FLORIDA LANDSCAPE CONSERVATION PROJECT – SALTWATER MARSH AND MANGROVE INDICATOR ASSESSMENT

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FWRI – FWC

Landscape Conservation

Systems-level, integrative and collaborative framework across geographies, jurisdictions, sectors and cultures to "re-weave" fragmented landscapes and safeguard the ecological, cultural and economic benefits they provide.

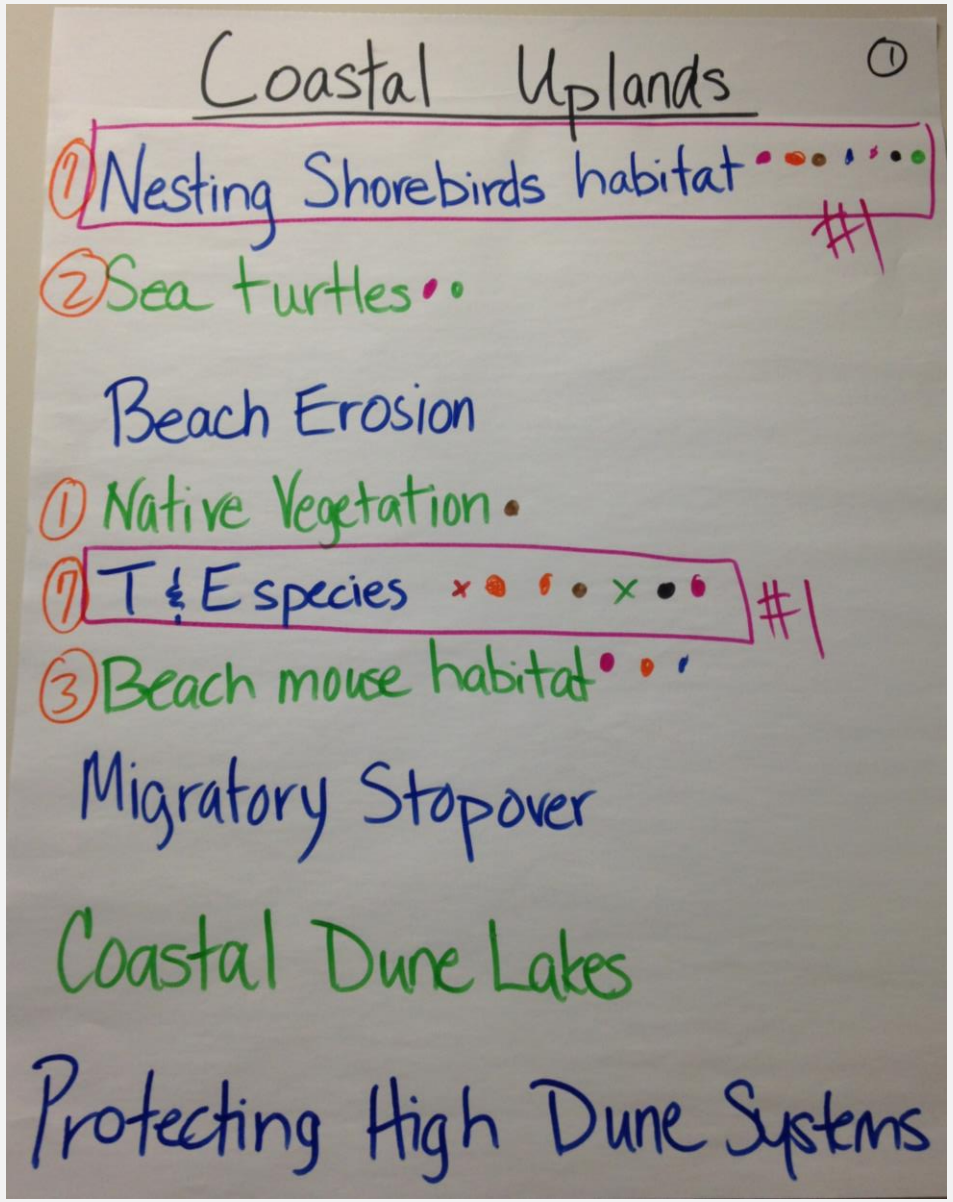
A shift in:

- Geographic scale
- Perspective
- Process

Conservation Assets are the set of biological, ecological, and cultural features and ecological processes collaboratively **identified as most important** and are the focus of Florida's planning.

Indicators are the measurable expressions of desired resource conditions. More specifically, indicators are the quantifiable biological, chemical, physical, or cultural attributes of a landscape that are important or valued to stakeholders identified during the biological planning process.

ASSET & INDICATOR IDENTIFICATION



1. Brainstorm list of indicators for each conservation asset at a series of workshops (2017)
   1. Participants prioritized which indicators staff would review first.
2. Data search & indicator finalization
   1. Established indicators already in use.
   2. Data to develop an indicator - must be an intention to continue data collection into the future, spatially widespread sampling throughout system.

Indicators should:
Represents important attributes of the conservation

Responds to environmental variation (anthropogenic or natural)

Responds to and allows for the evaluation of conservation and management actions

CURRENT MARINE INDICATORS

Asset		Indicator	Notes
Mangrove Swamp	Extent Runoff/hydrology Water quality*	Inland migration Fish diversity	* Analytes: Nitrate, Nitrite, Ammonia, pH, Total Phosphorus
Saltwater Marsh	Extent Runoff/hydrology Water quality*	Inland migration Fish diversity	

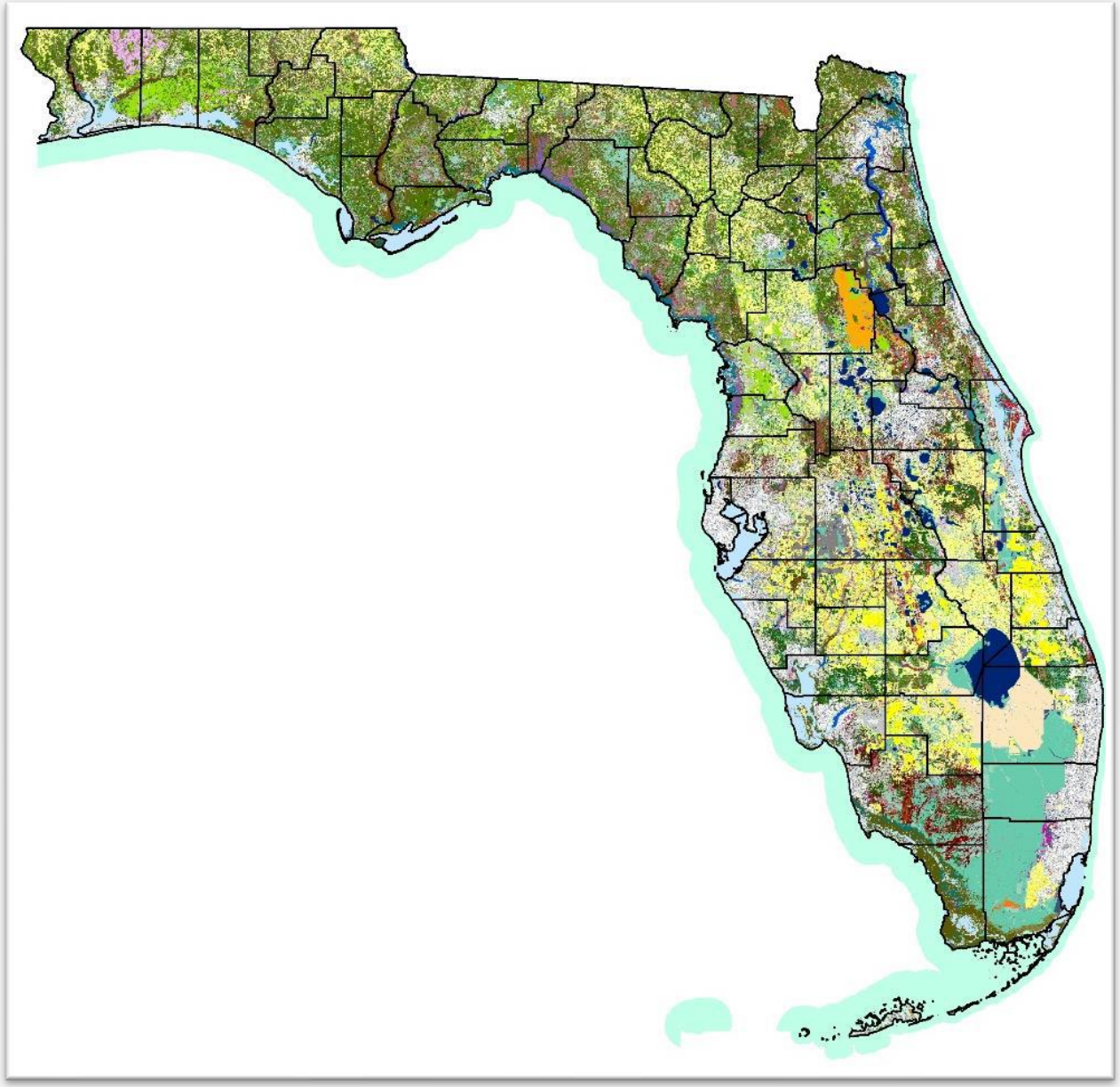
DATABASES AND DATASETS

- Cooperative Land Cover Map (CLC) FWRI – FWC
- Fisheries Independent Monitoring (FIM) FWRI – FWC
- National Estuarine Research Reserve System within Florida (ANERR, GTMNERR, RBNERR) NOAA
- NAVTEC Roads NAVTEC
- South Florida Water Quality Monitoring Program AOML – NOAA
- Storage and Retrieval Data Retrieval (STORET) EPA
- Watershed Information Network (WIN) Florida DEP

Coastal Habitat Integrated Mapping and Monitoring Program

- Florida DOT
- Northwest Florida Water Management District
- Suwannee River Water Management District
- Southwest Florida Water Management District
- South Florida Water Management District
- St. John's River Water Management District

COOPERATIVE LAND COVER (CLC) MAP



METHODS

Spatial Analysis

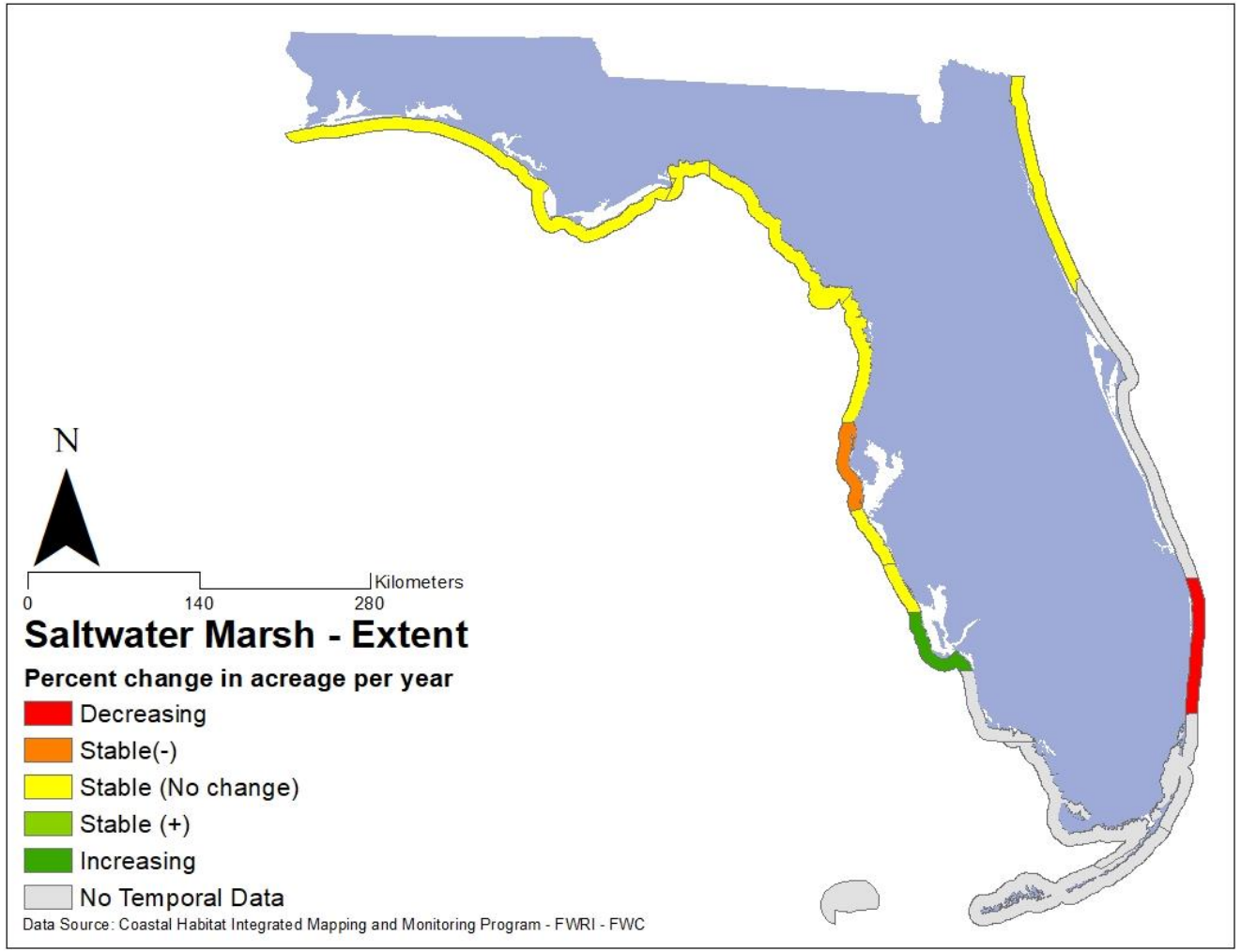
- Extent
  - IMMP assessments
    - Seagrass species composition and meadow texture
  - Margin of error (+/- 0.5%) associated with mapping errors
- Fish Diversity
  - FIM database
  - Point location and samples within 300 – meters
  - Species richness, Menhinick's index, Shannon-Weiner index, Gini-Simpson index
    - Full Reef Visual Census (RVC; NOAA) used for coral
- Water Quality
  - Parameter sample locations within 300 – meters
- Runoff/Hydrology
  - Road density
    - Road length / asset area (w/100 – meter buffer)
    - Includes paved and rural (i.e. dirt) roads
- Inland Migration
  - Modified Cooperative Land Cover map intersected with 300 – meter buffer around asset
  - Potential inland habitat further classified as 'Low', 'Moderate', 'High'
    - i.e. Natural habitats = 'High', Urban = 'Low'

