Northwest **Power** and
Conservation Council

January 5, 2016

MEMORANDUM

TO: **Council members**

FROM: **Karl Weist**

SUBJECT: **Presentation on recent studies conducted by the Oregon Hatchery Research Center**

BACKGROUND:

Presenters: Dr. David Noakes, Oregon State University and Senior Scientist at OHRC, and Bruce McIntosh, Assistant Administrator Fish Division for ODFW.

Summary: Dr. Noakes, Senior Scientist of the Oregon Hatchery Research Center (OHRC) and Bruce McIntosh of the Oregon Department of Fish and Wildlife will present some background on the OHRC and the results of recent studies including otolith marking, the use of stable isotopes for diet switching, and noninvasive sampling for diet and growth conducted by the Hatchery Research Center.

Relevance: The goal of the OHRC is to answer questions related to fish recovery and hatchery programs, including the differences that may exist between wild and hatchery fish, and how to better manage those differences. Information gained at the OHRC will help answer questions vital to the success of the Oregon Plan for Salmon and Watersheds and the Native Fish Conservation Policy.

Background: The OHRC is a cooperative effort between ODFW, which owns the facility, and Oregon State University. ODFW and OSU have signed a

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Memorandum of Understanding for operation and oversight of the OHRC . The organizations share the cost of a Senior Scientist, Dr. Noakes, who oversees OHRC research and operations.

Studies conducted at the Center address many questions about recovery and hatchery programs. Management partners include the National Marine Fisheries Service (NOAA Fisheries), the U.S. Fish and Wildlife Service, tribes and state agencies. No Bonneville funding went into the construction or operation of the facility. The Oregon Legislature and Governor developed $7 million in funding for the OHRC. The budget includes $4 million from Measure 66 capital funds, $1.125 million in Lottery Funds from the Restoration and Protection Research Fund, and $1.875 million in ODFW's Other Funds.

The Governor's Office also has requested Congressional support for federal funds to support research at the OHRC .Oregon is working with the U.S. Fish and Wildlife Service and the National Marine Fisheries Service to further explore federal funding options.

More Info:

Attached are the Mission Statement of OHRC and links to several recent papers on the results of studies conducted at the facility.

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The Oregon Hatchery Research Center Mission

Realizing that healthy wild and hatchery fish runs are a vital part of each Oregonian's heritage, the mission of the Oregon Hatchery Research Center (OHRC) is to be an internationally-recognized leader in fisheries science, specializing in defining the mechanisms that may create differences between hatchery and wild salmonids, recommending management strategies to manage those differences while meeting fishery and conservation objectives, and educating Oregonians on the role and performance of hatcheries in supporting and protecting Oregon's native fish and fisheries. The OHRC will foster and support a wide range of research and education projects and provide unique state-of-the-art facilities.

The OHRC is strategically located in the Alsea Basin, surrounded by streams and close to coastal fisheries that offer natural laboratories to study the life cycle and interactions of wild and hatchery fish and their management on a broad "basin-to-landscape" scale. The site also is close to other scientific institutions such as the Hatfield Marine Science Center and Oregon State University. Goals of the OHRC are to:

1. **Understand mechanisms that may create differences between hatchery and wild fish.**

    a. Determine the process and rate by which wild fish may change in the hatchery environment within and across generations.
    b. Determine the process, rate and pattern by which hatchery-produced fish adapt to the natural environment at each life history stage.
    c. Determine the possible genetic and ecological consequences of hatchery fish and their releases on native fish at each life history stage.

2. **Develop approaches to manage hatchery fish that conserves and protects native fish.**

    a. Determine hatchery breeding, rearing and release practices that allow hatchery-propagated fish to both contribute to fisheries and facilitate the conservation and recovery of naturally produced native fish.
        1. Identify possible effects, both locally and on a landscape scale, to natural ecosystems associated with different types and levels of hatchery production and identify approaches to manage these effects.
        2. Identify hatchery practices that may need to be altered in response to changes in the natural environment and other external factors.
    b. Identify breeding, rearing and release protocols that minimize possible adverse impacts on the natural ecosystem.
    c. Evaluate the effectiveness of producing hatchery fish, relative to other strategies, as a means to achieve commercial, recreational, conservation and ecological objectives.
    d. Determine the effects of hatchery operations (for example: flow alteration, effluent water quality, pathogens, migration and spawning distribution, etc.) on native fish, aquatic communities and their habitats.
    e. Work with ODFW to integrate key findings from research at the OHRC into ODFW fish and hatchery management programs.
    f. Conduct research that assists in the implementation and advancement of native fish population recovery as well as viable fisheries.

3. **Educate and train students, fishery biologists, managers and the public on the relationship between hatchery and wild fish, the connection between fish and watershed, estuarine and ocean systems, and the implications for fish management and stewardship.**

    a. Train the next generation of biologists and managers, ODFW and OSU staff through undergraduate, graduate, and continuing education programs and classes at the facility.
    b. Provide educational facilities and programs for K-12 students.

c. Design and manage the facility to provide an environment of passive and active learning for visitors.
d. Provide opportunities for educators and others to use the OHRC for meetings, workshops and programs that further public understanding of the relationship between fish and watershed health.
e. Help facilitate and coordinate on the ground efforts of groups and individuals that have a key interest in our fisheries and fish management.
f. Knowing that our wild and hatchery fish are a vital part of each Oregonians heritage, we will develop critical hatchery science to be used as applied knowledge for creating policy and management goals that strengthen, support and conserve our fish.
g. Conduct outreach in the communities impacted by wild fish or hatchery release issues.
h. Share research results through both publications and presentations on the local, state and international level.

OHRC

Northwest Power & Conservation Council

Portland, Oregon

12 January 2016

Oregon Hatchery Research Center (OHRC)

A cooperative effort between:

Oregon Department of Fish and Wildlife

and

Oregon State University
Department of Fisheries and Wildlife

OHRC

David Noakes

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Fisheries & Wildlife Department, OSU
Director, OHRC
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OHRC Mission

Understand mechanisms that may create differences between hatchery and wild fish.

