

# Fish Stock Survey of Transitional Waterbodies around the Irish Coast

2018

IFI/2019/1-4476



Iascach Intíre Éireann  
Inland Fisheries Ireland

Inland Fisheries Ireland

National Research Survey Programme

## **Fish Stock Survey of Transitional Waterbodies around the Irish Coast 2018**

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

CITATION: Ryan, D., Coyne, J., Corcoran, W., Robson, S., Dunphy, G. and Roche, W. (2019). Fish Stock Survey of Transitional Waterbodies around the Irish Coast 2018. Inland Fisheries Ireland, 3044 Lake Drive, Citywest Business Campus, Dublin 24, Ireland.

Cover photo: Gweebarra estuary © Inland Fisheries Ireland

© Inland Fisheries Ireland 2019

## Acknowledgements

The authors wish to gratefully acknowledge the help and co-operation of all their colleagues in Inland Fisheries Ireland.

## Project team

Senior Research Officer	Dr. William Roche
Project Manager	Dr. Diarmuid Ryan
Technician	Mr. Will Corcoran
Technician	Mr. John Coyne
Fisheries Assistant	Dr. Stephen Robson (Jun 2018 – Dec 2018)
Fisheries Assistant	Mr. Garreth Dunphy (Jun 2018– Dec 2018)

*The report includes Ordnance Survey Ireland data reproduced under OSI Copyright Permit No. MP 007508.*

*Unauthorised reproduction infringes Ordnance Survey Ireland and Government of Ireland copyright.*

*© Ordnance Survey Ireland, 2019.*

## Table of Contents

1. Summary .....	1
2. Introduction .....	2
3. Methods.....	2
4. Results.....	6
4.1 Avoca Estuary .....	6
4.1.1 Data Summary.....	6
4.1.2 Comparative Analyses.....	7
4.2 Ballysadare estuary .....	8
4.2.1 Data Summary.....	8
4.2.2 Comparative Analysis.....	10
4.3 Boyne estuary.....	11
4.3.1 Data Summary.....	11
4.3.2 Comparative Analysis.....	12
4.4 Castlemaine harbour .....	12
4.4.1 Data Summary.....	12
4.4.2 Comparative Analysis.....	14
4.5 Erne estuary .....	15
4.5.1 Data Summary.....	15
4.5.2 Comparative Analysis.....	15
4.6 Gweebarra estuary.....	17
4.6.2 Data Summary.....	17
4.6.1 Comparative Analysis.....	18
4.7 Kinvara bay .....	18
4.7.1 Data Summary.....	18

4.8	Relative abundance comparisons across estuaries .....	20
4.9	EMFI quality ratings.....	23
4.10	Species of angling interest.....	24
5.	Discussion.....	25
6.	References .....	27
	Appendices.....	28

## 1. Summary

This report presents fish capture data collected during Inland Fisheries Ireland (IFI) surveys of transitional waterbodies. Surveys were carried out in seven transitional water bodies around Ireland between September and October 2018. The survey was conducted to designate an ecological status based on fish populations, as per the requirements of the Water Framework Directive (Directive 2000/60/EC). The populations of species of angling and conservation importance are also discussed.

A total of 182 samples were taken using three different methods (seine nets, fyke nets and bean trawls). 21,790 fish were captured, counted and identified to species level prior to release. 51 different fish species were encountered over the course of the sampling programme.

Of the seven transitional water bodies surveyed in 2018, species richness was lowest in the Avoca estuary on the east coast. This estuary was the smallest surveyed in 2018 and it is also considered as heavily modified. Castlemaine harbour which is located in the Southwest and the largest transitional water body surveyed in 2018 had the highest species richness with 29 species recorded.

All sites were classified as “Good” status using the estuarine multi-metric fish index (EMFI) (Harrison and Kelly, 2013), with the exception of Kinvara Bay, which was classified as “Moderate” status.

A requirement of the WFD is to resample a selection of transitional water bodies, preferably every three years, in order to monitor how their status changes over time. Fish ecological status changed in the Erne estuary and Kinvara bay, where status improved and reduced respectively.

## **2. Introduction**

The economic and ecological value of estuarine nursery function in supporting marine fish populations is well characterised (Able 2005; Beck et al. 2001). Larval/juvenile stages of many marine species are transported to estuaries where they may spend the first few years of life, taking advantage of the food availability, warm temperatures and shelter which estuaries provide (Vasconcelos et al. 2011; Gillanders et al. 2003).

Fish stock surveys were conducted in seven transitional water bodies located within four river basin districts around the country as part of the programme of fish monitoring for the Water Framework Directive (WFD).

The main objectives of the current survey are:

- To measure the ecological status of fish populations in the estuary complex as per the requirements of the European Water Framework Directive (WFD; 2000/60/EC).
- To continue to monitor fish population dynamics in the estuaries.
- To provide scientific advice to support conservation measures within each estuary system.
- To inform on the role of this waterbody in relation to important marine recreational fish species

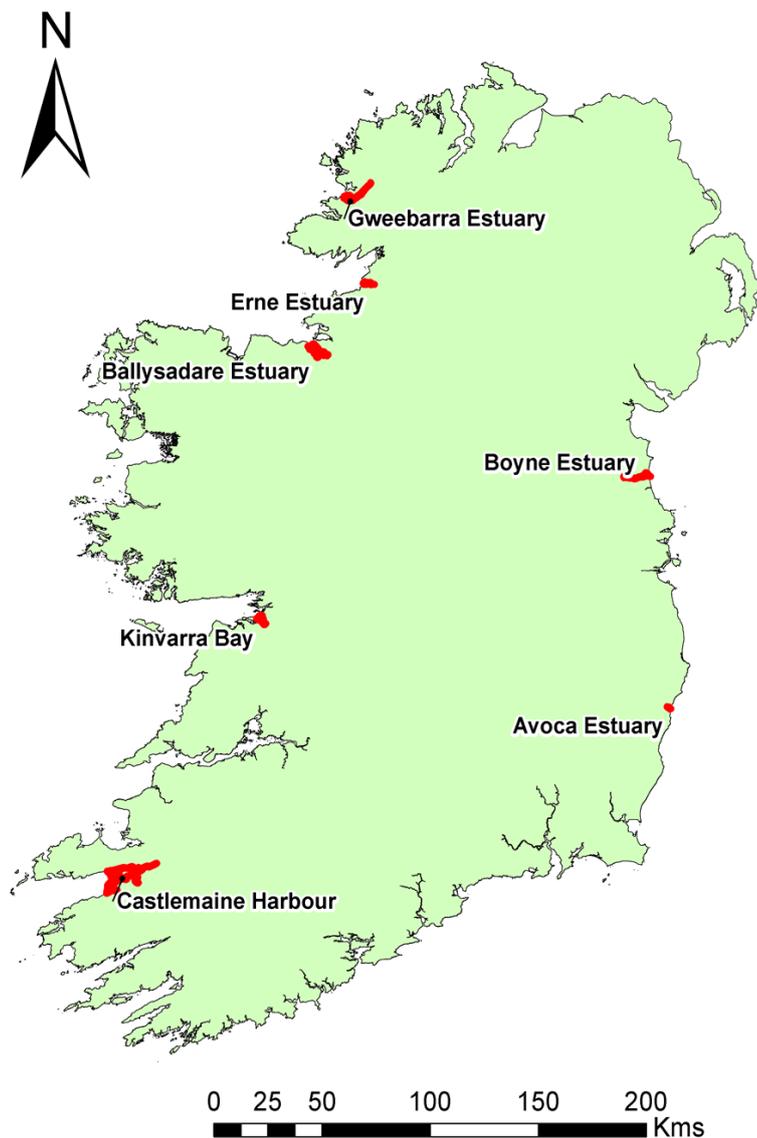
According to the WFD, ecological status of waterbodies must be assessed by both a number of physical and chemical characteristics and a range of biological indicators. Fish populations are one of the key biological indicators of ecological status in transitional waters. Essentially they are assessed by comparing data collected from monitoring against reference (natural) conditions. Fish status was assessed using the estuarine multi-metric fish index (EMFI) (Harrison and Kelly, 2013) to derive ecological status. As the transitional water bodies presented in this report are subject to repeat surveys every three years as part of a surveillance monitoring programme, any change in fish population structure within the estuary over time was also discussed.

## **3. Methods**

Sampling of the seven transitional waterbodies took place between the 18<sup>th</sup> of September and the 24<sup>th</sup> of October 2018 by staff from Inland Fisheries Ireland. Estuaries surveyed were the Avoca, the Boyne, the Erne, the Gweebarra, Kinvara bay, Ballysadare and Castlemaine harbour (Fig. 1). The waterbodies were a range of different sizes (Table 1). Habitat type

across all sites ranged from soft mud to hard sandy substrate and brackish to fully. The separate waterbodies are described in more detail in [www.wfdfish.ie](http://www.wfdfish.ie).

Current work in the Republic of Ireland and United Kingdom indicates the need for a multi-method (beach seine, fyke net and beam trawl) approach to sampling fish in estuaries. These procedures are now the standard IFI methodology for fish stock surveys of Irish transitional waterbodies.



**Fig. 1:** Transitional waterbodies sampled in 2018.

Beach seining is conducted using a 30m x 3m net (10mm mesh size) to capture fish in littoral areas (Fig 2). The bottom of the net has a weighted lead line to increase sediment

Transitional water body	MS Code	Lat	Long	Area (km <sup>2</sup> )
Avoca Estuary	EA_150_0100	52.797	-6.148	0.17
Ballysadare Estuary	WE_460_0300	54.223	-8.556	17.04
Boyne Estuary	EA_100_100	53.725	-6.277	48.94
Castlemaine Harbour	SW_230_0200	52.138	-9.805	57.64
Erne Estuary	NW_030_0100	54.505	-8.227	2.57
Gweebarra Estuary	NW_120_0100	54.869	-8.264	8.25
Kinvara Bay	WE_160_0100	53.158	-8.954	5.72

**Table 1:** Transitional waterbodies surveyed for the WFD fish surveillance monitoring programme, Sep-Oct 2018.

disturbance and catch efficiency. Fyke nets (15m in length with a 0.8m diameter front hoop, joined by an 8m leader with a 10mm square mesh) are used to sample benthic fish in the littoral areas. Beam trawls are used for sampling benthic fish in the littoral and open waters, where bed type is suitable. The beam trawl measures 1.5m x 0.5m, with a 10mm mesh bag, decreasing to 5mm mesh in the cod end. The trawl is attached to a 20m tow rope and towed by a boat. Trawls are conducted along transects of 100m in length. Sampling effort depended largely on estuary size. However, factors such as site suitability for a particular sampling technique were also relevant (Table 2).

Estuary	Sampling dates	Salinity Range (Average)	Temperature range (Average) °C	No. Beach Seine	No. Fyke net	No. Beam trawl
Avoca Estuary	18 <sup>th</sup> – 20 <sup>th</sup> Sept	0.1-30.4 (4.8)	12.4-16.2 (14.8)	5	6	5
Ballysadare Estuary	15 <sup>th</sup> – 18 <sup>th</sup> Oct	0.2-34 (17.5)	13.1-10.3 (11.6)	14	8	9
Boyne Estuary	8 <sup>th</sup> – 10 <sup>th</sup> Oct	0.4-34.6 (16.6)	15.2-12.3 (13.3)	10	7	10
Castlemaine Harbour	1 <sup>st</sup> – 3 <sup>rd</sup> Oct	0.1-32.6 (17.7)	14.8-12.6 (14)	12	8	11
Erne Estuary	24 <sup>th</sup> – 25 <sup>th</sup> Sept	0.2- 23 (6.1)	13.3-11.9 (13)	10	6	6
Gweebarra Estuary	22 <sup>nd</sup> – 24 <sup>th</sup> Oct	0.1-27.9 (8)	10.3-11.2 (10.7)	15	9	7
Kinvara Bay	26 <sup>th</sup> – 27 <sup>th</sup> Sept	4.4-31.5 (26.9)	13.1-14.9 (14)	11	6	7

**Table 2:** Site details of transitional waterbody surveys 2018. For sampling locations refer to appendices.

All nets are processed on-site by identifying the species present and counting the total numbers caught in each. Length measurements are recorded for each species using a representative sub-sample of 30 fish if necessary. Unidentified fish specimens were retained for subsequent identification in the laboratory.

A handheld GPS was used to mark the precise location of each site. Physiochemical data were also collected at each site (Table 2).



