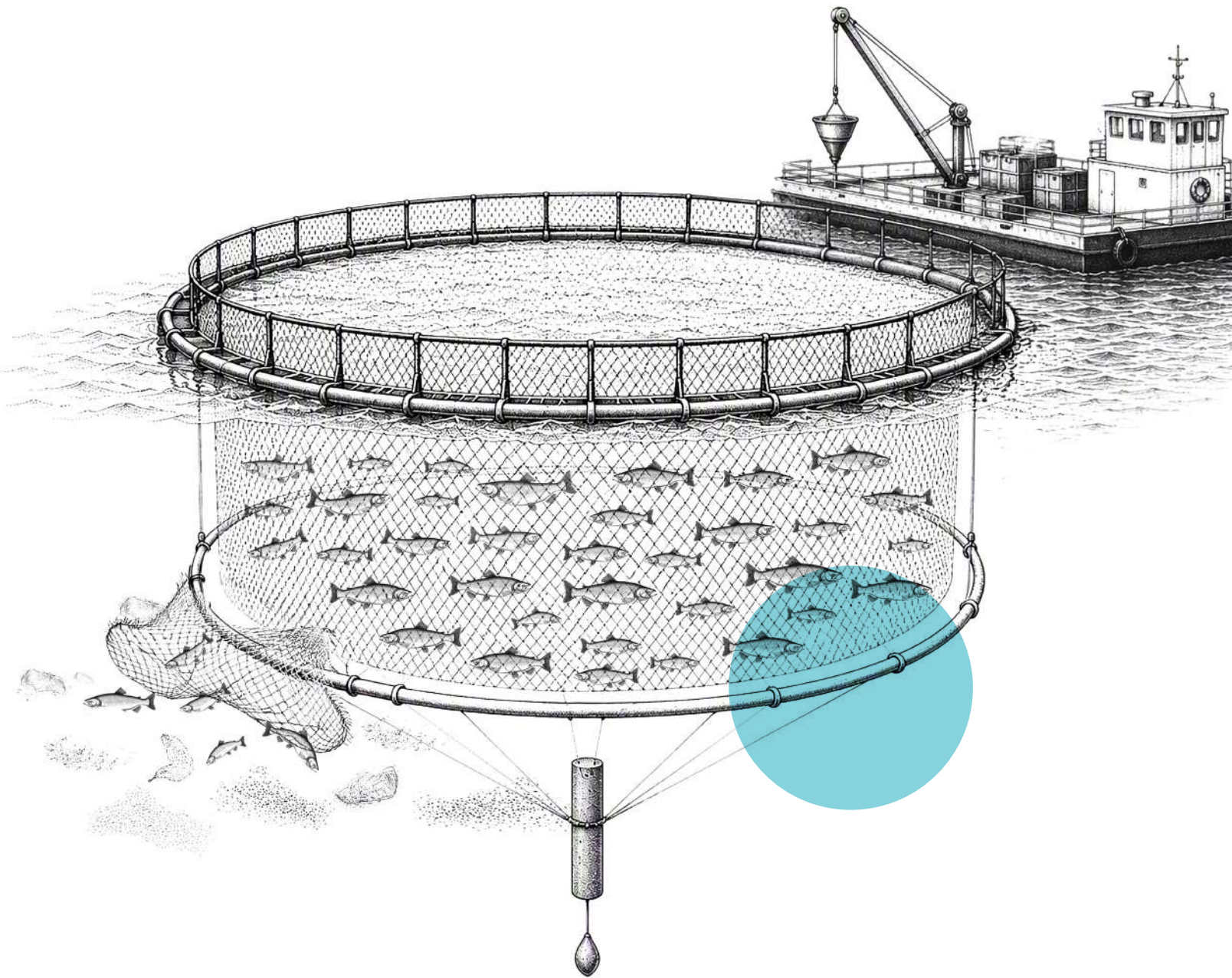




# THE HUNGRY MACHINE

FALL 2026

MAPPING THE SALMON INDUSTRIAL COMPLEX

The hidden cost behind every ocean-farmed salmon.

SALMON.INFO



Since the 1970s, wild Atlantic salmon populations have declined by 80%. Yet in the waters from Chile, to Maine, to Norway and beyond, hundreds of millions of Atlantic salmon are mass-produced in crowded industrial sea cages for human consumption.<sup>1</sup> To feed them, we are rapidly depleting and polluting the oceans we rely on for oxygen, food and carbon capture.

Like any healthy ecosystem, a healthy ocean is structured like a pyramid. It rests on a solid foundation: a vast, self-renewing base of plankton and small fish that support larger predators at the top. For millions of years, wild Atlantic salmon have occupied a critical place near the top of the food pyramid. But in our lifetime, climate change, habitat loss and the rapid growth of salmon aquaculture have pushed that balance to the brink, consuming the foundation of the pyramid faster than nature can replenish it. This unsustainable growth has turned the pyramid upside down, creating a highly unstable and vulnerable ecosystem.

Raising approximately 650 million farmed salmon in sea cages has created an environmental and ethical crisis on multiple fronts. The industry driving this system is:<sup>2</sup>

- **Feeding ocean-farmed salmon by emptying the ocean.**

Vast quantities of smaller fish and marine life are extracted for feed. This is displacing local food systems and forcing an inequitable protein transfer from the Global South to the Global North.<sup>3</sup>

- **Polluting the ocean waters we depend on.<sup>4</sup>**

Untreated waste, plastics, pesticides and antibiotics are released directly into marine environments.<sup>5</sup>

- **Subjecting ocean-farmed salmon to deadly conditions.**

Crowded sea cages can be miserable, disease-ridden and deadly. Between 2012 and 2022, 865 million ocean-farmed salmon died before harvest.

- **Putting wild Atlantic salmon at risk.**

Sea lice from crowded cages and disease spread to wild salmon.<sup>6</sup> Escaped farmed salmon interbreed with wild ones, diluting their genes. Sea cage salmon farming is a leading driver pushing wild Atlantic salmon toward extinction.

While profits flow to a small number of company owners and shareholders, the public, environment and other marine life often pay a high price.<sup>7</sup> The industry often is propped up by government subsidies, but it is seldom held to account for the damage done to the environment, coastal communities, wild salmon and other ocean species.

