *Florida Keys National Marine Sanctuary*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Turbidity - Continuous

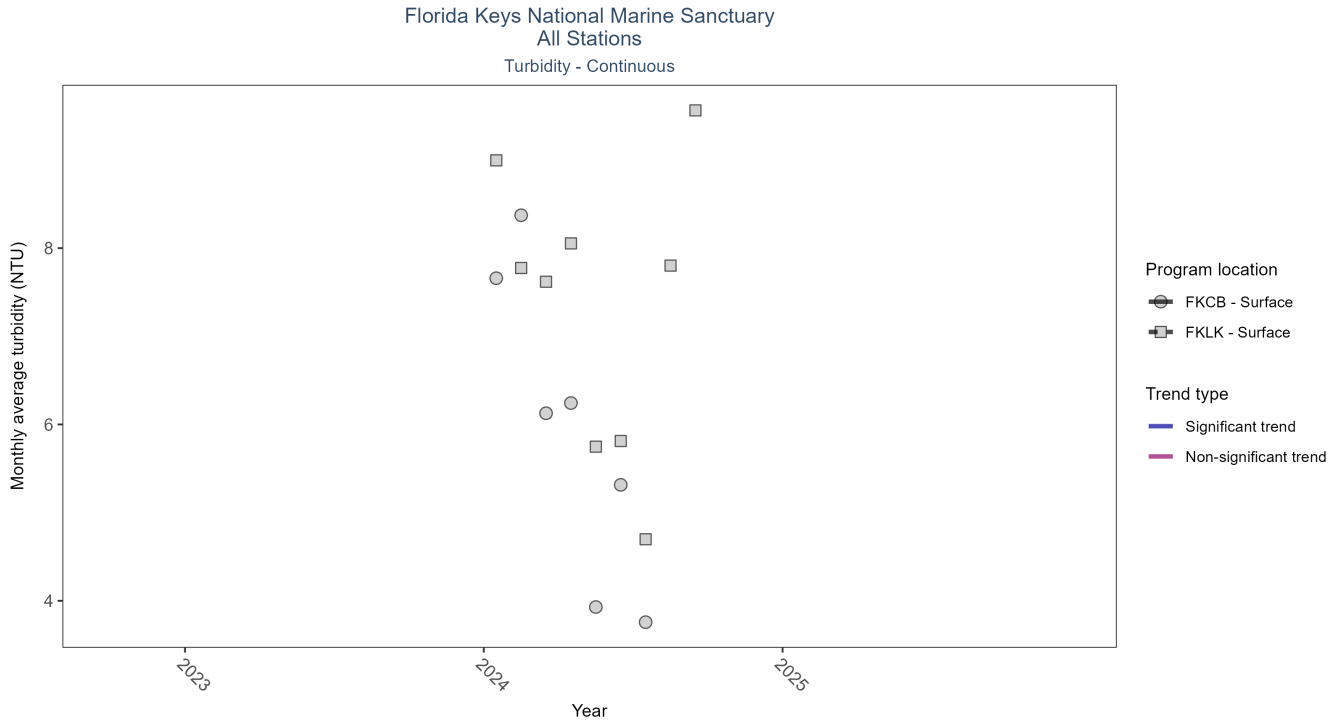

Figure 36: Scatter plot of monthly average turbidity over time at continuously monitored program locations. Each location is analyzed separately, with significant (blue) or non-significant (magenta) trend lines shown for time series that included five or more years of observations.

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
FKLK	Insufficient data to calculate trend	21399	1	2024 - 2024	6	-	-	-	-
FKCB	Insufficient data to calculate trend	16240	1	2024 - 2024	4	-	-	-	-

There was insufficient data to fit a model for two locations.

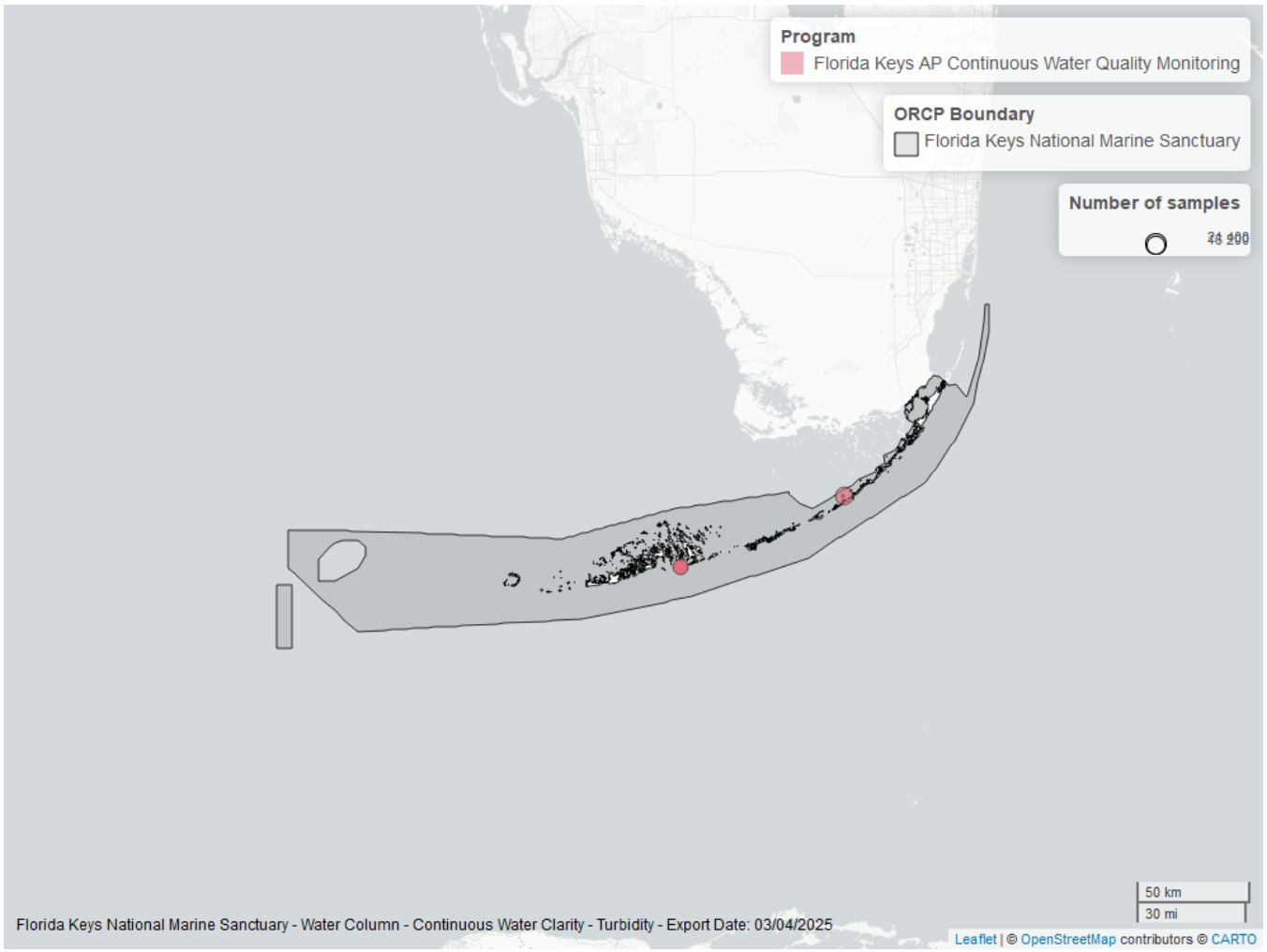

Figure 37: Map showing location of turbidity continuous water quality sampling locations within the boundaries of *Florida Keys National Marine Sanctuary*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Water Temperature - Continuous - Program 2

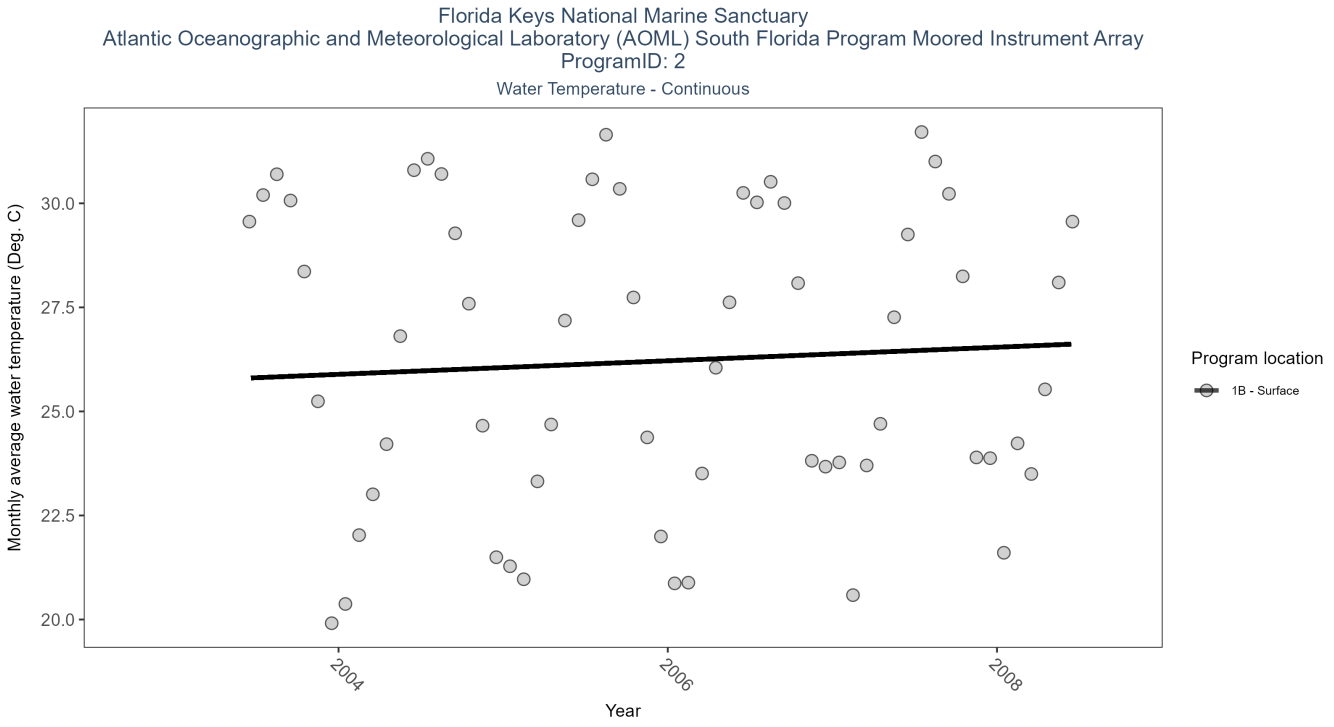

Figure 38: Scatter plot of monthly average water temperature over time at continuously monitored program locations. Each location is analyzed separately, with significant (blue) or non-significant (magenta) trend lines shown for time series that included five or more years of observations.

Table 38: Seasonal Kendall-Tau Results for Water Temperature - Program 2

Station	Statistical Trend	Sample Count	Years with Data	Period of Record	Median	tau	Sen Intercept	Sen Slope	p
1B	Significantly increasing trend	86204	6	2003 - 2008	26.38	0.26	25.73	0.16	0.04

At seventy-four program locations, monthly average water temperature increased between 0.01 and 0.16°C per year. No detectable change in monthly average water temperature was observed at forty-eight locations. There was insufficient data to fit a model for ten locations.

Water Temperature - Continuous - Program 5

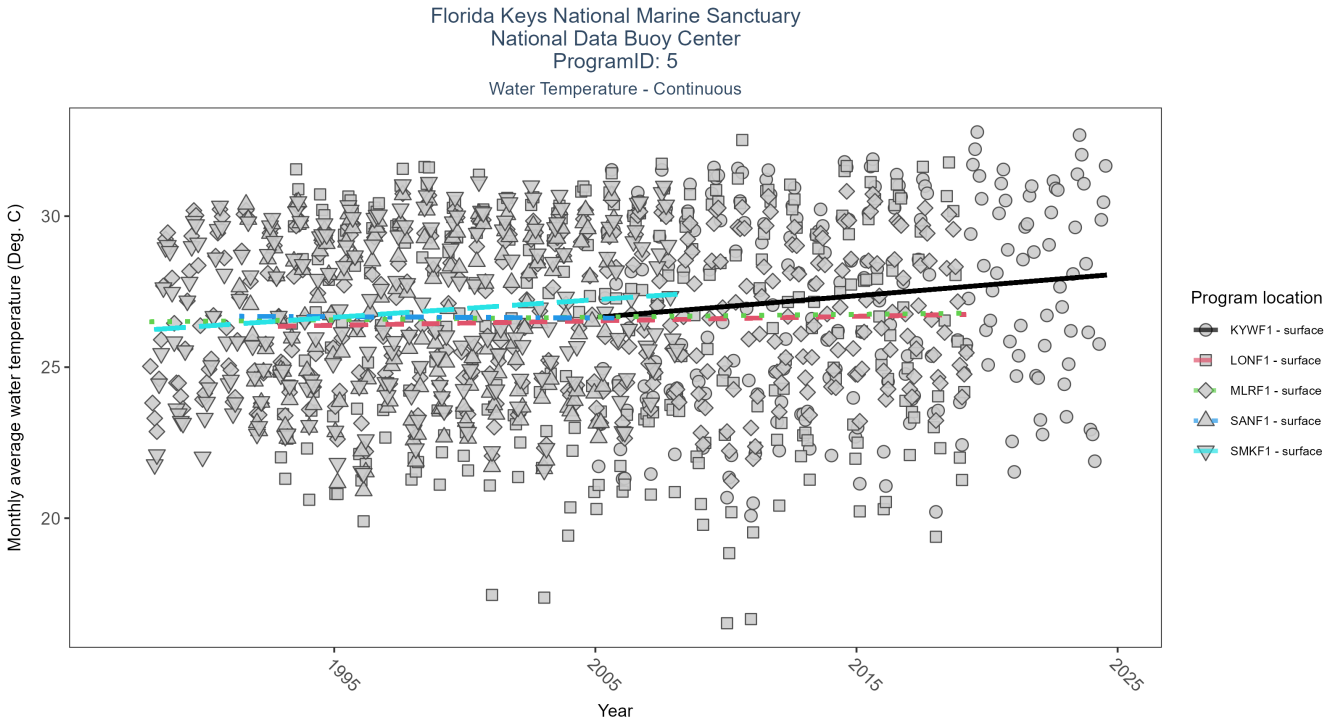

Figure 39: Scatter plot of monthly average water temperature over time at continuously monitored program locations. Each location is analyzed separately, with significant (blue) or non-significant (magenta) trend lines shown for time series that included five or more years of observations.

