

# Fish Stock Survey of the River Liffey

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Iascach Intíre Éireann  
Inland Fisheries Ireland

## ***Fish Stock Survey of the River Liffey 2021***



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## PROJECT STAFF

Research Officer:	Dr. Karen Delanty
Technician:	Mr. Rory Feeney
ERBD Fisheries Inspector:	Ms Josie Mahon
ERBD Assistant Inspector:	Fergal Caffrey
ERBD Fisheries Officer:	Alan Carter
ERBD Fisheries Officer:	Carl Owens
ERBD Fisheries Officer:	Jarlaith Gallagher,
ERBD Fisheries Officer:	Joe Delaney,
ERBD Fisheries Officer:	Gary Condren,
ERBD Fisheries Officer:	Robert Mulvihill
Senior Research Officer:	Dr. Sam Shephard

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## Table of Contents

ACKNOWLEDGEMENTS.....	3
PROJECT STAFF.....	3
Executive Summary.....	6
1. Introduction .....	7
1.1 General Introduction.....	7
1.2 River Liffey Catchment.....	7
1.2.1 Geology and Soils .....	9
1.2.2. Landuse .....	9
1.2.3. Special Area of Conservation (SAC).....	10
1.2.4. Arterial Drainage Works.....	11
1.2.5. Water quality and Ecological quality (WFD) in the River Liffey catchment .....	11
1.2.6. Barriers & Hydromorphology.....	12
1.2.7. Brown Trout Genetics .....	13
1.2.8. Recreational angling.....	14
1.2.9. Management of the River Liffey catchment .....	14
2. Sampling Methods .....	15
2.1 Site Selection.....	15
2.2 Survey Requirements.....	17
2.3 Electrofishing methods .....	17
2.3.1 Ten-minute single pass electrofishing (TME).....	18
2.4 Other methods.....	18
2.4.1 Habitat assessment .....	18
2.4.2 Age and growth of fish .....	18
2.4.3 Data analysis .....	19
2.5 Biosecurity and decontamination procedures.....	19

2.6	Ecological Status .....	19
3.	Results .....	20
3.1	River Liffey main channel.....	20
3.1.1	Species Richness.....	20
3.1.2	Fish species abundance and distribution .....	21
3.1.3	River Liffey main channel - General findings .....	36
3.1.4	Water Framework Directive Fish Ecological Status 2021 .....	36
3.2.	River Liffey Tributary Sampling .....	37
3.2.1	River Liffey sub-catchments overview .....	39
3.3	Review of the Liffey 2021 survey with historical River Liffey Surveys and other large Irish river systems .....	39
4	Discussion.....	50
5	References .....	56
	APPENDICES I - VII .....	60

## **Executive Summary**

Inland Fisheries Ireland undertook a catchment wide electrofishing survey of the River Liffey catchment during summer 2021. The study surveyed 22 sites on the Liffey main channel and 10 tributary sites. The main aim of the survey was to determine the current status of fish stocks within the Liffey main channel, middle reaches.

Brown trout were recorded at all sites surveyed in both main channel and tributaries and were generally the dominant species. Other species recorded were salmon, minnow, pike, perch, roach, three-spined stickleback, gudgeon and lamprey. Crayfish were also noted.

The Liffey main channel is used for spawning by both trout and salmon – which is uncommon in most large river catchments, e.g., Barrow, Suir, Boyne. In some of these rivers, salmon do use the main channel for spawning but not commonly trout.

Good trout numbers were most frequently present in faster flowing waters like shallow glides and riffle areas.

Poor numbers of trout were noted in the Upper Ballymore Eustace Section and the mid Clane Section

Excessive growth of instream vegetation was noted for the mid Clane Section.

Liffey brown trout are fast growing and short lived.

Tributaries are generally small, with the exception of the Rye Water and those upstream of Poulaphouca Reservoir. Recruitment of juvenile salmonids is greatly enhanced by the spawning effort noted within the middle reaches of the Liffey main channel.

# **1. Introduction**

## **1.1 General Introduction**

In 2021, Inland Fisheries Ireland (IFI) undertook an electrofishing survey in the middle reaches of the River Liffey (hereafter 'Liffey') main channel, between Ballymore Eustace (BME) and Clane. Included in this survey were a small number of tributary sub-catchments. The Liffey was identified for additional survey work, following the catchment wide survey 2019, by the Eastern River Basin District (ERBD) of IFI due to the concerns of several Liffey Angling Clubs that brown trout fishing across the main channel appeared to be in decline. The main objectives of this study were as follows.

1. To undertake a survey of the fish stocks in the Liffey main channel, to provide information and data necessary to determine the status of fish stocks, in particular brown trout, within the middle reaches of the river downstream of Poulaphouca.
2. To review archival data on salmonid populations within the Liffey main channel.
3. To assess changes in brown trout populations over the period 1970 to 2021.

The Liffey main channel and tributary sub-catchments have been the subject of several previous studies by IFI and its predecessors Central Fisheries Board (CFB) and Inland Fisheries Trust (IFT), over the period 1971 to 2021. The results of the current survey will provide additional baseline information for potential inclusion in future management of the fish stocks in the Liffey catchment.

This report presents the results of the current survey and a review of fish stocks within the Liffey catchment over a 50-year period (1970 – 2021).

## **1.2 River Liffey Catchment**

The Liffey rises only 12 miles south of Dublin city (Kippure in the Wicklow mountains), but follows a meandering journey west, north and northeast through Wicklow and Kildare before turning east towards Dublin City (Fig. 1). It flows for over 82 miles (120km) before entering the sea at Dublin Bay. It drains a catchment of nearly 530 square miles, starting as a poor acid mountain river and transforming into a rich trout river as it glides and meanders through the plains of Co. Kildare. The lower stretches from Leixlip to the city tend to be slow and deep with a series of old mill weirs present. The main tributaries of the Liffey are the Kings, Brittas, Upper Liffey, Morell, Rye Water, Griffeen and Camac rivers.

The River Liffey has four main distinct sections:

- Upper reaches, upstream of Poulaphouca Reservoir.



- Middle reaches, from Golden Falls to Leixlip.
- Lower reaches, from Leixlip to Islandbridge.
- Tidal reaches, from Islandbridge to Ringsend where it enters the sea.

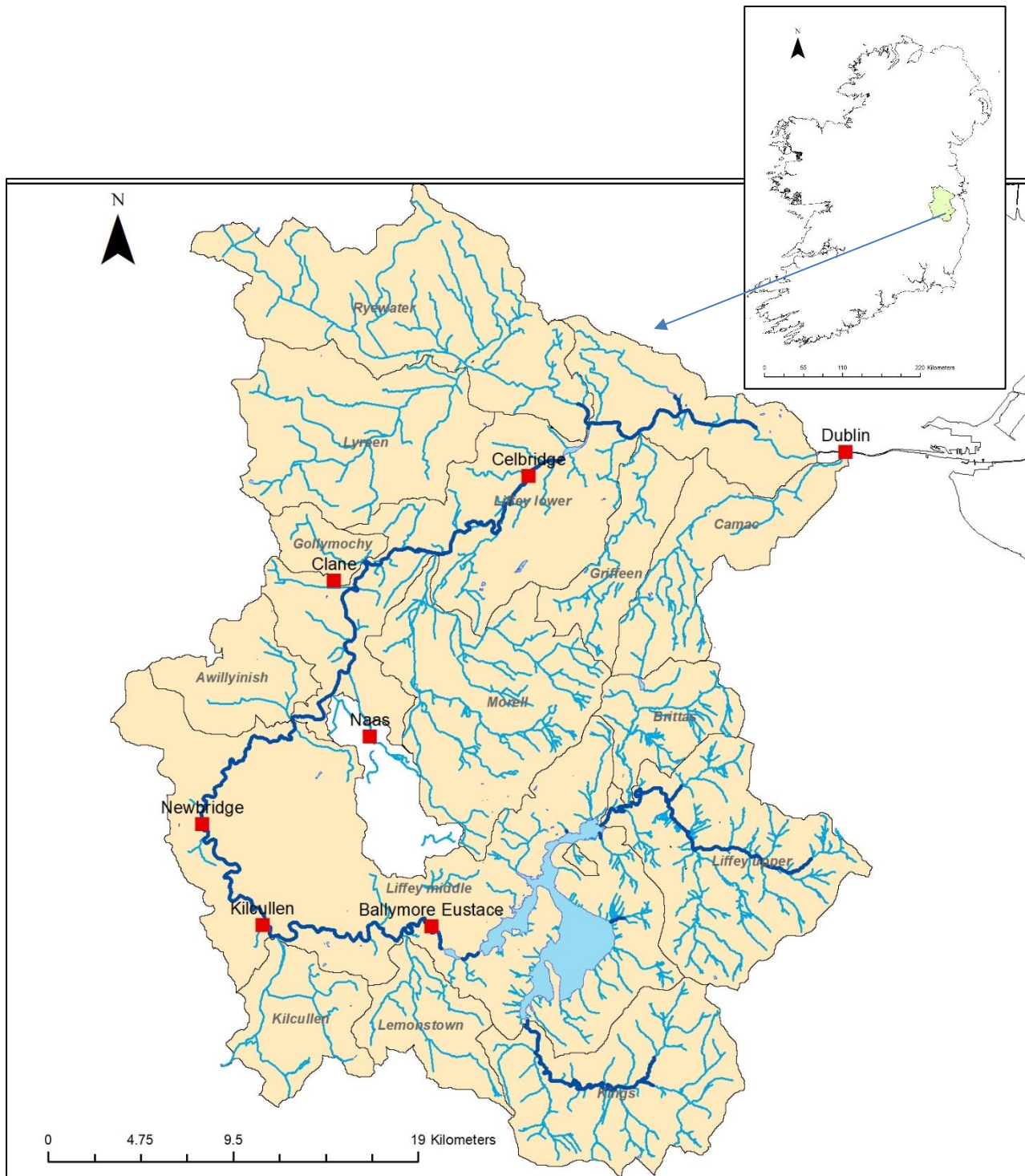
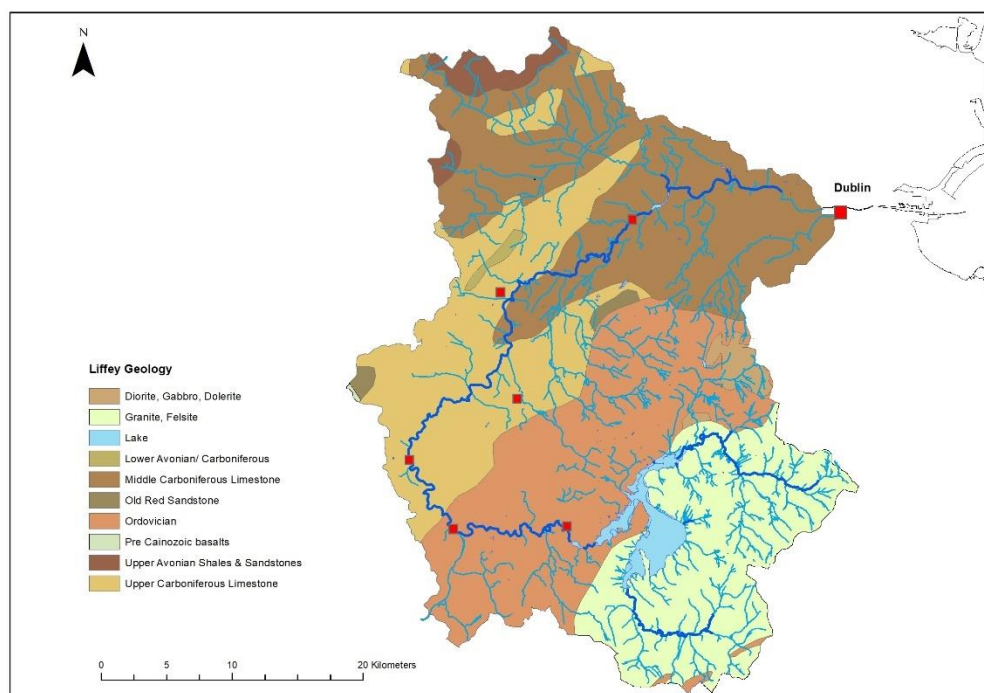


Figure 1. Liffey catchment map. Individual Liffey sub-catchments are also highlighted.



### 1.2.1 Geology and Soils

The geology of the Liffey catchment is mostly granite in its upper reaches (upstream of Poulaphouca), sandstone and shale in the middle reaches and limestone in its lower reaches (Fig. 2). The soils consist mainly of gley brown podzols with associated brown earths and gleys derived from limestone morainic gravels and sands. In the upper reaches, peaty podzolic soils, lithosols and blanket peat occur. These soils are overlain by large glacial drift deposits of sand, gravel and clayey tills which vary in thickness (Holland, 1981).



**Figure 2. Underlying geology of the Liffey Catchment.**

### 1.2.2. Landuse

The main land uses are peat bog and forestry in the upper catchment, agriculture in the middle reaches and urban as the river flows through Dublin suburbs and the city (Fig. 3). Overall, pastures/agricultural lands accounts for 96% of the Liffey catchment landuse (EPA CORINE 2018). Images 1 to 3 show the Liffey as it flows through this mostly agricultural landscape.



Image 1. Ballymore Eustace

Image 2. Downstream of Carragh Br.

Image 3. Downstream of Clane

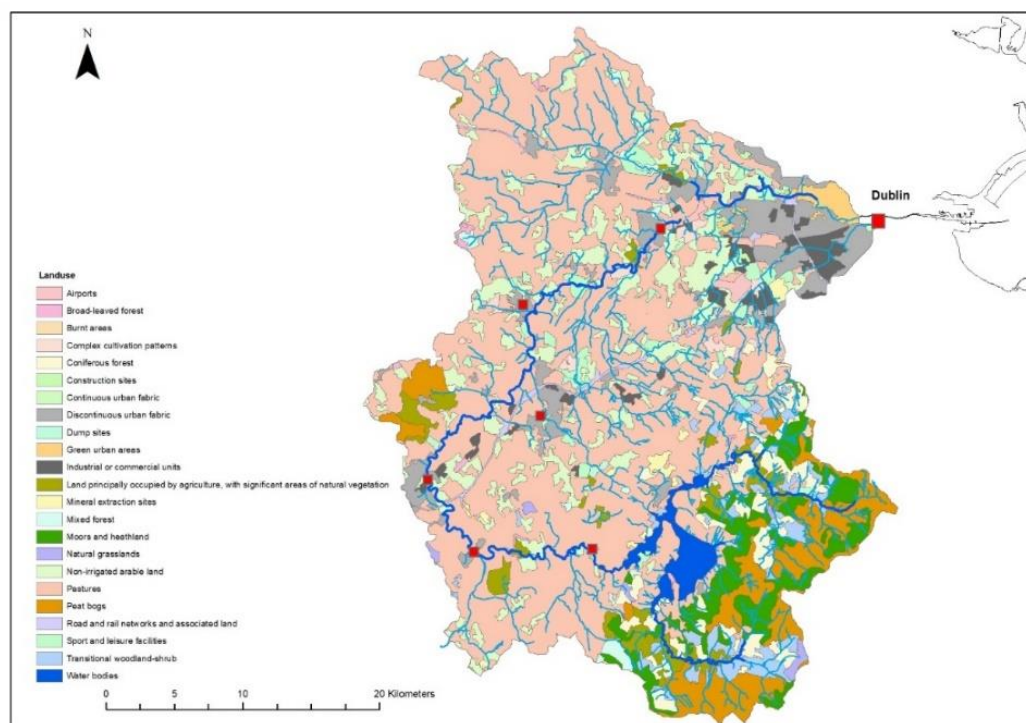


Figure 3. EPA CORINE landcover for the Liffey Catchment.

### 1.2.3. Special Area of Conservation (SAC)

Special Areas of Conservation (SACs) are designated under the EU Habitats Directive (92/43/EEC) for the conservation of flora, fauna and habitats of European importance. These sites form part of the “Natura 2000” network of protected areas throughout the European Union. Annex I of the EU Habitats Directive lists certain habitats that must be given protection through the designation of SACs and

Annex II of the Directive lists species whose habitats must be protected throughout the designation of SACs such as Atlantic salmon (*Salmo salar*).

Included within the SAC Complexes of the Liffey Catchment are the Wicklow Mountains, Rye Water Valley Complex, Mouds Bog and Red Bog (Appendix I). The main importance of the Rye Water site lies in the presence of several rare and threatened plant and animal species including salmon and the white-clawed crayfish (*Austropotamobius pallipes*) (NPWS 2022).

#### **1.2.4. Arterial Drainage Works**

The Duke of Leinster initiated artificial drainage in the catchment in the 1850's, by deepening the Rye Water and installing field drains (O'Reilly, 2002, Kelly *et al.*, 2008)). Arterial drainage was carried out on the Rye Water and its tributary, the Lyreen, by the Office of Public Works (OPW) over a two-year period from 1952 to 1954, to alleviate persistent flooding in Leixlip village. As part of this Ryewater Arterial Drainage Scheme OPW operate an annual maintenance programme across the catchment. Separate to this, an OPW Flood Management Scheme (lead by Kildare County Council, KCC) has commenced across the Morell sub-catchment (<https://www.morellfms.ie/>). The Flood Management Scheme will see work being carried out on the Morell main channel, Slane, Hartwell and Painestown (Kill) rivers. Some works have already been completed. Those works and that still to be carried out involve:

- construction or restoration of over 9,000 metres of sloped embankments
- construction of up to 480 metres of flood walls to direct the flood water away from high-risk areas
- realigning two streams, and
- up to 11 culvert alterations/upgrades

#### **1.2.5. Water quality and Ecological quality (WFD) in the River Liffey catchment**

Water quality (biological and chemical) in the Liffey has been monitored by the Environmental Protection Agency (EPA) and its predecessors since 1971. The EPA has established a network of monitoring sites on the main channel and on selected tributaries that are monitored every three years. Since 2007; this monitoring programme has been expanded to accommodate other biological elements such as fish and plants following the requirements of the EU Water Framework Directive 2000/60/EC (WFD) (European Parliament and Council, 2000).

The Liffey catchment has suffered from water quality issues historically, and this impact continues today. Catchments currently most at risk include the Lyreen and Rye Water, the Griffeen and the Camac sub-catchments. There have been improvements in several of the WWT plants located and discharging into the Liffey middle reaches, but water quality continues to be a noted pressure on the Liffey system. The changes noted in WFD Ecological Status (2013-2018) since the previous Status report (2010-2015) do suggest that there have been improvements in some areas (Rye water tributaries, Griffeen and main channel lower) but a decline in others (Morell, main channel upper, Kings and upper Liffey tributaries) (Delanty & Shephard, 2021).

