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Postprint

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Citation for the original published paper (version of record):

**Storm, A. (2018)**

**Atomic Fish: Sublime and Non-Sublime Nuclear Nature Imaginaries**

*Azimuth*, VI(12): 59-75

Access to the published version may require subscription.

N.B. When citing this work, cite the original published paper.

Permanent link to this version:

<http://urn.kb.se/resolve?urn=urn:nbn:se:kth:diva-264592>

Pre-print version of

Storm, A. (2018). Atomic Fish: Sublime and Non-Sublime Nuclear Nature Imaginaries. In: Rispoli G. & Rosol C. (Eds.), *Technology and the Sublime*, Azimuth VI/12, 59-75.

## ATOMIC FISH

### SUBLIME AND NON-SUBLIME NUCLEAR NATURE IMAGINARIES

#### Introduction

In the decades after the Second World War, US nuclear bomb tests were staged as spectacular public events within a long established popular quest for experiencing the technological sublime.<sup>1</sup> After one such test, in 1946, a seemingly healthy surgeonfish proved to be radioactively contaminated when it produced its own x-ray image. As part of the wide-ranging scientific investigations surrounding the bomb tests, the fish had been caught and placed on a photographic plate overnight, leaving behind a radiographic photo. This particular image was a key factor contributing to the decision to immediately halt ongoing clean-up work at the site, in order to protect the workers from radiation.<sup>2</sup> The so-called autoradiograph thus became a visualisation of the invisible dangers of nuclear energy.

The spectators' experience of the sublime moment of the bomb test, similar to experiencing the terrifying and irresistible force of a hurricane or volcano from a safe distance, was thus followed by a materialized imprint of the test's consequences for the fish. The bright parts of the fish photo, rendering a meal of radioactive algae as well as plutonium distributed throughout the body, conveyed a worrying message about the creation of nuclear natures and the impact of nuclear nature imaginaries – a message that is still topical today.<sup>3</sup>

In this article, the sublime characteristics of nuclear technology will be examined and challenged not only through the essential contradiction of a nuclear sublime per se, as has been pointed out in previous research,<sup>4</sup> but also through the articulation of an underlying tension between sublime and non-sublime nuclear nature imaginaries. Through a focus on atomic fish, in connection with nuclear energy production rather than nuclear weapons, I will explore the role of non-sublime, mundane and

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<sup>1</sup> David E. Nye, *American Technological Sublime* (Cambridge, Mass.: MIT Press, 1994) 233f.

<sup>2</sup> Jonathan M. Weisgall, *Operation Crossroads: The Atomic Tests at Bikini Atoll* (Annapolis, Md.: Naval Institute Press, 1994) 119, 242; Joseph Masco, *The Nuclear Borderlands: The Manhattan Project in Post-Cold War New Mexico* (Princeton, N.J.: Princeton University Press, 2006) 303–307.

<sup>3</sup> For a similar perspective, see Masco, *The Nuclear Borderlands*, 292.

<sup>4</sup> Nye, *American Technological Sublime*, 255.

everyday human practices and imaginaries in relation to a persisting sublime nuclear imaginary.<sup>5</sup> It will be a story of oscillations between trust and fear, between the exceptional and the everyday, and between the wild and the domesticated. The empirical material consists of archival documents, interviews and on-site observations. These were gathered primarily in Sweden, a country that early on had high ambitions for nuclear power, as well as a high percentage of nuclear power in its energy mix.<sup>6</sup>

What sublime and non-sublime nuclear nature imaginaries become visible through the lens of historic and contemporary atomic fish practices? To be able to scrutinize this issue, we need to make a move ‘from terror and toward control’, which David Nye has pointed out as a ‘central characteristic of the technological sublime’.<sup>7</sup> Nye continues: ‘Atomic power reaffirmed man’s control over nature, both in the awesome explosions of the bomb and even more impressively (it was thought) in the use of this power for peaceful purposes’.<sup>8</sup> This control, I suggest, can be termed a containment of the exceptional.

### Containment of the exceptional

Since 1945, nuclear technology has been understood to be exceptional. The splitting of the atom created, as Gabrielle Hecht formulates it, ‘rupture in nature’s very building blocks’,<sup>9</sup> and the atomic bomb had unrivalled geopolitical implications. Nuclear dangers were seen as ‘qualitatively and quantitatively distinct [and] never-before-encountered’,<sup>10</sup> while nuclear benefits promised a future with not only unlimited energy for free, where ‘people would soon drive their cars for a year “on a pellet of atomic energy the size of a vitamin pill”’,<sup>11</sup> but also truly revolutionary potential for medical and food treatment. In short, nuclear technology was regarded as ontologically distinct, and this exceptionality was emphasized by both its proponents and its critics. In a wider historical and environmental context as well, nuclear technology is seen as an outstanding transformative power, as

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<sup>5</sup> I acknowledge that combining the ‘sublime’ and ‘imaginaries’ may present a logical problem, since the sublime denotes an all-senses experience, while imaginaries operate between imagination and action, but I still found this approach reasonable and productive as it relates to the purpose of this text.

<sup>6</sup> Arne Kaijser, ‘From Tile Stoves to Nuclear Plants – The History of Swedish Energy Systems’ in *Building Sustainable Energy Systems: Swedish Experiences*, ed. Semida Silveira (Stockholm: Svensk byggtjänst, 2001); Per Högselius and Arne Kaijser, *När folkhemselen blev internationell: Elavregleringen i historiskt perspektiv* (Stockholm: SNS Förlag, 2007); Anna Storm, *Post-industrial Landscape Scars* (New York, NY: Palgrave Macmillan, 2014) 50f.

