



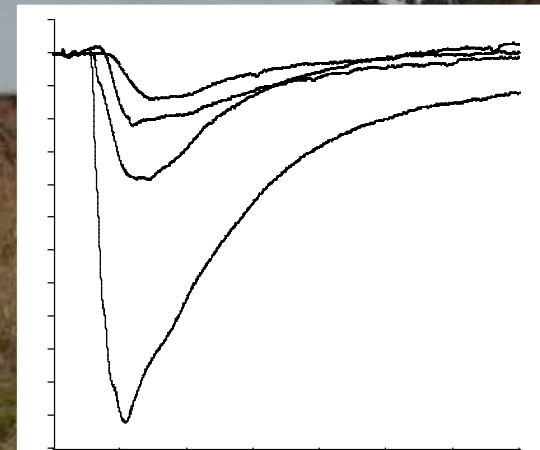
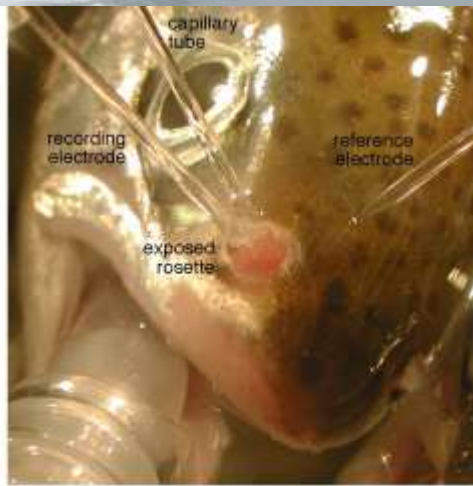
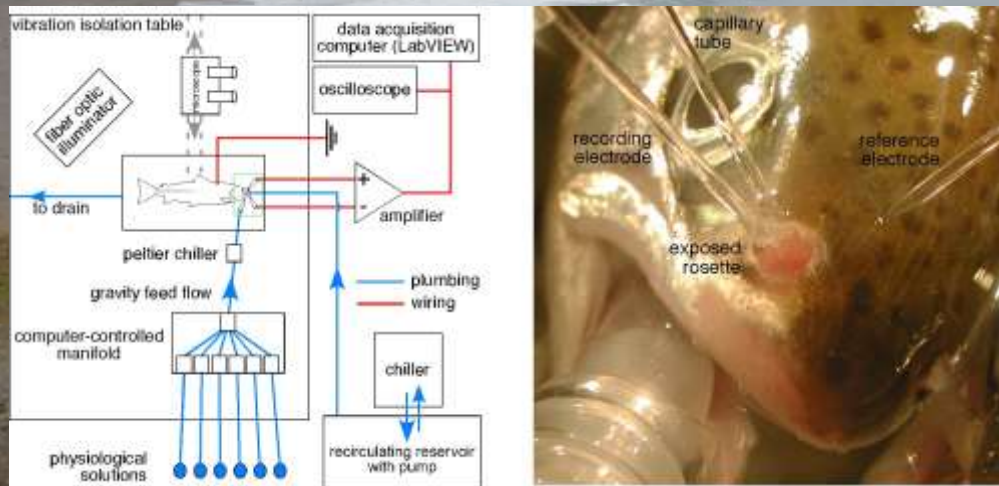
# Identify odorants that produce sensory neural responses in Pacific salmon

Assess the olfactory sensitivity of salmon to candidate odorants using electro-olfactograms (EOGs)

For each candidate odorant:

-Initially screen for EOG sensitivity to a relatively high concentration of odorant ( $10^{-4}$  M) (N=6-8 fish/odorant).

-After initial screening, odorants that elicit olfactory responses will be tested for sensitivity by exposing fish (n=6-8) to decreasing concentrations of the candidate odorant to determine olfactory detection thresholds.



# Test for innate behavioral responses by juvenile salmon to candidate odorants

Two-choice mazes (Y-mazes) to test for innate behavioral responses (attraction or avoidance) by juvenile Elk River Chinook salmon to candidate odorants.

