2018 Folly Beach Nourishment

sediment composition, benthic invertebrates, zooplankton, nekton, and fish stomach contents

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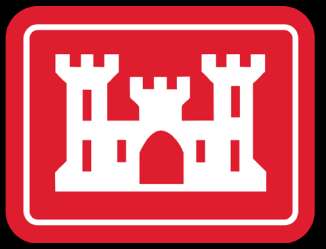
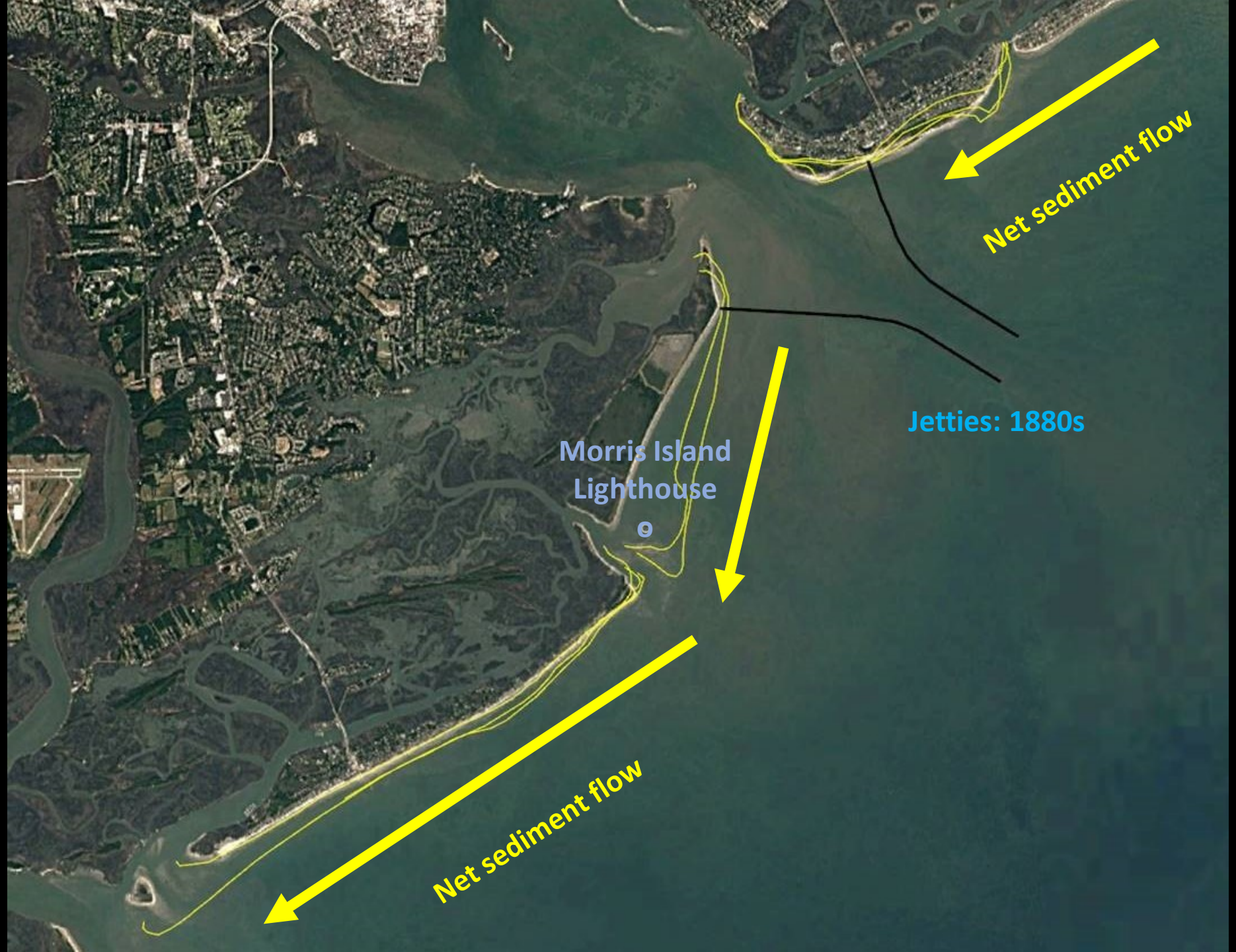




- Net sediment flow is to the southwest
- Jetties (built 1880s) significantly altered sediment flow
- Sullivan's Island: Accreting new land
- Morris Island: Severe erosion due to jetties
- Folly Island: Increase in erosion


Middle Coles Island
Cole Island
Slurry piped along the bottom of the Folly River
Borrow Area
+40,000 cy
Bird Key Stono
Seabird Sanctuary
earth
N

<u>Purpose of Monitoring Study</u>:

To better understand the potential biological impacts of conducting beach renourishment during the summertime, when fish and their prey base are highly active (growth / reproduction)

