



# Mechanical Management of Burrowing Shrimp on WA Coast

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WASHINGTON STATE DEPARTMENT OF  
**NATURAL RESOURCES**

[dnr.wa.gov](http://dnr.wa.gov)

Burrowing shrimp (ghost shrimp)

*Neotrypaea californiensis*

- a native species
- an important food source in Willapa Bay for Green sturgeon, Dungeness crab
- Creates extensive burrows in sandy mud flats.
- Disrupts sediment to the extent it negatively affects shellfish ground culture.



*Photo by Phillip Colla*



- Burrowing shrimp in Willapa Bay have been controlled through an Integrated Pest Management approach over the past 20 years.
- DNR Aquatics began investigating feasibility of mechanical management in 2018.

To investigate feasibility of mechanical alternatives for burrowing shrimp, DNR's Aquatics Assessment and Monitoring Team conducted two experiments:

- 1) Proof of Concept study to examine 3 different mechanical methods: flooding, wet harrowing and dry harrowing.
- 2) Supplemental to further investigate dry harrowing method which appeared most promising.

# Proof of Concept (POC) Study

Tested 3 different mechanical methods:

1) **Flooding** –hydraulic pumping at low tide



2) **Dry Harrowing**- Marshmaster towing “roller chopper” across mudflat at low tide



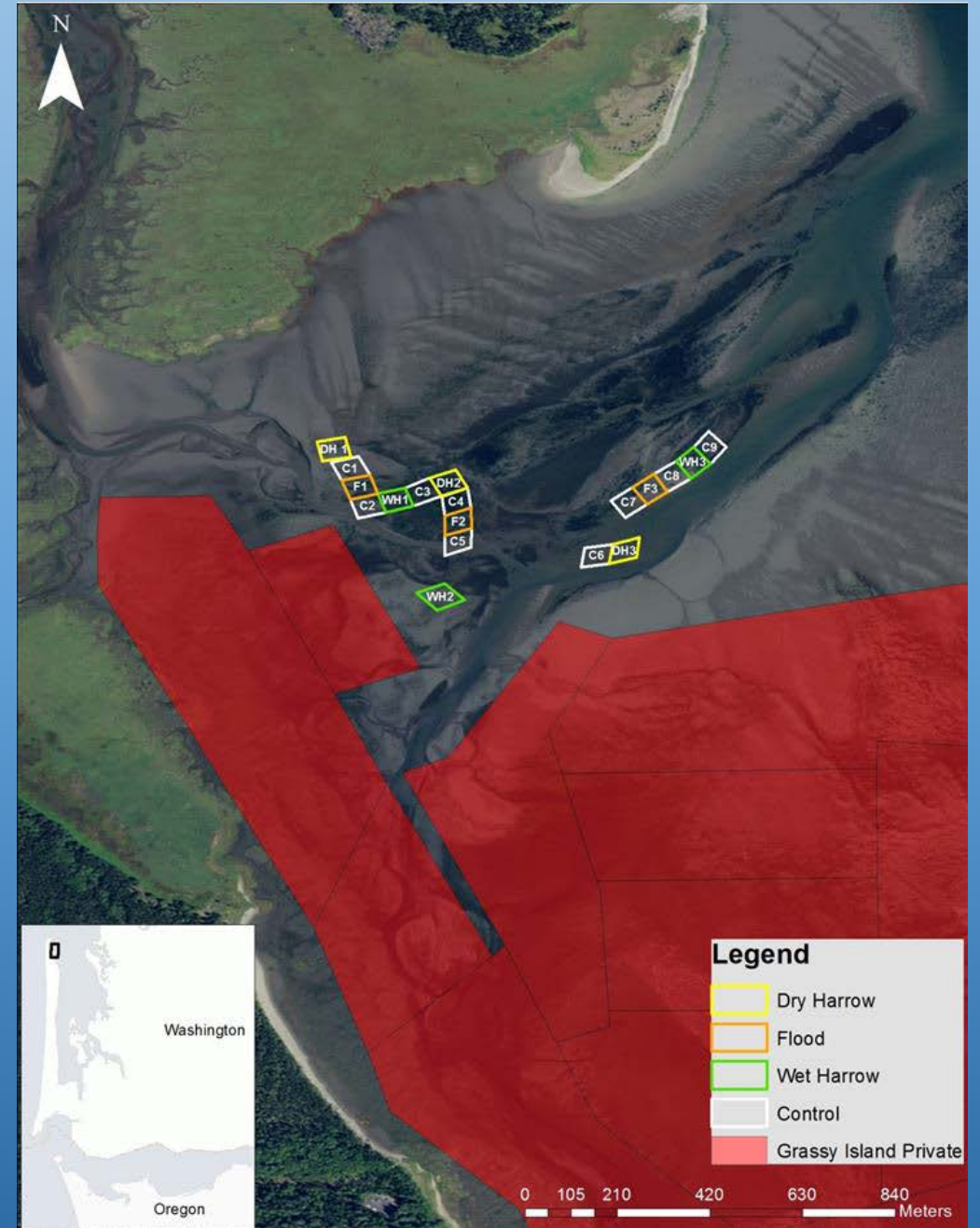
3) **Wet Harrowing** -pulling weighted agricultural harrow across mudflat at high tide



## Experimental site - Grassy Island, Willapa Bay

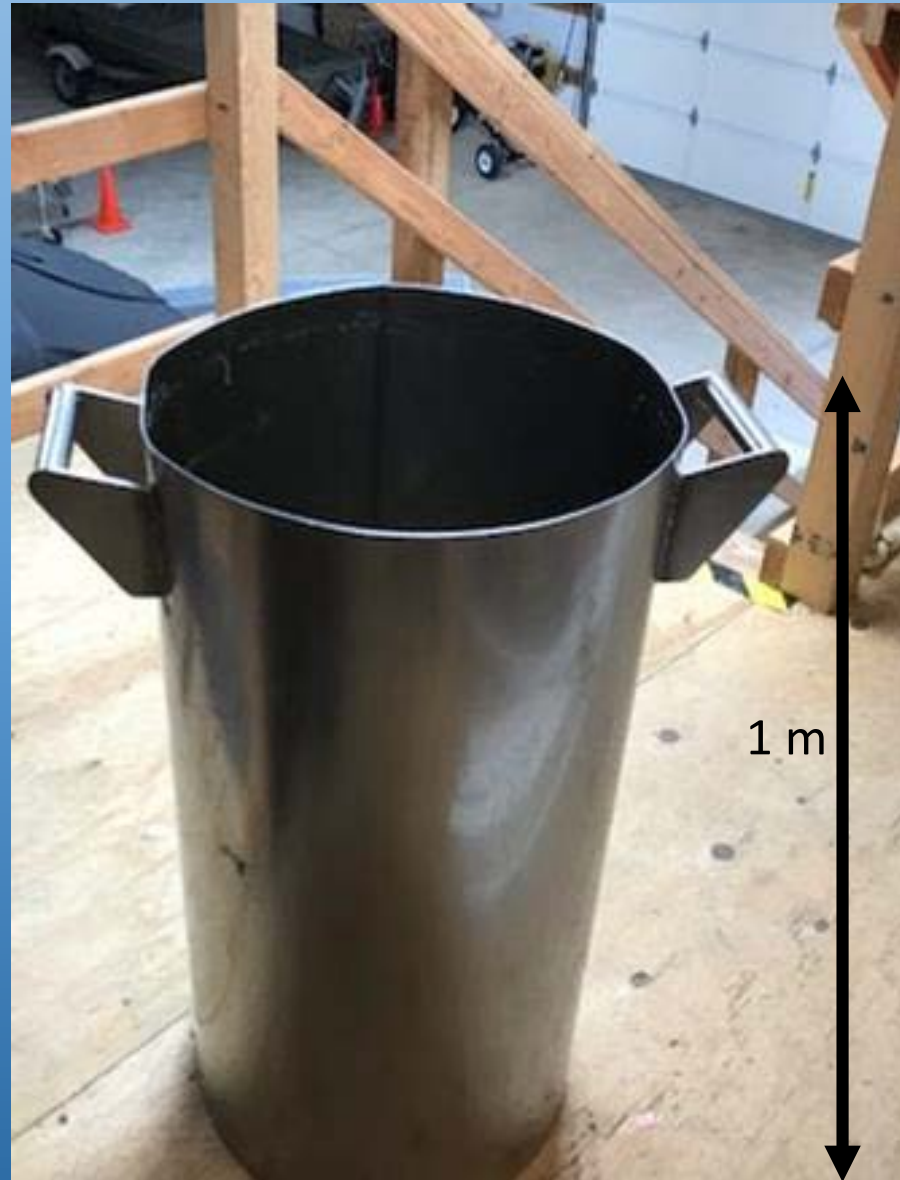
- 3 flood plots
- 3 wet harrow plots
- 3 dry harrow plots (2 passes with roller chopper)
- 9 control plots

All plots 0.5 acres in size.

