



Agenda item 5.4
For information

Council

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***Review of International Salmon-Related Literature
Published in 1999***

The attached literature review, covering articles published in 1999, is presented to the Council, for information, in accordance with Article 12, paragraph 2, of the Convention. It has been prepared by carrying out a computer-based search of the relevant databases and includes material abstracted from the scientific literature and the press (articles written in English only). We have made efforts to increase the scope of the press articles included in the review, particularly with regard to articles from the North American press. Only selected information considered to be relevant to the Council has been included in the attached review. A complete listing is available from the Secretariat.

Secretary
Edinburgh
17 April, 2000

***Review of International Salmon-Related Literature
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PRESS ARTICLES

Salmon catchers seek action over huge increase in seal numbers

Aberdeen Press And Journal, 6 January 1999

Salmon netmen believe that while a cull may be ruled out at present, it should still be possible to introduce measures to control the spiralling seal population. The Salmon Net Fishing Association of Scotland says it is somewhat perplexed at Scottish Office Fisheries Minister Lord Sewel's call for more research before the Government can decide what action is necessary to reduce the grey seal population round the Scottish coast to numbers which the Eco-System can sustain. The Association, in its own publication, says that research related to seal predation on salmon stocks and catches has been in progress for almost 50 years. And although the evidence that seals are a major predator on salmon stocks is not conclusive, the International Council for the Exploration of the Sea Working Group on North Atlantic Salmon has concluded that two decades of increasing seal populations and a decline in many North American salmon stocks suggest that the potentially significant impact by seals should not be discounted. And although the Working Group was referring to North America the decline in salmon stocks and the massive increase in seal numbers are common on both sides of the Atlantic, the Association adds. Nearer home, the results of a study carried out by Aberdeen University concluded that in the River Dee the number of salmon recorded eaten by seals may be having a significant impact on the salmon population of that river during the winter when the component of the stock generally agreed to be under most pressure in its fight for survival is returning from the sea in the greatest numbers. This study, says the Association, merely confirms the results obtained by the Scottish Office who also concluded after a study lasting some 30 years that the level of seal damage among both rod and net catches was highest in the spring. 'Although the logistics of carrying out an effective seal cull at present may make such action impossible the introduction of measures to stop the spiralling increase both in seal numbers and satellite colonies should be possible.' Early indications are that the 1998 salmon catch is unlikely to exceed that taken in 1997 which was the lowest - 295 tonnes - on record and could even be worse. Although a few fisheries reported average catches, more fisheries reported catches less than reported in 1997, some by significant amounts.

Scientists search stream for source of salmon virus

Boston Globe, 21 January 1999

It began with a few dead salmon floating inside a North Attleborough hatchery, killed by strange tumors that took hold on the "swim bladders" the fish use for balance and grew until the bladders burst. Now, biologists are struggling to understand, and contain, a rare viral outbreak before it threatens the region's already depleted wild salmon population, which conservationists are trying to restore. Since the virus was confirmed last month, officials have quarantined a second hatchery in Maine, killed hundreds of exposed fish, and sent others to a federal lab in West Virginia for further study. But that may not be enough. Conservationists now face the frustrating possibility that they will have to kill some of the endangered wild salmon when the fish return this spring to spawn in Maine's Pleasant River. All the diseased hatchery fish had come from the eastern Maine stream, suggesting the outbreak began there. "It's not something we want to do, but if salmon returning next year test positive (for the virus), we may have to reclaim the river and start all over again," said Ed Baum, senior biologist for the Atlantic Salmon Authority, which oversees efforts to rebuild the state's salmon populations. The outbreak of swim bladder sarcoma virus, reported only twice before in salmon populations, is a cruel turn for a species that has already had more than its share of misfortune. When the European settlers first arrived, salmon spawned by the millions in rivers from eastern Maine to Connecticut. Dams and pollution have since reduced New England's population to fewer than 2,000, mostly spawning in Maine. Some suspect that the outbreak became almost inevitable as commercial salmon farms sprung up along the Maine coast. Every year, tens of thousands of fish escape from their holding pens, allowing them, scientists speculate, to spread diseases to which the wild native population has no immunity. Federal regulators are particularly concerned about the import of salmon sperm from Norway and Scotland to create hybrid fish here, noting that the swim bladder virus was first reported in Scotland in 1978. Escaped imported salmon can also breed with native salmon, causing long-term genetic damage, according to Ray Owen, US Commissioner for the North Atlantic Salmon Conservation Organization, which oversees international salmon agreements. But aquaculture companies stress that their fish appear to be virus-free. "We're very concerned about diseases. That's the reason we have such strict health standards," said Joseph McGonigle of the Maine Aquaculture Association, which represents commercial salmon growers. "Every single fish is vaccinated before they're even put in the water at a commercial hatchery." Indeed, biologists know so little about the virus that they can shed little light on its origins or how far it may have spread. "Our scientific literature resources are extremely limited," said Paul R. Bowser, a specialist in fish pathology at Cornell University who helped identify the virus at the federal hatchery in North Attleborough. What they do know is that the virus is deadly, causing cancerous tumors up to eight inches long inside the fish's abdomen, pressing on the swim bladder and eventually killing the fish. Ironically, another possible source of the trouble is human efforts to help the wild salmon. Because the Pleasant River is a spawning ground for only a handful of salmon - just 25 to 50 return each spring - the US Fish and Wildlife Service had tried to improve the odds by taking some fish from the Pleasant River to hatcheries in Massachusetts and Maine where they could reproduce in relative safety. But salmon kept in close quarters are more vulnerable to disease - just like

people in a city - and, by 1996, officials at the North Attleborough hatchery had begun to see salmon mysteriously die. By 1998, the deaths had become so frequent that they isolated the building where the Pleasant River salmon were kept and called in biologists from Cornell. The virus ultimately killed 80 of the 280 Pleasant River salmon in North Attleborough, and 160 more were destroyed as a precaution. The remaining 40, all infected with the virus, were spared so that federal researchers could watch the disease progress at a West Virginia lab. As the investigation widened, biologists found more infected Pleasant River salmon at the Down East Salmon Federation hatchery in Columbia Falls, Maine, and the Connors Brothers commercial hatchery in Deblois, Maine. In both locations, the fish were destroyed, and the Columbia Falls facility quarantined. Bowser believes the outbreak is limited to the Pleasant River salmon, noting that hatcheries have seen no swim bladder virus when they raise wild fish from other rivers. But so little is known that he can give no guarantees.

Scotland is suspect over fish virus: salmon industry suffers new blow

The Herald, 28 January 1999

Scotland's beleaguered salmon industry is suspected to be the source of a deadly new cancer-causing virus among fish, according to scientists in the United States. Researchers from the Veterinary Medical Centre at Cornell University, New York, have made the first identification of the salmon swimbladder sarcoma virus (SSSV) after an outbreak of disease among farmed fish at a hatchery in North Attleboro, Massachusetts. They found that fatal tumours in the Atlantic salmon were caused by the virus. The scientist who made the discovery told *The Herald* yesterday that the only similar outbreak occurred among farm-raised salmon in the west of Scotland in 1978. Dr James Casey, associate professor of veterinary microbiology and immunology, said that he had contacted scientists from the Government-funded marine laboratory in Aberdeen to obtain samples for analysis and comparison. He added that genetic testing methods were not available in the 1970s to identify the virus, which affected about 25 fish. Dr Casey said there was a suspicion that Scotland was the source of the New England outbreak, which has so far led to the death of 200 fish. The virus has also been identified at a second hatchery, in Maine. He added: 'We have had an outbreak here in a hatchery in Massachusetts. It appears to be pathologically identical to the outbreak which occurred in Scotland in the 1970s. We have not established a connection with Scotland, though the only time it was ever reported was at a fish hatchery there. People involved in commercial fish work may have brought them here. That is always a problem.' Dr Casey said the disease could have been exported from Scottish fish or salmon products, such as sperm, to the US. The concern is that, because the disease occurs only in fish up to three years old, it could have arrived from Scotland in the last few years. That would mean it could still exist in Scotland, he said. He added that the virus appeared to have emerged now because it was more obvious in fish kept in an artificial environment. The infected fish were originally caught in the wild and taken to farms as part of a breeding programme. Dr Casey stressed that the virus is believed to be 'species specific' and should have no effect on human health. But he added that more work had to be done on how it is transmitted and the level of infection. SSSV is thought to cause a slow-growing cancer which produces bulging tumours on the swimbladders of the fish. Its existence in Scotland would prove a further blow to farmed and wild salmon interests, which have already been hit by the effects of infectious salmon anaemia (ISA) and sea lice. ISA has led to the destruction of about four million farmed fish and smolts in Scotland. It has been confirmed at 10 of the country's 353 fish farms and is suspected at another 15. Atlantic Salmon Trust Director Jeremy Read said there was some concern about the prospect of a new disease. It was too early to judge the potential effects in Scotland, though there did not appear to be any immediate danger. 'This reinforces the need for firm regulation of fish farming to avoid the potential for the transference of disease,' he said. A Scottish Office spokeswoman stressed that the original outbreak had been a 'low level occurrence' and had not been identified since. She said that the source of the disease was unknown, and added that it had not been scientifically demonstrated that the outbreaks in New England and Scotland were connected. Mr William Crowe, Chief Executive of the Scottish Salmon Growers' Association, said the disease must have originated from wild fish because of the low prevalence among farmed salmon. He acknowledged that it could still exist, though he insisted it must be rare. He doubted any link between Scotland and the US. He added: 'There is no human food safety issue here - there is no evidence of a risk to human health, and this part of the fish gets taken out in the guts anyway.' The Scottish Office yesterday announced details of EC and Government grants totalling £3m for 27 fisheries projects around the country. Some of the money went to salmon farms for measures to tackle fish disease.

State agency overruled on alien salmon. Farm-raised fish could colonize, board finds

Seattle Post-Intelligencer, 3 April 1999

The state Department of Ecology was wrong to dismiss the possibility that Atlantic salmon escaping from fish farms might colonize Puget Sound streams, according to a new ruling by the state Pollution Control Hearings Board. But the board Thursday agreed to let Ecology Department officials decide what to do about it. The ruling disappointed salmon farm opponents, who have been pressing the state to withdraw farm net-pen permits or impose new restrictions on them to stem the accidental release of farmed salmon. In Canada, where salmon farming is much more common than in Washington waters, researchers have found evidence that Atlantic salmon have been spawning in Vancouver Island's Tsitika River. The Ecology Department, relying on failed past attempts to establish Atlantic salmon on the West Coast, had said that the risk of that happening was minimal. Atlantic salmon are not native to the Pacific Ocean. The Marine

Environmental Consortium, a group of net-pen opponents, charges that escaping Atlantic salmon pose a risk to the survival of weak Puget Sound wild Pacific salmon and steelhead runs. If Atlantic salmon establish a foothold here, the group contends, they could compete with or even prey on native runs. But while upholding the Marine Environmental Consortium's claim that Atlantic salmon reproduction was a significant risk, the Pollution Control Hearings Board balked at its request to impose stringent conditions on net pens. Instead, the board ordered the Ecology Department to thoroughly review and evaluate the evidence of Atlantic salmon reproduction, and take whatever action it finds appropriate on permit renewal. Stephan Volker, who represented the Marine Environmental Consortium, charged that the board abdicated its responsibility. "The net pens will continue to operate for at least 2½ years (under existing permits) and will continue to release Atlantic salmon to Puget Sound waters," he said. "This is an unacceptable risk." According to Volker, a Canadian study found about 400 Atlantic salmon in the Tsitika River, including sexually mature adults. Similar populations of Atlantic salmon may colonize other rivers, he said. The ruling appears to leave salmon farm regulation unchanged, at least until the Ecology Department decides whether to impose new restrictions. Ecology Department officials could not be reached for comment. The ruling was the second to be won by net-pen critics. The board previously ruled that Atlantic salmon should be considered a pollutant in Puget Sound. Salmon farms won most of the issues in dispute, however. Last December, the Pollution Control Hearings Board said that opponents failed to prove that Puget Sound's net pens cause significant pollution, interfere with other uses of regional waters, or threaten native stocks of Pacific salmon. The board reconsidered part of that ruling in light of evidence that Atlantics had spawned successfully in Canada, and that review produced its ruling Thursday.

Salmon anemia virus pops up in Nova Scotia

Anchorage Daily News, 27 April 1999

A virus that forced New Brunswick salmon farmers to slaughter more than a million fish last year has been found in neighboring Nova Scotia. Scientists have discovered the virus that causes infectious salmon anemia at three fish farms in the province. Worries are mounting that the virus could infect wild stocks of Atlantic salmon, the species that is reared in fish farms. Wild stocks should be on the aquaculture industry's "radar because, ultimately, it is from this gene pool that the aquaculture fish are being drawn from," said Ray Plourde of the Nova Scotia Salmon Association. "If that reserve deposit is exhausted or damaged by sloppy biological practices, then there will be nothing to go back to when another problem occurs," he said. "We've been holding our breath since it broke out in New Brunswick," said Marli MacNeil, executive director of the Aquaculture Association of Nova Scotia. Testing for the virus began two years ago, but it was first discovered in January at Seal Island, on the southern tip of the province. About 2,000 Seal Island salmon were destroyed after the farmer harvested their eggs and sperm. To date, there has been no scientific evidence showing the disease is passed along genetically, said Roland Cusack, the province's fish disease veterinarian. So far, none of the salmon carrying the virus have been sick. They were just carriers. "No fish have died from this in Nova Scotia," Cusack said. Robin Stuart, manager of Saddle Island Fisheries in St. Margaret's Bay, had one of his salmon test positive for the virus. "You've got to be worried because of the fact that it's a virus and viruses aren't treatable by antibiotics," Stuart said. The disease first appeared at fish farms in Norway about 13 years ago, then in New Brunswick and later Scotland. "We know that it can have devastating results if it takes off," said Stuart, who sold about a million pounds of salmon in 1998. Stuart and other Nova Scotia salmon farmers hope to avoid an outbreak by following stringent disinfection rules developed in Norway. New Brunswick paid fish farmers more than \$16 million in compensation after the virus wreaked havoc on salmon stocks. Before the virus outbreak, New Brunswick harvested more than \$80 million worth of farmed salmon a year. Nova Scotia produces less than a tenth of that.

Swim in peace

The Ottawa Citizen, 13 May 1999

The Atlantic Salmon Federation (ASF) is right to propose to Fisheries Minister David Anderson that our Government start an international campaign for a fish 'sanctuary' off Greenland. The alarming decline in fish stocks worldwide (the ASF says mature adult wild Atlantic salmon are down from 800,000 20 years ago to 100,000 today) certainly generates pressure to do something. This 'something' would actually help, and can be done. Let's do it. In case you do not hang out much with fish, we should explain that the life of both European- and North American-born Atlantic salmon involves a good deal of swimming about, some eating of other fish, and winters off south-western Greenland (Atlantic salmon do not die after spawning). That makes them vulnerable to commercial fishing that kills huge numbers for little return (economically, sport fishing is far more lucrative), damages the ocean ecosystem and multiplies the threat to salmon posed by other human activities like dam-building. And it is easy to stop. The main problem with fish conservation is the well-known 'tragedy of the commons.' Everyone's property is no one's property, which is why cod are in trouble but cows are not. The farmer who doesn't eat his cow this spring can milk her this fall; the fisherman who spares a cod will see it caught by someone else. No private individual has much incentive to protect cod, nor any legal right to. Thus protection of fish requires government action and political mechanisms, such as quotas, that are positively harmful when superimposed on privately owned resources like dairy cows or wheat fields. And if fishing of certain stocks should be reduced, governments should withdraw quotas or other political rights to fish, and compensate their owners. If conserving something makes sense, there is always enough to compensate existing users and leave a surplus for society or humankind. In this case, Greenland has special treaty rights to these fish, so not only various

domestic fishermen but also Greenland should be compensated by the various governments now in the fishery. The biggest practical problem will not be cheaters or pirates, but nations that decide to get into the 'commercial' ocean fishing game if those now in it get out. This is not a trivial problem: as no governments own the oceans, it's not entirely proper for some of them to decide that others will be excluded from certain uses. Some governments (not to mention Japanese whaling specifically) will take some persuading, moral or material, to make it unanimous. And, curiously, the fact that it makes little economic sense makes it harder to use rational persuasion on governments inclined to engage in it. Still, that's what we pay our diplomats for, and if they must make tradeoffs elsewhere to bring some nations on side, they should make them in this worthwhile cause. A fish sanctuary would help protect not just salmon, but an entire habitat and all its species (except to some extent species that salmon eat: sorry, guys) from economically unsound, ecologically horrible sea-scouring trawler fleets. Few environmental problems have such a technically simple solution. Let's do it.

North America has lost 96% of Atlantic salmon

The Ottawa Citizen, 13 May 1999

The Atlantic salmon, a tough, long-lived fish that can grow to a 20 kilogram monster, has been killed in such numbers that just four per cent of North America's original population remains. 'There have been tremendous declines in the salmon population in the past few years,' says Sue Scott, Vice-President of the Atlantic Salmon Federation. Twenty years ago there were 20,000 to 40,000 salmon in rivers that flow to the inner Bay of Fundy. Today there are fewer than 100 wild fish, and escaped fish from fish farms threaten to overwhelm them, spread disease and perhaps change the genetic nature of the population. Blame a whole host of causes, says fish scientist Fred Whoriskey of St. Andrews, NB. Chemical pollution is one likely culprit. So is logging that exposes cool streams to hot sun and dumps silt and tree branches in the water. Dams almost certainly kill many fish, a trade-off our society made in the days when electricity was of more value than wildlife. The Saint John River in New Brunswick has four dams between spawning areas and the sea. There are fish ladders and people with tanks of water and trucks to give spawning fish a lift past dams on the trip upstream, but nothing to help the young fish on their way down to the sea. 'Last year we tagged 60 smolts (young fish heading for the sea) above the dams,' says Bill Taylor, the Salmon Federation's President. The radio 'tags' sent out signals that allowed researchers to follow the fish on their journey. 'Not a single one made it past all four dams.' 'We've had all kinds of habitat destruction,' Mr. Whoriskey says. 'Dams are just the tip of the iceberg.' Then there are predators - the seal population in the North Atlantic has grown in a big way with the decline of sealing. Some seabird populations are also growing, and these birds are suspected of changing their diet to young salmon as other fish, such as capelin, become scarce. Finally, there's acid rain. 'Yesterday's crisis,' Mr. Whoriskey says. 'Everybody's forgotten about it.' Yet the Salmon Federation says salmon are completely gone from 18 to 20 Nova Scotia rivers because of acid rain, while another 20 rivers in the Province are so acidic 'they're on the brink.' Starting in the late 1970s, when the numbers were beginning to slide, the Federal Government bought out all 10,000 commercial fishermen licensed to catch Atlantic salmon. They had been catching 500,000 fish a year. 'That spared half a million fish a year,' Mr. Taylor said, 'but those fish still aren't showing up (today).' The 1980s continued the decline. There seemed to be an improvement in the overall salmon prospects in 1997. 'Fishermen were all excited because there were some good numbers and we thought we were seeing the beginning of a comeback,' Ms. Scott said. 'We had stopped the commercial fishery and things looked pretty good. But it was only a blip. Things bottomed out in 1997.' The salmon have been worst hit in the United States. Only seven US rivers still have salmon in them, all in Maine, and all in low numbers. Extinction of the species in the United States is a real possibility.

Pesticide linked to mass kill of salmon: federal scientists name 'gender bender' chemicals as prime suspect in decline

The Ottawa Citizen, 14 May 1999

'Gender-bender' pollutants that trick the body's hormone systems are strong suspects in mass kills of young Atlantic salmon, scientists from the federal Fisheries and Environment departments say. The new research is based on studies that began in 1977, when something killed many young salmon from New Brunswick's Restigouche River. Evidence gradually pointed to a pesticide, not used since 1985, that was once sprayed to kill spruce budworms. But a key ingredient in the insect spray is still used in a wide range of cleaning chemicals and industrial processes, and still goes down drains and into rivers at levels as high as those in the old days. And today's Atlantic salmon are still dying the same mysterious death on their migration to the sea as the Restigouche fish killed back in 1977. As the salmon continue their dizzying fall from abundance - there are just one-eighth as many today as there were in 1980 - researchers trying to save them are looking closely at pollutants nicknamed 'gender benders.' 'There is something happening to them and they're dying, but we don't know what it is,' said Wayne Fairchild, a researcher at Fisheries & Oceans Canada in Moncton. He believes there's a strong link with the pesticide and its chemical relatives: 'What we found is that for one river, there was an association between the amount of Matabac 1.8D (insecticide) sprayed in 1977 and the number of salmon returning two years later. The more they sprayed, the fewer fish returned.' A similar pattern held for 14 other watersheds, as well as for mass kills of herring. And in the early 1980s, when New Brunswick stopped using the spray but Quebec and Newfoundland continued, only the New Brunswick fish escaped the mysterious 'die-offs.' 'Here is a land-based factor, something we do to them before they go and which we don't

understand, that is affecting them at sea,' he said. The research by Mr. Fairchild and Scott Brown of Environment Canada is being published in the current issue of *Environmental Health Perspectives*, a science journal. They don't claim there's an absolute cause-and-effect relationship, but call it 'an association': where the spray was used, the fish also died, whatever the cause. Though they don't know how the silent killer works, they're pretty sure when it attacks. Young salmon spend their first two to four years as small, trout-like fish in freshwater streams. Then they migrate to the ocean, a process called smolting, and begin to grow to maturity. 'This is a change in their life form,' Mr. Fairchild says, similar to the tadpole's change into a frog, though without as visible a change. Young salmon are adapted to soaking up all the salt they can, and they eat flies and larvae. Smolts adapt to rid their bodies of salt so they won't overdose on salt in the ocean. Once there, they eat small fish. But many smolts today are dying soon after they reach the sea. In the lab, they starve when they make the move to salt water. 'They look like fish heads on little bodies,' Mr. Fairchild says. And beginning some 18 months ago, his research started to look at the chance that the salmon's hormone system, which governs this change of life, is skewed by gender-benders. These chemicals, though not thoroughly understood, imitate the female hormone estrogen and trick the systems of many kinds of animals. Usually they cause fish to lay eggs that don't hatch, or that have deformed baby fish inside them. But the salmon are hatching and moving downstream in apparent good health. Mr. Fairchild and his co-workers gathered data on spraying of spruce budworms with Matacil 1.8D. Eventually they saw a pattern: the young smolts died soon after reaching the sea if their original streams had been sprayed with pesticide. The pattern was so obvious, he says today, 'that we couldn't believe it. We spent months trying to see where we'd bugged up the data.' But every new study - into wider areas and more years - confirmed the original finding. All over the Atlantic coast, he says, 'we could identify that where this stuff had been sprayed, the reduction (in salmon numbers) was much worse.' Worse, the suspect chemicals, a group called nonylphenols, are widespread ingredients in cleaning products, plastics and solvents. And there are other chemicals with a similar ability to imitate estrogen, including the waste from pulp mills. Even estrogen itself, in human urine and birth-control pills, may be going down toilets and eventually into rivers in amounts that matter to fish. 'If other chemicals are capable of doing this, then nonylphenol may not even be the most important thing out there,' Mr. Fairchild says. In the lab, about 30 per cent of the smolts exposed to nonylphenol or pure estrogen were stunted. 'Perhaps these smolts don't physiologically adapt to sea water,' says Mr. Brown, an expert in pollutants and fish reproduction at Environment Canada. 'The other thing is that they don't eat properly, and it may be a change in their competitive behaviour.' Because the pesticide Matacil is no longer used, 'we want to look at today's effluents - things like sewage treatment plants, pulp mill effluents .. to see if it causes (the same) effect.' 'We hope to do some research on it this summer in the Miramichi (a major salmon river in New Brunswick),' says Bill Taylor, President of the Atlantic Salmon Federation. 'We know that smolts, the young salmon going out of the rivers (to mature in the sea) are dying off in larger numbers than previously,' he said. 'They're dying off early in their marine migration, and this might be one of the causes. The gender-benders might be impacting on the ability of smolts to go from fresh water to salt water.' The news isn't all bad. The salmon that do survive to maturity seem robust. The trouble is that not enough are reaching that stage in the first place. And the tricky thing with gender-benders is that a fish, bird or mammal exposed to them is often perfectly healthy, while its offspring are born with defects. That means the presence of healthy-looking adult salmon is no guarantee the fish are free of chemical damage. 'There's a murderer out there, but we don't know what it is yet,' says Fred Whoriskey, a fish researcher in St. Andrew's, NB. 'There does seem to be something about nonylphenol that results in dead salmon.' 'Salt is a big element in everybody's body,' says Mr. Whoriskey. The salmon have gills that are adapted to pump any salt in their surroundings into their bodies. But once they hit the ocean, they can overdose on salt if they don't adapt to rid their bodies of it. With too much, the electrical impulses in their nerves literally short-circuit. So the salmon's gills change subtly. New cells grow, the enzymes change, and the gills begin to pump salt out of the body and into the water, keeping a healthy balance inside the fish. Except, Mr. Whoriskey believes, in fish tainted by pollutants. A few months after reaching salt water, 'they all roll over and die at the same time.' The working theory says this may be triggered by the damaged hormones that regulate the change from freshwater fish to sea creature. As for the dead fish, they never show up as a cluster of dead bodies the way sudden fish kills in a river does. Gulls eat them, as do predators in the sea, and humans only find out in later years when they stand on the shore of a river during a spawning run and wonder where all the salmon are. 'Some of these rivers have decent young fish numbers,' says Mr. Fairchild. 'What they don't have is good numbers (of adult fish) coming back.'

