Pike Research Programme Scientific FAQs

Iascach Intíre Éireann
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What were the main scientific objectives addressed in this study?

- Describe the seasonal diet of pike in Loughs Derravaragh and Conn, and assess any dietary change since colonisation by invasive roach.
- Develop statistical models to predict the probability of coexistence between pike and trout in Irish lakes.
- Investigate whether invasion by roach has changed the likely effectiveness of pike removal as a tool for brown trout enhancement in Lough Sheelin.
- Develop a mathematical modelling tool that could project the likely outcomes of a set of candidate fisheries management strategies, quantify uncertainty and support objective decision making.

What were the main scientific findings?

- Invertebrates were common in the diet of pike in both study lakes, but pike also fed on fish from very early stages in their life history. Roach were the most important fish species consumed by pike in both lakes. Other fish which appeared in the diet of pike in both lakes included perch, stickleback, trout and pike. The greatest proportion of trout in the diet occurred in April on Lough Derravaragh and May-June on Lough Conn. This observed peak in trout predation coincides with the period of downstream migration of river trout to lake environments.

Prey selectivity indices indicated that there were more roach and less perch in pike stomachs than would have been expected from the relative abundance of these species in the lakes, while the number of trout in pike stomachs reflected lake abundance.

Comparison of current pike diet with data from the 1960's and 1970's indicated a profound shift in the diet of pike in Loughs Derravaragh and Sheelin: perch and trout were the dominant fish prey in the early period, while roach are now most important.

- Statistical models suggested that relatively large, deep lakes with strong stream connectivity are likely to support coexistence of pike and trout. However, pike introductions to small low-complexity systems have potential for strong negative impacts on resident trout populations
- In Lough Sheelin, the shift in pike diet from trout to roach was associated with contrasting effects of pike removal on survey abundance of trout in the following year. Pike removal had some positive effect on trout in years of 'low' roach abundance, but little effect at 'high' roach abundance.
- A mathematical model was developed to express key features in the population dynamics of trout and pike, including predation by pike on trout and on alternative prey species. Management Strategy Evaluations using this model supported empirical evidence that the likely effect of pike removal on trout populations will change strongly with the abundance of alternative prey, e.g., invasive roach. The model showed that angling probably has a stronger impact on trout than pike predation.

Can you give me a simple summary of the results?

The overall picture in the lakes studied here is of systems that show strong ecological changes since pike management was initiated in the 1950s. While pike do consume trout (seasonal peaks coincide with the period when juvenile trout move out of streams) pike diet seems to have shifted significantly from trout and perch to roach where the latter species has invaded.

This shift means that pike removal may no longer be a very effective trout enhancement tool in larger lakes where the fish community now includes established populations of roach and other potential prey species. These larger well-connected systems also provide habitat diversity and potential spatial refuges that can better support on-going coexistence of pike and trout.

A different situation exists in smaller lake systems, where pike may have appeared relatively recently and where brown trout remain the only available prey fish. In these situations, coexistence of pike and trout is unlikely.

Outputs from the mathematical model show 'considerable uncertainty' in the estimates of exploitable brown trout biomass. Does this uncertainty invalidate the results?

Any forecasts of natural systems have associated uncertainty. The important factor is to quantify and acknowledge uncertainty, and convey this to stakeholders. The size-based modelling approach applies cutting-edge concepts in population modelling, and quantifies uncertainty arising from underlying ecological assumptions. The level of uncertainty observed in the current model outputs suggests that general trends can be accepted, i.e., the relative effects of different management strategies, but absolute levels of predicted brown trout biomass are less reliable.

There is no mention in the executive summary of the impact of pike on migratory salmonids – what is the impact here?

The seasonal diet study found that the greatest proportion of trout relative to other fish prey in the diet of pike occurred in April on Lough Derravaragh and May-June on Lough Conn. This peak coincides with the period of downstream migration of river trout to lake environments. This observation agrees with evidence that pike are flexible and opportunistic feeders, targeting whichever prey is most available and that lake entry is believed to be a pike predation bottleneck for salmonids in natural lakes with hydropower barriers and reservoirs. Further study is required to quantify the potential effect of such peak predation events on brown trout populations.

Is the complex statistical and mathematical modelling used in this report obscuring the results?

