Before-After-Gradient Fishery Monitoring Design in the US Wind Lease Area OCS-A0490

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Sea Born Seafood

Goal: Impact to black sea bass **fisheries**

1. Using fishing gears and BAG and BACI designs, detect impacts of,
    - Construction disturbance
    - Reef effect (<120 m from foundations)
    - Spill over effect (>120 m from foundations)
2. Deploy and test ropeless gear in the pot fishery
3. Engage commercial and recreational fishers

152nd ANNUAL MEETING
Spokane
AUGUST 21-25, 2022
OFFSHORE WIND, FISH, AND FISHERIES: EMERGING KNOWLEDGE AND APPLICATION

US Wind
Fuelling our future, naturally.

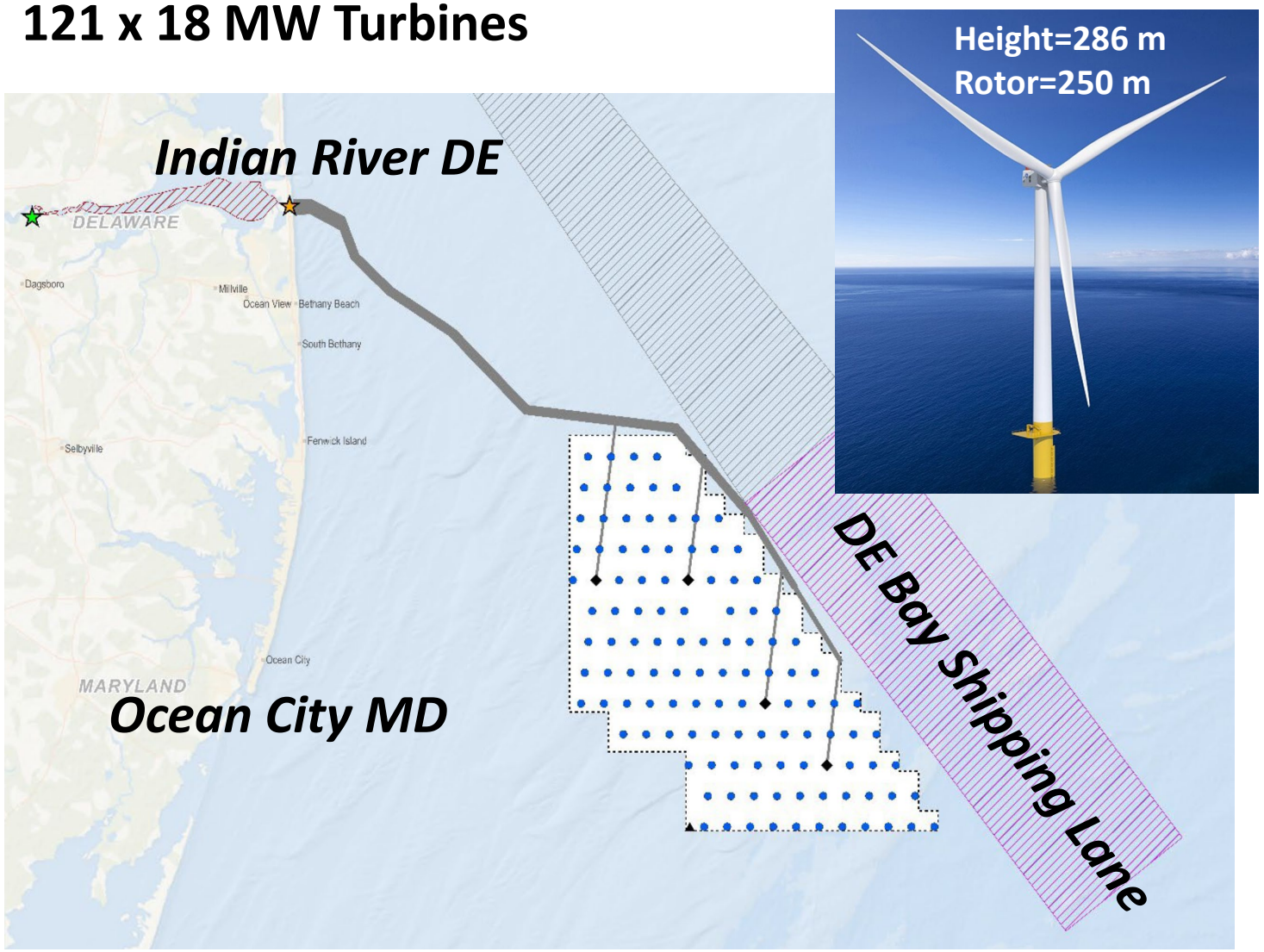
Ocean City, MD Fisheries

Recreational Charter – Robust

FIN CHASER

Commercial – In decline, some resilience

Lease OSC-A 0490
US Wind Projects MarWin and Momentum
121 x 18 MW Turbines

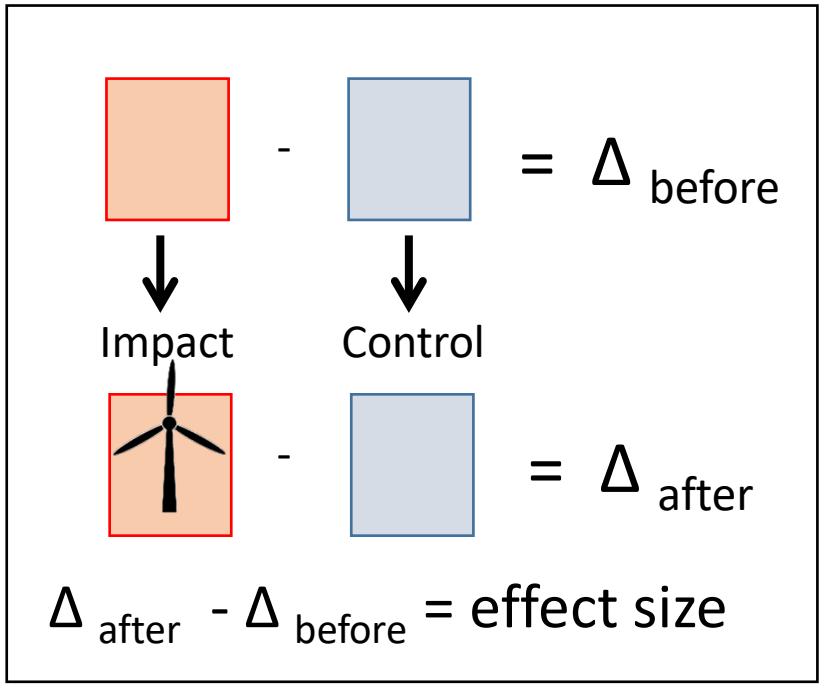


Goal: Impact to black sea bass <u>fisheries</u>

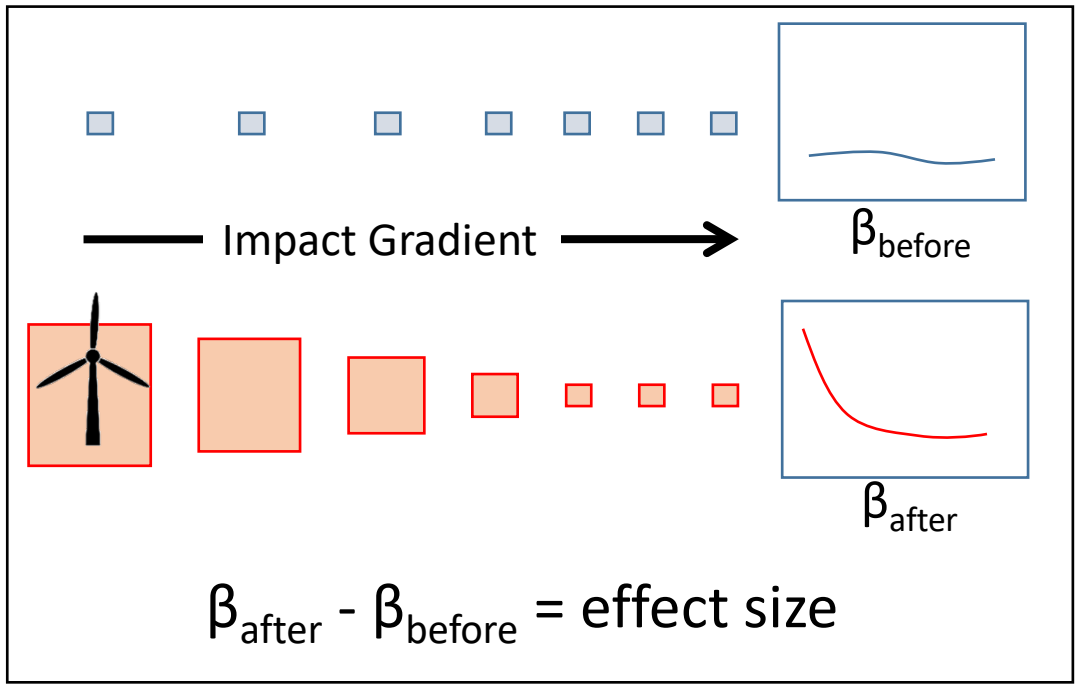
1. Using fishing gears, detect impacts:
   - Construction disturbance
   - Reef effect (<120 m from foundations)
   - Spill over effect (>120 m from foundations)
2. Test ropeless gear in the black sea bass pot fishery
3. Engage commercial and recreational fishery sectors in the survey