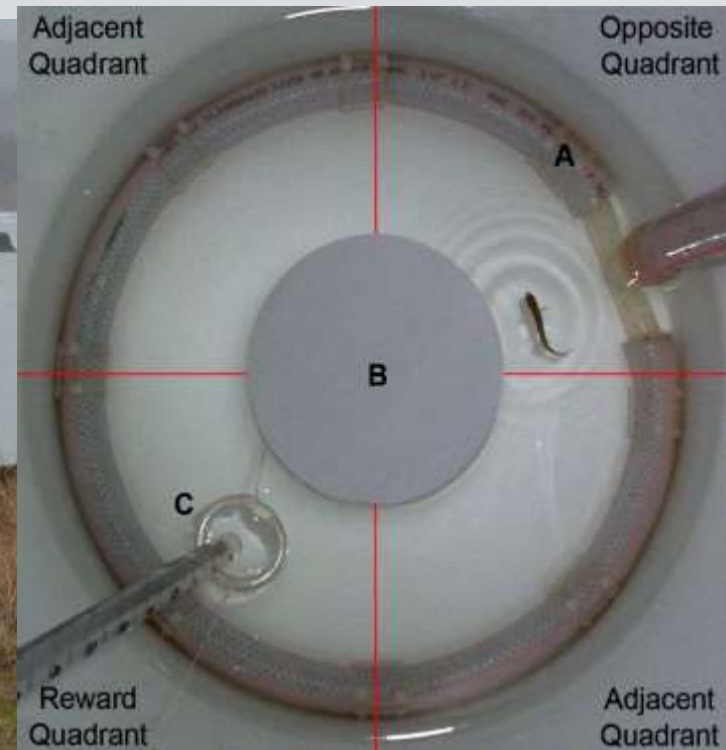


# Identify candidate odorants that elicit learned response in juvenile salmon

Assess learning of candidate odorants using classical conditioning studies

Training with paired presentation of odor/ctl and food reward

Test conditioning (turns/min) with odor alone

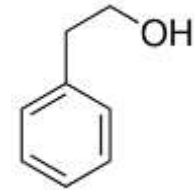
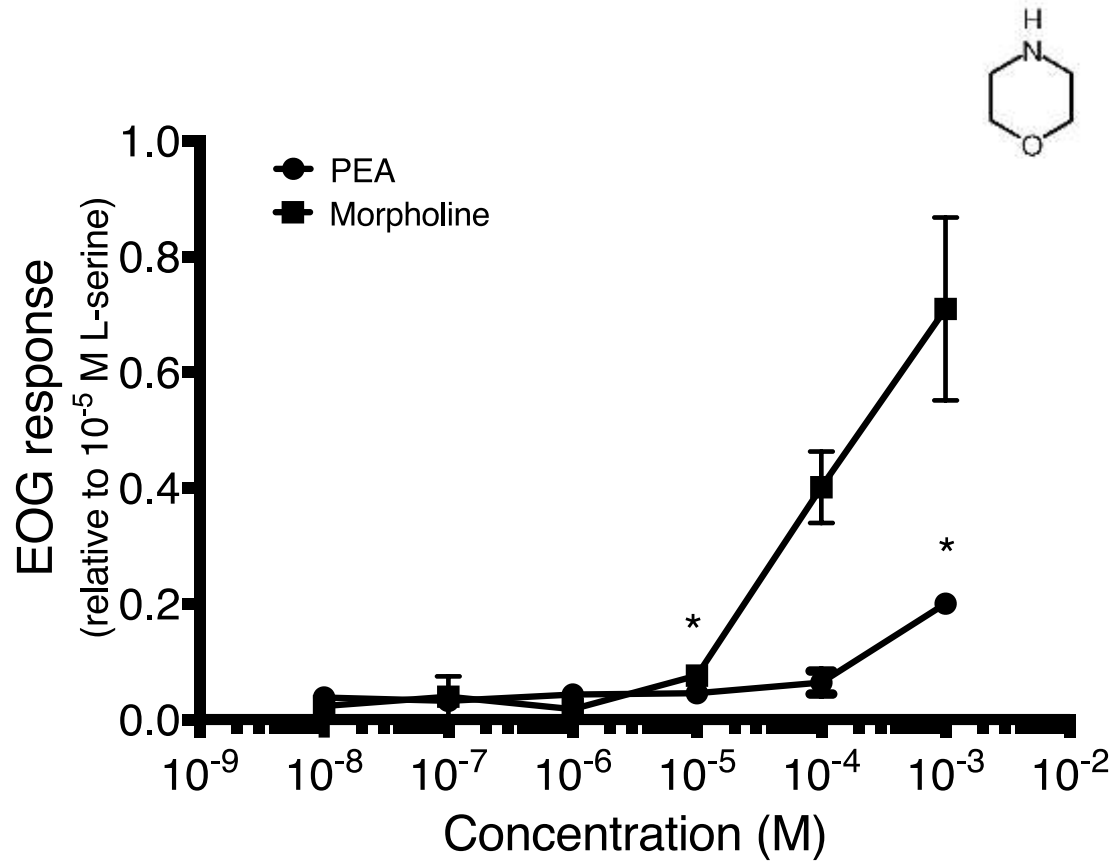


