Developments in Inland Fisheries Ireland Research

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Welcome to the Newsletter

With the end of the year closing in fast, we bring you more updates on current IFI research. We would like to thank all staff who contributed to IFI research programmes and to this newsletter.

This issue features some topical research papers with which IFI staff were involved that were published over the last few months. We also highlight two new research initiatives, the Pike Research Programme and the AMBER project.

Please feel free to contact me with any comments or feedback you may have. Slán, agus Nollaig Shona daoibh.

Dr. Cathal Gallagher, Head of Research & Development

In this issue

Modelling the Ecological Interactions of Pike

Paul McLoone with a pike on a boom-boat survey

Pike are famed amongst anglers as voracious ambush predators. As a keystone species at the top of freshwater food chains, pike can alter fish community structure, and this has led to debate about their impact in Ireland's wild brown trout fisheries. To investigate the pike's dietary preferences and ecological interactions with other fish in Irish lakes, IFI launched a new project in 2016—Pike in Ireland: Developing Knowledge and Tools to Support Policy and Management.

Loughs Conn and Derravaragh are being surveyed regularly over a year using boom-boat electrofishing to examine seasonal variation in the diet of pike. This effort is being supplemented by angling to sample larger pike. Using a minimally invasive technique called gastric lavage, the captured pikes' stomachs are gently flushed with a little water, causing the fish to regurgitate their stomach contents, which are then preserved for analysis. After a few measurements and photographs for morphometric analysis and a scale sample for age analysis, the pike are then released unharmed back to where they were caught.

Gastric lavage: a small pike spits up its stomach contents

Together with archival survey data collected over several decades, the new data on pike feeding will be used for mathematical modelling to simulate the ecological interactions of pike, trout and other species in lakes. The model's outputs will aim to predict the consequences of stock management strategies for Ireland's lake fisheries. Ultimately, a robust model of pike ecology will enable decision-making for a scientifically based IFI pike policy.

The project team—Paul McLoone, Sinead O'Reilly and Colm Fitzgerald—is led by Fiona Kelly and Sam Shephard. The team gratefully acknowledge the assistance of Stephen Robson and of Business Development, ShIRBD and WRBD staff.

Perfect camouflage: a pike disappears back into the weeds

Eel Migration: the Long and Dangerous Road to the Sargasso Sea

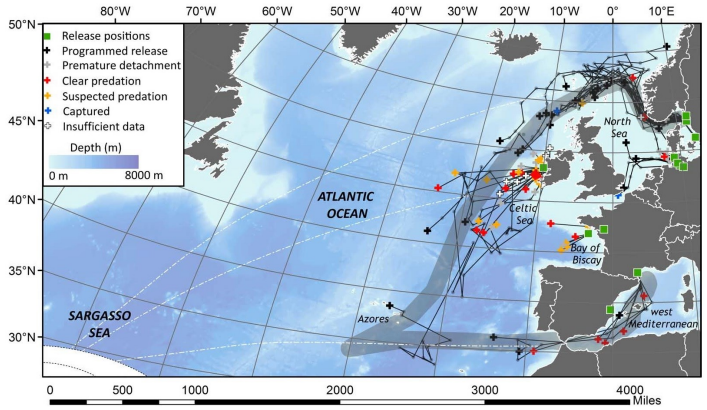
Since the early 20th century, scientists have believed that European eels spawn in the Sargasso Sea, a remote area of the Atlantic Ocean almost 5,000 km from Ireland. In October in Science Advances, Paddy Gargan of IFI and colleagues on the Eeliad project reported new insights into how eels achieve this incredible migration.

Silver eels tagged with PSATs

Around Europe, adult silver eels captured on their winter migration to sea were fitted with electronic tags that were programmed to record water pressure, temperature and ambient light, and then to subsequently detach. Some tags were recovered when they floated back to the coast, whereas others were pop-up satellite archival tags (PSATs): after detaching, they floated to the surface and transmitted their data via satellite. The Eeliad scientists reconstructed the eels' likely route using this data and oceanographic information to reach a surprising conclusion.

The data indicated that not all eels simply swim straight across the Atlantic to spawn the following spring, as previously widely believed. Some eels probably do, but the new data showed that other eels swim slowly and must take longer to cross the Atlantic, and they probably spawn the following year. Some eels seem to follow an indirect, convoluted route along ocean currents that flow south to the Azores, then west to the Sargasso.

The data showed that eels swim from shallow to deep water between night and day, perhaps to regulate temperature, to navigate or to avoid predators. This strategy does not always work—for approximately half of the eels that reached open waters, the tags recorded spikes in temperature or changes in depth that suggest that the eels were eaten by marine mammals or fish.



Reconstructed migrations of European eels

The eel that travelled furthest was Irish, meandering about 6,982 km from Galway Harbour until its tag popped off 273 days later near the Azores. Let's hope it made it!

