

A photograph of a forest stream. The water flows over dark, moss-covered rocks. Large logs, also covered in moss, lie across the stream. The surrounding forest is dense with tall trees and lush green ferns and undergrowth. The scene is misty or foggy, creating a serene and natural atmosphere.

Interactions between coastal cutthroat trout and sculpins and differential impacts on underyearling hatchery and wild steelhead

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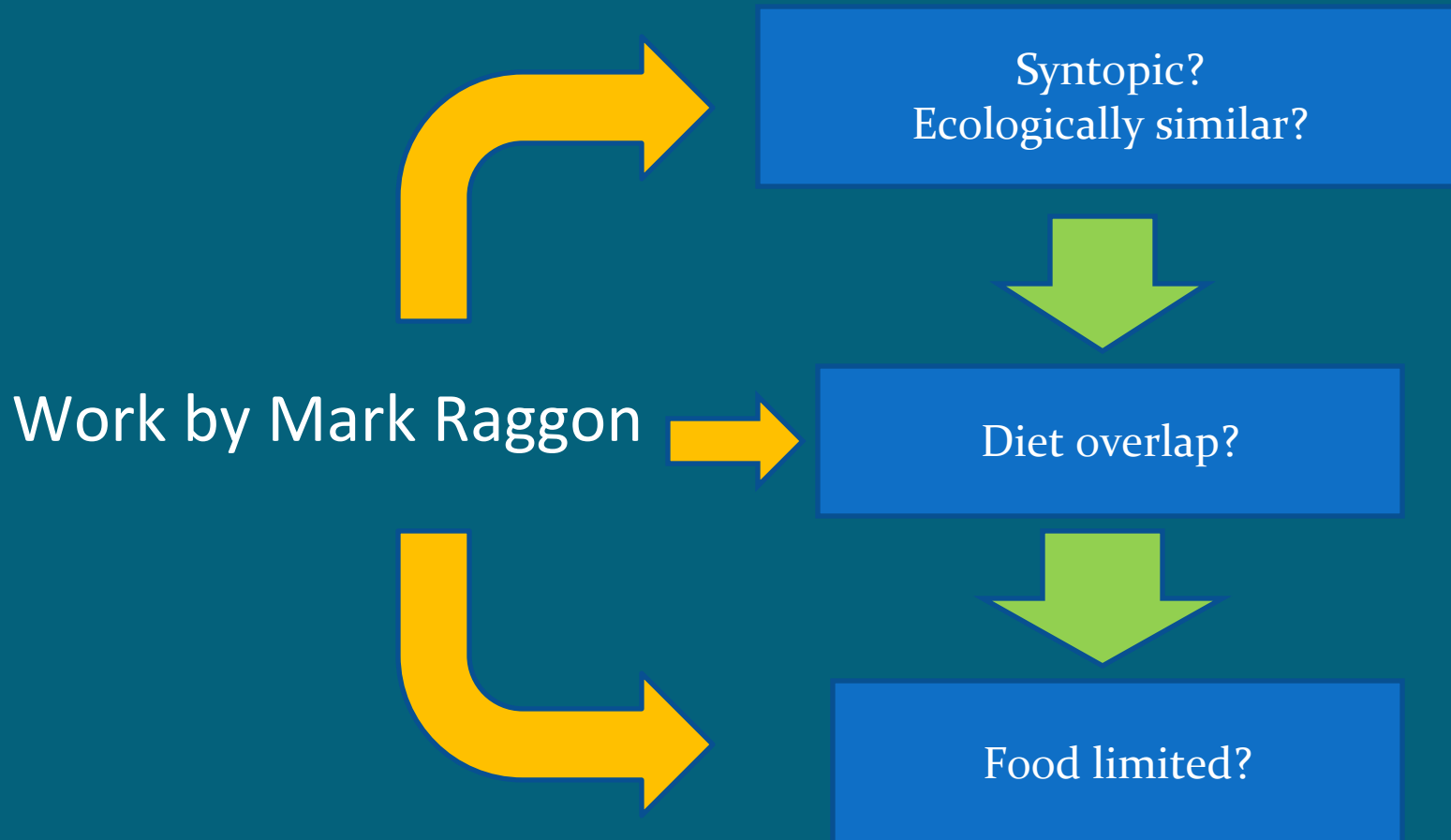
Sculpins are the most abundant but least known species in coastal rivers – do they interact with species like coastal cutthroat trout?



