



# LEAP OF FAITH

PHOTOGRAPHY: KEITH RINGLAND/[WWW.RINGLANDLIFEIMAGES.CO.UK](http://WWW.RINGLANDLIFEIMAGES.CO.UK); DAVID HAY; DEIRDRE BRENNAN; ASFB; LAURIE CAMPBELL

WILD ATLANTIC SALMON MAY SEEM ABUNDANT IN SCOTTISH RIVERS, BUT THIS MAJESTIC FISH FACES UNKNOWN PERILS AT SEA THAT COULD THREATEN THE COMPOSITION OF OUR SALMON STOCKS. **IDA MASPERO** REPORTS

**O**N A MISTY AUTUMN AFTERNOON, wrapped up against the season's advancing chill, we're gazing at a stretch of the River Ettrick where it gushes over a weir. Then, in a calm pool below the white-water rush, there's a swirl, a splash and a glimpse of tail ... just a hint of the powerful beast below, gearing up for action. Seconds later, from the standing wave of white water beneath the weir, a lithe form breaks free, leaping and landing in the heart of the flow.

With mighty thrusts of its entire body, the fish battles and squirms upward, slithering at a

seemingly impossible angle, exuding an almost electric aura of energy. But before long it loses its hold, slips down and disappears into the froth again. For half an hour we watch, entranced and astonished, as fish after fish attempts to scale the weir in this dramatic fashion. We cannot help but cheer them on, applauding their displays of raw energy and instinctive determination. As we leave, we wonder just how many found the fish ladder and made it into the river beyond.

The power and courage displayed by Atlantic salmon during their upstream migration has long filled humans with awe. The fish is a Celtic **▶**



**D** symbol of wisdom, strength and resilience. Evidence of the Picts' reverence for the Atlantic salmon can still be seen today – standing stones bearing unmistakable, anatomically accurate outlines of the king of fish (a good example stands in the manse garden at Glamis in Angus). To the people of this land, salmon mysteriously reappeared every year, providing a precious protein bounty seemingly from nowhere.

These people had no idea where the fish came from – or where they went when not in the river – but until very recently, their great migration provided sustenance for coastal communities around Scotland. Today, however, traditional netting practices have largely ceased and the demand for wild-caught salmon has all but disappeared with the advent of fish farming. Now, the wild Atlantic salmon is more sporting quarry – its bounty financial rather than food – with anglers coming from all over the world to experience Scotland's legendary salmon rivers.

But the ancient mythical significance of this heroic fish remains, as even today's city-dwelling Britons seem to value and respect it. "We know from studies that the fish has an iconic cultural status," says Dr Malcolm Windsor, Secretary of the North Atlantic Salmon Conservation Organisation (NASCO), based in Edinburgh. "The general public admire it and care about it in a way they don't about other fish."

As Windsor explains, a recent economic survey indicated that Londoners greatly value the Atlantic salmon and are willing to pay to have it restored to the Thames. It is seen as a symbol of purity and hope for the future, he says. "If salmon are in the Thames, the river must be clean and life can't be so bad. People are prepared to pay for salmon as indicators of the health of rivers."

It is little wonder that the salmon is sometimes referred to as the 'aquatic canary', he adds. "It is a sampler of both freshwater and marine environments, telling us something about the health of the rivers, the estuaries and the deep sea. What other sampling tool can do all that for you, and come back?"

**TO SEA AND BACK**

The spectacle of salmon leaping is all the more awe-inspiring considering what we now know about the complex life story of the species. Incredibly, the fish who put on this energetic display do not feed while making their way upstream to breed. Their last meal would most likely have been at sea, where they spent one or more years fattening up in the nutrient-rich North Atlantic before the first flush of sexual maturity drove them to return in search of the rivers of their birth. Once in fresh water, they may have spent weeks or months, perhaps even a year or more, languishing in quiet pools before a final dash upstream to their spawning grounds.

Here, in early winter, they will spawn at or near the very spot they themselves hatched. Adult salmon will attempt to fend off other adult males and sexually mature parr with their formidable kypes – or hooked jaws – as the females

Fishy business (clockwise from right): a typical fish farm; salmon alevin; different sized parr; angling on the River Don; enjoying the sport at Amnuinnsuidhe, Harris



“WE KNOW FROM STUDIES THAT THE FISH HAS AN ICONIC CULTURAL STATUS”

release massive numbers of bright orange eggs in gravel depressions, or redds.

The kelts – fish that have spawned – are weak and vulnerable. Utterly spent having competed for mate after mate, most males will not make it back to sea but will instead die in the river, their bodies ultimately bequeathing phosphates and other precious marine-harvested nutrients to the land.

