Advancement of Sunray Venus Culture *Macrocallista nimbosa* through Evaluation of Alternative Growout and Harvesting Methods

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Sunray Venus Clam Culture in Florida

Eight Years of Research and Development

Evaluation of Growout Methods: Bottom Bag

- Standard hard clam culture methods used as a starting point
  - In Florida, the typical culture method is the bottom bag
- Results were not consistent, 2007-9
  - Survivals ranging from 24-76%
  - Site and substrate-dependent

Bottom bags (4' x 4', 16 ft^2) made of 9 mm polyester mesh material

Limited to ventral margin with one valve having excessive curvature resulting in a depression

- Shell deformities or irregularities observed of sunray venus in bags
  - Observations ranging from 8-48% per bag in early trials

Evaluation of Growout Methods: Bottom Plant

Broadcasted seed covered with 9 mm mesh polyester netting edged with lead line and additional layer of plastic netting staked with PVC pipe

- Preliminary evaluation of bottom plants as a culture method, 2009-10
  - Good survival
  - Faster growth than bottom bags
  - Shell deformities <2%

- Special lease provisions limit use of mechanical harvesting on shellfish aquaculture leases
- Growers restricted to use of hand tools (e.g., rake) to harvest bottom-planted sunray venus clams

Project Objectives

1) Eliminate barriers to commercial production of a promising new aquaculture species by utilizing alternative culture and harvest methods
   - Document production and product quality characteristics of two culture methods
2) Compare effects of harvesting bottom-planted sunray venus clams with a mechanical harvesting device versus those associated with harvesting bottom bags
   - Document water quality and soil properties associated with two harvest methods

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Growout Methods

- Treatments
  - Bottom plants, 9 mm polyester mesh netting, ½” mesh HDPE cover netting, 8’ x 10’, 80 ft^2
  - Bottom bags (16 ft^2), belt of 5, 80 ft^2 per row
- Replication, n=4
- Stocking density, 55/ft^2
- Seed size, 15-20 mm SL
- Site, UF lease, Cedar Key, FL
- Plant, November 2012
- Harvest, ~12 months later, 2013

Harvest Methods

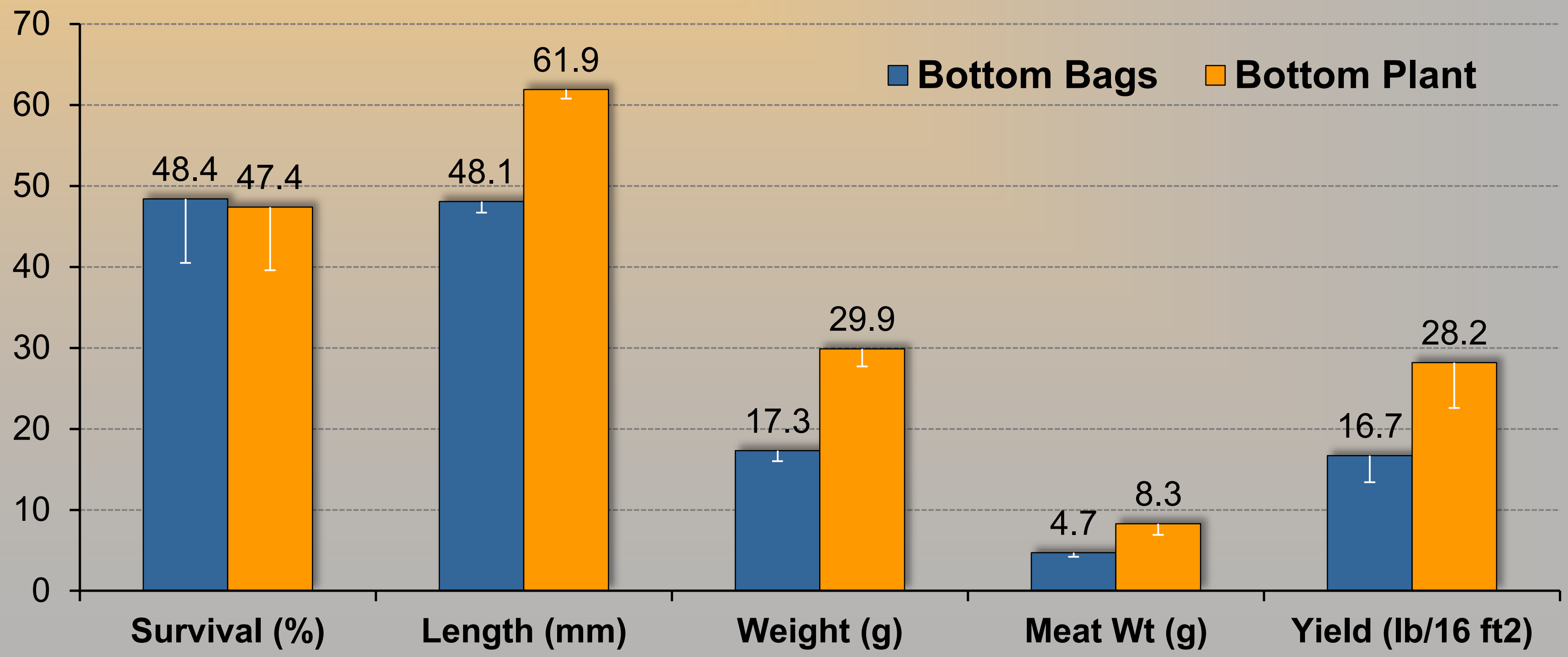
- Mechanical harvesting device, “box” harvester used in Virginia
  - SS box-shaped
  - 5 hp pump delivers pressurized water via nozzles along spray bar
  - No tines, angle of box digs into substrate
  - Wire basket collects clams

Sampling Design

- Before-After, Control-Impact, Paired (BACIP)
  - Establish baseline prior to planting or harvesting
    - Control sites
  - Direct comparison of culture and harvest methods
    - Experimental sites
  - Differentiate natural changes from those caused by harvesting
    - Reference sites

