May River Project

Assessing Change After 20 Years

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Rationale

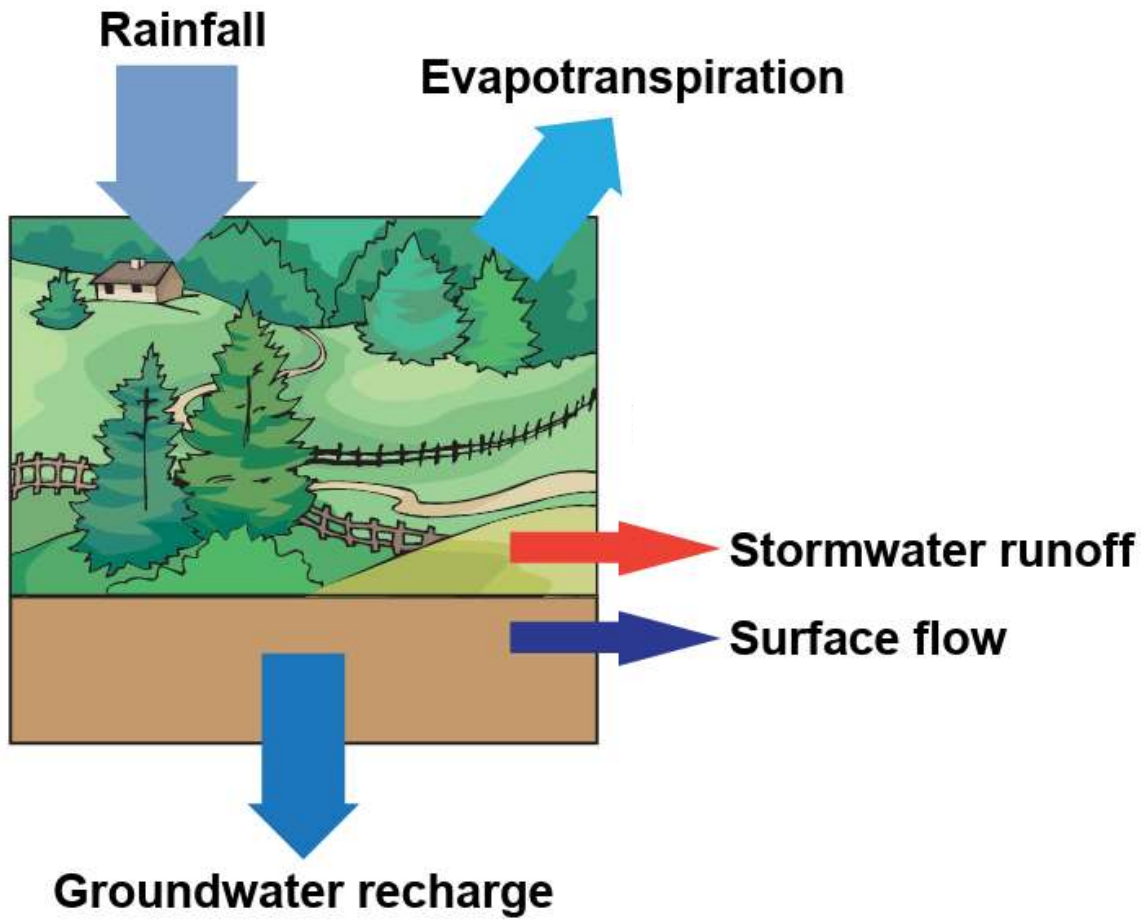
- In 2002, with several large developments planned, the Town of Bluffton commissioned a study to characterize the environmental condition of the May River and its contributing tidal creek habitats.

- This *Baseline Study* leveraged existing state-wide monitoring programs and research to allow for comparison to other areas
  - SCECAP
  - Tidal Creek Project
  - State-wide oyster research

The watershed has changed a lot

1984

2024



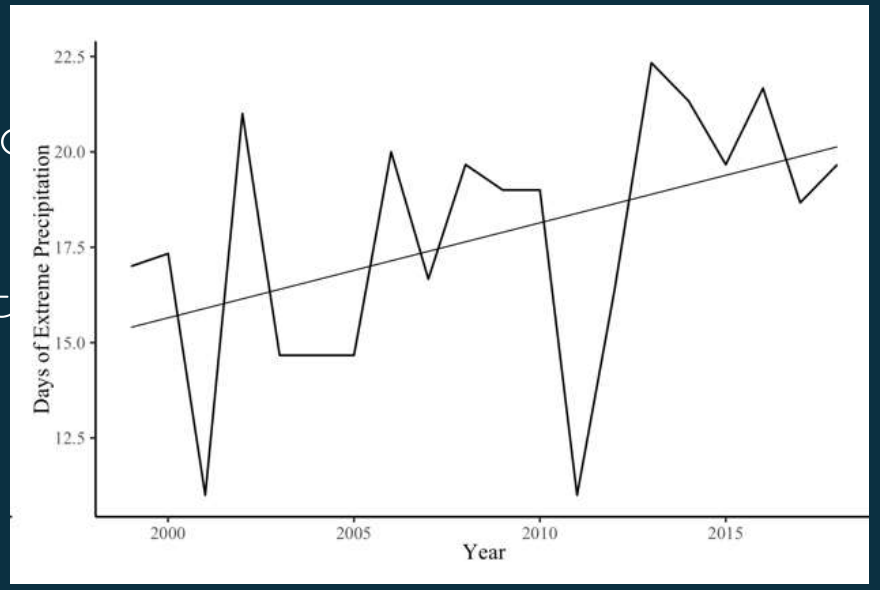
Forested Watershed

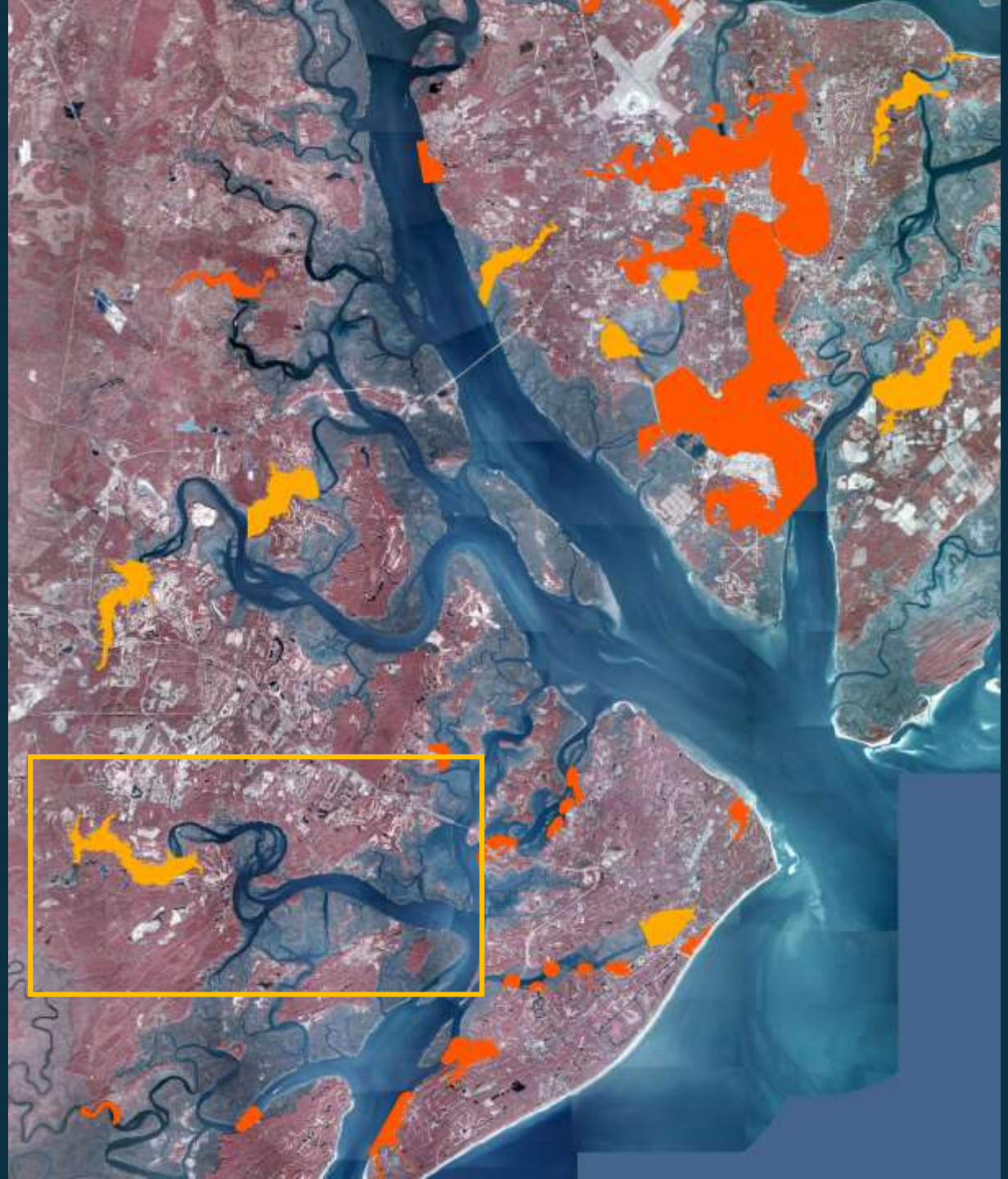
Some outcomes of development and BMPs

- Net result of increased impervious cover:
  - Increased volume of water conveyed to coastal system
  - Often increased concentration of contaminants in stormwater
  - Increased contaminant load conveyed to coastal system
  - Often occurs in tandem with loss of natural buffers such as wetlands and vegetated areas

- Other changes, such as increases in precipitation magnitude may further exacerbate this

- Stormwater ponds are designed as a BMP to
these changes
  - Rain event/storage requirements
  - Detain/retain stormwater, slow flow to coast
  - Allow for particle settling




Prohibited shellfish harvesting
Restricted shellfish harvesting

Goals of current study

- Assess changes that have occurred since 2002 Baseline Study
  - Land use/watershed
  - Variety of coastal waters ranging from small to large
  - Oyster demographics, disease, contaminants and stressors
- Assess current state of May River watershed
- Provide recommendations for management

