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lascach Intíre Éireann Inland Fisheries Ireland

Welcome to the Newsletter

Travel is somewhat restricted for Ireland's human population at the moment, but Ireland's fish are still on the move. This issue features work by IFI Research on migratory species that travel between river and sea, resident fish moving around their home ranges and a non-native species recently introduced to Ireland.

Not all work by IFI Research revolves around studies in the field: research staff have continued providing consultation and advice on fisheries issues during lockdown.

As always, we thank all IFI staff who contribute to our research programmes and to this newsletter. Slán,

Dr. Cathal Gallagher, Head of Research & Development

In this issue	
Salmon marine survival	Telemetry studies
Eel eDNA	Chub invasion of the Inny
Shad survey	And more

Atlantic Salmon — Their Unseen Battle for Survival at Sea



The survivors: migrating salmon leaping a waterfall

So far this year, the numbers of Atlantic salmon returning to Irish rivers are up, according to anecdotal reports. IFI's angling reports have also featured plenty of great salmon fishing this summer. A bumper year for returning salmon enjoyed by salmon anglers in Ireland's rivers is a reminder that part of their story happens out of sight beyond our shores: salmon fight an unseen battle for survival at sea.

Salmon numbers returning to Ireland annually have fallen from a peak of around 1,700,000 in the 1970s to as little as around 250,000 in recent years. This decline appears to be happening at sea: marine survival of Irish salmon peaked at around 25% in the mid 1980s but is now around 5%. These numbers are stark: today, out of every 100 smolts that leave Irish rivers, 95 die at sea. This raises the question of whether a good run of salmon in a year is linked to an increase in their survival at sea and why this might occur.



The battle for survival begins immediately for migrating salmon smolts. In June in the *ICES Journal of Marine Science*, Sam Shephard and Paddy Gargan of IFI Research report that exposure of smolts to high levels of sea lice from coastal salmon aquaculture was associated with less one-sea winter grilse returning to rivers the following year. This relationship seemed worse for smolts exposed to low or moderate lice levels in years in which climatic indexes indicate that ocean conditions were warmer.

Sam and Paddy's findings are just one aspect of salmon marine mortality. The North Atlantic oscillates between warmer and cooler temperatures in cycles that span decades. This climatic forcing pushes the distribution of plankton and fish species around the ocean, shifting the prey, competitors and predators of salmon in their migration routes and feeding grounds over time. More and more studies are linking marine survival of salmon with the impacts of ocean warming on marine ecosystems.

Mortality is a natural part of every species' life cycle, but the catastrophic increase in salmon is worrying. The Atlantic salmon is a canary-in-the-coalmine: an indicator species that connects water quality in the smallest headwater streams with distant marine ecosystems that are changing at an oceanic scale. Any increase in their numbers is welcome news, not just for anglers, but also for the complex web of aquatic ecosystems that they connect.



Sea lice visible on the fins of a smolt

Using eDNA to Detect Eels in Irish Lakes — What Lies Beneath?

Environmental DNA (eDNA) has emerged as a powerful tool in conservation biology, allowing researchers to detect the presence of species using samples of water, sediment or even air from a location. The Eel Monitoring team at IFI Research now report that this technique can detect European eels in lakes.

Animals shed DNA into their environment from cells in their skin, scales, hair, mucus etc. This genetic material can be filtered from environmental samples and amplified to sufficient quantities for analysis using a technique called polymerase chain reaction (PCR). The sample can then be probed for genomic sequences to identify the species from which the DNA was obtained.





Funded by the EU Interreg Atlantic Area programme, the DiadES project involves partner organisations around Europe working together to assess the conservation status of migratory fish, the ecosystem services they provide and the expected impacts of climate change on their distributions. For DiadES, IFI is focusing on twaite shad, thin-lipped mullet and smelt, and shad anglers are helping to quantify the value of their recreational fishery as an ecosystem service.

In early summer, shad migrate from the open sea to spawn in the River Barrow, where anglers congregate at hotspots to target specimen fish. With their help, IFI staff measure captured shad, take scale samples, then tag and release the fish to monitor their population status. In 2019, these anglers also participated in an online Irish Shad Survey. Sixty-six percent of respondents who fish for specimen shad return every year, highlighting the Barrow's importance.

The shad anglers' participation provides valuable insights into the economic and social benefits of this recreational fishery, which will help the DiadES project to create transnational management tools for migratory fish.



Eels in a fyke net

In a cooperative study with Laura Weldon of the University of West England, the Eel Monitoring team collected water samples during fyke-net surveys in five lakes, with known eel populations categorised from high to low. The study was reported in May in *Environmental DNA* and found that eel eDNA was detected in 83% of samples. Furthermore, there was a positive relationship between eDNA concentrations and eel biomass captured at net locations.

Although fyke netting allows live capture of eels to monitor their health, eDNA analysis has two important advantages: it is easy to obtain samples, and it is sensitive to very low numbers of eels that might easily be missed by netting. The Department of the Environment, Climate and Communications is now funding further research to establish the link between eel eDNA and catches of silver eels.



Top: Angler-caught twaite shad at St. Mullins on the Barrow, 2019 Bottom: Shad anglers on the Barrow

Migration Milestone: Long-Distance Tracking of Atlantic Salmon Smolts at Sea

In June in Fisheries Management and Ecology, James Barry of IFI Research and colleagues reported the first evidence that salmon smolts from rivers on the east coast migrate north out of the Irish Sea. As well as confirming a previously unrecorded migration route, the study describes some of the first long-distance tracking of individual salmon smolts at sea using acoustic telemetry.