## **Phase 2: Odorant Selection and Imprinting Effectiveness**

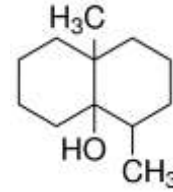
**Identify and screen a variety of natural compounds released from aquatic plants and organisms and other known fish odorants for their potential use as artificial imprinting/homing cues and identify the most likely effective scent(s) to incorporate into Elk River Hatchery water.**

- 1) safe for release into natural waters**
- 2) inexpensive and readily available**
- 3) stable for storage and after release into natural waters**
- 4) detected by the salmon olfactory epithelium at relatively low concentrations**
- 5) ideally does not elicit innate behavioral (attraction or avoidance)**
- 6) embryo and juvenile salmon are able to learn and respond behaviorally to the compound.**

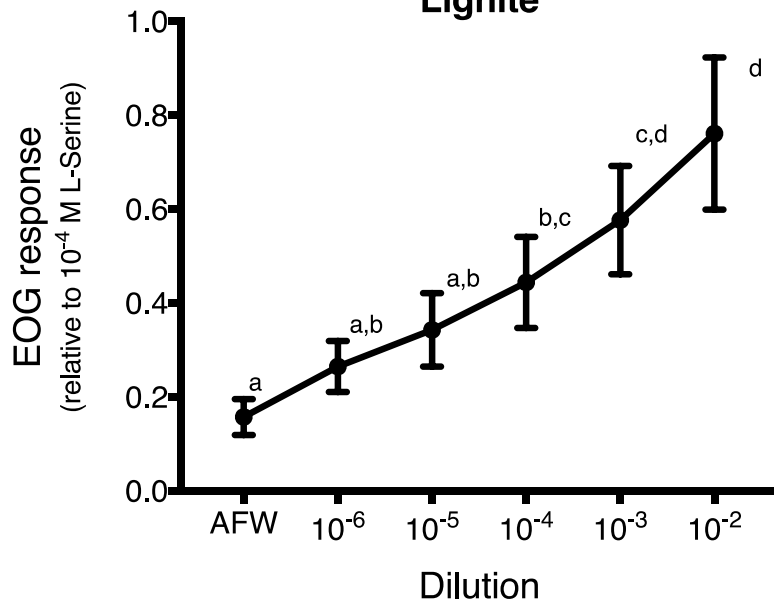
# Artificial odors



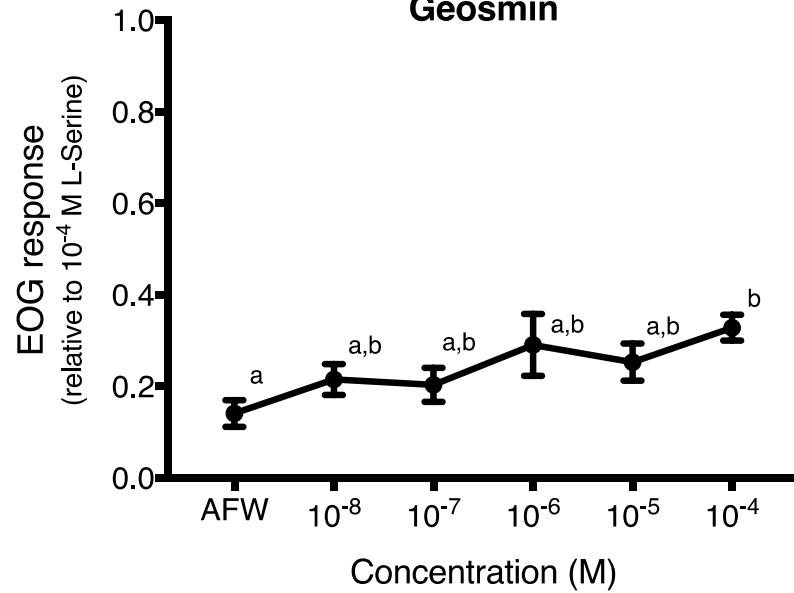
# Soil-associated odors



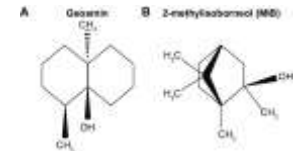
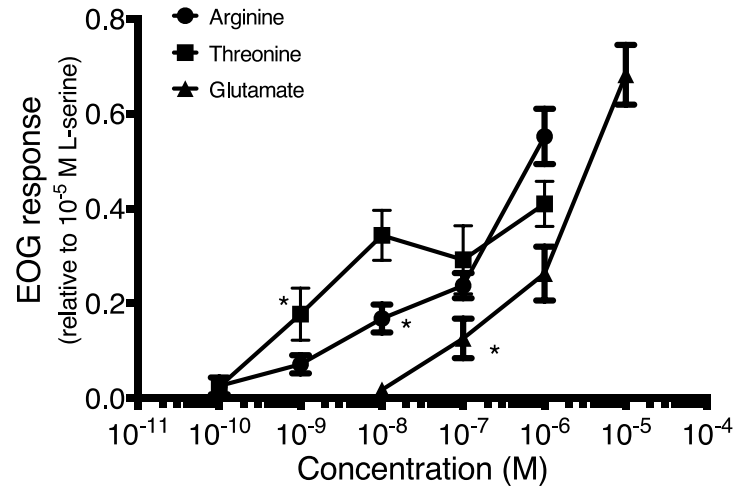
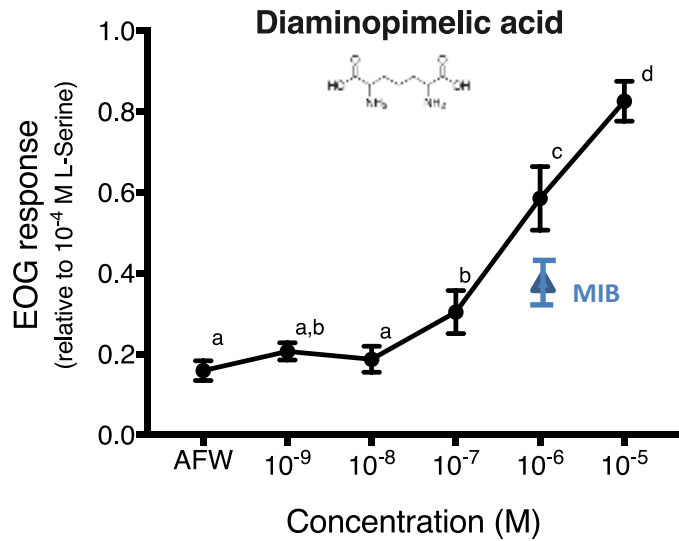
### Lignite



