Underwater video measurements of Dungeness crab (*Cancer magister*) responses to thin-layer dredged material disposal

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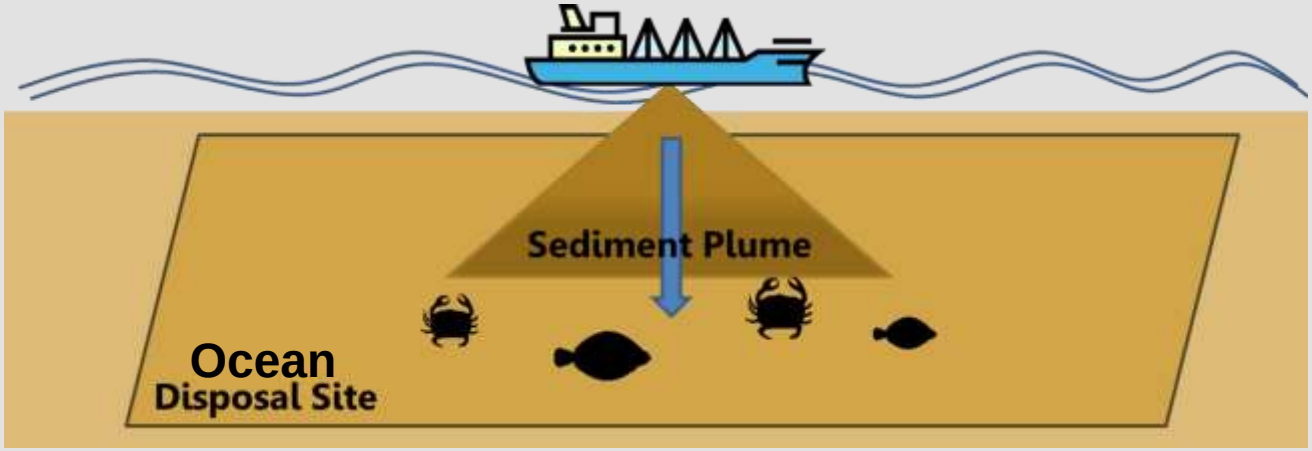
CREC 2016 | Astoria, OR

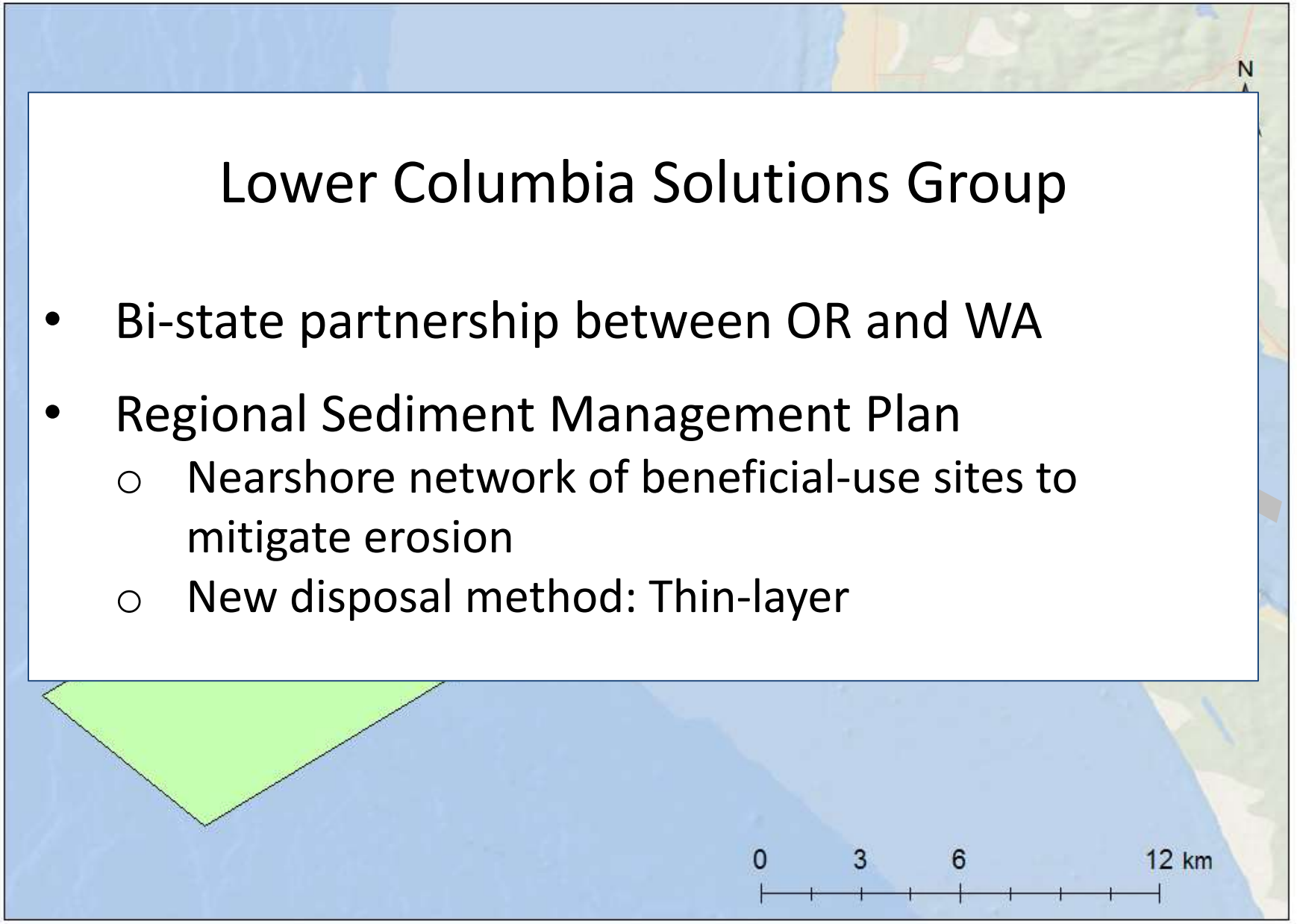
Dredging at the Mouth of the Columbia River

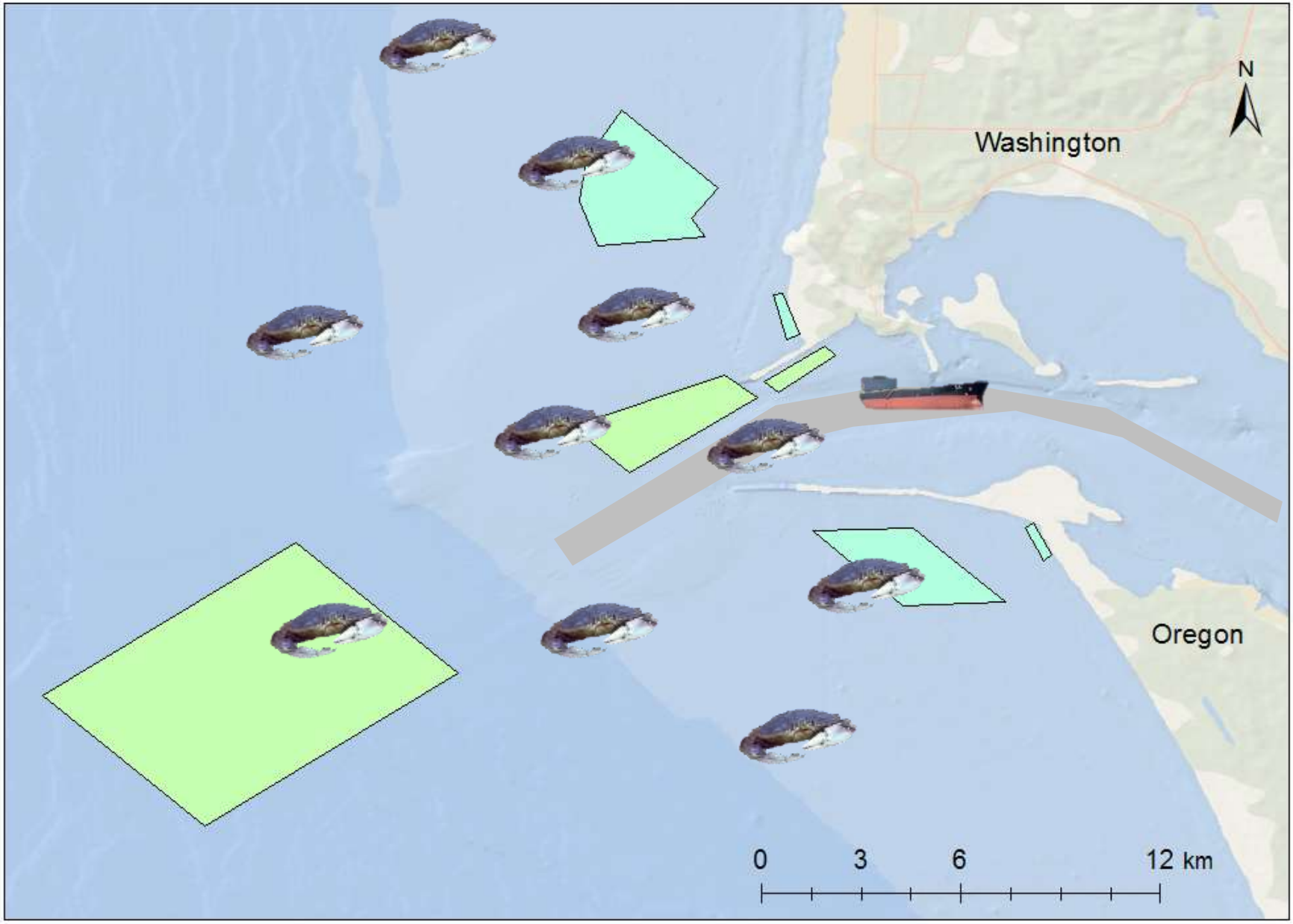
- Required to maintain a shipping channel
  - $24 billion in cargo
  - 40,000 local jobs
- Annually, ~3 million m^3 of sediment removed and placed at ocean disposal sites