Develop approaches to manage the differences to meet fishery AND conservation goals.

Help Oregonians understand the relationships among wild fish, hatchery fish and the surrounding environment.

Collaboration, Cooperation

http://www.dfw.state.or.us/OHRC/

- Problems
- Questions
- Research
- Education
- Operations

Some OHRC Research Projects

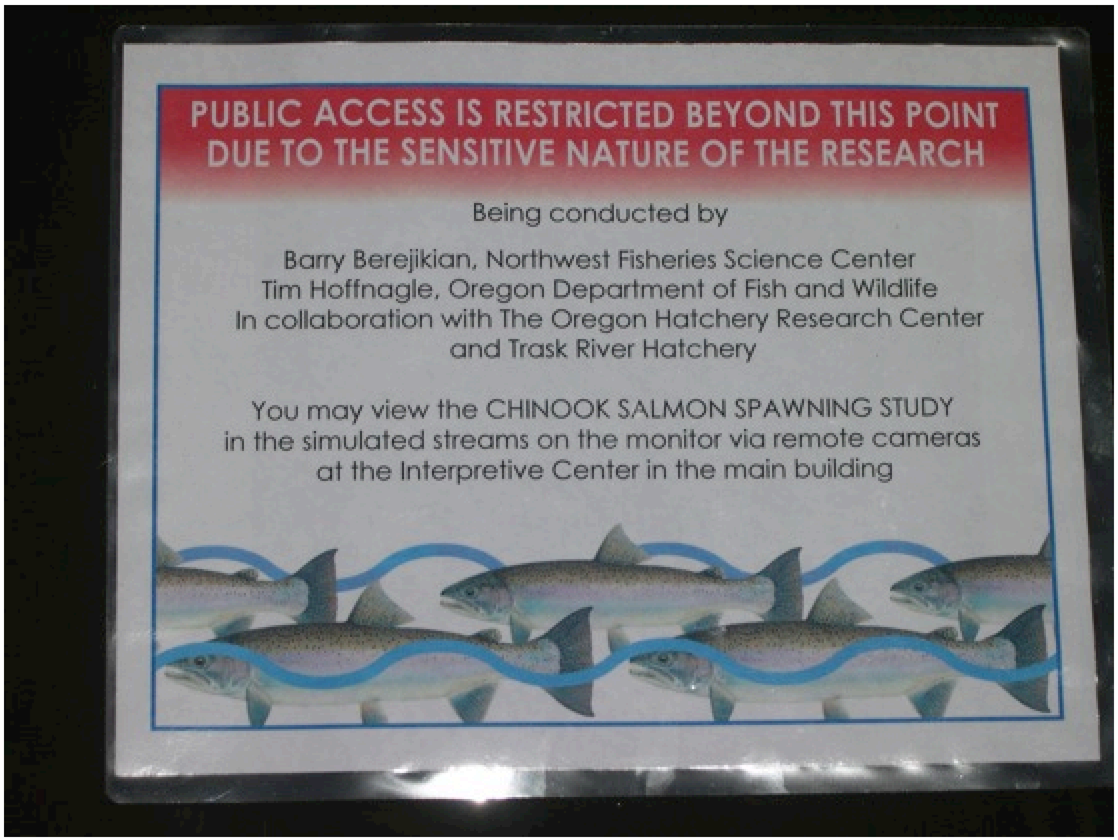
- Wild steelhead broodstock - hatchery program needs
- Chinook jack spawning success - hatchery policy
- Otoliths – active and passive marking
- Smolt diets - preparing fish for smolt release
- Triploids - stocking and fishing
- Adult sterilization – hatchery : wild interactions
- Mucus, stable isotopes and diets - carcass programs
- Juvenile growth and survival – hatchery : wild
- Sterile steelhead - recreational fishing
- Rearing densities, diet, structure
- Steelhead genetics, rearing, survival & growth
- Tagging & telemetry - recreational fishing
- Smolt study - physiology and behavior – survival

All completed, publications available

Wild Broodstock

Oregon Hatchery Research Center (triploid salmon and trout)

Chinook spawning



Otoliths

- Microchemistry
- Stable isotopes
- H:W
- Tributary river
- Passive marking
- Active Marking
- Diet

