

Matt Hawkyard

Assistant Ext. Professor and Finfish Nutrition Specialist

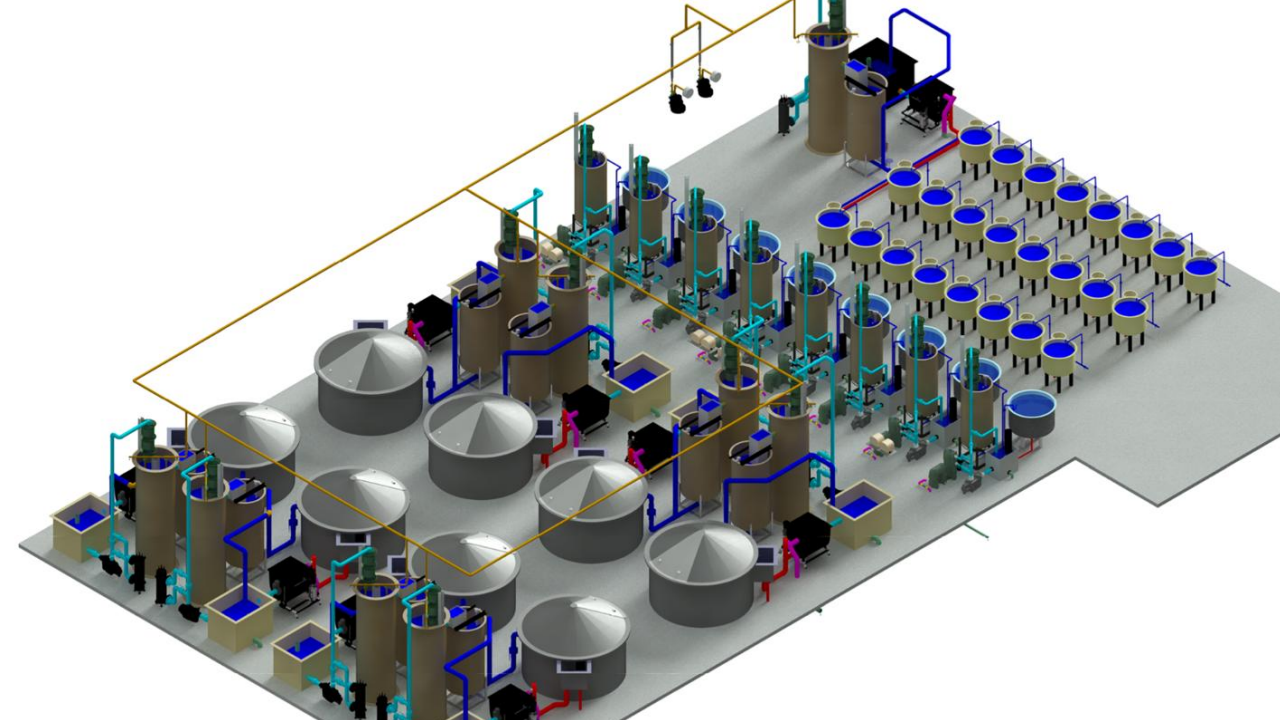
Research areas: Early life nutrition of finfish, feed technology, fish nutrition