**Fig. 2:** 30x3m beach seine net.

## 4. Results

### 4.1 Avoca Estuary

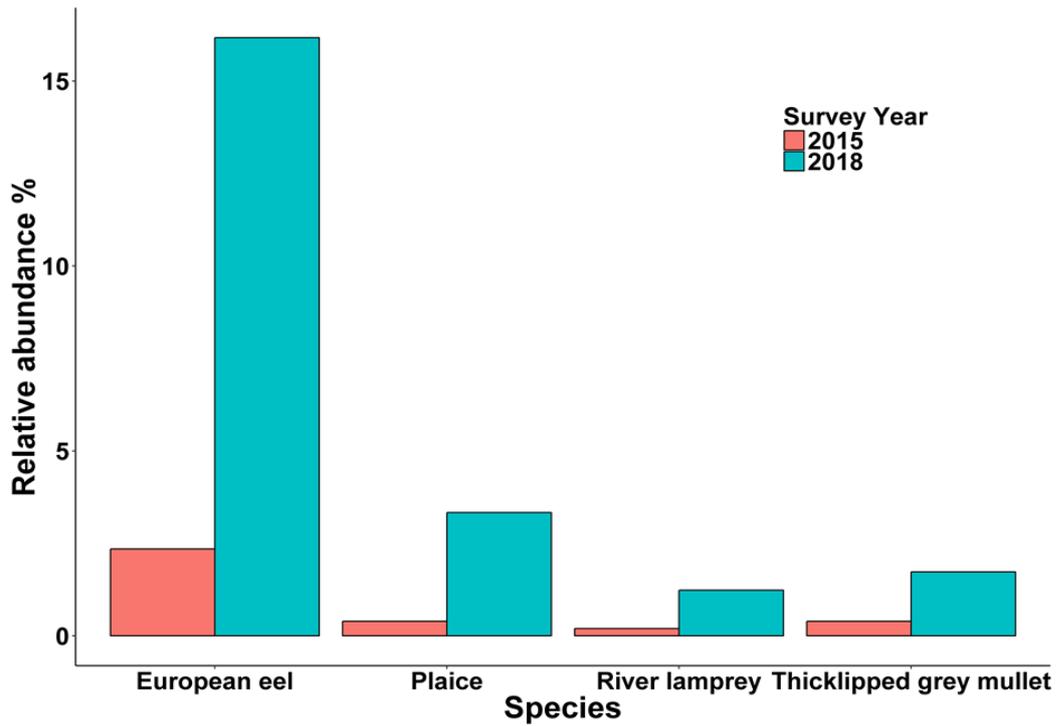
#### 4.1.1 Data Summary

810 individuals were captured which included 16 species (Table 3).

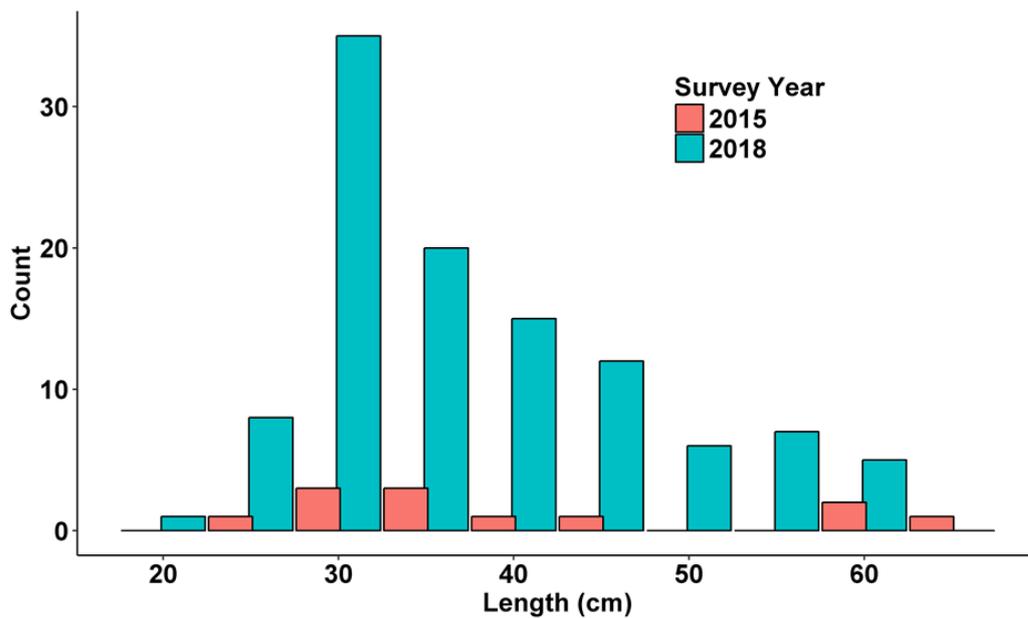
Species (Scientific name)	Species (Common name)	Total count	Count measured	Ave length(cm)	Max length(cm)	Min length(cm)	Standard deviation	Relative abundance %
<i>Dicentrarchus labrax</i>	Bass	1	1	15.60	15.6	15.6	NA	0.12
<i>Salmo trutta</i>	Brown trout	3	3	19.47	23.4	16.8	3.48	0.37
<i>Gadus morhua</i>	Cod	2	2	26.85	35	18.7	11.53	0.25
<i>Pomatoschistus microps</i>	Common goby	173	93	3.27	6.3	1.7	0.94	21.36
<i>Anguilla anguilla</i>	European eel	131	109	37.47	61	18	9.70	16.17
<i>Ciliata mustela</i>	Fivebearded rockling	23	23	18.08	21.3	14.2	1.86	2.84
<i>Platichthys flesus</i>	Flounder	273	171	12.96	27.1	6	5.04	33.70
<i>Pleuronectes platessa</i>	Plaice	27	27	9.17	11.1	7.3	0.95	3.33
<i>Pollachius pollachius</i>	Pollack	6	6	12.22	14.6	9.5	1.84	0.74
<i>Trisopterus minutus</i>	<b>Poor cod</b>	2	2	11.10	11.1	11.1	0.00	0.25
<i>Trisopterus luscus</i>	Pouting	5	5	12.26	13.5	11.2	0.91	0.62
<i>Lampetra fluviatilis</i>	<b>River lamprey</b>	10	10	31.08	34.5	28	2.32	1.23
<i>Pomatoschistus minutus</i>	Sand goby	11	11	6.55	7.6	3	1.25	1.36
<i>Atherina presbyter</i>	Sand smelt	112	30	5.27	6.3	4.5	0.43	13.83
<i>Chelon labrosus</i>	Thicklipped grey mullet	14	14	6.22	46.3	2.4	11.56	1.73
<i>Gasterosteus aculeatus</i>	Threespined stickleback	17	17	3.70	4.5	2.5	0.64	2.10

**Table 3:** List of species captured during the 2018 survey of the Avoca estuary. Species not encountered in any of the other waterbodies during the 2018 surveys highlighted in **bold**.

#### 4.1.2 Comparative Analyses



**Fig 3:** Relative abundance of species of interest captured during the 2018 WFD survey of the Avoca estuary and comparison with the 2015 survey.



**Fig 4:** Length frequency analyses of European eel captured during the last two WFD surveys of the Avoca Estuary.

The large increase in the proportion of juvenile plaice and thick lipped grey mullet in the current survey as compared to 2015 is notable. There was also an increase in the presence of European eel and river lamprey (Fig. 3). No juvenile salmon were captured in the current survey as opposed to the 16 caught and released in 2015 (Ryan et al. 2016).

European eel capture lengths ranged from 18 to 61cm, which was similar to 2015, however, the frequency of captures was far greater in 2018 (Fig. 4).

## 4.2 Ballysadare estuary

### 4.2.1 *Data Summary*

A total of 1025 fish were caught and released over the course of the survey. Although 27 species were identified, only four (flounder, common goby, sprat and sand smelt) made up 82% of all captures (Table 4).

Species (Scientific name)	Species (Common name)	Total count	Count measured	Ave length(cm)	Max length(cm)	Min length(cm)	Standard deviation	Relative abundance %
<i>Scophthalmus rhombus</i>	Brill	5	5	7.84	11.5	5.6	2.30	0.49
<i>Pollachius virens</i>	Coalfish	10	10	17.95	23	15	2.47	0.98
<i>Gadus morhua</i>	Cod	4	4	18.08	20.8	15	2.38	0.39
<i>Pomatoschistus microps</i>	Common goby	484	67	3.68	7.9	2.4	0.98	47.22
<i>Anguilla anguilla</i>	European eel	5	5	60.10	72	45	10.16	0.49
<i>Spinachia spinachia</i>	Fifteenspined stickleback	12	12	10.61	12.2	8.7	1.00	1.17
<i>Ciliata mustela</i>	Fivebearded rockling	29	29	14.84	21.9	11.5	2.15	2.83
<i>Platichthys flesus</i>	Flounder	50	50	7.70	37.5	3	5.44	4.88
<i>Hyperoplus lanceolatus</i>	Greater sandeel	1	1	20.60	20.6	20.6	NA	0.10
<i>Ammodytes tobianus</i>	Lesser sandeel	19	19	6.39	12.4	5.1	1.65	1.85
<i>Taurulus bubalis</i>	Longspined sea scorpion	3	3	6.70	7.5	6.1	0.72	0.29
<i>Syngnathus rostellatus</i>	Nilsson's pipefish	3	3	11.37	13.8	8.7	2.56	0.29
<i>Pleuronectes platessa</i>	Plaice	25	25	5.69	15.5	3.5	2.59	2.44
<i>Pollachius pollachius</i>	Pollack	3	3	12.00	12.6	10.8	1.04	0.29
<i>Trisopterus luscus</i>	Pouting	1	1	11.50	11.5	11.5	NA	0.10
<i>Rutilus rutilus</i>	Roach	1	1	13.20	13.2	13.2	NA	0.10
<i>Gobius paganellus</i>	<b>Rock goby</b>	1	1	7.70	7.7	7.7	NA	0.10
<i>Salmo salar</i>	Salmon	1	1	13.60	13.6	13.6	NA	0.10
<i>Pomatoschistus minutus</i>	Sand goby	28	28	5.70	12	3	1.80	2.73
<i>Atherina presbyter</i>	Sand smelt	246	116	6.87	11.9	3.6	1.36	24.00
<i>Myoxocephalus scorpius</i>	<b>Shortspined sea scorpion</b>	1	1	8.10	8.1	8.1	NA	0.10
<i>Entelurus aequoreus</i>	Snake pipefish	1	1	12.80	12.8	12.8	NA	0.10
<i>Sprattus sprattus</i>	Sprat	61	42	5.12	6	4	0.35	5.95
<i>Chelon labrosus</i>	Thicklipped grey mullet	3	3	2.90	3.2	2.7	0.26	0.29
<i>Gasterosteus aculeatus</i>	Threespined stickleback	5	5	4.08	6.1	3.4	1.16	0.49
<i>Gobiusculus flavescens</i>	Twospotted goby	21	21	4.40	6.4	2.7	0.98	2.05
<i>Merlangius merlangus</i>	Whiting	2	2	16.55	17	16.1	0.64	0.20

**Table 4:** List of species captured during the 2018 survey of the Ballysadare estuary. Species not encountered in any of the other waterbodies during the 2018 surveys highlighted in **bold**.

#### 4.2.2 Comparative Analysis

Although the overall numbers of captures were low, juvenile brill (Fig. 5) were present in both surveys. A relatively high abundance of juvenile plaice caught in both surveys provides some evidence of this site as a plaice nursery (Fig. 6).



Fig 5: Ballysadare juvenile brill.

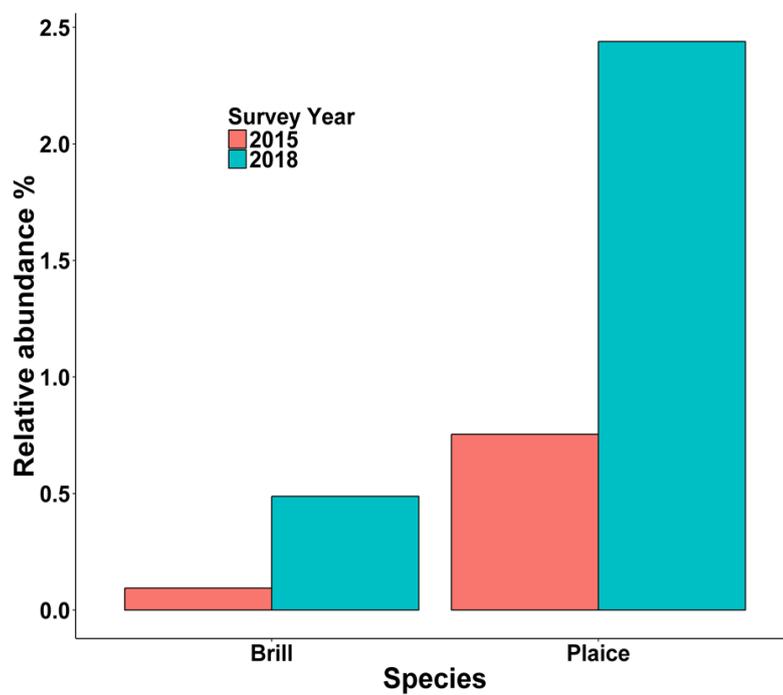


Fig 6: Relative abundance of species of angling interest captured during the 2018 WFD survey of the Ballysadare estuary and comparison with the 2015