New concerns over salmon virus disease seen in fish from 4 Maine rivers

Boston Globe, 23 May 1999

The mysterious virus that killed Atlantic salmon at a Massachusetts fish hatchery last winter has been detected in fish from three more Maine rivers, prompting a multi-state scientific effort to understand the disease before it threatens the tiny population of one of the Northeast's premier sport fish. None of the six salmon whose blood tested positive for the virus this month showed signs of the tumors that killed salmon at the North Attleborough federal hatchery. However, biologists were concerned to find the virus at all: it has now been detected in four of the seven Maine rivers that are the focus of efforts to restore salmon runs decimated by dams and pollution. Despite the unsettling findings, state officials began releasing 2.3 million salmon fry into the rivers this month to boost populations. Biologists said the young fish would have died in captivity anyway because hatcheries lack facilities to raise salmon to adulthood. The virus "is certainly a cause for concern," said Donald Hoenig, a Maine Department of Agriculture veterinarian who chairs the state fish health technical committee. "Whether we should be alarmed at this point, I would hold off on that."

However, state and federal officials are taking no chances. They are sending fish to a US Fish and Wildlife lab in West Virginia for analysis and are holding for research 500 to 1,000 salmon fry whose parents came from rivers where the virus has been detected. Meanwhile, researchers at Cornell University are studying the virus, and they have already developed an early detection test. Biologists hope that the so-called swim bladder sarcoma virus has always been present at low levels in the Atlantic salmon population, and they have only recently noticed it. They theorize that the outbreak at the North Attleborough hatchery, which killed 82 of 276 salmon in one group, was triggered by stress not normally found in the wild. But some observers fear the virus is a new invader, perhaps imported by aquaculture facilities that raise salmon in pens on the coast. Hoenig said aquaculture is an unlikely suspect since the virus has not been detected among the pen-raised fish. Still, researchers have frustratingly little evidence since the virus is newly discovered and there are few similar documented outbreaks among fish. Maine's effort to rebuild its salmon stock centers on hatcheries, where fish are segregated according to the river their parents came from. That way, each of the seven eastern Maine rivers in the program gets a genetically separate population that returns each year to spawn. After the outbreak at North Attleborough last year, state officials had to quarantine a second hatchery that raised fish from the same Maine river, the Pleasant. Two of 150 salmon tested positive for the virus, and all the fish were destroyed. Before releasing this year's fry, officials at the US Fish and Wildlife Service hatchery in East Orland used the Cornell blood test to determine if the virus was present. To their disappointment, they found a small number of fish from the Narraguagus, Machias, and East Machias rivers all carried the virus, though they showed no signs of illness. John Coll, regional chief of fish health at the US Fish and Wildlife Service in Pennsylvania, said he was encouraged that only three adults out of more than 150 tested carried the virus, along with another three juveniles, called smolts. However, he avoided drawing conclusions.

Warmer oceans could kill off salmon: report demands action

The Herald, 9 June 1999

Global climate change is pushing salmon populations around Scotland's coast and other sealife towards extinction, a report published yesterday claimed. The World Wide Fund for Nature (WWF), which released the paper to coincide with World Oceans Day, called for urgent action to tackle the problem. The report, *The Oceans in Peril*, said rising temperatures were disrupting marine life around the world. It said sea temperatures around the UK had reached their historic upper limit and predicted that a surface increase of only 1°C could lead to a mass northern migration of British marine species of between 200 and 400 miles. That could lead to the loss of many commercial fish species such as haddock, cod, plaice, and lemon sole, and cause further damage to North Atlantic salmon populations. Bird species dependent upon the marine environment, such as the black guillemot, the little auk, and the fulmar, might also be forced out of their British range. Other species affected would range from tiny plankton, which formed the basis of the food chain, through to polar bears, walruses, seals, sea lions, and coral reefs, the report said. It added that rising sea temperatures were already leading to more frequent sightings of species such as hammerhead sharks, triggerfish, and sun fish, and an increase in catches of rarer southern fish, such as red mullet, black bream, and cuttlefish in UK waters. Japanese oysters have also started to breed in British waters, threatening to push out the UK oyster in the future, the report said. The report concluded that global warming could be the 'knock-out punch' for many species which are already under stress from over-fishing, pollution, and habitat loss. WWF Scotland senior policy officer Elizabeth Leighton said: 'There is growing evidence that the continuing decline of North Atlantic salmon, with catches down 77% since the 1950s, can be partly related to climate change. We should act now to minimise damage and take precautions.' The WWF added that marine life was also a vital source of food and medicines, and provided livelihoods for millions of people around the globe through tourism and fishing. The wildlife group said that, following government talks in Bonn, Germany, not enough was being done to cut greenhouse gases, such as carbon dioxide from fossil fuels. A Scottish Office report published last year said temperatures in Scotland could have risen by as much as 2.6°C by 2080, with sea levels rising by up to 69cm. A spokesman said yesterday that work was being conducted on the correlation between sea temperatures and salmon populations, which has been acknowledged by Ministers.

DFO - Canada secures continued commitment to conservation at NASCO

Canadian Corporate News, 11 June 1999

Canada continued to promote a "conservation first" approach to Atlantic salmon management at the 16th annual meeting of the North Atlantic Salmon Conservation Organization (NASCO), which wrapped up today in Westport, Ireland. The Minister of Fisheries and Oceans, David Anderson, expressed satisfaction with the adoption of a precautionary plan giving long-term protection to wild salmon, the first by an international fisheries management Commission. He noted the Canada has been a proponent of the Precautionary Approach at both domestic and international levels and participated actively in the development of the NASCO plan. "I am gratified that our conservation message is not only being heard, but is now being translated into practice as well," said Mr. Anderson. At NASCO, Canada gave an overview of its 1999 Atlantic Salmon Management Plan, which is based on the Precautionary Approach, and is consistent with the advice from the International Council for the Exploration of the Sea (ICES) that Atlantic salmon fisheries - except those in-river fisheries where stocks of both grilse and large salmon are above conservation requirements - should be closed. "Salmon stocks are still in critical condition throughout the Northwest Atlantic. International cooperation on conservation measures is the key to rebuilding these stocks for the future,"

Minister Anderson noted. A conservation highlight of the NASCO meeting was a multi-year agreement on a regulatory measure that will restrict West Greenland's fishery for the next two years to a subsistence level that, in the past, has been estimated at 20 tonnes. "This is an excellent example of complementary international action in salmon management," stated Minister Anderson. "Greenland must be commended for its conservation-minded actions." He also pointed out that this decision followed similar actions taken by Canada to extend the closure of the commercial fishery. Canada took the opportunity to call on the European Union to discontinue its mixed stock driftnet fisheries and join in sharing the conservation burden to save the salmon. Aquaculture was also on the NASCO agenda. Canada and Norway made a joint presentation on the framework regulating the activities of the aquaculture industry in their respective countries. Canada promoted the establishment of a North Atlantic NASCO-Aquaculture Liaison Group aimed at facilitating exchanges between wild and salmon aquaculture interests and dedicated to specific initiatives, such as the development of a code of physical containment. "While the protection of wild stocks is paramount, the aquaculture industry must continue to develop in an environmentally sustainable manner," Minister Anderson concluded. NASCO 2000 is scheduled to take place in Miramichi, New Brunswick, the first time a NASCO meeting is being held in Canada.

Wintering salmon safe from commercial fishing: Decision limits catch of fish off Greenland

The Ottawa Citizen, 12 June 1999

There will be no commercial fishing for Atlantic salmon in their crucial wintering grounds near Greenland, a decision that has Canadian salmon lovers and conservationists cheering. Greenlanders have agreed to limit their fishery to a 'subsistence' catch for their own use during the next two winters, with no exports. That will still allow them to catch up to 7,000 salmon (20 tonnes), but in fact the actual subsistence catch may only be about half that much, said Bill Taylor, President of the Atlantic Salmon Federation. This quota continues a trend of limiting, but not eliminating, salmon catches near Greenland. Mr. Taylor says it will buy time to explore long term solutions to the problem of declining numbers. The decision came yesterday in Ireland after a week's meetings between Canada, US and northern European countries that share the world's Atlantic salmon rivers. Fish from both continents swim out to sea and spend their winters in the North Atlantic, returning to their birth streams as adults to spawn. Most of the fish that winter off Greenland come from North America. Atlantic salmon numbers have been terribly hard hit; a widely accepted estimate is that only about four per cent of the original salmon population remains today, and many spawning streams have no fish at all. These losses have accelerated in the past couple of decades. Twenty years ago there were an estimated 800,000 mature fish spawning in Canada, while today the figure is only 80,000. The salmon federation says 201,000 adults is the bare minimum for a population to sustain itself in the long run. 'We're quite pleased' at the decision not to allow commercial fishing off Greenland, Mr. Taylor said. 'It took us all week to hammer this out.' His organization represents conservationists in Canada and the United States. It has campaigned for strict limits on salmon fishing at sea, for catch-and-release fishing in rivers, and for protection against farmed salmon that can escape and carry disease. The fact that the commercial ban is a two-year deal also pleases him. Previous quotas have been established for just one year at a time. This week's talks at the North Atlantic Salmon Conservation Organization ended in a second significant deal: more research to see what measures will best protect the wild fish. Canada, the US, Denmark and the federation have agreed to collaborate on 'a comprehensive scientific management program.' This will include DNA testing to trace individual groups of the salmon. 'If there are stocks at risk maybe we can figure out some way to avoid having them harvested there,' Mr. Taylor said. The deal does not include one element the conservationists wanted: a 'sanctuary' with no fishing at all off the western coast of Greenland. But Mr. Taylor says he's content to settle for the subsistence fishery as long as commercial fishing is banned there. Commercial fishing will still continue in areas of the Atlantic farther east, where the fish are of European origin. European salmon numbers have not been as badly reduced, though the salmon federation argues more conservation measures are needed there as well. Meanwhile in Canada, research will continue this year on a second front. Young salmon that swim out to sea from their native rivers appear to be dying in unnaturally high numbers. Scientists suspect pollutants may be sabotaging the hormone systems that let the fish adapt from fresh water to salt water.

Farmed fish decimate wild salmon: Some wild species are close to extinction in New Brunswick rivers, report says

The Toronto Star, 25 June, 1999

Fish farms in the Bay of Fundy are destroying wild salmon stocks in local rivers, aggravating a crisis that has seen catastrophic declines in the salmon run over two years, according to new research. Two new reports show that escaped farm fish have taken over some New Brunswick rivers, edging out wild species that have a better chance of long term survival. Some rivers near the massive fish farms no longer have any salmon at all. 'Wild salmon populations in regions where salmon aquaculture is being heavily practised are now faced with potential extinction,' reads an Atlantic Salmon Federation report. Two years ago, West Coast researchers discovered that Atlantic salmon had escaped from seaside cages and bred with local salmon, raising the possibility that the farmed fish would eradicate local species in British Columbia. But it is only recently that researchers have realized the same thing is happening on this coast - in larger numbers. Reports by the Atlantic Salmon Federation and the Department of Fisheries and Oceans show alarming contamination of local rivers with salmon that was bred for cages. Almost 90 per cent of the salmon found in

New Brunswick's Magaguadavic River last spring had escaped from nearby cages. Researchers could find only 31 wild salmon in the river last year, down from 292 wild salmon in 1992 and more than 1,000 in the 1980s. Researchers could find only two salmon - both wild - in surveys of four other nearby rivers. Salmon stocks along the entire East Coast have collapsed in the past two years, but the problem is worst in areas closest to the massive aquaculture farms that grow salmon in cages for the market. 'Wild fish are teetering on the brink of extinction' in more than 30 rivers that empty into the Bay of Fundy, according to the federation report. In the 1980s, 800,000 Atlantic salmon returned to East Coast rivers each spring. This year, researchers believe that 80,000 - or only 10 per cent of the earlier run - will return. 'The recognition of a crisis has only come in the last year and a half,' said Fred Whoriskey, Vice-President of research for the Atlantic Salmon Federation. He said escaped farm salmon were clearly part of the problem. 'Farm salmon are bred to be fat, dumb and happy,' he said. 'In the wild, you want a fish that is lean, mean and able to evade predators.' Whoriskey said farm salmon edged out wild salmon in the river because they grew faster, but when they got to the ocean, they were too slow to compete for food or evade predators. Compared to wild salmon, only one-tenth as many escaped farm salmon survived the round-trip journey to the sea, he said. 'They are big lummoxes that edge out the wild salmon in the river,' he said. 'Maybe that would be fine if they came back from the sea, but they don't. It's a downward spiral.' Aquaculture is big business in the Bay of Fundy, the most important industry in southwestern New Brunswick, pumping \$130 million a year into the local economy. The industry has boomed in the past two decades, growing from a single experiment in 1979 to a network of companies that tend almost 6 million fish at any one time along the southern shore of the province. Officials with the New Brunswick Salmon Growers' Association did not return calls yesterday from The Star. A recent federal report suggested new regulations for the industry to help protect wild salmon stocks, including better cages and sterilizing any fish that might escape. The Atlantic Salmon Federation is a non-profit group dedicated to protecting Atlantic salmon stocks. Whoriskey said his group did not want to kill the aquaculture industry. He said the industry helped conserve wild stocks by undercutting the price of salmon fished from the sea. The industry also had the breeding expertise that would be needed to restore wild salmon in rivers. But he said it was increasingly clear that the industry that was once hailed as the salmon's saviour was now contributing to its demise.

'Monster' Salmon grown in secret tests

The Guardian, 29 July 1999

Scientists have carried secret research into genetically modified salmon, the government admitted last night. Atlantic salmon grew at four times their normal rate during research into GM fish but all were destroyed when the project was terminated. John Reid, Scottish Secretary, revealed details of the experiments in a reply to London MP Joan Ruddock this week. She had tabled a private member's question asking the Government to answer 'persistent rumours' about the research at a salmon farm. Dr Reid said the work was carried out three years ago at Otter Ferry Salmon near Loch Fyne in Argyll. 'Copies of a growth hormone gene taken from Chinook salmon were introduced into 10,000 Atlantic salmon eggs,' he said. 'The fish were grown in a land-based containment facility for up to one year. Approximately 50 of the fish grew at four times the normal rate, with no sign of abnormalities.' The fish farming industry is known to be looking at improving yields in salmon. The 'transgenic' salmon grown in the secret tests proved that fish can grow to market size in 12 to 18 months rather than three years. That could double the turnover of salmon raised in tanks and potentially double the profit. Ms Ruddock said: 'The results were obviously what they were looking for. If you can cut the costs of production and get the fish to market faster, you can maximise profits. That's obviously the route that many companies are trying to go down.' She added: 'I will be asking lots more questions about these matters when parliament resumes.' The revelations are certain to provoke a furious reaction from anti-GM campaigners, who have accused ministers of covering up the scale of experiments into the new biotech industry.

Tests on GM fish 'could lead to disaster'

Scotsman, 29 July 1999

Environmental campaigners today warned of a potential disaster if gene testing on animals continued. The warning comes as the Government revealed the existence of secret tests on fish in Scotland. Scottish Secretary John Reid said the Government gave permission for the gene trials to go ahead in tanks near Loch Fyne, Argyll. The genetically modified fish were found to grow up to four times as quickly as normal. Mr Reid said: 'Copies of a growth hormone from Chinook salmon were introduced into 10,000 Atlantic salmon eggs. The fish were grown in a land-based containment facility for up to one year.' The fish were destroyed after the tests were completed three years ago. Today, Friends of the Earth Scotland warned of a potential environmental disaster if such trials were continued. A spokesman said: 'Fish are always escaping from these places and the prospect of genetically modified fish free to breed with other fish is a real worry.' Greenpeace Executive Director Lord Melchett today said he had no regrets about his arrest for taking part in the destruction of a field of genetically modified maize. The former Government Minister, who walked free from Norwich Prison last night, said he believed a lot of people supported his action in trying to stop 'a very serious threat to the environment.' Lord Melchett spent a night in jail after 28 Greenpeace activists were arrested following the incident on Monday.

GM fish research deplored

Yorkshire Post, 30 July 1999

Britain's sole Green parliamentarian yesterday warned of an 'environmental nightmare' after details of secret research into so-called 'Frankenfish' were revealed. Robin Harper, a Green Member of the Scottish Parliament, demanded a full list of all experiments involving genetic modification being carried out by the Government and urged a ban on any further ones. He said he was horrified at learning genetically modified salmon - which grew at four times the normal rate - were reared in Scotland. Scottish Secretary John Reid revealed details of the experiments in a Commons reply to London MP Joan Ruddock but denied they were secret. Dr Reid said the work was carried out three years ago at Otter Ferry Salmon near Loch Fyne in Argyll. The fish were all destroyed after the experiment. He said: 'Copies of a growth hormone gene taken from Chinook salmon were introduced into 10,000 Atlantic salmon eggs. The fish were grown in a land-based containment facility for up to one year. Approximately 50 of the fish grew at four times the normal rate, with no sign of abnormalities.'

GM 'superfish' face ban in British waters

The Daily Telegraph, 9 August 1999

Genetically modified fish being developed for commercial production in America and China would dominate and replace natural strains within a few generations if they were released into the wild, scientists have found. The results of two studies led English Nature, the Government's conservation advisers, to issue a warning yesterday that it would oppose the release of GM fish in Britain unless they were made infertile. The discovery of how to transfer growth promoter genes from other species, even humans, has led to a number of research projects into the potential for making fish farming more efficient. Salmon, carp and tilapia are the main species being studied and it has been found that injecting a gene into salmon eggs can make them grow at up to 50 times the rate in the wild. But many, including a House of Lords Select Committee which called for a treaty to ban the release of GM fish, are concerned about the effect of unintended release on wild populations. A study at Purdue University, West Lafayette, Indiana, has found that GM, or transgenic, males are likely to have a fourfold advantage in breeding because larger fish are preferred as mates by females. The study, which looked at the effects of Atlantic salmon and chicken growth promoter genes on the Japanese medaka, a non-commercial fish, also found that the transgenic progeny were 22 per cent larger on average than their non-transgenic siblings. Researchers looked at the result of natural body size variation on the medaka's breeding success, from which they estimated the differences likely to occur in the wild between wild and transgenic males. Results showed that large males obtained 80 per cent of the matings, against 20 per cent obtained by small males. The researchers concluded that an initially rare introduced gene could spread quickly in a population of fish. The number of transgenic males in a population might start out at one in 100,000, but it would become 50 per cent of the population within 16 generations. If the number of transgenic fish was one in 1,000, half the population would be transgenic within 11 generations. Another study of concern to English Nature was carried out into Channel catfish given salmon growth promoter genes by researchers from Auburn University, Alabama, and Stanford University, California. This showed that some transgenic fish were better at avoiding predators than their natural counterparts. They concluded that family differences between strains of catfish were responsible. If genes were transferred into families with superior abilities at avoiding predators, then the "superfish" could proliferate in the wild population and change the balance of nature by out-competing other species. Brian Johnson, genetics adviser to English Nature, said: "If you make fish bigger, they will mate preferentially with wild stocks. If bigger fish are more successful in breeding, then transgenic fish would spread very successfully throughout the wild population. We would say that if transgenic fish are to be developed, we should expect the industry to ensure that they were infertile and that this sterility could not be reversed. We would also prefer to see contained farming and not sea farming of GM fish." In Britain all experiments on GM fish were halted after an experiment on salmon in tanks beside Loch Fyne, Argyll, caused alarm that rules on containment were not strict enough. English Nature is not aware of anywhere in the world where GM fish have been released into the environment or are farmed where they could escape. It says that China appears to have a much stronger ethical code than America on genetic engineering, believing that it is only ethical to use fish genes in fish rather than genes from other animals, including humans. English Nature points out that genetic pollution has occurred already in classically bred fish. The escape of fish from Scottish fish farms in bad weather or because of vandalism has already changed salmon stocks, not necessarily for the better. Salmon and trout are known to have evolved distinct genetic strains specific to the river where they are found. These strains contain the genes likely to be the most successful at surviving in that environment. Some conservationists believe that the escape of farmed fish hybridised with heavier and more docile Norwegian salmon may have had an effect on their ability to survive in small, steep west coast rivers and be a factor in the wild salmon's decline.

Tweed misses out on conservation status

The Scotsman, 9 August 1999

The Government has ignored its own scientific advisers and refused to nominate the River Tweed as one of the most important conservation areas in the country. Scottish Natural Heritage and English Nature - the agencies charged with protecting the countryside north and south of the Border - both believe that the internationally-renowned salmon river needs to be given the highest protection under European law. But Ministers have decided it should not be nominated as

and accused the Government of riding roughshod over its European commitments to preserve wildlife. Under the European Commission's Habitats Directive, the UK Government is obliged to nominate scientifically important areas as SACs, or Special Protection Areas, the equivalent for areas supporting important bird populations. SNH was asked, as usual, by the Scottish Office (pre-devolution) for its recommendations on the Tweed and concluded that the river is important for three reasons - as a breeding ground for Atlantic salmon, a habitat for otter and a location for a rare type of floating vegetation. A copy of the agency's advice states: "It is clearly a very important river system as these three interests imply that the Tweed is scientifically important; indeed from a scientific perspective, it is one of the most important river systems in the UK." SNH said it could not comment on the decision not to accept this advice. Since the Tweed forms what would have been a cross-border SAC, English Nature was similarly asked by the Department of Environment, Transport and the Regions for its advice. This was compiled by the Joint Nature Conservation Committee, the co-ordinating body for all UK conservation agencies. A spokesman for the JNCC said: "SAC status for the Tweed was supported by SNH and English Nature and we did propose that the Tweed should be an SAC. That is still our position. The Government can take other scientific advice and in this case that is what it has done and it is under no obligation to accept ours." The DETR deferred to the Scottish Office because most of the proposed SAC would have been in Scotland. Last month, Calum MacDonald, then a Scottish Office Minister, revealed its decision in parliamentary answers to questions from Michael Moore and Alan Beith, Liberal Democrat MPs whose constituencies cover the Tweed. Mr MacDonald said: "It is for the Government to decide what sites should be proposed to the European Commission as candidate SACs. The Government decided, in the light of their own appraisal of the scientific case for this site, that the River Tweed should not be proposed as a candidate SAC." He went on to say that the Tweed was not an "outstanding" case because of the relatively poor state of the spawning salmon stock, modification of the river bank by man and discharges into the river environment. Martin Mathers, a policy officer for the World Wide Fund for Nature in Scotland, said: "This is absolutely scandalous. The criteria under the Habitat's Directive clearly says the site does not have to be pristine to qualify as an SAC. The Tweed is now going to lose out on future European funding which would have helped the efforts by a number of organisations, including ourselves, to improve the natural habitat for Atlantic salmon." Matt Phillips, of Friends of the Earth in England, said: "What we are concerned about is that the Scottish Office has been prepared to completely undermine and marginalise SNH - its own scientific adviser. It is clear that the idea of wildlife designation in Scotland is still seen as a bad thing instead of a benefit which can aid sustainable development. What does this say about the prospects of cross-Border co-operation on these issues post-devolution?" Mr Phillips warned that the European Commission could take action against the whole of the UK if it felt the Government was not implementing the Habitats Directive properly. "More than £18 billion in development aid is being withheld from Germany because of its failure to comply with European environment law", he said. A spokesman for the Scottish Executive said: "The government has access to other scientific experts including its own freshwater fishery laboratories. In view of all the advice we received, including that of Scottish Natural Heritage, it was decided that the Tweed should not be designated a Special Area of Conservation." Implementation of the Habitats Directive in Scotland is now a matter for the Scottish Parliament.