<sup>7</sup> Nye, *American Technological Sublime*, 234f.

<sup>8</sup> *Ibid.*, 235.

<sup>9</sup> Gabrielle Hecht, ‘Nuclear Ontologies’, *Constellations* 13, no. 3 (2006) 321.

<sup>10</sup> *Ibid.*, 321.

<sup>11</sup> Daniel Ford, *The Cult of the Atom*, quoted in Nye, *American Technological Sublime*, 234.

indicated by the suggestion that the first detonation of a nuclear weapon should count as the beginning of the human geological era, the Anthropocene.<sup>12</sup>

Nuclear exceptionalism has often been expressed in the context of various biological, environmental or, as I call them here, nature imaginaries. In the utopian nuclear future, on the one hand, we practiced atomic gardening to design the best crops and plants,<sup>13</sup> artificial suns made it possible to grow vegetables indoors, and holiday resorts could guarantee enjoyable weather.<sup>14</sup> As for the dystopian nuclear future, on the other hand, scientists warned about ‘nuclear winter’<sup>15</sup>, and environmental horror movies excelled in depicting animal mutants and forever contaminated and deserted lands.<sup>16</sup> More recently, exceptional perspectives of eternity and future responsibilities concerning nuclear waste storage include not only potential societal institutions and physical markers carrying information to future generations, but also centuries and millennia of envisioned interaction with non-human elements like bedrock and clay, and even animals.<sup>17</sup>

Based on their concept of ‘sociotechnical imaginaries’, Sheila Jasanoff and Sang-Hyun Kim suggest that the dominant imaginary of nuclear technology in the US-Western world context is one of containment.<sup>18</sup> The genie in the bottle that was let out in the Second World War atomic bombings was to be contained within the realms of the peaceful atom – the move from terror to control, in Nye’s words – which implied a clear separation between nuclear weapons and commercial nuclear power production. This imaginary also included the containment of public fears – by means of expert and political reassurances of nuclear safety, and through laws on, for example, economic insurance related to worst-case accident scenarios – as well as the containment of radioactivity, with a focus on reliable waste disposal.

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<sup>12</sup> Sverker Sörlin, *Antropocen: en essä om människans tidsålder* (Stockholm: Weyler, 2017) 145ff; see also Masco, *The Nuclear Borderlands*, 1, 299, 313, 315.

<sup>13</sup> Helen Anne Curry, *Evolution Made to Order: Plant Breeding and Technological Innovation in Twentieth-Century America* (University of Chicago Press, 2016) 180ff.

<sup>14</sup> Ford quoted in Nye, *American Technological Sublime*, 234.

<sup>15</sup> Eglė Rindzevičiūtė, *The Power of Systems: How Policy Sciences Opened Up the Cold War World* (Ithaca: Cornell University Press, 2016) 150ff.

<sup>16</sup> William M. Tsutsui, ‘Looking Straight at “Them!” Understanding the Big Bug Movies of the 1950s’ in *Environmental History*, Vol. 12, No. 2 (Apr., 2007); Jerome F. Shapiro, *Atomic Bomb Cinema: The Apocalyptic Imagination on Film*. E-book. Taylor and Francis, 2013, ch 7; Masco, *The Nuclear Borderlands*, 294ff.

<sup>17</sup> A. Bowdoin Van Riper, ‘Into Eternity (2009)’ in *Film & History*, no. 1 (2013); Cornelius Holtorf and Anders Högberg, ‘Communicating with Future Generations: What Are the Benefits of Preserving for Future Generations? Nuclear Power and Beyond’ in *The European Journal of Post-Classical Archaeologies* (2014); OECD/NEA, ‘Radioactive Waste Management and Constructing Memory for Future Generations. Proceedings of the International Conference and Debate 15-17 September 2014, Verdun, France’ (2015); Donato Paolo Mancini, ‘How colour-changing cats might warn future humans of radioactive waste’ in *The Guardian* (8 January 2017); Masco, *The Nuclear Borderlands*, 38.

<sup>18</sup> Sheila Jasanoff and Sang-Hyun Kim, ‘Containing the Atom: Sociotechnical Imaginaries and Nuclear Power in the United States and South Korea’ in *Minerva* 47, no. 2 (2009).

From a broader historical perspective, the imaginary of containment of the exceptional nuclear technology is a prime expression of modernity.<sup>19</sup> A profound belief in scientific and technological progress as decisive and beneficial for society underpinned both the development of the nuclear industry and the negotiations on humans' ability to contain the dangers of nuclear technology. In the modern world, human mastery over nature successively came to mean 'to transform nature into something increasingly orderly, rational, and machine-like',<sup>20</sup> epitomized by sublime experiences like overlooking a huge dam reservoir or witnessing the launch of a space shuttle<sup>21</sup> in the company of large crowds of other secularized pilgrims. The released and then imaginatively contained atom was an exceptional part of the rapidly expanding industrialized natures, drawing the 'qualities of wildness, grandeur, and overwhelming power'<sup>22</sup> of the natural sublime into the domain of the controlled technological sublime.

However, in contrast to this dominant imaginary, there are also other imaginaries which could possibly challenge this picture, related to domestication, normality and the non-sublime. To explore these, I found atomic fish practices a productive area of investigation. But first, I will comment on the word 'nature' and what it may refer to in relation to the concept of imaginaries.