*This report traces the environmental, economic and social fallout of insatiable, unsustainable ocean-farmed industrial practices.*

*This is the hungry machine.*

## WHY WE SHOULD CARE ABOUT WILD ATLANTIC SALMON

Wild Atlantic salmon are an indicator species for the planet's health. They are the canary in the coal mine for us all. They need cold, clean water, abundant food and free passage from the sea to river spawning grounds. When Atlantic salmon thrive, other species do as well. When salmon suffer, it's an early sign something is wrong.

**99%** of Atlantic salmon sold worldwide is farmed in industrial sea cages. That includes salmon labeled sustainable, organic or responsibly raised.<sup>8</sup>

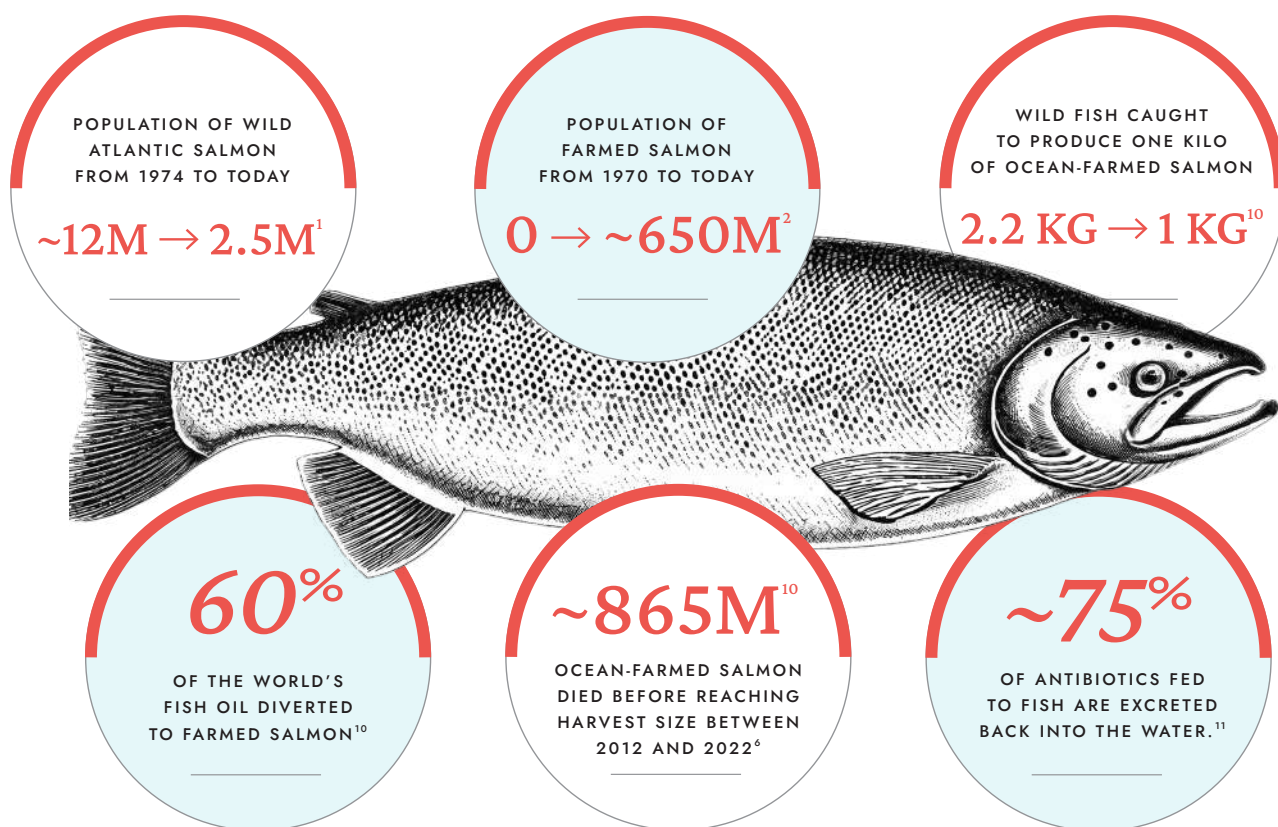
## A FLAWED MODEL: UNSTABLE AND UNSUSTAINABLE.

Atlantic Salmon is one of the world's most farmed and most consumed fish. Since the 1970s, thousands of industrial sea cages have been constructed off the coasts and in the fjords of Norway, Scotland, Iceland, Atlantic Canada, British Columbia, the United States, Tasmania and Chile.<sup>9</sup> But the industry is inherently out of balance, built on the mass production of one species at the expense of the ocean and its other inhabitants.

The Salmon Industrial Complex is the establishment producing the world's fastest growing food product. Until the 1970s, most salmon consumed had been caught in rivers and seas. Barely 50 years later, industrial farming has scaled so fast — and wild stocks declined so sharply — that 99% of the Atlantic salmon people eat now comes from sea cages.<sup>8</sup>

Millions of servings of ocean-farmed salmon are consumed daily without people knowing that the industry behind their dinner discharges tons of untreated waste into the ocean or that its practices breed resistant parasites and disease that can spread to wild marine life.

