Integrating a Rapid Assessment Protocol (RAP) into monitoring of subtidal oyster reefs

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Oyster monitoring

The Hybrid Approach: Integrating 3 Tools

1. Patent tong

2. Diving

Existing metrics = oyster and reef measurements currently used

3. RAP = “Rapid Assessment Protocol”

Qualitative scores collected via GoPro cameras

The Hybrid Approach: Integrating 3 Tools

1. **Patent tong**

2. **Diving**

3. **RAP** = "Rapid Assessment Protocol"

Existing metrics = oyster and reef measurements currently used

- Oyster density
- Oyster biomass
- Size classes
- Reef height

Qualitative scores collected via GoPro cameras

Hybrid approach

Combination of existing metrics & RAP

From scientific data to an applied framework

- **Results** from field study
- **Trade-offs:** Quantitative and Qualitative
- **Use scenarios**

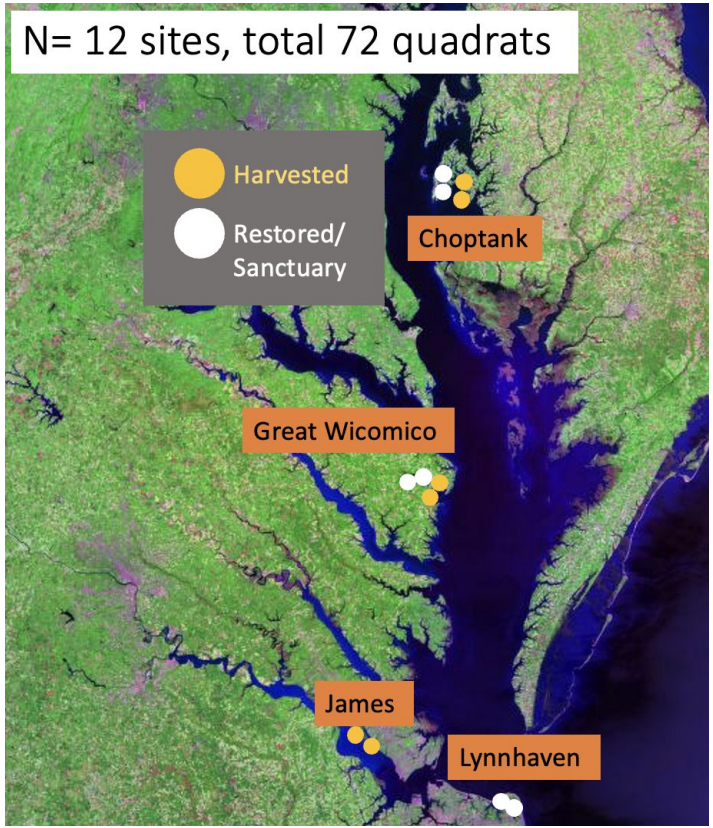
Research Questions

→ How do GoPro scores compare to existing oyster metrics?

→ How does this comparison depend on the type of site (salinity, restoration status, etc.)?

→ What is the relative time investment for diving vs. remote rapid assessment?

Field Study Methods



- Paired harvested and restored/ sanctuary reefs
- Collect data on the exact same quadrat
- Time the components of data collection

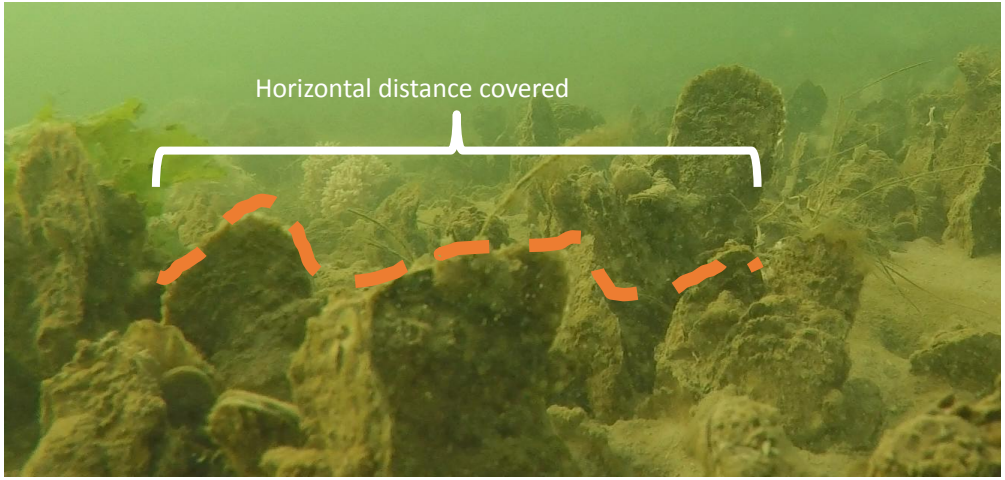
Diver-collected Metrics

1. **Oyster density**
2. **Oyster biomass**
3. **Multiple size classes**
4. **Reef height**

