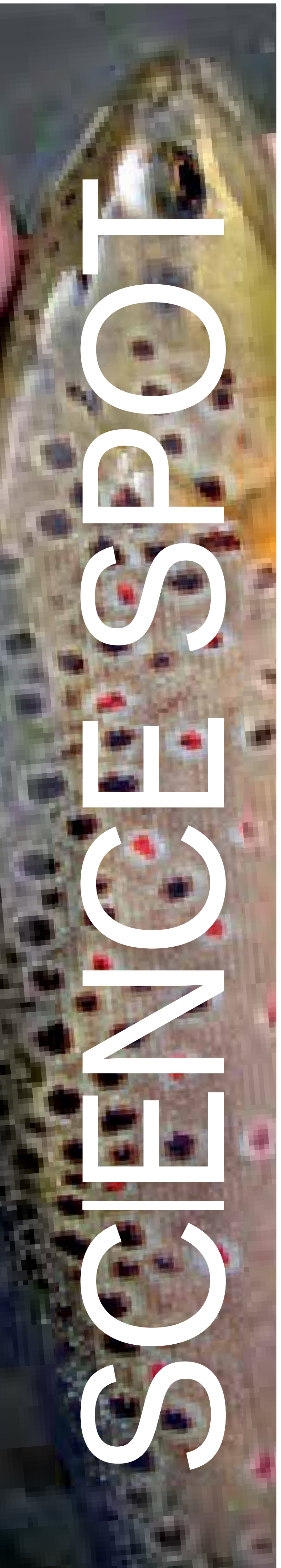


A round-up of the latest trout science stories
contributions by Paul Gaskell and Tim Jacklin

Celtic Sea Trout Project

Nigel Milner of the CSTP steering group provides an update

The Celtic Sea Trout Project (CSTP) is a European Union, Interreg IVA-funded, Ireland-Wales collaborative project on the status, distribution, genetics and ecology of sea trout around the Irish Sea.

Sampling

The CSTP is reliant upon effective field sampling to collect data and material for scientific analysis. River sampling of juvenile trout for the genetics was the focus of the CSTP scientific team's work in 2010 and was completed in 2011, using a large scale electro-fishing programme, taking samples from around 80 rivers.

Sampling in the sea

Marine sampling is a key part of the project because it has not been done before in Britain and Ireland. We want to know where they go, what they feed on and how fast they grow. We have had to develop new methods for trawl sampling and have used them successfully in surveys from Dublin to the Solway coast, via the Isle of Man. Shore sampling along the coasts of Wales, England and Scotland has proved more difficult; but the collections are still sparse and the marine sampling will be intensified in 2012. Shore sampling in Ireland has yielded good results and will be expanded in 2012.

Sampling in rivers

A major part of the sampling programme is the collection of scales for analysis of life histories, and growth rates. For this purpose we need to know which rivers they came from and, apart from fish traps, the sampling of adults in rivers has to be done by angling. This part of the sampling programme has required extensive communication with angler groups and distribution of thousands of sampling kits and scale envelopes. Several talks on the CSTP were given during the winters of 2008/9, 2009/10 and 2010/11 to clubs and associations across the UK. We aim to collect scales from at least 300 adult sea trout from each of the selected rivers over the course of the project.

The scale sampling to date has had mixed fortunes. The participation has been very good with over 1,600 anglers sending in 3,974 sets. Some rivers have done particularly well, such as the Border Esk, the Irish Dee, Argideen, Castletown and Currane, and on others some of the shortfall has been made up with other forms of sampling.

Sample processing and data analysis

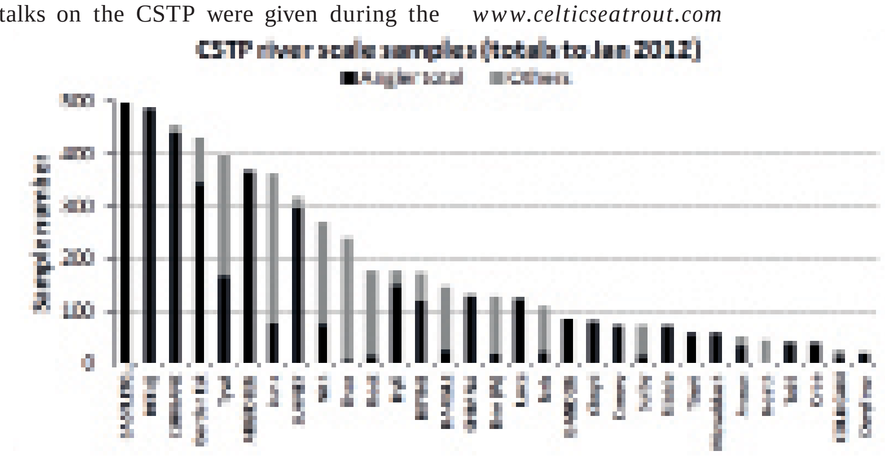
Genetic analysis at University College Cork and Bangor University has been completed to establish a baseline of genetic variation and has shown remarkably strong structuring, with patterns that appear to reflect the ancient glacial history of the Irish Sea. This information will be used to assign marine sea trout to their regions or rivers of origin, in order to learn how they distribute themselves at sea.