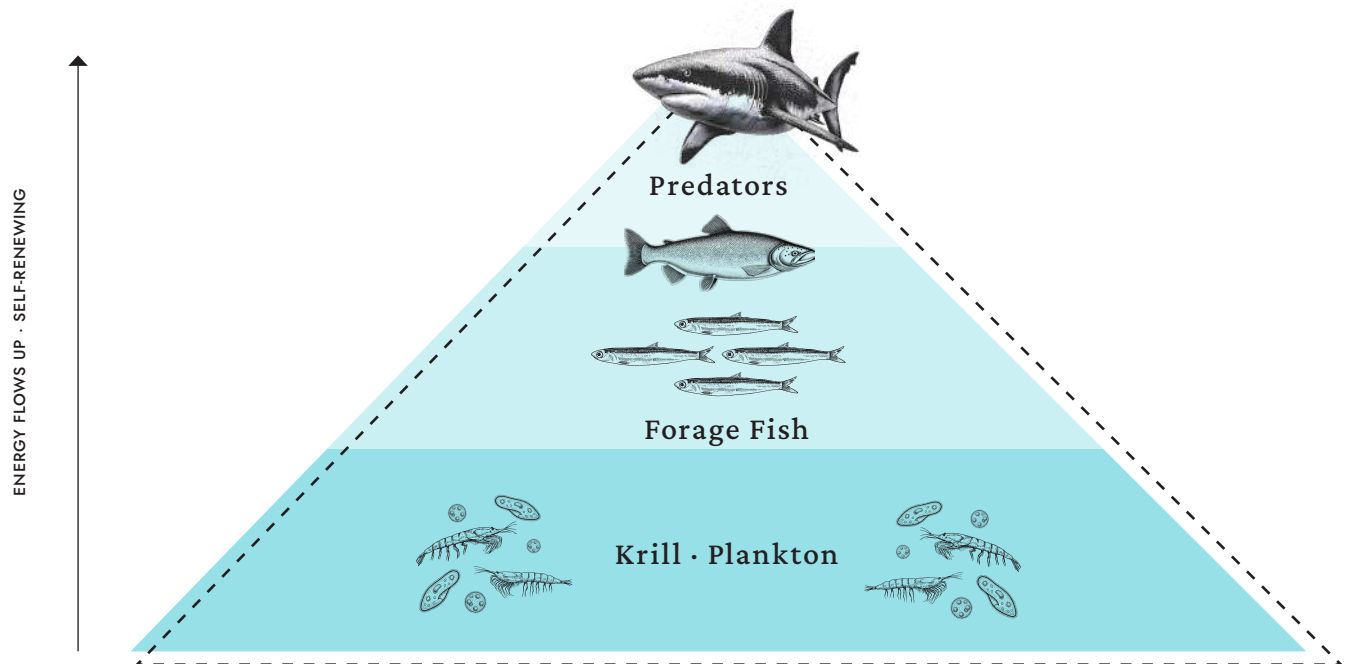
Research from around the North Atlantic has concluded industrial sea-cages are a leading cause of the decline of wild Atlantic salmon. Wild salmon did not decline because of farming alone — dams, habitat destruction, overfishing and climate change did much of the damage. But the decline is often steepest where the farms are densest.<sup>7</sup>



## FOR MILLIONS OF YEARS, ENERGY NATURALLY FLOWED UP.

In a healthy ocean, plankton feeds krill and small fish, and those in turn sustain larger fish such as salmon, tuna, cod and sharks. Wild Atlantic salmon are an indicator species — a barometer for the ocean’s health. When their populations thrive, it signals a healthy ecosystem.

### THE NATURAL OCEAN: A SELF-RENEWING PYRAMID



The natural ocean: a self-renewing pyramid. The base produced more than the top could ever eat and renewed itself every season. Nothing had to be added. This is the structure the following sections describe being turned upside down.

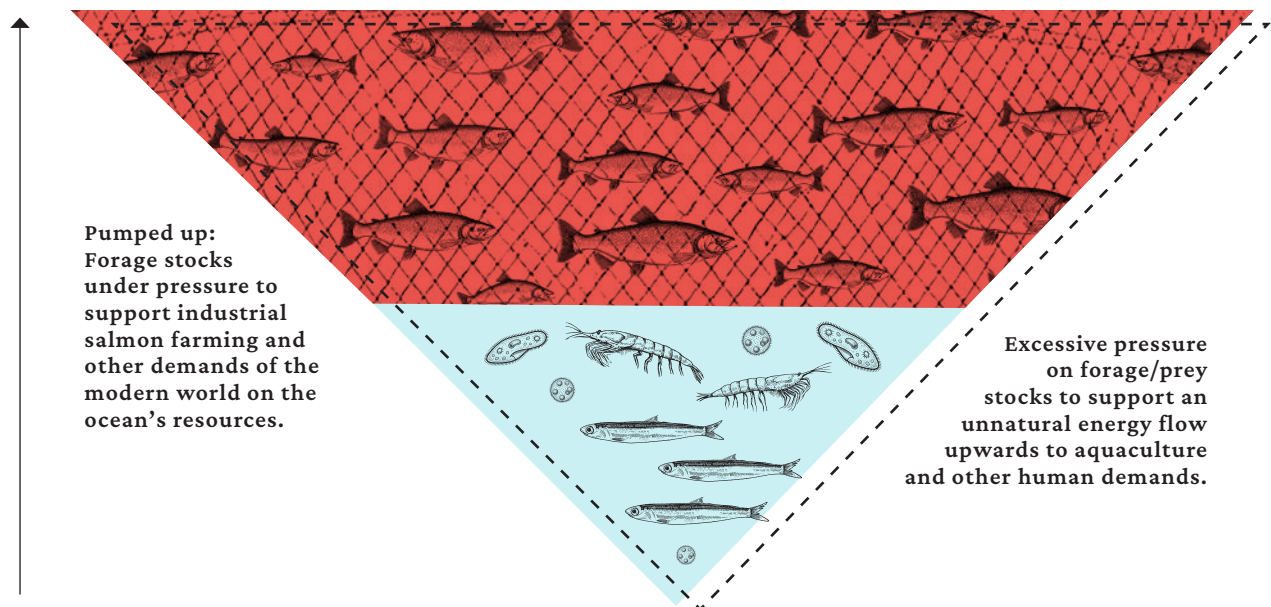
*In 1974, wild Atlantic salmon populations across the North Atlantic totaled about 12 million fish. Today, that figure stands at approximately 2.5 million — **a decline of ~80%.<sup>1</sup>***

## THEN INDUSTRIAL FARMING REWIRED IT.

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Today, industrial salmon farming has broken that natural flow. Instead of a broad, self-sustaining base that feeds predators at the top, the industry depletes krill and forage fish — grinding them into fishmeal to grow hundreds of millions of ocean-farmed salmon for human consumption, while harming wild salmon populations.

### EXCESSIVE PRESSURE AT THE BASE OF THE ECOSYSTEM



From the natural ocean to the industrialized ocean. To uphold the structure of the ocean-farmed salmon industry, fleets pull hundreds of billions of forage fish and krill from the sea every year. The stable pyramid sat on its base; this one balances on its point — a shape that cannot stand on its own.

The industry says it is improving feeding practices and cites falling feed-conversion ratios as proof of sustainability — but ratios aren't volumes. Aquaculture's fishmeal demand has risen by roughly 800,000 tonnes in the past decade, while the wild forage-fish supply feeding it has stayed flat for 50 years, fluctuating within the same 4–7 million tonne range it occupied in the 1970s.<sup>12</sup> With farmed salmon production on track to exceed 3 million tonnes by 2030, an industry that's getting more efficient per fish is still drawing a growing share from a wild fish supply that isn't growing at all.

We extract *trillions* of feeder fish.  
To make *billions* for the few.  
While *millions* of wild Atlantic salmon die.

