

Slippery: Field Notes on Empirical Ontology¹

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Empirical Ontology

In this paper we're interested in what a salmon is. Let's start with a textbook definition.

'The Atlantic salmon ... is a salmonid fish, a group of species typified by a laterally compressed body form and a dorsal adipose fin, posterior to the main dorsal fin....' (Webb and others: 2007, 18)

There's implicit reference to Linnaean systematics, and the physical characteristics of the salmon are also described. The text continues so:

'The early/ life-history stages of the species, encompassing eggs, alevins, fry and parr, live in fresh water. ... smolts, a later stage associated with the migration of fish from their natal rearing areas, are typically silver The coloration of adult salmon is typically silver while at sea However, this coloration begins to be lost soon after river entry and the fish become increasingly reddish brown as they approach spawning.' (Webb and others: 2007, 18-19)

This tells us more about the physical characteristics of the Atlantic salmon, but also describes its life cycle. And the next citation, albeit in contracted form, further describes that life-cycle, linking it to both geography and genetic segregation.

'The Atlantic salmon occurs in temperate waters and shows a complex, diverse biology. The species is quintessentially anadromous, spawning (i.e. reproducing) in fresh water and followed by a freshwater juvenile phase and subsequent oceanic feeding migrations. This is combined with a tendency to home to natal areas to spawn Homing results in the reproductive segregation of individuals into distinct groups whose members share a common natal origin ...' (Webb and others: 2007, 19-20)

We've taken these citations from The Atlantic Salmon: Genetics, Conservation and Management. Since the book is over 500 pages long, what we have here only a beginning. Even so at least in outline, we do have a beginning. The Atlantic salmon is being described and that description locates it in a taxonomic system, with particular physical and genetic attributes, and a specific life cycle, geographical range, and feeding characteristics.

Now consider this:

'Kristin fishes ... [the daufisk] out with a small net, and puts them in a bucket; she remembers the numbers in her head ('sort of', she laughs! And then writes the numbers [4, 5, 2 ...], onto one of the many sheets of paper in the common area) Some of the fish are very dead Sometimes they aren't.'²

² Unless otherwise specified, quotations are taken from our field notes. The co-authors have undertaken joint ethnography (though often in different locations on the same site), writing individual field notes, subsequently sharing and discussing the latter. This gives a distinctive character to the ethnography that deserves discussion in its own right. In the present paper, however, we treat all the field notes indifferently as materials, and do not, except incidentally, note their particular authorship.

With this we have moved from the textbook to a moment of ethnographic description on a salmon farm in west Norway. 'Daufisk' is the local vernacular for 'dead fish' and, as is obvious, Kristin is fishing dead salmon out of the water and removing them. So what is a salmon here?

Perhaps the answer comes in three parts. First, and matter-of-factly, it's a fish that is dead or alive, or injured or otherwise. If it is dead it is also something to be put in a bucket and dumped in a tank filled with formic acid and other dead fish. Second (and unlike the textbook), for Kristin the business of describing a daufisk is of secondary importance. Her work around the site involves quite a bit of note-taking and inscribing, but here, the fact of noting their numbers aside, she is more concerned with handling them than in providing an account of them. A salmon (more precisely a dead salmon) is an object that needs to be sifted out and removed. This means, third, that whatever it is, it isn't very much like the Atlantic salmon described in the textbook either practically or descriptively.

There are several ways of thinking about this difference, but let's attend to two.

It's possible to say that there's a 'reality out there': that salmon are whatever they are. Then it is possible to say that this salmon-reality is a focus of different perspectives. In this way of thinking, textbooks approach this salmon-reality in a particular and no doubt scientific way while an employee on a fish farm doing her morning rounds of the tanks looking for dead fish and noting their numbers approaches it in a different and practical manner. There's nothing surprising about this. Obviously the authors of textbooks and fish-farm workers interact with salmon in different ways. If they describe them then they describe them differently too, for they have different concerns and interests. Much of STS explores this insight. In what we might think of as empirical epistemology, it looks at the shaping of knowledge, theoretical and practical, explicit or tacit, or it asks analogous questions about the social shaping of technology³. But, here's the assumption. Deep down, behind the interactions and the interpretations, this way of thinking assumes that reality (for instance in the form of a salmon) is a somewhat stable object – or class of objects – that is somewhat beyond human control. It is taken for granted that there's a salmon-reality out there. This may be nudged by technoscience, it may be altered and reshaped as indeed it has been for farmed salmon, but there is nevertheless something outside practice for that practice to get to grips with.

