Using Side Scan Sonar to Estimate Height, does it Work?

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What We Have Done So Far

2.25 miles
Nature of the Challenge

- **5.14 acres** of oyster reef = 5 football fields
- Capable of filtering **1 billion gallons of water per day** = 1500 Olympic size swimming pools EVERY DAY
- Main construction effort used **5000 cubic yards of shell** = **2700 tons**
Side Scan Sonar Imagery (SI)

- HumminBird Helix 12
- CHIRP SI GPS
Side Scan Sonar Imagery (SI)

- Sends out sound waves at high frequency and interprets the returning echoes
- Like shining a flashlight on the bottom, but with sound
- Position of the “flashlight” related to the object determines shadow length
Similar Triangles

1) Related sides are proportional
\[
\frac{RH}{L} = \frac{D}{X}
\]

2) Solve for RH (Reef Height)
\[
RH = L \left(\frac{D}{X}\right)
\]
Estimating Reef Height

- Estimate height based on shadow length (HumViewer)
- Measure shadow length at regular intervals along the reef
- Determine maximum, minimum, average, etc.
How accurate is it?

- Compared to labor intensive ground-truthing
How accurate is it?

- Compared to labor intensive ground-truthing
- 127 reef surveys to compare
  - Statistically significant difference between methods of ≈ 2 cm
  - Biologically significant? Not really...
    - Difference could result from:
      - User error with each method
      - Different mathematical methods
How accurate is it?

• 53 reef surveys taken 2017 and again in 2018
  • Both methods caught the same differences in reef heights and sample years
    - **Ground-Truthing 2017**
      - **2017**
        - Ground: 27.9 cm ± 0.9 cm
        - Sonar: 29.2 cm ± 0.9 cm
      - **2018**
        - Ground: 24.2 cm ± 0.7 cm
        - Sonar: 27.0 cm ± 0.9 cm
    - **Side Scan Sonar 2017**
    - **Ground-Truthing 2018**
    - **Side Scan Sonar 2018**
Silver Bullet?

**Strengths**
- Much more efficient and cost effective:
  - Generates massive amounts of data quickly
  - Requires much less man power
  - Requires much less time
  - Less expensive overall than in water methods
  - Covers larger area with much less effort
- Water visibility isn’t a factor

**Weaknesses**
- Ineffective at shallow depths
- Shadows don’t show up for low profile reefs
- Requires favorable weather conditions
- Operation requires training and experience
- Processing the data is time consuming
Questions?
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