

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



Neil Ashton
University of Idaho



Photo by Eric Engbretson

Burbot: The Only Freshwater Cod

Common Ling (*Molva molva*)



10 Myr...or mtDNA genetic distance of $\sim 18\%$



(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



Juveniles



Adults



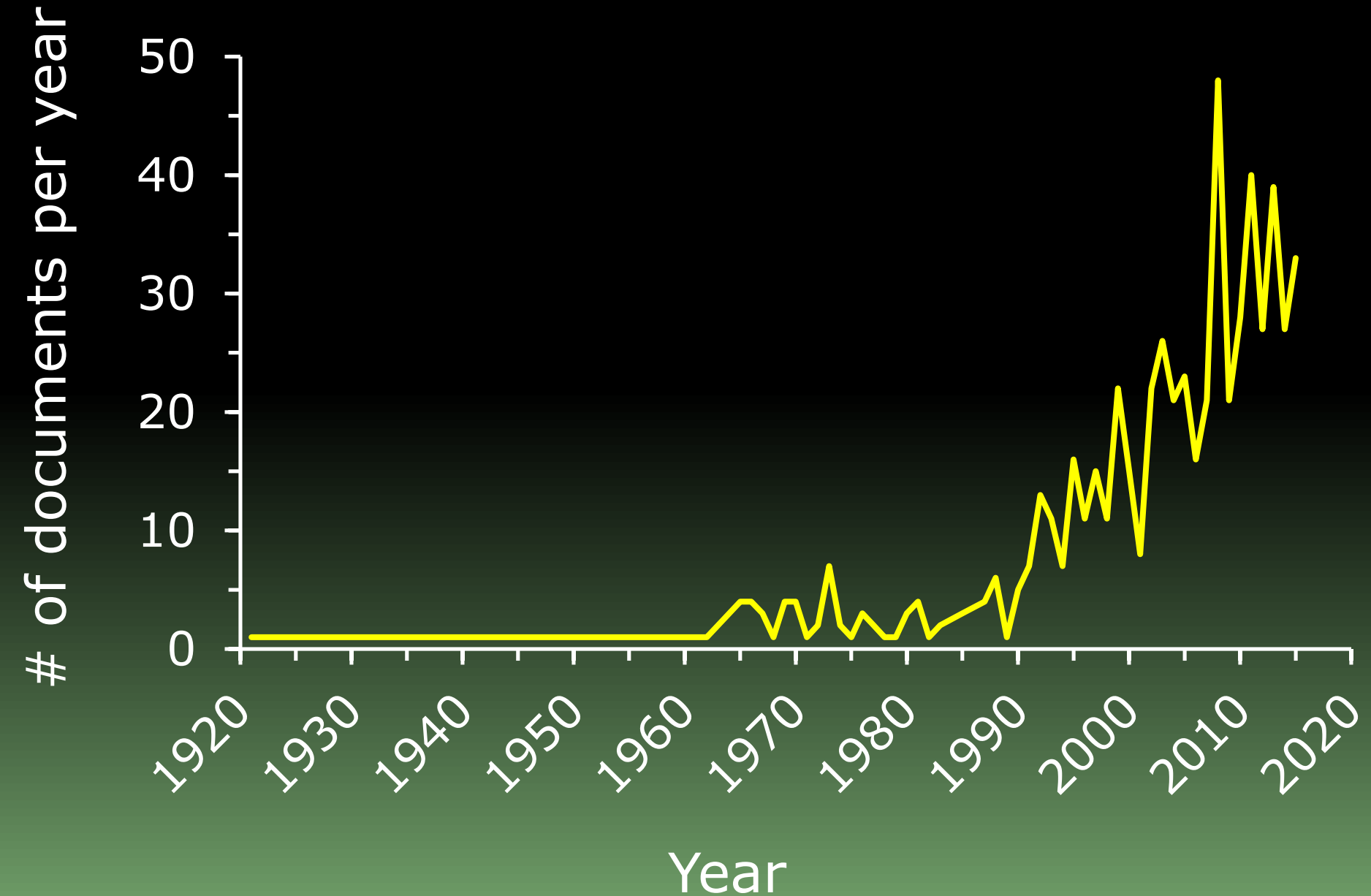
Pelagic
&
Floodplains

Littorals