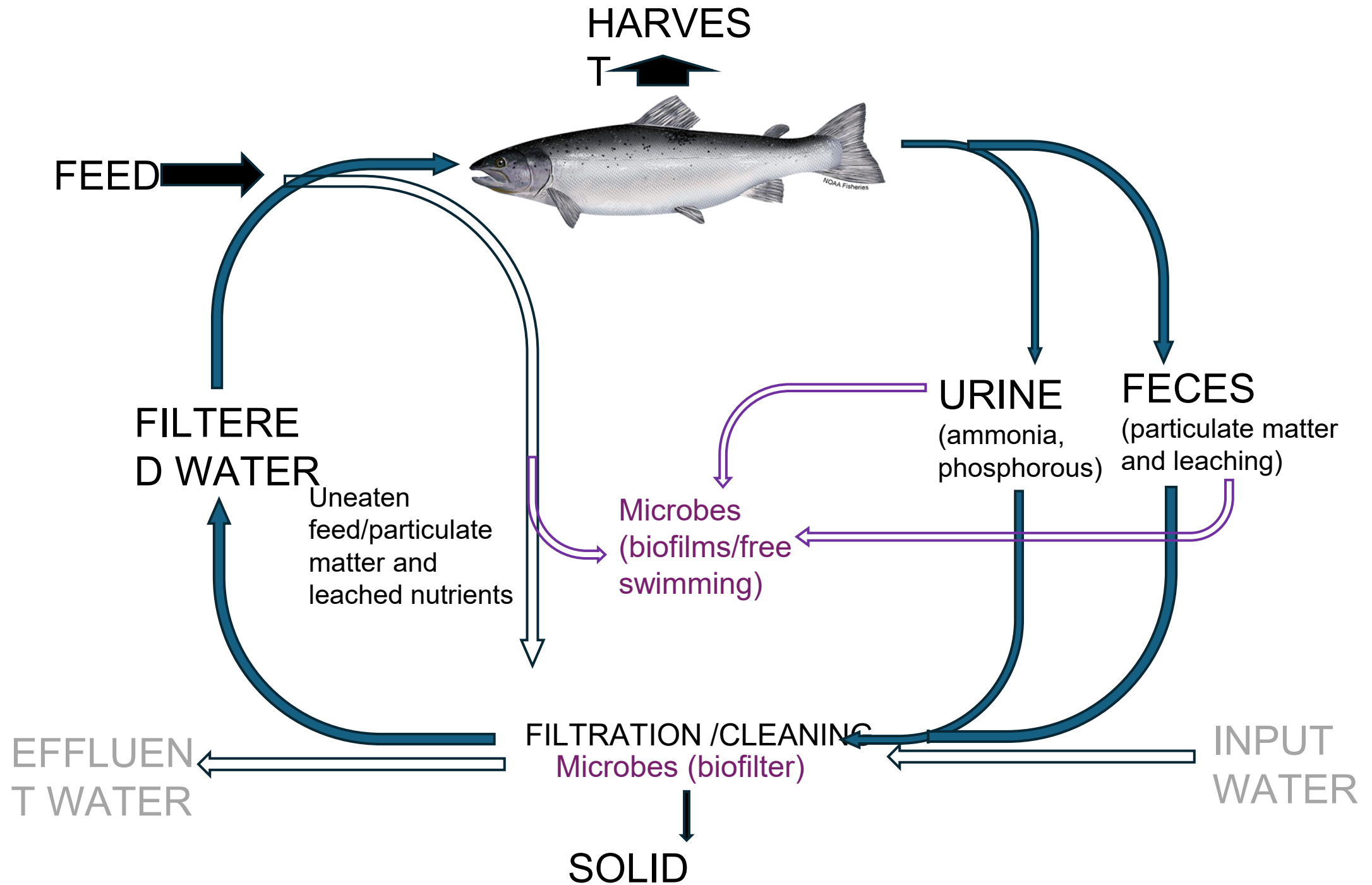
Projects: Preservation of fish oil; Optimizing feeding rates; New ingredient evaluation (algae, wood debris, insect meals) as alternatives to fish meal; Development of improved starter diets for marine fish larvae



ARI's fish nutrition and health team works in concert







↑ Digestibility

FEED



Fish health ↑

Using ingredients that are highly digestible will reduce fecal material and nutrient loading

↓ EFFLUENT WATER

FILTRATION / CLEANING
Microbes (biofilter)

