£6

ATLANTIC SALMON TRUST

SEA TROUT FACTS

River Avon, tributary of the river Spey

Pictures throughout this publication are courtesy of CKD Galbraith Sporting Lets Department

INTRODUCTION TO SEA TROUT FACTS

by Tony Andrews, Executive Director of the Atlantic Salmon Trust

Sea Trout Facts is the first of the AST's new style 'Blue Books'.

We have received widespread support for its publication, usually accompanied by the comment that it is long overdue. We are fortunate that Dr Andy Walker, recently employed by Fisheries Research Services at Faskally, has been available to write the text. Many will know of Andy's lifelong interest in trout and the deserved recognition he has as one of the country's leading experts in the field.

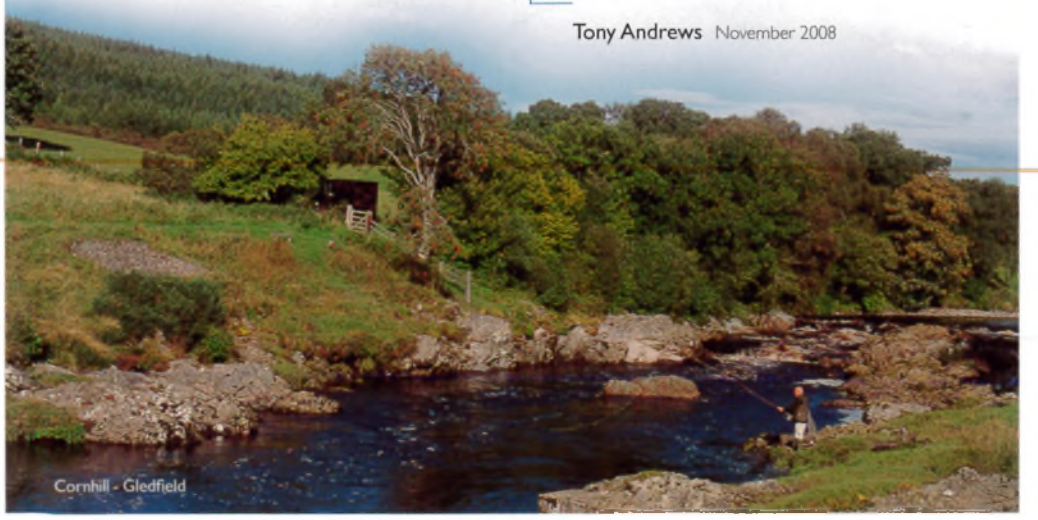
There are some species of wild animal that, above others, catch the imagination of country-minded people. Among them are the woodcock, the roe deer and the sea trout. These are all genuinely wild, migratory or itinerant, indigenous, and often at their most active at dusk. As the hunter's quarry species, they evoke a feeling of mystery and anticipation, connecting us spiritually with our hunter-gatherer ancestors. They are the creatures of our rural landscapes, for which we have a direct responsibility.

The sea trout is the ancestor of the native brown trout *Salmo trutta* L. It was the sea trout that led the colonisation of our rivers as the ice retreated ten thousand years ago. These mysterious and polymorphic fish continue to appear in the pools of our rivers suddenly and magically in the summer months, sadly in diminishing numbers.

It is now recognised that sea trout are in trouble in most, but not all, river systems in the United Kingdom and Ireland. Our knowledge of the lives of sea trout is limited, especially at sea, which reinforces our concern that public awareness of the plight of these fish is poor. In some areas scientists have identified specific problems, such as the recent research at Shieldaig in Wester Ross, which has revealed the catastrophic impact of aquaculture-generated sea lice on sea trout populations. But generally, throughout all our river catchments, we lack an understanding of what now needs to be done to restore stocks to the levels we saw in the 1980s.

The proceeds from donations made for this Blue Book will go directly to studying aspects of the life cycle of sea trout. The ultimate purpose of the Atlantic Salmon Trust is to provide the most up to date information available to everyone concerned with the care of our wild salmonid resources, so that standards of management can be improved and more salmon and sea trout made available for the enjoyment of all.

Tony Andrews November 2008



Cornhill - Gledfield

SEA TROUT FACTS

Q What is a sea trout?

A The sea trout is the anadromous (sea-going) form of the European brown trout (Salmo trutta. L.). It is native to western Europe from northern Portugal to the White Sea and Cheshkaya Gulf, Iceland and the Baltic Sea and has been established relatively successfully in eastern North America, but more so in the Southern Hemisphere, in Patagonia and the Falkland Islands, New Zealand and Australia/Tasmania.

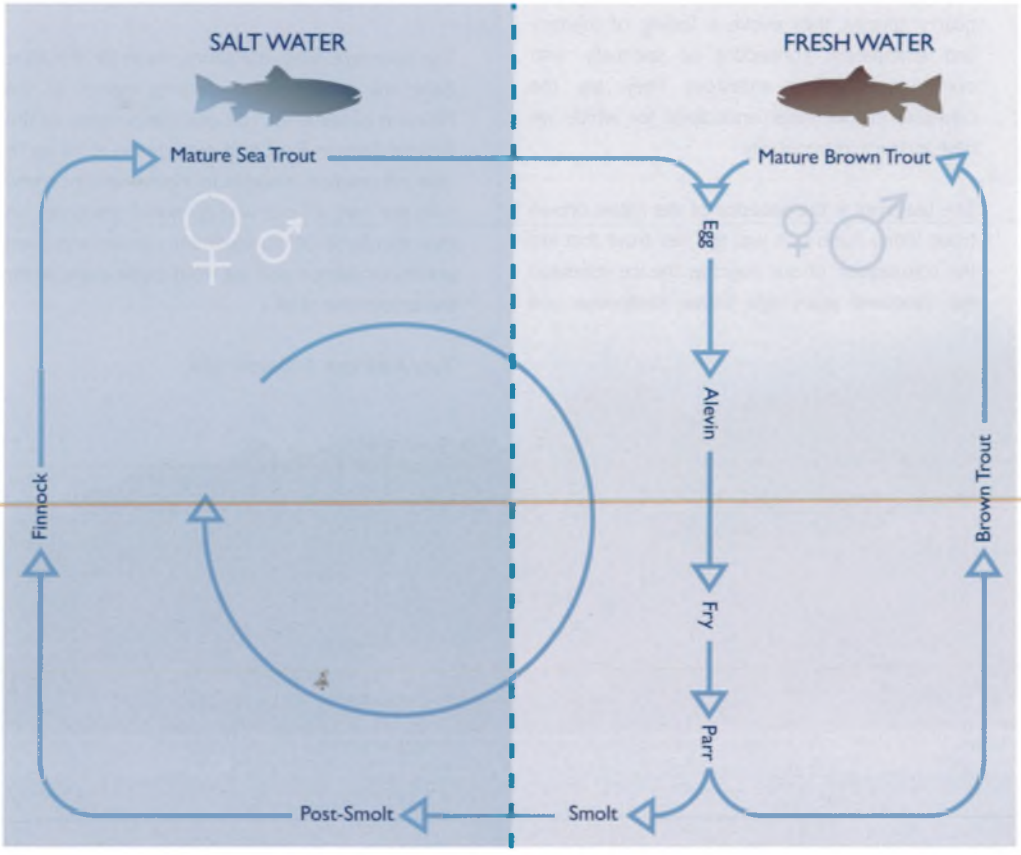
Q How far do sea trout migrate in saltwater?

A Sea trout are coastal migrants with marine dispersal patterns extending from close to natal river mouths to hundreds of kilometres.

Q How closely do sea trout relate to brown trout which remain in fresh water?

A The broad species that we call brown trout occurs in a wide range of forms differing in average size, in colouration and spot pattern, diet and migratory behaviour. Some live only in streams; others migrate to find better space and feeding in lakes or larger rivers, in estuaries, or in the sea. Sea trout become silvery smolts before or during migration to sea, but so do some strains of brown trout that migrate only as far as shallow freshwater lakes, for instance Loch Leven, Kinross-shire, in Scotland.

Generalised life cycle of mixed sea trout and brown trout populations.