### 4.3 Boyne estuary

#### 4.3.1 Data Summary

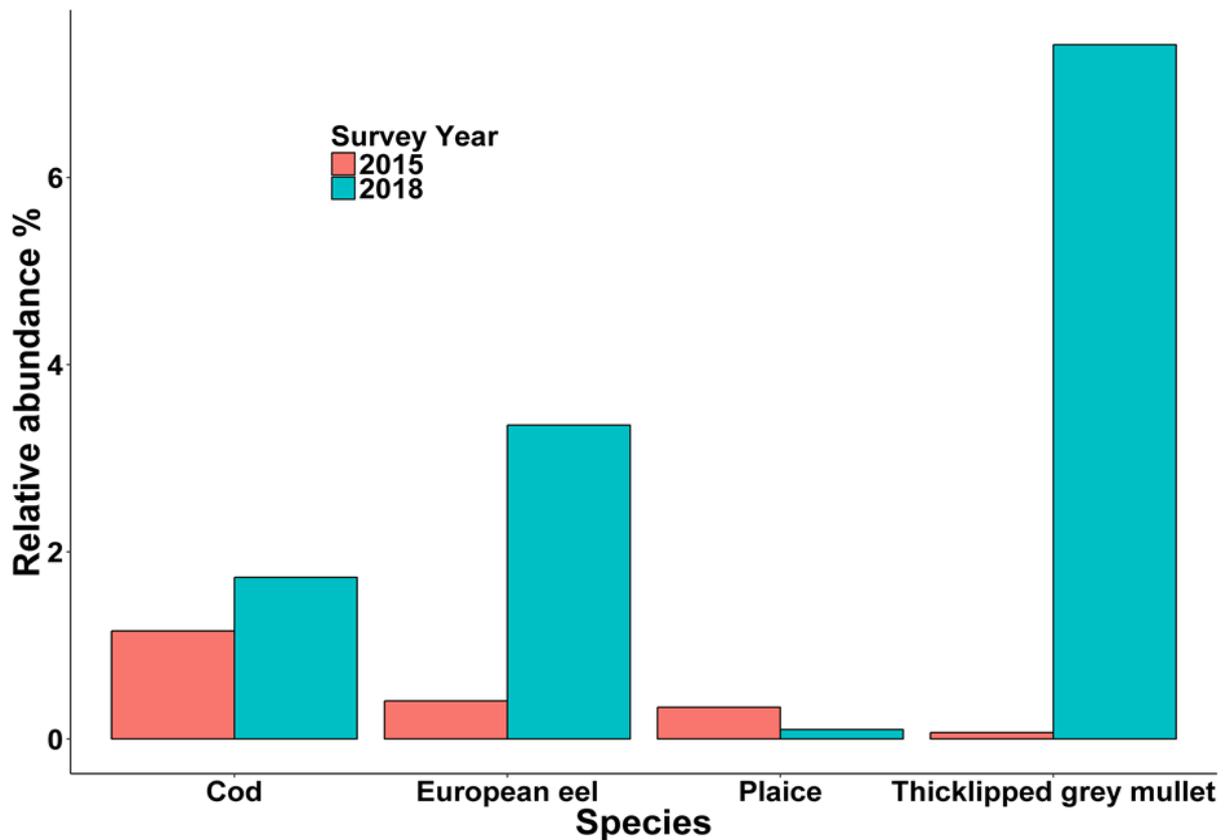
A total of 984 fish were caught and released over the course of the survey. The freshwater species minnow and roach were caught in large numbers high up in the freshwater tidal section of the estuary and thus, made up 47% of the total catch. In total, 21 separate species were identified over the course of the survey (Table 4).

Species (Scientific name)	Species (Common name)	Total count	Count measured	Ave length(cm)	Max length(cm)	Min length(cm)	Standard deviation	Relative abundance %
<i>Gadus morhua</i>	Cod	17	17	14.15	19.2	10	3.13	1.73
<i>Pomatoschistus microps</i>	Common goby	52	43	3.80	7.7	2.6	1.12	5.28
<i>Anguilla anguilla</i>	European eel	33	33	35.23	70	20	10.19	3.35
<i>Spinachia spinachia</i>	Fifteen spined stickleback	8	8	11.54	13.8	9	1.46	0.81
<i>Ciliata mustela</i>	Fivebearded rockling	24	24	15.19	20.8	11.1	2.19	2.44
<i>Platichthys flesus</i>	Flounder	52	52	10.54	19	3.8	4.50	5.28
<i>Gobio gobio</i>	<b>Gudgeon</b>	1	1	12.60	12.6	12.6	NA	0.10
<i>Ammodytes tobianus</i>	Lesser sandeel	1	1	6.10	6.1	6.1	NA	0.10
<i>Taurulus bubalis</i>	Longspined sea scorpion	1	1	7.60	7.6	7.6	NA	0.10
<i>Phoxinus phoxinus</i>	Minnow	246	39	3.48	4.6	2.7	0.41	25.00
<i>Syngnathus rostellatus</i>	Nilssons pipefish	1	1	13.80	13.8	13.8	NA	0.10
<i>Pleuronectes platessa</i>	Plaice	1	1	8.10	8.1	8.1	NA	0.10
<i>Agonus cataphractus</i>	Pogge	2	2	9.35	9.5	9.2	0.21	0.20
<i>Pollachius pollachius</i>	Pollack	1	1	8.80	8.8	8.8	NA	0.10
<i>Rutilus rutilus</i>	Roach	220	60	4.40	5.6	2.6	0.70	22.36
<i>Pomatoschistus minutus</i>	Sand goby	20	20	7.85	9.1	7.1	0.52	2.03
<i>Atherina presbyter</i>	Sand smelt	79	58	6.06	8.6	3.1	1.11	8.03
<i>Sprattus sprattus</i>	Sprat	121	77	7.23	11	4.4	1.54	12.30
<i>Chelon labrosus</i>	Thicklipped grey mullet	73	46	2.93	5	1.6	0.47	7.42
<i>Gasterosteus aculeatus</i>	Threespined stickleback	30	30	3.80	5.1	2	0.56	3.05
<i>Merlangius merlangus</i>	Whiting	1	1	13.00	13	13	NA	0.10

**Table 4:** List of species captured during the 2018 survey of the Boyne estuary. Species not encountered in any of the other waterbodies during the 2018 surveys highlighted in **bold**.

#### 4.3.2 Comparative Analysis

A relatively large portion of the catch was made up of juvenile thick lipped grey mullet (Table 4). No juveniles and just a single adult were caught in 2015. Juvenile cod were a constant presence between sampling years, making up a similar proportion of the total catch. The proportion of eels increased from less than 0.5% to over 3% (Fig. 7).



**Fig 7:** Relative abundance of species of interest captured during the 2018 WFD survey of the Boyne estuary and comparison with the 2015 survey.

#### 4.4 Castlemaine harbour

##### 4.4.1 Data Summary

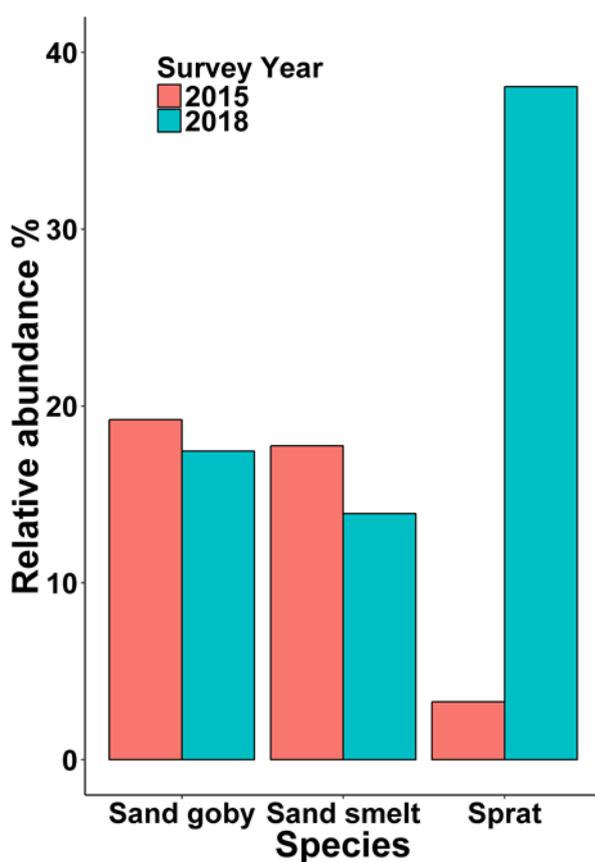
A total of 3513 fish were caught and released over the course of the survey. Sprat, sand smelt and sand gobys were caught in relatively high numbers and thus made up nearly 70% of the total catch. 26 other species made up the remaining 30% of the catch (Table 5). Six species were caught here which were not encountered in any other waterbodies during the 2018 survey.

Species (Scientific name)	Species (Common name)	Total count	Count measured	Ave length(cm)	Max length (cm)	Min length (cm)	Standard deviation	Relative abundance %
<i>Dicentrarchus labrax</i>	Bass	2	2	22.85	37.5	8.2	20.72	0.06
<i>Salmo trutta</i>	Brown trout	12	12	19.10	23.6	16.4	2.22	0.34
<i>Gadus morhua</i>	Cod	4	4	17.35	19.1	14.3	2.22	0.11
<i>Pomatoschistus microps</i>	Common goby	228	45	4.18	7.9	2.3	1.50	6.49
<i>Solea solea</i>	<b>Common sole</b>	3	3	11.33	15.6	8.5	3.76	0.09
<i>Symphodus melops</i>	Corkwing wrasse	129	92	6.16	16.6	2.4	3.01	3.67
<i>Anguilla anguilla</i>	European eel	5	5	26.30	41	11	13.68	0.14
<i>Spinachia spinachia</i>	Fifteenspined stickleback	95	95	9.17	12.7	5.4	1.60	2.70
<i>Ciliata mustela</i>	Fivebearded rockling	129	88	14.49	20.5	10.8	1.98	3.67
<i>Platichthys flesus</i>	Flounder	125	98	8.45	30.1	1.6	4.42	3.56
<i>Belone belone</i>	<b>Garfish</b>	1	1	13.60	13.6	13.6	NA	0.03
<i>Hyperoplus lanceolatus</i>	Greater sandeel	4	4	19.93	27	15	5.83	0.11
<i>Pholis gunnellus</i>	<b>Gunnel (Butterfish)</b>	1	1	6.20	6.2	6.2	NA	0.03
<i>Ammodytes tobianus</i>	Lesser sandeel	1	1	6.30	6.3	6.3	NA	0.03
<i>Scyliorhinus canicula</i>	<b>Lesser spotted dogfish</b>	1	1	75.00	75	75	NA	0.03
<i>Taurulus bubalis</i>	Longspined sea scorpion	9	9	10.53	18	8.2	3.52	0.26
<i>Phoxinus phoxinus</i>	Minnow	1	1	3.20	3.2	3.2	NA	0.03
<i>Syngnathus rostellatus</i>	Nilssons pipefish	46	46	11.11	17.8	5.6	1.84	1.31
<i>Pleuronectes platessa</i>	Plaice	34	34	6.74	9.6	4.9	1.27	0.97
<i>Agonus cataphractus</i>	Pogge	2	2	9.75	10	9.5	0.35	0.06
<i>Pollachius pollachius</i>	Pollack	202	47	12.92	19.9	8.2	2.55	5.75
<i>Salmo salar</i>	Salmon	2	2	12.80	13.2	12.4	0.57	0.06
<i>Pomatoschistus minutus</i>	Sand goby	613	69	5.74	8.7	3.1	1.34	17.45
<i>Atherina presbyter</i>	Sand smelt	489	215	6.68	16.1	3.3	1.50	13.92
<i>Sprattus sprattus</i>	Sprat	1337	119	7.79	11.2	5.9	1.08	38.06
<i>Chelon ramada</i>	<b>Thinlipped grey mullet</b>	1	1	54.80	54.8	54.8	NA	0.03
<i>Gasterosteus aculeatus</i>	Threespined stickleback	33	32	2.79	3.4	2.4	0.23	0.94
<i>Gobiusculus flavescens</i>	Twospotted goby	3	3	3.33	4.1	2.4	0.86	0.09
<i>Nerophis lumbiciformis</i>	<b>Worm pipefish</b>	1	1	8.70	8.7	8.7	NA	0.03

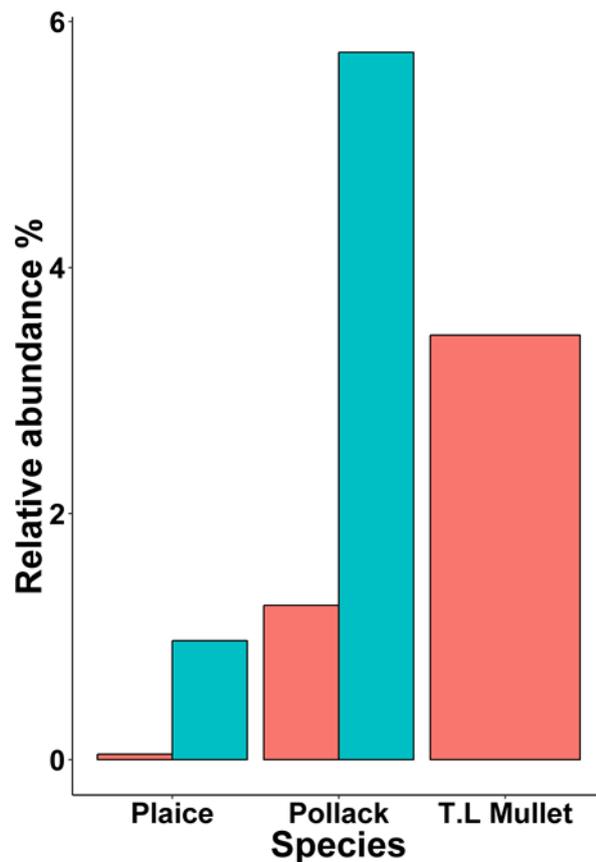
**Table 5:** List of species captured during the 2018 survey of the Castlemaine harbour. Species not encountered in any of the other waterbodies during the 2018 surveys highlighted in **bold**.