- Mucus
- Stable isotopes
- Diet
- Growth rate

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OHRC Research Plan

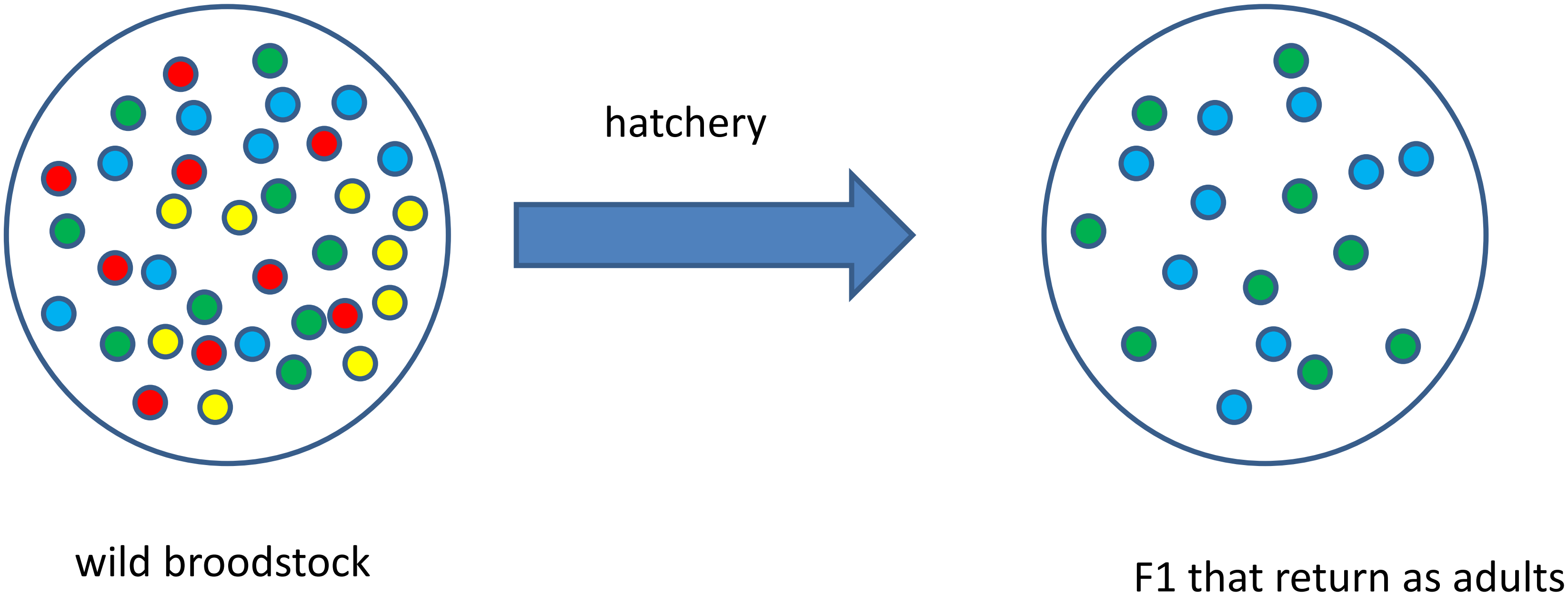
Advisory Board

Domestication

Mate Choice

Olfactory Imprinting

Domestication selection: some families do better than others



Overall Theriault et al (2011) found:

- Wild fish had more returns than hatchery

- W>H even for H fry releases
  - Which life-stages are common and which are different between wild fish and fry releases from hatcheries?
    - Juvenile rearing and adult ocean and return stages same
    - mating & incubation different

- H jacks fitness was no different than wild fish
  - How do jacks get into the spawning action?

- sneakers

Adult homing migration

Pacific Ocean – back to home river

Chinook & Steelhead Olfactory Imprinting Geomagnetic Navigation

Can salmon embryos learn incubation water?

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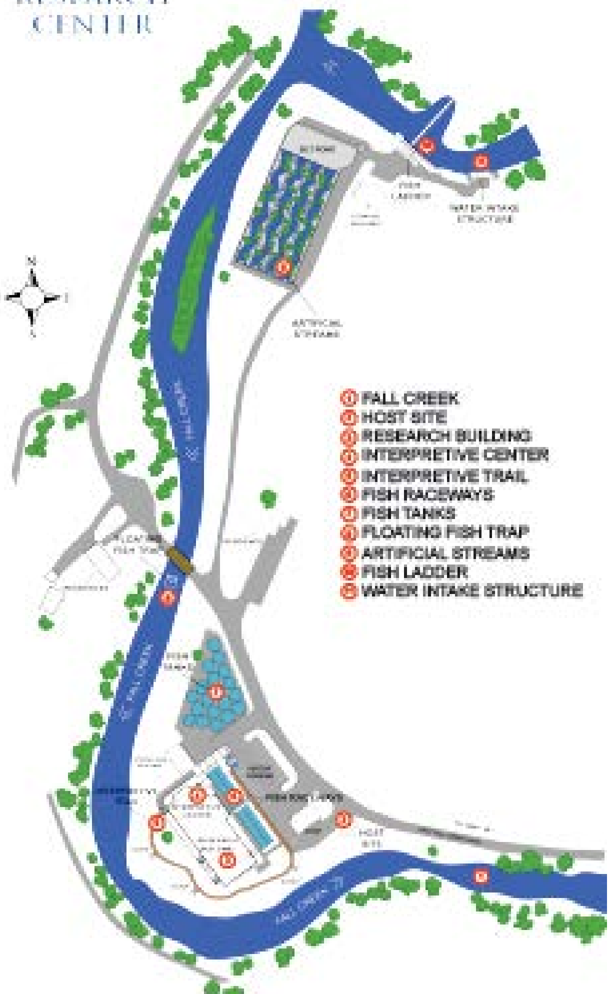
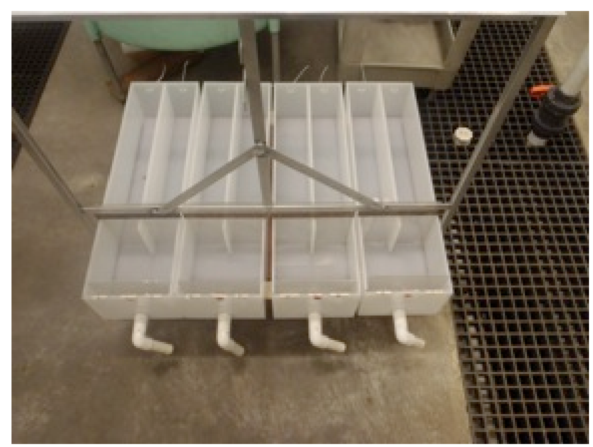


