National Programme: Habitats Directive and Red Data Book Fish Species

Summary Report

2017

IFI/2019/1-4464

Iascach Intíre Éireann
Inland Fisheries Ireland

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Habitats Directive and Red Data Book Fish species 2017:

Summary Report

1. Introduction

The Habitats Directive team carries out surveillance monitoring of Annex II/V fish species on behalf of the Department of Communications, Climate Action and Environment (DCCAE). The conservation status of these species is assessed every 6 years under Article 17 of the Directive, and 2017 constitutes year 5 in the current reporting cycle. Seven Annex II and/or Annex V fish species are monitored (Table 1.1), in addition to 2 conservation species which are listed in the Red Data Book (King *et al.* 2011).

A total of 152 sites were visited as part of the catchment-wide electrofishing surveys for larval lamprey on the Barrow and Mulkear SAC rivers. This was followed by an annual survey of SAC and non-SAC reference channels with the long-term objective of monitoring trends in distribution, densities and population structure of larval lamprey. Spawning activity, with a focus on sea lamprey, was investigated by repeat visits to a number of well-established spawning hotspots to record redd building over time. Once the spawning period had elapsed, float-over surveys for redd counts were conducted on the main channels of a number of rivers, including the Nore, Suir, Laune and Moy, in addition to a walk-over survey of the Mulkear river.

Table 1.1. Fish species monitored under the Habitats Directive and Red Data Book.

	Habitats Directive	Red Data Book
Sea Lamprey (*Petromyzon marinus*)	Annex II	Near threatened
River Lamprey (*Lampetra fluviatilis*)	Annex II, V	Least concern
Brook Lamprey (*Lampetra planeri*)	Annex II	Least concern
Twaite Shad (*Alosa fallax fallax*)	Annex II, V	Vulnerable
Killarney Shad (*Alosa fallax killarnensis*)	Annex II, V	Vulnerable
Pollan (*Coregonus autumnalis*)	Annex V	Vulnerable
Arctic Char (*Salvelinus alpinus*)	-	Vulnerable
Smelt (*Osmerus eperlanus*)	-	Least concern

Given its migratory life cycle, living at sea and returning to freshwater for a short period of time to spawn, the focus of twaite shad investigations has been on the monitoring of the juvenile life stages. As part of the National Bass Conservation Programme, beach seine netting surveys were carried out at a number of locations in the Barrow and Slaney estuaries, two SACs for twaite shad. Kick sampling for shad eggs at potential spawning locations is an established technique for examining population spatial extent (CSM 2015). In 2017, this method was successfully trialled at the upper tidal limits of the River Barrow (St Mullins) and River Nore (Inistioge), where annual spawning populations of twaite shad have been observed. For quality assurance purposes, eggs obtained from both locations were genetically tested and confirmed as shad eggs. This sampling strategy will be used to identify possible spawning sites on the Munster Blackwater and Suir rivers in 2018 and has the potential to become an integral part of the Habitats Directive monitoring programme for twaite shad.

An acoustic telemetry study, initiated in 2012, to investigate the behaviour of adult twaite shad during the spawning period was continued in 2017. An array of acoustic receivers was deployed in the

transitional waters of the Barrow-Nore and Suir, with an additional array in the Munster Blackwater (as part of the Eel Monitoring Programme). Unlike 2016, when it was difficult to source shad of a suitable size (>500g), 17 fish were tagged in the current study and results to date have given a greater insight into movement patterns of this species within the estuarine habitat.

The Habitats Directive team is also responsible for assessing the conservation status of the non-migratory Killarney shad, which is confined to Lough Leane in Co. Kerry. In 2017 data on Killarney shad were obtained from a general fish stock assessment survey of Lough Leane, as part of a 3-year Water Framework Directive (WFD) surveillance monitoring programme for the lake.

A campaign of seasonal sampling for pollan, using a pelagic netting technique, was commenced in 2015, the aim being to use this sampling strategy in the three lakes in the Republic where pollan are known to occur. In previous years, pollan data were obtained from summer, autumn and winter surveys of Lough Allen and Lough Ree and the Lough Derg sampling in 2017 completed this programme

Surveys for arctic char are carried out annually to get a contemporaneous overview of its distribution and status in Ireland's deep water lakes. While four lakes in Kerry and Donegal were earmarked for sampling in the current reporting period, inclement weather restricted survey work to two lakes (Loughs Anscaul and Coomasaharn) in Co. Kerry.

Of significance in reporting on conservation status for Article 17 is the identification of pressures that may be impacting on the distribution and ecology of Annex II/V fish species. Given the migratory life history of river lamprey, sea lamprey and twaite shad from the marine environment to freshwater to spawn, barriers, in the form of weirs, bridge floors and culverts, can be a major impediment to upstream movement. In 2017 passability surveys of weirs were carried out on the main stems of the Nore and Suir and on the Feale and Mulkear rivers located in the Lower River Shannon SAC. These surveys are part of a programme to survey all potential barriers to sea lamprey migration in SAC rivers by 2018.

The dissemination of information is an important aspect of IFI's research work and the team presented at the annual Freshwater Biologists Meeting in Dundalk IT in 2017 as well as at a renewable energy and fisheries conference hosted by the Institute of Fisheries Management in Newport, Wales. The Research and Development page of IFI's website provides general and project-related information on the numerous fish species of interest (https://www.fisheriesireland.ie/Research-and-Development/fish-species.html) and up-dated information on allis, twaite and Killarney shad was included in 2017. The Habitats Directive team presented findings from the Suir catchment-wide larval lamprey survey (2016) and the pollan seasonal surveys of Loughs Allen (2015) and Ree (2016) to IFI colleagues in Clonmel and Drumsna respectively.

2. Lamprey Programme

2.1 Larval Lamprey Investigations

2.1.1. Barrow Catchment Wide Survey

At 192km the River Barrow is the second longest river in Ireland draining a total area of 3,025km^2. It rises in Old Red Sandstone in the Slieve Bloom mountains of Co. Laois and flows through Kildare, Carlow, Kilkenny, Waterford and Wexford. The catchment is dominated by limestones in the northern and western sections, with granites dominating the eastern side of the catchment. The Barrow main channel is navigable for 68km between Athy Co. Kildare and the tidal limit at St Mullins Co. Carlow, where a series of constructed canal cuts serve to bypass shallow impassable sections of river. Major towns in the catchment include New Ross, Graiguenamanagh, Athy, Portlaoise, Mountmellick, Portarlington, Monasterevin and Kildare, with Carlow being the largest urban centre.

The Barrow catchment forms part of the River Barrow and River Nore SAC which incorporates the freshwater stretches of both river catchments and also includes the tidal elements and estuary as far down as Creadun Head in Waterford. Species of conservation concern in this SAC include the freshwater pearl mussel (*Margaritifera margaritifera*), white-clawed crayfish (*Austropotamobius pallipes*), sea lamprey (*Petromyzon marinus*), river lamprey (*Lampetra fluviatilis*), brook lamprey (*Lampetra planeri*), twaite shad (*Alosa fallax*), Atlantic salmon (*Salmo salar*) and the Nore freshwater pearl mussel (*Margaritifera durrovensis*).

Plate 2.1. View of River Barrow at Clashganna.

Water quality is an issue in the River Barrow with 57% of river water bodies and 50% of transitional water bodies failing to achieve good ecological status in the 2010 – 2015 assessment (EPA 2017). Despite these findings, the Barrow showed a net improvement in ecological status from the previous assessment in 2007 – 2009. Moderate or poor ecological status channels were reported for the mid to lower western sections of the River Barrow main channel and for the Figile, Slate, Owenass, Triogue and Burren sub-

catchments. Diffuse pollution from agriculture and hydromorphological impacts, from channel maintenance works and navigational structures, are the main pressures on the Barrow catchment.

Barriers to migration are a significant stressor for the anadromous sea and river lampreys. There is a substantial weir at the upper tidal limit at St Mullins (36km from its confluence with the River Suir) and sea lamprey spawn below this structure. The weir was assessed using the SNIFFER barrier passability method (2010) as a partial barrier of low or high impact to lamprey, depending on flow conditions. In fact, the weir at St Mullins is the first of 23 weirs over 65km of river. Channel maintenance work, predominantly in the upper catchment, has been on-going since the arterial drainage scheme of the early 1900s. Uniformity of channel and a reduced diversity in instream habitat is a feature of these operations and this is likely to impact on the requirement of lamprey for spawning gravels and nursery habitat.

A fish stock assessment of the River Barrow catchment (Delanty *et al.* 2017) in 2015 revealed that only 25% of sites in the main channel had a good fish status and these were located in the upper reaches above Mountmellick and downstream of weirs where flow and habitat condition were more favourable. The general trend in the sub-catchments was for good or higher status sites in the lower half of the River Barrow catchment while sites in the upper catchment (52% of total) were moderate or worse. Poor water quality, poor habitat, artificial barriers to migratory fish passage and possibly competition from the invasive dace (*Leuciscus leuciscus*) were cited as the main reasons for less than good fish status at sites.

Plate 2.2. A site on the Triogue River showing a proliferation of instream vegetation due to the deposition of fine sediments.

Results

A total of 122 pre-selected sites on the River Barrow were targeted for larval lamprey from 14th August to 5th October 2017. Of the sites sampled, 39% were located within the SAC, with the majority of these on the main river channel. Sampling was carried out along the main river channel as well as in a number of sub-catchments including the Figile, Slate, Cushina, Owenass, Triogue, Stradbally, Douglas, Greese and Burren (Figure 2.1). A semi-quantitative sample was taken at each site by electrofishing for 2 minutes in a

defined area (1m^2) of suitable nursery habitat comprising silty deposits (after Harvey & Cowx 2003). This was generally followed by a pushnet sample of adjacent sediments with the main objective to capture the smaller young-of-year larvae. Habitat features including sediment type, water depth, flow type, cover and instream vegetation were also recorded at individual sites.

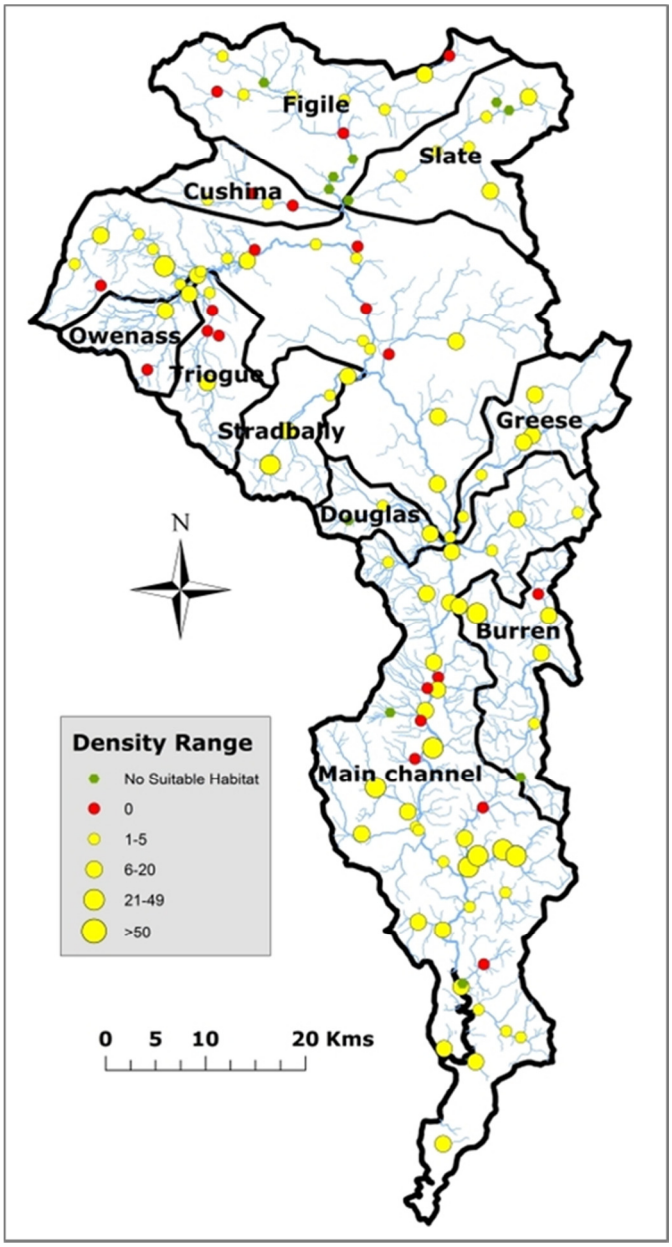


Figure 2.1. Map of the Barrow catchment showing larval lamprey densities for August/September 2017.

Of the 122 sites, 108 (88%) had suitable habitat while 4 sites could not be electrofished due to high water levels or access issues. A limitation of larval sampling is the inability to differentiate between brook lamprey and the anadromous river lamprey at this developmental stage. Consequently, it is only possible to report on *Lampetra* spp. and, for the current study, a total of 782 *Lampetra* spp. larvae were recorded from the Barrow catchment in its entirety. The highest density (47/m^2) was recorded from a site on the Mountain River, a tributary of the Barrow main channel, which flows through Borris, Co. Carlow (Figure 2.1 and Table 2.1). The 4 sites monitored on this river had the highest densities for the entire catchment. *P. marinus* was not recorded in this survey but there is growing evidence that larvae of this species are found in higher densities in deeper water and, therefore, not amenable to capture by electrofishing.

Table 2.1. Comparison of distribution, density, population structure of lamprey larvae across the Barrow catchment, August/September 2017.

	No. Sites	No Suitable Habitat	No. positive Sites	Max. Density (Fish/m²)	Min. Density (Fish/m²)	Mean Density (Fish/m²)	Max. Length (mm)	Min. Length (mm)
Burren (176 km²)	8	1	6	22	3	8.4	134	33
Cushina (89 km²)	4	0	2	5	4	2.25	143	41
Douglas (66 km²)	3	1	2	4	16		128	36
Figile (320 km²)	13	4	6	9	1	2	141	72
Greese (141 km²)	6	0	6	14	1	6.5	120	17
Main Channel (1687 km²)	67	2	50	47	1	8.7	170	9
Owenass (84 km²)	3	0	2	12	10	7.3	135	21
Slate (214 km²)	9	3	6	12	1	4.6	142	20
Stradbally (118 km²)	5	0	5	22	1	8.8	144	43
Triogue (115 km²)	5	0	2	9	1	2	134	71

In terms of monitoring for larval lamprey, the current guidance for assessing the conservation status of *Lampetra* spp. is based on defined targets for the population attributes of spatial extent, density and age structure (JNCC 2015). *Lampetra* spp. should have a mean density >5/m^2 in sites with suitable habitat within a catchment and should be present in not less than 50% of these sites (Figure 2.2). In relation to age structure, the full range of size classes, from young-of-year to metamorphosis, should be present. The criteria for assessing the conservation status of *P. marinus* have yet to be defined pending further general research on habitat utilisation by this species and the trialling of various sampling techniques for deeper water.

Within the Barrow study area, 80% (n=86) of sites with suitable habitat were positive for *Lampetra* spp. and the catchment as a whole had a mean larval density of 9/m^2. The full suite of age classes was encountered with lamprey measuring 9mm – 170mm and mean 76mm (Figure 2.3). Nine transformers and 15 macropthalmia (post metamorphosis individuals with eyes) were recorded, ranging in length from 112mm – 148mm. Based on the guidance criteria, *Lampetra* spp. is at favourable conservation status in the Barrow catchment in terms of its larval populations. On a sub-catchment scale, however, the Figile, Cushina, Slate and Triogue, located in the upper catchment, had mean densities <5/m^2 for *Lampetra* spp. larvae and, therefore, do not achieve favourable status.

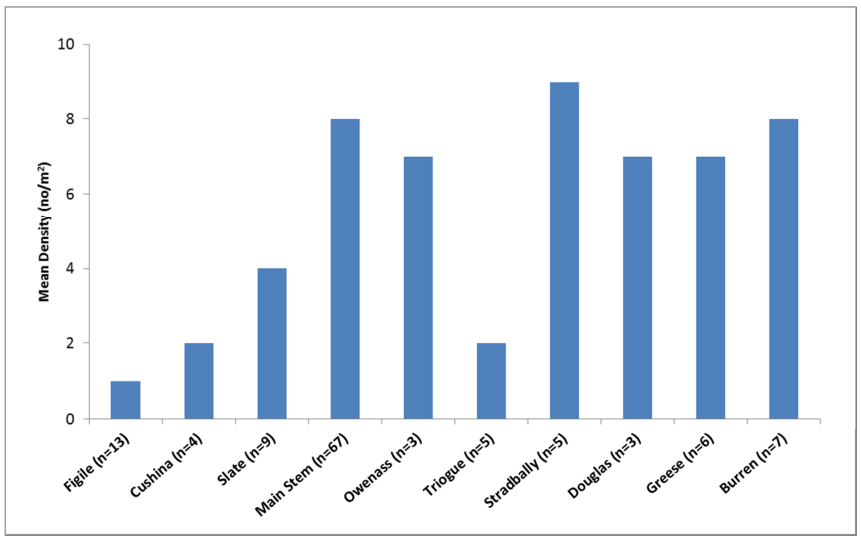


Figure 2.2. Mean densities of *Lampetra* spp. larvae recorded from tributary and main stem channels of the River Barrow catchment in 2017.

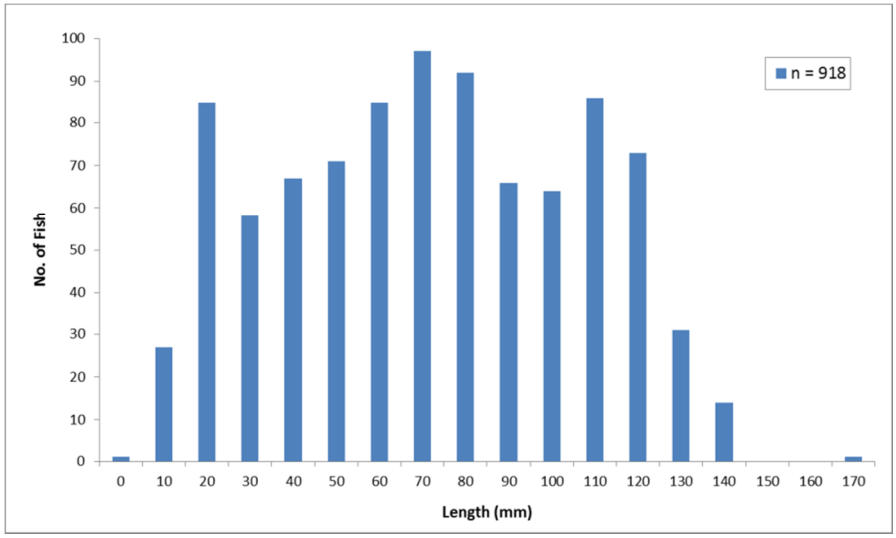


Figure 2.3. Length frequency distribution of *Lampetra* spp. larvae (n=918) from all sites in the Barrow catchment in 2017.

A previous study on the status and distribution of larval lamprey in the River Barrow SAC found that 52% of sites were negative for lamprey and a high proportion of negative sites occurred in tributaries discharging to the Barrow between Monasterevin and Carlow, i.e. in the upper catchment (King 2006). On that occasion, 8 *P. marinus* larvae were captured from 4 locations, one of which was in the Fusheoge tributary, 43km upstream of the tidal limit. It stated that, while the population density for *Lampetra* spp. was low in many of the tributaries examined, combined populations of juveniles frequently displayed the presence of several year classes. Four major tributaries located in the upper Barrow catchment, had low densities of *Lampetra* spp. in the current study, indicating issues have persisted over time in the general upper catchment area. While the two studies are not directly comparable in terms of sampling locations, the higher proportion of positive sites in the current study is a notable development nonetheless. Poor water quality, drainage works and migration barriers, especially in relation to the Barrow navigation, will continue to represent significant pressures for all 3 species of lamprey and particularly for the anadromous species (Figures 2.4-2.14).

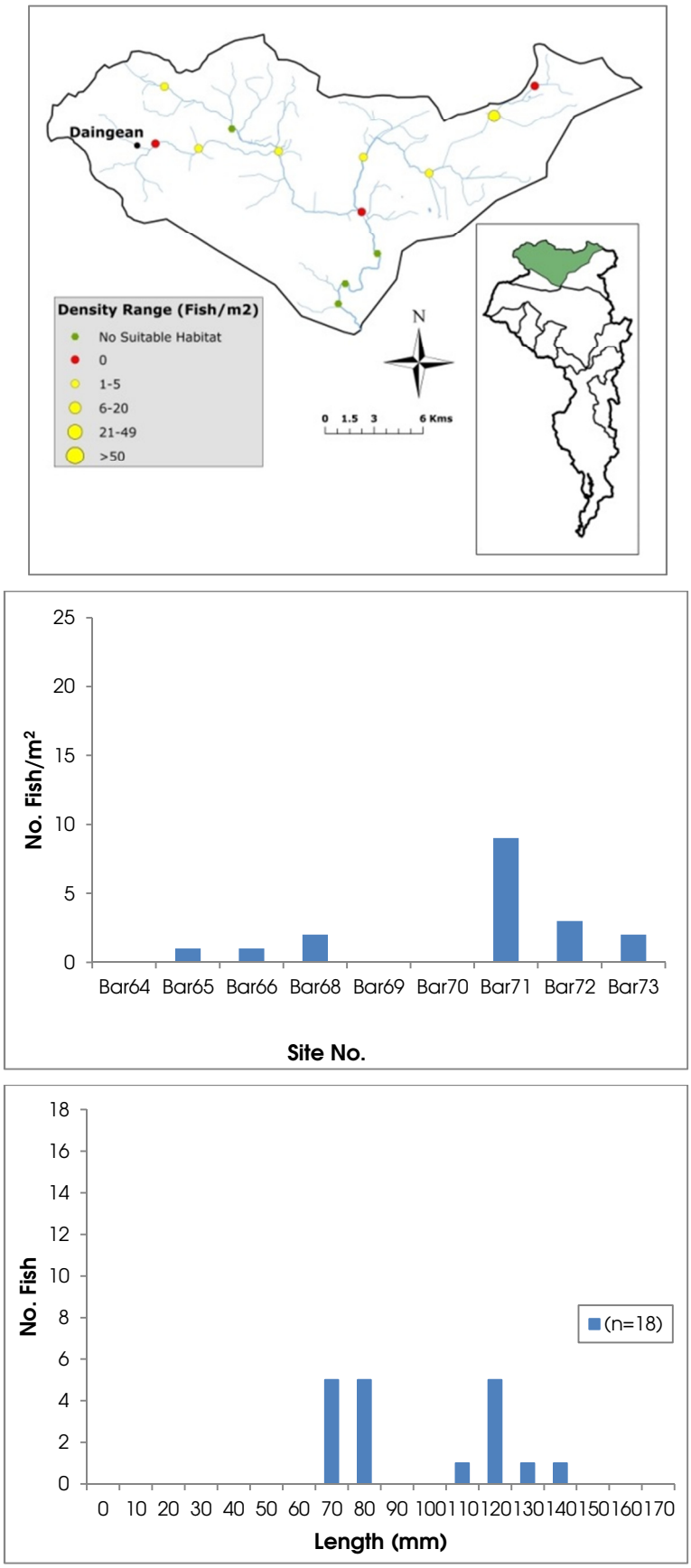


Figure 2.4. ***Lampetra*** **spp. larvae results for the Figile sub-catchment in 2017.**

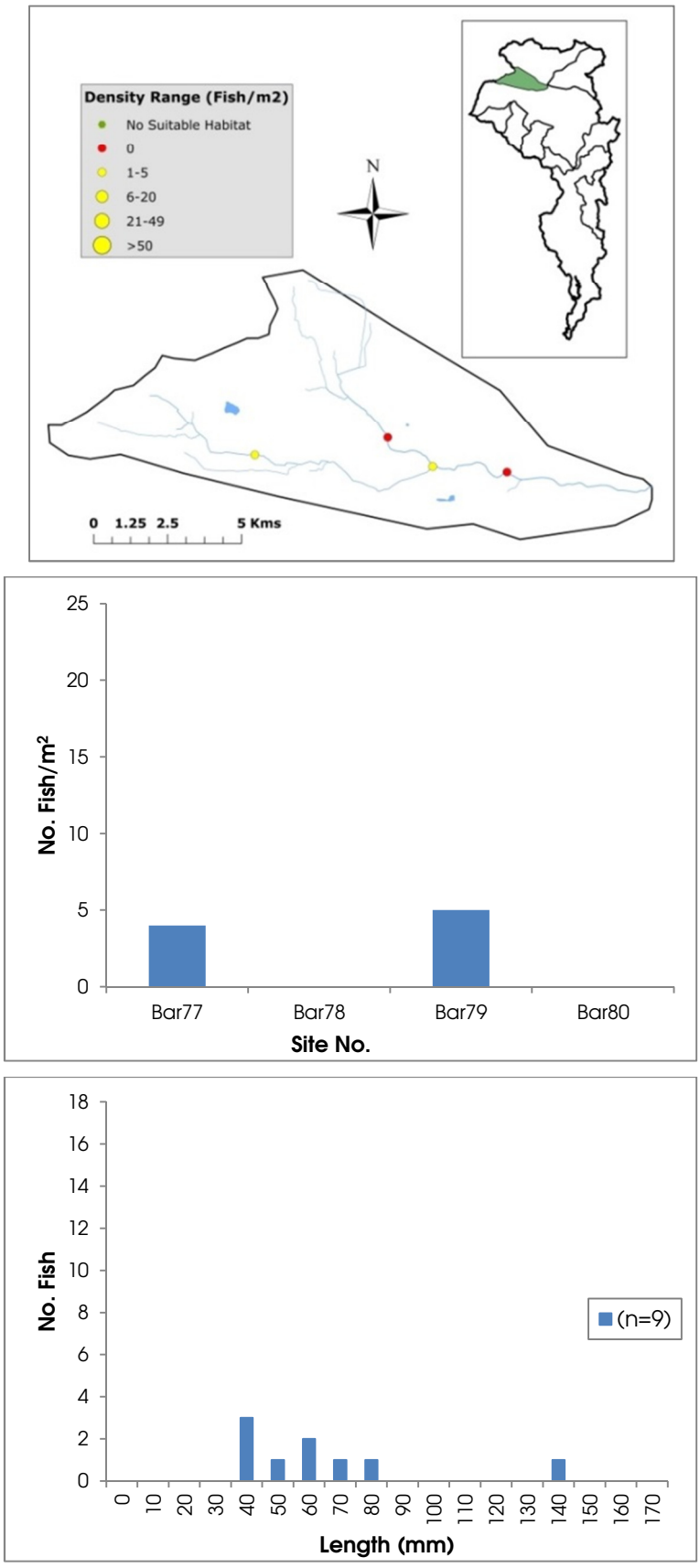


Figure 2.5. *Lampetra* spp. larvae results for the Cushina sub-catchment in 2017.