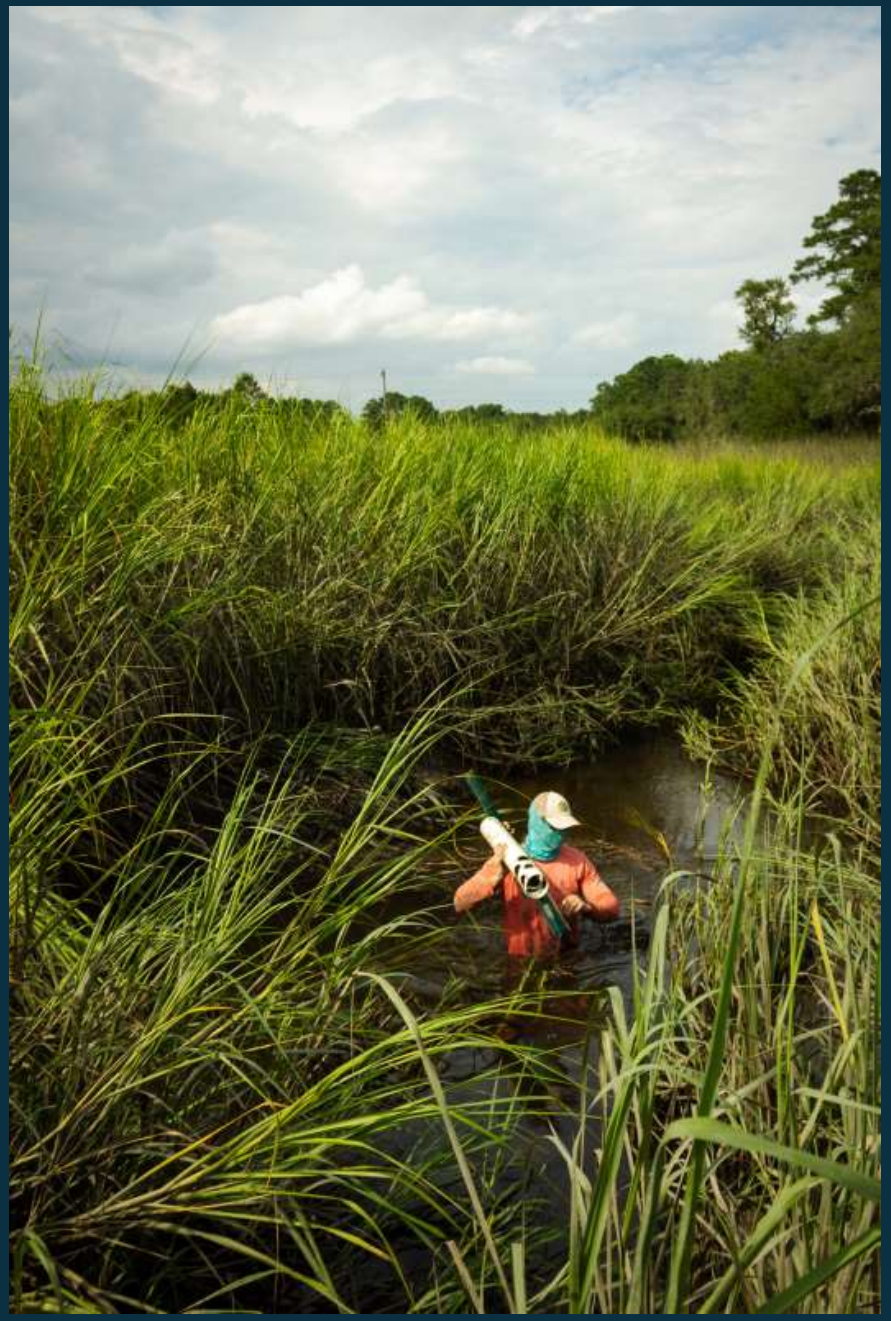
Definitions

- Small tidal creeks: Tidal Creek Project refers to as headwater tidal creeks, primary interface with upland areas. Intertidally-dominated, < 30 ft wide. Typically 10-15 ft.

- Tidal channels: Larger tidal rivers, secondarily connected to uplands. Subtidally-dominated, > 30 ft wide

Timeline

- Small tidal creek and tidal channel sampling: summer 2023
- Oyster sampling: collection summer 2023, retrieval of trays spring 2024

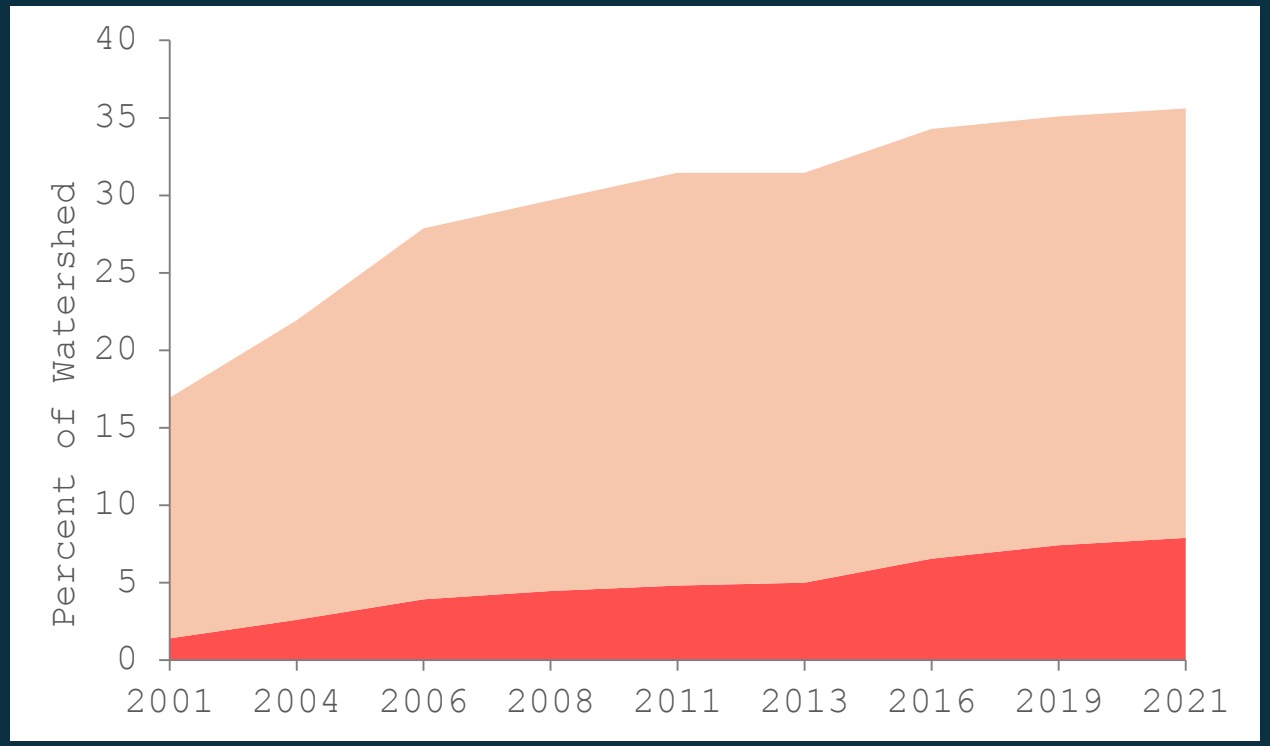


Land Use Assessment

- Land use data:
  - Impervious cover
  - Wetland and vegetated cover
  - Development types (high, medium, low density)
  - 2001 to 2021 (9 time points)
- Town-provided basins
- Small tidal creek subwatersheds

Results: Land Use

- Developed land cover classes increased rapidly between 2001 and 2021

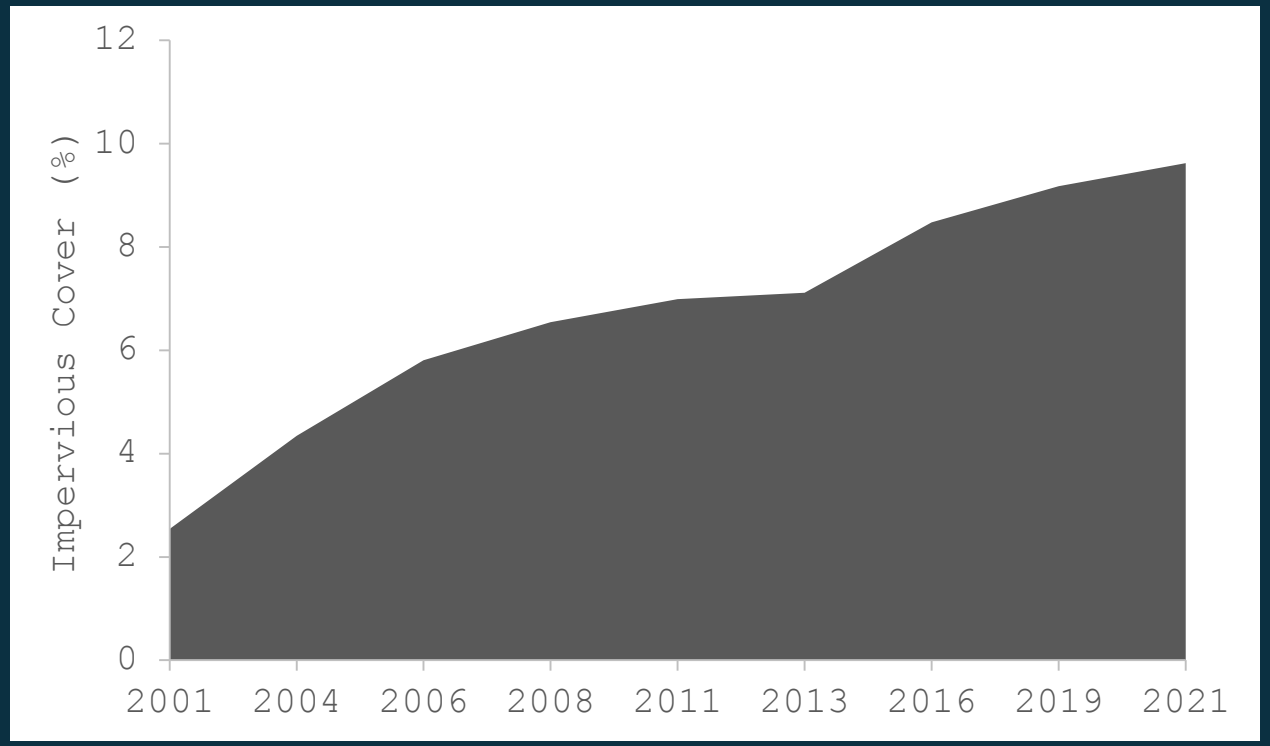


Low intensity

High and medium intensity

Results: Land Use

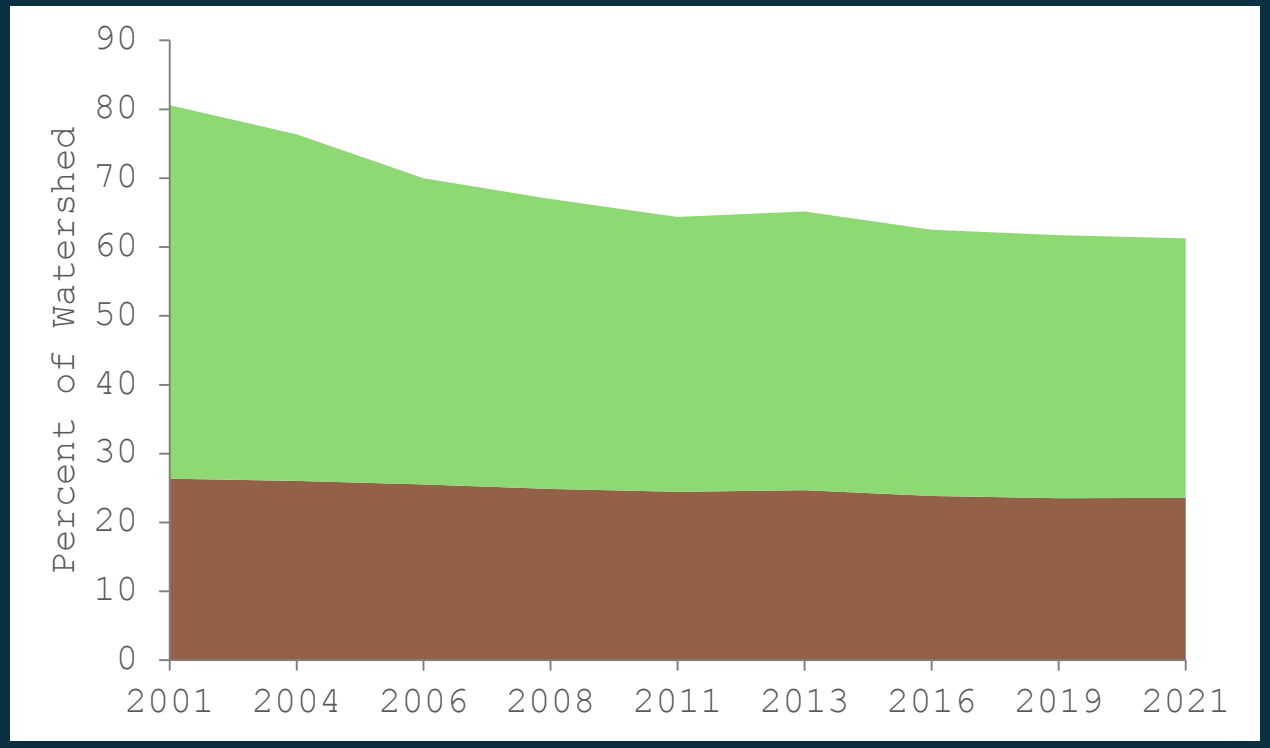
- Along with development, impervious cover increased similarly



9.6%

Results: Land Use

- Vegetated land cover classes decreased
  - Vegetated uplands (fields, forests)
  - Wetlands (forested or woody wetlands, emergent wetlands or fresh marsh)



