

# Eel guts, salmon blood: Maine companies look to make the most of fish waste

Converting waste from salmon, eel and other marine species into consumer and biomedical products has opened a new and lucrative path for Maine's seafood industry.

By [Hannah LaClaire](#), Staff Writer



A production crew works on a skinning machine at Bristol Seafood in Portland on Thursday. Since 2021, the company has used all parts of the fish it processes, creating zero waste. These fish skins are destined for cosmetics, where they help makeup shimmer. *Shawn Patrick Ouellette/Staff Photographer*

Liam Fisher has long been fascinated by the idea of transforming what other people see as garbage into something delicious.

“Being wasteful just kind of makes my skin crawl,” he said.

So when Fisher, of Thomaston, saw a video of the process of butterflying eels at American Unagi, a Waldoboro-based aquaculture company, he didn’t just see the final fillets, he saw what had disappeared: the rest of the eels, including the guts.

And so he started the Maine Garum Co.

Fisher is developing a new recipe for an ancient umami-rich fish sauce known as garum that he hopes to launch on the market sometime next year. The secret (and only) ingredient? Those discarded eel parts.

His is one of a growing number of Maine companies taking advantage of, and trying to reduce, the tremendous amount of waste generated by the seafood industry.

A recent report from the Seafood Economic Accelerator for Maine, a statewide initiative to bolster economic growth and improve resiliency for the seafood sector, estimates that Maine's seafood industry annually generates about 57 million pounds of waste – about 25% of its total seafood production.

This waste, known as seafood residuals, can be used in myriad ways across numerous industries, and experts believe it has serious economic potential.

Luke's Lobster, for example, uses lobster shells as plant fertilizer. It also supplies Marin Skincare, which makes moisturizers from lobster glycoproteins.

Coast of Maine Organic Products makes [compost with lobster](#), crab, salmon, and seaweed residuals.

[Bigelow Laboratory for Ocean Sciences](#) is testing whether seaweed leftovers can be used to [reduce carbon emissions](#) and allow seaweed harvesters to enter the carbon sequestration market. The laboratory is also exploring whether seaweed residuals can be used as [cow feed, causing cows to burp less](#) and thus reduce their methane emissions, and whether the seaweed diet would have an impact on the quality of the manure used for fertilizer.

## **AN OCEAN OF OPPORTUNITY**

SEA Maine's report breaks potential uses into three categories: highest and best use, medium use, and low use.

## Converting waste

Several Maine companies are investigating uses for fish and aquaculture waste, leading to new revenue and more environmentally sound operations.

### Estimated residual volumes by species

Species	Product	Volume	Residual %	Residual volume
Lobster	Live	54,451	4%	2,042
	Processed	54,451	38%	20,419
Seaweed/algae		15,724	2%	338
Mussels		8,540	1%	85
Clam, Monkfish, Elver/eel		8,544	49%	4,219
Oysters		6,304	6%	378
Crab		2,570	55%	1,413
Quahog		1,442	N/A	N/A
Groundfish	Haddock	192	50%	96
	Hake	248	50%	124
	Cod	47	35%	16
	Halibut	32	60%	19
	Pollock	323	50%	162
Tuna		411	3%	10
Sea scallops		64	0%	N/A
Salmon	Hatcheries	1,844	1%	19
	Grow-out	16,960	3%	509
Other		54,099	50%	27,050
<b>Total</b>		<b>226,288</b>	<b>25%</b>	<b>56,900</b>

SOURCE: SEA Maine

STAFF GRAPHIC | JAKE LAWS

Medium- to high-value opportunities can provide revenue streams for companies, while low ones typically just avoid waste removal costs through on-site use.

Medium-value opportunities include [composting](#), [fertilizer](#), fishing bait, and animal feed. Higher-value uses could include pet food, health care research materials, bioplastics, and “novel” food ingredients like Fisher’s sauce.

Maine companies could see a 7% to 20% return on investment for residuals, depending on how they’re used, according to the report. And that’s just for companies disposing of waste, not those using it to create new products.

The report breaks down residuals by species and the percentages swing wildly. Mussels and oysters, for example, which are sold as whole products, generate little waste – around 1% and 6% – for producers (though plenty for consumers or restaurants). In some cases, the majority of a product is wasted. According to the report, about 60% of harvested halibut and 50% of most other groundfish get thrown out.

These numbers are thought to be conservative. Information is not available for all species, so by-catch totals were not included in the report. Scallops are reported as meat weight, so no waste is reported – even though about 65% of their weight is shell, which largely is thrown out at sea. Salmon data is largely confidential, so salmon estimates were based on export data to Canada, where the fish are processed. A few proposed land-based salmon farms would have processing capacity and so could drastically change the data.

