

Map source - Giving Tree Gallery

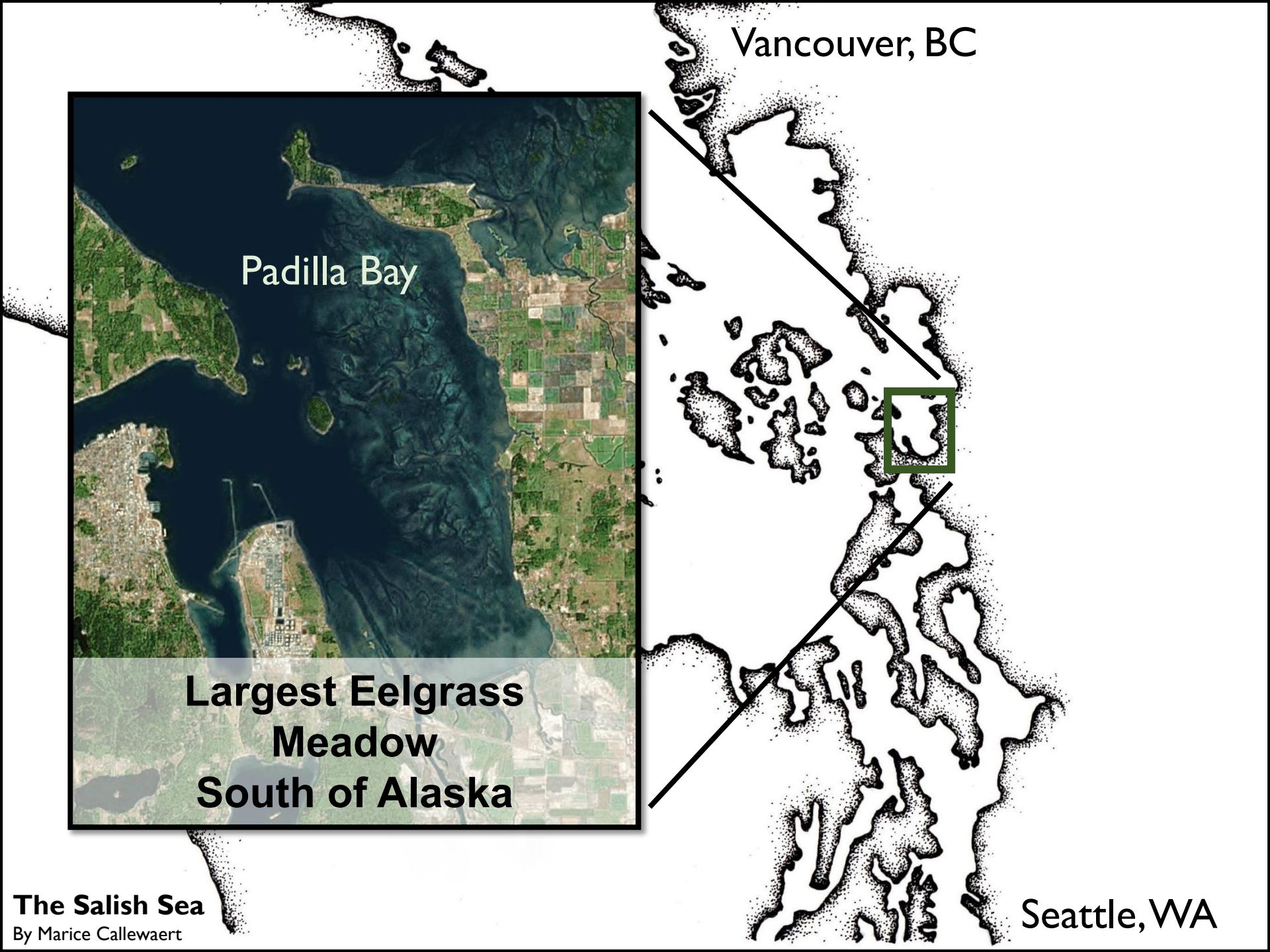


*Scaling from Plot to Landscape Scale  
in an  
Eelgrass Meadow*



*Padilla Bay*

National Estuarine Research Reserve





**Critical habitat**

# Nursery



CDFW

Herring spawn



Dungeness crab

# Birds



Lisla Boomer

Surf Scoter



Brandt

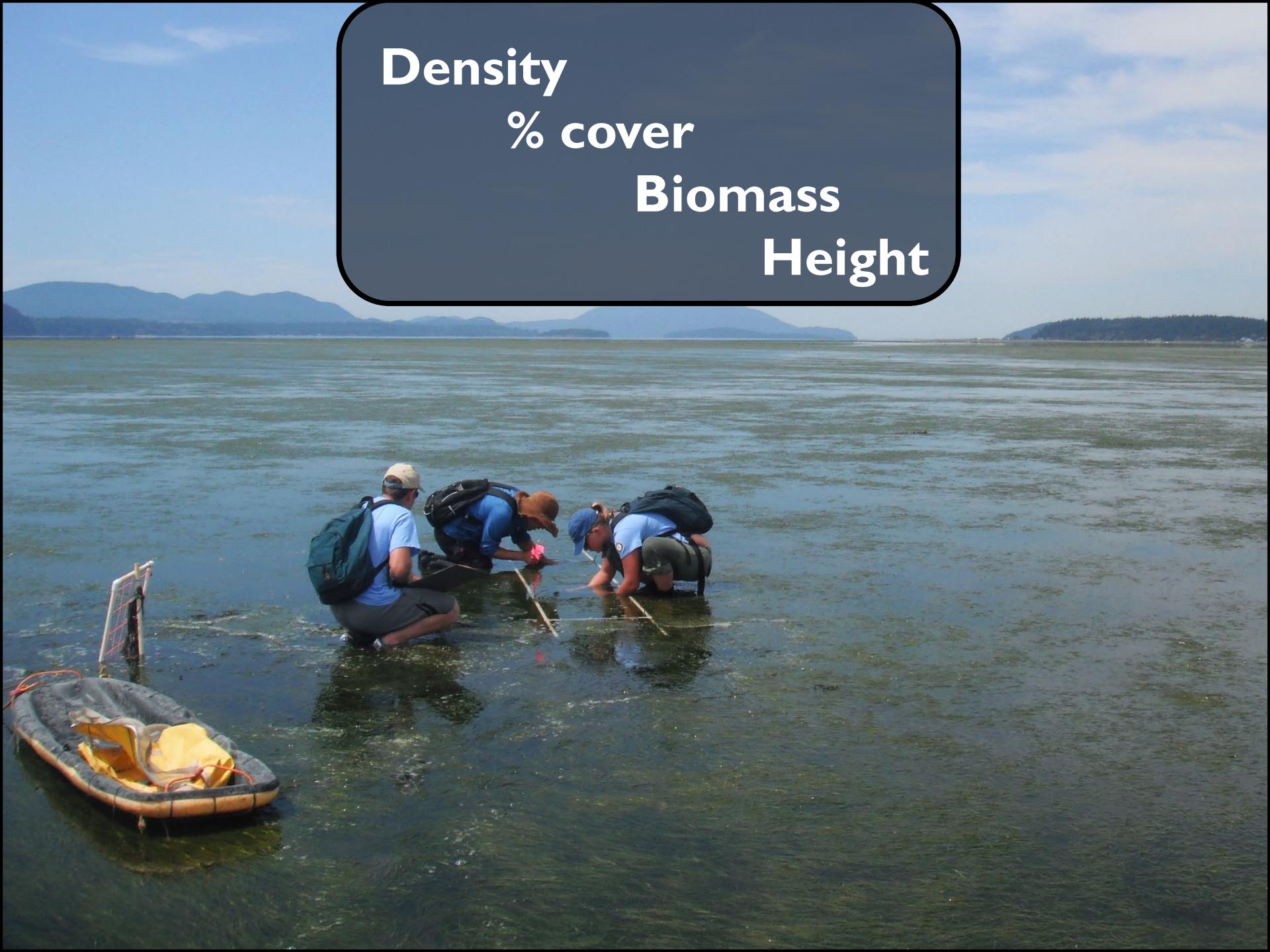
U.S. Fish & Wildlife Service

# Long Term Monitoring

- Water Quality
- Nutrients
- Weather
- Eelgrass**



**Density  
% cover  
Biomass  
Height**



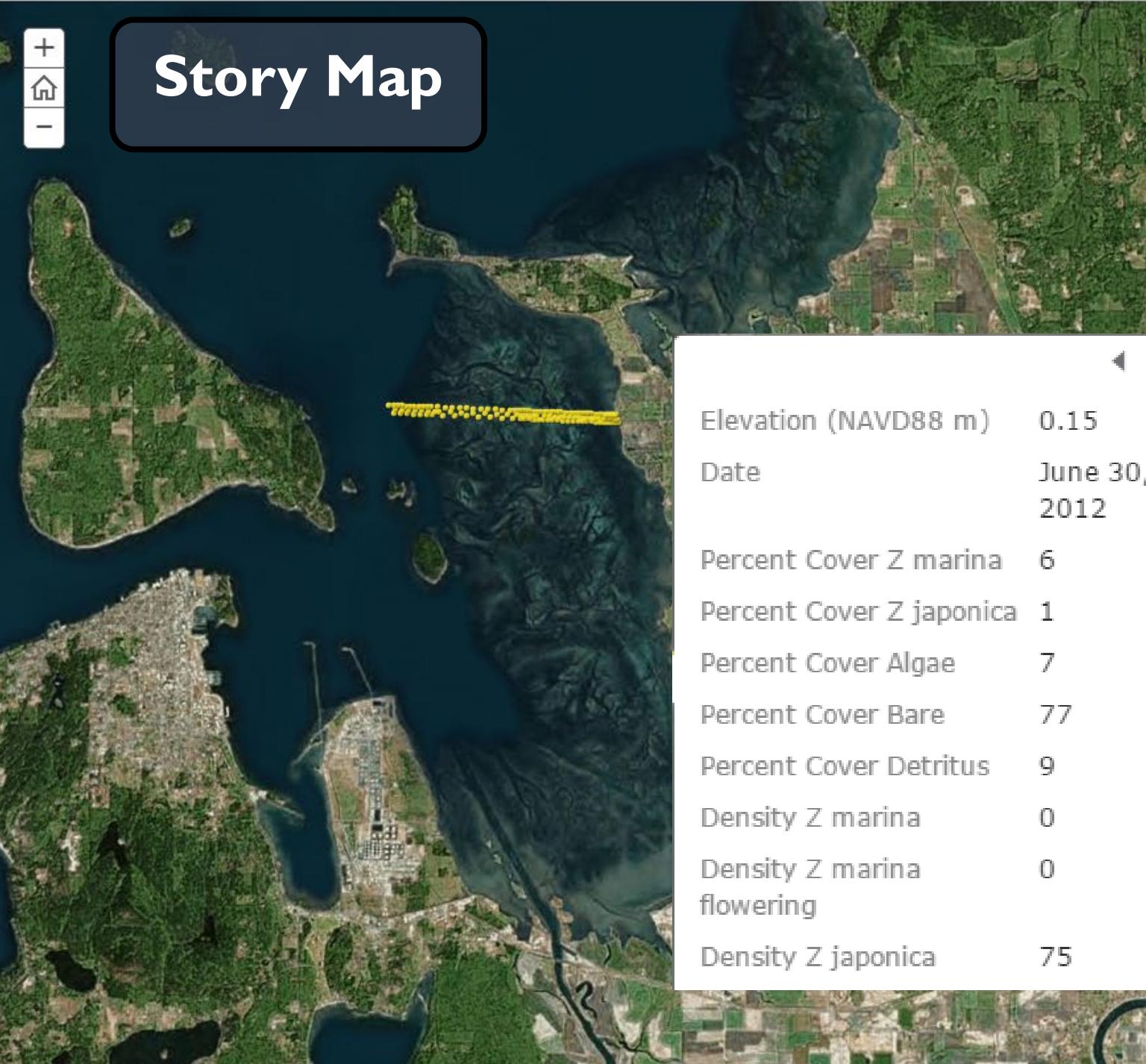
## Padilla Bay Reserve

### Biomonitoring Transect

The biomonitoring project, started in 2011, gives us an in depth look at the eelgrass in Padilla Bay. Percent cover, density, and height of the eelgrass are recorded annually along three 4 km transects (126 plots total).