Explore less-studied subtidal impacts, food web/diet impacts

Monitoring Timeline

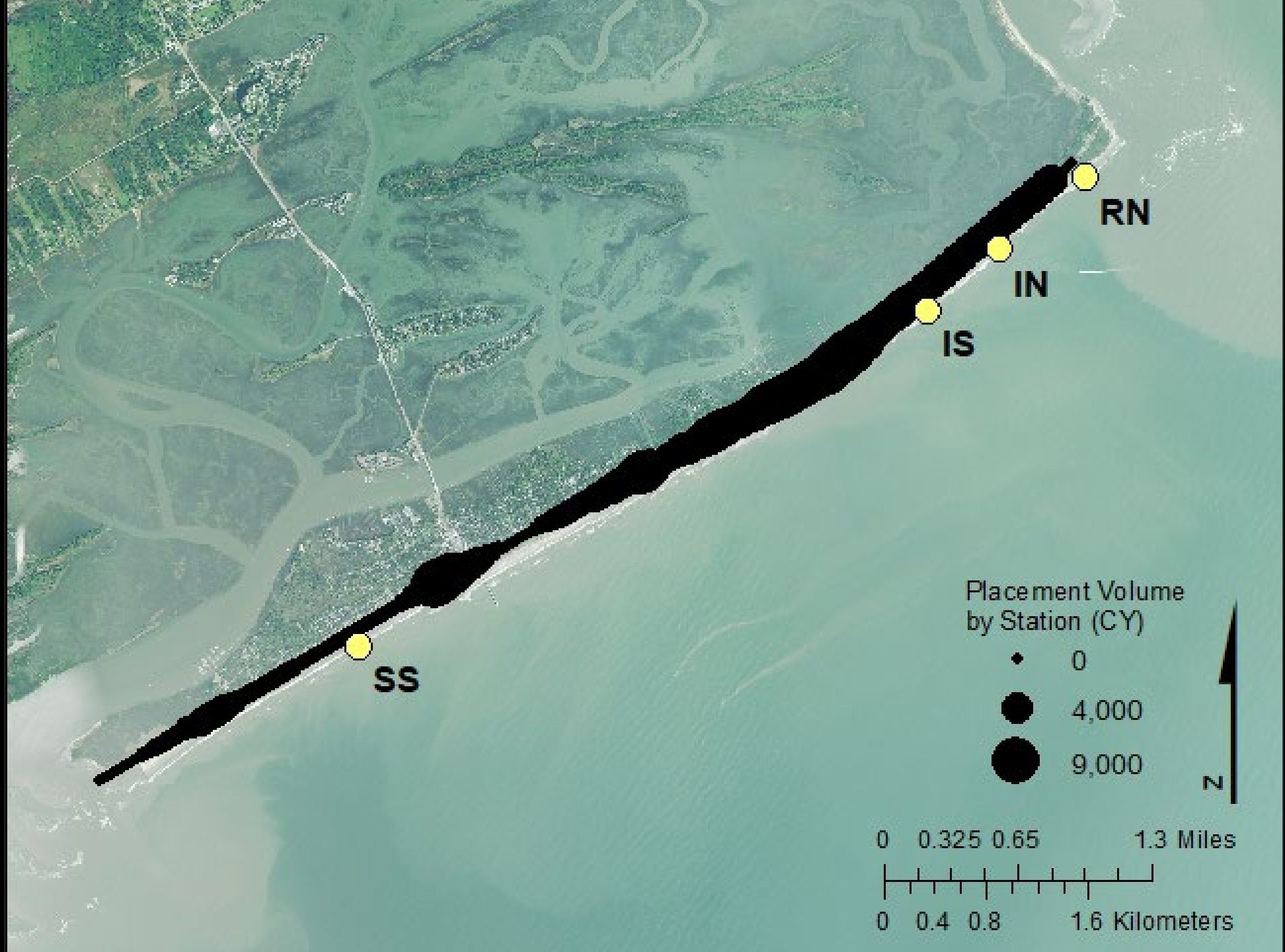
- ~~Pre-impact #1: May 2018~~
- Pre-impact #2: June 2018 (due to delay in start date)
- Immediate post-impact: September 2018
- 1 month post-impact: October 2018
- 9 months post-impact: June 2019
- 12 months post-impact: September 2019
- 13 months post-impact: October 2019

Changes to study design

- Nourishment was delayed, shifting sampling back a month
  - Additional pre-impact sampling was conducted to gather data closer to material placement
- All sites experienced unexpected changes
  - Northern reference sites experienced slow accretion of material, presumably from nearby nourished section
    - Additional transects added northward to avoid heavy accretion area
  - Southern reference site experienced an originally unplanned placement as additional funding became available
    - Additional elevation monitoring and benthic samples were collected
  - Impact sites experienced a second placement event in the Fall of 2018
    - Additional elevation data collected