METHODS

Indicator Condition

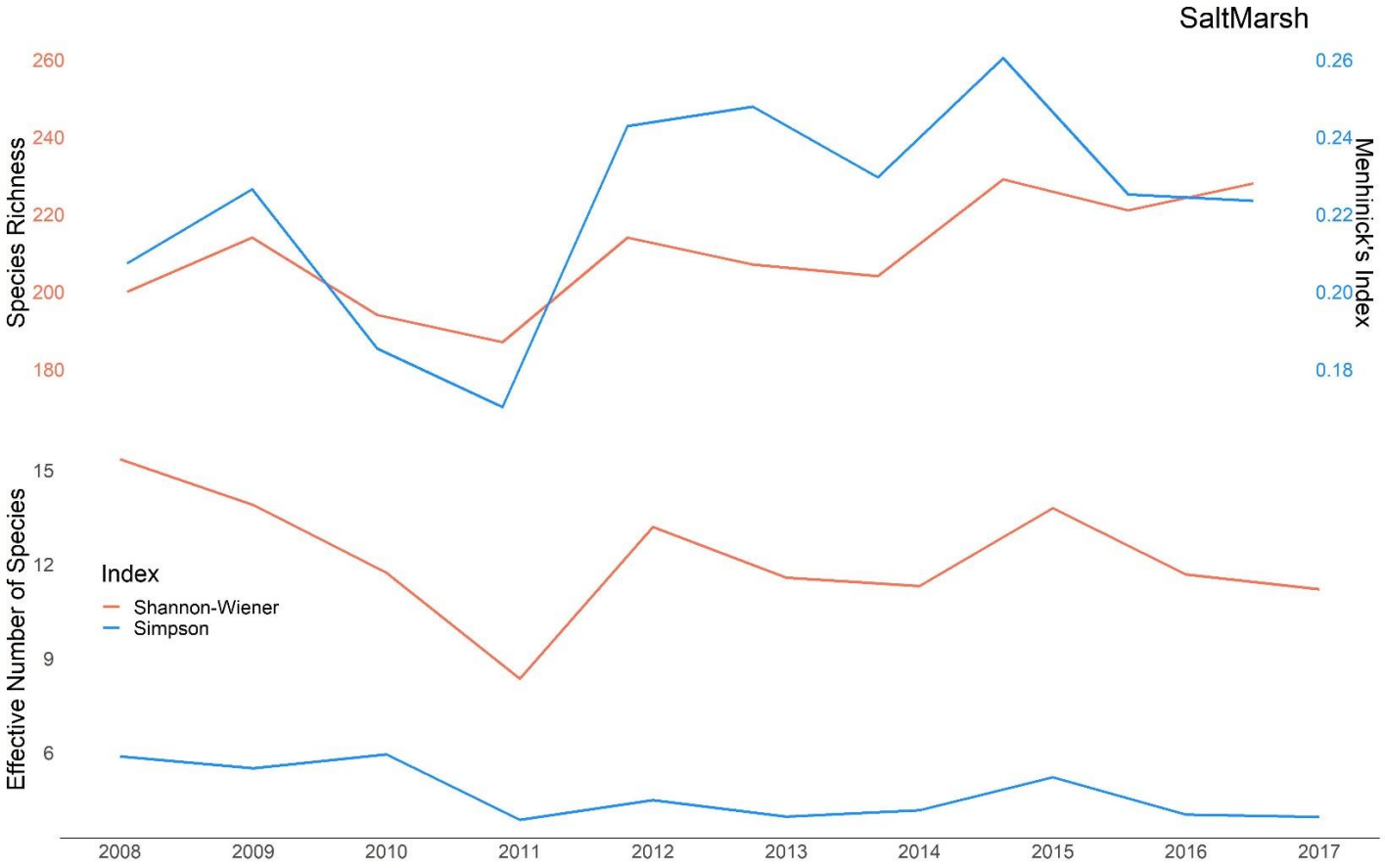
- Trends used to assess condition
  - Percent change per year
    - SIMM approach to extent change
  - Five-year, Three-year, One-year change considered
  - Condition assigned according to change:
    - ≤ -1.0 = "Decreasing"
    - > -1.0 but < 0 = "Stable (-)"
    - = 0 = "Stable (No change)"
    - > 0 but < 1.0 = "Stable (+)"
    - ≥ 1.0 = "Increasing"
    - Lacking data multiple years of data or years of concern = "No Temporal Data"
- Asset-wide and regional data analyzed and assessed
  - Assess the where for conservation actions
- Trends serve as triggers for conservation/management actions

SALTWATER MARSH - EXTENT



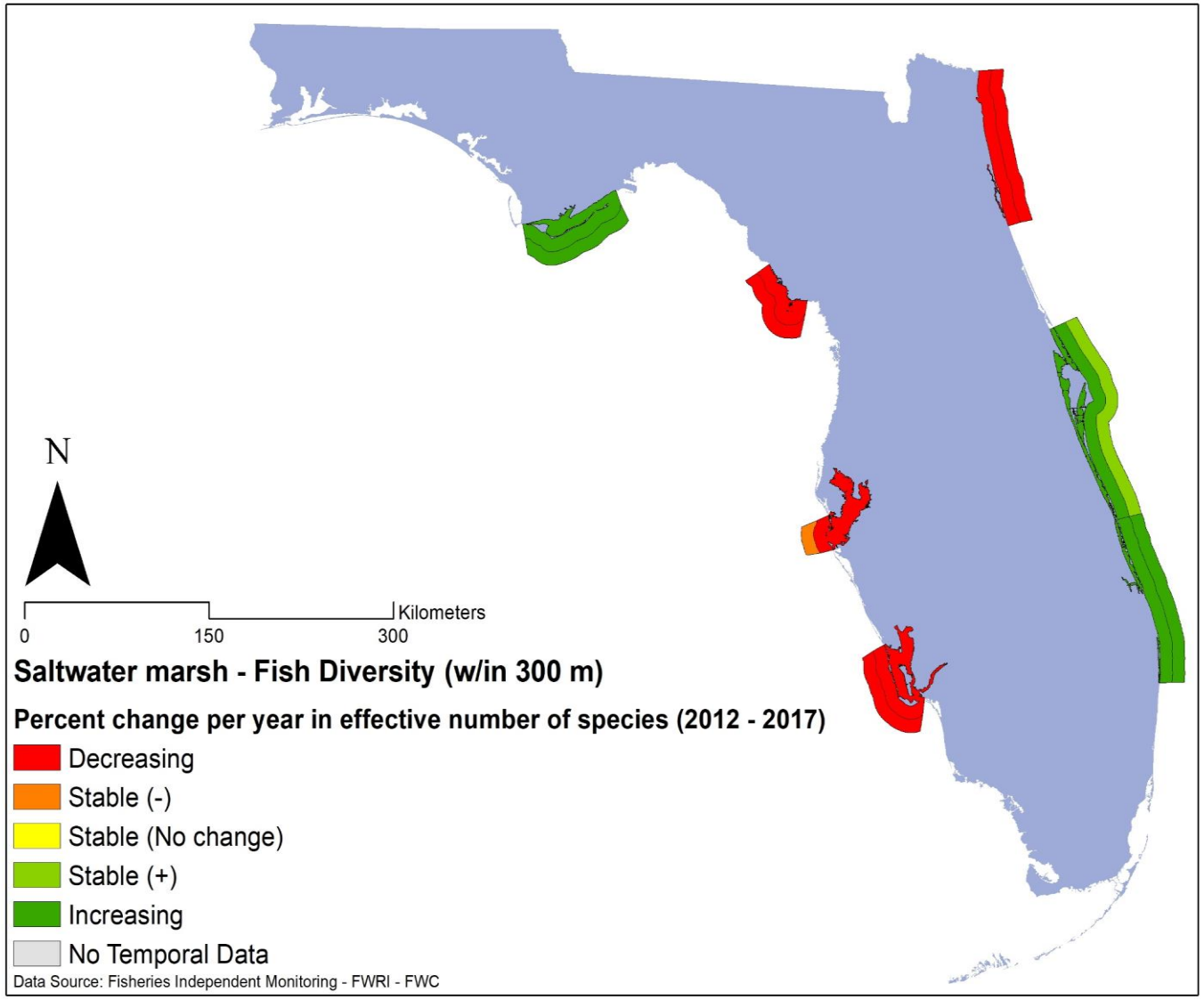
	Previous		Most Recent		Percent Change per Year	Condition
Estuary/region	Year	Acres	Year	Acres		
Northwest Florida	2006/07	36843	2009/10	36804	-0.04 %	Stable (No change)
Big Bend & Springs Coast (NWFWMD)	2006/07	20619	2009	20455	-0.27 %	Stable (No change)
Big Bend & Springs Coast (SRWMD)	2006/08	65772	2010/11	64672	-0.42 %	Stable (No change)
Big Bend & Springs Coast (SWFWMD)	2010	52620	2011	52442	-0.34 %	Stable (No change)
Tampa Bay	2010	4640	2011	4603	-0.80 %	Stable (-)
Sarasota Bay	2010	92	2011	92	0.00 %	Stable (No change)
Charlotte Harbor & Estero Bay (SWFWMD)	2010	7546	2011	7571	0.33 %	Stable (No change)
Charlotte Harbor & Estero Bay (SFWMD)	2004/05	4160	2008/09	4612	2.72 %	Increasing
Collier County	N/A	N/A	2014	25800	N/A	No Temporal Data
Everglades	N/A	N/A	N/A	N/A	N/A	No Temporal Data
Florida Keys & Dry Tortugas	N/A	N/A	N/A	N/A	N/A	No Temporal Data
Biscayne Bay*	N/A	N/A	N/A	N/A	N/A	No Temporal Data
Palm Beach & Broward County	2004/05	28	2008	21	-6.25 %	Decreasing
Indian River Lagoon	N/A	N/A	N/A	N/A	N/A	No Temporal Data
Northeast Florida	2004	82985	2009	82489	-0.12 %	Stable (No change)

SALTWATER MARSH – FISH DIVERSITY



			Effective Number of Species	
Year	Species Richness	Menhinick's Index	Shannon-Wiener Index	Gini-Simpson Index
2008	200	0.207	15.4	5.9
2009	214	0.226	13.9	5.5
2010	194	0.185	11.7	5.9
2011	187	0.170	8.4	3.8
2012	214	0.243	13.2	4.5
2013	207	0.248	11.6	4.0
2014	204	0.230	11.3	4.1
2015	229	0.260	13.8	5.2
2016	221	0.225	11.7	4.0
2017	228	0.224	11.2	3.9
Five year change per year			-3.0	-2.6
Five year condition			Decreasing	Decreasing

SALTWATER MARSH – FISH DIVERSITY

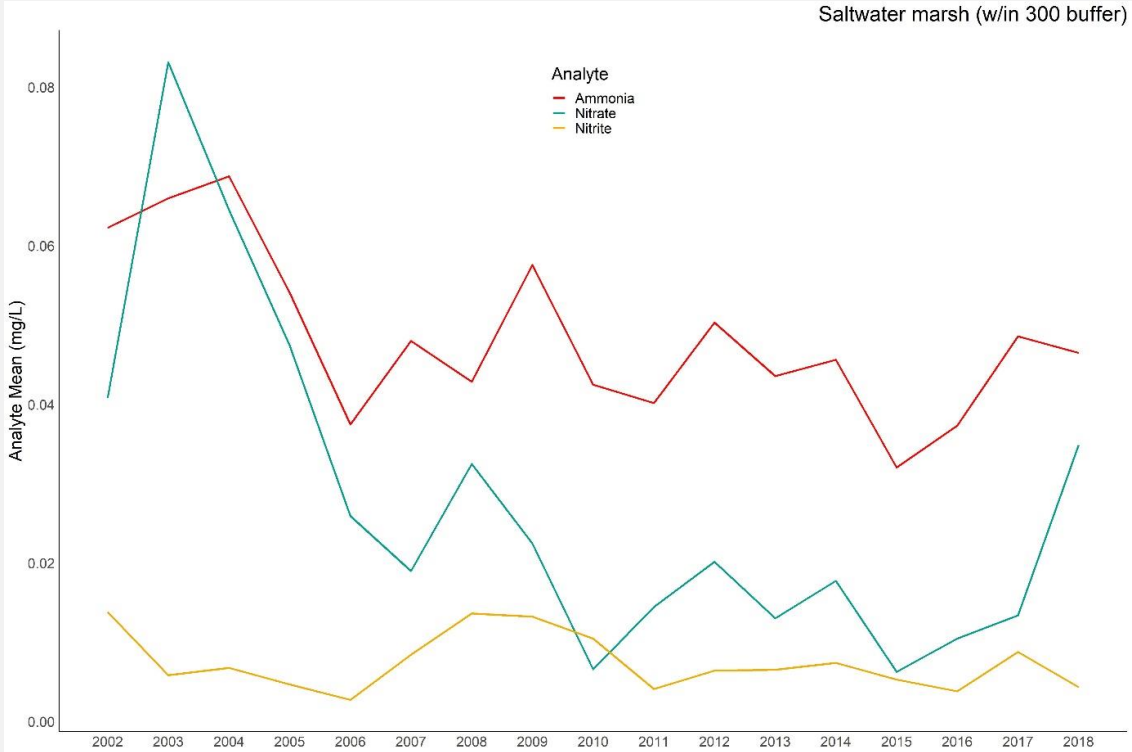


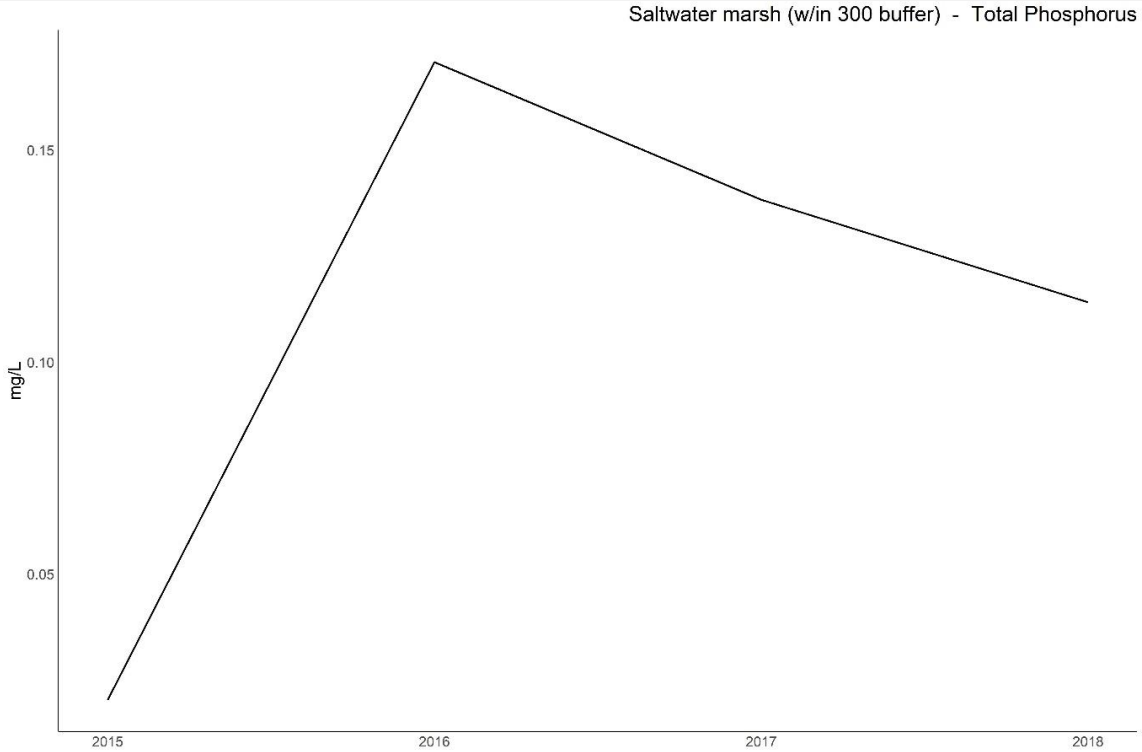
Estuary	Index	2012	2017	Percent Change per Year	Diversity Condition
Apalachicola	Shannon (ENS)	8.6	13.3	10.9	Increasing
	Simpson (ENS)	3.4	6.1	15.3	Increasing
Cedar Key	Shannon (ENS)	14.2	13.4	-1.2	Decreasing
	Simpson (ENS)	7.2	6.8	-1.2	Decreasing
Tampa Bay	Shannon (ENS)	4.8	4.1	-3.0	Decreasing
	Simpson (ENS)	2.3	2.2	-0.4	Stable (-)
Charlotte Harbor	Shannon (ENS)	10.7	9.9	-1.5	Decreasing
	Simpson (ENS)	6.3	5.6	-2.2	Decreasing
Tequesta	Shannon (ENS)	6.8	11.3	13.0	Increasing
	Simpson (ENS)	4.7	7.1	10.4	Increasing
Indian River	Shannon (ENS)	14.0	17.4	4.7	Increasing
	Simpson (ENS)	9.9	10.0	0.1	Stable (+)
Northeast Florida	Shannon (ENS)	9.9	7.9	-3.9	Decreasing
	Simpson (ENS)	4.4	3.3	-5.3	Decreasing

