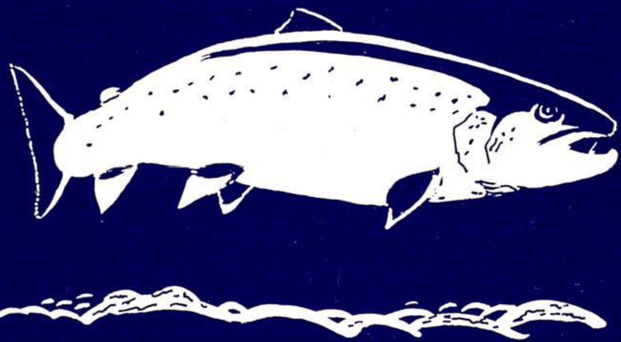
ATLANTIC SALMON TRUST

PROGRESS REPORT

June 1995



The Atlantic Salmon Trust
Moulin, Pitlochry
Perthshire PH16 5JQ
Telephone: Pitlochry (01796) 473439

HONORARY SCIENTIFIC ADVISORY PANEL

INTERNATIONAL CONSERVATION ORGANISATIONS WITH WHICH THE TRUST IS IN CONTACT

France:	Association Internationale de Defense du Saumon Atlantique
Belgium:	Belgian Anglers Club
Spain:	Asturian Fishing Association of Oviedo
Germany:	Lachs- und Meerforellen-Sozietat
U.S.A.:	Restoration of Atlantic Salmon in America Inc.
Canada and U.S.A.:	Atlantic Salmon Federation
Ireland:	Federation of Irish Salmon & Sea Trout Anglers

Registered Charity No. 252742

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CHAIRMAN'S FOREWORD

Last month I had the thrill of seeing the last of the fry from 1994 eggs being planted out in the headwaters of remote burns. Whitebait sized, they faced the harsh competition and predation of their new environment. Simultaneously smolts from plantings of 2 and 3 years ago were being trapped and micro-tagged; some 2% had survived to the 6-inch stage and the start of their ocean adventure; and just a few, a precious few (but perhaps a few more than in recent years, thanks to all the efforts on their behalf) of magnificent springers five times the smolts' length and fifty times their weight were coming to the fly covered in long-tailed sealice - most of them to proceed onwards to renew the cycle.

That is the reward for all the work of the Trust. I would like for once to pay tribute to all those scientists, anglers, administrators and riparian owners who give up so much of their time and struggle so hard to stem the tide of the multitude of problems that face the Atlantic salmon.

Much criticism is levelled at those who try to pursue policies intended to increase survival rates. Perhaps we would all do better to acknowledge that there are indeed many differing problems and many varied solutions and try to be a little more tolerant of those who may be pursuing different hobby horses from our own.

The support from the salmon angling fraternity for this Trust and for all the other salmon conservation organisations is on the whole splendid and enormously appreciated. But there are still a lot of anglers who put little or nothing back into this sport and feel that if they pay their rents or licence fees they are entitled to their money's worth regardless of the long term welfare of the species.

I would like to thank all our supporters wholeheartedly and, in the unlikely event of anyone else reading these words, is it too much to hope that their consciences might be pricked and they too would wish to play their own part in salmon conservation, if not for the benefit of themselves, for their children and grandchildren.

My time as Chairman of the Trust and that of Lord Moran as Vice Chairman comes to an end at the Annual General Meeting in November. With the endorsement of the President and Vice Presidents, and with their agreement, I shall be proposing to the Council of Management that our successors are, respectively, Colonel Bill Bewsher and Major-General John Hopkinson. I am absolutely confident that they will serve the Trust well and recommend them to you wholeheartedly.

I would particularly like to pay tribute to John Mackenzie and Jeremy Read, our Director and Deputy Director for all their support, encouragement, hard work and good humour over the last seven years. The Army may be taking over the high command this time round but the Navy provide the most splendid staff officers. I thank them most sincerely and salute them both.

NICKSON
Chairman

DIRECTOR'S REPORT

The summer is here already with very mixed reports from the rivers. The weather pattern has been varied and this, in some ways, must account for some of the differences in catches.

The AST auction was a success, raising just over £36,000 for the Trust, which is the same as last year. Bearing in mind all that has been said about the effect of the National Lottery on charitable giving and the recession, this was a very satisfactory outcome. While on the subject of money, I am conducting a search through our records to try and reduce the number of Progress Reports sent out and thus reduce postage. We are a subscribers organisation and, as such, we do depend on people's subscriptions which are entirely voluntary. As a rule of thumb a donation of £25 entitles a subscriber to Progress Reports for two years (total of 4 Reports). If a Deed of Covenant is taken out, the Progress Reports will continue for ever! A random look at our subscribers list shows that we are still sending Reports to some who last subscribed over 12 years ago. Please don't be offended if you get a letter before long inviting you to subscribe once more!

The Deputy Director visited the Fisheries Directorate General of the European Commission in early May to discuss salmon matters, and was given a very helpful reception. It appears that progress on the Commission's proposed ban on drift netting for salmon is unlikely to be rapid; although supported by the European Parliament last year, it is linked with the contentious issue of drift netting for tuna, which has yet to be resolved by the Council of Ministers. Among other subjects, he raised the effect of industrial fishing on salmon, particularly in the early stages of their migration. He was pleased to learn that this aspect is now being taken seriously by the Commission, which wishes to fund detailed research on how the heavy toll on sandeels and similar species affects the marine food chain. The Trust plans to help develop detailed proposals for this research. The Commission's move is very welcome.

It is encouraging to note that with reference to fisheries Mr. Gummer, in a written answer to a page giving the UK policy objectives at the June '95 North Sea Conference, stated "the topics which we expect to be discussed and the main points that the United Kingdom would wish to achieve are:- fisheries: getting the European Commission to propose measures to control over-fishing, especially in industrial fisheries, and to carry out more research into the effects of industrial fisheries and how to regulate them".

Let us hope that at last some attention is being paid to the dangers of industrial fishing. We await the outcome with interest.

This is the last Report to bear the J&B logo. We are most grateful for all the support given to us by J&B over the last five years.

D.J. Mackenzie

"THE FUTURE OF OUR SALMON"

Orri Vigfusson, Chairman and founder of the North Atlantic Salmon Fund - arguably the man who has done more in the past seven years to help reduce the indiscriminate interceptory fishing of salmon at sea - is the guest speaker at the 2nd annual Finlayson Hughes Forum being held at Battleby, Perth on Wednesday, October 4th 1995, 1000 - 1430 hours.

Speakers include **The Lord Nickson**, Chairman of the Atlantic Salmon Trust; **Jim Payne**, Vice Chairman Scottish Salmon Growers Association; **Richard Shelton**, head of Freshwater Fisheries Laboratory, Pitlochry; **Robert Clerk**, Vice President of the Association of District Fishery Boards; **Robert Rattray**, fisherman, writer and sport letting agent; **Fiona Armstrong**, fisher, writer and broadcaster. **Colin Whittle, WS** Secretary to the Atlantic Salmon Conservation Trust, will join the speakers for the Question and Answer session.

The Forum is co-sponsored by **Farlow's of Pall Mall** and the **North Atlantic Salmon Fund (UK)**. The cost per delegate including coffee, lunch and wine is £40 of which £10 is contributed to NASF(UK). Registration forms are obtainable from Finlayson Hughes, 45 Church Street, Inverness IV1 1DR.
Telephone: 01463 224343 Fax: 01463 243234.

It is recommended that reservations for this important event are made early.

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Forthcoming AST Conference

"ENHANCEMENT OF SPRING SALMON"

Preliminary Notice

It is planned to hold a conference on spring salmon issues in the meeting rooms of the Linnean Society in Burlington House, London, on 26th January, 1996.

The meeting follows a half-day workshop on 25th January of salmon experts currently studying factors affecting the survival, abundance and re-instatement of spring salmon stocks. The outcome of this meeting will be communicated to the main conference at which a number of invited speakers will address the assembly on current concerns over the future of spring salmon. The meeting is open to the salmon public in general and it is hoped that many salmon proprietors and anglers will attend. Seating is limited to 150 so anyone interested should write to the Director as soon as possible expressing a desire to attend. They will then be placed on a mailing list for further information and be sent an application form for attendance in due course.

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THE NORTH ATLANTIC SALMON FUND (UK)

The Fund is now well into its second year of operation, and is on the way to its target of providing a further £180,000 by 31 August, as the UK share of the cost of keeping the Greenland and Faroes high seas salmon fisheries closed. At the time of publication, a total of £130,000 had been transmitted to Orri Vigfusson's International Committee. A full report for the year will appear in the next Progress Report.

The origins of contributions have been even more varied than last year. In Scotland, there has been continued strong support from Scottish District Salmon Fishery Boards, and from groups of proprietors in districts where there are no formed Boards. South of the Border, with no equivalent organisation, the appeal was made once again to all known River Associations and Angling Clubs with salmon interests, and contributions are coming in steadily. As before, there have been some extremely generous individual donors; among these were those who attended a highly successful fund-raising dinner at Apsley House in the presence of His Royal Highness the Prince of Wales. In addition, the National Rivers Authority included an appeal notice in the catch return reminder sent at the end of last year to all holders of salmon and sea trout rod licences, with the offer of free postage for donations sent with a catch return; this alone brought in over £4000. The tackle trade is also beginning to support the Fund, with a generous donation from Sportfish and the inclusion in Farlow's summer magazine of an article by Orri Vigfusson and a channel for contributions, which is also evoking an encouraging response.

A very welcome, if perhaps unexpected, source of support has been the stillwater trout angling fraternity; an auction held at the NatWest Stillwater Trophy meeting at Steeple Langford raised over £2000 for the Fund. There could be no better example of unity of purpose among those who fish, and this unity is needed to continue funding the annual compensation payments until a long-term agreement on the future of the high seas fisheries can be reached. For us to go on seeing more multi sea winter fish in UK waters, they must stay closed, and this has to be paid for.

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"CAUGHT UP WITH A SNAPPY LITTLE NUMBER"

(Article from the Herald dated Saturday 1st April 1995, reproduced with kind permission of The Editor)

The introduction of an exotic breed to Scottish waters has been hailed as a pioneering move but, as Rod McGill reports, there is a catch

Government scientists are baffled by the appearance of a piranha fish in Loch Leven. The fish, which is native to the rivers of the Amazon Basin in South America, was hooked by angling writer and journalist Bruce Sandison. "I was amazed," he said. "I was fishing along the south shore of Castle Island when it took my fly, a size 14 Black Pennell, but it simply ate its way out of the landing net."

Scottish Secretary, Ian Lang, has ordered an inquiry by fishery scientists from the Government's Freshwater Fishery Research Laboratory in Pitlochry. Dr. Richard Shelton, chief officer of the laboratory, has promised prompt action and intends to "pull out all the stops" and produce a preliminary report within a year.

The most likely explanation is that the fish was introduced by a visiting angler. An English law prohibits the unauthorised introduction of alien species to English waters, but there is no similar law in Scotland: Loch Lomond has suffered from the introduction of ruffe *(gymnocephalus cernua)* which now represent a threat to indigenous species in the loch.

Zander *(stizostedion lucioperca)*, a predator from Eastern Europe, have colonised much of East Anglia and fishery biologists fear they might be brought north. Magnus Magnusson of Scotland's environmental watchdog agency, Scottish Natural Heritage, said: "There is nothing to stop people from doing so and the effect on wild fish would be devastating. Piranha fall into the same category as zander."

The owner of Loch Leven, Sir David Montgomery, is not concerned: "We already have North American Rainbow trout in Loch Leven, so why not South American piranha? I run a commerical operation, not a wildlife charity. I am sure anglers would welcome the opportunity to fish for these splendid creatures. Personally, I wouldn't mind zander as well, indeed, the more the merrier."

But many anglers are concerned that piranha could strip Scottish waters bare. Mike Spurgan, an Edinburgh angler and international traveller who has fished for piranha in Guatemala, claims the fish will destroy sport in Scotland: "Anyone who knows the havoc these ferocious fish cause would be alarmed. I have seen the carcass of a cow stripped bare in seconds."

However, a Scottish Tourist Board spokesman said: "Anything that extends the holiday season and fills empty beds in Scottish hotels has to be considered. Stocks of wild fish in Scotland are declining and something has to be done to attract anglers. Too many spend their money overseas. If piranha help to bring them back to Scotland it may not be a bad thing."

This view is not shared by other countryside users represented by the Scottish Sports Council. Its chief executive, Allan Alstead, speaking in Edinburgh yesterday, commented: "I have not seen the report, personally, but a number of organisations we work with are worried, particularly canoeists, swimmers, and other water-resource users. These fish could attack people in the water."

Stuart Housden, Scottish director of the RSPB, shares this concern: "Piranha will certainly be predators of wildfowl and place at risk our Loch Leven Vane Farm bird sanctuary. Furthermore, should they spread throughout Scotland, many rare species will also be at risk. I am thinking in particular of birdlife in the Flow Country of Sutherland where we have just acquired the Forsinard Estate. Something must be done."

Locating the piranha in Loch Leven's 3500 acres will not be easy. The option favoured by the owner is a competition where anglers using wire leaders and live bait trawl the loch for the fish. Teams of six anglers per boat are to be invited and an entry fee of £50 per angler has been suggested. Loch Leven has 50 boats and the event is scheduled to last six days.

Barry Hearn, chairman of "Matchroom Limited", organiser of Fish 'O' Mania 11 - the quest to find the king of the water - has offered to sponsor the event: "We would guarantee the same prize money for Fish 'O' Mania 11, £25,000, and bring along some very special guests, including Skye TV and luminaries from the angling world. It would be fun time for all the family, with sideshows and a computerised scoreboard."

Further information can be obtained from the Scottish Office who have set up a "Piranha Hotline" (tel: 0345 741 741). Anglers are urged to report immediately any piranha sightings. For competition details, contact: the fishery manager, the Pier, Loch Leven, Kinross. Tel: 0566 63407; Luke Riches Matchroom Ltd, 10 Western Road, Romford, Essex RM1 3JT. Tel: 0790 730480.

