Report on the Environmental Impact of farming of North Atlantic Salmon in Norway

CONFIDENTIAL

NORGES MILJØVERNFORBUND

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ENVIRONMENTAL FACTS OF NORWEGIAN SALMON FARMING
A report by Green Warriors of Norway (Norges Miljøvernforbund),
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Green Warriors of Norway (Norges Miljøvernforbund) is a democratic environmental NGO of volunteers, founded in 1993 and headquartered in Bergen. Green Warriors (GW) has active members and community environmental groups all over Norway and regional offices in Trondheim, Tromsø and Oslo.

Green Warriors is among Norway's most active environmental NGOs, and works on a wide range of environmental issues locally, regionally, nationally and internationally. This report was made at the Marine-Maritime Coastal Monitoring Centre in Bergen.

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INTRODUCTION

The total environmental load from the aquaculture industry is unacceptably high. Green Warriors documents an urgent need to bring an end to the spread of infectious diseases, contamination and animal abuse caused by the farming of salmonids, and also to the ongoing extermination of coastal cod stocks, sea trout and the North Atlantic wild salmon stocks. We demand that within three years all salmon farming should take place in floating closed containment systems supplied with water pumped from a depth of at least 50 metres, and all effluents should be treated.

Salmon farming has grown into a huge industry in Norway, providing large export revenues. However, there is a flip side to the coin. In this report, Green Warriors presents extensive documentation of the aquaculture industry's negative effects on the environment, animal welfare and human health. The time is ripe for looking at not only the economic consequences of salmon farming, but also the ecological impacts and the solutions to be found.

In 2006, Hans Inge Algerøy, regional director of the Norwegian Seafood Federation (*Fiskeri- og havbruksnæringens landsforening – FHL*), confessed that neither the industry itself nor the authorities had any overview of all its ecological impacts. He added that "society has said we shall have an aquaculture industry and then we must accept the burdens it imposes on on others," (Tomter and Lamo Hadland 2006.) The above quotation illustrates how the aquaculture industry has steam-rolled other interests in its quest for increased short term revenues. However, the industry now faces advancing resistance. An ever growing number of critical voices oppose the industry, and Green Warriors spearheads the campaign to move fish farms to closed containment systems.

The aquaculture industry and its allies respond to Green Warriors' criticism by trying to brand us as lacking seriousness rather than discussing with us the aspects of the industry. This is hardly a haphazard strategy and for that reason it is imperative for us to publish all documentation in our possession. **Because we do not make public any claims that we cannot substantiate, and the present report contains sufficient references to refute any allegation of a lack of seriousness.**

Furthermore we believe that there are, very unfortunate, bonds between the aquaculture industry and the public officers in charge of monitoring and managing the industry. We have also found it has been documented that the industry has corrupted the institutions and ministries who are entrusted with managing and assessing the industry. As an example, in this report we shed a critical light on the Norwegian Institute of Marine Research (*Havforskningsinstituttet*), while making references to documents and reports from the Institute to substantiate our arguments. There is in contradiction inherent to this; quite the contrary, it proves that our criticism rests on a solid foundation. As an institution with such ties to the aquaculture industry is obliged to describe the environmental problems linked to current salmon farming practices.

It is an irrefutable fact that the current Norwegian aquaculture industry represents a massive threat to the environment. Green Warriors believes it is correct to compare the aquaculture industry to the heavy industries of the Seventies, which were eventally forced to treat their emissions. Now it is time for the aquaculture industry to follow suit. It is only fair that fish farmers should care for their surroundings.

The environment can simply no longer accept the burdens created by the fish farming industry.

Photo: John Øystein Berg

MILLIONS OF FARMED FISH ON THE RUN

As per 22 November 2010, the Directorate of Fisheries had received reports of 44 escapes for the year-to-date. In 2010, the Directorate recorded a total number of about 378,000 escapees from Norwegian aquaculture facilities. Of these, 255,000 were salmon, 7,000 were rainbow trout and 119,000 were cod. In February 2011, 176,000 salmon escaped from a single aquaculture facility. This equals roughly 40 per cent of Norway's total population of wild salmon. The number of escaped farmed salmon caught in the Norwegian rivers in 2011 has increased dramatically.

Escapes threaten the wild salmon

Compared to a wild salmon population of about 500 000 spawning individuals, it becomes clear that escaped farmed salmon and rainbow trout represent a major ecological contamination problem when more than 311 million fish are found in the net pens of the fish farmers (Lyngmoe 2010.) Escaped farmed salmon and rainbow trout represent a considerable threat to the genetic diversity found in the wild salmon population. The Norwegian Directorate for Nature Management (*Direktoratet for naturforvaltning*) (2009b) has warned that escaped farmed salmon interbreeding with wild salmon are in the process of eradicating wild salmon stocks and replacing them with hybrid fish:

> The numbers of farmed salmon in spawning rivers have been consistently high in the past 20-30 years and in 2008 the average proportion of escaped farmed salmon in 39 monitored rivers was 16.3 per cent. **Even five per cent of farmed salmon in a river system is too much and will contribute towards destroying salmon stocks with time**
> (Directorate for Nature Management 2009b.)

The wild salmon is at risk and the greatest threat comes from the aquaculture industry. Because of the numerous escapes the Area Planning and Environmental Department of Møre and Romsdal County has rejected any increased production within the aquaculture industry.
The Department points out that the industry is not sustainable (Reite and Flatset 2009), an opinion that is seconded by the Norwegian Institute for Nature Research:

> - The future of the wild salmon is bleak. **In the medium to long term we are replacing wild salmon with feral salmon.** The fish that ends up in our salmon rivers are the descendants of escaped farmed salmon, says Kjetil Hindar, the leading genetician at the Norwegian Institute for Nature Research (*Norsk institutt for naturforskning - NINA*) (Lyngmoe 2010.)

The County Governor of Hordaland shares this worry and is therefore opposed to increasing the production volumes of the aquaculture industry. This is because "escaped salmon make up a substantial part of the spawning populations in virtually all salmon rivers in both Midthordland and Nordhordland," (County Governor of Hordaland 2009: 2.) The County Governor firmly states: **"There is no scientific doubt that the levels of escaped salmon in our county exceed sustainable levels"** (County Governor of Hordaland 2009: 1.)

Escapee volumes uncertain

According to official figures, almost 450 000 salmon escape Norwegian salmon farms every year (Lyngmoe 2010), but as Statistics Norway (*Statistisk sentralbyrå*) highlights: "Escapes are reported by the salmon farmers themselves and there is uncertainty attached to this figure," (Statistics Norway 2010a.) The Minister of Fisheries and Coastal Affairs, Ms Lisbeth Berg-Hansen, is also distrustful of the official figures, saying **"There are clear indications that the actual numbers of escapees are higher than those reflected in thestatistics,"** she said to the Storting (*Norwegian Parliament*) on 22 March 2010 (Stortinget 2010a.)

Nor does the County Governor of Hordaland fully trust the official escapee figures:

> In its report to the Ministry of Fisheries and Coastal Affairs, the Directorate of Fisheries writes that the risk of not reaching the environmental objectives in the case of increased aquaculture production in the area is *low* in Midthordland and *medium* in Nordhordland. One of the arguments for this statement is that in the areas concerned, low figures of escaped fish have been reported to the authorities. However, **lately these areas have experienced many incidents of unreported escapes.** Very few of the incidents with a large number of evidently recent escapees can be explained by referring to the reported escapes (County Governor of Hordaland 2009: 2.)

Researchers from the biological consultants Rådgivende Biologer AS have collected scale samples from salmon fished in rivers and along the coast. In addition they realise continuous studies and thus have a sound basis for deciding whether salmon are wild or feral. **Fish biologist Harald Sægrov says their calculations indicate that a total of 2.5 million salmon escape each year without authorities being notified", in addition to "a diffuse loss from smolt plants of 4-5 million salmon per year"** (Lyngmoe 2010.)

We can safely claim that **each year, at least 3 million adult fish and 2.5 million smolts escape from Norwegian fish farms.** The consequences for the wild fish are serious.

Fish Farm in Bjørnefjorden near Os outside Bergen. The farm belogs to Sjøtroll, part of Austevoll Seafood ASA.

LARGE QUANTITIES OF WASTE DIRECTLY INTO THE SEA

According to official figures, waste from this industry equals the sewage from more than twice the Norwegian population; however, the industry believes waste volumes are much higher. Waste feed and fish faeces pass straight into the sea from the open fish farms. Feed and faeces are eaten by wild fish, which become malformed and degenerated. The Climate and Pollution Agency (Klima- og forurensningsdirektoratet) worries about eutrophication, possibly reducing the number of animals and plants in the sea, to the detriment of fisheries, leisure and tourism, and nature itself. Waste from fish farms also scares the cod away from its natural spawning grounds.

Sewage/fish faeces

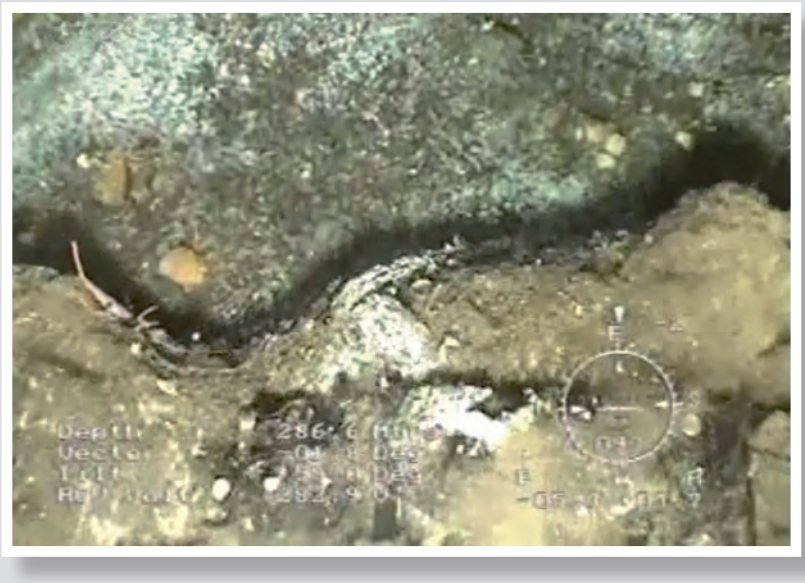
Before its recent change of name to the Climate and Pollution Agency (*Klima- og forurensnings-direktoratet*), the Norwegian Pollution Control Authority (*Statens forurensningstilsyn*) (NPCA)) stated that it feared eutrophication of Norwegian fjords because of the discharge of nutrient salts from the aquaculture industry. **"Waste from an average-sized fish farm of 3120 tonnes of salmon equals the sewage emissions of a city of about 50,000 inhabitants,"** according to the agency (CPA 2009c.) With at least 550,000 tonnes of farmed fish in Norwegian plants, we can establish that the industry discharges sewage equalling that of 8.8 million people (Hammerfjeld 2010), based on official figures. The actual figures may well be higher.

"We worry that increased waste discharge from fish farming, together with increasing sea temperatures, may cause eutrophication problems. In the worst case, this may lead to fewer animals and plants and increase dead sea bed zones. This will, in turn, reduce the value of fisheries, leisure and tourism," says Ellen Hambro, director of the Norwegian Pollution Control Authority (CPA 2009c.)

To examine the consequences of fish farms being allowed to let untreated waste into fjords, Green Warriors explored the South Fjord with our vessel M/S Miljødronningen. We sent ROV down to a depth

of 280 metres, maneuvering a camera on the bed of the fjord, below a fish farm. The sea bed was a sorry sight. We observed few signs of life and large parts of the bottom were covered with a thick white layer. When we stirred the bottom with our submarine, large bubbles of methane/hydrogen sulphide rose. It is clear that something is seriously wrong with the ecosystem and it is evident that the aquaculture industry is to blame.
The industry has tried to defend itself by claiming that waste discharged by aquaculture plants cannot be compared to sewage (Løvland 2010), but Anne Sundbye, head of the Water Section of the Climate and Pollution Agency explains that waste from aquaculture plants shares important properties with human sewage. "It may lead to eutrophication and sludge formation in affected environments, and nutrients are nutrients, independently of their source", she stated to the Norwegian daily Dagbladet (Hammerfjeld 2010.) Researchers at the Norwegian Institute of Marine Research warn against the negative consequences of salmon faeces:

> If substantial quantities are deposited, sediments will become anaerobic and hydrogen sulphide will be produced. Hydrogen sulphide is toxic both to the benthic fauna and to fish. Such sea beds are categorised as contaminated (Otterå, Nedraas, Ervik, Slinde and Karlsen 2007: 192.)



Photos taken by the ROV from the sea bed under an fish farm in the South Fjord outside Bergen. The photos were taken at a depth of 285 metres, the aquaculture farm is owned by Lerøy Seafood ASA.

Since the average Norwegian salmon farm has a biomass of 3120 tonnes and discharges equivalent of 70,000 ninety-kg pigs (personal communication from Jon Arne Grøttum, regional director of the Norwegian Seafood Federation (*Fiskeri- og havbruksnæringens landsforening*), at a meeting in Steinkjer on 20 March 2010) or 50,000 persons (CPA 2009c), we may claim that **the average fish farm avoids paying fees equivalent to approximately 20,800 households, or 45 – 72 MNOK in terms of sewage fees** (depending on locality.)

In 2009, the average Norwegian household paid 3.455.- NOK in sewage fees (Oslo Municipality 2009: 304.) If we apply our estimate of 20,800 households and multiply it by the average sewage fee, **the overall figure is 71.864 MNOK. These are potential annual cleanup fees that the aquaculture industry escapes paying because it is the last heavy industry in Norway not required to treat its waste!**
The municipality of Austevoll has 20 aquaculture locations with aquaculture licences totalling 42,900 tonnes of salmon. This equals roughly 14 licences of 3120 tonnes each. Green Warriors has been told that the sewage fee in Austevoll amounts to some 900 NOK per inhabitant. **If we translate this into land-based sewage, the potential income from fees is 14 x 45 MNOK = 630 MNOK.**

Norwegian fish farmers are subjected to waste regulations that differ radically from those that apply to agriculture. Green Warriors has tried to make a volumetric comparison of waste from pig farming and salmon farming, respectively. Norwegian regulations regarding animal density require 0.4 hectares of manure spreading land per manure animal unit (regulations FOR-2003-07-04-951, section 24.1.) For pigs, one animal unit is equal to 18 slaughter pigs (or 2.5 brood sows.) So 0.4 hectares/18 slaughter pigs = 0.022 hectares of manure spreading land per individual. Applying the same manure spreading area to an average fish farm, we arrive at 70,000 "slaughter pigs" x 0.022 hectares = 1,555

hectares (15.5 km^2.) **Thus, an average fish farm should have a spreading area in excess of 15 km2, similar to the total productive agricultural area of Bergen Municipality (1,5678 hectares.)** The total area of land in agricultural use in Norway in 2009 was 1,0113 18 hectares, equivalent to the manure from 650 fish farms if one were to apply the manure spreading area requirements of pig farming.

Aquaculture feed to wild fish

"The proportion of waste feed at the various aquaculture facilities may vary depending on the operation, but about seven per cent may be considered an average," write Gjøsæter, Otterå, Slinde, Nedraas and Ervik (2008: 52.) With an annual feed consumption of one million tonnes, they calculated an annual spill of 70,000 tonnes of feed. This feed is eaten by the wild fish foraging near the fish farms.

Studies made by researchers Ingebrigt Uglem at the Norwegian Institute for Nature Research (*NINA*) in Trondheim, Tim Dempster at SINTEF Fisheries and Aquaculture, and Pål Arne Bjørn from Nofima Marin, indicate that **an average in excess of 10 tonnes of wild fish of 15 species forage near fish farms.** In saithe an average of 33 grams of pellets were found (Ryen 2009.) Commercial fishermen have long believed that pellets from the aquaculture industry affect the quality of the saithe (see, inter alia, Tomter and Hadland 2006; Haraldsen 2006.)

In 2008, fish landing stations in Ryfylke refused to receive the season's saithe catches. Tor Bernhard Harestad, president of the Fishermen's Association of Stavanger and its surrounding district, which also runs a fish landing station, explained why the saithe was rejected:

> **The saithe we have received is discoloured and fatty, the fish meat is loose and the texture is doughy. It stinks, and stomach contents leave no doubt as to what the fish have eaten. Pellets intended for farmed salmon and salmon faeces** (the fisheries tradejournal Fiskeribladet Fiskaren 2008.)

Researchers from the Institute of Marine Research (Otterå, et al 2007) have also taken a closer look at how the aquaculture feed affects wild fish; they believe that saithe, cod and haddock caught near fish farms will be of a different quality than ordinary fish caught in the wild and that it must be handled differently:

> **Fish caught near fish farms may look different from ordinary wild fish.** It often looks well fed, has a large liver and seems rather soft. It may smell also of feed when gutted. Such fish must be handled with care. It is best to catch this fish alive, since it is quickly ruined if it is caught and dies in a net (Otterå et al 2007: 194.)

Otterå et al (2007: 194) point out that filleting such fish is difficult and they recommend it should be handled like farmed fish rather than wild fish. This entails the fish being caught alive and starved for some time prior to slaughter. Gjøsæter et al (2008: 53) emphasise that feed for salmonids is high in fat and when gadiform fish eat this feed their liver becomes very large.

Scares away spawning cod

Fishermen have long been sceptical to how salmon farming affects the cod's spawning behaviour, and both experiments in tanks and interviews with fishermen indicate that codfish avoid areas with fish farms (Røed 2003.) Subsequently, researchers from the Institute of Marine Research and the Institute of Fisheries and Aquaculture Research (*Fiskeriforskning*) have carried out several studies that have strengthened the suspicion that fish farms have a negative impact.

Svåsand, Bjørn, Dale, Ervik, Hansen, Juell, Karlsen, Michalsen, Skilbrei, Sæther and Taranger (2004) conducted experiments that demonstrated that both immature cod and spawning cod would choose to stay in tanks without salmon-holding water. The researchers concluded that **"cod caught in the wild will stay in the water with no, or the lowest, concentration of water added from tanks with salmon.** This change in behaviour is most likely due to waterborne chemical compounds from the salmon tank" (Svåsand et al 2004: 4.)

