Hybrid Approach to Oyster Reef Monitoring

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FishGIT Summer Meeting

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Outline: Towards an applied framework

- **Goals** of the Hybrid Approach
- **Supporting data** from field survey
- **Draft materials**
- **Trade-offs: Quantitative and Qualitative**
- **Use scenarios**: (1) Post-restoration monitoring and (2) Pre-restoration ground-truthing

The Hybrid Approach: Integrating 3 Tools

1. **Patent tong**
2. **Diving**

Existing metrics = oyster and reef measurements currently used in Chesapeake Bay monitoring (e.g. live oyster density)

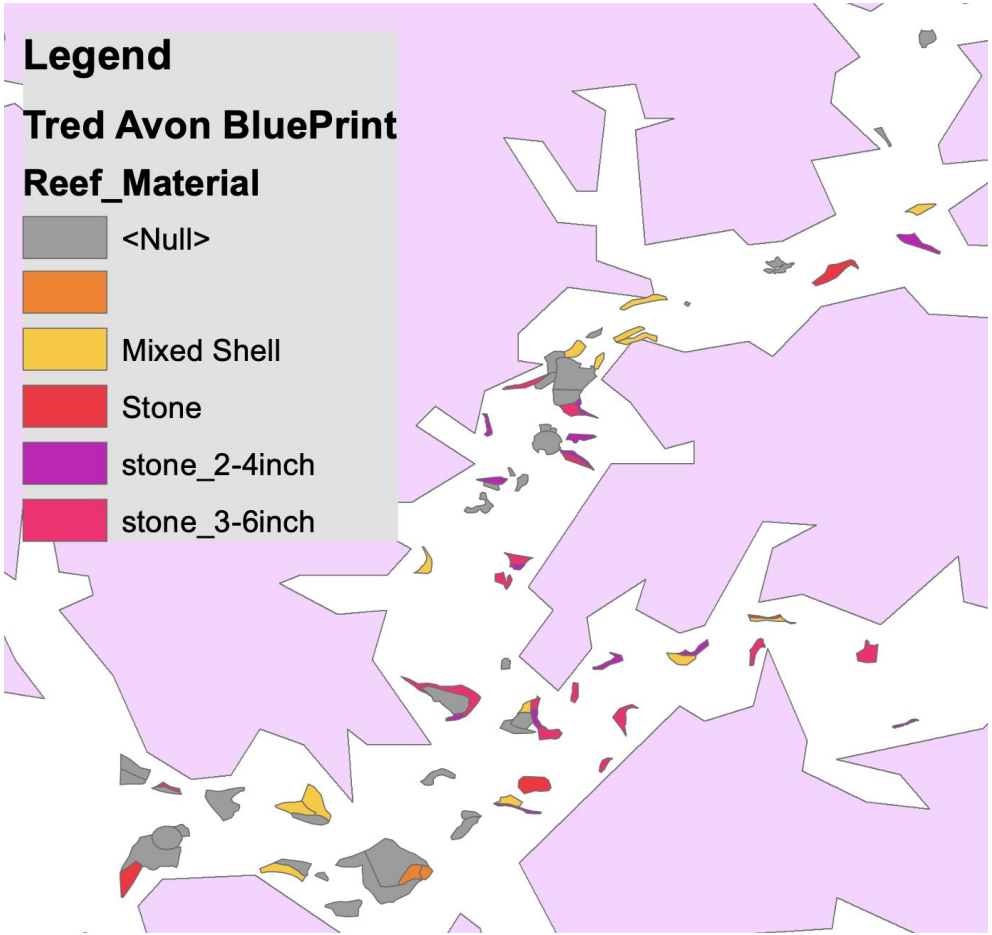
3. RAP = "Rapid Assessment Protocol"

