# Fish Stock Survey of Transitional Waters in the Shannon International River Basin District

## – Limerick Dock, Shannon Upper, Shannon Lower, and Fergus Estuaries

## 2017

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# Fish Stock Survey of Transitional Waters in the Shannon International River Basin District – Limerick Dock, Shannon Upper, Shannon Lower, and Fergus Estuaries 2017

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# Contents

# 1. Summary

This report presents fish capture data collected during Inland Fisheries Ireland (IFI) surveys of transitional waterbodies. Surveys which were conducted within the Shannon estuary complex, Ireland's largest transitional waterbody are discussed. It was conducted primarily 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 of conservation importance are also discussed.

A number of fish sampling methods were used across the two surveys, which ensured that a range of habitat types were sampled, thus making it likely that all fish species present in the estuary were captured. Across both surveys, a total of 49 species and 6750 individual fish were captured. Where applicable, current data was compared to previous surveys to assess how fish populations and ecological status have changed in the intervening years. Fish population status has improved since previous surveys. The presence of juvenile dab and common sole, as well as smelt throughout the estuary complex, highlights this estuary's importance as a habitat for these important species.

## 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).

The Shannon and Fergus rivers enter the sea on the west coast of Ireland near Limerick city forming a large, complex estuary system (Fig 1). As well as providing a nursery function for marine species, a number of diadromous species, such as Atlantic salmon and European eel move though it as they complete their life cycles. As with many water bodies close to population centres, the Shannon/Fergus estuary complex experiences a range of anthropogenic pressures.

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 inform on the role of this waterbody in relation to important marine recreational fish species
- To provide scientific advice to support any potential fish conservation measures within the estuary

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 Shannon/Fergus estuary complex is 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 examined.

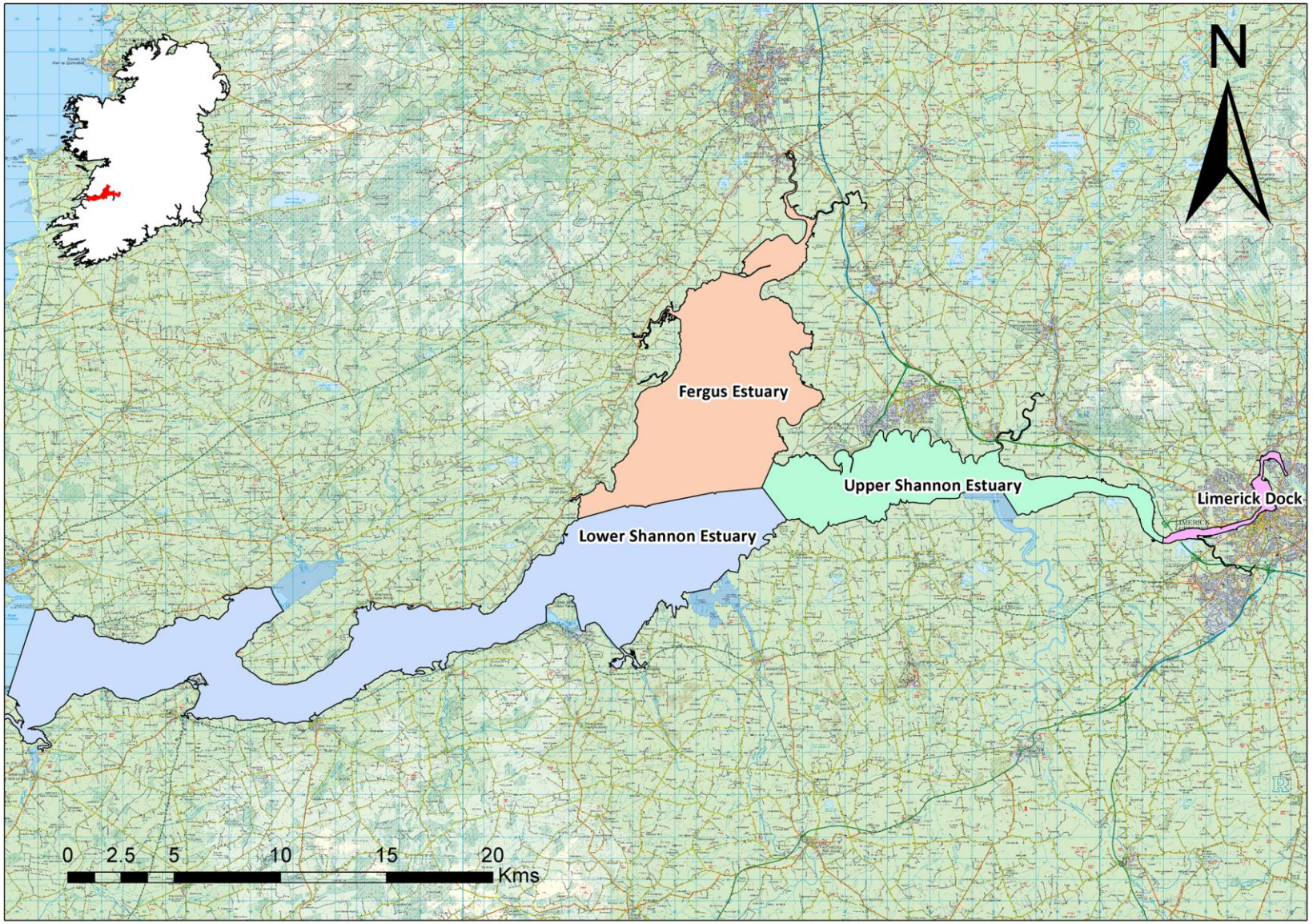


**Fig. 1**: Location map of the four transitional water bodies sampled within the Shannon estuary system.

## 3. Methods

For the purposes of WFD monitoring and reporting, the Shannon/Fergus estuary complex has been split into two separate estuary systems which will be analysed separately. These will be named the Shannon estuary (consisting of Limerick Docks, Shannon estuary upper and lower) and the Fergus estuary (Fig. 1) (Table 1). Fish stock surveys were conducted to ensure sufficient coverage of each separate water body so that stocks of each could be assessed. Sampling took place between 27th September and 14th October 2017. Habitat type across the sites ranges from soft mud to hard sandy substrate and brackish to fully saline and all in between. The separate waterbodies are described in more detail in www.wfdfish.ie.