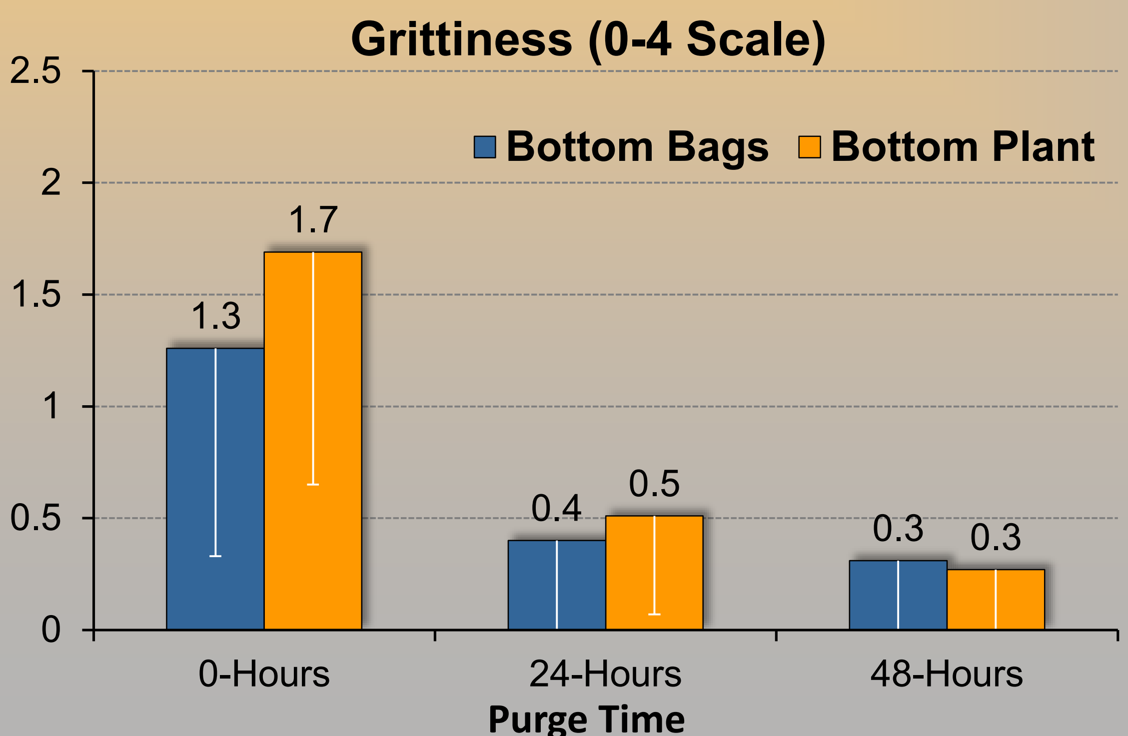
Production Characteristics

- Survival the same for both culture methods
- Bottom-planted sunray venus were
  - 29% larger in shell length (p<0.0001)
  - 76% heavier in total weight p<0.0001)
  - 60% more meat weight (wet) (p=0.0023)
  - 80% increase in yield ($lb/16ft^2$) (p=0.0126)



Product Quality Characteristics

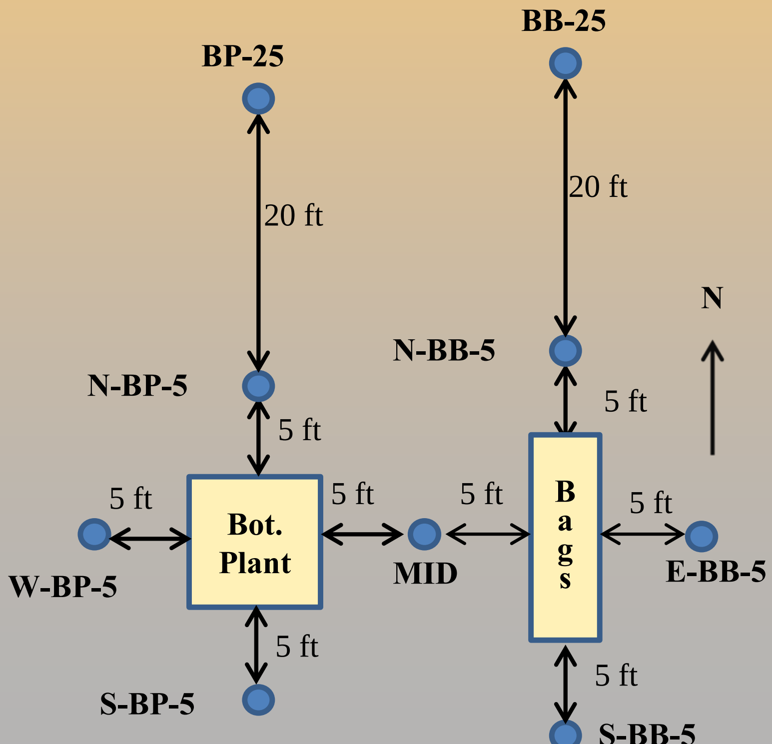
- Grit evaluation, 5-point scale where 0=no grit and 4=extremely gritty
  - At harvest, sunray venus were rated as "slightly to moderately" gritty
  - After 24 hours of purging, 70% reduction in grit for clams harvested by both methods
  - After 48 hours, values same for both methods



- Shell deformities (p=0.01)
  - 3.1 ± 0.9%, bottom bags
  - 0.5 ± 1.0%, bottom plant
- Shell breakage (p=0.12)
  - 0.5 ± 0.4%, bottom bags
  - 2.9 ± 2.2%, bottom plant
- Shelf life, 10 days
  - 100%, both culture methods

Effects of Harvest Methods on Water Quality

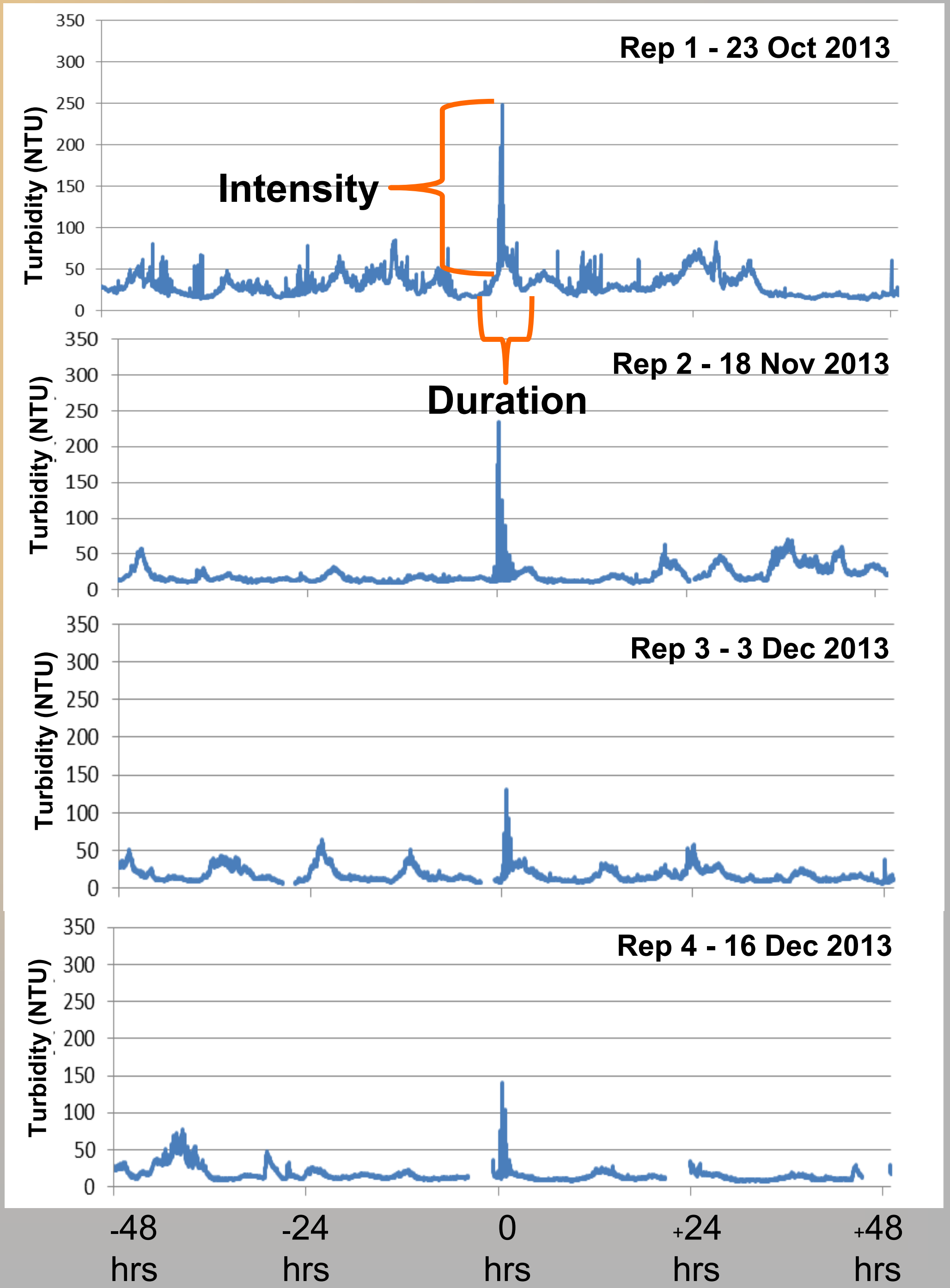
- Nine sondes (YSI 6600) deployed
  - 5' in cardinal directions from both bag and bottom plants
  - One sonde placed mid-way between culture unit replicates
  - Additional sondes placed 25' down current of both culture units