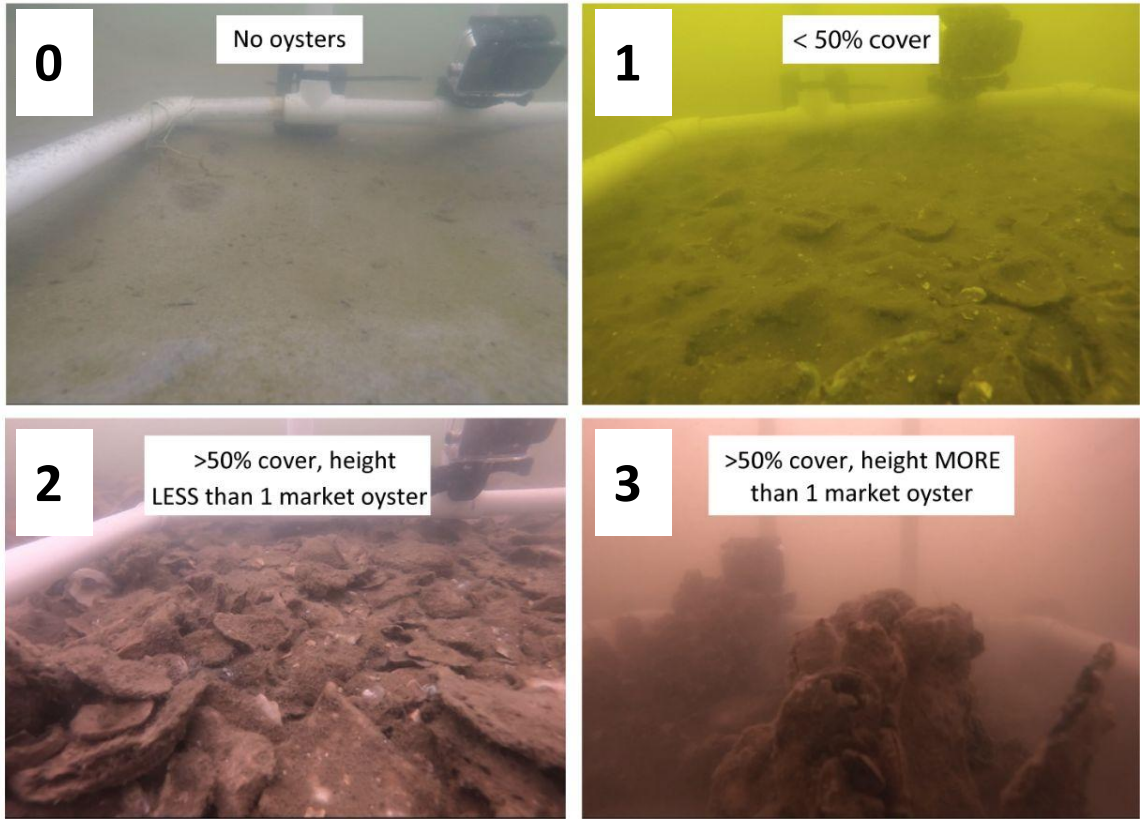
5. **Rugosity**

= length of chain/ distance covered

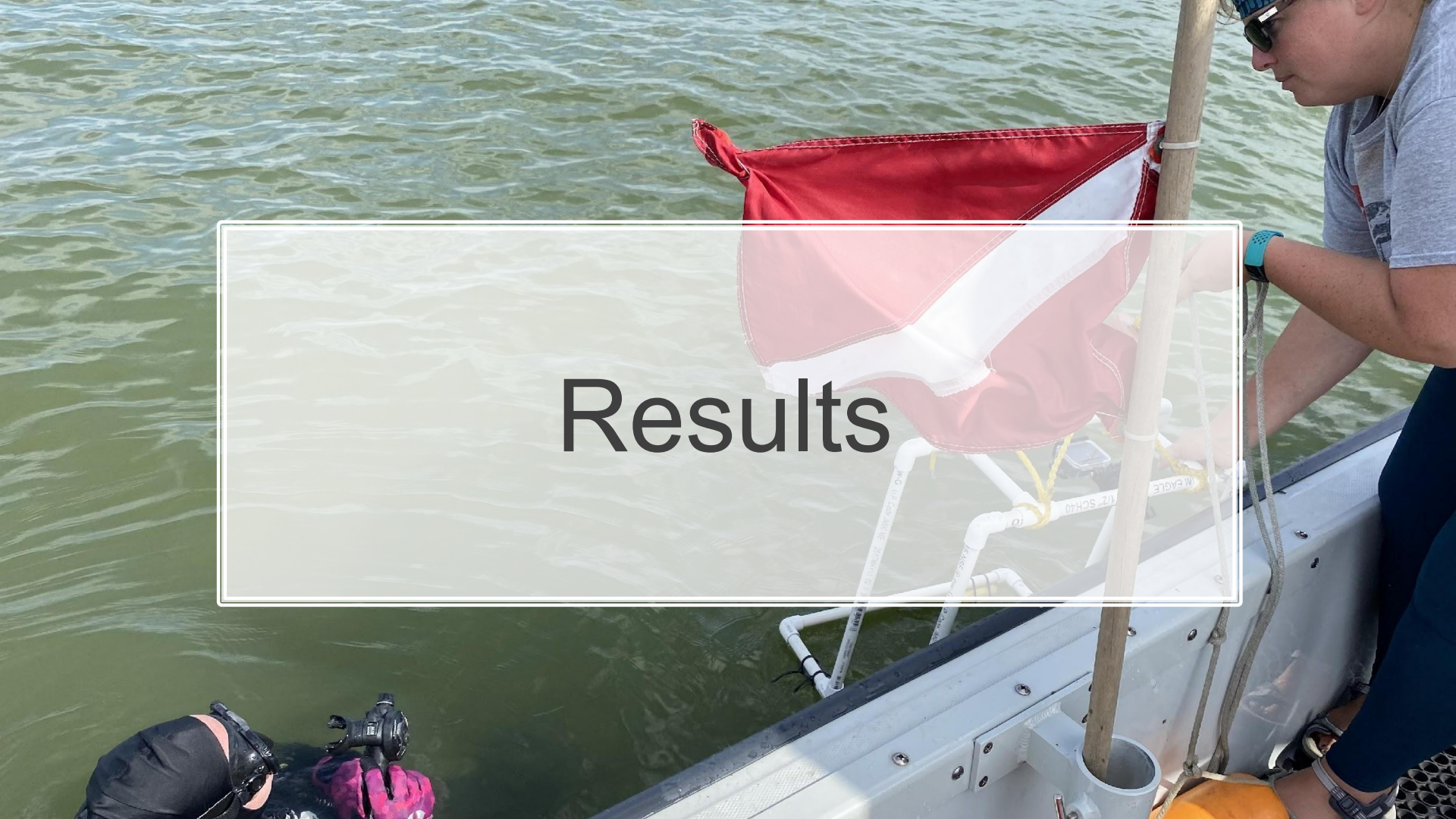
The higher the value, the more rugose



RAP Habitat Photo Analysis



* And likely in clumps



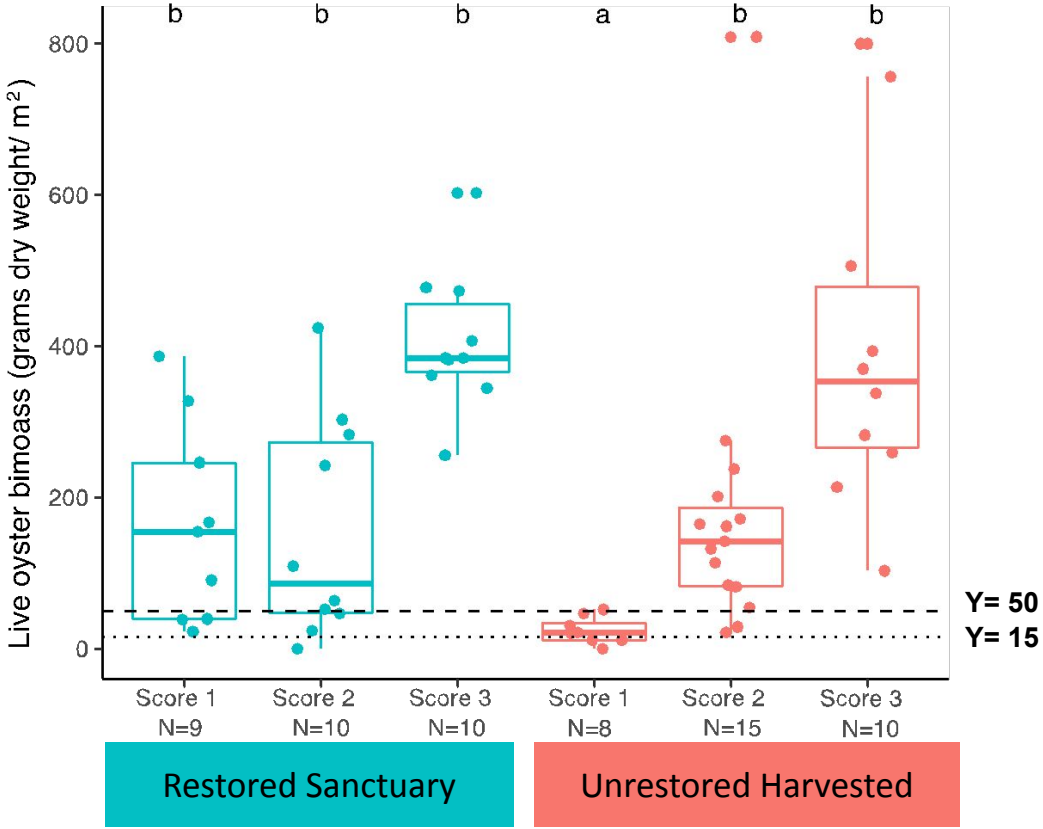
Results

Field Study Results

- **The highest score (3) from the RAP** captured high values of existing metrics
- **Scores of 3 consistently met the metrics** while other scores did not

Metric	Successful Rapid Assessment Protocol
Oyster biomass	✓
Oyster density	✓
Multiple size classes	✓
Reef height	✓
Rugosity	✓
Efficiency	✓