Is there anything at all that can be called 'nature' when there are no longer any pristine environments around? As Kate Soper points out, scholars have predicted the 'end of nature' precisely because this essentialist idea of a pristine nature, now lost, implies that our complete environment is unnatural. However, Soper calls attention to another understanding of nature, to which I accede, namely nature in the 'realist' sense, which 'refers us to structures and processes that are independent of human activity [...] and whose forces and causal powers are the condition of, and constraint upon, any human practice'.<sup>23</sup> She underscores that this 'nature' cannot be finite, since 'it will persist in its workings even in the midst of nuclear holocaust or destruction by asteroid or solar combustion'.<sup>24</sup> Consequently, I believe it is possible to use the word 'nature' in the context of the industrially changed environments where the atomic fish emerges.

Imaginaries, for their part, generally operate 'between imagination and action, between discourse and decision',<sup>25</sup> and they help to 'produce systems of meaning that enable collective interpretations

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<sup>19</sup> Sheila Jasanoff, 'Future Imperfect: Science, Technology, and the Imaginations of Modernity' in *Dreamscapes of Modernity: Sociotechnical Imaginaries and the Fabrication of Power*, ed. Sheila Jasanoff and Sang-Hyun Kim (Chicago: University of Chicago Press, 2015).

<sup>20</sup> Paul R. Josephson, *Industrialized Nature: Brute Force Technology and the Transformation of the Natural World* (Washington, D.C.: Island Press, 2002) 4.

<sup>21</sup> Nye, *American Technological Sublime*.

<sup>22</sup> David B. Morris, *The Religious Sublime*, quoted in *ibid.*, 1.

<sup>23</sup> Kate Soper, 'Unnatural Times? The Social Imaginary and the Future of Nature', *The Sociological Review* 57, no. 2 (2009) 226.

<sup>24</sup> *Ibid.*

<sup>25</sup> Jasanoff and Kim, 'Containing the Atom', 123.

of social reality'.<sup>26</sup> Imaginaries are borne only by humans. As Jasanoff argues, imagination, as 'a crucial reservoir of power and action, lodges in the hearts and minds of human agents and institutions'.<sup>27</sup> However, since sociotechnical imaginaries are 'temporally situated and culturally particular',<sup>28</sup> they also involve an engagement with the 'hard stuff'<sup>29</sup> like material infrastructures. In my use of the concept, I similarly regard the nuclear nature imaginaries as belonging to the human mind, while shaped and expressed through bodily interactions with 'realist' nature, for example, as in atomic fish practices.

### Atomic fish practices

I will dwell here upon four types of atomic fish practices with different emphases over time: fish farms, sports fishing, management of fish in cooling water systems, and finally, test fishing as part of environmental monitoring programs. The first two practices are set within a publicly visible nuclear nature imaginary, while the other two take place more behind the scenes. All four types are clearly localized, however, that is, they are framed as part of the unique life of a local industrial enterprise and community, and simultaneously they are very common in an international geography, that is, they exist as general features in most nuclear countries.

The 'Atoms for Peace' campaign of the 1950s and 60s was successful in that when the first generation of commercial nuclear power plants was built in the late 1960s and early 70s, public opinion was generally sympathetic toward the new energy infrastructure. The atom could be embraced as 'our friend',<sup>30</sup> and the industrial enterprise was labelled a 'wonderful [...] gift to the region'.<sup>31</sup> Among the few concerns expressed were worries that thermal pollution and radioactive outlets into the waters might affect the fish. For example, the magazine *Sports Illustrated* stated that 'what may become the "hottest" conservation fight in the history of the U.S.' had begun between 'the Atomic Energy Commission and utilities versus aroused fishermen'.<sup>32</sup> Likewise, local communities in the coastal areas where Sweden planned to build nuclear power plants raised the question of potential water pollution.<sup>33</sup> The marine biotopes and the associated human practices like fishing were seen as severely threatened by the envisioned large-scale development of nuclear power production.

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<sup>26</sup> Ibid., 122, with reference to Castoriadis, C. 1987. *The Imaginary Institution of Society*.

<sup>27</sup> Jasanoff, 'Future Imperfect', 17.

<sup>28</sup> Ibid., 19.

<sup>29</sup> Ibid., 22.

<sup>30</sup> Heinz Haber, *The Walt Disney Story of Our Friend the Atom* (New York: Dell Publishing Co., 1956); Nye, *American Technological Sublime*. 234.

<sup>31</sup> 'Sydkraft bygger atomkraftverk i Barsebäck för 350 miljoner kr' in *Arbetet* (23 December 1965); 'Planerna på atomkraftverk innebär industriellt uppsving' in *Sydsvenska Dagbladet* (24 December 1965).

<sup>32</sup> Robert H Boyle, 'The Nukes Are in Hot Water' in *Sports Illustrated* (20 January 1969), 24; Nye, *American Technological Sublime*, 235.

<sup>33</sup> Storm, *Post-industrial Landscape Scars*, 50.

Accordingly, the license to operate a nuclear power plant in Sweden was linked with the obligation to carry out substantial environmental monitoring programs in the immediate vicinity of the plants. The investigations, especially directed toward commercially valuable fish, began even several years before the first plant was operational in order to create a reliable set of reference data as a basis for subsequent surveillance.<sup>34</sup> During the first decades of nuclear power production, apart from some occasional problems like a mass death of garfish and considerable numbers of eel getting killed in the plants' cooling systems, the environmental monitoring appears to have calmed public worries. At the beginning of the 1980s, the concern seemed to have been transformed into its opposite: approval of the industrially changed environment. Shortly after the peak of anti-nuclear sentiments in the late 1970s and early 1980s, nuclear power plants began to house fish farms as a way to make use of hot spill water.