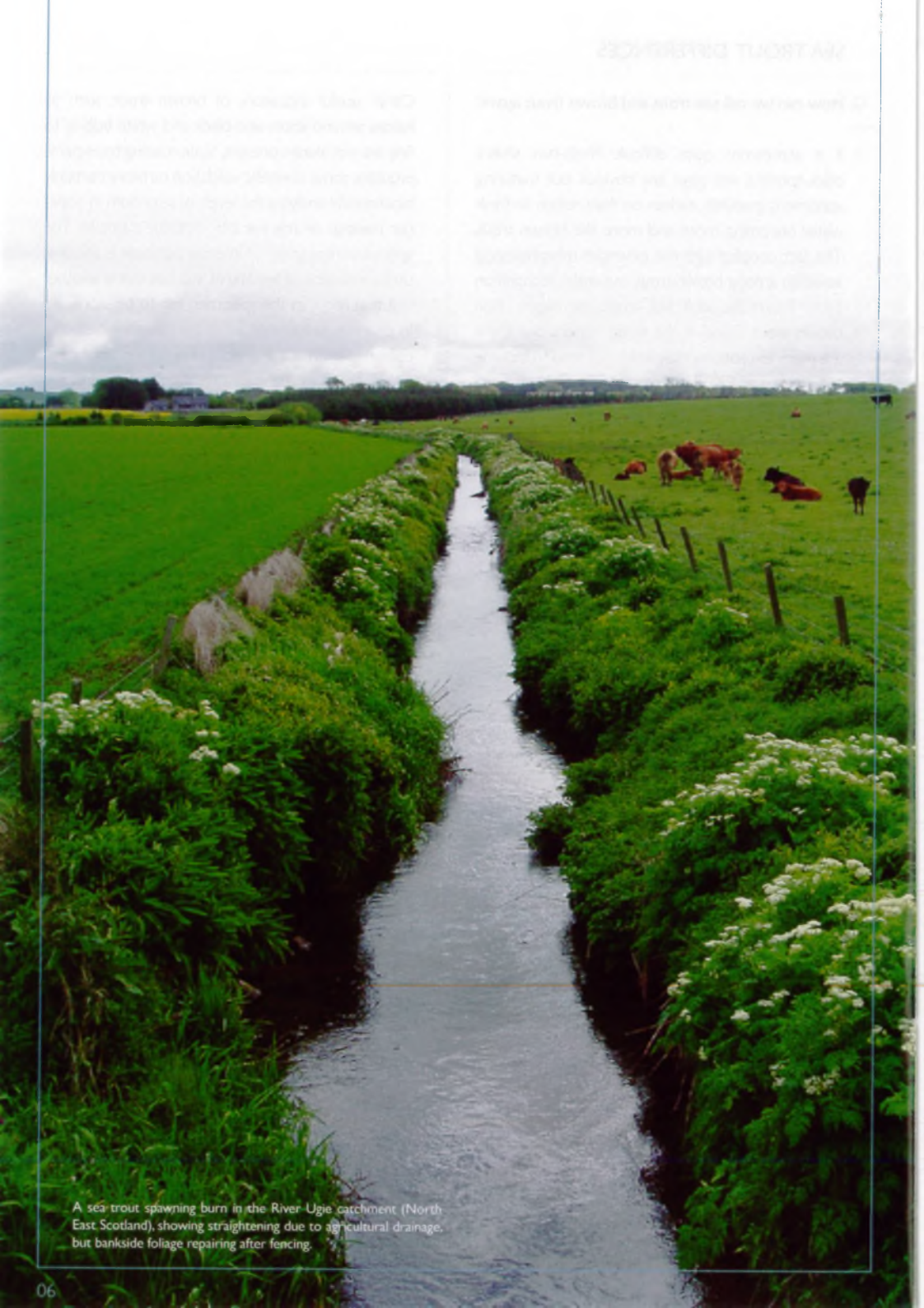
SEA TROUT DIFFERENCES

Q How can we tell sea trout and brown trout apart?

A It is sometimes quite difficult. Fresh-run, silvery, black-spotted, sea trout are obvious, but maturing specimens gradually darken on their return to fresh water, becoming more and more like brown trout. This fact, coupled with the extensive morphological variation among brown trout, can make recognition tricky. Normally, adult sea trout are bigger than brown trout found in the same waters, but there are many exceptions. Male sea trout tend to lack the truly red spots found on many resident brown trout, although they often have orange ones.

Other useful indicators of brown trout, such as haloes around spots and black and white edging to fins, are not always present. Scale reading by experts provides some scientific validation or, more certainly, biochemical analyses for levels of strontium in scales (or bones), or marine oils in tissue samples. The species composition of internal parasites is another useful indicator of feeding at sea, but this is another test that requires the specimen fish to be sacrificed. In practice, judgement by anglers as to whether a coloured trout is a sea trout or a brown trout must take account of the likely prevalence of sea trout in that system.

Q Which of these is a Sea Trout? A They are both Sea Trout



A sea trout spawning burn in the River Ugie catchment (North East Scotland), showing straightening due to agricultural drainage, but bankside foliage repairing after fencing.

SEA TROUT SEX

Q Are sea trout mainly female fish?

A Yes, that is normally the case. However, male sea trout are almost as common as females in rivers where poorer environmental conditions in fresh water appear to cause most of the young fish to go to sea. The broad picture is that females can produce both bigger and greater numbers of eggs by migrating to better feeding environments, in the case of sea trout thus enhancing the competitive value of the anadromous trait. Conversely, body size probably is less important for males, as even small males can fertilise all of the eggs of a large female. Large, apparently physically dominant, male sea trout of similar size to the females may accompany the females, but smaller male sea trout and especially male brown trout, which are usually present nearby, often take part in the spawning acts. This complex relationship between the sexes at spawning time is similar to the well-known participation of ripe male parr in the reproduction of Atlantic salmon. Cross-breeding of sea trout with brown trout probably helps to maintain a broad diversity of resident and migratory tactics among their progeny, leading to optimal utilisation of suitable freshwater and marine habitats. However, even pure matings of male and female sea trout have been shown to produce juveniles that differentiate into different forms of freshwater-resident brown trout and sea trout.

A sea trout spawning burn at Borve Ferare, South Harris (Outer Hebrides), showing extremely peaty and nutrient-poor habitat

STRAYING...

Q Are sea trout inclined to stray?

A Although they can wander from river to river, their homing ability in terms of successful spawning appears to be very good. The evidence for this suggestion is based on tag recapture patterns and genetic discreteness of different spawning stocks. However, some straying must occur as it was wandering sea trout during the retreat of the last Ice Age, ten to fourteen thousand years ago, that founded nearly all of the trout populations that we see in our rivers and lakes today. Also, sea trout have spread and are now established in nearly every accessible stream in southern Patagonia and the Falkland Islands after limited stocking.

MIGRATION INFLUENCES

Q What factors influence which young trout become smolts and migrate to sea?

A The process is not yet fully understood. Although there is strong evidence from scientific studies indicating a genetic basis to the seagoing tendency, the rearing environment also has been shown to be important. For example, artificial rearing of sea trout progeny can increase the proportion that remains in fresh water. Incubation of the eggs at water temperatures differing from natural cyclic levels and improved food availability for the fry and parr held in tanks, providing a 'soft' life-style compared with life in the wild, can change normal seasonal patterns of growth and advance the onset of sexual maturity, favouring the adoption of resident over migratory behaviour.