Vegetated cover excl. forested wetlands (3019 a

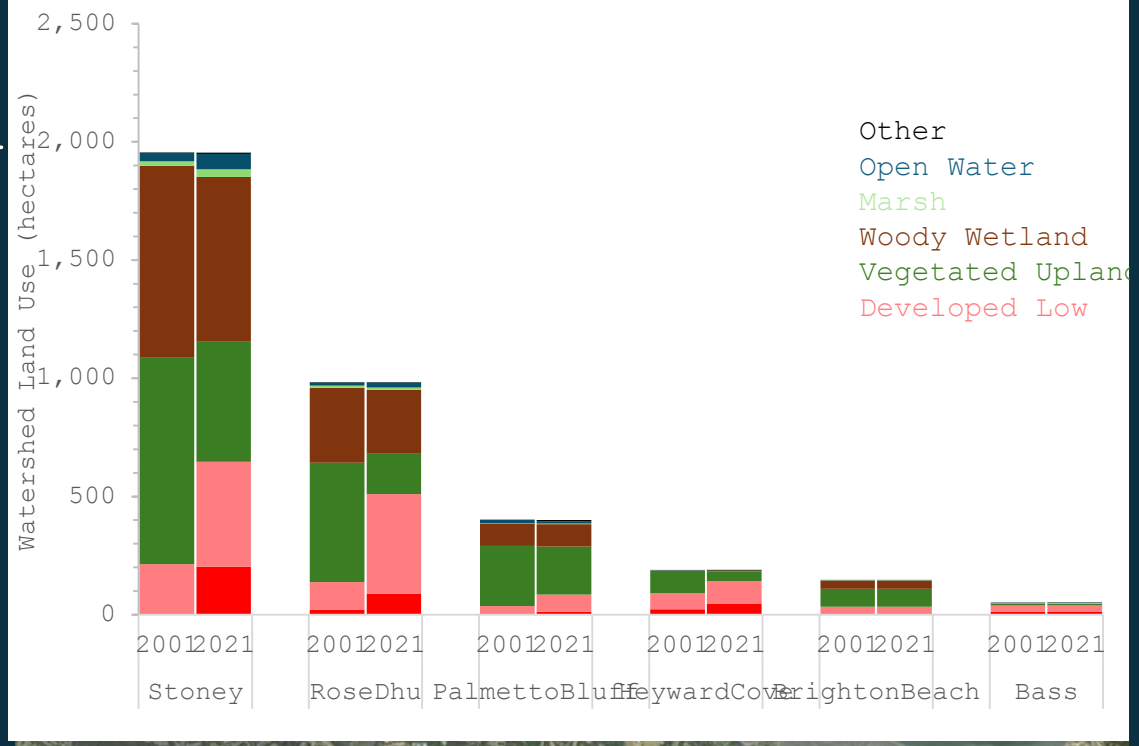
Forested wetlands (513 ac

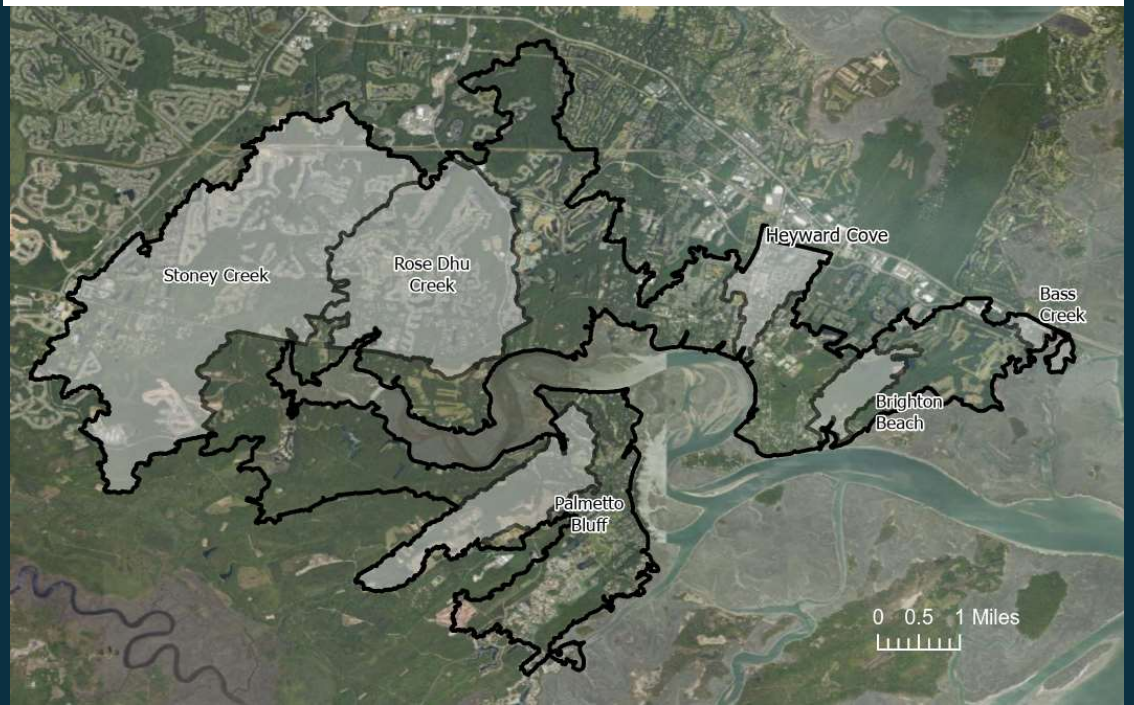
Results: Small Tidal Land Use

- Stoney and Rose Dhu Creek subwatersheds contain a large proportion of this development

- Still contain most of the remaining forested wetlands

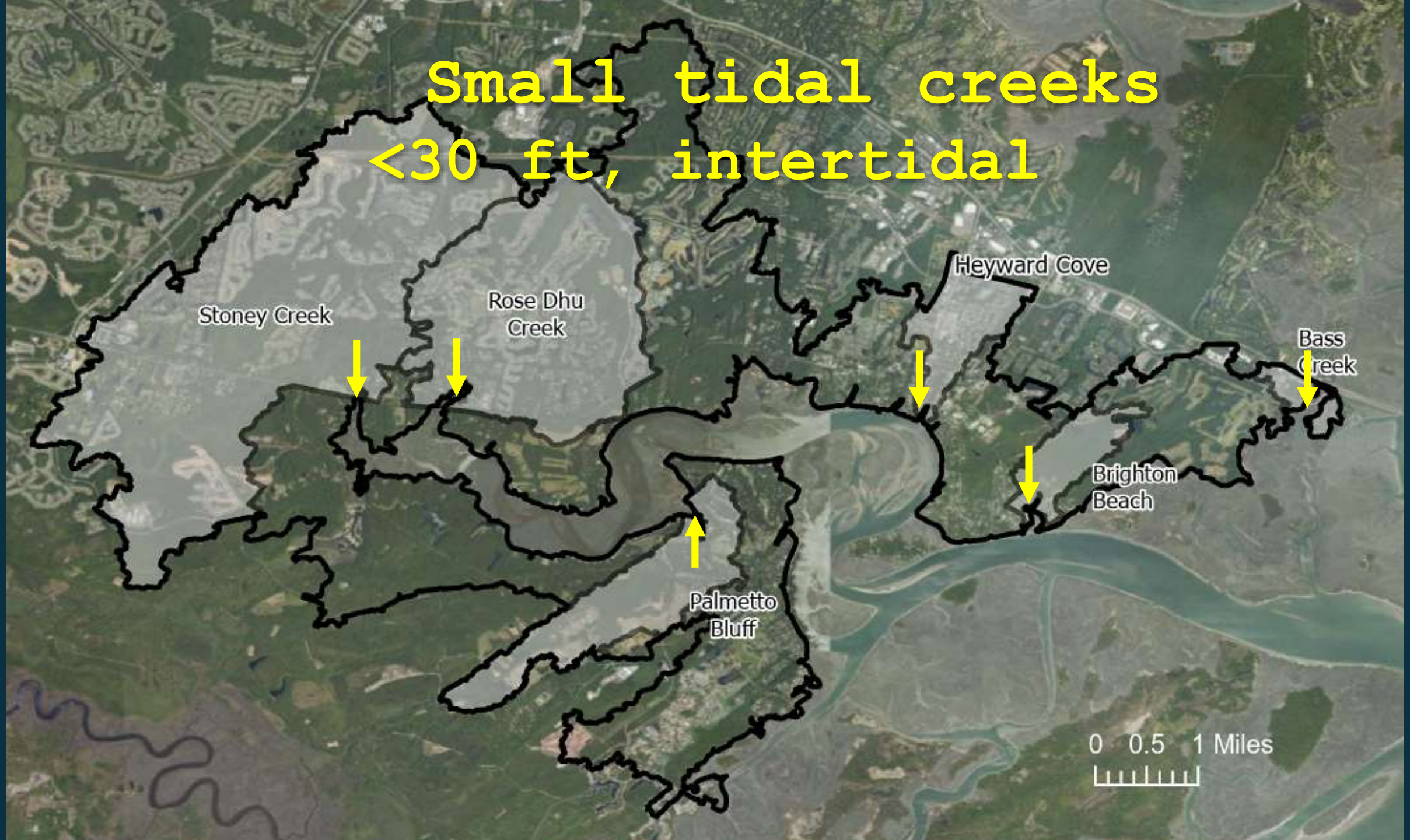
- Heyward Cove developed earliest

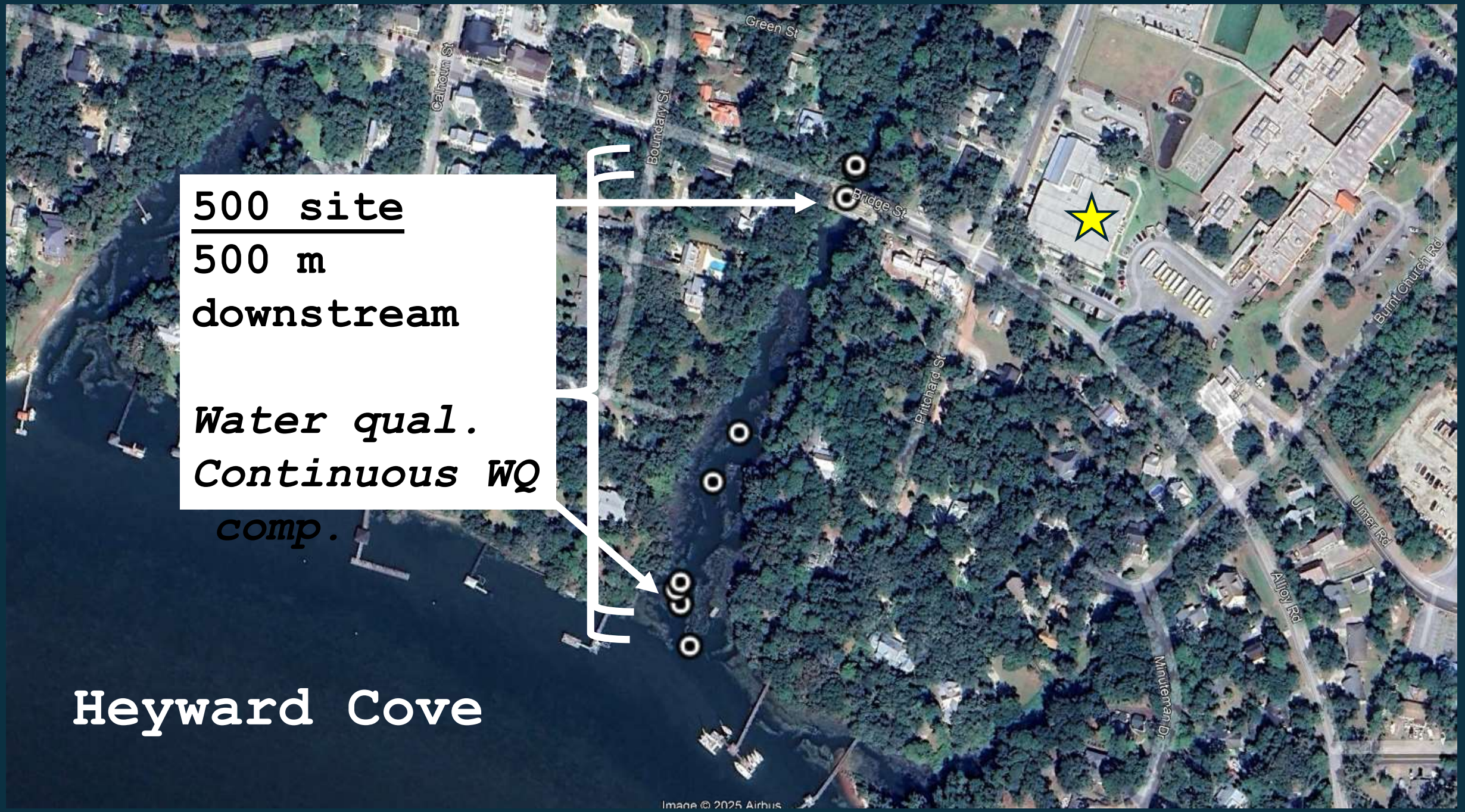




Small Tidal Creek

- Primary interface between u
  and coastal systems
- Sentinel ecosystem
  - Shows impact before larger sy
- Leverage SCDNR long-term Ti
  Creek Project, 1994-
- Six creeks
- Variety of parameters