Physical & Biological Monitoring

- Cross-sectional elevation profiles of beach
- Sediment characteristics (% sand, % silt/clay)
- Intertidal and subtidal benthic invertebrate community
  - # individuals by species
  - biomass
- Surf zone zooplankton community
  - Larval fish
  - Prey items for juvenile fish
- Surf zone nekton community (seine)
- Stomach contents (prey) of benthic-feeding fishes
- Before-After-Control-Impact (BACI) sampling design


RN
IN
IS
SS
Placement Volume
by Station (CY)
0
4,000
9,000
N
0 0.325 0.65 1.3 Miles
0 0.4 0.8 1.6 Kilometers

Nourished section, North

Pre (June 2018)

Post (Sept 2018)

13 mo post (Oct 2019)

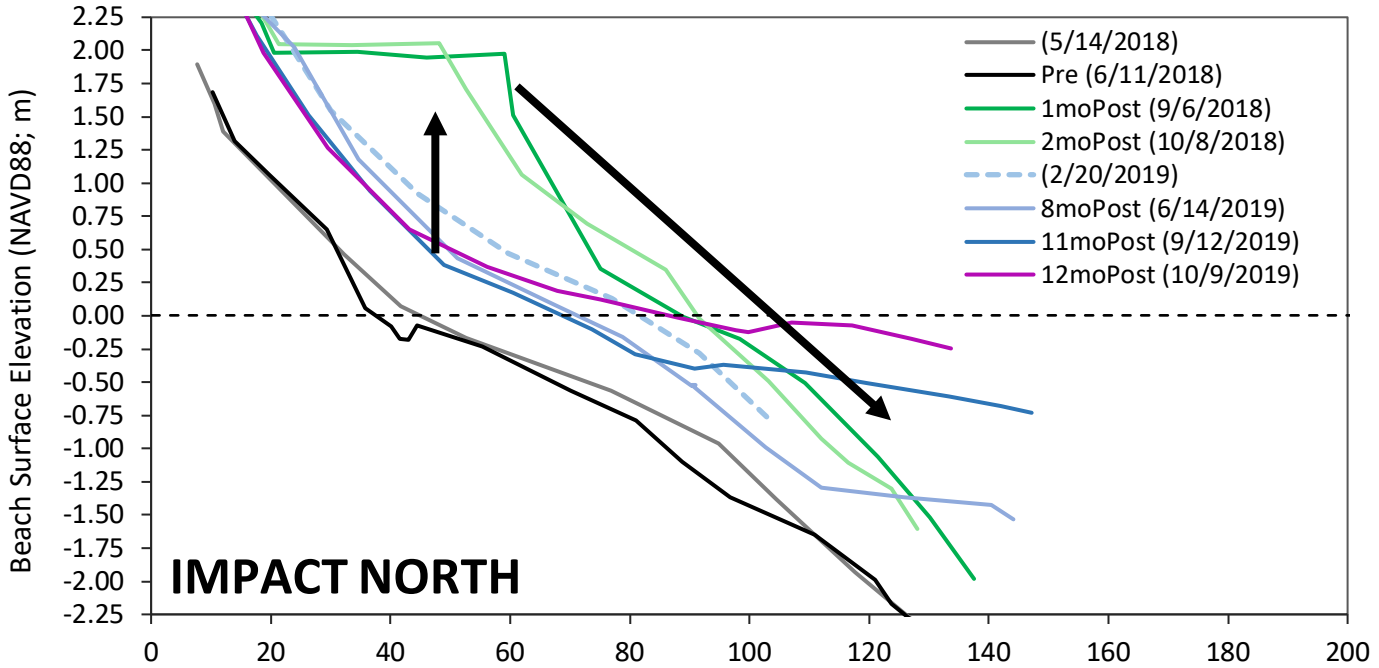
Reference section, North

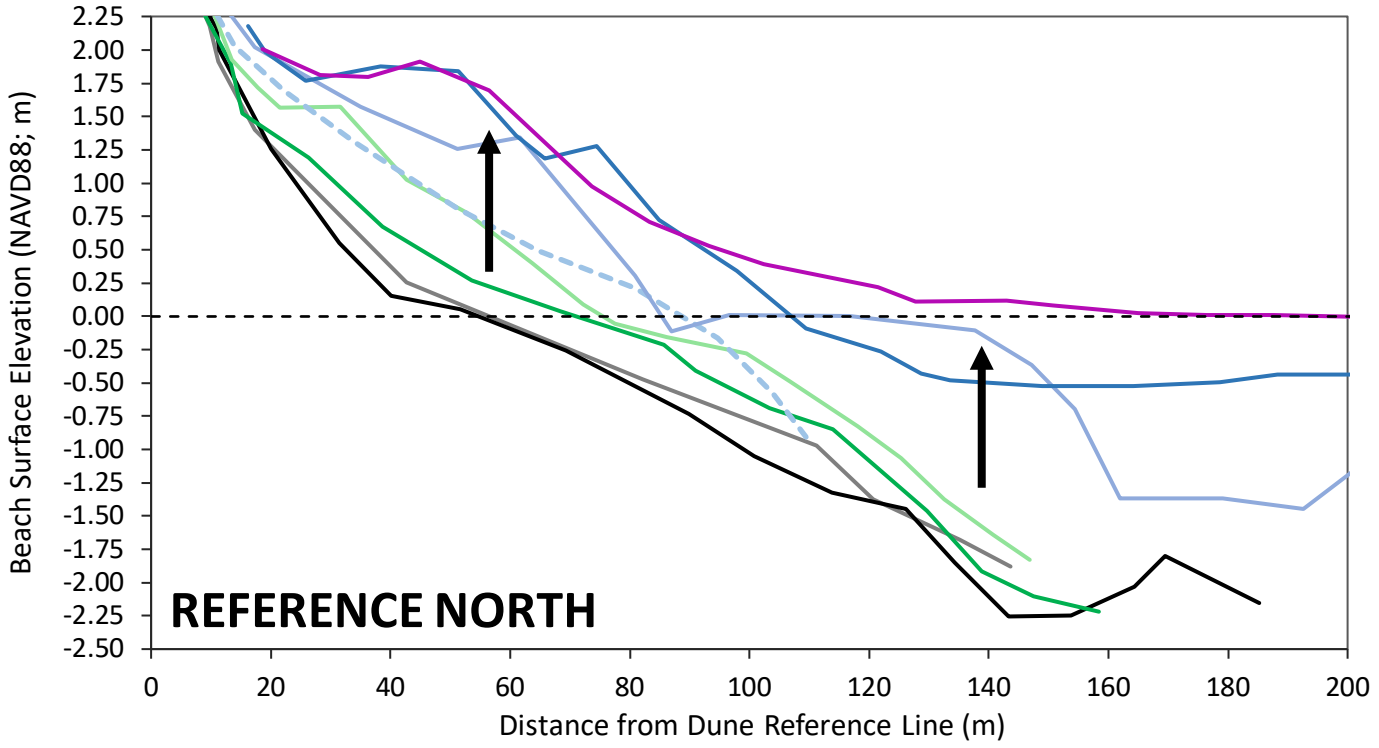
Pre (June 2018)

Post (Sept 2018)

13 mo post (Oct 2019)

