Trade-offs in Genetic and Ecological Risk and Enhancement Benefits in a Steelhead Conservation Program

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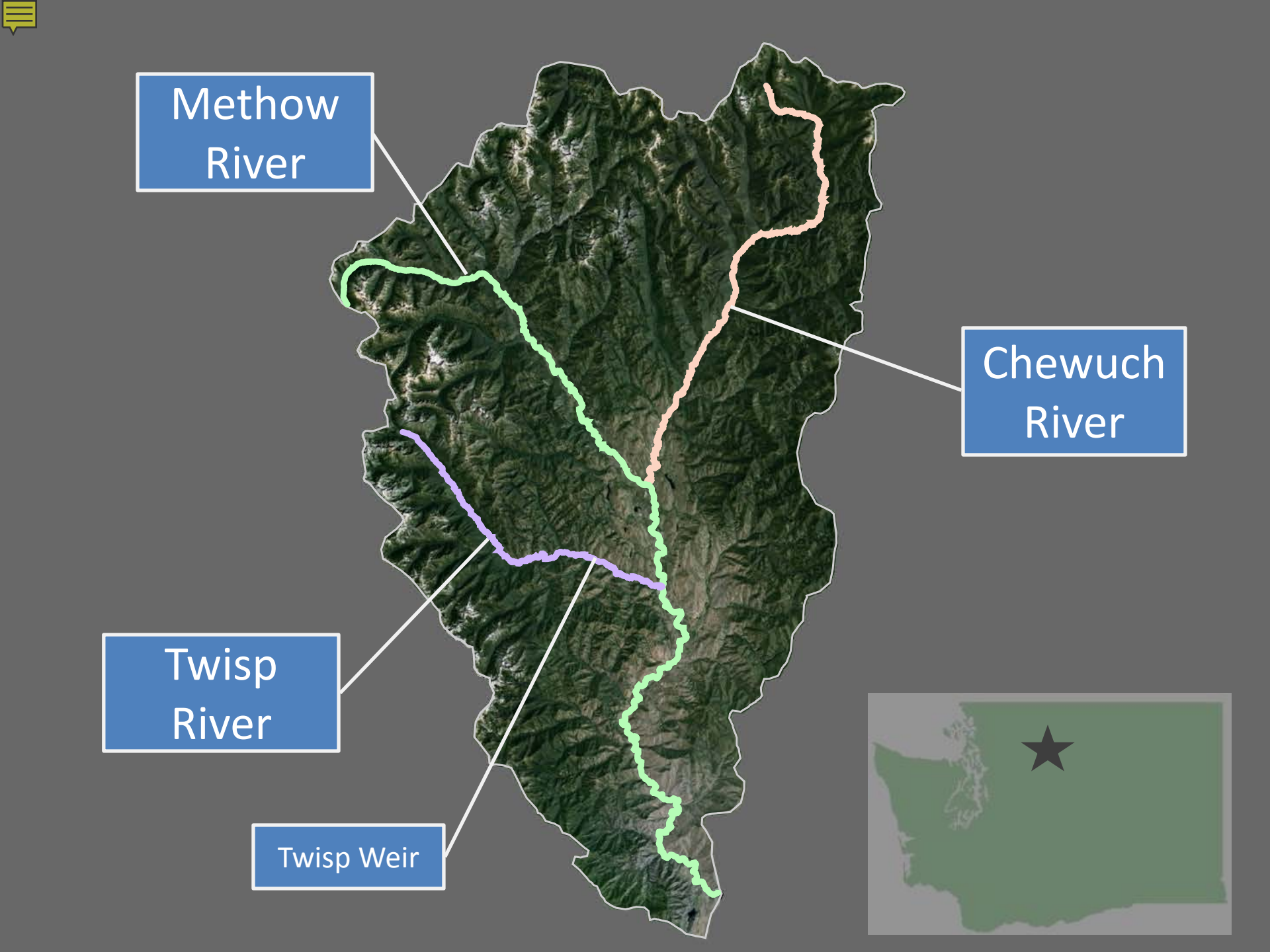
Habitat Conservation Plan

…contributing to the rebuilding and recovery of naturally reproducing populations in their native habitats, while maintaining genetic and ecologic integrity, and supporting harvest

