



**National Programme:
Habitats Directive
and Red Data Book
Fish Species**

Summary Report 2013



lascach Intíre Éireann
Inland Fisheries Ireland

National Programme: Habitats Directive and Red Data Book Fish species

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Habitats Directive and Red Data Book Fish species 2013: Executive Report

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1 Introduction

2013 marked a milestone for the Habitats Directive and Red Data Book fish team in Inland Fisheries Ireland (IFI) as it represented both the first year in a new six-year rolling cycle of monitoring and investigation under Habitats Directive (European Commission 1992) and was also the year in which status assessment reporting from member states, under Article 17 of the Directive, was due to be submitted to the EU Commission in Brussels. The start of a new six-year cycle provided an ideal opportunity to take stock – to examine what has been achieved, what sampling and analysis strategies have been successful – and to develop a programme appropriate for the six year period 2013 – 2018.

1.1 Status Assessment for Article 17 reporting - Habitats Directive

A detailed document trail has been developed by the EU for Article 17 reporting. All member states follow the same procedure, enabling comparison of status of various species and habitats between different countries in Europe. In Ireland, Article 17 reporting is undertaken through the state-funded National Parks and Wildlife Service (NPWS). The Minister for Communications, Energy and Natural Resources (DECNR) is specifically charged, in national legislation, with the surveillance and monitoring of the fish species listed in the Habitats Directive. IFI undertakes this task for the Minister. Thus, IFI compiled the Article 17 reporting for the relevant fish species – Atlantic salmon, Twaite-, Allis- and Killarney shad, pollan, sea-, river- and brook lamprey in the first instance. IFI closely liaised with NPWS who lodged all material into a centralised electronic database for transmission to the EU. Submission was completed on time and NPWS transmitted the entire database for Ireland to the EU in line with the June 2013 deadline.

Of the species dealt with by the Habitats team, only the river/brook lamprey was recoded as having good conservation status with positive prospects. The sea lamprey had an overall conservation status of 'bad'. While the Habitat assessment for the species was 'good', in terms of quality and extent of available habitat, it was considered that the population sizes were small and adults were restricted by barriers to passage in ascending into catchments.

Although restricted to a single location, Lough Leane, the Killarney shad was considered to have a good conservation status. Of the two anadromous shads, the Twaite shad had an 'inadequate' status in regard to all the relevant attributes, while the Allis shad was rated as having a 'bad' conservation status.

1.2 IFI strategies for Annex II fish species: 2013-2018

Lamprey are widely distributed throughout the country and survey work in regard to adult spawning and juvenile distribution has been a major component of the annual Habitats work programme. In the previous six-year cycle, data on brook lamprey spawning was compiled and a paper published in a scientific journal by the team. Over the course of the present six-year cycle,

investigations on spawning of river lamprey will be undertaken. Such surveys will examine the extent of penetration into freshwater by the adult river lamprey. This will include monitoring their migration from the sea in late summer-autumn to their spawning the following spring. Identification of spawning locations will be of conservation importance, aiding in the protection of these locations. As the juvenile river- and brook lamprey are indistinguishable, at least at field level, the location of adult river lamprey spawning sites takes on an added significance.

A status assessment approach based on developing numerical data for trends, consistent with the EU Article 17 documentation, was commenced in 2013. It was decided that all of the SAC catchments designated for lamprey would be surveyed on a catchment-wide basis over the period 2013-18. On a whole scale, this work was last undertaken between 2003 and 2007 with the aid of funding from the NPWS. The re-surveying commenced with the Corrib (Corrib SAC) and Feale (Lower River Shannon SAC) in 2013. Whole catchment comparison will be possible when reporting in 2019.

The data sets compiled for catchment-wide surveys in the 2006 – 12 period were examined and a short list compiled of channels where substantial habitat and populations of ammocoetes were recorded or where substantial habitat was available but populations of ammocoetes were low. Channels were selected to provide a geographical spread, taking stream order and topography into account. It is intended that this series of 'reference channels' will be examined every second year, with some receiving annual assessment. In all cases, a series of sites will be selected along the full linear extent of a channel or clustered in a small sub-catchment. The number of sites will range from 5 – 9, dependent on the length of channel or area selected.

The sampling strategy of bongo netting developed for post-larval and young-of-year shad has proved to be capable of annual replication and generates numerical data, albeit the numbers per unit volume are generally low. It is proposed that this strategy will be undertaken annually over the 2013-18 period. This sampling procedure has the added advantage that it collects juvenile smelt as well as juvenile shad and provides an opportunity to add to our information base on this species. Additional shad measures, including selective telemetry investigations on adult fish, will also be undertaken.

The existing synergies between the Water Framework Directive (WFD) team and the Habitats team in regard to shared interests in pollan, char and Killarney shad will be continued and further developed. Use of hydroacoustics as a tool to examine status of endangered fish species – pollan, char and Killarney shad – is the subject of a doctoral thesis currently being undertaken by a member of the WFD team. It is hoped that hydroacoustics will largely replace the need for extensive ground-truthing using gill nets. Another advantage of hydroacoustics is the extent of ground that can be covered relatively rapidly in the very large lakes of the Shannon – Lough Derg, Lough Ree and Lough Allen – where pollan are currently found. Selective use of large pelagic nets or of pelagic trawls in conjunction with the hydroacoustic assessment will, it is hoped, shed additional light on population size, spawning locations and extent, feeding patterns and other

aspects of pollan biology that may be important in trying to enhance the current conservation status of the species.

1.3 Lamprey investigations in 2013

Extended periods of fine, dry weather were a feature of the summer of 2013. Low water levels were prevalent and facilitated float-over surveys for sea lamprey spawning, using canoes, on the main stem of the River Suir and River Nore with local IFI RBD staff. These surveys complemented similar float-over surveys conducted up to ten years ago.

As per the sampling strategy for 2013-18, catchment-wide juvenile lamprey surveys were undertaken in the Corrib and Feale catchments, both of which contain extensive areas designated as SACs for lamprey species. In both cases, the whole catchment was surveyed as opposed to sampling within the SAC only.

1.4 Shad investigations in 2013

Bongo netting was employed with considerable success in 2013 in all of the SACs designated for shad in the south east – Slaney, Barrow-Nore, Suir and Blackwater. While level of occurrence was commonly low, the technique has now been well-developed as a standard method for IFI in its investigations of shad recruitment in any year. The positive results were complemented by data provided by the WFD team from its survey of the Suir-Barrow estuary in autumn 2013 – the WFD team encountering numbers of 0+ shad at a number of sampling stations. The weather conditions in summer, with low flow in rivers and warm temperatures, were considered conducive to shad spawning and recruitment.

Acoustic telemetry proved to be very successful and informative in 2012 and an expanded programme was implemented in 2013. This included some additional listening stations in the Barrow-Nore-Waterford Harbor as well as a series of stations in the Munster Blackwater, where an angling survey in 2011 had pointed to the presence of adult shad in the potential spawning ground in the May-June period. As in previous years, drift net sampling with IFI colleagues yielded small samples of adult shad on migration upriver to the spawning areas in early May on both the Barrow and the Munster Blackwater. The initial findings from the 2013 survey point to the value of the telemetry in elucidating aspects of the adult shad behaviors and movement at spawning time. The studies have also pointed to some substantial migrations on the part of individual tagged fish.

The major collection of shad scales compiled over a number of years was analysed and information on growth rate, frequency of spawning etc. extracted. This material has now been catalogued and representative photo images captured.

1.5 Pollan investigations in 2013

The survey team worked with IFI's Water Framework Directive (WFD) team on a WFD fish survey of Lough Ree on the River Shannon. The survey used hydroacoustics and conventional Nordic gill

nets, as well as a small number of deep (6m) pelagic nets. The latter were set on the basis of pointers in hydroacoustic traces. The survey generated a number of pollan and the hydroacoustic survey permitted an assessment of pollan population size.

The Habitats team also undertook a series of samplings, using bongo nets, to look for post-larval pollan. Sampling was strongly influenced by prevailing winds in the days prior to survey, as advised by colleagues from the Agri-Food and Biosciences Institute (AFBI) in Northern Ireland investigating pollan in Lough Neagh. The bongo sampling proved successful and recorded post-larval fish in small numbers in a substantial series of trawls.

1.6 Smelt investigations in 2013

Members of the project team attended and presented at a two-day workshop in Bangor, Wales organised by Bangor University focussed exclusively on smelt. The team participated in discussions and presented a paper on the current IFI bongo netting sampling strategy. Feedback from colleagues was very positive and colleagues in the Belgian state agency INBO were planning to adapt the technique for sampling for shad and smelt in the Schelde estuary during 2013.

At home, the estuarine bongo netting for shad also served as a smelt recruitment assessment mechanism. The WFD team also provided samples of smelt of various year classes from their autumn estuary survey of the Barrow-Suir- Waterford Harbour.

The major collection of smelt scales compiled over a number of years was analysed and information on growth rate, frequency of spawning etc. extracted. As with the shad scales, this material has now been catalogued and representative photo images captured.

1.7 Char lake surveys in 2013

Surveys were conducted in summer (Lough Nafooney, Co. Mayo) and early autumn (Muckross Lake and Cloonee Lakes system, Co. Kerry). In both cases, local staff of IFI provided staffing support during the surveys and assisted with permissions onto private fisheries. NPWS personnel from Killarney National Park facilitated the survey on Muckross Lake.

The netting procedure is identical to that used by WFD, enabling a sharing of data sets on char lakes. The Habitats team surveys lakes NOT on the WFD listing, to ensure maximum coverage of waters.

2. Lamprey Programme

2.1 Outcomes of Article 17 status assessment for lamprey species in Ireland

The Article 17 reporting on status assessment of Annex I habitats and Annex II species under the Habitats Directive fell due in June 2013. The report on lamprey compiled by IFI and submitted to the NPWS was based on work carried out in the period 2000 – 2007 as well as on specific surveillance in the period 2009 – 2012. The volume dealing with the full suite of species, including the fish, is available on line from NPWS at

http://www.npws.ie/publications/article17assessments/article172013assessmentdocuments/Article_17_Web_report_species_v1.pdf

The reporting procedure attempts to capture the status of each species, based as far as possible on quantitative data. Furthermore, the EU Commission is anxious that assessment be based on adult populations. Ireland has identified a preference for use of juvenile data in the case of lamprey, given the scope to compile quantitative data on juvenile population size, age structure and distribution at the catchment level. The sampling 'season' for juvenile lamprey is substantial in any year and the ammocoetes are confined to specific habitat types and are amenable to capture. Adult lamprey are essentially only available during spawning runs and these can be very extended, in the case of the river lamprey, or very short with limited evidence of activity, in the case of the brook lamprey. The IFI data collection process for lamprey in the 2009-12 period was specifically designed to inform Article 17 assessment, in regard to distribution and status of ammocoetes at a catchment level as well as compiling information on spawning spread and effort of brook and of sea lamprey.

The assessment of each species was summarized under the headings of 'Range' – 'Population' – 'Habitat' – 'Future Prospects' and 'Overall Assessment of Conservation Status'. The traffic-light colour coding of green-orange-red was used to emphasise the outcome of the assessment (Table 2.1).

Table 2.1 Summary Conservation Status for lamprey species in Ireland 2007-12 based on IFI data.

Attribute	River/Brook lamprey	Sea lamprey
Range	Favourable	Inadequate
Population	Favourable	Bad
Habitat	Favourable	Favorable
Future Prospects	Favourable	Bad
Overall assessment of Conservation Status	Favourable	Bad

In view of issues in regard to speciation of river-and brook lamprey at the juvenile or ammocoete stage, the two species were merged in regard to status assessment for Ireland. The situation for river/brook lamprey was considered Favourable in respect of all attributes. However, a much less

satisfactory situation presented itself for the sea lamprey. The range was considered 'Inadequate'. It is known from the literature that sea lamprey can migrate long distances into freshwater to spawn. This is considered an evolutionary advantage in maximizing access to downstream areas of fine sediment needed by the ammocoetes over the several years of life prior to developing into adult fish. Observations from sea lamprey redd counts reported here indicate a limited penetration into freshwater in most of the larger catchments frequented by sea lamprey, with large aggregations of redds commonly found downstream of the first major barrier that the fish encounter as they migrate upriver into freshwater. Population size, based on adult counts and counts of redds recorded in float-over surveys, appeared very low with indications of low hundreds, or less, in most cases. The float-over surveys have also confirmed that extensive suitable spawning habitat is present in the large river catchments but is unused by sea lamprey. This may be due to an inadequate population of adult fish or to inability to access the upriver locations of suitable habitat. Barriers are considered to be a major issue impacting on sea lamprey status and the future prospects for the species are likely to remain Bad unless concerted efforts are made to address the barriers issue. This whole area has been well-exemplified by the Mulkear LIFE project <http://www.mulkearlifeproject.com/recent-news.php?newsid=264#review-of-work-to-benefit-sea-lamprey-in-2013> which has identified problems and implemented solutions, including the most satisfactory strategy i.e. barrier removal

2.2 Juvenile lamprey catchment-wide surveys

2.2.1 Feale catchment

Catchment wide surveying for juvenile lamprey was undertaken by two teams working simultaneously during September 2013 (23rd to 27th). Forty-five sites were initially selected for appraisal, however a final total of 51 sites were visited over the course of the survey (Figure 2.1). Large sections of the catchment are in upland areas with many of the channels being spate in nature. As a result, it was anticipated that suitable nursery habitat for juvenile lamprey would be restricted in its distribution. An additional feature of the catchment is that several of the major rivers have undergone arterial drainage in their lower sections.

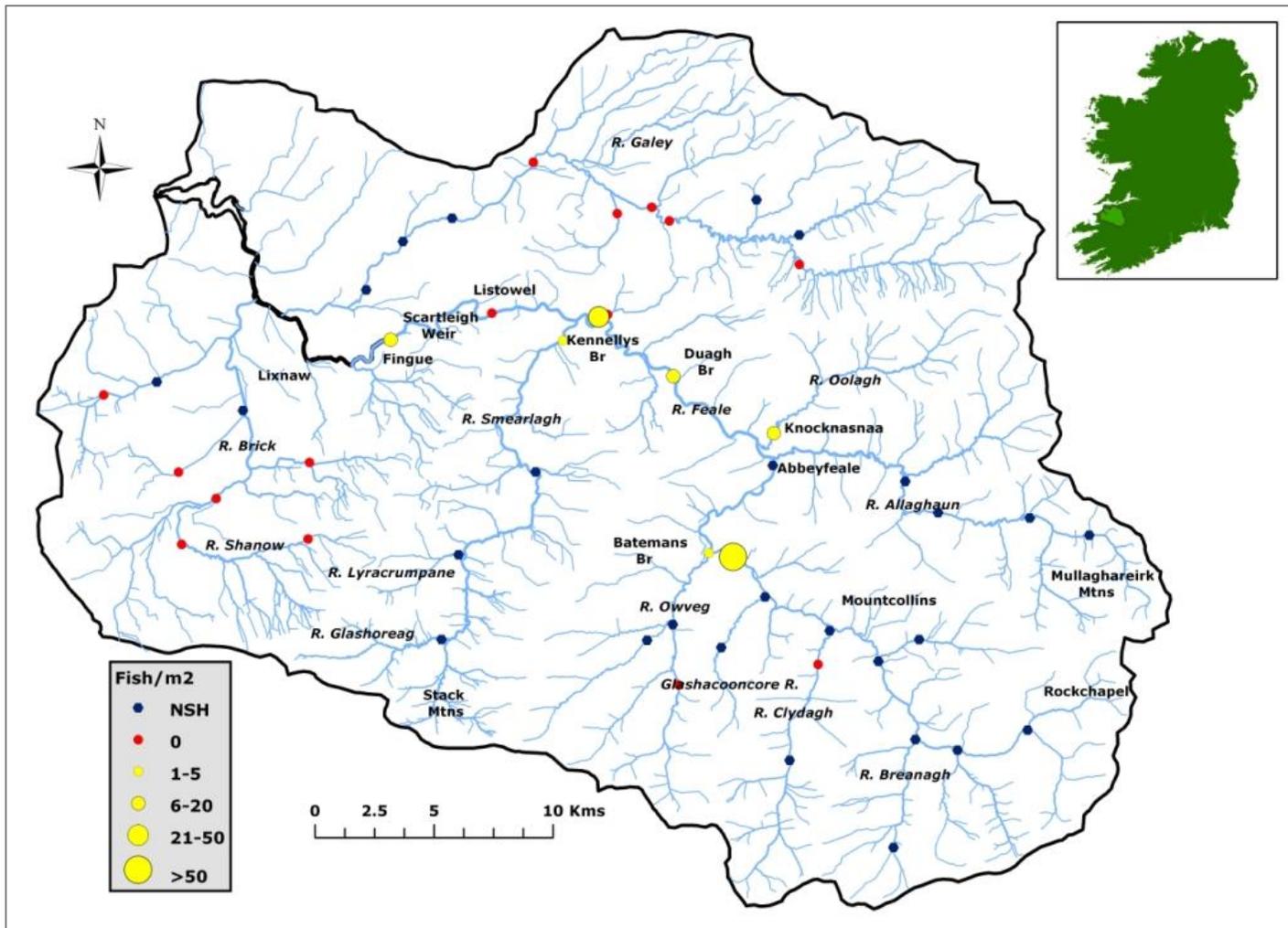


Figure 2.1. Sampling locations for juvenile lamprey across the Feale catchment.



Plate 2.1. The extensively drained Galey River, north of Listowel.

Allaghaun River

The Allaghaun is a major tributary in the eastern section of the catchment, rising in the Mullaghareirk Mountains and flowing westwards to join the Feale at Abbeyfeale. Four sites were selected for surveying along this channel. None of the sites had suitable habitat for juvenile lamprey.

Breanagh River

The Breanagh is a small tributary of the Feale in the southeast portion of the catchment, joining the main channel downstream of Rockchapel. Two sites were selected for surveying along this channel. None of the sites had suitable habitat for juvenile lamprey.

Clydagh River

Following the Breanagh, the Clydagh, another spate river, is the next major tributary, joining the Feale main channel downstream of Mountcollins. All three of the sites selected for survey along this channel had no suitable habitat for juvenile lamprey.

Brick River

The Brick is a major sub-catchment in the southwestern section of the catchment (Plate 2.2). It comprises several tributary streams, principally the Shanow flowing from the Stack's Mountains. Much of the lower sub-catchment has undergone arterial drainage and canalisation, particularly around Lixnaw. The Brick joins the Feale in the tidal section downstream of Finuge. As a consequence, sections of the Brick are tidal 2-3km upstream of Lixnaw.

Six sites were preselected for surveying throughout the Brick sub-catchment. A total of 8 sites were visited. Despite five sites having suitable habitat for juvenile lamprey, no individuals were captured during surveying.



Plate 2.2. Suitable juvenile lamprey habitat along the River Brick upstream of Lixnaw.

Galey River

The Galey is a significant tributary of the Feale, draining a large section in the north of the catchment (Plates 2.1 & 2.3). As with the Brick, the Galey enters the Feale in the tidal section downstream of Finuge. As a result the lowermost 3km are under tidal influence. The Galey has also undergone extensive arterial drainage and deepening along much of its main channel. Nine sites were preselected for surveying, six of which were on the Galey main channel. The remaining three sites were on tributary streams. During the survey a total of ten sites were visited. Suitable habitat was located and surveyed at four sites, three of which were on the Galey main channel. No juvenile lampreys were recorded. Remaining sites throughout the sub-catchment were typified by a lack of suitable habitat. Access was also difficult at a number of locations along the main channel due to steepness of the excavated bank slopes.



Plate 2.3. Suitable juvenile lamprey habitat on a section of the River Galey at Athea, Co. Limerick.

Smearlagh

The Smearlagh and its headwater rivers, the Glashoreag and Lyracrumpane, form a major tributary of the Feale in the south of the catchment, entering the main channel 5km upstream of Listowel. Much of this sub-catchment is located in upland areas and is prone to spate conditions, with exposed bedrock evident through the lower sections of the river. Four sites were nominated for surveying in this sub-catchment. Three of these sites had no suitable habitat for juvenile lamprey. The remaining site at Kennelly's Bridge, situated 1km upstream of the confluence with the Feale, contained several small dispersed patches of suitable habitat. Push net sampling in these patches revealed small numbers of juvenile river/brook lamprey (total n=12) ranging in size from 27mm to 63mm (Figure 2.2).

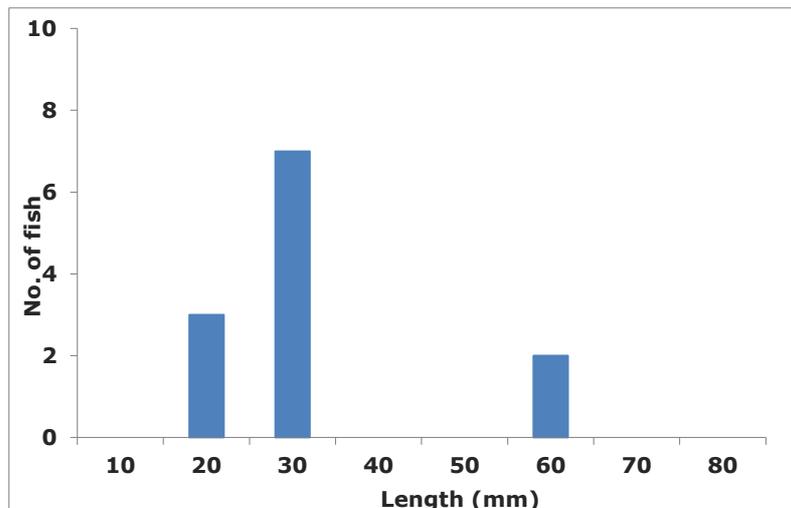


Figure 2.2. Length frequency distribution of juvenile lamprey (n=12) captured at a single site (Kennelly's Bridge) on the River Smearlagh. Owveg

The Owveg is another major tributary draining a mainly upland sub-catchment in the south of the overall study area (Plate 2.4). It joins the Feale 5km upstream of Abbeyfeale. Three sites were selected for survey. Small patches of suitable habitat were evident at one of these locations, however, no juvenile lamprey were captured. An additional site, located at Bateman's Bridge, was investigated following on from previous records of juvenile sea and river/brook lamprey presence. The area was devoid of suitable habitat, apart from a collection of leaf-matter in a semi-isolated side-channel. Push net surveying in this material revealed a single juvenile river/brook lamprey (32mm).



Plate 2.4. The Owveg River at Bateman's Bridge

Glashaconcore

Sandwiched between the sub-catchments of the Owveg and Clydagh, the Glashaconcore is a small spate river. The two sites selected for survey along this channel had no suitable habitat for juvenile lamprey when investigated.

Oolagh

The Oolagh is a relatively short yet substantial tributary, entering the Feale downstream of Abbeyfeale and the Feale-Allaghaun confluence. Two sites were selected for survey on the Oolagh. Suitable habitat was located at Knocknasnaa, the lowermost of the two sites. Quantitative electrofishing at this location captured 7 (78-112mm) juvenile river/brook lamprey (Figure 2.3).

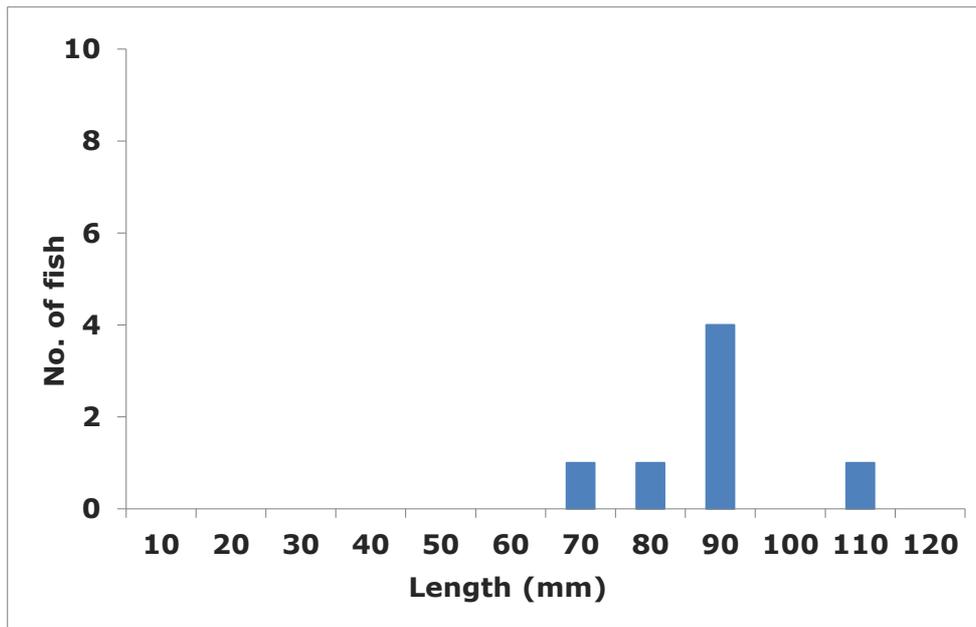


Figure 2.3. Length frequency distribution of juvenile lamprey (n=7) captured at a single site (Knocknasnaa) on the Oolagh River.

Feale Main Channel

A total of eight sites were selected for surveying along the main channel of the Feale, as well as two sites situated in small unnamed tributary streams. During surveying an additional two sites were visited along the main channel following on from previous records of juvenile sea and river/brook lamprey presence. Sites surveyed in the upper section of the Feale were lacking in suitable habitat. The first location where suitable habitat was encountered was at Wellesley Bridge, 5km upstream from Abbeyfeale. High densities of juvenile river/brook lamprey (54 / m², Figure.) were recorded at this location representing several year classes (32-165mm, Figure 2.4). A single transformer was also captured (167mm).



Plate 2.5. The River Feale at Duagh Bridge

Further downstream, moderate densities (13 / m², Figure 2.4) of juvenile river/brook lamprey were encountered at Duagh Bridge midway between Abbeyfeale and Listowel (Plate 2.5). Again several year classes were evident in this population (32-125mm, Figure 2.4) as well a single transformer (121mm). An accompanying push net survey also revealed individuals from predominantly younger cohorts (n=10, 30-41mm). Push net surveying at the next downstream main channel site produced similar densities (22 / m²), again dominated by younger age classes (mean length 39mm, range 19-94mm, Figure 2.4).

Downstream of Listowel, juvenile river/brook lamprey (n=11) were encountered at Finuge Bridge (5.5 fish/m², 38-116mm, Figures 2.4 & 2.6) along with a single transformer (124mm). This location marks the upper tidal limit in the Feale and is 1.3km downstream of Scartleigh Weir, a major obstacle for upstream migration.

