Pollution Prevention & Native Fish Keepers, Inc.

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Land Acknowledgement

- We acknowledge that we are on the traditional territories of the Apsáalooke (Crow), Niimîipuu (Nez Perce), Očhéthi Šakówiŋ (Lakota), Piikáni (Blackfeet), Séliš (Salish), Shoshone-Bannock, and Tsétsêhéstâhese (Northern Cheyenne) Nations.
- We would also like to acknowledge and give thanks to the Bitterroot Salish, Pend d'Oreille, and Kootenai Peoples who are the original and continuing stewards of these lands.

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About Me

- From northern Minnesota
- Pursuing a B.S. in Environmental Studies, emphasis in Environmental Health and Toxicology at Bemidji State University
- Passion for the outdoors, STEM, community involvement

About Native Fish Keepers, Inc.

- Nonprofit created and operated by Confederated Salish and Kootenai Tribes
- Established in 2017 for invasive lake trout suppression
- Process over 20,000 lbs of fish annually
  - Sold locally and donations to local food banks

Flow Diagram of Fillet Production

Pull nets

Pick fish

Count fish

Prep for fillet

Heads, Unfit fish

Fillet

Innards, bones

Remove pinbones

Bones, Fillet

Package

Vacuum pack

Flash freeze

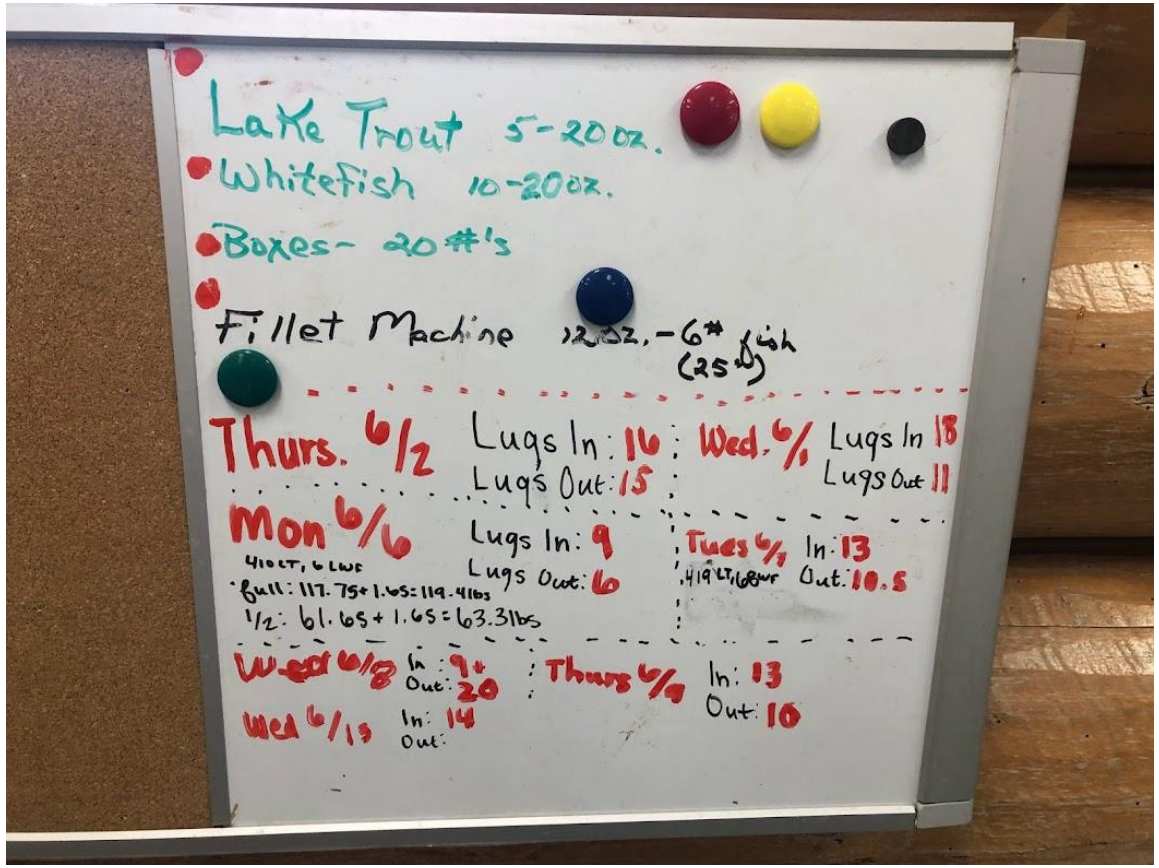
Fill lugs

Load boat

Remove waste

The Issue?