The following year these findings were strengthened through **both experimental studies and field studies indicating that coastal cod on spawning migrations avoid salmon holding water as well as cod holding water** (Bjørn, Sæther, Dale, Michalsen and Svåsand (2005): "Olfactory compounds accumulated from high fish densities in fish farms are a strong candidate for explaining such behaviour" (Bjørn et al 2005: 23.) There are, however, also cod that are attracted to fish farms. Bjørn et al (2005: 23) thus presume that there "may be two completely different responses in cod to the same stimuli: some may become habituated and attracted (stationary fjord cod) while others may

be repelled (migrating coastal cod on spawning migrations.)" The less prior exposure to "aquaculture water" the cod has experienced, the stronger its aversion. As a result, aquaculture facilities may substantially affect the spawning behaviour of migrating cod.

In 2007 another report was published regarding how aquaculture facilities may affect spawning behaviour (Bjørn, Uglem, Sæther, Dale, Kerwath, Økland, Nilsen, Aas and Tobiassen 2007.) Even though the researchers are careful in terms of drawing any clear conclusions, critics of the aquaculture industry will find arguments in the report to support their views:

> We have also examined migration patterns of wild coastal cod during spawning migrations in natural conditions in a large-scale telemetric study. **The results show that cod on spawning migration caught in the outer part of the Øksfjord, which are tagged and released at the catch site, turn around and leave the fjord within one week of being released.** These results support the claim of the fishermen that "incoming" (migratory) fish no longer migrate to the spawning grounds in the innermost parts of the Øksfjord (Bjørn et al 2007: 35.)

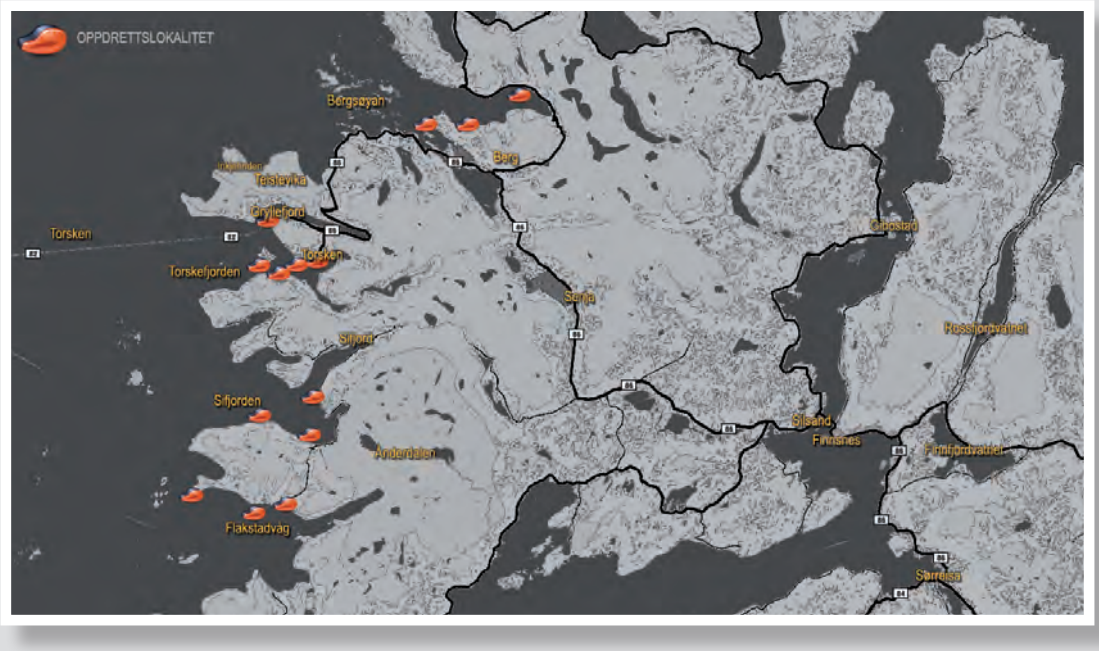
The researchers do, however, specify that their material contains some uncertainties, and they emphasise that "field studies and experimental preference tests of the kind performed so far will not be sufficient to demonstrate whether possible stimuli from fish farming actually lead to wild cod on spawning migrations staying away from traditional spawning grounds under natural conditions," (Bjørn et al 2007: 36), and they therefore recommend further research in this field.

A fisherman who contacted Green Warriors is in no doubt about the reason why the fish disappear. This is what he wrote to us in an email:

> I moved to Finnsnes two years ago but I even fished there the other year. Unfortunately there was nothing to catch. **I remember the times when we were 30 boats and in addition many fishermen from Harstad fishing with floating nets and long-lines joined us here. Unfortunately, everything has changed completely since the fish farm appeared.** We fished everywhere in both fjords and all the way in to Gryllefjordbotn; now there are not even small saithe near the quay. This year, no fishing has taken place in the fjord, there was an old man who put out fishing gear twice, but he did not catch anything. Between Månesodden and Kjerringberget there is virtually no fish. I have several times seen nets placed close to the fish farm, and half the net looks like it has been pulled through a peat bog
> (e-mail 13 August 2010.)

One fisherman from Senja, where the fjords used to be white from spawning cod, told us that on a 1,500 hook line, he recently caught only 12 fish, none of them cod.

We have fishermen with catch logs who recorded regular catch volumes for several years before a fish farm was established in the fjord system. The volumes then started to decrease and later vanished altogether.



Spreads diseases

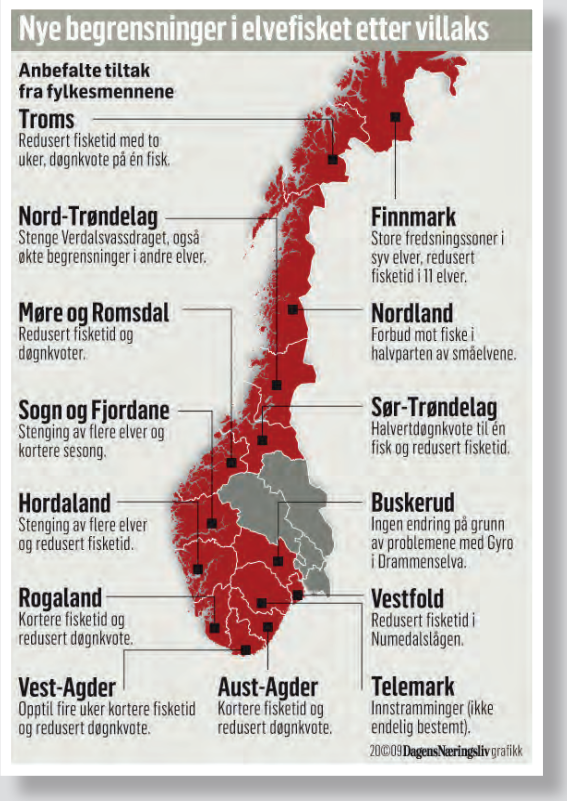
The large quantity of wild fish (up to 50 tonnes of 15 fish species), especially saithe, congregating around fish farms may be an important carrier of diseases between the different aquaculture facilities. Researchers from SINTEF, NOFIMA and NINA were able to document that between 8,000 and 18,000 saithe aggregated near two aquaculture facilities in a fjord, having moved quickly between three facilities that were between 1.6 and 4.7 kilometres apart from each other (SINTEF 2009.)
Tim Dempster at SINTEF sums up:

- The saithe's behaviour could indicate that it may be an important element in the spreading of disease. The saithe's behaviour shows if the saithe shares deseases with farmed salmon, it can contribute to the spreading of infections and parasites from one facility to another, says Dempster (SINTEF 2009.)

Ingebrigt Uglem, a research scientist at the Norwegian Institute for Nature Research, believes it is "especially pancreas disease (PD) which is considered to be a potential risk" (Ryen 2009.) This correlates with findings by researchers at the Norwegian Veterinary Institute, which point to fish infected with PD in nearby fish farms as the main source of infection of farmed salmon (Press 2009.)

DISASTROUS FOR WILD SALMON AND FISHERIES IN NORWAY

In most Norwegian salmon rivers, fishing has been banned or at least the season shortened because of a lack of wild salmon swimming up the rivers to spawn. A total of 117 out of 450 rivers will be completely closed for the next five years. This is due to escaped farmed fish and the aquaculture industry's spreading of salmon lice, which are decimating several local populations of wild salmon. The Vosso salmon, once the world's largest Atlantic salmon, currently exists only in the gene bank in Eidfjord. The Norwegian aquaculture industry and public authorities simply wash their hands and look the other way. The Norwegian Farmers' Union (Norges Bondelag) estimates that closed salmon rivers will lead to annual losses of up to MNOK 500 for Norwegian landowners as well as others who make a living from salmon tourism.



Limited salmon fisheries

The wild salmon populations of Norwegian rivers are now so vulnerable that county governors along the coast recommend new and far more radical restrictions on fisheries. In 10 out of 17 coastal counties, the county governor recommends reduced fishing periods or seasons. For details, see the illustration provided by courtesy of the financial daily Dagens Næringsliv.

The Norwegian Directorate for Nature Management (2009a) also wants restrictions on salmon fisheries in the sea from the 2010 season onwards. The proposed new regulations entail a ban on fishing in several regions and reduced fishing periods in a number of other regions.In 2008, 54 of Norway's 450 salmon rivers were closed to fishing, and in 2010 an additional 63 rivers were closed. In 2008, the NGO Norwegian Salmon Rivers (*Norske Lakseelver*) estimated **the salmon industry's losses due to this closure to be 300 MNOK (NTB 2008), while the Norwegian Farmers' Union in 2010 talked about a fifty per cent reduction of an annual turnover of about 1000 MNOK** (Wiker 2010.) Finn Erlend Ødegård of the Farmers' Union explains the importance of salmon fishing for Norwegian farmers:

> The wild salmon contributes to keeping the wheels turning and enabling farmers to invest in their farms. Norwegian farmers have a 150-year tradition of offering packages including

salmon fishing, lodging, local food and guiding. The first tourists to visit Norway were salmon fishermen (Wiker 2010.)

Having this in mind, there is reason to worry when 2009 turned out to be the worst year ever for salmon fishing. Only 151,000 wild salmon were fished in the sea and in rivers, and Torfinn Evensen, president of Norwegian Salmon Rivers, reports that many salmon fishermen (and women) now prefer to have their fishing holidays in other countries rather than in Norway (Harstad 2010.)

The Vosso salmon

The Vosso salmon was probably the world's largest Atlantic salmon, but towards the end of the Eighties the population collapsed. Even though the Vosso salmon has been protected since 1993 and more than 30 MNOK have been invested in the project to save it, the population has not recovered. **The County Governor of Hordaland (2007) presents calculations indicating that Voss loses 20-30 MNOK annually due to the disappearance of the Vosso salmon.**

It is logical to see the collapse of the Vosso salmon population as linked to the massive expansion of the aquaculture industry which took place precisely in the Eighties. The County Governor of Hordaland has voiced a clear opinion on the causal links:

> **Experiments have demonstrated there is a high probability that salmon lice from the aquaculture industry are an important factor in the loss of the Vosso salmon. It can also be established that escaped farmed salmon are a serious threat.** The volume of escaped salmon in the Vosso River is not particularly high compared to other rivers in the county, but still the problem of escapees is prominent as there is little wild salmon left (County Governor of Hordaland 2007.)

When the salmon from Vosso must pass 14 fish farms on its way to the sea it is evident that it is exposed to great risks.

The Directorate for Nature Management has preserved the original Vosso salmon at the gene bank in Eidfjord, but there is a limit to how long it is possible to preserve genes there because of inbreeding and loss of genetic diversity (Barlaup 2008: 11.) **"To avoid a total loss of the Vosso salmon, salmon lice attacks on smolts migrating from the river to the sea and the number of escaped farmed salmon in the river must be reduced substantially," reasoned Janne Sollie, director of the Directorate for Nature Management (2008), following the publication of the Directorate's report named "Now or never for the Vosso salmon – measures recommended on the basis of the population's development and threat factors" (Barlaup 2008.) The report concluded that lice and escapes from the aquaculture industry were the central causes of the destruction of the Vosso salmon.**

Good old days in the Vosso River.

SALMON LICE

Salmon lice occur naturally on wild fish, but farming in open net pens provides the lice with excellent conditions and so the number of lice increases dangerously. Wild stocks of both salmon and trout are threatened by the spreading of salmon lice from the aquaculture industry, and the industry's efforts to counteract this problem have been futile. We believe that slaughtering salmon infected by lice is necessary to solve the problem.

Deadly parasite

The salmon louse is a parasite that occurs naturally in Norwegian waters, but as the Institute of Marine Research (undated-b) points out: "The scope has increased substantially in parallel with the growth of the aquaculture industry." The Directorate for Nature Management also links the increasing salmon lice problems to the growth of the aquaculture industry:

> The salmon louse is a parasite that occurs naturally in the sea, but due to large volumes of salmon and rainbow trout in fish farms we now have unnatural and extremely high concentrations of salmon lice in our fjords and coastal areas. **The situation is so serious that there is a risk that salmon lice may kill off entire populations of wild salmonids** (Directorate for Nature Management 2010.)

The lice attack both wild salmon and sea trout and one has found **smolts covered with two hundred lice (Mugaas Jensen 2010) and sea trout covered with a hundred lice** (Namdalsavisa 2009.) Such fish face certain death. Jens Christian Holst a senior research scientist at the Institute of Marine Research, explains that **"smolts with more than ten lice die because of the quantity of lice and those with more than eight lice will most probably die from consequential problems,"** (Mugaas Jensen 2010.) The situation has been very serious for several years. In 2008, findings showed that 50 per cent of wild salmon had critical levels of salmon lice infection (Boxaspen 2009: 12.)

The consequences in terms of animal welfare will be examined in the chapter on mistreated farmed fish; below we shall focus on the wild fish.

Salmon with 70-80 female adult lice, each capable of producing 30 larvae daily, or up to 2400 per day

Rainbow Trout with lice in an open wound

Extensive spreading of lice

Salmon lice and their larvae are spread with water currents, and experiments suggest that spreading may take place over distances exceeding 100 kilometres (Asplin and Sandvik 2009: 18.) Lice larvae may survive 150 day-degrees without a host, which at a temperature of 10 ºC would be 15 days (Asplin and Sandvik 2009: 18.) Lice is thus a regional problem, not a local one restricted to areas near the farms.

When there are 300 million farmed salmon in Norwegian net pens (Statistics Norway 2010b) and the statutory limit is 0.5 adult female louse per salmon during the summer season and 1 adult female louse per salmon in the winter (regulations FOR 2009-08-18 no. 1095), it means that Norwegian authorities accept up to 150 million adult female lice in the pens in the summer and 300 million in the winter. These adult females of the salmon louse live up to 190 days at a water temperature of 7 ºC, so they can survive the winter and continue producing eggs (Heuch 2009: 16.)

At winter temperatures, an adult female louse will be able to produce at least ten pairs of egg strings, each containing up to a thousand eggs. This means that in an area with a lot of salmon lice there will be a «reservoir» of lice in the water even if farmed fish receives treatment (Heuch 2009: 16.) Maturation time of the egg strings depend on the ambient temperatures, so larvae production of lice will be faster in the summer than in the winter.

After maturation the eggs hatch and the free-living larvae are released from the egg strings. Because of their yolk sac, they have ample energy reserves and can survive for several weeks and be moved far away with the water masses before attaching to a host. New egg strings are produced and start maturing immediately after hatching.

Conservative estimates of larvae production of each individual, adult female louse, are about 25 larvae per day in winter temperatures and about 50 per day in summer temperatures. Since twice as many adult female lice are allowed in the winter, when the lice produce half as many larvae, the daily production of lice is quite stable year-round.

This means that Norwegian authorities accept that the current 300 million farmed fish release about 7.5 billion salmon lice larvae into the sea every day of the year.

With each adult female louse being capable of producing 10,000 eggs during its lifetime, and lice regulations allowing up to 300 million adult female lice in the pens in the winter, one might say that **Norwegian authorities accept a production of up to three hundred thousand millions of new salmon lice from the Norwegian aquaculture industry every winter.**

Boxaspen (2009: 12) points out that if the mandatory threshold for implementing corrective actions is not lowered as production increases, the result will be more salmon lice larvae in the sea. **Against this background it is highly worrisome that threshold values have remained static in**

recent years, even though the number of salmonids in open net pens has increased considerably. Thus, by keeping the threshold values for medicaiton or other countermeasures at the same level, while steadily increasing the number of fish in pens, the infection pressure on wild salmonids have increased dramatically.

There may also be reason to question whether today's thresholds of 0.5 adult female louse per salmon in the summer and 1.0 in the winter are too high, out of concern for the animal welfare of salmon in the pens, since it has been "demonstrated that **from 0.05–0.13 adult lice per gram of fish weight may reduce swimming capability and disturb the water-and-salt balance in larger salmon and sea char"** (Finstad and Bjørn 2009: 13.)

Failed measures

Despite major efforts, the problems relating to salmon lice have not diminished in recent years, and although the problems were vast in 2008 and 2009, no improvement is in sight for 2010. The Institute of Marine Research (2010b) closes its "Status Report to the Norwegian Food Safety Authority regarding Salmon Lice Infection of Wild Salmonids for the Period May–July 2010" with the following words:

> The observed development in salmon lice infections in wild fish still strongly resembles the situation in 2009, with few lice in the spring and early summer and followed by an increase during the summer and autumn. **The maximum lice infection pressure we observe in some areas, however, now considerably higher now than what we have registered in the last few years, particularly on the west coast and northwest coast** (Institute of Marine Research 2010b: 3)

In the aquaculture industry's early days, when farms were smaller, wrasses were part of the solution. Today, however, the use of wrasses may have serious negative consequences, and fail to solve the lice problem. Green Warriors worries about the consequences of fewer wrasses in nature, as wrasses have an important job in the ecosystem and we believe a large-scale harvest of wrasses would be a poorly analysed measure.

