

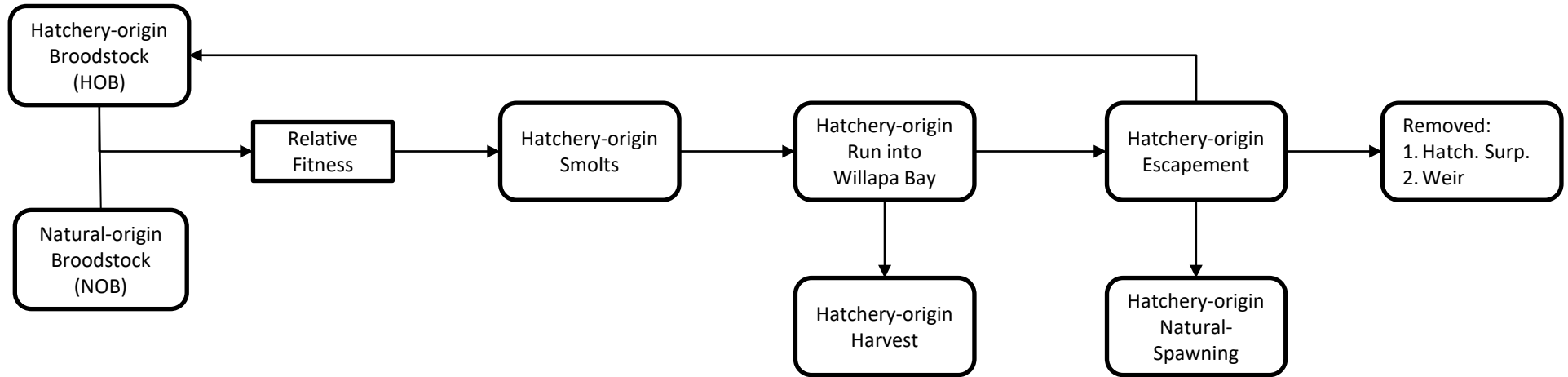
Fish Committee Meeting Willapa Bay Policy C-3622

August 04, 2022

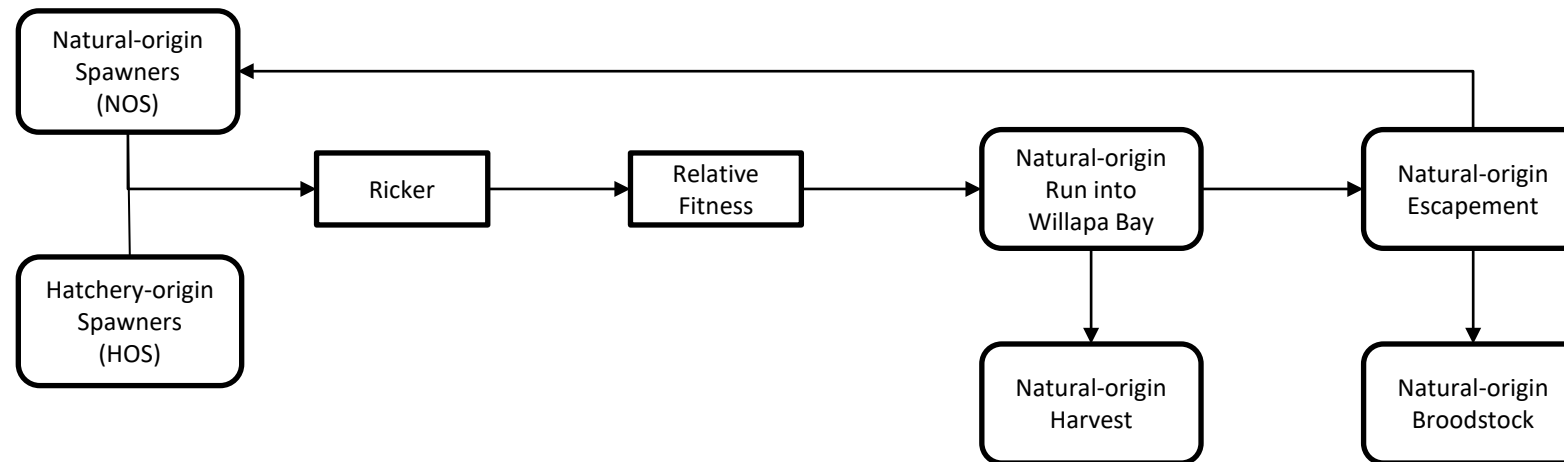
Kenneth Warheit
Marlene Wagner
Fish Program



HATCHERY ENVIRONMENT

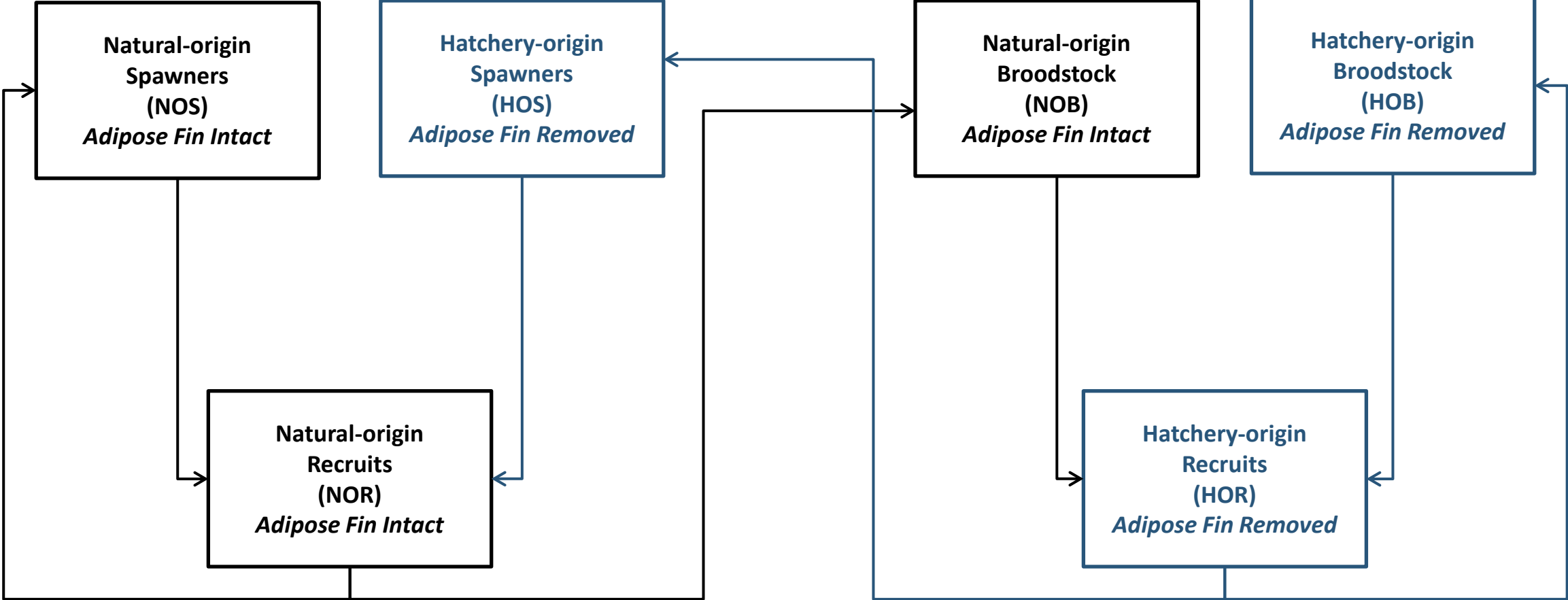


NATURAL ENVIRONMENT

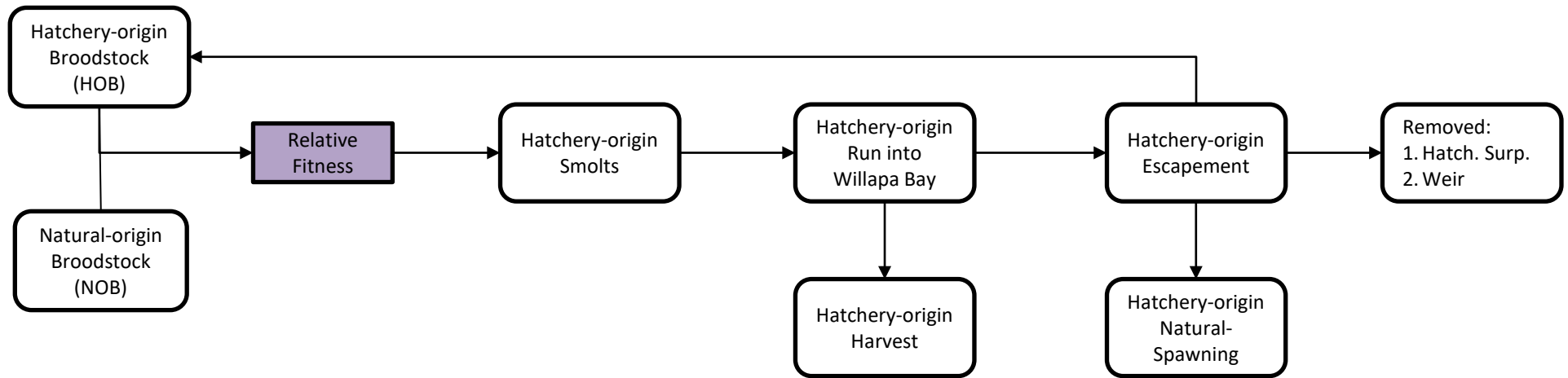


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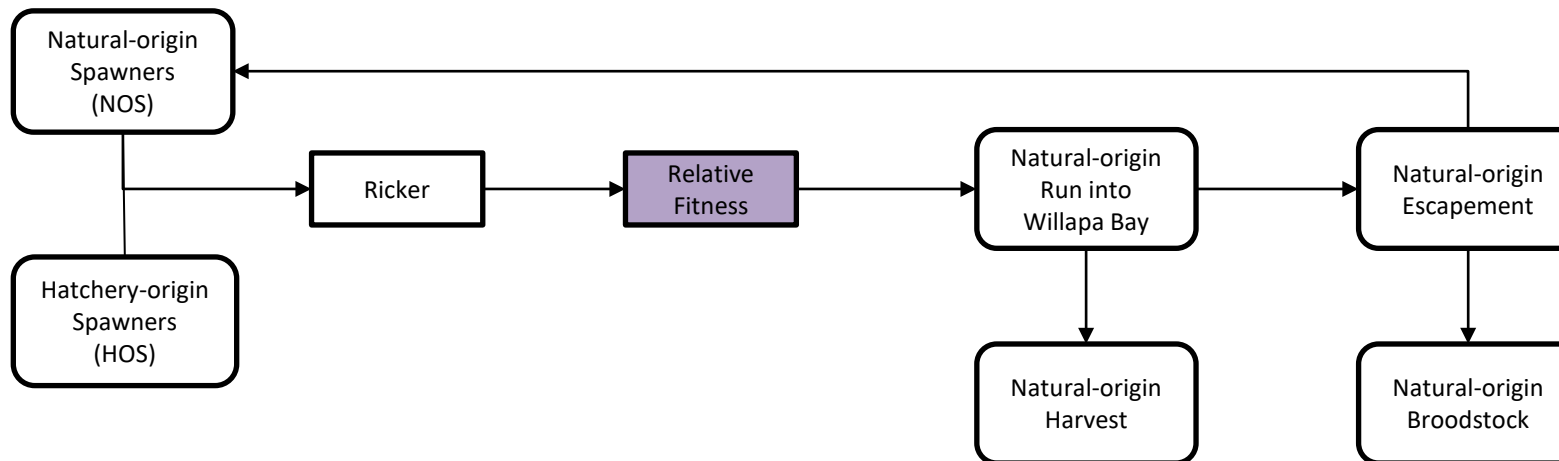
HATCHERY ENVIRONMENT



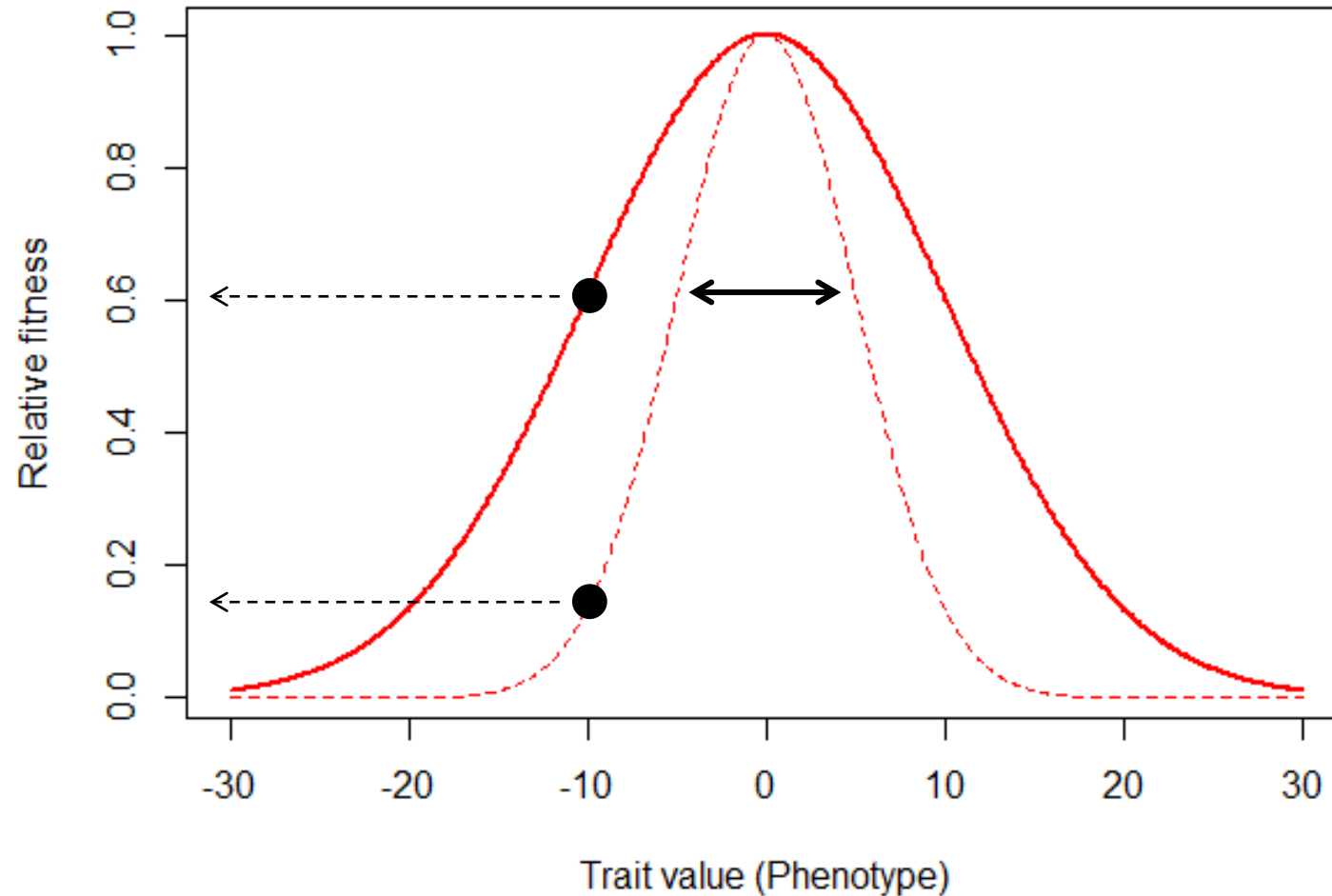
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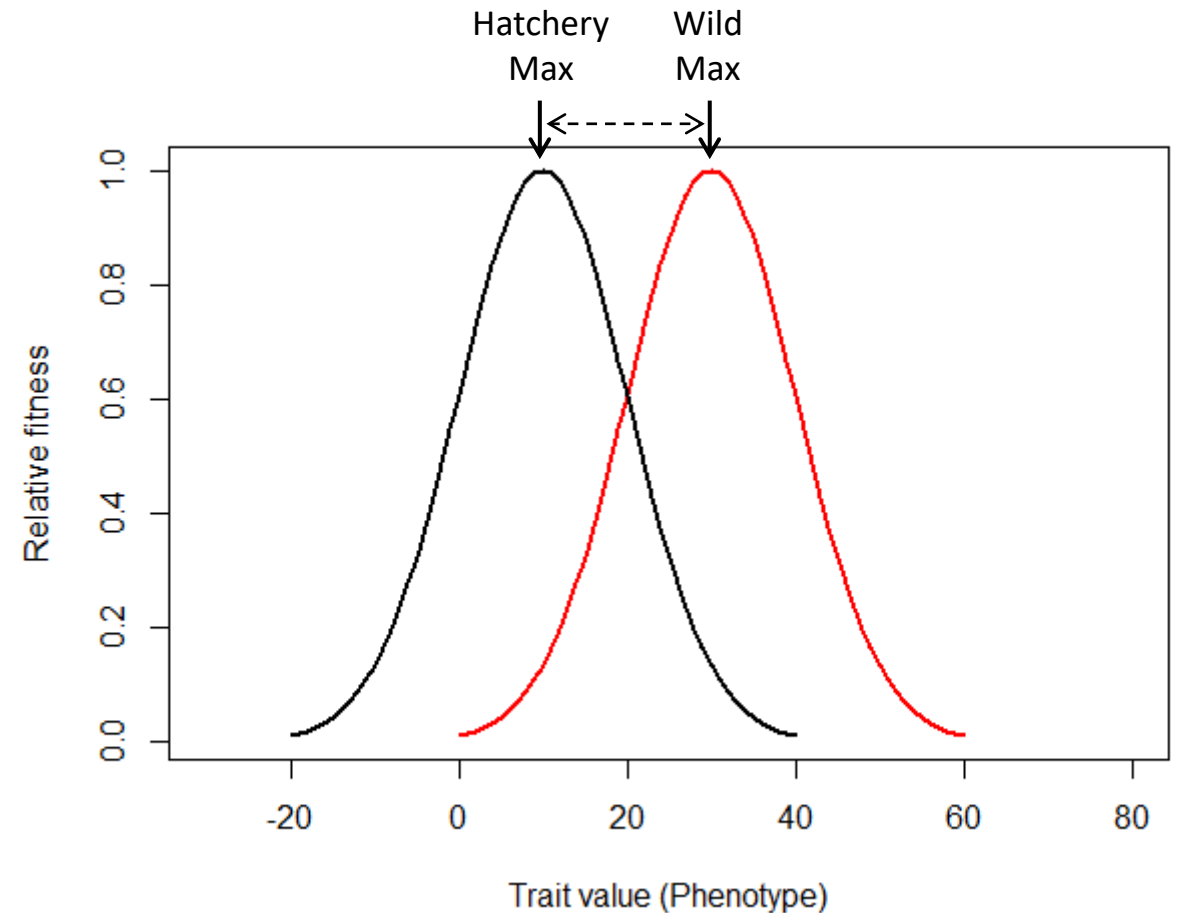
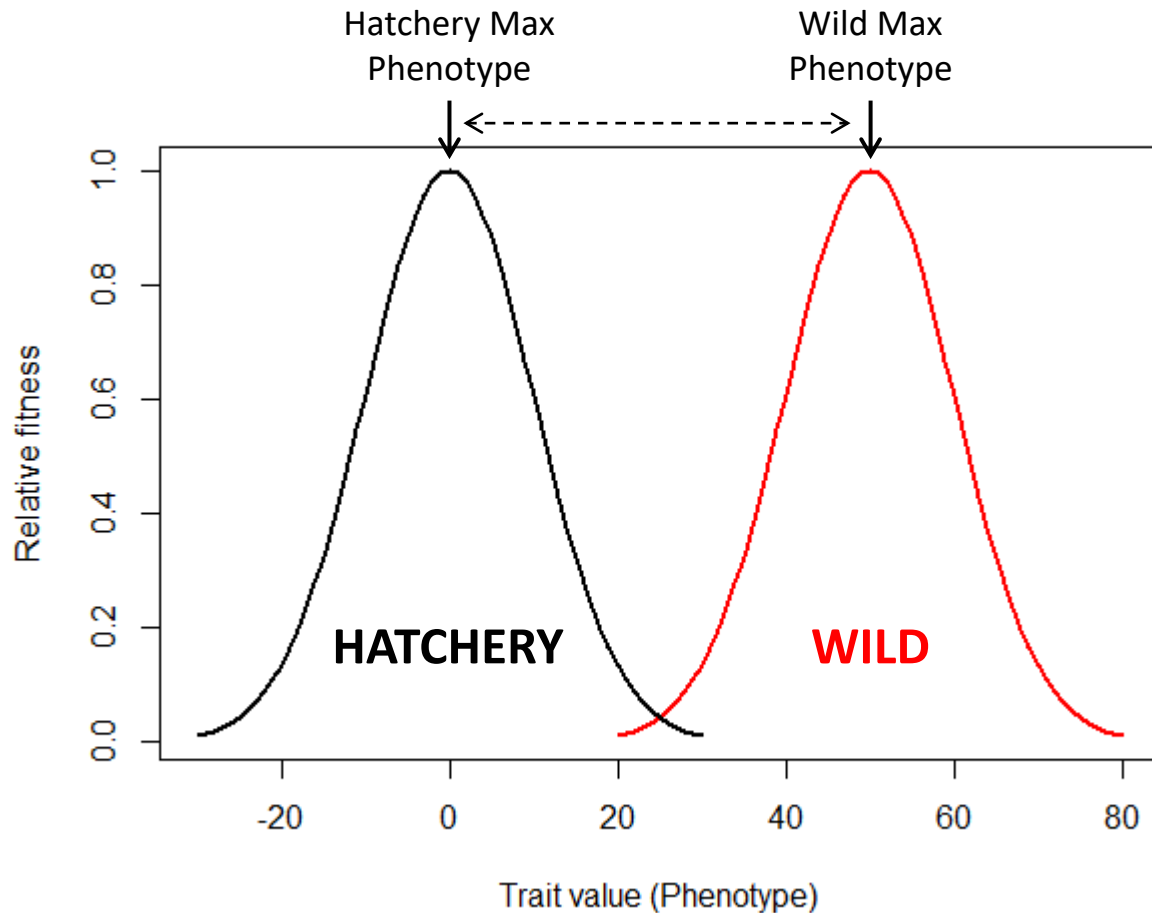
NATURAL ENVIRONMENT