The geographical and temporal scope of fish farms using heated waste water from nuclear power plants and the details of production and consumption have been mapped and analysed, to my knowledge, hitherto only fragmentarily. However, fish farms at nuclear power plants have been planned and built at least in Japan,<sup>35</sup> the US,<sup>36</sup> Russia,<sup>37</sup> Ukraine,<sup>38</sup> France,<sup>39</sup> Germany,<sup>40</sup> and the UK.<sup>41</sup> The heated waste water from production amounts to as much as two thirds of the energy produced at a plant, and fish farms constitute one among several envisaged and also realized uses of this valuable by-product, such as district heating,<sup>42</sup> heating of greenhouses, and crocodile breeding.<sup>43</sup> In Sweden, fish farms were established or planned at all four reactor sites. The fish farm at Barsebäck, for example, bred salmon and shrimps for sale. A specially built barn within the fenced industrial ground housed huge pools for the fish, and the farm was managed by regular plant employees as part of their everyday duties. Its opening in 1984 was portrayed in the local newspaper as a positive and

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<sup>34</sup> 'Kustlaboratoriets historia', <https://www.slu.se/institutioner/akvatiska-resurser/kontakt/kustlaboratoriet/kustlaboratoriets-historia/>, accessed on 13 June 2018.

<sup>35</sup> Lesbirel, S.H., and D. Shaw. *Managing Conflict in Facility Siting: An International Comparison*. Edward Elgar Publishing Limited, 2005, 118.

<sup>36</sup> M. Olszewski, *The Potential Use of Power Plant Reject Heat in Commercial Aquaculture*. ORNL/TM-5663, Contract No. W-7405-eng-26. Oakridge National Laboratory, 1977; Joseph F. Sullivan, 'Power Plant's Waste Heat Helps Start a Fish Farm' in *The New York Times* (September 4, 1979); *The Impact of Exelon's Nuclear Fleet on the Illinois Economy. An Analysis by the Nuclear Energy Institute*. Nuclear Energy Institute, 2014, 20.

<sup>37</sup> Thomas Nilsen, 'Oldest Kola reactor licensed for another 15 years' in *The Barents Observer* (9 July 2018); Paul Josephson, personal communication of 18 March 2018; Igor N. Lozhnikov, deputy chief engineer at Leningrad nuclear power plant, author's interview in Sosnovy Bor, 22 May 2018.

<sup>38</sup> Kate Brown, professor of history at UMBC, personal communication of 25 September 2017.

<sup>39</sup> Watt, Nicholas. 'When the plant was built there really was no debate' in *The Guardian* (18 May 2006).

<sup>40</sup> Costa-Pierce, Barry A. et al., *Urban Aquaculture*. Wallingford: CABI, 2005, 131.

<sup>41</sup> Ibid.

<sup>42</sup> Author's fieldwork at Leningrad nuclear power plant, Russia, 22 May 2018.

<sup>43</sup> Lars Kaijser, lecturer in ethnology at Stockholm University, personal communication of 8 March 2016.

productive, yet somewhat peculiar part of the local industry.<sup>44</sup> The Barsebäck fish farm was closed within a decade, presumably mainly for economic reasons.

The nuclear industry in Sweden has long encouraged sports fishing in the direct vicinity of the plants, for example by introducing young fish from the fish farms into nearby rivers,<sup>45</sup> or by regularly allowing fishing competitions in the cooling water canals.<sup>46</sup> Furthermore, private operators offering tours with sports fishing from a boat, as well as small-scale commercial fishermen, often frequent the waters just outside the plants.<sup>47</sup> The attraction of fishing close to the plants is connected to the industrial cooling system, in which water from the sea, a lake or a river is used to cool the steam generated by the nuclear fission process in the reactor. When the water leaves the nuclear power plant, it is generally about ten degrees Celsius warmer than when it entered. The warm water brings changes to the local waterscape such as longer seasons without ice, thriving vegetation which produces more food and draws bigger fish, and new exotic species whose presence is connected to the water outlet. The leaping mullet, for example, is a specialty around several nuclear power plants,<sup>48</sup> and anglers joke about ‘nuclear cod’, which are especially sought-after for their large size.<sup>49</sup> In short, the waters around nuclear power plants in Sweden and many countries are regarded as fishing hotspots.<sup>50</sup> In visual communications by the nuclear industry, sports fishing practices are also employed in descriptions of the industry’s environmentally responsible actions, for example through pictures of recreational fishermen, relaxed and surrounded by calm glittering water, with a nuclear plant discernible on the horizon.<sup>51</sup>

The existence of fish farming at nuclear power plants, along with sports fishing in the surrounding waters, shapes an understanding of atomic fish as an animal that can be bred or hunted, sold, bought and eaten by humans; a commercial or leisure harvest based on an industrial by-product of heated water that had otherwise been solely wasted. The nuclear nature imaginary here implies an industrially improved environment for the benefit of humans. The sought-after nuclear cod and the

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<sup>44</sup> ‘Här är fisken som har nytta av kärnkraften. Fiskodlingen vid Barsebäcksverket utnyttjar det varma spillvattnet’ in *Arbetet* (17 March 1984).

