



Hitting the Right Target: Rearing Innovations For Conservation Aquaculture

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**Matt Emmons
(2004 Olympics)**



Outline

- 1. Importance of aiming at the right target**
- 2. New target**
- 3. Old ways may not hit the new target**
- 4. Innovations that are aimed at the new target**
- 5. Path for aiming at the new target**

Importance of Aiming at the Right Target

- Relationship between rearing and target
- Examples will be described later





The New Target (HSRG)

- ***“The objective of the HSRG's Columbia River Basin review was to change the focus of the Columbia River hatchery system. In the past, these hatchery programs have been aimed at supplying fish for harvest, primarily as mitigation for hydropower development in the Basin. Hatchery reform centers around a new, ecosystem-based approach founded on the idea that harvest goals are sustainable only if they are compatible with conservation goals.”***



HSRG Summary Conclusions

- *“Manage hatchery broodstocks to achieve proper genetic integration with, or segregation from, natural populations;*
- *Promote local adaptation of natural and hatchery populations;*
- *Minimize adverse ecological interactions between hatchery- and natural-origin fish;*
- *Minimize effects of hatchery facilities on the ecosystem; and*
- *Maximize survival of hatchery fish.”*

New Target is Outside the hatchery

- **Target metrics are largely manifested and measured in the natural environment**
- **Reform – outside vs. inside hatchery (spawning, incubation, rearing, acclimation, release)**
- **Examples of metrics**



Traditional Rearing Approaches

- Grow fish aggressively, aseasonally, uniformly
- Rear fish at high densities
- Feed fish traditional diets
- Rear fish in vessels < 2 BL/second
- Rear fish at central facilities and acclimate or direct release in tributaries
- Release the same number of fish from the same location, year after year

Problems with Traditional Approach

- **Precocious maturation**
- **Reduced production of older age fish**
- **Increased straying if stray rate varies with age**
- **Increased pHOS if fish return at an early age**
- **Possible accentuation of ecological interactions**
- **Possible high nutrient discharge**
- **Ignores changing ecological conditions and capacities**

Actions that Don't Treat the Cause

- **Ignore problems**
- **Release more fish**
- **Release fewer fish**
- **Install weirs and remove adults at a weir to control pHOS and straying**
- **Implement “conservation fisheries” to control pHOS**