Design Principle

Before After Control Impact Design



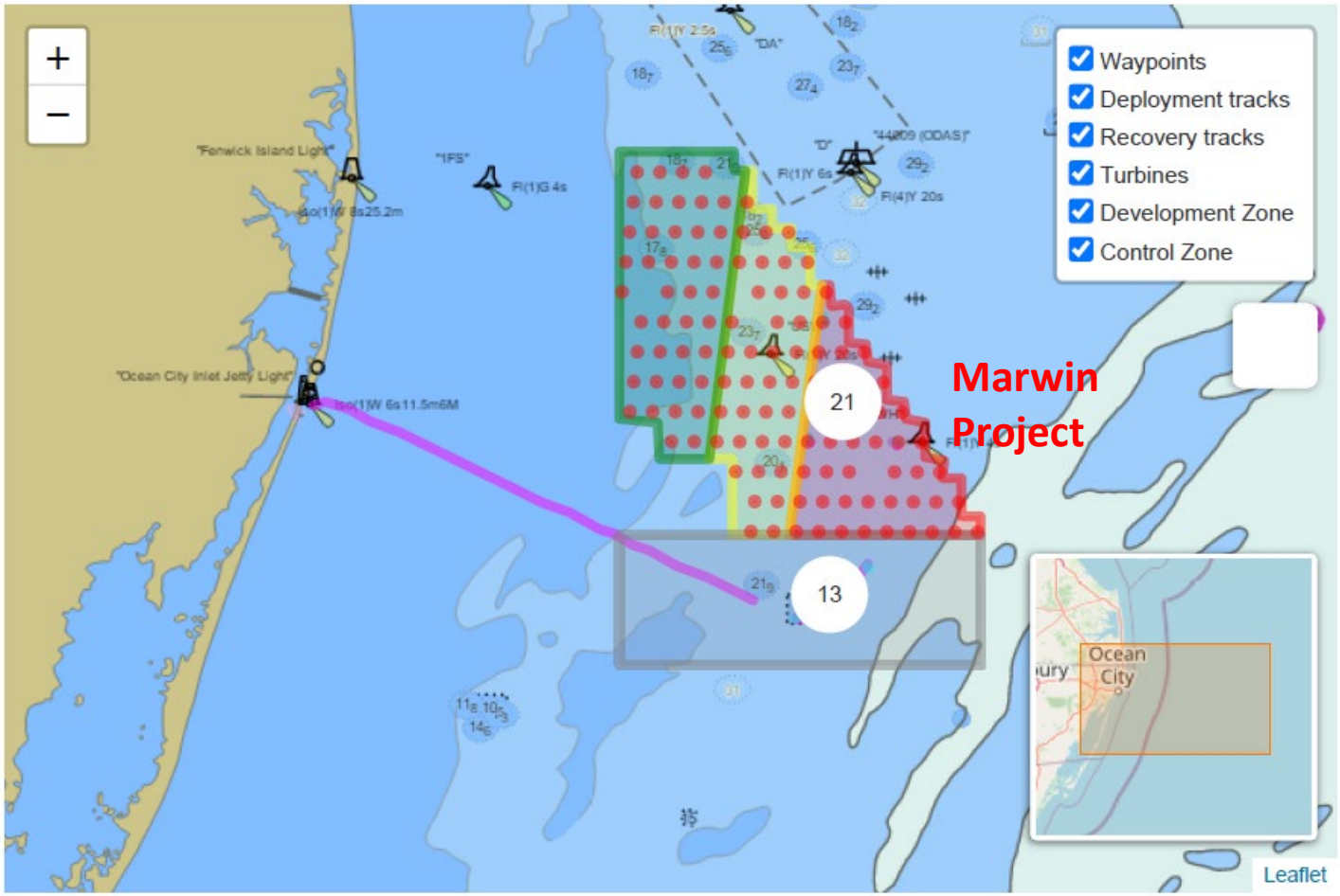
Before After Gradient Design

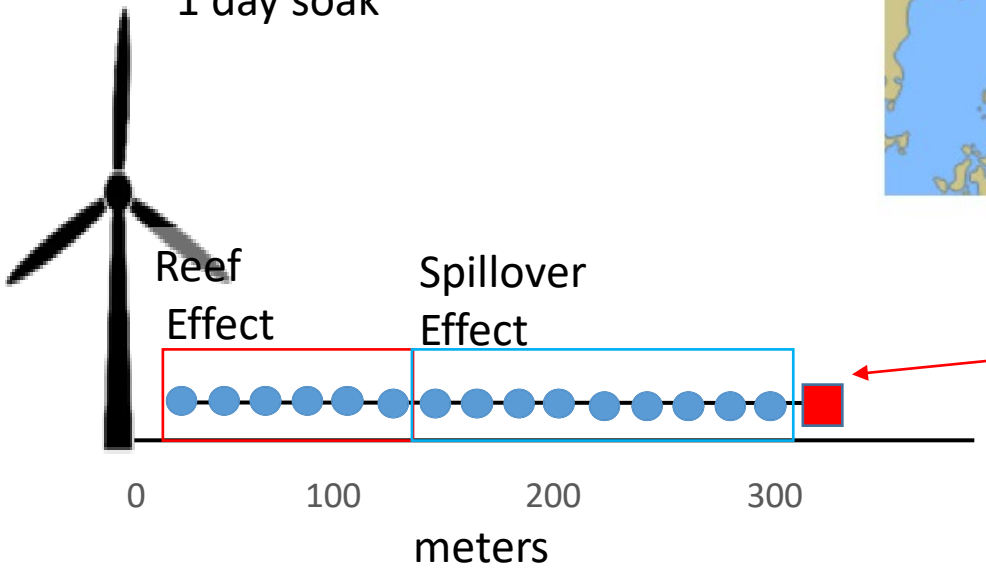


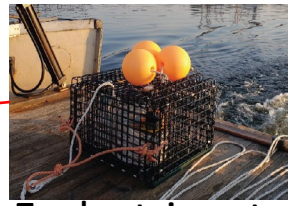
BACI and BAG designs both rely on baseline sampling (top rows) to assess impacts (bottom rows). BACI relies on careful control site selection, relying on the assumption that the wind tower influences along with other environmental forcing such as storms will influence control and impact sites similarly. BAG designs do not require control sites and rely on incorporation of key impact and environmental gradients (Secor 2018).

Pot survey lends itself to BAG design

15 x 40” ventless pots per rig
1 day soak





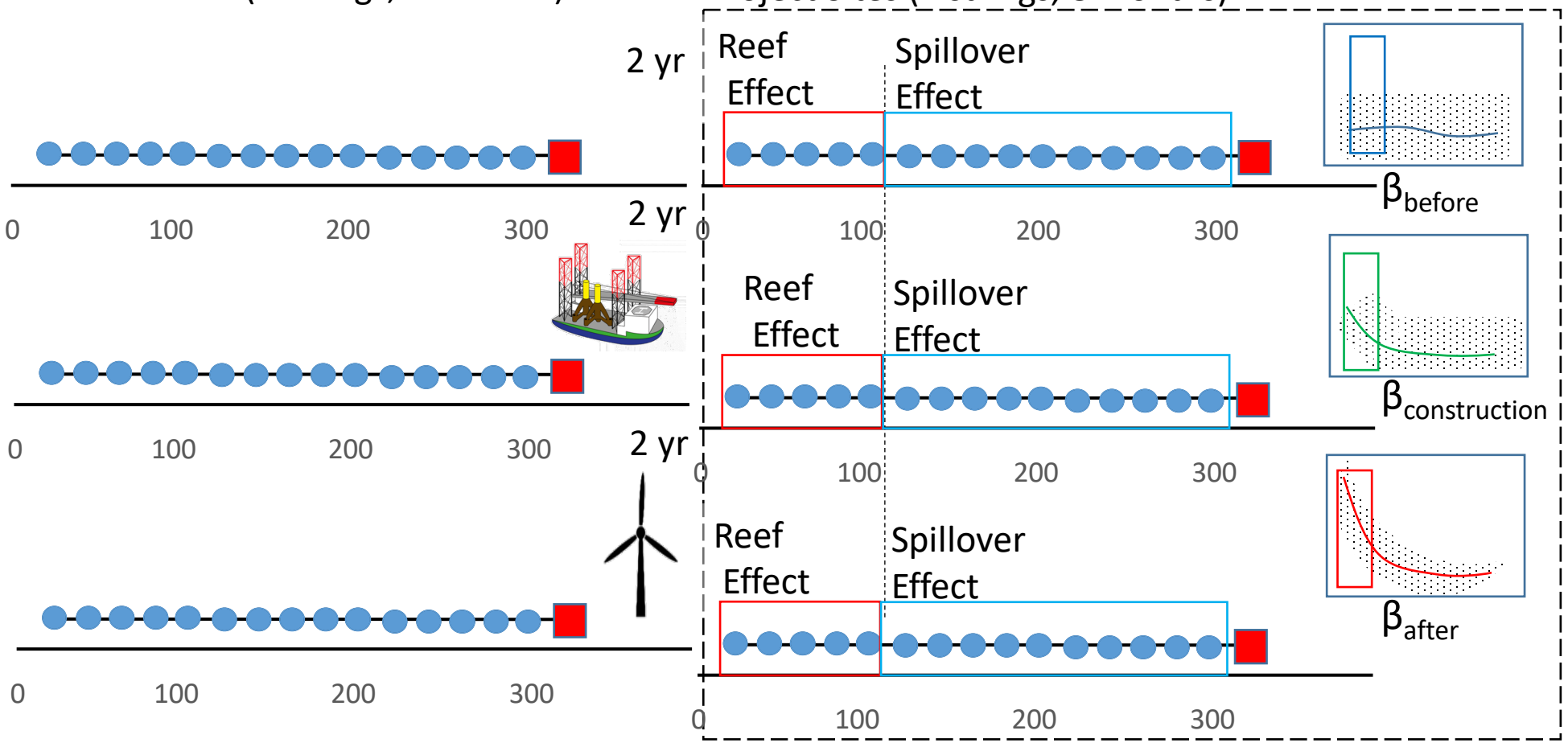


Each string, terminates with an Edgetech ropeless device

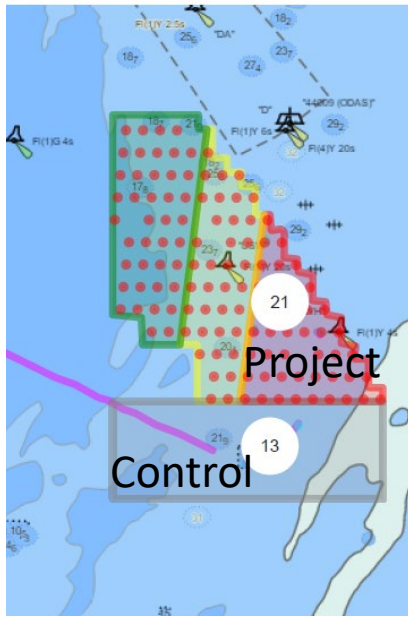
Pot Survey Hypotheses

Control Sites (2 strings, 9 months)