| Transitional water body | MS Code | Easting | Northing | Type | Area ($km^2$) |
|---|---|---|---|---|---|
| Limerick Docks | SH_060_0900 | 157383 | 157267 | FT | 2.49 |
| Shannon Estuary, Upper | SH_060_0800 | 143538 | 159394 | TW | 39.5 |
| Shannon Estuary, Lower | SH_060_0300 | 116583 | 152260 | TW | 123.1 |
| Fergus Estuary | SH_060_1100 | 132035 | 165677 | TW | 64.8 |

**Table 1:** Transitional water bodies surveyed for the WFD fish surveillance monitoring programme, Sep-Oct 2017 (FT=freshwater tidal, TW=transitional).

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 and these procedures are now the standard IFI methodology for fish stock surveys in transitional waters (Harrison and Kelly, 2013) for the WFD monitoring program.

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 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.

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.

**Fig. 2**: Closing the seine net in the lower Shannon estuary.

# 4. **Results**

## 4.1 Data summary – 2017 survey

Across all water bodies, a total of 127 samples were taken using three different sampling methods (Table 2), over the course of the sampling programme (Fig.3). Physiochemical characteristics were dependent on waterbody (Table 2).

6750 (6065 in the Shannon, 685 in the Fergus) individual fish were captured, counted and identified to species level prior to release. 49 different fish species (40 in the Shannon, 18 in the Fergus) were encountered, including juvenile thornback ray (Fig. 4) and a 41cm three bearded rocking (Fig. 5), over the course of the sampling programme (Tables 3 & 4).

