

Genetically engineered salmon: A threat to the environment and public health

Genetic engineering has been used primarily in crop plants to date, but more and more research is being done on genetically engineered animals, including fish. At least 35 species of genetically engineered fish are currently being developed around the world, including trout, tilapia, striped bass, flounder and salmon. These fish are being engineered for traits that make them better suited for fish farms (better known as aquaculture), such as faster growth, disease resistance and temperature tolerance. The genes engineered in these fish come from a variety of organisms, including other fish, coral, mice, bacteria and even humans. One of these fish — a genetically engineered salmon often referenced to as the “Frankenfish” — could soon appear on U.S. grocery shelves.

Genetically engineered super-salmon: Coming to a restaurant near you?

Despite insufficient food safety or environmental studies, the U.S. Food and Drug Administration announced that it is in the process of approving the AquaAdvantage Salmon, a genetically engineered Atlantic salmon produced by AquaBounty Technologies. The company originally submitted its application to the FDA in 2001 and the FDA announced in the summer of 2010 it was close to finalizing its approval of this fish — the first genetically engineered animal intended for human consumption.



The AquaAdvantage salmon, or “Frankenfish,” was developed by artificially combining growth hormone genes from Pacific salmon (*Oncorhynchus tshawytscha*) and DNA from the anti-freeze genes of an eel-like ocean pout (*Zoarces americanus*). This modification causes production of growth hormone year-round, creating a fish the company claims grows at twice the rate of conventionally farmed salmon, allowing factory fish farms to crowd fish into pens and still get high production rates.

Genetically engineered fish threaten the environment and wild salmon populations

Genetically engineered fish pose serious risks to wild populations of fish and our marine environment. Each year millions of farmed salmon escape from open-water net pens — outcompeting wild populations for resources and straining ecosystems. Even in land-based facilities farmed salmon have the ability to escape into the wild where they are virtually impossible to recover. Any approval of genetically engineered salmon would represent a serious threat to the survival of native salmon populations, many of which have already suffered severe declines thanks to salmon farms, over-fishing of wild populations, dam construction and other human activities.

Risk of escaped genetically engineered salmon

Escaped genetically engineered salmon can also lead to genetic pollution and a decline in population levels resulting from what scientists call the “Trojan gene” effect. Research published in the *Proceedings of the National Academy of Sciences* notes that a release of just 60 genetically engineered fish into a wild population of 60,000 would lead to the extinction of the wild population in less than 40 fish generations.¹ This is due to the mating advantage fish genetically engineered to grow quickly have over native fish



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despite the fact they are actually less fit to survive in the wild, as are their offspring. AquaBounty claims the “Trojan gene” effect will not apply to its salmon,² but other studies have noted that background genetics or behavior can change the likelihood of the “Trojan gene” effect, and suggest that in-depth risk assessment is crucial to understanding the potential risks of transgenic fish escape events.³ If the FDA opens this door, genetically engineered salmon will likely be among the millions of farmed salmon that escape every year. This could be the last blow to wild salmon stocks, many of which are already listed as endangered species.

Attempting to circumvent analyses of these dangers, AquaBounty has claimed that it will only raise its genetically engineered fish in land-based facilities. However, once the production of genetically engineered fish becomes commercialized, it will be impossible to control the whereabouts of every individual fish and assure compliance with appropriate containment measures. These fish are intended for use on a global scale and a reliable containment system following commercialization is just not conceivable. For example, according to a 2001 report from the Environmental Risk Management Authority in New Zealand, flaws in the safety system of the genetically engineered salmon tanks of the private company King Salmon were identified. In that case, genetically engineered salmon eggs could have come into contact with salmon sperm before escaping into the environment. This example highlights the difficulties in designing safety measures that are 100 percent effective.



Additionally, AquaBounty claims that it will only produce sterile females which would mitigate the risks from escaped genetically engineered salmon. However, the plan AquaBounty submitted to the FDA can only guarantee sterility for 95 percent of the eggs at a commercial scale.⁴ AquaBounty has claimed it has orders for 15 million eggs,⁵ meaning upwards of 750,000 fertile, genetically engineered salmon could be raised and escape from cage culture systems as the farming of these fish proliferates. Moreover, AquaBounty will need to keep stocks of fertile fish to produce new offspring. At present, the company’s breeding operation is on Prince Edward Island, a Canadian island in the area endangered Atlantic salmon have historically been found.

Genetically engineered salmon have been found to be more aggressive during food shortages, outcompeting wild salmon. Research from the Canadian department of fisheries on a related Coho salmon found that when food is scarce genetically engineered salmon are more aggressive in finding food and they can lead to a collapse of wild salmon populations. Genetically engineered salmon even resort to cannibalism when food is low.⁶

Climate change and warmer oceans may also give genetically engineered fish another advantage over wild populations. Research has found that genetically engineered salmon are better able to survive in warmer waters and to adapt to shifting environmental conditions than wild salmon.⁷ According to a report from Prince Edward Island’s Department of the Environment, “If the forecast trend in climate disruption continues, they can expect difficult times on Prince Edward Island ... In the last 10 years average temperatures in the province have been the warmest on record. Sea level has risen over 30 centimeters since 1911, and the frequency and severity of hurricanes and storm surges have increased noticeably.”⁸ So not only will there be more chances for genetically engineered salmon to escape their tanks on Prince Edward Island due to increased weather severity and rising sea levels, they will likely survive better than and outcompete wild salmon in a warming climate.

