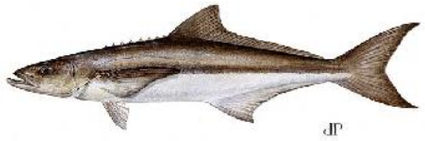


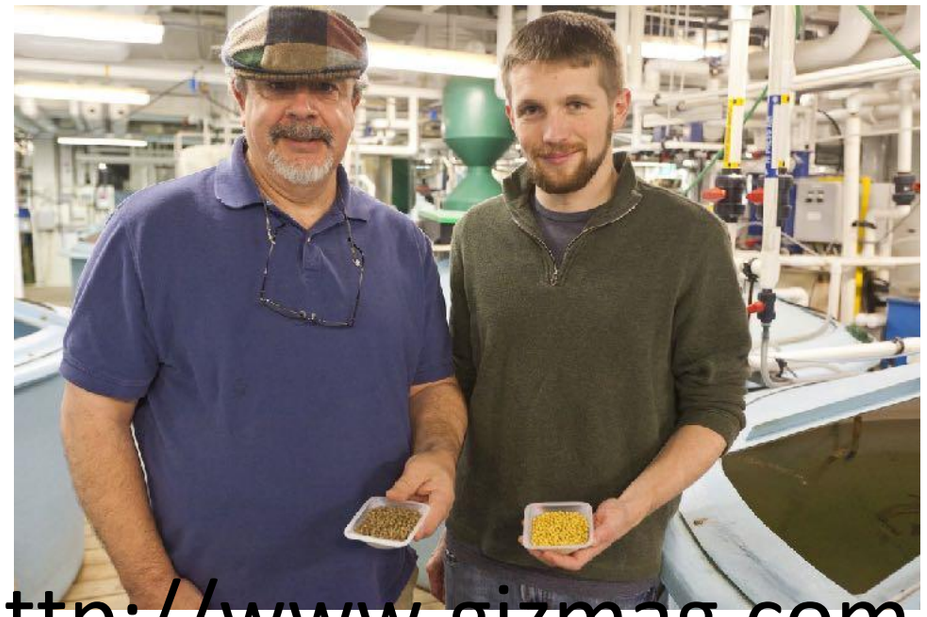
Fillet Contaminants
PCB 5X Lower
Mercury 4X Lower
FCR 1.46

Sustainability: Challenges

1. Complete independence from natural stocks through **DOMESTICATION**
2. Improved / more cost-effective **SEED PRODUCTION**
3. Better targeted **SPECIES SELECTION**
4. Development of more efficient stocks through **SELECTIVE BREEDING**
5. More **MICROBIAL MANAGEMENT** for more sustainable production
6. Better understanding of **IMMUNE SYSTEMS** in vertebrates and invertebrates
7. More **INTEGRATED PRODUCTION SYSTEMS** for plant and animal farming
8. **COASTAL AND OFF-SHORE FARMS** of food and energy
9. Full independence from fisheries stocks for **LIPID AND PROTEIN INGREDIENTS** in aquatic feeds
10. More attention for **INTEGRATION** of restocking activities with **FISHERIES** management
11. **SOCIETAL LEVERAGE:**
    1. multi-stakeholder interaction
    2. International cooperation on a win-win basis

Aquaculture, The Blue Biotechnology of the Future
Patrick Sorgeloos
World Aquaculture, 2013

Turning Carnivorous Fish into Vegetarians



http://www.gizmag.com/fishless-fish-

Why Salmon Eating Insects Instead of Fish Is Better for Environment

Companies in Europe have developed new kinds of feed for salmon farms that could help the environment—if they can scale up quickly.

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Potential of insect-based diets for Atlantic salmon (*Salmo salar*)