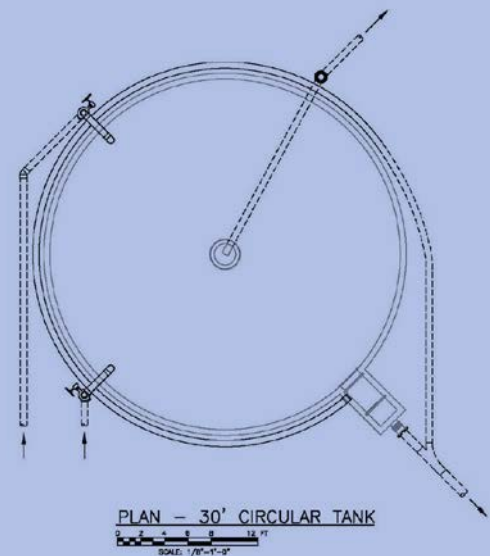
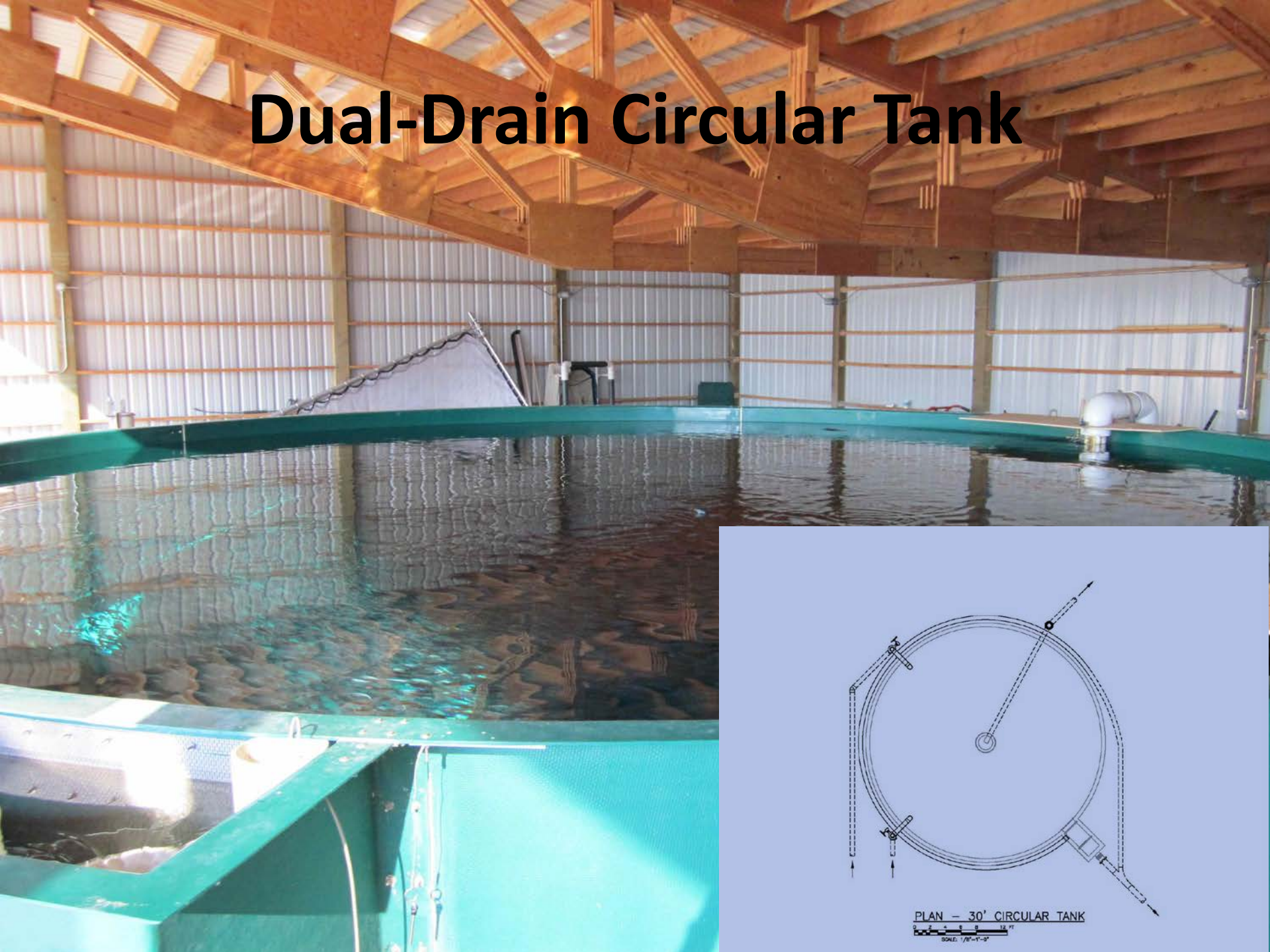
Assumptions for a New Path

- 1. Post-release performance goals have been recently reformed and are accepted**
- 2. Fish rearing, acclimation, and release will influence post-release performance**
- 3. Rearing and acclimation practices should be reformed to align with post release performance goals**

Potential Reform Solutions

- 1. Use better vessels**
- 2. Improve imprinting**
- 3. Manipulate temperature and ration food**
- 4. Formulate conservation aquaculture diets**
- 5. Implement strategies to reduce ecological interactions**
- 6. Adapt stocking relative to ecological conditions**

Dual-Drain Circular Tank



Imprinting Alternatives

- Overwinter acclimation
- Dispersed acclimation
- Multi-species acclimation
- **Early imprinting**



Growth and Diet Manipulation

- Grow fish in a way to mimic natural origin fish post-release performance
 - Temperature manipulation
 - Diet alteration
 - Diet rationing

