Do Canals in the Florida Keys Contribute to Nearshore Water Quality Degradation?

Kathleen Sullivan Sealey, Coastal Ecology Laboratory, University of Miami

TIMELINE OF EVENTS

1978	State of FL limits dredging; no new permits issued
1984	US EPA Hydrographic, Water Quality, and Biological Studies of general canal system
1995	FKNMS Water Quality monitoring program begins
1999	State of FL law passed to eliminate septic tanks
2002	State of FL issues no-discharge zone for vessels
2003	County-wide GIS canal inventory and assessment completed
March 2012	Phase I Canal Management Master Plan approved
October 2012	Phase II Canal Management Master Plan approved
2014-2017	FIU canal remediation project begins
2015	Septic tanks eliminated; advanced wastewater treatments implemented
February 2019	Hurricane Irma canal clean-up complete

WHY IS NEAR SHORE WATER QUALITY IMPORTANT?

- Near shore habitats are connected to off shore reefs and protected marine resources.

- Healthy near shore waters are important to human health and coastal residents

- Healthy near shore waters are valued by residents and tourists

STRATEGIES TO ADDRESS THIS QUESTION?

- Look at CANALS and "NON-CANALS"
- COLLECT SURFACE WATER QUALITY SAMPLES FROM STRATEGIC LOCATIONS FROM THE CANAL TO 500 m OFF SHORE
- MEASURE WATER QUALITY QUARTERLY
- MEAURE WATER QUALITY AFTER EXTREME WEATHER EVENTS
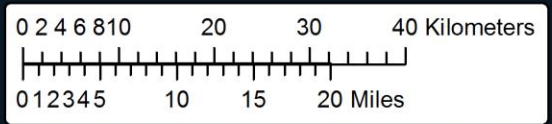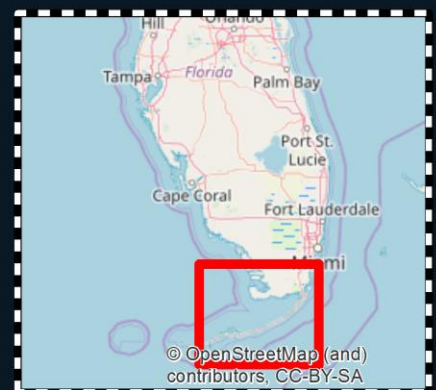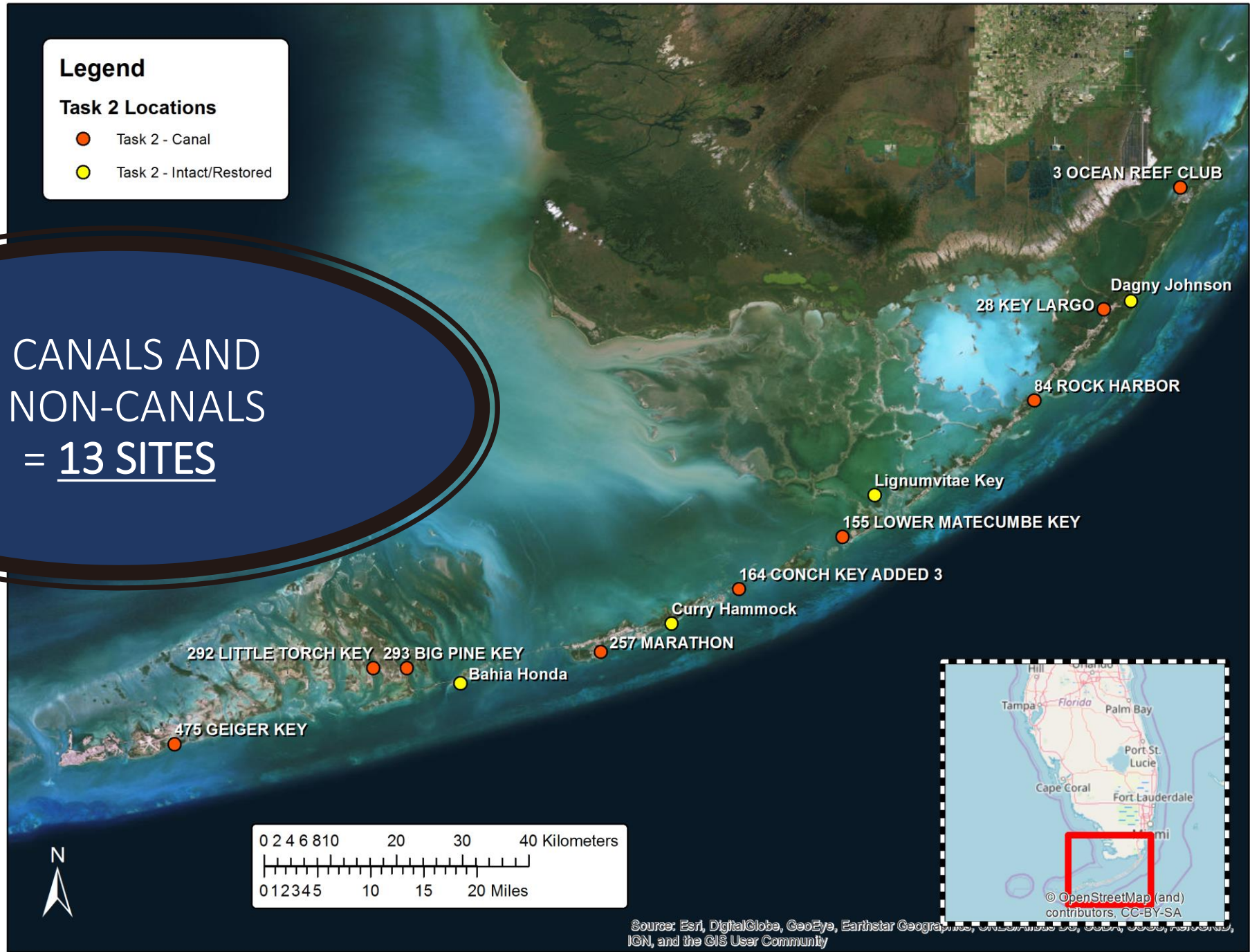- MEAURE WATER QUALITY ON OUT-GOING TIDES
- LINK TRENDS IN WATER QUALITY WITH TRENDS IN BENTHIC (BOTTOM) DIVERSITY OF MARINE PLANTS AND ANIMALS