Governed by DPUD, NMFS, WDFW, USFWS, CCT, YN

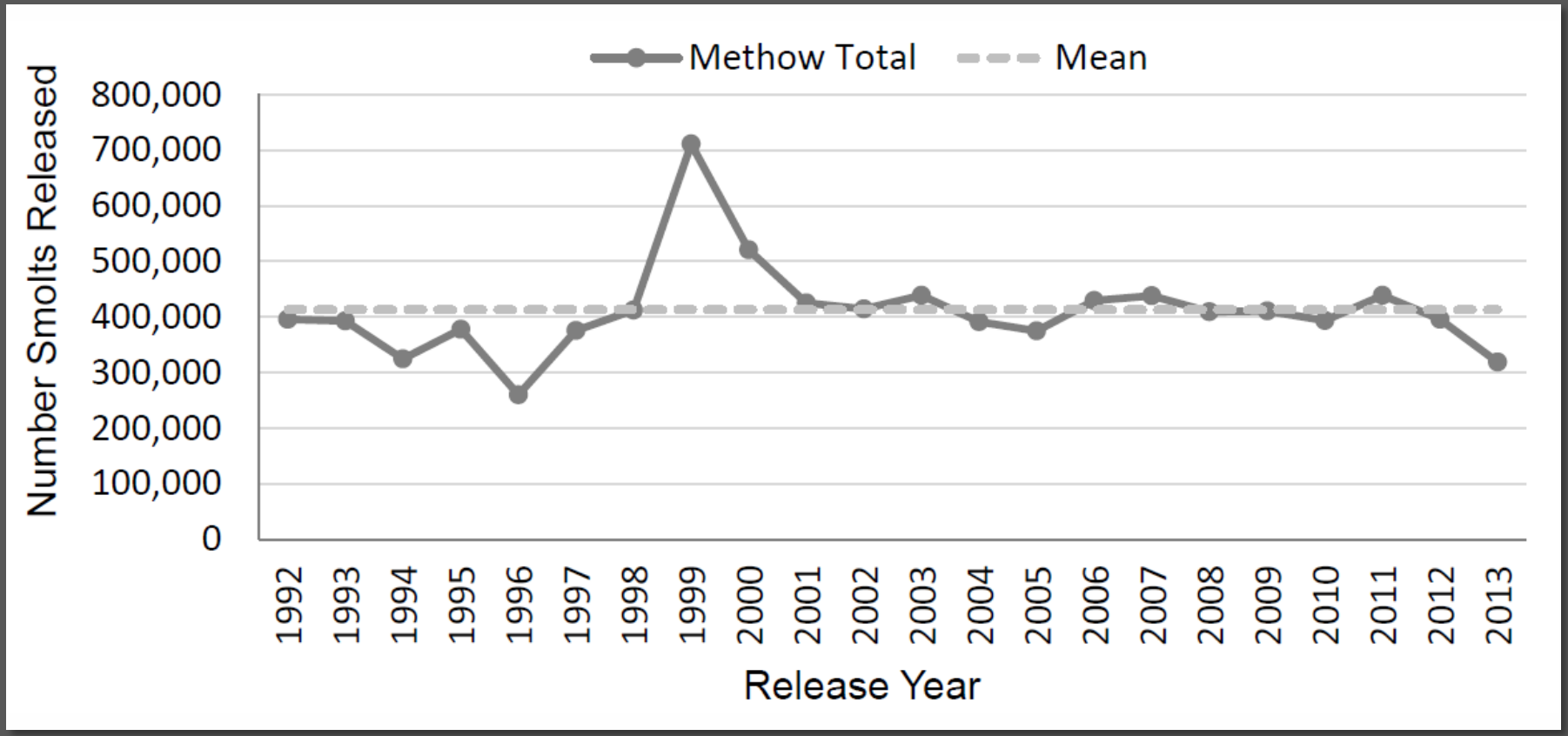

Methow River
Chewuch River
Twisp River
Twisp Weir

Twisp Steelhead Program Structure and History

Attribute	Pre-2011	2011-2017	2018 >>
Hatchery	Wells	Wells	Wells and WNFH
Program Size	~104,000	48,000	24,000 + 24,000
Brood Source	Wells stock H+W	Twisp WxW	Twisp WxW + Methow WxW
Brood Number	~200	26	14 + 150
Genetic Risk	NA	NA	Ryman-Laikre[1]
Smolt Age	1	1	1 and 2
pHOS Target	None	0.50	0.20
Estimated pHOS	0.85 (basin)	~0.50	TBD

