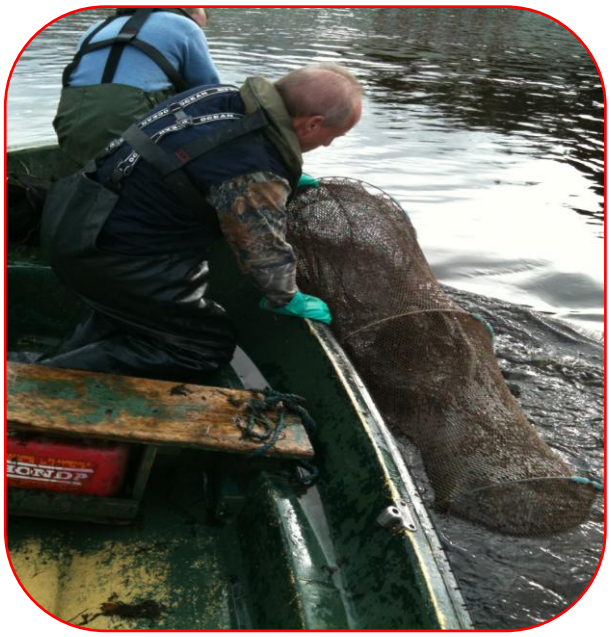
Lough Erne Fishery Management Plan



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1. Foreword

The Inland Fisheries Group (IFG) of the Department of Culture, Arts and Leisure (DCAL) has a statutory responsibility for the conservation, protection, development and promotion of salmon and inland fisheries as set out in the Fisheries Act (NI) 1966. The commercial and recreational fishing sectors make an important contribution to the socio-economic development of the local economy through employment, income, and exports as well as contributing to the health and well being of people.

The IFG strategy states that: “IFG aims to manage our natural fisheries resources in a sustainable way to add social and economic value. To do this we conserve, protect, develop and promote recreational and commercial fisheries, by developing evidenced based policy, working with partners, educating the public and delivering service excellence to our customers”.

There is broad support from fisheries stakeholder interests for IFG to develop a more strategic long term approach to the management of the fish stocks in both Upper and Lower Lough Erne and its tributaries in view of the many activities that impact on it from both internal and external sources. For this to be meaningful it requires a catchment based approach of integrated fisheries management, combining both biological considerations and social and economic considerations.

The aim of the Fishery Management Plan (FMP) is to provide this strategic approach to the sustainable management of the fisheries resources and its habitat whilst also maximising its value to the economy and the environment and ensuring stakeholder input to it.

The draft FMP sets out how IFG will seek to manage the fishery and what scientific information is required to fully inform this process. It also highlights many of the key issues / concerns raised by stakeholders in consultation meetings that have taken place to date. There is wide recognition that the Erne catchment has the potential to play an even more significant role in contributing to the development of the local economy.

We will do this by:

- Conserving, protecting, enhancing and restoring fish stocks and their habitat in the Lough and its tributaries
- Maintaining and developing fisheries for both the angling and commercial sectors
- Optimising long-term and sustained economic and social returns to local communities dependent on fishing and addressing poverty and social exclusion
- Using the best available science to inform management decisions
- Engaging with stakeholders, involving them in the management process and to ensure transparency in any decisions taken
- Developing education programmes that promote compliance and understanding of fisheries regulations

2.1 OVERVIEW OF THE FISHERY

Lough Erne

Lough Erne is the collective name for two inter-connected lakes in County Fermanagh, Northern Ireland. It is the fourth biggest lake system on the island of Ireland. The Lough Erne catchment consists of two sub lakes (Figure 6.1), Upper and Lower Lough Erne and drains an area of 4,306km^2 with 44% of the catchment in the North and 56% in the South of Ireland (McElarney et al., 2015). The town of Enniskillen lies on the banks of the River Erne between the Upper and Lower Loughs. This catchment can be divided into 13 sub catchments (Figure 1). The catchment land use is mostly agricultural (70% of the catchment), forest cover makes up 14.8% of the catchment and urban cover is low at 1.9% (McElarney et al., 2015).This system makes up one of the most complex and interesting water bodies on the island of Ireland (Gibson, 1998). The Lough Erne catchment:

- Surface Area: Upper: 34km^{2,} Lower: 110km^2
- Average depth: Upper: 2.3m, Lower: 12m
- Maximum depth: Upper: 27m, Lower: 66m
- Maximum length: Upper: 42km Lower: 19km
- Maximum width: Upper: 5km Lower:16km
- Trophic status: Eutrophic
- Major tributaries: Termon, Bannagh, Kesh, Ballinamallard, Colebrooke, Finn, Annalee, Upper River Erne, Woodford, Swanlinbar, Arney, Sillees, Lower River Erne

Water levels in Lough Erne are regulated by the Electricity Supply Board in the South and the Rivers Agency in the North under the terms of an agreement made in 1950 when the lower River Erne was harnessed for hydroelectric power generation (DARD, 2015). The agreement stipulates that levels are maintained in the Upper Lough between 45.72 – 46.93 m ordnance datum (OD) in the period April to September and 47.24 m during the period spanning October to March. In the Lower Lough the level is maintained between 44.8 and 46.3 m OD throughout the year.

Water levels are controlled by structures such as sluice gates at Portora and power stations at Cliff and Ballyshannon.

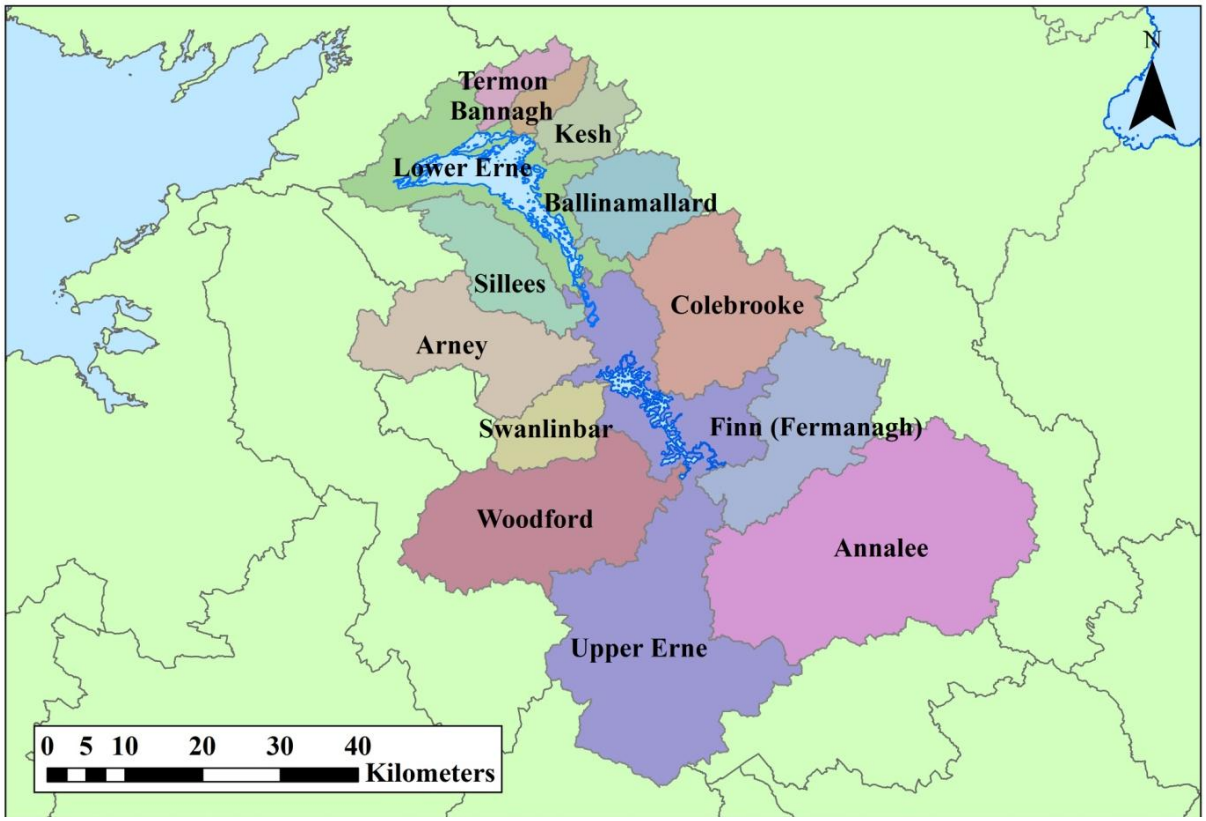


Figure 1: Lough Erne and surrounding river catchments (taken from McElarney et al. (2015))

The Fishery

The Lough Erne mixed fishery is of considerable socio-economic importance. Boat hire for angling is a significant tourist activity in the area, together with other businesses that contribute to the tourist industry including recreational fishing (Rosell, 2001). In both Upper and Lower Lough Erne there is much local and international interest in angling with good catches of pike, perch rudd, bream and brown trout annually. Coarse fishing from boats has been prohibited in the north western area of Lower Lough Erne, with only game fishing from boats permitted. Throughout the rest of the two lakes both coarse and game fishing can be practiced from shore and boat.

Until 2009, Lough Erne supported a commercial eel fishery. Between 10 and 16 commercial fishing licences were issued annually between 2007 and 2009 (DCAL,

2014); subsequently commercial eel fishing was prohibited on Lough Erne from 2010 due to a pan-European decline in eel abundance and a need for conservation led management. Currently the only significant commercial fisheries are a small pike fishery consisting of only two to six active fishermen and a conservation eel fishery which captures migrating eels and transports these past the hydro-electric stations.

Governance/Policy

The fishing rights for Upper and Lower Lough Erne are owned by DCAL and are managed as part of the Department's Public Angling Estate. It has been the Department's long established and generally accepted policy that Lough Erne and its fisheries should be used primarily for recreation and amenity purposes, while respecting the rights of the traditional commercial fishermen. Lough Erne is central to the maintenance and development of the tourist industry in Fermanagh and its surrounding area.

To fish on Upper or Lower Lough Erne, recreational anglers require either a game or coarse rod licence (unless under 12 years of age) and either a game or coarse DCAL permit. The game angling season is from 1 March to 30 September and the Lough is open for coarse angling all year round. As rod licences are valid throughout the DCAL jurisdiction it is not possible to indicate the specific numbers of anglers fishing Lough Erne.

Commercial fishermen require the appropriate licence for their fishing engine and a DCAL permit. DCAL's current policy has capped the number of permits issued to 24 with no further permits being issued for the harvesting of scale fish once fishermen either retire or become deceased. The commercial eel fishery on Lough Erne closed in 2010 and as a conservation measure to ensure that the EU eel escapement target for the catchment is being met. The Lough is open for commercial fishing from 1 December to the last day of February and currently the only scale fish permitted to be taken is pike.

Table 1 - Analysis of Lough Erne Commercial Licence sales 2005-2014

Year	Eel long line <1200hooks*	Coarse Net**	Fyke Nets*	Bait nets*
2005	15	2600	46	8
2006	15	3000	20	12
2007	16	3200	56	9
2008	11	2900	68	8
2009	10	2800	20	5
2010	1	2800	2	1
2011	Nil	2800	Nil	Nil
2012	Nil	2800	Nil	Nil
2013	Nil	2400	Nil	Nil
2014	Nil	2300	Nil	Nil

Footnotes:

* All fishing for eels on Lough Erne prohibited by The Eel Fishing Regulations (NI) 2010;

** Licensed in 100m lengths, no limit on total length purchased by an individual.

DCAL's policy on the management of inland fisheries is derived from various domestic and international legislation and guidelines and the main ones are listed below:

The Fisheries Act (NI) 1966 provides for the conservation, protection and development of inland fisheries;

The Public Angling Estate Byelaws (NI) 2005 prescribes permitted methods of angling and bag limits for PAE waters;

The Fisheries Regulations (NI) 2014 regulates recreational and commercial fishing activity for all fish species bar eels;

The Eel Fishing Regulations (NI) 2010 prescribes methods of fishing, minimum sizes and time for eel fishing;

Council Regulations (EC) No. 110/2007 established measures for the recovery of the stock of European eel, necessitating the implementation of Eel Management Plans for all river basins including the Erne;

Water Framework Directive (2000/60/EC) to protect the water environment and to achieve "good status" for all waters;

Habitats Directive 1992 defines a common framework for the conservation of wild plants and animals and habitats of Community interest. This protection extends to both pollan and salmon;

North Atlantic Salmon Conservation Organisation (NASCO) whose objectives are to conserve, restore, enhance and rationally manage Atlantic salmon through international co-operation.

Economic, Social and Cultural Importance of the Fishery

Good quality, well-managed fisheries are a valuable asset which can make a significant contribution to social and economic conditions in the immediate area. Research undertaken for Inland Fisheries Ireland in 2013 indicated that up to 406,000 individuals participated in recreational angling in Ireland in 2012, with an estimated total direct expenditure on angling of €555 million, of which an estimated €121 million was generated by visiting anglers.

Lough Erne is a large wild fishery and is a major attraction for visiting anglers who are more used to fishing in highly managed, stocked venues. Coarse match angling has been particularly popular over the years, with major annual competitions such as the Classic Fishing Festival regularly drawing over 200 visiting anglers to the area for a week. In 2014 Fermanagh District Council estimated that visiting anglers participating in the Classic generated around £200,000 in local revenue over the week and all coarse matches over the year around £630,000.

A wide range of local businesses derive economic benefit from the various disciplines of recreational angling on Lough Erne. DCAL recognises the potential to generate socio-economic growth through further enhancement of angling on Lough Erne as anglers will spend varying amounts of money on accommodation, food and drink, and fishing tackle etc.

The number of licensed commercial fishermen on Lough Erne has decreased in recent years and the commercial eel fishery was closed in 2010 as a condition of the North West International River Basin District (NWIRBD) Eel Management Plan. While the economic value of the commercial fishery has declined there are still important social and heritage benefits provided by the remaining fishermen. The commercial fishermen also operate the “trap and truck” eel conservation fishery in conjunction with the Electricity Supply Board (ESB), Inland Fisheries Ireland (IFI) and DCAL.

Fishery Management Plan Process

This draft Fisheries Management Plan has been developed through engagement and dialogue with relevant stakeholders and is now subject to full public consultation which will include distribution of the document to key stakeholders, advertisement in daily newspapers and publication on the DCAL website. As part of the consultative process we will engage with interested groups and Assembly Committees as appropriate, to ensure that as wide a range of views is reflected in the final analysis. Following collation and consideration of responses, a final Plan will be submitted for Ministerial and Assembly approval. Implementation of agreed proposals will be subject to budgetary cover and the plan will be subject to review every three - five years. Where legislative change is required, this too will be subject to public consultation and the normal Ministerial and Assembly approval processes.

2.2 FISH STOCKS

Biological Synopsis

The fish community of Lough Erne is relatively simple and internationally renowned for trout, pike and coarse angling. It is currently dominated by the non-native species perch (*Perca fluviatilis*) and roach (*Rutilus rutilus*). Pike (*Esox Lucius*), also probably non-native, are the major predatory fish species in Lough Erne, with larger specimens of perch and trout also exhibiting some piscivorous behaviour. Pike, perch and roach are keystone species in European lakes, as they have been shown to affect ecosystem function or population structure under certain conditions, e.g. by predation on other species (pike), grazing on phytoplankton (roach), and in changing the ratio between species associated with the impact of the zebra mussel (perch and roach) resulting in an apparent shift in expression of lake trophic condition (Brabrand et al., 1986b, Kurmayer and Wanzenböck, 1996).

Roach are unusual in the context of European freshwater fish as they are generalist omnivores throughout their lifecycle. They switch from a juvenile diet of zooplankton to a diet dominated by macroinvertebrates as they enter sexual maturity. The generalist diet, efficient zooplanktivory and rapid recruitment are all perceived factors in the capacity of this species to succeed in eutrophic lakes outside of their natural distribution (Rask et al., 2000, Fitzmaurice, 1981), presumably through competitive superiority over native or other resident fishes (Persson, 1991, Bergstrand, 1990, Persson and Greenberg, 1990). Perch are carnivorous throughout their life cycle, but follow a marked and well documented ontogenetic shift from zooplanktivory, benthivory through to piscivory (Svanbäck and Eklöv, 2002, Hjelm et al., 2001). Perch tend to dominate fish communities when present in mesotrophic lakes.

While the island of Ireland has approximately 4,000 lakes larger than 5 ha, the rare and protected pollan (*Coregonus autumnalis*), a whitefish, only occurs in 5 large lowland waterbodies: Lower Lough Erne, Lough Neagh, Lough Allen, Lough Derg and Lough Ree (Harrison et al., 2012, Harrod et al., 2002). It is thought that each population has been isolated from conspecific populations since the last glacial maxima (circa 10,000 years ago) and therefore gene flow between waterbodies is unlikely. The presence of pollan in Lough Erne affords the lake an elevated conservation status. The pollan stock in Lough Erne is small but early signs suggest it may be increasing (Rosell, 2014).

Stock Assessment

Lower Lough Erne fish stocks have been monitored at three yearly intervals since 1991 using a standard series of survey gill nets set in margin habitats from July to September. These surveys provide an index of fish stock status over a twenty-two year period (Rosell, 2014, Rosell, 2012, Rosell and MacOscar, 2002, Rosell, 2001, Rosell, 1994).

