

YY 'Trojan' Males as an Eradication Tool

Andrew Whiteley

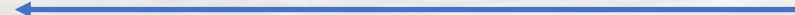
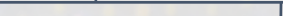
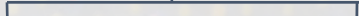
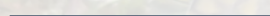
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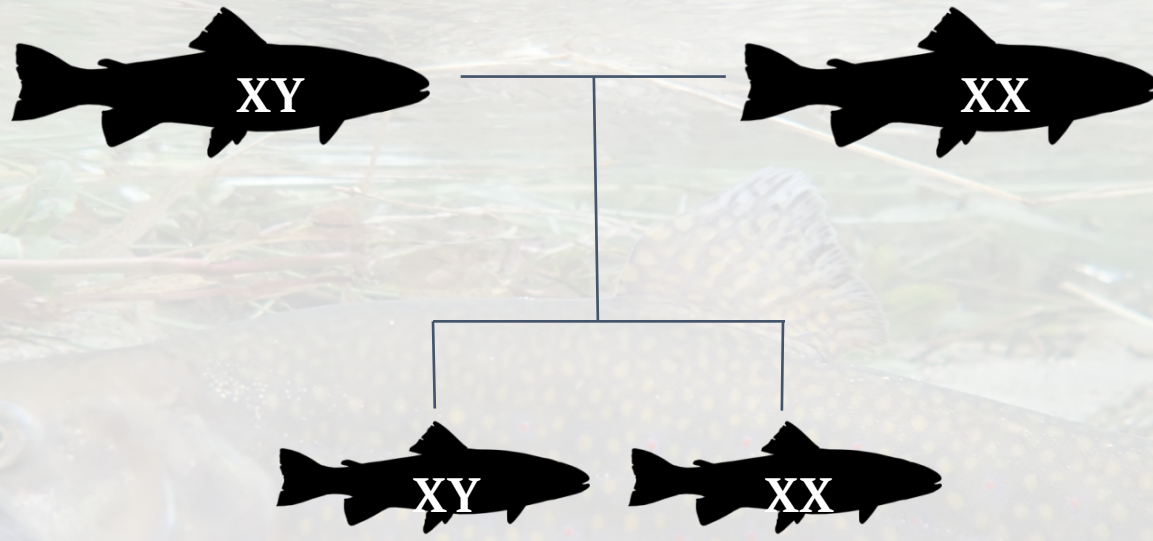


Options for reducing or eliminating non-native trout

- Non-native species is allopatric
 - Options: chemical or mechanical eradication
- Non-native species is sympatric with high priority native species
 - Option: Mechanical
 - Attempt removal
 - Might not be successful
 - Suppression only (mowing the lawn)
 - Newly developed tool
 - YY 'Trojan' males

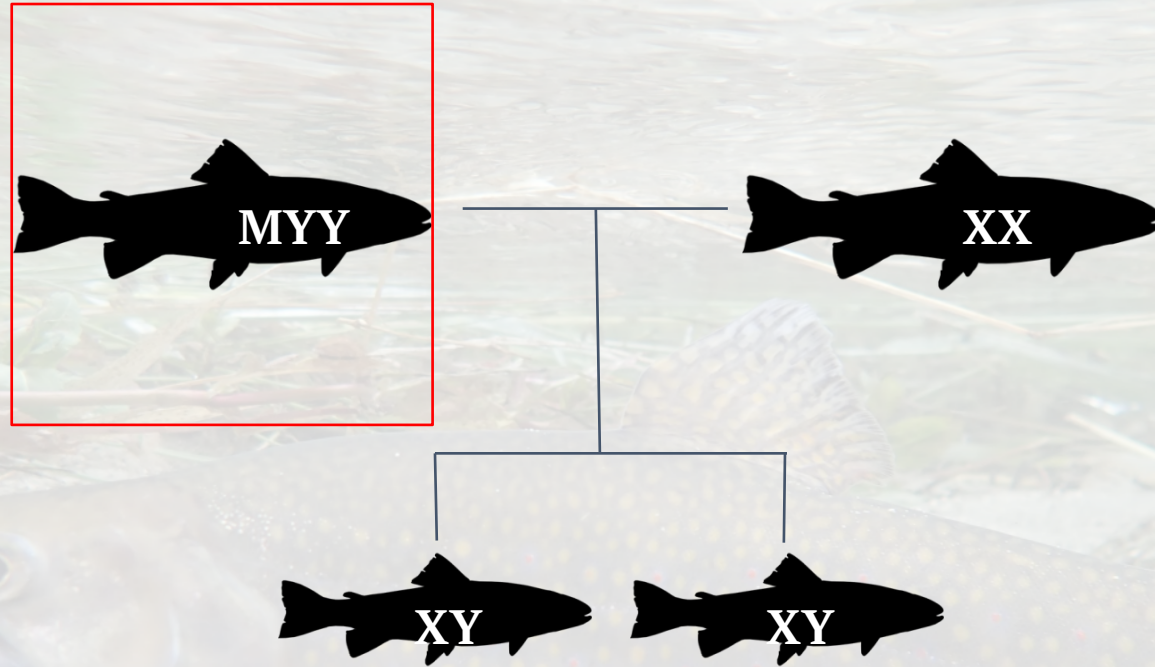
Estrogen





Sex ratio~equal

YY Males (MYY)