This possibility underpins much fruitful work in STS. But there is an alternative. Thus it is possible to say that reality is not pre-given and so to resist the idea that it (for instance in the form of salmon) is out there, a more or less stable focal point for different concerns, interactions, needs and/or viewpoints. It is to propose instead that realities are enacted in relations: that (again for instance) salmon-realities are done in salmon-related practices. So, for instance, on the fish farm, during the morning round, salmon are being done as alive or dead, and hungry or otherwise. That is what they are, in that set of practices, nothing more, and nothing less. By contrast, in the pages of the textbook they are being done quite differently – as a distinctive species with a particular geographical range, attributes and habits. Again, this is what they are in textbook practice.

³ This approach has been developed in a variety of versions in many STS literatures. For early texts on science, see Bloor (1976) Barnes (1977) and Collins (1985). For analogous arguments on technologies see Bijker, Hughes and Pinch (1987) and Bijker and Law (1992). There are also important Marxist (Yoxen: 1983) and feminist (Cockburn: 1983) versions of these positions, and the position has been explored in anthropology by authors such as Pfaffenberger (1988; 1992).

So we have two approaches in STS. If the first is epistemological and perspectival, then the second is a form of empirical ontology. It washes away assumptions about pre-given realities and instead asks questions about how realities are done in practices. The two approaches have co-existed within STS for several decades⁴. We've mentioned that the tradition of empirical epistemology underpins the sociology of scientific knowledge and related approaches. However, despite talk of a recent turn to ontology, Michel Callon's 1986 paper on the scallops and the fishermen of Saint Briec Bay is just one of many studies that falls within this second tradition of empirical ontology⁵. As is well known, in that paper Callon looks at practices, and asks how fishermen, scallops, and scientists are being done in them: what these different actors are made to be in those practices. In order to do this he traces the changing patterns of relations that compose those practices. So he describes how for a time fishermen were rendered passive and scallops active. Their relations, what they were, were defined by no-fishing zones and places where the larvae or scallops could grow. Then he tells how this web of relations fell apart. Overnight fishermen became active and scallops passive, as the former ignored the no-fishing zones, destroyed the collectors, and took their haul to market. Callon's argument is about the enactment of two sets of relations and, as a part of this, the enactment of two versions of fishermen and scallops. It is ontological. Scallops and fishermen are effects of practices. That is what they are. And indeed it was this ontological suggestion that was the source of the succès de scandale that attended this paper. Notoriously, Callon chose to treat the fishermen and the scallops in a symmetrical manner, making no prior assumptions about the character of either.

In the present paper we're interested in salmon, not scallops, and our field-site takes us to the west coast of Norway rather than the Atlantic coast of Brittany. Nevertheless like Callon and many who have followed him, our concern is with empirical ontology. That is, we're interested in exploring how relations and realities are done in salmon-human practices. Drawing on ethnographic data we consider the choreographies of those practices, attending in particular to their uncertainty and their fragility. Then we argue that salmon practices are productive in several senses. Thus they enact precarious but fixed realities – moments when salmon are whatever it is they are made to be in the practice in question. On the other hand, and at the same time, we suggest that those practices of fixing also enact salmon as slippery, elusive, and as something other. We conclude the paper by briefly considering the productivity of this slippery otherness.

Choreography

So how do practices work, what can we say about them, and how do they enact realities such as salmon? We tackle these questions empirically.

We're on shore and salmon parr, young salmon, are being delivered to the farm by lorry. They will be raised here in fresh water until they are moved to the sea, and shortly after they arrive they will be vaccinated.

The vaccination cabin stands on stilts and is surrounded by pipes and cables. Water pours steadily through the gaps in its floor. To enter it you climb a short vertical ladder, five or six rungs, and push

⁴ For a recent account, see Law (2008).