Qualitative scores collected via GoPro cameras

Hybrid approach

Combination of existing metrics & RAP

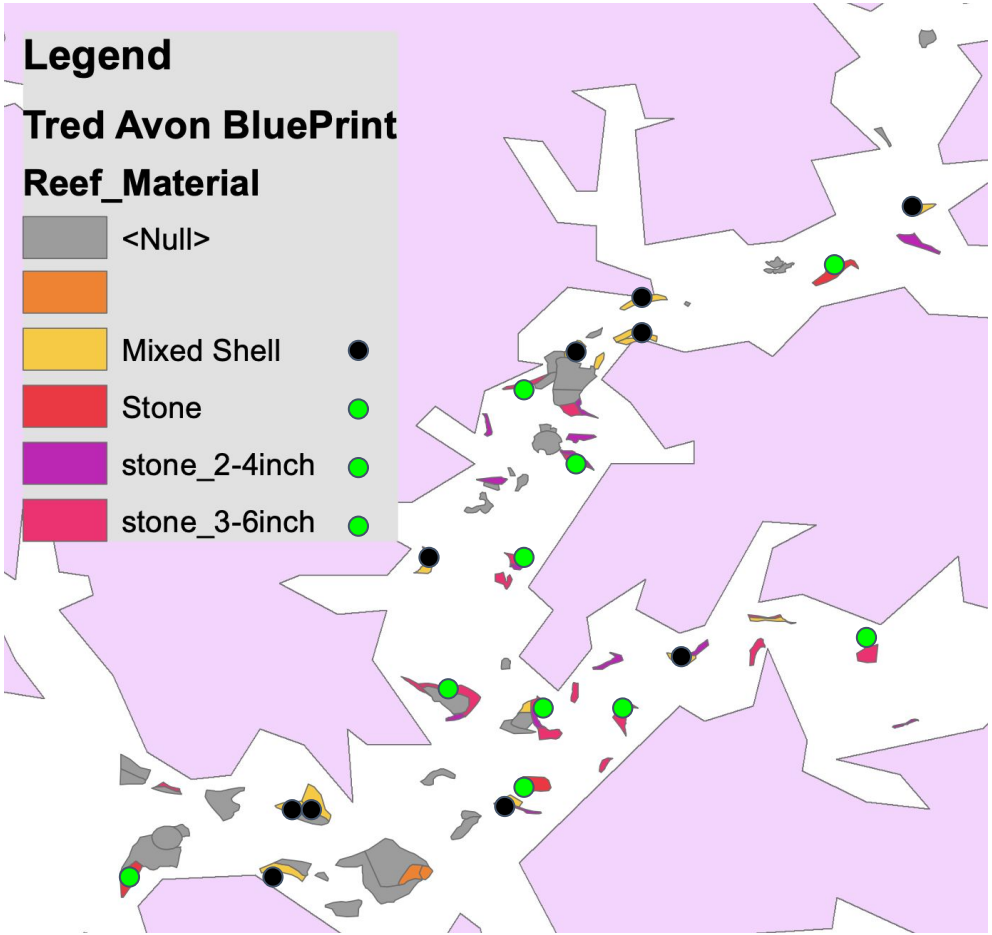
Example Hybrid Approach Scenario



Example Hybrid Approach Scenario

- **10 diving points**
- **10 patent tong points**

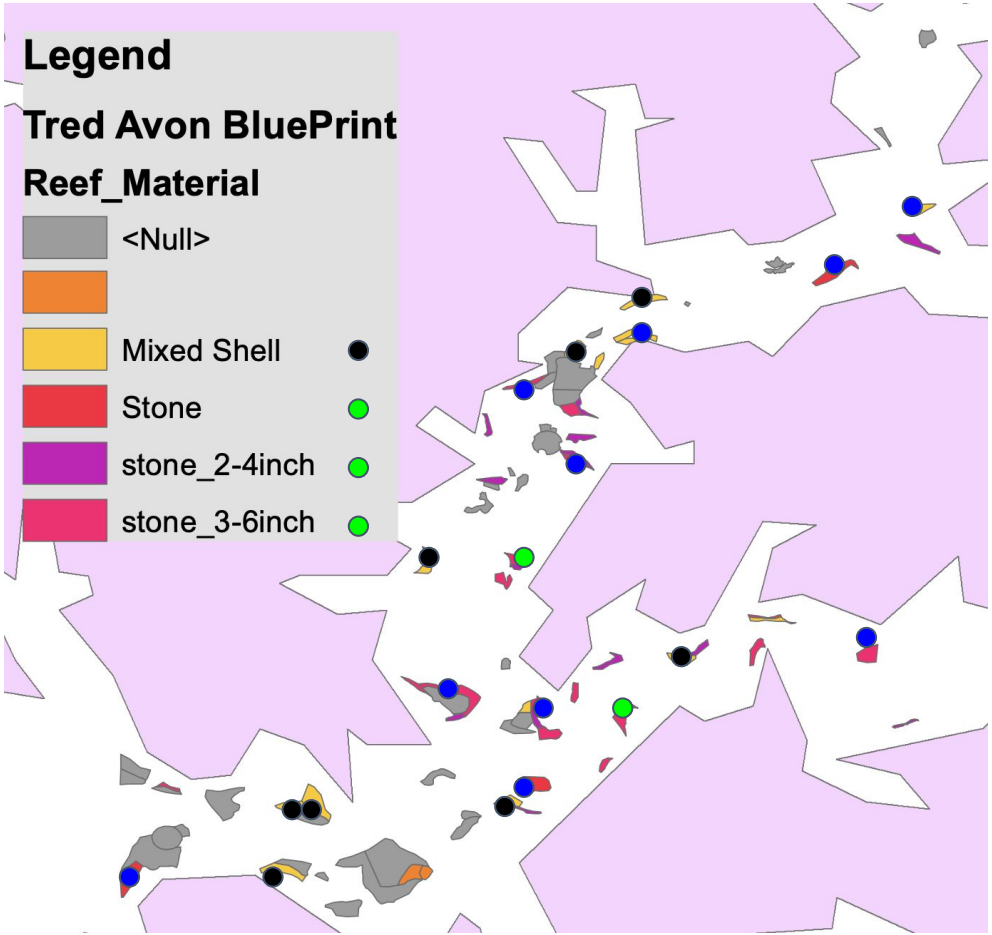
<u>= 800 minutes</u>



Example Hybrid Approach Scenario

- 2 diving points
- 8 patent tong points
- 10 RAP points

= 430 minutes



Goals

1. **Draft Hybrid Approach**
A framework for combining the RAP with existing metrics

Steps to Implementation

Goals

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2. **Potential use scenarios**
Analyze and consider

Steps to Implementation

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3. **Stakeholder feedback**
Seek and incorporate

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1. **Draft Hybrid Approach**
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4. **Increase efficiency of oyster reef monitoring**

Steps to Implementation

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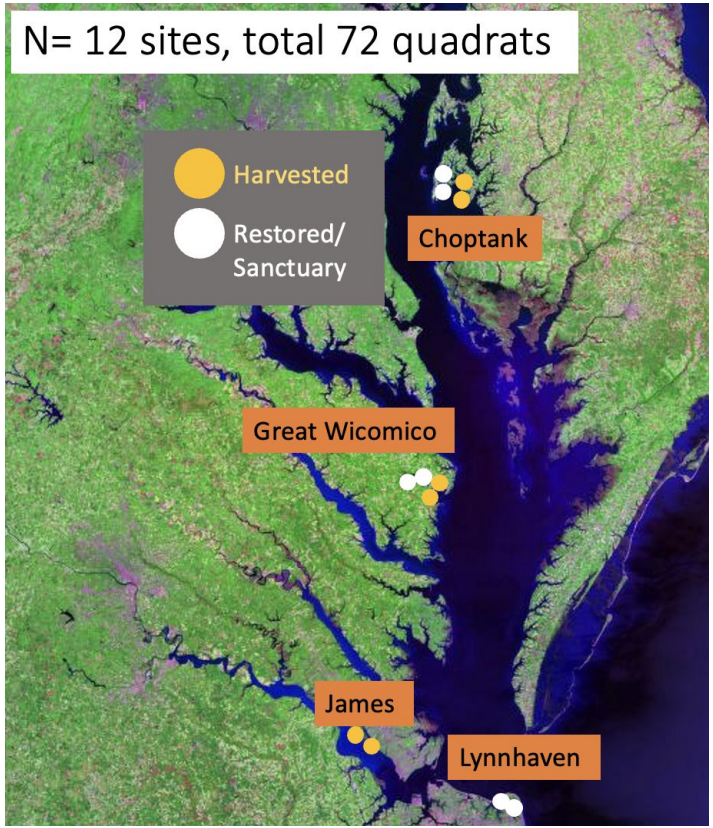
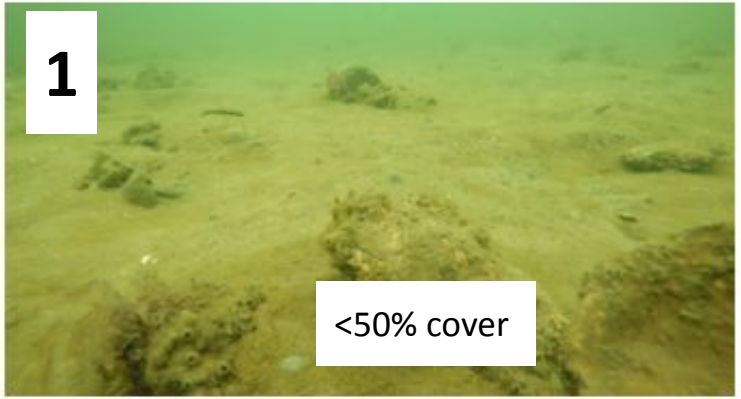
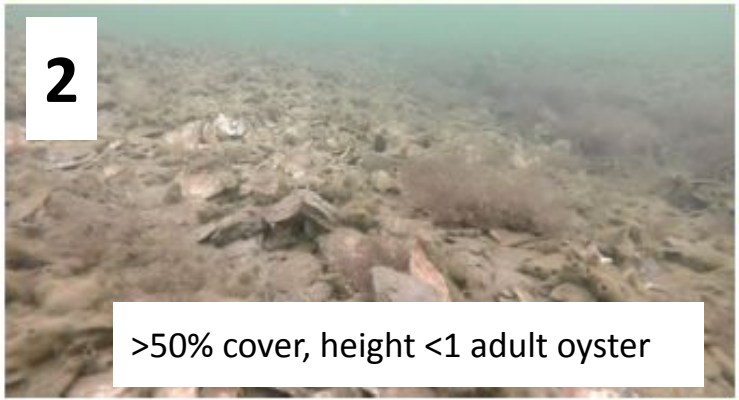
Field study using the Rapid Assessment Protocol and diver-collected metrics

