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Olfactory Imprinting of Salmonid Embryos

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Embryo olfactory imprinting ?

Chinook and steelhead

Sequential Imprinting Hypothesis: Imprinting to “natal” sites

The concept

Background

Predictions

Set-up

Experiments

Embryo learning

Testing – OHRC, Leaburg Hatchery



Art Hasler

**Olfactory imprinting hypothesis for salmon homing –
smolts (stream odours)**

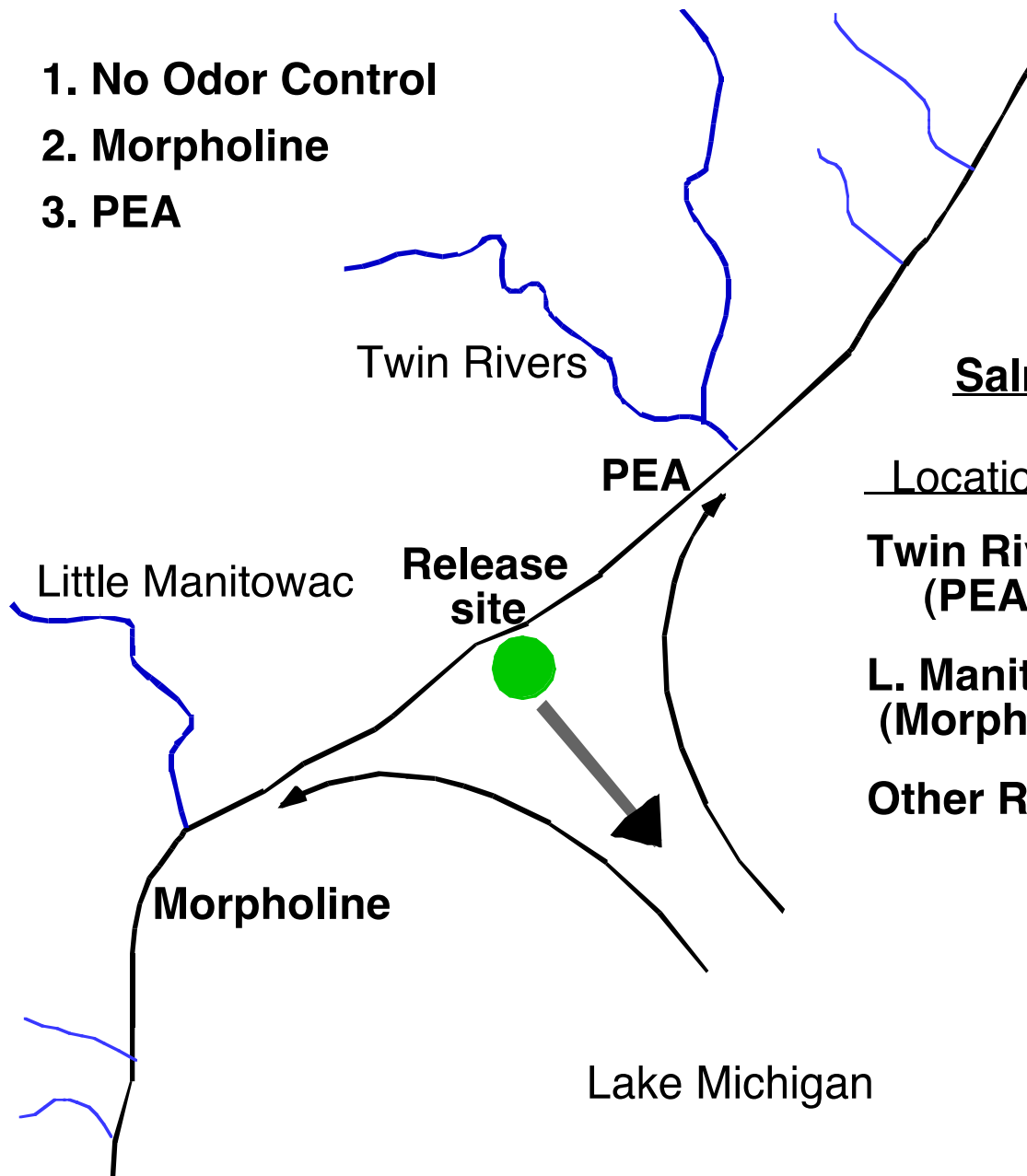


Hans Nordeng

An alternative hypothesis for salmonid homing – kin recognition – chemical cues

Experimental evidence for imprinting hypothesis

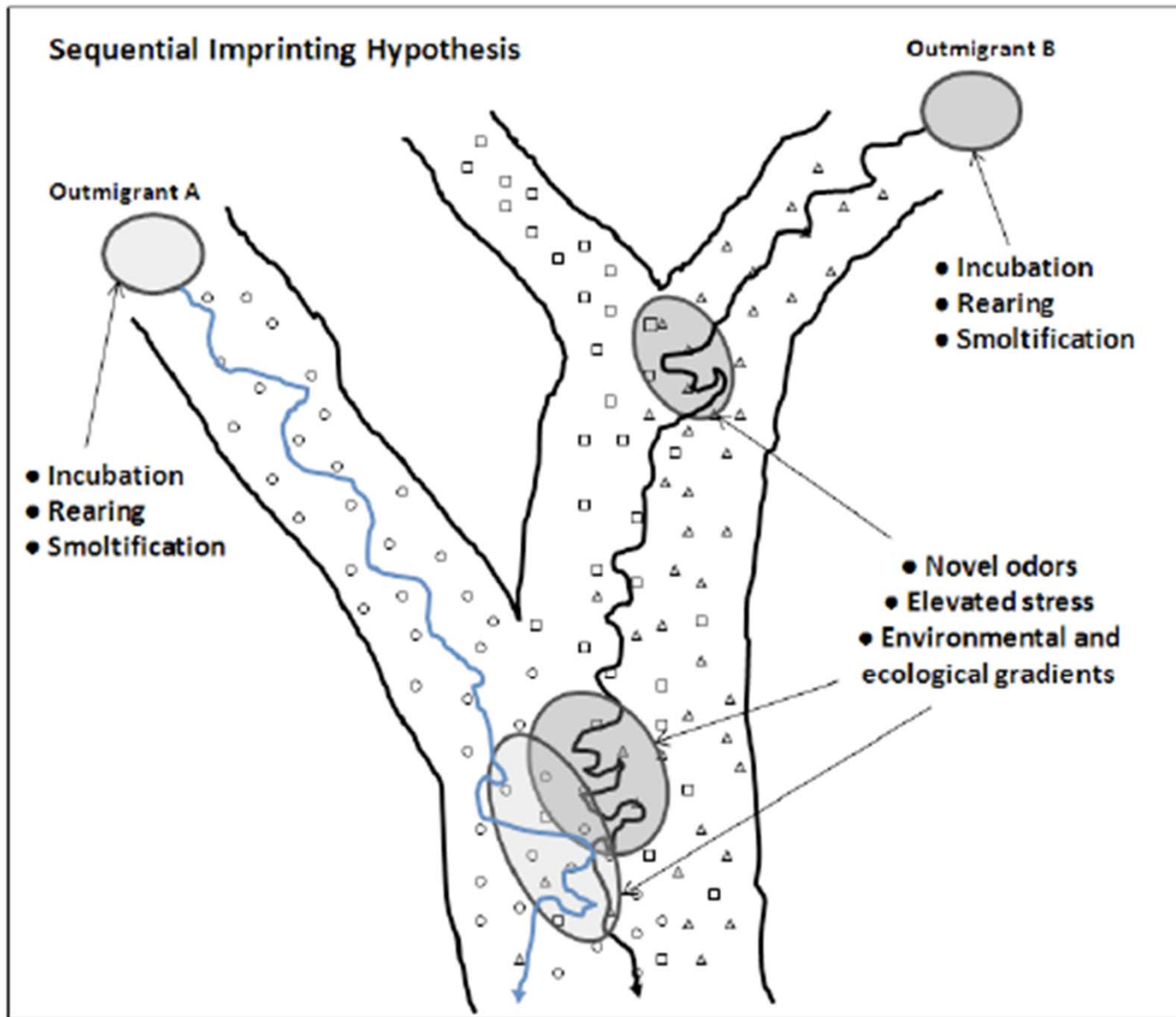
1. No Odor Control
2. Morpholine
3. PEA



Salmon recovered during homing

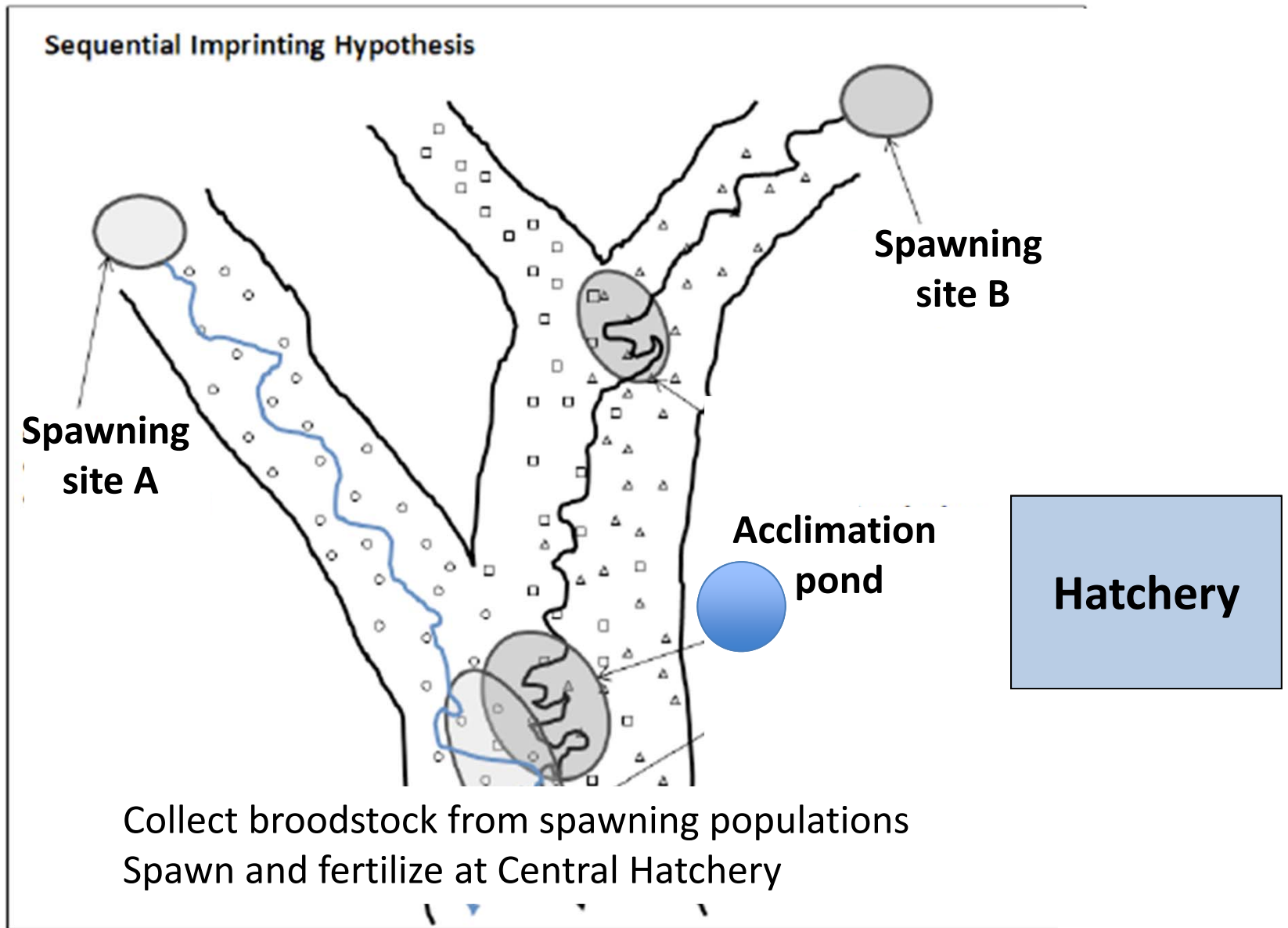
<u>Location</u>	Morpholine	PEA	Control
Twin Rivers (PEA)	8	333	55
L. Manitowac (Morpholine)	659	20	76
Other Rivers	14	9	154