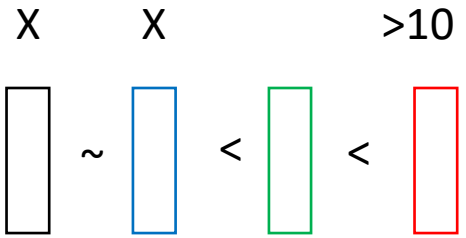
Project Sites (4 strings, 8 months)



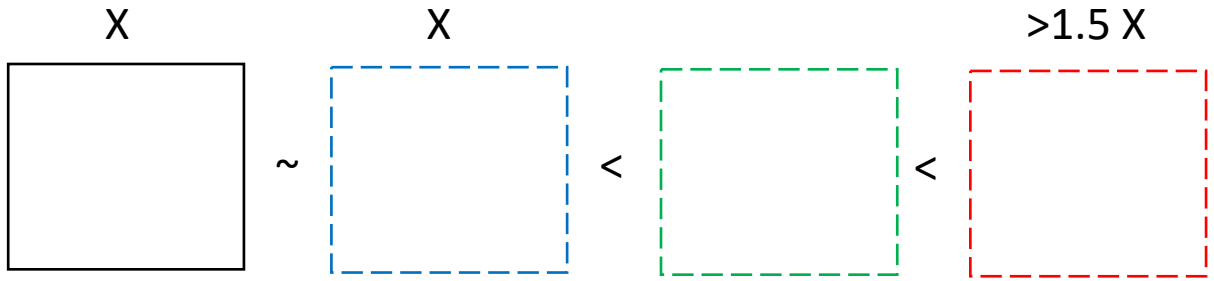
(2) Turbine Impact: Distribution function and variance