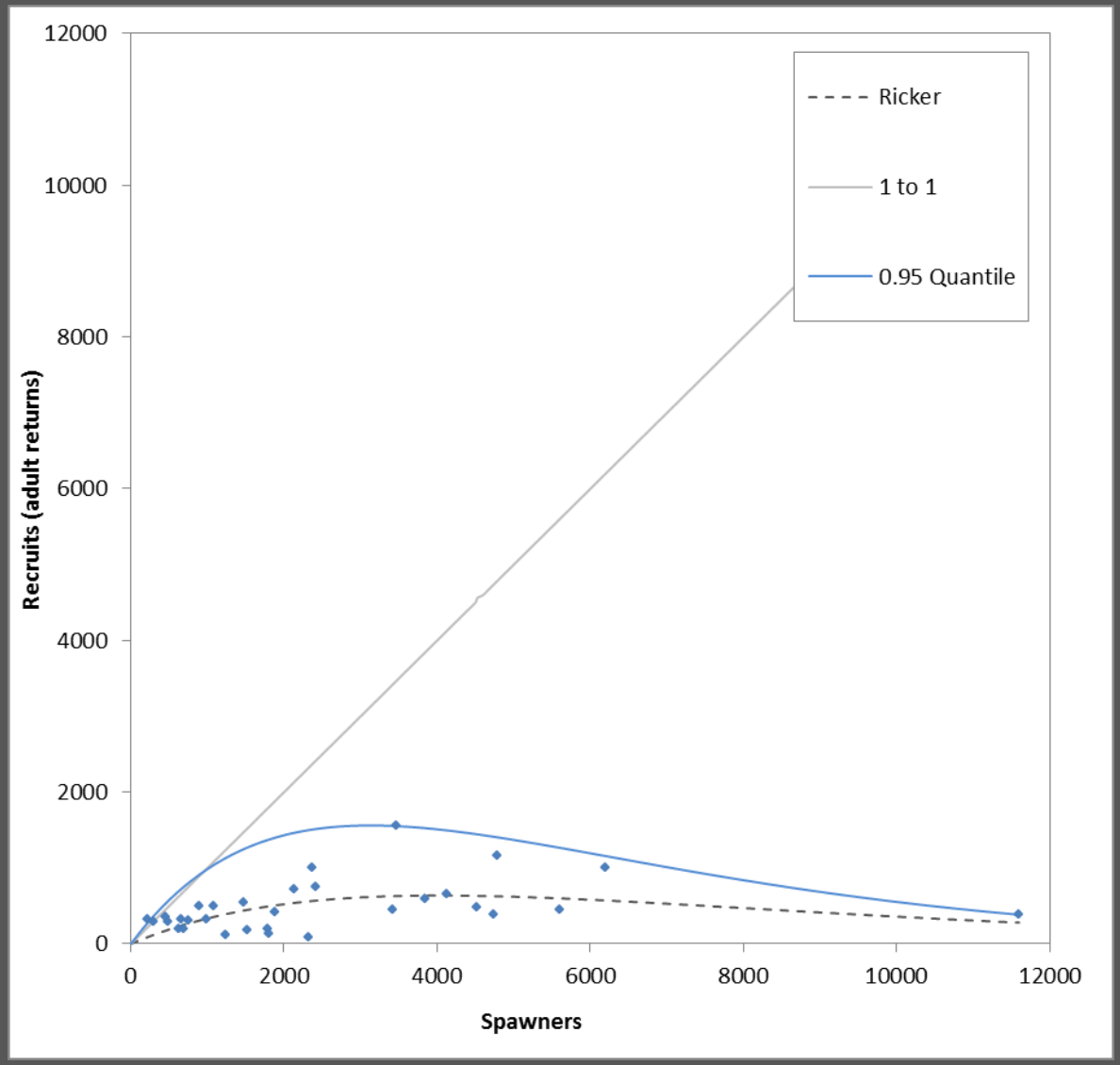
[1] T. Seamons, WDFW, Memo to HCP Hatchery Committee, November 2017

Summer Steelhead Releases



NMFS 2016

Methow Basin Population Status



Proportionate Natural Influence PNI

- Genetic influence of wild portion of population greater than the hatchery portion.
- PNI ≥ 0.67