Fitness Curve – Selection Strength



Fitness Curve – Selection Differential



Relative Fitness

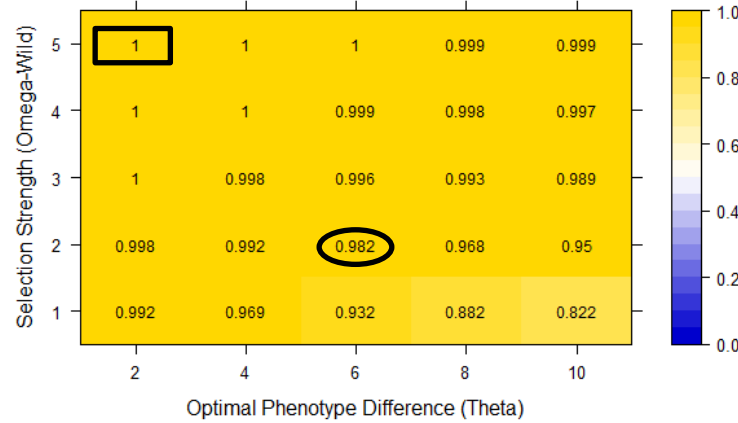
Selection in Captivity during Supportive Breeding May Reduce Fitness in the Wild

MICHAEL J. FORD
National Marine Fisheries Service, Northwest Fisheries Science Center, Conservation Biology Division, 2725
Mondlake Boulevard E., Seattle, WA 98112, U.S.A., email mike.ford@noaa.gov

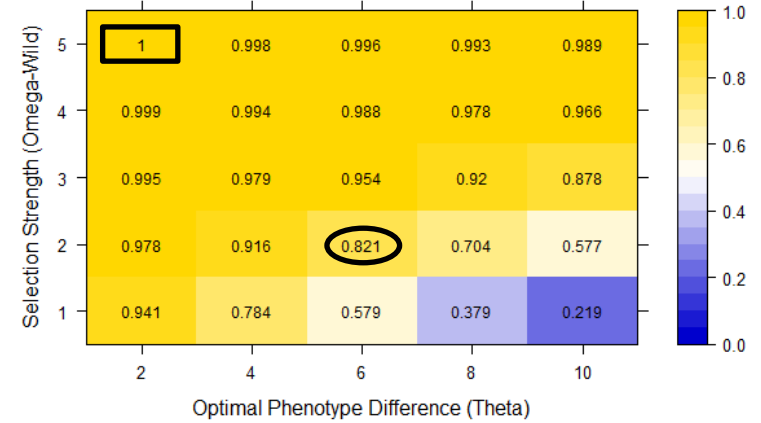
Conservation Biology, Pages 815-825
Volume 16, No. 3, June 2002

- Heritability = 0.50
- Selection strength
- Selection difference
- pHOS
- pNOB

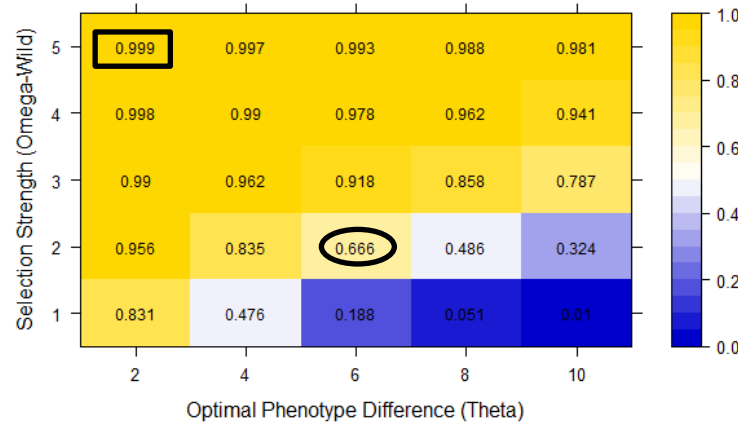
PNI = 0.89
(pHOS=0.1 | pNOB=0.8)



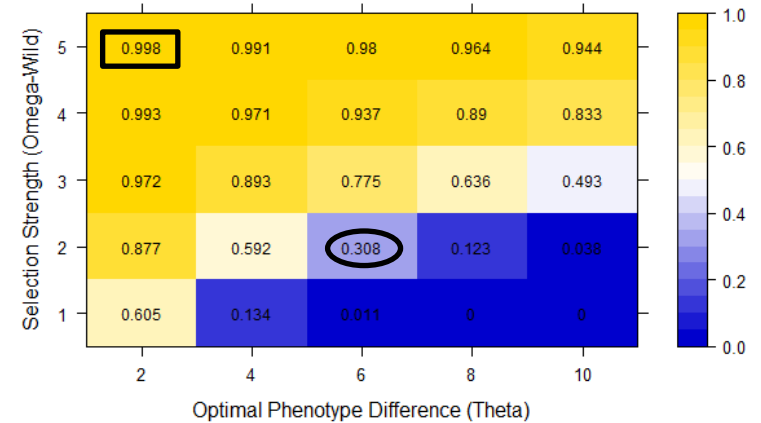
PNI = 0.50
(pHOS=0.1 | pNOB=0.1)



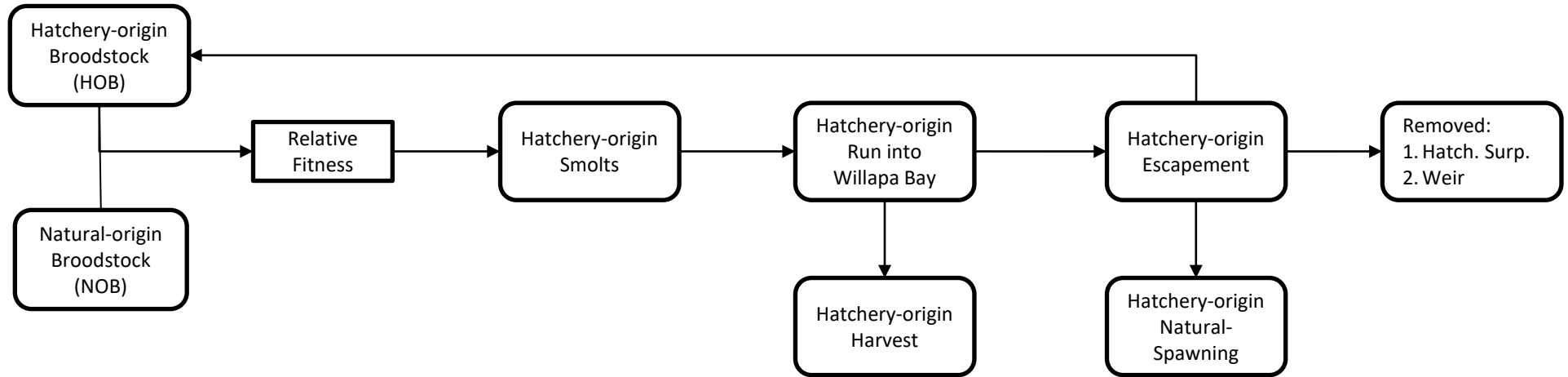
PNI = 0.50
(pHOS=0.8 | pNOB=0.8)



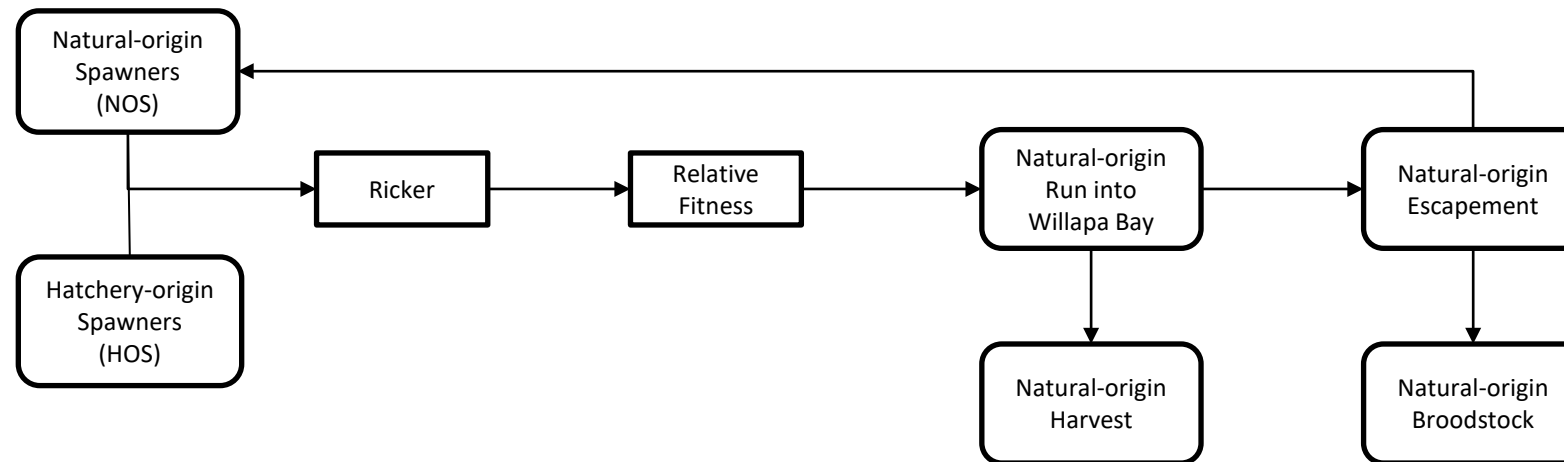
PNI = 0.11
(pHOS=0.8 | pNOB=0.1)



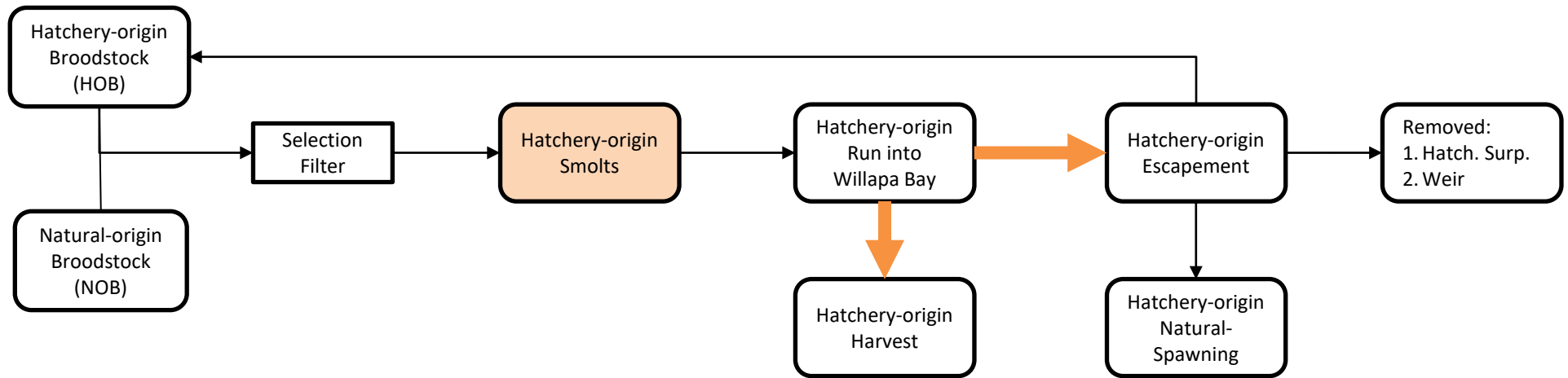
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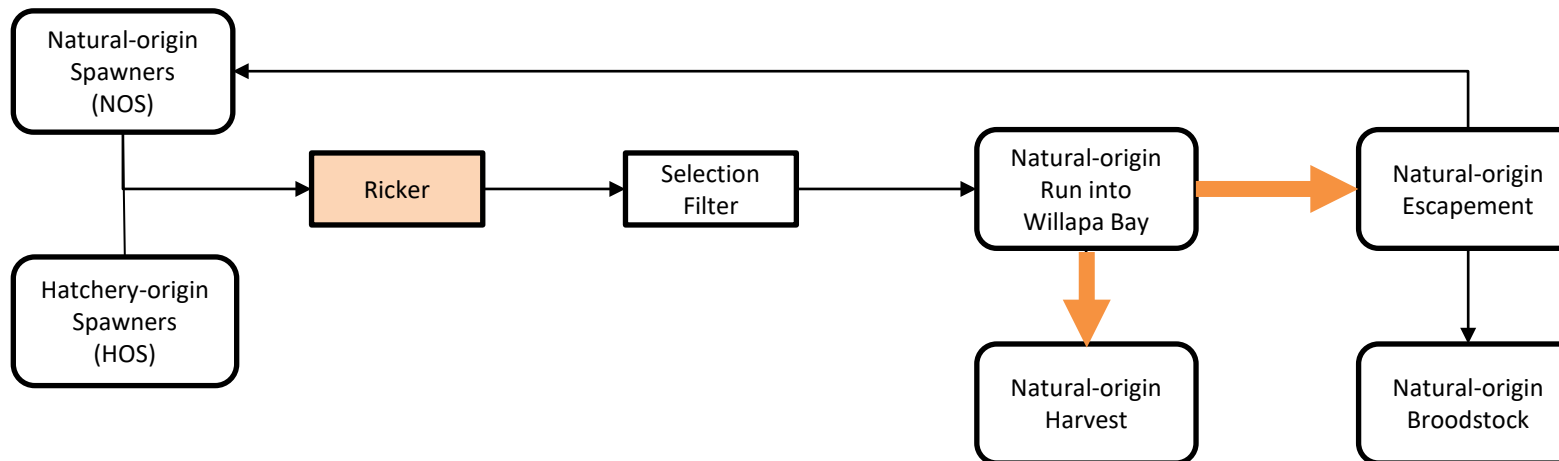
NATURAL ENVIRONMENT