Massachusetts firm draws criticism for genetic engineering of fish – A/F Protein is on the cutting edge of producing genetically-engineered fish

Boston Globe, 23 August 1999

The Massachusetts-based company, A/F Protein, is gearing up for large-scale production of fast-growing trout and Atlantic salmon. Worldwide, researchers have found the genetic keys to rapid growth in at least 11 commercially valuable fish species, including shrimp growing at the University of Connecticut. But, before the first genetically altered smoked salmon hit the market, the fledgling industry is caught in the rising controversy over genetic tinkering with the food supply. Critics warn that the lab-created fish could escape and damage wild fish stocks, while consumers worry that genetically altered food of all kinds may not be healthy or tasty. Controversy over genetically modified food, including attacks on crops in Europe, is taking a toll. New England salmon farmers, growers of the region's third most valuable seafood, have shown little interest in genetically altered salmon, fearing that they, too, could be drawn into the backlash. Meanwhile, genetic engineering of fish faces a steady stream of criticism ranging from groups such as Greenpeace that oppose it to developing nations that fear the technology will help the industrialized world at the expense of the poor. Several observers fear that the new fish could cause allergic reactions or other unexpected side effects for consumers that regulators such as the US Food and Drug Administration could easily miss. Neither US nor Canadian regulators have raised concerns about the safety of the new fish so far. Canadian government-funded studies of the genetically altered salmon have found that they appear, swim, and behave like ordinary salmon, except that they eat and breathe a lot more. Still, A/F Protein officials are trying to ease public edginess by promising to label genetically altered products and using only fish genes in their research rather than the mouse and bacteria genes that some have used. In addition, they expect the FDA to insist on conditions to prevent the fish from escaping, such as enclosed tanks or fish that cannot reproduce.

Home news: conservationists challenge list of designated wildlife sites

Irish Times, 2 September 1999

Far too few vulnerable Irish habitats are being designated by the Government as special areas of conservation (SACs), leading conservation and wildlife groups have claimed. They are submitting a list of an additional 201 sites needing special protection to the European Commission under its controversial SAC designation scheme. The group is particularly concerned about a failure to protect wild Atlantic salmon habitats and important otter sites, but also many bog and sand dune complexes. The group comprises Coastwatch Europe, the Irish Peatland Conservation Council (IPCC), the Irish Wildlife Trust, An Taisce and Birdwatch Ireland. 'We find that not only is the coverage of many habitats inadequate to date, but specific critical species listed in the EU Directive (on SACs) have been entirely ignored,' they said in a statement. The non-governmental organisations have recommended to the Minister for Arts, Heritage, Gaeltacht and the Islands, Ms de Valera, the designation of 46 sites to protect the otter and 22 sites for the salmon. All are omitted from the Irish SAC list to date. The recommendations follow moves by the Commission to bring the Government to court over its failure to designate SACs within legally ratified dates. The World Wide Fund for Nature (WWF) has also been alerted about the concerns. Some of Europe's most prominent wildlife scientists and conservation experts are to visit Ireland next week. Under the Commission's Natura 2000 initiative, they are to assess the extent of SACs designated across Europe, and specifically in Ireland, at a meeting in Kilkee, Co Clare. To coincide with this the five Irish NGOs have issued an interim draft of a joint study on SAC designation in Ireland funded by the Heritage Council. The study, which outlines details of the further 201 sites (mainly along the western seaboard), is due to be published in December. The group hopes it will result in 'better balance and more complete adherence to the obligations of the European legislation'. Mr Tony Lowes of An Taisce said: 'We have an obligation under the directive to list the sites of these priority species (salmon and otter) regardless of national legislation.' If a much greater number were not designated as SACs, it would lead to a grave shortfall in protection of both habitats and wildlife. 'But there is still time to correct it,' he said. National designation - rather than European control facilitated by SACs - Mr Lowes added, would not offer the same degree of protection or recourse if things started to go wrong; for example in the event of damage to a salmon river as a consequence of intensive agriculture. A spokesman for the Minister said she would not comment in advance of the Natura 2000 meeting when officials of Duchas, the heritage arm of her Department, would outline their reasoning on SAC designation. Ms de Valera had always facilitated a full and open debate on the issue, he added. In reply to a Dail question, she indicated willingness to include additional sites after the final list was completed if shown to be necessary. Appeal hearings on disputed SAC designations are being expedited. Delays in the process have prevented the Government completing its SAC list. When appellants realised they could appeal SAC designations only on scientific grounds, the number of appeals, it is understood, was reduced from about 260 to some 90, of which an estimated 36 will require determination by the SAC advisory appeals board. This body has also been provided with additional resources to complete its work.

Frankenfish wiping out wild salmon

The Mail On Sunday, 19 September 1999

Strains of farm-bred fish developed to grow fat quickly are threatening to drive Britain's majestic wild salmon into extinction. Millions of modified fish have escaped into the Atlantic from offshore farms in Europe and America. And the new strains are mating with wild salmon, polluting their gene pool - and producing hybrids that can't survive in the open ocean. Don Staniford, of the Scottish office of Friends of the Earth, said yesterday: 'Wild salmon are nearly extinct in a number of Scottish regions and rivers where they used to be plentiful. There's certainly a link between the decline of our wild salmon and the escape of these farm-bred fish. It's genetic pollution.' Sue Scott, of the Atlantic Salmon Federation in New Brunswick, Canada, added: 'The farm fish are bred to be fat and lazy. Their genes have been manipulated by cross-breeding to produce a fish that grows quickly. They are kept in huge pens in the open ocean off the coast of New Brunswick and the coast of Maine in the States. And over the last few years millions of them have escaped into the Atlantic. Wild salmon are muscular and built to make a long voyage into the ocean and back. But over the longer term the farm fish can't survive in the ocean and neither can the offspring of wild salmon and farm fish. The resulting fish can't make the rigorous migration - and that's one of the reasons the wild salmon are being wiped out.' Selective breeding with salmon strains from all over the world means that farm fish are much bigger than their wild cousins. 'In fact, they're so big they look like footballs,' said federation President Bill Taylor. And scientists believe the female wild salmon choose the bigger males for mating. Miss Scott blamed unrestrained commercialism, saying: 'The problem is that governments have let the salmon farming industry grow without regulation.' In the US, two major environmental groups - Defenders of Wildlife and Trout Unlimited - are suing the Federal Government in an effort to force them to put Atlantic salmon on the endangered species list. The government would then have to protect the wild salmon and drop some of the support it gives the salmon farming industry. Scottish Secretary John Reid has admitted that experiments on genetically modified salmon have been conducted in secret in Scotland. But he said in July that all the fish in the trial had been destroyed.

Top River Tay salmon beat on market at £2 million despite declining stock fears

The Scotsman, 21 September 1999

One of Scotland's prized salmon beats has been put on the market for the first time in more than half a century, at an asking price of £2 million. Stobhall Fishings on the River Tay is known to anglers as among the most productive fishing stretches in the country, but anyone tempted into purchasing the fishing rights will be limited to just one bank of the river. The price means that the average cost of hooking a salmon would amount to £5,000 per fish. However, over the past century, five salmon weighing more than 50lb have been hooked from the stretch of the river, near Perth. The beat has been put on the market by the 100-year-old Tay Salmon Fisheries Company, which operated netting stations on the river until 1997. The selling agent, CKD Finlayson Hughes, expect the 1.9 mile stretch to be divided up and sold as individual timeshares. A total of 15 weeks of the angling season are available on the river's left bank, from 1 July until the end of the season in mid-October. Robert Rattray, of CKD Finlayson Hughes, said that in the past up to 12,000 salmon would have been caught in the company's netting stations along the river. He said: "These fish are now free to run up the river unhindered and this gives rise to greater optimism for the future. The river, with a catchment of 2,800 square miles, is wide and fast flowing at Stobhall. Anglers normally use one of the four boats which are operated by the two experienced ghillies who service that stretch of the river." The beat, near the village of Stanley, has produced an average of just under 400 salmon a year during the period on offer. As well as the giant fish which have been landed, salmon weighing more than 20lb are regularly hooked. Although only the left bank rights are for sale, there is an agreement with the proprietors of the right bank to allow fishing from both banks on alternative dates. On top of the price paid to buy the beat, the new owners will have to pay a management charge to maintain banks and huts. However, only last week a neighbouring beat went on the market for £220,000, which was described as a "bargain". A syndicate had paid £350,000 for the two-week spring and autumn stretch at Ballathie just two years ago. One observer of the salmon angling industry in Scotland warned that the steady decline in salmon stocks had made beats such as Stobhall less attractive to potential buyers than they once were. Colonel Robert Campbell, a board member of the North Atlantic Salmon Fund UK, said any move to split the beats for timeshare purposes would also make the river more difficult to manage for conservation purposes. He said: "I would say the market is depressed at the moment. The trouble is there has been a very serious decline in the numbers of fish caught. I would think there are unlikely to be a lot of people after this sale, because none of the indications are particularly rosy at the moment." Andrew Dingwall-Fordyce, of the Scottish Landowners' Federation, said that proposed legislation to overhaul Scotland's ancient land laws did not appear to be deterring those keen on buying fishing and shooting interests. He said: "It seems that people with money to spend are still prepared to buy, and there is still a demand for estates with diverse interests."

Deesiders fight to offset salmon decline

Aberdeen Press & Journal, 25 September 1999

Tourism in Deeside is set to benefit from a major initiative to reverse the steep decline in salmon stocks. The move comes amid fears that the fall in salmon numbers threatens the survival of the tourism industry throughout the royal glens. Nearly 200,000 fry have been released into the Dee's tributaries in a bid to boost the multi-million-pound industry. Fisheries experts and tourism chiefs yesterday praised the scheme. But fears were expressed that the £50,000-a-year hatchery the fry were released from last month could prove too expensive, with no obvious return until after the first five-year life cycle. The hatchery, built at an old waterworks on the river, was created last year by the Middle Dee Project (MDP). The MDP is a 150-strong independent group of fishery owners, ghillies and tenant fishermen set up to arrest the decline in salmon stocks in the river between Kincardine O'Neil and Banchory. A recent survey commissioned by Grampian Enterprise revealed a 65% fall in the annual salmon catch in the Dee since the early 90s. Some fishery owners have suffered a five-fold cut in their seasonal rents from around 30 weeks to six in the past few years. The effect on the local economy, which benefits from fishers to the tune of around £3million a year, has been drastic. Marion Montgomery, tourism executive with Grampian Enterprise, which helped fund the hatchery, said the decline in stocks had to be quickly reversed to prevent falling rents, fewer jobs and less money in the economy. She said: "The middle stretch of the Dee is home to more than a third of the rod beats on the River Dee and in 1997 attracted 913 visitors, 610 of whom came from outwith Grampian. With the aggregate income from a rod beat estimated at £16,800, this equates to £475,000 generated by the middle Dee beats and £1.6million by the total Dee beats per year. "Fishers are traditionally very high spenders and to this must be added the expenditure on accommodation, food and beverages, entertainment etc, bringing the total revenue to the area to around £3million." Anglers yesterday voiced their delight at the early success of the hatchery. The mortality rate for the first batch of eggs was 2.6% - well below the average of 7.8%. Michael Wrightson, who is on the MDP committee, said: "We got very good results with below-average mortality." The MDP is also working to improve the natural habitat of the Cattie, Beltie and Birse tributaries, vital to a salmon's chances of survival. MDP treasurer Robert Strang Steel said: "This has included the removal of blockages, clearing silt from the burn beds and erecting fences to stop livestock and deer disturbing the river banks. The hatchery is to give the natural production of salmon a kick-start and the group hopes that within 10 years it may be redundant due to natural breeding in the improved streams." It is hoped the scheme will spread to other parts of Grampian if successful. Beverley Tricker, spokeswoman for Grampian Tourist Board, backed the initiative to encourage free-spending anglers back to Deeside. "We have been told by hoteliers that their numbers have been dropping so any initiative that tries to replenish salmon stocks is to be welcomed." While welcoming the

hatchery, some fisheries experts feared it could prove too expensive. Jeremy Read, Director of the Atlantic Salmon Trust, said: "I support anything that's done to tackle the major concerns that we do have about salmon decline, particularly in the Dee. But I think one has to approach hatchery work very carefully. It can be a very expensive way to boost stocks. One of the problems is that we don't know how many fish are going to come back." He said the return rate was likely to be less than 5%. Robert Fettes, river manager for the Dee Salmon Fishery Board, said: "We would encourage the use of a hatchery provided it follows good management practices." The MDP hopes to raise £12,000 from a raffle at its annual meeting on October 1. First prize is a week's salmon fishing on the River Yokanga in Russia, worth £6,000.

Fishing: Why I will not allow myself to eat salmon again

The Independent, 25 September 1999

Last year I wrote about salmon, my most favourite fish of all (living, not dead). I said that it was facing extinction and that I would not eat salmon, wild or farmed, ever again unless I had caught it on a rod and line myself and it had had a fair fight. Since then, I have refined this to not killing one ever, unless it was so badly injured that returning it to the water would be crueller than priesting it, ergo I will never eat salmon again. Most of us see salmon on the supermarket shelves. This is farmed salmon and it bears almost no relation to its wild cousin. Farmed salmon are kept, hundreds, thousands to a cage, and stuffed full of antibiotics to keep them from getting diseased. They can hardly move; their tails, which should be magnificent, powerful and fan-like are stumpy and nibbled (in boredom, fish do terrible things to each other). Whereas a wild salmon will be (should you ever be lucky enough to see one) torpedo-shaped and with fighter genes - the weak ones would long ago have been dealt with by nature - a farmed salmon will be flabby, almost balloon-shaped and with any old pissy genes you like. Because these cages are kept in the sea, off our coastlines, as the wild salmon go past, the sea lice and other parasites that infest the cages think "yippee, new flesh" and attack the wild fish who, because they are not stuffed full of drugs, suffer badly from this barrage, if they survive at all. One particularly lovely parasite is called *Gyrodactylus salaris* and it covers the salmon, eating it dead. (Sea lice and parasites are an accepted part of sea life, the problem is that the cages concentrate them and act as a breeding ground.) And sometimes these cages break open and the fat, pale salmon get out and breed with the wild fish, thereby introducing their weak genes into the chain. Why salmon are facing extinction is due to many things, some of them known, some not. Commercial netting - where this is still allowed - pollution, bank erosion that destroys their breeding ground (the place where they were also born and to where they return), environmental changes, genetic weakening by breeding with farmed salmon, and something else. Something happens at sea, where they go to feed for a year or three, and we don't know what. "Something terrible is happening in the ocean," says Bill Taylor of the Atlantic Salmon Federation. This year, our government imposed various netting/rod and line restrictions which were the subject of another column. In Maine, in north-east America, the wild Atlantic salmon may be proposed for listing under the Endangered Species Act. Once 500,000 salmon returned to the New England rivers, last year just 60 to 120 found their way back to the rivers in Maine, which is a decline of 99.9 per cent (and it is not due to the salmon's navigation system, which is excellent). If relative figures were applied to something cuddly like pandas or tigers there would be an outcry and once-attractive French actresses would hold press conferences. But we are talking about fish, cold-blooded, slimey creatures that will never grace a chocolate box. You could try to argue here that, by being a fisherman, I am not helping their plight. But you would be wrong. That I know any of this is because I am a fisherman. Fishermen notice when river banks have been eroded by cattle or sheep, thus making the river too shallow and silty for the salmon to breed in. Fishermen much older and wiser than I first noticed that something was very wrong when they saw the numbers of salmon returning to spawn decrease alarmingly. I spend very much more time learning about salmon and helping their plight than I do fishing for them or eating them. They are, anyway, notoriously difficult to catch.

Something pharmaceutically fishy down on the farm

The Scotsman, 6 October 1999

They began harvesting the fish a week ago, fully-grown salmon, glinting and silvery and impressively large. Those that were still alive, that is. Because below, piling up in the nets which circumscribe the life of farmed Atlantic salmon, were dozens, then hundreds, of dead fish, suffocated, if fish can suffocate, by their gills' inability to cope with water which had turned into soup. Jellyfish and algae soup, to be precise. An algal bloom, caused by a long period of unseasonably warm, still weather, last week began spreading through salmon farms on the west coast of Shetland. One cage began to sink with the weight of fish killed by water thick with poisonous murk and thousands of tiny jellyfish and nematodes. The fatalities were sold as offal for fish meal, the living salmon, hauled from the water in haste, for human consumption. But the wrigglers could not be graded as "superior", because farmed salmon have to be starved for ten days before harvesting to reach that status. Why? Don't ask. It'll put you off your dinner. Well, all right, then. See that salmon you can pick up for peanuts these days? Farmed salmon? To keep the fish free of lice and disease while they're growing under artificial conditions, above a barren seabed, you need drugs. To make the flesh pink, as the market demands, you can't feed the things the delicately-coloured shellfish wild salmon eat. You need to put stuff in the food. And hey, none of this is harmful to humans who eat the fish, you understand. It's just that purging the creatures for ten days prior to harvesting - okay, slaughtering - is supposed to make them a bit sort of, well, more natural. Like putting mussels picked off a polluted shore in clean salt water for 24 hours before sticking them in the

pan with garlic and Chardonnay. Not that you're actually going to know that the pack of smoked salmon you buy from the supermarket may be from a less-than-superior, unstarved, unpurged fish with a rather high (but still officially harmless to humans) internal level of pharmaceutical gunge. It's going to be pink, and tangy, and full of the tasty, smoky carcinogens that I for one am prepared to put up with. And I eat quite a lot of smoked salmon. It is very plentiful in these islands, along with the fresh variety. We have many friends and neighbours in the business, and sometimes there can be so much pink fish flesh around you can run out of ways of dealing with it. Like the 18th-century apprentices of Glasgow who had it written into their contracts that salmon could not be served more than a set number of times per week, you can have too much of a good thing. I have fried smoked salmon for breakfast along with bacon and sausage. Tried everything from onion to marmalade with it. I have baked, poached, grilled, slow-cooked under rocks and barbecued the fresh variety. Have discovered how much nicer both trout and halibut are. I'm avoiding the question, though, am I not? What about this non-superior, unpurged salmon? Should it be eaten? Will it do us harm? The answer, officially, is no. But if we did know, if on the packet it said "made from salmon harvested early due to an algal bloom, and hence we didn't have time to let all the bits and pieces of, well, pharmacopoeia, soak out of them, but don't worry" wouldn't we have a right to be worried? I mean, have you ever tasted a wild salmon? I have, just once. The difference between farmed and wild salmon is like that between grouse breasts fried on the hill and Bernard Matthews's turkey burgers, straight from the freezer. And it pains me to say this. The livelihoods of many people I like and admire depend on farmed salmon. But the fact is that salmon farming is one of the most chemically dependent animal food industries on the planet. It is visually intrusive, dirty and destructive to other marine life. Escaped farmed salmon have already affected the gene pool of wild salmon very badly. And I haven't even mentioned infectious salmon anaemia, ISA, the disease which has closed several farms in Scotland and which, you will be delighted to know, is in most other countries considered nothing more than an irritant. Oh, and it's not harmful to humans, either. Anyway, this past weekend the first big equinoctial gale hit, the sea turned the colour of rancid milkshake, and all the algae ran for cover, taking the jellyfish and nematodes too. The bloom has been blasted for another year, the sea and air temperature is falling like a stone, and harvesting can be delayed in most cases until the salmon have had a chance to sweat out all the (harmless to humans, anyway in these quantities, sonny) toxins used to keep them live 'n' thrivin'. So that's all right then. Now where did you say this sushi came from?

Prognosis said poor for Atlantic salmon

Reuter News Service, USA, 8 October 1999

The last known wild Atlantic salmon face extinction despite efforts by the state of Maine to ensure their survival, U.S. fisheries officials said on Friday. Dwindling numbers of adult salmon are returning to Maine rivers to spawn, and young salmon are surviving at lower-than-expected rates, according to a report released jointly by the National Marine Fisheries Service and the U.S. Fish and Wildlife Service. The prognosis is poor unless greater steps are taken, such as controls on water diversion, to ensure continued flow into the rivers and better safeguards to prevent Maine's farm-raised salmon from mingling with the native population, officials said. In 1997 federal officials withdrew a proposal to list the Atlantic salmon under the Endangered Species Act - a move that would trigger measures to protect the fish - after Maine unveiled a less-rigorous plan to protect the species. In August this year, two conservation groups filed a lawsuit against the federal government in Washington seeking to put the Atlantic salmon on the Endangered Species List. The U.S. government is set to make a filing in the legal case next week, when officials also will announce recommendations based on the report released on Friday. Since the Maine protection plan took effect, new environmental threats such as disease have emerged, including diseases, officials said. "Right now, things don't look good," said Andy Rosenberg, deputy director of the National Marine Fisheries Service. Maine Gov. Angus King, an independent, said he opposes putting the salmon on the federal list. He warned it would turn the various constituencies now cooperating to save the salmon into adversaries. In the past, about 500,000 wild Atlantic salmon spawned in New England rivers each year, experts said. But in 1998, only between six and 120 such Atlantic salmon returned to spawn in the Maine rivers that are the focus of a state conservation plan.