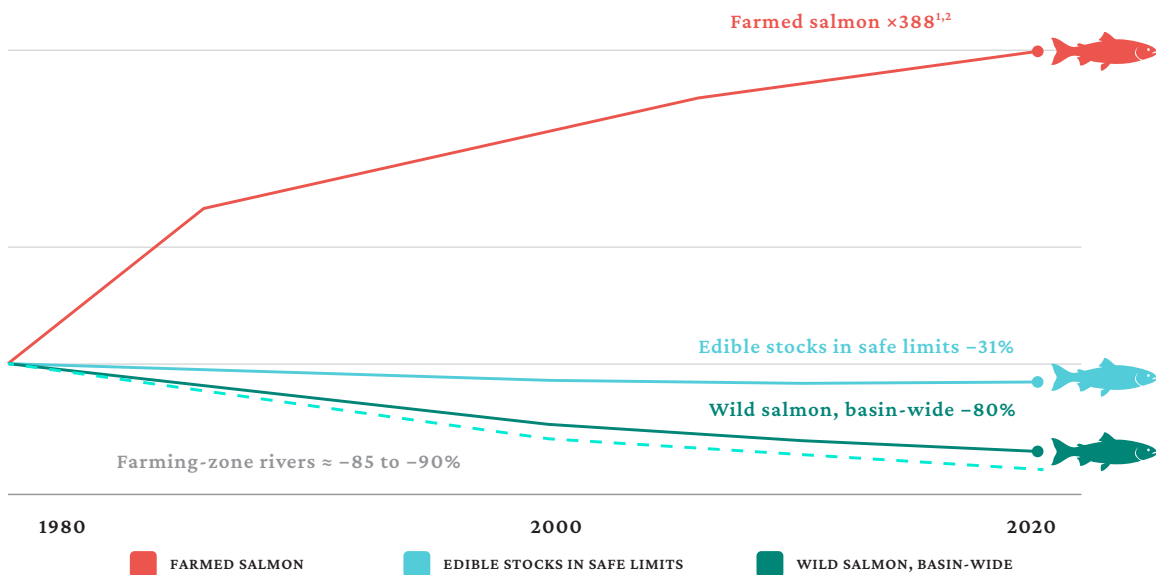


## AS OCEAN-FARMED SALMON INCREASE, WILD NUMBERS PLUNGE.

Since 1980, the reversal of fortunes is impossible to dismiss. Farmed salmon production has increased exponentially, with their numbers expanding almost 400-fold. Over the same period, wild salmon populations have declined by about 80%.

Norway's national salmon run fell from around 1 million fish in the 1980s to just 323,000 in 2024 — an all-time low, with 32 rivers closed to fishing. The River Vosso, once home to the largest Atlantic salmon run on Earth, collapsed to functional extinction by 1992 and survives only via gene-bank rescue.<sup>15</sup>

### POPULATIONS OVER THE YEARS



Populations over the years (indexed, log scale), 1980–2020: farmed salmon  $\times 388$ ; edible stocks within safe limits  $\sim 31\%$  down; wild salmon, basin-wide,  $\sim 80\%$  down; rivers in farming zones  $\sim 85\text{--}90\%$  down.

### ON THE RECORD

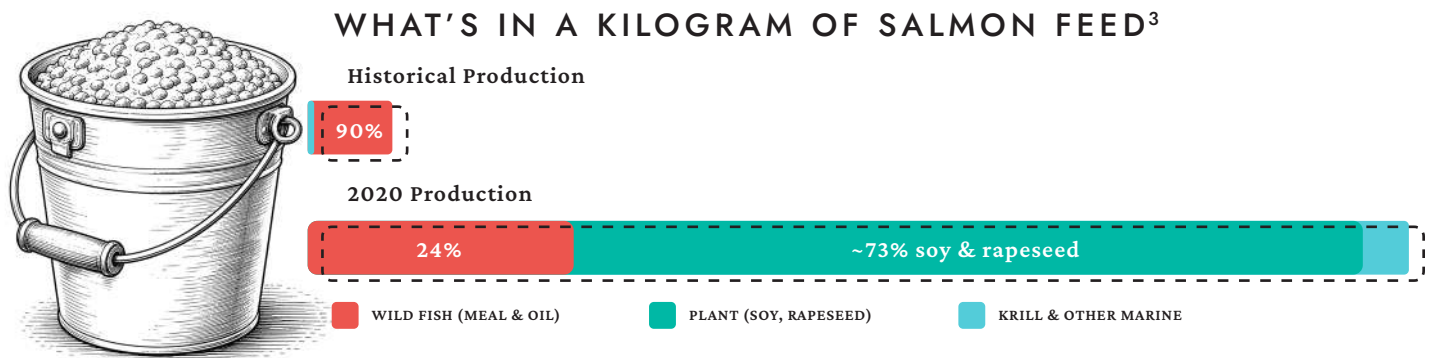
In 2025, Norway's government-appointed Scientific Advisory Committee for Atlantic Salmon concluded that the two biggest human-caused threats to wild Atlantic salmon are salmon farming and climate change — with sea lice from fish farms the single greatest threat. The committee also found that the impact of aquaculture is a major reason that nearly half of rivers in Western and Central Norway no longer hold a surplus of wild Atlantic salmon to fish.<sup>15</sup>

## A RECIPE FOR ECOLOGICAL AND SOCIAL IMBALANCE.

To keep 650 million ocean-farmed salmon fed, the industry converts hundreds of billions of wild forage fish into fish meal and fish oil every year. In fact, an estimated **20% of all wild fish** caught worldwide are ground up, rendered and fed to farmed fish, including salmon.<sup>4</sup>

As stocks of wild fish tightened, feed makers swapped in soy and rapeseed and announced they had “reduced their dependence on wild fish.” Per kilogram of salmon, wild-fish use did fall from 90% to 24%. But overall output grew roughly 13 times over the same years, so the absolute pressure on the ocean never dropped.

“Reducing dependence” was indicative of a resource running out, not a problem being solved.<sup>3</sup>



What's in a kilogram of salmon feed, 2020: 24% wild fish (meal & oil), ~73% plant (soy, rapeseed), remainder krill & other marine — down from ~90% marine historically.

### NUTRITION DISPLACEMENT & GLOBAL INEQUALITY

Coastal and fishing communities across the Global South have depended on sardines, anchovies and other forage fish as food and economic lifelines for millennia.

