

Terje Finstad

Pre-print, for final version, go to: <http://muse.jhu.edu/article/648251>

## **Naked Gene Salmon: Debating Fish, Genes and the Politics of Science in the Age of Publics**

In the early 1980s, a new creature saw the light of day in an application sent to the Norwegian Agricultural Research Council (NLVF) and, later, to the Norwegian Technical-Scientific Research Council (NTNF). These applications stated that the research project would develop techniques that could be used to produce a fast growing, healthy and meaty salmon for the aquaculture industry. The salmon was to be produced by injecting fertilized salmon eggs with new genetic material. A company, Marine Genetics, was later formed in cooperation with the company Selmer Sande, who, at the time, aimed to become the largest aquaculture actor in the world. I intend to tell the story of this fish and of its destiny at the end of the twentieth century and argue that the creatures of the biotech field should be investigated as creatures where epistemic, technological, social and political histories meet and mingle.<sup>1</sup>

In doing this, I relate to recent discourses on the intersection of organisms, technoscience and culture.<sup>2</sup> For instance, in 2001, the historian Edmund Russell posed the question, “Are animals technology?”, in an effort to show that many animals can be studied as products of anthropogenic evolution and that the perspectives developed within the history of technology are well suited for this.<sup>3</sup> Anthropologist Sarah Franklin broadened the perspective some years later, in her study of the genealogy of “Dolly the sheep.” She showed how Dolly was indeed a

---

<sup>1</sup> This article builds on my MA thesis: Terje Finstad, *Våte drømmer. Konstruksjonen av en genetisk modifisert fisk i Norge på 1980-tallet*.

<sup>2</sup> Tora Holmberg, *Investigating Human/Animal Relations in Science, Culture and Work*.

<sup>3</sup> Susan Schrepfer and Philip Scranton, *Industrializing Organisms*; Edmund Russell, *Evolutionary History*.

technology, but also a product of new technoscience and old agricultural practices, the British colonial empire, agro-industrial capitalism and public engagement.<sup>4</sup> In short, Dolly and her sibling creatures troubled the established notions of, and boundaries between, nature, culture, science, industry and politics. Dolly and her clones enacted debates about the very shape of our societies.<sup>5</sup> These works inspire this article's investigation of how the birth, life and death of a genetically modified salmon was woven into debates about the relationship between biotechnology and society.

Several scholars have written about breeding, animal technologies and human–animal relations, but not many have dealt with fish, and certainly not fish in connection with genetic engineering. This lack of interest in fish might be because they are seen as untamed natures that are not part of society.<sup>6</sup> The difficulties of building affective relations with fish might have made them less obvious as creatures embedded into social, political and cultural assemblies. This is unfortunate, as the aquaculture industry has tamed and bred salmon, turning them into a global export commodity. While the beginnings of the industry were small-scale and reliant upon local initiatives, it quickly turned to advanced science and high-tech engineering, and, during the 1980s, the industry exported fish all over the world.<sup>7</sup>

---

<sup>4</sup> Sarah Franklin, *Dolly Mixtures*.

<sup>5</sup> Donna Haraway, *Modest\_Witness@Second\_Millennium.FemaleMan©\_Meets\_OncoMouse*<sup>TM</sup>.

<sup>6</sup> Exceptions include: Joseph E. Taylor III, *Making Salmon*; Graham D. Burnett, *The Sounding of the Whale*; Gro B. Ween and Benedict J. Colombi, "Two Rivers."; Marianne Lien, *Becoming Salmon*.

<sup>7</sup> In 1997, the Norwegian aquaculture industry sold more than 300,000 tons of salmon. By 2011, the number had risen to 1.14 million tons. See Statistics Norway: <http://www.ssb.no/jord-skog-jakt-og-fiskeri/statistikker/fiskeoppdrett/aar/2012-12-03#content>.

However, although the industry went global, local publics still matter in shaping the new natures that form the backbone of the industry.<sup>8</sup>

The intersection between organisms, science, technology and society is a promising ground for the humanities in general and the history of technology in particular, as shown by a range of studies of the construction of animals in laboratories, agriculture and business.<sup>9</sup> Even so, few investigations have questioned how new animals are integrated into wider society and how they become part of processes where science-society relations are shaped. This is true even though the study of the integration of technology is a major part of the history of technology in general.<sup>10</sup>

One way to investigate the integration of new science and technology is to target controversies. Controversies can be seen as “fights” over the interpretation of something new and how it should be adapted to a particular context.<sup>11</sup> The sociologist Noortje Marres writes about how controversies contribute to the making of publics. According to her, the making of issues has escaped the attention of constructivist studies of science, technology and society. This is unfortunate, she claims, as the framings of issues are essential for the assembly of publics, and controversies often spring up around these issues. Publics, then, are not steady categories. They are continuously assembled around specific issues. For this reason, the framing of an issue shapes the kinds of publics that are assembled.<sup>12</sup> In line with this, controversies can be seen as processes where issues are articulated and contested. At stake is what the new issue is going to be, and for whom. Investigating the integration of a new animal

---

<sup>8</sup> Law, “And if the Global were Small and Noncoherent?”

<sup>9</sup> William Boyd, “Making Meat”; Rader, *Making Mice*.

<sup>10</sup> Donna Haraway, *When Species Meet*; Franklin, *Dolly Mixtures*; Hård and Jamison, *The Intellectual Appropriation of Technology. Discourses on modernity, 1900-1939*.

<sup>11</sup> Dorothy Nelkin, *Controversy*; Thomas F. Gieryn, *Cultural Boundaries of Science*.

<sup>12</sup> Noortje Marres, “The Issue Deserves More Credit.”

into society therefore means targeting controversies and showing how the animal, its publics and parts of society, are at stake in these controversies.