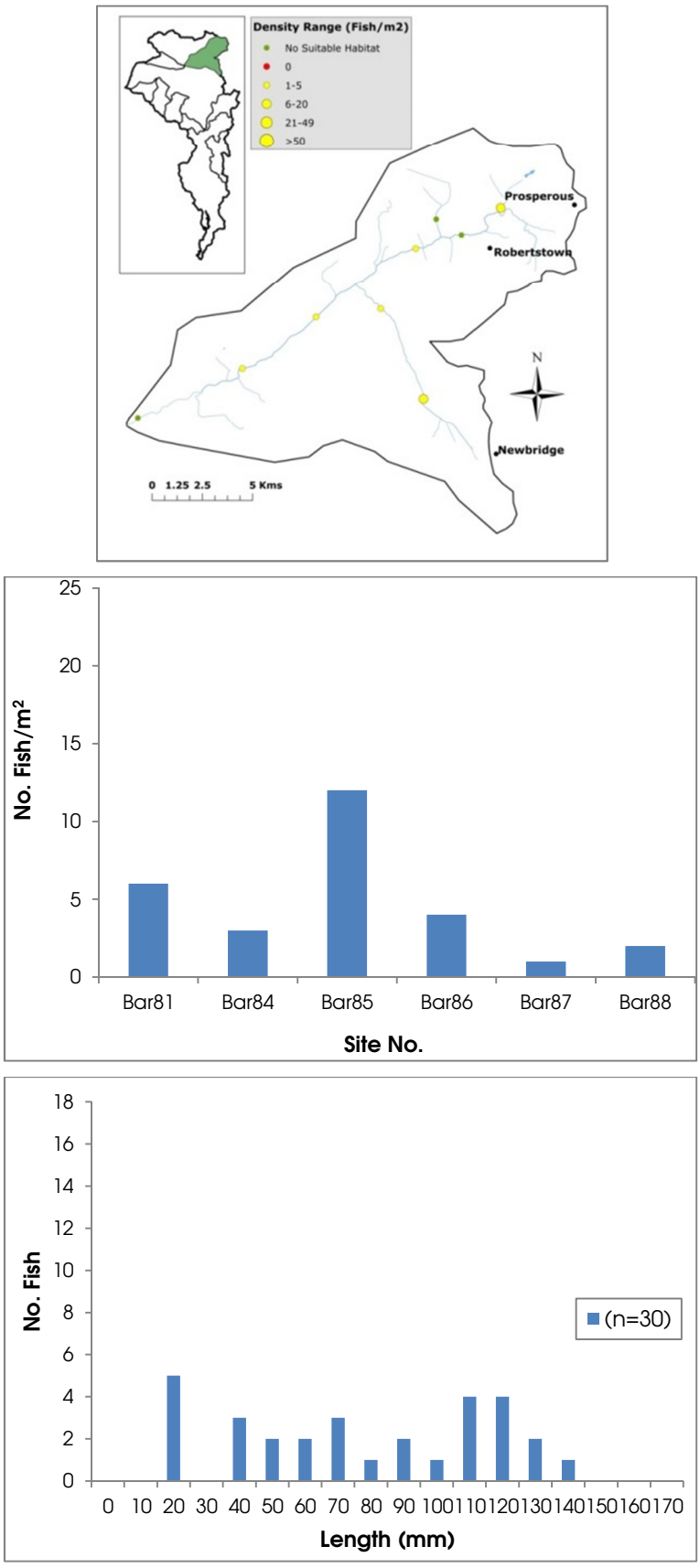


Figure 2.6. ***Lampetra*** **spp. larvae results for the Slate sub-catchment in 2017.**

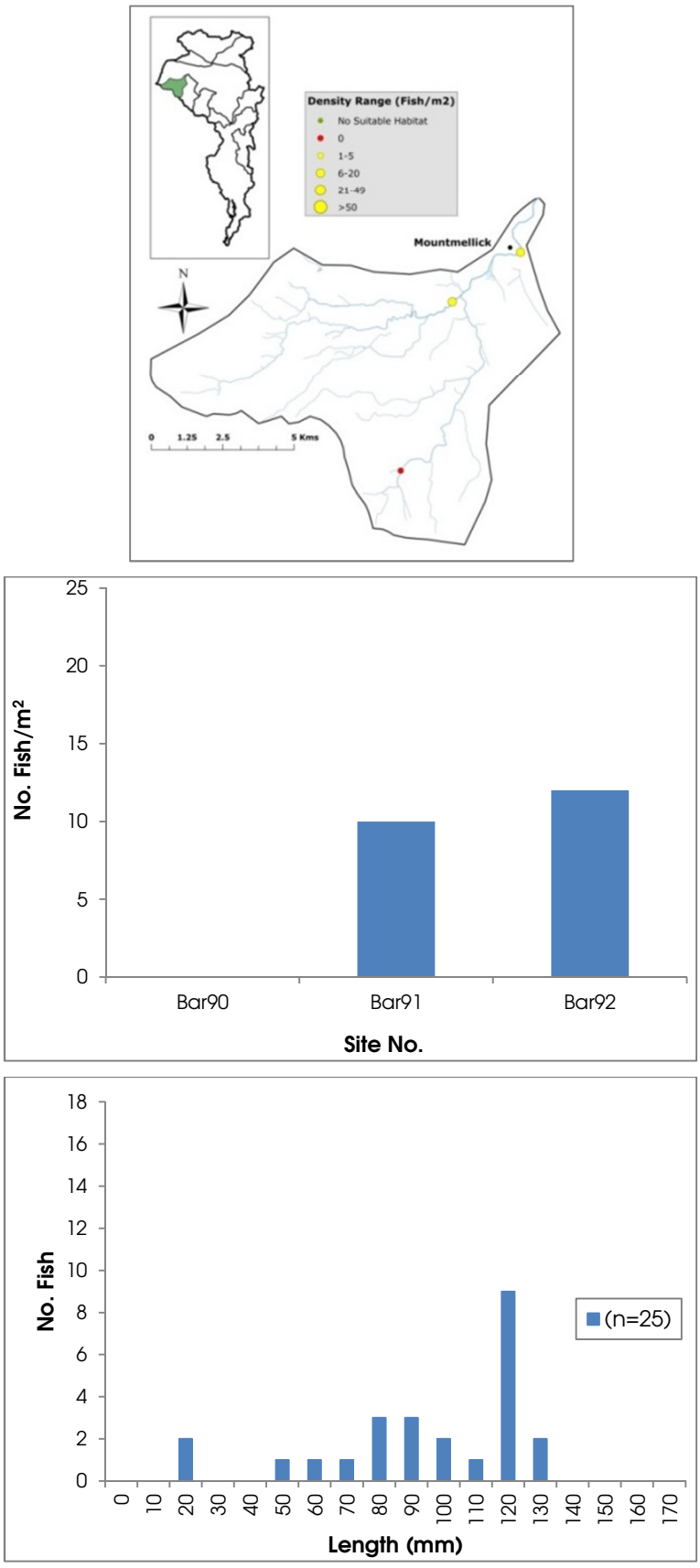


Figure 2.7. *Lampetra* spp. larvae results for the Owenass sub-catchment in 2017.

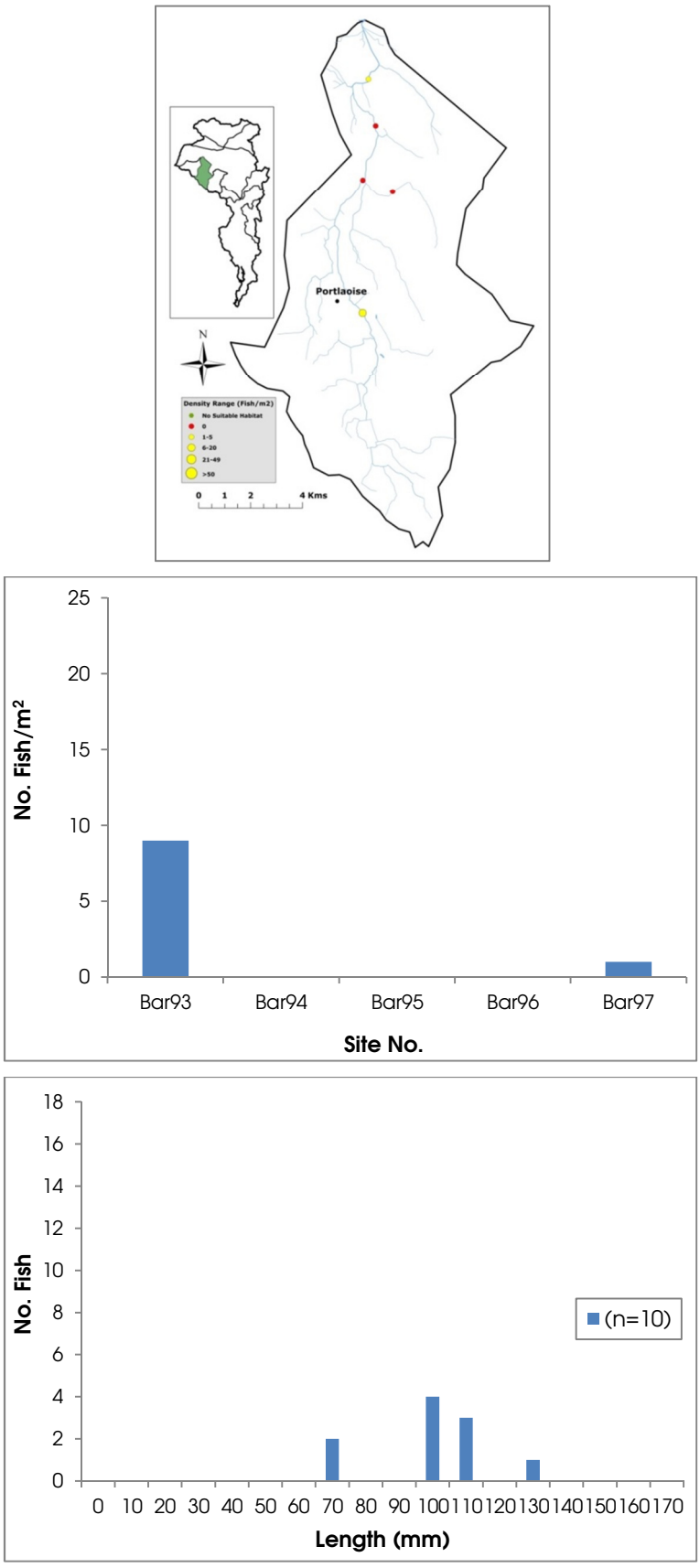


Figure 2.8. ***Lampetra*** **spp. larvae results for the Triogue sub-catchment in 2017.**

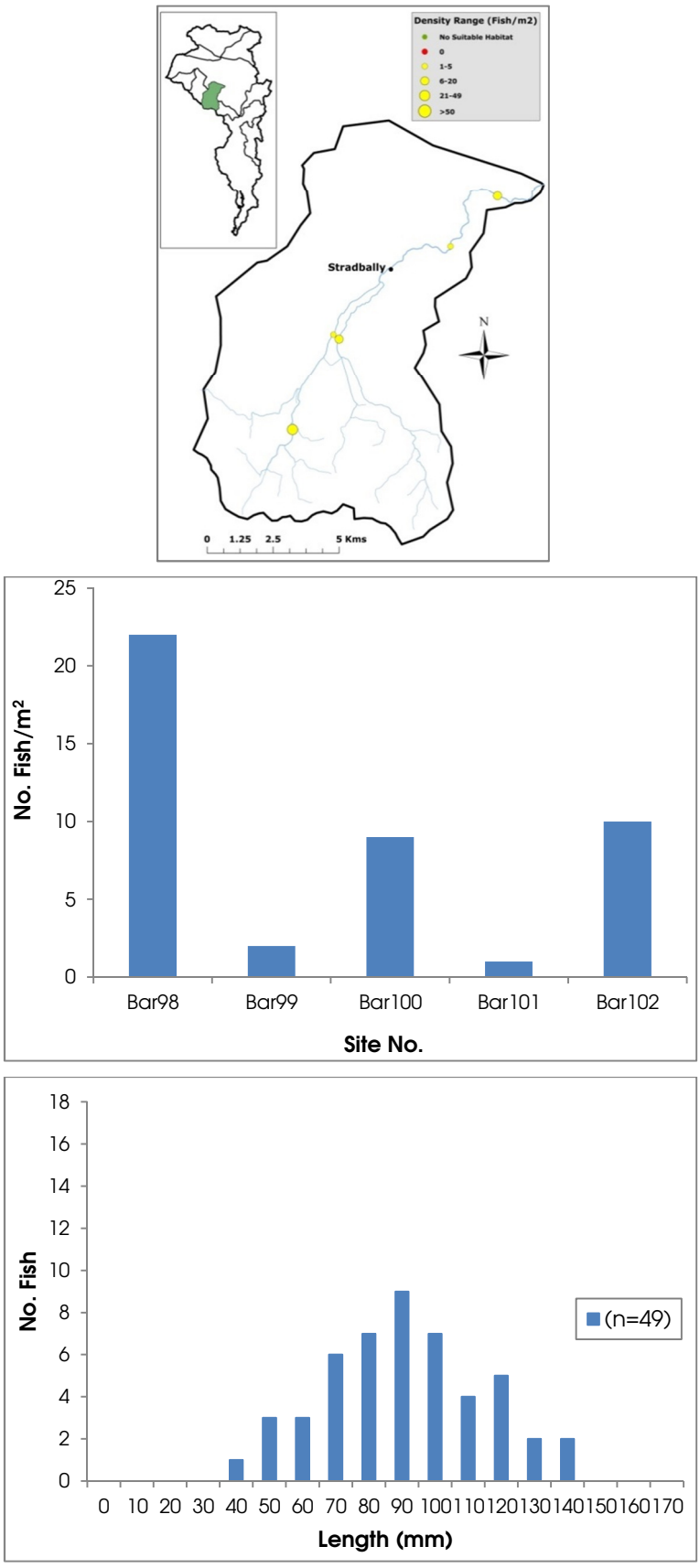


Figure 2.9. ***Lampetra*** **spp. larvae results for the Stradbally sub-catchment in 2017.**

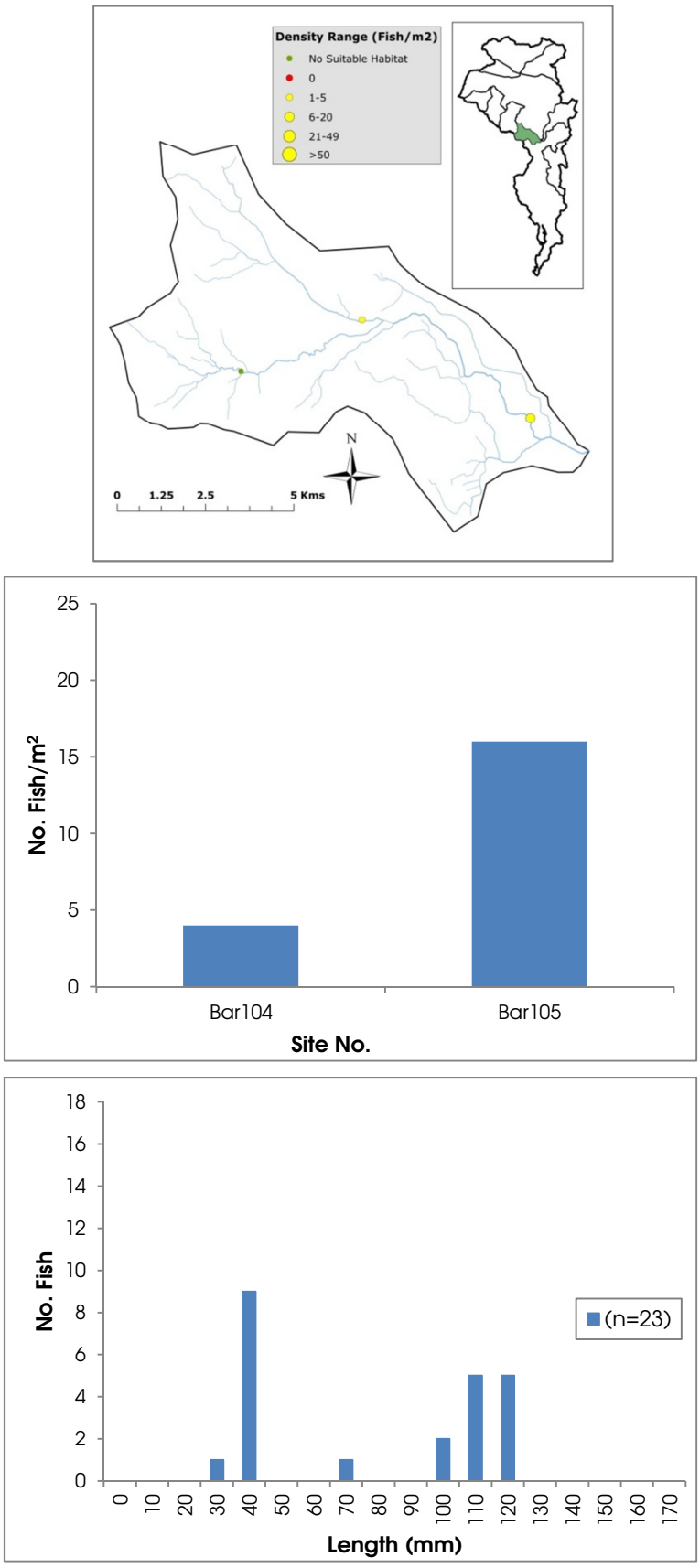


Figure 2.10. ***Lampetra*** **spp. larvae results for the Douglas sub-catchment in 2017.**

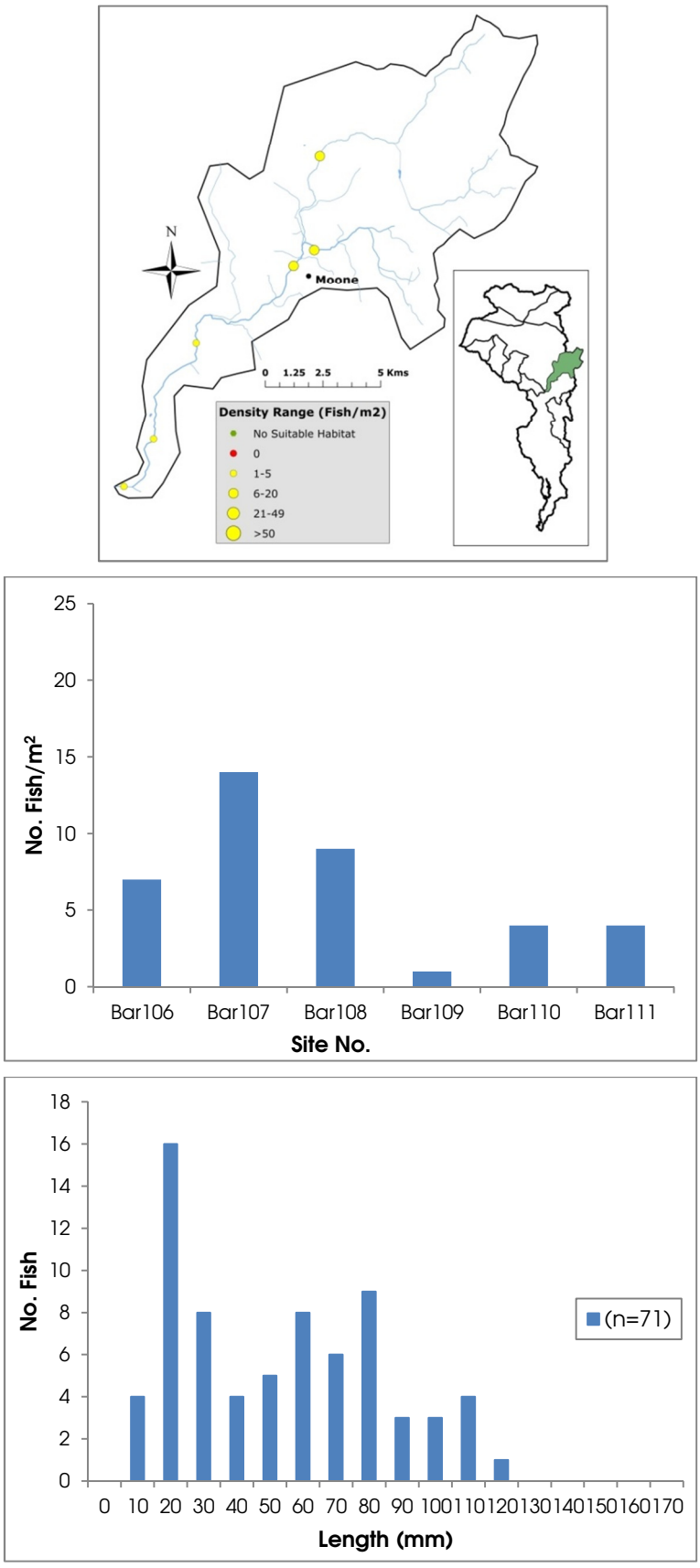


Figure 2.11. ***Lampetra*** **spp. larvae results for the Greese sub-catchment in 2017.**

