NORTH ATLANTIC SALMON CONSERVATION ORGANIZATION

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ORGANISATION POUR LA CONSERVATION DU SAUMON DE L'ATLANTIQUE NORD



Agenda Item 4.5 For Information

Council

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Review of Salmon Related Literature

The attached literature review covering articles published in 1996 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. 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. We are looking at ways of increasing the coverage of the press items included in this review.

Secretary Edinburgh 14 April 1997

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Review Of Salmon Related Literature

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PRESS ARTICLES

Norway's Fish Farms Strays Threaten Native Salmon

Anchorage Daily News

Wild Atlantic salmon returning to spawn in the freshwater streams of their birth now face a startling threat; interlopers. New research shows that more than a quarter of the spawning salmon in Norwegian rivers and streams are escapees from fish farms -- fish hatched in metal tanks, vaccinated against infections and raised in sea pens artificially lighted to speed maturation. In several rivers, the ratio of escaped farm fish to wild salmon is four to one. Geneticists warn that without stiffer controls, the rapidly growing aquaculture industry in Europe and North America could wipe out what is left of the wild Atlantic salmon population. Lars Petter Hansen, a senior scientist at the Norwegian Institute for Nature Research who did the research, said, "The heavy numbers of escaped farm fish make us believe that the genetic constitution of wild stocks will change so that they will be less adapted to their local habitats." Norwegian fish farmers expect to produce 330,000 tons of salmon this year. The genes of the farm stock, after five generations of artificial selection, favour fast growth and a high fat content. By comparison, the entire catch of wild salmon in the Atlantic Ocean in 1995 was 3,800 tons, down from 14,000 tons in 1973. Norway's Atlantic salmon farmers account for half the world's production of such fish; Norway's output is more than three times as much as that of its nearest competitor, Britain. Norwegian aquaculture enthusiasts hope for continued growth, but salmon prices have already plunged, and the European Union is considering sanctions against Norway for flooding the market. An estimated 200.000 to 650.000 individual salmon escaped from Norwegian fish farms in 1995. That is less than 1 percent of the captive population but is nonetheless "a lot of fish," said Rune Bildeng, a special adviser to the Ministry of Fisheries. Finding the negligent fish farmers can be a hopeless task. In the Saltdals Fjord, near the city of Bodoe. 90 percent of the salmon netted over several weeks last summer were identified as farmed fish, but the authorities failed to find the source. Most of the strays get out when storms or seals damage their floating sea pens. Other escapes are attributed to damage from boat propellers, vandalism, poor maintenance and accidents during fish transfers and sorting. In a series of storms in 1990, Bildeng said, some four million salmon burst from their pens along the Norwegian coast. Another large breakout occurred during a hurricane in 1992. In recent years, the Norwegian authorities have stepped up the regulation and inspection of the 700 fish farms in the west coast fjords. But while environmental conditions, particularly the amount of pollution generated by the farms, have improved, the number of escapees remains unacceptably high by most accounts. Fish-pen manufacturers are working on more storm-resistant designs, but indestructibility is an elusive goal. Environmentalists and sport anglers are demanding that production be cut and are threatening to boycott farmed salmon. "The unchecked growth of the salmon farming industry is a national scandal, Borre Pettersen, head of the Norwegian Association of Hunters and Anglers, said: "It's a national scandal how the salmon farming industry has been allowed to grow so explosively. The wild Norwegian salmon could well be lost forever." The fish farmers' association admits that wild salmon strains are threatened by the strays, but it insists that dams and acid rain are more serious threats. Wild salmon have an impressive homing instinct that lets them find their native streams after spending a lifetime at sea. Fish-farm strays, by contrast, seem to dart up whatever stream is nearest when the urge to spawn strikes. They are less successful at reproduction than their wild cousins, but researchers say there is little doubt that crossbreeding is taking place. Since wild Atlantic salmon are genetically different from one river to the next, the fear is that crossbreeding with strays will erase the river-specific characteristics necessary for long-term survival. In addition, plump strays that fail to leap salmon ladders often block the route for wild fish by crowding the water just downstream. The strays that do spawn get to the spawning grounds late, sometimes destroying the already established nests of natives in the commotion. They also carry parasites like sea lice, and even though they are vaccinated against many pathogenic bacteria and viruses, they can still be carriers of disease. On the other side of the ocean, wild Atlantic salmon are almost extinct in American rivers. While casual observers may rejoice at the sight of a few big fish in the rivers of eastern Maine, a disappointingly high proportion are fish-farm strays, said Chris Mantzaris, division chief for the National Marine Fisheries Service. "The farmed fish just don't have the sleekness and sparkle that the wild fish have," he said. Canadian and American research into fish-farm escapes remains preliminary, but the Magaguadavic River in New Brunswick has become a sort of scientific fishbowl for studying the effects of intermingling wild and domesticated fish. The Atlantic Salmon Federation reported that DNA studies comparing today's wild salmon in the river with specimens preserved from the 1970s showed an unwelcome genetic drift or mongrelization attributable to crossbreeding with farm strays. Various Pacific salmon species are cultivated on a large scale, but American fish farmers produce only about 19,000 tons of Atlantic salmon annually, about 6 percent of Norwegian production.

Fished-Out New England Turning To Commercial Farms

Reuter News Service

Scientists, casting about for a solution to the declining stocks of fish in New England, are turning to aquaculture. Aquaculture has become a multi million-dollar industry for New England. In Connecticut, the

harvesting of farm-raised Long Island oysters provides about \$65 million in revenue for the state and farmraised Atlantic salmon net about \$54 million for Maine's economy. In Massachusetts, the New England Aquarium is hoping to begin a pilot programme shortly to see if bluefin tuna, a highly prized and high-priced species, can be grown in a sea-farm setting. Some bluefin tuna species, which weigh about 1,500 pounds, fetch up to \$30,000 a fish, but those are the best quality fish that are used for sushi and rarely sold in this country. The aquarium is trying to raise smaller bluefins, averaging about 600 pounds, that will still be worth between \$10 and \$30 a pound depending on the season, officials said. 'These will be Boston bluefins, or maguro as they're known in Japan,' said the aquarium's Heather Taufig. 'They have really red meat and are quite tasty.' The tuna will be caught and dragged to a 94-foot cage the aquarium intends to float off the shore of Provincetown at the tip of Cape Cod and, according to documents filed with the US Army Corps of Engineers, will be fed a combination of frozen and fresh mackerel, herring and butterfish. The tuna will be harvested when they reach marketable size. 'It's just an experiment at this point,' said Greg Stone, associate director for conservation at the New England Aquarium, 'But we think it can work. 'You remember salmon? Up until a few years ago, it used to be a delicacy,' said Stone. 'Now, you can find it at a local diner. Well that's because of aquaculture. The price was reduced from \$6 and \$7 a pound to \$2.50 a pound.' Stone said usually with aquaculture 'you have to raise premium fish,' but officials at Maine's Aquaculture Association said that was no longer true. 'The trick to aquaculture,' said the association's Joe McGonigle, 'is to spend \$1 on feed and be able to take out \$2 of fish. The core cost is feed,' McGonigle said experimental programmes were under way for both halibut and cod, two staples of the western Atlantic region that are now commercially fished out. 'We haven't had much success yet with cod.' McGonigle said. 'The hard part is finding out exactly what kind of feed you need for a species and that is something we just don't have down yet, but I'm certain that within the next five years we will have commercially farmed cod and halibut.' Between \$3 million and \$4 million of capital is needed to start a salmon farm 'and you'd better be prepared to harvest about 1 million pounds annually to make a go of it,' McGonigle said. The more than 100 aquaculture operations in New England are not only creating revenues for the states involved, they are also helping to replenish wild stocks of Atlantic salmon. 'It doesn't pay now to go out and commercially fish Atlantic salmon,' noted the aquarium's Stone. And the salmon, once almost fished out, are returning.

Fish Farm Begins Super Salmon Test

Glasgow Herald

Salmon that grow at 10 times the normal rate will be starting life in a Scottish loch today. Scientists have injected 10,000 salmon eggs with genes from another fish to speed up their growth. Now the Scottish fish-farming industry hopes the genetically altered salmon will become money-spinning giants. But conservationists fear that, if the fish escape, they could be a threat to the already beleaguered wild salmon in the North Atlantic. The trial is first with genetically altered fish on this scale in Europe. Experts at Otter Ferry Salmon are this week injecting the growth hormone into eggs at their fish farm at Loch Fyne. Director Alastair Barge hopes the revolutionary technique will make the salmon grow to a sellable size more quickly. The technique was stumbled upon by scientists at the Memorial University of Newfoundland, when they tried to produce salmon which could survive cold winters. The gene produces a protein that lowers the freezing point of the blood of some types of white fish so that they can tolerate the northern winter. But they found that, in salmon, the gene turned into a growth hormone. However, Dr Malcolm Windsor, director of the North Atlantic Salmon Conservation Organization in Edinburgh, fears the new fish could endanger wild salmon. Salmon that have escaped from fish farms have already had a large impact on the wild salmon population.

Farm Hopes To Cash In On Giant Salmon

Independent

Genetically altered salmon which grow 10 times faster than normal are being created by scientists in Scotland, it was reported yesterday. The scientists are injecting 10,000 salmon eggs at a hatchery on Loch Fyne with genes from another fish to accelerate their growth. The Scottish fish-farming industry hopes the salmon will become money-spinning giants, according to a report in New Scientist magazine. Conservationists fear that if the fish escape, they could endanger wild salmon in the North Atlantic. The growth genes were discovered accidentally by scientists at the Memorial University of Newfoundland when they were trying to produce salmon which can tolerate cold winters. They were experimenting with a so-called 'anti-freeze' gene which lowers the freezing point of the fish's blood. In salmon the gene had the unexpected effect of putting a growth hormone which is normally kept in check into overdrive. Only some salmon were affected. But those that were grew 10 times faster than normal. Now Otter Ferry Salmon, a company on Loch Fyne which produces eggs for the fish farming industry, has bought the technique and the services of the scientists to test the commercial potential.

Farm Salmon Grow 10 Times Normal Rate

Chicago Tribune

Farmed salmon may grow to sellable size at 10 times the normal rate as a result of a genetic experiment at a Scottish fishery. Experts at Otter Ferry Salmon on Loch Fyne, on the west coast of Scotland, have injected 10,000 salmon eggs with genes from white fish to speed their growth. The technique stems from an attempt by the Memorial University of Newfoundland to breed salmon that could endure cold winters. The injected gene lowers the blood-freezing point in white fish but in salmon it acts as a growth hormone. The experiment is the first large-scale test of genetically altered fish in Europe. The potential money-spinner for the fish-farming industry has raised fears among conservationists about the future of wild Atlantic salmon. "The trouble with fish farms is that large numbers of salmon escape," said one expert. "They can introduce diseases and parasites to wild stocks. In the worst case they interbreed and alter the genetic make-up of Atlantic salmon."

Salmon Test Fears - Testing A Gene That Speeds Up The Growth Of Salmon

Seafood International

Otter Ferry Salmon of Loch Fyne, Scotland, UK, is testing a gene that speeds up the growth of salmon. The fishery is injecting 100,000 Atlantic Salmon eggs with a gene that can accelerate the growth of salmon by 10 times. The gene, which was discovered by Memorial University of Newfoundland researchers who were working with a fish anti-freeze gene, works by producing a protein that lowers the freezing point of the fish's blood. According to Alastair Barge, Otter Ferry director, tests to determine the commercial viability of the fast growing salmon would run for one year. Barge assured that the tests would be conducted with the utmost safety.

Hopes For Sterile Breed Of Salmon

Scotsman

Scottish scientists are leading an investigation into breeding sterile salmon for the fish-farm industry. The project is being carried out because of worries about the effect on wild salmon stocks in the Atlantic if there was ever a big escape of farmed salmon. Experts are unsure about the effect on wild salmon numbers if they were to interbreed with cultured fish. The sterile salmon, which only occur rarely in the wild, can now be produced on a large scale and would prevent any interbreeding. But scientists say not enough is known about the biology, migratory or interaction patterns of the sterile salmon to allow their use. Now a four-year project being coordinated by the Marine Laboratory in Aberdeen hopes to evaluate breeding the salmon. The laboratory is working with St Andrews University on the project.

Scots Research Leads Salmon Plan

Glasgow Herald

Scientists in Scotland are leading research into breeding sterile salmon for the fish-farm industry. The unique research comes in response to fears that a large-scale escape of farmed salmon would devastate wild salmon stocks in the Atlantic. Sterile salmon rarely occur in the wild but can now be bred in large numbers, making it possible to prevent interbreeding. However, the scientists say more needs to be known about the biology and behaviour of the sterile fish before they can be farmed. The four-year study by Aberdeen's Marine Research Laboratory will evaluate the consequences of breeding the sterile fish. Project co-ordinator Dr Ray Johnston said: 'This is not the kind of genetic manipulation that you hear horror stories about. The fish occur naturally, which is how we first found out about them. All we are doing is making it happen more frequently. Some would say we shouldn't do this type of breeding because we are interfering with nature but others would say we shouldn't even be doing fish farming. But if it is to be done, we must ensure everyone is kept informed of the wider impact of the breeding. The Marine Research Laboratory has linked up with St Andrews University to look at the disease biology of the fish unable to breed because of the presence of an extra chromosome.

Salmon Fall Linked To Global Warming

The Times

A decline in numbers of spring salmon in British rivers has been linked to global warming. Researchers believe the area of the northwest Atlantic able support the fish during the winter has fallen by a fifth. Dave Reddin, a scientist at the Canadian Government's North West Atlantic Fisheries Centre in St John's, Nova Scotia, said: 'Sea temperatures in the northern part of the habitat have been getting colder but in the south they have been getting warmer. So the area the salmon can inhabit is collapsing on itself.' The findings mirror computer models of global warming caused by pollution rises: 'Part of the predictions is that the northern part of the northwest Atlantic will get colder because of Arctic ice melting, bringing colder waters in the Labrador current.' Some spring salmon runs have declined markedly in recent years, forcing the authorities and anglers to adopt restrictions. Captain Jeremy Read of the Atlantic Salmon Trust said it was vital that fishing of spring salmon in the sea and rivers was reduced.

Seal Numbers 'Must Be Halved' To Save Salmon

Scotsman

A salmon conservation group says the Scottish seal population should be halved with the use of a revolutionary contraceptive to halt the decline in numbers of wild salmon. Scotland's shores are home to an estimated 120,000 seals, which experts claim consume more than the total landings of all fish in the UK each year. Now the head of the country's leading wild salmon conservation organisation wants the seal population halved. Rear Admiral John Mackenzie, director of the Atlantic Salmon Trust, says the seal population is increasing by up to 10 per cent a year and it is a major reason for the declining numbers of wild salmon. Statistics just released by the Scottish Office show that last year was the worst since records began for catches of salmon and grilse. The total of just under 168,000 caught and kept - 74,000 of them by rod and line - has also been blamed on drought conditions in rivers. While the numbers caught by anglers have remained reasonably constant, catches by netting have slumped, though fewer nets are being used now. The Scottish Office says there is no real evidence that fewer salmon are returning to Scotland from their feeding grounds - only that fewer are being caught. But not everybody agrees. On some rivers there is a voluntary agreement - mainly in the spring - that anglers only keep one salmon to conserve stocks. The Atlantic Salmon Trust and the Scottish Office are studying a pioneering project being carried out in Canada in which a contraceptive is introduced into the seals' natural fish diet. The programme, which involves placing a sterility compound in fish that are fed to seals, has been running for two years and is already showing some signs of success. While fish farms and netters can legally shoot seals suspected of being a threat to their livelihoods, anglers cannot. Rear Admiral Mackenzie believes the Scottish seal population has to be drastically reduced, but he does not favour a cull. I am not in favour of having a large cull, but I want to see something more being done to reduce the seal population. That is why we have been studying closely - with the Scottish Office - the contraceptive diet trials in Canada,' he said. 'Over a period of time this would naturally reduce the seal population. Undoubtedly not as many salmon are returning to our shores, and the consumption of fish by seals is more than the whole of the catch of the entire fishing industry in this country. However, Rear Admiral Mackenzie believes that one factor that no-one can control is crucial for a good fishing season next year - the weather. 'If the Good Lord sends us water we will be all right,' he said.