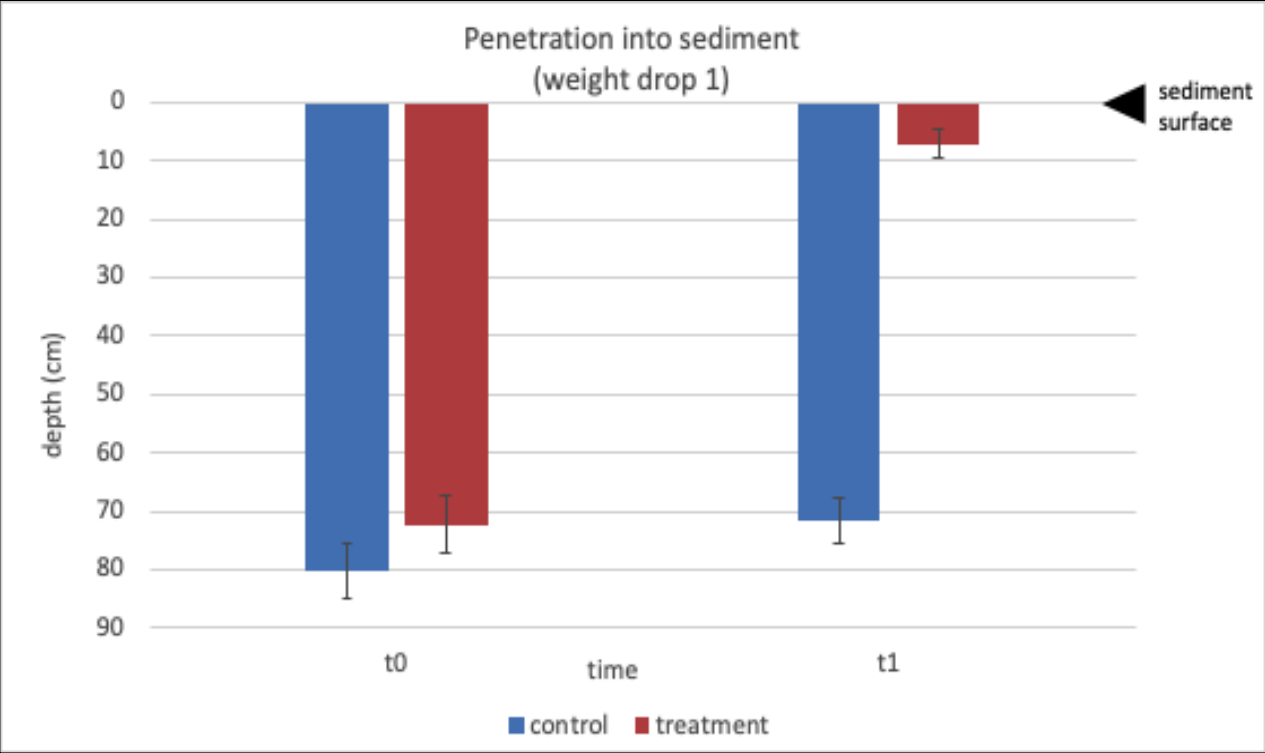
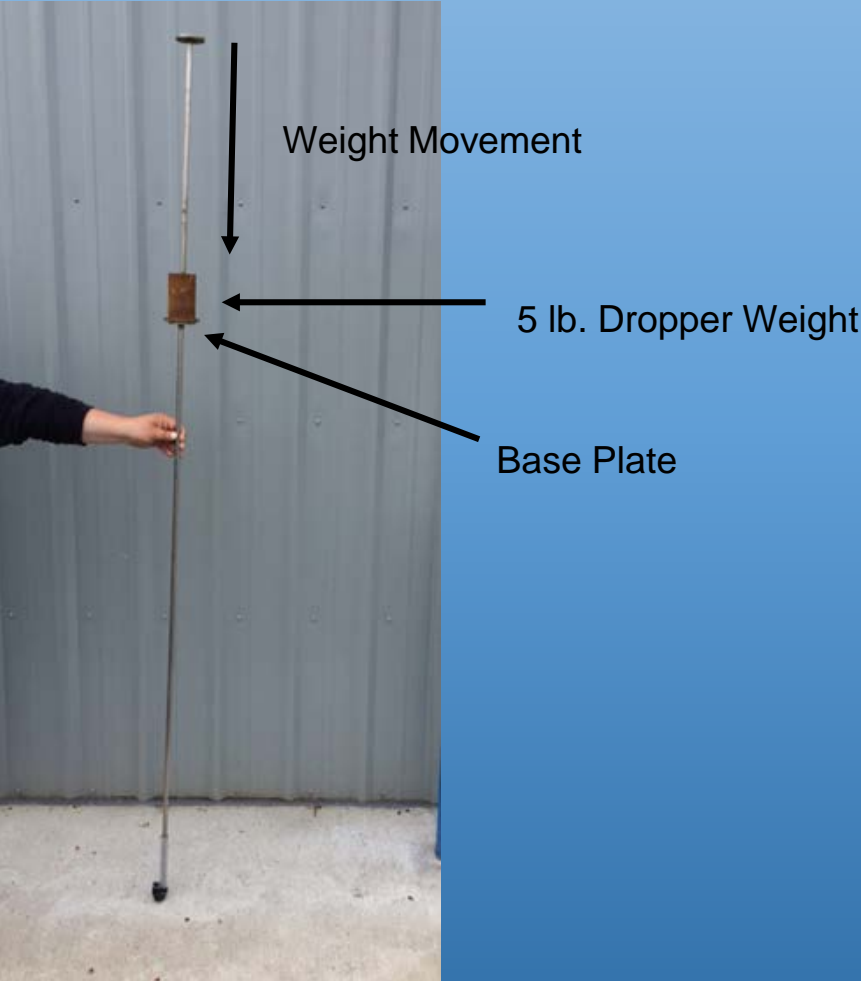


Before and after  
treatment monitoring of:

- shrimp density,
- shrimp biomass,
- sediment compaction
- sediment grain size
- burrow count