Legend

Task 2 Locations
- 🔴 Task 2 - Canal
- 🟡 Task 2 - Intact/Restored

9 CANALS AND
4 NON-CANALS
= 13 SITES

3 OCEAN REEF CLUB

Dagny Johnson

28 KEY LARGO

84 ROCK HARBOR

Lignumvitae Key

155 LOWER MATECUMBE KEY

164 CONCH KEY ADDED 3

Curry Hammock

257 MARATHON

292 LITTLE TORCH KEY 293 BIG PINE KEY

Bahia Honda

475 GEIGER KEY

0 2 4 6 8 10   20   30   40 Kilometers

0 1 2 3 4 5   10   15   20 Miles

N

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

© OpenStreetMap (and) contributors, CC-BY-SA

NULL HYPOTHESIS 1: There are no significant changes in water quality from the midpoint of the canal out 500 m to the near shore environs

Legend

Sample Points

Values
- 0 – 0.15
- 0.16 – 0.29
- 0.30 – 0.43
- 0.44 – 0.57
- 0.58 – 0.71
- 0.72 – 0.85
- 0.86 – 1.00

Sample Area

Zone
- 1
- 2
- 3
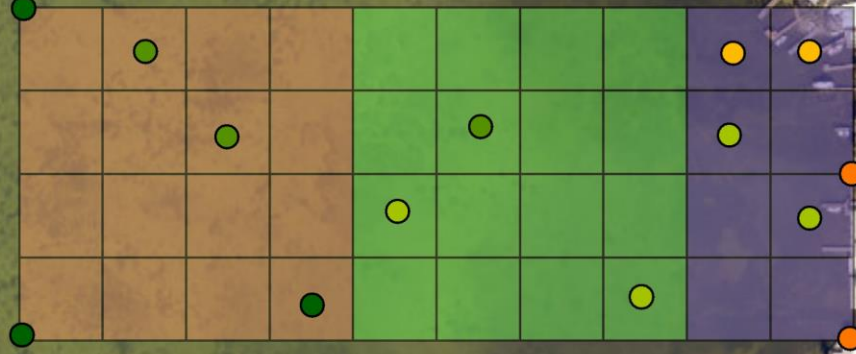
- ✓ RANDOMIZED BLOCK PATTERN OF SAMPLING (rather than transect)