Rosell (2014) found that roach and perch now dominate the catches by number and biomass, with a marked and consistent long term shift from roach to perch as the most abundant species by number present, consistent with changes brought about by zebra mussel colonisation. Perch now outnumber roach by three to one in samples, a complete reversal of the ratios of the early 1990s. This shift is also reflected in total biomasses of roach and perch caught, but the greater mean individual biomass of roach means that there is currently equal biomass of these species. Rosell (2014) also states that the two year period prior to 2013 appear to have been historically poor for roach recruitment which may further the shift from roach to a perch dominated fish community over the next 5 to 6 years as older roach pass out of the population. A small but significant number of unusually large perch taken in the 2010 and 2013 surveys indicate an increase in the growth capacity of perch for the cohorts produced post zebra mussel introduction.

Rosell (2014) found that there has been a marked decline in bream stocks over the past 20 years, alongside an increase in the number of roach/bream hybrids. Factors bringing together the spawning seasons, fertilisation of bream eggs by the more abundant roach, along with infertility of most hybrids appear likely to be the key drivers of this decline. Rosell (2014) postulates that this situation cannot persist indefinitely if bream maternal stock falls too low to generate further quantities of hybrids. Roach/bream hybrids are longer lived than either parent species and some of the hybrids present now are set to persist as a significant element of stocks for a further decade despite the very low bream parent stock.

Rosell (2014) explains that there are significant problems in understanding trends in brown trout numbers present. While numbers in nets tailored to sample large fish appear to be relatively stable, numbers of smaller trout encountered in recent

surveys are low in the long term context. Given that large trout must have grown on from smaller fish, and that river stock surveys of juvenile fish potentially available to migrate to the Lough are also relatively stable, these two observations do not seem to tally. Behavioural or distributional change in the smaller trout fish reducing their catch-ability in margin nets in summer may be a possible explanation

Pike show a similar phenomenon to trout in the summer surveys, with reduced catches of small pike apparently not linked to any reduction in larger fish. A pike targeted survey in spring 2013 (Rosell, 2013), found the pike stock to be within the numerical range of earlier data (1990s) (Rosell, 1994) but with a higher mean individual size. The reasons for the differing results for young and mature pike are not clear, but could indicate recruitment issues in 2012 and 2013. Fluctuations in lake levels due to works on the hydroelectric dams on the efferent river Erne could affect pike egg survival as the spawn is laid in shallow water which could dry out if levels fall within 6-8 weeks of spring spawning.

A limited open water survey in August 2013 revealed again that the stocks of fish over the deep water of the Broad Lough are very different from those of the margins. The survey found trout in a subsurface layer, mid-water pelagic young of the year perch and pollan at 20-30m deep on a dividing line between warm surface and deep cold water. Pollan numbers were the best recorded in samples since their very low stocks in early 1990s.

Upper Lough Erne has been covered by EU water framework directive compliant (CEN, 2005) netting surveys at dates in 2010 and 2013. The time series is as yet too short to be clear about major trend, but significant features of the recent two surveys are the very small catches of bream (mirroring results from Lower Lough Erne), variable perch recruitment with potential differences between Upper and Lower Lough patterns, and low trout numbers when compared to the Lower Lough.

In addition to the lake surveys many of the catchment's rivers and streams are routinely monitored for stock status and international reporting (ICES and NASCO). This also feeds local DCAL area allocation of any available harvest quota. The data are reported annually in arrears on the DCAL digest of fishery statistics (Link).

Genetics

There is a paucity of genetic data relating to fish from the Lough Erne catchment. AFBI has completed a small study on genotyping salmon from the Garvary River. To be useful for fisheries management this study would have to be expanded to include all afferent and efferent rivers and streams. Questions that require answering are:

What contribution (if any) has salmonid stocking had on the fish stocks?

Has stocking affected the genetic integrity of wild salmonid populations?

Are there genetic differences between trout originating in the feeder streams?

Are there any barriers preventing gene flow in the system?

A study emulating that conducted on Lough Neagh by Keenan and Prodohl (2015) would answer most of these questions.

Stocking

Freshwater fish throughout Ireland have been frequently moved and stocked to new waters, and populations manipulated by man either intentionally or inadvertently for centuries (Rosell et al., 2012). Transfer and stocking of fish maybe carried out to create new recreational or commercial fisheries, for mitigation or restoration of loss of fish through pollution events or over-exploitation, to enhance angling opportunities through increasing stock density or by adding a novel species (Rosell et al., 2012).

A major shift is underway in the scientific view of the long term desirability of some stocking practices, capable of at worst, damaging genetic diversity within species (Rosell et al., 2012) and at best having no major long-term significant impact on stock density (Keenan and Prodohl, 2015). This work has started with salmonids, and has demonstrated a degree of local adaptation to environments. Advice flowing from this field of research indicates that supplemental stocking with non native / local strains, or other hatchery selected fish might sometimes at best achieve nothing in terms of long term contribution to wild stocks and might even cause harm by weakening or taking resource space from those wild stocks.

Until now there has been a salmon and trout stocking programme in the Lough Erne catchment. Over a 25 year period it is estimated that approximately 17 million

salmonids (Brown Trout & Salmon) have been stocked into the Lough Erne catchment system. In light of recent genetics studies conducted in the Lough Neagh catchment, future stocking programmes in the Lough Erne catchment should fully consider the information gleaned from Lough Neagh by Keenan and Prodohl (2015), and must have precise objectives to prevent biodiversity loss. Until such study is undertaken resources should be prioritised to habitat restoration.

Traditional or local Ecological Knowledge

Incorporating traditional ecological and fishers' knowledge is a an approach taken in fisheries research that has a history spanning generations, yet traditionally has failed to become incorporated in fisheries science and management alongside approaches that rely primarily on the knowledge of professional scientists (Hind, 2014). This knowledge is often passed down generation to generation and some learned first-hand through personal experiences and therefore provides an insight into long term ecological trends or fluctuations. Effective and sustainable fishery management plans can potentially be developed with the aid of traditional ecological knowledge and compliments a scientific research programme. Local fishermen hold a wealth of industrial, fishery, ecological and environmental knowledge that is pivotal to the fishery management plan.

Invasive Species

Non-native invasive species are one of the greatest threats to biodiversity worldwide and this threat is amplified on islands with depauperate flora and fauna such as Ireland. Invasive species often out-compete or prey upon native species resulting in the domination and often bioengineering of the occupied habitat and environment.

The zebra mussel is a freshwater bivalve which attaches itself to hard substrates. It is native to the Ponto-Caspian region and has spread throughout much of central and northern Europe through canal networks over the past two centuries. Zebra mussels are considered a significant threat to aquatic environments and can cause dramatic changes to an ecosystem through both direct and indirect actions. Abiotic impacts of zebra mussel invasion include the fouling of aquatic structures and enhanced water clarity due to the filtering of the water column by the mussels. Biotic impacts can include the suppression of zooplankton populations due to competition

and predation. Zebra mussels have also been shown to change fish population structures due to loss of spawning grounds to mussel colonies, and lack of food resources due to the reduction in the zooplankton population. Strayer et al. (1999) predicted that shallow or well-mixed systems, such as that of Lough Neagh may experience a shift in energy and biomass from pelagic to benthic food webs. The improved water clarity may also cause an increase in macrophyte growth due to increased light transmission through the water column. This increase in water clarity and subsequent decrease in chlorophyll *a* has been reported in many Irish lakes invaded by zebra mussels.

The bloody-red shrimp (*Hemimysis anomala*), a crustacean originating from the Ponto–Caspian region, was discovered in Lough Derg in the Shannon River Basin District in the Republic of Ireland during 2008 and subsequently in Lough Ree, on the same river system (Minchin and Boelens, 2010). The species is a small (Borcherding et al., 2007, Ketelaars et al., 1999), opportunistic omnivore (Salemaa and Hietalahti, 1993, Mauchline, 1980) that inhabits deep-water to the sublittoral zone. It aggregates and swarms in shaded locations during the day and disperses during the night in the pelagic zone (Salemaa and Hietalahti, 1993). This species' path of spread has been identical to that of the zebra mussel and it has now been identified throughout the Shannon system and in Upper Lough Erne (Gallagher et al., 2015) (Figure **2**). An earlier study (Dick et al., 2013) concluded that *H. anomala* showed dramatically higher predatory functional responses than native mysids when presented with zooplankter prey items over a range of sizes. Furthermore, *H. anomala* is also capable of preying on pollan eggs and larvae under experimental conditions (Gallagher et al., 2010), raising significant concerns about the potential negative impacts of this species on pollan and other lake spawning fish species.

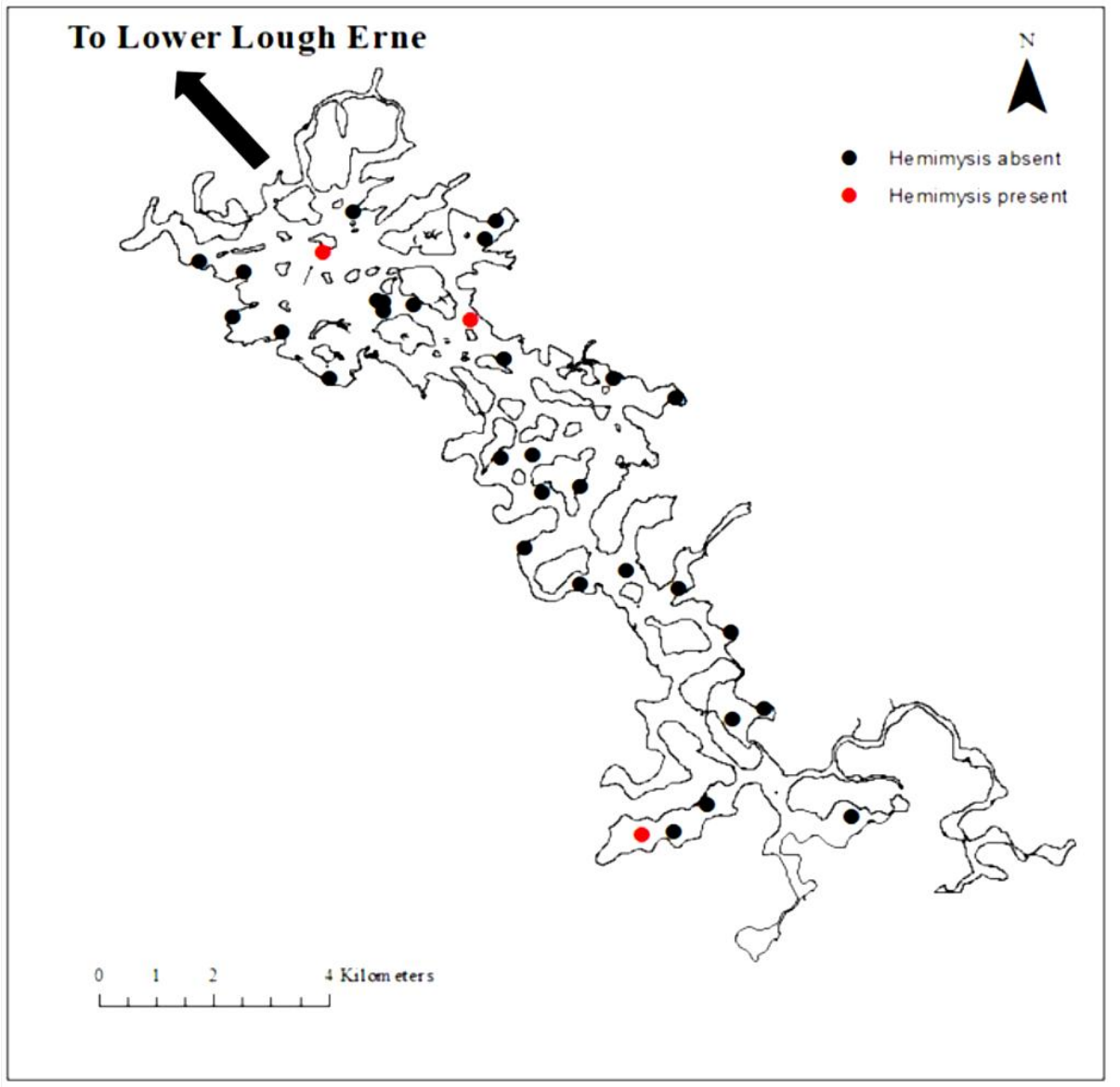


Figure 2: Map of Upper Lough Erne detailing sites at which Hemimysis anomala were found (taken from Gallagher et al. (2015)).

2.3 WATER QUALITY

The Northern Ireland Environment Agency is responsible for water quality in Northern Ireland. The NIEA's policy on water quality is to maintain or improve quality in surface waters and waters in underground strata as required by national policy, European Commission (EC) directives and international agreements, and to generally manage river, estuarine, and coastal waters to be at least "Good" under the adopted classification schemes with no downward movement between classes.

The most recently published status assessments are in the Draft plans

http://www.doeni.gov.uk/niea/water-home/rbp_water_framework_directive/2015-water-framework-directive.htm and the associated web mapper http://maps.ehsni.gov.uk/wmuviewerplan2/. Section 7 of the plans gives summaries at a Local Management Area Level

The detailed LMA for Lough Erne is available at

http://www.doeni.gov.uk/niea/water-home/rbp_water_framework_directive/wfd/north_western_rbp/nw-actionplans.htm

2.4 FISHERY MANAGEMENT ISSUES

Initial consultation meetings were held in Enniskillen in July 2014 with representatives of coarse, game and pike anglers, commercial fishermen, Fermanagh District Council officials and local politicians. In January 2015 a further series of stakeholder meetings was held to consider outline proposals for the Fishery Management Plan. These meetings were well attended and it was very useful way to not only find out what he main fishery issues were in the Lough Erne catchment but also to discuss possible management options directly at a very early stage in the process.

The following is a summary of the issues raised that stakeholders considered the Fishery Management Plan needed to consider:

- **Legislation**

    1. Legislation is complex for recreational anglers and needs to be simplified.

- **Governance**

    1. Cost of angling licences compared to commercial licences
    2. Need to review policy on commercial fishing on Lough Erne
    3. Improve communication with commercial fishermen
    4. Improve level of angling catch returns
    5. Licence/permit to cover both game and coarse fishing
    6. Number of rods to be allowed from a boat

- **Development**

    1. Develop angling infrastructure for coarse fishing from the banks in deeper areas of the Lower Lough
    2. Co-ordinate the promotion and development of angling in the catchment with the relevant statutory and non statutory stakeholders
    3. Maximise the economic returns from both the recreational and commercial fishing sectors
    4. Research into the possibility of commercial exploitation of perch stocks

- **Protection**

    1. Ensure an effective enforcement programme is in place to protect fish stocks and their habitat
    2. Education of stakeholders to improve compliance with the legislation

- **Conservation**

    1. Restrictions on the use of commercial nets in the Upper Lough
    2. Change minimum landing size and introduce bag limits for recreational trout angling
    3. Improve habitat and water quality, reduce and remove fish barriers in the tributaries of Lough Erne
    4. Has the DCAL trout stocking programme on the Erne been a success or failure?
    5. Use of commercial pike fishery to help manage trout stocks
    6. Limit on the amount of pike to be removed annually by commercial fishermen

- **Scientific Data**

    1. Require regular scientific monitoring of fish stocks on Lough Erne and tributaries to provide long term datasets to identify trends in fish populations
    2. Collect catch per unit effort (CPUE) data on rod caught fish
    3. Need for information on trout stocks in the deep areas
    4. Information on salmon movements and spawning sites in the Erne catchment needed to assess stock levels
    5. Improve the level of angling catch returns
    6. More genetic information on trout stocks in Lough Erne
    7. More information on bream stocks in Lough Erne

2.5 FISHERY MANAGEMENT PLAN OBJECTIVES

The aim of the Fisheries Management Plan (FMP) is to provide a strategic approach to the sustainable management of the fisheries resources and its habitat whilst also maximising its value to the economy and the environment and ensuring stakeholder input. Management objectives identified need to be clear and measurable and the approach must be strategic, effective and efficient.

Key Objectives:

The key priority areas for the Fisheries Management Plan are as follows:

Fishery Management Plan – The Precautionary Approach (PA)

The precautionary approach/principle should be applied when ecosystem resilience and anthropogenic impact (including mitigation measures) are difficult to predict and hard to decipher from natural changes (Cochrane and Garcia, 2009). The precautionary approach requires the assumption that an action risks harm and should not be undertaken until proven otherwise by scientific research. In practice, implementing a precautionary approach means that the less that is known about a system (i.e. greater uncertainty), the more caution is required and the more conservative fishery managers should be in relation to fishing effort (Cochrane and Garcia, 2009). To avoid population collapse, fishing mortality must be kept to a level which will ensure that stocks are sustained and maintained. This approach allows a legal and social framework for the fishery. It establishes rules controlling the fishery e.g. licensing, open/closed season and minimum landing sizes. This framework also facilitates data reporting requirements.