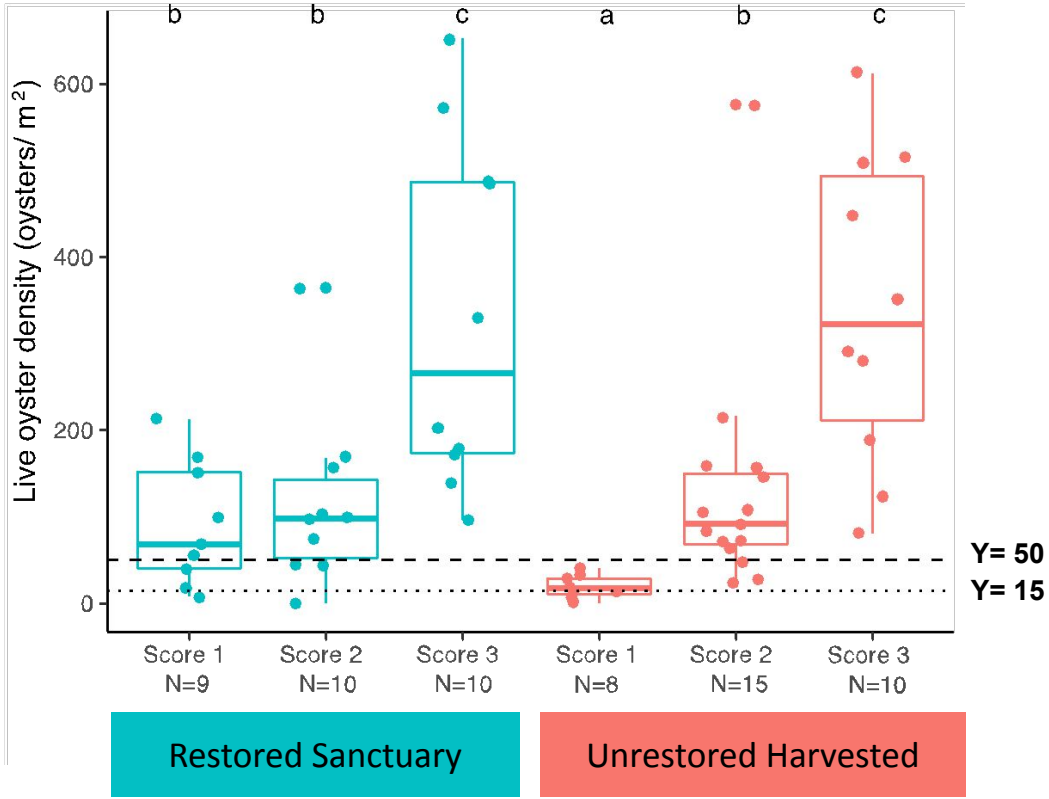
Oyster Biomass



- Restoration* GoPro score is the best model
- Did not depend on salinity

Tracy et al. 2025 *Rest. Ecol.*

Oyster Density



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