Small tidal creeks
<30 ft, intertidal
Stoney Creek
Rose Dhu Creek
Heyward Cove
Bass Creek
Brighton Beach
Palmetto Bluff
0 0.5 1 Miles


500 site
500 m
downstream
Water qual.
Continuous WQ
comp.
Heyward Cove
Green St
Calhoun St
Boundary St
Bridge St
Pritchard St
Burnt Church Rd
Ulmer Rd
Alljoy Rd
Minuteman Dr
Image © 2025 Airbus

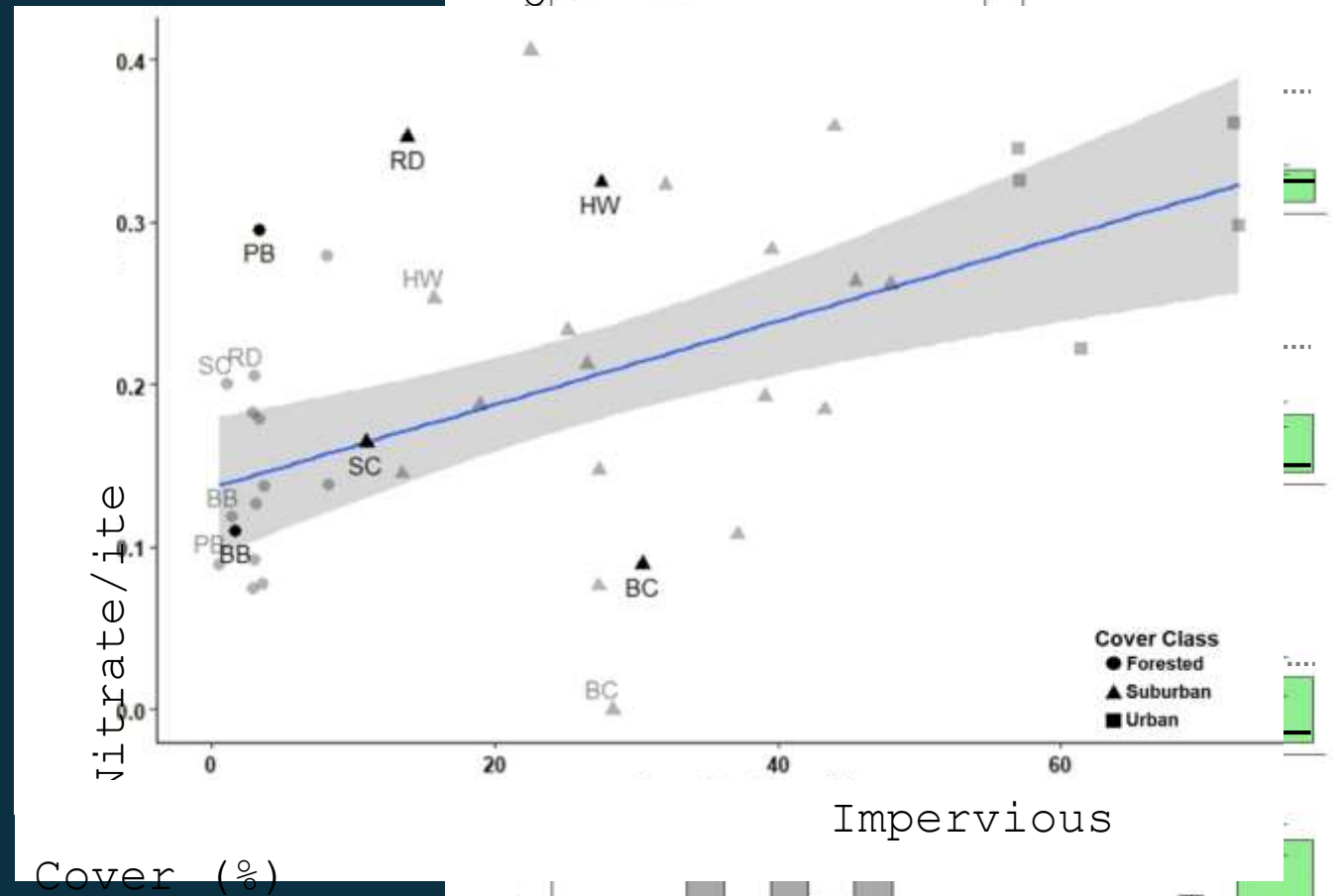
Measures of habitat quality

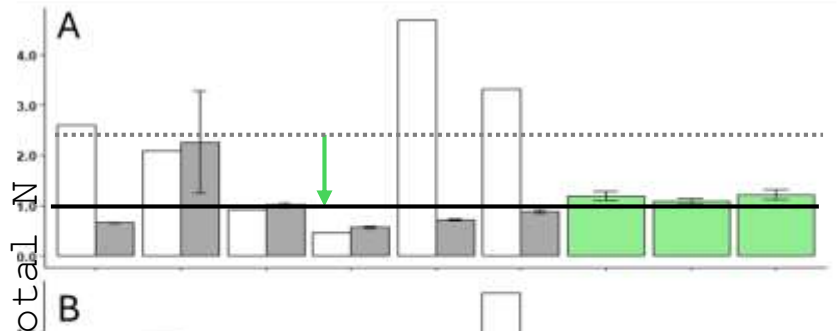
Water Quality	Sediment Quality	Biological
Nutrients (5)	Contaminants (20+)	Benthic community
Fecal Coliform	legacy sources (e.g., DDT)	% poll. sens.
Chlorophyll a	ongoing sources (e.g., PAH)	% poll. tolerant
Dissolved Oxygen	Grain size	
Salinity	Total Org. Carbon	
pH	Toxicity	

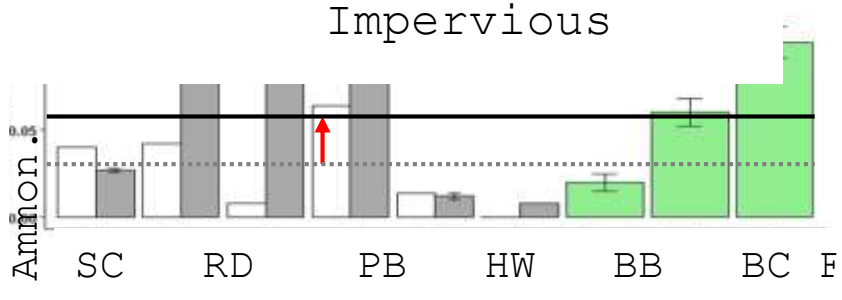
Results: Small Tidal Creek Water Quality

Baseline Study
Current Study
Comparison Sites

- One-time sampling events, may include natural variability
- Most parameters decreased except nitrate/nitrite.
- Surrounding land use may explain high nitrate/nitrite