Research Seminar: What Acoustic Telemetry Reveals About Fish & Their Environment

On Monday 5th December, staff at IFI Citywest enjoyed a visit from Dr. Nicholas Payne of the Roehampton University Behavioural and Energetics Lab (RUBEL). Nick has studied the movement patterns, biogeography and energetics of a fascinating array of marine animals, such as giant cuttlefish, ocean sunfish and tiger sharks. In his talk "How does temperature influence fish performance in the wild?", Nick illuminated a fundamental principle in fisheries science: fish biology is governed by water temperature.

Nick's work on the activity levels of fishes found in estuaries along Australia's east coast involved acoustic telemetry, a method in which data loggers attached to fish transmit information about their movements to receivers. The telemetry data showed that there is a clear relationship between the distribution of estuarine fish species over a wide range of latitudes and their optimal temperatures for swimming activity, growth and reproduction.

Acoustic telemetry has become an important tool for researchers in the R&D Division who track the movements of migratory fish species, and Nick faced some enthusiastic questions on the use of this technology.

Nicholas Payne at Citywest HQ

Sea Lice & Sea Trout: Can We Quantify the Influence of Salmon Farms?

Sea lice are parasitic copepods: small crustaceans that attach to fish to feed on their mucus, skin and blood, thereby causing physical damage to the fish. Sea lice infestations of wild sea trout in an era of increasing marine finfish aquaculture are a major concern for the angling community. This year, IFI contributed two research papers that address gaps in knowledge on this issue.

Earlier this year in the ICES Journal of Marine Science, Paddy Gargan, John Coyne and Willie Roche of IFI and co-authors reported a study on levels of the sea lice *Lepeophtheirus salmonis* and *Caligus elongatus* on sea trout in the Irish Sea over a wide area where there are no marine salmon farms. The study, which was part of the Celtic Sea Trout Project, concludes that sea lice abundance in the Irish Sea probably represents the natural background levels of sea lice on sea trout around Ireland.

Sea lice at different ages

Salmon farm in Killary Harbour. Inset: sea lice on a sea trout fin

In October, the journal Aquaculture Environmental Interactions featured a paper by Sam Shephard and Paddy Gargan of IFI and by the Argyll Fisheries Trust on the influence of distance from salmon farms and of climate on sea lice infestations. Statistical modelling of a massive 25 year dataset with >20,000 sea trout sampled from 94 river systems in western Ireland and Scotland indicated that sea trout captured closer to salmon farms had significantly higher levels of lice infestation, especially in warmer years, and also had significantly reduced body condition, especially in dryer years.

The paper concludes that these sub-lethal effects of sea lice on wild sea trout and their relationship with proximity to marine salmon farms has implications for current lice control strategies and the recovery of sea trout stocks.

Why are Some Salmon Springers? A Clue from the Logbooks

Every year, salmon anglers look forward to the arrival of springers—those large, fresh Atlantic salmon that return from the sea in the cold months of early spring. In contrast to the summer run of grilse, springers must spend longer holding up in deep river pools or in lakes before spawning the following winter. A fundamental aspect of this migration is poorly understood: why do springers leave their rich marine feeding grounds and return to rivers months before spawning time?

A paper by Reed *et al.* in the Canadian Journal of Fisheries and Aquatic Sciences tackled this question with the help of Kealan O'Higgins, Paddy Gargan and Willie Roche of IFI. The co-authors collated information from anglers' logbooks on spring runs of multi-sea-winter salmon and summer runs of grilse in 70 river catchments. The data were modelled against two potential explanatory variables, lake habitat and river width. The results indicated that some variation in salmon runs was explained by a higher frequency of spring-migrating salmon in catchments with more accessible lakes and, to a lesser extent, larger river size.

A happy angler from R&D with a Carrowmore Lake springer

Reed *et al.* speculate that spring migration in Irish salmon may have evolved to offset mortality by trading off the opportunity to feed at sea, with its associated risk of marine predators, for the increased likelihood of surviving to spawn by holding up in freshwater habitat. This interesting insight into the salmon's life history would not have been possible without the Wild Salmon and Sea Trout Tagging Scheme or without the effort by IFI staff nationally to collect salmon catch statistics and fish counter data.

Transitional Waters Surveys 2016

R&D staff operating under the Marine Sport Fish Programme had a busy autumn, surveying several estuaries on the south coast to assess the ecological status of their fish communities. The team used beach seines, fyke nets and beam trawls to survey four large estuary systems: the Bandon, Barrow, Nore and Suir Estuaries.

The team also surveyed two small lagoons in Co. Kerry with an interesting contrast in fish community diversity. Lough Gill is fed by two freshwater streams, and brown trout, three-spined stickleback and eel dominated the seven species present. In contrast, Drongawn Lough has a tidal input and had more marine fishes among the 15 species present, including pollack, pipefish, wrasses and lesser-spotted dogfish.

Readers' challenge: can you identify these species?