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In our last Progress Report we carried an obituary of Neil Graesser.

Shortly before his death he sent the following observations to the Council of the Association of Scottish District Salmon Fishery Boards. They are reprinted here with the kind permission of his family.

> I would like to raise two points about conserving MSW fish on the Dee and other rivers.
>
> First, unlike salmon, sea trout on their return to fresh water have to feed daily in order to sustain themselves the same as all other freshwater species. Amongst their daily diet is quite a heavy percentage of fry and parr, especially once they reach 2 lbs and over,

and after spawning. They also spread wide and far throughout a river system and often penetrate to MSW fish spawning grounds in the head waters. Finally, again unlike salmon, a large proportion of these fish survive after spawning, return to the sea and spawn many times. Each time they spawn they get larger in size. I once caught a 16½ lb sea trout, which had spawned nine times, and this is not unusual. Unless something is done to curb this specific population of fish, it will be difficult to achieve this aim. You only need to see how on the West and North coast rivers, where sea trout stocks have declined over the last few years, salmon stocks have vastly increased in accordance with this decline.

My second point is that if you do not control summer runs by some realistic means you are bound to get this seasonal element getting out of proportion and this, although many deny the fact, will eventually lead to overcrowding of both spawning fords and feeding capacity, always to the detriment of the early run fish.

Rod fishing is the most inefficient form of culling runs of salmon to the proportion that a river is capable of supporting simply because its efficiency is almost entirely in the hands of weather conditions, water conditions, and the prowess and effort put in by those concerned. There is no doubt that from the opening day and throughout April and May provided water flows are favourable angling is at its best, and anglers will catch at least 25% or even more of the stock that is present. However, from then on to mid-September, there is a drastic change as water flows diminish, water temperatures rise, and fish runs are much heavier and move quickly through the system whenever water flow allows. So the catch/stock ratio falls significantly to 5% at best, and realistically as low as 1%. Then, once September comes in, nights grow steadily longer, frosts are more frequent and evenings are cooler, therefore, water temperatures continue to drop appreciably, rainfall increases and angling efficiency improves accordingly. In the period 15th September to November 30th, the catch/stock ratio returns to approximately 10-15%.

It would seem, therefore, that it is not just one step that is required to put the balance of runs back to their correct proportions, but a combination of many actions run concurrently. These would be:-

1. A properly controlled realistic method of culling seasonal runs to a reasonable proportion and cull sea trout runs into that system. This would mean a regulated net fishery in the upper estuary from mid-May to 1st August on rivers that have this problem or have bought off their nets.

2. A comprehensive study and repair of upper spawning tributaries, many of which have gone into drastic disrepair and dilapidation due to afforestation on sensitive areas, land drainage and the erosion of banks and overgrazing by stock. There is no doubt that the productivity of many crucial spawning areas has fallen significantly.

3. More care must be taken in checking that access to these burns has not been impeded. Special emphasis should be concentrated on road culverts and drainage of new road construction works, both main and minor public roads and especially estate roads, following spawning tributaries far out into the upper catchment.

4. Some realistic means of limiting spring catches by rod angling on rivers where there is a decline in this seasonal component. This must be carefully thought out, as any badly devised or panicky scheme could have wide repercussions to revenue raised from the angling resource. This, in turn, would make it difficult for the District Board to meet its obligations.

In my opinion, this is one of the most important problems that we have been faced with for many years, but we must think it out carefully and at full depth and, above all, must not be panicked into making hasty, careless decisions.

Neil Graesser

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ADULT SALMON IN THE RIVER DEE: PATTERNS OF MIGRATION, DISTRIBUTION AND SPAWNING

(John H. Webb, Atlantic Salmon Trust, Moulin)

[Extract from a paper give at the Glen Tanar Conference]

The varying fortunes of the salmon resource are often reflected in the catches of commercial and recreational fisheries. While some variation in annual salmon production is normal, severe depressions are usually symptoms of either biological, environmental or man-made stress. Increasingly, in the face of an apparent decline in many stocks of Atlantic salmon there is a requirement for the management of juvenile and adult spawning populations. This is particularly important for stocks whose adult numbers at spawning are not sufficient to fully stock juvenile rearing areas with eggs (Pepper and Oliver, 1986). Management of salmon populations in various guises has been carried out on many of Scotland's largest rivers for many years. Although the scientific basis of many of these schemes have often been far from clear (Maitland, 1986). However, the past 10 years has seen an increasing amount of research into the structure of salmon populations and the promotion of an increasing level of awareness of the potential damage that can be caused to existing stocks if management protocols or introductions are of the wrong type.

The decline in the angling catch during the early months of the Dee fishery has raised concerns about the status of the river's salmon populations. It is therefore timely to review the findings of the research carried out so far and discuss briefly how some of the results may impinge on a fisheries management plan for the river.

1. The Characteristics of the Dee Salmon

The Dee is one of the most productive Atlantic salmon rivers in Western Europe and has an unrivalled reputation as an early spring salmon fishing river. Between 1952 and 1992 the Dee's spring rod fishery yielded an average 39% of the total reported Scottish rod catch of MSW salmon landed before the end of April (Anon, 1993). Despite this distinction, the Dee like many of the larger rivers on the east coast of Scotland is characterised by the return of runs of fresh salmon over the whole year (Shearer, 1992).

1.1 Adult Dee Salmon

There are three main runs of fish that enter the river. These are the spring and summer runs of salmon and summer runs of grilse. In part these runs of river entrants correspond to the main sea age-classes of adult fish that return to the river. These groups are the one sea-winter salmon or grilse, and the older, larger salmon that have spent either two (2SW) or three (3SW) years at sea. Among the true MSW salmon returning to the Dee, fish that have spent two winters at sea (2SW) are the most common group. The generally larger and older 3SW salmon rarely exceed 4-6% of the catches or the spawning population.

Perhaps the most famous run of MSW salmon that enters the Dee is the spring run. Despite their name, springers begin to enter the river in the late autumn and over the following winter months prior to the opening of the new season in early February. However, the main spring run does not occur until February and it peaks in late March and into early April. Most of the 2SW fish entering the river over these early months of the year are quite small, weighing on average 7-9½ lbs. A few larger 3SW fish, weighing between 13 and 25 lbs are usually also present.

The end of April sees the gradual tailing off in the numbers of spring fish entering the river and the beginning of the arrival of summer salmon. Most of the salmon that enter the Dee during the summer months have also spent two years at sea feeding but are distinct from the spring salmon in that they have resumed relatively fast body growth ("plus growth") prior to river entry. They are therefore distinguished from spring salmon by their scale growth patterns. The transition is a gradual one between late April and May. Over this period "spring" and "summer" salmon come into the river "side by side" though by late May relatively few true springers are among the fresh run entrants. The larger late summer and early autumn salmon (15-27 lb) arrive from late August onwards.

The month of May also sees the arrival of the first grilse. However, the largest runs of grilse usually enter the Dee later in the summer in July, August and September - though the precise timing of their movement upstream from the estuary may depend upon flow levels. Grilse and a smaller proportion of salmon continue to enter the river until spawning.

1.2 The size of salmon and grilse entering the Dee

The average size of grilse and salmon increases through the summer (see Table 1). Typically, within each sea-age class of returning adults, the later running fish of each group tend to be larger having spent an increasingly longer time feeding at sea. This pattern is particularly evident among the grilse, which as fresh entrants in late May and early June often weigh less than 4 lb. By late summer some of the fresh-run grilse may have attained weights often in excess of 10 lbs. As a general rule, most grilse are smaller than the 2SW salmon entering the river at the same time having spent a year less at sea.

The same pattern of increasing weight is repeated among the 2SW salmon - but interestingly not so clearly among the rarer 3SW fish. Consequently, fresh run fish that enter the River Dee in the late summer and early autumn tend to be the largest of their class.

Therefore despite its reputation, the Dee is not just a "spring " salmon river. Instead the Dee supports a wide range of adult migrant classes that return at different ages and at different times of the year. In this respect the Dee is typical of many of the larger rivers on the east coast of Scotland. Nevertheless, its historical capacity to produce large numbers of very early running salmon is unique and particularly valuable.

Table 1. Variation in the mean weight (kg) of salmon and grilse entering the Dee between February and August 1983 (Shearer, 1985)

	Grilse	Salmon	
	1 SW	2 SW	3 SW
February		-	
March	-	3.9	7.7
April	-	4.1	8.0
May	1.7	4.2	8.2
June	1.9	4.9	9.8
July	2.4	5.5	7.8
August	2.9	6.1	-

1.3 The behaviour of adult salmon in the Dee

For many years, anglers, biologists and fishery managers alike have speculated about the likely patterns of distribution and destinations of the wide range of salmon and grilse that enter larger river systems like the Dee. Perhaps the commonest questions posed are - do the returning adult fish distribute themselves at random in a large river like the Dee or is there some sort of order? Does the river simply fill up with adult fish from the top down?
The development of small, reliable radio transmitting tags in the early 1980s has enabled scientists to monitor the movements of adult salmon and grilse tagged at or just after river entry in considerable detail. A number of such studies have been undertaken on the Dee. Between 1985 and 1989, 109 adult salmon and grilse returning to the river were radiotagged and released into the estuary at Aberdeen. In addition, during the early spring of 1987 a further nine rod-caught fish were tagged and released at Park.

The behaviour of many of the radiotagged fish was monitored up to spawning. The studies focused on two particular areas of interest: the patterns of movement in the river of different classes of river entrants and the relationship between date of entry to the river and the final spawning position. Detailed accounts of this research are given by Hawkins and Smith (1986), Hawkins *et al.* (1990) and Laughton and Smith (1994). Their findings are summarised as follows:

1.4 Patterns of movement

For many entrants, four phases can be identified during river migration. The first consists of a rapid movement upstream from the tidal reaches. This may continue for 24-36 hours after river entry. This activity is evident over a range of seasonal flows and times of day. The second phase, comprises of a period of discontinuous movement upstream. Over this period, fish generally move at night and remain in many of the recognised holding pools during the day. However, when spate conditions prevail, daylight movements are often evident. It is during this period that many fish complete most of their upstream progress. The third phase is associated with fish spending up to three months in a single pool, exhibiting little or no movement over a wide range of flows - although minor relocations up or downstream, may take place over this time. The final phase, sees the resumption of upstream movement that usually coincides with autumn spates, as the fish move to their final spawning positions. Similar patterns of behaviour have been recorded during the course of different studies on other rivers in Scotland.

Among most migrants, the precise pattern of movement among salmon and grilse in the Dee appears to be associated with the time at which fish enter the river and the location of the place where they will spawn. Spring salmon, and early running grilse tend to exhibit extended forms of all four phases of movement described. In contrast, late running salmon and grilse may move upstream to within a few kilometres of their spawning position on completion of the first movement up from the tide.

Early in the season the underlying patterns of migration of spring salmon are obscured by the effects of low water temperatures. Low water temperatures delay the movement of fish from the lower reaches to areas further upstream. Later in the spring and summer, this constraint is removed and entrants can run upstream more quickly. Flow-limited tributary access and the presence of waterfalls (eg. on the Feugh) may also disrupt movements.

Differences in the behaviour of fish returning to the river at different times of the year determine the character of the fishery. Susceptibility to capture with rod and line appears to be related to levels of migratory activity (Milner, 1990; Laughton, 1991), migrants being most susceptible to capture by anglers during the second and fourth phases of activity described earlier. In contrast, relatively few fish are captured with sporting methods during phase one or three. Consequently, patterns of migratory behaviour of different groups of fish entering the river at different times of the year determine where catchable fish will occur.

1.5 The relationship between date of entry to the river and spawning position

In general, within each sea-age class of adult fish, the earlier in the season that a salmon or grilse enters the Dee the further upstream it migrates before spawning. For example, spring salmon returning to the Dee before the end of April migrate upstream through most of the angling beats on the river and spawn in the upper reaches of the main stem (ie. from Ballater upstream) or in upper spawning tributaries like the Clunie, Geldie, Girnock, Gairn and Muick. Early running summer salmon (entering the river between May and July) migrate upstream to the middle reaches of the river, and some enter tributaries like the Tanar, Cattie, Beltie and Feugh. Later running summer salmon (entering the river from August onwards) limit their penetration of the river system to the large spawning beds in the lower reaches of the main stem below Banchory - with a few of these quite large fish entering the Crathes and Sheeoch burns.

Given suitable river flow conditions during the summer months, this structured pattern of behaviour is repeated by the grilse. However, among this group the relationship between the date of river entry and their final spawning designation upstream is necessarily compressed by the comparatively shorter period of the year over which they enter the river (May-December), Early running grilse that enter the Dee in May and June migrate to areas in the upper part of the river. In contrast, many of the later running grilse (late July-December) tend not to move further upstream than the Feugh and the lower reaches of the main stem.

The relationship between the date of river entry and spawning location is therefore more or less definable among each seasonal and sea-age group of fish entering the river. The time of return to the river is therefore associated with the position of the final spawning location. Consequently, it is possible to predict that those fish that spawn in, for example, the very highest areas of the Dee watershed - above Ballater or Braemar, are the very earliest of their sea-age class to return to the river (spring salmon and early grilse). Furthermore, at the other end of the watershed, many of the fish that spawn below Banchory downstream to the outskirts of Aberdeen are fish that enter the river from late June to the end of the year. Different areas of the Dee and its main tributaries are therefore used for spawning by salmon and grilse that enter the river at different and definable times of the year.

1.6 The salmon of the Girnock Burn

The Girnock Burn is a small spawning tributary near Ballater - in the upper part of the Dee watershed. Many of the juvenile salmon that have left the Girnock Burn over the past 27 years have been tagged. In each year, prior to spawning in the autumn, the pattern of recaptures of adult salmon bearing Girnock tags have then been monitored and recorded.

Most of the Girnock salmon that have been recaptured by anglers have been reported between the first day of the fishing season in early February to the end of May - as clean spring salmon. Most of the recaptures are of the 2SW class with a few larger 3SW fish. Typically, many of the earliest recaptures reported each season are confined to the lower and middle reaches of the main river - below Potarch bridge. However, by May and early June, few tagged salmon or grilse from the Girnock have been reported to have been recaptured anywhere in the river.