<sup>45</sup> ‘Gratis sportfiskare! 500 laxar släpps ut i Kävlingeån’ in *Skånska Dagbladet* (18 April 1984).

<sup>46</sup> ‘Firre’s bildblogg’, <https://firre85.blogspot.com/2018/05/fisketavling-i-kanalen-254.html>, accessed on 26 June 2018.

<sup>47</sup> Ulf Gerdman, angler and owner of the sport fishing company ‘Torskturer’, author’s interview in Malmö on 2 November 2016; Hans Hammar and Tobias Hammar, fishermen, author’s interview in Malmö on 2 November 2016.

<sup>48</sup> ‘Mulle står ofta på Mariannes meny’ in *Sydsvenskan* (13 July 2008); Therese Thomasson, ‘Vill fortsätta att fånga mulle’ in *Sydsvenskan* (12 February 2012); Shaun Cumming, ‘There’s something about mullet’, *fishing magic* (7 August 2014).

<sup>49</sup> Hans Nilsson, angler, personal communication of 19 April 2018.

<sup>50</sup> Brian Donohue, ‘Why a Nuclear Power Plant is New Jersey’s Hottest Fishing Spot’ in *New Jersey Local News* (9 March 2016); ‘South West England, British Sea Fishing’, <http://britishseafishing.co.uk/south-coast-and-south-west-england/>, accessed on 25 June 2018.

<sup>51</sup> ‘Forsmark och miljön’ <https://corporate.vattenfall.se/om-oss/var-verksamhet/var-elproduktion/forsmark/miljo/>, accessed on 14 June 2018.



popular, hard-fighting leaping mullet, along with locally shared knowledge about the best fishing spots, also bring aspects of relaxing leisure time activities and a fellowship of hunting. From the broader perspective of modernity, this connects to an imaginary of a more than sufficient availability of food, and of a harmonic, yet hierarchical, relation between man and nature.

The management of fish in the plants' cooling water systems has a different character. The current of the water intake to a plant draws fish and other living organisms into the system, which either get stuck in filters or are severely affected by heat and chemicals in the system's tunnels and pipes. The dead or injured fish and other organisms have to be continuously removed by plant employees in order to enable the production of nuclear energy. Keeping the cooling water system functioning at all times is more crucial than one might think. If the cooling does not work, the whole nuclear power production process is endangered. When a tsunami flooded the Fukushima Daiichi nuclear power plant in Japan in 2011, the emergency shut-down system worked as planned and the fission process in the reactors stopped. The meltdown was caused instead partly by the inability of the flooded and damaged backup generators to drive the pumps of the cooling water system.<sup>52</sup> With no cooling, the reactors could not contain the heat and exploded.

A nuclear power plant like Forsmark in Sweden, with three reactors, needs about 150 cubic meters of water per second flow into the cooling systems.<sup>53</sup> This is comparable to the flow of a medium-sized river. Given the criticality of sustained water flow, the work to assure that the intake is free from hindering objects is one of the most important tasks at a nuclear power plant. The workers clearing the intake canals of seaweed, underground pipes of mussel colonies, and filters of different sizes of fish and jellyfish, are thus a key category of nuclear professionals, yet seldom acknowledged as such. The number of living organisms that has to be continuously removed is difficult to estimate, but a calculation at Forsmark stipulates that around 1 million individual fish are killed there per week.<sup>54</sup> The most common species is stickleback, making up 80–95 percent of all fish killed in the filters. The resulting 'biomass' is simply transported away. Tanker trucks filled with fish and algae and other unwanted biological entities are shuttled away from the nuclear plants. The fish is then minced and burnt, dumped back into the sea or on special dump sites, transferred to local farmers as

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<sup>52</sup> 'The official report of The Fukushima Nuclear Accident Independent Investigation Commission. Executive summary', [https://www.nirs.org/wp-content/uploads/fukushima/naaic\\_report.pdf](https://www.nirs.org/wp-content/uploads/fukushima/naaic_report.pdf), 12ff, accessed on 23 August 2018; Sara Pritchard. 'An Envirotechnical Disaster: Negotiating Nature, Technology, and Politics at Fukushima' in *Japan at Nature's Edge: The Environmental Context of a Global Power*, ed. Ian Jared Miller, Julia Adeney Thomas, and Brett L. Walker (Honolulu: University of Hawaii Press, 2013) 259f.

<sup>53</sup> Anders Adill and Yvette Heimbrand, *Biologisk recipientkontroll vid Forsmarks kärnkraftverk*, Aqua reports 2015:7, Årsrapport för 2014 (SLU Institutionen för akvatiska resurser, 2015), 5.

<sup>54</sup> *Ibid.*, 11, 21.

fertilizing material, or used in experiments attempting to turn it into biogas.<sup>55</sup> However, in spite of these efforts to keep the cooling water system clean, there are recurring reports of congestion, and jellyfish, especially, seem to be able to clog the filters in a way that puts the nuclear power production at risk.<sup>56</sup>

The management of fish in the cooling water system testifies to the flipside of modernity's industrialized natures: the benefit of nuclear energy comes at a price. In this case the price consists of the unintentional killing of large numbers of marine organisms, as well as the constant necessity to manage a messy corpus of dead and half dead fish that happens to be in the water needed for the industrial process. To the imaginary of atomic fish, it brings to the fore the dirty everyday routine work behind the scenes of a nuclear power plant – a visitor might be shown the shining clean reactor hall, the control room and the turbines, but never the muddy filters of the cooling water system.