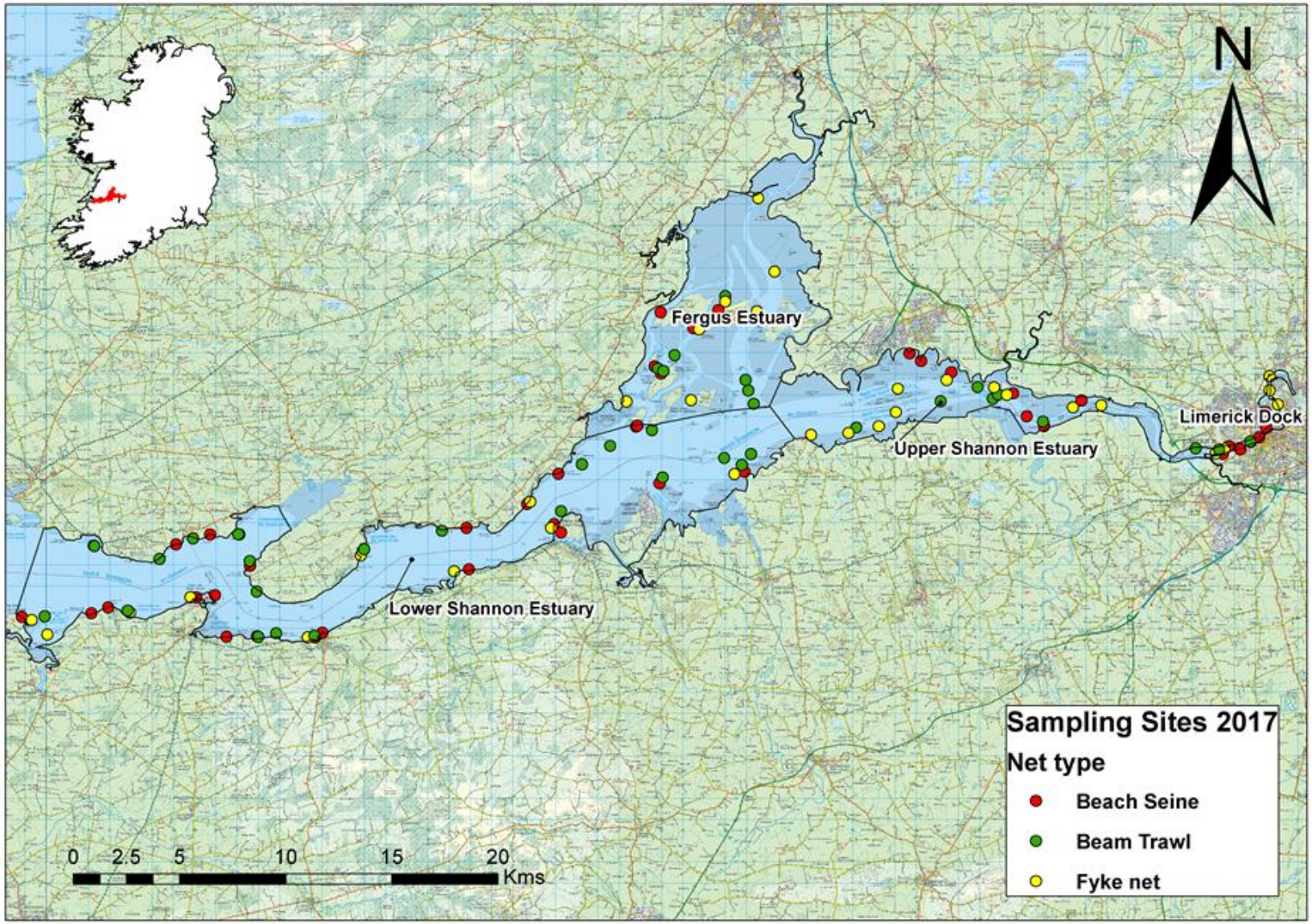


**Fig. 3**: Map of the Shannon estuary system showing all samples taken during the survey in October 2017.

**Fig. 4**: Juvenile thornback ray caught in the Shannon estuary, October 2017.

| Estuary | Sampling dates | Salinity Range (Average) | Temperature range (Average) °C | Distance from Mouth (Km) | No. Beach Seine | No. Fyke net | No. Beam trawl | Species Richness |
|---|---|---|---|---|---|---|---|---|
| Limerick Dock | 1st-11th Oct | 0.2-0.4 (0.247) | 13.5-14.5 (14) | 58.4 | 6 | 6 | 3 | 8 |
| Shannon Estuary, Lower | 26thSep-10th Oct | 6.5-27.2(19.3) | 13.1-16(14) | 0 | 22 | 12 | 21 | 35 |
| Shannon Estuary, Upper | 27thSep-12th Oct | 0.2-12 (4.3) | 12.4-14.5 (13.4) | 38.5 | 7 | 10 | 6 | 15 |
| Fergus Estuary | 4th-6th Oct | 11.5-17.4 (14) | 12.3-14.7 (13.4) | 30.5 | 6 | 7 | 8 | 18 |

**Table 2:** Survey details 2017 Shannon estuary complex.


**Fig. 5**: Three bearded rockling caught in the Fergus estuary, October 2017.

| *Species (Scientific name)* | Species (common name) | Total count | Count measured | Ave length(cm) | Max length(cm) | Min length(cm) | Standard deviation | Relative abundance % |
|---|---|---|---|---|---|---|---|---|
| *Labrus bergylta* | Ballan wrasse | 1 | 1 | 6.7 | 6.7 | 6.7 | *NA* | 0.0 |
| *Scophthalmus rhombus* | Brill | 1 | 1 | 31.4 | 31.4 | 31.4 | *NA* | 0.0 |
| *Salmo trutta* | Brown trout | 2 | 2 | 25.3 | 31.6 | 19.0 | 8.9 | 0.0 |
| *Callionymus lyra* | Common dragonet | 48 | 48 | 7.3 | 12.7 | 4.0 | 2.0 | 0.8 |
| *Pomatoschistus microps* | Common goby | 815 | 223 | 5.2 | 9.2 | 2.0 | 1.5 | 13.4 |
| *Solea solea* | Common sole | 13 | 13 | 12.0 | 16.8 | 6.2 | 3.2 | 0.2 |
| *Conger conger* | Conger eel | 12 | 12 | 47.0 | 67.0 | 29.5 | 13.5 | 0.2 |
| *Symphodus melops* | Corkwing wrasse | 30 | 30 | 7.6 | 17.9 | 3.2 | 3.8 | 0.5 |
| *Limanda limanda* | Dab | 55 | 55 | 5.1 | 7.8 | 3.2 | 0.7 | 0.9 |
| *Leuciscus leuciscus* | Dace | 4 | 4 | 15.6 | 17.9 | 12.7 | 2.6 | 0.1 |
| *Anguilla anguilla* | European eel | 22 | 22 | 36.6 | 55.0 | 11.0 | 10.9 | 0.4 |
| *Dicentrarchus labrax* | European seabass | 2 | 2 | 8.0 | 8.3 | 7.6 | 0.5 | 0.0 |
| *Spinachia spinachia* | Fifteen spined stickleback | 8 | 8 | 11.8 | 13.8 | 10.6 | 1.2 | 0.1 |
| *Ciliata mustela* | Five bearded rockling | 124 | 124 | 14.3 | 22.0 | 9.5 | 2.4 | 2.0 |
| *Platichthys flesus* | Flounder | 286 | 283 | 13.4 | 35.1 | 3.6 | 5.6 | 4.7 |
| *Eutrigla gurnardus* | Grey gurnard | 10 | 10 | 7.5 | 11.3 | 4.9 | 2.4 | 0.2 |
| *Ammodytes tobianus* | Lesser sandeel | 4 | 4 | 7.9 | 9.2 | 7.0 | 1.0 | 0.1 |
| *Scyliorhinus canicula* | Lesser spotted dogfish | 22 | 22 | 65.2 | 74.0 | 58.0 | 3.9 | 0.4 |
| *Cyclopterus lumpus* | Lumpsucker | 1 | 1 | 8.6 | 8.6 | 8.6 | *NA* | 0.0 |
| *Syngnathus rostellatus* | Nilsson's pipefish | 111 | 89 | 10.7 | 17.5 | 4.4 | 2.1 | 1.8 |
| *Pomatoschistus pictus* | Painted goby | 10 | 10 | 3.9 | 4.9 | 2.2 | 1.0 | 0.2 |
| *Perca fluviatilis* | Perch | 4 | 4 | 10.8 | 17.7 | 6.6 | 5.3 | 0.1 |
| *Pleuronectes platessa* | Plaice | 39 | 39 | 7.9 | 26.2 | 4.5 | 3.8 | 0.6 |
| *Agonus cataphractus* | Pogge | 2 | 2 | 11.5 | 13.0 | 10.0 | 2.1 | 0.0 |
| *Pollachius pollachius* | Pollack | 12 | 12 | 13.5 | 28.5 | 9.5 | 5.0 | 0.2 |
| *Trisopterus minutus* | Poor cod | 6 | 6 | 11.2 | 17.6 | 8.9 | 3.3 | 0.1 |
| *Trisopterus luscus* | Pouting | 9 | 9 | 11.8 | 14.9 | 10.5 | 1.3 | 0.1 |
| *Rutilus rutilus* | Roach | 4 | 4 | 8.0 | 12.2 | 3.7 | 3.5 | 0.1 |
| *Pomatoschistus minutus* | Sand goby | 634 | 190 | 5.5 | 9.3 | 2.8 | 1.1 | 10.5 |
| *Atherina presbyter* | Sand smelt | 251 | 182 | 9.1 | 15.5 | 4.6 | 2.9 | 4.1 |
| *Trachurus trachurus* | Scad | 7 | 7 | 7.1 | 9.3 | 5.5 | 1.5 | 0.1 |
| *Myoxocephalus scorpius* | Short spined sea scorpion | 1 | 1 | 22.5 | 22.5 | 22.5 | *NA* | 0.0 |
| *Osmerus eperlanus* | Smelt | 53 | 53 | 9.7 | 18.0 | 4.4 | 3.9 | 0.9 |
| *Sprattus sprattus* | Sprat | 3360 | 256 | 7.3 | 12.2 | 4.0 | 1.3 | 55.4 |
| *Chelon labrosus* | Thick lipped grey mullet | 7 | 7 | 33.4 | 51.0 | 5.5 | 16.1 | 0.1 |
| *Raja clavata* | Thornback ray | 2 | 2 | 52.4 | 91.0 | 13.7 | 54.7 | 0.0 |
| *Gasterosteus aculeatus* | Three spined stickleback | 85 | 61 | 4.3 | 5.5 | 3.3 | 0.4 | 1.4 |
| *Gobiusculus flavescens* | Two spotted goby | 2 | 2 | 4.5 | 5.0 | 3.9 | 0.8 | 0.0 |
| *Merlangius merlangus* | Whiting | 5 | 5 | 14.5 | 17.5 | 12.0 | 2.6 | 0.1 |
| *Nerophis lumbriciformis* | Worm pipefish | 1 | 1 | 10.2 | 10.2 | 10.2 | *NA* | 0.0 |