Proportionate Natural Influence PNI

$$\frac{Hs}{(Hs + Ns)} = pHOS$$

$$\frac{Nb}{(Hb + Nb)} = pNOB$$

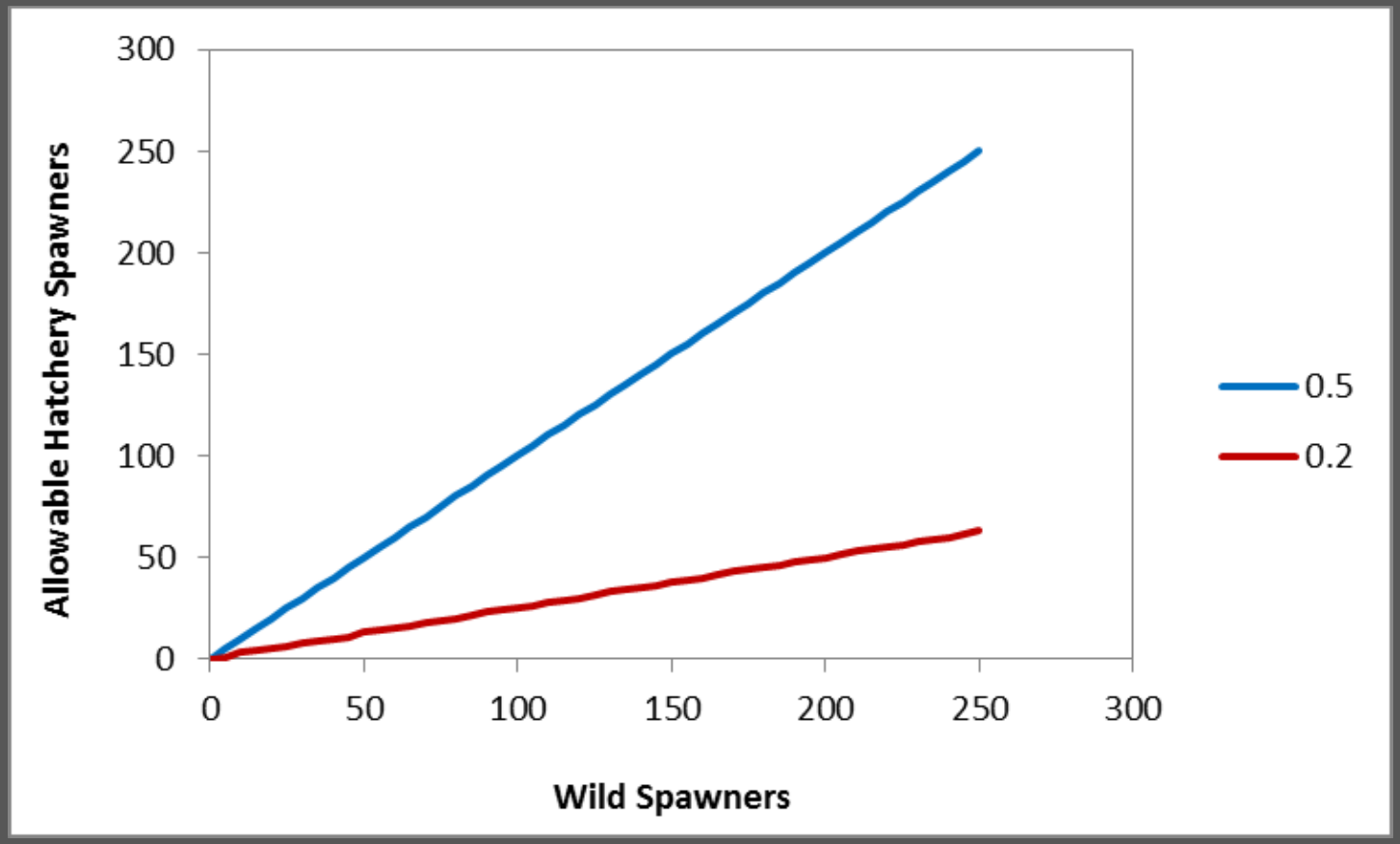
$$\frac{pHOS}{(pHOS + pNOB)} = PNI$$

HSRG, 2009

pHOS >> Gene Flow Management

- Removal of Hatchery Surplus Adults
  - Angling season to remove hatchery returns
  - Twisp Weir

Allowable Hatchery Origin Spawners pHOS



Twisp Program Modeling

- Stochastic model
- Based on historical data
- Modeled management scenarios to estimate:
  - Escapement
  - Numbers of hatchery fish to remove
  - Program size