SOLID

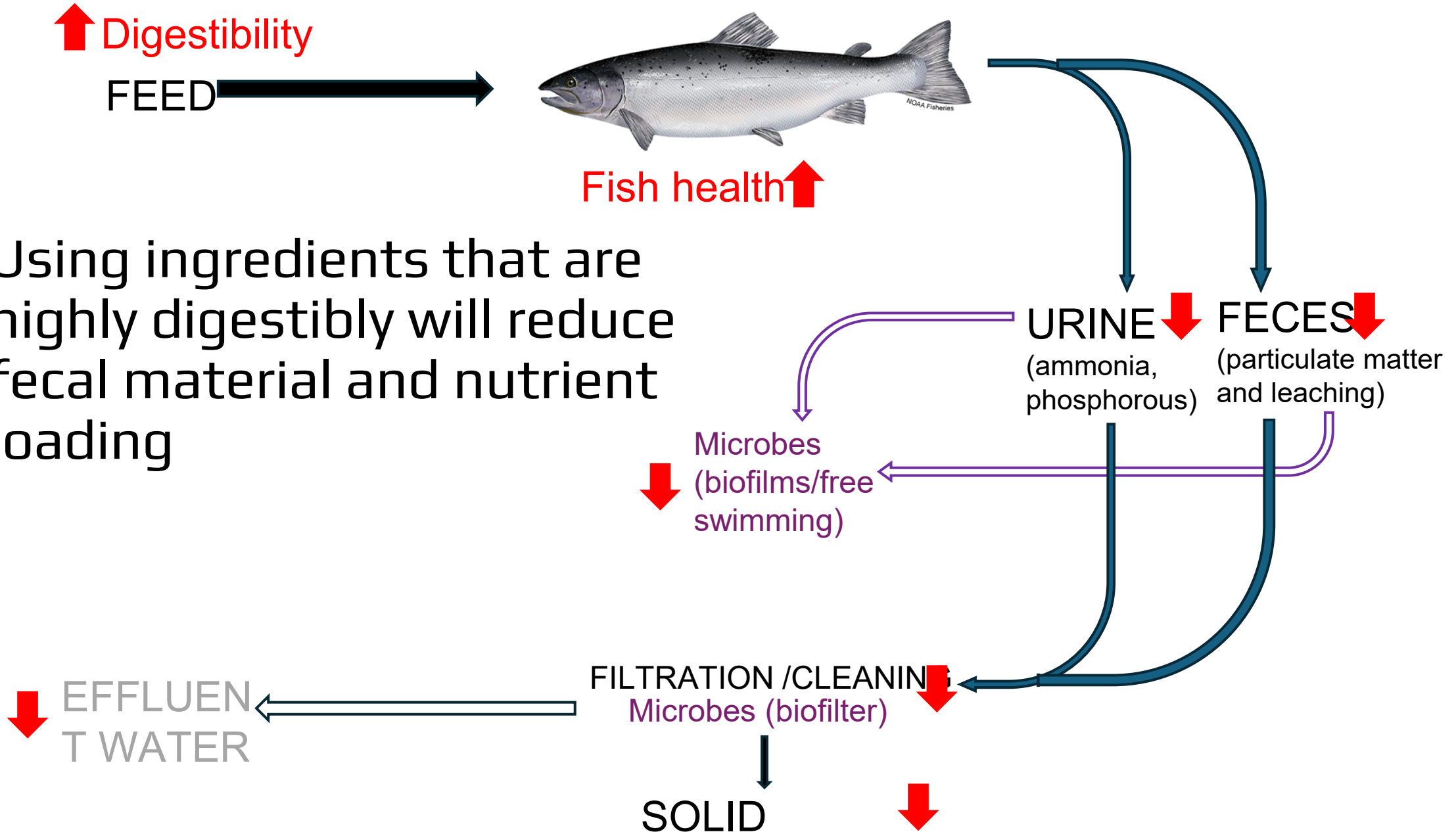
URINE

(ammonia, phosphorous)

FECES

(particulate matter and leaching)

Microbes
(biofilms/free swimming)