US officials sound warning on wild Atlantic salmon

Boston Globe, 9 October 1999

In their first status report on New England's prized but imperiled wild Atlantic salmon since opting two years ago for a state of Maine recovery plan over federal protection, two federal agencies said yesterday that the salmon have continued to decline and are in danger of extinction. The US Fish and Wildlife Service and National Marine Fisheries Service report will likely play a role in a federal lawsuit filed this year against the agencies by environmentalists claiming the agencies are not protecting the salmon. It has also prompted questions about the Clinton administration's policy of deferring to state plans in protecting species. Maine has taken some steps to help the salmon, and Governor Angus King defended those steps yesterday. But the agencies said the species remains at risk from threats that include Maine's exploding, \$60 million salmon aquaculture industry. Its salmon are escaping from pens and may breed with, and genetically disrupt, wild salmon, they say. Also threatening the salmon are water withdrawals from the seven Downeast rivers at issue - the Dennys, Machias, East Machias, Narraguagus, Sheepscot, Pleasant, and Ducktrap - riverbank erosion, pollution, poaching, harsh marine conditions, recreational and commercial fishing, and disease, the agencies said. Several hundred thousand young salmon reared in hatcheries have been stocked each year in some of the

rivers since 1997. Only 29 were seen returning this year, down from 83 in 1995 and 74 in 1996, they said. "The species itself is a measure of whether things are working, and right now, things don't look good," said Andy Rosenberg, Deputy Director of the National Marine Fisheries Service, during a press conference yesterday. "The biological conclusion from this review is that the wild salmon on these seven rivers are in danger of extinction," Rosenberg said. He declined to say whether the agencies would once again seek to "list" the salmon under the federal Endangered Species Act, which could result in tough protection measures. Environmentalists who have sought such protection throughout New England even before the agencies first proposed it in 1995 renewed their call yesterday, arguing that the report confirms that Maine's conservation plan will not work. "What Maine is required to do, it isn't doing," said David Carle of the Conservation Action Project. His group among others filed the suit, and is seeking an immediate "emergency listing" for the salmon under the act. But Joseph McGonigle, of the Maine Aquaculture Association, said there is no evidence of aquaculture fish escaping from pens and breeding with wild fish. Those fish said to be from the pens have not been subjected to rigorous scientific analysis, he said. And the industry, which produced 1 million fish in 1988 but 30 million fish last year, has developed and implemented new pen technologies to better contain its fish, he said. "We have no desire to lose fish, and the evidence thus far is that we're not," he said. The agencies say two recently identified diseases have complicated recovery efforts, even though neither has affected Maine salmon as yet. One, salmon swim bladder sarcoma virus, was found in the Fish and Wildlife Service's North Attleborough hatchery, which is used to rear wild salmon for the Pleasant River. The other, infectious salmon anemia, has been found in the salmon's coastal range, but not in US waters. The agencies are expected to file legal briefs Oct. 15 in federal court. When asked how the agencies could defend their efforts when their own report says the salmon are in peril, Rosenberg said only that the report "is biological information that we will utilize and refer to when we respond to the court." As for protecting salmon through state plans like the one Maine crafted in 1997, King said he "continues to believe" that state plans make more sense for drawing a consensus among many affected players. The Endangered Species Act, he says, "only converts allies into adversaries."

Proposal to protect salmon criticized

Boston Globe, 15 October 1999

Pleasing neither side in the issue, Interior Secretary Bruce Babbitt confirmed through a top assistant yesterday that he will seek to protect wild Atlantic salmon under one of America's toughest environmental laws, based on a federal report released last week by two Interior agencies which found that the once abundant species is near extinction. "It is the intention of the agencies to propose a listing for Atlantic salmon under the Endangered Species Act," said Terry Garcia, Assistant Secretary of commerce for oceans and atmosphere. The report by biologists from the Interior Department's US Fish and Wildlife Service and National Marine Fisheries Service found that, despite a two-year effort by Maine to save salmon on its own, the species continues to face threats from the growing, \$60 million salmon aquaculture industry, whose cultivated fish are escaping, breeding with, and genetically disrupting, wild fish. Also threatening salmon are water withdrawals, riverbank erosion, pollution, poaching, recreational and commercial fishing, and disease on the eight Downeast rivers at issue: the Dennys, Machias, East Machias, Narraguagus, Sheepscot, Pleasant, and Ducktrap, and Cove Brook. Several hundred thousand young salmon have been stocked yearly on some of the rivers since 1997. Only 29 were seen returning this year. Finalizing the proposal could take over a year. But if finalized, salmon would be considered an endangered species, the most protective classification under the law. The federal government first proposed such protection in 1995, but as a threatened species, a weaker classification. It withdrew that proposal in 1997 in favor of a plan by Maine, which it now considers insufficient. Maine Governor Angus King and US Senator Olympia Snowe, a Republican, lambasted the proposal as a "betrayal," as King described it in an interview. Protecting salmon this way would cripple industries, especially aquaculture, that have provided jobs in economically depressed Washington County, where five of the rivers are located, they say. Such protection "would have disastrous consequences in Maine," said Snowe, who chairs the Senate Commerce Sub-committee on Oceans and Fisheries. King and Snowe also said the proposal flies in the face of efforts the federal and state governments have made since 1995 to develop and implement Maine's plan, which they say is preferable to federal protection because it was devised collaboratively with many affected local participants. Deferring to such plans in species protection is a policy of the Clinton administration, which prefers such "partnering." "If this is the way these folks treat partners, then I have to wonder whether I want to be one," King said, calling the Endangered Species Act "the atomic bomb of environmental laws" because of its "intrusive" habitat protection provisions. He said the state will try to convince Babbitt his decision was wrong, and if it cannot, will sue. Babbitt's action has also left some environmentalists unsatisfied. Litigants in the suit against the federal government to win immediate protection for the salmon under emergency provisions of the Endangered Species Act fear Babbitt's approach will take too long to protect the species. The federal government is expected to file a legal brief in court today on the suit. "Though it's heartening to see the agencies recognizing the salmon's dire straits, this proposal is too little, too late," said Charles Gauvin, president and chief executive of Trout Unlimited, a litigant. "This is where we were in 1995, except that we're talking about endangered rather than threatened status now. But it could take 15 months for this to happen, and you don't need a crystal ball to see that Babbitt will likely not be secretary then, and this will be on the doorstep of a new administration. The agencies are punting." Garcia insisted that state and local interests will have every opportunity in the next year to have a say in whether salmon should be protected as an endangered species.

Salmon famine hits West tourist trade

Western Daily Press, 18 October 1999

The number of salmon caught in the River Wye this season has fallen to its lowest level ever - threatening the livelihood of communities which benefit from the influx of anglers each season. Just 400 fish were caught during the season, which ended yesterday, compared with nearly 8,000 20 years ago. It is a pattern repeated in other West runs such as the Avon where a mere 34 were caught this season compared with about 1,000 in the early 1980s. Thousands of anglers from across the globe flock to the river for the annual spring run of fish, when the salmon return from the Atlantic to the spawning grounds of their birthplace. But it is not just fishermen who are missing out with a low count. On a plentiful river millions could be spent in the neighbouring pubs, hotels, B&Bs, restaurants and shops by the visitors. Dr Stephen Marsh-Smith, chairman of the Wye Foundation, said: "About 3,000 would be a good season we think it will about 400 to 450 this year. We have a problem with juvenile fish production. But it is not just this year. It has happened over the last ten years. We are getting into a downward spiral. A river of equal size such as the Tweed generates £12.5 million for the rural economy. We are not doing £750,000. It is quite depressing. We are simply under-performing. Hotels, B&Bs all benefit - this used to be a self sustaining industry." Dr Marsh-Smith said there were many reasons for the plummeting numbers of stock, the most severe of which is over-killing in the estuaries and poor environmental conditions. He said: "We had a big pollution incident about five years ago and that killed off many of the invertebrates that fish feed on and some of the fish themselves. Silting levels caused by farm animals are also a problem. The stock levels on farms have gone up but the land area hasn't and they are having to eat the bank-side vegetation. We can't introduce fish because we have to get them from somewhere and nobody has got any spare ones." Work is currently underway to improve the dire situation in the Wye, but Dr Marsh-Smith said the easiest way to increase numbers was not to kill all the catch. Blockage clearance and opening up new areas of the river are also helping but such schemes will only have an impact in the next Millennium. The Wye Habitat Improvement Project (WHIP), is helping to improve environmental conditions in the river by working with farmers and the surrounding communities to give value back to the run. The WHIP has been working on improving three Wye tributaries, the rivers Clywedog, Edw and Marteg.

Recovery of salmon in Maine may take decades, biologist says

Boston Globe, 21 October 1999

It will likely take decades for the state's Atlantic salmon population to recover, even if the fish is listed as an endangered species, according to a federal biologist. "I'm not going to gloss it over," US Fish and Wildlife Service biologist Paul Nickerson said Tuesday. "I think we're in for a long haul." The outcome of the federal proposal to place wild Atlantic salmon on the Endangered Species List is uncertain. Some environmentalists are suing for quick action, while state government and private industry groups fear listing the species will damage the economy. The US Fish and Wildlife Service and the National Marine Fisheries Service said last week they plan to list the Atlantic salmon as endangered in the Narragausgus, Pleasant, Machias, East Machias, Sheepscot, and Ducktrap rivers and in Cove Brook, a tributary of the Penobscot. Federal and state biologists counted only 29 adult salmon in the rivers during this year's spawning run between May and September, far below the thousands of fish reported in historical records. Listing the fish would mean that federal authorities believe it is in danger of extinction and that the agencies could use broad authority granted by the Endangered Species Act to regulate any activities that could damage the fish or its habitat. That could mean changes for sport fishermen, blueberry growers, and fish farmers.

Uphill swim for Atlantic salmon

Boston Globe, 24 October 1999

Interior Secretary Bruce Babbitt's proposal to add the Atlantic salmon to the endangered species list has put federal and Maine officials at odds after several years of cooperation. A smooth working relationship between the two levels of government is vital if the species is to be rescued. The conflict emerged earlier this month when a report by two federal agencies found the wild Atlantic salmon close to extinction. When Babbitt's office hinted it might change the status of the salmon from "threatened" to "endangered," Maine's governor, Angus King, and Senator Olympia Snowe cried foul, calling the move for tighter restrictions a betrayal of two years of federal-state cooperation in restoring salmon stocks. The raw numbers are discouraging. Surveys of Maine rivers used by salmon for spawning have found only 29 fish returning this year. The issue is complicated by rapid growth of salmon aquaculture in Maine, now a \$60 million industry. Federal officials claim that some of these fish are escaping and mating with wild salmon to the detriment of the species. Maine officials counter that the problem is European salmon escaping from Greenland hatcheries, over which neither state nor federal officials have authority. In either case, it is essential that dependable barriers prevent the escape of the European hybrids used in Maine hatcheries, and spawning rivers must be monitored against invasion by non-Atlantic salmon. Federal officials also wisely recommend wider use of American hybrids, which are less threatening genetically to Atlantic salmon. Fish farming can play a role in the economic recovery of Maine's coast - provided it is properly managed. The key is close cooperation among governments and aquaculturists to preserve the unique character of the Atlantic salmon, which is seriously threatened despite what appeared only a few years ago to be good chances of recovery.

Salmon in Maine worse off than here - to aid ailing runs, dams are breached - even demolished

Seattle Times, 24 October 1999

By Pacific Northwest standards, the Pleasant River is not much of a river at all. It's more of a creek that gurgles out of the woods, past the blueberry fields, through this roadside village in eastern Maine and tumbles down into a coastal lagoon. Yet the Pleasant River is about to go big time, joining Northwest rivers such as the Columbia and Snake on an environmental roster of dubious distinction - salmon runs on the endangered-species list. Folks here remember when hundreds of oceangoing Atlantic salmon returned to this river each year, climbing the shallow falls to their spawning grounds upstream, luring sports fishermen from across the region. Not any more. In recent years, the returns have dwindled to virtually nothing. "It's been years since we had a real run," says Torrey Sheafe of the Downeast Salmon Federation, a citizens group whose tiny office is propped alongside the river here. "Fishermen don't even stop here any more." The diagnosis is just as bad for the nearby Machias, the Narraguagus and other rivers in rural eastern Maine. That's why, before the end of the year, the federal government plans to formally propose placing Atlantic salmon in seven Maine rivers on the list of endangered species. "The trend is not good," says Terry Garcia, deputy director of the National Marine Fisheries Service in Washington, D.C. If this all sounds familiar, it should. The environmentalists who formally asked for the Atlantic listing modelled their petition after appeals filed years ago by Northwest environmental group. Maine and the New England states are just setting off on a scientific and political journey that the Pacific Northwest began years ago. And the route is no clearer in Maine than in Washington State. Northeast decline began in the 1800's. Geographically, the Northwest and Northeast corners of the nation present mirror images. Each is characterized by an intricate coastline and island archipelagoes, by deep, cold seas and glistening rivers and a long tradition of sports and commercial fishing. Each geography lends itself to the romantic life cycle of the salmon, a fish that is born in freshwater rivers, migrates to the ocean where it feeds and grows, then returns to fresh water to spawn, or reproduce. There is one fundamental difference. Pacific salmon lay eggs just once, and then die on the spawning grounds. Atlantic salmon return to the ocean for a year or more, and may spawn three or more times before dying. Despite that biological advantage, the Atlantic salmon are in far worse shape than their Pacific cousins. The decline in New England probably began early in the 19th century and has continued for nearly 200 years. Preliminary estimates indicate about 1,400 wild salmon returned to New England rivers from Maine to Connecticut this fall - down from an estimated 500,000 per year a century ago. A total of just 29 fish have been counted in the seven rivers to be listed. Compared with those numbers, Puget Sound salmon are thriving. Some individual wild runs in Washington had 1,000 or more spawning fish this year. And the overall return this year will be in the hundreds of thousands - down from tens of millions a century ago. The Atlantic runs are so depleted that some critics argue there is nothing left to rescue. After years of interbreeding with hatchery fish, the remaining salmon may have little genetic relationship to the fish that spawned there 200 years ago, they say. Either way, there is a familiar list of suspected causes for the decline - dams and habitat, hatcheries and aquaculture, overfishing, natural predators, ocean conditions ... and this complicates the debate over who, or what, is to blame. "The main issue is dams," says David Carle, a former high-school history teacher and environmental activist who drafted the original petition that eventually forced the government to act. While there are no huge Grand Coulees or even Elwha dams in New England, there are hundreds or even thousands of small and largely obsolete dams along New England rivers. Most were built in the 19th century to turn the wheels of the Industrial Revolution. Most have been abandoned and a few have been torn down. The 850-foot-long Edwards Dam on the Kennebec River was breached amid considerable fanfare in June. A smaller, 10-foot-high dam on the Pleasant River at Columbia Falls was removed in 1990. But Garcia, the key federal official, argues that "dams are not a huge factor" in Maine. The real issue, he says, appears to be the commercial salmon farms which grow Atlantic salmon in floating pens along the coast. But the aquaculture industry responds that wild fish runs were in decline long before fish farms arrived on the scene. Don't point the finger at us, they say. Others point to loss of habitat - coastal development or agriculture, including the thirsty blueberry farms that are burgeoning in eastern Maine. Gov. Angus King, a political maverick elected as an independent, dismisses all of the above. "My theory is seals," King says. Protected by the federal Marine Mammals Act, the Northeast seal population has exploded, and they are feasting on juvenile salmon, he says. "It's one of those things nobody wants to talk about. We may never reach a real conclusion," says Andy Rosenberg, a biologist and deputy director of the National Marine Fisheries Service who has studied the salmon collapse in Maine. "You have a combination of man-made and environmental factors at work, and how you weight them is always difficult." Uncertainty over the biology makes for a foggy political landscape. Most elected officials, regardless of party, are opposed to the proposed Endangered Species Act (ESA) listings. But the issue in New England has far less political heft than it does in the Northwest. That's the important difference between the two salmon issues, says Charles Gauvin, of Trout Unlimited, a national sports-fishing group that has advocated ESA listings in both regions. In the Northwest, politicians are obligated to be pro-salmon, Gauvin says. Commercial fishermen and processors, treaty Indian tribes and thousands of sports anglers live or die by the health of the salmon runs. And even non-fishermen seem to understand that salmon define the regions. In New England, that hallowed position is held by the Maine lobster or the Northwoods moose, by the basketball Celtics or baseball Red Sox. "In Maine, people will look at you point blank and say: 'Salmon are not really very important'," Gauvin says. And, politically speaking, they're right. As a result, while Pacific salmon have been thoroughly studied for many years, relatively little is known about their Atlantic cousins, he says. The absence of a New England salmon fishery means there is no group of stakeholders

to lobby for better management or research, he says. Scientists have not figured out how best to use hatcheries, how to deal with dams or how to protect wild runs from disease. To complicate things further, efforts to rescue wild runs have collided head-on with two fledgling industries - aquaculture and blueberry agriculture. Blueberries, an emerging health food, grow well along this coast, providing much-needed income for rural farmers. But scientists fear berry fields draw too much water from the rivers and encroach on critical spawning habitat. And salmon farms, which generate healthy jobs and sales in depressed coastal communities, are under increasing attack from environmentalists who believe that escaped fish transmit diseases and even interbreed with wild fish, which weakens the natural genetic pool. So the listing will get a reception very unlike the Seattle press conference, where governors and mayors stood shoulder to shoulder with federal officials and declared "extinction is not an option." In Maine, extinction may be deemed inevitable, even acceptable. King, the governor, argues vehemently that the salmon in one river cannot be distinguished from the fish in the next. "If they are truly a distinct species," he says, "then I'll guarantee that the Augusta mouse is a different species from the Bangor mouse, because they evolved in isolation from each other." And if the fish in one river are indistinguishable from the fish in the next, that weakens the argument for listing them as endangered. Given that fierce debate, federal authorities have been in no hurry to impose the ESA upon the political swing states of New England. The Clinton administration was reluctant to announce another listing, grumbles one environmentalist, until after the New Hampshire primary. It is a safe guess that the ESA impacts, economic and political, have barely begun. "Salmon are bound to cause conniptions on both coasts," says Gauvin, of Trout Unlimited. "They're complex critters that are exposed to man's perturbations in a variety of natural systems - freshwater and saltwater, shallow rivers and distant ocean. They're the ultimate challenge for fish managers, and now for politicians as well."

Half of Europe's freshwater habitats ruined. Few freshwater habitats still in natural condition

The Independent, 26 October 1999

Half of Europe's freshwater wildlife habitat has been destroyed over the last 50 years, according to a new report by the World Wide Fund for Nature (WWF). The United Kingdom is no exception, with most of its rivers and streams severely degraded and no longer able to support significant wildlife. Only 15 per cent of the UK's 250,000km (155,000 miles) of freshwater channels remain in a "natural condition", according to WWF's Living Rivers report, with the remainder dredged and culverted into drainage ditches, straightened and canalised for navigation, or constrained by hard, lifeless banks. Only one acre in 40 of the flood-plain wetlands that once spread over our river valleys has survived centuries of drainage for intensive farming and urban development. One in three UK rivers is colonised by alien plants, and pollution is widespread, from sewage works and factories and poor agricultural practice. The legal protection given to surviving wildlife-rich fresh water is completely inadequate, the WWF says. For example, the river Usk in Wales, with its otters, salmon, brook lampreys and trout, has the highest level of protection as a site of special scientific interest. Yet a 28-acre greenfield site on its banks is likely to be developed by the Welsh Rugby Union as a centre of sports excellence - with roads, training halls, floodlit pitches, and parking for 500 cars. In other European countries, yet more destructive developments are planned or under way. The Greek government is rerouting the entire river Acheloos in defiance of EU environment law. Construction works will cause irreversible damage to otter and trout populations and the dessication of the Messolongi wetlands. Giant engineering projects such as these have already had a catastrophic effect across the EU. Damming has blocked the passage of migratory fish such as salmon and sturgeon, while dredging and siltation has deprived them of their spawning gravels. Of Europe's 33 species of migratory fish, 11 are globally endangered, six are vulnerable and three are rare. Juvenile recruits of Atlantic salmon have collapsed from 600,000 in the early Seventies to 100,000. Yet all is far from lost. The WWF report applauds the efforts being made across Europe to restore rivers and return their original wildlife. In Germany, 50,000 acres of the Rhine's flood plains are being rehabilitated, while a band of protected areas is planned for the Elbe. The Danube is slowly coming back to life. In Hungary, moves are afoot to restore the Gemenc Forest and allow the river to flood into its many oxbow lakes and backwaters, preparing the way for the reintroduction of the beaver. In Britain, Scottish Natural Heritage is preparing to reintroduce the beaver, extinct in the country for 500 years. The Environment Agency in England and Wales also has a number of projects to restore rivers - although the funds available are under 1 per cent of that spent on land drainage and flood control. Now the WWF is urging the Government to push for the strongest possible Water Framework Directive, under negotiation at the EU, to ensure protection of wetlands and freshwater habitats.

Aquaculture Commissioner releases report on potential genetic interaction between wild and farm salmon

Canadian Corporate, 27 October 1999

Yves Bastien, Commissioner for Aquaculture Development, today announced the release of a new report entitled Potential Genetic Interaction between Wild and Farm Salmon of the Same Species by Dr. R.G. Peterson, Associate Professor (emeritus) of Animal Breeding and Genetics, University of British Columbia. "Dr. Peterson's report, commissioned by my Office, provides new insight and perspective into our understanding of the principles of genetics as they apply to the interaction between farm and wild salmon stocks," said Mr Bastien. The debate over the potential

of escaped farm salmon to negatively impact wild salmon stocks has hindered the development of salmon aquaculture in Canada. Groups opposed to salmon farming have highlighted the possible detrimental effects of farm salmon breeding with wild salmon by stating that wild stocks are specifically adapted to their native streams and rivers. They argue that farm salmon breeding with wild salmon will impair the wild stocks' ability to survive. "Perhaps one misconception colours the discussion of genetic interaction between wild and farm fish more than any other - the idea that natural selection has transformed wild salmon stocks to the optimum 'genetic solution' for their ecological niche," stated Dr. Peterson, a research scientist at UBC's Department of Animal Science for over 30 years. "This idea is, in general, not true. Natural selection, in a stable environment, will increase fitness to a certain point. But, this local point is only one of many possible solutions and is not likely the 'best' solution. My objective in requesting this report was to contribute new scientific information to the debate that currently exists in Canada and elsewhere regarding the potential genetic impacts of escaped farm salmon on wild salmon populations," added Mr. Bastien. "I believe Dr. Peterson's report will add a new dimension to the debate." In 1997, the world production of farmed salmon (900,000 tonnes) surpassed the total world harvest of wild salmon (728,000 tonnes) for the first time. Of that amount, Canada produced 61,000 tonnes (6.8 % of world production) of farmed salmon for a landed value worth \$324 million. About 85% of the total Canadian production are Atlantic salmon, the balance being composed of Chinook and Coho salmon. Salmon farming is now established on both the east and west coasts of Canada with British Columbia producing about two-thirds of total production and the balance coming primarily from New Brunswick, Nova Scotia and Newfoundland. Prince Edward Island and Quebec produce limited amounts. In December 1998, the Government of Canada appointed Mr. Bastien as the first Commissioner for Aquaculture Development. He reports to the Minister of Fisheries and Oceans and works closely with all federal and provincial departments on aquaculture matters.

Fears for salmon as virus spreads to wild

The Scotsman, 5 November 1999

A deadly virus which has crippled Scotland's salmon farming industry has spread to the wild for the first time. Scottish Executive officials confirmed yesterday that infectious salmon anaemia (ISA) has been found in wild Scottish salmon, trout and eels in several locations. Previously, the virus has been confined to farmed fish, but its spread threatens to decimate the wild population if it goes unchecked. The ISA virus, which is not a threat to humans, has been detected in wild fish from several lochs and rivers. It can be carried by other species including rainbow trout and brown trout without developing the full-blown disease. Last night, environmental campaigners and fish farmers accused the salmon farming industry and the government for failing to check the spread of the disease, saying officials were playing "Russian roulette" with fish stocks. If the virus continues to spread, the implications could be devastating for Scotland's tourism industry. Angling is estimated to generate about £400 million for the economy each year, a high proportion from salmon fishing. Confirmation of the virus's spread came as John Home Robertson, the Fisheries Minister, announced that it had been found in six more salmon farms. There are now 24 fish farms across the country which have been suspected of harbouring the disease and 11 in which outbreaks have been confirmed. Under European law, fish infected with the virus have to be destroyed. The disease has cost the industry millions of pounds since it was first discovered 18 months ago. Mr Home Robertson said: "Of course, we will be carrying out our usual investigations into the source of the infection on the new farms, but we are urgently considering the implications of this new evidence that the virus is present in wild fish." Monitoring this summer has confirmed the ISA virus in several species in locations around the country including sea trout in Laxo Voe, Shetland, and the River Snizort in Skye. Eels in Loch Uisg, Mull, were also found to be carrying the virus. Laboratory results indicate that the virus may also be present in brown trout in the Rivers Conon and Easaidh in Sutherland. Atlantic salmon in these rivers and the Tweed also show signs of the infection as do rainbow trout in freshwater farms in Aberdeenshire and in Kinross-shire. Three of the new fish farms affected by ISA are in Shetland as well as the first ever cases in the Western Isles - two in Loch Roag, and one in Orkney. Andrew Wallace, the Director of the Association of Salmon Fishery Boards, accused the Government and the fish farming industry of playing "Russian roulette" with wild salmon stocks. He said: "This news confirms our worst fears about diseases associated with salmon aquaculture and demonstrates, once again, the risks attached to intensive production of salmon in a relatively unregulated environment in which disease and parasites can be transferred easily from farmed to wild fish." Dr Richard Dixon, head of research at Friends of the Earth Scotland, said: "Scotland's fish farming industry is now on a knife edge. The government told us that it had beaten ISA - it hasn't. They told us ISA would not spread to wild fish - it has. ISA in wild fish is a disaster, with major potential implications for the environment and the rural economy. This could be a final nail in the coffin for wild salmon and sea trout in Scotland." The Scottish Executive said it would be reviewing its monitoring and control procedures but did not envisage a fundamental change in its policy, which is to try to kill off the disease by slaughtering millions of infected or suspected fish. Lord Lindsay, the Chairman of the Scottish Salmon Growers Association, said: "In order to safeguard the thousands of jobs that support fragile rural economies in the Highlands and Islands and maintain investor confidence, the Scottish Executive must review, with utmost urgency, measures to manage the outbreaks of the virus and financial assistance to help the industry recover from the subsequent losses of unaffected stock."

