National Programme: Habitats Directive and Red Data Book Fish Species

Summary Report

2022

IFI/2023/1-4649



Iascach Intíre Éireann Inland Fisheries Ireland

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Habitats Directive Report 2022

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Executive Summary

Inland Fisheries Ireland (IFI), on behalf of the Department of the Environment, Climate and Communications (DECC), is responsible for monitoring and reporting on the Habitats Directive Annex II/V fish species (lamprey, shad, pollan and salmon). In the most recent Article 17 report (2019), brook lamprey (*Lampetra planeri*) and Killarney shad (*Alosa fallax killarnensis*) were assessed as having a favourable conservation status. The status of river lamprey (*Lampetra fluviatilis*) is unknown and there is a focus on assessing the distribution of this species in the current reporting cycle. Sea lamprey (*Petromyzon marinus*), twaite shad (*Alosa fallax*) and pollan (*Coregonus autumnalis*) have a bad conservation status and conservation measures will have an important role in attempting to improve the prospects for these species into the future.

The monitoring programmes for lamprey and shad continued in 2022, which represented the fourth year in the 6-year Article 17 reporting cycle (2019 - 2024). The field work schedule runs from March to October and the HD team use a variety of survey techniques to collect data on the various life stages of these conservation fish species.

Larval lamprey surveys were conducted between the 17th August and 14th October in 2022. A total of 53 index sites within 7 catchments and 4 RBDs (Eastern, South-Eastern, Western & Shannon) were sampled. These included the Slaney, Barrow, Suir and Garavogue (Bonet) SAC channels and the Liffey, Maigue and Graney (Lower Shannon) non-SAC channels. A total of n=818 *Lampetra* spp. (river/brook lamprey) was recorded and a single sea lamprey larva was captured at a site on the River Suir.

River lamprey redd counts were carried out from March to May on seven SAC and non-SAC catchments (Dee, Boyne, Avoca, Nore, Owenavorragh, Slaney and Suir). Sites where redds were previously observed were visited on a number of occasions, while investigative surveys identified an additional spawning location on a tributary stream at the lower reaches of the River Boyne. As in previous years, two sites on the Aughrim and Slaney, had the highest number of redds but overall results indicate that river lamprey spawning activity was generally lower than in the previous year.

Sea lamprey spawning hotspot surveys were undertaken in May and June across the network of established locations. Redd count data for 2022 indicate a generally stable situation, with activity noted across several SACs. A noteworthy observation was the substantial increase in the number of redds (n=98) recorded on the River Barrow at St. Mullins this year. Also of note was the complete absence of redds from hotspot locations on the lower River Nore.

Shad egg kick sampling was undertaken on the River Barrow at St. Mullins in 2022. Egg surveys are an effective technique for investigating the location, timing and duration of twaite shad spawning events. Weekly sampling occurred over a 15-week period from 1st April to 15th July. Eggs were first recorded in the third week of April (with a water temperature of 13.3°C) and almost continuously up to the third week of June. The total number of eggs was n=242, with the highest count (n=97) occurring in the second week of May. Surveys in 2021 and the current year have revealed that spawning commences earlier than expected and at lower water temperatures. There are also indications that spawning appears to be continuous throughout the season, rather than being restricted to one or two events.

Investigative shad egg surveys at 3 locations on the River Suir in 2022 has identified spawning activity at a site in the upper estuary (upstream of Carrick-on-Suir). This site was sampled weekly over a 10-week period from 4th May – 8th July. Eggs were recorded consecutively for 7 weeks, peaking with a very high count (n=496) on 25th May when the water temperature was 14.2°C. Given the absence of connectivity issues in the lower reaches of the river Suir/upper estuary, the identification of this site reinforces the belief that twaite shad spawn in the tidal freshwaters of Irish rivers. Identifying important spawning grounds will benefit the management and conservation of this species, particularly in light of on-going pressures including potential climate change impacts.

Environmental DNA (eDNA) water sampling was undertaken on the River Barrow at St. Mullins between the 6th April to 18th July 2022 in collaboration with the DiadES project. The aim of this survey is to use shad eDNA concentrations in order to assess the timing and duration of the shad spawning period and understand the impact of St. Mullins weir on shad migration. In total 80 water samples were collected within this time period (including controls). These were subsequently processed and adequately stored prior to further analysis.

As part of IFI's National Bass Conservation programme, seine netting surveys for juvenile bass (*Dicentrarchus labrax*) were carried out between 23rd and 25th August 2022 at 3 locations on the Munster Blackwater, Barrow and Slaney estuaries, all of which are designated SACs for twaite shad. As young-of-year shad are often captured as bycatch in these surveys, they give an indication of successful spawning events for this species in the respective rivers. Five shad, measuring 165 - 182 mm total length (i.e., no young-of-year fish) were captured from Lickey Point on the lower Munster Blackwater estuary/Youghal Harbour. Another 23 shad (81 – 102 mm) were captured at Fisherstown on the Barrow/Nore estuary while no shad were recorded from Mary's Point on the lower Slaney estuary.

Juvenile smelt (*Osmerus eperlanus*), a Red List species (King *et al.* 2011), were also recorded from the seine netting surveys of the Barrow estuary. Six young-of-year smelt (33 – 79 mm)

were captured at Fisherstown. No smelt were recorded from the seine nets at Lickey Point on the Munster Blackwater estuary or Mary's Point on the Slaney estuary.

The fish communities in 3 estuaries (Munster Blackwater, Barrow-Suir and Slaney) were surveyed *via* trawled transects from the 29th August – 21st September 2022. These surveys are conducted annually primarily to provide data for IFI's National Bass Programme. Species of interest to the Habitats Directive Monitoring Programme are also occasionally encountered. Eleven shad (105 - 228 mm) and 4 smelt (ranging in length from 190 - 245 mm) were captured from trawls on the Barrow-Suir estuary. Ten shad (measuring 173 - 220 mm) but no smelt were captured from the Munster Blackwater estuary while neither species were encountered in the Slaney estuary trawls.

IFI carries out surveillance monitoring of fish in transitional waters under the Water Framework Directive (WFD). The monitoring programme is carried out on the Barrow-Nore-Suir complex on a 3-year rolling programme and was sampled in October 2022. Three netting techniques were used in this survey but juvenile shad were captured from the beach seines exclusively. They were recorded from 9 out of 42 seine net hauls stretching from the mouth of the estuary to the upper estuarine stretches. A total of 23 shad were captured ranging in length from 75 – 160 mm. Twenty-one smelt were recorded from 7 seine net hauls and 1 beam trawl, these fish measured 52 - 91 mm in length. Surveys of the Boyne, Liffey and Tolka estuaries were also carried out in the current reporting period but no shad or smelt were captured.

1. Introduction

Biodiversity loss and ecosystem collapse, accompanied by climate change and environmental degradation, have been identified as the biggest threats facing the planet in the next decade and into the future (Global Risks Report, 2020). Significant alterations have already occurred, with numerous indicators of ecosystem health and biodiversity vigour showing rapid decline (IPBES, 2019). These negative trends in biodiversity and ecosystem functions are projected to continue and worsen. By way of example, monitored populations of migratory freshwater fish globally have declined by an average of 76% between 1970 and 2016 (Deinet, S. *et al.* 2020, WWF, 2022), with average declines especially pronounced in Europe (-93%) in comparison with other continents. These data, unfortunately, point to an alarming regional trend across the EU with 60% of rivers, lakes, wetlands, and streams currently deemed not healthy, thereby impacting on the quality and availability of water and the species populations they house, including freshwater fish species (migratory and non-migratory), as well as birds, mammals, and amphibians. At least 37% of Europe's native species of freshwater fishes and lampreys were classified as threatened (Freyhof, J. *et al.*, 2011), a figure which will doubtless be revised upwards.



Plate 1.1. Cottoners River, Laune Catchment, Co. Kerry

Major threats include increased abstraction of water - further exacerbated by increasing droughts and temperature scenarios due to climate change, pollution, invasive species, overfishing, presence of historical and obsolete man-made barriers along with current dam construction resulting in loss of connectivity, increased fragmentation, and alteration of aquatic habitats (Almeida, P.R. *et al.*, 2023). Europe has the most obstructed and fragmented river landscape on the planet, with at least 1 million barriers in operation (Belletti, B., *et al.*, 2020).

There is a requirement for far-reaching and effective legislation which protects habitats and species into the future, as well as restoring biodiversity and rehabilitating ecosystem functions.