&
Tributaries

Benthos
&
Tributaries

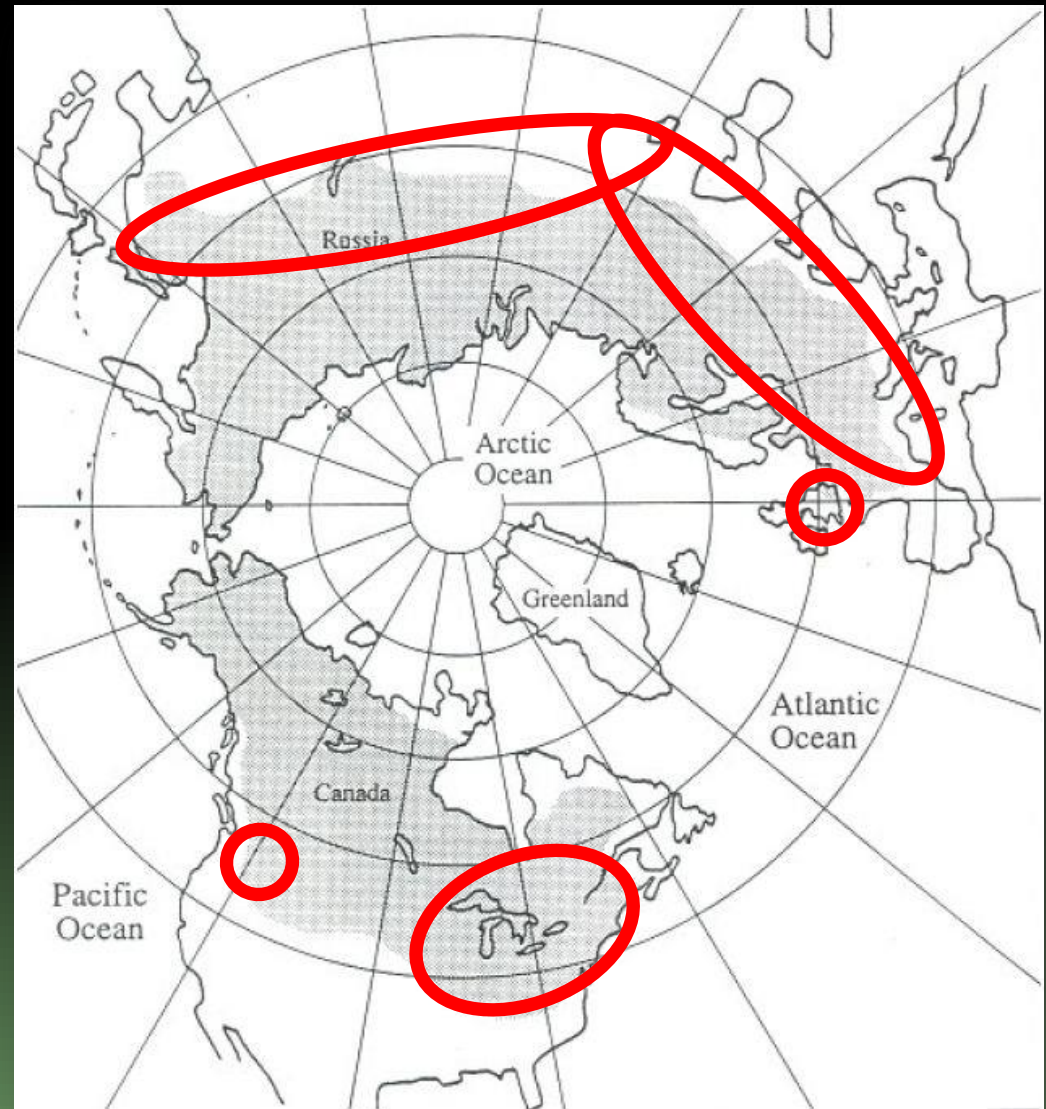
Web of Science™ results for documents

(topic or title search terms: Burbot or *Lota lota*)



Burbot are an Indicator Species

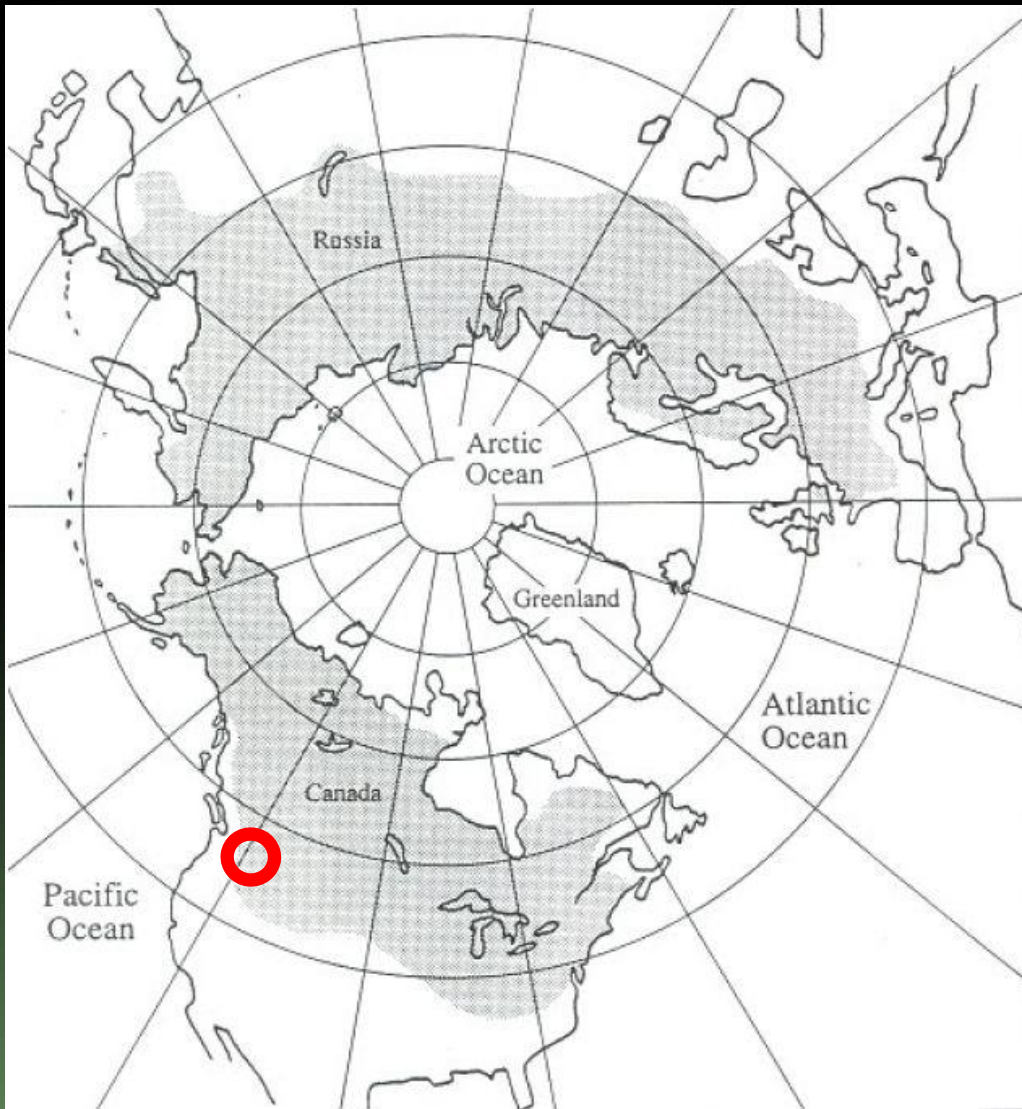
- Distribution spans many landscapes
 - Habitat alteration
 - Pollution
 - Invasive species
 - Climate change
 - Mismanaged fisheries