#### **1.2.6. Barriers & Hydromorphology**

There are three Electricity Supply Board (ESB) hydroelectric power stations with associated dams and reservoirs [Golden Falls (1943) (Image 4), Poulaphouca (1944) (Image 5) and Leixlip (1949)] along the course of the Liffey. Water abstraction is also an ongoing pressure - Poulaphouca and Leixlip Reservoirs supply most of the drinking water to Dublin City. Management at these stations means that water flows are highly controlled and volume discharge is regulated by the ESB. The river is therefore subject to artificial spates which are not directly related to natural rainfall patterns. The dam at Poulaphouca was built on a waterfall that was naturally impassable to migratory fishes prior to dam construction, and thus salmon have been limited to the main channel and tributaries downstream of the original falls at Poulaphouca (Went, 1945-1948).



**Image 4. Golden Falls Dam**



**Image 5. Poulaphouca Dam**

There are over 20 weirs and barriers along the Liffey main channel alone (Appendix II). All these structures pose some level of obstruction to anadromous salmonids and other migratory fishes, including eels and lampreys, at different times of the year and depending on water levels. Many of these weirs are now redundant and several are in disrepair. Even so, they disconnect the river, continue to impound water and build up sediment behind them for extended lengths of the river.

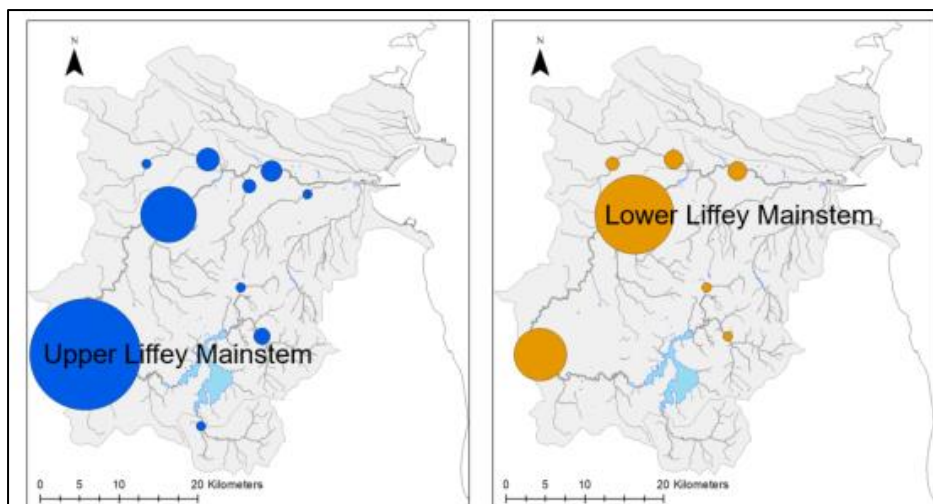
Movement of fish in both the upstream and downstream direction can be impeded especially during periods of low flow.

#### **1.2.7. Brown Trout Genetics**

A catchment wide study of brown trout genetics was carried out on the Liffey in 2013-2015. As part of that study over 290 adult trout were sampled from the Liffey main channel downstream of Poulaphouca and upstream of Leixlip. Genetic analysis of those adults indicates that the majority assign (were born) within that area and or its tributaries. Interestingly few adult fish from other areas of the Liffey catchment were found here. Approximately 11% of adult fish taken elsewhere within the system assigned to the Liffey main channel section, meaning they were spawned in the study area but migrated to other sections of the Liffey at some stage and were caught there as adults.

It was possible to separate out the main channel section into an Upper and Lower mainstem as distinct genetic differences exist between baseline trout samples from the two areas. The results presented for the two divisional areas (Fig. 4) clearly show that fish from each one is dominated by fish assigning to its own section. It is worth nothing, but not surprising, that there is much movement of fish between the two areas, much more so than any other Liffey areas. The study found that juvenile baseline samples from these two regions could not distinguish between tributary juveniles and main channel juveniles. From this current electrofishing survey, it is clear, that juvenile trout are abundant within the main channel. However, a juvenile baseline sample from the main channel was not provided to the genetic study. This has meant that main channel juveniles and related tributary juveniles could not be clearly identified and so all have been presented as a regional juvenile baseline group, i.e Upper mainstem and Lower mainstem.

This spawning contribution of the main channel is greater in the Liffey than is seen in most river systems, where most recruits would generally come from tributary streams.



**Figure 4. Adult Brown Trout Assignments from the Upper and Lower Liffey mainstems.**

### **1.2.8. Recreational angling**

The Liffey is primarily a game fishery with well-established fisheries for trout, salmon and sea-trout. Some coarse fishing takes place in reservoir at Poulaphouca, mainly for pike and occasionally perch. Game angling waters are generally located immediately below the weirs and many of these fisheries are controlled privately and by angling associations.

### **1.2.9. Management of the River Liffey catchment**

There are many agencies and stakeholders with an interest in the Liffey; key parties include the ESB, Irish Water, Kildare CC, Wicklow CC, Dublin City Council, the OPW and IFI. Consultation between and amongst various groups does occur. ESB has the statutory responsibility in relation to the management of fisheries throughout the Liffey catchment (along with the Shannon, Erne and Lee systems). The input of ESB resources into the conservation of the fisheries to ensure their accessibility and enhancing their amenity value continues ([esb.ie](http://esb.ie)). However, a more collaborative approach, involving all key agencies and stakeholders, to the management of the aquatic environment of the Liffey is the best way to safeguard this resource into the future.



## **2. Sampling Methods**

The primary focus of this study was to survey the Liffey main channel downstream of Poulaphouca, between Golden Falls and Clane. More recent IFI electrofishing surveys concentrated on tributary sub-catchments (IFI 2017 & 2019, WFD 2008-2014).

Fish data from the main channel were limited, three WFD sites are sited on the Liffey main channel, one upstream of Poulaphouca and two downstream. However, the constraints of surveying a large river excluded these sites on many sampling occasions. Such large rivers (in terms of river width and depth) are resource intensive and can require several boats for survey work, additional staff and good access points.

A small number of tributary sites were also included as part of the current study for the main purpose of comparing with previous and historical electrofishing datasets.

All fish species present were recorded at all sites surveyed. General physical characteristics of the site were also recorded, e.g., land use, riparian vegetation and instream features – flow, width, depth and substrate type.

### **2.1 Site Selection**

The Liffey was sampled along four main channel sections. Within each of these sections, five to six representative locations were surveyed. In total, 22 main channel sites were surveyed between August 13<sup>th</sup> and 24<sup>th</sup> 2021 (Fig. 5) (Appendix III). A variety of habitat types were covered, namely slow flowing deep glides, deep pool areas, moderate flowing shallow glides and fast flowing riffle areas (Image 6).

Five Liffey tributaries were also included in this survey (Fig. 5 & Image 7 & Appendix III). In total 10 tributary sites were sampled. All sites selected were sampled during previous electrofishing studies. These tributary sites were sampled between August 9<sup>th</sup> to 12<sup>th</sup>, 2021.



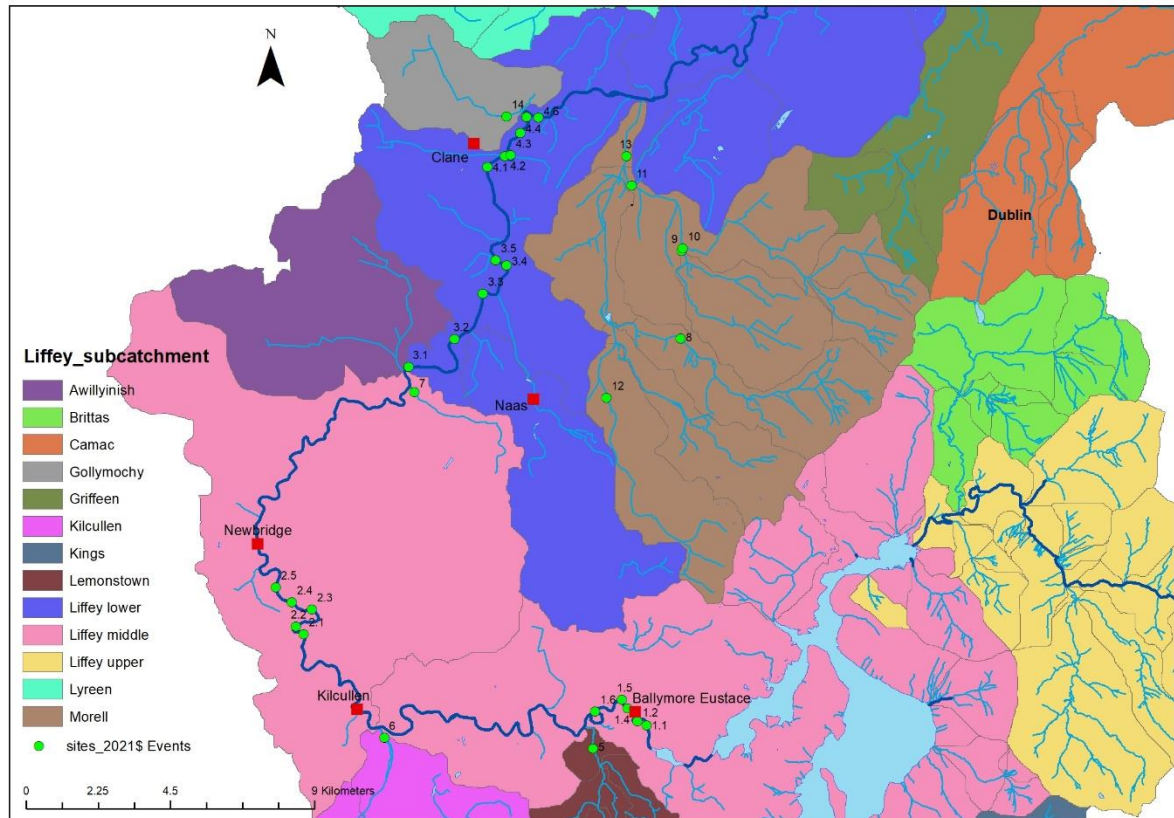


**Image 6. Selection of Liffey main channel electrofishing sites and habitat type**



**Image 7. Selection of tributary channels electrofished and habitat type**





**Figure 4. Liffey catchment map, with location of all electrofishing sites, August 2021 (with numbered identification). Individual Liffey sub-catchments are also highlighted.**

## 2.2 Survey Requirements

All fish species present were recorded at all sites surveyed. General physical characteristics of the site were also recorded (e.g. landuse, riparian vegetation and instream features – flow, width, depth and substrate type).

## 2.3 Electrofishing methods

Electrofishing is the method of choice to obtain a representative sample of the fish assemblage in river sites. The 10-minute timed method was used for both wadeable and non wadeable sites. This method was applied at the tributary sites as it follows the sampling method used during the 2019 Liffey Catchment survey (IFI, 2019). Using the 10-minute method with boats on the main channel was identified as the most suitable, in that it would allow for a larger number of sites to be surveyed within the period allocated for the survey, thus ensuring greater coverage and assessment of the main channel.

### **2.3.1 Ten-minute single pass electrofishing (TME)**

In the wadeable tributary sites, timed 10-minute electrofishing (TME) was employed. This method involved only two operators at sites less than 5m wide, all tributary sites sampled were <5m in width. No stop-nets were used to isolate the survey stretch. Electrofishing equipment consisted of one portable generator (220/240 v) with an appropriate control unit (DC converter), a cathode and an anode. Electrofishing took place by one person wading in a zig-zag manner in an upstream direction for exactly 10 minutes and electrofishing at a steady pace (width < 5m).

In the non-wadeable sites of the main channel, the boat-based TME method was employed. This used two boats, one on each bank with a crew of three people fishing in a downstream direction. Again, as with the 10-minute bank-based electrofishing, a stretch of river is fished for 10 minutes only, and no stop nets are used. It should be noted here that this approach represents a semi quantitative method whereby approximately only 8m of river channel is effectively electrofished by each boat used. In general channel width, of the Liffey main channel surveyed, ranged from 20m to 30m approximately.

## **2.4 Other methods**

### **2.4.1 Habitat assessment**

An evaluation of habitat quality is critical to any assessment of ecological integrity. A rapid habitat assessment was performed at each survey site where the percentage of overhead shade, substrate type and instream cover were visually assessed. Wetted width and depth measurements were also recorded.

### **2.4.2 Age and growth of fish**

A subsample of the dominant fish species was aged. Fish scales were read using a microfiche reader. Growth was determined by back-calculating lengths at the end of each winter using the following formula:

$$Ln=(Sn/S)l$$

Where:

Ln= length of fish when annulus “n” was formed

l= length of fish when scale sample was taken

Sn = radius of annulus “n” (at fish length Ln)

S = total scale radius

### **2.4.3 Data analysis**

Fish abundance is presented as (minimum) population density estimates (number of fish/m<sup>2</sup>). Following the method described by Matson *et al.* (2017) a conversion factor was applied to the salmonid fish counts for all tributary sites, only. Extrapolating catch from the rapid assessment technique (10 minute timed electrofishing) allowed for direct comparison with existing catch time series where the depletion electrofishing method was previously used. Even so applying this conversion factor only allows for minimum density estimates based on a first fishing to be calculated. Data presented for main channel sites, where 2 boats were used to fish the site, did not undergo such calculations. Salmonid fish density estimates were calculated using channel area (length of site fished x width of channel covered by 2 boats, 16m in total) again providing a minimum density estimate for trout and salmon. This follows the method employed for Water Framework electrofishing sites where boats are used.

### **2.5 Biosecurity and decontamination procedures**

Procedures are required for disinfection of equipment to prevent dispersal of alien species and other organisms to uninfected waters. A standard operating procedure was compiled by IFI for this purpose (Caffrey, 2010) and was followed by staff undertaking the survey on the Liffey.

### **2.6 Ecological Status**

An essential step in the EU Water Framework Directive 2000/60/EC (European Parliament and Council, 2000) process is the classification of the ecological status of lakes, rivers and transitional waters, which in turn will assist in identifying objectives that must be set in the individual River Basin District Management Plans. An ecological classification tool for fish in rivers (Fisheries Classification Scheme 2, FCS2-Ireland) was developed in 2011 to assign ecological status to fish in rivers for the Republic of Ireland and Northern Ireland along with a separate version for Scotland (SNIFFER, 2011). Using this tool and expert opinion, each site surveyed on the Liffey was assigned a draft fish classification status.

### 3. Results

The electrofishing survey results are presented below for the main channel and then separately for the tributaries included in the current study. A general over-view is also provided. Data are explored in terms of the whole Liffey, the contribution each section makes to the Liffey and then what is going on in each individual section.

#### 3.1 River Liffey main channel

##### 3.1.1 Species Richness

A total of 10 fish species were recorded in the Liffey main channel sites, August 2021, with a total of 4070 fish being captured. Most sites were dominated by trout. Fish species encountered (in order of abundance) during the sampling programme on main channel sites were brown trout, minnow (*Phoxinus phoxinus*), Atlantic salmon, stone loach (*Barbatula barbatula*), pike (*Esox lucius*), gudgeon (*Gobio gobio*), eel (*Anguilla anguilla*), roach (*Rutilus rutilus*) and three-spined stickleback (*Gasterosteus aculeatus*) (Table 1).

**Table 1. Total number of each fish species recorded, number of sites where present and percentage occurrence of each species recorded throughout the Liffey main channel electrofishing survey.**

Fish Species	Total Count	No sites present	% Occurrence
Brown trout	1288	22	100
European eel	25	11	50
Gudgeon	19	9	41
Minnow	377	22	100
Perch	3	3	14
Pike	49	15	68
Roach	16*	6	27
Salmon	226	20	91
Stone loach	95	20	91
3 Sp. stickleback	11	5	23

\* shoals of very small roach fry observed also

### 3.1.2 Fish species abundance and distribution

#### Brown Trout

Brown trout ranged in length from 5 to 40 cm with 6 age classes present, ranging from 0+ to 5+. The largest fish recorded was aged 4+, 40.1 cm in length and weighed 790 g. Brown trout were recorded at all sites surveyed on Liffey main channel. Length frequency distribution of Liffey main channel trout (all sites combined) indicates a typical pattern with good representation of juvenile trout (0+) and parr (1+) (Fig. 6).



Image 8. Adult brown trout, BME section. Liffey 2021.