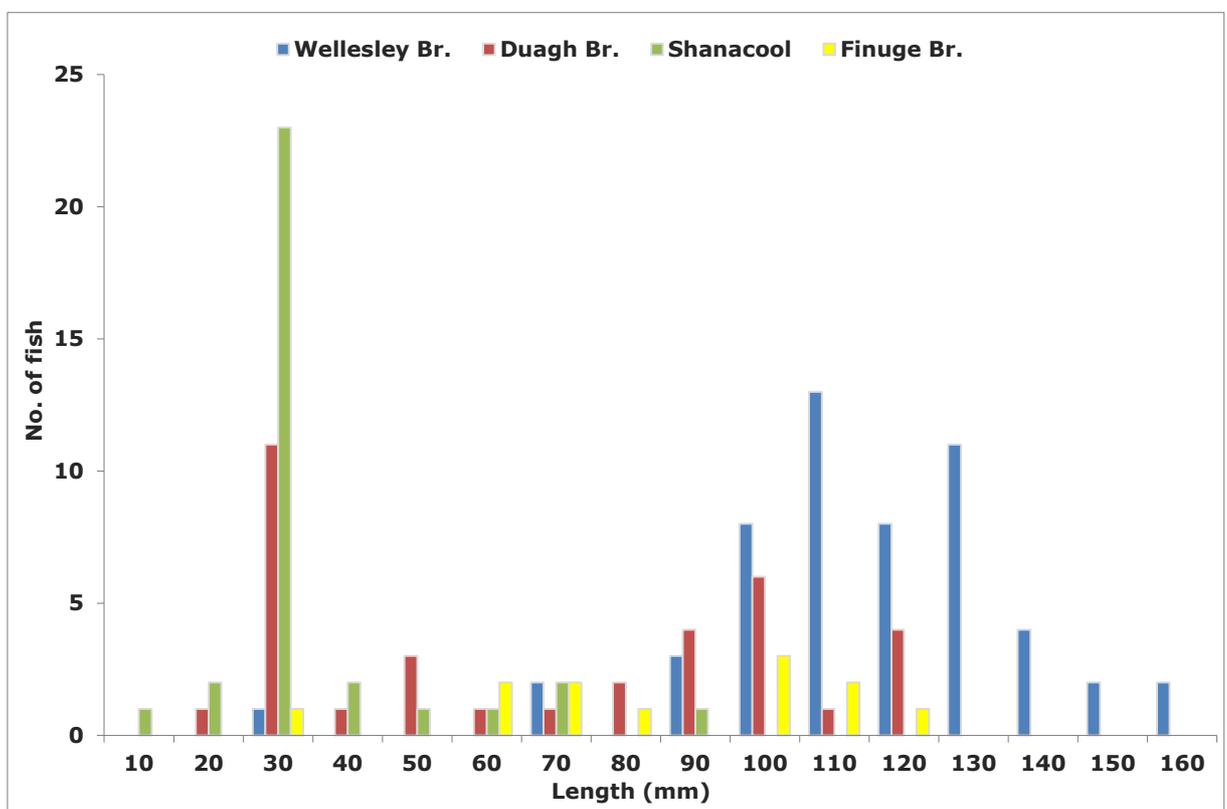


Figure 2.4. Length frequency distribution of juvenile lamprey (n=134) captured at four locations on the main River Feale.

River Feale Catchment Wide Survey – Overall Findings

Suitable habitat for juvenile lamprey was recorded at 19 of the 51 sites surveyed. Ammocoetes were, however, only detected at seven of these locations. An overall total of 154 juvenile lamprey were encountered at these 7 sites (Figure 2.5) ranging in size from 19mm to 167mm. Juvenile densities at quantitatively surveyed locations ranged from 5.5 to 54 individuals per square metre (Figure 2.6).

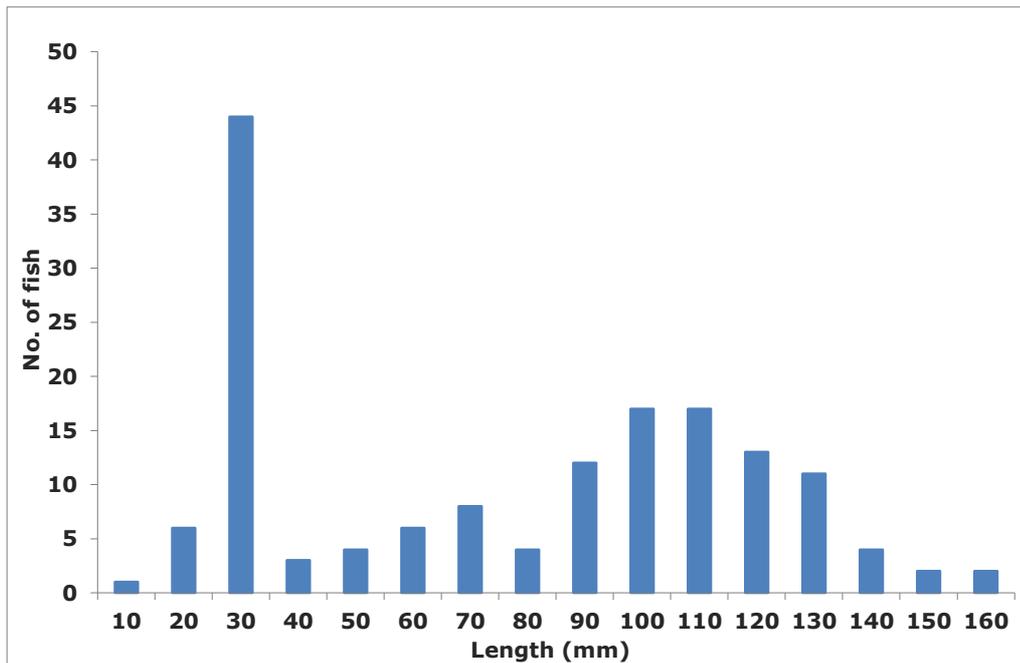


Figure 2.5. Length frequency distribution of all juvenile lamprey (n=154) captured at survey locations throughout the River Feale catchment.

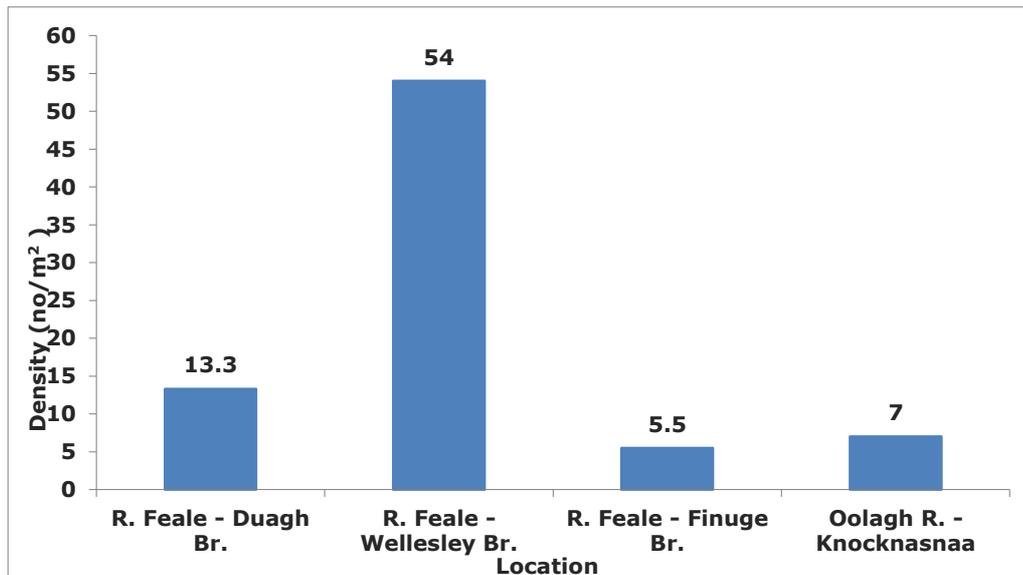


Figure 2.6. Densities of juvenile lamprey recorded at survey locations throughout the River Feale catchment.

As anticipated, large sections of the upper Feale catchment were devoid of suitable juvenile lamprey nursery habitat due to prevailing spate conditions. In the lower sections of many sub-catchments, however, juvenile lamprey remained absent despite the presence of suitable habitat (Plates 2.6 & 2.7). This was especially marked in the Brick and Galey sub-catchments. Both have undergone extensive arterial drainage, particularly in the case of the latter. The resultant altered flow regimes may be significant in precluding recolonisation and establishment of lamprey populations. Lamprey were absent from the Galey during the 2005 survey, whilst the Brick was not investigated.



Plate 2.6. The confluence of the Rivers Moyvane and Galey, indicating the extent of excavation and deepening in the latter

No sea lamprey larvae were encountered from any of the sites surveyed along the main channel, in contrast to previous surveying (O' Connor 2006). A number of sites along the Feale main channel as well as on the Owbeg were specifically surveyed with sea lamprey in mind, following on directly from positive observations made during the previous survey in 2005. Returning adult sea lamprey on their upstream spawning migration contend with a number of barriers in the lower section of the Feale which have the potential to restrict access to much of the upper catchment.



Plate 2.7. The heavily modified Douglas River, north of Listowel

2.2.2 Corrib catchment

The Corrib catchment occupies an area of just over 3,000km², including three major lakes, namely Lough Corrib (176km²), Lough Mask (83km²) and Lough Carra (16km²)(Figure 2.7). The section of the catchment to the west of the lakes complex is dominated by upland. The central portion of the catchment mainly comprises lowland and the principal tributaries, the Robe and the Black-Kilshanvy, drain westwards into Loughs Mask and Corrib. The eastern section of the catchment is drained by the Clare River and its tributaries, the Dalgan, Sinking, Grange and Killaclogher-Abbert along with the Cregg River (Plate 2.8). Many of these channels have undergone substantial arterial drainage.



Plate 2.8. The Clare River.

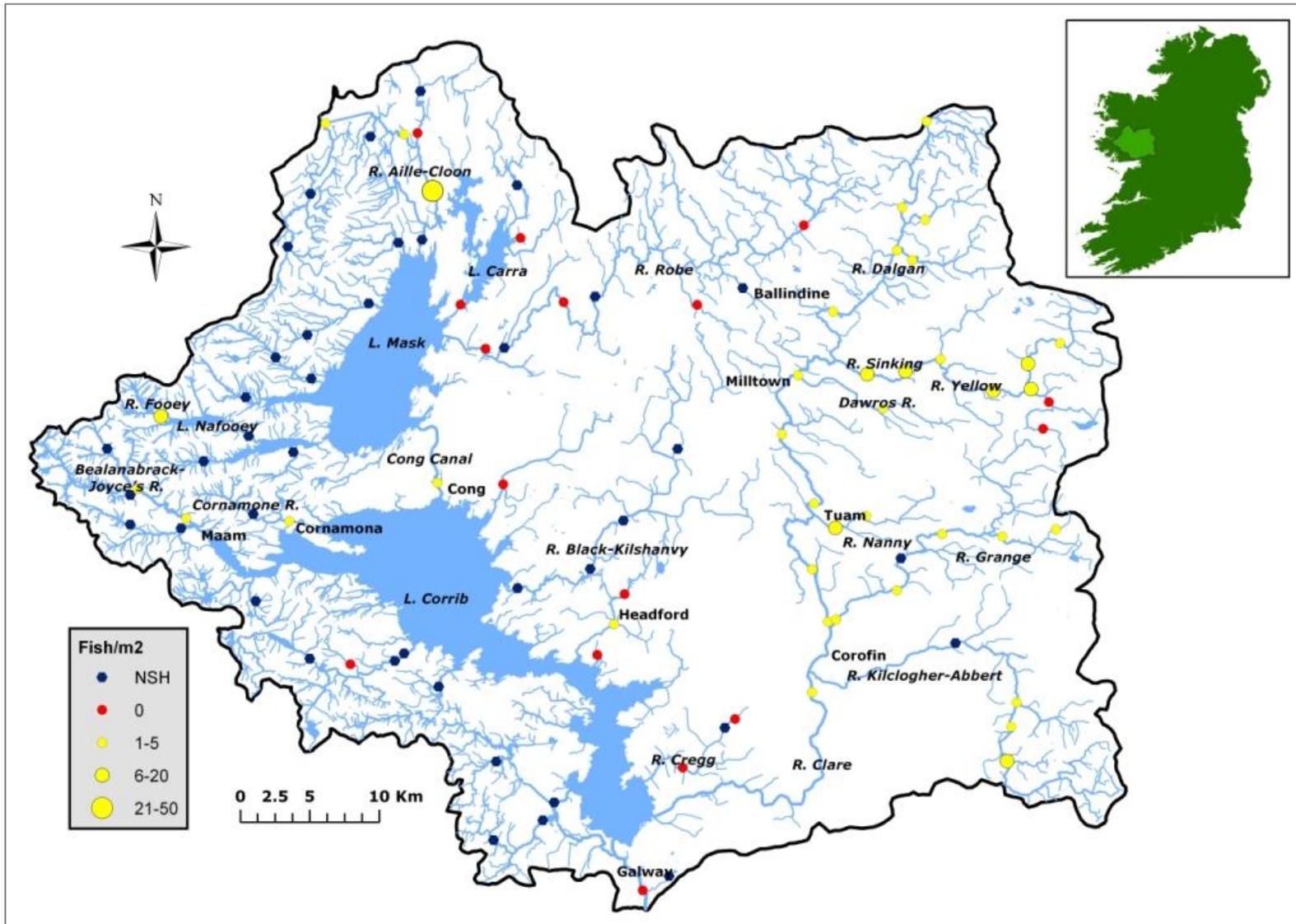


Figure 2.7. Sampling locations for juvenile lamprey across the Corrib catchment.

Catchment wide surveying for juvenile lamprey was undertaken during October and early November 2013, often by two teams working simultaneously. A total of 111 sites across the entire catchment were selected for assessment. During the survey period a total of 100 sites were visited with investigations undertaken at 83 of these. Surveying in this catchment could not be completed during 2013, as deteriorating weather conditions and raised water levels during late October and early November brought about a premature cessation of surveying with 12 remaining sites left outstanding.

Corrib Catchment - West

The majority of channels in this section of the catchment are spate streams and rivers originating in upland areas and offering little suitable habitat for juvenile lamprey. A total of 38 sites were visited, with surveys undertaken at 28 of these. Juvenile lamprey were observed at 8 of these locations (Figure 2.8). Four of the 9 sites surveyed on the Aille-Cloon system to the north of Lough Mask were positive ($n=38$, mean length = 55mm, range 22mm-130mm) with densities ranging from 1-27 juveniles per m^2 . Ammocoetes were also captured on the Fooley close to Lough Nafoeey ($n=48$, mean length = 45mm, range 18mm-104mm)(Plate 2.9), as well on the Cornamona at Cornamona ($n=10$, mean length = 67mm, range 16mm-113mm). Juvenile lamprey were also located at 2 sites on the Bealanabrack-Joyce's River system near Maam ($n=38$, mean length = 70mm, range 23mm-108mm). Transformers were noted at 4 of the 8 positive sites in this section of the catchment ($n=5$, range 85mm-113mm). The vast majority of sites in this region ($n=27$) contained no suitable habitat.

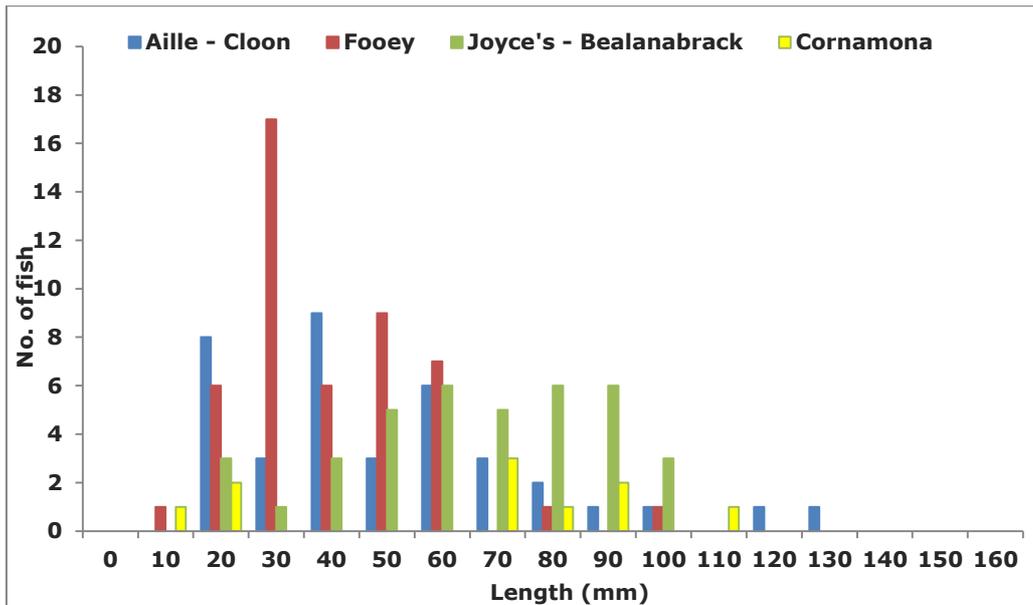


Figure 2.8. Length frequency distribution of juvenile lamprey (n=134) captured at eight locations across the Corrib Catchment – West.



Plate 2.9. The Fooley with Lough Nafoeey in the background

Corrib Catchment - Central

Twenty-six sites were chosen for surveying throughout the central section of the Corrib catchment, however, only twenty-two of these sites could be visited. Surveys were undertaken at 17 of these sites, with juvenile lamprey observed at just three locations (Figure 2.9). Low numbers were recorded at two separate locations (n=2 & 3, resp., length range 85mm-145mm) on small unnamed rivers entering Lough Corrib to the south of Headford. Higher densities (28 per m², n=28, mean length = 88mm, range 47mm-138mm) were encountered in Cong on a section of the Cong Canal linking Lough Mask with Lough Corrib. Nine of these ammocoetes were transformers (mean length = 113mm, range 89mm-138mm). Overall, juvenile lamprey were absent from a large swathe of the central portion of the Corrib catchment, in particular from the Robe and Black rivers,

the principal sub-catchments in this area (Plate 2.10).

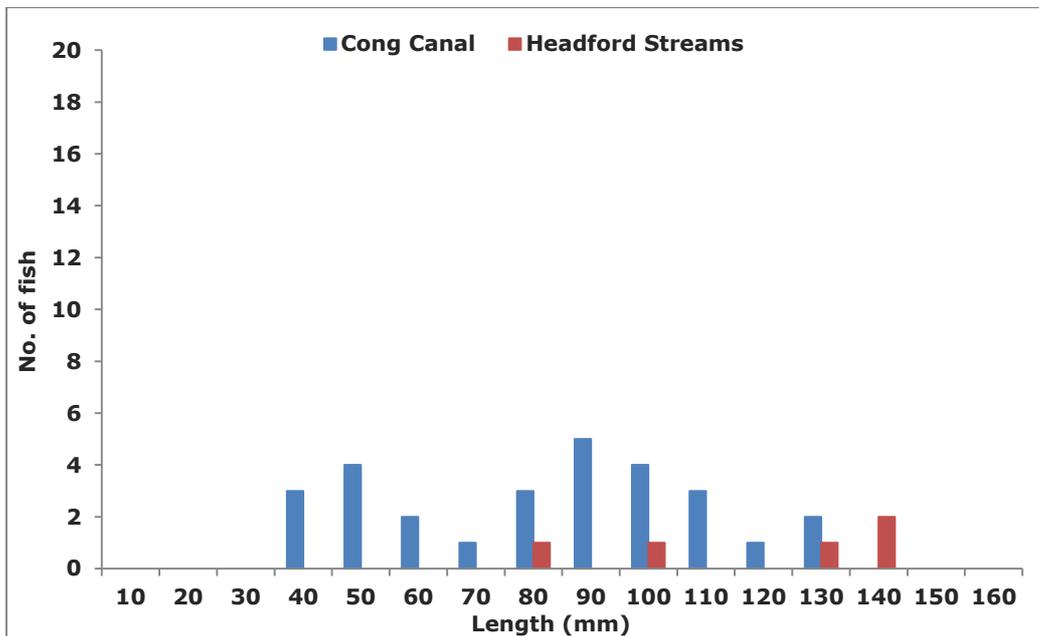


Figure 2.9. Length frequency distribution of juvenile lamprey (n=33) captured at three locations across the Corrib Catchment - Central.



Plate 2.10. The Robe River, north of Ballindine.

Corrib Catchment - East

The eastern third of the Corrib catchment is dominated by the Clare River and its numerous tributaries, namely the Dalgan, Yellow-Sinking, Dowros, Nanny, Grange and Killaclogher-Abbott systems. The remainder of this region is drained by the Cregg, a relatively small and discrete sub-catchment in comparison with the Clare system. A total of 48 sites were selected for surveying, however only 40 of these were visited. Surveys were undertaken at 38 of these sites with juvenile

lamprey recorded at 31 of these locations.

Dalغان River

The Dalغان is the uppermost tributary of the Clare system. Seven sites were inspected throughout this sub-catchment. Juvenile lamprey were present in all locations at low densities (1-3 per m²). The overall sample comprised large ammocoetes (n=11, mean length = 115mm, range 100mm-126mm), two of which were transformers (113mm-115mm).

Sinking River

The Sinking is a major tributary of the Clare River in East Galway. Nine sites were selected for surveying (Plate 2.11). Juvenile lamprey were absent from 2 headwater sites but were present at the remaining 7 downstream sites at low-to-moderate densities (2-11 per m²). In addition, a single individual was detected at a survey site on the adjacent Dowros River, a small tributary of the Clare joining at Milltown, 4km downstream of the Dalغان-Sinking confluence. A range of age cohorts were visible across the pooled sample (n=70, mean length = 80mm, range 26mm-151mm, Figure 2.10) including 3 transformers (107mm-151mm).

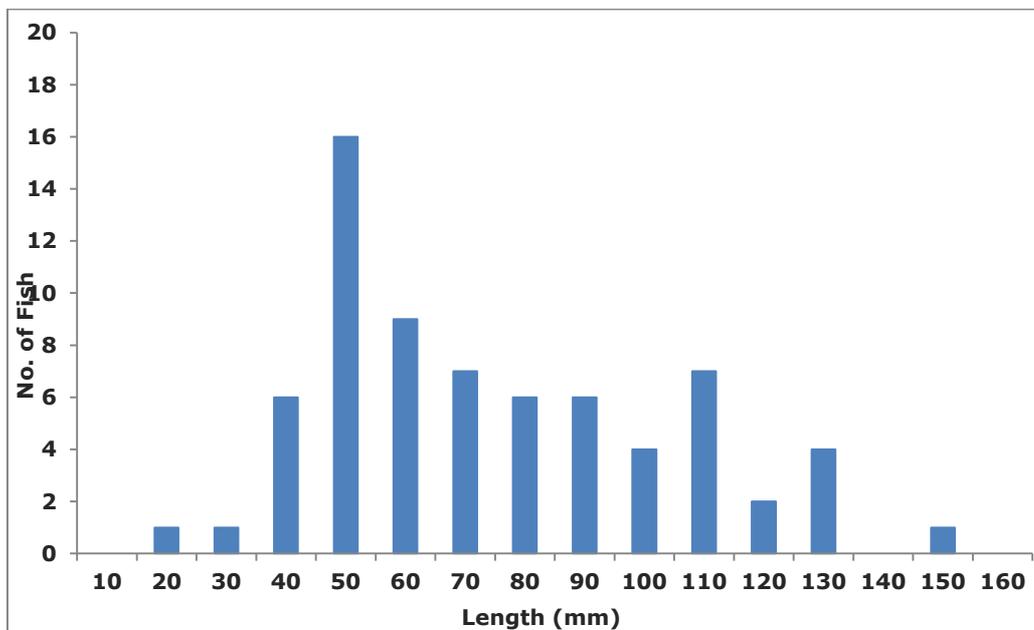


Figure 2.10. Length frequency distribution of juvenile lamprey (n=70) captured at eight locations throughout the Sinking and Dowros sub-catchments.



Plate 2.11. The Sinking River downstream of Dunmore

Grange and Nanny sub-catchments

The Grange represents another significant tributary of the Clare River system in east Galway, joining 1.5km upstream from Corofin (Plate 2.12). A smaller tributary, the Nanny, joins the Clare previously at Tuam. Seven sites selected for survey along the Grange were visited with juvenile lamprey present in low densities (1-2 per m²) at all but one location, namely Grange Bridge situated midway along the main stem where arterial drainage excavation into the underlying bedrock has resulted in a long river section with no suitable habitat. The pooled sample of juvenile lamprey from positive sites along the Grange contains a number of age classes (n=11, mean length = 89mm, range 29mm-150mm, Figure 2.11). On the Nanny, juveniles were present at the lowermost of the two sites surveyed. This location, immediately downstream of Tuam, supported moderate densities (10 per m²) with a bias towards older age classes (n=11, mean length = 113mm, range 77mm-137mm, Figure 2.11) including 3 transformers (124mm-137mm). Juvenile lamprey were absent at a survey site upstream of Tuam, despite the presence of highly suitable habitat. A significant structure on the Nanny in the centre of Tuam is noteworthy as a potential barrier to upstream migration.

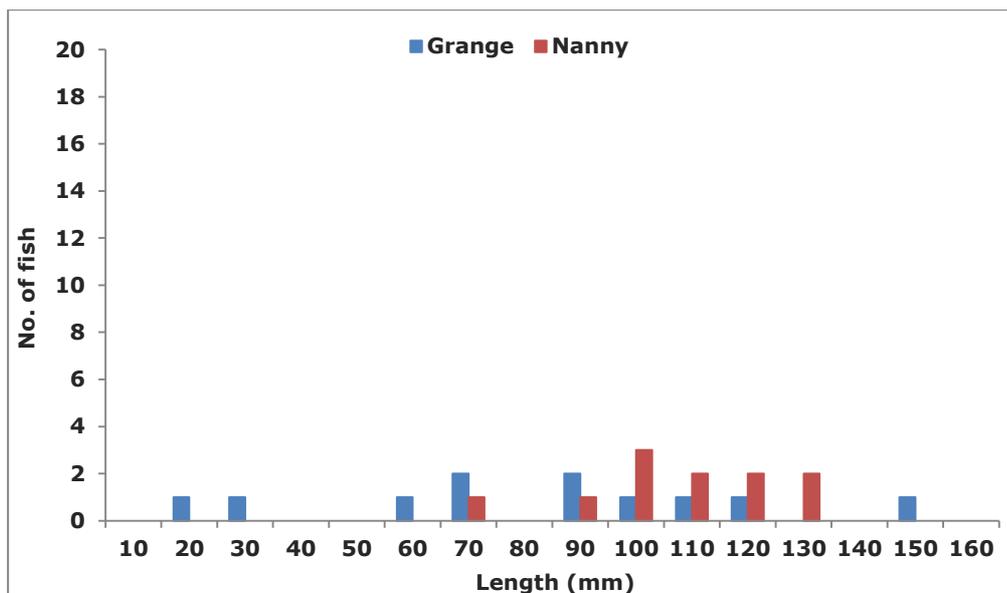


Figure 2.11. Length frequency distribution of juvenile lamprey (n=22) captured at seven locations throughout the Grange and Nanny sub-catchments.