We are evaluating the digestibility of feed ingredients used in salmon feeds

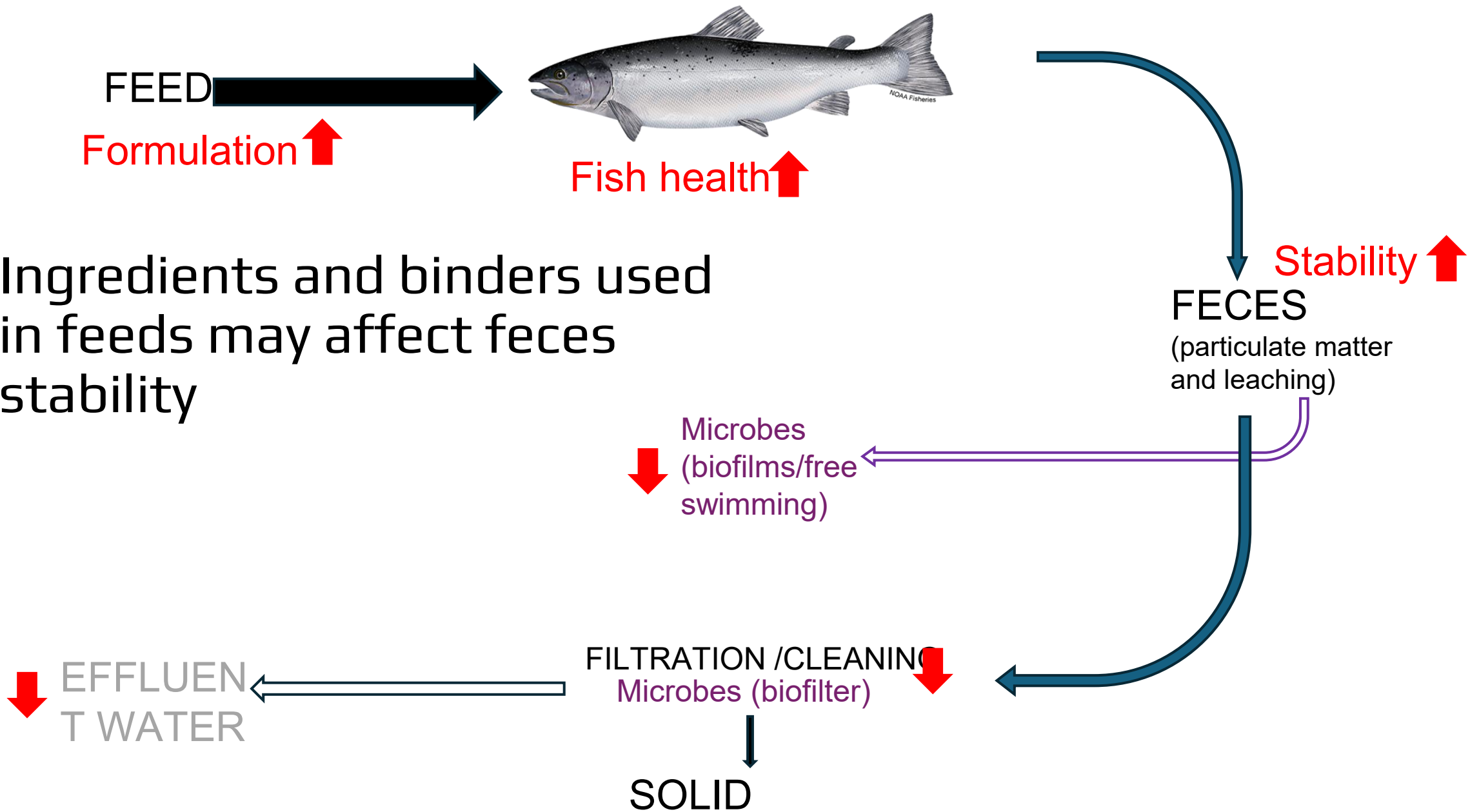


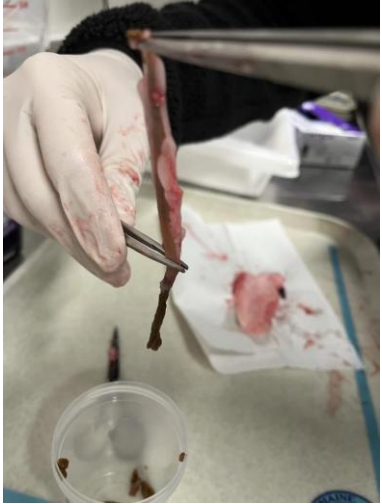
Nutrient density in feces are compared to those in the feeds (ADCN)