Table 39: Seasonal Kendall-Tau Results for Water Temperature - Program 5

Station	Statistical Trend	Sample Count	Years with Data	Period of Record	Median	tau	Sen Intercept	Sen Slope	p
SMKF1	Significantly increasing trend	154326	21	1988 - 2008	26.8	0.34	26.24	0.06	0.00
KYWF1	Significantly increasing trend	1441302	20	2005 - 2024	27.6	0.31	26.65	0.07	0.00
LONF1	No significant trend	205971	28	1992 - 2019	26.6	0.07	26.34	0.01	0.08
MLRF1	Significantly increasing trend	256798	33	1987 - 2019	26.5	0.10	26.49	0.01	0.00
SANF1	No significant trend	117833	15	1991 - 2005	26.7	-0.03	26.69	0.00	0.62

At seventy-four program locations, monthly average water temperature increased between 0.01 and 0.16°C per year. No detectable change in monthly average water temperature was observed at forty-eight locations. There was insufficient data to fit a model for ten locations.

Water Temperature - Continuous - Program 7

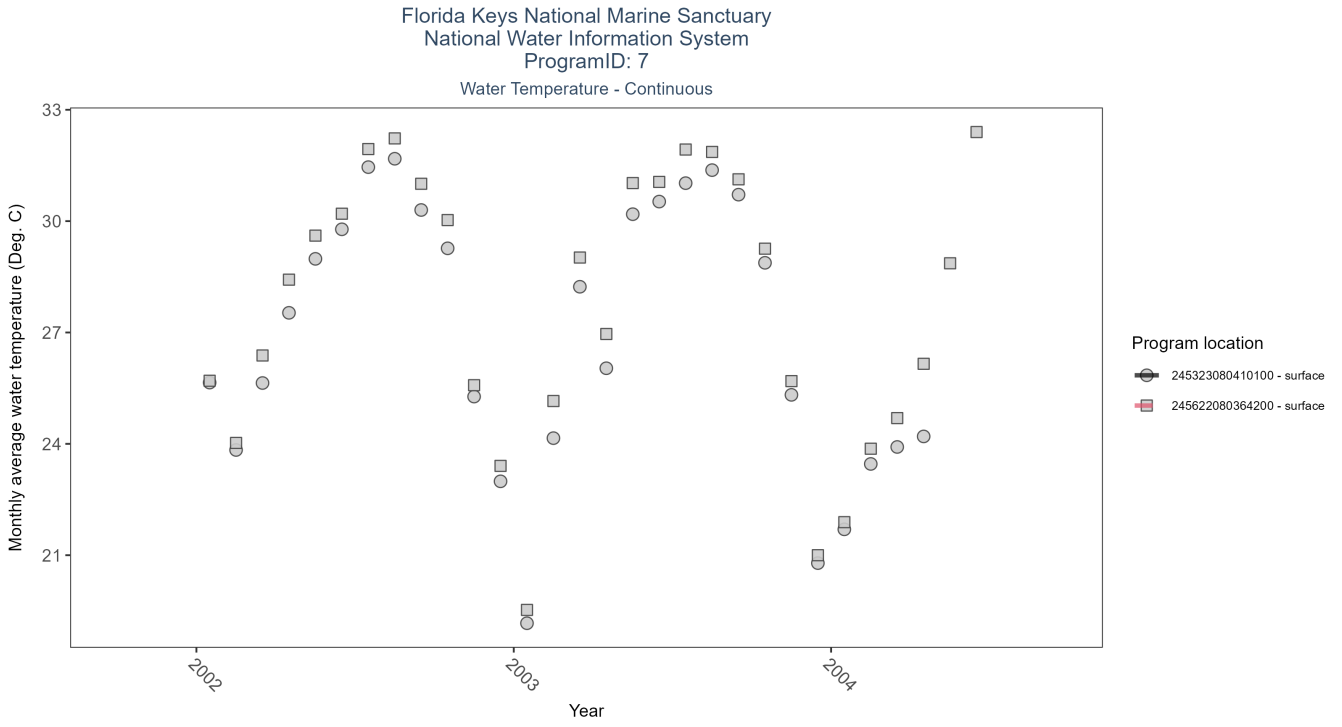

Figure 40: Scatter plot of monthly average water temperature over time at continuously monitored program locations. Each location is analyzed separately, with significant (blue) or non-significant (magenta) trend lines shown for time series that included five or more years of observations.

Table 40: 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
245323080410100	Insufficient data to calculate trend	791	3	2002 - 2004	27.9	-	-	-	-
245622080364200	Insufficient data to calculate trend	853	3	2002 - 2004	28.3	-	-	-	-

At seventy-four program locations, monthly average water temperature increased between 0.01 and 0.16°C per year. No detectable change in monthly average water temperature was observed at forty-eight locations. There was insufficient data to fit a model for ten locations.

Water Temperature - Continuous - Program 296

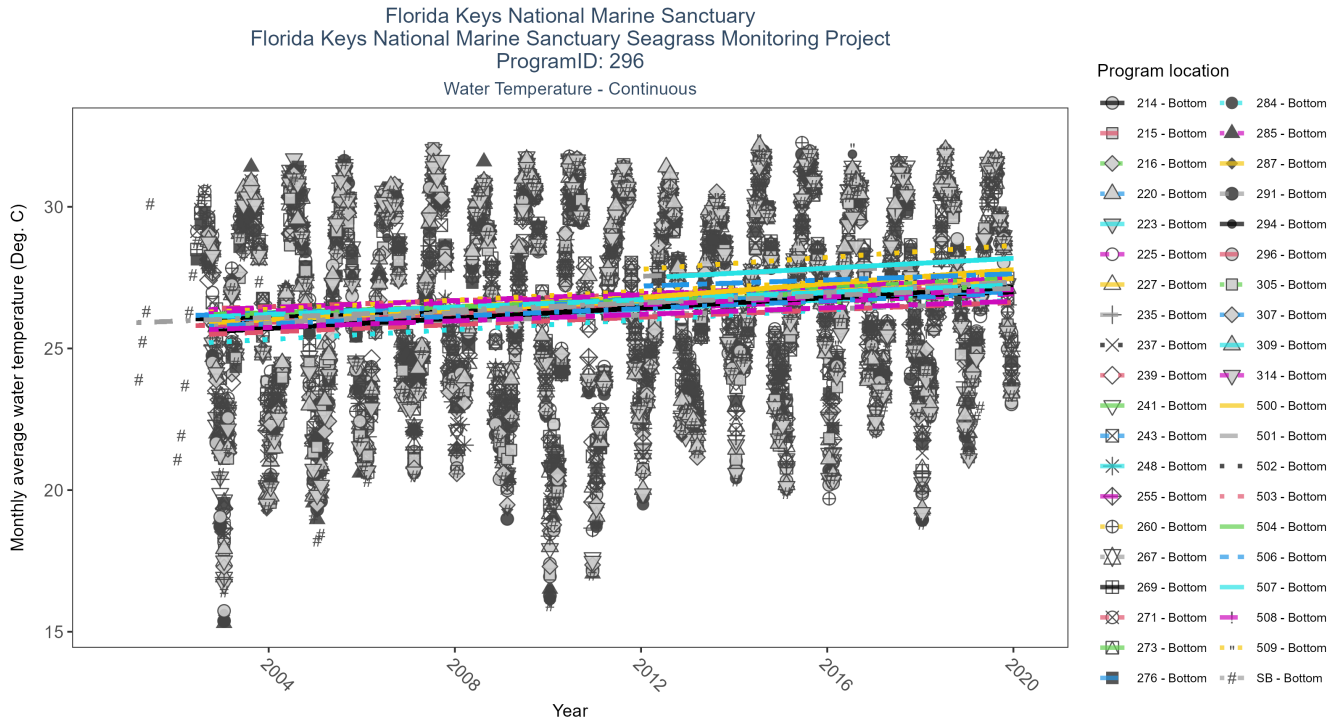

Figure 41: Scatter plot of monthly average water temperature over time at continuously monitored program locations. Each location is analyzed separately, with significant (blue) or non-significant (magenta) trend lines shown for time series that included five or more years of observations.

Table 41: Seasonal Kendall-Tau Results for Water Temperature - Program 296

Station	Statistical Trend	Sample Count	Years with Data	Period of Record	Median	tau	Sen Intercept	Sen Slope	p
241	Significantly increasing trend	127914	18	2002 - 2019	27.26	0.27	25.91	0.09	0
243	Significantly increasing trend	121593	18	2002 - 2019	26.62	0.3	26	0.07	0
255	Significantly increasing trend	119939	18	2002 - 2019	26.35	0.24	25.73	0.07	0
260	Significantly increasing trend	97832	16	2002 - 2019	27.07	0.28	26.22	0.08	0
284	Significantly increasing trend	123977	17	2002 - 2019	26.86	0.28	25.14	0.09	0
285	Significantly increasing trend	121423	18	2002 - 2019	26.86	0.25	26.17	0.07	0
287	Significantly increasing trend	133008	18	2002 - 2019	26.87	0.29	25.84	0.08	0
291	Significantly increasing trend	116240	18	2002 - 2019	26.38	0.26	25.72	0.09	0
294	Significantly increasing trend	112348	18	2002 - 2019	26.92	0.27	25.52	0.09	0
239	Significantly increasing trend	111523	17	2002 - 2018	26.92	0.24	25.96	0.07	0
267	Significantly increasing trend	99735	18	2002 - 2019	26.57	0.24	25.64	0.05	0
269	Significantly increasing trend	106458	17	2002 - 2019	26.74	0.21	26.02	0.05	0
271	Significantly increasing trend	133627	18	2002 - 2019	26.92	0.26	25.77	0.07	0
273	Significantly increasing trend	129817	18	2002 - 2019	27.16	0.24	26.16	0.05	0
276	Significantly increasing trend	123833	18	2002 - 2019	26.87	0.21	26.15	0.05	0
216	Significantly increasing trend	98535	17	2002 - 2018	26.26	0.31	25.86	0.06	0
220	Significantly increasing trend	126033	17	2003 - 2019	26.52	0.25	25.94	0.06	0
223	Significantly increasing trend	133082	18	2002 - 2019	26.89	0.3	25.84	0.08	0
225	Significantly increasing trend	117692	17	2002 - 2019	26.82	0.32	26.32	0.06	0
227	Significantly increasing trend	105351	17	2003 - 2019	26.67	0.29	26.06	0.08	0
235	Significantly increasing trend	128499	18	2002 - 2019	27.14	0.28	25.77	0.08	0
237	Significantly increasing trend	122250	18	2002 - 2019	26.38	0.31	25.74	0.09	0
296	Significantly increasing trend	114497	17	2002 - 2019	27.36	0.21	25.45	0.07	0
305	Significantly increasing trend	122296	18	2002 - 2019	26.43	0.22	26.07	0.06	0
307	Significantly increasing trend	110802	17	2002 - 2019	26.74	0.22	25.73	0.07	0
SB	Significantly increasing trend	145514	19	2001 - 2019	26.34	0.23	25.9	0.06	0
214	Significantly increasing trend	136333	18	2002 - 2019	26.52	0.27	25.84	0.07	0
215	Significantly increasing trend	133286	16	2003 - 2018	26.74	0.26	26.42	0.05	0
314	Significantly increasing trend	110686	18	2002 - 2019	27.41	0.23	25.63	0.06	0
309	Significantly increasing trend	107410	18	2002 - 2019	27.85	0.27	26.07	0.06	0
248	Significantly increasing trend	111702	18	2002 - 2019	26.79	0.31	25.54	0.08	0
500	Significantly increasing trend	69048	8	2012 - 2019	27.33	0.23	26.79	0.12	0.01
506	No significant trend	35198	7	2012 - 2019	27.41	0.04	27.2	0.05	0.74
507	No significant trend	47517	8	2012 - 2019	27.36	0.18	27.48	0.09	0.12
508	No significant trend	24021	6	2012 - 2019	26.67	0.33	26.54	0.07	0.29
509	No significant trend	38607	8	2012 - 2019	27.70	0.05	27.79	0.11	0.47
502	Insufficient data to calculate trend	22765	4	2016 - 2019	26.70	-	-	-	-
501	No significant trend	34805	5	2012 - 2018	27.48	0.11	27.55	0.05	0.65
503	Insufficient data to calculate trend	7490	1	2016 - 2016	28.74	-	-	-	-
504	Insufficient data to calculate trend	4339	1	2018 - 2018	29.84	-	-	-	-

At seventy-four program locations, monthly average water temperature increased between 0.01 and 0.16°C per year. No detectable change in monthly average water temperature was observed at forty-eight locations. There was insufficient data to fit a model for ten locations.