(Stapanian et al. 2010)

(adapted from McPhail 1997)

Burbot in Idaho: The Lower Kootenai River



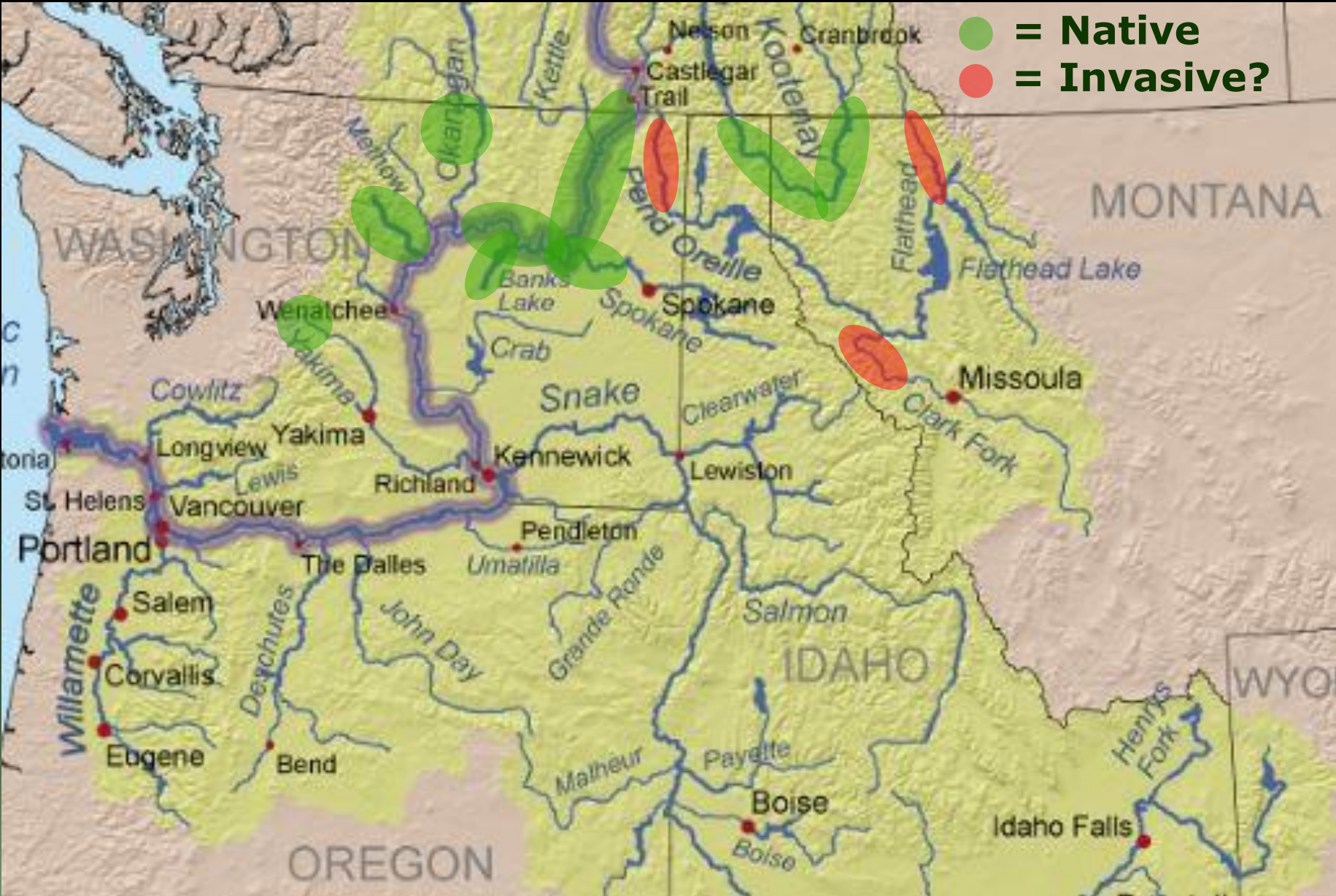
- Population imperiled
- < 100 adult burbot
- Recruitment?