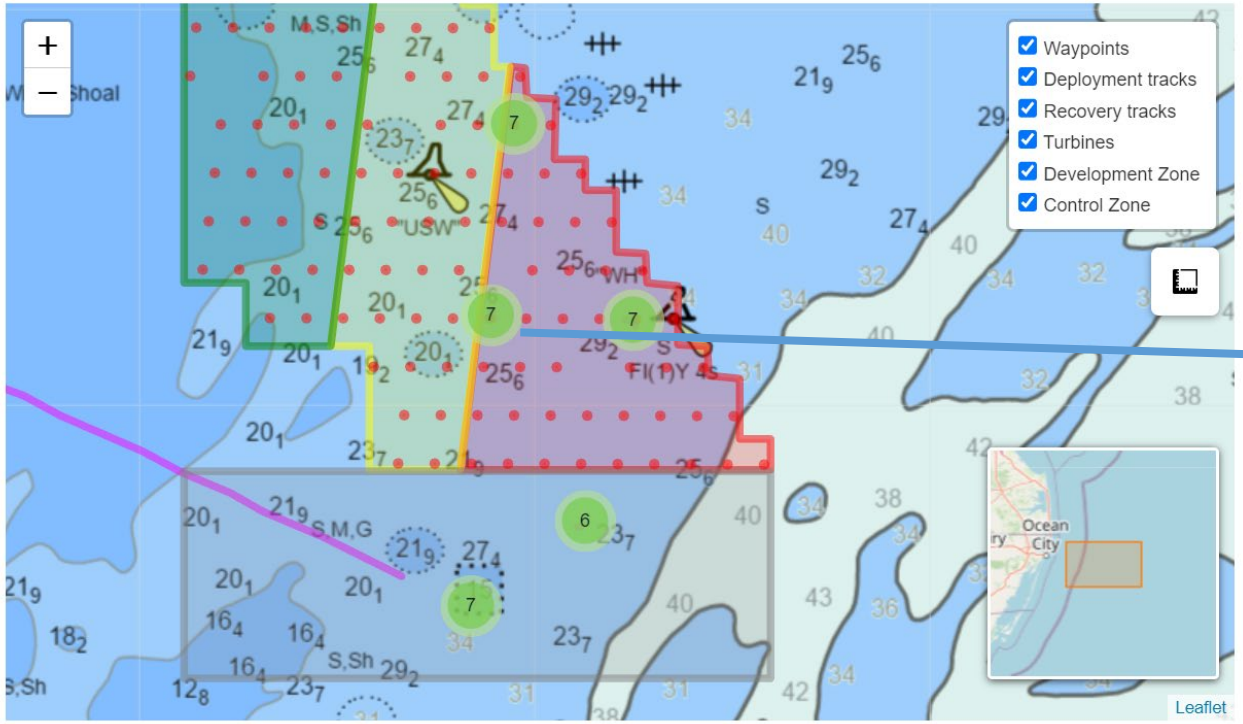


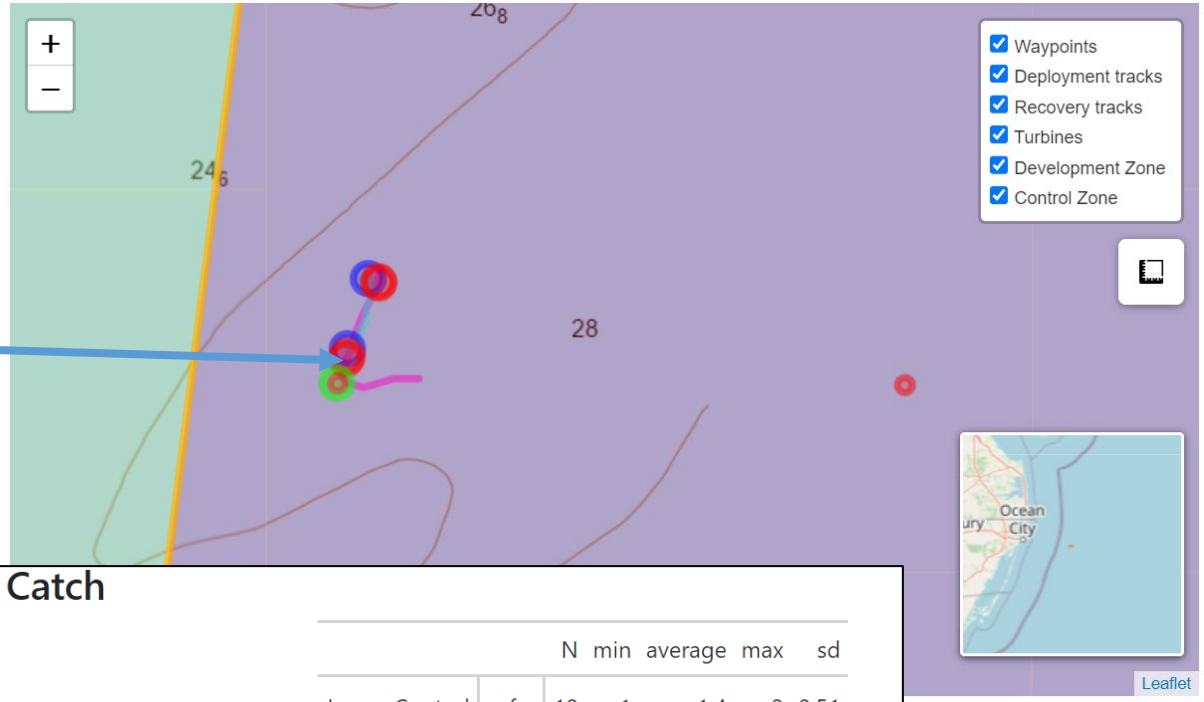
(1) Reef Effect (<120 m): amplitude

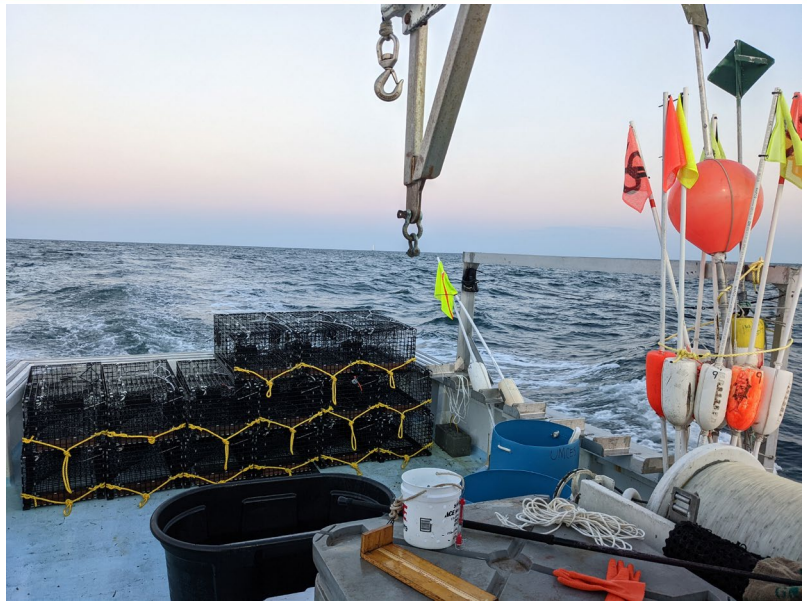


(3) Spillover Effect (≥120 m): amplitude









Catch

		N	min	average	max	sd
June - Control	far	18	1	1.4	2	0.51
	near	10	1	2.5	5	1.73
	Total	28				
June - Project	far	6	1	1.2	2	0.45
	near	5	1	1.2	2	0.50
	Total	11				
July - Control	far	18	1	3.0	6	2.00
	near	11	1	1.6	3	0.98
	Total	29				
July - Project	far	13	1	1.2	3	0.60
	near	4	1	1.0	1	0.00
	Total	17				

Pot Survey, 6+ years, 8 surveys/yr; 2 d/survey

BACI Period	Years	Monthly Surveys	N	Sites
TRIAL (BEFORE)	2022	May-Aug	4	4-6