- The amount of waste going out
  - Much more serious of an issue than previously thought
  - Average: ***1,400 pounds/day***
- Over 2/3 of harvested biomass often ends up as waste
- Environmental impacts of shuttling waste across the bay 4x per week
  - ~272 gallons of fuel per season = 2.4 metric tons of CO_2 emissions



Approach

Extruded human snack

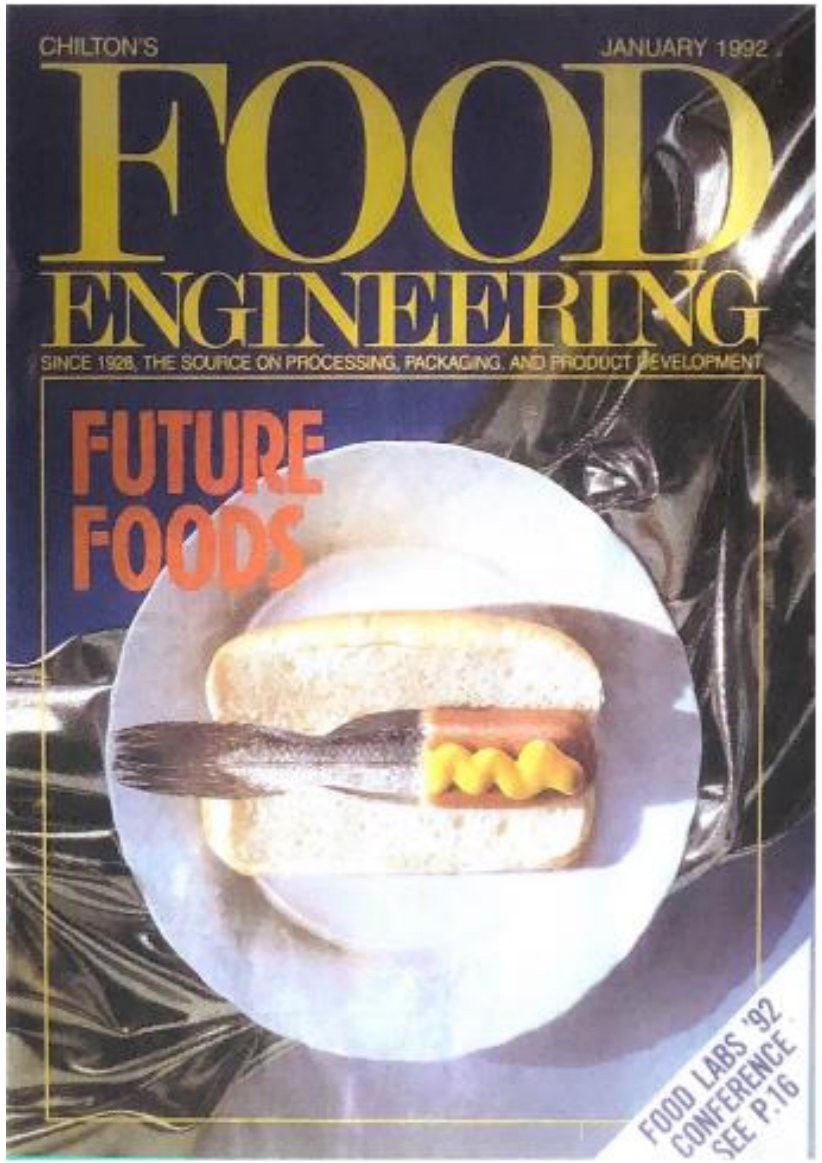
Extruded fish food

Biofertilizer

- Take notes of fishery background and daily data
- Average amount of outgoing waste
- Research existing fishery/aquaculture waste solutions
- Identify possible solutions for Native Fish Keepers, Inc.