Water Temperature - Continuous - Program 899

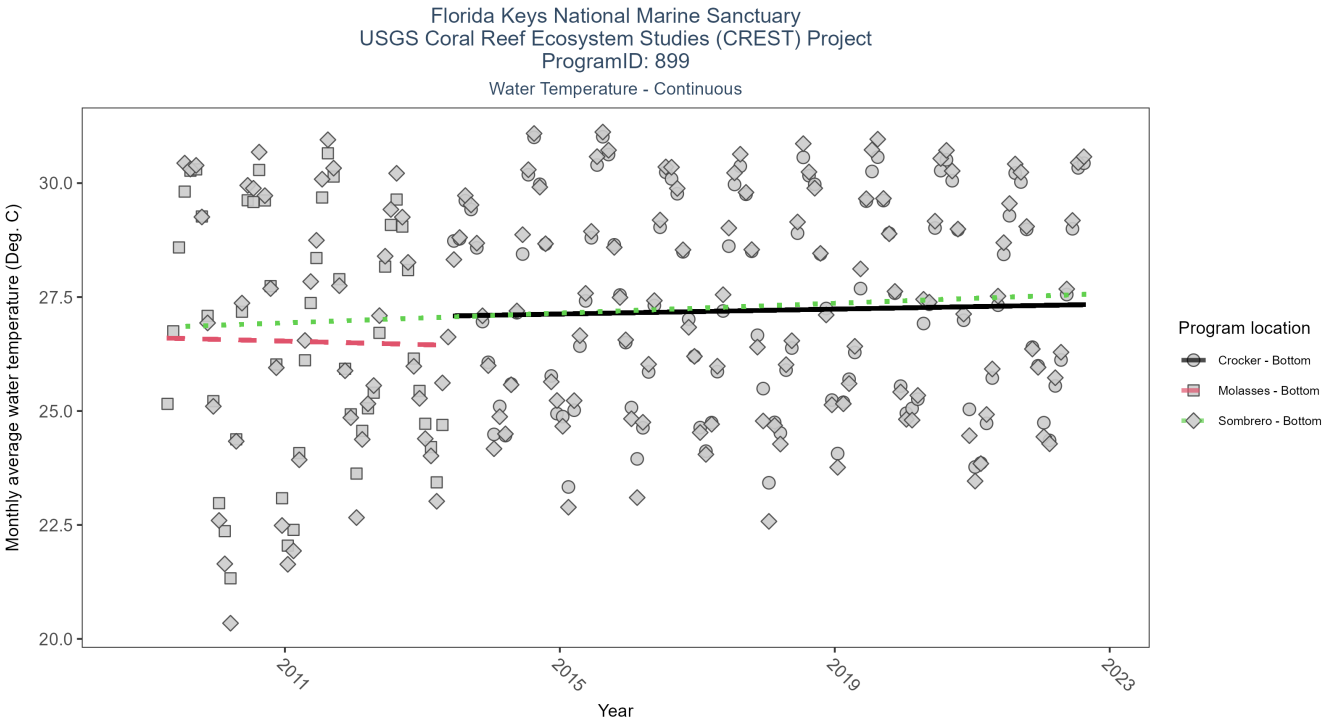

Figure 42: Scatter plot of monthly average water temperature over time at continuously monitored program locations. Each location is analyzed separately, with significant (blue) or non-significant (magenta) trend lines shown for time series that included five or more years of observations.

Table 42: Seasonal Kendall-Tau Results for Water Temperature - Program 899

Station	Statistical Trend	Sample Count	Years with Data	Period of Record	Median	tau	Sen Intercept	Sen Slope	p
Sombrero	Significantly increasing trend	459354	14	2009 - 2022	27.16	0.26	26.83	0.05	0.00
Crocker	Significantly increasing trend	322670	10	2013 - 2022	27.32	0.15	27.07	0.03	0.04
Molasses	No significant trend	140713	5	2009 - 2013	26.72	-0.03	26.61	-0.04	0.92

At seventy-four program locations, monthly average water temperature increased between 0.01 and 0.16°C per year. No detectable change in monthly average water temperature was observed at forty-eight locations. There was insufficient data to fit a model for ten locations.

Water Temperature - Continuous - Program 986

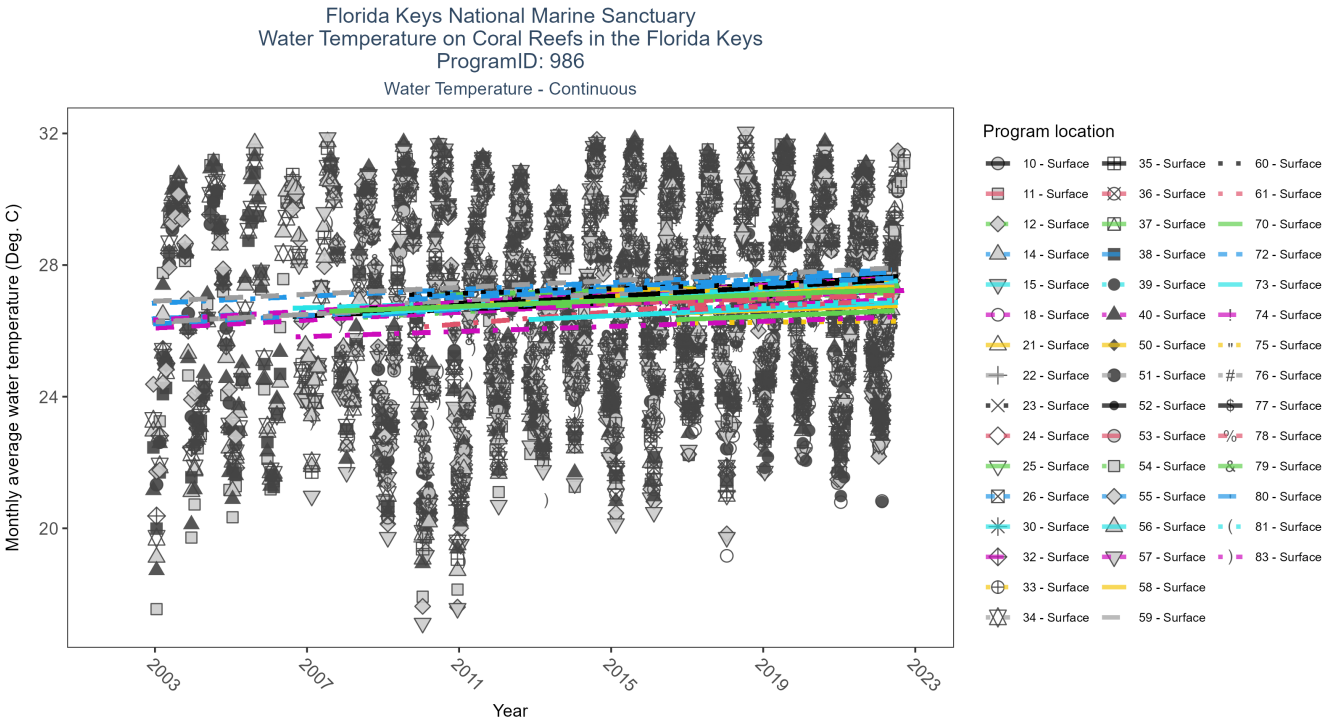

Figure 43: Scatter plot of monthly average water temperature over time at continuously monitored program locations. Each location is analyzed separately, with significant (blue) or non-significant (magenta) trend lines shown for time series that included five or more years of observations.

Table 43: Seasonal Kendall-Tau Results for Water Temperature - Program 986

Station	Statistical Trend	Sample Count	Years with Data	Period of Record	Median	tau	Sen Intercept	Sen Slope	p
35	Significantly increasing trend	217666	17	2006 - 2022	26.84	0.22	26.41	0.05	0
36	Significantly increasing trend	192871	16	2007 - 2022	26.89	0.24	26.52	0.06	0
34	Significantly increasing trend	274006	21	2002 - 2022	26.74	0.31	26.19	0.07	0
56	Significantly increasing trend	175648	17	2006 - 2022	26.67	0.14	26.67	0.03	0.02
79	Significantly increasing trend	175394	16	2007 - 2022	26.79	0.21	26.56	0.04	0
53	Significantly increasing trend	179447	15	2008 - 2022	26.98	0.37	26.53	0.07	0
14	Significantly increasing trend	223851	19	2002 - 2022	26.84	0.24	26.31	0.06	0
24	Significantly increasing trend	111388	11	2010 - 2022	26.89	0.33	26.12	0.09	0
32	Significantly increasing trend	223104	18	2003 - 2022	26.69	0.31	26.09	0.06	0
40	Significantly increasing trend	244138	21	2002 - 2022	26.79	0.28	26.27	0.07	0
59	Significantly increasing trend	191677	18	2002 - 2022	26.81	0.27	26.85	0.05	0
22	Significantly increasing trend	171553	14	2009 - 2022	26.91	0.25	26.43	0.07	0
72	Significantly increasing trend	188119	15	2008 - 2022	26.77	0.42	26.42	0.08	0
15	Significantly increasing trend	212659	17	2006 - 2022	26.99	0.19	26.4	0.05	0
77	Significantly increasing trend	188336	15	2008 - 2022	26.89	0.27	26.57	0.07	0
76	Significantly increasing trend	168914	14	2009 - 2022	26.84	0.23	26.82	0.05	0
12	Significantly increasing trend	138064	13	2008 - 2022	27.16	0.21	26.39	0.06	0
57	Significantly increasing trend	187914	15	2008 - 2022	26.96	0.3	26.66	0.07	0
80	Significantly increasing trend	167362	14	2009 - 2022	26.87	0.21	26.92	0.05	0
74	Significantly increasing trend	130333	11	2012 - 2022	26.87	0.24	26.64	0.05	0
73	Significantly increasing trend	179435	15	2008 - 2022	26.74	0.35	26.49	0.07	0
58	No significant trend	72230	9	2014 - 2022	27.11	0.01	27.23	0.01	0.96
11	Significantly increasing trend	228643	18	2003 - 2022	26.81	0.3	26.1	0.06	0
55	Significantly increasing trend	225636	21	2002 - 2022	26.86	0.28	26.79	0.05	0
54	Significantly increasing trend	130399	11	2012 - 2022	27.06	0.25	26.77	0.06	0
75	Significantly increasing trend	144589	13	2010 - 2022	27.06	0.27	26.71	0.07	0
60	Significantly increasing trend	150013	14	2009 - 2022	26.94	0.17	27.07	0.04	0.01
38	Significantly increasing trend	256177	21	2002 - 2022	26.47	0.28	26.15	0.06	0
61	No significant trend	54044	7	2016 - 2022	27.06	0.15	26.58	0.05	0.15
33	No significant trend	38112	6	2016 - 2022	27.13	0.08	26.23	0.01	0.66
23	Significantly increasing trend	113161	11	2012 - 2022	27.33	0.19	26.83	0.07	0.01
83	Significantly increasing trend	130599	16	2006 - 2022	25.79	0.14	25.79	0.04	0.01
52	Significantly increasing trend	188237	15	2008 - 2022	26.92	0.34	26.63	0.07	0
39	No significant trend	33723	5	2018 - 2022	27.01	-0.09	27.6	-0.08	0.69
37	No significant trend	52521	7	2016 - 2022	26.74	0.07	26.3	0.05	0.47
78	No significant trend	87924	9	2014 - 2022	26.98	0.11	26.81	0.03	0.19
50	Significantly increasing trend	103998	10	2013 - 2022	27.01	0.23	26.85	0.05	0
18	No significant trend	44119	7	2016 - 2022	27.03	0.13	26.59	0.06	0.29
25	No significant trend	117274	12	2010 - 2022	27.19	0.08	27.07	0.03	0.27
26	Significantly increasing trend	142040	14	2009 - 2022	26.96	0.21	26.97	0.06	0
51	Significantly increasing trend	222780	18	2003 - 2022	26.67	0.31	26.27	0.06	0
30	Significantly increasing trend	116701	11	2012 - 2022	26.62	0.21	26.3	0.05	0.01
21	No significant trend	55870	7	2016 - 2022	27.18	0.13	26.51	0.04	0.22
81	No significant trend	53957	7	2016 - 2022	27.03	0.13	26.63	0.05	0.22
70	Significantly increasing trend	104819	10	2013 - 2022	26.91	0.22	26.73	0.05	0
10	Insufficient data to calculate trend	18268	3	2020 - 2022	27.72	-	-	-	-

At seventy-four program locations, monthly average water temperature increased between 0.01 and 0.16°C per year. No detectable change in monthly average water temperature was observed at forty-eight locations. There was insufficient data to fit a model for ten locations.

Water Temperature - Continuous - Program 989

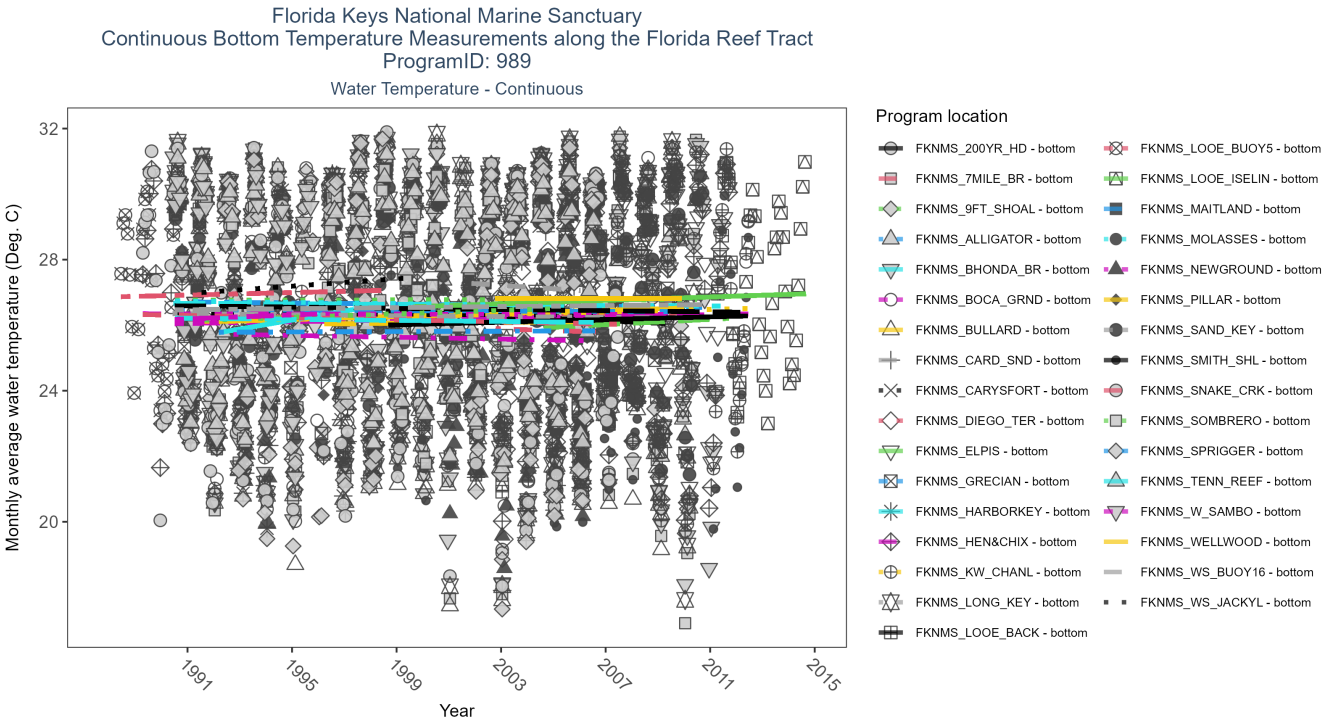

Figure 44: Scatter plot of monthly average water temperature over time at continuously monitored program locations. Each location is analyzed separately, with significant (blue) or non-significant (magenta) trend lines shown for time series that included five or more years of observations.