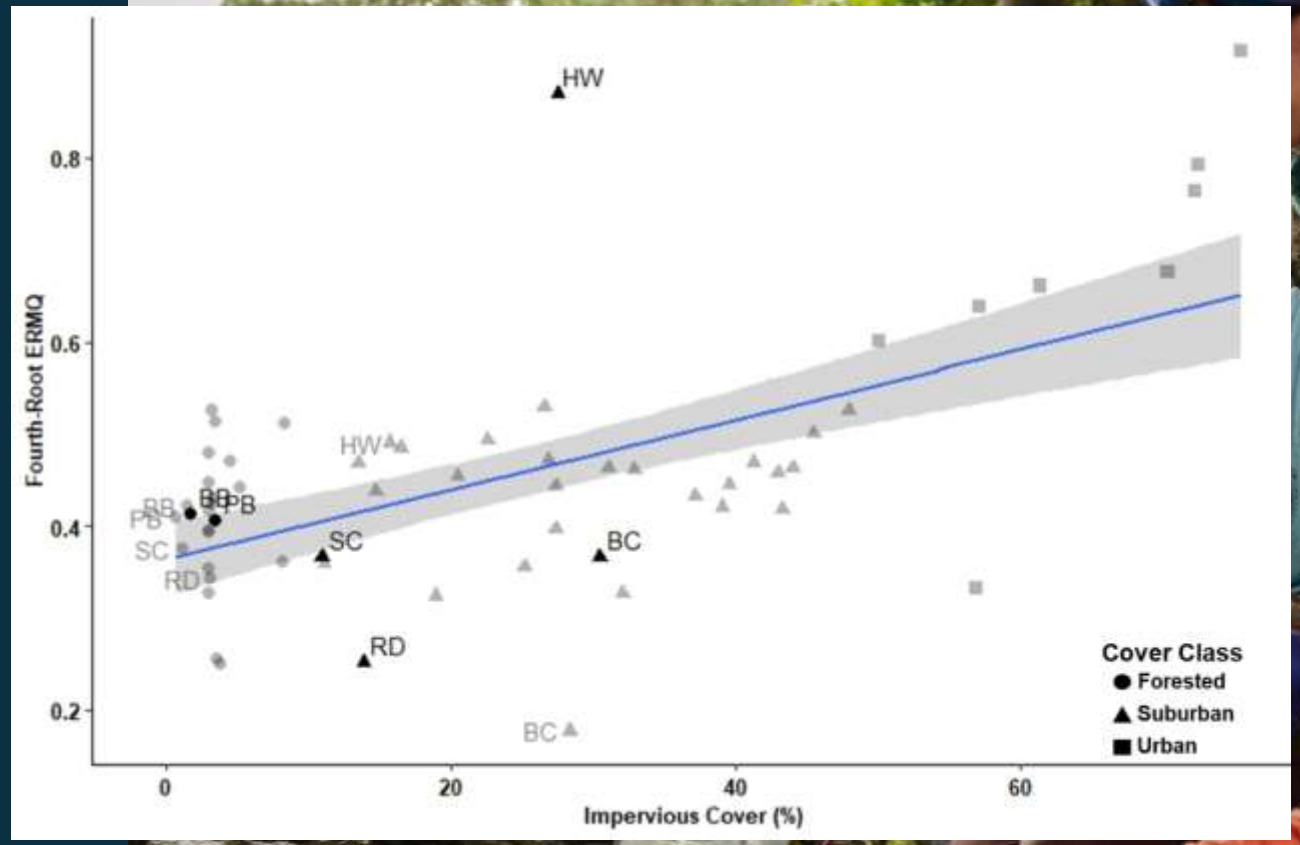






Results: Small Tidal C
Sediment Contaminants

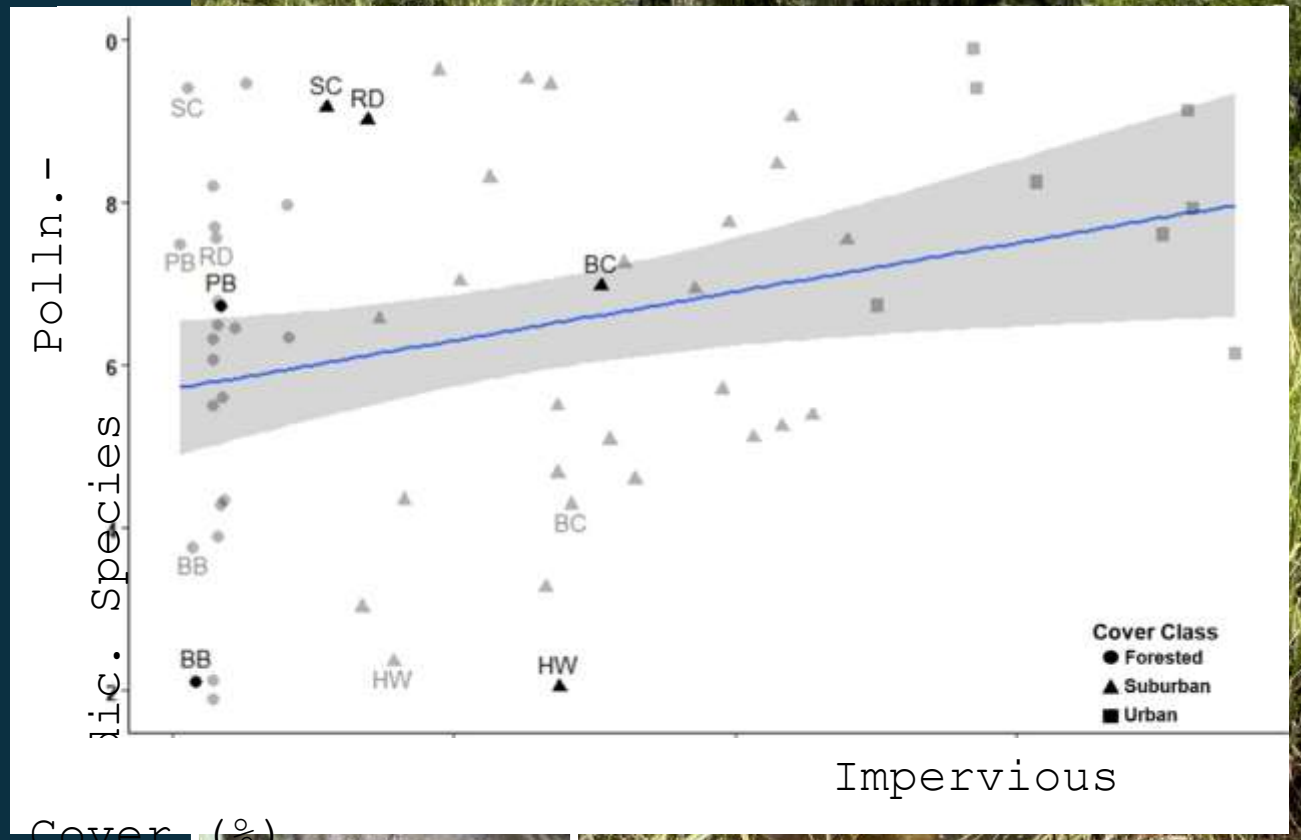
- Mixed results- some higher, some lower.
  - Legacy contaminants DDT, PCB
  - PAH, Pesticides, Metals
- Heyward Cove had high PAH in 2001 and had even higher PAH in 2023
  - ERL (11) and ERM (7) exceedances in 2023, EPA classifies as 'poor'
- Aside from PAH in Heyward Cove, levels generally within



Results: Small Tidal Cre
Benthic Community

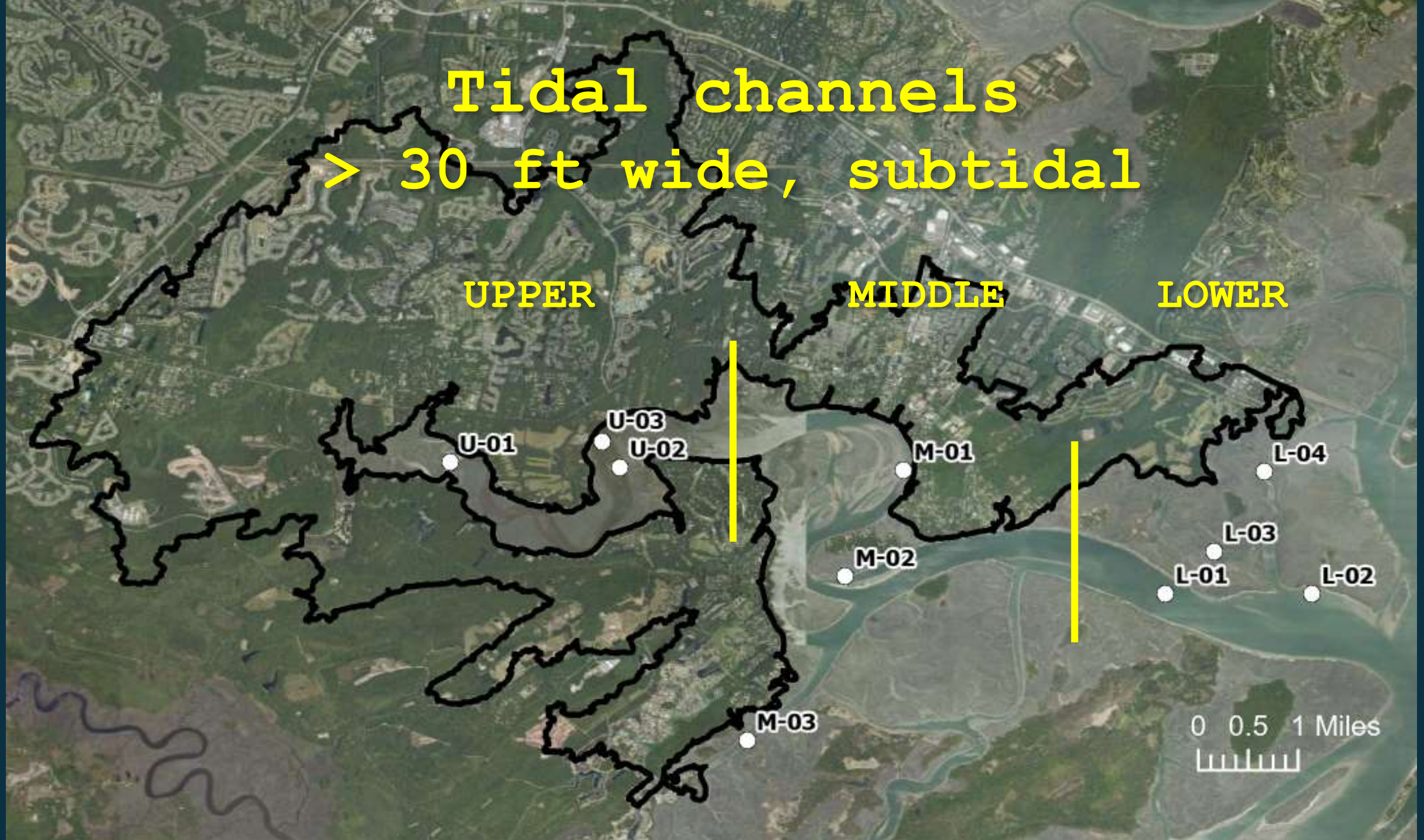
- Paired t-test, no significant change in pollution-indicative or -sensitive species

- Overall, across all creeks studied, impervious cover is significantly correlated to an increase in pollution-



Tidal Channel Study

- Represents most of the coastal h
  by area
- Leverages large SCDNR SCECAP dat
  1999-present
- Indices to evaluate ecosystem
  holistically
- Ten sites
- Variety of parameters


Tidal channels
> 30 ft wide, subtidal
UPPER
MIDDLE
LOWER
U-01
U-02
U-03
M-01
M-02
M-03
L-01
L-02
L-03
L-04
0 0.5 1 Miles


0 1.5 3 Miles

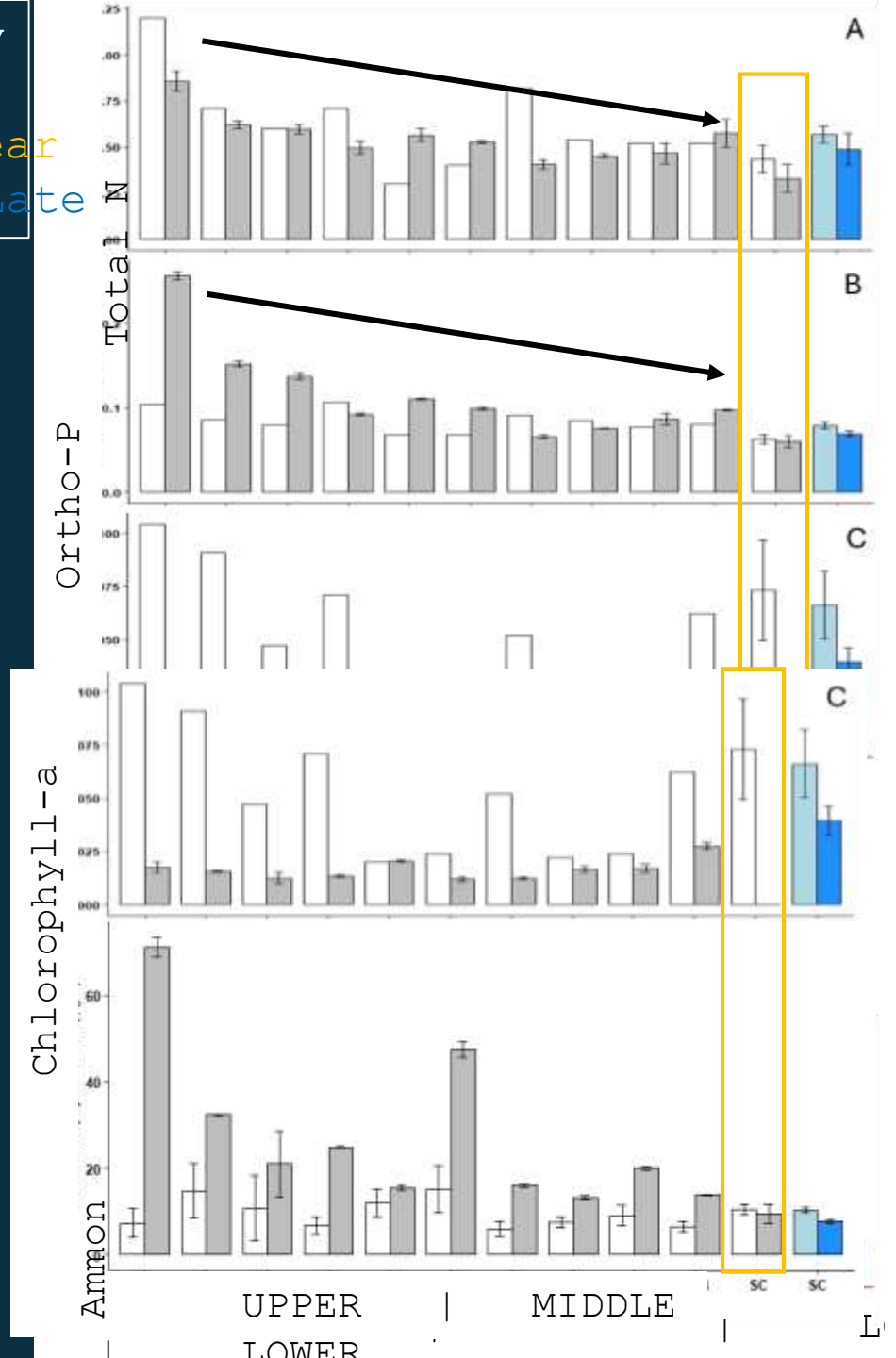
Measures of habitat quality

Water Quality	Sediment Quality	Biological
Nutrients (5)	Contaminants (20+)	Benthic community
Fecal Coliform	legacy sources (e.g., DDT)	B-IBI
Chlorophyll a	ongoing sources (e.g., PAH)	Nekton
Dissolved Oxygen	Grain size	
Salinity	Total Org. Carbon	
pH	Toxicity	