*Note: Inner polygon = Shannon, Outer polygon= Simpson

SALTWATER MARSH – WATER QUALITY

Nutrients



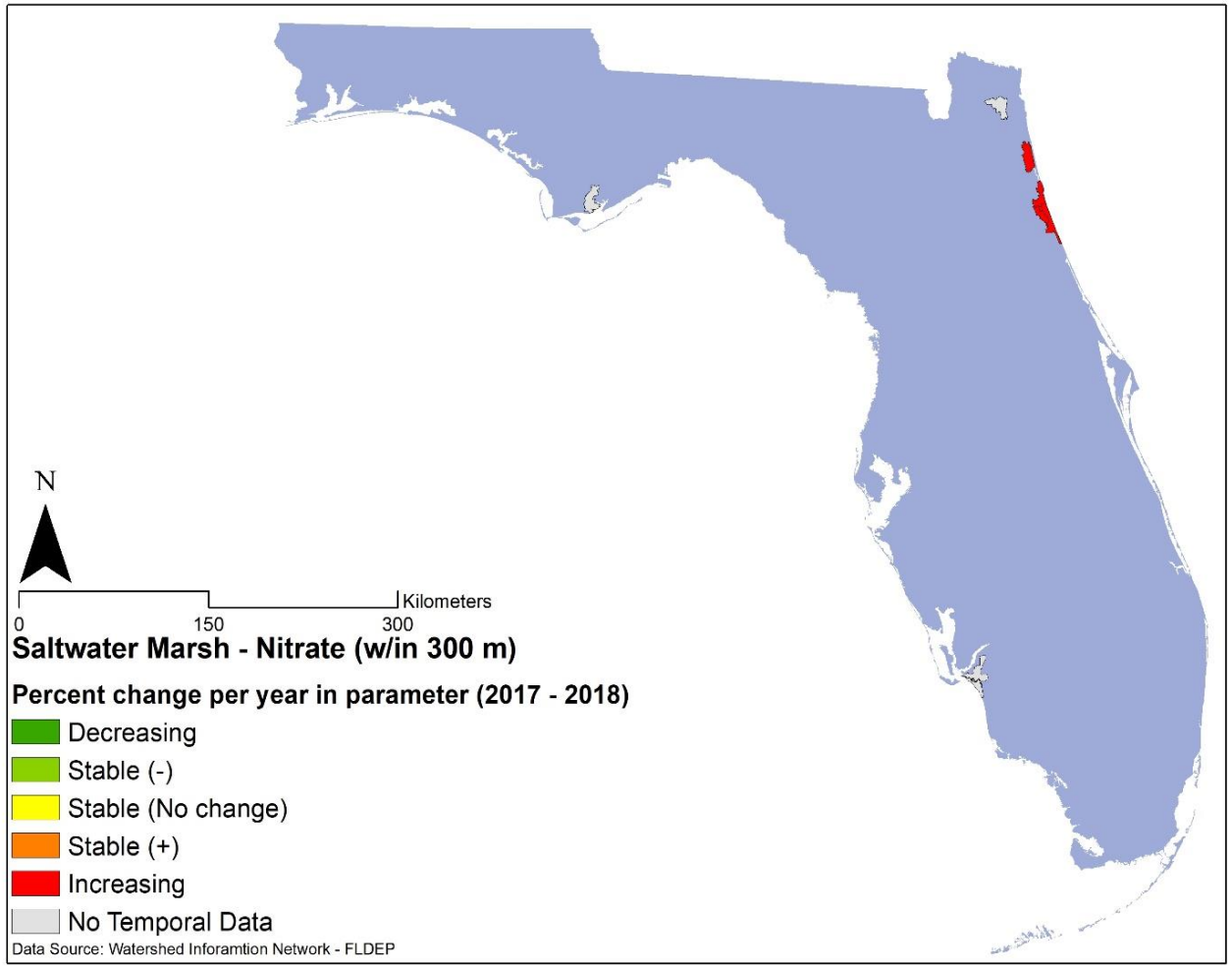


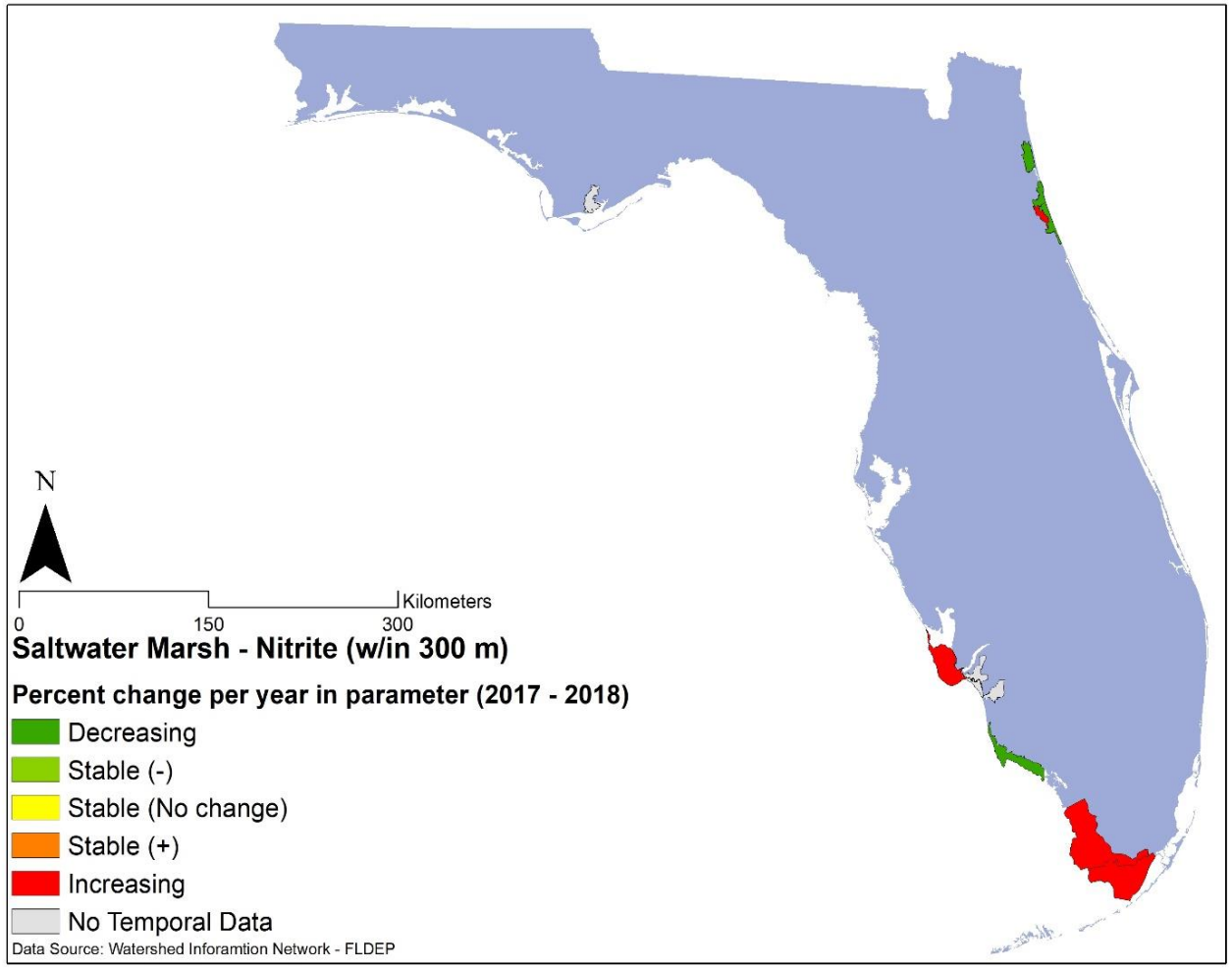
Year	Nitrate	Nitrite	Ammonia	Total Phosphorus
2013	0.0130	0.0065	0.0436	N/A
2014	0.0177	0.0074	0.0456	N/A
2015	0.0063	0.0052	0.0320	0.0203
2016	0.0105	0.0038	0.0373	0.1707
2017	0.0134	0.0088	0.0485	0.1383
2018	0.0347	0.0043	0.0465	0.1141
Three year change per year	150.3%	-5.7 %	15.1 %	154.0 %
Three year condition	Increasing	Decreasing	Increasing	Increasing