- Multiple parameters measured continuously (every minute) for 48 hours pre- and post-harvest
  - Water temperature
  - Salinity
  - Dissolved oxygen
  - Turbidity

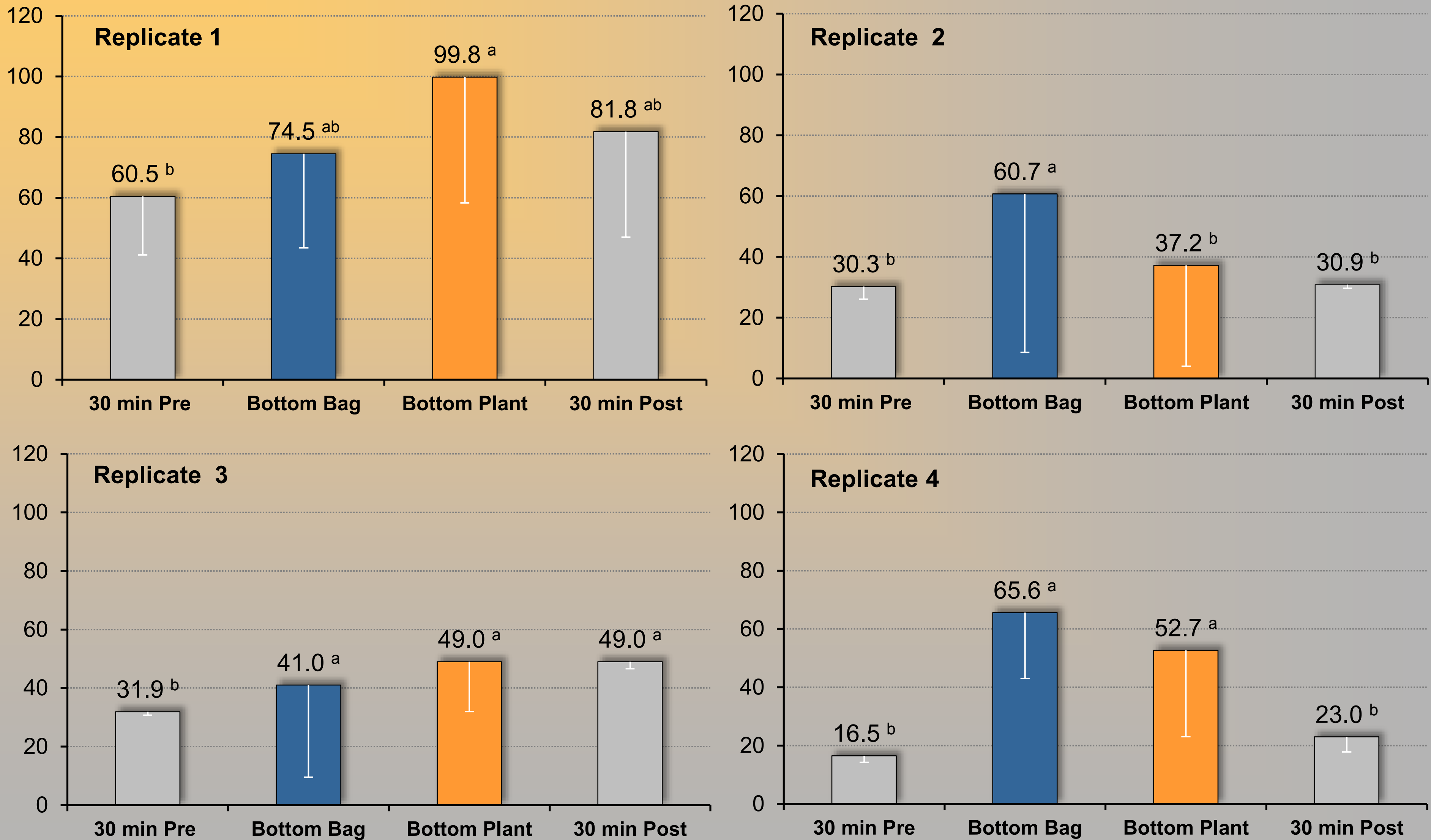
Effects of Harvest Methods on Turbidity

- Turbidity (resuspension of small soil particles into water column) was greatest concern and showed noticeable differences
  - Intensity: Maximum values and max mean values of sondes with highest detected turbidity
  - Duration: Time required to return to corrected background conditions (30 min pre-harvest)
- Each harvest replicate treated as an independent evaluation as ambient conditions (tide, current, wind, back-ground turbidity) differed



Effects of Harvest Methods on Turbidity (NTU)

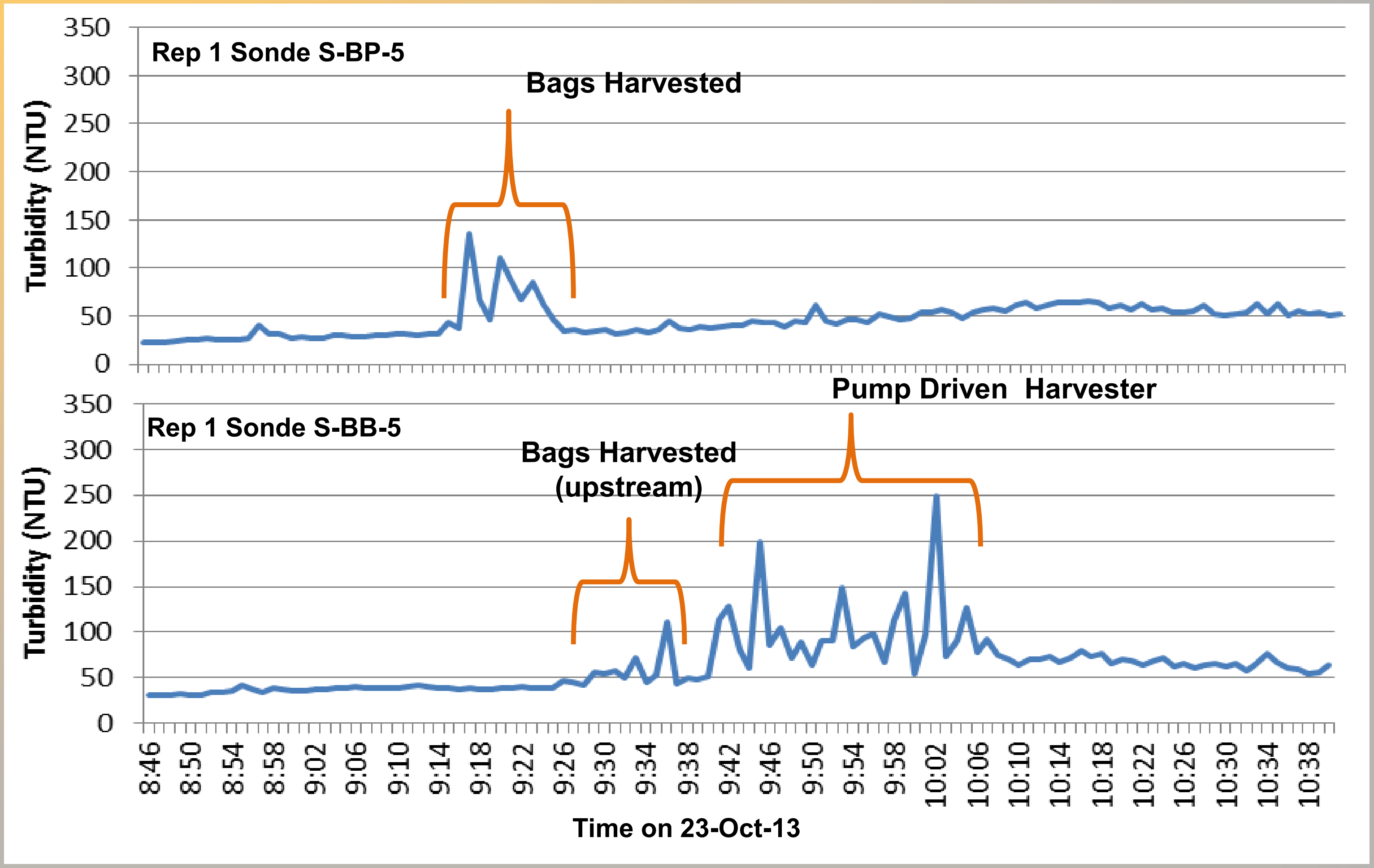
Comparison of highest mean turbidity values for harvest methods with 30 min pre- and post-harvest values