Results: Tidal Channels Water Quality

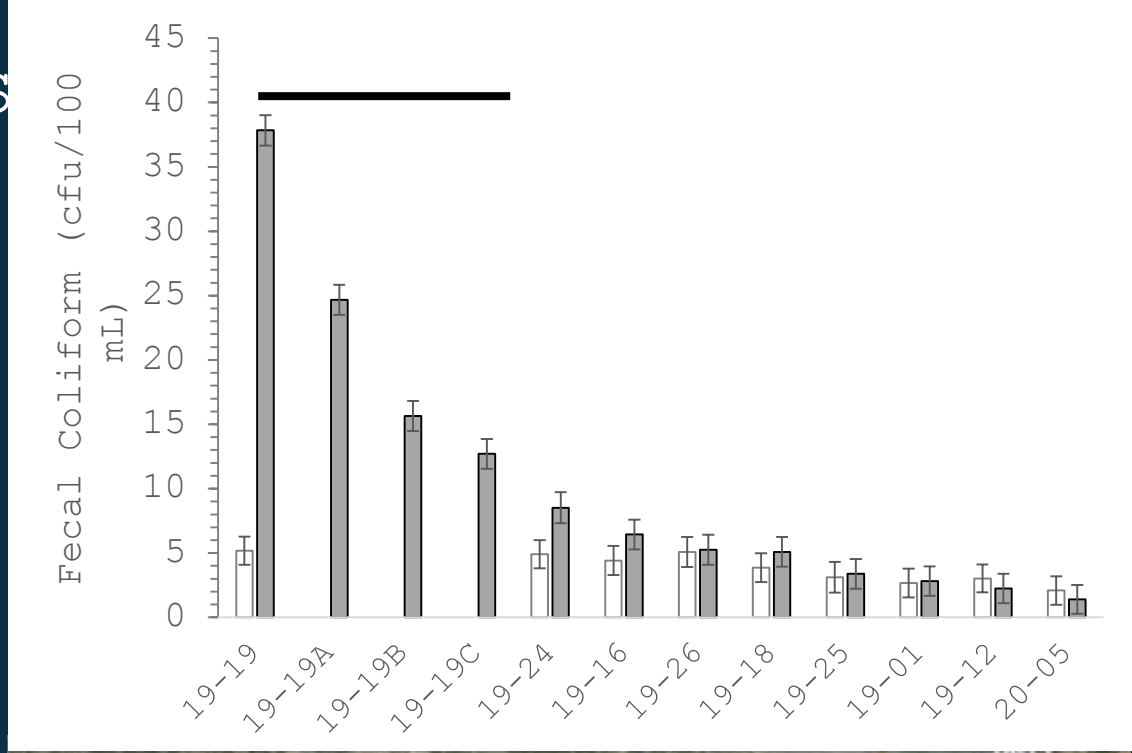
- One-time sampling events, may include natural variability
- Total N, P, Ortho-P higher in upper watershed
- Chlorophyll a significantly increased, ammonia significantly

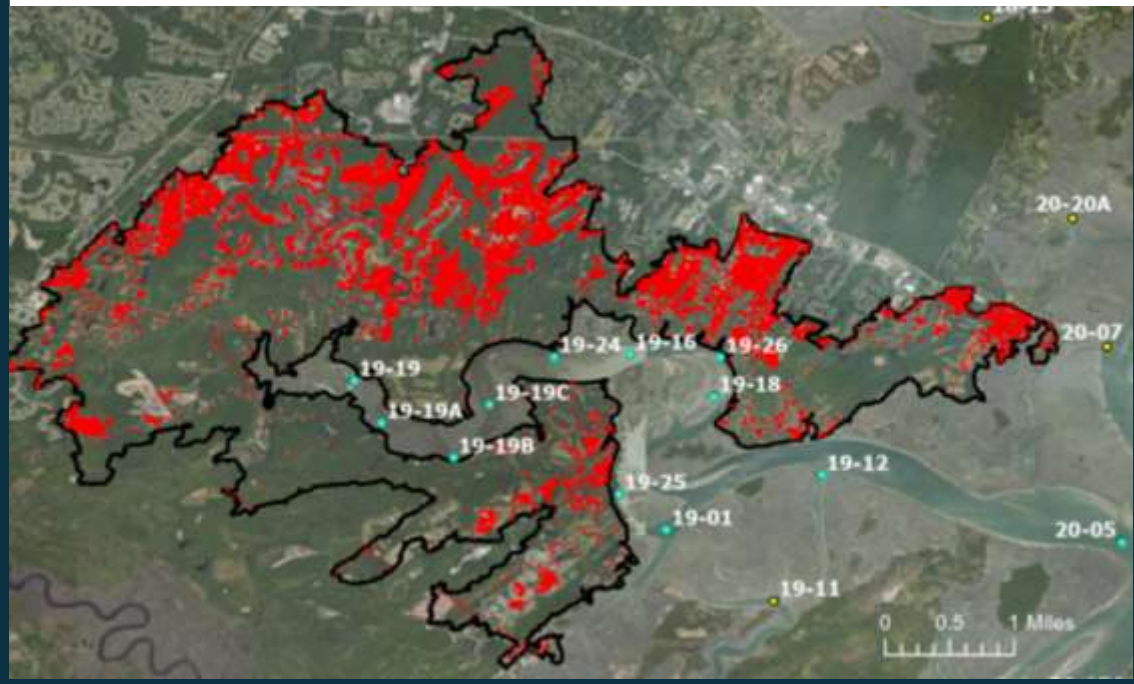
Baseline Study
Current Study
SCECAP Same Year
SCECAP Early/Late



Results: Tidal Channels Fecal Coliform

- SCDES Shellfish Sanitation data
  - 3000+ observations
  - Restricted harvest
- Uppermost long-term sites both increased most
- Lower sites decreased

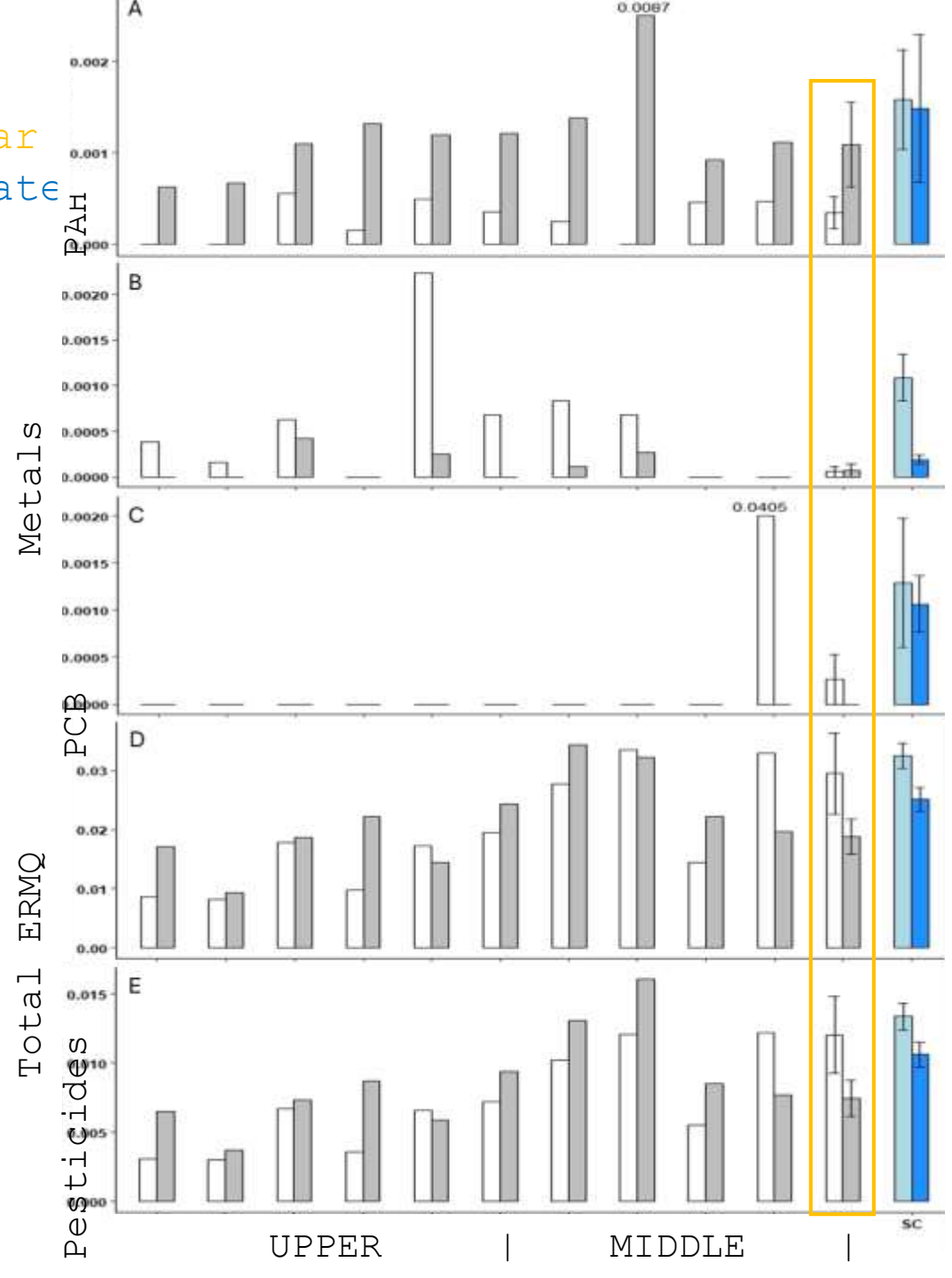




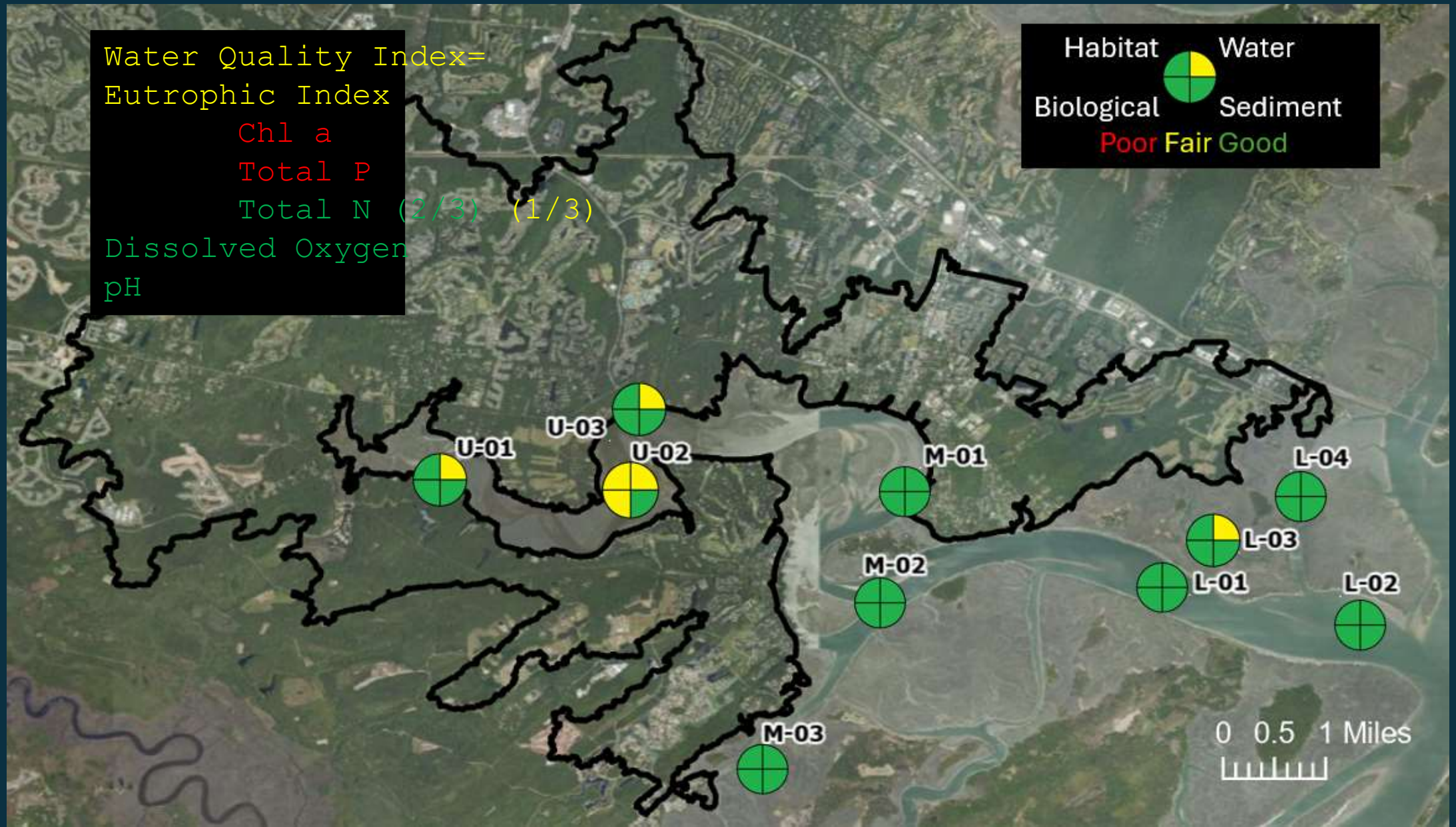
Results: Tidal Channels Sediment Quality