Reel Worthwhile Cause

Glasgow Herald

Paul Young pays tribute to those working to protect the Atlantic salmon and reveals a rewarding way to help boost their funds. It is generally recognised that the Atlantic salmon is in trouble, and has been for some time, but as is often the case when a species is threatened, there appears a body of people who work tirelessly to find the reasons and to try to rehabilitate it. Thus many people on both sides of the ocean are addressing the problems of Atlantic salmon and prominent for the work it does in this country is the Atlantic Salmon Trust. Concerned with the welfare and management of the fish, the Trust works closely with like-minded organisations for the betterment of this magnificent wild creature. In a progress report in June, there was ample evidence of the kind of work the Trust believes necessary for the long-term survival of the salmon. There are reports on the Thirteenth Annual Meeting of the Council of the North Atlantic Salmon Conservation Organisation which took place in Gothenburg in Sweden and addressed such matters as High Seas Fisheries, the Impact of Salmon Farming, The Salmon as Predator and Prey and the efficacy of Catch and Release. There is also an article on Swedish salmon fishing, a piece about the problems of fish-eating birds, and an erudite discussion on 'The Effects of Temperature on the Larval Development of Early and Late-Running Atlantic Salmon'. Of course, all this extremely worthwhile work costs money and the Trust has for many years raised funds for its work by holding an auction of fishings donated by concerned owners. This is an excellent way of getting fishing on waters where it is not always easy to obtain a day or two and there is the bonus of knowing that your money is going towards a good cause. Though it is now a postal auction, James Hay and I attended an earlier one in aid of the Trust in March, 1985, held at Hopetoun House where we brought three days on that lovely little river, the Fyne. We subsequently fished there for many years and had some great sport, so a successful bid could lead to a longer acquaintance. Opening the catalogue for this year's auction, one's eye is drawn perhaps to the better known waters - Tay, Tweed, Dee . . Itchen, Test, and Wye, so if there wasn't a photograph of Mr Bob Hill, who was the successful bidder for fishing on Loch Damph in 1995, you might slide past that particular lot and favour the big names. Mr Hill is standing holding a beautiful brown trout of over 11 pounds which he took from the loch on five-pound nylon and as if that wasn't enough to whet interest in Damph, the successful bidder in 1991, Harry Watson, also took a fish over 11 pounds on the fly. Some coincidence, some trout, some loch! It is in this year's catalogue. Lot 29 in fact and for 'Trout fishing at Loch Carron Estate on Loch Damph, Coultrie and Loine, three miles north of Kishorn. Two days to be agreed with the donor, Mark Pattinson, Esq for two rods, fly only', the estimated price is £100. Not bad, with 11 pounders a possibility. The catalogue makes interesting reading, with opportunities to fish the length and breadth of the land for salmon, sea trout, and brown trout. I'd love to try Lot 24, a day down in Dorset on the River Cerne and two lakes coming into it. The Cerne is a tributary of the Frome which flows into a Channel through Poole Harbour and you can fish dry fly on a minichalk stream for brown trout and wet fly on the lakes of rainbows. Or come north to the opposite end of the country and fish the Naver, which flows into the Pentland Firth past Bettyhill and Torrisdale Bay. You could

not have two more different opportunities to fish - a southern, clear chalk stream and a peaty, northern river. Brown trout and silver salmon. The Cerne is estimated at £65 and the Naver between £200-390 for two rods for a week. Another interesting point: the Naver has, I think, been unique among the salmon rivers of Scotland in that the two rods fishing each beat must be one man and one woman. Husband and wife, mother and son, father and daughter, or brother and sister I presume would all be welcome. Great idea - certainly stops the men getting together and boring the pants off everyone! Another interesting item for auction is a week exploring some of the trout lochs of Islay for a party of four. This trip is offered by Islay Estates Company and the lochs in question are Ardnahoe, Skerrols, Gorm, and Finlaggan. The offer is available in May and June. usually excellent troutfishing months and with self-catering accommodation for six people included, the guide price of £600 looks quite attractive. Well-known rivers feature too and there are many chances to fish famous beats of world famous rivers - a testament to the fact the owners and proprietors are well aware of the good work done on their behalf by the Atlantic Salmon Trust. We anglers should show our appreciation too, by bidding for something within our price-range. We'll help the Trust and who knows, we too may have a trip to remember.

Trouble Brews Down At The Salmon Farm

Scotland On Sunday

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New doubts have emerged on the effect of salmon farming on human health and the environment. Marie McBain reports. A call for radical changes to British Columbia's farmed salmon industry because of alleged human and environmental health risks has been dismissed as 'lunatic' by the Scottish Salmon Growers Association. Scotland's fish farm industry uses the same free-floating sea cage methods which the report demands should be ended - because the cages become breeding grounds for disease and the fish in them immune to antibiotics. The problems have been compounded on Canada's Pacific coast by the use of fish grown from imported Atlantic salmon eggs. To combat the threat of disease, the report says, the industry injects fish with drugs whose effect on human health has not been monitored by the Canadian government. The report, by an independent team of scientists from the Vancouver-based David Suzuki Foundation, also claims that unacceptable levels of sewage from fish faeces and other wastes build up in the areas around the cages and go back into the food chain. If the report's recommendations to abandon cages are accepted by the British Columbia environmental panel, it could be difficult for the much larger Scottish and Norwegian fish farming industries to ignore the international pressure that would then be placed on them to address its claims. Yet William Crowe, of the Scottish Salmon Growers Association, dismissed the report. 'This seems like another of the usual Greenpeace or Friends of the Earth arguments. None of us in Scotland is putting diseased fish in the sea, and we don't use antibiotics, we use vaccines, developed by us with Glasgow University. The comment about imported eggs is utter rubbish, as Canada has operated a closed policy for many years. They used to import, so we conducted a four-year monitoring project with the Scottish Office marine lab which showed there were no eggs with disease. Nowadays every country is able to use their own eggs. They don't need to get them from overseas.' Crowe added that research had shown that while open cage fish farms did have an effect on marine life and the seabed, this effect was reversible with time. 'We were accused four or five years ago of polluting Scottish sea lochs, and spent £400,000 investigating what happens to sea bed communities. Three sites where the farms had been removed were looked at and it appeared that Mother Nature had claimed back the sea bed within nine months. Faeces on the seabed at an unsustainable level would cause gassing, and a depletion of oxygen that would be dangerous to the fish. The last thing we would do is muck up our own sites.' The infant British Columbia salmon farm industry produced 32,000 tonnes of fish last year, a doubling of output since 1991. It is now seeking permission for a six-fold increase. Scotland produced more than double that at 80,000 tonnes this year, an increase of 10,000 tonnes on 1995. A much larger producer of farmed salmon is Norway, whose output this year is 300,000 tonnes, up 50,000 on last year's 247,000. While the market has been growing by about 15-20% a year. Norway has been increasing its production by some 40% annually. Last week there were calls within the European parliament for immediate sanctions against Norwegian salmon exporters, who the SSGA says are dumping their fish at rock bottom prices on the Scottish and Irish markets. As a result prices are 35% down on last year, a trend which Crowe says is completely unsustainable for the industry. Allan Macartney, MEP for Scotland North-east, has called the Norwegian moves a disaster for the 5,000 people employed in the Scottish industry. Crowe said the sanctions call was the seventh time since 1989 the EU had tried to intervene, and that Norway presented far more of a threat to the Scottish industry than the Canadian scientists' findings. 'If the Canadian government is daft enough to implement that report then the knock-on effect on the Scottish industry will be that we would pick up on the 30,000 tonnes a year the Canadians currently export to the US market. Aquaculture is the future as the only sustainable protein farming for many of the world's people.'

Fish Farm's Plan Raises Sea Trout Fear - Estate Warns Of Decline

Glasgow Herald

Battle has been joined in one of Scotland's most beautiful and remote landscapes between an English-based estate landlord and a fish-farming company owned by a Belgian businessman over a proposed expansion of salmon-rearing cages in a sea loch. The bitter dispute is the latest chapter in the controversy surrounding

allegations - widely accepted in Ireland but still contested here - that sea lice infestations from salmon farms on the western seaboard are responsible for the catastrophic decline in the wild sea trout population. The estate owner, Mr Robin Davidson, an Inverness-born plant-hire magnate who lives in Suffolk, claims that the sea trout runs into his Morsgail river and loch system on Uig, Lewis, have been devastated since the first sea cages were sited in West Loch Roag 10 years ago. In his lengthy objection to the Crown Estate Commissioners, the government agency that leases seabed sites around Scottish coasts, he attacks proposals by the Western Isles Seafood Company of Maruig, Harris, to increase greatly the size of its operation in West and East Loch Roag. Wisco is owned by a Belgian group of which Mr Gilbert Pieters is president. It bought up a number of small fish farms during the crisis precipitated by Norwegian over-production and subsequent salmon dumping in EU countries. The £80m business currently produces about 2000 tons of farmed salmon a year, a figure the company aims to increase to 5000 tons by 1999. This could also mean around 12 more fish-farming jobs and possibly as many as 20 more jobs in its processing plant at Stornoway. The company claims it wants modification of the two sites to allow rotation of the sea sites in Loch Roag. Rotational management would act to reduce sea lice populations and bacterial disease outbreaks. Mr Davidson said: 'The expansion application is very confused and poorly presented. We have in the past kept a low profile because the large estates in Lewis are looked upon as a leper community by local people. 'At the same time we have to look after our interests the land, the fish, the animals, and the birds. Our priority is to keep this estate going for the wildlife, and that includes the sea trout. It is not a commercial estate.' He said two other large estates nearby were in the process of objecting to the expansion of salmon cages in Loch Roag. In his objection, Mr Davidson claimed the new cages would be sited directly in the path of sea trout and salmon trying to enter the Morsgail system from the Atlantic. Salmon in sea cages, he said, are plagued by sea lice, which migrate to wild fish that swim past the cages. Morsgail has in the past caught 1200 sea trout but now the return is down to 100 often badly-infested fish. He cited the Irish evidence blaming the fish farms as causing the major reduction in sea trout stocks there. The Crown Estate Commissioners yesterday told The Herald that the proposal was out for public consultation with a decision expected in a few weeks. Mr William Crowe, director of the Scottish Salmon Growers' Association, pointed out that the industry's view was that many estate owners were failing to recognise many other factors that could have played a part in sea trout decline. These included a doubling of the seal population in the past 10 years, an increase in sea temperature and salinity in the North Atlantic, the effects on fish of additional exposure to ultra-violet from ozone layer depletion, parasitic disease of gall bladder and eyes, and, on land, overgrazing and bank erosion by too many sheep and the flushing away of fish eggs by heavy rainfall concentration in successive January's. 'A study of the official catch figures shows cyclical sea trout declines every seven to nine years with a catastrophic decline every 14 or 16 years,' he said. 'The figures also show declines in east coast rivers and there is no salmon farm within 100 miles of them.' A spokesman for Wisco said that because its captive salmon were treated and rotated it was far more likely that they would be infected with sea lice from wild salmon and sea trout.

Salmon Fishing: There's Gold In Them There Gills - Study Discovers That The King Of Fish Brings £12.5 Million Into The Borders Economy

The Scotsman

Big spending anglers are paying the equivalent of £156 per lb for each salmon they land from the £500-a-day prime fishing beats of the Tweed, a study by financial consultants has shown. It means that each of the 10,000 rod-caught salmon landed by the anglers who fish the Tweed each season (some 12,000) yields £1,250 for local salmon proprietors, tackle shops and other businesses. The anglers are supporting more than 500 jobs and spend as much as all of the overseas tourists who visit the area. When the various elements of an angler's expenditure are added together - hotel accommodation, permits, gillies, boatmen and so on - the cost of catching an averagesized 8lb salmon works out at £156 per lb. The king of fish is currently being sold in local shops for £4 per lb, while the retail price at fish farms is little more than £1 per lb. The study by Deloitte & Touche was commissioned by the Tweed Foundation, which is attempting to reverse the decline in spring runs of fish by improving spawning habitats. According to the consultant, 97 per cent of the money spent by the fishermen is retained in the area. The firm was able to calculate that salmon anglers contributed £12.5 million to the Borders economy, a figure boosted to £13.1 million when trout fishing was added in. A considerable part of the total (£4.8 million) was spent on permits for 40,000 days of salmon fishing each year. The average salmon angler booked four days and spent £160 a day during his or her stay. Ian Gregg, chairman of the foundation, yesterday told a news conference there was potential to increase the number of salmon rod days by 20 per cent by restoring the spring runs during months when accommodation bookings in the Borders were at a low level. There was scope to generate a further £1.5 million in revenue and create an additional 100 jobs. But the valuable fishing resources of the Tweed faced a number of problems, said Mr Gregg. These included the continuing operation of the Greenland fishery unless a successful buyout could be concluded by the North Atlantic Salmon Conservation Association. He was also highly critical of the continuing threat to Tweed salmon stocks from the drift net fishery off the Northumberland coast. Mr Gregg described the continuing existence of the fishery as a disgrace and made it clear he was not prepared to wait for up to 30 years while the drift netters were removed from the North Sea. 'It is widely accepted that this fishery, with a declared catch of 50,000 salmon and 50.000 sea trout annually, does not represent sound management methods,' claimed Mr Gregg. 'We believe the actual catch is significantly higher than the official figures and will continue to press for its closure. Current efforts are aimed at having the start of the drift netting season postponed from 1 April until May to help the spring runs.' Judith Nicol, foundation director, revealed that during the peak of the salmon fishing season in October and November, anglers occupied 50 per cent of the holiday accommodation in the central Borders, allowing businesses to benefit from a dramatic extension to the tourist season. 'The report from the consultants concludes that, without angling, seasonal unemployment in the Borders would be very much higher.' Mrs Nicol said. Mr Gregg denied the owners of the fishing beats were making vast profits from the sale of permits. He said most of the money went on wages, administration and maintenance of the river banks, as well as on the levy paid to the Tweed Commissioners.

Storm Swirls Over Aboriginal Salmon In Maine's Rivers

New York Times

No less than the eagle, the wolf and the bear, the bullet-sleek Atlantic salmon has inspired human wonder. It captivated the Romans, who named it "salio" (the leaper), and Izaak Walton, who in 1653 crowned it the king of freshwater fish. The species even figures in Cro-Magnon cave art. In America now, just as the bald eagle, wolf and grizzly bear are imperiled in the contiguous 48 states, so the original wild salmon of New England has come dangerously close to extinction, and some geneticists say it may already have vanished for all practical purposes. Whether the "aboriginal" salmon has disappeared or not is at the center of a political storm in Maine. where the Federal Government proposes to list what its biologists say is "the last known wild remnant of U.S. Atlantic salmon" as officially threatened under the Endangered Species Act. State officials, arguing that aboriginal salmon are no longer genetically identifiable, vehemently oppose the listing. The wild salmon has generally declined throughout the North Atlantic basin in recent years, but its situation in the United States is desperate, fisheries biologists say. Despite longtime efforts to restore the fish to New England rivers through restocking from hatcheries, a mere 1,500 to 3,000 salmon -- down from 6.000 to 8,000 a decade ago -- are estimated to make the annual spawning run to those rivers from feeding grounds off Greenland. Historically, as many as 500,000 made the trip. Of those that do make spawning runs today, say Federal biologists, only about 500 are truly wild. That is, they still carry a significant part of their unique genetic inheritance, developed over millenniums of reproductive isolation. Since salmon return to the stream of their birth to spawn, each river has, or at least had in the past, its own genetically distinct fish. The remaining 500 fish, the targets of the Federal proposal, spawn and mature in seven Maine rivers; the Sheepscot, Ducktrap, Narraguagus, Pleasant, Machias, East Machias and Dennys. But a study conducted by scientists for the state concluded that the seemingly wild fish have become so genetically swamped by interaction with hatchery fish that their distinctiveness has been lost. If so, the proposal to list them may be too late. "There are no individual fish that retain the genetic integrity of pre-colonial times", said Dr. Irv Kornfield, a population geneticist at the University of Maine at Orono, who headed the state study. While some original genes may remain, he said, they do not add up to the significant legacy cited by the Federal biologists. "Either we have a tiny bit left or there's none," he said. If there is none, the overall salmon gene pool has been correspondingly weakened. This is a case "where reasonable men can disagree." said Paul Nickerson, endangered species coordinator for the United States Fish and Wildlife Service Northeast region in Hadley, Mass. "I don't think any of us says the original salmon that was here before European settlement still exists." But, he contended, enough of the original genetic material lives on in the Maine fish to warrant Federal protection. The State of Maine objects to listing the salmon as threatened "in the strongest possible terms," Gov. Angus S. King Jr. has told Federal officials. The state argues that conservation measures already under way are beginning to bring the salmon back. Officials also fear that listing the salmon as threatened could bring Federal regulations harmful to blueberry growers who draw water from the salmon rivers and to aquaculturists who artificially raise salmon for market in ocean pens just off the mouths of the seven rivers. The state is pressing the Federal officials to accept a state-devised conservation plan in lieu of listing. Some conservationists also question whether listing is necessary. They cite the actions already under way and worry that many local citizens, who have expressed strong anti-Federal sentiments, would withdraw their support for conservation measures in the event of a listing. But others argue that without the spur to action provided by listing, progress in restoring the salmon will be too slow. "The state has failed and it's time to try something new," says David N. Carle, associate executive director of a Massachusetts-based conservation group called Restore: the North Woods. A petition by this group forced Federal officials to consider the listing and catapulted the issue to a new level of urgency. The group has favoured declaring all salmon in New England endangered, including the progeny of hatchery fish. The creature at the center of the argument, Salmo salar. has long been a human icon. Hardy and muscular, it can jump 12-foot waterfalls that its cousins, trout and Pacific salmon, cannot. And while all Pacific salmon die after spawning once, the Atlantic salmon can make several spawning runs, typically two or three. Those that survive to reproduce many times can reach majestic proportions, weighing more than 50 pounds, although 5 to 20 pounds is more usual. In North America, the salmon's spawning range historically began with the Housatonic River in Connecticut and extended east and north through the Canadian maritime provinces. But by the early 1800's, the fish were gone from rivers like the Connecticut, driven out by dams, fishing and pollution. For years, biologists in New England have been trying