Zoom in and click on a point, a pop-up table of the the data taken that plot displays the plot averaged data by year. Note - the deep water dive plots are not surveyed all four years (those plots display 0 values in the pop-up).

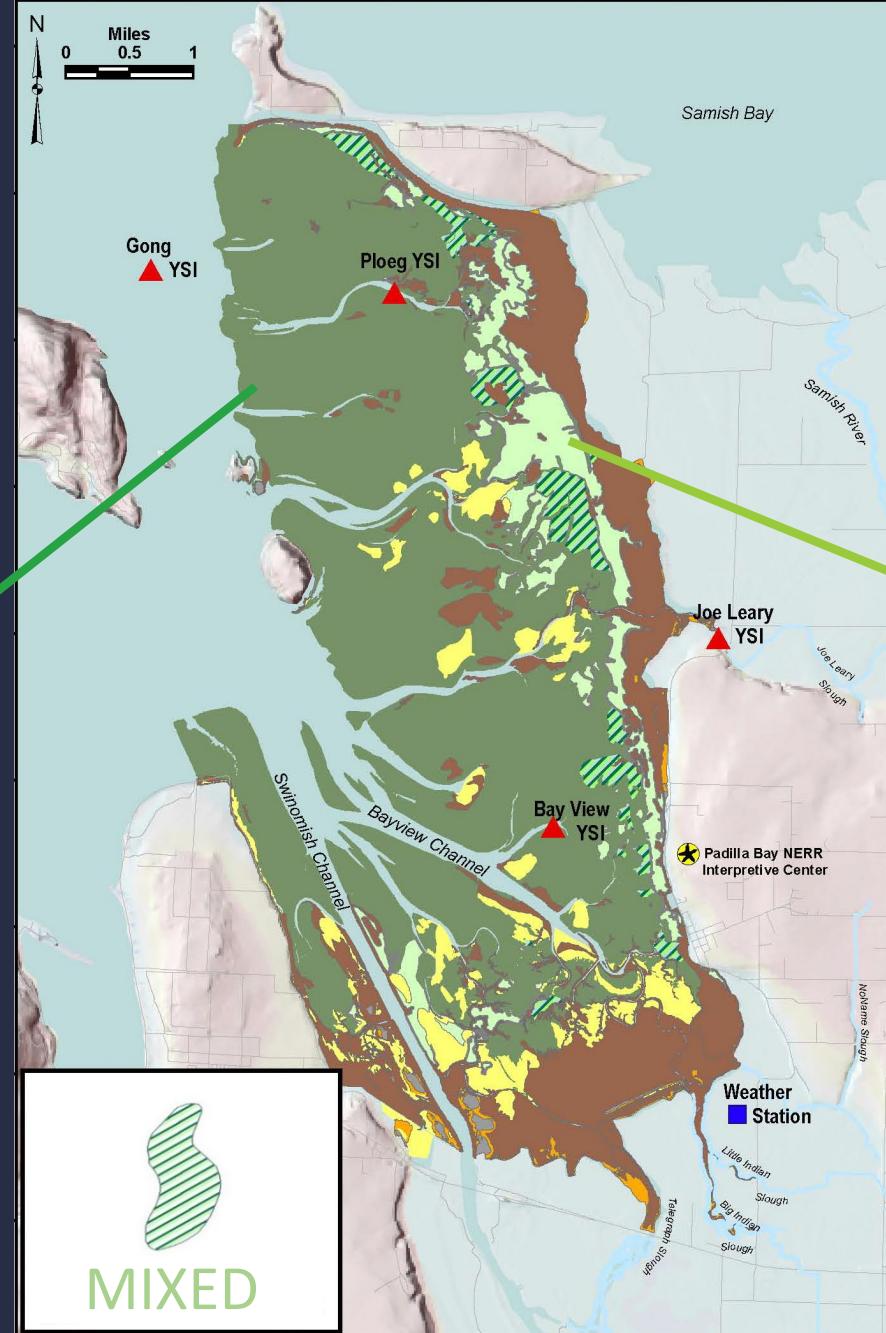
<https://arcg.is/rzKmT>



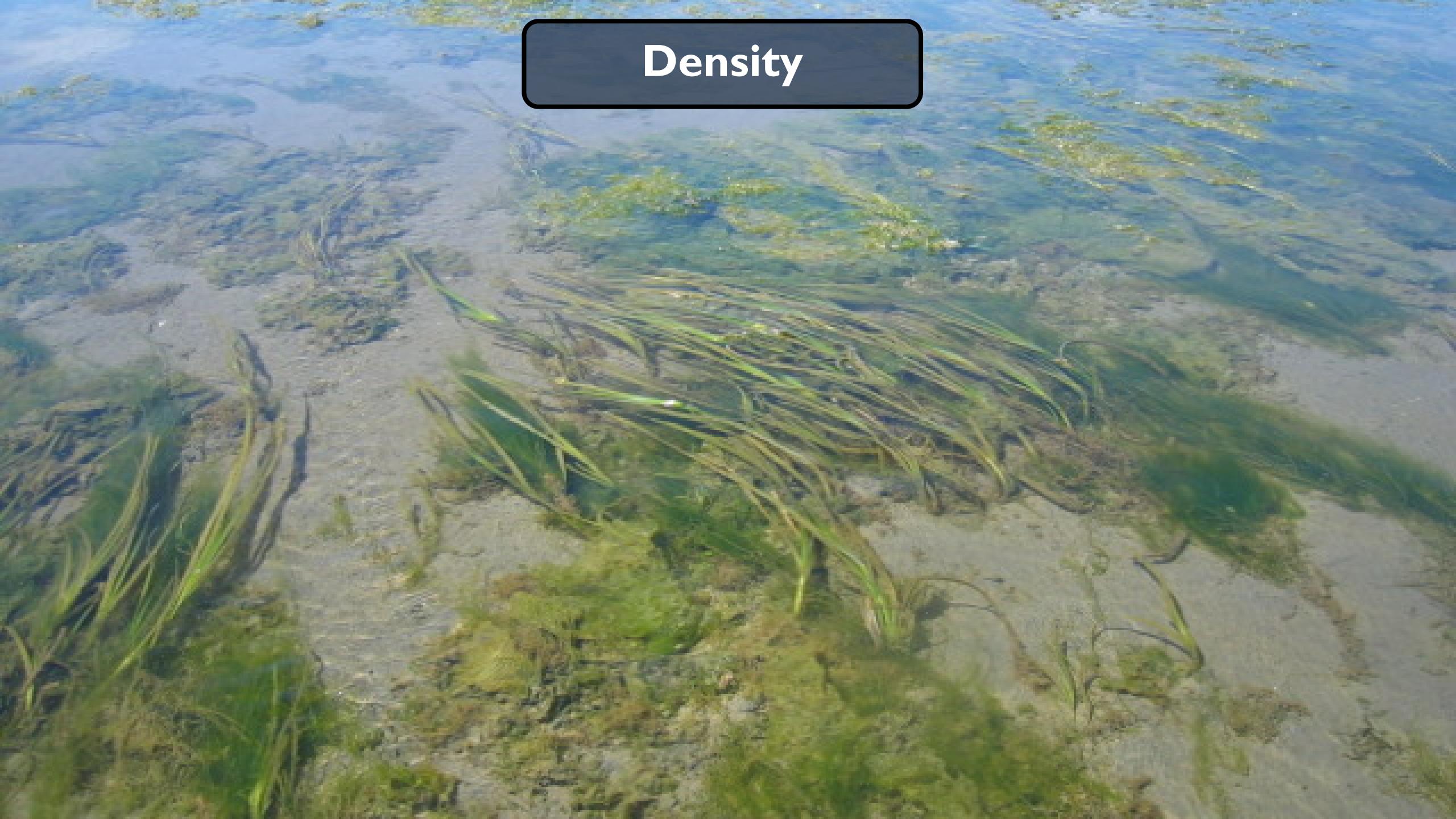
San Juans



M  
A  
R  
I  
N  
A



J  
A  
P  
O  
N  
I  
C  
A



A photograph of an underwater environment, likely a seagrass bed. The water is clear, revealing the sandy bottom and the long, thin, green blades of seagrass. The blades are densely packed in some areas and more sparse in others. A dark, rectangular text box is positioned in the upper center of the image, containing the word "Density" in a white, sans-serif font.