Baseline Study
Current Study
SCECAP Same Year
SCECAP Early/Late

- ERMQ: biologically-relevant concentrations
- Large increase in PAH all sites, PCB decrease
- Overall ERMQ driven by metals, 2002-2023 patterns
- No ERL or ERM exceedances, levels are ok



Results: Tidal Channels Indices



Oyster Study

- Demographics, disease, and stressor
  - Ecosystem engineer
    - Creates or maintains habitat for other spec
  - Sessile
    - Good indicator to represent a loca
  - Culturally and economically imp
  - Six sites (2 upper, 2 mid, 2 lo

Measures of oyster quality

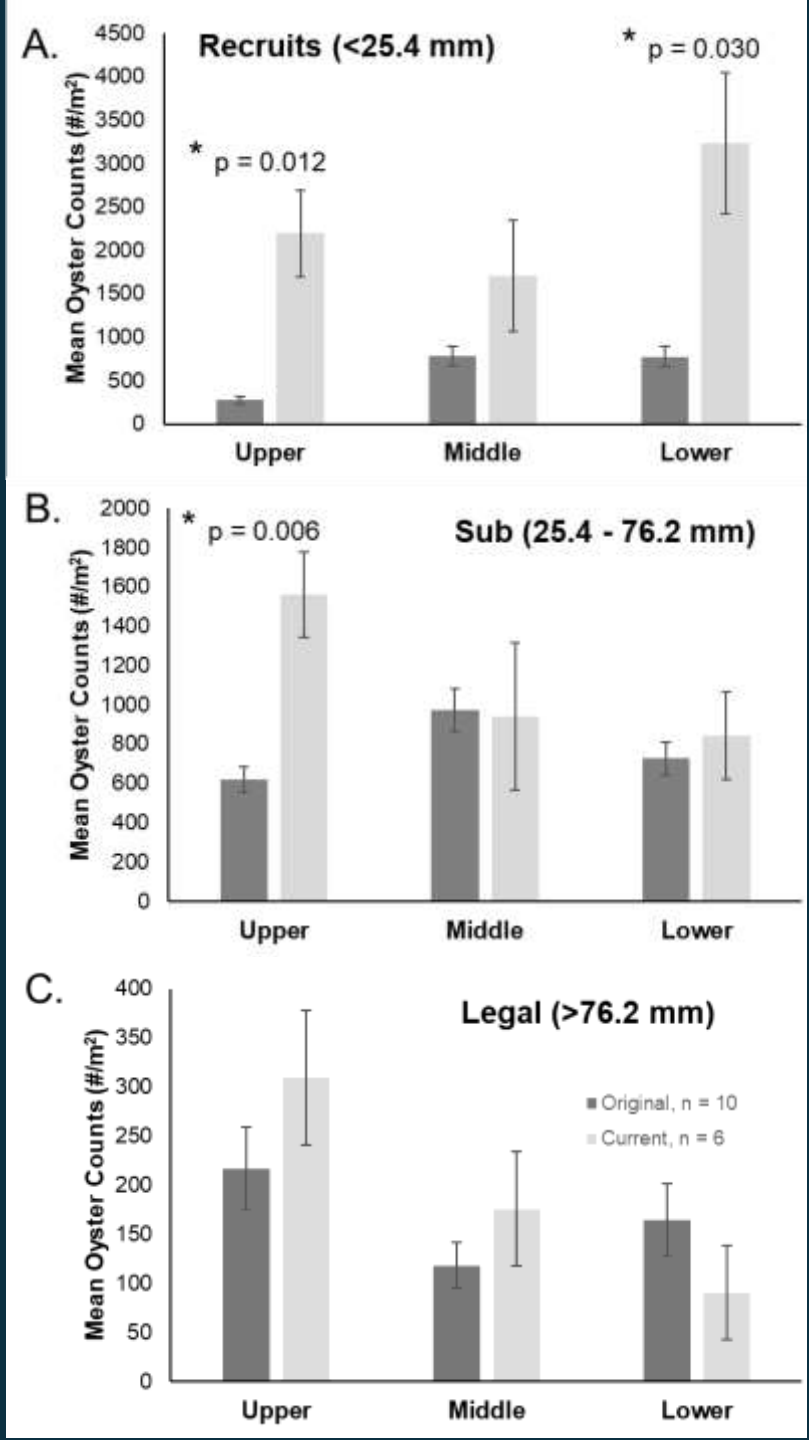
Demographics	Disease and Stress	Contamination
Density	Dermo (preval./intens.)	Contaminants (20+)
Size	MSX (preval./intens.)	legacy sources (e.g., DDT)
Recruitment	Stress metabolites (2)	ongoing sources (e.g., PAH)
Mortality	Genetic markers (3)	
Associated fauna		

Results: Oyster Demographics

- Quadrats: smaller mean shell height & higher density
  - More small oysters
- Trays: similar or larger recruit height
- Low mortality
  - Consistent with state-wide average (2023-24 lowest in last 9 years)

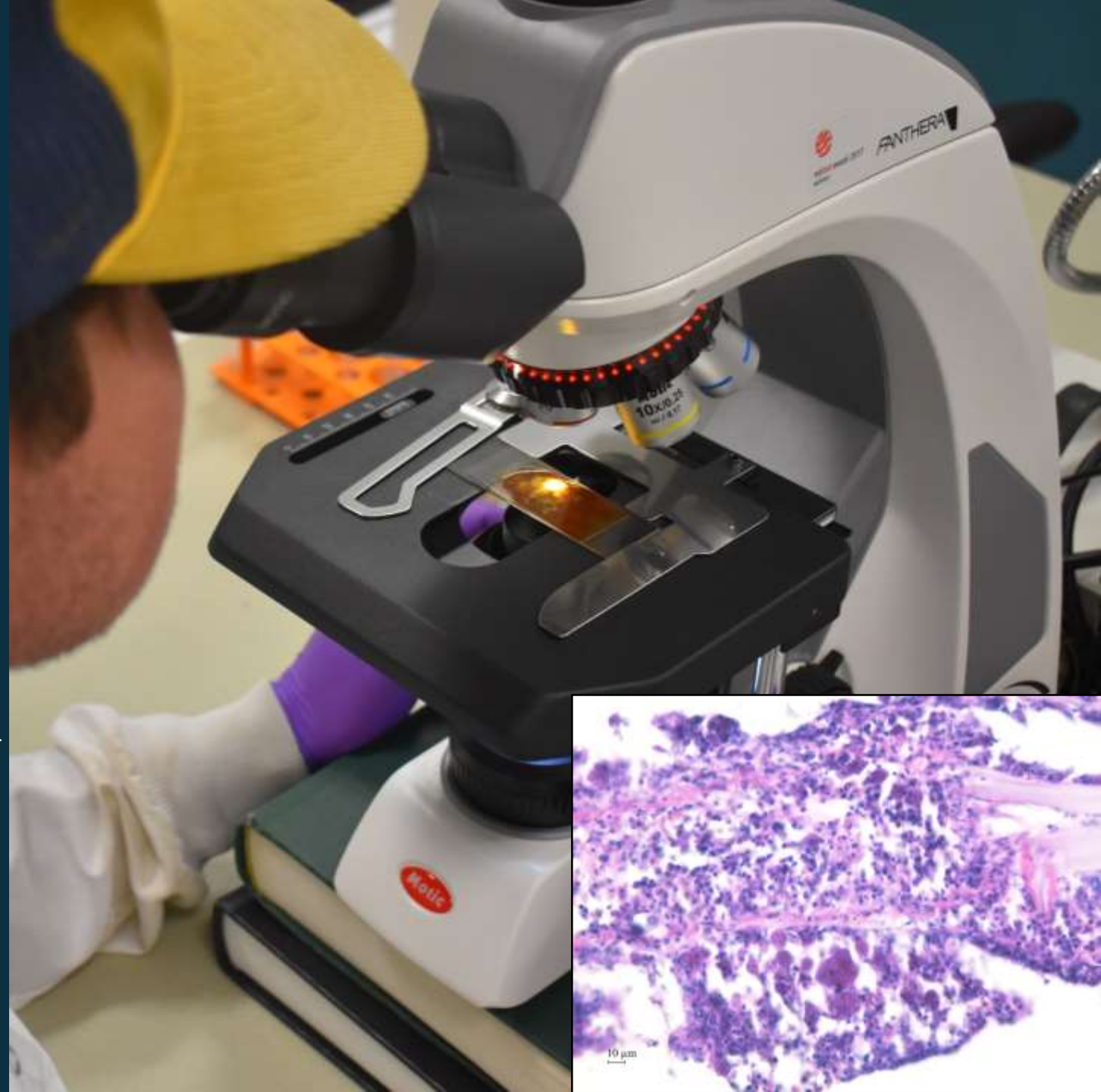
Results: Oyster Demographics

- Higher density of recruits and sub-legal oysters in upper section
- Larger average size of recruits in upper section
- Upper section closed to harvest since 2009
- Part of lower section (L-02) opened to increased harvest