⁵ Callon (1986). The approach is also developed in Latour and Woolgar (1986), Latour (1988) and Law (1986). There is partially related work in feminist technoscience studies, and in particular from Haraway (1989; 1991b).

back a sliding door. Inside there isn't much space. The cabin is filled with more pipes and cables, together with buckets, tables and machines, and it is wet, busy and quite noisy. The parr are being pumped up through a pipe from a large holding tank outside, and arrive in batches in a gush of water at the back of the cabin. They drop into a container filled with water and anaesthetic. Once they go limp they're lifted in a metal basket and decanted onto a small chute. They slide down the latter, a couple of hundred at a time, onto a stainless steel work surface. In front of the surface there's a rapidly moving blue conveyer belt. Katrine is standing there in waterproof overalls and rubber gloves. She's lifting the fish, two at a time, and dropping them into grooves on the conveyer belt. She's working so fast that she fills every groove, 120 a minute. The fish are being whisked to the right and vanish under a safety guard. Beyond the safety guard there's a vaccination machine. If the fish are large enough, more than 11 centimetres long, and they're also the right way round, then they're vaccinated and washed into a pipe that leads to the large tank in which they will grow for months until it is time for them to be taken from to the marine site.

This is hard work, it's cold, it's wet, and the fish are difficult to handle:

'... the fish are slippery. Perhaps they are more slippery for Marianne and myself than for the three women? They are certainly less easy to handle, more elusive.'

With the motion of the conveyer belt it's also dizzying. Work starts about half past seven in the morning, and goes on until half past two in the afternoon, though there are moments when the routine is punctuated. Since the fish are anaesthetised in batches, there's a moment of rest between each batch. This is a moment of silence too, since the vaccination machine makes an enervating clicky-clack sound 120 times a minute when it is working. There are other reasons why the work stops as well. Sometimes the anaesthetic has to be topped up because the fish are still too lively. From time to time the vaccine runs out, the old bottle is removed, and a new one is attached to the machine. And after 3,500 injections the needles in the machine have to be changed too. But all in all it is hard and unremitting work. Kristin and her colleagues between them handle about 1.6 million salmon a year.

What is a salmon here? What kind of a creature is being done in this practice? And how is it being done? Here's one answer. It is a matter of agency. This is being done and distributed. Thus if a salmon is anaesthetised then its capacity for agency is restricted. It is being done as passive, more easily handled by people, and as possible to vaccinate. If it is moving – if, for instance, it is flopping around because the anaesthetic is too dilute – then the whole process grinds to a halt. At the same time, agency or its absence is not restricted to salmon alone. Peoples' hands reach out, lifting the fish, two at the time, sensing their weight, and dropping them into grooves on the conveyer belt, belly to the left. When they're picking them up Kristin and her colleagues don't usually look at the fish. They juggle them without looking down. They know how they feel. Novices including ethnographers can't do this. Gradually, however, after hours of practice something about the distribution of the weight of each fish (it's heavier at the head) and how it feels (the back is firmer than the slightly spongy belly) starts to tell the beginner which way it's pointing. It is as if the hands begin to learn how to do the sorting by themselves: another ordering and distribution of agency. But the same applies to machines. If someone gets it wrong and drops a salmon in the wrong way round then the machine goes 'beep', and a red light flashes. The offending fish is dropped into a bucket of water to be picked up and put through the process again. There's a display on top of the machine

too, with the number of so-called 'feilvendte', misplaced fish. The total increases each time we get it wrong, distributing (in)competence between those doing the work. Unsurprisingly the novices don't do well. But the machine isn't perfect either:

'Both yesterday and today I ... vaccinated, but today ... it went better ... but it was also very cold ..., fingers stiffen after a while even with woollen gloves, and my grip becomes less sensitive and I don't feel the difference of the two sides of the salmon as accurately, and my wrist is not as smooth and then I make more mistakes. I learned that 'feilvendt' is registered by a sensor that detects light. Machine 1 is not as sensitive as machine 2, but yesterday afternoon Kristin washed it with alcohol and thinks it has improved somewhat. They say that sometimes when the salmon is very dark, it makes mistakes, mistakes right for wrong. While the insensitive machine mistakes wrong for right.'⁶

