

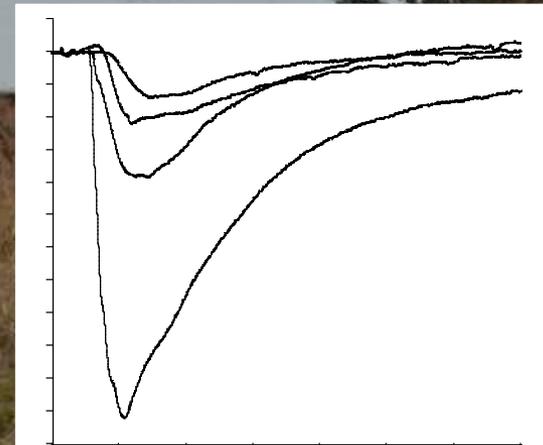
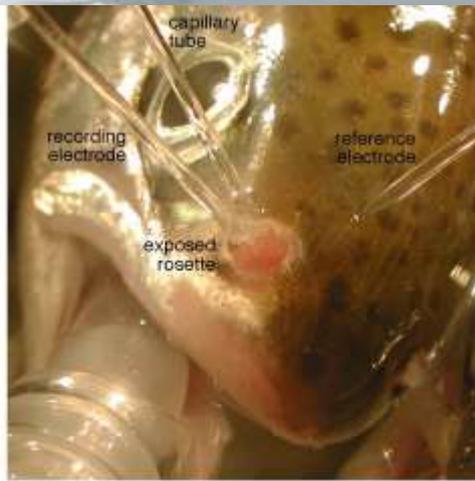
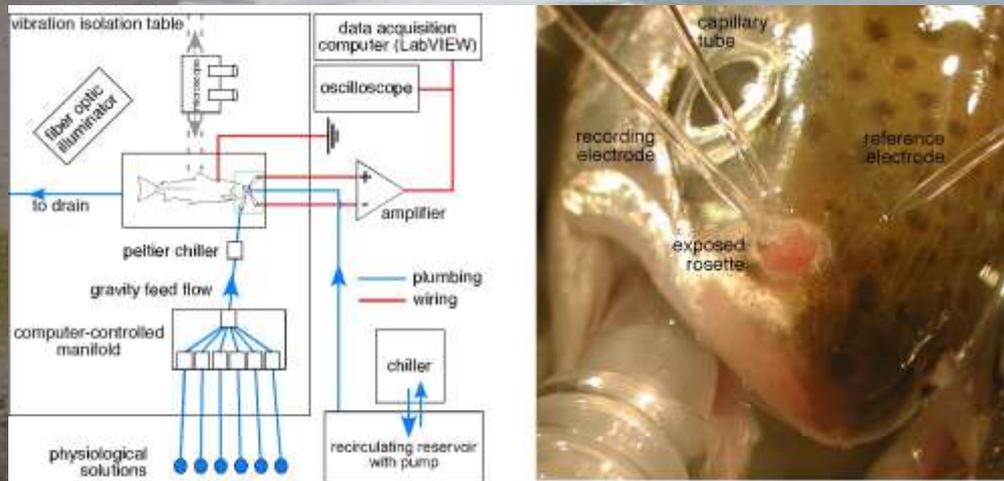
Identify odorants that produce sensory neural responses in Pacific salmon

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.