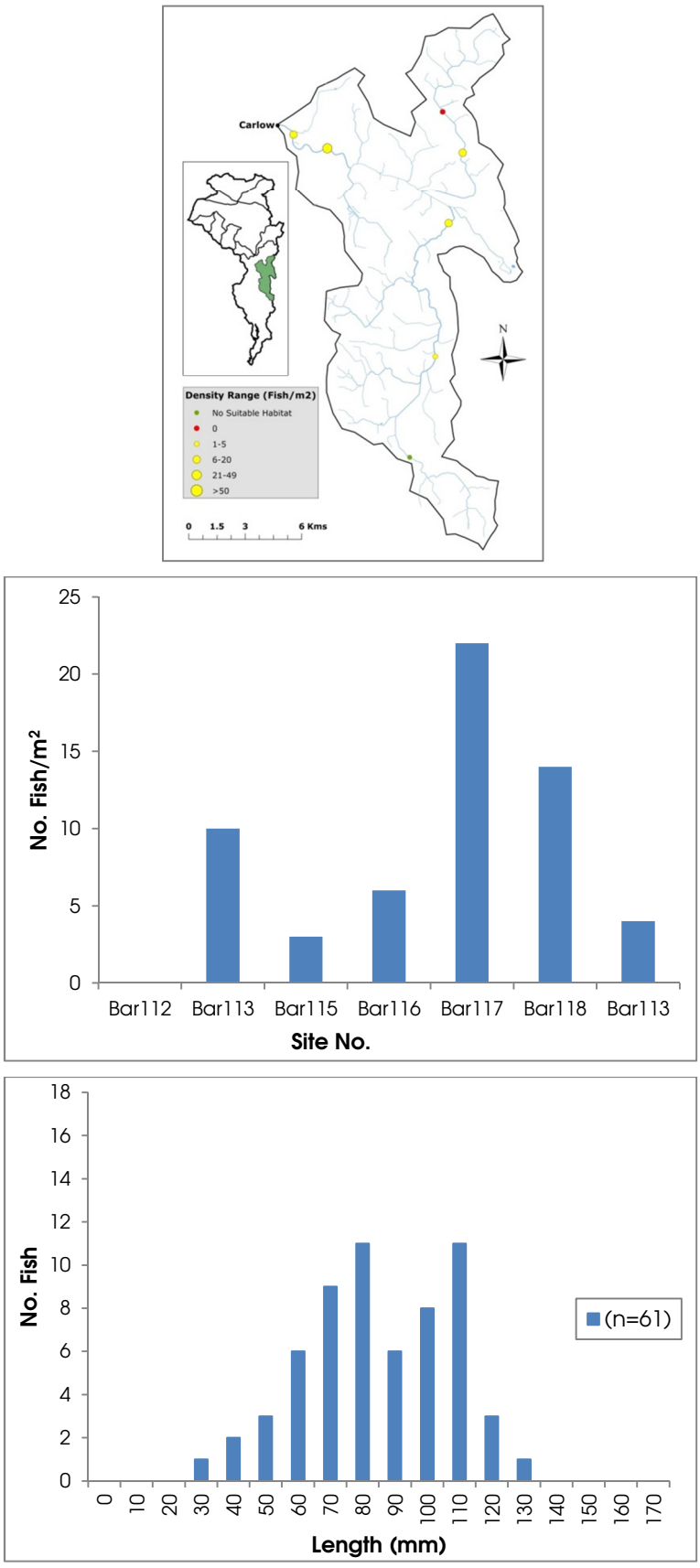


Figure 2.12. ***Lampetra*** **spp. larvae results for the Burren sub-catchment in 2017.**

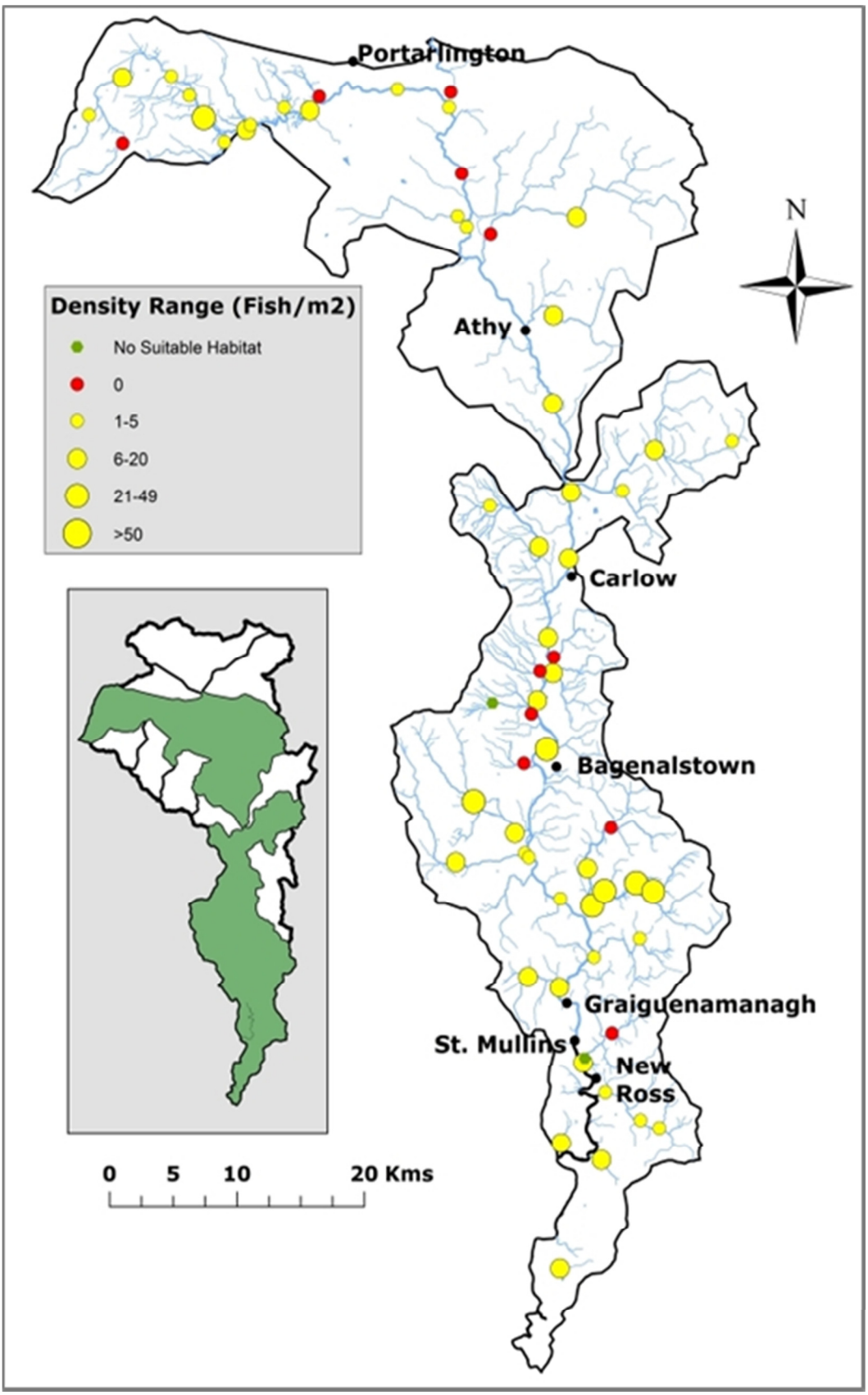


Figure 2.13. Map of the main channel of the River Barrow showing *Lampetra* spp. densities.

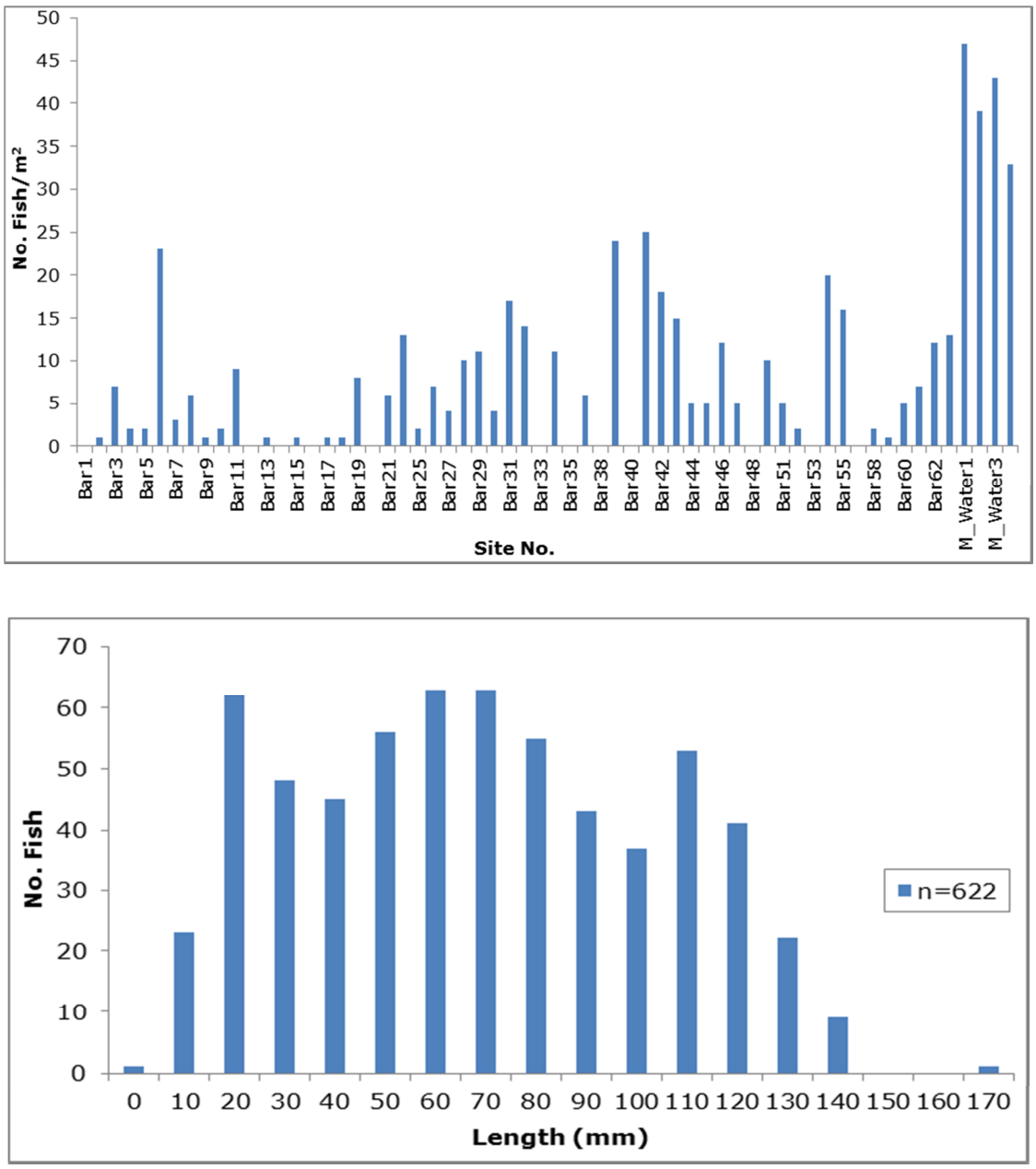


Figure 2.14. *Lampetra* spp. larvae results for the main channel of the River Barrow in 2017.

2.1.2. Mulkear Catchment Wide Survey

The Mulkear River is a tributary river of the lower Shannon (Figure 2.15), with its confluence situated 6km by river upstream of the River Shannon tidal limits in Limerick city. Straddling two counties, Tipperary and Limerick, the Mulkear system comprises a number of tributaries, namely the Dead, Bilboa, Newport and Annagh rivers, which, along with the main channel, amount to 200km of river corridor. The catchment area is 650km², consisting of upland and lowland areas. The upland area is extensive and has numerous mountain peaks in excess of 400m. The lowland area is largely a flat river plain. The majority of the catchment is included within the Lower River Shannon SAC (#002165), with relevant species of interest such as freshwater pearl mussel (*Margaritifera margaritifera*), sea lamprey (*Petromyzon marinus*), brook lamprey (*Lampetra planeri*), river lamprey (*Lampetra fluviatilis*), Atlantic salmon (*Salmo salar*) and otter (*Lutra lutra*).

Much of the Mulkear catchment has been subject to channel maintenance operations. In addition, a number of significantly large manmade barriers are present in lower sections especially, undoubtedly impacting upon upstream movements of sea and river lampreys and limiting the extent of their spawning migration into upper sections of the catchment. Removal or modification of some of these barriers was undertaken to improve passage for migratory species.

The first catchment wide survey for larval lamprey on the Mulkear was undertaken in 2012. Subsequently, the Mulkear became a reference catchment with 6 sites on the Newport/Killeenagarriff/Mulkear Rivers surveyed on an annual basis.

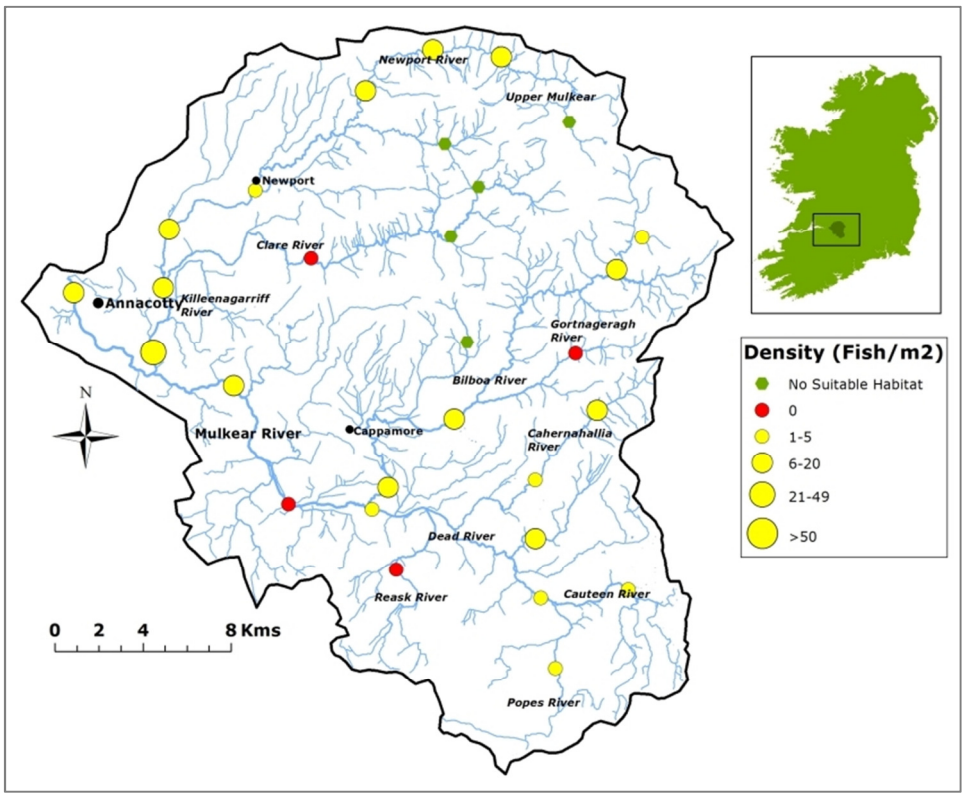


Figure 2.15. Map of the Mulkear catchment with results from juvenile lamprey surveying undertaken during October 2017 at 30/29 locations.

Results

Thirty sites, selected for surveying throughout the Mulkear catchment in 2012, were revisited in 2017. Site visits and fieldwork were undertaken over the period October 3rd to 18th 2017. Semi-quantitative surveying *via* electrofishing and/or quantitative surveying *via* push net sampling was undertaken at 29 independent locations (Figure 2.15). Of the 30 pre-selected sites, successful re-surveying occurred at 28 of these locations. Despite several attempts, a site on the Annagh River (Mulk 9) could not be adequately surveyed due to high water levels and elevated colour. A further site (Mulk 7) was successfully relocated 2km downstream due to access issues at the original location. This, as well as a further four pre-selected sites, all located in upland areas, were characterised by an overall lack of suitable habitat, as expected given their altitude and stream order. As a consequence, no larvae were obtained at these sites. Presence of juvenile river/brook lamprey was recorded at 20 of the 24 sites where suitable habitat was recorded. A grand total of 234 ammocoetes were obtained across all of these positive sites, ranging in size from 14mm to 142mm (mean = 65mm; Figure 2.16). The presence of several year classes is evident from the frequency distribution of body length measurement data. No

transforming larvae were obtained. Definitive sea lamprey larvae were also absent, despite successful spawning having occurred at locations within the catchment during 2017 and preceding years.

Table 2.2. Comparison of distribution, density, population structure of lamprey larvae across the Mulkear catchment, October 2017.

	No. Sites	No Suitable Habitat	No. positive Sites	Max. Density (Fish/m²)	Min. Density (Fish/m²)	Mean Density (Fish/m²)	Max. Length (mm)	Min. Length (mm)
Mulkear (650 km²)	29	5	20	30	1	11.05	142	14

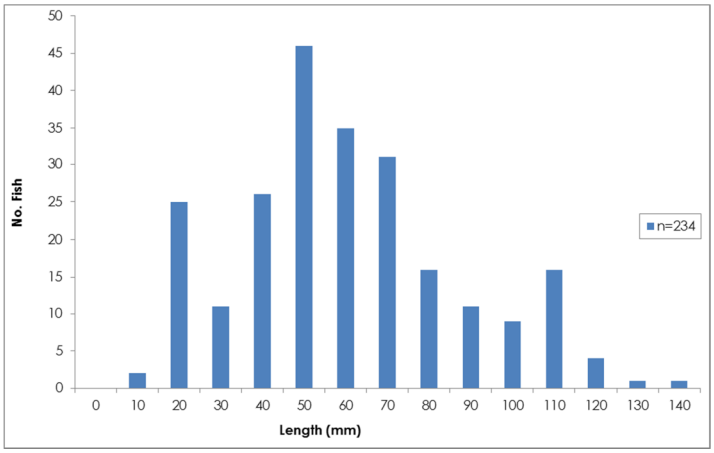


Figure 2.16. Length frequency distribution for juvenile lampreys (n=234) pooled across 20 sites within the Mulkear catchment during 2017 surveying.

Densities of larval lamprey at sites with suitable nursery habitat (n = 24) ranged from 0 to 30 ammocoetes per m² (Table 2.2). Highest densities were recorded on the Killeenagarriff River at Barrington's Bridge (30 larvae/m²), followed by the Mulkear River at Abington Bridge (18/m²)(Figure 2.17). As expected, larvae remained absent at a number of upland sites. There was only 1 record of absence in 2017 from a site where presence had previously been noted during 2012, namely on the Gortnageragh River, a headwater tributary of the Bilboa. Conversely, there were two instances of presence recorded where previous absence was noted, namely on the Dead and Killeenagariff Rivers.

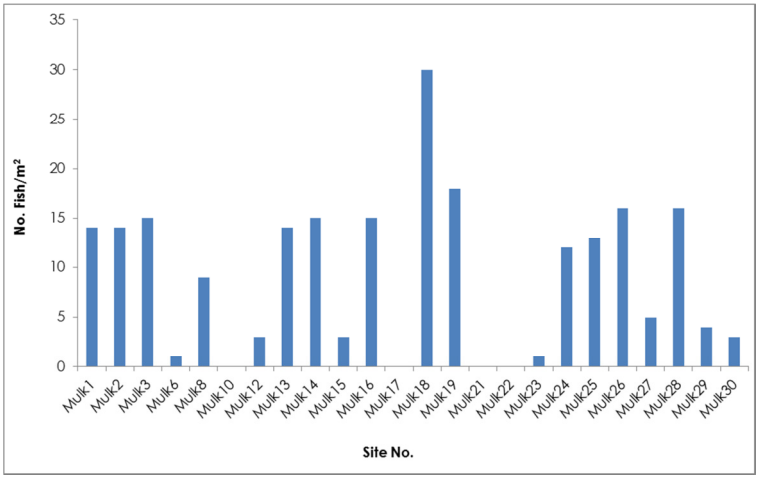


Figure 2.17. Densities of juvenile lamprey (number per m²) recorded at study sites across the Mulkear during October 2017.

Comparison with 2012 Survey

Similar numbers of ammocoetes were encountered during both surveys, with 248 captured during 2012 and 234 during 2017 (Figure 2.18). Larval sea lamprey were obtained in the initial 2012 survey at two sites, both in the lower section of the Mulkear River at Annacotty (n=1, 96mm) and Abington Bridge (n=1, 106mm), respectively. Transforming larvae (n = 10, 109-154mm) were also detected during 2012 at 8 sites. In contrast, no sea lamprey larvae or transformers were captured during 2017. Both surveys identified the presence of several age classes in the overall populations. Younger fish were, however, more prevalent in the 2017 survey (overall mean = 64.7 ± 26.7mm) in comparison to 2012 (mean = 85.0 ± 24.7mm).

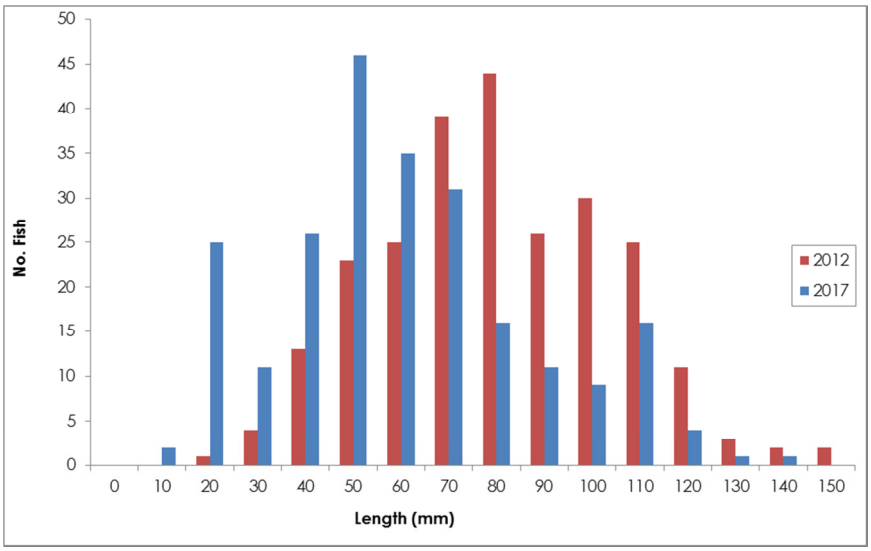


Figure 2.18. Length frequency distributions for juvenile lampreys obtained during catchment wide surveys in 2012 (n=248) and 2017 (n=234).

A degree of spatial variation in densities across survey sites was also in evidence between years (Figure 2.19).

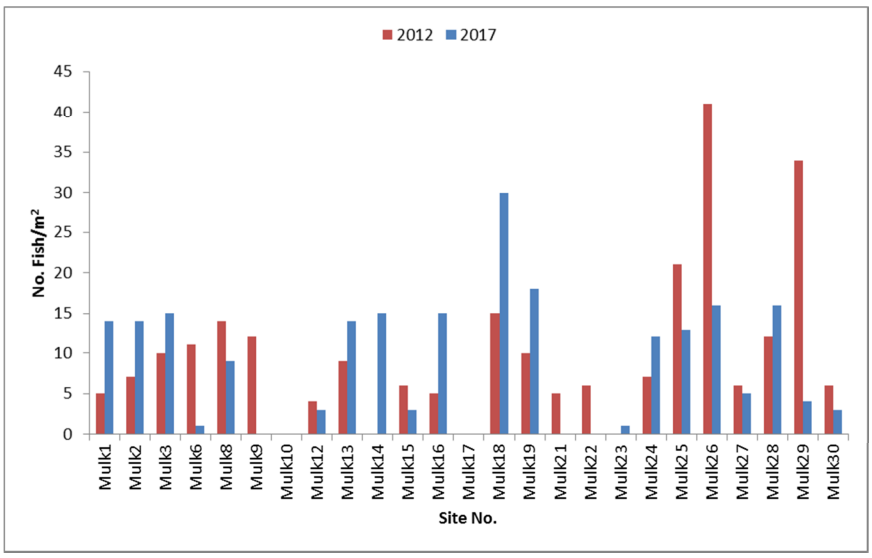


Figure 2.19. Densities of juvenile lamprey (number per m^2) recorded at study sites across the Mulkear during repeat surveys conducted during 2012 and 2017.

2.1.3 Larval Reference Channels

Monitoring of larval lamprey 'Reference' or 'Index' channels continued during 2017. Article 17 reporting requires comment on population trends and changes in geographic range. To satisfy these criteria for

lampreys it was decided to develop a list of reference channels, each comprising 5-9 sites, to be surveyed for ammocoetes annually or during alternate years. A grand total of 24 original reference channels were assigned in 2013, selected to be nationally representative of geographic distribution, stream order and water chemistry but also to typify a range of prevailing population densities as well as habitat types and suitability for ammocoetes.

A total of 11 reference channels were visited during 2017 (Figure 2.20). Higher than average rainfall during late summer and autumn frequently resulted in elevated water levels and unfavourable conditions for electrofish surveying. Sampling continued beyond October into November. A number of channels, namely the Swilly-Leannan system in Co. Donegal, the Annalee (Erne), Clodiagh (Brosna) and the Sinking River (Corrib catchment) could not be visited, whilst sampling on the Kells Blackwater (Boyne catchment) and the Mulkear was protracted across several weeks whilst awaiting return of suitable water levels to allow completion of surveying.