We're saying that a salmon (along with a person or a machine) is an effect of the relations being done in practices – for instance in the vaccination cabin. Perhaps the metaphor is ill-chosen, but this is why actor network theory talked of 'networks'. Practices are a somewhat patterned weave of relations, and the vaccination cabin weave is doing salmon in particular ways. Following Charis Cussins we may think of this as an intricate choreography⁷. Salmon passivity and human or vaccination-machine agency are being done relationally, in practice, and moment-by-moment. There's nothing static here. But if this is a choreography then it takes effort, work, continual redoing, and is more or less precarious. All in all, it isn't surprising that sometimes the choreography goes wrong. If there's too much anaesthetic in the water the salmon die (not that this actually happened). Without inner woollen gloves fingers stiffen and drop the salmon into the machine the wrong way round. If the optical sensor on the vaccination machine gets dirty it stops working properly and fish get injected in the back and don't get immunised properly. If realities, including salmon realities, are being done in practices, then it follows that they are only as stable as those practices. The choreography has to be sustained, which means that there is always the possibility that things will go wrong. Looked at in this way stabilities come to look like minor miracles. They are achievements. So the question becomes: how do they hold steady, if they do, at all?

Slippery

The salmon grow, they turn into smolts, and are moved to the marine site on the fjord. The next story comes from this site.

'Let's be honest. This is not the most appealing form of work. Sucking the dead salmon out of the pens. Putting them in a wheelbarrow. Carting them along the central walkway. ... Up the small ramp to the raft with the office, the social area, the warehouse and the plant. And then turning to the left to put them with some small difficulty in a large metal container where they are dissolved by formic acid to make an absolutely noisome slurry that is subsequently removed and fed to mink. ...'

With around 600,000 salmon in the farm on the fjord, the people who work there are walking around on the rooftops of a city of fish. The sheer size of that city means that some salmon are going

⁶ Most fish are lighter underneath than on top, and salmon parr are no exception. The machine works by detecting the level of reflected light.

⁷ Cussins (1996).

to die each day, and it's important to extract these to reduce the risk of infection. So the daufisk are sucked out of the bottom of each pen up a large flexible pipe and disgorged in a cascade of water into a container or onto the deck where they can be picked up by hand and taken to the daufisk tank. Carting 80 or 100 kg of dead salmon in a wheelbarrow is quite demanding. But so too is the job of getting hold of daufisk in the first place to drop them into the tank⁸:

'My first attempts to get hold of salmon are ... inexpert. I've got blue rubber gloves on. And then I am grabbing them, or trying to, by two hands, my right hand round the tail and my left hand under the belly towards the front. This works, especially if they don't slip off my left hand. But then I start to watch Knut ... Knut is a powerfully built man, and he picks the salmon up ... by their tails. In one hand. And they don't slip out of his grasp. ... So ... I give it a go. And, no surprise, though I'm not very good at it, it also turns out that it works. I'm not very good at it because it takes some strength. You need to grab the fish by the base of the tail, just where the fin starts. And then you need to hold it very tight. And if you do that, the fin itself, or rather its stiff part, is just a little broader than the base of the tail. Then you can hold the salmon and lift it up so long as you hold it tight enough.'

More field-notes:

'Whether or not I can get a grip of the salmon this way depends on at least three factors.

- One, and most important, the weight of the salmon. These are quite big. Some of them are monstrous, at least to my eyes. They weigh up to 5½ kilos, I'll later learn. The biggest simply slither out of my grasp when I try to pick them up that way. Slither with a clunk, that is, when they flop back onto the deck. They weigh too much and their 'natural slipperiness' means that I can't get a grip on them.
- Two, whatever it is that is holding them. Like gloves. The gloves provided by Sjølaks are somewhat rough, that is the palms and the fingers on them are, but even so the salmon, the big ones, slip through them. We need, then, to attend to the textures of relationality.
- And, three, partially related to this, on whether I pick them up with my left hand or my right. The arthritis in the base of the thumb of my right hand, though not painful, turns out to mean that I don't grip as hard with my right hand as do with my left. I didn't know this, or at least was only mildly aware of it, until faced with the salmon slither test.'

