Burbot Conservation Aquaculture: A Decade of Advancements in the Kootenai Region

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Photo by Eric Engbretson
Burbot: The Only Freshwater Cod

Common Ling (*Molva molva*)

10 Myr...or mtDNA genetic distance of ~18%

(Van Houdt et al. 2003)

Burbot (*Lota lota*)
Success in Colonizing Freshwater

Rooted in marine ancestry

- High fecundity – up to 3 million eggs
- Broadcast spawning (Sorokin 1971)
- Cool, pristine, circumpolar habitats
Burbot are an Indicator Species

- Spawns in mid-winter at 0–6°C (Becker 1983)
- Sensitive to changes in climate & hydrology
Burbot are an Indicator Species

- Life cycle spans a gradient of ecosystems

**Larvae**  
Pelagic & Floodplains

**Juveniles**  
Littorals & Tributaries

**Adults**  
Benthos & Tributaries
Burbot are an Indicator Species

- Distribution spans many landscapes
  - Habitat alteration
  - Pollution
  - Invasive species
  - Climate change
  - Mismanaged fisheries

(Stapanian et al. 2010)

(adapted from McPhail 1997)
Burbot in Idaho: The Lower Kootenai River

- Population imperiled
- < 100 adult burbot
- Recruitment?

Habitat alterations
- Libby Dam (1975)
- Hyperoligotrophy
- Water temperature
- Diking/Channeling
- Floodplain degradation
Pacific NW Distribution

= Native
= Invasive?
Burbot Restoration in Idaho

Goal
Restore a viable, self-sustaining, harvestable population in the Lower Kootenai River

(Illustration courtesy of Kootenai Valley Resource Initiative)
Conservation Aquaculture

- Wild stock functionally extirpated
- Donor population needed for broodstock
- Supplementation with hatchery fish
Multi-Agency Effort

U.S. Army Corps of Engineers

IDAHo FISh & GAME

U.S. FISH & WILDLIFE SERVICE

BRITISH COLUMBIA

Northwest Power and Conservation Council

University of Idaho
Research Forges Collaboration

• An outlet for creative planning
• A vehicle for progress through innovation
• A refuge for interests extrinsic to policy
Population Genetics Research

Paragamian et al. 1999

- Pacific clade
- Upper and lower Kootenai stocks genetically different
- Suitable donor population identified in Moyie Lake, BC

Campbell et al. 2014 - verified
Donor Population Research

- Adults & eggs collected from Moyie Lake
Donor Population Research

Neufeld et al. 2007 – 2011

- Abundance estimates
- Mark–recapture methods
- Age structure
- Spawning surveys
- Egg fertilization
Jensen et al. 2007 – 2008

- Captive spawning
- Semen cryopreservation

Foltz et al. 2012

- Oocyte development
Early Life Stage Research

Jensen et al. 2010 – 2011

- Egg incubation
- Larval rearing

Egan et al. 2014

- Embryo development
Polinski et al. 2010 – 2013

- Disease susceptibility
- Therapeutics

Terrazas et al. 2015

- Stress-induced diseases

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Extensive Hatchery Research

Paragamian et al. 2011
• Cage-culture in ponds
• Zooplankton abundance

Barron et al. 2013
• Pond culture

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Intensive Hatchery Research

Barron et al. 2012 – 2013

- Larval growth & survival
- Juvenile growth & survival
- Cannibalism
- Grading
Intensive Hatchery Research

Ashton et al. 2013 – 2015

- Mass production
- Artificial & genetic tagging
Restoring the Population

Source: IDFG
Aquaculture Milestones

Twin Rivers Hatchery

- Completed in 2015
- ~275K fingerling burbot released this fall
- World’s largest burbot aquaculture program
Other Conservation Milestones

Monitoring & Evaluation

• Large-scale PIT tagging
• Genetic markers
• Age-based survival
• Growth patterns
• Telemetry
• Migration patterns
• Spawning behavior
Future Aquaculture Research

Conservation

- Recruitment bottlenecks
- Thermal optimums & hydropower operations

Commercial

- Potential as seafood
- Model for cod research
Q & A

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