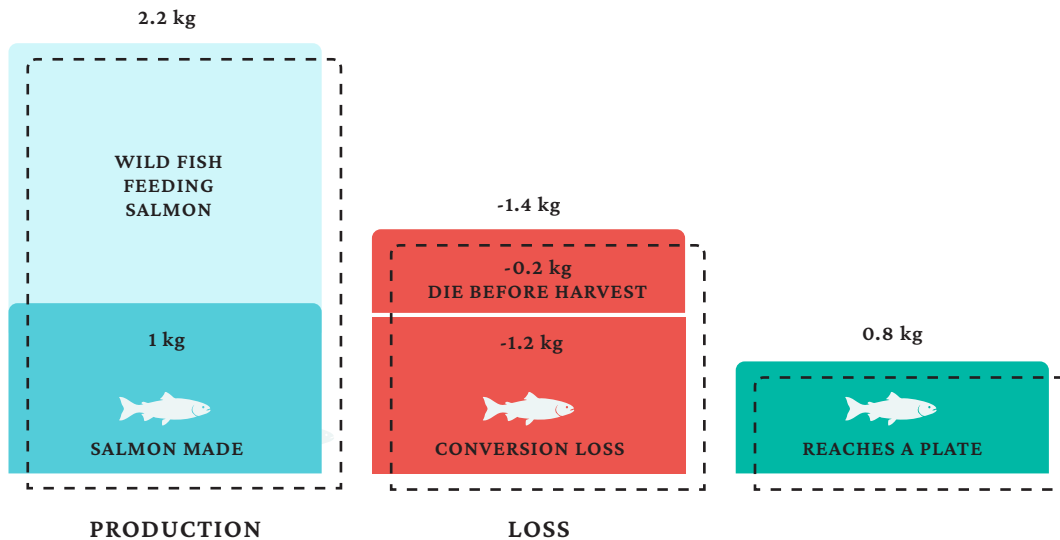
When wild stocks are diverted to produce industrial salmon feed for wealthier markets, the first people who lose resources and opportunity are those who can least afford it. Peru sends more than 1 million tonnes of fish meal and fish oil to countries and regions like Canada, the United States, the United Kingdom and the EU. The half a million tons of fish extracted off the coast of West Africa could feed more than 33 million people in the region.<sup>16</sup>

The ocean's base is not an abstract resource: It is the food system of many low-income and vulnerable countries, re-purposed for the plate of the global affluent.<sup>4</sup>

## MOST PROTEIN IS LOST IN THE FARMING PROCESS.

Follow 2.2 kg of wild fish — the amount it takes to produce 1 kg of farmed salmon — through the aquaculture system and **see more than half** of that wild protein lost in conversion.<sup>10</sup>

### PROTEIN LOSS PER KILOGRAM OF SALMON



Protein loss per kilogram of salmon: 2.2 kg wild fish in -1.2 kg conversion loss 1 kg salmon made -0.2 kg die before harvest ~0.8 kg reaches a plate.

About 2.2 kg of wild fish goes into every 1 kg of salmon produced. More than half that wild protein is lost in conversion, and a further 1 in 6 fish die before harvest. The green column is the only food that remains. Everything in red represents destroyed marine protein.<sup>3</sup>



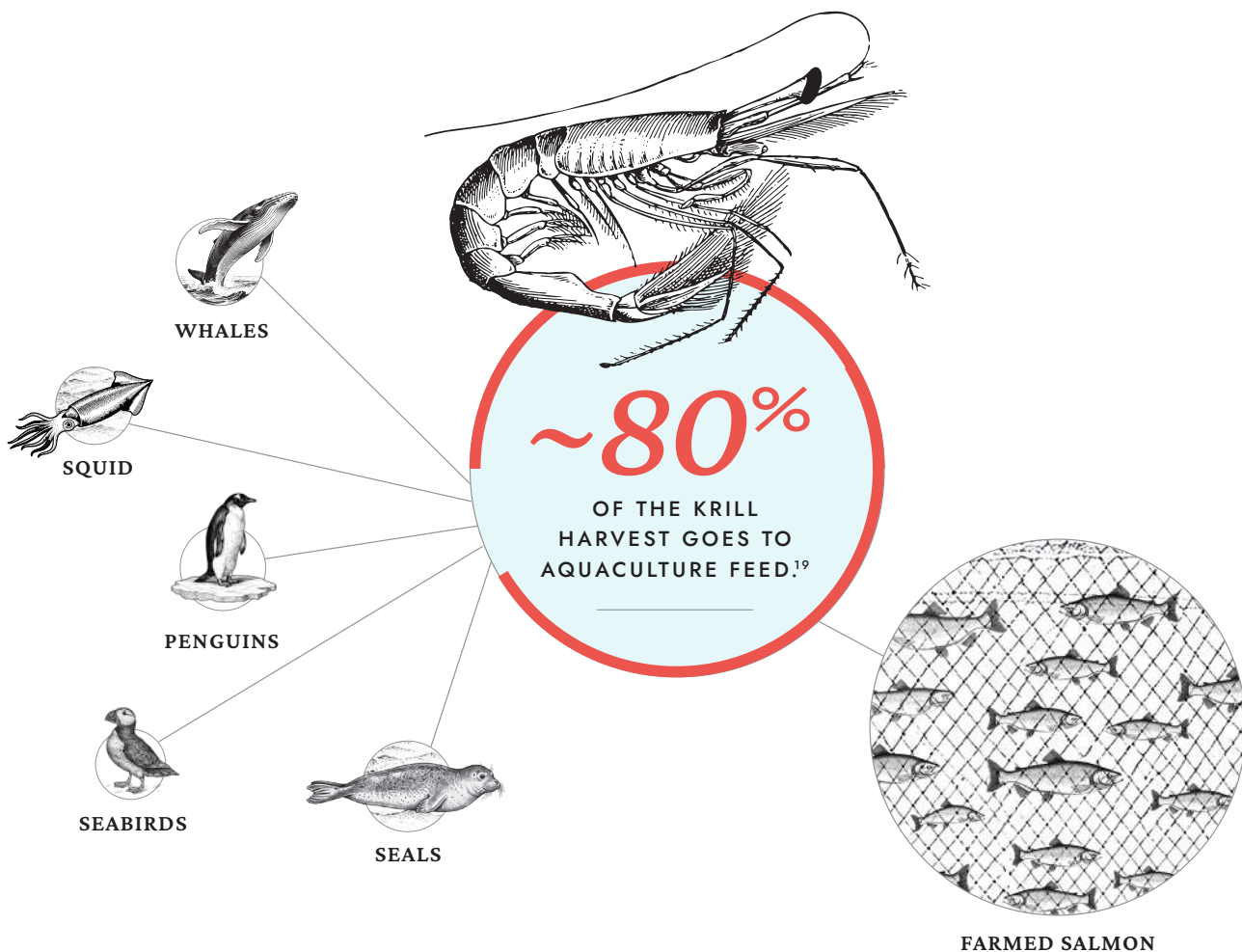
## FORAGE FISH DECIMATED, AND NOW KRILL.