This is another web of relations: there is more choreography, more ordering, more precariousness. A salmon gripped and rendered passive may suddenly slip from a gloved hand and make off on its own. In this practice, when an arthritic joint seizes agency then so too does a fish, even if it is dead. As with vaccination, here a passive salmon is a more or less precarious achievement of that web of

⁸ In this paper we elaborate on the dealings with dead fish in a way that does not begin to do justice to the endless variety of fish-relevant activities at Sjølaks. The emphasis on 'daufisk' is partly a reflection of our own position as 'newcomers' to the salmon farm. Like fish, salmon workers are sorted too, and the task of collecting daufisk lies at the bottom of the chain, requiring as it does a minimum of training, and unlikely to cause much harm if done wrongly. But our focus also reflects an attempt to look beyond whatever most immediately meets the eye to explore many of different ways in which salmon are done. 'Daufisk' is merely one set of salmon-enactments.

relations⁹. It is difficult to grasp a salmon, difficult to hold it steady for very long, even with the right gloves and even when it is dead. So they slither around in the vaccination cabin, and they are slithering around here too.

Now let's shift scene.

'Christoffer is checking the feed levels very carefully. Four or five times during the day he runs up the gantry and along the walkways, scooping feed out of a bucket and looking to see how the fish respond as it hits the water. It is clear that some of the pens are not particularly hungry, but in one of the others ... the water is boiling with the fish. In one of the quieter pens he points to the ballet of the fish and the pellets: the latter are sinking, and though the salmon are not actually frantic to feed, they are taking the pellets as they sink through the water. He tells me that he is reducing the level of feeding in some of the pens. He suspects, he does not know for sure, that they have been overfeeding in some of them. [Perhaps they are less hungry now because it is hot.] Christoffer asks me to tell him if I see any feed pellets as I collect the daufisk. That would be a sign that the salmon are not eating all of the feed.'

Feeding is big business for the industry, Sjølaks included:

'Feed is so much of the cost of producing the fish, about 60% that it is crucial not to waste feed.'

So how is it done? The answer is, more or less automatically. Brought to the farm by a large coastal vessel in bags similar to those used by builders' merchants to deliver sand or aggregate, it is stored up to the ceiling in the floating warehouse before being dumped by fork-lift truck into silos. From these it is blown above the heads of the employees with a noisy and pervasive high-pitched rattle through plastic and galvanised iron air pipes. It goes a hundred metres or more to the pens, where it is sprayed onto the surface of the water. The supply is controlled by a computer that turns it on and off, and routes it to this pen or to that. This means that the amount of feed going into each pen is known at least in theory and can in principle be linked to the total body weight, the biomass, of all the salmon in the pen. But knowing whether the inhabitants of the pens are hungry also depends just as much on Christoffer when he goes out in the way we've just described to 'sjekke foringa', to check the feeding. How are the salmon behaving in this pen? Are they ravenous? Are they mildly interested? Or are they simply ignoring the scoops of feed that he throws at the surface of the water above their heads? And he's thinking about more than hunger too. Because Christoffer is also asking himself: are they doing OK today? Do they look poorly? Are there signs of disease? Are they too warm? And how well have smolt recently arrived on the farm adapted to their new environment?

Though its specificities are different, like lifting slippery fish this practice is another set of choreographed relations. When all goes well, salmon are done as limp and passive when they're being vaccinated. Here, by contrast, when all goes as it should they are being rendered active, albeit in a very specific way. One of the industry specialist software companies boasts: 'We make your fish talk,'¹⁰ and something like this is happening here. When Christoffer climbs up on the gantry the

⁹ This point is developed in a quite different context by Gomart and Hennion (2002).

¹⁰ The company is called AkvaGroup and its program is called 'Fishtalk'.

object is to endow the city of fish with a particular kind of voice within the reality being done by Sjølaks. This is a practice in which the salmon come to speak. They can say: we are hungry; we are healthy; or alternatively, we are off our food; or perhaps, we have this or that disease. The salmon are slippery in vaccination, but they are also slippery here. Or perhaps, since touch is rarely involved, we need a different metaphor. Perhaps we should be saying instead that they are elusive. Remember that Christoffer sees very little as he peers through its 'attic window' into the city of fish. If he is lucky then the sun is shining and the wind isn't rippling the water surface. Perhaps, under these circumstances, he can see what is going on a couple of meters down. But if he's unlucky he sees far less. Either way, most of what is going on below the surface is invisible¹¹. Here's the lesson that we want to draw. There's a kind of indeterminacy at work here. The extent to which the realities done in salmon practices and those of humans actually intersect is uncertain. And even when they start to speak the fish are also elusive.