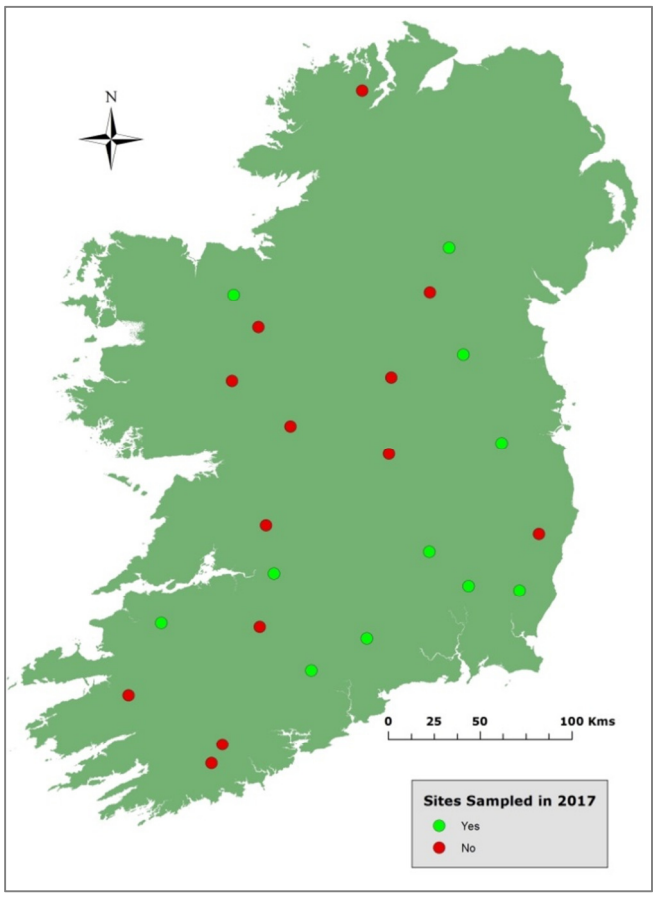


Figure 2.20. Location of larval reference channels throughout Ireland, with site visited during 2016 indicated (green dots).

2.2 Adult lamprey investigations

Overview

These investigations in 2017 focused on sea lamprey. The principal elements involved were broadly similar to those employed in 2016 i.e.

- Float-over (walk over) surveys of selected main stem SAC rivers to identify locations of sea lamprey spawning and to enumerate spawning effort
- 'Hot spot' surveys at selected, localised sites of known sea lamprey spawning activity – with the

aim of compiling an annual programme of such visits permitting an examination of annual effort and how this may vary over time

- Survey programme of large barriers on main stem SAC rivers that might impede upstream migration for sea lamprey. As previously, the SNIFFER or WFDIII sampling protocol was used to survey a series of structures
- Investigations on so-called 'land-locked' sea lamprey found in certain Irish lakes

Float-over surveys

These were conducted on the main stems of the Nore, Suir, Moy and Laune systems. Canoes or sit-on-top kayaks were used for floating downriver. Local RBD staff were available to assist in a number of these surveys and this additional support enabled a more detailed viewing across each of the channels as the boats passed downstream.

2.2.1. Nore float-over survey

This survey covered the 22 km of river from Bennettsbridge down to the tidal limit at Inistioge and was undertaken in early July 2017 (Figure 2.21). A total of 17 redds was counted, with the majority of these located downstream of Thomastown. This number was very small, even compared to the 2013 float-over result of 33 redds, for the same channel length. A series of 6 float-over surveys have been conducted on the River Nore since 2000, covering the Bennetsbridge – Inistioge sector, providing a valuable insight into spawning effort and degree of penetration into the main river.

During 2017, the weir at Bennettsbridge, as well as structures further upstream, were assessed for passability for adult sea lamprey. All three structures, at Bennesttbridge, the Saw Mills weir and the Ormonde Weir in Kilkenny city, were assessed as Impassable to sea lamprey in the survey conditions (see Hydromorphology chapter).

Plate 2.3. The River Nore float-over survey.

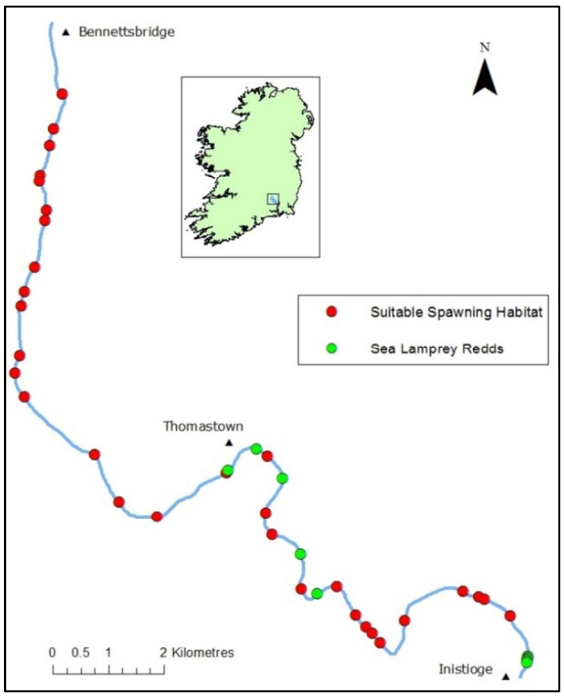


Figure 2.21. Location of redds and suitable spawning habitat of sea lamprey on the River Nore in 2017.

2.2.2. Suir float-over survey

This survey covered the 54km of river from Cahir, through Clonmel down to the tidal limit at Carrick-on-Suir and was undertaken in early July 2017 (Figure 2.22). A total of 5 redds was counted, one downstream of Cahir and 2 each downstream of Clonmel and downstream of Kilsheelan. This number was extremely low, even compared to the 2013 float-over result of 26 redds, for the same channel length. The very small number of redds counted in Clonmel, downstream of the twin weirs mirrors the small numbers and absence of spawning at this prime location recorded in the last 2-3 years.

A series of 5 float-over surveys have been conducted on the River Suir since 2000, all covering the sector from the River Nier confluence (downstream of Adrfinnan) to Carrick-on-Suir, providing a valuable insight into spawning effort and degree of penetration into the main river.

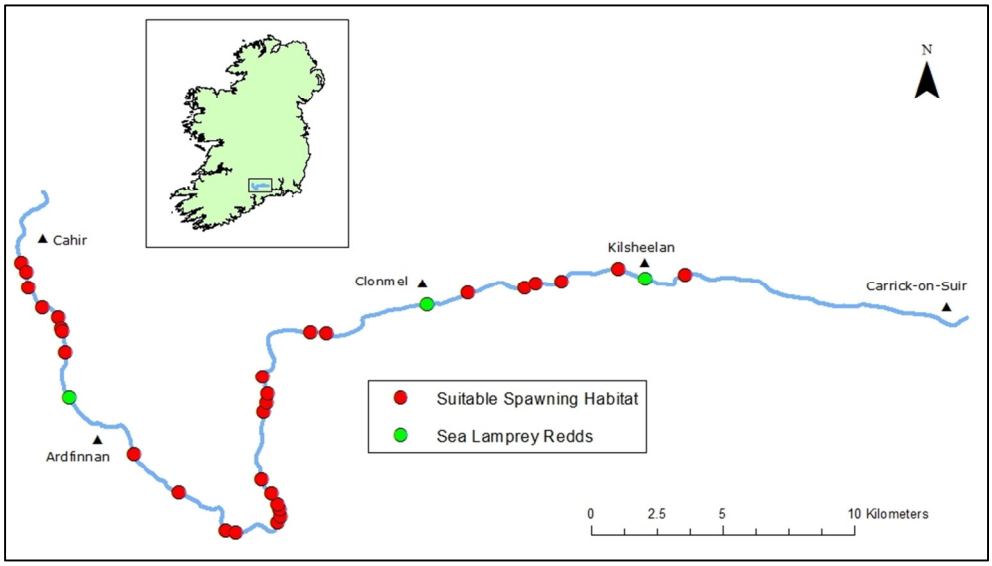


Figure 2.22. Location of redds and suitable spawning habitat of sea lamprey on the River Suir in 2017.

The sector from Cahir to Clonmel has been included in a number of these, to assess any degree of success in passing the weirs in Clonmel. The SNIFFER barrier assessment method was used to examine the twin weirs in Clonmel for sea lamprey passability in 2016. This assessment protocol was used to examine possible obstructions to sea lamprey passage at Ardfinnan (bridge apron) and at Cahir (weir) during 2017. The Ardfinnan bridge apron was assessed as Impassable (Score '0') and the weir at Cahir was a high risk structure for sea lamprey passage (Score 0.3)(see Chapter 7).

Plate 2.4. The River Suir float-over survey.

2.2.3. Moy float-over survey

This survey complemented that undertaken in 2011. It commenced considerably further upstream on the main stem, at Cloonbanniff Bridge, with the intention of viewing graveled areas reportedly used by spawning Atlantic salmon, and extended for 28 km down to Ballanacurra Bridge. The survey was undertaken over two days in mid July 2017 with IFI RBD staff from Ballina. No sea lamprey redds were observed in the section examined and a small number of areas of suitable spawning gravel, of limited surface area that might be used by adult sea lamprey in summer or by adult Atlantic salmon in winter, were identified. The areas identified were widely separated over the 28 km float0over distance. The 2017 float-over overlapped by 5 km with that of 2011, which had continued downstream to Ballylahan Bridge. Over the two sampling events, a total of 51 km of the main stem of the River Moy was examined for sea lamprey spawning evidence and spawning habitat.

The 2017 survey did identify a number of minor barriers - bridge floors or fords - that could impede adult sea lamprey upstream migration during conditions of low flow.

Individual adult sea lamprey were found in the Eignagh River in each of 2006 and 2007 in the course of boat electric fishing surveys. It is possible that adult sea lamprey navigate the main Moy stem and use tributary rivers for spawning.

There are a number of records of spawning sea lamprey activity on the River Deel, a major tributary of the Moy system that discharges directly to Lough Conn. An initial overview in 2017 identified a number of barriers to passage, both natural rock sills and man-made structures , upstream of Crossmolina town. Historical (1950s-60s) and recent reports of sea lamprey spawning come from a number of areas on the

Deel main stem, both up- and down river of Crossmolina and this channel is scheduled for survey in 2018.

2.2.4. Laune float-over survey

This float-over survey focused on a habitat-rich 8.5km section of the River Laune from the Lough Leane outflow to Ballymalis Castle, Complementary walkover surveys were conducted on sections of the Gearhameen and Flesk Rivers. In addition, a section of the Long Range, situated between the Lower and Upper Lakes, was inspected by boat. Surveying was undertaken in mid July 2017. Single redds were identified on the main River Laune between Beaufort Bridge and Ballymalis Castle, and on the Killarney town section of the River Flesk, a separate major tributary discharging to Lough Leane (Figure 2.23). Redds (n=3) were also detected on the Gearhameen River at Lord Brandon's Cottage, situated in the upper catchment. Surveying along this river further upstream towards the headwaters of the Black Valley yielded 2 more redds. These latter observations, as well as that on the Flesk, represent new records for the Laune catchment.

Plate 2.5. Clockwise from top-left: Spawning locations on the Gearhameen River in the Black Valley and at Lord Brandon's Cottage; on the Laune near Ballymalis Castle; on the Flesk River downstream of Flesk Bridge, Killarney.

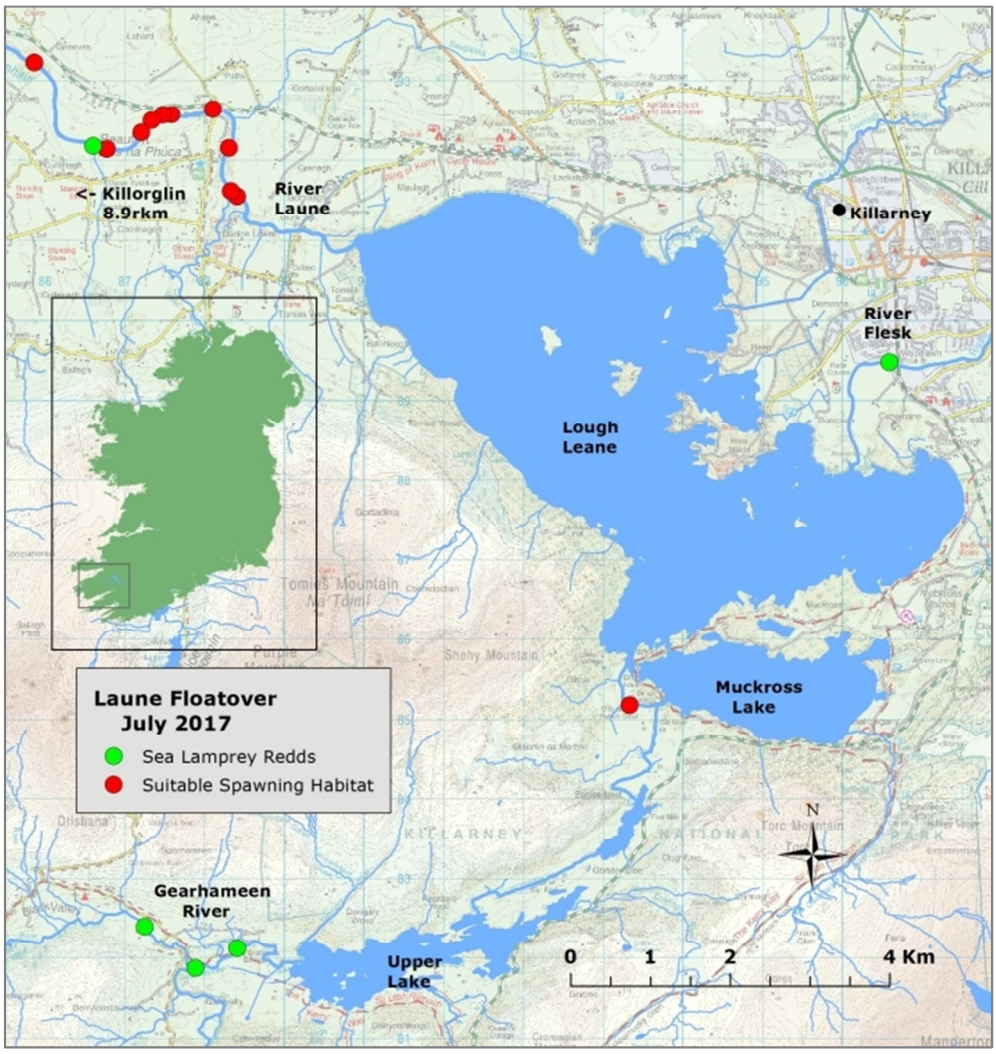


Figure 2.23. Map showing location of sea lamprey redds across the Laune catchment in 2017. Also indicated are sections of suitable spawning habitat where no redds were present.

2.2.5. Monitoring Sea Lamprey Spawning Activity

As with previous years, a selection of sea lamprey spawning 'hot-spots' were visited during 2017 in order to ascertain timing, extent and annual consistency of breeding effort. Hot-spots comprise traditionally renowned spawning sites on individual SAC rivers across the south and south east as well as within the Lower Shannon SAC (Figure 2.24). The locations visited during 2017 are listed in Table 2.2.1.

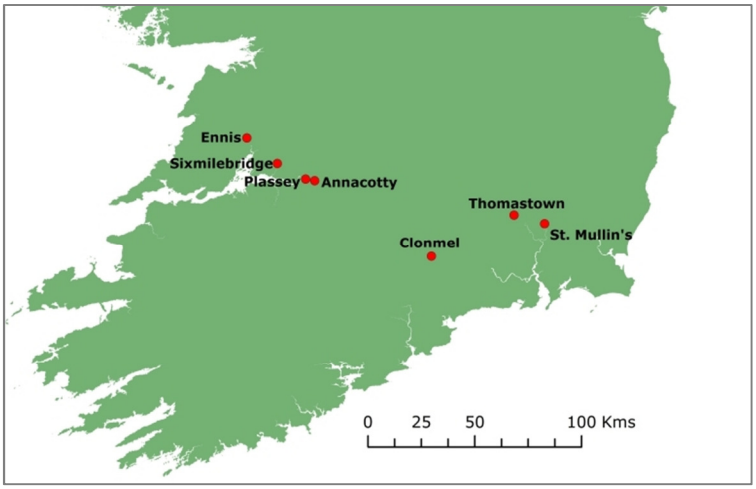


Figure 2.24. Location of principal sea lamprey spawning 'hot-spots' surveyed annually.

Spawning Observations

For the River Fergus in Ennis Town, records of sea lamprey presence and spawning activity were provided on an almost daily basis by a highly reputable local amateur naturalist. Adult fish were first noted on May 30th, excavating nests in 3 traditional locations, namely d/s of Mill Road Bridge & Weir, u/s of Bank Place Bridge at Harvey's Quay and finally in the section from Club Bridge along Newbridge Road / Steele's Rock towards the Court House. These are the 3 major hot-spots in Ennis Town where adult aggregation and spawning is expected annually. Varying numbers of adult fish exhibiting spawning behaviour were noted at these locations throughout early June. No adults were observed after June 14th with the exception of two late spawning events on June 22nd. Activity ceased completely after this date.

The Mulkear River at Annacotty, Co. Limerick was visited in late May and twice in June 2017. The first visit confirmed the presence of sea lamprey (n=5) and the commencement of redd-building. The 2nd visit (June 14th) coincided with elevated water levels and coloration following rain, thereby precluding any worthwhile surveying. The final visit (June 30th) encountered favourable conditions. As with previous years, a 150m section, extending 100m downstream and 50m upstream of the old Annacotty bridge, was thoroughly searched, with counts compiled of all visible adult sea lamprey (n=3) and redds (n=83) present (Table 2.23).

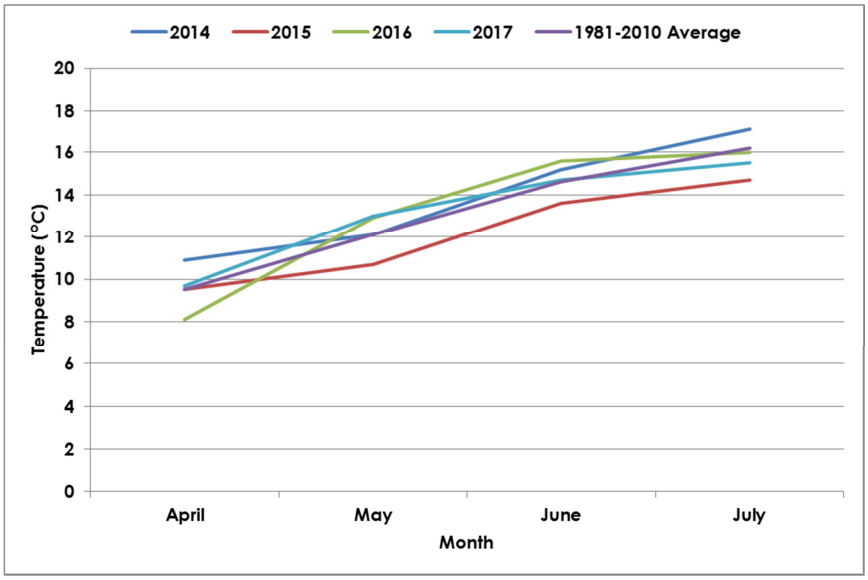
Redd building was recorded on the River Shannon in the grounds of UL at Plassey in late May with 10 discernible nests (7 upstream & 3 downstream of the Living Bridge) and adult fish (n=3) present. By the end of June the redds upstream of the bridge had been developed into a series of compound structures. No adult fish were viewed. No redds were found on the Kilmastula River at Birdhill. Nor were any noted on the River Suir in Clonmel and at Ardfinnan, Co. Tipperary. In contrast, redds (n=5) were observed at 3 separate locations along the Nore in the environs of Thomastown, Co. Kilkenny, with 3 adult fish noted at one of the nests. Spawning activity was also recorded on the River Barrow below St Mullins Weir, a perennial hot-spot. The Owengarney River in Sixmilebridge, Co. Clare was not visited during 2017.

Table 2.3. Sea lamprey spawning activity across a number of annual 'hot-spots' during May, June and July 2017.

Date	Location	Sea Lamprey	Redds	Temp (°C)
30/05/2017 to 22/06/2017	River Fergus, Ennis Town, Co. Clare	Numerous	Numerous	NA
26/05/2017	Mulkear River, Annacotty	5	7	18.1
30/06/2017	,Co. Limerick	3	83	14.6
26/05/2017	River Shannon, UL Living Bridge,	3	10	NA
30/06/2017	Plassey, Co. Limerick	0	10-15	NA
14/06/2017	Kilmastula River, Birdhill, Co. Tipperary	0	0	14.0
22/06/2017	River Nore, Thomastown, Co. Kilkenny	3	5	15.7
01/06/2016	River Barrow, St Mullins, Co. Carlow	0	1-2	18.5

In addition to surveying the annual hot spot on the Mulkear River immediately downstream of Annacotty Weir, the opportunity was taken to survey locations on upstream tributaries in order to appraise the continuing efficacy of fish passage structures incorporated into the aforementioned barrier. Sea lamprey redds were noted on the Mulkear River at Scart (n=6) and Abington (n=1), on the Killeenagarriff (n=3), and on the Bilboa at New Bridge (n=1) and Cappamore (n=2). No redds were found during searches further upstream at locations along the Newport, Annagh and Bilboa rivers, respectively. Presence of redds on several tributaries implies successful ascension of Annacotty Weir followed by onward progression into the interior of the catchment.

To broadly summarise the breeding phenology of sea lamprey during 2017, adult fish were observed excavating redds from late May to the end of June. Ambient river water temperatures during this time ranged from 14.0 to 18.5°C. Air temperatures were broadly in line with the long-term average for this period (Figure 2.25a). Rainfall amounts were lower than average during April and May but exceeded the mean for June and July (Figure 2.25b). Rainfall events during June often interfered with hot spot surveys and contributed to a reduced number of visits to some locations. Meteorological data were obtained from a weather station at Shannon Airport, Co. Clare, the data from which should be broadly representative of the Lower Shannon area.



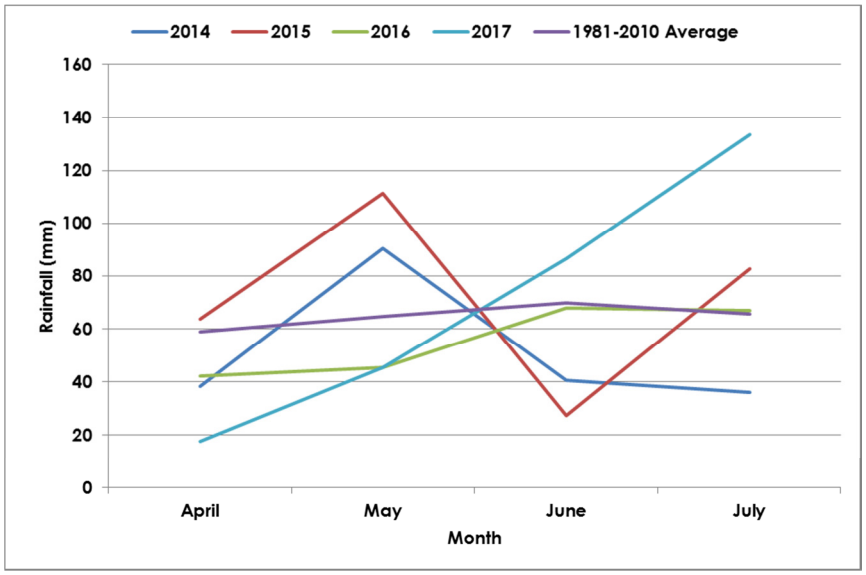


Figure 2.25. Monthly mean air temperatures (a) and total rainfall (b) from April to July over consecutive years (2014 - 2017) recorded at Shannon Airport (Met Eireann) in comparison with the 30 year (1981-2010) long-term average (LTA).

Plate 2.7. A sea lamprey redd on the Bilboa River, a tributary of the Mulkear River, at Cappamore, Co. Limerick.

2.2.6. Investigations on 'landlocked' sea lamprey

Inland Fisheries Ireland has been compiling information, data and sample material on `landlocked lamprey' for several years from some of Ireland's large fishery lakes, particularly Lough Conn and Lough Derg (Shannon). In doing so it is building on `historical' material initially compiled by the Inland Fisheries Trust from the late 1950s to the mid-1960s.

These fish are known to be sea lamprey, based on dental patterns. What is not known is whether these fish represent a true `land-locked' or non-migratory form of sea lamprey or whether they are merely juvenile sea lamprey that have begun their parasitic feeding phase while still in freshwater. The typical life history pattern is for the young, post-transformer, sea lamprey to migrate downstream from their natal sites and travel out to sea where they begin their parasitic feeding behavior.

A number of survey techniques and citizen science campaigns have been employed by the Habitats Directive team to investigate the occurrence and activities of juvenile sea lamprey in the 2010-2017 period. Active sampling has focused on the mayfly season on Lough Derg and Lough Conn, when there is a substantial sampling effort by anglers for brown trout and when the majority of reports of the feeding juvenile lamprey – as actual bodies or as attachment marks on captured fish – materialize.