All these findings therefore suggest that the Girnock Burn is a spawning tributary that generates migrant juveniles that return to the river almost exclusively as early running MSW salmon or early running grilse. The Girnock is probably typical of many of the other juvenile rearing areas in the upper reaches of the river.

2. Homing behaviour of source populations: the basis for adult return migration structuring and distribution

The tendency of salmon and grilse to return to their native rivers to spawn by homing is well documented. However, perhaps less well known is that homing is also used by many adult fish to return to their own streams at spawning. Among the adult spawners that return to the Girnock each autumn, about 50% were tagged there (Youngson *et al.*, 1994).

Salmon returning to the Dee therefore tend not only to return to their river of origin, but to the more or less precise area of the watershed where they spent their freshwater lives as parr. Migratory behaviour within the river is therefore directed and not random. This homing combined with the tendency of different areas of the river to produce fish that return to the river at different times of the year combine to produce the patterns of migratory behaviour previously described.

2.1 Patterns of migratory behaviour: a determinant of fishery character

During their upstream migration, salmon and grilse are exposed to exploitation by anglers fishing on different beats along the river. Consequently, in view of the behavioural structuring described above the various classes of adult fish returning to the river over the year are exploited differentially by anglers fishing on different stretches of the river. The upper, middle and lower beats therefore exploit different combinations of the various seasonal groups of returning adults. Fish returning to the river early in the year migrate upstream to natal rearing areas in the upper reaches of the river and pass through nearly every beat on the main stem.

Spring fish returning to the river early in the year are also exposed to the pressures of fishing effort by anglers for a longer period than fish entering the river later in the year. Consequently, the spring salmon are probably the most susceptible migrant group to exploitation by anglers and predation and poaching. In contrast, fish entering the river later in the year are exposed to fishing pressure for a lesser period as many (excluding "early" grilse) home to the lower reaches and are therefore not available to fisheries operating upstream.

2.2 Distribution and behaviour at spawning

The common aim of all the adult salmon that return to the Dee is to locate gravel beds near to where they lived as juveniles (via homing) and spawn. In many of the smaller salmon rivers in Scotland, spawning is often restricted to the upper reaches where the spawning and juvenile rearing habitat are concentrated.

However, in the Dee, the distribution of spawning and juvenile rearing habitat is more extensive; spanning a range of altitude of nearly 400m - from the main river above the Linn of Dee near Braemar downstream to just above the tidal limit at Aberden. Spawning also takes place in nearly all of the river's accessible tributaries. Spawning and subsequent juvenile rearing in the Dee therefore takes place throughout a wide range of river environments that span more than several hundred kilometres of river and stream bed.

2.3 Timing of spawning

Though fresh salmon enter the Dee all the year round, most spawning usually occurs during the late autumn and winter months between October and early January. Late September and early October sees adults of various sea-ages regrouping near their natal rearing areas. Spawning date is dictated by the timing of ovulation among the gravid females. Spawning begins first in mid-October among the spring salmon and early grilse in the upper reaches of the river. However, the season is short and spawning is more or less complete by mid November. In contrast, the fish that have returned to areas further downstream begin to spawn in late November onwards and may continue well into January and early February of the following year.

The variation in the timing of spawning by fish in the upper reaches compared with the lower reaches is such that there is little or no overlap. The differences are probably controlled by both genetic and environmental factors. The rates at which eggs develop during the incubation period to hatch and then on to emergence is dictated by local water temperature. Eggs spawned in higher altitude (and therefore colder) streams in the upper part of the watershed tend therefore to take a longer time to incubate to the emergence stage than eggs deposited in lower altitude streams further downstream. However, the differences in spawning date do not reflect a drive among all groups of eggs towards a common hatch date. Despite spawning occurring in the Clunie about a month before the Sheeoch, the timing of the hatch date of the eggs is reversed in favour of the Sheeoch by about a month (Webb and McLay, in prep.). The reason for this pattern probably reflects the time at which conditions become suitable for the young fry to survive the first few weeks of early life. Spring, (and therefore the availability of suitable food) comes later to the upper catchment than areas further downstream.

From this work it is clear that differences exist in the timing of spawning of adults returning to different areas of the river system. These differences, together with the differences in the thermal regimes during the incubation period associated with different areas of the river combine to optimise the time of hatch and emergence in streams with different thermal regimes. These differences are probably adaptive and serve to maximise the survival of the emerging fry.

3. Changes in "run timing" in the Dee: A Spawning Tributary Perspective

The past 30 years has seen variations in the strength and sea-age composition of the various seasonal groups of adult salmon returning to the Dee: with the relative seasonal numbers of salmon and grilse entering the Dee changing from periods of comparatively high spring salmon numbers towards a preponderance of fish entering the river in the late summer. These and other changes have, in turn, affected the seasonal pattern of exploitation of salmon and grilse by both net and angling fisheries within the fishery district over much of the same period (see George, 1982; Martin and Mitchell, 1985; Shearer, 1985). In this respect however, the Dee is probably not unique, as similar changes are also reported to have taken place in many other rivers in the UK over the same period (SAC, 1994).

However, in the Dee, despite these very obvious changes, characterisation of tagged recaptures and adult Girnock trap catches since the late 1960s has shown that the Girnock Burn has more or less consistently generated adult salmon that have returned to the river as early running spring salmon (83%) together with only a small number of early running grilse (17%). Larger, later running 2SW salmon bearing plus growth on their scales (suggesting river entry after late April - as summer salmon) have not been recorded in significant numbers at the Girnock trap site at any stage.

There is therefore no evidence to suggest that Girnock salmon and grilse are returning to the Dee any earlier or later in the year than they did in the late 1960s and 1970s - when the numbers of early running salmon entering the river were probably much higher than today. Furthermore, despite a gradual reduction in the number of female MSW spawners returning to the stream since 1967, there appears not to have been a truly compensatory increase in the numbers of female grilse to indicate a significant shift in the average sea-age of the population. The slightly larger numbers of grilse that have returned to the stream in recent years have not been consistently above what might normally be expected with the removal of the Aberdeen Harbour Board nets in 1987 (D. Hay, pers. comm.).

Dunkley (1985) describes an apparently similar phenomenon associated with many of the seasonal stock components of the North Esk. Though there has been an increase in the grilse:salmon ratio in recent years there has not been an absolute increase in grilse numbers. Consequently, the author proposed that rather than fish returning at an earlier sea-age (ie. grilse) the fish that would have returned as MSW salmon are being lost due to mortality. Despite the changes in the Dee's stocks and its fisheries, over the past 30 years, the characteristics of all three main sea-age groups of tagged adults that have returned to spawn in the Girnock since 1967 have appeared to have remained more or less fixed. Girnock salmon and grilse are returning to the river at the same time as when records began. If this is typical of many of the other source populations of fish in the Dee, then it is possible to explain the well documented changes in the river's stock.

In view of the population structure previously described, the research that has been undertaken at the Girnock since 1967 strongly suggests that the annual and longer term variations in the strength of seasonal runs of adult fish returning to the River Dee are unlikely to have been the result of inherent changes in the return times and migratory patterns of fish. Rather, the situation probably reflects more wider scale variations in the juvenile rearing production and subsequent sea-survival of smolts derived from broadly different areas (ie. upper, middle and lower) of the river system. At present, juvenile migrants reared in upper parts of the catchment; a group that are generally predisposed to return as early spring running salmon and early grilse, are probably performing less well than they did when the Dee was at its height as a spring fishery. Indeed, smolts from the upper reaches may be performing less well than juveniles derived from rearing areas in the lower reaches of the river - areas known to generate fish that return to the river as later running summer salmon and grilse. These effects are probably being driven by the consequences of differential sea-mortality and may in part explain the imbalance in the numbers of adult fish of different sea-ages returning to different areas of the river system at the current time.

4. Conclusions

The Dee's salmon populations have been defined in terms of behavioural structuring of returning adults. The patterns probably reflect broad adaptations of the various juvenile source populations.

The structuring of the salmon populations in the River Dee is evidently complex. Though not exhaustive, the objective of this brief review has been to outline some of the main behavioural characteristics of the salmon that enter the Dee and how these characteristics determine the performance of the various fisheries on the river.

Adult salmon and grilse return to native streams or main river areas supporting source populations of juveniles. This behaviour is directed by homing. Homing, provides the mechanism by which the behavioural and genetic (see Eric Verspoor in Dec 1994 PR) structures have evolved. Behavioural structuring among homing adults destined for different areas of the watershed of the type found in the Dee has potentially different consequences for the susceptibility of each seasonal class of migrants to commercial netting and angling exploitation and other losses. In this respect, spring salmon in particular have been identified as a group that is particularly vulnerable to excessively high levels of exploitation. Homing may also serve to perpetuate deficiencies in local egg deposition by restricting the possibility of compensatory spawning by members of populations derived from elsewhere.

Nevertheless, the structuring in the Dee does allow juvenile populations known to generate parr and smolts that are predisposed to produce particularly valuable classes of returning adults (eg. spring salmon) to be identified within geographically definable areas of the river system.

This in turn allows managers and biologists to target scarce resources towards the protection and enhancement of these populations.

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ATLANTIC SALMON POPULATION MANAGEMENT: MAXIMISING PROGENY NUMBERS FROM NATURAL AND ARTIFICIAL SPAWNING

(John Webb, Marine Laboratory Aberdeen)

Family performance of different families of salmon fry in their first summer of distribution and growth.

In my last progress report (December 1994) I described the initial phase of a study into the distribution and growth of salmon, stocked as eyed ova in an upland stream. The study uses recently developed genetic markers, (so called single locus probes or SLPs). These techniques can be used to genetically fingerprint fish and to identify their progeny from the DNA. In April 1994 36,000 eyed ova, derived from twelve single parent crosses, were stocked throughout an area of a high altitude tributary of the River Dee. Samples of fry were electro fished in September following their dispersal and the period of density dependent mortality and growth over the first summer of life.

Genetic screening of samples of tissue from the parent broodstock suggested that two SLPs would distinguish between the 12 families stocked in the stream. Analysis of 200 fry samples has been completed and there are already indications of differences in the frequency and

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distribution of families within adjoining sectors of the stream. These analyses will be continued and extended in the coming months to further study patterns of family dispersal and growth. From the final results it should also prove possible to examine the effects of stocking density and location, trout fry density and habitat characteristics on the distribution, survival and growth of stocked salmon fry.

Lifetime fitness studies on spring running salmon

In the same stream, genetic screening techniques are also being applied in a larger study to assess the contribution of individual fish to future generations of spawners.

The second year of this project saw the in-stream incubation facility, developed in 1993, expanded to accommodate a larger number of eggs. In autumn 1994 approximately 103,000 eggs, the progeny of 28 single parent crosses between a random selection of the spring MSW salmon and early running grilse broodstock which returned to the stream to spawn, were laid down.

In late April 1995 eggs were removed from the incubation facility, picked and counted. Overall survival assessed a week prior to hatch, at 97%, was extremely good. On the basis of genetic screening of adult fish, 20 families were selected for stocking. Eyed ova from these families were distributed in gravel packed baskets buried at regular intervals along the stream. Fry survival to emergence will be monitored between May and late June.

Using the fingerprinting techniques the fortunes of the single year class of the 20 stocked families will be followed to their return to the stream as spawning adults. This will be possible by virture of SOAFDs fish trapping facilities on the study stream. The stream is equipped (at its lower end) with two permanent traps. There is an adult trap that catches adult salmon that enter the stream to spawn and a descending smolt trap to catch migrating juveniles. This combination allows biologists to monitor the production of migrant juveniles and subsequent adult returns to the tributary.

Migrant parr and smolts generated from this years stocking will be trapped as they leave the study stream. Each fish will then be measured and microtagged and its adipose fin removed (a routine procedure when using microtags) and preserved in ethanol for DNA screening. At the same time a small sample of scales will be taken for age determination.

The fin clip will allow each migrant fish to be identified back to one of the 20 families stocked. Using these new genetic tools we hope to monitor the smolt production and characteristics of particular families of eggs and their subsequent survival to spawning as particularly prized 2SW and 3SW spring running adults.

The Aberdeenshire Dee - Catch and release

Following the introduction of the *Dee Conservation Code* earlier this year and its voluntary catch and release policy, I have been conducting a pilot study on the behaviour and survival of spring and early summer salmon returned to the river by anglers. Fish caught on normal fly fishing tackle on a beat below Banchory, have been tagged with a radiotag and a Floy tag and released back into the river. Particular attention is being paid to the behaviour of tagged fish in the first few days after release. It is however, proposed to continue observations until spawning later in the year.

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WEST HIGHLAND SEA TROUT & SALMON GROUP

(by The Director - Chairman of WHST&SG)

The West Highland Sea Trout & Salmon Group has produced its Report. I can do no better than reproduce the summary and extracts of my introduction. The Group has employed a Development Officer, Mr. Andrew Wallace, and he has started on the job of encouraging the setting up of trusts or groups on the West Coast.

The Report may be summarised as follows:

The West Highland Sea Trout and Salmon Group was formed in March 1994 arising out of concern about the state of sea trout and some salmon stocks in the West Highlands and Outer Islands of Scotland.

As its starting point, the Group sought to establish whether the problems were part of a more general pattern affecting sea trout and salmon stocks in the UK, or whether they were different and much more deep-seated. The Group concluded that sea trout and some salmon stocks in the area had been particularly badly affected, with the virtual collapse of some stocks.

The possible cause or causes of the problem were looked into and various aspects were considered in detail. Despite this, the Group was unable to establish conclusively the cause or causes of the problem. The Group also recognised that considerable time would be required to investigate this fully, with no guarantee of producing a conclusive answer.

Against this background, the Group decided that the best prospect of halting the decline, as well as eventually restoring stocks, would be through broadly-based action. To that end the Group drew up a positive and forward-looking Action Plan. The Plan is in two parts. Part I makes recommendations affecting Wild Fisheries Management: Part II covers Fish Farming. One of the key recommendations relates to the need to establish a Fishery Trust or Trusts covering the West Highlands and Outer Islands. Without strong local structures, local commitment, and appropriate resourcing to cover the cost of all the recommendations, the Group felt that it would be very difficult to implement the Plan.