- ✓ 15 STATIONS AT EACH CANAL SITE SAMPLED ON OUTGOING TIDES

- ✓ SAMPLES REPEATED QUARTERLY

- ✓ SAMPLES TAKEN AFTER AN "EXTREME EVENT"

- ✓ SAMPLES USED TO UNDERSTAND PATTERNS IN WATER QUALITY

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Legend

Sample Points
Values
- 0 - 0.15
- 0.16 - 0.29
- 0.30 - 0.43
- 0.44 - 0.57
- 0.58 - 0.71
- 0.72 - 0.85
- 0.86 - 1.00

Value
High : 1

Low : 0
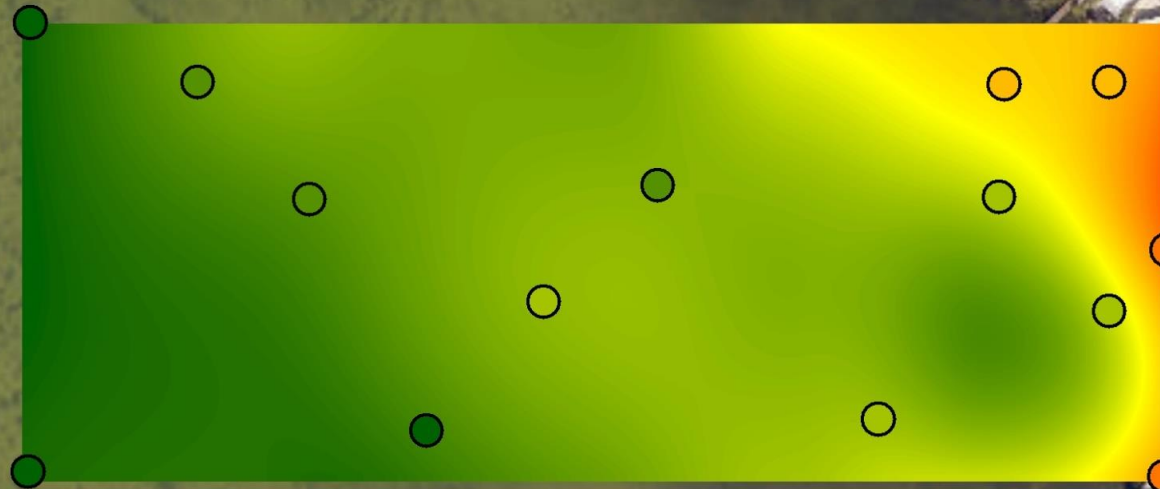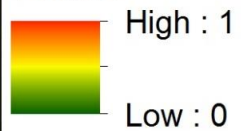
THIS EXAMPLE SHOWS A PATTERN OF HIGHER NUTRIENT VALUES AT THE MOUTH OF THE CANAL

NULL HYPOTHESIS 2: There are no significant changes in benthic diversity with distance from the canal.

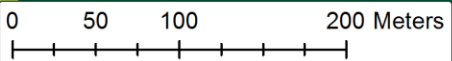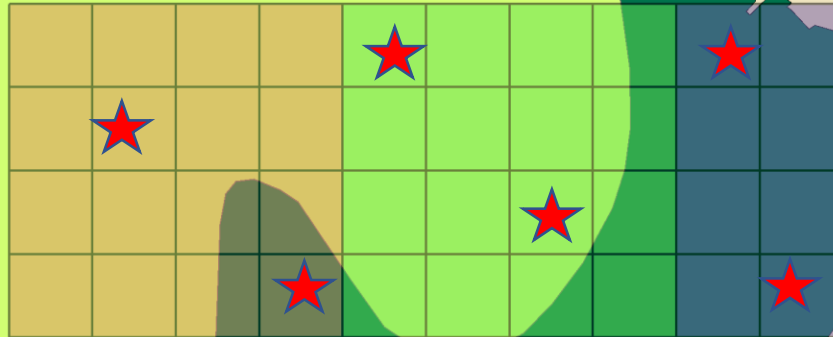**ASSUMPTIONS:** Benthic Diversity is a function of Benthic Habitat, and Benthic diversity should mirror Water Quality patterns