Table 44: Seasonal Kendall-Tau Results for Water Temperature - Program 989

Station	Statistical Trend	Sample Count	Years with Data	Period of Record	Median	tau	Sen Intercept	Sen Slope	p
FKNMS-SMITH-SHL	No significant trend	94527	10	1998 - 2012	25.45	0.13	25.99	0.02	0.19
FKNMS-SAND-KEY	No significant trend	59287	18	1990 - 2010	26.70	0.05	26.46	0.01	0.32
FKNMS-SPRIGGER	No significant trend	41834	13	1992 - 2006	26.10	0.02	25.78	0	0.86
FKNMS-TENN-REEF	No significant trend	63260	16	1990 - 2006	26.70	-0.06	26.22	-0.01	0.27
FKNMS-SOMBRERO	No significant trend	48974	13	1991 - 2005	26.50	0.13	26.14	0.03	0.05
FKNMS-200YR-HD	No significant trend	44601	12	1998 - 2009	26.10	-0.1	26.45	-0.04	0.17
FKNMS-7MILE-BR	No significant trend	73055	19	1991 - 2010	26.66	0.05	26.22	0.01	0.35
FKNMS-DIEGO-TER	No significant trend	16693	5	2002 - 2006	25.58	-0.05	25.91	-0.03	0.84
FKNMS-ELPIS	No significant trend	31035	8	2004 - 2011	26.35	0.06	25.9	0.04	0.53
FKNMS-BHONDA-BR	No significant trend	77111	22	1990 - 2011	26.60	-0.02	26.67	0	0.66
FKNMS-BULLARD	Significantly increasing trend	66230	18	1992 - 2009	26.31	0.12	26.11	0.02	0.03
FKNMS-LOOE-ISELIN	No significant trend	194367	13	1999 - 2014	26.88	0.13	26.55	0.03	0.08
FKNMS-PILLAR	No significant trend	40805	11	1996 - 2006	26.24	0.02	26.04	0.01	0.94
FKNMS-MOLASSES	No significant trend	36146	13	1990 - 2002	26.70	-0.05	26.74	-0.01	0.48
FKNMS-BOCA-GRND	No significant trend	73434	17	1990 - 2012	26.14	0.08	26.04	0.01	0.17
FKNMS-MAITLAND	Insufficient data to calculate trend	12421	4	2004 - 2007	26.07	-	-	-	-
FKNMS-CARYSFORT	No significant trend	55001	16	1990 - 2006	26.40	-0.03	26.38	0	0.64
FKNMS-9FT-SHOAL	No significant trend	80299	21	1990 - 2010	26.50	0	26.76	0	0.99
FKNMS-HEN-and-CHIX	No significant trend	72285	21	1989 - 2011	26.50	-0.01	26.35	0	0.88
FKNMS-KW-CHANL	No significant trend	123578	18	1991 - 2012	26.27	0.1	26.11	0.02	0.08
FKNMS-GRECIAN	No significant trend	51723	18	1990 - 2010	26.65	-0.03	26.48	0	0.66
FKNMS-LONG-KEY	No significant trend	69656	19	1990 - 2010	26.64	-0.03	26.35	-0.01	0.58
FKNMS-WELLWOOD	No significant trend	30427	8	2002 - 2009	26.43	0	26.82	0	1
FKNMS-SNAKE-CRK	No significant trend	56777	19	1989 - 2007	26.16	-0.06	26.33	-0.02	0.28
FKNMS-ALLIGATOR	No significant trend	65144	19	1990 - 2010	26.55	-0.06	26.72	-0.01	0.23
FKNMS-W-SAMBO	No significant trend	18786	6	1990 - 1995	26.90	0.09	26.16	0.03	0.56
FKNMS-LOOE-BACK	No significant trend	84984	18	1990 - 2012	26.80	-0.06	26.6	-0.01	0.42
FKNMS-LOOE-BUOY5	No significant trend	35252	10	1988 - 1998	26.90	0.05	26.86	0.02	0.36
FKNMS-NEWGROUND	No significant trend	35329	12	1992 - 2006	25.49	-0.05	25.73	-0.01	0.52
FKNMS-WS-JACKYL	No significant trend	29557	9	1991 - 1999	26.40	0.17	26.96	0.06	0.09
FKNMS-CARD-SND	No significant trend	18249	6	2001 - 2006	26.52	-0.05	27.32	-0.05	0.79
FKNMS-HARBORKEY	No significant trend	15407	5	1992 - 1997	26.50	0.14	25.74	0.14	0.33
FKNMS-WS-BUOY16	Insufficient data to calculate trend	8123	3	2003 - 2005	25.99	-	-	-	-

At seventy-four program locations, monthly average water temperature increased between 0.01 and 0.16°C per year. No detectable change in monthly average water temperature was observed at forty-eight locations. There was insufficient data to fit a model for ten locations.

Water Temperature - Continuous - Program 10004

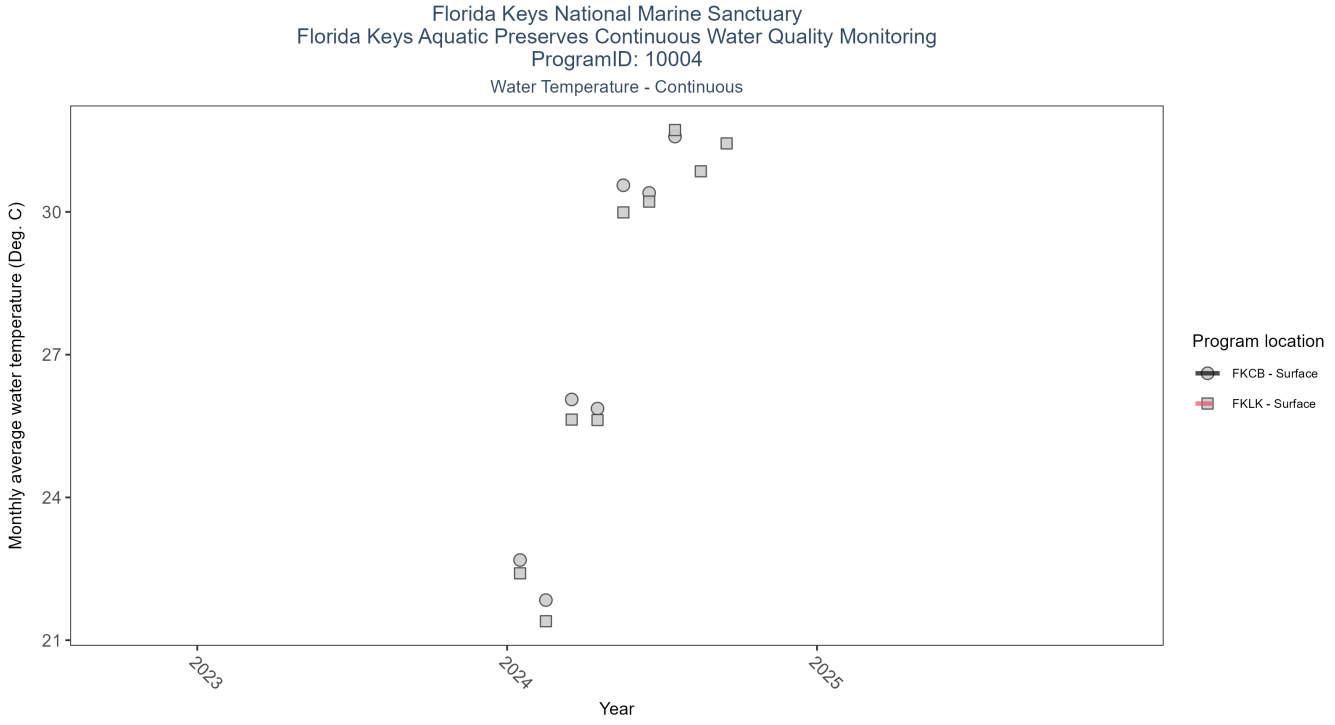

Figure 45: Scatter plot of monthly average water temperature over time at continuously monitored program locations. Each location is analyzed separately, with significant (blue) or non-significant (magenta) trend lines shown for time series that included five or more years of observations.

Table 45: Seasonal Kendall-Tau Results for Water Temperature - Program 10004

Station	Statistical Trend	Sample Count	Years with Data	Period of Record	Median	tau	Sen Intercept	Sen Slope	p
FKLK	Insufficient data to calculate trend	21517	1	2024 - 2024	29.0	-	-	-	-
FKCB	Insufficient data to calculate trend	16263	1	2024 - 2024	26.8	-	-	-	-

At seventy-four program locations, monthly average water temperature increased between 0.01 and 0.16°C per year. No detectable change in monthly average water temperature was observed at forty-eight locations. There was insufficient data to fit a model for ten locations.

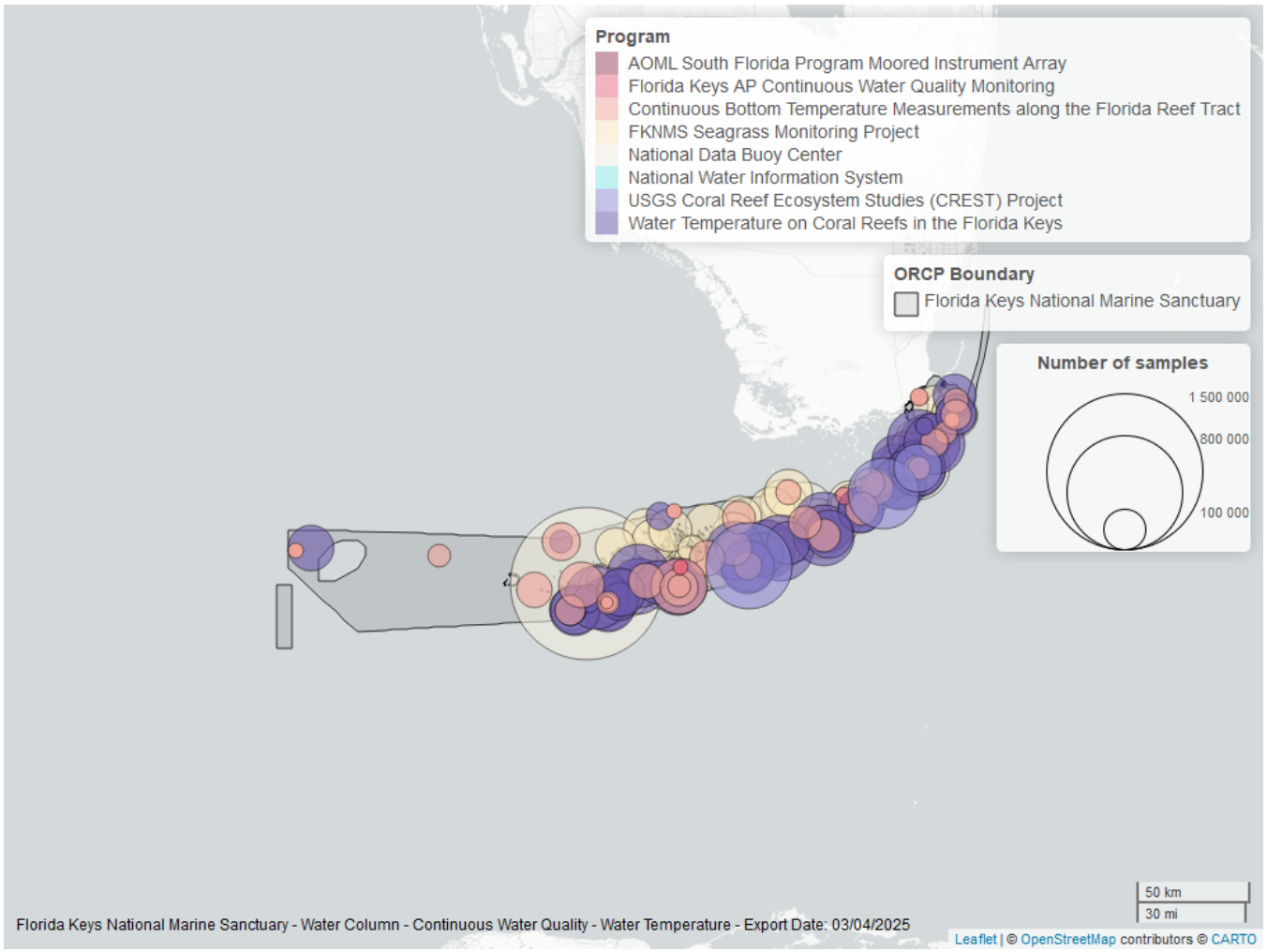

Figure 46: Map showing location of water temperature continuous water quality sampling locations within the boundaries of *Florida Keys National Marine Sanctuary*. The bubble size on the maps above reflect the amount of data available at each sampling site.

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

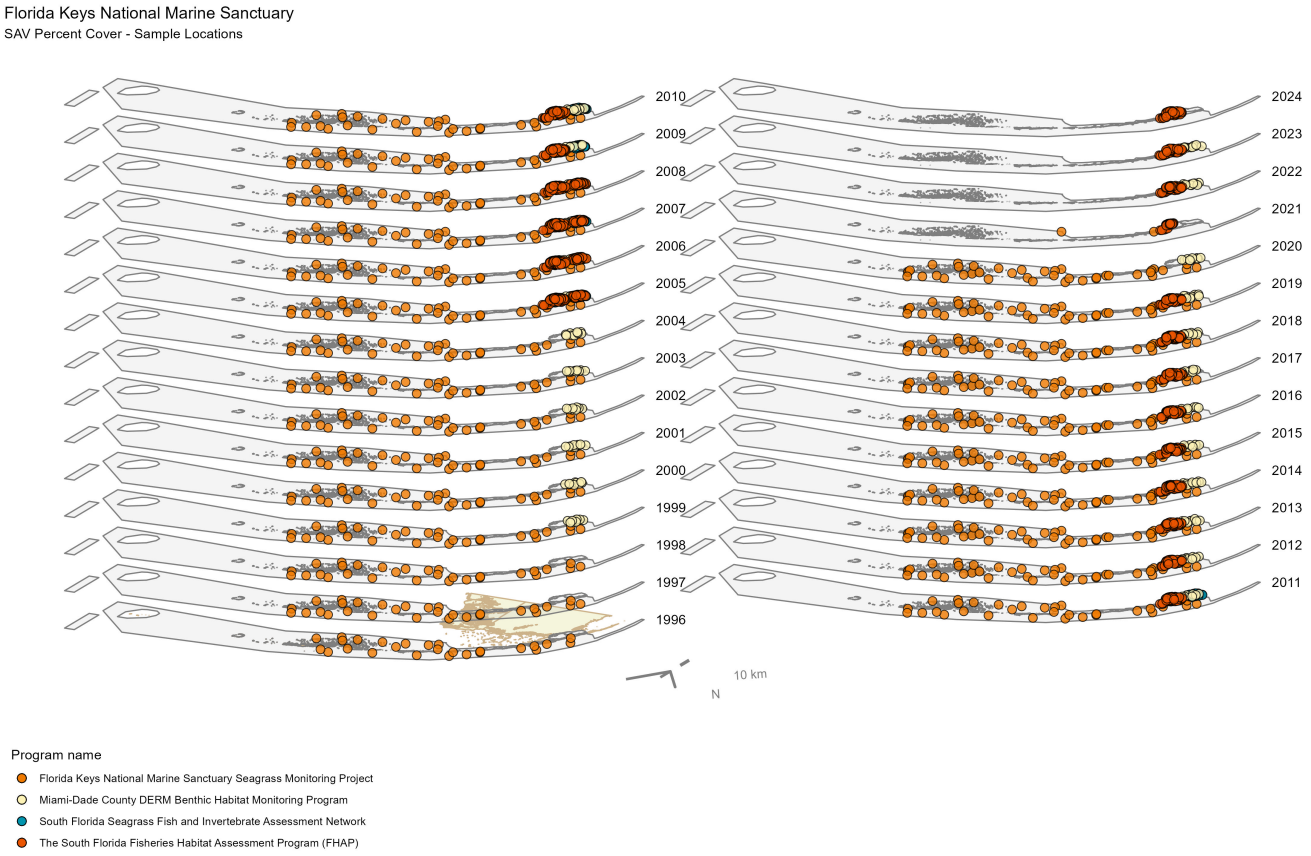

Figure 47: Maps showing the temporal scope of SAV sampling sites within the boundaries of *Florida Keys National Marine Sanctuary* by Program name.