The EU Habitats Directive (Council Directive 92/43/EEC), along with the Birds Directive and Water Framework Directive (WFD), are the principal legislative tools for the protection of nature in Europe. Habitats and species that are listed in the Directive's annexes are required to achieve favourable conservation status and a network of protected sites, called Special Areas of Conservation (SACs), have been established across Europe for their protection. Under Article 11 of the Directive, member states are required to carry out surveillance monitoring of the listed species and Article 17 requires reporting on the conservation status of species on a 6-year rolling cycle. Inland Fisheries Ireland (IFI), on behalf of the Department of the Environment, Climate and Communications (DECC), is the state agency responsible for reporting on the fish species across this jurisdiction (Table 1.1).

In addition to fulfilling the reporting requirements of the Directive, the IFI Habitats Directive surveying team also monitors 2 fish species of conservation interest listed in the Irish Red Data Book (King, J.J. *et al.*, 2011), namely, Arctic char (*Salvelinus alpinus*) and smelt (*Osmerus eperlanus*).



Plate 1.2. Lough Acoose, MacGillycuddy's Reeks, Co. Kerry

It is critically important that changes to biodiversity and the status of species are accurately identified and quantified through effective monitoring programmes (Lindenmayer, D.B *et al.*(2015), Pocock, M.J.O. *et al*, (2012)). To this end, the scope and scale of surveying and monitoring efforts are important considerations to avoid biased, incomplete and inaccurate

appraisal (Anderson, C.B. (2018), Valdez, J.W et al., (2023)). Large-scale, long-term monitoring programmes can yield invaluable datasets lending themselves to establishment of baselines, detection of trends and forecasting of future prospects, however it is imperative that they are well-designed, correctly implemented and sustained over time (Lindenmayer, D.B. et al., (2018), Lindenmayer, D.B. et al., (2022)). To this end, the IFI Habitats Directive team has endeavoured to undertake a comprehensive and relevant monitoring programme, focussing upon species distributions, abundances, and phenology, thereby satisfying the requirements for Article 17 reporting on listed fish species. During this current 6-year reporting period, the team has built upon and further developed a nationwide network of larval lamprey index sites. Systematic efforts directed towards cryptic and data-deficient species, such as river lamprey, sea lamprey and twaite shad, has dramatically increased our knowledge of their distribution and spawning behaviour. The HD team liaises closely with colleagues to gather data from lake surveys regarding the status of Killarney shad and pollan, whilst also undertaking routine resurveys of lakes where populations of Arctic char are known to persist. Staff members are also on hand to assist with netting and trawling surveys in transitional habitats of SACs where various life-stages of several species of interest are encountered. The current year, 2022, represents the fourth year in the present 6-year monitoring and reporting cycle (2019–2024) for Article 17. When required, assistance and advice in the field was provided by regionally based IFI colleagues. The HD team also had access to a seasonal research staff member, Cristina Cunha, for much of 2022.



Plate 1.3. Ballinglen River, Avoca Catchment, Co. Wicklow.

2. Lamprey Monitoring Programme

2.1 Larval lamprey Sampling

As part of the current 6-year monitoring cycle (2019 – 2024), a number of index sites are being sampled for larval lamprey. These sites were selected from previous catchment-wide surveys carried out over the period 2009 – 2018. They will be used to assess the range and population size for brook lamprey (*Lampetra planari*) as well as the extent and quality of habitat for all 3 lamprey species. The anadromous river lamprey (*Lampetra fluviatilis*) is indistinguishable from brook lamprey at the larval stage and, while larval *L. fluviatilis* may be captured during the surveys, it is assumed the majority of larvae are *L. planeri*, particularly when occurring above natural or artificial barriers to migration. Once metamorphosis has occurred, it is possible to distinguish between the 2 species and, while rarely encountered, river and brook macrophthalmia (post-metamorphic juveniles) are noted during surveys. Sea lamprey (*Petromyzon marinus*), also an anadromous species, is distinguishable from *Lampetra* spp. at the larval stage but they are rarely encountered in surveys. This may be due to a number of reasons including a smaller distribution and population size. Further research is also required to understand their habitat utilisation at this early life stage.

A selection of index sites was targeted for larval lamprey sampling in 2022. Index sites have been allocated for 13 SAC and 10 non-SAC catchments within 7 River Basin Districts (RBDs) and will provide data for the assessment of short-term and long-term trends in the population size of *L. planeri*. In this regard, sites within SAC rivers will be sampled 3 times, while non-SAC sites will be sampled twice within the 6-year reporting cycle.

Larval lamprey surveys were carried out between the 17th August and 14th October in 2022. A total of 53 index sites within 7 catchments and 4 RBDs (Eastern, South-Eastern, Western & Shannon) were sampled (Table 2.1). These included the Slaney, Barrow, Suir and Garavogue (Bonet) SAC channels and the Liffey, Maigue and Graney (Shannon-Lower) non-SAC channels. Of these, the Maigue and Bonet are OPW arterially drained channels. All of the index sites have been sampled once previously in the current 6-year monitoring cycle.

A semi-quantitative sample was taken at each site by electro-fishing for 2 minutes in a defined area (1 m²) of suitable nursery habitat, generally comprising fine sediments. A single anode backpack is used to electro-fish for lamprey using a pulsed DC and a low frequency (10 Hz) setting. The anode is placed approximately 10–15 cm above the sediment, energized for 20 seconds, switched off for 5 seconds and this cycle is repeated for a period of 2 minutes. Immobilised larvae are collected using a fine mesh net and transferred to a bucket of water.

Once 5 mins have elapsed, a second fishing and, occasionally a third fishing, is carried out until an approximate 50% depletion is achieved. All lamprey are enumerated and measured to the nearest millimetre. As young-of-year larvae can be difficult to capture using this method, a quantitative pushnet sample is also taken from adjacent suitable areas of deposition, if available. The spoil from these pushnet samples is emptied onto a tarpaulin sheet and any larvae present are collected for processing.

Water temperature and conductivity were measured at each site and habitat characteristics were noted, including sediment type, water depth, flow type, shading, channel modification etc. Water temperatures during the survey period ranged from 11.9°C to 19.1°C. Despite lower-than-average rainfall and river flows across the country during the summer period into September, it was possible to carry out larval lamprey sampling. Only one site on the Suir (SUI54) could not be sampled on the first visit (late August) due to low water levels and had to be revisited mid-September following an increase in rainfall.

A total of n=818 larval *Lampetra* spp. was recorded from the catchments surveyed (Figures 2.1 to 2.7). In addition, a single *P. marinus* larva, measuring 66 mm, was recorded from a site on the River Suir (SUI39). This site is located upstream of the weirs in Clonmel indicating that sea lamprey can achieve passage beyond these structures and possibly further upstream *via* the fish passage. There were no larvae recorded at 2 sites, on the Suir (SUI106) and Bonet (GAR13). Densities ranged from $1/m^2$ at a site on the Barrow (BAR32) to $69/m^2$ on the Graney (GRA02), with high densities $(41/m^2 - 61/m^2)$ recorded at a number of sites on the Slaney. Mean densities ranged from $8/m^2$ on the Bonet to $37/m^2$ on the Graney (Table 2.1).

Length-frequency data indicated a range of size classes across the majority of catchments (Figures 2.8 to 2.11), with lengths measuring from 13 mm (young-of-year larvae) to 161 mm. No larvae less than 60 mm were recorded from the Bonet (Figure 2.5) which may be of concern in terms of recruitment. Younger age classes were recorded in previous surveys of this catchment (Gallagher *et al.*, 2017). As part of the current reporting cycle, the index sites on the Bonet are due to be surveyed again in 2024. Four transformers were recorded from sites on the Liffey, Barrow, Maigue and Suir and these ranged in size from 115 mm to 147 mm.

One of the targets of the Common Standards Monitoring protocol for assessing populations of brook and river lampreys (JNCC, 2015) is that, to achieve favourable condition, larval *Lampetra* spp. should have a mean density $>5/m^2$ in sites with suitable habitat within a catchment. They should also be present in not less than 50% of these sites and the full range of size classes, from 0+ to metamorphosis, should be present. In previous catchment-wide

surveys, over the period 2009 - 2018, favourable condition was achieved for the Slaney (2015), Suir (2016) and Barrow (2017) catchments. The Maigue (2012) and Bonet (2016), both arterially drained catchments, did not achieve favourable condition, as larval *Lampetra* spp. were recorded from <50% of sites with suitable habitat and with mean densities of 2.8/m² and 1.6/m² respectively.