- RTK GPS on beach
- Tied into sight level and stadia rod in subtidal zone





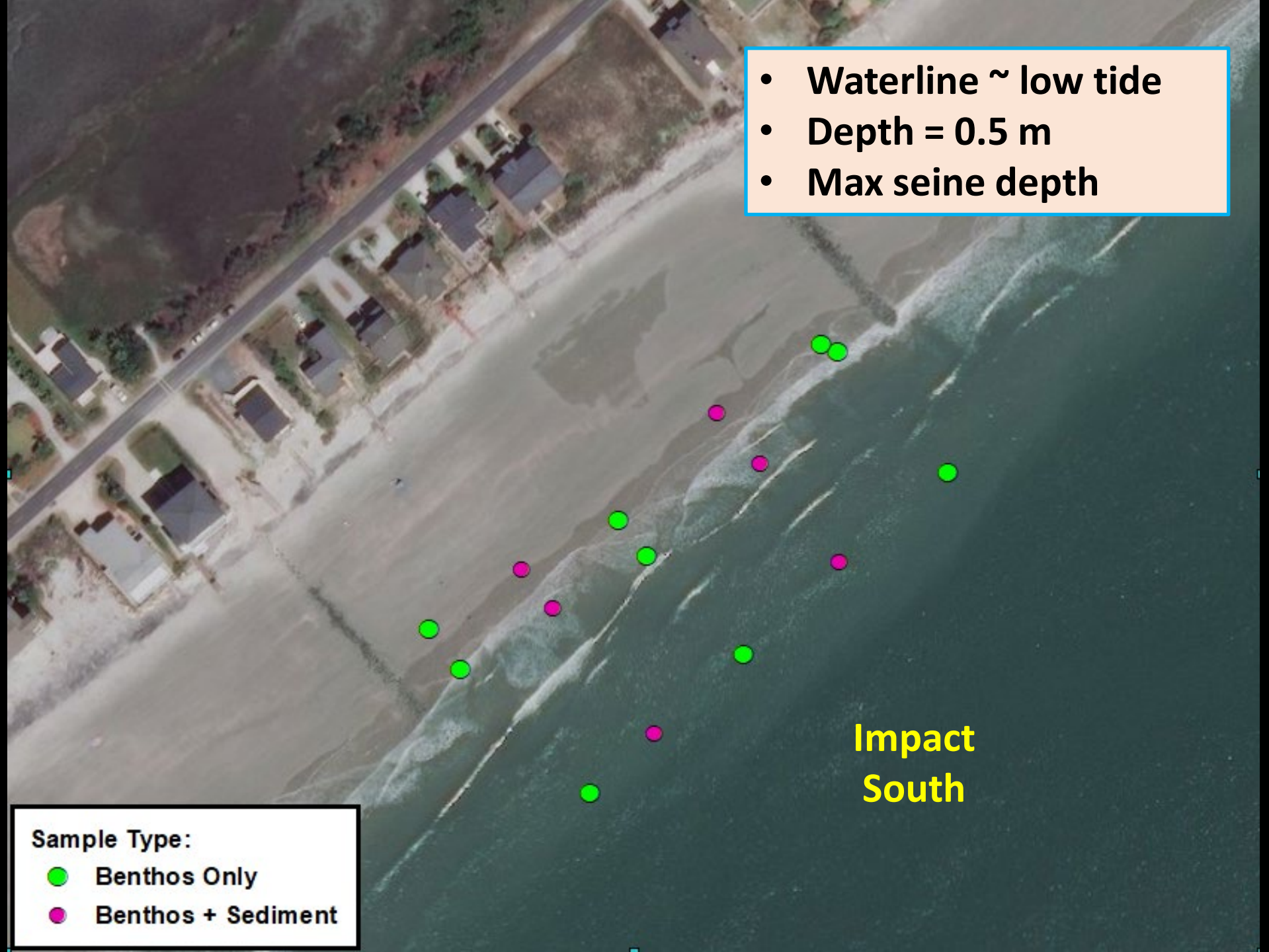
Large placement high in tidal frame