Sex ratio = 100% male

YY male salmonids

- ▣ Primarily inducing a demographic phenomenon
 - Extreme skew in sex ratio to induce extirpation
- ▣ Different from biotechnology solutions such as bioengineered mosquitoes
 - Passing lethal alleles to offspring
- ▣ However, extreme hatchery breeding could lead to low fitness of YY males that are stocked
 - More extreme than typical hatchery production

Many remaining questions.....

- ▣ How many to add? Over how many years? Number of release locations?
- ▣ In conjunction with suppression? How much suppression? How often?
- ▣ What age of YY males?
- ▣ When do they mature?
- ▣ Fitness of YY males once they are stocked?
- ▣ Fitness of their offspring?

Example: YY Brook trout in the western US

- Brook trout outcompete and replace cutthroat trout in the west
- Chemical eradication is often used when brook trout are allopatric
- Manual suppression (electrofishing) has been used when brook and cutthroat trout are sympatric
- Suppression and YY males are starting to be used in combination
 - Reduce abundance then skew the sex ratio to cause eradication

Empirical work

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FEATURED PAPER

Survival and Reproductive Success of Hatchery YY Male Brook Trout Stocked in Idaho Streams

Patrick A. Kennedy,* Kevin A. Meyer, and Daniel J. Schill

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Simulation work



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Simulated Effects of YY-Male Stocking and Manual Suppression for Eradicating Nonnative Brook Trout Populations

Daniel J. Schill, Kevin A. Meyer & Michael J. Hansen

Biological Conservation 221 (2018) 10–22

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Using simulation modeling to inform management of invasive species: A case study of eastern brook trout suppression and eradication

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RESEARCH ARTICLE

Journal of Applied Ecology



Simulating effects of fitness and dispersal on the use of Trojan sex chromosomes for the management of invasive species

Casey C. Day¹ | Erin L. Landguth¹ | Ryan K. Simmons² | William P. Baker³ | Andrew R. Whiteley⁴ | Paul M. Lukacs⁴ | Andrew Bearlin²