Thus, I will approach the genetically modified salmon as a boundary object rather than as a technology. Susan Leigh Star and James Griesemer developed the concept to explain how trappers, collectors, administrators and scientists at Berkley's museum of vertebrate zoology managed to cooperate even if they had differing interests and backgrounds. The museum was a boundary object that brought them together. These kinds of objects are, according to Leigh Star and Griesemer, flexible enough to satisfy the informational needs and interests of diverse actors, yet robust enough to maintain an identity across them. It is a concept aimed at capturing complex interactions between people, things and institutions.<sup>13</sup> While many researchers are more interested in these interactions in space rather than over time, Leigh Star has noted that over time, people tend to want to control and standardize boundary objects.<sup>14</sup> Similarly, Joan Fujimura also pointed out that the fluid character of boundary objects can make them unsuitable for stabilizing alliances or cooperation over time.<sup>15</sup> That is, the flexible and boundless nature of boundary objects, could make it difficult to know what and whose issue they belong to.<sup>16</sup>

Following these clues to the temporal dimensions of boundary objects, this article aims to show that it is a useful concept for historians analyzing complex assemblies of actors and objects over time, assemblies that seem typical of the biotechnology field and its creatures.<sup>17</sup>

---

<sup>13</sup> Susan Leigh Star and James Griesmer, "Institutional Ecology, 'Translations' and Boundary Objects."

<sup>14</sup> Susan Leigh Star, "This is not a boundary object".

<sup>15</sup> Joan H. Fujimura, *Crafting science*.

<sup>16</sup> Noortje Marres, "The Issue Deserves More Credit."

<sup>17</sup> Donna Haraway for example, has shown how the figure of the Oncomouse is a creature living at the crossroads between a range of field. Oncomouse is a creature deeply connected to science and medicine, but

The concept of boundary objects, I claim, makes it possible to tell stories about the creatures of the biotech field as more than technologies or epistemic creatures and shows that they are creatures in which epistemic, technological, and social and political histories are woven together. A second claim then, is that the boundary object concept might help us see how such creatures have been central in the shaping of biotech-society assemblies, as they can bring a wider public into this shaping process. Thus, although I agree that animals are treated as technologies in many technoscientific fields and can be studied as such, approaching them as boundary objects opens up even richer stories.

Drawing on these threads of inspiration and adapting them to a historical study, I will follow the represented fish through society and controversy and investigate how its integration into society turned into a reshaping of both the creature's identity and the boundaries of science in what can be named the "age of publics." We will see how the salmon was transformed from a creature living mainly in research funding applications to a creature that lived its life in a much broader Norwegian public sphere. As it escaped the safe confines of the research world, the salmon changed. From being presented as a potential innovation for a booming aquaculture industry, the salmon came to be presented as an example of unethical research in the new biotechnology field. In fact, representations of the salmon changed so much that, in the early 1990s, the salmon transformed into a zebrafish. This then is a story about a salmon that only existed as an idea in research funding applications, business plans, media articles and political documents, but that still had an impact on Norwegian society, politics and the biotechnology field.

### **Fishy Alliances**

---

also patent and legal systems, politics of life, death and gender, as well as deep seated cultural and mythical stories. See: Donna Haraway, *Modest\_Witness@Second\_Millennium.FemaleMan@\_Meets\_OncoMouse™*, 49-121.

The project that received research funding in 1984 was one that set out to make so-called naked gene transfers to fertilized salmon eggs. The project was initiated by Harald Skjervold, professor of livestock breeding at the National Agricultural College and one of the grand old men in Norwegian, and European, livestock breeding. Not only did he contribute significantly to the modernization of breeding after WWII by bringing in new technologies such as electronic data processing and computed tomography, he was also central in establishing and modernizing breeding organizations, journals, and research stations. In addition to being the creator of the modern Norwegian leaner pig, he was one of the first researchers to use salmon in breeding experiments. This involved him in the creation of a research-based aquaculture industry during the 1960s and 1970s. By the early 1980s, this industry was booming,<sup>18</sup> and his former students were placed in institutions dealing with breeding, health and development.<sup>19</sup> At this time, the breeding entrepreneur turned to genetic engineering and its promise for animal breeding.

Skjervold was the project initiator, but did not carry out the research. For that he recruited a group at the Department of Medical Biochemistry (DMB) at the University in Oslo (UiO). The project leader was a medical biochemist who, together with his colleague, was among the first Norwegian researchers to work on gene transfers. They recruited a gynecologist to be the project PhD student, because he “knew a lot about eggs.” The PhD student did most of the

---

<sup>18</sup> By 1985, the value of the salmon export, alone, was almost 1.4 billion Norwegian kroner and increasing. At the end of the 1980s, the aquaculture industry stood for about thirty percent of the total export value of all Norwegian fish produce. See Statistics Norway:

<https://www.ssb.no/statistikkbanken/SelectVarVal/Define.asp?MainTable=LaksOrret&KortNavnWeb=fiskeoppdrett&PLanguage=1&checked=true>.

<sup>19</sup> NBL: [http://snl.no/nbl\\_biografi/Harald\\_Skjervold/utdypning](http://snl.no/nbl_biografi/Harald_Skjervold/utdypning); Torben Hviid Nielsen et al., *Livets tre og kodenens kode*; Svein Overskott, *Teori og praksis*.

research, but they all shared an interest in studies of gene expression and function.<sup>20</sup> The project cooperated with the Svanøy Foundation and The Research Station for Salmon. The Svanøy Foundation had been established by the state, in cooperation with industrial and scientific actors, to do research and development (R&D) to further the economic potential of Norway's natural resources, with a particular focus on aquaculture. The Research Station for Salmon was the central institution in the Norwegian scientific fish breeding program, led by one of Skjervold's earlier students. These institutions were to provide expertise on the care of eggs, smolt, and fish.<sup>21</sup>

In the grant application, the researchers explained that they aimed at increasing “the growth potential/meat production in salmon using naked gene transfer” by isolating growth stimulating genes and injecting them into fertilized salmon eggs.<sup>22</sup> The researchers also needed to analyze whether, and in what way, the gene integrated into smolt and grown fish, and to conduct studies of the fish's growth rate, protein and fat composition, and ability to reproduce. Further, the application contained information about the “background, public needs, and utilitarian value” of the research. In this section, they stated that the biochemist Richard Palmiter and his group had transferred growth-stimulating genes to mice eggs to create mice that grew more than eighty percent faster than untreated mice. The researchers omitted the fact that the Palmiter group had worked with “human” genes, and simply stated that they wanted to carry out similar research and to introduce “useful” genes to fish eggs. Further, they specified which genes these might be in a very general way: “growth advancing genes, genes that slow down pubescence and genes that increase the resistance to disease.”<sup>23</sup>

---

<sup>20</sup> Peter Aleström, in discussion with the author; Kaare Gautvik, in discussion with the author.