Data were analyzed using General Linear Model analysis with Tukey's post-hoc test in SAS Software

Effects of Harvest Methods on Turbidity

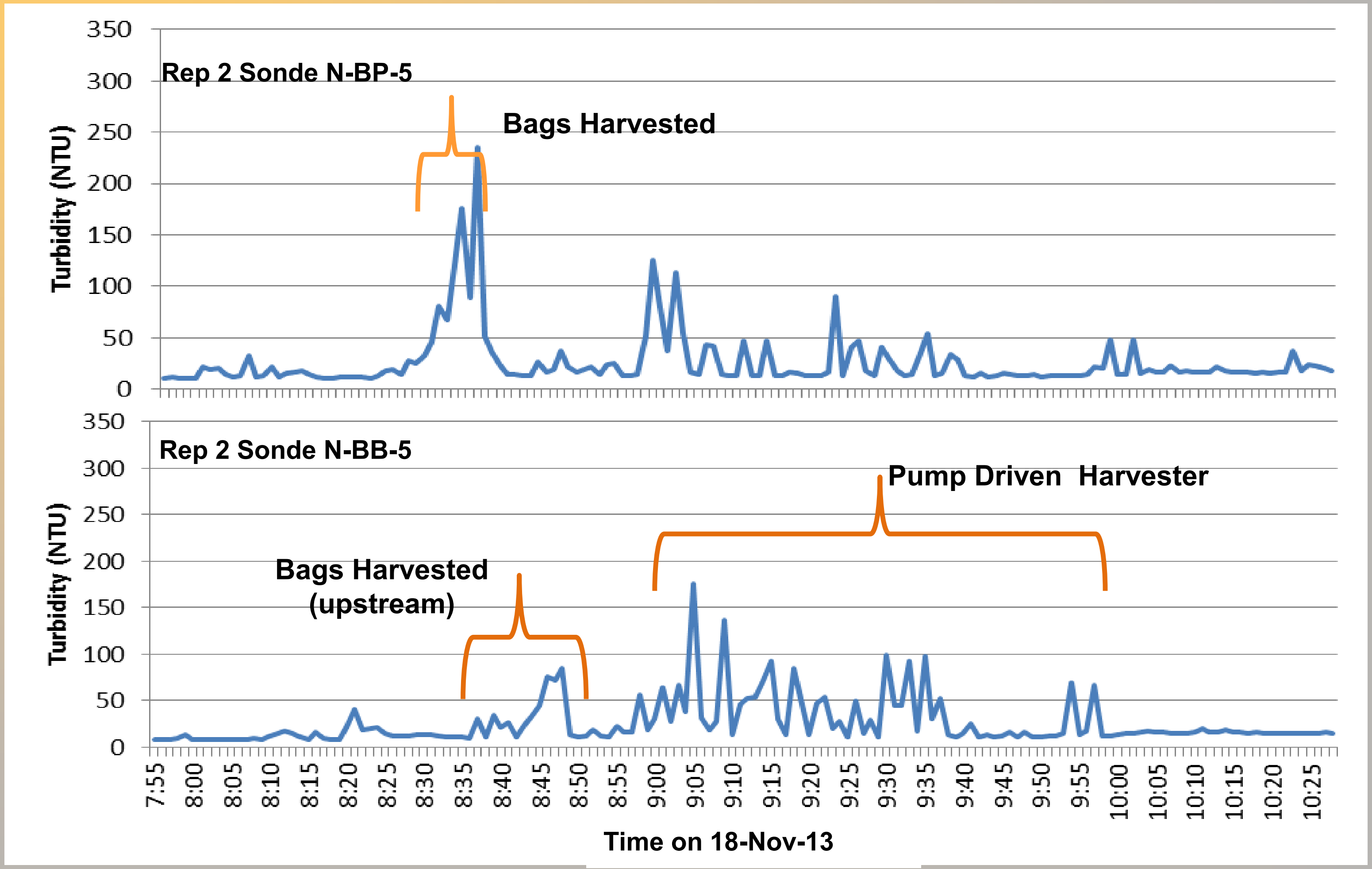
Comparison of bag harvest duration (top graph) and pump-driven harvester (bottom graph)



- **Replicate 1** – Outgoing tide, winds light (6-10 knots) out of north, following falling tide
- Turbidity associated with harvesting bags returned to background levels in 2 minutes, and in 5 minutes with pump harvester

Effects of Harvest Methods on Turbidity

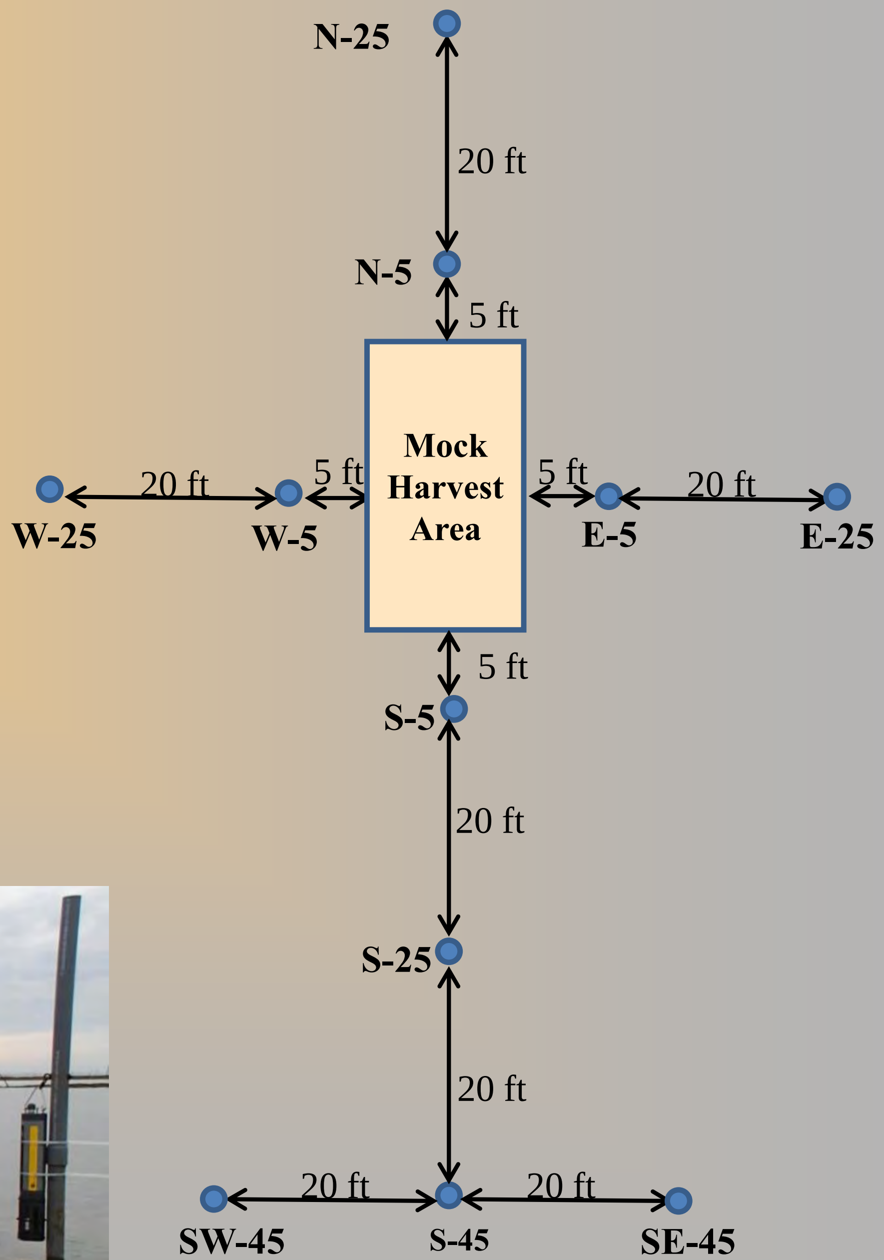
Comparison of bag harvest duration (top graph) and pump-driven harvester (bottom graph)