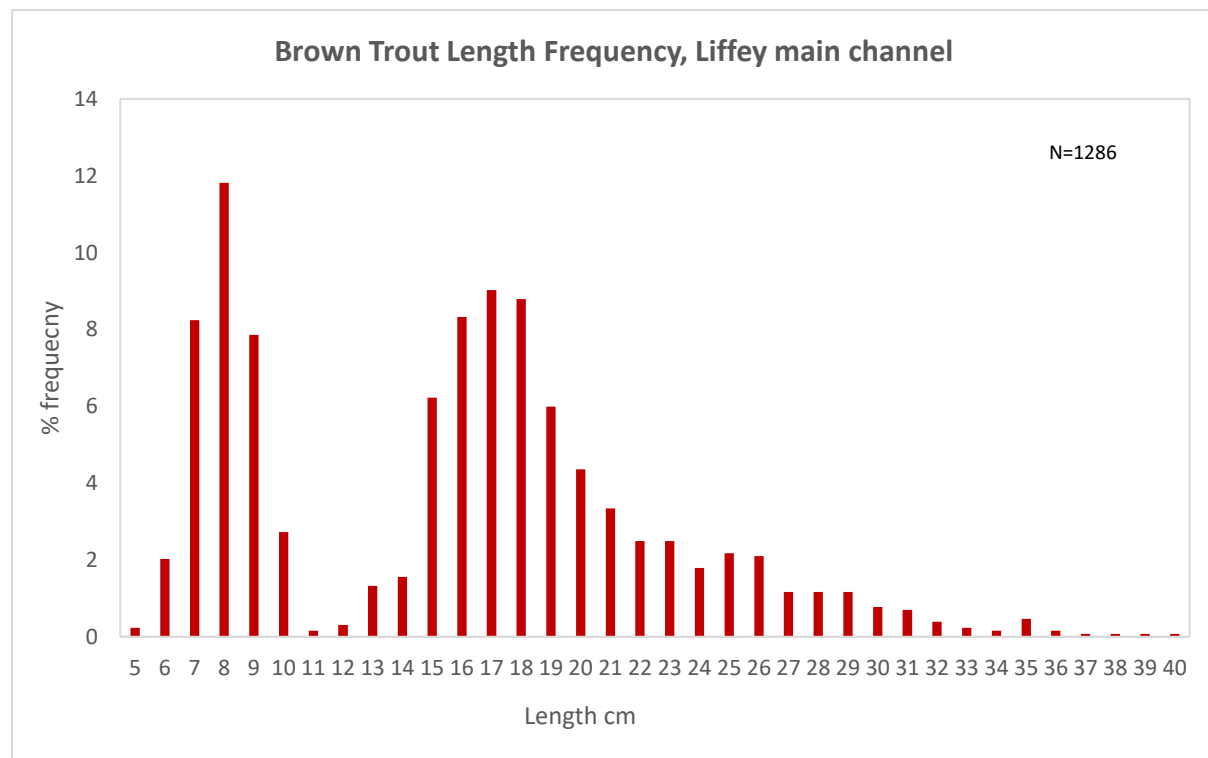
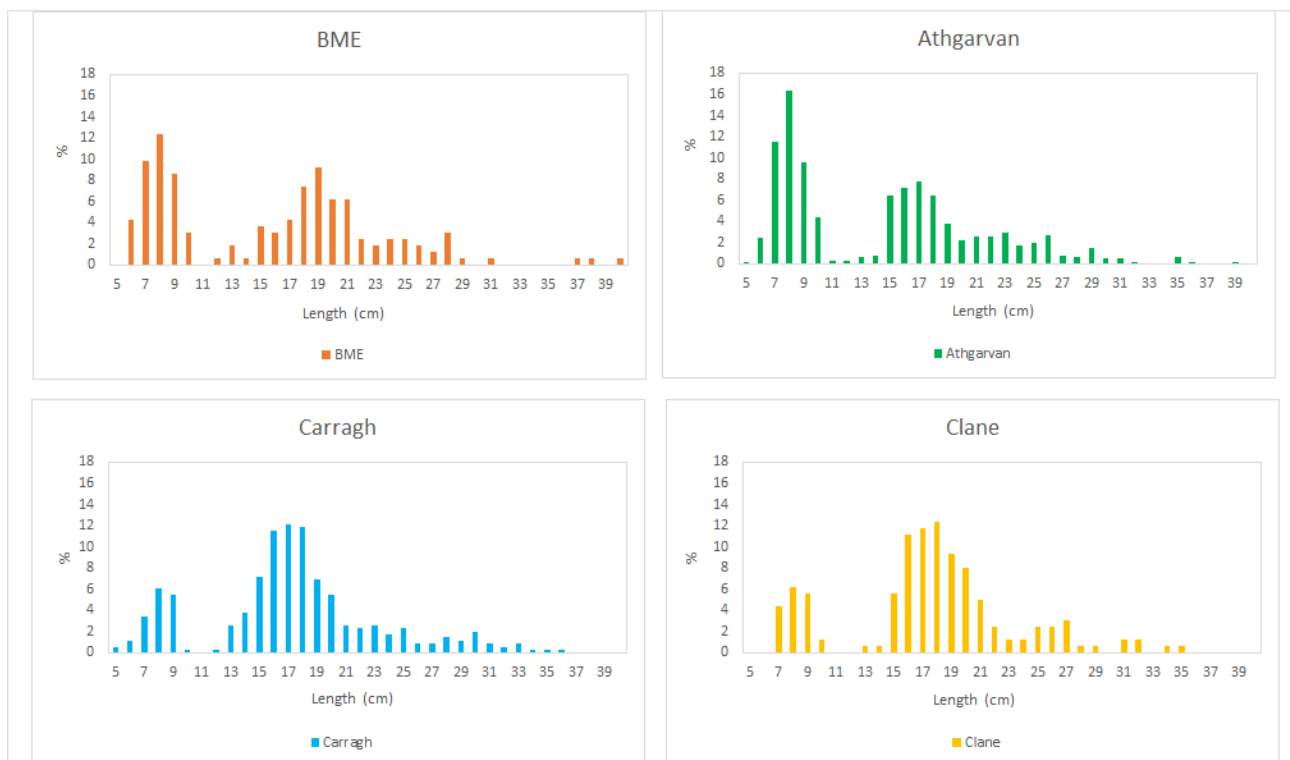


Figure 6. Length frequency of brown trout all surveyed sites combined, the River Liffey main channel, August 2021.

Length range was typical of a trout population of a large river (one without a ‘natural’ lake system). For the most part, the population was dominated by juveniles and young adult fish (in the range of 15 to 26 cm). Fish having length greater than 30 cm represented less than 4% of the population recorded during the electrofishing survey. Taking each main channel section separately, the same length frequency pattern was observed (Fig. 7). Fish greater than 30 cm for each section represented 2% of observed individuals in BME, 2.11% Athgarvan, 5.2% Carragh and 4% in Clane. This observation suggests that slightly more bigger fish were present in the two lower sections.



**Image 9. Adult brown trout, Clane section (left photo) and lower Morell (right photo).**



**Figure 7. Length frequency distribution of brown trout from each section of the Liffey main channel. (All sites within a section have been combined and presented per section).**



### Age Structure and Growth

The age structure for the brown trout population, for all Liffey main channel sites combined, showed that the oldest fish recorded was 5+ (Fig. 8). Most fish were in the 0+, 1+ and 2+ age classes, with fish 3+ and older representing less than 4% of the trout population. This pattern reflects that of the length frequency presented earlier. Generally, Liffey brown trout do not live to an old age - most fish grow fast and are short lived.

Again, the % of older trout within the population for each main channel section suggest very few are present (Fig. 9). The Liffey, in its middle reaches, is a river with a lot of younger age class trout (mainly 0+ to 2+), and the drop off after this age class is obvious.

Table 2 presents the numbers and % occurrence of the three main life stages noted for Liffey brown trout, for each section electrofished. The data indicate that juvenile fish 0+ are more prevalent at the two upper sections, while the lower sections of Carragh and Clane are dominated by 1+ and older fish.

Table 3 shows that the Athgarvan section recorded the greatest % of 0+ fish out of the four sections surveyed. This is also true for >1+ fish, while for 1+ fish Athgarvan and Carragh were the better sections. This observation highlights the importance of the Athgarvan section of the Liffey as being an extremely important and productive section of the river in terms of spawning and as a nursery water for brown trout (Fig. 10 & Table 3).

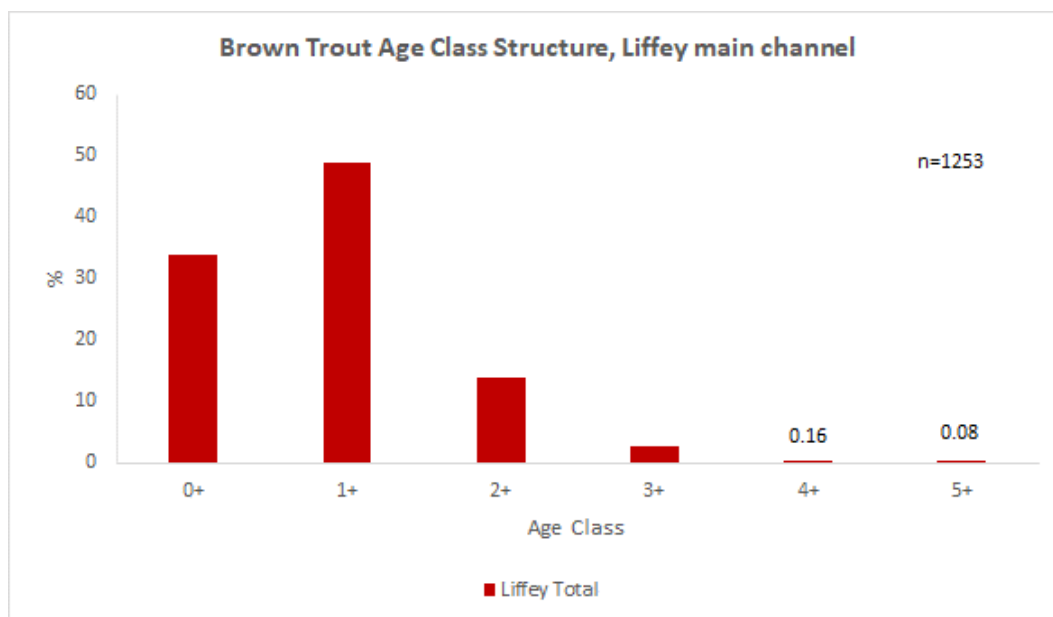


Figure 8. Age class structure of brown trout Liffey main channel (all sections combined).

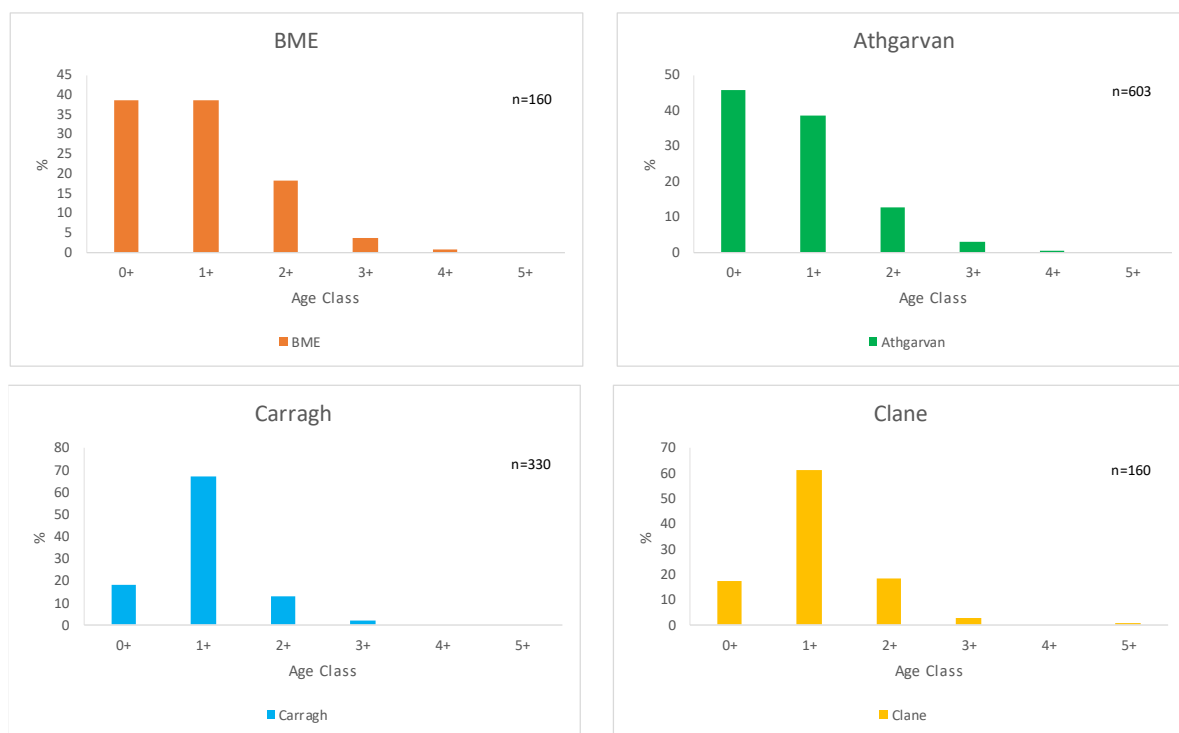


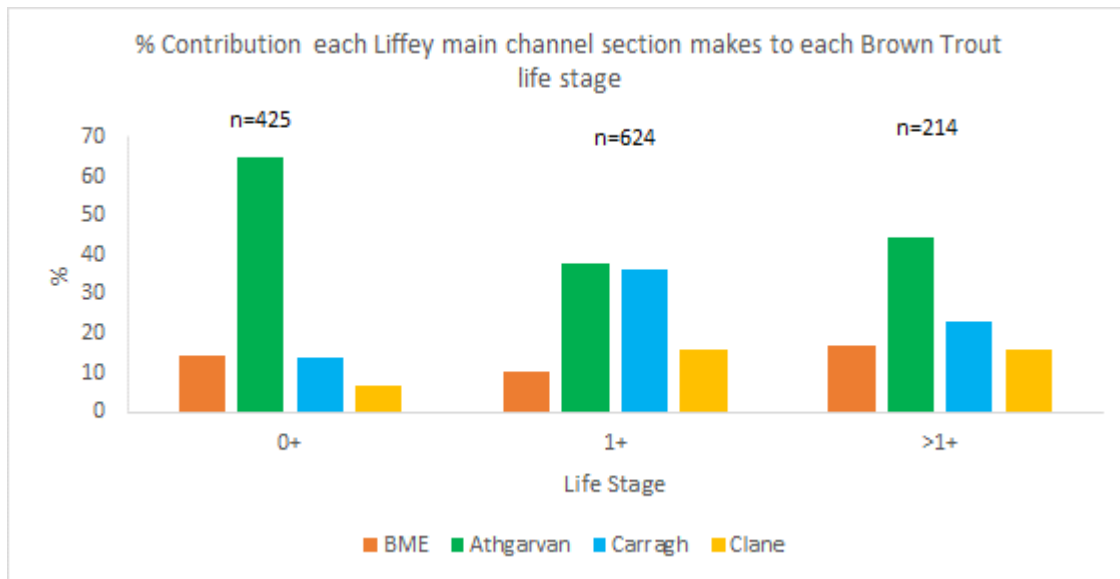
Figure 9. Age class structure of brown trout for each Liffey main channel section (section sites combined).

Table 2. Life stage % based on all Liffey brown trout.

Section	Trout Life Stage Totals			Total	Trout Life Stage %		
	0+	1+	>1+		0+	1+	>1+
BME	62	62	36	160	38.8	38.8	22.5
Athgarvan	276	232	95	603	45.8	38.5	15.8
Carragh	59	222	49	330	17.9	67.3	14.8
Clane	28	98	34	160	17.5	61.3	21.3

Table 3. Life stage % based on each individual Liffey main channel section.

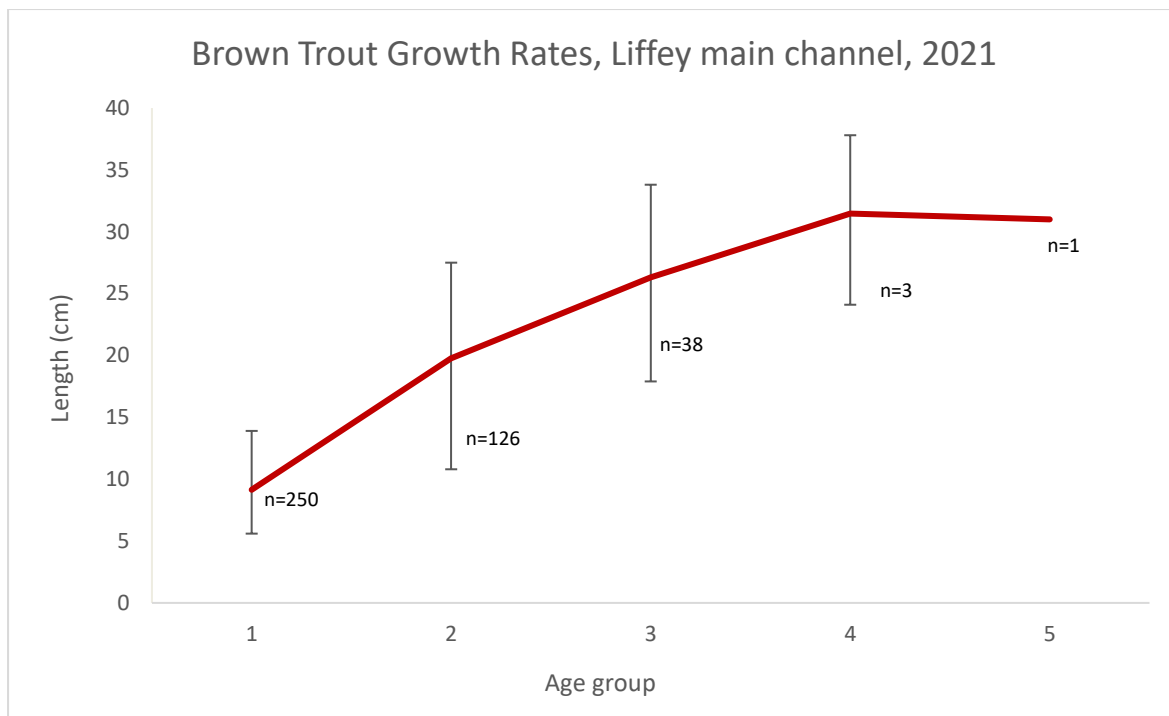
Brown Trout					
Life Stage	BME	Athgarvan	Carragh	Clane	n
0+	14.59	64.94	13.88	6.59	425
1+	10.10	37.79	36.16	15.96	614
>1+	16.82	44.39	22.90	15.89	214



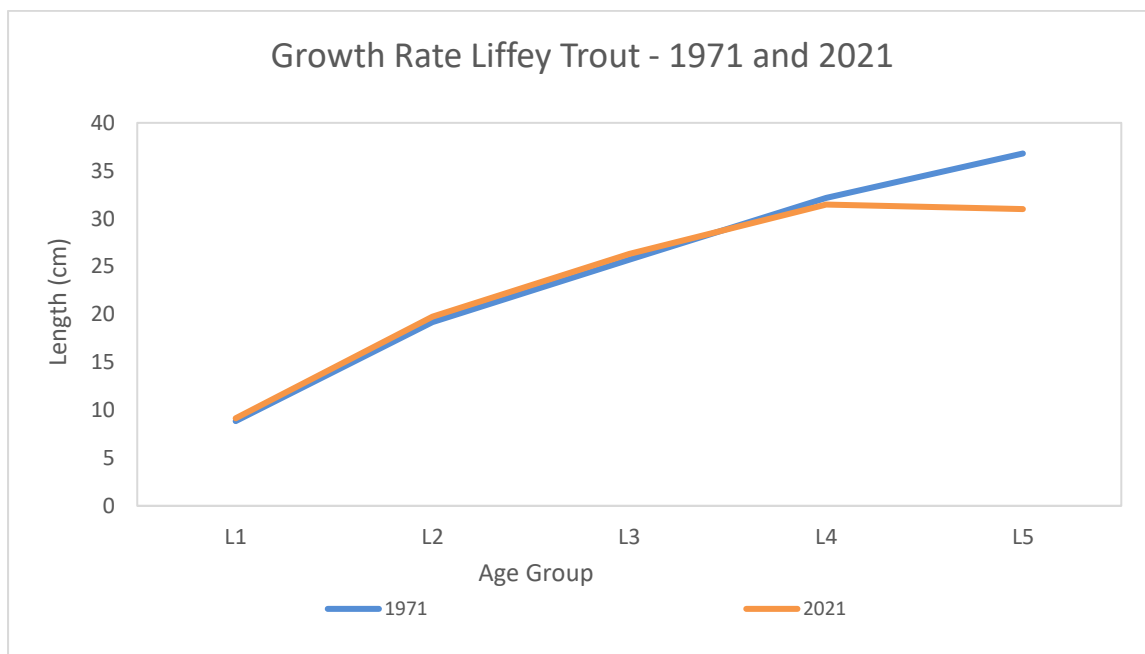
**Figure 10. Brown trout life stages: % contribution from each section to the over-all Liffey main channel.**

#### ***Growth rates and back calculations***

Growth rates for Liffey main channel brown trout are presented in Figure 11a. According to Kennedy & Fitzmaurice (1971), in which they present categories for the growth of Irish streams and rivers brown trout, the Liffey brown trout exhibit a fast growth rate. It is worthy to note that the example given by Kennedy & Fitzmaurice (1971) for fish that show fast growth is the Liffey between Kilcullen and Straffan which covers three of the sections surveyed in this study. The fourth section at BME is quite close. The growth rates given by Kennedy & Fitzmaurice at that time, 1971, are very similar to those recorded during the current survey (Fig. 11b). The difference noted for L5 is due to the low number of fish recorded in this age group, only 1 in 1971 and 1 in 2021. Again, this reflects the paucity of older fish within the Liffey system.