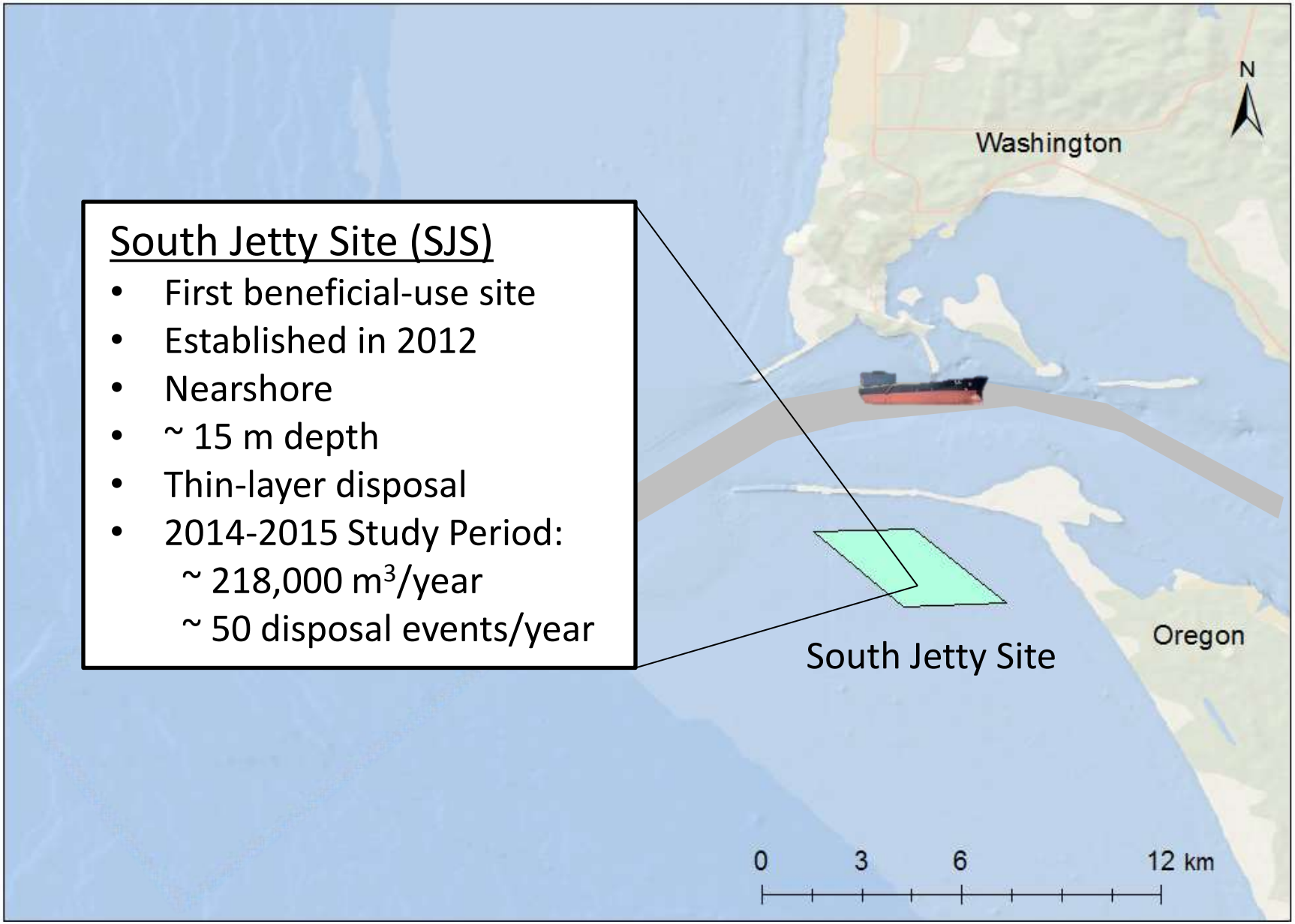


Lower Columbia Solutions Group

- Bi-state partnership between OR and WA
- Regional Sediment Management Plan
  - Nearshore network of beneficial-use sites to mitigate erosion
  - New disposal method: Thin-layer




N
Washington
Oregon
0
3
6
12 km


South Jetty Site (SJS)
• First beneficial-use site
• Established in 2012
• Nearshore
• ~ 15 m depth
• Thin-layer disposal
• 2014-2015 Study Period:
~ 218,000 m3/year
~ 50 disposal events/year
N
Washington
Oregon
South Jetty Site
0
3
6
12 km

Monitoring Approaches

Crab pots

Abundances (traditional tool)

Baited Lander

Relative abundances before and after a disposal event

Video Sled

Densities of benthic community

Acoustic Tags

Movement of crabs in control and impact areas

Research Objectives

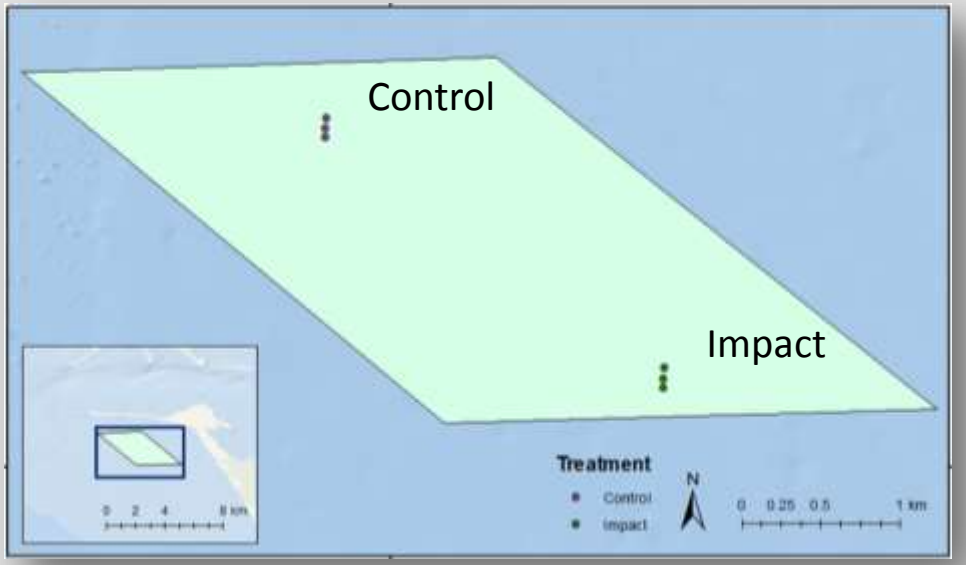
1. Use *baited landers* (CamPods) to assess the response of Dungeness crab to individual disposal events
   - How abundant are crabs before and after a sediment plume?
   - Do *relative abundances* or *recruitment rates* differ before and after the plume?