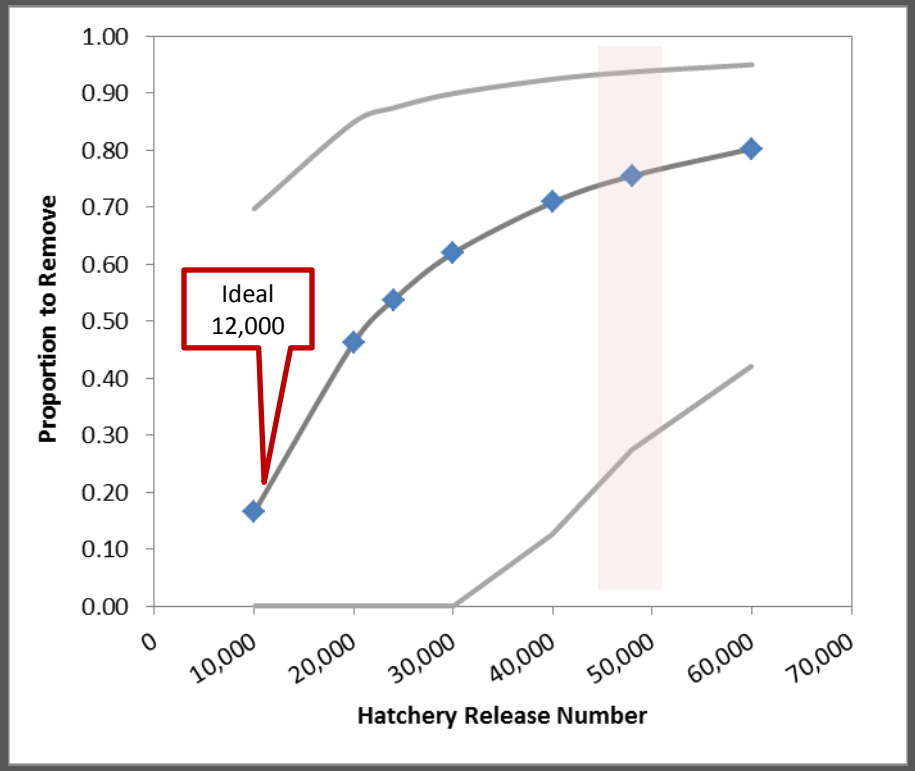
Twisp Program Modeling

- Wild spawners = ~103 (30-175)
  - pHOS = 0.50 = ~103 hatchery spawners
  - pHOS = 0.20 = ~21 hatchery spawners

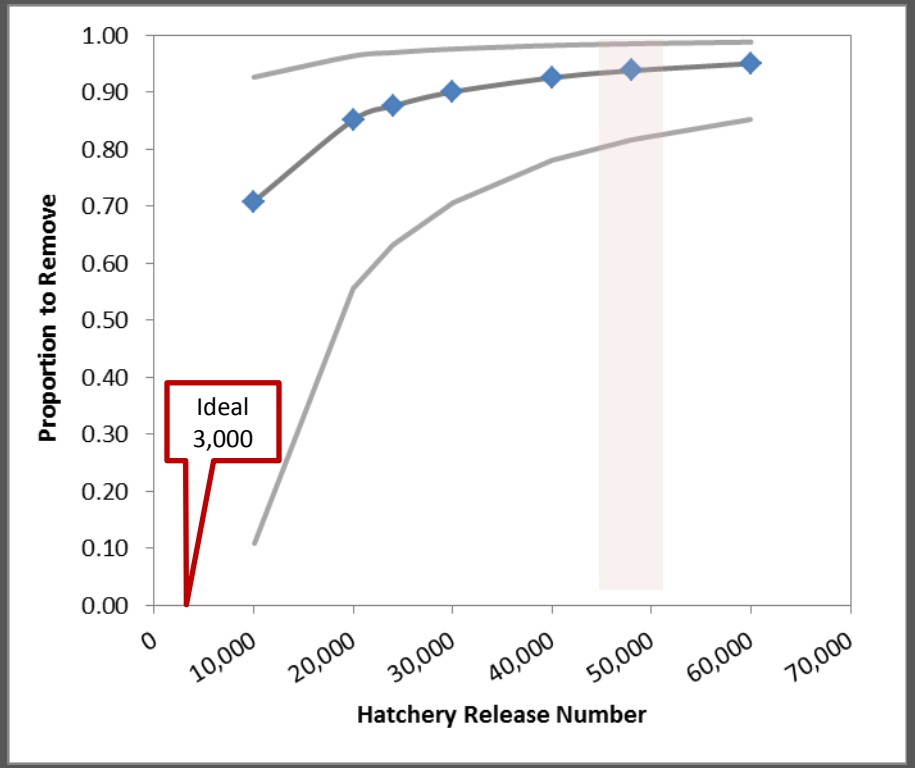
- Program size = 48,000 smolts
  - About 644 hatchery spawners (173-1,138)