The Group believes that, given the natural, economic and other constraints, the recommendations in the Action Plan represent the most positive way of addressing this highly complex problem.

In my introduction I said:

Right from the start I realised that the task which the Group had set itself was ambitious. It was also difficult because the retrospective nature of the problem made it very hard to establish the underlying cause and agree the most appropriate action needed to recover the situation. Differences of opinion emerged within the Group on this key issue. Several members felt that the circumstantial evidence of a link between infestation by sea lice - through the presence of salmon farming - and the decline/collapse of wild stocks was sufficiently convincing to warrant placing the full focus of attention on salmon farming. Others considered that many interactive factors may have been involved.

We spent a great deal of time considering this issue. In doing so, it was acknowledged that events have moved on and, for example, major improvements in management and husbandry techniques, including sea lice control, have taken place since salmon farming started in Scotland. Moreover, we recognised that under the present legislative and administrative arrangements, it was neither practical nor possible to compulsorily remove cages from the near vicinity of sea trout and salmon rivers. I appreciate that it was not easy for those who believed that sea lice had been the principal cause of the problem to accept this. It is to their credit that they have agreed the Report with only a few reservations.

The publication of this Report, while important, is but a preliminary step in the lengthy process of recovery. The Action Plan - and I believe it is a very positive and comprehensive Plan - will fulfil its objectives only if it has the full co-operation and support of those on the ground. Substantial resources will be needed to implement the Plan. But I am confident that these can be secured if all who wish to see the return of wild sea trout and salmon in sustainable numbers to our West Highland lochs and rivers support what has been proposed.

I remain convinced that the way forward is by co-operation and not confrontation.

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THE SCALISCRO SEA TROUT PROGRAMME - A PROGRESS REPORT

(Dr. Bob Morgan and Douglas Paveley)

Tank reared sea trout progeny fed at different ration levels demonstrated different somatic growth and maturation rates. Feeding every day (high ration) produced larger fish and some male and female sexual maturation after 17 months in September/October ie. at age 1+. Feeding once every 5 days (low ration) produced smaller fish and no sexual maturation at age 1+. Saltwater challenges at 40% (normal saltwater strength is 32%) suggested that high ration fish were not as well adapted to saltwater as low ration fish as two year old (S2) smolts. Good feeding opportunity gave rise to sexual maturation and an apparent reduction in saltwater tolerance.

Low ration tank reared sea trout progeny were tagged (Morgan and Paveley, in press) and released as S2 smolts in May 1993. There were no returns from these fish in 1994 that perhaps suggested poor marine survival. However, the transfer of further low ration S2 smolts to seawater cages in May 1994 and their subsequent development may provide an explanation for the nil returns in 1994.

In May 1994, a batch of two year old (S2) sea trout smolts were transferred to a sea cage for ongrowing. The results were disappointing due to the unwelcome attention of mink and the population numbers were severely reduced. However, culling some of the survivors in September 1994 showed interesting maturation responses. There was no evidence from the September cull of any fish that were maturing. Some of the males showed slight testicular thickening. An explanation may be that the low ration levels did not allow sufficient body fat reserves to be present at the time of the increasing photoperiod in February/March/April to initiate maturation. If this was the case, the lack of returning fish from the 1993 release could be explained on the grounds that maturation triggers the return from saltwater to freshwater.

In May 1995, a batch of 2000 low ration three year old (S3) sea trout smolts were transferred to a cage for ongrowing. Approximately one month later, these fish were feeding but were still tending to occupy the lower half of the cage. They will be sampled in September to establish growth and state of sexual maturation. Before transfer a sample of these fish was culled and examined for sex ratio and sexual maturation. The sex ratio was approximately 1:1 and little evidence was present of sexual maturation. The pre transfer sampling demonstrated that only a small number of the males were showing signs of maturity.

The results so far from this study suggest enhancing sea trout stocks through either smolt production or the planting of earlier development stages may not be an entirely straightforward process. The presumption that sea trout can be enhanced through the use of techniques developed for salmon may be premature.

Acknowledgements

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LOUSY TROUT

(Sally J. Northcott, Freshwater Fisheries Laboratory, Pitlochry
and Alasdair D. Campbell, Marine Laboratory, Aberdeen)

Last summer, Mr. David Brien, owner of the Sandyknowes Fishery at Bridge of Earn arrived at the Freshwater Fisheries Laboratory with two trout, killed and mutilated by lice. But these were not *sea* trout infested with *sea* lice but brown trout covered in freshwater lice.

The freshwater louse population had exploded in the put-and-take fishery at Sandyknowes, which is largely stocked with rainbow trout but also some brown trout. The louse was identified as, *Argulus foliaceus*, a branchiuran parasite that occurs on a wide range of fish species. The first sign of something wrong was the strange behaviour of some trout; shoals were observed swimming in small circles in two areas of the loch. Early in July, anglers began to take trout that were covered in freshwater lice. The feeding activity of the lice was associated with severe scale loss, fin damage and lesions notably on the backs of the fish. By the end of July it was clear that there was a serious problem in the loch and the Fishery was closed. Water temperatures had reached 20°C and there had been little rain for three months. Large numbers of sticklebacks were seen dead and dying in the shallows and the trout seemed to have disappeared. Gill nets were set throughout the loch and even left overnight but only small roach and a few grass carp were captured. The stocking records showed that there should have been over 2000 trout in the loch. A dive survey was carried out to see whether large numbers of dead trout were lying on the bed but none was found. From the end of July all experimentally stocked trout were adipose fin-clipped and some of these fish were subsequently captured heavily infested with *Argulus*. By the end of August, however, much lower infestations were observed and by this time the water temperature had dropped to 14°C. Although *Argulus* has been present at low levels throughout the '94-'95 winter no associated mortalities have been observed. It remains to be seen whether the problem will manifest itself again once temperatures rise next summer.

The parasite is believed to have been introduced to the Sandyknowes Fishery on roach which invaded the loch from the River Earn during severe floods in 1993. There have been reports of louse infested trout and salmon from anglers on this river recently but no data are available concerning the impact of the parasite on the wild fishery. The River Earn partly supplies Glenfarg reservoir where large numbers of freshwater lice have also been reported in recent years. *Argulus foliaceus* is normally associated with more southern waters. In 1971, one of us (A.D.C.) reviewed information on the occurrence of *Argulus* in Scotland. *Argulus coregoni* was reported from the River Clyde but *Argulus foliaceus* appeared to be confined to an area south of the Central Highlands. Whereas *A. coregoni* prefers cooler, fast-flowing rivers, *A. foliaceus* favours warmer, slow-flowing or static waters (Campbell 1971). The recent invasion of more northerly waters by *A. foliaceus* may be linked to fish introductions from other parts of the United Kingdom. This has been suggested for the arrival of *A. japonicus* in Britain which was first reported in 1992 (Rushton-Mellor, 1992). These recent events may also result from changing climatic conditions and particularly from mild winters which may increase year-to-year survival. *A. foliaceus* thrives at raised water temperatures and has been reported as the cause of major fish mortalities abroad (Menezes et al 1990). These authors studied an outbreak similar to that at Sandyknowes which occurred in a lake in the Azores. Many fish species had been introduced to the lake and along with them the parasite *A. foliaceus*. There appeared to be a stable host-parasite relationship until a rainbow trout farm was established. The sudden large increase in suitable hosts for the parasite resulted in an epizootic and a massive mortality of the farmed fish.

The incidents at Sandyknowes and in the Azores warn against enhancing host availability in confined areas under environmental conditions that allow parasites to flourish.

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ANNUAL MEETING OF SUPERINTENDENTS & BAILIFFS OF DISTRICT SALMON FISHERY BOARDS & MANAGERS OF SALMON FISHERIES

(by John Webb)

March of this year saw the 1995 Superintendents' and Bailiffs' meeting held at Scotland's Hotel in Pitlochry. Representatives from many of the District Fishery Boards and Fishery Management Trusts in Scotland heard a series of eight presentations on a range of management topics including hatcheries and stocking, river habilitation techniques and fish passage.

The first presentation of this year's meeting was by Dr. Alastair Stephen of the West Galloway Fishery Trust. Dr. Stephen's talk was entitled 'A case for stocking?' He began by quoting a number of recently published cautionary statements and comments about the use of stocking for enhancement purposes and emphasised why it is important to establish exactly why stocking might be necessary. Managers should always seek to gain a full understanding of the nature and impact of any production 'bottlenecks' or limiting factors that affect their fish stocks. Furthermore, stocking requirements, like any other form of management activity should be tailored to individual streams. For example, in many larger rivers, management requirements in one area of a river system may be quite different from those in others. Finally, in all circumstances Dr. Stephen suggested that before undertaking any enhancement programme, well-planned field research by fisheries staff to identify and quantify shortfalls in juvenile recruitment and production was essential.

Mr. Willie Lawson, Superintendent of the Luce DSFB gave a very practical account of his work in setting up a low cost, low technology hatchery on the River Luce in Ayrshire, Galloway. By acquiring a variety of second hand tanks, pipe, and screens and putting them together with a range of innovative and original ideas to control incoming debris, silting and water flow, Mr. Lawson has managed to construct a fully-covered hatchery with a capacity of about 180,000 ova for less than £1,500!
To obtain suitable numbers of eggs for the new facility, anglers fishing on the River Luce have been encouraged to place gravid fish that would otherwise be returned to the river into special holding cages placed at some of the most productive pools on the river. Fisheries staff then collected the fish with a tank on a trailer for transport to their holding facility.

To many, acquiring fish for stripping in this way may seem an attractive alternative to trying to catch spawners in remote tributary streams later in the year. This approach is a very unselective method of broodstock collection as no distinction is being made for fish that may have entered the river at different times of the season. Therefore this method will be appropriate only for quite small rivers with relatively few adult spawners. However, on many larger rivers, with more varied and structured salmon populations this approach may not be the most appropriate management option.

Mike Miles from the SOAFD salmon rearing facility at Almondbank near Perth, gave an update on the salmon kelt reconditioning work. He reported that the results from this new research continue to be encouraging - with experimental groups of eggs stripped from reconditioned females being stocked out into the River Lochay on Tayside for trials earlier this year. However, despite the apparently good number and quality of the eggs being obtained from reconditioned females so far, concern was expressed by some of the delegates present about the likely high costs of setting up such an operation elsewhere.

The final presentation of the first day was given by Julian McLean from the SOAFD Field Station at Montrose. His theme was to outline the latest results of an ongoing investigation into the variation in the numbers of eggs produced by the various seasonal groups of fish that enter the River North Esk over the year. This work is important as it provides a basis for estimating the likely total egg deposition for the whole river in any one year. Interestingly, spring salmon entering the river early in the year tend to produce a relatively small number (per unit body length) of relatively large eggs. In contrast, fish entering the river later in the year produce generally larger numbers of relatively smaller eggs. However, despite these differences, the apparent total energetic resources (incl. lipid and protein) committed by both groups of females (per unit body size) for egg production are about the same.

Over the period 1981 to 1993 (inclusive), the mean total annual run of grilse and MSW salmon over the Logie fish counter on the lower river was about 8000 fish. Over the same period, using the egg yield relationships recently developed, the total egg deposition in the whole river is estimated to have ranged from 7 to 22 eggs per square metre. However, it was stressed that these figures were mean values and therefore assume that the eggs are evenly distributed throughout the whole of the river system.

The second day began with a presentation by Dr. John Armstrong of the Freshwater Fisheries Laboratory at Pitlochry on the behaviour of radiotagged brown trout in the rivers Eden (Fife) and Don. Much of the work has involved displacing wild fish up or downstream of their capture sites and monitoring their behaviour after release. The results of this work have been variable. During studies conducted in 1993 most of the displaced fish returned with considerable accuracy to their original capture point. However, in the following year none of the fish returned to their original positions.

Dr. Trevor Hoey of the river rehabilitation research group at the University of Glasgow gave a brief account of his work on hydraulic conditions in river and streams and the design and placement of structures for habitat improvement in stream channels. Members of the team are currently conducting a range of research studies both in their laboratory and on some of the upper spawning tributaries of the Tweed. Aspects of gravel riverbed structure and stability were described and Dr. Hoey stressed the importance of gaining a better understanding of the processes and circumstances that encourage armouring of river bed sediments that are not used for spawning. By promoting armouring processes in rivers engineers and fishery managers could perhaps in the future take a range of practical measures to reduce the release and mobilisation of sediment material during flood events.

The final two presentations of the day focused on various aspects of fish passage and screening. Andrew Veitch, habitat manager for the Tweed Foundation began by posing the question - what is a barrier? Drawing a wide range of experience and examples from the Tweed system he gave a detailed account of the extensive catchment-wide survey that is currently being carried out on the river system. To date, most of the upper reaches of the River Tweed have been examined for man-made structures or natural obstacles that may impede the movement of fish and the total number located so far exceeds 280!

Mr. Veitch then went on to describe the various types of criteria used by him and his team to assess the seriousness of structures perceived to be obstacles to fish passage and the likely costs and benefits of their alleviation or removal. Finally, we were shown a rather nice selection of slides illustrating some examples of the different kinds of obstructions tackled by the team and kinds of alleviation works that have already been carried out.

Robert Williamson OBE gave what will be his last presentation to the meeting as Inspector for Salmon Fisheries (Scotland), as he is retiring later this year. His theme was the latest amendments to the Fishpass and Screening Regulations. Schedule G to the Salmon Fisheries (Scotland) Act 1868 is now superseded by the Salmon (Fish Passes and Screens)(Scotland) Regulations 1994. However, Schedule G is retained in force until the dates the Regulations apply. These new regulations effectively mean that all off-takes will require to have suitable screens fitted to prevent smolts entering from above and adults from below as of 1st January 1995, and all dams be provided with a suitable fish pass by 1st January 2000. There are however, two exceptions; dams covered by the HEP Electricity Acts and structures constructed under Water Acts.