### Geosmin



# Biofilm/bacterial odors

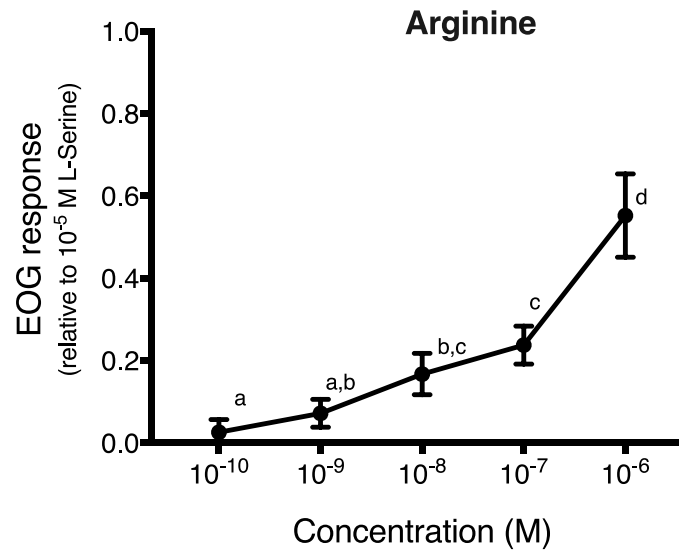
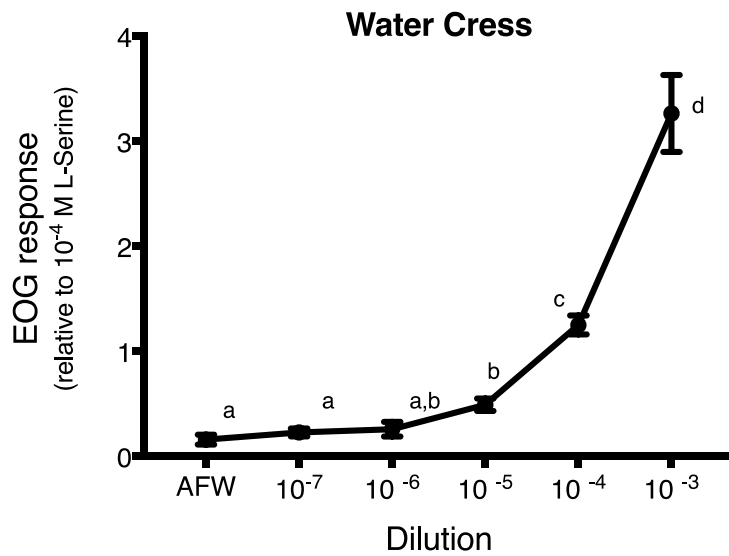




# Plant-associated odors



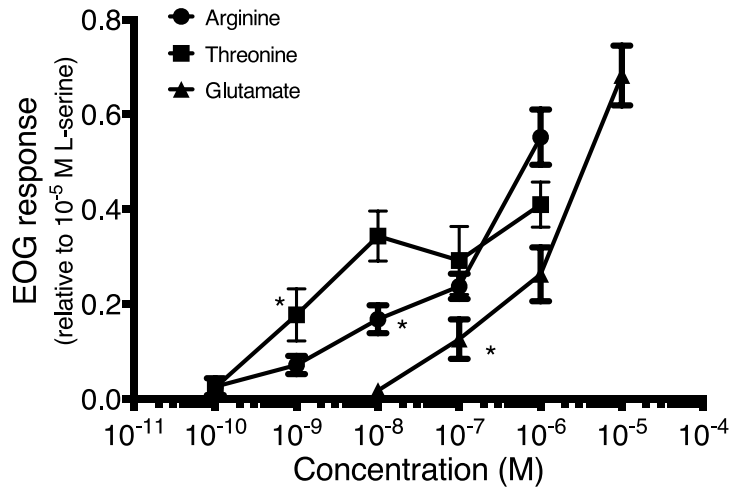
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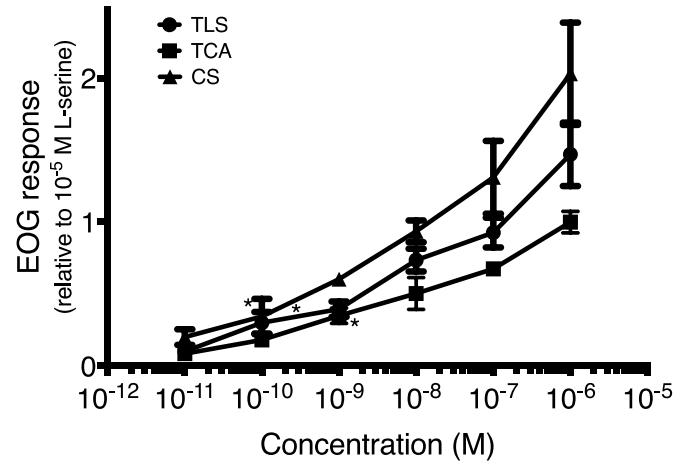
# Fish-associated odors