The IFI sampling has included

- drift netting in open areas of the lake favoured by anglers
- boom boat electric fishing sheltered shallow bays of Lough Conn
- use of a scented (pike oil) floating drogue, towed along slowly behind an angling boat, to mimic the movement of a swimmer – these fish attaching to swimmers in Muckross Lake
- Walkover surveys on a number of streams flowing into the west side of Lough Conn and Lough Derg to investigate potential spawning locations and spawning activity

The Habitats team was particularly busy during May and June in 2017, attending angling competitions, networking with angles, boat-hire personnel and tackle shops with the aim of meeting people,

distributing information leaflets and seeking help with regard to specimens of lamprey taken, verbal reports and images of fish with lamprey attachment marks. The IFI staff attended trout angling competitions on Lough Conn and Lough Derg during 2017 to network with anglers, collect data from trout landed and to look for evidence of lamprey on landed trout. The team has been strongly supported by local RBD staff of IFI in all of the target lakes. This local networking has been invaluable in creating linkages and on foot of the local IFI staff involvement valuable information, photo images and samples have come forward. There appeared to be a consensus that lamprey attacks were much fewer in recent years, compared to some years previously. The anglers reported on lamprey taken feeding on pike as well as on trout. A competition on May 7th on Lough Derg landed 15 trout, none with lamprey marks.

The direct surveying has yielded small amounts of information and samples. The 'citizen science' or networking with anglers, mediated via IFI locally-based staff, has generated the majority of the information compiled to date by the Habitats team and this was again the case during 2017.

The team began compilation of collected data during 2017 to form a review paper to be submitted for publication in early 2018. The review is intended to present known information from Irish waters but will not answer the question as to whether the 'land-locked' form is truly non-migratory and distinct. It is considered that the answer must await a genetic study. The collection by the Habitats team of tissue samples from 'land-locked' lamprey provides the basis for a genetic study.

IFI has been part-funding an Irish Research Council-facilitated post-doctoral research on sea lamprey at University College Dublin over the last two years (2016 – 18). The research has two strands - (a) investigating use of environmental DNA or eDNA for detection of rare aquatic species of conservation importance and (b) use of citizen science approaches to data collection. In both cases the focus is on sea lamprey, with the citizen science element targeting the 'land-locked' sea lamprey.
The post-doctoral researcher was also successful in attracting a grant from the government Dept. of Agriculture (DAFM)- funded genetic resources grant aid scheme for a proposal to undertake a population genetics investigation of 'land-locked' sea lamprey and of anadromous sea lamprey. This investigation will address the issue of genetic uniqueness, or otherwise, of the 'land-locked' sea lamprey.

3. Shad Programme

3.1 Juvenile Shad Investigations

3.1.1 Kick sampling for shad eggs

Kick sampling for eggs is an established technique for assessing the spatial extent of allis and twaite shad spawning activity (CSM, 2015). In 2017 the method was trialled on the River Barrow (at St Mullins) and River Nore (at Inistioge), both of which are SACs for twaite shad. The 2 locations are at the top of the tidal influence and they experience annual spawning runs of shad during May – July. St Mullins, in particular, is well known for its run of shad and they are thought to spawn below the navigation weir which acts as a barrier to upstream migration.

Shad eggs are clear, non-adhesive, semi-buoyant and range in size from 1.5 to 5mm in diameter (usually 2.4mm). Samples were collected by kick sampling for 15sec upstream of a hand-held macroinvertebrate net (250 µm mesh). At each site, samples were taken working upstream to avoid re-recording eggs dislodged from an earlier kick sample. Bed material from the net was sorted by hand and any eggs were placed in bottles containing 70% ethanol for verification at a later date.

The River Barrow was sampled at low tide on 30th May 2017 during a period of warm weather and with a water temperature of 17.6°C. The first sample was collected in the main river channel approximately 10m downstream of St Mullins Lock. Water depths ranged from 0.7 – 1m on a slack to rising tide. A total of 7 eggs were collected from 15 kick samples. Sampling of the River Nore was carried out on 1st June with the site located 700m downstream of the bridge in Inistioge. Four eggs were collected from 7 kick samples in total. While it was not possible to distinguish between allis and twaite shad, all eggs were genetically tested and verified as shad eggs, confirming both of these locations as spawning grounds in 2017.

It is envisaged that this sampling technique for collecting shad eggs will be incorporated into the monitoring programme for twaite shad on an annual basis, with the main objective for 2018 to investigate potential spawning sites on the Munster Blackwater and Suir SAC rivers.

3.1.2 Beach seine netting survey of the River Barrow Estuary August 2017

A seine net survey was carried out at Fisherstown on the River Barrow estuary as part of IFI's Bass Conservation programme (Figure 3.1). This location is sampled on an annual basis as it is a good nursery site for juvenile fish. No shad were captured during the survey. This compares with a count of 69 juvenile shad captured from 6 hauls at Fisherstown in 2016. Depending on spawning success, shad numbers will vary on a year by year basis in the Barrow, Nore and Suir estuaries. Spawning success is dependent on water temperature and flow conditions in the river. High temperatures at the general spawning time in May/June were followed by a major flood event in 2017 (Figure 3.2) and it is likely that many eggs or shad larvae were flushed downstream and out to sea, with significant mortality for the species.

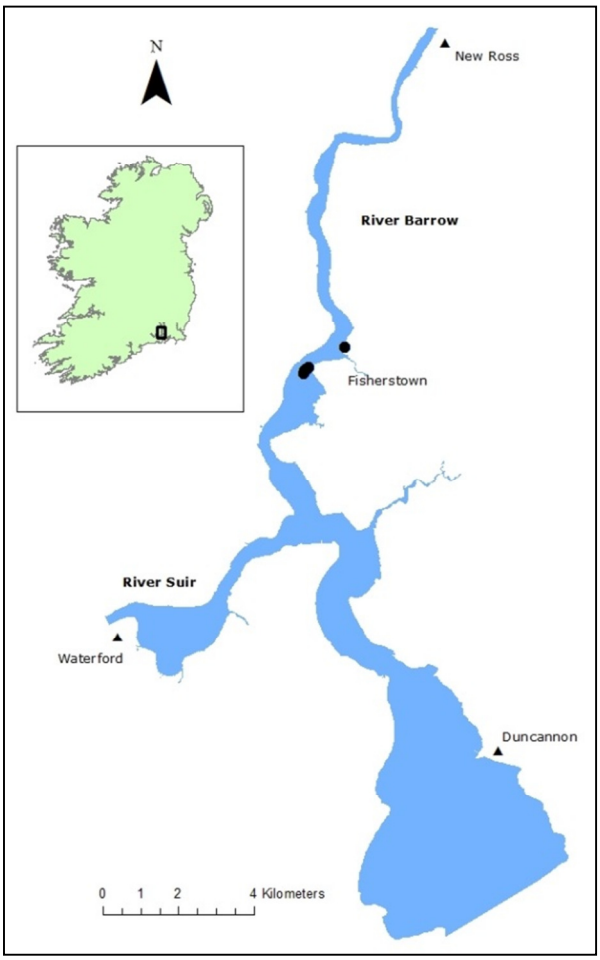


Figure 3.1. Location of seine net survey at Fisherstown on the River Barrow as part of IFI's National Bass Conservation Programme in 2017.

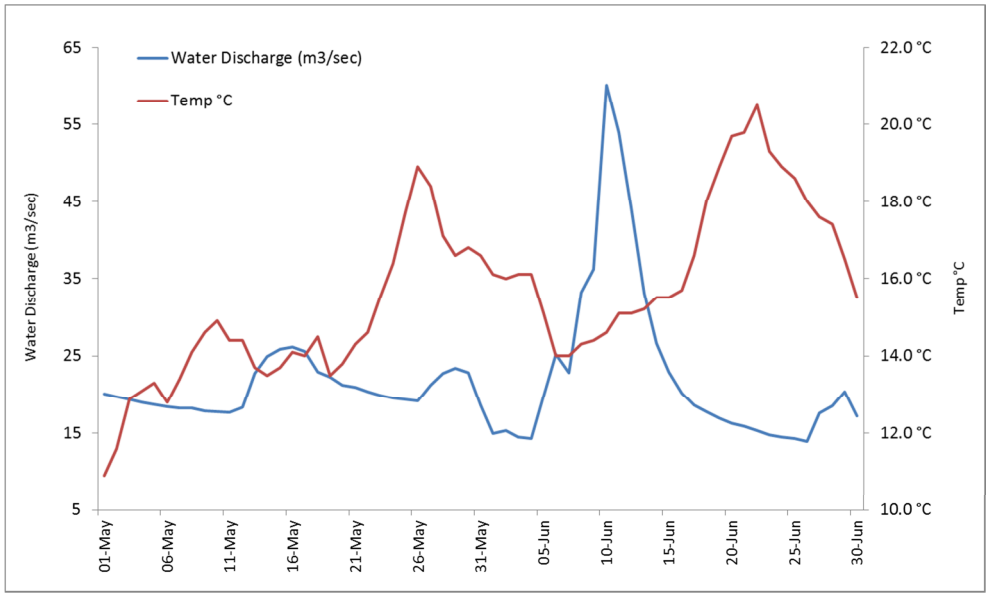


Figure 3.2. Mean daily water temperature (St. Mullins) and water discharge (Graiguenamanagh gauging station) data for the River Barrow during the shad spawning period in May/June 2017

JNCC (2015) *Common Standards Monitoring Guidance for Freshwater Fauna*, ISSN 1743-8160 (online) http://jncc.defra.gov.uk/page-3514

3.2 Trawling Surveys

The fish communities in a small number of Irish estuaries were surveyed *via* trawled transects during 2017. These surveys are conducted annually primarily to provide data for IFI's National Bass Programme. Species of interest to the Habitats Directive Monitoring Programme, namely twaite shad, smelt and lampreys, are also occasionally encountered. Repeat surveys for 2017 were undertaken on Waterford Harbour / Barrow-Suir Estuary and Youghal Harbour / Munster Blackwater Estuary during late August / early September. The trawling surveys were expanded to incorporate a new location in 2017, namely Wexford Harbour / Slaney Estuary. Towed transect trawling was undertaken by a commercial trawler and crew (Plate a.b.) with 2 IFI staff also on board to process catches.

Plate 3.1. Trawling a transect on the River Barrow at Fisherstown.

3.2.1 Waterford Harbour Trawling Survey

Trawling surveys on the Barrow-Suir Estuary / Waterford Harbour took place over two days (August 31st & September 1st). A total of 16 individual trawls were undertaken (Figure 3.3), ranging in duration from 5 to 16 minutes length (average 11.5 minutes) at locations in the lower Barrow and Suir (Fisherstown, Great Island, Kilmokea, Kings's Channel, Belview and Cheekpoint) as well as locations throughout Waterford Harbour (Passage East, Duncannon and Woodstown). Water temperatures encountered ranged from 16.3 to 18.5°C, with higher temperatures recorded in the vicinity of the cooling water outflow from the power generating stations at Great Island. Depth of the water column sampled varied from 1.4m to 15m, with trawling undertaken across the entire range of tidal conditions (flooding, high, ebbing, low). A total of 25 species were obtained on this occasion, similar to the range captured in 2016 (n=26) but considerably less than 2015 (n=35). A single twaite shad (266mm) was encountered at Great Island. No lamprey species were recorded.

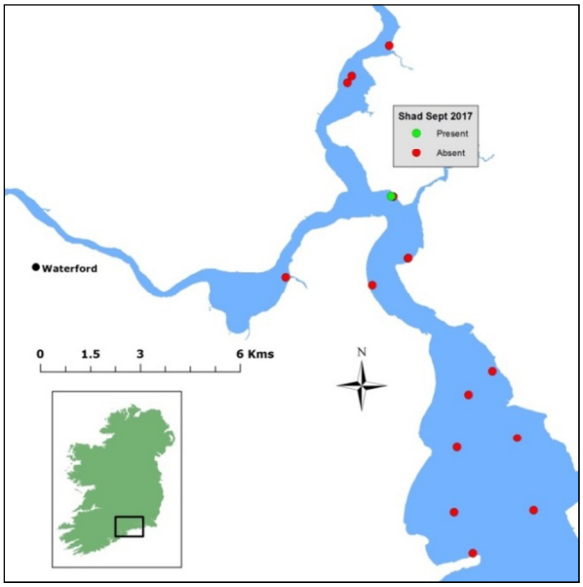


Figure 3.3. Incidence of capture of shad on trawling survey transects (n=15) in the Barrow-Suir Estuary / Waterford Harbour in September 2017.

3.2.2 Munster Blackwater Trawling Survey

Trawling surveys on the Munster Blackwater Estuary took place over two days (September 5th & 6th 2017). A total of 15 individual trawls were undertaken, ranging from 6 to 21 minutes in duration (average 12 minutes) at locations in the lower estuary as well as throughout the inner and outer harbour (Figure 3.4). Average water temperature was 16.2°C (range 15.5-16.6°C). The depth of water along transects varied from 1m to 8m. A total of 15 species, including twaite shad and smelt, were obtained on this occasion, lower than the total number encountered in 2016 (n=23). Single twaite shad (221mm & 355mm) were captured on each of two trawls in the lower section of the estuary at Ballinaclash and Greenlands, respectively.

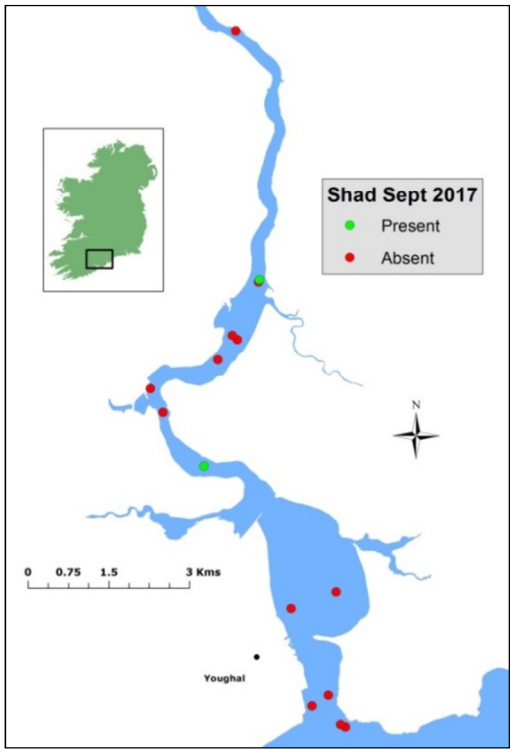


Figure 3.4. Incidence of capture of shad on trawling survey transects (n=15) in the Munster Blackwater Estuary/Youghal Harbour in September 2017.

3.2.3. Wexford Harbour Trawling Survey

Trawling surveys on the Slaney Estuary/Wexford Harbour took place over two days (September 7th & 8th 2017). A total of 12 trawls were undertaken, ranging from 5 to 21 minutes in duration (average 11 minutes) at locations in the lower estuary as well as throughout the harbour (Figure 3.53). Average water temperature was 17°C (range 16.3-17.5°C). The depth of water along transects varied from 0.7m to 3.7m. A total of 11 species were obtained on this survey. Unfortunately no shad were captured along any of the transects.

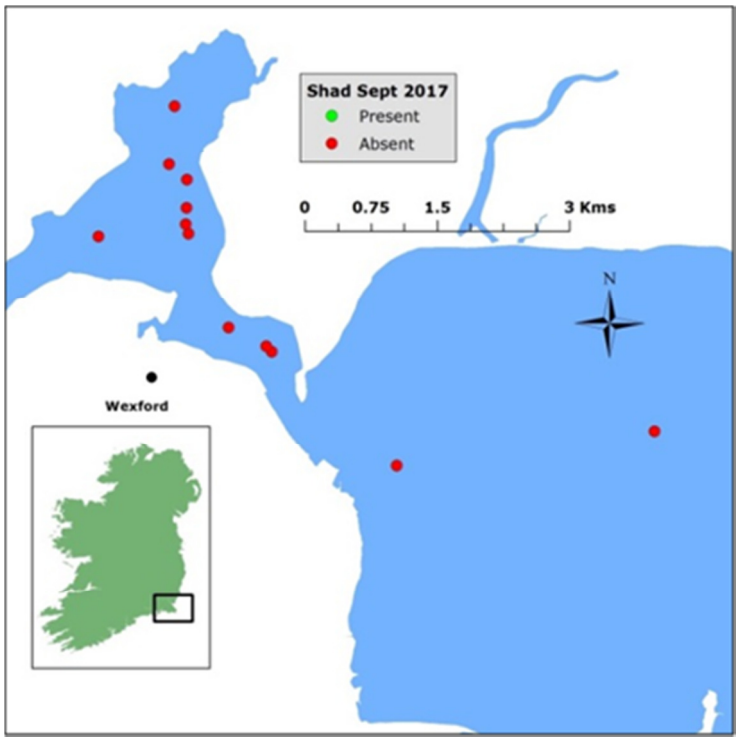


Figure 3.5. Incidence of capture of shad on trawling survey transects (n=12) in the Slaney Estuary/Wexford Harbour in September 2017.

Plate 3.2. Trawling in Waterford Harbour with Creadan Head in the background.

3.2.4. Marine Caught Shad

Records of allis shad (*Alosa alosa*) and twaite shad (*Alosa fallax*) exist for around the Irish coast but very little is known on their movements at sea once they leave the estuaries. An informal arrangement exists between the Habitats Directive team and Bord Iascaigh Mhara (BIM), the Marine Institute (MI) and the Sea Fisheries Protection Authority (SFPA) for the sharing of information on marine caught shad. On occasion the Habitats team has acquired shad bodies which were taken as by-catch from commercial fisheries or from specific surveys carried out by BIM and the MI for target species or as part of general fish stock assessments.

A single female allis shad was obtained from a BIM survey off the SW coast of Ireland in 2017 (Table 3.1).

Table 3.1. Marine caught allis shad obtained from a BIM survey in 2017.

Species	Date	Capture Method	Location	Sex	Fork length (cm)	Total length (cm)	Weight (g)	Gill raker Count
Allis Shad	March	Raised Fishing Line	SW Coast	Female	34	38	317	95

3.3. Anadromous Shad Investigations

The acoustic telemetry study on the Barrow-Nore-Suir, initiated in 2012, was continued during 2017. A total of 14 acoustic receivers were deployed throughout the study area during 2017, including 4 on the Suir (Carrick-on-Suir, Fiddown, Grannagh & Waterford City), 2 on the Nore (Inistioge & Rathsnagadan), 7 on the Barrow (5 upriver from New Ross to St Mullins, 2 downriver from New Ross at Barrow Bridge/Kilmokea) and 1 in outer Waterford Harbour at Passage East. In addition, an array of acoustic receivers was deployed throughout the tidal section of the Munster Blackwater between Cappoquin and Youghal during May 2017 by IFI Research colleagues as part of a tracking study for the National Eel Monitoring Programme. These receivers would detect tagged shad movements into this adjacent spawning river (Figure 3.6).

Plate 3.3. Twaite shad angling on the River Barrow at St Mullins.

A total of 18 Vemco V9 transmitters were available for external attachment to shad during 2017, including 10 with extended battery life (440 days) allowing the potential to track returning fish over 2 consecutive seasons. As with 2016, it was decided to concentrate on angler caught fish for tagging in 2017, as this might allow an element of experimental design to be incorporated into the study, e.g. equal numbers of males and females as well as a spread of sizes rather than fish caught randomly during drift netting. Angling for shad was undertaken on the Suir at Carrick-on-Suir (May 11th, 22nd & 24th) and on the Barrow at St. Mullins (May 23rd). Drift net sampling on the Barrow was also employed on one occasion (May 16th) at Mountelliott, immediately downstream of the confluence with the Nore. A total of 17 twaite shad were tagged between May 11th and 24th, 10 on the Suir (3 males, 7 females) and 7 on the Barrow (6 females, 1 unknown).

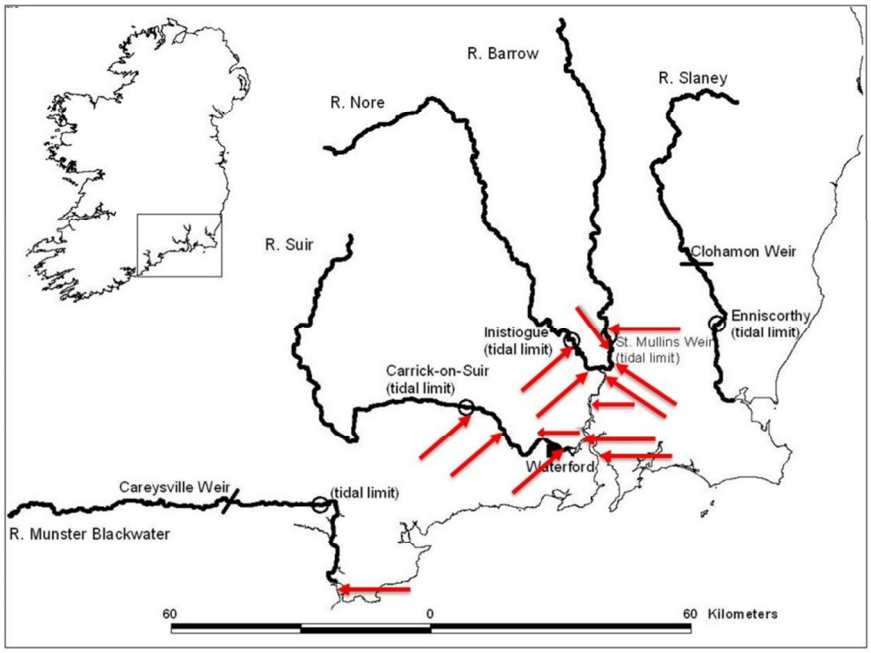


Figure 3.6. Locations of acoustic receivers during 2017 to monitor shad movements

Tagging batches of twaite shad at the upper tidal limits of both the Barrow and Suir yielded interesting results. Tagged fish from both sites typically dropped back to a common area in the lower estuary around Cheekpoint and Great Island. Fish were also detected frequently in the section of the Suir from Grannagh downstream through Waterford City. A number of fish made repeat journeys upriver during late May and early June, coinciding with a steady rise in water temperatures (Figure 3.7).

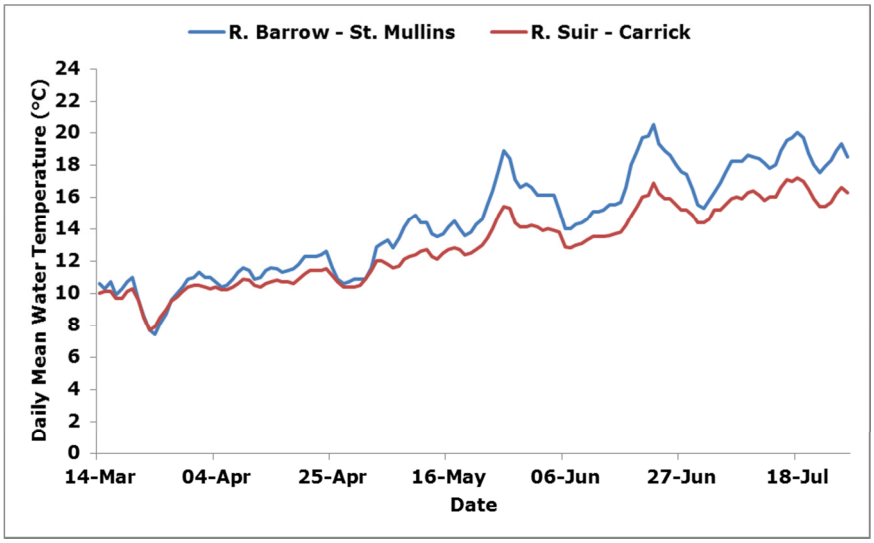


Figure 3.7. Water temperatures (Daily Mean, °C) on the River Barrow (St. Mullins) and the River Suir (Carrick-on-Suir) from mid-March to late-July 2017.

A definite spawning event on June 2nd to 3rd was simultaneously evident at both Carrick-on-Suir and St. Mullins from the directed movement of tagged fish. During this time 2 female fish, both initially tagged in Carrick-on-Suir (#267 & #39497), made spawning migrations into the Barrow, demonstrating plasticity of behaviour. A male fish, again tagged in Carrick-on-Suir, made forays upriver into the mid-sections of the Barrow and the Nore during early July. Tagged fish were finally detected at Barrow Bridge and Passage East from early June (6th) through to late July and even early August (8th), presumably having returned to sea.

Plate 3.4. An acoustic tagged Twaite shad prior to release on the River Barrow at St Mullins.