The final atomic fish practice I want to put in focus is test fishing within extensive and long-term environmental monitoring programs linked to the license to commission a plant. In the Swedish context, these programs have been going on since the 1960s and are still active, although the institutional affiliations and scope of the investigations have changed over time.<sup>57</sup> The basic line-up was a permanently staffed station at each of the four reactor sites in the country. Test fishing was carried out every day from a small boat, following a special scheme in relation to, for example, water depth and certain species. To be able to catch a range of ages and species, nets with different mesh were used, along with underwater explosions to catch fry. At regular intervals, more encompassing examinations were carried out. The programs initially involved a broad spectrum of flora and fauna on land and in the water, but were later focused on commercially valuable fish species like cod and eel and their well-being in relation to the nuclear industrial enterprise.

At the Forsmark plant, a very special feature of the environmental monitoring program was created: the so-called Biotest Lake, built when the underground tunnel was blasted for the plant's water outlet. The rock that was removed to build the tunnel was used to connect a number of small islands in the sea to make an artificial lake, 90 hectares in size and closed to fish migration by a filter. This huge field laboratory was inaugurated in 1977, three years before the first reactor at Forsmark went into operation, so that biologists and ecologists could follow in detail how the heated water

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<sup>55</sup> Bryhn, Andreas C. *Fiskförluster i svenska kärnkraftverk. En sammanställning av kunskapsläget*. Aqua reports 2012:10 (SLU Institutionen för akvatiska resurser, 2012) 5; Anders Adill, environmental monitoring and assessment analyst at the Department of Aquatic Resources, Institute of Coastal Research at the Swedish University of Agricultural Sciences, author's interview in Öregrund on 8 December 2016; Maria Taranger, communication officer at Barsebäck nuclear power plant, author's interview in Barsebäck on 26 January 2018.

<sup>56</sup> Erik Paulsson Rönnbäck, 'Maneterna i kärnkraftverket blev världsnöhet' in *Svenska Dagbladet* (1 October 2013); Adam Vaughan, 'In a Laver: Seaweed Shuts Nuclear Reactor again in Bad Weather. EDF's Torness plant east of Edinburgh has previously been taken offline due to jellyfish' in *The Guardian* (5 March 2018).

<sup>57</sup> Anders Adill, author's interview; 'Kustlaboratoriets historia'.

affected this specific area. Successively, academic research interest in this place has increased, while the nuclear industry's interest in funding such research has decreased. Recently, the Biotest Lake has been reframed as a laboratory for climate change challenges, and the filter preventing fish to move in and out of the lake has been removed.<sup>58</sup>

In spite of the far-reaching environmental programs, which have been underway for more than half a century now, my interviewees cannot recall any specific measures that were taken to compensate for the effects of the heated water, or any changes in the procedures at the plant.<sup>59</sup> The only exception is the commercially valuable eel, which on several occasions were killed in such numbers that young glass eel (some hundreds of thousands each time) were released to compensate for the loss. The underlying purpose of the monitoring programs is somewhat ambiguous. The initial aim was to exert societal control of the changed natures produced by the nuclear industry, while the programs' internal logic is now strictly scientifically motivated. The explicit control of the nuclear nature is systematic and detailed, but lacks a more general engagement with public trust or fears connected to the concerns about thermal and radioactive pollution that were raised when commercial nuclear power was introduced in the 1960s and 70s. In that respect, the political issue of nuclear water hazards has become de-politicized over time and turned into an issue for experts only.

As opposed to the imaginary of the edible atomic fish, shaped by the improved industrial nature of fish farms and sports fishing, and the unwanted 'biomass' from the cooling water systems, the fish caught in the test fishing are prohibited for human consumption, since they are considered to be 'laboratory animals'. One of my interviewees reflected upon the fact that he and his colleagues are systematically killing a lot of fish that is just dumped, wondering whether this was really justifiable in the long run.<sup>60</sup> After more than half a century of monitoring activities, the role of the atomic fish as a laboratory animal is perhaps no longer quite so self-evident.

The four practices described above shape a nuclear nature imaginary of atomic fish as a normal, or even slightly improved human diet, to harvest or to hunt. The fact that it is a by-product of the key activity – energy production – is also visible in controlling practices, the cleaning of filters and the monitoring program. Here the nuclear nature imaginary is shaped around reassurances of control, although mostly without featuring any nuclear exceptionalism, no 'nuclear uncanny',<sup>61</sup> and certainly nothing like an experience of the technological sublime. The atomic fish practices instead build a nature imaginary of normality based on everyday routines. The practices are all localized and relate

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<sup>58</sup> Adill and Heimbrand, *Biologisk recipientkontroll...* 7. Author's fieldwork at Forsmark nuclear power plant, Sweden, on 30 November and 8 December 2016.

<sup>59</sup> Anders Adill, author's interview.

<sup>60</sup> Ibid.

<sup>61</sup> Masco, *The Nuclear Borderlands*, 27ff.

to what I have elsewhere termed a ‘distance of fear’.<sup>62</sup> With this expression I denote the intuitively paradoxical observation that the closer you live to a hazardous industrial enterprise, the less afraid you are. Fear instead increases with distance, and from far way, the danger of a nuclear power plant can transform into something almost mythical.<sup>63</sup> Hence, the nuclear natures at the local scale have become part of normal and everyday experiences. Now, how do these normalizing atomic fish practices resonate with broader understandings of nuclear technology, nuclear natures and a nuclear sublime?