**Table 3:** List of species captured during the 2017 WFD survey of the Shannon estuary.

## 4.2 Shannon estuary comparative analyses

### *4.2.1 Abundant species*

Although a wide range of fish species were encountered during the survey, abundance was generally quite low (Table 3), except for four species (sprat, common goby, sand goby and flounder) which made up 84% of the total catch. Combinations of the same species also dominated the catch during the previous two surveys (2008, 97%; 2014, 96%) (Fig.6).

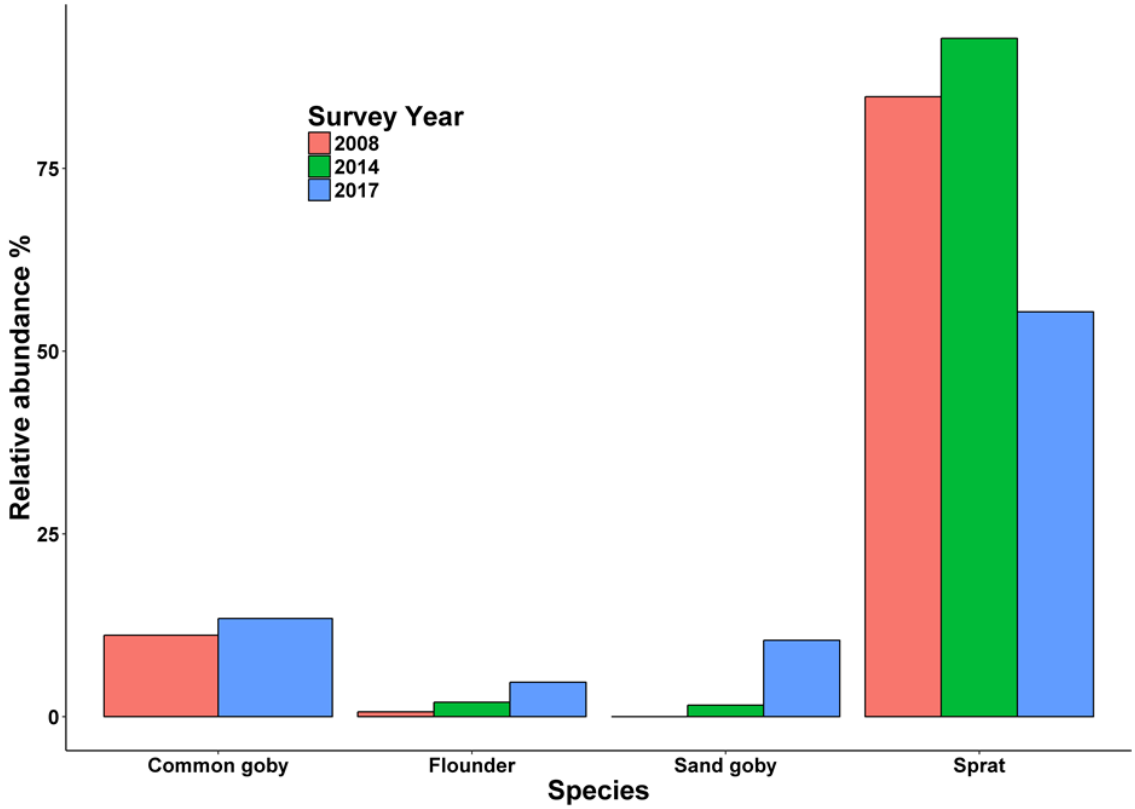


**Fig 6:** Relative abundance of the four most dominant species captured during the last three WFD surveys of the Shannon Estuary.

Although sprat dominated the catch in all surveys, they were particularly abundant in 2008 and 2014, making up 85 and 92% of the catch respectively due to large numbers captured in the lower sections of the estuary.

### *4.2.2 Key Species*

Four species, considered important for their conservation status (smelt, European eel) or angling value (dab, plaice), also made up a small but important proportion of the total catch across all sampling years (2008, 0.4%; 2014, 1%; 2017, 2.8%) (Fig. 7). The representation of all of these species has clearly increased in the most recent survey.