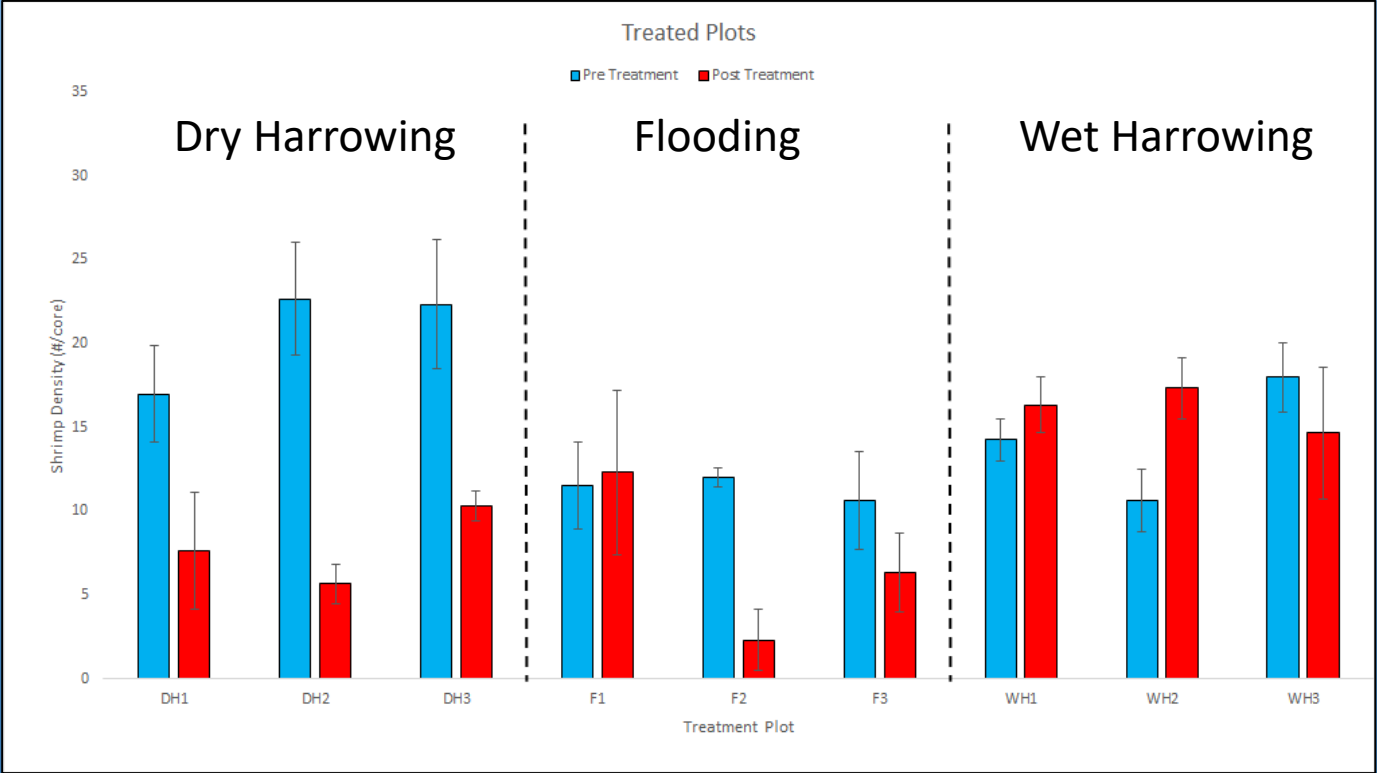


# Sediment Compaction

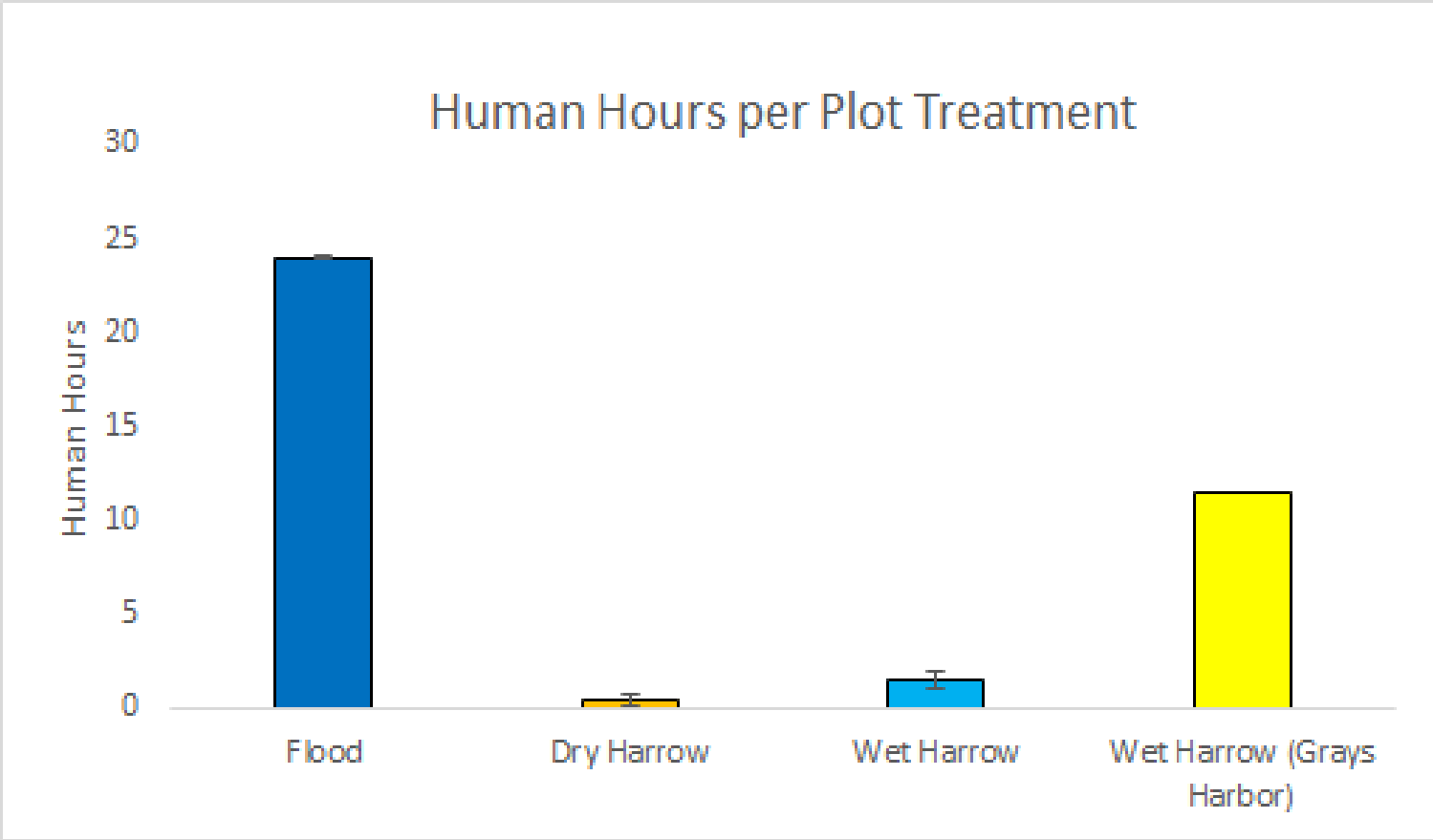




# Before and after shrimp density (#shrimp/core) for each treatment type



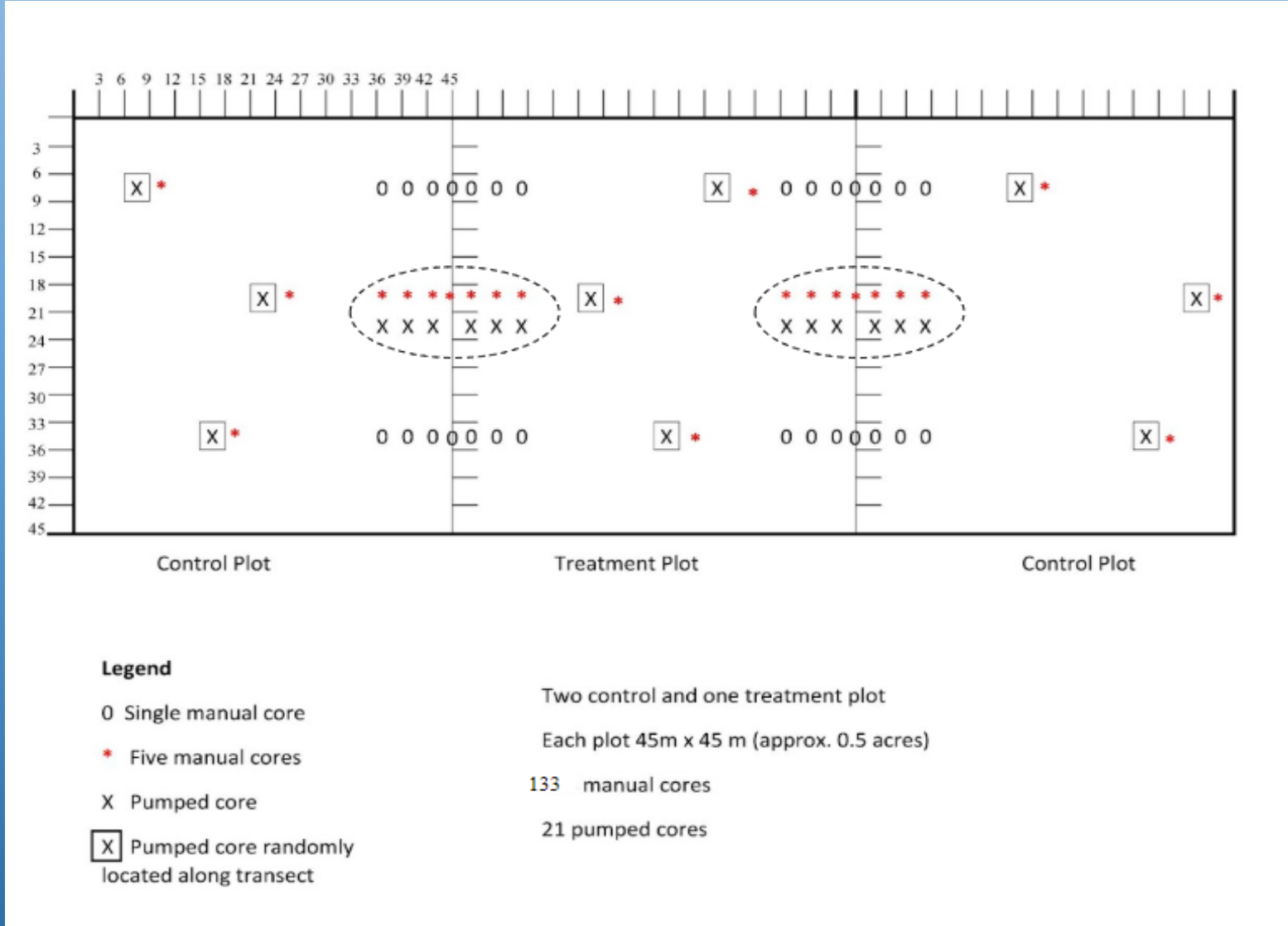
# Effort involved for each treatment type