It’s not just a Maine problem.

A 2015 analysis by the Johns Hopkins Center for a Livable Future found that 40% to 47% of the [U.S. seafood supply may be wasted](#), while the United Nations estimates that [35% of all seafood harvested globally](#) is later lost or wasted.

“We aren’t very good with seafood as a society. We also aren’t very good about taking advantage of the opportunities that come around seafood,” said Ben Martens, executive director of the Maine Coast Fishermen’s Association.

A great deal of what would otherwise be wasted can be used as lobster bait, but while that’s a value-added product, it’s not always valuable, he said.

The industry can and should be looking at other ways to add more value to the seafood chain, he said, and he sees a lot of potential in groundfish, like haddock, cod, halibut, hake, and pollock.

“There are a lot of fishermen right now that are interested in diversifying into groundfish,” he said. “If we’re going to have more people participating in this smaller fishery, what can we do to increase the value?”

With so much waste and so much opportunity to use it not only to offset costs but also to make money, why don’t all seafood operators dabble in residuals? The SEA Maine report says it comes down to resources. Many

companies don't have enough volume to make a residuals-based revenue stream worth it. Many lack the capital needed for the processing. Profitable uses for some of the waste may not be immediately obvious, and time and expertise are needed to test them.

More sources of funding and education are needed, said Chris Davis, steering committee member of SEA Maine and executive director of the Maine Aquaculture Innovation Center. The report will help "get the ball rolling," he said, and he sees tremendous potential.

"(Fifty-seven) million pounds of material that is going to the waste stream ... we can do better than that," he said, adding that tapping into it will create new products, processes, and jobs.

## **NO WASTE, BETTER TASTE**

Fisher, of the Maine Garum Co., already had a relationship with American Unagi founder Sara Rademaker and processing manager Charlie Walsh, so teaming up was natural. American Unagi, the country's [first large-scale eel farming operation](#), provides its raw material.

It's a win-win. Fisher gets the eel guts, and American Unagi gets to cut its waste.

The two companies' missions closely align, Fisher said.

"Both of us looked at an existing resource and thought, 'Why the hell aren't we doing anything with this?'" he said.

Fisher is now also working at American Unagi on its processing end and simultaneously taking what he needs for his sauce – the eel heads, tails, and viscera – on the side.

The ingredients are simple. Just eel bits and salt, but Fisher said the flavor is rich and complex. He hopes to launch in three or four months.

When he does, his garum will be one of the only commercially available fish sauces made in the U.S. and one of the only sauces anywhere made with discarded parts.

"Pretty much any fish sauce I'm aware of on the market utilizes whole fish," he said.

But that could change.

"The resources to make a really good one are going in dumpsters every day," he said.

Fisher believes more companies will start to see the potential in the waste – both for sustainability and profit.

"I think aquaculture and fish processing is [going to continue to grow in Maine](#) and that's going to mean a lot of garbage and a lot of opportunity," he said.

## **SCIENTIFIC SALMON BLOOD**

In 2021, the global production of salmon was 2.7 million metric tons. That total included roughly 27 million liters of salmon blood, the vast majority thrown out.



Cem Giray is the founder and CEO of Salmonics, a Brunswick biotech startup that uses salmon blood to provide fish-derived plasma proteins and reagents for biomedical research throughout the world. The blood, thousands of liters every year, would otherwise be discarded. *Gregory Rec/Staff Photographer*

Cem Giray doesn't think it should have to go to waste.

Giray launched his biotech company Salmonics in 2020.

“The whole initiator was ‘Hey, there’s all this salmon blood waste, why can’t we do something with it? What kind of things can be obtained with salmon blood and how can that be utilized?’” Giray said.

Salmonics aims to commercialize the biotech products developed over the past 20 years by research and development company Sea Run Holdings Inc., which Salmonics has acquired, and to develop and market new reagents and products, such as fibronectin and serum, from blood harvested from farmed salmon. The proteins and reagents from the blood, he said, can be used in regenerative medicine, cell proliferation, pain treatment, and other research applications.

Animal blood, especially from pigs and cows, is a common ingredient in the biomedical sector, Giray said, but some studies have shown that salmon blood is just as effective, without the same risk for mammalian pathogens of viruses.

Typically blood is removed from fish for the same reason it is removed from cows and chickens, to prevent an off taste in meat and keep it fresh longer.

During the traditional harvest process, salmon are stunned and euthanized, have their gills cut, and are placed in an ice bath, where they bleed out before they are gutted and filleted. Left behind is a vat of bloody water that needs to be disinfected and hauled off to a wastewater treatment site.