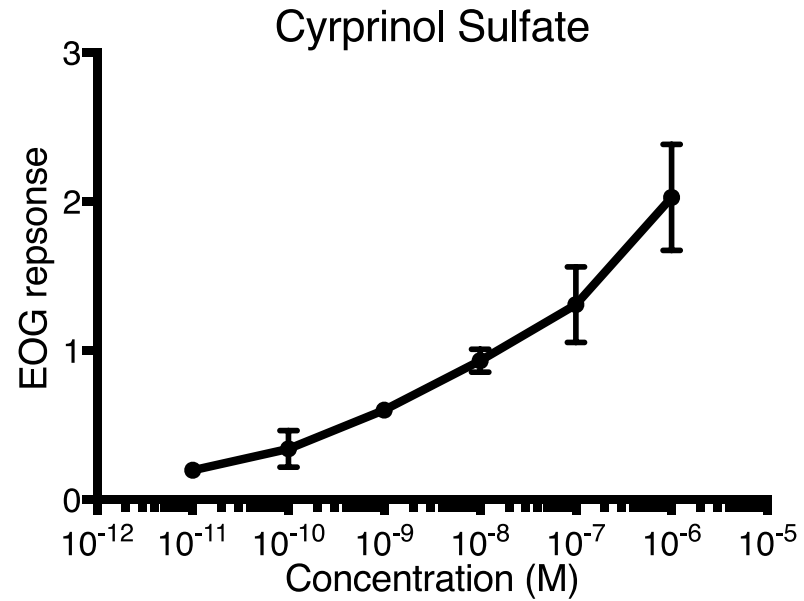
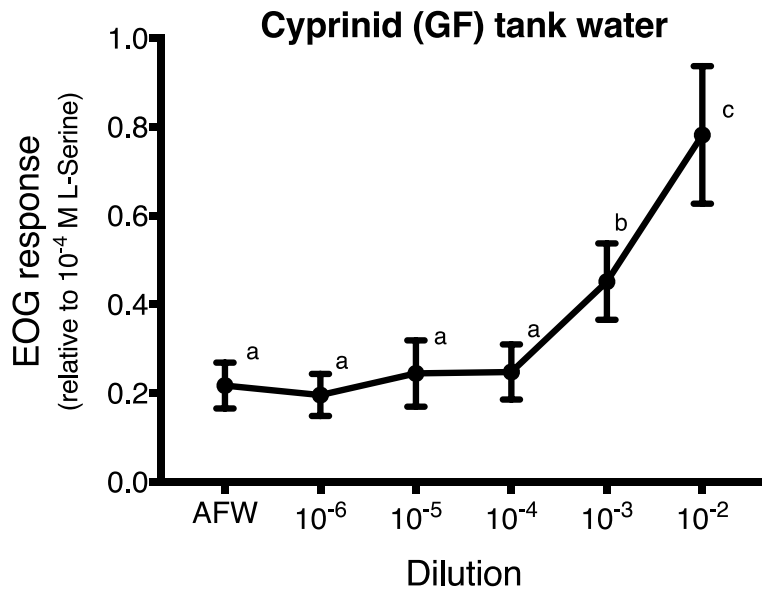
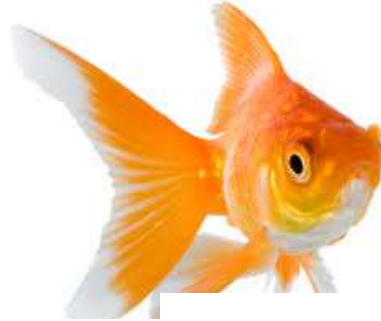
### Amino Acids