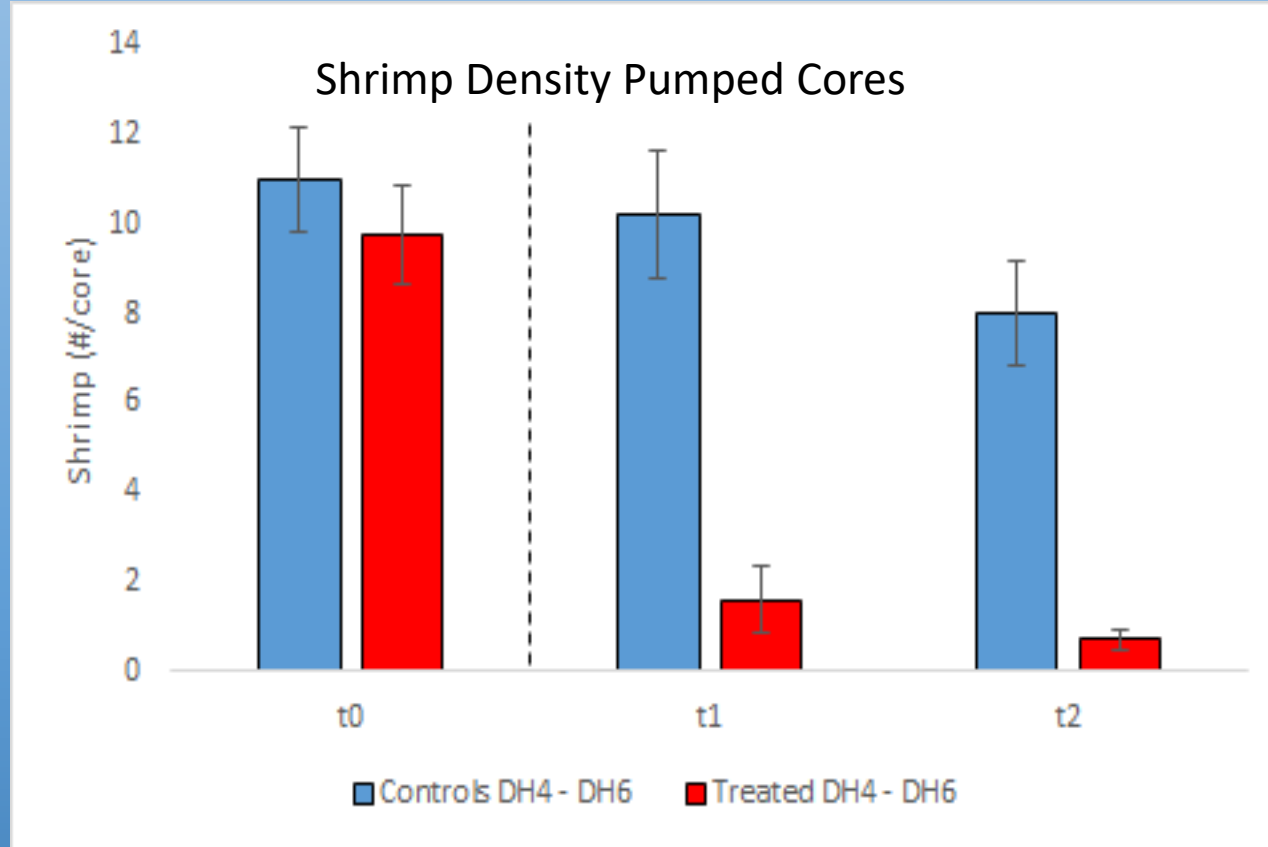


# Supplemental Study

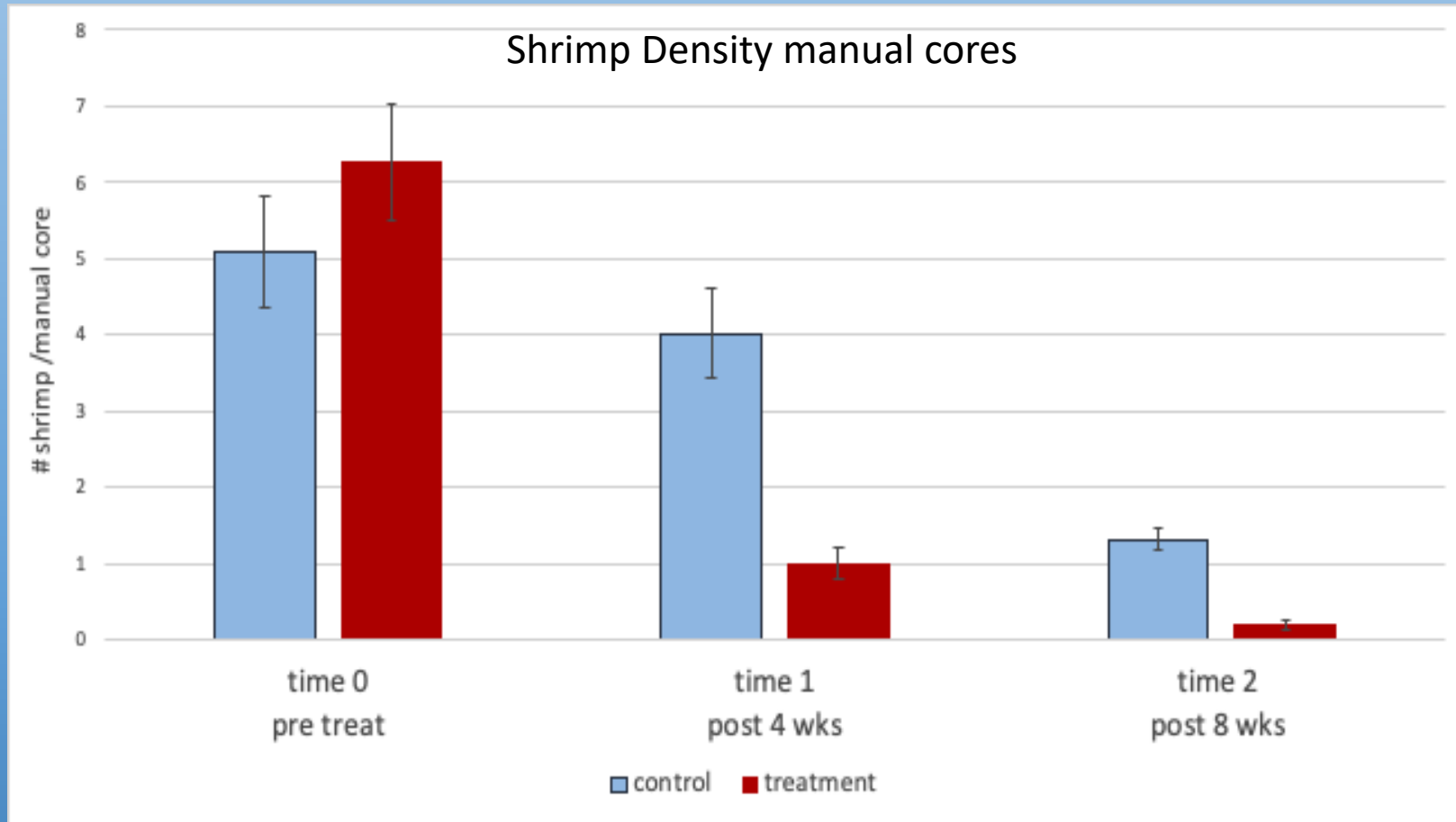
Focus on Dry Harrow method

- 4 passes with roller-chopper
- Investigate recolonization from non-treated areas
- Increased number of pumped cores sampled
- Added manual sample cores





Mean shrimp density collected per pumped core at Control and Treated plots at t0 (pre treatment), t1 (3 weeks post), and t2 (6 weeks post).