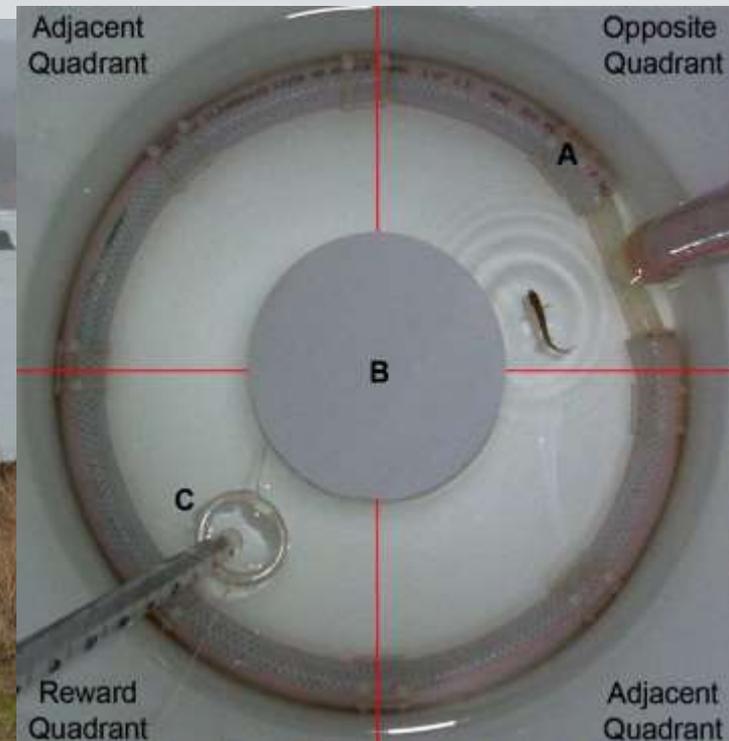


Identify candidate odorants that elicit learned response in juvenile salmon

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

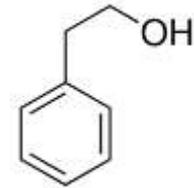
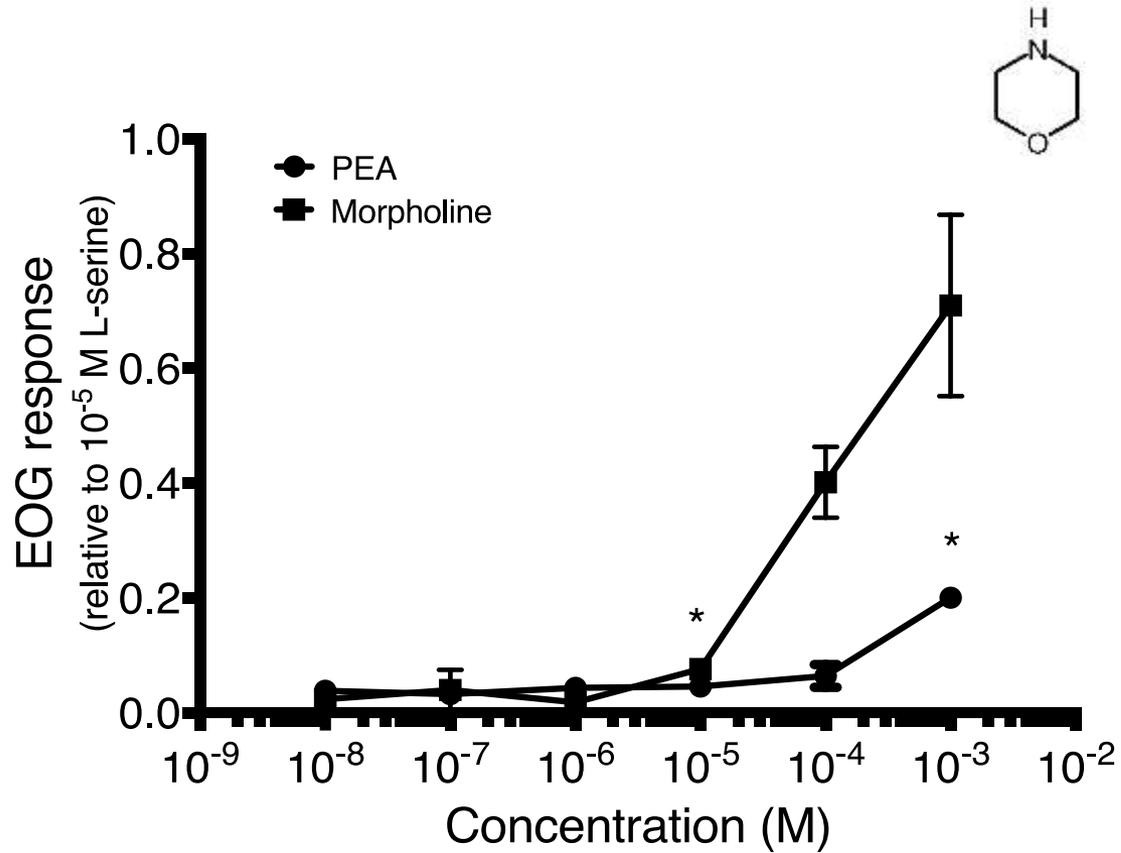


Phase 2: Odorant Selection and Imprinting Effectiveness

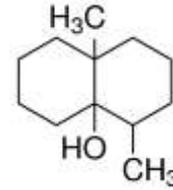
Identify and screen a variety of natural compounds released from aquatic plants and organisms and other known fish odorants for their potential use as artificial imprinting/homing cues and identify the most likely effective scent(s) to incorporate into Elk River Hatchery water.