**Figure 11a.** Liffey main channel growth rates for brown trout, August 2021. Minimum and maximum growth also indicated along with the number of fish in each age group (n).



**Figure 11b.** Growth rates of brown trout, this survey (2021) and that as reported by Kennedy & Fitzmaurice (1971).

### Density Estimates Liffey Main Channel

Minimum density estimates were calculated for brown trout, as the survey method employed did not allow for true estimates to be generated (Appendix IV). The survey method involved only one timed (10-minute) fishing to be carried out at each site, used only two boats. This qualitative electrofishing approach provides a very minimum density estimate. Many more fish were present and observed, in particular where riffle and shallow glide sections were encountered. The main exceptions to this were some sites within the BME section and all but the last site within the Clane section, which did not have those fast-flowing shallow glide and riffle areas noted elsewhere. In most cases, large numbers of trout 1+ and 2+ along with some juvenile salmon were observed.

Trout minimum density estimates for 0+ fish ranged from 0.0 (BME site 2 & Clane site 4) to 0.02/m<sup>2</sup> (Athgarvan site 4). Only two sites within the Athgarvan section recorded values greater than 0.01 fish/m<sup>2</sup> (Fig. 12 & Appendix IV). Trout 1+ and older were much more common, and density estimates for these age groups ranged from 0.0/1m<sup>2</sup> (Clane site 4) to 0.02/m<sup>2</sup> (Carragh site 2). Generally, the Athgarvan section of river showed more abundant 1+ and older trout. However, all sections had at least one site where estimates were greater than 0.01m<sup>2</sup> for trout 1+ and older.

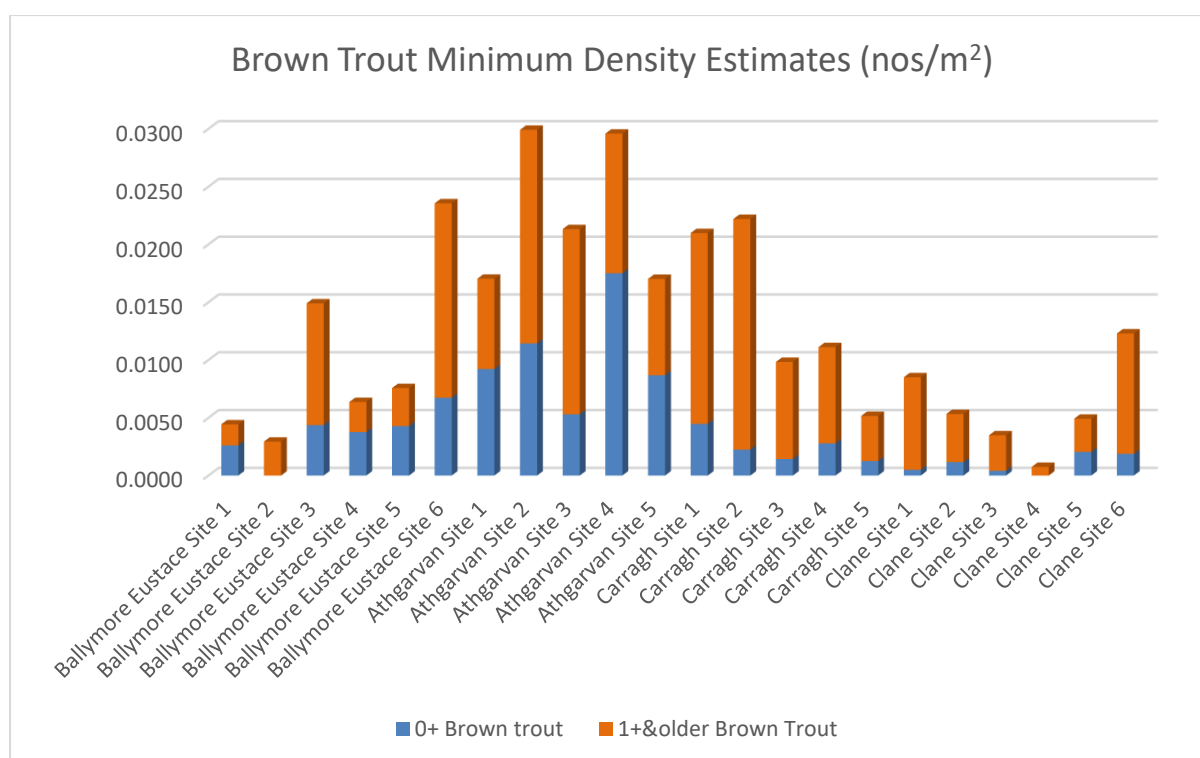


Figure 12. Brown trout minimum density estimates for each main channel site.

**Trout Diet** (based on information and data provided by University College Dublin Dr. Jan Robert Baars)

Diet analysis was carried out from a sub-sample of fish taken during the electrofishing surveys conducted along two stretches of the Liffey including downstream of Athgarvan and of Clane. Sampled fish were measured (length and weight), and scale samples were taken to confirm age. The gut contents of each fish was flushed with a water pump and this material was collected and preserved. Each sample was washed in a 500µm mesh sieve and then placed in an illuminated tray. Each specimen was extracted and later identified using a microscope. All identifications were done to species level where possible, and detached body parts were identified mostly to species level and only the most sclerotized structures were used to get a count (e.g., head capsule of *Ecdyonurus* or head capsule of *Simulium* larva and thorax of *Simulium* adults).

A total of 4687 individuals were recorded in the diet of 155 fish assessed during the laboratory processing. Although varying between stretches fished, the majority of recorded taxa were of aquatic species (~87%). Many taxonomic groups were represented, including insect groups such as Ephemeroptera, Plecoptera, Chironomidae and Simuliidae. Some opportunistic feeding occurred on terrestrial species, particularly those emerging during the survey including the ant *Myrmica scabrinodis*. Of most significance, was the high occurrence of invasive and naturalized alien species. Of all the individual brown trout assessed, 67.7% had at least one of four recorded alien taxa in their diet. Three of the species are considered naturalized in Ireland, one of which (White Clawed crayfish *Austropotamobius pallipes*) is a protected species. The other two species include the New Zealand mudsnail (*Potamopyrgus antipodarum*) and the minnow (*Phoxinus phoxinus*). The invasive alien crustacean *Crangonyx* was found in 29.1% of all sampled brown trout. The percentage occurrence of these species in the diet varied most between stretches but also seemed to vary within stretch but to a lesser extent (Table 4). The percentage occurrence of each of the four species also varied between fish age sampled (note the sample size of 4+ fish was very low) (Table 4). Of all the individuals recorded in each fish, the four alien species made up 1-26% of the gut contents.

**Table 4: The % occurrence of each of the 4 alien species, along with all other species combined, recorded in the gut contents of the brown trout sampled from 2 stretches of the River Liffey.**

Site	Age class	<i>n</i>	<i>Crangonyx</i> <i>spp</i>	*White clawed crayfish	*New Zealand mudsnail	*Minnow	Other Taxa/Spp
Athgarvan	1+	38	2.7	7.0	9.1	0.7	80.6
Athgarvan	2+	33	0.9	1.1	17.8	2.1	78.0
Athgarvan	3+	11	3.4	0.2	19.9	2.9	73.6
Clane	1+	40	3.9	0.0	22.2	2.7	71.2
Clane	2+	22	3.5	0.0	12.6	3.3	80.6
Clane	3+	11	2.4	0.0	19.6	1.0	77.0
Clane	4+	1	0.0	33.3	0.0	0.0	66.7

**Table 5. % Occurrence of main food groups identified in brown trout, by age class and river section.**

Stretch	Fish age	<i>n</i>	% Aquatic	%Terrestrial	% Alien Species*	%Ephem	%Plecoptera	%Trichoptera	%Mollusca	%Diptera	%Crustacea	%Coleoptera
Athgarvan	1+	38	81.4	18.6	21.2	17.2	1.2	7.9	9.5	29.7	14.3	0.1
Athgarvan	2+	31	79.1	20.9	20.3	17.2	1.5	6.6	21.1	19.5	9.4	0.0
Athgarvan	3+	11	73.8	26.2	23.6	11.0	3.2	2.6	32.4	16.3	4.9	0.6
Clane	1+	40	98.9	1.1	26.5	11.7	1.2	10.6	25.6	40.6	6.9	0.0
Clane	2+	21	91.3	8.7	22.3	25.5	1.7	6.8	23.3	25.8	4.4	0.0
Clane	3+	11	97.9	2.1	20.2	36.2	0.1	4.7	25.9	25.2	4.8	0.0
Clane	4+	1	100.0	0.0	33.3	0.0	0.0	0.0	0.0	66.7	33.3	0.0

\*Aliens include crayfish & minnow aswell as *crangonyx* & *Pot. Antipodarum*

**Table 6. Number of fish samples and those with food items and without food items.**

Site	Age class	Total no fish	with food items	without food items
Athgarvan	1+	41	38	3
Athgarvan	2+	35	31	2
Athgarvan	3+	11	11	0
Athgarvan	4+	1	0	1
Clane	1+	43	41	3
Clane	2+	22	21	1
Clane	3+	11	11	0
Clane	4+	1	1	0

\*Species are naturalized but still count as neobiota if unaltered ecosystems are considered



**Table 7. Number of fish with crayfish and minnow in diet.**

Site	Age class	# fish with crayfish	# fish with minnow
Athgarvan	1+	9	2
Athgarvan	2+	5	5
Athgarvan	3+	1	3
Clane	1+	0	8
Clane	2+	0	5
Clane	3+	0	2
Clane	4+	1	0

Diet was comprised principally of aquatic larvae (diptera, chironomids and simuliids), terrestrial diptera adults (simuliids or black flies) and mayfly larvae (*Alainites* and *Baetis*) and snails (*Pot. Antipodarum*) (Table 5). Crayfish were more common in fish from Athgarvan than from Clane, while minnows were more common in fish from Clane. Terrestrial insects were an important component of the Athgarvan trout diet. Alien species represent between 20 to 33% of the overall trout diet. Only 10 fish, out of 164 examined contained no food items (6.1%) (Table 6).

#### Atlantic Salmon

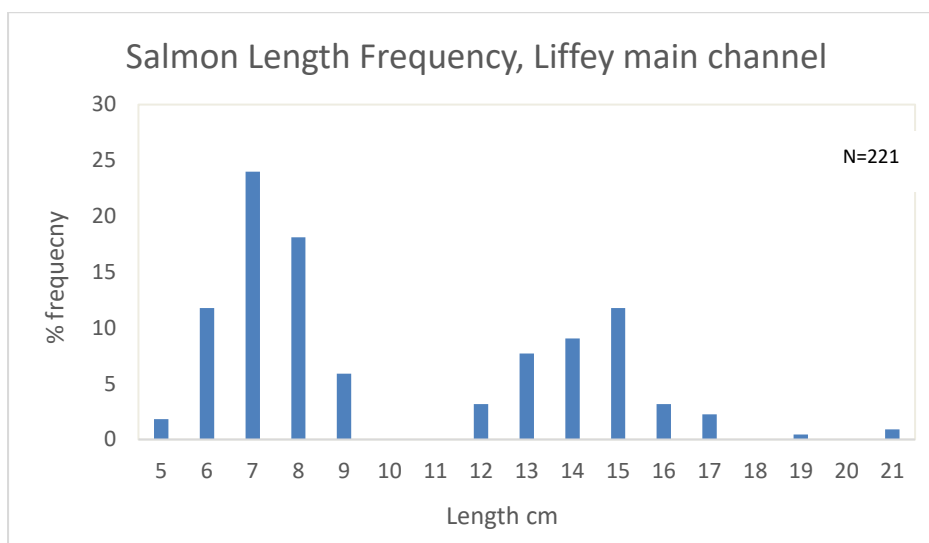
Golden Falls was historically the furthest upstream natural limit of Liffey Atlantic salmon (hereafter 'Salmon'), due to a natural waterfall present there (Went 1945-1948) and is now where the ESB Golden Falls hydro station is located.

Juvenile salmon ranged in length from 5 cm to 21 cm, with three age classes present (0+, 1+ and 2+) (Fig. 13). The population for the Liffey as a whole (all sites combined) was dominated by 0+ fish (61%) (Table 8). Two age classes of salmon parr were noted (1+ and 2+ fish) with the 1+ age group dominating that life stage (Fig. 14). These fish were generally big in size and in good condition (Image 10). When each section was examined separately, the same pattern was noted. The contributions each river section makes to the different life stages showed that both the BME and Athgarvan stretches are important (Table 9).

Salmon were present at 91% of the sites surveyed on the main channel. Ballymore Eustace site 6 recorded the highest 0+ numbers and Athgarvan sites 3 and 4 the highest 1++. Overall, the Ballymore Eustace section was the best for salmon. There were smaller numbers of juvenile salmon elsewhere on the Liffey main channel, mainly restricted to the riffle areas, as was also noted at the BME section. A small number of adult salmon (seven) were also recorded during the electrofishing survey.

Table 8 presents the numbers and % occurrence of the three main life stages noted for salmon, for each section electrofished. The data indicate that juvenile fish 0+ are more common across all four sections surveyed then 1+ and older salmon parr (Fig. 15).

Both the BME and Athgarvan sections were more productive in terms of salmon than the two lower sites. This is a reflection of the more suitable habitat occurring at those two upper sites. The Carragh section of the Liffey yielded the poorest number of salmon with only 4 fish recorded (Fig. 16).



**Figure 13. Salmon length frequency distribution at surveyed sites on the River Liffey main channel, August 2021.**



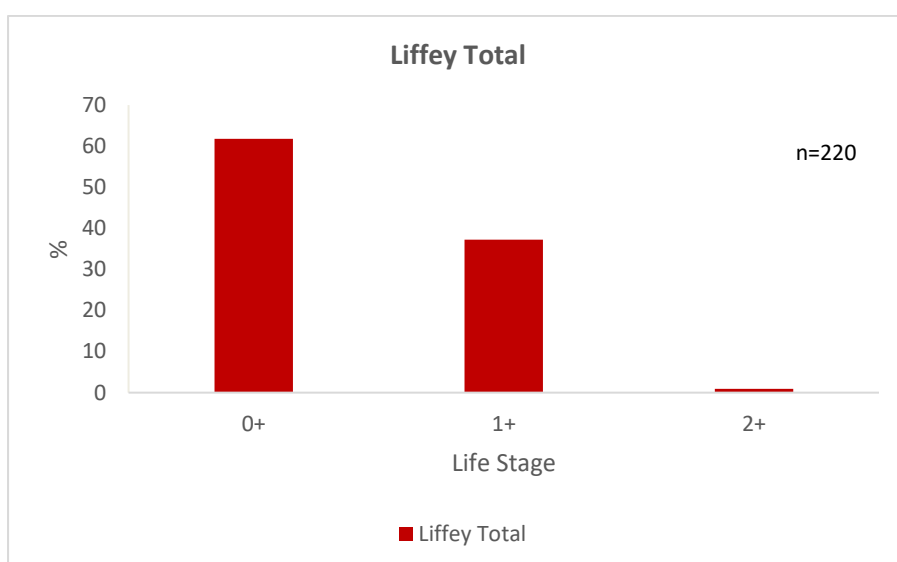
**Image 10. Salmon parr, BME section, Liffey 2021.**

**Table 8. Salmon age structure for each main channel sections and the Liffey as a whole (all sections combined).**

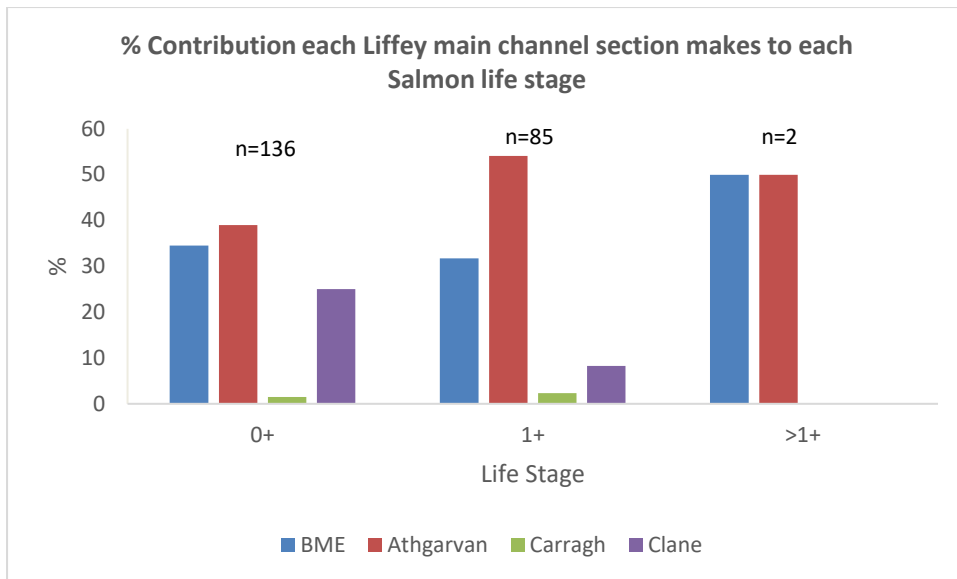
Age Class	Age Structure %				
	Salmon				
	BME	Athgarvan	Carragh	Clane	Liffey Total
0+	53	62.7	50	82.9	61.8
1+	46	36	50	17.1	37.3
2+	1	1.3	0	0	0.9
n	100	75	4	41	220

**Table 9. Contribution each section makes to the whole Liffey age class structure.**

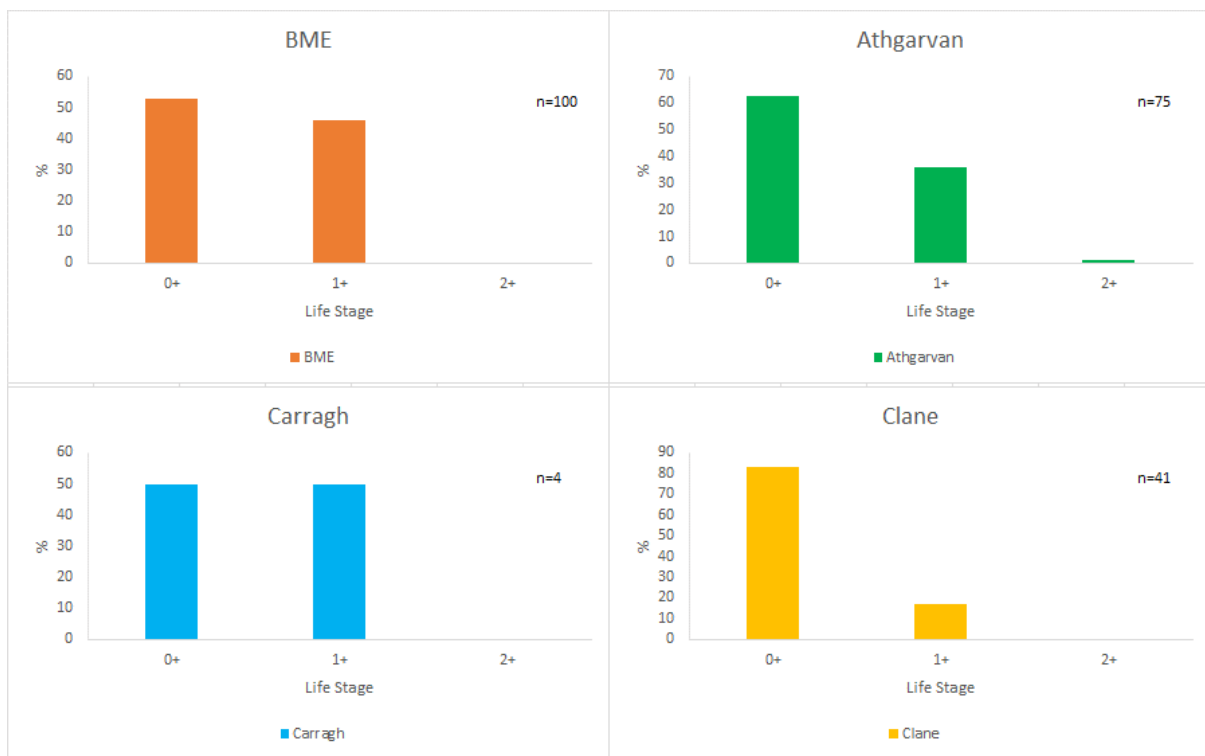
Age Class	Salmon				
	BME	Athgarvan	Carragh	Clane	n
0+	34.56	38.97	1.47	25	136
1+	31.76	54.12	2.35	8.24	85
>1+	50	50	0	0	2



**Figure 14. Age class structure of salmon whole Liffey main channel, August 2021.**



**Figure 15. Salmon age class contribution from each section to the over-all Liffey main channel.**



**Figure 16. Age class structure for salmon from each Liffey main channel section, August 2021.**

### Density Estimates Liffey Main Channel

Minimum density estimates were calculated for salmon, as the survey method employed did not allow for true estimates to be generated (Appendix IV). The survey method involved only one timed (10-minute) fishing to be carried out at each site, used only two boats. This qualitative electrofishing approach provides a very minimum density estimate. Many more fish were present and observed, in particular where riffle and shallow glide sections were encountered.