The annual St Mullins twaite shad angling competition was held on Sunday May 7th. Water temperatures during the afternoon of the competition averaged 14 °C on a flooding tide. Fishing was a slight improvement on previous years with 20 fish recorded, the largest of which was 990g. During 2017

large specimen sized fish were, according to anglers, still relatively uncommon with catches dominated by smaller fish weighing less than 1kg. Six twaite shad claims were forwarded to Irish Specimen Fish Committee (ISFC) for 2017, all taken in the River Barrow in May. A total of 15 specimen sized (>1100g) fish were recorded for this location during 2016, in comparison with 34 for 2015 and 37 for 2014.

3.4. Killarney Shad

Introduction

Lough Leane is located in the Killarney National Park, Macgillycuddy's Reeks and Caragh River Catchment Special Area of Conservation (SAC). This is an SAC for a number of plant and animal species including the three lamprey species and the Killarney shad (*Alosa fallax killarnensis*). The SAC is designated for a number of Annex I habitats including alluvial woodlands and both upland and lowland oligotrophic lakes. Lough Leane is the largest of the Killarney lakes at 1978 hectares and the maximum depth is 60 meters.

There are a number of fish species present in Lough Leane including brown trout, salmon, sea trout, ferox trout, tench, eel, perch, flounder, arctic char and Killarney shad (Kelly, 2015r). Killarney shad are a non-migratory sub species of twaite shad and are only present in Lough Leane. Under the EU Habitats Directive 92/43/EEC, they are listed as an Annex II and V species. Inland Fisheries Ireland has undertaken a number of fish stock assessment surveys of Lough Leane as part of the Water Framework Directive monitoring programme. Surveys were completed in a three year rolling cycle.

Materials and Methods

The most recent survey was undertaken over three nights from 11th to the 14th September 2017 by the lakes survey team within IFI. The Killarney Shad captured during the survey were shared with the Habitats Directive team in order that both teams gained from the survey. A total of twenty-four benthic monofilament multi-mesh (12 panel, 5-55mm mesh size) CEN standard survey gill nets (6 @ 0-2.9m, 4 @ 3-5.9m, 4 @ 6-11.9m, 4@ 12-19.9m, 3 @ 20-34.9m and 3 @ 35-49.9m), three floating nets (12 panel, 5-55mm mesh size) and six sets of Dutch fyke nets were deployed randomly in the lake. Four-panel braided nets were also deployed at 5 locations. The four panel nets consist of 4 x 27.5 meter panels with different mesh sizes connected together randomly. The gang consists of a 4.25" panel (55mm mesh knot to knot), 4.75" panel (60mm mesh knot to knot), 5.5" panel (70mm mesh knot to knot) and a 7" panel (90mm mesh knot to knot) (Connor, 2018). In addition, six pelagic multi mesh nets were deployed (12 panel, 6.25-55mm mesh size) 30m x 6m CEN standard survey gill nets. A hydroacoustic and pelagic gill netting survey was also carried out on Lough Leane between the 11th to the 14th September 2017.

Results

A total of nine fish species were recorded on Lough Leane in September 2017, with 555 fish being captured. Brown trout was the most common fish species recorded. Perch, rudd, salmon, arctic char, tench and eels were also recorded (Connor, 2018). In total 45 Killarney shad were captured over the course of the survey. The length of Killarney shad ranged between 16.1 and 21.3 centimetres (Figure 3.8).

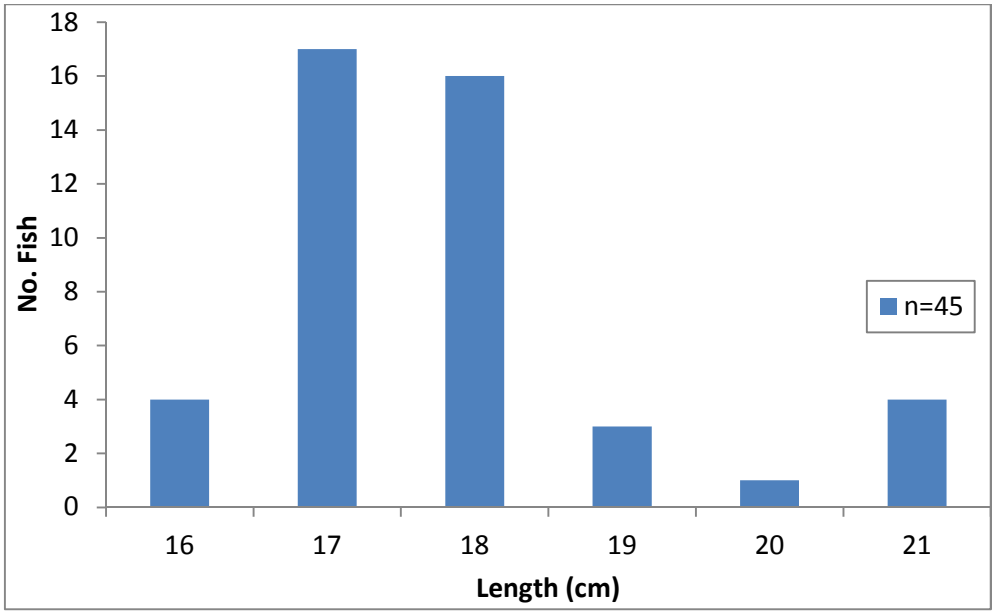


Figure 3.8. Length frequency of Killarney shad, September 2017.

The length versus weight analysis of Killarney shad revealed that the weight of the fish were 2.12 times that of the length based on mean values (Figure 3.9).

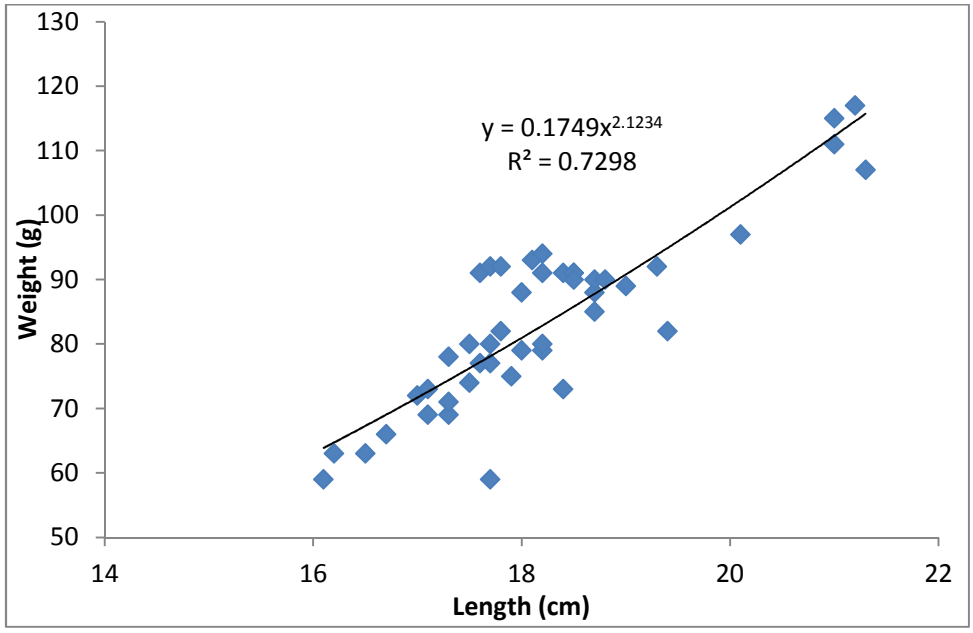


Figure 3.9. Length versus weight of Killarney shad, September 2017.

The majority of Killarney shad were found to be consuming zooplankton, with high numbers of *Bosmina* sp. recorded in the gut contents. The ratio of males to females demonstrated that the majority of the fish in the sample were male fish. These males demonstrated a lack of gonadal development consisting of many immature fish. One female was noted to have undertaken spawning.

Table 3.2. Ratio of males to females in Killarney shad from Lough Leane, September 2017.

	Lough Leane			
	Male	**Female**	**Immature**	**n=**
September	0.64	0.09	0.27	45

Discussion

Lough Leane has been surveyed every three years since 2008 as part of the Water Framework Directive monitoring programme. The sample collected during the most recent survey was the largest sample size to date. The fish present in the sample were all of a similar size class, with no young of the year or smaller fish recorded in the sample. The length versus weight of the fish was similar across the sample.

The majority of the fish captured were males with little gonadal development. The presence of a spent female indicated that recent recruitment had occurred.

Analysis of the hydroacoustic data will enable the enumeration of the population size of Killarney shad in Lough Leane. This, along with the population structure and distribution, is a requirement when reporting for Article 17 of the Habitats Directive on the status of the Killarney shad population in this lake.

4. Pollan Programme

4.1 Pelagic netting on Lough Derg, 2017

Pollan are protected as an Annex V species under the Habitats Directive (92/43/EEC). Populations of pollan are known in Loughs Allen, Ree and Derg within the Republic of Ireland (Figure 4.1). Pollan are also present in two lakes in Northern Ireland, Lough Neagh and Lower Lough Erne. Previous investigations by IFI have used pelagic netting as a sampling device for this species. A seasonal programme of sampling was undertaken with success on Lough Allen in 2015-16 and Lough Ree in 2016-2017, in summer (June), autumn (September) and winter (February 2018). During 2017 this seasonal sampling strategy was employed in Lough Derg.

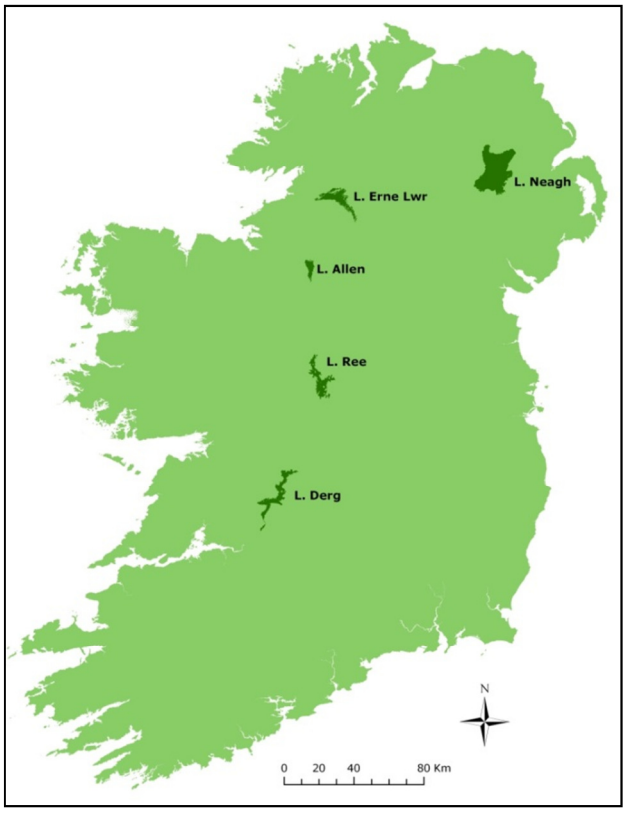


Figure 4.1. Map outlining locations of pollan lakes in Ireland.

Materials and Methods

Using information previously collected in surveys by IFI, net locations were based on areas of the lake where these studies had gained positive results for pollan (Figure 4.2). The deepest section of Lough Derg lies in the southern area of the lake, deeper waters are known to be the preferred habitat of pollan.

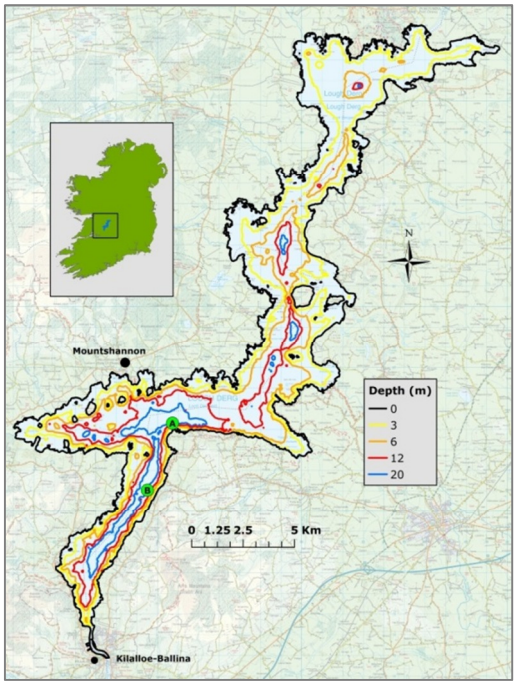


Figure 4.2. Depth contour map outlining locations of pelagic nets on Lough Derg (highlighted in green).

Pelagic monofilament multi-mesh (30 meter x 6 meter, 12 panel, 5-55mm mesh size) CEN standard survey gill nets were used for the survey. The net locations were uploaded to a handheld GPS (Global Positioning System). This GPS was used on site to determine where the nets were to be deployed. The lake depth was measured at the beginning and end of each net in order to position them in the correct depth zone. Nets were generally deployed in an east to west direction and left to sample overnight. The nets were set to fish at specific depths in the water column i.e. they were sampling pelagically. Six nets were deployed at different depth zones to monitor the whole pelagic zone of the lake (Table 4.1). Areas A and B (Figure 4.2) were sampled twice in June. No pollan were caught in Area B so the subsequent sampling was undertaken at Area A (Figure 4.2).

Table 4.1. Number of pelagic nets set in depth zones in Lough Derg, 2017-18

Depth (m)	June 2017 (A)	June 2017 (B)	September 2017 (A)	February 2018 (A)
0-5.9	1	1	1	1
6-11.9	1	1	1	1
12-17.9	1	1	1	1
18-23.9	1	1	1	1
24-29.9	1	1	1	1
30-35.9	1	1	1	1
Total	**6**	**6**	**6**	**6**

The nets were deployed in June (2017), September (2017) and February (2018). This was to identify any seasonal changes within the population structure and to examine gonad development and timing of spawning. Due to the movement of pollan to, presumed, shallow exposed gravelled areas during spawning times, and to avoid catching ripe fish in any numbers, it was decided to complete the sampling cycle in February, following spawning time. If spent fish were captured, it would indicate that recent recruitment had occurred.

As the nets were retrieved, any fish which were alive were measured, scales collected for ageing and the fish were released. The remaining fish were removed from the nets and the fish from each net retained in a labelled bag, specific to each net. These fish were frozen until such time that they were dissected. During the dissection process the species, length, weight, scales, sex, gill rakers, maturity and stomach contents of all fish captured were collected.

Results

Pollan were captured during the June and September sampling events. No pollan were captured during the February survey. When sampled in June all nets had pollan present. In September five of the six nets had pollan present. The highest numbers of pollan were caught during the September survey. In June and September the majority of fish were captured in the two deepest nets set from 24-30m and 30-36m (Figure 4.3). No pollan were caught in the surface net in September.

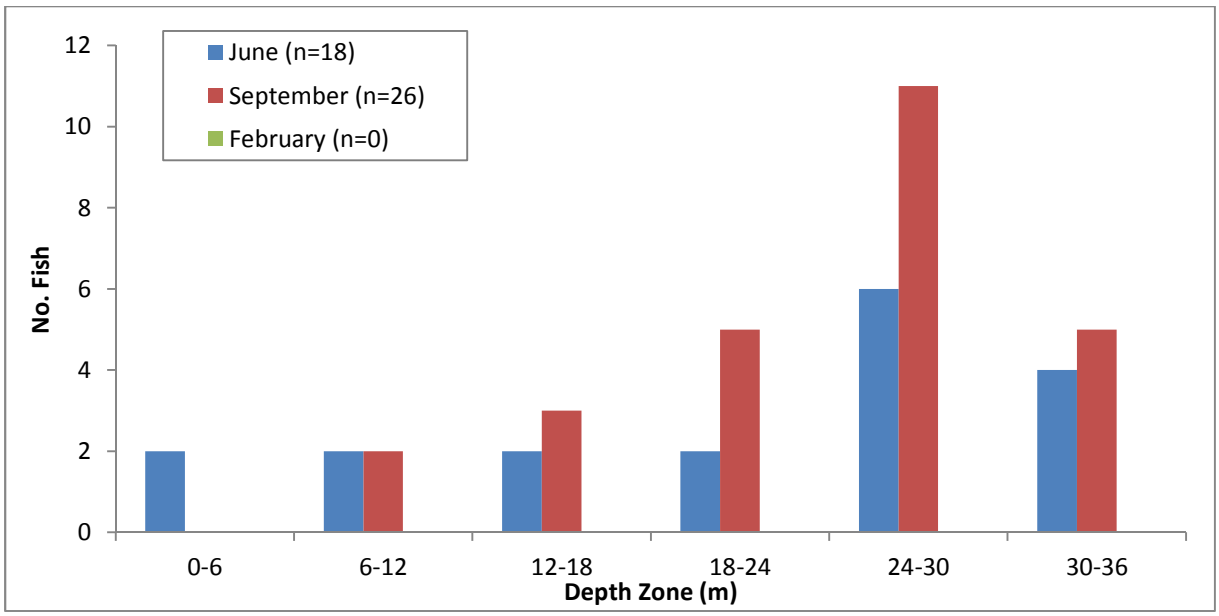


Figure 4.3. Number of pollan captured at different depth zones across a temporal variation on Lough Derg.

Plate 4.1. Lough Derg, September 2017.

The length of pollan captured ranged between 160 and 275 millimetres (Figure 4.4). Two size classes were observed in June – 160-180mm and 210-230mm. In the June sample no fish were captured less than 160mm, at this time pollan were present in the nets at the six different depth zones (Figure 4.4).

During September all fish captured were greater than 180mm, no smaller fish were recorded during the sampling. Pollan were present in the five nets deployed below the 6 meter depth zone. The most productive net was the net deployed at 24-30m.

During February, no pollan were recorded. The fish encountered during this survey included roach, trout and perch.

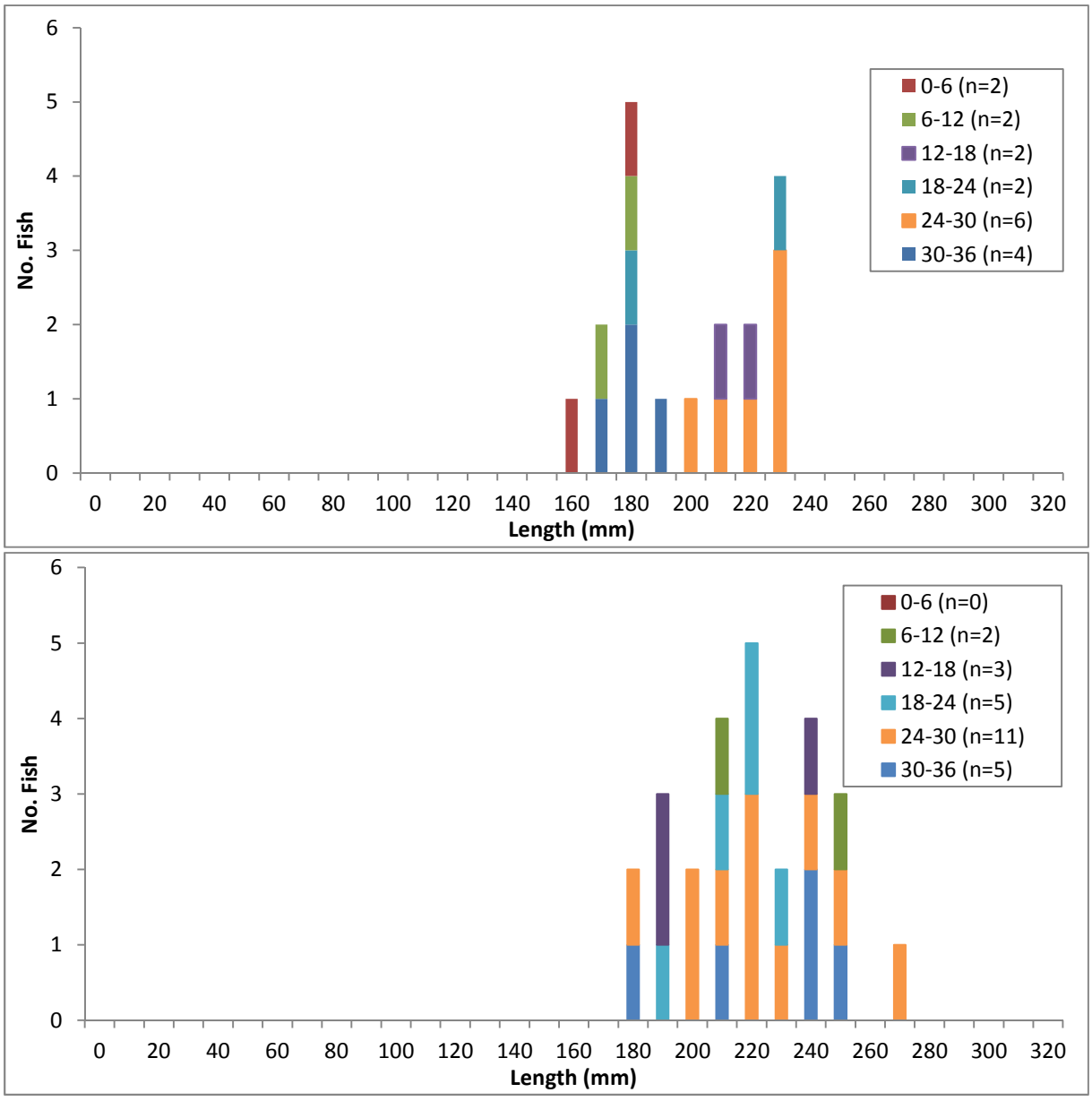


Figure 4.4. Length frequency of pollan caught in specific depth zones during June and September, 2017 on Lough Derg.

The length - weight relationship was compared for pollan across the two positive sampling occasions (Figure 4.5). Length-to-weight comparisons were similar in both sampling events. No fish greater than

234mm were present in the June sample; however fish larger than this were present in the September sample.

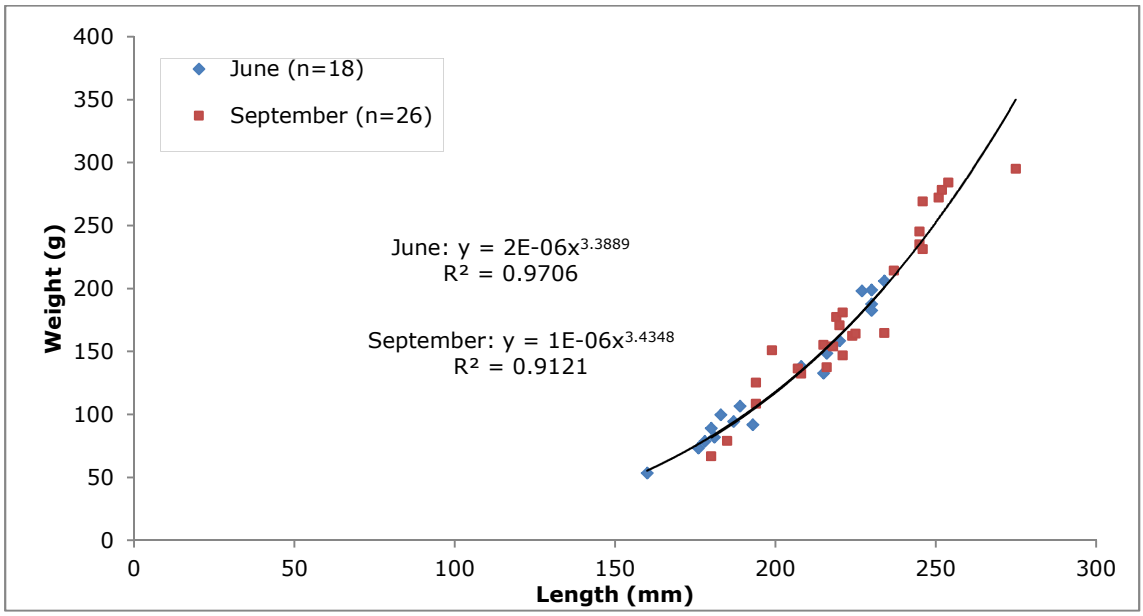


Figure 4.5. Length versus weight of pollan caught across a seasonal variation on Lough Derg.

The stomachs of the pollan were retained during dissection for further investigation into their dietary habits.

Information from dissected fish revealed the presence of a population comprising of more males than females on the June sampling occasion (Table 4.2). The reverse was the case when sampled in September. The September survey, when the highest numbers of individuals were captured, displayed the largest variation in the male to female ratio. During June, mature females ranged between 178 and 234 millimetres, mature males ranged between 176 and 230 millimetres. The length of immature fish was 160 millimetres. When sampled in September mature females ranged between 185 and 258 millimetres, with males sizes between 180 and 275 millimetres.

Table 4.2. Ratio of males to females in pollan from Lough Derg.