ARTICLE

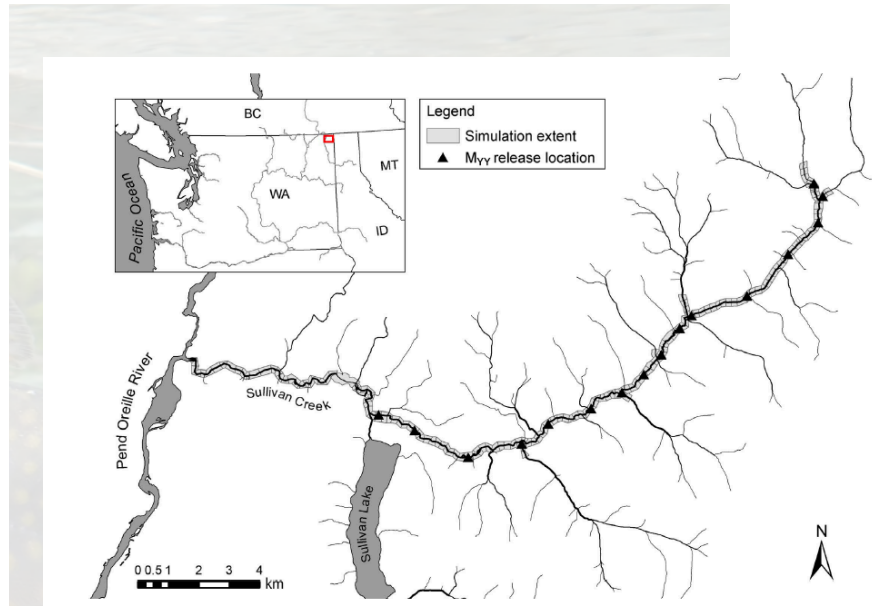
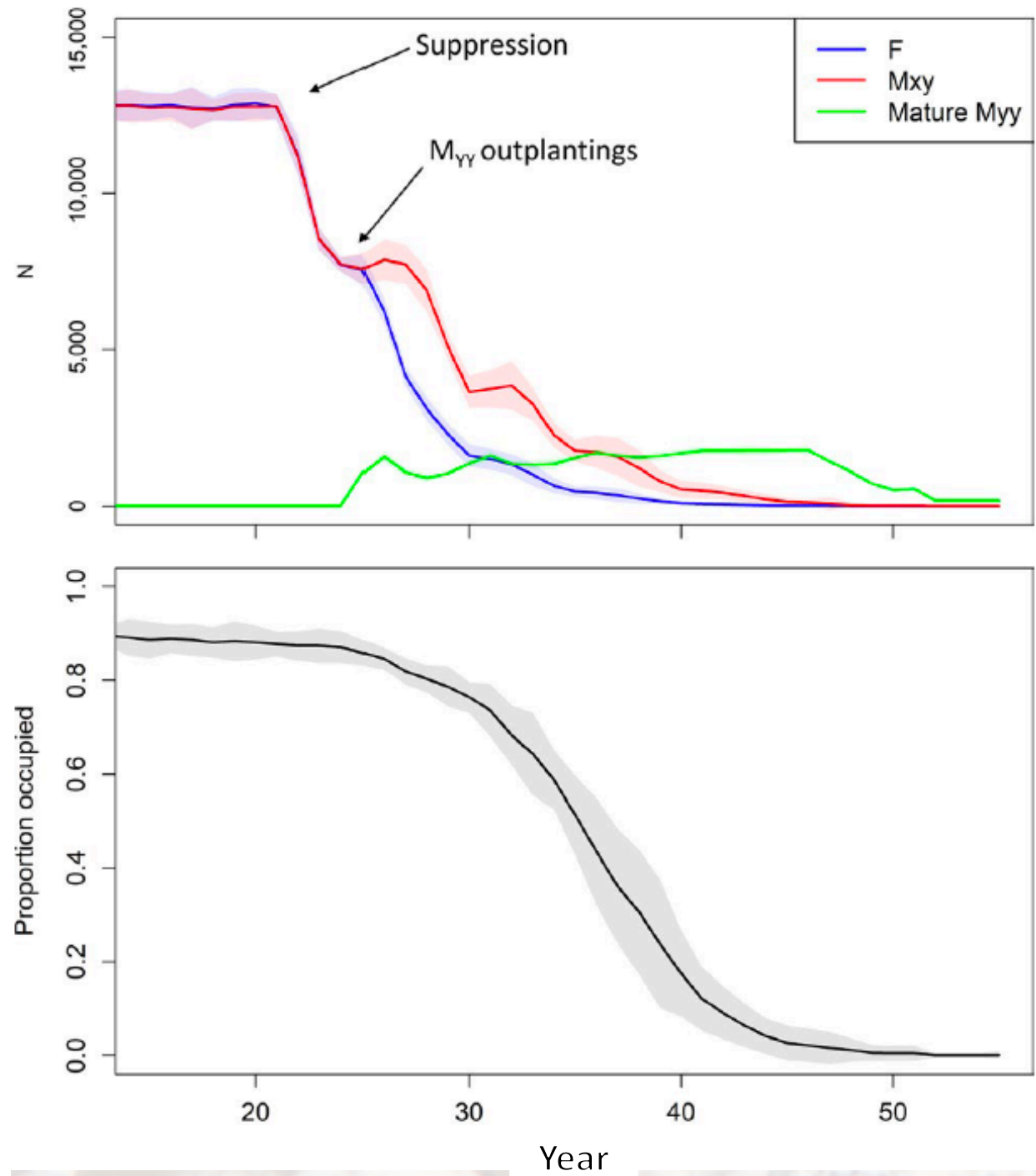
Evaluation of management factors affecting the relative success of a brook trout eradication program using YY male fish and electrofishing suppression