2.6 FISHERY MANAGEMENT PLAN PROPOSALS

Having considered the issues and listened to stakeholder concerns IFG would propose the following:

- **Proposal is to remove the imaginary line defining the coarse and game areas of Lower Lough Erne and allow the use of maggots and ground bait in designated areas of the lower lough shore. To review the legislation and simplify where possible**

Background

On Lower Lough Erne an imaginary line is used to define coarse and game fishing areas and different restrictions apply in each of them. Fish surveys have confirmed that game and coarse fish stocks can be found anywhere on the Lower Lough and it is not possible to separate out areas for either type of fish. The current legislation can be complex and difficult for recreational anglers and many visitors or tourists to understand and they also get confused over the requirement to have either a game licence (allows fishing for trout, sea trout or salmon) or a coarse licence (allows fishing for other species such as pike, bream, perch, roach etc).

Proposal

That the Department will remove the imaginary line from legislation which defines the game and coarse areas on Lower Lough Erne and allow the use of ground bait and maggots in designated areas of the shore of the Lower Lough. It will review the legislation currently used and seek to consult widely on the issue of the need to regulate or alternatively provide advice to anglers.

- **DCAL to review of the cost and number of available commercial and angling licences**

Background

There are concerns that the current recreational angling licence is similar in cost to that for 100yds of a commercial net that can be used to commercially catch fish. A significant number of recreational anglers consider that their licence is too cheap and that its cost should be raised and that a commercial licence should also be raised to reflect the use of this to earn a living and catch fish on a commercial scale. Revenue raised through the sales of licences and permits is factored into annual budget allocations and used to finance core IFG business activities such as enforcement, habitat improvements, community education and outreach events etc.

Proposal

IFG would propose to carry out a full review of the cost structure for both licences and permits. This will also form part of a wider business review of all licences and statutory permissions granted by IFG. Consideration should also be given to simplifying the licensing regime by reducing the number and type available.

- **DCAL to review the policy on permits for commercial fishermen on L Erne**

Background

The current policy for the management of fisheries on Lough Erne is that they are used primarily for recreational and amenity purposes while respecting the rights of traditional commercial fishermen. It also caps the number of permits to be issued at 24 based on the current criteria but that coarse permits will not be reissued on the death or retirement of a commercial fisherman. The only species currently allowed to be taken by commercial nets is pike

Proposal

IFG would propose to carry out a full review of the policy to set out how new entrants may gain a permit if the current cap on the number of permit holders allowed is still required or needs adjusted.

- **DCAL to hold regular meetings with commercial fishermen**

Background

The fishermen attending the stakeholder meetings have expressed their desire to kept informed about any fishery management decisions and to included as part of the decision making process.

Proposal

IFG would propose that regular meetings are held with commercial fishermen and that there is a consultation process for all significant proposals which could affect them. IFG have already increased the level of contact with fishermen in relation to the drafting of the FMP for L Erne and details of formal meetings held to date can be found in this document.

- **DCAL to consider mechanisms to improve the return rate of annual angling catch returns**

Background

Angling catch returns provide very useful data on stock levels of salmonids and other species on a yearly basis which helps to identify trends in stocks. The Standing Scientific Committee for salmon in the DCAL area uses this rod catch data to help assess stocks levels in rivers and make an assessment on whether to recommend to DCAL that such rivers could be re-opened for the harvesting of salmon by anglers. Anyone holding a rod licence is legally required to make a catch return for any salmon or sea trout caught (even if released) throughout the fishing year. Despite this legal requirement less than 25% of anglers make any return at all. In addition, the current method for the collection of data on rod licence sales makes it difficult to identify individual anglers that have failed to make a catch return or to follow up enforcement action on those anglers to ensure compliance with the legislation.

Proposal

It is proposed that IFG modernise its data system which would allow for non compliant anglers to be targeted making them aware they have not submitted an angling catch return and that legal proceedings could follow. In addition education around the use made of the catch return would help anglers to appreciate how valuable they are and how they can contribute to reopening their fishery for the harvesting of salmon.

- **DCAL to consider the introduction of a single licence to allow both game and coarse angling**

Background

The current legislation for recreational angling is complex and it can difficult for those involved to know when they are compliant or in breach of the legislation. Many visitors and tourists get confused over the requirement to have either a game licence (allows fishing for trout, sea trout or salmon) or a coarse licence (allows fishing for

other species such as pike, bream, perch, roach etc). An angler with a game rod licence is only entitled to fish with one rod, but the angler with a coarse rod licence can use up to 2 rods at designated coarse fisheries.

Proposal

It is proposed to have a single rod licence that will entitle the holder to use up to 2 rods at both a game and coarse fishery. A single Department permit is also proposed which will permit an angler to fish at any DCAL game or coarse fishery. This should make it simpler for visitors and tourists to understand and comply with the legislation.

- **DCAL to allow up to 2 rods per angler with a maximum of 4 rods allowed per boat on L Erne for trolling**

Background

The legislation allows trolling on Lough Erne with the number of rods permitted dependant on the number of persons in the boat. This can be confusing for visiting and tourist anglers and was put in place to restrict fishing effort.

Proposal

The proposal is that anglers can use 2 rods with a maximum of 4 rods per boat for trolling on Lough Erne and this will simplify the legislation for anglers.

- **Development of angling infrastructure for coarse anglers in deeper areas of Lough Erne**

Background

The impact zebra mussels have had on the water clarity on Lower Lough Erne may have been sufficient to displace prey species from their normal shallow habitat areas. Brown trout have moved from the shallower margins where they are normally found to deep water to avoid predators and coarse anglers are also concerned the same has happened to their target species and are seeking to be allowed to fish deeper areas of the Lower Lough.

Proposal

In line with the proposal previously outlined to allow maggots and ground bait in designated areas of Lower Lough Erne shore, IFG would propose to assist with the identification of these areas and to develop along with other stakeholder the required infrastructure around the shore to enable anglers to fish.

- **Co-ordinate the promotion and development of angling on the Lough Erne catchment with the relevant statutory and non statutory stakeholders**

Background

IFG is responsible for the promotion and development of angling in the DCAL area. The Strategic Review of Angling in Northern Ireland carried out by Sport NI highlighted a number of key issues in relation to the promotion of angling and the need to co-ordinate in a better manner its promotion by all the stakeholders involved. This has also been highlighted as a problem by many of stakeholders that IFG have met with.

Proposal

IFG will continue to work as a member of the Northern Ireland Angling Forum in partnership with the other members and other key stakeholders to advance the promotion and development of angling in the Erne catchment. It will seek to set out realistic targets and goals in relation to this and assess progress on these issues.

- **DCAL to work with the stakeholders to maximise the economic returns from both the recreational and commercial fishing sectors**

Background

The socio economic importance of inland fisheries is in the value it contributes to the local social and economic welfare, which is primarily based in the rural areas. Both the recreational and commercial fisheries have the potential to increase the benefits derived, providing the fisheries are managed in a sustainable manner and the fisheries resource is used in a way that maximises its value to the local economy. Many stakeholders consider that much of this potential is untapped due the lack of co-ordination along with poor marketing of services and goods. The Price,

Waterhouse, Coopers report titled The Social and Economic Impact to Northern Ireland, and areas within the Loughs Agency, of Recreational Fisheries, Angling and Angling Resources indicated that “potential exists to increase the net economic value of angling”.

Proposal

IFG will seek to work with stakeholders and other appropriate bodies to maximise the value of the fishing resource in the Erne catchment. Key to this will be assessing the opportunities to exploit the fish stocks present in a sustainable way and also to maximise the income generated.

- **DCAL to consider the commercial exploitation of perch fish stock on Lough Erne by carrying out some assessments using a variety of non lethal methods to inform the policy**

Background

The Lough Erne fish stock survey in 2013 identified perch as the most abundant species by number present which is consistent with changes brought about by zebra mussel colonisation. Perch now outnumber roach by three to one in samples, a complete reversal of the ratios of the early 1990s. This shift is also reflected in total weights of roach and perch caught, but the larger average individual weights of roach mean that there is currently equal biomass of these species. As pike are the only species currently allowed to be caught commercially on the Erne, commercial fishermen have asked that consideration is given to allow them to catch perch as well given the stock abundance.

Proposal

This proposal requires more scientific information to be collected before making a decision on the commercial capture of perch. Such a proposal has to be viable not only in terms of verifying the amount of perch present, but also that the method to be use should not negatively impact on other non target species and angling catches for coarse anglers.

- **DCAL to ensure an effective enforcement programme is in place to protect fish stocks and their habitat which will include training and support for Private Water Bailiffs**

Background

IFG is responsible for the protection of salmon and inland fish stocks in the DCAL area. This is a key role in ensuring that fish are taken only when they are legally allowed to be, so to ensure that stocks are kept at a sustainable level. There are 11 full time Fisheries Protection staff across the DCAL jurisdiction involved in enforcement as their main role. There are also approximately 300 Private Water Bailiffs (PWBs) that carry out this enforcement role in their own fisheries to protect fish stocks present from illegal activity.

Proposal

IFG will carry out intelligence led patrols to protect fish stocks and their habitat throughout the DCAL area and will provide reports on the key enforcement activities on a regular basis. It will provide training and support for the PWBs in protecting their own fisheries and where appropriate will take forward prosecution cases based on their evidence.

- **DCAL to promote the education of stakeholders to improve compliance with the legislation**

Background

It is clear that in instances where an offence is detected, that the defendant is unaware of the legislation. Whilst this is not in itself a defence, it does highlight the complexity of fisheries legislation for commercial and recreational fishermen, which makes it difficult to ensure compliance. Clearly where voluntary compliance is not achieved, we can use a variety of sanctions, including prosecution, to compel compliance.

Proposal

IFG will seek to promote compliance and provide more education on the legislation to both commercial and recreational anglers. This will be carried out through a wide variety of mediums and through a variety of opportunities.

- **Proposal is for DCAL not to permit the use of commercial nets in Upper Lough Erne**

Background

The current policy for the management of fisheries on Lough Erne is that they are used primarily for recreational and amenity purposes, while respecting the rights of traditional commercial fishermen. In recent years, much of the commercial activity has been located in Lower Lough Erne. The main focus in the Upper Lough is coarse angling and concerns have been raised about the possible negative impact the presence of a commercial fishery could have on attracting tourists to the area.

Proposal

The proposal is that IFG will not allow the use of commercial nets on Upper Lough Erne, so that it is used for recreational angling only. It is important that monitoring of trout stocks continues for those tributaries that flow into the Upper Lough, as part of the overall stock assessment work being carried out.

- **To increase the minimum takeable size for rod caught trout to 35.5cm for Lough Erne and introduce a minimum takeable size for trout of 25.4cm for all its tributaries and all waters in the DCAL area. DCAL propose a daily bag limit of 3 trout per angler per day to apply to Lough Erne and all other trout fisheries**

Background

The current minimum size of takeable trout on the Lough is 30cm but there is no size limit for the tributaries. Currently a bag limit of 6 trout per day per permit is allowed. The minimum landing size is used to ensure that any fish caught below the size where it may not have spawned will be returned to the water and to discourage the targeting of these juvenile fish. Scientific evidence indicates that many fish above 30cm may yet not have spawned as they grow very fast in the rich lake waters and therefore these fish need protection to enable them to contribute to the spawning stock. It also important that as a conservation measure that the number of fish allowed to be retained by anglers is also restricted so that sufficient adult fish remain in the system to produce the next generations. There is currently no bag limit for trout in the DCAL jurisdiction, other than at PAE waters.

Proposal

Proposal would be to increase the minimum takeable size for brown trout on Lough Erne to 35.5cm, for river caught trout to 25.4cm (for all the tributaries) and to introduce a bag limit of 3 trout per day per angler.

- **DCAL to improve fisheries habitat, remove fish barriers or improve fish passage at barriers in the tributaries of the Erne Catchment**

Background

Habitat, water quality and free passage for fish movement are key elements for the maintenance of healthy fish stocks in rivers. NIEA has carried out work to assess barriers on some of the rivers in the Lough Neagh catchment and identified a number that represent a total or significant barrier to the movement of salmonids. It is clear from the discussions with stakeholders and assessment work being carried out to date, that there are areas of habitat that could be improved to increase fish stock production especially for salmonids and that there are barriers that prevent fish moving upstream to spawn. To improve fish stocks throughout the catchment these

issues need to be addressed and this can only be done by working with all the stakeholders involved.

Proposal

IFG propose that regular meetings are held with stakeholders to plan and prioritise actions to improve habitat and fish passage throughout the catchment. In particular to hold meetings with fishery owners and angling clubs to plan how they can assist with this work.

- **DCAL to review stocking policy under-pinned by further scientific analysis**

Background

The placing of additional fish into rivers and lakes has long been used in fisheries, most often with the specific intention to increase or boost fish stocks present. There is a concern that stocking could actually be in the best case scenario a waste of effort or in the worst case scenario, possibly harmful to locally adapted fish populations present. Clearly there may be cases where a population is extinct and the only way to reintroduce the species is by stocking fish from elsewhere. With the advance of genetic techniques scientists are now able to differentiate stocks at a much lower local level than previously possible and the differences that are present in populations are likely to help them adapt to their specific environment. These differences are important to help fish adapt to their local environment and scientific advice is that this local diversity should be maintained to allow the species to adapt to environmental conditions now and in the future. There is currently no policy in place regarding fish stocking in the DCAL area. One of the recommendations in the recent report by Queens University on Dollaghan genetics was that future stocking programmes in Lough Neagh should fully consider the information from the genetics study, and have clear and well defined objectives to prevent biodiversity loss. Other, less impacting approaches for assisting local trout populations including; habitat and water quality improvement, should also be considered. Concerns have also been

raised by stakeholders on Lough Erne that the IFG stocking programme has not worked.

Proposal

IFG should develop a policy on stocking based on the best scientific advice available. Such a policy should then be subject to public consultation to allow stakeholder input to the process and should link up with Loughs Agency and Inland Fisheries Ireland to create a joined up approach on this issue.

- **To continue to allow commercial fishing for pike on Lough Erne using existing regulations but to restrict it to a maximum catch of 10 tonnes per annum**

Background

Trout are a target species for pike which are predatory by nature. Scientific evidence collected from the analysis of the contents of pike stomachs has shown a high preference for trout. In order to help with the management of trout stocks it is beneficial to crop pike stocks to manage their levels, but not to such an extent as has occurred in the past when pike numbers significantly declined. The commercial fishery has been used a means to remove pike and to manage their stocks levels.

Proposal

The proposal is that IFG will continue to allow the commercial fishery on Lough Erne to catch pike as per the current regulations, but to cap the maximum amount allowed to be take each year to 10 tonnes to maintain a healthy population. This is consistent with other scientific evidence to assist with the management of trout stocks.

- **DCAL to commission regular scientific monitoring of fish stocks on Lough Erne and it's tributaries to provide long term datasets to identify trends in fish populations**

Background

The aim of fisheries management can vary but in general should be to maintain the system in a biologically and economically productive state so that it can benefit society through jobs, food, earnings and recreation. The questions of how many of a species there are and the state of the stocks in comparison to historical levels are fundamental for any fishery. The use of fish stocks assessments, and in particular regular assessments over a period of time, are therefore essential requirements for the sustainable management of fish stocks. Whilst some assessments have been carried out in the main tributaries of Lough Erne for salmonids and significant data exists for eels, there are significant gaps in the knowledge for other species and areas which do not allow long term trends in species to be identified. There is also a need to integrate data from both the Lough and the tributaries, which will help to develop a stock relationship for brown trout. This scientific approach provides a formal and consistent means of evaluating management alternatives with respect of outcomes and ensures uncertainties are described and evaluated during the decision making process.

Proposal

It is proposed that DCAL will carry out a regular assessment of fish stocks in Lough Erne with a full lake survey for all species every three years. Index sites on the tributaries will be surveyed for juvenile salmonids annually and data collected on

adult and juvenile eels also. In between surveys data from the commercial and angling catches can be analysed. The collection and collation of catch data for both commercial and recreational fisheries in the catchment is an essential element of this scientific assessment.

- **To collect Catch per unit effort (CPUE) data on rod caught fish**

Background

Whilst data on the number of fish caught is an important indicator of the abundance of fish present, the time taken to catch a fish and the overall abundance of species are also vital information which help in the overall assessment of stocks. Various stakeholders have indicated their concerns about catches of fish on the Erne compared to those historically and this can be evidenced in the reported results for angling competitions held there. There is however a need to ensure that sufficient data is captured that will inform the management of fish stocks.

Proposal

The proposal is that IFG, along with stakeholders, will seek to collect the required data to help with the analysis of stocks in the Erne, needed to help identify trends in their abundance. This will compliment the scientific stock surveys planned for the catchment.

- **To collect data on trout stocks in deeper areas of the lough**

Background

Fish stock surveys have taken place every three years on Lough Erne for a considerable period of time and survey nets were set according to where the species would normally be found. The change in water clarity has resulted in s shift of young trout from their normal shallow areas to deeper areas of the Lough to avoid predators such as pike. The value in these data sets is the collection of information

at the same sites over a period of time and this allows trends in population sizes to be identified.

Proposal

The proposal is that IFG will continue to collect scientific data on fish stocks at sites previously surveyed, but that new deep water sites will also be surveyed to help assess trout stocks in these areas. This will compliment the juvenile stock assessments carried out in the tributaries and other planned scientific work.