To close, Dr. Andy Walker thanked all the speakers and members of the audience for attending what was a very interesting and stimulating meeting.

SALMON FARMING

Each year, the Scottish Office Agriculture and Fisheries Department Marine Laboratory publish an annual production survey. The following summary concerning Atlantic salmon production is reproduced with kind permission of SOAFD and the authors - A.L.S. Munro and J.A. Gauld.

Ova and Smolts

Production of smolts has been reasonably consistent for the last few years but growers recorded a 9.9% increase in 1994 and forecast comparable increases over the next two years. There were again modest increases in the numbers of S½, S1 and S1½ smolts produced and industry is devoting an increasing effort in the production of out of season smolts. These increases in production were achieved despite there being a reduction in the number of smolt producing companies. The establishment of the single market in Europe in 1993 has resulted in a significant import/export trade in ova. Ova produced in Scotland go to both home and foreign markets. The foreign markets are governed by outside forces and in some areas their future is uncertain due to changing health regulations. The downward trend in manpower observed in 1993 was reversed with increases reported in both full-time and part-time staff in 1994.

Production fish

Production increased from 48,691 tonnes in 1993 to 64,067 tonnes (up 31.6%) in 1994. This increase was achieved by harvesting a greater proportion (65.5%) of the 1993 smolt year class than has been customary for preceding year classes (<55%), by achieving greater survivals in the 1992 smolt year class (79%) and almost certainly in the 1993 smolt year class, and by achieving greater growth rates partly by reduced disease and related stresses and by improved feedstuffs. Mean weights at harvest were also greater. The greater survivals and growth rates will have been a major factor in many companies decisions to market increased numbers of the 1993 smolt class in 1994. The high culling rate of the 1993 smolt class in 1994 explains the somewhat unexpected large jump in production in 1994. The survival of the 1992 smolt year class harvested over 1993-1994 was 79%, an increase of 12% over 1991 year class harvest. This is a significant achievement over the previous years and indicates much more effective control of disease by both management techniques and use of vaccines. The increased production was achieved with much the same cage capacity and smolt input as in 1993 and 1992. Productivity, measured as kilograms fish produced per cubic metre of cage space, has increased by 78% since 1992. Care needs to be exercised to ensure that optimal stocking levels are not exceeded and possible disease problems reintroduced. The 1994 year class appears to be growing and surviving as well if not better than the 1993 year class.

It is noticeable that the increased tonnage and numbers harvested on a Regional basis are not uniform, Highland being the biggest producer with Shetland and Strathclyde vying for second place and Western Isles occupying fourth position. Production by Region however is not an absolute measure of efficiency as area and coastal geography and site suitability are important factors. There would appear to be scope in all Regions to strive to attain even better survival. Individual site survivals greater than 90% have been reported and this should continue to be the standard for all sites within the industry. Because disease control is clearly so important the number of sites still apparently not following fallowing principles clearly remains a concern. All Regions reported increases in production and in productivity but there were wide variations between Regions in the latter. Employment varied between Regions with increases and decreases in both full and part-time staff being recorded, overall employment increased by approximately 2%. The highest productivities are only achieved with a significant degree of costly mechanisation but nevertheless the great range in values suggest the operation of some companies could be improved in this area.

* * * * *

"THE MUCKLE FUSH"

Here is Andrew Nicol's account of the occurrence on his water after interviewing the ghillie and other members of the party fishing at Ballogie Estates.

The report that I have received is as follows:

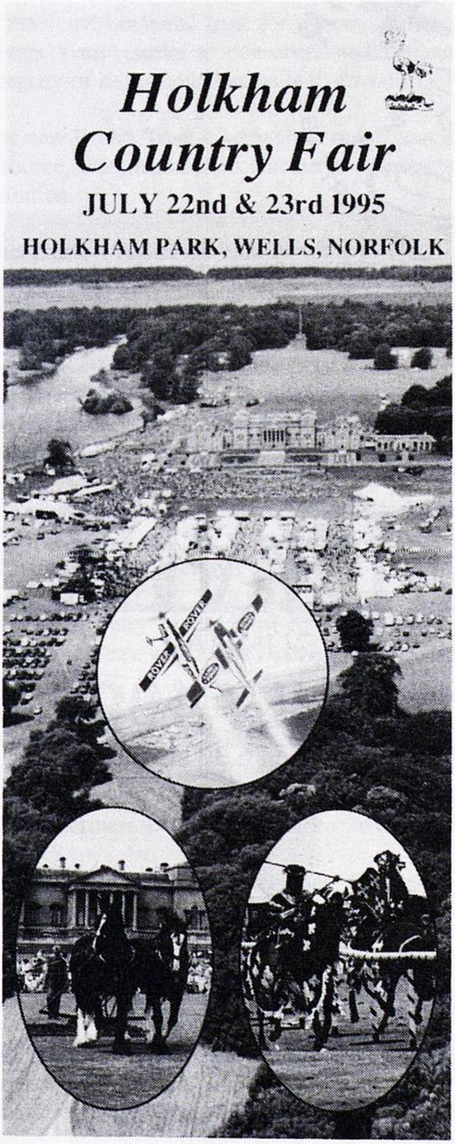
Name:	Mr. Harvey Milne, Banchory. Former ghillie, Banchory Lodge Hotel (age about 50). He was fishing with a party of fishing guests led by Mr. Barry Gough, Surrey.
Date:	Thursday 8th June 1995
Time:	Hooked at c. 11.30am. Took c. 55 minutes to play.
Place:	"Top Flat", Ballogie water, River Dee. A few hundred yards up from the Potarch Hotel.
Height of water:	3ft 7in. on Potarch Bridge gauge. The river had just started to drop and had perhaps peaked at 3ft 8in at around 11.15am.
Water colour:	River lightly coloured with peat but no debris.

Method of fishing:	Mr. Milne was wading some 6 feet from the bank and was fishing a 15ft Hardy fly rod with a floating line and sink tip and 12lb nylon cast. The fly was a 1 ¼ in tube fly, a "Gruff special" tied by Mr. Barry Gough, Surrey 15 to 20 years ago and which remained unused in a flybox until now.
	The fish was brought in to the side of the river where the depth was about 9 to 10 inches. The first two times it took off again out to the middle of the water. The third time Mr. Milne was able to lay down his rod on the bank, wade into the water and roll the fish onto the bank. It was a cock fish and there were several (say 12-20) long-tailed sea lice on it. Alas no camera was to hand and Mr. Milne was on his own.
	He attributes his success in landing the fish in part to the fact that it was fresh run and therefore tired.
Measurement:	All figures given are rough estimates only. The rod was put across the depth of the fish. At the fattest point the depth was estimated at 20in. He lifted the fish by the tail up to his shoulder to gauge its length. With both hands he was unable to reach round the base of the tail. The length of the fish was later estimated at 56in.
Method of release:	The fish was clearly over 33in and was therefore released. It was out of the water for a maximum of one and a half minutes. The hook was taken out and the fish was lifted back into the water and led to a streamy bit where there was some current. It moved out towards the middle of the river and was gone. Mr. Milne sat down and only then realised what he had done. When he met the ghillie, Mr. David Gibbon, later Mr. Milne's hands were still shaking.
Scales:	To date, despite a thorough search, no scales have been traced.

I should only comment that only a well experienced angler could have successfully played this fish. I enjoy the mystery of it all: was it a Dee salmon? Where did it come from? Who's going to catch it next? Will it be found as a kelt next spring?

A.H. Nicol for Smiths Gore

(*This account comes from the Chairman of The Dee District Fishery Board*)



Grand Ring Spectacular

The Programme on both days is from approximately 10.30 a.m. to 6.30 p.m.

GRAND OFFICIAL OPENING CEREMONY
at noon each day

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THE LOWLAND BAND OF THE SCOTTISH DIVISION & THE PIPES & DRUMS OF THE ROYAL SCOTS DRAGOON GUARDS

::

JOUSTING BY THE KNIGHTS OF ARKLEY AND THE NORFOLK POLICE SADDLE CLUB

::

FLYING DEMONSTRATIONS WITH BIRDS OF PREY AND JEMIMA PARRY-JONES

::

FREE FALL PARACHUTING BY THE TIGERS

::

ONE HUNDRED YEARS OF HORSE POWER

::

MOUNTED GAMES

::

VINTAGE CARS

::

FIELD SPORTSMEN AND HOUND PARADE WITH DESERT ORCHID

::

HOT AIR BALLOON RACE

::

TERRIER RACING

::

THE FLYING GUNNERS MOTORCYCLE DISPLAY TEAM

::

MELTON MOWBRAY TOY SOLDIERS MARCHING DISPLAY BAND

::

FIREBIRD ROVER DUO AEROBATIC DISPLAY

::

OPEN AIR SERVICE (Sunday)

WESTCOUNTRY RIVERS TRUST

NEW RIVERS TRUST FOR THE WESTCOUNTRY

A new environmental trust for the south west was launched on June 2nd. The "Westcountry Rivers Trust" seeks to conserve, maintain and improve the natural beauty and ecological integrity of rivers and streams in Cornwall, Devon and West Somerset.

The new Rivers Trust is very concerned about the enormous pressures put on our natural water resource, from abstraction, sucessive drainage schemes, and often increased sediment load and pollution.

The Trust, a registered charity, aims to meet its objectives through **education**, concentrating on man's impact on the environment and an appreciation and understanding of nature as part of promoting the **wise use** of our water resource for **recreation**, the Trust has already acquired an area of suitable river, allowing free access and fishing for children.

The Rivers Trust will be working closely with farmers and riparian owners offering **practical advice** based on sound **research**. The Trust is also **seeking funds** to assist them with **river restoration projects** and sustainable **environmental improvements**.

The Westcountry Rivers Trust will seek to involve local communities in its work in accordance with Agenda 21 and has a close relationship with the South West Rivers Association. It is also working with the County Farming and Wildlife Advisory groups, the N.F.U. and the C.L.A.

The Westcountry Rivers Trust enjoys an impressive line up of trustees, including Ted Hughes the poet laureate and Teddy Goldsmith the ecologist.

Arlin Rickard, the Trust's director explained, "all of us are water users, of one form or another. We must all take responsibility for past mistakes and learn how to protect our heritage. We intend to make a real difference on the ground, acting as catalysts and co-ordinating action for change. We will be active in vital areas often starved of funds, such as helping farmers to solve the problem of diffuse pollution."

N.R.A. South Western Regional General Manager, Katharine Bryan said, "the active involvement of the local community in safeguarding the water environment is vital for the future. The NRA welcomes the launch of the Westcountry Rivers Trust. All our experience from working with similar organisations is that rivers greatly benefit from this kind of partnership and collaboration."

The Trust has already made an application to the European Union for funding for a major river catchment restoration project, in the heart of the region. Submitted under the Objective 5B programme, European Agricultural Guidance and Guarantee Fund measure 5.1. The 5 year project, based on partnerships, features the integrated application of proven best land use practice. It aims to protect, maintain and enhance the river catchment and promote the sustainable management of the areas natural resources.

The Trust have been fortunate in receiving a great deal of help in this and other areas, from Professor Edward Maltby, director of the Wetland Ecosystems Research Group, along with Gordon Bielby and Clem Davies formerly of the N.R.A. now B.D.B. Associates.

For further information contact:
The Director; Arlin Rickard on 01208 851369

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The Atlantic Salmon Trust welcomes this initiative and wishes The Westcountry Rivers Trust every success.

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HIGHLAND FIELD SPORTS FAIR at MOY HALL, near INVERNESS

4th and 5th AUGUST 1995

The Highland Field Sports Fair will be held again at Moy Hall, where it has been held in recent years. The beautiful Highland setting has proved to be a great attraction to visitors and traders. The Fair will continue our committment to countryside pursuits.

The 1995 Programme will again cover Shooting, Angling and Gundog events and the usual successful Main Ring Programme will be continued. Competitions and Demonstrations will follow last year's pattern.

* * * * *

MODELLING GROWTH IN SALMONIDS: FINAL PROGRESS REPORT

(by J. Malcolm Elliott, Institute of Freshwater Ecology, Windermere Laboratory)

A previous article in the Progress Report for June 1993 introduced a new research project supported by a grant for two years from the Atlantic Salmon Trust. The chief objective was to develop an improved mathematical model for predicting the growth of brown trout (including sea trout), especially in relation to varying water temperature. The earlier article introduced the concept of mathematical models and their importance in ecology, then described an earlier growth model developed in the early 1970's and summarized its chief weaknesses. A second article in the Progress Report for June 1994 described the new experimental methodology used to obtain a much larger data set on trout growth, then described the fitting and testing of the new model, and finally discussed differences between the old and new models and between the old and new data sets. The mathematical development of the model and its fitting to the large data set (individual growth rates for 185 trout) are described in detail in an article by Elliott, Hurley & Fryer (1995). The purpose of this final report is to show how the model can be used to solve real problems. All the data are from two brown trout populations; one a population of juvenile sea trout in Black Brows Beck and the other a population of resident trout above an impassable waterfall in Wilfin Beck, (for more information on both populations, see Elliott 1993, 1994).

Detecting growth retardation

It is clearly important to know if trout in the wild are growing at their maximum potential or are restricted in their growth by some external factor, shortage of food being the most obvious. Figure 1 provides an example for the freshwater stage of the life cycle of a sea trout population in Black Brows Beck. The average weight of the fry at the start of feeding was known from field samples and mean water temperature was estimated over periods of 15 days. These values were inserted into the model to provide a growth curve over the two-year period. The example is for only one year-class (fish hatching from the egg in 1967), but similar information is now available for over 25 year-classes. The trout were clearly not growing at their maximum potential (Curve A in Fig.1) and the discrepancy was chiefly due to a check in growth during the first, but not the second, winter of the life cycle. When this 1st-winter check was built into the model, there was good agreement between the predicted curve (Curve B) and the average weights of trout in samples taken by electrofishing (solid dots in Fig.1). Further analyses showed that fish weights in the second year of the life cycle were about 80% of the estimated values. When this was also built into the model, the latter was an excellent fit to growth data for all year classes.