VS.



Setting the stage for interaction



Mark Raggon



Ben Ramirez



Syntopic?
Ecologically similar?



Diet overlap?



Food limited?



Population effects?
Laboratory experiment?

Research Questions

- Interactions between coastal cutthroat trout and riffle/reticulate sculpins and consequences for -
 - Individuals: growth, survival, condition, emigration, size
 - Population: density and size distribution

Mechanisms

- Can be both competitors and predators
 - What process is most important?
- Strength of interactions within and between species?

The Oregon Hatchery Research Center

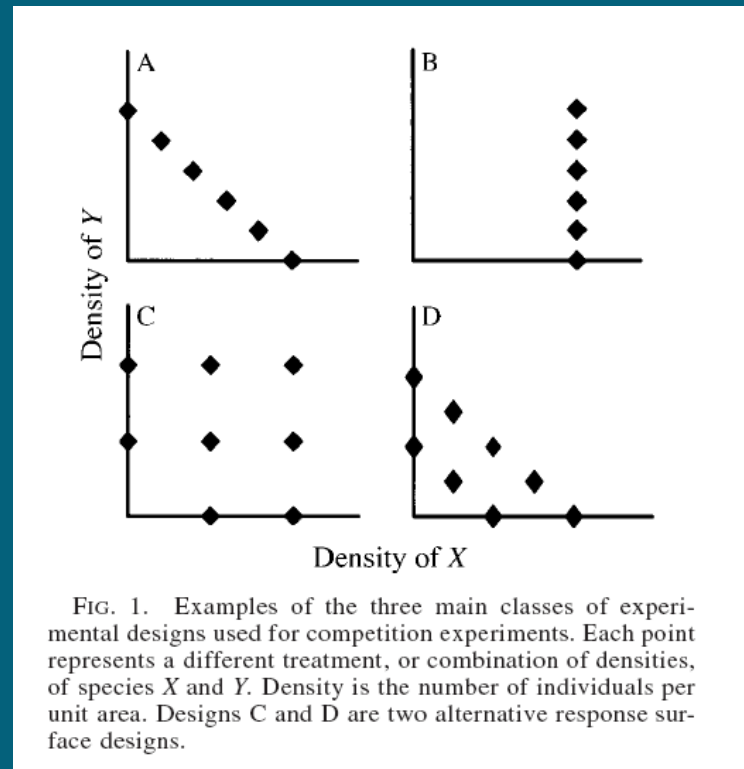


Artificial stream channels at the OHRC

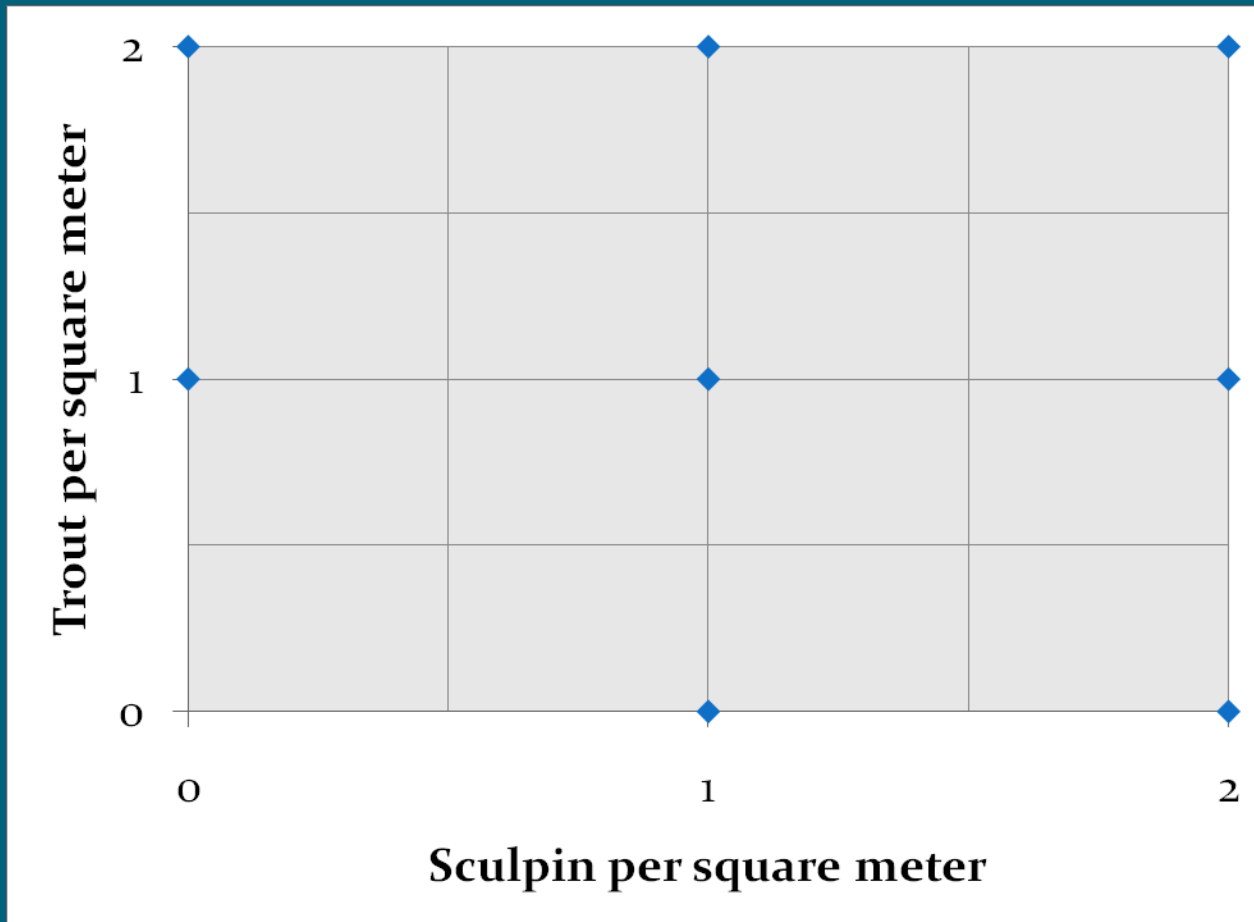


Experimental Design

- Response Surface Designs
 - Inouye 2001
 - Cousens 1991
 - Young 2004
 - Forrester et. al. 2006