Morsgail bottom

ENVIRONMENTAL INFLUENCES

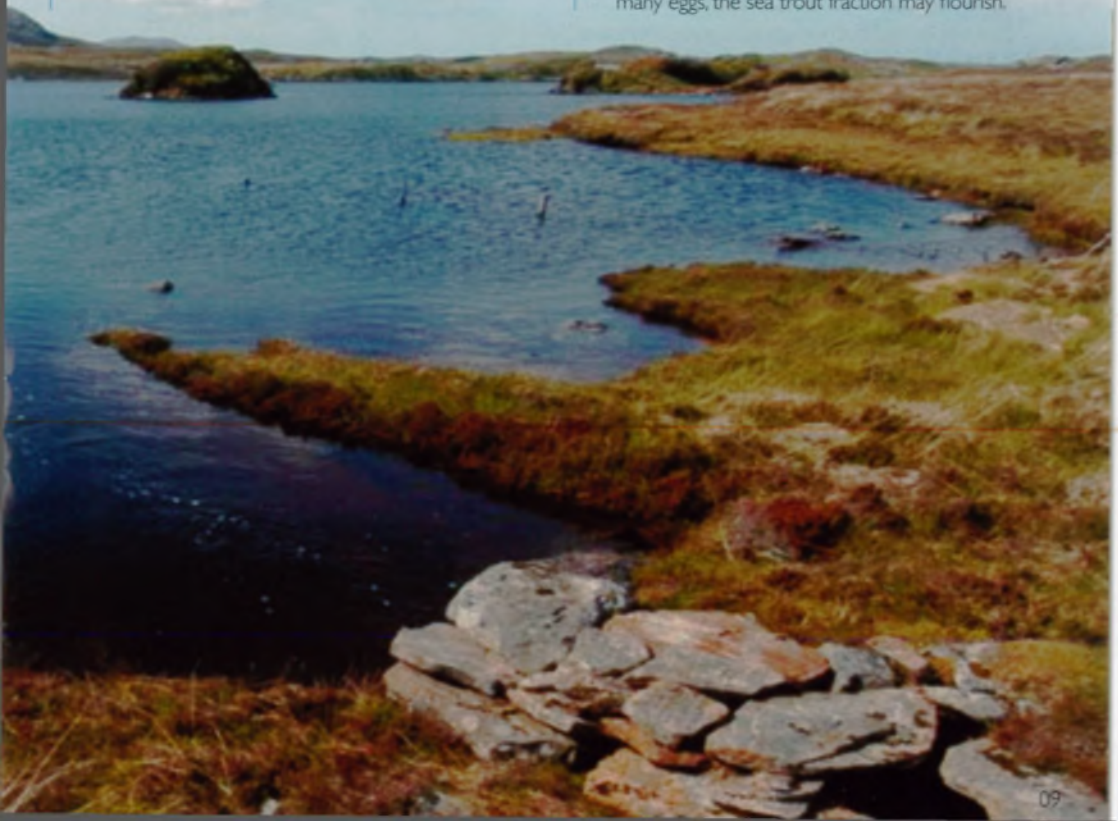
Q Is there evidence that environmental changes may influence the ratio of sea trout to brown trout under natural conditions?

A The relative influence of inheritance and environment probably varies among wild trout populations, but also may change over time. Sea trout used to be rare in the River Teifi, one of the UK's foremost sea trout rivers, in the late nineteenth and twentieth centuries and only started to appear in numbers around 1920. The Rio Grande in Tierra del Fuego, now famous for its giant sea trout, was stocked with what was believed to be a non-migratory strain of brown trout during the 1930s, from Puerto Montt in Chile, having originally been introduced from Europe. Conversely, sea trout progeny, stocked above impassable waterfalls in a fishless stream in the River Earn system in eastern Scotland, in the early 1980s, soon resulted in the establishment of a small resident population of brown trout.

RIVER REQUIREMENTS

Q Why are some rivers good for sea trout while others are not?

A Sea trout probably occur in every river where there is access to and from the sea. Their relative abundance in each seems to be linked with a balance of advantages and disadvantages of the various traits that the local trout may adopt. Intuitively, richer, slower-flowing rivers should favour freshwater residence; low-nutrient, spatey rivers should favour sea trout. However, it isn't that simple. The overall production of sea trout smolts may be greater in richer rivers than in poor ones, although a smaller proportion of the juvenile trout may migrate to the sea from rich rivers. Variation in marine conditions also must be taken into account. If growth and survival levels for sea trout at sea are persistently low, the anadromous trait may be a poorer option than one of freshwater residence and will be selected against. On the other hand, if the post-smolts encounter rich marine feeding and grow big, the returning females carrying many eggs, the sea trout fraction may flourish.



SMOLTING...

Q Do all sea trout undergo smolting?

A No, it seems not. The process of smolting occurs in spring once a threshold size is reached and transforms relatively sedentary and highly-coloured parr which live close to hiding cover in the stream bed into free-swimming, streamlined, silvery fish, better-adapted to feeding at sea. [Smolting is not obligatory for the transition to saline water. Non-smolting brown trout from inland sources survived and grew well when released in Norwegian fjords, indeed some brown trout strains gave better returns than most of the sea trout strains that were tested.] Under natural conditions, most young sea trout become smolts and migrate to sea after one or more years (commonly two or three years in the UK) of growth in fresh water. However, some move down in a less advanced silvery condition, or as parr, into brackish estuaries, or sea lochs and develop into 'ordinary looking', or semi-silvered brown trout, the so-called slob trout, others eventually becoming fully silvered after a further period of growth. Lastly, some smolts may not manage to migrate down river, perhaps due to inability to get past barriers at the appropriate time for their physiological state to be maintained. These fish may revert to the appearance of 'ordinary' brown trout, remaining in fresh water to maturity, or they may become smolts again in the following year.

FINNOCK EXPLANATION

Q What is a finnock?

A Finnock (otherwise locally named whitling, herling, school peal, harvesters etc) are small sea trout in their first year after smolt migration, often found in the estuaries or lower areas of rivers. They do not necessarily remain faithful to their natal areas at this stage, instead they range widely up and down coasts, moving into and out of fresh water with the tides. Often congregating at "choke points" around estuaries, they are highly vulnerable to excessive angling pressure, as well as natural predation. Many of these attractive and energetic fish may over-winter in fresh water while still immature, making only limited growth until they return to the sea properly in spring. Why they do this and lose potential growing time utilising richer marine feeding is unknown. It seems unlikely to be an avoidance response to osmotic problems because salinity tolerance trials have shown that even small post-smolt sea trout have no apparent problems coping with full-strength seawater, in summer or winter.

While finnock are characteristic of the rivers further north, the prolific sea trout rivers of south-east Scotland and north-east England largely lack this early-returning itinerant form. [The term "Whitling" is also used on the River Till in Northumberland, a lower tributary of the Tweed. Here it refers to small sea trout, mostly of 1+ sea winters]. Tagging has shown that many of the post-smolt trout from the Rivers Tweed and Coquet move down the North Sea and remain there during winter, taking full advantage of the rich potential for feeding. These further-travelling, faster-growing sea trout appeared historically in netting catches off the Northumberland and Yorkshire coasts, then East Anglia, Holland and Denmark, before returning to their native rivers to spawn. The erratic movements of finnock between rivers in general and the extensive migrations of sea trout in the southern North Sea indicate significant mixing of stocks during the marine phase, raising complex issues for their conservation and fishery management.

Sea trout from the River South Esk in Angus, Eastern Scotland.

SEA TROUT SIZE

Q How big can sea trout grow?

A Specimens weighing over 10 kgs have been caught in Scottish and Welsh rivers, but the place to find really big ones (perhaps 15+ kg) is Tierra del Fuego, at the southern tip of South America. Another area where sea trout growth is very fast and a large size can be reached is the Baltic Sea. In the UK, big sea trout can be relatively young, fast-growing, individuals (perhaps 4 – 6 years old) that have spent two or more years at sea before returning, or slower-growing, repeat spawners which have reached large size by living longer. Multiple spawning (mostly annual) is much more common among sea trout than among salmon. Prior to the 1990s, when local stocks collapsed, old sea trout weighing several kilos were common in the rivers and lochs of north-west Scotland. Sadly, few of these fish are found there now. In this region, both longevity and annual marine growth have fallen significantly, with huge implications for both fisheries and egg deposition levels. However, large, young, fast-growing sea trout remain a feature of rivers entering the southern North Sea and English Channel, from rivers such as the Tweed, Coquet and Wear. Wales also remains a stronghold for fast-growing, large sea trout, some of which survive to spawn several times.

MEAN WEIGHT EXPLANATION

Explanation for Mean Weight of One-Sea-Winter Sea Trout in Tweed and Annan Nets 1981-83)

Sea trout of the main sea age group (1-SW) caught in commercial sweepnets at Berwick-on-Tweed became larger as the season progressed, in the same way as salmon, implying an extended run of rapidly growing fish (the same was true of the 2-SW fish). In contrast, those caught in stake nets near Annan in the Inner Solway Firth, peaked early (May-early June) in size (and in numbers), then the run appeared to taper off. Commercial sampling further up the East Coast of Scotland resembled the Annan pattern, with most of the sea trout being caught early and little evidence of additional growth. This observed difference in seasonal availability and growth performance may be linked to the more extensive marine migrations of sea trout from the Tweed (and rivers of North east England) shown by tagging studies.