to restore them to a few rivers like the Connecticut and Massachusetts' Merrimack. Progress has been slow. Self-sustaining populations -- those not dependent on the stocking of hatchery-raised "fry," or baby fish -- have yet to become established. It simply takes a long time, given that salmon take several years to reach spawning age and that relatively few live that long, said Dr. Steve Gephard, supervising fisheries biologist for the State of Connecticut. This year, 20 years after restoration began, about 260 spawners returned to the Connecticut River. These are not enough to insure the establishment of a new, self-sustaining population. In an attempt to speed the process, biologists are stripping eggs from these fish, fertilizing them, and raising fry in hatcheries, where many, many more can be produced than in the wild. Small populations like those in New England are especially vulnerable to overfishing and natural disasters at sea. Curbs have been placed on commercial fishing for salmon, and a decade ago the outlook seemed bright: salmon returning to the seven Maine rivers numbered more than 2,000 in some years. In the early 1990's, however, the species at large entered a general decline, even as commercial fishing was further restricted. No one knows whether the cause was climatic change, a decrease in the shrimp and fish that salmon eat, a natural fluctuation in salmon population, or something else. In any case, salmon began disappearing into what biologists are calling a "black hole" in the Atlantic. Like the wolf, bald eagle and grizzly, the salmon is relatively abundant north of the contiguous 48 states. Salmon populations have nevertheless declined there. For instance, 200,000 to 220,000 fish returned this year to the Miramichi River in New Brunswick, the most prolific Atlantic salmon stream in North America. That compares with about half a million 30 years ago and a million historically, according to Bill Taylor, president of the Atlantic Salmon Federation, an international conservation group based in St. Andrews, New Brunswick. While the population plunge has depressed Canadian and European salmon stocks, it has put wild American salmon in critical condition. Their plight was exacerbated, biologists say, by Maine's former practice of stocking the seven rivers with hatchery fish, which competed with and genetically diluted the wild ones. "It probably did more harm than good," Edward Baum, a fisheries biologist who heads the state's salmon recovery program. Since 1992, the state has been trying to build up the wild population in each of the seven rivers by stocking it with fry raised in hatcheries from eggs produced by wild fish found only in that particular river. Mr. Baum said this year's returns of adults from the sea, the 500 fish, represent at least a 25 percent increase from last year. Since the program "is just starting to pay off," he said, he believes it would be best to hold off a bit on listing. Federal officials, however, say the measures taken by the state are the reason they are proposing to list the salmon only as threatened, rather than giving it the more serious label of endangered. If the measures fail, say the officials, the fish would be declared endangered. This would mean much more stringent Federal involvement. Under a listing of threatened, the state could retain its leading role in managing the salmon population. In response to the listing proposal, the state has prepared a conservation plan intended to prevent escaped salmon from the offshore aquaculture pens from genetically swamping wild fish, and to protect salmon habitat from pollution, agricultural water withdrawal and tree cutting. Catch-and-release angling would be permitted. The plan was worked out by state officials, scientists, industry and some conservationists, including the Atlantic Salmon Federation. The more serious "endangered" listing, should it ever come, would prohibit angling for salmon on the streams in question. Proponents of the proposed state conservation plan say this would drive away anglers who have been mainstays of the conservation effort. Mr. Carle rejects the state's conservation plan as inadequate, not least because, he says, it would be inadequately financed. Federal funds for salmon recovery would accompany a threatened listing. But Governor King insists that the Government accept the state plan in lieu of any listing; otherwise, he said in a letter to Federal officials, state cooperation will be withdrawn and legal action will be taken. The Federal officials could accept the plan and still list the salmon. A decision on the listing question is expected in mid-spring. In the meantime, the Government is looking for a way to protect the salmon without igniting a rebellion in Maine. Mr. Nickerson of the Fish and Wildlife Service said he was worried that a lot of energy now being put into conservation would instead "go into fighting the Feds" if the salmon is listed. "And the salmon," he said, " doesn't win there."

First Major Review Of Wild Salmon Stocks Since 1987

Irish Times

The Salmon Management Task Force was established by the Minister of State for the Marine, Mr Eamon Gilmore, in October 1995 and was charged with examining and reviewing the management of wild salmon in Ireland, and recommending 'realistic' policy options and an effective framework. It is the first major Government initiative on the controversial stock since the 1987 Report of the Salmon Review Group, which identified management of the catch, rather than the method of catching, as the key concern. The task force was chaired by Prof Noel P. Wilkins, associate professor of zoology at University College Galway. Its members were: Mr John Browne, Inspector, Marine Institute's Fisheries Research Centre; Mr Niall McCutcheon, principal, Department of the Marine; Mr Harry Lloyd, manager, Northern Regional Fisheries Board; Mr Patrick Byrne, National Anglers Representative Association; Mr TP O'Conchuir, Ballydavid Fishermen's Association, Dingle, Co Kerry; and its secretary, Ms Mary Kinsella, Department of the Marine. It considered 232 written submissions and heard oral submissions at six centres throughout the State. It also met managers of the seven regional fisheries boards and staff of the North Atlantic Salmon Conservation Organization (NASCO) in Edinburgh; and discussed salmon management regimes with the appropriate authorities in Canada and Iceland.

Maine Tribe Backs Salmon Guards

Boston Globe

Leaders of the Passamaquoddy Tribe have decided to support special protection for wild Atlantic salmon, the tribe's representative to the Maine Legislature said. Fred Moore said that tribal leaders at Pleasant Point and Indian Township have reached a consensus to support a proposal by the US Fish and Wildlife Service and the National Marine Fisheries Service to have Atlantic salmon in Washington County rivers listed as "threatened" under the Endangered Species Act.

Saving The Salmon

Irish Times

Brickbats and bouquets will come as no surprise to the authors of the new report to Government on salmon management. As the first such initiative - in almost a decade, the task force appointed last year was given a difficult brief. Ireland is one of the 'strongholds' of wild Atlantic salmon, but the debate over its stewardship is usually charged with emotion, with less regard for cold, hard fact. First, the good news from the report. In spite of perceptions to the contrary, the stocks are not in extremis. But there are up to 40 reasons why the fish does not thrive in our waters, it says. Illegal commercial fishing is just one of many - pollution is a major factor while legal drift netting is 'not the only, and may not even be the main cause, of the perceived decline'. In fact, the report says, 'vociferous' calls for a ban on drift netting have been counter productive. With goodwill and appropriate endeavour, it sees no reason why the stocks cannot be enhanced, and it outlines an action plan for the Minister of State for the Marine, Mr Eamon Gilmore, to implement. The plan includes a shift in the commercial season, a six mile limit on fishing at sea to ensure that only those fish destined for a particular catchment are netted, quotas, community involvement on regional fisheries boards, and tagging at sale to monitor legal activity. It advocates establishment of a salmon management commission, and lays much emphasis on equitable sharing of a common resource. That the report has not recommended a driftnet ban will raise some eyebrows. Compiled by an experienced panel under the chairmanship of Professor Noel Wilkins of University College, Galway, the study notes how unsatisfactory management at home has contrasted with the international situation, where there is increasing opposition to non recreational salmon fishing. During its extraordinary life cycle between fresh and sea water, the salmon feeds as far away as the Faroe Islands and Greenland before returning to its natal rivers. Iceland, whose economy is based on fishing, has had a long standing driftnet ban, while Norway introduced one in 1989. A lobby group set up by an Icelandic businessman has received US government support for its attempts to buy out salmon fishermen in the Faroes, Newfoundland and Greenland. Such a buy out here poses complex problems, at a time when driftnet activity is falling anyway due to economic factors, and the report wisely advises that this issue should be examined by another panel. The proposals compare favourably to those in the last such study in 1987, which also ruled against a driftnet ban and said that greater emphasis should be placed on controlling the catch ashore. Given the high cost and risks involved in policing inland and coastal fisheries, control in the marketplace is a sensible option. Yet this study also takes a very practical approach. It is critical of inadequate and unreliable data, and of the plethora of State agencies involved who do not cooperate. The experts raise pertinent questions, and even address the seals issue recommending more research towards a seal management programme. A confident lead is demanded overall from the Department of the Marine.

Report Calls For 6 Mile Fishing Limit And Rejects Drift Net Ban: Irish Salmon Stocks Not In Poor State, According To Government Task Force

The Irish Times

The Government's salmon management task force has said that a ban on drift nets would be unenforceable and has called for a change in the salmon season and an outer six mile limit on coastal fishing of the stock. A drift net ban would not contribute significantly to better management, it says. Tagging at sale is the most effective way to eliminate poaching and illegal fishing, but this must be introduced on an all Ireland basis. Irish salmon stocks are now in a poor state, it says. The report by the Salmon Management Task Force, which is due to be published by the Minister of State for the Marine, Mr Eamon Gilmore, today, recommends establishing a new salmon management commission, a reconstitution of fisheries boards to reflect wider community involvement, and new licensing arrangements for anglers. It recommends delaying the annual draft net and drift net seasons to May 15th and June 1st respectively, to run until a later date of August 31st, subject to quota. A total allowable catch (TAC) and quota system is also recommended. An outer limit of six miles for catching at sea would not only meet a 'moral obligation' to an international fishery, but would also contribute to conservation, the report suggests. The nearer the catchment is to the river mouth, the more likely that the nets used will seize only those fish destined for that estuary, it says. The report is the first major initiative on the controversial stock in a decade, and is also the first to give express recognition to the right to fish salmon in the sea. 'Real pragmatism demands that we recognise that harvesting the resource in the rivers, and not in the sea, redistributes wealth from coastal to inland communities, and that the coastal communities realise and resent this,' it says. "Calls to find alternative jobs for displaced salmon netsmen cannot be easily fulfilled, do not meet communities"

needs and are, fundamentally, negative and defeatist", it says. The report demands an equitable sharing of the resource and notes that there has been a drop in the uptake of drift net licences in recent years. The price of wild salmon has fallen, and it has heard evidence of commercial catchers resorting to selling salmon to fish farmers during a glut period. Yet continued 'vociferous calls' for a ban on drift netting have contributed to the 'aggressively defensive' intransigent and polarised position of the commercial sector, it says. In contrast to that last initiative - the 1987 Report of the Salmon Review Group - which was compiled by civil servants, this task force involved industry representatives. It considered over 230 submissions and held regional and international consultations, under the chairmanship of Prof Noel P. Wilkins, associate professor of zoology at University College Galway. There are up to 40 ways of killing a salmon in sea and fresh water, including pollution. Legal drift netting is not only, and may not even be, the main cause of perceived decline in salmon, it says. Stressing that catch statistics must be improved, the report says - far too many State agencies are involved in the resource, and there is no clear cooperation. Other recommendations include: * Ban on drift nets unenforceable * A six mile limit on sea fishing salmon * Change in salmon season * Tagging carcasses at sale the most effective way to eliminate poaching and illegal fishing * Change in legislation to outlaw non tagged fish * Reconstitution of fisheries boards to reflect wider community involvement * New licensing arrangements for anglers * A total allowable catch and quota system * Radical improvement in catch statistics, with measurement of spawning escapement in all State rivers * Training by BIM to improve quality and marketing of wild Irish salmon * Further research on seals and a seal management programme.

Ireland To Curb Salmon Netting As Stocks Decline

Reuter News Service - Western Europe

The Minister of State for the Marine Eamon Gilmore on Thursday announced severe restrictions on the netting of wild Atlantic salmon off the Irish coast in a bid to conserve stocks. 'Wild salmon is a priceless resource and Ireland is one of the last strongholds of wild Atlantic salmon stocks. Action needs to be taken now to conserve stocks and to rebalance the salmon catch between the commercial and angling sectors.' In recent decades stocks have been declining and an increasing proportion of salmon have been caught by drift nets at sea.' Gilmore said. He was speaking at the publication of the report of the Salmon Management Task Force, which included commercial fishermen and anglers, and which the government has agreed is to be implemented from next spring. The commercial netting of salmon, using what are known as drift nets, is to be more than halved. At present they can be used from the shore to the 12-mile limit but from next spring, they will only operate within the six mile limit. Drift-net operators will also be limited to fishing four days a week, instead of the present five, and to day-time fishing, from 0400 to 2100, in place of the present 24 hours. The season they can fish is also being cut, to end on June 1 instead of July, as at present. To overcome an anomaly in the law, which at present makes it legal to possess monofilament salmon nets but illegal to fish with them, possession is being legalised. Curbs on the use of draft nets, used in river estuaries, are also being implemented and the areas in which they will be allowed are being limited. In a move aimed at salmon poachers, the sale of allegedly rod-caught salmon is being banned. Legislation is to be introduced to provide for a total allowable salmon catch and for a carcass tagging programme. Discussions are also to be held with angling interests with a view to restricting spring salmon angling 'by reference to a possible catch and release policy', Gilmore said.

MAFF - Government Announces Further Safeguards To Protect Salmon Stocks

Hermes - UK Government Press Releases

New measures to maintain Great Britain's high fish health status and to prevent the introduction of Gyrodactylosis, a serious disease of salmon, have been announced today. They come into effect right away. The disease is caused by the freshwater parasite of salmon and trout, Gyrodactylus salaris, which is too small to be seen by the naked eye. The parasite has been known to occur in fish stocks in countries bordering the Baltic for many years. Recently it has been identified in Denmark, and provisionally identified in Germany and Spain. It is spread by transfers of infected or carrier fish. Baltic salmon, and trout, do not develop the disease, but it can cause serious mortalities in Atlantic salmon and has led to major losses of Atlantic salmon in Norway. Once it affects wild salmon populations it cannot be controlled or cured. If the parasite was introduced into the UK, salmon stocks on entire river systems could be threatened. Commission Decision 96/490/EC prohibits the introduction into the British Isles of live salmon and trout from elsewhere in the European Community, with the aim of preventing the spread of the parasite into areas with highly susceptible fish stocks. Ova may continue to be imported subject to separate fish health requirements, but consignments must now be certified as having been thoroughly disinfected. Gyrodactylosis has been a notifiable disease in Great Britain since 1988. The UK operates national control measures for Gyrodactylosis and has been pressing for effective Community controls for some time. Fisheries Departments believe that the new arrangements are an important addition to the suite of existing guarantees designed to maintain Great Britain's high fish health status and protect freshwater fish stocks. The measures will have little impact on current trade patterns or on the fish farming industry. Under existing fish health legislation, only the few countries or regions which have demonstrated that they are free from other serious salmon diseases are entitled to export live salmonids to the British Isles. Imports of other fish will not be affected. In addition to the new safeguard measures, the Commission has also published proposals to

amend the Fish Health Directive 91/67 so as to reclassify *Gyrodactylosis* as a List II disease, ie one of the most serious fish diseases already present in the European Community. Fisheries Departments strongly support this proposal. The new measures will be kept under review pending the outcome of these separate discussions. *Gyrodactylus salaris* has no implications for human health.

Angling - Special Efforts Enhance Atlantic Salmon Survival

Daily Telegraph

All things considered, 1996 was not a bad year for the Atlantic salmon. There were several major developments, and lots of minor ones, all aimed at preserving this still threatened species. Agreements were made to reduce catches off Greenland, and there are high hopes of reducing the immense Irish catch. Netsmen there admit to taking 350,000 fish each year, but undeclared catches may be almost as much again. Salmon survival, though, is a problem to be tackled in many different ways. Collectively the many small and seemingly insignificant projects are almost as important as the major initiatives. The latest example is from the River Usk, where a rolling programme began last summer to survey the spawning tributaries. They are beginning to discover why some areas have stopped producing salmon. On the rivers Grwyne Fawr and Grwyne Fechan, near Crickhowell, in Wales, some stretches were found to be devoid of young salmon simply because of timber blockages from fallen trees and branches. Adult salmon had been unable to get past the obstructions to reach the spawning gravels. Within months of clearing these log jams the Environment Agency were seeing spawning salmon in the headwaters of both rivers. Some of England's most noted game fishing rivers have suffered too. Spawning success has been as low as nil on the rivers Test and Itchen, thanks to high levels of silt and compaction. The Environment Agency blames historic dredging methods, low winter rainfall and changes in agricultural practices. This year, having studied preferred spawning conditions for salmon, including water depth, flow velocity, and the size and type of spawning gravel, they have set about either re-creating or restoring them. It has involved narrowing the rivers in some areas to increase the flow. There has been bankside planting, water jet cleansing of spawning gravels and extensions to the gravels. Spawning success is improving dramatically, from almost nil to 38 per cent at one site, and similar measures are being taken to improve the nearby Avon for game and coarse fish. Other projects include a scheme to use a River Trent tributary as a nursery for salmon, if agreement can be reached with coarse fishing interests. In Wales the Environment Agency is attempting to restore the productivity of the River Dee by reducing the number of net licences.