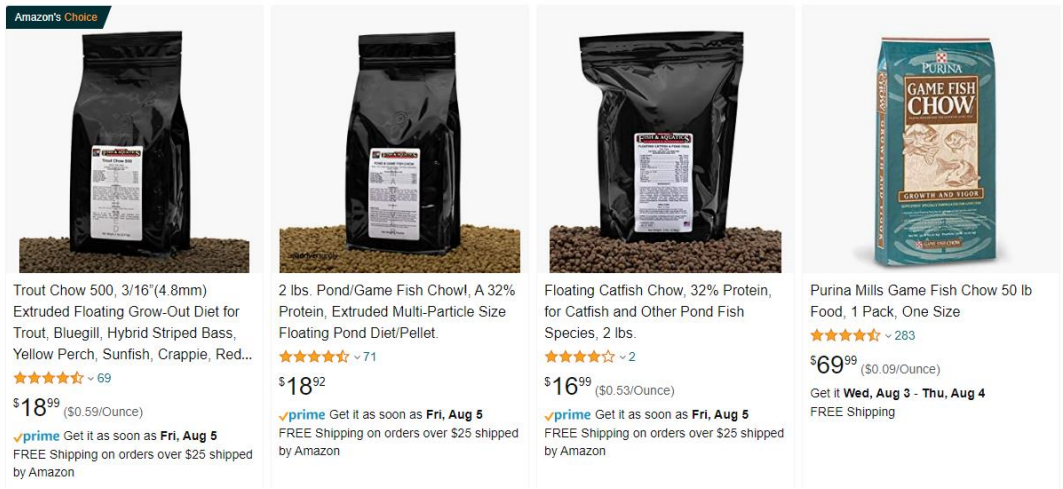
Extruded Human Snack

- Food grade waste composes small fraction of waste
  - Most would still be dumped
- Not many feasible options
- Cultural/dietary differences with possible options
  - No local market



Extruded Fish Food

- Uses all fish waste produced
- Time- and energy-intensive relative to amount of waste
- Industry desires to move away from ocean-based products
  - Plant-based fish feed
- Fish meal = <$1/pound
- Expensive start-up for production and no local plants to ship to



Machine	Price
Grinder	4,500
Processor	1,000
Freeze Dryer	20,000+
Extruder	Unknown
Total =	**$25,500+**

Flow Chart of Fish Food Extrusion Process

Fish waste

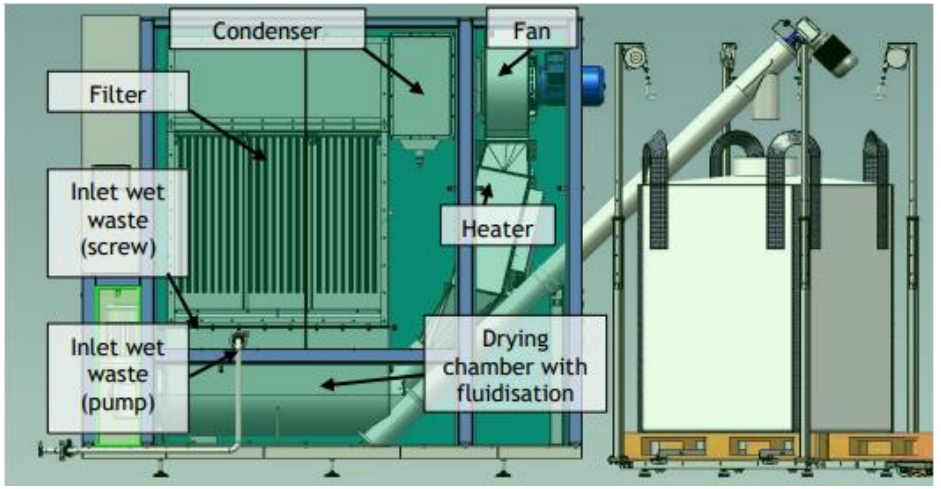
Grinder → Freezer → Freeze Dryer → Processor → Mixer → Extruder → Dryer