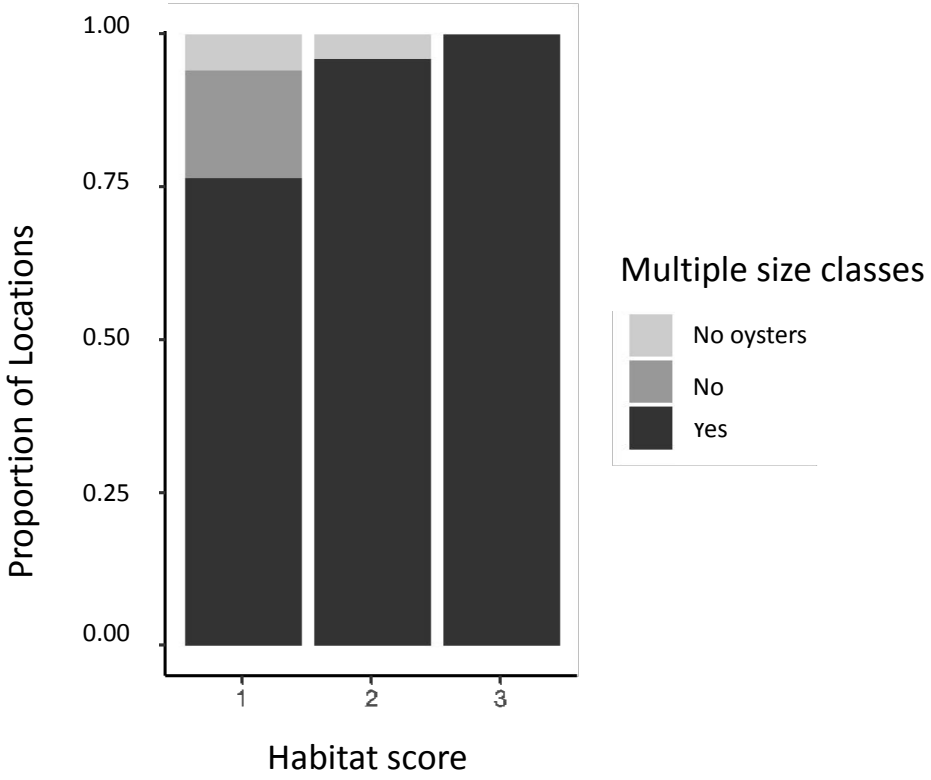
Size Variation



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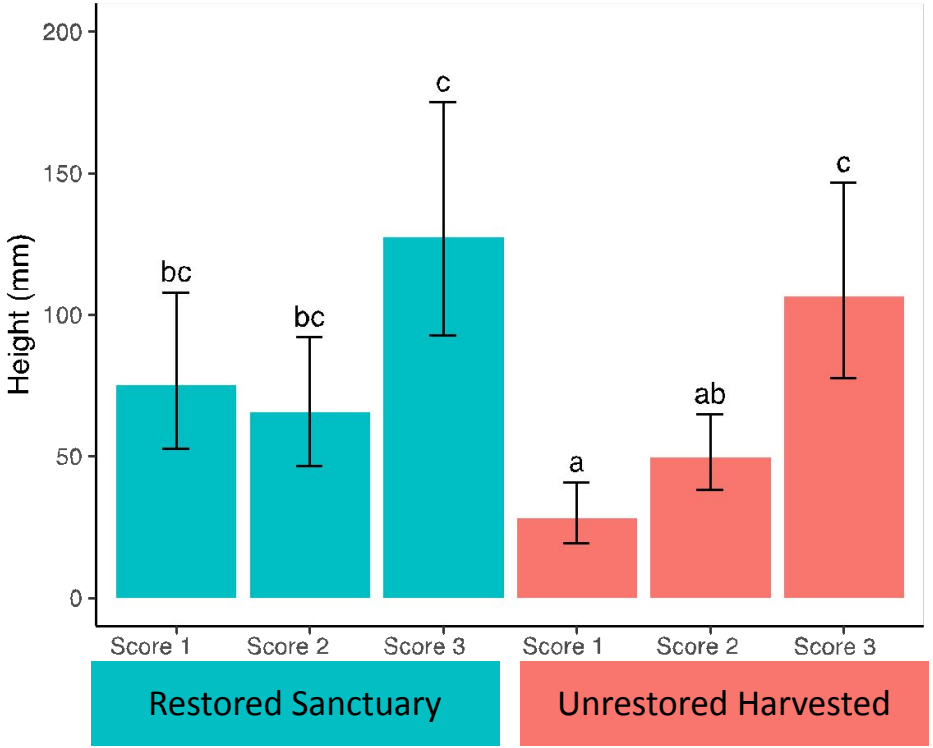
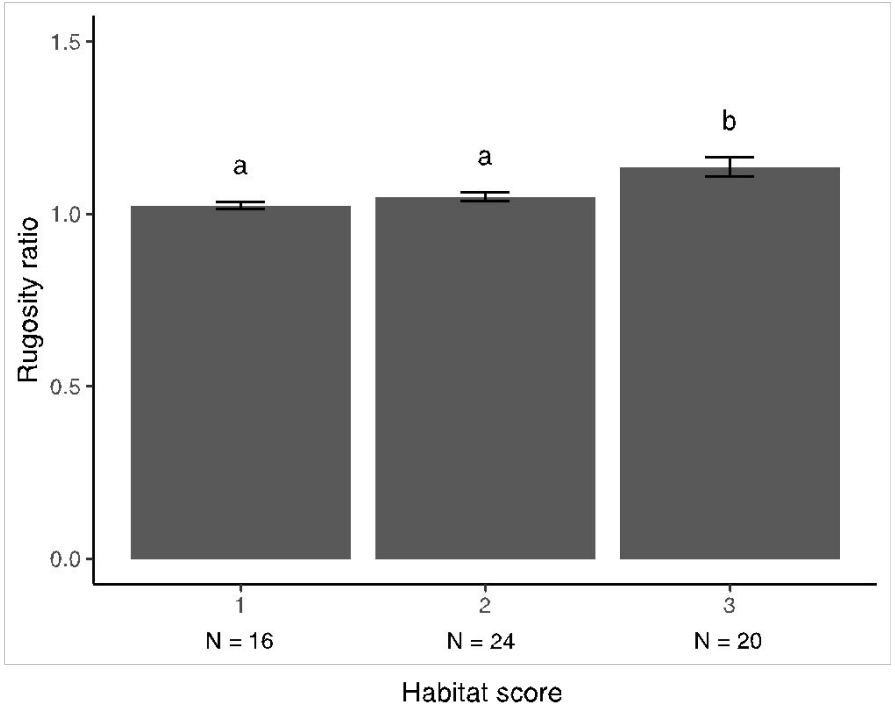
Reef Height & Rugosity