Salmon numbers recorded during the course of this survey were generally low. Salmon minimum density estimates for 0+ fish ranged from 0.0/m<sup>2</sup>, at several sites but more so across the BME and the Carragh sites, to 0.02/m<sup>2</sup> (BME site 6) (Appendix IV). While salmon 1+ and older ranged from 0.0/m<sup>2</sup> (again several sites but most within the Carragh sites) to 0.0053/m<sup>2</sup> (BME site 6). Generally, the BME and the Athgarvan sections were better for salmon. At only one site were salmon more plentiful than trout, specifically salmon 0+, this was at the BME site 6. This same site also recorded good numbers of salmon 1+ and older.

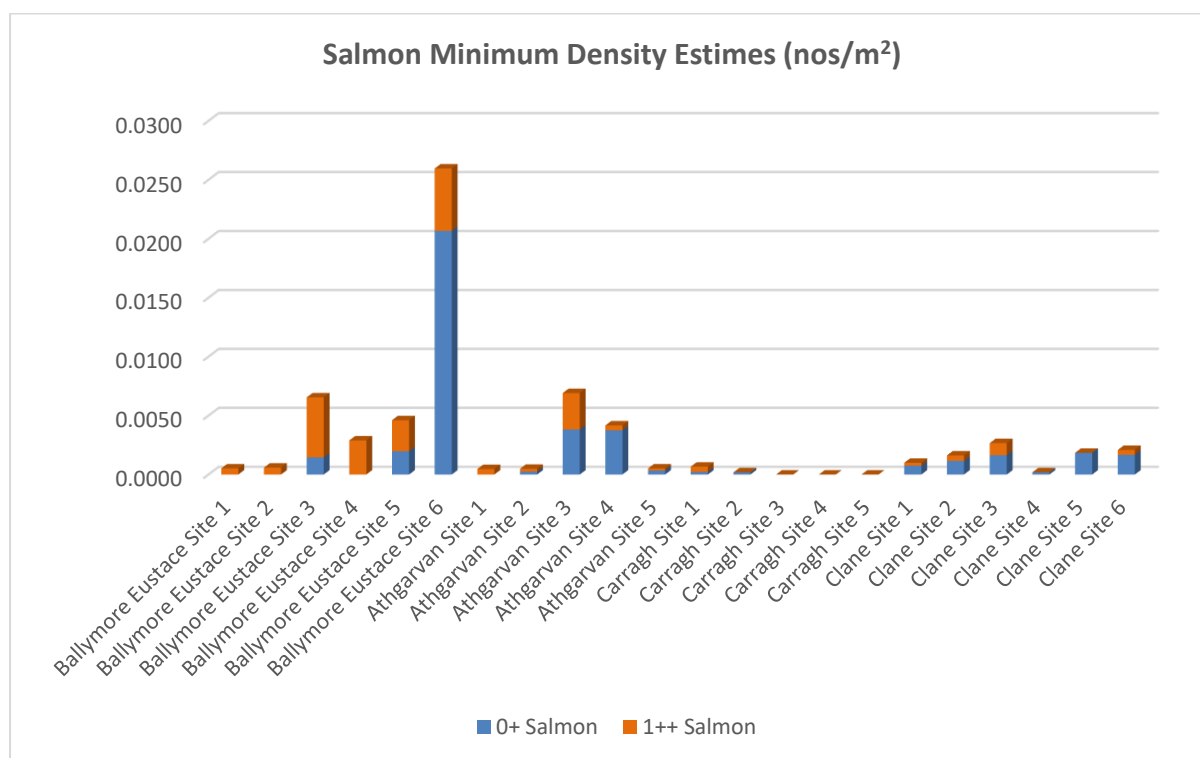
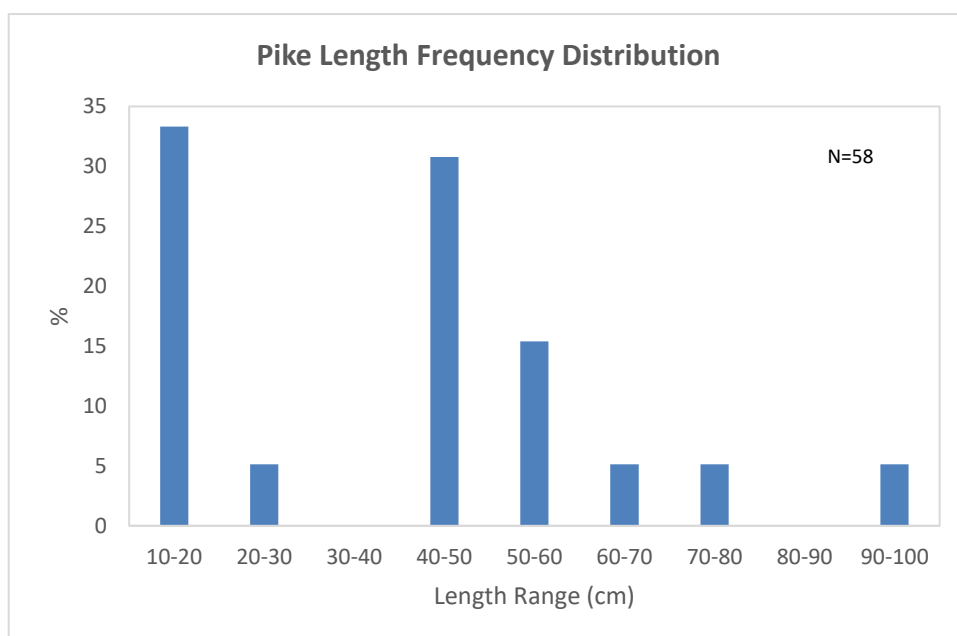


Figure 17. Salmon minimum density estimates for each main channel site.

## Pike

Pike were recorded from all four main channel sections surveyed, though presence varied across the individual sites within each section (Appendix V) being present at 15 sites. Length of observed pike ranged from 12 cm to 100 cm (Fig. 18).



**Figure 18. Length frequency distribution of pike at surveyed sites on the River Liffey main channel, August 2021.**

## Roach

Roach have been present in the Liffey since c.1978 (Mulrooney & Fahy, 1985). During the main channel survey, they were noted at three of the four main channel sections, albeit in small numbers. Lengths of recorded fish ranged from 4 cm to 19 cm and a total of 13 specimens were caught. No roach were recorded along the Athgarvan section. Shoals of small 0+ roach were observed at both the BME and Clane sections.

## Other fish species

Other fish species recorded during the electrofishing survey of the Liffey main channel were minnow, gudgeon, European eel, stoneloach, three-spined stickleback and perch. Minnow and stoneloach were the most common, being widely distributed throughout the main channel (Appendix V).

### **3.1.3 River Liffey main channel - General findings**

- 10 fish species were recorded
- Brown trout were the most common fish species recorded across all the main channel sites, followed by minnow and salmon
- All 22 sites recorded trout
- Trout of 0+, 1+ and 2+ ages dominated the population
- Salmon were present at 20 sites and covered all four main channel sections
- Pike were present at 15 sites
- Habitat was characterised as riffle/glide/pool sequences, with good bankside tree cover. Bed material in shallow glides and riffles was stony, though lacking good spawning gravels in some places

### **3.1.4 Water Framework Directive Fish Ecological Status 2021**

Fish ecological status for sites surveyed on the Liffey main channel is presented below (Table 11). Only one site recorded High Status (4.5% of sites), six were at Good Status (27.3%), over half of all sites (12) attained a Moderate Status (54.6%) while Poor Status was noted for 3 sites (13.6%). In general, Athgarvan sites were at Good Status, Carragh and Clane sites at Moderate, while BME sites varied in fish status the most. The main reason for WFD Fish Status failures (fish status score of moderate, poor or bad) was the absence of specific type indicator species (i.e. brown trout and salmon) or absence of certain age classes (e.g. 0+ and 1+ & older) which is indicative of recruitment failure for one reason or other, such as water quality or habitat issues. For most sites, fish status was reduced due to the complete absence of or low numbers of salmon age classes.



**Table 11. Ecological status of fish at surveyed sites on the River Liffey Main Channel, August 2021.**

Site Code	River Name	Site Name	Fish Status
1.1	Liffey main channel	Ballymore Eustace site 1.1	Poor
1.2	Liffey main channel	Ballymore Eustace site 1.2	Poor
1.3	Liffey main channel	Ballymore Eustace site 1.3	Good
1.4	Liffey main channel	Ballymore Eustace site 1.4	Moderate
1.5	Liffey main channel	Ballymore Eustace site 1.5	Moderate
1.6	Liffey main channel	Ballymore Eustace site 1.6	High
2.1	Liffey main channel	Athgarvan site 2.1	Good
2.2	Liffey main channel	Athgarvan site 2.2	Good
2.3	Liffey main channel	Athgarvan site 2.3	Good
2.4	Liffey main channel	Athgarvan site 2.4	Good
2.5	Liffey main channel	Athgarvan site 2.5	Moderate
3.1	Liffey main channel	Carragh site 3.1	Good
3.2	Liffey main channel	Carragh site 3.2	Moderate
3.3	Liffey main channel	Carragh site 3.3	Moderate
3.4	Liffey main channel	Carragh site 3.4	Moderate
3.5	Liffey main channel	Carragh site 3.5	Moderate
4.1	Liffey main channel	Clane site 4.1	Moderate
4.2	Liffey main channel	Clane site 4.2	Moderate
4.3	Liffey main channel	Clane site 4.3	Moderate
4.4	Liffey main channel	Clane site 4.4	Poor
4.5	Liffey main channel	Clane site 4.5	Moderate
4.6	Liffey main channel	Clane site 4.6	Moderate

### 3.2. River Liffey Tributary Sampling

Five River Liffey tributaries with a total of 10 sites were included in this survey, and the results for each are presented here (see Section 2, Fig. 4). A more wider scope catchment wide electrofishing survey had been undertaken in 2019 (Matson *et al.* 2019). The five tributary rivers were the Lemonstown, Millstream, Ladyswell, Morell (Hartwell and Painestown) and Gollymochy.

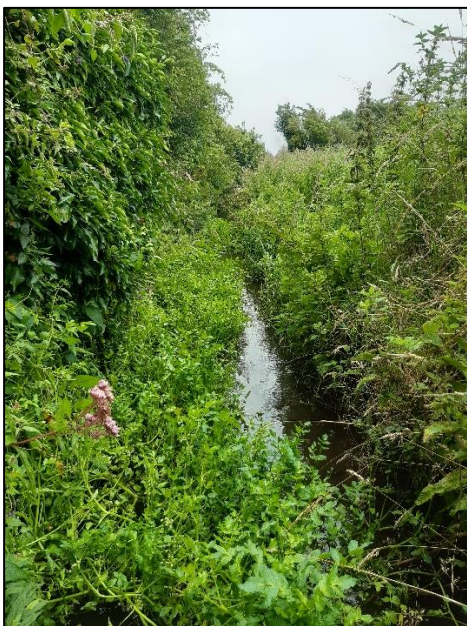
#### ***Tributary Survey Results***

Five fish species were encountered: brown trout, Atlantic salmon, lamprey sp., three spined stickleback, stone loach and minnow. Brown trout were present at all sites while Atlantic salmon were only recorded at two sites (Appendix IV & VI). Brown trout ranged in length from 5 cm to 35 cm and ranged in age from 0+ to 4+, while salmon ranged in length from 5 cm to 19 cm and were aged 0+ to 2+. Trout 0+ were present across all sites surveyed (Appendix VII). Trout 1+ and older less so, reflecting

the habitat type of the site fished. In general, trout minimum density estimates were relatively good for all surveyed sites. Brown trout aged 0+ occurred at all sites, and density estimates ranged from 0.0861 (Lemonstown site 5) and 1.1064 (Hartwell site 8), while 1+ and older fish were recorded at 8 out of the 10 sites with density estimates ranging between 0.0 (Painestown site 9 & Gollymochy site 14) and 0.8066/m<sup>2</sup> (Morell upper site 12). Both the Morell lower site 12 and the Millstream recorded good numbers of 1+ and older fish. Salmon on the other hand showed comparatively low abundance (Appendix IV) and were only recorded at two sites, Painestown site 11 and Morell site 13. It should be noted that the surveyed Lemonstown site was above the waterfall and hence difficult to access for spawning salmon.

These reasonably good 1+ brown trout minimum density estimates, reported for several of the Liffey tributaries, suggest successful spawning at these locations during 2020/2021. Overall, trout density estimates point to some of these tributaries being important for spawning and /or as nursery waters, except for the Gollymochy. The site surveyed on the Gollymochy was very shallow, low flows were evident and bed material was mainly of fine material, very little in the way of spawning gravels or large stone were present at this site (Image 11). Older trout were mostly recorded in channels with greater depth good cover and reasonable flows, being more common towards the lower reaches of these tributaries (such as the Morell and the Millstream).

Of the other fish species recorded stone loach and minnow were the most common (Appendix VI).



**Image 11. Site surveyed Gollymochy, July 2021.**

### ***Fish Ecological Status***

Fish ecological status for tributary sites surveyed is presented below (Table 12). In general fish status was at High or Good at 70% of sites and only 3 sites (30%) were at the less than favourable status of Moderate.

**Table 12. Ecological status of fish at surveyed sites on the River Liffey Main Channel, August 2021.**

Site Code	River Name	Site Name	Fish Status
5	Lemonstown/ Ardinode	d/s of main road bridge	Moderate
6	Millstream	Graveyard	Good
7	Ladyswell	Halverstown Cross	High
8	Hartwell	u/s of road bridge	Good
9	Painestown 1	d/s Painestown Bridge	Moderate
10	Painestown 2	u/s land bridge right-hand branch	Good
11	Painestown 3	u/s bridge	High
12	Morell	Morell Bridge	Good
13	Morell Lower	d/s main road	Good
14	Gollymochy	d/s of road bridge	Moderate

#### **3.2.1 River Liffey sub-catchments overview**

- Six fish species were recorded across the 10 sites surveyed
- Brown trout were the most common species recorded and were present at all tributary sites
- Trout populations were dominated by 0+ fish
- Salmon were recorded at only two survey sites

### **3.3 Review of the Liffey 2021 survey with historical River Liffey Surveys and other large Irish river systems**

Access to historical river survey data can help to evaluate the current status of the system and put it into perspective in terms of any changes noted. Historical Liffey surveys carried out during the course of 1971 to 2005 were available and a narrative review of the river then and now is provided. Information was collected on fish, habitat characteristics, instream flora and fauna. Direct comparisons of fish data were not generally possible due to changes in survey methodology over the years. However, the valuable information collected and presented in those survey reports clearly showed that, for the most part, little has changed ecologically across the middle reaches of the Liffey. In an effort to capture those survey results and as an alternative to comparing quantitative fish density

estimates over the various survey years, it was decided that the addition of quotes from available Liffey reports would supplement the data presented above and provide valuable insights to the status of brown trout stocks at those times. The information below gives relevant narrative comments with the survey year and the sampling location provided in the corresponding report. Direct quotes are provided.

#### Trout abundance and angling opportunity

**1971** (R. Fluskey) Rathmore-Newtown-Lodgepark-Twinings Lower ‘yield of trout is poor ... , ‘anglers seldom seen here’ .. ‘only the odd trout is landed on the fishery’.

**1972** – Athgarvan to below Newbridge \_Old Connell) ‘Brown trout stocks very limited, average 3oz fish odd fish to 1/2lb, very odd to 1lb. Again restricted to streamy areas. Main concentration of fish immediately below Athgarvan and immediate vicinity of Newbridge’ ... ‘Good stocks of salmon parr present in streamy shallow areas’.

**1973** – Straffan Bridge to near Celbridge -‘It would appear that only a few trout are present in this stretch of water’

‘Heavy beds of *Ranunculus* in shallow areas making fishing and visibility a little difficult’

**1973** – ‘There is a lot of attractive trout water between Kilcullen and Millicent Bridge. In most stretches there is ample feeding for trout. The stock of trout generally is less than one would expect for the type of water and the amount of food available. Sizeable trout are relatively scarce.... The tributary streams flowing in between Kilcullen and Millicent have, in general, a limited spawning and nursery potential, hold few young trout, and have only a very limited potential for improvement.’