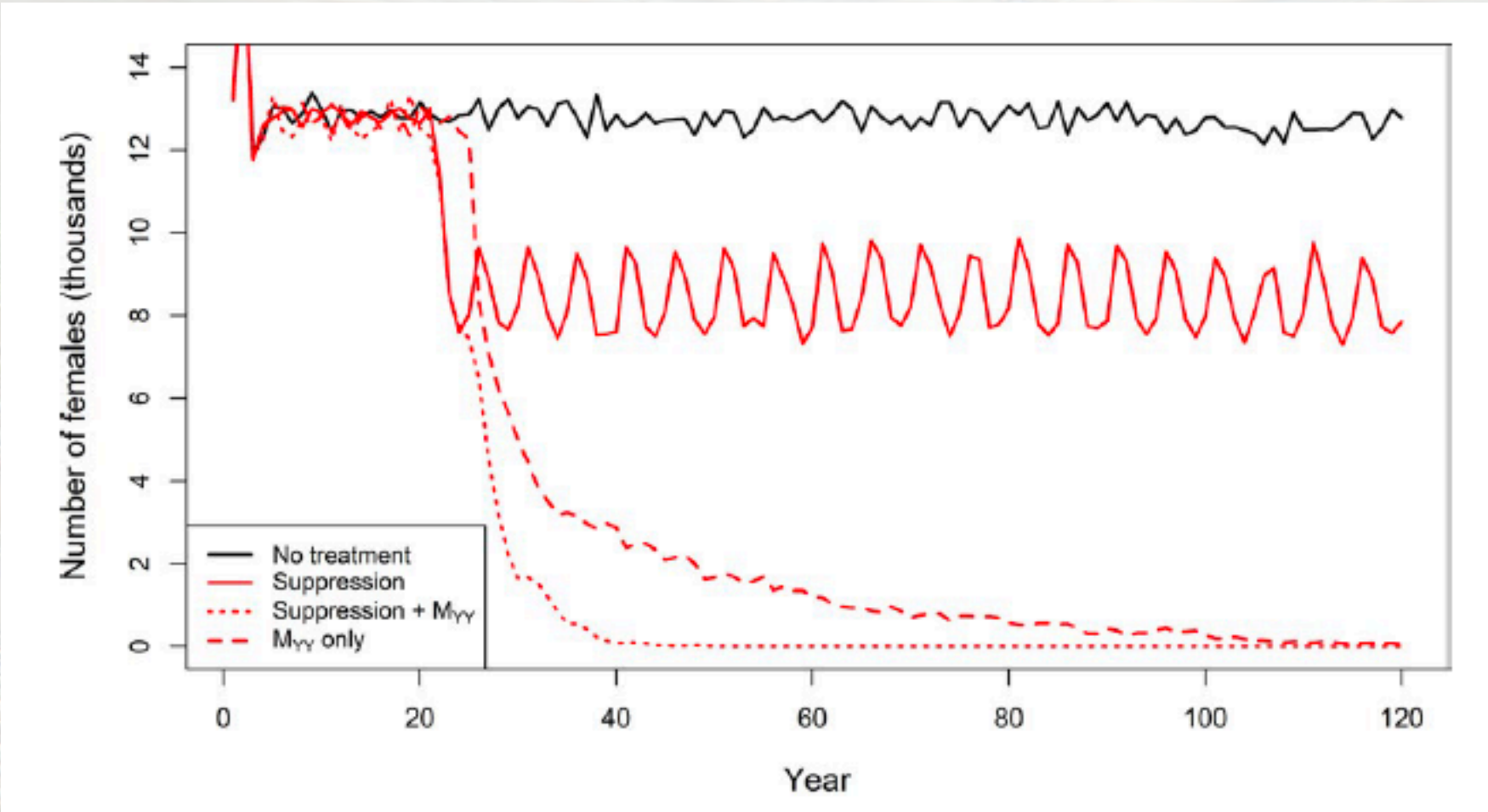
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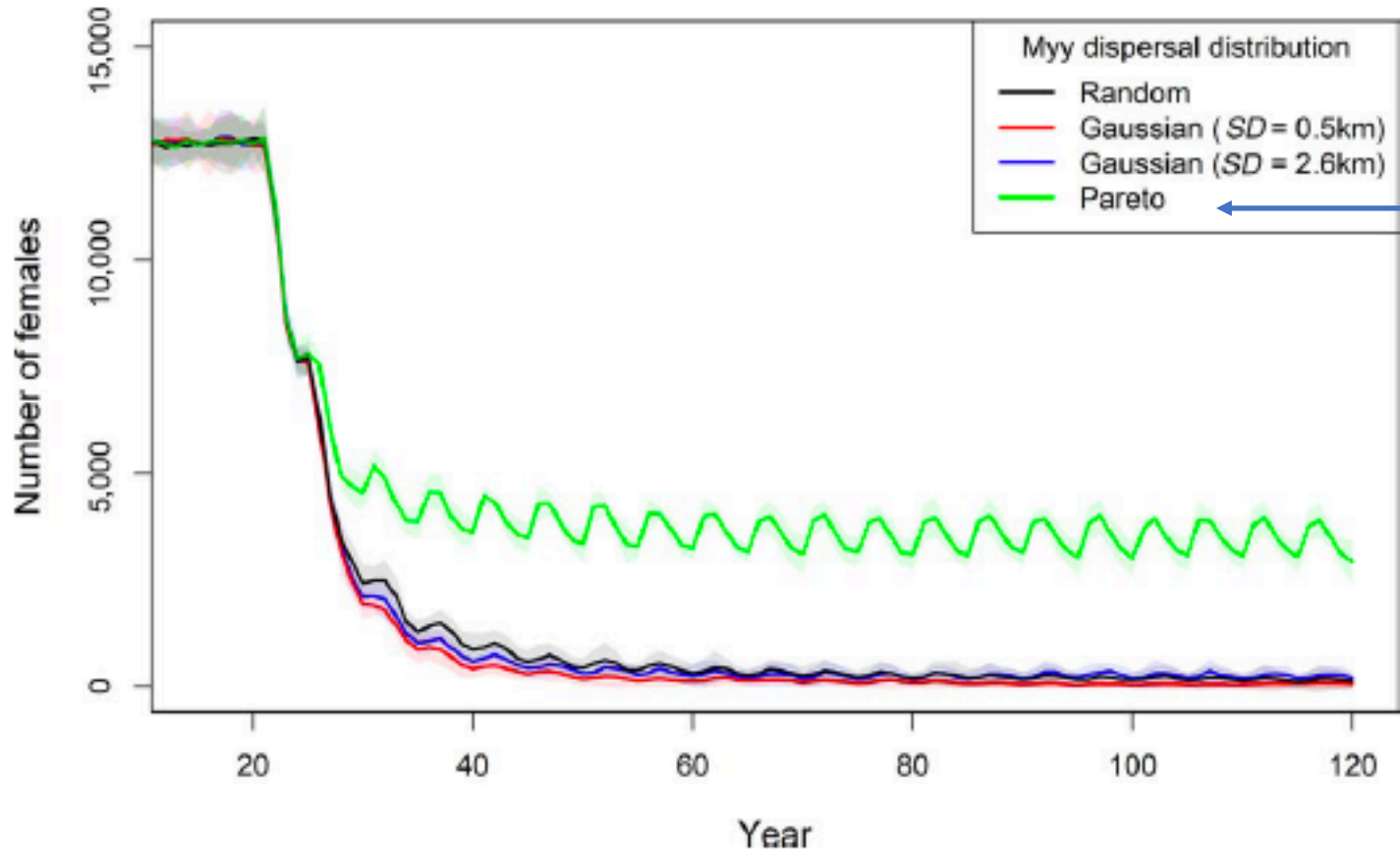
