

# Use of RAS Technology in Serial Re-Use Fish Culture and Lessons Learned



Steve Sharon, Fish Culture Supervisor

Wyoming Game & Fish Department

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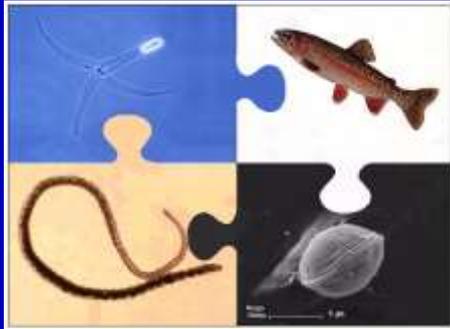
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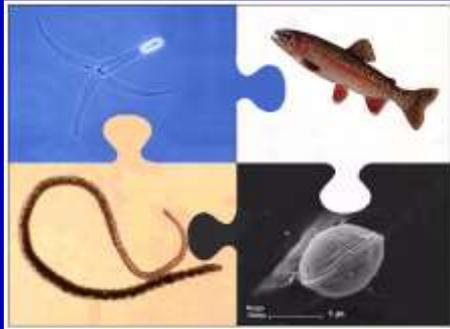
- ✓ Why we turn to Recirculation Aquaculture Systems (RAS) technology
- ✓ Overview of the technology and its impact
- ✓ Review of the Benefits and Challenges of using Dual Drain Circulars vs Linear Raceways
- ✓ Other things learned in the last 15 years

# Why RAS in Serial Re-Use?



Five hatcheries were exposed or infected by Whirling Disease from 2000 to 2010.

## Why RAS in Serial Re-Use?



Operations changed due to open water supplies, dirt pond production & spring contamination. Reduced water supplies: 71 to 47 CFS

- Overall, Wyoming is an arid state
- Closed water systems are limited
- Traditionally, several hatcheries were partially supplied by surface water sources
- Dirt ponds were also a mainstay

# Why RAS in Serial Re-Use?

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= \$30,000,000 over 12 years

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- Objective #2- Protect rearing units
- Objective #3 - Maximize water quality & use

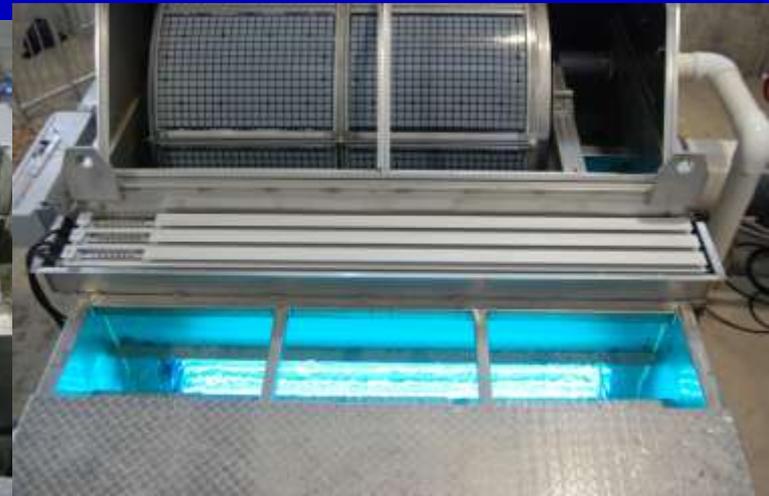
Vacuum Degassing



Oxygen Enhancement



Drum Filter & UV Disinfection



# Why RAS in Serial Re-Use?

- Support and funding available by the Dept and Legislature -- \$30,000,000 over 12 years
- Objective #1 - Secure water sources
- Objective #2- Protect rearing units
- Objective #3 - Maximize water quality & use
- Objective #4 - Improve rearing environments



# Dual Drain Circular



# The Benefits of Dual Drain Circulars

- Self Cleaning – only pull sumps twice a day
  - ✓ Limited vacuuming or brushing required (covered units)
  - ✓ Cleaning labor greatly reduced
  - ✓ Solids drop to the floor and typically leave quickly
  - ✓ Fish are not exposed to waste as much as raceways
- Water Reuse – Only about 3% loss through radial separator if bottom drain of the separator is open continuously.
  - ✓ 85% of water is released via the side box, a cleaner effluent for reuse.
  - ✓ 15% leaves via the bottom drain, clarified by a radial separator to greatly reduce transfer of waste to next use.