- 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.**

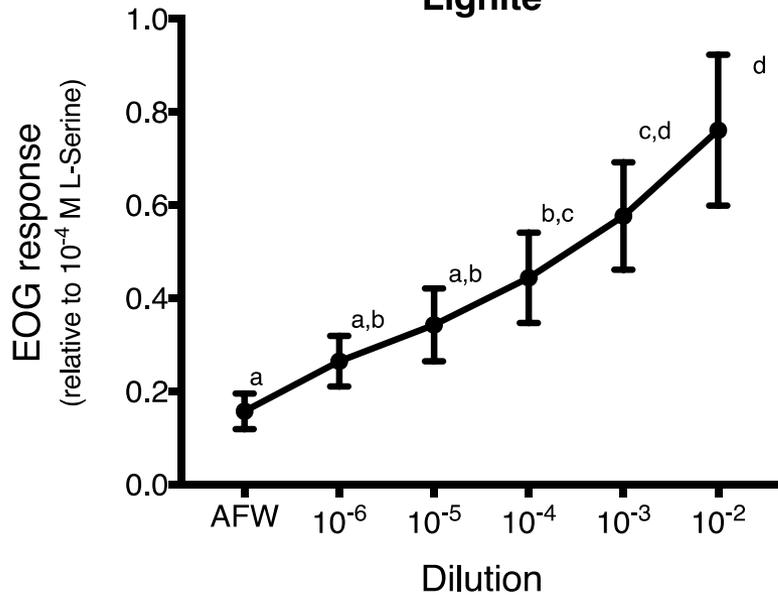
Artificial odors



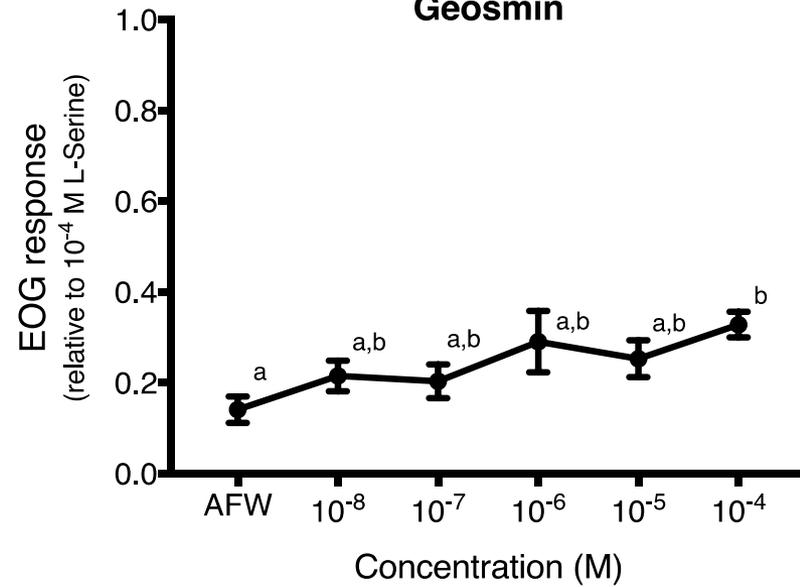
Soil-associated odors



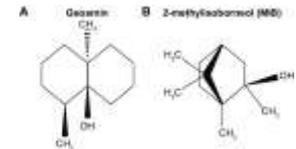