When one source of food for farmed salmon is exhausted, the industry reaches one link lower on the food chain. With forage stocks maxed out, the industry targeted the very bottom of the food chain: Antarctic krill, the keystone prey of whales, penguins and seals.

The krill catch has quintupled since 2006 and, in 2025 and 2026, slammed into the precautionary cap set by the Commission for the Conservation of Antarctic Marine Living Resources.<sup>17</sup>

The wild predators that depended on that base are already roughly 90% gone, and now they must compete with the industry feeding hundreds of millions of caged fish for what little remains.<sup>18</sup>

**The Salmon Industrial Complex is feeding farmed predators by starving wild ones.**



Antarctic krill catch, 2006–2025 (thousand tonnes): 106 kt (2006) ~518 kt (2025), +400% in two decades, against a precautionary cap of 620 kt.

# A CITY TREATS ITS SEWAGE. A SALMON FARM DOES NOT.

Salmon farms are not equipped with sewage treatment facilities. Feces, uneaten feed and chemicals flow straight into the ocean. Each farm discharges the raw-waste equivalent of a city of **50,000–65,000 people** with no treatment, no cap, no cleanup required. The scale is hard to picture — so picture it as people.<sup>20</sup>

| Comparison                             | Population / Waste Equivalent             |
|----------------------------------------|-------------------------------------------|
| UK population                          | ~69M people                               |
| All the world’s fish farms — raw waste | hundreds of millions of people-equivalent |
| Scotland population                    | ~5.4M people                              |
| Scotland’s fish farms — raw waste      | ~half to all of Scotland                  |

## NEW NUMBERS FROM NORWAY

A May 2026 Sunstone Institute analysis put hard numbers on the issue. In 2025, Norwegian aquaculture released **75,000 tonnes of nitrogen, 13,000 tonnes of phosphorus and 360,000 tonnes of carbon** straight into coastal waters — the nutrient load of the untreated sewage of roughly **17 million, 20 million and 30 million** people, respectively.<sup>21</sup> For a country of 5.5 million, that is three to five times the toilet waste of the entire population. Oxygen levels are already falling in the Sognefjord and Hardangerfjord. In March 2026, officials rejected nine new farm applications over the pollution they would add.<sup>22</sup>

## KEEPING IT HONEST

This is not the ocean’s single largest source of nutrient pollution — farm-fertilizer runoff is, and 80%+ of marine pollution comes from land. What makes salmon farming distinct is that its waste is **untreated** and **concentrated** in semi-enclosed fjords and along the exact migration routes wild salmon must swim.

## OVER 50 YEARS OF PLASTIC POLLUTION.

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While sea cages release large amounts of organic waste into the ocean, the plastic they shed, particularly Styrofoam, can persist in the environment for hundreds, if not thousands, of years. Off the coasts of the major salmon-producing countries, much of the plastic lost from sea-cage infrastructure is never recovered.

**Styrofoam** does not biodegrade. It breaks apart into tiny plastic particles that can drift through marine ecosystems for decades. Those particles are swallowed by fish, as well as sea turtles and seabirds, adding to the growing burden of microplastics found throughout ocean food webs and in the seafood we eat.

*~250 billion  
“cigarette butts” of plastic.*

~50,000 TONNES — PREDOMINANTLY EXPANDED POLYSTYRENE (STYROFOAM) FROM FLOATS, PONTOONS AND FEED BOXES — SHED, ABANDONED AND NEVER REMOVED FROM THE OCEAN.<sup>23</sup>

### THE MATH BEHIND THE NUMBERS

A deliberately rough order-of-magnitude estimate — ~0.5–2 kg permanently lost per tonne of salmon (EPS fragments, rope and net shedding, lost buoys, abandoned gear, packaging) × ~52 Mt ≈ 25,000–100,000 t (central ~50,000 t), cross-checked against global aquaculture plus fishing ghost-gear (~45,000 t/yr); converted at ~0.18 g per cigarette butt (4.5 trillion littered yearly ≈ 845,000 t) □ ~140–560 billion butts. Order-of-magnitude figures, offered to convey scale, not precision.<sup>12</sup>

## THE DEADLY CHEMISTRY OF CROWDED CAGES.

Pack hundreds of millions of fish into floating sea cages, and disease is inevitable.

Routine medication is not an accident of open-net farming. It is built into how it works. Chile doses its waters at roughly **340g of antibiotics per tonne** of salmon and has taken steps to reduce its use, while Norway, leaning on vaccines, uses barely **1g**. The gap proves industrial-scale dosing is a decision, not a necessity.

Sea cages also **discharge delousing pesticides and other toxic chemicals** straight into ocean waters that flow freely.<sup>24</sup> Peer-reviewed studies link them to harm to crustaceans, shellfish, other non-target wildlife and coastal communities near the farms.<sup>25,26,27</sup>