<sup>21</sup> NBL: [http://nbl.snl.no/Harald\\_Skjervold/utdypning](http://nbl.snl.no/Harald_Skjervold/utdypning).

<sup>22</sup> Application 11.06.1985 from the project “Nakengenoverføring til egg fra laksefisk” to NTNf.

<sup>23</sup> Ibid.

If successful, the study had the potential to bring aquaculture into “a new phase where specific genetic treatments supplement familiar genetic methods.”<sup>24</sup>

In the early 1980s, the transfer of genes between species was at the cutting edge of genetic engineering. Palmiter’s research group was to be enrolled as reassurance that gene transfer would be possible, since they had previously managed to control the growth of animals without taking the long route of traditional breeding.<sup>25</sup> Also, the application – as well as the collaborative constellations of the project – showed that the project would target potential users from the very beginning. However, the researchers had their own interests. They were especially interested in growth hormones and hoped that the research would allow them to study the genes that produced growth hormones in humans. This is probably the reason why the research came to focus on genes producing growth hormones rather than those slowing pubescence or improving health. For the researchers, the project was a funding opportunity and the fish was a potentially new laboratory animal due to its speedy reproduction and growth.<sup>26</sup> The worlds of livestock breeding and biomedicine were to thus be united through the salmon.

The salmon served as an object around which differing interests could assemble and perhaps be satisfied. It could, at one and the same time, serve as a model for studying gene expression and as an experimental organism for developing breeding techniques for the aquaculture industry.<sup>27</sup> As such, the fish was a means of producing knowledge about more general biological processes and of developing new breeding techniques. Standard constructivist accounts of technology tend to focus on the ways in which various social groups fight to

---

<sup>24</sup> Ibid.

<sup>25</sup> Nielsen, *Livets tre og kodenets kode*.

<sup>26</sup> Peter Aleström, in discussion with the author; Kaare Gautvik, in discussion with the author.

<sup>27</sup> Rachel A. Ankeny and Sabina Leonelli, “What’s so Special About Model Organisms?”

narrow the number of possible interpretations of a technology and to stabilize it, but, in this case, there is no need for such a story line—the fish became an object around which differing interests could assemble.<sup>28</sup> Through its framing in the application, the fish became a boundary object.<sup>29</sup> Let us investigate this further in order to see how this fishy construction can be seen as a distributed enterprise, rather than the work of the researchers alone. In short, how did the fish express larger transformations in Norwegian society?

### **Distributing the Origin Story**

Boundary objects are flexible enough to satisfy the informational needs and interests of diverse actors, yet robust enough to maintain an identity across them. Thus, the concept explains how cooperation across “social worlds” is possible despite actors having differing interests.<sup>30</sup> However, identifying the fish as a boundary object or highlighting the many interpretations of the fish does not explain how a particular presentation of the research could have worked to convince partners and funding agencies.<sup>31</sup> Thus, it says little about the conditions of possibility in which the fish was produced in this particular way. In order to understand this, I will investigate how the project description was enacted through a network of actors, rather than a single actor or social group. In short, in the following, I will historicize the fish by investigating the conditions under which it was enacted as a boundary object and why the project description promoted a vision wherein the techniques were portrayed as useful for the aquaculture industry.

---

<sup>28</sup> Mol, *The Body Multiple*.

<sup>29</sup> Susan Leigh Star and James Griesmer, “Institutional Ecology, ‘Translations’ and Boundary Objects.”

<sup>30</sup> Ibid.

<sup>31</sup> Shapin, *The Scientific Life*.

Looking at Norwegian science policy reports from the early 1980s published by various research councils, one quickly sees that institutions shared a strong belief in the field of biotechnology. Many of the reports in this period agreed that the distance from basic research to practical application was especially short in biotechnology. Basic research promised almost immediate innovations, according to the research councils. These claims were not based on local developments, since the biotech field hardly existed in Norway at this time. Rather, they referred to developments in the United States, where firms had sprung out of biotech labs. The Norwegian research authorities thus wanted to promote and build national expertise in this booming field. Also, reports regularly stated that the biotech revolution would have consequences for animal breeding and aquaculture.<sup>32</sup> In the beginning of 1985, the Norwegian Parliament issued a white paper, “On research in Norway,” which described the road ahead. The paper identified five prioritized areas of funding, of which one was biotechnology. Biotechnology, it was claimed, would have enormous economic potential if research were to target fields in which Norway had “natural advantages,” such as aquaculture and the cultivation of sea animals.<sup>33</sup>

Thus, the salmon surfaced at a time when the relationship between biotechnology and society was developing. The field of research was seen to potentially serve society through developing “new products, and new enterprises.”<sup>34</sup> The research policy of the time was increasingly directed towards R&D, while “innovation” and “user orientation” were becoming buzzwords. One funding agency predicted that the world economy, with increased competition between nations, would require a strengthened effort towards utilizing advanced

---

<sup>32</sup> NAVF, *Rekombinant DNA i grunnforskning og anvendelse*; NLVF, *Bioteknologi i husdyrbruket*.

<sup>33</sup> Stortingsmelding (St.m.) no. 60, *Om forskningen i Norge*.

<sup>34</sup> *Ibid.*

technology in fields with considerable growth potential.<sup>35</sup> Biotechnology fit hand in glove with such discourses and, in the funding agency reports, it was portrayed as necessary for bringing the biotech revolution to Norway. Such beliefs also fed into media hype. This configuration of the biotech-society assembly seemed to dominate the early reception of biotechnology by research agencies, the media and, not least, researchers, who saw the potential to increase their research funding.<sup>36</sup> Thus, in its early life, the salmon research was presented to funding agencies that wanted to build a new field and pair it with the booming aquaculture industry and also a research policy aimed at satisfying what was presented as an innovation-hungry public.