Scales from the past two years are currently being analysed and used to derive ages, spawning history and growth rates. The bulk of this time-consuming work will be done by summer 2012. Other work includes dissecting organs and tissues from 2,000+ adult fish, microchemical analysis of the inner ear bones, measuring and weighing 5,000+ fry, and scale reading.

Sampling by anglers in 2012

The prize draw for the champion scale samplers will be held in Carmarthen March 21, 2013, but the CSTP needs the continued support of anglers in 2012. Sampling is easy and CSTP project team members are available to present talks to your club if required.

www.celticseatrout.com




Hatchery brown trout – fit for the wild?

Two plus two is five

Take a wild trout (or salmon), mate it with another from the same river system – and what do you get? Surely wild offspring that are genetically matched to your river? Confusingly, the real answer appears to be "I'm afraid not". As with so many other fascinating phenomena, nature turns out to be more complicated than we imagined. Granted, the result of such supportive breeding or wild broodstock schemes are likely to produce stock fish that are more similar to local wild populations than those derived from many generations of domestication, particularly where the latter originate from outside the local river catchment. But how, with wild broodstock, can these differences begin to arise from the very first mating event? And how different is too different to still be well-adapted to local conditions?

Given the variety of methods adopted, it is useful to distinguish between different approaches to artificial support of wild populations. At one end of the spectrum, there are the full supportive breeding projects that catch local wild brood fish and hold them just until they come into breeding condition before fertilizing and planting out their eggs or emergent fry into the wild. Hopefully this all occurs within just one breeding population. Next there are semi-supportive breeding methods that catch and retain a head of wild brood stock in captivity. These are periodically topped up with new fish from the wild and a mixture of local populations is used. Finally, there is the establishment of a domesticated strain of fish that are periodically crossed with fish from other domestic or wild strains to avoid inbreeding depression; these domesticated stock fish are typically fed and grown on to a size targeted by anglers.

Starting with domesticated strains of stock fish, the most likely breeding contribution that fertile domesticated fish can make to wild populations is to *reduce* how well-adapted those populations are to their local stream. This well-documented process (called out-breeding depression) is extensively covered in our updated "Stocking Position Statement" drafted in 2012, and isn't the main focus of this article (See the WTT website).

So what can scientific research tell us about what contribution a semi-supportive system might make to wild populations? Work carried out in a Norwegian lake fed by three geographically distinct tributaries provides a superb insight. Here was a system receiving huge numbers of supplementary brown trout produced from broodstock taken from each of the three spawning tributaries.

The investigators developed genetic techniques that allowed them to distinguish fish that belonged to three distinct wild breeding populations that corresponded to each of the three tributaries (Wollebaek, Heggenes & Roed, 2010). Their sampling revealed that there was a small amount of "wandering" by wild fish; fish born in one tributary would, once in a while, travel up a different tributary to spawn as adults. This behavior is, of course, what allows populations to establish in new areas. More interestingly from a management point of view was the finding that significant numbers of stocked fish survived in the lake (making up just less than one fifth of the total trout population).

However, these fish were found to have no breeding success in the wild – contributing no surviving juveniles to the populations. In fact, despite extensive introductions of fish from the semi-supportive breeding system, the separate breeding populations belonging to each tributary remained genetically distinct from each other and no hybridization was evident. On top of that, the fish that were bred from wild brood fish were also genetically distinct from all three wild, tributary populations.

The exact same pattern as above, but on an even more impressive scale, was found in the trout populations of the River Dart system in Devon. In this case, researchers genetically identified 22 distinct breeding populations. First generation offspring of brood stock captured in the wild were dramatically different from any of the wild source populations (Griffiths, Bright & Stevens, 2009). These sorts of attempts at supportive breeding highlight the great difficulty in knowing whether the fish you are catching and selecting to breed actually belong to one, clearly identified, breeding population. In fact, the only possible way of achieving that in most cases would be to catch fish when they are already on the redds. This would, of course, destroy their own natural breeding efforts that are already taking place without any help from human hands.