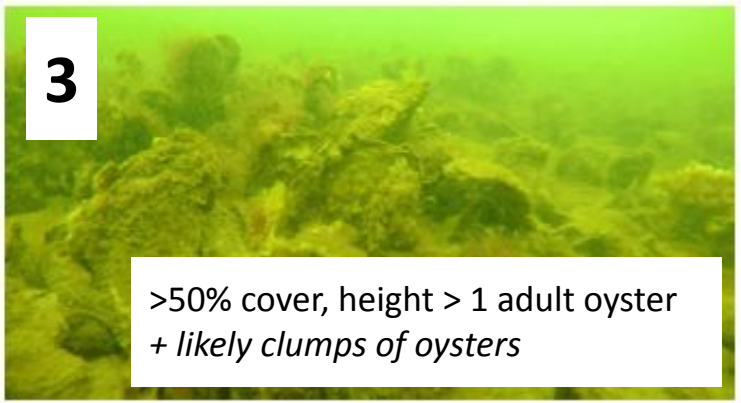


Data on same quadrat

Habitat Photo Analysis: Scores from 0 to 3







Summary of Field Study Results:
A direct comparison between RAP & existing metrics

- **The highest score (3) from the RAP** captured habitat quality across multiple metrics

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

Summary of Field Study Results:

A direct comparison between RAP & existing metrics

- **The highest score (3) from the RAP** captured habitat quality across multiple metrics
- **The highest score from the RAP** consistently met metrics (including thresholds & targets), but other scores do not

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

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Draft Hybrid Approach Materials

1. Conversion table for **Post-restoration monitoring**
2. Conversion table for **Pre-restoration ground-truthing**
3. User Guide: a Word document with further detail on the tables

Conversion Tables:
What are they intended for?

YES	NO
To act as guidance for whether and how to incorporate RAP into monitoring scenarios	To replace existing metrics To gather precise data on densities, biomass, etc.

Conversion Table: Post-restoration monitoring

Metric	**RAP Score 0** (no oysters present)	**RAP Score 1** (<50% cover) **RAP 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	✓

Conversion Table: Pre-restoration ground-truthing

Metric	RAP Score 0 (no oysters)	RAP Score 1 (<50% cover)	RAP Score 2 (>50% cover, height < 1 oyster)	RAP Score 3 (>50% cover, height > 1 oyster, clumping)
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Multiple Year Classes (Y/N) Presence of oysters in at least 2 size classes: market (>76 mm); small (40-75); spat (<40)	X	O	O	✓
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Inferred Shell Budget Based on biomass & density (above)	X	X	O	✓

May 1, 2022

User Guide: Hybrid Approach

Allison M. Tracy and Matthew B. Ogburn
Smithsonian Environmental Research Center

Table of Contents

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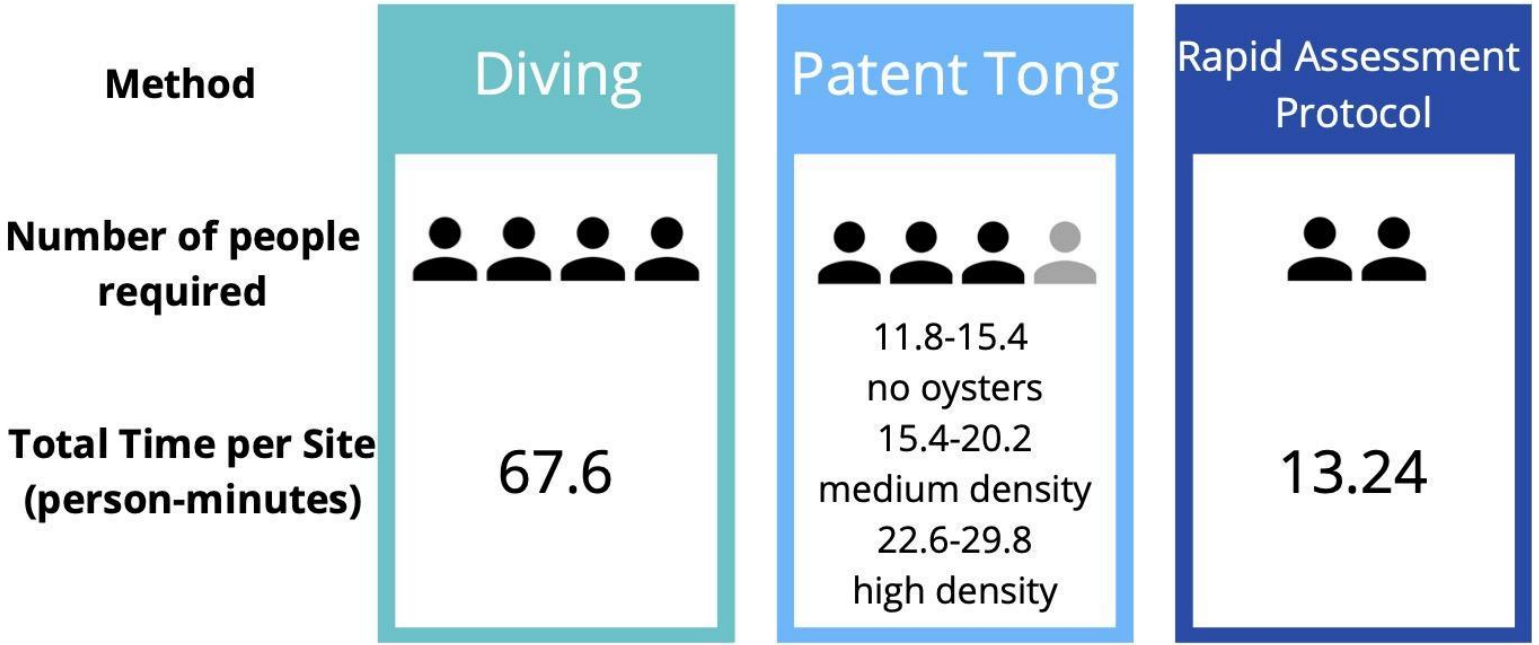
Efficiency Comparison



Efficiency depends on the monitoring tool and oyster density.

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

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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

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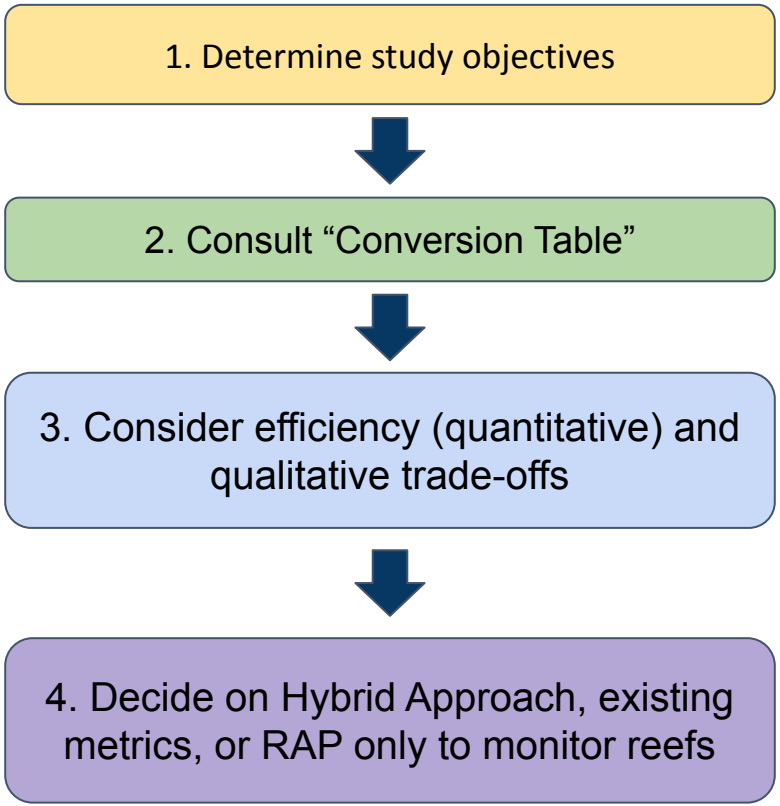
Hypothetical scenarios

Based on efficiency comparison

Use Scenarios



1. Post-restoration monitoring

2. Pre-restoration ground-truthing

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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ex) Harris Creek Sampling > 6 years

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

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

Conversion Table: Post-restoration monitoring

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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

Applying the conversion table

Scores of 0: This will reliably denote metrics ARE NOT met.