**1982** – Straffan Bridge to Ferris’ Whirlpool to Celbridge weir - ‘Very small numbers of catchable trout in relation to total stock. Majority of trout were from 5 ozs to 3/4lbs and found to be in the fast shallows immediately downstream of the bridge’

‘Very heavy stock of young fish ranging from fingerlings to approx. four ozs. These were in excellent condition and well spread over the shallows.... Very few small fish in this range in the deeper water’

**1986** – Kilcullen to Clane. ‘Riffles and short glides with abundant spawning gravel were well distributed along the channel....’ ‘Instream vegetation changed dramatically downstream of the Osberstown outfall with unnatural growths of fennel pondweed smothering the stream bed in every fast glide and shallow flat. These growths seriously reduce the fishability of the channel ....’ ‘They deprive salmonids

of their traditional spawning sites and are likely to cause oxygen depletion during the hours of darkness in prolonged periods of warm weather....' 'The shallower fast flowing areas appear to carry good stocks of small fish but large trout in excess of one pound are limited in the upper reaches...' 'Some good trout to four pounds were noted downstream of Clane ...' 'but may not be resident in this area. The Kilcullen stretch was the most densely stocked ....' 'At Clane the overall stock density was reduced. Fish were found to be feeding on a wide variety of invertebrates'

Leinster Aquaduct to Millicent Br. – 'all glides in this section were weed choked ...' 'Instream vegetation dominated by *Potamogeton pectinatus* ...' '100% cover of Pot. P ...' 'Many glides unfishable due to the probable likelihood of losing fish in weeds'

#### **1987 – BME & Liffey Cottage & Castlekeely Ford –**

BME 'Fish stocks are depressed throughout the section because of widely varying discharge velocities...'

Liffey Cottage 'A short fast flowing section upstream of Osberstown sewage treatment works outfall contained a very good stock of small trout and juvenile salmon....' 'Slow flowing deep water about 400m further downriver held few trout and some adult salmon...'

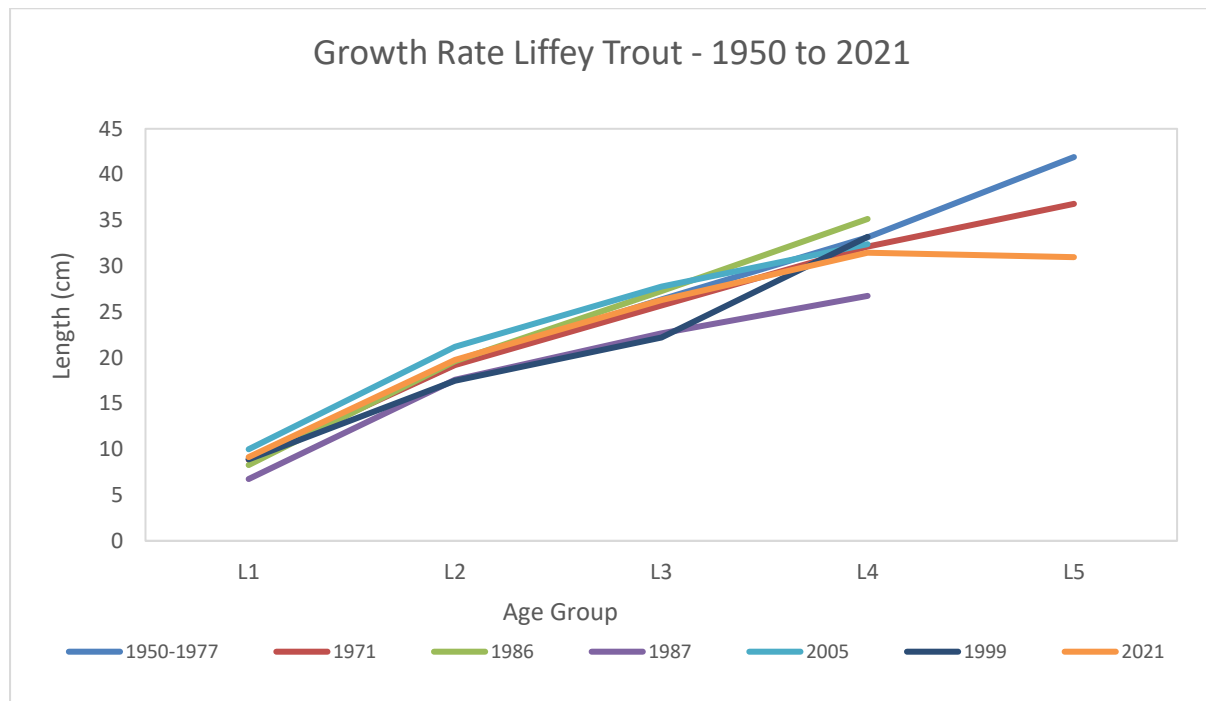
Castlekeely Ford 'the river contains a mixed stock of salmon parr and trout...' 'There is some evidence, from fish stocks, of heavy angling pressure at easily accessible locations'

**2005** BME to Railway Bridge at Harristown - 'The River Liffey, in the vicinity of BME is significantly cleaner than it was when this section of the river was surveyed in 1987....' 'Stocks of trout and juvenile salmon have improved considerable in the BME area since 1987...' 'However stock densities of trout and salmon upstream of BME are still low. This is not unusual for locations in rivers where the flow is regulated especially considering the proximity of the survey site to the hydro-dam upstream at Golden Falls. The trout stocks are low in the two sections surveyed quantitatively in the main Liffey...' 'The river holds only a moderate stock of trout... but some sections (moderate depths alternating with shallow glide/riffle) were better stocked than the many long deep stretches'

#### ***Trout growth rates***

During the period 1950 to 2005 scale samples from Liffey trout, taken from angler caught fish and/or IFT and CFB fish surveys, were aged and back calculations of length at age were determined. This historical data was available for inclusion in this study as the method for fish ageing remains unchanged. Growth rates of trout estimated from the various sample sets (angler-caught fish 1950-

1977, IFT studies 1971 and CFB studies 1986 to 2005) were plotted alongside growth rates of trout as estimated from this study (Fig. 19). While the graph shows some interannual variability no obvious directional change over the period 1950 to 2021 is evident.



**Figure 19. Comparison of Liffey brown trout growth rates, over different sampling periods.**

### ***Comparison data for Liffey tributaries***

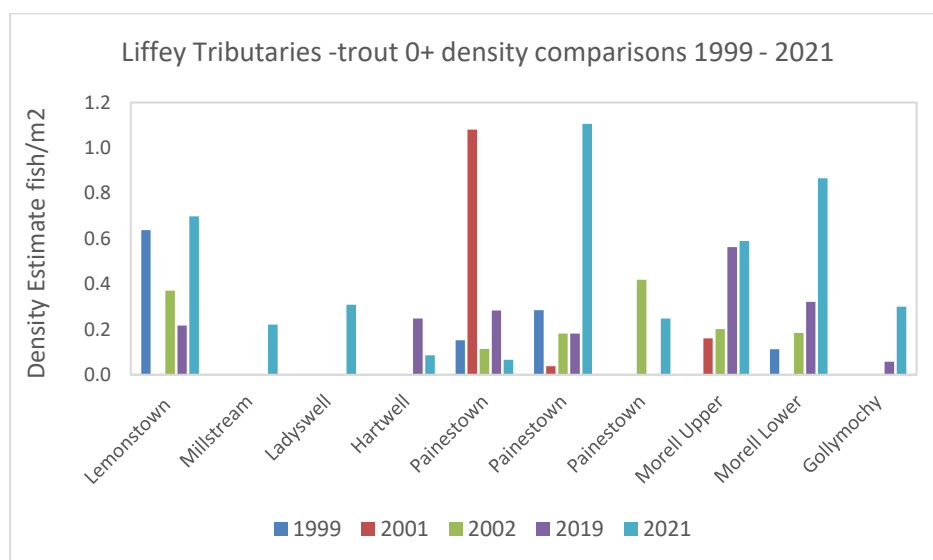
A number of electrofishing surveys have previously been carried out on Liffey tributaries and data from these were available for comparison with this study (Table 13). Having fish data across several years provides an insight into the stability or fluctuations of fish populations within these rivers/tributaries. Fish data across several years provides a range of density estimates making it possible to measure increases or declines in density estimates over survey years, in particular, if fish numbers are typical of the normal range or outside of it. General fish abundances vary annually, and so the range of density values will have a wide range. The variables that influence fish numbers is considerable, and this is reflected in the fluctuations usually noted across density estimates over several years.

The data available for Liffey tributaries followed similar sampling methodologies making comparisons possible. Data from the 1999, 2001 and 2002 surveys employed the depletion method and the 2019 and 2021 surveys the converted 10-minute timed method (Matson *et al.*, 2017).

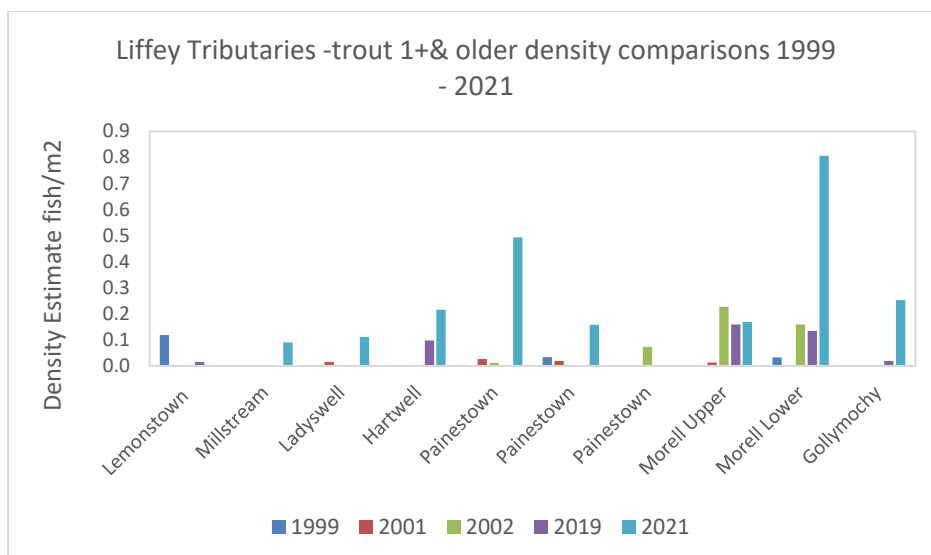
Electrofishing data from surveyed tributaries were reviewed and are presented in Figures 20 & 21 for brown trout 0+ and 1+ and older. Fluctuation across survey years is noted for some sites but also similarities on occasions. The results from the 2021 survey generally indicate higher density estimates than for those from other survey years. This would suggest good spawning in these tributaries and potential recruitment to the main channel that year and in 2022/2023.

**Table 13. Tributary sites and availability of previous surveys.**

Site ID	Tributary	Site	2021	2019	2002	2001	1999
5	Lemonstown	d/s of main road bridge	*	*	*	*	*
6	Millstream	Graveyard	*		*	*	
7	Ladyswell	Halverstown Cross	*		*	*	
8	Hartwell	u/s of road bridge	*	*	*		
9	Painestown	d/s Painestown Bridge	*		*		*
10	Painestown	u/s land bridge right-hand branch	*	*		*	*
11	Painestown	u/s bridge	*		*	*	
12	Morell	Morell Bridge	*	*	*		*
13	Morell Lower	d/s main road	*				*
14	Gollymochy	d/s of road bridge	*	*		*	



**Figure 20. Trout 0+ minimum density estimate comparisons, 1999 to 2021**



**Figure 21. Trout 1+&older minimum density estimate comparisons, 1999 to 2021**

### ***Comparison data, main channel, with other large Irish River Systems***

Irish river catchments fall into two broad categories, those with large lakes and those without. The Liffey is one of those systems that does not have a 'natural' lake. Poulaphouca reservoir was created when the river was dammed during the 1940's and is located within the upper reaches of the main channel. Other catchments with few lakes within their system include the Suir, Barrow, Nore, Munster Blackwater and Boyne. Survey data is available for a number of these large river catchments namely the River Suir and the River Barrow. A review of fish stocks within these rivers will help put the Liffey into perspective in relation to its brown trout population structure.

#### **The River Suir**

The River Suir is about 115 miles long and drains an area in the southeast of the country of approximately 3546 km<sup>2</sup>. The river is renowned for its game angling, holding both salmon and brown trout. The river is a paradise for both the trout and the angler. Unlike most rivers, it cannot easily be divided into distinct ecological zones. Almost its entire channel from Templemore down to the estuary at Carrick-on-Suir is a continuous series of shallow and deep (< 2.0m) glides interrupted occasionally by shallow riffles. It simply increases in width as one proceeds downstream, remaining relatively shallow and maintaining its very good trout carrying capacity over practically its entire length. It has many tributaries, which drain large areas of limestone and these give to the river, most of the best characteristics of a chalk stream (<https://fishinginireland.info/trout/south/suir/>).



This combination of a rich limestone base and huge areas of relatively shallow glides makes the Suir ideal for the production of brown trout. There is massive recruitment of young trout from the extensive tributary systems and the trout survive and grown in what is a near perfect environment.

The Suir is one of Ireland's premier brown trout fisheries. Only a handful of rivers can compare with in terms of trout density and in terms of overall numbers of trout that it produces and that are available to the angler. The trout range in size from 12oz to 2lb, depending on the habitat. Their lifespan is relatively short and few live to much older than four years (O'Reilly, 2002).

### *The River Barrow*

The Barrow is about 120 miles long and drains a huge catchment area consisting of mountain, bog, pastureland, and tillage farming. It is a river that has had recurring serious water pollution problems in recent times, and fish kills have occurred. Some of the tributaries and part of the upper river have had arterial drainage schemes carried out in the past.

The Grand Canal joins the river at Athy, and from there to the tide the river is navigable. The conversion of the river to a navigable channel involved the construction of locks and weirs, which have notably altered the character of the river and have resulted in much ponding and deep water upstream of each weir.

The salmon fishing is generally regarded as poor, and what fish are taken are mostly grilse, taken either during the summer or late in the season. The brown trout fishing is fair to good and even very good in places, the average weight ranging from 0.5 to 1.25 lb, depending on location (<https://fishinginireland.info/trout/south/barrow/>).

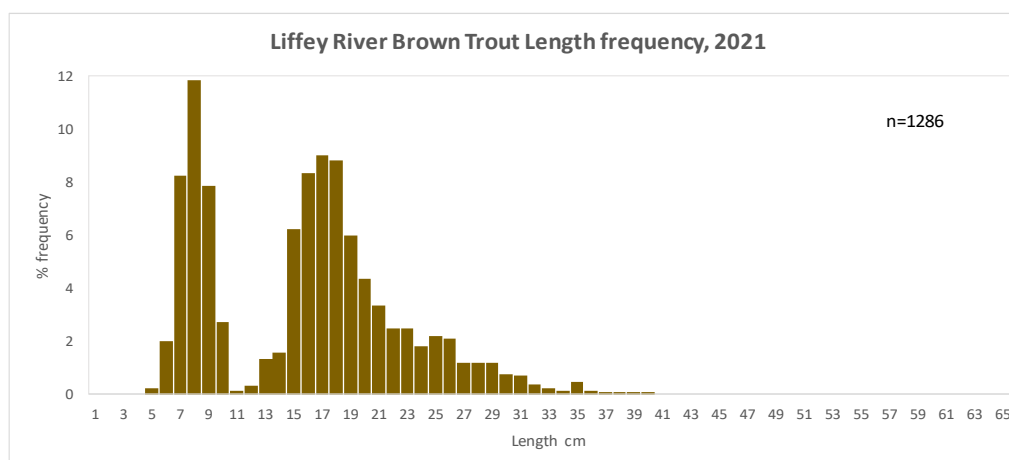
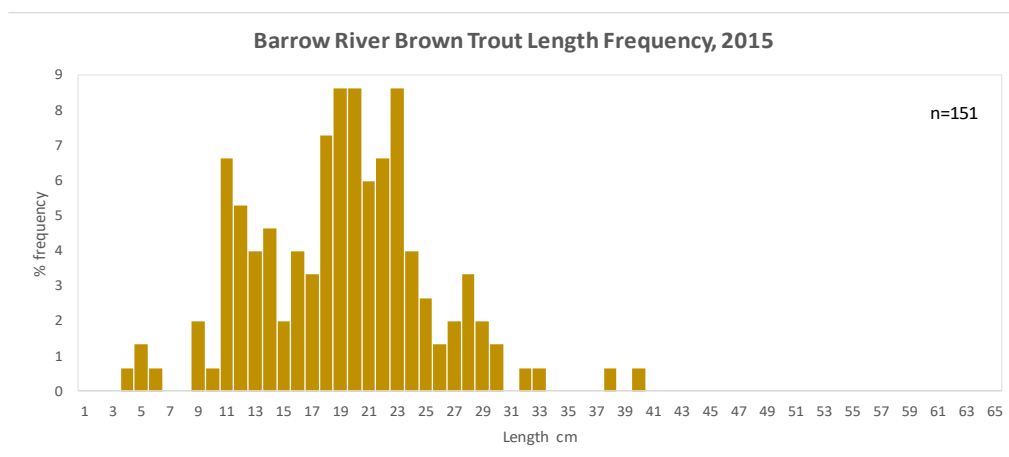
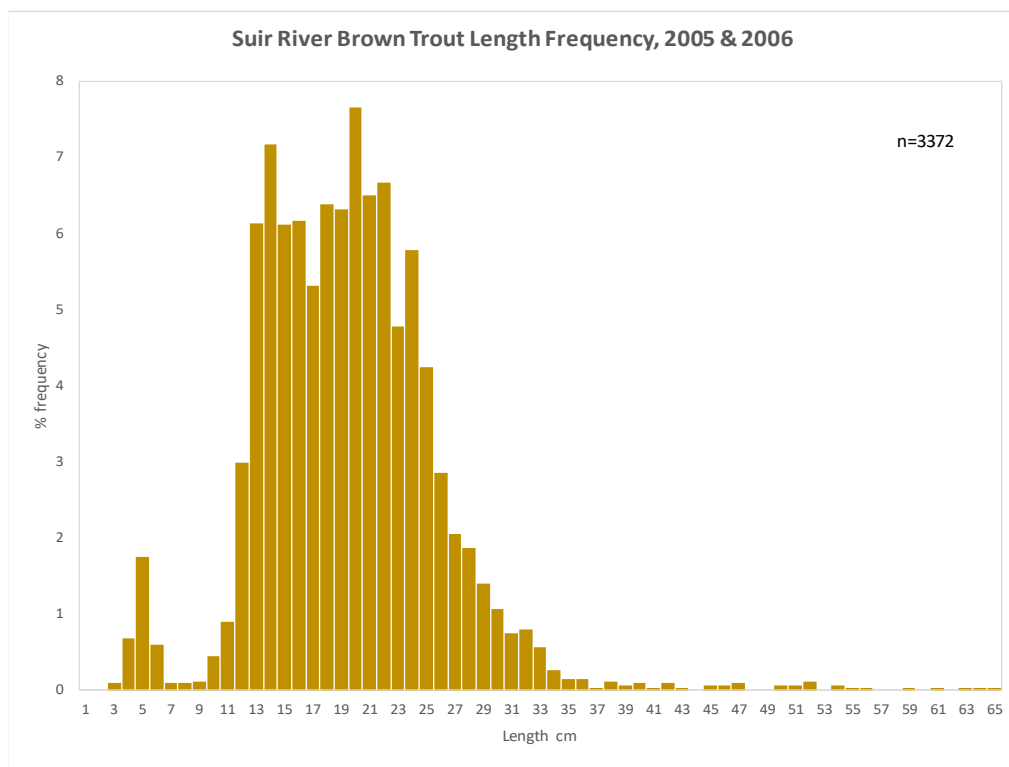
For the purpose of this report survey results from these rivers are only reviewed in terms of brown trout. Survey data available across all three river systems include information on length frequencies, age structure and growth rates. In all surveys several main channel sites were surveyed and electrofished over many kilometres. Data presented in this report combines all main channel sites to represent the main river as a whole.