A large haul of sprat in the Bandon Estuary

The National Bass Programme and Habitats Directive Monitoring Programme also collaborated on a survey with a commercial trawler in two estuaries—the Munster Blackwater and the Barrow—to assess populations of bass and listed conservation species, such as smelt and shads. Some bass were floy-tagged prior to their release to help track Ireland's bass populations. The National Bass Programme also conducted beach seine surveys for juvenile bass on the Slaney, Barrow, Suir, Munster Blackwater and Tralee Estuaries.

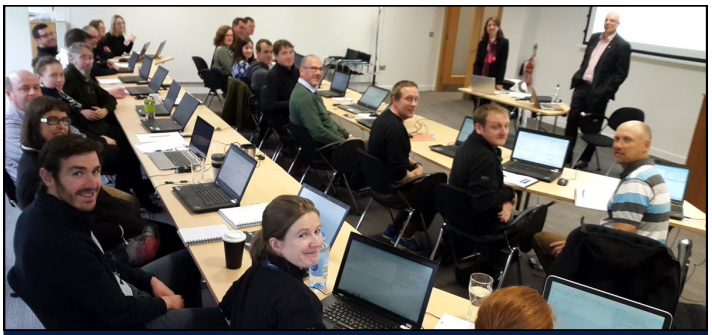
Trawl coming aboard near Cheekpoint, Barrow Estuary

Training Workshops in R, Fish Welfare & Fish Ageing

Over the past few months, R&D staff have taken part in workshops to enhance skills in key areas for IFI's research programmes. In October, Alain Zuur and Elena Ieno of Highland Statistics presented a challenging course on R, a programming language for statistical analysis. Participants gained a great insight into data exploration and R coding that will be very beneficial in making the most of IFI's data.

In November, Susie Mitchell and colleagues of Vet-Aqua International presented a quite wide-ranging course on fish health and welfare. The course provided an overview of fish disease, a demonstration of fish anaesthesia as well as topics such as stress in fish, biosecurity and transport of fish.

Finally, in November, R&D staff were joined by their counterparts from Northern Ireland's Agri-Food and Biosciences Institute for a workshop in fish age analysis. Participants jointly evaluated scale and otolith samples from a diverse range of freshwater species. The workshop aimed to standardise the methods used for fish age analysis.



Ready for R in the Citywest Training Room

So what age is it? A magnified pike scale

AMBER—Adaptive Management of Barriers in European Rivers

On Monday 28th November, IFI celebrated its involvement in the AMBER project with an official launch at Citywest HQ. Staff from IFI joined project partners and interested stakeholders from other institutions for talks by James Barry, Paul McLoone and Alan Cullagh of IFI that provided context for this initiative in river connectivity.

Over the centuries, Europe's rivers have been harnessed as a resource for navigation, hydropower and water abstraction with the installation of dams, weirs, etc. This infrastructure fragments river ecosystems and, from a fisheries perspective, obstructs fish movement. This is a major problem for migratory fish species—such as salmon, eel, lampreys and shads—because it prevents them from fully dispersing into potential river habitat.

James Barry with a salmon on the Munster Blackwater

Funded by the EU Horizon 2020 programme, AMBER (**A**daptive **M**anagement of **B**arriers in **E**uropean **R**ivers) involves 20 partner organisations in 11 countries working together to map barriers to connectivity in Europe's rivers. AMBER hopes to use innovative approaches, such as harnessing citizen science through a smartphone app. The project will also develop an environmental DNA (eDNA) tool, in which DNA is extracted from water or sediment samples to assess species distribution around barriers.

At the launch, James Barry described how IFI is contributing to AMBER by compiling data on river barriers around Ireland. A survey of the River Nore catchment identified 500 barriers, and surveys by IFI staff around the country are ongoing. Paul McLoone also described boom-boat electrofishing surveys of the current fish

Sea lamprey—a migratory species that benefits from barrier mitigation

community structure in sections of the Munster Blackwater impounded by weirs. As part of AMBER, IFI will look at improving fish passage at large weirs on the Munster Blackwater to open up spawning habitat for sea lamprey, a priority species for conservation.

Attendees at the launch also enjoyed an engaging talk by Alan Cullagh from IFI Clonmel on the growing complexity of designing and planning fish passages. Alan illustrated his talk with examples of barriers that were removed or that were modified with a fish pass or a fish-friendly by-pass channel. One such project on the Nore was Castletown Weir, where a rock ramp recreates a gently sloped riverbed, allowing fish to swim freely past the weir.

Dr. James King, who leads the AMBER project in IFI, was very pleased with the interest in the launch and points out that this interface of theory and practise is one in which IFI and its predecessors have always been active. Through links with EU partners, the AMBER project should be fruitful in identifying new technologies and strategies that IFI can use to mitigate barriers to fish passage and to ensure the connectivity of river ecosystems.

Fish-friendly rock ramp at Castletown Weir, Co. Laois

Iascach Intíre Éireann
Inland Fisheries Ireland

We Hope You Enjoyed the Newsletter

Feedback is always welcome, so please get in touch if you have any comments.

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