Sequential Imprinting Hypothesis

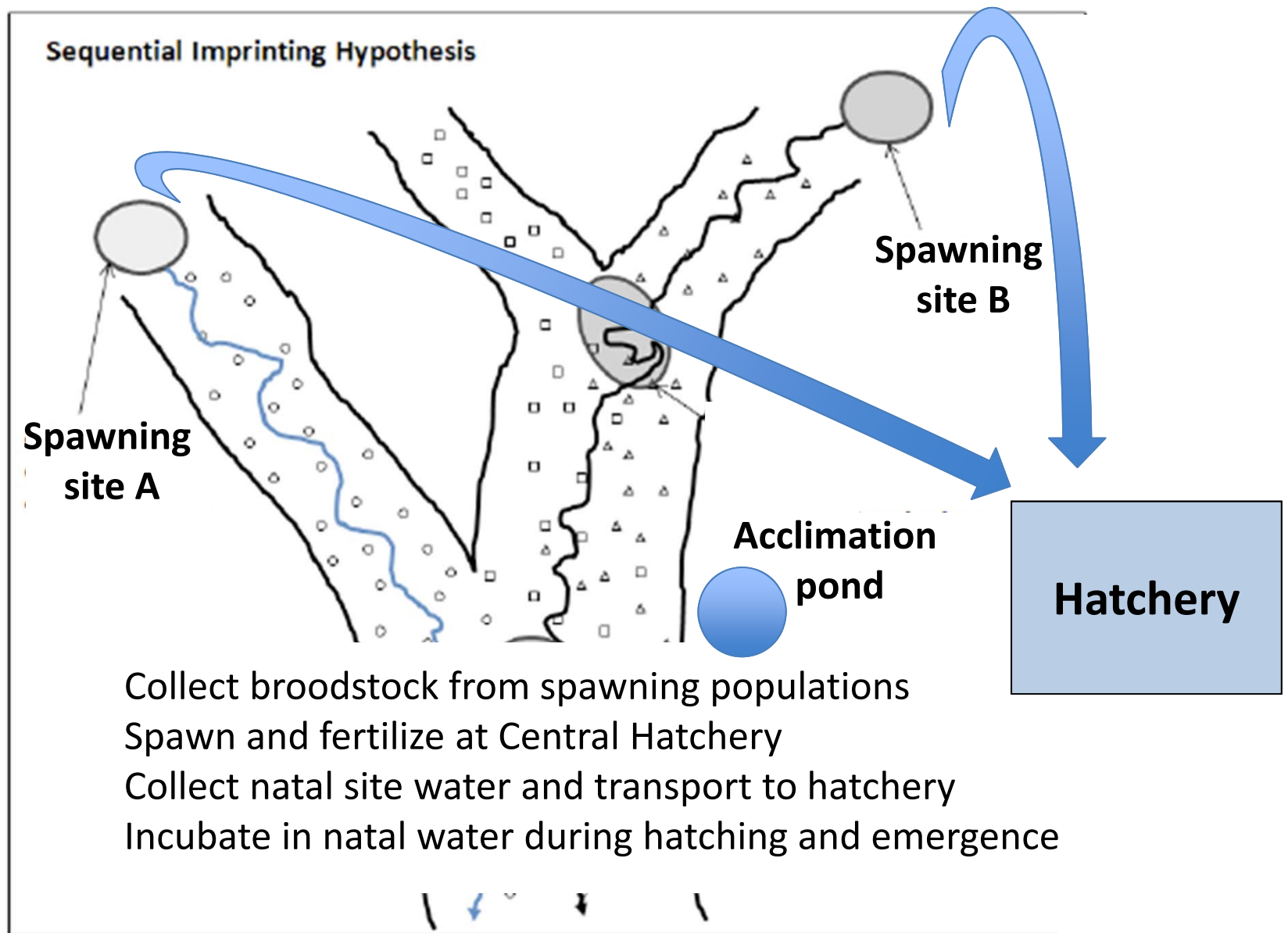


From Keefer and Caudill 2012

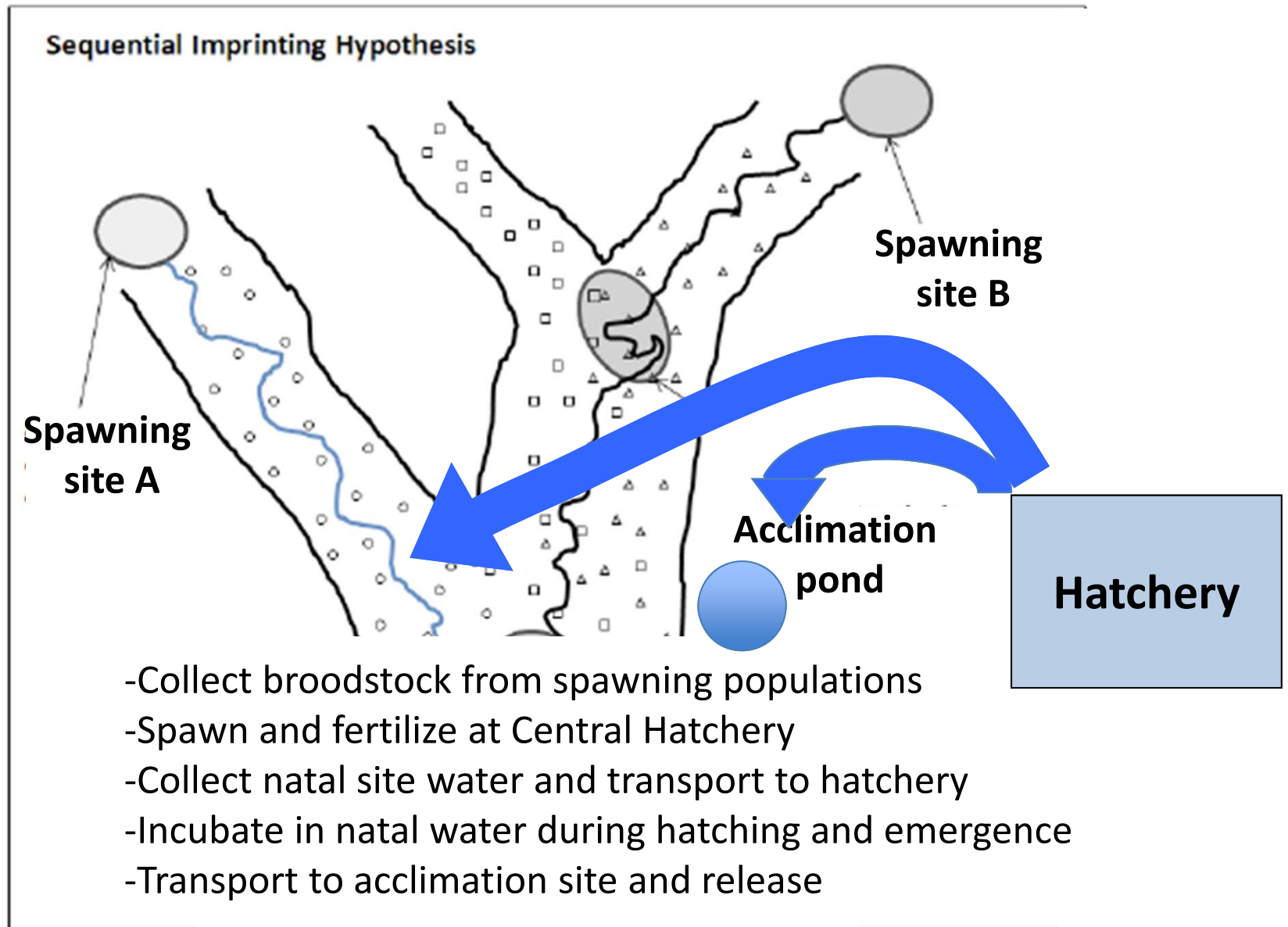
Embryo Imprinting Scenario



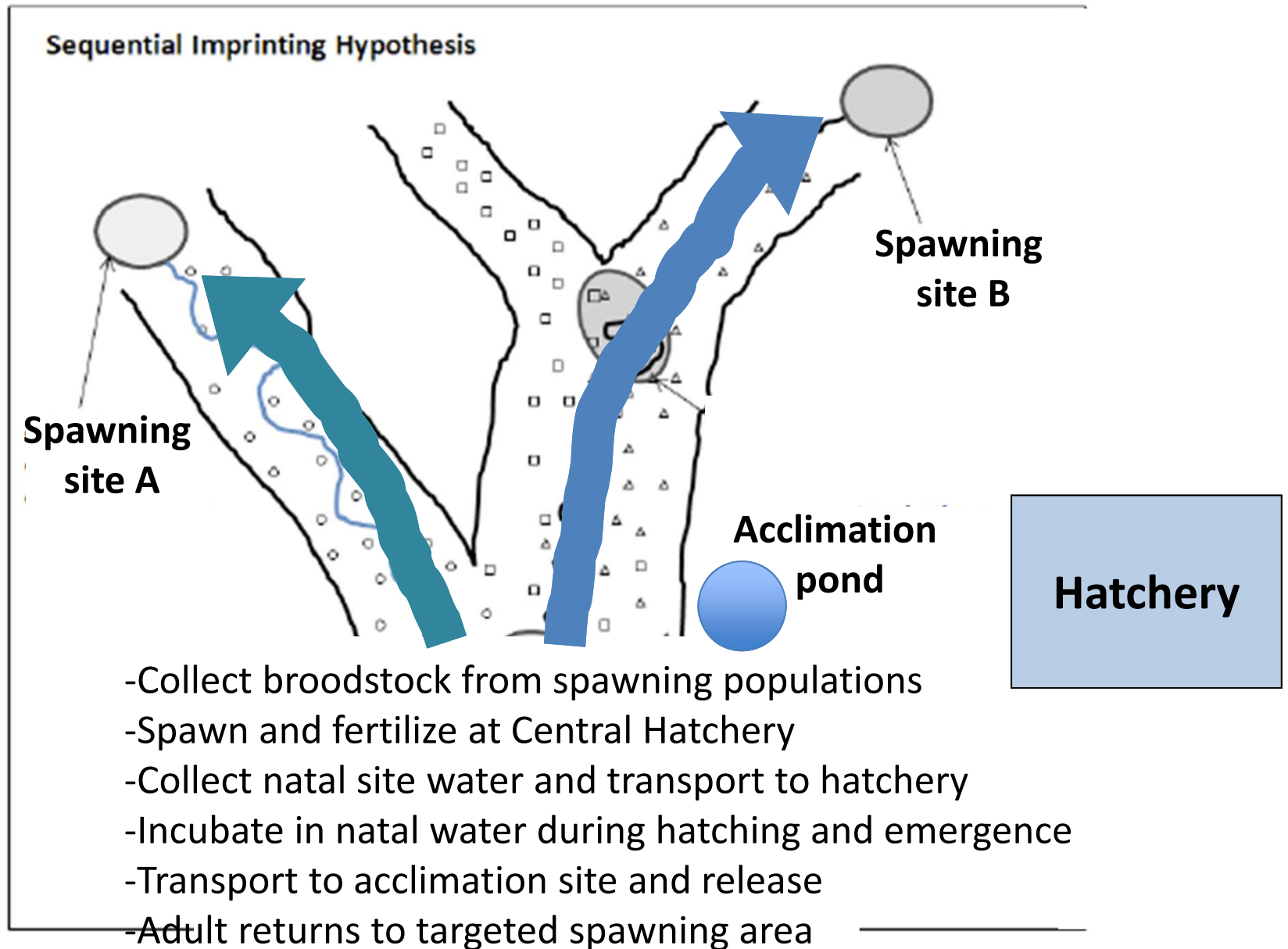
Embryo Imprinting Scenario