Habitat alterations

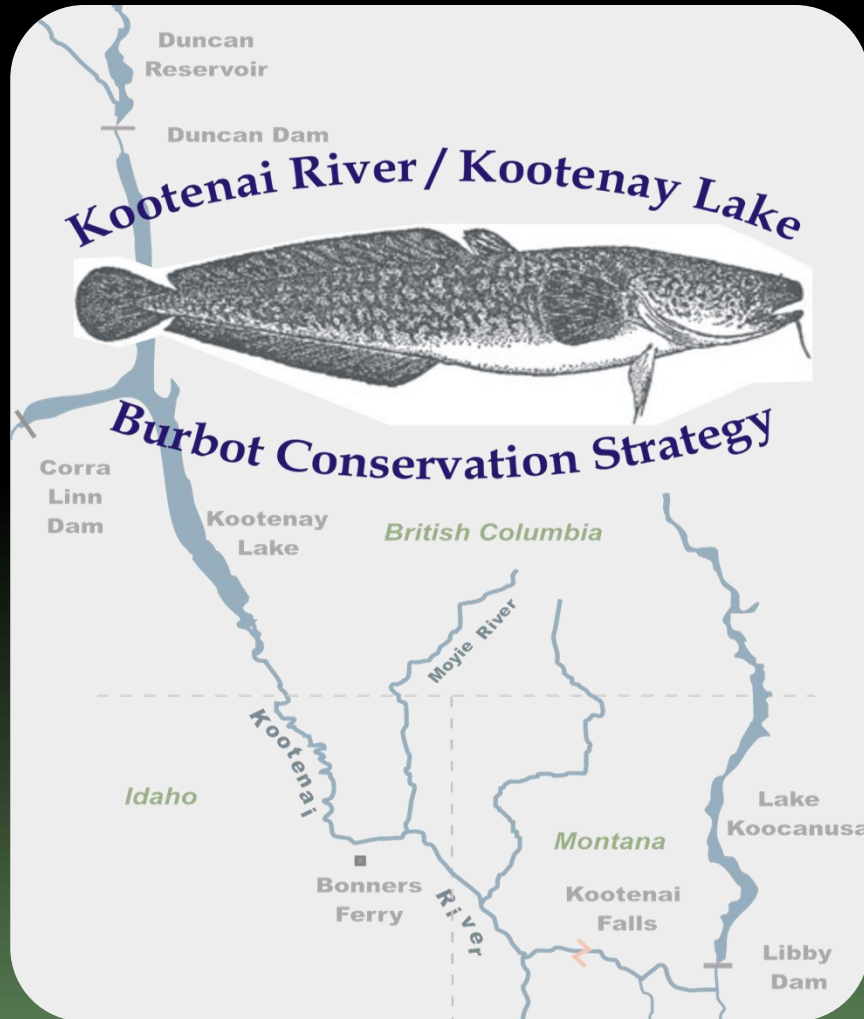
- Libby Dam (1975)
- Hyperoligotrophy
- Water temperature
- Diking/Channeling
- Floodplain degradation

Legend:
 ● = Native
 ● = Invasive?

The map shows the Pacific Northwest region, including Washington, Oregon, Idaho, and Montana. Major cities and rivers are labeled. Green ovals indicate native species, and red ovals indicate invasive species. The distribution of native species is concentrated in the western part of the region, while invasive species are found in the eastern part, particularly in the Snake River and Clark Fork areas.



Burbot Restoration in Idaho



Goal

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

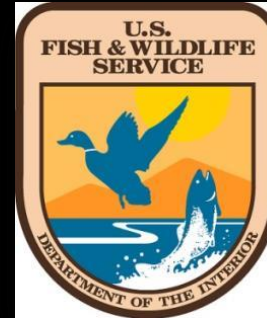
(Illustration courtesy of Kootenai Valley Resource Initiative)

Conservation Aquaculture

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



Multi-Agency Effort



University of Idaho

Research Forges Collaboration

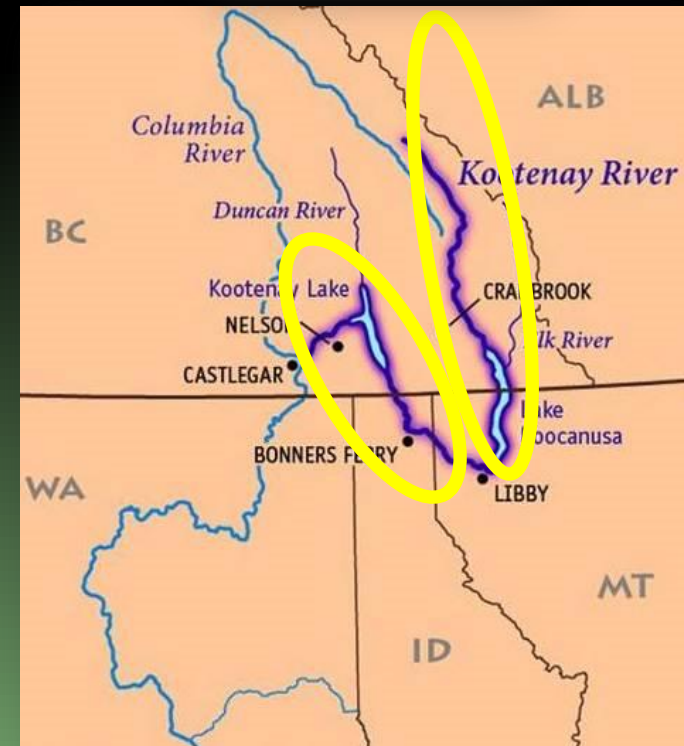
- An outlet for creative planning
- A vehicle for progress through innovation
- A refuge for interests extrinsic to policy