Scores of 1 or 2: More data is needed to determine if thresholds are met, so existing metrics are needed.

Scores of 3: This will reliably denote the metrics ARE met.

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.

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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↓

Estimate efficiency & consider trade-offs

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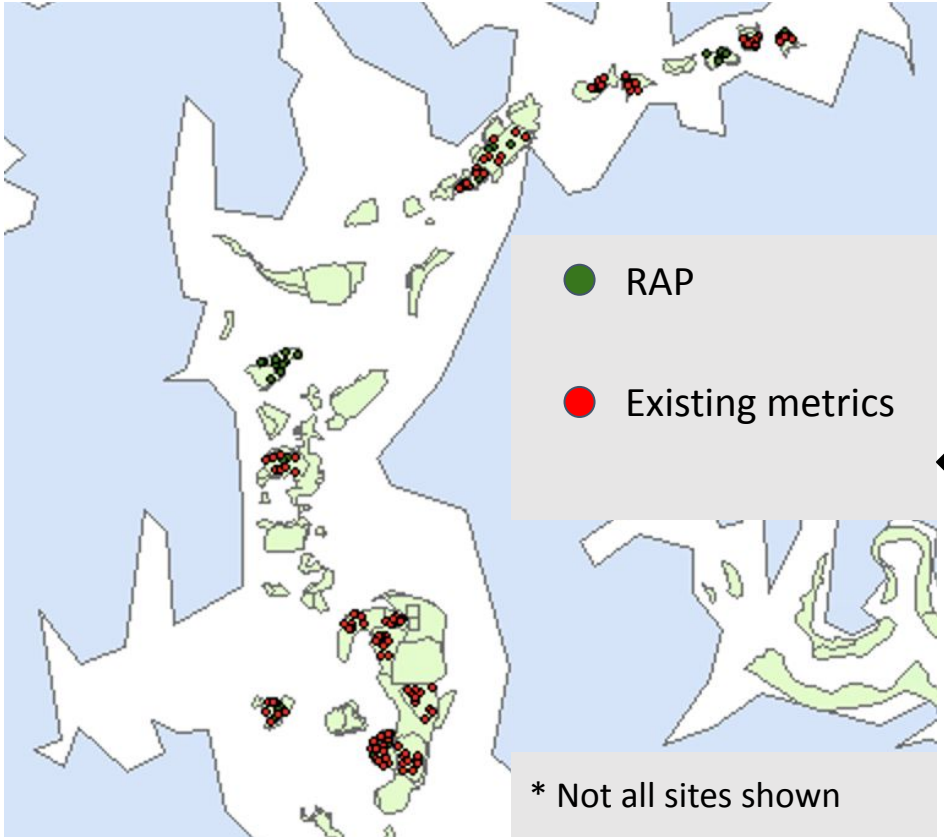
Harris Creek Hybrid Approach