A finnock from the Estuary of the River Don in Aberdeenshire containing brown shrimps and a sprat.

Uig Lodge

SPAWNING AGE

Q What is the most common age at first spawning?

A In British and Irish rivers, most sea trout seem to become sexually maturity at overall age 3+, although there is wide variation (1+ to about 6+). Some return from the sea to spawn in their first sea year, most appear in their second, some in their third and more rarely in their fourth. Sea age at maturity appears to be influenced by marine growth rate, but also may be affected by earlier growth pattern as parr. Mean sea age at mature has been found to be 3 - 4 years in north Norwegian populations versus 1 - 2 years in France and Spain.

MIGRATION FACTS

Q When do sea trout come up our rivers?

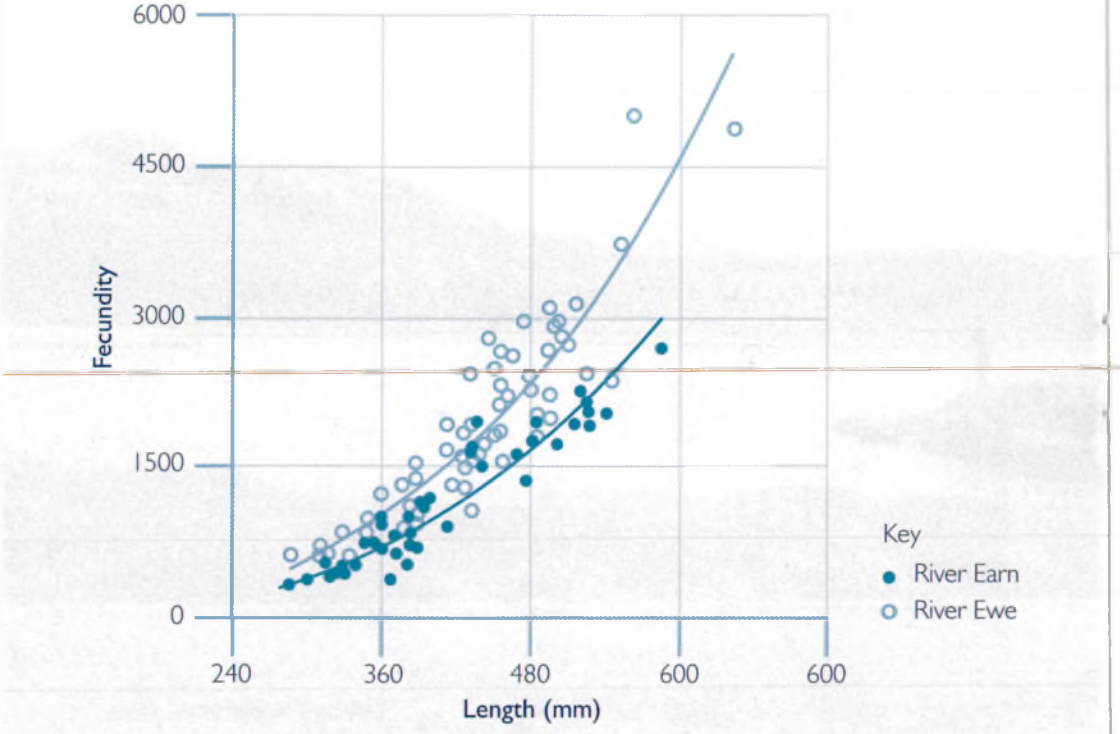
A The timing of upstream migration varies among regions. In Scotland, early-running sea trout stocks ascend some of our larger river systems from about April through to early June. These fish are more likely to have originated within headwater streams. Lower tributaries often are populated more by later-running fish, some coming into the rivers so late that angling is closed. Early-running sea trout at first are relatively easily caught by angling as they move upriver. Soon they settle down for the summer in accessible lochs (lakes) or, often in rivers, in slow, deeper pools, hiding during daylight hours under overhanging banks or tree cover, or overhead water turbulence, jumping and moving more during and after dusk. Smaller in body size on average than most salmon, they have a tendency to progress upriver during the hours of darkness at times through remarkably shallow water. In the absence of automatic fish counters and video equipment sited at key points of passage, adult sea trout stock abundance is difficult to estimate.

EGG PRODUCTION

Q How many eggs do sea trout produce?

A There is quite a lot of variation, although the theoretical average figure of 800 eggs per pound of body weight has been cited in the past. Overall, British and Norwegian stocks of sea trout have similar levels of fecundity, but French sea trout produce many more eggs for the same body size. It is unclear how much of this natural variation is inherited and how much it depends on early growth rate, overall age and levels of feeding at sea. In Scotland, River Ewe System (Wester Ross) sea trout contain significantly fewer (but larger) eggs than River Earn (East Coast) sea trout of the same size. Unlike in birds, egg size in trout increases with overall body size, but it also increases with age, independently of body size. So, large, old sea trout produce the biggest eggs, while smaller, but fast-growing, young sea trout have lots of small ones. The early survival prospects of fry may be positively linked with egg size, but many other factors come into play in deciding their fate.

Differences in levels of fecundity of Scottish sea trout from the River Ewe system (North-West) and the River Earn (East).



SPAWNING LOCATIONS

Q Where do they spawn?

A They spawn extensively throughout river systems, normally choosing redd sites slightly earlier and in smaller streams (often 1-5m wide) than most salmon, although there is some overlapping of spawning timing and requirements, so that some sea trout redds can be 'over cut' by later-spawning salmon and grilse. *[Also, hybridisation between salmon and trout has been shown to occur at a low level (overall about 1.0%), as detected by biochemical genetic methods. The offspring tend to be morphologically intermediate between the parental species and thus are difficult to recognise. Fortunately, they are virtually sterile. Backcrossing to either salmon or trout is extremely rare. There is evidence from the UK and Norway that salmon which have originated in artificial culture are more likely than wild salmon to hybridise with trout].*

A mature male salmon/trout hybrid (age 2+) – reared origin – showing intermediate morphology

SEA TROUT SPAWNING & KELTS

Q What do you call a sea trout that has spawned?

A The word 'kelt' is used for both salmon and trout that have spawned.

Q When do the sea trout kelts return to the sea?

A Some return there soon after spawning (generally mid-October to December), while others remain in the rivers and estuaries before migrating out in spring.

SEA TROUT KELT PROTECTION

Q Do we need to protect sea trout kelts?

A Mending sea trout kelts (like overwintered finnock), are very vulnerable to angling and natural predators. Unlike the case with most Atlantic salmon, where repeat spawning is fairly uncommon (generally much less than 10% of the stock), sea trout may spawn for several years, growing substantially in body weight and producing both more numerous and bigger eggs. Therefore, sea trout kelts are especially important fish to conserve. Although by early spring those which remain in tidal estuaries may be feeding and have regained some of their lost condition, they are usually soft-bellied and lack the firm muscle that they can soon put on in a few weeks of better nourishment at sea.

SEA TROUT SPAWNING & KELTS

Q What do sea trout feed upon at sea?

A They are opportunistic feeders and consume a wide range of marine organisms, from small crustaceans taken from the seabed and midwater to fish such as sandeels, sprats and juvenile herring. Early post-smolts can even be seen feeding at the surface of Scottish sea lochs on wind-blown terrestrial flies. Rapid growth seems to be associated with a quick transition to feeding upon fish. Seasonal prey abundance and quality may be key components affecting marine growth and survival of sea trout.

Q What are the main predators of sea trout?

A They have many natural predators at all stages of the life cycle, ranging from various fish-eating birds, eg, saw-billed ducks and terns, which attack the smolts gathering in lower rivers and estuaries and the post-smolts in their early life at sea, to gadoid fish such as pollack and cod and pelagic dogfish, then they must pass through areas frequently inhabited by common and grey seals. Back in fresh water, mink and otters take a proportion of sea trout, as occasionally do ospreys and, in some rivers, pike. Humans have the potential to take many more.

SEA TROUT KELT PROTECTION

Q Are sea trout stocks prone to diseases and parasites?