BEFORE	2023-2024	Mar-Nov	8	6
CONSTRUCTION	2025-2026	Mar-Nov	8	6
AFTER	2027-2028	Mar-Nov	8	6
Total	2022-2028	Mar-Nov	8	6

Key question: Do we have sufficient power?

Boxplot of black sea bass catches per pot.

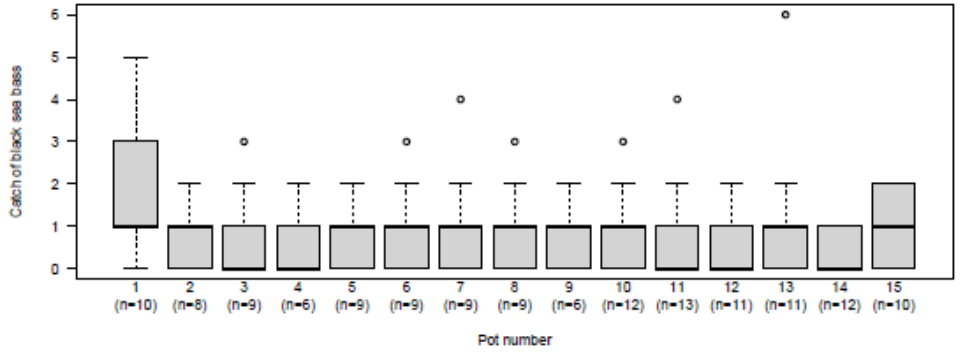


Table 1: Approximate ANOVA table for the suggested design

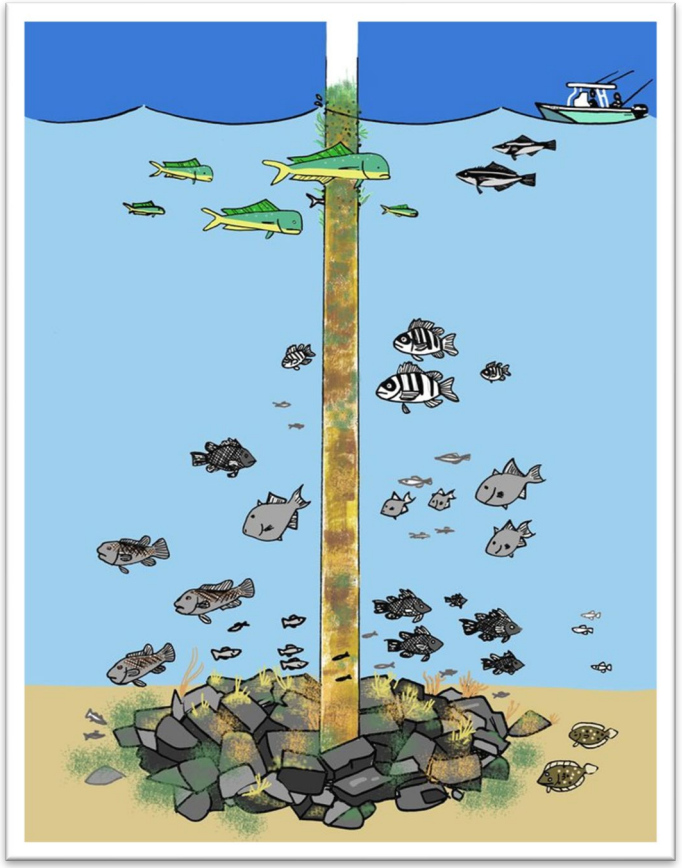
Source	SS	d.f.	F
Period: Before–During–After	SS_{BDA}	$3-1=2$	
Month	SS_t	$9-1=8$	
Location: Control–Impact	SS_{CI}	$2-1=1$	
Interaction BDA × CI	SS_{BDACI}	$(3-1)(2-1)=2$	MS_{BDACI}/MS_E
Error	SS_E	$647-2-8-1-2=634$	
Total	SS_{Total}	$3\times144+3\times72-1=647$	