The links between national science policy and the project were many. Harald Skjervold served on several of the committees reporting on the potential of biotechnology, while, at the same time, he was a member of a planning group for aquaculture that had been established by the NTNRF. He knew that the project's connections to aquaculture would make it attractive to the funding agencies. The very questions on the application form that was sent to the NTNRF referenced the focus of Norwegian research policy at the time. The application form contained various long-answer questions that asked applicants to describe their individual and institutional affiliation, as well as the project title, goals, budget, abstract, background, and, not least, *utility* and *user contact*. The application guided the way in which researchers could describe their projects and, at the same time, implied what was of interest to the funding agencies. The form included these questions about utility and user contact, but none relating to ethics, animal welfare or environmental considerations.<sup>37</sup>

---

<sup>35</sup> Norwegian Technical-Scientific Council (NTNR), *Årsberetning 1983*.

<sup>36</sup> Dorothy Nelkin and M. Susan Lindee, *The DNA Mystique*; Nielsen, *Livets tre og kodenes kode*.

<sup>37</sup> Application 11.06.1985.

The application form, then, cannot be reduced to a documentation of what the researchers wanted to research. Rather, it was a disciplining technology that shaped the presentation of the research and situated the research project into a broader policy context that the researchers were made to answer to. Through the form's standardized paragraphs, the funding agencies took part in the writing of the application and communicated their interests. In this way, the form was a material connection – or a mediator – between the researchers, the politicians and the bureaucracy that funded the research. It was as if the researchers, the research policy of the period, and the funding agency co-composed the salmon research presented in the application.<sup>38</sup> The salmon research as presented in the form was a result of meetings between the interests of the researchers, stories structured by bureaucratic procedures, a interpretation of the interests of the aquaculture industries and an imagined innovation-hungry public. As such, the represented salmon was a distributed creature whose origin was not solely within the researchers' minds. Rather, it was the child of a particular science–society assembly that existed in research policies and research documents at this particular time.

### **Becoming the Salmon of Tomorrow**

Though the salmon led a textual and conceptual life in the documents and strategies of the researchers, aquaculture actors, and funding organizations, it had not yet surfaced as a living, grown-up being within the laboratory. This did not matter to Skjervold, who expanded the project as he had planned before initiating the research. In 1983, he contacted Kjell Kleppe, a professor at the Department of Biochemistry at the University of Bergen, to investigate the possibility of establishing a company that could utilize biotechnology in salmon breeding.<sup>39</sup> Kleppe had been involved in making biotechnology a prioritized field in Norwegian research

---

<sup>38</sup> Don Brenneis, "Reforming Promise."

<sup>39</sup> Skjervold, "Genteknologi i husdyravlen."

policy and was central in the establishment of a shared biotech lab in Bergen, a hub for researchers from academia and industry. Kleppe had close ties to Selmer Sande, a company that was big in contract operations, real estate, offshore oil installations and aquaculture.<sup>40</sup>

The effort bore fruit and the two men managed to convince Selmer Sande to establish a company utilizing biotechnology in salmon breeding. In 1985, a new company, Norbio, was established in Bergen. Norbio developed vaccines for the aquaculture industry, but also worked to produce a new kind of salmon by utilizing the techniques developed by the researchers at the DMB. Soon, the latter effort was transferred to a new company called Marine Genetics. The companies Sea Farm and Sabico funded the enterprise. Sabico was part of the Selmer Sande system and coordinated its interests in aquaculture. These included Sea Farm, Noraqua, Biotech, and the planning and operation of fish farms in Canada, the US, Australia, Chile, Iceland, Bermuda, Portugal and Norway.<sup>41</sup> Marine Genetics was led by the director at the University of Bergen, Magne Lerheim, who was a firm believer in connecting private enterprise to university research – something that he, together with Kleppe, had facilitated when establishing the shared biotech lab. No wonder, then, that Marine Genetics was located there.<sup>42</sup>

So, together with Kleppe, Skjervold initiated the establishment of a biotech company by one of the largest aquaculture actors in Norway, which was supposed to produce research on gene transfers to salmon eggs. The establishment of this company represented a fusion between scientific and commercial interests and, as such, it was born out of the belief that

---

<sup>40</sup> NAVF, *Rekombinant DNA I grunnforskning og anvendelse*; Hatling, *Nasjonalt handlingsplan for bioteknologi*; “Felleslaboratoriet for bioteknologi,” *Teknisk Ukeblad*.

<sup>41</sup> Marine Genetics, *Foredling av laks ved bruk av molekylærmedisinske teknikker*.

<sup>42</sup> *Ibid.*; Geir K. Totland, in discussion with the author; Astrid Forland and Anders Haaland, *Universitetet i Bergens historie*.

biotechnology was a field in which the road between research and commercialization was very short. The imagined genetically modified salmon was associated with a very real creature that already was a major commodity in a booming fish farming industry, and as such could be used as leverage to produce investments in the new company and its research. As such, the establishment of this company, and the research it was going to do, shows how an imagined creature could serve as a resource linking scientific research and business interests. Skjervold had always been a keen believer in integrated research and was an experienced research entrepreneur through his close connection with the cooperative organizations of livestock farmers. However, while these organizations were grounded in cooperative ideals, the new company was a commercial company located outside the cooperative systems of Norwegian agriculture and fisheries.<sup>43</sup>

In Norway, the 1980s were a decade in which many formerly state owned companies were privatized, the credit sector was let loose, and the Labor Party took a marked turn to the right in its economic policies. What Francis Sejersted called “the happy moment of social democracy” was ending and a new era of neoliberal economic policy was making its mark. Selmer Sande managed to take advantage of the situation and grew to become one of the biggest companies in Norway. It had interests in several sectors, and one of its goals was to become the world’s largest actor in the aquaculture business. Marine Genetics, then, was part of this effort, funded mainly by credit loans from risk-willing Norwegian investment banks. The cooperative organization of livestock breeding was challenged as aquaculture and biotech hype fused with significant change in Norwegian politics.