Population Genetics Research

Paragamian et al. 1999

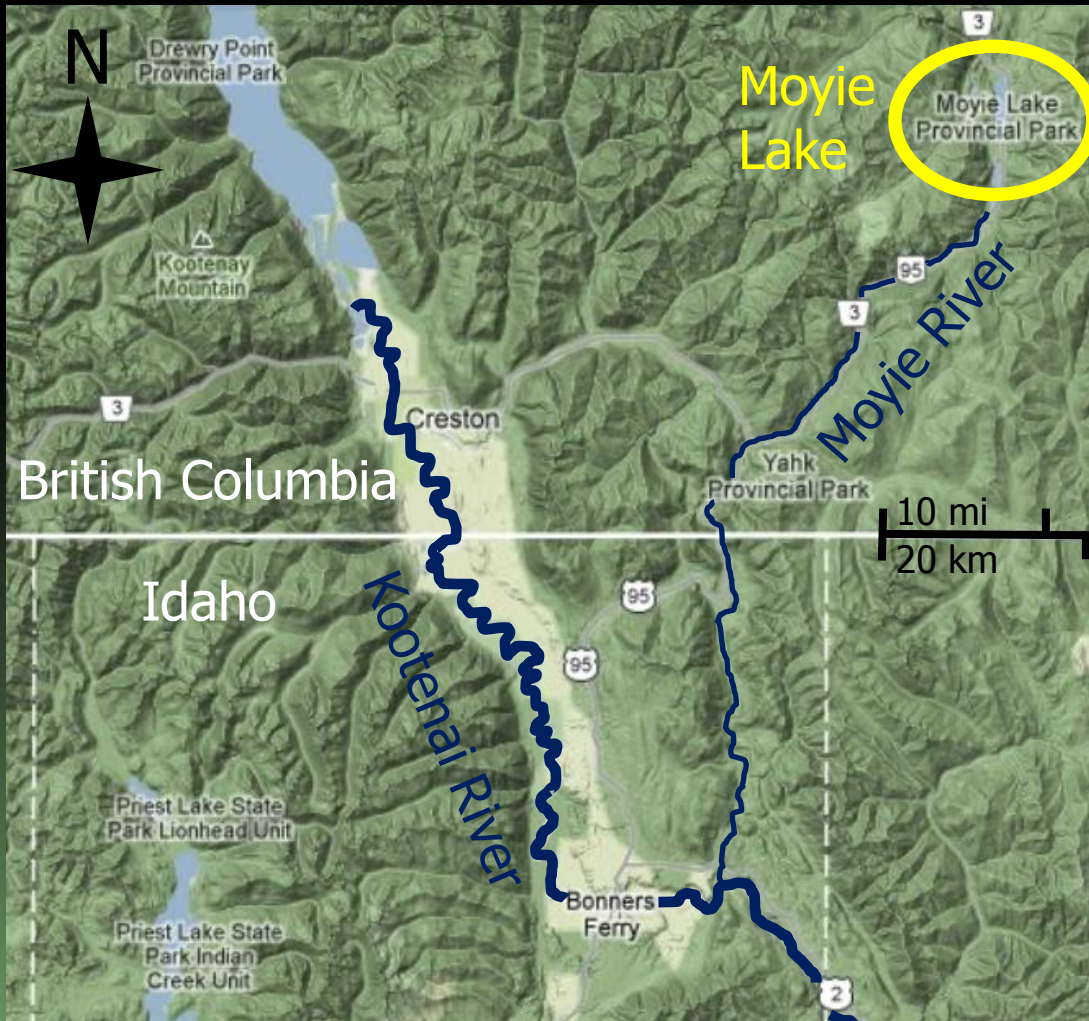
- Pacific clade
- Upper and lower Kootenai stocks genetically different
- Suitable donor population identified in Moyie Lake, BC



Campbell et al. 2014 - verified

Donor Population Research

- Adults & eggs collected from Moyie Lake



Donor Population Research

Neufeld et al. 2007 – 2011

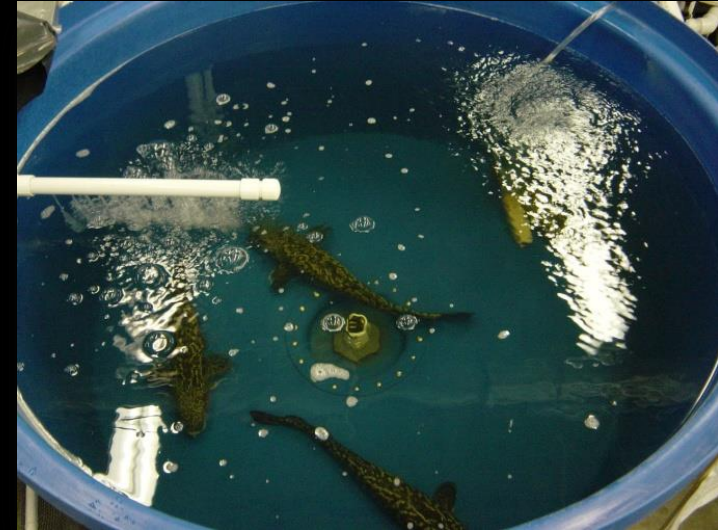
- Abundance estimates
- Mark–recapture methods
- Age structure
- Spawning surveys
- Egg fertilization