Effect of fry size

The juvenile sea trout in Black Brows Beck are always larger than the resident trout of similar age in Wilfin Beck. Figure 2 shows that the growth model is an excellent fit to the average weights in both populations. Once again, an additional assumption built into the model was that growth ceased from the end of September to the beginning of March in the first, but not the second, year of the life cycle. The weight of the trout is on a log scale and shows the large difference in the initial weight of the fry in the two populations. The smaller fish in Wilfin Beck are growing as fast as they can, but simply never catch up with the larger juvenile sea trout in Black Brows Beck. Being large at the start of the life cycle is clearly a major advantage for the juvenile sea trout. The growth check in the first winter occurs in both populations. There is also a departure from the model for the adults in Wilfin Beck when their energy reserves are channelled into eggs and milt rather than growth.

The importance of fry size at the start of the life cycle became even more obvious when trout were reared from eggs obtained from both populations. Fish from the same year-class were reared in a hatchery under similar conditions and identical water temperatures. Figure 3 shows that in each year-class (eggs hatched in 1969 and 1974), larger fry were responsible for Black Brows trout always being larger than Wilfin Beck trout at similar stages in the life cycle. The cessation of growth in the first winter also occurred in the hatchery, and was not due to a shortage of food which was in excess, nor to low water temperatures that rarely fell below 4°C, the lower temperature limit for growth in trout. There was a noticeable loss of appetite during this period of growth cessation. A similar loss of appetite and cessation of growth can occur in juvenile Atlantic salmon reared in laboratory ponds. This application of the growth model for the hatchery trout strongly suggests that the winter cessation of growth in first-year trout in the wild is due, not to low temperatures or lack of food, but to loss of appetite. It is not known why appetite should decrease in the first winter of the life cycle, but not in subsequent winters.

Effect of environment

The model can also be used to compare growth in different year-classes from the same population and identify years when growth is exceptionally poor. For example, the 1970 year-class in Black Brows Beck is typical of the faster growing year-classes whereas the 1975 year-class exhibits the poor growth that is typical of year-classes affected by summer droughts. Figure 4 shows that the model predicts correctly the marked difference in growth rates with an estimated smolt weight of 43g in the good year-class and only 30g in the poor year-class (note that weight is on a log scale and therefore the differences for the older fish are greater than they appear to be on Fig. 4). From similar analyses, it has been possible to use the growth model to predict the length and weight of older trout on the 30 April, just before they leave the stream as smolts. Field samples in some years verified the accuracy of these predictions. Figure 5 (A) compares estimates of smolt length and weight for 22 year-classes. It can be seen that the fish were exceptionally small in the 1975, 1976, 1982 and 1983 year-classes. These were all year-classes affected by severe summer droughts in which stream temperatures were exceptionally high. As the growth model shows, high temperatures as well as low temperatures inhibit growth. Figure 5 (B) compares female mortality rates at sea with the estimated smolt weight in each year-class. It can be seen that mortality was exceptionally high in the year-classes affected by the droughts. Life at sea is obviously hazardous if you are a small smolt!

Such comparisons are useful because they show how the effects of an adverse environment in one year may be responsible for poor survival at a much later stage in the life cycle. For example, the fry at the start of the 1979 and 1980 year-classes were chiefly the progeny of females from the 1975 and 1976 year-classes. Female survival was low in both these year-classes, presumably because of the small size of the smolts (see Fig. 5), and therefore egg and fry production was poor. By the time these fish had become adults and returned from the sea, the drought of 1976 had been forgotten and any poor catches would be attributed to a variety of causes. We still know little about the delayed effects of poor years for growth and survival, but the development of predictive, realistic models will lead to a greater comprehension of these effects and reduce rather pointless speculation!

Fortune telling

All the previous examples show the use of the growth model with data that already exists. It can also be used to answer "What if .....?" questions. Figure 6 shows what would happen to the growth of Black Brows trout if there was an increase in water temperature due, for example, to climate change. The "normal curve" for the 1967 year-class in Black Brows Beck is compared with growth curves for rises of 2°C and 4°C. Smolt weight would be slightly below normal for -2°C but markedly less for +4°C. As shown earlier, the smaller size of the trout at the end of the summer would affect their survival. The increases in temperature could therefore lead to a reduction in numbers as well as growth rates.

The model can be used in similar fashion to test various scenarios such as warmer winters with cooler summers or vice-versa, and earlier emergence of fry because of milder winters. Although debates about climate change continue, temperature changes could be due to many causes such as the construction of a reservoir, water transfers between rivers, afforestation or deforestation. The development of the new growth model and similar models facilitates the prediction of the possible effects of such changes on the fish populations **before** the change occurs with irreversible damage.

Elliott, J.M. (1993). A 25-year study of production of juvenile sea-trout, *Salmo trutta,* in an English Lake District stream. Canadian Special Publication of Fisheries and Aquatic Sciences, 118: 109-122.

Elliott, J.M. (1994). *Quantitative Ecology and the Brown Trout.* Oxford University Press, Oxford. xi + 286 pp.

Elliott, J.M., Hurley, M.A. & Fryer, R.J. (1995). A new, improved growth model for brown trout, *Salmo trutta*. Functional Ecology, in press.

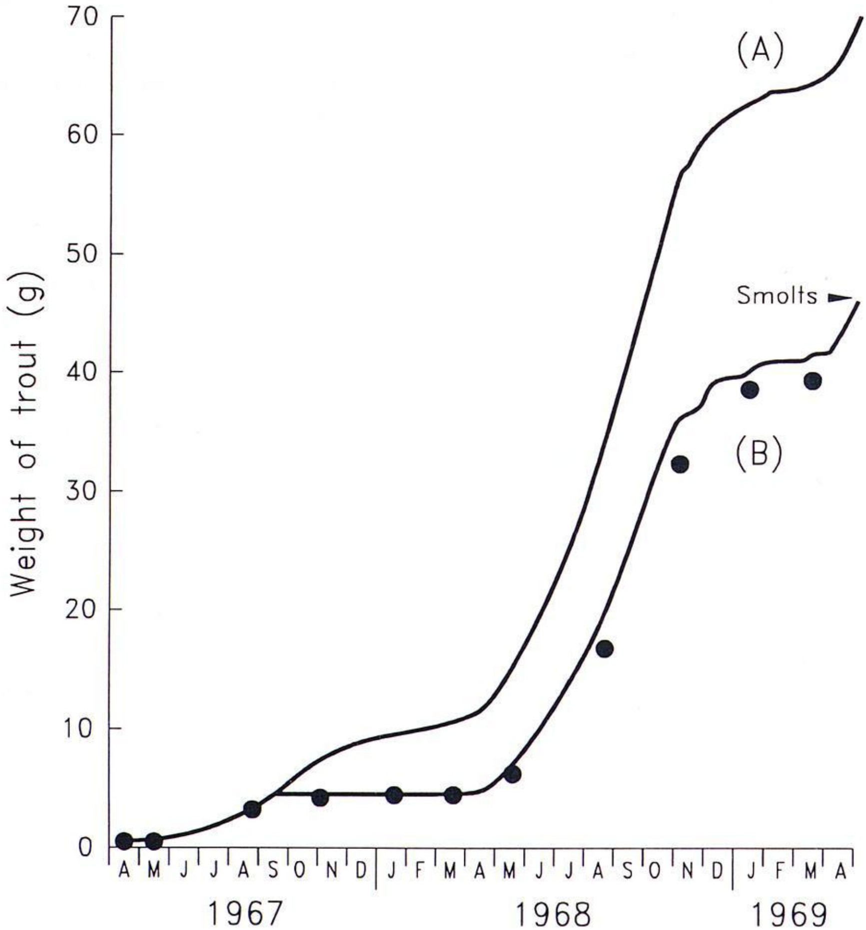


Fig. 1 Growth pattern for the 1967 year-class in Black Brows Beck: (A) No growth check in first winter; (B) with growth check; actual mean weights are shown as solid dots

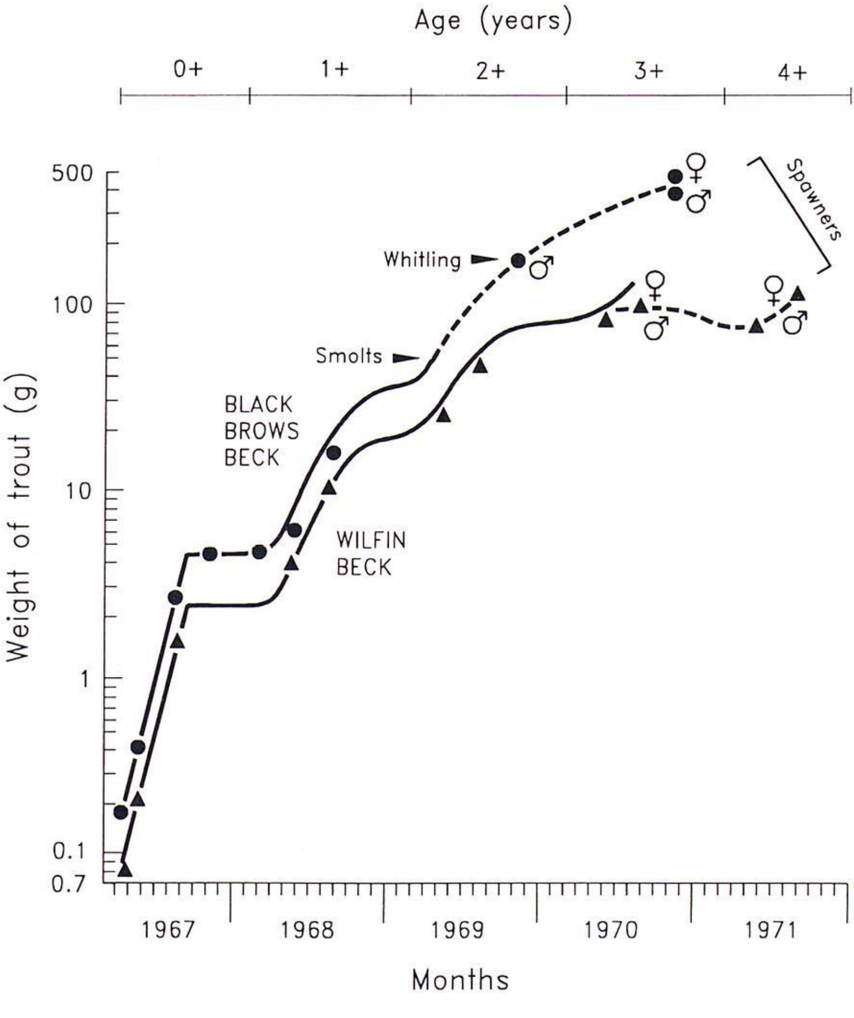


Fig. 2 Growth pattern for the 1967 year-classes in Wilfin Beck and Black Brows Beck (note that trout weight is on a logarithmic scale).

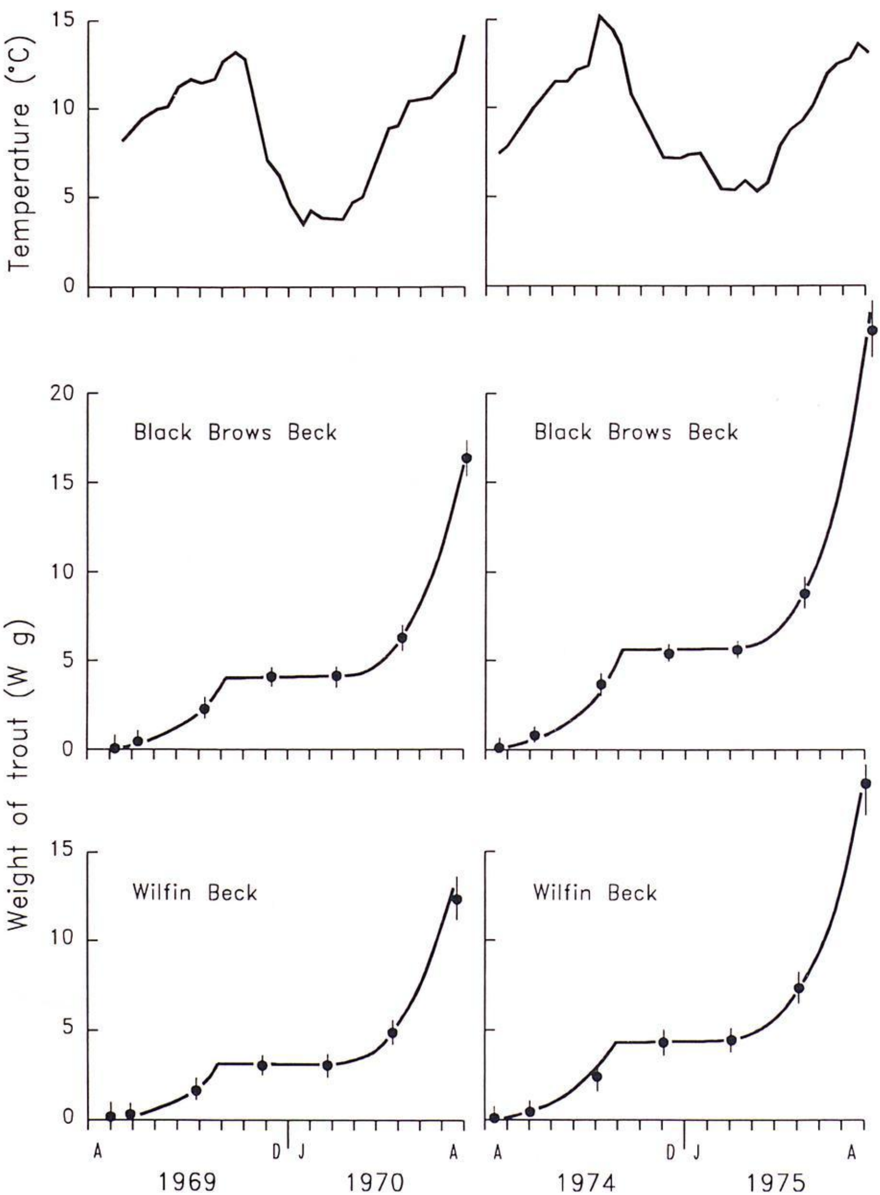


Fig. 3 Daily mean water temperatures (°C) in the rearing ponds and growth of trout reared from eggs belonging to the 1969 and 1974 year-classes from Wilfin Beck and Black Brows Beck.