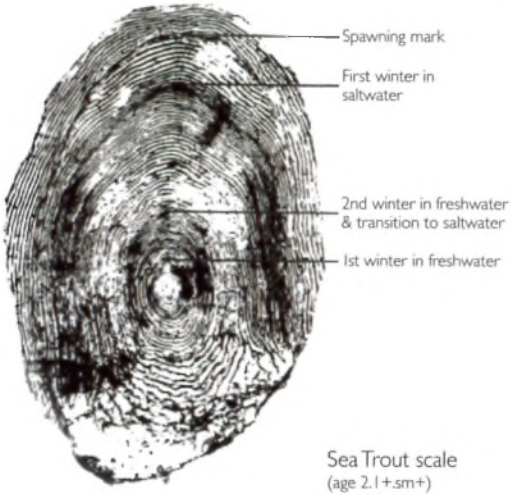
A Yes, sea trout and salmon are prone to a wide range of these pathogens because they live in both freshwater and marine environments. Diseases and parasites are widespread and are a natural means of controlling the relative abundance of natural populations. Normally in the wild, however, sick and dying animals are soon removed by predators, or scavengers and by fungi and bacteria. Therefore, the impacts of pathogens can be hard to detect. In contrast, the severely damaging outbreak of Ulcerative Dermal Necrosis (UDN), which occurred in the UK and Ireland in the mid-1960s, at a time of high abundance of both sea trout and salmon stocks, was very obvious. This was because of the presence in many rivers of so many dead and dying fish which were secondarily infected by fungus, although the causative agent was never fully determined. Most disease or parasites are not normally so virulent and the rare, more obvious, outbreaks may indicate periods of stressful environmental conditions.

South Esk Boat Pool

SEA TROUT AGE

Q How do you tell the age of sea trout?

A Age is normally estimated by scale reading. This can be more difficult than for salmon because of the complex variety of migration and feeding patterns that sea trout may undergo. It takes time and patience to establish normal patterns of growth for particular localities. This process can be helped considerably by recapturing marked fish of known age and checking their scales. Age also can be determined using sections of otoliths (ear bones), but the fish must be sacrificed for these bones to be extracted.



Sea Trout scale
(age 2.1+.sm+)

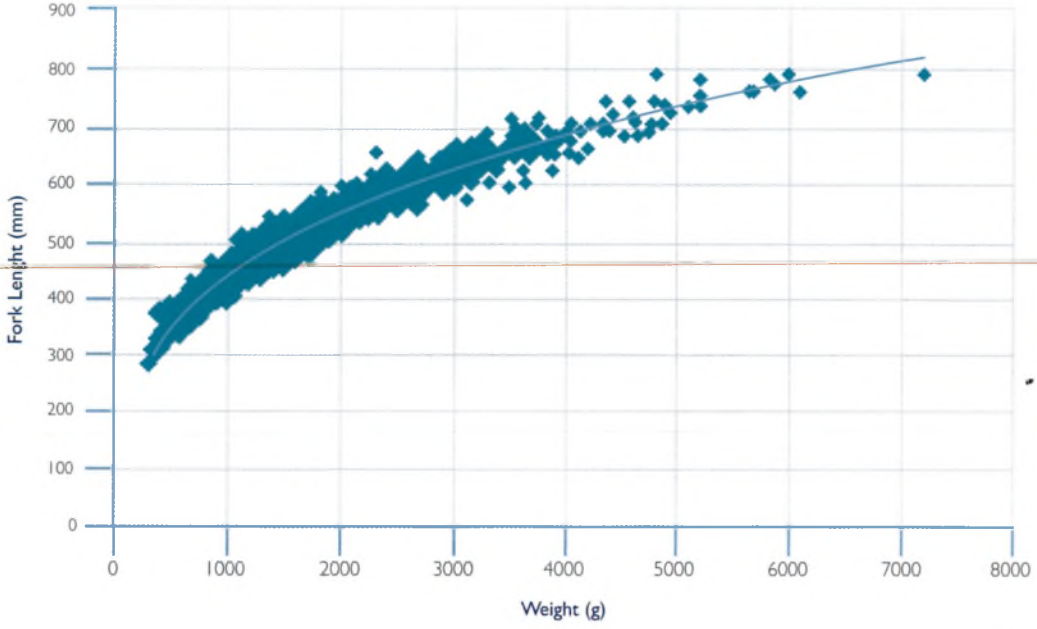
ESTIMATING SEA TROUT WEIGHT

Q How do you estimate the weight of a sea trout?

A Anglers often speculate about the weight of caught and released sea trout in the same way that they do for salmon. However, sea trout are rounder in section and therefore heavier for the same body length.

The scatterplot below, based on net-caught sea trout taken at the bottom end of Scottish rivers, shows a wide range in weight for length, although the trendline provides an indication of the average fish. Bear in mind also that mature sea trout, like salmon, gradually lose condition with time in fresh water.

Lenght/Weight Scatterplot of Net-caught Sea Trout (Tweed, Tay, Inner Solway Firth) 1981 - 83



SEA TROUT PARASITES

Q Why and where are sea lice believed to be serious parasites of sea trout?

A Sea lice (mainly the salmon louse, Lepeophtheirus salmonis (L.)) are naturally occurring and widespread skin parasites of salmon and sea trout in their marine phases. Other lice (Caligus spp.) also can be found on sea trout and salmon at sea, but are more common on other fish species. At the low background levels of infection found in areas away from marine salmon culture, Leps. cause sea trout few problems. However, coastal rearing of salmon in net cages leads to a sharp increase in the potential for louse infestation. Given that these parasites are extremely well-adapted to finding and attaching to their normally relatively scarce salmonid hosts, it is unsurprising to find that in areas of intensive salmon culture louse infection levels can become very heavy on coastal sea trout post-smolts. [Wild salmon post-smolts are vulnerable too, less so those than can migrate out quickly to the open sea.] Sadly, recent history, in Scotland Ireland and Norway, has shown that marine mortality levels soon escalate among sea trout that migrate into bays or sea lochs containing salmon farms and their spawning stocks may collapse. Control of sea lice on the farms has improved lately, but is still largely limited to chemical treatment within the cages and the use of fallow periods after the salmon reach a marketable size in order to limit opportunity for cross-infection between cage sites and age groups. Inevitably, there is a tendency for the lice to develop immunity to the few lice-removing chemicals that are sanctioned for use. In recent years, better control of sea lice has been achieved through the use of SLICE, but this may be only a temporary success as resistance to the treatment has already been detected. Under the present prevalent rearing regime involving open cages, there is an urgent need for new chemicals to be found regularly, their efficacy and safe use examined and authorised. [In the longer term, through local and international agreements, commercial salmon culture may have to move to totally enclosed onshore rearing facilities].

Uig Lodge

SEA TROUT STOCK FACTS

Q But is it not the case that stocks of sea trout well away from the influence of salmon culture also are declining?

A The First International Sea Trout Symposium, held in Cardiff, July 2004 (Harris and Milner, 2006) found that stocks were apparently healthy in some regions and countries, but weak in others. In the UK, there has been in a dramatic increase in catch and release of sea trout (and salmon) over the past ten years, helped by a combination of conservation measures, byelaws, voluntary agreements, club rules, incentive schemes and angler awareness. While greatly to be applauded, these measures have complicated interpretation of the national catch statistics in comparison with earlier decades. However, there is a growing concern, based not only on catches but on sightings by experienced observers, that sea trout numbers have fallen to low levels in several areas of the country distant from threats of salmon farming, although not to the extent of the population collapses that have occurred in the north west of Scotland and the west of Ireland.

STOCK DECLINE CAUSES

Q What are the main causes of these wider declines?

A It is wrong to believe that sea trout stocks should remain stable. Clearly, this is not the case in natural ecosystems. Also, there are some doubts about how accurately we can assess the level of stocks. The main indicator of sea trout stock abundance remains reported catches and, while these provide a broad picture of stock abundance, they are affected by levels of reporting accuracy, weather conditions, fishing effort and new regulations etc. More importantly, the stocks upon which the catches are based are vulnerable to a wide range of habitat impacts, notably from droughts and spates, water abstraction and pollution, hydro power schemes, land drainage, nutrient enrichment and siltation and other effects of intensive farming and forestry, urbanisation, road improvements and even aggressive flood defence schemes, together with other creeping anthropogenic development of large parts of river catchments. Increases in predation pressure on sea trout stocks by growing numbers of fish-eating birds and seals, both at sea and in our rivers, also may be an important factor. Superimposed on all of these concerns are potentially serious effects of climate change, of increases in ambient air and water temperatures, frequency and severity of drought events and localised flash-flooding, rising sea temperature, levels and current patterns and inter-related effects on marine ecology, including changes in fish species composition and abundance.

