Aquaculture, Eelgrass, and Fish

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Oregon State University

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Project Information

- **Project no:** C1617-3
- **Secondary:** Shivani Patel
- **Client name:** Measure N. Fish
- **Client degree:** M.S. student
- **Department:** CEOAS - Marine Resource Management
- **Statistical background:** ST 511, ST 512
- **Major professor:** Flaxen Conway
- **Approximate timeline:** Data collected, defend June ’17

Requested Help

In client's words...

- Advice on analysis procedures
- Advice on interpretation of (computer) analysis
- Writing R script
- Figuring out what my variables are (response, independent, etc)
- What to put in my models
- How to put my numbers from my data into models
- How to import a spreadsheet into r to run analyses

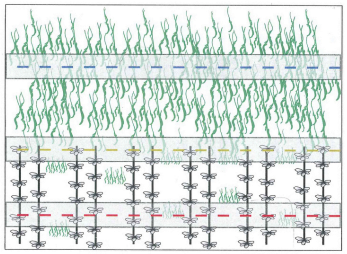
Introduction

- Shellfish aquaculture
  - Oysters (yum?) $\rightarrow$ $$$
- Estuary $\Longleftrightarrow$ bay - where freshwater and saltwater meet
  - Where eelgrass lives
- Robust eelgrass habitats $\rightarrow$ happy, healthy fish
- Overarching research qeustion
  - What is the relationship between shellfish aquaculture, predation, eelgrass habitat complexity, and fish species abundance and activity?