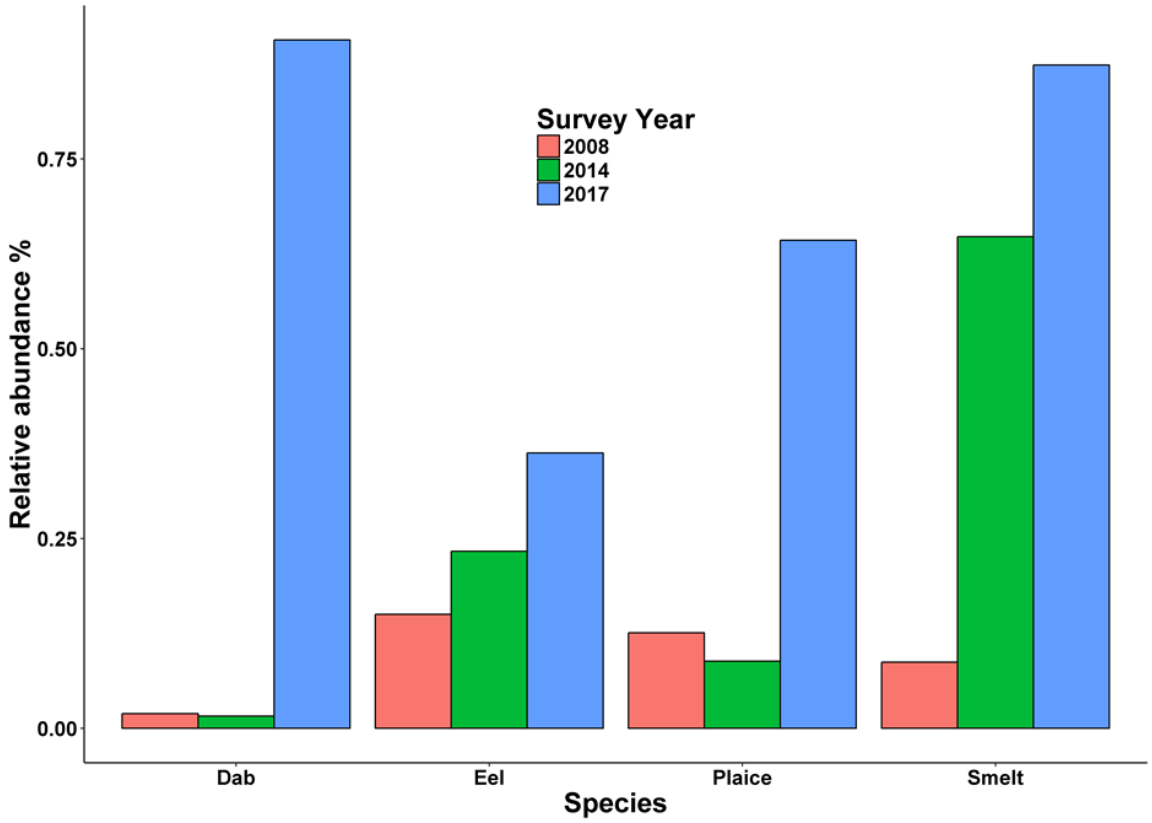


**Fig 7:** Relative abundance of important species captured during the last three WFD surveys of the Shannon Estuary.

### *4.2.3 Length frequency analyses*

Although total counts of European eel capture have reduced in the latest survey, the population structure is similar (Fig. 8(a)). Larger overall numbers of juvenile sprat were captured in previous surveys. A stable population structure is currently represented (Fig. 8(b).

Relatively large numbers of juvenile plaice and dab were caught for the first time in the Shannon estuary (Fig. 8(c and d)).