#### 4.4.2 Comparative Analysis

Sprats were the dominant species in 2018, making up 38% of the total catch. However, this highly mobile marine migrant (Harrison and Kelly 2013) was not present in great numbers in 2015 and made up only 3.3% of the catch. The proportions of the other dominant species remained consistent (Fig.8). The 2018 data indicates that the estuary may be a productive nursery for some popular angling species. A relatively high proportion of juvenile plaice and pollack were caught. However, juvenile thick lipped grey mullet made up 3.4% of the catch in 2015 but no specimens were identified in 2018 (Fig. 9).



**Fig 8:** Relative abundance of the most dominant species captured during the 2018 WFD survey of Castlemaine harbour and comparison with the 2015 survey.



**Fig 9:** Relative abundance of species of angling interest captured during the 2018 WFD survey of Castlemaine harbour and comparison with the 2015 survey.

## 4.5 Erne estuary

### 4.5.1 Data Summary

A total of 3632 fish were caught and released over the course of the survey. However, as per previous surveys in the Erne estuary, lesser sandeel dominated the catch. On this occasion, this highly mobile marine migrant, made up 85% of the total catch, as opposed to 2015 when it made up 95% of the total catch (Ryan *et al.* 2016). 18 other species made up the remaining 15% (Table 6).

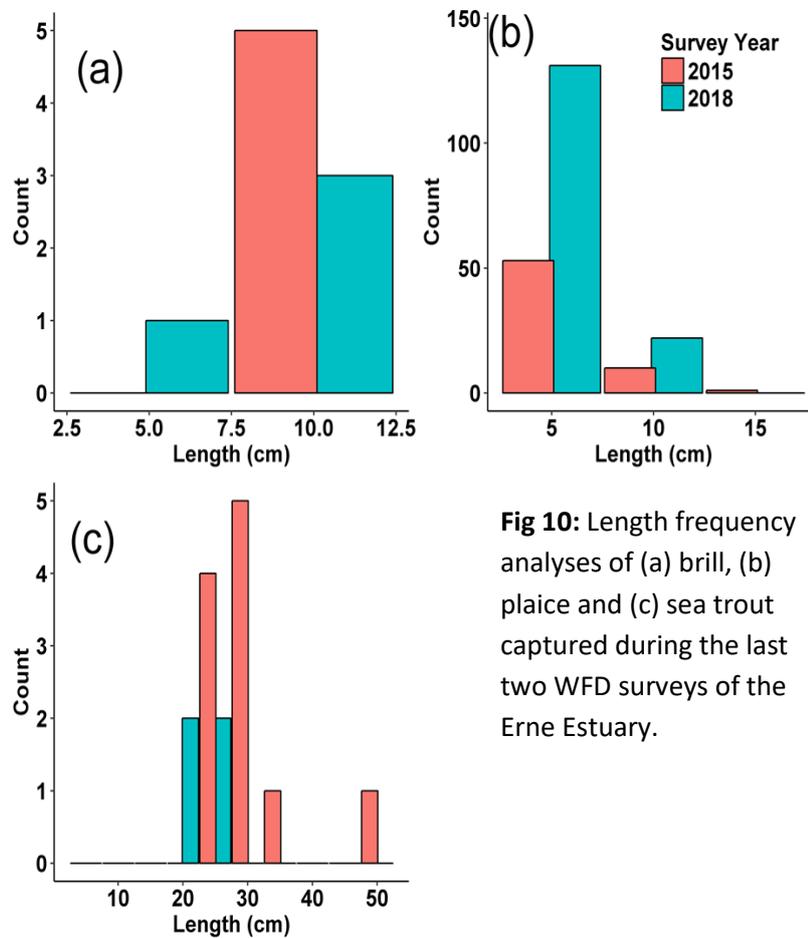
Species (Scientific name)	Species (Common name)	Total count	Count measured	Ave length (cm)	Max length(cm)	Min length (cm)	Standard deviation	Relative abundance %
<i>Scophthalmus rhombus</i>	Brill	4	4	8.68	10.2	7.4	1.15	0.11
<i>Gadus morhua</i>	Cod	4	4	17.35	18.2	15.9	1.04	0.11
<i>Pomatoschistus microps</i>	Common goby	9	9	6.39	7.3	5	0.75	0.25
<i>Anguilla anguilla</i>	European eel	7	7	36.29	54	13.5	15.24	0.19
<i>Spinachia spinachia</i>	Fifteen spined stickleback	4	4	12.70	19	9	4.46	0.11
<i>Ciliata mustela</i>	Fivebearded rockling	32	32	12.85	16.1	8	1.80	0.88
<i>Platichthys flesus</i>	Flounder	12	12	14.88	24.8	6.5	5.10	0.33
<i>Ammodytes tobianus</i>	Lesser sandeel	3079	130	6.69	10.4	4.6	1.28	84.77
<i>Taurulus bubalis</i>	Long spined sea scorpion	1	1	7.70	7.7	7.7	NA	0.03
<i>Syngnathus rostellatus</i>	Nilsson's pipefish	3	3	13.17	16	8	4.48	0.08
<i>Perca fluviatilis</i>	<b>Perch</b>	1	1	10.30	10.3	10.3	NA	0.03
<i>Pleuronectes platessa</i>	Plaice	186	153	5.75	12.5	3.2	1.53	5.12
<i>Agonus cataphractus</i>	Pogge	4	4	4.85	5.7	4.4	0.58	0.11
<i>Pollachius pollachius</i>	Pollack	31	31	14.31	19	7.4	2.27	0.85
<i>Rutilus rutilus</i>	Roach	1	1	4.70	4.7	4.7	NA	0.03
<i>Pomatoschistus minutus</i>	Sand goby	229	158	4.38	7	2.5	1.21	6.31
<i>Atherina presbyter</i>	Sand smelt	20	20	2.65	3	2.3	0.21	0.55
<i>Salmo trutta</i>	Sea trout	4	4	23.48	27.4	21.7	2.68	0.11
<i>Gasterosteus aculeatus</i>	Three spined stickleback	1	1	4.80	4.8	4.8	NA	0.03

**Table 6:** List of species captured during the 2018 survey of the Erne estuary. Species not encountered in any of the other waterbodies during the 2018 surveys highlighted in **bold**.

### 4.5.2 Comparative Analysis

Plaice were the 3<sup>rd</sup> most abundant species encountered in the Erne estuary in both 2018 (Table 6) and 2015 (Ryan *et al.* 2016), indicating its importance as a nursery for plaice in this

region of Ireland. Juveniles of the less common flatfish species, brill were also encountered during both surveys, albeit in far lower numbers than plaice (Fig. 10). Sea trout, a popular angling species were also caught during both surveys (Fig. 11).



**Fig 10:** Length frequency analyses of (a) brill, (b) plaice and (c) sea trout captured during the last two WFD surveys of the Erne Estuary.



**Fig 11:** Measuring Sea trout caught in the Erne.

## 4.6 Gweebarra estuary

### 4.6.2 Data Summary

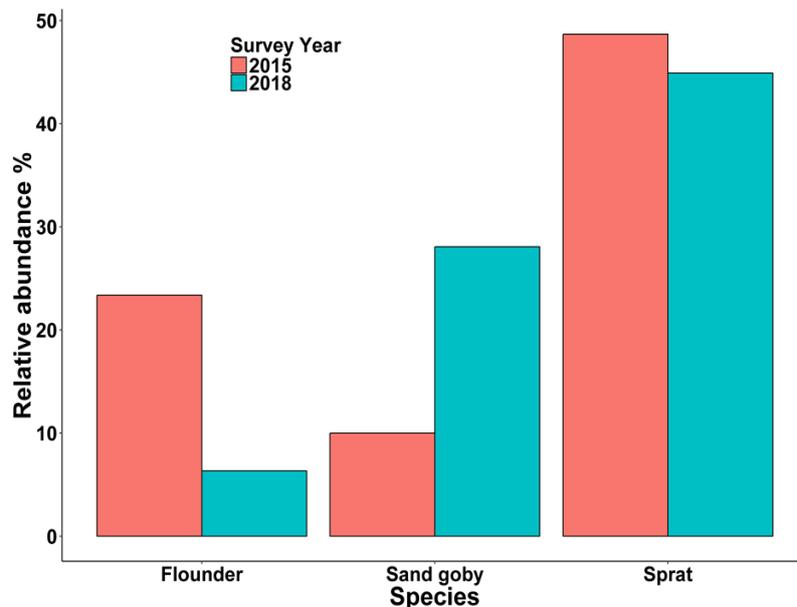
A total of 1247 fish were caught and released over the course of the survey. The common species, sand goby and sprat made up 73% of the catch. 21 other species made up the remainder (Table 7).

Species (Scientific name)	Species (Common name)	Total count	Count measured	Ave length (cm)	Max length (cm)	Min length (cm)	Standard deviation	Relative abundance %
<i>Scophthalmus rhombus</i>	Brill	4	4	10.25	13.4	7.6	3.04	0.32
<i>Salmo trutta</i>	Brown trout	11	11	14.81	18.7	11.5	2.58	0.88
<i>Pollachius virens</i>	Coalfish	14	14	14.59	20	11.8	2.27	1.12
<i>Gadus morhua</i>	Cod	8	8	14.70	21.6	11.4	3.30	0.64
<i>Pomatoschistus microps</i>	Common goby	2	2	4.25	4.7	3.8	0.64	0.16
<i>Anguilla anguilla</i>	European eel	7	7	31.21	49	7	12.87	0.56
<i>Spinachia spinachia</i>	Fifteenspined stickleback	3	3	11.67	13.9	10.3	1.95	0.24
<i>Ciliata mustela</i>	Fivebearded rockling	7	7	14.61	16.6	11.4	2.08	0.56
<i>Platichthys flesus</i>	Flounder	79	79	9.37	32	2.7	4.91	6.34
<i>Clupea harengus</i>	<b>Herring</b>	7	7	10.26	12.9	7.5	2.41	0.56
<i>Ammodytes tobianus</i>	Lesser sandeel	66	52	6.84	14	5.3	1.77	5.29
<i>Taurulus bubalis</i>	Longspined sea scorpion	2	2	9.20	9.9	8.5	0.99	0.16
<i>Syngnathus rostellatus</i>	Nilssons pipefish	10	10	11.85	13.4	9.8	1.24	0.80
<i>Pleuronectes platessa</i>	Plaice	70	70	5.99	11.8	3.9	1.64	5.61
<i>Agonus cataphractus</i>	Pogge	1	1	5.00	5	5	NA	0.08
<i>Pollachius pollachius</i>	Pollack	14	14	11.11	18.1	8.9	2.55	1.12
<i>Pomatoschistus minutus</i>	Sand goby	350	117	5.30	11.2	2.7	1.21	28.07
<i>Trachurus trachurus</i>	Sea trout	1	1	25.10	25.1	25.1	NA	0.08
<i>Salmo trutta</i>	<b>Scad</b>	23	23	6.33	7.1	5.6	0.46	1.84
<i>Entelurus aequoreus</i>	Snake pipefish	2	2	17.10	17.8	16.4	0.99	0.16
<i>Sprattus sprattus</i>	Sprat	560	68	7.74	9.6	6.1	0.83	44.91
<i>Chelon labrosus</i>	Thicklipped grey mullet	3	3	2.77	2.9	2.6	0.15	0.24
<i>Gasterosteus aculeatus</i>	Threespined stickleback	3	3	4.37	4.9	3.8	0.55	0.24

**Table 7:** List of species captured during the 2018 survey of the Gweebarra estuary. Species not encountered in any of the other waterbodies during the 2018 surveys highlighted in **bold**.

#### 4.6.1 Comparative Analysis

The three most dominant species (sprat, sand goby and flounder) were the same for 2015 and 2018, making up 82% and 79% of the total catch respectively (Fig. 12). Good ranges of juvenile plaice were encountered in the Gweebarra in both 2018 and 2015, indicating its ongoing importance as a nursery in the region (Fig 13).



**Fig 12:** Relative abundance of the dominant species captured during the 2018 WFD survey of the Gweebarra estuary and comparison with the 2015 survey.