Legend

Sample Area

Zone
- 1
- 2
- 3

Benthic Habitat
- CONTINUOUS SEAGRASS
- PATCHY (DISCONTINUOUS) SEAGRASS
- HARDBOTTOM WITH SEAGRASS
- LAND

0   50   100   200 Meters

✓ 6 STATIONS AT EACH SITE, randomly selected in the three zones;
✓ 25-meter transect at each station with 6 sampling points.
✓ Surveys carried out twice per year; 36 BENTHIC SURVEYS PER SMAPLING EVENT
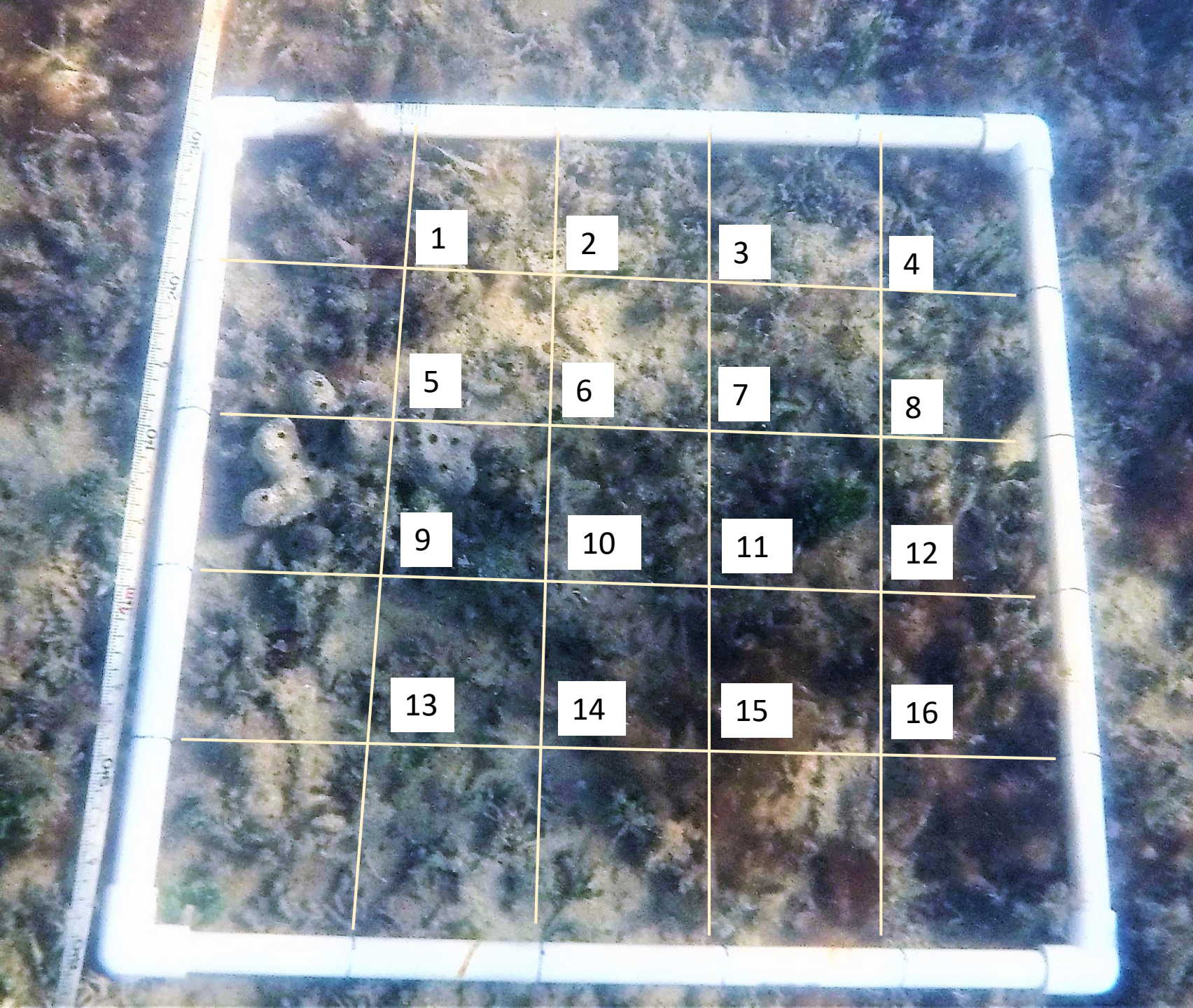
INVERTEBRATE EPIFAUNA