Click here to view spatio-temporal plots on GitHub.

Sampling locations by Program:

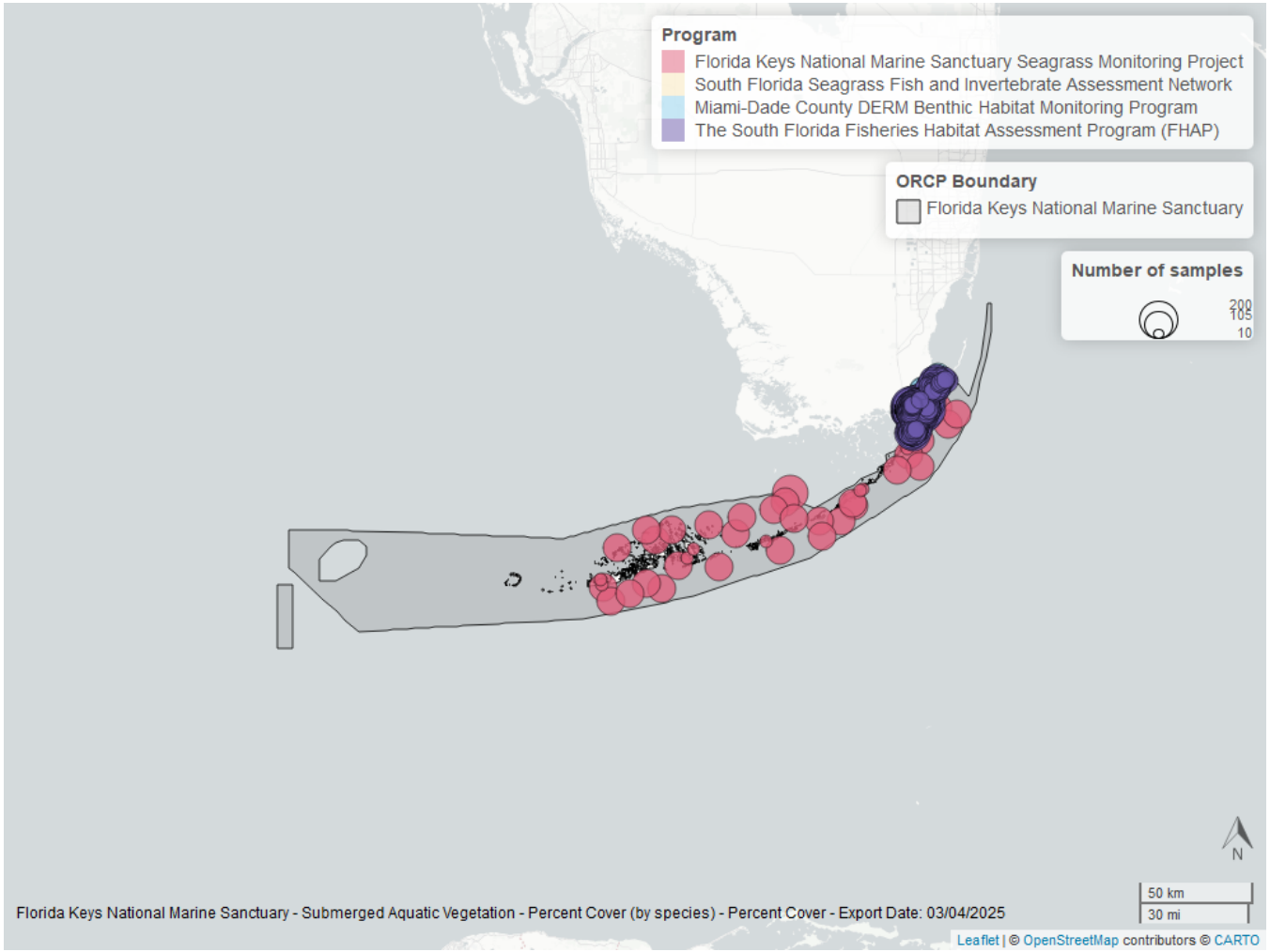

Figure 48: Map showing SAV sampling sites within the boundaries of *Florida Keys National Marine Sanctuary*. The point size reflects the number of samples at a given sampling site.

Table 46: Program Information for Submerged Aquatic Vegetation

ProgramID	*N-Data*	*YearMin*	*YearMax*	*method*	*Sample Locations*
296	4200	1996	2021	Braun Blanquet	40
965	65538	2005	2011	Braun Blanquet	87
4018	3925	1999	2023	Braun Blanquet	115
4049	104563	2005	2024	Braun Blanquet	1267
4018	279	1999	2007	Percent Cover	67

Program names:

296 - Florida Keys National Marine Sanctuary Seagrass Monitoring Project[23]
965 - South Florida Seagrass Fish and Invertebrate Assessment Network[18]
4018 - Miami-Dade County DERM Benthic Habitat Monitoring Program[27]
4018 - Miami-Dade County DERM Benthic Habitat Monitoring Program[27]
4049 - The South Florida Fisheries Habitat Assessment Program (FHAP)[15]

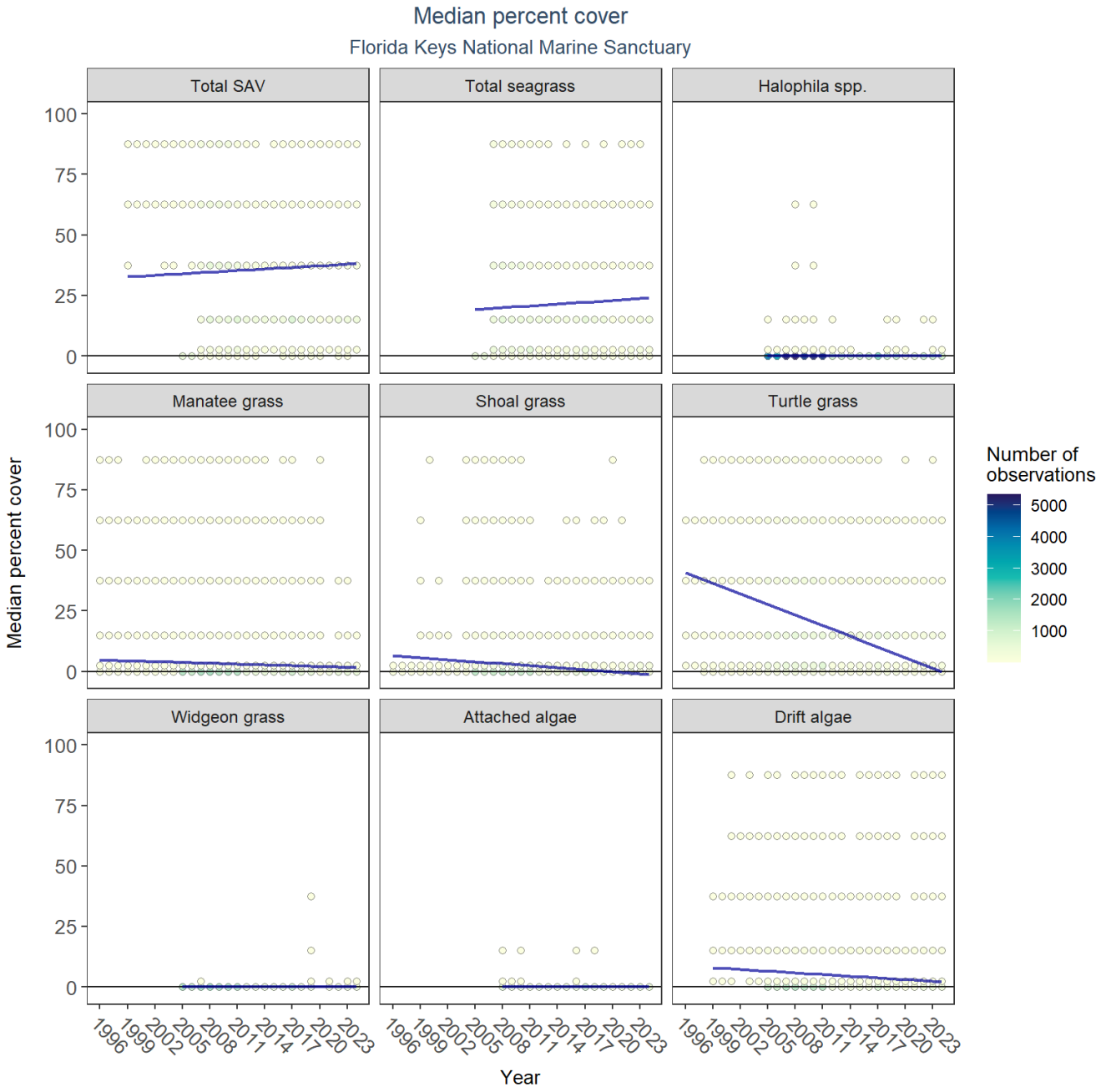

Figure 49: Scatter plots of median percent cover of submerged aquatic vegetation over time by group. Plots for time series that included five or more years of observations show the estimated trend as a blue line.

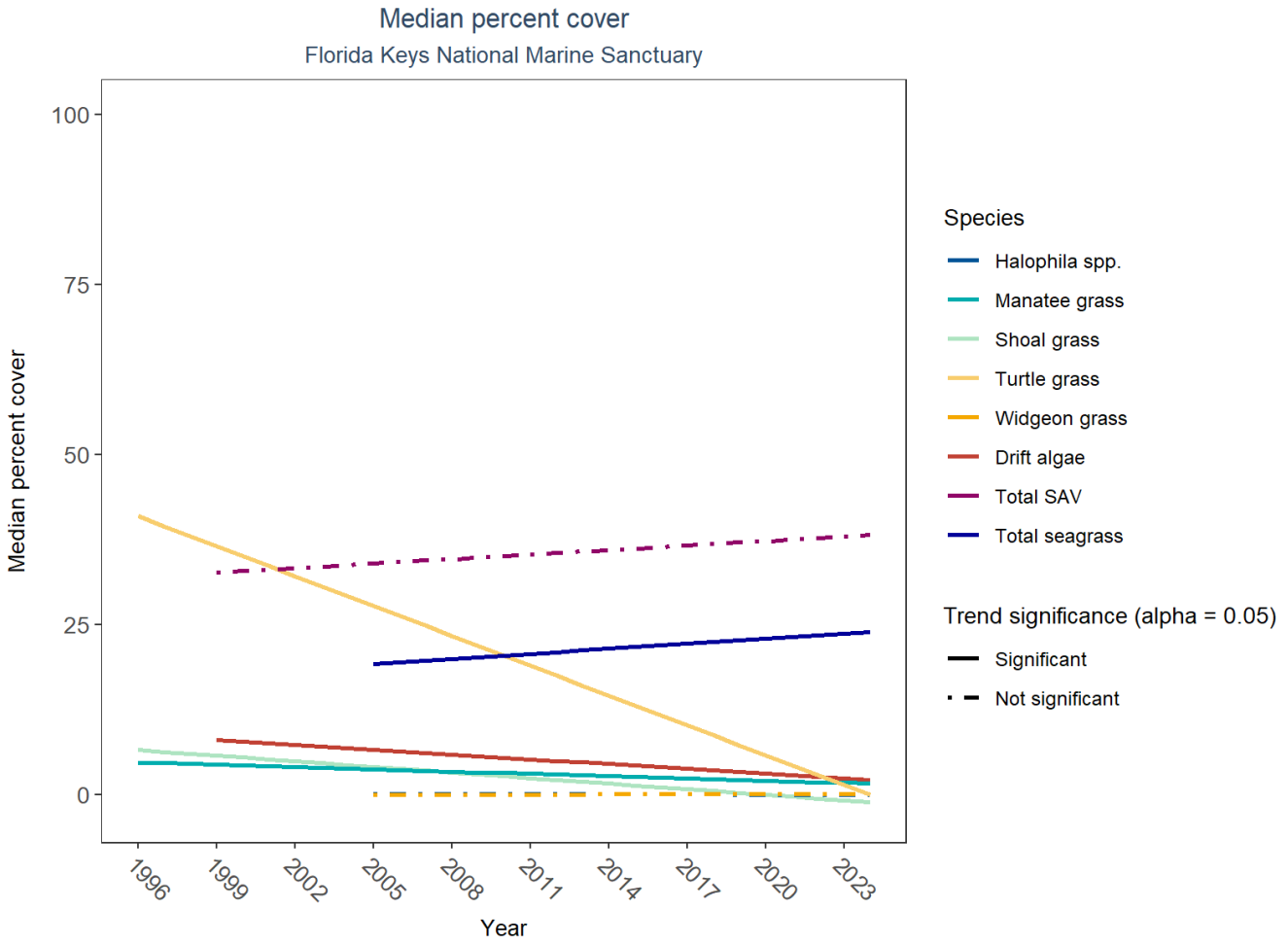

Figure 50: Trends in median percent cover for various seagrass species in Florida Keys National Marine Sanctuary - simplified

Table 47: Percent Cover Trend Analysis for Florida Keys National Marine Sanctuary

CommonName	*Trend Significance (0.05)*	*Period of Record*	*LME-Intercept*	*LME-Slope*	*p*
Attached algae	No significant trend	2008 - 2024	0.0761161	-0.0025432	0.2165299
Drift algae	Significantly decreasing trend	1999 - 2024	9.1453632	-0.2334903	0.0000182
Shoal grass	Significantly decreasing trend	1996 - 2024	7.0786462	-0.2741281	0.0001016
Halophila spp.	No significant trend	2005 - 2024	0.0749728	-0.0023143	0.3291618
Widgeon grass	No significant trend	2005 - 2024	-0.0383108	0.0028175	0.1044281
Manatee grass	Significantly decreasing trend	1996 - 2024	4.9248479	-0.1110174	0.0174460
Turtle grass	Significantly decreasing trend	1996 - 2024	43.8162349	-1.4638927	0.0000000
Total SAV	No significant trend	1999 - 2024	31.5258442	0.2203815	0.1700662
Total seagrass	Significantly increasing trend	2005 - 2024	16.4149550	0.2503526	0.0067937

An annual increase in percent cover was observed for total seagrass (0.2%). Annual decreases in percent cover were observed for manatee grass (-0.1%), shoal grass (-0.3%), turtle grass (-1.5%), and drift algae (-0.2%). Total SAV, *Halophila* spp., widgeon grass, and attached algae showed no detectable change in percent cover.