Removal of dam has restored salmon and bass populations in Maine river

S. Louis Post Dispatch, 6 November 1999

The 162-year-old Edwards Dam was dismantled for environmental reasons. To the delight of conservationists and fishermen, Atlantic salmon have returned to the waters above the site of a 162-year-old dam that was torn down earlier this year to allow fish to swim upstream. Striped bass have come back too, in such numbers that fly fishermen have been having a field day on the upper Kennebec River. The stripers have been feeding on yet another species that swims upstream from the sea, alewives. The removal of the 24-foot-high Edwards Dam has completed the rebirth of what was historically such a rich fishery that early Colonial settlers grew weary of eating fish. The first stage involved cleaning up the Kennebec River, which along one stretch was so polluted that it was practically an open sewer. After the cleanup, attention turned toward the closest dam to the Atlantic, the Edwards. The Edwards Dam was built in 1837 to supply power to mills that rose along the river's banks. It was about 40 miles upstream from the Atlantic and stretched 917 feet across the Kennebec, blocking salmon, shad, herring and other fish from reaching their spawning grounds upstream. In 1997, the Federal Energy Regulatory Commission decided the dam should be torn down for the good of the environment. The Edwards became the first hydroelectric dam in the country ordered removed by the U.S. government against its owners' wishes. Contractors completed the removal of the timber, stone and concrete structure Oct. 8. With the dam gone, gazing at the Kennebec from its high banks in Augusta is like looking more than a century and a half back in time. The flat, gravelly Cushnoc Island is again in view as it was when colonial fishermen filled barrels of salmon at a time from the river. In Augusta and upstream, rapids ripple as they did until Henry David Thoreau's time, while sturgeon, Atlantic salmon and stripers swim easily upstream. "A lot of fish were caught, a lot were seen. It was easy fishing," said Mike Holt, a guide who owns a fly-fishing shop in Fairfield, about 20 miles north of Augusta.

Scotland's salmon farms face strict curbs

The Independent, 23 November 1999

Salmon farming in Scotland is to be heavily restricted, with no new farms allowed on the north and east coasts, because of Government fears that the industry is destroying the environment. In future the creation of any sites will not be permitted unless the owners can demonstrate that they will improve environmental conditions. The landmark decision, contained in guidance from the Scottish Executive, follows decades of official support for the industry, which has been promoted for providing jobs in the employment-starved Highlands. But the outbreak of several diseases in wild salmon, blamed on their caged counterparts, has forced Ministers to issue the new restrictions. Last week the Sea Trout Group, representing two angling associations, began legal action against Ministers for allegedly failing to control the spread of sea lice from farmed fish. The group claims that wild species have been infested and decimated by the lice. Salmon fish farming has also been blamed for the spread of the "fish flu" virus, or infectious salmon anaemia, which has recently been found in British wild salmon. It has proved impossible to control salmon anaemia - which now affects 35 farms - and the transmission of the virus (though not yet the disease) to wild stocks, including Atlantic salmon and brown trout, is bad news for anglers. Finally, salmon farming has also been implicated in an epidemic of amnesic shellfish poisoning (ASP), which broke out in the summer along the west and north coasts of Scotland. The resulting ban on scallop fishing has led the Scottish Fishermen's Federation to warn that many of its members now face bankruptcy. The outbreak of ASP is caused by a build-up of toxic algae, on which scallops feed. Human consumption of the poisoned scallops can cause vomiting, headaches, numbness of the limbs and memory loss. In Canada recently, 150 people fell ill from the disease; four died. Although no link has been proved between the disease and caged fish, many experts think that high levels of ammonia cause the toxic algae to proliferate. Scottish salmon farming produces 7,000 tons of ammonia a year, which is discharged, untreated, into the sea. Although the Government claims that the phenomenon occurs naturally, a Scottish Executive spokesman admitted: "It is true that if you look at where the fish farms are and then examine where we have had outbreaks of amnesic shellfish poisoning, there are some correlations." The new restrictions on salmon farms also represent acceptance that there are too many problems linked to the £260m industry for it to continue to expand unchecked: production has risen six-fold in the past 10 years, and the number of farms has increased from 32 in 1980 to 330 today. After a decade of discussions, the Scottish Executive has published the new rules in a document entitled: "Locational Guidelines for the Authorisation of Marine Fish Farms in Scottish Waters". Friends of the Earth Scotland welcomed the initiative. Don Staniford, the group's fish farming research officer, said: "It is a good first step, but we want these controls rigorously enforced. We would prefer to see a complete moratorium on fish farm expansion."

In Maine, a stew over plan to override salmon policy. U.S. agencies say state effort to save fish is failing

The Washington Post, 27 November 1999

Time was when fly rods packed the wooden racks at Eddington Salmon Club, and dozens of fishermen waded into swirling Penobscot River pools. Anglers here still recall how sportsmen waited their turn along the shore, ribbing one another over coffee and trading tips on how to play the fish whose dexterity and strength made them feel as if they had succeeded in hooking a pickup truck. "You'd see 10, 12 salmon at a time jumping here, jumping there, and hundreds of people fishing," said Richard Ruhlin, a Democratic state senator and president of the Penobscot Salmon Club,

incorporated in the 1880s when this river was one of the nation's most famous salmon holes. But these days, with a glance outside to the roiling waters, he said, "we'll look out these windows and occasionally we'll see a salmon jumping, occasionally. But I don't think I've seen more than 25 people at a time." What Ruhlin has witnessed is the vanishing of wild Atlantic salmon, an event more than a century in the making that is finally threatening to put eight rivers of this Northeast state on a course already charted by the Pacific Northwest: the Endangered Species List. Continued threats to wild salmon - as opposed to the farm-raised ones that appear on restaurant menus - and preliminary evidence that adult fish are spawning and young ones surviving at lower rates than expected recently prompted the federal government to override Maine's conservation plan and propose classifying the nation's last self-sustaining wild salmon runs in danger of extinction. While acknowledging its efforts, the U.S. Fish and Wildlife Service and National Marine Fisheries Service determined that the state is failing to protect certain salmon. If approved, the endangered species classification would likely accelerate Maine's five-year plan (now in its third year) with added protections and restrictions on salmon farming and agricultural industries, officials said. A final determination is expected within a year. "Some elements of the plan are working and maybe working well, but it's not enough," said Andrew Rosenberg, deputy director of the National Marine Fisheries Service. "The fish are in trouble." The No. 17 announcement shocked Maine Gov. Angus King (I) and provoked fighting words from state officials, salmon farmers, fishermen and conservationists who say the proposal goes too far or not far enough. Critics complain that the listing unfairly focuses on rivers in an economically depressed region of the state and disregards other factors such as predators, habitat destruction and pollution that have effected an overall decline in North Atlantic stocks. Such a move could "well spell the end of aquaculture in Maine" and "serves neither the salmon nor the people of Maine," King said. Senator Olympia Snowe (R-Maine), who chairs the Senate panel overseeing oceans and fishing, predicted "disastrous consequences" and asked the National Academy of Sciences to conduct an independent review. "Regrettably, the result of this step will be less - rather than more - protection for wild salmon," said Snowe, who blasted the Clinton administration for its "abrupt reversal" two years after endorsing Maine's salmon recovery plan. "Clearly, the many different industries that would be affected by such a listing will fight ... every step of the way." Environmentalists contend that federal agencies stepped in too late, allowing the state to underfund and delay conservation as salmon reserves declined. Their pending lawsuits demand immediate emergency listing of Atlantic salmon as an endangered species, while hearings heat up here on a proposed statewide ban on salmon fishing altogether. "The last thing these wild Atlantic salmon need is more politics," said Charles Gauvin, president of Arlington, Va.-based Trout Unlimited, a leading fish conservation group. "Emergency listing is the only way to avoid political stalling." Andrew Goode, director of U.S. programs for the Atlantic Salmon Federation in Brunswick, Maine, agreed: "The listing is good, but it's not coming soon enough." Survival of wild salmon has been an issue in Maine at least since the first federal government hatchery was established near Bangor in the late 19th century. Since then, the salmon has been assaulted by everything from forest clear-cutting that erodes waterways to dams that impede migration. (Unlike Pacific salmon, which spawn once and die, Atlantic salmon migrate to the ocean and return upstream to spawn again.) The two federal agencies considered listing the salmon as a threatened species in 1995 but withdrew their proposal in December 1997 after Maine launched its recovery strategy. The plan called for increased stocking, improved habitats and the creation of watershed councils, among other initiatives. It also included improved oversight of salmon farms, which use European hybrids, and agribusiness that diverts water for irrigation. Federal biologists recently became alarmed, however, after detecting two new salmon diseases. They have also blamed the state for failing to regulate water withdrawals and the use of hybrids by aquaculture. Only 23 returning adult fish were documented by federal biologists on two rivers over a short sampling period this year, representing a severe decline from when hundreds of fish returned years ago to their native waters to spawn. The Pleasant River, for instance, used to attract 40-pound salmon large enough to stretch across the hood of a car, said Torrey Sheafe, an assistant program coordinator for the Downeast Salmon Federation in Columbia Falls, which acts as a liaison between the federal government and watershed councils. But Sheafe hasn't seen an adult fish return in two years, and the only salmon angler he knows travels to Russia to fish. "In my opinion, the state of Maine can't do enough," he said. "Maine hasn't got the economy to do a salmon plan, and the plan didn't hold anyone accountable to the results. The only option is to use the federal government's assistance." At stake, too, is the survival of Maine's \$60 million-a-year aquaculture industry, the nation's largest producer of salmon with 10 farms statewide. Conservationists and federal officials worry that European-strain salmon can escape from sea cages near river mouths and mingle with wild salmon, diluting the species and spreading disease. But salmon farmers say the last known escape occurred in 1994, and no disease has been traced to their operations. "We really see the listing as pretty much a declaration of war on the aquaculture industry once and for all," said Joseph McGonigle, executive director of the Maine Aquaculture Association in Brewer, located across the Penobscot River from Bangor. "There is no possibility that the Maine industry will be able to survive under the conditions we are told will occur after listing." Before talks with federal officials broke down last year, McGonigle said the industry had agreed to install fail-safe cage systems within one year and fully contain hybrid strains within two. Banning the use of European genetic material would make Maine uncompetitive against international salmon producers, as would other restrictions, he said. "If the federal government tells us tomorrow to go 20 miles offshore, we're done. There is no alternative. If they tell us to stop using genetic strains from Europe, we're done slower, but we're done," said Des Fitzgerald, general manager of Atlantic Salmon of Maine, one of the largest salmon farms in the state. "I care about the critter. I also care about the salmon farms, and they are not mutually exclusive." Caught in the middle of the tussle are lone fishermen such as Penobscot's Ruhlin, who may be first to feel

the squeeze if their pastime does indeed become a thing of the past. At the Eddington Salmon Club several miles north of Bangor, anglers don't expect to receive much support from the public, whose sympathies lie with the Maine lobster and its cuddly red stuffed replicas in airports and tourist shops throughout the Northeast. They also recognize that salmon fishing is considered an elitist hobby because it requires special skills, as evidenced by the framed collections of salmon flies on clubhouse walls. Still, many anglers say they will go along with what is best for the fish if everyone else does. They believe they are the true conservationists, the eyes and ears of the salmon, and the best river guardians of all. "We have to start working together," said Louis Horvath, 72. "If we fix up this habitat, they will return. I know that will happen, and I'm going to live long enough to see that happen, too."

Salmon safeguard called overkill in Maine

Boston Globe, 3 December 1999

Accusing the Clinton administration of abusing the Endangered Species Act and betraying his state, Maine Governor Angus King vowed yesterday to oppose federal efforts to protect the last "wild" Atlantic salmon in the United States, arguing that the few remaining fish that spawn in Maine rivers are neither endangered nor even a species. King's contentious remarks signal a new round in what is already one of the most heated wildlife battles in New England. Atlantic salmon, perhaps the region's most prized sportfish, have been driven out of many rivers by dams, pollution, and other causes, leaving just eight eastern Maine rivers that have become the focus of efforts to save a remnant population. Last month, the US Fish and Wildlife Service and the National Marine Fisheries Service proposed adding salmon in the eight rivers to the endangered species list, a move that could put costly new limits on two key coastal industries, aquaculture and blueberries. But, responding to the federal plan, King argued that it's too late to save the "wild" salmon because they are already gone. Millions of hatchery-raised salmon released to Maine rivers to stop the salmon's decline have wiped out the genetic uniqueness of Maine salmon, he said, making them little different from hundreds of thousands of Atlantic salmon in eastern Canada or even in Maine's aquaculture pens. "It is hard for me to understand how an animal that numbers in the millions can possibly be in danger of extinction," said King, in an address sent over the Internet. "If you carry it too far, everything's an endangered species: I guarantee that a mouse in Waterville, Maine, is different in some ways from a mouse in Watertown, New York." King called on the Clinton administration to drop the endangered species listing, and allow a state protection plan to go forward, declaring, "The return of the majestic Atlantic salmon would be a tremendous achievement for Maine." Clinton administration officials challenged King's assertions, arguing that some studies show that the salmon in the eastern Maine rivers show small genetic differences from other salmon that can be detected in the lab. Moreover, they said King's attack on the salmon's genetic heritage undercuts his claim to be concerned about saving them. "It's a little difficult when somebody says, 'We want to take all protection measures for this wild stock and we should have the lead,' but, then in the next sentence, says, 'We don't really believe they're a wild stock anyway,'" said Andrew Rosenberg, deputy director of the National Marine Fisheries Service. "There is a conflict there." Environmentalists added that the genetic dispute misses the more important concern that the number of mature salmon returning to eastern Maine rivers has plummeted 90 percent from historic highs to about 75 to 150 fish that returned last year. Meanwhile, they say the state has been slow to take needed steps, such as reducing water withdrawals from salmon rivers for the blueberry industry. "The genetics argument is bogus because nobody really knows enough about the genetics of any of these species to say what's pure," said Michael Kellett of Restore: The North Woods, a group in Concord, Mass., that first petitioned the federal government to declare the salmon endangered. "The real question is: Do we want salmon in Maine?" However, both sides agree that the state's \$65 million aquaculture industry, which employs nearly 1,000 people in eastern Maine, has the most economically at stake in the debate. Biologists regard their fish pens as a hazard to wild fish, and they have been pressing for tougher measures to prevent the farm-raised fish from escaping to join wild population. "We could go out of business," warned Joseph McGonigle of the Maine Aquaculture Association, if federal regulators make good on a threat to stop them from using imported European salmon to create faster growing hybrid fish. King's speech also highlighted the difficulty of protecting a fish that divides its time between rivers in Canada and the United States and the sea west of Greenland, 1,000 miles away, where local residents still fish for them. Since the 1980s, the number of mature salmon congregating off West Greenland has fallen from roughly 500,000 to fewer than 100,000, according to the US Fish and Wildlife Service, bringing smaller salmon runs to rivers throughout North America. Wildlife biologists believe the decline is at least partly related to falling water temperatures off Greenland. And when the salmon do head for the rivers, they are eaten in increasing numbers by the growing population of seals, which are protected from harm under US law. Maine and the federal government have been trying for decades with limited success to buck these trends by capturing wild salmon to reproduce in hatcheries. Since the 19th century, King estimates that 100 million hatchery-raised salmon have been released into Maine rivers, in the process erasing genetic differences among fish in the different rivers. As a result, King argues, applying the tough standards of the Endangered Species Act to salmon now would damage Maine's economy without helping the salmon significantly. "We could close all of Washington and Penobscot counties (in eastern Maine), send everyone home and turn out the lights, and still not bring the fish back," said King. But Dan Kimball, salmon biologist for the US Fish and Wildlife Service, argues that the state and federal government have a special responsibility to salmon that return to the rivers in Penobscot and Washington counties. Unlike other eastern rivers, where there would be no salmon if not for human stocking, he believes the eastern Maine rivers always had some wild salmon because the rivers were relatively undeveloped. "This is the last legacy from US wild Atlantic salmon stocks," said Kimball. "Our strategy is to protect

and maintain the small core we have left of wild salmon until marine conditions improve to such a point that they can respond and return to a healthy state." Maine officials insist they, too, have been trying to protect the salmon in the eastern rivers, spending \$1 million on salmon protection under a state plan that Clinton administration officials approved two years ago as a substitute for adding the salmon to the endangered species list. In his speech, King promised to step up the state program to save the salmon, calling for more salmon stocking, better protection of the land along salmon rivers, and stepped-up efforts to prevent salmon from escaping from fish farms. "The state of Maine will fight for the salmon," concluded King. "The only question is whether the federal government will force us to fight them as well."

Editorial page (in time's eye): precious salmon

Irish Times, 4 December 1999

Disease is part of the natural world. In cattle we have long had TB, then BSE. There are questions and scares about the health of chickens reared intensively. But, often in recent years, there has been reporting on the state of the salmon farming industry. Let it be said that there is no evidence that any disease that afflicts farmed salmon could be transferred to a human being, but the insistent stories of this or that outbreak of disease in other countries makes you wonder how our own industry is affected. Prof Graham Shaw, Chairman of SOS (Save Our Sea-trout), has sent a press statement from the Scottish Executive, which, in announcing a review of the current controls system on infectious salmon anaemia, has already closed down fish farms suspected of harbouring the disease. Mr John Home Robertson repeats that, while the disease will have no implications for human health, the virus can be found in wild fish sampled, including sea trout and, indeed, eels in Lough Uisk, Mull. Even more species, says the press release, may be affected, including brown trout in two named rivers, and Atlantic salmon parr in three, including the Tweed. This disease is notifiable and, as a result, requires eradication. A hard decision, for fish farmers are often, if not usually, in areas of little other employment. In all, 24 farms in Scotland have been suspected of the disease over 18 months and all but three have been cleared of fish. Eleven other sites have been likewise declared infected, and five are back in production. Salmon farms in Norway and Canada have been affected, too, and in Canada the virus (but not the disease, says the press release) has recently been found in wild salmon. And the Highlands and Islands Enterprise have available £9 million over three years to assist fish farmers directly affected. If the disease poses no threat to human health, it surely does pose a threat to the wild Atlantic salmon. And this is of some concern, and not only to anglers. For it could seriously bear on our valuable tourist industry. Not only anglers, but all of us, would be losing a creature of great beauty from our lives. That is the very pessimistic view. Be sure our Government is aware of the threat (or scare) and will be taking steps. That is a precious invasion from the sea that comes up our rivers in late autumn. We must cherish it.

Scientists change tack on action against ISA

Aberdeen Press & Journal, 8 December 1999

New Ways of handling Infectious Salmon Anaemia, which has blighted fish farms across the Highlands and Islands, are set to be announced by the Scottish Executive later this month. Scientists are likely to recommend changes in the handling of the disease following research involving farmed and wild fish. Fisheries minister John Home Robertson indicated that there would be a change in policy following a private meeting with representatives from Councils across the Highlands and Islands, and enterprise company officials. He said: "I will be making an announcement in the Scottish Parliament later this month in the light of advice from Government officers about the handling of ISA." Government scientists have been investigating whether the disease is endemic or whether it has come from an outside source. The current number of suspected ISA cases on farms is 24. It has been confirmed on a further 11 farms. Brown trout in the rivers Conon and Easaidh, Atlantic salmon parr in the rivers Conon, Easaidh and Tweed, and rainbow trout in freshwater farms in Aberdeenshire and Kinross-shire are also harbouring the virus. Despite the crisis facing the industry, Mr Home Robertson was bullish about its prospects yesterday. He sought to assure the public that there was no question of diseased salmon going on the market. "I have made sure it doesn't happen," Mr Home Robertson said. He admitted that traces of the virus might be more widespread than originally understood. But he stressed that fish were cold blooded creatures and the virus was destroyed at temperatures below human blood temperatures. "Consumers need have no concerns about this," Mr Home Robertson concluded. Michael Foxley, Highland Council's land and environment select committee chairman, said yesterday's talks had been productive and would hopefully lead to better handling of ISA. He added that the councils and HIE were pushing ahead with a marque for Highland salmon signifying quality. The first allocations from a £9million fund administered by HIE to restructure salmon farms affected by ISA are expected to be paid out early next year. Mr Foxley said it was vital salmon farming was helped through the crisis. "The industry is one of the biggest employers in the coastal and island communities and needs financial support, directly linked to restructuring and operating a zonal policy," he said. Campbell Cameron, deputy leader of Argyll and Bute Council, also said yesterday's meeting had been useful. He went on: "The minister has shown an interest in all aspects of Highland rural communities and salmon farming is part of it. We must do everything we can to ensure the reputation of Highland salmon is maintained and enhanced." Scottish Tory Euro MP Struan Stevenson yesterday called for a radical overhaul of the strategy for combating ISA. He said: "Clearly the disease is endemic even in wild fish and given the size of the industry and the thousands of jobs involved in aquaculture

and related industries, we must change our policy from one of elimination, which is clearly impossible, to one of containment." He called for an end to the compulsory slaughter policy; the establishment of a code of best practice in aquaculture hygiene and management; a removal of the ban on vaccines and the introduction of a compensation scheme.

Yesterday's fish supper or the new salmon?