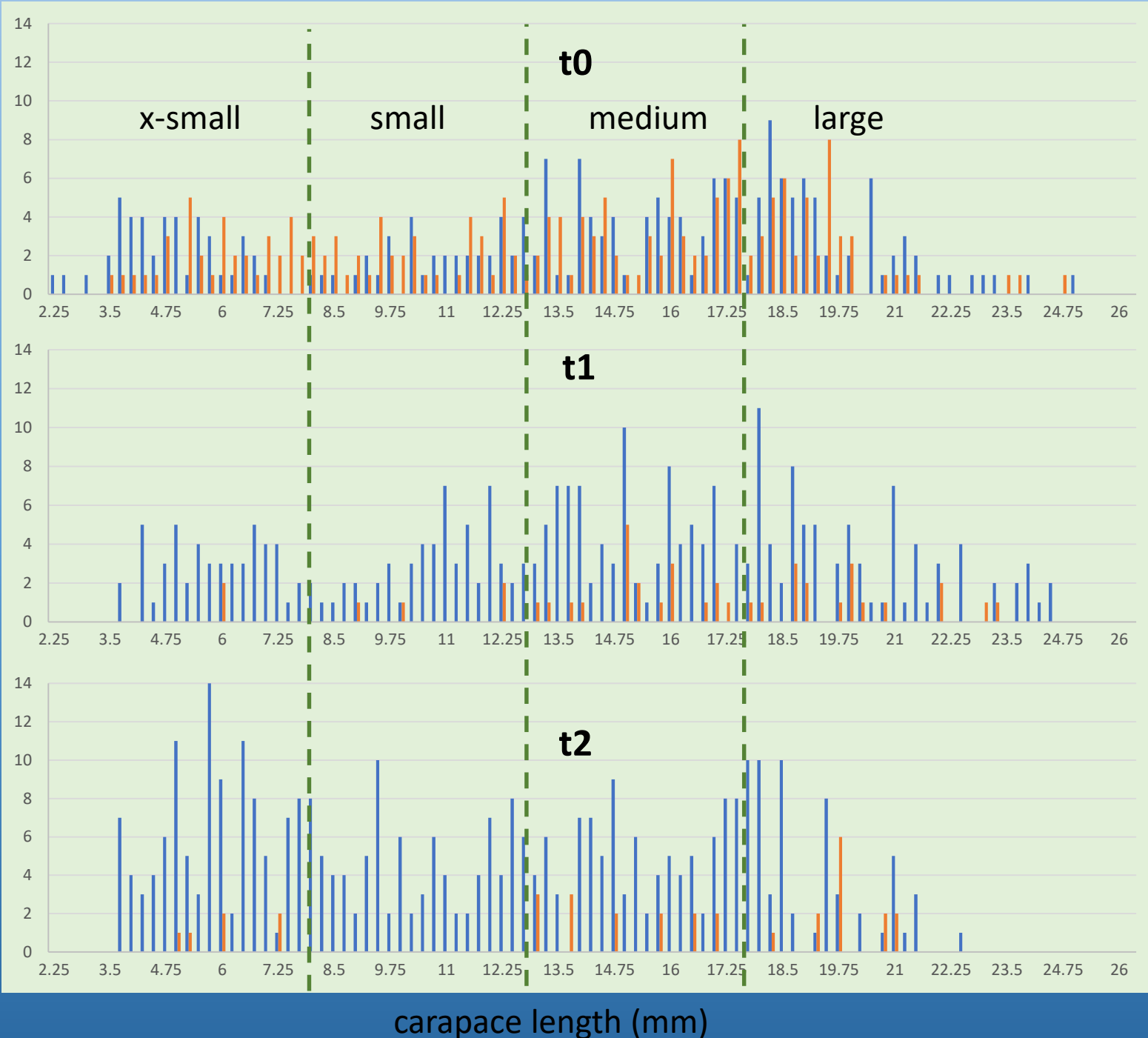
Mean shrimp density collected per manual core at Control and Treated plots at t0 (pre treatment), t1 (3 weeks post), and t2 (6 weeks post).

# Shrimp size class thresholds and means

Size Class Ranges	Large	Medium	Small	Extra Small
Carapace Length (mm)	> 17.42	17.42 - 12.49	12.49 - 8.28	8.28 >
Total Length (mm)	> 69.95	69.96 - 49.25	49.25 - 30.94	30.95 >
Mass (g)	> 6.85	6.85 - 2.41	2.41 - 0.62	0.62 >

Mean size class (mm)	Large		Medium		Small		Extra Small	
	WDNR	Bosley & Dumbauld (2011)	WDNR	Bosley & Dumbauld (2011)	WDNR	Bosley & Dumbauld (2011)	WDNR	Bosley & Dumbauld (2011)
Carapace Length $\pm$ SD (mm)	20.33 $\pm$ 2.36	13.26 $\pm$ 1.97	14.58 $\pm$ 1.69	10.75 $\pm$ 0.31	10.32 $\pm$ 1.41	8.55 $\pm$ 1.49	6.16 $\pm$ 1.60	6.28 $\pm$ 1.78

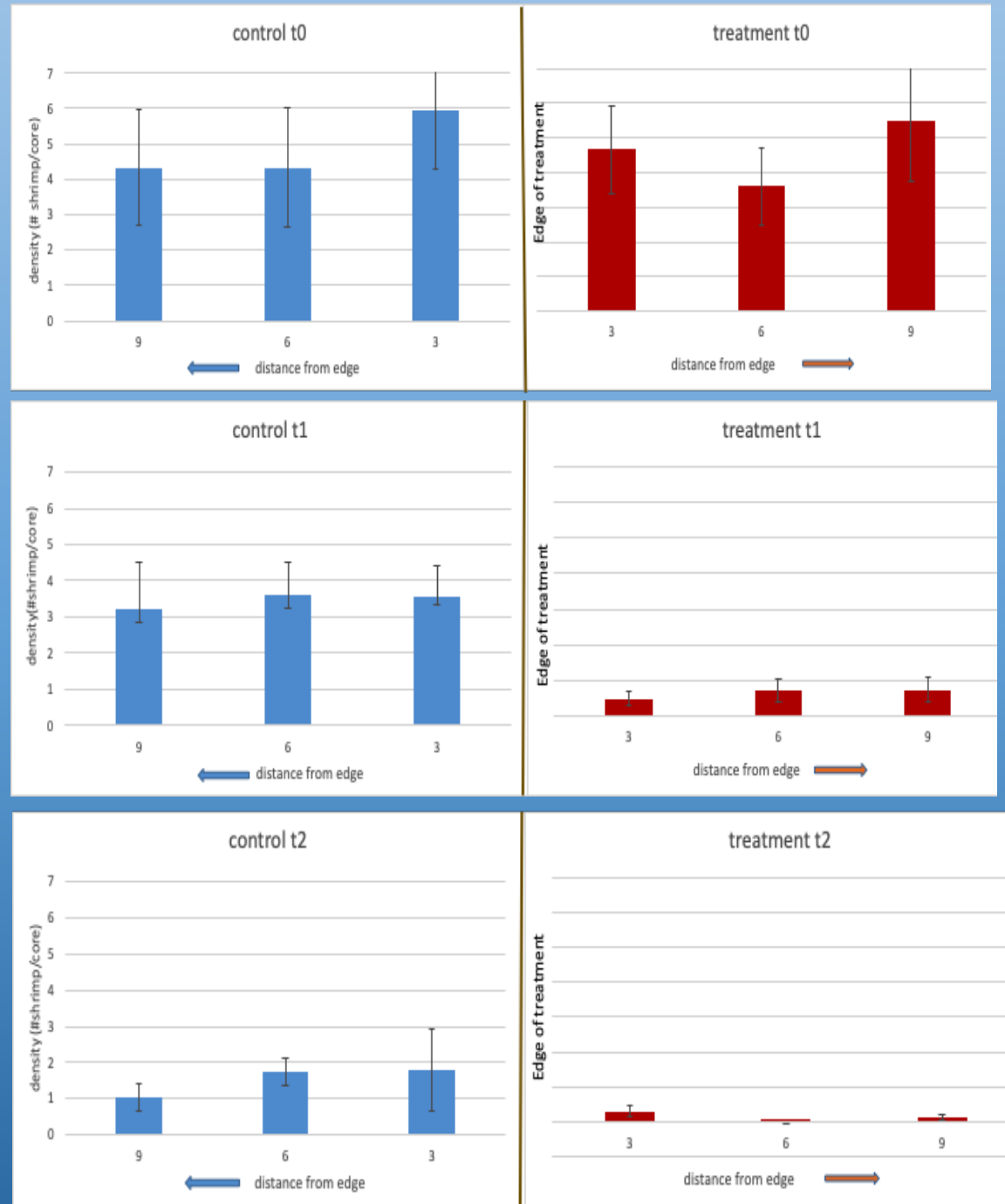
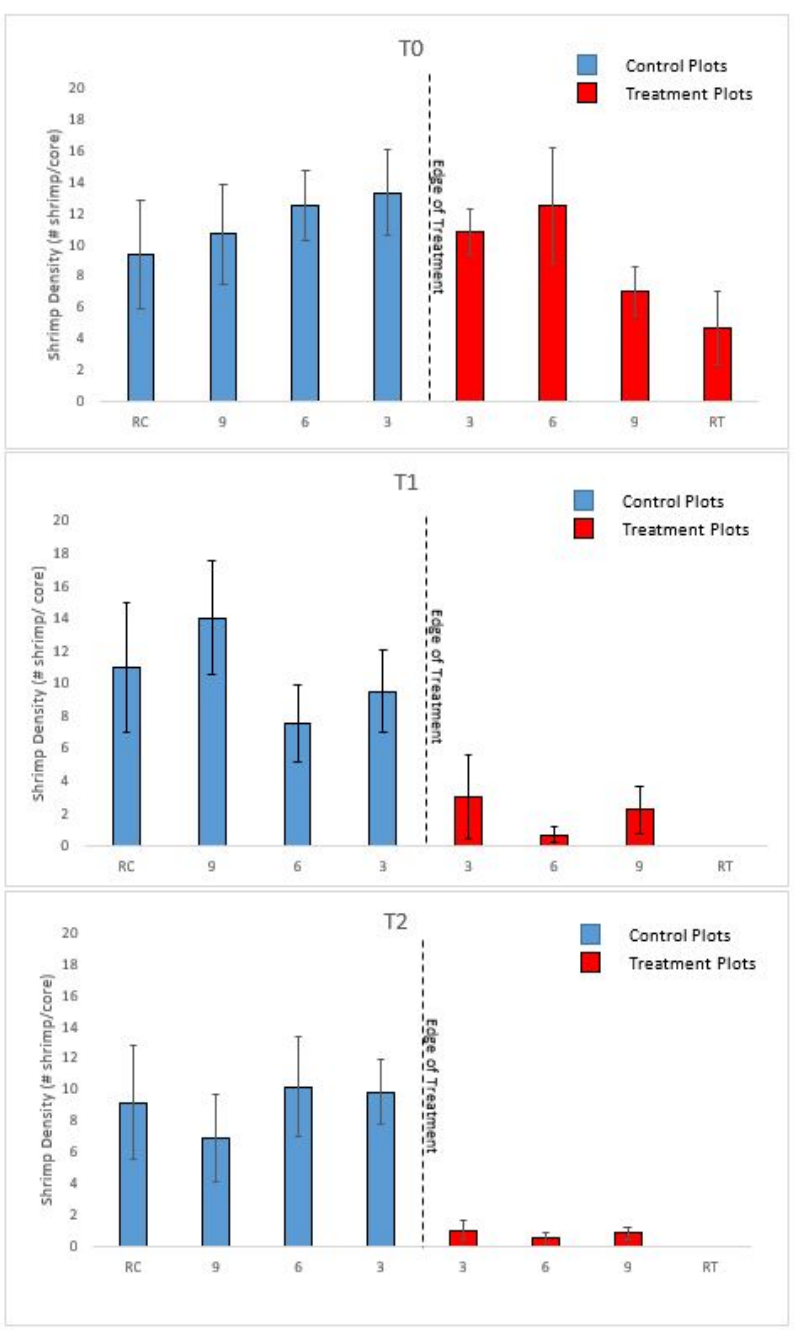
Number of shrimp