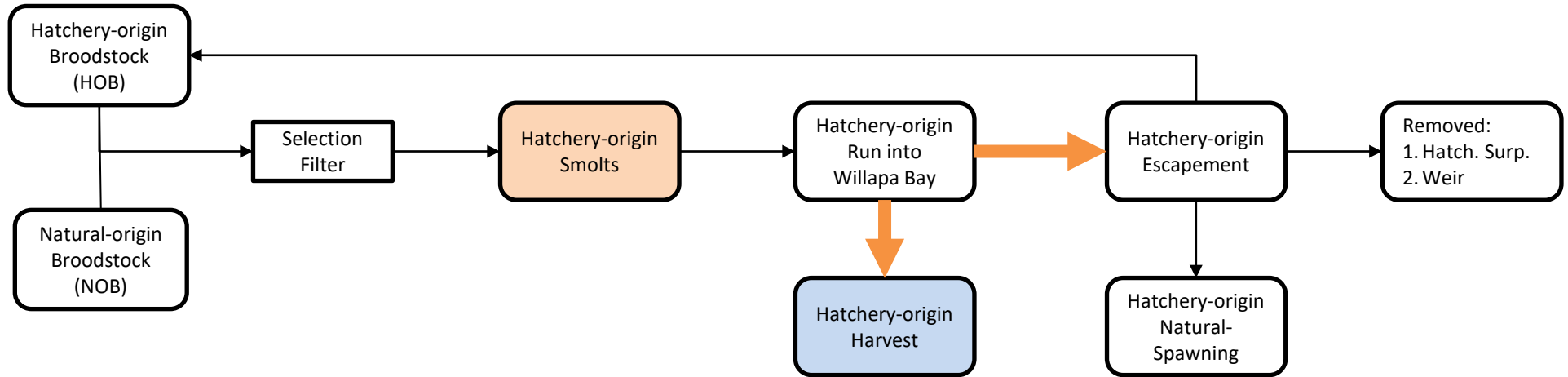
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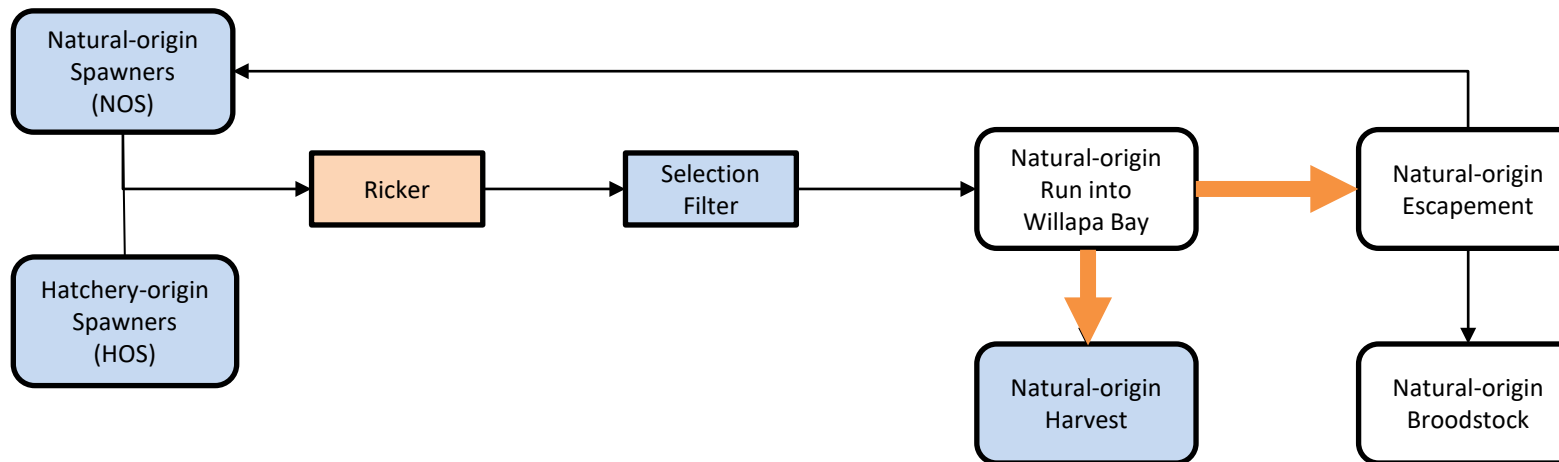
NATURAL ENVIRONMENT



HATCHERY ENVIRONMENT



NATURAL ENVIRONMENT



Parameters

1. Smolt Production

- 1,000,000 to 12,000,000 in 500,000 intervals
- 23 smolt production runs of model

2. Total Run Exploitation Rate

- Proportion of run that is harvested
- Random distribution of natural and hatchery fish
- 0.30 to 0.60 in 0.02 intervals
- 16 harvest proportion runs of the model

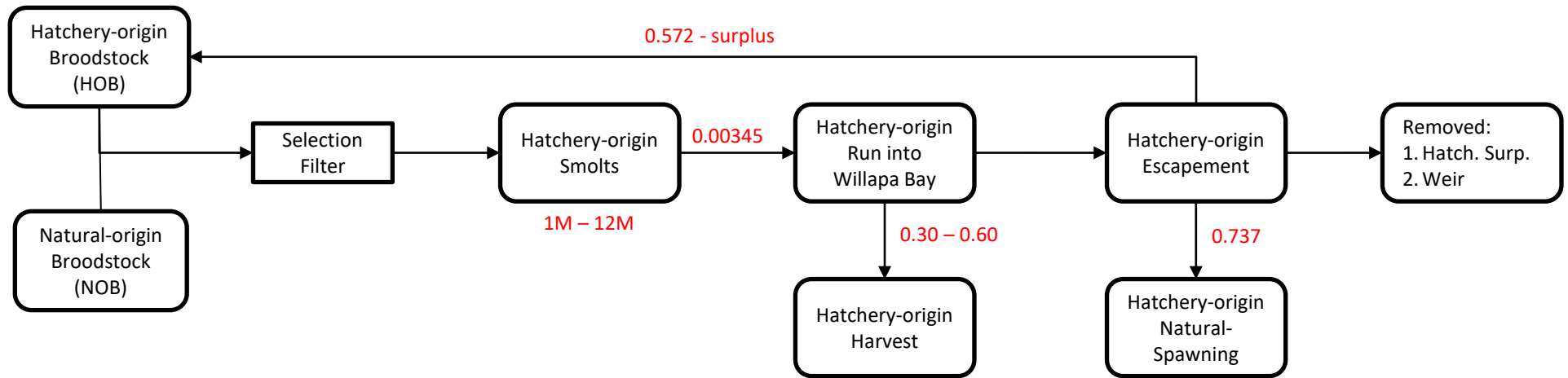
3. Natural-spawning capacity

- Part of Ricker model
- 2000, 4000, 6000 fish

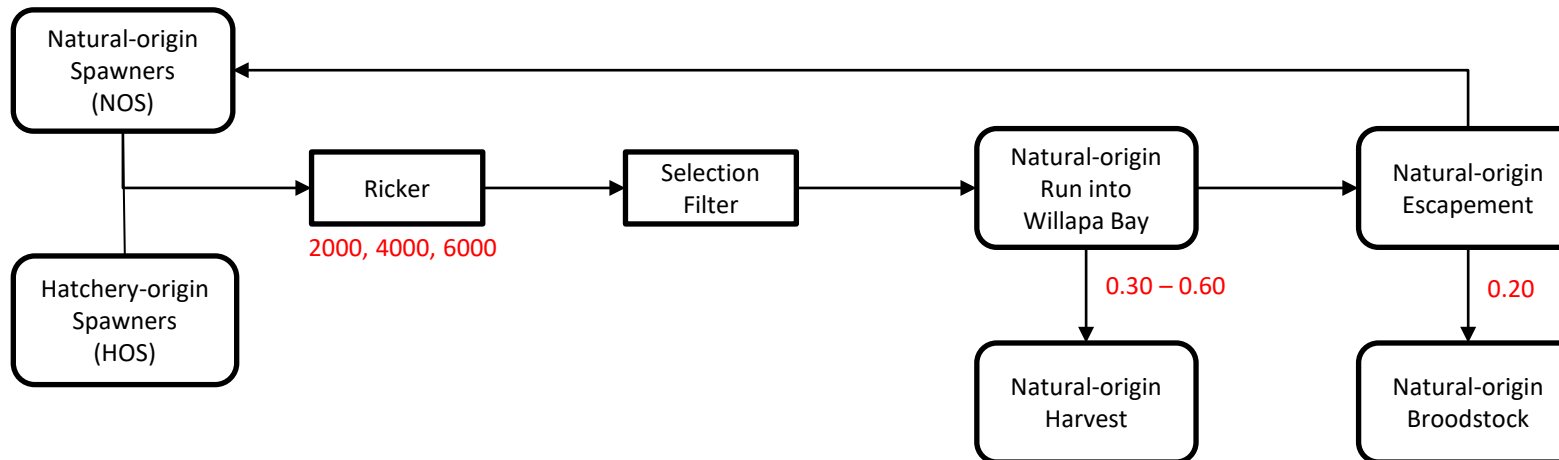
- Run model for 15 generations
- $23 * 16 * 3 = 1,104$ model run
- $1,104 * 15 = 16,560$ model cycles



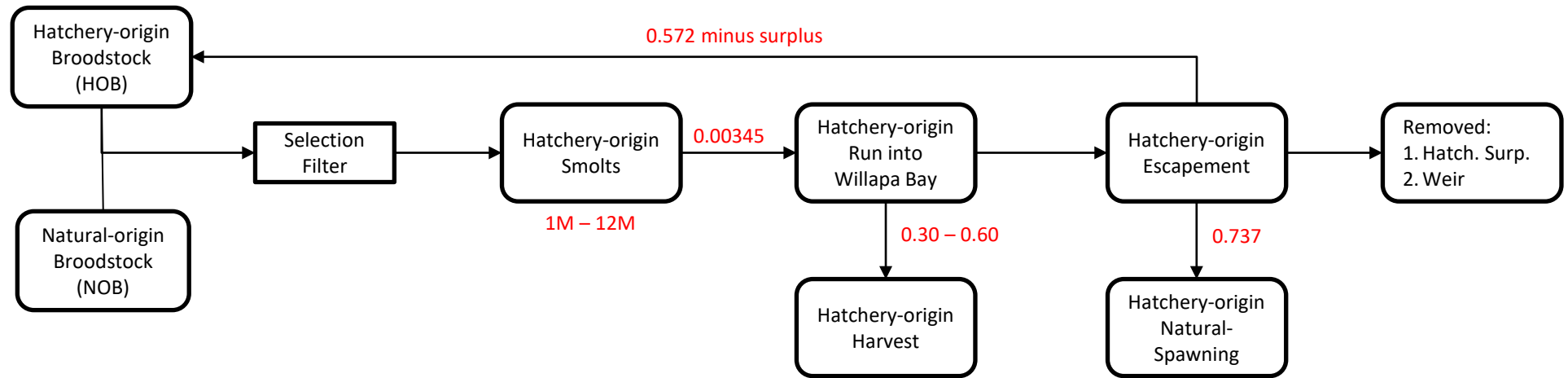
HATCHERY ENVIRONMENT



NATURAL ENVIRONMENT



HATCHERY ENVIRONMENT



Example:

- Smolts: 10,000,000 Fecundity = 3,430
- Harvest: 0.50
- HOB needed = $(10,000,000 / 3,430) * 2 = 5,831$ (minus NOB [350])

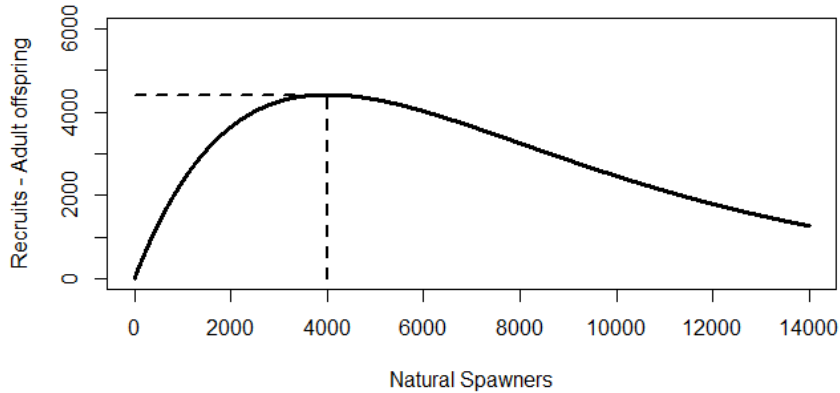
1. Hatchery Run: $10,000,000 * 0.00345 = 34,500$
2. Harvest: $34,500 * 0.50 = 17,250$
3. Escapement = 17,250
4. # Fish to Hatchery: $17,250 * 0.572 = 9,867$
5. Removed1 (Surplus): $9,867 - 5,831 - 350 = 3,686$
6. HOS (Potential) = $17,250 - 9,867 = 7,383$
7. HOS (below weir) = $7,383 * 0.737 = 5,441$
8. Removed2 = $7,383 - 5,441 = 1,942$

Run: 34,500
Harvest: 17,250
HOB: 5,831
HOS: 5,441
Removed: 5,628
<hr/>
Total: 31,150



Example:

- Capacity: 4000
- Harvest: 0.50
- Generation 1: NOS = 4000. HOS=0

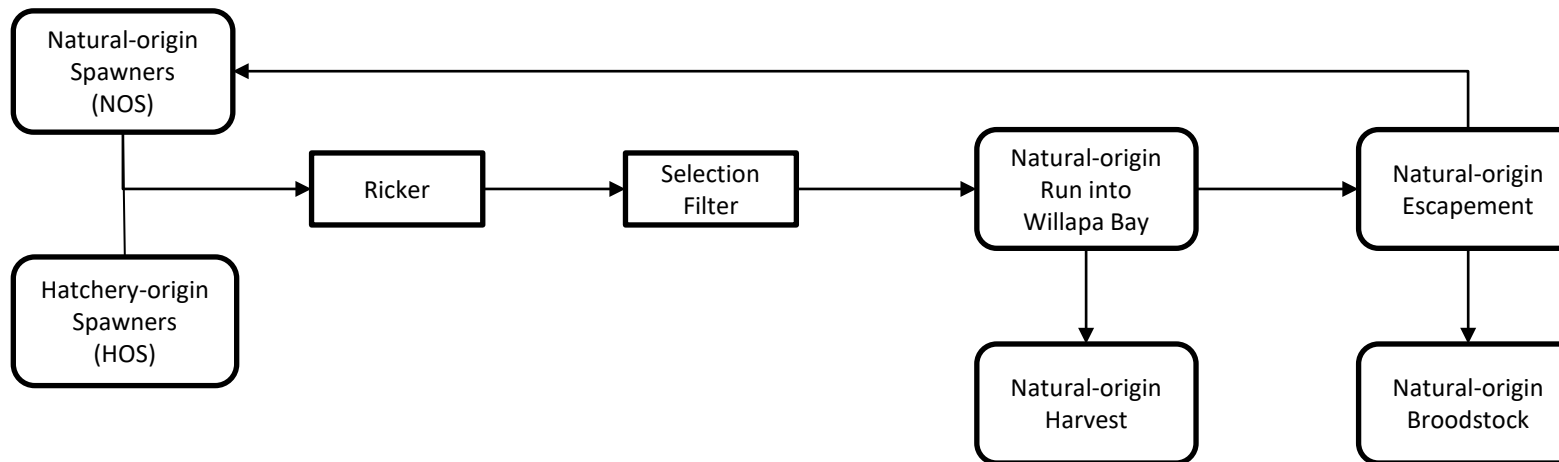


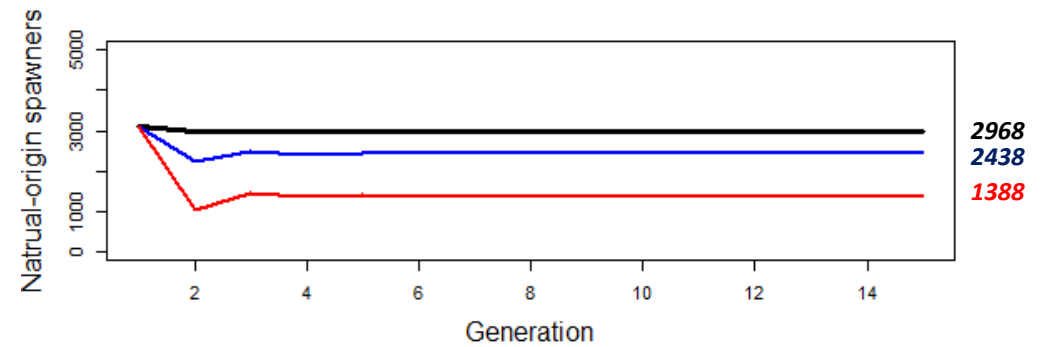
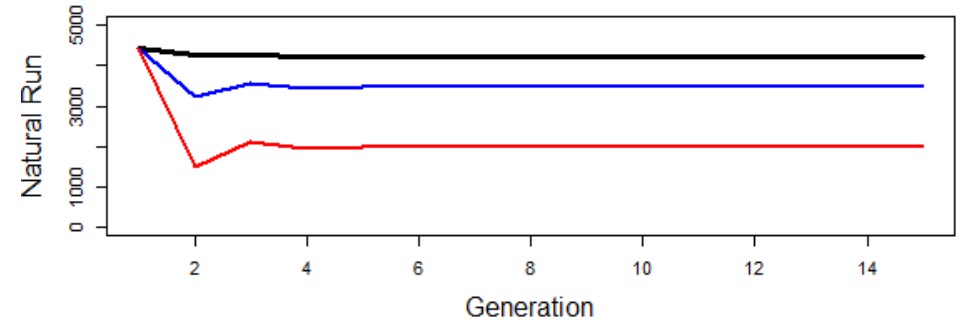
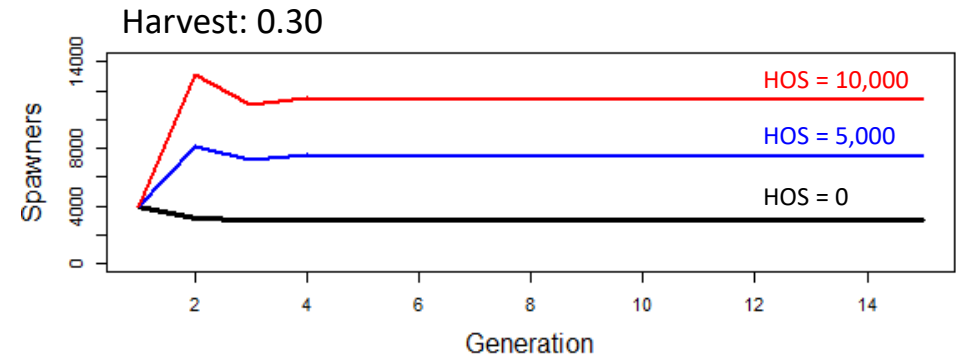
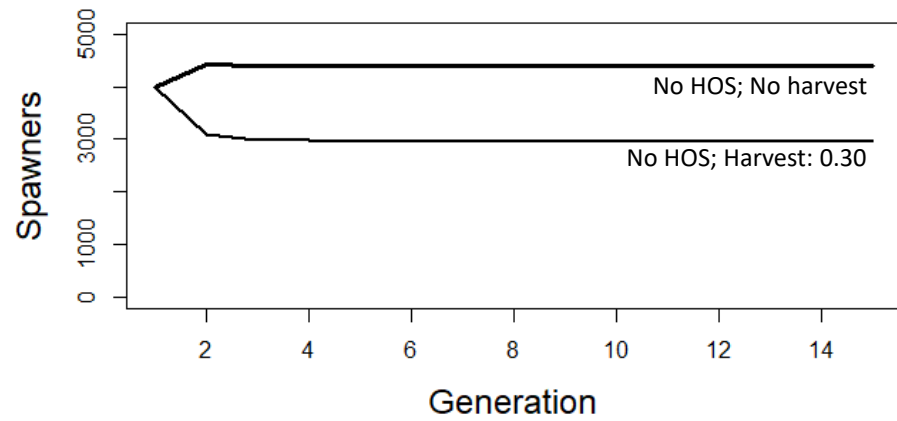
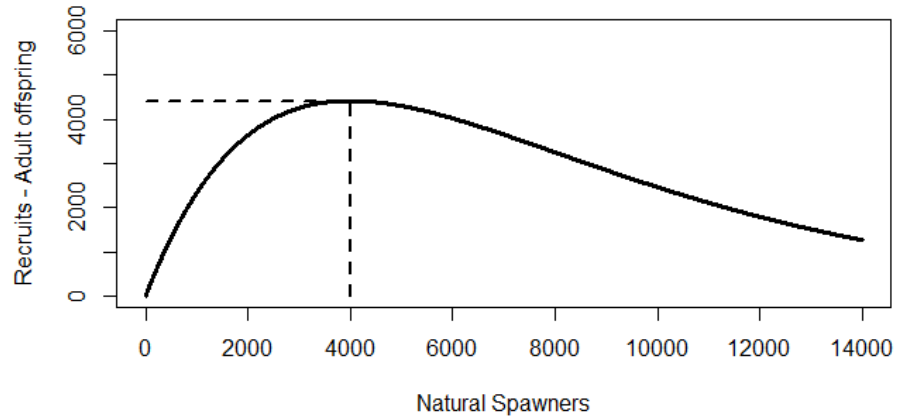
1. Ricker: $NOS = 4,000 \rightarrow 4,415$
2. Gen1: Relative Fitness = 1
3. Natural Run = 4,415
4. Harvest: $4,415 * 0.50 = 2,208$
5. Escapement = 2,208
6. NOB: $2,208 * 0.20 = 442$
7. NOS: $2,208 - 442 = 1,766$

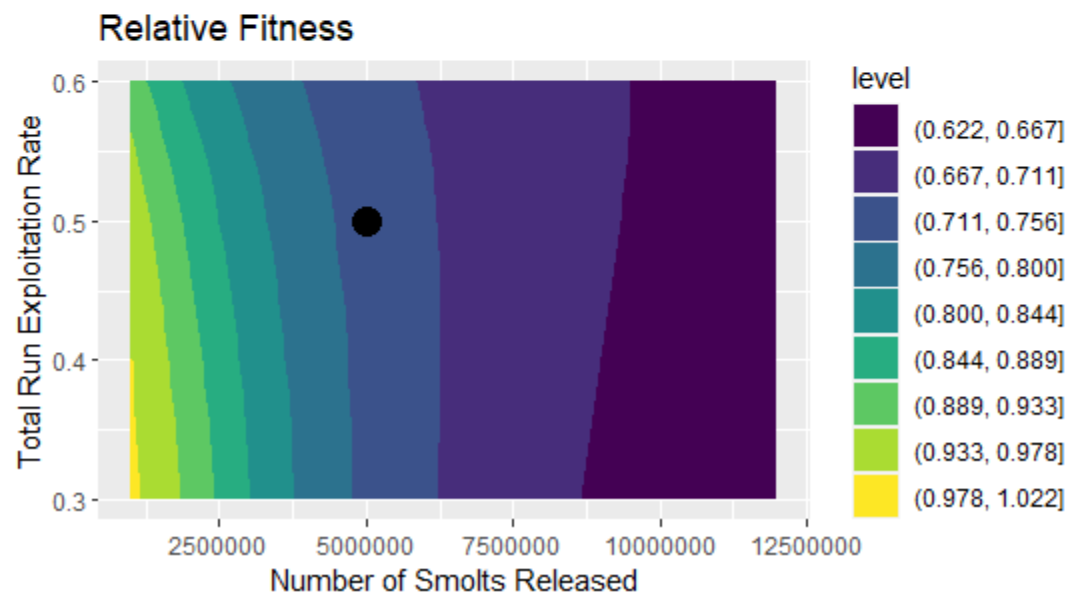
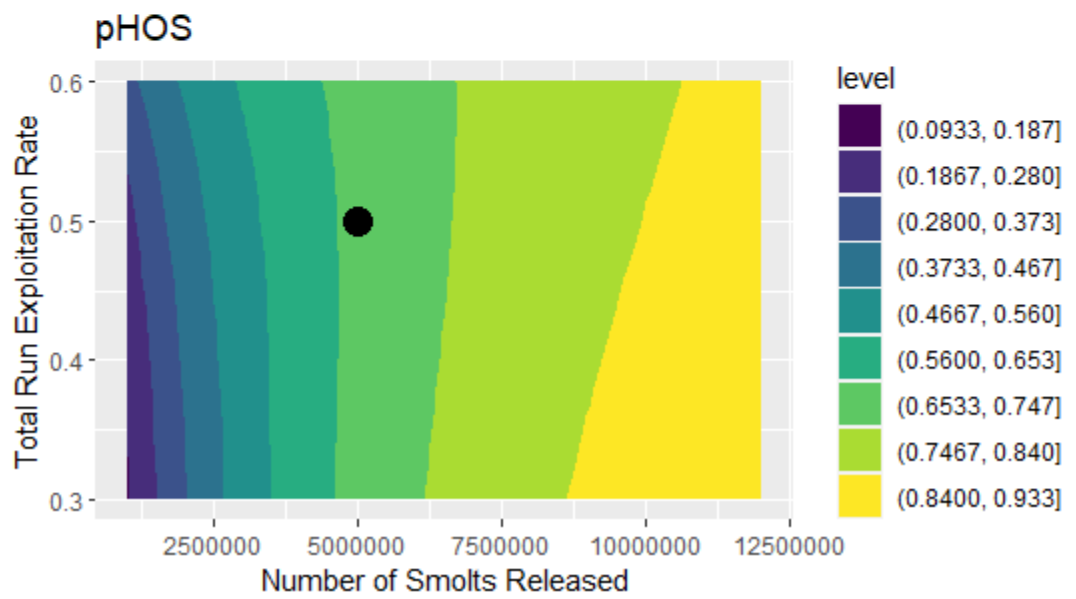
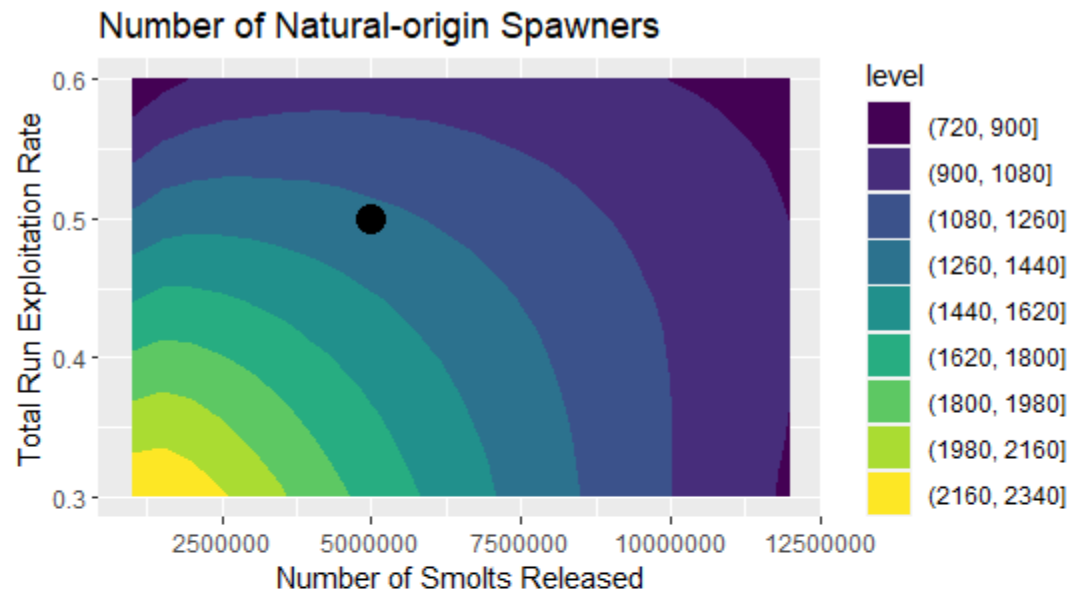
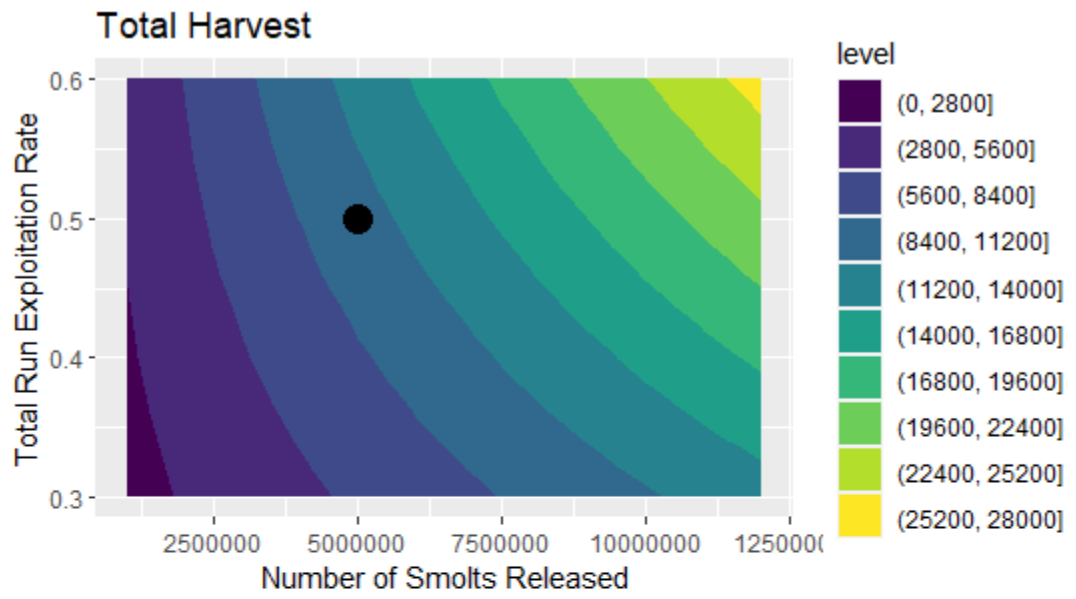
Observations

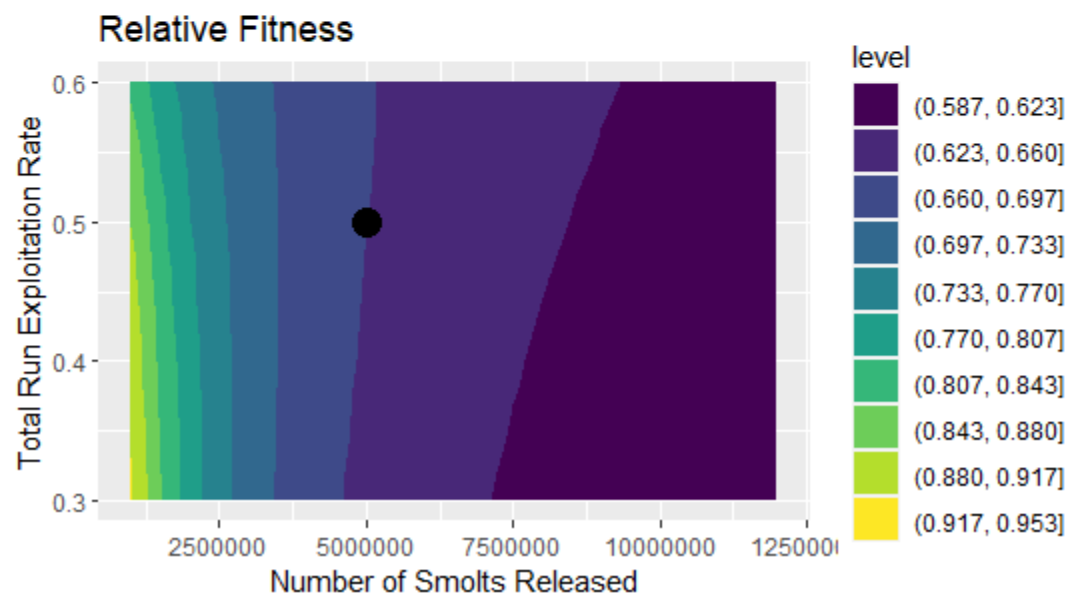
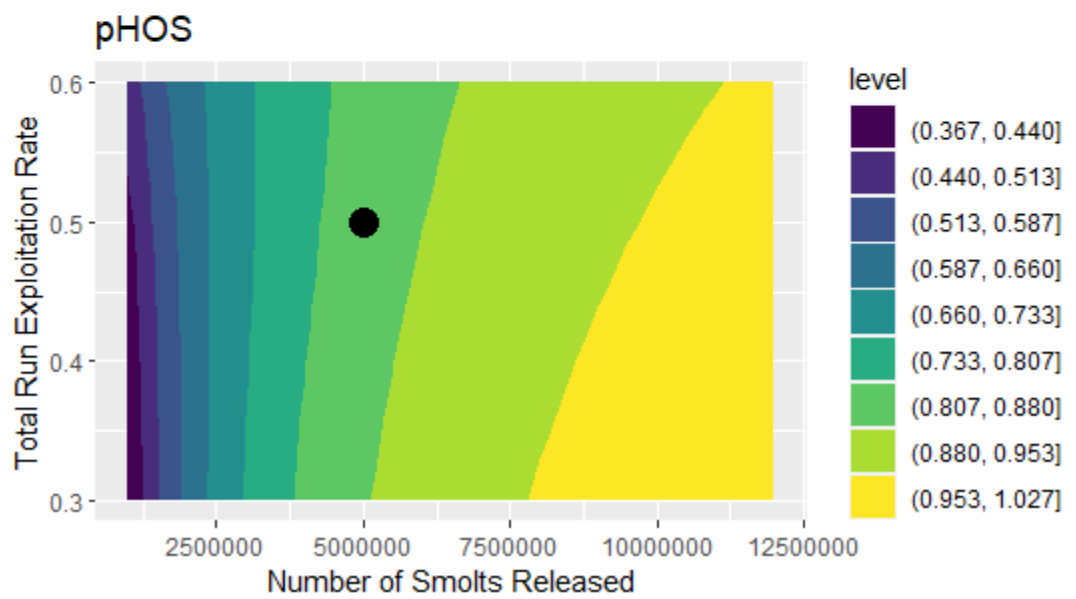
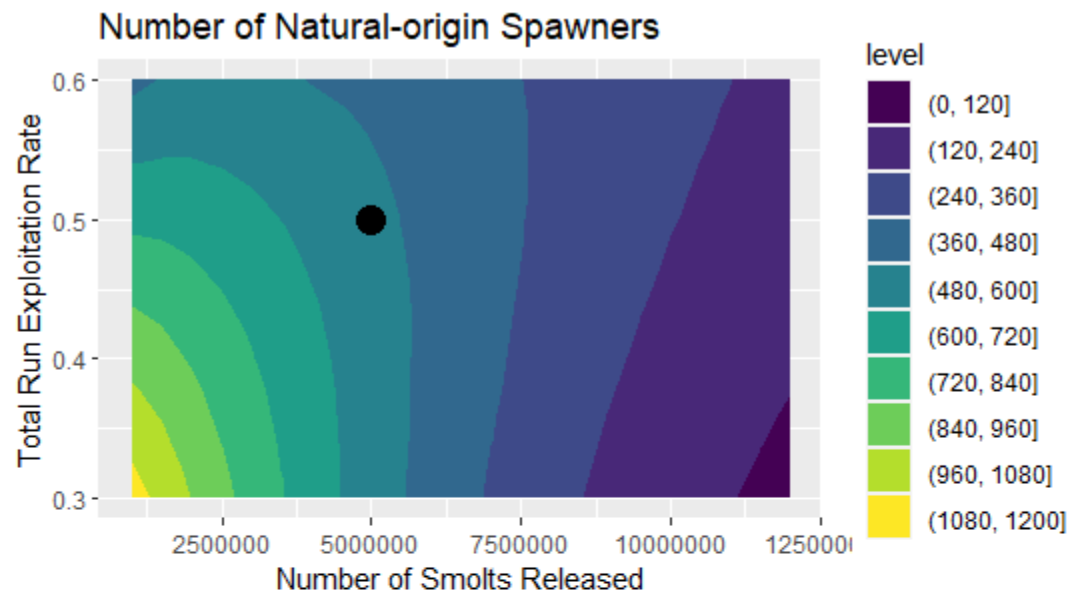
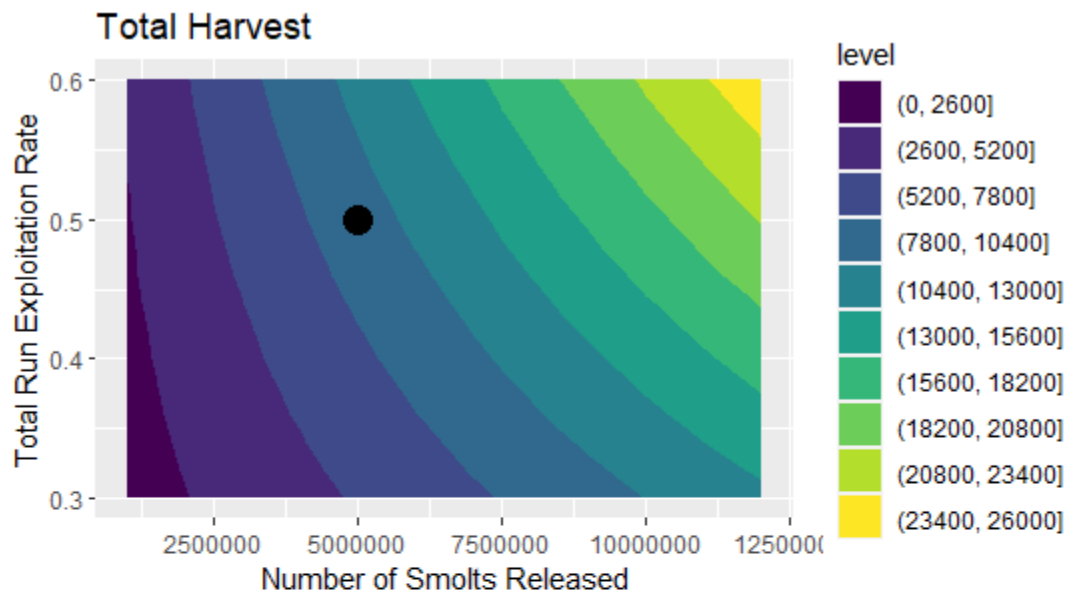
- Without immigration (e.g., hatchery stray), and 50% harvest rate, population stabilizes at $n = 729$.
- In Gen 2: HOS = 5,441 (previous slide)
 NOS = 1,766
 Total = 7,207
 Ricker: 3,568