Scotland On Sunday, 26 December, 1999

It is being called the new salmon. The lumpsucker, a stumpy, green-grey fish with an unpalatable name, is being lined up as the fresh taste of the nation. The flesh of the male *Cyclopterus lumpus* was once eaten throughout Scotland but fell out of favour after the Second World War. Marine scientists now believe the lumpsucker is a viable alternative to farmed salmon on both commercial and environmental grounds following successful trials in the west of Scotland. They are calling for a chain of lumpsucker farms to be set up so the fish can once again form part of the national diet. It comes at a time when the salmon farming industry is reeling from the impact of the disease Infectious Salmon Anaemia, which has led to farms being quarantined and has been blamed for the destruction of more than four million fish, estimated losses of Pounds 37m, and at least 180 job cuts. The lumpsucker is still eaten in large quantities in Scandinavia, Iceland and parts of Canada but only the female roe - known as lumpfish caviar - is still consumed in Britain. The adult lumpsucker grows to around 50 centimetres in length and has a large, bony, thickset body with no scales. Its pelvic fins form a sucker underneath its body, giving it its name and the ability to stick to surfaces to conserve energy and avoid detection. It is found in large shoals in the North Atlantic and was hunted by Scottish fishermen until the government, in the late 1940s, encouraged the industry to target white fish such as cod and haddock instead. Research on the species as an alternative to farmed salmon began at the government's Dunstaffnage Marine Laboratory near Oban three years ago, after rogue lumpsuckers were found living happily alongside their more illustrious cousins. Juvenile lumpsuckers were grown in tanks in Dunstaffnage and at the Salar fish farm on Loch Carnan in South Uist. The trials found that lumpsuckers can be grown successfully in cages and growth rates can be accelerated so that the fish reach maturity within two years. As a farmed species, they were discovered to be better than salmon. "When compared with salmon, lumpsuckers are a viable and potentially more productive species for marine aquaculture," said the project head, Dr Martin Sayer. "Not only can accelerated growth rates be attained on an artificial diet, but they are also less prone to handling stress and less susceptible to disease." There are also benefits for both fish farmers and the environment as the fish stays still for long periods, so requires less food to keep up energy levels. Meanwhile, the lumpsucker may also answer to environmental concerns that the escape of farmed salmon from cages into rivers is destroying stocks of wild North Atlantic salmon. "Lumpsucker farmers could produce a commercial harvest in a short space of time which means risks associated with species diversification are reduced." Kevin Dunion, director of Friends of the Earth Scotland, agreed. "Given the environmental problems associated with intensive salmon farming, this is exactly the type of diversification that FoE has been calling for in the industry," he said. One of the main hurdles now, Sayer acknowledges, is regaining public acceptance. Although the global market for lumpfish caviar - a low-cost alternative to sturgeon caviar - has grown since the 1930s, the fish itself has been almost forgotten. Before the Second World War, filleted and smoked lumpfish was commonly eaten in Scotland. There are other commercial advantages to the fish too. Its tissue can be put to a similar use as gelatine and could be harvested and sold to the food, pharmaceutical and electronic industries, and a component of its blood has a laboratory use. "Our view is that we have now demonstrated that lumpsucker can be farmed," Sayer said. "It is now up to the industries involved to take it on." Highland Council, which helped fund the trials, believes fish farmers need to diversify into other species if they are to survive in the long term. Fisheries development manager George Hamilton said the industry was vulnerable to fluctuating prices and crippling outbreaks of disease. "It is important to find other species which can be farmed," he added. "The lumpsucker seems like a good prospect."

Maine charges salmon listing bears Gore stamp

Washington Times, 28 December 1999

A proposal by Interior Secretary Bruce Babbitt to list Atlantic salmon on the endangered species list would kill aquaculture in Maine, where 27 million pounds of farm salmon are produced annually, industry officials said. Mr. Babbitt had praised the state's ongoing plan to protect the wild fish as recently as July, then abruptly announced last month the plan wasn't working and the fish must be federally protected. Industry officials say there is no scientific basis for the decision, and that Vice President Al Gore's dwindling popularity among environmentalists is the administration's motivation for the sudden listing. "This is an extraordinarily, politically charged issue," said Tom Royal, president of Atlantic Salmon of Maine, the largest producer of farmed salmon in the U.S. The Clinton administration is not concerned about protecting the fish, it is concerned about "protecting jobs and a political statement," Mr. Royal said. Federal officials threatened to list the Atlantic salmon two years ago as endangered but instead opted for a five-year plan drawn up by local and state officials to identify threats to the salmon and mitigate or eliminate the problems. "To abort the Salmon Conservation Plan, a plan that offers so much promise, after only two years, is a setup of the first order," Gov. Angus King said in a Dec. 2 speech. To say that plan is now inadequate is "nonsensical and grossly unfair," said Mr. King, an independent. "Already there are reports of increased spawning activity in several of the rivers, but we'll never know if this is luck or the beginnings of success under the plan if the

federal government persists in pulling the rug out from under us now," Mr. King said. If the fish are listed, aquaculture would be eliminated, because it would forbid the importation of European salmon sperm; which farmers need to breed with Atlantic salmon. Critics say the crossbred salmon often escapes from its ocean pen, and when they breed with other North Atlantic salmon, they are creating a sort of mongrel salmon. This genetic intrusion "poses a serious threat" to the survival of the salmon, said a biological report issued by the U.S. Fish and Wildlife and National Marine Fisheries Service in the Commerce department. "Atlantic salmon are an important part of the heritage of Maine, and we must do everything possible to ensure their survival and recovery," said Penny Dalton, National Marine Fisheries Service. The report said fewer adult salmon are returning to spawn, and young salmon in the rivers are surviving at a lower rate than expected. If current aquaculture practices continue, the report said they have the "potential to disrupt, displace, and genetically contaminate" the fish. "If the process continues to be politicized and enforced in the most draconian measure possible with the misconception brood stock is genetic pollution, then we would be competed out of business by other countries not held to the same standards," Mr. Royal said. Atlantic Salmon of Maine said it will ask its senators, Republicans Olympia J. Snowe and Susan M. Collins, to investigate the motives of the Clinton administration. A spokeswoman for Mrs. Collins said they were disappointed the administration was abandoning the state's efforts in favor of federal efforts. Mrs. Collins sent a letter to Mr. Babbitt and Commerce Secretary William Daley, asking them to provide her by Jan. 3 with all documents and records concerning their decision based on the biological report. Mrs. Collins also asked the two secretaries to tell her who made the decision to conduct the report and whether it was based on lawsuits brought by out-of-state environmental groups to list the salmon as endangered in Maine. A spokeswoman for Mrs. Snowe said her office was urging the federal agencies to hold a public hearing on the listing in Maine. Mrs. Snowe also called on the agencies to immediately publish all underlying data for review. "I understand that some papers cited in the proposed rule have not yet been published, and that ordinarily this data would not be made public until the publication review process has been completed," Mrs. Snowe said in a letter to Mr. Babbitt and Mr. Dale. "Given the serious questions that have been raised about the validity of the scientific basis of this proposed listing, it is critical that this data be made available immediately," she said. Public comment on the proposal ends Feb. 15.

Salmon netmen support stocks

Aberdeen Press & Journal, 28 December 1999

Salmon netmen have shown they are willing to make sacrifices to protect salmon stocks. In return, anglers should adopt an effective reciprocal policy. This is spelled out by executive council members of the Salmon Net Fishing Association of Scotland in the new edition of the association's own publication. The council members outline 11 points in response to the joint review paper on interceptory exploitation of salmon published jointly by the North Atlantic Salmon Fund (UK) and the Atlantic Salmon Trust. The executive team says it is universally accepted that the stocks of multi-sea-winter salmon, particularly those exploited in the spring, are outside safe biological limits and require immediate protection. In 1998, the last year for which published data is available, the nets caught less than 15% of the reported all-Scotland, all-method retained catch taken in January to April. The remaining 85% were caught and retained by the rod fishery. And since the right to fish for salmon by net and rod and line is a heritable title, the council members go on, the sacrifice necessary to reduce the level of exploitation must be borne equally, irrespective of the type of gear employed. The executive adds that, since 1951, seven statutory limitations have been imposed on netting but during the same period the only limit placed on the rods has been the banning of some baits and lures on some rivers at the request of the relevant district salmon fishery boards. The "fragmentary and partially voluntary" catch-and-release policy which has allowed some 89% and 80% respectively of the rod-and-line catch taken before May 1, 1997 and 1998 to be retained is not sufficient to safeguard the future of Scottish spring salmon. "A much more positive approach more akin to the netmen's voluntary cessation of netting in the spring is urgently required." Although it is realised that the closure of a rod fishery may have serious financial implications for hotels and proprietors, perhaps anglers are unaware that most netmen still pay their assessment to district salmon fishery boards in full whether they fish part of the season or not at all. Closure of netting stations will remove the last line of organised defence against seals and also against illegal fishing. The Scottish net fishery should not be linked to the North-east of England drift net fishery principally because drift netting was banned in Scotland in 1962. Neither should it be the pawn in any discussions relating to the closure of this fishery.

Minister hears concerns over ISA

Aberdeen Press & Journal, 1999

Fisheries Minister John Home Robertson yesterday heard the concerns of the Highland fish farm industry about the challenges it faces, in particular from infectious salmon anaemia. Mr Home Robertson visited officials from the Conon District Salmon Fishery Board at Loch an Croic, near Contin in Strathconon, to review the Board's work. He also viewed parts of the River Conon in which the ISA virus was detected in wild fish earlier this year. Earlier this month the Government confirmed ISA was suspected at a further six salmon farms. In addition, tests revealed the virus - but not the disease itself - in several types of wild fish. The six farms were in Shetland at Burra, Gonnifirth and on the east mainland coast, one in the south of Orkney and two in Loch Roag in the Western Isles. The latest farms suspected of having ISA brought the number of suspected ISA cases on farms to 24. It has been confirmed on a further 11 farms.

Brown trout in the rivers Conon and Easaidh, Atlantic salmon parr in the rivers Conon, Easaidh and Tweed and rainbow trout in freshwater farms in Aberdeenshire and Kinross-shire are also harbouring the virus. Officials have previously admitted they were unsure how significant these findings are, but stressed rainbow trout and sea trout, although carriers of the virus, have never been known to develop the disease. Mr Home Robertson praised the efforts of the Board in keeping a dialogue open between all interested parties, who may not always agree on policy. He said ways in which the spread of ISA could be halted included a greater control of fishing and the control of pollution. Miles Larby, clerk of the fishery board and chairman of the association of fishery boards, counselled caution and stressed that until scientists can prove any link between the transfer of the ISA virus between wild stocks and from fish, calm should prevail.

SCIENTIFIC JOURNALS

Pattern and prevalence of predator damage on adult Atlantic salmon, *Salmo salar* L., returning to a river system in north-east Scotland

Thompson P M; Mackay F

Fisheries Management and Ecology 6 (4):335-343

There remains considerable debate over the impact of predation upon Atlantic salmon, *Salmo salar* L., populations. The pattern and prevalence of predator damage on salmon returning to a river system in North-east Scotland were recorded. Overall, 214 (19.5%) out of 1099 fish sampled were damaged, and 10 distinct categories of damage were identified. Measurements of scratches indicated that the damage was caused by a number of different factors. In particular, damage typically attributed to seals was suggested to be the result of attacks by odontocete cetaceans. These results highlight the multispecies nature of interactions between salmon and their predators, but suggest that damage levels may be of limited use in assessing the impact of different predators on salmonid population dynamics.

Cessation of the Norwegian drift net fishery: changes observed in Norwegian and Russian populations of Atlantic salmon

Jensen A J; Zubchenko A V; Heggberget T G; Hvidsten N A; Johnsen B O; Kuzmin O; Loenko A A; Lund R A; Martynov V G; Naesje T F; Sharov A F; Okland F

ICES Journal of Marine Science 56 (1):84-95

The aim of this study was to evaluate effects of the ban on the Norwegian coastal drift net fishery in 1989 on the spawning run of Atlantic salmon (*Salmo salar*) populations in four Norwegian and four Russian rivers. Catches/escapements, size distribution, sea-age proportions, and mean weights of different sea-age groups were collected from official catch statistics and analyses of scale samples. In three of the Norwegian rivers, catches of grilse (1SW) increased significantly after the ban on the drift net fishery. No changes were recorded for multi-sea-winter (MSW) fish. In addition, the proportion of grilse increased in all the Norwegian rivers, and 2SW salmon increased in three of them. The mean weight of grilse increased in all four Norwegian rivers, whereas the mean weight of 2SW fish decreased in the two rivers in southern Norway. The size of 3SW fish did not change. These changes correspond well to actual net selection curves and reported mean weight of drift net catches in different parts of Norway. Trends in the Russian populations were more variable. In the three rivers draining to the Barents Sea, changes were similar to those in the Norwegian rivers. However, these changes were less obvious than those observed in Norwegian populations. The authors conclude that the ban of the drift net fishery significantly affected the structure of the spawning run in Norwegian Atlantic salmon populations. Furthermore, the results indicate that the drift net fishery affected Russian salmon populations in rivers draining to the Barents Sea to a lesser extent than Norwegian salmon, and had no effect in rivers draining to the White Sea.

Temperature-related loss of smolt characteristics in Atlantic salmon (*Salmo salar*) in the wild

McCormick S D; Cunjak R A; Dempson B; O'Dea M F; Carey J B

Canadian Journal of Fisheries and Aquatic Sciences 56 (9):1649-1658

Atlantic salmon (*Salmo salar*) that had previously been released as fry in tributaries of the Connecticut River were captured from 1993 to 1997 during their normal spring smolt migration 198 km from the mouth of the river. Smolts had peak levels of gill Na⁺,K⁺-ATPase activity and salinity tolerance early in migration (early May), indicating physiological readiness to enter seawater. Significant decreases in gill Na⁺,K⁺-ATPase activity (29-66%) and salinity tolerance were seen in smolts at the end of the migratory period (late May and early June). Reduced gill Na⁺,K⁺-ATPase activity occurred earlier in warm years and was directly related to the degree-days during migration ($r^2 = 0.75$). Reduced gill Na⁺,K⁺-ATPase activity was found at the end of migration in warmer, southern rivers (Connecticut River and Penobscot River, Maine) but not in northern rivers (Catamaran Brook, New Brunswick, and Conne River, Newfoundland). Both hatchery- and stream-reared fish held in the laboratory exhibited a more rapid loss of physiological smolt characteristics when held at higher temperature. The results indicate that late migrants in southern rivers lose physiological smolt characteristics due to high temperatures during spring migration. Delays in migration, such as those that occur at dams, may have negative impacts on smolt survival in warmer rivers.

Relationships between marine growth and marine survival of one-sea-winter Atlantic salmon, *Salmo salar* L., from the River Bush, Northern Ireland

Crozier W W; Kennedy G J A

Fisheries Management and Ecology 6 (2):89-96

An examination of marine growth/marine survival relationships in Atlantic salmon, *Salmo salar* L., was carried out, based on scale growth measurements in relation to two indices of marine survival in wild fish from the River Bush, Northern Ireland. The survival of cohorts to the Irish/Northern Irish coast (prefishery) and to fresh water was

statistically unrelated to variation in growth from smolt migration to the end of the first winter at sea ($P > 0.1$; $P > 0.7$). Marine growth of 1+ smolts decreased significantly during the period of the study ($P < 0.05$), but growth of 2+ smolts did not change ($P > 0.05$). The variability in marine growth was much less than the variation in natural survival at sea, suggesting that factors instead of, or in addition to, growth influence natural survival in the marine environment. Survival to fresh water was not related to survival to the coast ($P > 0.4$), although it was inversely correlated with exploitation rate ($P < 0.01$). These results are discussed in relation to the use of freshwater returns to assess marine survival and the potential for the variation in natural marine mortality to influence total life-cycle variation.

Infection with low numbers of the sea louse *Lepeophtheirus salmonis* induces stress-related effects in postsmolt Atlantic salmon (*Salmo salar*)

Nolan D T; Reilly P; Wendelaar Bonga S E

Canadian Journal of Fisheries and Aquatic Sciences 56 (6):947-959

Infection of postsmolt Atlantic salmon (*Salmo salar*) with three, six, or 10 preadult and adult sea lice (*Lepeophtheirus salmonis*) per fish resulted in changes to epithelial structure and at sites in the skin and gill, distant from lice attachment and feeding. In the skin, increased apoptosis and necrosis occurred in the superficial epithelial cells and numbers of mucous cells decreased. In the gill, where no lice were found, uplifting of the epithelium, intercellular swelling, and infiltration by leukocytes occurred in filaments and lamellae. High cell turnover of chloride cells was associated with significantly elevated gill Na^+/K^+ -ATPase activities. Serum chloride levels were elevated in the 3 and 6 lice/fish groups, and the serum Na to Cl ratio was lower in all parasitized groups at 5 days. The results indicate that infection with low numbers of the preadult and adult parasite induced changes characteristic of a stress response. In the low and medium-infested groups, homeostatic recovery had occurred by 10 days, but recovery was incomplete in the highly infected group. Thus, 10 lice per fish, which is a low infestation level in nature, is stressful and creates a long period during which the overall condition of the skin and gill epithelia may render the fish susceptible to secondary infections.

A history of identification to continent of origin of Atlantic salmon (*Salmo salar* L.) at West Greenland, 1969-1997

Reddin D G; Friedland K D

Fisheries Research (Amsterdam) 43 (1-3):221-235

Atlantic salmon caught in the commercial fishery at west Greenland have routinely been identified to continent of origin, viz., North American or European, since 1969, using the scale pattern recognition technique. Although specific details have varied over the 29-year period, the technique generally has remained the same. Discriminant analysis of scale samples collected in the commercial fishery (mixed samples) and a known origin database (training samples) collected in homewaters are used to identify the continental origin of individual fish. The proportions of North American salmon in the catch samples have ranged from a low of 34% in 1971 to a high of 75% in 1990. Comparisons of the North American proportions showed no consistent spatial trends; however, differences were noted in proportions with latitude along the West Greenland coast. The proportions of continent of origin, although varying annually, have generally shown an increasing proportion of North American salmon in recent years. Biological characteristics of individual salmon identified to continent of origin have been used in models to provide catch advice to managers for the West Greenland salmon fishery and to define the impacts of the fishery on salmon stocks.

How juvenile Atlantic salmon, *Salmo salar* L., respond to falling water levels: experiments in an artificial stream

Huntingford F A; Aird D; Joiner P; Thorpe K E; Braithwaite V A; Armstrong J D

Fisheries Management and Ecology 6 (5):357-364

The responses of juvenile Atlantic salmon, *Salmo salar* L., to an experimentally imposed drop in water level were studied in an artificial stream. In a pilot experiment, 20% of fish which had a feeding station in an area of riffle remained there throughout the period of low water level. The remaining riffle-dwelling fish moved into areas of deeper water, although not necessarily to the pool nearest their feeding station. Out of the fish which left the area, 89% moved in an upstream direction and 11% moved downstream. In a second experiment, which was designed to look in more detail at this response to de-watering, 95% of riffle-dwelling fish left when the water level dropped and moved into a pool, mostly within the 4-h period after water levels started to fall. Seventy-four per cent of fish which left moved upstream and the remainder moved downstream. There was a strong tendency to leave in an upstream direction as shallow areas began to dry out, and this tendency persisted irrespective of variability in fish size, prior social experience and the size of the home range prior to de-watering. It is suggested that the prior opportunity to explore alternative habitat may be an important determinant of response of riffle-dwelling salmon to a sudden drop in water level.

The phylogeography of European Atlantic salmon (*Salmo salar* L.) based on RFLP analysis of the ND1/16S rRNA region of the mtDNA

Verspoor E; McCarthy E M; Knox D; Bourke E A; Cross T F

Biological Journal of the Linnean Society 68 (1-2):129-146

The diversity and distribution of mtDNA haplotypes in Atlantic salmon (*Salmo salar* L.) from 13 river systems across the species' European range was investigated. Salmon were screened by agarose electrophoresis for variation in a 1400 base pair fragment spanning the ND-1 and 16S rRNA genes. The fragment was amplified by PCR and digested using the restriction endonucleases *Ava*II, *Dra*I, *Hae*III, *Hinf*I and *Rsa*I. Nine haplotypes were identified and resolved by parsimony analysis into two major clades. Clade I was ubiquitous and predominated in all samples while Clade II was restricted to eight out of 94 individuals in two of the 13 rivers. The first clade shows two sublineages whose frequency distribution is strongly associated with geography. One sublineage dominated in river systems draining into the Baltic sea and in Iceland, and the other in the river systems elsewhere in Europe. No geographical patterns were apparent within these regions but haplotype frequencies among samples, both within and outside the Baltic region, were significantly heterogeneous. Approximately 8% of haplotype frequency variation occurred among samples, 44% between Baltic and non-Baltic samples and 48% within samples. Baltic samples had a significantly lower haplotype and nucleotide diversity than non-Baltic samples. Current and historical factors potentially responsible for the observed levels and distribution of the haplotype variation are discussed.

Transmission of the monogenean *Gyrodactylus salaris*

Soleng A; Jansen P A; Bakke T A

Folia Parasitologica (Ceske Budejovice) 46 (3):179-184

The present study is focusing on the transmission of the monogenean ectoparasite *Gyrodactylus salaris* Malmberg, 1957, a major pathogen on natural populations of Norwegian Atlantic salmon, *Salmo salar* L. In laboratory experiments the transmission rate of *G. salaris* after direct host to host contact was positively correlated with water temperature (1.2, 4.7 and 12.2°C). The transmission of detached *G. salaris* in the planktonic drift was studied in field experiments where salmon parr were individually isolated for 24 hours in small wire mesh cages suspended in the water column. Ten out of 157 salmon parr (prevalence 6.4%, mean intensity 1.0) contracted *G. salaris* infections after this exposure. Furthermore, 200 uninfected marked salmon parr were released into the same area of the river. After 24 and 48 hours, respectively 18 and 19 marked parr were caught by electro-fishing. The prevalence of *G. salaris* was 44.4% (mean intensity 1.9) after 24 hours, rising to 57.9% (mean intensity 2.3) after 48 hours. Gyrodactylids have no specific transmission stage or swimming ability, but detached *G. salaris* drifting in the water column were found to infect salmon parr. However, the transmission rate was markedly higher to free-living fish, suggesting that transmission routes, such as indirect transmission from the substrate or direct contact transmission from infected live and/or dead fish, are relatively more important than transmission by drifting detached parasites.

Reproductive priming in mature male Atlantic salmon parr exposed to the sound of redd cutting

Moore A; Waring C P

Journal of Fish Biology 55 (4):884-887

The sounds of a wild female Atlantic salmon cutting a redd were associated with significant increases in the levels of plasma 17,20beta-dihydroxy-4-pregnen-3-one (17,20betaP) and of expressible milt in mature male parr, comparable with levels of the steroid and milt produced in parr exposed to the priming pheromone, prostaglandin F2alpha. Hence auditory cues may have a significant role in synchronising reproductive physiology in Atlantic salmon.

The impact of obstacles on the Pau River (France) on the upstream migration of returning adult Atlantic salmon (*Salmo salar* L.)

Chanseau M; Croze O; Larinier M

Bulletin Francais de la Peche et de la Pisciculture 0 (353-354):211-237

Radio-tracking of 114 returning adult Atlantic salmon on the Pau River during a 3-year study (1995-1997) was used to determine the impact of 31 of the 37 obstacles built on the river. Five obstacles located downstream of spawning areas have a major effect on upstream migration with respect to the proportion of fish being able to pass over and the migration delays. An improvement in the facilities allowing fish to pass over these obstructions would enable more than 80% of them (as opposed to 13% currently) to reach good spawning grounds. Migration delays can prevent a large proportion of the population from reaching the spawning grounds in time, and this is especially true for fish which enter the river later in autumn or fish which stop their migration for a "quiescent period" in the lower part of the river after being delayed by several obstacles. The lowest weirs (< 1.5 m) seem not to delay fish migration with most of the fish being able to pass over within 24 hours. Higher weirs (> 2.5 m) have variable effects on migration depending on the type of fishpass. Pool passes and natural bypass channels are the most efficient. Denil fishpasses with floor baffles are not very efficient and this is mainly due to limited operational flow and higher sensitivity to upstream flow level

variations. Effects of hydroelectric power plants without diversion depend on the location of fish pass entrances and the flow in the fishway: minimum effects on migration have been observed at plants fitted with fish passes with significant flow ($2\text{--}4\text{ m}^3/\text{s}$) located in the tailrace. The effect of plants with diversion canals, all fitted with fish passes at the dam, are related to the restricted flow in the by-passed section of the river. Dam flow discharge with values greater than 500 l/s/m of width at the confluence with the tailrace attract fish. Most upstream passing of obstacles (85.6%) occurs during the day. Only natural bypass channels enable a significant proportion of fish to pass over the obstacles at night.