RBD	Channel (* SAC)	No. Sites	Min Density (No./m ²)	Max Density (No./m ²)	Mean Density (No./m ²)	Min Length (mm)	Max Length (mm)
Eastern	Liffey	7	4	36	16	21	161
South-Eastern	Slaney*	11	2	61	30	14	110
South-Eastern	Barrow*	10	1	28	9	24	147
South-Eastern	Suir*	12	0	29	11	13	134
Western	Garavogue (Bonet)*	4	2	21	8	61	138
Shannon	Maigue	6	3	19	10	20	125
Shannon	Graney	2	5	69	37	16	112

Table 2.1. Density and population structure of larval lamprey from index sites on 7 channels in 2022.



Figure 2.1. Larval *Lampetra* spp. densities at index sites on the Liffey & Tolka Catchments in 2022.



Figure 2.2. Larval *Lampetra* spp. densities at index sites on the Barrow Catchment in 2022.



Figure 2.3. Larval lamprey densities at index sites on the Suir Catchment in 2022.



Figure 2.4. Larval *Lampetra* spp. densities at index sites on the Slaney Catchment in 2022.



Figure 2.5. Larval *Lampetra* spp. densities at index sites on the Garavogue (River Bonet) Catchment in 2022.



Figure 2.6. Larval *Lampetra* spp. densities at index sites on the River Graney in 2022.



Figure 2.7. Larval *Lampetra* spp. densities at index sites on the Maigue Catchment in 2022.



Figure 2.8. Length frequency data for larval lamprey from index sites on the River Liffey (Eastern RBD) in 2022.



Figure 2.9. Pooled length frequency data for larval lamprey from index sites on the Barrow, Suir & Slaney (South-Eastern RBD) in 2022.



Figure 2.10. Length frequency data for larval lamprey from index sites on the River Bonet (Western RBD) in 2022.



Figure 2.11. Pooled length frequency data for larval lamprey from index sites on the Maigue & Graney (Shannon RBD) in 2022.



Plate 2.1. Low water levels at a site on the Clodiagh-Tipp tributary of the River Suir (SUI54) in late August 2022.



Plate 2.2. Larval lamprey habitat at a site on the main channel of the River Slaney (SLA05) in 2022.

2.2 Adult lamprey investigations

2.2.1 Sea lamprey spawning distribution

River Suir spawning surveys

For the River Suir, a total of 5 visits were undertaken during May (25th) and June (1st, 10th, 15th and 23rd) 2022, each comprising visual inspections and counts at various known spawning locations between Clonmel and Carrick-on-Suir, while also including hotspot surveys in the traditional Clonmel town section. Small numbers of redds (n=2) were noted from the outset in

Clonmel town (Table 2.2), with this number increasing to 9 by the end of the survey period. Redd construction was also noted at other locations, namely upstream of the Anner confluence (n=1) and a cluster of 6 redds at a location 3kms upriver of Carrick-on-Suir. Water temperatures rose gradually during subsequent visits with an overall range of 14-19°C recorded for the period in question (Figure 2.12).



Figure 2.12. River Suir levels and water temperatures measured in Clonmel town (OPW hydrometric gauging stations 16011 and 16148, respectively) during the 2022 sea lamprey migration and spawning period.

Monitoring Sea Lamprey Spawning Hotspots

Annual sea lamprey spawning hotspot surveys continued in 2022. Repeat visits were undertaken from mid-May (16th) through to late-June (24th) at recognised spawning sites on individual SAC rivers across the south and southeast, as well as within the Lower Shannon SAC (Figure 2.13), with the aim of recording timing, extent, and annual consistency of breeding effort. Details of hotspot visits as well as results are listed in Table 2.2.



Figure 2.13. Location of principal sea lamprey spawning 'hotspots' surveyed annually.

The River Fergus in Ennis town is a notable sea lamprey spawning location, specifically the 1km urban stretch from Mill Street Bridge downstream through Wood Quay and Harvey's Quay, through Bank Place and onwards past Club Bridge, along Newbridge Road to Steele's Rock and the rear of Cusack Park. A single survey visit along this urban section was undertaken in early June (2nd). A total of 37 redds were counted, with 10 adult sea lampreys interspersed throughout, some engaged in excavation and spawning behaviour (Table 2.2)



Plate 2.3. Sea lamprey spawning hotspot in Ennis town on the River Fergus.

The Mulkear River at Annacotty, Co. Limerick was visited on 5 occasions from mid-May (16th) to late-June (21st) 2022. The first visit on May 16th confirmed that spawning had commenced with redds and fish visible (Table 2.2). Spawning activity continued during June with numerous and widespread nest excavation noted on all subsequent visits. Water levels and temperatures at Annacotty for the spawning period are displayed in Figure 2.14.



Figure. 2.14. Mulkear River levels and water temperatures measured at Annacotty (OPW hydrometric gauging station #25001) during the 2022 sea lamprey migration and spawning period.



Plate 2.4. Sea lamprey migration obstacle on the Mulkear River at Annacotty Weir, Co. Limerick.

For the Mulkear catchment in general, several locations on upstream tributaries exist where spawning is noted almost annually for some and less frequently for others. These sites were

revisited in 2022 to detect upstream migration and to appraise the potential of Annacotty Weir to act as an obstacle to passage. Adult fish and redds were noted at Scart immediately downstream of the confluence of the Mulkear and Killeenagarriff rivers. Adult fish and redds were also found during searches further upstream at Killeenagarriff Bridge. A previously noted spawning location on the Bilboa river at Cappamore had no redds in 2022, the 7th year in succession where none were recorded. The presence of nests at selected locations in the mid/upper catchment implies passage was possible to an extent at Annacotty Weir, however a general absence from other noted locations suggests ongoing problems posed by this structure.



Plate 2.5. Sea lamprey redds at Scart on the Mulkear River, Co Limerick.

Date	Location	Sea Lamprey	Redds	Temp (°C)
2/06/2022	River Fergus, Ennis Town, Co. Clare	10	37	18.1
16/05/2022 2/06/2022 8/06/2022 15/06/2022 21/06/2022	Mulkear River, Annacotty, Co. Limerick	9 7 10 3 3	7 52 Numerous Numerous Numerous	16.3 15.4 16.3 15.5 17.3
16/05/2022 8/06/2022	River Shannon, UL Living Bridge, Plassey, Co. Limerick	3 6	2 7	17.3 18.3
2/06/2022	Owengarney River, Sixmilebridge Co. Clare	0	4	18.0
25/05/2022	River Suir, Clonmel Co. Tipperary	0	2	14.2
1/06/2022 10/06/2022 15/06/2022 23/06/2022		2 0 0 0	5 7 8 9	NA 16.3 NA 19.4
9/06/2022	River Nore, Thomastown, Co.	0	0	18.4
16/06/2022	Nikenity	0	0	NA
9/06/2022	River Nore, Inistioge, Co.	0	0	17.5
16/06/2022	Nikenity	0	0	NA
13/05/2022	River Barrow, St. Mullins, Co.	0	1	15.5
19/05/2022 27/05/2022 2/06/2022 9/06/2022 16/06/2022 24/06/2022	Canow	0 13 37 NA 21 17	4 29 64 64 95 98	16.8 16.1 17.1 16.3 18.1 19/0

Table 2.2. Sea lamprey activity (counts of adult fish and redds) recorded during repeatvisits to recognised spawning hotspots during 2022.

Plate 2.6. Sea lamprey spawning hotspot on the Owengarney River in Sixmilebridge village, Co. Clare.

Extensive redd building (n=98) was recorded on the River Barrow below St. Mullins Weir, with extremely low water levels and enhanced clarity allowing unhindered observation of spawning effort. Spawning was also noted on the Owengarney River in Sixmilebridge and the River Shannon in the grounds of UL at Plassey (Table 2.2). Noteworthy for a different reason was the lack of redds on the River Nore at both Thomastown and Inistioge where spawning has been typically recorded in previous years.

Prevailing weather conditions for the entire period both before and during the sea lamprey spawning run were obtained from the Met Eireann synoptic weather station at Shannon Airport, Co. Clare, the data from which should be broadly representative of the Lower Shannon area where most hotspots are located. Air temperatures in May were slightly warmer than average (Figure 2.15a), accompanied by relatively dry conditions in late spring and early summer which resulted in generally low river levels until well into June (Figure 2.15b).

Figure 2.15. Monthly mean air temperatures (a) and total rainfall (b) from April 2022 to July 2022 recorded at Shannon Airport (Met Eireann) in comparison with both the 30 year (1981-2010) long-term average (LTA) and the preceding 8 year (2013-2021) average.