#### 4.7 Kinvara Bay

##### 4.7.1 Data Summary

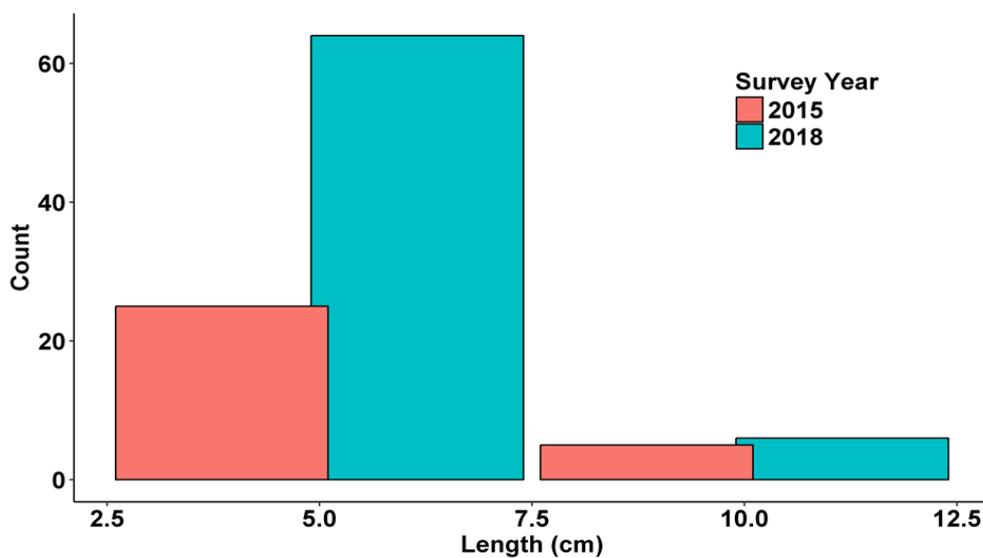
Sprat dominated the catch in 2018, making up 93% of a total catch of 10579 individuals. Otherwise, captures of the remaining 20 species encountered were quite low (Table 8). However due to its marine type environment and rocky substrate, seven of the species encountered in Kinvara bay were absent from the other transitional waterbodies surveyed in 2018 (Table 8)

Species (Scientific name)	Species (Common name)	Total count	Count measured	Ave length (cm)	Max length (cm)	Min length (cm)	Standard deviation	Relative abundance %
<i>Labrus bergylta</i>	<b>Ballan wrasse</b>	2	2	15.15	16.2	14.1	1.48	0.02
<i>Gobius niger</i>	<b>Black goby</b>	5	5	9.88	11.5	6.9	1.84	0.05
<i>Gadus morhua</i>	Cod	14	14	14.54	18.6	11	2.24	0.13
<i>Callionymus lyra</i>	<b>Common dragonet</b>	1	1	11.40	11.4	11.4	NA	0.01
<i>Pomatoschistus microps</i>	Common goby	18	18	4.35	6.8	2.5	1.24	0.17
<i>Solea solea</i>	<b>Conger eel</b>	6	6	50.58	60.5	34.5	9.69	0.06
<i>Conger conger</i>	Corkwing wrasse	11	11	6.24	12.5	3.1	3.11	0.10
<i>Limanda limanda</i>	<b>Dab</b>	1	1	5.90	5.9	5.9	NA	0.01
<i>Spinachia spinachia</i>	Fifteenspined stickleback	49	49	9.18	15.7	4.3	1.76	0.46
<i>Ciliata mustela</i>	Fivebearded rockling	6	6	14.25	18.7	10.7	3.12	0.06
<i>Platichthys flesus</i>	Flounder	10	10	14.26	31.3	6.6	8.00	0.09
<i>Hyperoplus lanceolatus</i>	Greater sandeel	1	1	16.40	16.4	16.4	NA	0.01
<i>Scyliorhinus canicula</i>	Lesser sandeel	2	2	7.00	8.3	5.7	1.84	0.02
<i>Taurulus bubalis</i>	Longspined sea scorpion	6	6	7.13	9.5	6.2	1.24	0.06
<i>Pollachius pollachius</i>	Pollack	26	26	11.90	15	9.4	1.33	0.25
<i>Pomatoschistus minutus</i>	Sand goby	131	74	5.72	8	3	0.79	1.24
<i>Atherina presbyter</i>	Sand smelt	408	189	6.79	15.6	2.2	2.65	3.86
<i>Sprattus sprattus</i>	Sprat	9875	104	8.25	10.7	3	1.01	93.35
<i>Gaidropsarus vulgaris</i>	<b>Threebearded rockling</b>	1	1	26.60	26.6	26.6	NA	0.01
<i>Gobiusculus flavescens</i>	Twospotted goby	4	4	4.13	4.5	3.7	0.33	0.04
<i>Merlangius merlangus</i>	Whiting	2	2	11.50	11.9	11.1	0.57	0.02

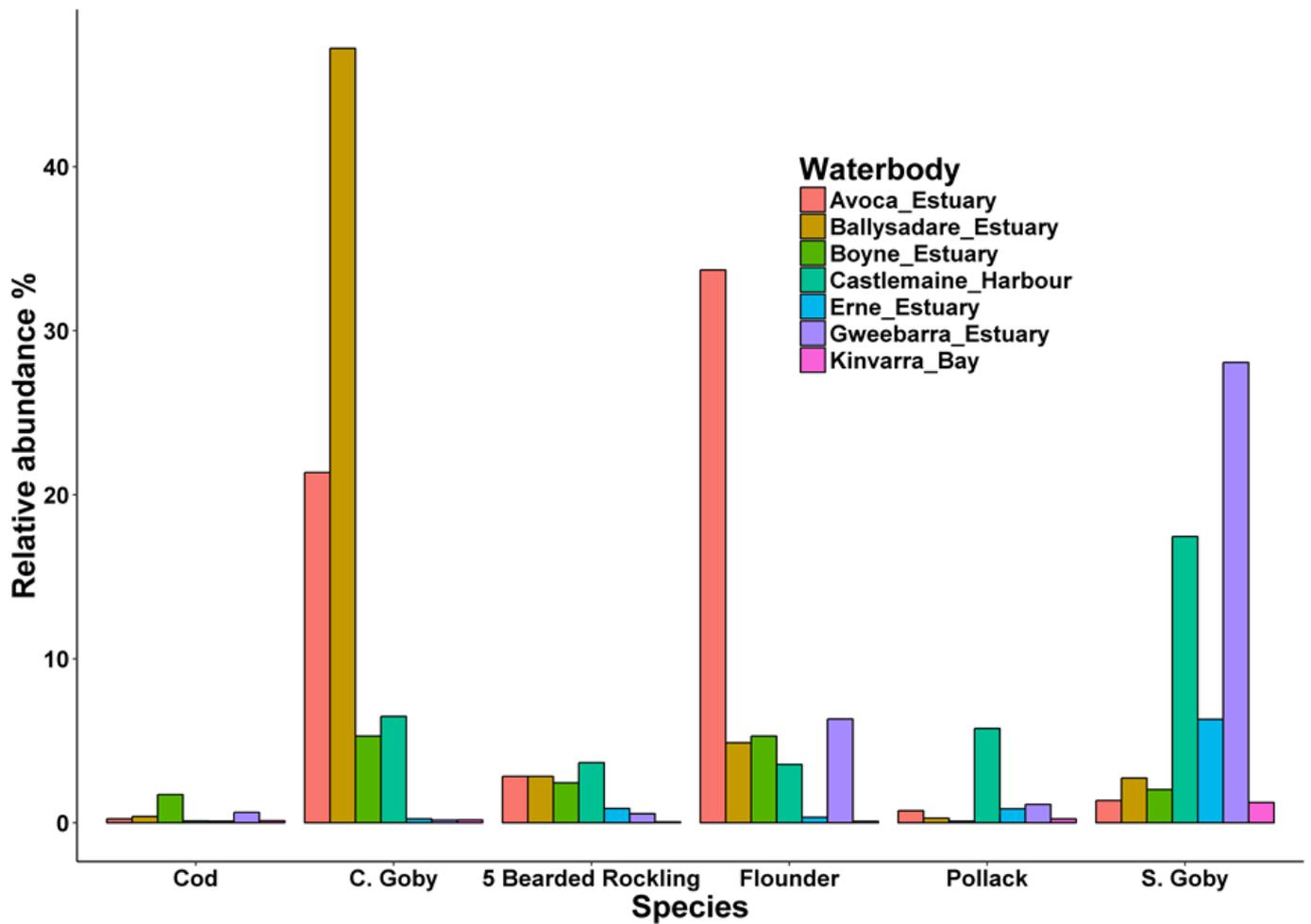
**Table 8:** List of species captured during the 2018 survey of the Kinvara Bay. Species not encountered in any of the other waterbodies during the 2018 surveys highlighted in **bold**.

#### 4.8 Relative abundance comparisons across estuaries

A total of 51 different species were identified over the course of the 2018 transitional waterbody survey programme. However, only six species were caught in every waterbody. Common goby, flounder, 5-bearded rockling, sand goby, pollack and cod. These species made up 16.4 % of all captures over the course of the survey. Their relative abundance varied widely within and between waterbodies (Fig. 14). Sprats were encountered in only five water bodies. However they were caught in such high quantities on occasion, that they made up 55% of all captures over the course of the survey programme. For example, 9,500 were caught in a single seine net in Kinvara bay.



**Fig 13:** Length frequency analyses of juvenile plaice captured during the last two WFD surveys of the Gweebarra Estuary.



**Fig 14:** Within site relative abundance of species common to all waterbodies during the 2018 WFD survey programme.

Relative abundances of species of angling (plaice, brill and thick lipped grey mullet) or conservation (European eel) interest varied between estuaries of capture (Fig. 15).

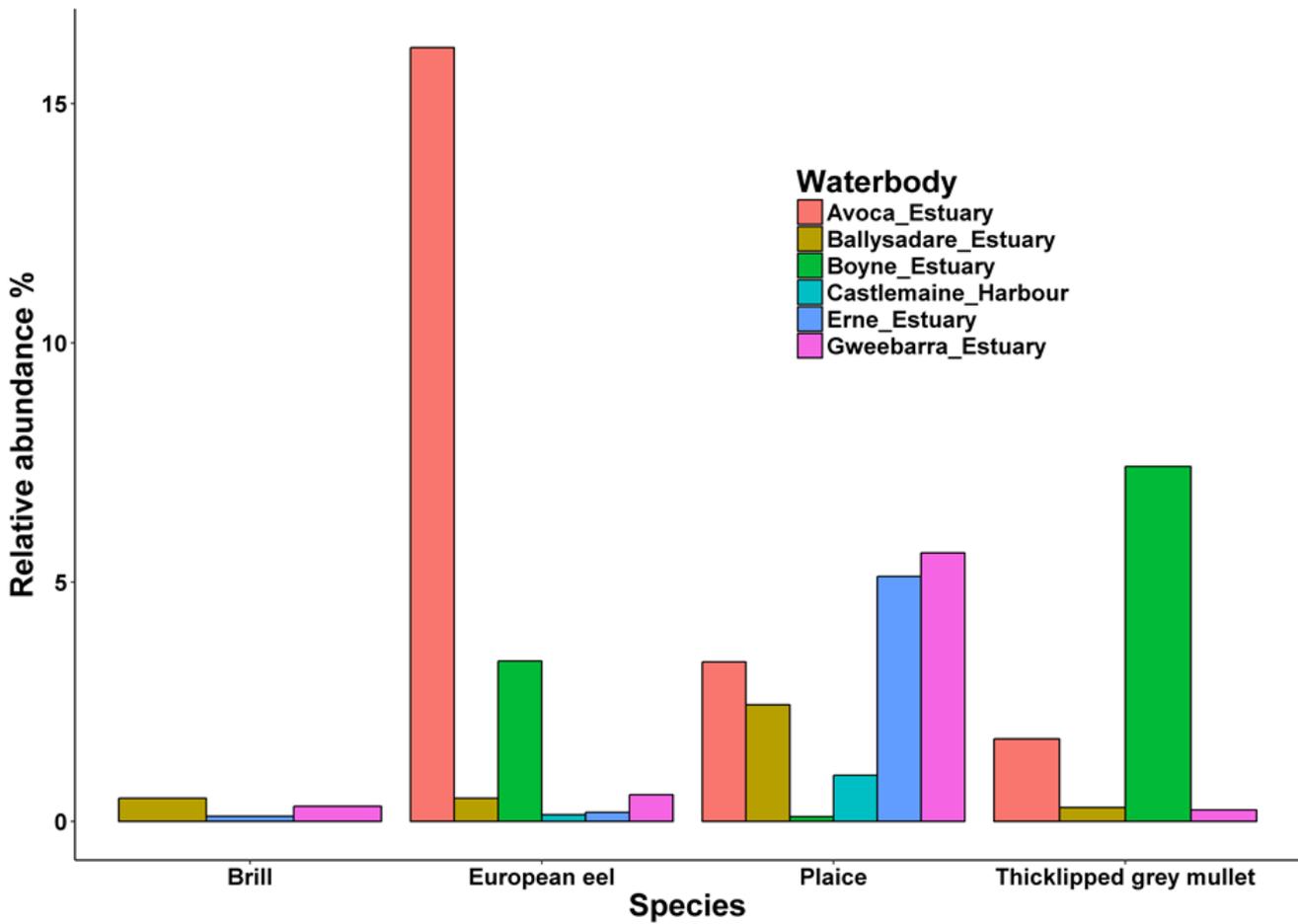


Fig 15: Within site relative abundance of species of interest caught during the 2018 WFD survey programme.