What happened to the fish in this new company? The research conducted at Marine Genetics was similar to that conducted at the DMB, but the context differed. While the researchers at

---

<sup>43</sup> Risan, *NRFs politiske ryggrad*.

the DMB carried out exploratory research, Marine Genetics dealt with product innovation. This affected the presentation of the fish. In a description concerning the research, Marine Genetics wrote about the consequences of developing a new kind of salmon: “A salmon with improved growth and resistance to disease will contribute to more profitable production. This will increase the industry’s earnings and strengthen the place of Norwegian salmon farming in the international market.”<sup>44</sup> Marine Genetics constantly linked the potential salmon to calculations “proving” its economic worth claiming that if “we take as a starting point that there will be produced 120,000 tons of salmon in Norway in 1990 at a price of 35 NOK pr. kilogram, then the landed value is 4.2 billion NOK. Assuming that the total economy can be improved by 1% as a consequence of lower production costs, this amounts to 42 billion NOK.”<sup>45</sup> Further, the description stated that it was probable that “a salmon with improved growth and increased resistance towards disease would improve the total economy with several percent each.”<sup>46</sup>

This description was taken from a report aimed at both the NTNF and the owners of the new company. No doubt this immediate context affected the presentation just as the grant application form affected the research at IMB. Also, this report can be seen to speak to a larger context that certainly mattered to the owners. Due to deregulation of the credit markets in the late 1970s and early 1980s, venture capital was readily available, especially for innovative projects that could be linked to the new aquaculture industry. For investors and owners, knowledge, while laying the ground for innovation, was but one of many tools mobilized in the race for innovation.<sup>47</sup> Out of this race, the potential fish came to be

---

<sup>44</sup> Marine Genetics, *Foredling av laks ved bruk av molekylærmedisinske teknikker*, 4.

<sup>45</sup> *Ibid.*, 8.

<sup>46</sup> *Ibid.*

<sup>47</sup> Berge Furre, *Norsk historie, 1914-2000*.

represented as a product in its own right. True, the fish had been represented as a possible product in the project description at the DMB, as well, but in that report, the techniques had been the focus. In contrast, the report from the new company made the fish the central product, while the techniques of gene transfer were presented as simply tools. Through the report and its publics, “the salmon of tomorrow” rose up as a market creature destined for consumption. Soon after, this was challenged.

### **The Rise of Naked Gene Ethics**

In May 1985, the salmon research caught the attention of the Norwegian media when Skjervold arranged a press conference to explain that a gene had been successfully transferred from a mammal to a fish.<sup>48</sup> The newspaper *Aftenposten* wrote of the transfer as “very successful and unique,” and explained that the research promised a future in which genetic technologies could be used to fight disease in fish. It was emphasized that Skjervold, “famous for his achievements in livestock breeding and his path-breaking work regarding the breeding of fish,” had initiated the research.<sup>49</sup> That Skjervold focused on the health of fish and animals in his presentation to the media, even if the research focused on growth promotion, was no wonder. The aquaculture industry was struggling with immense disease problems as fish were domesticated, and the consumption of antibiotics had skyrocketed in tandem with the industry’s economic worth during the 1980s.<sup>50</sup> In this way, Skjervold was able to turn the

---

<sup>48</sup> Dagsrevyen 28.05.1985; Audgunn Oltedal, in discussion with the author; Peter Aleström, in discussion with the author.

<sup>49</sup> Einar Kr. Holtet, “Arvestoff overført fra dyr til fisk.”

<sup>50</sup> In 1985, the Norwegian aquaculture industry consumed more than 200 million human doses of antibiotics. Up to 50 tons of antibiotics were used a year. From 1990, the number decreased and, in 1994, the number was below 1 ton. See: Tore Midtvedt, “Antibiotika og fiskeoppdrett”; Morten Haugdahl, “25 år med utfordringer og endringer.”

media into a mediator promoting the idea of “the salmon of tomorrow.” Thus, he and the media were making science-business-fictions for what they imagined to be an innovation-hungry public interested in the same things as funding agencies and actors in the aquaculture industry.

The very next day, however, at a biotechnology conference, ethics became a major theme.

Jacob Jervell, professor of theology at the UiO, wanted ethical regulations of biotech research because, as he saw it, the problems raised by the field were comparable to those that had been previously faced by nuclear physicists.<sup>51</sup> Jervell had expressed these concerns before, claiming that the manipulation of genes allowed for a problematic regulation of creation.<sup>52</sup>

Audgunn Oltedal, a journalist at the Norwegian Broadcasting Corporation (NRK) and former editor of the Socialist Left’s newspaper, attended the same conference. She also wanted a debate about the social and ethical aspects of the biotech revolution. This was stimulated by her discovery that the genes used by the researchers at IMB had been derived from humans. In fact, two of the researchers had visited Palmiter’s laboratory and received the same genetic material that he had transferred to his mice, which was composed of “human” genetic materials. Learning this, Oltedal broke the news at the national broadcasting company’s evening news the very same evening, stating that a “human growth hormone gene” had been transferred to salmon eggs. Jervell was interviewed, and he stated that he found the research ethically disturbing.<sup>53</sup>

---

<sup>51</sup> Dagsrevyen 28.05.1985; Audgunn Oltedal, in discussion with the author; Peter Aleström, in discussion with the author.

<sup>52</sup> Gisle Hollekim, “Genetisk forskning, trussel eller triumf?”

<sup>53</sup> Dagsrevyen 29.05.1985; Audgunn Oltedal, in discussion with the author; Audgunn Oltedal and Kristin Aalen Hunsager, *Inn i genalderen*.