Twisp Gene Flow Management

pHOS = 0.50

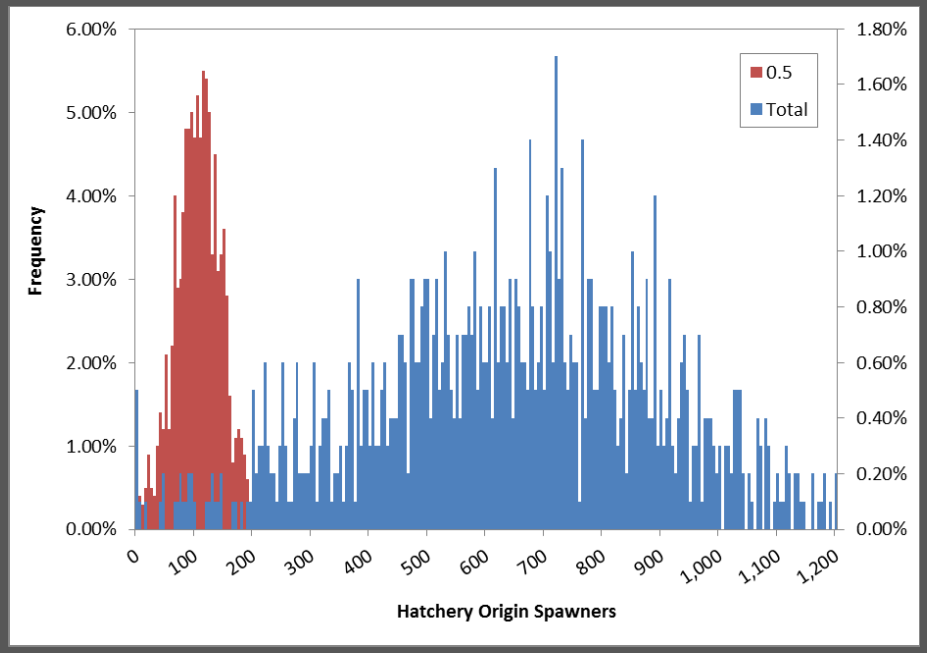


pHOS = 0.20

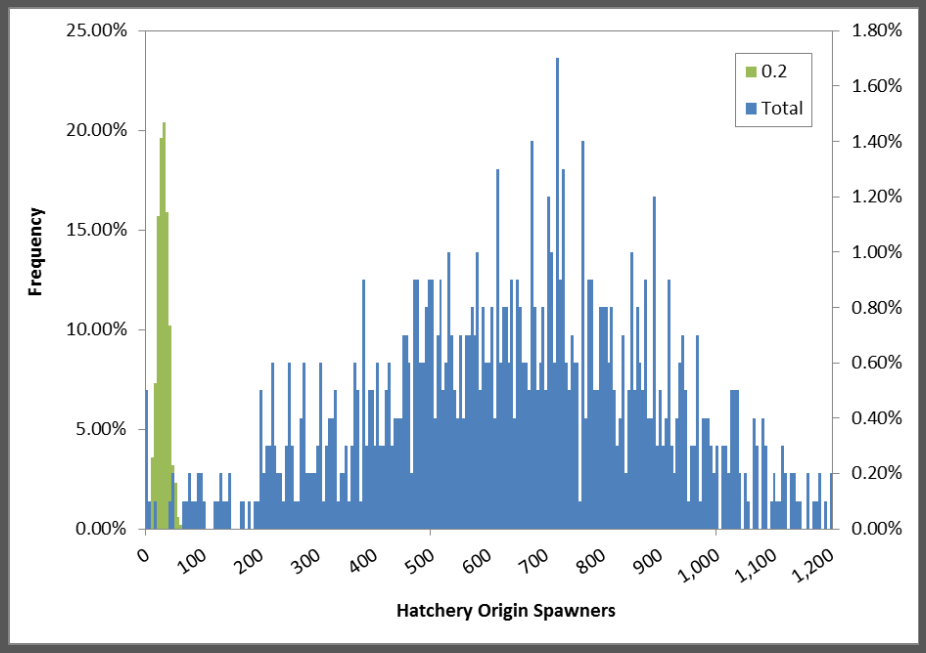


Twisp Gene Flow Management

48,000 smolts
pHOS = 0.50

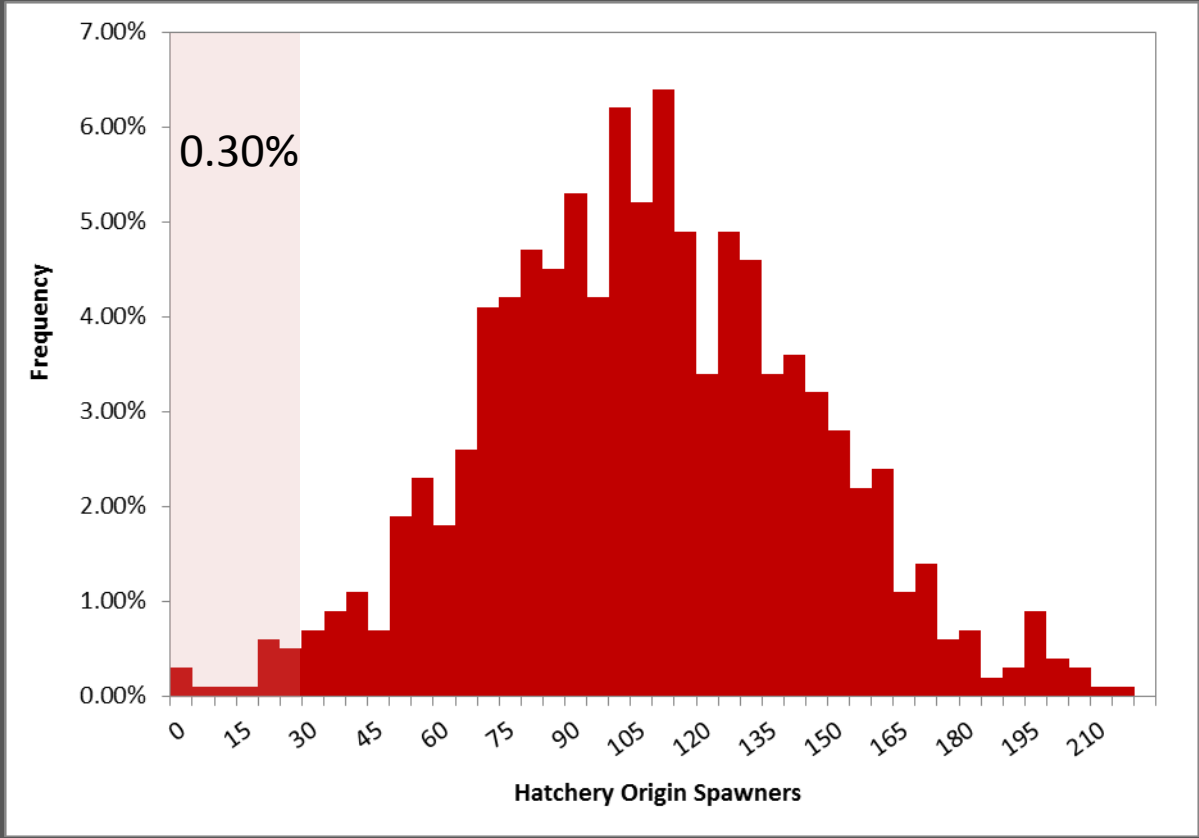


48,000 smolts
pHOS = 0.20



Potential for Mining

48,000 smolts; 26 broodstock
pHOS = 0.50