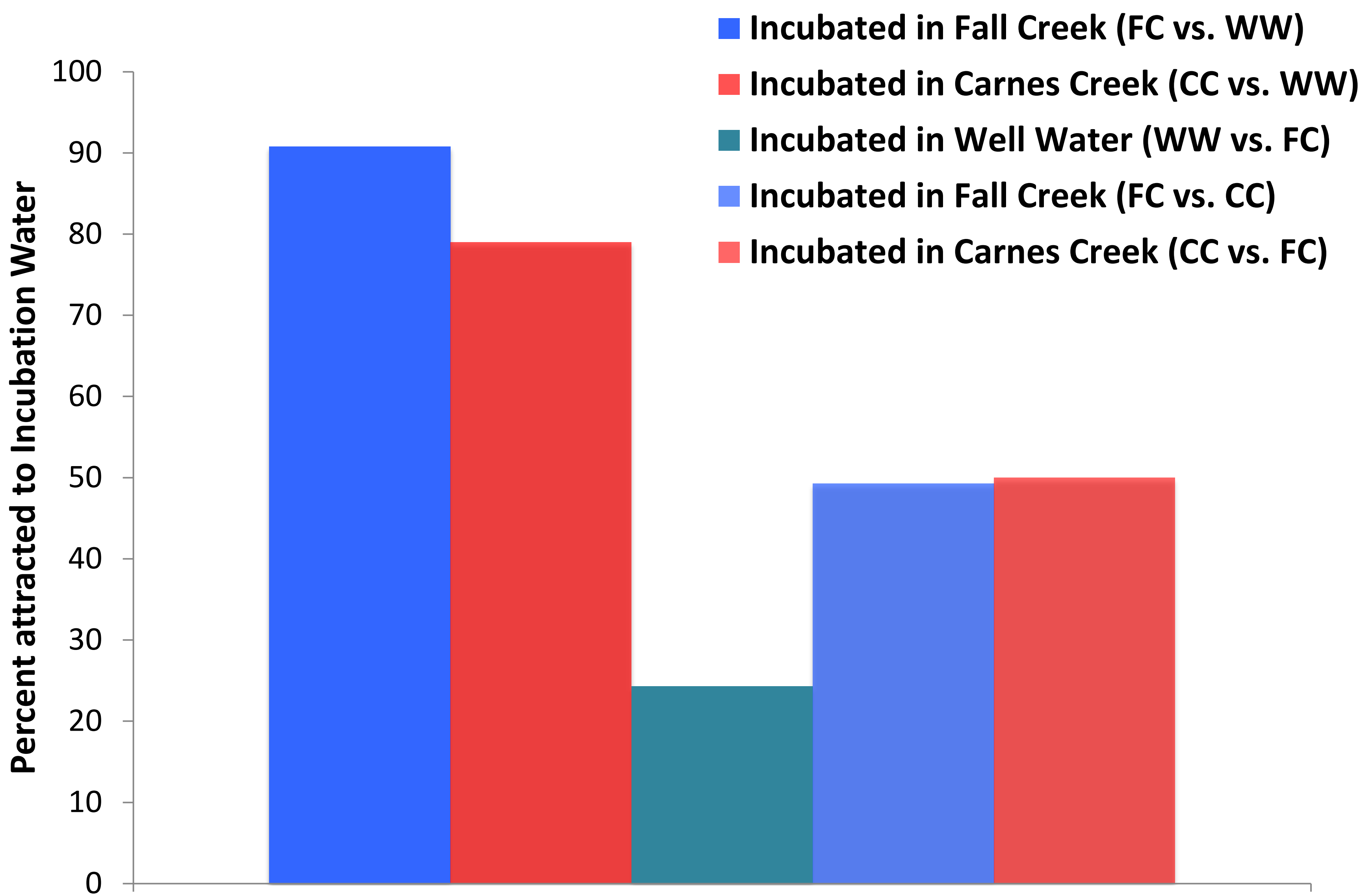
Clackamas Spring Chinook

Fall Creek | Well water | Carnes Creek

Y-maze testing of emergent fry

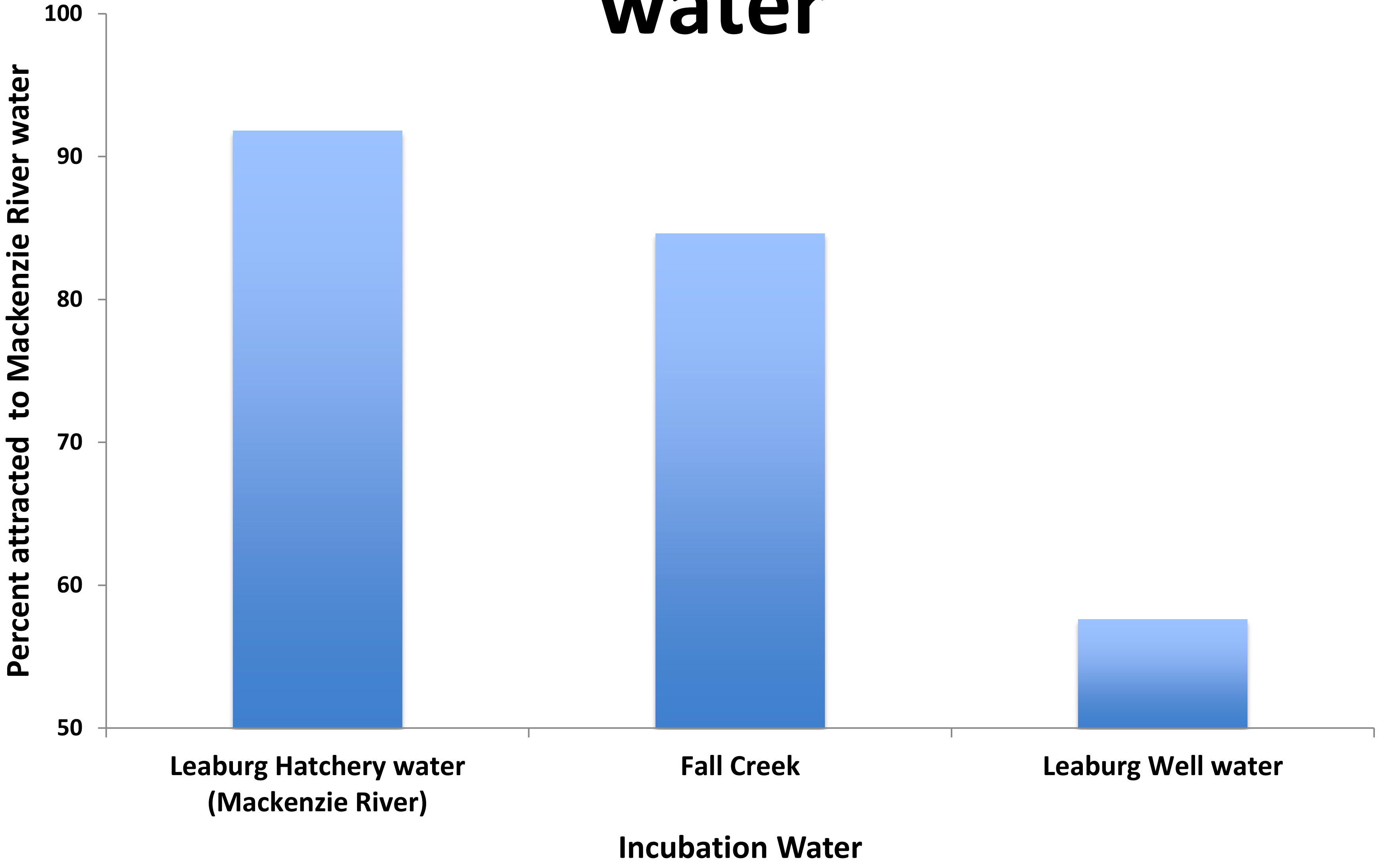


Spring Chinook embryonic learning?