Draining the oceans to feed genetically engineered salmon

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Salmon aquaculture is already draining our oceans of wild fish — a problem that will only be exacerbated by the cultivation of genetically engineered fish. Because salmon are carnivorous, they are often fed wild fish that are harvested from the oceans, usually in the form of fish oil and fish meal. In 2006, 90 percent of small, prey fish captured worldwide were used to feed aquaculture-raised fish.⁹ These prey fish, including anchovies, herring and sardines, are at the base of the ocean food chain and are an important source of food for marine mammals, birds and larger fish. These smaller fish are also an important source of protein and livelihood for many communities around the world.¹⁰ Farmed salmon typically need to consume three pounds in order to gain a single pound, making them a highly inefficient way to produce protein for the world.¹¹

Salmon that are engineered to grow year round to reach market weight in half the time of non-genetically engineered salmon will require even more prey fish inputs. According to company data, the AquaAdvantage salmon may consume up to *five times more food* than its non-genetically engineered counterpart¹² due to the genetically engineered salmon's need to produce growth hormone year round.

Genetically engineered fish threaten human health

As the long-shelved AquaBounty transgenic salmon is the first genetically engineered animal intended for human consumption, the importance of thorough human health and environmental studies can not be understated. This animal should not be approved for human consumption until and unless further study, including a full federal environmental impact statement, indicates it is safe for consumers, native salmon populations and the environment.

Data on human health impacts of genetically engineered fish is sparse, but some recent studies provide cause for serious concern. For example, the routine use of antibiotics to control diseases often found in farm-raised fish may already be impacting human health. If AquaBounty is correct in claiming its genetically engineered fish are less fit¹³ than wild salmon, they may in turn be susceptible to more diseases than fish currently grown in aquaculture facilities.

Consequently, the amount of antibiotics given to transgenic fish may be higher than the amount given to non-genetically engineered farmed fish; already farmed salmon are given more antibiotics than any other livestock by weight. By eating farmed fish treated with antibiotics humans will be ingesting antibiotics that may be harmful. Indeed, some antibiotics are toxic to humans and can even cause fatal allergic reactions.¹⁴ Finally, the use of antibiotics in aquaculture also exacerbates the significant problem of antibiotic resistant bacteria. The human health concerns connected with the use of antibiotics in aquaculture, including the unique role transgenic fish may play in exacerbating such use, must be fully assessed by the FDA. Only one small study on one fish disease was done on the AquaAdvantage salmon. That study found that the AquaAdvantage salmon got sick faster than control salmon.¹⁵ The FDA's analysis of AquaBounty data also noted that increased prevalence inflamed tissues in these fish is most likely due to genetic engineering.

No federal laws specifically govern the regulation of genetically engineered animals

Instead of writing new laws to oversee the production and sale of genetically engineered animals, the FDA decided in 2001 to “regulate” them as “new animal drugs” under outdated animal drug laws written well before animal genetic engineering was conceptualized. The FDA claims that the foreign genes in genetically engineered salmon are a “drug” intended to change the physical properties of the fish — even though the genetically engineered fish are *less* healthy than wild salmon.



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To receive FDA approval to sell a genetically engineered fish, producers must complete a New Animal Drug Application and demonstrate the “efficacy” of the fish and the inserted genes. One major drawback to this regulatory approach is that New Animal Drug approval process is confidential and closed to the public until it is over, severely limiting the degree to which the public can participate in the regulatory process.

The FDA’s decision to go ahead with this approval process is misguided and dangerous. There is a great appetite for salmon, but the solution is not to “farm” genetically engineered versions; the solution is to work to bring our wild salmon populations — and the ecosystems they depend upon — back. The approval of transgenic fish will only exacerbate the problems facing wild fish and marine environments.

Friends of the Earth strongly opposes the commercialization of genetically engineered fish and is urging the FDA to reject AquaBounty’s “Frankenfish.” Should the FDA decide to approve the AquAdvantage genetically engineered salmon despite widespread public opposition, clear, mandatory labeling is an absolute must to allow consumers to make informed purchasing decisions.

What you can do: Get involved

Visit our website, www.foe.org, to get involved!

You can also send comments to the FDA, write a letter to the editor of your local paper, or send a letter to your representatives in Congress. Chefs, restaurants, food companies, retailers and seafood distributors can sign a Genetically Engineered Fish Pledge, promising not to intentionally purchase, sell or serve genetically engineered fish.

Write and call your representatives in Congress and ask them to support S. 230/H.R. 521 and S. 229/H.R. 520, which would prevent the approval of genetically engineered salmon or require that the FDA label the salmon as such!

Learn more at our coalition website, www.ge-fish.org.

Endnotes

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- 14 Rebecca Goldberg and Tracy Triplett. *Murky Waters: The Environmental Effects of Aquaculture in the U.S.* (p 44). *Environmental Defense Fund* (1997).
- 15 *Food and Drug Administration-VMAC Briefing Packet*, 2010, p.41.



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