What might be going on in the process of supportive breeding that could produce these domestication effects in a single generation? Domestication seems to be a result of both genetic and environmental factors and the process is set in train from the very beginning. It seems that, completely against our intentions, it is not possible to avoid bias when selecting brood fish.

It is this first human intervention that prevents the usual natural processes of mate choice and competition known to determine pairings in the wild (McLean, Bentzen & Quinn, 2005). Salmonid fish (including trout) use both scent (Forsberg et al., 2007) and visual (Wedekind et al., 2008) cues to gain honest indications of a potential mate's genetic makeup. Amazingly, the fish can actively select their preferred mates based on the genetics underlying those cues. Even more amazingly, the choices directly influence the viability and survival of any resultant offspring. At present, these natural processes determining such optimal pairings are beyond our technical ability to recreate in a hatchery.

Additionally, the rearing environment itself is known to directly affect the characteristics of fish. For example, the shape (Vehanen &

HuuskoO, 2011) and predator avoidance abilities (Alvarez & Nicieza, 2003) of juvenile salmonid fish are both impaired by early life experiences in an artificial environment. Similarly, salmon parr produced in artificial facilities can only learn to forage effectively on live prey by copying experienced individuals (Brown, Markula & Laland, 2003). Currently, we aren't routinely able to reduce or remove these negative social and physical effects caused by hatchery environments.

Whilst there may be certain, very specific, sets of circumstances that mean a supportive breeding programme could be the best available compromise, it will only rarely be the case. The hidden complexity involved in trying to artificially boost production of well-adapted wild trout and salmon actually points to a much simpler solution.

It seems that the most reliable option is to provide good habitat, clean and plentiful water with good access for fish to move between different habitats throughout their lifecycle. Now does anybody know where I can get some advice on habitat restoration…?

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Awareness is growing of the role of woodland in regulating and protecting our watercourses

Woodland for Water

In the last issue of *Salmo Trutta*, Dr Mark Everard discussed the concept of ecosystem services: those things provided by the landscape that we tend to take for granted, not least the regulation of the quantity and quality of water, sediments and chemicals flowing down our rivers. Other services provided by the landscape, so-called extractable provisions that can be grown (food), mined (fuel and minerals) or manufactured have traditionally been given the most economic worth. Conflicts arise between these different uses, for example between intensive food production and the capacity of the landscape to yield clean water.

Woodland has long been part of our landscape and provided fuel, timber and the less utilitarian values of recreation and wildlife habitat. But its benefits to the water environment have only been recognised relatively recently. Awareness is growing of the role of woodland in regulating and protecting our watercourses.

In July 2011 the Environment Agency and the Forestry Commission published a review of the ways that woodlands may help deliver environmental benefits to our rivers and lakes and in doing so contribute towards meeting Water Framework Directive (WFD) objectives. The review was carried out by Forest Research and ADAS and is available in full at *www.forestry.gov.uk/fr/woodlandforwater*.

Other partners involved in the project were Countryside Council for Wales, Scottish Natural Heritage, Natural England and the Scottish Environment Protection Agency.

The review concentrates on the creation of native woodland, but also considers the impact of new coniferous and bio-energy plantations in light of renewable energy policies. There is strong evidence that creating woodland in appropriate locations helps achieve water management and water quality objectives. Woodland contribution to tackling diffuse pollution includes both a barrier and interception function, helping to trap and retain nutrients and sediment in polluted runoff.

The benefits of riparian and floodplain woodland for protecting river morphology and moderating stream temperatures are well proven, while a good case can also be made for mitigating downstream flooding. Targeted woodland buffers along mid-slope or downslope field edges, or on infiltration basins appear effective for slowing down runoff and intercepting sediment and nutrients, but currently the evidence base is limited.

Wider targeted woodland planting in the landscape can reduce fertiliser and pesticide loss into water, as well as protecting the soil from regular disturbance and so reduce the risk of sediment delivery to watercourses. Evidence from Europe and further afield provides a range of examples of effective action plans and incentive schemes for water-related woodland services, which have succeeded in achieving woodland creation and a reduction in nutrients reaching watercourses. The evidence presented in the review supports the use of woodland measures in helping to meet water quality objectives in future WFD River Basin Planning cycles.