Density

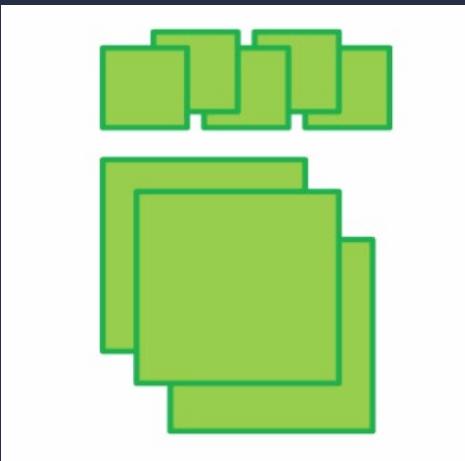
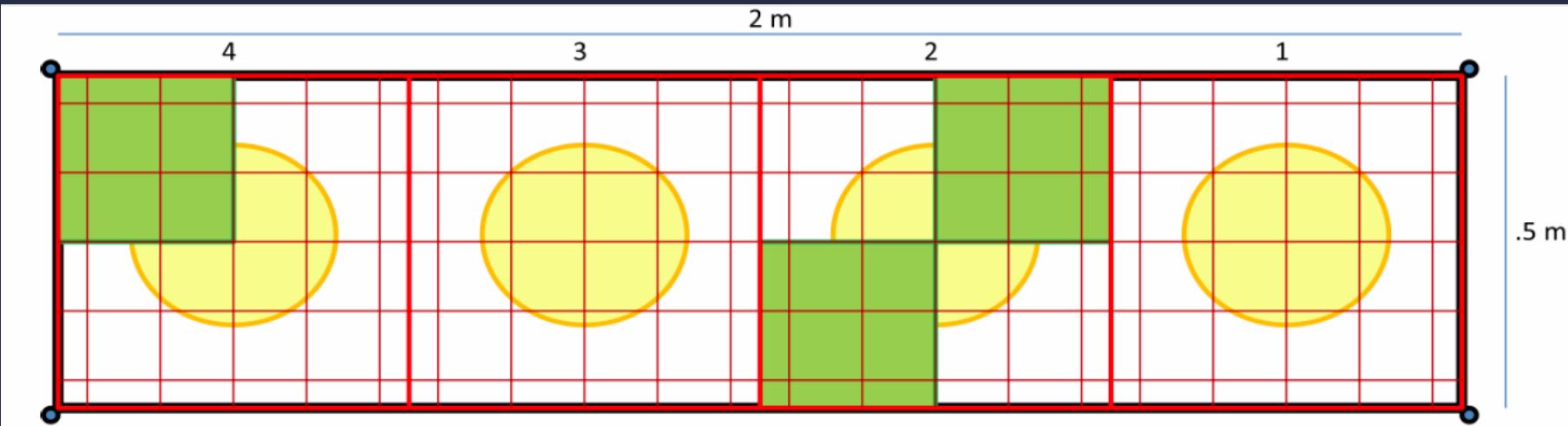
# Plot Densities



# Plot Densities



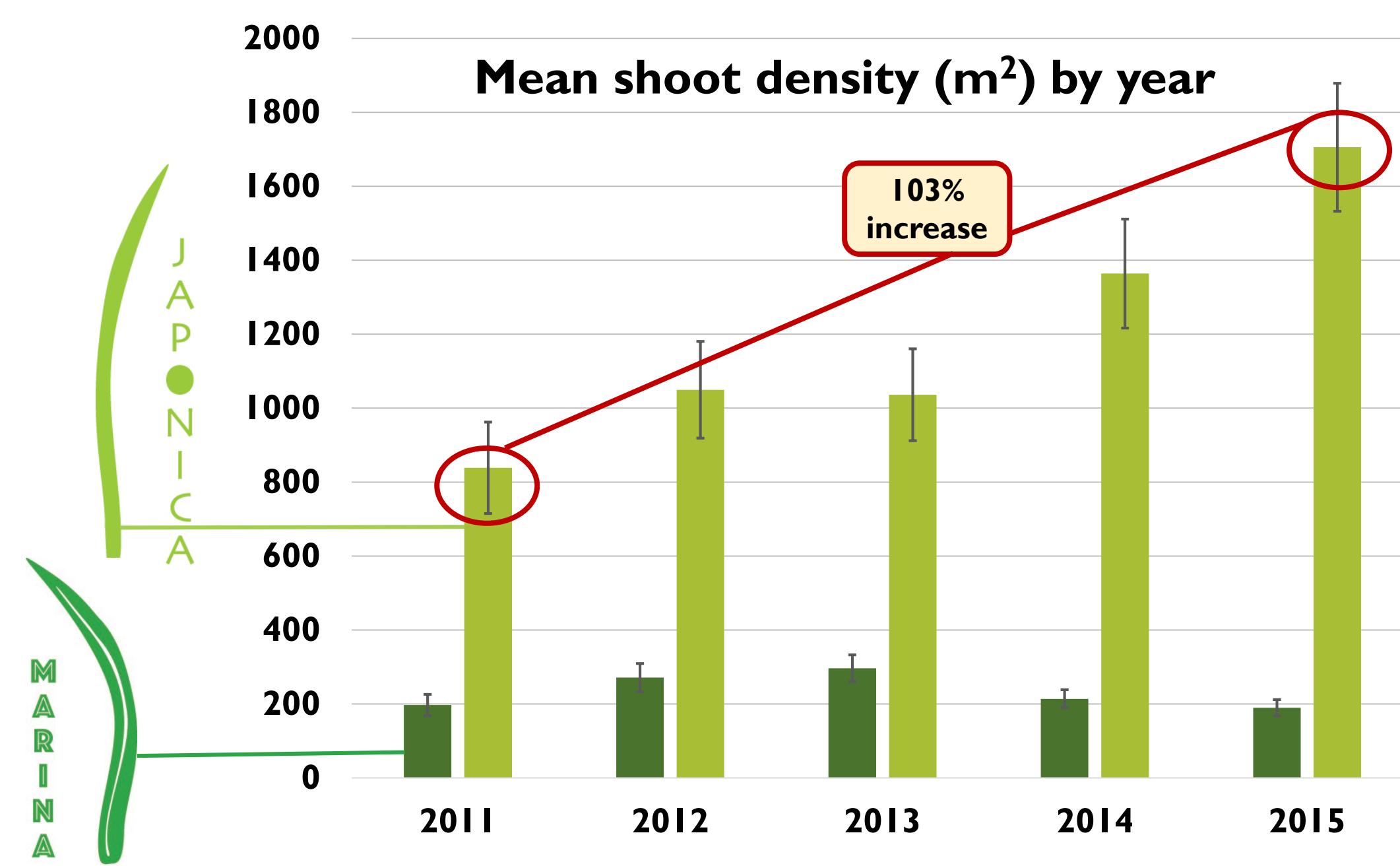
# Density Replicates

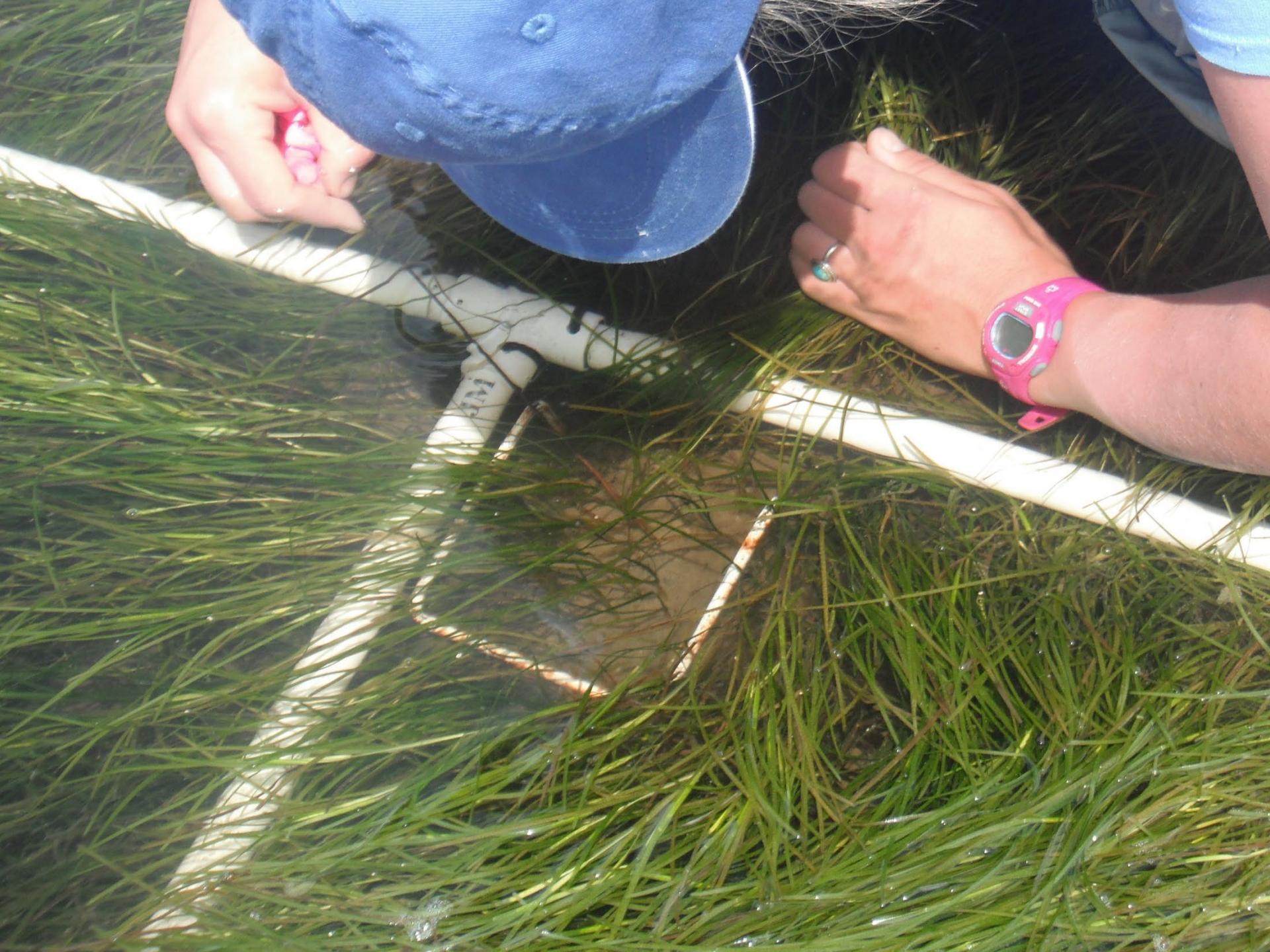


10x10 cm randomly placed at five replicates (out of 100)