Plate 2.7. Sea lamprey spawning hotpot on the River Nore at Inistioge, Co. Kilkenny.

2.2.2 River lamprey spawning distribution

River lamprey are listed in Annex II and V of the Habitats Directive. Due to being listed as an Annex II species, they have designated Special Areas of Conservation (SACs). In the most recent reporting cycle 2013 to 2018, river lamprey were given a conservation classification as 'unknown' due to a deficiency of data on their distribution and population size. One of the main reasons was based on the life cycle of the river lamprey. As larvae, they cannot be distinguished from brook lamprey and so are considered a 'cryptic species'. Challenges associated with monitoring river lamprey include the elusive nature of their spawning activity and the short spring spawning season. This can often coincide with flooding and inclement river conditions to undertake these surveys. A dedicated monitoring programme was initiated in the current reporting cycle (2019 - 2024) involving adult spawning/redd count surveys. An additional objective is to investigate the timing and duration of the river lamprey spawning season in Ireland.

Adult river lamprey, spawning surveys were undertaken on the Rivers Avoca, Boyne, Dee, Nore, Owenavorragh, Slaney and Suir. Sites were pre-selected based on former larval lamprey surveys which noted the presence of suitable spawning gravels and also on information from locally based IFI colleagues. In addition, known spawning locations or 'hotspots' on the Avoca and Slaney were visited over the course of the spawning season.

At each site a habitat survey was undertaken in order to determine if the site was worth revisiting or adding to the 'hotspot' list of sites. Potential spawning areas were investigated on the lower Boyne (SAC) at 4 locations for the first time in 2022, these sites were visited on two occasions. One redd was recorded close to Slane.

The spawning surveys were undertaken between 08/03/2022 and 12/05/2022. Over this period 36 sites were surveyed on between one and six occasions (Table 2.3). Of these, evidence of river lamprey spawning was evident at 12 sites between 14/04/2022 and 12/05/2022 (Figure 2.16).

Figure 2.16. Map displaying sites surveyed for spawning river lamprey in 2022.

River	Location	No. of visits	Redds	River lamprey	Temp. Range (°C)
Avoca					
Aughrim	u/s Woodenbridge	5	Present - 21	Absent	6.6-10.9
Aughrim	u/s Woodenbridge (u/s weir)	4	Present - 1	Absent	6.5
Aughrim	Coates Bridge	5	Present - 3	Present - 1	6.8
Aughrim	Woodenbridge	5	Present - 4	Present - 1	6.5-10.8
Ow	u/s Aughrim	4	Absent	Absent	6.7-10.6
Derrywater	1 st Bridge d/s Moyne	1	Absent	Absent	
Derrywater	2 nd Bridge d/s Moyne	1	Absent	Absent	
Derrywater	Laceys Brothers Bridge	2	Absent	Absent	10.9
Boyne *					
Boyne	Slane Castle	2	Present - 1	Absent	11-11.8
Boyne	Broadboyne Bridge	2	Absent	Absent	
Boyne	Bridge outside Slane	2	Absent	Absent	11.1-11.3
Mattock	Bridge u/s of confluence	2	Absent	Absent	8.2-9.8
Dee					
Dee	St Mary's Hospital	1	Present - 9	Present	12.4
Dee	Woodstown, Nobber,	1	Present - 8	Present	11.8
Nore *					
Nore	Brownsbarn Br.	1	Absent	Absent	
Owenavorragh					
Owenavoragh	Ballywater Br.	1	Absent	Absent	14
Owenavoragh	d/s confluence R. Bracken	1	Absent	Absent	13.4
Owenavoragh	Ballycannew	1	Absent	Absent	13.4
Owenavoragh	u/s Ballycannew	1	Present - 1	Absent	13.1
Slaney *					
Slaney	Rathvilly	3	Absent	Absent	9-9.1
Slaney	Tomnafinnoge Woods	3	Present - 1	Absent	8.5-11
Slaney	1km d/s Aghade Br	3	Present - 11	Present	9.9-11.2
Slaney	Baltinglass	1	Present - 1	Absent	8.8
Slaney	Tullow	4	Absent	Absent	9.5
Derry	Shillagh	6	Absent	Absent	11.3
Suir *					
Suir	Cahir	1	Absent	Absent	
Suir	Killoan Church	1	Absent	Absent	10.4
Suir	Kilsheelan	2	Absent	Absent	10.6-11.9
Suir	Knocklofty	2	Absent	Absent	11.3-12
Suir	Ardfinnan	1	Absent	Absent	
Suir	Swiss Cottage	1	Absent	Absent	
Suir	Newcastle	1	Absent	Absent	.4
Suir	Clonmel	3	Present - 4	Absent	11.2-14.7
Suir	Cahir	1	Absent	Absent	
Tar	Tar Br	1	Absent	Absent	11.8
Tar	Goats Br	1	Absent	Absent	9.2
Anner	Anner Br	3	Present - 3	Absent	10.2-14.7

Table 2.3. River lamprey activity (counts of adult fish and redds) recorded during repeatvisits to recognised spawning 'hotspots' during 2022 (* River lamprey SAC).

Plate 2.8. River lamprey redds identified from spawning surveys on the River Aughrim, Avoca catchment, 28/04/2022.

Surveys in 2022 were based on sites where activity was recorded in 2021. There were large variations in the number of redds recorded in 2021 (n=170) and 2022 (n=68). There was also a variation in the spawning season in 2021 and 2022 (25/03/2021 to 26/04/2021 - 32 days, compared to 06/04/2022 to 12/05/2022 - 25 days).

These spawning surveys have demonstrated the lack of knowledge we have in relation to river lamprey density and distribution. It is essential that we continue the monitoring programme in order to establish the baseline information in relation to spawning and what drives spawning events. The monitoring programmes will continue across the river lamprey SACs and known spawning locations, such as those on the Avoca and Owenavorragh.

Plate 2.9. River lamprey redds on the River Slaney (left), algal growth on the spawning gravels (right), an indication of poor water quality, 19/04/2022.

3. Shad Monitoring Programme

3.1 Juvenile shad Investigations

3.1.1 Shad Egg Surveys

Four Special Areas of Conservation (SACs) are designated for twaite shad (*Alosa fallax*) in Ireland. These are located along the south and south-east coasts and include the estuaries of the Slaney, Barrow-Nore, Suir and Munster Blackwater. Shad egg surveys are an effective technique for determining the timing and spatial extent of spawning activity (JNCC, 2015) and have been carried out since 2017, as part of the monitoring programme for this species. All four SACs have been surveyed and, to date, shad (*Alosa* spp.) eggs have been recorded from the Barrow (St. Mullins), Nore (Inistioge), Suir (Carrick-on-Suir) and Munster Blackwater (Lismore).

St. Mullins, located at the upper tidal limit of the Barrow, is well known for its annual run of twaite shad. Spawning occurs below the weir which acts as a substantial, if not complete, barrier to upstream migration. St. Mullins was the focus of an intensive study in 2021 which involved egg and eDNA sampling over an 11-week period from April to July. Eggs were recorded in the first week of sampling and continuously for a 9-week period (Gallagher *et al.*, 2022). The study continued in 2022 but with an earlier start date and over a more protracted timeframe of 15 weeks, taking into account the earlier than expected presence of eggs in the previous year.

Another important objective during this reporting period was to identify the main spawning location for *A. fallax* on the River Suir. Once there are no obstacles to migration, twaite shad can migrate many kilometres up into the freshwater reaches of rivers to spawn. In Irish rivers it is thought they spawn in the tidal freshwaters even where access is not restricted by migration barriers. The weir at St. Mullins prevents access beyond the top of the tidal influence on the River Barrow but there are no such connectivity issues on the River Suir. The task in 2022 was to identify and assess a number of locations on this river, both estuarine and freshwater, for spawning activity. Identifying the spawning grounds for twaite shad in Irish rivers is important for Article 17 reporting and for the long-term conservation management of this species.

Increasing water temperature is an important environmental cue for spawning behaviour and the literature states that eggs develop successfully in the range of 15°C to 25°C. Spawning in Irish rivers has been recorded in the zone of tidal influence over substrates characterised by coarse sand, gravels, cobbles and boulders. The eggs are clear, non-adhesive, semi-buoyant

and range in diameter from 1.5 - 5 mm (usually 2.4 mm). Eggs and sperm are broadcast into the water column with the majority of eggs sinking to the river bed and remaining in crevices until they hatch 3 - 5 days later.