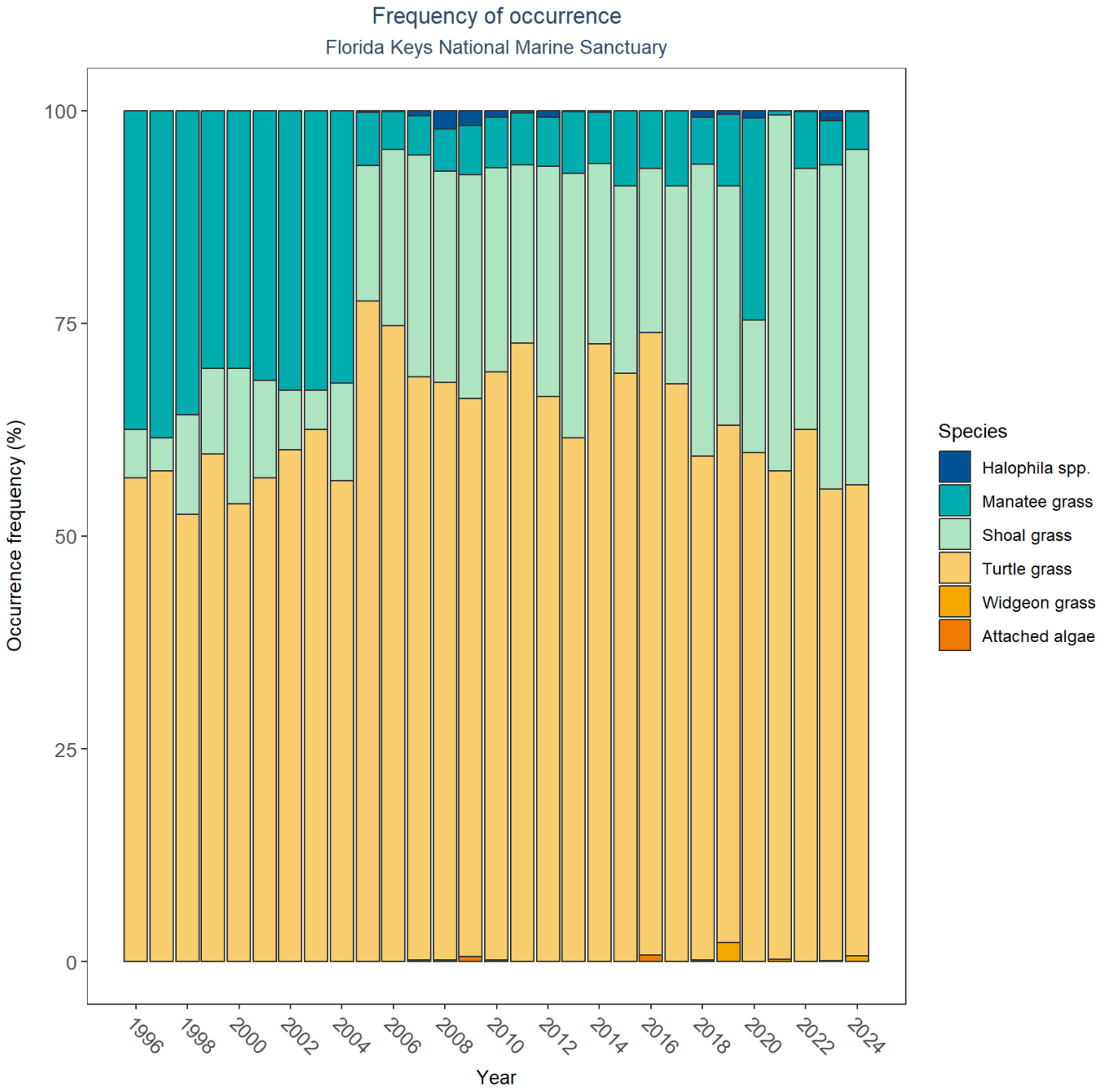

Figure 51: Frequency of occurrence for various seagrass species in Florida Keys National Marine Sanctuary

SAV Water Column Analysis

The following parameters are available for Florida Keys National Marine Sanctuary within the SAV_WC_Report:

- Colored Disolved Organic Matter
- Chlorophyll a
- Dissolved Oxygen
- Dissolved Oxygen Saturation
- pH
- Salinity

- Secchi Depth
- Water Temperature
- Total Nitrogen
- Total Suspended Solids
- Turbidity

Access the reports here: DRAFT_SAV_WC_Report_2024-11-20.pdf

Coral Reef

The data file used is: **All_CORAL_Parameters-2025-Mar-06.txt**

Percent Cover

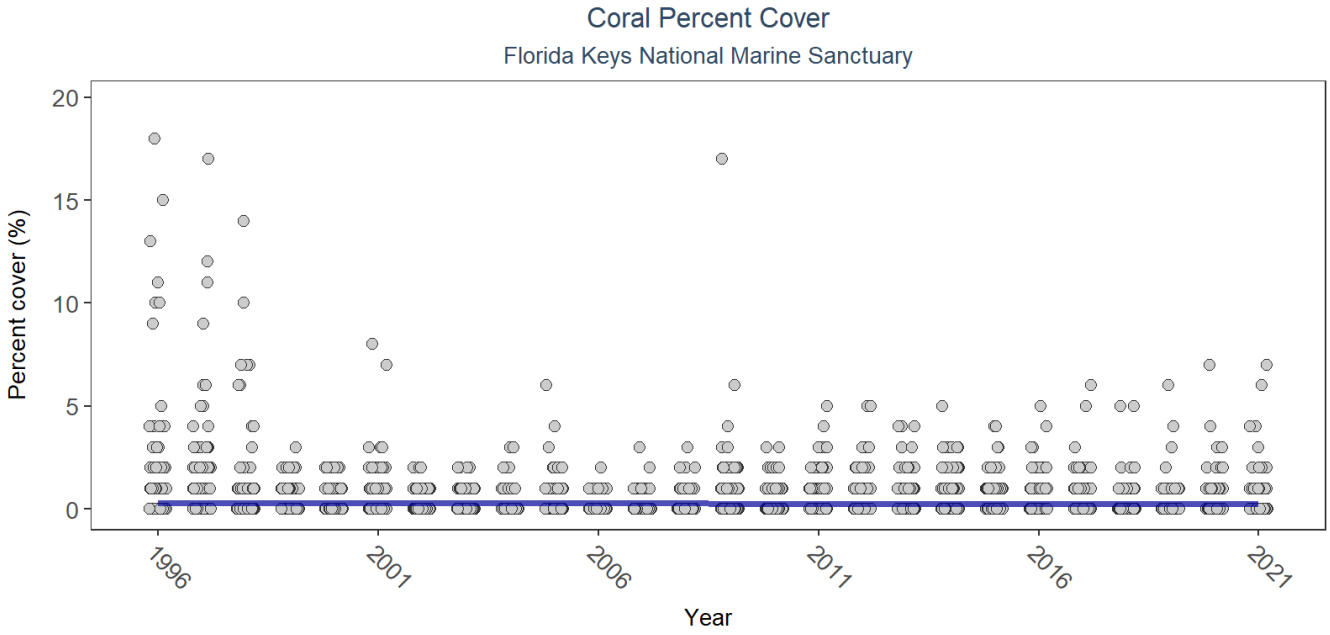

Figure 52: Scatter plot of live coral coverage over time as a percent of reef surface. Species groups include octocorals, milleporans, and scleractinians. If the time series included five or more years of observations, a significant (blue) or non-significant (magenta) trend line is also shown. Data points are jittered horizontally to reduce overlap.

Table 48: Coral Percent Cover

Statistical Trend	Period of Record	LME Intercept	LME Slope	p
No significant trend	1996 - 2021	4.96407	-0.00233	0.05266

Percent cover showed no detectable trend between 1996 and 2021.

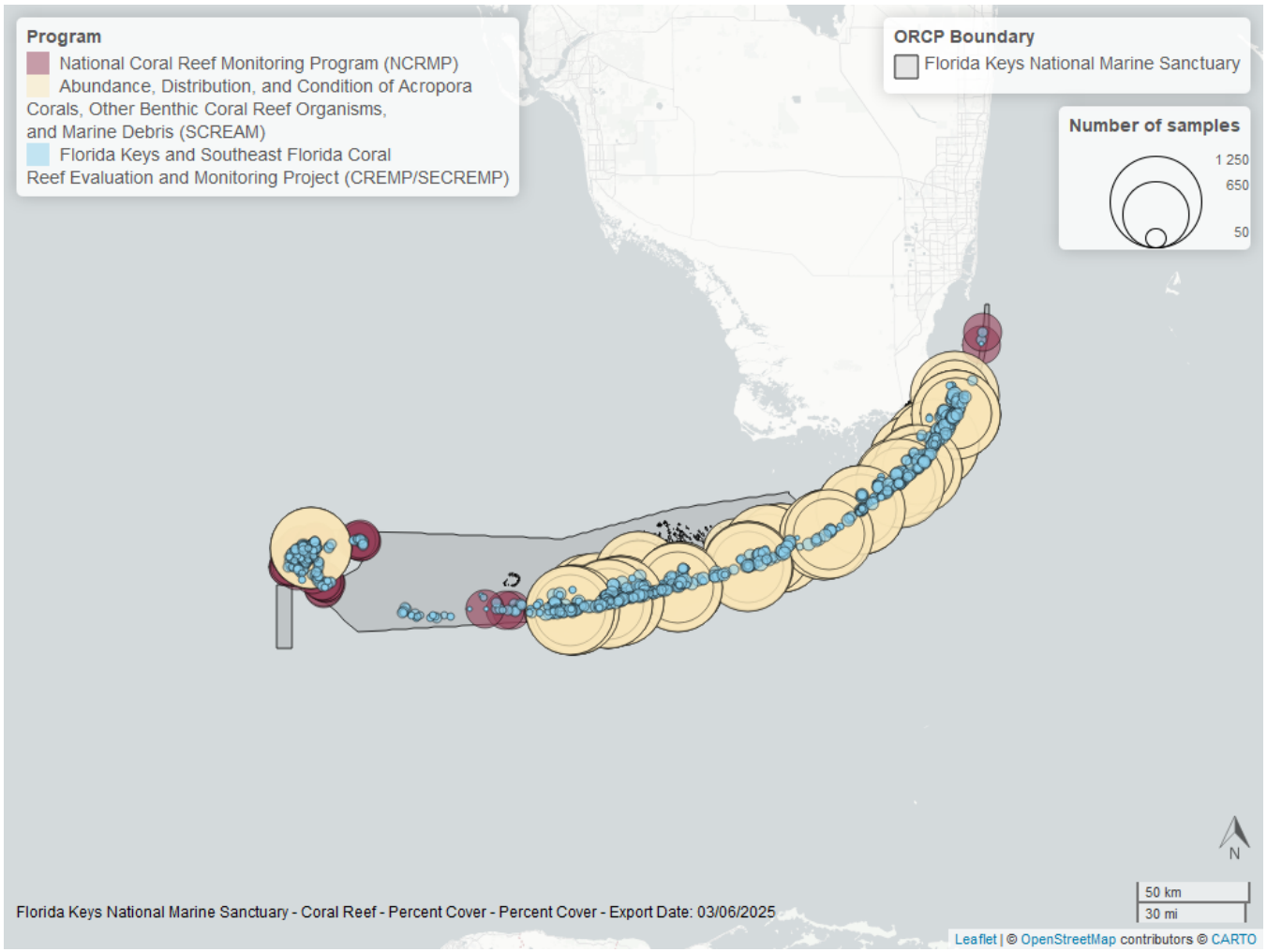

Figure 53: Map showing location of coral percent cover sampling locations within the boundaries of *Florida Keys National Marine Sanctuary*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Species Richness

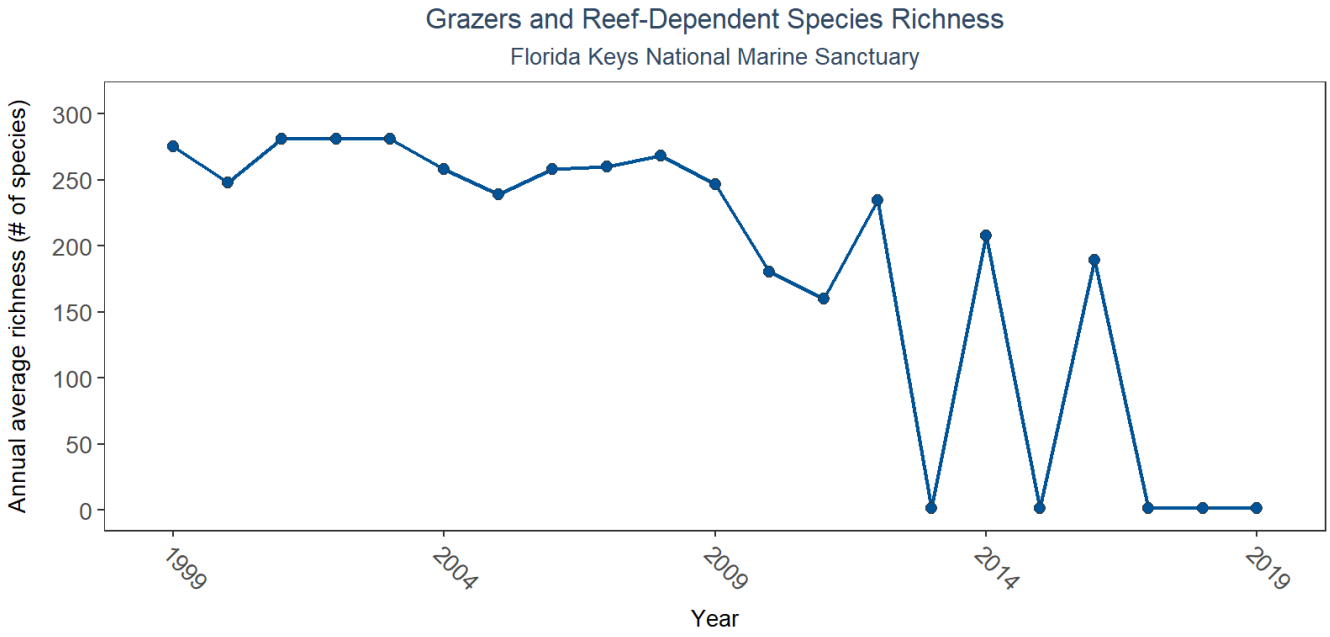

Figure 54: Line graph of annual average species richness of grazers and reef-dependent species over time. If the time series included more than one year of observations, a line connects the data points for visualization.