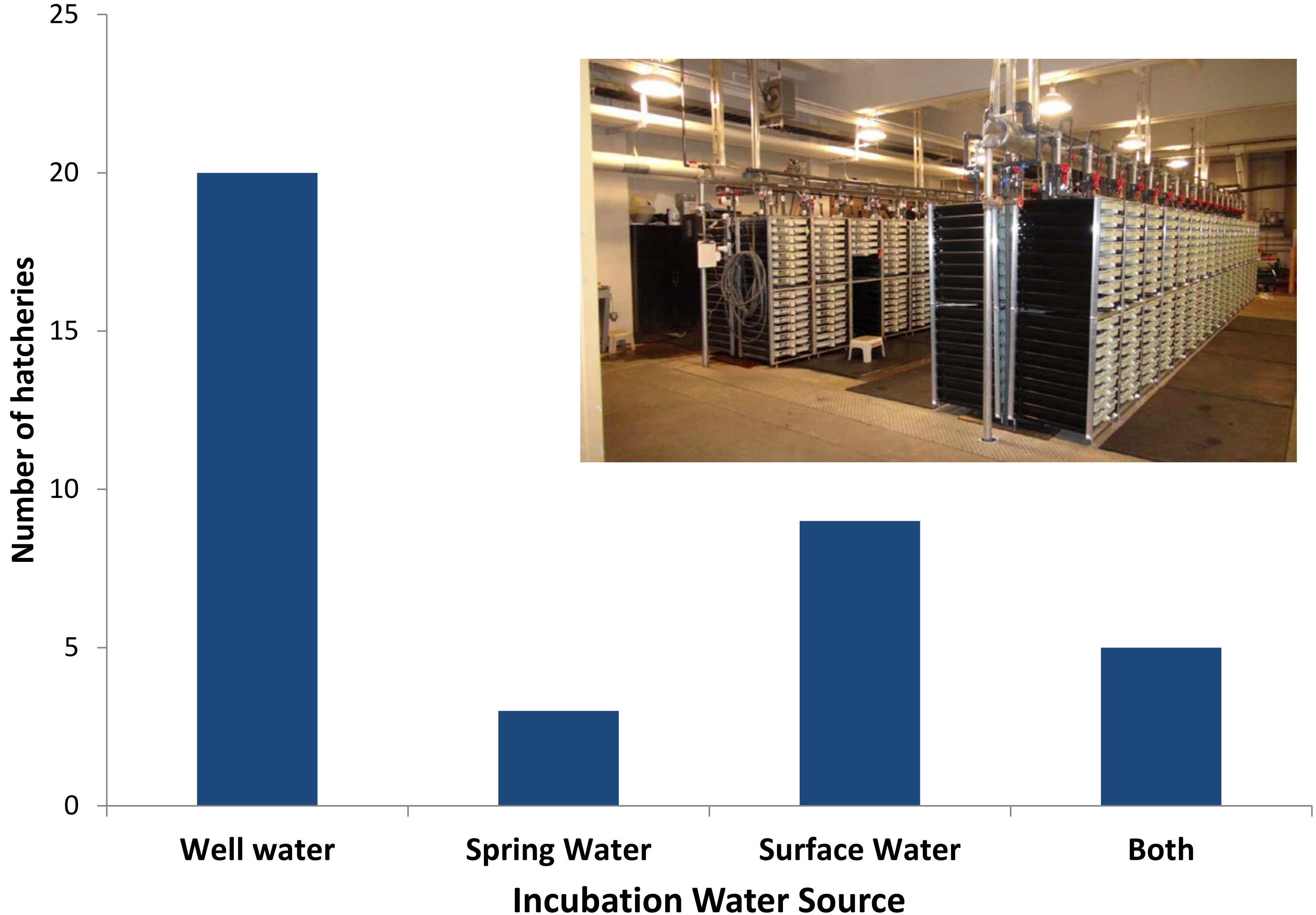


Dittman, Couture, O'Neil, and Noakes

Leaburg Y maze trials: Mackenzie River water vs. well water

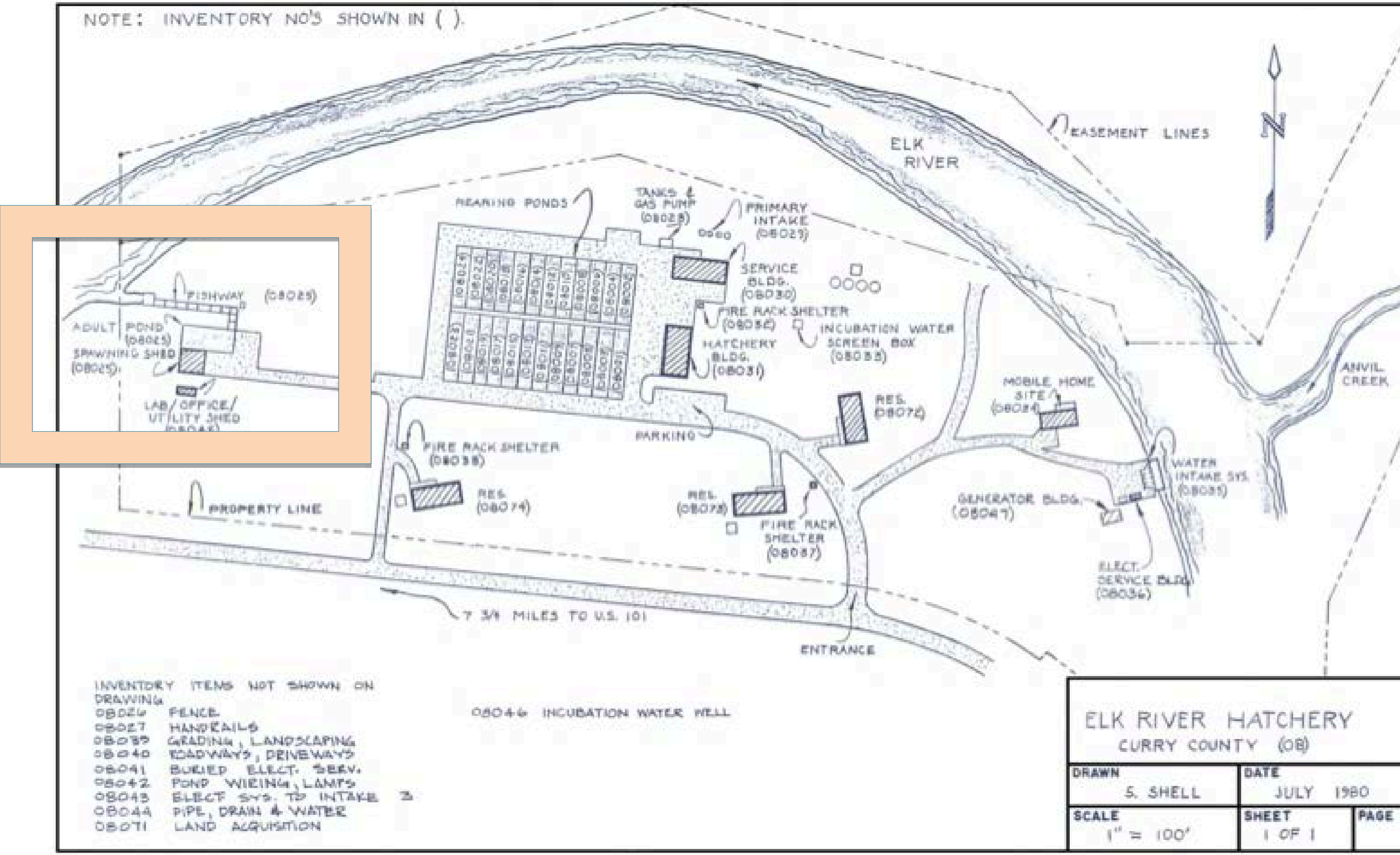


Incubation water in Columbia River hatcheries



Source: Hatchery and genetic management plans

Hatchery Fishway