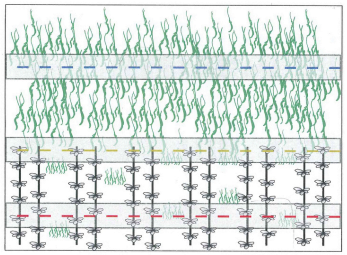
Project Layout

Bay 1

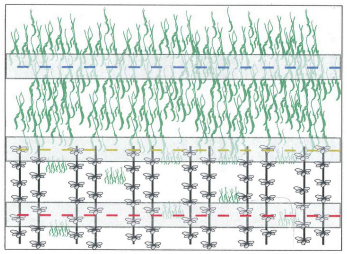
Site 1



Site 2

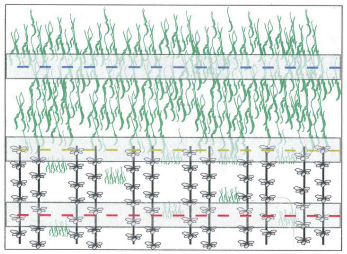


Site 3

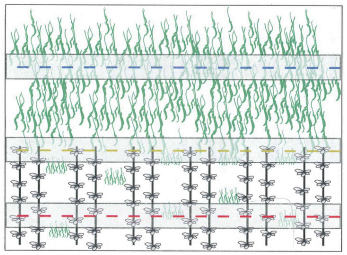


Bay 2

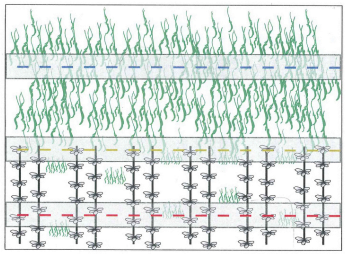
Site 4



Site 5



Site 6

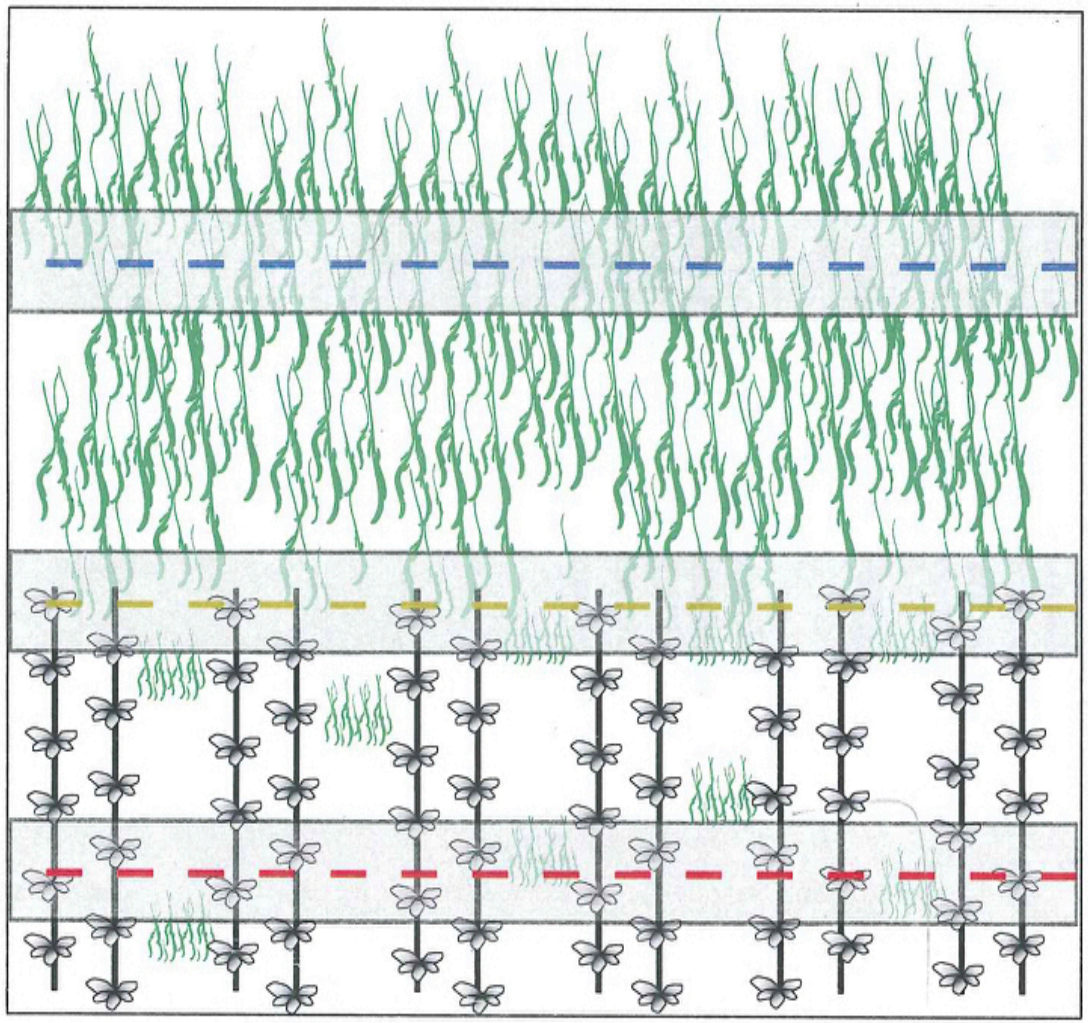


Site Layout

Eelgrass

Edge

Shellfish

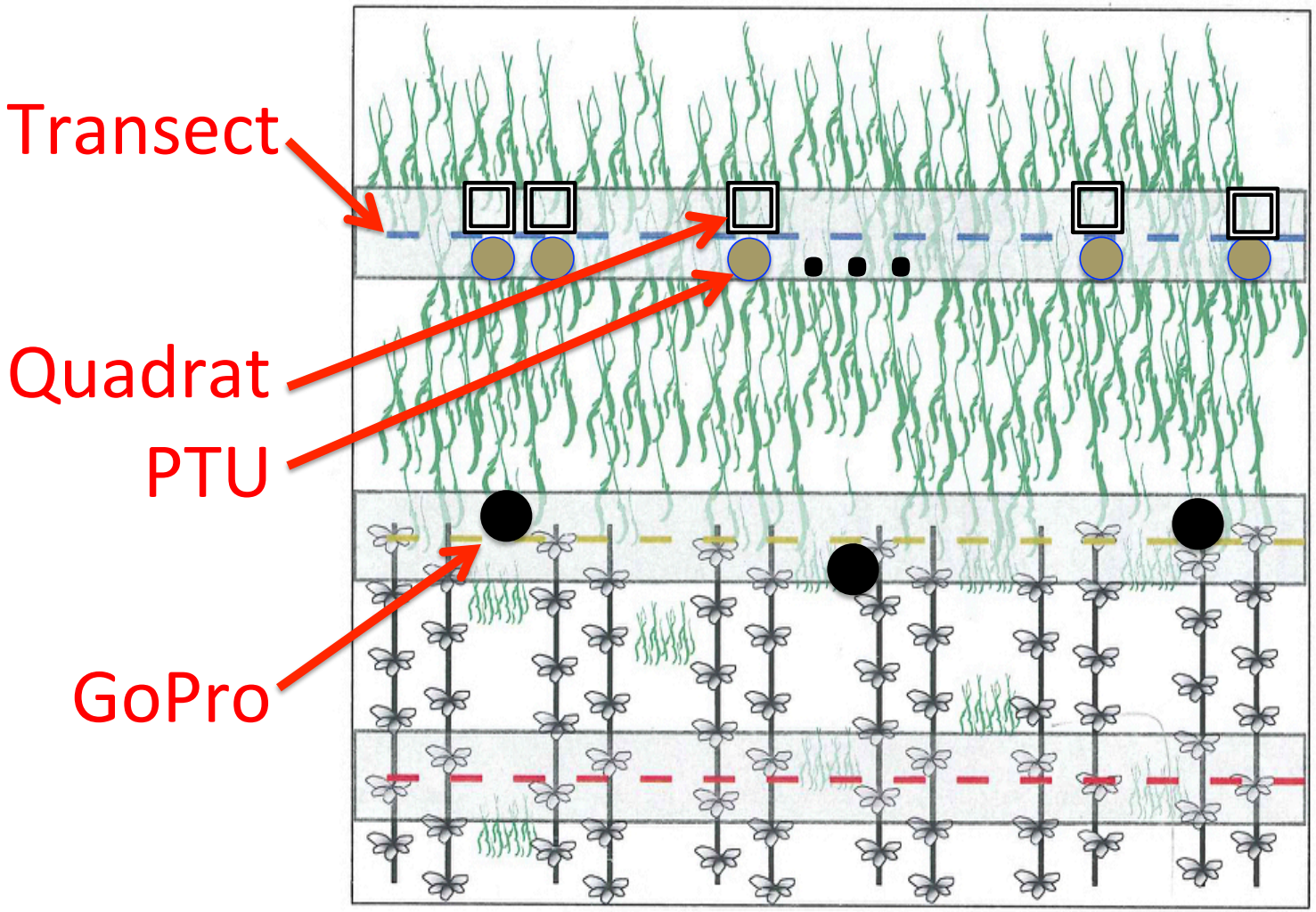


Data

What is the relationship between shellfish aquaculture, eelgrass habitat complexity, and fish species abundance and activity?

- Shellfish aquaculture
- Predation
- Eelgrass habitat complexity
- Fish species abundance and activity

Data Collection Mechanisms



Data Collection Procedures

What is the relationship between shellfish aquaculture, eelgrass habitat complexity, and fish species abundance and activity?

- Shellfish aquaculture
- Predation - PTUs
- Eelgrass habitat complexity - Quadrats
- Fish species abundance and activity - GoPros

Data Collection - Predation

- Shellfish aquaculture
- Predation - PTUs
  - PTU - Predation Tethering Unit
  - Two squid chunks tied to stick at two heights
  - Checked for presence/absence 9 AM, 9:30 AM, 7:30 AM
- Eelgrass habitat complexity - Quadrats
- Fish species abundance and activity - GoPros

Data Collection - Eelgrass Habitats

- Shellfish aquaculture
- Predation - PTUs
- Eelgrass habitat complexity - Quadrats
  - Quadrat - Square, PVC pipe, 0.5m on each side
  - Inside quadrat boundaries, visually assess: percent cover, percent epiphyte cover, percent macroalgae, shoot density
  - Remove one eelgrass shoot (if possible*) and store for further analysis in laboratory setting
- Fish species abundance and activity - GoPros

Data Collection - Species

- Shellfish aquaculture
- Predation - PTUs
- Eelgrass habitat complexity - Quadrats
- Fish species abundance and activity - GoPros
  - Place three cinder blocks at 5m, 25m, 45m at low tide
  - Snorkelers place two GoPros one hour before high tide
  - Retrieved one hour after high tide
  - Data... to be continued

Research Questions...

...in the **client's words**.

- Are there differences in fish and crab composition across habitat types?
  - H_0: There is no difference among fish and crab community across habitat types.
  - H_1: There is a difference among fish and crab community across habitat types.
- Does relative predation vary across habitat types?
  - H_0: There is no difference in relative predation across habitat types.
  - H_1: There is a difference in relative predation across habitat types.