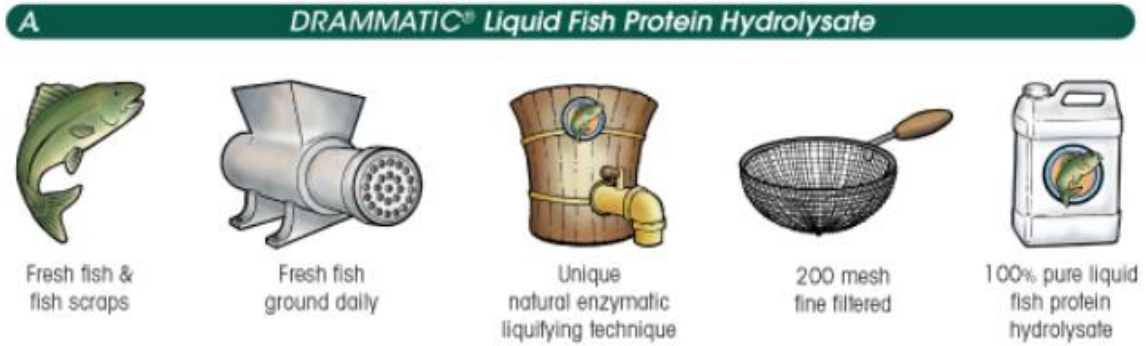
Optional

Oil Coating

Biofertilizer

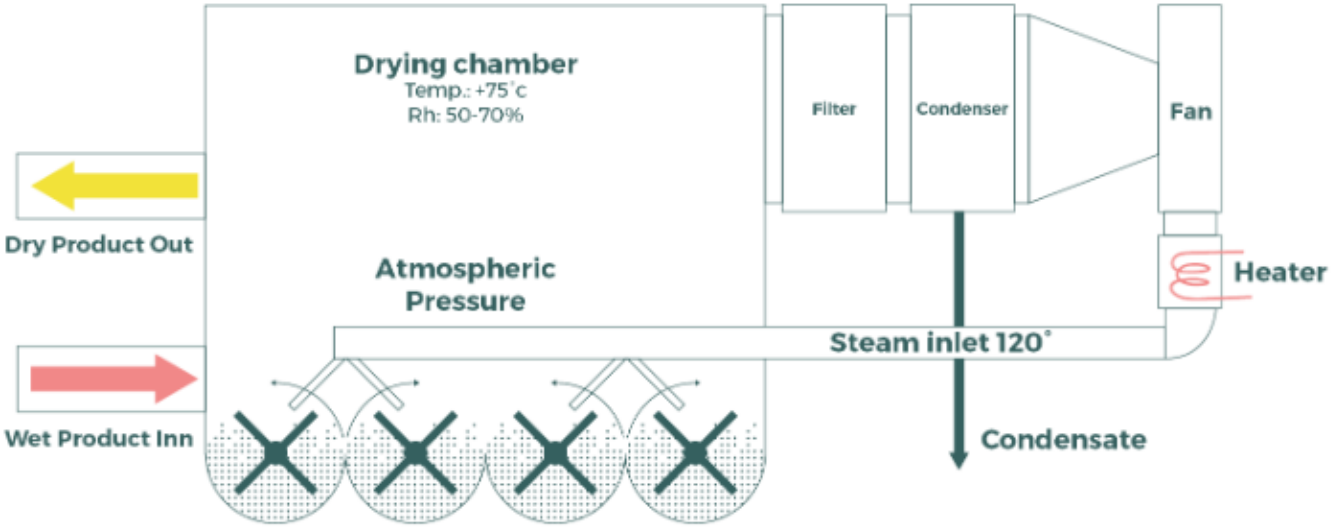
- Most feasible option
- Current community wants for fish waste fertilizer
- Two options
  - Waister equipment: powder
  - Phosphoric acid: liquid hydrolysate