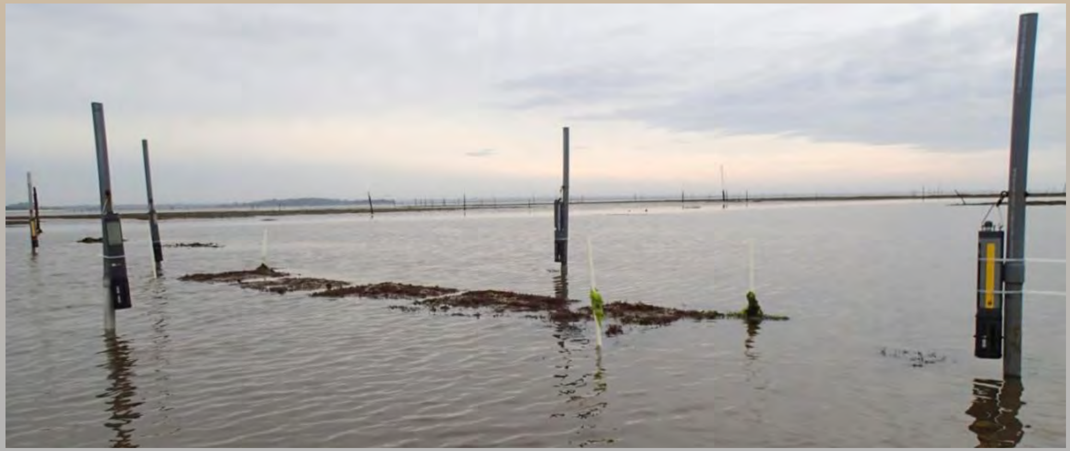


- **Replicate 2** – Incoming tide from S to N, winds (3-5 knots) out of sout
- Return interval for bag harvest not determined as it was greater than time between harvest activities, return to background for pump-driven harvester was 9 minutes

Effects of Pump-driven Harvest on Turbidity

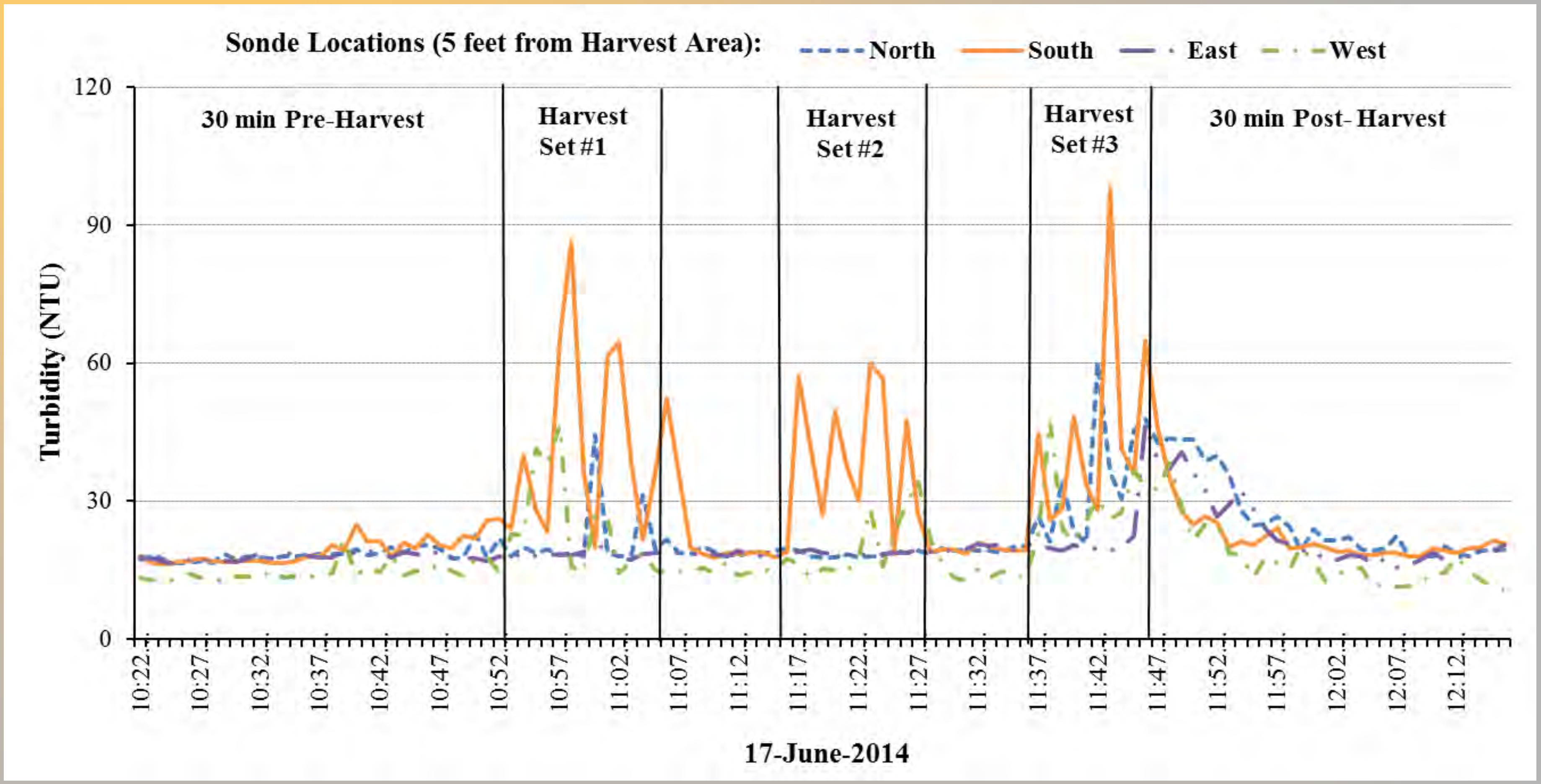
- Commercial-scale trial, 17 June 2014
  - Unfarmed area of 300 ft^2 (25' by 12' plot)
- Eleven sondes deployed
  - 5' and 25' in cardinal directions from mid-points of test plot
  - 45' to south of plot with one sonde located at mid-point of plot and two located 20' to east and west
- Turbidity measured every minute for 24 hours pre- and post-harvest