Samples were collected by kick-sampling for 15 seconds upstream of a hand-held macroinvertebrate net (250 µm mesh) and during low tide conditions. At each site, samples were taken working upstream to avoid re-recording eggs dislodged from an earlier kick sample. Gravels and plant material from each net were sorted by hand and the presence/absence of eggs was recorded. Water levels were stable and low throughout the spawning period. In April, May and July, total monthly rainfall at Oak Park weather station was below the Long-Term Average (LTA) for each of these months. Monthly average river flows for the Barrow and Suir were below the long-term monthly average flows for April – July. https://www.epa.ie/publications/monitoring--assessment/freshwater--marine/hydrology-bulletin/.

Weekly samples were collected downstream of the weir at St. Mullins on the River Barrow over a 15-week period from 1st April to 15th July 2022. Riverbed material consisted of a mixture of cobbles, gravels and coarse sand. Eggs were first recorded in the third week of April (n=3) and almost continuously up to the third week of June (Table 3.1 & Figure 3.1). The total number of eggs recorded during the survey period was n=242, with the highest count (n=97) occurring on 13th May. This represents a similar pattern to results in 2021, when the highest counts were recorded in the second (n=82) and third week of May (n=77). Water temperatures during the current survey period ranged from 9°C to 20.8°C. The temperature was 13.3°C on the day when eggs were first encountered and 15.5°C when the highest egg count was recorded. Mean daily water levels (Table 3.1 & Figure 3.2) at the OPW hydrometric station at Graiguenamanagh ranged from 0.403 m (15th July) to 0.515 m (1st April).

Date	No. Eggs	Moon Phase	Water Temp (°C)	Water Level (m)
01/04/2022	0	New moon	9.00	0.515
13/04/2022	0	First Quarter	11.80	0.509
22/04/2022	3	Full moon	13.30	0.492
28/04/2022	53	Third Quarter	11.80	0.459
05/05/2022	14	New moon	16.10	0.480
13/05/2022	97	First Quarter	15.50	0.462
19/05/2022	6	Full moon	16.80	0.468
27/05/2022	41	Third Quarter	16.10	0.445
02/06/2022	25	New moon	17.10	0.445
09/06/2022	0	First Quarter	16.30	0.444
16/06/2022	3	Full moon	18.10	0.407
24/06/2022	0	Third Quarter	19.00	0.405
30/06/2022	0	New moon	16.90	0.506
07/07/2022	0	First Quarter	17.40	0.421
15/07/2022	0	Full moon	20.80	0.403

Table 3.1. Shad egg data for St. Mullins in 2022 with water temperature (observed on day of sampling) and water level (OPW Hydrometric Station at Graiguenamanagh)

Figure 3.1. No. of shad eggs recorded at St. Mullins (River Barrow) in 2022 with accompanying water temperature data (observed on day of sampling).

Figure 3.2. No. of shad eggs recorded at St. Mullins (River Barrow) in 2022 with accompanying water level data recorded from the OPW station at Graiguenamanagh

Investigative sampling on the River Suir commenced on 4th May, once it was known that spawning was underway on the River Barrow and that there was a chance of encountering eggs. Three sites were sampled (Figure 3.3), with their selection based on a scoping exercise undertaken earlier in the year and on advice from local IFI staff in the SERBD. These included one freshwater site (SUIR01) and two estuarine sites located at Carrick-on-Suir (SUIR03) and the upper tidal influence (SUIR02). All three sites were sampled on 4th and 12th May and eggs were recorded at both of the estuarine sites (Table 3.2). The higher counts at the upper tidal limit suggests that this is an important spawning area, with the potential for being the main spawning location, for the shad population on the River Suir. Given the high egg counts here, weekly sampling was continued at this site up to 8th July. Eggs were recorded consecutively for 7 weeks, peaking with a very high count (n=496) on 25th May when the water temperature was 14.2°C (Figure 3.4). Mean daily water levels (Table 3.2 & Figure 3.5) at the OPW hydrometric station at Clonmel ranged from 0.267 m (23rd June) to 0.71 m (1st July). No eggs were recorded from the freshwater site on 4th or 12th May or on an extra sampling day later in the season (1st June).

Date	Site No.	No. Eggs	Moon phase	Water Temp (°C)	Water Levels (m)
04/05/2022	SUIR01	0	New moon	15.80	0.457
04/05/2022	SUIR02	31	New moon	16.30	0.457
04/05/2022	SUIR03	9	New moon	16.30	0.457
12/05/2022	SUIR01	0	First Quarter	14.00	0.422
12/05/2022	SUIR02	53	First Quarter	14.50	0.422
12/05/2022	SUIR03	3	First Quarter	14.70	0.422
18/05/2022	SUIR02	88	Full moon	15.60	0.461
25/05/2022	SUIR02	496	Third Quarter	14.20	0.384
01/06/2022	SUIR02	11	New moon	16.50	0.343
01/06/2022	SUIR01	0	New moon	16.80	0.343
10/06/2022	SUIR02	3	First Quarter	16.30	0.371
15/06/2022	SUIR02	1	Full moon	18.40	0.310
23/06/2022	SUIR02	0	Third Quarter	19.40	0.267
01/07/2022	SUIR02	0	New moon	14.80	0.710
08/07/2022	SUIR02	0	First Quarter	15.10	0.392

 Table 3.2. Shad egg data for River Suir sites in 2022 with water temperature (observed on day of sampling and water level (OPW Hydrometric Station at Clonmel).

Figure 3.3. Shad egg kick sampling locations on the River Suir in 2022

Figure 3.4. No. of shad eggs recorded at River Suir Site (SUI02) in 2022 with accompanying water temperature data (observed on day of sampling).

Figure 3.5. No. of shad eggs recorded at River Suir Site (SUI02) in 2022 with accompanying water level data recorded from the OPW station at Clonmel

Preliminary results for the egg surveys of 2021 and 2022 have provided valuable information on the spawning behaviour of shad in Irish rivers. Results to date, particularly in terms of the timing and frequency of spawning, have been somewhat unexpected, with indications that spawning activity:

- commences earlier than previously thought, with eggs recorded in late April
- commences at lower-than-expected water temperatures (12°C 13°C)
- appears to peak in mid-May
- appears to be continuous throughout the season, rather than being restricted to one or two events

As stated, these are preliminary results and further work will need to be carried out to support these findings. Shad egg surveys will continue in 2023 on the Barrow and Suir and data will be assessed against a range of environmental parameters over the timeframe of the study.

The identification of an important spawning site on the upper Suir estuary appears to support the long-held belief that twaite shad spawn at the top of the tidal influence on Irish rivers. Further investigative surveys are required and planned for the other SAC rivers and eDNA surveys could have a role in investigating shad migration into freshwater reaches.

In summary, this research will provide valuable insights into the location, timing and duration of spawning activity and will benefit the management and conservation of shad populations in Irish rivers, particularly in light of potential climate change impacts.

Plate 3.1. The weir at St. Mullins on the River Barrow which acts as a barrier to the upstream migration of twaite shad, river lamprey and sea lamprey.

Plate 3.2. The shad spawning location at St. Mullins on the River Barrow showing the navigation canal cut on the right.

Plate 3.3. Investigative kick sampling for shad eggs at the upper freshwater site (SUIR01) on the River Suir in 2022

3.1.2 Shad eDNA study

Overview

In 2022 IFI undertook eDNA water sampling on the River Barrow at the location of St. Mullins. The River Barrow was chosen as it is the most renowned Irish river for twaite shad with a known spawning area below St. Mullins weir in Co. Carlow. This area is frequented by IFI annually to undertake various shad specific surveys in conjunction with the catch and release based angling effort which occurs every spring. Environmental DNA (eDNA) sampling is used in the aquatic environment as a method of detection for target species without invasive/ physical sampling. This makes it a favourable method of sampling for fish species which are sensitive to physical sampling such as shad.

The main aims of this study were as follows:

- Use shad eDNA concentrations to investigate the timing and duration of the shad spawning period across 3 different sites
- To understand the impact of St. Mullins weir on shad migration, specifically whether shad can navigate this barrier when moving upstream

Site Selection

Within the St. Mullins stretch of River Barrow, 3 sites were chosen to sample for eDNA (Figure 3.6p):

- 1) This location is known as 'the scar' and is located approximately 2 km downstream of the weir.
- 2) Site 2 was labelled as 'Island', this is the known spawning area for shad located approximately 800 m below the weir
- 3) This site was the 'upstream' site located 2 km upstream of the weir, this was taken in an area of absolute freshwater

Site 1 – The scar

Site 2 - Island

Site 3 – Upstream

Plate 3.4. eDNA sampling site, St. Mullins, River Barrow.