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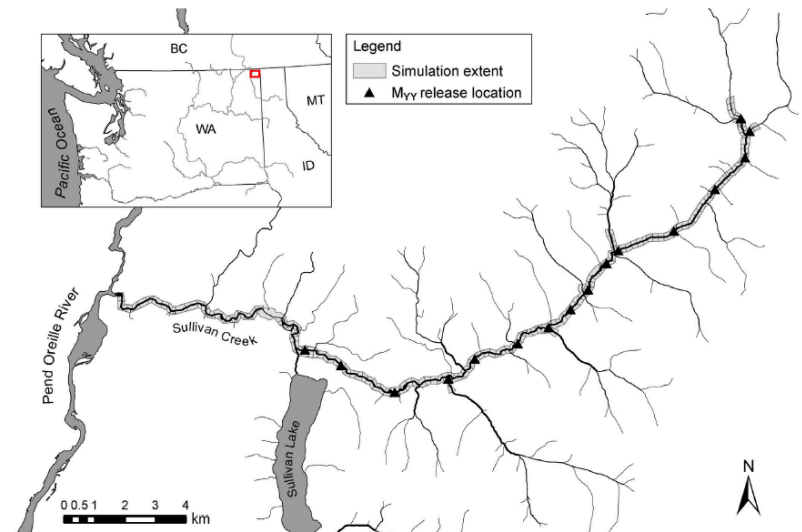