Effects of Pump-Harvester on Turbidity

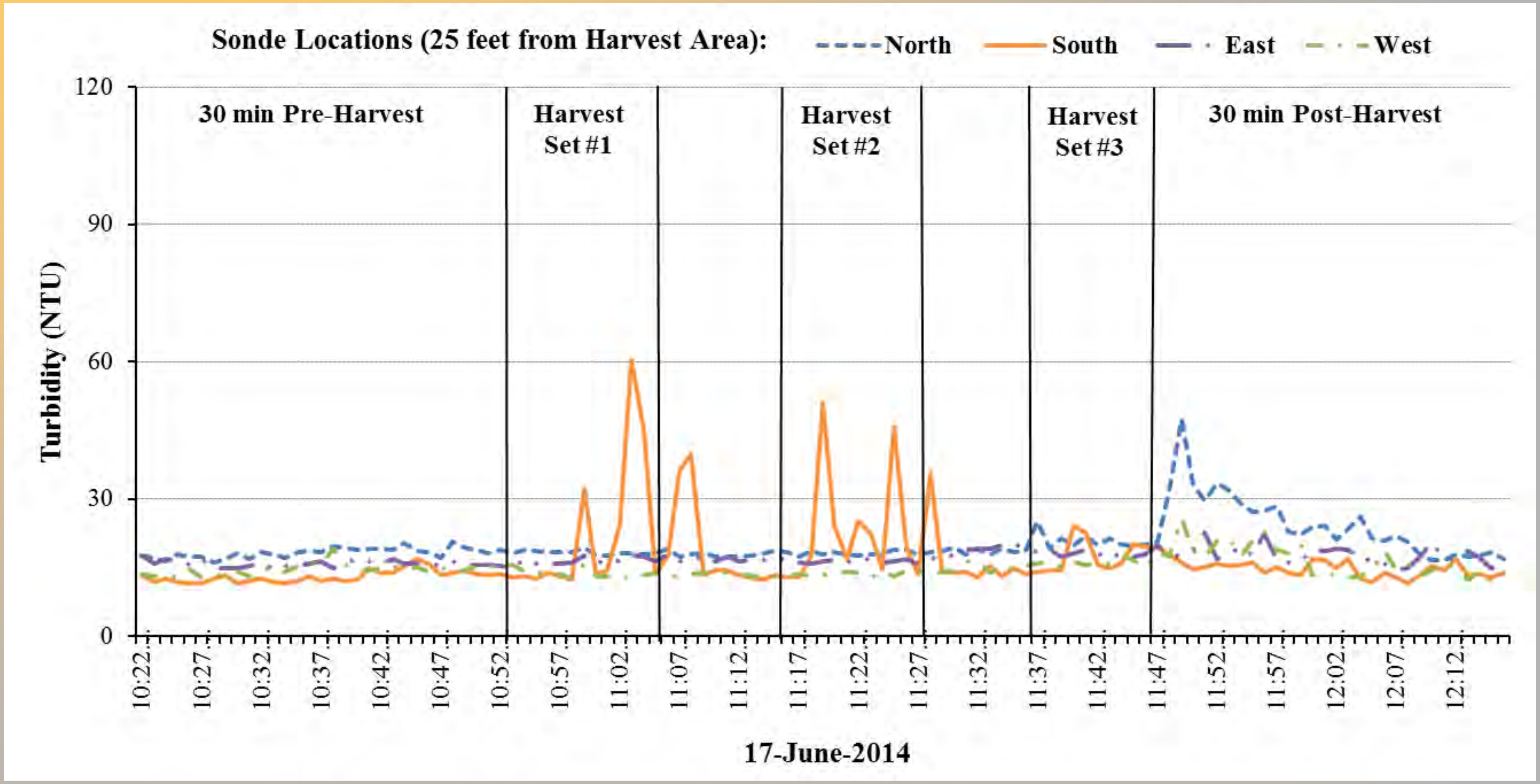
Comparison of sondes located **5'** from harvest area over 30 min pre- and post-harvest



- Maximum turbidity values per harvest set ranged from 62 to 98 NTU
- Return to baseline levels (19.1±2.6 NTU) was within 3 min after first harvest set, immediately after second set, took longer after third set (7 min) due to tidal change

Effects of Pump-Harvester on Turbidity

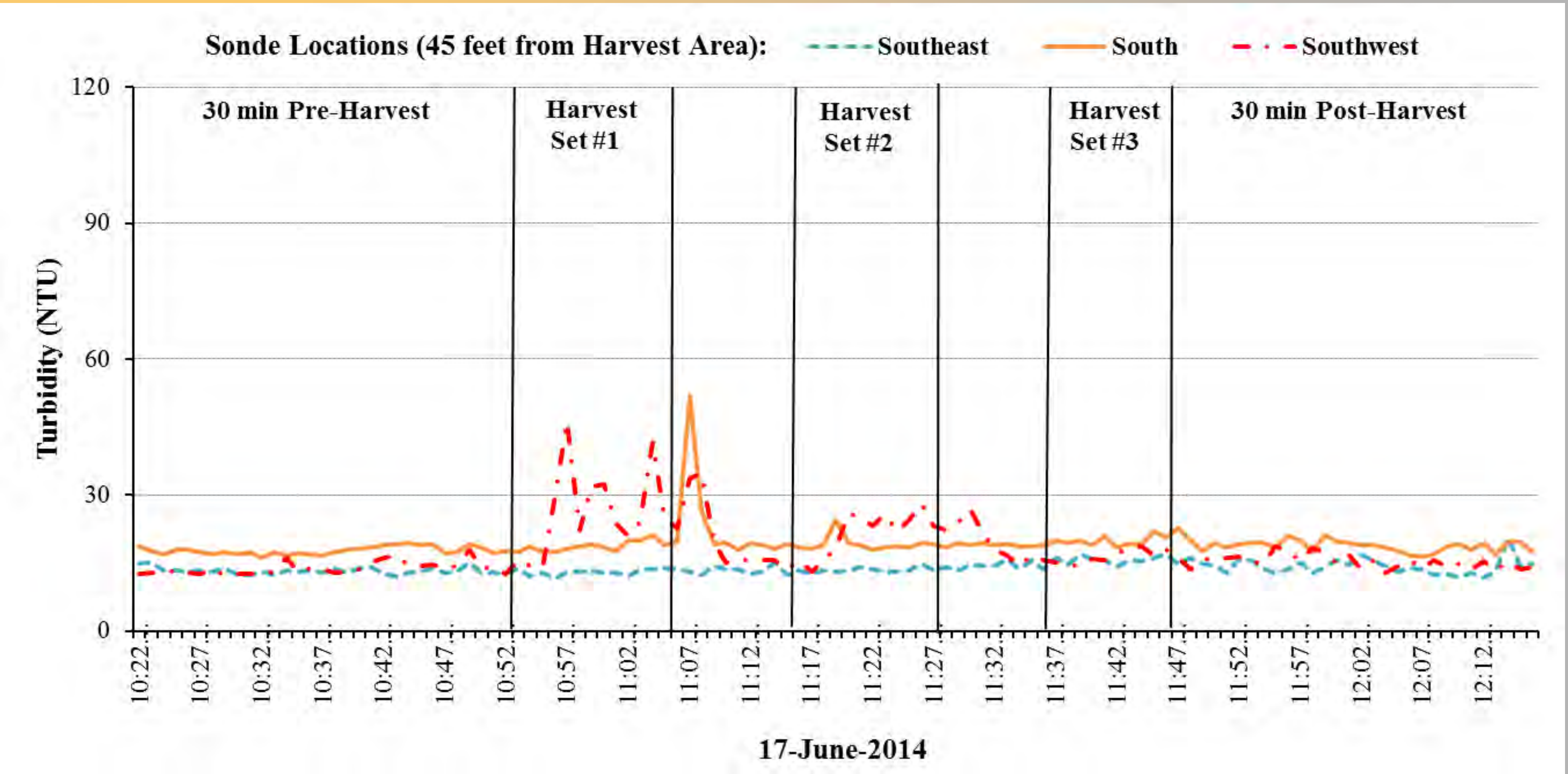
Comparison of sondes located **25'** from harvest area 30 min pre- and post-harvest