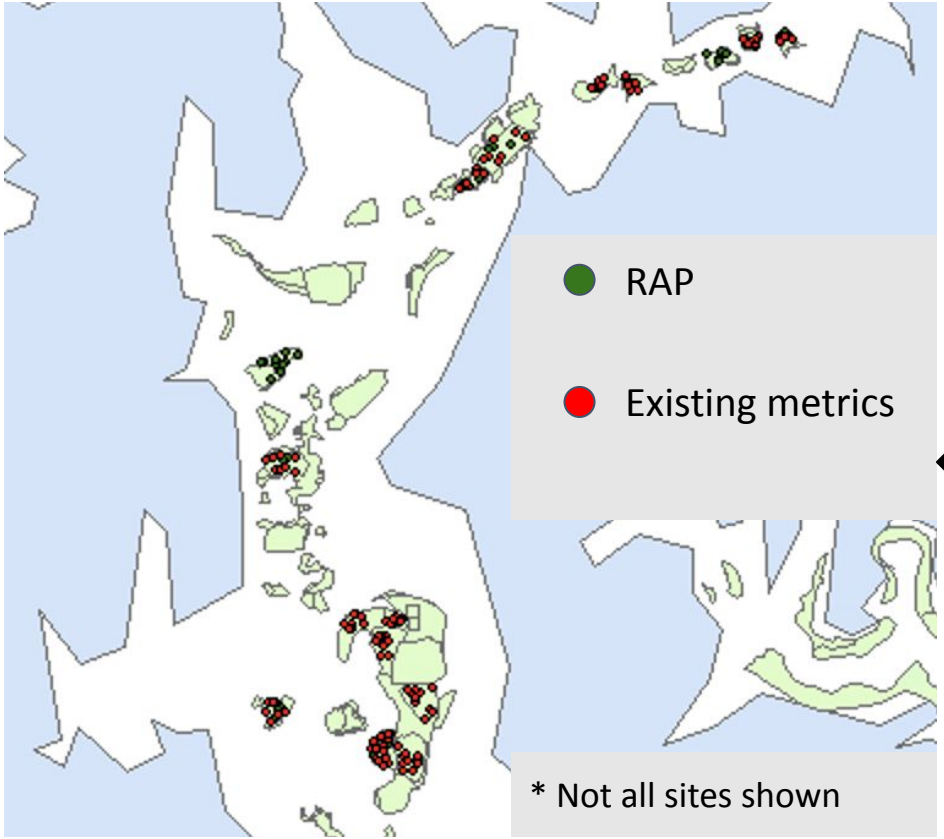


Efficiency Comparison

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

* Applying RAP at 88 high density sites that are likely to score 3

Harris Creek Hybrid Approach



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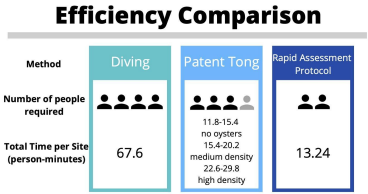
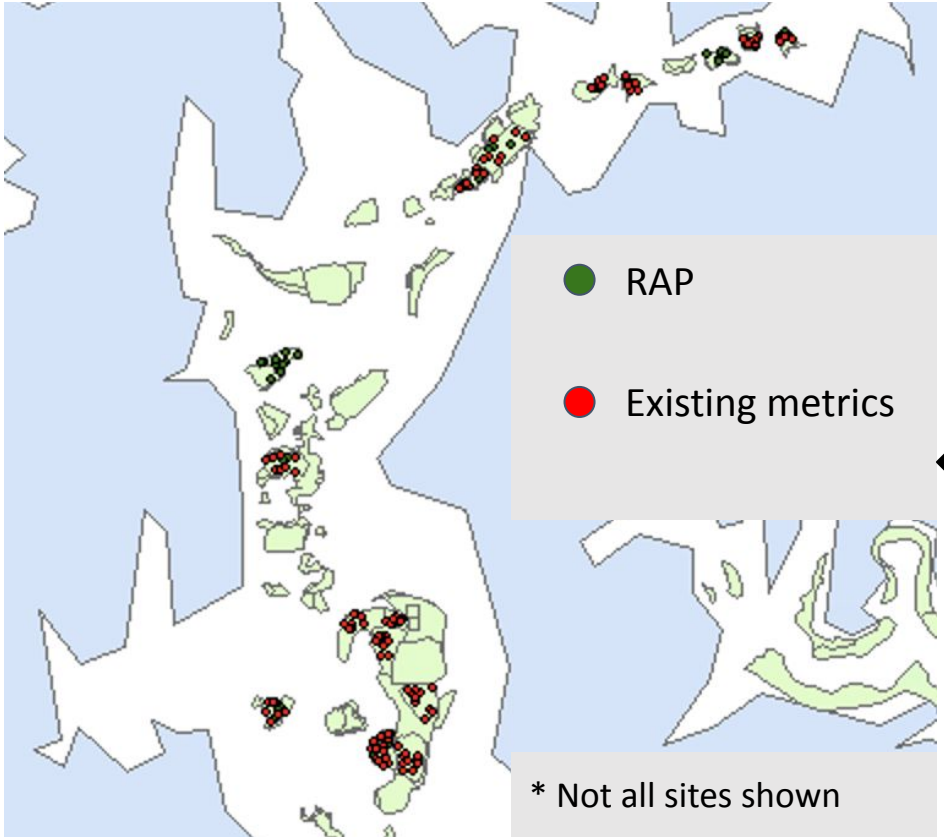


* Time based on efficiency table person-minutes/ site and a 3-person patent tong crew at medium oyster densities

Harris Creek Hybrid Approach



Efficiency Comparison

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

Use Scenario #1: Post-restoration monitoring

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

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↓

Estimate efficiency & consider trade-offs

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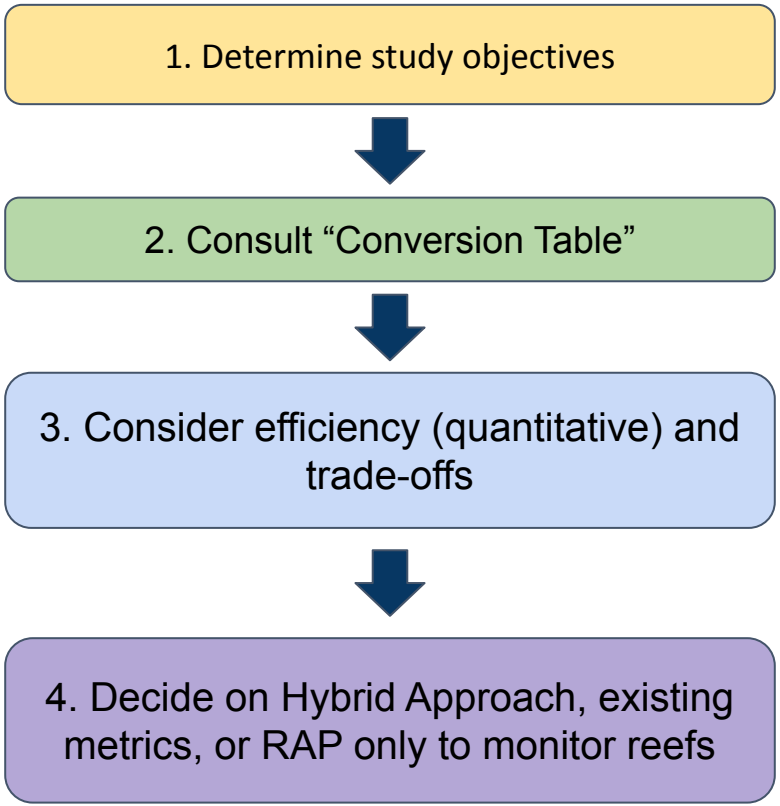
Decide to use the Hybrid Approach

Use Scenarios



1. Post-restoration monitoring
2. **Pre-restoration ground-truthing**

Use Scenario #2: Pre-restoration ground-truthing

Goal = determine sites in a tributary suitable for restoration re: oyster density

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

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GoPro-based Reef Height Height of 1 adult oyster (relative to oysters in image) with oysters likely in clumps	X	X	X	✓
Rugosity (Y/N) Ratio of horizontal distance covered by 1m chain relative to 1m	X	X	O	✓
Inferred Shell Budget Based on biomass & density (above)	X	X	O	✓

We don't have data on 0s in unrestored reefs

Conversion Table: Pre-restoration ground-truthing

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Inferred Shell Budget Based on biomass & density (above)	X	X	O	✓

We don't have data on 0s in unrestored reefs

But the RAP alone will indicate if oysters are present above the sediment

Use Scenario #2: Pre-restoration ground-truthing

Goal = determine sites in a tributary suitable for restoration re: oyster density

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

Use ONLY RAP if goal is to find oysters above the sediment

Use existing metrics if goal is to compare to a maximum oyster density

Use Scenario #2: Pre-restoration ground-truthing

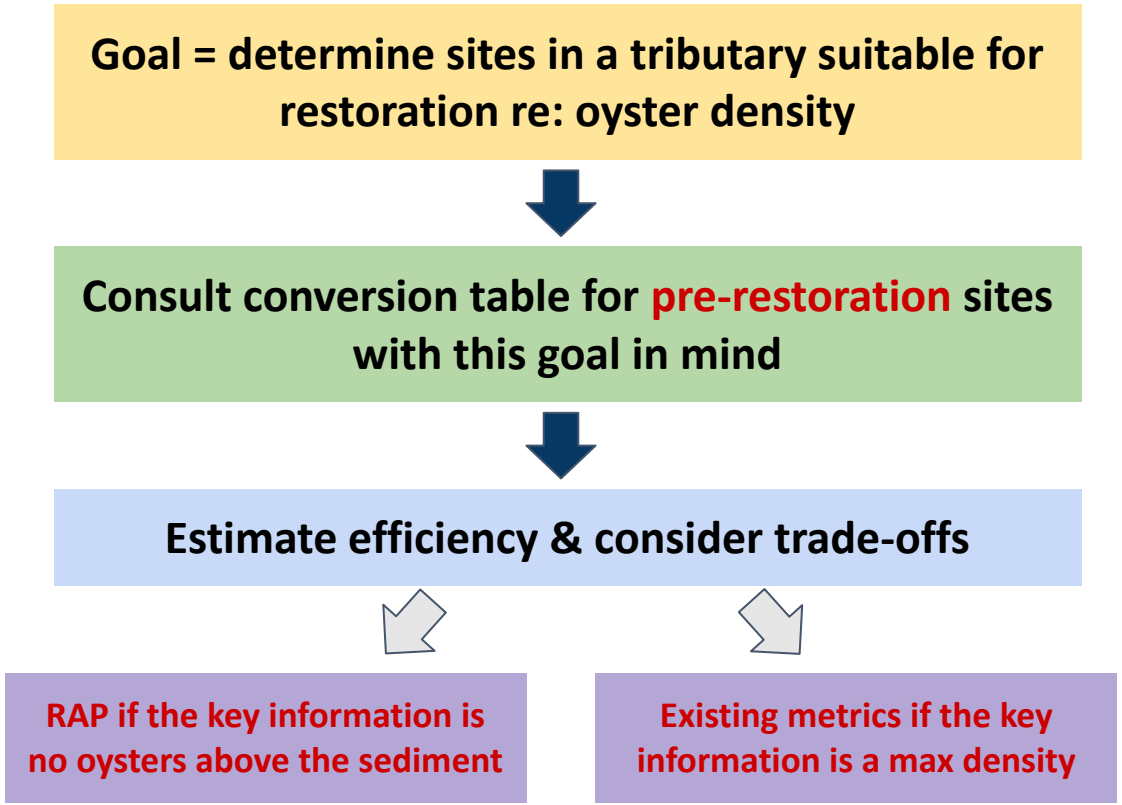
Goal = determine sites in a tributary suitable for restoration re: oyster density

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

Estimate efficiency & consider trade-offs

Estimate could play into decision
ex) many 0s expected

Use Scenario #2: Pre-restoration ground-truthing



In this case, the Hybrid Approach offers a choice

Integrating Multiple Considerations

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

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?