SALTWATER MARSH – WATER QUALITY

Nutrients

- Nutrients within 300 meters

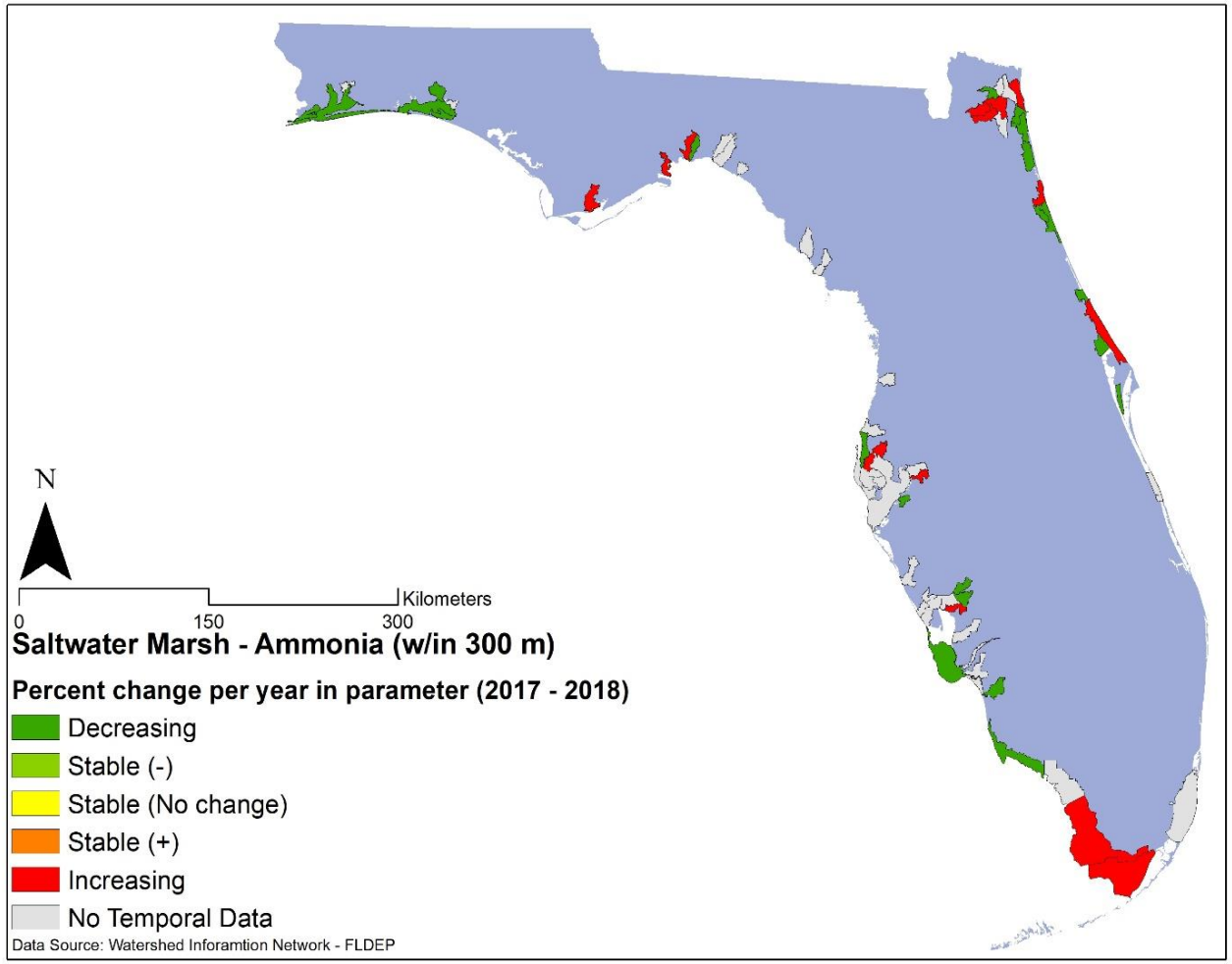


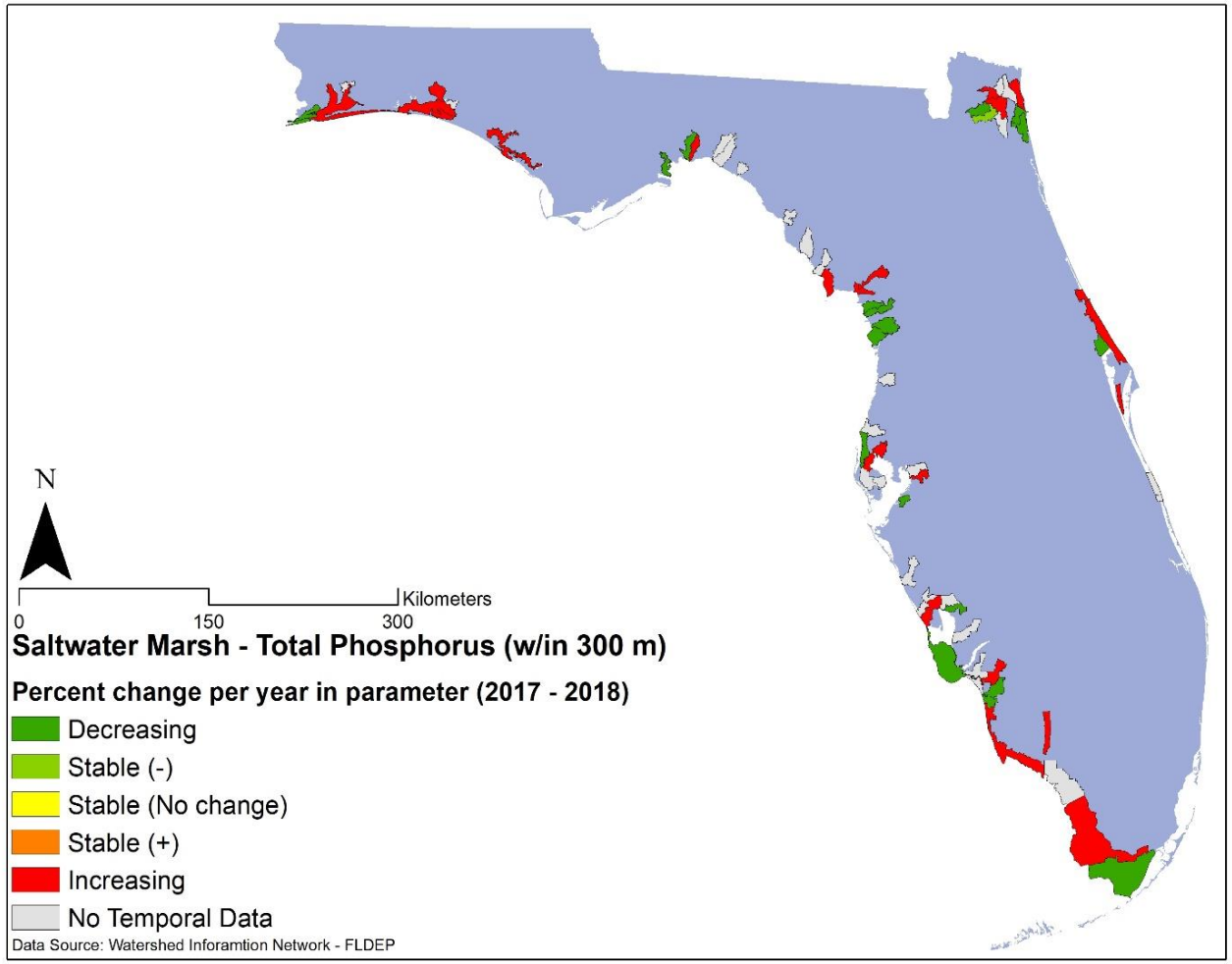


SALTWATER MARSH – WATER QUALITY

Nutrients

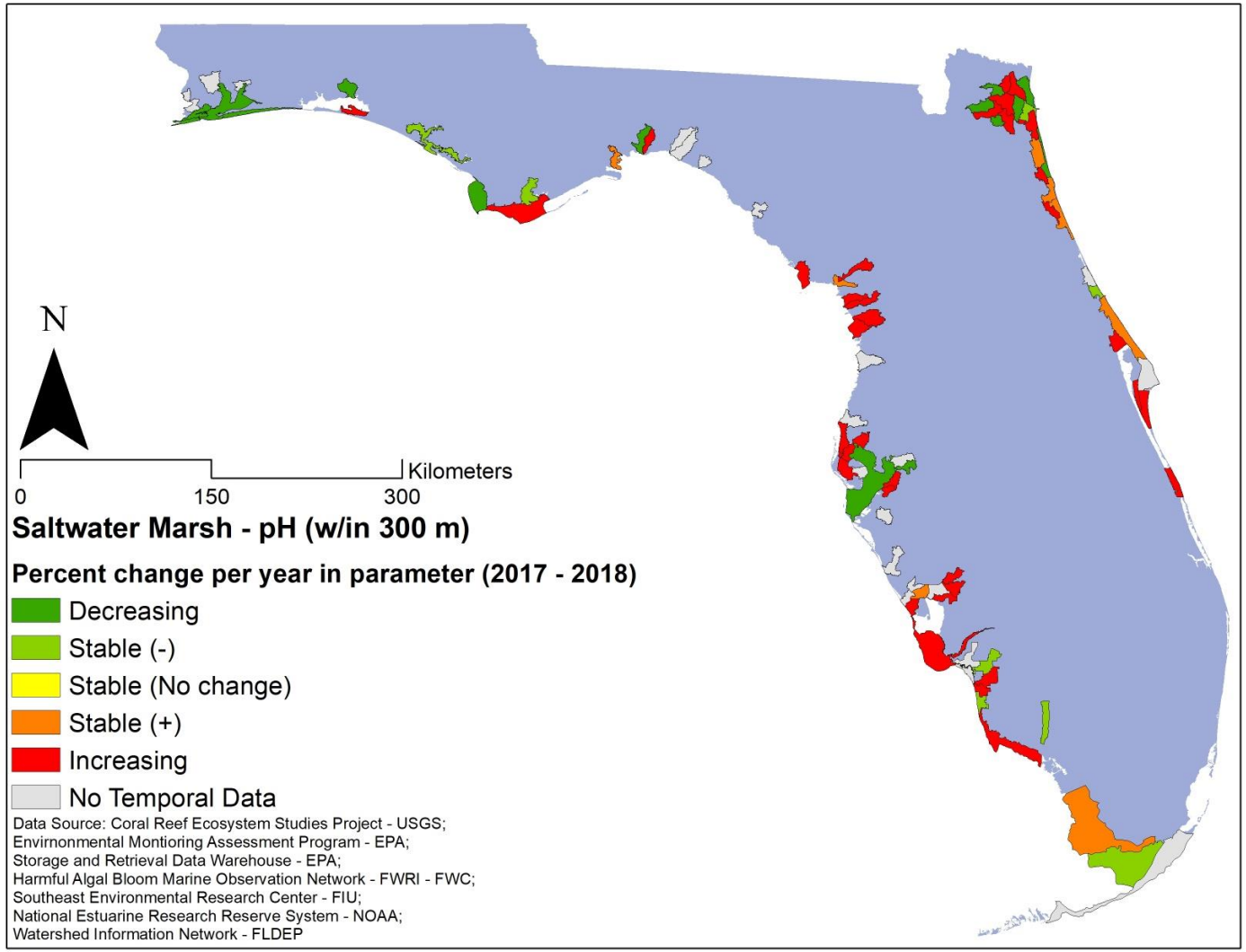
- Nutrients within 300 meters





SALTWATER MARSH – WATER QUALITY
pH

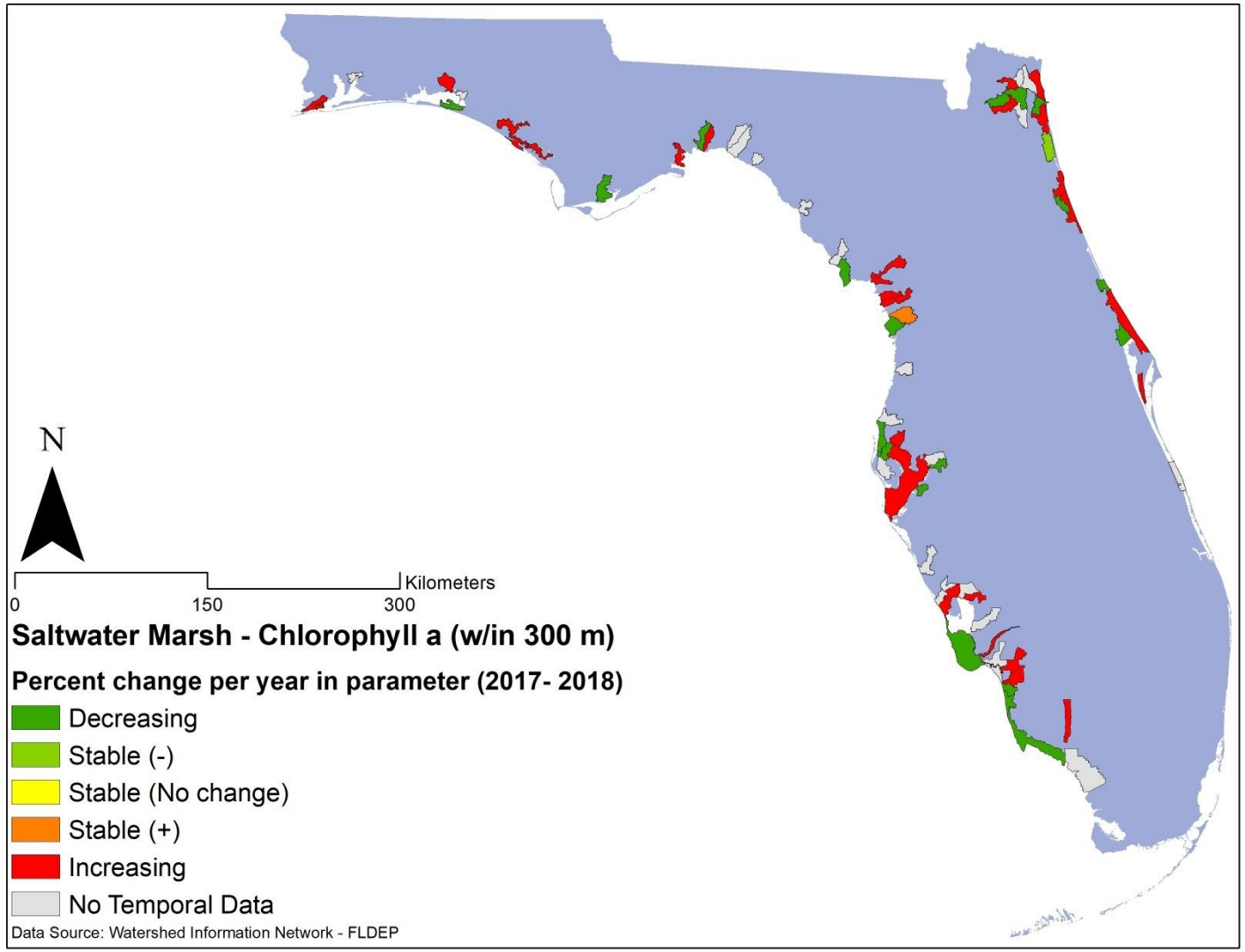
Year	pH
2013	7.54
2014	7.51
2015	7.60
2016	7.71
2017	7.52
2018	7.51
Three year change per year	-0.4 %
Three year condition	Stable (-)



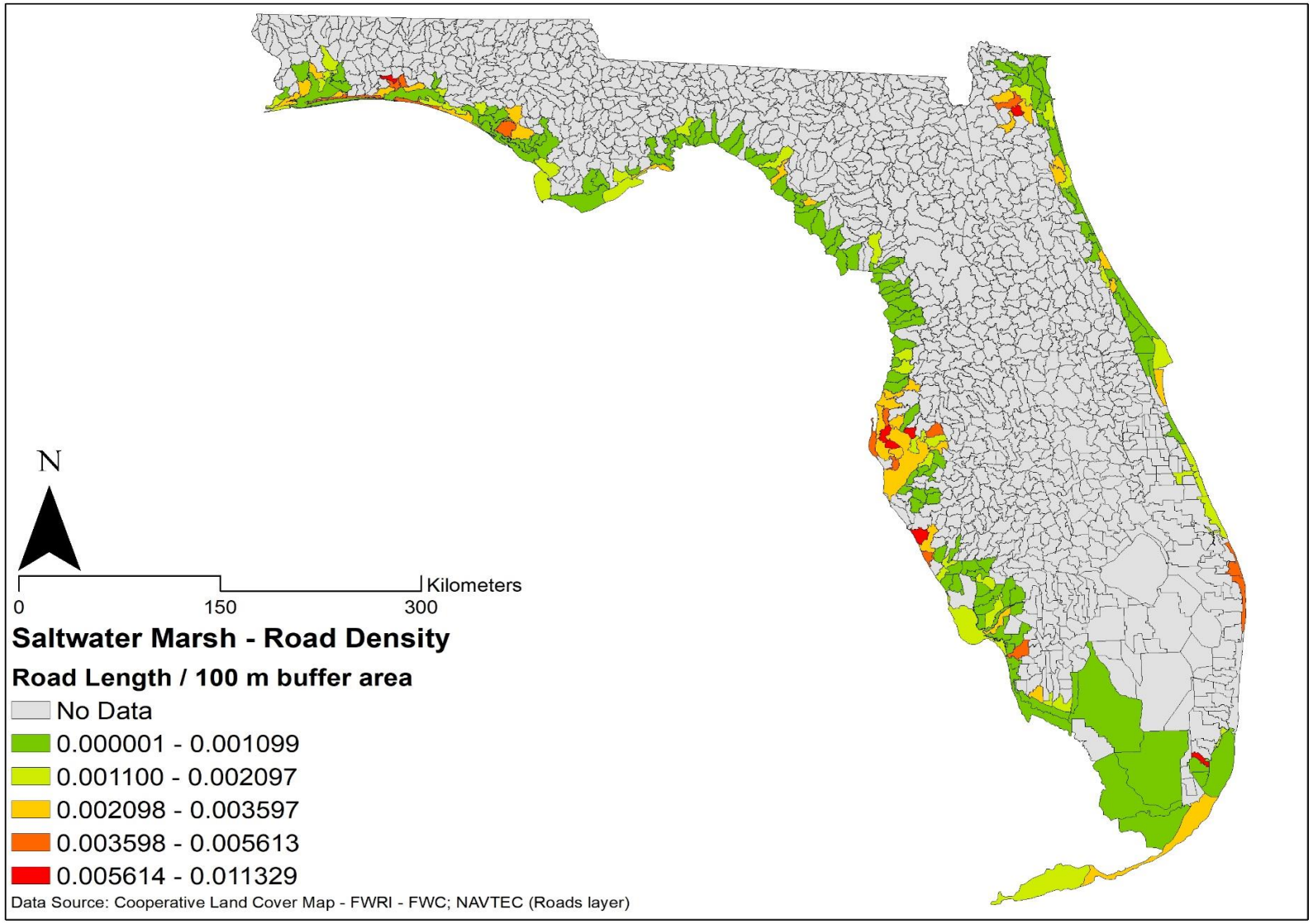
SALTWATER MARSH – WATER QUALITY

Chlorophyll a

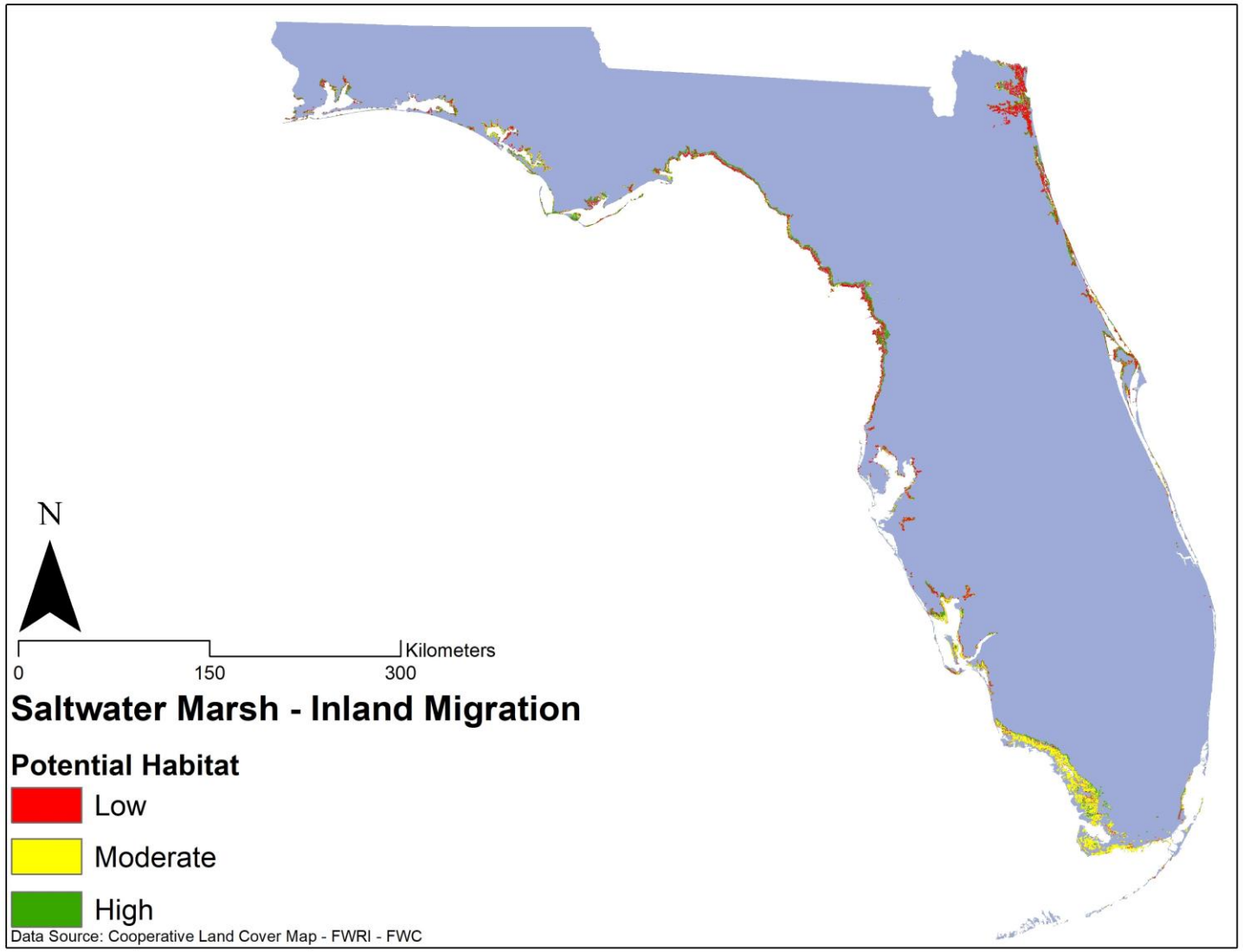
Year	Chlorophyll a
2013	6.87
2014	6.04
2015	5.98
2016	5.76
2017	5.94
2018	8.12
Three year change per year	11.9 %
Three year condition	Increasing