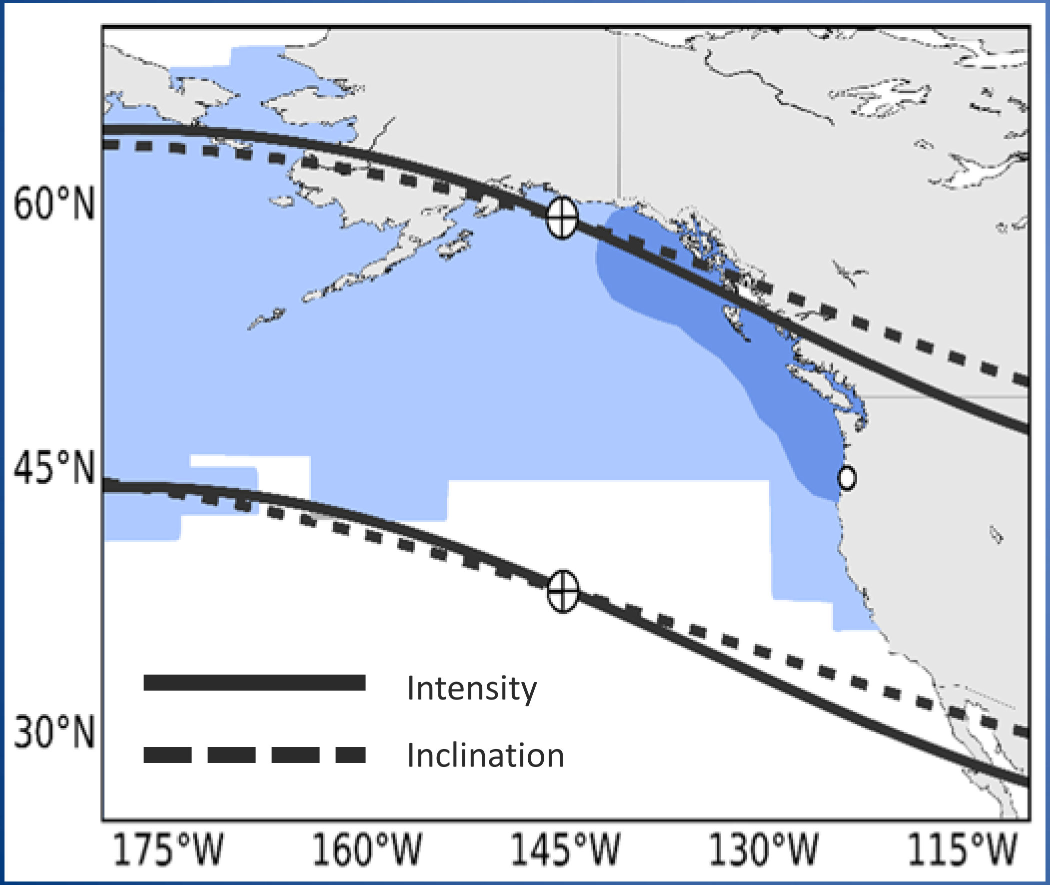


Salmon Geomagnetic Orientation

- The "BIG IDEA"
  - HOW do salmon DO it?
  - Orientation, homing, migration, navigation
  - Homing: straying

- Why is it important to Oregonians?
  - Salmon management, conservation, harvest
  - Hatchery: Wild considerations
  - Coastal energy development