### ***Comparative review***

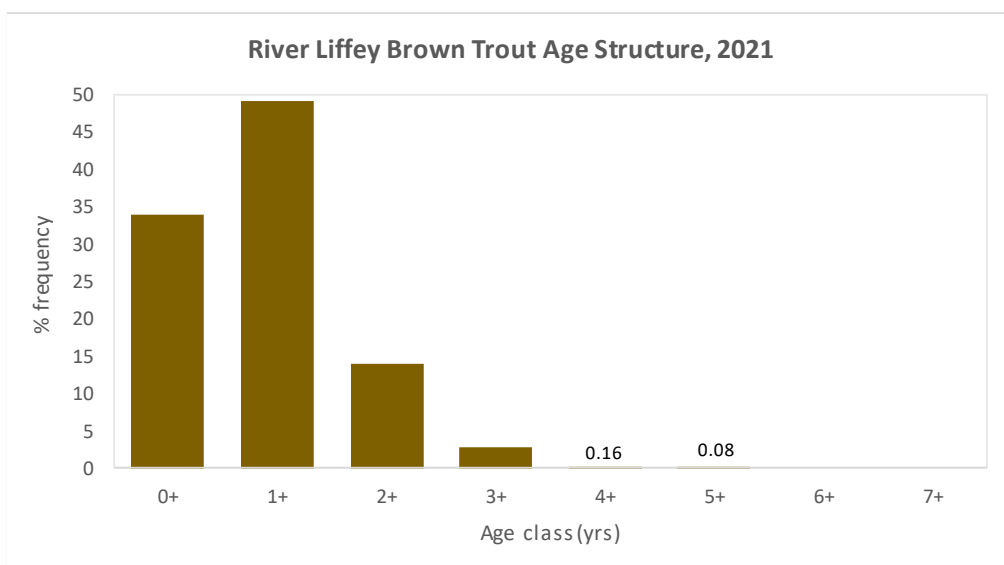
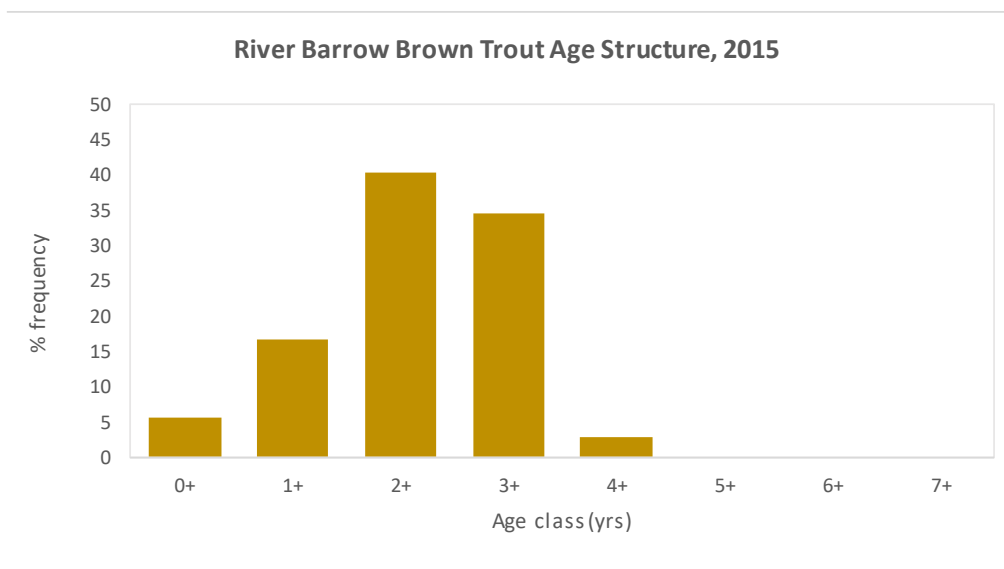
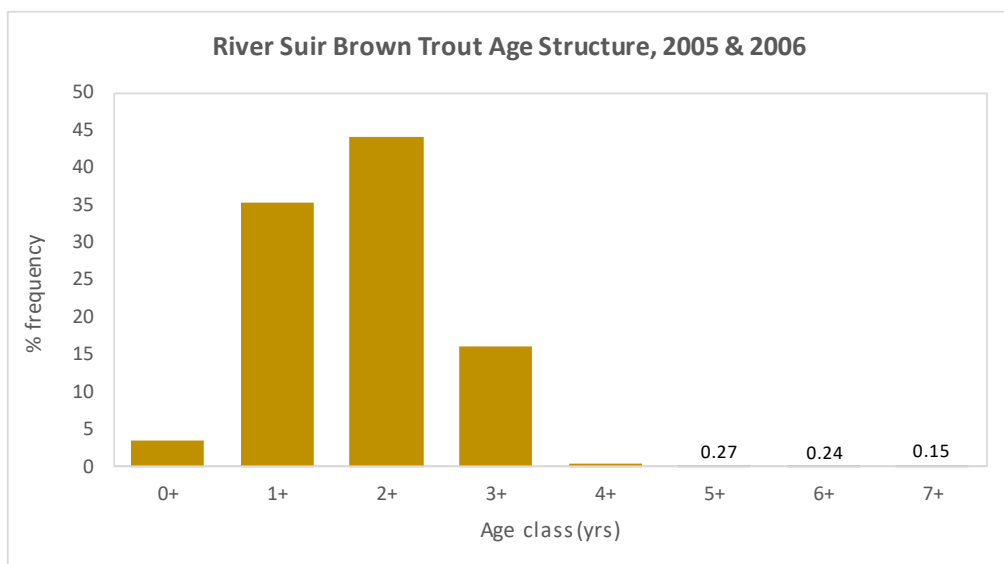
Length distributions for brown trout from the Liffey, Suir and Barrow are presented below (Figure 22). This graph shows the Liffey River has a high proportion of 0+ fish compared to the other two rivers. This is due to the high level of spawning activity that occurs throughout the Liffey main channel. Trout spawning on the Suir and the Barrow mostly occurs across the many large tributaries occurring in both

these systems. In all cases, the majority of the trout population are of fish in the range of 11cm to 30cm (1+ and 2+ fish). Older fish are poorly represented in all three rivers.

Age structure of trout from these three rivers again indicated that there is a noted difference amongst Liffey fish (Figure 23). That is the population has a high proportion of 0+ fish, unlike the Suir and Barrow and as mentioned above reflects the level of spawning activity occurring throughout the Liffey middle reaches. Less trout spawning takes place in the main channels of the Suir and Barrow. Also, in the case of the Barrow and Suir the age class structure of the trout population contains more 1+, 2+ and 3+ fish than the Liffey, which is dominated by 0+, 1+ and 2+ fish. In both the River Liffey and Barrow very few, if any, 4+ were recorded. Only the River Suir had fish up to 7+, albeit in small numbers.

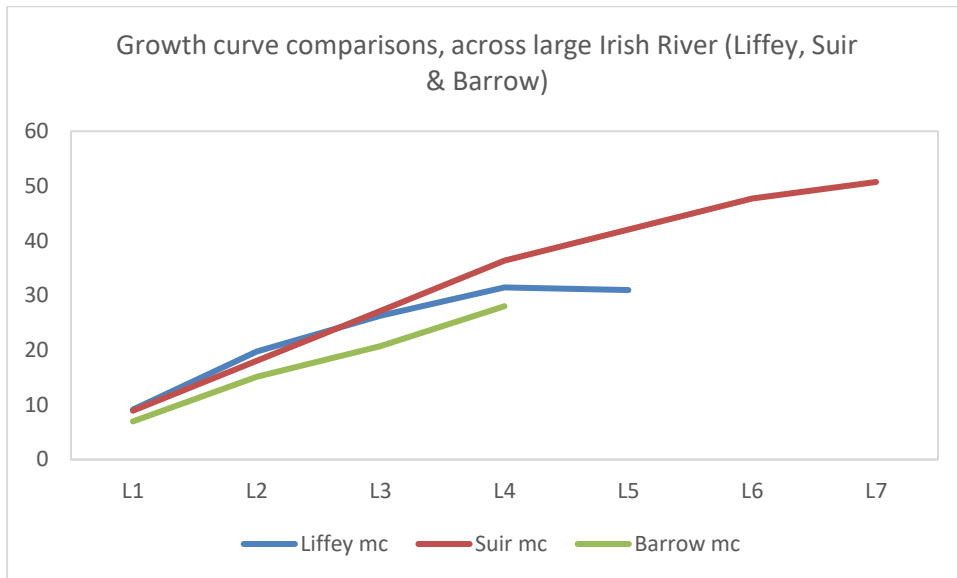


**Figure 22. Brown Trout Length frequencies, Suir, Barrow and Liffey main channels.**



**Figure 23. Brown Trout age structure, Suir, Barrow and Liffey main channels.**

Similar growth patterns were observed across all three rivers (Fig. 24). For the most part, fish grow fast but their lifespan is relatively short and few live to much older than four years. Older, bigger fish were only noted in the River Suir in its middle to lower reaches.



**Figure 24. Growth patterns of trout from three large Irish River Systems, Liffey, Suir and Barrow.**

Both the Suir and the Barrow catchments differ to the Liffey in that the available tributary sub-catchments are much greater and trout recruitment from these tributary systems contributes significantly to the adult trout populations of their main rivers. This is unlike the Liffey, where tributary systems (principally feeding the middle reaches of the main channel) are generally small with the Morell being the main exception. Trout recruitment from Liffey tributaries is for the most part reduced. The Liffey main channel, middle reaches, is the primary source of trout spawning and recruitment of juveniles. Trout recruitment from the Rye Water, Camac and Griffeen sub-catchments are not of importance to this section of the Liffey as demonstrated by the brown trout genetic study (see Section 1.2.7 & Fig. 4).

The River Suir would be considered and described as one of the premier trout fisheries in the country, the trout fishing on the River Barrow has been described as fair to good. The Liffey is somewhere in between these.

## 4 Discussion

The Liffey is a big river and a very interesting one with a great diversity of character (O'Reilly). The character of the river as described in the early 1970's by P. Sheehy (IFT) has really remained relatively the same since then.

*The Liffey is an interesting and varied trout river. Below Poulaphouca Lake the Liffey is a winding, gravelly river with a fairly swift flow and few weeds. There are some long pools..... It flows through rich farm land. Between Kilcullen and Newbridge the banks are more wooded and are heavily overgrown in places. Between Newbridge and Celbridge there are less rapid streams, some long deeps and some weedy glides. There is some good trout fishing in this area, but the best of it is rather local and an angler may have to search for fish.....The best trout fishing in the Liffey is probably between Athgarvan and Celbridge. The average weight above Athgarvan is about 6oz, below it is about 8oz, but locally it may be higher. (Extract of text from P. Sheehy report based on survey work of IFT 1971/1972).*

Earlier fisheries surveys of the Liffey main channel from the period 1970 – 2005 describe the Liffey main channel as a series of long deep slowing flowing glides, deep pool areas interspersed with shallow glides and riffle areas. Even though the Liffey River has two major ESB hydro schemes the basic morphology of the river remained relatively natural retaining the typical riffle/glide/pool sequence expected in that of a large river. The most significant impact of the hydro scheme can be seen in the artificial hydrological regime of the channel.

The current study noted many natural features present throughout the Liffey middle reaches, including good bank cover, overhanging /trailing branches providing shade and cover and cooler water and reasonable amounts of LWD (large woody debris). Liffey main channel has several large weirs along its course which also impacts flow and sediment movement. Ponding for long sections behind these weirs are commonplace.

Recruitment of gravels to the main channel is poor - largely due to the damming of the Liffey at Poulaphouca and Golden Falls and the relatively small and few tributaries that join the Liffey main channel between BME and Naas. The largest of the tributaries (upstream of Leixlip) is the Morell which meets the Liffey around Straffan. Therefore, any gravel recruitment from this system will only be of benefit to the main channel downstream of there.

The River Liffey main channel has four main distinct sections (see Section 1.2) but the current study focused on the middle reaches only (from Golden Falls to Straffan). The main objectives of this study were as follows:

1. To undertake a survey of the fish stocks in the Liffey main channel, to provide information and data necessary to determine the status of fish stocks, in particular brown trout, within the middle reaches of the river downstream of Poulaphouca.
2. To review archival data on salmonid populations within the Liffey main channel.
3. To assess changes in brown trout populations over the period 1970 to 2021.

‘Overall, the river appears to contain a fair stock of trout. Trout and salmon parr are very numerous in the riffles and fast glides. In the deeper flats fewer fish were encountered and large trout were not as plentiful as might be expected’ this comment was made by Champ & Caffrey in 1986 and applies even today based on the survey work carried out during this study.

Issues of concern with the middle reaches of the Liffey are similar to those associated with many large river catchments and include water quality, agriculture, localised extensive weed growth, drainage & embankment works, siltation flow regimes managed by the ESB, hydromorphology and climate change. According to the EPA (2018) alteration of hydromorphological (or physical) conditions is one of the most significant issues in rivers in the Liffey Catchment. This includes inputs of excess fine sediment and alteration of the morphology of the river channel, which in turn alter habitat conditions. This can occur as a result of implementing river and field drainage schemes, forestry activities, animal access, and discharge from quarries (EPA, 2018). Agriculture has also been identified as a significant pressure. The issues related to farming are predominantly due to enrichment from diffuse phosphorus loss to surface waters from sources such as direct discharges, runoff from yards, roadways or other compacted surfaces, or runoff from poorly draining soils. Sediment can also be a problem from land drainage works, bank erosion from animal access or stream crossings (EPA, 2018).





**Image 12. Bank trampling, Clane section**



**Image 13. Weir at Newbridge College**

The current survey of the Liffey main channel was a very useful exercise. Carrying out fish stock assessment on such large rivers is resource restrictive and often leaves examples of wider rivers poor in number. This survey provided an insight to the current state of the river in terms of its aquatic habitat - bank side vegetation and tree cover, instream vegetation, available bed material, suitable salmonid spawning grounds, riffle/pool/glide sequence and flows.

Over the course of the survey approximately 22km of river was floated over and assessed. Riffle/pool /glide sequences were commonplace, but by the very nature of a large wide river they were well spaced out. Tree cover was adequate for the most part and instream vegetation was reasonable, at the time of the survey. The exception to this was the Clane section. Even so the extensive weed beds were most pronounced along the glides and the less defined riffle areas between the section downstream of Alexandra Bridge and upstream of the Clane Trout and Salmon Anglers Association boundary. At either end of these two points riffle areas were more defined and faster flowing with a lot less vegetation present. Brown trout were more abundant at these two sites.

Trout were recorded at every sampled site. Good numbers of trout (0+ to 2+) were common most often wherever a moderate flowing shallow glide ran into a fast-flowing riffle. Salmon 0+ and parr were also present in these same sections, though generally speaking in smaller numbers. Fewer than expected larger trout and indeed adult salmon were noted. While the Liffey is not noted for an abundance of large trout occasional fish up to 4lb have been taken.

The middle reaches of the Liffey main channel are an important spawning location for both trout and salmon, and the results from this study highlights the Athgarvan area as extremely important section. The tributaries feeding the middle reaches of the Liffey are for the most part small and short systems (average width < 3m) with the exception of the Morell. This bigger tributary system is the only one which contributes to any great extent to the brown trout population of the main channel.

Available spawning areas do not seem to be a serious issue, it is more the composition of the spawning bed material that there may be some concern for. Many of the riffle areas surveyed were dominated by cobble with insufficient suitable gravels present.

The most significant feature altering the natural flow of the main Liffey channel has been the construction of three dams, Poulaphouca, Golden Falls and Leixlip. When first built, their prime purpose was to provide hydroelectricity. Years later the reservoir became an important source of potable water and today water supply (to Dublin City) takes precedence over power generation (Kelly-Quinn et al 1999).

The flow regime of the River Liffey has been greatly altered by the use of the reservoir for power generation. The operating regime of the power station at Golden Falls is such that, during non-flood periods the release may be fixed at one of two possible discharges (either 1.5m<sup>3</sup>/s or 32m<sup>3</sup>/s) (Kelly-Quinn, 1999; MCOS, 2002 & [esbhydro.ie/Liffey/01-Liffey-Releases.pdf](http://esbhydro.ie/Liffey/01-Liffey-Releases.pdf), 2022). This release may be changed from one discharge to the other many times each day depending on whether the station is on maximum or minimum load. The effects of control are less evident down river where river flow consists largely of inflow from various tributary rivers and streams (Kelly-Quinn *et al.*, 1999).

Baseflows in the middle Liffey are effectively determined by the releases at Golden Falls dam. The minimum (compensation) flow released at Golden Falls is 1.5m<sup>3</sup>/s. The ESB generator at Golden Falls releases a fixed flow of 30m/s during generation. The generation duration is approximately 7-8 hours at a time with an interval of 5-6 hours between runs, to prevent sudden flooding downstream. In the summer, the normal discharge of 1.5m/s is occasionally supplemented by short high flow discharges or freshets (MCOS, 2002).

It seems obvious the Liffey main channel, middle reaches, has suitable spawning, nursery and angling waters. The quality of each of these though may have some room for improvement. However, management of the Liffey requires many agencies and stakeholders working together for the future of the resource. There are many small-scale and localised issues of concern as well as a small number of larger scale ones.

A review of the regulation and management of flows and water releases from Golden Falls is key to this. There is a need to mimic more natural water flows and floods throughout the year. Regulated rivers will have altered hydrological cycles. These changes can affect the available energy to erode, transport, and deposit sediment in the river, and as a result, can cause changes in channel form (Loire *et al.*, 2021). The morphological changes observed in the river channel may have biological repercussions insofar as they determine the structure and availability of habitats like that required for spawning and as nursery waters. Ecosystem changes experienced due to altered flows can have multiple impacts on fish, not only to the physical habitat but also to habitat access, food supplies, behaviour, community composition, energy expenditure, and population dynamics (Clark *et al.*, 2008 & Murchie *et al.*, 2008).

Increased levels of filamentous algae cover on riverbed material and localised increased silt loads would benefit from a revised 'water release' regime from Golden Falls. Other local issues include bank fencing to exclude farm stock to the river, land drainage and run-off from yards, roadways or other compacted surfaces.

The localised extensive weed growth observed downstream of Alexandra Bridge, Clane, for approximately 5km or so is of extreme concern for those that fish this stretch of river. The coverage of instream vegetation is also a worry for the fishery in relation to the impact this has on the availability and use of this section for spawning and as a nursery area for salmonids.