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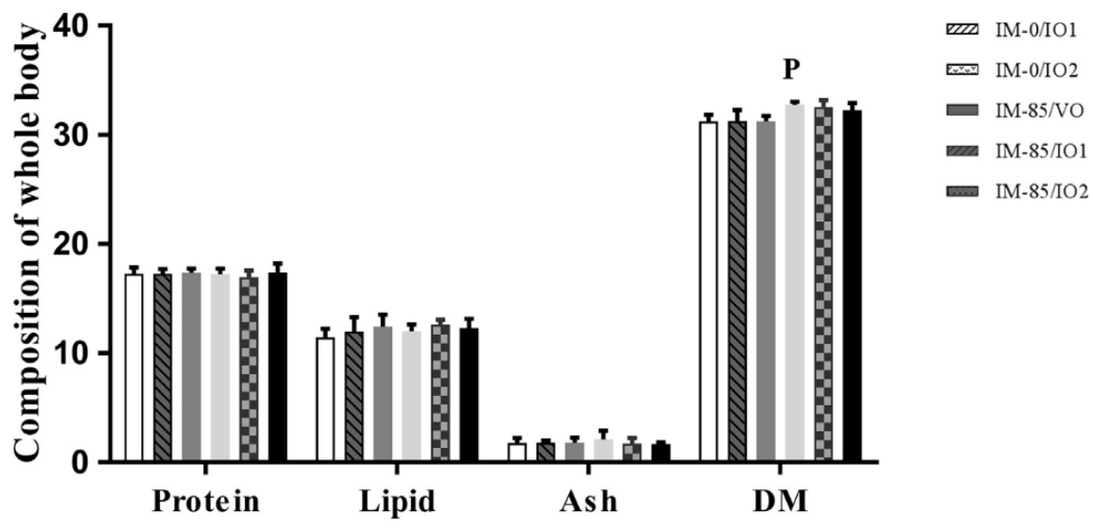


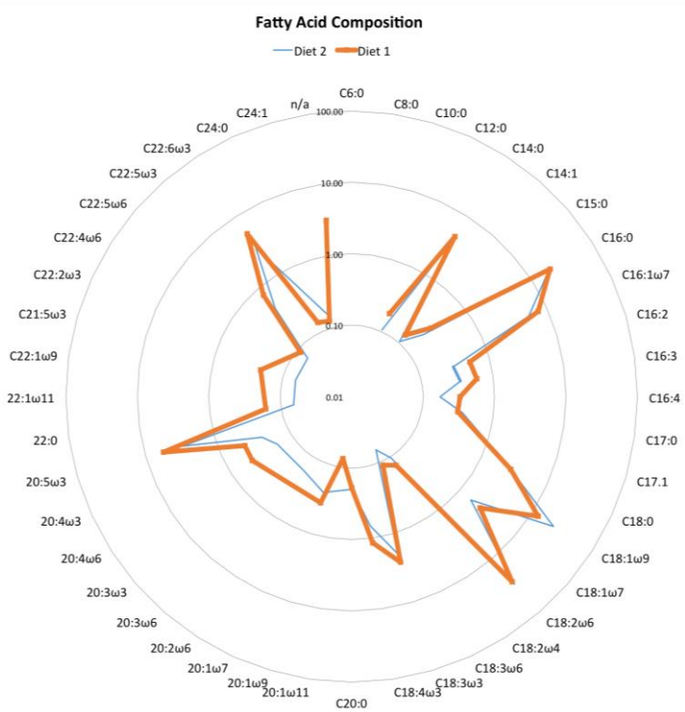
Fig. 2. Composition of whole body (% of wet weight) of freshwater Atlantic salmon fed a control diet (IM-0/VO) or diets containing IM and/or IO1 or IO2 for a period of 8 weeks. Values are means, with their standard deviation represented by vertical bars. P, significant effect of dietary protein source. O, significant effect of dietary lipid source. P × O, interaction between the main effects of the two factors ($P < 0.05$, two-way ANOVA). DM; P ≤0.01, O = 0.75, P × O = 0.75.

Atlantic Salmon Diet

Insect Digestibility
Protein 89 ± 3.84
Lipids 92 ± 3.84

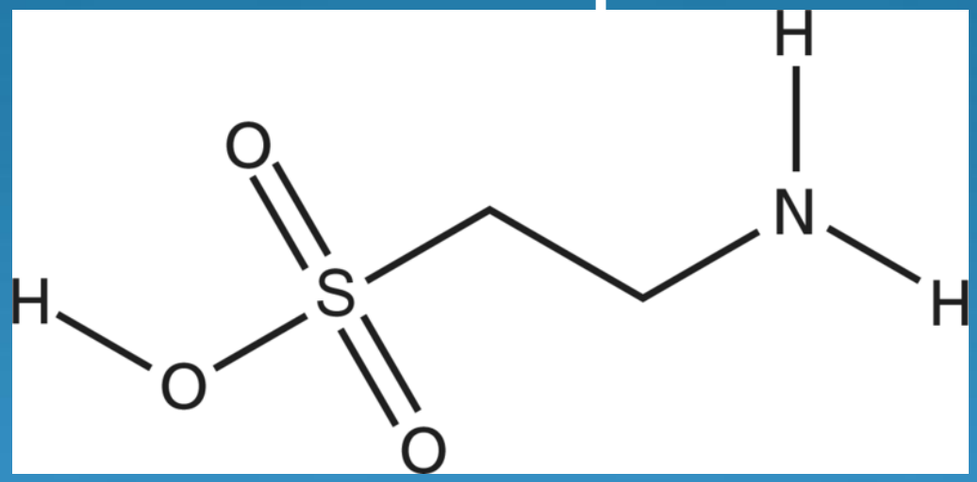
Diet 2

Moisture	3.85 %
Protein (crude)	46.07 %
Fat (crude)	15.71 %
Fiber (crude)	2.69 %
Ash	8.30 %