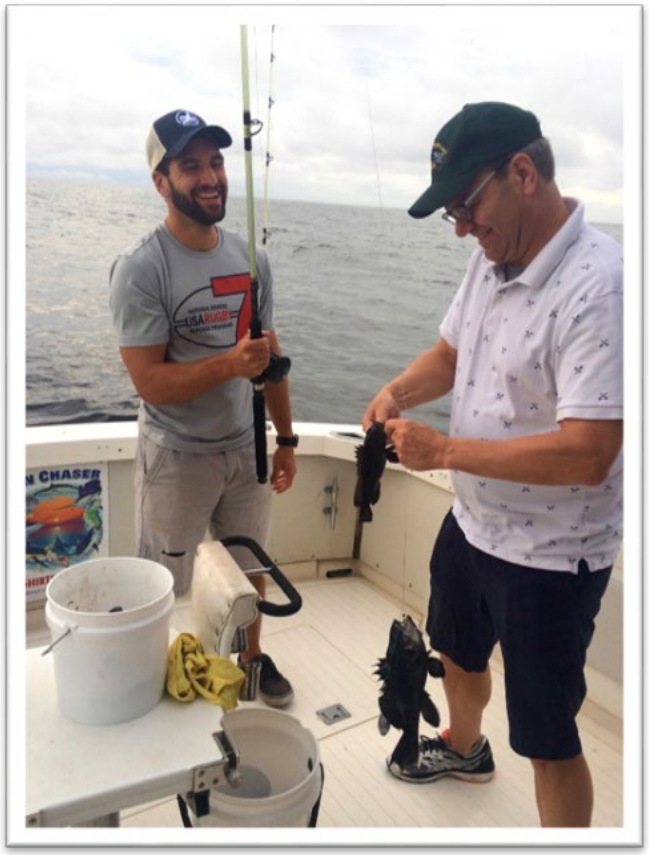
The ANOVA results show high statistical significance (low p-value) of the interaction term

```
m0 = lm(CPUE ~ Period + Month + CI + Period:CI, data = D)
car::Anova(m0)

## Anova Table (Type II tests)
##
## Response: CPUE
##             Sum Sq  Df F value Pr(>F)
## Period      14014   2 2555.80 <2e-16 ***
## Month          20   8    0.93   0.49
## CI           4086   1 1490.49 <2e-16 ***
## Period:CI    7606   2 1387.12 <2e-16 ***
## Residuals    1738 634
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

#summary(m0)
```

```
MC = 1000
```

The Reef Effect: Recreational fishing

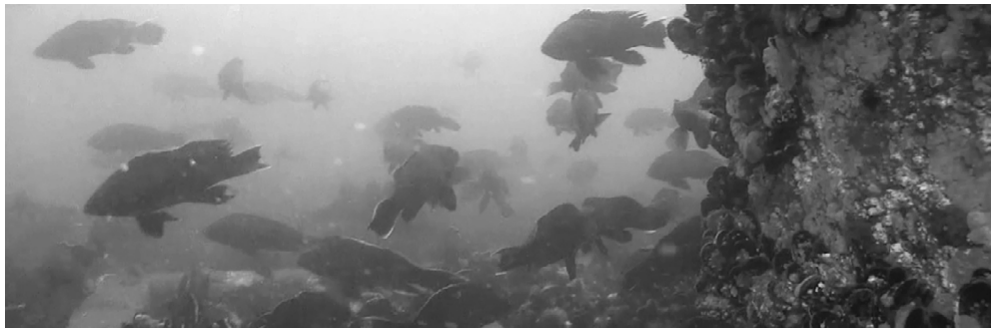




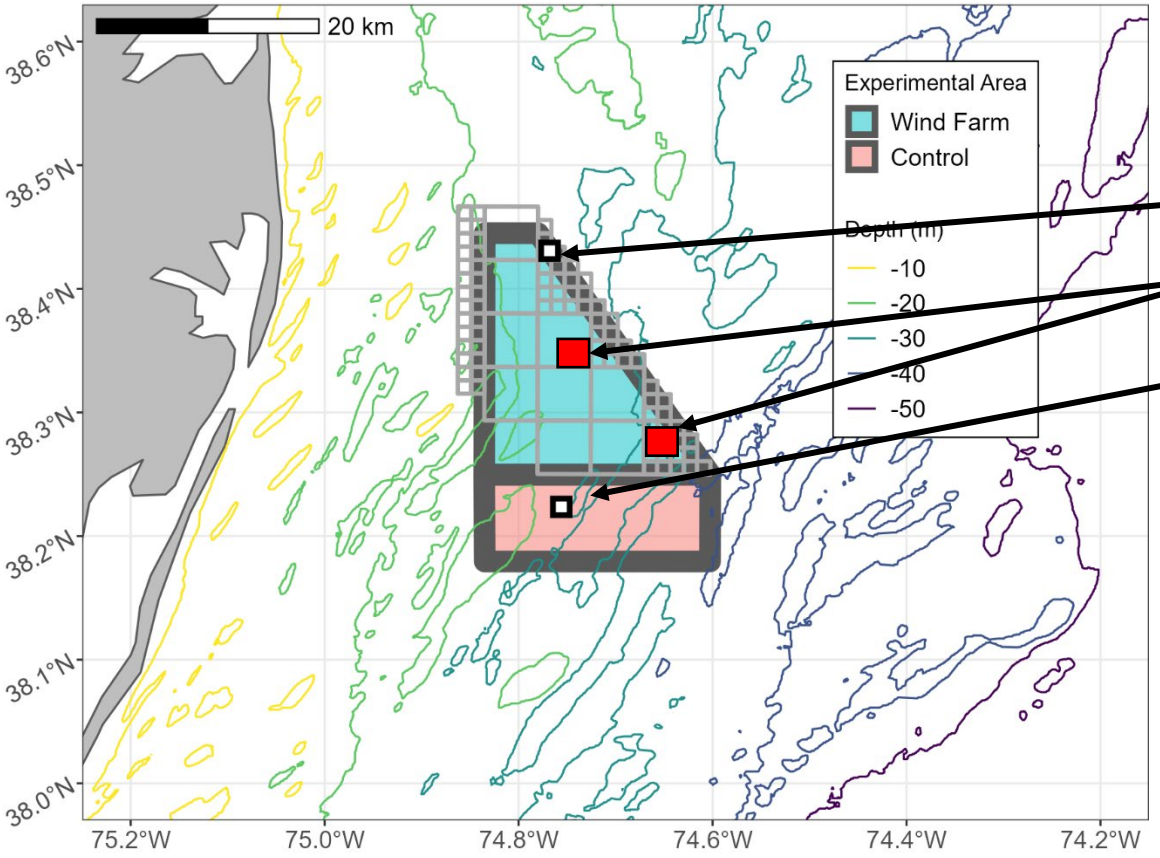
Key challenge: What's the control?