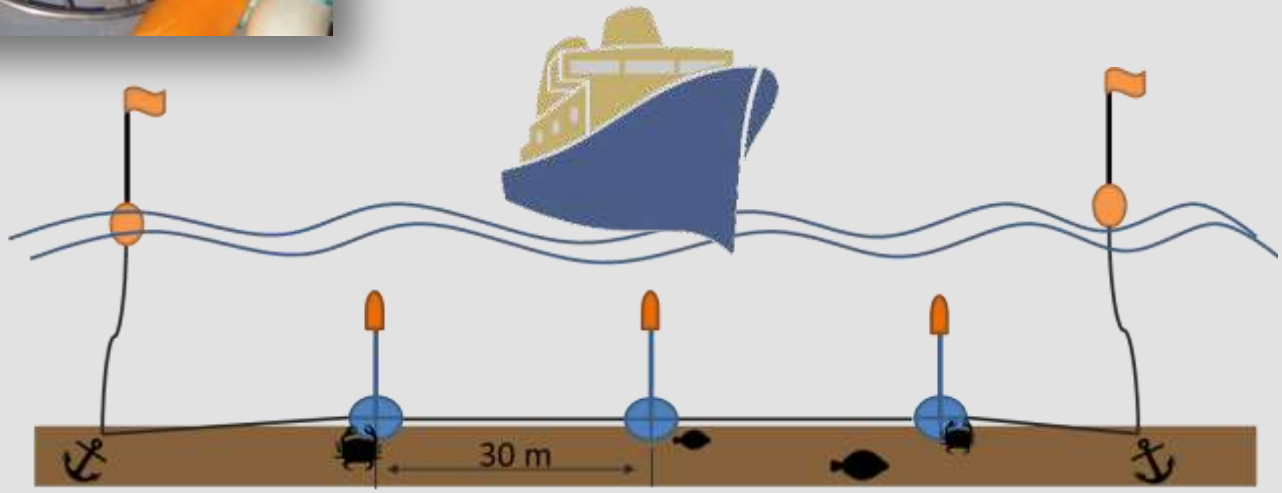
2. Use *crab pots* to compare the abundances of Dungeness between disposal and control areas
   - Do crab *abundances* differ between disposal and control areas?

3. Use *video sleds* to assess the response of the Dungeness crab throughout the disposal season
   - Do crab *densities* differ between disposal and control areas?