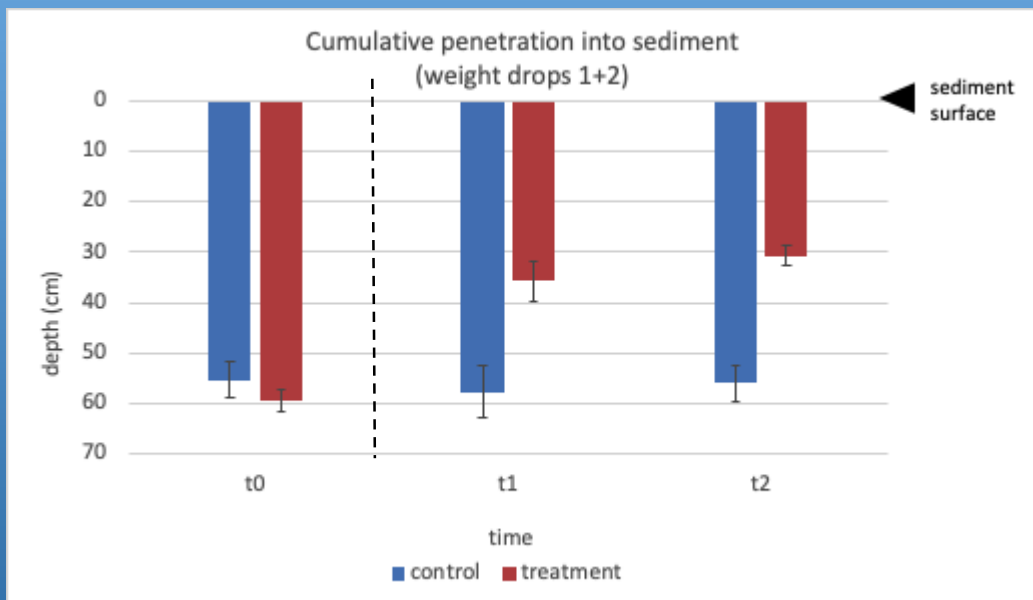
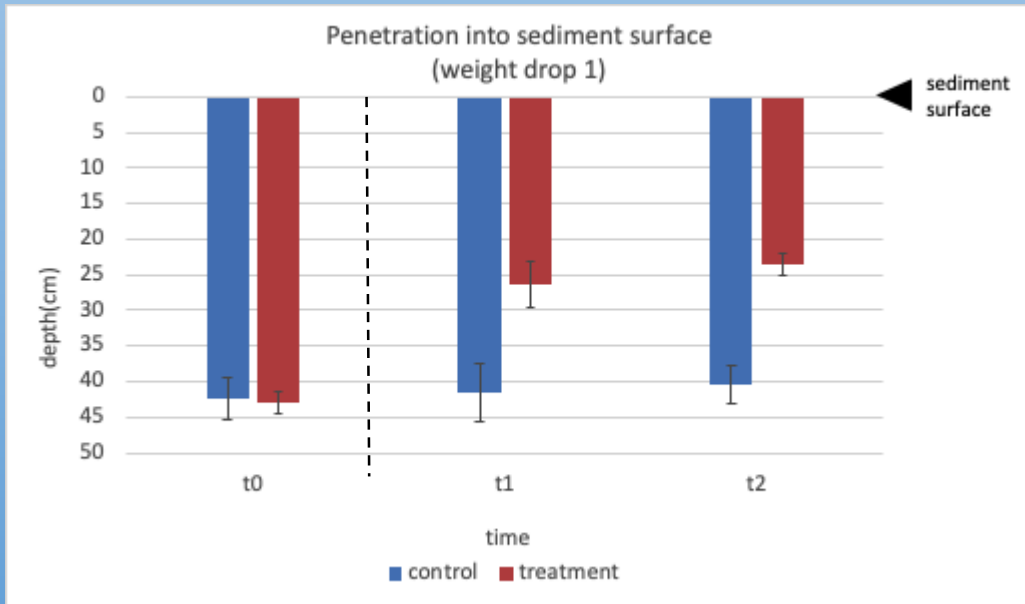
Dry harrowing showed a reduction in treated vs. control sites in all size classes, for each sample time.

Mean shrimp densities from pumped (left) and manual cores (right) along a distance gradient from treatment edge, at times t0, t1 and t2.