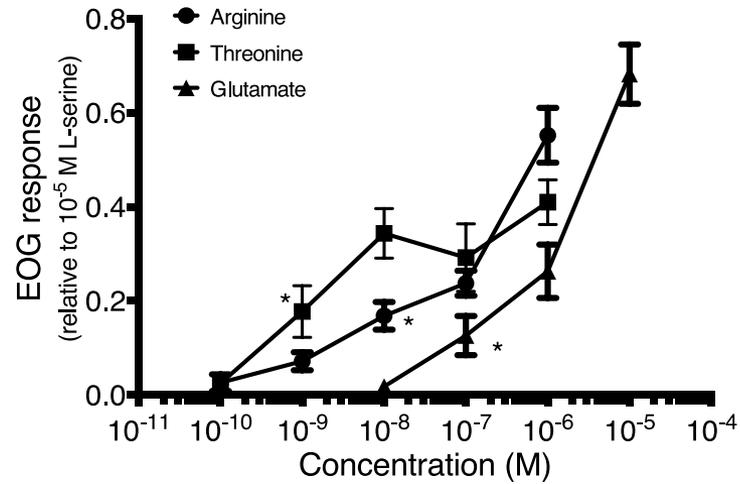
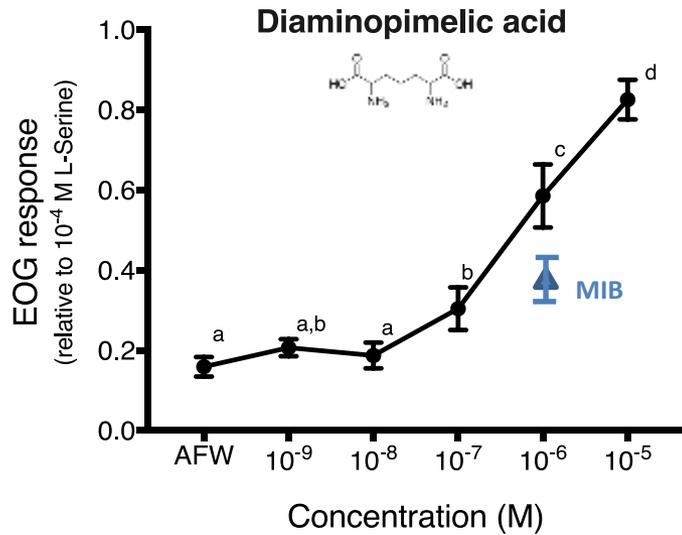
Lignite



Geosmin



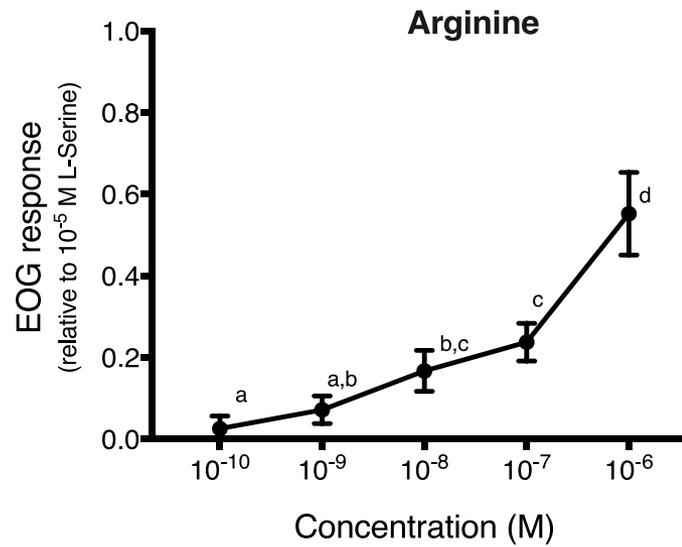
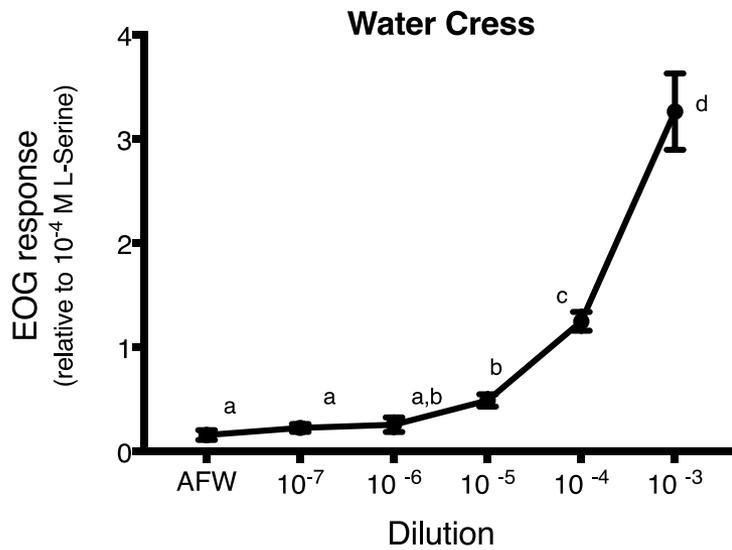
Biofilm/bacterial odors