The increased use of wrasses in the last few years has not prevented salmon lice numbers from growing.

In one of the applications to the Norwegian Medicines Agency (*Statens legemiddelverk*) for using flubenzurons to reduce the number of lice the following is stated: **"All the facilities have for a long time bet on wrasses to combat salmon lice. In spite of this, in 2009 they still suffered massive infestations of lice in late autumn"** (application dated 6.5.2010.)

Slaughtering infested salmon is the only solution we know to be effective. Green Warriors demands immediate slaughtering, a demand we have made both this year and last year. Had the industry and the authorities heeded this advice, the problem would have diminished substantially and the wild salmon would have been much safer.

Green Warriors' conclusion is that within a three-year period, the lice produced by the fish farms will remove the greater part of the remaining Norwegian stocks of wild salmon and sea trout.

EMPTIES THE SEA OF WILD FISH

To produce 1 kilogram of farmed salmon, the aquaculture industry consumes between 2.5 and 5.5 kilograms of wild fish, and more than half of the raw material used in salmon feed is nutritious and fully suitable for human consumption. Industrial aquaculture of fish-eating fish is incredibly resource-demanding and empties the sea of wild fish. Wild fish which could have been eaten by humans or other animals forming part of the ecosystem. The harvesting of fish for use as fish feed also poses a threat to large populations of seabirds and wild fish.

Consumption exceeds production

1000 kilograms of wild fish become 228 kilograms of fish meal or 50-120 kilograms of fish oil. According to the feed producer Skretting AS, their salmon feed contains 15 per cent of fish oil and 31 per cent of fish meal (Skretting 2010.) **This means that Skretting in this case uses at least 3.5 kilograms of wild fish to produce 1 kilogram of salmon feed.** In 1995, the figure was 7.5 kilograms of wild fish per kilo of farmed salmon, in 2005 this figure decreased to 5.4 kilograms, and the current figure is around 3 kilograms (Olsen and Karlsen 2009: 140.) The figure will depend somewhat on the kind of wild fish used.

Although salmon are carnivorous, the aquaculture industry uses a growing proportion of plant feed. Skretting (2010) aims at producing feed where two-thirds will be of plant origin within a few years, but the health benefits decrease when the fish has been fed plant oils (Heggelund 2006.) **Salmon that has been fed a large proportion of plant oils contain more omega 6 and less omega 3.** This will affect all those eating the fish, since the Norwegian diet is already characterised by a surplus of omega 6 and a deficit of omega 3 (Tveit 2010.)

Giving plant feed to a carnivore like the salmon is unnatural and weakens the fish's health, Green Warriors is opposed to this practice.

Human food

About half of the raw materials of salmon feed are fish oil and fish meal, to a large extent produced from fish species that are fully adequate as food for humans, such as herring, mackerel and blue whiting. **Large quantities of food are reduced to lesser quantities by the aquaculture industry which offers prices making it unprofitable to use such fish for human consumption.**

Fishing vessel are offered 2.80 NOK per kilogram for Norwegian spring spawning (NSS) herring from the meal and oil factories. This is 0.59 NOK above the average price for delivery for human consumption (Lindbæk 2010: 8.) The aquaculture industry buys fully adequate food away from humans, and the trend is increasing. **While 10.7 per cent of catches of NSS herring were sold to fish meal factories in 2009, in the first few months of 2010 the share almost doubled to 20.5 per cent** (Engø 2010.)

Food for birds and fish

Other fish species, which form part of the same production, are species upon which larger wild fish prey. When feed factories increase their pay for sand eel (Lindbæk 2010), this key fish species becomes even more overfished than at current (Institute of Marine Research 2010a.) Sand eel is a cornerstone of the ecosystem, it feeds on animal plankton and is eaten by fish like cod, whiting, haddock, saithe and mackerel, as well as seabirds (Kirkeng Andersen 2004.) A collapse of the sand eel stock may have very grave consequences for seabird populations in the North Sea, which already are in a serious situation (Pedersen 2006; Myklebust 2009.)

Artic Puffin (Fratercula Artica) with a serving of Sand Eel. Photo by Bjørnar Pedersen.

Professor Olivier Chastel has done research on seabirds for 30 years and currently participates in a major research project on the kittiwake in cooperation with the Norwegian Polar Institute (*Norsk Polarinstitutt*) and the Norwegian University of Science and Technology (*Norges teknisk-naturvitenskapelige universitet*.) Professor Chastel is in no doubt that the aquaculture industry has had a negative influence. He stated the following to the Norwegian TV channel TV2:

> - We see there are massive fisheries on some small fish species that have not traditionally been used as human food. **Before there was no money to be made from these species and they were largely left undisturbed. However, now many species are being fished and used as feed in the aquaculture industry. I believe this may have destroyed much of the seabirds' food base** (Korsvold 2010.)

Green Warriors is concerned about this situation, believing it is indispensable to have tougher restrictions and environmental standards applied to the use of feeds in the aquaculture industry. Green Warriors wants a total ban on sand eel fishing.

FARMED FISH ARE MISTREATED

Greedy fish farmers break the law and subject the fish to high levels of stress by cramming too many fish in the net pens. Fish without fins and with open sores are a part of the aquaculture fairytale that people are not allowed to hear. The wish for ever-increasing profits takes precedence over the concern for the fish's health, living conditions and natural needs. No other Norwegian industry runs a more lawless and reprehensible animal husbandry than the aquaculture industry. Between 10 and 20 per cent of the fish die on their way from stocking to slaughtering due to their unbearable living situations as well as high rates of disease, injuries and malformations.

Animal abuse in the net cages

It has been well documented that fish feel pain (Norwegian Animal Protection Alliance (*Dyrevern-alliansen*) 2010; Børresen 2000) and fish are covered by the Animal Welfare Act (following, amongst other things, a ten-year effort by Green Warriors), and yet the aquaculture industry still fails to care for the animals' wellbeing. Torrisen (2004: 13-14) divides the animal welfare problems into four categories:

1) treatment and handling that inflicts stress and discomfort
2) diseases and parasites
3) sub-optimal environmental conditions
4) deformities and malformations

Transport in well boats or tanker trucks leads to crowding, hypoxia and a change in the water quality, and is a critical point. Stunning of the fish prior to slaughter is made by pumping CO2 into the net pens, leading to several minutes of the surface "boiling" with the violent splashing of fish desperately trying to escape what they probably experience as slow suffocation (Norwegian Animal Protection Alliance 2007.)

In the Veterinary Institute's fish health report from 2008 there are separate descriptions of 15-20 diseases (National Veterinary Institute 2009a), and with almost half of all farmed salmon affected by heart inflammation and nine in ten with increased fatty deposits in the heart (Solheim 2009.) Stefansson, Holm and Taranger (2002: 79) point out that farmed salmon have limited possibilities of swimming in the net pens and reduced motivation, since the food comes to them. This may affect fat deposition, growth and sexual maturation, among other things. **"It is also probable that reduced swimming affects muscle texture. This may be one explanation for why some consumers prefer wild salmon,"** they say**.** (2002: 79.)

"One of the major welfare problems we observe in the current Norwegian aquaculture industry is salmon lice; they cause sores and in cases of heavy infestations they clearly affect the fish's general condition", writes Torrisen (2004: 13.) This is echoed by the Institute of Marine Research (undated-b):

> Salmon lice injure salmonids by feeding on their mucus, skin and blood. This paves the way for infections via bacteria and fungi amongst others, while also affecting the osmotic balance of the fish.

Salmon covered in lice are being eaten alive and suffering great pain. A salmon without fins is like a person without hands and feet. They are the fish's balancing organs and removal of them is animal mistreatment of the worst kind.

"Sub-optimal environmental conditions are a far larger problem than the industry is aware of," according to Torrisen (2004: 14), who cites a mortality in the sea stage in excess of 20 per cent. He lists the causes in order of decreasing importance: "undefined, disease, normal mortality, wounds, algae and jellyfish, predators, sexual maturation, escapes, malformations and mortality following stocking" (Torrisen 2004: 14.)

Farmed fish struggle with deformities of both external and internal organs, which can cause issues such as problems in closing the mouth, exposed gills or a deformed spine, as well as too few pyloric caeca or an abnormally developed swim bladder (Norwegian Animal Protection Alliance 2007.) Torrisen (2004: 14) writes that deformities are caused by "sub-optimal environmental conditions, nutrition, side effects of vaccines, aggression among individuals and genetic factors."

The most common deformities are cataract, deformities of the spine, malformations of jaws and gill covers, incomplete metamorphosis and eye migration in flatfish, incomplete skin pigmentation, adhesions in the abdominal cavity following vaccination, as well as eye injuries and wounds caused by aggression (Torrisen 2004: 14.)

Stress and behavioural problems are common with the lack of possibilities to escape may create aggression between fish. **The starvation of fish prior to slaughter increases aggression levels in the net pens, increasing subsequent injuries to fish** (Norwegian Animal Protection Alliance 2007.) "Starvation of fish shall not be used as a means for regulation of markets, production or quality" states the Animal Ethics Council (*Rådet for dyreetikk*) (1997) appointed by the Ministry of Agriculture.

Salmon with serious lesions caused by lice. Photo John Øystein Berg

Excessive density

We believe there are too many fish in the net pens and that it would be an advantage to grant the fish more space. It is a clear indication of low animal welfare when 20 per cent of the fish die during the sea-water phase. **Fish are also given a triple vaccine against vibriosis, cold water vibriosis and furunculosis (Fossen AS undated); three diseases that are all caused by stress to the fish.** This must be seen in the light of stocking density, because it reaches a point where "high density of individuals triggers a certain aggression. This may in turn trigger stress reactions in the salmon. It is also possible that small net pens may make it difficult for the fish to maintain normal schooling behaviour. A less structured behaviour in the net pen may lead to more "clashes" among individuals and increased

aggression" (Stefansson, Holm and Taranger 2002: 79.) The Ministry of Agriculture (2002) raised the issue in White Paper no 12 (2002-2003) *On Animal Husbandry and Animal Welfare*:

> Farmed fish often suffer fin injuries, especially if the stocking density is high. Such injuries may be caused by wear or bites. Lesions to the skin may lead to osmotic balance problems and may pave the way for infections. Worsening these problems, in the winter, lesions heal slowly (Ministry of Agriculture 2002: 59.)

Cold water vibriosis is a stress-induced disease and nature's own way of regulating the number of individuals in a population. A vaccine prevents this process, thus leading to the occurrence of numerous other diseases.

The Veterinary Institute (2010) furthermore states that **the vaccines that are administered for stress-induced diseases have negative side-effects for the salmon's health:**

> All Norwegian farmed salmonids receive vaccines intraperitoneally, leading to enormous health gains in terms of protection against, for instance, furunculosis and vibriosis.
> The vaccine may, however, cause side-effects such as peritonitis, which may weaken the fish (National Veterinary Institute 2010: 19.)

The problem has been known for a long time. The Animal Ethics Council (1997) notes: "Vaccination is not unproblematic in terms of animal health, as it involves tissue irritating adjuvants which frequently cause extensive reactions (peritonitis)." In the white paper on animal protection, **peritonitis followed by intra-abdominal adhesions is described as a "common side-effect" of oil based vaccines and as "a substantial welfare problem"** (Ministry of Agriculture 2002: 58.)

The high density of fish in pens also increases the oxygen consumption in the hatcheries, accompanied by correspondingly increased levels of carbon dioxide. As a result of this, fish farmers try to compensate by adding oxygen to the water, but a recent study at NIFES suggests that such oxygenation doubles the chance of the salmon developing cataract (Norsk Fiskeoppdrett 2008: 61.)

Cancer in the salmon

In the autumn of 2005, the Veterinary Institute discovered an epidemic of intestinal cancer with metastasis in the liver and other organs among farmed salmon, and what they found that they had in common was the feed. Plant feed, to be more specific.

The Veterinary Institute points out that plant fodder is not natural for predators like salmon, and that several studies have shown that plant-based feed leads to inflammation of the intestine in salmon and trout. Breeding companies, a feed manufacturer, the Veterinary Institute, the Norwegian School of Veterinary Science (*Norges veterinærhøgskole*), Laboratorium for Patologi AS and the University of Oslo all cooperated with each other on a study which found that chronic inflammation may develop into an adenocarcinoma cancer (National Veterinary Institute 2009b.)

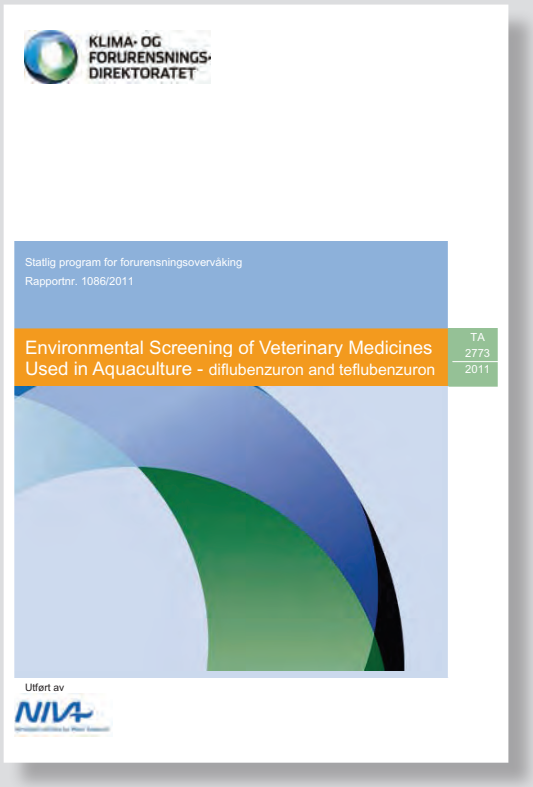
Green Warriors believes that all the lesions caused to the fish by the plant-based feed represents that this is mistreatment of animals and they are therefore opposed to the use of such feed components.

CARCINOGENIC SUBSTANCES

Both recent and earlier research give clear indications that the medicinal agents used by the Norwegian aquaculture industry for delousing of farmed fish, diflubenzuron and teflubenzuron, lead to carcinogenic substances in fish both inside and outside the fish farming facilities. As much as ten per cent of the dangerous substances may remain in the fish. Upon consumption of the fish, the cancer risk may be transferred to humans. These chemical agents are also detrimental to animals and nature on a larger scale.

Flubenzurons

The use of teflubenzuron and diflubenzuron for delousing may create a risk of cancer in people who eat the salmon or some of the wild fish foraging close to the fish farms. Salmon treated with diflubenzuron is subject to a pre-sale withdrawal period of 105 day-degrees, while the corresponding quarantine period is 96 day-degrees for teflubenzuron and three times longer if fish are to be exported to the



USA (Mugaas Jensen 2009; Nygaard 2010: 15-16.) Despite this, the salmon still contains traces of such carcinogenic substances when it is sent out to the markets. There are no similar restrictions on wild fish, which also ingest flubenzurons, even though wild fish are equally as affected by these substances as the farmed fish.

Studies done by the US Environmental Protection Agency show that if a mammal (human being) ingests these flubenzurons, that are given to the fish, the mammals may form parachloroaniline in their intestine and stomach. This means that any humans who are unfortunate enough to eat wild fish that have ingested these substances, may form parachloroaniline and thus have carcinogenic substances in their bodies. In the Pesticide Properties DataBase (PPDB 2010), developed at the University of Hertfordshire, teflubenzuron is defined as a possible carcinogen, status not defined, and it is classified as R40 according to the EU risk classification, meaning it has, "limited evidence of a carcinogenic effect."

EPA (1997: 2-3) believes that diflubenzuron is not directly carcinogenic in itself, but that **the metabolite parachloroaniline probably is carcinogenic,** together with another metabolite, CPU (4-chlorophenylurea.)

As mentioned, an average of about ten tons of wild fish forage near each aquaculture facility (Ryen 2009.) "No pharmacokinetic studies have been made on wild fish and so one cannot disregard the possibility of exceeding the ADI by eating, for instance, the liver of saithe that has ingested medicated feed," write Samuelsen, Ervik and Nilsen (1999: 2) of the Institute of Marine Research, with reference to the acceptable daily intake (ADI) of diflubenzuron estimated at 0.02 mg/kg per day. The same applies to teflubenzuron, "No pharmacokinetic studies have been made on wild fish relating ADI to expected concentrations of teflubenzuron in wild fish," they say (Samuelsen, Ervik and Nilsen 1999: 8.)

In a paper from the Norwegian Medicines Agency the following is stated: "As regards for instance diflubenzuron and teflubenzuron, a large portion (about 90 per cent) will exit with the faeces without being decomposed. Both the above substances will adhere strongly to sediments and organic material. **Because of their long half-lives, they may bioaccumulate in sediments in the case of repeated treatments. With time, the substances will leak and affect the surrounding environment"** (Fadum 2000: 21.) Nygaard (2010: 15-16) therefore recommends that 12 weeks should pass between each treatment "because of accumulation and long half-lives in the environment." **Fat regurgitation, dust from feed, waste feed and faeces, as well as the fact that aquaculture facilities are presently**

more exposed to sea currents, all contribute to the spreading of diflubenzuron and teflubenzuron over larger areas. A realistic estimate is that these substances are spread over a radius of five kilometres from the aquaculture facilities, depending on currents.

The Scottish Environment Protection Agency (SEPA 1999: 5) confirms that 90 per cent of ingested teflubenzuron is excreted by the salmon, while 10 per cent remains within. In addition, a certain percentage of the medicine will pass straight through the open net pens without even passing through the fish. "Medicines for farmed fish are administered as a group treatment. The fish's appetite will decide how much of the medicated feed is eaten, and sick fish often has a low appetite. Because of this, some of the medicine will find its way into the surrounding environment through waste feed," state Samuelsen and Ervik (2001: 17) of the Institute of Marine Research. It is worth noting that Fiskehelse og Miljø AS, represented by Nygaard (2010: 15-16) believes treatment with flubenzurons should not be applied to "fish with a failing appetite."