	Lough Derg			
	Male	**Female**	**Immature**	**n=**
June	0.50	0.44	0.06	18
September	0.35	0.65	0	26
February	0	0	0	0

Discussion

The seasonal survey of Lough Derg gave an insight into pollan population structure on the lake. Three quarters of the fish were found in the nets deployed below 18 meters. Zooplankton comprised the majority of the pollan diet. Zooplankton migrate up and down in the water column, with the pollan following the movement of the zooplankters. No fish were present in the smaller size classes which would represent young of the year. This could be an indication that no recent recruitment had

occurred over the previous winter or that young-of-year fish occur in separate areas of the lake. The modal peak displayed during the June sampling (180 millimetres) was skewed to 220 millimetres by the September sampling.

The length versus weight comparison revealed a similar relationship in weight as a function of length in June and September, with a number of larger fish caught in the September survey. When gonadal development was investigated, the female fish displayed greater gonadal development on both positive sampling occasions than males.

Article 17 of the Habitats Directive requires the estimation of population size, along with the population structure and species distribution of pollan for the EU. No fish were captured which were less than 160 millimetres in the Lough Derg survey, representing an absence of young of the year in the sample. The numbers of fish caught during the sampling occasions indicated a small sample of pollan within the lake. The February survey was undertaken with the prospect of catching spent fish which would demonstrate recent recruitment. The absence of fish in the February sample meant no assessment could be made on the reproductive state of adult fish. As neither spent fish nor young of the year were captured in any numbers it could be argued that not all population stages were represented in the sample collected.

5. Smelt Programme

5.1. Juvenile Smelt Programme

5.1.1 Beach seine netting survey of the River Barrow Estuary August 2017

The Habitats team works with IFI's Bass Conservation team in a programme of beach seining for juvenile fish. At a single location (Fisherstown) on the River Barrow estuary, 181 juvenile smelt were captured from 7 seine net hauls (Figure 5.1). The smelt ranged in size from 48mm – 92mm (Figure 5.2) with an average length of 67mm. This compares with 114 smelt from 6 seine net hauls taken at the same location in 2016.

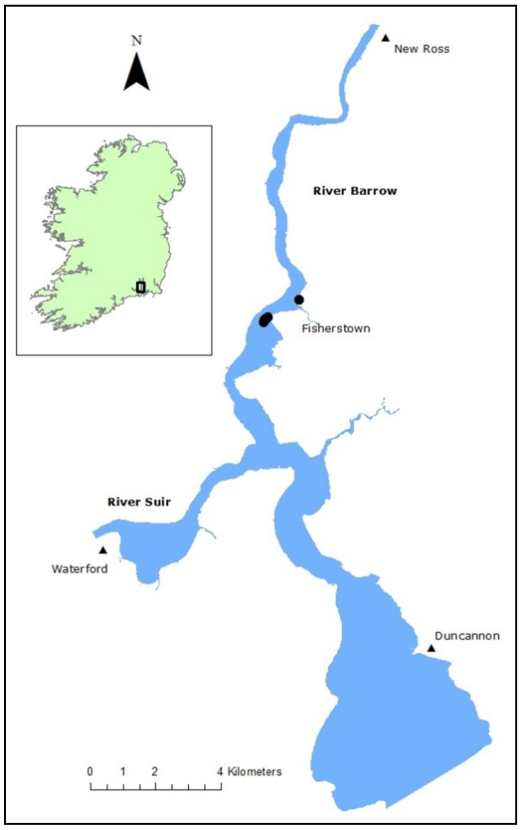


Figure 5.1. Location of seine net survey at Fisherstown on the River Barrow as part of IFI's National Bass Conservation Programme in 2017

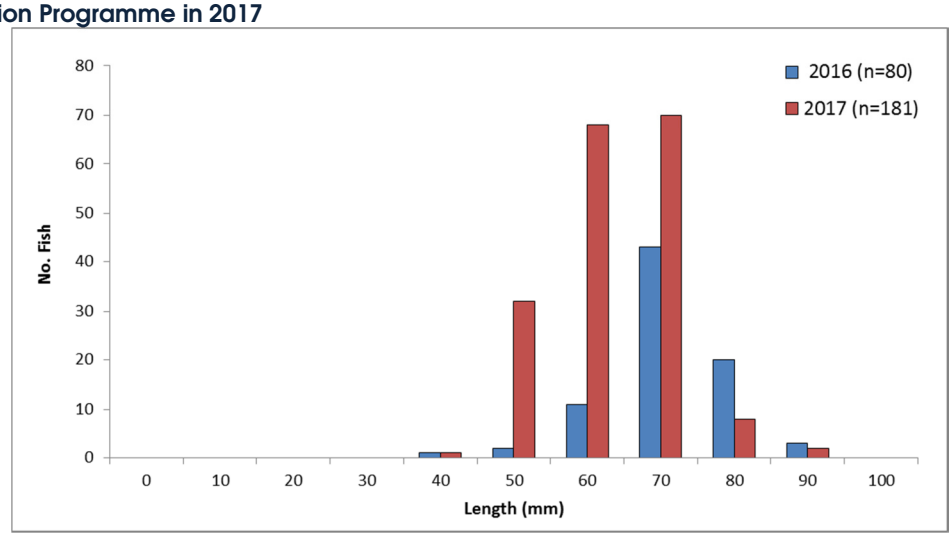
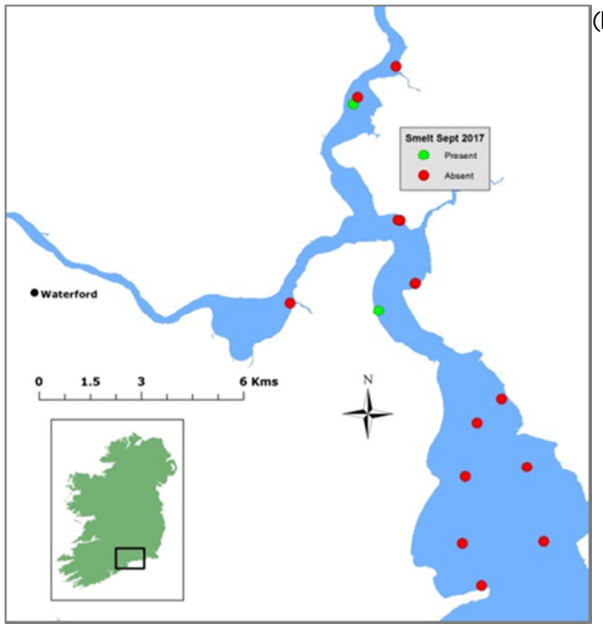


Figure 5.2. Length frequency of juvenile smelt from the River Barrow and River Suir (2016) and the River Barrow (2017)

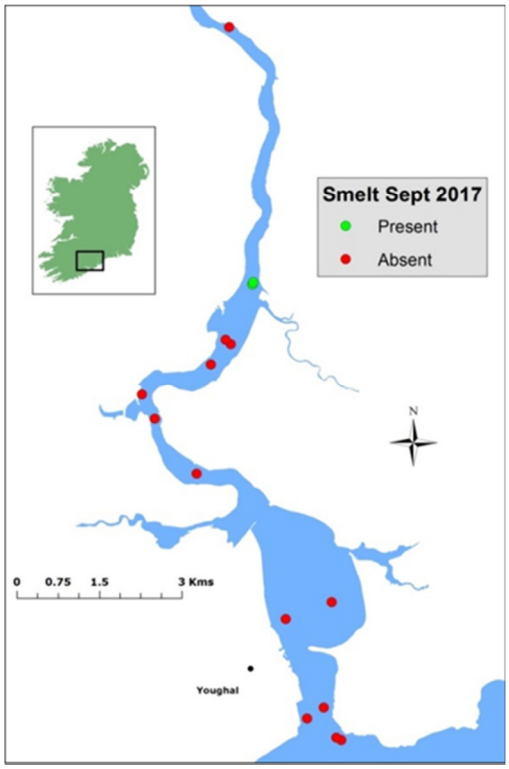
5.1.2 Trawling Surveys

Smelt were encountered during some of the trawling surveys documented previously (Section 3.2). Six individuals, ranging in length from 166 to 245mm, were captured on the Barrow-Suir Estuary / Waterford Harbour along transects at Fisherstown (n=1 smelt) and Passage East (n=5 smelt), respectively (Figure 5.3a). On the Munster Blackwater Estuary, smelt (n=5, 166mm-245mm) were captured on two adjacent trawls at Ballinaclash (Figure 5.3b). No smelt were captured in any of the12 trawls undertaken on the Slaney Estuary / Wexford Harbour (Figure 5.3c).

(a)



(b)



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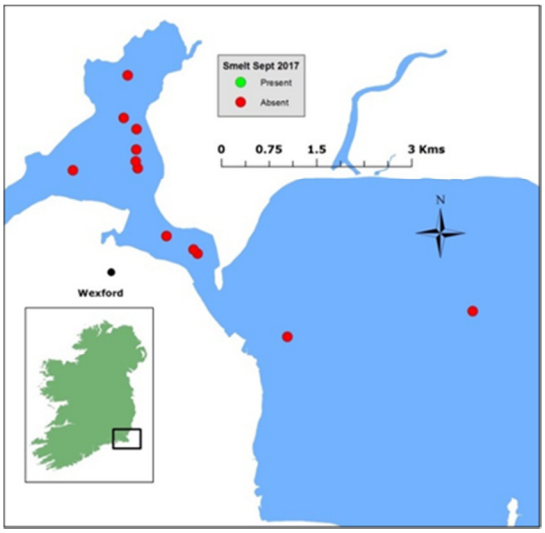

Figure 5.3 Incidence of capture of smelt on trawling surveys in (a) the Barrow-Suir Estuary / Waterford Harbour (n=15 transects), (b) the Munster Blackwater Estuary/Youghal Harbour (n=15 transects) and (c) the Slaney Estuary/Wexford Harbour (n=12 transects) during September 2017.

6. Char Programme

Introduction

The Habitats Directive team undertakes sampling on a number of lakes annually to expand the existing knowledge and gain an up to date picture of Arctic char (*Salvelinus alpinus*) populations. In 2017, four lakes were identified for sampling. Two of the lakes were in Co. Kerry and two were in Co. Donegal. Unfortunately, due to inclement weather conditions when the lakes in Co. Donegal were due to be sampled, the surveys were cancelled. The two lakes sampled in Co. Kerry were Loughs Coomasaharn and Anscaul. Both lakes were referred to in `Arctic Char – *Salvelinus Alpinus* (L.) in Ireland – A millennium review of its distribution and status with conservation recommendations' (Igoe, 2003). The first record of Arctic char in Lough Anscaul was a fish caught by rod and line in 1994 (Quigley, 1997). Subsequent efforts to capture spawning Arctic Char from Lough Anscaul were unsuccessful (McCarthy, 2004). There have been a number of investigations into the Lough Coomasaharn Arctic char. It was postulated that the Arctic char present on Lough Coomasaharn were a separate species of char, due to the different number of gill rakers and body shape than those of other populations such as from Lough Melvin (Twomey, 1960).

Lough Coomasaharn is located in the Killarney National Park, Macgillycuddy's Reeks and Caragh River Catchment Special Area of Conservation (SAC). This is an SAC for a number of plant and animal species including salmon and otter (Figure 6.1 and Table 6.1). Lough Anscaul is located in Mount Brandon Special Area of Conservation (SAC). This is an SAC for a number of plant and animal species including freshwater pearl mussel (Figure 6.1 and Table 6.1). The SAC is designated for a number of Annex I habitats including oligotrophic waters containing very few minerals and oligotrophic to mesotrophic standing waters. These habitats are ideal to support char populations due to their lack of pollution and low nutrient levels. Between 2009 and 2017 the Habitats Directive team has sampled twenty six lakes for Arctic char (Figure 6.1). Two of these have been sampled twice (Loughs Nalugraman and Greenan) as there is water abstraction from them which could have negative impacts on juvenile fish. Of the twenty six lakes sampled, 18 had Arctic char present.

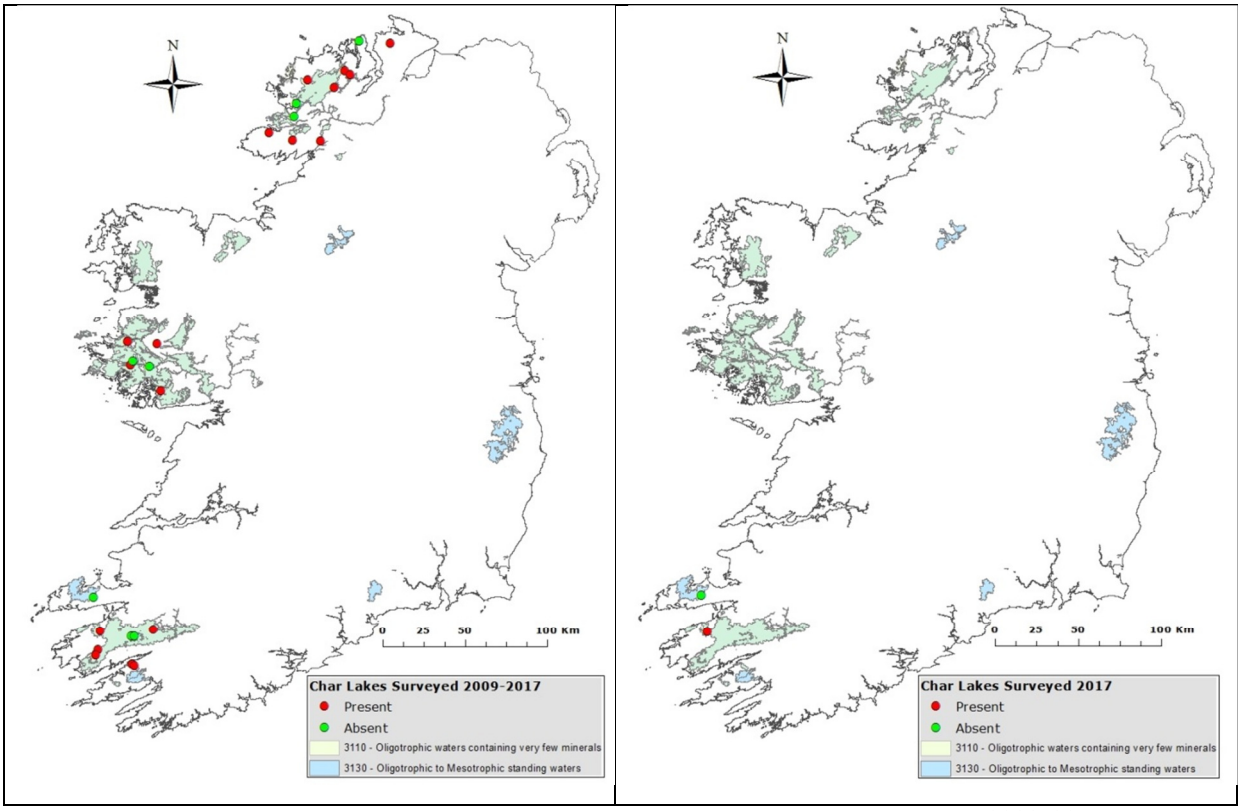

Figure 6.1. Map showing locations of lakes surveyed by the Habitats team between 2009-2017 and lakes sampled for Arctic Char during 2017.

Materials and Methods

Lake surveys were undertaken using CEN Standard Guidelines for lake monitoring (Kelly, 2003). Using the area and maximum depth of the lake the number of nets in the different depth zones was calculated (Table 6.1). Prior to each survey a bathymetric survey was undertaken to map the depth of the lakes. Using this information, a model of the lake was created. This yielded the different contours identifying the differing depth zones. A numbered grid was placed over the lake. Using this information, random net locations were chosen in the different depth zones. Three types of nets were used including fyke nets, benthic monofilament multi-mesh (12 panel, 5-55mm mesh size) CEN standard survey gill nets and surface floating monofilament multi-mesh (12 panel, 5-55mm mesh size) CEN standard survey gill nets (Table 6.2). The random net locations were uploaded to a handheld GPS (Global Positioning System). This GPS was used on site to determine where the nets were deployed. The lake depth was measured at the beginning and end of each net in order to position them in the correct depth zone. Nets were deployed in random directions in relation to the shoreline.

Table 6.1. Physical characteristics of the individual lakes sampled during July and August 2017.

	Lough Anscaul	Lough Coomasaharn
Area (hectares)	25.7	80.4
Maximum Depth (m)	27.3	62.6
SAC	3130	3110 & 3130

3110 - Oligotrophic waters containing very few minerals of sandy plains (Littorelletalia uniflorae)

3130 - Oligotrophic to mesotrophic standing waters with vegetation of the Littorelletea uniflorae and/or Isoeto-Nanojuncetea

Table 6.2. Number and type of nets deployed in different depth zones.

Net Type	Depth (m)	Lough Anscaul	Lough Coomasaharn
Benthic Nets	0-2.9	2	4
	3-5.9	2	4
	6-11.9	2	5
	12-19.9	2	2
	20-34.9	2	2
	35-49.9	-	2
Surface Nets		2	4
Fyke Nets		3	3
Total		**15**	**26**

As the nets were retrieved, any fish that were alive were measured and scales were collected. The fish were then released back into the lake. The remaining fish were removed from the nets and the fish from each net were retained in individual labelled plastic bags for dissection at a later date. During the dissection process the species' length, weight, scales, sex, gonad maturity and stomach contents were collected. Scales were used to determine the age of the fish. Any Arctic char specimen was photographed for further morphometric analysis, the stomach contents were retained, the gill rakers were removed for counting and a tissue sample was retained for future genetic studies.

Results

In total six species of fish were recorded across the two lakes (Table 6.3). Arctic char were present in Lough Coomasaharn but were not recorded in Lough Anscaul. Brown trout and eel were recorded in both lakes.

Table 6.3. Number and species of fish captured in different nets and depth zones.

	Net Type	Lough Anscaul	Lough Coomasaharn
Brown Trout *Salmo trutta*	Benthic Nets	55	16
	Surface Nets	3	1
	Fyke Nets	1	11
Atlantic salmon *Salmo salar*	Benthic Nets	1	
	Surface Nets		
	Fyke Nets		
Arctic Char *Salvelinus alpinus*	Benthic Nets		28
	Surface Nets		
	Fyke Nets		
Sea trout *Salmo trutta*	Benthic Nets		1
	Surface Nets		
	Fyke Nets		
European eel *Anguilla anguilla*	Benthic Nets		1
	Surface Nets		
	Fyke Nets	5	16
Three spined stickleback *Gasterosteus aculeatus*	Benthic Nets	23	
	Surface Nets		
	Fyke Nets		

Lough Anscaul

Lough Anscaul is located within the Owenscaul catchment on the Dingle peninsula in County Kerry. Lough Anscaul was sampled over one night, the 31st July to 1st August, 2017.

Plate 6.1. Lough Anscaul, July/August 2017.

Based on the bathymetric survey, fourteen nets were deployed at predetermined locations (Figure 6.2).

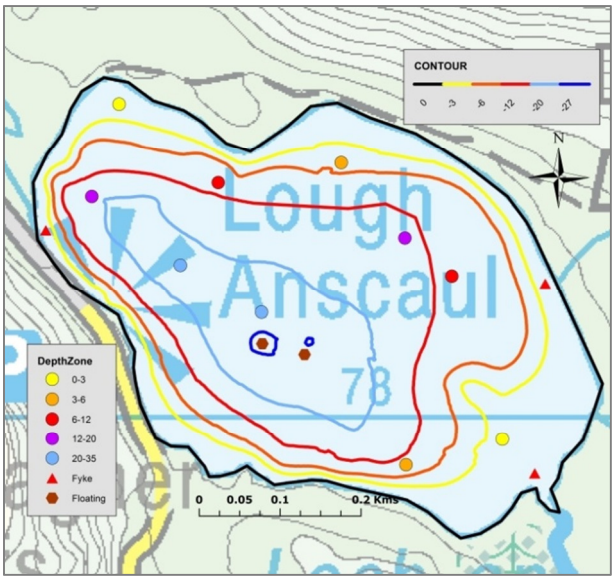

Figure 6.2. Map showing net locations for Lough Anscaul, July/August 2017.

Brown trout, European eel and three spined stickleback were captured during the survey of this lake (Table 6.4). No Arctic char were caught during the survey.

Table 6.4. Number of each fish species captured by each gear type during the survey on Lough Anscaul, July/August 2017.

Net Type	Depth (m)	Brown trout *Salmo trutta*	Atlantic Salmon *Salmo salar*	European eel *Anguilla anguilla*	Three spined stickleback *Gasterosteus aculeatus*
Benthic Nets	0-2.9	18			15
	3-5.9	15			5
	6-11.9	20	1		1
	12-19.9	2			1
	20-34.4	0			1
Surface Nets		3			
Fyke Nets		1		5	
Total		**59**	**1**	**5**	**23**

The length of brown trout varied between 11 and 48 centimetres (Figure a.d). The smaller age classes indicate recent recruitment had occurred.

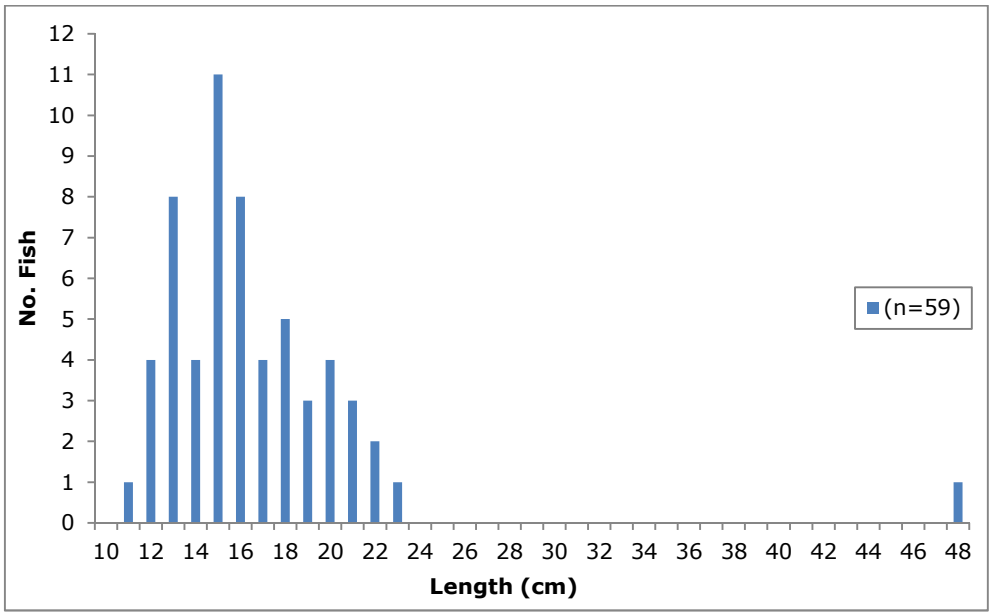

Figure 6.3. Lough Anscaul length frequency of brown trout.

The population of brown trout was represented by a number of sizes classes and the sample size was large.

Lough Coomasaharn

Lough Coomasaharn is located within the Behy catchment on the Iveragh peninsula in County Kerry. Lough Coomasaharn was sampled over three nights on the 1st to 4th August 2017.

Plate 6.2. Lough Coomasaharn, August 2017.

Based on the bathymetric survey, twenty six nets were deployed at predetermined locations (Figure 6.4).

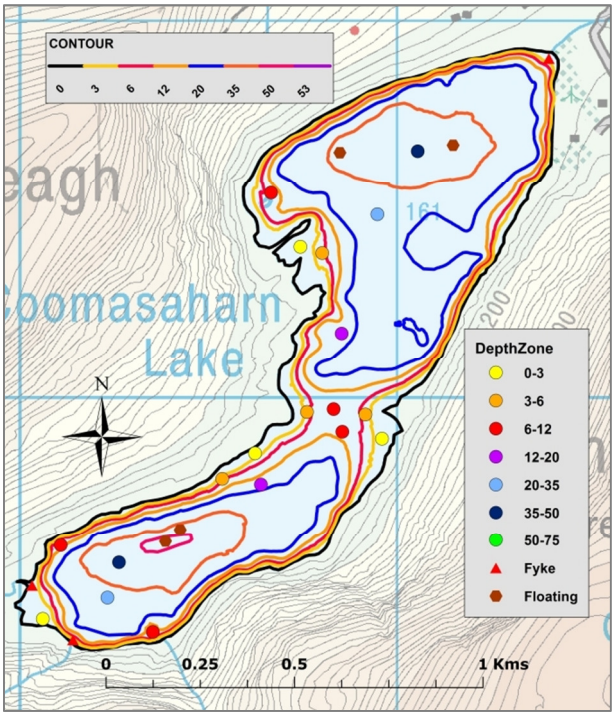

Figure 6.4. Map showing net locations for Lough Coomasaharn, August 2017.