#### 4.9 EMFI quality ratings

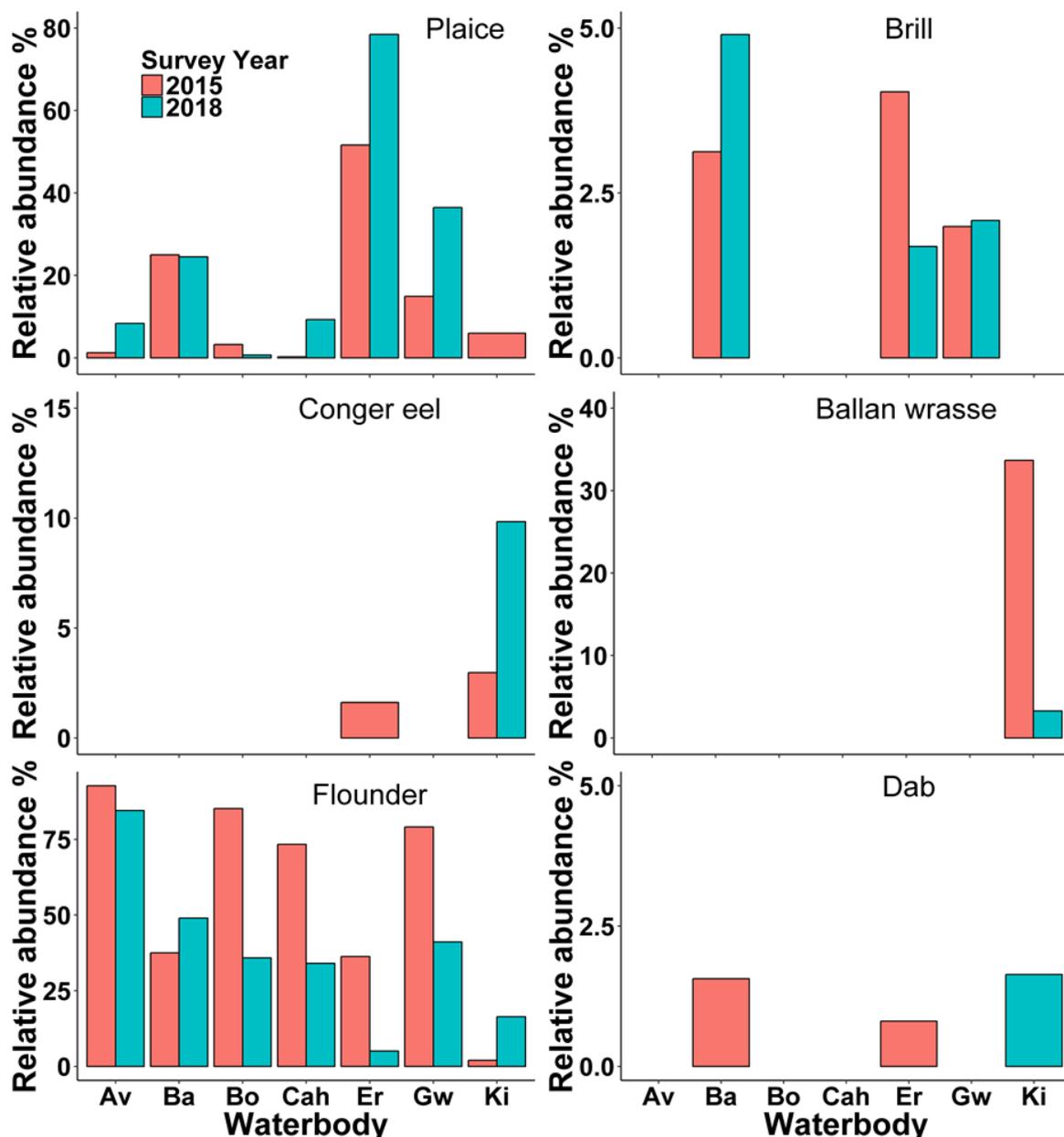
All waterbodies sampled in 2018 remained at good status, with the exceptions of the Erne estuary, which increased in status and Kinvara Bay, which decreased in status.

River basin District (RBD)	Transitional waterbody	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Eastern RBD	Boyne Estuary			Moderate			Good			Good			Good
	Avoca Estuary		Moderate		Good					Good			Good
Southern RBD	Barrow NoreT	Moderate			Moderate			Good				Good	
	BarrowNore Suir T										Good		
Southwestern RBD	SuirT	Good			Good			Good			Good		
	Bandon Estuary			Good							Good		
	Argideen Estuary		Moderate									Good	
	Drongawn Lough										Moderate		
Shannon iRBD	Castlemaine Harbour					Moderate				Good			Good
	Gill Lough									Moderate			
	Lee Estuary (Tralee)		Poor							Moderate			
	Shannon T		Moderate						Moderate			Good	
Western RBD	Fergus Estuary		Moderate					Moderate				Good	
	Kinvarra Bay			Good						Good			Moderate
	Camus Bay			Good						Good			
Northwestern iRBD	Ballysadare Estuary		Moderate							Good			Good
	Erne Estuary			Moderate			Moderate			Moderate			Good
	Gweebarra Estuary			Good			Moderate			Good			Good

**Table 9:** Schematic of EMFI quality ratings of all waterbodies sampled during the Transitional waterbody survey programme and their variation between sampling times. Rating in table equates to actual year of survey and ratings are extended to next survey.

#### 4.10 Species of angling interest

A subset of 12 popular angling species (bass, cod, coalfish, pollack, whiting, thick-lipped mullet, plaice, brill, conger eel, ballan wrasse, flounder and dab) was also examined independently to visualise their abundance relative to each other within each waterbody surveyed. Any change between previous sampling in 2015 was also visualised. Some species (flounder and plaice) made up a large proportion of the catch regardless of site (Fig. 16), whereas others (cod and pollack) were generally present albeit in far smaller proportions (Fig. 17). Another cohort (conger eel, ballan wrasse, dab, bass and whiting) were absent from most waterbodies sampled (figs. 16 & 17).



**Fig. 16:** Relative abundance of a selection of 12 angling species (six presented) across all sites sampled in 2018 and comparison with 2015 sampling records. Av: Avoca estuary, Ba: Ballysadare estuary, Bo: Boyne estuary, Cah: Castlemaine harbour, Er: Erne estuary, Gw: Gweebarra estuary, Ki: Kinvara bay.

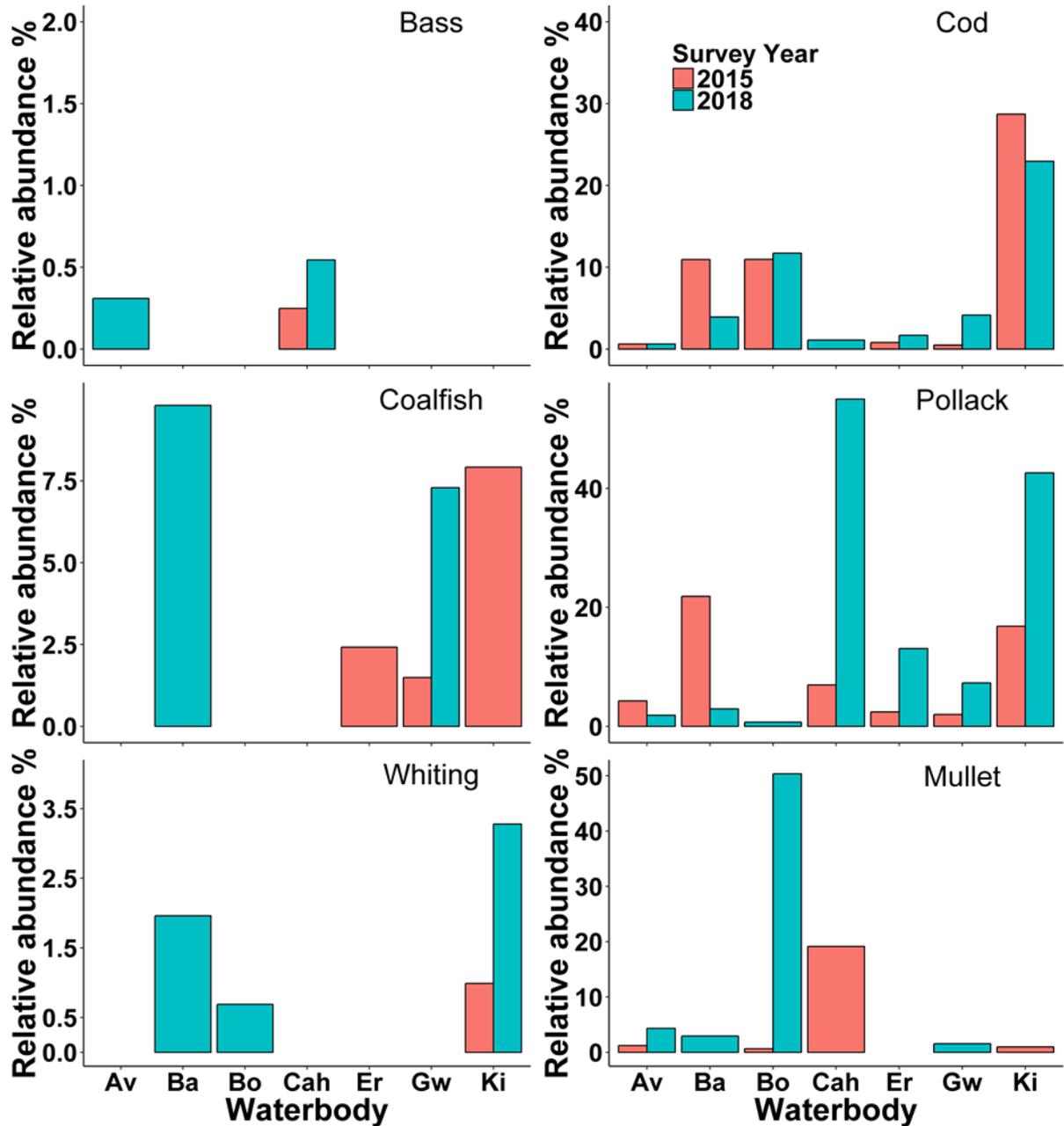


Fig. 17: Relative abundance of a selection of 12 angling species (six presented) across all sites sampled in 2018 and comparison with 2015 sampling records. Av: Avoca estuary, Ba: Ballysadare estuary, Bo: Boyne estuary, Cah: Castlemaine harbour, Er: Erne estuary, Gw: Gweebarra estuary, Ki: Kinvara bay.

## 5. Discussion

Applying fish-based quality ratings two transitional waterbodies had changes in status between the 2018 and 2015 surveys. The status of the Erne increased from moderate to good. The main driver of this change was a reduction of lesser sandeel numbers from 95 to

85% of the catch. An important metric which contributes to the EMFI is species dominance, whereby it is assumed that the more species that make up 90% or more of the total catch of a survey, the better functioning the system is (Harrison *et al.* 2013). Sandeel are defined as an inshore species (Reay 1973) and although they are usually highly abundant, if particularly large numbers of them reside within a waterbody, they may displace other estuarine species and thus affect proper functioning.

Kinvara bay, on the other hand experienced a drop in status. This is a result of sprat making up 93% of the total catch during the survey. Unlike the lesser sandeel, sprat are considered a marine migrant to transitional waterbodies which can form huge shoals and move into and out of estuaries over short periods of time, so, spatial and temporal variation in abundance can be great (Henderson, 2014). Therefore, the large numbers captured is likely as a result of timing rather than any particular anthropogenic pressure within Kinvara bay.

The proportion of the diadromous species, river lamprey and European eel captured in the Avoca estuary increased between surveys. However, it should be noted that due to high winds and rain during the survey, researchers were forced to leave fyke nets fishing for two nights, rather than the usual one night. This factor is likely to be a major reason for the increase in captures of these species.

Kinvara bay has very different physiochemical characteristics to the other transitional waterbodies described in this report. Due to the lack of a significant freshwater influx, average salinity within the transitional waterbody was 26.9. This factor also contributes to the lack of sand and mud deposits around the waterbody. These differences are reflected in the different fish population make up. Not only were six species captured in Kinvara bay which were not encountered in any of the other estuaries described in this report, but three species ubiquitous to the other waterbodies were not caught in Kinvara bay. The lack of European eels can be attributed to the lack of a notable river entering the bay. The absence of juvenile plaice is probably due to the lack of sandy areas in the substrate. Finally, no three - spined sticklebacks were caught, which is likely because there is no freshwater tidal region within the bay.