MARINE PLANTS (SAV)

Marine Plants (SAV) scored via Braun-Blanquet method:

- Standard, and will allow comparisons to previous studies

- Rapid

- Non-destructive

- Will include species list from a checklist of conspicuous marine plants

Marine Invertebrate Epifauna scored via Point Intercept method:

- Standard, and will allow comparisons to previous studies

- Rapid, species identified to lowest taxa from checklist

- Non-destructive

- Will include species list from checklist of conspicuous invertebrates (Cnidaria, Porifera, Annelida, Echinodermata, and Tunicates)

- Check lists are habitat specific

DIVERSITY CAN BE EXPRESSED AS THE PERCENT OF THE TOTAL EXPECTED SPECIES:

33 species of invertebrates seen out of a possible 43 species known to occur in Florida Keys seagrass beds = 76%

Legend

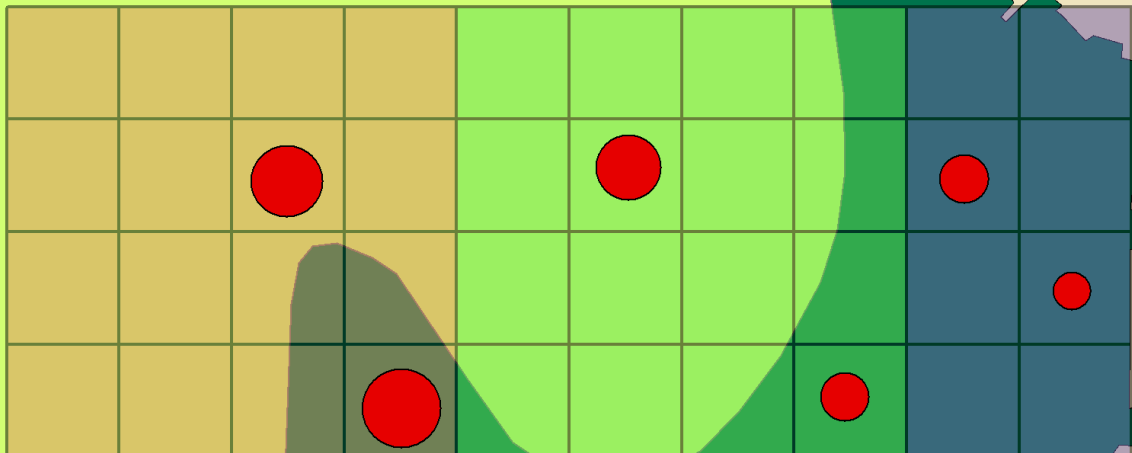**Percent of Expected Species**

- 10
- 25
- 50
- 100

Sample Area

Zone

- 1
- 2
- 3

Benthic Habitat

- CONTINUOUS SEAGRASS
- PATCHY (DISCONTINUOUS) SEAGRASS