Table 49: Coral Species Richness

Sample Count	*Number of Years*	*Period of Record*	*Median N of Taxa*	*Mean N of Taxa*
11167	21	1999 - 2019	281	220.2253

The median annual number of taxa was 281 based on 11,167 observations collected between 1999 and 2019.

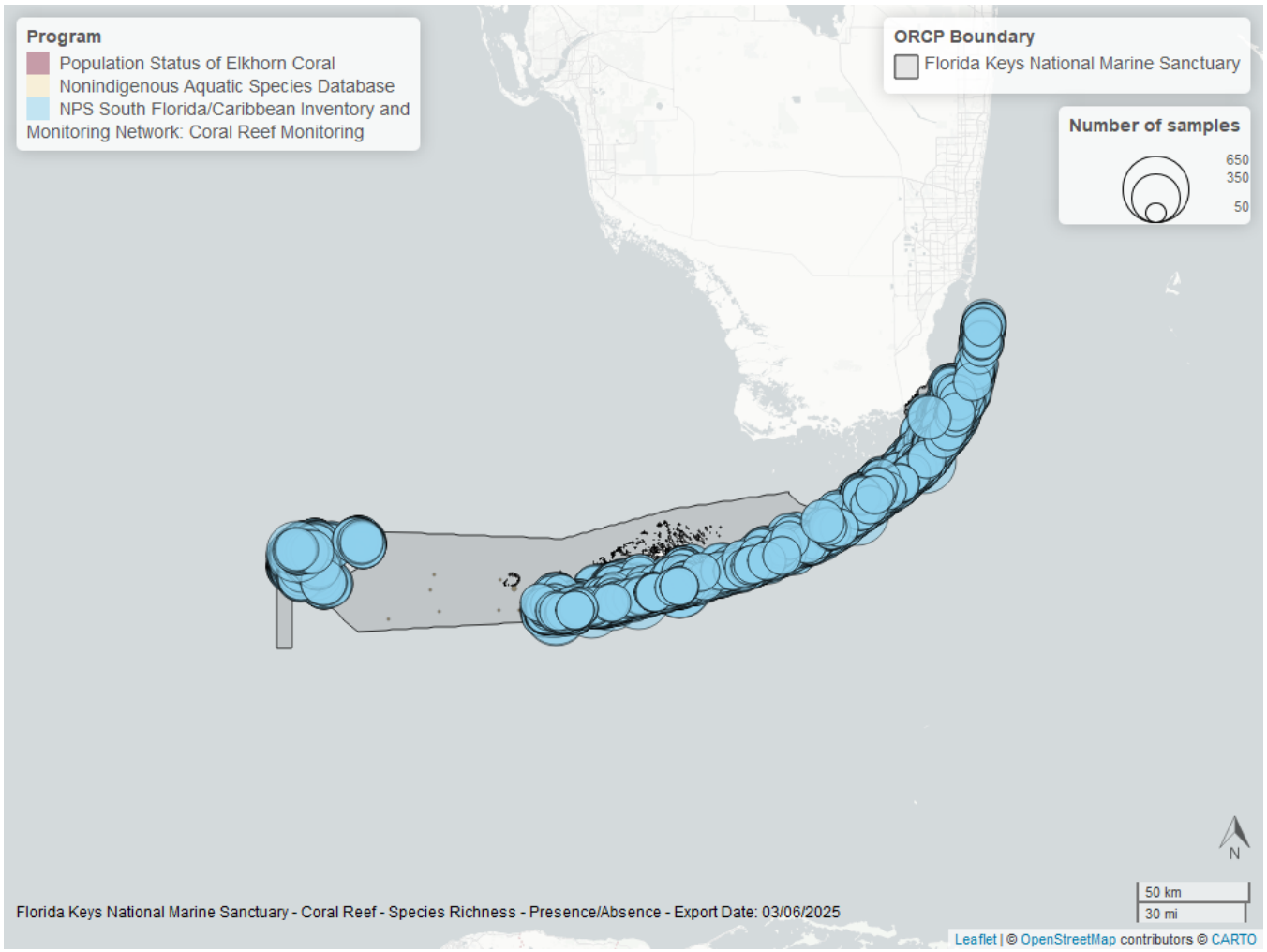

Figure 55: Map showing location of coral species richness sampling locations within the boundaries of *Florida Keys National Marine Sanctuary*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Species list

Abudefduf saxatilis[2]
Acanthemblemaria aspera[2]
Acanthemblemaria chaplini[2]
Acanthemblemaria maria[2]
Acanthemblemaria spinosa[2]
Acanthocybium solandri
Acanthophora muscoides[1]
Acanthostracion polygonium[2]
Acanthostracion quadricornis[2]
Acanthurus bahianus[2]
Acanthurus chirurgus[2]
Acanthurus coeruleus[2]
Acanthurus sp.[2]
Acetabularia sp.[1]
Acetabularia spp.[1]
Acropora cervicornis[3]
Acropora palmata[3]
Acropora prolifera[3]
Actiniaria
Aetobatus narinari
Agardhiella ramosissima[1]
Agaricia agaricites[3]
Agaricia fragilis[3]
Agaricia grahamae[3]
Agaricia humilis[3]
Agaricia lamarcki[3]
Agaricia sp.
Agaricia spp.[3]
Agaricia tenuifolia
Agaricia undata[3]
Agelas clathrodes
Agelas conifera
Agelas dispar
Agelas schmidtii
Agelas wiedenmayeri
Ahlia egmontis
Aiolochroia crassa
Albula vulpes
Alcyonacea sp.[3]
Alectis ciliaris[2]
Alphestes afer[2]
Aluterus monoceros[2]
Aluterus schoepfii[2]
Aluterus scriptus[2]
Aluterus sp.[2]
Amblycirrhitus pinos[2]
Amphimedon compressa
Amphimedon viridis
Amphiroa spp.[1]
Anadyomene linkiana[1]
Anadyomene spp.[1]
Anadyomene stellata[1]
Anchoa lyolepis
Anisotremus surinamensis[2]
Epinephelus morio[2]
Epinephelus striatus[2]
Eques lanceolatus[2]
Equetus punctatus[2]
Ernodesmis sp.[1]
Erylus formosus
Erythropodium caribaeorum[3]
Eucinostomus argenteus
Eucinostomus gula
Eucinostomus jonesii
Eunicea calyculata[3]
Eunicea flexuosa[3]
Eunicea fusca[3]
Eunicea knighti[3]
Eunicea laciniata[3]
Eunicea laxispica[3]
Eunicea mammosa[3]
Eunicea palmeri[3]
Eunicea succinea[3]
Eunicea tourneforti[3]
Eusmilia fastigiata[3]
Euthynnus alletteratus
Favia fragum[3]
Fine turf
Fistularia tabacaria[2]
Fowlerichthys ocellatus[2]
Galaxaura spp.
Galeocerdo cuvier[2]
Geodia gibberosa
Geodia neptuni
Gerres cinereus
Ginglymostoma cirratum
Gnatholepis thompsoni[2]
Gobioclinus bucciferus[2]
Gobioclinus filamentosus[2]
Gobioclinus gobio[2]
Gobioclinus kalisherae[2]
Gobiosoma sp.[2]
Gorgonia flabellum[3]
Gorgonia mariae[3]
Gorgonia ventalina[3]
Gracilaria sp.[1]
Gramma loreto[2]
Grateloupia[1]
Griffithsia[1]
Gymnothorax funebris[2]
Gymnothorax miliaris[2]
Gymnothorax moringa[2]
Gymnothorax nigromarginatus[2]
Gymnothorax saxicola[2]
Gymnothorax vicinus[2]
Haemulon album[2]
Haemulon aurolineatum[2]
Haemulon carbonarium[2]
Padina gymnospora[1]
Pagrus pagrus[2]
Palythoa mammillosa
Palythoa spp.
Pandaros acanthifolium
Parablennius marmoreus[2]
Paraclinus marmoratus[2]
Paraclinus nigripinnis[2]
Paralichthys albigutta[2]
Paranthias furcifer[2]
Pareques acuminatus[2]
Pareques umbrosus[2]
Pempheris schomburgkii[2]
Penaeus monodon
Penicillus sp.[1]
Penicillus spp.[1]
Peyssonnelia
Phaeoptyx xenus[2]
Phorbas sp.
Phyllangia americana[3]
Phymanthus crucifer
Plakortis angulospiculatus
Plexaura homomalla[3]
Plexaura kuna[3]
Plexaurella dichotoma[3]
Plexaurella grandiflora[3]
Plexaurella grisea[3]
Plexaurella nutans[3]
Polysiphonia sp.[1]
Pomacanthus arcuatus[2]
Pomacanthus paru[2]
Porifera
Porifera spp.
Porites astreoides[3]
Porites branneri[3]
Porites cf. branneri
Porites colonensis[3]
Porites divaricata[3]
Porites furcata[3]
Porites porites[3]
Porites sp.
Porites spp.[3]
Priacanthus arenatus[2]
Priolepis hipoliti[2]
Prionotus ophryas[2]
Prionotus rubio[2]
Pristipomoides aquilonaris[2]
Pristis pectinata
Prognathodes aculeatus[2]
Pseudobatos lentiginosus
Pseudodiploria clivosa[3]
Pseudodiploria strigosa[3]
Pseudoplexaura crucis[3]
Pseudoplexaura flagellosa[3]

Anisotremus virginicus[2]
Antillogorgia acerosa[3]
Antillogorgia americana[3]
Antillogorgia bipinnata[3]
Antillogorgia kallos[3]
Antillogorgia rigida[3]
Aplysina archeri
Aplysina cauliformis
Aplysina fistularis
Aplysina fulva
Aplysina lacunosa
Apogon aurolineatus[2]
Apogon binotatus[2]
Apogon maculatus[2]
Apogon phenax[2]
Apogon pseudomaculatus[2]
Apogon quadrisquamatus[2]
Apogon townsendi[2]
Archosargus probatocephalus[2]
Archosargus rhomboidalis[2]
Arturia canariensis
Astrapogon puncticulatus[2]
Astrapogon sp.[2]
Astrapogon stellatus[2]
Astroscopus guttatus
Atherinomorus stipes
Aulostomus maculatus[2]
Avrainvillea levis[1]
Axinellida
Azurina cyanea[2]
Balistes capriscus[2]
Balistes sp.[2]
Balistes vetula[2]
Bare substrate
Bartholomea annulata
Batophora oerstedii[1]
Batophora spp.[1]
Blenniidae sp.[2]
Bodianus pulchellus[2]
Bodianus rufus[2]
Bollmannia boqueronensis[2]
Bothus lunatus[2]
Bothus ocellatus[2]
Brachygenys chrysargyreum[2]
Branching gorgonian[3]
Briareum asbestinum[3]
Brockius nigricinctus[2]
Brotula barbata
Brown algae[1]
Bryopsis[1]
Bryozoa
Calamus bajonado[2]
Calamus calamus[2]
Calamus leucosteus[2]
Calamus nodosus[2]
Calamus penna[2]
Calamus proridens[2]
Haemulon flavolineatum[2]
Haemulon macrostomum[2]
Haemulon melanurum[2]
Haemulon parra[2]
Haemulon plumierii[2]
Haemulon sciurus[2]
Haemulon sp.[2]
Haemulon striatum[2]
Haemulon vittatum[2]
Halichoeres bivittatus[2]
Halichoeres caudalis[2]
Halichoeres cyanocephalus[2]
Halichoeres garnoti[2]
Halichoeres maculipinna[2]
Halichoeres pictus[2]
Halichoeres poeyi[2]
Halichoeres radiatus[2]
Haliclona (Reneira) aquaeductus
Haliclona (Reniera) tubifera
Haliclona sp.
Halimeda spp.[1]
Halisarca sp.
Halodule wrightii[1]
Halophila decipiens[1]
Halophila engelmannii[1]
Halophila johnsonii[1]
Halophila sp.[1]
Harengula humeralis
Harengula jaguana
Helioseris cucullata[3]
Hemiemblemaria simula[2]
Hemiramphus brasiliensis
Heteroconger longissimus
Heteropriacanthus cruentatus[2]
Higginsia strigilata
Hippocampus erectus[2]
Hippocampus reidi[2]
Hippospongia sp.
Holacanthus bermudensis[2]
Holacanthus ciliaris[2]
Holacanthus tricolor[2]
Holocentrus adscensionis[2]
Holocentrus rufus[2]
Hydrozoa
Hypanus americanus
Hypleurochilus bermudensis[2]
Hypnea[1]
Hypoatherina harringtonensis
Hypoglossum[1]
Hypoplectrus chlorurus[2]
Hypoplectrus gemma[2]
Hypoplectrus gummigutta[2]
Hypoplectrus guttavarius[2]
Hypoplectrus hybrid[2]
Hypoplectrus indigo[2]
Hypoplectrus nigricans[2]
Hypoplectrus puella[2]
Pseudoplexaura porosa[3]
Pseudoplexaura wagenaari[3]
Pseudupeneus maculatus[2]
Ptereleotris calliura
Ptereleotris helenae
Pterocladiella sanctarum[1]
Pterogorgia anceps[3]
Pterogorgia citrina[3]
Pterogorgia guadalupensis[3]
Pterois miles[2]
Pterois volitans[2]
Ptilocaulis sp.
Rachycentron canadum
Ramicrusta spp.
Razorfish sp.[2]
Red calcareous branching algae
Red frondose algae
Remora remora
Rhinoptera bonasus
Rhipocephalus[1]
Rhipocephalus phoenix[1]
Rhipocephalus spp.[1]
Rhodactis osculifera
Rhomboplites aurorubens[2]
Ricordea florida
Rubble
Ruppia maritima[1]
Rypticus bistrispinus[2]
Rypticus maculatus[2]
Rypticus saponaceus[2]
Sand-sand
Sand on hard-bottom
Sardinella aurita
Sargassum sp.[1]
Sargassum spp.[1]
Sargocentron bullisi[2]
Sargocentron coruscum[2]
Sargocentron vexillarium[2]
Scartella cristata[2]
Scarus coelestinus[2]
Scarus coeruleus[2]
Scarus guacamaia[2]
Scarus iseri[2]
Scarus sp.[2]
Scarus taeniopterus[2]
Scarus vetula[2]
Schizothrix calcicola
Schultzea beta[2]
Scianid sp.[2]
Scleractinia[3]
Scolymia cubensis[3]
Scolymia lacera
Scolymia sp.[3]
Scolymia spp.[3]
Scomberomorus cavalla
Scomberomorus maculatus
Scomberomorus regalis