Meanwhile, the early life of young fish – as alevins, fry and then parr – is fraught with danger. Massive numbers fall prey to birds and other fish, notably trout. After a few years of growth in freshwater, the surviving offspring, now known as smolt, leave the familiar surroundings of their natal stream and run the gauntlet downriver, into the estuary and then the open ocean. Once there, they instinctively navigate their way to rich feeding grounds in the Norwegian Sea. A few will remain there for several years, gorging on crustaceans and small fish, though most individuals, known as grilse, will make the long journey home after just one winter's feeding at sea.

Exactly how salmon navigate on the migration to and from their oceanic feeding grounds is not fully





understood, but it seems they use a combination of senses. In open water, they most likely use the earth's magnetic field (as pigeons do) which they sense via particles of magnetite – magnetic material – in their lateral lines. Once close inshore, they home in on their natal river by smell, eventually finding the right one after a bit of trial and error.

This extraordinary life cycle has allowed the salmon to live and breed in its current range since the end of the last Ice Age, some 10,000 years ago. "There are various life history pathways they can follow," explains Dr Richard Shelton, former Research Director at the Atlantic Salmon Trust and author of *To Sea and Back*. "Salmon procreation is a belt and braces business. Salmon of different ages and stages spawn together, and the upshot is that very few eggs are left unfertilised. Most eggs and young don't survive, nor do most spawning grilse, so the whole thing looks like a wasteful mess, but it's a successful strategy."

#### SPORTING CHANCE

This successful survival strategy means that salmon continue to provide valuable income for rural communities in Scotland. Since the advent of fish farming, the inshore netting operations that once dotted our coasts have all but disappeared. However, recreational angling is as popular as ever, with Scotland seen as the spiritual home of

salmon fishing – to such an extent that the image of a ghillie guiding his tweed-clad charge beside a glittering Highland river is as much a Scottish cliché as tartan and heilan' coos.

The cultural and economic significance of salmon in Scotland is huge, reckons Brian Davidson, Operations Director at the Association of Salmon Fisheries Boards (ASFB) – the representative body of Scotland's 41 District Salmon Fishery Boards. "According to a recent study commissioned by the Scottish Government, salmon angling is worth well over £100 million a year and the knock-on income is far greater," he says.

Salmon fishing is intrinsically linked with Scotland – to the point that it is widely considered to be the world's premier salmon angling destination. "This is because few countries offer the diversity of salmon fishing in terms of Scotland's wide range of seasonal runs, geography, landscape and the individual character of rivers," believes Davidson. "Also, very few countries have such a wide range of salmon habitats, from remote west coast streams to the impressively grand east coast rivers – and everything in between."

And with the decline in heavy industry, lowland rivers are generally in better health, with even the Clyde seeing the return of salmon. In recent years, much has also been achieved by carefully planned habitat improvements, including obstacle removal and riparian habitat **D**



**D** restoration. As Davidson says, “This is one area where the fisheries managers can make an active difference, and have been doing so.”

Though the key principle of salmon fisheries management remains much the same as in Victorian times – local, river by river management – the style has shifted significantly. Each river is still managed by fisheries boards, driven by the fishery owners who raise revenues among themselves and coordinate their actions. “The key difference these days is that we are much more reliant on good scientific data to inform management decisions,” explains Davidson.

Catch and release is now common practice, and enforced on most rivers for at least part of the season. This allows a river to generate an income – which funds a wide

“The numbers of salmon in the ocean have halved over the last 30 years, although the decline in returning spawners has been less marked because of marine fishery closures. Something is going wrong at sea,” asserts Malcolm Windsor at NASCO. “We have done everything else to ensure salmon survival. Twenty years ago, we believed the main threat to Atlantic salmon stocks was exploitation by distant-water interception fisheries that at their peak harvested around 3,000 tonnes or 30% of the total catch. That was the international problem facing NASCO at its inception in 1983. We have solved that one, gradually.”

Exploitation in the feeding grounds has now either ceased or been restricted to a subsistence harvest thanks to NASCO's inter-governmental convention to which all North Atlantic nations are party. In addition, coastal netting in Scotland and elsewhere has been greatly reduced, while salmon farming has taken the bottom out of demand for wild-caught Atlantic salmon. So, as Richard Shelton emphasises:

“The question is, with virtually all marine exploitation halted, why are we not seeing more salmon returning?”