### Wilderness, domestication and the non-sublime

Not all nuclear natures are normal and everyday; some are quite wild in character. Perhaps the most striking example of a nuclear wilderness is the return of wild animals to the Chernobyl exclusion zone – the radioactively contaminated area around the disastrous nuclear power plant with very restricted access for humans. This rewilding of a previously human-inhabited area is attracting popular attention as it is visually combined with the abandoned decaying built environment of the ‘atomic city’ of Pripjat. A range of different media, like blogs and traditional newspapers as well as coffee table books, features images of ‘nature taking back’, for example, big mammals like the European bison and elk, majestically crossing a disintegrating road while meeting the gaze of the human observer.<sup>64</sup> The nuclear nature wilderness in this version resembles the widespread genre of ‘ruin porn’ photography of post-industrial sites,<sup>65</sup> although the post-Chernobyl wilderness also carries lingering uncertainties of the non-sensible radioactive dangers; in other words, it has an extra load of nuclear exceptionality. The implicit message of this nuclear wilderness, I would say, is that nature has a remarkable capacity for recovery; in other words, it performs ‘a natural adaptation to a radioactive environment’,<sup>66</sup> and possibly also the ability to contain the exceptional atom. Joseph Masco described a radioactively contaminated chamisa shrub as ‘one example of the strange duality of the nuclear age, that contamination, and the possibility of mutation, can travel hand in hand with visible signs of health and prosperity’, which further ‘confounds belief in the containability of the nuclear age’.<sup>67</sup> Blossoming fruit trees in the sun, primeval animals in evening backlight and birds’

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<sup>62</sup> Storm, *Post-industrial Landscape Scars*, 47.

<sup>63</sup> Some previous research contradicts this interpretation and instead argues that what might look like normalization is in fact suppressed or numbed fear and anxiety. Françoise Zonabend. *The Nuclear Peninsula*. (Cambridge: Cambridge University Press, 1993) 6, 101, 20; Masco, *The Nuclear Borderlands*, 12ff, 24, 32, 39, 291, 324, 326f.

<sup>64</sup> See, for example, Dzianis Ramaniuk, *Chernobyl: The Twentieth Anniversary of the Chernobyl Atomic Plant Accident* (2006).

<sup>65</sup> Nate Millington, ‘Post-industrial Imaginaries: Nature, Representation and Ruin in Detroit, Michigan’ in *International Journal of Urban and Regional Research* 37, no. 1 (2013).

<sup>66</sup> Masco, *The Nuclear Borderlands*, 306.

<sup>67</sup> *Ibid.*, 33.

flight over a calm lake indicate that everything is fine again, now that humans have left the scene. In a safe position behind the camera, it may even come close to a sublime experience.

There is an element of nuclear wilderness, I suggest, in the atomic fish practices described above as well, and perhaps primarily in the behind-the-scenes activities of managing fish in the plants' cooling water systems and the test fishing of the monitoring programs. The potential risks for humans caused by the not-so-easily controlled fish can be conceptualized, as artist Tora Wallander has done, as an animal's 'soft resistance' in failing to adhere to the logics of industrial production.<sup>68</sup> In this particular human interaction with a nuclear wilderness – through managing and surveying injured or dead fish on an everyday basis – there is, however, no sublimity in sight, neither natural nor technological. Instead, in addition to the imaginary of nuclear technology and nuclear nature as sublime, exceptional and possibly contained – as outlined in the beginning of this article and in the post-disaster nuclear natures of Chernobyl described above – I propose there is a partly interrelated, partly parallel set of nuclear imaginaries characterized by domestication, normality and the non-sublime.

One example of this domesticated imaginary is the widely used metaphors employed to explain how nuclear technology works, the most common probably being 'a way to boil water'. A nuclear power plant is said to be nothing mysterious and special, but just another way to boil water. This phrase recurs almost as a mantra in nuclear industry representatives' presentations and in guided tours of nuclear power plants.<sup>69</sup> At the Russian state nuclear organization Rosatom's training centre in Saint Petersburg, there is even a showcase featuring a household kettle connected to a light bulb, illustrating what nuclear power is all about.<sup>70</sup> Other frequent metaphors and rhetorical figures similarly pinpoint the everyday and normal character of nuclear power production, explicitly addressing what industry representatives regard as irrational public fears. For example, to ride a bike or drive a car is held to be far more dangerous than producing electricity in a nuclear power plant,<sup>71</sup> and since these commonly practiced activities are not questioned, why question nuclear power?

When it comes to nature imaginaries, too, it is easy to find examples reassuring normality. At many nuclear power plants there are everyday practices going on, implicitly but also articulated, highlighting the presumed ordinary character of the industrial enterprise. Along with the fish farms

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<sup>68</sup> Author's visit to the art exhibition ISOTOP in R1, Stockholm, 27–29 April 2018.

<sup>69</sup> Author's fieldwork at Forsmark nuclear power plant, Sweden, 30 November and 8 December 2016; at Barsebäck nuclear power plant, Sweden, 31 October 2016 and 26 January 2018; at Risø nuclear research facility, Denmark, 21 September, 2016; at Fessenheim nuclear power plant, France, 20–23 February 2017; at Leningrad nuclear power plant, Russia, 22 May 2018; at Zion nuclear power plant, USA, 5 May 2017; at Ågesta nuclear power plant, Sweden, 15 September 2017; and at Ignalina nuclear power plant, Lithuania, 25 November 2010.