No evidence of lateral shrimp movement to recolonize the treated plots

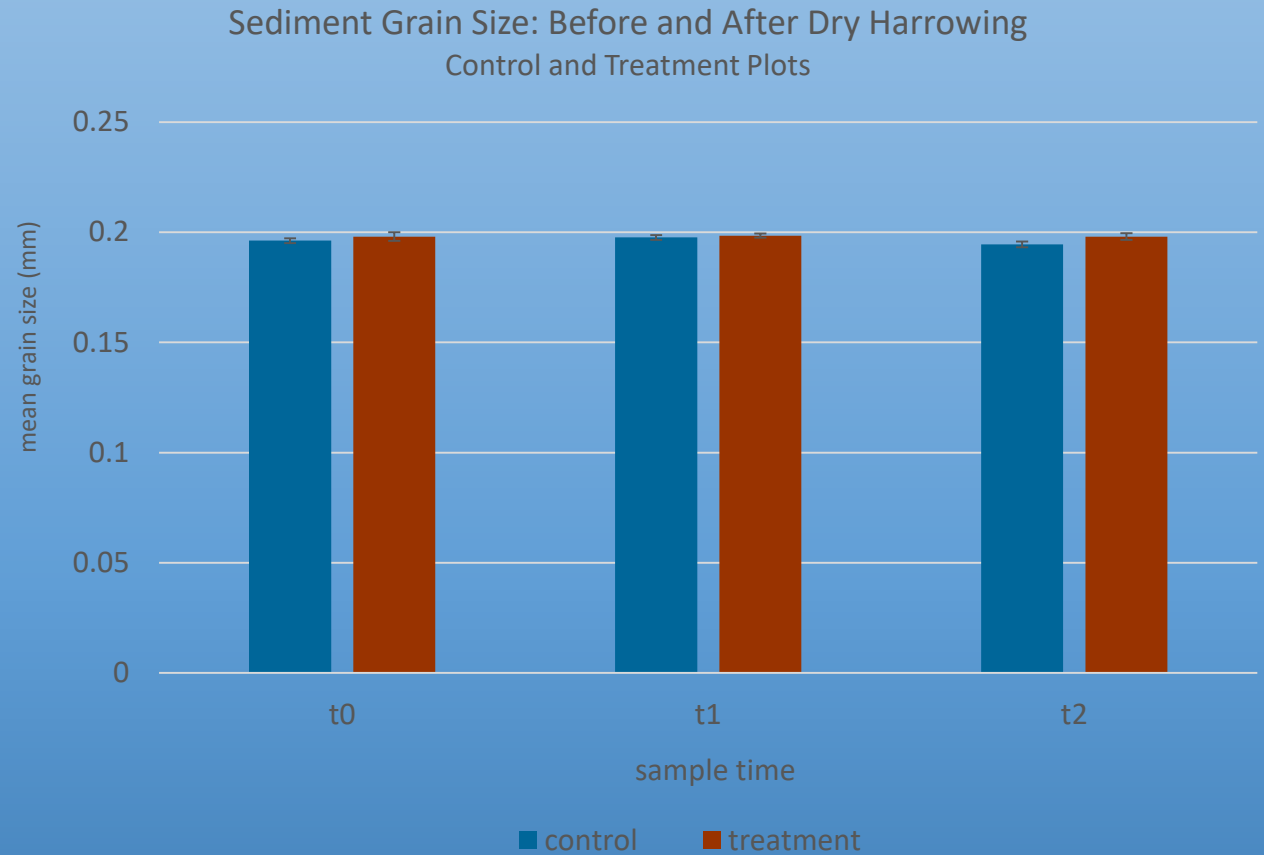






Mean sediment penetration was significantly less (sediment more compact) in treated plots compared with untreated plots

Sediment grain size analyzed using standard sieve shaker



No significant difference in grain size between control and treated plots pre and post treatment

# Findings from experiments on Grassy Island, Willapa Bay, April through Sept 2018

- Shrimp density in dry harrowed plots dropped significantly from pre-treatment densities (by an average of 89%).
- After another four weeks (six weeks post-treatment, @ t2) this low shrimp density ( $0.73 \pm SE .23$ ) shrimp/core persisted.
- Dry-harrowing impact on shrimp densities was greater than natural shrimp population variability

The POC and Supplemental study results provide evidence that dry harrowing may have some potential to play a role in the management of burrowing shrimp yet specific technical and broader questions still remain:

### Technical Questions

- *What is the sediment compaction threshold that allows for productive ground culture?*
- *Is there a strong relationship between shrimp density and sediment compaction?*
- *How long do the effects of mechanical treatments persist?*
- *How much does timing with respect to shrimp life cycle influence treatment effect?*

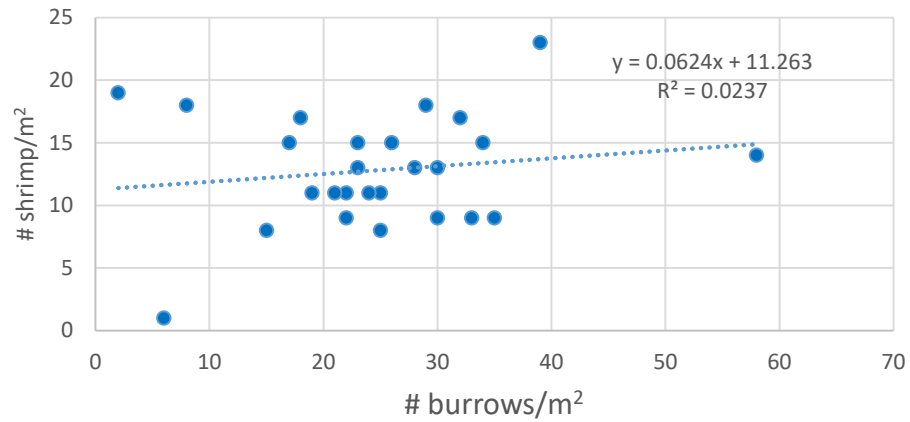
### Broader issues

*Are the methods:*

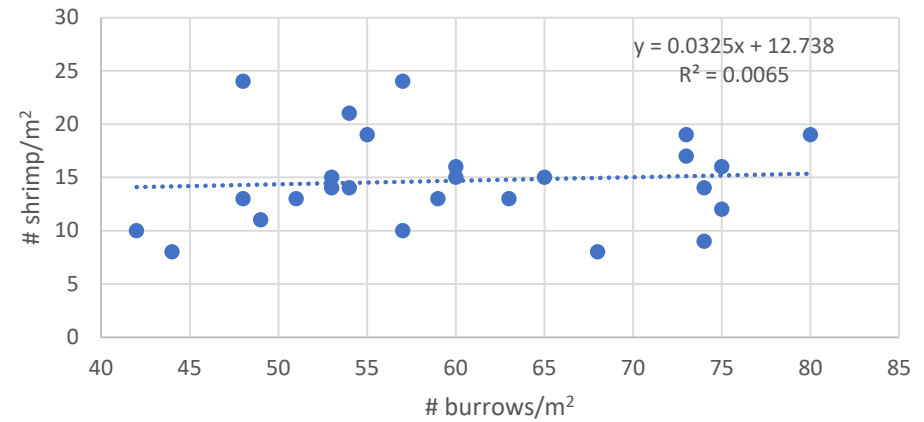
- *viable on a larger, commercial scale?*
- *compatible with shellfish ground culture?*
- *economically realistic?*



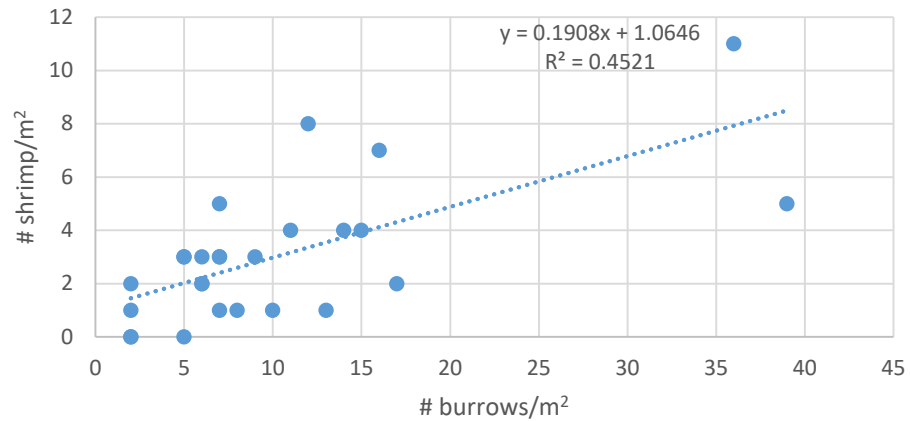
Grassy Island, Willapa Bay  
March, 2015