Evidence for a bicoordinate magnetic map in Chinook Salmon



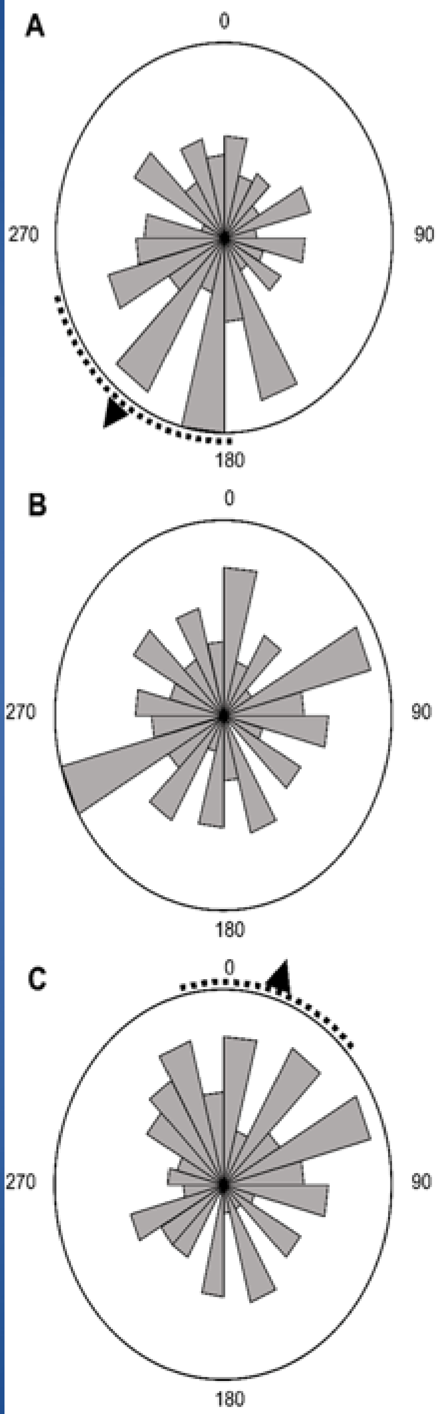
Putman et al. 2014

Northern field
215°
Rayleigh r = 0.135
Rayleigh p = 0.014
n = 233

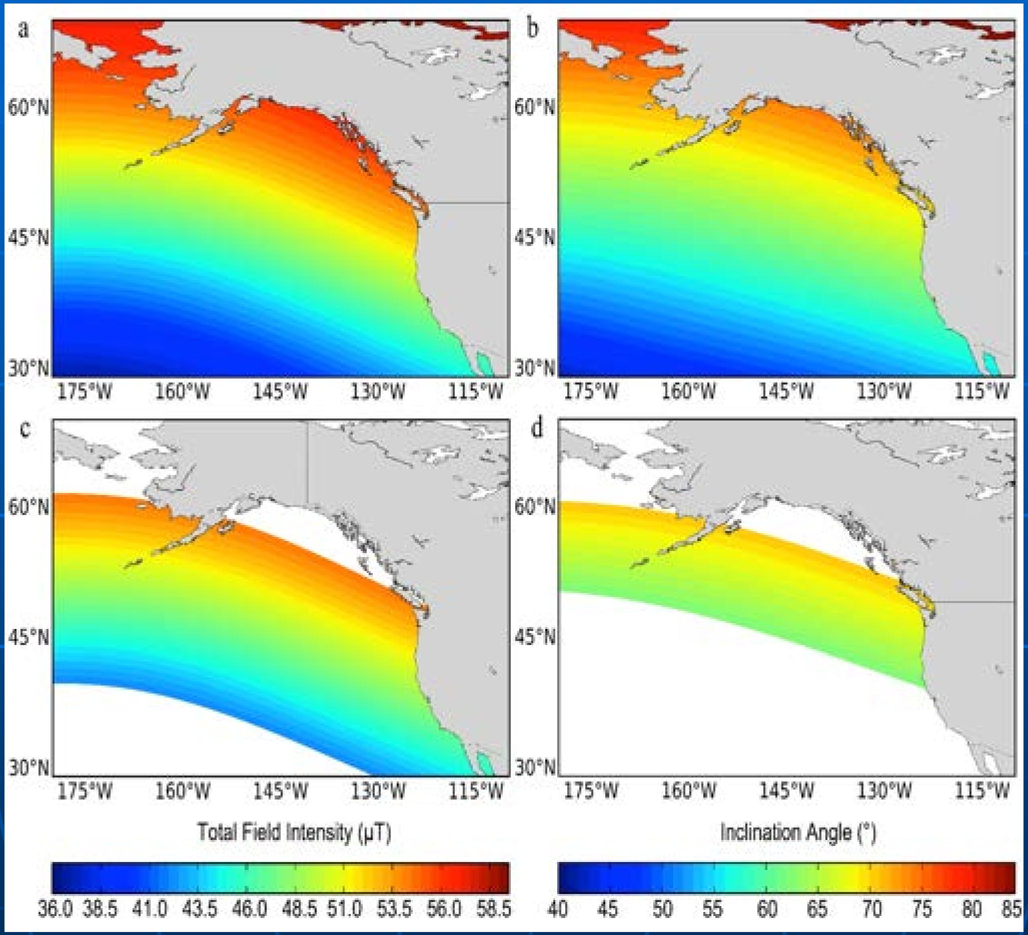
Ambient field

Rayleigh r = 0.048
Rayleigh p = 0.582
n = 240

Southern field
17°
Rayleigh r = 0.163
Rayleigh p = 0.002
n = 234

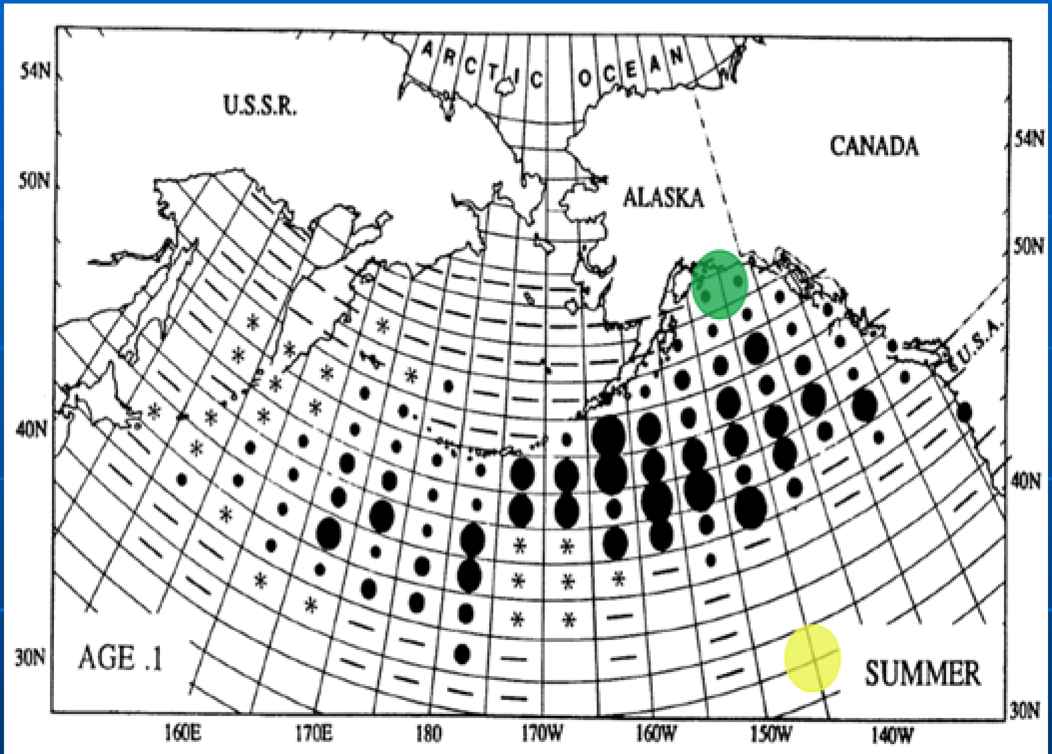