The current study of the Liffey has provided a valuable insight into fish stocks and the general aquatic environment of the Liffey. Local abundance of relatively small brown trout adults were recorded, commonly occurring in areas of shallow glides with moderate flows and faster flowing riffle areas. Long deep slow flowing glides and pool areas produced few fish, whether this was partly due to the inefficiency of the electrofishing equipment in deeper waters could not be determined. For the most part, Liffey trout were small and short lived with trout over a pound in weight being common. Pike were noted in small numbers but across all sections surveyed. The majority of roach encountered were shoals of juveniles, few larger fish recorded. No roach were found along the Athgarvan section. Salmon juveniles (0+) and parr (1+ and 2+) were present in low numbers at most sites. Where high gradient riffles occurred, salmon numbers were better, probably reflecting the available habitat. These localised areas were noted in the lower BME and middle Athgarvan sites. The extensive coverage of instream vegetation observed downstream of Alexandra Bridge, Clane, is of concern. That level of instream vegetation was not noted elsewhere. The prevalence and abundance of instream vegetation reduced the electrofishing effort and made capture of what fish were present difficult. The issue of excessive vegetation cover within this stretch of water had been identified during previous fishery

surveys and attempts to implement management plans have failed or been relatively short lived (Caffrey, 1990). River conditions along this section of the Liffey seem to suit the growth of floating pondweed, in particular several varieties of *Potamogeton*. Conditions such as enrichment, increased silt load, lower gradient and reduce flows all favour this plant group.



**Image 14. Instream vegetation cover lower section of Liffey Middle Reaches (Carragh Bridge and Clane)**

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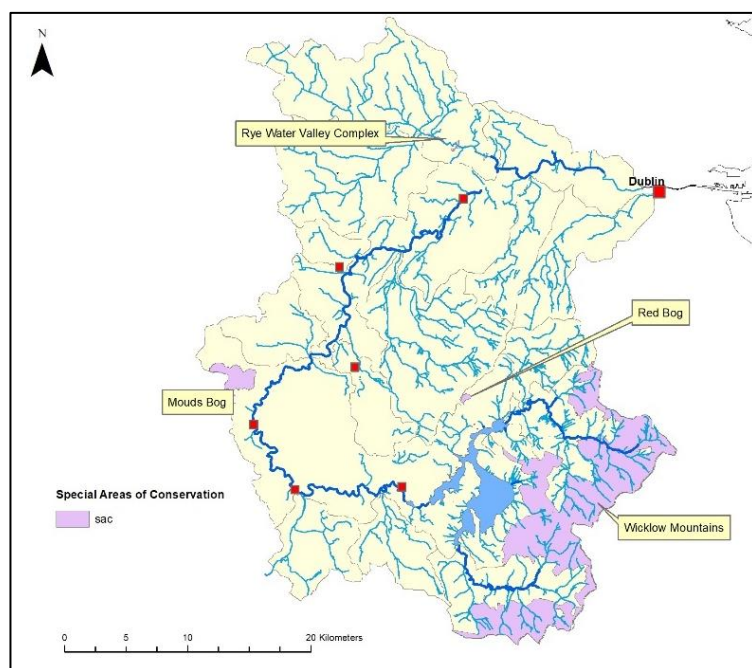
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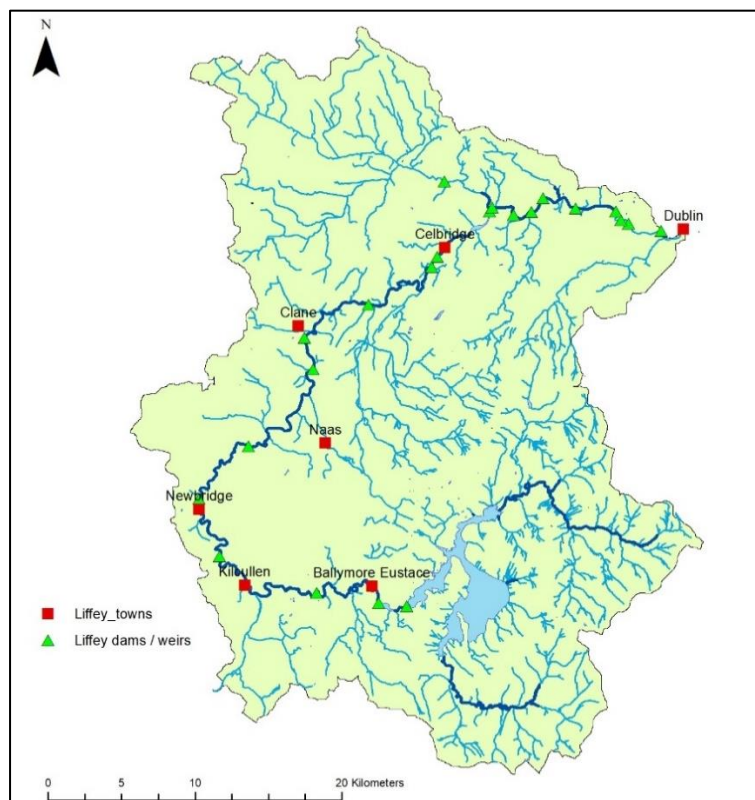
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## APPENDICES I - VII

### Appendix I. SAC's within the Liffey Catchment.



### Appendix II. Liffey Barriers map (weirs and ESB dams)



### Appendix III. Details of Electrofishing Sites, Liffey 2021

Site ID	Site	Easting	Northing	length (m)	width fished (m)	area (m2)	E/F method
1a	Ballymore Eustace Site 1	292728	209751	240	16	3840	Boat
1b	Ballymore Eustace Site 2	292479	209778	213	16	3408	Boat
1c	Ballymore Eustace Site 3	292371	210046	172	16	2752	Boat
1d	Ballymore Eustace Site 4	292137	210280	216	16	3456	Boat
1e	Ballymore Eustace Site 5	291928	210318	190	16	3040	Boat
1f	Ballymore Eustace Site 6	291382	209941	130	16	2080	Boat
2a	Athgarvan Site 1	281859	212550	400	16	6400	Boat
2b	Athgarvan Site 2	282153	212787	257	16	4112	Boat
2c	Athgarvan Site 3	281949	213233	425	16	6800	Boat
2d	Athgarvan Site 4	281500	213500	300	16	4800	Boat
2e	Athgarvan Site 5	281412	214247	360	16	5760	Boat
3a	Carragh Site 1	285756	220764	280	16	4480	Boat
3b	Carragh Site 2	287205	221824	335	16	5360	Boat
3c	Carragh Site 3	288043	223014	305	16	4880	Boat
3d	Carragh Site 4	288309	224011	270	16	4320	Boat
3e	Carragh Site 5	288048	224328	400	16	6400	Boat
4a	Clane Site 1	288128	227171	250	16	4000	Boat
4b	Clane Site 2	288674	227234	270	16	4320	Boat
4c	Clane Site 3	288589	227673	305	16	4880	Boat
4d	Clane Site 4	289166	228337	335	16	5360	Boat
4e	Clane Site 5	289250	228632	305	16	4880	Boat
4f	Clane Site 6	289828	228548	300	16	4800	Boat

Site ID	Tributary	Site	Easting	Northing	length (m)	width (m)	area (m2)	E/F method
5	Lemonstown	d/s of main road bridge	291214	208841	26.8	2.6	69.68	H/S
6	Millstream	Graveyard	284694	209185	22.5	2.7	60.75	H/S
7	Ladyswell	Halverstown Cross	285630	219977	30	4.13	123.9	H/S
8	Hartwell	u/s of road bridge	293949	221641	23.3	3.53	82.249	H/S
9	Painestown	d/s Painestown Bridge	293972	224378	26.5	2.7	71.55	H/S
10	Painestown	u/s land bridge right-hand branch	294010	224462	38.1	3.8	144.78	H/S
11	Painestown	u/s bridge	292416	226415	28.5	4.1	116.85	H/S
12	Morell	Morell Bridge	291630	219791	22.1	2.3	50.83	H/S
13	Morell Lower	d/s main road	292254	227341	27.5	4.6	126.5	H/S
14	Gollymocky	d/s of road bridge	288519	228568	32.6	2.6	84.76	H/S

**Appendix IV. Minimum Density Estimates for brown trout and salmon, Liffey main channel sites, August 2021**

Site ID	Catchment	River	Site	E/F method	0+ Brown trout	1+&older Brown Trout	0+ Salmon	1++ Salmon
1a	Liffey	Liffey main channel	Ballymore Eu	Boat	0.0026	0.0018	0	0.0005
1b	Liffey	Liffey main channel	Ballymore Eu	Boat	0.0000	0.0029	0	0.0006
1c	Liffey	Liffey main channel	Ballymore Eu	Boat	0.0044	0.0105	0.0015	0.0051
1d	Liffey	Liffey main channel	Ballymore Eu	Boat	0.0038	0.0026	0	0.0029
1e	Liffey	Liffey main channel	Ballymore Eu	Boat	0.0043	0.0033	0.0020	0.0026
1f	Liffey	Liffey main channel	Ballymore Eu	Boat	0.0067	0.0168	0.0207	0.0053
2a	Liffey	Liffey main channel	Athgarvan Si	Boat	0.0092	0.0078	0	0.0005
2b	Liffey	Liffey main channel	Athgarvan Si	Boat	0.0114	0.0185	0.0002	0.0002
2c	Liffey	Liffey main channel	Athgarvan Si	Boat	0.0053	0.0160	0.0038	0.0031
2d	Liffey	Liffey main channel	Athgarvan Si	Boat	0.0175	0.0121	0.0038	0.0004
2e	Liffey	Liffey main channel	Athgarvan Si	Boat	0.0087	0.0083	0.0003	0.0002
3a	Liffey	Liffey main channel	Carragh Site	Boat	0.0045	0.0165	0.0002	0.0004
3b	Liffey	Liffey main channel	Carragh Site	Boat	0.0022	0.0200	0.0002	0
3c	Liffey	Liffey main channel	Carragh Site	Boat	0.0014	0.0084	0	0
3d	Liffey	Liffey main channel	Carragh Site	Boat	0.0028	0.0083	0	0
3e	Liffey	Liffey main channel	Carragh Site	Boat	0.0013	0.0039	0	0
4a	Liffey	Liffey main channel	Clane Site 1	Boat	0.0005	0.0080	0.0008	0.0003
4b	Liffey	Liffey main channel	Clane Site 2	Boat	0.0012	0.0042	0.0012	0.0005
4c	Liffey	Liffey main channel	Clane Site 3	Boat	0.0004	0.0031	0.0016	0.0010
4d	Liffey	Liffey main channel	Clane Site 4	Boat	0.0000	0.0007	0.0002	0
4e	Liffey	Liffey main channel	Clane Site 5	Boat	0.0020	0.0029	0.0018	0
4f	Liffey	Liffey main channel	Clane Site 6	Boat	0.0019	0.0104	0.0017	0.0004

Site ID	Tributary	Site	E/F method	0+ Brown trout	1+&older Brown Trout	0+ Salmon	1++ Salmon
5	Lemonstown	d/s of main road bridge	H/S	0.0861	0.2153	0	0
6	Millstream	Graveyard	H/S	0.0658	0.4938	0	0
7	Ladyswell	Halverstown Cross	H/S	0.5892	0.1695	0	0
8	Hartwell	u/s of road bridge	H/S	1.1064	0.1581	0	0
9	Painestown	d/s Painestown Bridge	H/S	0.6988	0	0	0
10	Painestown	u/s land bridge right-hand branch	H/S	0.2210	0.0898	0	0
11	Painestown	u/s bridge	H/S	0.3081	0.1113	0.2739	0.0171
12	Morell	Morell Bridge	H/S	0.8656	0.8066	0	0
13	Morell Lower	d/s main road	H/S	0.3004	0.2530	0.0632	0.0316
14	Gollymochy	d/s of road bridge	H/S	0.2478	0	0	0

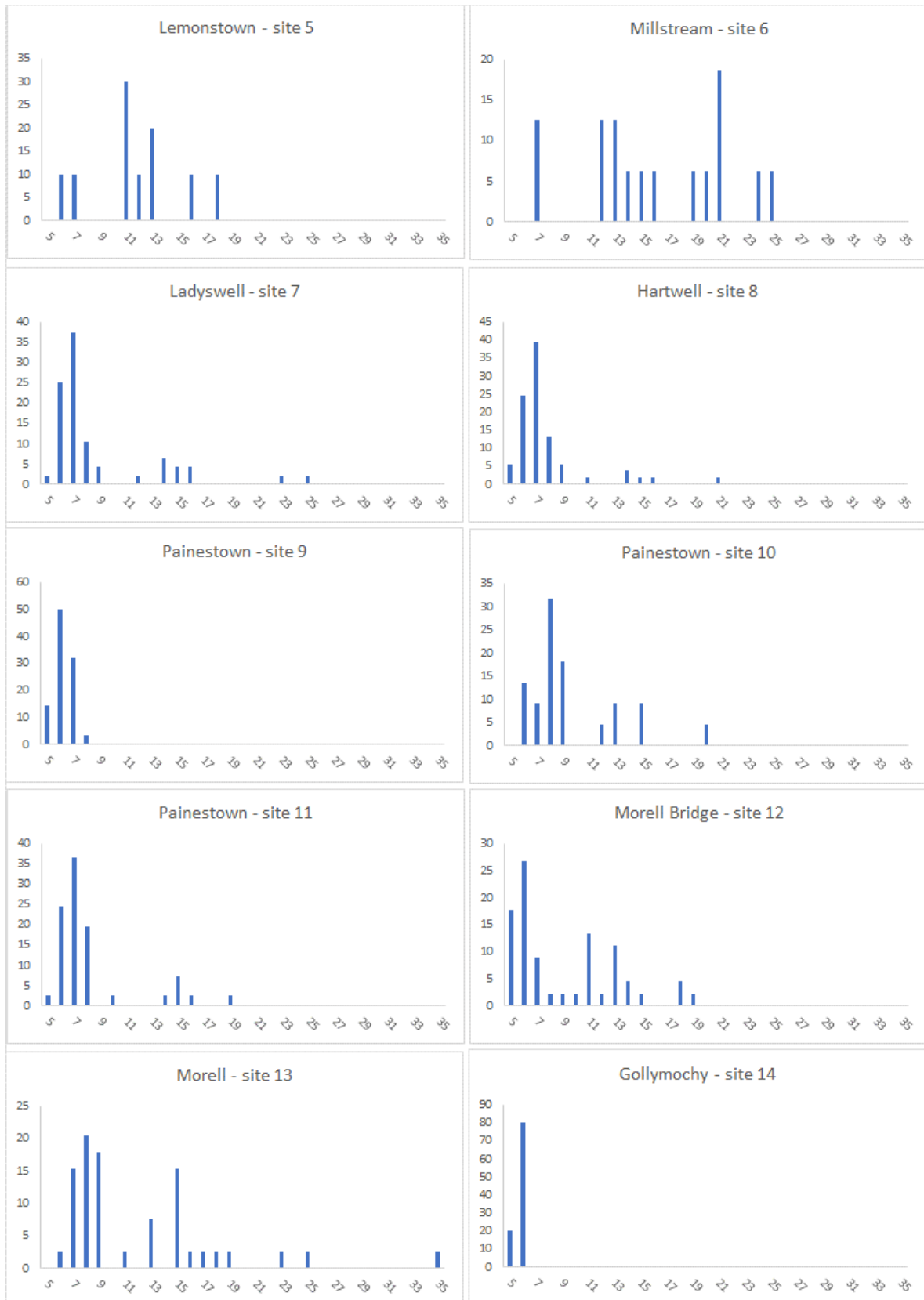
# Appendix V. Species recorded at each individual main channel site, August 2021

Site ID	Site Name	Section	Brown					3 Spined						
			Trout	Salmon	Pike	Perch	Roach	Minnow	Stickleback	Stoneloach	Gudgeon	Eel	Lamprey	Crayfish
1a	Liffey	Ballymore Eustace Site 1	+	+				+		+				+
1b	Liffey	Ballymore Eustace Site 2	+	+	+			+		+				+
1c	Liffey	Ballymore Eustace Site 3	+	+			+	+		+		+		
1d	Liffey	Ballymore Eustace Site 4	+	+	+			+				+		
1e	Liffey	Ballymore Eustace Site 5	+	+				+	+	+		+		
1f	Liffey	Ballymore Eustace Site 6	+	+				+		+		+		+
2a	Liffey	Athgarvan Site 1	+	+	+			+		+				
2b	Liffey	Athgarvan Site 2	+	+	+			+		+	+			
2c	Liffey	Athgarvan Site 3	+	+				+		+				
2d	Liffey	Athgarvan Site 4	+	+				+	+	+				+
2e	Liffey	Athgarvan Site 5	+	+	+			+			+			
3a	Liffey	Caragh Site 1	+	+	+			+		+	+			
3b	Liffey	Caragh Site 2	+	+	+	+		+		+				
3c	Liffey	Caragh Site 3	+				+	+		+	+	+		
3d	Liffey	Caragh Site 4	+		+			+	+	+	+	+		
3e	Liffey	Caragh Site 5	+		+			+	+	+				
4a	Liffey	Clane Site 1	+	+	+			+		+				
4b	Liffey	Clane Site 2	+	+	+		+	+		+	+	+		
4c	Liffey	Clane Site 3	+	+	+			+		+	+			
4d	Liffey	Clane Site 4	+	+	+	+	+	+	+	+	+			
4e	Liffey	Clane Site 5	+	+	+	+		+		+	+	+		
4f	Liffey	Clane Site 6	+	+	+			+		+	+	+		

## Appendix VI. Species recorded across tributary sites, August 2021

Site ID	Tributary Name	Section	Brown					3 Spined						
			Trout	Salmon	Pike	Perch	Roach	Minnow	Stickleback	Stoneloach	Gudgeon	Eel	Lamprey	Crayfish
5	Liffey tributary	Lemonstown												
6	Liffey tributary	d/s of main road bridge	+											+
7	Liffey tributary	Graveyard	+						+					
8	Liffey tributary	Halverstown Cross	+					+	+				+	
9	Liffey tributary	u/s of road bridge	+											
10	Liffey tributary	Hartwell	+					+						
11	Liffey tributary	d/s Painestown Bridge	+					+		+				+
12	Liffey tributary	u/s land bridge right-hand bran	+					+		+				
13	Liffey tributary	u/s bridge	+	+						+				+
14	Liffey tributary	Morell Bridge	+											
15	Liffey tributary	d/s main road	+	+				+						+
16	Liffey tributary	Gollymochy	+					+	+	+			+	

## Appendix VII. Brown Trout Length Frequency Liffey Tributary sites, August 2021.





## The Team



**Inland Fisheries Ireland  
3044 Lake Drive,  
Citywest Business Campus,  
Dublin 24,  
Ireland.  
D24 Y265**

**[www.fisheriesireland.ie](http://www.fisheriesireland.ie)  
[info@fisheriesireland.ie](mailto:info@fisheriesireland.ie)**

**+353 1 8842 600**