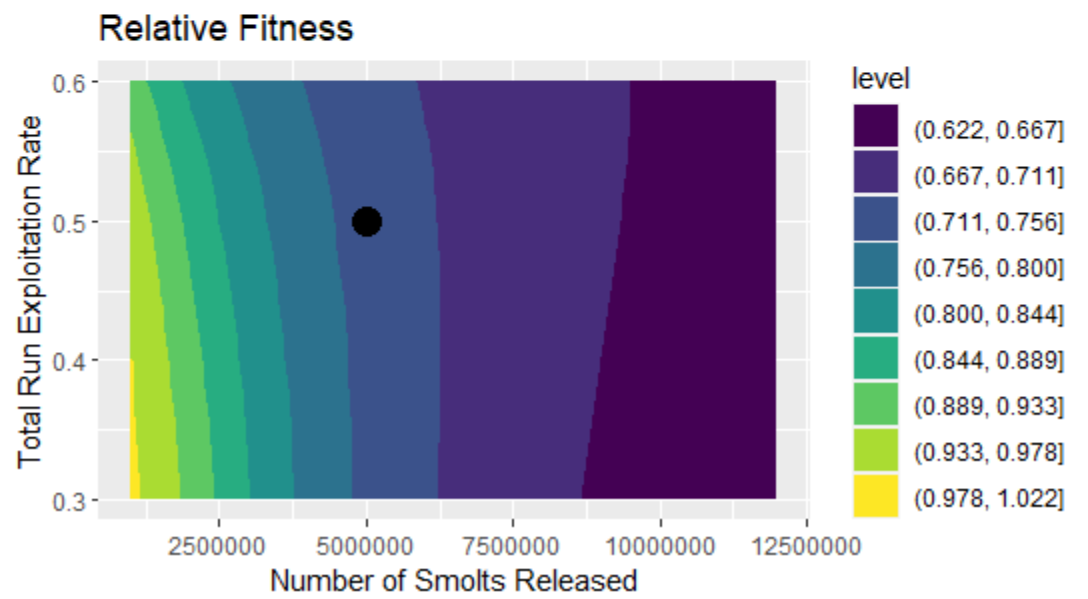
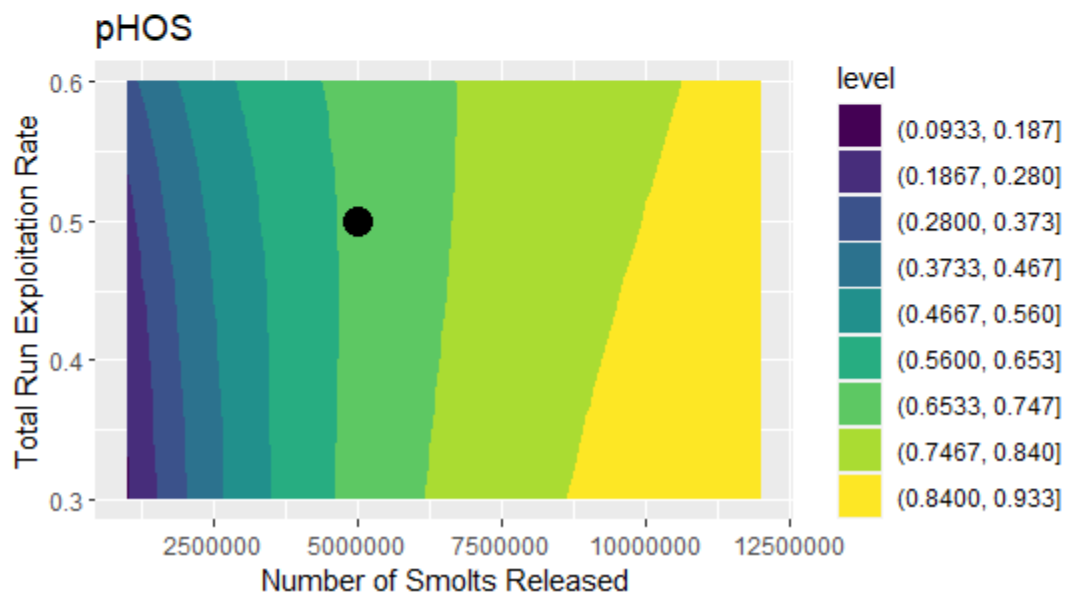
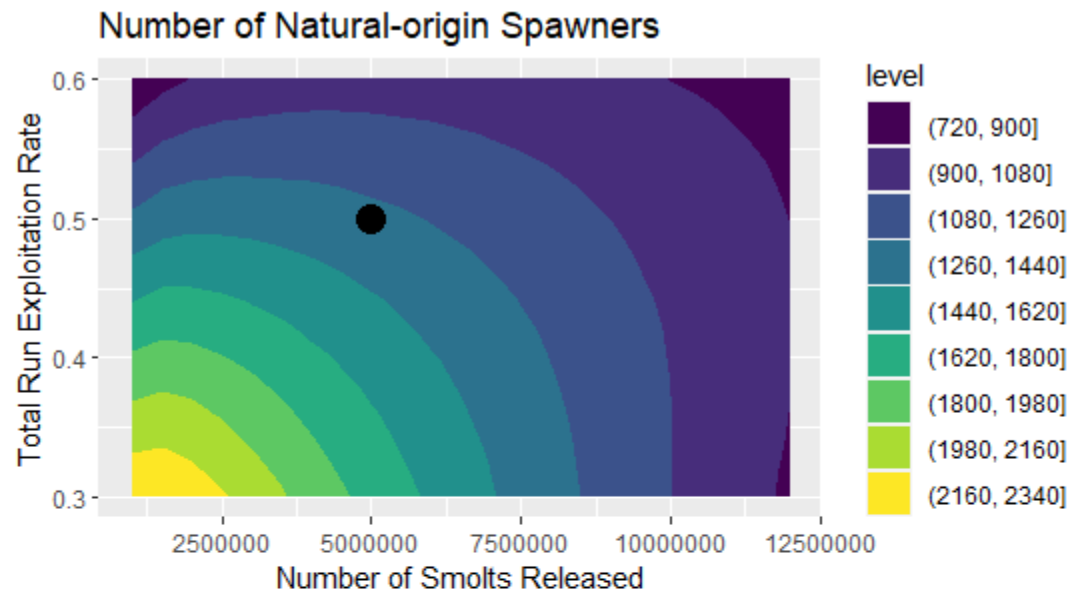
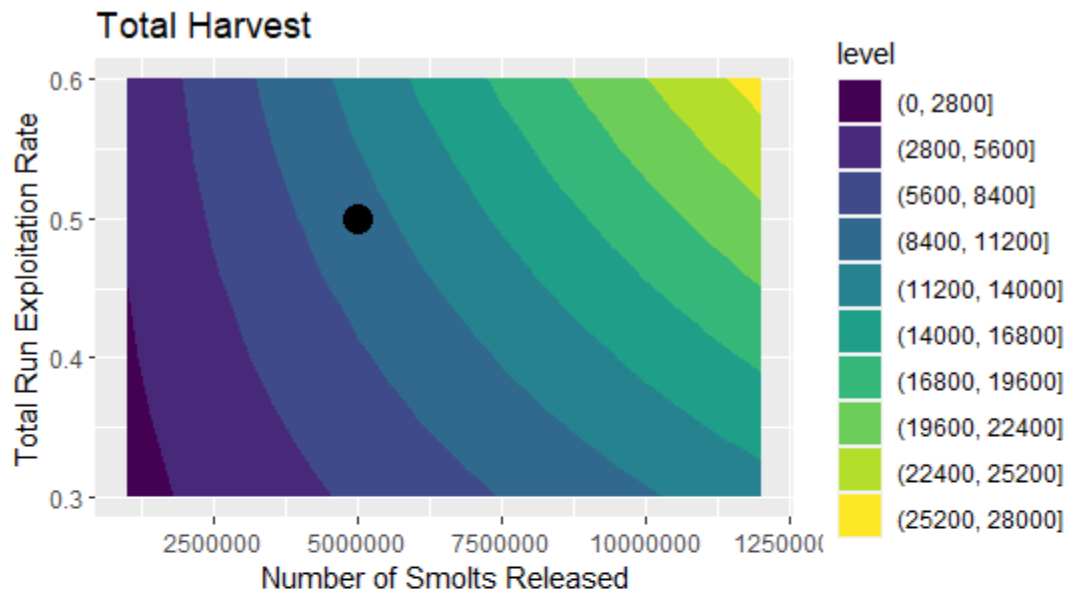
NATURAL ENVIRONMENT

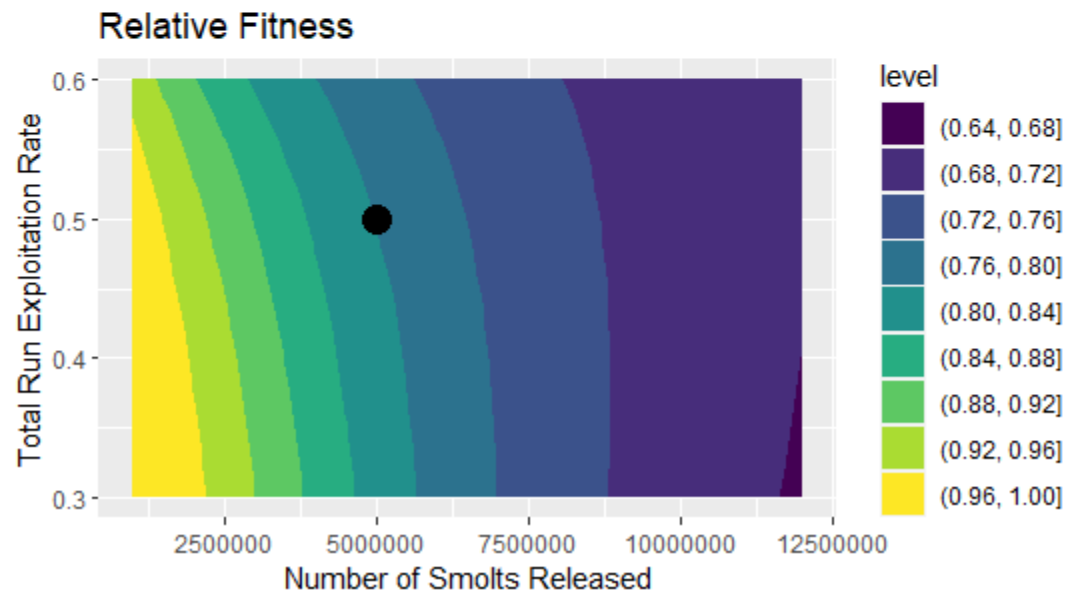
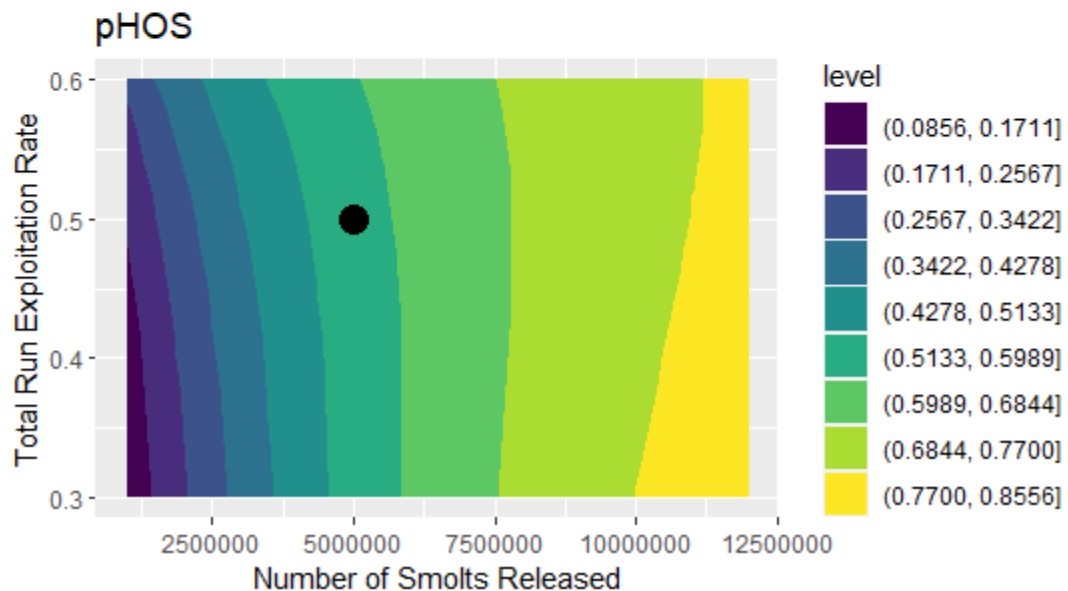
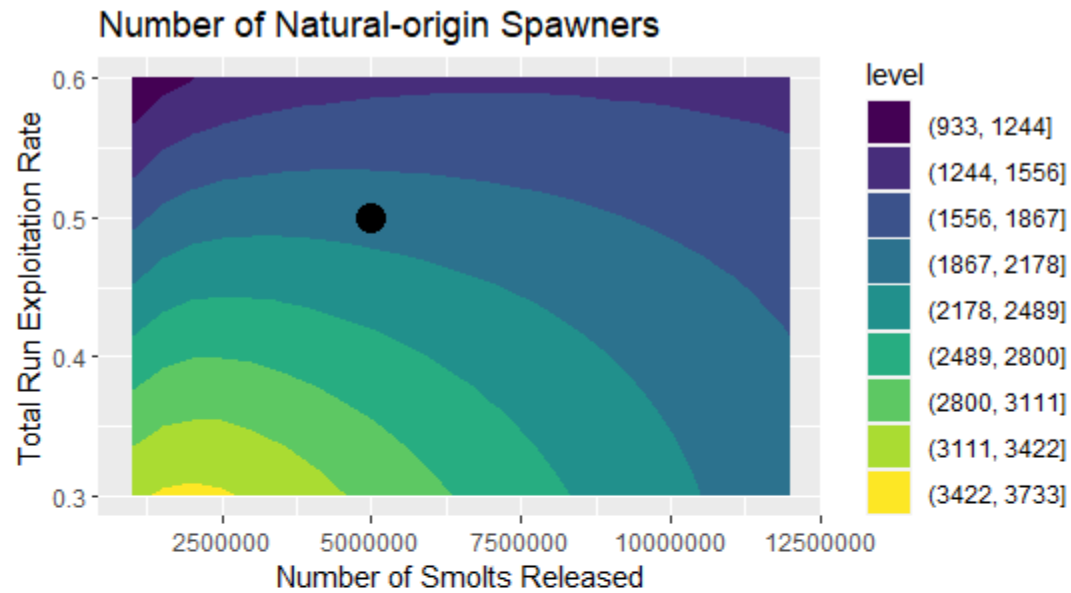
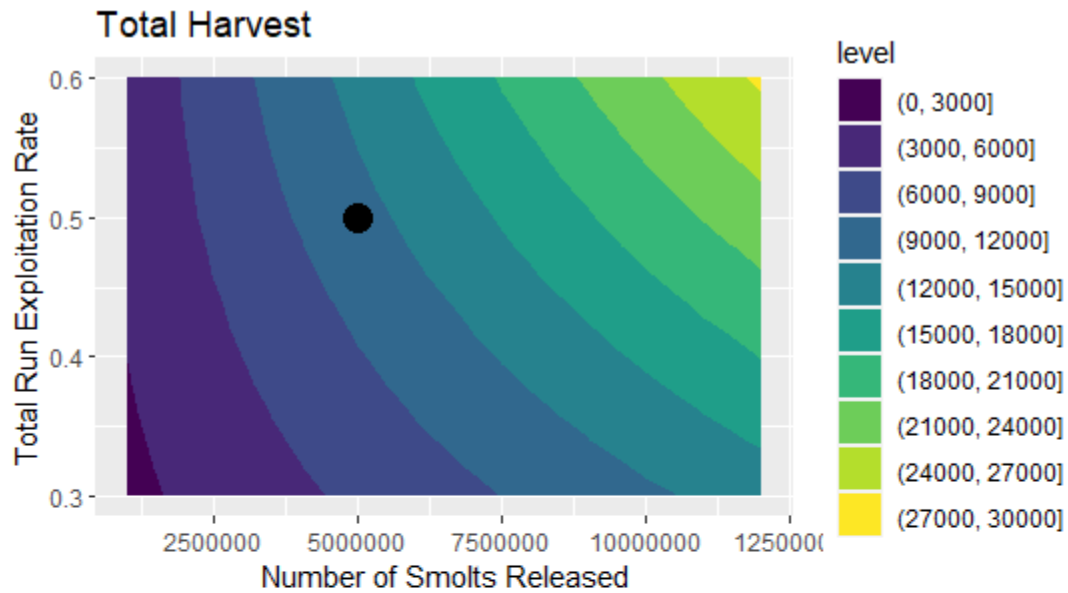