Broodstock & Gametes Research

Jensen et al. 2007 – 2008

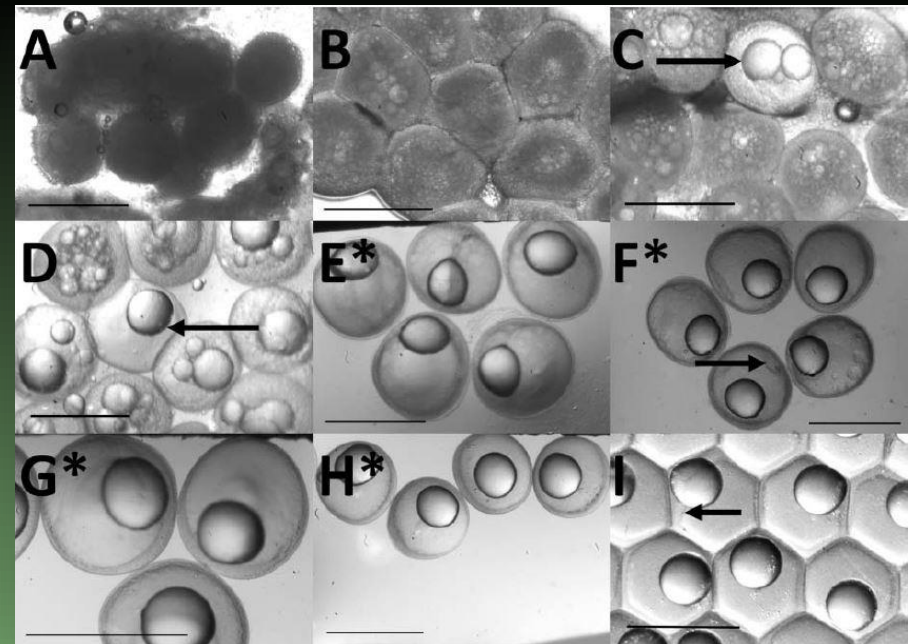
- Captive spawning
- Semen cryopreservation