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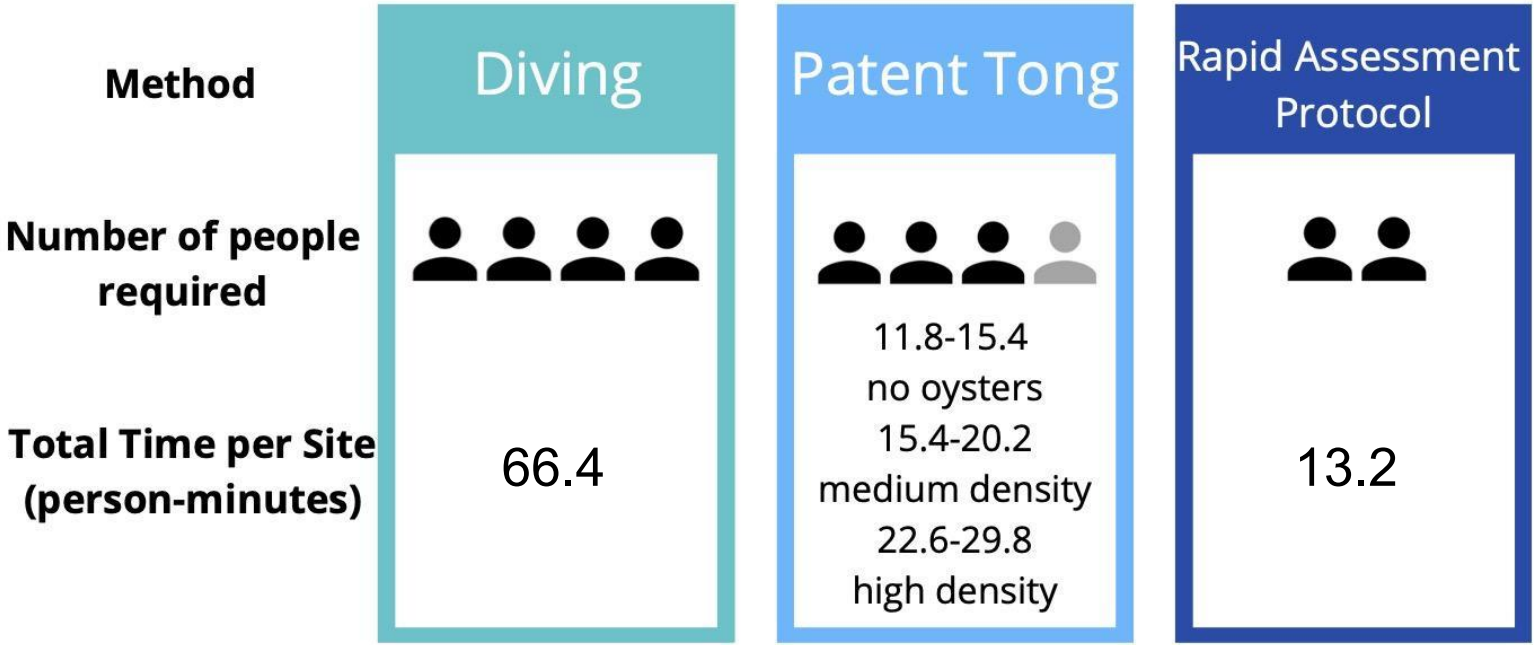
Efficiency Comparison



Efficiency depends on the monitoring tool and oyster density.