1. Use existing wreck sites as controls
2. Use controls as baselines to evaluate
   - Colonization by black sea bass
   - Relative catch rates

Black sea bass shoaling on Block Island Wind Farm structures (from Hutchison et al. 2020)



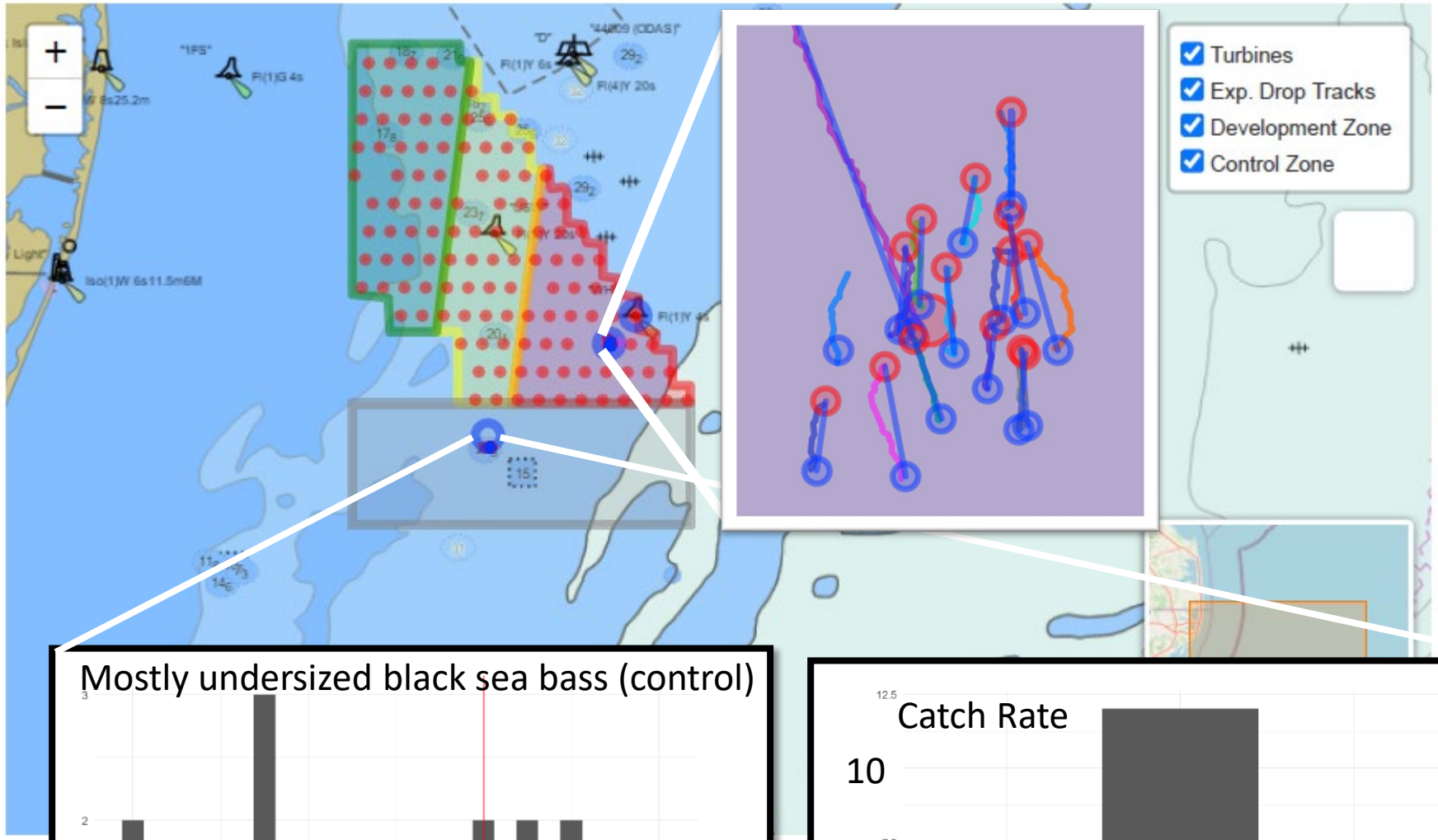
Recreational Survey Design Implementation
BACI Design



Control Wreck 1: Great Eastern Reef (<2 m relief)

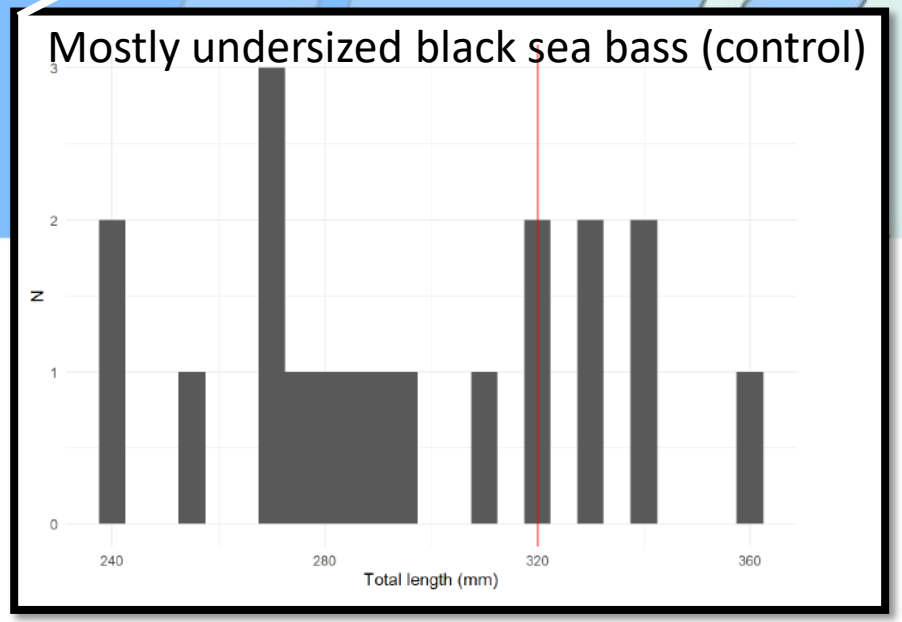
Treatment Planned Turbine Foundations (BACI)

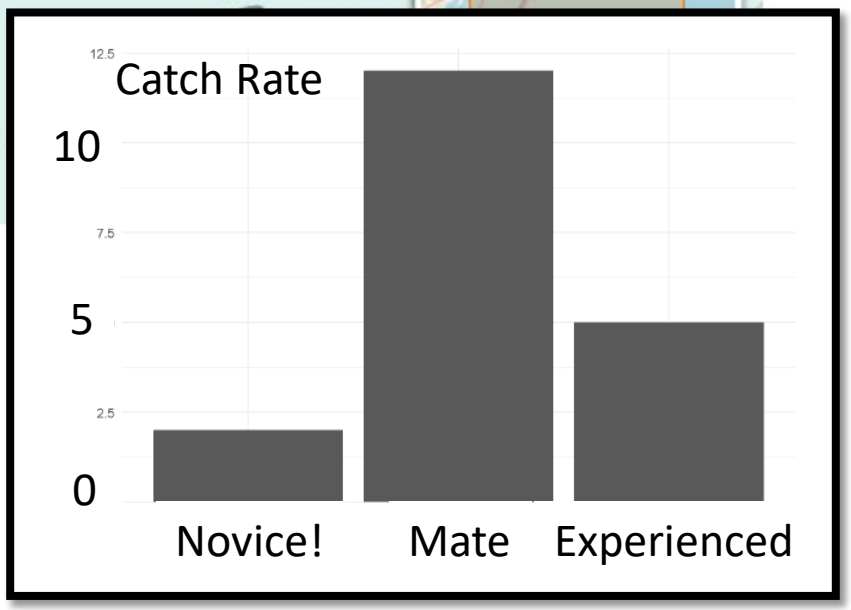
Control Wreck 2: USS *Saetia* (2-4 m relief)