STOCKING...

Q Is stocking the answer?

A No. There are deep genetic concerns over the impact of stocking on wild salmonids populations, largely through a loss of population 'fitness.' Where, after careful consideration of other options, stocking can be justified, it needs to be carried out using the offspring of native broodstock, a procedure known as 'supportive breeding.' The period in the hatchery should be as short as possible commensurate with overcoming the natural 'bottleneck' in production e.g. loss of spawning habitat. It is important that rearing is carried out in such a manner so as not to result in inbreeding and loss of genetic variability, or inadvertent selection.

Q What else can be done?

A Basically, stop killing so many sea trout and act now to restore and protect their habitat. Fishery owners and managers, fishery boards, trusts etc have to decide whether there is a harvestable surplus in their waters and regulate fisheries accordingly. Control of exploitation by nets and catch and release by anglers can make a substantial difference to fish size, abundance and population fecundity in future generations. Government environmental agencies now have stronger powers, through the E.U. Habitats and Water Framework Directives, to mitigate many environmental problems. Even so, the continuing growth in human numbers, aspirations and social expectations seriously threaten the future quality and quantity of fresh water. Nor can anyone predict with certainty how precious freshwater and marine resources will be affected by ever-changing climatic conditions. Sea trout stocks provide a very important economic and social asset. Their status is a sensitive barometer of the continuing health of the arterial systems of our rivers and our coastal seas. We are urgently in need of more research directed towards sensitive and well-informed measures to assist in their conservation and fishery management.

Hope

In the Declaration after the First International Sea Trout Symposium, Harris and Milner (2006) state that:

'Fishery management regulations for sea trout are poorly formulated and inadequately protective in some respects. There is a need to monitor more closely catches in all fisheries. There is a need to better control fishing in some licensed salmonid fisheries, to eliminate illegal fishing and sea trout by-catch in other coastal and estuarine fisheries, and to effectively control the genetic and ecological risks of stocking and in particular the impacts of parasitic infestation from marine aquaculture.

The Symposium noted exciting new developments in sea trout related science. Genetics, population dynamics, the statistical and ecological basis of biological reference points and geographical information systems all offer potentially powerful and cost-effective management tools. But funding for research is quite inadequate. In particular, commitment is needed to support long-term, integrated ecosystem–based freshwater and marine studies, incorporating ecology and genetics, to improve understanding of the sea-going migratory habit in trout.'

FURTHER INFORMATION

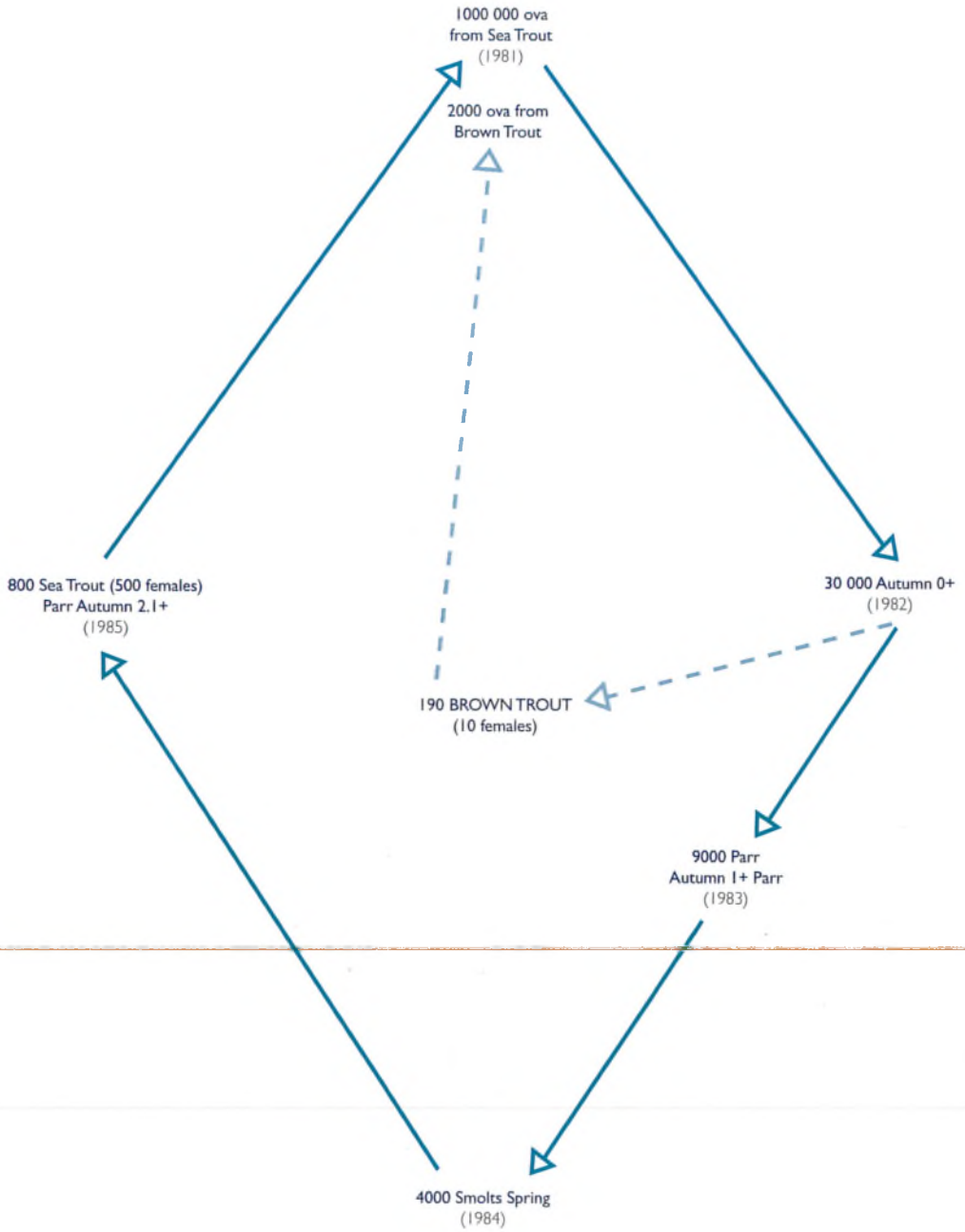
The most up-to-date source of scientific papers and references on sea trout is **Sea Trout Biology, Conservation and Management.** Proceedings of the First International Sea Trout Symposium. Cardiff, July 2004, edited by Graeme Harris and Nigel Milner (2006) Blackwell Publishing Oxford, 499 pp.

Scale Reading: **A Guide to the Interpretation of Sea Trout Scales.** J. M. Elliott and S. Chambers (1996). NRA R&D Report 22, Institute of Freshwater Ecology, Windermere Laboratory, Far Sawrey, Ambleside, Cumbria, LA22 0LP.

G. Herbert Nall's magnificent book **The Life of Sea Trout: especially in Scottish Waters** (1930), London, Seeley, Service &Co. Ltd, 335 pp., has never been surpassed for background information on sea trout.