Selecting ingredients with high Apparent Digestibility Coefficients (ADCNs) will result in lower levels of solid waste

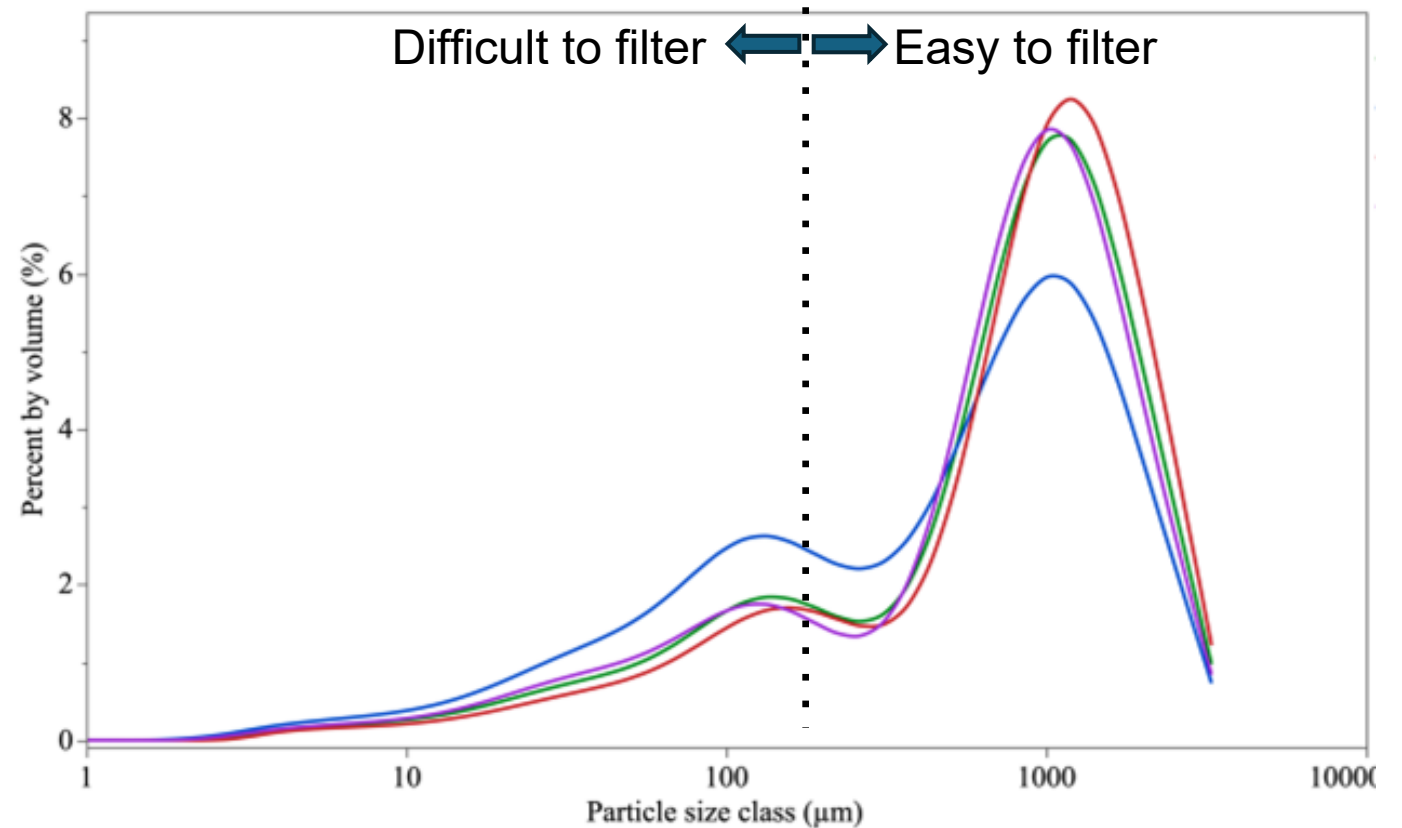
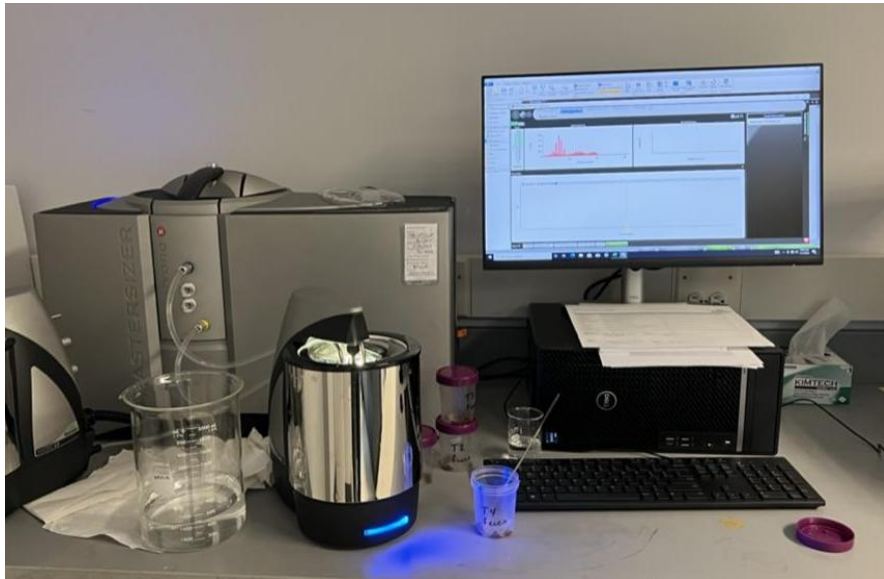
	Protein	Lipid	Dry Matter	Organic matter
UMaine/USDA study				
Defatted mealworm meal	90.3 ± 2.0	89.2 ± 22.0	91.3 ± 8.8	95.0 ± 6.5
Whole mealworm meal meal	90.4 ± 3.9	96.1 ± 3.1	87.2 ± 7.3	87.4 ± 6.4
Related studies with Atlantic salmon				
Algae	84.7 ¹	-	82.1 ¹	85.5 ¹
Barley protein conc.	96.3 ¹	-	81.1 ¹	80.0 ¹
BSF meal	89 ²	97 ²	87 ²	-
Corn gluten meal	94.2 ¹ , 95 ³	-	86.4 ¹	88.4 ¹
Corn protein conc.	85 ²	69 ²	75 ²	
Fish meal, anchovy	77 ³	-	-	-
Fish meal, herring	83-94 ³	-	-	-
Fish meal, menhaden	86 ³	-	-	-
Soy bean meal	97.3 ¹ , 96 ² , 88 ³	80 ²	69.6 ¹ , 71. ²	80.2 ¹