Code		Description	Actual	Percent
5592700		Profine VF	575.0000	28.7500
9008600	0	AP INSECT MEAL-C0	466.6000	23.3300
5522000		CN GLUTEN 60%	306.8000	15.3400
4463000		WHEAT FLOUR BAGGED	300.8000	15.0400
3422100		MENH GOLD OIL TOPDRESS	119.2000	5.9600
6610400		MONOCALCIUM PHOSPHATE FG	79.0000	3.9500
3430000		LECITHIN FG	60.0000	3.0000
8302000		TAURINE 98.5% FG	30.0000	1.5000
8877000		L LYSINE 98.5%	15.0000	0.7500
7758000		CHOLINE CL-70%	12.0000	0.6000
6626000		POTASSIUM CHLORIDE (DYNA K) FG	11.2000	0.5600
8880000		DL METHIONINE 99	9.0000	0.4500
6636000		SALT	5.6000	0.2800
7769200		TIGER C-35	4.0000	0.2000
9076620		PREMIX AQUA-VIT	2.4000	0.1200
9098000		PREMIX AQUA-MIN FISH	2.4000	0.1200
6641000		MAGNESIUM OXIDE FG	1.0000	0.0500

Taurine
The missing ingredient for development of fish free diets for aquaculture?



Supplement Facts		
Serving Size 8.0 fl.oz. (240 ml)		
Serving Per Container 3		
Calories	100	
Total Carb	27g	9%
Sugars	27g	
Vitamin B2	1.7mg	100%
Vitamin B3	20mg	100%
Vitamin B6	2mg	100%
Vitamin B12	6mcg	100%
Sodium	180mg	8%
Taurine	1000mg	
Panax Ginseng	200mg	
Energy Blend 2500mg		
L-Carnitine, Glucose, Caffeine, Guarana Inositol, Glucuronolactone, Maltodetrin		
Percent Daily Values are based on a 2000 calorie diet.		

Aaron Watson, Ph.D. Rick Barrows, Allen R. Place

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Atlantic salmon (*Salmo salar*) require increased dietary levels of B-vitamins when fed diets with high inclusion of plant based ingredients

Gro-Ingunn Hemre[1], Erik-Jan Lock[1], Pål Asgeir Olsvik[1], Kristin Hamre[1], Marit Espe[1], Bente Elisabeth Torstensen[1], Joana Silva[2], Ann-Cecilie Hansen[1], Rune Waagbø[1], Johan S. Johansen[3], Monica Sanden[1] and Nini H. Sissener[1]

[1] National Institute of Nutrition and Seafood Research (NIFES), Bergen, Norway
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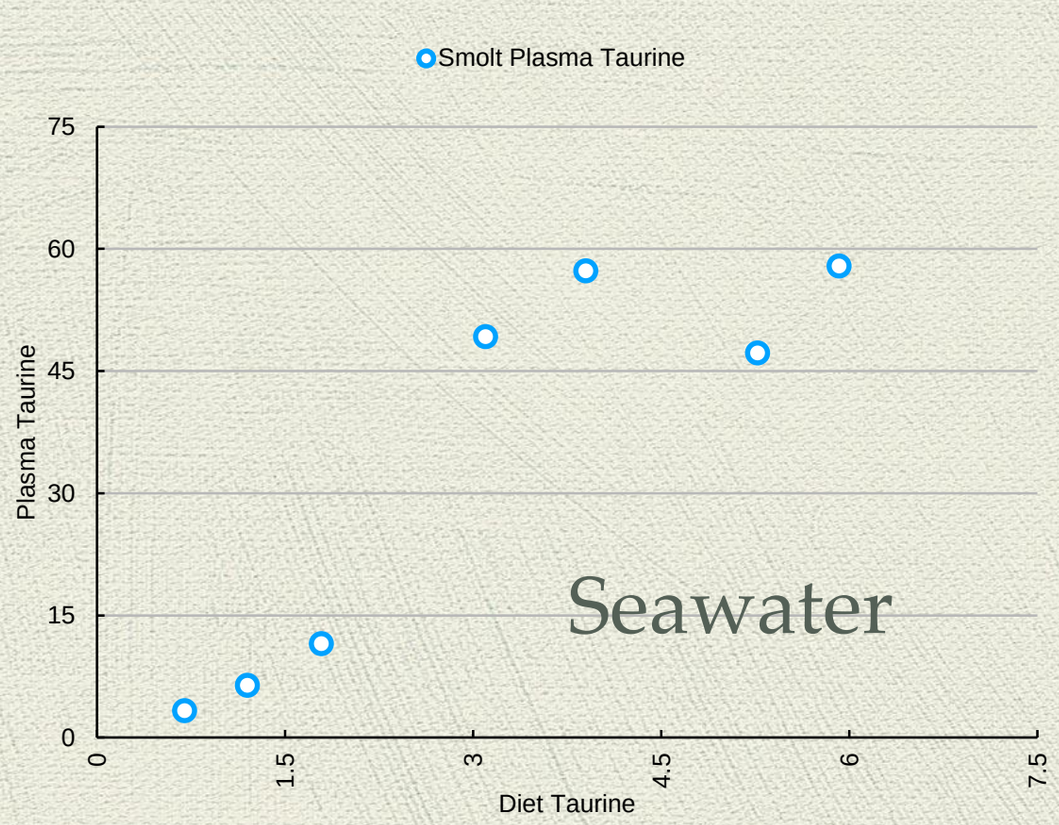