- **To collect information on salmon movements and spawning areas in the Erne catchment to help assess stocks levels**

Background

Salmon stocks are monitored in the Erne catchment and this is achieved with the cross border co-operation of Inland Fisheries Ireland and the ESB. A recent review meeting of all these agencies identified that, despite the fact that the numbers of salmon entering Lower Lough Erne have increased, there is still poor knowledge as to the key areas these fish go to spawn. This information is vital to the management of salmon in the Erne and essential to help protect these areas, increase and improve stock levels.

Proposal

The proposal is that IFG will collect information on salmon movements in the Erne catchment to help identify key spawning areas in the tributaries. This will help identify key index sites for salmon in the tributaries and compliment other planned scientific work.

- **DCAL to commission more genetic research on brown trout stocks in the Erne catchment**

Background

The recent genetics research carried out on dollaghan stocks in Lough Neagh highlighted the existence of significant levels of population genetic structuring among brown trout populations inhabiting the main catchment rivers of Lough Neagh. This evidence has been achieved with the advancements in genetic techniques compared to those previously carried out. The report makes various recommendations about the need to protect these differences and of their value to the local populations of trout. It is therefore likely that this structuring may also occur in trout stocks inhabiting the tributaries of the Erne catchment.

Proposal

It is proposed that IFG will seek to commission genetic research into trout stocks in the tributaries of the Erne catchment to assist with the management of the species.

- **DCAL to commission more research on bream stocks in the Erne catchment**

Background

The fish surveys on the Erne have identified a marked decline in bream stocks over the past two decades, alongside an increase in the number of roach/bream hybrids. Factors bringing together the spawning seasons, fertilisation of bream eggs by the more abundant roach, along with infertility of most hybrids appear likely to be the key drivers of this decline. This situation cannot persist indefinitely if bream parent stock falls too low to generate further quantities of hybrids. Roach/Bream hybrids are longer lived than either parent species and some of the hybrids present now are set to persist as a significant element of stocks for a further decade despite the very low bream parent stock.

Proposal

It is proposed that IFG will seek to commission research into Bream stocks in the Erne catchment to assist with the management of the species.

Glossary

Abundance: Number of individuals in a stock or a population.

Age Composition: Proportion of individuals of different ages in a stock or in the catches.

Anadromous: An anadromous species, such as salmon, spends most of its life at sea but returns to fresh water grounds to spawn in the river it comes from.

Bait net: Net used to catch juvenile fish to use as bait for long lines to catch eels

Biomass: total weight of all individuals in a stock or a population.

By-catch: The unintentional catch of one species when the target is another.

Catch per Unit Effort (CPUE): The amount caught for a given fishing effort. Ex: tonnes of shrimp per tow, kilograms of fish per hundred longline hooks.

Licences*: Regulations* for participation in the general commercial fishery.

Discards: Portion of a catch thrown back into the water after they are caught in fishing gear.

Ecosystem-Based Management: Taking into account species interactions and the interdependencies between species and their habitats when making resource management decisions.

Escapement: Reference to salmon - the number of fish escaping the fishery and reaching the spawning grounds. For eels refers to the number of silver eels leaving the catchment to migrate to sea to spawn.

Fishing Effort: Quantity of effort using a given fishing gear over a given period of time.

Fishing Mortality: Death caused by fishing, often symbolized by the mathematical symbol F.

Fixed Gear: A type of fishing gear that is set in a stationary position. These include traps, weirs, gillnets, longlines and handlines.

Gillnet: Fishing gear: netting with weights on the bottom and floats at the top used to catch fish. Gillnets can be set at different depths and are anchored to the lake bed.

Hybrid: Offspring resulting from the breeding of two species

Hypereuthropic: A nutrient rich system

Landings: Quantity of a species caught and landed.

Licences*: Issued by Government* for participation in the general recreational or commercial fishing.

Long lining: Using long lines with a series of baited hooks to catch eels.

Maximum Sustainable Yield (MSY): Largest average catch that can continuously be taken from a stock.

Mesh Size: Size of the mesh of a net. Different fisheries have different minimum mesh size regulation.

Mobile Gear: A type of fishing gear that is drawn through the water by a vessel to entrap fish. These include otter trawls and Danish/Scottish Seines.

Natural Mortality: Mortality due to natural causes, symbolized by the mathematical symbol M.

Otolith: A hard calcium carbonate structure located posterior of the brain in bony fish. Otoliths are used to determine the age of fish: annual rings can be observed and counted. Daily increments are visible as well on larval otoliths.

Permit: Permission issued by the fishery owner to allow someone to catch fish in their fishery

Population: Group of individuals of the same species, forming a breeding unit, and sharing a habitat.

Precautionary Approach: Set of agreed cost-effective measures and actions, including future courses of action, which ensures prudent foresight, reduces or avoids risk to the resource, the environment, and the people, to the extent possible, taking explicitly into account existing uncertainties and the potential consequences of being wrong.

Purse Seine: Large net used to encircle fish from a boat called a "seiner" and equipped with a wire rope on the bottom to draw the net together. A small boat, called "skiff", participates in manoeuvring the net.

Quota: Portion of the total allowable catch that a unit such as vessel class, country, etc. is permitted to take from a stock in a given period of time.

Recruitment: Amount of individuals becoming part of the exploitable stock e.g. that can be caught in a fishery.

Research Survey: Survey on a research vessel, allowing scientists to obtain information on the abundance and distribution of various species and/or collect oceanographic data. Ex: bottom trawl survey, plankton survey, hydroacoustic survey, etc.

Silver eel fishery: An interceptor fishery for migratory eels

Spawner: Sexually mature individual.

Spawning Stock: Sexually mature individuals in a stock.

Stock: Describes a population of individuals of one species found in a particular area, and is used as a unit for fisheries management. Ex: NAFO area 4R herring.

Stock Assessment: Scientific evaluation of the status of a species belonging to a same stock within a particular area in a given time period.

Total Allowable Catch (TAC): The amount of catch that may be taken from a stock.

Traditional Ecological Knowledge (TEK): A cumulative body of knowledge and beliefs, handed down through generations by cultural transmission, about the

relationship of living beings (including humans) with one another and with their environment.

Tonne: Metric tonne, which is 1000kg or 2204.6lbs.

Trawl: Fishing gear: cone-shaped net towed in the water by a boat called a "trawler".

Validation: The verification, by an observer, of the weight of fish landed.

Year-class: Individuals of a particular size class. Also called "cohort".

Yellow eel fishery: A fishery for immature / resident eels

Lower Lough Erne fish stocks, DCAL-AFBI Surveys 1991 to 2013

Report on stock status January 2014

Compiled by Robert Rosell, AFBI

Executive summary of key findings – status and trends in the stocks

Lower Lough Erne fish stocks have been monitored at three yearly intervals since 1991, using a standard series of survey gill nets set in margin habitats from July to September. These surveys provide and index of fish stock status over a twenty-two year period.

Roach and perch dominate the catches by number and weight, with a marked and consistent long term shift from roach to perch as the most abundant species by number present consistent with changes brought about by zebra mussel colonisation. Perch now outnumber roach by three to one in samples, a complete reversal of the ratios of the early 1990s. This shift is also reflected in total weights of roach and perch caught, but the larger average individual weights of roach mean that there is currently equal biomass of these species. The two years prior to 2013 appear to have been historically poor for roach recruitment which may further the shift from roach to perch over the next two surveys as older roach pass out of the population. A small but significant number of unusually large perch taken in the 2010 and 2103 surveys indicate an increase in the growth capacity of perch for the generations post zebra mussel introduction.

There has been a marked decline in bream stocks over the past two decades, alongside an increase in the number of roach x bream hybrids. Factors bringing together the spawning seasons, fertilisation of bream eggs by the more abundant roach, along with infertility of most hybrids appear likely to be the key drivers of this decline. This situation cannot persist indefinitely if bream parent stock falls too low to generate further quantities of hybrids. Roach X Bream hybrids are longer lived than either parent species and some of the hybrids present now are set to persist as a significant element of stocks for a further decade despite the very low bream parent stock.

There are significant problems in understanding trends in trout numbers present. While numbers in 50mm nets, representing the larger trout, appear to be relatively stable, numbers of smaller trout encountered for recent surveys are low in the long term context. Given that large trout must have grown on from smaller fish, and that river stock surveys of juvenile fish potentially available to migrate to the Lough are also relatively stable, these two observations do not seem to tally. Behavioural or distributional change in the smaller trout fish reducing their catch-ability in margin nets in summer may be a possible explanation. It is also possible that the temporal resolution of the data set with surveys every three years may create gaps in the record and miss the impact of short term variation in recruitment. More and better annual fry and juvenile surveys and targeted work to examine the distribution of trout in the Lough including open deep water on feeder streams may offer a solution,

Pike show a similar phenomenon to trout in the summer surveys, with reduced catches of small pike apparently not linked to any reduction in larger fish. A pike targeted survey in spring 2013, reported separately, shows the pike stock to be

within the numerical range of earlier data (1990s) and with a higher average individual size. The reasons for the differing results for young and mature pike are not clear, but could indicate recruitment issues in 2012 and 2013.Fluctuations in lake levels due to works on the hydroelectric dams on the exit river Erne could affect pike egg survival as the spawn is laid in shallow water which could dry out if levels fall within 6-8 weeks of spring spawning.

A limited open water survey in August 2013 revealed again that the stocks of fish over the deep water of the Broad Lough are very different from those of the margins. The survey found trout in a subsurface layer, mid-water pelagic young of the year perch and pollan at 20-30m deep on a dividing line between warm surface and deep cold water. Pollan numbers were the best recorded in samples since their very low stocks in early 1990s.

Upper Lough Erne has been covered by CEN (Water Framework Directive standard) survey netting date a in 2010 and 2013. The time series is as yet too short to be clear about major trend, but significant features of the recent two survey are the very small catches of bream, matching the Lower Lough Situation, variable perch recruitment with potential differences between Upper and Lower Lough patterns, and low trout numbers as compared with the Lower Lough

Introduction

Lower Lough Erne fish stocks have been monitored by gill net survey with surveys to the current design since 1991. Surveys were initially at variable intervals but are now conducted every three years due to the value of the long term time series for understanding change in the fish stocks. Surveys are generally conducted from July to September, and data are available from 1991, 1996, 2000, 2002, 2004, 2007, 2010 and now 2013. Trends and changes in fish stocks over time can be seen in catch per unit effort indices of numbers and weights captured of the key species.

Methods

For this report, data is presented based on catches in two types of net, i.e "Survey" nets and "Fixed mesh size" nets, with some supplementary information from other nets where available.

For each triennial summer survey, nets are set around the margins of Lower Lough Erne and in the "Back Lough" north of Boa Island at a standard set of 30 sites representing a range of habitats, and shore slopes and water depths down to about 8 metres. Nets are set at right angles to the shore at the nearest safe location to a set grid reference. The netting team has discretion to move a net up to 100m to adjust for conditions (e.g. wind direction, moving to the lee of an island, avoiding water sports or boating activity, variation in water levels). Nets are set for approximately 24 hours to cover one dusk and one dawn fish peak activity period, and marked with regulation (Erne navigation bye-laws) labelled yellow floats each end.

Methods – From survey to data processing

After retrieving nets, all fish were taken out and recorded to location, date and net type. Fish were separated to individual net catch of each species. Fish were frozen in bags and later transferred frozen to the AFBI laboratory at Newforge Lane, Belfast. For each sampling day, a record was made of the nets set and catches at the level of number of individuals of each species for each net. This data was forwarded to the Laboratory team in advance of their thawing out and processing samples.

Fish were thawed in workable batches and each fish weighed (nearest gram or .1g in the case of 0+), measured (fork length, nearest mm), and its sex determined (male, female, immature). Samples were taken (10 per cm length class) of material for later age determination (Scales from bream, hybrids, roach, trout), opercular bones for perch and scales + cleithra for pike)

Details of length of net set were used to calculate standardised catch per unit effort: Recorded as catch weight or number of fish per unit metre of net per night.

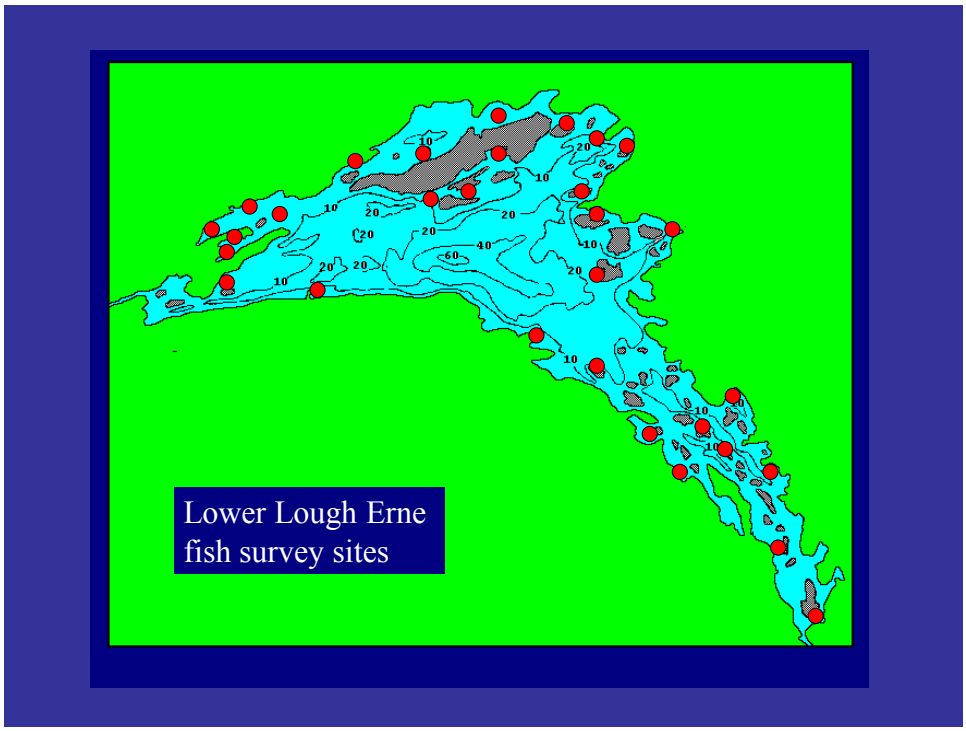


Fig. 1 Net survey sites used in 2013

Types of net used

"Multi-panel" or "Survey" nets

These consist of a number of panels ranging from small to large mesh sizes in one single net (Fig. 2). This design is intended to catch a broadly representative sample of fish of all sizes and species present and over time the catches from these give an index of the overall fish population. Changes in net material availability and standardisation of methods (the latest change for the Water Framework Directive) have over time forced several changes in net design. The early series in the 1990s used 6 panel nets of meshes from 12.5 to 46 mm. This was replaced in 2004 with a 12 panel "Baltic" net with meshes in an incremental progression (mesh sizes increasing in even steps, in order end to end of the net) from 8 to 50mm (Fig 2). A further change in standard available survey nets came in with the current WFD ("CEN") standardised net of 5 to 55 mm meshes in a randomised geometric progression (increment between mesh size increasing with each step increase, and panels arranged randomly) in 2006-8 (fig 3). Each time the net type has changed the new method has been run together for at least one survey to inter-calibrate the results and create a basis for a standard time series. Currently, to preserve the time series, results are still only reported for data based only on incremental mesh progression (Baltic) nets. AFBI is collating data for catch comparison between CEN and Baltic nets with a view to changing the new type when its stock of the last remaining "Baltic" nets is used up. There are, however, significant challenges in maintaining the integrity of the time series data through changes in the selection of meshes used.