Methods

- 15 min water column jigging
- 15 x 3 min “drops”
- 3 anglers





Recr. Survey, 6+ years, 6 surveys/yr; 2 d/survey

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Total	2022-2028	May-Oct	6	4

Do we have sufficient power….Not quite relevant (yet)

- Black sea bass dominant at control wreck sites
- Only Northern sea robin caught at project sites (structureless)
- Will not be able to evaluate power until turbines are in place

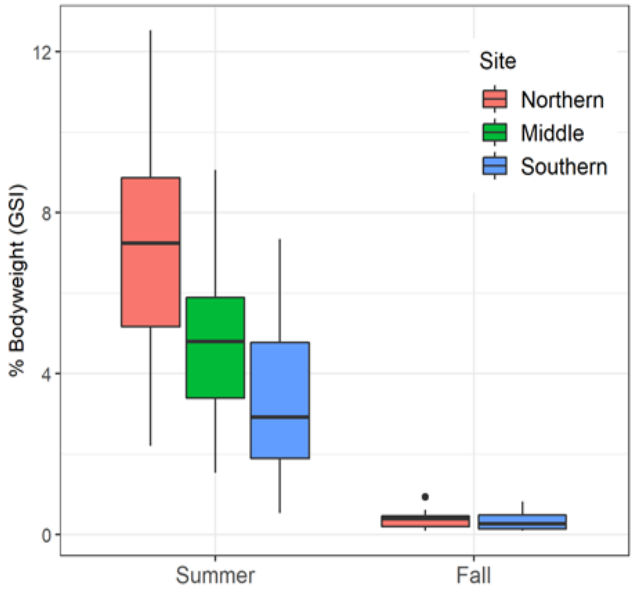
Biological Sampling

Hypotheses

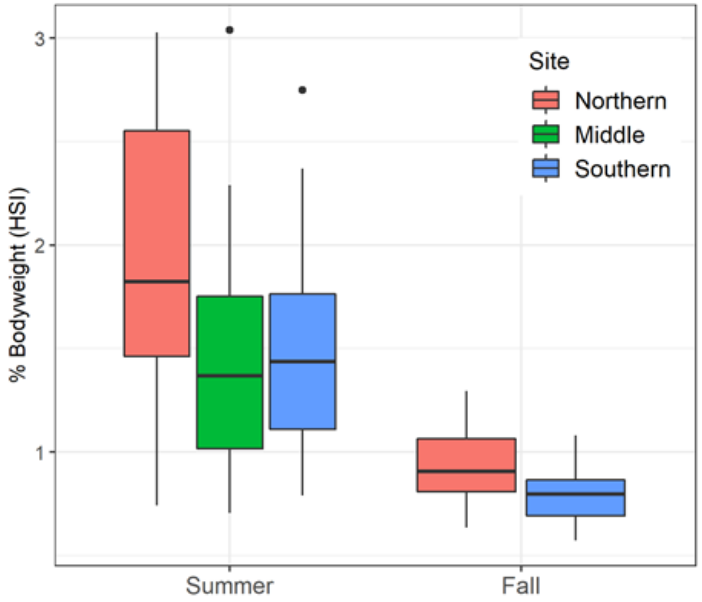
1. Smaller fish will initially colonize sub-foundations
2. Condition indices will be higher for sub-foundations than for wrecks (density-dependence)
3. Diet will be less diverse on sub-foundations than for wreck
4. Pelagic prey will be more important for sub-foundations than for wrecks

<u>MD WEA baseline data from past MD DNR support</u>

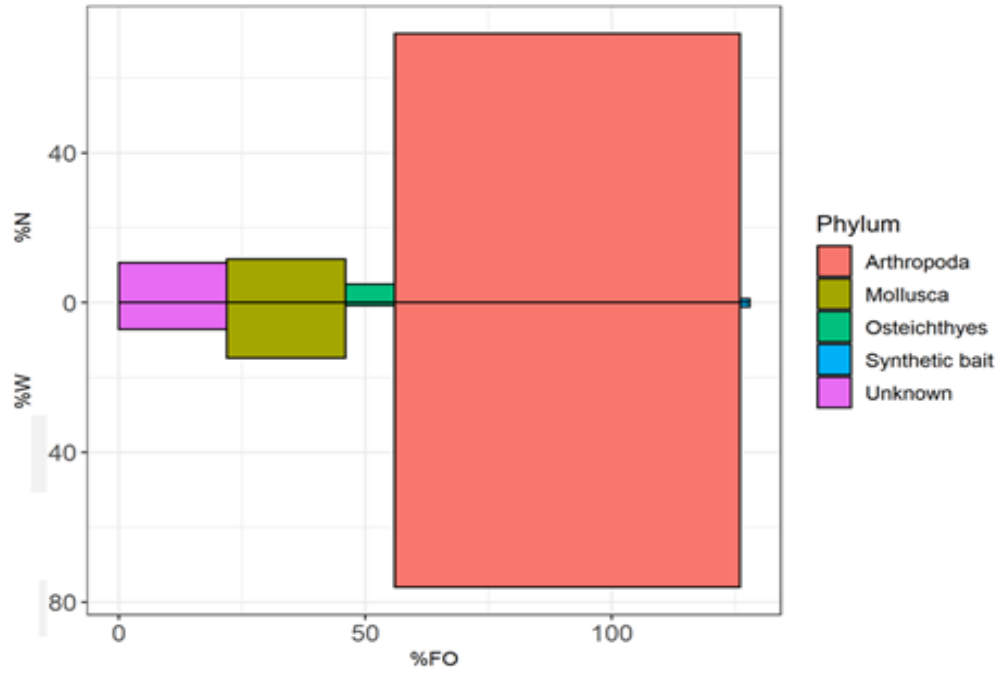
GONADOSOMATIC INDEX



HEPATOSOMATIC INDEX



DIET



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Take-homes

1. Think about fisheries, not just fish biology.
2. Ask fishers their views on survey goals.
3. Structure designs around hypotheses.
4. Build in a trial year - you'll need it!
5. Less may be more - incorporate power design.
6. Build interactive tools for stakeholders (Leaflet).

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