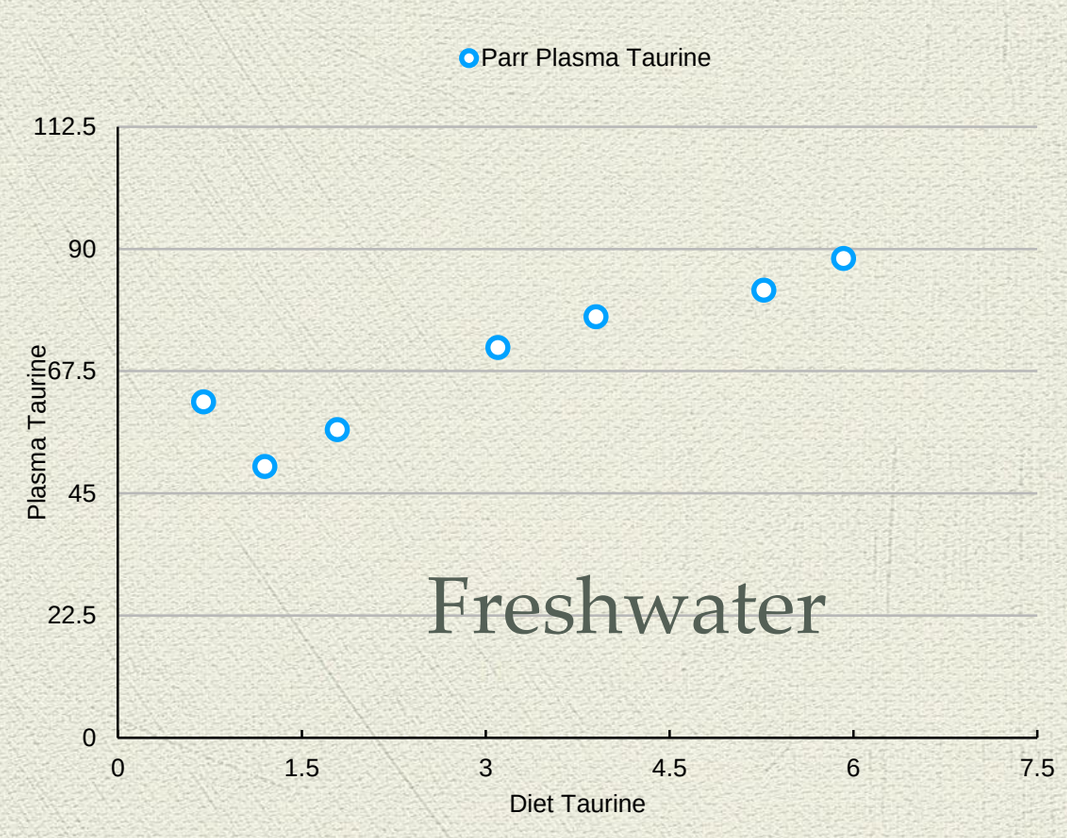

Take Home Lessons

- Aquaculture has the potential to feed the world
  - Must be done in environmentally and economical sustainable manner
  - Harmful Algal Blooms could prevent aquaculture from reaching its true potential

Limiting Resource

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