Plant-associated odors



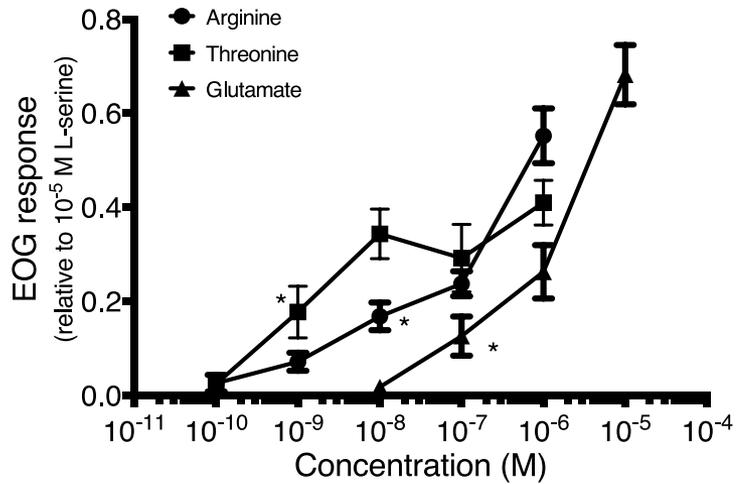
© CanStockPhoto.com - csp49610525



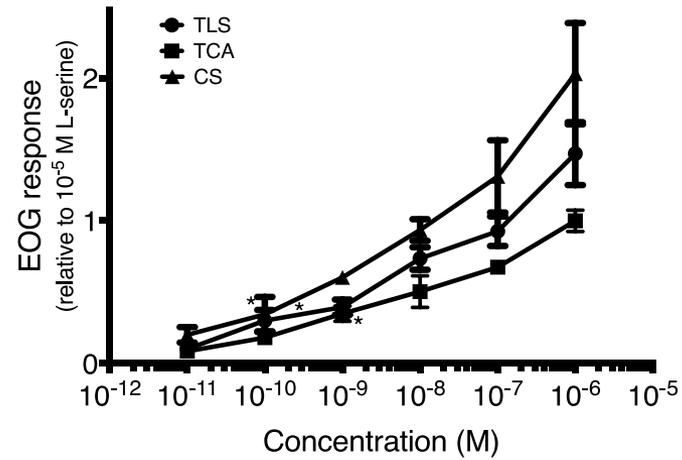
Fish-associated odors



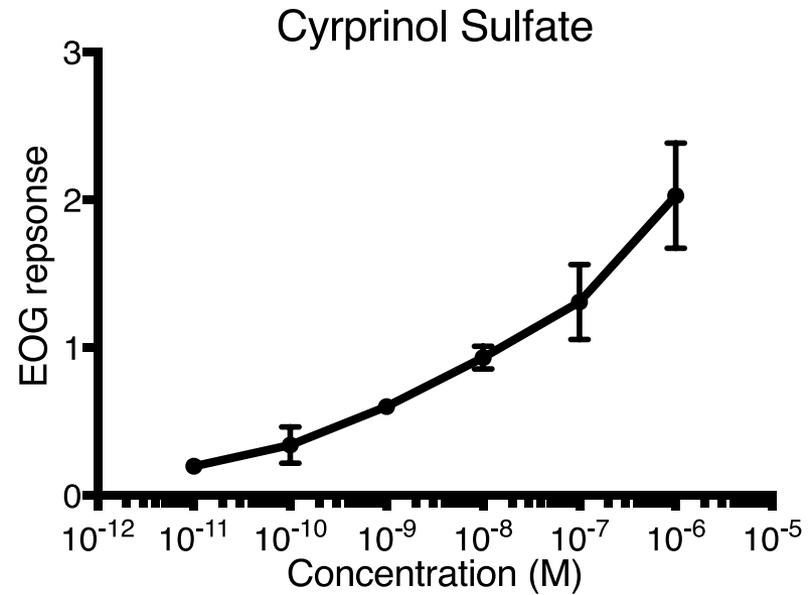
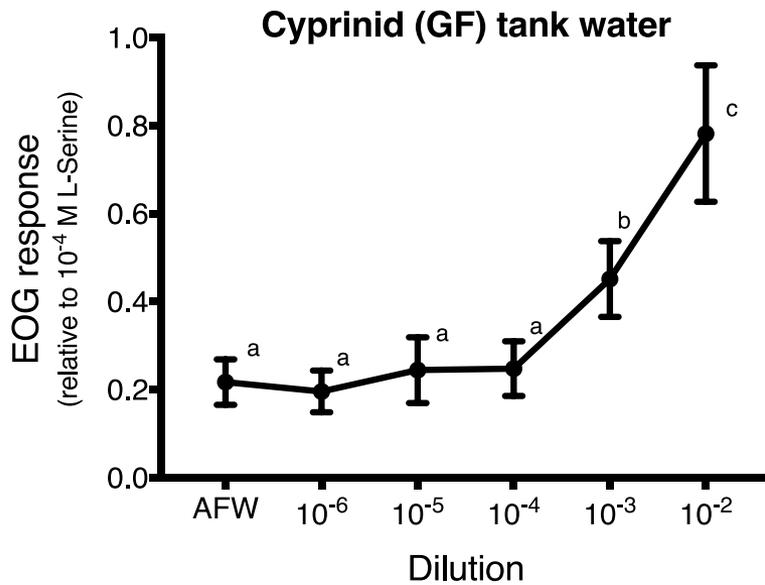
Amino Acids