1. Use *baited landers* to assess the response of Dungeness crab to individual disposal events

Baited Landers = CamPods



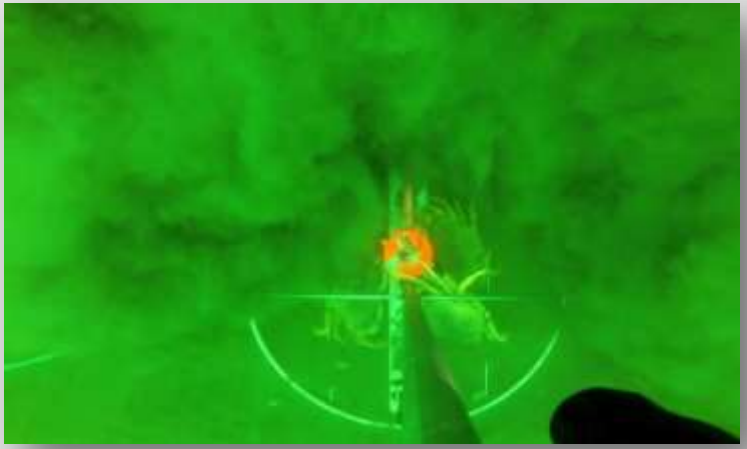


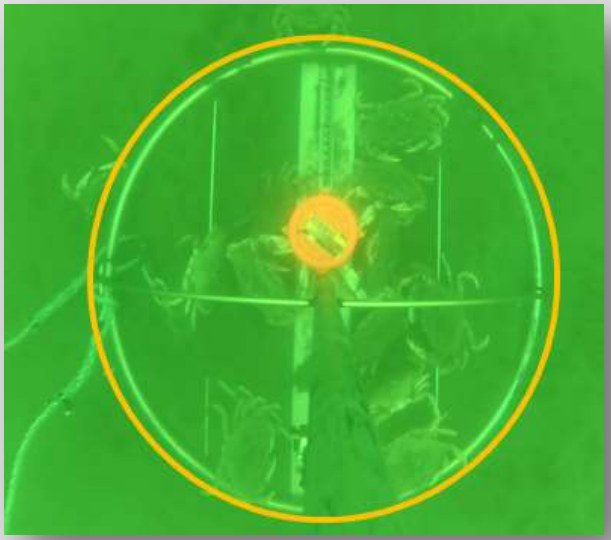
CamPod Deployment

Drone footage credit: RYKA UAS

Methods

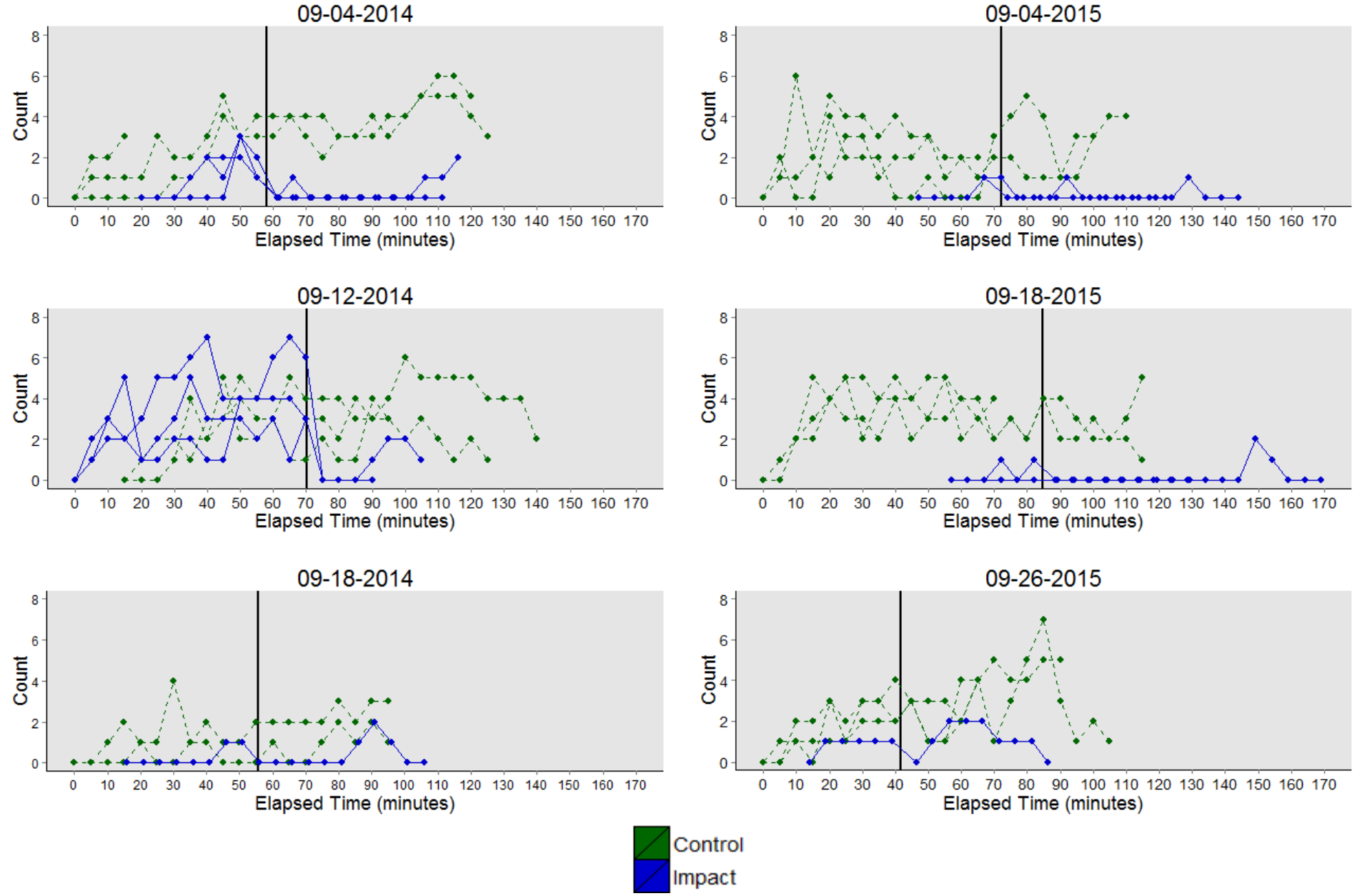
Video Processing





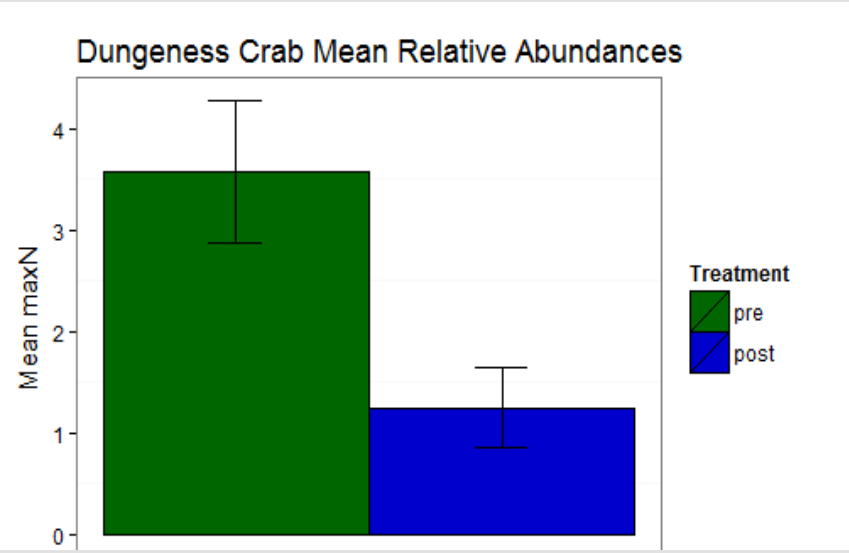
Metrics & Analyses

- Time series counts (no statistics)
- Pre- and post-disposal relative abundances
  - maxN: Max number in single frame (paired t-test)
- Pre- and post-disposal recruitment rates
  - T1: time of first arrival (paired t-test)


09-04-2014
09-04-2015
09-12-2014
09-18-2015
09-18-2014
09-26-2015
Count
Elapsed Time (minutes)
0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170
0 2 4 6 8
Control
Impact

Results

- Pre- and Post- Plume
  - **A difference** in mean relative crab abundances between pre- and post-plume clips (df = 8, p-value = 0.032)
    - On average 2.08 more crabs pre-plume
  - **No difference** in recruitment rates between pre- and post-plume (df = 8, p-value = 0.074)



2. Use *crab pots* to compare the abundances of Dungeness crab between disposal and control areas

Methods

Deployments

Year	Date	Control	Impact
2015	27-Aug	3	3
	3-Sep	3	3
	25-Sep	3	3

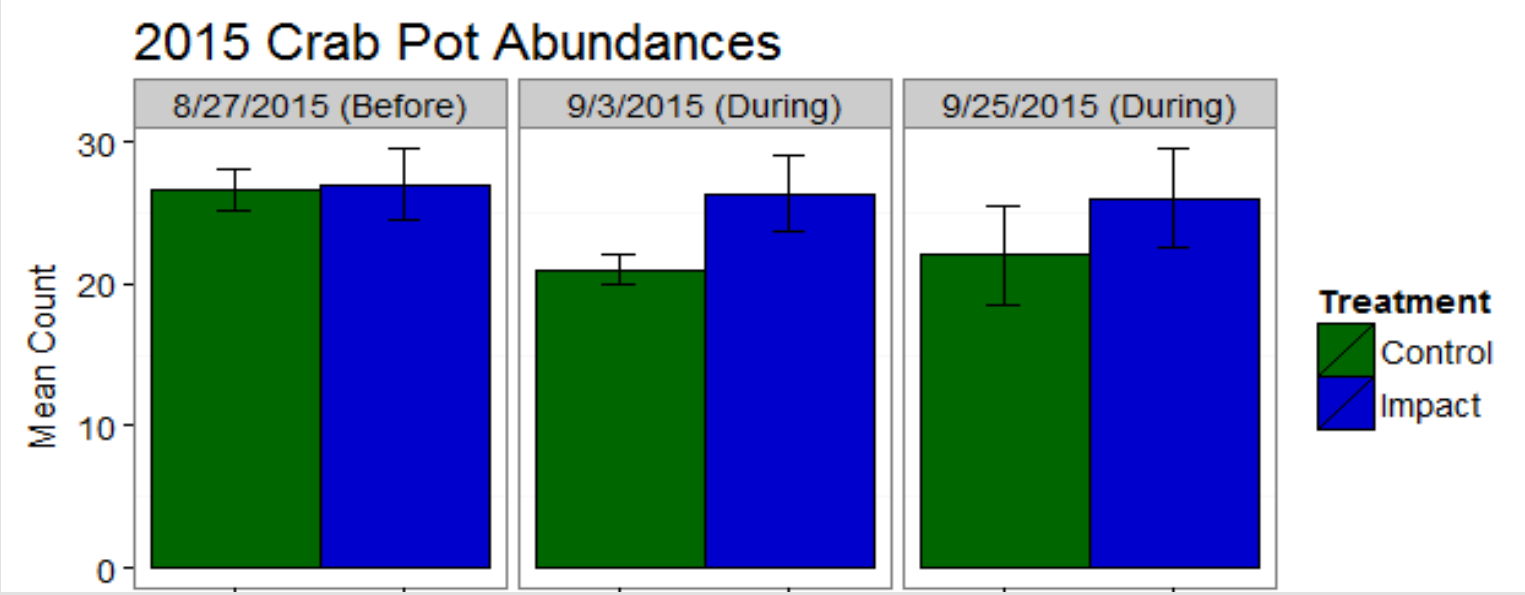
Analysis

2-way ANOVA :

Abundance ~ Treatment + Date+ Treatment*Date

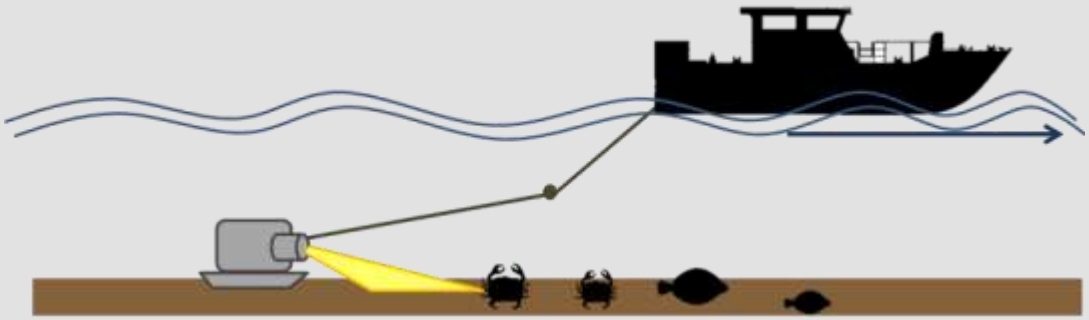
Results

- **No difference** in abundances between treatment area (p-value = 0.129) or dates (p-value = 0.178)



3. Using *video sleds* to assess Dungeness crab responses throughout the disposal season

Video Sleds



Methods

Survey Design

- Before-After/Control-Impact (BACI)
  - Additionally, a DURING disposal season component
- x3 replicate video transects within impact and control locations
  - 500m transect length

Methods

Video Processing

- Organism ID (lowest taxonomic level possible)
- Quantified Area: Counting window and transect