Data

Eelgrass: 20 x 3 x 3 x 2 = 360 observations

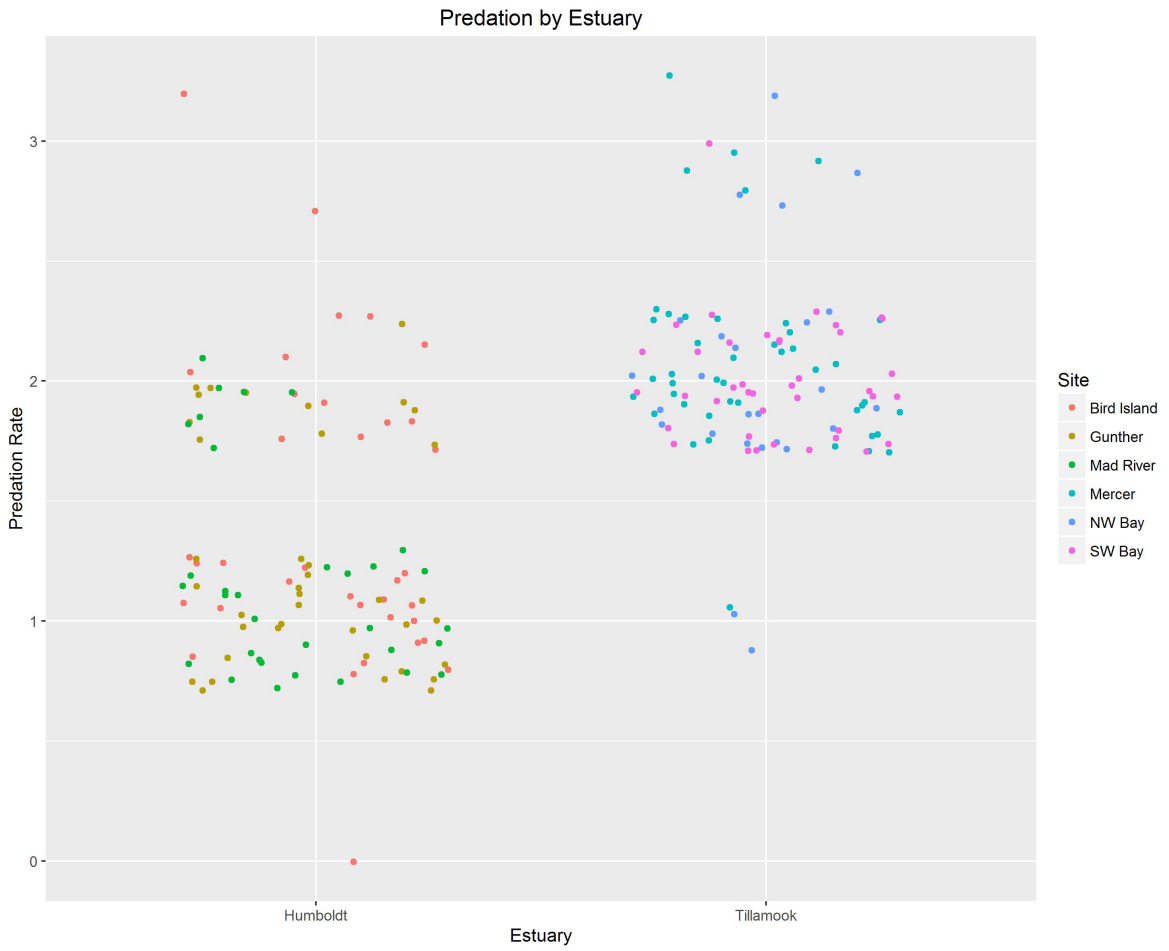
	ID	Estuary	Site	Habitat	Date	Col_by	Ent_by	Quad#	Inun	%Epi	%MacAl	Sht_dnsty
1	241	Tillamook	Mercer	AQ	07/07/16	L. Clarke	L. Clarke	1	Y	0	100	0
2	242	Tillamook	Mercer	AQ	07/07/16	L. Clarke	L. Clarke	2	Y	0	100	0
3	243	Tillamook	Mercer	AQ	07/07/16	L. Clarke	L. Clarke	3	Y	0	25	0
4	244	Tillamook	Mercer	AQ	07/07/16	L. Clarke	L. Clarke	4	N	85	60	2
5	245	Tillamook	Mercer	AQ	07/07/16	L. Clarke	L. Clarke	5	N	0	5	1
6	246	Tillamook	Mercer	AQ	07/07/16	L. Clarke	L. Clarke	6	Y	0	100	0