Such concern is echoed by Scotland's fisheries boards, as Brian Davidson of ASFB explains: “Logic suggests we might expect to see a corresponding upward trend in rod catches now that there's much less netting. Yet the numbers of rod-caught salmon appear simply stable – there has not been the corresponding upturn.” In fact, he says, Scotland has seen a gradual but serious decline in rod catches of spring salmon – fish that enter rivers early in the year – since the 1960s.

But why would this decline in ‘springers’ over the last 40 years be a cause for alarm if overall abundance seems good? It's all about what they represent. “Spring-running salmon are invariably fish that have spent more than one season in the ocean,” explains Shelton. As such, their decline indicates that fewer fish are surviving multiple seasons at sea. “We're seeing not only fewer spring salmon, but fewer big salmon. A decline in the proportion of older fish in the population is a classic symptom of increased

“WITH THE DECLINE IN HEAVY INDUSTRY, LOWLAND RIVERS ARE GENERALLY IN BETTER HEALTH”

Eye to eye (clockwise from above): seen up close, salmon have a remarkable sheen; fishing on the Tweed; researchers bring in a trawl; counting salmon ova; a research scientist with an adult salmon

range of actions, including fishery law enforcement and habitat improvement – without over-exploiting stocks. Catch and release also sits well with the conservation-minded younger generation of anglers.

At present, from an angler's perspective, salmon stocks seem to be in reasonable shape in Scotland and numbers for recreational catches are stable; in fact, says Davidson, the numbers of catches recorded on some of our top salmon rivers, for example the Dee and Tweed, are looking particularly good this year. “Rod fishing is buoyant and figures for rod catches have been relatively steady over the last 40 years or so,” he notes.

LOST AT SEA

Of course, the statistics for rod catches in Scotland's rivers are not necessarily an accurate reflection of the overall health of the species. Speak to scientists and conservationists working with Atlantic salmon and the overwhelming feeling about the future of the species is one of concern.



total mortality rate. The reason you don't get so many big fish is that they are not surviving long enough at sea to grow large."

Exactly why this is happening is not understood, but the reasons are likely to be complex. "There have been huge changes in marine climate, especially in the southern and western sectors of the salmon's range, causing changes in the structure of the plankton which impacts on fish species," explains Shelton. Both he and NASCO's Malcolm Windsor also point to the possible problem of by-catch of salmon in large-scale pelagic fisheries targeting species such as mackerel and herring.

It is a mystery so deep and so pressing that NASCO launched a massive ocean-going research project, called SALSEA, in 2008. Using innovative trawl sampling, genetic techniques to determine the origin of fish sampled, sophisticated scale reading techniques to look at fine-scale growth patterns and acoustic tracking, SALSEA aims to improve understanding of migration and distribution of salmon at sea and the factors influencing them. Thousands of samples have been collected and work is now underway, in the final year of the project, to analyse and collate the data. SALSEA's conclusions will be unveiled in October 2011 at NASCO's Salmon Summit.

Windsor is hopeful that SALSEA will provide some clues as to the fate of salmon at sea. Either way, it is an exceptional show of international commitment and cooperation: "This multi-million pound project, involving a public/private partnership, could only have been staged as a multi-national effort," he points out. "No single country could afford it."

#### HOME HAZARDS

Whether or not the problems in its North Atlantic feeding grounds are man-made or not, the other known perils facing Scotland's stocks certainly are. Ironically, salmon farming, the industry which rescued wild stocks from continued commercial exploitation by providing a seemingly limitless supply of fresh salmon at affordable prices, is now viewed by experts as a serious threat to wild fish.

"At the time when there were worries about the 

#### SALMON SPEAK

The Atlantic salmon, *Salmo salar*, is anadromous, meaning it spends the majority of its life in the ocean, where it does most of its feeding and growing, and then migrates to freshwater to breed. It has various names depending on the stage in its life cycle:

- Alevin** – newly-hatched offspring still feeding off the remainder of its yolk sac
- Fry** – with fully developed gills and able to hunt, it starts venturing beyond the location where it hatched
- Parr** – the final freshwater stage before preparing to leave the river system of its birth
- Smolt** – the fish embarks on its ocean migration (having undergone the physiological changes necessary to live in a marine environment)
- Post-smolt** – the fish in its first season at sea
- Grilse** – a fish that returns to its home river to breed after just one winter feeding at sea
- Salmon** – strictly speaking, has spent multiple winters at sea (multi sea-winter fish). The breeding sexes are referred to as cock and hen
- Kelt** – the fish after spawning, before returning to the sea. Most male kelt will not make it back to sea



## CONSERVATION • ATLANTIC SALMON

**D** impact of high seas fisheries, the real breakthrough was the advent of fish farming,” explains Shelton. “But it has created other problems, one of the greatest being the enormous numbers of sea lice attracted by caged salmon. The clouds of lice larvae around the cages threaten post-smolt salmon as they head out to sea.”