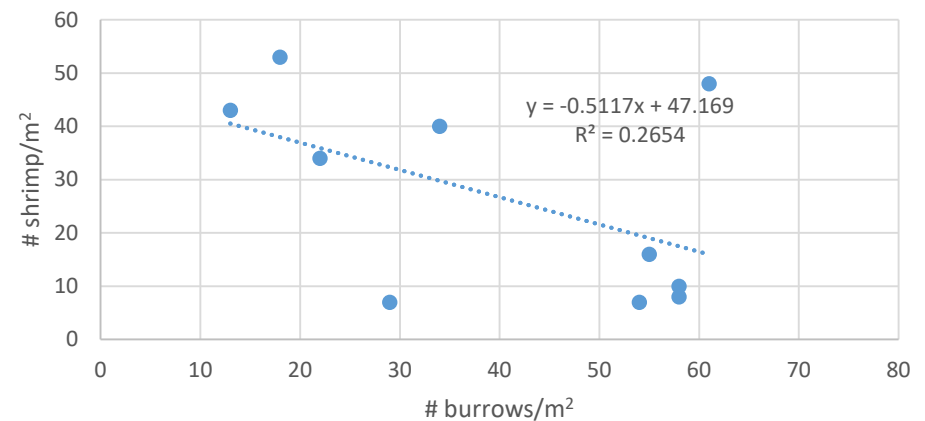
Stoney Pt, Willapa Bay  
July 2015



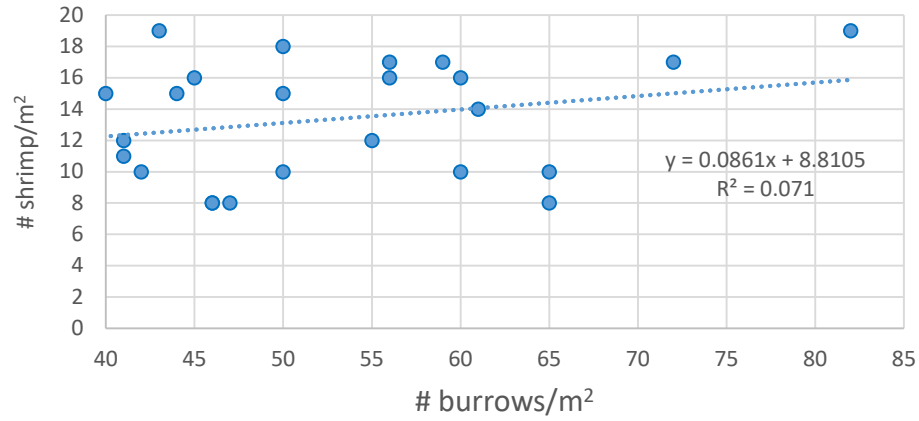
Midde Sands, Willapa Bay  
August 2015



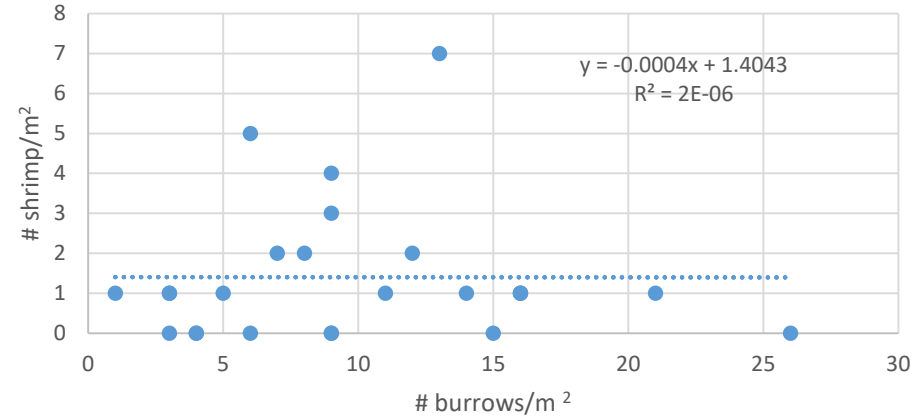
Middle Sands, Willapa Bay  
May 2016



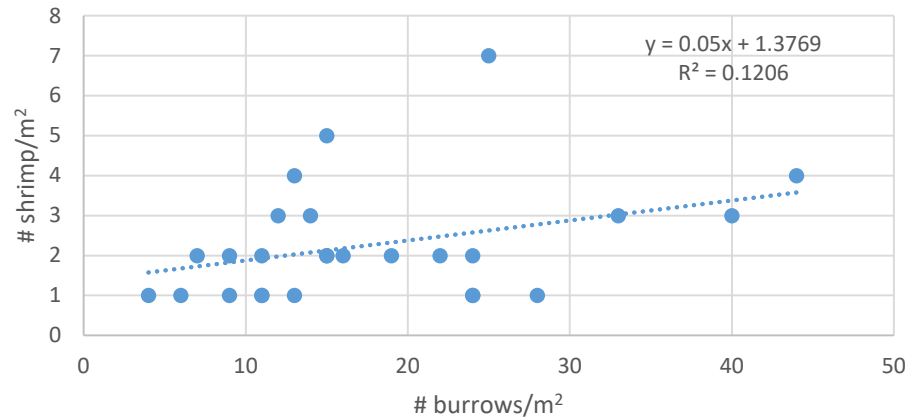
Ellen Sands, Willapa Bay  
July 2015



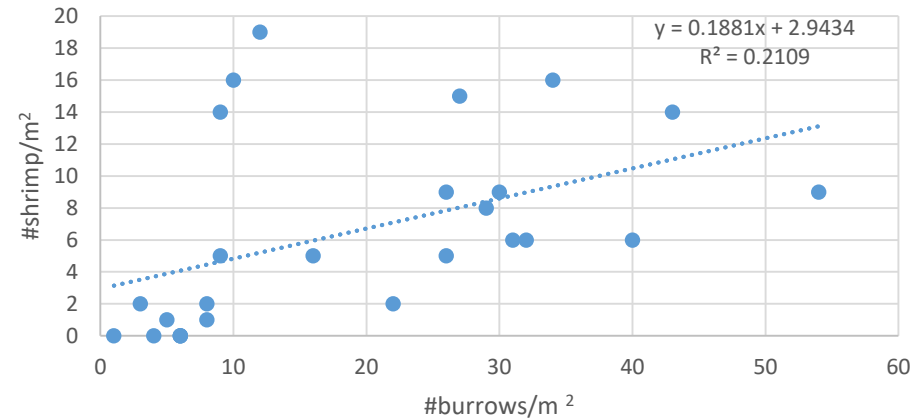
Oysterville, Willapa Bay  
July 2015



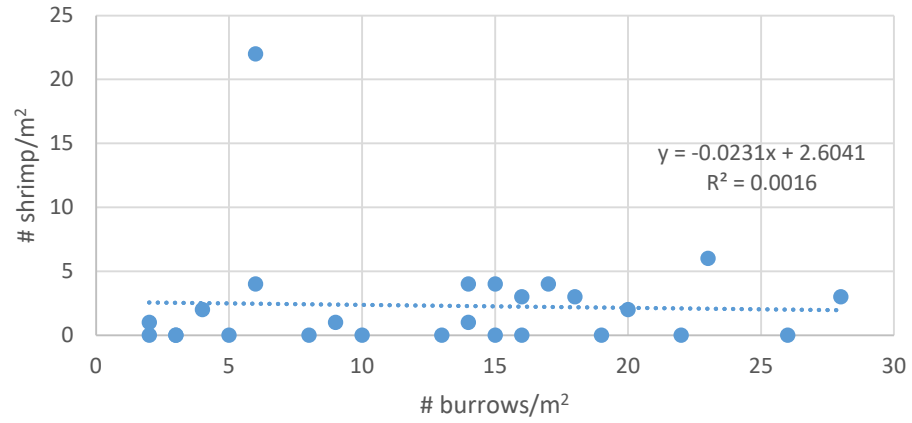
Nemah North, Willapa Bay  
July 2015



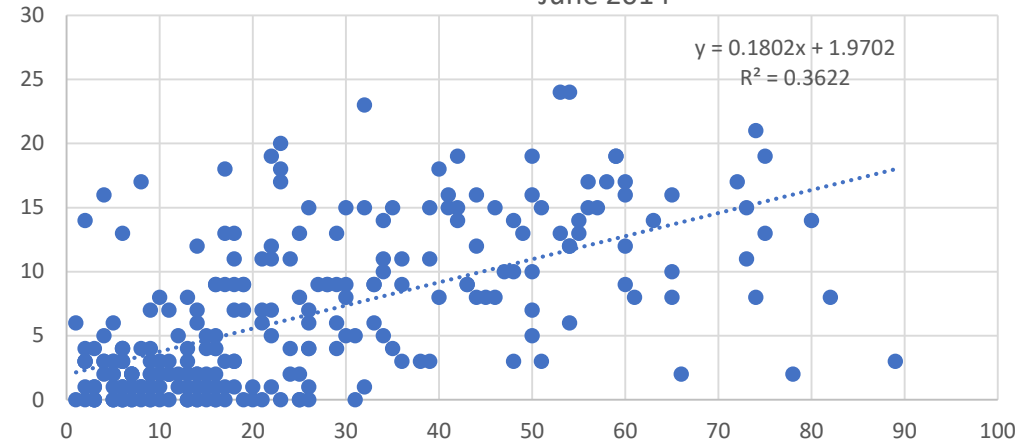
North Long Island, Willapa Bay  
July 2015



Port of Peninsula, Willapa Bay  
July 2015



Grassy Island, Middle Sands, Mill Channel  
Rhodesia Beach, Oysterville, Stony Pt., Ellen Sands  
June 2014



Rhodesia Beach, Willapa Bay  
July 2015