- Maximum turbidity values per harvest set ranged from 24 to 60 NTU
- Return to baseline levels (13.1±1.4 NTU) was within 2-10 minutes

Effects of Pump-Harvester on Turbidity

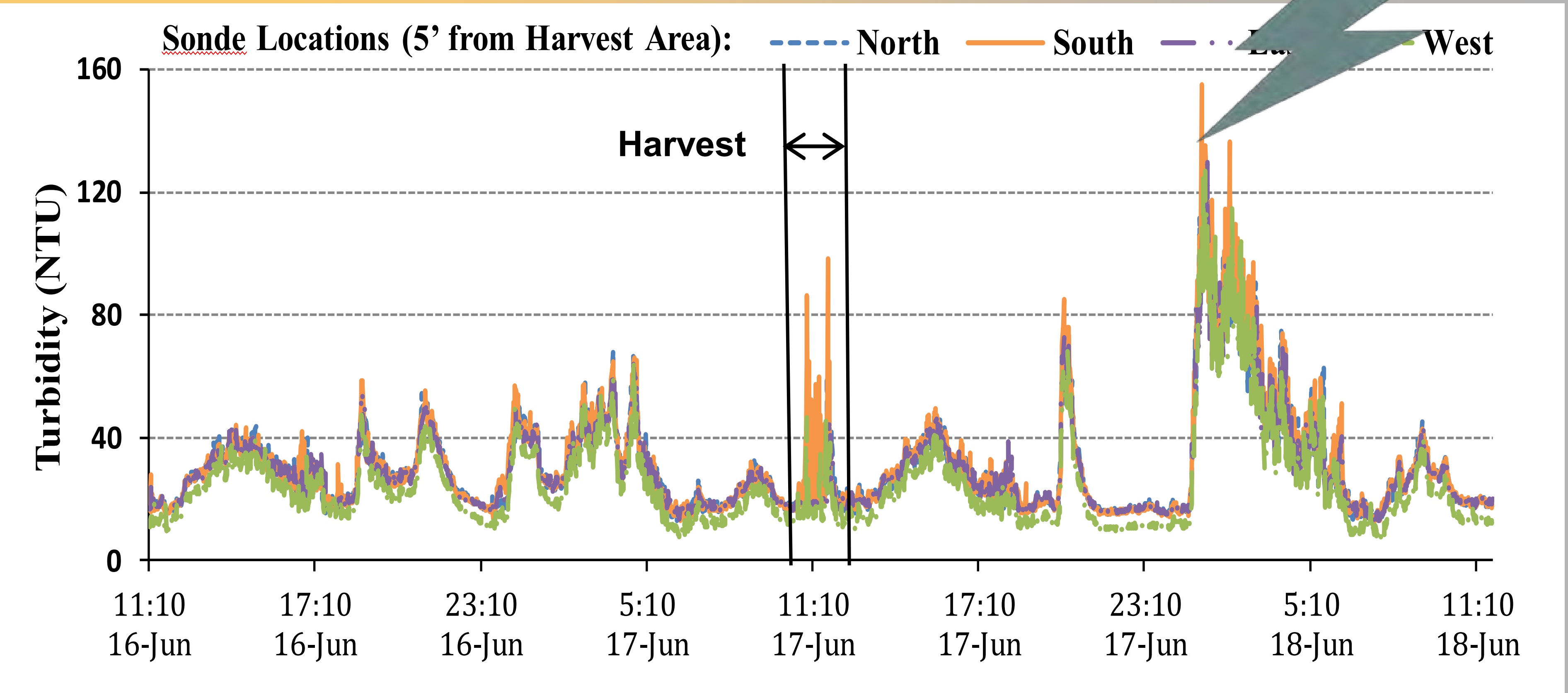
Comparison of sondes located **45’** from harvest area 30 min pre- and post-harvest



- Maximum turbidity values in first and second harvest set were 25 and 52 NTU
- Return to baseline levels (17.8±0.9 NTU) was within 6 min after first harvest set, with little to no change during or after second and third sets as values returned to baseline during harvest

Effects of Pump-Harvester on Turbidity

Comparison of sondes located **5'** from harvest area **24 hours** pre- and post-harvest

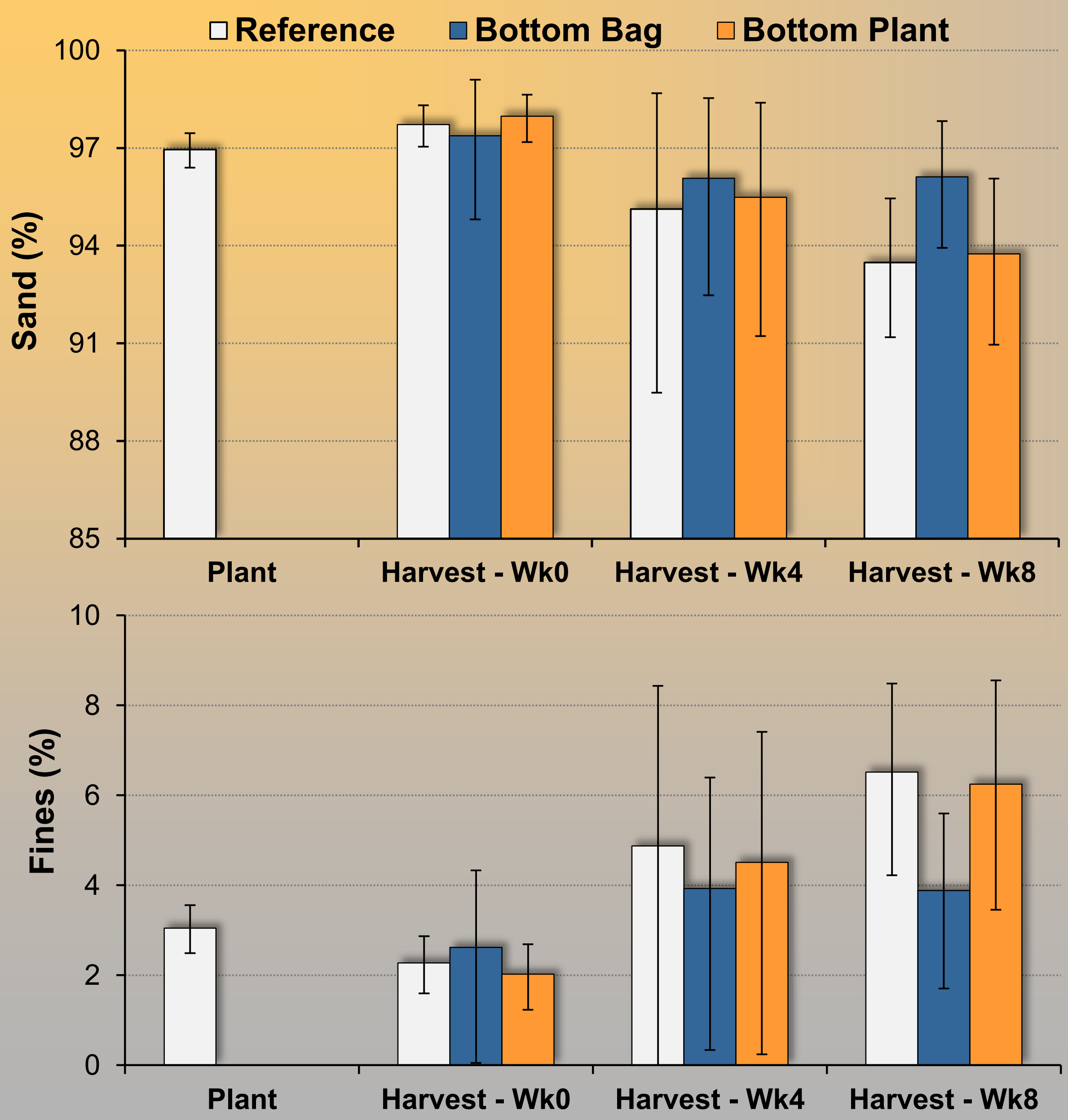


- A weather event was captured 14 hours post-harvest (1:10 am) with wind speeds gusting to 26 knots out of ESE (wind direction which most influences test area)
- Maximum turbidity recorded at all sondes ranged from 123 to 155 NTU
- Duration (4.5 hrs) and wind effect had greater influence on turbidity than harvester