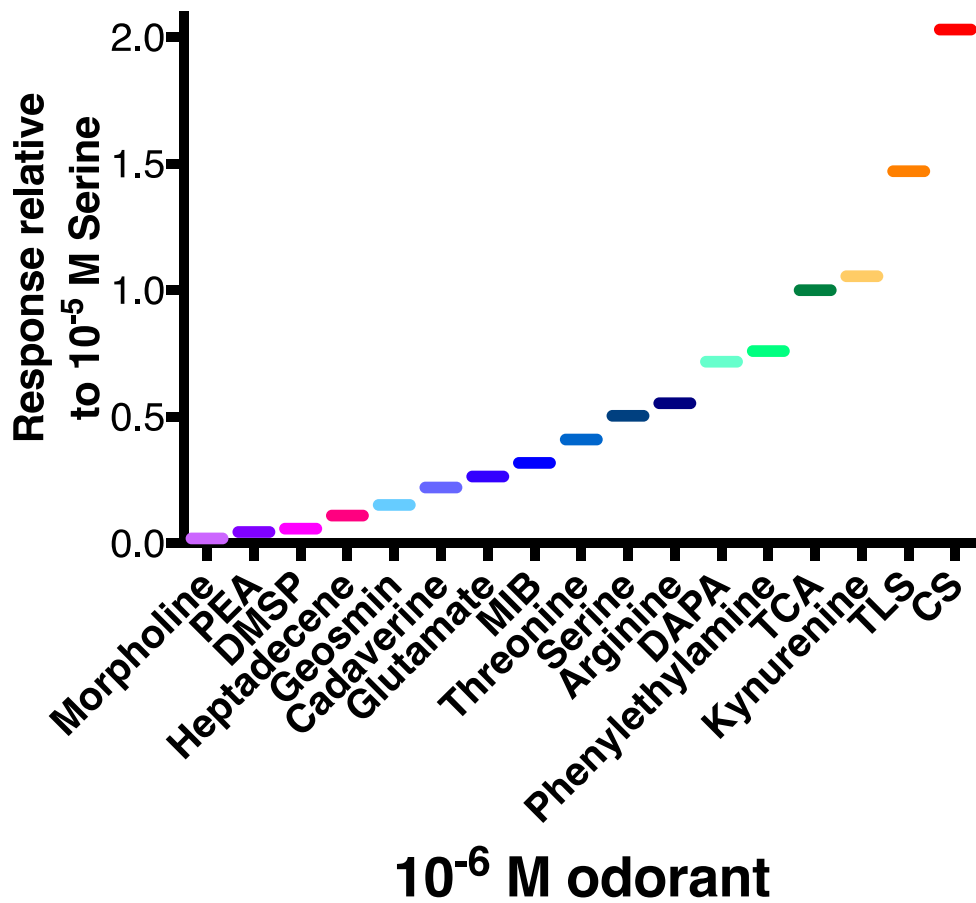
### Bile Acids



# Cyprinid-associated odors



# Relative olfactory potency



Odorant	Detectable? (EOG)	Innate response?	Learnable ? (Conditioning)	Imprintable? (Literature)	Cost effective?	Safety/ Permitting?
Phenylethyl Alcohol (PEA)	+	No response	??	Yes	0	?
Morpholine	+	No response		Yes	0	?
Geosmin	++	No response	??		-	-
Lignite	+++	No response			+	0
2-methyl isoborneal	++	No response	??		-	?
Dimethylsulfon-iopropionate (DMSP)	+	?	??		-	?
<b>Amino acids</b>	<b>++/++++</b>	<b>Avoid?</b>	<b>??</b>	<b>Yes</b>	<b>0</b>	<b>+</b>
Glutamate	++	Not tested			0	+
Threonine	++	Not tested			0	+
Serine	+++	Not tested			0	+
Arginine	+++	Not tested	??	Yes	0	+
Diaminopimelic acid	+++	Not tested			-	+
Kynurenine	++++	Not tested			-	?
<b>Bile acids</b>	<b>++++</b>	<b>Not tested</b>			<b>0</b>	<b>?</b>
Taurocholic acid (TCA)	++++	Avoid			0	?
Taurolithocholic acid 3-sulphate (TLS)	++++	Not tested			-	?
Cyprinol sulfate (C-S)	++++	Not tested			-	+
1-Heptadecene	++	No response			-	
<b>Amines</b>	<b>++/+++</b>	<b>Not tested</b>			<b>-</b>	
Phenylethylamine	+++	Not tested			-	-
Cadaverine	++	Not tested			-	-
Natural stream odors	++++	No response		Yes	+	+
Watercress	++++	Avoid			+	?
Cyprinid odors	+++	No response			+	?
Food extract (Control)	++++	Avoid/NR				
Alarm substance (Control)	++++	Avoid				
MilliQ water (Control)	0	No response				

# Next Steps

- Complete chemical analysis; modeling of virtual salmon**
- Finalize imprinting odor selection**
- Initiate hatchery-scale study 2020**

Thanks to ODFW for funding  
Staff at Oregon Hatchery Research Center and Elk River hatchery