Salmonics, though, extracts the blood from the fish, often in an onsite lab or it can be done by the processors, with the blood sent to the Brunswick facility. After the blood is drained, the fish end up back on the production line with the rest of the fish.

It takes about 10 to 20 salmon to provide a liter of blood, and Giray estimated that the current salmon production in Maine would equal about 200,000 liters. That's a lot of waste.

Giray estimated that through its process, Salmonics can remove 50 to 150 milliliters of blood per salmon – more than is drained by just letting the fish bleed out.

The company is still in the startup phase, with a team of about five working out of Brunswick Landing's TechPlace business accelerator. So far they're dealing with relatively small numbers, in the range of thousands of liters per year, Giray said.

[Salmonics](#) works with land-based salmon aquaculture companies across the U.S. and Canada, but none from Maine, since the state's only salmon producer, Cooke Aquaculture, raises the fish in oceanic net pens.

Land-based companies provide a cleaner environment to extract and collect the blood and the fish are available onsite, Giray said, adding that he's excited about some of [the land-based operations](#) proposed in Maine.



Sea Block is one of the products made at Salmonics, a Brunswick biotech startup that uses salmon blood to provide fish-derived plasma proteins and reagents for biomedical research. *Gregory Rec/Staff Photographer*

Giray said that aquaculturists benefit from working with companies like his.

“Salmon companies are investing a lot of time and money into growing this fish,” he said. “It’s to their advantage to create as much value or money in that fish as possible. If they can do something with it, a fish that may have been worth \$25 dollars is suddenly worth \$30 or \$35 and that’s a huge impact on their bottom line.”

## **REPLACING PFAS WITH SEAWEED**

Many companies processing kelp for food want the leafy part of the plant, which is cut when it's pretty young when it's filmy and easier to eat.

They leave the holdfast – essentially the root that holds the plant to the sea floor, or in seaweed aquaculture, to the rope it grows on. The holdfast either gets chopped up and used as fertilizer or thrown away.

But Jessica Chalmers, co-founder and CEO of Everything Seaweed, sees a much bigger future than fertilizer for kelp holdfasts.

Everything Seaweed, or EvSe, plans to use seaweed cellulose nanofibers as a replacement for PFAS coatings on food packaging – and eventually as polyacrylate texturizers in skincare.

The PFAS replacement is the primary focus for now, Chalmers said.

Perfluoroalkyl and polyfluoroalkyl substances, or [PFAS](#), are a group of chemicals used in cookware, food packaging, and food processing for their nonstick and grease-, oil- and water-resistant properties. Often referred to as “forever chemicals,” they have been linked to slow fetal growth, thyroid disease, liver enzyme alterations, and cancers.

However, the water-resistant properties of PFAS are also found in seaweed cellulose.

“It can absorb an incredible amount of water, like 700 times its weight,” Chalmers said. What it doesn’t absorb, it repels.

The leaves are generally too flimsy for Everything Seaweed’s engineering and biorefining process, but the holdfasts have potential.

“There’s already a [glut of seaweed on the market](#) right now,” Chalmers said. “We could help those farmers on the market by buying what they have and getting more from it. ... A company that’s interested in the food could take the leaf and we would take the root.”

Everything Seaweed, which launched in 2020, is still in the development phase. The company is fundraising to try to build a factory that would employ about 40 people by 2025.

“We could really turn Maine [into the seaweed hub](#) that it’s been touted as,” Chalmers said, and raising seaweed’s value would help.

### **‘IT’S THE RIGHT THING TO DO’**

Between Bristol Seafood’s two processing facilities on Portland Fish Pier, nothing is wasted.

The 30-year-old company has been marine-waste-free for two years, according to CEO Peter Handy.

“There’s nothing that isn’t being passed along for somebody to use,” he said.

After haddock and cod are processed on the fillet line, for example, the remnants are passed through another round of processing. The last bits of meat are separated from the bone and ground up to be used in pet food. The bones can be used in agriculture – a natural fertilizer, fish bone meal is rich in phosphorus, calcium, and nitrogen. The leftover skins are also highly valued. Fish scales contain guanine, which is used as the shimmer in many cosmetic products, such as lipstick, eyeshadow, and nail polish.

“None of the fish goes in the garbage and those companies don’t have to tap into other resources,” Handy said.

The residuals have become an additional revenue source for the company, but the additional processing and contacts require an investment of time and money that may be beyond many smaller operations.

For companies that can manage it, Handy said the decision to reduce and invest in waste is a no-brainer.

“It’s the right thing to do and it makes good business,” he said. “I think it’s incumbent on all of us who want to focus on environmental sustainability to make sure that in the period we’re entrusted with a resource, to fully utilize that resource and not leave anything of value behind.”