Does the bizarre magnetic environment of hatcheries impair magnetic navigation in juvenile fish?



Putman et al. (2014)
Biology Letters

Steelhead trout in the Pacific Ocean

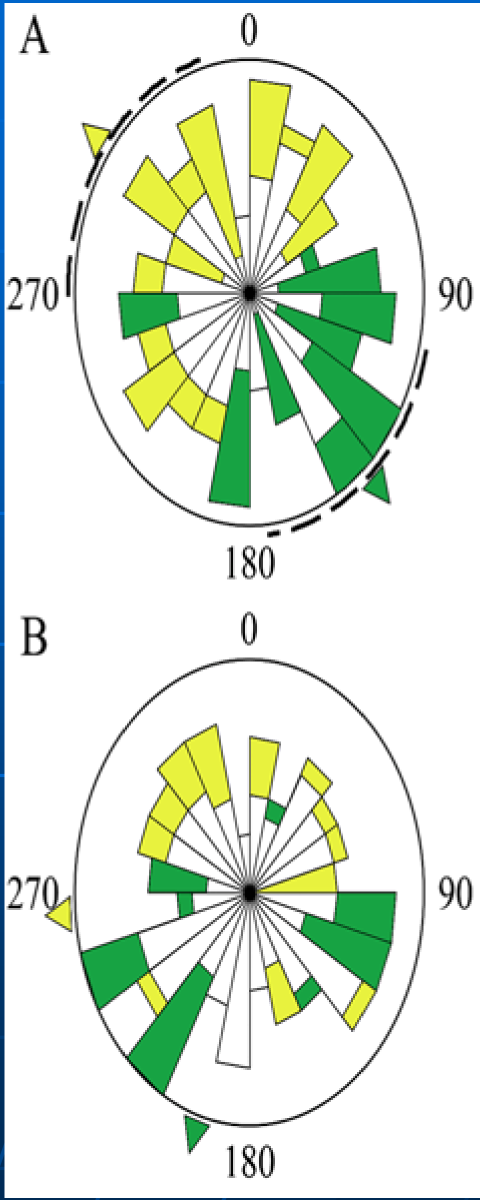


(A) Fish reared in "normal" field

Mardia-Watson-Wheeler Test
P = 0.00016
n = 160

(B) Fish reared in "bizzare" field

Mardia-Watson-Wheeler Test
P = 0.387
n = 159



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Methods – Behavioral Testing