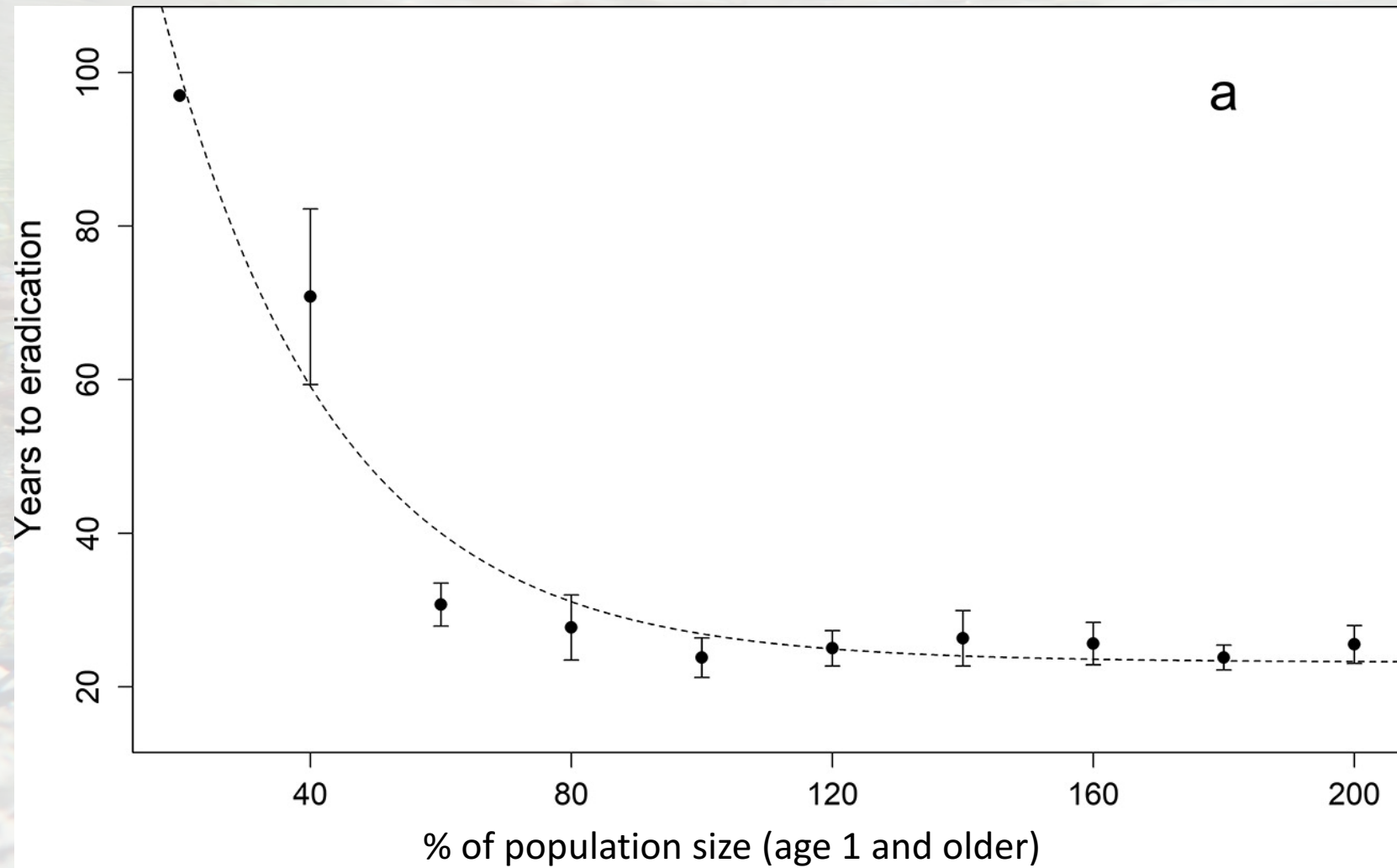
Dispersal from release locations



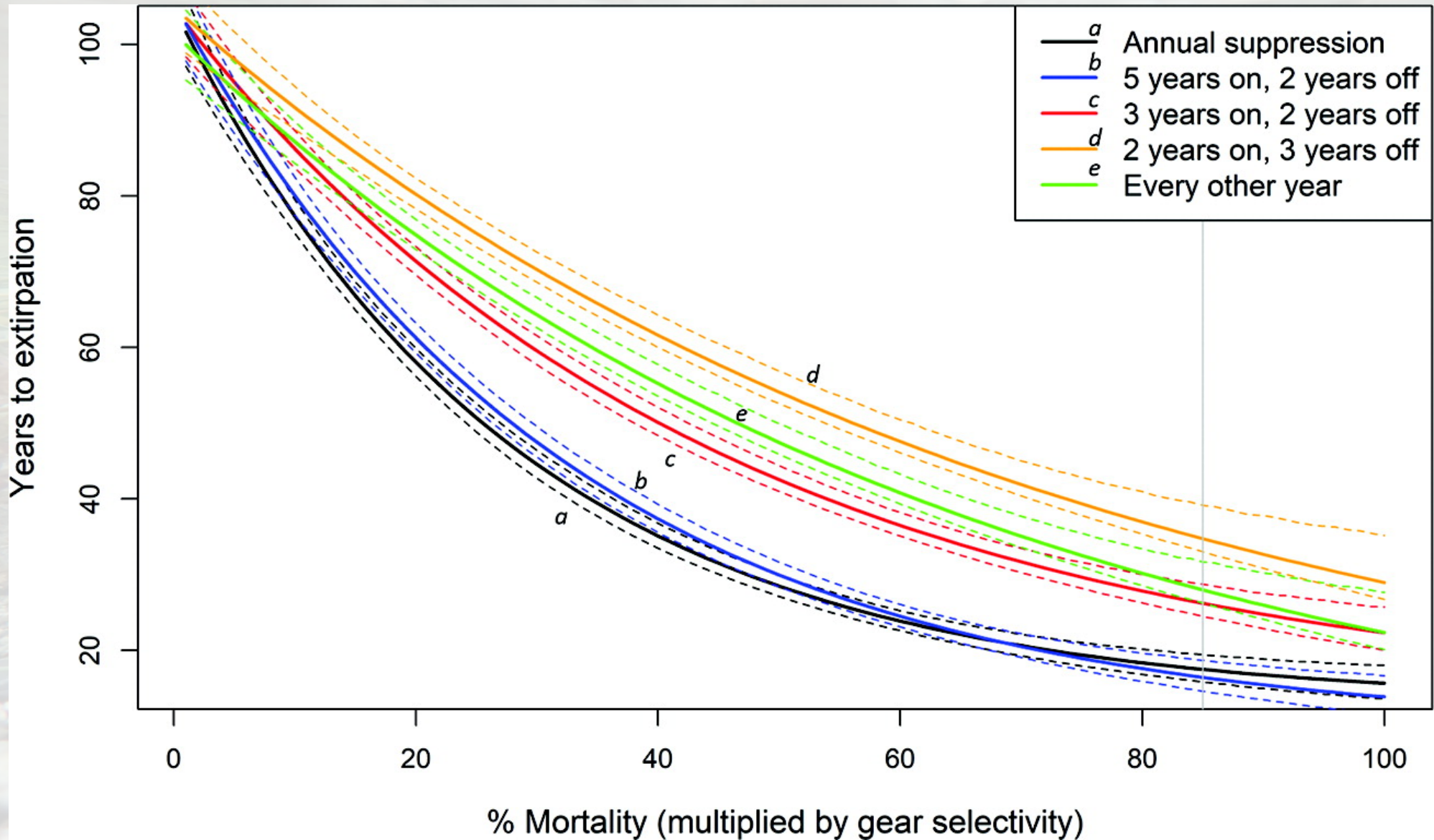