Calcareous green algae[1]
Callionymus bairdi[2]
Callyspongia (Callyspongia) fallax
Callyspongia (Cladochalina) aculeata
Callyspongia (Cladochalina) plicifera
Callyspongia (Cladochalina) tenerrima
Calyx podatypa
Cantherhines macrocerus[2]
Cantherhines pullus[2]
Canthidermis sufflamen[2]
Canthigaster rostrata[2]
Caranx bartholomaei[2]
Caranx crysos[2]
Caranx hippos[2]
Caranx latus[2]
Caranx lugubris[2]
Caranx ruber[2]
Caranx sp.[2]
Carcharhinus falciformis
Carcharhinus leucas
Carcharhinus limbatus
Carcharhinus obscurus
Carcharhinus perezii
Carcharhinus plumbeus
Caulerpa spp.[1]
Centroceras sp.[1]
Centropomus undecimalis
Centropristis ocyurus[2]
Centropristis striata[2]
Centropyge argi[2]
Cephalopholis cruentata[2]
Cephalopholis fulva[2]
Ceramium[1]
Chaenopsis limbaughi[2]
Chaetodipterus faber
Chaetodon capistratus[2]
Chaetodon ocellatus[2]
Chaetodon sedentarius[2]
Chaetodon striatus[2]
Chaetomorpha linum[1]
Champia parvula[1]
Chara spp.[1]
Chilomycterus antennatus[2]
Chilomycterus reticulatus[2]
Chilomycterus schoepfii[2]
Chloroscombrus chrysurus[2]
Chondria capillaris[1]
Chondrilla nucula
Chondrosia sp.
Chriodorus atherinoides
Chromis enchrysurus[2]
Chromis insolata[2]
Chromis multilineata[2]
Chromis scotti[2]
Cinachyra sp.
Cladocephalus[1]
Cladocora arbuscula[3]
Hypoplectrus sp.[2]
Hypoplectrus tann[2]
Hypoplectrus unicolor[2]
Hyporthodus flavolimbatus[2]
Hyporthodus niveatus[2]
Hyrtios violaceus
Iciligorgia schrammi[3]
Iotrochota birotulata
Ircinia campana
Ircinia felix
Ircinia strobilina
Ircinia variabilis
Isophyllia rigida[3]
Isophyllia sinuosa[3]
Isophyllia sp.
Istiophorus platypterus
Jania spp.[1]
Jenkinsia sp.
Kallymenia spp.
Kyphosus sectatrix[2]
Labrisomidae sp.[2]
Labrisomus nuchipinnis[2]
Lachnolaimus maximus[2]
Lactophrys bicaudalis[2]
Lactophrys trigonus[2]
Lactophrys triqueter[2]
Lagodon rhomboides[2]
Laurencia spp.[1]
Lebrunia neglecta
Liagora spp.
Liopropoma eukrines[2]
Liopropoma mowbrayi[2]
Liopropoma rubre[2]
Lobophora spp.
Lutjanus analis[2]
Lutjanus apodus[2]
Lutjanus buccanella[2]
Lutjanus campechanus[2]
Lutjanus cyanopterus[2]
Lutjanus griseus[2]
Lutjanus jocu[2]
Lutjanus mahogoni[2]
Lutjanus synagris[2]
Macroalgae
Madracis auretenra[3]
Madracis carmabi[3]
Madracis decactis[3]
Madracis formosa[3]
Madracis myriaster[3]
Madracis senaria[3]
Madracis sp.
Madracis spp.[3]
Malacanthus plumieri
Malacoctenus aurolineatus[2]
Malacoctenus gilli[2]
Malacoctenus macropus[2]
Malacoctenus triangulatus[2]
Scopalina ruetzleri
Scorpaena plumieri[2]
Scorpaenodes caribbaeus[2]
Selachii
Selene vomer[2]
Seriola dumerili[2]
Seriola rivoliana[2]
Seriola sp.[2]
Seriola zonata[2]
Serranid sp.[2]
Serranus annularis[2]
Serranus baldwini[2]
Serranus phoebe[2]
Serranus subligarius[2]
Serranus tabacarius[2]
Serranus tigrinus[2]
Serranus tortugarum[2]
Siderastrea radians[3]
Siderastrea siderea[3]
Siderastrea sp.
Siderastrea spp.
Silt on hard-bottom
Siphonodictyon coralliphagum
Siphonodictyon siphonum
Snapper sp.[2]
Solenastrea bournoni[3]
Solenastrea hyades[3]
Solenastrea sp.
Solenastrea spp.[3]
Sparidae sp.[2]
Sparisoma atomarium[2]
Sparisoma aurofrenatum[2]
Sparisoma chrysopterum[2]
Sparisoma radians[2]
Sparisoma rubripinne[2]
Sparisoma sp.[2]
Sparisoma viride[2]
Spermothamnion[1]
Spheciospongia vesparium
Sphoeroides[2]
Sphoeroides nephelus[2]
Sphoeroides spengleri[2]
Sphoeroides testudineus[2]
Sphyraena barracuda[2]
Sphyraena guachancho
Sphyraena picudilla
Sphyrna lewini
Sphyrna mokarran
Sphyrna tiburo
Spirastrella coccinea
Spirastrella mollis
Spongia sp.
Spyridia filamentosa[1]
Squirrelfish sp.[2]
Stegastes adustus[2]
Stegastes diencaeus[2]
Stegastes leucostictus[2]

Cladophora[1]
Clathria (Thalysias) venosa
Clathria (Thalysias) virgultosa
Clathria sp.
Clepticus parrae[2]
Cliona caribbaea
Cliona delitrix
Cliona sp.
Cliona spp.
Cliona varians
Colpophyllia natans[3]
Colpophyllia spp.[3]
Condylactis gigantea
Corallimorpharians
Coralliophila erosa
Coryphopterus dicrus[2]
Coryphopterus eidolon[2]
Coryphopterus glaucofraenum[2]
Coryphopterus lipernes[2]
Coryphopterus personatus[2]
Coryphopterus punctipectophorus[2]
Coryphopterus sp.[2]
Cribrochalina vasculum
Crustose coralline algae[1]
Cryptotomus roseus[2]
Ctenogobius saepepallens[2]
Cyanobacteria
Cyanophyta spp.
Dactylopterus volitans
Dasya sp.[1]
Dasycladus[1]
Decapterus macarellus[2]
Decapterus punctatus[2]
Decapterus sp.[2]
Dendrogyra cylindrus[3]
Derbesia[1]
Dermatolepis inermis[2]
Desmapsamma anchorata
Diadema antillarum
Dichocoenia stokesii[3]
Dictyosphaeria[1]
Dictyota spp.[1]
Diodon holocanthus[2]
Diodon hystrix[2]
Diodon sp.[2]
Diplastrella megastellata
Diplectrum formosum[2]
Diplodus argenteus[2]
Diplodus holbrookii[2]
Diploria labyrinthiformis[3]
Diploria sp.
Diploria spp.[3]
Discosoma carlgreni
Doratonotus megalepis[2]
Dragmacidon lunaecharta
Drift red algae[1]
Dysidea etheria
Malacoctenus versicolor[2]
Manicina areolata[3]
Meandrina jacksoni
Meandrina meandrites[3]
Megalops atlanticus
Melichthys niger[2]
Menidia sp.
Microgobius carri[2]
Microgobius microlepis[2]
Microspathodon chrysurus[2]
Millepora alcicornis[3]
Millepora complanata[3]
Millepora spp.[3]
Mobula birostris
Monacanthus ciliatus[2]
Monacanthus tuckeri[2]
Monanchora arbuscula
Montastraea cavernosa[3]
Mulloidichthys martinicus[2]
Muraena retifera[2]
Muricea atlantica[3]
Muricea elongata[3]
Muricea laxa[3]
Muricea muricata[3]
Muricea pinnata[3]
Muriceopsis flavida[3]
Mussa angulosa[3]
Mycale (Mycale) laevis
Mycale sp.
Mycetophyllia aliciae[3]
Mycetophyllia danaana[3]
Mycetophyllia ferox[3]
Mycetophyllia lamarckiana[3]
Mycetophyllia sp.
Mycetophyllia spp.[3]
Mycteroperca acutirostris[2]
Mycteroperca bonaci[2]
Mycteroperca interstitialis[2]
Mycteroperca microlepis[2]
Mycteroperca phenax[2]
Mycteroperca tigris[2]
Mycteroperca venenosa[2]
Myrichthys breviceps
Myrichthys ocellatus
Myripristis jacobus[2]
Narcine bancroftii
Needlefish sp.
Negaprion brevirostris
Neofibularia nolitangere
Neomeris[1]
Neoniphon marianus[2]
Neopetrosia carbonaria
Nes longus[2]
Nicholsina usta[2]
Niphates amorpha
Niphates digitalis
Niphates erecta
Stegastes partitus[2]
Stegastes planifrons[2]
Stegastes sp.[2]
Stegastes variabilis[2]
Stephanocoenia intersepta[3]
Stephanolepis hispida[2]
Stichodactyla helianthus
Strongylacidon sp.
Strongylura notata[2]
Strongylura timucu
Stygnobrotula latebricola
Stypopodium spp.
Substrate
Syacium micrurum[2]
Syngnathus scovelli[2]
Syngnathus sp.[2]
Synodus foetens[2]
Synodus intermedius[2]
Synodus synodus[2]
Syringodium filiforme[1]
Tectitethya crypta
Tedania (Tedania) ignis
Tethya diploderma
Thalassia testudinum[1]
Thalassoma bifasciatum[2]
Thick turf
Tigrigobius macrodon[2]
Tigrigobius saucrus[2]
Total brown algae[1]
Total calcareous green algae[1]
Total green algae[1]
Total macroalgae[1]
Total other green algae[1]
Total other red algae[1]
Total SAV[1]
Total seagrass[1]
Trachinotus falcatus[2]
Trachinotus goodei[2]
Trachurus lathami[2]
Trachyteleia hispida
Tunicata
Turbinaria turbinata
Turf algae free of sediment
Turf algae with sediment
Tylosurus crocodilus
Udotea[1]
Udotea spp.[1]
Ulaema lefroyi
Ulva sp.[1]
Umbrina coroides[2]
Undaria sp.
Unidentified mangrove
Unidentified species
Unknown black smooth encrusting sponge
Unknown bowling ball sponge
Unknown brown encrusting sponge
Unknown brown smooth sponge

Dysidea fragilis	Octocorallia[3]	Unknown brown tube sponge
Dysidea janiae	Oculina diffusa[3]	Unknown brown vein sponge
Echeneis naucrates	Oculina robusta[3]	Unknown green encrusting sponge
Echeneis neucratoides	Oculina sp.	Unknown olive sponge
Echinoidea	Ocyurus chrysurus[2]	Unknown orange encrusting sponge
Ectyoplasia ferox	Odontoscion dentex[2]	Unknown orange massive sponge
Elacatinus dilepis[2]	Ogcocephalus nasutus[2]	Unknown pink lumpy sponge
Elacatinus evelynae[2]	Ogcocephalus sp.	Unknown red encrusting sponge
Elacatinus horsti[2]	Oligoplites saurus[2]	Unknown red lumpy tube sponge
Elacatinus oceanops[2]	Ophioblennius macclurei[2]	Unknown red squishy sponge
Elacatinus randalli[2]	Opistognathus aurifrons	Upeneus parvus[2]
Elacatinus xanthiprora[2]	Opistognathus macrognathus	Urobatis jamaicensis
Elagatis bipinnulata[2]	Opistognathus sp.	Valonia[1]
Elops saurus	Opistognathus whitehursti	Verongula gigantea
Emblemaria pandionis[2]	Opsanus tau[2]	Verongula reiswigi
Emblemariopsis bahamensis[2]	Orbicella annularis[3]	Verongula rigida
Emmelichthyops atlanticus[2]	Orbicella faveolata[3]	Wrightiella[1]
Enchelycore carychroa[2]	Orbicella franksi[3]	Xestospongia muta
Enchelycore nigricans[2]	Orbicella sp.	Xyrichtys martinicensis[2]
Encrusting gorgonian[3]	Orthopristis chrysoptera[2]	Xyrichtys novacula[2]
Enneanectes altivelis	Other calcareous macroalgae	Xyrichtys splendens[2]
Enneanectes boehlkei	Other coral	Zanclus cornutus
Epinephelus adscensionis[2]	Other fleshy macroalgae	Zoanthidae
Epinephelus drummondhayi[2]	Other green algae[1]	Zoanthids
Epinephelus guttatus[2]	Other red algae[1]	Abudefduf saxatilis[2]
Epinephelus itajara[2]	Oxyurichthys stigmalophius[2]	Acanthemblemaria aspera[2]

1 - Submerged Aquatic Vegetation, 2 - Coral Reef - Species Richness, 3 - Coral Reef - Percent Cover

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