Gradually re-distributed to subtidal Zone

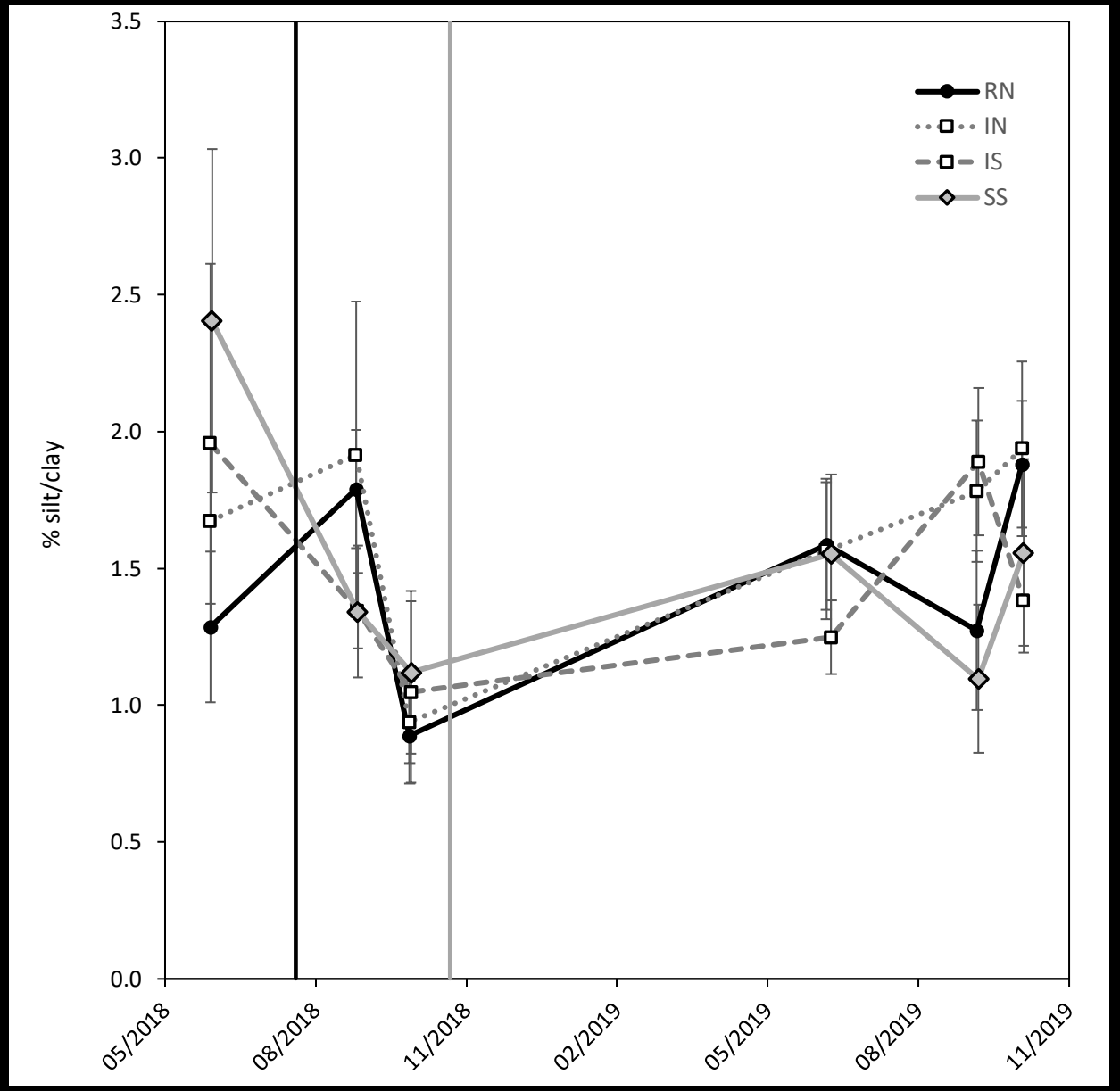
About 50% vertical and horizontal loss by end of study (at NAVD88)