Metrics

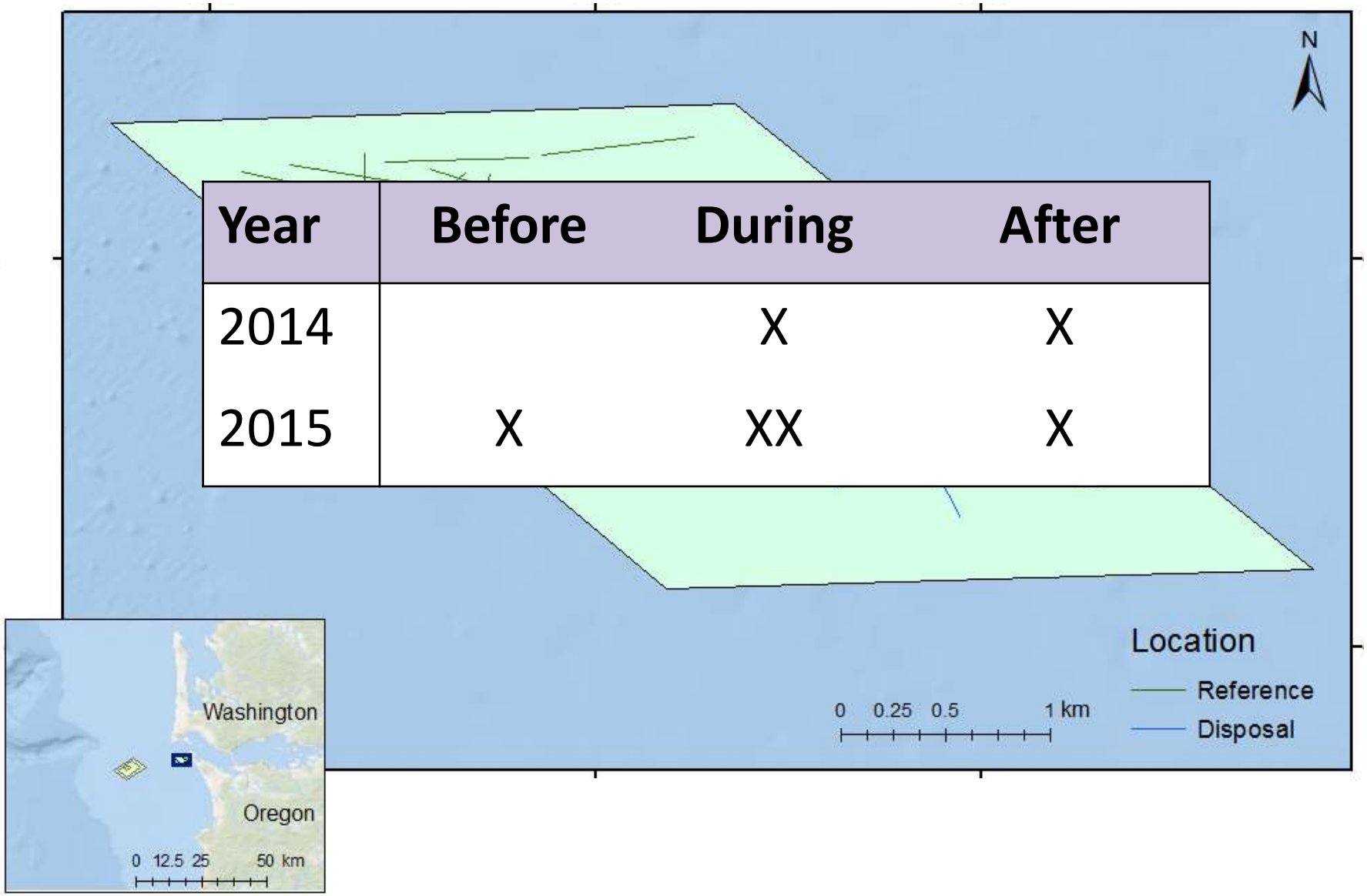
- Taxa density (/100m^2)