Saving Salmon

Irish Times

Sir, - I would like to compliment the Minister, Mr Eamonn Gilmore, on commissioning a report by a management task force in 1995 for the protection of Atlantic salmon. On appointing a competent and professional group of people, he forged a new chapter at a critical time for salmon. Professor Wilkins and his formidable team grasped the complexity of the problem of declining salmon stocks and presented a balanced, realistic and scholarly report. Now it devolves on the people of Ireland, and in particular on fishing interests, to use this window of opportunity to protect and nourish a rare and beautiful species, for the enjoyment and benefit of their children. I urge netsmen, fishery owners and anglers to adopt the broad principles and central thrust in this report. We must forget sectional interests and place the salmon in its true, central role, as our primary game fish. Only through our combined efforts can we achieve the objectives set out in this report. Salmon stocks are indeed in decline. If we fail to act now in a spirit of cooperation, we may well be responsible for the demise of the salmon as a species.

US Fish And Wildlife Service Report Describes Vital Role Of National Fish Hatchery System In Fisheries Managment

PR Newswire

If you're wondering where most of the nation's fish come from, the US Fish and Wildlife Service's annual report on the National Fish Hatchery System can provide you with some answers. Service hatcheries in the Northeast play key roles in such programs as restoration of Atlantic salmon in New England, rebuilding lake trout in the Great Lakes and restoring striped bass along the Atlantic coast. Each year, the Service, an agency of the Department of the Interior, releases the Fish and Fish Egg Distribution Report, a treasure trove of statistics and other information on hatchery operations nationwide and how they fit into the agency's role in fisheries management. The Service produces, transports and stocks hundreds of millions of fish and fish eggs of more than 60 different species annually to states and Native American Tribes, bolstering fishery populations as well as fishing opportunities nationwide. The present stressed state of the nation's fisheries and aquatic systems gives such information on hatchery operations new relevance. Pollution, poor water quality and destruction of habitat put extreme strains on fisheries to the point that many are not considered sustainable. 'National fish hatcheries are one of fishery managers' most effective tools for restoring depleted fish stocks,' said John Rogers, acting Service director. 'And those of us who enjoy sportfishing have come to appreciate the critical role they play in providing millions of Americans with great fishing opportunities.' The National Fish Hatchery System currently

includes 72 national fish hatcheries, 9 fish health centers and 5 fish technology centers. In 1995, these facilities distributed some 170 million fish and 140 million fish eggs. The report notes that 41 species listed under the Endangered Species Act or candidates for the Act's protection are held at 35 Service hatcheries. Propagation at 29 hatcheries and 4 fish technology centers supplements depleted stocks and helps the Service meet its responsibilities to recover listed species. Fisheries conservation efforts in which national fish hatcheries play a significant role include: - Restoration of Atlantic salmon in New England, a cooperative effort with the states and the Commerce Department's National Marine Fisheries Service. During the past 6 years, national fish hatcheries have provided more than 35 million Atlantic salmon for stocking in New England waters, including the Penobscot, Connecticut, Merrimack and Pawcatuck rivers. The Service also helps restore salmon habitat, regulate harvest and provide fish passage facilities. - Rebuilding lake trout in the Great Lakes. This program combines an aggressive stocking program with efforts to control the sea lamprey, an exotic species that preys on lake trout; improving water quality; and regulating harvest. During the past 11 years, national fish hatcheries have stocked more than 85 million lake trout eggs, fry and juveniles into the Great Lakes. Notable progress has been made especially in Lake Superior, Lake Huron, and Lake Erie, where the lake trout has been showing signs of better reproductive success. Many areas of Lake Superior will no longer require stocking of hatchery fish. - Striped bass restoration along the Atlantic and Gulf coasts, a cooperative effort with several states and the Atlantic States Marine Fisheries Commission. In 1995 alone, the Service stocked 10 million striped bass along these coasts. After reaching record lows in the early 1980s, striped bass have made a remarkable comeback, especially in the Chesapeake Bay. Along with stocking, tagging and monitoring programs and harvest regulation have contributed to the striped bass success story.

Salmon Cash Is Slipping Away

Glasgow Herald

It's been a grim season for Scotland's salmon anglers, faced with a second summer of drought in a row on top of the general decline in the numbers of the King of Fish. The palpable feeling of gloom across the countryside, especially in the catchment areas of the Tay and Dee, is tending to focus attention once again on Government policies, particularly the insistence on keeping open the wasteful drift net fishery off the English North-East coast for nakedly political reasons. Although it is difficult to get traditionally conservative anglers and fishery proprietors to say so publicly, there is little doubt that the majority believe they have been betrayed. Betrayed by politicians afraid of creating an outcry by closing down drift net fisheries around the English coasts while they have had for years the unanswerable evidence that the Atlantic salmon caught by rod and line for sport is 10,000 times more valuable to the general economy than the same fish strangled in a monofilament gill net. The Tories have had a long time in which to make major change, but they have not done so. Westminster, if it is any consolation, is not alone. The other major salmon neighbour, Ireland, pursues the same shocking policy, keeping open an even more anarchic and wasteful drift-net industry - little more than legalised poaching - in order to appease a rump of netsmen. Small wonder that England and Ireland are regarded with some disdain by the other Atlantic salmon nations as the dirty men of Europe. At least our Government makes no real pretence over the angling industry, having connived at the destruction of the sea trout resource at the hands of the salmon farming industry (although the fish farmers resolutely maintain that their practices with lethal chemicals and their sea lice plagues have nothing whatever to do with sea trout population collapse). The same weary justifications for the lack of intervention on behalf of the wild species are trotted out despite the declining graphs. The Irish, on the other hand, have set up a high-powered task force to tackle their decline and are ostensibly committing millions to schemes to enhance stocks in particular rivers and lochs. Sandy Levenson, editor of the British game fishers' bible, Trout and Salmon magazine, points out, however: 'Most of it is little more than cosmetic. But they have at least made a start.' He is even tougher on our own politicians. 'Unless they realise the value of a rod caught salmon compared to one killed in a net and act on it fast we have had it. Anglers themselves are beginning to realise just how wonderful and valuable a salmon is. In bygone years where they might have killed a dozen or more during the autumn run they are now willing to settle for a couple and be very thankful for that,' he says. He agrees that anglers will have been discouraged by the poor summer, although most will realise that while something could be done to reverse the long-term British stock decline little can be done about the weather. On that score Glasgow Weather Centre figures show Scottish rainfall averaging out about normal from January to May, followed by 65% rainfall in June, 105% in July, 73% in August and 41% in September. The result of that below average summer was low river flows and salmon trapped in the tidal estuaries where they were vulnerable to criminals and disease. Locally, there are other reasons for poor catch figures - notably on the Tay. The water was so low at Dunkeld House Hotel that a stone appeared from the river bed with a date carved on it which had never before been seen in living memory. One experienced commentator told The Herald that the failure of the grilse (maiden salmon) run was probably due to the disastrous floods of 1993 when much salmon spawn was simply washed away while the meagre spring run was due to the same reason. The coveted spring salmon, a discrete, larger race, have usually spent three winters at sea on top of their three winters as juveniles in fresh water. That sequence takes them back to a birthday in 1990 - another year when disastrous flooding swept the Tay basin. The picture across Scotland is inconsistent, with some areas more hopeful than others, apart from the general decline, which can only be fixed by

politicians. That does not prevent tourist boards and fishery proprietors, hoteliers, shopkeepers and bankside service industries from worrying that the wealthy Continentals will next year opt to spend their fishing holiday in one of the many new destinations, from Arctic Russia to Patagonia or even the Falklands which are being promoted hard at the expense of the home-grown product.

Planners Back Expansion Of Salmon Farming

Aberdeen Press And Journal

Planners have given the go-ahead for a rearing unit of up to 40 cages producing 30 tonnes of salmon smolts in Loch Shin, despite concerns about possible pollution and endangering wild salmon stocks. Sutherland planning committee agreed at Dornoch yesterday for a 10-year approval of the application by the Rev Alexander Murray and his son Hugh, directors of Migdale Smolts Ltd. They discounted a plea from Raymond Bixley from Suffolk - who runs a holiday fishing cottage close by the site - to defer consideration for two years so that the effect of the smolt farm could be fully evaluated. Other objections had come from the Kyle of Sutherland Fishery Board, The Atlantic Salmon Trust, the RSPB, the Anglers Clearwater Associated Presbyterian Churches, had indicated the chance of a rise in the number of six people employed on the farm. Almost 100 other jobs from helicopter pilots to processing workers are being associated with the development.

Angling - Rivers May Become Salmon Nurseries

Daily Telegraph

Two of Britain's leading coarse fishing rivers could be used as nurseries for salmon, if anglers go along with a scheme to be put forward for discussion by the Environment Agency next month. The main nursery would be the River Dove and the Trent would be the highway to and from the sea for fish running in to spawn, or migrating as smolts. It would not be done to create a salmon fishery, they say, though the Trent was a fine salmon fishery in the last century. The main idea is to assist the conservation of Atlantic salmon. It would not be financed out of rapidly shrinking fisheries budgets. The £30,000 a year required to get it up and running would have to come from a private trust similar to that for River Thames salmon. The project would start with the planting of fry and part in the River Dove, and little else would happen in the first five years of what could be a 20 to 30-year project. The prospect of cleaner water and better-maintained levels is being held out to mollify the coarse fishing clubs which own or lease most of the fishing along the two rivers, but it may not be enough to win their support. Opinion-sounding among club officials produced many objections and questions, one of which was: The EA may say the Trent is 'unlikely to become a salmon fishery', but if the fish are there other people will regard it as such. Owners of key sections would want more rent, or make the prolific weirpools off-limits for coarse fishermen.

The Salmon Is Not Just Meat

Irish Times

You miss the soft Northern voice, (yes, there are such), the slow delivery, the warm appreciation of all creatures and plants, the insignificant flower on the forest floor, the little bird with the big name as he said, troglodytes troglodytes, the wren. Olly McGilloway on UTV, didn't force his opinions down other people's throats. For example, in one recent replay of his series, he was in full flow, praising the Atlantic salmon, as he called it, its strength, its gracefulness, its courage: setting out as a small, maybe six inch, smolt to cross the Atlantic, and then, a developed fish, making for home, with just one idea - to reproduce and start the cycle again. And these smolts might be just, perhaps, two per cent of the five thousand eggs that the parents had spawned and fertilised. He didn't have to go on for long. It was written on his face and enriched his quiet voice - the Atlantic salmon, he said, is a wonder, not just meat. Then he stood by while a salmon farmer, on the raft or construction, told of his mission. It was to produce high quality protein for human consumption. He said they had ninety per cent reproduction instead of the tiny per cent of survivors in the wild. Olly stood at the side of the picture and said nothing and looked nothing. It was farming, after all, the other man had said. We are in the early days of that story in Ireland. So far it has raised controversy over the depredations of sea lice, encouraged, it is said, by the presence in the wrong places, of these sea farms. To some extent, the jury is still out on that. Fish farming has given high quality protein, as the man said, at times when the wild fish is not available. And cheaper. What we don't know is something like the things we didn't know when we went into intensive chicken rearing and intensive cattle farming. Olly didn't come in there, and the other man had his fair say. But it is possible that, as farmed salmon and trout escape and breed with the wild fish, there may be repercussions. Also in this programme Olly saw virtue in the scrappy sea buckthorn - and looked with some pleasure at rabbits grazing. He helped us to see with his uncomplicated enjoyment of so many things in the natural world.

Rights Of Coastal Communities Must Be Observed

Irish Times

The international climate of opinion is 'increasingly hostile' to non recreational salmon fishing. Yet abolishing one sector in favour of another is 'intrinsically divisive', inequitable and fails to recognise that legal drift netting is not the only, and may not even be the main, cause of the perceived decline of salmon, according to the Salmon Management Task Force report. The legitimate right of coastal communities must be acknowledged, it says. With the right strategy in place, Ireland could be well placed to influence opinion in the international debate. The report says this 'pro active' strategy is crucial, if a sustainable, renewable and harvestable resource is to be maintained and augmented for the lasting benefit of the Irish people. While salmon management has deteriorated here in recent years, international moves to stem the stock decline have gathered pace. This changed international climate means that commercial fishing for salmon in international waters has been reduced, and is carefully monitored through the North Atlantic Salmon Conservation Organisation. Quotas have been placed on fisheries in the salmon feeding grounds at Greenland and the Faroe Islands, and schemes have been set up to lease quotas in those fisheries aimed at ending all interceptory fishing. The result is 'crystallisation of an international ethos which opposes all fishing for salmon at sea and encourages conservation strategies based on spawning escapement catchment management'. Irish salmon stocks are not in as poor a state as some suggest, the report says, but it is also critical of inadequate and unreliable data. The lack of such data raises serious questions. Only half a dozen Irish rivers have useful counters and/or traps, and in only one of these the Burrishoole system is it possible to monitor the fishery with total accuracy. In spite of a widespread perception to the contrary, the decline in the value of wild fish has resulted in a fall in drift net licence holders. For those remaining, the response has been to seek even more fish to maintain income. The potential danger this represents to stocks has not been acknowledged generally. The drift net fishery is now largely carried out close to shore by bona fide fishermen in boats of less than 40 foot in length, and almost all admit to using monofilament nets on grounds of safety, efficiency and low cost. Other evidence indicates that drift netting at sea continues in the close season in some areas. Almost all draft nets are now operating in estuaries and tidal areas of rivers, it says. Draft netting is considered by many to be the preferred form of salmon net fishing, in that it harvests mainly single stocks and each draft net fishery can be managed by direct reference to the single stock it harvests. It also produces a better quality fish, it says. The report says that 25,000 rod angling licences were issued last year, and there is no statutory limitation on numbers. The revenue exceeds revenue from sales of all net licences by a factor of four, and yet nominal catch figures would suggest that holders take less than one fish on average per licence.

Radio Tags Chart Salmon Network Nature Watch

Sunday Telegraph

The odd salmon has swum free from the nets this season, but the cobblenet fishermen of Berwick-upon-Tweed haven't minded. Not only do they receive a payment for the salmon that live to be returned to the river, but they are also supporting a conservation project that could help to preserve their centuries-old trade. Scientists working for the Tweed Foundation, a charity set up to promote the conservation of stocks in the Tweed and its tributaries, are carrying out a radio-tagging exercise to discover more about the habits of the much sought-after game fish. Their work adds to the knowledge of the region's ecology as well as its economy. The Atlantic salmon (Salmo salar) that return to the Tweed to spawn are prized targets for anglers, as well as for the net fishermen of Berwick. The Tweed has a reputation that can command prices of thousands of pounds for a week's fishing along some beats. A study published by the Foundation last week suggests that salmon angling generates £12.5 million in the Borders each year - more than 10 per cent of the region's tourism revenue. 'We estimate that every pound of salmon caught is worth £156 to the local economy,' said Judith Nicol, the Foundation's director. Until recently, salmon catches in the Tweed system had been in decline since the 1970s. The Foundation is trying to encourage a recovery by clearing obstacles that may block fish from spawning in remote burns and other stretches. It is also cultivating the banks in ways that do not lead to erosion or to the loss of vegetation that affords the salmon food and cover. 'We've shown that you can really improve the quality and productivity of a river without having to resort to stocking it with imported fish,' said Dr Ronald Campbell, the Foundation's senior biologist. The radio-tagging survey is another initiative to help the Foundation track salmon movements up the river. The information gleaned may help to identify stretches of water where conservation efforts should be targeted. That is why James Maclaine, a young biologist, has been wading out to the sandbanks from where the Berwick fishermen cast their nets. By the end of the netting season this week, he expects to have tagged about 100 fish, divided from the spring and autumn runs. Once a fish has been caught and selected, it is placed for a few moments in a tank of water mixed with an anaesthetic. Then it is quickly weighed and measured, a scale sample is taken, and two tags are attached. One tag, a blue strand, means the fish can be recognised if it is subsequently caught by an angler. The other is a tiny radio transmitter pushed down into the salmon's stomach before the fish is revived and freed. A network of automatic radio listening posts enables Maclaine to track the salmon. The survey is being done alongside other research to try to solve the mysteries of the salmon. One programme involves electric fishing in which a metal detector-like device is used to catch young fish to assess their numbers. The research hopes to reveal, for example, why most spring fish opt to breed in the Ettrick or Whiteadder waters, ignoring other tributaries. And why so many autumn fish make the longer journey to the upper Tweed.