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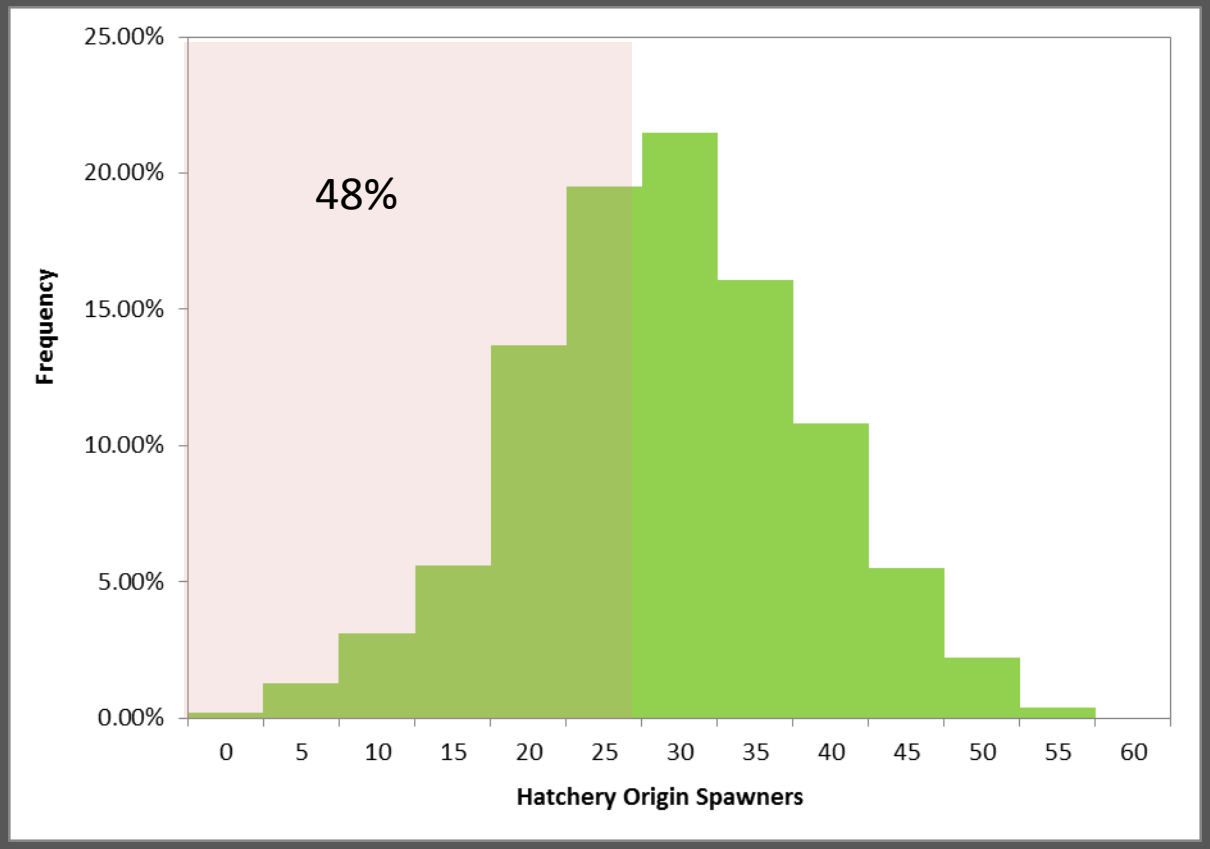
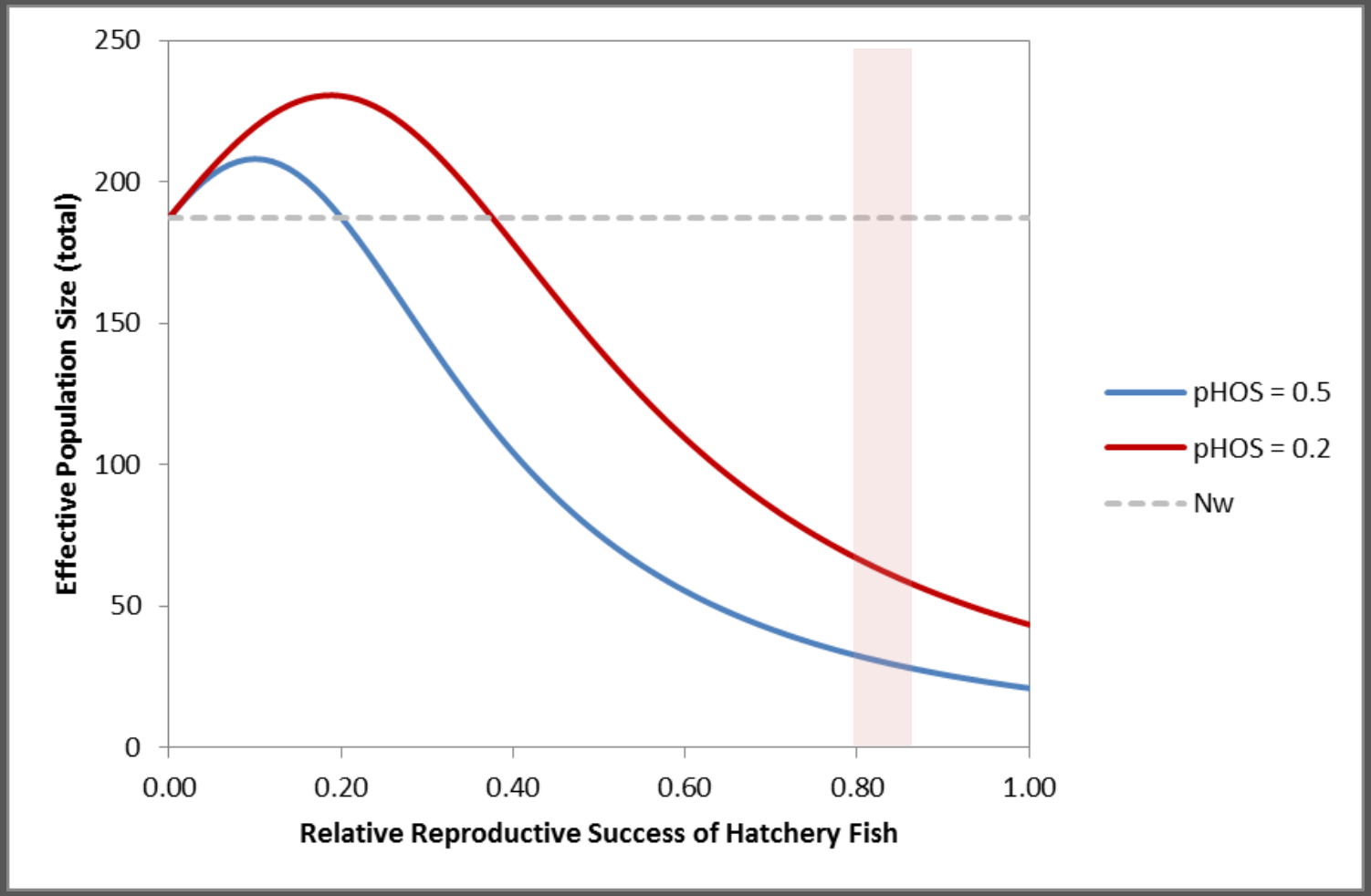


Ryman-Laikre Effect



Between a Rock and a Hard Place

Action	Pro	Con
Program size unchanged	• Ensures lots of fish	• Lots of gene flow management • Risk of mining
pHOS reduced to 0.20	• Higher PNI • Reduces ecological interactions	• Exacerbates R-L effect • Reduces potential demographic benefit
Diversify Broodstock Source	• Reduces R-L effect • Injection of genetic diversity • Mixing dictated by natural selection	• Risk of homogenizing local adaptation
S1 and S2 smolts	May reduce R-L effect	• Performance difference is unknown

Conclusions

- Science is available to manage more effectively
- Governance!
  - [Real] Adaptive Management