25x25 cm randomly placed at three replicates (out of 16)

# Mean shoot density ( $\text{m}^2$ ) by year



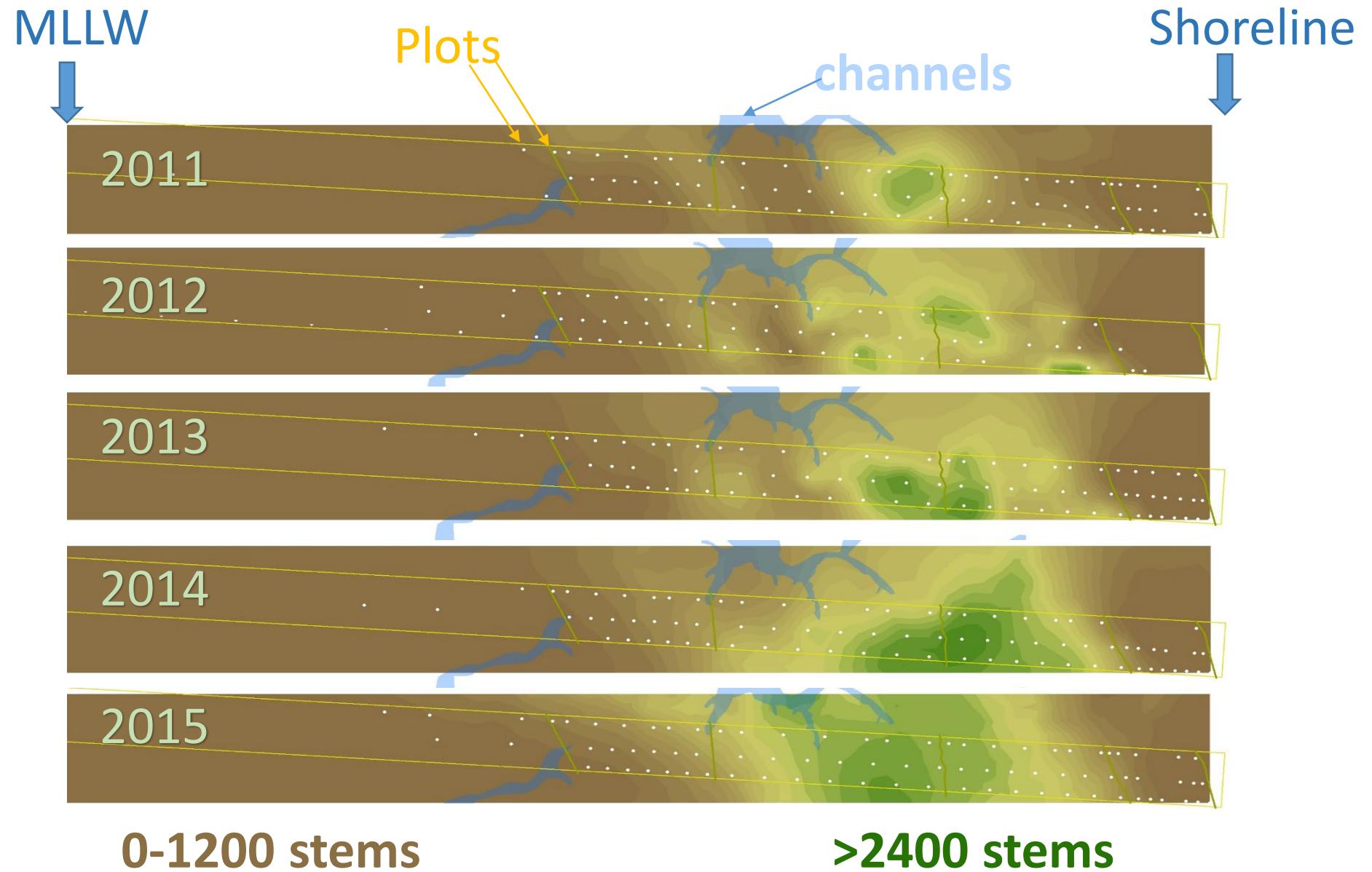


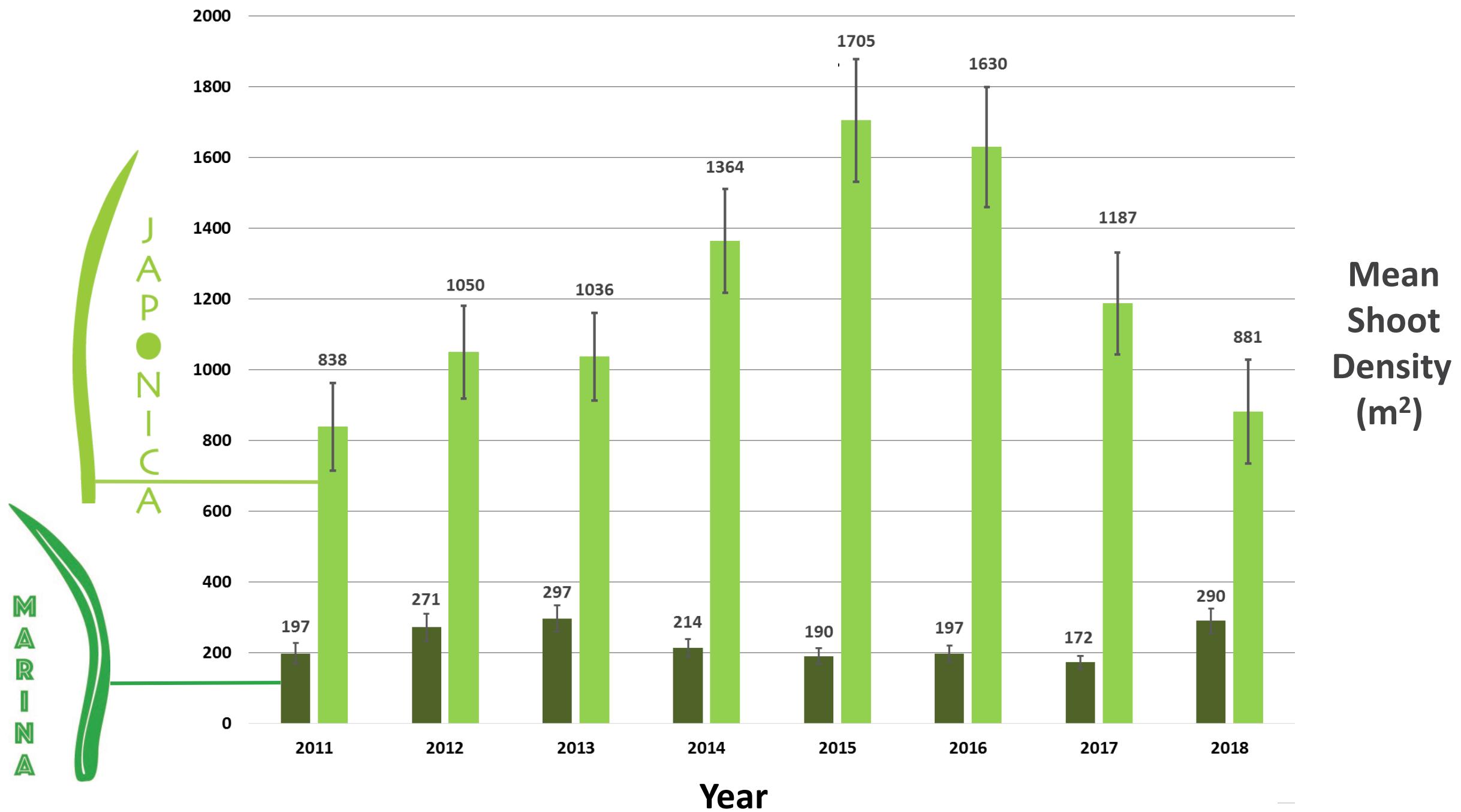
**Empirical  
Bayesian  
Kriging  
(EBK)**