Summary of Use Scenarios for Hybrid Approach

Restoration Monitoring	Harvest Monitoring
#1: Monitoring a restored tributary (at 3, 6, or >6 years)	#1: Monitoring harvested areas to answer questions outside of the Fall Survey
#2: Ground-truthing prior to restoration	#2: Add new sites to the Fall Survey
#3: Data on questions we don't have bandwidth for with existing metrics alone	#3: Determine where to conduct stock enhancement (planting)
???	???

Implementation Questions

- What are the considerations at play for quantitative and qualitative trade-offs?
- How can this apply to different restoration settings/ substrates?
- Are there scenarios we do not currently monitor at all because of the cost-benefit calculation that could be revisited with the Hybrid Approach?
- What additional information should we include for broader stakeholder engagement?

Steps to Implementation

1. **Draft Hybrid Approach**
A framework for combining the RAP with existing metrics

2. **Potential use scenarios**
Analyze and consider

3. **Stakeholder feedback**
Seek and incorporate

4. **Increase efficiency of oyster reef monitoring**

Conversion Tables

User Guide

Restoration

Harvest

1-pager/ flyer

Stakeholder feedback

Webinar (September*)

Acknowledgments

Co-authors: Matt Ogburn & Caitlyn Dittmeier

RAP Workgroup

Allison Colden (CBF)
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Rochelle Seitz (VIMS)
Russ Burke (CNU)
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Stephanie Westby (NOAA)

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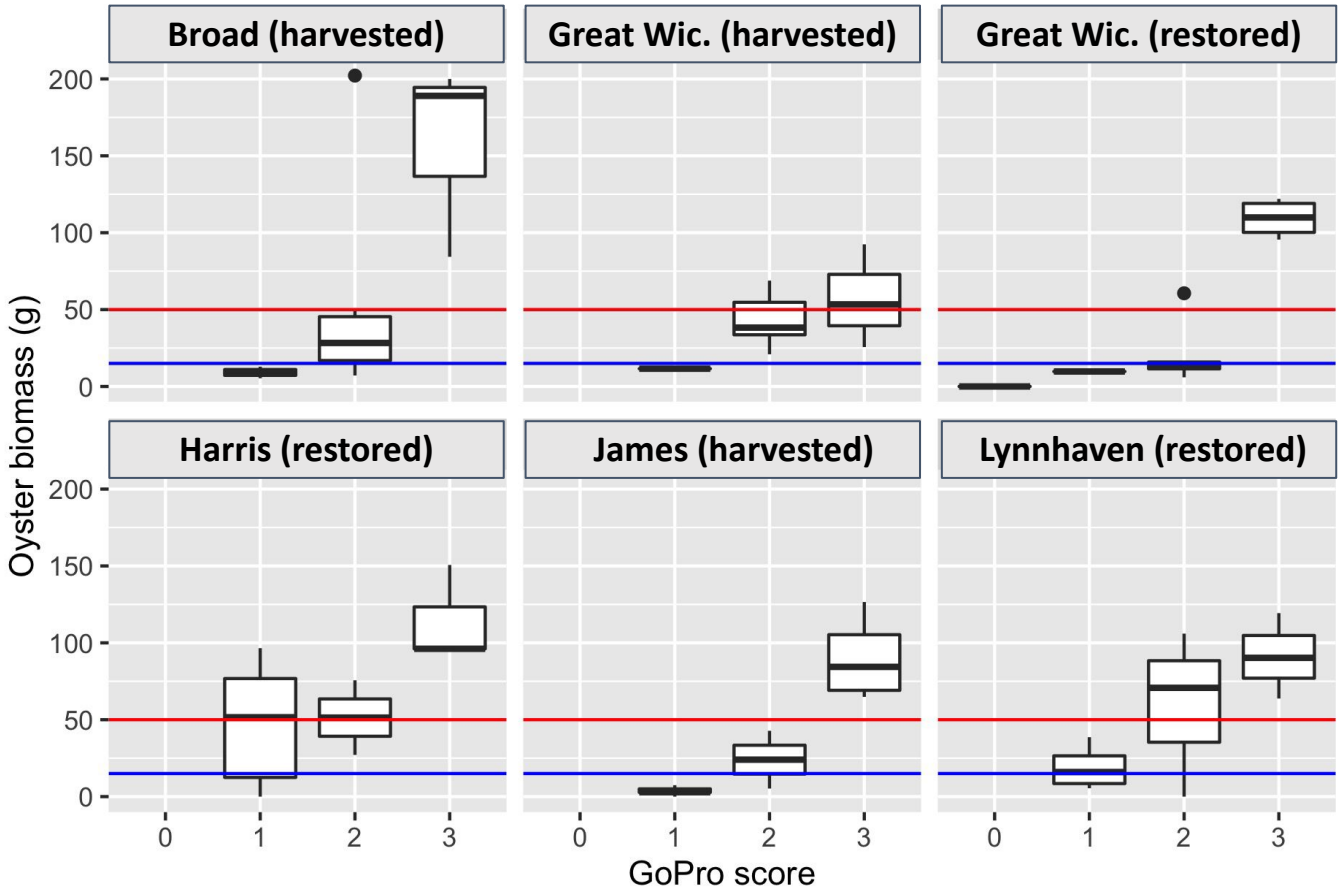
Andrew Button (VMRC)
Melissa Southworth (VMRC)
David Schulte (USACE)