Most restricted dispersal



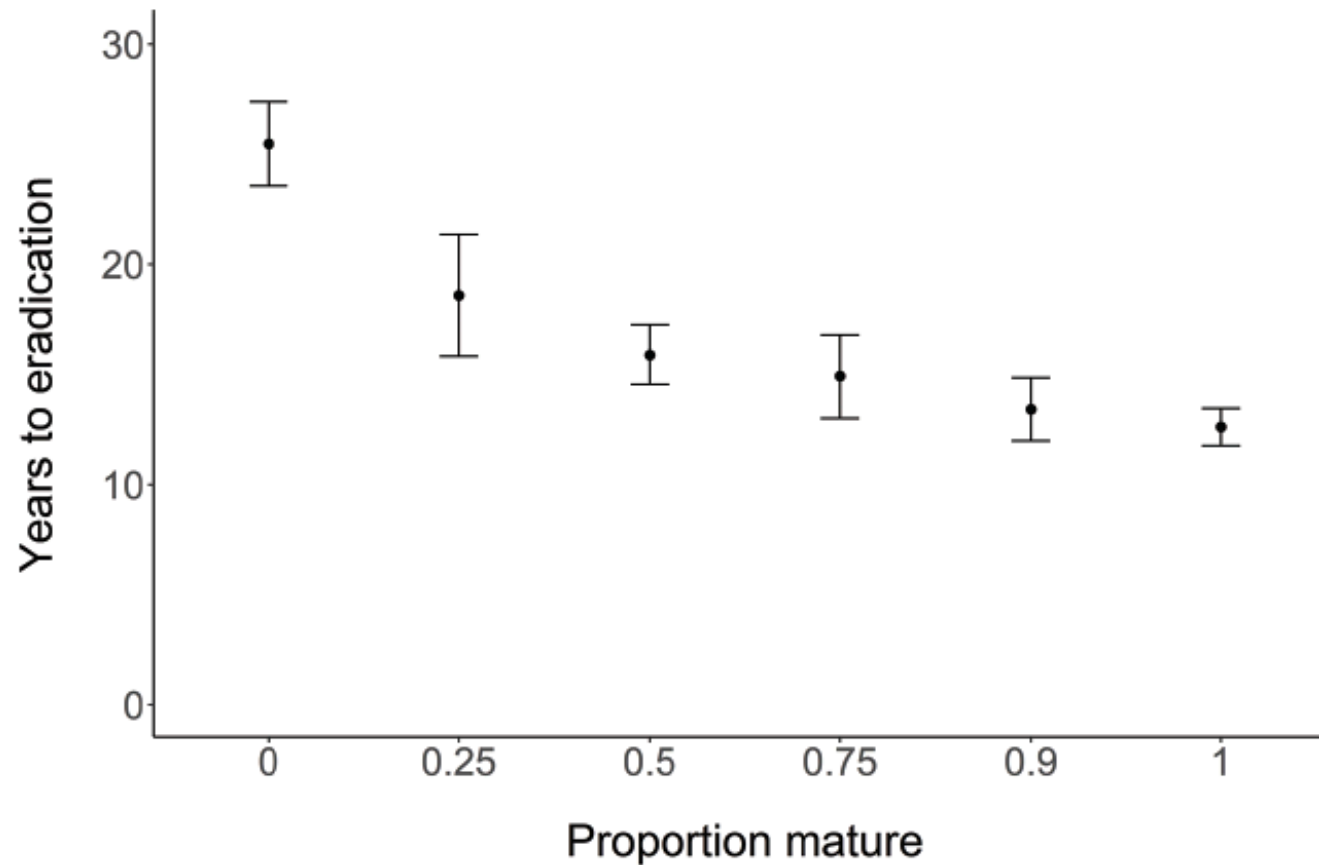
What percentage of the adult population needs to be stocked as YY males?