Plate 2.12. The Grange River near Corofin

Abbert River

The Abbert and its headwater river, the Killaclogher, forms a major tributary of the Clare in the southeast of the Corrib catchment. Eight sites were originally selected for inspection, however only 4 of these were visited before surveying was curtailed. Ammocoetes were present at three sites in low to moderate densities (5-19 per m²) with a general absence of younger age classes in the pooled sample (n=25, mean length = 103mm, range 73mm-129mm, Figure 2.12).

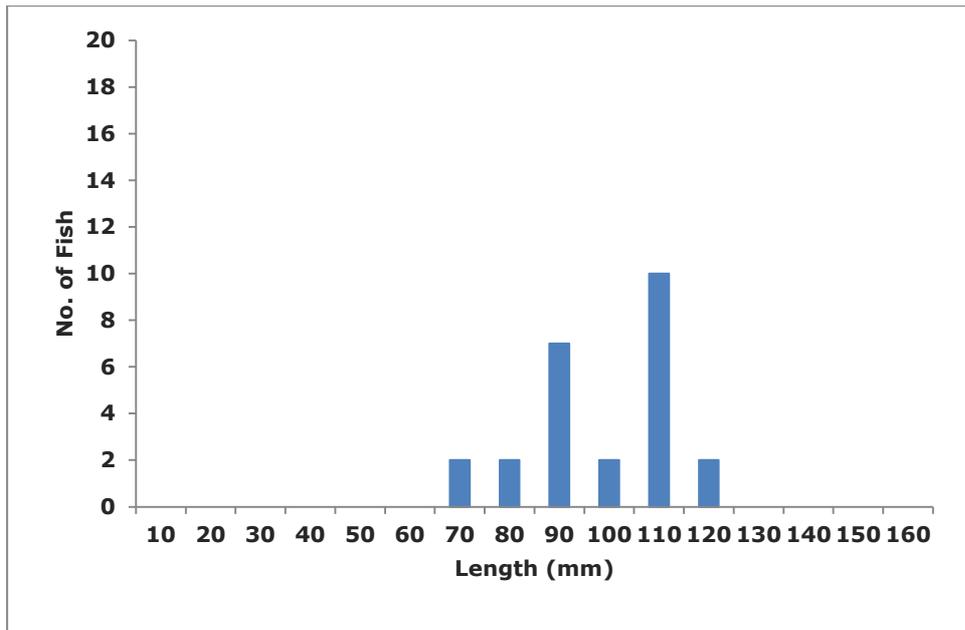


Figure 2.12. Length frequency distribution of juvenile lamprey (n=25) captured at three locations throughout the Abbert sub-catchment.

Clare River – Main Stem

Nine sites were selected for survey along the main stem section of the Clare River from the confluence of the Dalgan & Sinking Rivers to the inflow at Lough Corrib (Plate 2.13). The three most-downstream sites (Lackagh Bridge, Claregalway and Curraghmore Bridge) could not be surveyed due to high water conditions at the time. Juvenile lamprey were present at the remaining 6 sites at generally low densities (1-8 per m²). Despite the low numbers captured (n=13) a range of age classes are apparent from the pooled sample (mean length = 88mm, range 41mm-123mm, Figure 2.13) including a single transformer (104mm).

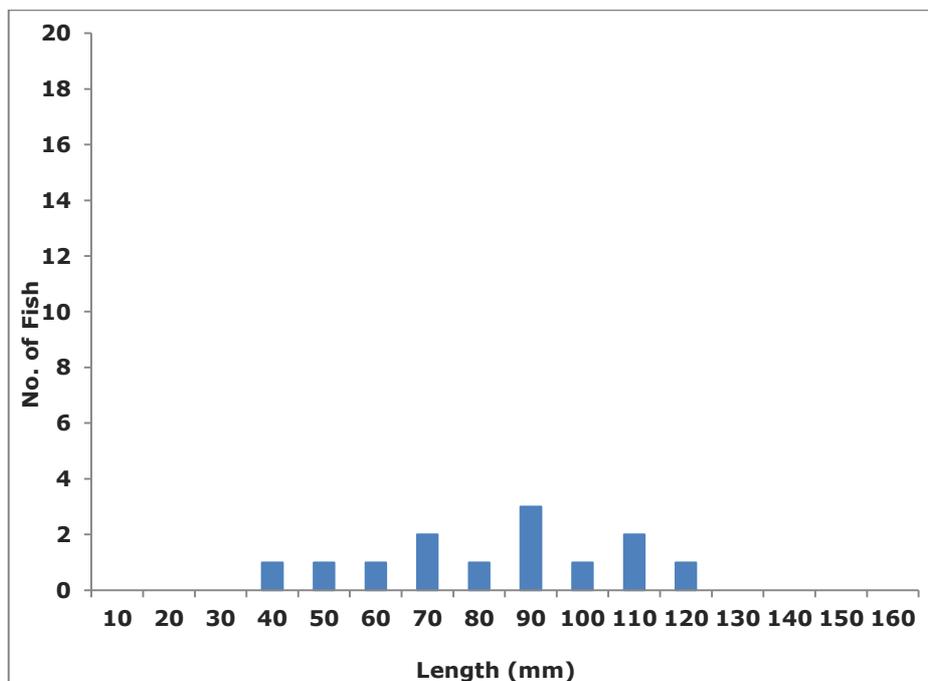


Figure 2.13. Length frequency distribution of juvenile lamprey (n=13) captured at six locations throughout the main stem of the Clare River.



Plate 2.13. The deeply excavated Clare River, north of Tuam

Cregg River

Three sites were selected for survey along the Cregg River. All three were visited with surveying undertaken at two. No juvenile lamprey were detected.

Corrib Catchment Wide Survey – Overall Findings

Suitable habitat for juvenile lamprey was encountered at 56 of the 100 sites visited (Figure 2.14). Lack of habitat was particularly pronounced in the western third of the catchment due to the prevailing topography, with only 11 (29%) of the 38 sites visited having suitable nursery habitat (Plate 2.14).

Ammocoetes were encountered at the majority (8/11) of these locations. Conditions in the central section of the catchment were slightly more favorable, with suitable habitat recorded at 9 of the 22 sites (41%) visited. Ammocoetes were less-frequently encountered, however, with presence noted at 33% of suitable locations (3/9). The eastern section, in contrast, had a widespread distribution of suitable habitat at 36 (90%) of the 40 sites visited. Juvenile lamprey were present at 31 (86%) of the 36 suitable habitat sites. Densities were typically low to moderate across most of the catchment (Figure 2.15).

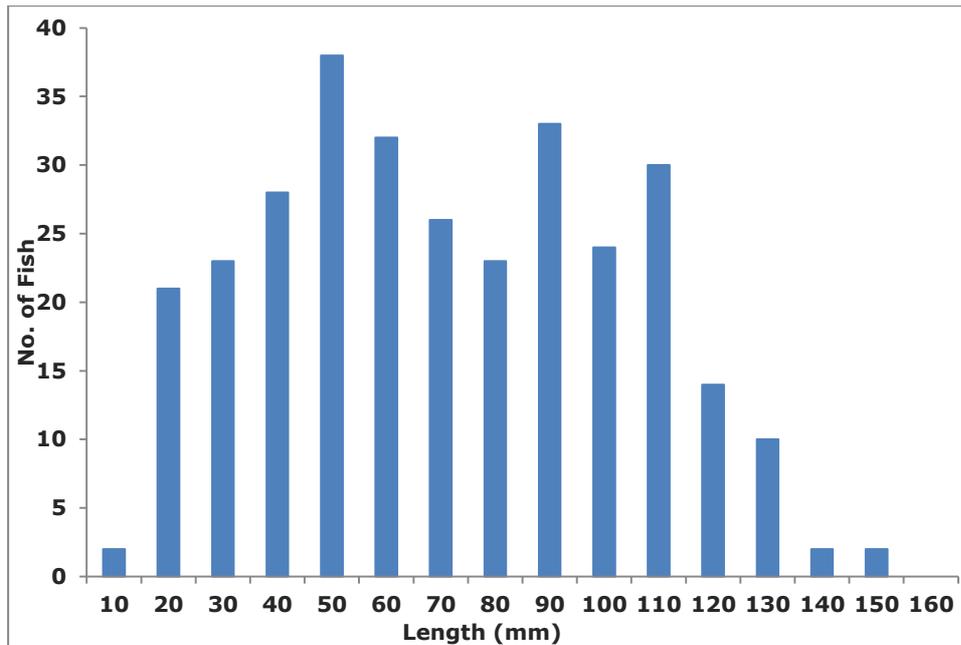


Figure 2.14. Length frequency distribution of all juvenile lamprey (n=308) captured at survey locations throughout the Corrib catchment.



Plate 2.14. A push net sample from the Sinking River.

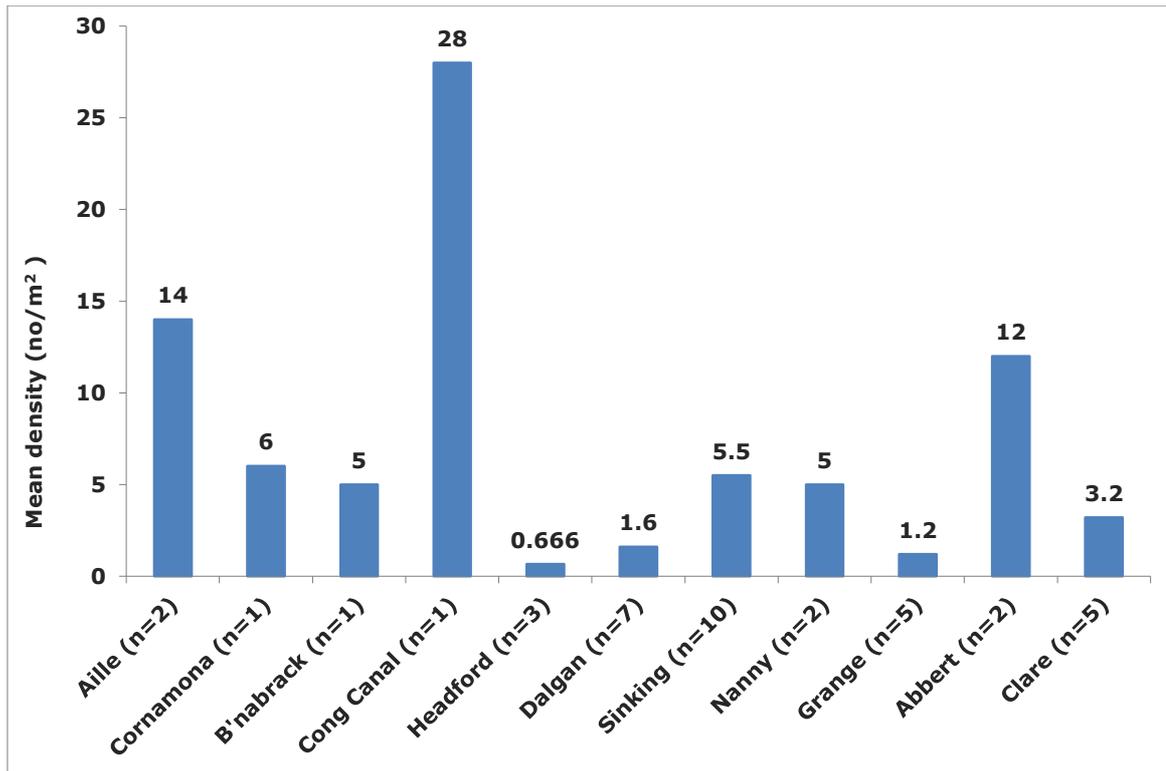


Figure 2.15. Densities of juvenile lamprey recorded at survey locations throughout the Corrib catchment.

No sea lamprey larvae were encountered from any of the sites surveyed around Lough Corrib, despite previous reports of adult spawning activity at Cong.

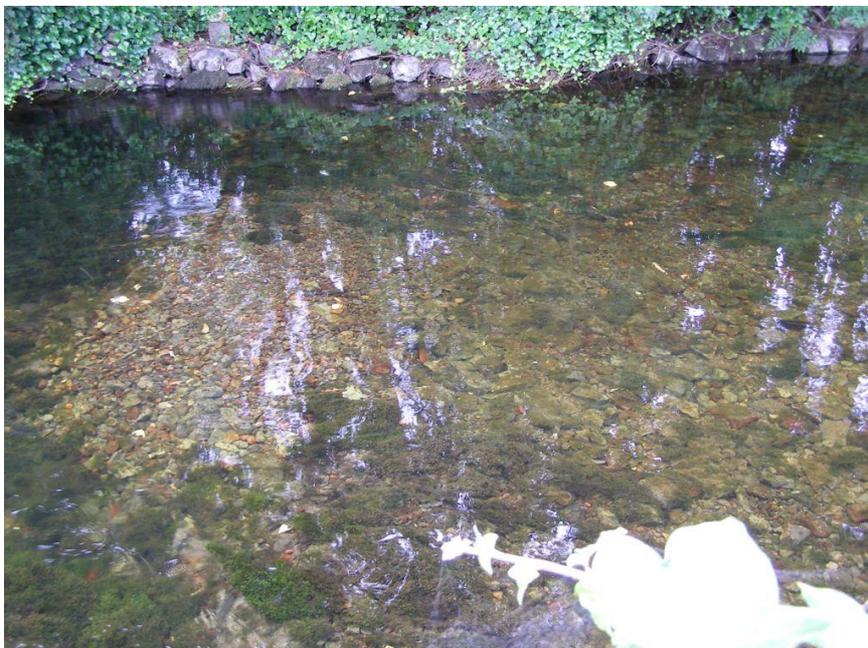


Plate 2.15. Sea lamprey redd, Cong, June 2009.

2.2.3 Ballyteige-Bannow hydrometric area

The Ballyteige-Bannow hydrometric area is located in the south east of Ireland along the Wexford coast. The area of the hydrometric area is 654 km². The order of rivers sampled varied between stream order 2 and 5. The maximum elevation of the catchment is 190 meters, however, the highest sampling site had an elevation of 52 meters. No prior information was available on the status of juvenile lamprey within the catchment (Kurz and Costello 1997). The survey was undertaken between the 19th and 27th June 2013. The Corock River and its tributary the Mulmontry, drain the centre of the hydrometric area. This river discharges at Wellington Bridge which lies at the north of Bannow Bay. The Owenduff and Tintern Abbey Stream also discharge to Bannow Bay. The Bridgetown River flows through the east of the catchment to Ballyteige Bay. The underlying geology is slate, shale and sandstone.

In total twenty three sites were sampled for juvenile lamprey. Of these three presented with No Suitable Habitat (NSH). Lamprey were present at 10 of the sites which presented with suitable habitat (Figure 2.16). All sites were sampled using a Smith Root electric fishing back pack.

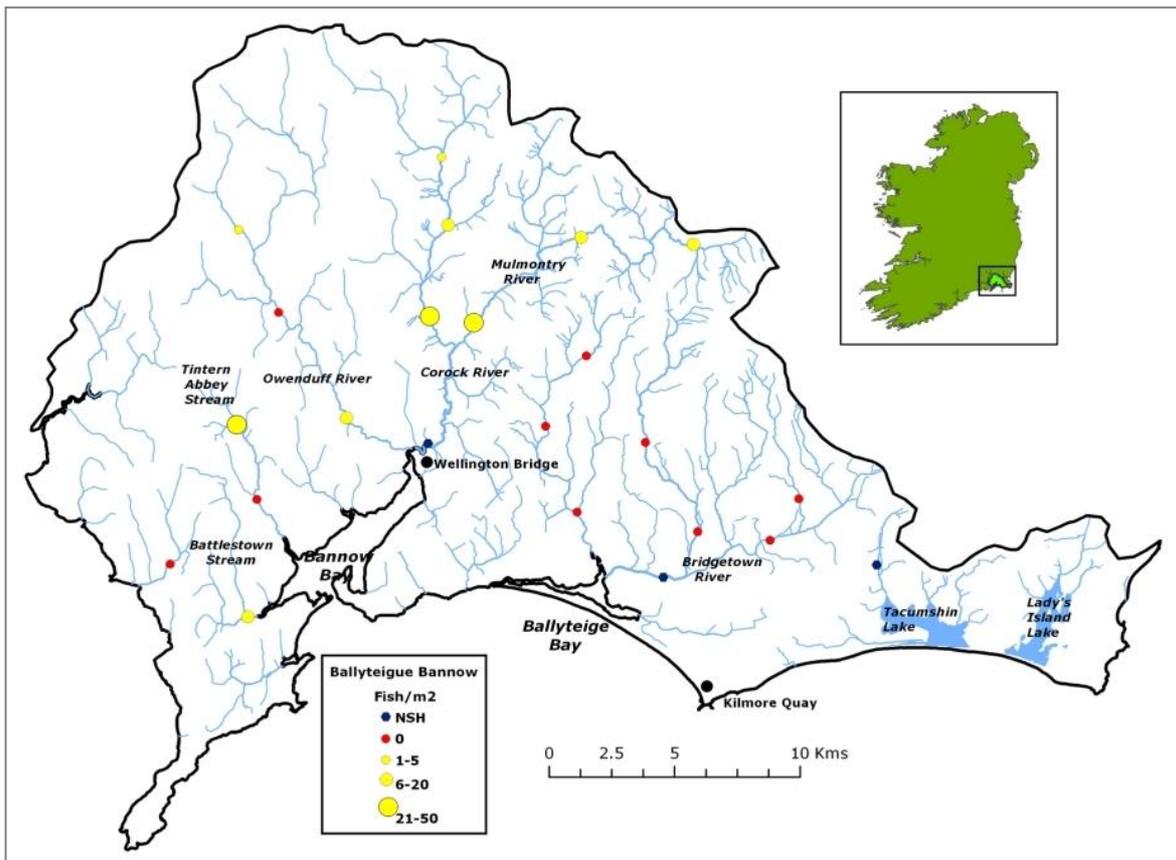


Figure 2.16. Sampling locations for juvenile lamprey across the Ballyteige-Bannow hydrometric area.

In total 162 juvenile lamprey were captured over the course of the survey (Figure 2.17). The length of fish varied between 30 and 126 millimetres. The length of fish recorded indicated a distribution of fish across all size classes indicating a good population structure. The smaller sizes

represent young of the year and indicate recent recruitment. The larger fish demonstrate the possibility of future spawning events to continue the population numbers. No transformers were encountered during the survey. This was possibly due to the fact that the survey was undertaken earlier than usual juvenile lamprey surveys and the larger fish encountered were pre-transformer.

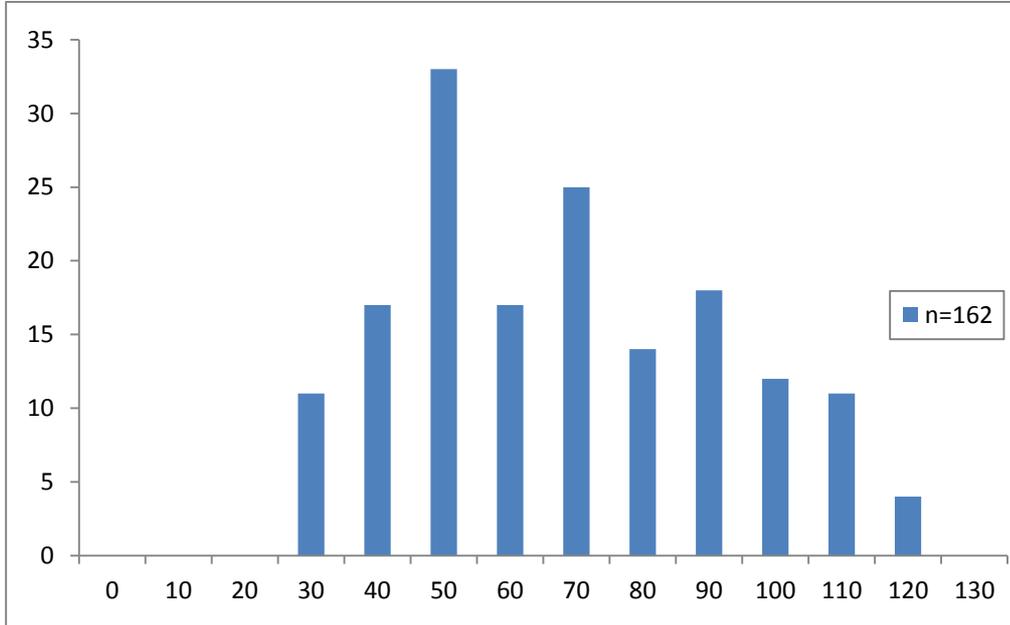


Figure 2.17. Length frequency of juvenile lamprey captured across the Ballyteige-Bannow hydrometric area.

The density of fish recorded at sites with suitable habitat varied between 0 and 36 fish per meter squared. The mean density was 9 fish, across sites which presented with suitable habitat. This would indicate a high mean density considering there were no lamprey at nine sites. Juvenile lamprey were absent from the eastern section of the surveyed area (Figure 2.18) despite the fact that suitable habitat was present at a number of sites in this part of the catchment.

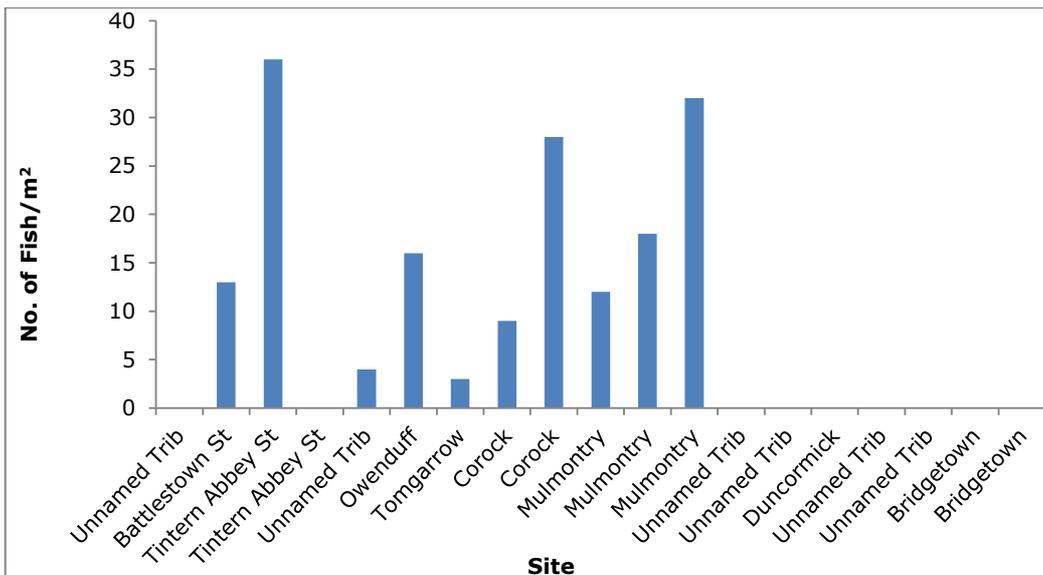


Figure 2.18. Density of juvenile lamprey recorded across the Ballyteige-Bannow hydrometric area.

Juvenile lamprey were present at 50% of sites which presented with suitable habitat. There was a large variety in the density of juvenile lamprey recorded at positive site between 3 and 36 fish/m². Two sites had densities of >30 fish/m² which indicates a good population of fish present. All size classes were represented in the length frequency of juvenile lamprey surveyed. The juvenile lamprey population on the Ballyteige Bannow hydrometric area would be considered to be in moderate conservation status. No juvenile sea lamprey were captured.

2.2.4 Colligan-Mahon Hydrometric area

The Colligan-Mahon hydrometric area is located in the south east of Ireland along the Waterford coast. The area of the hydrometric area is 665 km². The stream order of the sites sampled varied between 2 and 5. The maximum elevation of the catchment was 255 meters and the highest sampling location was at 162 meters. No prior information was available on the status of juvenile lamprey within the catchment (Kurz and Costello 1997). Both rivers, the Colligan and Mahon rise in the Monavullagh Mountains. The Mahon flows in a west-south-east direction and enters the sea at Bunmahon, a seaside village in the centre of the hydrometric area. The Colligan flows in a south easterly direction and enters the sea at Dungarvan. The dominant underlying geology is sandstone with some pockets of slate.

The survey was undertaken between the 9th and 31st July 2013. Twenty eight sites were preselected for juvenile lamprey monitoring (Figure 2.19). Only sixteen of these sites contained suitable habitat and ammocoetes were recorded at 5 sites.

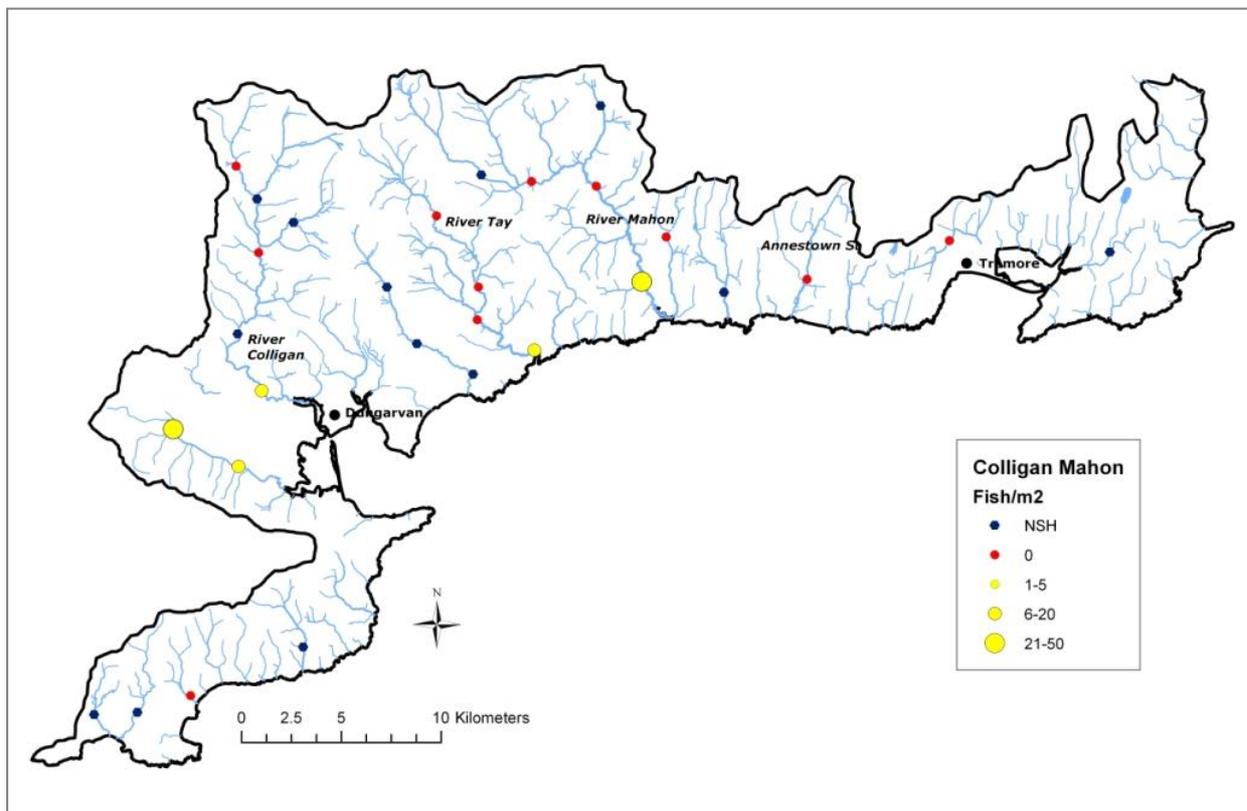


Figure 2.19. Sampling locations for juvenile lamprey across the Colligan-Mahon hydrometric area.