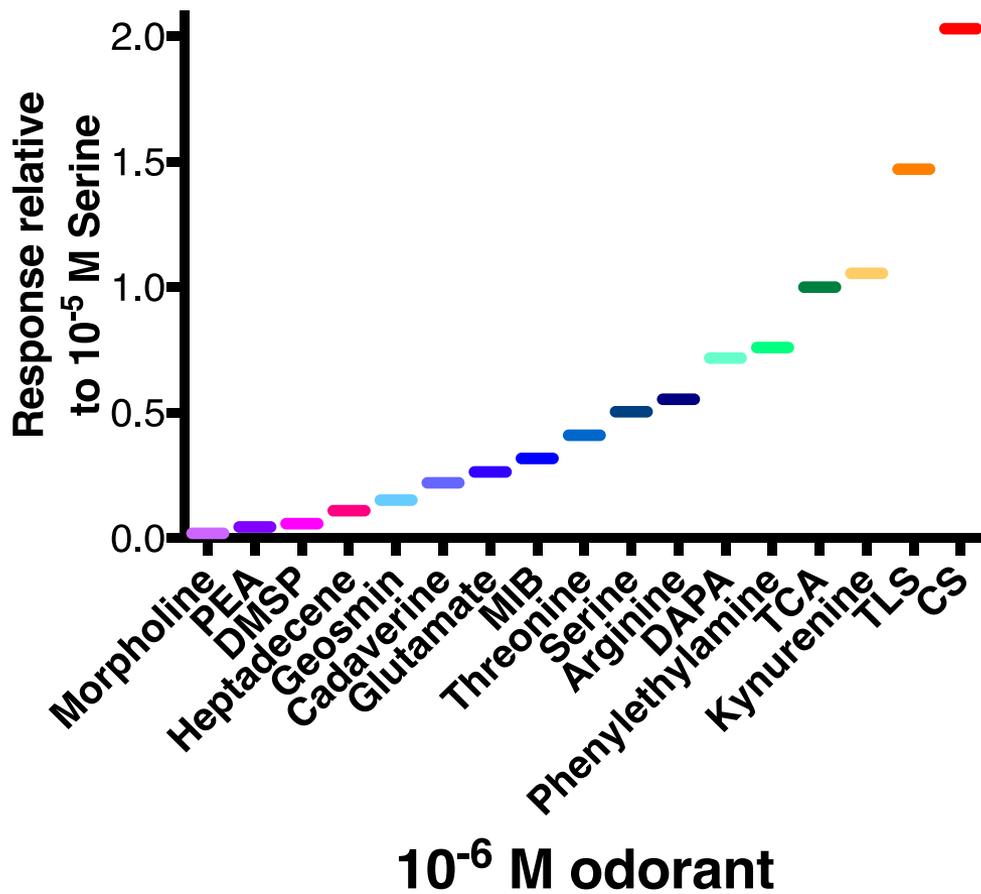
Bile Acids



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)	+	?	??		-	?
Amino acids	++/++++	Avoid?	??	Yes	0	+
Glutamate	++	Not tested			0	+
Threonine	++	Not tested			0	+
Serine	+++	Not tested			0	+
Arginine	+++	Not tested	??	Yes	0	+
Diaminopimelic acid	+++	Not tested			-	+
Kynurenine	++++	Not tested			-	?
Bile acids	++++	Not tested			0	?
Taurocholic acid (TCA)	++++	Avoid			0	?
Taurolithocholic acid 3-sulphate (TLS)	++++	Not tested			-	?
Cyprinol sulfate (C-S)	++++	Not tested			-	+
1-Heptadecene	++	No response			-	
Amines	++/+++	Not tested			-	
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