Efficiency of a downstream bypass for Atlantic salmon (*Salmo salar* L.) smolts and fish behaviour at the Camon hydroelectric powerhouse water intake on the Garonne river

Croze O; Chanseau M; Larinier M

Bulletin Francais de la Peche et de la Pisciculture 0 (353-354):121-140

Three experiments were conducted from 1996 to 1998 at the Camon hydroelectric powerhouse water intake, on the Garonne River, to test the efficiency of a surface downstream bypass for Atlantic salmon smolts. This bypass was built into the trashrack itself at its left edge. The efficiency of the device was evaluated using the mark-recapture method. Smolt behaviour in the intake canal was studied using the radiotelemetry technique. In 1996, the bypass efficiency was low (34%). Radio-tracking showed that the bypass location was not responsible for its low efficiency, fish being detected most of the time in the vicinity of the bypass. Nevertheless, an unstable upwelling hid the device entrance. After installing submerged horizontal screen and plates upstream of the bypass entrance gate, the average efficiency increased to 73%. Good hydraulic conditions in the intake canal and good local hydrodynamics in the vicinity of the bypass entrance are essential to obtain a satisfactory downstream bypass efficiency. Intermittent nocturnal lighting has an effect on smolt behaviour in the intake canal by maintaining fish in directly lighted areas and on the rhythm of fish entry in the bypass, more fish being captured during the first part of the lighting off period. The catching of 7,715 wild salmonids has permitted the study of downstream migration rhythms at dam. Daily downstream migration peaks seems to be linked with high water discharge and/or an increase of water temperature. Moreover, downstream migration activity at a dam appears to be mainly nocturnal.

Efficiency of a downstream bypass as estimated by the mark-recapture technique and behaviour of Atlantic salmon (*Salmo salar* L.) smolts at the Bedous water intake on the Aspe River (France) monitored by radiotelemetry

Chanseau M, Larinier M; Travade F

Bulletin Francais de la Peche et de la Pisciculture 0 (353-354):99-120

Two experiments were conducted at the Bedous water intake on the Aspe River in 1995 and 1998 to test the efficiency of a downstream bypass for salmon smolts (*Salmo salar* L.). The surface bypass was located on the right bank a little way upstream from the trashrack. During the experiment period, the discharge into the bypass varied from $0.4\text{ m}^3/\text{s}$ to $1.2\text{ m}^3/\text{s}$, representing from 1.6% to 4.3% of the turbine discharge. The efficiency of the device was evaluated using the mark-recapture technique. The behaviour of smolts in the intake canal was studied using radiotelemetry. In 1995 the bypass efficiency was very low (with a success rate of 17%), due mainly to hydraulic conditions. A training wall was built in 1997 to reverse the flow pattern in the canal and to better guide the fish to the water intake of the bypass. The mean efficiency of the bypass was thus improved with 55% of the smolts being recaptured in the trap in 1998. The efficiency of the device and the smolt behaviour were directly affected by the turbine operation and the hydraulic conditions in the intake channel. It appeared that a smaller proportion of smolts of less than 19 cm in length were recaptured in the trap and that in spite of the tangential component of the velocity which created a louver effect, size selection was due to the spacing between the bars of the trashracks (30 mm). A light placed near the bypass entrance appeared to have no effect on the movement patterns of the smolts with the hydraulic factor being preponderant. However, the light did affect the rhythm of capture in the trap as more fish were captured when it was turned off.

The behaviour of returning adult Atlantic salmon (*Salmo salar* L.) in the vicinity of Baigts hydroelectric power plant of the Pau River as determined by radiotelemetry

Chanseau M; Larinier M

Bulletin Francais de la Peche et de la Pisciculture 0 (353-354) 239-262

The behaviour of 19 radiotagged adult Atlantic salmon (*Salmo salar* L.) was studied during the summer and autumn of three successive years (1995 to 1997) in the vicinity of the Baigts hydroelectric plant. Most of the time, the fish stayed away from the dam. Visits to the site and the time which they remained downstream were generally short lived (less than 1 hour), with the fish generally being within 300 m downstream from the plant. When fish were absent for a longer time, i.e. more than 6 hours, they were often observed in a pool located between 500 m and 1.2 kilometers downstream from the obstacle. Behavioural rhythmicity of fish was pointed out: they approached the plant mainly at dawn and were more prevalent and active during the day. Mean daily temperature and turbine discharge influenced salmon behaviour in the vicinity of the plant. Fish were more often found approaching the plant when the temperature

was higher than 16°C and stayed less time in the vicinity of the obstacle. Presence of fish in the tailrace and at the dam was influenced by temperature and by operation of the hydroelectric power plant with fish being less prevalent in the tailrace when temperature exceeded 20°C and more present at the dam when the turbine discharge was lower than 50 m³/s. Studies revealed that the plant impeded the upstream migration of salmon with fish being delayed up to 137 days and only a small percentage (34%) being able to pass over the obstacle. The location of the fish pass, at the opposite side of the tailrace, was not responsible for its poor efficiency since all fish were monitored near the entrance. The conditions encountered by fish at the entrance of the fish pass were not optimal with most of the visits lasting less than 5 minutes. Moreover, only 0.86% of the visits resulted in fish moving into the pass.

Efficiency of a downstream bypass and a behavioural acoustic barrier for Atlantic salmon smolts (*Salmo salar* L.) at the S. Cricq hydropower plant on the Ossau River (France)

Travade F; Gouyou C; De Faveri N

Bulletin Francais de la Pêche et de la Pisciculture 0 (353-354):157-180

An experiment was conducted in 1996 at the St. Cricq hydropower plant on the Ossau River with a view to testing two downstream migration devices designed to prevent Atlantic salmon smolts (*Salmo salar* L.) from entering the turbines. The first, at the dam, consisted in a deterrent acoustic barrier, designed to direct smolts toward a flap gate. The sound field, generated by 16 underwater sound projectors, was within the 100-600 Hz range with a maximum sound level of 120-130 dB. The second, at the powerhouse forebay, was composed of a surface bypass located on the bank in the immediate vicinity of the trashrack. The efficiency of the two devices was evaluated by means of marking-recapture, and the behaviour of the smolts was monitored by radiotelemetry. Smolts passage over the flap gate ranged from 20 % to 60 %; this efficiency appeared essentially due to the strong discharge through the flap gate. Tests performed with and without the acoustic barrier revealed no significant effect due to the sound field. The efficiency of the surface bypass in the forebay was found to be about 80%. This good result may be explained by the small width of the intake (11 m), the narrow spacing of the bars in the trashrack (2.5 cm), the hydraulic conditions in front of the trashrack, which rapidly guided the fish toward the entrance to the bypass, and the configuration of the bypass entrance, which created flow with a low velocity gradient.

A study of Atlantic salmon (*Salmon salar* L.) smolt behaviour at the Pointis hydroelectric powerhouse water intake on the Garonne River and an estimate of downstream migration over the Rodere dam

Croze O; Larinier M

Bulletin Francais de la Pêche et de la Pisciculture 0 (353-354):141-156

An experiment was conducted in 1998 at the Pointis water intake, on the Garonne River, to define a location for a future downstream bypass for Atlantic salmon smolts. The study of the movements of 28 radio-tagged smolts revealed that under low hydraulic conditions (flow velocities < 0.5-0.6 m/s), the smolts maintain their position for a significant time (median time greater than one day) in the intake canal, despite the large spacing (5 cm) between the bars of the trashrack. During this time, they explore the whole area of the intake canal above the trashrack. A light placed on the left bank just upstream from the trashrack concentrated the fish on the same bank as the lamp, in the vicinity of the lighted area. The proportion of fish passing downstream from the Rodere dam itself was estimated. This dam, located downstream from the Pointis plant, supplies the Camon hydroelectric powerhouse. It appeared that the proportions of smolts passing through the Rodere dam were related to the ratio of discharge at the dam to the total Garonne flow: 70% of the smolts passed by when the discharge at the dam corresponded to 40-50% of the total Garonne flow. The time taken by radiotagged smolts to go from the Pointis plant to the Camon powerhouse (5.4 km) varied from 1 hour 17 minutes to 12 days with a median value of more than one day, and depended on river discharges. The downstream displacements in the intake canals of Pointis (1.9 to 4.2 km/h) and Camon (2.5 to 7 km/h) were positively correlated with flow velocities.

Prior residence, territory quality and life-history strategies in juvenile Atlantic salmon (*Salmo salar* L.)

Cutts C J; Brembs B; Metcalfe N B; Taylor A C

Journal of Fish Biology 55 (4):784-794

Three groups of juvenile salmon were introduced sequentially into an artificial stream to investigate the effects of prior residence on behaviour and territory choice. Almost half of the first group obtained and defended distinct territories, the other half being constrained to an area approximately the size of one large territory. All of the fish in the subsequent groups, bar one, were also constrained to the same site. Since the fish were of similar size, prior residence alone seemed to influence which individuals obtained territories. However, within the first group, the fish that obtained territories were larger and more aggressive. The territorial fish did not appear to choose the most profitable territories, although they had the greatest opportunity to do so. Since juvenile salmon emerge from their gravel nests fairly synchronously, a time constraint on site sampling is hypothesised: there may be a risk in taking time to sample sites,

since these same sites may become occupied with conspecifics. However, fish with territories fed at faster rates than non-territorial fish, possibly because of reduced competition for prey items. Consequently, fish from the first group (containing most of the territorial fish) grew faster than the other two groups. Moreover, most of the territory holders, but only one of the non-territorial fish, reached the threshold size that increases their probability of smolting the following year. This suggests that ability to obtain a defensible territory, primarily through prior residence, influences the age at which juvenile salmon can migrate to sea.

Aggressive interactions in pure and mixed groups of juvenile farmed and hatchery-reared wild Atlantic salmon *Salmo salar* in relation to tank substrate

Mork O I; Bjerkeng B; Rye M

Aquaculture Research 30 (8):571-578

Total aggression and individual behavioural traits of equal-sized juveniles of farmed Atlantic salmon *Salmo salar* selected for five generations in the Norwegian Breeding Programme for Salmonids and a wild strain originating from the River Rauma, Norway, were compared in pure (10 fish) and mixed (5 + 5 fish) groups. Total aggression was defined as the sum of the following five offensive behaviour patterns: intentional movements, lateral display, frontal display, charge and bite. Experiments were carried out in 2m² tanks with either a grey fibreglass substrate (pure and mixed groups) or diagonally divided into a fibreglass and river cobble substrate (mixed groups only.) In mixed groups kept on a fibreglass substrate, the aggressive behaviour directed by wild salmon towards farmed salmon was more frequent than the reverse (84.2 and 27.0 aggressive acts h⁻¹, respectively, $P < 0.025$). Total aggression was not significantly different between wild and farmed juveniles in tanks with divided substrate. The aggressive behaviour of wild and farmed salmon was significantly increased when kept in tanks with fibreglass substrates (437%, $P < 0.005$, and 296%, $P < 0.05$ respectively.) Pure groups of either wild or farmed salmon kept on a fibreglass substrate exhibited similar frequencies of total aggression (85.7 and 101.6 0 aggressive acts h⁻¹, respectively, $P > 0.1$) and single behaviour patterns. The aggressive behaviour of farmed offspring was not influenced by vertical distribution in the tanks with a fibreglass substrate. Farmed salmon tended to position pelagically (78%) and used the water column more frequently than wild salmon (19%), whereas wild salmon hid more. It is concluded that social interactions among groups of juvenile Atlantic salmon are influenced by substrate.

Nocturnal habitat use of Atlantic salmon parr in winter

Whalen K G; Parrish D L

Canadian Journal of Fisheries and Aquatic Sciences 56 (9):1543-1550

We completed 22 night snorkeling surveys between November and March 1995-1997 to quantify Atlantic salmon (*Salmo salar*) parr habitat use relative to habitat availability in the Rock River, Vermont, U.S.A. On average, post-young-of-the-year (PYOY) parr selected greater water depths in winter than young-of-the-year (YOY) parr, whereas YOY and PYOY parr both selected water velocities (≤ 19 cm/s) that were significantly lower than random measurements (46 cm/s). Maturity of PYOY parr had no significant influence on habitat selection. The majority of YOY and PYOY parr at night were found in contact with the stream bottom resting on silt-sand or gravel substrates in velocity dead-zone habitats created by the stream edge or depositional habitats created by midstream rocks and boulders. The strong selection that nocturnal Atlantic salmon parr exhibit for low water velocity areas in winter indicates the importance of maintaining large instream cover that provides refuges from high flows. The similarity that YOY and PYOY parr exhibited in many elements of habitat selection suggests that both stages may be similarly susceptible to habitat limitations in winter.

Microsatellite genetic variation between and within farmed and wild Atlantic salmon (*Salmo salar*) populations

Norris A T; Bradley D G; Cunningham E P

Aquaculture 180 (3-4):247-264

Genetic diversity between three farmed and four wild populations of Atlantic salmon from Ireland and Norway were analysed using 15 microsatellite markers. High levels of polymorphism were observed over all populations with the average number of alleles and average heterozygosity at 17.8 and 0.70, respectively. Farmed salmon showed less genetic variability than wild salmon in terms of allelic diversity but not necessarily in terms of overall heterozygosity. Between farmed populations significant differences were observed in expected heterozygosity suggesting that more intensive breeding practices may have resulted in a further erosion of genetic variability. Phylogenetic analysis using either populations or individuals as nodes show a clustering of populations into two groups, farmed and wild. This suggests that founder effects and subsequent selection have had more effect on the genetic differentiation between these strains than geographical separation. This technology has great potential for use in aquaculture situation where levels of genetic variation could be monitored and inbreeding controlled in a commercial breeding program.

The efficacy of emamectin benzoate as an oral treatment of sea lice, *Lepeophtheirus salmonis* (Kroyer), infestations in Atlantic salmon, *Salmo salar* L.

Stone J; Sutherland I H; Sommerville C S; Richards R H; Varma K J

Journal of Fish Diseases 22 (4):261-270

The efficacy of emamectin benzoate as an oral treatment of sea lice, *Lepeophtheirus salmonis* (Kroyer), infestations in Atlantic salmon, *Salmo salar* L., was evaluated in a dose titration study and two dose confirmation studies. Replicated groups of salmon with induced infestations of sea lice were given emamectin benzoate on pelleted feed at doses of 0, 25, 50 and 100 $\mu\text{g kg}^{-1}$ biomass day^{-1} for seven consecutive days. Sea lice were counted at 7, 14 and 21 days from the start of treatment, and comparisons made with control fish given the same diet without emamectin benzoate. Total numbers of sea lice were significantly reduced at all doses in all three studies when compared to control fish. There was no significant difference between doses of 50 and 100 $\mu\text{g kg}^{-1}$, but the 50 $\mu\text{g kg}^{-1}$ dose resulted in significantly fewer lice than the 25 $\mu\text{g kg}^{-1}$ dose. Emamectin benzoate was highly effective in reducing numbers of pre-adult and adult lice and prevented the maturation of chalimus to motile stages. The optimum therapeutic dose was selected as 50 $\mu\text{g kg}^{-1}$ day^{-1} for seven days. Treatment reduced the incidence of epidermal damage by sea lice and, in one study, survival of treated fish was 48% higher than in control groups. No fish mortalities or adverse effects were attributed to treatment with emamectin benzoate at any of the doses tested.

Evaluation of an alternative strategy to enhance salmon populations: Cage rearing wild smolts from Conne River, Newfoundland

Dempson J B; Pepper V A; Furey G; Bloom M; Nicholls T; Hoskins G

ICES Journal of Marine Science 56 (4):422-432

Five-thousand wild Atlantic salmon (*Salmo salar* L.) smolts from Conne River, Newfoundland, were captured during their downstream migration in May 1995, and transferred to an estuarine aquaculture rearing site at Roti Bay, 23 km away. Survival was monitored throughout the experiments. The greatest mortality occurred in July, approximately 6-8 weeks following transfer. Survival of smolts to one-sea-winter salmon was 18.5%, over four times higher than the average survival of wild salmon to Conne River during the past 6 years. Growth was monitored at monthly intervals until November 1995, with additional sampling in the spring and early summer of 1996. Survivors were split into two groups and released directly into the Bay d'Espoir fjord; one group was released 27-28 June 1996, at a site approximately 7 km from the mouth of Conne River. The second group was retained at Roti Bay and released 23 July 1996. Lotek radio transmitter tags were used in evaluating the success of the experiment by tracking migration timing and subsequent distribution of cage-reared salmon throughout the Conne River system. Approximately 80% returned to Conne River and 20% strayed to other streams. Less than 50% of the surviving fish were later accounted for in local Bay d'Espoir rivers. Results are discussed in relation to the utility of this technique to enhance salmon populations.

Induction of hepatic estrogen receptor in juvenile Atlantic salmon in vivo by the environmental estrogen, 4-nonylphenol

Yadette F; Arukwe A; Goksoyr A; Male R

Science of the Total Environment 233 (1-3):201-210

Alkylphenol ethoxylate degradation products such as nonylphenol and octylphenol are shown to have estrogenic effects. Nonylphenol induces synthesis of vitellogenin (a precursor of egg yolk proteins) and zona radiata proteins (egg shell proteins) in juvenile and/or male fish. Little is known about the molecular mechanisms of estrogenicity of environmental chemicals such as nonylphenol. To study the mechanisms of estrogenic effects of 4-nonylphenol (NP), we examined its in vivo effects on the expression of the estrogen receptor (ER), vitellogenin (Vtg) and zona radiata protein (Zrp) genes in juvenile Atlantic salmon liver. We show that the ER mRNA synthesis is induced by NP in a dose-dependent manner in juvenile Atlantic salmon liver. The induction of the ER mRNA synthesis is followed by the induction of Zrp and Vtg mRNA synthesis. The ER transcripts reach peak levels earlier than the Zrp and Vtg mRNA and proteins, which is in agreement with the physiological effects of estradiol during zonation and vitellogenesis. Various studies have also shown that NP competitively inhibits the binding of 17 β -estradiol (E2) to ER. Our results further suggest that NP directly mimics E2 in inducing the ER, Zrp and Vtg genes in salmon liver.

Devices to aid downstream salmonid migration: behavioral barriers

Gosset C; Travade F

Cybiu 23 (1 supply):45-66

Two behavioral guidance devices, one electric screen and one sonic screen, were tested in the intake canal of the Halsou hydropower plant on the River Nive (France). The purpose of such devices is to guide the salmon smolts (*Salmo salar*) towards a by-pass before they pass through the turbines. This study was conducted from 1995 to 1997 on a wild salmon population. The efficiency of the devices was evaluated by mark-recapture techniques and double trapping. Smolt behavior was studied by direct observations, video recording and radio-tracking. The influence of the electric parameters of the screen, of water velocity, bypass shape and lighting of the bypass was studied. The guidance

effect of the electric screen was observed, but this effect is frequently no more than partial and is not effective for all fish. Complementarity between the screen and the bypass did not prove satisfactory: many smolts are guided by the screen but do not want to enter into the bypass. The maximum efficiency of the electric screen, obtained with the adjustment "130 V - 10 electric pulses" varied from 5 to 28. Under the same experimental conditions, the sonic screen was found to have no effect on smolt behavior. Lighting of the bypass entrance with a mercury vapor lamp during the night resulted in a spectacular rise in its efficiency, which can reach 70%.

Competitive asymmetries in territorial juvenile Atlantic salmon, *Salmo salar*

Cutts C J; Metcalfe N B; Taylor A C

Oikos 86 (3):479-486

Many animals may face brief periods of extreme intraspecific competition for resources, an example being when populations of territorial species first migrate into a habitat. The factors that determine an individual's success in obtaining a territory will then depend on its relative competitive ability, which in turn is influenced by many potential asymmetries between contestants. Here we compare the relative importance to competing Atlantic salmon fry of several such asymmetries (size, prior residence and relative Standard Metabolic Rate (rSMR)) that have previously been suggested to be important when examined in isolation. Concurring with earlier studies, SMR was higher in the earliest fry from a nest to begin feeding and was a better predictor of dominance than body size in pairwise contests for territories. However, prior residence (where one fish was resident on a territory for 48 h before the arrival of the other) was found to be the best predictor of dominance, masking any effect of relative SMR. Moreover, body size also played a role in encounters involving a prior resident, as an intruder was more likely to displace a resident territory holder if it was larger. The outcome of competition for territories among dispersing salmon fry is therefore likely to be a complex interaction between these asymmetries.

Aqueous aluminium eliminates *Gyrodactylus salaris* (Platyhelminthes, Monogenea) infections in Atlantic salmon

Soleng A; Poleo A B S; Alstad N E W; Bakke T A

Parasitology 119 (1):19-25

This study focuses on the effect of acidic water and aqueous aluminium on the monogenean ectoparasite *Gyrodactylus salaris*, infecting Atlantic salmon (*Salmo salar*) parr. *G. salaris*-infected salmon were exposed to various combinations of acidity and aluminium concentrations. The most pronounced effect was the elimination of parasites after 4 days when 202 µg Al/l was added to the water. The effect of aluminium was concentration dependent, but was relatively independent of pH (5.2, 5.6 and 5.9). At the lowest pH of 5.0 the effect of aluminium was enhanced. Acidic aluminium-poor water had no or minor effects on the *G. salaris* infections except at pH 5.0 where all parasites were eliminated within 9 days. The *G. salaris* populations increased exponentially in untreated control water. The results show for the first time that aqueous aluminium can, to a limited extent, have a positive effect on fish health. This study emphasizes that basic knowledge about abiotic environmental factors is of importance in order to understand the population dynamics, range extension and dispersal of ectoparasites such as *G. salaris*. Finally, our results suggest that aluminium treatment could form an effective disinfection method against ectoparasites in hatcheries and laboratories, as well as complementing the controversial rotenone treatments used against natural populations of *G. salaris*.

Return migration of Atlantic salmon in the River Tana: the role of environmental factors

Erkinaro J; Okland F; Moen K; Niemela E; Rahiala M

Journal of Fish Biology 55 (3):506-516

Multi-sea-winter Atlantic salmon (75-115 cm fork length LF, 2-4-winter fish) were radio-tagged in the Tanafjord (70°N), Norway, in 1992-1993, and 130 fish entered the large subarctic River Tana (Teno). They entered the fresh water at any time of the tidal cycle but more so during the high and ebbing tides. No diel rhythm was detected in river entry under polar day conditions. There were no differences in the change of flow between days when salmon moved and when they did not, but during active migration increasing discharge was associated with increased swimming activity of salmon, especially later in the summer. Increasing air temperature was also associated with enhanced migration activity. Low river flow was associated with increasing delay in salmon passing the first riffle area of the river, 35 km from the sea.

Favorable foraging locations for young Atlantic salmon: Application to habitat and population restoration

Nislow K H; Folt C L; Parrish D L

Ecological Applications 9 (3):1085-1099

Declines in the populations of salmonid fishes have generated major interest in conservation and restoration of wild populations and river habitats. We used a foraging-based model, combined with field observations and surveys, to predict individual habitat use, and to assess the effects of stream habitat conditions and management practices on the

potential for re-establishing Atlantic salmon, *Salmo salar*. Using a model based on a simple trade-off between increasing prey encounter rate and decreasing salmon capture success with increasing stream current velocity, we predicted favorable foraging locations for salmon in their first (age-0) spring and summer. We tested, in six streams, whether (1) salmon preferred locations (=microhabitats) that were predicted to yield high consumption rates, (2) salmon growth and survival was greater in streams with a greater proportion of preferred, profitable, microhabitats, and (3) stream habitat remediation (introduction of large in-stream structures such as large woody debris) increased the availability of microhabitats found to be preferred by salmon, and energetically profitable. Salmon early in their first season (May-June) were predicted to obtain the highest consumption rates (within 10% of maximum) in microhabitats with a narrow range of relatively slow current velocities (0.08-0.18 ms⁻¹). In contrast, later in the season (July-August) fish were predicted to obtain highest consumption rates over a wide range of fast current velocities (0.21-0.57 ms⁻¹). Salmon in both the early and late seasons showed strong preferences (use in proportion to availability) for microhabitat in velocity categories predicted to provide high consumption. Streams with the greatest proportion of preferred early-season, but not late-season, microhabitats retained a higher proportion of salmon as measured at the end of the first summer. Stream habitat remediation increased the amount of preferred early-season microhabitat and did not negatively affect invertebrate prey abundance, or the amount of preferred late-season microhabitats. Thus, the availability of favorable foraging areas for juveniles significantly improves the retention of salmon during the critical first summer, and stream remediation provides better foraging habitat during this important period. Our results are encouraging for broader application to identify sites that show promise for salmon reintroduction, and to help guide restoration of particular sites to provide suitable habitat.