Data Analys

- 2-way Al

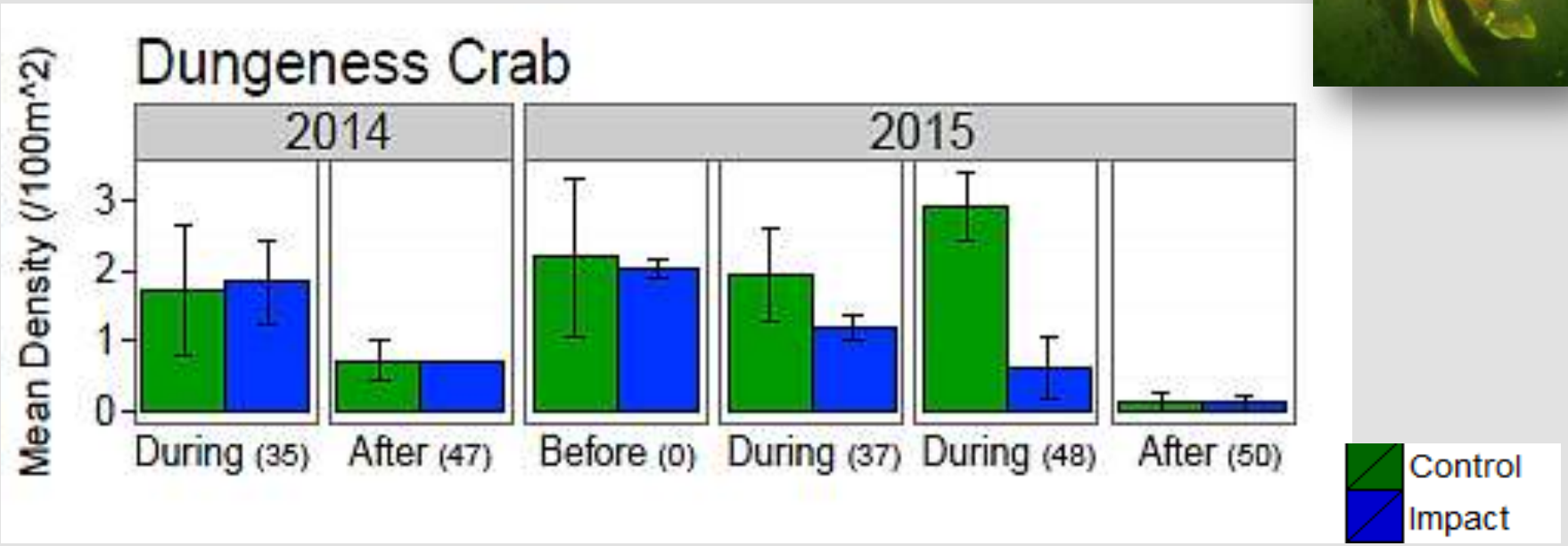
  Density ~ T

SJS Sled Surveys

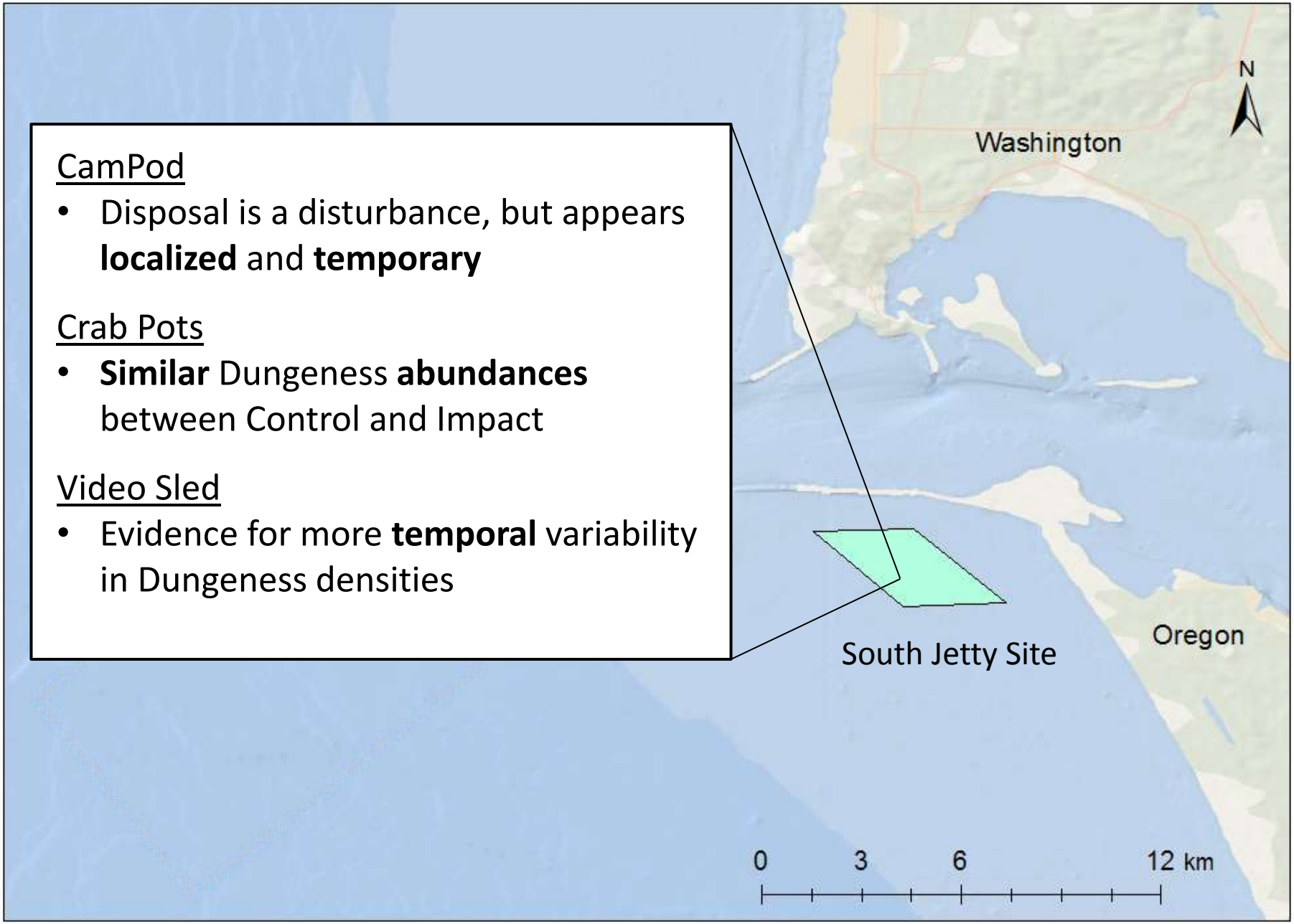


Year	Before	During	After
2014		X	X
2015	X	XX	X

Results



- **No difference** in densities between treatment areas (p-value = 0.264) or years (p-value = 0.857)


CamPod
• Disposal is a disturbance, but appears **localized** and **temporary**
Crab Pots
• **Similar** Dungeness **abundances** between Control and Impact
Video Sled
• Evidence for more **temporal** variability in Dungeness densities
N
Washington
Oregon
South Jetty Site
0
3
6
12 km

Video Methods

- Sled surveys collected density data of Dungeness (and the benthic community)
  - Limited by water clarity
- CamPods provided a new perspective on disposal impacts that differ from the traditional crab pots
  - For Dungeness crab, not as limited by water clarity
  - Effective communication tool: Crab's perspective
  - Could be applied beyond the Columbia region

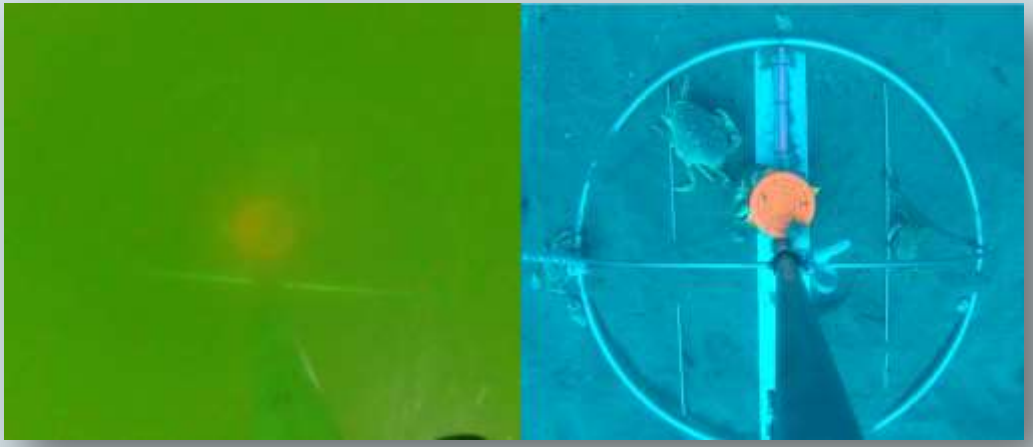
Acknowledgements

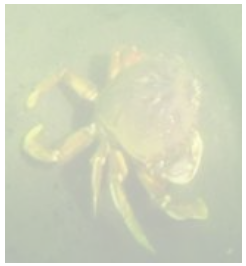
US Army Corps of Engineers
Portland District

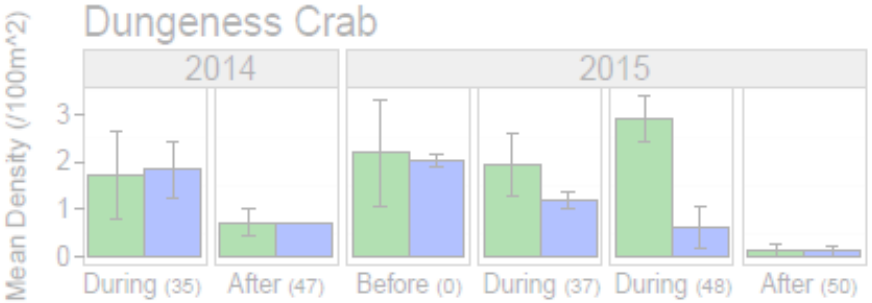

Questions

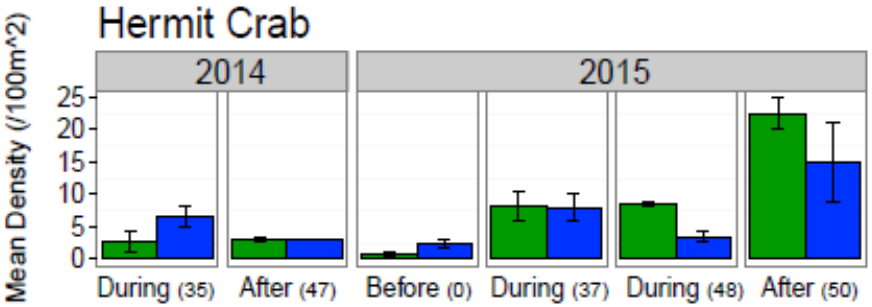
CamPod Deployments

Year	Date	Visibility	Number of Videos	
			Control	Impact
2014	4-Sep	Poor	3	3
	12-Sep	Good	3	3
	18-Sep	Moderate	2	1
2015	4-Sep	Good/Moderate	3	2
	18-Sep	Moderate	3	2
	26-Sep	Good	3	1