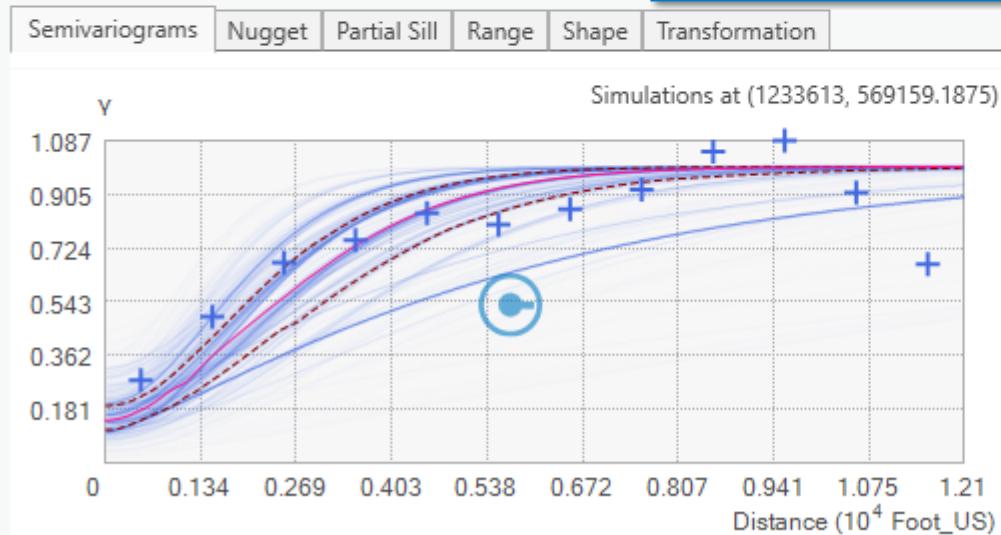
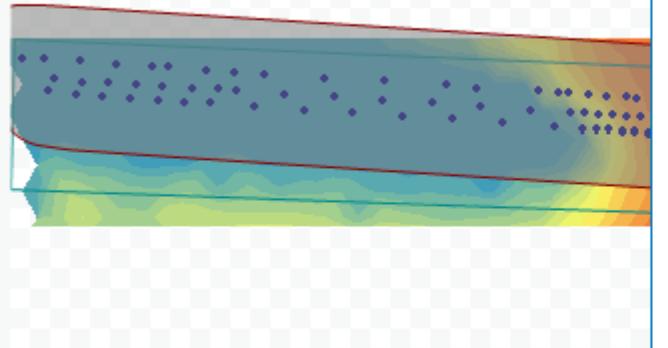


ArcMap 10.3 'EBK robust and easy to use'

JAPONICA







# Empirical Bayesian Kriging Regression

The minimum cumulative percent of variance from the principal components of the raster. Before building the regression model, the principal components of the explanatory variables are calculated, and these principal components are used as explanatory variables in the regression. Each principal component captures a certain percent of the variability of the explanatory variables, and this parameter controls the minimum percent of variance that must be captured by the principal components of each local model.

Value range [0.0; 99.9]

Identify Result

X 1233613  
Y 569159.1875  
Prediction 2667.90179714739  
Standard Error of Prediction 686.014419214452

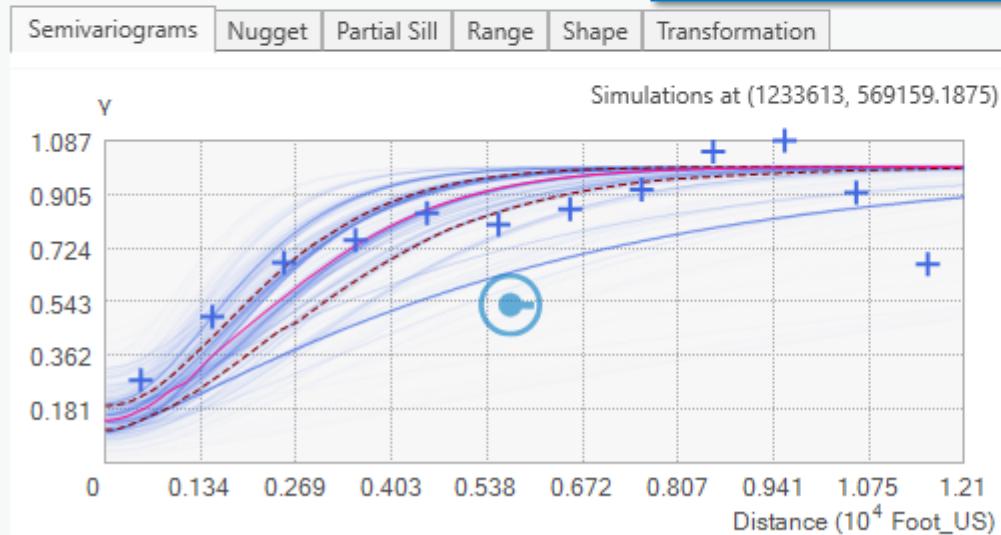
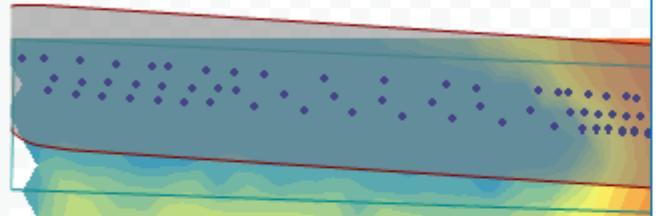
Weights (1 polygons)  
Found 13 neighbors

< Back Next > Finish

## General Properties

Minimum cumulative percent of variance	95
Subset Size	100
Overlap Factor	1
Number of Simulations	10000
Output Surface Type	Prediction
Transformation	Log Empirical
Semivariogram Type	K-Bessel
Neighborhood Type	Standard Circular
Maximum Neighbors	15
Minimum Neighbors	10
Sector Type	1 Sector
Radius	794.081652320676

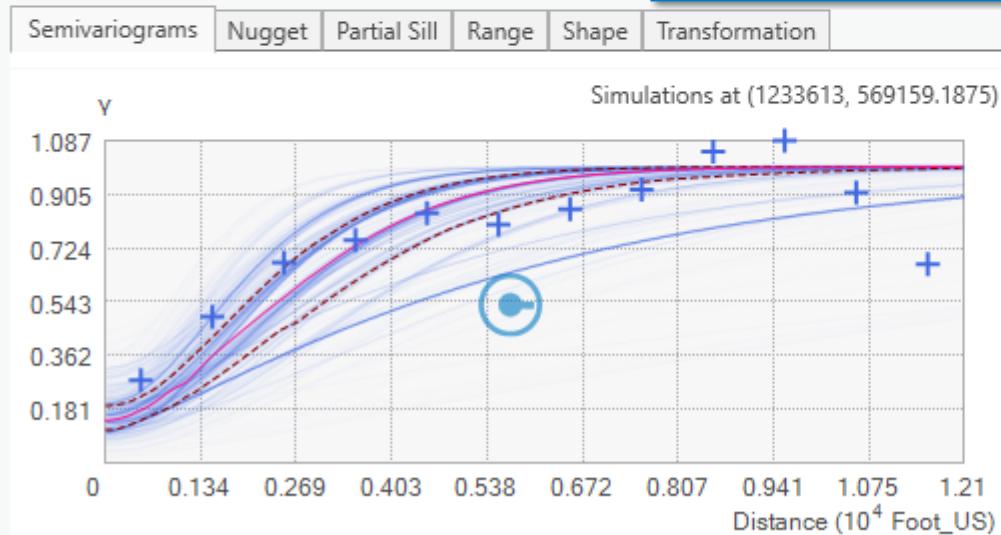




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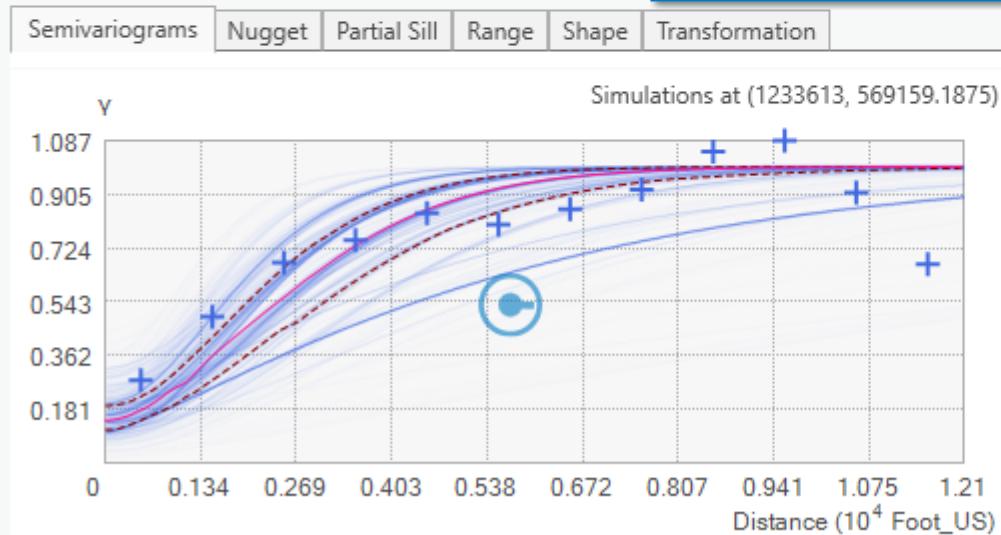
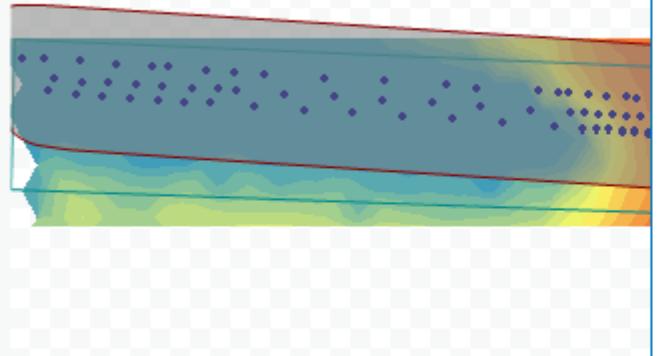
Sector Type