NOAA Chesapeake Bay Office
MD Oyster Workgroup
VA Oyster Workgroup
MDNR

NOAA Award
#NA21NMF0080474

Extra slides

Tributary Patterns: 3s Consistently High

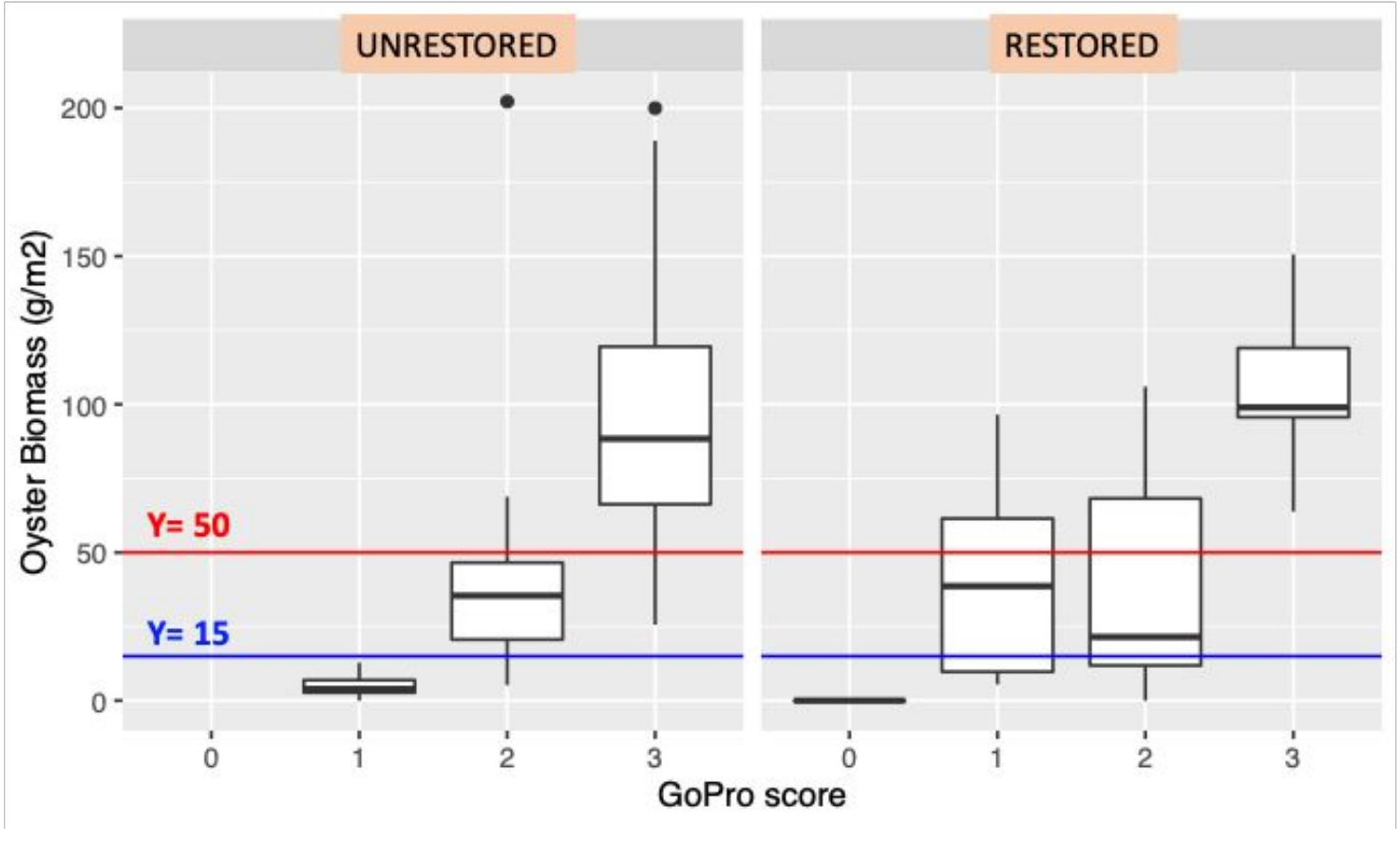


Efficiency comparison

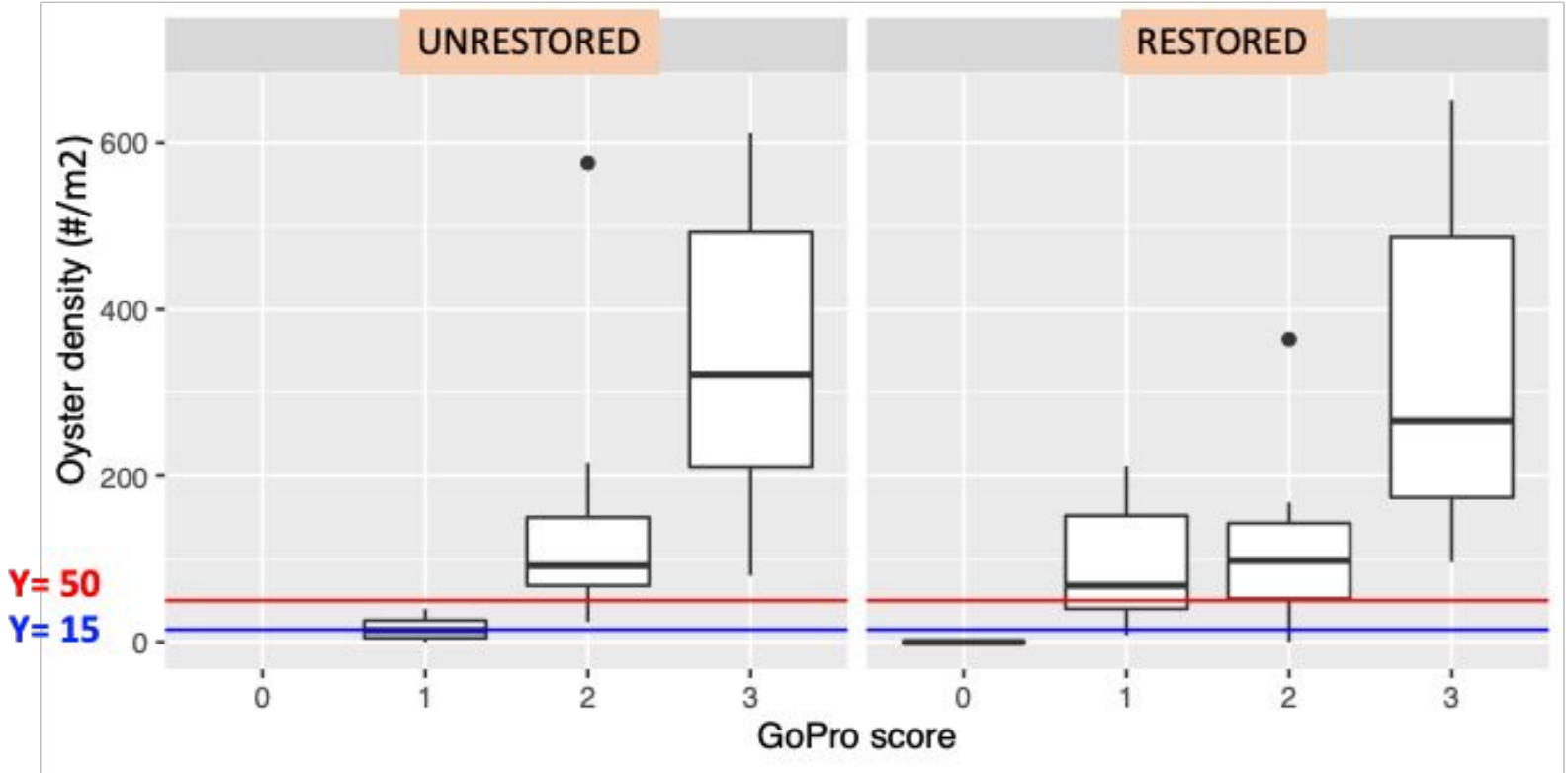
	Non-field Time (person-minutes/ site)	Field Time (person-minutes/ site)	# of People (accounted for in times)	TOTAL Time (person-minutes/ site)
Patent Tong (3 people)	1 (estimated)	**10.8** (no oysters) **14.4** (medium density) **21.6** (high density)	3	**11.8** (no oysters) **15.4** (medium density) **22.6** (high density)
Patent Tong (4 people)	1 (estimated)	**14.4** (no oysters) **19.2** (medium density) **28.8** (high density)	4	**15.4** (no oysters) **20.2** (medium density) **29.8** (high density)
Diver	1 (estimated)	**66.6**	4	**67.6**
GoPro RAP	3.6	**9.6**	2	**13.24**