SALTWATER MARSH – ROAD DENSITY



SALTWATER MARSH – INLAND MIGRATION



Habitat Migration Potential (within 300 m)	Percent Area
Low	32.99 %
Moderate	34.85 %
High	32.16 %

SALTWATER MARSH – INLAND MIGRATION

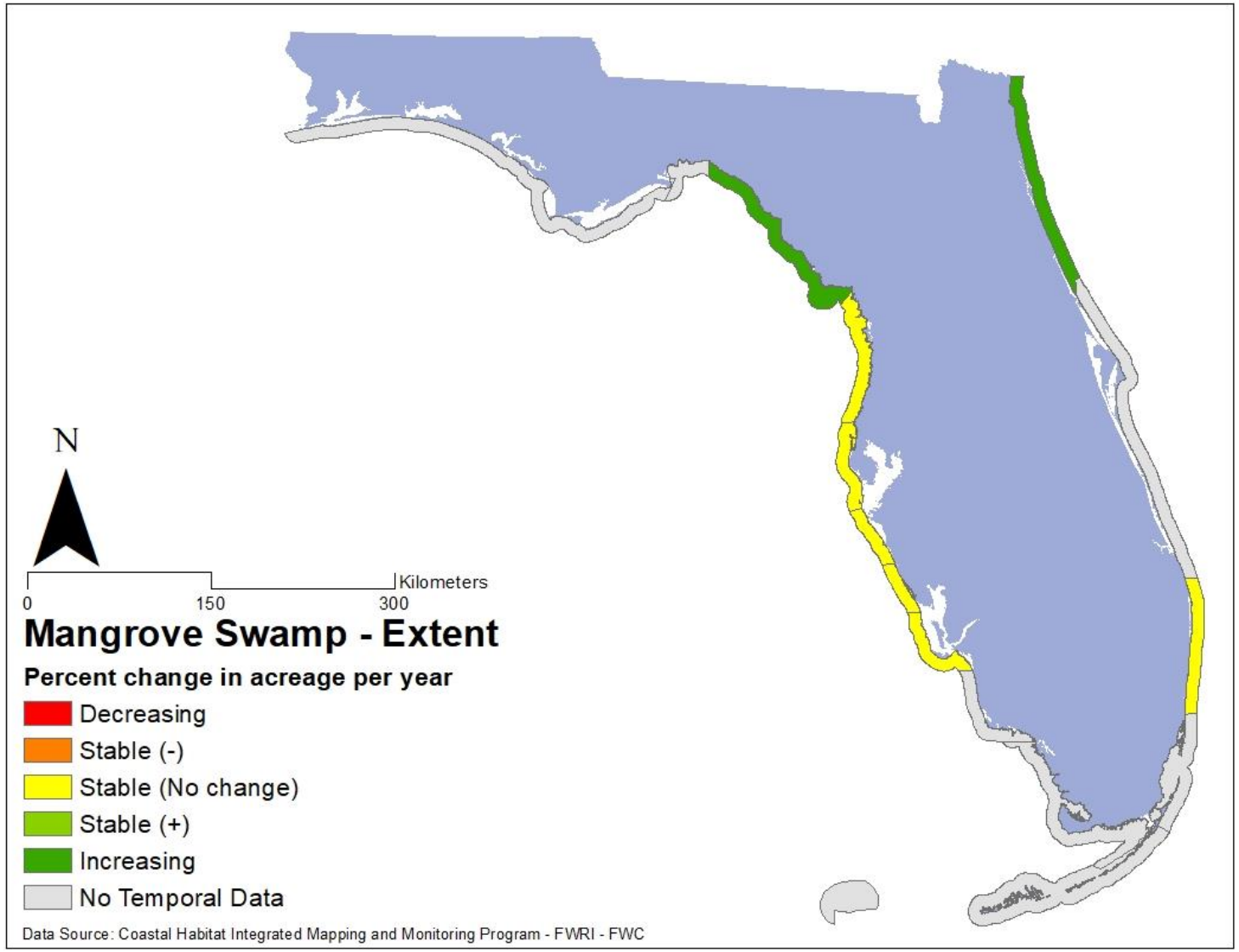
Modified CLC land use classifications within 300 meters

Land Use (Modified CLC)	Area (km^2)	Area Percent	Habitat Migration Potential
Estuarine	1229248.6	45.89 %	See Estuarine table (below)
Natural	861420.0	32.16 %	High
Urban	369671.9	13.80 %	Low
Working Lands	112328.7	4.19 %	Moderate
Freshwater	71897.6	2.68 %	Low
Other Agriculture	20802.2	0.78 %	Moderate
Marine	8856.3	0.33 %	Low
Other Land Use	4262.8	0.16 %	Low

Subdivided estuarine/marine habitats within 300 meters

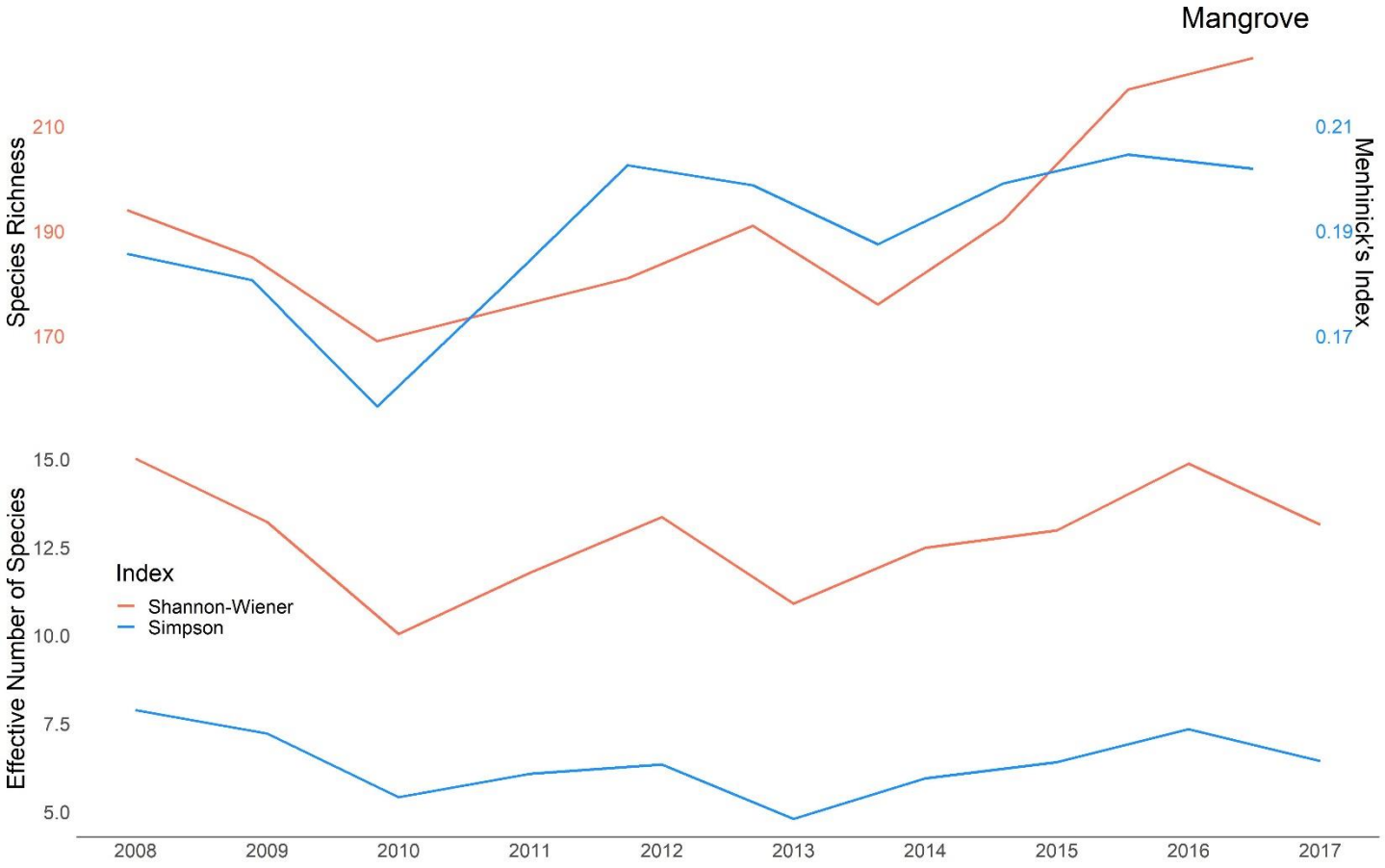
CLC Site – Site Name	Area (km^2)	Area Percent	Habitat Migration Potential
5250 Mangrove Swamp	770340.1	28.76 %	Moderate
5000 Estuarine	408460.1	15.25 %	Low
5220 Tidal Flat	25133.8	0.94 %	Moderate
5310 Estuarine Ditch/Channel	12566.8	0.47 %	Low
5230 Oyster Bar	4875.8	0.18 %	Low
5252 Scrub Mangrove	4539.9	0.17 %	Moderate
5300 Cultural - Estuarine	2360.9	0.09 %	Low
5212 Non-vegetated	641.8	0.02 %	Low
5200 Intertidal	129.3	0.00 %	Moderate
5320 Estuarine Artificial Impoundment	115.7	0.00 %	Low
5221 Mud	79.6	0.00 %	Moderate
5210 Exposed Limestone	2.4	0.00 %	Low
5100 Subtidal	1.8	0.00 %	Low

MANGROVE SWAMP - EXTENT



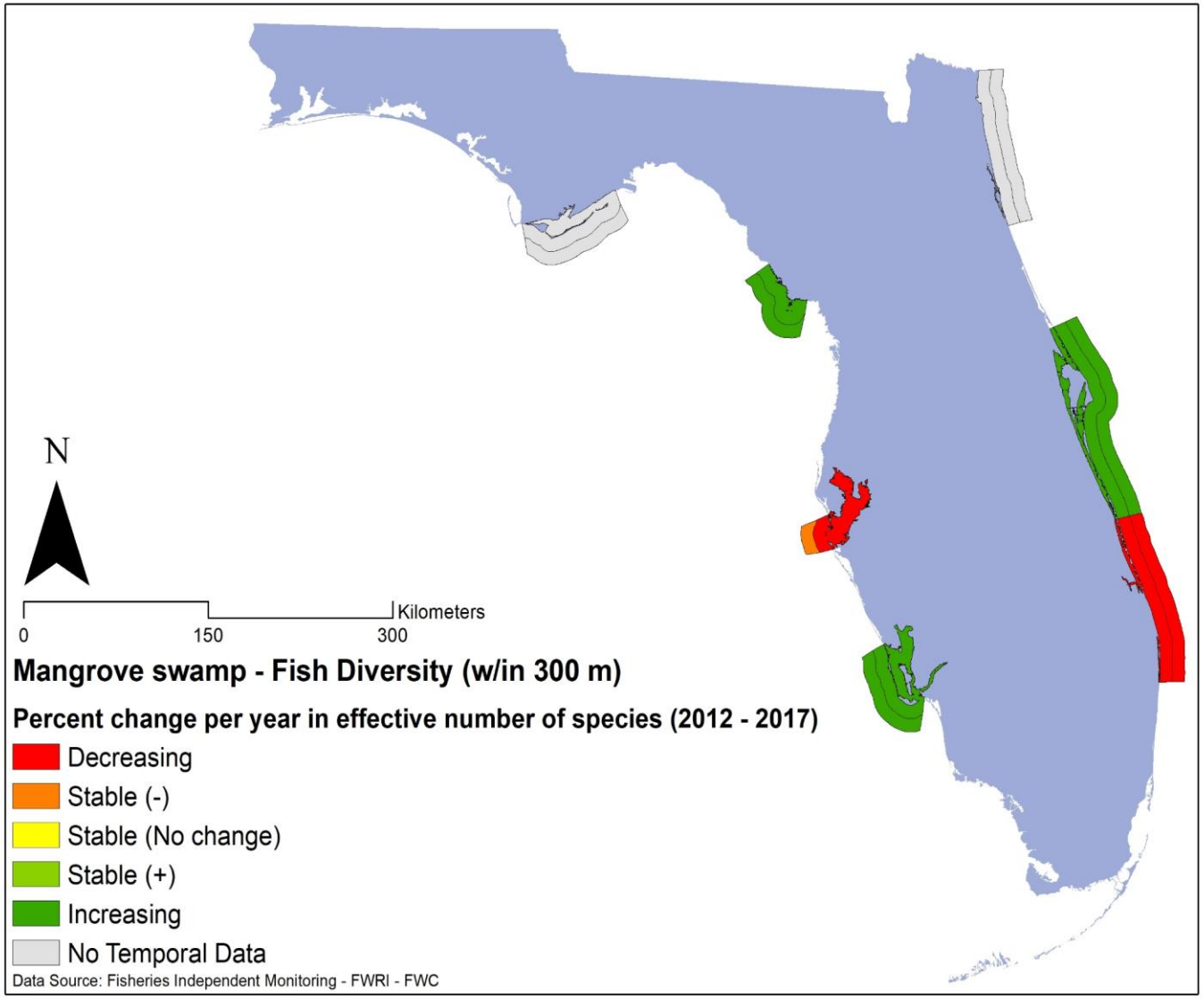
	Previous		Most Recent		Percent Change per year	Condition
Estuary/region	Year	Acres	Year	Acres		
Northwest Florida	N/A	N/A	N/A	N/A	N/A	No Temporal Data
Big Bend & Springs Coast (NWFWMD)	N/A	N/A	N/A	N/A	N/A	No Temporal Data
Big Bend & Springs Coast (SRWMD)	2006/08	103	2010/11	110	2.27 %	Increasing
Big Bend & Springs Coast (SWFWMD)	2010	1034	2011	1033	-0.10 %	Stable (No change)
Tampa Bay	2010	15495	2011	15500	0.03 %	Stable (No change)
Sarasota Bay	2010	2337	2011	2337	0.00 %	Stable (No change)
Charlotte Harbor & Estero Bay (SWFWMD)	2010	20457	2011	20461	0.02 %	Stable (No change)
Charlotte Harbor & Estero Bay (SFWMD)	2005	41057	2009	41482	0.26 %	Stable (No change)
Collier County	N/A	N/A	2014	86300	N/A	No Temporal Data
Everglades	N/A	N/A	N/A	N/A	N/A	No Temporal Data
Florida Keys & Dry Tortugas	N/A	N/A	N/A	N/A	N/A	No Temporal Data
Biscayne Bay	N/A	N/A	N/A	N/A	N/A	No Temporal Data
Palm Beach & Broward County	2005	2015	2009	2042	0.33 %	Stable (No change)
Indian River Lagoon	N/A	N/A	N/A	N/A	N/A	No Temporal Data
Northeast Florida	2004	1360	2009	1573	3.13 %	Increasing