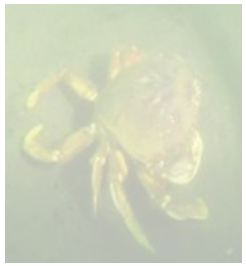


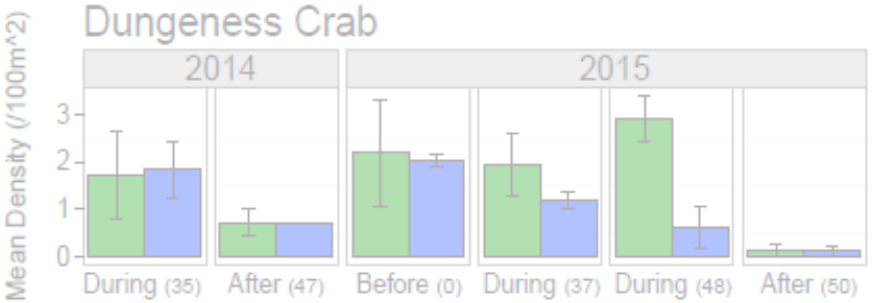


Control
Impact

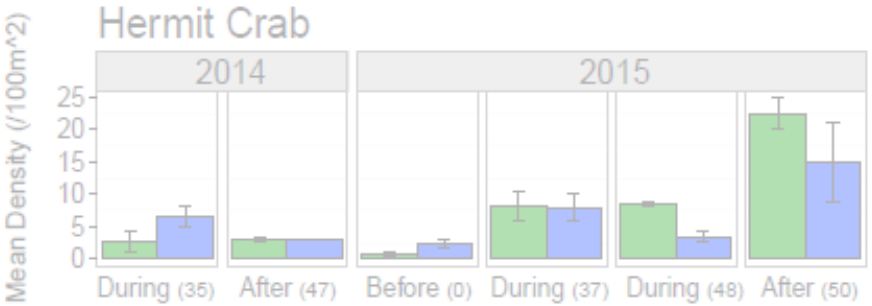
All p-values > 0.05

All p-values > 0.05

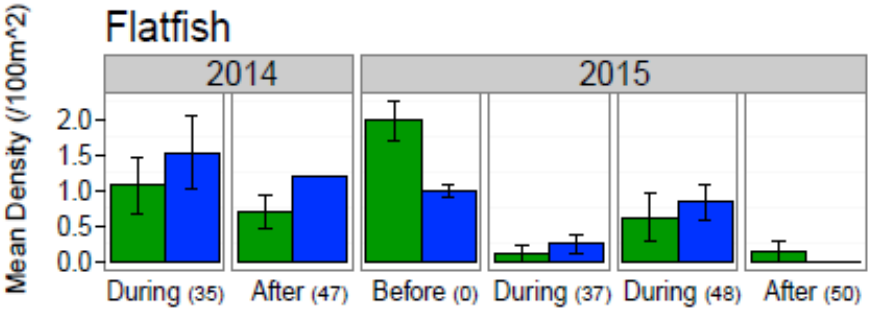




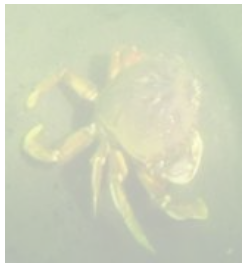
All p-values > 0.05

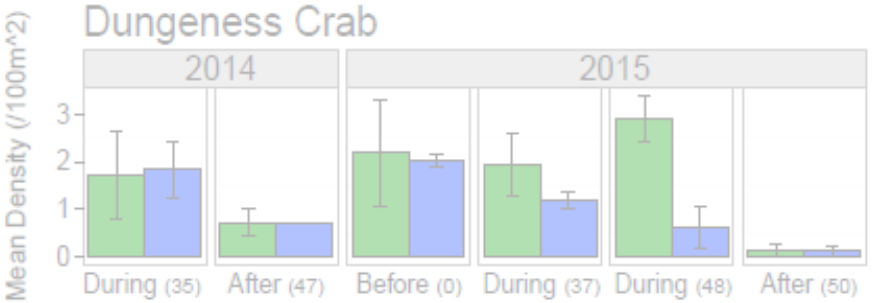


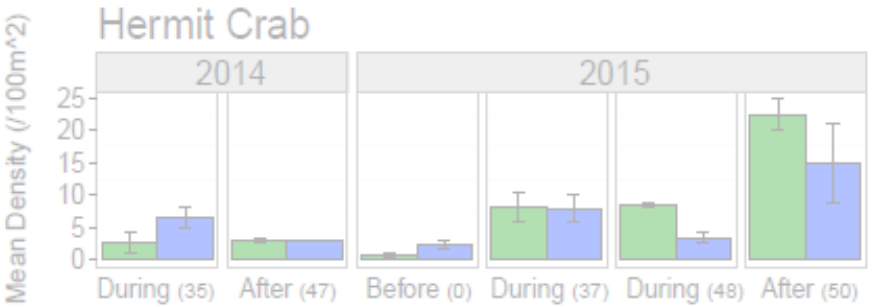
All p-values > 0.05

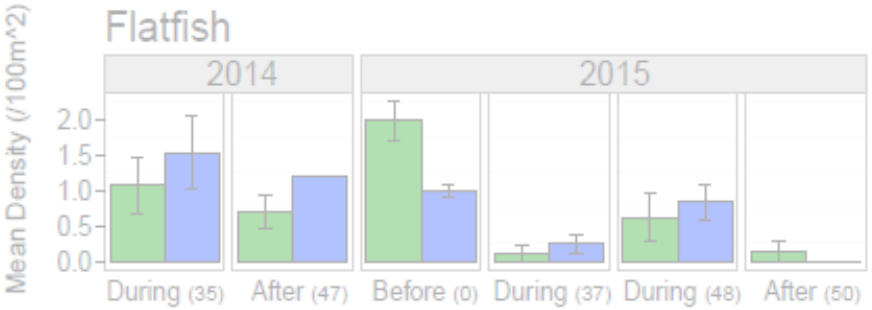


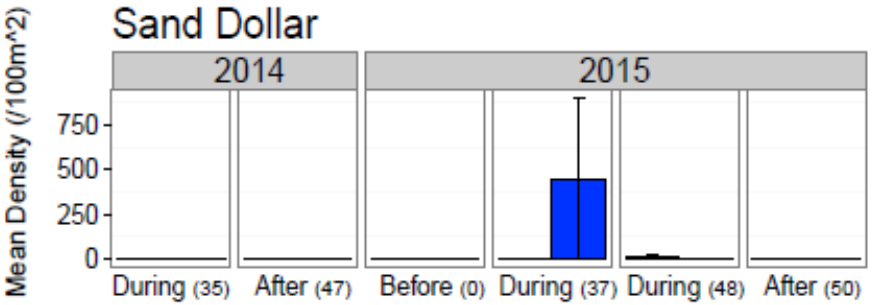
YEAR
p-value = 0.036







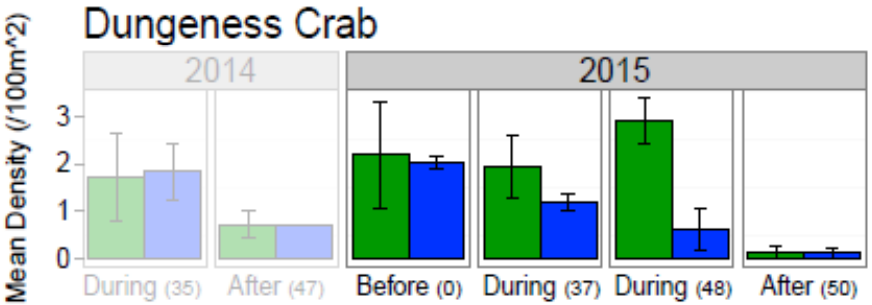




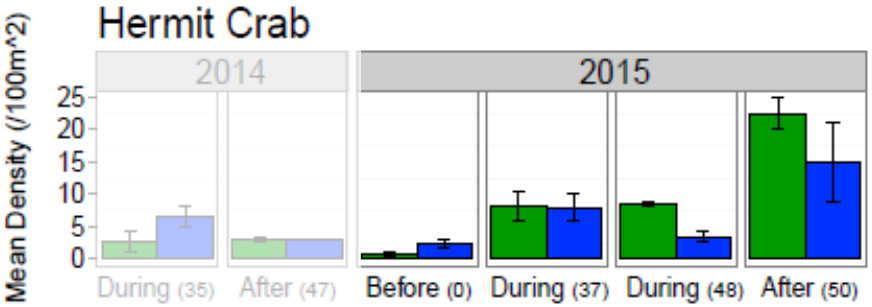
All p-values > 0.05

All p-values > 0.05

YEAR
p-value = 0.036



Difference between Date



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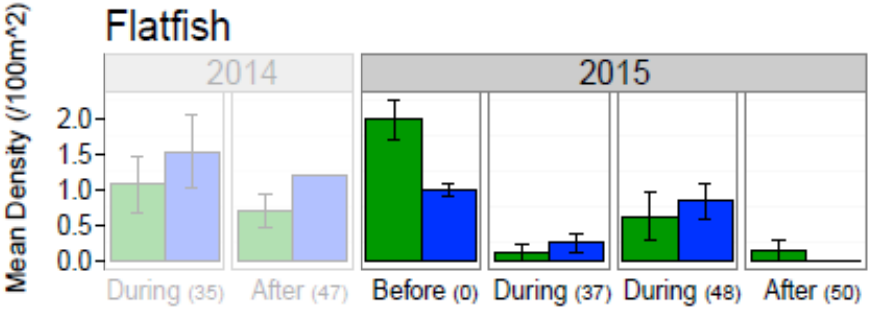