This research utilises recent best-practice in statistical and mathematical modelling. Standard statistical methods (e.g. general linear models and Bayesian modelling) were applied to historical data and to data collected during this research in order to advance understanding of the factors determining pike-trout coexistence, the nature of pike diet on several lakes, and the likely effects of roach invasion on pike and trout ecology and management.

This research also utilises mathematical modelling methods from fisheries science to project the likely outcomes of a set of fisheries management strategies, quantify uncertainty and support objective decision making. This ecosystem-based modelling approach to fisheries management is considered best practice for inland and marine fisheries systems and supports management evaluation for numerous fish stocks globally.

The report states that most fish were captured in the marginal (littoral) zone, does this bias the results?

Pike are considered to be a littoral species, i.e., they typically inhabit the shoreline or other shallow areas of the lake. The sampling programme for this study aimed to catch as many pike as possible, and so sampling concentrated on the main (littoral) habitat where most pike are found. This sampling protocol is in contrast to long-term sampling programmes, e.g., for WFD reporting, which aim to provide standardised whole lake abundance indices that track relative abundance of given fish species through time.

The earlier data (1960's and 1970's) was also collected in the marginal areas and it is therefore directly comparable.

Historical studies in L. Derravaragh recorded only one species or prey group, how does this affect the analysis? How many prey items would typically be expected?

Because individual numbers of prey were not evaluated in the earlier period, the Frequency Occurrence metric was used to compare diet across eras. Effectively this means that additional smaller prey items (e.g. invertebrates if consumed with trout or perch) may be under represented to a small degree in the earlier period. No inter era difference in consumption of invertebrates was detected suggesting that impact upon results was unimportant.

Given the level of historical stocking of trout in these catchments – how would this affect the analysis?

This question was not specifically analysed but it can be speculated that pike might opportunistically target naïve stocked brown trout, and that this may have contributed to historical observations of trout in pike stomachs.

On Lough Conn, a large proportion of samples were taken from two locations (Enniscoe Bay and the River Deel), while on Lough Derravaragh most samples come from the Roach Hole and Inny inflow. Does this sampling pattern bias the feeding study?

The sampling programme for this study aimed to catch as many pike as possible for the feeding study, and so sampling concentrated on the habitats where pike were most likely to be found. This sampling protocol is in contrast to long-term programmes, e.g., for Water Framework Directive reporting, which provide standardised abundance indices based on whole-lake surveys to track relative abundance of given fish species through time.

Does Inland Fisheries Ireland have an opinion on the rationale for the negative selectivity ratio associated with perch?

Pike showed a positive feeding ratio for roach and negative ratio for perch. It may be speculated that perch spines make this species more difficult for pike to handle.

What were the main conclusions of the Inter-era comparison of pike diet on Derravaragh and Sheelin?

The main conclusion is that pike diet was dominated by perch and brown trout in the historical period but is now dominated by roach. The roach invasion can thus be inferred to have reduced pike predation pressure on trout. This effect may have changed the effectiveness of pike removal as a tool for trout enhancement.

Can you please outline in layman's terms the results of the coexistence analysis?

This analysis explores abiotic factors that might influence the probability of successful coexistence of pike and trout in Irish lakes. The results suggest that larger lakes with a high level of stream connectivity are likely to support coexistence, while small and poorly-connected lakes have a very low probability of coexistence.

Note: The co-existence analysis is based on the presence & absence of trout and pike in an Inland Fisheries Ireland survey of 821 lakes.

Please explain in layman's terms: "Removing top predators may have unanticipated and potentially negative effects on target fish stocks in systems experiencing multiple anthropogenic pressures".

The ecology of the designated Irish trout Lakes has changed markedly since the 1960s, when these systems were reasonably pristine and the fish community was dominated by brown trout and pike. The lakes currently experience impacts from agricultural run-off, invasive species, angling and other human pressures.

These factors probably interact to influence the fish community and the relative abundance of particular species. In this complex environment, the effect of removing a predator such as pike is difficult to predict and may be negative in terms of its impact on trout stocks. The Inland Fisheries Ireland study suggests that pike removal may have benefited trout in the healthier lake systems of the past, but is likely to be much less effective in the current impaired situation.