1 Sector

Radius

794.081652320676

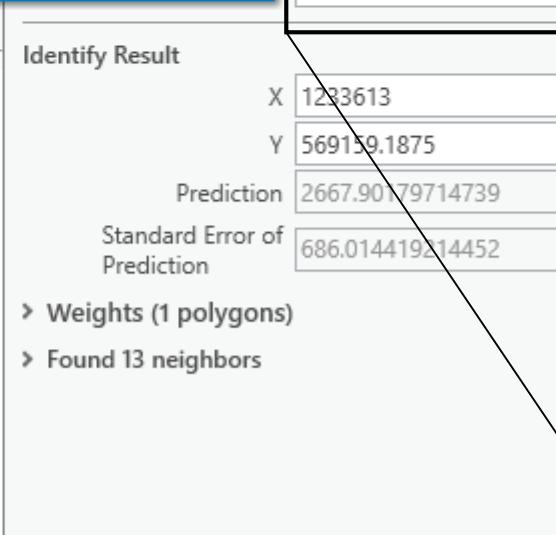
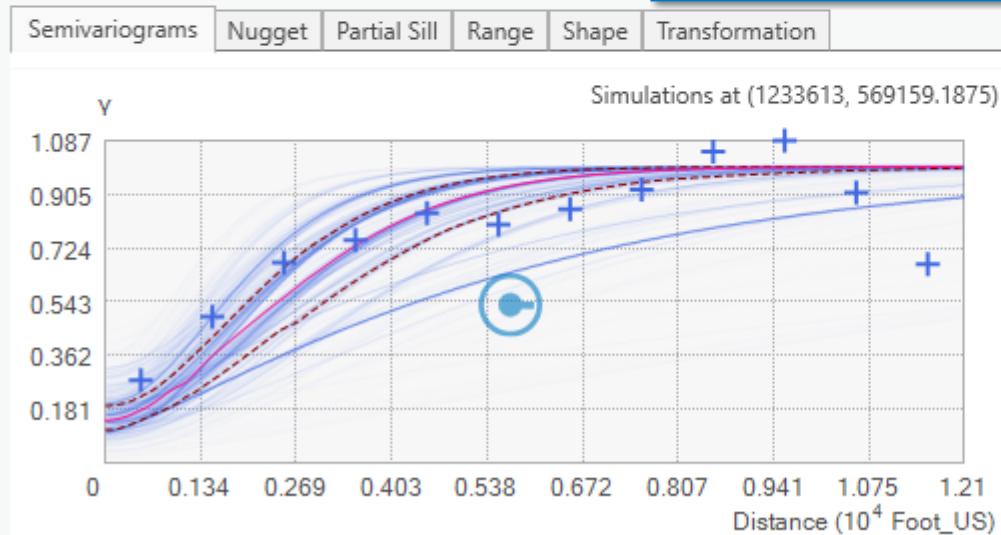




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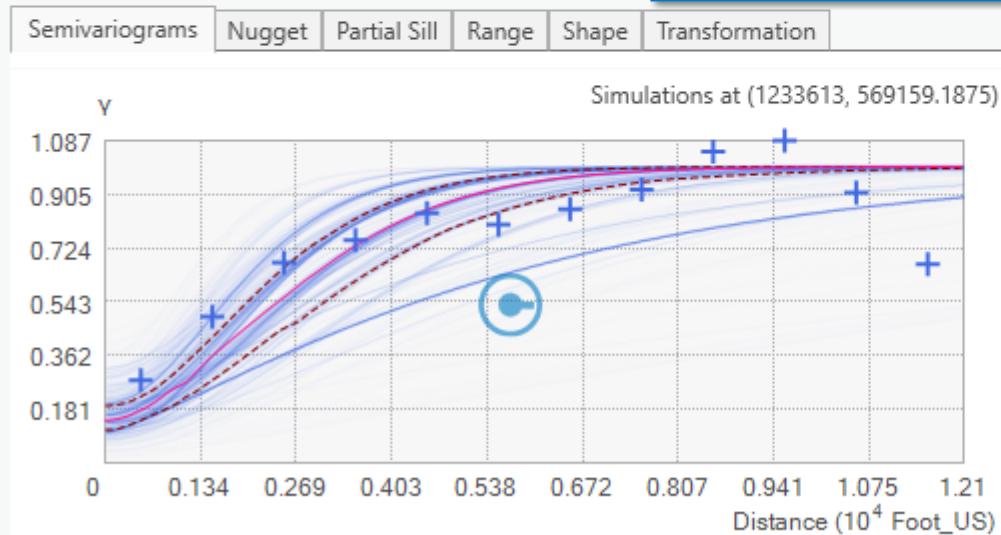
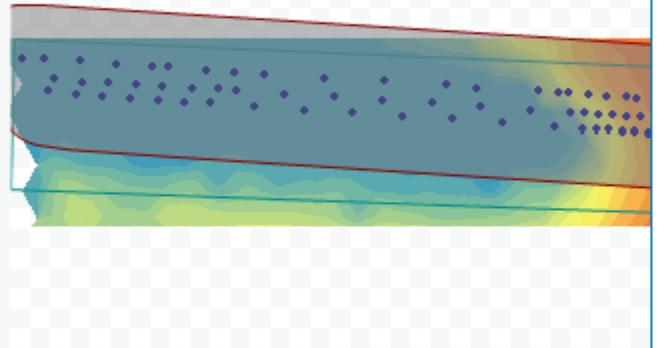


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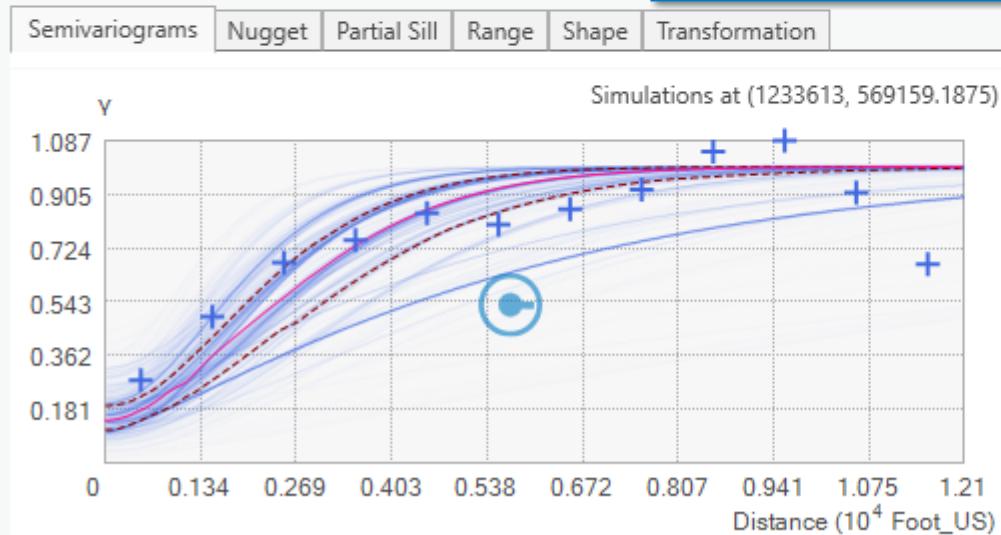