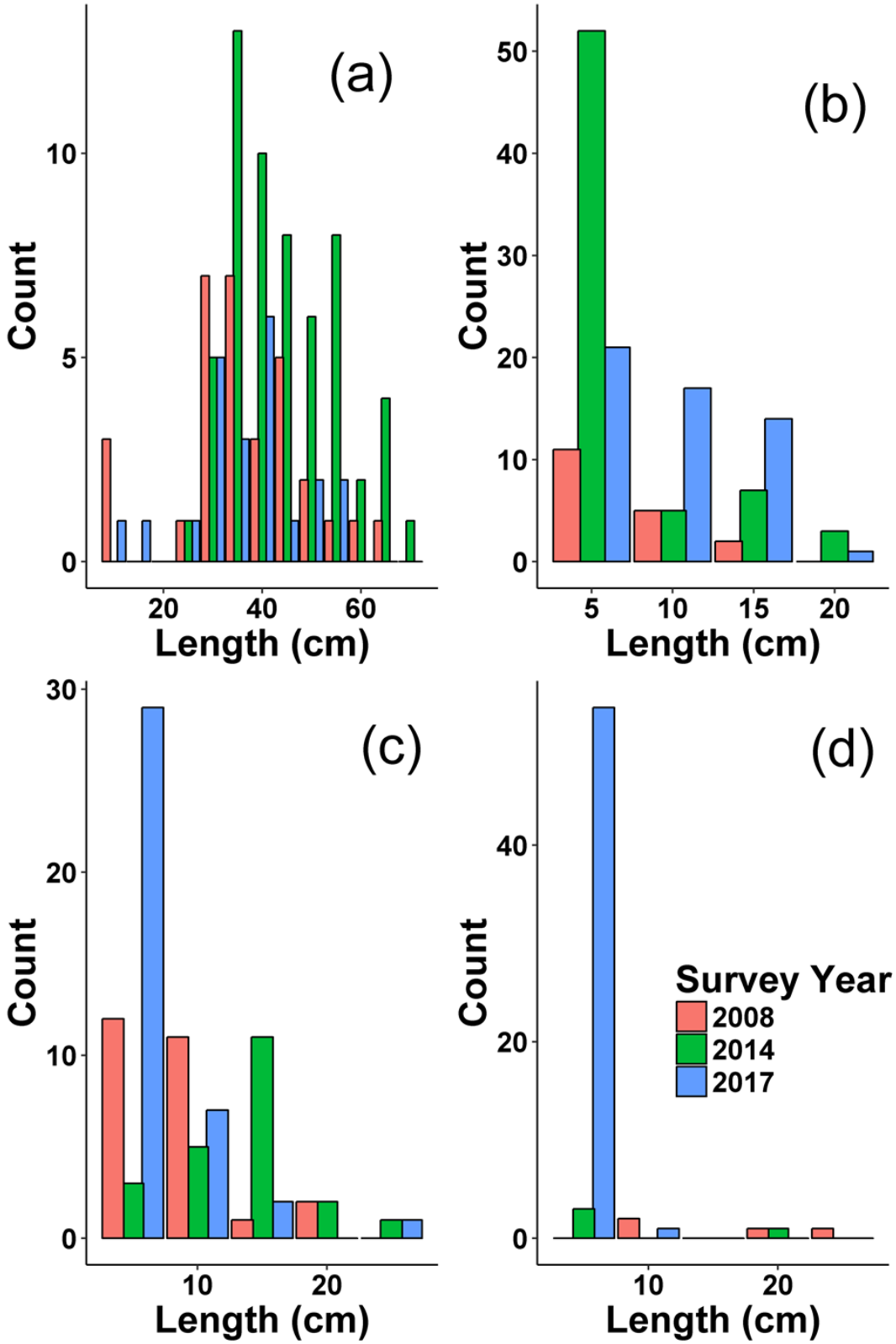


**Fig 8:** Length frequency analyses of: (a) European eel, (b) smelt, (c) plaice and (d) dab captured during the last three WFD surveys of the Shannon Estuary.

## 4.3 Fergus estuary comparative analyses

| *Species (Scientific name)* | Species | Total count | Count measured | Ave length(cm) | Max length(cm) | Min length(cm) | Standard deviation | Relative abundance % |
|---|---|---|---|---|---|---|---|---|
| *Pomatoschistus microps* | Common goby | 447 | 139 | 5.8 | 7.8 | 3.0 | 1.3 | 65.3 |
| *Solea solea* | Common sole | 25 | 25 | 9.1 | 16.6 | 5.7 | 2.8 | 3.6 |
| *Conger conger* | Conger eel | 1 | 1 | 95.0 | 95.0 | 95.0 | *NA* | 0.1 |
| *Limanda limanda* | Dab | 3 | 3 | 4.8 | 5.0 | 4.6 | 0.2 | 0.4 |
| *Anguilla anguilla* | European eel | 5 | 5 | 31.0 | 44.0 | 10.5 | 16.4 | 0.7 |
| *Ciliata mustela* | Five bearded rockling | 48 | 46 | 15.2 | 18.2 | 11.9 | 1.8 | 7.0 |
| *Platichthys flesus* | Flounder | 42 | 42 | 13.4 | 27.5 | 6.7 | 5.4 | 6.1 |
| *Eutrigla gurnardus* | Grey gurnard | 2 | 2 | 7.7 | 8.6 | 6.7 | 1.3 | 0.3 |
| *Syngnathus rostellatus* | Nilsson's pipefish | 46 | 46 | 10.4 | 14.0 | 6.0 | 2.0 | 6.7 |
| *Agonus cataphractus* | Pogge | 8 | 8 | 11.6 | 13.9 | 9.3 | 1.4 | 1.2 |
| *Pollachius pollachius* | Pollack | 1 | 1 | 29.6 | 29.6 | 29.6 | *NA* | 0.1 |
| *Pomatoschistus minutus* | Sand goby | 11 | 11 | 5.6 | 7.4 | 4.0 | 1.5 | 1.6 |
| *Trachurus trachurus* | Scad | 1 | 1 | 5.6 | 5.6 | 5.6 | *NA* | 0.1 |
| *Osmerus eperlanus* | Smelt | 13 | 13 | 12.1 | 19.5 | 6.0 | 5.1 | 1.9 |
| *Sprattus sprattus* | Sprat | 29 | 29 | 6.9 | 11.0 | 4.0 | 2.0 | 4.2 |
| *Gaidropsarus vulgaris* | Three bearded rockling | 1 | 1 | 41.5 | 41.5 | 41.5 | *NA* | 0.1 |
| *Chelidonichthys lucerna* | Tub gurnard | 1 | 1 | 9.0 | 9.0 | 9.0 | *NA* | 0.1 |
| *Merlangius merlangus* | Whiting | 1 | 1 | 11.0 | 11.0 | 11.0 | *NA* | 0.1 |

**Table 4:** List of species captured during the 2017 WFD survey of the Fergus estuary.

*4.3.1 Abundant species*

Common goby were the most abundant species within the Fergus estuary in 2017, making up over 65% of the total catch (Fig. 9). The other usually abundant species, flounder and sprat, made up 6.1 and 4.2 % of total catch respectively, whereas, in previous surveys, sprat dominated the catch (2008, 78.7%; 2010, 72.7%). Surprisingly, five bearded rockling were the second most abundant species captured in the Fergus estuary (Table 4).