Gradual but significant accretion throughout study, comparable in magnitude to nourished sites but different timescale

Flattening of profile and partial loss of trough and bar structures


• Waterline ~ low tide
• Depth = 0.5 m
• Max seine depth
Impact South
Sample Type:
Benthos Only
Benthos + Sediment

Sediment characteristics



No major changes

Sediment was a good match

Benthic Infauna

- Bivalves, amphipods, other crustaceans (cumaceans, isopods, crabs), polychaete worms (61 taxa identified)

- Greatest densities observed at low tide line, during warm conditions, and were comprised mostly of mollusks.

- Erosive sites (nourished areas) had lower abundances in general, before and after

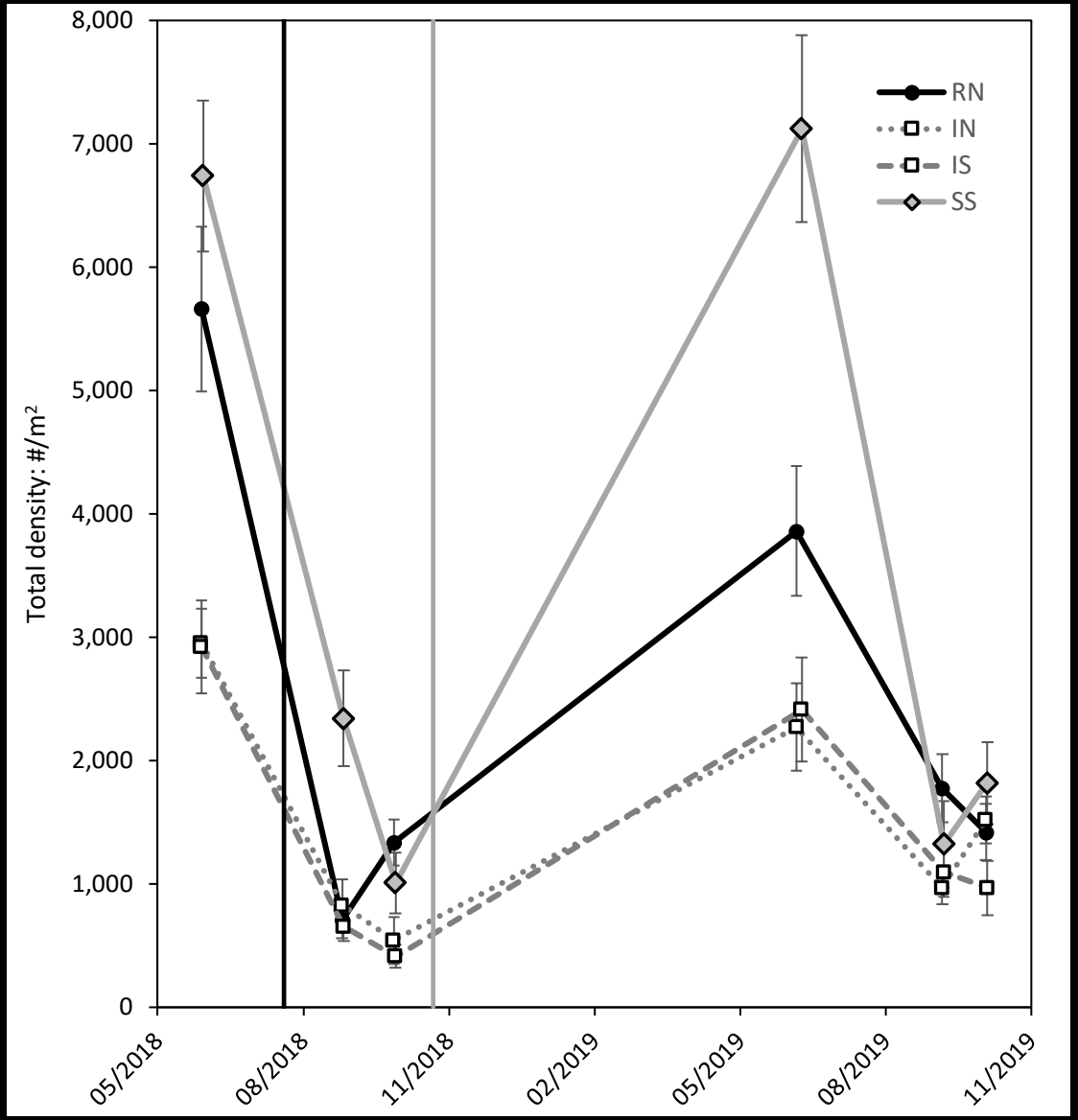
- Shallow subtidal habitats more dominated by amphipods