Here we have a kind of biotech–society assembly that differed from the one of research, business, and policy. Jervell and Oltedal were not particularly concerned with the specific research on salmon, but instead wanted a debate about the ethics of biotech research in general. The salmon research could be used to bring up other matters of concern than those of industry and economics. The “undressing” of the gene opened the ethical debate that Jervell and Oltedal wanted, because it showed how the new techniques and knowledge blurred what were seen as “sacred” and “natural” boundaries between kinds of creatures. The gene, interpreted as human, connected the salmon to a discourse regarding human worth. This intervention by the theologian and journalist can be viewed as an attempt to create broader public engagement in the ethical issues related to the new biotechnologies.

In the same evening news show, Skjervold claimed that the use of human growth hormone genes was unproblematic as long as the research was conducted inside the laboratory. The leader of the Supervisory Board for Recombinant DNA-research (the only organ to evaluate and regulate biotech research in Norway at the time), Wenche Blix Gundersen, agreed and assumed that the research was safe. The Supervisory Board consisted of people working within the field.<sup>54</sup> Skjervold also started to write a book about the new biotechnologies, which was published the next year. In the book, he claimed that the biotech field had interested the media and led to a “flourishing of a literature close to science fiction,” which made it difficult for unskilled readers to evaluate what was real and what was fiction. His book claimed to give readers a base from which to evaluate the development in a more “rational” way.<sup>55</sup> The controversy also fed into the researchers’ progress report to the NTNF, which stated that the “research that so far has been conducted using human growth hormone genes has been necessary to develop and show that our techniques and model works” but that “fish growth

---

<sup>54</sup> Dagsrevyen 29.05.1985.

<sup>55</sup> Harald Skjervold, *Genteknikk, arv på en ny måte*.

hormone genes will be of greater value.”<sup>56</sup> They were therefore establishing a new cooperation with a group at the Norwegian Technical University (NTU) that was to make a “genetic library” of Atlantic salmon and aim at isolating fish genes for further R&D. The fish entering industrial use would thus contain only fish genes.<sup>57</sup>

Thus, the origin of the gene became important as the research went public. In a later interview, one of the researchers maintained that genes are the same even if they are taken out of “salmon and green peas or humans”; what makes the difference is the “sequence of the information or building blocks.”<sup>58</sup> This conceptualization of genes is probably why the controversy came as a surprise to Skjervold and the researchers. Also keep in mind that the research conducted at the DMB was inherently unclear in its agenda and that it was very difficult to say what the salmon “really” was. While Skjervold saw and promoted a project that would develop techniques to be used in the future breeding of salmon and developing the salmon of tomorrow, the researchers were mostly interested in gene expression and the salmon as a new laboratory animal for their biomedical research. While the salmon, or rather the imaginary salmon, had thus far acted as a boundary object that united the separate interests, Skjervold and the researchers now had to build boundaries between the laboratory and industry if their science-business-fictions were not to be overtaken by another narrative.

Thus, through the controversy, the fish in the laboratory and the potential “salmon of tomorrow” became separate figures. While the porous boundaries between laboratory and society (in the form of an imagined public eager for innovation) had been an argument for the research at the start of the project, a separation between the laboratory and the wider society was now constructed in an attempt to define who could speak about the research and the

---

<sup>56</sup> Progress report 11.06.1986; letter 13.06.1986.

<sup>57</sup> Ibid.

<sup>58</sup> Kaare Gautvik, in discussion with the author.

relevant surrounding issues.<sup>59</sup> We can say that the fish, by the contestations brought forth by Jervell and Oltedal, was in danger of becoming part of a much wider issue than it had been through the funding applications and researcher reports. It was about to become a boundary object assembling not only the interests of researchers, funding organizations, and industrial interests, but also a public debating the ethics of such research.

### **A Hungry Mink and the Parliament**

If the “ethicists” did not catch the fish at first cast, a hungry mink would. As the fish eggs grew into smolt and were transferred to pools, the researchers prepared to analyze if the genetic material was incorporated into the smolt. However, a mink entered the facility and became the first being in Norway, and possibly the world, to get a taste of the (possibly) genetically modified salmon. And it did a good job preserving its unique status, as it ate every single specimen.<sup>60</sup> This slowed the research, but the researchers later received funding to transfer growth hormone-producing genes to eggs from plaice. This was a collaborative project that included researchers from the Department of Biotechnology at the Norwegian Technical University and the company SINTEF’s Aquaculture group. A company, NorGen, was established to deal with future product development.<sup>61</sup> New eggs were injected with genes, and everything seemed to be on track despite the unfortunate visit paid by an uninvited dinner guest.

However, just a few months later, and basically synchronous with the establishment of the new company, a bomb hit the research as the NRK premiered a series of television and radio

---

<sup>59</sup> Gieryn, *Cultural Boundaries*.

<sup>60</sup> Progress report 11.06.1986.

<sup>61</sup> Application 27.02.1987; grant letter 03.07.1987; NorGen, Note to shareholders; NorGen, Description of the company.

shows about the new biotechnologies. One of the shows focused on attempts to produce “super animals,” and the audience met a pig that had been modified with human growth hormone genes, and was also introduced to the salmon research.<sup>62</sup> Later that evening, the NRK broadcast a debate in which actors from agriculture and research discussed the ethics of transgenic organisms.<sup>63</sup> Several actors entered the debate. The Norwegian Synod and the Smallholders Union criticized the fact that the development of the biotech field had been left to experts and industrial interests.<sup>64</sup> A book published by Audgunn Oltedal and her colleague Kristin Aalen Hunsager in 1988 summarized much of the criticism. The book discussed futures faced in the age of the gene and claimed that neither experts nor the authors should decide how to utilize and control the new techniques; this was the task of politicians and a much wider public than the one including only funding agencies, business interests, and other innovation-oriented actors. They explicitly used the salmon project as a case for showing how the biotech field had been ridden by a productivity craze.<sup>65</sup>

The media was not simply mediating, as if they ever were; they were translating the salmon that the researchers had represented as a potential innovation into a creature that could be used as focus in a debate about ethics. This was stirred up by a political debate about a new law concerning assisted conception that quickly turned into a more general debate about the ethical, legal and social sides of the new biotechnologies. As a consequence of this debate, a committee was given the task of reporting on the environmental, ethical and medical

---

<sup>62</sup> Oltedal and Hunsager, *Inn i genalderen*.