It is interesting that juvenile cod were present in all transitional waterbodies sampled in 2018, albeit in small numbers. As it can be concluded from this result that cod larvae had settled within all waterbodies sampled, it indicates that there are breeding sub-populations of cod all around the Irish coast.

## 6. References

Able, K. W. (2005). A re-examination of fish estuarine dependence: evidence for connectivity between estuarine and ocean habitats. *Estuarine, Coastal and Shelf Science*, 64, 5-17.

Beck, M. W., Heck Jr, K. L., Able, K. W., Childers, D. L., Eggleston, D. B., Gillanders, B. M., Halpern, B., Hays, C.G., Hoshino, K., Minello, T.J. & Orth, R.J. (2001). The identification, conservation, and management of estuarine and marine nurseries for fish and invertebrates: a better understanding of the habitats that serve as nurseries for marine species and the factors that create site-specific variability in nursery quality will improve conservation and management of these areas. *Bioscience*, 51, 633-641.

Gillanders, B. M., Able, K. W., Brown, J. A., Eggleston, D. B., & Sheridan, P. F. (2003). Evidence of connectivity between juvenile and adult habitats for mobile marine fauna: an important component of nurseries. *Marine Ecology Progress Series*, 247, 281-295.

Harrison, T. D., & Kelly, F. L. (2013). Development of an estuarine multi-metric fish index and its application to Irish transitional waters. *Ecological Indicators*, 34, 494-506.

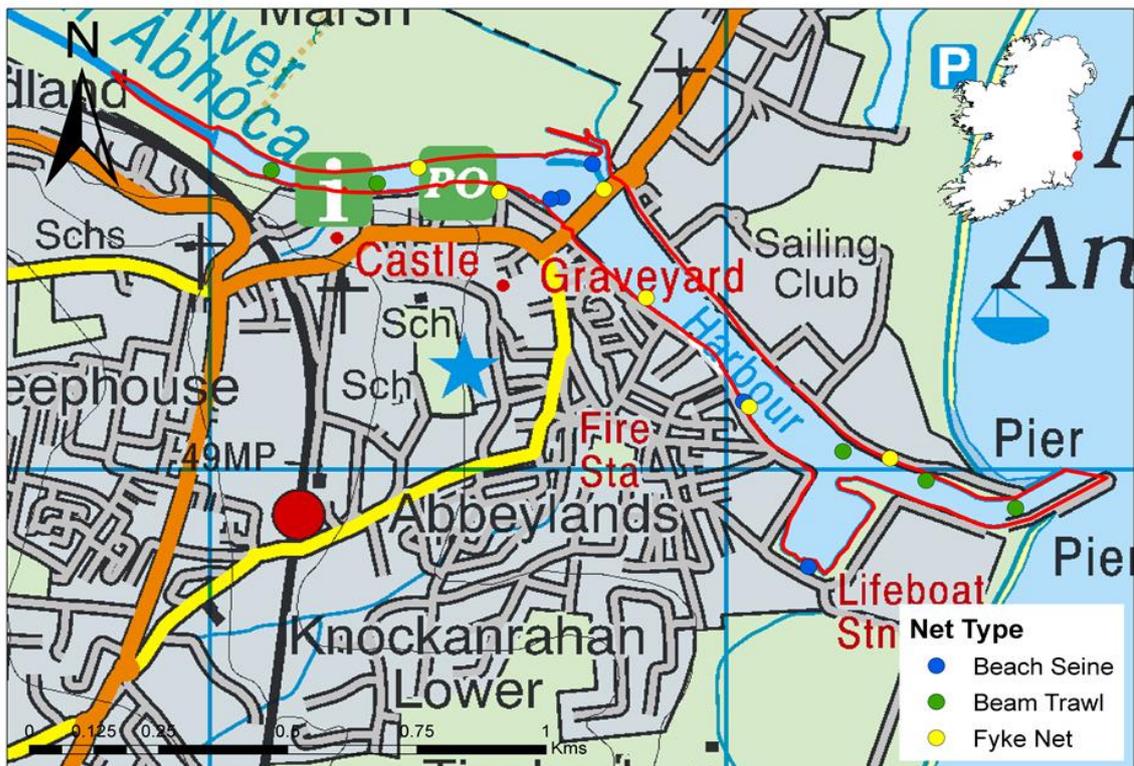
Henderson, P. 2014. Identification guide to the inshore fishes of the British Isles. Pisces Conservation Ltd., Pennington, UK.

Reay, P.J. (1973). Some aspects of biology of the sandeel. *Ammodytes tobianus* L., in Langstone Harbour, Hampshire. *Journal of the Marine Biological Association of the United Kingdom*, 53 pp 325-346.

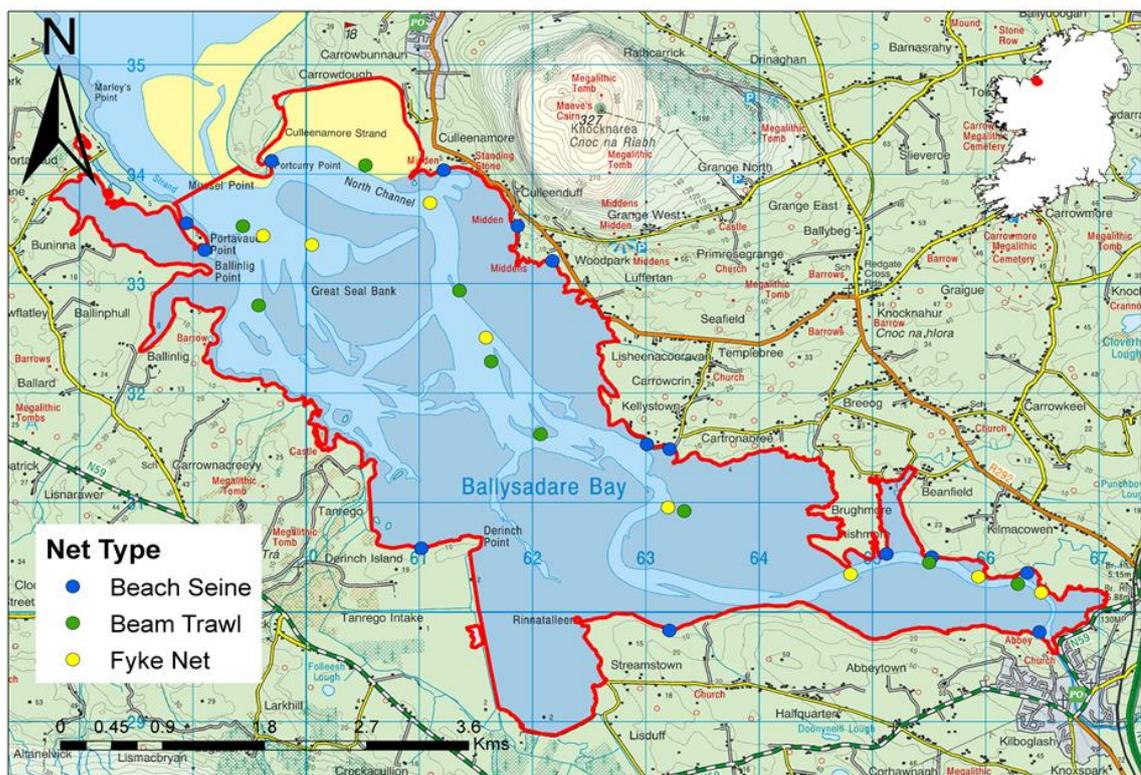
Ryan, D., Coyne, J., Corcoran, W.(2016). Report on Transitional Water Monitoring of Fish Stocks for the Water Framework Directive 2015. Inland Fisheries Ireland, 3044 Lake Drive, Citywest Business Campus, Dublin 24, Ireland.

Vasconcelos, R. P., Reis-Santos, P., Costa, M. J., & Cabral, H. N. (2011). Connectivity between estuaries and marine environment: Integrating metrics to assess estuarine nursery function. *Ecological Indicators*, 11, 1123-1133.