Tails You Lose - Salmon Poaching

Guardian

All along the Tweed, poaching salmon is a way of life. Landowners were losing the annual battle until hi-tech bailiffs with wide-ranging legal powers were organised. As the season reaches its summer peak. Peter Hetherington views the guerrilla war from both sides of the lines bleary-eyed after a hard day's night, he plans his campaign with the dedication of a guerrilla facing a modern army. Keith Hall knows the enemy well. Along with a hard-core of border raiders on both banks of the Tweed, he's been slipping behind their lines since boyhood, on to the estates of the rich and famous. He's been captured more times than he cares to remember and served a couple of short prison sentences. But he soldiers on. As they respond with more patrols and ever more sophisticated gear, the envy of many a police force - night-sights, communications secure from interception leading to better on-the-ground intelligence - he tries to stay one step ahead. There are times when it seems like a losing battle. But he insists he has a job to defend, a tradition to maintain, a family to feed - and positively no apology to make for challenging the law. 'I am a professional salmon poacher,' he calmly volunteers in his headquarters, a large shed with an equally impressive array of gear a few miles inside Scotland. 'I have never met a better one. I am not ashamed of what I do. I don't mind telling people. I've never done anybody any harm. I don't break into houses, steal cars, anything like that. It's a job. I respect folks. I have a clear conscience." Along the banks of Britain's premier salmon river, where they are preparing for the annual battle of the Tweed this month, Keith Hall has achieved a notoriety few can match. Hero to some, and villain to others, he portrays the battles as little more than a class war between Britain's biggest landowners who have lucrative beats along the Tweed system - the Buccleuchs and Roxburghes, for instance - and the common man. But for impartial observers along the border, the law-abiding majority who often have little time for the landed elite, such principled objectives sit uneasily on the shoulders of 'criminal classes' who - some say - have been known to use intimidation, and worse, to further their interests. In the confrontation now building up, squads of bailiffs in fast four-wheel drives or speedboats - armed with handcuffs and batons - have the poachers on the defensive. Hall, and the band of professionals based near the estuary of the river - boundary between England and Scotland for part of its course - have to fight for every inch of territory as tactics change and attitudes harden. There's a new determination on the part of an enforcement agency, the River Tweed Commissioners, born out of bitter experience in the eighties when the annual battles became uglier, the tactics more ruthless: a patrol launch mysteriously sunk in Berwick harbour, holed below the water line; the Commissioners' headquarters in the border town fire bombed and badly damaged. 'They left a foul mess behind - did, I believe, what only happens in Northern Ireland - smashed up everything,' said a former official. Bailiffs were intimidated, their cars and houses vandalised. 'Even at school, children would go up to other kids in the playground and say 'My dad is going to get your dad'.' In the new Commission headquarters, now conveniently higher up the Tweed valley well away from Berwick and the ruthless professionals, Judith Nicol recalls the dark days when the law enforcers were themselves on the defensive and the poachers, 'criminal elements' appeared to have the upper hand. 'Things were in a very bad way. We had to put more resources in. We now have a team of very professional bailiffs, better equipped and organised.' As clerk to the River Tweed Commissioners (RTC) and director of a scientific offshoot - the Tweed Foundation - formed to promote the development of salmon and trout stocks, she represents the new image of an organisation dismissed by some as an anachronism, a front for the rich and powerful landowners who fund much of its work and elect, as river 'proprietors', 38 members of the governing Tweed Council - the remaining 43 being appointed by local authorities. Certainly there is no other organisation quite like the cross-border RTC. It is still charged with upholding three Tweed fisheries acts, dating back to 1857, designed to 'preserve and increase' salmon and trout stocks in a huge catchment area embracing 2,000 miles of rivers and streams - tributaries of the Tweed - and a 30-mile coastal area stretch from Holy Island in Northumberland to Cockburnspath in Scotland. Their jurisdiction even extends five miles out to sea. Confusingly, bailiffs operate under Scots law, which empowers them to take cases to magistrates' and sheriffs' courts in England and Scotland respectively, depending on which side of the border criminals are apprehended - as Keith Hall knows to his cost. He proudly displays one tool of the trade, a homemade 'coracle' a large tractor inner tube inside a thick PVC jacket. He will load it into his red four-wheel drive, with a range of anti-bailiff devices - including a tiny light under the chassis to guide the way along dark tracks - and make for a prime beat. Then he will paddle the flimsy craft to the middle of the river with a long net which has already been attached to the shore - and wait. On a good night, 20 or more salmon will be bagged. If he's caught, the law will come down hard. 'Because of the likes of me, a majority of offences now carry six-month prison sentences,' he laments while recalling his two three-month spells in jail nine and 13 years ago. 'These people have the power to arrest you without a warrant ... they can even stop you and say 'we have reason to believe there is (stolen) fish in your house or shed.' Two years ago, he says, they did just that. They came with a search warrant to his shed, beside Eyemouth harbour on the Berwickshire coast, saying they suspected he was in possession of illegal salmon. They discovered a few. 'Well, 20 actually.' He was fined £400. 'They're a cross between a private police force and an army,' he thunders. 'Not a nice bunch to deal with. They've got draconian

powers, you know, far more than the police.' Ask him how often he's appeared in court, and he thinks long and hard. 'Oh, 14 - something like that.' And the cost: 'Say around £17,000 in fines and confiscated equipment.' Hall, in the business for 30 years, also nets out at sea - legally, he says. Like other professionals, he began young - 15 in his case - in a trade often handed down from father to son and traditionally centred around Berwick. Some poachers put the number involved - directly, or otherwise - at around 1,000 with others, outwardly more respectable, covertly oiling the wheels of a supply chain which stretches to markets in the south of England and beyond. Just say a fair percentage in Berwick poach, have poached, or have poachers in the family,' says a former senior bailiff. 'This town is steeped in salmon, whether caught legally or illegally.' Not so long ago James Leeming, a former clerk to the Tweed Commissioners, now a principal letting agent for prime salmon beats, pointed to a more sinister side to the trade far removed from the romantic, popular image of the poacher, the loveable rogue, nipping down to the river under a full moon to take 'one for the pot'. Sure, in the upper reaches, the 'jack the lads' might head for the Tweed or its many tributaries, after a good night out, and try their luck. But on the prime beats, principally a 50-mile stretch between Galashiels and Berwick, it was a different matter. 'People have said it's a Mafia-type activity,' he volunte ed. 'I'm not saying there are protection rackets, but they've got an extensive system of spies and a radio network. And there's organised thuggery.' With the Tweed offering the longest fishing season of the four major rivers (the others being the Spey, Dee and Tay) from February to November, salmon has become a multi-million pound industry, rather than a sport - as the Duke of Roxburghe acknowledges. With an estimated 68,000 border acres under his belt, along with some of the best beats, he sees angling - which can cost anything from £25 to £1,000 per rod for a day - as 'a very considerable asset', which underpins the capital value of his land, pumping an estimated Pounds 5m annually into the wider area. If you happen to own stretches of the river which offer good quality fishing you are going to command high prices . . it's an integral part of the management of the estate.' And sadly, with such high stakes, the punters can get marginalised - 'an unfortunate consequence of supply and demand'. But they do, at least, have their place - on the Teviot, an estuary of the Tweed, which offers reasonable fishing. 'We give a large part of it, with no rent, to a local angling association, which they run themselves and let out on cheap tickets to the local people . . we try to take a balanced view.' Generally, there appears a feudal indifference to the great river divide - of the high commanding just about everything big that swims, and the lowly knowing their place and accepting the smaller fry. Andrew, from Selkirk, fined £50 two years ago for taking a salmon with crude stick and big hook from the Yarrow, a tributary of the Tweed, was filmed on video camera. They were hiding, waiting for me. It was a fair cop, but the fish wasn't very big - only 10lbs.' The Duke is philosophical. Yes, a year or so ago, he'd met someone 'who might have been' Keith Hall. 'He was engaged in a poaching activity, which was his wont. One of my keepers caught him. He was being restrained at the time, but we were perfectly pleasant to one another.' For Hall, it was anything but a fair cop. He is familiar with the Roxburghe estates. Over the years, they'd landed him in a lot of trouble, along with the dreaded bailiffs. He knows that the number has doubled since the eighties to 12 full-timers, supplemented by additional staff when the summer season is at its peak. Ian Gregg, chairman of the Commissioners, who heads a big bakery group (and is a member of an angling syndicate) says enforcement has radically changed. 'They used to operate by hunch and didn't have very regular scheduling of their policing,' he recalls. 'Now they have a strict rota to go around the likely places. It's so much more organised and systematic. The chances of people getting away with it for any length of time are massively reduced although we do have specific campaigns to catch a particular person.' De facto policing? Surely not. 'Yes, they are there to stop people breaking the law. We can't just have people making the laws to suit themselves.' Last year they prosecuted 69 - 12 more than in 1994 - and confiscated 346 nets. Beside his state-of-the-art, black four-wheel drive Tony Coleman, the superintendent of bailiffs, insists that enforcement is only part of their work these days. He sees his men as the eyes and ears of the local community, sometimes reinforcing an over-stretched local constabulary. 'Really we are more countryside police than bailiffs. We work very closely with the police force, supporting what they do. It's just being a good neighbour, that's all.' And that neighbourliness extends to improving the lot of the salmon - within reason, of course - to ensure the security of its spawning grounds. This has led to the Commissioners developing a twin-track strategy of upholding the law while conserving stocks, with marine biologists studying the complex lifestyle of the salmon - even installing small, cylindrical electronic trackers in selected fish to check their movements from leaving the river after one year or so, in their tens of thousands, for the north Atlantic. They return up to three years later with up to 50,000 entering the Tweed system annually to breed, and then die, but their precise lifestyle still remains a mystery. Almost 10,000 were caught by anglers last year, with legal netsmen accounting for an equal number in the estuary and at sea. But while the Commissioners' scientific work through the Foundation is attracting international attention and praise, their policing role and apparent exclusivity is still a matter of intense debate as Ian Gregg acknowledges. Just why should a few extremely well-heeled people have all the best beats? Good point, he acknowledges. And yes, the working man did have an argument. 'I think I can justify our position. As well as the prime beats on the Tweed, lots of water is still available to the punter and there's pretty good access to the system for trout fishing.' Yet he had now changed his position, from sportsman to conservationist - 'I am now rather more interested in looking after them than pulling them out.' Sadly, Keith Hall isn't. In his stinking four-wheel drive - 'that's salmon blood you're smelling' - he claims it's indefensible for the landowners to claim that the fish belongs to them. 'It's a wild salmon, for God's sake - it doesn't belong to anybody, does it? The only reason the bailiffs want to get at the likes of me is so that their paymasters can catch more salmon.' Soon, when

the hunting season returns with a vengeance, the rural guerrillas will prepare for another round of battle by the water - well aware that their trade is becoming riskier by the day. And if the bailiffs don't catch them, the tax man surely will. Not so long ago, Keith Hall was stung with a £35,000 bill from the Revenue. Did he pay up? 'Don't be daft.' He declared himself bankrupt instead. But he's under no illusions. 'They'll be back.'

Open Space - Urgent Measures Are Needed To Rescue The Scottish Salmon Scotsman

Eric Begbie travels to Nova Scotia to examine salmon conservation measures Tweed. Tay, Dee and Spey, four of the many Scottish rivers with names synonymous with high quality salmon fishing; broad streams with a noble past but, tragically, gloomy prospects for the future. So severe has been the deterioration of Scotland's great salmon rivers that I paid two visits to Nova Scotia to study conservation methods being employed to halt the decline of the salmon runs in Canada's eastern maritime provinces. The problems faced by the Atlantic salmon in Canada were almost identical to those which have so adversely affected angling in Britain. Commercial netting at sea and around the coasts had combined with irresponsible angling practices to reduce many fisheries to a shadow of their former glory. Unlike Britain, however, the Canadian salmon revival is now in full swing. As in Scotland, the major problem was the operation of commercial netting. Clearly, any conservation programme had to start with the elimination of this factor, particularly in coastal waters. To show they were willing to make a contribution to the conservation process, however, anglers were also required to make concessions. Lynda Calvert, of the Margaree Salmon Association, says: 'It was relatively straightforward to persuade the government that the economic value of a rod-caught salmon was much higher than that of one caught in the nets. We estimated that each fish caught by a sport angler brought \$200 to the local economy, while a sea-netted salmon contributed less than \$5, but we had to demonstrate that the angler was committed to a conservation programme and was willing to accept sensible restrictions on angling methods.' The results have been staggering. All commercial netting has been banned in Nova Scotia for several years and, in 1991, the Newfoundland commercial fishery was shut down and the licence-holders bought out at a cost to the federal and provincial governments of almost \$40 million. Those measures alone have resulted in hundreds of thousands of Atlantic salmon escaping the netsman's harvest to return to their rivers of origin. The management of the sport fishery has been equally radical. In Nova Scotia, there is a fly-only rule on all salmon rivers and neither treble hooks nor weighted flies are allowed. When I showed Lynda Calvert my box of tube flies and Waddingtons, she swore in disgust before offering me one of her favourite deer-hair dry flies. Limits on the number and size of fish an angler may take have also been imposed. In Nova Scotia the limit is two grilse in a day and ten per season. All fish over 25 inches in length must be returned unharmed. Katherine Rice, of the Nova Scotia Salmon Association, has watched the number of salmon steadily increase since the grilse-only rule was introduced, and assured me the great majority of anglers are perfectly happy to return their big fish. In addition, on the River Margaree, a ten-mile stretch of the headwaters is designated as a sanctuary zone with no fishing permitted so that the fish can remain unmolested while preparing to spawn. A hatchery releases almost 200,000 young salmon annually to augment natural spawning. Scottish salmon rivers will never be restored to their former greatness until drift-netting on the Northumberland coast and estuary netting everywhere are eradicated. The task is to persuade the Government that it makes economic sense to close down the commercial fisheries and thus greatly boost the sport fishing trade. As in Canada, much of this effort would count for naught if the angler did not also contribute to a conservation programme. Because the tenure and management of Scottish rivers is very different from those in Canada, it is doubtful if identical solutions could be successfully applied. Seasonal salmon licences, permitting the angler to fish all of the rivers in Nova Scotia, cost only \$107 (about £50) for non-residents. Fishing is, therefore, inexpensive and access to it is readily available, so it is perhaps reasonable to expect sport fishers to make substantial concessions in order to promote conservation. In Britain, where good quality salmon fishing is relatively expensive and in short supply, the principal beneficiaries from effective conservation measures might be the multiplicity of private proprietors who own the fishing rights. Unless this inequity is addressed, it is unlikely that anglers could be persuaded to accept bag limits, catch and release or a fly-only rule. There is, however, a potential solution to this impasse. A consequence of the deteriorating salmon stocks during the past two decades has been grossly inflated prices for salmon fishing. Scottish rivers have been subjected to the scourge of timeshare and syndication schemes and, on many beats, local anglers have been squeezed out. A conservation agreement which guaranteed a reasonable level of access to local anglers in return for restrictions upon methods and catches might prove a popular move. The challenge is there to be met. Our salmon can be saved but urgent action is required. Without it, the only winners will be the transatlantic airlines as more and more Scottish anglers seek their sport on Canadian rivers.

Porpoises Threatened By Lifting Of Net Ban

Scotland On Sunday

Thousands of increasingly-rare harbour porpoises are being slaughtered every year by a sea fishing method that the government intends to reintroduce to Scottish waters. The Scottish Office will next month ask for parliamentary approval to lift a ban on the use and carriage of large-mesh monofilament gill nets imposed 10 years ago as part of a package of measures to protect declining stocks of Atlantic salmon. Environmental groups

claim that lifting the ban will endanger the schools of harbour porpoises off the west coast, one of the marine mammal's last strongholds. New research to be published this week shows that populations of the smallest member of the dolphin family are being decimated by the nets in fishing grounds in the North and Irish seas and off the east coast of Canada. The research was compiled for WWF Scotland, a leading environmental group which has presented its findings to the Scottish Office. 'The evidence of serious harbour porpoise by-catch problems associated with bottom-set gill net fisheries is extremely strong,' said Elizabeth Leighton, WWF's marine policy officer. There is no reason to suppose that similar problems would not be associated with the use of these nets off Scotland. Porpoise populations have already been on a downward slide and if the Scottish Office lifts the ban on these nets around Scotland's coast then it will be another nail in their coffin.' Large mesh monofilament gill nets, which are almost invisible to fish, are used on the seabed in deep water to catch large bottom feeders such as skate, turbot and monkfish. They were banned in 1986, after pressure from landowners, because they were thought to snare valuable salmon returning to their home rivers. Fisheries minister Raymond Robertson announced recently that the Scottish Office no longer considered this to be the case and that allowing the use of nets with a mesh size above 250 millimetres would help west coast fishermen. Fishing organisations have been pressing for the lifting of the ban as they claim it had deprived them of the ability to catch large bottom-feeding flatfish and so part of their income. Although banned in Scottish waters, the nets have been in constant use in the North Sea and the Celtic Sea, the stretch of deep water between the south-west coast of England and Ireland - both areas where harbour porpoises have been in decline, prompting the species' protection under various national and international treaties signed by the government. Scientific studies collated by WWF Scotland found that in the North Sea up to 7,000 porpoises a year are being caught in large-mesh monofilament nets deployed by Danish fishing boats alone. A second survey conducted off the south-west coast of England indicated that more than 2,000 were being accidentally snared annually. A further 2,000 die every year in fisheries off Canada's east coast. Fisheries ministers argue that large mesh nets do not pose any additional risk to marine mammals and that their use in deep water on the sea bed will minimise their impact on sealife, a view backed by fishermens' organisations. But the alliance of environmental groups fighting the ban which also includes the RSPB and the RSPCA - is concerned that as monofilament nets are cheaper and stronger than types of net currently in use, they will be used increasingly in shallower waters closer to shore where they will also pose a threat to seals and diving sea-birds.