GENERALISED LIFE CYCLE OF FINDHU GLEN BURN SEA TROUT AND BROWN TROUT

(River Earn System, Eastern Scotland) in 1981-1985 (from Walker, 2006)



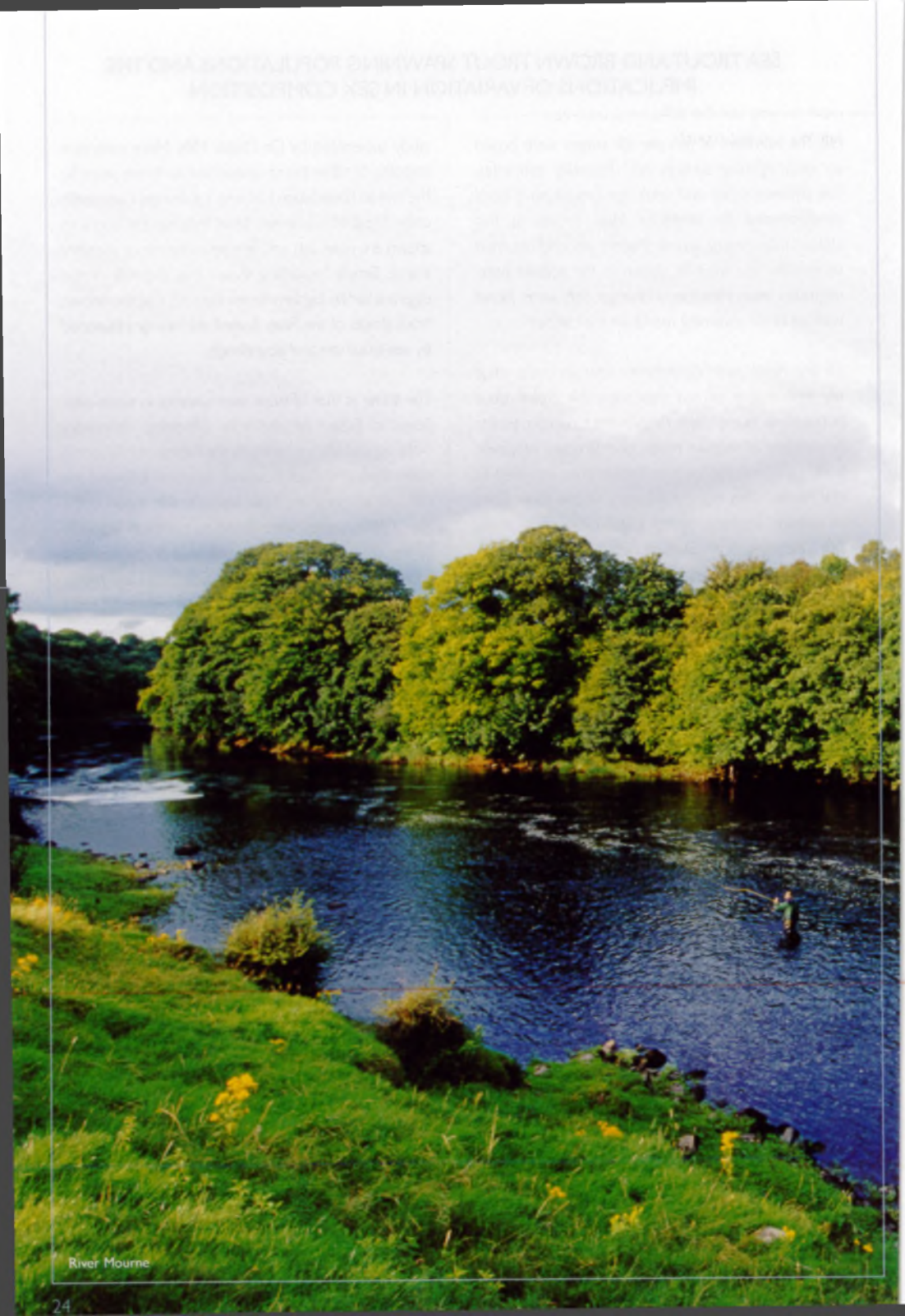
SEA TROUT AND BROWN TROUT SPAWNING POPULATIONS AND THE IMPLICATIONS OF VARIATION IN SEX COMPOSITION

NB. The numbers of fish per life stages were based on electro-fishing surveys and fecundity estimates. The different smolt and adult age groups have been amalgamated for simplicity. Most smolts in this stream migrated to sea at 2 years old and returned as maiden sea trout to spawn in the second post-migration year. However, individual fish were found with up to six spawning marks on their scales.

Clearly, most river catchments contain areas that are inaccessible to sea trout and the brown trout populations found there, as expected, contain similar proportions of mature males and females. However, 98% (301) of 306 mature brown trout sampled in the Findhu Glen Burn, a tributary of the River Earn in eastern Scotland, during 1980-1986, were male fish (including both burn-residents and main river-migrants). Only five mature female brown trout were found during this period. In contrast, 60% of mature sea trout sampled there were females (1223 out of 2022 fish). However, when the samples of adult brown trout and sea trout were combined the sex ratio was roughly 1.0:1.0 (1100:1228). Further studies carried out at this burn twenty years later confirmed these results. The strong inference is that the Findhu Glen Burn contains a unified spawning population of brown trout and sea trout that is almost entirely dependent on sea trout eggs. Rearing, marking and stocking trials showed that the local sea trout progeny diversified into all three forms, i.e. burn-residents, river-migrant brown trout and sea trout.

The Findhu Glen results emphasize the hidden significance of sea trout to brown trout stocks in some situations and seem to be typical of burns flowing into the River Earn. But is this a common situation elsewhere? It appears to be quite common. The River Tweed has a very long tradition of trout fishing, yet the surprising fact is that nearly all of the brown trout in the very substantial proportion of that river system which is accessible to migratory fish come from sea trout eggs. This challenging idea was first suggested by Scott Campbell (1977), based on his trapping study of the Kirk Burn near Peebles, carried out as part of a PhD study supervised by Dr Derek Mills. More extensive trapping of other burns carried out in recent years by the Tweed Foundation has now confirmed Campbell's claim. Most of the brown trout that run the burns to spawn are male fish and female brown trout are very scarce. Simple modelling shows that the bulk of the eggs are laid by big female sea trout, so that the brown trout stocks of the River Tweed are heavily influenced by sea trout size and abundance.

The same is true of most river systems in north-west Scotland. Based on disparate gillnetting, temporary trapping and electro-fishing by the Freshwater Research Laboratory (Fisheries Research Services) following the collapse of many sea trout stocks in this region in the late 1980s, males were found to comprise 93-98% of the mature brown trout sampled in the Laxford, Ewe, Squod, Shieldaig and Ailort systems (1307 males and 54 females). There also, by clear inference, most of the eggs available for deposition in the spawning burns were from sea-run females. After the sea trout stocks collapsed, the brown trout began to grow to a larger average size, probably mainly due to reduced juvenile competition although, in some cases, nutrient enrichment from freshwater aquaculture sites has been implicated. If years of critically reduced levels of marine survival of post-smolt sea trout continue to occur in north-west Scotland, almost as if a physical barrier is being imposed at the mouths of the rivers, and there is a continued shift in some systems from oligotrophic to mesotrophic status due to nutrient enrichment, natural selection among the local trout stocks can be expected gradually to favour freshwater residence over anadromy. If so, the proportions of mature male and female brown trout should begin to approach parity as the genetic influence of sea trout fades away. The trout populations will survive and may prosper, but they will not sustain sea trout fisheries like those seen in the past.



River Mourne

IDENTIFICATION OF SEA TROUT

Q How do you tell the difference between salmon and sea trout?

A

	SALMON	SEA TROUT
General appearance	Slender and streamlined	More round and thickset
Head	Pointed	More round
Position of Eye	Maxilla (bony plate alongside mouth) does not extend beyond rear of eye	Maxilla usually extends beyond rear of eye
Colour	Relatively few spots	Often heavily spotted
Scale count (number from adipose fin to lateral line)	10-13	13-16
Fork of tail	Usually forked	Usually square or convex
Wrist of tail	Slender	Broader
Handling	Easy to pick up by tail	Tail slips through hand

Salmon

Sea Trout

SEA TROUT RECOGNITION

Fresh run sea trout

Easily recognised by bright silver sides, white lower fins and loose, easily detached scales. Some carry sea lice which drop-off in fresh water within a few days. After 2 or 3 weeks they lose the silver and appear like dull coloured brown trout, lacking true red spots. Mature sea trout vary widely in size depending on marine growth and longevity. Typically, at first spawning return they may be about 350-450 mm in body length and weigh around 0.5-1.5kg. Older specimens, which may have spawned several times, can range to in excess of 10kg, while maiden sea trout of this very large size can be found in the southern North Sea and the Baltic Sea.

Kelt

Encountered in Springtime, well-mended kelts are silvery and can be mistaken for fresh run sea trout. They are normally slimmer in shape and can often be distinguished by whitish-silver flanks which lack the iridescent colours of fresh-run fish.

Breeding cock

Coloured male sea trout can be indistinguishable from male brown trout which also spawn with sea trout hens. Males develop enlarged snouts and an obvious kype on the lower jaw – females retain normal head proportions at all life stages.