Sampling across the Colligan-Mahon revealed a range of size categories (Figure 2.20). This indicates that a number of age classes were present, demonstrating recent recruitment and older ammocoetes which will spawn in future seasons. The length of fish captured ranged between 39 and 123 millimetres. One fish was in the primary stages of transformation.

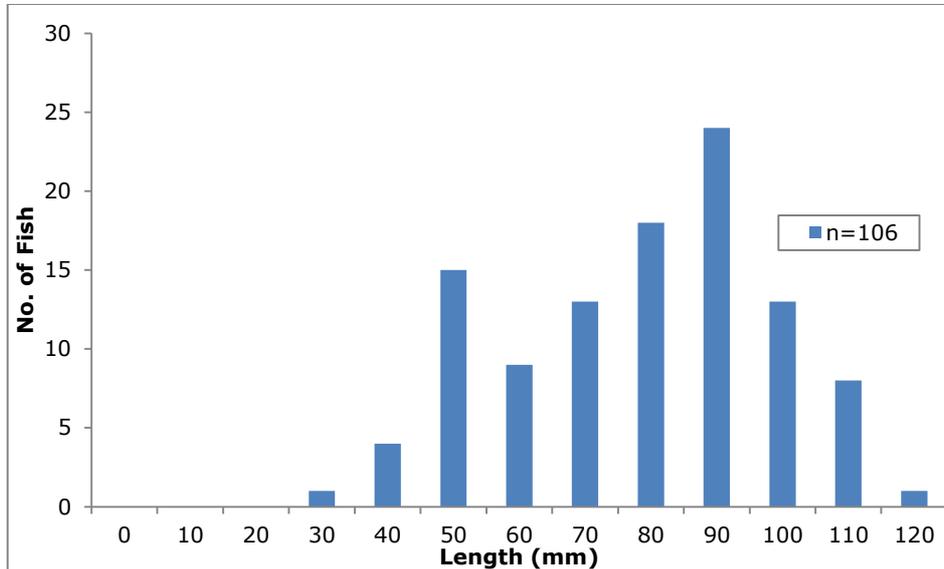


Figure 2.20. Length frequency of juvenile lamprey captured across the Colligan Mahon hydrometric area.

Of the 28 sites preselected for the juvenile lamprey survey, twelve sites had no suitable habitat present. The density of fish recorded at positive sites varied between 7 and 44 fish/m² (Figure 2.21). The mean density across sites with suitable habitat was 6.4 fish/m². The density of fish was >13 fish/m² at four of the five positive sites. Densities recorded at positive sites would be considered high when compared to the country as a whole. The fact that there were only five positive sites over the area surveyed could raise cause for concern. A portion of the catchments lies within the Monavullagh Mountains with elevations to 617 meters (Coumaraglin Mountain). The gradient of the rivers may have an effect on the lamprey populations from a number of aspects including the prevention of colonisation due to lack of sediment deposition and the presence of barriers to migration. No juvenile sea lamprey were identified despite the area being located on the coast.

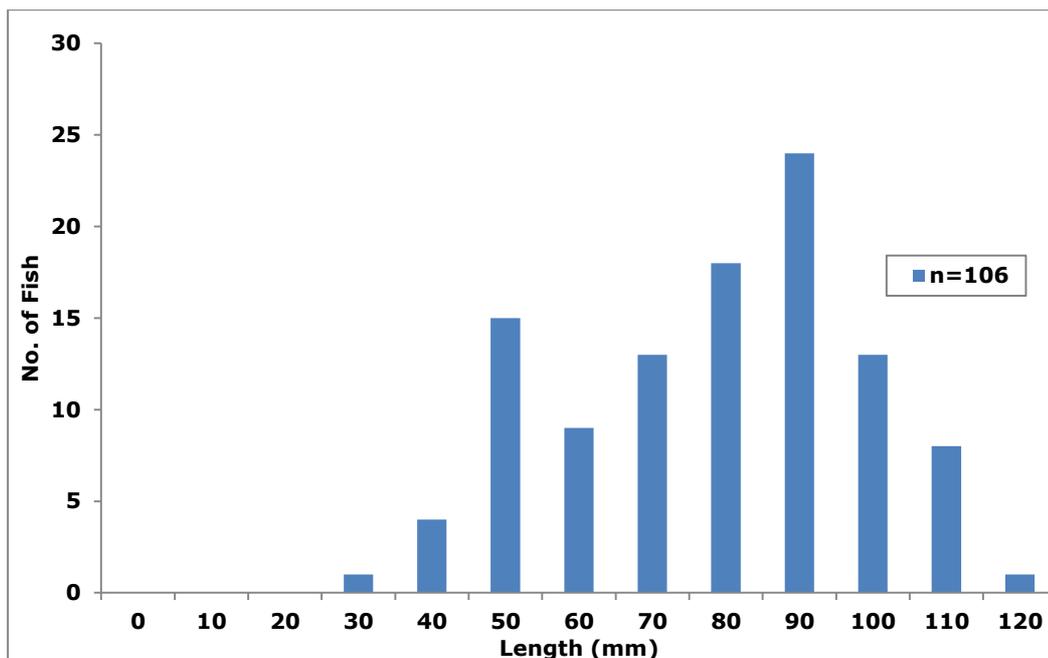


Figure 2.21. Density of juvenile lamprey recorded across the Colligan-Mahon hydrometric area.

2.3 Adult lamprey surveys

Float-over surveys to investigate location and extent of sea lamprey spawning were undertaken in mid-July 2013 on the main stem of the River Suir and River Nore. Kayaks and two-person canoes were used in both channels, in conditions of low flow, dry weather and bright sunshine working with staff of IFI's Southeast RBD. The summer of 2013 was very suitable for this type of survey, given the extended periods of low flow in rivers.

2.3.1 River Suir survey

This survey was undertaken over a 3-day period in mid-July and covered the main channel from Cahir downstream to Carrick-on-Suir. A single structure, considered to be a sea lamprey redd was recorded between Cahir and Ardfinnan. No further redds were encountered until the survey passed downstream over the weirs in Clonmel town. The river splits in two around Suir Island in the town, with one branch flowing over Lady Blessington's weir and the other passing through the Old Bridge and flowing on the town side. The two branches converge a little upstream of Gashouse Bridge, the main crossing point in the town. The 'town side', only, was examined by boat and *circa* 18 redds, including some multiple redds, were encountered here. These were geo-referenced, dimensions recorded and bed sediment samples taken adjacent to redds.

The next spawning structures were noted a short distance upstream of Kilsheelan village, where three redds were recorded close together. No further redds were recorded from here to Carrick.

This redd count survey yielded a very low total, well below those recorded in previous float-over surveys in 2000, 2001 and 2005. The occurrence of redds in Clonmel on the town side of the

channel is a regular feature and this location could serve as a reference or index location for subsequent comparisons. The very low number of redds (n=1) upstream of Clonmel points to possible issues with sea lamprey migration or capacity to pass the weir structures in the town. The low flows recorded during the summer period prior to the survey may have deterred sea lamprey from migrating upstream.

2.3.2 River Nore survey

The survey of the River Nore main channel was undertaken over two days in July 2013 using a Canadian canoe. The area surveyed was between Bennettsbridge and Inistioge. Approximately 800 meters downstream of the start an area of suitable spawning gravel was identified. This contained three structures, considered to be sea lamprey redds, one of these being a multiple redd used by a number of fish to spawn. A number of areas with suitable gravels were surveyed before further redds were identified. Immediately downstream of the confluence with the little Arrigle River three redds were documented. One multiple redd was identified upstream of Thomastown. The weir at Thomastown has been breached for the past number of years and, as redds were presents upstream of this, it would suggest that the barrier was no longer impeding the upward migration of the fish. Downstream of Thomastown there was long section of slow flowing river, unsuitable for sea lamprey spawning. Three sections had redds present, out of seven graveled areas deemed to contain suitable habitat. All areas of suitable habitat were geo-referenced. Redd dimensions were measured and a number of gravel samples were collected for sediment analysis.

The low numbers of sea lamprey redds recorded would suggest a decline in the population of sea lamprey compared to previous surveys undertaken in 2000, 2001 and 2005. The outcomes were similar to those recorded in the R. Suir in 2013.

3. Shad programme

3.1 Outcomes of Article 17 status assessment for shad species in Ireland

The Article 17 report on shads compiled by IFI and submitted to the NPWS was based on work carried out in the period 2000 – 2007 as well as on specific surveillance in the period 2009 – 2012. The volume dealing with the full suite of species, including the fish, is available on line from NPWS at

http://www.npws.ie/publications/article17assessments/article172013assessmentdocuments/Article_17_Web_report_species_v1.pdf

The reporting procedure attempts to capture the status of each species, based as far as possible on quantitative data. Furthermore, the EU Commission is anxious that assessment be based on adult populations. Ireland has identified significant issues in trying to satisfy these EU requirements. Three species of shad are recorded in Ireland – the anadromous Allis and Twaite shads and the non-migratory Killarney shad, found only in Lough Leane in Killarney. The populations of the anadromous species are considered to be small and the adult fish spend most of their lives at sea or in deeper waters in the lower reaches of estuaries. The testing of sampling protocols by IFI in the 2009-12 period has identified that surveying for post-larval and young-of-year shads in July and August can yield positive results, using fine-mesh zooplankton or bongo netting. Adult shads have been sampled via focused angling surveys and telemetry studies are also elucidating valuable information on the behavioural ecology of the adult fish. The Habitats team has worked closely with the WFD team in regard to the Killarney shad and this synergy will continue in the 2013-18 period.

The assessment of each species was summarized under the headings of 'Range' – 'Population' – 'Habitat' – 'Future Prospects' and 'Overall Assessment of Conservation Status'. The traffic-light colour coding of green-orange-red was used to emphasise the outcome of the assessment (Table 3.1).

Table 3.1. Summary Conservation Status for shad species in Ireland 2007-12 based on IFI data.

Attribute	Twaite shad	Allis shad	Killarney shad
Range	Inadequate	Inadequate	Favorable
Population	Inadequate	Bad	Favorable
Habitat	Inadequate	Inadequate	Favorable
Future Prospects	Inadequate	Bad	Favorable
Overall assessment of Conservation Status	Inadequate	Bad	Favorable

The situation for Twaite shad was considered to be Inadequate. It is considered that the Twaite shad should have a wider Range and should be found in other large linear Irish estuaries such as the Bandon, Liffey and Boyne. The species was known from the Liffey up to the 1960s and individual shads have been taken in each year on the Boyne in the 2010-12 period. Known

spawning populations continue to occur and be recorded in the designated SAC waters but population size is considered to be small, apart from that on the River Barrow where a significant annual angling effort continues to confirm the presence of a spawning population. The shads, like the migratory lamprey, have a substantial capacity to migrate long distances from the sea up into freshwater. They are constrained from doing so on the Barrow by a large weir at the head of the tide but are not impeded from penetrating the freshwater reaches of the other SAC rivers. In spite of this, there are no records of Twaite shad migrating up into the Suir or Nore, where significant salmon and trout angling occurs. Limited records of adult fish in freshwater are listed for the Slaney – to Clohamon weir – and for the Munster Blackwater – to Clondulane weir. In view of the apparent disinclination to travel up into freshwater, the Habitat attribute is considered Inadequate. The species is considered, despite the Inadequate status assessment, to be in a stable mode with a prospect of continuing to maintain a modest population size and distribution.

The Allis shad appears to occur in much smaller numbers than the Twaite shad (King and Roche 2008). Evidence of hybridization in the Irish populations is confirmed and the Allis may be the more disadvantaged as a result. The restriction on further upstream migration on the River Barrow, due to an impassable barrier, may serve to telescope the shad populations and increase the likelihood of hybridization.

A Favourable status in respect of all attributes was recorded for the Killarney shad. The species has been recorded in fish surveys from the 1980s up to the present. It has survived through a period when Lough Leane was suffering cultural eutrophication. While the species may be 'vulnerable' due to its being present in one location, only, it appears to continue to thrive in Lough Leane.

3.2 Juvenile Anadromous Shad Programme

3.2.1 Bongo netting surveys

Sampling for juvenile shad was undertaken on the larger southern estuaries in both July and August 2013. Information from the adult shad tagging programme indicated that spawning had occurred around the 9-10th June. These spawning events coincided with a rise in temperature giving suitable conditions for spawning to occur. Based on fish activity in and around St. Mullins, a second spawning event was thought to have occurred on 21-22nd June. In order to ensure shad eggs had hatched and fish had developed to an identifiable size, bongo netting was undertaken 4 to 5 weeks post spawning. Sampling commenced downstream of the spawning area and extended to the lower reaches of the estuary.

Sampling in each waterbody was undertaken using bongo nets (Plate 3.1) and sampling stations were approximately 2 kilometres apart. Fishing was conducted against the flowing tide, in slacker water adjoining the depositing banks of the river. The duration of each trawl was 10 minutes. A GPS point was recorded at the start and end of each trawl to measure the distance surveyed and to permit mapping the distribution of fish using ArcMap 10. The contents of each bongo net were sieved and, where fish were present, retained in 70% alcohol for preservation.



Plate 3.1. Bongo net used to undertake juvenile fish surveys.

The survey targeted slacker waters with little flow. In view of the size and fragility of the fish in this early development phase this habitat type was considered to suit their requirements, including a need to hold station and not getting displaced with tidal flows. On occasion a larger or smaller distance was left between sampling stations where suitable slacker water was present to survey on a depositing bank (Table 3.2). The knowledge and experience of locally based regional staff aided in the completion of the survey.

Table 3.2. The number of trawls performed on each river during both sampling periods.

	Distance Sampled (km)	No. of Trawls	Max. length Trawl (m)	Min. length Trawl (m)	Mean length Trawl (m)	Max. no. fish/m ³	Mean no. fish/m ³	No. positive locations
Barrow (J)	35	17	573	42	423	0.237	0.018	4
Nore (J)	14	8	405	219	327	0.111	0.027	3
Suir (J)	40	18	663	298	467	0.013	0.001	1
Slaney (J)	20	10	648	445	548	0.000	0.000	0
Munster Blackwater (J)	20	10	629	268	449	0.000	0.000	0
Barrow (A)	35	16	545	160	374	0.039	0.008	5
Nore (A)	14	7	407	250	311	0.000	0.000	0
Suir (A)	40	14	835	255	525	0.008	0.001	1
Slaney (A)	20	11	610	175	379	0.000	0.000	0
Munster Blackwater (A)	20	10	660	46	401	0.000	0.000	0

During July, juvenile shad were present on the Rivers Barrow, Nore and Suir (Table 3.2). Results were converted to standardized units of no. fish / m³ of water filtered. Juvenile shad were captured at four sites on the River Barrow - two locations upstream and two downstream of New Ross. On the River Nore, fish were captured at three sites (Figure 3.1). A positive sample was taken on the Suir at the Suir-Barrow confluence during the July survey. This is approximately 35 km

downstream of the known spawning area of St Mullins on the River Barrow, and 40 kilometres downstream of the spawning area, upstream of Carrick on Suir.

No shad were captured on the Rivers Slaney and Munster Blackwater, during either the July or August sampling event.

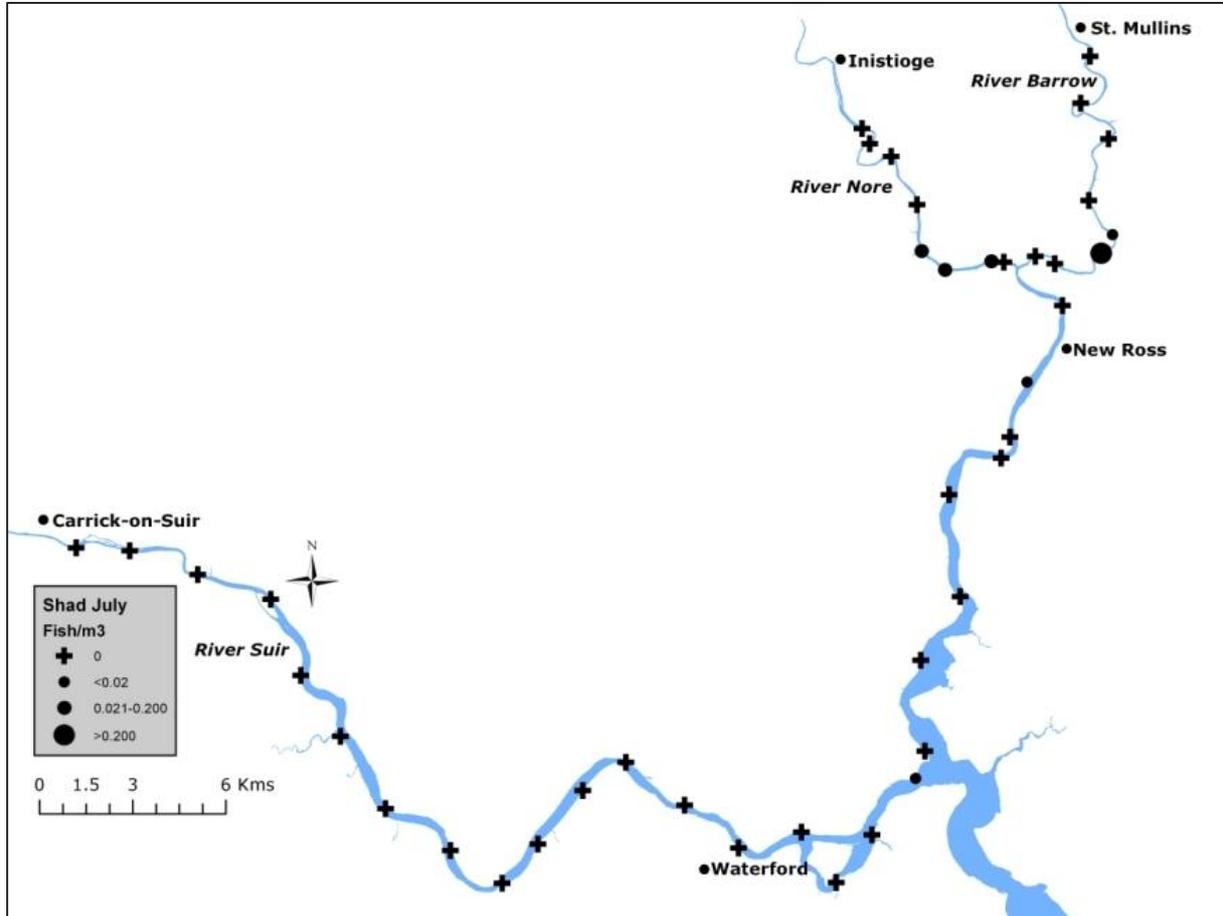


Figure 3.1. Distribution of juvenile shad on the Rivers Barrow, Nore and Suir during July 2013.

During the bongo netting trawls undertaken during August 2013, juvenile shad were encountered at four sites on the River Barrow and one site on the River Suir. The River Nore shad would have migrated to the River Barrow at the time of sampling, thus, no juveniles were captured. Results from the River Barrow displayed the presence of shad at four of the five sites sampled downstream of New Ross. Shad were encountered at one site downstream of Waterford on the River Suir (Figure 3.2).

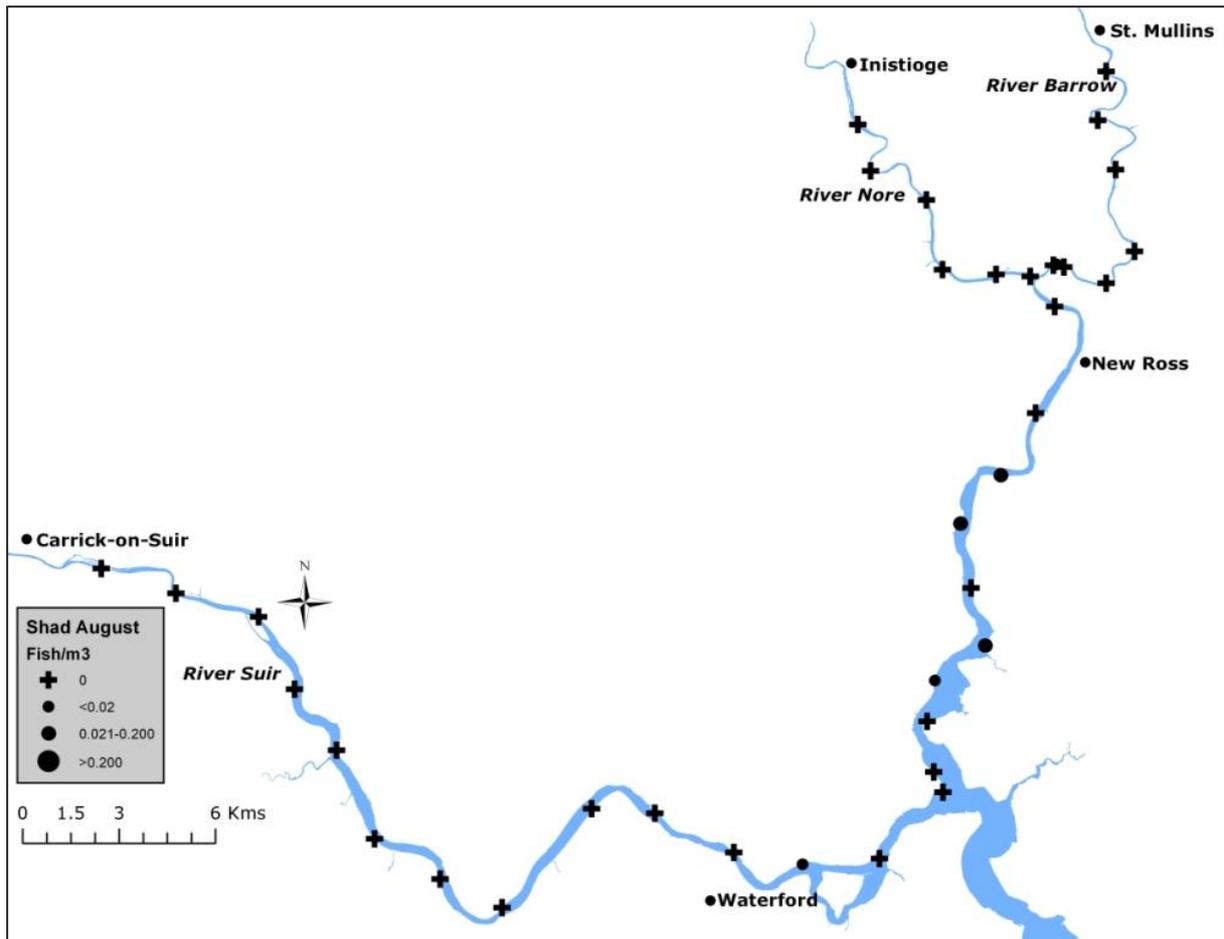


Figure 3.2. Distribution of juvenile shad on the Rivers Barrow, Nore and Suir during August 2013.

All fish captured were measured in order to compare the lengths recorded across all rivers on the two sampling occasions (Figure 3.2). A wide range of shad lengths was recorded on the River

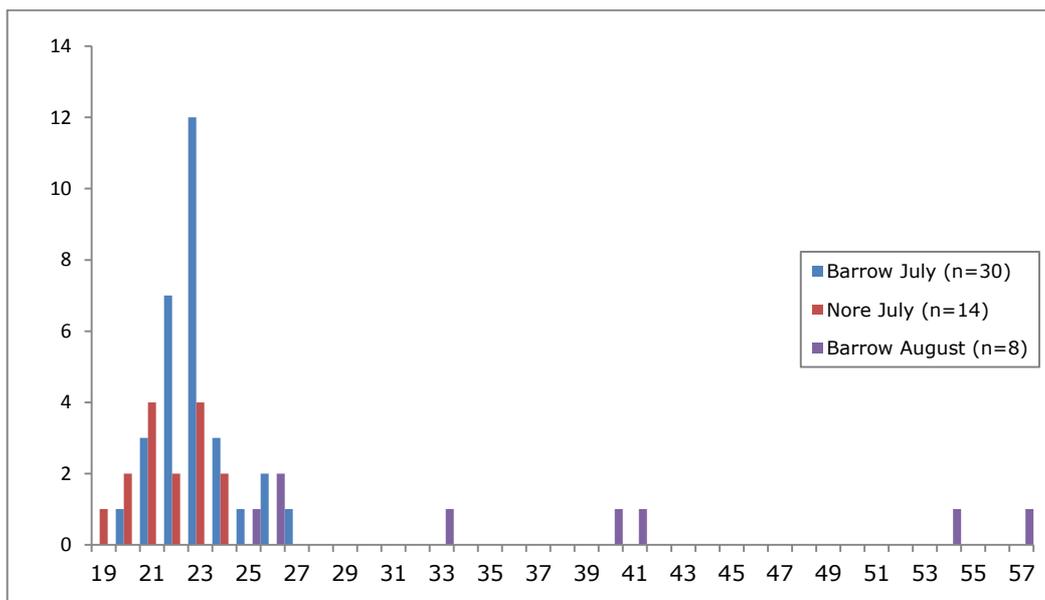


Figure 3.3. Length frequency of juvenile shad on the Rivers Barrow, Nore and Suir during July and August 2013.

Barrow during August, indicating the possibility of a number of spawning events. However, given the small sample size, no such judgement can categorically be made. Fewer fish were caught on the River Barrow in August compared to July. This may be the result of a high mortality rate in the young fish. It may also be due to the small sample sizes. The use of bongo netting to monitor the density and distribution of juvenile shad, and smelt as a by-catch, is a useful method of gleaning

more information on the movement and growth rates of these Annex II species. Similar surveys conducted during 2012 revealed no juvenile shad on any of the five rivers on either sampling occasion. This was due to very heavy rainfall and subsequent flooding during June, resulting in mortality of the juvenile fish. There is a paucity of knowledge of the juvenile phase of shad in Ireland. Tweaking and refining bongo netting procedures and methodologies aid the collection of information on the habitat usage of this fragile stage of the fish life cycle. The dataset collected to date on the density, distribution and growth rates of juvenile shad is still in its infancy but with annual assessment a more detailed picture of this life stage can be drawn.