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Semivariogram Type

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15

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10

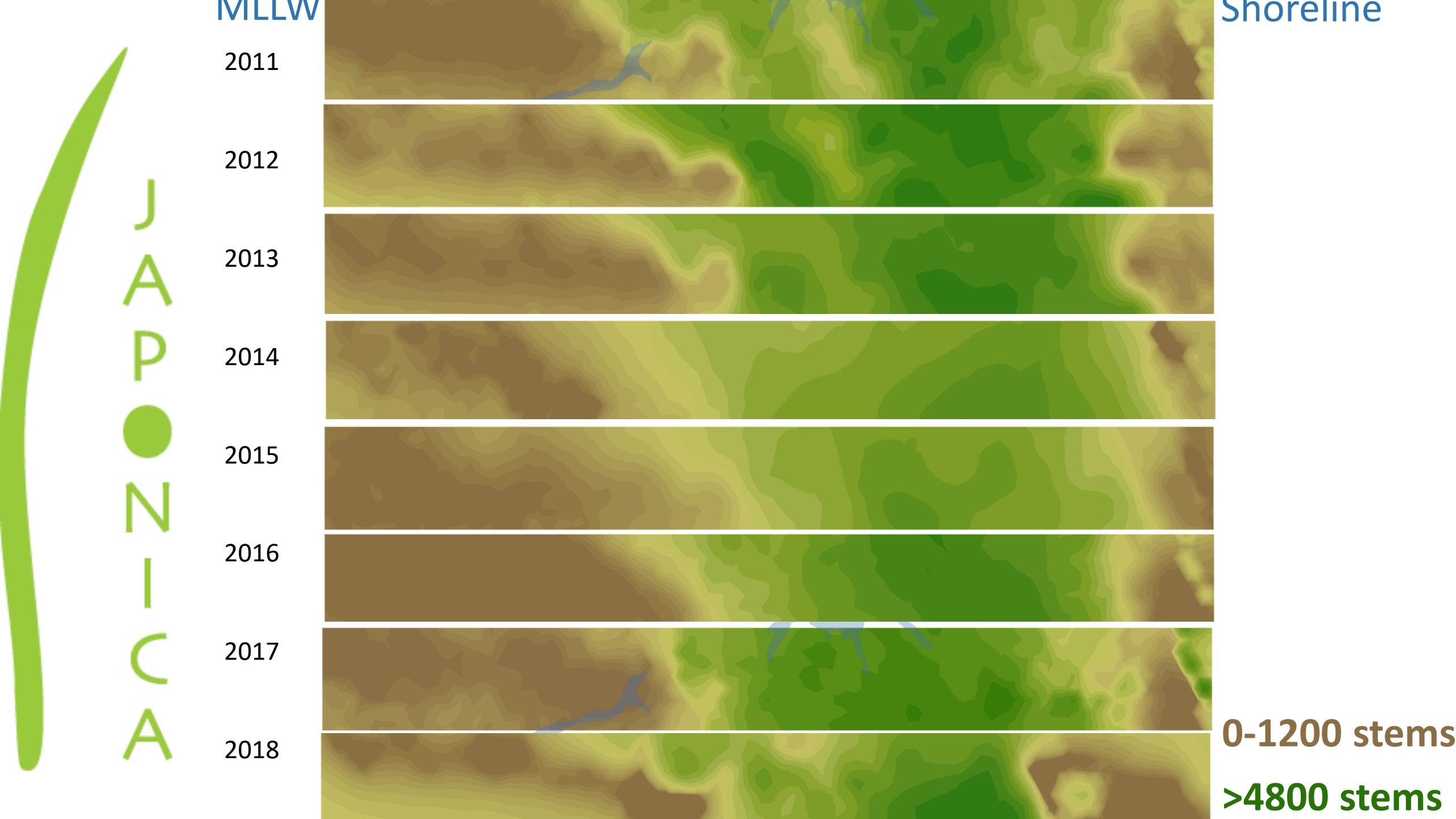
Sector Type

1 Sector

Radius

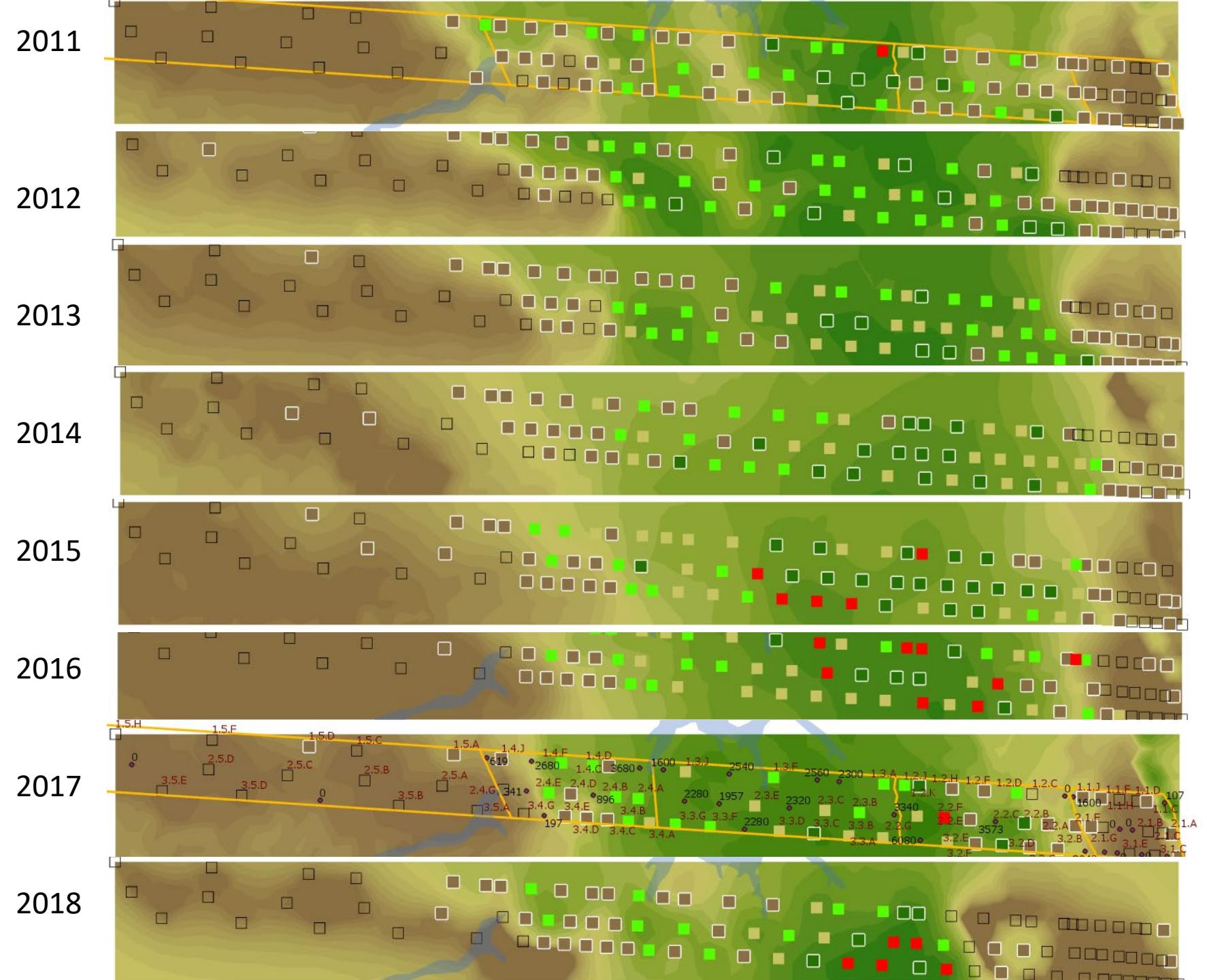
794.081652320676

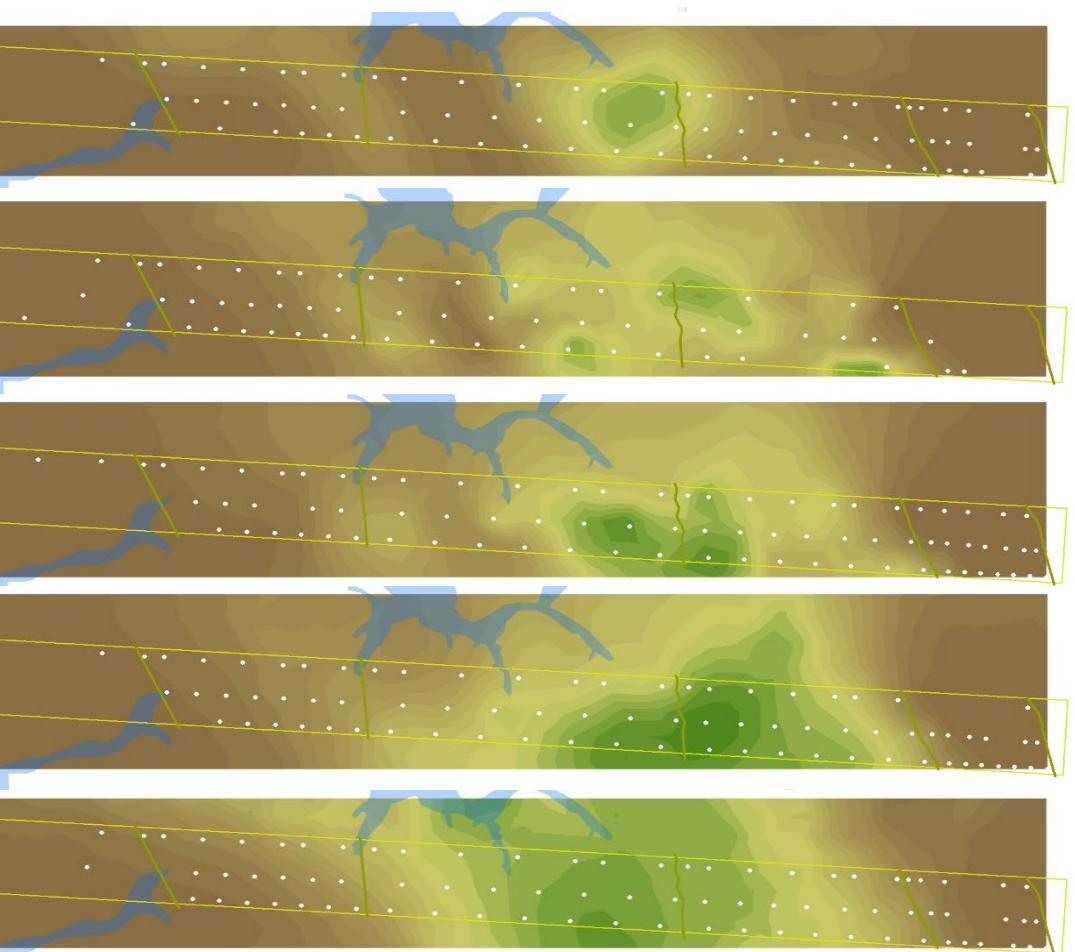




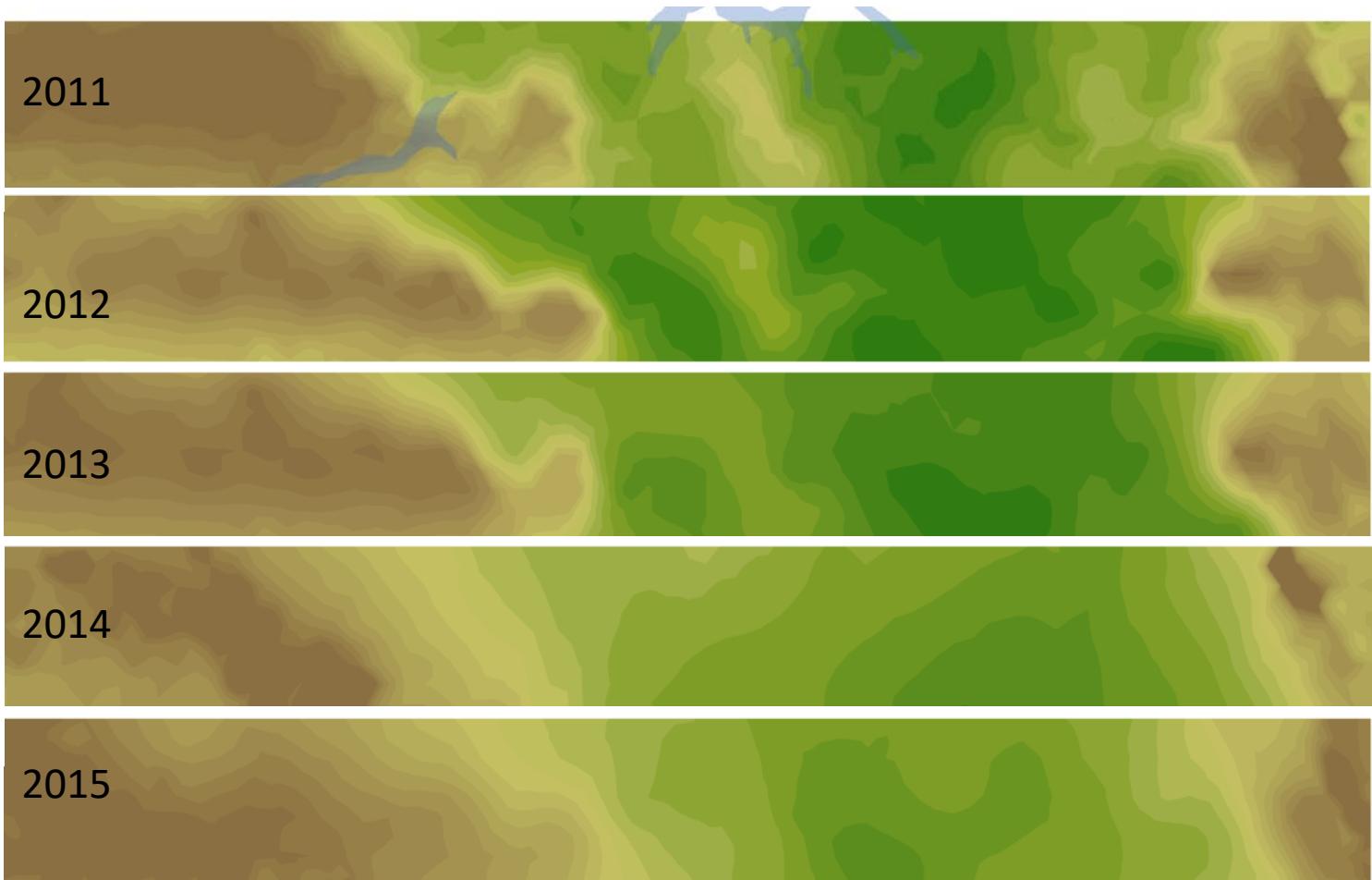
## Shoot density/m<sup>2</sup>

- <= 0.001
- <= 1200
- <= 2400
- <= 3600
- <= 4800
- <= 6000



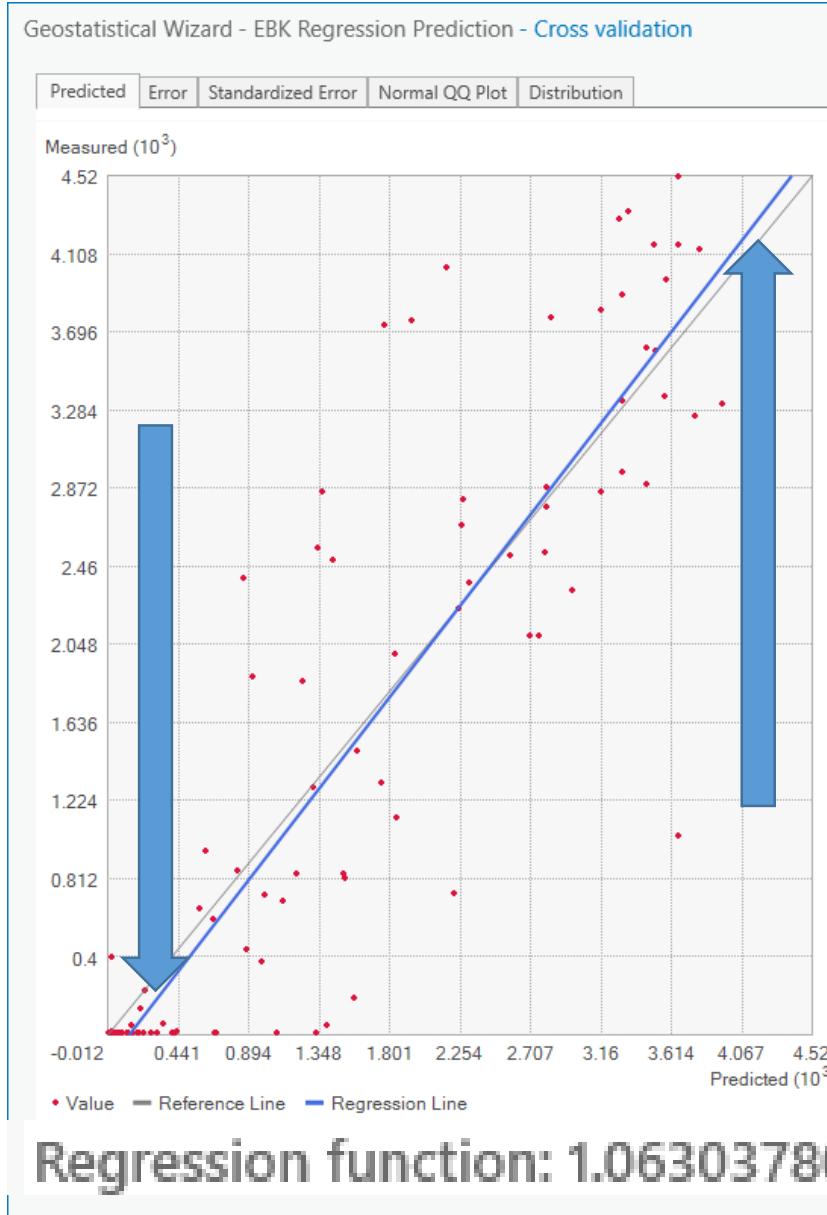


EBK



EBK Regression

# Cross Validation Positive slope



## Cross Validation

RMS Standard Error about equal to 1 means prediction standard errors are valid, but under estimating error

	Summary	Table
Count		99
Mean	4.2240	
Root-Mean-Square	700.96	
Mean Standardized	0.0030	
Root-Mean-Square Standardized	0.9621	
Average Standard Error	740.17	

**Cross Validation  
Confidence  
Intervals look good**