Breeding hen

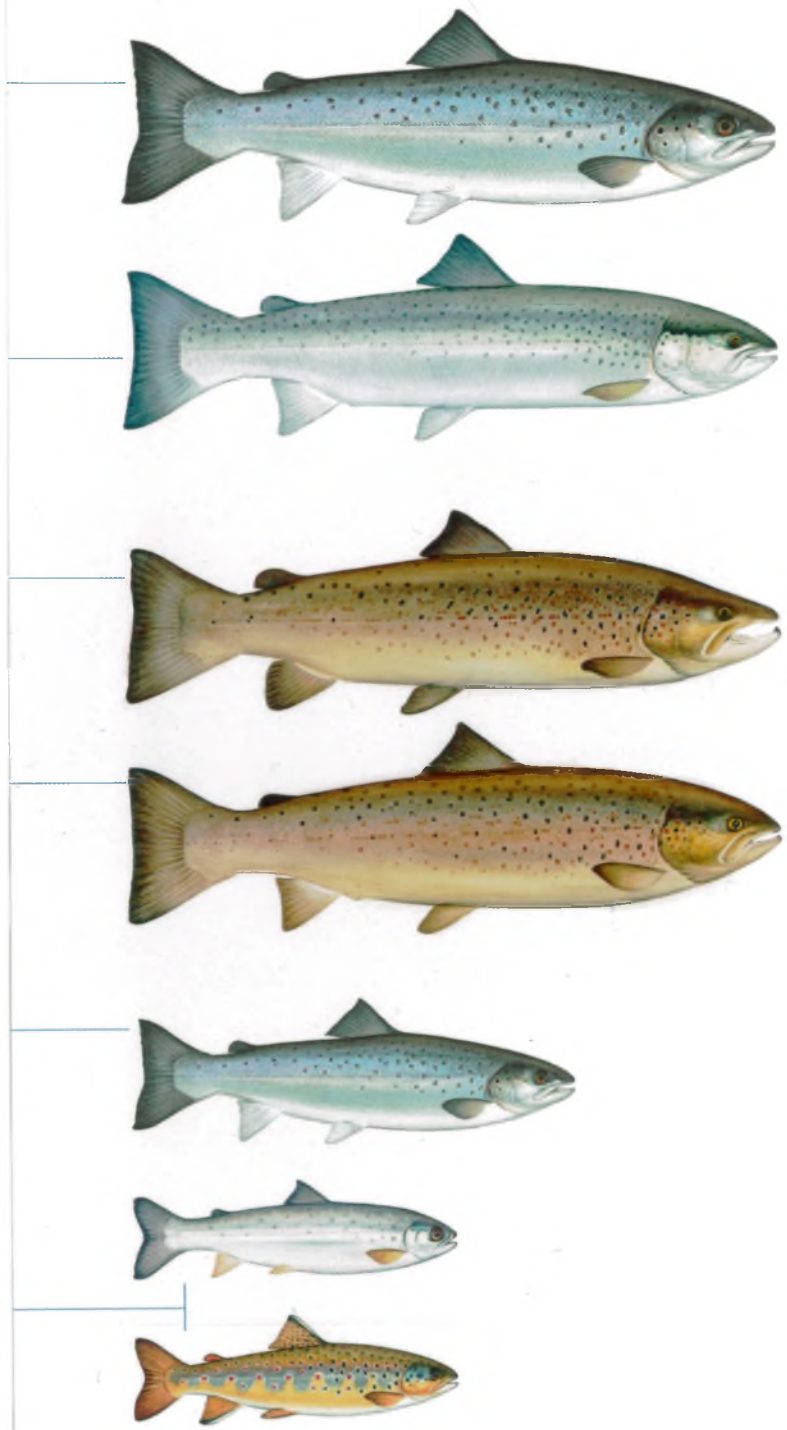
Sea trout/brown trout breed in autumn when the river temperatures reach about 6 degrees, this is usually in October or November. Most are coloured (illustrated) but late-running fish may still be silver-sided.

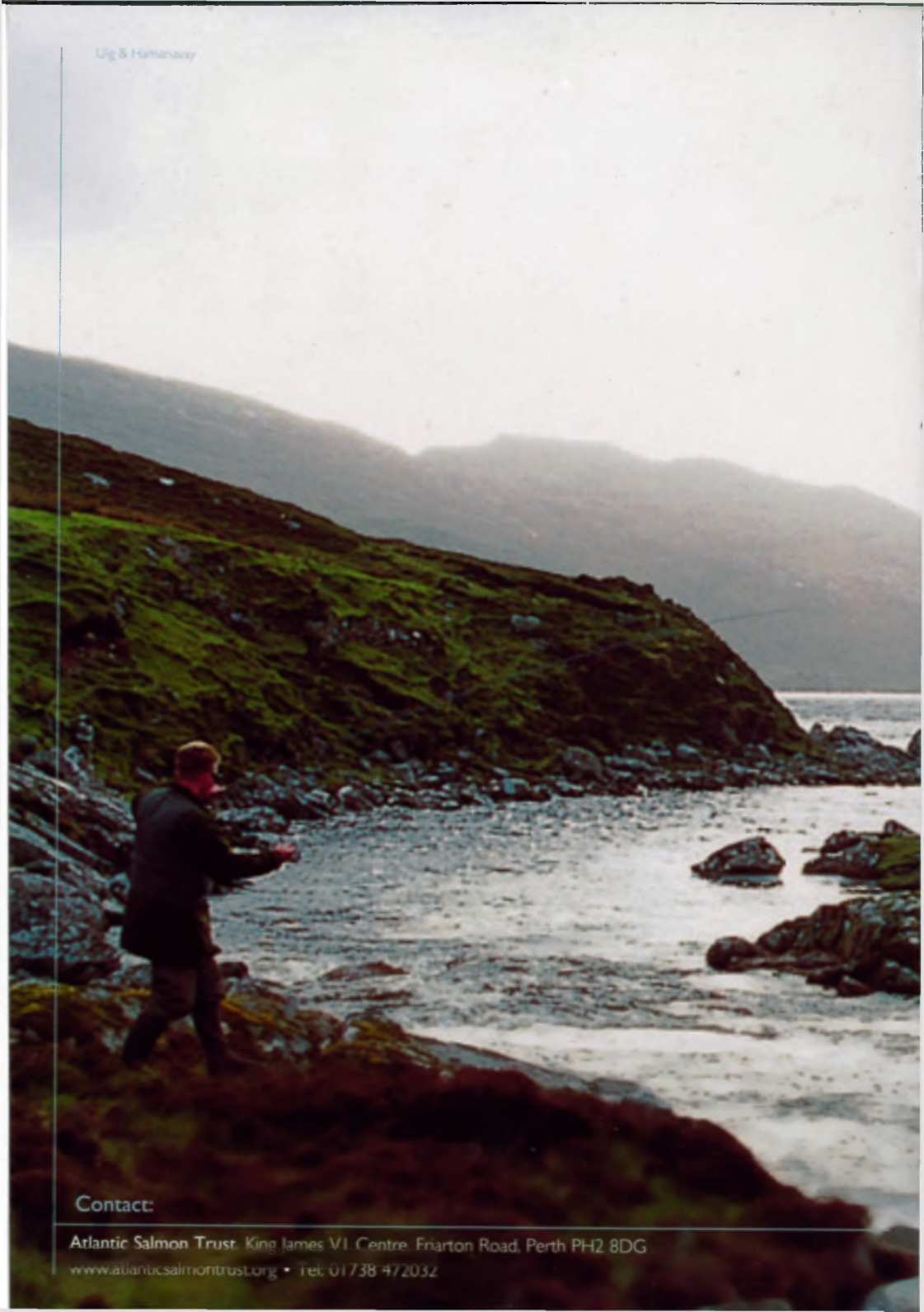
Herling, Finnock, Whitling, Peal, Sewin etc.

These are young sea trout returning to their home rivers in the same year as their first migration. They depart as smolts in April/May and return from July onwards typically averaging around a half pound or ten inches long – those over 13 inches are usually mature one sea winter sea trout. Unlike salmon grilse many of these small sea trout are sexually immature. They should not be killed in excess – they are the large sea trout of the future.

Young trout and smolts

Sea trout are sea-going brown trout – their young (bottom picture) are indistinguishable until those about to migrate to sea become silvery smolts (above). Most British sea trout are females, their male partners often remaining behind in the rivers as resident brown trout.





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