In a memorandum from the Institute of Marine Research the following is stated: "It was possible to detect small quantities of the metabolite 4-chloraniline by basic hydrolysis of tissue samples from salmon treated with diflubenzuron" (Samuelsen, Ervik and Nilsen 1999: 1.)
The European Agency for the Evaluation of Medicinal Products (1998: 5) found the metabolite 4-chloroaniline in salmon, and the Physical and Theoretical Chemistry Laboratory at the University of Oxford (PTCL 2003) describes 4-chloroaniline in this way: "Very toxic if inhaled, swallowed or absorbed through the skin. May act as a human carcinogen."

When Green Warriors started the mapping of these environmental toxins we came across a memorandum from the EPA stating, inter alia: "diflubenzuron metabolize in animals to parachloroaniline (PCA), which induces cancer in animals. EPA assumes that diflubenzuron will be converted into PCA in human as in animals." **When the EPA in 1994, put this environmental toxin on its list of substances that should be phased out, the manufacturer (the food industry) filed a suit against the environmental authorities and forced through a reclassification by straightforward threats.**

The EPA did not change its view with respect to diflubenzuron being capable of transforming into PCA (which has been documented to cause cancer.) Green Warriors received a written reply from the EPA to our request concerning this (dated 27 Oct. 1998) in which EPA's caseworker states the following: **"My understanding of the toxicology of this chemical is that diflubenzuron is not carcinogenic in lab studies, but metabolism studies show that it is converted at some percentage to PCA. PCA is carcinogenic."** It is furthermore stated that "there is concern that diflubenzuron can become **PCA in vivo**." Green Warriors are unaware of any research that, **beyond any doubt**, establishes that this conversion does not take place in humans.

In a recent and comprehensive document, the EPA (2009a: 15) states: "Degradates of diflubenzuron include 2,6-diflubenzoic acid (DFBA), 4-chlorophenylurea (CPU), 4-chloroaniline (PCA), and 2,6-diflubenzamide (DFBAM.)" The EPA goes on to say:

> Several degradates have been shown to be of similar toxicity to fish compared with parent diflubenzuron. In particular, PCA has been shown to be more toxic than diflubenzuron to fish with LC50 values ranging from 2 mg/L to 23 mg/L. DFBA and PCPU appear to have similar toxicity relative to parent diflubenzuron with 96-hr LC50 values of approximately 70 mg/L to >100 mg/L in fish. The most sensitive LC50 in fish was 127 mg/L for diflubenzuron (EPA 2009a: 16.)

In its assessment of diflubenzuron, the then Agricultural Inspection Authority made reference to a research report where one had found a "concentration increase of 4-chloroaniline of about 41, CPU of 1.3..." (Agricultural Inspection Authority 1999: 5.) Both these substances are carcinogenic.
We were denied access to the report itself. Eisler (1992: 24) writes that "A minor metabolite, 4-chloroaniline, which is classified as a mutagen by the National Cancer Institute and the Cancer Assessment group of the U.S. Environmental Protection Agency (Schaefer et al. 1980), is significantly more toxic to fish and Euglena gracilis than is diflubenzuron." In the aforementioned Health and Safety Guide No. 99 from the International Programme on Chemical Safety (IPCS 1995) the following is however stated: "The 4-chloroaniline metabolite has not been detected in fish." A memorandum from the Institute of Marine Research is highly ambiguous: "It is claimed at first that: "The metabolite 4-chloroaniline was not detected in salmon," but the following is then stated a couple of lines further down on the same page: "It was possible to detect small quantities of the metabolite 4-chloroaniline by basic hydrolysis of tissue samples from salmon treated with diflubenzuron" (Samuelsen, Ervik and Nilsen 2009: 1.) **Ambiguous, to put it mildly – one might as well call it deception.**

Unhealthy wild fish caught near a salmon farm.

American environmental authorities believe the cancer risk linked to chloroaniline has not been sufficiently mapped (EPA 2009b.) The Extension Toxicology Network, the cooperative effort of a number of American universities, states that: "It does not appear that diflubenzuron would pose a cancer threat to humans at low levels of exposure" (ExToxNet 1993), however, nothing is written concerning the risk accompanying higher levels of the substance. The network does report, though, that moderate levels may pose a risk:"

> Rats given moderate amounts of the compound for two years had enlarged spleens while mice in a similar study had liver and spleen enlargement at slightly lower levels of exposure. **This suggests that moderate levels of exposure over a lifetime might pose a risk to humans** (ExToxNet 1993.)

An extensive report from the National Cancer Institute (NCI 1979) included testing of chloroaniline on rats and mice: It reported: "The findings of small numbers of fibromas and sarcomas in the spleens of male rats was considered strongly suggestive of carcinogenicity, due to the rarity of these tumors in the spleens of control rats. Hemangiomatous tumors in dosed mice may also have been associated with administration of p-chloroaniline" (NCI 1979: viii.) The conclusion was nevertheless that there was insufficient evidence to state that the substance is carcinogenic for rats and mice (NCI 1979: viii.) As a result of this substantial uncertainty surrounding the matter, it is necessary to inform consumers of the above as a cautionary measure.

Green Warriors believes Norwegian farmed salmon currently contains such quantities of potentially carcinogenic substances that it should not be part of the Norwegian diet.

Farmed salmon is not safe to eat

On the basis of the information cited above, Green Warriors has warned against consuming farmed salmon and wild fish that foraging near fish farms.

The Institute of Marine Research rejects the health hazard in a recent note. Samuelsen and Ervik (2010: 2) write:

> **Based on available information on pharmacokinetics and withdrawal periods for these medicinal substances it is not hazardous to consume farmed fish. This is in agreement with the conclusion of the National Institute of Nutrition and Seafood Research (*Nasjonalt institutt for ernærings- og sjømatforskning - NIFES*) and the Norwegian Institute for Public Health (*Folkehelseinstituttet - FHI*)** (Samuelsen and Ervik 2010: 2.)

Samuelsen and Ervik (2010: 2-3) emphasise that there is not enough knowledge about flubenzurons in the wild fauna, and despite these same researchers previously, like Torrisen (2004: 13), having pointed out the low appetite in sick fish (Samuelsen and Ervik 2001: 17), this is their conclusion today:

> One must furthermore be able to presume that most of the medicated feed is actually eaten by the salmon in the net pens, and if there is a lot of fish around the pens the competition for the waste feed among the wild fish will be great, the probability of single individuals ingesting substantial amounts of medicinal substances will be small (Samuelsen and Ervik 2010: 3.)

The Norwegian Food Safety Authority (2010b) also concludes that eating wild fish that have foraged near fish farms does not pose a risk:

> It is safe to eat wild fish that have foraged near fish farms that use flubenzurons against salmon lice. Flubenzurons are used for a limited period of the year, and if wild fish were to eat feed with a medicinal substance it is only slightly absorbed in the fish meat.

Green Warriors believes that the Food Safety Authority and the Institute of Marine Research present mere suppositions that lack any scientific basis.

It is worth noting that the Institute of Marine Research makes reference to the withdrawal period to render the farmed salmon innocuous, while in the absence of a withdrawal period for fish outside the pens there is seemingly no need for any withdrawal period for that fish. The effects of flubenzurons are hardly limited to the fish inside the pens, and Green Warriors finds it irresponsible to presume the substances become innocuous the moment they leave the pens.

Moreover, the Norwegian withdrawal period is short compared to the American one. **For the diflubenzuron-based drug Releeze the withdrawal period is 340 day-degrees for exports to the USA, compared to 105 day-degrees for sales in Norway** (Nygaard 2010: 15.)

Fungus infection as a result of earlier lice attack. Photo: John Øystein Berg

Breach of agreement

In 1999, Green Warriors signed an agreement with the Norwegian Medicines Agency, the Directorate of Fisheries and the Norwegian Fish Farmers Association that the use of diflubenzuron and teflubenzuron in salmon feed was to be discontinued (see next page and translation of same.) The use of these substances stopped after the signing of the agreement and fish farmers used other medicines, but after the salmon lice became resistant to them, the controversial chemicals began to be poured into Norwegian salmon pens once again. **Oppedal and Vigen (2009: 157) point out that the pens have become so large and hard to control that traditional delousing is difficult, and that as a consequence the salmon can probably avoid the delousing agent allowing the lice to develop resistance.**
Green Warriors has, through the Ministry of Health and Care Services, gained access to all applications for using teflubenzuron and diflubenzuron, and we are appalled by the lack of control on the part of the Norwegian Medicines Agency. Teflubenzuron became available from the supplier Skretting on 12 August 2009, and the first applications were submitted to the Norwegian Medicines Agency the same day. The Norwegian Medicines Agency has received and granted a total of 39 applications. Diflubenzuron became available from the supplier EWOS on 22 September 2009: similarly, the first applications for this were also submitted immediately and a total of 30 applications have been received and granted.

This makes a total of 69 applications, which in reality covers the entire coast, as some of the applications, such as that from Marine Harvest, concern virtually all their facilities.

All registered aquatic veterinarians and fish health services from Lofoten in the north to Lindesnes in the south have submitted applications. Most apply for a virtual carte blanche by using the expression **"the necessary quantity for one year."** Some applications are more complete, since they state the quantity of medicated food, they are the exceptions.
The Norwegian Medicines Agency has granted permits to all that have applied to be allowed to use flubenzurons, despite the fact that many applications are incomplete, which means that the Norwegian Medicines Agency and other Norwegian authorities lack any control whatsoever over the quantities of flubenzurons being poured into the fjords.

DET KONGELIGE
FISKERIDEPARTEMENT

Vår dato
12 FEB. 1999
Deres dato

Vår referanse

Deres referanse

Saksbehandler, innvalgstelefon
Rune Bildeng, 22 24 64 75
h:\avtalelus.doc

Landbruksdepartementet
Sosial- og helsedepartementet
Miljøverndepartementet

99/472-1 150299

AVTALE MELLOM FID, NFF OG NORGES MILJØVERNFORBUND VEDR. BRUK AV TO LEGEMIDLER MOT LAKSELUS.

Det ble onsdag kveld den 3. februar d. å avholdt møte mellom Statens Legemiddelkontroll (SLK), Fiskeridepartementet (FID), Norske Fiskeoppdretteres Forening (NFF) og Norges Miljøvernforbund (NMF) vedrørende bruk av Diflubenzuron og Teflubenzuron i fiskefôr for å fjerne lakselus. To dager tidligere ble det avholdt et større fagmøte om samme sak der Statens dyrehelsetilsyn (SDT), Fiskeridirektoratets kontrollverk, SLK og Havforskningsinstituttet var representert. Møtene ga en grundig gjennomgang av SLK's godkjennelserutiner, og av veterinærfaglige og helsemessige forhold når det gjelder disse stoffene.

FID har full tillit til de vurderinger SLK gjør ved godkjenningen av disse legemidlene. Godkjennelsesorganet SLK og rådgivningsorganet SFT er underlagt andre fagdepartement (SHD og MD) og således utenfor FID's myndighetsområde. Sakens næringspolitiske og eksportmessige konsekvenser er imidlertid FID's anliggende, og var også bakgrunnen for at møtene kom i stand.

Undersøkelser av stoffens toksikologi og økotoksikologi har ikke påvist noen fare med stoffene. Helse- og matsikkerhetsmessig utgjør stoffene ikke noe problem. Stoffene nedbrytes i løpet av tilbakeholdelsestiden og fisken er "ren" ved slakting. Miljømessig kan imidlertid stoffene utgjøre et problem for villfisk, krabbe, hummer og andre krepsdyr rundt matfiskanleggene.

I etterkant av møtene ble det den 4. februar inngått en avtale mellom NFF, NMF og FID som følger vedlagt. Fiskeridepartementet vil ta nærmere kontakt med LD og SDT når det gjelder punkt 2 i samarbeid med F.dir's kontrollverk. Når det gjelder punkt 3 berøres dette av SLK og produsentene EWOS og Skretting, som produserer de aktuelle legemidlene. FID vil inngå en dialog med de berørte parter om hvordan dette mest hensiktsmessig lar seg gjøre. Når det gjelder punkt 4 vil FID ta et initiativ med det første. (Kopi av dette brev m/vedlegg er sendt SLK, SDT, F.dir, HI og NFF).

Med hilsen

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ROYAL MINISTRY OF FISHERIES

Ministry of Agriculture
Ministry of Health and Social Affairs
Ministry of the Environment

MINISTRY OF THE ENVIRONMENT

AGREEMENT BETWEEN THE MINISTRY OF FISHERIES, THE NORWEGIAN FISH FARMERS ASSOCIATION AND GREEN WARRIORS OF NORWAY REGARDING THE USE OF TWO MEDICINAL SUBSTANCES AGAINST SALMON LICE.

In the evening of Wednesday the 3rd of February of this year, a meeting was held among the Norwegian Medicines Agency (SLK), the Ministry of Fisheries (FID), the Norwegian Fish Farmers Association (NFF) and Green Warriors of Norway (GW) regarding the use of diflubenzuron and teflubenzuron in fish feed to remove salmon lice. Two days earlier, a technical meeting was held concerning the same issue, at which the Norwegian Animal Health Authority (SDT), the Directorate of Fisheries' Control Authority, the Norwegian Medicines Agency and the Institute of Marine Research were represented. The meetings provided a thorough review of the Norwegian Medicines Agency's approval procedures and of veterinary and health-related concerns regarding these substances.
The Ministry of Fisheries fully trusts the assessments made by the Norwegian Medicines Agency upon approval of these medicinal substances. The approving body Norwegian Medicines Agency and the consultative body the Norwegian Pollution Control Authority report to other Ministries (the Ministry of Health and social Affairs and the Ministry of the Environment) and are thus outside the field of authority of the Ministry of Fisheries. The consequences of the issue in terms of industrial policies and exports are however matters pertaining to the Ministry of Fisheries and were the reasons why the meetings were called.
Studies of the substances' toxicology and ecotoxicology have not revealed any risk attached to the substances. They do not represent any problem in terms of health or food safety. The substances de-compose in the course of the withdrawal period and the fish is "clean" at the time of the slaughtering. In terms of the environment the substances may however cause problems to wild fish, crabs, lobsters and other crustaceans near the fish farms.
Following the meetings an agreement was signed on the 4th of February between the Norwegian Fish Farmers Association, Green Warriors of Norway and the Ministry of Fisheries, which is enclosed.
The Ministry of Fisheries will contact the Ministry of Agriculture and the Norwegian Animal Health Authority regarding point 2 in cooperation with the Control Authority of the Ministry of Fisheries.
As regards point 3, it concerns the Norwegian Medicines Agency and the manufacturers EWOS and Skretting, who produce the medicinal substances concerned. The Ministry of Fisheries will establish a dialogue with the affected parties to find the most adequate way to do this. As regards point 4, the Ministry of Fisheries will take an initiative shortly. (A copy of this letter w/ encl. has been sent to the Norwegian Medicines Agency (SLK), the Norwegian Animal Health Authority (SDT), the Directorate of Fisheries (D.dir), the Institute of Marine Research (HI) and the Norwegian Fish Farmers Association (NFF).)

Yours faithfully,

Magnor Nerheim
Director General

Rune Bildeng
Adviser

Det Kongelige Fiskeridepartement (FID), Norges Miljøvernforbund (NMF) og Norske Fiskeoppdretters Forening (NFF) har på møtet 03.02.99 blitt enige om følgende avtale vedrørende bruk av midlene Diflubenzuron og Teflubenzuron som legemiddel mot lakselus og miljøkonsekvensene rundt disse.

1) Godkjenning av legemidler for bruk i oppdrett ligger under Statens Legemiddelkontroll sitt kompetanseområde. FID har full tillit til de vurderinger SLK gjør ved godkjenning av legemidlene Diflubenzuron og Teflubenzuron. Miljøvernforbundet er uenig i disse vurderingene.

2) SLK har gitt strenge forskrifter for bruk av disse legemidlene som blant annet innebærer at andre metoder/midler først skal være forsøkt. FID vil ta kontakt med Statens dyrehelsetilsyn og ellers stille de nødvendige ressurser til rådighet for kontroll av at forskriftene blir etterlevd. Dette vil i praksis medføre at bruken av legemidlene blir minimalisert.

3) Produsentene av legemidlene har pålegg om miljøovervåking i perioden for midlertidig godkjenningsfritak. FID og NFF oppfordrer til at NMF får innsyn i produsentenes miljødokumentasjon.

4) Miljøkonsekvensene ved bruk av legemidlene skal i tillegg evalueres av et uavhengig omforenet institutt.

5) NFF mener at det er i næringens interesse at bruken av legemidler minimaliseres. Dette gjelder spesielt midler som inntas gjennom fôr.

6) NMF vil på bakgrunn av denne avtalen og i påvente av den uavhengige miljøkonsekvensvurderingen avholde seg fra å sette i verk de planlagte aksjoner.

7) NFF er tilfreds med at NMF tar ansvar for og avstår fra å iverksette planlagte aksjoner mot norsk laks. NFF er positiv til fokusen på miljøspørsmål i næringen. NFF og NMF har felles interesse i å skape en mest mulig miljøvennlig næring og håper avtalen skal bidra til å bedre en framtidig dialog.

Oslo, 4. februar 1999

Norges Miljøvernforbund .....

Norske Fiskeoppdretters Forening .....

Det Kongelige Fiskeridepartement .....

At the meeting on 03.02.99, The Royal Ministry of Fisheries (FID), Green Warriors of Norway (GW) and the Norwegian Fish Farmers Association (NFF)) reached the following agreement regarding the use of the substances diflubenzuron and teflubenzuron as medicinal agents against salmon lice and the environmental consequences surrounding them.

1) The approval of medicinal substances for use in aquaculture lies within the field of authority of the Norwegian Medicines Agency. The Ministry of Fisheries fully trusts the assessments made by the Norwegian Medicines Agency upon approval of diflubenzuron and teflubenzuron.
Green Warriors of Norway disagrees with these assessments.

2) The Norwegian Medicines Agency has issued strict regulations for the use of these substances which entail, inter alia, that other methods/substances must have been tried first. The Ministry of Fisheries will contact the Norwegian Animal Health Authority and otherwise facilitate the necessary resources to ensure compliance with the regulations. In practice this will lead to the use of the medicinal substances being reduced to a minimum.