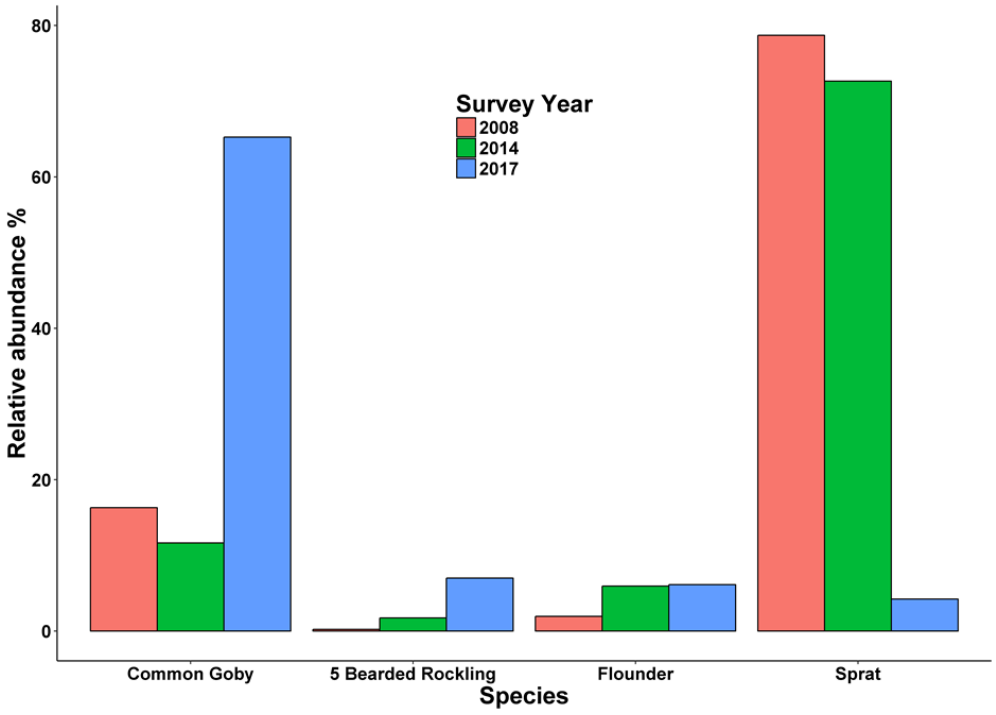


**Fig 9:** Relative abundance of the most abundant species captured during the last three WFD surveys of the Fergus

*4.3.2 Key Species*

The only species of substantive angling interest which was represented in any number is common sole, which made up 3.6% of the current catch. Indicating that the Fergus estuary may be a common sole nursery. Juvenile examples of other popular angling species were also captured, albeit in low numbers (dab, 3 caught; grey gurnard, 2 caught; tub gurnard,1 caught; whiting, 1 caught). Smelt which is of conservation interest, made up 1.9% of the current catch. Eels were also present, albeit in small numbers (Fig. 10). The representation of these species except for eels has increased in the most recent survey.

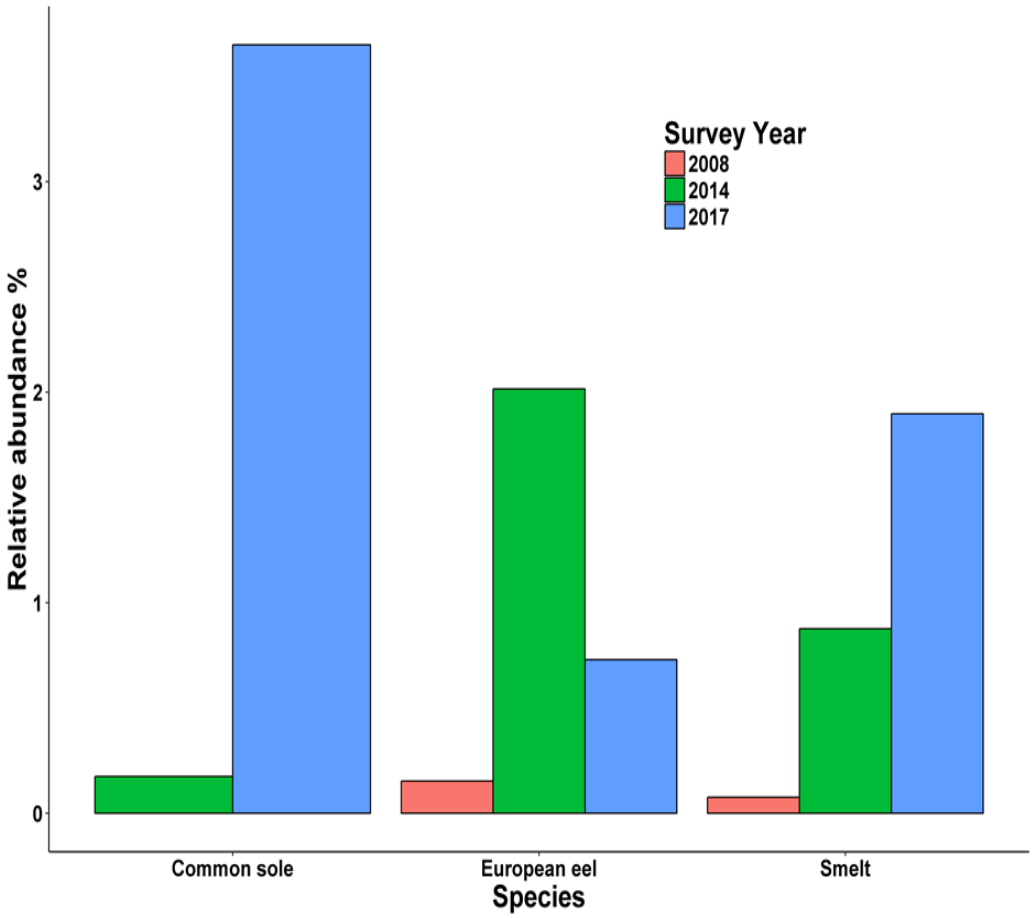


**Fig 10:** Relative abundance of important species captured during the last three WFD surveys of the Fergus estuary.

### *4.2.3 Length frequency analyses*

European eel captures and size ranges have reduced since the latest survey. A greater size range of smelt were captured. Relatively large numbers of juvenile common sole were caught for the first time in the Fergus estuary (Fig. 11).