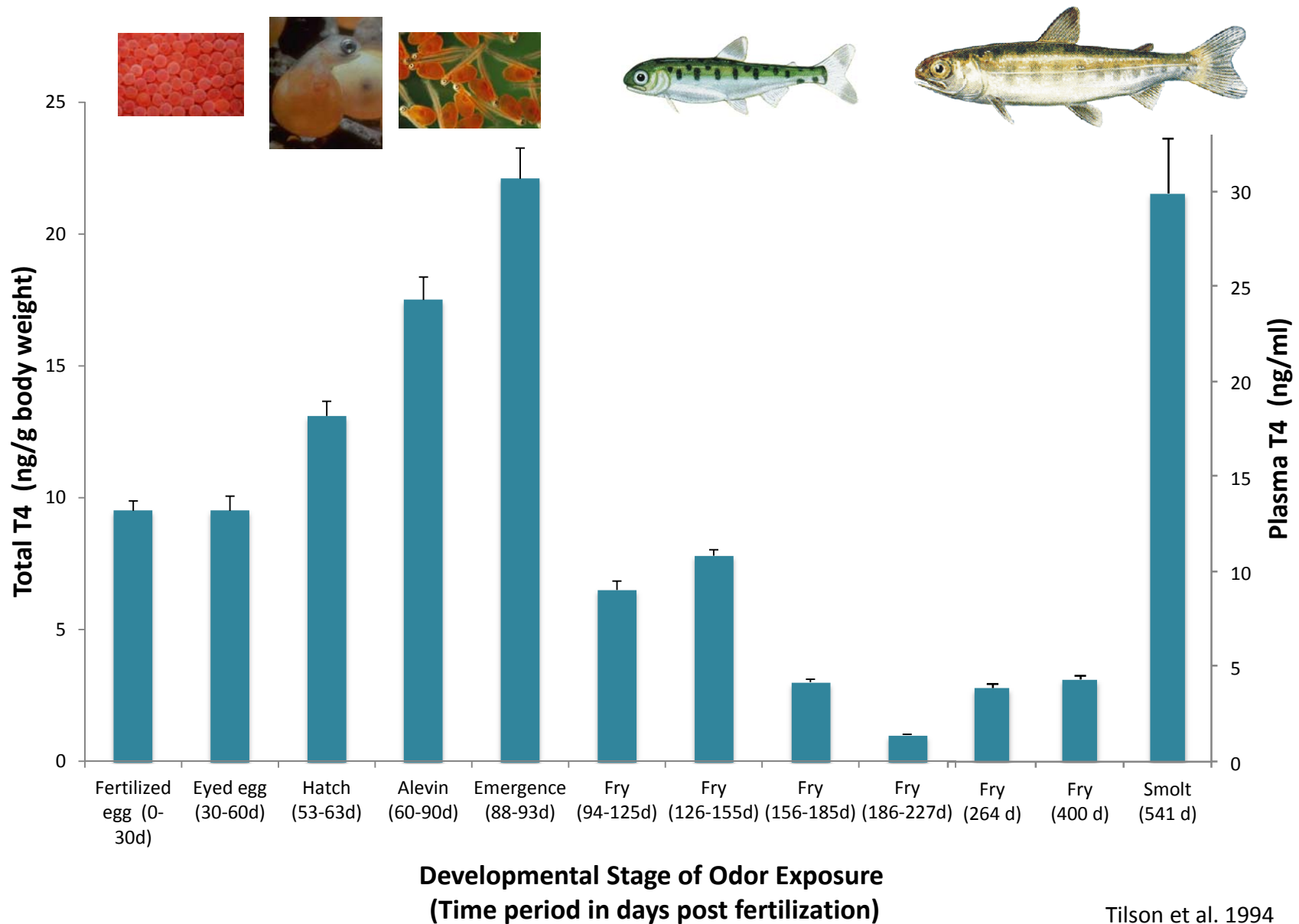
Embryo Imprinting Scenario



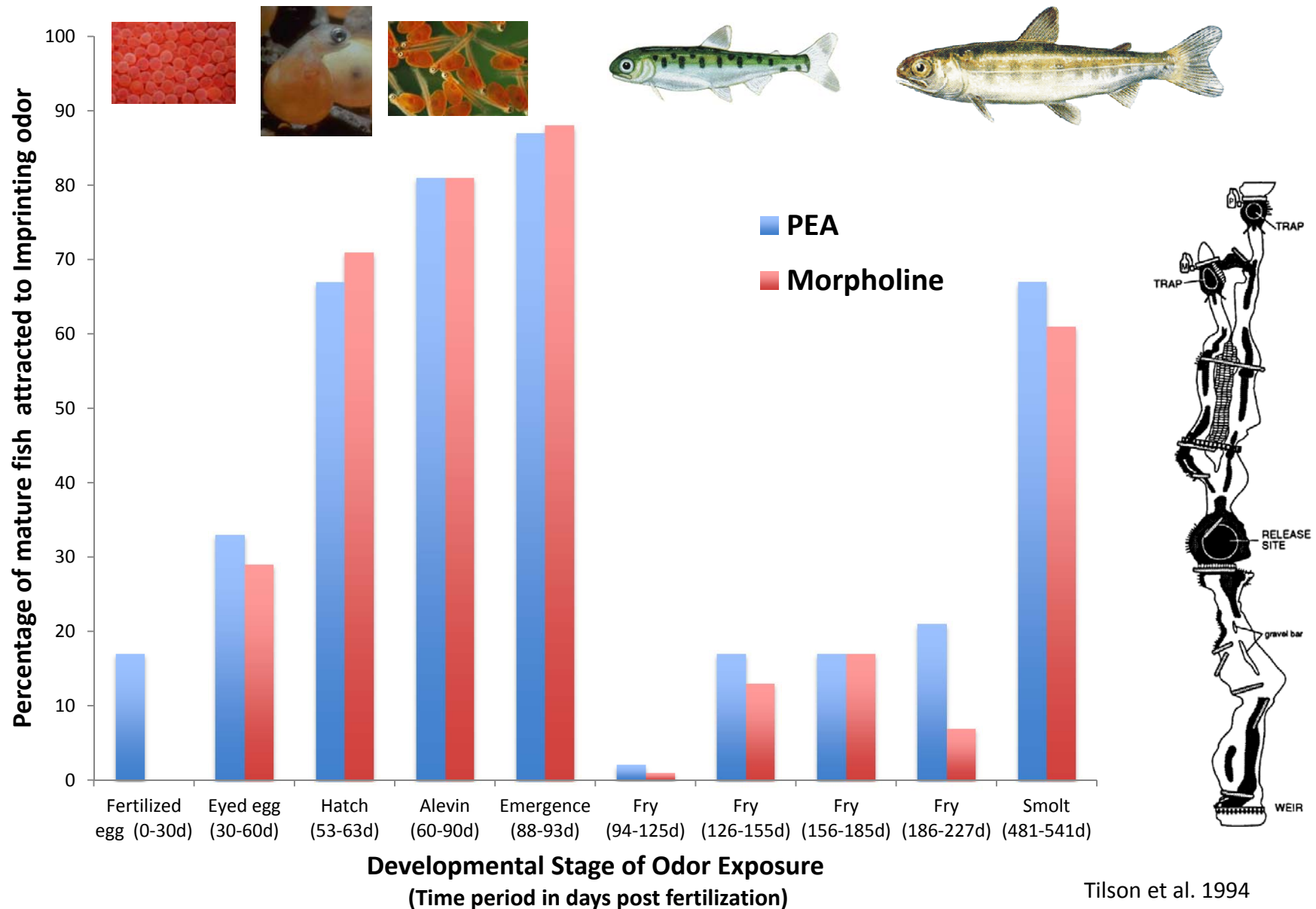
Embryo Imprinting Scenario



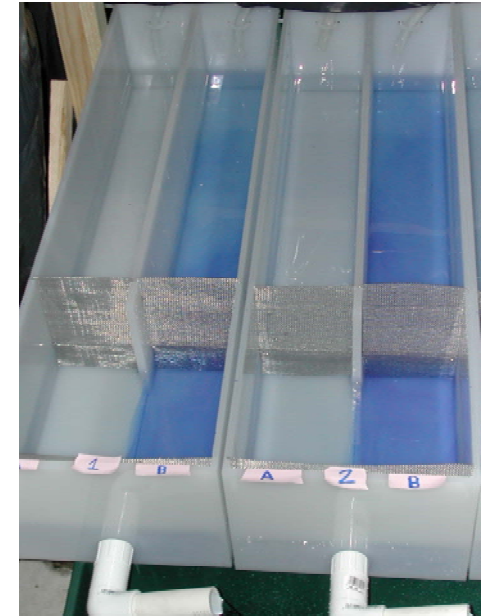
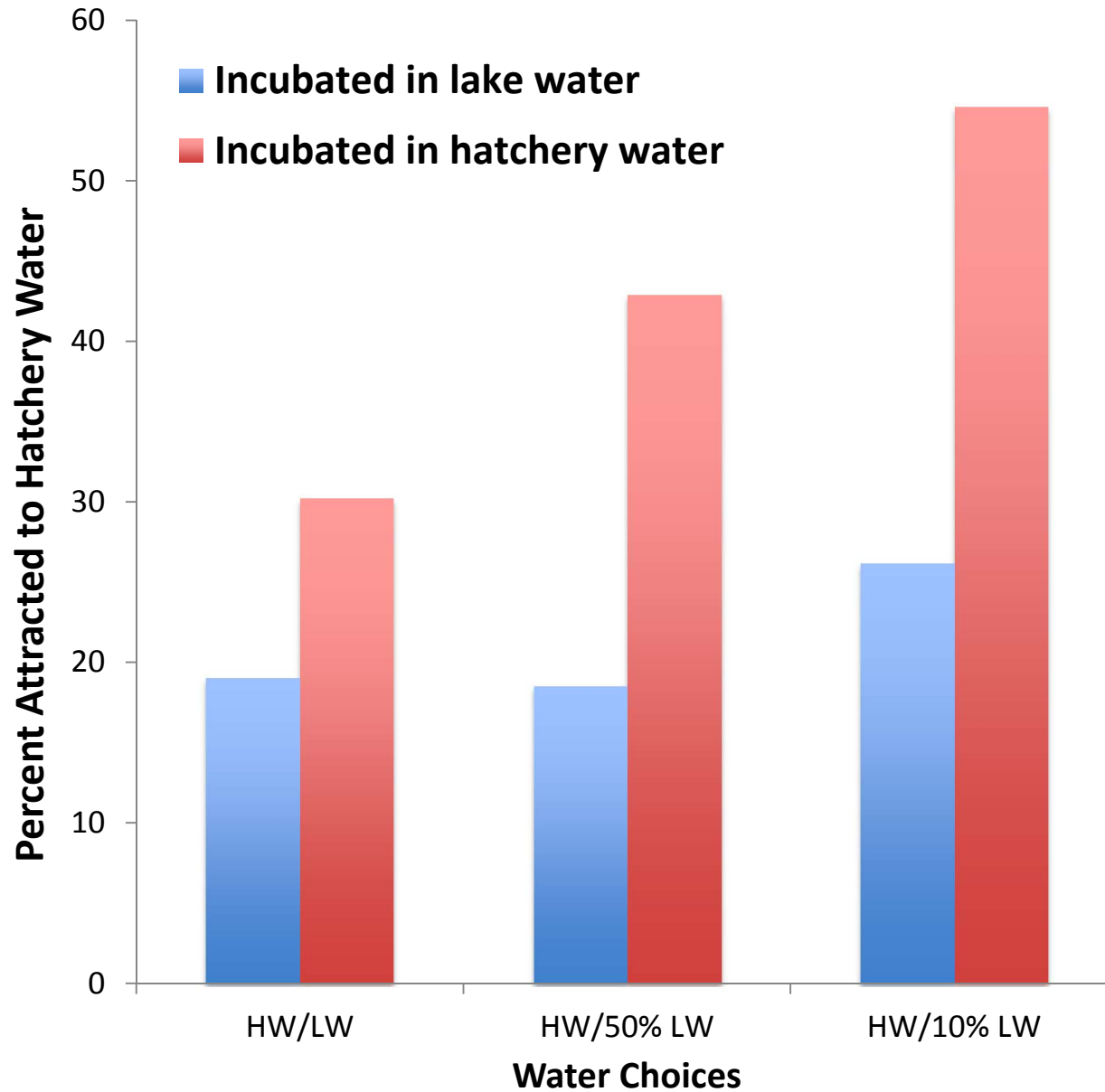
Salmon experience T4 surge as smolts and as embryos



Salmon imprint to natal site as smolts and as embryos



Salmon learn natal waters during embryonic exposure



Dittman, Havey, and Quinn

Experimental Test of Predictions

- OHRC and ODFW Leaburg Hatchery
- Chinook salmon
- Fertilized, incubated in one of three water sources: Fall Creek or Carnes Creek or well water
- Fertilized, incubated in Mackenzie River, Fall Creek or well water
- Test fish at swim up – paired water sources

Can Chinook salmon embryos learn incubation water?