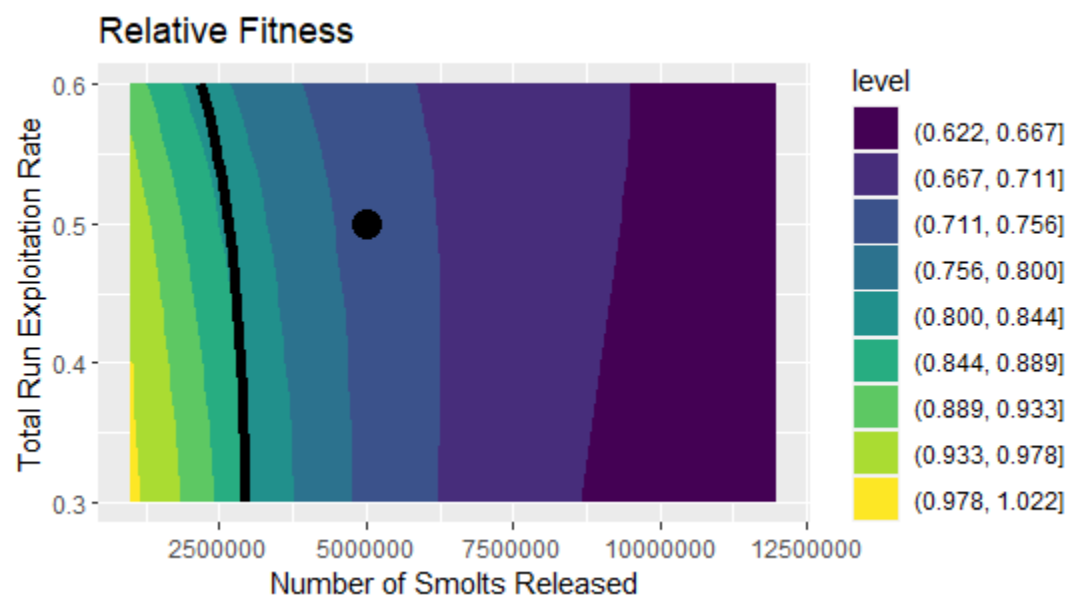
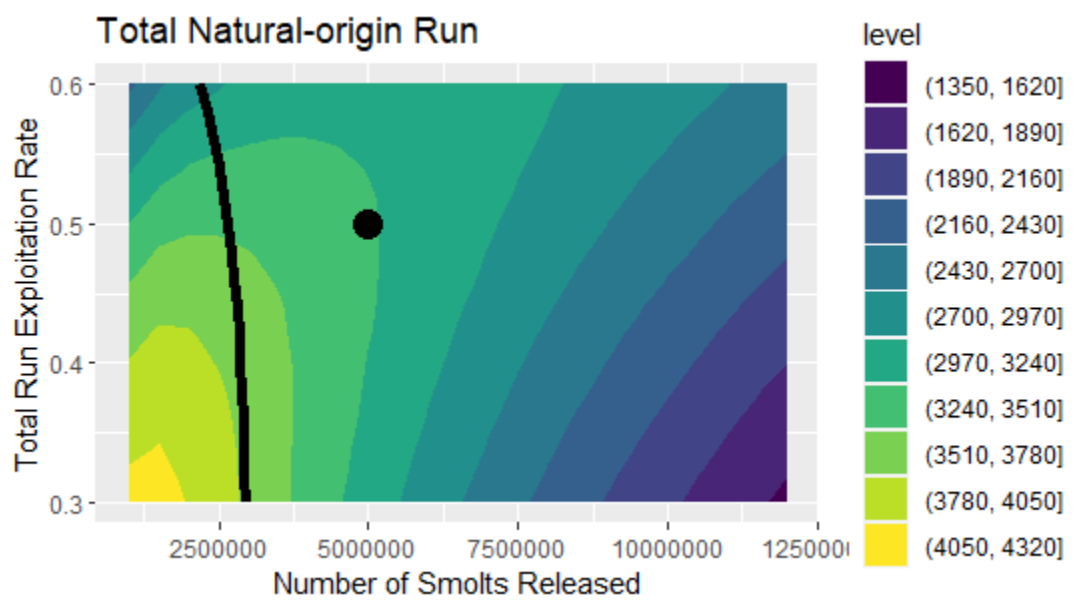
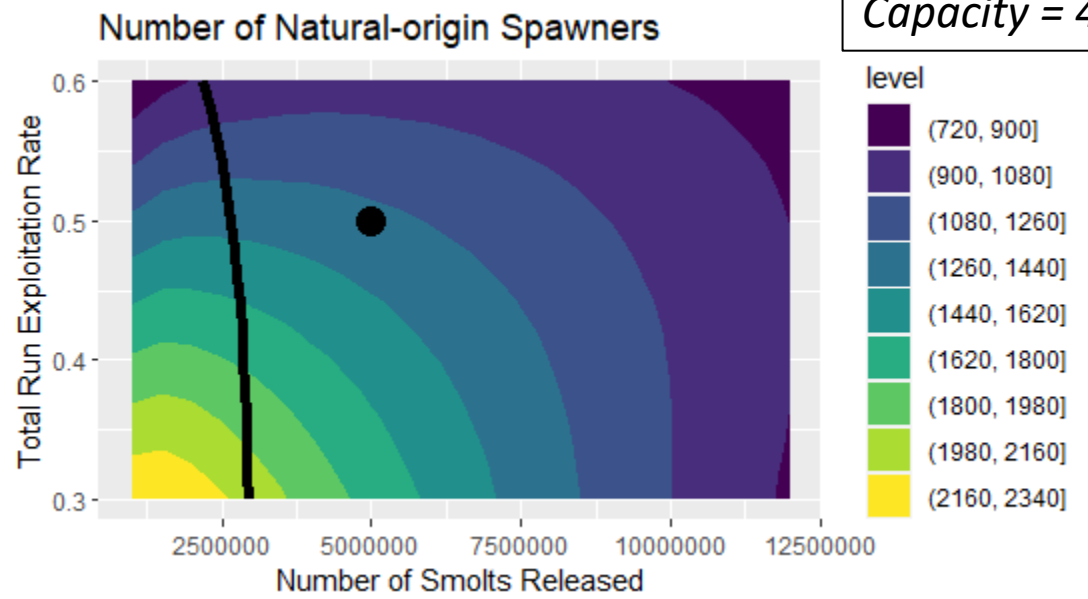
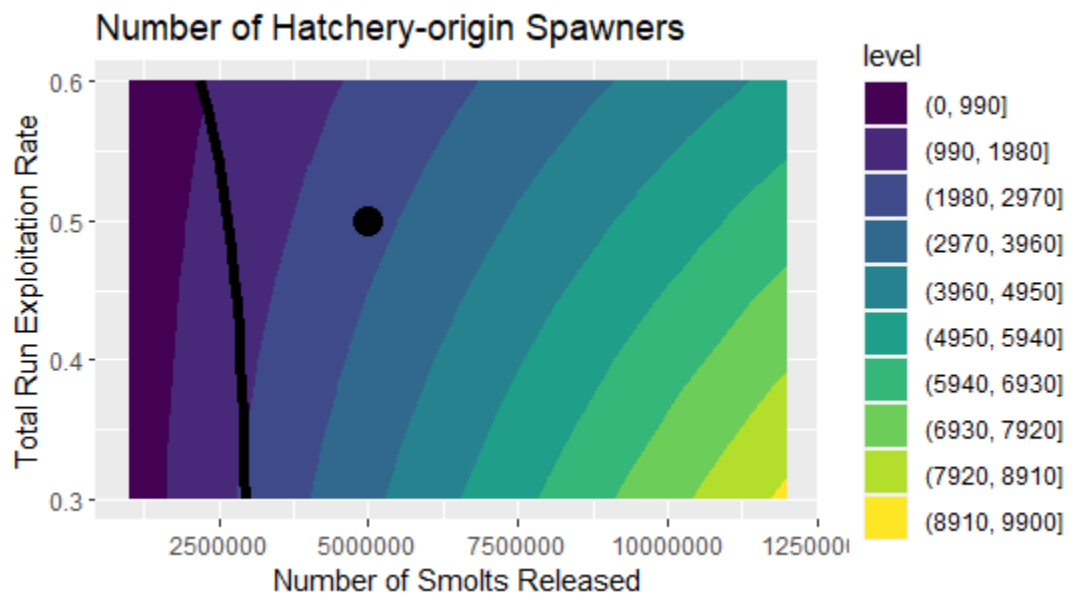


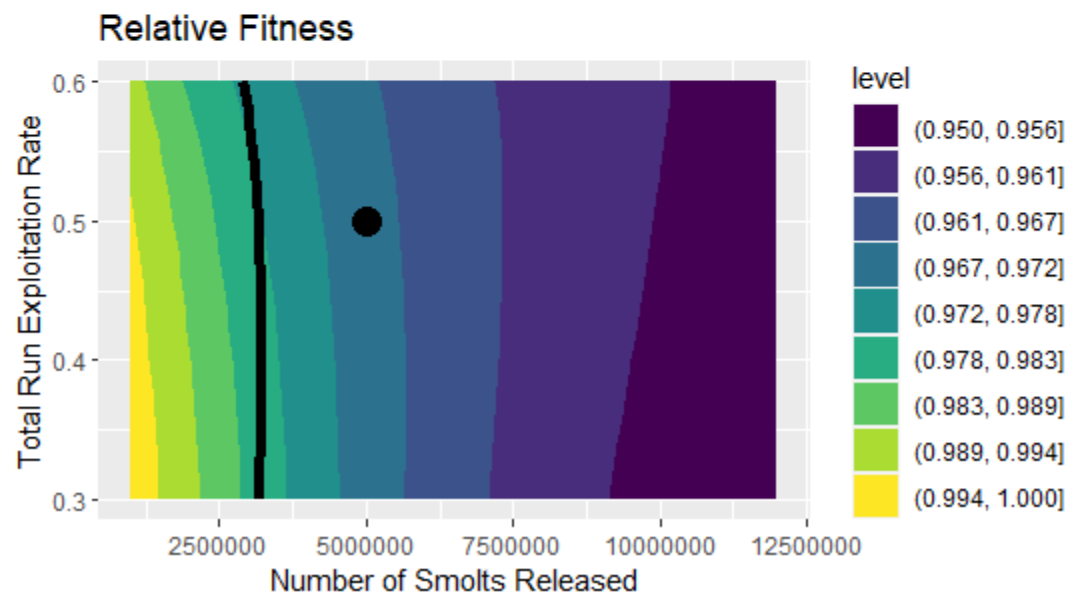
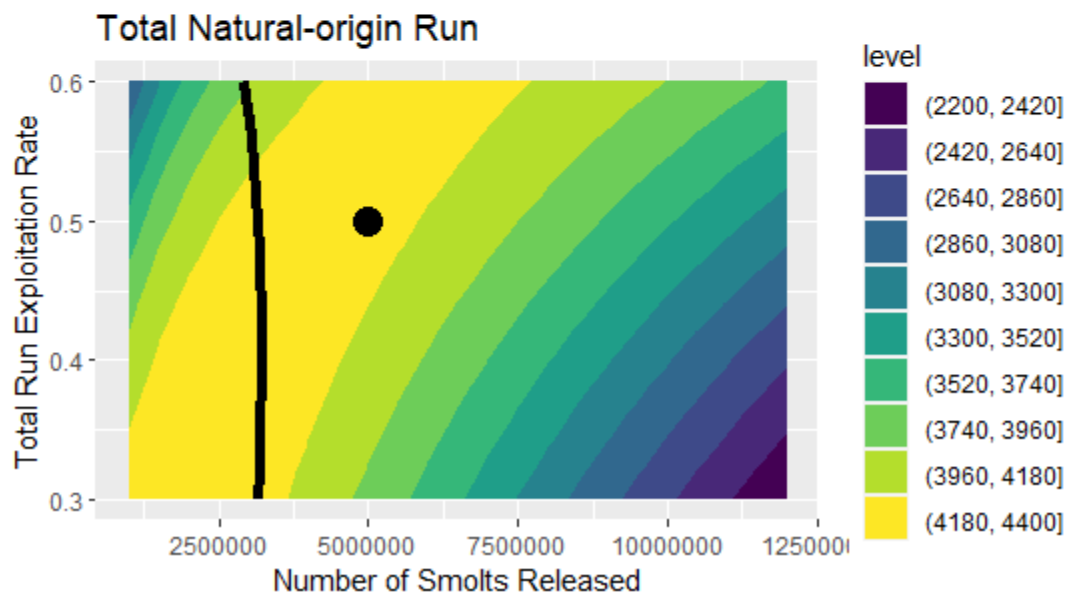
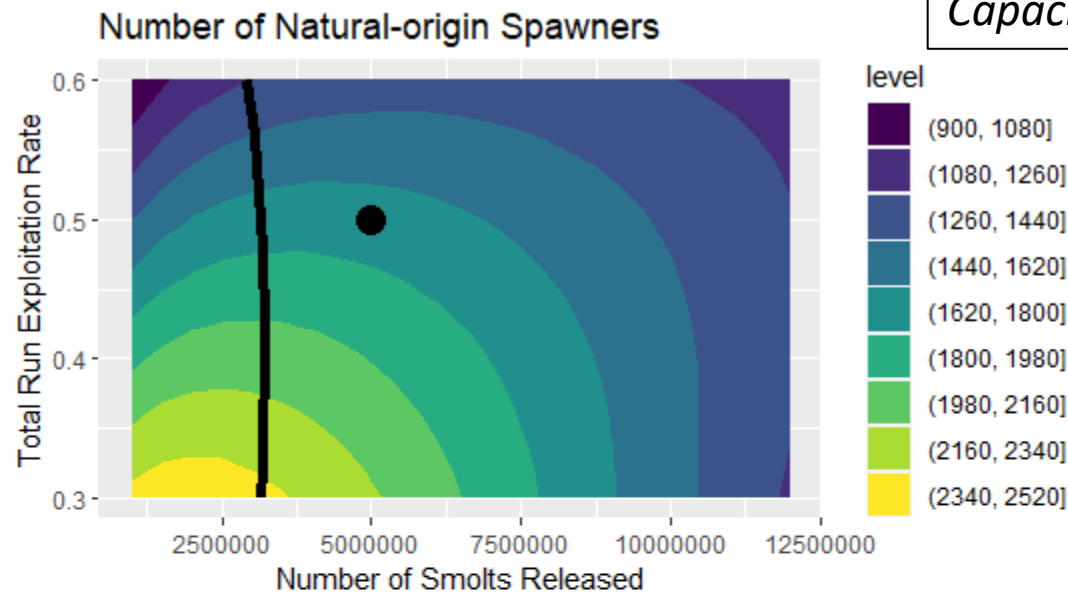
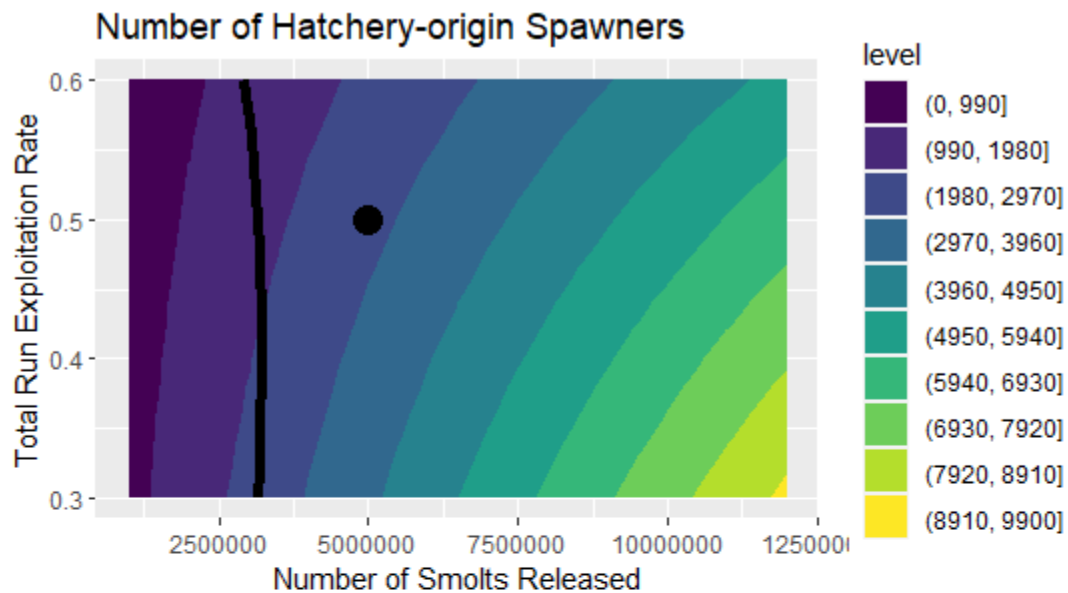