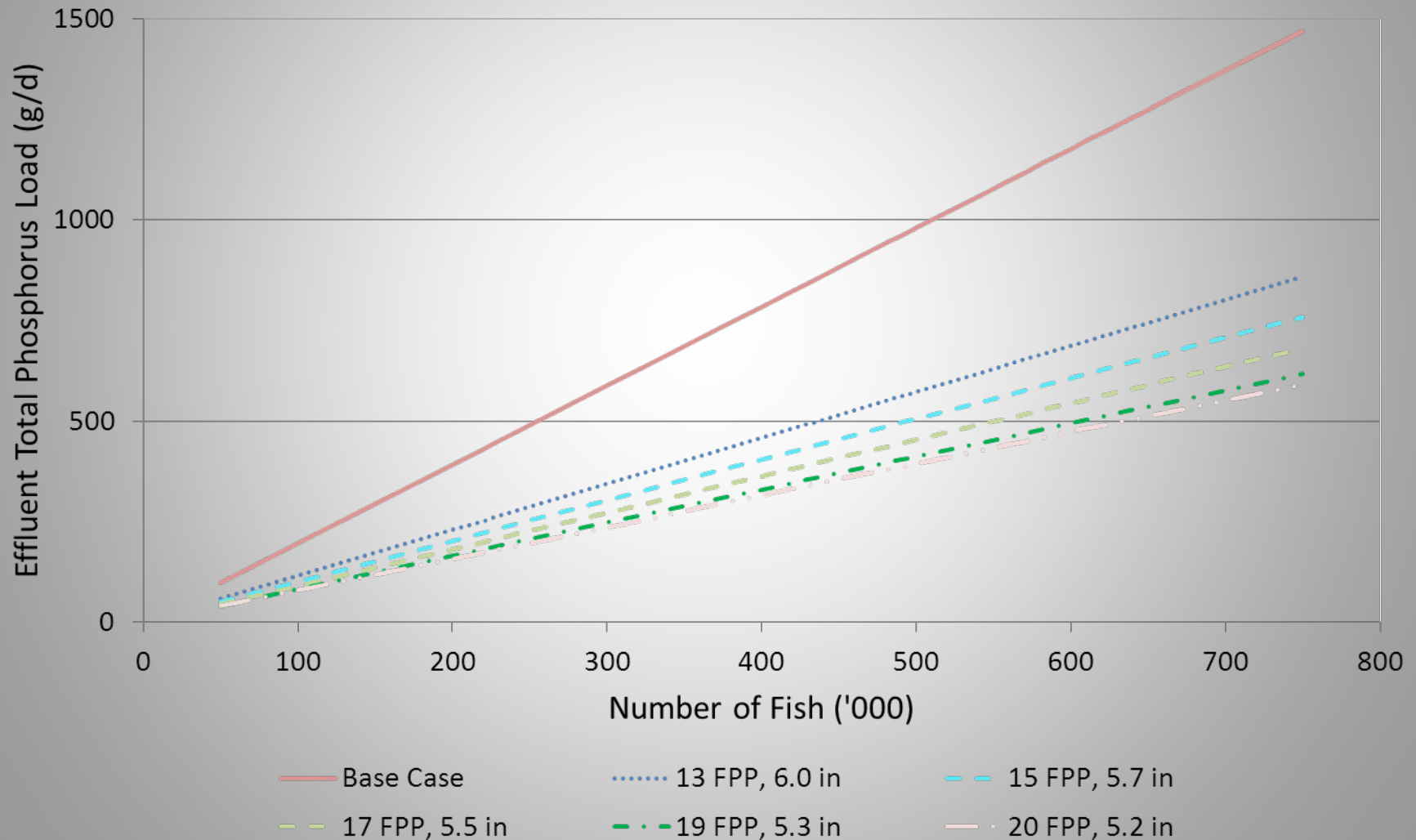


Low P in Effluent (Twibell et al.)