3.2.2 Water Framework Directive estuary autumn survey

Fish sampling was undertaken by IFI's Water Framework Directive team in autumn 2013 in the estuaries of the Suir, Barrow and Waterford Harbour. A suite of sampling was undertaken as the standard method, including beach seining, fyke netting and beam trawling.

A relatively large number of 0-group shad was collected, among a range of other species, and the shads were retained for additional examination by the Habitats team. The fish were processed for length, weight and gill raker counts were also undertaken. The sample ranged in size from 60 to 100 mm (in 10 mm length groups) with a modal peak at 80 mm (Figure 3.4). This provides valuable information to cross-check with length-at-age as calculated from scale readings. The gill raker counts were done under magnification and spanned a wide range from 26 to 58. The majority of the sample ($n = 54$) was clustered around a modal peak of 29, with a range of 26 – 34 (Figure 3.5). There were two 'outliers' – one at 39 and one at 58. The latter was re-counted and may indicate the presence of a Twaite X Allis shad hybrid. The main cluster of fish had a gill raker count substantially below the typical adult Twaite shad gill raker count of *circa* 41, suggesting that the number of gill rakers increases with age.

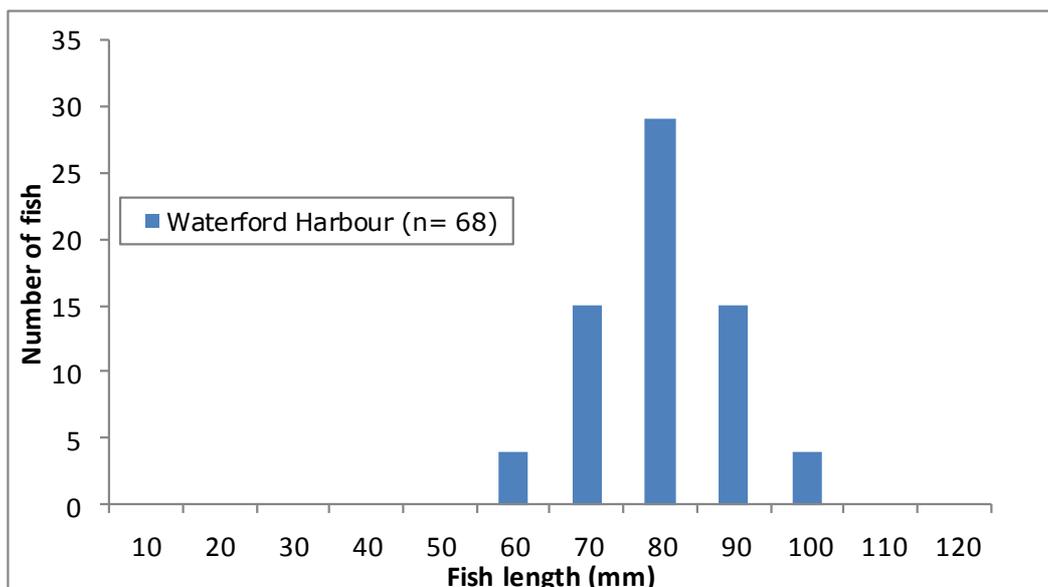


Figure 3.4. Length frequency of young-of-year shads captured in Waterford Harbour, October 2013.

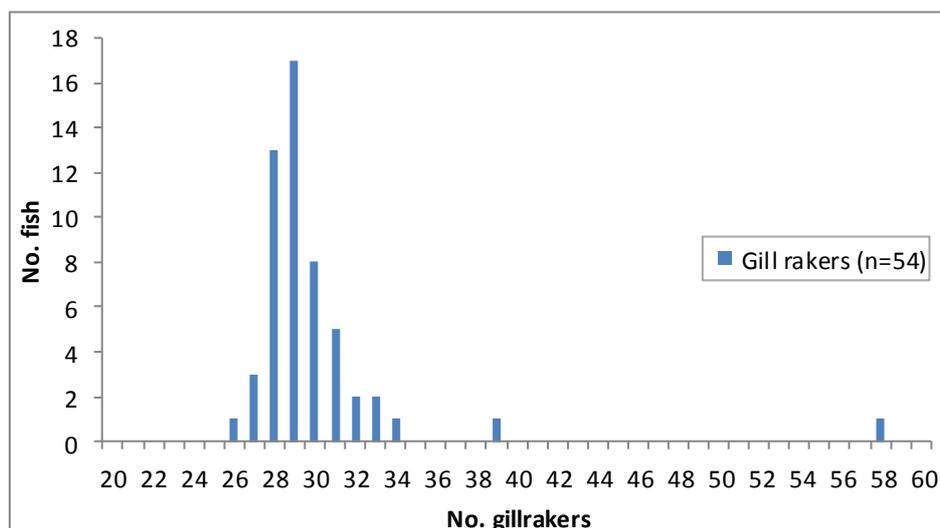


Figure 3.5. Gill raker counts of young-of-year shads captured in Waterford Harbour, October 2013.

3.3 Spawning Behaviour of Twaite Shad

A programme of acoustic telemetry, first undertaken in 2012 to determine spawning behaviour of Twaite shad (*Alosa fallax*) in the tidal sections of the Barrow and Nore rivers, was continued in 2013 and expanded to include the Munster Blackwater. On the River Barrow a total of 13 adult Twaite shad were captured over two days during May 2013 (10th and 22nd) using drift netting. Fish were fitted with an external acoustic transmitter and released at point of capture. Movements of tagged shad throughout the tidal sections of the Barrow and Nore rivers were monitored *via* an array of 11 fixed listening stations covering a distance of 43 km by river from the upper tidal limits at St. Mullins and Inistioge, respectively, to the lower reaches of Waterford Harbour at Passage East.

On the Munster Blackwater, an array comprising six listening stations was installed during May

2013 at locations from the upper tidal limits at Lismore, Co. Waterford to Youghal, Co. Cork, a distance of 25 km by river. During May (16th, 17th, 28th) and early June (5th) a total of four adult Twaite shad were captured, again using drift netting, tagged and released along a section of river at Villierstown, Co. Waterford.

Acoustic tracking of spawning Twaite shad progressed during May and June. On the River Barrow, tagged adult shad (n=11) began congregating in the upper tidal reaches at St. Mullins to spawn from May 23rd until June 8th, corresponding with a steady rise in water temperatures (Figure 3.6). Three of these fish were also detected briefly in the lower Nore. None of these were detected closer to the tidal limits at Inistioge. An identical spawning scenario occurred on the Munster Blackwater with tagged shad (n=2) concentrating their activity at a location between Lismore and Cappoquin known as the Hut Pool (Figure 3.6).

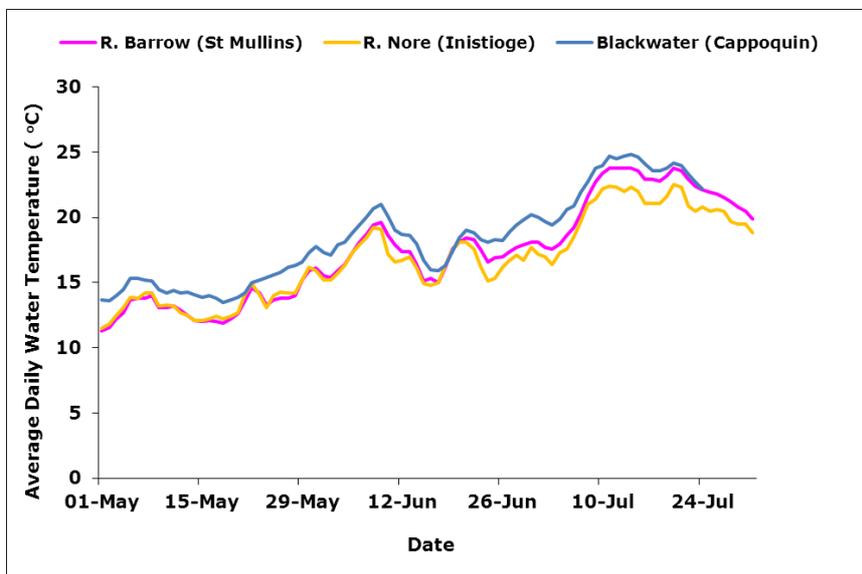
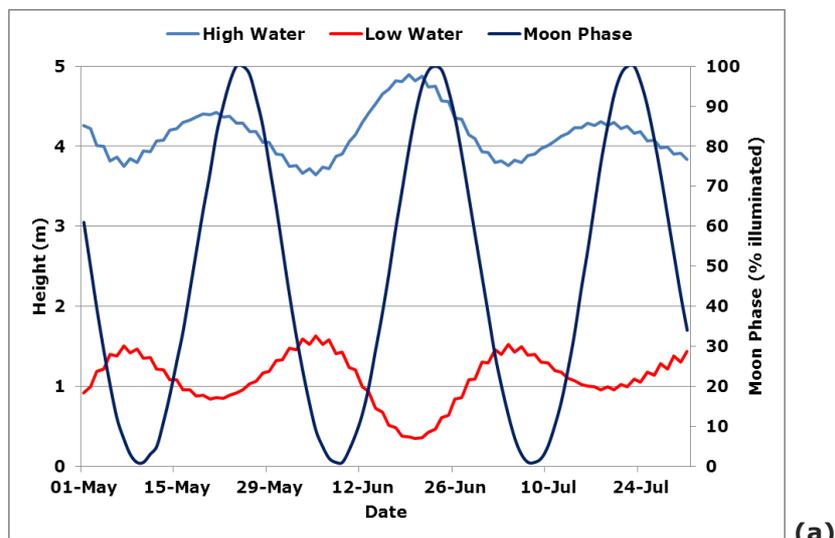


Figure 3.6. Water temperatures recorded from the upper tidal sections of the rivers Barrow, Nore and Blackwater from May to July 2013.



(a)

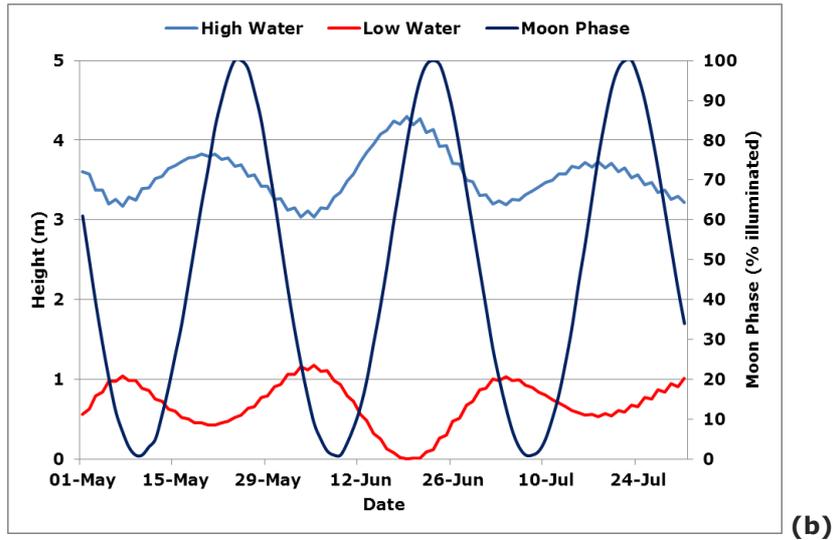
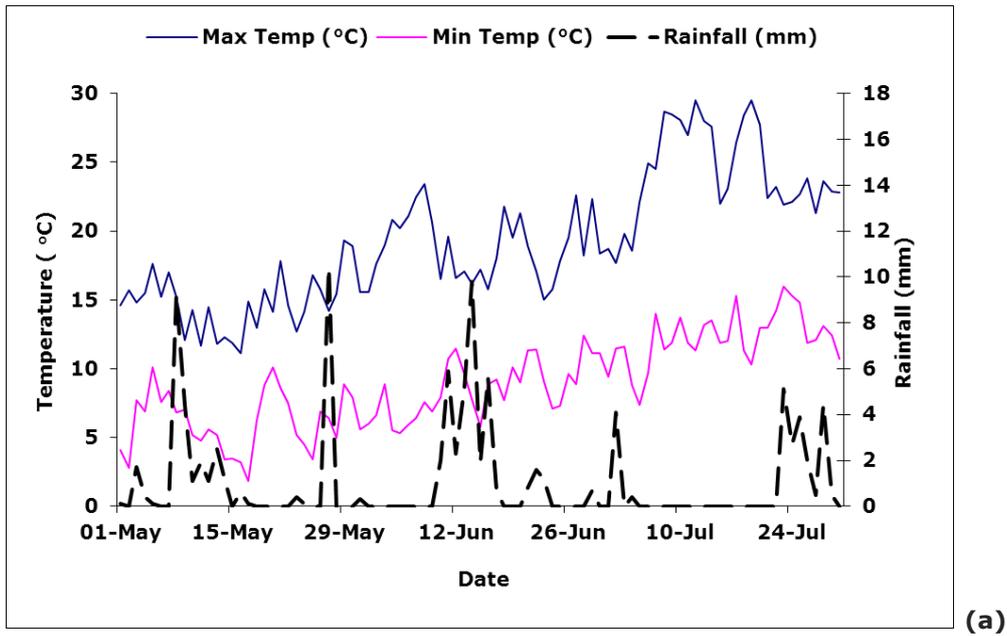


Figure 3.7. Tidal regimes and moon phase for New Ross (a) and Youghal (b) during the period May to July 2013.

Spawning activity during 2013 at both locations coincided with periods of neap tides and decreasing moon phase (Figure 3.7a and 3.7b). Air temperatures, recorded at Carlow and Fermoy, increased steadily during this period from 13 to 23 °C (Figure 3.8a and 3.8b), with rainfall amounts generally low. Corresponding river levels were also relatively low (Figure 3.9).



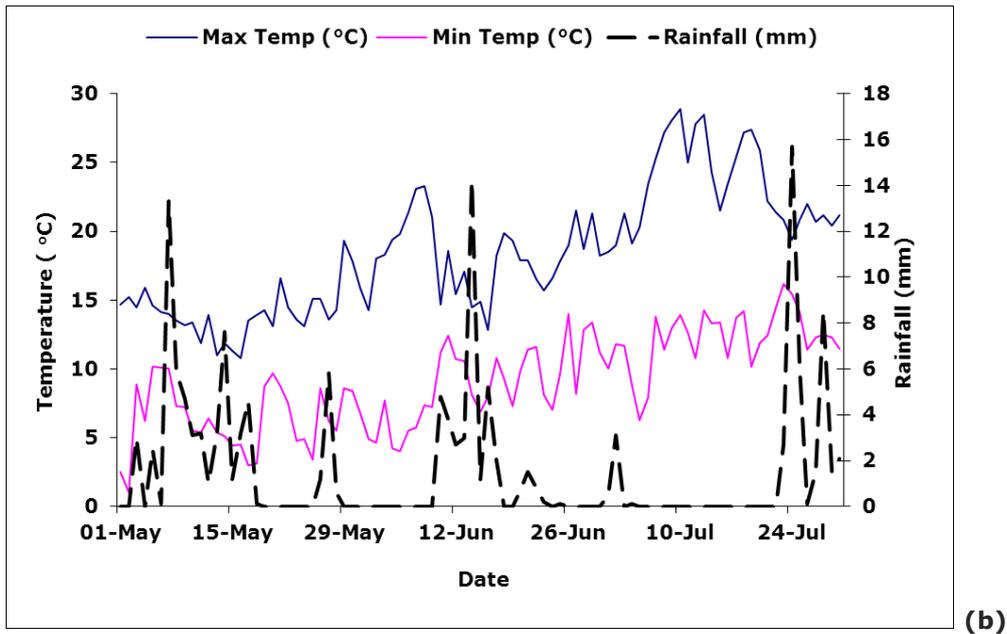


Figure 3.8. Local air temperatures (maximum and minimum) and rainfall amounts (mm) for the River Barrow, Carlow (a) and the Munster Blackwater, Fermoy (b) during the period May to July 2013.

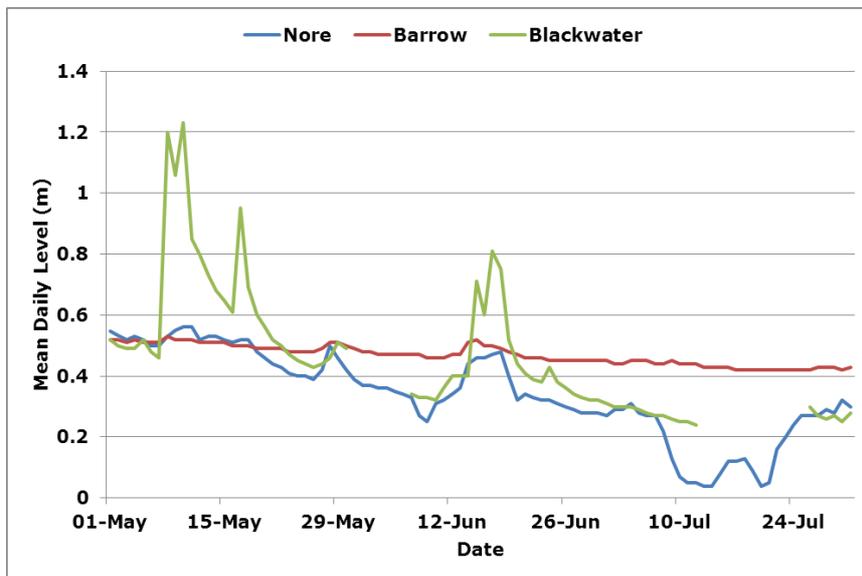


Figure 3.9. Water levels (m) in the Nore, Barrow and Blackwater Rivers during the study period, recorded at hydrometric stations upstream of the tidal limits at Brownsbarn, Graigenamanagh and Ballyduff, respectively.

Following these spawning aggregations, both sets of tagged shad generally dispersed seawards to the lower sections of the respective estuaries. Detections on the listening station in Waterford Harbour at Passage East generally ceased after mid-August, with the exception of a brief reappearance by one tagged fish during late October. In Youghal Harbour no tagged shad were detected after October 8th. Interestingly, one of the shad tagged in the Munster Blackwater, last detected in Youghal on July 12th, appeared in Waterford Harbour at Passage East 3 days later, a distance of 85km by sea. Other interesting observations occurred in early July (2nd) when a Barrow

tagged shad was captured by fishermen in the River Suir upstream of Waterford at Granny. Later that month (15th) another Barrow tagged shad was captured in shrimp nets near Dunmore East in Waterford Harbour.

4. Pollan Programme

4.1 Outcomes of Article 17 status assessment for pollan species in Ireland

The Article 17 report on pollan compiled by IFI and submitted to the NPWS was based on work carried out in the period 2000 – 2007 as well as on specific surveillance in the period 2009 – 2012. Much of the work was undertaken under the NORTH-SOUTH SHARE project, including a combined hydroacoustics – netting survey of Lough Allen. That survey led to the first published report of pollan in Lough Allen. The Water Framework Directive fish survey team was established in IFI in 2008 and developed a 3-year cycle of surveillance on lakes. Within this programme, both Lough Derg and Lough Ree were included. Thus, over the past 10 years, all three major lakes on the Shannon, now known to contain pollan, have been subject to detailed fish surveys. Both Loughs Ree and Derg were surveyed twice in the period 2008 – 2013. The NPWS Article 17 report dealing with the full suite of species, including the fish, is available on line from NPWS at http://www.npws.ie/publications/article17assessments/article172013assessmentdocuments/Article_17_Web_report_species_v1.pdf

The reporting procedure attempts to capture the status of each species, based as far as possible on quantitative data. Furthermore, the EU Commission is anxious that assessment be based on adult populations. Ireland has identified significant issues in trying to satisfy these EU requirements in respect of both the lampreys and the anadromous shads. However, the combined hydroacoustics – gill netting approach used in the IFI lake surveys facilitates enumeration of adult populations and these have been published in two separate journal articles (Harrison *et al.* 2010; Harrison *et al.* 2012). The Habitats team has worked closely with the WFD team in regard to pollan surveys undertaken and this synergy will continue in the 2013-18 period.

The assessment of pollan was summarized under the headings of 'Range' – 'Population' – 'Habitat' – 'Future Prospects' and 'Overall Assessment of Conservation Status'. The traffic-light colour coding of green-orange-red was used to emphasise the outcome of the assessment (Table 4.1).

Table 4.1. Summary Conservation Status for pollan (*Coregonus autumnalis*) in Ireland 2007-12 based on IFI data.

Attribute	Pollan
Range	Favourable
Population	Bad
Habitat	Inadequate
Future Prospects	Inadequate
Overall assessment of Conservation Status	Bad

A consistent approach was taken insofar as any Attribute rated as 'Bad' would automatically lead to an overall conservation assessment of 'Bad' i.e. a "one out – all out" approach. The 'Range' for pollan was considered as favourable. The species is now known from the three largest lakes of the

Shannon system. Two of these – Lough Derg and Lough Ree - are among the largest lakes in Ireland. Both have zones of deep water, in excess of 20 meters depth, providing a cooler climate in summer in conditions of potential thermocline formation. The IFI studies undertaken using hydroacoustics enabled construction of models of population size, based on targets intercepted by the hydroacoustics. The hydroacoustic –netting survey on Lough Ree in both 2010 and 2013 pointed to a modest population of pollan in that lake. In the course of the two surveys on Lough Derg, little information was captured of pollan targets and individual fish only were taken in the companion gill net survey. A small number of pollan have been taken as by catch of experimental eel netting operations at Killaloe in all years from 2009 and retained by staff of IFI Limerick for examination by the Habitats team. These small samples confirm the on-going recruitment of young fish into the Lough Derg system. The outcomes from the Lough Derg survey do not point to the presence of a substantial pollan population in that lake.

The 'Habitat' attribute was rated as 'Inadequate'. This was based, in part, on current pressures and envisaged future threats to the three lakes. Invasive aquatic species have impacted significantly in the Shannon system, as witnessed by the Zebra mussel. Recent reports of the occurrence of the Asian clam from the Shannon, in particular on Lough Derg, are a further cause of concern. Ongoing diffuse pollution of water is a major issue, given the size of the three lakes and the size of catchment areas draining to each one. The pollan is a cold-water species, living at the most-southerly extreme of its range in Ireland, and it is reliant on refuges in the cold thermal regime that should be available in the deep-water areas of the large Shannon lakes in warm summer conditions. In very warm summers, such as that of 2013, lakes can stratify, with the warmer upper layers of lake water becoming 'separated' i.e. not mixing with the lower layers. In these conditions, the lower layers can suffer reduced oxygen levels, particularly if the lake is enriched. Such conditions may 'squeeze' the pollan between warmer upper surface layers and lower, reduced-oxygen, layers. The pollan is pelagic, migrating in the water column and feeding on zooplankton. The feeding regime will have been impacted through the invasive Molluscs – Zebra mussel and Asian clam – which filter out large volumes of plankton from the water. The 'Future Prospects' for pollan were rated as 'Inadequate' based on the continuing presence of current Pressures. Climate change, with a gradual increase in surface water temperatures, is a further factor that would impact adversely on pollan.

4.2 Adult Pollan Surveys

During March 2013, sampling was undertaken for adult pollan, in tandem with bongo-netting for post-larval fish. It was expected that the adult fish would have spawned at this stage. Fyke nets were set for adults during March 2013 in selected areas based on anecdotal evidence paired with knowledge of spawning requirements of exposed gravel shores. In total six gangs of fyke nets were set overnight from 19th March to 20th March, on the east shore where, in the past, trout fisherman had seen shoals of Pollan. No fish were captured in the fyke nets.

A combined hydroacoustics – ground -truing strategy has been developed by IFI's Water Framework Directive (WFD) team and this has been rolled out in several large lakes, including the pollan lakes of Lough Derg and Lough Ree on the Shannon. In June 2013 the Habitats team

assisted the WFD team in its survey of Lough Ree. Use of deep pelagic nets was successful in collecting a small sample of pollan. Detailed examination will provide information on length, weight, gender and gonad condition. Scales will enable ageing and back-calculation of length-at-age.

Pelagic netting combined with hydroacoustics was undertaken by the combined WFD – Habitats team in December 2013 and a further sample of pollan was confirmed in Lough Ree.

4.3 Juvenile Pollan Surveys

The use of bongo nets to survey juvenile shad has been reported earlier (see 3.2.1 above). Studies on Lough Neagh by AFBI have successfully managed to locate and catch juvenile pollan using a similar method to bongo netting. Given this information it was decided to sample for juvenile pollan in L. Ree (Plate 4.1) using the same method.

Pollan spawn on exposed rocky shores during December, when temperatures drop below 5°C. Initial bongo net sampling was undertaken during late March 2013 on the eastern shores of L. Ree and also around a number of islands, including Nuns Island and Scholars island. These islands had exposed, gravelled areas, determined from previous reconnaissance trips, considered suitable for pollan spawning. On this first occasion no juvenile pollan were captured.



Plate 4.1. Juvenile pollan captured during Spring 2013.

During much of February and March the prevailing wind was easterly. On the second and subsequent sampling occasions, trawling was focussed on the western shore of the lake (Figure 4.2). Trawls were generally conducted approximately 20 to 50 meters from the shoreline, running parallel to the shore. The bongo net was adjusted to fish approximately 1 metre below the water surface. Fish tended to be present in choppy waters in a depth of greater than three meters. A number of sheltered bays were sampled and no fish were captured.

A narrow environmental window exists between the eggs hatching and the fish descending to the pelagic zone of the lake. It is at this free floating stage pollan are available for sampling using a

bongo net. The numbers of fish caught per trawl were very low. The density varied between 0.005 and 0.062 fish/m³. The length of fish captured varied between 10 and 16 mm. In total 46 trawls were undertaken and fish were present in 11 of these samples (Figures 4.2 & 4.3). It may be significant that positive samples were taken in two widely-separated areas of the western shore (Figure 4.2).

As this was the first such survey conducted on Lough Ree, these factors may be coincidental and have no bearing on the presence or absence of juvenile fish. At the beginning of April the wind changed direction to the west. Subsequent sampling focussed on the south-eastern shore where one individual fish was captured over 17 trawls.