Predation Tethering Units: 20 x 3 x 3 x 2 = 360 observations

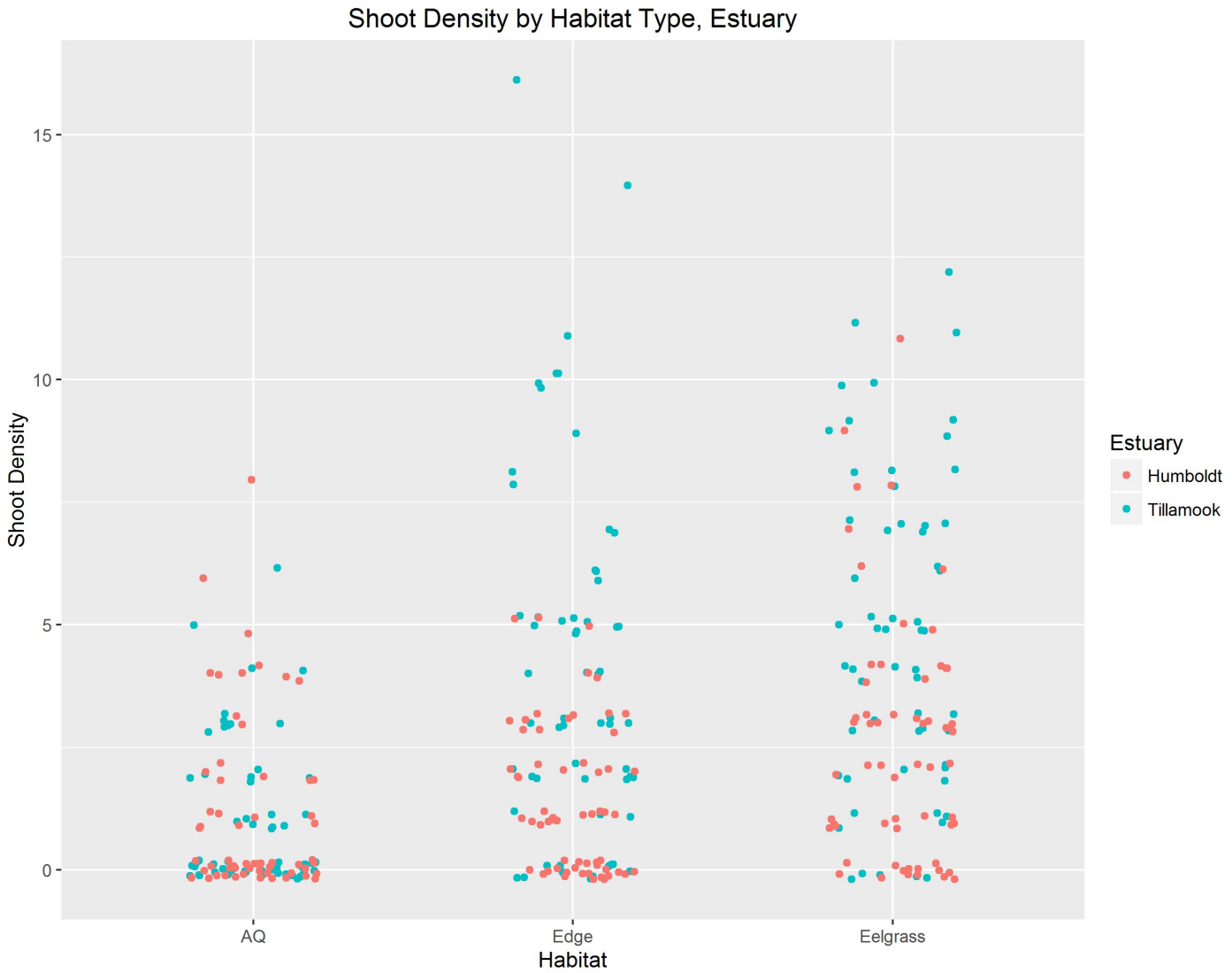
	Date	Estuary	Site	Hab	TDepl	RecBy	CollBy	Ch1Time	Ch2TND	Ch1L	Ch2L	Ch1H	Ch2H
1	07/07/16	Tillamook	Mercer	AQ	855	Suhbrier	L. Clarke	1145	940	1	NA	1	0
2	07/07/16	Tillamook	Mercer	AQ	855	Suhbrier	L. Clarke	1145	940	0	0	1	0
3	07/07/16	Tillamook	Mercer	AQ	855	Suhbrier	L. Clarke	1145	940	1	NA	1	NA
4	07/07/16	Tillamook	Mercer	AQ	855	Suhbrier	L. Clarke	1145	940	1	NA	1	0
5	07/07/16	Tillamook	Mercer	AQ	855	Suhbrier	L. Clarke	1145	940	1	NA	1	0
6	07/07/16	Tillamook	Mercer	AQ	855	Suhbrier	L. Clarke	1145	940	0	0	1	0