N.B. Additional costs beyond time include changing boats with crew size or diving insurance

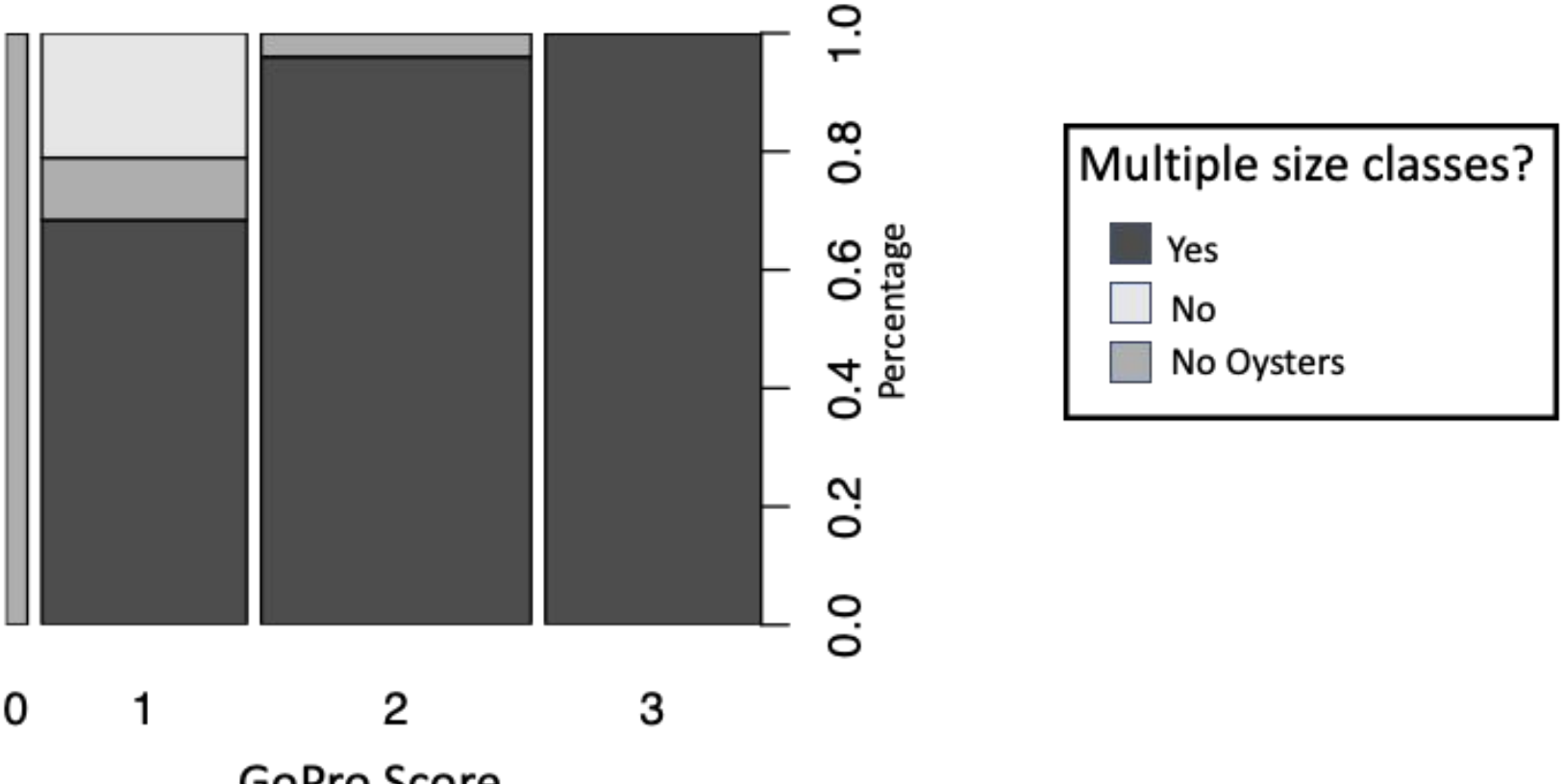
Oyster Biomass: restored vs. unrestored



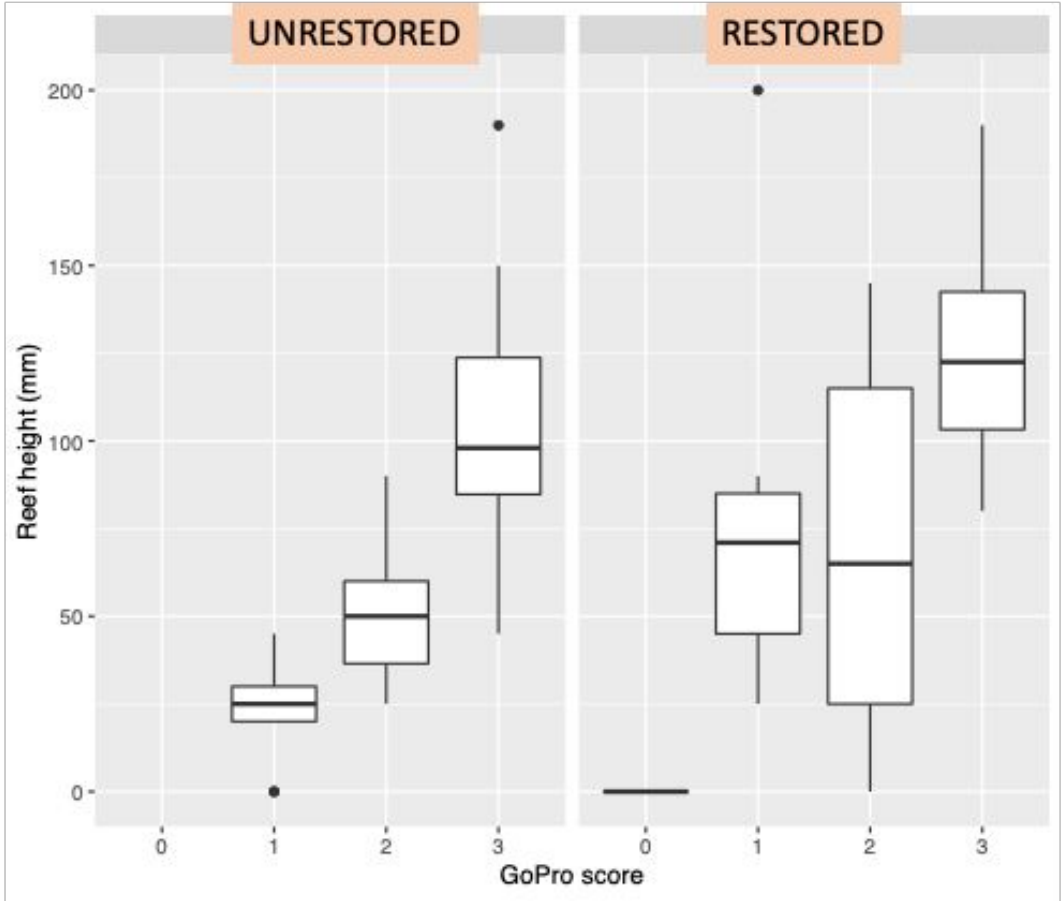
Oyster Density: restored vs. unrestored



Multiple size classes vs. GoPro Scores



Reef Height: restored vs. unrestored



Rugosity: restored vs. unrestored