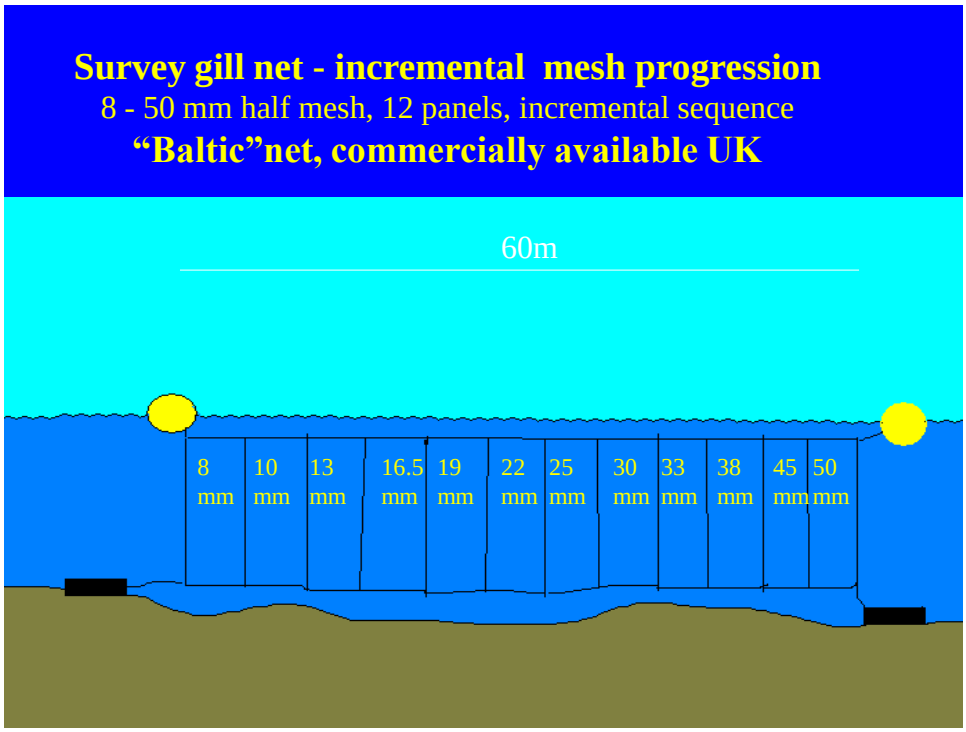


Fig 2. Layout of a Mesh sizes in a (Baltic) standard Gill net

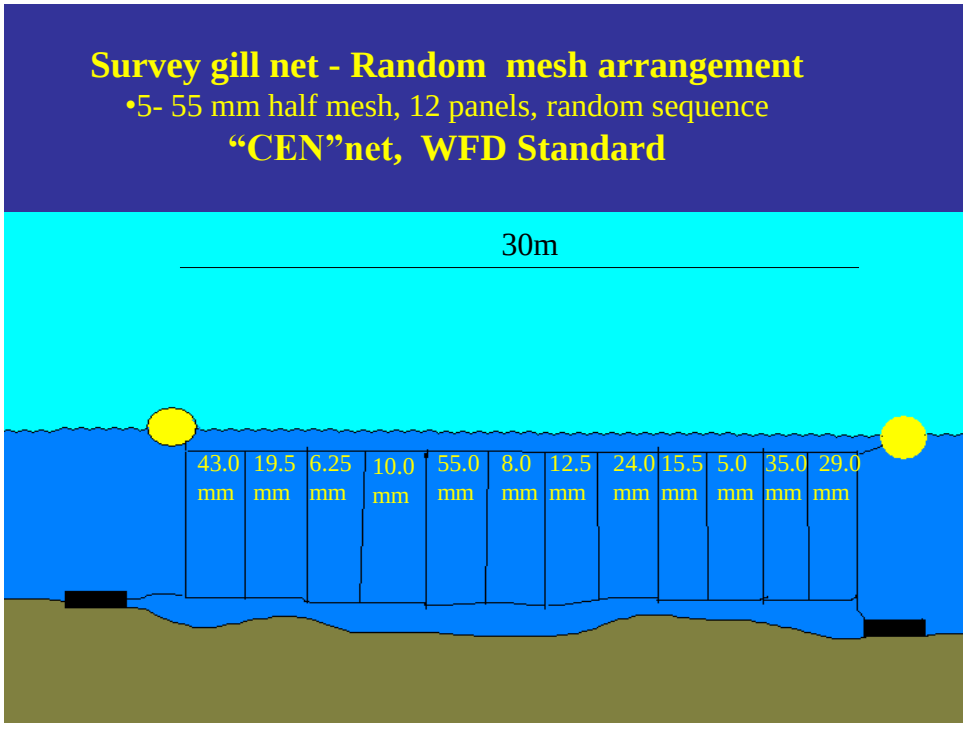


Fig 3 Layout of a Mesh sizes in a CEN standard Gill net

"Fixed mesh" nets

These are nets of a single mesh size. They are selective for a particular size range of each particular species. The most important of these nets used is a net of fixed 50mm (formerly 2 inch) square mesh. This is particularly useful for catching pike above about 50 cm and trout above 30 cm, and gives a good indication of the population of adults of these species. Larger roach, bream and cyprinid hybrids are also taken. This series also has the advantage that there is data going back to 1971using nets of this type.

Nets used in 2013

In 2013 4 nets were set at each chosen site: a 30m CEN survey net, a 60m "Baltic" net, a 40m 50mm fixed mesh net and a 40m 60mm fixed mesh nets. All nets for the standard set were set to rest as a curtain on the lake bed and were 1.5m deep from lead rope to head rope.

Issues with the 50mm net series in 2013- net construction

In 2013, due to availability issues, the older type of net made from multifilament twine was initially (July and August) replaced with commercially available fine stranded monofilament net. This proved to be a problem as trout, pike, roach and hybrids were able to break the fine monofilament mesh resulting in underestimation of number of larger trout, hybrids, roach and pike. This net series was then re-run in September at all sites with stronger multifilament twine nets and only the data from the multifilament nets is used for the time series. In a comparison of catches between the mono- and multifilament 50mm nets, Perch were more abundant in the monofilament but all other species were more abundant in the multifilament (table 1).

Table 1: Comparison of catches in 50mm mesh nets of mono- and multifilament construction in 2013

	Catch	PIKE	PERCH	ROACH	BREAM	HYBRIDS	TROUT
Monofilament nets 30 x 30m Sets (Jul-Aug)	Number	2	35	131	1	87	0
	Total Weight (g)	3598	14800	62275	642	57506	0
Multifilament nets 27 x40m sets (Sep)	Number	12	15	212	2	115	10
	Total Weight (g)	20138	7548	108837	960	73585	10282

Only the September series data for braided multifilament twine nets is used for reporting results for 50mm nets in 2013

Results and discussion

Numbers of fish per unit effort over time

The core data are the adjusted “survey” net time series, in terms of numbers and weights of the major species. The raw numbers data are dominated by smaller species, roach and perch, as one would expect in a natural population (Fig 4).

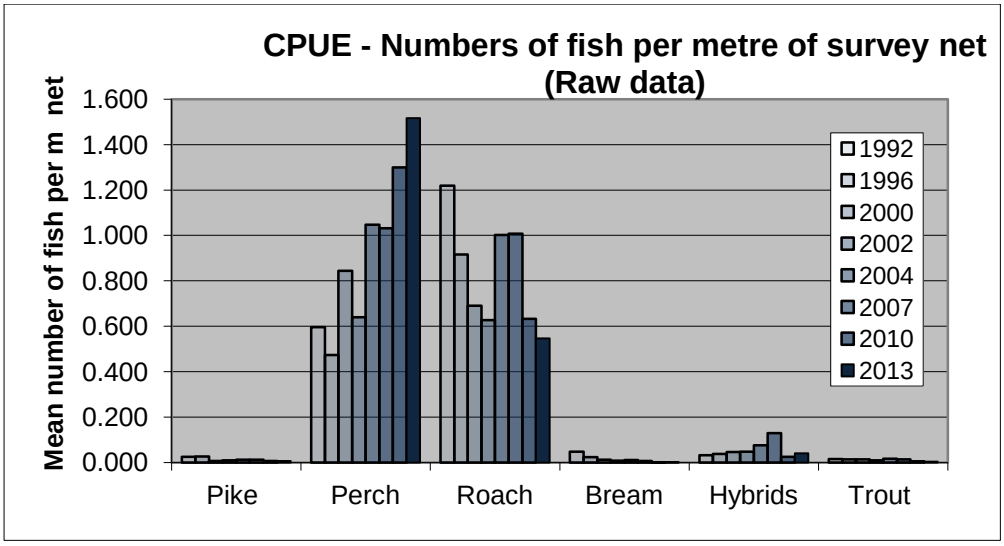


Fig 4 Numbers of fish per metre of survey net split to species, 1992 to 2013, raw numbers

In order to show the trends in the data for all species data in a single easy to understand picture, the numbers data is log transformed and corrected for effort (Fig. 5):

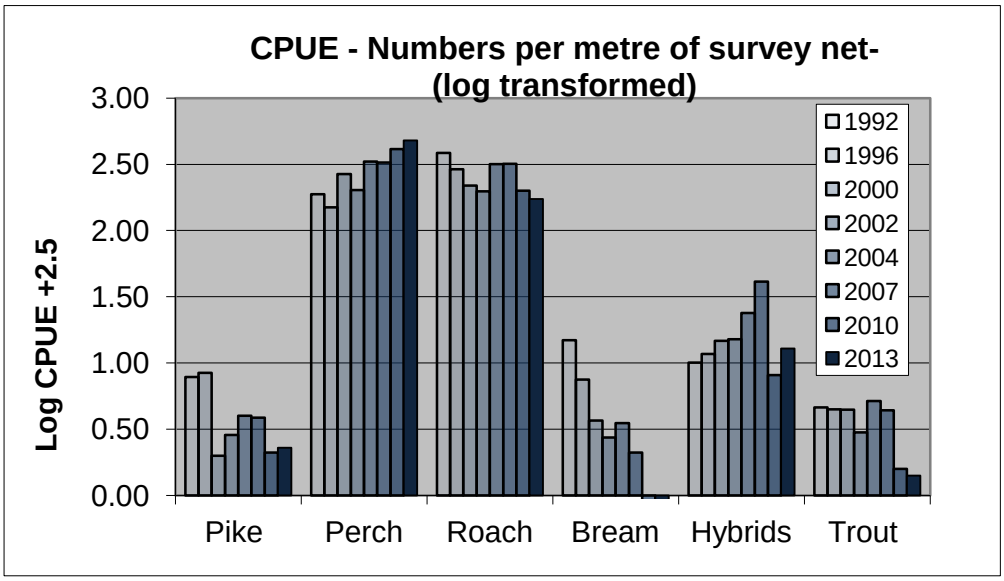


Fig 5. Catch per survey net split to species, 1992 to 2013, Y axis transformed to log scale show trends in one figure

Numbers or weight?

Analysis of fish population should not only look at number, but also consider relative total weights (biomass) of species. The following graph (Fig. 6) shows clearly that the weight (Biomass) of fish present is still dominated by roach weights. Whereas survey net catches of perch have risen steadily over the past 20 years, latterly driven by ecological changes due to the zebra mussel invasion of the late 1990s, this has not yet translated into perch dominance by weight, although the 2013 data is now close to parity between the weights present of these species. (Fig. 6)

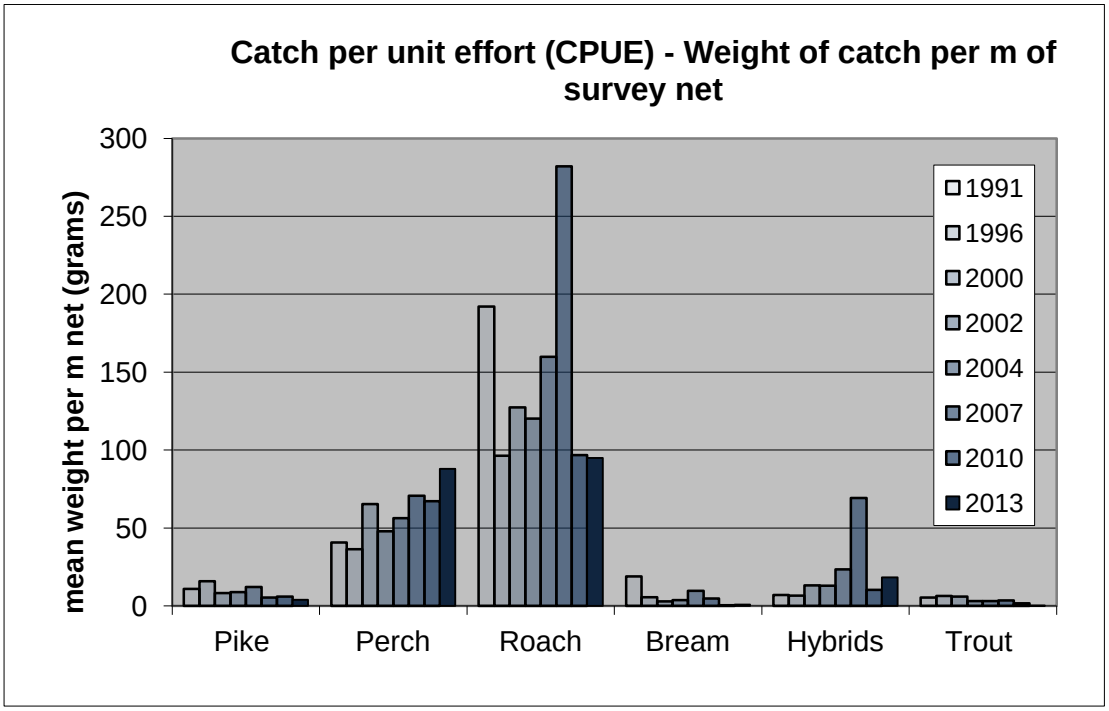


Fig 6. Catch of fish in weights per metre of survey net set. Note that the weight of roach drives the trends in total fish biomass ("all fish/2")

Change in ratio of perch to roach numbers

The dramatic extent of the change in relative abundance of roach and perch post zebra mussel is not fully evident in some of the plots above. Fig. 7 gives a better view of the true scale of the change. Between them these two fish species make up 90% of the survey gillnet catches. There was a step change after the zebra mussel introduction and population explosion from 1996 to 2000, and the trend is still shifting. Perch are now dominant in numerical terms. However due to large numbers of small perch as opposed to fewer roach which are on average heavier, there is approximately parity between biomass of perch and roach (Fig.8).

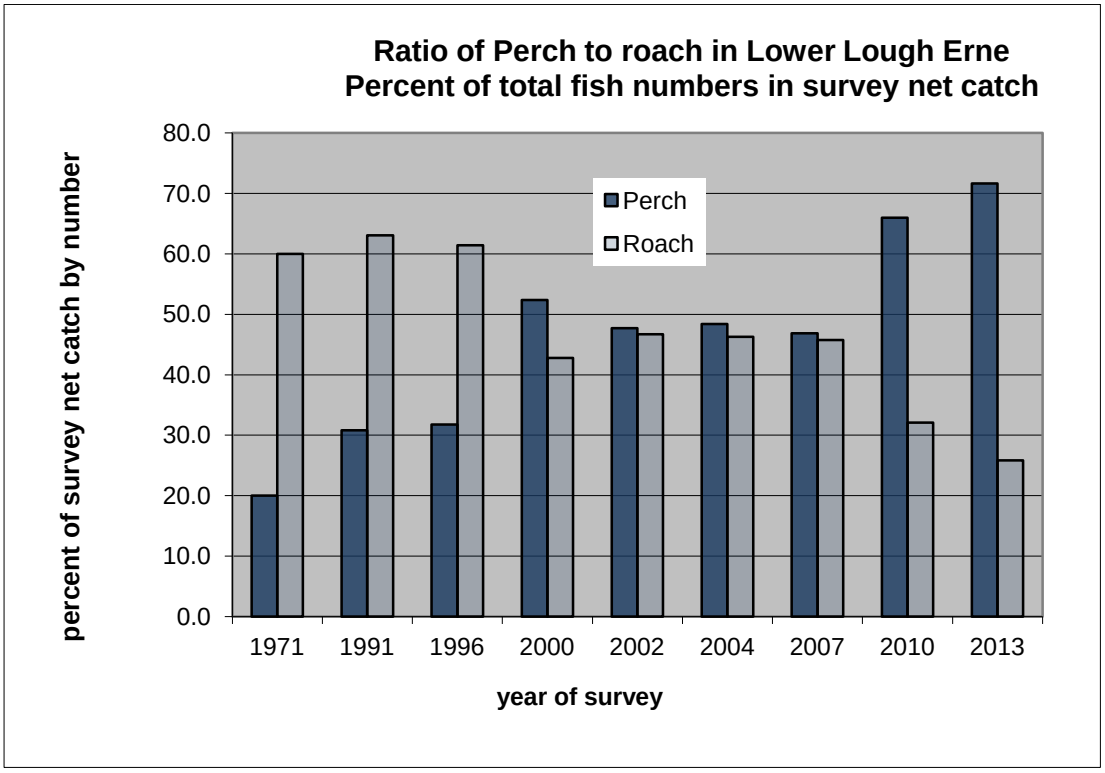


Fig. 7 Changes in percent by number of survey net catch of perch and roach 1992 to 2013.

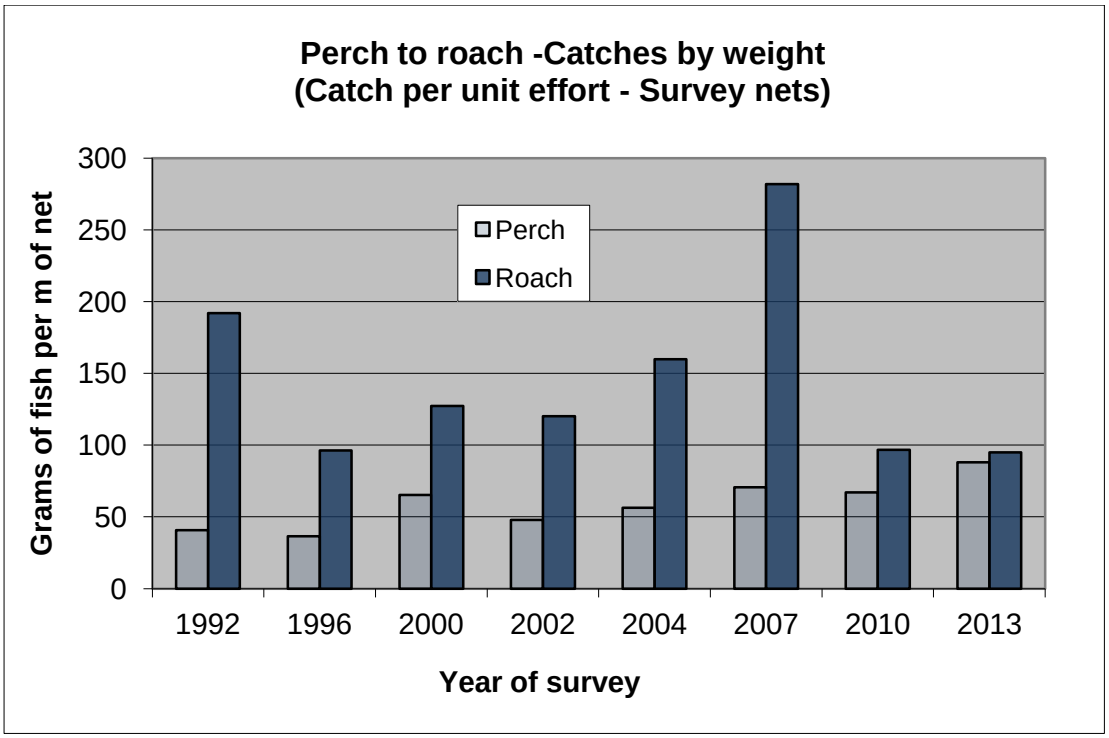


Fig. 8 Perch and roach catches by weight in survey nets 1992 to 2013. Note perch (blue) total weights rising slowly but roach (maroon) weights are highly variable. One can see the growth and eventual death of the 1995 and 1994 born strong roach cohort in catches from 1996 on.