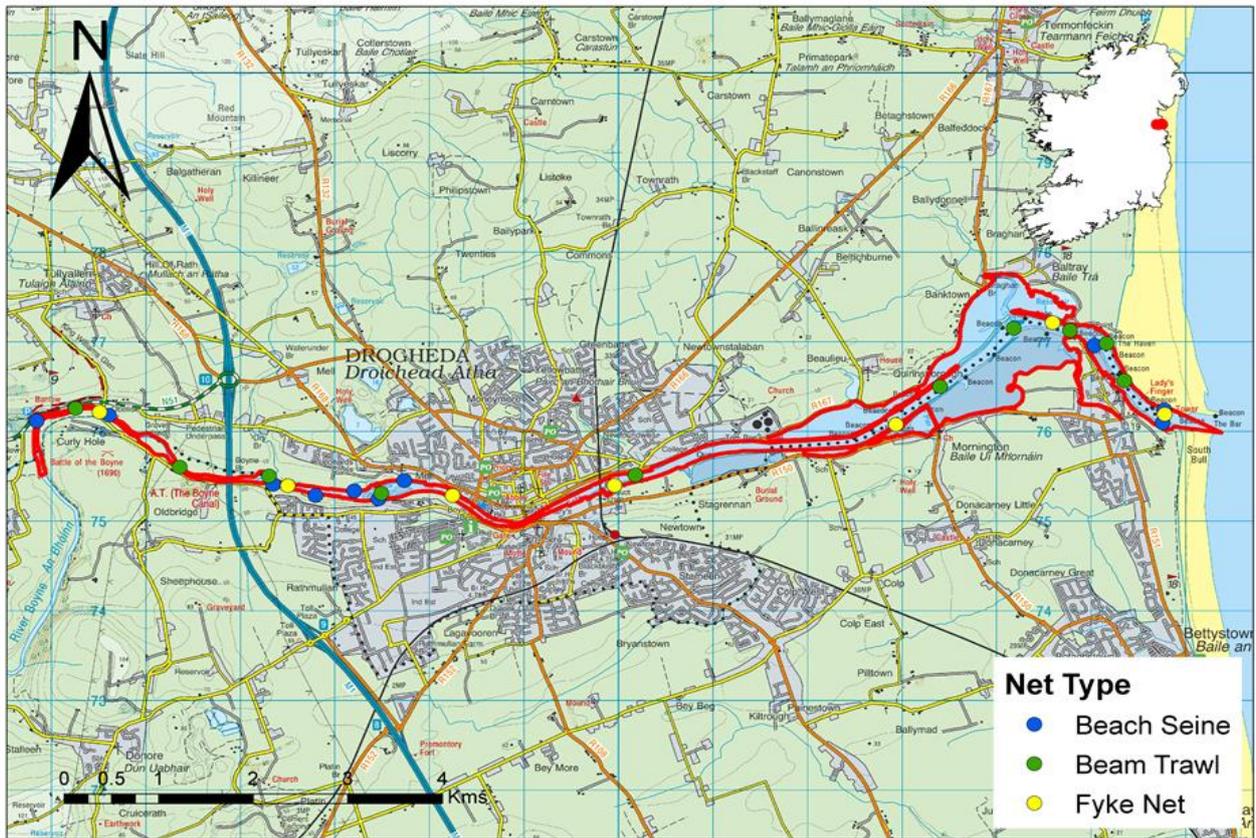
## Appendices



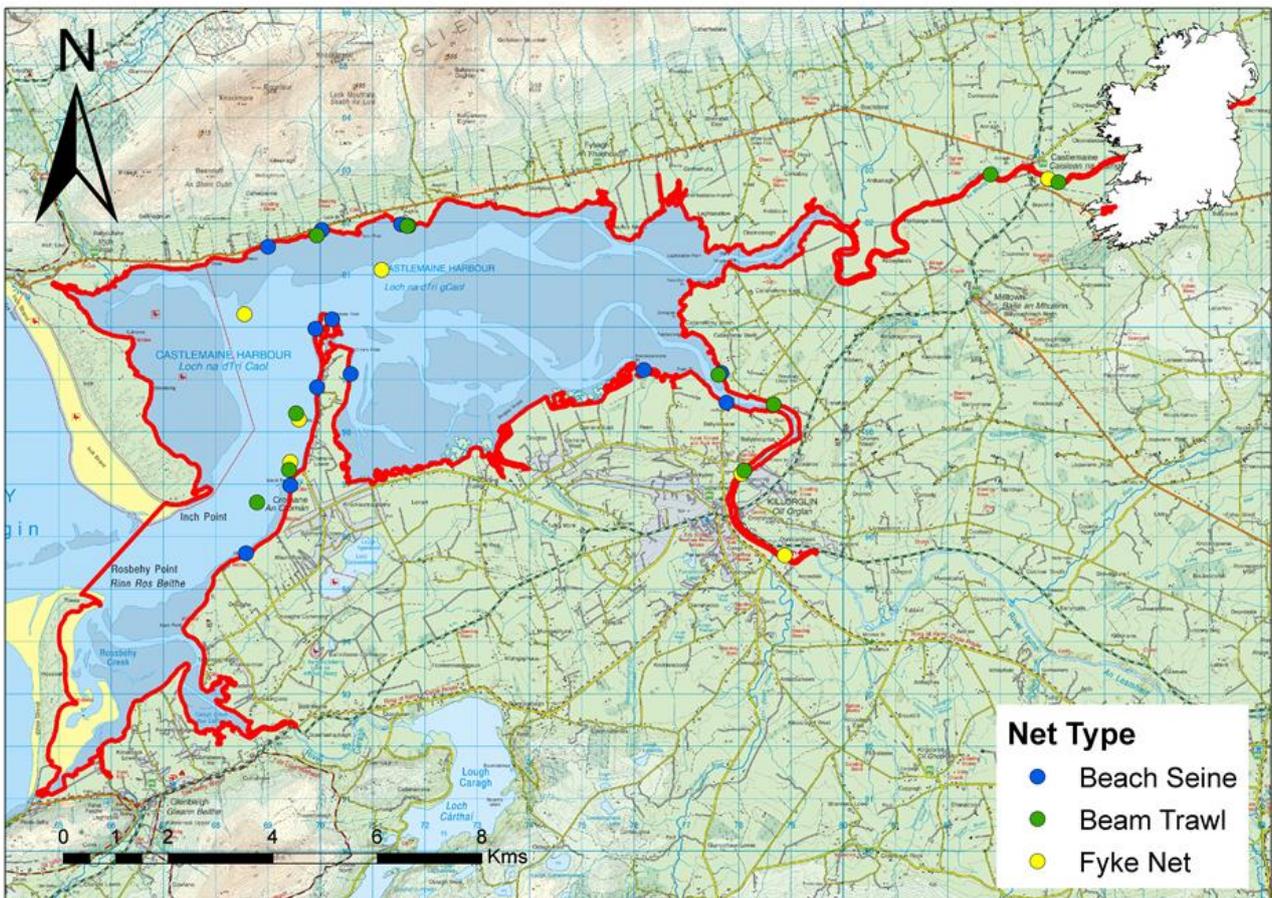
Map of the Avoca estuary showing all samples taken during the 2018 WFD survey.



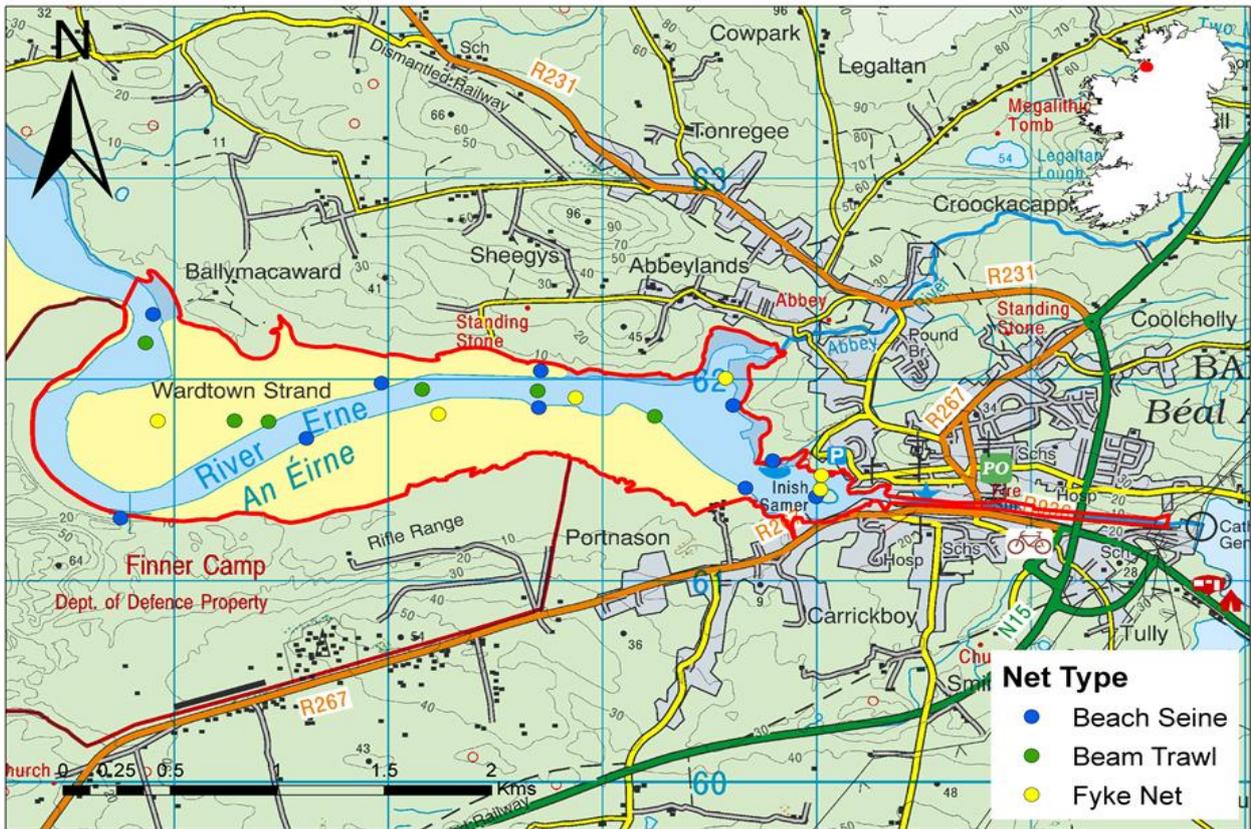
Map of the Ballysadare estuary showing all samples taken during the 2018 WFD survey.



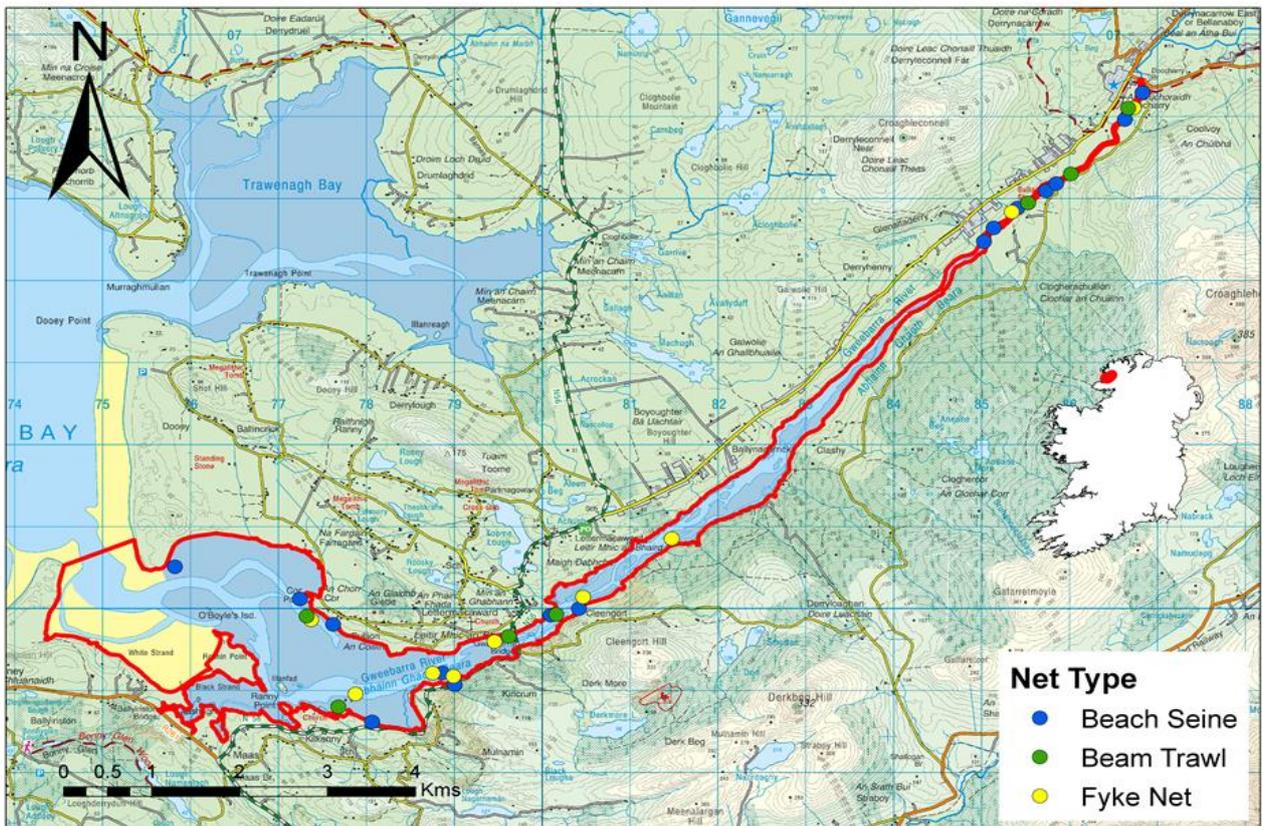
Map of the Boyne estuary showing all samples taken during the 2018 WFD survey.



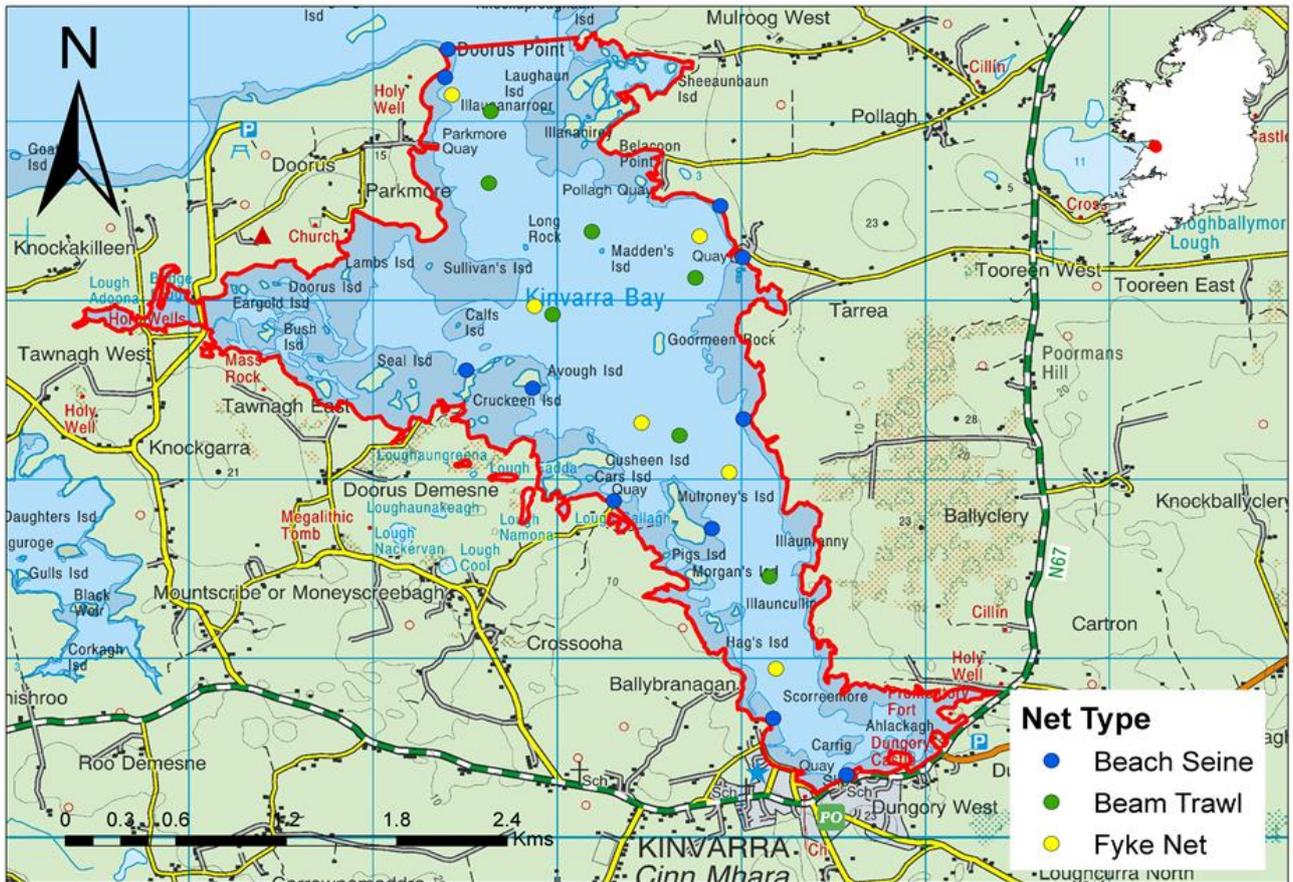
Map of Castlemaine harbour showing all samples taken during the 2018 WFD survey.



Map of the Erne estuary showing all samples taken during the 2018 WFD survey.



Map of the Gweebarra estuary showing all samples taken during the 2018 WFD survey.



Map of Kinvara bay showing all samples taken during the 2018 WFD survey.