Othering

In the vaccination hut the salmon parr vanish into the machine. Are they the right way round, head down and belly to the left? The machine checks, but it also checks their size. 11 centimetres long, that's the minimum. Most of them make it but a few don't. The machine goes click, and washes the sub-sized fish down a different pipe. They will be delivered to a tank a few metres behind the vaccination cabin: tank number 15.

From the outside tank 15 looks much like all the others. It's cylindrical, five metres across and two-plus metres deep. But if you get close this is where the resemblance ends. Most of the tanks are nearly filled up with water. Most are being fed a steady stream of fresh water. In most of the tanks the water is slowly moving too, going round and round, and the young fish are lined up and gently swimming against the current. Many of the tanks are artificially lit. All have a hopper that holds feed, and a system for sprinkling this into the water. They have a system, too, for pumping in extra oxygen when this is needed. But tank 15? It's different. It isn't full: perhaps there's a metre of water in it. There's only a limited fresh water feed. No current. No lighting. No feeding. No oxygen supply. This is where the reject salmon go, those that are less than 11 centimetres long. If you look into it you can see them, hundreds of them. If you pass along the catwalk above the tank they get excited and dart about. But that's it. It's the end of the road. They may be there for a period, while the vaccination is going on, but in the end they'll be asphyxiated. So why is this happening? Why is there this segregation?

The answer is that the salmon in tank 15 were probably going to grow too slowly. But why? One reason is that they may simply eat less. They do not transform pellets into body weight quite the same way as 'hungry' salmon. Or not as fast. People working here onshore, but also out on the fjord point to the 'taperne', that can be seen 'sulking' close to the edge, swimming slowly by themselves, smaller than the rest. Sometimes they get sucked up with the other daufisk. 'Taperne' is Norwegian for 'losers'. For one reason or another, these are fish that didn't get enough to eat. They are small compared with the other salmon, sometimes emaciated. And tank 15 contains potential losers – potential because they're going to go no further. 'If they don't grow here, they won't grow anywhere', says Tore, the manager.

¹¹ Parts of the industry use underwater television. See Lien (2005).

But how come some fish (might) become losers? How come some salmon fail to thrive?

One answer is that thriving necessarily goes with failure to thrive. Like weeds and flowers, one implies the other¹². That which fits and is desirable is impossible without that which does or is not. Control and ordering is impossible without othering. On the farm this is done in a series of practices. First, for instance veterinary practice enacts fish that do not thrive in a variety of ways, but sickness and injury are two likely candidates. The latter are the others to those being done as healthy and whole. Here's the first resonance with the occupants of tank 15. Small salmon aren't necessarily sick or injured, but they might be. Second, the practices of animal behaviour treat salmon as creatures with a range of behavioural attributes distributed across a population¹³. In this reality some become timid whilst others grow bold. Again, some end up as more aggressive whilst others are less so. This is the second resonance with the reality of tank 15. Those that are timid or pacific may grow less well, at least on the farm¹⁴. Third, along with a whole lot else, fish biology enacts salmon as varying metabolic systems¹⁵, also with their differences distributed across populations (including captivity and non-captivity)¹⁶. In a world of abundance (for most of their lives the inhabitants of Sjølaks' city of fish are scarcely on starvation rations) some salmon eat less than others for reasons that are not necessarily clear¹⁷. These will probably be slow growers. Others may eat plenty, but are metabolically inefficient. A skinny fish is a fish ill-adapted to life on the farm. This is the third resonance with tank 15. And then, fourth, salmon are not easily held in place. The choreography of marine aquaculture involves nets with a mesh size between 1.9 and 3.8 cm¹⁸. Parr that don't grow properly are much more likely to escape into the sea after they turn into smolts. But this needs to be avoided too: it is crucial that they do not 'contaminate' their wild cousins by interbreeding with them¹⁹.

Salmon that can be held and those that escape; fish that conform and those that do not: our argument about reality and its others is condensed in this location. Tank 15 is the place of the others. Accordingly, the triage in the vaccination cabin is a process that recognises and enacts the limits that go with reality-practices. It institutionalises and condenses the necessary relation between realities that fit and those that escape. It acknowledges that choreographies do not simply fail, but that it is in the order of things that they also necessarily fail. It is a material expression of the fact that every reality enacted has its shadowy others, that every time a practice selects it is at the same time backhandedly acknowledging those others.