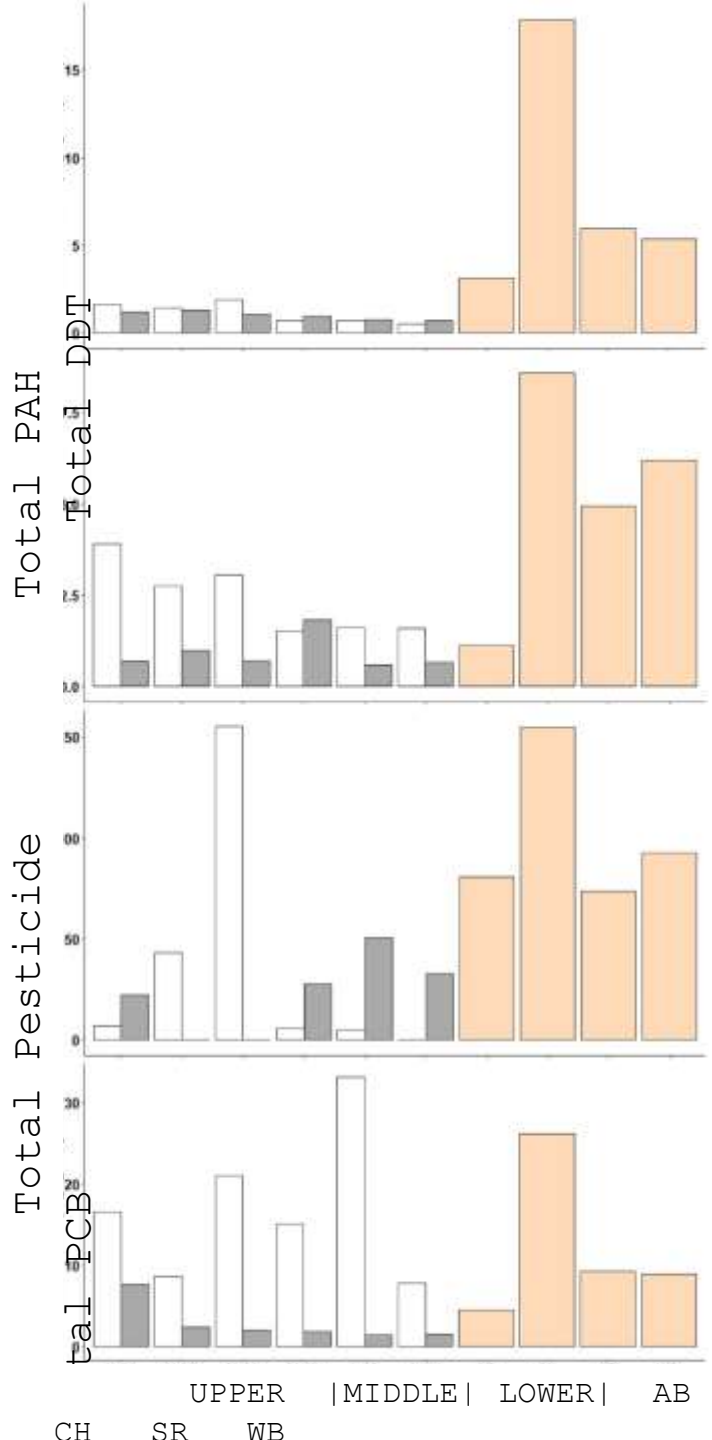
Results: Oyster Study Health and Disease

- Dermo (*Perkinsus marinus*)
  - Ubiquitous
  - Prevalence slightly higher
- MSX (*Haplosporidium nelsoni*)
  - Mid and lower sites only
  - Consistent with previous study
- Consistent with previous study and



Results: Oyster Study Tissue Contaminants

- Values generally low compared to urbanized watersheds
- Values decreased for pesticides, PCB between 2002 and 2023
- PAH is mixed. Consistent increase at lower sites
- Higher than adjacent



Key Results

- The May River watershed has developed substantially since 2002, converting a forested and agricultural watershed to a suburban landscape

- Despite these changes, marine habitats in the May River watershed are still healthy in many regards, relative to SCDNR long-term datasets

- But there are also several indicators of degradation…

Key Results

- In *small tidal creeks*:
  - Chlorophyll
  - Nitrate/nitrite
  - Fecal coliform
  - Heyward Cove PAH in sediments
- In *tidal channels*, especially upper reach and smaller branches:
  - Chlorophyll
  - Total phosphorus
  - Fecal coliform
- Oyster populations and health are consistent with other areas of the coast and primarily reflect changes in management rather than urbanization

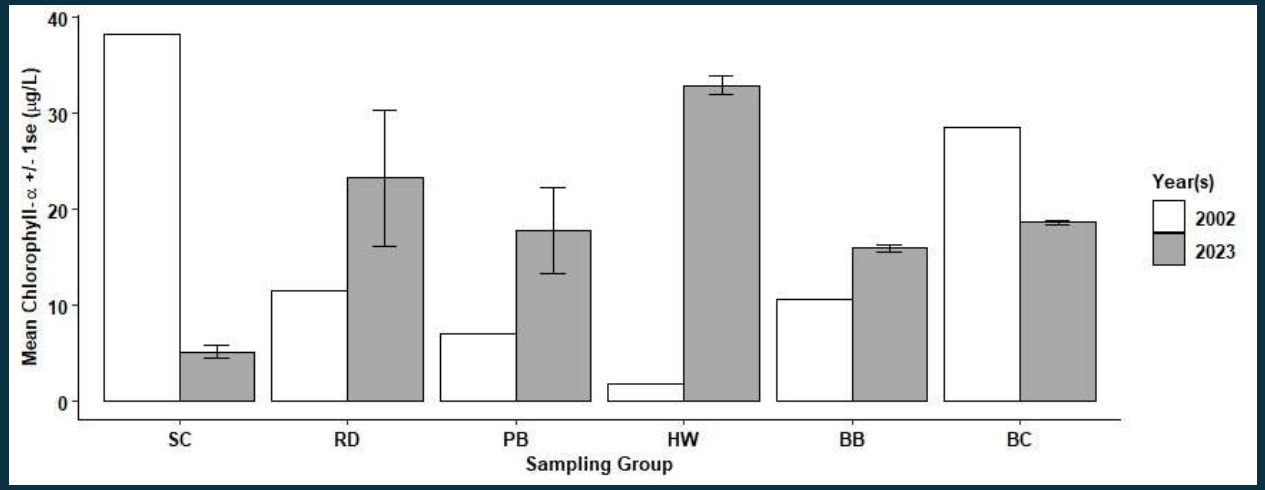
Recommendations

- Continued monitoring and synthesis of data
  - Especially for metrics that indicate degradation trend
  - Identify focus areas (i.e. spatially targeted sampling)
  - Distinguish natural variability from urbanization impacts

- Potential management priorities, consistent with Blueprint Bluffton
  - Improvements to stormwater and wastewater infrastructure (public and private)
  - Conservation of remaining natural landscape features


Thank you
tweela@dnr.sc.gov
Thank you to SCDNR staff,
Town of Bluffton, NOAA,
SCDNR support
SOUTH CAROLINA
DEPARTMENT OF NATURAL RESOURCES

Supplemental Information


Mean Chlorophyll-α +/- 1se (µg/L)
40
30
20
10
0
SC
RD
PB
HW
BB
BC
Sampling Group
Year(s)
2002
2023

Small Tidal Creek		Area	Impervious Cover 2001	Impervious Cover 2021	Ponds 1999	Ponds 2021	VP and P Draining Soils
Subwatershed		acres	%	%	acres	acres	%
Stoney Creek	SC	4830	1.1	10.9	58.6	321.9	0.33
Rose Dhu Creek	RD	2431	3.1	13.8	0.6	125.2	0.31
Palmetto Bluff	PB	990	0.6	3.4	0.0	41.7	0.40
Heyward Cove	HW	466	15.7	27.5	4.9	12.5	0.39
Brighton Beach	BB	365	1.5	1.6	4.4	5.1	0.14
Bass Creek	BC	124	28.4	30.4	1.2	2.1	0.13

Type	Site	Year	Lat	Long	Water Quality								Sediment Quality				Biologic	Habitat
					Total Nitrogen	Total Phosphorus	Chlorophyll-a	Eutrophic Index	Dissolved Oxygen	pH	Fecal Coliform	Water Quality Index	Toxicity	Sediment TOC	Contaminants	Sediment Quality Index	Biological Index (B-IBI)	Habitat Quality Index
TC	U-01	2002	32.224	-80.926				0				3				5	5	5
OW	U-02	2002	32.224	-80.901				5				5				5	5	5
OW	U-03	2002	32.227	-80.904				5				5				5	5	5
OW	M-01	2002	32.232	-80.941				5				5				5	5	5
OW	M-02	2002	32.208	-80.868				5				5				5	5	5
OW	M-03	2002	32.184	-80.883				5				5				5	5	5
OW	L-01	2002	32.205	-80.822				5				5				5	5	5
OW	L-02	2002	32.205	-80.010				5				5				5	5	5
TC	L-03	2002	32.211	-80.815				5				5				5	5	5
TC	L-04	2002	32.223	-80.808				5				5				5	5	5
TC	U-01	2023	32.224	-80.901				0				3				5	5	5
OW	U-02	2023	32.227	-80.903				0				3				5	3	3
OW	U-03	2023	32.223	-80.860				0				3				5	5	5
OW	M-01	2023	32.208	-80.866				3				5				5	5	5
OW	M-02	2023	32.184	-80.883				3				5				5	5	5
OW	M-03	2023	32.205	-80.822				3				5				5	5	5
OW	L-01	2023	32.205	-80.801				5				5				5	5	5
OW	L-02	2023	32.224	-80.925				5				5				5	5	5
TC	L-03	2023	32.211	-80.815				3				3				5	5	5
TC	L-04	2023	32.223	-80.808				5				5				5	5	5

Index / Parameter	Criteria		
	Poor	Fair	Good
WATER QUALITY			
Water Quality Index	< 3	3 ≤ x < 4	≥ 4
Dissolved Oxygen (mg/L)	< 3	3 ≤ x < 4	≥ 4
pH (salinity corrected)	≤ 7.22	7.22 < x ≤ 7.35	> 7.35
Fecal Coliform (cfu/100mL)	> 400	43 < x ≤ 400	≤ 43
Eutrophic Index	< 3	3 ≤ x < 4	≥ 4
Total Nitrogen (mg/L)	> 1.05	0.81 < x ≤ 1.05	≤ 0.81
Total Phosphorus (mg/L)	> 0.12	0.10 < x ≤ 0.12	≤ 0.10
Chlorophyll a (µg/L)	> 16.4	11.5 < x ≤ 16.4	≤ 11.5
SEDIMENT QUALITY			
Sediment Quality Index	< 3	3 ≤ x ≤ 4	> 4
Contaminants (ERM-Q)	> 0.058	0.020 < x ≤ 0.058	≤ 0.020
Toxicity	≥ 2	1 ≤ x < 2	< 1
Sediment TOC (%)	> 5	3 ≤ x ≤ 5	< 3
BIOLOGICAL CONDITION			
Benthic-IBI	< 2	2 ≤ x < 3	≥ 3
HABITAT QUALITY			
Habitat Quality Index	≤ 2	1.5 < x ≤ 2.5	> 2.5

	U-03		U-01		M-03		M-01		L-03		L-02	
Row Labels	2002	2023	2002	2023	2002	2023	2002	2023	2002	2023	2002	2023
2,4'-DDD	0	0	0	0	0	0	0	0	0	0	0	0
2,4'-DDE	0.294	0	0.301	0	0	0	0.312	0	0.322	0	0	0
2,4'-DDT	0	0	0	0	0	0	0	0	0	0	0	0
4,4'-DDD	0	0	0	0	0	0	0	0	0	0	0	0
4,4'-DDE	1.13	1.31	1.3	1.2042	0.7	0.9651	1.57	1.086855	0.179	0.704239	0.733	0.741431
4,4'-DDT	0	0	0	0	0	0	0	0	0	0	0	0
Aldrin	0	0	0	0	0	0	0	0	0	0	0	0
Chlorpyrifos	1.37	0	0.678	0	0.972	0	13	0	0.586	0	7.7	0
cis-Chlordane	0.149	0.79	0.23	0.8239	0.0983	0.7721	0.192	0.865057	0	0.828517	0.121	0.741431
DDT_Total	1.424	1.31	1.601	1.2042	0.7	0.9651	1.882	1.086855	0.501	0.704239	0.733	0.741431
Dieldrin	0	0	0	5.3239	0	0	0	0	0	0	0.249	0
Endosulfan I	0.4125	0	0.528	0	1.79	0	0.136	0	0.423	0	1.88	0
Endosulfan II	0	0	0	0	0	0	0	0	0	0	0	0
Endosulfan sulfate	0	0	0	0	0	0	0	0	0	0	0	0
Gamma-HCH (g-BHC, lindane)	3.295	0	12.2	0	11.5	0	4.28	0	4.91	0	21.7	0
Heptachlor	0	0	0	0	0	0	0	0	0	0	0	0
Heptachlor epoxide	1.1335	0	0.445	0	0	0	0.986	0	1.14	0	0.685	0
Hexachlorobenzene	0.0319	0	0	0	0	0	0	0	0	0	0	0
Mirex	0.6775	0.33	0.737	0.2535	0	0.1351	0.301	0.088722	0.28	0	0	0
Total_Pest	8.6554	2.42	16.552	7.6055	15.0603	1.8723	20.996	2.040634	7.84	1.532756	33.068	1.482862
Trans-nonachlor	0.162	0	0.133	0	0	0	0.219	0	0	0	0	0