- Significant decrease in *Donax* density at impact sites, particularly in deeper subtidal areas, for fall of 2018 and September of 2019 samples. No difference at end of study (October 2019)

- Small but significant decrease in certain amphipod species, recovered by 2 mo-post

- Fairly rapid recolonization for most other species, particularly small polychaetes. Longshore drift, wave action, and zooplankton?

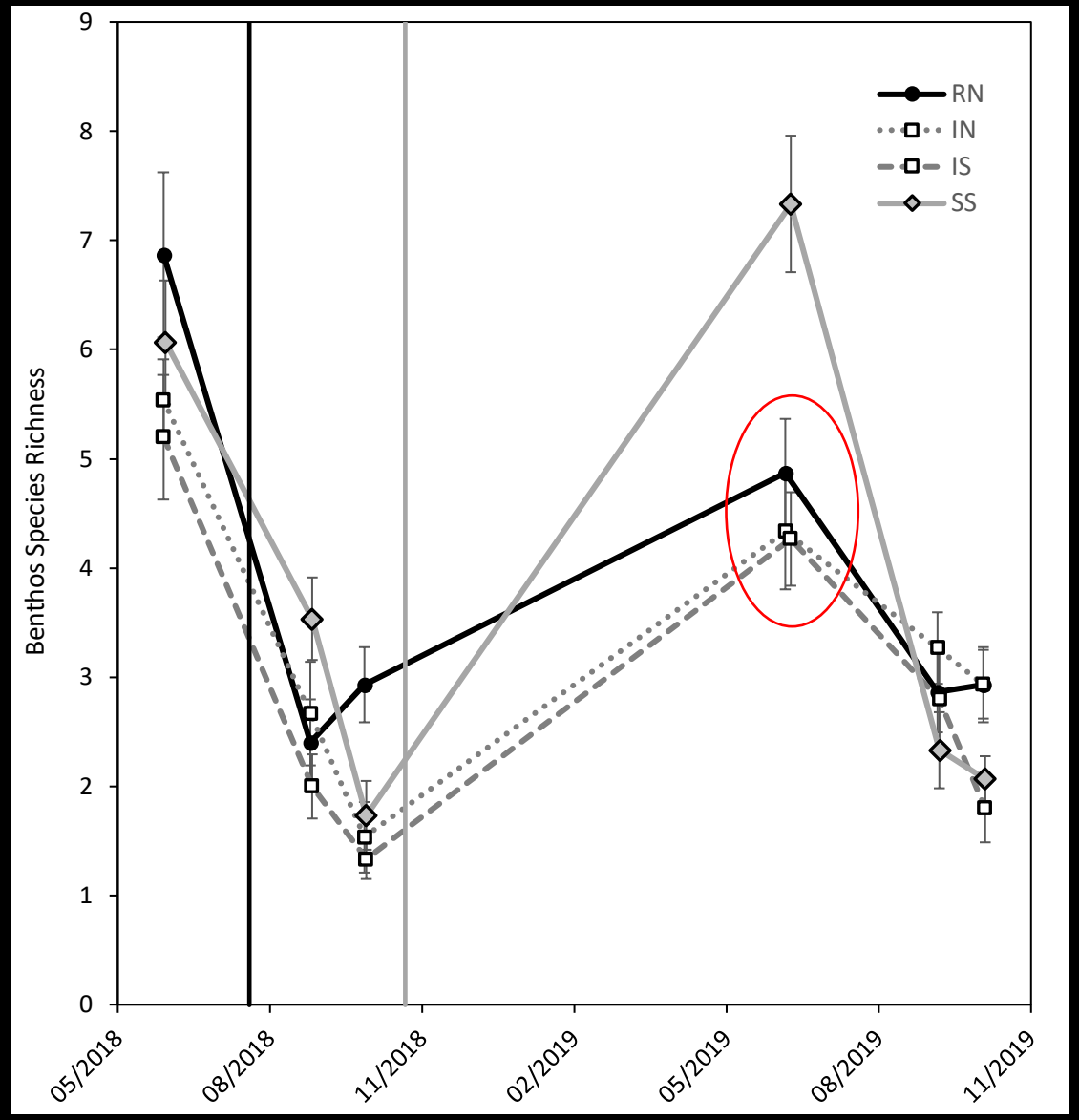
Benthic organism abundance



Benthic organism abundance varied widely seasonally

These seasonal differences appear to dwarf inter-site differences in most cases

Benthic species richness



Like benthic abundance, big seasonal swings

Following summer peak is lower for sites that exhibited greatest physical change:

RN (slow accretion and flattening)
IN/IS (placement and flattening)

All sites similar again by end of study

Benthic Infaunal Production / Biomass

- Funding from NMFS to analyze samples for biomass
- In progress, complete in November 2020
- Potential changes to size or overall biomass not detectable by count-based data
- Ash-free dry weight (AFDW), soft tissue only
  - Per-organism estimates (body mass)
  - Per unit area (mass available as prey)

Benthic Infaunal Biomass Results

- Total biomass at deep subtidal site significantly lower following nourishment, primarily driven by amphipods and mollusks. Changes at other strata not significant.
  - Reasonably consistent with abundance data but more apparent in biomass

- However, across all elevations, individual mollusk and amphipod biomass in nourished areas generally higher
  - Larger *Donax* (i.e. fewer but larger after nourishment)
  - Species shift in amphipods, larger per-individual mass
    - *M. raneyi,* ubiquitous amphipod, highly abundant in post-nourishment, more readily colonized?
    - Surf zone-preferring amphipod species remained dominant at reference sites (Haustorid amphipods)

Zooplankton

- 3 tows / site, 50 m, 505 µm mesh, 75 cm diameter net
- Very diverse, up to 40 taxa per sample
  - **…but relatively few fish!**
  - Copepods, shrimp, cnidarians, arrow worms, crabs, snapping shrimp, cumaceans, amphipods, etc.
  - Larval fish relatively uncommon, **About 1 per 10 m^3**
    - Anchovies
    - Gobies
    - Pipefish
    - Mojarras
    - Clupeids
    - Sciaenids (spot, croaker…etc.)
    - A few filefish, burrfish, puffers
  - Too few to perform statistics

Nekton / seine sampling

- 2 tows / site / visit, sampled in morning near low tide
- 19 m x 1.8 m x 9 mm mesh bag seine; 12 m rope
- Seine towed parallel to the shore, with the current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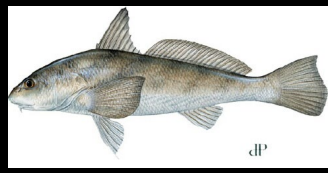
meters (
17 0
18 0
19 0


SWANSON

Nekton sampling

- Nekton community dominated by Florida pompano*, anchovy, whiting*, and speckled crabs
- 38 taxa total
- Many unique species including a diverse array of juveniles:
  - Permit, lookdown, gray snapper, filefish, mackerels
- And some adults:
  - black drum, sheepshead, lots of stingrays
- Significant reduction in species richness persisted through end of study, but no change in total abundance observed
- Richness may be tied to reduction of habitat complexity
    - Straightening of beach profile, loss of trough/bar structure
    - Reduction of exposed rock groin
    - Expected to gradually recover as beach continues to re-work and bar/trough structures develop

Stomach contents of benthic-feeding fishes



- *Menticirrhus americanus,* whiting *(n=197)*
  - *Donax* sp. siphons (average 16/stomach)
  - Mysid *Bowmaniella dissimilis* (average 2/stomach)
  - Other crustaceans (amphipods, isopods, mysids, cumaceans); crushed bivalves; polychaete worms
- *Trachinotus carolinus,* Florida pompano (n=119)
  - Amphipods, bivalves, decapod crustaceans, mysid shrimp
- Adult black drum stomach full of *Donax*
- Spot and sheepshead mostly consumed amphipods
- No significant impacts detected. Possible increase in foraging success by some species (pompano), perhaps dislodged organisms as beach reworks to new profile


1mm
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Summary of findings

- Minimal impacts to benthic community, no impact detected to zooplankton or foraging success of small fish.
  - Decrease in *Donax* abundances, a primary prey species
  - Decrease in fish species richness
  - Full benthic biomass results forthcoming

- Relatively low impacts may be due to:
  - Beach species well-adapted to a changing landscape
  - Good similarity of placement material
  - Placement of material following spring/early summer recruitment periods. Perhaps the delay in dredging helped with this
  - Placement of bulk of material high in the tidal frame may allow more gradual reworking to full profile

Future research and monitoring

- Some loss of ability to detect impact may be due to unexpected impacts to reference sites
  - Future monitoring should explore use off-island reference sites to minimize impacts
  - Logistically challenging

- Addition of multiple pre-impact sampling events to capture natural variability
  - Challenging to distinguish seasonal/natural differences from potential impact differences when limited pre-impact data exist

- Some species not well represented by this sampling (e.g., *Emerita,* mole crabs), larger fish

- Can habitat complexity be incorporated into design?

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