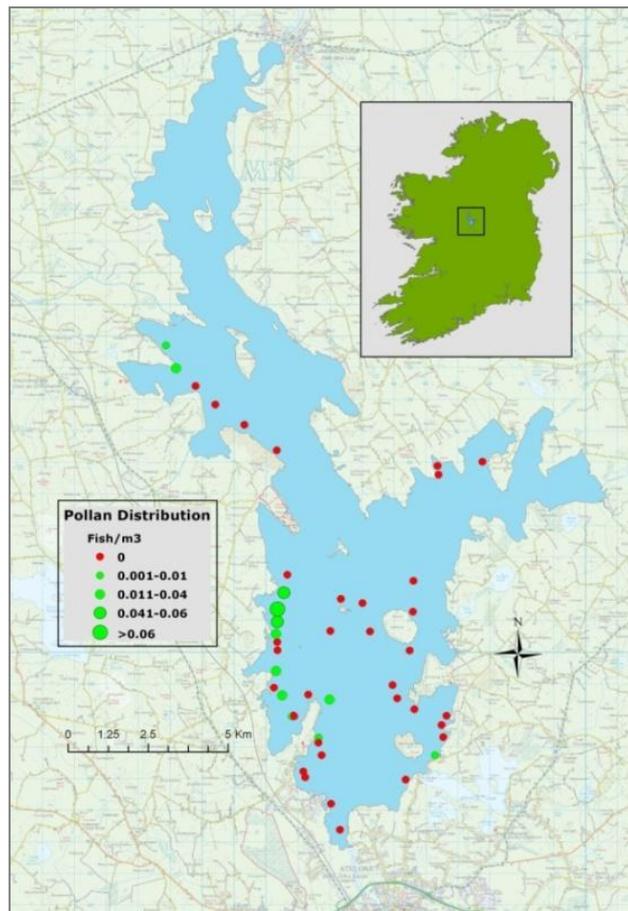


Figure 4.2. Juvenile Pollan distribution on Lough Ree during March and April 2013.

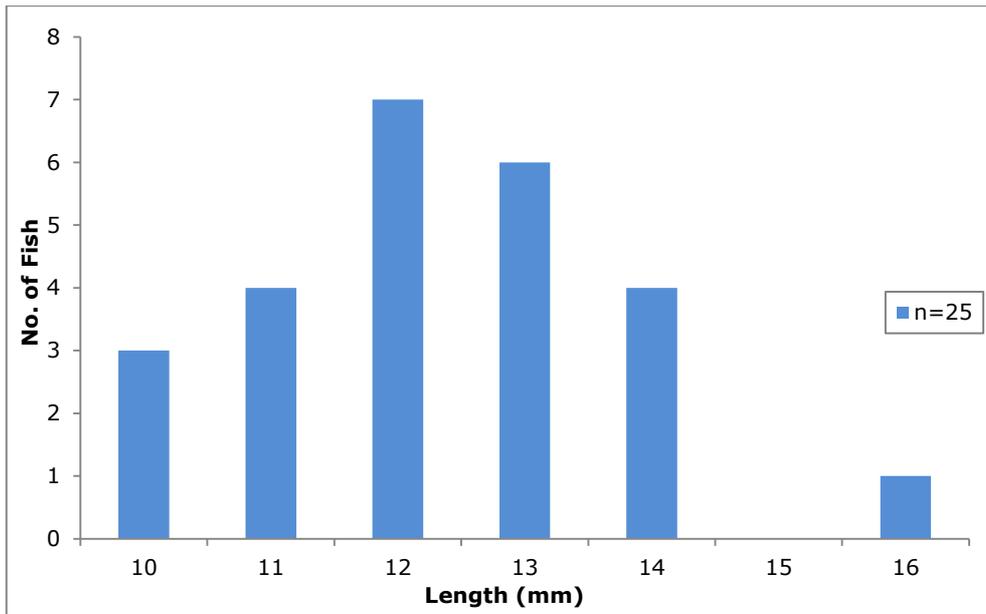


Figure 4.3. Length frequency of juvenile pollan on Lough Ree, Spring 2013.

Given the size of the fish, physical characteristics, such as fin ray counts, were difficult to enumerate. Fins were undeveloped and thus the fish were noted as pollan by process of elimination, given that no other species of fish in the lake spawn at this time. A number of fish presented with what appeared to be remnants of a yolk sac still attached to the fish, thus reinforcing the immature, post-larval nature of the fish captured.

Given the success of the sampling effort in 2013, further investigations will be undertaken in 2014 to further the knowledge of habitat usage by this life stage of pollan.

5. Smelt Programme

5.1 Juvenile Smelt Programme

Sampling for juvenile smelt was undertaken on the larger southern estuaries during July and August using a bongo net (Plate 5.1). Sampling is primarily undertaken for juvenile shad but as a by-catch, smelt were also captured.

Fishing was conducted against the flowing tide, in slacker water on the depositing banks of the river. The duration of each trawl was 10 minutes. A GPS point was recorded at the start and end of each trawl in order that the distance surveyed. Sampling stations were placed approximately 2 kilometres apart (Table 5.1). Based on the distance travelled (volume of water filtered by the net) a density estimate of fish could be calculated and reported as number of fish/m³. The contents of each bongo net were sieved and, where fish were present, retained in 70% alcohol for preservation. On both occasions sampling commenced downstream of the spawning area to the lower reaches of the estuary.



Plate 5.1. Bongo net used to undertake juvenile fish surveys.

As was the case with juvenile shad, no smelt were captured on the Rivers Slaney or Blackwater during either sampling event.

No smelt were present from samples collected on the River Nore. This was possibly due to the time the samples were collected. Smelt spawn in late March to April. Given the length of time between spawning and sampling, the Nore smelt may have moved downstream of the confluence with the River Barrow.

Table 5.1. The number of trawls performed on each river during both sampling periods.

	Distance Sampled (km)	No. of Trawls	Max. length Trawl (m)	Min. length Trawl (m)	Mean length Trawl (m)	Max. no. fish/m ³	Mean no. fish/m ³	No. positive locations
Barrow (J)	35	17	573	42	423	0.099	0.073	3
Nore (J)	14	8	405	219	327	0.000	0.000	0
Suir (J)	40	18	663	298	467	0.046	0.000	2
Slaney (J)	20	10	648	445	548	0.000	0.000	0
Munster Blackwater (J)	20	10	629	268	449	0.000	0.000	0
Barrow (A)	35	16	545	160	374	0.040	0.007	4
Nore (A)	14	7	407	250	311	0.000	0.000	0
Suir (A)	40	14	835	255	525	0.020	0.001	1
Slaney (A)	20	11	610	175	379	0.000	0.000	0
Munster Blackwater (A)	20	10	660	46	401	0.000	0.000	0

During the July sampling, juvenile smelt were identified at three locations on the River Barrow and two on the River Suir. When the locations of juvenile smelt on the River Barrow were compared during July and August, little or no changes in the locations were observed. On both occasions fish were present upstream of the confluence with the River Nore. In previous surveys a pronounced downstream migration was noted in the distribution of juvenile smelt between the July and August sampling occasions.

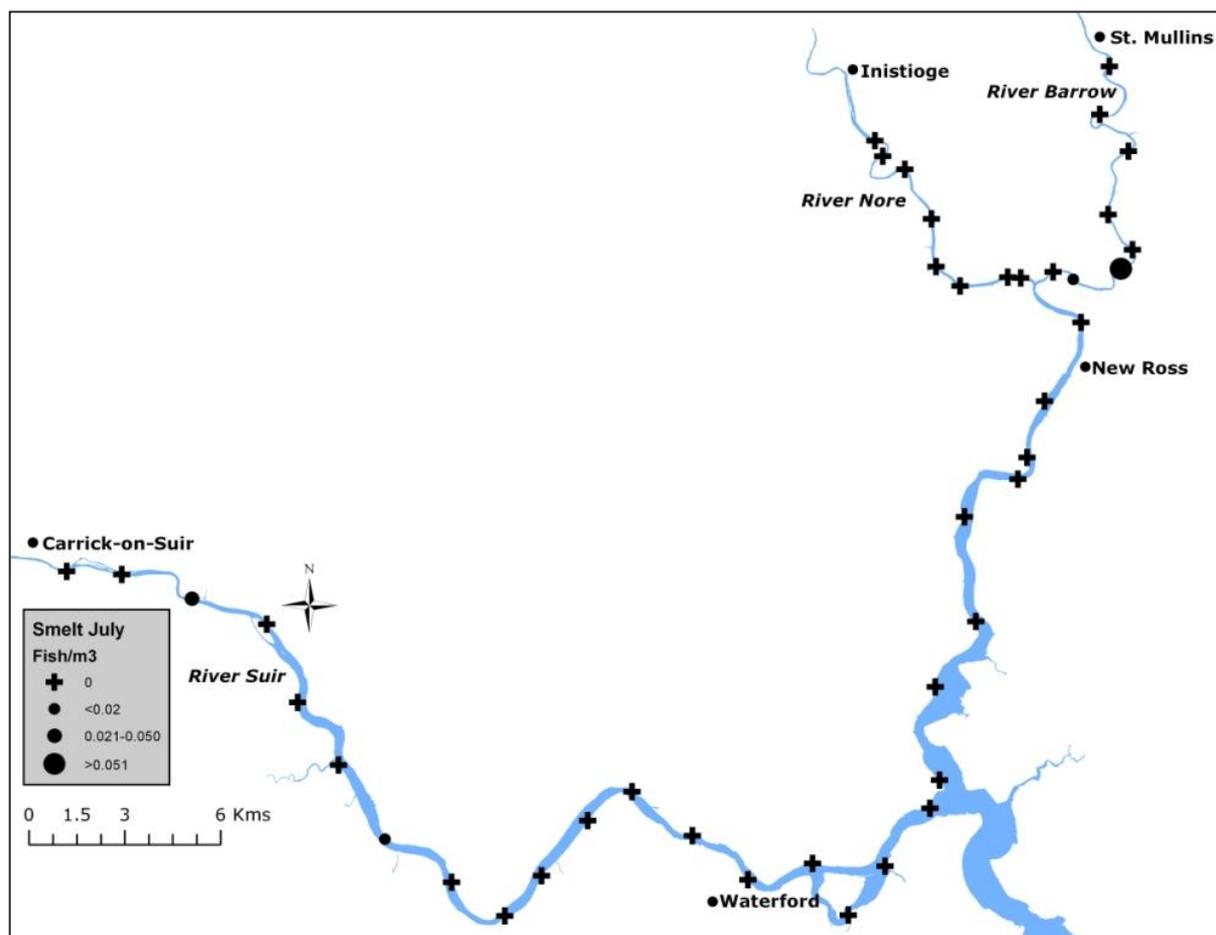


Figure 5.1. Distribution of juvenile smelt on the Rivers Barrow, Nore and Suir during July 2013.

On the River Suir a downward migration of juvenile smelt was observed, with August fish located 7.5 kilometres further than those captured during July 2013 (Figure 5.1). Juvenile smelt on the River Barrow were captured 34 kilometres downstream of the spawning area, as well as at two sites upstream of the River Nore confluence (Figure 5.2). Investigations into the density and distribution of juvenile smelt are ongoing, the use of bongo netting as a monitoring tool being refined on an annual basis. Results obtained from year to year to date vary greatly in the distribution and the density of juvenile smelt.

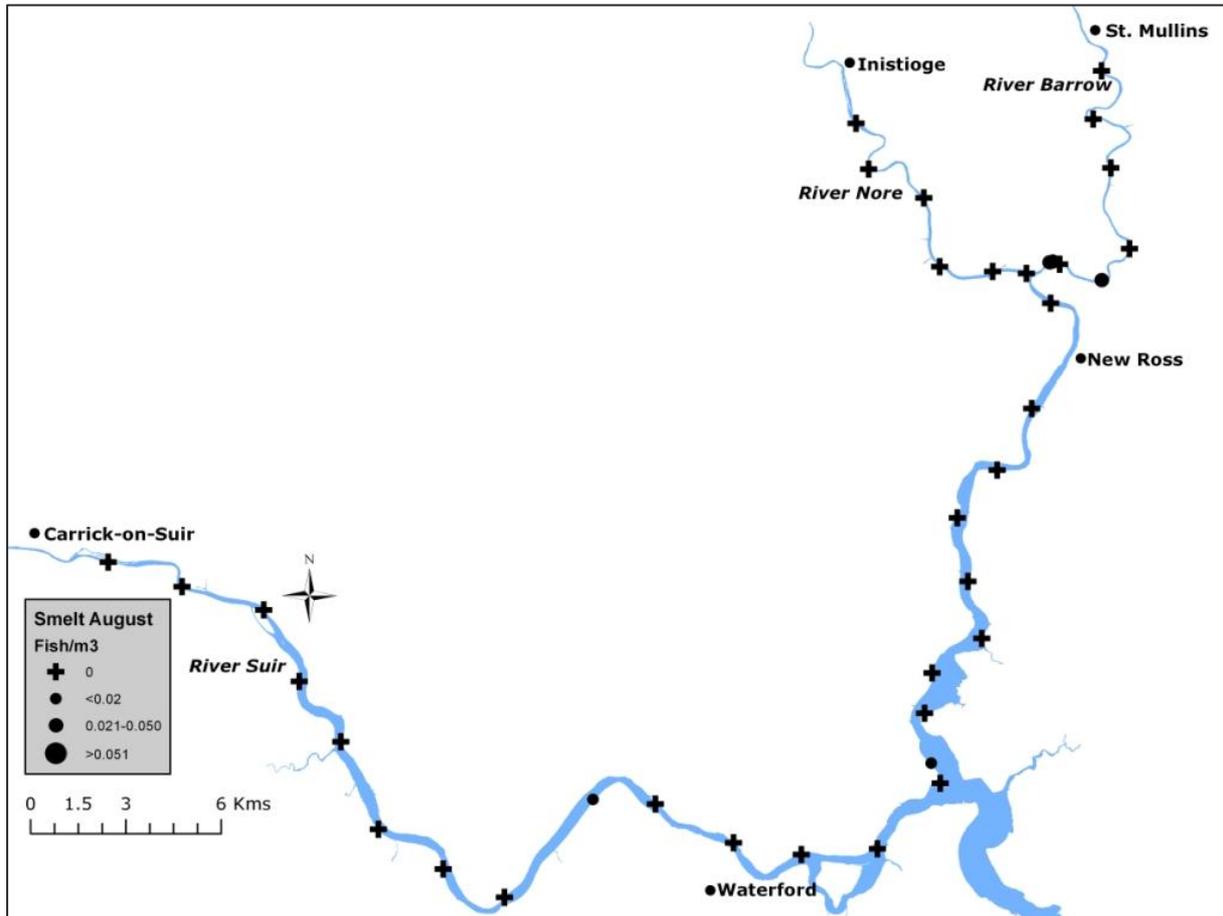


Figure 5.2. Distribution of juvenile smelt on the Rivers Barrow, Nore and Suir during August 2013.

Fish captured on the Rivers Barrow and Suir during July revealed a number of different size classes, with lengths recorded between 26 to 48 mm (Figure 5.3). This variation in lengths would suggest that there were a number of spawning events rather than one occasion. Although only 7 fish were captured on the River Suir in July, three distinct size classes were visible. The largest fish recovered was on the River Suir during August, 57mm, this was the only smelt captured during the August trawls on the River Suir. The size range of fish recorded on the River Barrow during August was narrower than those in July, 32 to 43 mm.

As smelt spawn during March and April, a future study could focus on capturing the post larval stage of juvenile smelt. Sampling undertaken in May would enable this. Information on the density and distribution of juvenile smelt after the post larval stage would be of interest as there is currently no data available in Ireland. The use of bongo netting to monitor juvenile fish has only

been used for the past two to three years and further rounds of monitoring should built an insight into recruitment and survival of juvenile smelt.

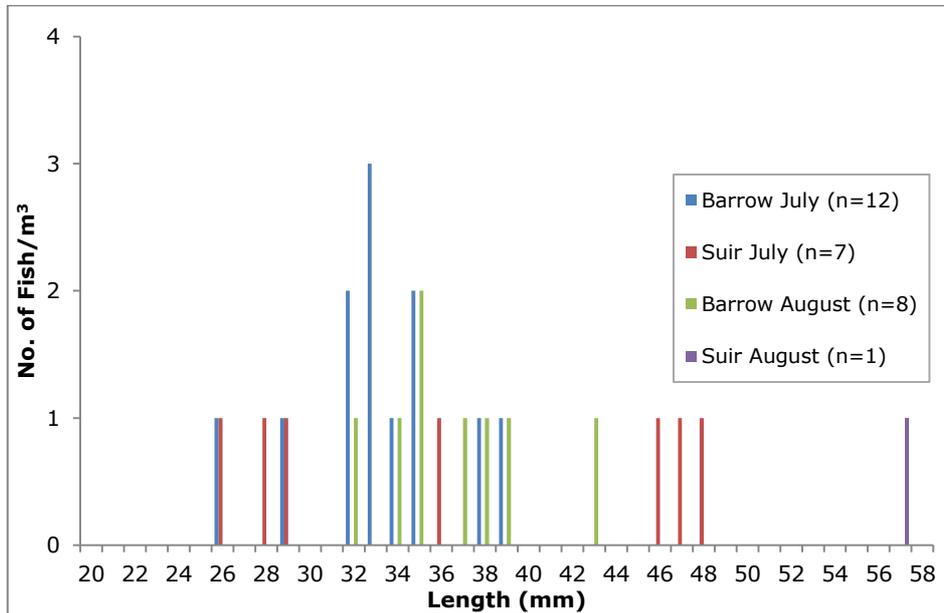


Figure 5.3. Length frequency of juvenile smelt on the Rivers Barrow, Nore and Suir during July and August 2013.

6. Char Programme

The sampling strategy in the char programme matches that used in IFI's Water Framework Directive survey programme. The two teams have generated a listing of char lakes, based on the review of Igoe *et al.* (2003), and the sampling programmes are complementary, permitting the surveying of a larger number of lakes, using the same sampling techniques and data processing. Lakes in three areas of the country were surveyed in 2013 – Lough Nafoeey in Co. Mayo, Muckross Lake in the Killarney National Park and two of the lakes in the Cloonee system in west Kerry. These latter lakes had previously been surveyed by the predecessor of IFI in the late 1980s, using a different netting technique designed to capture larger, angling sized fish, only. Muckross Lake had been surveyed in 2002 by the Irish Char Conservation Group. The strategy of undertaking repeat surveys on waters previously examined is one of the aims of the Char Programme within the overall remit of the Habitats Directive and Rd Data Book Fish Species team.

6.1 Lough Nafoeey

Lough Nafoeey is a glacial lake located in the North West of the Corrib catchment in County Galway. The lake is long and narrow and is situated within a steep-sided valley, surrounded by mountains to the south and north, rising to 617 meters. A section of the north eastern shore of the lake is the border between counties Galway and Mayo. The area of the lake is 248 hectares and its maximum depth is 47 meters. The River Fooley, which rises from the Devils Mother Mountain, enters the western end of the lake. The River Finney exits from the lake on the south eastern shore and drains into the southwest of Lough Mask. There are sandy shores on both the western and eastern edges of the lake.



Plate 6.1. Lough Nafoeey.

Lough Nafooeý was surveyed over three nights between 6th and 9th August 2013. A total of six sets of Dutch fyke nets, 21 benthic monofilament multi-mesh (12 panel, 5-55mm mesh size) CEN standard survey gill nets (4 @ 0-2.9m, 4 @ 3-5.9m, 5 @ 6-11.9m, 3 @ 12-19.9m, 3 @ 12-34.9m and 2 @ 35-49.9m) and four surface floating monofilament multi-mesh (12 panel, 5-55mm mesh size) CEN standard survey gill nets were deployed in the lake (31 sites, Figure 6.1).

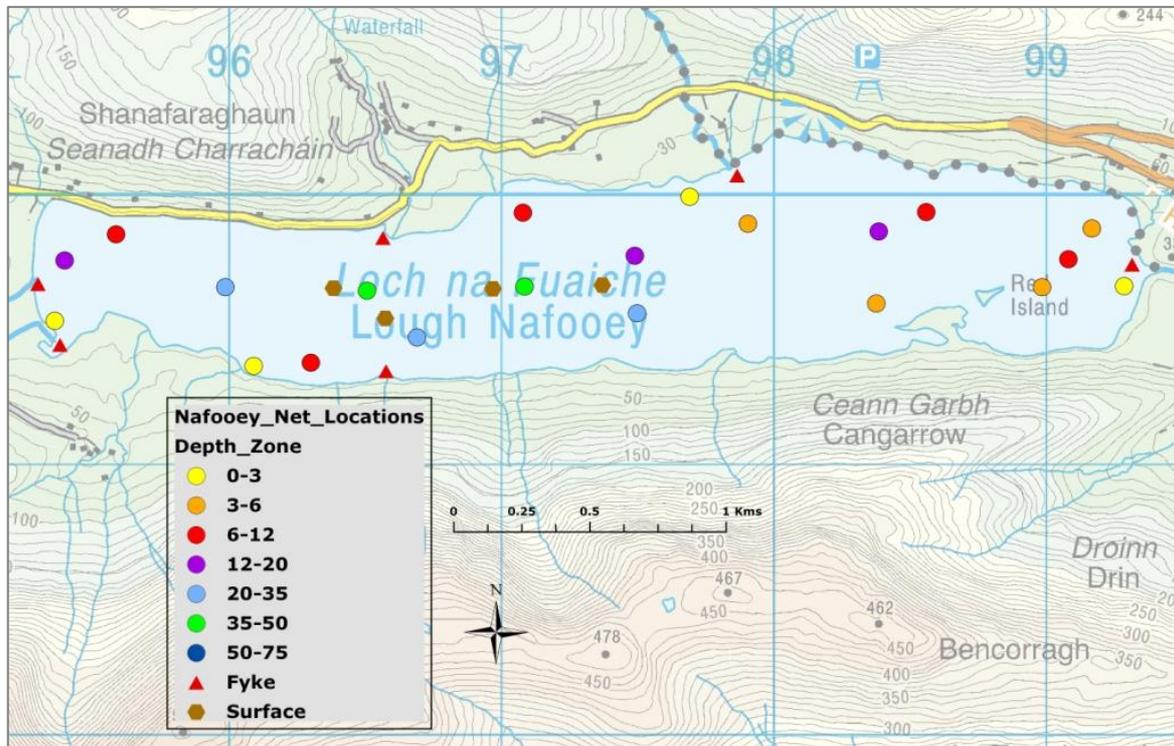


Figure 6.1 Map displaying net locations for Lough Nafooeý.

In total 534 fish were captured on Lough Nafooeý. Perch was the dominant species, followed by roach and arctic char. Brown trout and pike were also recorded during the survey (Table 6.1). This is the first time the lake has been comprehensively investigated using the CEN standard method so no full comparisons can be made with previous surveys.

Table 6.1. Number of each fish species captured by each gear type during the survey on Lough Nafooeý, August 2013.

Scientific name	Common name	Number of fish captured			Total
		Benthic mono multimesh gill nets	Surface mono multimesh gill nets	Fyke nets	
<i>Salmo trutta</i>	Brown trout	5	1	1	7
<i>Salvelinus alpinus</i>	Arctic char	10	5	0	15
<i>Perca fluviatilis</i>	Perch	460	0	21	481
<i>Rutilus rutilus</i>	Roach	15	14	1	30
<i>Esox Lucious</i>	Pike	1	0	0	1

A total of 15 char were netted during the survey (Figure 6.2). The length of fish sampled varied between 6.1 and 27.2 centimetres. The fish in the smaller age categories represent young of the year and therefore indicate recent recruitment. The larger fish present in the sample demonstrate the presence of mature adults and ongoing population regeneration.

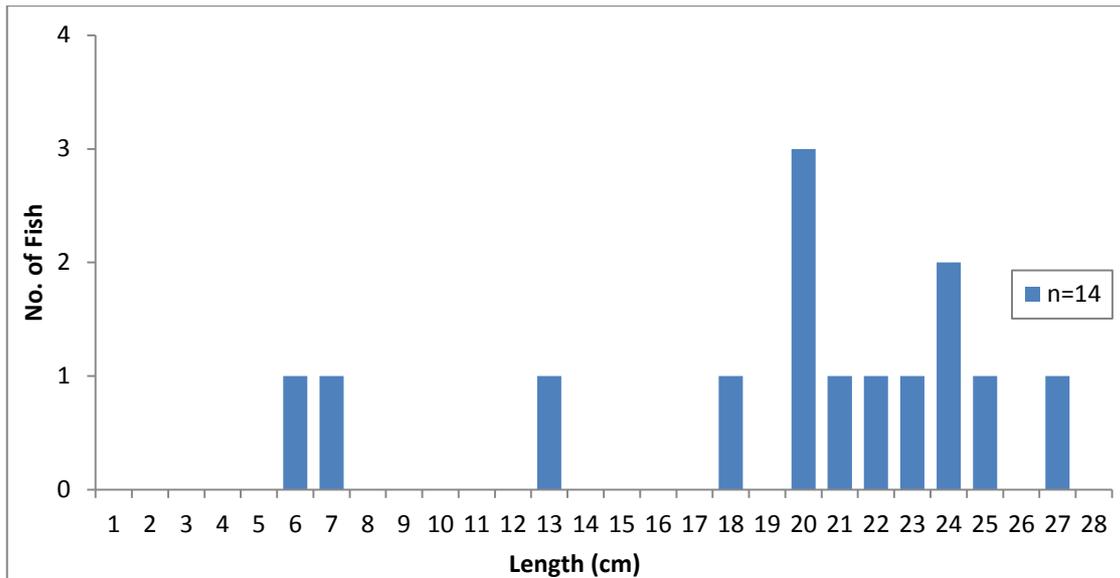


Figure 6.2. Length frequency of char captured in Lough Nafooeey (Lengths were only available for 14 fish, as the remaining fish was damaged and correct lengths could not be obtained).

The dominant species during the survey was perch consisting of 90% of the fish population sampled. The length of perch captured varied between 4 and 29.9 centimetres (Figure 6.3). A number of different size classes were present in large numbers indicating a well-established population of perch.

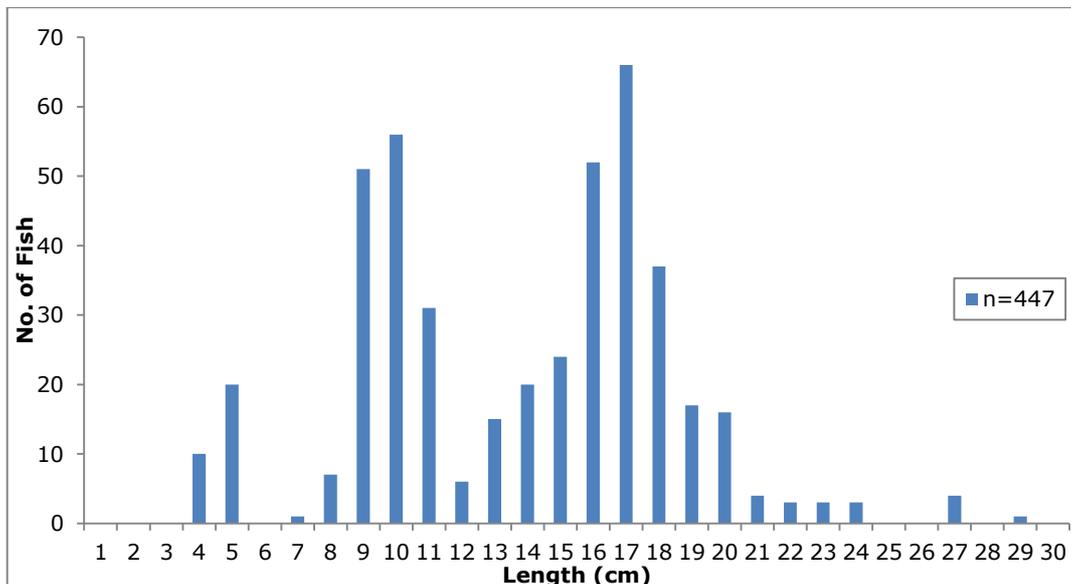


Figure 6.3. Length frequency of perch captured in Lough Nafooeey.