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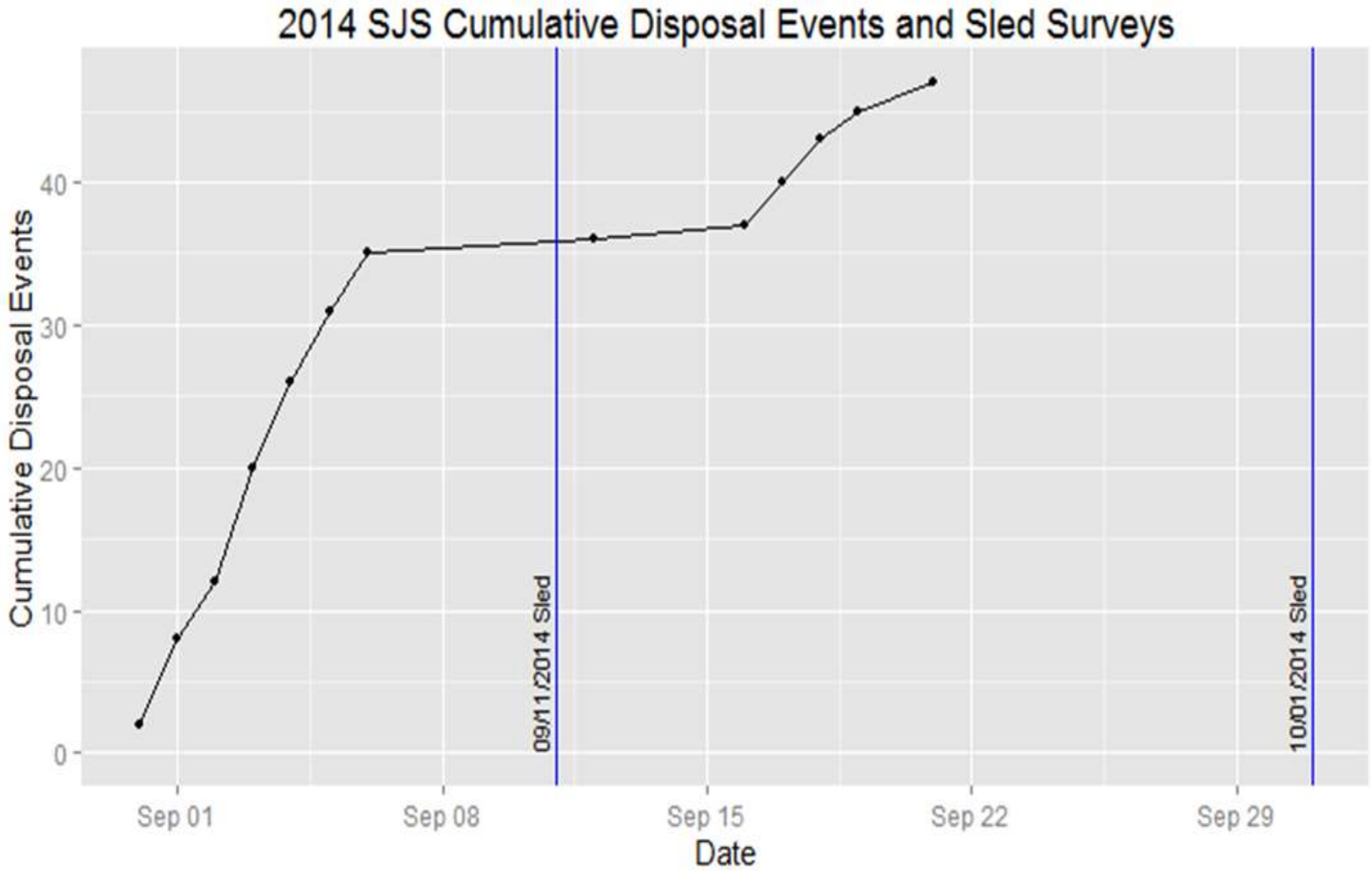
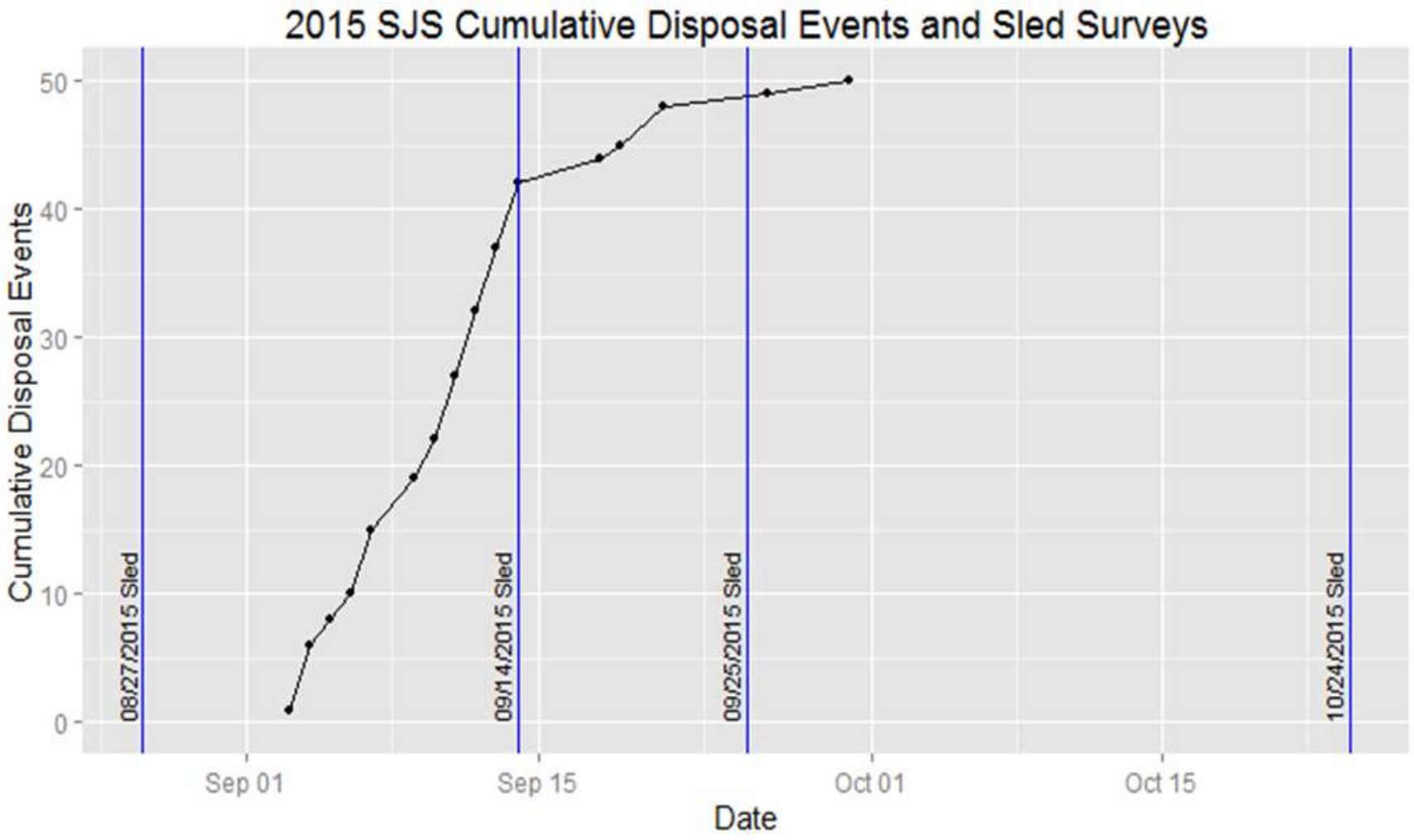

2014 SJS Cumulative Disposal Events and Sled Surveys
Cumulative Disposal Events
0
10
20
30
40
09/11/2014 Sled
10/01/2014 Sled
Sep 01
Sep 08
Sep 15
Sep 22
Sep 29
Date


2015 SJS Cumulative Disposal Events and Sled Surveys
Cumulative Disposal Events
50
40
30
20
10
0
08/27/2015 Sled
09/14/2015 Sled
09/25/2015 Sled
10/24/2015 Sled
Sep 01
Sep 15
Oct 01
Oct 15
Date