<sup>63</sup> Margrethe Soløy, “Genteknologi.”

<sup>64</sup> Norges Bonde- og Småbrukerlag, *Innstilling om bioteknologi*; Erik Solheim, “Ta bioteknikken på alvor!”; Oltedal and Hunsager, *Inn i genalderen*.

<sup>65</sup> Oltedal and Hunsager, *Inn i genalderen*.

consequences of the new biotechnologies.<sup>66</sup> However, the committee was criticized for being too slow and the salmon research was used as an example of politics lagging behind science. This was followed by parliamentary debates in which representatives of the Socialist Left and Christian Democrats took the lead in criticizing what they saw as the responsible ministers, particularly the Minister of Agriculture and the Minister of Social Affairs (both from the Labor Party that was in power, with Gro Harlem Brundtland as prime minister). The critique took as its point of departure the agricultural traditions that were being challenged by the new alliances in the biotech field and the ethical aspects of moving genes between species. Both ministers replied that they did not yet know enough to answer properly, but that a committee had been established and an investigation was underway.<sup>67</sup>

Furthermore, the Christian Democrats suggested a temporary law over biotechnological R&D. They wanted a quick ban on gene transfers between humans and animals and on the patenting of life.<sup>68</sup> The media entered the debate and predicted that the government would receive harsh criticism for its slow handling of the questions. In the parliamentary debate that followed, it is possible to see two sides, with the first represented by the Christian Democrats, the Socialist Left and some members of the Centre Party, and the other represented by the Labor Party, the Conservatives and the Liberals. The first group emphasized the precautionary principle and wanted regulation as soon as possible, whereas the latter group feared that Norway would lose the international race for new drugs and products. The salmon was brought in by Kjell Magne Bondevik, parliamentary leader of the Christian Democrats, as an example of the need for

---

<sup>66</sup> NOU, *Moderne Bioteknologi, sikkerhet, helse og miljø*; NOU, *Mennesker og bioteknologi*.

<sup>67</sup> Stortingstidende (St.t.) 7b (1987/1988): 1986–1987; St.t. 7a (1988/1989): 1668.

<sup>68</sup> Innstilling til Stortinget (Innst. St.) 6a no. 99 (1988/1989).

stricter regulations.<sup>69</sup> Even the Prime Minister, Gro Harlem Brundtland, admitted that biotechnology – and especially the transfer of genes – posed large ethical questions.<sup>70</sup>

The alliance between the Socialists and the Christian Democrats might seem odd, but the Socialists had broken out of Labor in the 1960s due to the latter's friendliness to the US, its centralistic tendencies and focus upon rationalization. Instead of Labor's technocratic politics, the Socialists came to propose a populist program based on politics from below and the empowerment of local communities. Thus, the biotech debate followed a pattern that was, and is, quite common in Norwegian politics. While the Socialist Left and the Christian Democrats had a tradition of being critical of economic rationalizations and new technologies, the Labor Party especially, but also the Conservatives, had a tradition of being optimistic in questions concerning science and technology and centralist in economic matters. Such alliances had previously formed, for instance, over questions regarding the industrialization of fisheries and the building of hydroelectric dams.

In the biotech debates, the critical alliance used the salmon research as an example of development gone awry. First, the salmon research represented a problem in accordance with Norwegian agricultural traditions, where the use of growth hormones for increasing animals' growth had long been banned. Expert rule and industrialization were met with significant skepticism from farmers' cooperatives and unions. Science had long played a part in the fields of agriculture and aquaculture, but in cooperation with farmers' organizations, not with private capital. Second, the research was problematized for being unethical due to the blending of species. This was based on religious and humanist views, held by both the Socialists and the Christian Democrats, in which "human worth" was a key concept. In this

---

<sup>69</sup> St.t. 7b (1988/1989): 2752–2772.

<sup>70</sup> *Ibid.*: 3697.

regard, we can say that the various science–society assemblies imploded as the represented fish travelled into the realm of parliamentary politics. First of all, the researchers brought together research and business into one assembly, and then, as publics formed around their representation of the fish through a kind of ethics assembly, the researchers tried to separate it again by keeping “social aspects” out.

### **From Boundary Object to Bounded Creature**

By the time the committee delivered its report to the government, the salmon research had been terminated. In a memo found in the project folder dated 1992, the research council stated that the results would not be pursued due to the expectation of stricter regulations on the use of transgenic fish.<sup>71</sup> In 1989, the Conservatives seized power, together with the Christian Democrats and the Center Party. However this was a short-lived government, as it lasted only one year before Labor took over again. Even so, the tide in regard to biotechnology seemed to turn, as work on the establishment of a law to regulate the field of biotechnology neared an end. Ultimately, this work resulted in two laws. The first, the Gene Technology Act of 1993, was a law regulating the use and production of genetically modified organisms outside of the laboratory, while the other law (established the year after), the Biotechnology Act, regulated the medical and laboratory use of biotechnologies.<sup>72</sup>

These laws bear witness to a process wherein the new biotech field was becoming integrated into Norwegian society. The laws represent a reorganization of what had seemed like a boundless field in which medical and agricultural research, science and industry, basic research and innovation went hand in hand or were two sides of the same coin. With the laws, new separations between basic human medical research and agricultural and commercial

---

<sup>71</sup> End report 22.4.1988.

<sup>72</sup> Nielsen, *Livets tre og kodenes kode*.

research were instituted. The lawmaking process was a form of boundary work in which a new field of R&D was being ordered; this had consequences for the salmon research. While the salmon research could have fallen under both laws (as the researchers at IMB were mainly interested in using salmon as a laboratory animal in their research), the framing of the project as closely connected to the aquaculture industry brought it under the Gene Technology Act. The law, which was later characterized as the strictest law in the world, prohibited the transfer of genes from humans to animals for non-scientific purposes and set strict regulations on the use of GMOs outside the laboratory.<sup>73</sup> It would seem that the “salmon of tomorrow” died as the new law reordered and stabilized biotech–society relations in a way that made the fish an impossible boundary object.