This is a particular problem in the enclosed waters of sea lochs where water circulation is poorer. In Scotland, most fish farms have been located in the sea lochs of the west coast – a “sad legacy”, as Davidson puts it.

The other major concern around aquaculture is ‘genetic pollution’ by escapee fish. Because salmon home, they tend to form genetic sub-populations that are perfectly tuned and adapted to particular rivers or even sections of rivers. “The escapee farmed salmon – and they escape in enormous numbers – are not adapted in the same way, and risk polluting the gene pool of the wild, adapted fish,” says Shelton.

“The evidence we have from distinguished studies in Ireland is that farmed fish have an immediate advantage when breeding, because they are bigger,” adds Windsor. “But the hybrid offspring are not as fit. That means a decline in fitness of stock in a particular river, and gradually that population loses its unique genetic adaptation to its home river.” This, of course, could spell disaster.

But while the true impact of such genetic pollution is unclear, experts are unanimous in their view that fish farming, as currently practised in Scotland, does the wild fish no favours. To make it truly sustainable, sites well away from salmon rivers and sea lochs need to be chosen, the density of fish in cages reduced and escapee numbers brought down to zero.

“The industry’s voluntary codes of practice seem to indicate a superficial desire to address these problems, but in reality nowhere near enough is being done,” says Davidson, adding that organisations including ASFB are lobbying for greater enforcement. “Politically there are major hurdles to overcome. Our parliamentarians on the whole largely view aquaculture as a benign income generator and job provider for rural coastal communities, but fail to see the immense ecological damage the industry has perpetrated on our West Coast stocks.”

The drive for green energy may also pose a hazard to salmon, say both Davidson and Shelton. “Large- and small-scale hydro schemes, and wind farms, are being heavily promoted by the Scottish Government – and



understandably so,” says Davidson. “But they do present challenges in terms of ecological impacts on our salmon and freshwater fish populations.”

Small-scale community hydro projects, in particular, are at risk of not properly assessing and mitigating their effect on fish. Fisheries boards and trusts continue to raise awareness of these issues to ensure enough resources are allocated to freshwater ecology in these schemes, says Davidson.

But, ultimately, as Richard Shelton emphasises, concerns relating to aquaculture and green energy development can be tackled, as can that of mackerel by-catch. After all, these problems are all known. In contrast, the precise reasons why Atlantic salmon are lost at sea – simply not surviving in their ocean environment as they should – remains a puzzle that has yet to be solved. Until then, the future of this majestic species is far from certain. ■

Close inspection: taking samples of a post smolt (top); a diseased salmon (above)

## ESSENTIALS

### Salmon leaps

Though salmon running in Scotland’s rivers is not restricted to autumn, September to November is the prime time for watching salmon leaping up waterfalls, weirs and other obstacles. They are particularly active after heavy rain – especially when this follows a dry spell when the river levels have been low.

### Buchanty Spout

On the River Almond near Crieff. Here you can get very close to the action.

### The Hermitage, Dunkeld

A popular woodland walk beside the River Braan, just outside Dunkeld.

### Falls of Shin, near Lairg, Sutherland

Visitor Centre and viewing platform.  
[www.fallsofshin.co.uk](http://www.fallsofshin.co.uk)

### Falls of Feugh, Banchory

A short walk from the town centre, the bridge at the falls is a popular spot for watching leaping salmon.

### Philippaugh Estate, near Selkirk

A weir with fish ladder on the River Ettrick in the Borders. Live webcam, underwater cams and fish counter. [www.salmonviewingcentre.com](http://www.salmonviewingcentre.com)

### Pitlochry fish ladder

Fish ladder at the Pitlochry Dam, with glass-panelled observation chamber and fish counter.

## FURTHER INFO

Association of Salmon and Fisheries Boards  
[www.asfb.org.uk](http://www.asfb.org.uk)

Atlantic Salmon Trust  
[www.atlanticsalmontrust.org](http://www.atlanticsalmontrust.org)

SALSEA Project  
[www.salmonatsea.com](http://www.salmonatsea.com)

North Atlantic Salmon Conservation Organisation (NASCO)  
[www.nasco.int](http://www.nasco.int)

*To Sea and Back – the Heroic Life of the Atlantic Salmon*, Richard Shelton, Atlantic Books, 2009