3) The manufacturers of the medicinal substances are subject to an obligation to perform environmental monitoring during the period of temporary exemption from the duty to obtain approvals. The Ministry of Fisheries and the Norwegian Fish Farmers Association recommend that Green Warriors of Norway should be given access the manufacturers' environmental documentation.

4) In addition to Green Warriors, the environmental impact of the use of the medicinal substances shall be assessed by an independent institute chosen by agreement.

5) The Norwegian Fish Farmers Association believes it is in the industry's interest to minimise the use of medicinal substances. This applies in particular to substances taken in through feed.

6) On the background of this Agreement and pending the independent environmental impact assessment, Green Warriors of Norway will refrain from implementing the planned actions.

7) The Norwegian Fish Farmers Association is content that Green Warriors of Norway assumes responsibility for and refrains from implementing planned actions against Norwegian salmon. The Norwegian Fish Farmers Association is positive to the focus on environmental issues in the industry. The Norwegian Fish Farmers Association and Green Warriors of Norway have a shared interest in creating an industry that is as environmentally friendly as possible and hope that the Agreement will contribute towards improving a future dialogue.

Oslo, 04 February 1999

Green Warriors of Norway
Norwegian Fish Farmers Association
Royal Ministry of Fisheries

THE END OF CRUSTACEANS

Chitin synthesis inhibitors like diflubenzuron and teflubenzuron are used for delousing because these substances destroy the salmon lice's ability to form an exoskeleton. Since the substances are administered through medicated feed and in open net pens, the toxin produces the same effects both inside and outside the pens: All moulting animals near a fish farm are threatened by the flubenzurons. Consequently, the treatment may be disastrous to all crustaceans along the coast, including shrimps, crabs, lobsters and crayfish. In the USA, authorities warn against using diflubenzuron less than five kilometres from the coast, while Norwegian agriculture authorities warn against using them less than 30 metres from larger water bodies.

Scepticism brushed aside

The newspaper Firda revealed that the Norwegian Medicines Agency first rejected diflubenzuron and teflubenzuron for lack of environmental documentation, but was pressed into approving these toxic substances nonetheless. There are good reasons to worry about the extensive use of medicines against salmon lice, says Tonje Høy, scientific director of veterinary medicine of the Norwegian Medicines Agency (Huus 2010.)

The Norwegian Pollution Control Authority expressed scepticism when the diflubenzuron based drug *Lepsidon vet*. was assessed in 2000:

> Having assessed the new documents regarding the environmental effects of Lepsidon vet, the Norwegian Pollution Control Authority (NPCA) is still sceptical to the use of this drug. **The use of *Lepsidon vet* in aquaculture facilities may bring into the environment a toxic substance that degrades slowly and accumulates in sediments.** If the Norwegian Medicines Agency (SLK) is considering to allow the use of *Lepsidon vet* its environmental effects should be taken into consideration and conditions attached to its use (NPCA 2000: 1.)

Among the conditions proposed are restrictions on the frequency of use, a ban on use during crustacean moulting periods and monitoring of concentrations in sediments (NPCA 2000: 5.) Avoiding moulting periods requires extensive knowledge. "In order to grow, crustaceans must moult their shell. Early in life, the lobster moults often, while moulting takes place more infrequently as they grow older," writes Otterlei (undated), while the Institute of Marine Research (undated-a) describes frequent moulting in young crabs: "Crabs have small larvae that swim around in the water for two months. They moult their shell seven times. When they settle they measure about 2.5 mm; one year later they are about 1.5 cm and have moulted several times." **Nygaard (2010: 15-16) advises against using flubenzurons during the period of June-August out of concern for moulting crustaceans. However, this does not help sexually mature crabs, which moult their shell during the period from September to November** (Woll 2005: 9.) In an application to use teflubenzuron at the Norwegian Aquaculture Centre it is stated that **"during delousing treatment at the facilities in the course of the summer of 2010 it may become necessary to use chitin synthesis inhibitors."**

Unlike the Norwegian Scientific Committee for Food Safety (*Vitenskapskomiteen for mattrygghet VKM*), which has not considered the environmental impacts of flubenzurons (NTB 2010a), the European Food Safety Authority has produced extensive scientific reports on both diflubenzuron (EFSA 2009b) and teflubenzuron (EFSA 2008.) **For both substances it has been established that they are highly toxic to aquatic organisms, even though EFSA (2008: 25) only examines the use of teflubenzuron in apple orchards and tomato greenhouses.** Under the heading "Critical areas of concern," EFSA writes (2008: 48-49):

> For greenhouses use, aquatic risk assessment can only meet the triggers for all aquatic organisms if negligible emissions (i.e. 0.0001% of total emission) to surface water are assumed. Attainability of these low levels of exposure has not been demonstrated. **For the outdoor application a high risk was identified with respect to aquatic invertebrates in a higher-tier assessment** (mesocosm study even with a 100 m no-spray buffer zone.)

Kills lobsters, crabs and other crustaceans

When Green Warriors intervened in this case, one of the reasons was that the Norwegian Medicines Agency in its summary of product characteristics (SPC) of the active substance teflubenzuron stated that studies suggested changes of a certain duration in the soft-bottom fauna. It also suggested that crustaceans like crabs and lobsters that stay close to aquaculture facilities may be affected, and that **"extensive use of Ektobann in the aquaculture industry may cause unacceptable effects in Norwegian fjords."**

Illustration photo: Hans Hillewaert

Lobsters and other crustaceans go through several larval stages when they moult their shell at least once a week (the three first larval stages.) This larvae form part of the zooplankton fauna and are highly susceptible to environmental toxins.

The Scottish Environmental Protection Agency confirms that teflubenzuron "is potentially highly toxic to any species which undergo moulting within their life cycle," and highlights the consequences for lobsters, crabs and shrimps (SEPA 1999: 5.) The Institute of Marine Research also shares the view that **"crustaceans are in the danger zone,"** criticising many of the experiments linked to effects on non-target organisms for not covering moulting (Samuelsen, Ervik and Nilsen 1999: 6-7.)

The U.S. Environmental Protection Agency establishes that diflubenzuron is "very highly toxic to freshwater aquatic invertebrates, including marine/estuarine crustacea, and it is highly toxic to marine/estuarine mollusks. The results indicate that diflubenzuron affects reproduction, growth and survival in freshwater invertebrates as well as reproduction in marine/estuarine invertebrates" (EPA 1997: 4.)

In a publication from the Norwegian Medicines Agency, it is stressed that chitin synthesis inhibitors become deposited in sediments and then leak from them over time. There is "a risk that crabs and lobsters close to the pens will be affected," and the conclusion is that the efficiency of these substances is low from an environmental point of view (Fadum 2000: 21.)

In a document linked to the U.S. Office of Pesticide Programs it is stated that the use of diflubenzuron is restricted out of concern for marine ecosystems: **"Warning statements include instructions not to apply to water or to areas where surface water is present, or to intertidal areas below the mean high tide mark"** (Patterson 2004: 23.)

For use in agriculture, not aquaculture

The use of diflubenzuron is most widespread within agriculture, where it is used to combat insects on fruit trees and mushrooms. The substance has been used in the USA since 1976, and Eisler (1992) does not even mention the possibility of using it directly in water.

In Norway, some diflubenzuron is used as an insecticide in agriculture, but the volumes are rather modest. Since 2005, on average 118 kilograms of the active substance has been sold per year (Food Safety Authority 2010a: 6.) Diflubenzuron is the active substance of the product Dimilin SC-48, which carries a telltale label: **"Highly toxic to aquatic organisms, may cause unwanted long-term effects to the aquatic environment.** Must not be used less than 30 metres from water-draining ditches, brooks, dams or larger water bodies" (Agricultural Inspection Authority 2003, see label on the next page.)

The U.S. Fish and Wildlife Service goes even further in its warnings, and Eisler (1992: 39) gives the following recommendation:

> Since diflubenzuron toxicity seems to be similar in both insects and crustaceans, extreme care must be taken when this compound and other chitin synthesis inhibitors are used for insect control in areas where aquatic crustaceans occur. Otherwise, ecological instability may result, with consequences for feeding, metabolism, growth, reproduction, and survival of numerous nontarget organisms (Christiansen 1986.) Specifically, **diflubenzuron use in saltmarsh mosquito breeding areas or on agricultural lands less than 5 km from coastal areas is not recommended because of concerns that runoff may reach the adjacent estuaries**, which are the primary hatcheries for many economically important species of crustaceans (Costlow 1979; Cunningham 1986; Cunningham and Myers 1986.) Also, diflubenzuron concentrations in seawater should not exceed 0.1 µg/L, the minimum concentration known to produce measurable behavioral changes in estuarine crustacean larvae (Cunningham and Myers 1986.)
> **If diflubenzuron and other insect growth regulators continue to be used near productive aquatic habitats, then food chain transfer studies are recommended.** High accumulations of diflubenzuron by aquatic algae, up to 4.5 mg/kg DW in some cases (Booth and Ferrell 1977), strongly implicate food chain transfer as a potential mechanism of contaminant transfer in aquatic invertebrate food webs. To protect certain fishes, diflubenzuron use to control copepod vectors of human disease including various species of *Cyclops*, is not recommended in areas where these fishes breed or feed on *Cyclops* (Rao and Paul 1988.)

Fifteen EU countries have approved the use of teflubenzuron (PPBD 2010), but the conditions are very different from those in Norway, and from 01 December 2009 the EU Commission has decided that **"Only uses as insecticide in glasshouses (on artificial substrate or closed hydroponic systems) may be authorized"** (EU Commission 2009: 30.) Member states are obliged to take into consideration:

> - the protection of aquatic organisms. Releases from glasshouse application must be minimised and, in any case, should not have the potential to reach, in significant levels, water bodies in the vicinity,
> - the safe disposal of condensation water, drain water and substrate in order to preclude risks to non-target organisms and contamination of surface water and groundwater (EU Commission 2009: 31)

It is thus clear that the European Commission does not want to have teflubenzuron in the water, a view that contrasts sharply with the Norwegian practice of pouring this substance directly into the sea. Green Warriors believes this clearly shows how Norwegian authorities let themselves be forced by the aquaculture industry into accepting the use of a substance directly into the mouth of the fish; a substance that in the EU is subject to strict restrictions even for use in greenhouses.

Green Warriors of Norway made the Climate and Pollution Agency (CPA) aware of our case and the renewed use of the extremely toxic flubenzurons. As a consequence, the Agency decided to perform its own investigations, which were published in March 2011.
(CPA: 24.03.2011) ; New environmental investigations commissioned by the Climate and Pollution Agency reveal two delousing agents from salmon farming in environmental concentrations sufficiently high to threaten crustaceans like crabs and shrimps.
The investigations were performed in the autumn of 2010 near two aquaculture facilities in the county of North Trøndelag and one in the county of Hordaland. They were done by the Norwegian Institute for Water Research (Norsk institutt for vannforskning - NIVA) on behalf of the Climate and Pollution Agency. The two delousing agents were found in water, seafloor sediments, mussels, crabs, shrimps and amphipods. **The concentrations detected exceed those which according to British threshold levels for water and seafloor sediments may impair the formation of exoskeletons in crustaceans. This in spite of the samples having been collected some time after the substances had been used at the facilities.** The samples, collected at three aquaculture facilities, show that the delousing agents spread throughout the fjords. **The chemical substances were found up to a kilometre away from the aquaculture facilities.** Norway has yet to establish threshold values for these substances in terms of potential environmental damage. However, Great Britain has, and many of the samples taken near the three aquaculture facilities show levels of these substances that exceed British threshold levels for water and seafloor sediments.

International reactions

Green Warriors has felt obliged to inform authorities in other countries of the use of flubenzurons in Norwegian salmon farming. The Russian food and health authority considers the use of this toxic substance to be a serious issue and in a letter to Green Warriors, the director of the authority writes:

> The Russian Federation will implement the necessary measures to examine levels of teflubenzuron and diflubenzuron in seafood from Norway, suppliers will be informed of a requirement to submit certificates regarding all medicinal substances that have been used in the production process (Bogen 2010.)

The French Minister of Agriculture and Fisheries, Bruno Le Maire, has also reacted to the revelation of Norway's use of toxins presented in a French TV documentary. Le Maire (2010) has therefore sent a letter to his Norwegian colleague, Lisbeth Berg-Hansen, expressing his worry about "food safety, protection of public health and protection of the environment." In his letter, the minister pays particular attention to diflubenzuron:

> This substance has no marketing authorisation as a veterinary medicine in the EU or in France. It is used exclusively for the pharmaceutical treatment of certain plant species and as an insecticide in buildings used for animal husbandry. Consequently, it is not permitted to use diflubenzuron for fish intended for human consumption (Le Maire 2010.)

The European Green Party, which has the fourth largest group in the European Parliament, is also worried about the use of chemical substances in Norwegian aquaculture. Their spokesperson Monica Frassoni believes a boycott of Norwegian farmed salmon is an option if its production does not become more environmentally friendly (EGP 2010.)

FARMED FISH IS NORWAY'S MOST TOXIC FOODSTUFF

Several studies conclude that fatty fish is the most important source of dioxins, PCB and PBDE in the Norwegian population, and that farmed salmon is the worst by far. These are fat soluble substances that decompose slowly, thus accumulating in nature, and their concentrations increase higher up in the food chain in fatty fish species like salmon. The toxic substances are in the fat and when the feed given to farmed fish contains large parts of fish oil (fat) from five times as many wild fish it is evident that farmed fish will contain a lot of toxins. Chronic exposure to dioxins and PCB may lead to cancer, a weakened immune system and reduced reproductive capacity.
Another environmental toxin that accumulates through the food chain is mercury. In fish it is found as methyl mercury, which affects the nervous system and blood pressure, and it may contribute towards heart and coronary disease. Since this toxic substance is excreted in human milk it is particularly dangerous to unborn and newborn children and it may disturb both cognitive and motor development. Are we really willing to subject our descendants to such risks?

International scientists have repeatedly warned against too high levels of environmental toxins in Norwegian farmed salmon, and in late November 2005 Russian veterinary authorities found high levels of lead and cadmium in salmon imported from Norway. On 1 January 2006, a Russian ban on the import of fresh Norwegian salmon was introduced. Russian authorities complained of insufficient control on the Norwegian side.

Norwegian authorities have for years tried to make the EU allow higher levels of toxic substances. We believe this bears witness to an altogether irresponsible policy.

Farmed salmon with extensive wounds caused by lice. Photo John Øystein Berg

Dioxins

The Climate and Pollution Agency rates dioxins among the most dangerous environmental toxins. Dioxin is a generic name used to describe a family of compounds known as chlorinated dibenzo-p-dioxins and dibenzofurans, consisting of 75 different chlorinated dioxins and 135 different chlorinated furans. **"Exposure to dioxins may lead to changes in the immune system and the reproductive capacity and to the development of cancer,"** states the Agency (CPA 2009a.) **Norwegian farmed salmon has particularly high levels of PCB, dioxin-like PCBs and the pesticide DDT** (Shaw, Berger, Carpenter, Hong and Kannan 2006.) The Scientific Committee for Food Safety has calculated that the content of dioxins and dioxin-like PCB in farmed salmon is 23 per cent higher than in wild salmon (VKM 2006: 109.) Figures for farmed salmon of a more recent date are somewhat lower, but they are still 13 per cent higher than for wild salmon, and there are no new corresponding figures for wild salmon in the same report (VKM 2006: 108.)

In January 2004, six American scientists published a paper in *Science* in which they established the presence of too high levels of dioxins in North-Atlantic farmed salmon. The risk analysis suggested that consuming farmed salmon may have more adverse than positive effects on health (Hites, Foran, Carpenter, Hamilton, Knuth and Schwager 2004.) According to the study, farmed salmon contains ten times more dioxins than wild salmon. "Salmon is mainly carcinogenic. **What we tell people is that if they want to reduce the risk of cancer they should not eat more than one meal of farmed salmon per month"**, said scientist David Carpenter of the University at Albany (NTB 2004.)

There was little doubt regarding the American scientists' findings of dioxins, but Norwegian institutions like the National Institute of Seafood and Nutrition Research denied that the dioxins represented any health hazard (NTB 2004.) The then fisheries minister, Svein Ludvigsen, claimed the study was a report commissioned by the American meat industry. This was disputed, however, by **Professor Henrik Huitfeldt of the Institute of Pathology at Rikshospitalet University Hospital: "I wondered why they acquitted the salmon so fast. It has, for instance, been stated that the EU limits for these environmental toxins contain a substantial safety margin, so exceeding these limits does not necessarily represent a health hazard. However, more recent studies have shown that dioxin levels of about three times the EU threshold values may increase the risk of cancer. Many Norwegians, especially those who eat a lot of fatty fish, ingest more than this,"** the professor said to the newspaper Klassekampen (Hustad 2005.)

Knutsen and Alexander (2004), researchers at the Norwegian Institute of Public Health, Division of Environmental Medicine and Department of Food Toxicology, look at dioxins and PCB and claim that "a single meal of salmon equals about 40 per cent of maximum weekly intake," and that **"fatty fish is among the most important contributors of dioxins and PCB"** (Knutsen and Alexander 2004: 167.) Dietitian Marianne Elisabeth Lien points out that "environmental toxins like dioxins and PCB in fish are bad even if concentrations are low," and she believes feeds should be decontaminated (Aas 2007.) **Stig Larssæther, a Ph.D candidate at the Centre for Technology and Society, Norwegian University of Science and Technology, believes that farmed salmon is among the foodstuffs that contribute the highest quantity of environmental toxins in a normal diet, pointing out that farmed salmon contains four times more dioxins than the maximum levels permitted in meat, egg and milk on the European market** (Larssæther 2006.) Ph.D. Claudette Bethune (2006) makes reference to several studies that conclude that fatty fish is the most important source of dioxins, PCB and PBDE for the Norwegian population.

In 2006, the Scientific Committee for Food Safety published a raport on fish and other seafood in the Norwegian diet, and three of the conclusions are of particular interest (VKM 2006: 132-135):

1. **With current levels of dioxins and PCB we should not eat more than two meals of fatty fish per week.**
2. Two- and four-year-olds who both eat fish and take cod liver oil may end up with too high an intake of dioxins and PCB.
3. Up to 15 per cent of the adult Norwegian population exceed the acceptable intakes of dioxins and PCB .