<sup>70</sup> Andrei Stsiapanau, associate professor at the Department of Social Sciences, European Humanities University in Vilnius, personal communication of 5 March 2018.

<sup>71</sup> Jasanoff and Kim, 'Containing the Atom', 129.

set up and managed on plant grounds, and sports fishing in the cooling canals, berry picking within the fenced industrial area is another appreciated employee activity during lunch breaks; bird and seal watchers know that the heated bodies of water are attractive areas for these animals' food search, and canoers use the currents created by the cooling water outlet to practice.<sup>72</sup> While David Nye has shown how 'women played a vital part in the incorporation of the technological object into ordinary life'<sup>73</sup>, I would assert that in the case of atomic fish practices, this role is to a large extent filled by men, especially in relation to sports fishing, but also with regard to fish farming. Nye writes: 'Once the initial shock of the sublime object had passed, it was domesticated and made familiar through a process of feminization'.<sup>74</sup> This familiarization and feminization is valid for nuclear technology, for example through the links made to the individual scale and everyday activities, like the equation between nuclear technology and boiling water in a household kettle.<sup>75</sup> However, the 'disappearance' of nuclear power production into the 'ordinary experience'<sup>76</sup> of a local community, I suggest, takes place largely through male-coded fishing practices.

I consider this range of everyday activities, with the atomic fish practices playing a key role, to make up an imaginary of normalization, and that its most obvious function is to let nuclear proponents describe nuclear technology in less exceptional and thereby less dangerous terms. At first glance, it may also seem as if this imaginary in fact smoothly co-exists and even reinforces the sociotechnical imaginary of containment suggested by Jasanoff and Kim. The human ability to control and contain the exceptional atom is linked to the ability to tame and domesticate the wild nuclear natures, and thereby, it also proclaims that a nuclear sublime is possible.

However, the domesticated nuclear nature imaginary is not a coherent category, and while domestication can imply containment of the exceptional, it can also imply normalization and everyday, non-sublime experiences. The atomic fish practices of fish farms and sports fishing do not have much of a connection to the untamed grandeur of a natural sublime. Instead, its presence signals the everyday normality of men going fishing, and of tasty fish on the dinner table as an indicator of the absence of, or esteemed contrast to, 'the dirt, pollution and disruption of the urban, industrialised world'.<sup>77</sup> To eat atomic fish, no matter whether it is bred in a fish farm or caught by an angler in the waters around a plant, is to embody one's trust in the nuclear industry as forming a normal part of everyday life in a modern society. Fish is no longer an exception to local communities' approval of

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<sup>72</sup> Author's fieldwork at Forsmark nuclear power plant and at Barsebäck nuclear power plant.

<sup>73</sup> Nye, *American Technological Sublime*, 283.

<sup>74</sup> Ibid.

<sup>75</sup> Zonabend. *The Nuclear Peninsula*, 93f.

<sup>76</sup> Nye, *American Technological Sublime*, 283.

<sup>77</sup> John Rundell, 'Modernity, Humans and Animals. Tensions in the field of the technical-industrial imaginary', In *New Formations* (2012 Winter) 11.

nuclear power production, but has, through atomic fish practices, turned into a sign of normalization, of a non-sublime domestication of the nuclear natures. The three-eyed fish Blinky, appearing in the waters of the nuclear power plant in the Simpson cartoon series, has long made up a part of popular culture and, as such, transcends the context of a local nuclear community. Successively, Blinky's existence has become more of a joke of nuclear fears and dystopias of the past, and thereby also supports the evolving atomic fish imaginary of non-sublime domestication.

### Concluding remarks

In this article, I have combined the understanding of nuclear technology as exceptional with the sociotechnical imaginary of containment, and suggested this to be an expression and condition of the nuclear technological sublime. At the same time, as previously highlighted by David Nye, the nuclear exceptionality in terms of a threatened life-world is in fact a component that makes a nuclear sublime essentially contradictory, and which, in principle, marks the end of all technological sublime experiences. In this context, the different variations of domestication – as another way to denote a containment of the flip sides of industrialized natures, but also as normalizing female and male-coded metaphors and practices on the household scale – offer a palette of new understandings and conceptualizations of nuclear nature imaginaries. Ultimately, these imaginaries of domestication partly reinforce a still persisting readiness for the nuclear sublime, manifested primarily when facing the existential future prospects for the very long-term danger of radioactive waste. However, the imaginaries of domestication also bring perspectives of local lived realities to light. On this community or household scale, the 'distance of fear', or, rather, the trust connected to living a life next to a nuclear power plant, has one of its expressions in the practices and imaginaries of atomic fish.

On the palette of nuclear nature imaginaries, I would therefore like to emphasize the existence of domesticated, localized and non-sublime nuclear nature imaginaries. As I demonstrated above, domestication must not only imply the control and containment of something exceptional or wild, but can also denote normalization without grandeur. The nuclear nature imaginary may be completely non-impressive and non-sublime, and at the same time highly decisive for local perceptions of the nuclear technology. The nearly religious excitement of finally catching a hard-fighting leaping mullet therefore has nothing to do with any possible connections to nuclear thermal pollution, nor to an inherently contradictory nuclear sublime.

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I wish to thank Eglė Rindzevičiūtė, Tatiana Kasperski, Kati Lindström, Anders Houltz, Paul Josephson, Lars Kaijser and two anonymous reviewers for their help and valuable comments on earlier versions of this article.