Clackamas Spring Chinook



Fall Creek

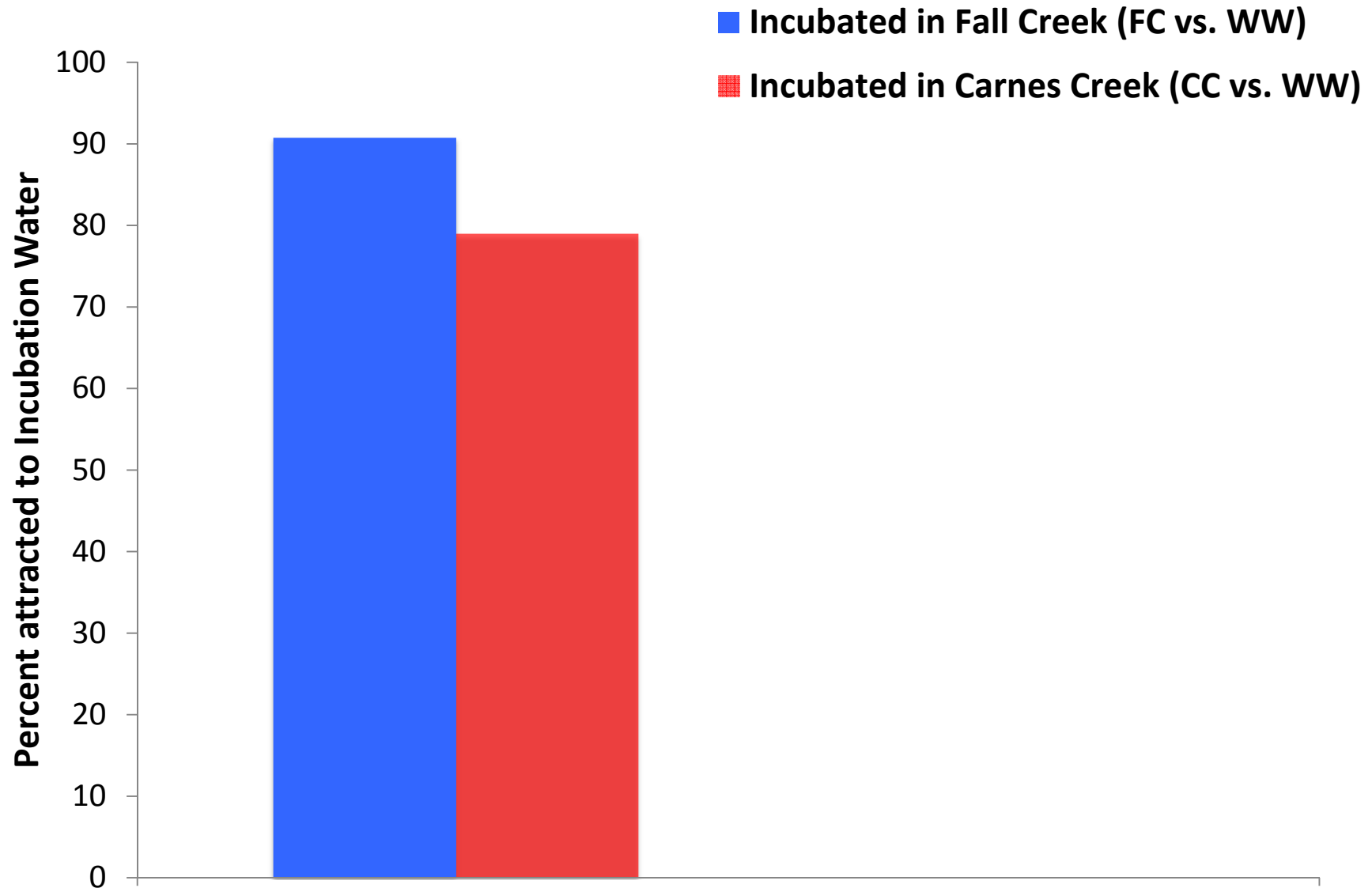
Well water

Carnes Creek

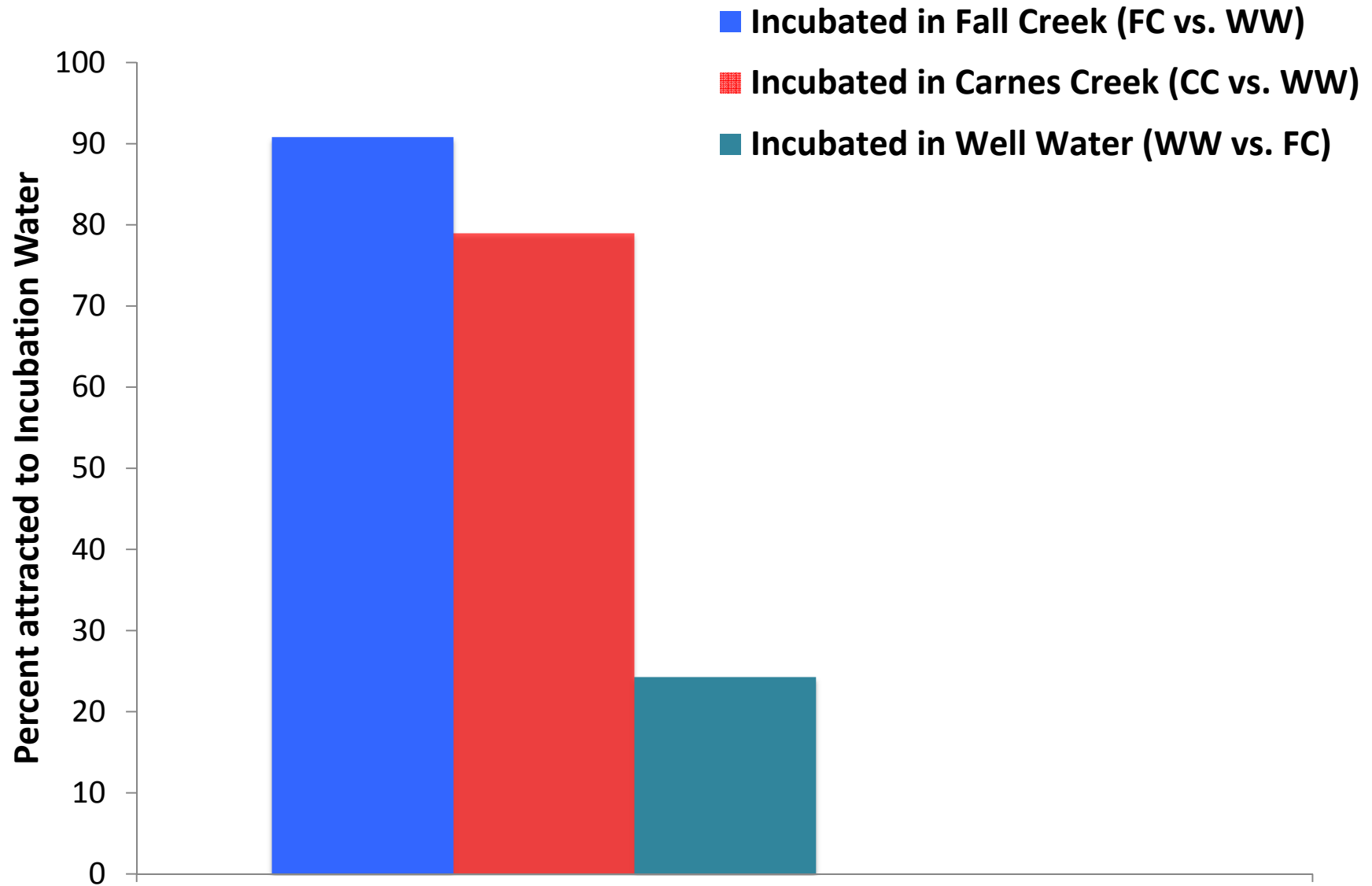
Y-maze testing
of emergent fry



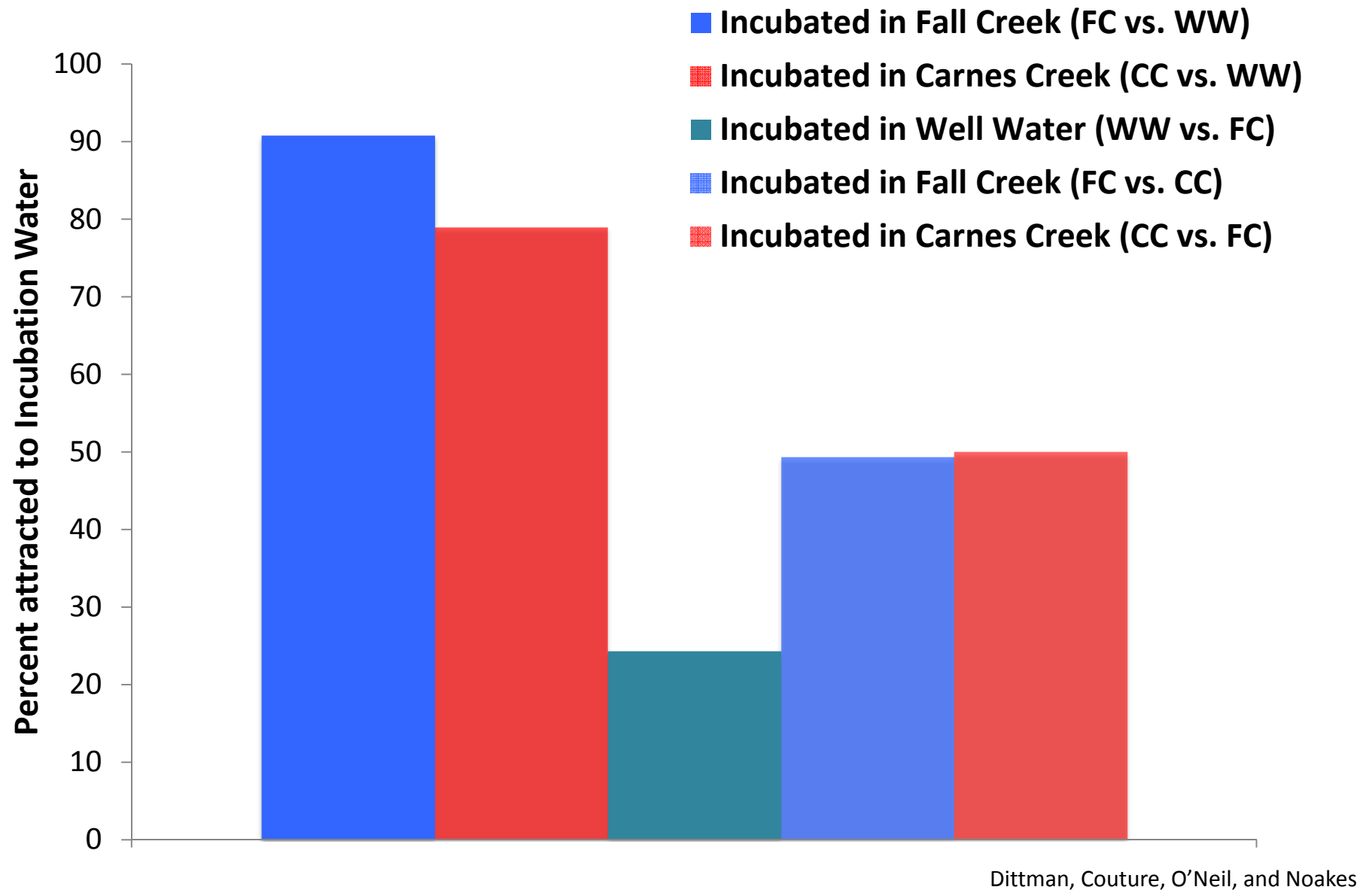
Spring Chinook embryonic learning?



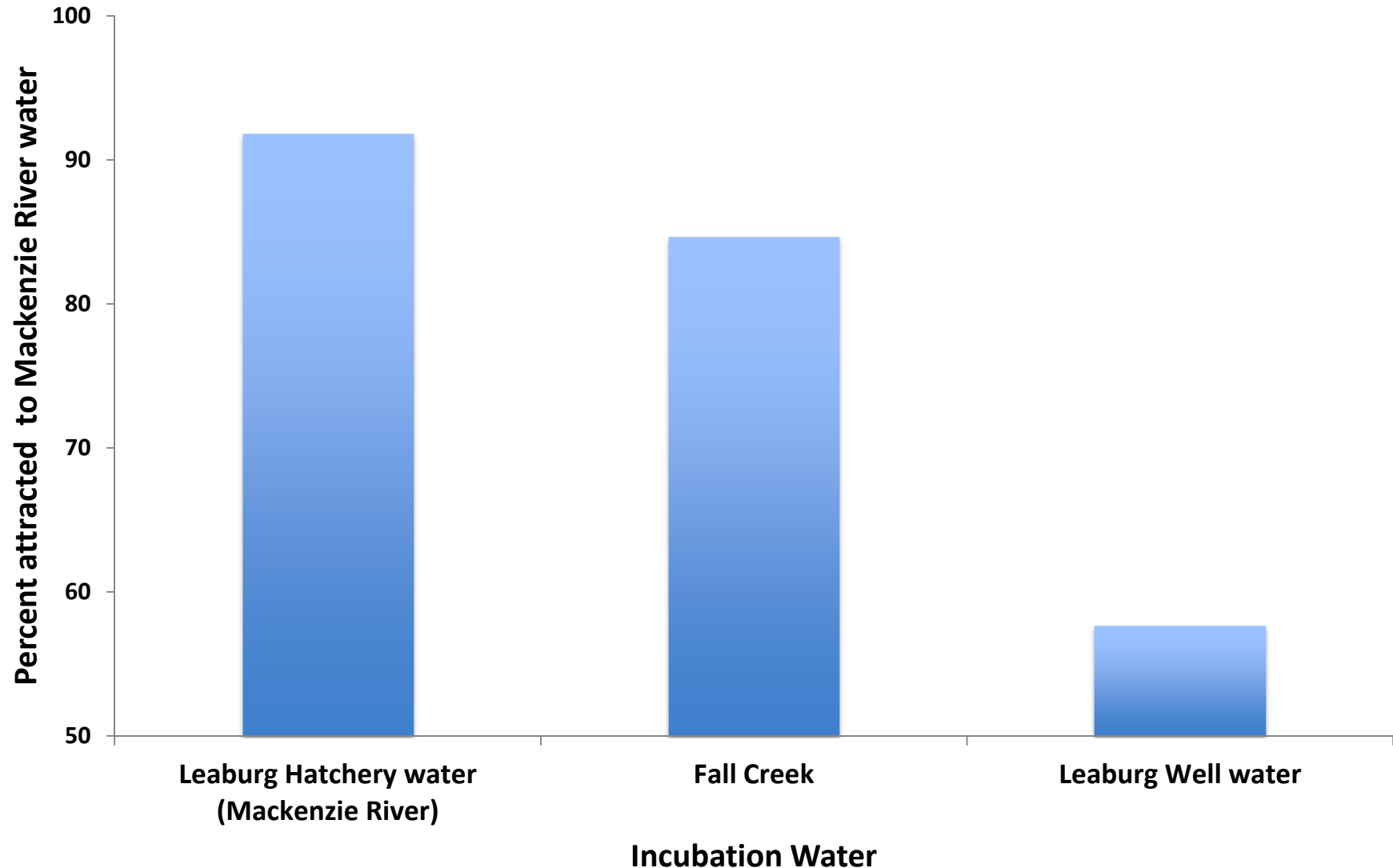
Spring Chinook embryonic learning?



Spring Chinook embryonic learning?



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



Future Directions

- Importance of incubation in well vs. surface water.
- Chemical analysis of water olfactory signatures.
- Assess physiological correlates of early imprinting.
- Explore the use of “artificial” imprinting odors.
- **Program level field test of early olfactory imprinting**