The roach population is often dominated by fish of particular ages, deriving from variable spawning success. The following series of graphs (Fig. 9) show roach successfully spawned from a strong year class circa 1995passing through the population and eventually disappearing through old age by 2010. Thereafter, the roach population appears currently to have been more uniformly distributed by age in 2010 than it has been since surveys began, but 2013 data again shows very low recruitment from the previous 2 years (much like 2002 and 1992).

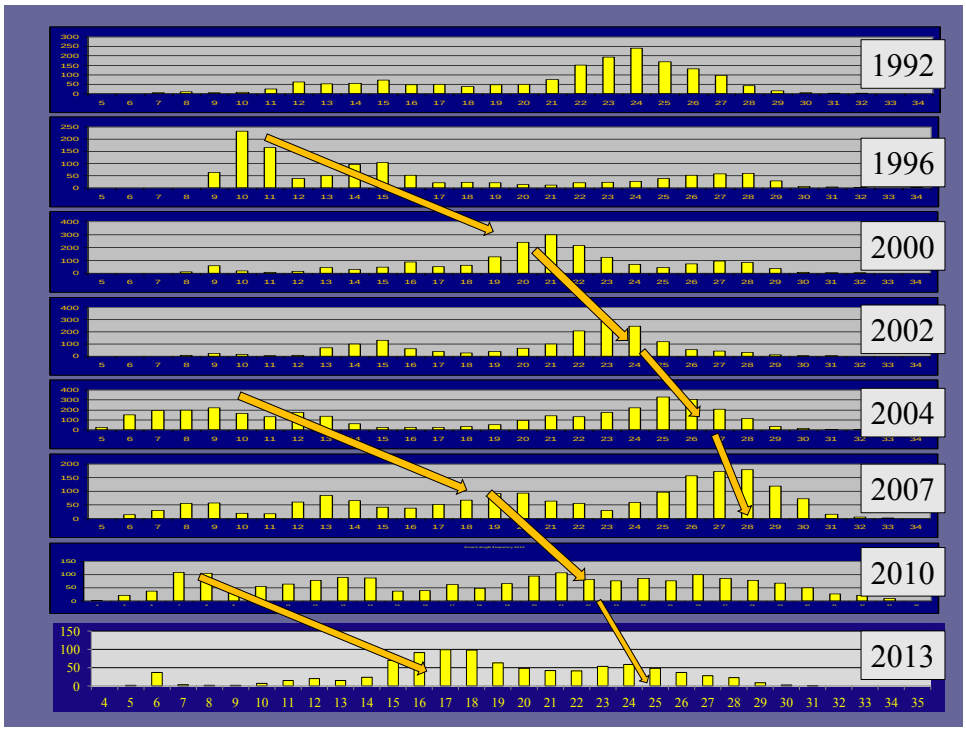


Fig. 9 Roach length frequency distribution showing the track of two strong year groups first evident in 1996 and passing out of the population through old age (at circa 12 years) between 2007 and 2010. Subsequent recruitment has been lower and note the low number of small roach from the two previous year classes in 2013

The instability in the roach population has an effect at any one time on the perch to roach biomass ratio. While the equivalent total perch weights per unit effort have risen slowly over time, the variation in roach weights can be marked as strong year classes pass through. The loss through old age of the 1994 and 1995 year class of roach is now complete and the steady rise in the perch population means that perch and roach biomass now approach parity (Fig 8). If roach recruitment continues at current low levels then perch could in future exceed roach in both biomass and numerical analyses.

Data for other species in "survey" nets (Figs. 4, 5, &6)

Bream

Bream have virtually disappeared from the survey net catches. Only two specimens were caught in these nets in 2013 (1 in 2010). Small bream have always tended to be scarce in these surveys, leading to speculation that the population may not naturally have large numbers of small fish and have been reliant on movement of fish from further afield, perhaps even upper Lough Erne. Nevertheless, the current low numbers give rise for concern over the future of bream in the system given the lack of recruitment and the high number of Roach-Bream hybrids. Bream and hybrids are discussed under the 50mm mesh net catches below

Pike

Young of the year and 2 year old pike are caught in the margin surveys with survey nets. The older and larger fish are better sampled with 50mm fixed mesh nets and at other times of year. The catch of small pike in the 2013 survey nets is at the lower end of the range recorded since surveys began in 1991. The overall status of pike is discussed below with contributions from targeted surveys and the data from the 50mm mesh nets below

Trout

The multi-mesh survey nets catch trout of a size range from first recruitment to the lake from feeder streams to circa 40 cm, but most trout in these nets are the smaller fish below the minimum take-able size of 30 cm. It is noteworthy that both the 2010 and 2013 surveys both show low numbers of trout in these summer margin survey nets. This species is discussed as a whole in the context of the 50mm net series data below.

Minor species present in low numbers

Tench (2 individuals) were caught in a net sample near Devenish Island. This is not the first record of tench from LLE, others having been recorded in eel fyke nets, but it is the first in the standard triennial gill net survey.

One adult salmon was also caught (Rossmore Bay) in a 50mm gill net.

Data from the large mesh 50mm fixed mesh nets.

As described above, the survey nets are supplemented with "fixed mesh" 50mm gill nets to increase the sample size and population trend information of less abundant larger species. Of particular interest are larger individuals of trout, pike bream and roach-bream hybrids, though small numbers of perch have grown large enough to be caught in this mesh in 2010 and 2013.

Perch in 50mm mesh nets: The appearance of some larger fish first noted in 2010.

A small number of large perch (28 to 33 cm long and 450 to 650 g weight) were caught in the 2013 50mm net series (Fig 10.) . Perch of this size are unusual in the context of the past 20 years and were first recorded in 2010. The 50mm mesh size nets rarely caught perch prior to 2010 and even then the individuals caught tended to be smaller perch meshed in tyings between mesh and headline or lead line, i.e. not genuinely selected by the mesh. It is worth noting that in addition to the 15 specimens caught in the retained multi-filament nets some 35 perch were caught in the 50mm monofilament nets whose data was excluded from population trend analysis due to concerns that these new nets were not strong enough to retain pike, large bream and trout (see under table 1 above). Perch were the only species of which more were caught in the fine mono - filament nets than in the multifilament type (See table 1 above). Age and growth analysis of these fish is still being undertaken but the implication is of at least a temporary increase in growth rate. Future analyses and surveys should show whether this is a long term new feature of the perch population, or a one off event from a particular set of conditions pertaining to a particular cohort. If the former (longer term change) applies, the implications of increased numbers of larger piscivorous perch for ecology and management will need to be considered, as these fish are large and numerous enough to exert significant predation pressure on smaller fish of all species including newly recruited trout parr entering the Lough from feeder streams.

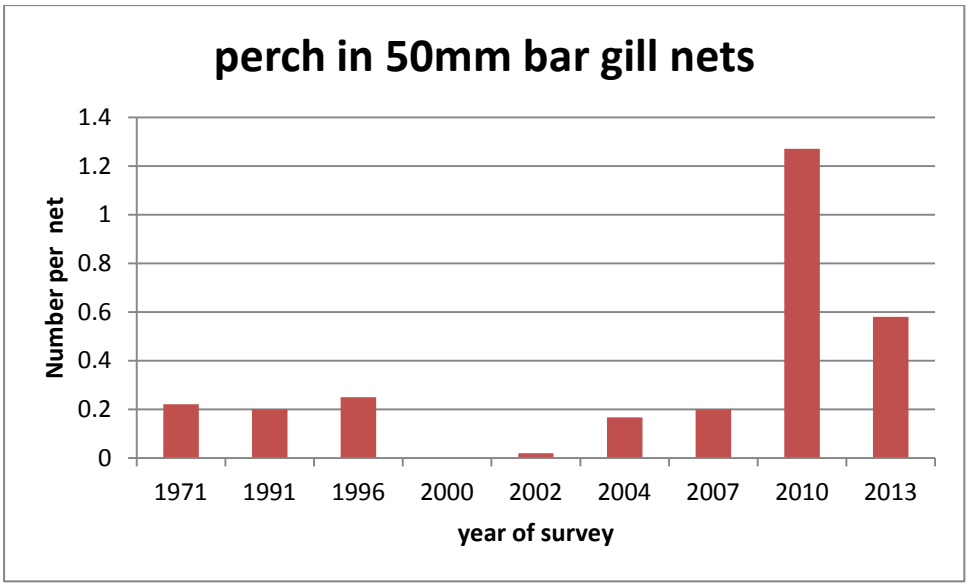


Fig. 10 Perch catches in 50mm nets 1971 to 2013,

Larger Roach, Bream and Hybrids in 50mm nets

Roach catches in 50mm nets showed a steady increase as a strong year class passed through the system from 1996 to 2010 (Fig. 11b). This year class is due to die progressively of old age after 2010 (Fig 11a, also evident in Fig. 9 above) Bream numbers have undergone decline since 2004 (Fig. 11b), possibly due to competition with the strong roach group. Hybridisation with roach spawning alongside bream is perhaps the most likely of the possible reasons for bream decline, as there is has been no evidence of disease, and numbers of hybrids have increased. The current stock of genetically pure bream is so low that it is at first glance difficult to understand how the hybrids are generated. A more detailed examination reveals that the hybrids live much longer than either parent species and that the hybrids can persist in the stock beyond their parents. If hybridisation with roach at shared spawning locations is, as seems likely, the cause of the decline of genetically pure bream, this could explain the hybrids outnumbering bream (as they do now) and persisting as the bream stock dwindles to very low levels. Eventually, the incidence of hybrids should decline as a proportion of the Roach/Bream/Hybrids mix with the decline of potential bream parents, but this could lag up to a decade after the bream stock has almost disappeared.

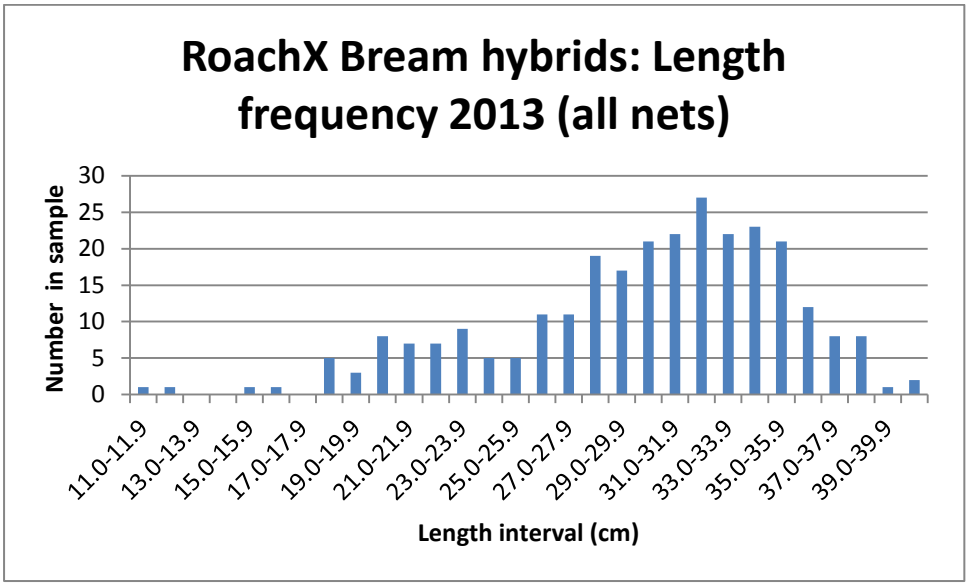


Fig. 11a Length frequency distribution of Roach X Bream hybrids 2013, all nets

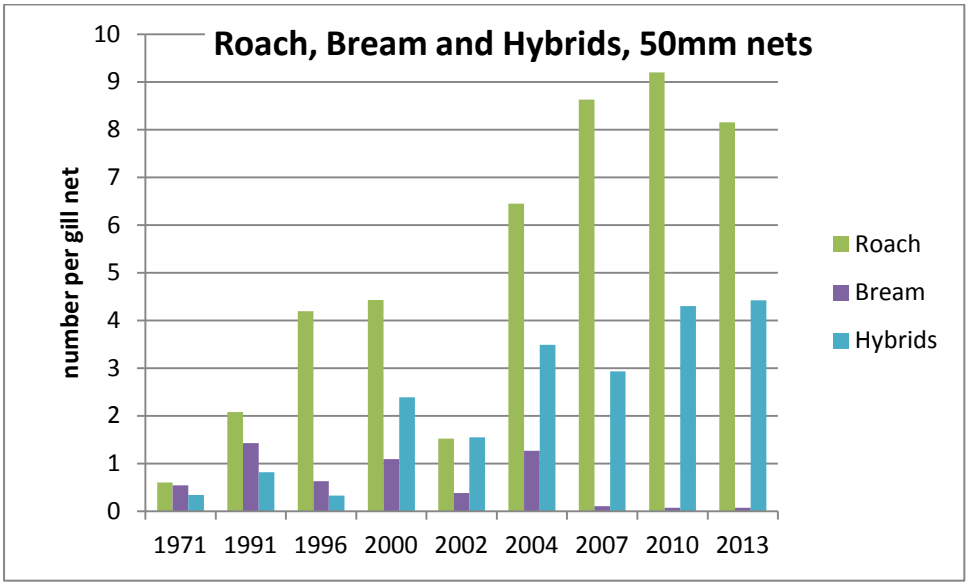


Fig. 11b, roach, bream and hybrids in 50mm gill nets

Pike and trout in 50mm nets

The numbers of pike and trout caught in the 50 mm nets are shown in Fig.12. This data does not indicate any obvious relationship between the two species, but note that sample sizes are small and confidence limits high. Both pike (generally >50cm) and trout (>30) cm in 50mm nets showed an increase in 2010 over two low years in 2004 and 2007, and that this situation was maintained in 2013.

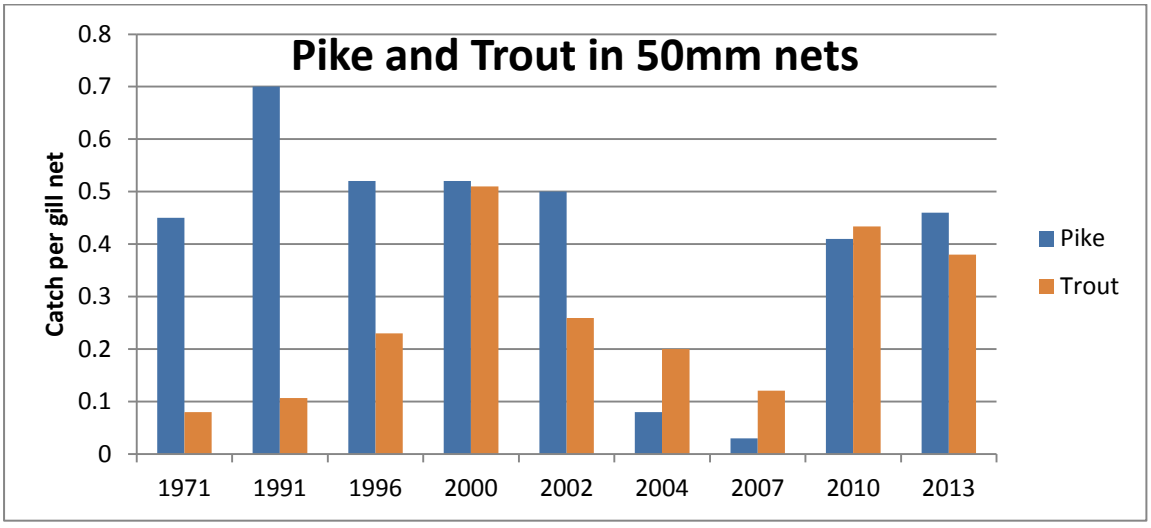


Fig.12 Pike and trout in large mesh nets

The scenario, for both pike and trout, where the catch of smaller fish in margin "survey" nets is at the low end of historical range in 2013 (Figs 4 and 5 above) and

the catch of larger fish in 50mm nets at the same sites (Fig 12) is within or at the higher end of the range of previous surveys, is at first glance difficult to explain.