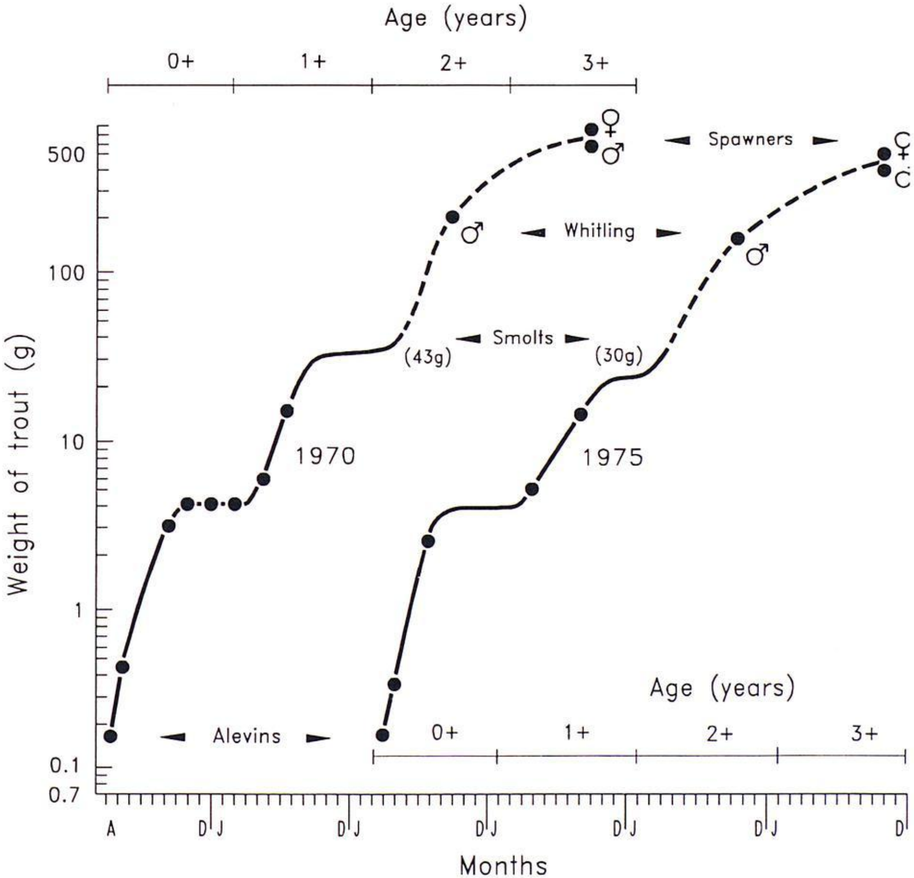


Fig.4 Growth pattern for the 1970 and 1975 year–classes in Black Brows Beck (note that trout weight is on a logarithmic scale).

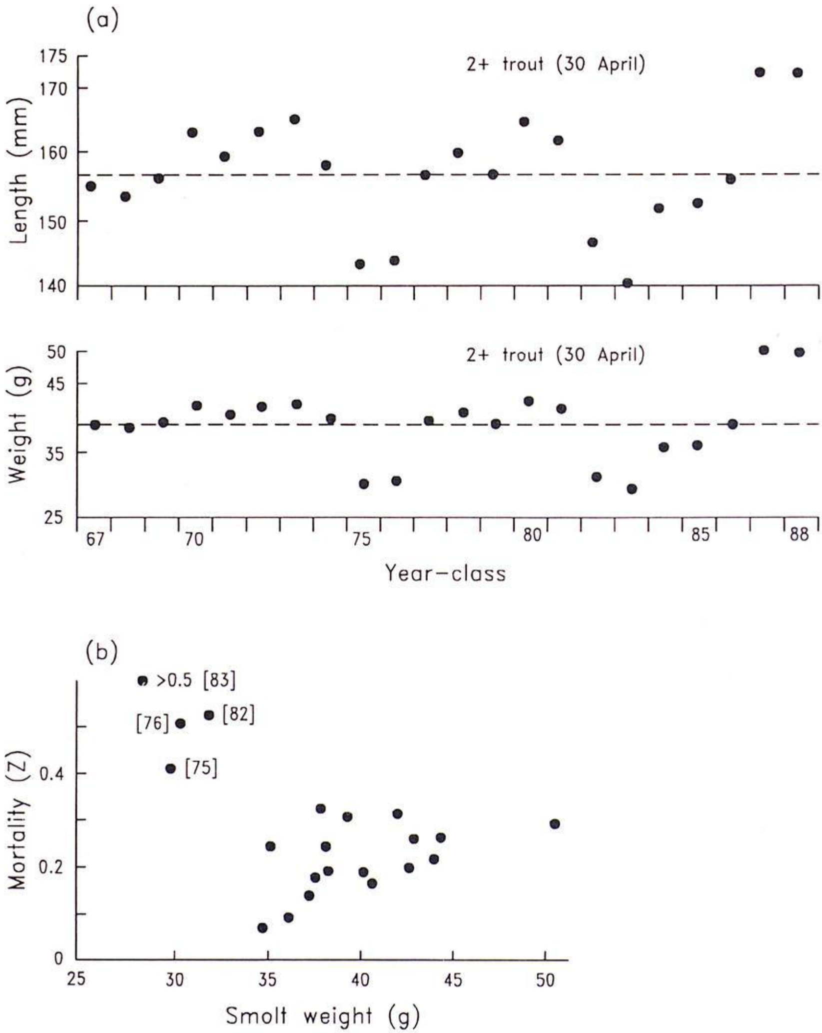


Fig.5(a) Estimated values for mean lengths and mean weights of older trout (aged 2+ years) on April 30 in each year-class in Black Brows Beck (horizontal lines are arithmetic means).

(b) Relationship between female mortality at sea (Z) and smolt weight in each year-class.

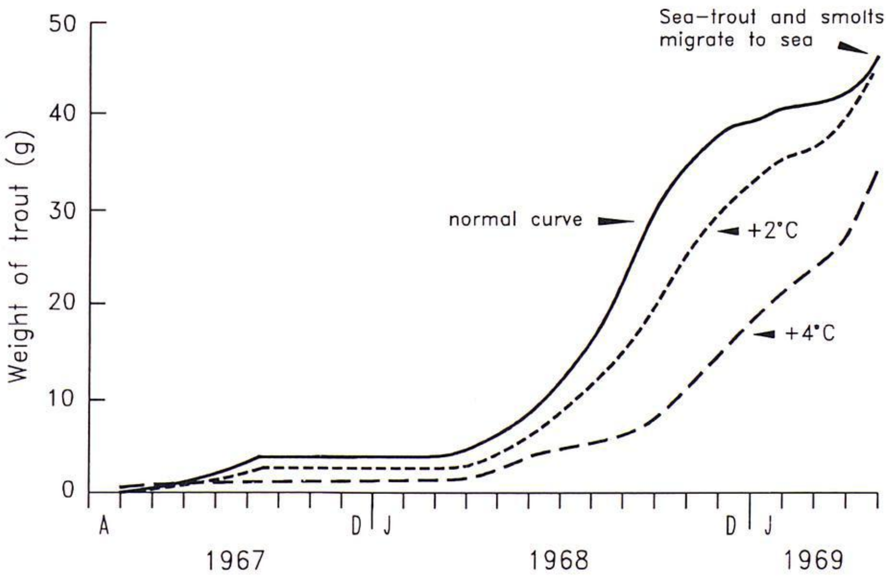


Fig. 6 The predicted effects of increased temperature (+2°C; +4°C) on the growth of brown trout.

REVIEW OF SCIENTIFIC LITERATURE ON SALMON

(by Dr. Derek Mills, Institute of Ecology and Resource Management, University of Edinburgh)

1. Juvenile Salmon

Redistribution of juvenile salmonid fishes after localized catastrophic depletion. J.D. Armstrong, P.E. Shackley & R. Gardiner. Journal of Fish Biology, 1994, 45, 1027-1039.

Juvenile Atlantic salmon and brown trout were depleted at three sites of a natural stream during the summer months of 1991 and 1992. Local population changes and movements of fish marked in sections adjacent to each depleted area were monitored thereafter. There was very little movement of marked salmon parr into the central regions of the depleted areas following the immediate post-marking period. Upstream movement by young-of-the-year fish from high density sections in mid-late summer was noted for trout but not salmon. Unmarked 1-year old salmon parr immigrated into depleted areas in June 1992, and the pattern of recolonisation was consistent with migration upstream from the adjoining river. It is concluded that resident salmon were very strongly site-attached and resource tracking was of no functional significance as a compensatory mortality mechanism. The occurrence of a long distance migratory component in the population during early-mid summer indicates that this, rather than local resource tracking, constitutes a potential compensatory mechanism.

Spatial and temporal distribution of fish in a small lowland stream. A. Ibbotson, P. Armitage, W. Beaumont, M. Ladle & S. Welton. Fisheries Management and Ecology. 1994, 1, 143-156.

The fish fauna and habitat characteristics in five reaches of a small lowland stream were studied through the summer and winter of one year. All species densities, except Atlantic salmon, were correlated with either instream or outstream cover, reaffirming the importance of cover to maintain the local abundance of fish populations.

2. Predation

Consumption of Atlantic salmon smolts and parr by goosanders: estimates from doubly-labelled water measurements of captive birds released on two Scottish rivers. M.J. Feltham. Journal of Fish Biology, 1995, 46, 273-81.

The field metabolic rates of 9 captive goosanders released on 2 Scottish rivers were estimated using the doubly-labelled water technique. The FMR of captives and dietary data from previous studies were used to estimate daily consumption of salmon smolts and parr by natural populations of these ducks on the river North Esk. Goosanders are likely to consume 480-522g of fish per day of which two-thirds are juvenile salmon: equivalent to a daily intake of 10-11 smolts and 48-52 parr. Annual predation of smolts by goosanders was estimated to be between 8000 and 15000 or 3 and 16% of annual production.

3. Movements

Influence of river flow on rod catch of Atlantic salmon, Salmo salar L., from the lower River Derwent, north-east England. M.W. Aprahamian & M. Ball. Fisheries Management and Ecology, 1995, 2, 1:75-86.

Twenty seven years of daily salmon rod catch and flow data from the River Derwent were analysed. Daily catch was standardised for each month between June and October and the mean value determined for each 2-cumec flow band. In June and July the mean standardised catch remained relatively low and stable for flows up to approximately 9 cumecs. Thereafter it increased steadily with increasing flow, reaching a peak at 21 cumecs and 41 cumecs for each month respectively. A linear model accounted for the greatest proportion of the variability in August and September with mean standardised catch increasing steadily up to a maximum value of 43 and 39 cumecs respectively. However, in October, a quadratic model was more appropriate, with mean standardised catch decreasing as flow increased up to 9 cumecs and thereafter increasing steadily with flow, reaching a maximum value at 21 cumecs.

Relationship between river flow and entry to the Aberdeenshire Dee by returning adult Atlantic salmon. G.W. Smith, I.P. Smith & S.M. Armstrong. Journal of Fish Biology. 1994, 45, 953-60.

One hundred and nine returning adult salmon were radio-tagged in the estuary of the Aberdeenshire Dee between February and August 1985 to 1989 and the times when 62 fish entered the river were recorded. Elapsed times between tagging and river entry were significantly greater during periods of lower than average river flows in all months where there were sufficient data to allow statistical comparison. The degree of association between river entry and particular levels of discharge rate varied seasonally. The proportion of days associated with river entry declined at the lower end of the range of flows available to tagged fish in the summer months. Absolute levels of river discharge played a significant role in modifying the response of salmon to changing flows. During periods of lower than average seasonal flow, river entry was closely associated with days when flow had increased since the previous day. During periods of higher than average flow, river entry was not significantly associated with such periods of increased flow. The results suggest that models which relate river entry by salmon to absolute river discharge rates alone are unlikely to be generally reliable.

Migratory behaviour of wild and farmed Atlantic salmon (Salmo salar) during spawning.
F. Okland, T.G. Heggberget & B. Jonsson. Journal of Fish Biology. 1995, 46, 1-7.

Migratory behaviour at spawning of wild and newly-escaped farmed Atlantic salmon was analysed by radio telemetry in the River Alta. Spawning areas were located by aerial surveys. Farmed females moved significantly more than wild females. There was no such difference between the two groups of males. About 83% of the wild fish stayed within identified areas for 1 day or longer. The corresponding figure for farmed salmon was only 43%. Wild salmon stayed 8.1 days inside spawning areas and farmed salmon 5.2 days. The present results suggest that escaped farmed salmon had reduced spawning success compared with wild fish.

4. Ocean life

Environmental continuity in fluctuation of fish stocks in the North Atlantic Ocean; with reference to Atlantic salmon stocks. T. Antonsson, G. Gudbergsson & S. Gudjonsson. International Council for the Exploration of the Sea. C.M. 1994. M:20.

Large masses of cold, low salinity water, or warm, high salinity water move with ocean currents in the North Atlantic Ocean, drastically changing the condition for the biota. Fish stocks are also affected. Oceanic conditions in the Barents sea seem to occur in the Iceland Sea 2 to 3 years later. Sea temperatures in these areas show similar fluctuations with a 2 and 3 year time lag. Atlantic salmon stocks in rivers in north Iceland show similar fluctuations in abundance as salmon stocks in the Kola Peninsula 2 to 3 years earlier. Correlation coefficients of salmon stock size in 3 rivers in the Kola Peninsula and the salmon catch in 3 rivers in north Iceland were highly significant. Similar trends can be observed in the recruitment of cod and the catch of capelin and the catch of cod in these distant areas. It is suggested that fish stocks in other areas in the North Atlantic show similar fluctuations in abundance with time difference based on the rate of movement of the ocean currents.

Timing of the Baltic salmon run in the Gulf of Bothnia - influence of environmental factors on annual variation. L. Karlsson, O. Karlstrom & T. Hasselborg. International Council for the Exploration of the Sea. C.M. 1994. M:17.