MANGROVE SWAMP – FISH DIVERSITY



			Effective Number of Species	
Year	Species Richness	Menhinick Index	Shannon-Wiener Index	Gini-Simpson Index
2012	181	0.202	13.4	6.3
2013	191	0.199	10.9	4.8
2014	176	0.187	12.5	5.9
2015	176	0.199	13.0	6.4
2016	217	0.205	14.9	7.3
2017	223	0.202	13.1	6.4
Five year change per year			-0.4 %	0.3 %
Five year condition			Stable (-)	Stable (+)

MANGROVE SWAMP – FISH DIVERSITY

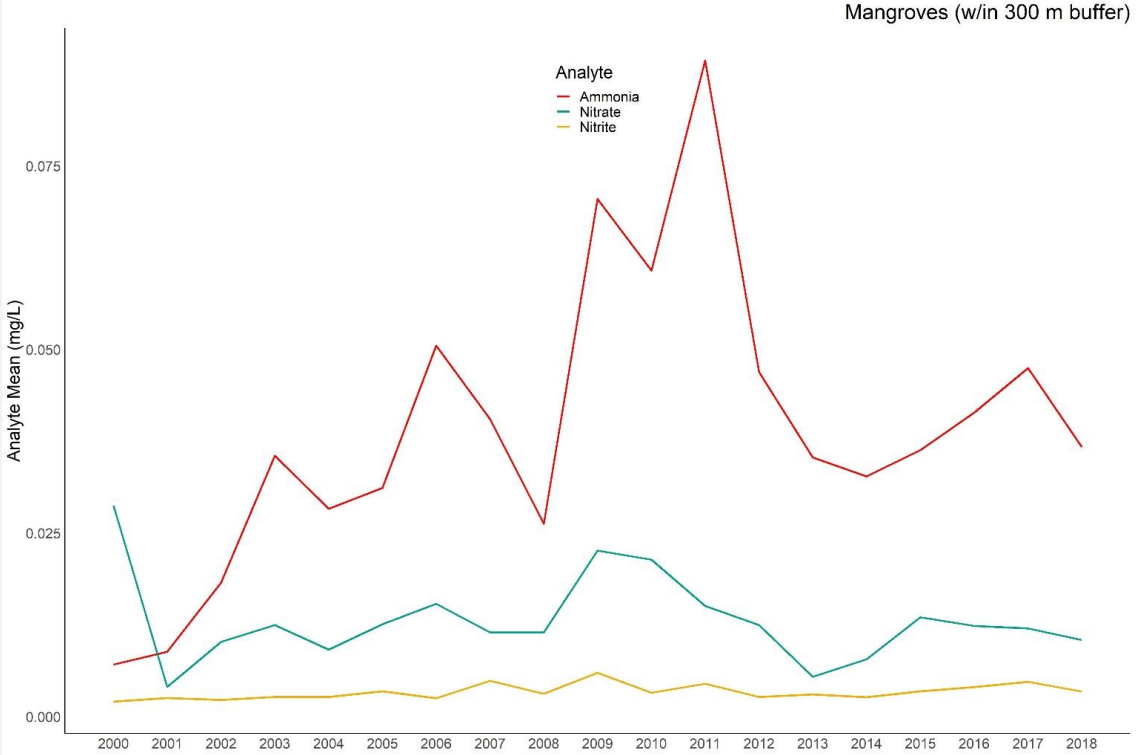


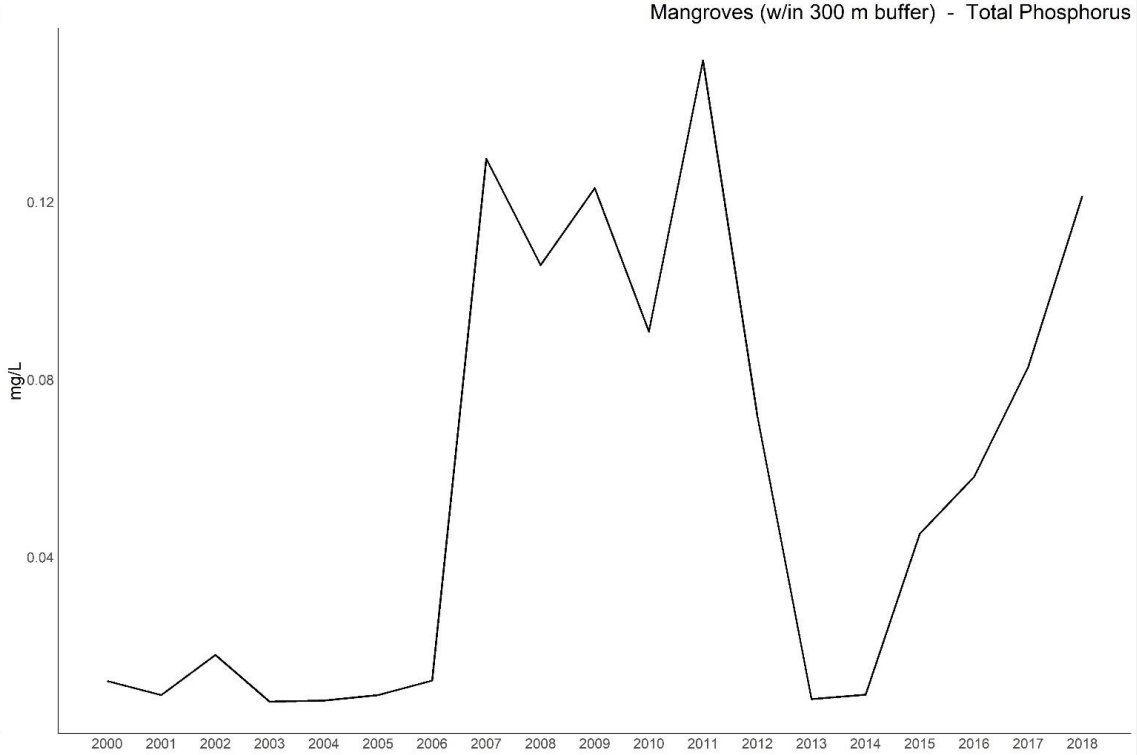
Estuary	Index	2012	2017	Percent Change per Year	Diversity Condition
Apalachicola	Shannon (ENS)	N/A	N/A	N/A	No Temporal Data
	Simpson (ENS)	N/A	N/A	N/A	No Temporal Data
Cedar Key	Shannon (ENS)	12.5	18.0	8.8	Increasing
	Simpson (ENS)	5.8	9.2	11.6	Increasing
Tampa Bay	Shannon (ENS)	9.3	8.1	-2.4	Decreasing
	Simpson (ENS)	4.2	4.0	-0.6	Stable (-)
Charlotte Harbor	Shannon (ENS)	11.8	13.0	2.1	Increasing
	Simpson (ENS)	6.9	7.9	2.8	Increasing
Tequesta	Shannon (ENS)	17.1	15.9	-1.5	Decreasing
	Simpson (ENS)	10.1	8.8	-2.6	Decreasing
Indian River	Shannon (ENS)	12.6	25.2	19.9	Increasing
	Simpson (ENS)	7.2	16.1	24.9	Increasing
Northeast Florida	Shannon (ENS)	N/A	N/A	N/A	No Temporal Data
	Simpson (ENS)	N/A	N/A	N/A	No Temporal Data

*Note: Inner polygon = Shannon, Outer polygon= Simpson

MANGROVE SWAMP – WATER QUALITY

Nutrients

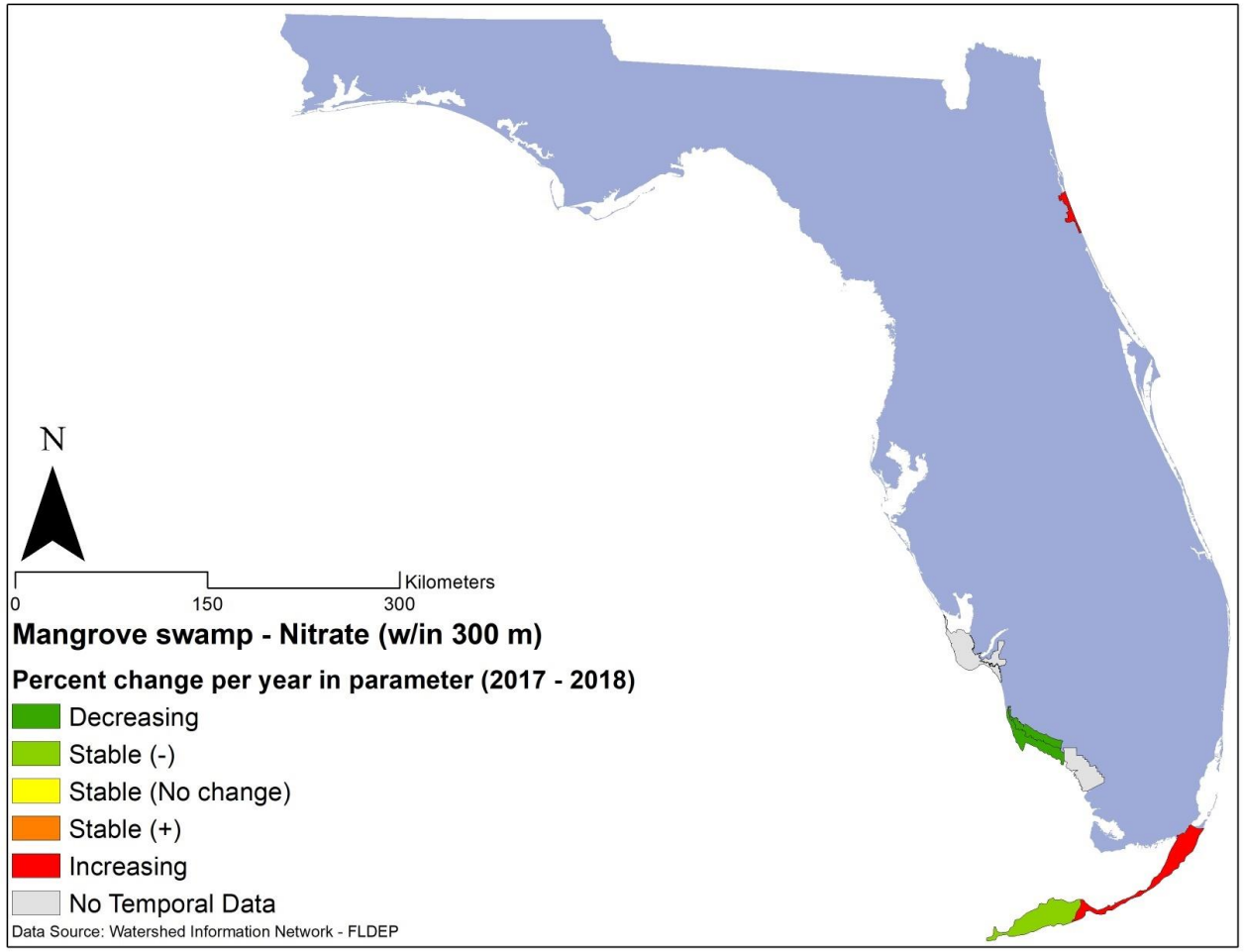


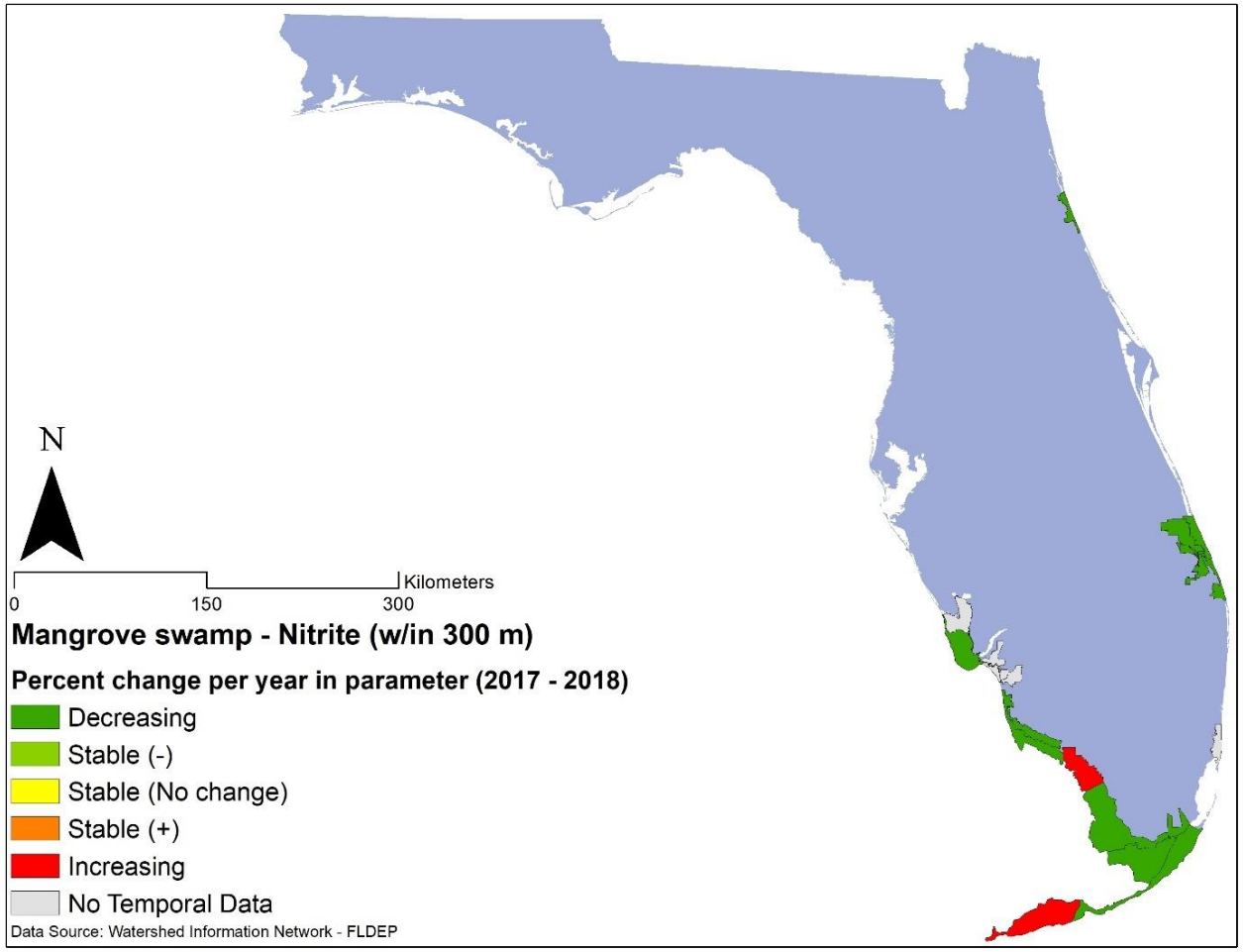


Year	Nitrate	Nitrite	Ammonia	Total Phosphorus
2013	0.0054	0.0030	0.0353	0.0079
2014	0.0078	0.0026	0.0327	0.0089
2015	0.0135	0.0035	0.0363	0.0452
2016	0.0123	0.0040	0.0414	0.0581
2017	0.0120	0.0047	0.0475	0.0829
2018	0.0104	0.0034	0.0367	0.1214
Three year change per year	-7.7 %	-0.9 %	0.4 %	56.2 %
Three year condition	Decreasing	Stable(-)	Stable (+)	Increasing