Summary	Table
Count	99
Average CRPS	379.85
Inside 90 Percent Interval	88.888
Inside 95 Percent Interval	92.929

**Cross Validation  
Confidence  
Intervals look good**

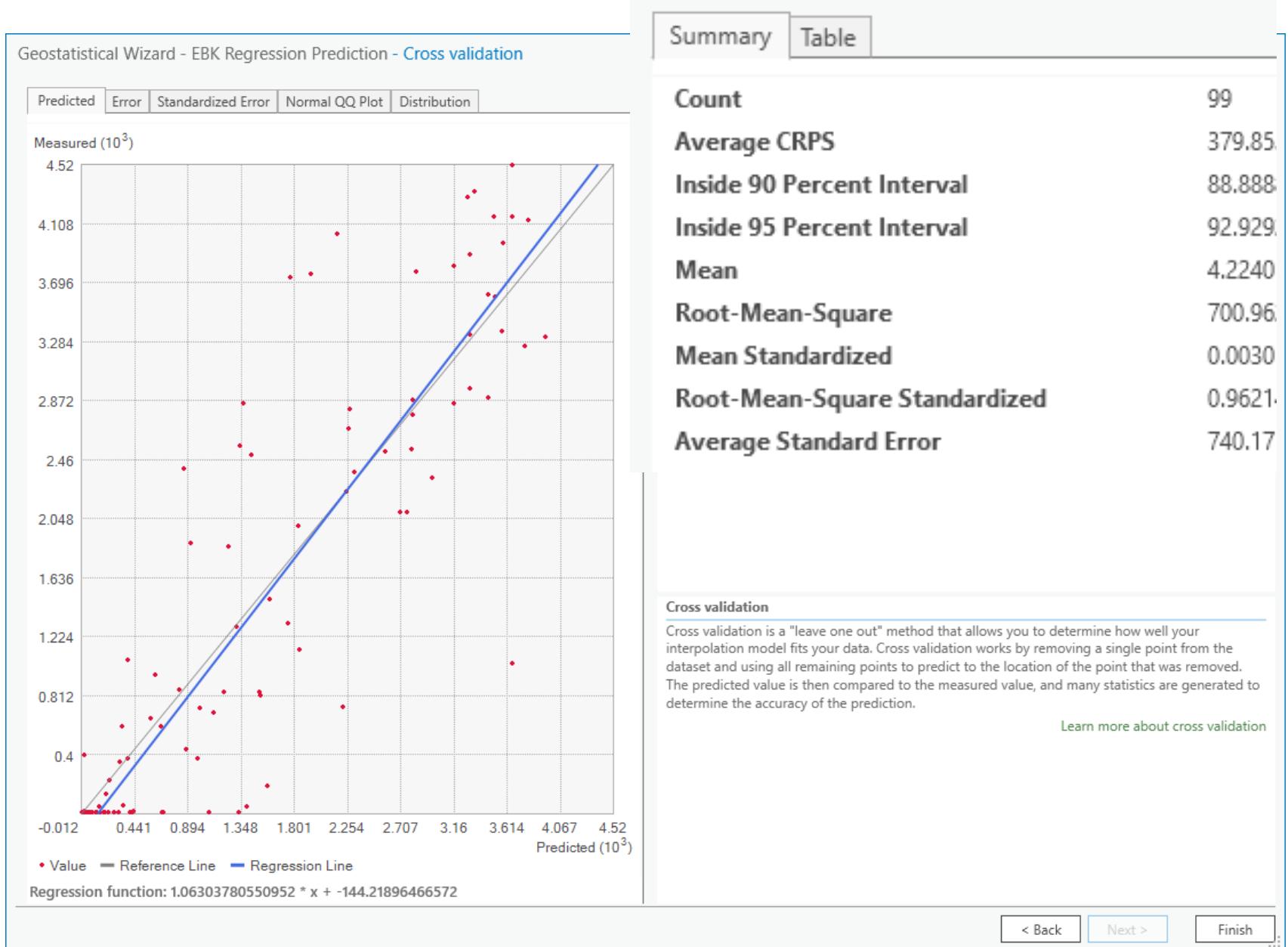
**Continuous Ranked  
Probability Score  
(CRPS) of all points,  
is it low enough?**

The CRPS is a diagnostic that measures the deviation from the predictive cumulative distribution function to each observed data value. This value should be as small as possible.

This diagnostic has advantages over other cross-validation diagnostics because it compares the data to a full distribution rather than to single-point predictions.

Summary	Table
Count	99
Average CRPS	379.85
Inside 90 Percent Interval	88.888
Inside 95 Percent Interval	92.929

# Cross Validation



**Next Steps:**  
**Consult with a Geostatistical Analyst!**  
**Add explanatory variables**  
**Apply to native eelgrass and salt marsh**





Thank you!  
sshull@Padillabay.gov