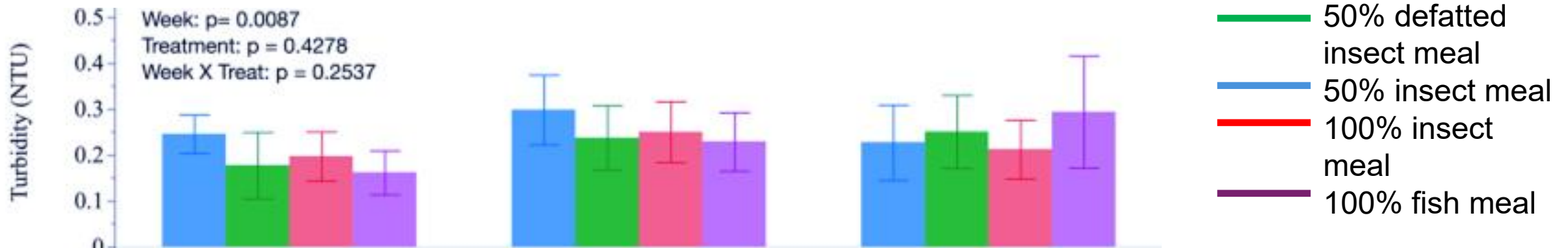


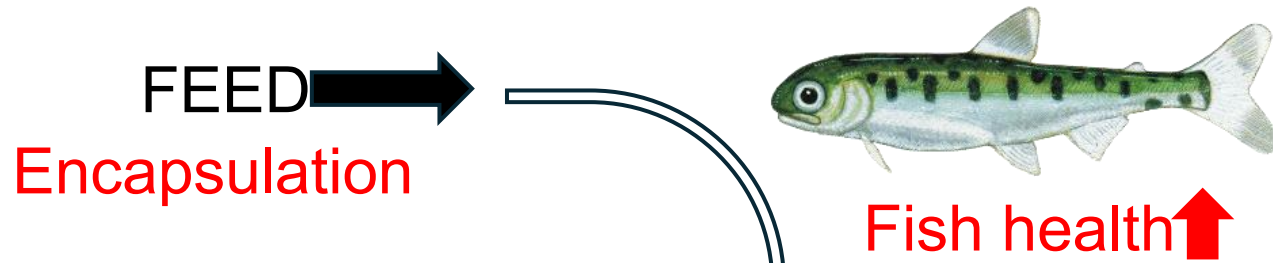
The feed ingredients used in feed can impact fecal stability

- 50% defatted insect meal
- 50% insect meal
- 100% defatted insect meal
- 100% fish meal



Direct measures of fecal stability should be paired with *in situ* measurements





Uneaten feed

Particulate matter and leached nutrients

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Microbes (biofilms/free swimming)

A red arrow points downwards from the text 'Microbes (biofilms/free swimming)'.

Increasing particle stability and nutrient retention will reduce nutrient loading and accumulation of particulate matter

FILTRATION /CLEANING

Microbes (biofilter)

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SOLID

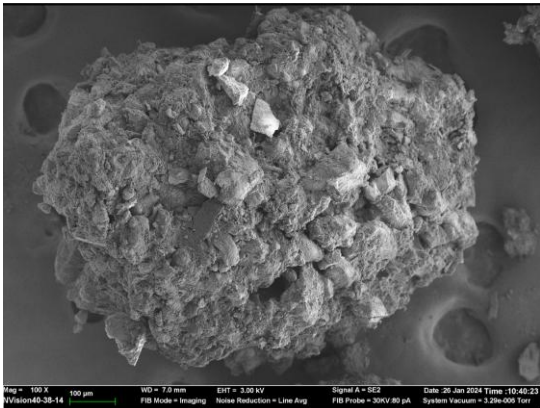
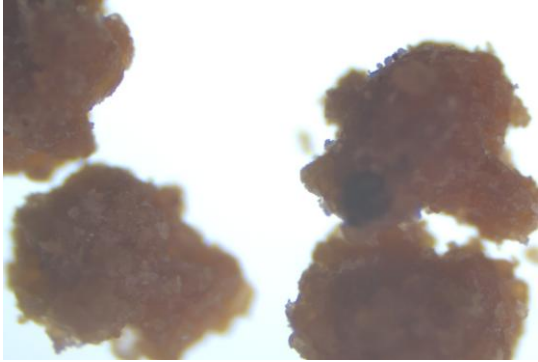
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We're investigating novel protein coatings that improve particle stability and reduce nutrient leaching

Top: Image captured with stereoscope

Bottom: Image captured with scanning electron microscope

Uncoated microparticles



Protein coated microparticles