MANGROVE SWAMP – WATER QUALITY

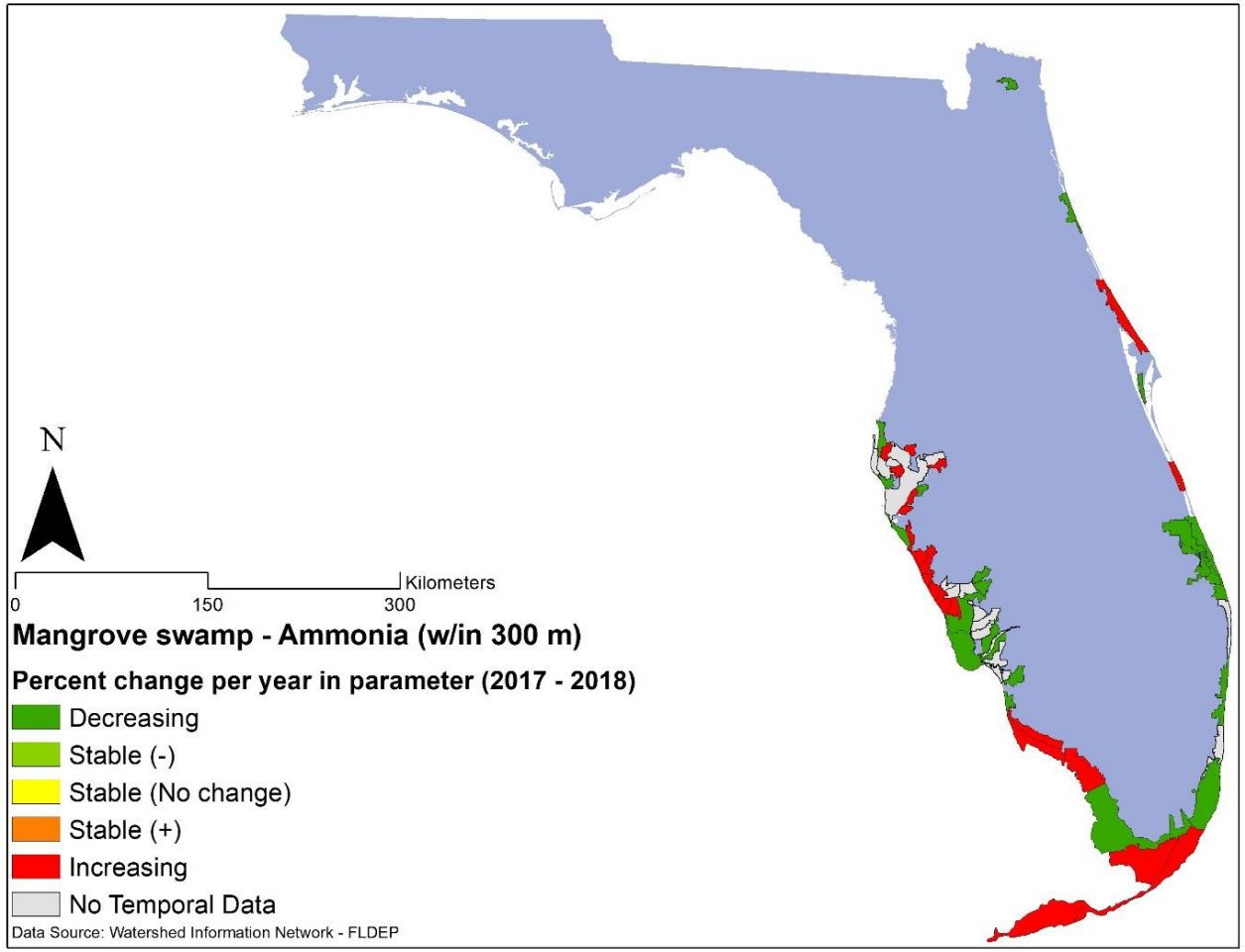
Nutrients

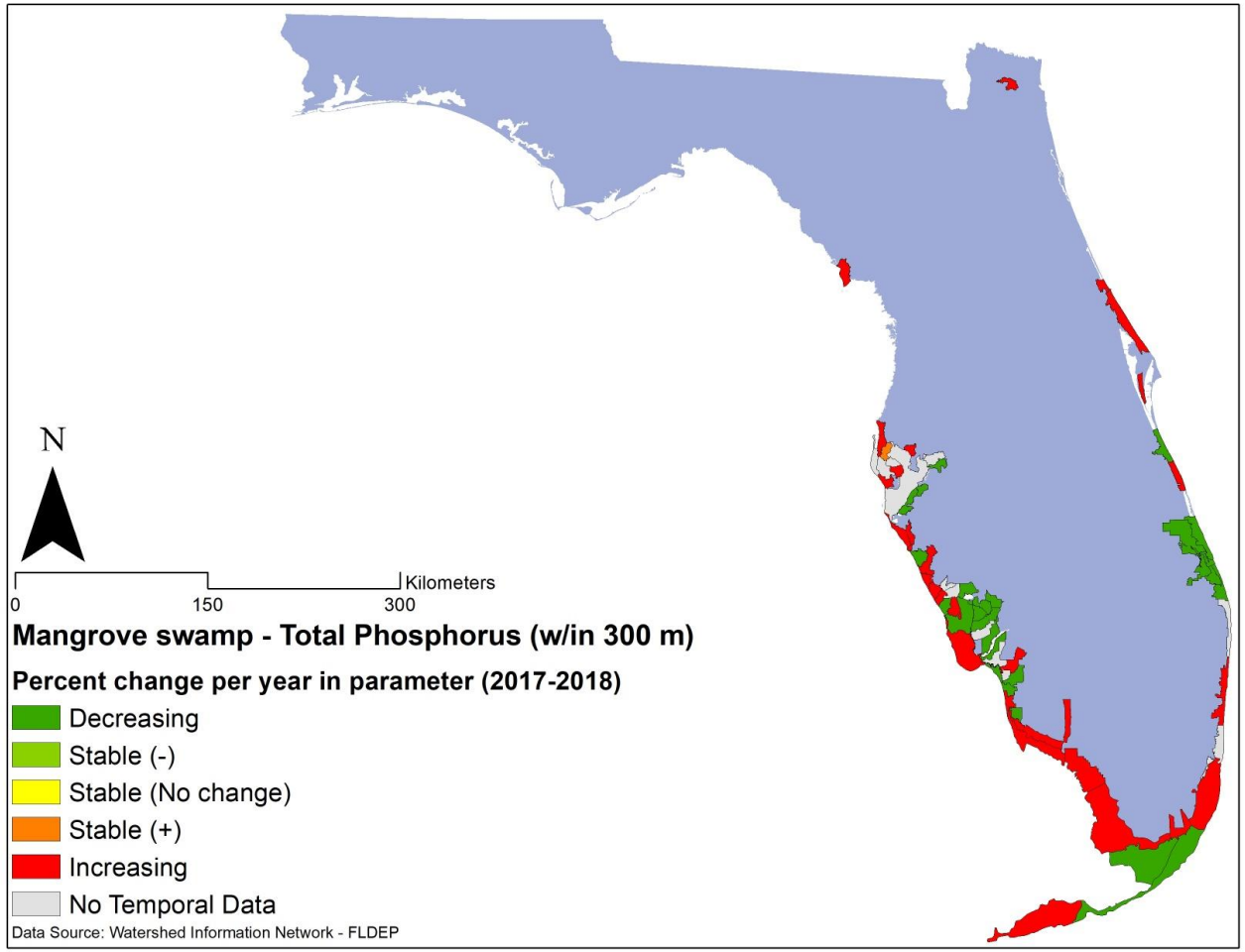




MANGROVE SWAMP – WATER QUALITY

Nutrients

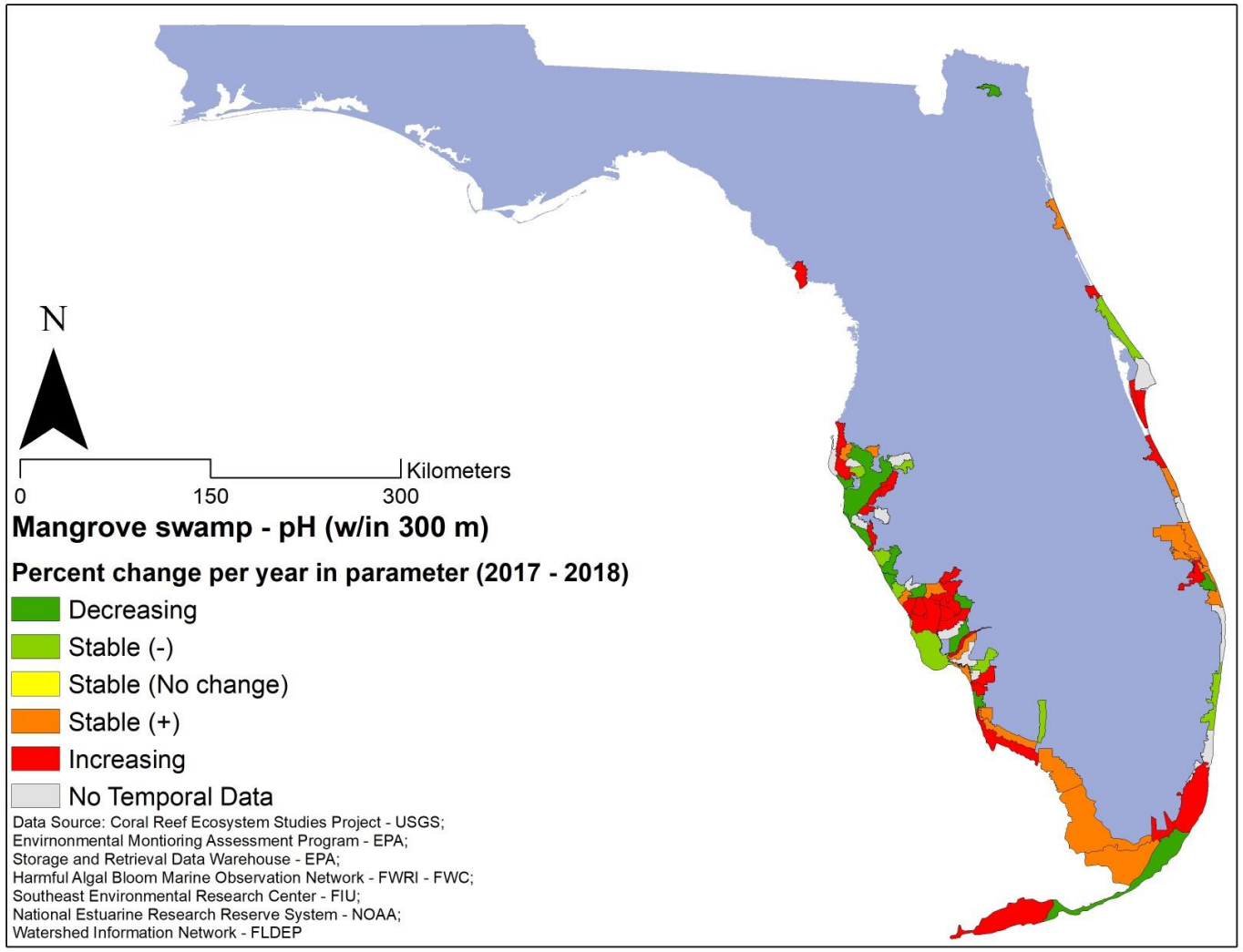




MANGROVE SWAMP – WATER QUALITY

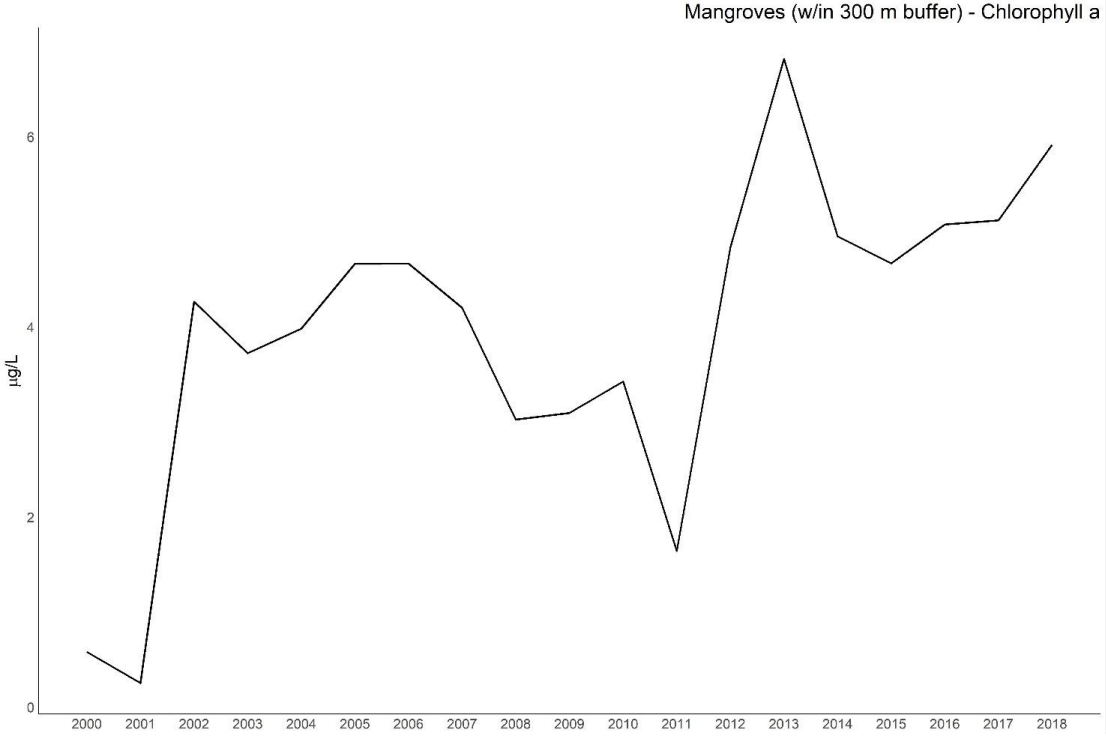
pH

Year	pH
2013	7.74
2014	7.78
2015	7.73
2016	7.74
2017	7.71
2018	7.80
Three year change per year	0.3 %
Three year condition	Stable (+)