Salmon spawners arrive in the Gulf of Bothnia from their feeding areas in the main Baltic from May-August. Three-year old salmon were taken about 14 days earlier than two-year old fish which, in their turn, started 14 days earlier than grilse. In a comparison of two catch series from 1973-92, wild salmon were on average caught 8.1 days earlier than reared fish. Both reared and wild stocks showed a good correlation between the timing of their run and surface temperatures in the main basin of the Baltic in March and April, whereas the correlation with temperatures in the Gulf of Bothnia was lower. The strong correlation with temperatures in the main basin feeding area probably reflect the influence of water temperatures on the rate at which salmon become physiologically prepared for the spawning migration.

5. Genetics

Application of low frequency genetic marking at GPI-3* and MDH-B1,2* loci to assess supplementary stocking of Atlantic salmon, Salmo salar L., in a northern Irish stream. W.W. Crozier & I.J. Moffett. Fisheries Management and Ecology. 1995, 2, 27-36.

At the River Bush salmon station in Northern Ireland, a genetically marked strain of Atlantic salmon was established with a low frequency of a glucose-6-phosphate isomerase genotype (GP-3*100/93). As part of a salmon enhancement programme, 43,500 of these fish were stocked as swim-up fry into a tributary of the nearby Margy River in spring 1990, following a baseline genetic survey which indicated an absence of the GP-3*93 allele in the wild population. This survey also indicated a significant frequency difference of a malate dehydrogenase allele (MDH-B1,2*85) present both in the stocked and wild fish. A post-stocking electrofishing survey in summer 1990 indicated high summerling densities in stocked sections compared with unstocked (control) sections, with an estimated survival of stocked fry to summerling ranging from 24% to 29%.

Genetic variability in susceptibility of Atlantic Salmon, Salmo salar L., to furunculosis, BKD and cold water vibriosis. J. Gjedrem & H.M. Gjoen. Aquaculture Research. 1995, 26,2, 129-134.

Genetic variation in susceptibility of Atlantic salmon to furunculosis, bacterial kidney disease (BKD) and cold water vibriosis was studied by challenge testing one-year old fingerlings. Fish from 81 full-sib families within 32 sire progeny groups were infected with furunculosis, bacterial kidney disease and cold water vibriosis. Estimated heritabilities were relatively low, being highest for BKD and lowest for cold water vibriosis. Genetic correlations between the ability to survive the disease were all positive. The application of selection to develop resistant populations is advocated.

6. Salmon farming

Content of synthetic astaxanthin in escaped farmed Atlantic salmon, Salmo salar L., ascending Norwegian rivers. H. Lura * F. Okland. Fisheries Management and Ecology. 1994, 1,3, 205-216.

Isomeric ratios of astaxanthin in eggs and alevins of Atlantic salmon have proven useful in identifying female spawners of farmed origin, but the method underestimates the proportion of fish of farmed origin. The rate of underestimation was studied by analysing astaxanthin content in tissue of 55 farmed salmon ascending two Norwegian rivers. The astaxanthin content fell into two distinct classes. Fifty-one percent of the escaped adult salmon had isomeric ratios similar to salmon fed synthetic astaxanthin, whereas all the remaining fish had ratios similar to wild fish. The observed isomeric ratios of astaxanthin in the escaped farmed salmon and the relationship with morphology indicates that a significant proportion of the escapees ascending rivers have spent more than 1 year in the wild after escape.

7. Sea trout

Artificial reconditioning of wild sea trout, Salmo trutta L., as an enhancement option: initial results on growth and spawning success. W.R. Poole, M.G. Dillane & K.F. Whelan. Fisheries Management and Ecology. 1994, 1,3, 179-192.

Wild sea trout kelts were successfully reconditioned in brackish water using semi-moist pellets and a commercial broodstock diet. The on-growing of wild sea trout smolts was not so successful. Natural mortality was 12.9%, and 36.1% of the fish failed to adapt to the artificial diets: 82% of these were smolts. At the end of the first year, 36 females and 26 males matured: 34 females, with a mean fork-length of 33.2cm, were stripped yielding 22,860 eggs at a mean rate of 682 eggs per female. The survival of green to eyed eggs was 90-98%, and survival from green eggs to hatched alevins was 95%.

Sea Trout Stocks in England and Wales. D.J. Solomon. R&D Report 25, NRA. 1995. 102pp.

Copies of this most informative report are available from : Foundation for Water Research, Allen House, The Listons, Liston Road, Marlow, Bucks SL7 1FD at £10.00.

* * * * *

DEED OF COVENANT

TO THE ATLANTIC SALMON TRUST LIMITED

(Registered Charity No. 252742)

I promise to pay you for ...... years, or during my lifetime, if shorter, such a sum as after deduction of income tax at the basic rate amounts to £....... each month/quarter/half year/year from the date shown below.

Signed and delivered ....

Date ....

Full Name (**BLOCK CAPITALS**) ....

Address (**BLOCK CAPITALS**) ....

.... Post Code ....

Witnessed by:

Signed ....

Full Name ....

Address ....

.... Post Code ....

THE ATLANTIC SALMON TRUST LIMITED

BANKER'S ORDER

Subscriber's Bank

To .... Bank plc

Branch Address ....

....

.... Post Code ....

Please pay to BANK of SCOTLAND, 76 Atholl Road, Pitlochry PH16 5BW (80-09-41) for the credit of THE ATLANTIC SALMON TRUST LIMITED, account No. 00890858 the sum of £ ..... (............. pounds) on the (i) .... day of .... 19... and a like amount on the same day each (ii) month/quarter/half year/year for a total period of (iii) ..... years. Total number of payments ....

Signed .... Date .... 19...

Name (**BLOCK CAPITALS**) .... A/C No. ....

Address (**BLOCK CAPITALS**) ....

.... Post Code ....

(i) This date must be the same as or later than the date on which the covenant is signed.

(ii) Please delete as appropriate.

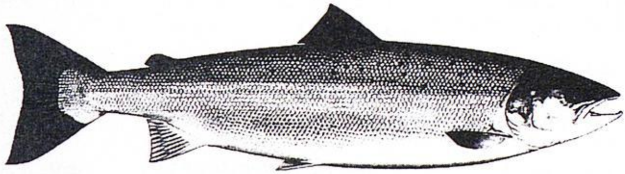
(iii) Insert number of years (minimum four years).

PLEASE RETURN THIS DOCUMENT TO THE ATLANTIC SALMON TRUST, MOULIN, PITLOCHRY, PERTHSHIRE PH16 5JQ

SALMON *a fisherman's guide* RECOGNITION

FRESH RUN SALMON

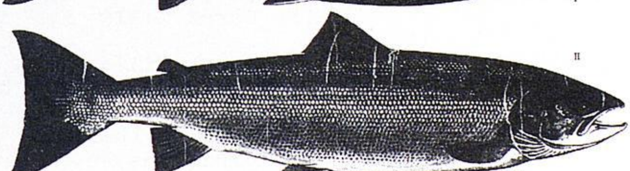
Recognised by the pristine condition and bright silver flanks. Fish straight from salt water have loose, easily detached scales and many carry sea lice which drop off within a few days. Hen salmon (illustrated) have a tiny kype on the lower jaw but unlike cocks they retain normal head proportions while in the river. Fresh run salmon make the best eating.



KELT

Kelts are salmon which have spawned. Usually identified by the thin shape, distended vent and presence of "gill maggots" on the red gill filaments, they are often encountered by anglers in spring when they regain a silvery appearance and can be mistaken for fresh run Springers. Kelts must be returned unharmed to the water.

I



II

MATURING COCK & HEN

I. Cock. Recognised by the enlarged jaws, cocks often become coloured soon after leaving salt water. This one shows typical appearance after a few weeks in fresh or brackish water; some are more reddish, others less so but all will have the partially developed kype. At this stage cocks are still good to eat.

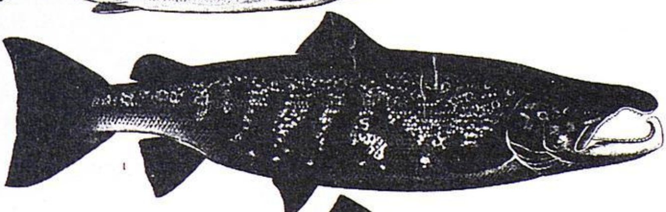
II. Hen. These are usually less coloured than cocks of similar river age and they never have enlarged jaws. This one will have spent a few weeks in river or estuary – note the coloured head and lack of true silver flanks. Hens should not be killed on the basis of colour alone – autumn fish are closest to spawning regardless of colour. For conservation purposes hens are the most important.

COCK & HEN IN BREEDING DRESS

I. Cock. The combination of "tartan" colours is typical although shades vary – the fully developed kype, used in fighting rivals, is the most consistent indicator of maturity. Condition can be gauged by viewing from above (fig.1) – if the back is still thick a fish is in better condition (and more likely to be edible) than a thin "kipper" which, unless it is a first salmon, is better returned.

Fig 1.

II. Hen. This is a summer fish – Springers are often darker by spawning time while late entrants may still be silver flanked. Fully mature hens have soft, swollen bellies and spawning is imminent if they also have protruding vents.



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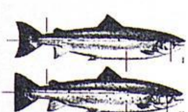
ROBIN ADE · 94



I

II

SALMON & SEA TROUT

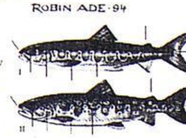
Salmon (I) can be distinguished from large Sea Trout (II) by a more streamlined shape, concave tail, slimmer tail wrist, upper jaw reaching no further than rear of eye, few if any black spots below lateral line, 10 to 15 (usually 11-13) scales counted obliquely forward from adipose fin to lateral line - trout have 13-16.

GRILSE & SALMON

Grilse or one sea winter salmon, which comprise most of the annual rod catch, are often indistinguishable from multi sea winter salmon except by scale reading. They are smaller on average (2-3lb. in May, 5-7lb. in July) but grilse entering rivers in September often attain 8-10lb. and in October 12-15lb. Salmon usually weigh over 8lb. Most are 2SW fish; these returning in spring average 8-10lb., in summer 12-14lb., in autumn 16-18lb. Salmon tend to double in weight during each full growing period (May - Oct) spent at sea.

SALMON & TROUT PARR

Salmon Parr (I) can normally be distinguished from young Brown/Sea Trout (II) by the more streamlined shape, deeply forked tail, longer pectoral fin, lack of orange on adipose fin, smaller mouth, sharper snout, only 1-4 spots on gill cover (often one large spot), well defined parr marks.



I

II

ATLANTIC SALMON TRUST PUBLICATIONS

Atlantic Salmon: Planning for the Future (Proceedings of the 3rd International Atlantic Salmon Symposium, Biarritz, 1986)	edited by D. Mills and D. Piggins	£ 45.00
The Biology of the Sea Trout (Summary of a Symposium held at Plas Menai, 24-26 October, 1984)	by E.D. Le Cren	1.50
Salmon Stocks: A Genetic Perspective	by N.P. Wilkins	1.50
Report of a Workshop on Salmon Stock Enhancement	by E.D. Le Cren	1.50
Salmonid Enhancement in North America	by D.J. Solomon	2.00
Salmon in Iceland	by Thor Gudjonsson and Derek Mills	1.00
A Report on a Visit to the Faroes	by Derek Mills and Noel Smart	1.00
Problems and Solutions in the Management of Open Seas Fisheries for Atlantic Salmon	by Derek Mills	1.00
Atlantic Salmon Facts	by Derek Mills and Gerald Hadoke	0.50
The Atlantic Salmon in Spain	by C.G. de Leaniz, Tony Hawkins, David Hay and J.J. Martinez	2.50
Salmon in Norway	by L. Hansen and G. Bielby	2.00
Water Quality for Salmon and Trout	by John Solbé	2.50
The Automatic Counter - A Tool for the Management of Salmon Fisheries (Report of a Workshop held at Montrose, 15-16 September, 1987)	by A. Holden	1.50
A Review of Irish Salmon and Salmon Fisheries	by K. Vickers	1.50
Water Schemes - Safeguarding of Fisheries (Report of Lancaster Workshop)	by J. Gregory	2.50

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Genetics and the Management of the Atlantic Salmon	by T. Cross	2.50
Fish Movement in Relation to Freshwater Flow and Quality	by N.J. Milner	2.50
Acidification of Freshwaters: The Threat and its Mitigation	by R. North	3.00
Strategies for the Rehabilitation of Salmon Rivers (Proceedings of a Joint Conference held at the Linnean Society in November 1990)	by D. Mills	5.00
Salmon Fisheries in Scotland	by R. Williamson	3.00
The Measurement and Evaluation of the Exploitation of Atlantic Salmon	by D.J. Solomon and E.C.E. Potter	3.00
Salmon in the Sea and New Enhancement Strategies (Proceedings of the 4th International Atlantic Salmon Symposium, St. Andrews, New Brunswick, June 1992)	edited by D. H. Mills	30.00
Surveying and Tracking Salmon in the Sea	by E.C.E. Potter and A. Moore	3.00
Problems with Sea Trout & Salmon in the Western Highlands	edited by R.G.J. Shelton	3.00
Automatic Salmon Counting Techniques - A Contemporary Review	by G.A. Fewings	3.50
Salmon in the Dee Catchment: The Scientific Basis for Managment (Proceedings of a one day meeting held at Glen Tanar House, 13 October 1994)	by A. Youngson	3.50

FILMS AND VIDEO CASSETTES AVAILABLE FOR HIRE

"Will There Be a Salmon Tomorrow"	- 16 mm film
"Salar's Last Leap"	- 16 mm film
"The Salmon People"	- Video (VHS)
"Irish Salmon Harvest"	- Video (VHS)
"Managing Ireland's Salmon"	- Video (VHS)
"Salmon Tracking in the River Dee"	- Video (VHS)
"Salmon Kelt Reconditioning"	- Video (VHS)

Films and videos may be obtained from the Trust for private showing by Clubs, Fishery Managers, etc. A donation to AST funds is required in return.