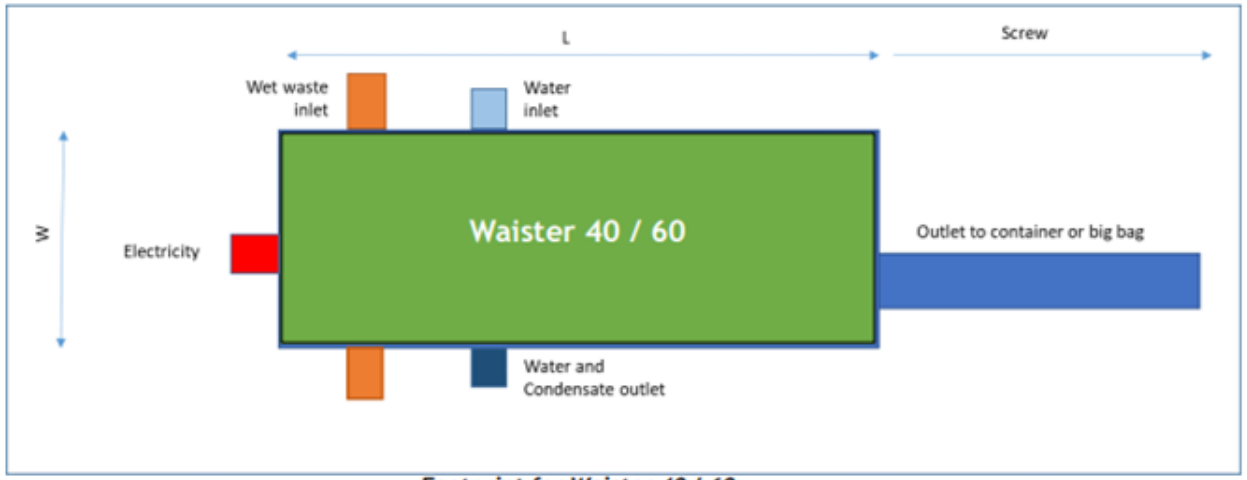


Biofertilizer: Waister Equipment

- Energy and time efficient
- Utilizes all fish waste
- Shelf Stable
- Works well for grains based on N,P
- Costly
  - ~$200,000 for machine (excludes shipping) + $5,000 annually for maintenance

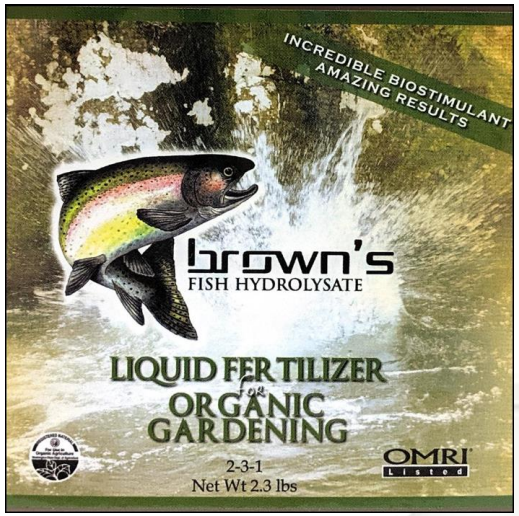


Model	Evaporation capacity	Power consumption	Footprint	Power supply	Max installed power
Waister 40	40 kg/h	0,85 kWh/kg water	H=2,50 m, W=0,99 m, L= 2,70 m*	400 V 50 Hz (3P+N+E) - 80 A	51 kW
Waister 60	60 kg/h	0,85 kWh/kg water	H=2,51 m, W=1,31 m, L= 3,04 m*	400 V 50 Hz (3P+N+E) - 114 A	67 kW



Footprint for Waister 40 / 60

Biofertilizer: Hydrolysate/Silage



- Globally utilized Relatively cheap and accesible
- Can be kept for 6+ months on site if pH is stabilized
- Needs to be worked with more often
- ~$0.30-$5 / ounce