¹² Bauman (1989).

¹³ Huntingford et al. (2006), Damsgård, Juell and Braastad (2006).

¹⁴ Fish behaviour experiments with Arctic Cod indicate that agonistic behaviour in a farmed environment is a threat to animal welfare, especially when individuals of different sizes are reared together with no possibility for individuals to select habitats or refuges. See Hansen, Skajaa and Damsgård (2006, 71).

¹⁵ See, inter alia, Talbot et al. (1999).

¹⁶ Generally, the farmed strains of Atlantic salmon tend to grow faster than natives, are more aggressive and more prone to risk-taking. See Einum and Fleming (1997).

¹⁷ The link between behavioural characteristics and food intake is often stressed. See Huntingford (2004).

¹⁸ Bostick et al. (2005).

¹⁹ Norwegian Directorate of Nature Management treats farmed salmon as an alien species: 'The current spreading of farmed salmon must also be looked upon as a problem in the context of alien species.' Gederaas et al. (2007, p 63).

Productivity

Take any practice. Ask about its choreography. Ask how it weaves its relations. Ask how realities are enacted in that weave. These are the questions for an empirical ontology. In this way of doing STS the answer to the question with which we started is that a salmon is a reality enacted in salmon-relevant practices. It is an effect of those practices and nothing more. This means that the salmon in the textbook is just that: a textbook salmon. It's done by the textbook, or wherever the textbook enters into other forms of practice, but not elsewhere. For at the same time Kristin's practices or those of Christoffer also do salmon-realities. It follows that if we want to do empirical ontology well we need to take what they do just as seriously as anything that we might learn from a textbook. Perhaps this is another version of the old STS principle of symmetry.

So what follows? One lesson that has been well rehearsed elsewhere is that realities – objects, animals or people – are multiple. In different practices they are done in different ways. There is no single reality²⁰. A second is that how practices and their realities intersect with one another deserves careful attention. Salmon may be done in different ways in different locations, but these practices are not entirely disconnected. Again there is STS work that explores such overlaps and interferences. These literatures suggest that realities may become fluid or lumpy and not very coherent, or indeed, that they may be discontinuous²¹. Indeed, the latter has arguably happened for salmon, since those that are farmed have now been enacted an 'alien species' in specific Norwegian environmental practices despite the fact that they are only seven generations removed from their ancestors that were originally retrieved from Norwegian waters²². A third which we have been rehearsing here, is that no individual practice enacts a single reality. Instead it is realities in the plural that are being done.

There are various ways of developing this thought. For instance, it is possible to argue that any practice enacts additional realities implicitly, so to speak incidentally, by mistake, and along the way. We might think of such incidental effects as 'collateral realities', and since they are done by stealth and without a lot of noise there are reasons for suspecting that they may have important power-effects²³. But in this paper we've explored the plurality of realities differently. We have attended to the ordering and sorting of the vaccination cabin. We have tried to highlight the slippery character of human-salmon interactions. We have touched on the often uncertain and elusive character of what goes on between salmon and people. And we have done so because each teaches us something about the productivity of practices.

Ordering and sorting. We've told the story of the inhabitants of tank 15. We've seen how their separation resonates with divisions and discriminations in fish biology, animal behaviour, veterinary science, and environmental protection. And then we've said that these 'taperne', these 'losers', are also being enacted in the practices of ordering and sorting in the vaccination cabin. Understand that this is not a complaint. All practices order, sort and other: the practices of salmon farming are no different from anywhere else. Perhaps, indeed, it is a definition of practice that it orders, sorts and others. But our point is this. Read aright, this teaches us that even when ordering is successfully

²⁰ See, especially, Mol (2002) and Law (2002).

²¹ In addition to Mol (2002), on fluidity see de Laet and Mol (2000), on non-coherence see Law (2004), Thompson (2002) and Moser (2008), and on othering discontinuity or 'fire' see Law and Singleton (2005).

²² Gederaas *et al.* (2007), see also Lien and Law (forthcoming).