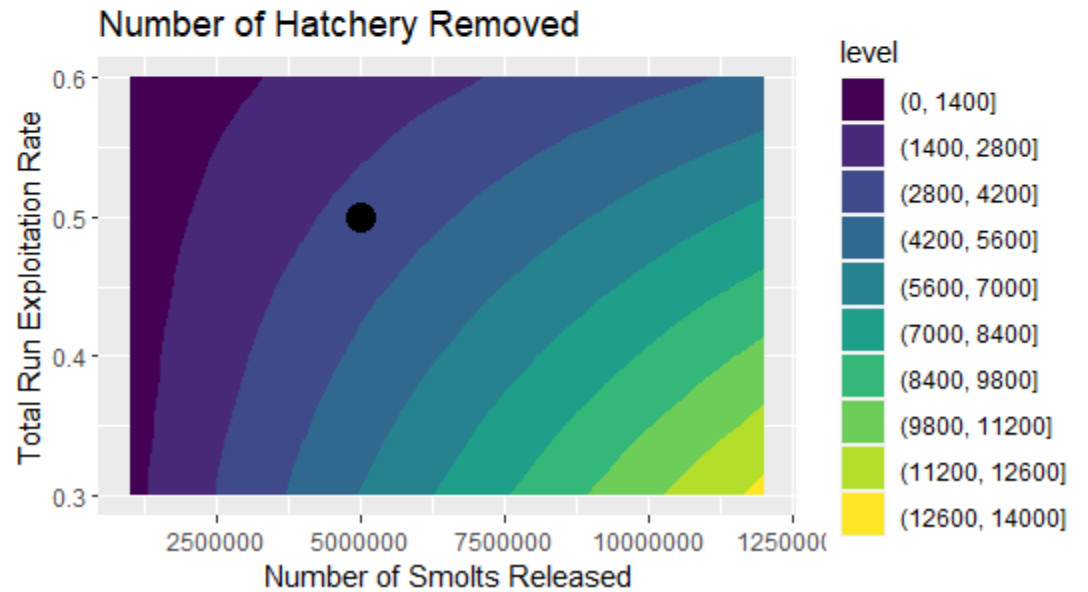
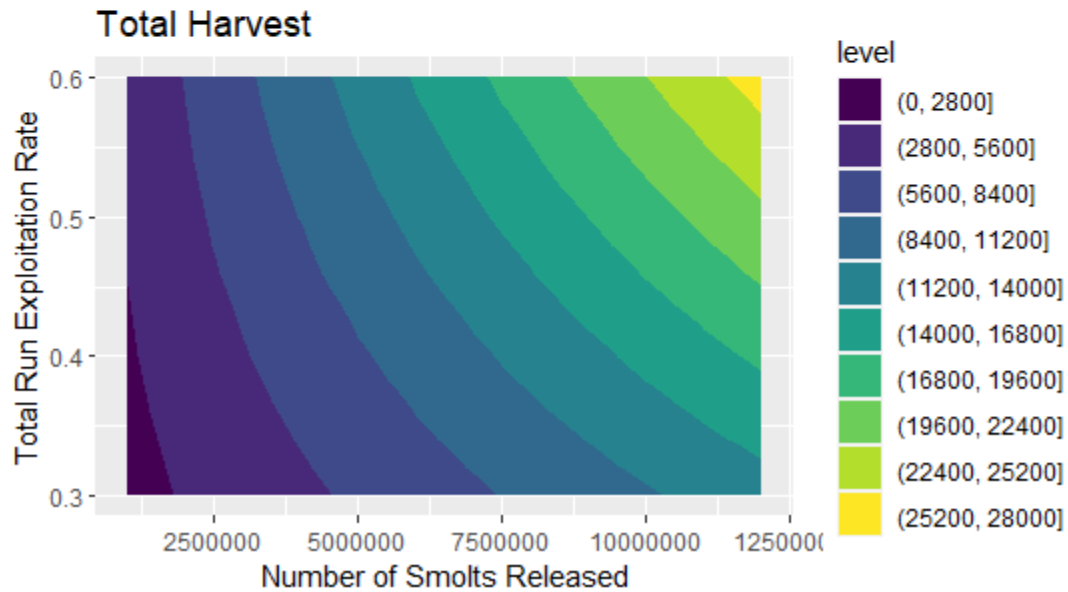
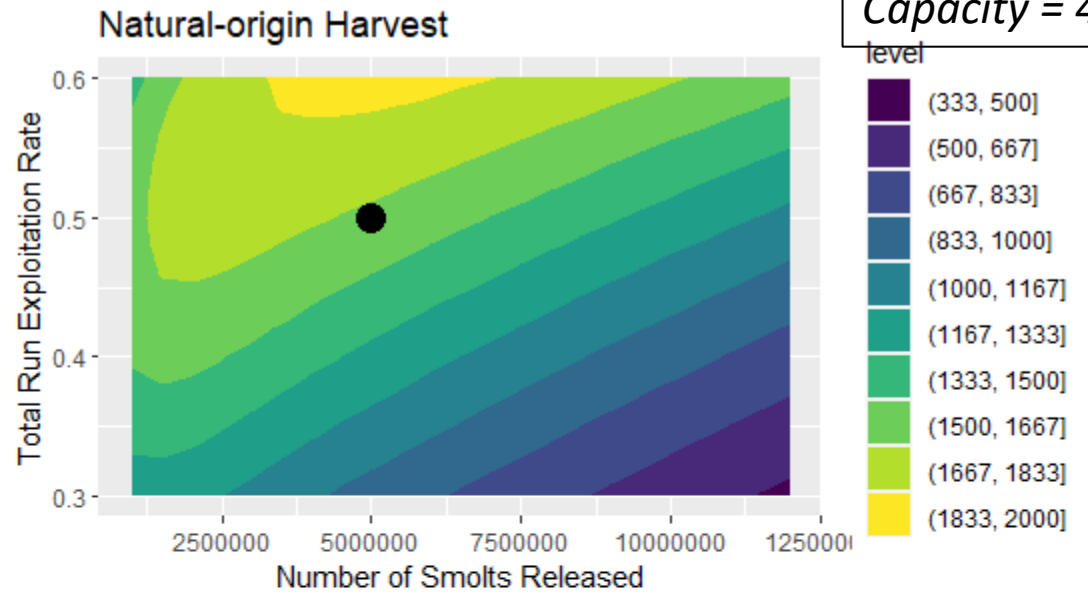
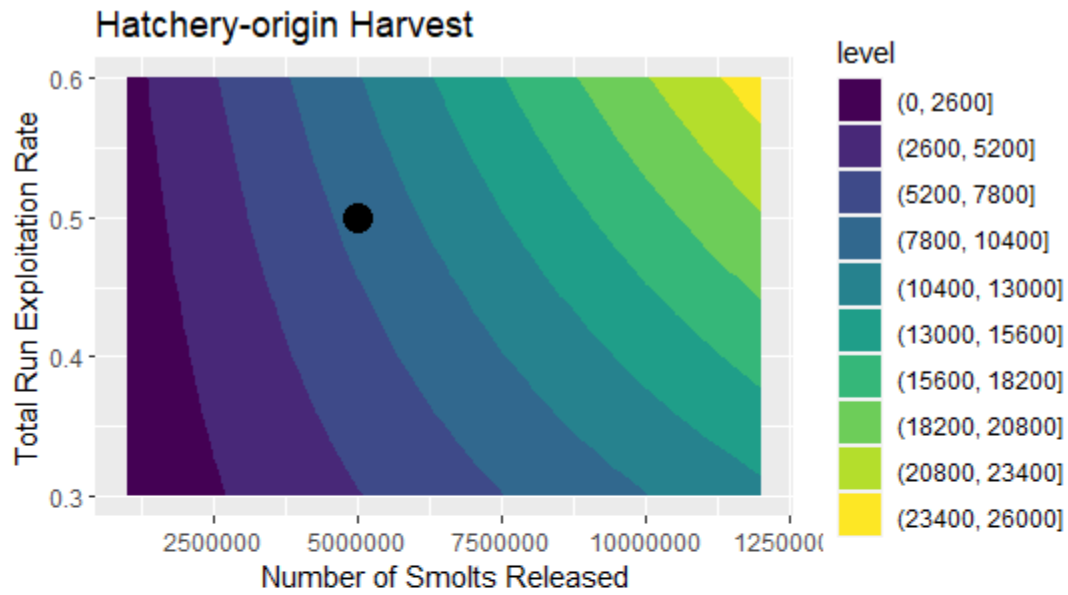


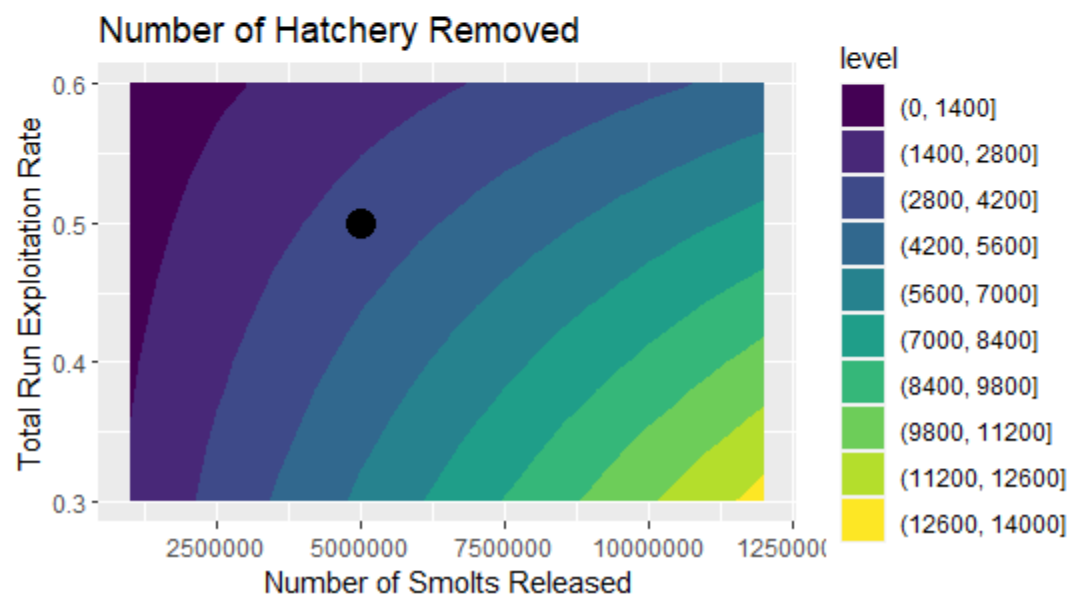
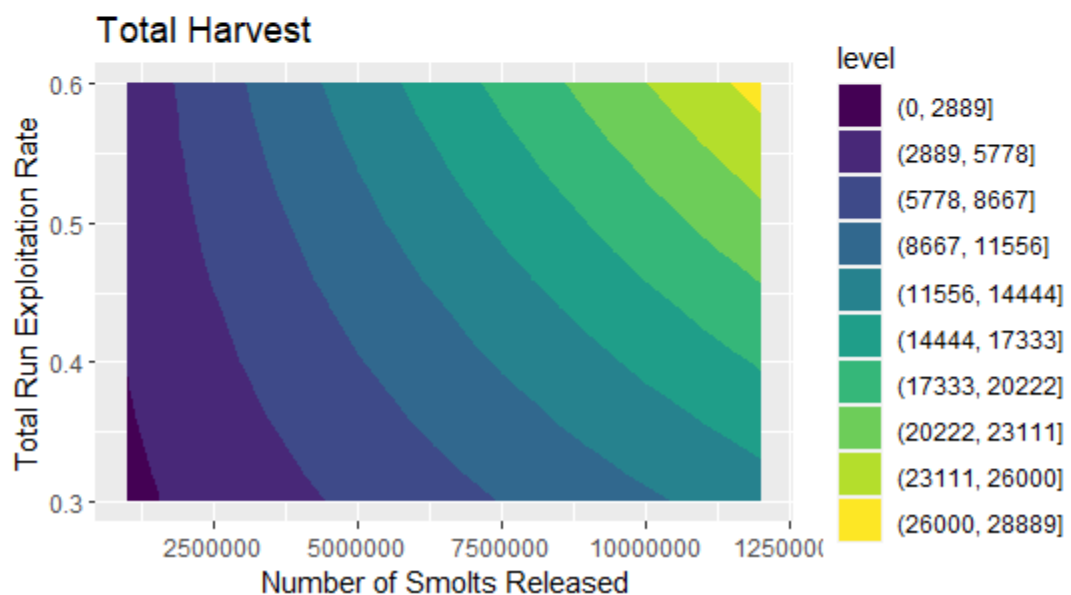
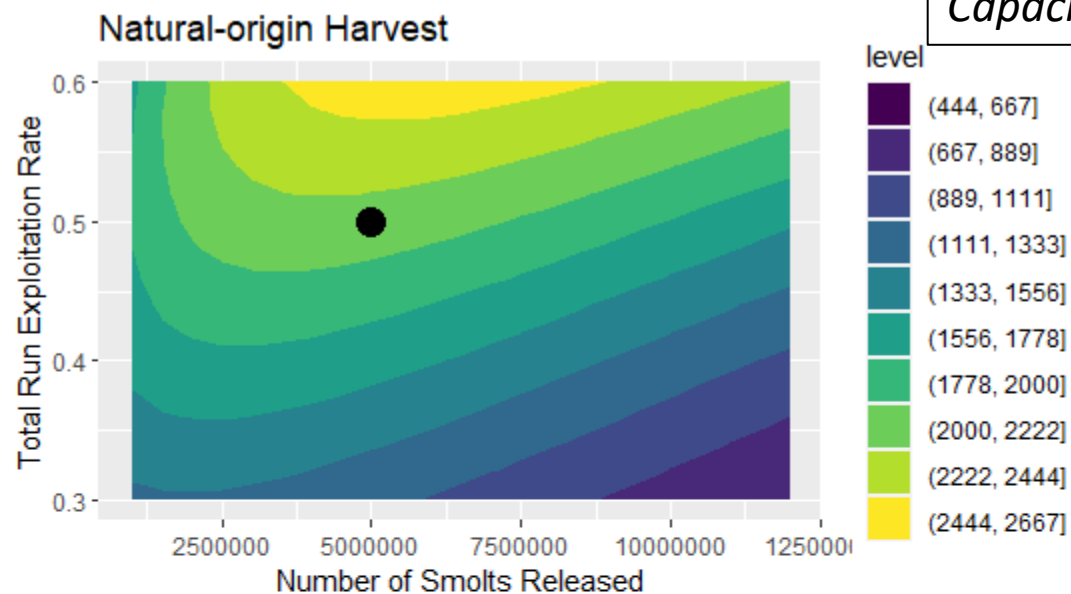
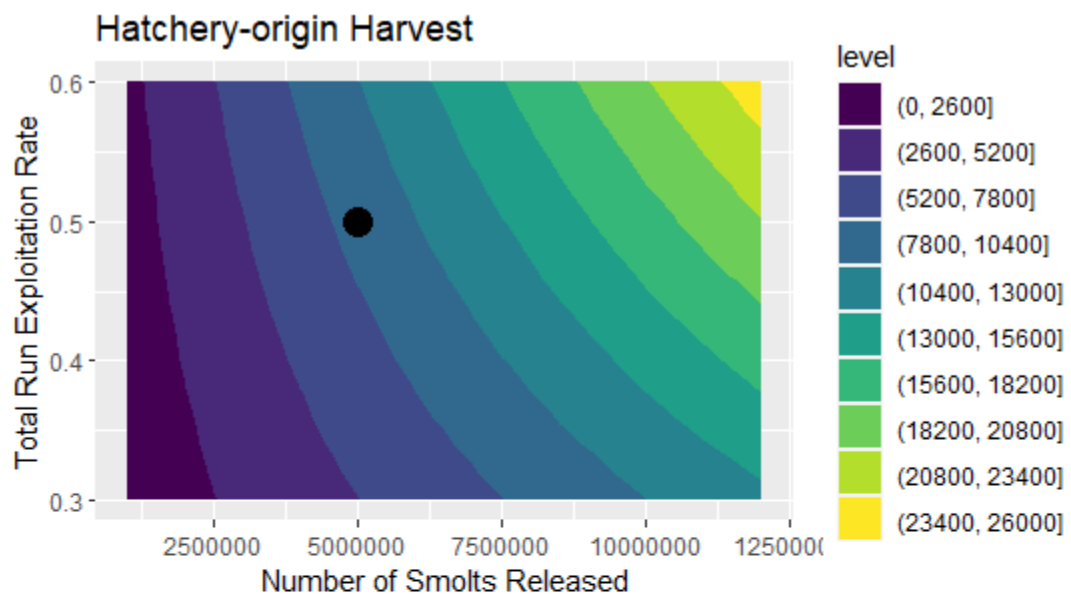
- Comparison between moderate selection and weak or no selection
- Address some of the initial questions asked of staff concerning the different alternatives, harvest, and status of natural spawning populations