Neither brown trout or pike was represented in high densities during the survey. The length of brown trout varied between 9.6 and 48.5 centimetres. The span of size classes captured would indicate recent and ongoing recruitment. However, the paucity of brown trout captured demonstrates that the lake does not support a large population of trout. One pike measuring 10.6 centimetres was captured.

The length of roach varied between 8 and 22.8 cm (Figure 6.4). As with the previous species, a number of size classes were represented within the roach population. Younger fish indicated recent recruitment and larger fish indicated a recruitment of adult spawning fish.

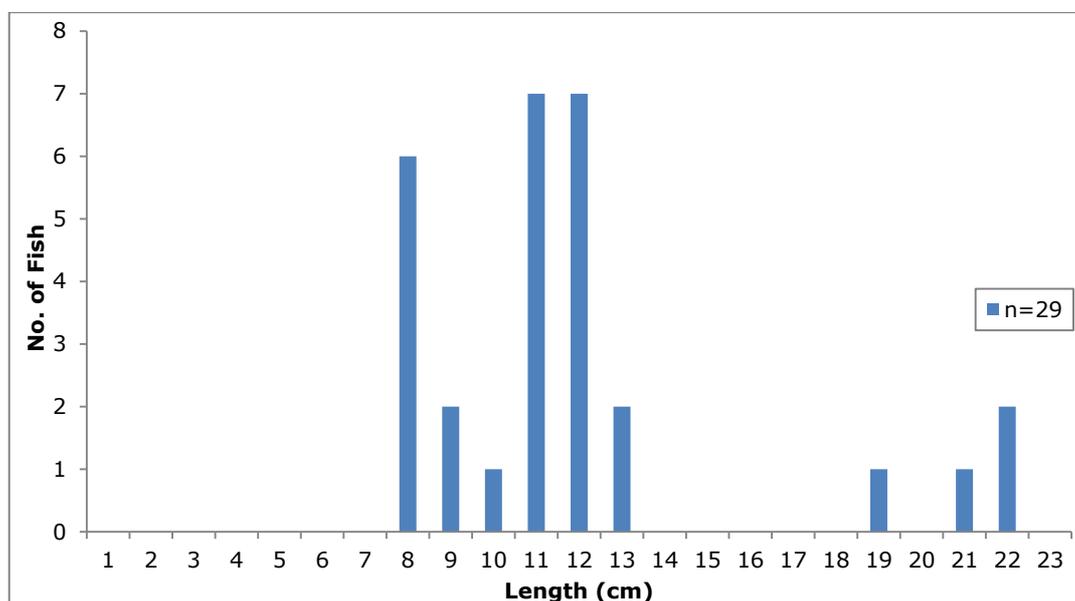


Figure 6.4. Length frequency of roach captured in Lough Nafaoey.

The very well established population of perch could be responsible for out competing the brown trout and arctic char, thus accounting for the poor representation of these species in the overall fish population composition. As there are no recent comprehensive studies of the lake it is difficult to compare and contrast the species structure, and identify if there have been any alterations in the densities of perch, brown trout and arctic char over time. The low densities of brown trout and arctic char would be of concern and ongoing monitoring of the lake should be a priority in order to protect the stocks of arctic char in particular, which is listed as Vulnerable in Ireland.

6.2 Loughs Inchiquin and Uragh/Cloonee Upper

Loughs Inchiquin and Cloonee Upper were surveyed during August 2013 using CEN Standard guidelines for lake monitoring. The lakes are connected *via* the Ameen River. The Ameen River rises in the Coomnadiha Mountain (644m) and flows in an east-south-west direction through two lakes before it reaches Lough Inchiquin, and further downstream Lough Uragh or Cloonee Upper as it is also known. Both lakes surveyed are within the Cloonee catchment on the Beara peninsula in County Kerry which drains an area of 2868 hectares. Lough Inchiquin is larger of the two lakes, 77 hectares and 36 meters deep. Lough Cloonee Upper/Uragh is 42 hectares and 24 meters deep (Figure 6.5). The lakes are closely connected with 1 river kilometre between them. The underlying geology of the area is Old Red Sandstone.



Figure 6.5. Map displaying the proximity of Loughs Inchiquin and Cloonee Upper/Urugh.

Both lakes are located within the **Cloonee and Inchiquin Loughs, Uragh Wood SAC**. One of the qualifying interests is the habitat type

- Oligotrophic waters containing very few minerals of sandy plains (*Littorelletalia uniflorae*)

Arctic char are known to have preference for glacial, oligotrophic waters and are sensitive to an increase in trophic levels.

The fishing rights for both lakes are owned by local angling clubs, and the clubs kindly facilitated the present survey. The lakes were previously surveyed in September 1989 at the request of the local angling clubs by the Central Fisheries Board. During the survey the dominant species of fish were brown trout, followed by char, minnow and eel in both lakes.

6.2.1 Lough Inchiquin

Lough Inchiquin was surveyed over two nights, 26th to 28th August 2013. A total of three sets of Dutch fyke nets, 18 benthic monofilament multi-mesh (12 panel, 5-55mm mesh size) CEN standard survey gill nets (4 @ 0-2.9m, 4 @ 3-5.9m, 5 @ 6-11.9m, 3 @ 12-19.9m and 2 @ 12-34.9m) and four surface floating monofilament multi-mesh (12 panel, 5-55mm mesh size) CEN standard survey gill nets were deployed in the lake (25 sites, Figure 6.6).



Plate 6.2. Lough Inchiquin with Uragh Wood in the background.

A total of 242 fish were captured during the survey, covering four fish species (Table 6.2). Brown trout was the most abundant species followed by arctic char. During the previous survey in 1989, sea trout were also recorded on Lough Inchiquin while none were encountered in the course of this investigation.

Table 6.2. Number of each fish species captured by each gear type during the survey on Lough Inchiquin, August 2013.

Scientific name	Common name	Number of fish captured			Total
		Benthic mono multimesh gill nets	Surface mono multimesh gill nets	Fyke nets	
<i>Salmo trutta</i>	Brown trout	173	7	8	188
<i>Salvelinus alpinus</i>	Arctic char	27	1	0	28
<i>Phoxinus phoxinus</i>	Minnnow	17	0	0	17
<i>Anguilla anguilla</i>	European eel	4	0	5	9

The length of brown trout varied between 6 and 57.5 centimetres (Figure 6.7). The brown trout length-frequency data indicated a number of size classes represented in high numbers. Data from the survey undertaken in 1989 indicated that three brown trout were captured during that survey. It is difficult to make a comparison between fish densities across both surveys as they were undertaken using very different methodologies. The nets used during the 1989 survey used a larger mesh and thus targeted larger fish. The nets used in the 2013 survey targeted all fish sizes in order to give great insight into the overall population structure.

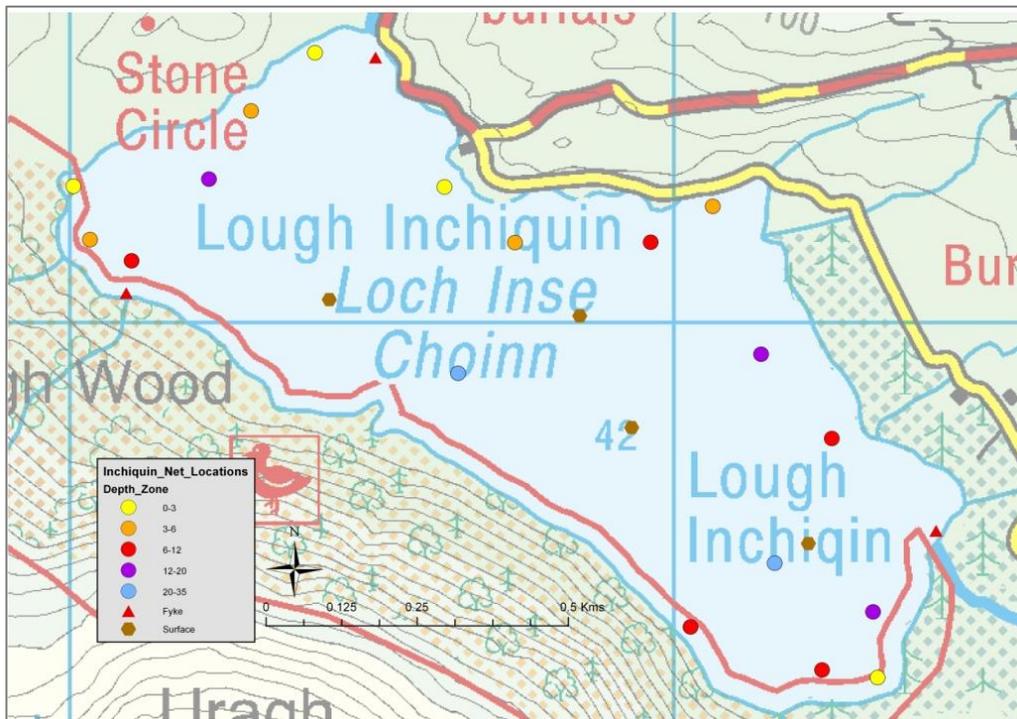


Figure 6.6. Map displaying net locations for Lough Inchiquin.

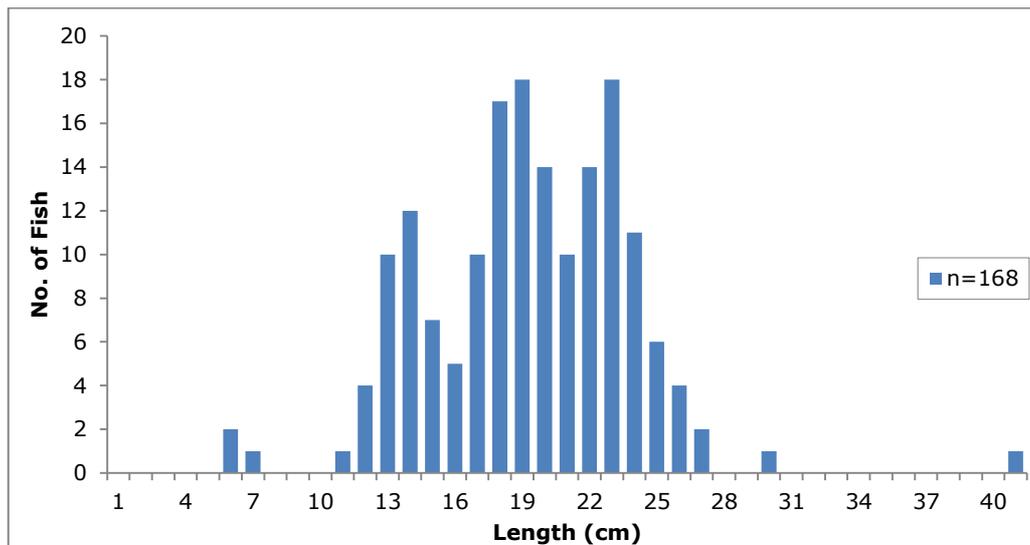


Figure 6.7. Length frequency of brown trout captured in Lough Inchiquin.

The length of arctic char captured varied between 3.9 and 20.9 centimetres (Figure 6.8). The younger and older age classes are represented. However, there is a gap of 10 cm in the results where no fish are represented. This absence of fish within a certain length class does raise cause for concern in relation to ongoing recruitment over the next number of years.

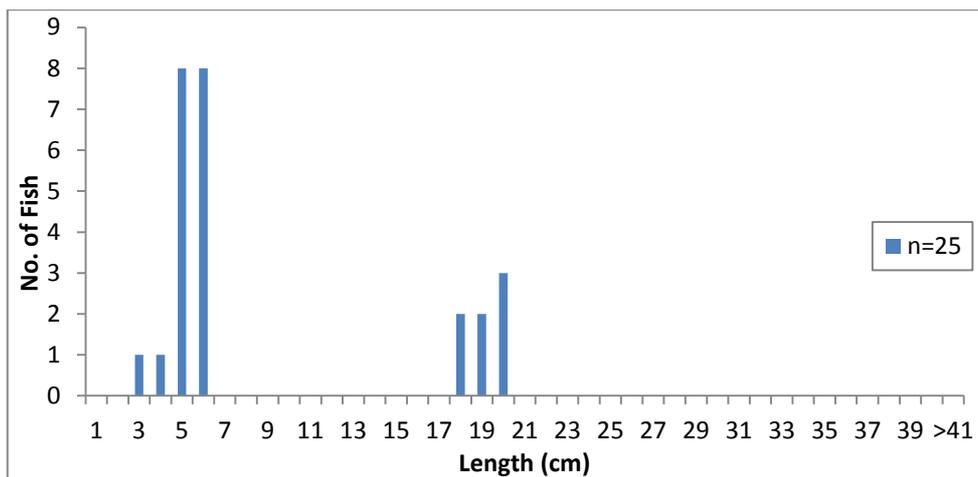


Figure 6.8. Length frequency of char captured in Lough Inchiquin.

The length of minnow recorded varied between 3.9 and 7.3 cm (Figure 6.9). No minnow were recorded during the 1989 survey, due to the mesh size used for sampling.

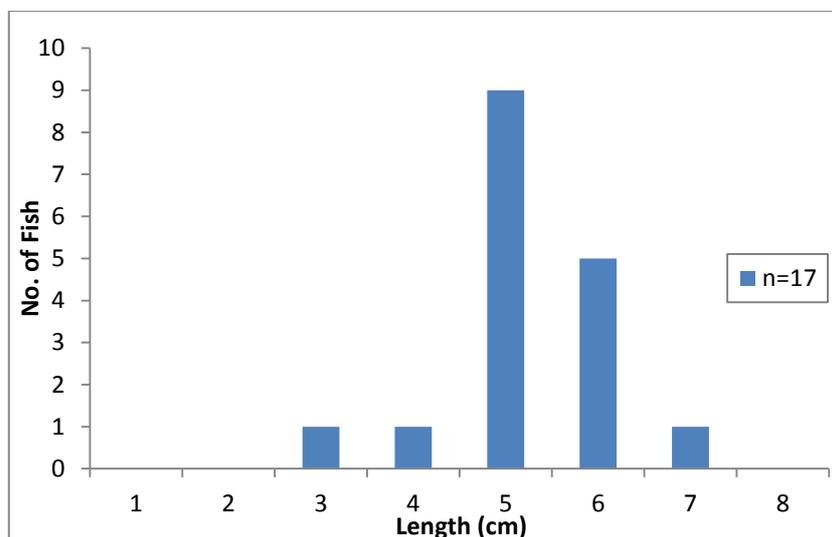


Figure 6.9. Length frequency of minnow captured in Lough Inchiquin.

During the 1989 survey 15 arctic char were captured, compared to 28 arctic char in the 2013 investigation. There was also a difference in the length of fish recorded. During the 1989 survey, the fish measured between 18 and 22 cm, compared to 3.9 to 20.9cm in 2013. The variation is largely due to the nets used. Larger mesh sizes were used in the first net survey which would account for the larger fish recorded. If future surveys are to be undertaken on Lough Inchiquin it is essential that the same type nets and net locations be used as in 2013.

6.2.2 Lough Uragh/Cloonee Upper

Lough Uragh (Plate 6.3) was surveyed over two nights, 26th to 28th August 2013. A total of three sets of Dutch fyke nets, 18 benthic monofilament multi-mesh (12 panel, 5-55 mm mesh size) CEN standard survey gill nets (2 @ 0-2.9m, 2 @ 3-5.9m, 2 @ 6-11.9m, 2 @ 12-19.9m and 2 @ 12-34.9m) and two surface floating monofilament multi-mesh (12 panel, 5-55 mm mesh size) CEN standard survey gill nets were deployed in the lake (19 sites, Figure 6.10).

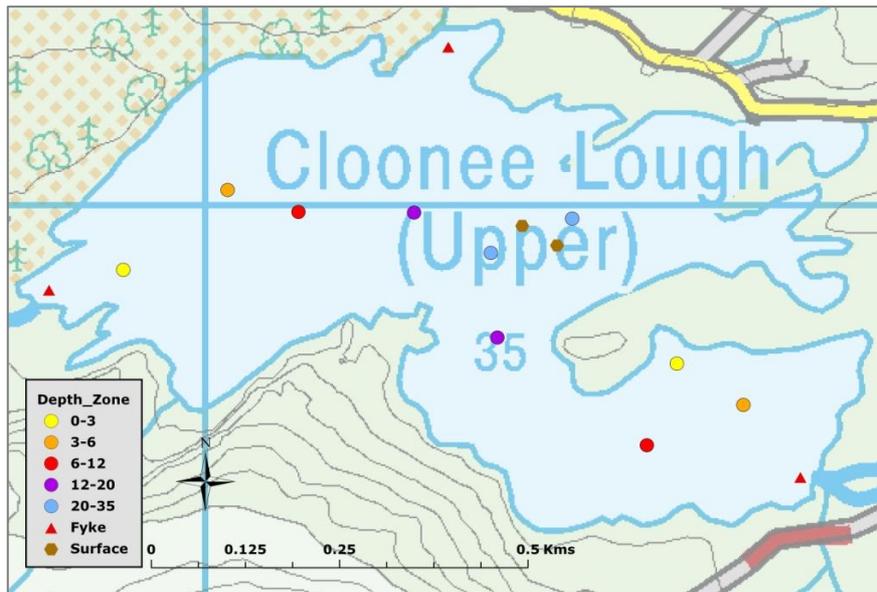


Figure 6.10. Map displaying net locations for Lough Uragh/Cloonee Upper.

As with Lough Inchiquin, the same four species of fish were present (Table 6.3). Brown trout was the dominant species, followed by arctic char. In total 165 fish were captured during the survey. During the 1989 survey, both Ferrox trout and Sea trout were recorded, neither of which were identified in the 2013 survey.



Plate 6.3. Lough Uragh/Cloonee Upper.

Table 6.3. Number of each fish species captured by each gear type during the survey on Lough Cloonee Upper, August 2013.

Scientific name	Common name	Number of fish captured			Total
		Benthic mono multimesh gill nets	Surface mono multimesh gill nets	Fyke nets	
<i>Salmo trutta</i>	Brown trout	84	10	1	95
<i>Salvelinus alpinus</i>	Arctic char	37	2	0	39
<i>Phoxinus phoxinus</i>	Minnow	23	0	0	23
<i>Anguilla anguilla</i>	European eel	0	0	8	8

The lengths of brown trout recorded varied between 8 and 38 cm (Figure 6.11). The length frequency distribution indicates a population of trout containing a range of all age classes. The

smaller sizes captured demonstrate ongoing recent recruitment. When surveyed in 1989, 19 brown trout were encountered.

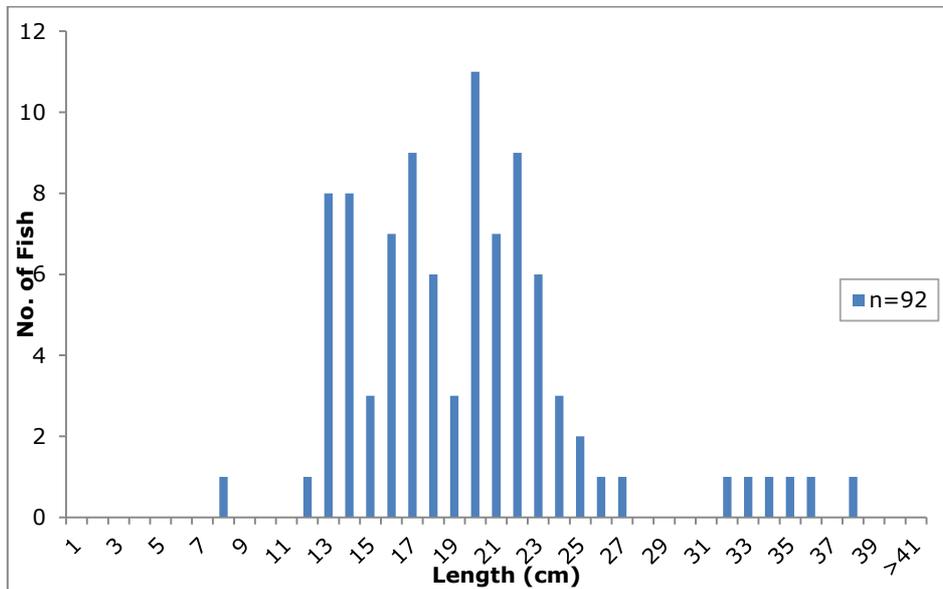


Figure 6.11. Length frequency of brown trout captured in Lough Cloonee Upper/Uragh.

The lengths of char recorded during the survey varied between 5.1 and 33.6 cm (Figure 6.12). All size classes were represented in the sample obtained. The presence of a number of peaks in the size distribution would indicate several age classes. The presence of smaller individuals (5 – 6 cm) indicated recent recruitment. Mature, larger fish were also obtained indicating ongoing recruitment. When surveyed in 1989, 10 arctic char measuring between 20 and 24 cm were recorded.

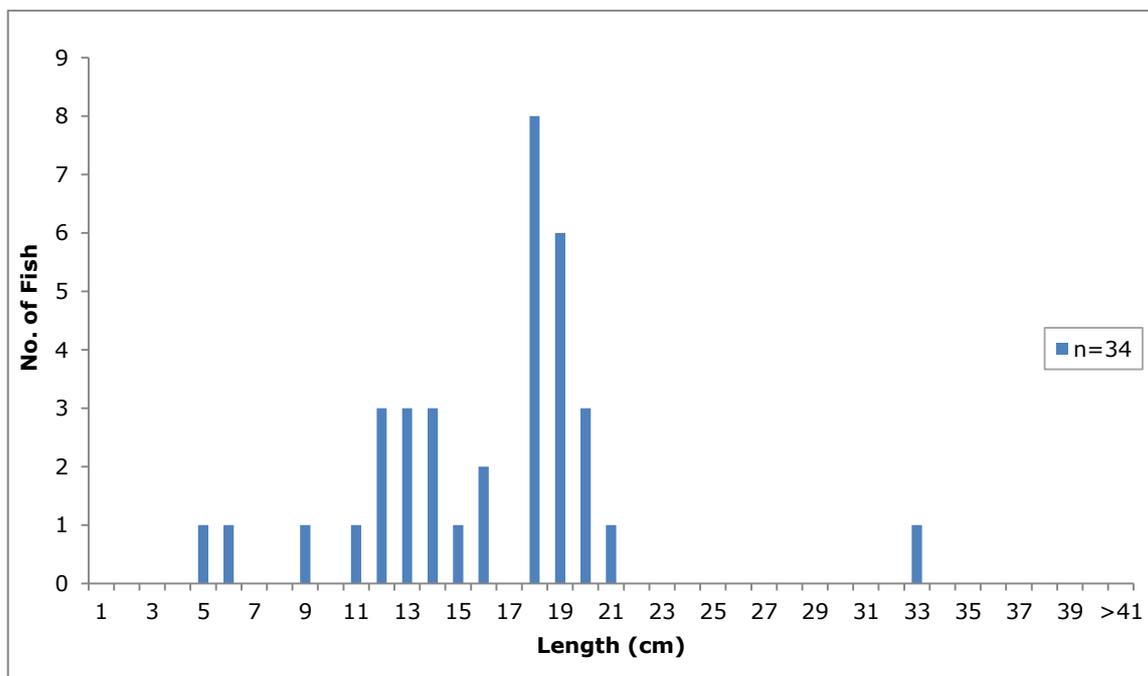


Figure 6.12. Length frequency of char captured in Lough Uragh/Cloonee Upper.

The length of minnow captured varied between 5.2 and 7.7 centimetres (Figure 6.13).

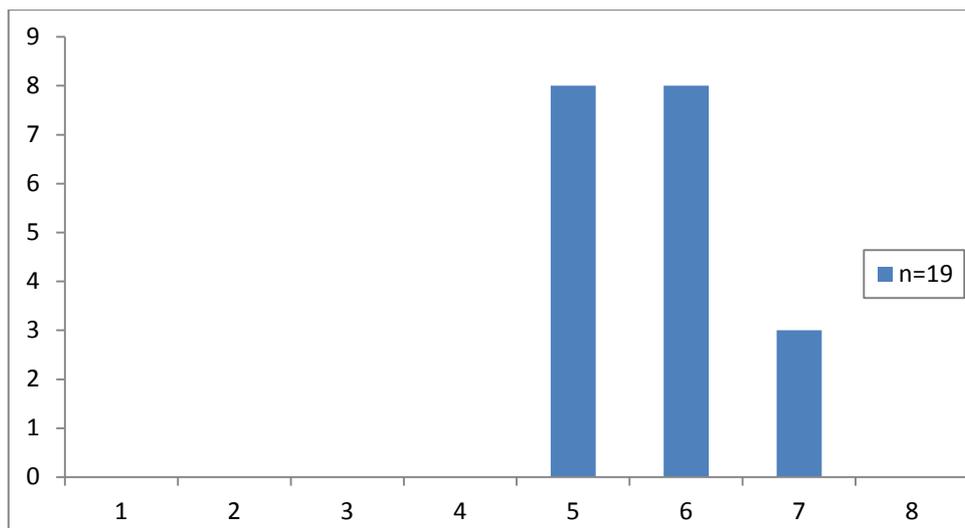


Figure 6.13. Length frequency of minnow captured in Lough Uragh/Cloonee Upper.

Both Inchiquin Lake and Uragh Lake appear to support a good population of both brown trout and char. Both species were present in high densities with a number of size classes observed. The presence of young of the year through to mature adults indicated ongoing recruitment which is essential to maintain healthy populations of brown trout and char.

The number of nets deployed in 1989 was far fewer than those in 2013. The nets in the 1989 survey were specifically targeting larger fish, compared to the shorter multi mesh nets used in the 2013 survey.

6.3 Muckross Lake

Muckross Lake is located within Killarney National Park. There are three main lakes in the Killarney National Park, Upper Lake, Middle/Muckross Lake and Lower/Leane. Muckross is the deepest of the three lakes and also one of the deepest lakes in Ireland. The maximum depth recorded during the survey was 71 meters, the area of the lake is 266 hectares, the middle sized of the three lakes (Plate 6.4). Killarney National Park has been designated an SAC under the Habitats Directive for a number of species and habitat types. Of relevance to IFI are the three lamprey species and also Killarney shad. Populations of char are reported to be present in Muckross Lake, the only one of the three lakes known to support a population. The lake is supplied from Upper Lake, which passes through the Long Range and enters Muckross Lake at Dinish Cottage. Muckross Lake is connected to Lough Leane through Brickeen Bridge. The lake lies on a geological boundary with Devonian sandstone mountains to the south and west (maximum height 840 meters) and Carboniferous limestone to the north.