Threshold values of river discharge and temperature for anglers' catch of Atlantic salmon, *Salmo salar* L.

L'Abée-Lund J H; Aspas H

Fisheries Management and Ecology 6 (4):323-333

The catch by anglers of adult Atlantic salmon, *Salmo salar* L., was studied over a 5-year period in the River Gaula, Norway. Atlantic salmon were caught over a wide range (23-570 m³s⁻¹) of the observed extent of river discharge (13-950 m³s⁻¹) and throughout the range of temperature (4-23°C), but both factors strongly affected catch rate. Significant correlations between the number of Atlantic salmon caught daily, and water temperature ($r = 0.33$) and river discharge ($r = -0.42$) were found in 1987 and 1989, respectively. The highest daily catch occurred between 50 and 150 m³s⁻¹, and at temperatures between 13 and 16°C. Threshold values for water discharge and temperature were found to exist at 250 m³s⁻¹ and 8°C, with the highest catches below and above these values, respectively.

Density-dependent habitat selection by juvenile Atlantic salmon (*Salmo salar*) in experimental riverine habitats

Bult T P; Riley S C; Haedrich R L; Gibson R J; Heggenes J

Canadian Journal of Fisheries and Aquatic Sciences 56 (7):1298-1306

We investigated habitat use of Atlantic salmon (*Salmo salar*) parr in experimental riverine enclosures made up of pool, riffle, and run habitats over a range of densities (0.1-1.25 fishcntdotm⁻²) to test the implicit assumption in habitat modelling that habitat selection does not change with population density. Results indicated that habitat use changed with population density, with relatively more parr in pools and fewer in runs at higher population densities. Temperature influenced parr distribution, with relatively more parr in runs and fewer in riffles and pools at higher temperatures. Parr distribution was primarily affected by hydromorphological differences among pool, riffle, and run habitats. Effects of population density and temperature on use of pool, riffle, and run habitats were often as large as effects of hydromorphological differences among pool, riffle, and run habitats on fish distributions over the range of temperatures and densities observed. Results varied considerably, despite controlled experimental conditions. We concluded that habitat selection by juvenile Atlantic salmon parr may be density dependent and potentially quite variable.

Revealing trends in densities of juvenile Atlantic salmon, *Salmo salar* L., in the subarctic River Teno using cluster analysis on long-term sampling data

Niemela E; Julkunen M; Erkinaro J

Fisheries Management and Ecology 6 (3):207-220

The density of juvenile Atlantic salmon, *Salmo salar* L., was monitored at 57 sites representing different habitats in the River Teno and two of its major tributaries from 1979 to 1995. Cluster analyses were used to combine sites with similar densities and to study trends in densities within clusters. It was found that management measures have played an important role in maintaining salmon stocks and there was some evidence of increasing juvenile salmon densities. Parr densities decreased significantly in one cluster containing 45% of the sites studied in the River Utsjoki, whereas densities increased significantly in one cluster in the River Teno and in one cluster in the River Inarijoki containing 38% of the sites in these rivers. Fry densities increased significantly in two clusters containing 16% of all the sites

studied in the three rivers. In general, the mean densities in successive years in the clusters were independent. The results demonstrate the value of long-term monitoring in ecological investigations.

Spatial association of genetically similar Atlantic salmon juveniles and sex bias in spatial patterns in a river

Mjølnerød I B; Refseth U H; Hindar K

Journal of Fish Biology 55 (1):1-8

Atlantic salmon (*Salmo salar*) juveniles were electrofished along a 300-m stretch of a river to test for possible associations between genetic similarity and geographical distance between individuals. Multilocus DNA fingerprinting showed that genetically similar juveniles (1-4 years old) were found closer together in the river than less related individuals. However, the association between genetic similarity and geographical distance, although significant, was not strong. This may indicate that factors other than genetic relatedness influence the positioning in the river. A sex bias in the relationship between genetic similarity and geographical distance was caused by a difference between sexually mature and immature males. The study shows that sampling of salmon juveniles should be spread over a wide stretch of the river in order to avoid sampling relatives. Moreover, by including several year classes, the overall degree of genetic similarity is effectively reduced compared with sampling individuals of similar age.

Growth patterns in post-smolts and the nature of the marine juvenile nursery for Atlantic salmon, *Salmo salar*

Friedland K D; Dutil J D; Sadusky T

Fishery Bulletin (Washington D C) 97 (3):472-481

We examined scale samples from historical collections of post-smolts from the Gulf of St. Lawrence, Canada, with the aim of understanding the role of estuarine and coastal habitats as a juvenile nursery for Atlantic salmon. Circuli spacing patterns were extracted from the scales of 580 post-smolts collected in the Gulf during three seasons, 1982-84. Post-stratification of the samples by collection date within year suggests that in some years post-smolts remain in the Gulf throughout the entire summer growth season, whereas in other years only slower growing fish remain in these area. Growth patterns for Gulf of St. Lawrence post-smolts were compared with patterns for returns from three salmon stocks from the southern end of the range in North America. These data suggest that in some years post-smolt growth in the Gulf is as robust as that observed for both the one seawinter (1SW) and two seawinter (2SW) returns to southern rivers. Post-smolts are believed to use oceanic nursery areas generally; thus, comparable growth between the two stock groups suggests that the Gulf may serve as an important part of the post-smolt nursery range in some years. The concept of the post-smolt nursery as a continuum between neritic and oceanic areas is essential to evaluating ocean climate and productivity effects on salmonid recruitment.

Life-history patterns in a southern population of Atlantic salmon

Utrilla C G; Lobon-Cervia J

Journal of Fish Biology 55 (1):68-83

Juvenile Atlantic salmon *Salmo salar* in the river Esva, Asturias, north-west Spain, developed a bimodal growth pattern during their first growing season. Segregation between the two modes was apparent by late autumn. All fish in the upper modal group (UMG) grew throughout the year and migrated downstream in the following spring (by April) at the age of 14 months. Some lower modal group (LMG) fish (56% of the main stem, 31% and 50% of the two tributaries) silvered like smolts and apparently migrated downstream the same spring, although c. 1.5 months after UMG fish. Larger LMG fish appeared more likely than smaller ones to migrate. LMG fish did not grow in winter, but they grew fast between March and May. Maturing male parr were detected first at 5 months old in July, and they occurred initially among the faster growers, >6.8 cm long. In spite of this, length of maturing males did not change from late summer and throughout the winter, whereas that of non-maturing UMG and LMG fishes continued to diverge from September onwards. These findings suggest that favourable conditions for growth (very early start of a long growing season) at the southern limit of the species' range may influence the life-history pattern of this population.

Sea migration patterns in the Atlantic salmon: a comparative study of two stocks and their hybrids

Kallio-Nyberg I; Koljonen M L

Boreal Environment Research 4 (2):163-174

The sea migration patterns of the Atlantic salmon in the Baltic Sea were examined in a crossing and transplantation experiment. Two genetically different salmon stocks originating from rivers Neva and Iijoki and their hybrids were released as smolts (6 561, 485 and 993 smolts, respectively) into the estuary of the Kymijoki, in the Gulf of Finland. The spatial and temporal marine distributions of the experimental groups were analysed from tag recovery data received during 3½ years (42 months) after release. The recovery rate was 6.5%-17.5%. Multi-way contingency analysis showed that the spatial distributions of the stocks differed in the sea. The feeding migration distance of the

hybrids was longer than that of the parental Neva stock, and the male line affected the spatial marine distribution of the hybrids more than did the female line. Genetically different parental stocks showed no significant difference in migratory behaviour in this experiment. No differences were recorded in the temporal distributions of the stocks in the sea. The observed differences confirm that the sea migration pattern is a stock-specific, inherited trait. The longer migration pattern of hybrid stocks than that of parental stocks may be due to coadaptive gene combinations that break down in crossing or to a high phenotypic variation in parents within the stocks.

Densities of juvenile Atlantic salmon (*Salmo salar* L.) in the subarctic Teno River watercourse, northern Finland

Niemela E; Julkunen Mu; Erkinaro J

Boreal Environment Research 4 (2):125-136

Changes in juvenile wild Atlantic salmon densities in the subarctic Teno River watercourse, northern Finland, have been studied and recorded since 1979 at 57 sites representing different biotypes. Densities were very low in the first few years, after which there was substantial variation. The lowest and highest mean densities of fry at a site in the Teno River were 0.2 and 135 fish per 100m², respectively; respective values for parr were 0.9 and 50 fish per 100m². The lowest and highest values in the Utsjoki, a river in northern Finland, were 0.1 and 136 fish per 100m² for fry and 2.3 and 71 fish per 100m² for parr. The highest densities of fry and parr ever recorded in the Teno River were 424 and 106 fish per 100m², respectively. The annual densities of fry and parr were interdependent only in a few cases. Different densities in some other northern rivers relative to those in the Teno watercourse might reflect the different fishing culture, but also the stocking of juveniles can increase densities, thus hampering the interpretation. The densities of juvenile salmon fluctuated within sampling sites and between years, primarily as a result of fluctuations in the spawning stock, which is strongly affected by changes in the in-river fishing effort. Fluctuations in the juvenile salmon densities are obviously not affected by predation as the proportion of other species in the juvenile salmon's habitat is low. Parr densities in the Teno River catchment are on average clearly lower than those found in rivers which lack a diverse net fishery. Several fishing regulations set after the year 1984 have functioned only partly. Juvenile densities have not crashed despite the increased in-river exploitation by rod and reel anglers but densities of the juvenile salmon have not increased either.

Return migration of the Atlantic salmon in the Tana River: distribution and exploitation of radiotagged multi-sea-winter salmon

Erkinaro J; Okland F; Moen K; Niemela E

Boreal Environment Research 4 (2):115-124

A total of 174 multi-sea-winter Atlantic salmon (75-115 cm fork length) were radiotagged in the Tanafjord in 1992-1993 and their upstream migration and exploitation in the Tana River (Teno) were studied. Of the tagged fish, 75% and 77% entered the river, and 40% and 69% of them were later recaptured in 1992 and 1993, respectively. The lower 60 km of the river accounted for 36% of the recaptures. Gillnets and weirs took 68% of the fish recaptured in the river in 1992 but only 40% in 1993, the rest being caught by rod and line. Weirs caught more recently entered salmon than gillnets. The rod and line fishery caught smaller fish than gillnets and weirs. There were no differences in the size distributions between the initially tagged salmon, those that entered the river, were recaptured in the river, or the ones survived until spawning. Exploitation rates (n recaptured fish/n entered the river) were the highest in the upper reaches of the river system.

Migration timing of Atlantic salmon smolts relative to environmental and physiological factors

Whalen K G; Parrish D L; McCormick S D

Transactions of the American Fisheries Society 128 (2):289-301

We determined the migration timing of fry-stocked smolts of Atlantic salmon *Salmo salar*, relative to environmental and physiological factors, by using net weirs and counting fences in three tributaries of the West River, Vermont. Smolt migration began in late April and early May when water temperature was 5°C, peak movements occurred in early and mid-May at temperatures exceeding 8°C, and migration was complete by early June. Within this seasonal window, significant differences in migration timing and gill Na⁺,K⁺-ATPase activity occurred among tributaries. In both years of the study, smolts tended to migrate earlier and exhibit greater gill Na⁺,K⁺-ATPase activity in the warmest tributary than in the coolest tributary. Smolt migration timing differed most among tributaries in mid-May when (1) water temperatures were more than 8°C, (2) smolts peaked in gill Na⁺,K⁺-ATPase activity, and (3) discharge peaked, stimulating smolt migration. Smolts captured after the migratory period had lower gill Na⁺,K⁺-ATPase activity than migrating smolts. Relating smolt physiology to migration was crucial for explaining complex interactions among water temperature, discharge, and smolt behavior during both the onset and cessation of migratory activity. Because the period between onset of migration and loss of smolt physiological characteristics may be brief, delays in downstream passage that may occur at dams must be minimized to maximize the successful recruitment of smolts to the marine environment.

Spatial distribution of Atlantic salmon parr (*Salmo salar* L.) and bullhead (*Cottus gobio* L.) in lotic and lentic habitats of a diversified watercourse in northern Fennoscandia

Jorgensen L; Amundsen P-A; Gabler H-M; Halvorsen M; Erkinaro J; Niemela E
Fisheries Research (Amsterdam) 41 (2):201-211

In 1979, bullheads (*Cottus gobio* L.) were registered for the first time in the River Utsjoki (70°N, 27°E), a large tributary of the River Tana, which is one of the most important Atlantic salmon (*Salmo salar* L.) rivers in the world. The bullhead was probably introduced into the river by man. The occurrence of bullheads in the River Utsjoki has raised the question of whether their presence may reduce the production of salmon smolts by occupying, e.g., favourable salmon habitats. The spatial distribution of bullheads and salmon parr was investigated by electrofishing in different river habitats and by gillnetting in 13 lakes in the watercourse. Salmon and bullheads were segregated predominantly along the river reaches, and there was an inverse relationship between the densities of the two species at individual localities. Almost all bullheads (98%) were caught within 50 m of a lake, while they were almost completely absent from typical river reaches which were the principal habitat of salmon parr. Different physical conditions seemed to explain the different densities of salmon parr in the different parts of the watercourse, while the presence of bullheads appeared to have little or no influence. Both salmon parr and bullheads inhabited a number of lakes in the watercourse, coexisting with grayling (*Thymallus thymallus* (L.)), whitefish (*Coregonus* spp.) and burbot (*Lota lota* (L.)), among other species.

Swimming speed and morphological features of mixed populations of early maturing and non-maturing fish

Boucher E; Petrell R J
Aquacultural Engineering 20 (1):21-35

Positional and temporal variations in swimming speed and some morphological attributes were assessed in various mixed populations of early maturing (grilse) and non-maturing Atlantic salmon (*Salmo salar* L.) to examine the potential of using such data to improve grilse management and predict the percentage of the grilse in a population. Bimodal distributions, which could have been used to estimate the percentage of the grilse, were not observed; the data from all the sets were normally distributed with a single mode. Significant positional and temporal variations in swimming speed and condition factor were found, which implied that the maturing and non-maturing salmon segregated from each other. An improved grilse removal system may be developed if the fish can be induced to segregate under controlled condition.

Movements of two strains of radio-tagged Atlantic salmon, *Salmo salar* L., smolts through a reservoir

Aarestrup K; Jepsen N; Rasmussen G; Okland F
Fisheries Management and Ecology 6 (2):97-107

Smolt migration through a shallow and turbid hydro-reservoir in a major Danish river system was investigated using radiotelemetry. Hatchery-reared 1+-year-old Atlantic salmon, *Salmo salar* L., smolts of equal size from two different non-native strains were radio-tagged and followed during their downstream migration through the 12-km-long reservoir. A total of 50 salmon smolts, 25 of Swedish (Atran River) and 25 of Irish (Burrishoole River) origin, were surgically implanted with miniature radiotransmitters. The tagged smolts were tracked daily over a 3-week period in May 1996. The Atran smolts initiated migration first ($P < 0.001$), moved faster ($P < 0.01$), were delayed less when passing a culvert ($P < 0.001$) and were more successful in moving through the reservoir than the Burrishoole smolts. The observed differences in migratory behaviour are interpreted as evidence of a genetic component influencing smolt migration.

Movements of adult Atlantic salmon through a reservoir above a hydroelectric dam: Loch Faskally

Gowans A R D; Armstrong J D; Priede I G
Journal of Fish Biology 54 (4):727-740

Movements of adult Atlantic salmon were determined as they migrated through Loch Faskally, a 4-km long hydroelectric reservoir in North-east Scotland. The horizontal and vertical movements of four salmon were monitored for periods of 4-7 days using depth-sensing acoustic transmitters in June-July 1995. Each fish began sustained directed upstream movements within 5.5 h after release at swimming speeds of 0.15-0.40 bl s⁻¹. Three fish reached the head of the loch after 7.25-17 h, but then returned downstream. The four fish remained in the upper half of the loch for 15-51 days, making localized movement. Mean depths of fish were 3.7-4.0 m (max 20.7 m). Two fish were recorded at significantly shallower depths at night than during the day. Departure from the loch coincided with periods of high water flow into the reservoir. In May-July 1996, 17 radio-tagged salmon entered Loch Faskally and reached the head

of the loch in 3 h-5.8 days (mean 39 h). The durations of stay in the loch varied from 3 h 50 min to 67.4 days (mean 10.9 days). Only two radio-tagged salmon left the loch under conditions of high water flow into the loch.

Movements of adult Atlantic salmon in relation to a hydroelectric dam and fish ladder

Gowans A R D; Armstrong J D; Priede I G

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The movements of adult Atlantic salmon were recorded as they approached, entered and ascended the pool-and-orifice fish ladder at Pitlochry Dam, Scotland. Thirty-nine returning salmon were captured in the River Tummel by rod-and-line angling, radio-tagged and released near where they were caught. The subsequent movements of each fish were then monitored. An electronic fish counter collected additional data on movements of untagged fish past a fixed point in the ladder. Of the 39 fish that were radio-tagged, 29 individuals were recorded approaching and ascended the ladder. The remaining fish either did not approach the dam (three fish), approached the dam after detailed tracking had ended (two fish), were recaptured by anglers (three fish), or the radio tags failed (two fish). Salmon released earlier in the year delayed longer before first approaching the dam. Delays between first approaching the dam and ascent of the ladder were greater for fish that approached the dam earlier. The majority of salmon visited the ladder entrance more than once (maximum 10 visits) before ascending. Having entered, all but four salmon ascended the fish ladder successfully on their first attempt. The four individuals that failed to do so succeeded on their second attempt. The rate at which salmon ascended the ladder was related directly to temperature. The shortest ascent time of a radio-tagged salmon was 5.25 h. Movements of eight of 11 tagged fish through the ladder ceased with the onset of darkness but continued on the following morning. No radio-tagged fish entered the ladder at temperatures below 9°C. Similarly, few untagged fish were recorded ascending the ladder by the electronic fish counter at water temperatures below 8.5°C. Records from the fish counter indicated that 92% of upstream movements were made during daylight.

Effect of ice formation on selection of habitats and winter distribution of post-young-of-the-year Atlantic salmon parr

Whalen K G; Parrish D L; Mather M E

Canadian Journal of Fisheries and Aquatic Sciences 56 (1):87-96

We determined how ice affects selection of habitats and distribution of post-young-of-the-year Atlantic salmon (*Salmo salar*) parr during winter. Night snorkeling surveys were completed between November and April to evaluate parr habitat use and movements. Systematic measurements of water depth and velocity were recorded during ice-free and $\leq 5\%$ iced conditions to quantify habitat availability. Ice formation altered the distribution and reduced the abundance of habitats commonly used by parr; differences between parr habitat use and habitat availability were greatest when ice was present. Edge ice formation resulted in the concentration of flows, and areas of high flow were formed in mid-channel; few parr were observed in mid-channel after ice had formed. Through the winter, most parr were found lateral to high flows on the ice edge boundary or in the post-ice period lateral to the stream mid-channel. The correspondence of parr movements during winter to changes in the physical habitat associated with ice formation indicates that movements and redistributions may be important for survival in streams affected by ice.

Effect of maturation on parr growth and smolt recruitment of Atlantic salmon

Whalen K G; Parrish D L

Canadian Journal of Fisheries and Aquatic Sciences 56 (1):79-86

We determined the effect of maturation on parr growth and smolt recruitment of Atlantic salmon (*Salmo salar*) stocked in Vermont tributaries of the Connecticut River. Both among and within tributaries, mature parr ranged between 28 and 52% of the age-1 parr collected and up to 67% of the age-2 parr collected. Percent age-1 parr maturing in October-November was positively related to mean length the preceding June. In October-November, immature age-1 parr were greater in mean length than age-1 mature parr. Data from parr individually tagged in June and recaptured in October showed immature parr exhibited two-fold greater individual growth than maturing parr. Smolt recruitment was highly dependent upon state of maturity the preceding fall; fewer individuals that matured as parr recruited to smolt compared with parr remaining immature. Our study shows, over a broad spatial scale, that variation in incidence of maturation is largely explained by parr size among tributaries and river reaches and, furthermore, empirically demonstrates a direct negative effect of maturation on parr growth and recruitment to smolt. Thus, parr maturation is an important consideration for the enhancement and (or) restoration of Atlantic salmon populations via stream stocking programs.

Stability of population structure and genetic diversity across generations assessed by microsatellites among sympatric populations of landlocked Atlantic salmon (*Salmo salar* L.)

Tessier N; Bernatchez L

Molecular Ecology 8 (2):169-179

It may often be necessary to perform genetic analyses of temporal replicates to estimate the significance of spatial variation independently from that of temporal variation in order to ensure the reliability of estimates of a defined

population structure. Nevertheless, temporal studies of genetic diversity remain scarce in the literature relative to the plethora of empirical studies of population structure. In vertebrates, a limited number of studies have specifically assessed the temporal stability of population structure for more than one generation. In this study, we performed a microsatellite analysis of DNA obtained from archived scales to compare the population structure among four sympatric landlocked populations of Atlantic salmon (*Salmo salar*) over a time frame of three to five generations. The same patterns of allele frequency distribution, theta, RST and genetic distance estimates were observed among populations for two time periods, confirming the temporal stability of the population structure. Despite population declines and stocking during this period, no statistically significant changes in intrapopulation genetic diversity were apparent. This study illustrates the feasibility and usefulness of microsatellite analysis of temporal samples, not only to infer changes of intrapopulation genetic diversity, but also to assess the stability of population structure over a time frame of several generations.

Diel feeding rhythms and daily food consumption of juvenile Atlantic salmon in the River Alta, northern Norway

Amundsen P-A; Bergersen R; Huru H; Heggberget T G

Journal of Fish Biology 54 (1):58-71

Atlantic salmon fry (0+) sampled from the River Alta exhibited only minor differences in stomach content weights and feeding rates throughout diel periods, but feeding rates were generally lowest at night. In contrast, salmon parr (1+ to 3+) had large diel fluctuations in stomach content weight, with the largest weights usually being recorded during the night and early morning. Accordingly, their feeding rates were highest at night. This nocturnal feeding pattern was consistent throughout all sampling occasions, and appeared to reflect a persistent feeding periodicity in the salmon parr. The daily food consumption rates of both fry and parr were highest during midsummer and decreased towards autumn.

The effects of endocrine disruptors on sea water adaptability, growth and survival of salmon smolts

Brown S B; Fairchild W L; Haya K; Burridge L E; Swansburg E O; Arsenault J T; Sherry J; Bennie D; Eales J G

Comparative Biochemistry and Physiology Part A Molecular & Integrative Physiology 124 (Suppl.):S45

No text available.

Sea lice, *Lepeophtheirus salmonis* (Copepoda:Caligidae) in Atlantic salmon, *Salmo salar*: the dynamics host resistance and of parasite fecundity in infested fish

Mustafa A; Conboy G A; Burka J F

Comparative Biochemistry and Physiology Part A Molecular & Integrative Physiology 124 (suppl.):S119

No text available.

Towards an automated system for the identification of notifiable pathogens: using *Gyrodactylus salaris* as an example

Kay J W; Shinn A P; Sommerville C

Parasitology Today 15 (5):201-206

No text available.

Variations in Atlantic salmon, *Salmo salar* L., smolt age in tributaries of the River Teno, Finland

Englund V; Niemela E; Lansman M; Heino M

Fisheries Management and Ecology 6 (1):83-86

No text available.