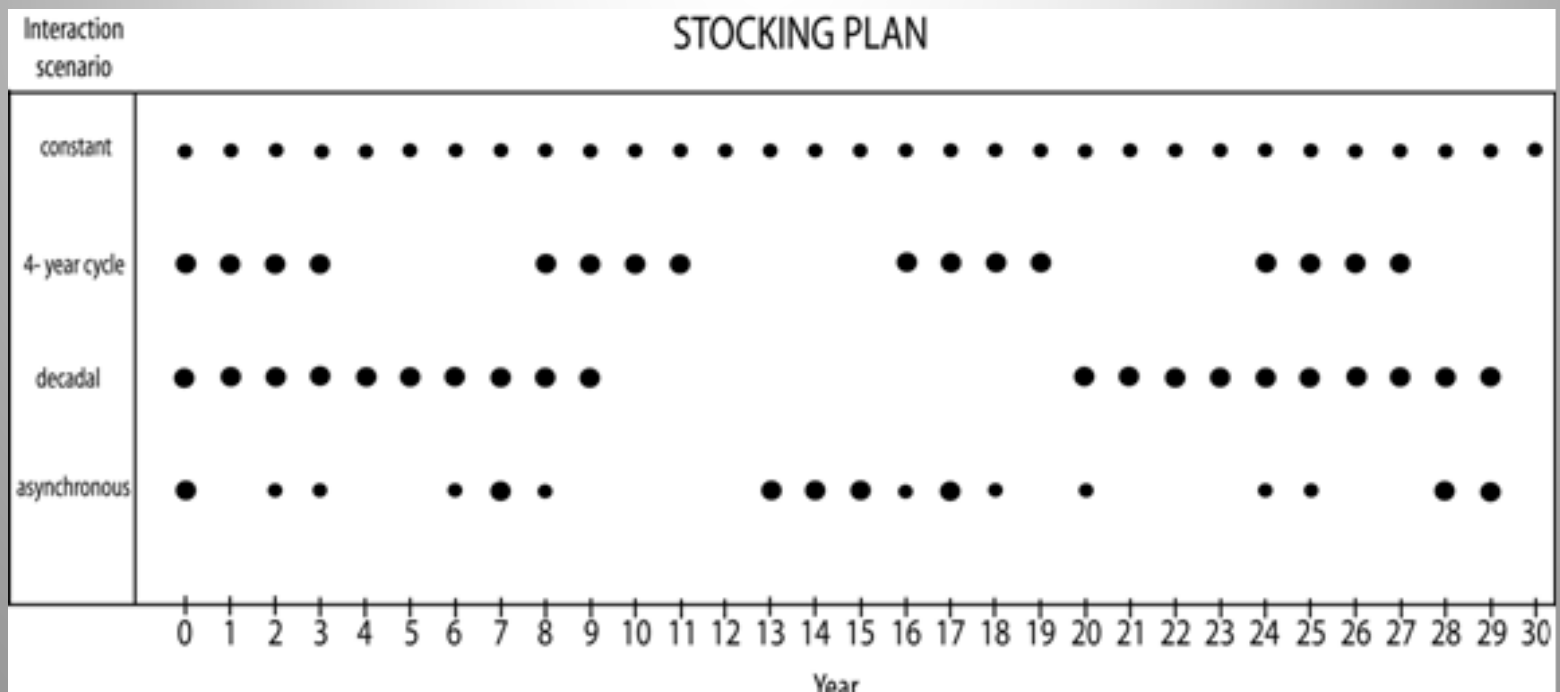
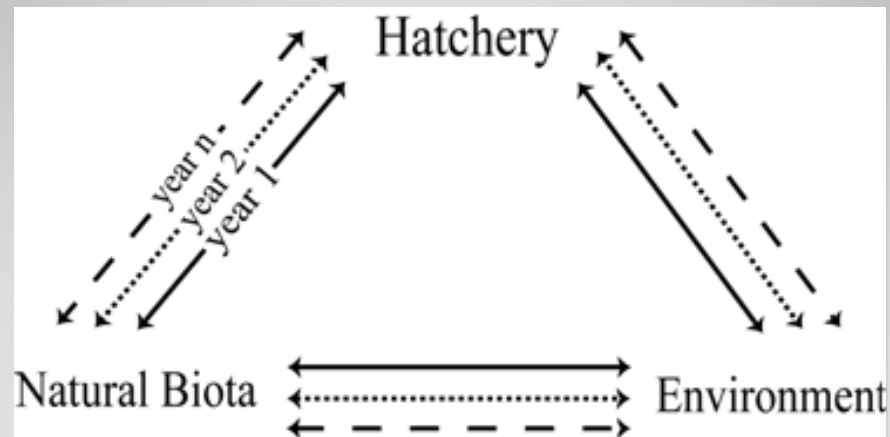
- Development of low P and low leaching feeds
- Experimental results
- Further work is needed



0.8% to 0.6% P Feed (Mugunthan et al. 2012)



Adaptive Stocking (Pearsons 2010)



Next Steps in the New Target Path

- 1. Consider changing vessels**
- 2. Develop temporally stratified biologically based size targets**
- 3. Develop conservation aquaculture diets**
- 4. Consider alternative imprinting approaches**
- 5. Consider adaptive stocking**
- 6. Conduct M&E and adaptive management**

Matt Emmons (2004 Olympic Gold)