Effects of Harvest Methods on Soil Properties

- Soil cores collected (n=3)
  - Prior to planting to establish baselines
  - At harvest (week 0) per culture replicate to compare effects of harvest methods
  - At reference (unfarmed) sites to compare with baseline and harvest methods
  - At 4 and 8 weeks to evaluate changes over time
- Soil samples analyzed for particle size distribution
  - Sand
  - Fines (clay + silt)
  - Organic matter

Effects of Harvest Methods on Soil Properties

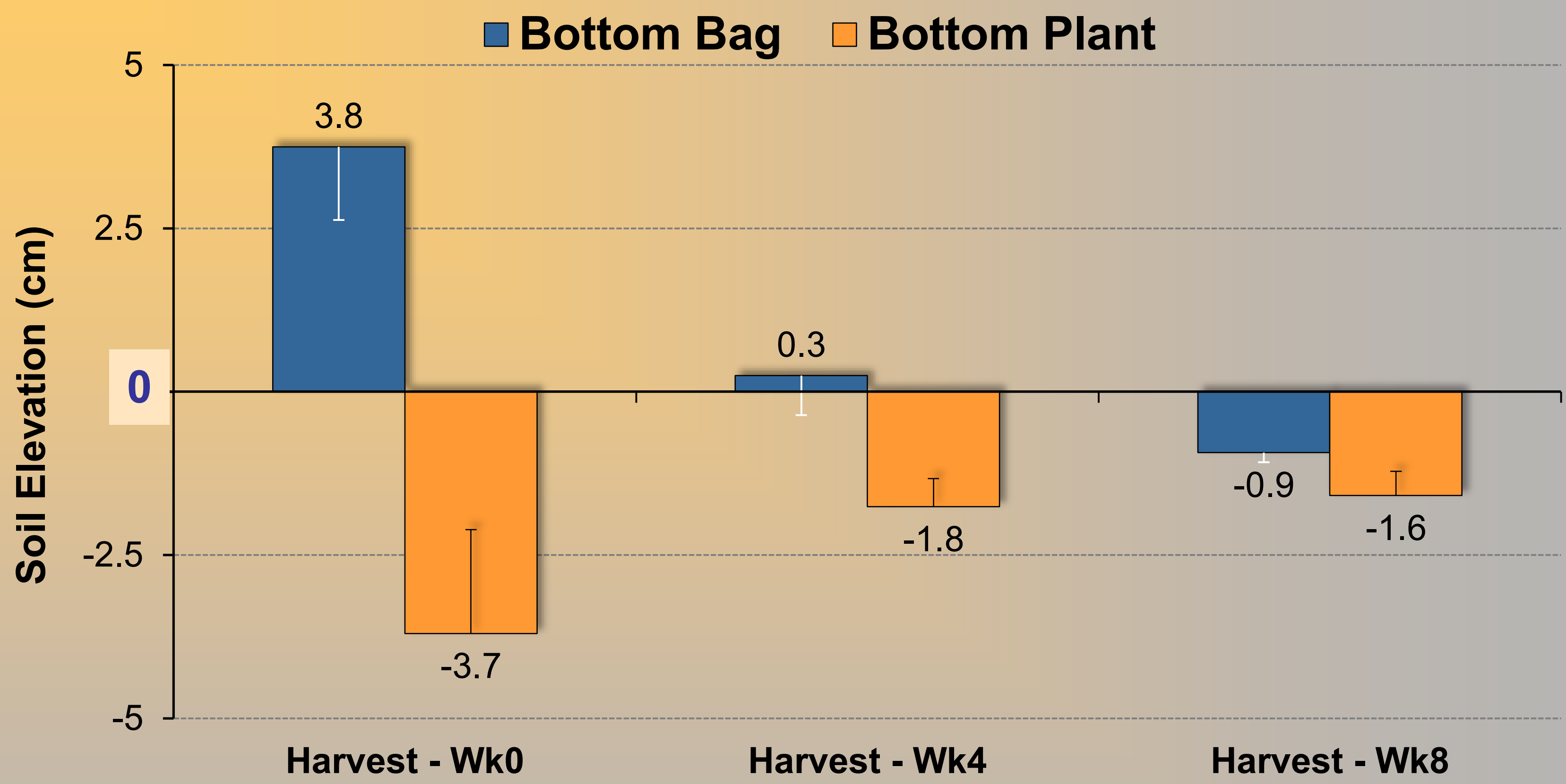


- Sand and fines content differed significantly between plant and harvest
  - Variation minimal over year
  - Sands increased 97-98%
  - Fines decreased 3 to 2.3%
- At harvest and 4 weeks post-harvest, sand and fines were similar at all sites
- At 8 weeks, sand was higher and fines lower at bottom bag sites in comparison to bottom plant and reference sites
- Over time, sand content significantly decreased and fines content significantly increased at bottom plant and reference sites

Recovery of Harvest Tracks

- Cross-sectional soil elevation profiles were monitored to capture harvest tracks and recovery
  - PVC pipe arrays pushed into the substrate perpendicular to harvest sites
    - 3-6 pipes located in harvest area
    - Reference pipes on each end of the array placed outside harvest area
  - Distances from bottom substrate to top of the frame at each pipe measured at weeks 0, 4, and 8
  - Differences in elevation at week 0 to reference values reflected effects of culture/harvest methods
  - Differences in subsequent weeks reflected soil infill or loss over time

Recovery of Harvest Tracks



- Soil elevations of harvest tracks standardized to reference conditions (“ground 0”)
- At harvest, sediments were mounded at bag sites while a track depth of -3.7 cm was created by the harvester. By week 4, adjacent bottom bag sites appeared to have supplied sediments to fill in harvester tracks. By week 8, both recovered to levels similar to reference conditions.
- Soil elevations significantly differed between harvest sites at each sampling period; differences were only ~7.5 cm at week 0 and <1 cm by week 8.

Summary

- Sunray venus production was increased by 80% using the bottom plant method versus bottom bags
- Culture period to reach market size (~50 mm SL) could be reduced by 15-20% (1.8-2.5 months) using bottom plant method, which lessens risks associated with mortality
- Product quality of sunray venus harvested from bottom plants was not compromised

Summary

- Turbidity values either did not differ between harvest methods or were higher during the bag harvest and natural events compared to the pump-driven harvester
- Impacts to water column were short term as turbidity values returned to background levels within 5-9 minutes
- Consistent changes in the soils suggested that natural processes were more active in sorting particle size than were harvest methods

Summary

- Physical effects of mechanical shell-fish harvesters are reported in the literature to be short-lived with rate of recovery varying among study sites
- To determine extent and duration of potential impacts of mechanical harvesting in Florida, a pump-driven harvester was tested under actual lease conditions
- Science-based information was provided to FDACS to address statutory or regulatory barriers to allow for this harvesting activity

Questions?

For more infomaton, contact
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