However, a report written by the researchers during the controversies in parliament reveals another ending to the story than the one suggested above. In the report, the researchers state that they had “found it practical to develop the micro injection technique for zebrafish eggs.”<sup>74</sup> They argued that this fish was suitable, as it grew faster than salmon, and that it would be a “model system for the testing of gene constructions that can be transferred to salmon” so they would not “have to wait for months and years before getting the results of the experiments as one had to if only salmon were used.”<sup>75</sup> While other documents show that the research was stopped, this report shows that “the salmon of tomorrow” was turned into a zebrafish, one of today’s most popular biomedical model organisms. This creature entered biomedical laboratories in heaps in the early 1990s, in the decade when the very word “model organism” began to appear.<sup>76</sup> As such, the transfer from a salmon to a zebrafish model was in

---

<sup>73</sup> Nielsen, *Livets tre og kodenes kode*.

<sup>74</sup> Progress report 14.06.1988.

<sup>75</sup> Ibid.

<sup>76</sup> Ankeny and Leonelli, “What’s so Special About Model Organisms?”

accordance with larger trends within the life sciences as creatures like zebrafish, e-coli and banana flies were becoming the main laboratory creatures.

Thus it is possible to conclude that the switch to zebrafish was a purely scientific switch that was in line with the current trends within the life sciences. Zebrafish breed faster than salmon and are, as such, more suitable as laboratory animals or model organisms than are salmon. Also, they are easier to keep, because of their size. The switch, then, can be seen to have been purely pragmatic. However, if we look beyond the reports and investigate this in a wider context, we see that this interpretation is not satisfactory. For instance, one of the researchers claimed that the zebrafish was excellent because “it’s not used for food, and thus we and our research on the fish cannot be suspected for making some kind of monster fish, or something useful in an industrial sense.”<sup>77</sup> Here we see that the zebrafish allowed the researchers to distance their research from industrial R&D and to reframe it as basic biomedical research. As such, it was regulated not by the Gene Technology Act, but by the Biotechnology Act, a law that did not impose strict restrictions on the transfer of genes. Thus, it might seem that the legal reordering of the biotech field had significantly affected and transformed the research.

The histories of the fish played a major part in this parliamentary process, as it had when Skjervold worked to establish Marine Genetics. Salmon had a long history of entanglement with hungry humans, while zebrafish were about to become heroes in stories about the improvement of human health. For the researchers, both creatures were models for studying genes for a future farm salmon, but their histories and entanglements sent them down different paths through society. The switch to zebrafish was not only motivated by epistemic considerations, but also by changes in the politics of biotechnology that had been brought about by the prospect of a new organization of the biotech field and the rise of a critical

---

<sup>77</sup> Peter Aleström, in discussion with the author.

public. The irony, of course, is that the grand visions concerning the short distance between research and innovation served as a legitimization of the regulations. The “usefulness” of the biotech field started out as an argument for funding such research, but ended up as an argument for intervention.

So, the discourse of biotechnology significantly changed during the 1980s, and ethics became a major issue. Ethical expertise entered the public stage and new laws were made. However, even if the salmon research had lost its funding due to stricter restrictions on the industrial use of genetically modified fish, the use of fish as a model organism in biomedical research was able to continue. And it did, as one of the researchers involved in the salmon project became one of the leading providers of zebrafish models to Norwegian biomedical research.<sup>78</sup> Today, zebrafish are models in research on the genetics of human and animal disease. While “the salmon of tomorrow” became unwanted due to its human gene, the zebrafish was seen to be confined to the laboratory and became a model for, amongst other species, the human. The controversy might have ended with new laws, but the history of the fish continued.<sup>79</sup> The genetically modified salmon transformed into a zebrafish. Thus, it was the beginnings of what can be seen as the afterlife of the salmon. Furthermore, the story about the naked gene salmon’s life and death is in fact the history of how a specific model organism was integrated into society as a perceived laboratory-bound creature.

### **Debating Fish, Genes and the Politics of Science in the Age of Publics**

---

<sup>78</sup>Andreas Tjerneshaugen, “Slik bruker de genmodifiserte fisker” and “Den stripete supermodellen.” See also the web pages of the Research Council and the Norwegian School of Veterinary Science (NSVS); NSVS: “Zebrafish Model in Functional Genomics.”

<sup>79</sup> In fact, “the salmon of tomorrow” seem to have re-emerged as the AquaAdvantage salmon in North America in the first decade of the 2000s.

In this article, we have seen that new means for the production of animals and knowledge were introduced in the 1980s, and that this caused heated debates about human worth, ethics, and science–society relations. For the critics, techniques for transferring genes between species seemed to transgress what they saw as a holy separation between animal and human, and science, business, and politics. For others, the techniques and the resulting creatures were means by which the wealth of the nation could be secured in a future in which global competition would increase. In both versions, the salmon signaled futures in which the relation between humans and kindred beings was at the center of social transformation. The salmon was, at one and the same time, a creature of promise and a monster.

By following the representations of the fish as they travelled from the grant application and the laboratory into various publics, this article has shown how a creature born out of the biotech hype of the 1980s was transformed through controversies. As we have seen, the question of biotechnology was, from the very start, a public issue in Norway. The public controversies concerned what and whose issue it was going to be. As such, the 1980s can be termed the “age of publics.” It was through the contestations of established biotech–society assemblies, in which economic gain was the issue and industrial and commercial actors were the publics, that the fish changed. By “following the fish” on its swim through varying assemblies, this story holds a somewhat different perspective on the construction of “animal technologies” than do studies that have followed researchers, entrepreneurs, and so on. It differs in that it twists what could easily have been a story about a failed innovation into one of the prehistory of the successful integration of a model organism into society. As such, this article argues for investigating the way in which animals are integrated into society, in addition to focusing on them as inventions or innovations. This can shed interesting new light on the biography of model organisms and other creatures that are normally seen as epistemic creatures without social or political histories.