Consideration of trout data combining survey and larger mesh nets and river data.

The trout numbers are particularly problematic, as the relatively high numbers of larger trout within the context of the 50mm time series must have grown on from smaller trout at least some of which were present in LLE in 2010.

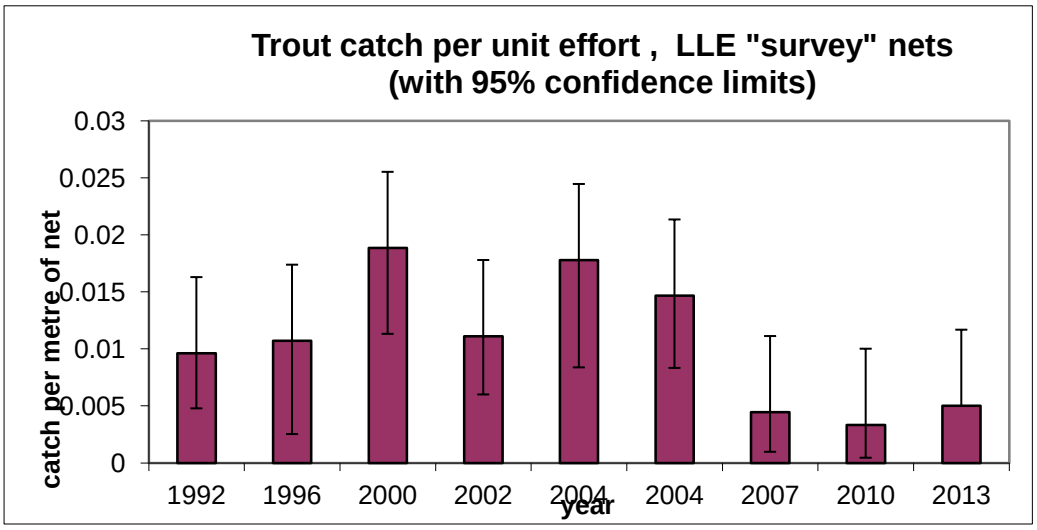
The “survey net” and 50mm single mesh net catches of trout in isolation from data on other species are shown in fig 13a and 13b. Sample sizes of trout in these lake margin survey nets are very small, confidence limits high and conclusions must be tempered accordingly. The upper figure 13a shows catch per unit effort as a measure of abundance of fish in the “survey” net series, and shows relatively low numbers in recent surveys 2007 to 2013. These multi-mesh nets catch fish of ages mainly 1 year or less after their entering the lake, under angler take-able size of 30 cm. The 50 mm mesh selects for trout at and above 35 cm long, typically 3 or more years old and with at least one or two full years in the lake (Fig. 14).

It is possible to examine whether the mismatch in apparent abundance between trout in “survey” nets and in 50mm nets three years later is due to the three year gap between surveys being too coarse to record a pattern of variable recruitment, and this does indeed appear to be a possibility (compounded by the uncertainty associated with low sample numbers).

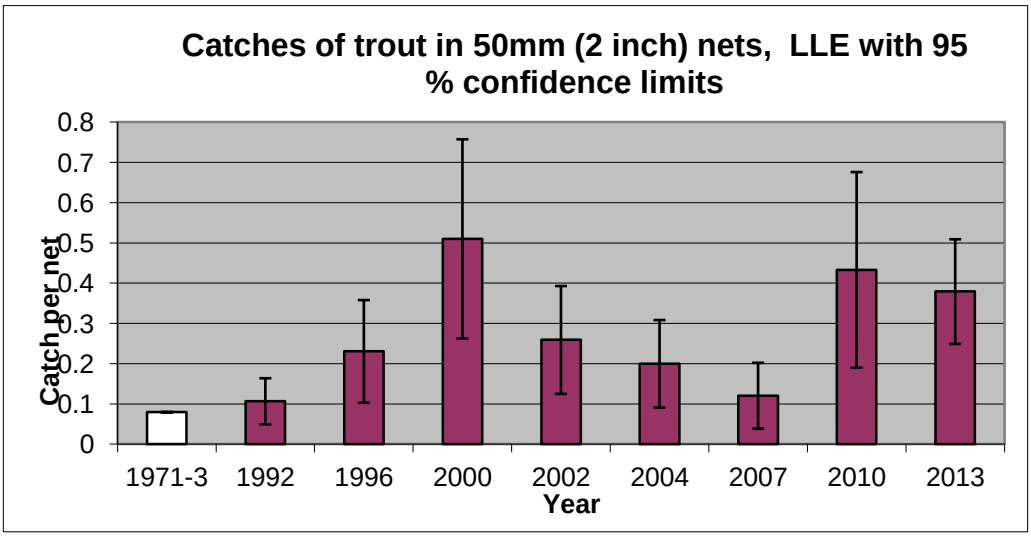
Therefore, due to relatively short lifespan in the lake there may not be much basis for a relationship between smaller trout catches in “survey” net data and larger fish in 50mm net data three years later, as most fish will have passed out of the lake population between by 2 years after recruitment.

Behavioural change or variability is also a possible reason for changes in trout numbers and distribution. It is known from open water surveys for pollan (see below) that there can be significant numbers of trout away from the margins in the open water of the “Broad Lough” and there is a real possibility that at some times of year the bulk of the trout are not present in the margins at all. A set of survey nets fished in the surface layer of the Broad Lough over 25-30m of deep water in August 2013 recorded catches averaging 2 trout per gill net, mainly smaller fish. The presence of trout over the deep water is not a new observation and some trout survey methods advocate targeting summer trout samples in the surface layers of deep water. There is, however no time series data from organised sampling of the Broad Lough of Lough Erne, as previous surveys have focussed on the margins to survey coarse fish and avoided open water netting due to hazard to navigation. While the possibility of behavioural shift of trout to open water is real for some or all of the year, one cannot yet quantitatively examine whether or not there has been any recent change of this type in trout distribution. It is not known what factors or changes might drive the smaller trout to select open water over margin habitat, but factors such as feed

availability, avoidance of warm water in warm summers (such as 2013), and predator avoidance are potentially important.



13a trout numbers in survey nets, Lower Lough Erne, 1992 to 2103



13b trout numbers in 50mm nets, Lower Lough Erne, 1992 to 2103

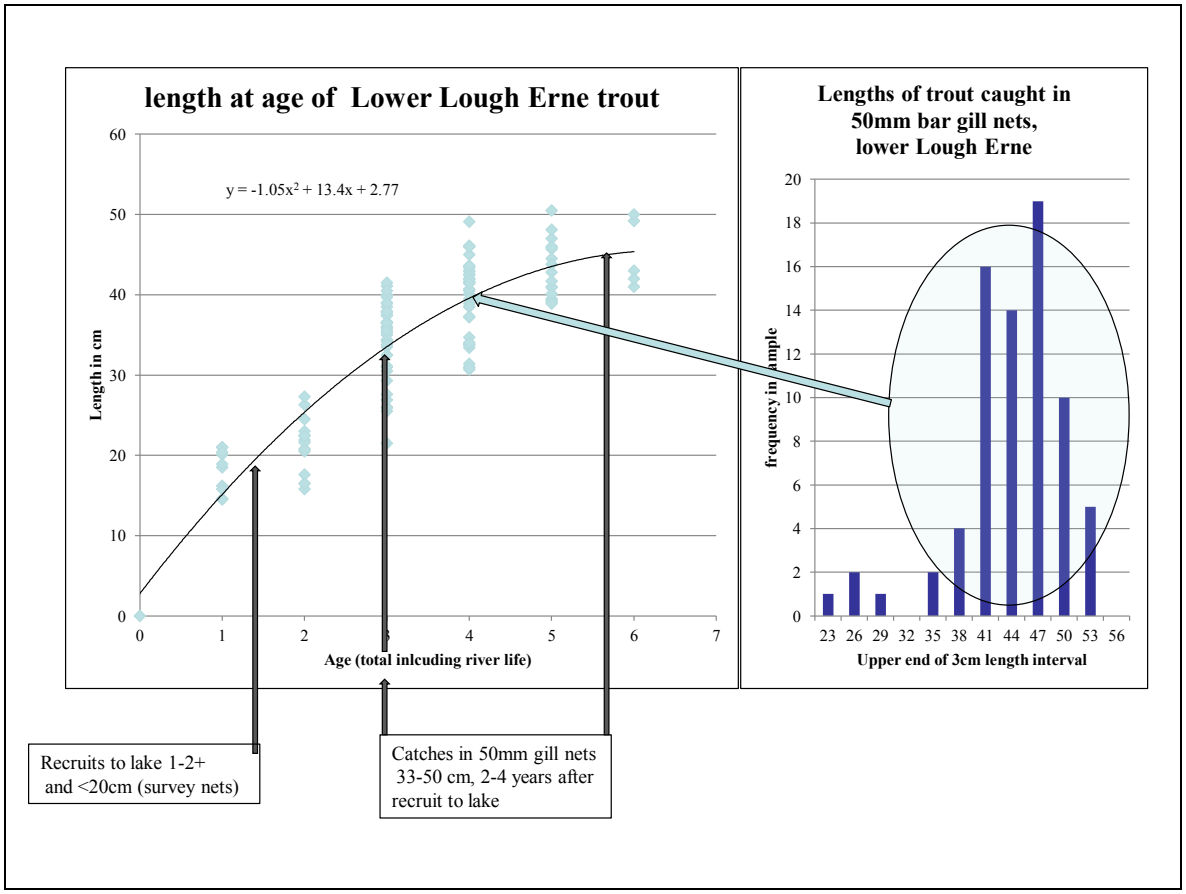


Fig. 14. Length at age related to mesh selection, Lough Erne trout

Trout data: Additional information available from spawning streams

River electro-fishing surveys can be informative for trout. The Garvary River, which enters Lower Lough Erne at its North-Western end, has been monitored as a natural 'index' of salmonid abundance on Lower Lough Erne since 2005. The monitoring data includes Redd counts and annual 0+ fry electrofishing data.

Redd counts undertaken at spawning time have been used as a proxy for adult trout abundance on the Garvary River (fig, 15a). The trout redd count on the Garvary has shown no directional trend across the available time series (2000 - 2012). Despite one poor year in which only 74 trout redds were detected (2006), the number of trout redds have been relatively stable with an average of around 200 redds counted each year

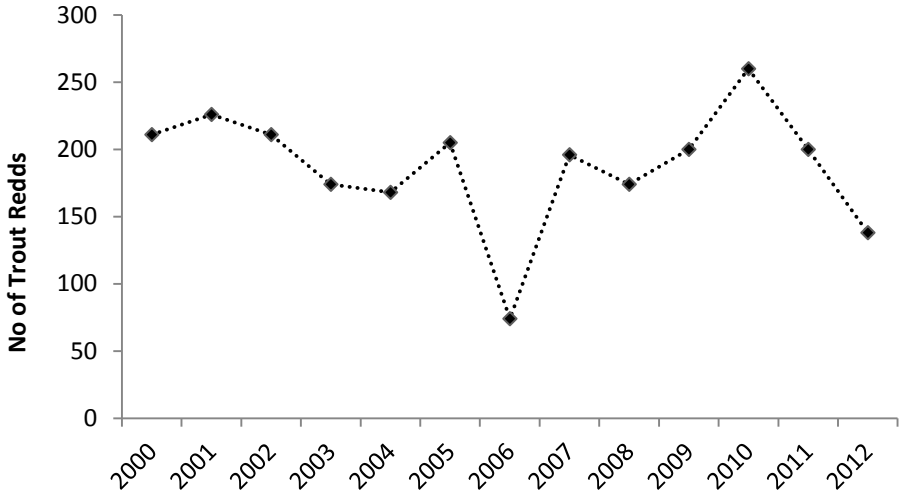


Fig 15 a. Trout redd count on the Garvary River, Lower Lough Erne, 2000 – 2012.

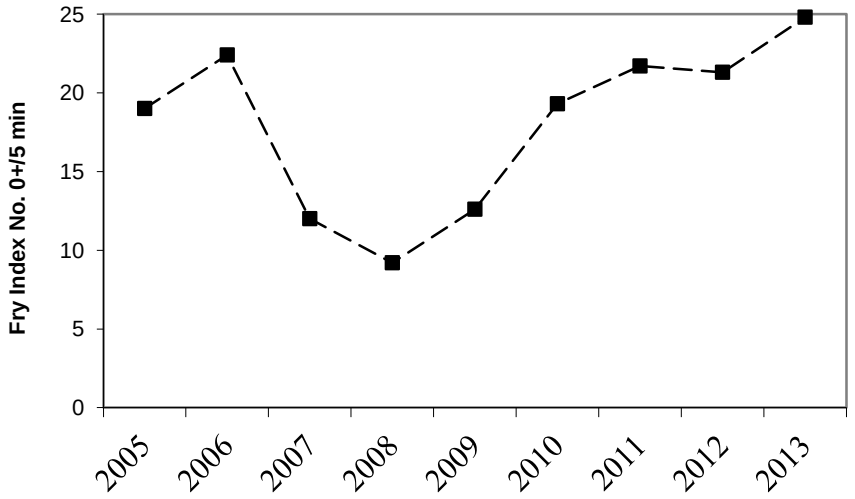


Fig. 15b Juvenile (0+) trout fry index for the Garvary River, Lower Lough erne 2005 – 2013.

Juvenile trout

No stocking has been undertaken on the Garvary since 2005 to ensure that the river reflects natural recruitment dynamics for trout and salmon. Semi-quantitative electric fishing surveys have been undertaken annually on the Garvary since 2005. Although these data are generated principally for the assessment of 0+ salmon recruitment, trout data is also collected. A fry index (fig 15b) has been calculated for the Garvary each year which is descriptive of juvenile (0+) trout recruitment and provides a basis for comparison of any potential trend in juvenile abundance across the available time series. Although the trout fry index has varied from a low position of 9.2 0+ 5 min^{-1} (2008) to a high of 24.8 0+ 5 min^{-1} (2013) no overall trend was evident indicative of a degree of stability in recruitment over the available time series (Fig 15b).

Other River data for trout is available, but not yet as a detailed time series, on the Kesh and Ballinamallard tributaries of LLE. As the river indices do not tend to show the same degree of variation as the lake netting data, it is clear that there is some way to go to full understanding of the trout population dynamics.

Future improvements in trout assessments could benefit from more and more regular data to resolve whether or not there is a problem with trout numbers in LLE. Whether or not the margin summer surveys designed originally for relatively long lived coarse fish every three years are adequate to assess trends is a critical question. The low numbers of small trout in the margin samples over the last 2 surveys would require some further investigation if they persist for future surveys. Structured sampling of surface layers of the deep water may also be worth considering, alongside more regular and widespread river surveys

Pike data combining survey and larger mesh nets and the 2013 spring pike spawning season survey.

Pike show the same pattern as trout in the past 2 summer surveys (2013 and 2010) , namely low numbers of younger fish in the multi-mesh survey nets, with more consistent and relatively higher numbers in the 50mm net series (Figs. 4,5 and 11). If the reduced 2010 summer survey nets represent a population level change, then this could reasonably have been expected to show in the 2013 50mm net series. As this is not the case and 50mm net catches were not reduced to the same extent, other explanation is required. One real possibility is that low sample numbers and high confidence limits in the summer survey data are such that the survey simply has insufficient resolution to make these links.

As pike are more reliably surveyed in spring when the adult stock gathers in particular selected bays to spawn on weed mats and flooded margins, a survey of the pre-spawning pike stock was commissioned and conducted for DCAL by AFBI in March 2013. This has been reported separately. The conclusions from the spring 2013 pike survey are that pike abundance is within the ranges recorded in intensive surveys in the 1990s, and that individual fish are of higher average size in 2013. These tallies broadly with the 50mm net results of the 2013 summer surveys showing adult pike stocks in 2010-2013 at more or less the same level as previous surveys. In the context of pike spawning, it is worth noting that recent highly variable lake levels linked to maintenance of the hydropower stations dams at Ballyshannon and Cliff could affect pike as they spawn in very shallow water and can be subject to drying out of eggs if water levels fall post spawning.

The question of pike-trout interactions: Could pike predation be affecting trout numbers?

Being almost totally piscivorous after their first year of life, pike have the potential capacity to influence numbers of other fish species through predation. They have in some cases been demonstrated to take disproportionately high numbers of salmonids in relation to the balance of supply of fodder fish. The possibility therefore exists that while their overall population is driven by the mass supply of fodder fish (roach or perch), the behaviour of selectively taking salmonids at certain times of year could cause disproportionate impact on trout numbers.

In this context, one has to look at Irish lakes in the light of changes brought about by zebra mussels. The filter feeding behaviour of ZM has caused reduced phytoplankton crops, increased growth of macrophyte beds, and is the probable driver of the shift in LLE from perch to roach as the most common species (Fig. 6). There is also evidence that pike spawning habitats (shallow water with weed growth) may have benefited from water clarification by zebra mussel activity. The ecology and fish stock dynamics in LLE now must be considered as very different from 1992 to 2000 before the impacts of zebra mussel.