Plate 6.4. Lough Muckross, September 2013.

Muckross Lake was surveyed over four nights, 9th to 13th September 2013. A total of six sets of Dutch fyke nets, 21 benthic monofilament multi-mesh (12 panel, 5-55mm mesh size) CEN standard survey gill nets (5 @ 0-2.9m, 6 @ 3-5.9m, 5 @ 6-11.9m, 4 @ 12-19.9m, 4 @ 12-34.9m, 3 @ 35-49.9m and 3 @ 50-74.9m) and six surface floating monofilament multi-mesh (12 panel, 5-55mm mesh size) CEN standard survey gill nets were deployed in the lake (42 sites, Figure 6.14). In total seven species were recorded during the survey, perch being the dominant species followed by brown trout (Table 6.4). Perch comprised 45% of the fish numbers sampled, followed by brown trout 44%. A flounder was captured in one of the benthic nets, the species being commonly found in Lough Leane, despite the long distance from estuarine or saline water.

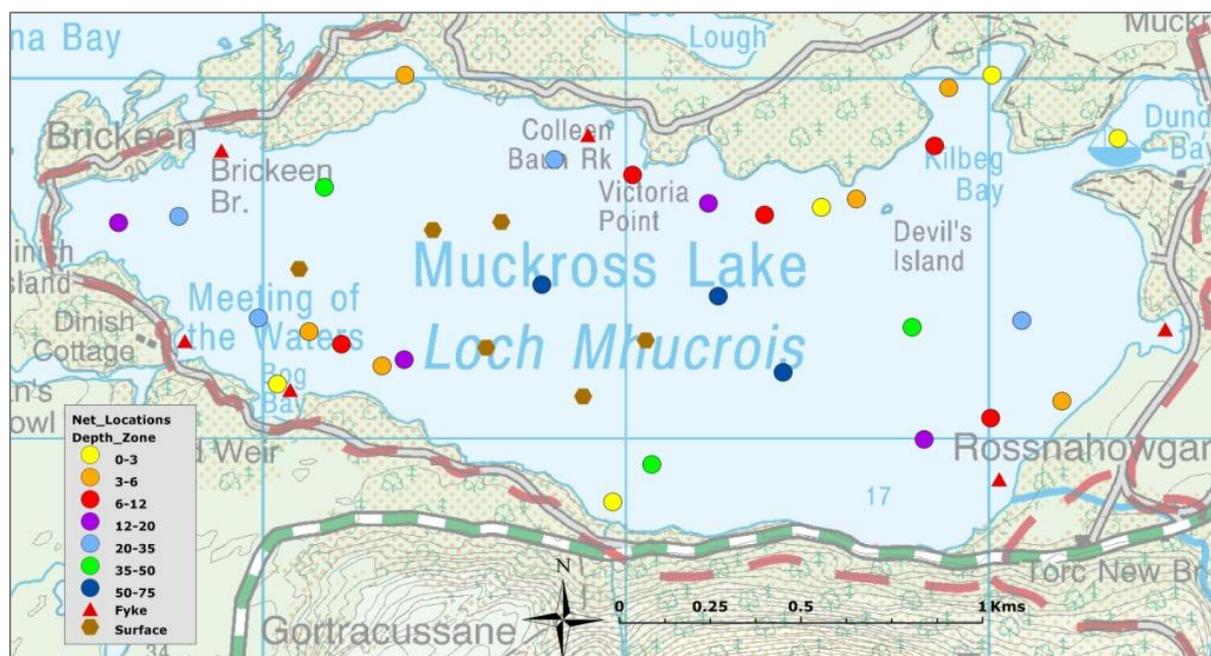


Figure 6.14. Map displaying net locations for Lough Muckross.

Table 6.4. Number of each fish species captured by each gear type during the survey on Lough Muckross, September 2013.

Scientific name	Common name	Number of fish captured			Total
		Benthic mono multimesh gill nets	Surface mono multimesh gill nets	Fyke nets	
<i>Salmo trutta</i>	Brown trout	154	6	13	173
<i>Salvelinus alpinus</i>	Arctic char	3			3
<i>Scardinius erythrophthalmus</i>	Rudd	9		3	12
<i>Perca fluviatilis</i>	Perch	126		52	178
<i>Platichthys flesus</i>	Flounder	1			1
<i>Salmo salar</i>	Salmon	1			1
<i>Anguilla anguilla</i>	European eel			25	25

The length of brown trout captured varied between 13.9 and 52.5 centimetres (Figure 6.15). The lack of fish in the smaller size categories could be slight cause for concern as it could indicate lack of recent recruitment. No young of the year fish were identified in the sample collected.

Only three char were encountered during the fish stock assessment. These fish varied between 6.2 and 16.3 centimetres. This reflects a very poor representation by char within the population structure. Two of the fish were <10 centimetres which would indicate recent recruitment. On the opposite end of the scale, only one larger fish was captured, which would cause concern for the future of the char population. The Irish Char Conservation Group (ICCG) conducted a survey of Muckross Lake in 2002. During this survey 36 char were captured. The survey was not conducted using the CEN method and so they cannot be compared. However, the extremely low numbers of char captured during the most recent survey would indicate a population reduction.

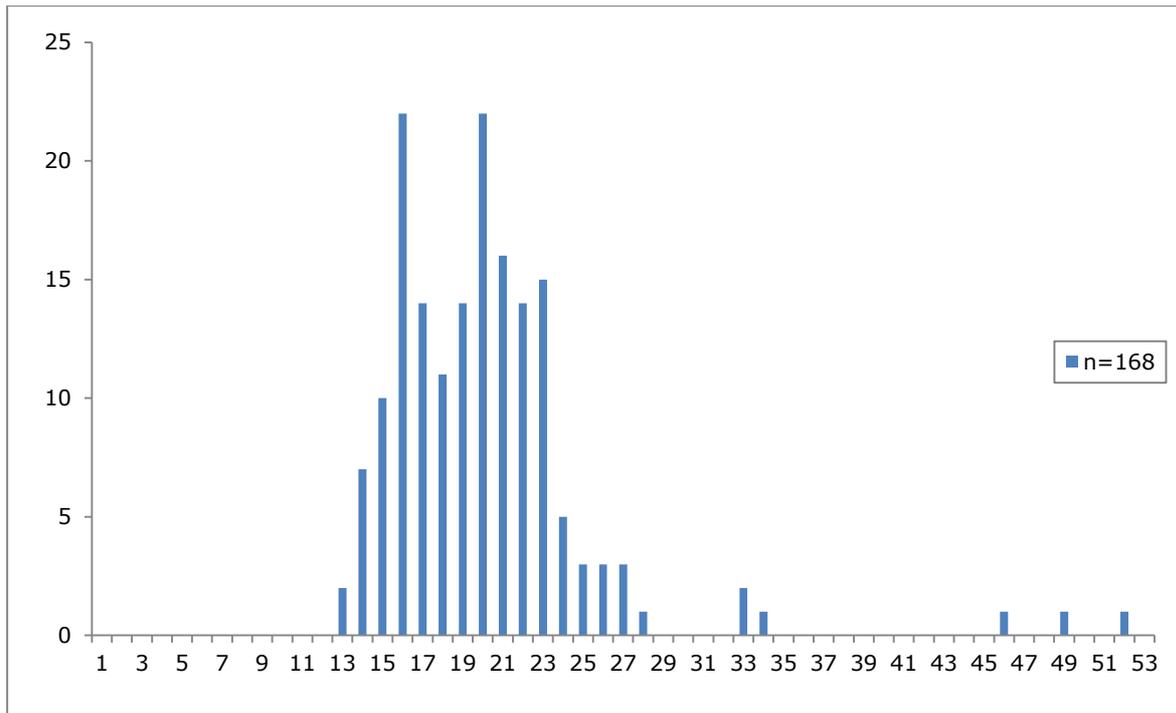


Figure 6.15. Length frequency of brown trout captured during September 2013.

The size of perch recorded varied between 6.1 and 26.5 centimetres. This indicates a well-established population with a number of different size classes represented (Figure 6.16). According to the ICCG report, three perch were recorded during the 2002 survey. Given the difference in methodology between the two lake surveys, it is hard to make a comparison between both samples. The low numbers recorded would suggest that in the last 12 years there has been a proliferation in the number of perch in the lake. As a possible consequence there has been a decrease in the population of char.

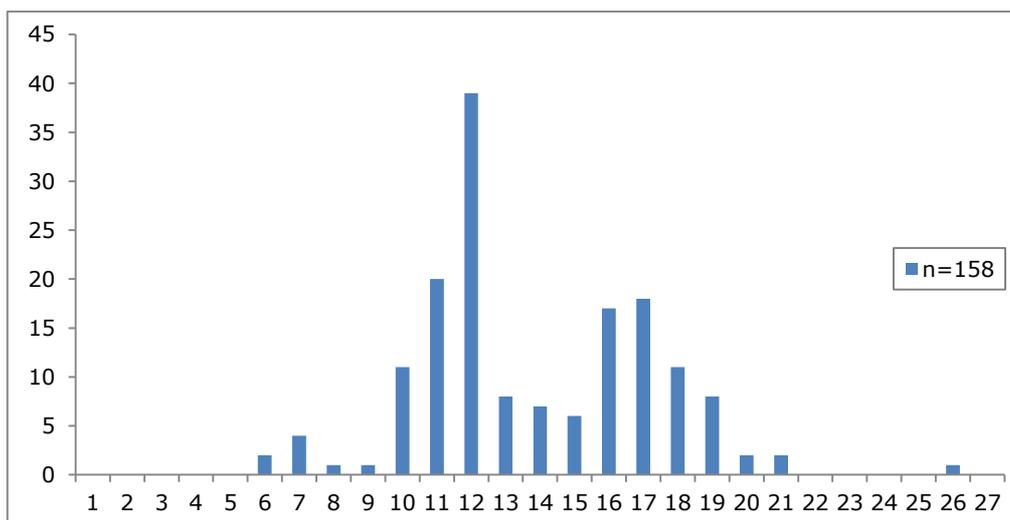


Figure 6.16. Length frequency of perch captured during September 2013.

In total 25 eels were captured during the survey. The length of fish varied between 35.7 and 53 centimetres (Figure 6.17). All fish were caught in fyke nets.

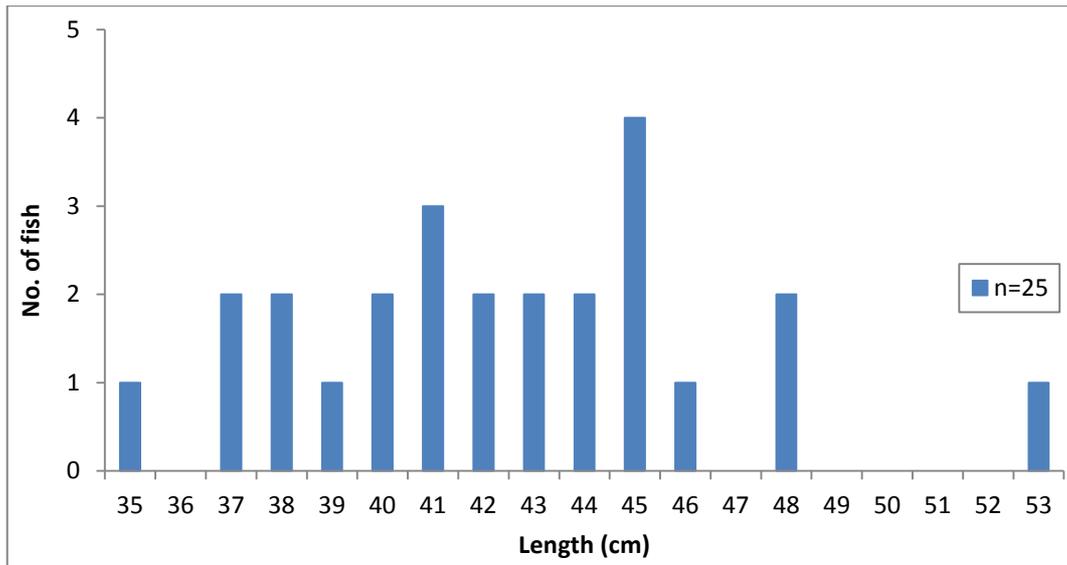


Figure 6.17. Length frequency of eel captured during September 2013.

The incidence of eel is not a major surprise. This species has been commonly captured in gill nets during previous IFI netting surveys on the adjoining Lough Leane. It is highly unusual for IFI staff to encounter eel in gill nets – pointing to a large population of the species in Lough Leane.

The scale reading of brown trout indicated the oldest fish was captured on Inchiquin, these were also the fastest growing fish (Figure 6.18). There is little difference in the growth rates between the four lakes in the first three years. After this a slightly slower growth rate was evident in the Lough Muckcross fish.

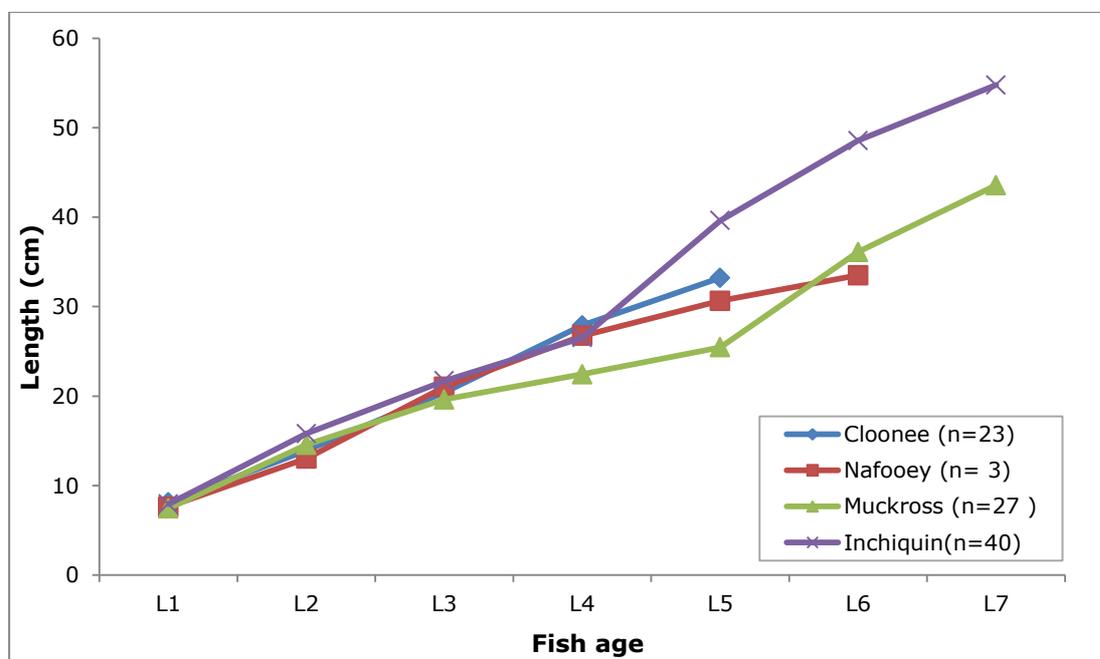


Figure 6.18. Comparison of growth rates of brown trout across the four lakes sampled during 2013.

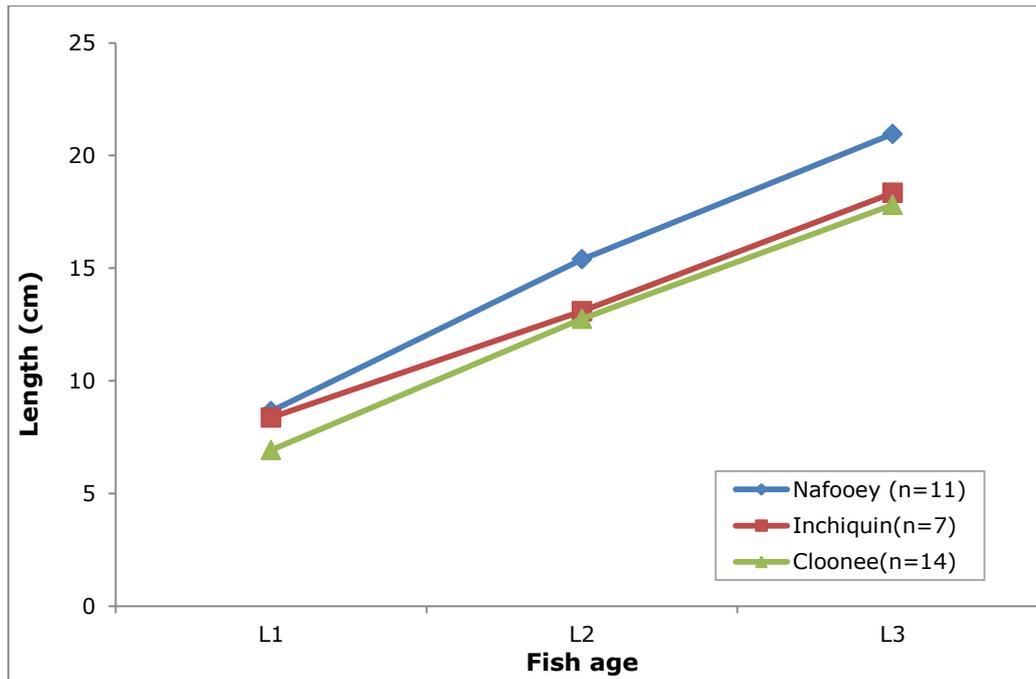


Figure 6.19. Comparison of growth rates of char across the three lakes sampled during 2013.

Similar growth rates were displayed by char across the three lakes with data available (Figure 6.19). A slightly faster growth rate was displayed in results from Lough Nafooey. Only three young of the year fish were captured on Lough Muckcross, no scales were available from these for aging.

7. Looking Forward

The Article 17 reporting to the EU for June 2013 was important to the Habitats team in bringing together information on distribution and status of the relevant species over the period from 2009, when the present IFI programme began, to 2013. In addition, the process was valuable in identifying gaps and shortcomings in the surveillance processes used to date and in flagging conservation status issues.

Lamprey: From 2009 to 2012 the juvenile lamprey monitoring process followed the earlier lead of the NPWS, in undertaking catchment-wide surveys on distribution, status and population structure and density. Over the current 6-year reporting cycle it is intended to confine the catchment-wide surveys to the lamprey SACs. These have been surveyed previously in the 2003 – 2006 period and the new round of surveys will provide a temporal review of status. This survey requirement is no small task, given that large catchments such as the Corrib, Moy, and Suir etc. are included. A good start was made in 2013 with the Corrib and Feale (Lower Shannon SAC) being surveyed. In 2014 and the following years it is intended to survey a 'large' and a 'small' SAC in each year.

In addition to these catchment-wide surveys, a series of Index or Reference channels has been selected by the team. It is intended that each of these will be surveyed for lamprey ammocoetes at least every second year over the 6-year cycle. The EU supporting documentation on Article 17 stressed the importance of 'trends' and it considered that a trend graph for any water with three points examined in a 6-year cycle will be more informative than a graphic where points are recorded once in a 6-year period. The Index channels have been selected to represent a range of geological, topographic, stream order and water quality and quantity variables, distributed across the country. One Index channel has been selected within each of the lamprey SACs. Further Reference channels have been selected in catchments where good lamprey status was reported and where substantial ammocoete habitat was available. Additional channels were selected where ammocoete status was poor, despite presence of suitable habitat. Channels were selected to have sufficient length to contain between 5 and 8 sampling stations. A standard sampling protocol is to be implemented at each sampling station. It is felt that this dual process will provide a solid platform to address the issue of 'trends' when reporting in Article 17 in 2018.

At this stage, float-over surveys to assess sea lamprey status, based on spawning activity, have been undertaken throughout the network of SAC catchments. In the large SACs of the south-east these surveys have been undertaken on repeat occasions. A notable feature has been the impact of major barriers – principally weirs – in impeding sea lamprey penetration into these rivers. In other cases, the paucity of adult sea lamprey encountered is a cause for concern – as is the virtual absence of sea lamprey ammocoetes in catchment-wide surveys. Two strands will be pursued during 2014. On the one hand, the traditional float-over survey, using canoes and kayaks and

working with local RBD staff, will be undertaken on specific waters. In addition, a short-list of 'hot-spots' has been compiled. These are locations where sea lamprey spawning tends to be confined to relatively short sections or areas of a channel, where sea lamprey spawning tends to occur annually and where the entire sector can be relatively easily accessed for staff to record spawning effort. It is proposed to visit these hot-spots on an annual basis and this will provide a 'trend' data set on annual effort at the specific locations. IFI is conscious of a need to give a major priority to sea lamprey in regard to identifying and implementing measures to facilitate migration into extensive areas of freshwater. There is also a requirement to elucidate the habit of sea lamprey ammocoetes, given their low level of occurrence in sampling programmes.

Examination of lamprey ammocoetes by eye cannot distinguish between the river and brook lamprey. It is proposed to undertake a series of walkover surveys to search for evidence of river lamprey spawning, commencing in the Boyne SAC in 2014. Successful sightings will enable information to be compiled on the attributes of spawning sites and the habits of river lamprey at these sites.

Shads: Reference has been made in previous annual reviews to the need for having sampling procedures that generate results and that provide consistency, repeatability and replicate generation. The trials with bongo-netting (zooplankton-type trawling) for post-larval shad have proved to be repeatable and findings from 2010-2013 have been encouraging. However, numbers of fish captured has been low and, in some cases, no fish have been taken. This has been the case even when adult fish were found at spawning time in characteristic spawning locations. The basic protocol will be continued during the current cycle. However, additional sampling to test the robustness of the current sampling protocol will be undertaken in the Barrow estuary, where the largest spawning population appears to occur.

The use of telemetry to examine adult shad in the Waterford Harbour – Suir – Nore – Barrow complex commenced in 2012 and continued in 2013. The outcomes have been very interesting with results in 2012 showing a pattern of movement of the adult fish up to the St. Mullins spawning ground on the River Barrow. In 2013, the telemetry study confirmed this movement pattern on both the Barrow and Munster Blackwater estuaries. The programme also pointed to substantial degrees of movement of the adult fish in the more downstream estuarine areas following spawning. In the short term, the Habitats project proposes to establish an array of listening stations in Waterford Harbour and the 'Three Sisters' estuaries in order to monitor adult shad movements both during the spawning season and also during the post-spawning period when adult fish drop down into Waterford Harbour and re-commence feeding. It is hoped that the array can detect fish that may migrate out of the estuary into the open sea. The establishment of such an array is intended to synergise with other IFI projects involving telemetry, notably in regard to bass and European eels. The current programme has been synergising with the IFI National Eel Programme from the outset, with tagged eel and tagged shad activating the listening stations in the estuarine Barrow.

Pollan: A combined hydroacoustics – ground truthing strategy has been developed by IFI’s Water Framework Directive fish survey team and this has been rolled out in several large lakes, including the pollan lakes of Lough Derg and Lough Ree on the Shannon. At present one of the WFD team is undertaking field work for a doctoral thesis examining the two techniques and developing protocols to reduce the need for destructive sampling of rare fish species such as the pollan, char and Killarney shad. The Habitats team is working in tandem with the WFD team in addressing the status of these three species. It is evident that hydro acoustic surveys in winter may be valuable in possibly identifying aggregation of spawning pollan and thereby identifying likely spawning areas. Targeted netting combined with hydro acoustics was successful in Lough Ree in December 2013 and a similar combination approach with gears and teams is planned for summer 2014 in regard to pollan on Lough Allen.

The Habitats team also proposes to undertake further annual springtime sampling for post-larval pollan in the large Shannon lakes using bongo-netting in the 2014-18 period.

Char: Sampling of char will continue in 2014, using the standard multi-mesh gill net approach as used by IFI’s WFD team. Lakes have been selected for sampling in May 2014 in Connemara - the timing being arranged with local IFI RBD staff in order to minimize adverse impacts on sea trout movements and on descent of salmon smolts to sea. A further set of lakes have been selected in west Kerry for late summer sampling.

Smelt: In addition to the synergies with the post-larval shad surveying in July - August, an earlier round of bongo netting has been scheduled for April in 2014 specifically to look for evidence of recruitment and dispersal of post-larval smelt. Autumn trawl sampling has also been scheduled for smelt. This survey should also generate young-of-year samples of shad as well as smelt.

Project Personnel and Acknowledgements

The IFI R&D team involved in the Habitats Directive and Red Data Book fish investigations during 2013 comprised Dr. James King, Ms. Nicola O’Gorman, Dr. Sean Rooney and Mr. Daniel Cierpial.

In all waters surveyed, the team received full support from our colleagues within the individual IFI River Basin Districts (RBD) and thanks are due to the RBD Directors and their Inspectors, who organised logistics and support, and to officers within each area where surveys were undertaken.

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References

European Commission. 1992. Directive 92 / 43 / EEC of the European Parliament and the Council of 21st May 1992 on the conservation of natural habitats and of wild fauna and flora. *Official Journal of the European Communities* **L 206**: 7-50.

Harrison, A.J., Kelly, F.L., Rosell, R.S., Champ, T.W.S., Connor, L. and Girvan, J.R. (2010) First record and initial hydroacoustic stock assessment of pollan *Coregonus autumnalis* Pallas in Lough Allen, Ireland. *Biology and Environment: Proceedings of the Royal Irish Academy* 110B, 69-74.

Harrison, A.J., Connor, L., Morrissey E., and Kelly, F.L. (2012) Current status of pollan *Coregonus autumnalis* pollan in Lough Ree, Ireland. *Biology and Environment: Proceedings of the Royal Irish Academy*. 112B, 1-9.

Igoe, F., O'Grady, M.F., Tierney, D. and Fitzmaurice, P. (2003) Arctic char *Salvelinus alpinus* (L) in Ireland – a millennium review of its distribution and status with conservation recommendations. *Biology and Environment: Proceedings of the Royal Irish Academy*, 103B, 9–22.

King, J. J. and Roche, W. K. (2008) Aspects of anadromous Allis shad (*Alosa alosa* Linnaeus) and Twaite shad (*Alosa fallax* Lacepede) biology in four Irish Special Areas of Conservation (SACs): status, spawning indications and implications for conservation designation. *Hydrobiologia* 602, 145 – 154.

Kurz, I. And Costello, M. J. 1999 An outline of the biology, distribution and conservation of lampreys in Ireland. *Irish Wildlife Manuals*, No. 5, 27pp, Dublin, Duchas – The Heritage Service.

O'Connor W. (2006) A baseline survey of juvenile lamprey populations in the River Feale catchment. *Irish Wildlife Manuals* No. 22. National Parks and Wildlife Service. Dept. of Environment, heritage and local Government, Dublin.

Rooney, S.M., O' Gorman, N.M., Greene, F. and King, J.J. (2013) Aspects of brook lamprey (*Lampetra planeri* Bloch) spawning in Irish waters. *Biology and Environment : Proc. R. Ir. Acad.* 113B, 13-25.