From scientific data to an applied framework

- Results from field study
- **Trade-offs: Quantitative and Qualitative**
- Use scenarios

Tool	Method	Strengths	Seasonality
(1) Diving *(existing tool)*	Collect oysters for physical counts	•Differentiates between reef quality at low and medium densities •Provides data on spat	•Warm water months •Better in high visibility

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(2) Patent tong *(existing tool)*	Collect oysters for physical counts	•See diving strengths •Fast at low densities	•Waterman availability varies and requires switching out crabbing gear for tongs
(3) Rapid Assessment Protocol (RAP)	Collect and score GoPro camera images	•More efficient, cost-effective - allows for more sampling pts •Direct info on habitat •Low tech allows diverse users •Non-destructive •Creates a record of reef appearance	•Best visibility in November to April, low in July/ August •Year-round visibility in southern bay •May be low visibility ~2 days after heavy wind and/or rain

From scientific data to an applied framework

- Results from field study
- Trade-offs: Quantitative and Qualitative
- **Use scenarios (Supplemental User Guide)**

Use Scenario #1: Post-restoration monitoring

ex) Harris Creek Sampling > 6 years

Survey 307 sites post-restoration for monitoring: Are they meeting the metrics?

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Consult conversion table for RESTORED sites with this goal in mind.

Conversion Table: Post-restoration monitoring

Metric	RAP Score 0 (no oysters present)	RAP Score 1 (<50% cover) & Score 2 (>50% cover, height < 1 oyster)	RAP Score 3 (>50% cover, height > 1 oyster, clumping)
Biomass **Threshold** = 15 g dry weight/ m2 **Target** = 50 g dry weight/ m2	X Does not meet metric	O May meet metric	✓ Meets metric
Density **Threshold** = 15 oysters/ m2 **Target** = 50 oysters/ m2	X	O	✓
Multiple Year Classes (Y/N) Presence of oysters in at least 2 size classes: market (>76 mm); small (40-75); spat (<40)	X	O	✓
GoPro-based Reef Height Height of 1 adult oyster (relative to oysters in image) with oysters likely in clumps	X	X	✓
Rugosity (Y/N) Ratio of horizontal distance covered by 1m chain relative to 1m	X	O	✓
Inferred Shell Budget Based on biomass & density (above)	X	O	✓

Scores of 3 consistently meet metrics in restored areas

Use Scenario #1: Post-restoration monitoring

ex) Harris Creek Sampling > 6 years

Survey 307 sites post-restoration for monitoring: Are they meeting the metrics?

Consult conversion table for post-restoration sites with this goal in mind.

What proportion of the sites are 3s?

88 of the 307 sites are very high density (>80 / m2) and would likely score a 3.

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↓

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↓

Estimate efficiency & consider trade-offs

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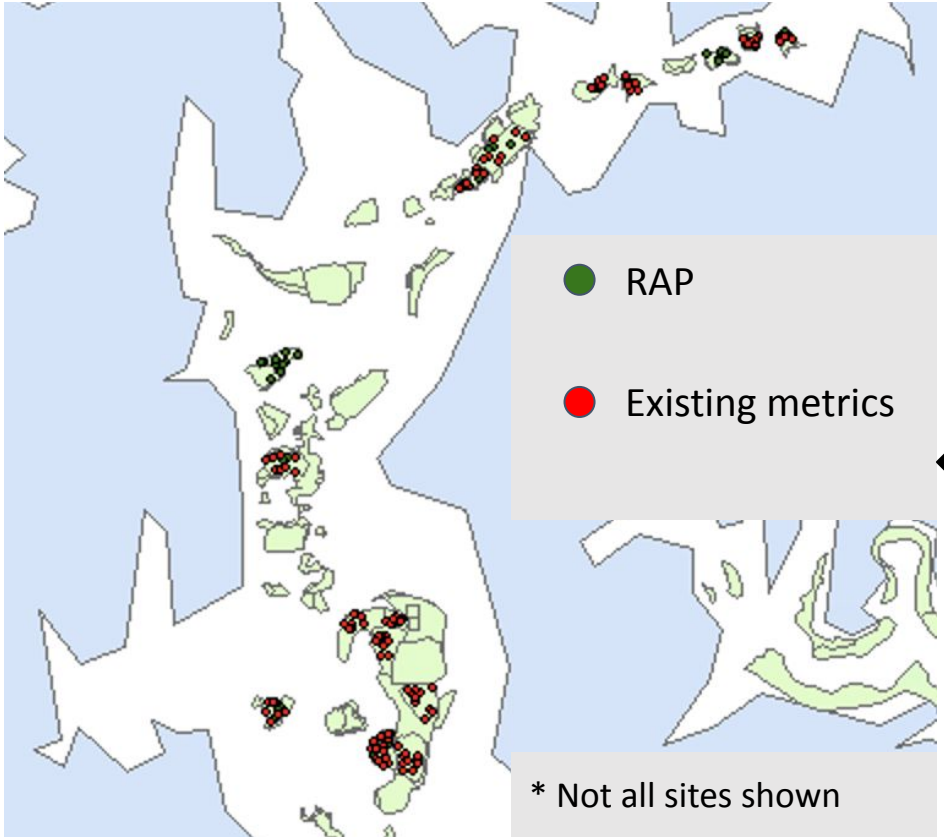
88 of the 307 sites are very high density (>80 / m2) and would likely score a 3.