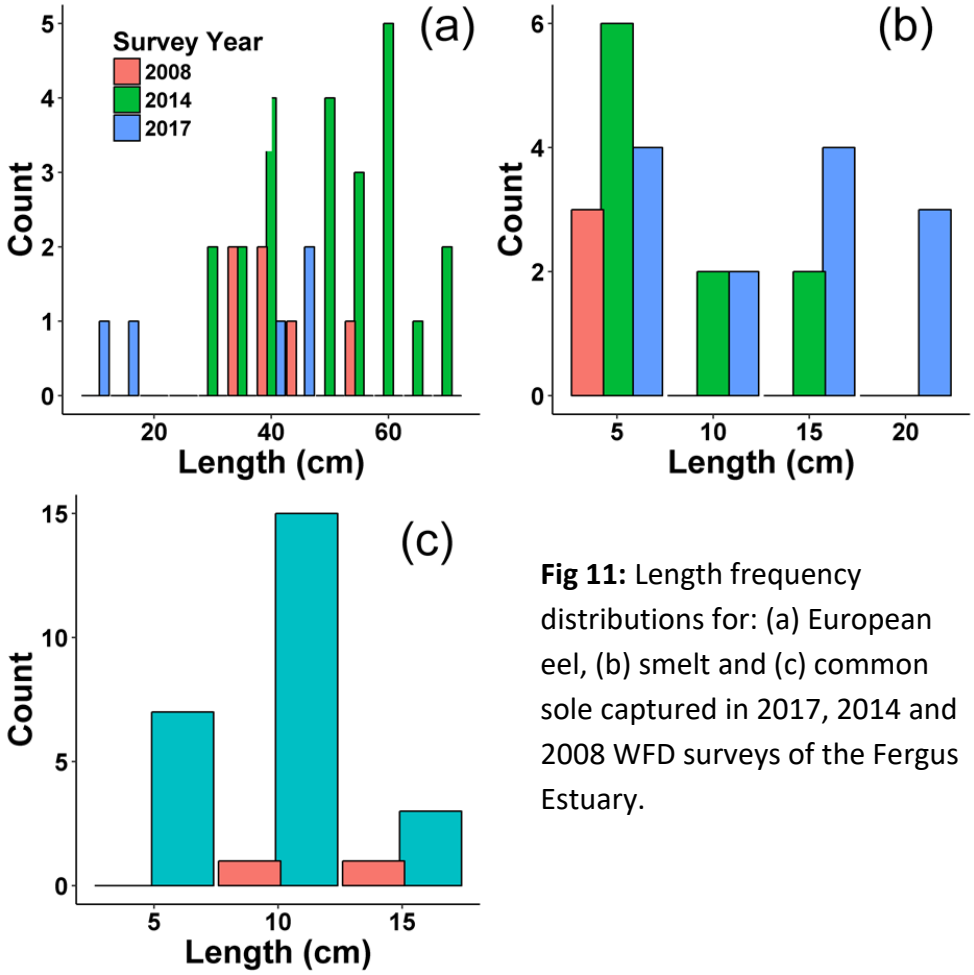


**Fig 11:** Length frequency distributions for: (a) European eel, (b) smelt and (c) common sole captured in 2017, 2014 and 2008 WFD surveys of the Fergus Estuary.

### *4.4 EMFI Quality Ratings*

Both estuaries sampled achieved good status in 2017, an improvement on previous surveys (Table 5)

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

**Table 5:** Schematic of EMFI estuarine multi-metric fish index 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 period.

# 5. Discussion

The Fergus and Shannon estuaries achieved “good” status for their fish populations. This is an improvement on the previous two surveys at these sites. This is largely due to a change in the relative abundance of sprat. Although sprat again dominated the fish fauna captured in the Shannon estuary, it was not to the same extent as previous surveys. Sprats are known to shoal and move into estuaries to feed, providing a food source for other residents. Species dominance is an important EMFI metric. If a species is dominant in a waterbody, it is often seen as an indicator that the waterbody is not functioning properly (Harrison and Kelly 2013). The large numbers of sprat were a contributor to both the Shannon and the Fergus estuaries not achieving good status in 2014 and 2008. As this species is both highly mobile and has a propensity to shoal, very large captures of sprat in beach seines are likely due to timing and not a true reflection of perceived pressures within the estuary ecosystem.

The EMFI found the fish population structure in the Fergus and Shannon estuaries to be of good quality, due to the range and composition of species caught. However, impacts due to enrichment from surface runoff and industrial discharge, particularly in the upper sections of the Shannon estuary, means that the sites will continue to be at risk of not achieving an overall good ecological status.

As anticipated flounder and gobies made up a large proportion of captures within the estuary systems, which is indicative of transitional waterbodies which have a large fluvial influence. Both gobies and juvenile flounder are associated with muddy substrates caused by fluvial deposition, where they feed on plant matter and invertebrates associated with mud (Aarnio *et al*. 1996). Subsequently, these species provide an abundant and important food source for piscivorous fish feeding within the shelter of the estuary.

Comparisons between the current and previous WFD surveys suggest that there was a substantial increase in juvenile common sole abundance within the Fergus estuary, which indicates that this site has potential as a nursery for this species. As capture numbers were comparably low in previous surveys, common sole recruitment may be only occasional. This will be followed up in future surveys.

Dace were once again captured in low numbers in the freshwater tidal sections of the Shannon estuary. This invasive species has the potential to outcompete native species and ultimately dominate the fish fauna in the site, as has happened in upper sections of the Barrow estuary (Ryan *et al.* 2016). Dace populations will be monitored closely in future surveys.

Although recruitment of smelt was not as strong in 2017 as 2014, a stable population is present in the Fergus and Shannon estuaries.

The Shannon transitional waterbody is the largest in the country. Not only is the estuary a vital transit route for diadromous species of international importance, such as salmon and eels this report has shown its importance as a nursery for marine species of both angling and conservation importance. Currently fish populations are sufficiently diverse for it to achieve good status. However, it is located adjacent to Limerick city, one of the largest population centers, in the country. In addition, heavy industrial sites are located on the banks of the estuary so regular monitoring must continue to ensure that any potential environmental problems are detected.

## 6. **References**


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