### THE RESISTANCE PATHWAY: HOW A DOSE BECOMES A SUPERBUG RISK<sup>16</sup>

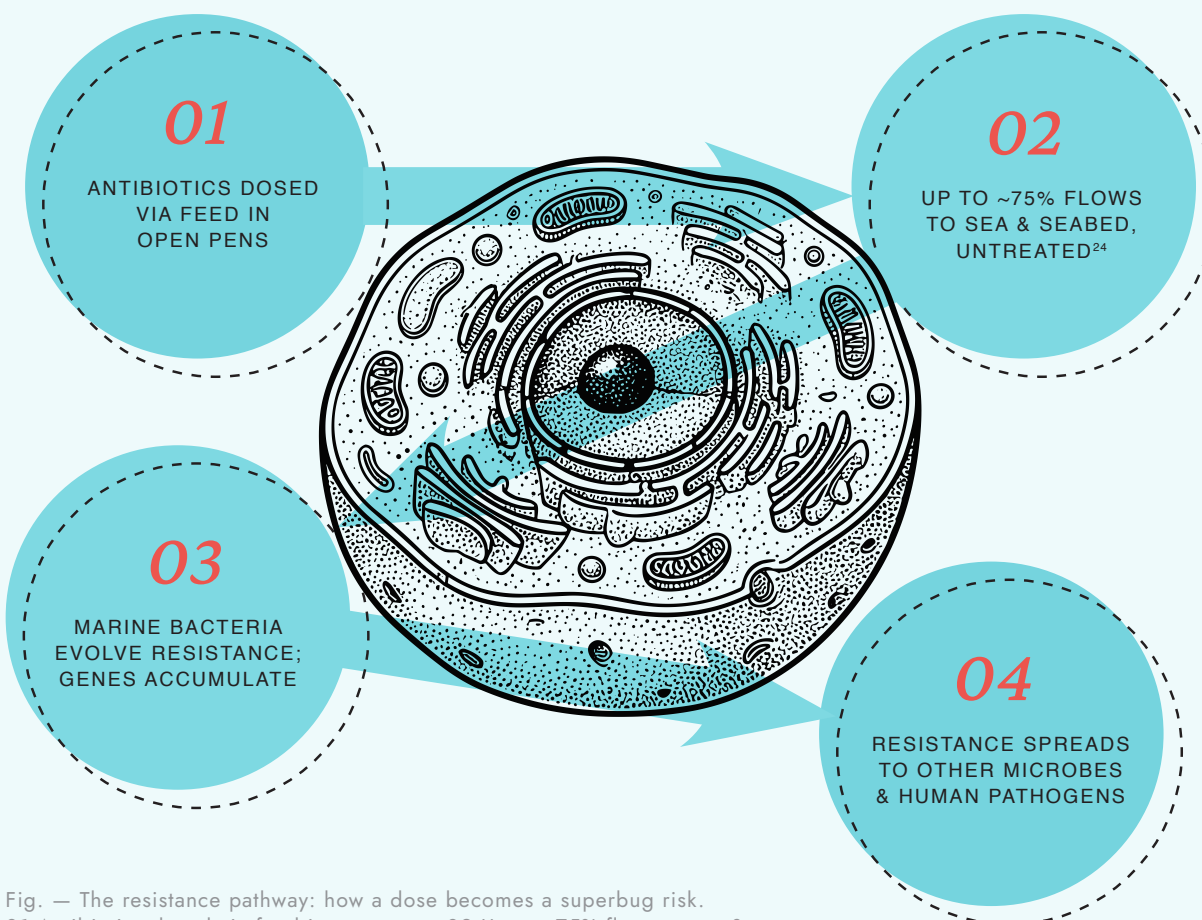
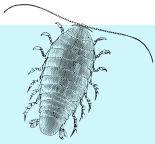


Fig. — The resistance pathway: how a dose becomes a superbug risk.

01 Antibiotics dosed via feed in open pens 02 Up to ~75% flows to sea & seabed, untreated 03 Marine bacteria evolve, resistance genes accumulate 04 Resistance spreads to other microbes & human pathogens.

## THE FARMED FISH TURNS ON THE WILD ONE.

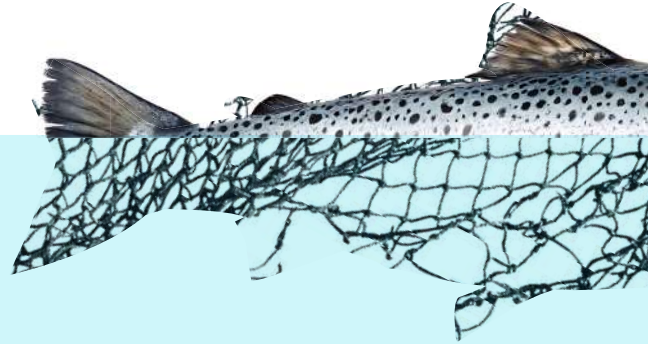
The same crowding that drives the chemistry causing disease and harming other species also makes the ocean-farmed salmon population a weapon against the wild salmon it replaced — in two distinct ways.



### THE SUPER LICE

Overcrowded ocean pens are sea-lice factories. The tiny, parasitic crustaceans breed prolifically in the cages, feed on the skin, mucus and blood of farmed salmon and drift onto juvenile wild salmon swimming freely nearby. They are a documented killer of wild Atlantic salmon. Farms traditionally dosed the water with delousing pesticides, but the lice have evolved.<sup>15</sup>

Today's "super lice" are immune to the chemicals that once killed them.<sup>28</sup>

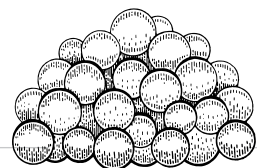


### THE BLOODLINE

When ocean-farmed salmon escape and interbreed with wild populations, they **weaken a gene pool** shaped over millions of years to carry survival traits unique to each river. This makes it harder for wild Atlantic salmon to thrive.<sup>29</sup>

Norway alone — the largest producer of farmed salmon — reported **~1.7 million escaped farmed salmon between 2011 and 2021, averaging roughly 170,000 a year**, set against only ~500,000 wild adult salmon left in the whole country. Reported figures almost certainly undercount the true total.<sup>15</sup>

*Bred for the cage, escapees push farmed genes into the wild. A landmark study of 6,900 salmon from 105 rivers found that genetic introgression weakens the wild gene pool and alters growth and maturation across the full life cycle.<sup>29</sup>*



## CONCENTRATED CONTROL. A SHARED OCEAN.

Ownership and control of salmon aquaculture is remarkably concentrated. About **25 companies control roughly 80%** of global output, and production is concentrated in just eight places: Norway, Chile, the United Kingdom, Canada, the Faroe Islands, Iceland, Ireland and Australia.<sup>2</sup>