²³ See Law (2010, forthcoming).

achieved and at its clearest, there is an accompanying realm of more or less shadowy alternative realities. Such is Bauman's point. Orders go with regulated disorders, gardens with recognisable weeds. This, then, is the first way in which practices are productive. They leave a trail of realities that didn't quite make it; a trail of nearly-reals; a trail of reals that are promptly othered.

But then practices aren't just successful. They fail too. They are precarious. Their choreography is uncertain. Sometimes indeed they work and hold things in place, but sometimes they don't. A salmon slithers from the gloved hands and flops onto the deck. This is the moment when we suddenly find ourselves in the realm of the slippery, of the unexpected, of a reality that was not anticipated. And this is the second way in which the generativity of practice expresses itself. If the successful ordering implied in triage produces a shadowy realm of nearly-reals, then so too do the choreographic failures. This is another shadow-land of practice, another mechanism in which it generates multiple versions of the real. To order is to fail, and to fail is to generate a trail of unexpected realities.

And then third, there is the elusive. When Christoffer looks down from the gantry to check how the fish are feeding he learns something. At the same time, as he knows well, almost everything that is going on within the city of fish is out of sight. What does this teach us? The answer is that we learn that human-salmon practices are also productive in ways that are hardly visible. For the city of fish out in the fjord is being done in innumerable human-salmon practices, and we have touched on only a few. But though what goes on in the pens is in part an effect of human-salmon practices, it is also in large measure beyond human knowledge. And this is a third way in which the generativity of practice expresses itself. Practices generate an unknowable and elusive penumbra of reality-possibilities.

Empirical ontology in STS has taken many forms and some have indeed attended to the productivity of othering, of the unexpected, and the elusive²⁴. Some, indeed, have sought to interfere and rework the real²⁵. But if we look back at actor-network theory, in hindsight it becomes clear that at least in its most straightforward early forms this tradition usually made a choice, no doubt implicit, to attend to the chosen realities, their struggles, their successes, and their failures, while playing down the multiplication of their shadowy others. It attended, so to speak, to the flowers in the garden rather than to the weeds. To say this is not necessarily to criticise: there were good reasons for working in this way. It was already a triumph to show that sociotechnical or political successes could be understood as an effect of more or less precarious practical, heterogeneous, and contingent relations rather than as the products of individual genius, or the consequences of the inexorable workings of macro-social forces²⁶. But if there were good reasons for doing this, there was also a price to pay. It was to participate in the predominant processes of othering, and to lose sight of the generativity of practice. Our argument is that it is time to undo this. It is time for an empirical ontology to attend to the productivity of practice and its shadowland of alterities.

If we think of animals, then what might this mean? One answer is that since many species have been domesticated for millennia this tells us that there are shadowy hosts of enacted but not-quite realised animals: first, there are those that were enacted in the past but have been othered; second,

²⁴ See, for instance, Singleton and Michael (1993).

²⁵ This is particularly obvious in the work of Haraway (1991a), but see also Mol (1999) and Moser (2008).

²⁶ See in particular Latour (1988).

within human-animal practices there are clouds of possible animals alongside those that are being realised; and then third, there are endless animal uncertainties and unknowabilities too. Perhaps as we consider the endless might-have-beens and nearlies, we might borrow from postcolonial theory and think in terms of the subaltern beasts that go with subaltern humans²⁷. For like sheep or goats or dogs, salmon can be understood as human companion species²⁸. It is true that they are newcomers to the farm: the selective breeding of farmed Atlantic salmon goes back only thirty years, but the history of people-salmon interaction goes back to the Palaeolithic²⁹. Human-salmon practices have thus been generative for at least twelve millennia, and the cloud of not-quite real salmon and their related people continues to grow year-by-year. We take it that one of the tasks of an empirical ontology sensitive to the generativity of practice is to explore and articulate some of those not-quite-realities.

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²⁷ On subaltern histories, see *inter alia*, Chakrabarty (2000).

²⁸ Haraway (2007).

²⁹ Archaeologists speculate that salmon was a crucial human food source during the last ice age. See Adán *et al.* (2009). For an analysis of the notion of domestication in anthropology, see Cassidy and Mullin (eds.) 2007, and for more restricted definition of domestication, and its relation to carp, see Balon (1994).

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