Foltz et al. 2012

- Oocyte development

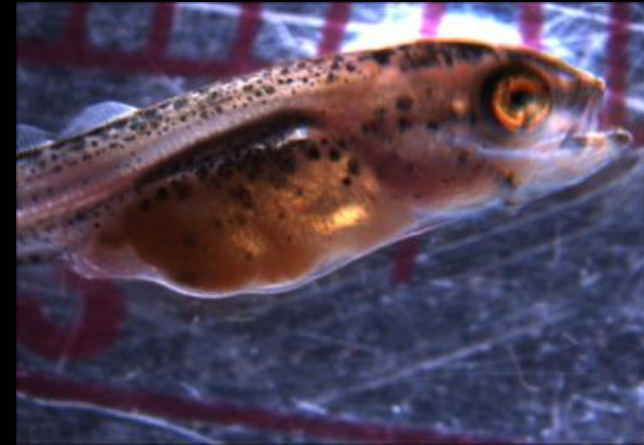
University of Idaho



Early Life Stage Research

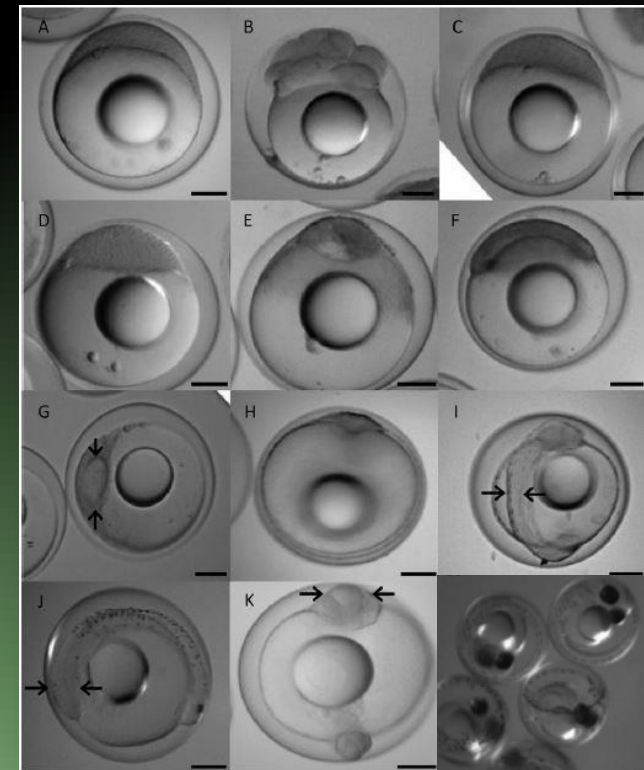
Jensen et al. 2010 – 2011

- Egg incubation
- Larval rearing



Egan et al. 2014

- Embryo development



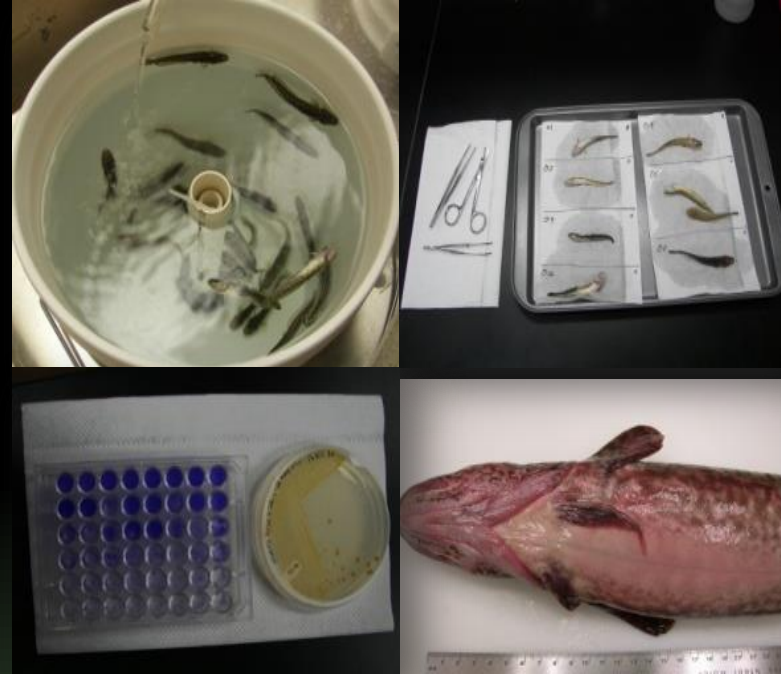
University of Idaho



Disease & Physiology Research

Polinski et al. 2010 – 2013

- Disease susceptibility
- Therapeutics



Terrazas et al. 2015

- Stress-induced diseases



University of Idaho



Extensive Hatchery Research

Paragamian et al. 2011

- Cage-culture in ponds
- Zooplankton abundance

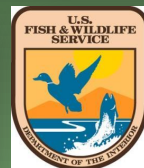


Barron et al. 2013

- Pond culture



University of Idaho



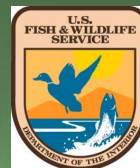
Intensive Hatchery Research

Barron et al. 2012 – 2013

- Larval growth & survival
- Juvenile growth & survival
- Cannibalism
- Grading



University of Idaho



Intensive Hatchery Research

Ashton et al. 2013 – 2015

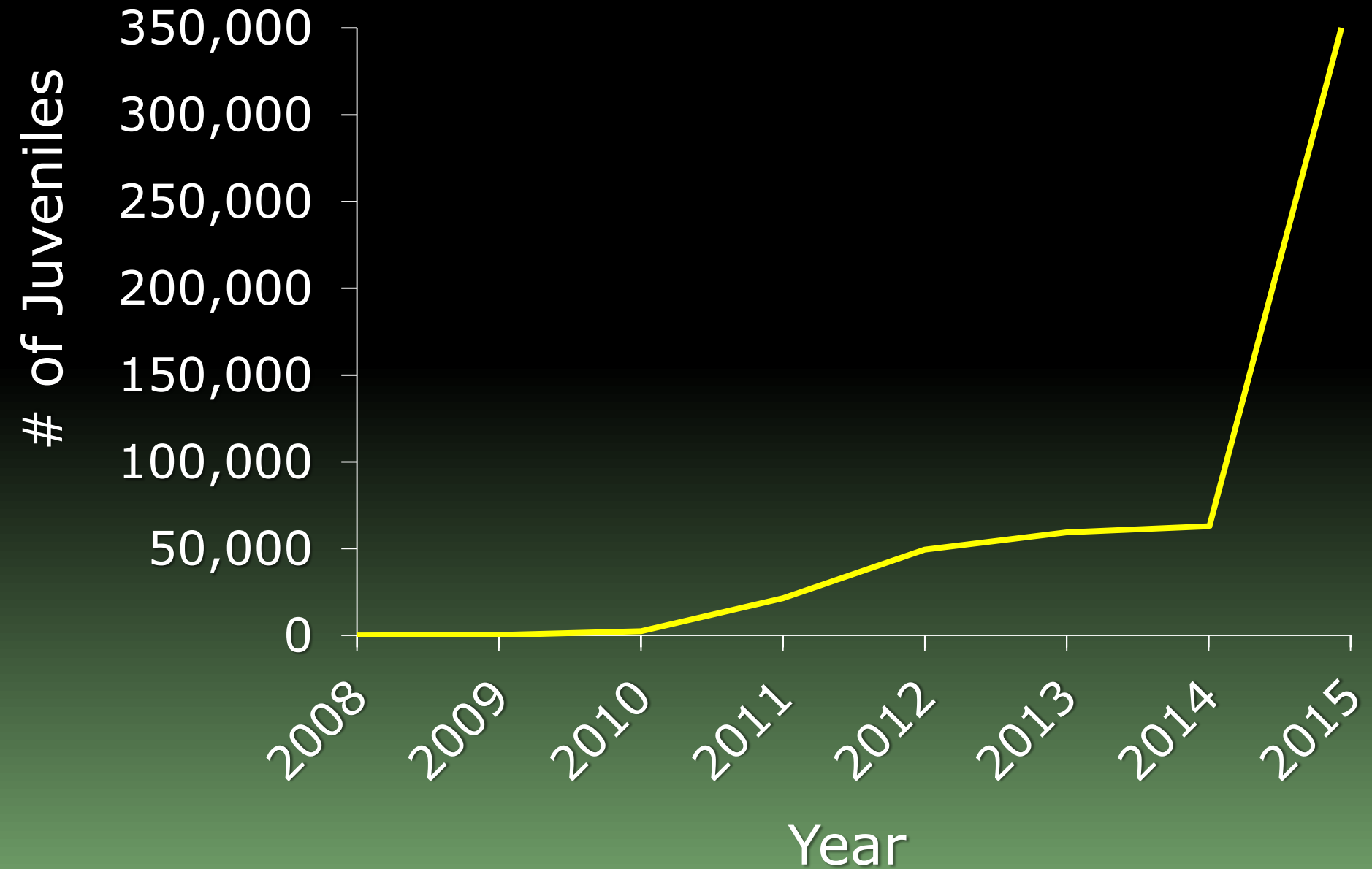
- Mass production
- Artificial & genetic tagging