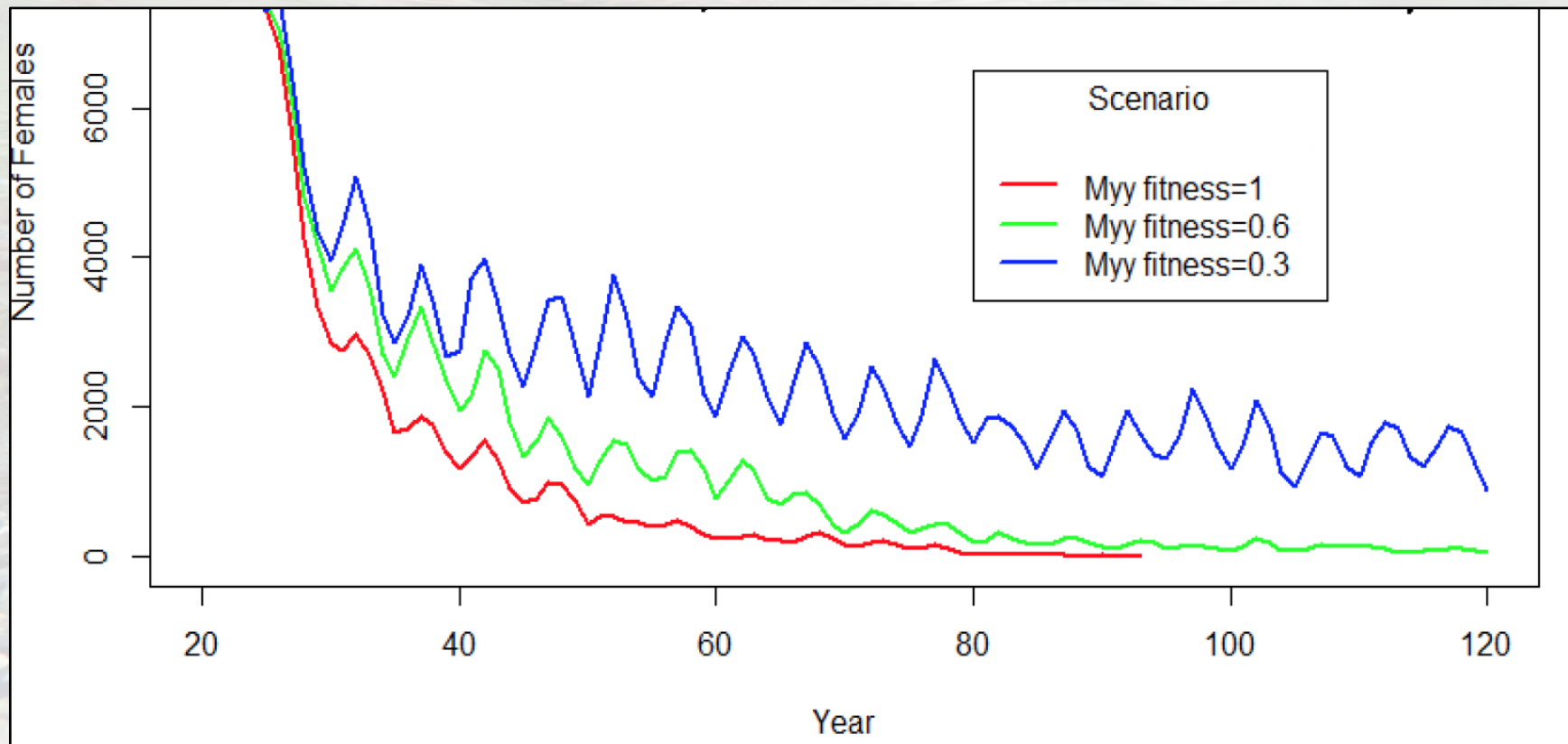
Suppression interval vs. percentage of mortality induced by suppression



Proportion of stocked age-0 YY males that are mature



- Relative fitness (survival and reproductive)
 - Hatchery fish have lower fitness than wild fish
 - Might be more pronounced with YY brood stocks



Here: fitness only includes the ability of a YY male to reproduce, not the fitness of its offspring

Empirical work: YY Brook Trout in the western US

4 Idaho streams

- YY offspring were found in the same proportion as YY adult males
- Only ~ 3% of the population

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Example: YY Brook Trout in the west

- Various states have introduced YY male brook trout in some streams (WA, ID, NM)
- Some have adopted a wait and see approach (MT)
- Is it a panacea?
 - Seems like it could work in small isolated systems
 - Prophylactically after chemical or mechanical removals
 - Need to suppress and introduce enough YY males
 - Might take many years
 - Open systems seem less likely to work
 - Could be recolonized quickly after efforts end

Acknowledgements

- Erin Landguth, Casey Day (U Montana)
- Seattle City Light
 - Ryan Simmons
 - Andrew Bearlin



Questions

1. If YY brown or rainbow trout were developed, would you consider attempting YY-based eradication?
2. Under what scenarios do you envision using YY-based eradication if it becomes an option? (open system, closed system, in conjunction with manual suppression)