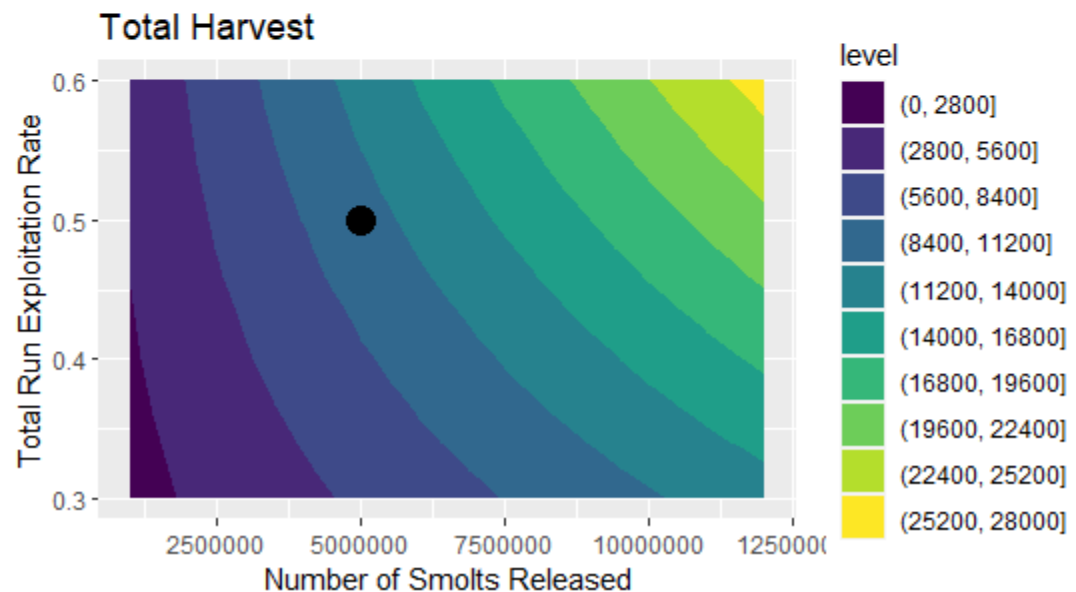
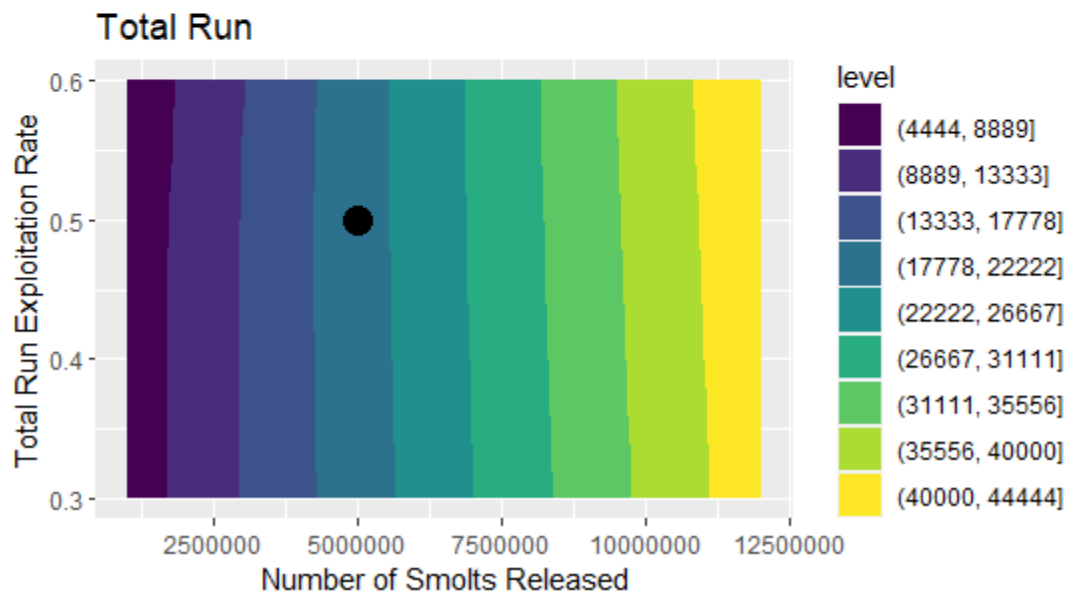
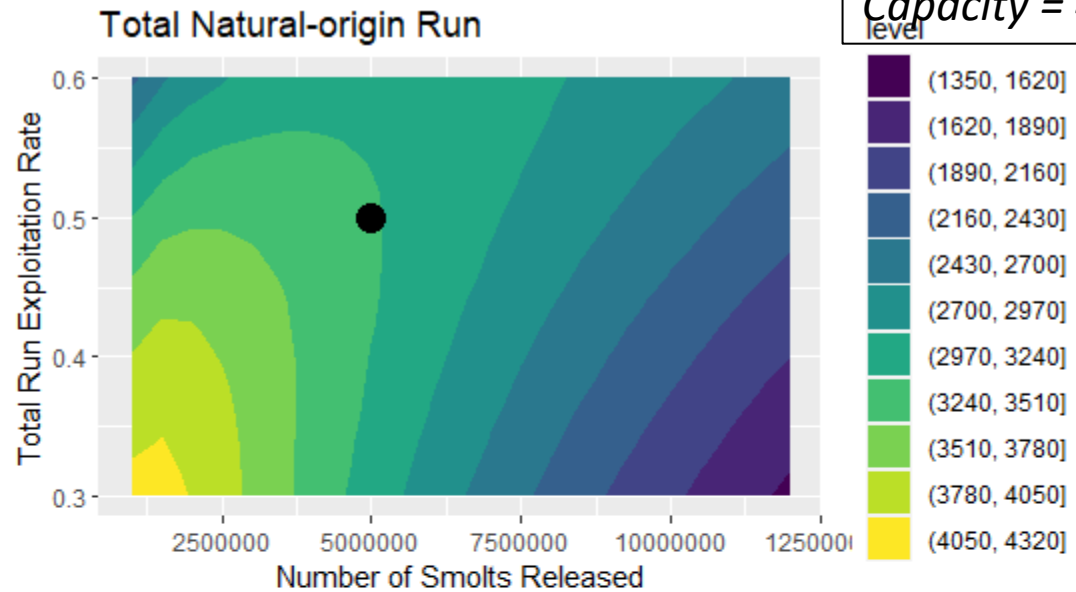
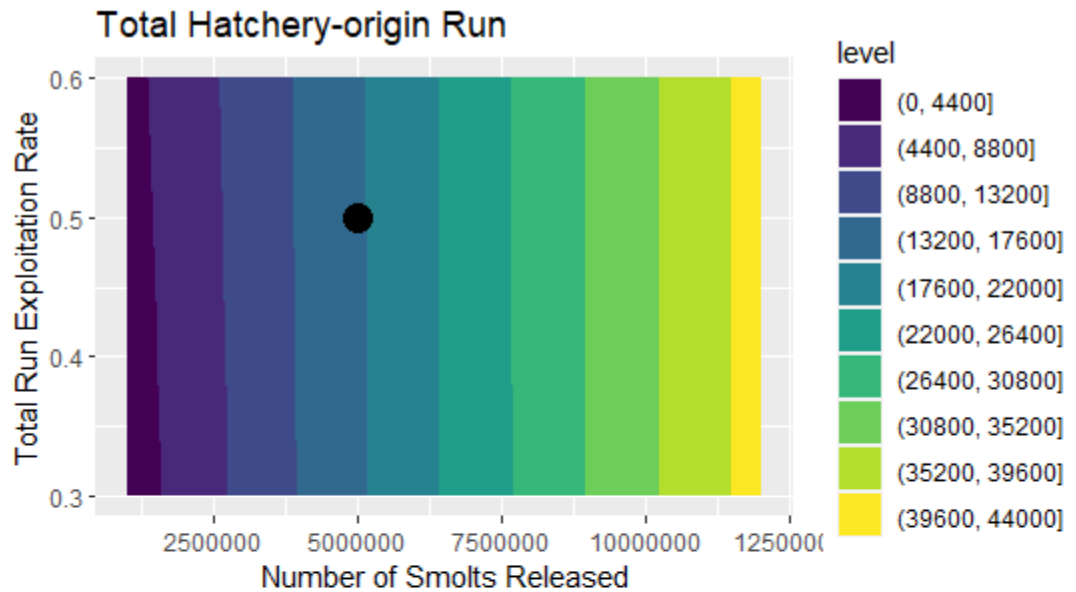


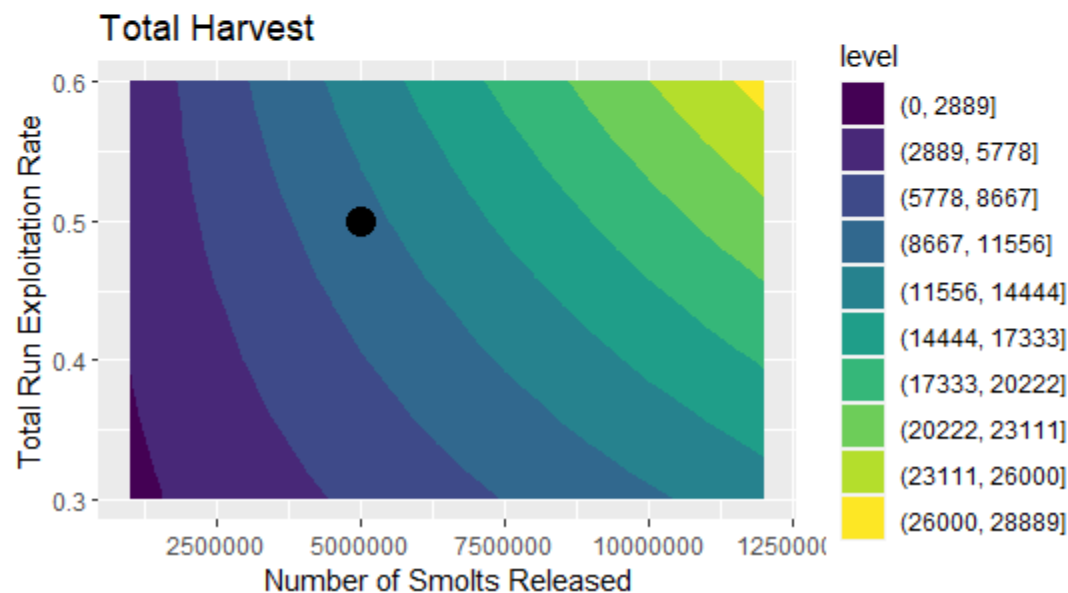
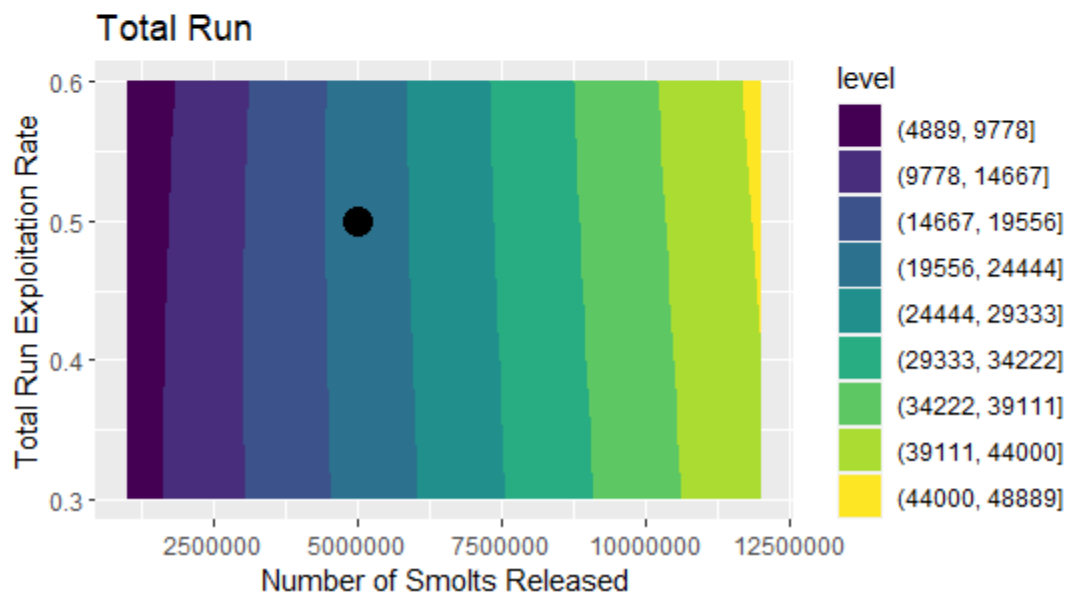
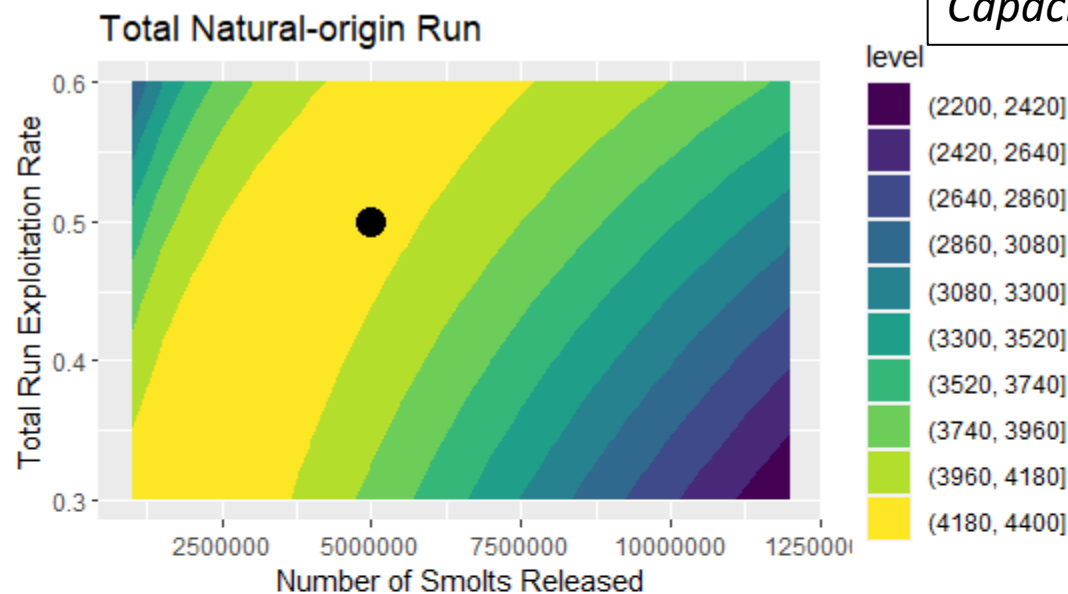
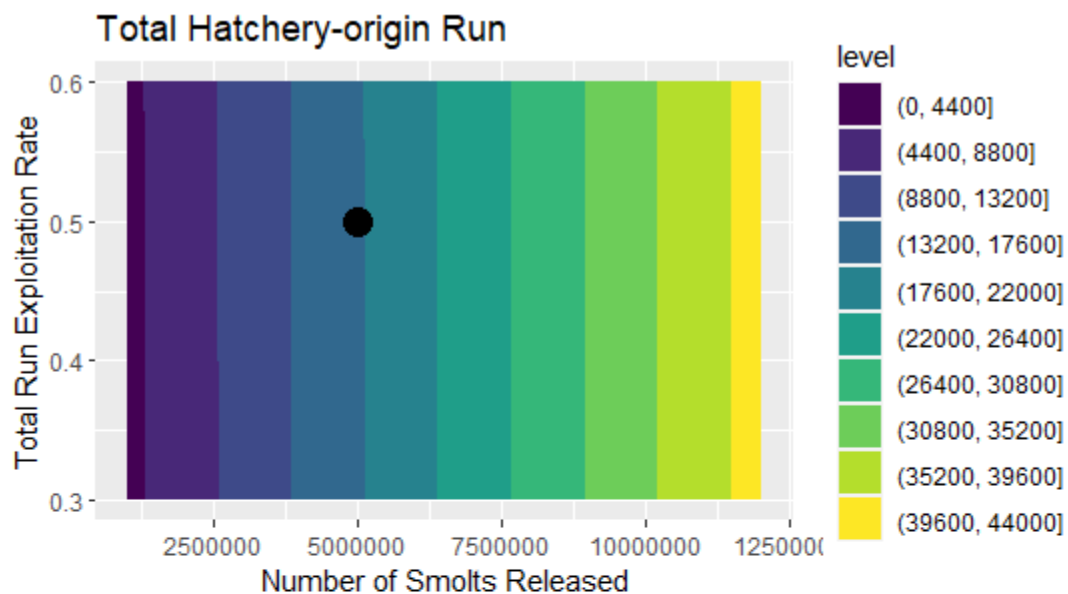






Selection: Moderate
Capacity = 4000





Some Conclusions

1. The greater the number of smolts released:
 - The greater the number hatchery fish harvested, regardless of exploitation rate,
 - The fewer the number of natural-origin spawners, the smaller the natural-origin run (i.e., lower natural productivity), and the fewer number of natural-origin fish harvested
2. As spawner capacity increases, the more productive, the lower the pHOS, and the higher the fitness of the natural-spawning population for a given number of smolts released
3. These general conclusions are relatively independent of fitness differences between natural- and hatchery-origin natural spawners
4. Of the three parameters, increasing smolt production produced the greatest increase in the number of fish harvested and the greatest decrease to natural production, compared with comparable changes in exploitation rate and spawning capacity





Questions and Discussion