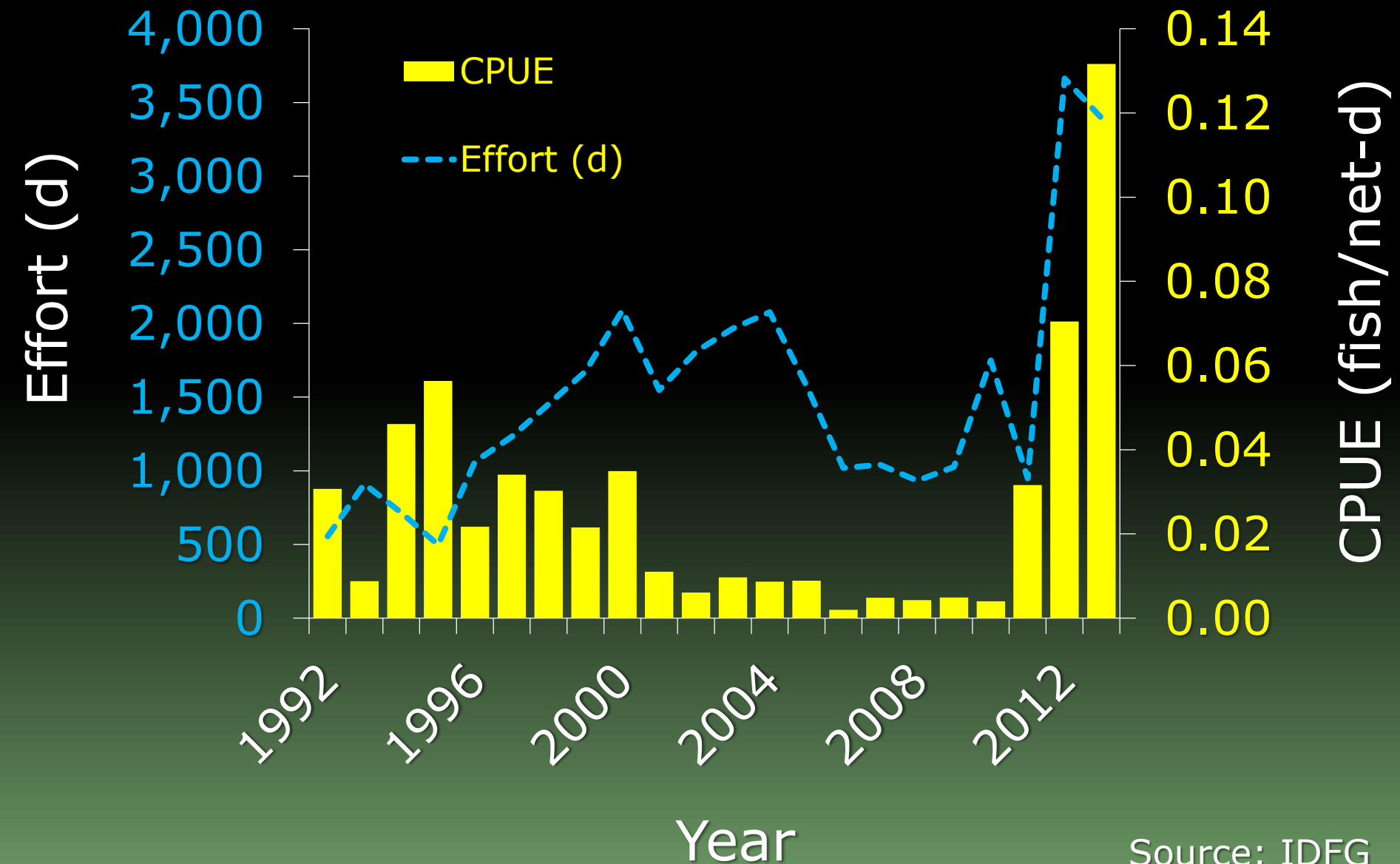
University of Idaho



Cumulative Juvenile Releases



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

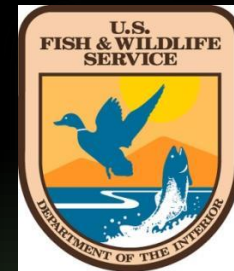


Kootenai Tribal Chair Gary Aitken Jr.
Photo by Doug Marshall ©Sandpoint Magazine

Other Conservation Milestones

Monitoring & Evaluation

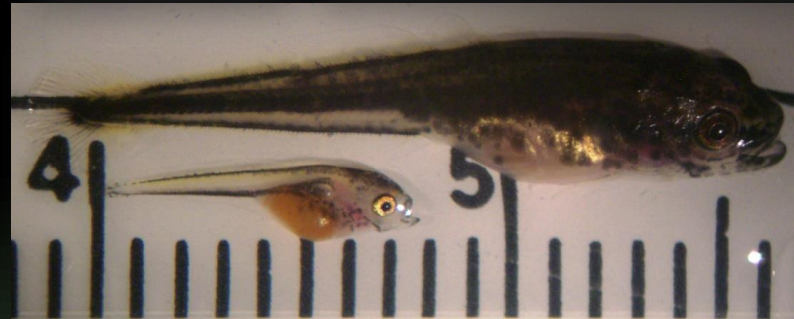
- Large-scale PIT tagging
- Genetic markers
- Age-based survival
- Growth patterns
- Telemetry
- Migration patterns
- Spawning behavior



Future Aquaculture Research

Conservation

- Recruitment bottlenecks
- Thermal optimums & hydropower operations



Commercial

- Potential as seafood
- Model for cod research



Q & A

Acknowledgments

Dr. Ken Cain (UI)
Sue Ireland (KTOI)
Dr. Shawn Young (KTOI)
Nate Jensen (KTOI)
Ryan Hardy (IDFG)
T.J. Ross (IDFG)
Pete Rust (IDFG)
Mike Faler (USFW)
Matt Neufeld (BC)
Sara Stephenson (BC)
James Barron
Josh Egan
John Foltz
Vaughn Paragamian
Mark Polinski
Marc Terrazas