Fisheries Ministers To Discuss Driftnets Again

Reuter News Service - Western Europe

Brussels Fisheries ministers will again discuss a proposal on Monday to ban the use of drift nets but will not take any decision, EU officials said. A European Commission proposal of April 1994 (COM(94)50) to ban drift nets for catching tuna in the northeast Atlantic, swordfish in the Mediterranean and salmon in the Baltic by end 1997 was opposed by all countries except Spain and Greece. 'There's no prospect of a decision,' said one official. Italy is expected to brief other member states about a judgement by the United States Court of International Trade that it had broken international resolutions on driftnet fishing. Officials said that Italian fishermen were using drift nets longer than the authorised length of 2.5 kilometres. Some said that nets of up to 20 km were being used. The United states has warned that it could impose trade sanctions if an agreement is not reached by end-July 1996.

Angling - Salmon Netsmen Feel The Pinch Of 'Fairness'

Daily Telegraph

Salmon fishery owners have given about £42,000 for research aimed at improving wild salmon stocks. They donated a day's fishing, several days in some cases to The Atlantic Salmon Trust, and as reported here in January it all went into a postal auction to raise funds. The Daily Telegraph clearly has many salmon fishers among its readership, as applications for the auction catalogue soared. We helped raise a record-breaking sum for a worthy cause, and the venture will also generate much enjoyment for successful bidders. The sport has a great capacity for helping itself, but it would appreciate some outside support occasionally. Unfortunately the Government's propensity for identifying votes and figuring out how to lose them is as evident in salmon fishing as it appears to be elsewhere. A National Rivers Authority review in 1995 concluded that licence charges for salmon netsmen were historically low. To be 'fair and consistent' with road licence charges, the netsmen would need to pay £400-600 a time more. In the end they recommended a 75 per cent increase for netsmen and slapped £10 on the road licence. That will raise an extra £270,000 from anglers - £105,000 more than the total income from netsmen. Thus an exercise seemingly intended to achieve greater fairness did exactly the opposite. The nets now take 70 per cent of the salmon and sea trout catch, and contribute a mere 20 per cent of the licence income. This particular fisheries fiasco is the present and future of salmon fishing, devised entirely in Whitehall and rubber-stamped by a Government which is phasing out grant aid to angling. The Salmon and Trout Association are seeking leave for a Judicial Review. They cannot see how the Ministry of Agriculture can justify their decisions. The S & T A point out that a large number of rod and line fishermen are having to provide greater subsidies for a handful of people who helped to spoil their sport. It will get worse, too. Salmon licences, now £45, will soon cost £75. That is not the only indication that doing down the angler is a long-term aim. The S & T A offered to go along with proposals if the ministry would phase in fair net licence charges over five years, but the suggestion has fallen on deaf ears.

Angling - Drifting Into Decline

Daily Telegraph

The National Rivers Authority's action plan to restore salmon fishing has had a mixed reception from the Salmon and Trout Association. They S & T A say they welcome the attempt to construct 'a much needed overall strategy' and cannot fault the section relating to rivers. But they believe the NRA have not been listening to them over the controversial issue of drift netting. Chris Poupard, the association's director, said: 'It seems anomalous that the NRA should strongly condemn the Irish Drift Net Fishery for intercepting English and Welsh salmon, while continuing to take a dilatory view of their own north east drift nets, which catch large numbers of salmon bound for Scottish east coast rivers. 'To compound this felony, the NRA ... do not propose to include those Scottish fish in the calculation of (the cost of) these net men's licences.' One of salmon fishing's major concerns is the ongoing decline of spring running fish. Last month the Atlantic Salmon Trust organised a brain-storming session hoping to come up with some solutions. One depressing possibility which emerged was that early running wild salmon may suffer much higher mortality at sea, probably because of changes in ocean temperature and salinity patterns. It affects seeding, and ultimately the age at which the fish become ready to spawn. The fear is the numbers of spring running salmon will fall below viability level, and springers would then disappear altogether. So preserving them is there fore a priority? Apparently not. They are still running into drift nets - and the NRA recently wasted a golden opportunity to help. They were told by the Ministry of Agriculture that they could postpone the opening of the north east drift nets but, according to the S & T A, failed to do so on the flimsiest of excuses, namely that they had no power to act. The S & T A will be pressing for changes when the NRA is swallowed up by the new Environment Agency in April.

Angling - NRA To Leave Salmon Safe

Daily Telegraph

The National Rivers Authority, which disappears as a separate entity in six weeks' time, presented a parting gift to game fishermen yesterday - a national strategy to protect salmon. The NRA becomes part of the new Environment Agency on April 1. It will be the agency's job to implement what is described as the first national strategy to protect salmon where they are under threat, and to encourage them to return to rivers where water quality is now improving after years of pollution. It may be seen as reassurance for those who think angling and the environment will fare less well under the agency. There are obvious questions, particularly about funding, but the initiative will receive a qualified welcome from salmon fishers. Plans will be made for all the main salmon rivers in England and Wales by 2000. This will involve extensive consultations with all concerned, including anglers and netsmen. There will be spawning targets, based on the numbers of fish each river should support. Factors limiting salmon stocks - including physical barriers, habitat degradation, silt-clogged spawning grounds, even over-fishing and poaching - will be identified and hopefully dealt with. The NRA will seek simplified fisheries regulations so they can act quickly and effectively when stocks are threatened. Action could include the imposition of temporary catch limits when not enough fish are running to meet spawning targets. Poaching penalties will be tougher, bailiffs' powers extended and - a controversial suggestion that works well in America - the sale of rod-caught fish will be prohibited. Anglers can catch and keep what they like from Lake Michigan, for example, but if they try to sell the fish they will be trouble. The new strategy is not unlike a political manifesto. If there is something the salmon fisher wishes to hear it is probably in there somewhere, but the costing is a grey area. It would work well as a fully funded national strategy, especially if it became part of a wider international masterplan, Sadly the Atlantic salmon has more than local problems to contend with.

SCIENTIFIC JOURNALS

An Experimental Study Of The Reproductive Behaviour And Success Of Farmed And Wild Atlantic Salmon (Salmo Salar)

Fleming I A; Jonsson B; Gross M R; Lamberg A

Journal Of Applied Ecology 33 (4), 1996, 893-905.

1. Escape of cultured organisms into natural ecosystems may threaten wild populations both ecologically and genetically. In the aquaculture industry, farmed Atlantic salmon (*Salmo salar* L.) often escape and enter the spawning grounds of wild salmon. We report experiments to assess the competitive and reproductive abilities of fifth-generation farmed salmon and their potential impacts upon wild salmon. 2. The farmed and wild females had similar levels of competitive behaviour; however, they differed in reproductive behaviour and success. Farmed females displayed less breeding behaviour, constructed fewer nests, retained a greater weight of eggs unspawned, were less efficient at nest covering, incurred more nest destruction, and suffered greater egg mortality than wild females. As a result, farmed females had less than one-third of the reproductive success of wild fish. They were less aggressive, courted less, partook in fewer spawnings, and achieved only an estimated one to three percentage of the reproductive success of the wild males. 4. The farmed males exhibited inappropriate mating behaviour, that led to poor fertilisation success, even in the absence of competition with wild males. 5. Adult farmed fish are thus likely to be relatively unsuccessful in natural environments due to a competitive and reproductive inferiority apparently resulting from domestication.

Prespawning Migratory Behaviour Of Wild And Farmed Atlantic Salmon, Salmo salar L., In A North Norwegian River

Heggberget T G; Okland F; Ugedal O

Aquaculture Research 27 (5). 1996. 313-322.

The migration patterns of wild and released farmed Atlantic salmon, Salmo salar L., were studied by radiotelemetry during migration from entering a river to after spawning. The wild salmon were caught during return migration in bagnets and the farmed salmon were produced in a near by fish farm. Both groups were tagged and released at sea near the river mouth of the River Alta, North Norway. A pronounced individual variation in migration pattern was observed. No significant differences was found between wild and farmed salmon in the distance from entering the river mouth to the place of the first stop (recorded in the same pool for 5 days or longer) and the days from entering the river mouth to arrival at the first stop. For both wild and farmed salmon, mean migration speed was 2.6 km day-1, varying from 0.4 to 11.0 km day-1. A larger proportion of farmed salmon distributed to the upper part of the river at spawning; mean distances from the river mouth were 30.1 and 19.1 km, respectively. Farmed salmon spent a significantly longer time from entering the river to reaching the area occupied during spawning.

Marine Post-Smolt Growth And Age At Maturity Of Atlantic Salmon

Friedland K D; Haas R E

Journal Of Fish Biology 48 (1). 1996. 1-15.

The annual variation in sea-age of maturation for a hatchery dependent stock of Atlantic salmon was compared to variation in post-smolt growth as evidenced by circuli spacing patterns. The proportion of returns of 1-seawinter (1SW) and 2SW salmon and the fraction of the smolt year class or cohort that maturated as 1SW fish, were compared to seasonal growth indices determined from circuli spacing on the scales of smolt class survivors returning as 1SW and 2SW spawners. Using image processing techniques, we extracted inter-circuli distances from scales from 2244 recaptured fish. Spacing data for the first year at sea were collected and then expressed as seasonal growth indices for the spring period, when post-smolts first enter the ocean; the summer, when growth appears maximal; and winter, when growth appears to be at a minimum. In general, circuli spacings were wider for 1SW than for the 2SW returns of the same smolt cohort. The 1SW fraction was significantly and positively correlated with late summer growth, suggesting that growth during this season is pivotal in determining the proportion of a smolt class that matures early.

In-Season Management Of Atlantic Salmon (Salmo salar): An Example Using Southern Gulf Of St. Lawrence Rivers

Clayton R R

Canadian Journal Of Fisheries And Aquatic Sciences 53 (6). 1996. 1345-1359.

Adjusting harvest allocations on the basis of in-season forecasts would have improved management of summer returning Atlantic salmon (Salmo salar) compared with preseason methods at 12 stock assessment sites in

southern Gulf of St. Lawrence rivers. Allocation changes based on improved in-season forecasts did not always improve management performance as the season progressed. The relative effectiveness of making a single inseason allocation change or updating allocations once a week depended on the penalty associated with overharvesting. Weekly updated allocations were always better when penalties for overharvesting and underharvesting were equal. When the penalty for overharvesting was greater than for underharvesting, the management performance of single versus weekly updated allocations was site dependent. Sites with shorter migrations were better managed by single allocations than those with longer migrations, but the timing of these allocation changes was critical for effective results. Sites with mean returns three times higher than spawning escapement targets were not improved by in-season management. Increased harvest variation was also an important effect of in-season management. Defining the relative penalty to place on overharvesting is the most important factor in determining how in-season management is implemented.

Environmental Continuity In Fluctuation Of Fish Stocks In The North Atlantic Ocean, With Particular Reference To Atlantic Salmon

Antonsson T; Gudbergsson G; Gudjonsson S

North American Journal Of Fisheries Management 16 (3). 1996. 540-547.

Large masses of cold, low-salinity or warm, high-salinity water move with ocean currents in the North Atlantic Ocean, drastically changing the conditions for the biota and affecting the sizes of fish stocks. Oceanic conditions in the Barents Sea seem to be repeated in the Iceland Sea 2 to 3 years later. The sea temperatures in these areas fluctuate similarly with time lags of 2 and 3 years; the correlation coefficients are 0.63 and 0.62 for 2- and 3-year differences, respectively (P lt 0.05). The abundance of stocks of Atlantic salmon Salmo salar in rivers in north Iceland show fluctuations similar to those of Atlantic salmon stocks in rivers on the Kola Peninsula in Russia 2 to 3 years earlier. Correlation coefficients of Atlantic salmon stock size in three rivers of the Kola Peninsula and the salmon catch in three rivers in north Iceland were 0.62 to 0.90 (P lt 0.01). Similar trends were observed in recruitment and catch of Atlantic cod Gadus morhua and catch of Capelin Mallotus villosus in these distant areas. We hypothesize that fish stocks in other areas of the North Atlantic Ocean show similar fluctuations in abundance with time differences based on the rate of movement of the ocean currents.

Genetic Structure Of European Populations Of Salmo salar L. (Atlantic Salmon) Inferred From Mitochondrial DNA

Nielsen E E; Hansen M M; Loeschcke V

Heredity 77 (4). 1996. 351-358.

The genetic relationships between the only natural population of Atlantic salmon (Salmo salar L.) in Denmark and seven other European salmon populations were studied using RFLP analysis of PCR amplified mitochondrial DNA segments. Six different haplotypes were detected by restriction enzyme analyses of the NADH dehydrogenase 1 segment, employing four endonucleases. Significant genetic differentiation was observed among populations. A hierarchical analysis of the distribution of the mtDNA variability revealed that only a small part was distributed among geographical groups within the study area. No correlation was found between genetic and geographic distance among populations. The effective migration of females (Nm)-F among rivers was estimated to be approximately one per generation.

Protein And Microsatellite Single Locus Variability In Salmo salar L. (Atlantic Salmon)

Sanchez J A; Clabby C; Ramos D; Blanco G; Flavin F; Vazquez E; Powell R

Heredity 77 (4). 1996. 423-432.

We describe genetic variation at three microsatellite single loci and six allozyme loci of seven natural Atlantic salmon populations from Ireland and Spain. A comparison of genetic variability detected at both types of loci is performed. Also, the relative value of microsatellite single locus variability with regard to the identification of individual salmon populations is assessed. Microsatellite loci are shown to display higher levels of variation than allozyme loci. Mean number of alleles (6 + 1.53) and heterozygosity (0.46 + 0.04) at microsatellite loci are greater than those found for allozymes (1.85 + 0.05 and 0.21 + 0.03, respectively), and some microsatellite alleles appear to be specific for a location or geographical area. Allozyme and microsatellite variation show the same pattern of differentiation between populations with Irish and Spanish populations grouped into different clusters. However, greater values of genetic distance were found among microsatellite (D = 0.0747 + 0.01 1) rather than among allozyme loci (D = 0.0449 + 0.008). These results provide evidence that microsatellite-based analysis of genetic variation will be useful in the identification of individual populations of Atlantic salmon.

Transmission Of Infectious Salmon Anaemia (ISA) Through Natural Secretions And Excretions From Infected Smolts Of Atlantic Salmon Salmo salar During Their Presymptomatic Phase

Totland G K; Hjeltnes B K; Flood P R

Diseases Of Aquatic Organisms 26 (1). 1996. 25-31.

Short-term (48 h) exposure of healthy Atlantic salmon Salmo salar L. smolts to infectious salmon anemia (ISA)-inoculated cohort smolts showed that the disease was transmitted with near 100% mortality from Day 7 post-inoculation and onwards. This is more than a week before the inoculated fish show any clinical signs and long before the typical petechial breedings occur. A bloodborne transmission of the disease is therefore unlikely. Skin mucus, faeces, urine and blood, isolated from ISA-inoculated smolt, transmitted the disease to healthy cohort smolt with variable efficiency depending on how the inoculum was administered. All the sources were infectious and transmitted the disease with high efficiency when injected intraperitoneally (i.p.) into cohort smolt. After i.p. injection, skin mucus had somewhat lower infectivity than blood homogenates. Furthermore, in some experiments application of skin mucus to the gills was as efficient as i.p. injection for transmission of the disease. When introduced into the stomach none of the inocula caused ISA. Coprophagy thus seems to be ineffective in the transmission of ISA under laboratory conditions. Skin mucus from non-inoculated cohabitants exposed to ISA-inoculated smolts for 2 d transmitted the disease with close to 100% efficiency to healthy cohort smolts when injected i.p. This indicates that the infectious agent is waterborne and absorbed by the skin mucus rather than being secreted with the skin mucus. Since healthy smolts have an intact skin barrier, proximity to inoculation directly to the vascular bed seems unlikely. An ultrastructural study of 10 different organs, all in close proximity to the secretions/excretions, revealed that at early stages of the disease, the virus was exclusively found in the pillar cells and endocardial cells. This indicates that the gills are the most likely port of entry of the virus. It also supports a causal relation between the observed virus and the disease.