- HARDBOTTOM WITH SEAGRASS
- LAND

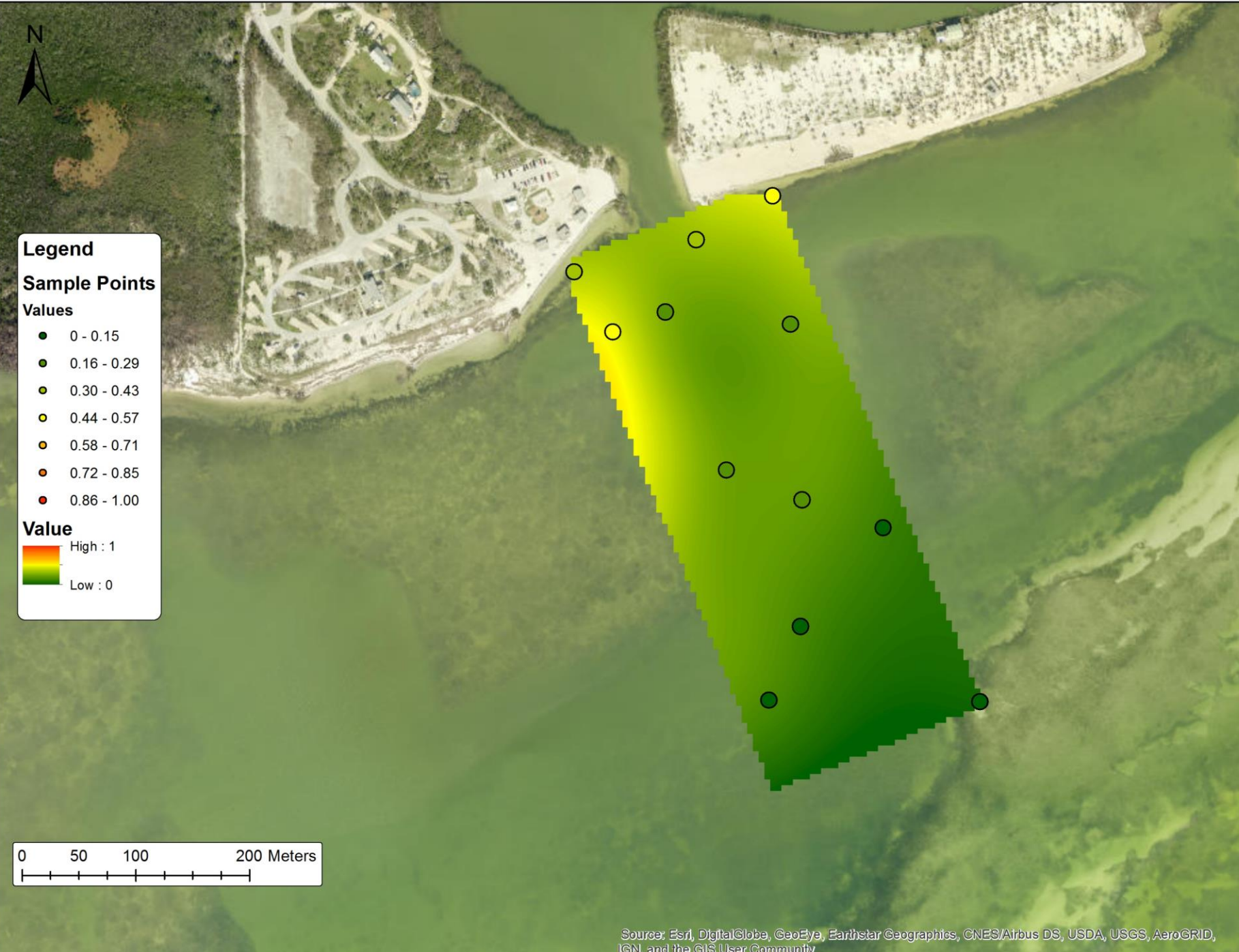**FOUR NON-CANAL STUDY SITES IN STATE PARKS:**

✓ CURRY HAMMOCK (shown)
✓ BAHIA HONDA
✓ LIGNUM VITAE KEY
✓ DAGNY JOHNSON

Same sampling protocols carried out with water quality and benthic sampling.

Quarterly sampling, with one extreme event sampling per year.

Test hypotheses with a spatial comparison (Between Sites) to identify specific canal impacts

NULL HYPOTHESIS 1: *There are no significant changes in water quality from the midpoint of the canal out 500 m to the near shore environs*
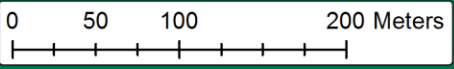
Test hypotheses with a spatial comparison (Between Sites) to identify specific canal impacts

NULL HYPOTHESIS 2: *There are no significant changes in benthic diversity with distance from the canal.*

The highest near shore benthic diversity should be at non-canal sites.

Questions?

COASTAL ECOLOGY TEAM

Kathleen Sullivan Sealey (ksealey@miami.edu)

Jacob Patus

Zoi Thanopoulou

Caitlin Camarena