Twenty-eight arctic char were captured during the survey of Lough Coomasaharn in addition to brown trout, sea trout and European eel. (Table 6.5).

Table 6.5. Number of each fish species captured by each gear type during the survey on Lough Coomasaharn, August 2017.

Net Type	Depth (m)	Brown trout *Salmo trutta*	Sea trout *Salmo trutta*	Arctic Char *Salvelinus alpinus*	European eel *Anguilla anguilla*
Benthic Nets	0-2.9	10		1	1
	3-5.9	6		6	
	6-11.9		1	5	
	12-19.9			2	
	20-34.4			2	
	35-49.9			12	
Surface Nets		1			
Fyke Nets		11			16
Total		**28**	**1**	**28**	**17**

The length of brown trout varied between 6 and 24 centimetres (Figure 6.5).

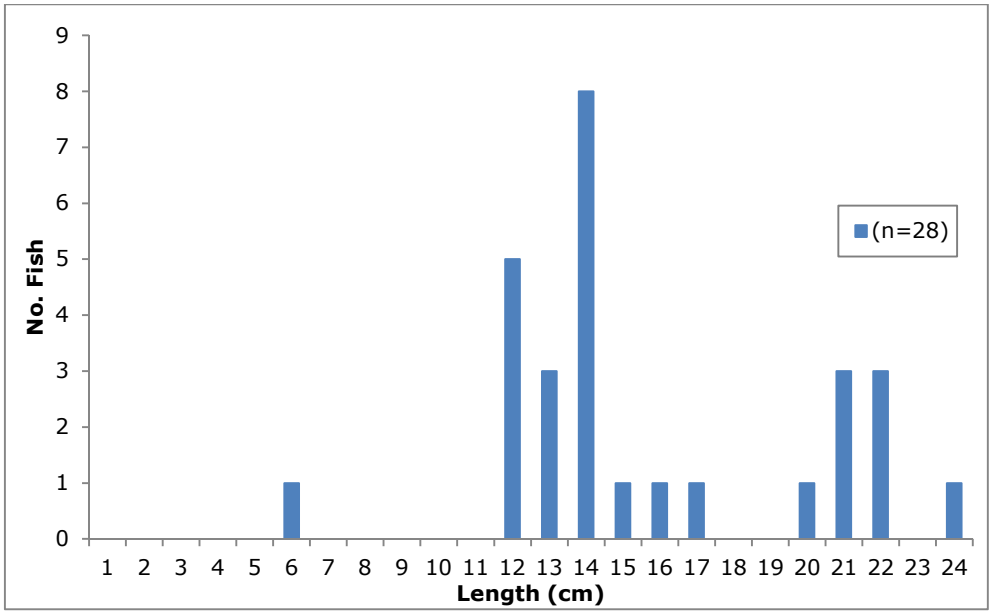

Figure 6.5. Length frequency of brown trout on Lough Coomasaharn, August 2017.

The population of brown trout was represented by a number of sizes classes and the sample size was large.

The length of Arctic char caught varied between 9.3 and 18.6 centimetres (Figure 6.6).

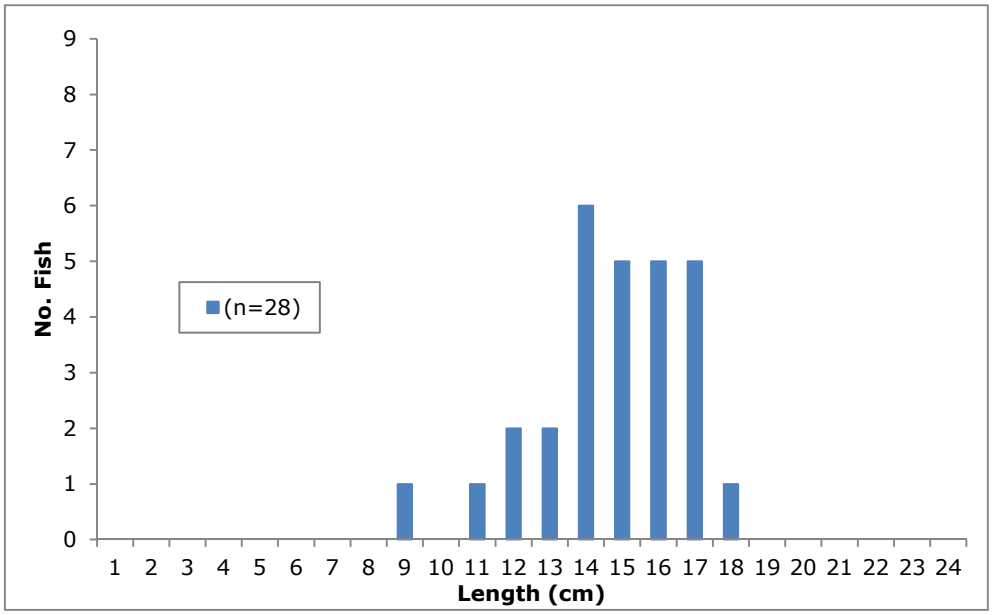

Figure 6.6. Length frequency of Arctic char on Lough Coomasaharn, August 2017.

The 9 cm Arctic char indicates that there was recent recruitment.

Length versus weight was calculated for the Arctic char captured on Lough Coomasaharn (Figure 6.7).

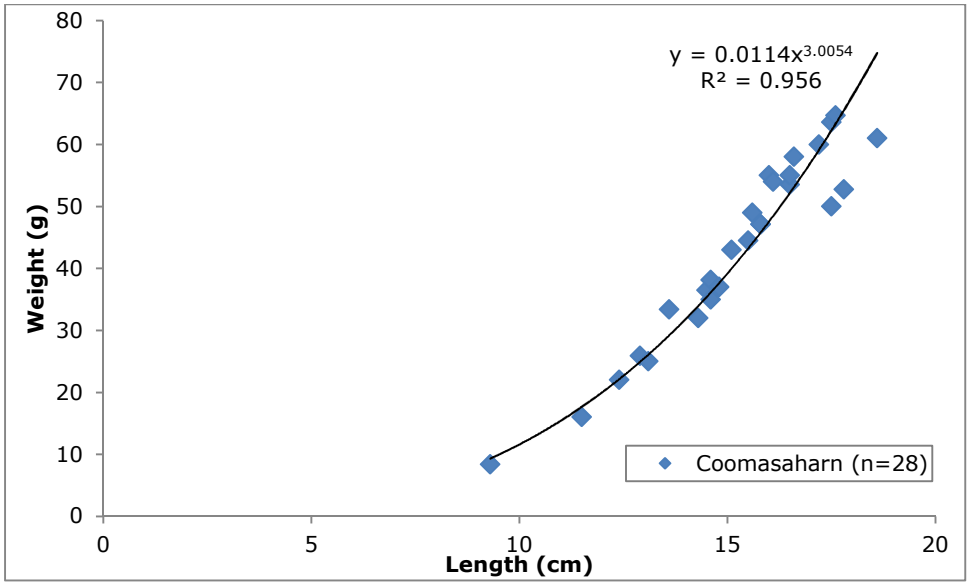

Figure 6.7. Length versus weight for Arctic char in lakes surveyed during July/August 2017.

The ratio of males to females of brown trout and Arctic char was compared across the two lakes (Table 6.6).

Table 6.6. Ratio of males to females in brown trout and Arctic char samples.

	Brown trout				Arctic Char			
	Male	Female	Immature/ Unknown	n=	Male	Female	Immature/ Unknown	n=
Anscaul	0.27	0.15	0.58	59				
Coomasaharn	0.32	0.04	0.64	28	0.43	0.14	0.43	28

Discussion

The net surveys of the two lakes in 2017 were carried out in order to expand the information on the distribution of Arctic char and to gain an up to date picture of the fish population structure in these lakes. No arctic char were recorded from Lough Anscaul during the 2017 survey. The first record of char in Lough Anscaul was in 1994 when an angler caught one using a rod and line (Quigley, 1997). Subsequent investigations in 2000 by NUI, Galway (McCarthy, 2004) and the Irish Char Conservation Group in 2003 (Igoe, 2004) failed to produce any Arctic Char. A number of research studies have been undertaken into the Arctic Char population of Lough Coomasaharn (Cullen, 2007, Igoe 2004 and McCarthy, 2004). A survey by the Irish Char Conservation group yielded 39 Arctic char ranging between 8 and 20 centimetres, with a modal peak at 16 centimetres (Igoe, 2004). Arctic char obtained in 2017 ranged from 9 to 18 centimetres with a modal peak at 14 centimetres. A further study yielded 63 char and 3 brown trout (McCarthy, 2004). When the numbers of fish obtained in the 2017 survey were compared to previous investigations, fewer char were captured in 2017. The number of Arctic char captured was twenty eight in the 2017 survey. McCarthy describes deploying six nets for the 2004 study and capturing 63 specimens of Arctic char. In 2017 twenty six nets were deployed yielding 28 arctic char. This could indicate a reduction in the population of Arctic char in Lough Coomasaharn.

The survey completed by IFI in 2017 was a WFD-compliant fish stock assessment in order to estimate the density, distribution and population structure of the fish community, including Arctic char (if present), within the two lakes.

Brown trout and European eel were present in both lakes. A 56.5 centimetre salmon was captured in Lough Anscaul. This fish was alive as the nets were being processed and so was released back to the lake. Three spined stickleback were also present in Lough Anscaul. On Lough Coomasaharn a 37.2 centimetre sea trout was captured.

The Habitats Directive team will undertake further investigations into lakes within SACs designated as oligotrophic waters containing very few minerals and oligotrophic to mesotrophic standing waters in the future. Lakes characterised by these habitat types are ideal environments to support char populations. The designation of the habitat types e.g. Oligotrophic waters, is made in relation to the habitat type but is also considered to include the suite of species that may be 'associated' with that designated habitat. One outcome of the char sampling programme is the degree to which char are being recorded in oligotrophic-type lakes, including those designated as SACs for this lake type. There may be an ecological linkage between the occurrences of char in such oligotrophic lakes. The retention of the status of SAC-designated oligotrophic lakes may require these lakes to be capable of retaining populations of char that are viable into the future.

7. River Connectivity – barriers to fish migration in SAC rivers

Within the Habitats Directive team, the focus has been to survey barriers in main stem SAC channels that may impact on Atlantic salmon and sea lamprey migration. The data from sea lamprey spawning and redd surveys indicate strongly that barriers in rivers appear to impede sea lamprey upstream migration. One of the Conservation Objectives for sea lamprey status is that adult sea lamprey should have unimpeded access along 75% of the main stem length of each of the SAC rivers. The Habitats team is using the SNIFFER barrier assessment protocol (SNIFFER 2010) to examine all barriers in the SAC rivers designated for sea lamprey migration, to be completed by end 2018.

7.1. SNIFFER surveys of barriers in selected SAC main stem channels in 2017

During 2017 the barrier survey programme continued, with surveys on the Nore and Suir main stems and in the Lower River Shannon SAC at sites on the Feale and Mulkear. The passability scores for the structures examined were all indicative of problems for upstream migration (Table 7.1). Barriers downstream of the structures surveyed in 2017 had been surveyed previously and yielded equally challenging results for sea lamprey passage.

The weir at Bennetsbridge is currently the first major upstream structural barrier to spawning adult sea lamprey on the River Nore, the weir downstream at Thomastown having been breached by floods in 2008. The SNIFFER survey indicated the Bennetsbridge structure to be Impassable to adult sea lamprey (Score '0'). There is a series of five weirs on the main River Nore upstream of Bennetsbridge in the vicinity of Kilkenny city. Two of these were surveyed in 2017 – Brett's weir and the Ormond weir at Kilkenny castle. Outstanding structures to be SNIFFER-surveyed include the rock ramp structure at Lacken weir, a flood/velocity regulating weir (the Bishop's weir) constructed during the Kilkenny city flood relief scheme in the early 2000s, and an older upstream mill.

The survey programme on the River Suir continued upstream from the paired weirs in Clonmel and examined the weir and bridge floor at Ardfinnan and the weir in Cahir town. In common with the weirs in Clonmel, the structures examined in 2017 were identified as problematic for adult sea lamprey (Table 7.1). The Ardfinnan bridge apron was assessed as Impassable (Score '0') and the weir at Cahir was a high risk structure for sea lamprey passage (Score 0.3).

On the Feale, the first major barrier is created by a weir for potable water abstraction at Scartlee, a short distance upstream of the tidal limit. This was previously surveyed and scored as Impassable to sea lamprey. Otter have been observed downstream of this weir feeding on sea lamprey adults. Structures on the main stem Feale at Listowel race course and on two tributaries, the Galey and the Shannow, were SNIFFER-surveyed in 2017 and all proved to be problematic for adult sea lamprey at time of survey (Table 7.1).

Table 7.1. Barriers in SAC rivers surveyed via the SNIFFER protocol in 2017 along with passability score outcomes for adult salmon and for sea lamprey.

Catchment	River	Barrier name	Barrier type	Fish Pass structure(s) present	Overall SNIFFER passability score: adult salmon	Overall SNIFFER passability score: adult sea lamprey	Distance upstream from tidal limit (km)
Nore	Nore	Bennetsbridge weir	weir	No	0.3	0	22
	Nore	Brett's weir/sawmills weir	weir	3 X chutes; 1 X pool pass	0.6	0	29
	Nore	Ormond Weir	weir	2 X pool pass	0.3	0	32
Suir	Suir	Cahir Weir	weir	1Xpool pass	0.6	0.3	54
	Suir	Ardfinnan Bridge	Bridge floor	No	0.6	0	42
Feale	Feale	Racecourse Footbridge, Listowel	Bridge floor	No	0.6	0.3	5.5
	Galey	Shrone Bridge	Weir; stilling structure	1Xchute	0.3	0	6
	Shanow	Shanow Bridge	Stepped bridge floor	No	0.3	0	6
Mulkear	Bilboa	Blackboys Bridge	Gravel/sand trap	Denil pass	0.3	0	48

The Mulkear River is also included as part of the Lower River Shannon SAC. Large numbers of sea lamprey have been observed in many years actively spawning at Annacotty, downstream of the bottom weir in this channel. Modifications to this weir and a breaching of the upstream weir at Ballyclogh were made during the lifetime of the EU-funded Mulkear LIFE project. These measures contributed to an increased dispersal of adult sea lamprey into the Mulkear catchment. The modification at Annacotty was a temporary one, consisting of modular plastic sheeting with moulded knobs extending upward creating a baffle-board effect that reduced velocity locally and permitted adult sea lamprey to surmount the face of the weir. The sheeting required annual maintenance or replacement. When in damaged condition the sheeting was problematic for sea lamprey passage (via SNIFFER survey).

A gravel trap at Blackboys Bridge was re-instated on the River Mulkear during the Cappamore Flood Relief Scheme in the late 1990s and a Denil fish pass installed. This trap was surveyed for fish passage via SNIFFER protocol in late 2017 and found to be Impassable at time of survey.

The contrasting fortunes of migrating adult fish species are clear from Table 7.1. Populations of Atlantic salmon adults would have made passage through all of the structures surveyed by SNIFFER, although many of the structures had a high level of difficulty (Scores of 0.3). Of the nine structures surveyed, seven were rated as complete barriers to adult sea lamprey and the remaining two were a high risk of preventing passage.

7.2. Overall SNIFFER barrier assessment programme in SAC rivers

A target for the Habitats Directive fish programme is to SNIFFER-survey all identified major barriers in the SAC main stem channels designated for sea lamprey by end 2018. This coincides with the end of the current 6-year reporting cycle for Article 17 reporting under Habitats Directive.

A desk study of aerial imagery and of contemporary and historical digital maps has indicated that some of the SAC channels have a high level of identified barriers e.g. the Slaney and the Barrow (Figure 7.1). In the case of the latter, the barriers are all navigation weirs on the main stem River Barrow. It is unlikely that all of these will be surveyed. To date three of them have been SNFFER-surveyed, including the most downstream weir at St. Mullins and upstream structures at Tinnahinch and at Milford, near Carlow town. A large flood control structure is in position in Galway city at the downstream end of Lough Corrib. Individual structures, natural or man-made, are also present on the River Garvogue in Sligo and on the River Moy and its major tributary, the River Deel.

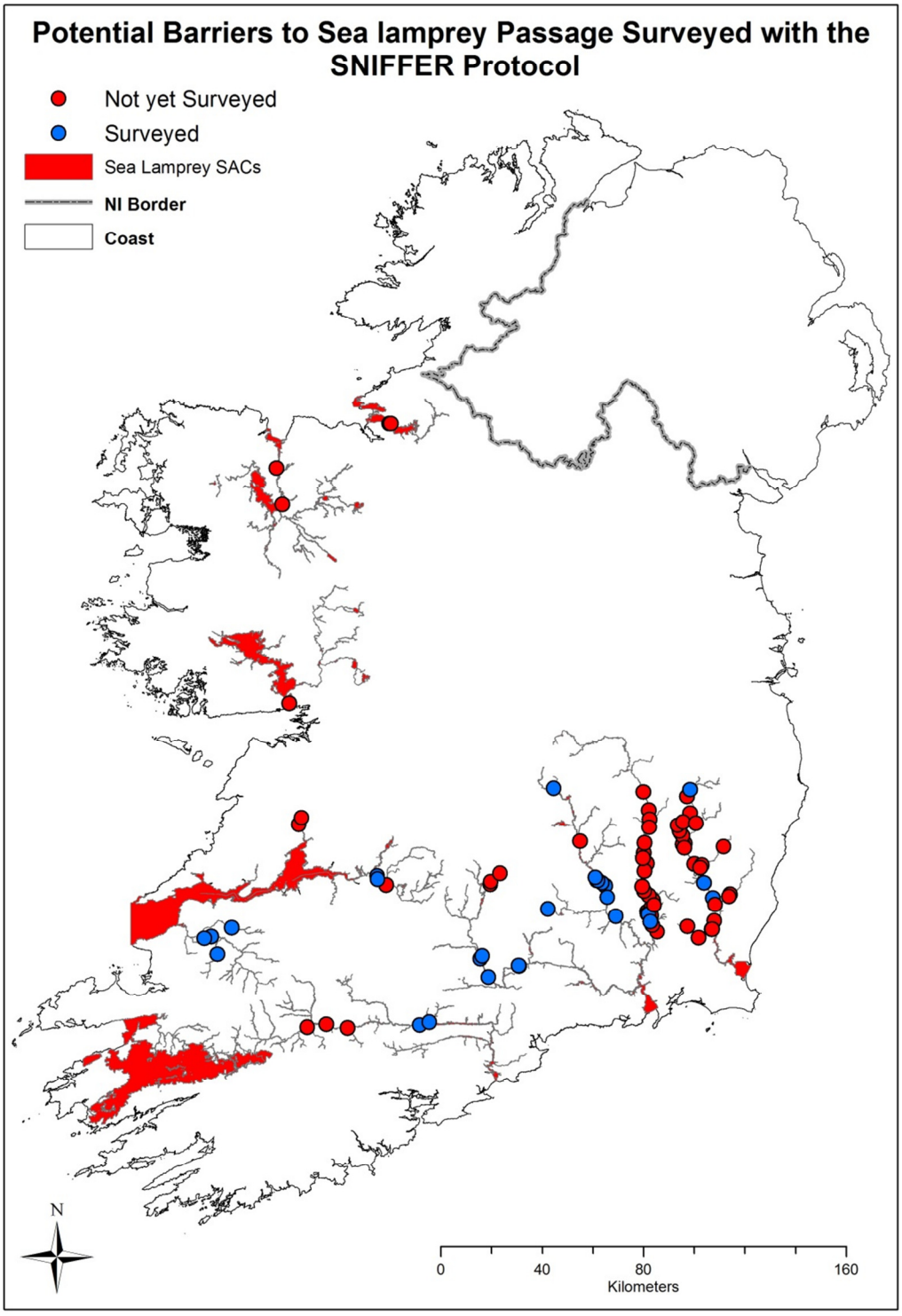

Figure 7.1 Map of Ireland to show locations of barriers to sea lamprey passage where SNIFFER surveys have been completed (blue dots) and where SNIFFER surveys are planned (red dots). Solid red areas are lakes or estuaries designated as SACs for sea lamprey conservation.

Conclusions and Plans for Future Work

One of the principal functions of IFI's Habitats Directive and Red Data Book Fish Programme is to fulfill legal obligations of our Fisheries Minister in regard to undertaking monitoring and surveillance of the fish species listed in Annex II of the Habitats Directive. A direct extension of this is to comply with the reporting requirements of Article 17 of the Directive. This Article requires Member States to report on the status of species on a six-year rolling cycle. The reporting obligation extends to the national territory and not just to species status within the range of *Natura* 2000 sites within the state.

The programme of work in 2017 represented Stage five of the overall six-year work programme (2013-2018) that will feed into the Article 17 report for the EU. The single largest work package in any year consists of the catchment-wide larval lamprey surveys in two SAC systems and this challenge was met in 2017 with completion of the large Barrow survey and the smaller Mulkear survey. The underlying aim in surveying the series of SAC catchments is to allow a comparison with the previous studies in these catchments in the early 2000s (2003 – 07) and to create an information platform that will permit an examination of trends in the longer term.

This year saw the successful conclusion of a pelagic sampling programme for pollan on the three large lakes on the River Shannon – Loughs Allen, Ree and Derg – with one lake being sampled each year, in three seasons, over the period 2015-17. This sampling approach has been identified by IFI as a suitable strategy to examine the status of pollan in these lakes and complements hydroacoustic studies also being done by IFI (Morrissey-McCaffrey *et al*, 2018). A net outcome is that IFI will have a robust information base to report on pollan status for the Article 17 reporting due in autumn 2018.

The team has compiled a very substantial information base on the various species it is involved with. Much of this is relevant to the larger scientific community and it is planned to submit a number of manuscripts to scientific journals for publication. Of particular interest is the process of status assessment for larval lamprey. An important guidance document was provided by Harvey and Cowx (2003) covering this area and it has provided a basis for reporting for the Habitats team. Given the extent of data compiled by the team over the period 2009 – 2017, a manuscript is planned that will examine the outcomes of the Irish catchment-wide studies with the guidance for status assessment provided by Harvey and Cowx (2003) and to see if the guidance is suitable as is or whether criteria and guidance of status classes might be adjusted. To date in 2017, team members have submitted manuscripts to journals covering analysis of the demographic structure of larval lamprey, initial observations on lake-feeding immature sea lamprey in some Irish lakes and on a comparative study of two barrier passability protocols for fish.

Looking forward, the major deliverable for the IFI Habitats directive team in 2018 is the compilation of the Habitats Directive Article 17 report on the relevant fish species and its submission to National Parks and Wildlife Service for compilation into the overall report for Ireland to the EU. The Article 17 reporting format is quite specific but can incorporate the outcome s of the substantial work programme of the Habitats team.

Project personnel

The studies reported and the analyses and reviews compiled here were undertaken by the project team members listed in the report citation. During 2017 the team was joined by Mr. Usna Keating as a temporary Fisheries Assistant. Usna undertook painstaking work to edit and correct issues relating to the larval lamprey database. He also participated in a range of the field surveys. Ms. Amy McCollom, working on the EREP study as a temporary Fisheries Assistant, also contributed to some of the field work reported here. The project facilitated the completion of a 2-month internship for Mr. Michael Mc Glynn, as part of his final year undergraduate studies at GMIT.

Dr. Fiona Bracken continued her Irish Research Council (IRC) funded post-doctoral work in UCD, working with Dr. Mary Kelly-Quinn and Dr. Jens Carlsson. This undertaking is supported financially by IFI and the work is investigating two aspects in regard to rare fish species, using the sea lamprey as a reference – the use of eDNA to detect locations of occurrence of target species and public perceptions of the species. The research is scheduled to conclude in 2018 and publication of relevant papers in scientific journals is anticipated.

The Habitats team worked closely with R&D members of the Marine Sport Fish team in IFI in surveys of shared interest, including beach seine sampling for juvenile bass – yielding juvenile shad and smelt as well - and trawling surveys in the large estuaries of the south-east. Members of other teams in R&D provided 'by-catch' information to the Habitats team in relation to records of larval lamprey and of crayfish.

Acknowledgements

As in every year, many thanks go to the staff members in the various RBDs who assisted the project team in expediting tasks. Support ranged from driving lake boats and RIBs in waters, well-familiar to the local staff but largely unfamiliar to the team, to forming two-person teams in undertaking barrier assessments or larval lamprey surveys. The support of the RBD Directors and their Inspectors in organizing staff for the Habitats team is very much appreciated.

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