In other words, there is good reason to worry about the farmed salmon's levels of dioxins and PCB.

Cadmium

"Cadmium and cadmium compounds are acutely and chronically toxic to humans and animals. Most cadmium compounds are also carcinogenic," according to the Climate and Pollution Agency (CPA 2009b.) The Scientific Committee for Food Safety (VKM 2010) also establishes that cadmium, a heavy metal, is carcinogenic and may cause kidney damage. The Scientific Committee for Food Safety has initiated a new risk assessment of cadmium following EFSA's (2009a) reduction of the tolerable weekly intake from 7 to 2.5 micrograms per kilogram of body weight. Against this background it is **frightening how unconcerned Norwegian authorities have been about the findings of cadmium in farmed salmon.**

At the end of November 2005, Russian veterinary authorities found worrying levels of lead and cadmium in salmon imported from Norway. On 1 January 2006, a Russian ban on the import of fresh Norwegian salmon was introduced. Russian authorities complained of insufficient control on the Norwegian side. Senior research scientist Claudette Bethune at the National Institute of Seafood and Nutrition Research largely admitted the Russians were right in that the monitoring of Norwegian farmed salmon is inadequate. She believed the alleged cadmium contamination of Norwegian farmed salmon detected in Russia might be caused by contaminated fish feed in Norway (Ergo 2006a.)
The Food Safety Authority and NIFES (National Institute of Nutrition and Seafood Research) nonetheless quickly gave the Norwegian salmon a clean bill of health, rejecting any link to the high levels of cadmium in feed additives found in 2005. **NIFES and the Food Safety Authority believed the cadmium contamination of feed could not be linked to the Russian claims of toxic salmon, especially because the Russians supposedly discovered not only cadmium, but also lead (Ergo 2006b.) However, the link became clear when, in June 2006, Økokrim (the Norwegian National Authority for Investigation and Prosecution of Economic and Environmental Crime) informed that the company that had imported 20 tons of cadmium-contaminated zinc sulphate had been given an optional fine of NOK 500,000 in lieu of prosecution, a fine that was accepted by the company (Økokrim 2006; Vogt 2006.)**

In 2004, researchers at NIFES and the Food Safety Authority believed that salmon accumulated 2-6 per cent of cadmium in feed (Julshamn, Berntssen, Lundebye Haldorsen, Måge and Lorentzen 2004: 5.) The following year, several of those same researchers believed the correct figure to be 1-5 per cent, although they did not have a single source more recent than 2003 (VKM 2005.) Claudette Bethune believed this was because **if salmon accumulates 6 per cent of the allowed maximum of 1 mg cadmium per kilogram, the salmon would contain 0.06 mg cadmium per kilogram**, thus exceeding the allowed maximum of 0.05 mg cadmium per kilogram. Bethune believed the new figure of 1-5 per cent was taken out of thin air. **"It is not scientifically based or documented. The new figures were presented to get us within the EU maximum values,"** she said, making reference to documentation suggesting that salmon accumulate much more cadmium from feed than what

Norwegian authorities are prepared to admit (Korneliussen 2006.) Professor Henrik Huitfeldt, at the University of Oslo, was also critical to the new figures after having examined the documentation from NIFES (Korneliussen 2006):

> **- I cannot see that the statements on how much cadmium in feed is absorbed by the salmon are scientifically well documented.** The conclusions that 1-5 per cent or 2-6 per cent of cadmium in feed is absorbed by the fish seem to be best guess estimates, without any concrete documentation. Consequently, these will not be exact figures.

It is worth remembering that **Norway has fought for a 100 per cent increase of the maximum permitted level of cadmium in feed**, from 0.5 mg/kg to 1.0 mg/kg (Julshamn et. al. 2004: 5.)

Mercury and arsenic

There have also been findings of mercury and arsenic in Norwegian farmed salmon and there is reason to question the attitude of Norwegian authorities towards these substances. Indeed, Julshamn et al. (2004: 4-6) inform that Norwegian authorities have repeatedly approached the EU to have the maximum permitted values raised.

In 2003, the EU increased the maximum permitted content of arsenic in complete feedingstuffs to 6.0 mg/kg, but the values in Norway were still too high, at between 3 and 9 mg/kg complete feedingstuff. Because of this, Norwegian authorities made efforts to have the maximum permitted content raised to 10 mg/kg complete feedingstuff (Julshamn et al 2004: 4-5.) **Thus, the authorities want to allow higher levels of arsenic compounds which the Climate and Pollution Agency believes to be toxic to many organisms even at low concentrations, besides being carcinogenic** (CPA 2009d.) Norway wanted to raise the maximum permitted value in order to better accommodate the fact that farmed salmon are fed fish with "a high natural cadmium content" (Julshamn et al 2004: 4.)

"Mercury is among the most dangerous environmental toxins and a threat to the environment and human health," informs the Climate and Pollution Agency (2009e.) **Despite this, Norwegian authorities have fought for a five-fold increase of the EU maximum level, from 0.1 mg/kg complete feedingstuff** (Julshamn et al 2004: 6.) Green Warriors believes that the repeated attempts at increasing permitted toxin levels indicate a failure to take environmental toxins seriously, and that the interests of the industry are given priority. Public health becomes less important than the aquaculture industry's export opportunities.

Ethoxyquin

The antioxidant Ethoxyquin (EQ) produced by the industrial giant Monsanto is a food preservative added to fish feeds to prevent rancidification of fats, but also to prevent heat development and risk of explosion by self ignition during transport. Extoxyquin prevents rancidification by preventing oxidation of fats. EQ also prevents degradation of vitamins and pigments. EQ was registered in 1965 by Monsanto as a pesticide used to eliminate development of brown spots on the skin of apples and pears. EQ is allowed to use in fish feeds, but not as an additive in food for human consumption. The upper limit in fish feeds is 150 ppm (parts per million) and the residual value in food items should not exceed 0,5 ppm. This is because EQ may cause damage to liver and kidneys of animals.

Etoxyquin undergoes metabolic changes in fish flesh, where several byproducts are formed. The most common end product is Ethoxyquin dimer (EQDM.) It is not known whether any of these metabolized byproducts are harmful, simply because no tests are performed to evaluate their toxidity. However, Victoria J. Berdikova did investigate the effects of adding EQ in salmon feed in her Ph.D thesis that was published in 2007. This was the first study of the metabolic pathways of EQ in fish.

Feeding salmon with feeds containing 107 ppm of EQ resulted in enlarged hearts. Feeding salmon with higher doses, up to 1800 ppm, led to enlargement of both heart and liver. Hearts were significantly larger in fish fed with 107 and 1800 mg per kilo feed than they were in fish fed diets not containing EQ. Salmon is starved before slaugthtering. During the feeding period the levels of EQ and EQDM in fish rose gradually and were peaking when feeding stopped. Levels of EQ were higher than levels of EQDM when feeding was terminated. After two weeks of starvation only traces of EQ was found in fish muscle, while levels of EQDM were peaking. After starving of fish ended, there was 100 times more EQDM than EQ in the fillets. Berdikova (2007) also found 10 other metabolic by-products with unknown toxicology, most probably derived from EQ, of which 3 of these were shown to originate from EQ. Since EQ mainly

is transformed into EQDM, it would be the most likely candidate compound for food safety tests and evaluation of possible health risks. In some cases metabolized by-products are less toxic, but in other cases far more toxic, than the compounds they were derived from.

Berdikovas (2007) research showed that EQ could be harmful even when small concentrations of EQ were added to feed, as a concentration of just 107 ppm led to enlarged hearts. Use of EQ as feed additives in fish for human consumption thus represents an unacceptable health risk until it is firmly proven that fish flesh contaminated by EQ, EQDM and other metabolites deriving from EQ does not represent a health risk. Such research must also seek to establish baselines for which concentrations of EQ and it's family of derivatives that can be allowed in fish presented for the consumers. Since the toxicity of EQ and it's metabolic by-products is not established scientifically, neither in humans nor in any animal group, NMF demands that the use of EQ as a feed additive for fish and other animals is banned immediately in order to ensure food safety and animal welfare.

EQ and EQDM were shown to pass the blood-brain barrier in salmon. This barrier prevents uncontrolled inflow of substances like hormones, glucose, foreign molecules and disease propagules. The blood-brain barrier thus acts as a shield to keep the brain safe, e.g. from substances that have potential neurotoxicological effects. This barrier consists of 4 physiological thresholds. Given that these substances manages to pass all thresholds in the blood-brain barrier of salmon, there is reason to believe, and fear, that the same could happen in humans.

Cancer risk

Cancer is still among the most important causes of death in Norway. "Mortality caused by cancer has decreased slightly the past 20 years. Around 1990, 275 people per 100,000 died of cancer; in 2008 the number was approximately 250," writes the **Norwegian Institute of Public Health** (2010.) Could this figure be even lower with a lower consumption of farmed salmon containing heavy metals, PCB and other dioxin-like and carcinogenic substances like teflubenzuron and diflubenzuron? These substances accumulate and their combined effects may be even worse. At the same time, the aquaculture industry claims that salmon prevents cancer (www.Laksefakta.no, undated.) The latter is, however, based on studies of the health effects of eating fish, not farmed fish, and the levels of environmental toxins vary between wild fish and farmed fish (Foran et al 2005; Shaw et al 2006; Hamilton et al 2005.) "Salmon, especially farmed salmon, are a good source of healthy n-3 fatty acids, but they also contains high concentrations of organochlorine compounds such as PCBs, dioxins, and chlorinated pesticides," write Hamilton et al (2005: 8622.) The most restrictive recommendation is not to eat North-European farmed salmon more than once very fifth month to avoid cancer risks (Huang et al 2006.) **On the Norwegian Cancer Association's website the following can be read: "There is no basis for concluding that fish protects against cancer"** (Lund-Iversen undated.)

The aquaculture industry gives dangerous advice when claiming that people should eat more fish to prevent cancer. It is of fundamental importance to draw a distinction between wild fish on the one hand and farmed fish on the other, and Green Warriors supports researchers who argue that fish sold to consumers should be clearly marked as either farmed or wild (Foran et al 2005.)

> **The consumption of farmed salmon entails taking a health risk:**
>
> Our results show that farmed salmon are high in n-3 fatty acids. They are also high in persistent chlorinated contaminants that are known to cause cancer, neurobehavioral decrements in children, and reduced memory function in older adults. Thus, **the consumer must balance the clear benefit in reducing risk of sudden cardiac death after a heart attack against the risk of cancer and neurobehavioral decrements, especially in children born to mothers who have significant body burdens of these contaminants**
> (Hamilton et al 2005: 8628.)

Green Warriors believes it is evident that environmental toxins influence the incidents of cancer in the Norwegian population and farmed salmon is the most important source in this context. We demand decontamination of the feed.

MANAGEMENT AUTHORITIES WITH OBVIOUS VESTED INTERESTS

There is no doubt that the industry wields a lot of power in Norway. The aquaculture industry is dominated by a small number of players and there are close ties between fish farmers, management authorities and the political elite. The Minister of Fisheries and Coastal Affairs, Ms. Lisbeth Berg-Hansen, and the Director General of Fisheries, Ms. Liv Holmefjord, are Norway's highest-ranking political and public administration representatives within the aquaculture industry. With this in mind, most people find it strange that they hold ownership interests worth millions in that same industry. No other Norwegian commercial industry is publicly governed by two persons who to such an extent are on both sides of the table. It is hard to find a more blatant example of politicians and public servants with vested interests and more conflict og interest within their own field of authority.

The Minister of Fisheries and Coastal Affairs, Ms. Lisbeth Berg-Hansen, in Tromsø 2009. Photo: Bernt Sønvisen.

Power and vested interests

When Lisbeth Berg-Hansen became the minister of fisheries and coastal affairs in 2009, she came from a position as a fish farmer in the family company SinkaBerg Hansen AS, while also having held a number of offices linked to the aquaculture industry. **Amongst other positions, Berg-Hansen has been the chair of the board of the Norwegian Seafood Federation**, a board member of SinkaBerg-Hansen AS, vice chair of the board of the Institute of Marine Research and a board member of the Institute of Fisheries and Aquaculture Research (Ministry of Fisheries and Coastal Affairs undated.) **She was even a member of the board of SinkaBerg Hansen for one month after she assumed the position as minister** (Solberg 2009.)

Lisbeth Berg-Hansen owns 88.89 per cent of the shares of Jmj Invest AS, a company of which she is both the managing director and a board member. Jmj Invest AS owns 10.71 per cent of the shares of the aquaculture company Sinkaberg Hansen AS, alongside affiliate companies Bindalslaks AS, Bindalssmolt AS and Sinkaberg-Hansen Invest AS. In 2010, Sinkaberg Hansen AS had sales of 810 MNOK and profit before tax of 210 MNOK (Proff.no 2011.) **Lisbeth Berg-Hansen has made a fortune from salmon farming.** In 2009 she had a personal income of 1.6 MNOK, while her net worth had grown to almost 20 MNOK (Skattelister.no 2011.)

Berg-Hansen's government colleague, Mr. Lars Peder Brekk, the minister of agriculture and food, is also involved in SinkaBerg Hansen AS. He owns 0.25 per cent of the company together with his brother Are Brekk (Solaas Moen 2010), who is also the chairman of the board (Proff 2010.) **On the background of the above, the Legislation Department of the Ministry of Justice has declared that Lars Peder Brekk "as a general rule will be disqualified" in aquaculture matters, while the same Legislation Department believes Lisbeth Berg-Hansen, with a far larger ownership share, is only "disqualified in exceptional cases"** (Solaas Moen 2010.)

In six years, 102 owners have disappeared from the aquaculture industry, and Professor Torbjørn Trondsen and Associate Professor in Fisheries Law, Peter Ørebech of the Norwegian College of Fishery Science (*Norges Fiskerihøgskole*) believe the remaining 186 companies that make up the Norwegian aquaculture industry are "a small circle of legal subjects" (NTB 2010b):

> This means that **the minister will become disqualified, not only in cases where Sinkaberg-Hansen is a party, but also in those cases where the industry is to be regulated**. In some of these cases, Sinkaberg-Hansen is strongly affected, in other cases not at all. This must be assessed in each individual case, Ørebech and Trondsen say to the Norwegian news agency NTB (2010b)

SinkaBerg Hansen AS owns 40.74 per cent of the shares in Åsen Settefisk AS, which in turn owns 100 per cent of the shares in Flatanger Settefisk AS (Proff 2010.) As a result of this, it was deemed controversial when the Ministry of Fisheries and Coastal Affairs stopped collecting infringement fees linked to aquaculture, as among the companies that should have paid a fee for having had too many fish in the pens was Flatanger Settefisk, which had been issued with a fee of one million NOK (Blindheim 2010.) The minister drew harsh criticism from Ørnulf Rasmussen, a professor of law at the University of Bergen:

> She was disqualified when she made the decision to suspend the collection of infringement fees. I cannot see any decisive difference between making such a decision and issuing or refraining from issuing a fee. **The suspension decision obviously influences the liquidity and financial situation of companies where she and her family have huge ownership interests. She has granted herself a credit**, says Rasmussen to the Norwegian daily Dagbladet (Blindheim and Lode 2010.)

The suspension of infringement fees was also very beneficial for another central player within the aquaculture industry, Director General of Fisheries Liv Holmefjord and her family company Bolaks, which had been issued with a 5.6 MNOK fee (Blindheim 2010.) Liv Holmefjord owns 100 per cent of the shares in P2h Invest AS, where she is also the chair of the board, and P2h Invest AS owns 8.35 per cent of the shares in the aquaculture company Bolaks AS. Bolaks has experienced a massive growth in the past few years, reporting 2010 sales of 342 MNOK and profit before tax of 104 MNOK (Proff.no 2011.) This has paid off handsomely for Liv Holmefjord, who in 2009 had a personal income of close to 1.2 MNOK and a net worth of almost 11 MNOK (Skattelister.no 2011.)

Additionally, the Ministry of Fisheries and Coastal Affairs gave Holmefjord permission to become the Director General of Fisheries at the headquarters in Bergen, while she kept her shares in the family company Bolaks AS. **Until 2004 there had been special regulations in place preventing employees of the Directorate from having ownership interests in the industry. They were repealed** (Elliott 2010.)

It was Green Warriors that, in December 2009, reported Holmefjord and Bolaks to the police for intentionally having engaged in overproduction at their facilities, thus violating the Aquaculture Act and the Animal Welfare Act (GW 2009a.)

SinkaBerg Hansen AS is also being investigated by the Norwegian National Authority for Investigation and Prosecution of Economic and Environmental Crime (Økokrim), after having been reported by Green Warriors for the escape of farmed salmon. According to the company, between 5,000 and 10,000 salmon escaped, while much indicates that the real figure is close to 90,000 (Fondenes 2010.) As far as connections and lack of impartiality are concerned, it is worth noting that the Directorate of Fisheries exonerated the company before Økokrim's investigation had even started, and that the decision was signed by Regional Director Otto Gregussen, who to the daily Adresseavisen admitted being a good friend of Lisbeth Berg-Hansen's (Winge 2010.)

However, it is not only individuals within politics and public administration who have ownerships interests in the aquaculture industry. **The Ministry of Trade and Industry is the largest shareholder with 43.54 per cent of the shares of the aquaculture giant Cermaq**, a company with operating income of NOK 8.9 billion and operating profit of NOK 545 million (Proff 2010.)

IN CONTROL OF PUBLIC AGENCIES

The aquaculture industry has placed its people in central positions and wields considerable regulate over public agencies that are supposed to control the industry. Three agencies often stand up to defend the aquaculture industry against criticism from environmentalists and wild salmon advocates: the Food Safety Authority, the National Institute of Seafood and Nutrition Research, and the Institute of Marine Research. All three agencies are biased and there is reason to be sceptical to that Food Safety Authority transferred the monitoring of salmon lice from the Norwegian Institute for Nature Research to the Institute of Marine Research.