Considerations prior to sampling

Once the sites were selected, a specific sampling design was formulated prior to the commencement of sampling. The main aims within this design were: preventing contamination of the sample in both field and laboratory environments, ensure adequate sample preservation with minimal degradation, obtain accurate and reproducible results.

Summary of eDNA sampling 2022

Between the 6th April – 18th July 2022, a water sample was collected weekly at each site, a 'field control' and a 'laboratory control' were also obtained during these sampling days. In total 80 water samples were collected within this time period (including controls). Sites 1 and 2 (Figure 3.6) were located within a tidal area. For consistency, these samples were collected

one hour either side of high tide. The reasoning for this was that at this time there was maximum mixing between the incoming tidal water and the river freshwater.

A 2 litre sample was collected at the three sites. The 'field control' and 'laboratory control' were sampled in a 1 litre bottle. Once collected the samples were returned to the IFI laboratory where they were filtered. The filters were subsequently labelled and stored in a freezer until they were delivered to UCD for further biochemical analysis.

Figure 3.6. River Barrow, eDNA shad sampling locations.

3.1.3 Beach seine netting surveys August 2022

As part of IFI's National Bass Conservation Programme, seine netting surveys for juvenile bass (*Dicentrarchus labrax*) were carried out at 3 locations on the Munster Blackwater, Barrow and Slaney estuaries (Figure 3.7 & Table 3.3), all of which are designated SACs for twaite shad. As young-of-year shad are often captured as bycatch in these surveys, they give an indication of successful spawning events for this species in a given year.

Estuary	Date	Location	No. Hauls	Mean Salinity (ppt)	Mean Water Temp (°C)	No. Shad
Barrow	23/08/2022	Fisherstown	9	16.28	21.4	23
Slaney	24/08/2022	Mary's Point	8	22.26	19.86	0
Munster Blackwater	25/08/2022	Lickey Point	9	10.65	18.28	5

 Table 3.3. Seine netting locations as part of the Bass Conservation Programme in

 August 2022.

The surveys were conducted between the 23^{rd} and 25^{th} of August, 2022. A Collins seine net was used to carry out the survey. This net measured 30.8 m x 2 m with a 14 mm mesh size and a 5 m central panel with a 6.5 mm mesh. This net was deployed by boat in an arc shape and slowly drawn to shore with 30 m warps on each side of the net.

Figure 3.7. Locations of beach seining surveys of estuaries in 2022 as part of IFI's National Bass Conservation Programme, with presence/absence of juvenile *Alosa sp.*

Beach Seine netting survey of the Lower Munster Blackwater Estuary/Youghal Harbour Beach seine netting on the Lower Munster Blackwater estuary/Youghal Harbour occurred at Lickey Point locations on the 25th of August 2022 (Figure 3.7). Nine seine net hauls were taken from the muddy littoral of Lickey Point. The survey was undertaken in neap tide conditions with a mean salinity 10.65 ppt across the 9 hauls with a mean water temperature of 18.28° C. Five shad were captured at Lickey point with lengths ranging from 165 - 182 mm (total length) (Figure 3.8). No young-of-year fish were captured at this location. Seven species of fish were recorded at this site in 2022. In previous years, *Alosa sp.* were also recorded at this site: 2021 (n=17), 2020 (n=4), 2019 (n=15) and 2018 (n=3) (Figure 3.9)

Figure 3.8. Length frequency of juvenile *Alosa* sp. from the River Barrow and Munster Blackwater in the IFI Bass survey programme, August 2022.

Beach Seine netting survey of the Barrow/Nore estuary (New Ross Port Waterbody)

Beach seine netting on the Barrow/Nore estuary was carried out at a single location (Fisherstown) on the 23rd of August 2022. This site is sampled annually by the Bass programme. A total of 9 hauls were undertaken at this location with 9 species of fish recorded. Mean salinity was 16.28 ppt and the mean water temperature was 21.4°C. Twenty-three shad in total were captured ranging from 81 mm to 102 mm in total length (Figure 3.8). These shad may have originated from spawning grounds located at the upper tidal limits of the River Barrow at St. Mullins and/or the River Nore at Inistioge. In previous years, *Alosa sp.* were also recorded at this site: 2021 (n=193), 2020 (n=4), 2019 (n=14), 2018 (n=32), 2016 (n=69) and in 2014 (n=7) (Figure 3.10).

Figure 3.10. Length frequency of juvenile Alosa sp. from the River Barrow 2016- 2022.

Beach seine netting survey of the Lower Slaney Estuary

One location was sampled in the Lower Slaney Estuary in 2022 (Mary's Point). This location was surveyed on the 24th of August. Eight seine net hauls were undertaken at this site. Mean salinity at Marys Point was recorded at 22.26 ppt with a mean water temperature of 19.86°C. In total, 9 species of fish were captured. As in previous years however, no shad were captured in the Lower Slaney Estuary in 2022.

3.1.4 Trawling Surveys

The fish communities in 3 Irish estuaries were surveyed *via* trawled transects in August 2022. 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 2022 were undertaken on the Munster Blackwater Estuary, the Barrow-Suir Estuary and the Slaney Estuary from the 29th August - 21st September. Towed transect trawling was undertaken by a commercial trawler and crew with IFI staff also on board to process catches and record data.

Munster Blackwater Trawling Survey

Trawling surveys on the Munster Blackwater took place over two days (August 31^{st} & September 1st 2022). A total of 19 trawls were undertaken (Figure 3.11) across both days (average of 13 minutes per trawl). Trawling on the 31^{st} August was undertaken on an ebbing tide while trawling on September 1st occurred in a slack tide. The trawl locations stretched from the mouth of the estuary at Youghal to Woods Point Area (d/s of Ballinaclash) (Figure 3.11). Mean water temperature recorded across the 19 trawls was 17.8°C (range 17.2–18.8°C). Depth of the water column recorded across each trawl varied from 2.1 m to 9.2 m. Mean salinity was recorded as 30 ppt (range 22.7 - 34.3 ppt). Ten twaite shad were captured during the Munster Blackwater trawl in 2022. These shad were captured across 3 different sites with sizes ranging from 173 – 220 mm (total length).

Figure 3.11. Incidence of capture of shad (n=10) during the trawling survey transects (n=19) on the lower Munster Blackwater Estuary in August & September 2022.

Barrow-Suir Estuary Trawling Survey

Trawling surveys on the Barrow-Suir Estuary/ Waterford Estuary took place over two days (August 29th & 30th 2022). A total of 18 trawls were undertaken in the lower Barrow and Suir estuary at locations including Fisherstown, Cheekpoint, Woodstown, Kings channel and Duncannon (Figure 3.12). Mean water temperature recorded across the 18 trawls was 19.2°C (range 17.2–23.5°C). Depth of the water column recorded across each trawl varied from 0.6 m to 12.6 m with an average of 14 minutes per trawl. Mean salinity was recorded as 26.6 ppt (range 15.8 - 33.1 ppt). Trawling occurred across a mix of flooding and ebbing tides over the two survey days. A total of eleven twaite shad with total lengths ranging from 105 mm – 228 mm were captured over both survey days.

Figure 3.12. Incidence of capture of shad (n=11) during the trawling survey transects (n=18) on the Barrow-Suir/ Waterford Estuary in August 2022.

Lower Slaney Estuary Trawling Survey

Trawling surveys on the Lower Slaney Estuary were undertaken on the 20th and 21st of September 2022. A total of 15 trawls took place over both days (Figure 3.13) with an average of 13 minutes per trawl. Water temperatures ranged from 15.6- 17.4°C across all 15 trawls with an average of 16.3°C. Depth of the water column across sampling sites varied from 1.2 – 8 m (average 3.3 m) while trawling occurred across flooding and ebbing tides. No shad were caught over the 2022 Slaney trawling survey.

Figure 3.13. Incidence of capture of shad (n=0) during the trawling survey transects (n=15) on the Slaney Estuary in September 2022.

3.1.5 WFD Surveillance of Transitional Waters – October 2022

IFI carries out surveillance monitoring of fish in transitional waters under the Water Framework Directive. This monitoring programme is carried out on the Barrow-Nore, Suir complex on a 3-year rolling programme and was sampled in October 2022. The standardised method for sampling fish in transitional waters in Ireland for the WFD monitoring programme is a multi-method approach using various netting techniques:

- Beach seining using a 30 m fine-mesh (10 mm) net to capture fish in littoral areas
- Beam trawling for specified distances (200 m) in open water areas adjacent to beach seining locations
- Fyke nets set overnight in selected areas

Of the 3 netting techniques used in this survey, juvenile shad were captured from the beach seines exclusively. They were recorded in 9 out of 42 seine nets sampled stretching from the mouth of the estuary to the upper estuarine stretches. A total of 23 shad were captured across all net samples in 2022. (Figure 3.14).