Conclusion and Solutions

- Need more data on annual amount of waste and environmental pollution
- Very expensive process both in and out of facility
- Although it is the costliest up front, the Waister machine would convert all waste on site to a usable form
  - Doesn’t require extensive training
  - Can be kept on site or shipped out without needing refrigeration or acidity checks

Lake Trout Nutrient Profiling

Background

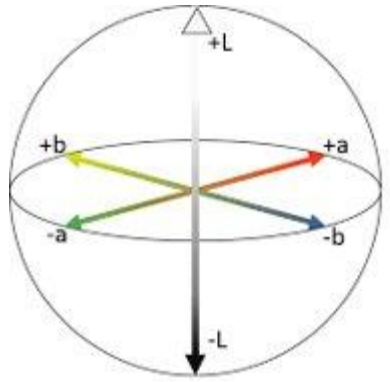
- Great variability among lake trout fillets depending on set, season, age, length, weight, and location
- Known data of trout's high Omega 3 Fatty Acid content
  - Not as much for Flathead Lake trout
- Possible marketing approach for local fillet sales and distribution
  - Further suppression and conservation for native species

Current Work

Test	Location	Types Tested
Color	MSU Lab	All bright, pale
Moisture	MSU Food Lab	All bright, pale, waste?
Fat, Total	NP Analytical	Bright. Pale, waste
Fatty Acid	NP Analytical	Bright, pale
Protein	NP Analytical	Bright, pale
Mercury	NP Analytical	Bright, pale
Vitamin D	NP Analytical	Bright, pale
Cholesterol	NP Analytical	Bright, pale
Sodium	NP Analytical	Bright, pale
Vitamin A	NP Analytical	Bright, pale

L	A	B	Length
30.82	10.38	10.55	8.33

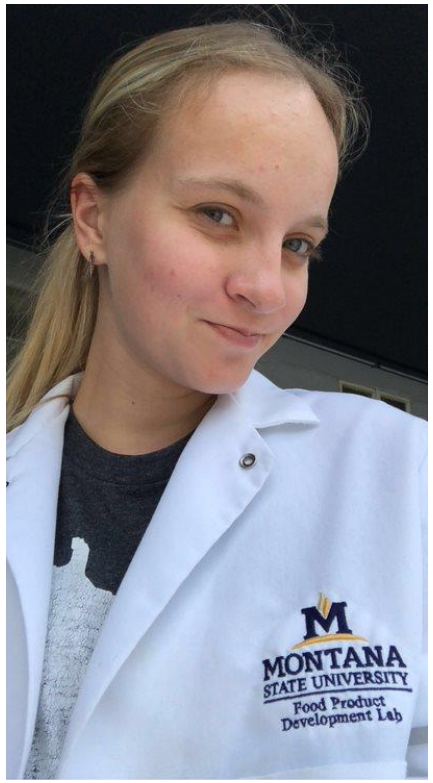
- Colorimetry analysis for 36 typical fillets
- Mass and length data for 36 fillets collected
- Fillets sent off to NP Analytical for nutritional information



What's Next?

- Further data collection on lug counts (process Vs. unprocessed)
- Incorporate laboratory analysis for Waister requirements
- Possible aquaculture visits to see biofertilizer equipment utilization
- Research and analyze more fillet types
- Receive and share fillet nutritional analysis with Native Fish Keepers, Inc.
- Continue conversation with CSKT Tribal Council on project updates

Personal Benefits



- More expansive understanding of natural resource conservation efforts
- Stronger collaboration skills
- Learned how to work in a fillet processing center
- Learned food manufacturing food/facility safety standards
- Enhanced professional skills

Personal Thanks and Acknowledgements

- **Native Fish Keepers, Inc., Montana Manufacturing Extension Center, Mission Mountain Food Enterprise Center, Salish Kootenai College, Bozeman Fish Technology Center, MSU Food Product Development Lab, Montana State University, Waister**
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THANK YOU!