The Norwegian Food Safety Authority

The Food Safety Authority works to protect both food safety and animal welfare. It reports to the Ministry of Agriculture and Food, the Ministry of Health and Care Services and the Ministry of Fisheries and Coastal Affairs, but it is the first of these three ministries that has the administrative responsibility (Food Safety Authority undated.)
In this way, the Food Safety Authority is headed by a minister, Lars Peder Brekk, whom the Legislation Department of the Ministry of Justice deems largely disqualified in aquaculture cases (Solaas Moen 2010.)

The Food Safety Authority has drawn a lot of criticism from Green Warriors and in the autumn of 2009, Green Warriors filed a report with the police against the Food Safety Authority, represented by its director Joakim Lyngstad, the regional director Roald Vaage (Region Hordaland / Sogn and Fjordane) and the regional director Bjørn Røthe Knudtsen (Region Trøndelag/Møre and Romsdal.) The report concerned the Authority's gross negligence in the performance of duty, or rather non-performance, of duty, and violation of the regulations for combating lice in aquaculture facilities (GW 2009b.)

National Institute of Seafood and Nutrition Research

The National Institute of Seafood and Nutrition Research (NIFES) is state owned through the Ministry of Fisheries and Coastal Affairs and acts as an advisory body to the fisheries authorities, the Food Safety Authority and the fishing and aquaculture industry. **It is the government that appoints the Institute's director** (Ministry of Fisheries and Coastal Affairs 2009a) **and the director reports to a board also appointed by the Ministry of Fisheries and Coastal Affairs** (Ministry of Fisheries and Coastal Affairs 2009c.)

NIFES receives 40 per cent of its income from the Ministry of Fisheries and Coastal Affairs, being NIFES' largest source of financing by far, followed by the Research Council of Norway (*Norges forskningsråd*) and the Food Safety Authority (Ministry of Fisheries and Coastal Affairs 2009c.)

In White Paper no. 19 (2008-2009), *A Public Administration for Democracy and Community*, it is stated **that the board of NIFES lacks statutory independence in terms of financing and decision-making powers within its field of action** (Ministry of Government Administration and Reform 2009.)

The Norwegian Seafood Federation (FHL) is also represented on the board of NIFES by the FHL health and quality director, Henrik Stenwig (NIFES 2009; FHL 2010.)
(Unfortunately, the NIFES logo is not accurately rendered since they refused to send us a high-resolution image of it.)

National Veterinary Institute

"The National Veterinary Institute is a biomedical research institute in the fields of animal health, fish health and food safety.

The Institute is funded by the Ministry of Agriculture and Food, the Ministry of Fisheries and Coastal Affairs and the Research Council of Norway." This is how the National Veterinary Institute (undated) presents itself on its website.

It is worth noting that it is the Ministry of Agriculture and Food which appoints the board of the National Veterinary Institute (Ministry of Agriculture and Food 2008.) Consequently the Veterinary Institute, like the Food Safety Authority, reports to a minister who is disqualified in aquaculture cases (Solaas Moen 2010.)

Aquaculture interests are well represented on the Veterinary Institute's board, by Knut A. Hjelt from FHL Aquaculture, Heidi Meland from the Knowledge Centre in Gildeskål, and Inger Solberg of the Marine and Agriculture Section of Innovation Norway (National Veterinary Institute 2009c.)

Institute of Marine Research

The Institute of Marine Research gives advice to the Ministry and is entrusted with central tasks regarding the study and monitoring of issues including fish stocks, coastal environments and aquaculture, but its board is dominated by stakeholders with interests in the aquaculture industry. It is difficult not to link this to the fact that the board is appointed by the

Ministry of Fisheries and Coastal Affairs, headed by aquaculture millionaire Lisbeth Berg-Hansen. The board of the Institute of Marine Research is thus well populated with persons clearly sympathetic to the aquaculture industry:

1. **Otto Gregussen (President):** The former managing director of the **Norwegian Fish Farmers Association** (Stortinget 2008) and a personal friend of the Minister of Fisheries and Coastal Affairs, Lisbeth Berg-Hansen. He used his position as a regional director of the Directorate of Fisheries to his friend's advantage (Winge 2010.)
2. **Reidun Ann Støle (Vice President)**: A sales manager of the equipment supplier AKVA group, and has held several positions within the aquaculture industry, including in the family enterprise Støle Fiskeoppdrett and as a district secretary of Norwegian Fish Farmers Association (Kyst.no 2007.)
3. **Camilla Røsjø:** The managing director of Nofima Marin, which works with "research, development, innovation and knowledge dissemination for the national and international fisheries and aquaculture industry" (Nofima undated.)
4. **Liv Holmefjord:** The Director General of Fisheries who owns 8.35 per cent of the shares in the aquaculture company Bolaks AS and has become an aquaculture millionaire (Proff 2010; Skattelister.no 2010.)
5. **Turid Moldenæs:** The associate professor of political science, member of a committee established to help the fisheries and aquaculture industry through the financial crisis (Ministry of Fisheries and Coastal Affairs 2009b), and has previously headed research aimed at assisting the industry in foreign markets (Research Council of Norway 2006.)
6. **Jan Skjærvø:** A representative of the Norwegian Fishermen's Association, also a member of the Seafood Export Council's board, and represents the Fishermen's Association on the board of Nor-Fishing (Proff 2010.) The Nor-Fishing Foundation, established in 1992 by the Ministry of Fisheries, is the organiser of the trade fairs Nor-Fishing and Aqua Nor. The board is chaired by Liv Holmefjord (appointed by the Ministry of Fisheries and Coastal Affairs.) Other members are Beate Bøe Nilsen (Ministry of Fisheries and Coastal Affairs), Inger Solberg (Innovation Norway), Snorre Glørstad (Trondheim Municipality) and Trond Davidsen (Norwegian Seafood Federation), in addition to Skjærvø (Nor-Fishing 2010.) According to the Norwegian Broadcasting Corporation, it is Skjærvø's opinion that fish farming is "an artificial intervention with substantial consequences for the environment" (Losvik and Horn 2006.)
7. **Lars Walløe:** A professor with particular competence regarding marine mammals, human circulatory physiology, informatics, statistics and demography, but not in aquaculture (UiO 2010.)
8. **Magnus Johannessen:** An expert consultant with competence regarding plankton and jellyfish, but not aquaculture (Institute of Marine Research 2009.)
9. **Kathrine Michalsen:** A research scientist who has participated in several projects that have examined the effects of aquaculture on the spawning behaviour of cod (Svåsand et al 2004; Bjørn et al 2005.)

One sees a clear preference for research on pelagic species on the part of the Institute of Marine Research, with correspondingly little attention to the environmental effects of aquaculture and activities near the coastline. These priorities are in agreement with the interests of the aquaculture industry and there is little doubt that pelagic species are a far less controversial issue than aquaculture along the coast. **On the basis of the above, Green Warriors has demanded that the Standing Committee on Scrutiny and Constitutional Affairs of the Norwegian Parliament (Storting)** (*Stortingets kontroll- og konsitutsjonskomité*) **should examine both the board and the management of the Institute of Marine Research and also whether the Institute, with its current board, may fulfil its task as an independent advisory body especially on coastal environments and aquaculture.**

NINA sidelined

In 2010, the Food Safety Authority decided that the monitoring of salmon lice is to be transferred from the Norwegian Institute for Nature Research (NINA) to the Institute of Marine Research. On its own website, the Food Safety Authority (Food Safety Authority 2010c) explains that the intention is "to gather all our programmes that concern lice and wild fish under a single umbrella, to exploit resources bet-

ter." The Norwegian Association of Hunters and Anglers (*Norges Jeger- og Fiskerforbund*), the Norwegian Farmers' Union, Norwegian Salmon Rivers and several environmental organisations have criticised the decision; nor is NINA's managing director Norunn S. Myklebust content (NTB 2010c.) In the Storting, MP Tord Lien of the Progress Party has asked the Minister of Fisheries and Coastal Affairs whether she thinks this was a fortunate decision by the Food Safety Authority. Lisbeth Berg-Hansen defended the Institute of Marine Research:

The Institute provides unbiased research and advice independently of the Ministry and other public authorities. In that respect, the scientific advice offered by the Institute of Marine Research is as independent as the scientific advice from the Norwegian Institute for Nature Research (Stortinget 2010b.)

Norunn S. Myklebust, of NINA, does not accept that argument. In a newspaper article she points out that **in 1998 NINA was made independent of the Directorate for Nature Management "precisely to separate research from public administration"** (Myklebust 2010.) She believes it is "like setting the fox to keep the geese," and she writes:

> NINA has raised issues concerning copyrights and breaches of the government's own procurement regulations. Wild salmon advocates also call for independent research. **The managing director of the Institute of Marine Research gives his assurances that the Institute is independent, while the Food Safety Authority argues that the procurement regulations are irrelevant to the case because the Food Safety Authority and the Institute of Marine Research belong to the same *legal* entity** (Myklebust 2010.)

Having the composition of the Institute of Marine Research's board fresh in mind, there is good reason to be sceptical of the Food Safety Authority's transfer of the responsibility for counting salmon lice.

IMPROPER PRESSURE ON RESEARCHERS AND VETERINARIANS

The aquaculture industry strikes down hard on critacal voices. Researchers that dare to denounce salmon farming experience problems, while aquatic veterinarians are pressed into "overlooking" errors and defects

The process against Claudette Bethune

In January 2006, following findings of environmental toxins in Norwegian farmed salmon, Russian authorities complained of inadequate control on the Norwegian side. Claudette Bethune, Senior research scientist at the National Institute of Seafood and Nutrition Research (NIFES), went far towards confirming the Russian view that **the monitoring of Norwegian farmed salmon is inadequate**, making reference to the fact that only a few fish were tested for lead and cadmium levels (Ergo 2006a.) Monitoring has not improved since then. In 2009, 50 farmed salmon were tested for lead and 50 for cadmium (NIFES 2010), while at year-end 2008 there were 300 million salmon in Norwegian fish farms (Statistics Norway 2010b.) **In 2007, the year after the toxins were discovered, NIFES chose to drop the testing of salmon for cadmium; not a single salmon was tested** (NIFES 2010.)

Claudette Bethune linked the cadmium-poisoned Norwegian farmed salmon to contaminated fish feed in Norway (Ergo 2006a); later her suspicion was confirmed (Vogt 2006.) Nonetheless, NIFES went against their own employee before any details had been uncovered. "The person in question does not work on this issue and lacks the total overview of everything that has been done in relation to it. This easily leads to inaccuracies," NIFES' director Øyvind Lie said to NTB (2006a.)

NIFES took the radical step against their own employee and issued a press release stating: "NIFES distances itself strongly from the contents of Claudette Bethune's media initiatives, where she speaks on issues she is not an expert on nor is responsible for. This scientist does not represent NIFES' scientific view on this issue. Consequently, Claudette Bethune's statements are her own private opinions. **NIFES is unaware of why the issue is presented like this and why Norwegian food authorities are unjustly slandered in this way."** (NIFES 2006.) Although it later turned out that the content of Bethune's statement was correct (Vogt 2006), no apology has been offered by NIFES. "I have put that issue behind me," was all director Øyvind Lie was willing to tell Aftenposten three months later (Moy 2006a.)

Claudette Bethune was recruited to NIFES in August 2003 as an expert on seafood risk assessment. She was to write a report on the presence of brominated flame retardants, toxic

substances, in fish for the Scientific Committee for Food Safety. **The report was written but Bethune was not allowed to publish it.** She was not offered any reason why (Moy 2006a.) **The withholding of this report conflicts with the statement that NIFES "shall make the results of its research known"** (NIFES undated.) Bethune informs Green Warriors that she was not allowed to present "any consumption advice or tolerable limits in fish as in the USA" (e-mail 25 August 2010.)

In March 2006, Bethune felt she was forced to resign from NIFES. **"Officially I left of my own accord, but there is no hiding the fact that I was fired,"** she stated (Korneliussen 2006.)

It is not easy to stand up against the mighty aquaculture industry; as **"Researchers who oppose the official view of their research institution experience harassement."** This is how the Norwegian daily Aftenposten summed up a letter from the Association of Marine Researchers (*Havforskerlaget*) in Bergen to the Norwegian Association of Researchers (Norsk forskerforbund), and it was confirmed that the letter was written on the background of the case surrounding Claudette Bethune (Moy 2006b.)

"Grants and allocations of funds are currently governed too heavily by industrial policies and political concerns," said Erik Slinde, a senior research scientist at the Institute of Marine Research (Moy 2006c.) Large sums are at stake when farmed salmon is the issue, and critical scientists are highly unpopular. Director Svein Berg of the Seafood Export Council (*Eksportutvalget for fisk*) admitted that he had Claudette Bethune and others in mind when in 2006 he **accused researchers that spoke of farmed salmon in negative terms of "acting as fifth columnists"** (NTB 2006b.)

Pressure on animal health professionals

In both 2008 and 2009, aquatic veterinarians who reported disease in aquaculture facilities or suspicion thereof, experienced subsequent loss of assignments. The Norwegian Broadcasting Corporation (NRK) interviewed aquatic veterinarians who confirmed this to be a known problem and explained that it affected veterinarians with few clients in particular (Guddal and Buvarp Aardal 2010.)

The board of the Association of Aquatic Veterinarians (*Akvaveterinærenes forening*) prepared a discussion note on this issue for its annual assembly in October 2009, and in the introduction the following is stated: **"Lately there have been repeated examples of animal health professionals who have had their assignment contracts terminated after reporting notifiable diseases or suspicion of such disease whilst performing fish health inspections."** (AVF 2009: 1.)

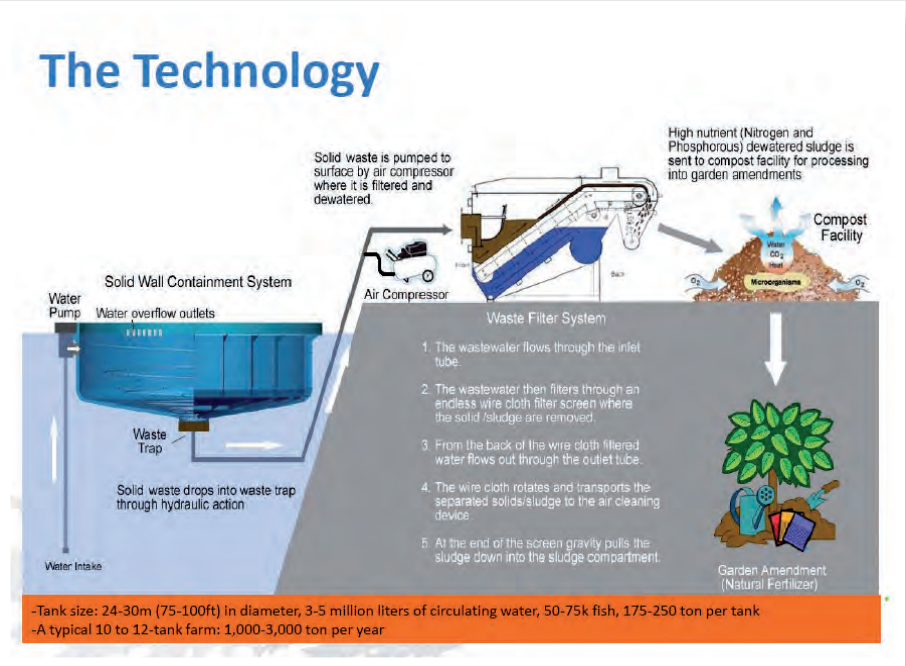
The aquatic veterinarians elaborate on the kind of difficult situation they may forced into:

> **Animal health professionals in such positions are often subjected to more or less explicit pressure from those hiring them to have them "overlook" signs of disease or dubious behaviour.** For the owner of the facility, both reputation and considerable economic values may be at stake. Moreover, an external fish health service may be more or less dependent on income from such clients to have a viable business basis. Often, strong professional and personal integrity is required to carry out one's duty to fish and society under such work conditions. It is evident that an aquaculture business cannot be forced to use a fish health service it does not want. As the consequence, contracts may be terminated at any time following the notice period stated in the contract.
> Animal health professionals who are employees of an aquaculture business may experience pressure at least equally strong in relation to their professional assessments and actions. The perceived or real threat that their contract will be terminated if negative circumstances are pointed out will not be as strong for someone who is an employee, since an employee cannot be dismissed without fair cause. (AVF 2009: 3.)

According to Guddal and Buvarp Aardal (2010), the debate at the annual meeting showed that the problem was not very common, but the following is stated in the minutes of the annual meeting: "There was broad agreement that this is an important issue and that there is a need for standardisation of agreements that are signed between fish health services and aquaculture facilities" (Blakstad 2009: 2.)

THE SOLUTION: FLOATING CLOSED CONTAINMENT SYSTEMS

Green Warriors demands the aquaculture industry be transferred to floating closed containment systems with seawater pumped from a depth of at least 50 metres and all waste to be collected. This would largely solve the problem of escapes, salmon lice and waste feed, and would remove the need for using toxic substances like diflubenzuron and teflubenzuron. Together with a general reduction of the scope of the aquaculture industry, and stricter feed restrictions, this would be an important step towards more environmentally friendly operations in an industry that currently represents a huge environmental problem.



Advantages

"Fish farming in closed units is nothing new," wrote Leffertstra (1991: 69.) The industry has long been aware of the ecological advantages of closed systems, and Lefferstra (1991: 69-70) **particularly many advantages of the combination of closed containment systems and filtering, mentioning, fewer emissions of delousing agents, less probability of the salmon being affected by communicable diseases or passing on diseases to wild fish, and treatment which is simpler and requires less chemicals among other benefits.** He also points out that one avoids the build-up of sludge on the bottom near the aquaculture facility and the danger of farmed fish escaping will be significantly reduced. All these arguments are as valid today as they were 20 years ago.

Green Warriors wants a transfer to floating closed containment systems. Sea water should be pumped from a depth of at least 50 metres, following an analysis of the currents, to avoid the entrance into the systems of salmon lice and other disease vectors that often live in the photo-synthetic layers into the system, and waste should be filtered off and used for beneficial purposes.