Species Abundance and Activitiy: 3 x 3 x 3 x 2 = 54 GoPros...

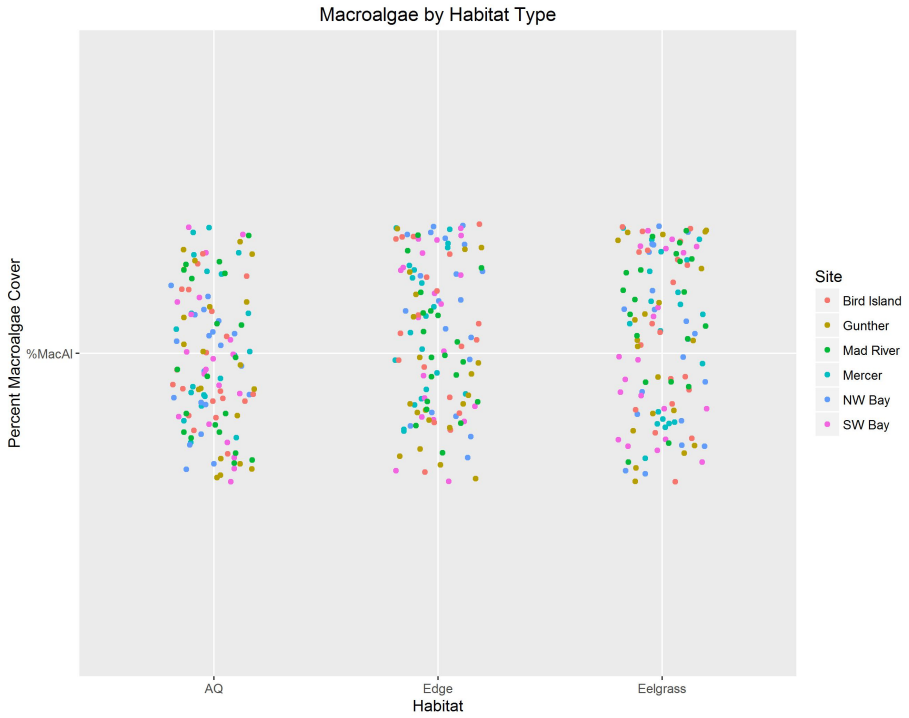
Predation


Predation by Estuary
Predation Rate
3
2
1
0
Humboldt
Tillamook
Estuary
Site
Bird Island
Gunther
Mad River
Mercer
NW Bay
SW Bay

Habitat Complexity



Habitat Complexity



Initial Recommendations

- Since no random selection of bay, sites $\rightarrow$ no inference to all bays, sites
- Hypothesis tests need a parameter
- What are the covariates?
- Use presence/absence = 0/1 instead of the opposite, and sum for a “rate”
- Review literature for techniques to turn video footage into species abundance measurements

Initial Recommendations

- Response and explanatory variables need to have the same number of observations
- When a quadrat has no shoots—record that. Do not pull shoots from outside of quadrat.
- Be aware, numerous sources of uncertainty
- Could fit GLM, log link for Poisson fish count, random effect for bay, random effect for site

- Bay: $i = 1, 2 \rightarrow$ Random effect: $\alpha_i \sim N(0, \sigma^2_\alpha)$
- Site: $j = 1, 2, \ldots, 6 \rightarrow$ Random effect: $\delta_j \sim N(0, \sigma^2_\delta)$
- Habitat: k=1,2,3 $\rightarrow$ Fixed effect
- $\log(E[y_{ijk}]) = \mu + \alpha_i + \delta_j + \beta_k$
- $\log(E[y_{ijk}]) = \mu + \alpha_i + \delta_j + \beta_k + \boldsymbol{X}\boldsymbol{\beta}$