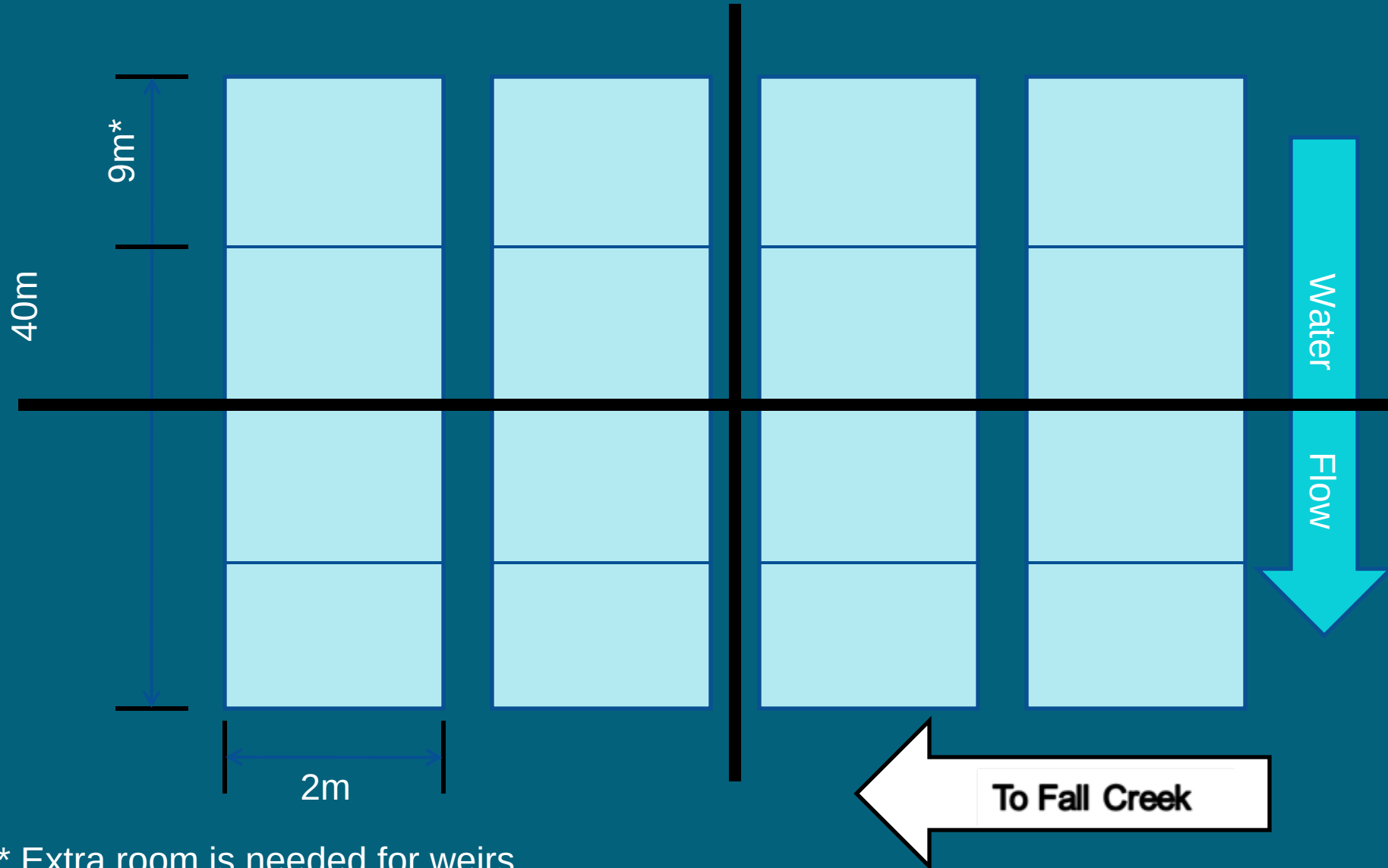
My Response Surface Design



Sculpin and Trout Numbers

Treatment	Trout/m ²	Sculpin/m ²	# Trout for 9 x 2 m (18m ²)	# Sculpin for 9 x 2 m (18m ²)
1	0	1	0	18
2	0	2	0	36
3	1	0	18	0
4	1	1	18	18
5	1	2	18	36
6	2	0	36	0
7	2	1	36	18
8	2	2	36	36
Total			162	162

Experimental Design with Randomization Axes



* Extra room is needed for weirs

Steelhead Component

Experimental Design

- 50 underyearling steelhead per treatment
- All hatchery steelhead in first treatments
- All wild steelhead in replication treatments

Response measure

- Survival of underyearling steelhead

Hypothesis and Predictions

$$Y_1 = \beta_0 - \beta_1 X_1 - \beta_2 X_2 - \beta_3 X_1 X_2$$

Intra- and Interspecific Competition

- Which will be stronger in my experiment?
- Intraspecific > Interspecific
 - Between-species differences
 - Within-species similarities

Hypothesis and Predictions

What will the effect be of a species on itself ($\beta_1 X_1$)?

- Conspecific effect will be negative ($\beta_1 < 0$)
 - Decrease in available cover, territories, and food
 - Decreased growth due to resource limitation
 - Increased agonistic activity
 - Increase in size selective predation
 - Increase in emigration

Hypothesis and Predictions

- What will the effects of a heterospecific be ($\beta_2 X_2$)?
- Heterospecific effect will be negative ($\beta_2 < 0$)
 - To a lesser extent than conspecific effect
 - Intraspecific > interspecific competition
 - Ecologically similar within-species

Hypothesis and Predictions

Will there be a significant interaction term ($\beta_3 X_1 X_2$)?

- Interaction will be significant
 - Intraspecific modifies interspecific competition or vice-versa
- A second-order polynomial will also be investigated
 - Nonlinear responses in biological data

Hypothesis and Predictions: Steelhead Component

Will there be a difference in survival between hatchery and wild steelhead?

- Wild > Hatchery
 - Wild fish should show greater survival and growth
 - How do different predators at different densities affect this response?

Hypothesis and Predictions: Steelhead Component

Will sculpins or cutthroat trout be the dominant predator of underyearling steelhead?

- Cutthroat trout > Sculpins
 - Salmonids should share similar activity and feeding patterns
 - Greater possibility of competitive interaction within salmonids
 - What about predation?

Questions?



Photo credit: Dave Leer