# The Benefits of Dual Drain Circulars

- Water Quality – Uniform water quality throughout the rearing unit.
  - ✓ Oxygen added to inflow at elevated concentration – Mixes evenly throughout rearing environment
  - ✓ Passive removal does not break down feces and maintains water quality.
- Footprint – Less footprint required for rearing volume.
  - ✓ Entire parameter of unit accessible

# The Benefits of Dual Drain Circulars

- Smooth Tank Surface – Fiberglass or PVC are smooth, not abrasive.
  - ✓ Surfaces are easier to clean and disinfect between uses
- Better Lot Management – lots are isolated
  - ✓ individual units with higher separation than most raceways (no common walls, equipment separation between use)
- Rearing Conditions
  - ✓ Can set rotational speed proportional to fish length
  - ✓ Fish easily distribute throughout the tank and water column versus linear raceways.

# The Benefits of Dual Drain Circulars

## ➤ Feeding

- ✓ Easier to get feed to the fish, typically standing in place to feed the entire circular.
- ✓ Depth and flow spreads the feed out and stays in the column longer
- ✓ Fish spread out to feed throughout the unit.

## ➤ Sampling & Harvesting

- ✓ Elevated tank improves access, saves on staff's back to net
- ✓ Do not have to get in tank to crowd
- ✓ Can use bag seine to easily crowd to sample or harvest.

# The Benefits of Dual Drain Circulars

## ➤ Stress Management/Health

- ✓ Limited brushing units, not stressing the fish or exposing them to waste
- ✓ Workers do not need to get into the rearing unit.
- ✓ Flight response is not as dramatic.
- ✓ Velocity management improves health and fish condition.
- ✓ If treatments are required, unit can be easily isolated and effluent controlled.
- ✓ Chemical or feed treatments distributed evenly
- ✓ If static bath needed, oxygen can be used effectively.

# The Benefits of Dual Drain Circulars

## ➤ Stress Management/Health (Continued)

- ✓ If water source is lost, units can be maintained for much longer than raceways with oxygen introduction and water level management.
- ✓ If recirculation is available, unit setup can manage water quality very effectively.

# The Challenges of Dual Drain Circulars

- Adjusting the Radial Separators
  - ✓ Can be difficult to set balance when flows and fish densities increase
- Units require elevation (32" average) for raised access.
- Reuse requires a minimum of 18" between series for oxygen and spray bars for downstream reuse
- Consistent and close monitoring of percent saturation oxygen at outflow
- Increased cost in equipment operation
- Increased cost in utilities, tripled our carbon footprint
- Increased maintenance of support equipment

# What We Have Learned

## ➤ Fish Condition

- ✓ Fins erosion has been noted to be less
- ✓ Fish coloration is typically not as dark as raceways
- ✓ CV measurements are typically lower values
- ✓ Can adjust velocity to improve fitness

## ➤ Dual Drain Circular Management

- ✓ Velocity management is more a function of setting spray bars and the center drain outflow versus just increasing inflow
- ✓ Flow Index and Density Index parameters for linear raceways are not applicable, focus on DI upper range of .14 to .18 dependent on species

# What We Have Learned

## ➤ Dual Drain Circular Management (continued)

- ✓ Manage rearing units by 70% to 75% oxygen saturation at outflows
- ✓ Standard trout diets can result in suspended solids. Use of steelhead and recirculation diets remove this issue
- ✓ Availability of oxygen supplementation for each unit reduces issues in LHO management between each reuse.
- ✓ Be cautious of tank velocity versus exercising the fish requiring more oxygen than anticipated, causing potential stress  $\leq 2$  body lengths/second – species & size dependent

# What We Have Learned

## ➤ The Take Home Messages

- ✓ Tradition is the largest challenge for how personnel respond
- ✓ Proof is in the total pounds produced
  - Remember – reduced water supply from 71 to 47 CFS
  - 1999 Fish Production = 5.6 million fish, 413,000 lbs (13.8/lb)
    - ❖ 5,817 lbs/CFS
  - 2017 Fish Production = 5.6 million fish, 490,583 lbs (11.4/lb)
    - ❖ 10,438 lbs/CFS

**An increase of 79.4%!**

# Questions?