Figure 3.14. Seine net results for juvenile shad as part of the WFD surveillance monitoring of the Barrow-Nore and Suir transitional waters October 2022.

Fish lengths ranged from 75 - 160 mm (Figure 3.15). The Barrow-Nore estuary upper site captured the largest number of fish (n=10) (Figure 3.15). The largest fish was caught in the Middle Suir estuary measuring 160 mm with an average length of 111 mm across 7 individuals. No shad were captured in the lower sections of the estuary (Figure 3.14).

Figure 3.15. Length frequency of juvenile shad from WFD surveillance monitoring of the Barrow-Nore and Suir transitional waters October 2022.

In 2022, four other sites were surveyed as part of the WFD transitional waters surveillance monitoring. These were the Boyne estuary, Liffey estuary lower, Liffey estuary upper and the

Tolka estuary. Across these four sites, 16 fyke nets, 18 beach seines and 19 beam trawls and were undertaken between $10^{th} - 19^{th}$ of October. No shad were recorded in these locations.

4. Smelt Monitoring Programme

4.1 Juvenile Smelt Programme

Beach seine netting surveys August 2022

Beach seining surveys of the Barrow, Slaney and Munster Blackwater estuaries were carried out by the Bass Conservation Programme in August 2022 (Figure 4.1). European bass (*Dicentrarchus labrax*) were the target species however, juvenile smelt (*Osmerus eperlanus*) were also recorded from the Barrow estuary. A Collins seine net was used to carry out the survey. This net measured 30.8 m x 2 m with a 14 mm mesh size and a 5 m central panel with a 6.5 mm mesh. This net was deployed by boat in an arc shape and slowly drawn to shore. All species of fish that were captured were counted and measured on site.

Figure 4.1. Locations of beach seine netting surveys in 2022 as part of IFI's National Bass Conservation Programme, with presence/absence of juvenile smelt.

Nine seine net samples were taken at 'Fisherstown' in the Barrow/Nore Estuary on the 23^{rd} August 2022 (Figure 4.1). Mean salinity was 15.49 ppt with a mean water temperature at 21.56°C across the nine net hauls. A total of 6 smelt were captured with their total lengths varying from 33 – 79 mm (average length 62.5 mm). This site is surveyed annually by the Bass Programme. Lower numbers of smelt were recorded in 2022 compared to 2021 (Figure 4.2).

Figure 4.2. Length frequency of juvenile smelt from the Barrow estuary from 2016-2022.

One location (Lickey Point) was surveyed in the Munster Blackwater estuary on 25th of August 2022. Nine seine net samples were taken at Lickey Point but no juvenile smelt were recorded (Figure 4.3). Mean salinity was 10.7 ppt on the day with a mean water temperature of 18.3°C.

Figure 4.3. Length frequency of measured juvenile smelt from the Munster Blackwater estuary 2019- 2022.

Beach seine netting survey of the Lower Slaney Estuary

One location was sampled in the Lower Slaney Estuary in 2022 (Mary's Point). This location was surveyed on the 24th of August. Eight seine net hauls were undertaken at this site. Mean salinity at Mary's point was recorded at 22.26 ppt with a mean water temperature of 19.86°C.

In total, 9 species of fish were captured. As in previous years however, no smelt were captured in the Lower Slaney Estuary in 2022.

Trawling surveys

Smelt were captured during some of the trawling surveys previously described (Section 3.1.4 above). Four smelt, ranging in total length from 190 – 245 mm (average 226 mm) were captured on the Barrow-Suir Estuary. These were captured in 2 out of the 18 transects that were carried out in the estuary (Figure 4.4). Two smelt each were captured at both Trawl 9 & 10 respectively. No smelt were captured during the trawling surveys on the Munster Blackwater (Figure 4.5) or the Slaney estuary (Figure 4.6) during the 2022 surveys.

Figure 4.4. Incidence of capture of smelt (n=4) during the trawling survey transects (n=18) on the Barrow-Suir/ Waterford Estuary in August 2022.

Figure 4.5. Incidence of capture of smelt (n=0) during the trawling survey transects (n=19) on the lower Munster Blackwater Estuary in August and September 2022.

Figure 4.6. Incidence of capture of smelt (n=0) during the trawling survey transects (n=15) on the Slaney Estuary in September 2022.

WFD Surveillance of Transitional Waters – October 2022

IFI carries out surveillance monitoring of fish in transitional waters under the Water Framework Directive. This monitoring programme is carried out on the Barrow-Nore, Suir complex on a 3-year rolling programme and was sampled in October 2022. The standardised method for sampling fish in transitional waters in Ireland for the WFD monitoring programme is a multi-method approach using various netting techniques:

- Beach seining using a 30 m fine-mesh (10 mm) net to capture fish in littoral areas
- Beam trawling for specified distances (200 m) in open water areas adjacent to beach seining locations
- Fyke nets set overnight in selected areas

A total of 21 smelt were captured from the Barrow, Nore and Suir estuaries in 2022 using the WFD netting methodologies. These fish were captured from 7 seine net hauls and 1 beam trawl sample. The highest number captured from a single haul was from a beach seine within the Middle Suir estuary (n=9) (Figure 4.7).

Figure 4.7. Seine net results for juvenile smelt as part of the WFD surveillance monitoring of the Barrow-Nore and Suir transitional waters October 2022.

The fish lengths ranged from 52 mm – 91 mm across all sites (Figure 4.8). The largest smelt was captured in the Middle Suir Estuary measuring 91 mm (Figure 4.8) with an average of 76 mm at this site across 9 fish. No smelt were captured in the lower estuarine sites (Figure 4.7). The smallest smelt to be captured measured 52 mm, with two individuals measuring at this length, both caught in the Upper Barrow Estuary and New Ross port respectively.

Figure 4.8. Length frequency of juvenile smelt from WFD surveillance monitoring of the Rivers Barrow-Nore and Suir transitional waters October 2022.

In 2022, four other sites were surveyed as part of the WFD transitional waters surveillance monitoring. These were the Boyne estuary, Liffey estuary lower, Liffey estuary upper and the Tolka estuary. Across these four sites, 16 fyke nets, 18 beach seines and 19 beam trawls and were undertaken between $10^{th} - 19^{th}$ of October. No smelt were recorded in these locations.

5. Char Programme

The Habitats Directive team undertook sampling on Loughs Gartan and Greenan during September 2022 in order to gain an up to date picture of Arctic char (*Salvelinus alpinus*) populations. Both lakes are located in County Donegal. The lakes had both been sampled on a number of occasions in the past. The most recent survey results were Lough Gartan, 2012 and Lough Greenan, 2016. Lough Gartan is located in the <u>River Leannan SAC (Site code: 002176)</u>. This is an SAC for a number of plant and animal species including freshwater pearl mussel, salmon and otter. 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. Lough Greenan is adjacent to Cloghernagore Bog and Glenveagh National Park SAC.

Lake surveys were undertaken using CEN Standard Guidelines for lake monitoring. Using the area and maximum depth of the lake the number of nets in the different depth zones was calculated (Table 5.1). 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 5.1). 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.

	Lough	Lough
	Gartan	Greenan
Area (hectares)	204	23
Maximum Depth (m)	15	24
SAC	3110 [†] & 3130*	na

 Table 5.1. Physical characteristics of the individual lakes sampled during September 2022.

[†]3110 - Oligotrophic waters containing very few minerals of sandy plains.

*3130 - Oligotrophic to mesotrophic standing waters with vegetation of the Littorelletea uniflorae and/or of the Iso-to-Nanojuncete

As the nets were retrieved, any fish that were alive were measured and a few scales were collected. These 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 a labelled plastic bag. These fish were frozen until such time that they were dissected. During the dissection process the species' length, weight, scales, sex, gonad maturity and stomach contents were collected. Further criteria were examined in relation to Arctic char. Prior to dissection the fish were photographed for morphometric analysis. The gill rakers were counted. The adipose fin was removed and stored in 95% ethanol, otoliths were retained and the dissected fish was individually wrapped, labelled and refrozen for possible future projects.