As part of the transnational COMPASS project, supported by EU Interreg VA funding, 100 smolts from the Boyne and Castletown rivers were tagged with tiny acoustic transmitters and tracked by an array of 31 receivers along the northeast coast. These listening stations recorded an impressive sprint offshore and northwards by three of the little fish: one smolt swam an estimated 250 km in 32 days. Interestingly, all smolts were detected when tidal flow was



Estimated route of a smolt from the Boyne to detection at sea

in a northerly direction more favourable for their migration. This research provides insights into the migration behaviour and marine survival of salmon smolts that will help the development of marine conservation policies.

Salmon Farming and Changes in the Growth and Migration of Sea Trout

Fish scales provide valuable data on the life history of fish. Scales have growth increments like tree rings that allow fish to be aged, and chemical isotopes absorbed by scales record the environmental conditions each fish lives in over time. In a collaborative study involving Diarmuid Ryan, Willie Roche and Paddy Gargan of IFI Research, the CHASES project used archive scale samples to explore how proximity to salmon farms affects the growth of sea trout.

In September in the ICES Journal of Marine Science, the CHASES project reported a time-series analysis of sea-trout scales over a period of 25-60 years from three Norwegian and two Irish rivers-the Erriff and the Cashla. Overall, the results indicated that proximity to salmon farming in coastal waters was associated with less growth of sea trout after they first enter the sea, with evidence of increased mortality of

Acoustic Telemetry of Brown Trout and Dace –

Data on how fish move around foraging for food and where they seek shelter are important for understanding their basic ecological requirements. In June in Aquatic Sciences, James Barry and colleagues of IFI Research reported on daily and seasonal movements by brown trout and dace in an artificially impounded section of lowland river.

As part of the AMBER project, the study tracked fish tagged with acoustic transmitters with a receiver array above Clondulane Weir on the Munster Blackwater, where the weir has created deep, slow-flowing habitat. Both species were most active at dusk, but dace were usually more active than trout. Both species remained highly resident in the section, especially larger individuals, with individuals' home ranges remaining stable in size and localised over time. Seasonal changes were associated with spawning



smaller smolts. The CHASES project used barium:calcium ratio in scales to determine the movements of sea trout between rivers and the sea—a method that was developed in IFI Research using our facilities for laser ablation inductively coupled plasma mass spectrometry (ICP-MS).

So Where Do Fish Like To Live in a River?



Impounded habitat above Clondulane Weir, Munster Blackwater

and overwintering behaviour. These activity patterns provide evidence that native trout and non-native dace may potentially compete with each other for food and shelter. The study also highlights how artificial barriers to fish movements can influence fish behaviour and ecology.

Chub in the River Inny — They're Back... Again?

An alien invasive species is one that is deliberately or accidentally introduced to a new area by human activity and that then reproduces uncontrollably, often damaging native ecosystems. Ireland's lakes and rivers have suffered their share of invaders over the years, but the latest is back after an eradication campaign ten years ago: chub are once again confirmed present in the River Inny.

The chub (*Squalius cephalus*) is widespread across continental Europe, preferring to inhabit moderately fast flowing rivers with plenty of aquatic vegetation, but it is not native to Ireland. Chub will eat almost any prey they can get their mouth around; for this reason, introduced chub threaten native species by either eating them, especially smaller juvenile fish, or by competing with them for food. Unfortunately for its local fish community, the River Inny features prime habitat for this predatory invader.



Electric-fishing for chub on the River Inny, 2020



In 2005, fisheries staff confirmed anglers' reports of chub in the Inny, and 30 chub were captured in a campaign of electric-fishing and netting surveys between 2006 and 2013. A novel technique was the use of so-called 'Judas' fish: chub sometimes form shoals, so two chub were fitted with radio transmitters and tracked to see if they betrayed the location of other chub. After the last Judas fish was recaptured in 2010, no further chub detected by surveillance monitoring operations maintained on the Inny.

Fast forward to 2020, and chub are back. It is not yet known if the current invasion is a new introduction of chub or represents a breeding population that survived the original eradication campaign. Over the summer, IFI Research have sampled the Inny, and the information gathered on chub's current abundance and distribution will help IFI to design potential management strategies.

Providing a Fisheries Perspective — Consultations and Advice

IFI as an organisation is tasked with the delivery of expert advice to support the conservation and protection of the inland fisheries resource. IFI Research, despite these unprecedented times, continues to be called on to support our parent department, the Department of Environment, Climate and Communications (DECC), with a wide range of advice across species, habitat and environmental issues.

Recently, we have been particularly busy supporting the Department of Housing, Planning and Local Government (DHPLG) with essential advice pertaining to fisheries and habitats associated with the Habitats Directive and Water Framework Directive (WFD). Indeed, IFI has been funded by DHPLG to assess fish populations and barriers in catchments critical to Ireland's WFD measures. There also has been a notable increase in interactions with the Department of Agriculture, Food and the Marine (DAFM) with support and advice offered in relation to bluefin tuna, bass and marine recreational angling species.

In Ireland, scientific research, sampling or movement of fish in catchments requires a specific Section 14 licence from DECC. This year has seen a large increase in such applications, with IFI offering analysis and advice on over 65 to date. When this work is coupled with advice offered on foreshore licences, parliamentary questions (PQs), ministerial advice requests and a range of national consultations, it is clear that despite the Covid-19 restrictions, it has been a very busy year. Given this, it is pleasing to see that IFI as an organisation is contributing to the conservation of the inland fisheries resource at a strategic national level supported by expertise from across all our organisation's divisions.



We Hope You Enjoyed the Newsletter

Feedback is always welcome, so please get in touch if you have any comments. Contact Rory Feeney at 01 8842636 or <Rory.Feeney@fisheriesireland.ie> Inland Fisheries Ireland, 3044 Lake Drive, Citywest Business Campus, Dublin D24 Y265 http://www.fisheriesireland.ie/Research-and-Development/fisheries-research.html

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