A New Species-Specific Nuclear DNA Marker For Identification Of Hybrids Between Atlantic Salmon And Brown Trout

Gross R; Nilsson J; Schmitz M

Journal Of Fish Biology 49 (3). 1996. 537-540.

The banding pattern of AluI-digested prepro-gonadotropin releasing hormone gene is species specific in Atlantic salmon and brown trout and can be applied for identification of their hybrids.

Predicting Biomass Of Atlantic Salmon From Morphometric Lateral Measurements Beddow TA: Ross LG

Journal Of Fish Biology 49 (3). 1996. 469-482.

Previously biomass predictions have been derived from simple weight-length relationships. This study measured a variety of truss and conventional dimensions covering the lateral body profile of Atlantic salmon *Salmo salar* and, using regression analysis, developed a series of multifactor weight-lateral dimension relationships. Single-factor regression equations proved inadequate for predicting weight with percentage errors between real and estimated values ranging from - 1.2 + 6.8% to 72.5 + 225-6%. Fifty-two multifactor regression equations were generated that predicted accurately the weight of individual fish to within +- 2% using combinations of conventional and truss measurements. Regression coefficients were found to be significantly different (P lt 0.05) between Scottish and Norwegian strains, indicating morphological differences between the genetic groups. Norwegian fish were generally heavier for a given length compared to Scottish strains. This suggests that morphologically different strains of *S. salar* would require individual weight: lateral dimension relationships to be developed in order to predict biomass accurately to within commercially acceptable levels.

Post-Smolt Growth, Maturation, And Survival Of Two Stocks Of Atlantic Salmon

Friedland K D; Haas R E; Sheehan T F

Fishery Bulletin (Washington D C) 94 (4). 1996. 654-663.

Marine survival and sea-age at maturity of two hatchery-dependent stocks of Atlantic salmon were compared in respect to differences in post-smolt growth as evidenced by the circuli spacing patterns of their scales. The two stocks, the Penobscot and Connecticut, are located at the southern extent of the range of Atlantic salmon in North America. Return rates for 1SW (one sea-winter) and 2SW salmon and the fraction of the smolt year class or cohort that matured as 1SW fish were found to be significantly higher for the Penobscot stock. Using image processing techniques, we extracted intercirculi distances from scales of 2,302 2SW fish. Circuli spacing data were expressed as growth indices for spring (when post-smolts first enter the ocean), summer (when growth appears maximal), and winter (when growth appears to be at a minimum). Circuli spacings of the Penobscot fish were wider during the summer season than were those for conspecifics from the Connecticut River of the same

smolt year class. The results suggest that post-smolt growth may play a significant role in deciding age at maturity and survival patterns for Atlantic salmon stocks.

Differences In The Time Of River Entry Of Atlantic Salmon, Salmo salar L., Spawning In Different Parts Of The River North Esk

Summers D W

Fisheries Management And Ecology 3 (3). 1996. 209-218.

Spawning adult Atlantic salmon, Salmo salar L., were sampled in five tributaries of the River North Esk. Scotland, during the winters 1989/90 and 1990/91. The fish furthest upriver had higher sea- and smolt-ages and the one-sea-winter fish were smaller and more coloured than those spawning further downstream. These differences indicate that the uppermost tributaries are populated by fish which enter the river early in the year and the lowest tributaries by fish entering late in the year. Exactly why such a structure exists is not clear, but it is suggested that these differences may be adaptive and that selection effects may continually be modifying these populations.

Long-Term Enhancement Of Habitat For Salmonids In Acidified Running Waters Lacroix G L

Canadian Journal Of Fisheries And Aquatic Sciences 53 (Suppl. 1). 1996. 283-294.

Application of crushed limestone on the bed of an acidic brook enhanced Atlantic salmon (Salmo salar) spawning habitat, and the mitigation strategy resulted in improvements in the survival of juvenile Atlantic salmon and brook trout (Salvelinus fontinalis). There was a small, lasting increase in pH in the limed section of the brook and downstream over 8 yr. Limestone was replenished once after 4 years because of washouts during floods; otherwise, requirements for maintenance were low. After liming, Atlantic salmon consistently dug most redds in the limed section, but this preference was possibly related to physical enhancement of spawning areas rather than to high pH. Liming resulted in a twofold increase in the number of occasions where more than a few juvenile Atlantic salmon survived severe acidic episodes in the brook. Brook trout were tolerant of lower pH episodes than juvenile salmon but, like salmon, they also responded to changes in minimum pH as a result of liming. Densities of age-0 salmon and brook trout were related to seasonal and interannual variability in pH, but they were always greater in the limed section than in the unlimed, control section upstream, especially at times when the difference in pH between sections was the largest.

Nutritional Status Assessed In Groups Of Smolting Atlantic Salmon, Salmo salar L., Developing Cataracts

Waagbo R; Bjerkas E; Sveier H; Breck O; Bjornestad E;

Journal Of Fish Diseases 19 (5). 1996. 365-373.

There has been an increasing number of reports on cataracts in Norwegian and international salmon farming. The present study was undertaken to examine physiological and nutritional conditions during an outbreak of cataracts observed in rapidly growing Atlantic salmon, *Salmo salar* L., smolt with emphasis on zinc status. During this study, the cataracts were classified as irreversible. The outbreak of cataracts was positively related to fish growth and negatively related to the condition factor of the fish. Zinc concentrations in liver, eye and plasma were recorded in fish with cataract and in healthy fish from December to May. Lower zinc status (around 20%) was found in fish with cataracts compared to healthy fish, both over time and with regard to severity of the cataract. The decline in organ zinc concentrations seems to be explained by increased relative liver size, lower dry matters in liver and eye, and lower plasma protein. From the present data, the incidence of cataracts could not be directly related to zinc or any of the other nutrients (vitamin A, iron) examined, although relative deficiencies caused by other unknown rearing factors cannot be excluded. The lower condition factor and differences in organ water composition in fish with cataracts indicate that the cataracts may be related to the smoltification processes. Smoltification in the fish population was most probably accelerated by elevated water temperatures.

Food Acquisition And Growth Of Juvenile Atlantic Salmon (Salmo salar) In Relation To Spatial Distribution Of Food

Jorgensen E H; Baardvik B M; Eliassen R; Jobling M

Aquaculture 143 (3-4). 1996. 277-289.

Triplicate groups of juvenile Atlantic salmon (Salmo salar) were exposed to either standing or flowing water (currents corresponding to a swimming speed of approximately 1.5 Bl s-1) for 79 days (17.06-04.09). Food was relatively evenly distributed throughout the entire water body in the 1.3 m-3 tanks with circumferential water currents, but food availability was limited to only a small part of the tanks with standing water. Most of the males (85%) were maturing at the end of the experiment. There were no significant differences in the

frequencies of maturing males between treatments. Fish exposed to water currents grew significantly better than those held in standing water. On average, the immature exercised fish grew 14% faster than their unexercised counterparts, whereas differences in growth rates between exercised and unexercised fish were 24% for maturing fish. Amongst immature fish there was greater inter-individual variability in food intake in groups (CV-g) held in standing water than in those exposed to water currents. Day-to-day variations in food intake of individual fish (CV-i) were also found to be significantly greater for the salmon held in standing water. Differences in CV-i and CV-g between treatment groups, were expected to lead to corresponding differences in the variability of growth rates (CV-SGR). The observed differences in CV-SGR were, however, small, but there was a negative correlation between CV-i and group average SGR. This may suggest that feeding behaviour was characterised by interference and scrambling conditions, rather than clear-cut hierarchies. The trends in the variabilities of food intake and growth of the maturing fish were similar to those seen in the immature fish, but overall variability was greater due to the fact that the maturing fish displayed reduced feeding and growth towards the end of the experiment. The results of this investigation clearly show that an adequate spatial distribution of food is essential in order to ensure rapid and homogeneous growth of farmed salmonids. The employment of water currents in rearing tanks would seem to be a useful measure for ensuring an even spread of food.

Spreading Of Freshwater Organisms In Norway

Hokstad O; Skurdal J

Fauna (Oslo) 49 (1). 1996. 10-19.

This article presents some of the current problems related to the spread of freshwater organisms in Norway. Canadian waterweed (Elodea canadensis) was introduced to Norway in 1925 and during the last decade the weed has spread to a large number of new localities and caused problems particularly in eutrophic, calcium rich lakes. The introduction of Mysis relicta as a fish food source in impounded lakes in mid-Norway has resulted in marked changes of the pelagic food-chain and reduced yield and quality of pelagic fish. Gyrodactylus salaris has decimated Atlantic salmon (Salmo salar) in 38 rivers, and the environmental authorities is combating the parasite by applying rotenone to eradicate all fish and restock rivers with material from the established gene bank. A study of aquariafish in Bergen yielded some 25 different infective organisms indicating the threat from the virtually uncontrolled international aquaria trade. European minnow (Phoxinus phoxinus) has since the turn of the century spread to all counties, and in lakes previously occupied by allopatric brown trout (Salmo trutta) the effects have been disastrous with large yield reductions. Bullhead (Cottus gobio) has recently been introduced to the famous Tana river, and an inverse relationship between density of Atlantic salmon parr and Bullhead has been documented. Introductions represent a major threat to the biological diversity and the homogenization of the fauna and flora is continuing at an increasing speed; Norway has very strict regulations on introductions; however to reach everyone with information and make them follow the regulations is a nearly impossible task. The counter measures have high priority and hopefully the dispersal of organisms will be reduced in the future.

The Physiological Effects Of Salmon Lice Infection On Post-Smolt Of Atlantic Salmon

Grimnes A; Jakobsen P J

Journal Of Fish Biology 48 (6). 1996. 1179-1194.

The physiological effects of salmon lice infections on post-smolt of Atlantic salmon were examined by experimentally infecting hatchery reared post-smolts with infective copepodids. Even at high infection intensities, ranging from 30-250 lice per fish, early chalimus stages did not have severe, physiological effects on the fish. There was a sudden increase in fish mortality after the appearance of pre-adult I stages. Infected fish were then suffering due to lesions and osmoregulatory failure. Plasma chloride level increased significantly and total protein, albumin and haematocrit decreased significantly in infected compared to uninfected fish. All infected fish became moribund before adult lice appeared. Infection intensities above 30 salmon lice larvae per fish thus appear to cause death of Atlantic salmon post-smolt soon after the lice reach their pre-adult stage.

Can Juvenile Atlantic Salmon Use Multiple Cue Systems In Spatial Learning?

Braithwaite V A; Armstrong J D; Mcadam H M; Huntingford F A

Animal Behaviour 51 (6). 1996. 1409-1415.

An ability to form a map or spatial representation of a home range should facilitate efficient foraging and promote the use of effective escape routes to shelter. Although a few experiments have shown some species of fish are capable of simple spatial behaviour, little is known about the behavioural mechanisms they use to orient as they forage. Whether juvenile Atlantic salmon, *Salmo salar*, have the capacity to use conspicuous visual landmarks to help them track a moving resource was investigated. The experiment was then modified to determine whether the salmon could continue to track the resource in the absence of conspicuous visual cues. The salmon followed a moveable food source in the presence and, after retraining, in the absence of distinct

coloured landmarks. It is suggested that juvenile salmon may be capable of using multiple forms of cue to help them solve spatial tasks such as tracking a moving resource.

Use Of Cleaner-Wrasse (Centrolabrus Exoletus (L.) And Ctenolabrus Rupestris (L.)) To Control Infestations Of Caligus Elongatus Nordmann On Farmed Atlantic Salmon Tully O; Dalv P; Lysaght S; Deadv S; Varian S J A

Trials were conducted in experimental tanks and in commercial scale sea cages to evaluate the ability of wrasse to control sea lice infestations on farmed Atlantic salmon smolts. In a 3 h tank trial rockcook wrasse, *Centrolabrus exoletus* (L.), removed an average of 19 lice per fish h-1 from salmon smolts infested mainly by *Caligus elongatus* Nordmann (93%) and with lower numbers of *Lepeophtheirus salmonis* (Kroyer) (7%). Goldsinny wrasse, *Ctenolabrus rupestris* (L.), did not remove lice from salmon over this 3 h period. Chalimus stages I and II were removed at a lower rate than were older and larger life history stages. Both species of wrasse failed to prevent rapid increases in infestations of *C. elongatus* in commercial cages in 1992 and 1993 at initial wrasse to salmon ratios ranging from 1:37 to 1:146. However, scuba diving observations confirmed that both wrasse species did remove *C. elongatus* from salmon in these cages. In the 10 m deep cages, wrasse occurred mainly at depths greater than 6 m while salmon occurred primarily between 2 and 5 m. Goldsinny had a significantly shallower distribution than rockcook. Both species associated closely with the cage net and with objects in the cage and interactions with salmon appeared to be relatively uncommon. Rigorously controlled trials on commercial farms need to be carried out in order to define protocol for the use of wrasse under these conditions.

The Relation Between Redd Counts And Atlantic Salmon (Salmo salar) Parr Populations In The Dennys River, Maine

Beland K F

Canadian Journal Of Fisheries And Aquatic Sciences 53 (3). 1996. 513-519.

In the Dennys River (eastern Maine), the abundance of age-1 part of Atlantic salmon (*Salmo salar*) estimated by electrofishing showed a significant linear relationship ($r^2 = 0.51$, p = 0.046) with the redd count obtained 2 years earlier. The relation between age-1 part and 1n(redds) was similar ($r^2 = 0.48$, p = 0.058). Approximately one half of the variability in part abundance for the years 1986-1993 could be attributed to the redd count. Similar relationships were observed in the analysis of data from the individual sampling sites. These data suggest that redd counts can be used to predict the future abundance of part when direct estimates of the numbers of spawners are unavailable and the level of egg deposition is unlikely to result in density-dependent mortality. Site-specific data indicate that redd counts could also be used to identify areas within a river that are under stocked by natural reproduction.

Evaluation Of A Portable Electrode Array For A Resistivity Fish Counter

Smith I P; Johnstone A D F; Dunkley D A

Fisheries Management And Ecology 3 (2). 1996. 129-141.

This study aimed to develop and test an electrode array for a resistivity fish counter that could be easily installed in a small river without a weir. An electrode array consisting of three steel cables laid in parallel across the stream channel and connected to a microprocessor-based counter was tested in an Atlantic salmon, *Salmo salar* L., spawning tributary. The accuracy of the counter was assessed by observing fish movements with closedcircuit television. Most salmon moving upstream were registered correctly (90% overall). Detection of downstream movement was less reliable (60% overall), as a consequence of downstream swimming behaviour. The accuracy of the downstream count was improved by tensioning the cable electrodes, but remained lower than that of the upstream count. Since salmon swam repeatedly up- and downstream, this discrepancy resulted in an overestimate of the net upstream count. The accuracy of the downstream count needs to be improved before a bed-mounted electrode array could be used for routine salmon counting.

Field Trials On The Efficacy Of The Organophosphorus Compound Azamethiphos For The Control Of Sea Lice (*Copepoda: Caligidae*) Infestations Of Farmed Atlantic Salmon (*Salmo salar*)

Roth M; Richards R H; Dobson D P; Rae G H

Aquaculture 140 (3). 1996, 217-239.

A study of the efficacy of azamethiphos (S-6-chloro-2,3-dihydro-2-oxo-1,3 -oxazolo (4,5b) pyridin-3-ylmethyl 0,0-dimethyl phosphorothioate) is described when used to treat Atlantic salmon (*Salmo salar*) infected with sea lice (*Lepeophtheirus salmonis* and *Caligus elongatus*) at several salmon farms on the west coast of Scotland. Prior to commencing the cage trials, relative lice sensitivity was evaluated through a series of in vitro exposures which demonstrated differences in the sensitivities of different lice populations to both azamethiphos and

dichlorvos. Treatments were carried out by completely enclosing pens within tarpaulins, or by surrounding pens with a tarpaulin skirt, and were 1 h in duration. A range of treatment concentrations were studied which included 0.05, 0.1 and 0.2 mg⁻¹ L azamethiphos, in addition to reference treatments with dichlorvos (0,0dimethyl-2,2-dichlorovinyl phosphate) at a concentration of 1.0 mg⁻¹ L. Lice response was measured before treatment, 1 h. 24 h, and 1 week after treatment. Azamethiphos was highly efficacious (85% or better) (Site 3) against adult and pre-adult lice, from a sensitive population, at a concentration of 0.05 mg⁻¹ L where complete tarpaulins were used. Where resistant populations were tested, a concentration of 0.2 mg⁻¹ L (complete tarpaulins) resulted in efficacies ranging from 7.1 to 82.1% (mean 57.1%) (Site 1) and 41 to 96.6% (mean 69.4%) (Site 2) against adult and pre-adult lice, and were generally more variable depending on local treatment conditions. Skirt treatments, tested only on resistant populations of lice, were found to be ineffective. A general trend was observed indicating that pre-adult I male lice were the most sensitive followed by, in order of sensitivity, pre-adult I females, pre-adult II females, pre-adult II males, adult males and adult females. Larval lice numbers, from both sensitive and resistant populations, appeared unaffected by treatment with azamethiphos following treatments with either complete tarpaulins or skirts. When used at the concentrations discussed above, fish tolerated treatments and did not display signs of acute mortality. However, hyperactivity was displayed by several of the treatment groups during treatments.