There have been many proposals to move aquaculture facilities onshore, but because of the extensive areas this would require Green Warriors believes floating closed containment systems are a better solution. Our view has received support from Per Helge Pedersen, the editor of the construction industry trade journal Byggeindustrien and website www.bygg.no, who argues in favour of concrete aquaculture facilities:

> Firstly, such a solution would be virtually maintenance free. It would be sturdy and one would have complete control of the fish at all times. For such a floating aquaculture facility one could bring water fresh from the deep and all waste could be taken care of. There would be no emissions to the sea. If a risk of pollution, oil spills, algal blooms etc arises, the facilities can be closed on short notice. In case of a disease, it will be contained within the closed facility.

> Such a structure will of course be more expensive to acquire but over its entire life span we are convinced it will be a solution that makes good business sense (Pedersen 2010a.)

Green Warriors believes concrete facilities are an interesting and constructive suggestion, but we are still open to using several materials, be they steel/aluminium, canvas or nets. Even though we prefer floating facilities, we strongly regret that the Ministry of Fisheries and Coastal Affairs has refused to grant a licence to the company NIRI that wanted to start land-based fish farming. **The Ministry wants to grant licences only to established fish farmers. This is just another example of how the network of fish farmers and public management officials keep other parties away, preventing innovation of the industry** (Mygland Storaker and Gytri 2010.)

Arve Gravdal of NIRI sees many advantages to abandoning open facilities: "With this new technology we get rid of the salmon lice problem. There is no need for vaccines and the problem of salmon escaping is inexistent," he said to the Norwegian Broadcasting Corporation (NRK) in Sogn and Fjordane (Mygland Storaker and Gytri 2010.)

On January 30, 2011, the Norwegian channel TV2 presented NIRI´s plans for a closed containment system **in Ireland as a consequence of the negative reply from Norwegian authorities.** TV2's report showed that while Norwegian fish farmers discharge waste straight into the sea, the Irish will collect all waste and use it as a raw material in bioenergy plants. Calculations show that waste from 20,000 tons of farmed fish provides sufficient energy to cover the electricity need of 4,000 households. The plants can also receive sludge and waste from agriculture, fish processing and other food processing industries. The electricity that is not used locally can be sent to the national grid. The cooling water can be used for district heating or greenhouses. Consequently, the need for fossil fuels will decrease. **This is off-the-shelf technology already being used by German farmers.**

Preline has conducted trials with floating closed containment facilities in the Hardanger Fjord for the past ten years and they are now ready for full-scale operation. The company reports that a more level temperature makes fish grow faster (Leirvåg 2010.) Marine biologist Peter Hovgaard of Fjord Forsk Sogn believes the project represents a breakthrough:

> If you take water from the deep you do not get salmon lice. The fish avoid lice, as well as other diseases that lice have been demonstrated to spread to the salmon, says Hovgaard to the TV 2 News (Leirvåg 2010.)

If we get rid of the salmon lice problem we also remove the reason for applying delousing agents like diflubenzuron and teflubenzuron, to the benefit of the entire ecosystem and the people eating the salmon.

Exploiting sludge

There are good alternatives allowing the fjord bottom under the aquaculture facilities become covered with sludge and several stakeholders are now examining possibilities of exploiting the fish faeces in a positive way.

"At Evje, a tomato grower and a fish farmer have big plans. They will join forces and build a shared facility for fish farming and tomato production in a closed system," reports NRK South Norway (Nilsen 2010.) While waste heat from the tomato greenhouse can be used to heat the water where the trout live, the manure from the fish may be used as a fertiliser for the tomatoes. Fish farmer Stein Uleberg says there is research on this concept all over the world and he insists it is not a castle in the sky (Nilsen 2010.)

Research director Olai Elnan at Nofima Marin is positive to testing second-generation aquaculture facilities, and to the construction industry trade journal Byggeindustrien he states:

> Due to the environmental aspect there will be an increased focus on all elements of aquaculture. Cleaning the facilities and their surroundings will become increasingly important and one should of course know that there are resources involved that can be exploited and produce income for the industry. **The fish faeces can be used as a fertiliser or for biogas production. We are talking about considerable quantities. However, more research is needed** (Pedersen 2010b.)

A report from AVS Chile and Nofima Marin looks into how sludge from hatcheries and juvenile fish facilities with water circulation may be exploited, and **the researchers concluded that there are two main areas of interest: sludge as a source of biogas and sludge as a source of fertiliser** (Del Campo, Ibarra, Gutierrez and Takle 2010: 57.) Based on ten juvenile fish facilities with recirculation technology, the researchers estimate a potential production of 487 tons of sludge annually, and they estimate that if the growth rate of the past few years continues it will be possible to produce 1602 tons of dry matter from sludge in 2015 (Del Campo et al 2010: 22.) If the 1602 tons are used annually for the production of biogas, it will still be too little to make biogas production profitable. Profitability will only occur with sludge from 300 juvenile fish facilities (Del Campo et al 2010: 34.) In 2009, there was a total of 214 juvenile fish facilities for salmon, rainbow trout and trout in all of Norway (Directorate of Fisheries 2010a), so even if they were all to recycle the water and separate off the sludge for biogas production, it would not be profitable in itself. However, the math changes radically if we include sludge

not only from juvenile fish facilities, but also aquaculture facilities in general, as 986 facilities were in operation in 2009 (Directorate of Fisheries 2010b.) **It will not be a problem to get enough sludge to have a profitable biogas production, not least because human food waste and sewage can also be used for biogas production, in addition to dead salmon and salmon trimmings**, as is being planned on the island of Frøya (Eide 2010.) However, it is not evident that all sludge is best exploited by using it for the same purpose, so we are open to the possibility of using sludge as a source of both biogas and fertiliser.

Feed use

Even though Green Warriors is sceptical to giving vegetable feed to farmed salmon, this does not mean we want the aquaculture industry to fish even more wild fish to be used as feed. The feed use must be regulated and we must ensure that feed comes from sustainable fisheries. If fish farming activities are to operate in an ecologically satisfactory way, a reduction of the size of the aquaculture industry is unavoidable. **It is difficult to make industrial farming of fish-eating fish environmentally friendly, but reducing the industry to one-fifth of its current size would be a major step in the right direction.**

The future

The aquaculture industry has been allowed to become vast and powerful in Norway, but large revenues must not be an impediment to necessary change. We second the Minister of Fisheries and Coastal Affairs Lisbeth Berg-Hansen when she says: **"The Norwegian aquaculture industry must improve and it is now, while times are good, one must prepare"** (Laugen 2010.)

If the Norwegian aquaculture industry is to keep up with the competition in other countries, it must stay abreast of technological developments. Closed containment systems are part of the development that Norway cannot ignore. Money now flows into the coffers of Norwegian fish farmers (Nyheim 2010, Olsen 2010) and we believe it is indispensable to use some of the current profits to secure the basis for viable ecosystems along the coast.

We demand full conversion to floating closed containment systems supplied with water pumped from a depth of at least 50 metres and treatment of all effluents, within three years.

GREEN WARRIORS COASTAL MONITORING CENTRE

M/S Miljødronningen - Queen of the Environment - is a high-tech vessel with diving equipment, a laboratory and various sampling and testing equipment. It has its own remotely operated vehicle (ROV) that can be used to map the conditions on the seabed and around the fish farms.

The aquaculture industry cannot hide its environmental sins when the M/S Miljødronningen is cruising. The vessel is an important tool now that we are intensifying the war against the environmental sinners.

M/S Miljødronningen is a catamaran equipped with an EC135 helipad and measures 35 metres in length and roughly 10 metres in width. The hull is reinforced in order to withstand impacts from ice.

M/S Miljødronningen is capable of cruising at 14 knots and has a maximum speed of almost 20 knots. She is fully equipped, including a galley, cabins, educational tools and a conference room large enough to accommodate 50 people.

M/S Miljødronningen is the first commercial vessel in Norway built to run her two MAN main engines on biodiesel.

The vessel features a Scottish made ROV (SubAtalantic, Mohican 2000) that can be used to a depth of 2000m, with a range of state of the art Kongsberg colour and HD cameras and a manipulator arm. She has diving equipment, a laboratory and miscellaneous sampling equipment.
The catamaran is used as a research and environmental monitoring vessel by Green Warriors of Norway, who own the vessel.

KURT ODDEKALV

Kurt Oddekalv – arguably the most hard-hitting environmental warrior in Norway, and the leader of the organisation Green Warriors of Norway since 1993. Having acquired almost 30 years of Norwegian and international war experience for a better environment both on land and at sea, an increasing number of people see the loud Bergense as a true hero in the ongoing fight for the environment.

He who dares, wins

Kurt has never been afraid to shout out loud in order to be heard. The fact that his tireless fight for the environment had yielded results is acknowledged even by his opponents. In fact, he wins most of the cases he engages in.

Together with all our old and new supporters, it is now only a matter of time before we are victorious over the fish farming industry too. We keep a close watch on the industry and the fight is intensifying. Green Warriors of Norway has already reported the industry to the police nearly 50 times for abuses such as the spread of diseases, escaped farmed fish and pollution. Many of these cases are currently working their way through the legal system. The fight will go on until we have won, says Kurt, who has already dealt many hard blows to the industry.

GREEN WARRIORS AND KURT ARE WINNING THE FIGHT FOR THE ENVIRONMENT

- Total ban on discarding fish following a police complaint filed against 3 fishing boats dumping mackerel into the sea.
- Exports to Denmark of salmon entrails containing antibiotics were stopped.
- Police complaint filed against a prime minister, in office at the time, for attempted smuggling of ivory; the police confiscated the tusks.
- The use of antibiotics and chemotherapeutics in the aquaculture industry has been reduced.
* Sulphur treatment plant built at the Mongstad industrial complex.
- National waste plan established for the construction industry, as well as a waste sorting system at the Norwegian State Railways.
- In 2009, Statoil was given a fine of 25 MNOK for oil spills following a police complaint filed by Oddekalv.
- In 2008, the Norwegian National Authority for the Investigation and Prosecution of Economic and Environmental Crime launched investigations on the basis of police complaints filed by Oddekalv; two of the cases are currently in court; the dumping of toxic sediments in the Oslo fjord, and the West Tank accident in Sløvåg.
- Following a police complaint filed by Oddekalv in 2002, Aluscan was given a fine of 4 MNOK for environmental crimes.

OBITUARY OF A NOT-SO-HAPPY SALMON

Although the present report is research-based and contains numerous scientific references, we also feel a fundamental compassion for and solidarity with nature. For this reason we have written an obituary of a not-so-happy salmon to show that it is not all about dry facts and figures, but about our living fellow beings.

My forefathers swam freely. In those times, all salmon did. Life was good and waters were pure – the ocean, rivers and fjords were pristine. Life of course offered challenges, disease and dangers, but that is how life is supposed to be. Some forefathers were eaten by bears, while others bit the hooks of human beings or got entangled in their nets, but we salmon eat other fish too and cannot condemn neither bears nor humans. This is how nature is.

Or: This is how nature was. The bears are not to blame; they are actually fewer than before. It is the humans who have changed nature, and that is why I keep swimming in a circle inside this net, feeling constantly dizzy.

The free and happy life of salmon is all but history. Here in this net pen there are two hundred thousand other salmon, and we all swim together, round and round again. Many of my friends are sick, but there is no way the rest of us can escape the contagion. All around me my friends sicken and die by the scores. Here, at least one salmon in ten ends its life floating belly-up in the net pen. The humans sometimes collect the dead, but they are often left for a long time with those of us who are still alive. The humans give us lots of food. It is not the kind of food we would eat in the wild, because salmon do not eat grains, but we have no other food, so we eat grain even though it makes us feel very strange. And we are not the only ones, because a lot of feed sinks past us down to the fishes outside the net. Those on the outside get plenty food, because here in the net pen many are sick and this dampens our appetite. It does not increase your appetite to have sick and dead friends floating around you. Some of them have large, open wounds in addition.

Sometimes some escape from the net pen. Once there is a chance to escape, thousands often find their way out. We recognise them as they pass by on the outside, because they are not like the other fishes out there. Nor am I like the wild salmon. None of us here in the net pen are like them, and those who escape continue to be like us. We on the inside look strange. Many of us have a constantly open mouth, exposed gills or twisted backs. Even though many smolts are removed because they look too strange, there are lots of strange-looking fish left in the net pen. Is this how humans want us to be?

I have some nasty little creatures on my body. They are called lice and they float around in the net pens together with us. They latch on to my skin and make my life painful. I have several of them on my body now and I feel them eating away at me, but there is nothing I can do. I cannot shake them off in fresh water because I cannot go anywhere. Ouch. And if I do manage to shake off a few lice they soon return. We cannot go anywhere and the lice increase in number day by day.
One day I was suddenly pumped into a narrow raceway together with lots of other salmon. We were squeezed tightly together and immersed in a strange liquid that caused a terrible burning sensation. Some of the lice fell off while the rest were still clinging tight. I don't know what has been worse; the lice or the liquid. Both hurt a lot. Some of the other salmon can no longer see after they were in contact with the liquid.
We have been given feed that is a bit different and now there are fewer lobsters and crayfish on the outside. They are gone and my body feels very strange. The lice, however, are not all gone.

There are so many salmon here in the net pen that there is some bickering. I try to keep out of trouble, but it is not easy because there is no way to run.

Now we are more aggressive than usual, because the past few days we have not been fed. So we just swim around in the net pen, hungry and angry. This leads to a lot of fighting.

Now something is happening to the water. At first I didn't notice much, but now it is becoming more difficult to breathe. I have to get away and I try every way out. But there is no escape. I make a jump into the air and catch a glimpse of humans pumping something into the water. There is a frenzy of panicking salmon around me, all trying to escape, but with nowhere to go. Then I pass out.

Soon one of the humans shall eat me. At last, I will get my revenge.

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NORSK			ENGELSK
Norges Miljøvernforbund	NMF	GW	Green Warriors of Norway
Fiskeri- og havbruksnæringens landsforening	FHL		Norwegian Seafood Federation
Havforskningsinstituttet	HI	IMR	Norwegian Institute of Marine Research
Mattilsynet			Norwegian Food Safety Authority
Nasjonalt institutt for ernærings- og sjømatforskning	NIFES	NIFES	National Institute of Seafood and Nutrition Research
National Veterinary Institute			National Veterinary Institute
Norsk institutt for naturforskning	NINA	NINA	Norwegian Institute for Nature Research
Direktoratet for naturforvaltning			Norwegian Directorate for Nature Management
Statistisk sentralbyrå	SSB		Statistics Norway
Norsk Havbrukssenter			Norwegian Aquaculture Centre
Fiskeri- og kystdepartementet			Ministry of Fisheries and Coastal Affairs
Directorate of Fisheries			Directorate of Fisheries
Klima- og forurensningsdirektoratet	KLIF	CPA	Climate and Pollution Agency
Statens forurensningstilsyn	SFT	NPCA	Norwegian Pollution Control Authority
Vannseksjonen i Climate and Pollution Agency			Water Section of the Climate and Pollution Agency
SINTEF Fiskeri og havbruk			SINTEF Fisheries and Aquaculture
Stavanger og omegn fiskarlag			Fishermen's Association of Stavanger and its surrounding district
Fiskeriforskning			Institute of Fisheries and Aquaculture Research
	SINTEF	SINTEF	
	NOFIMA	NOFIMA	
Norges Bondelag			Norwegian Farmers' Union
Norske Lakseelver			Norwegian Salmon Rivers
Statens legemiddelverk	SLV		Norwegian Medicines Agency
Norwegian Polar Institute			
Norges teknisk-naturvitenskapelige universitet	NTNU	NUST	Norwegian University of Science and Technology
Dyrevernalliansen			Norwegian Animal Protection Alliance
Rådet for dyreetikk			Animal Ethics Council
Landbruksdepartementet			Ministry of Agriculture
Norges veterinærhøgskole			Norwegian School of Veterinary Science
Folkehelseinsituttet			Norwegian Institute of Public Health
Vitenskapskomiteen for mattrygghet	VKM		Norwegian Scientific Committee for Food Safety
Institutt for patologi ved Rikshospitalet			Institute of Pathology at Rikshospitalet University Hospital
Nasjonalt folkehelseinstitutt, divisjon for miljømedisin, avdeling for næringsmiddeltoksikologi			Norwegian Institute of Public Health, Division of Environmental Medicine, Department of Food Toxicology
Senter for teknologi og samfunn, NTNU			Centre for Technology and Society, Norwegian University of Science and Technology
Den sentrale enhet for etterforsking og påtale av økonomisk kriminalitet og miljøkriminalitet	Økokrim	Økokrim	Norwegian National Authority for Investiga tion and Prosecution of Economic and Environmental Crime
Norges Fiskerihøgskole			Norwegian College of Fishery Science
Norges forskningsråd			Research Council of Norway
Fornyings- og administrasjonsdepartementet			Ministry of Government Administration and Reform
Stortingets kontroll- og konsitutsjonskomité			Standing Committee on Scrutiny and Constitutional Affairs of the Norwegian Parliament
Norges Jeger- og Fiskerforbund			Norwegian Association of Hunters and Anglers
Havforskerlaget			Association of Marine Researchers
Norsk forskerforbund			Norwegian Association of Researchers
Eksportutvalget for fisk			Seafood Export Council
Akvaveterinærenes forening	AVF		Association of Aquatic Veterinarians
Areal- og miljøvernavdelingen i Møre og Romsdal fylke			Area Planning and Environmental Depart ment of Møre and Romsdal County

"It is my hope that you, the reader of this report, understands that the current environmentally destructive form of Norwegian fish farming should be relegated to the history books as a failed experiment, and that the farming of fish-eating fish must be reduced to one-fifth of its current volume out of concern for all other forms of marine life. The industry must also be transferred to closed containment systems that are supplied with water from a depth of at least 50 metres and that clean all their effluents. If not, the angling trip with your children and the joy of catching a wild fish, be it in the sea or in a river, will soon be a thing of the past.

KURT ODDEKALV, GREEN WARRIOR

NORGES MILJØVERNFORBUND

NMF

2011