Harris Creek Hybrid Approach

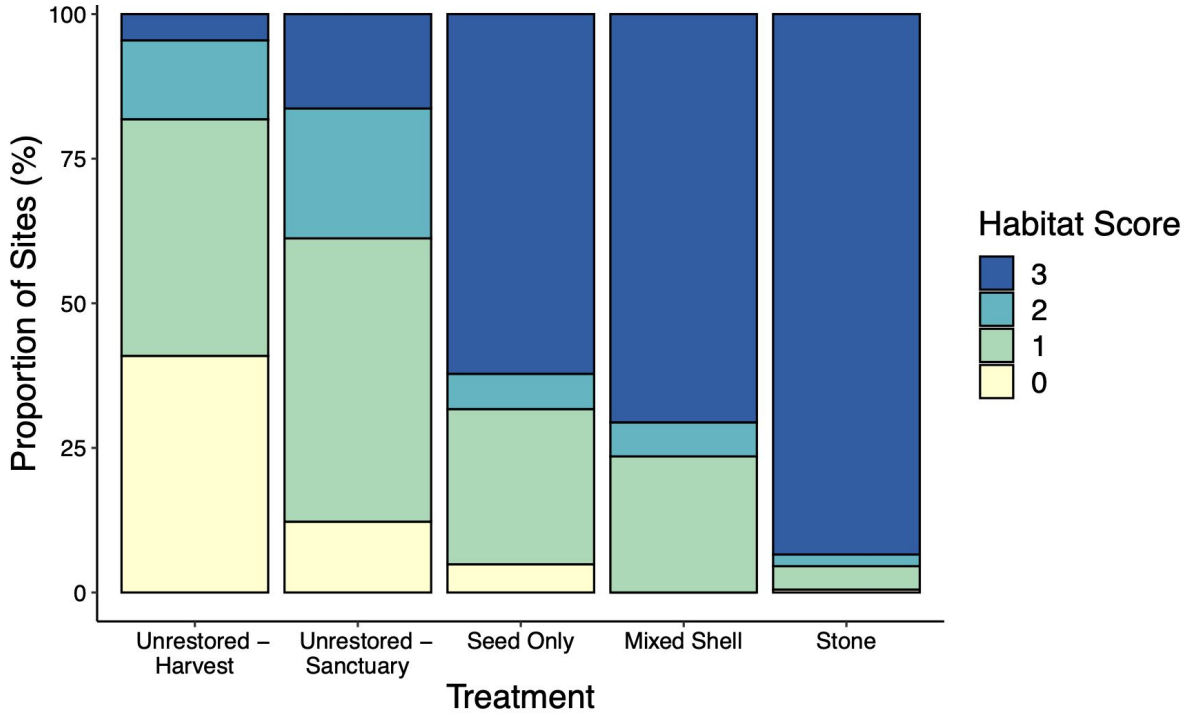


Efficiency Comparison

1. Existing metrics (242 patent tong sites + 65 diving sites): **130 hours**
2. Hybrid approach (219 patent tong sites + 88 RAP sites): **72 hours**

It's ~ 44% faster to use the hybrid approach instead of the existing monitoring methods alone

NCBO Study on 484 Harris Creek Sites



Tracy *et al.* in submission

(Jay Lazar & Anna He summer 2022 data, NCBO)

Integrating Multiple Considerations

How do trade-offs differ based on the organization conducting monitoring? Alternative substrates

Which sites are important enough to warrant collection of data with more than 1 of the 3 tools? (E.g. high density sites, mortality events)

When are habitat data vs. existing metrics (e.g. densities) most helpful?

Conclusions

- High RAP scores successfully capture high oyster density, biomass, reef height, rugosity, and multiple size classes
- The RAP is the most efficient and cost-effective tool across oyster densities
- Stakeholder discussions highlight strengths of each tool in the Hybrid Approach toolkit

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