Other zebra mussel induced impacts which may be driving change include reduced roach numbers as a food source for pike, the emergence of large predatory perch, and altered invertebrate communities. In the context of change over this range of key ecological factors, Fish behavioural change affecting survey results pre and post ZM colonisation is a distinct possibility.

The key datasets to examine for the potential for impact of pike on trout are probably the pike as surveyed in 50mm nets (which excludes the partly non-piscivorous young of the year) and the “target” group of trout in as determined by survey nets (Fig.16). Similarly, it is worth examining data for potential interaction between older pike caught in 50mm nets and young pike in “survey” nets (Fig. 17)

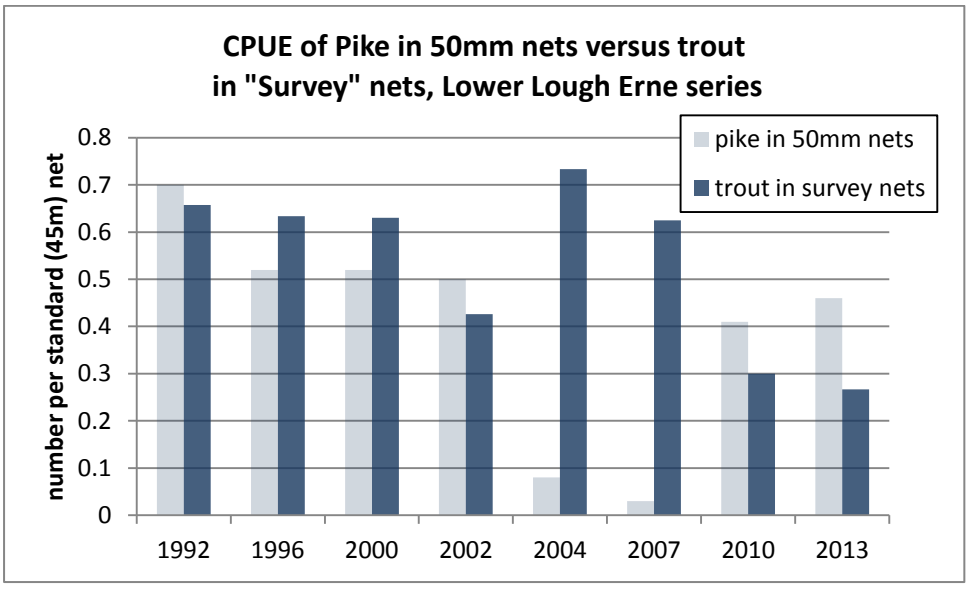


Fig.16 Catch of adult pike in 50mm nets versus trout in survey nets

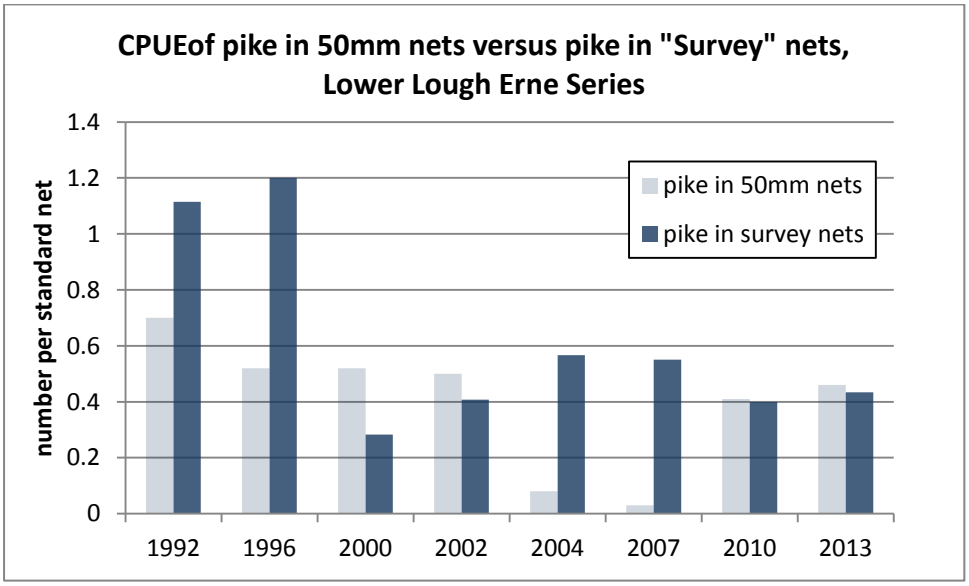


Fig.17 Catch of adult pike in 50mm nets versus pike caught in survey nets

These data (Fig. 16 and 17) show potential support for the concept of differing ecology in pre-and post zebra mussel impacted systems. Up to and including 2002 there is no sign of a relationship between adult pike and smaller trout numbers. Post 2002 however, there is a suggestion of an inverse relationship, higher pike numbers pairing with low small trout numbers in the margins. While this observation is not proof of cause and effect, it nevertheless merits further investigation, and suggest strongly that the current ecological relationships in LLE are effectively representative of a different system than existed before zebra mussel colonisation. Note that a similar picture is shown when comparing adult with smaller pike numbers (Fig 17), suggesting the possibility of increased or altered intra-specific behavioural interactions between large and small pike.

The 2013 Pollan survey with notes on deepwater fish

A separate exercise was carried out on 19 to 22 August 2013 to sample deep water for pollan. After identifying concentrations of fish in the pelagic zone on a SIMRAD EY60 Echo sounder operating at 120KHZ, three sites along the southern edge of the Broad Lough were sampled using gill nets set overnight. Details of nets set and catches are given in table 2.

These nets show a very different open water fish community from that sampled in the margins. There were three clearly separate and discrete groups of fish at the deepwater sites which were 25 to 30 metres deep. These comprised small trout (19 to 26 cm long) subsurface, shoals of very small (young of the year) perch in mid water at 10-12 m down, and pollan at 25 to 30m deep pelagic in open water or a few metres above the lake bed where this depth band touches the edge slope of the deep basin .

The pollan catch in these targeted nets was by far the largest concentration found since 1991. The previous highest CPUE was less than half this in a similar 2010 survey check – see 2010 report). Pollan were seen on the echo sounder over the 25-30 m contour band from Hills Island to Heron Island, with more echo targets in the open water of the Broad Lough at the same depths. The fish appeared to be gathered around a thermocline and plankton band at 25-30m from the surface and where temperature changed from a surface layer of 18 degrees celsius at depth 25m and less to a bottom layer of circa 14 degrees 30m and more. The pollan caught ranged in size from 17 to 32 cm in length and while age determination is not yet complete appear to represent all the 1+ to 5+ age groups. Young of the year pollan have never been found in quantity in AFBI Lough Erne surveys and their distribution remains unknown.

The observation that trout can be caught just subsurface in numbers in open deep water is not new, but it is worth noting that seven 30m long CEN nets set over 3 days in the deepwater surface test caught 8 trout, as compared with the a catches of 8 trout in thirty 60m “Baltic” survey nets in the margin surveys or 2 trout in thirty 30m CEN nets in the margin series. The implication is clear that for adequate survey representation of trout future surveys must consider building an open water surface netting time series.

The other group of open water fish is a mid water pelagic group of small (5 to 7 cm) pelagic young of the year perch fry. This type of behaviour has been recorded before for perch where there is plankton food in open water.

In Summary, this short open water survey demonstrates a summer open water fish community including deepwater pollan, subsurface trout and pelagic young of the year perch which is very different from the time series samples margin surveys. The distinctness of the thermocline in August 2013 probably accentuated the depth separation of echo-sounder targets and net catches. In future surveys should

consider building an open water surface netting time series into the dataset from the present onwards.

Table 2 Nets set and catches in a spot LLE deepwater survey in August 2013

Net Code	Type	Meshes	Set	Depth set 0r bottom of lake	Net length m	Grid ref	Catch (number of fish)		
							Pollan	perch	Trout
First series 18-19/8/2013, North of Hills Island									
1	Survey	CEN 5-55mm	Benthic	20	30	062589		1	
2	Survey	CEN 5-55mm	Benthic	20	30	063590	2		
3	Survey	CEN 5-55mm	Benthic	25	30	062591	1		
4	Survey	CEN 5-55mm	Benthic	25	30	063591			
5	Survey	CEN 5-55mm	Benthic	30	30	063591	2		
6	Survey	CEN 5-55mm	Benthic	30	30	064591	5		
Second series 19-20/8/2013, North of magho									
7	Survey	CEN 5-55mm	Benthic	25	30	099587	4		
8	Survey	CEN 5-55mm	Benthic	25	30	101587	3		
9	Survey	CEN 5-55mm	Benthic	30	30	101587	3		
10	Survey	CEN 5-55mm	1m subsurface	25	30	101585	1		1
11	Survey	CEN 5-55mm	1m subsurface	25	30	100558			4
12	Survey	CEN 5-55mm	1m subsurface	25	30	106559			1
13	Survey	12.5,19,25,33,38,45	Pollan Rigged 2m off bottom	30	45	099588	9		
14	Survey	12.5,19,25,33,38,46	Pollan Rigged 2m off bottom	30	45	100588	6		
15	Survey	CEN Progresion 5-55mm	Pollan Rigged 2m off bottom	30	30	102588	5		
Third series 20-21/8/2013, Hills Island									
16	Survey	CEN 5-55mm	0.5m subsurface	25	30	129575			2
17	Survey	CEN 5-55mm	0.5m subsurface	25	30	128576			
18	Survey	CEN 5-55mm	0.5m subsurface	25	30	112575			
19	Survey	CEN 5-55mm	0.5m subsurface	25	30	127576			
20	Survey	CEN 5-55mm	10m Midwater	25-30	30	128577	5	74	
21	Survey	CEN 5-55mm	10m Midwater	25-30	30	129578	5	101	

2013 Upper Lough Erne Netting Survey (Part funded by NIEA)

Upper Lough Erne (ULE) was surveyed using WFD protocols in October 2013, repeating an earlier 2010 IFI survey plan incorporating CEN Gill nets, braided twine 50mm large mesh nets and fyke nets for eels. There is no long term time series data from ULE, and therefore the method chosen reflects the needs of the WFD and will in time develop time series data to this standard. Figs. 18a and 18b give a summary of catch per unit effort compared between the two surveys. Fig. 19 shows a comparison between ULE and LLE CEN net data.

IN summary Key points to note are:

- Absence of bream from CEN nets in ULE in 2013, following low number in 2010
- Significant change in perch to roach numerical ratio between 2010 and 2013 surveys of Upper Lough Erne,
- Consistent Roach numbers in the upper Lough between the two surveys, with numbers of larger, older roach increasing the roach to perch biomass ratio as compared with the Lower Lough
- Very low sample sizes making difficulties in comparing trout and pike numbers between 2010 and 2013. The apparent high trout biomass in 2010 in ULE is down to two large (3Kg and 4Kg) trout in the sample, in 2013, only one small trout was caught. Pike numbers were less than 10 fish in both surveys
- A difference between perch numbers in LLE and ULE in 2013. In a like for like comparison between Lower and upper Lough Erne CEN nets, which can be tracked to a very large young of the year (2013 spawned fish) catch in the July to September Lower Lough nets which was apparently not represented in samples in the Upper Lough in October

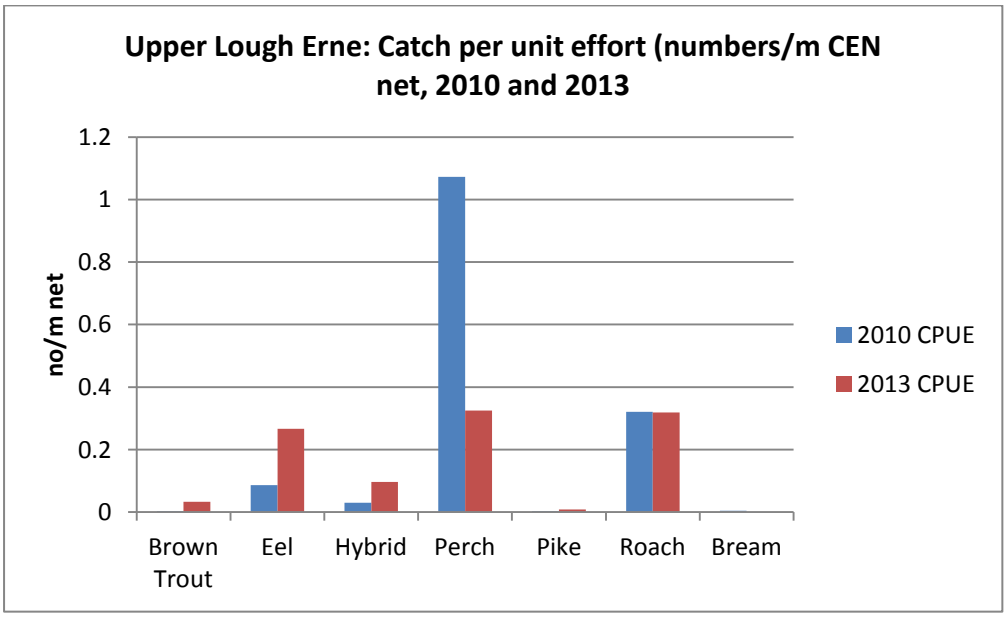


Fig 18a. Upper Lough Erne fish survey catches (CPUE Number), 2010 and 2013, CEN protocols

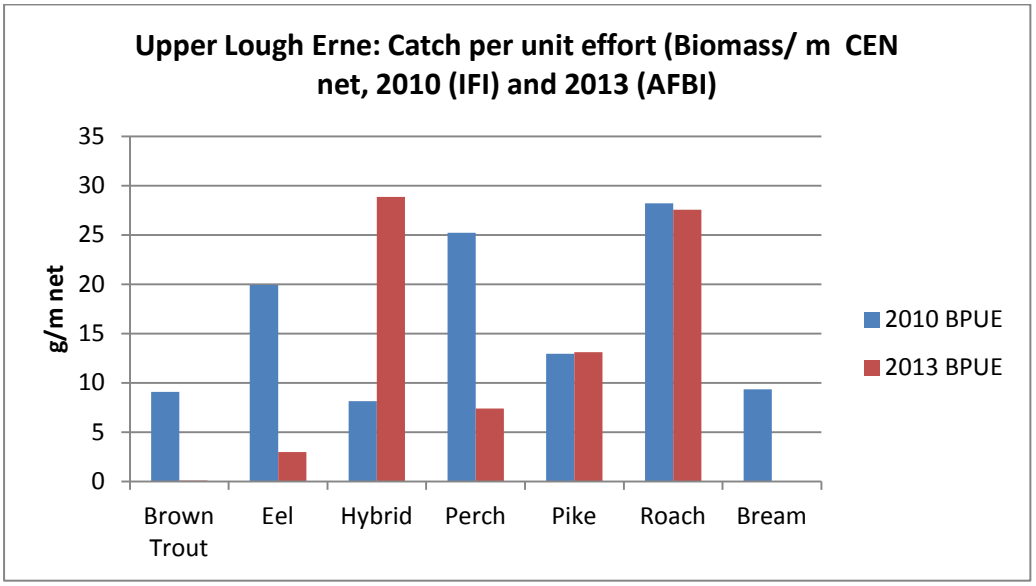


Fig 18b. Upper Lough Erne fish survey catches (CPUE Weight), 2010 and 2013, CEN protocols

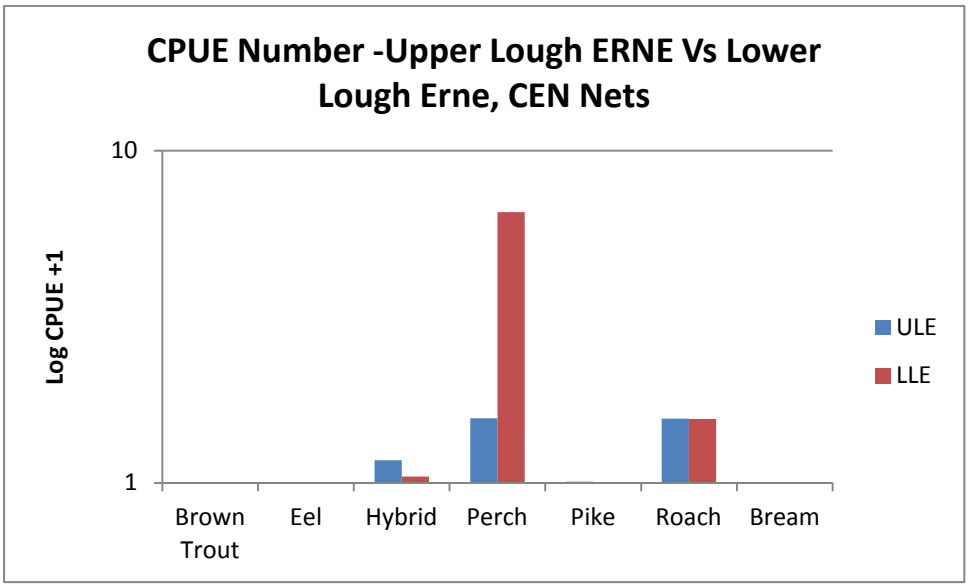


Fig 19. Upper Lough Erne fish survey catches, CEN protocols, compared with Lower Lough Erne CEN data

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