Evaluation Of The Construction Of Artificial Fluvial Salmonid Habitat In A Habitat Compensation Project, Newfoundland, Canada

Scruton D

Regulated Rivers Research & Management 12 (2-3). 1996. 171-183.

In 1987, the provincial transportation agency in Newfoundland, Canada requested approval from the Canadian Department of Fisheries and Oceans (DFO) to destroy a 162 m section of fluvial salmonid habitat to accommodate highway construction. The DFO's Policy for the Management of Fish Habitat required the proponent to compensate for this habitat loss through the construction of a replacement section of stream. The results are presented from a research programme to evaluate the success of this project focusing on: (1) considerations in the design and construction of the replacement habitat; (2) a comparison of key habitat attributes between the destroyed stream section and the compensatory habitat; and (3) the utilization of the compensatory habitat by resident fish. The results of the study indicate an increase in habitat area of 125 m-2 (23%) over the 162 m section of stream habitat lost due to construction, primarily related to the increase in thalweig length (20% increase) resulting from designed sinuosity in the compensatory habitat. Habitat design increased the amount and proportion of pool habitat to benefit the primary resident species, brook trout (Salvelinus fontinalis) and resulted in a 134% increase in pool quantity (increase of 98 m²), a 281% increase in pool volume (31.06 m-3), a 223% increase in the pool to riffle ratio and a 29% increase in the mean depth. Fish biomass, after an initial decrease after construction (1991), increased to the highest level during the study (93.5g per 100 m⁻² unit) in 1993, a 2.1-fold increase over the average pre-construction biomass. A corresponding decrease in salmonid densities was evident, primarily reflecting a shift in use from young of the year (YOY or 0+) Atlantic salmon (Salmo salar) to larger, older brook trout in response to desired habitat features. Using biomass as an indicator of 'productive capacity' and considering the increase in habitat quantity, there was a 2.58-fold increase in productive capacity over the stream lost due to highway construction and, in the context of DFO's habitat policy, compensation has resulted in a 'net gain' in habitat.

Comparative Diets Of Hatchery And Wild Atlantic Salmon Smolts In The Merrimack River

Johnson J H; Mckeon J F; Dropkin D S

North American Journal Of Fisheries Management 16 (2). 1996. 440-444.

We examined diets of smolts of 224 "wild" and 150 hatchery Atlantic salmon Salmo salar; wild smolts had been released as fry from the hatchery 2 years before collection, whereas hatchery fish were released as smolts from the hatchery 3-15 d before. Smolts were collected from 1991 to 1993 at trapping facilities at dams in the Merrimack River during spring out migration. About 50% of the hatchery smolts and 50% of the wild smolts examined had empty stomachs. For smolts containing food, terrestrial invertebrates were the major prey of both hatchery and wild salmon. Adult aquatic dipterans (i.e., chironomids, culicids, and simuliids) also composed a large portion of the diet of both groups of salmon. Hydropsychid and chironomid larvae were the main benthic taxa consumed. Surface-oriented prey dominated the diet of hatchery (73.7%) and wild (62.4%) smolts. The coefficient of dietary overlap (C-lambda) between hatchery and wild smolts was high during all years and ranged from 0.83 to 0.93. Stomach fullness of hatchery smolts was significantly less than that of wild smolts. Further research is needed to determine if the low food consumption of hatchery smolts affects survival.

The Effect Of Domestication On Some Life History Traits Of Sea Trout And Atlantic Salmon

Petersson E; Jarvi T; Steffner N G; Ragnarsson B

Journal Of Fish Biology 48 (4). 1996. 776-791.

During the period 1968-1991, certain morphological traits of Atlantic salmon Salmo salar and sea trout S. trutta have been recorded regularly at the hatchery at Alvkarleby, central Sweden: total body length, weight (for females both before and after stripping), number of eggs, egg size and date of ovulation. A smaller data set for fish marked and released as smolts, providing information about total body length of released smolts, time spent at sea and body size of the recovered adults, was also available for analysis. According to theory and empirical data, the process of artificial breeding results in an evolutionary divergence of the cultured strain from the wild phenotypic norm. The reason for such a divergence is that both natural and sexual selection pressures are altered or relaxed during the process of artificial breeding, as well as random genetic processes, such as founder effects and in- and outbreeding. A path analysis of both species and sexes revealed that the size of the released smolts had increased during the study period. Time spent in sea has decreased for both female and male sea trout, but not for Atlantic salmon. Adult body size for female and male trout have increased as well as female trout condition factor. The increase found in egg size of both species was greater for the salmon than for the trout, indicating that female salmon invest more in egg size with increasing body size. These results support the view that domestication probably has a significant and selective impact on the life history traits of the two salmonid species studied.

Predicting Fish Habitat Use To Changes In Water Flow: Modelling Critical Minimum Flows For Atlantic Salmon, Salmo salar, And Brown Trout, S. trutta

Heggenes J; Saltveit S J; Lingaas O

Regulated Rivers Research & Management 12 (2-3). 1996. 331-344.

To identify possible critical minimum flows, habitat availability and habitat selection by young Atlantic salmon and brown trout on selected stream reaches were studied in a spatially and temporally heterogeneous Norwegian west coast river. Based on direct underwater observations of 1768 individuals across transects on each reach, unimodal habitat suitability curves for water depth, water velocity and substrate were produced for both species. There was considerable spatial niche overlap between the two species, suggesting niche competition. Rather than narrow optima, they selected habitats within broad ranges of values of the measured microhabitat variables. Atlantic salmon used the broader range. Spatial variation in habitat use was attributed to different habitat availabilities, whereas temporal variations were partly explained by varying water flows and temperature. Variation in hydrophysical conditions, i.e. habitat availability, was quantified by measuring in the same transects at different water flows. A new hydraulic simulation model, the RIMOS (River Modelling System), was developed to allow for hydraulic simulation of habitat availability at a spatial and temporal scale relevant to the fish. By comparing spatial variations in habitat use and availability, habitat preference curves were calculated and applied in the model. Modelling of the availability of suitable habitats from extreme summer minimum flows to 30 year high flows identified critical minimum flow levels, below which suitable habitat was drastically reduced. These values depended on the habitat variable, fish species, temperature and spatial heterogeneity in the habitat. The negative effects of reduced water flow on fish habitat suitabilities were most pronounced for water velocities and for Atlantic salmon. Thus through hydraulic modelling combined with fish habitat preference data, it was possible to predict a likely change in species composition. Habitat-hydraulic modelling also indicated that resilience towards reduced water flows depended on the in situ stream structure and was much greater in pool-like stream reaches than in riffle/rapids areas. Modelling also allowed for time series analysis of fish habitat suitability to identify temporal bottlenecks in available spatial niches. Furthermore, some exploratory modelling was carried out to identify landscape phenomena in fish habitat use. Habitats were considerably more fragmented in riffle/rapids habitats than in pools, where three-dimensional connectivity tended to be complete over a wider range of flows. It is concluded that fish habitat selection data combined with hydraulic modelling at a scale relevant to the fish can be a useful tool in stream management. However, there is no such a thing as 'the' suitable minimum flow; the effect of reduced flows will vary with stream structure, the hydro-physical variables in question and the fish species. More studies are needed to elucidate possible spatial and in particular temporal variations in fish habitat selection. Care must be taken in aggregating habitat suitability data into single-valued functions.

The Performance Of All-Female Diploid And Triploid Atlantic Salmon Smolts On Transfer Together To Sea Water

Mccarthy I D; Carter C G; Houlihan D F; Johnstone R; Mitchell A I Journal Of Fish Biology 48 (3). 1996. 545-548.

On transfer to sea water for 45 days, the return of appetite was later and growth rates tended to be lower for triploid Atlantic salmon, Salmo salar, reared together with diploid Atlantic salmon. All mortalities comprised of

triploid salmon (29%) and were attributable to failed smolt syndrome. No correlation was found between the growth of diploid or triploid fish in fresh water and their subsequent growth on transfer to sea water.

Relative Production Of Atlantic Salmon From Fluvial And Lacustrine Habitats Estimated From Analyses Of Scale Characteristics

Dempson J B; O'Connell M F; Shears M

Journal Of Fish Biology 48 (3). 1996. 329-341.

Empirical and back-calculated growth of Atlantic salmon parr were compared between fish reared in fluvial and lacustrine habitats of Conne River, Newfoundland. Length at age was significantly higher for lacustrine parr. Various classification and maximum likelihood estimators indicated that 75% or more of the fish used takes for rearing. Lacustrine use is another aspect of the inherent variability and plasticity of Atlantic salmon life-history traits. As most Newfoundland river systems include lakes, estimates of regional spawning targets and potential smolt production will need to take lake habitat into account.

A Flat-Bed Passive Integrated Transponder Antenna Array For Monitoring Behaviour Of Atlantic Salmon Parr And Other Fish

Armstrong J D; Braithwaite V A; Rvcroft P

Journal Of Fish Biology 48 (3). 1996. 539-541.

A system for monitoring automatically the movements of individually identified small fish in natural habitats is described. The system incorporates novel flat-bed antennae to detect the passage of miniature passive integrated transponders.

Waste Loadings From Two Freshwater Atlantic Salmon Juvenile Farms In Scotland

Hennessy M M; Wilson L; Struthers W; Kelly L A

Water Air And Soil Pollution 86 (1-4). 1996. 235-249.

Studies of waste generation from the freshwater phase of Atlantic salmon (*Salmo salar* L.) production have not been substantially updated since the mid 1980's, and advances in husbandry practices designed to reduce wastage which have taken place in that period therefore remain unconsidered. In order to determine if reductions have been achieved, two Scottish fish farms were visited on a number of occasions during one year, and outputs of suspended solids (SS), biochemical oxygen demand (BOD), total ammonia nitrogen (TAN) (NH-3+NH-4+), dissolved reactive and total phosphorus (DRP, TP) were monitored. The range of waste loadings obtained were 9.1-10.0 kg TP t fish-1 yr-1, 410 kg BOD-5 t fish-1 yr-1, 191-606 kg SS t fish-1 y-1, and 20.3-39.3 kg TAN-N t fish-1 yr-1. Compared to existing data, a greater range of daily waste loadings were observed, suggesting that more frequent monitoring is required to reduce variations observed in the data set, and to obtain accurate information on waste outputs from such operations. Modifications of feeding methods remains a route through which further reductions in waste outputs may be made.

Life-History Transitions Among Atlantic Salmon (Salmo salar) Morphotypes

Presa P; Blanco G; Vazquez E; Sanchez J A

Canadian Journal Of Animal Science 76 (1). 1996. 35-40.

Morphotype distribution in Atlantic salmon populations is a critical determinant in the migration dynamics and rearing success of this species. The achievement of smolting status depends on the individual opportunities to reach the upper mode of the bimodal size distribution in the first winter. Growth of the morphotypes between 10 and 22 mo post-hatch was investigated. For this, an individual tagging system was applied on two replicates of part from a Sella River sample (northern Spain). The smolt-like part of the first winter (37%) became smolts in the first spring. Meanwhile, dwarf part (25%) and precocious males (6%) did not smolt and became precocious males in the second winter. Medium-sized part of the first winter (32%) became smolt-like part (19%) or precocious males (13%) in the second winter. The average smolt-like sizes in the first and the second winters were 11.39 cm and 14.97 cm, respectively. These results indicate that for the Sella River sample (i) only upper modal fish smolt in the first spring, (ii) 1 + smolts are mainly females (77%), and (iii) smolting does not depend upon a population threshold size.

Freshwater Reconditioning And Ranching Of Atlantic Salmon, Salmo salar L., Kelts: Growth And Reproductive Performance

Moffett I J J; Kennedy G J A; Crozier W W

Fisheries Management And Ecology 3 (1). 1996. 35-44.

Artificial reconditioning of Atlantic salmon in fresh water over two successive years produced kelt survival rates of 28% and 55% in years one and two, respectively. Eye damage and failure to identify non-feeders were important factors contributing to high mortalities. Average fecundities of kelts reconditioned for the first (1220

ova kg⁻¹) and second (1093 ova kg⁻¹) year were lower than obtained for virgin control fish (1590 and 1728 ova kg-1 respectively). Average survival to swim-up for progeny of first-year (64.5%) and second-year (71.4%) reconditioned fish were similar to survival of virgin control fish progeny (72.3% and 68.9% respectively). Ranched kelts showed better growth parameters than for freshwater reconditioning but had lower average fecundities (1310 ova kg⁻¹ compared with 1820 ova kg⁻¹) and lower average progeny survival to swim-up (60.8% compared with 88.6%) than their control group.

Seasonal Current Holding Performance Of Juvenile Atlantic Salmon In Relation To Temperature And Smolting

Graham W D; Thorpe J E; Metcalfe N B

Canadian Journal Of Fisheries And Aquatic Sciences 53 (1), 1996. 80-86.

The ability of juvenile Atlantic salmon to hold station against a water current was tested in relation to season, environmental temperature, and developmental strategy. The finding that holding velocities, relative to body length, were similar in the faster growing, earlier smolting fish (upper modal group) and the fish remaining in freshwater for a further year (lower modal group) suggests that there was no difference in relative performance or habitat availability. Seasonal changes in performance were generally related to water temperature, with the decrease in holding ability becoming more pronounced at low temperatures. The relative critical holding velocity of smolting fish was lower over the period of seaward migration than in previous months. However, within this period, critical holding velocity increased with degree of silvering. The implications of these results for the ecology and life-history strategy of juvenile salmon are discussed.

Lake-Use By Juvenile Atlantic Salmon (Salmo salar L.) And Other Salmonids In Northern Norway

Halvorsen M; Jorgensen L

Ecology Of Freshwater Fish 5 (1). 1996. 28-36.

The utilization of lakes, and inlet and outlet streams by juvenile Atlantic salmon (Salmo salar L.), brown trout (Salmo trutta L.) and Arctic charr (Salvelinus alpinus (L.), were investigated in 16 watercourses in northern Norway, all known to inhabit salmon stocks. In lakes, fish were caught by small mesh size gill nets, while in rivers fish were caught by electrofishing. In the shallow littoral (0-3 m depth) there were juvenile salmon in 15 of 19 investigated lakes, juvenile trout in 17 and juvenile charr in seven. Trout dominated significantly in numbers in the shallow littoral of seven lakes, while salmon and charr dominated in three lakes each. When trout and salmon were frequent in the shallow littoral, charr was usually not present in this habitat, but were found in the profundal zone in most of the lakes. Atlantic salmon parr utilized both shallow and deep lakes, and used both stones and macrophytic vegetation as shelter. The utilization of lakes by salmon parr seemed to be closely related to the utilization of small inlet streams for spawning. In most inlet and outlet streams salmon dominated over trout in numbers, while charr were absent. This is the first documentation of lake-use by naturally occurring salmon parr in Scandinavia.

High Incidence Of Atlantic Salmon X Brown Trout Hybrids In A Lake District Stream Hartley S E

Journal Of Fish Biology 48 (1). 1996. 151-154.

Hypervariable minisatellite DNA single-locus profiling and mitochondrial DNA analysis revealed that 18.18% of juvenile Atlantic salmon Salmo salar in Troutbeck, a stream in the R. Leven catchment of the English Lake District, were hybrids between Atlantic salmon and brown trout S. trutta, and that hybridization was bidirectional.

A Study Of Temporal Genetic Variation In A Natural Population Of Atlantic Salmon In The River Bush, Northern Ireland

Moffett I J J; Crozier W W

Journal of Fish Biology 48 (2). 1996. 302-306.

Temporal genetic variation in River Bush Atlantic salmon was low and much less than among geographically discrete samples reported from elsewhere.

Retention Of Visible Implant Tags In Farmed Atlantic Salmon, Salmo salar L

Treasurer J W Aquaculture Research 27 (4). 1996. 293-295. Environmental Influences On The Timing Of Spawning Of Atlantic Salmon, Salmo salar L., In The River North Esk Summers D W Fisheries Management And Ecology 3 (3). 1996. 281-283.

Tracing Tributary Origins Of Migrating Atlantic Salmon Using Stable Isotopes Kennedy B P; Harrington R; Folt C; Blum J D; Chamberlain C P Bulletin Of The Ecological Society Of America 77 (3 Suppl. Part 2). 1996. 230.

Effects Of Magnetic Microtagging On Atlantic Salmon Juveniles (Salmo salar) Prignon C; Micha J-C Aquatic Living Resources 9 (2). 1996. 107-112.

Retention Of Visible Implant Tags In Farmed Atlantic Salmon, Salmo salar L Treasurer J W Aquaculture Research 27 (4). 1996. 293-295.