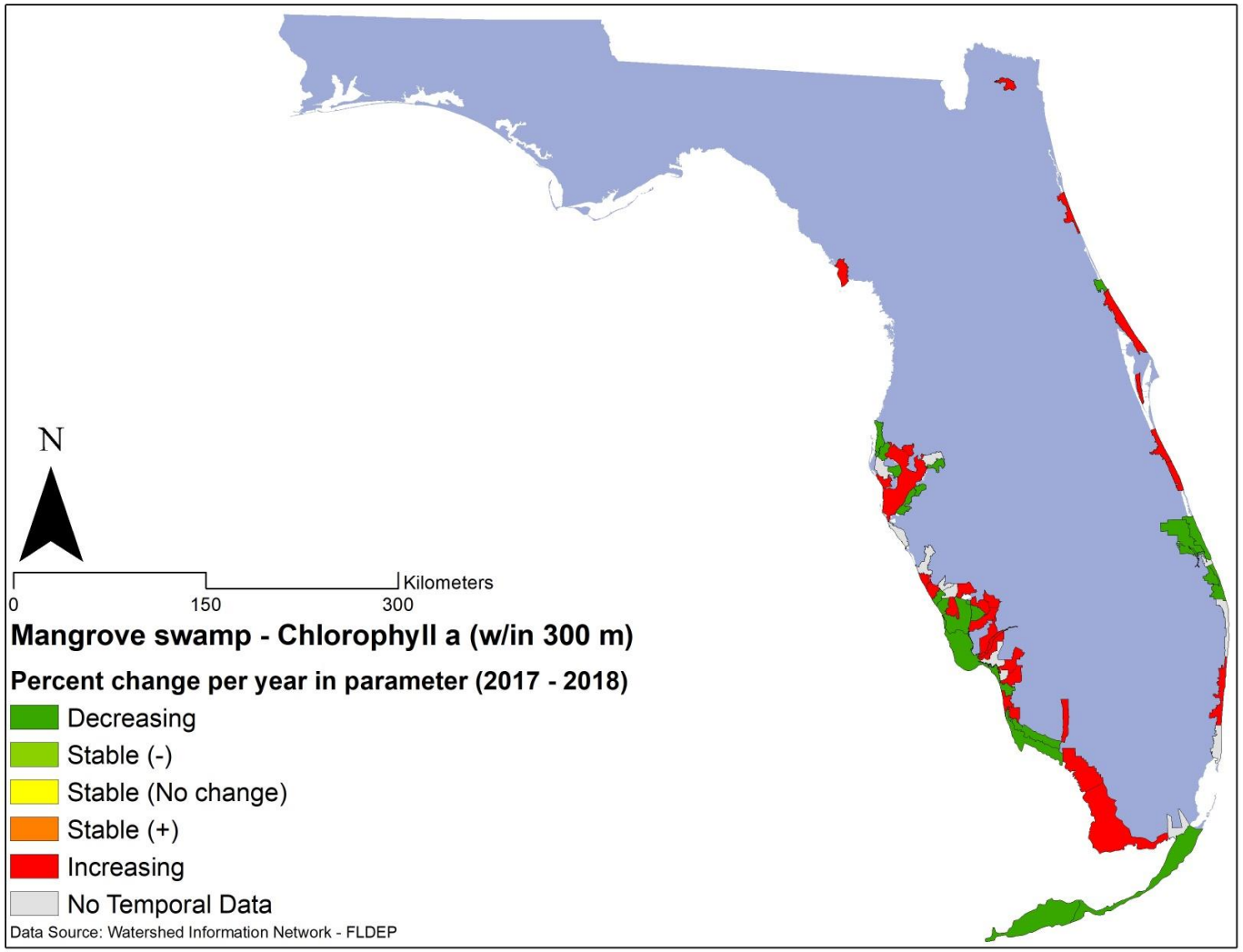


MANGROVE SWAMP – WATER QUALITY

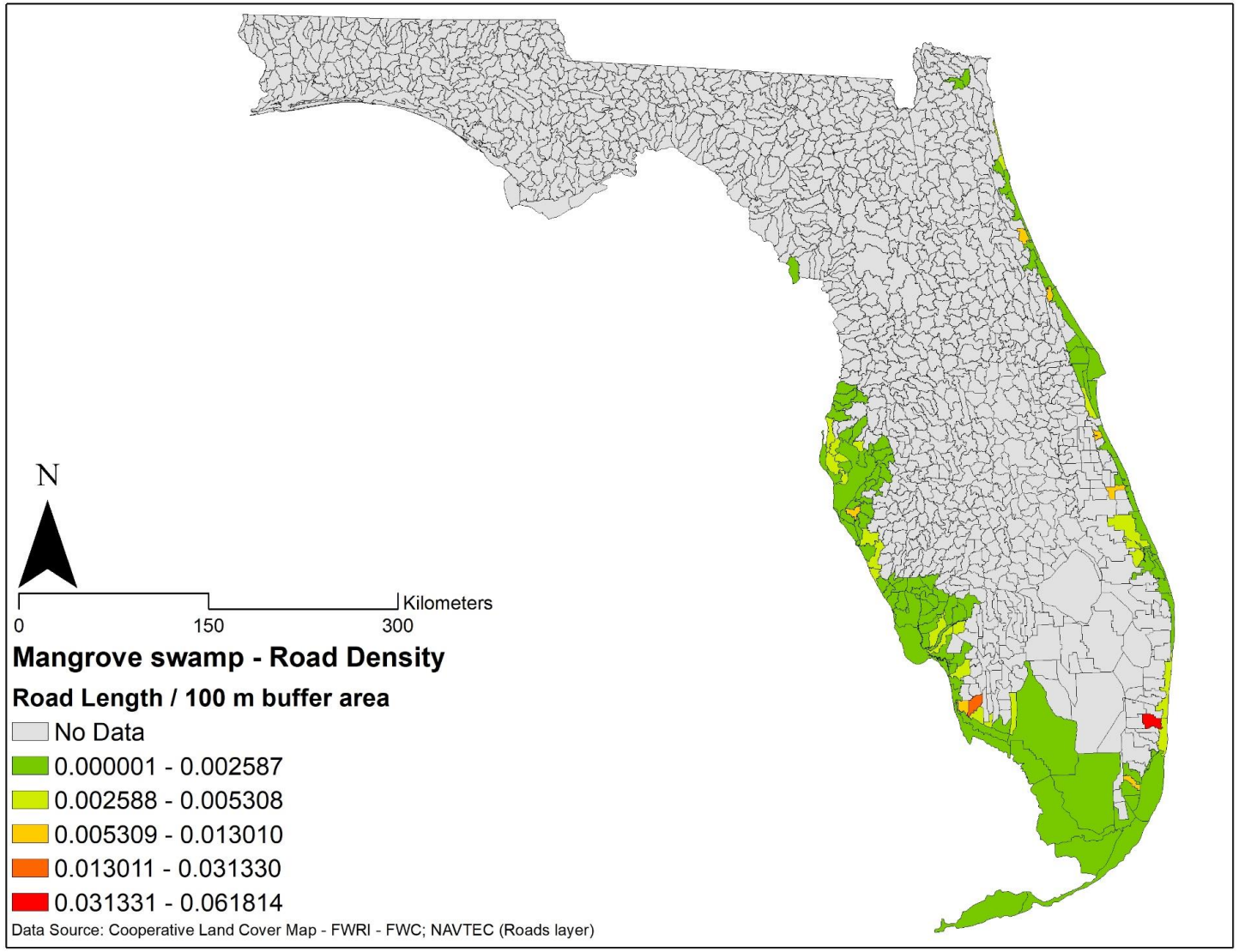
Chlorophyll a



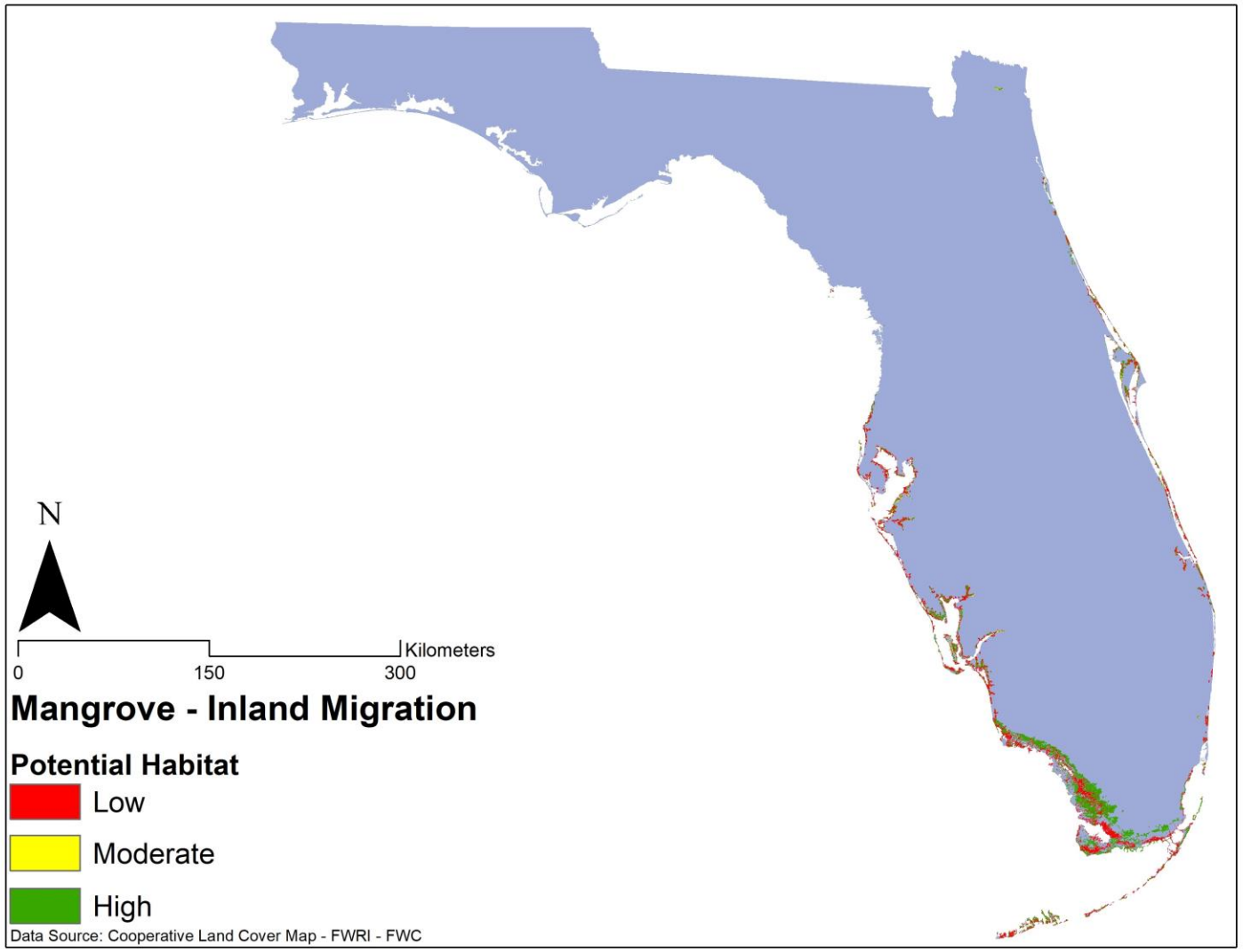
Year	Chlorophyll a
2013	6.82
2014	4.95
2015	4.67
2016	5.08
2017	5.12
2018	5.92
Three year change per year	8.9 %
Three year condition	Increasing



MANGROVE SWAMP – ROAD DENSITY



MANGROVE SWAMP – INLAND MIGRATION



Habitat Migration Potential (within 300 m)	Percent Area
Low	45.56 %
Moderate	2.83 %
High	29.90 %

MANGROVE SWAMP – INLAND MIGRATION

Modified CLC land use classifications within 300 meters

Land Use (Modified CLC)	Area (km^2)	Area Percent	Habitat Migration Potential
Estuarine	834336.4	45.10 %	See Estuarine table (below)
Natural	543453.6	29.38 %	High
Urban	392734.0	21.23 %	Low
Freshwater	25067.6	1.36 %	Moderate
Marine	24983.1	1.35 %	Low
Working Lands	22826.5	1.23 %	Moderate
Other Agriculture	4538.8	0.25 %	Moderate
Other Land Use	1977.7	0.11 %	Low

Subdivided estuarine/marine habitats within 300 meters

CLC Site – Site Name	Area (km^2)	Adjacent Area Percent	Habitat Migration Potential
5000 Estuarine	393897.8	21.29 %	Low
5240 Saltwater Marsh	381785.7	20.64 %	High
5220 Tidal Flat	29257.1	1.58 %	High
5310 Estuarine Ditch/Channel	19930.5	1.08 %	Low
5300 Cultural - Estuarine	7646.3	0.41 %	Low
5230 Oyster Bar	1391.8	0.08 %	Low
5200 Intertidal	219.9	0.01 %	High
5212 Non-vegetated	182.3	0.01 %	Low
5251 Buttonwood Forest	23.3	0.00 %	High
5100 Subtidal	1.7	0.00 %	Moderate

NEXT STAGE REPORTING

- "Report" Card/Executive summary
  - Changes in "condition" statements
    - Deleterious trend (or declining) = "Poor"
    - Stable (-, No Change, +) = "Fair"
    - Beneficial trend (improving) = "Good"
  - Water Quality considerations
    - Turbidity, pH will be inversed
    - Analytes rolled up in to general water quality category within each asset
  - All asset will receive condition classifications based on indicators within asset

DISCUSSION AND FUTURE DIRECTIONS (VERSION 2 AND BEYOND)

- Extent
  - Continue to update from IMMPs and data sources
  - Utilize Cooperative Land Cover (CLC) and/or MBC Map
  - Measure and assess northern migration of mangrove swamps
- Water Quality
  - SPARROW (USGS)
    - **SPA**tially **R**eferences **R**egression **W**atershed attributes
    - Nutrient load modelling considering hydrology (NHD+)
    - Reported to various HUC levels (i.e. HUC 4, HUC 8)
    - Look to combine with road density as more comprehensive view of runoff/hydrology
  - Compare values to established DEP and EPA standards
  - Water Quality indices
- Inland Migration
  - Combine with sea level rise (SLR) one meter model
    - Delineate areas that may serve as potential habitat for coastal ecosystems
- Consider thresholds for conservation actions

QUESTIONS?

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