Net Type	Depth (m)	Lough Gartan	Lough Greenan
Benthic Nets	0-2.9	4	2
	3-5.9	4	2
	6-11.9	5	2
	12-19.9	na	2
	20-34.9	na	2
Surface Nets		4	2
Fyke Nets		4	2
Total		21	14

Fable 5.1. Number and ty	pe of nets deployed	d in different depth zones
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In total four species of fish were recorded across the two lakes (Table 5.2). Arctic char, brown trout and European eel were present in both lakes. In addition, three spined stickleback was present in Lough Gartan.

Table 5.2. List of fish species recorded in the two lakes surveyed during 2022.

Scientific name (Common name)	Gartan (204ha, 15m)	Greenan (23ha, 24m)
Native Species		
Anguilla Anguilla (European eel)	Yes	Yes
Salmo trutta (Brown trout)	Yes	Yes
Gasterosteus aculeatus (Three spined stickleback)	Yes	No
Salvelinus alpinus (Arctic char)	Yes	Yes

Lough Gartan

Lough Gartan is located in the Leannan catchment in County Donegal and is situated within the Leannan River SAC (Plate 5.1). Previous surveys were undertaken in 2005 and 2012 by Inland Fisheries Ireland. The lake was sampled over two nights, 19th to 21st September 2022.

Plate 5.1. Lough Gartan, September 2022.

Based on previous bathymetric surveys, 21 nets were deployed at predetermined locations (Figure 5.1). Net locations used in 2022 were the same as those used in previous surveys in order that direct comparisons be made between surveys.

Figure 5.1. Map showing net locations for Lough Gartan, September 2022.

In total 162 brown trout were captured on Lough Gartan in September 2022 (Figure 5.2). The length of fish varied between 6.5 and 27.6 cm.

Figure 5.2. Length frequency of brown trout on Lough Gartan, September 2005, 2012 and 2022.

In total 69 Arctic char were captured on Lough Gartan (Figure 5.3). The length of fish varied between 6.3 and 19.7 cm.

Figure 5.3. Length frequency of Arctic char on Lough Gartan, September 2005, 2012 and 2022.

The catch per unit effort (CPUE) was calculated generating a metric of mean number of fish per meter of net deployed (Figure 5.4). For European eel, only the fyke nets were included in calculating the mean. In the 2022 survey the mean CPUE for Arctic char, brown trout and European eel was 0.106, 0.241 and 0.029 respectively.

Figure 5.4. CPUE of Arctic char, brown trout and European eel on Lough Gartan, September 2005, 2012 and 2022.

As the fish were dissected the sex of the fish was recorded. During the Arctic char analysis, the gravid state was determined and gonads were weighed. The ratio of M:F was 1:2.4. The number of eggs in 13 of the female fish were counted, these varied between 159 and 328

eggs. Using the weight of the fish and the gonads, the gonadosomatic index (GSI) was calculated for a subsample of the male and female fish (Table 5.3).

GSI = [gonad weight / total tissue weight] × 100

Table 5.3. GSI of Arctic char recorded during 2022 on Lough Gartan.

	Sample size	Min. GSI	Max. GSI	Mean GSI
Female	27	2.4	8.8	4.2
Male	13	1.7	5.2	3.6

Lough Greenan

Lough Greenan is located in the Lackagh catchment in County Donegal. Lough Greenan was previously sampled by IFI in 2009 and 2016. The lake was sampled over one night on the 26th to 27th September 2022 (Plate 5.2).

Plate 5.2. Lough Greenan, September 2022.

Based on previous bathymetric surveys, 14 nets were deployed at predetermined locations (Figure 5.5). Net locations used in 2022 were the same as those used in previous surveys in order that direct comparisons between surveys can be made.

Figure 5.5. Map showing net locations for Lough Greenan, September 2022.

In total, 57 brown trout were captured on Lough Greenan in September 2022 (Figure 5.6). The length of fish varied between 6 and 23.4 cm.

Figure 5.6. Length frequency of brown trout on Lough Greenan, September 2009, 2016 and 2022.

In total, 30 Arctic char were captured on Lough Greenan in September 2022 (Figure 5.7). The length of fish varied between 6 and 16.9 cm.

Figure 5.7. Length frequency of Arctic char on Lough Greenan, September 2009, 2016 and 2022.

The catch per unit effort (CPUE) was calculated generating a metric of mean number of fish per meter of net deployed (Figure 5.8). For European eel, only the fyke nets were included. In the 2022 survey the CPUE for Arctic char, brown trout and European eel was 0.07, 0.13 and 0.02 respectively.

Figure 5.8. Mean Catch per Unit Effort (CPUE) of Arctic char, brown trout and European eel on Lough Greenan, September 2009, 2012 and 2022.

As the fish were dissected the sex of the fish was recorded. The ratio of M:F was 1:1.9. During the Arctic char analysis, the gravid state was determined. In the female fish, the gonads were weighed. The number of eggs in 12 of the female fish were counted, these varied between

131 and 233 eggs. Using the weight of the fish and the gonads, the gonadosomatic index (GSI) was calculated for a subsample of the female fish (Table 5.4).

GSI = [gonad weight / total tissue weight] × 100

Table 5.4.	GSI of	Arctic cha	r recorded	durina	2022 on	Lough	Greenan.

	Sample size	Min. GSI	Max. GSI	Mean GSI	
Female	13	7	11.8	9.6	

Summary

On Lough Gartan there was an increase in the number of brown trout caught between 2005 and 2012, there was 67 fewer fish caught in 2022. The population structure remained similar across the three sampling occasions. The smaller and larger fish present in the sample demonstrates that there is ongoing recruitment.

From the Arctic char point of view, the fish recorded in 2022 are larger than those encountered in 2012. The presence of smaller fish indicates that there was recent recruitment. Of the three surveys undertaken, the number of Arctic char was lowest in the most recent survey. When dissected adult fish displayed preparation for reproduction overwinter 2022 by their gonadal development.

There was a slightly higher number of brown trout caught in Lough Greenan in 2022 when compared to the 2016 sample. The presence of a smaller fish indicated that there was recent recruitment. The brown trout in 2022 were slightly larger than those encountered during previous surveys.

In relation to Arctic char there were 14 fewer fish caught in 2022 when compared to 2016. The density of fish in 2022 is similar to that of 2009. The presence of a 6 cm fish indicated that recent recruitment had taken place. As in Lough Gartan, the structure of the gonads indicated that spawning was intended over winter.

6. Conclusions and Plans for Future Work

The monitoring programmes for lamprey and shad continued in 2022, which represented the fourth year in the six-year Article 17 reporting cycle (2019 - 2024). Highlights and notable findings for the current reporting period include:

- River lamprey spawning activity at hotspots was lower than the previous year.
- Shad egg sampling at St. Mullins has indicated that spawning commences earlier than expected and at lower water temperatures.
- A major spawning location for shad was identified in the upper estuary of the River Suir. This finding is important for the protection and conservation of this species. Given the lack of connectivity issues in the lower Suir, it reinforces the theory that shad spawn in the tidal freshwaters of Irish rivers.
- Redd count data for sea lamprey indicated a generally stable situation with a substantial increase in the number of redds at St. Mullins (River Barrow).
- Netting surveys of Lough Greenan and Lough Gartan returned lower numbers of the Red List species, Arctic Char, than in previous surveys.

In addition to the annual surveying and reporting requirements, members of the HD team presented at a number of conferences and symposia throughout the year, including a shad symposium (Worchester), IFM telemetry conference (Dublin), EIFAAC conference (Killarney) and DiadES conference (Bordeaux).

Monitoring of the Annex II and Red List fish species will continue in 2023. In addition to the on-going surveying of river lamprey spawning hotpots, there will be a focus on the Mulkear River, which forms part of the Lower Shannon SAC. A weir in the lower reaches of the Mulkear (at Annacotty), represents a significant impediment, if not complete barrier, to migrating adult lamprey. A report is currently being prepared to assess fish passage improvement works at the weir and there are plans to install lamprey tiles to aid upstream migration. A selection of sites, with suitable spawning habitat, will be surveyed in 2023 to investigate river lamprey distribution and the impact of migration barriers.

Annual sea lamprey hotspot surveys will continue and the Munster Blackwater SAC river will be targeted in 2023 for a floatover redd count survey and habitat assessment of the main channel. Shad egg surveys will continue next year at St. Mullins and at the newly identified spawning site on the River Suir. Data from these surveys will build on the valuable information obtained in the past 2 years on the spawning behaviour of twaite shad.

Redd count surveys are an integral component of the monitoring programme for adult river and sea lamprey. The HD team are currently developing a Survey123 phone app to record redds in the field. The app will be trialed by the team and by a number of IFI colleagues in 2023, with a view to rolling it out to all staff in the following year.

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