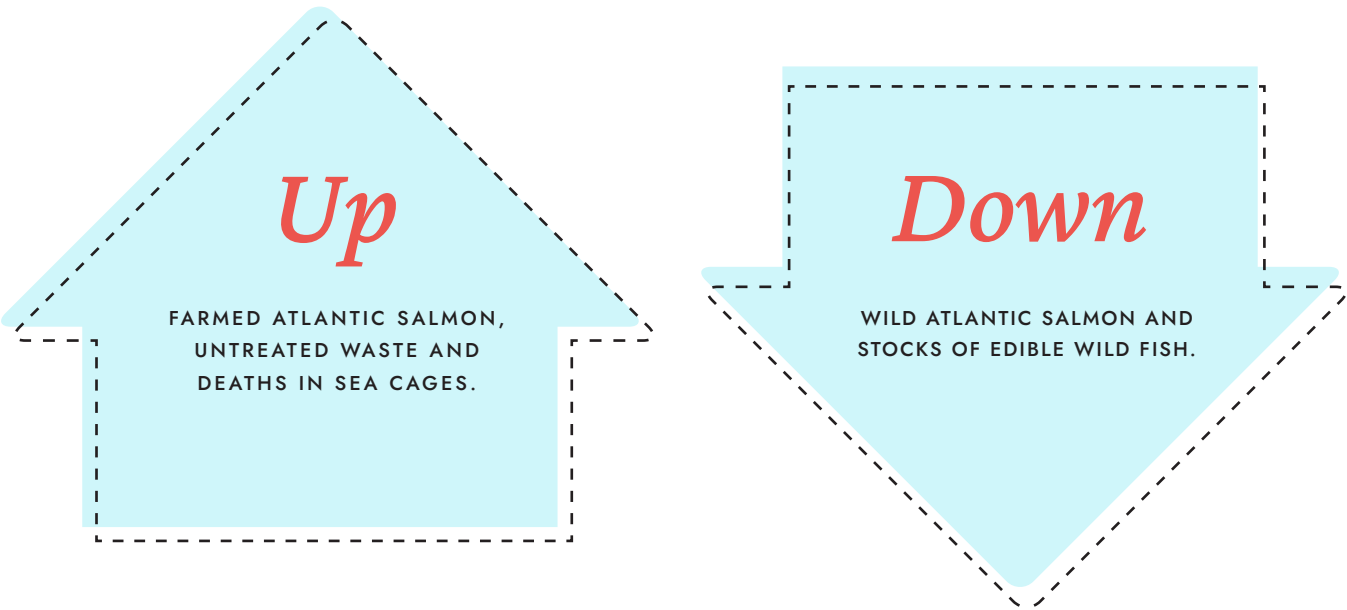
The public costs, on the other hand, are dispersed: forage fish stripped from West Africa, krill culled from Antarctica, pollution in Chilean, Scottish and Canadian waters and a wild salmon population collapsing across the North Atlantic.

### GLOBAL SEA CAGE FOOTPRINT



Where salmon farms are banned or being phased out: British Columbia (federal open-net phase-out), Washington State (Atlantic net-pen phase-out, 2022) and Argentina's Tierra del Fuego (the first jurisdiction to ban salmon farming, preventing it from starting, 2021).

# SALMON IS THE INDICATOR.



## BY KEY MEASURES, THE TRENDS ARE HEADING IN THE WRONG DIRECTION

| METRIC                       | THEN        | NOW                      |
|------------------------------|-------------|--------------------------|
| Farmed Atlantic salmon       | ~0 kt       | ▲ ~3,100 kt              |
| Wild Atlantic salmon         | ~12M (1974) | ▼ ~2.5M                  |
| Edible stocks in safe limits | 90% (1974)  | ▼ 62% (2021)             |
| Antarctic krill catch        | <100 kt     | ▲ ~518 kt                |
| Untreated farm waste         | ~0          | ▲ 600M people equivalent |
| Farmed salmon mortalities    | ~0          | ▲ 865M in a decade       |

## THE TIME FOR SEA CHANGE IS NOW.

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This system must evolve. Here's how we can work toward something more sustainable:

### 01. SCALE CLOSED-CONTAINMENT AND LAND-BASED SYSTEMS

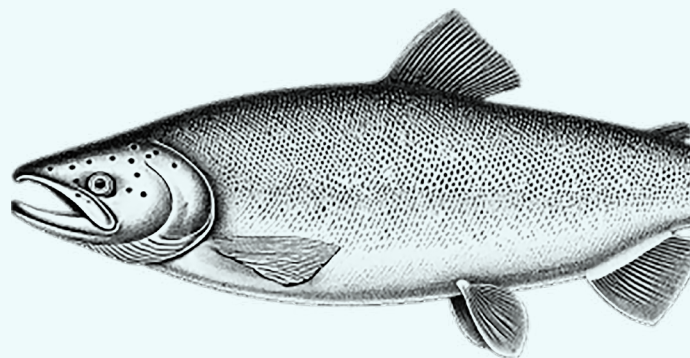
Recirculating Aquaculture Systems are closed, land-based systems that capture their own waste and end escapes and lice transfer.

#### In the meantime:

- Explore escape-liability insurance and cleanup bonding. Insurers already price catastrophic risk. Requiring operators to carry it prices the externality directly, instead of waiting on enforcement after the fact.
- Consider Norway's resource-rent tax as a template — proof that governments can treat aquaculture's outsized returns as a shared resource, not a private windfall.

#### Strengthen legal and regulatory levers:

- Tie existing sea-cage capacity to demonstrated environmental outcomes, supported by independent review.
- Institute real-time, third-party-verified escape reporting (satellite or independent observer requirement).
- Require free, prior and informed consent (FPIC) for new farm siting in or near Indigenous territorial waters.
- Strengthen enforceable limits on discharge, plastic pollution and antibiotic/pesticide use, with penalties that scale to the harm.



## 02. REDUCE DEPENDENCE ON SMALL FISH

Explore ways to reduce the share of feed drawn from wild fish and krill and accelerate the development and adoption of alternative feeds. This is one of the most significant opportunities to reduce pressure on ocean biomass while supporting food security for coastal communities. Encouraging progress is already being made, with new feeds potentially coming to market in the next three to five years.

## 03. STRENGTHEN FISH WELFARE

Consider how animal-welfare principles applied to land-based livestock could inform stronger standards for fish raised in sea cages.

## 04. USE THE MARKET TO REWARD BETTER OUTCOMES

Retailer and foodservice sourcing commitments, together with strengthened certification standards, can create incentives for better environmental outcomes.

## 05. INCREASE TRANSPARENCY AT THE POINT OF SALE

Explore clearer consumer-facing information about feed composition, antibiotic use and other environmental impacts, giving buyers greater transparency into how salmon is produced.

Rewiring the Hungry Machine will require a concerted effort by policymakers, business innovators, scientists, food system leaders in multiple countries and the aquaculture industry itself. But a leaner, cleaner, greener machine could help sustain us all: people, the planet, farmed fish, wild Atlantic salmon and billions of other sea creatures.



# SCIENCE IS SOUNDING THE ALARM.

This report synthesizes industry production data, national fish-health reports, intergovernmental fisheries science and peer-reviewed marine ecology. Figures stated as estimates carry real uncertainty and are flagged where they do. Where industry and independent scientists disagree, both are represented. Common over-claims have been corrected rather than repeated.

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